

F115C LF115C

SERVICE MANUAL



LIT-18616-02-71

68V-28197-1F-11

NOTICE

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

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

**F115C, LF115C
SERVICE MANUAL
©2003 by Yamaha Motor Corporation, USA
1st Edition, October 2003
All rights reserved.
Any reprinting or unauthorized use
without the written permission of
Yamaha Motor Corporation, USA
is expressly prohibited.
Printed in USA
LIT-18616-02-71**

HOW TO USE THIS MANUAL

MANUAL FORMAT

All of the procedures in this manual are organized in a sequential, step-by-step format. The information has been compiled to provide the mechanic with an easy to read, handy reference that contains comprehensive explanations of all disassembly, repair, assembly, and inspection operations.

For instance, the condition of a faulty component will precede an arrow symbol and the course of action required will follow the symbol.

- Bearings

Pitting/scratches → Replace.

To assist you in finding your way through this manual, the section title and major heading is given at the top of every page.

MODEL INDICATION

Multiple models are mentioned in this manual and their model indications are noted as follows.

Model name	F115AET	FL115AET
USA and Canada name	F115TR	LF115TR
Indication	F115AET	FL115AET

ILLUSTRATIONS

The illustrations within this service manual represent all of the designated models.

CROSS REFERENCES

The cross references have been kept to a minimum. Cross references will direct you to the appropriate section or chapter.

IMPORTANT INFORMATION

In this Service Manual particularly important information is distinguished in the following ways.

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

WARNING

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

CAUTION:

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

NOTE:

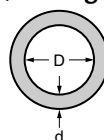
A NOTE provides key information to make procedures easier or clearer.

HOW TO USE THIS MANUAL

- ① The main points regarding removing/installing and disassembling/assembling procedures are shown in the exploded views.
- ② The numbers in the exploded views indicate the required sequence of the procedure and should be observed accordingly.
- ③ Symbols are used in the exploded views to indicate important aspects of the procedure. A list of meanings for these symbols is provided on the following page.
- ④ It is important to refer to the job instruction charts at the same time as the exploded views. These charts list the sequence that the procedures should be carried out in, as well as providing explanations on part names, quantities, dimensions and important points relating to each relevant task.

Example:

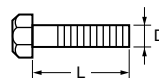
O-ring size 39.5×2.5 mm: inside diameter (D) $\times$ ring diameter (d)



- ⑤ In addition to tightening torques, the dimensions of the bolts and screws are also mentioned.

Example:

Bolt and screw size 10×25 mm : bolt and screw diameter (D) $\times$ length (L)



- ⑥ In addition to the exploded views and job instruction charts, this manual provides individual illustrations when further explanations are required to explain the relevant procedure.

LOWR **LOWER UNIT (REGULAR ROTATION MODELS)** E

LOWER UNIT (REGULAR ROTATION MODELS)
REMOVING/INSTALLING THE LOWER UNIT

Order	Job/Part	Q'ty	Remarks
1	Speedometer hose	1	
2	Propeller nut	1	
3	Washer	1	
4	Propeller	1	
5	Spacer	1	
6	Bolt	1	
7	Trim tab	1	
8	Bolt	1	(with washer)
9	Bolt	6	(with washer)
10	Lower unit	1	
11	Dowel pin	2	

For installation, reverse the removal procedure.

6-1

LOWR **DRIVE SHAFT (REGULAR ROTATION MODELS)** E

REMOVING THE DRIVE SHAFT
Loosen:
• Pinion nut

- Drive shaft holder ①
- Pinion nut holder ②
- Pinion nut holder attachment ③

DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY
Remove:
• Needle bearing

- Bearing/oil seal attachment ①
- YB-06196 / 90890-06610 ②
- Driver rod ③
- YB-06071 / 90890-06652

DISASSEMBLING THE FORWARD GEAR ASSEMBLY
1. Remove:
• Tapered roller bearing

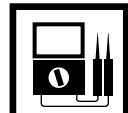
- Bearing separator ①
- YB-06219 / 90890-06534

CAUTION:
Do not reuse the bearing, always replace it with a new one.

2. Remove:
• Needle bearing

- Slide hammer ①
- YB-06096 ②
- Guide plate ③
- 90890-06501 ④
- Guide plate stand ⑤
- 90890-06538 ⑥
- Bearing puller ⑦
- 90890-06535 ⑧
- Small universal claws ⑨
- 90890-06536

6-18

① GEN INFO 	② SPEC 
③ INSP ADJ 	④ FUEL 
⑤ POWR 	⑥ LOWR 
⑦ BRKT 	⑧ ELEC 
⑨ TRBL ANLS 	⑩ 
⑪ 	⑫ 
⑬ 	⑭ 
⑮ 	⑯ 
⑰ 	⑱ 
⑲ 	⑳ 
㉑ 	㉒ 
㉓ 	㉔ 

SYMBOLS

Symbols ① to ⑨ are designed as thumb-tabs to indicate the content of a chapter.

- ① General information
- ② Specifications
- ③ Periodic inspections and adjustments
- ④ Fuel system
- ⑤ Power unit
- ⑥ Lower unit
- ⑦ Bracket unit
- ⑧ Electrical systems
- ⑨ Trouble analysis

Symbols ⑩ to ⑮ indicate specific data.

- ⑩ Special tool
- ⑪ Specified liquid
- ⑫ Specified engine speed
- ⑬ Specified torque
- ⑭ Specified measurement
- ⑮ Specified electrical value
[Resistance (Ω), Voltage (V), Electric current (A)]

Symbol ⑯ to ⑱ in an exploded diagram indicate the grade of lubricant and the location of the lubrication point.

- ⑯ Apply Yamaha 4-stroke outboard motor oil (TC-W3)
- ⑰ Apply water resistant grease (Yamaha grease A, Yamaha marine grease)
- ⑱ Apply molybdenum disulfide oil

Symbols ⑲ to ㉔ in an exploded diagram indicate the grade of the sealing or locking agent and the location of the application point.

- ⑲ Apply Gasket Maker®
- ⑳ Apply Yamabond #4 (Yamaha bond number 4)
- ㉑ Apply LOCTITE® No. 271 (Red LOCTITE)
- ㉒ Apply LOCTITE® No. 242 (Blue LOCTITE)
- ㉓ Apply LOCTITE® No. 572
- ㉔ Apply silicon sealant

CONTENTS

GENERAL INFORMATION	 GEN INFO	1
SPECIFICATIONS	 SPEC	2
PERIODIC INSPECTIONS AND ADJUSTMENTS	 INSP ADJ	3
FUEL SYSTEM	 FUEL	4
POWER UNIT	 POWR	5
LOWER UNIT	 LOWR	6
BRACKET UNIT	 BRKT	7
ELECTRICAL SYSTEMS	 ELEC	8
TROUBLE ANALYSIS	 TRBL ANLS	9

CHAPTER 1

GENERAL INFORMATION

IDENTIFICATION
SERIAL NUMBER
STARTING SERIAL NUMBERS

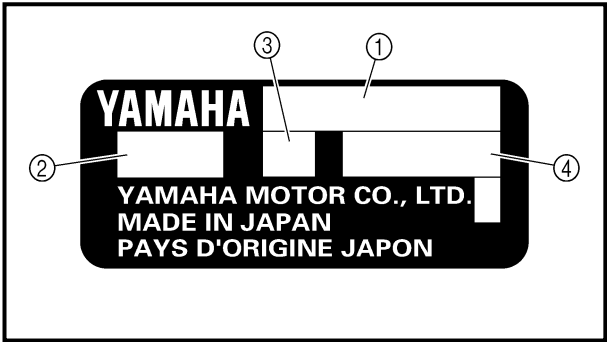
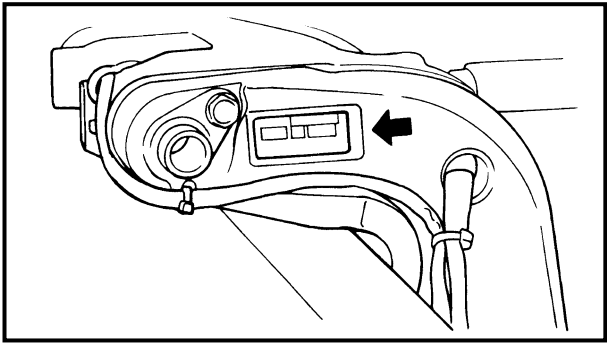
1-1
1-1
1-1

SAFETY WHILE WORKING
FIRE PREVENTION
VENTILATION.....
SELF-PROTECTION.....
OILS, GREASES AND SEALING FLUIDS.....
GOOD WORKING PRACTICES
DISASSEMBLY AND ASSEMBLY

1-2
1-2
1-2
1-2
1-2
1-3
1-4

SPECIAL TOOLS
MEASURING
REMOVING AND INSTALLING

1-5
1-5
1-7



IDENTIFICATION
SERIAL NUMBER

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

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

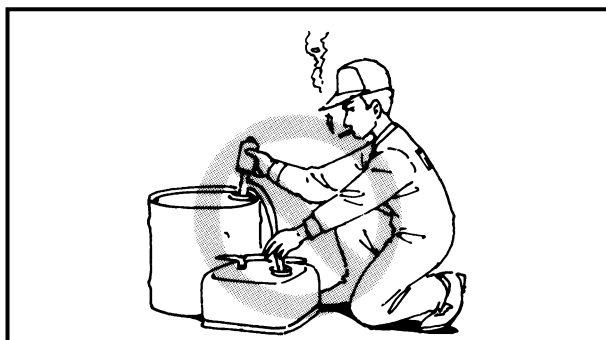
STARTING SERIAL NUMBERS

The starting serial number blocks are as follows:

Model name	Approved model code	Starting serial number
F115TR	68V	L: 1016859 -
		X: 1016859 -
LF115TR	68W	X: 1000743 -

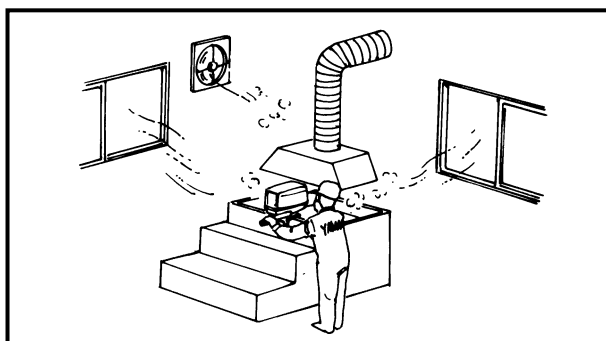
SAFETY WHILE WORKING

The procedures given in this manual are those recommended by Yamaha to be followed by Yamaha dealers and their mechanics.



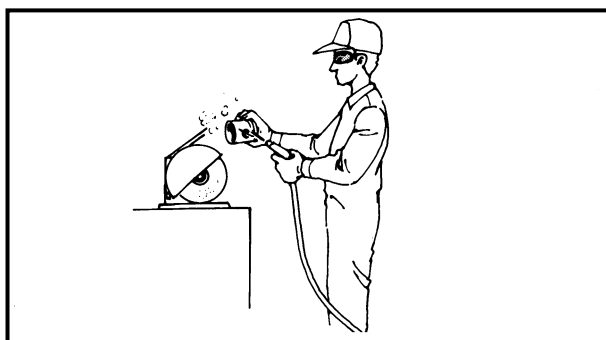
FIRE PREVENTION

Gasoline (petrol) is highly flammable. Petroleum vapor is explosive if ignited. Do not smoke while handling gasoline and keep it away from heat, sparks and open flames.



VENTILATION

Petroleum vapor is heavier than air and is deadly if inhaled in large quantities. Engine exhaust gases are harmful to breathe. When test-running an engine indoors, maintain good ventilation.



SELF-PROTECTION

Protect your eyes with suitable safety glasses or safety goggles, when grinding or when doing any operation which may cause particles to fly off. Protect hands and feet by wearing safety gloves or protective shoes if appropriate to the work you are doing.



OILS, GREASES AND SEALING FLUIDS

Use only genuine Yamaha oils, greases and sealing fluids or those recommended by Yamaha.

Under normal conditions of use, there should be no hazards from the use of the lubricants mentioned in this manual, but safety is all-important, and by adopting good safety practices, any risk is minimized. A summary of the most important precautions is as follows:

1. While working, maintain good standards of personal and industrial hygiene.
2. Clothing which has become contaminated with lubricants should be changed as soon as practicable, and laundered before further use.
3. Avoid skin contact with lubricants; do not, for example, place a soiled wiping-rag in your pocket.
4. Hands and any other part of the body which have been in contact with lubricants or lubricant-contaminated clothing, should be thoroughly washed with hot water and soap as soon as practicable.
5. To protect the skin, the application of a suitable barrier cream to the hands before working, is recommended.
6. A supply of clean lint-free cloths should be available for wiping purposes.

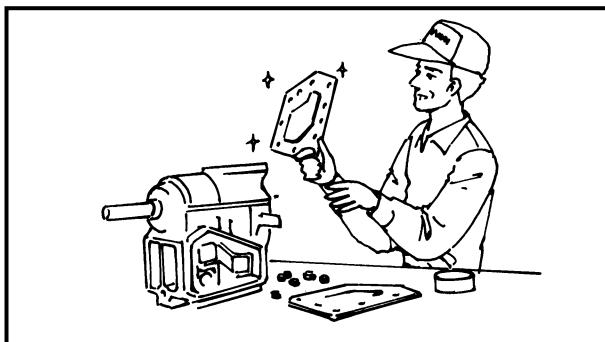


GOOD WORKING PRACTICES

1. The right tools

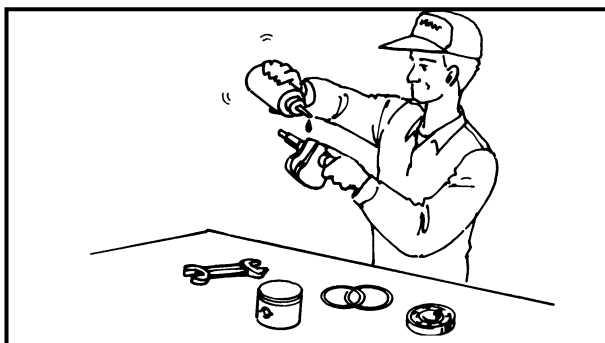
Use the recommended special tools to protect parts from damage. Use the right tool in the right manner – do not improvise.
2. Tightening torque

Follow the tightening torque instructions. When tightening bolts, nuts and screws, tighten the large sizes first, and tighten inner-positioned fixings before outer-positioned ones.



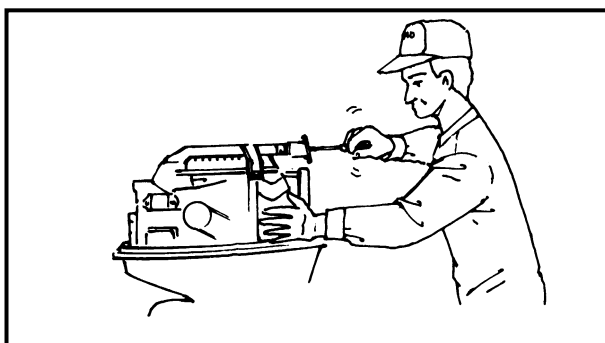
3. Non-reusable items

Always use new gaskets, packings, O-rings, split-pins, circlips, etc., on reassembly.



DISASSEMBLY AND ASSEMBLY

1. Clean parts with compressed air when disassembling.
2. Oil the contact surfaces of moving parts before assembly.



3. After assembly, check that moving parts operate normally.

4. Install bearings with the manufacturer's markings on the side exposed to view, and liberally oil the bearings.
5. When installing oil seals, apply a light coating of water-resistant grease to the outside diameter.

SPECIAL TOOLS

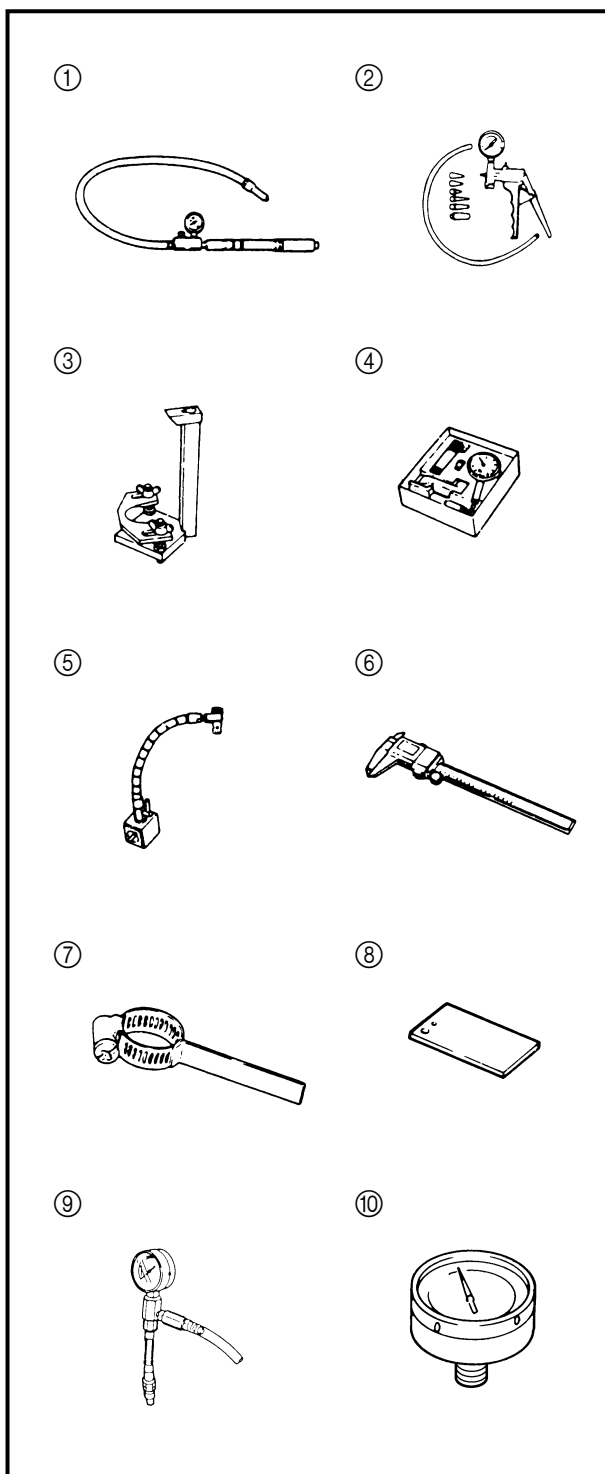
Using the correct special tools recommended by Yamaha, will aid the work and enable accurate assembly and tune-up. Improvising and using improper tools can damage the equipment.

NOTE:

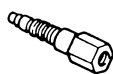
- For U.S.A. and Canada, use part numbers that start with "J-", "YB-", "YM-", "YU-" or "YW-".
- For others countries, use part numbers that start with "90890-".

MEASURING

- ① Pressure tester
P/N. YB-35956
90890-06762
- ② Mity vac
P/N. YB-35956
90890-06756
- ③ Pinion height gauge
P/N. YB-34432-6, YB-34432-11,
YB-34432-97
90890-06702
- ④ Dial gauge set
P/N. YU-03097
90890-01252
- ⑤ Magnetic base
P/N. YU-34481
90890-06705
- ⑥ Digital caliper
P/N. 90890-06704
- ⑦ Backlash indicator
P/N. YB-06265
90890-06706
- ⑧ Magnetic base attaching plate
P/N. YB-07003
90890-07003
- ⑨ Fuel pressure gauge
P/N. YB-06766
90890-06786
- ⑩ Hydraulic pressure gauge
P/N. 90890-06776



11

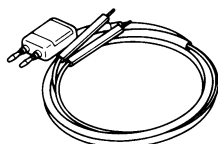


12

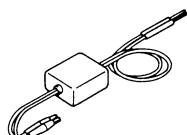


13

a

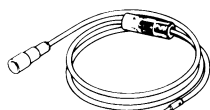


b

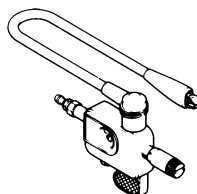


14

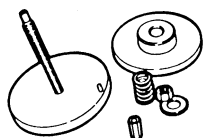
a



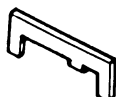
b



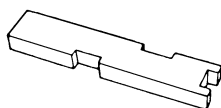
15



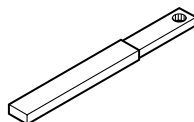
16



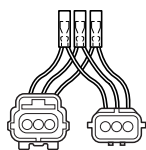
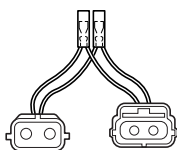
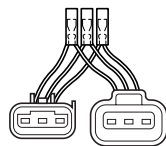
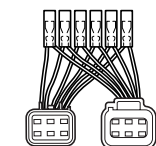
17



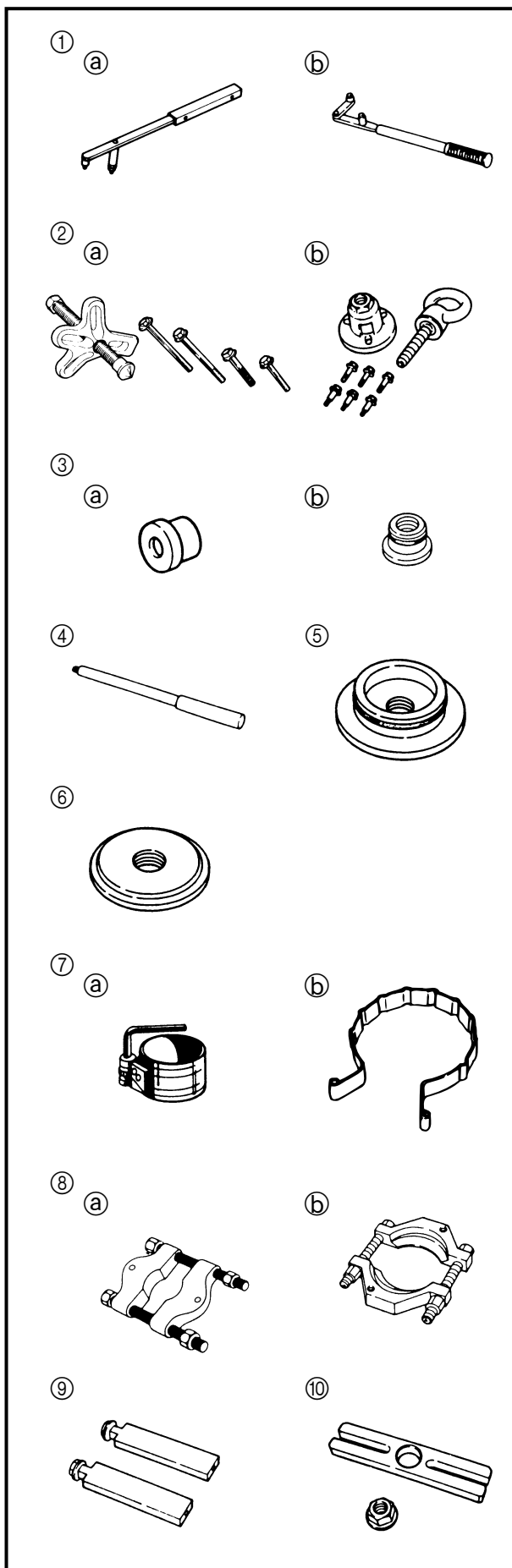
18



19

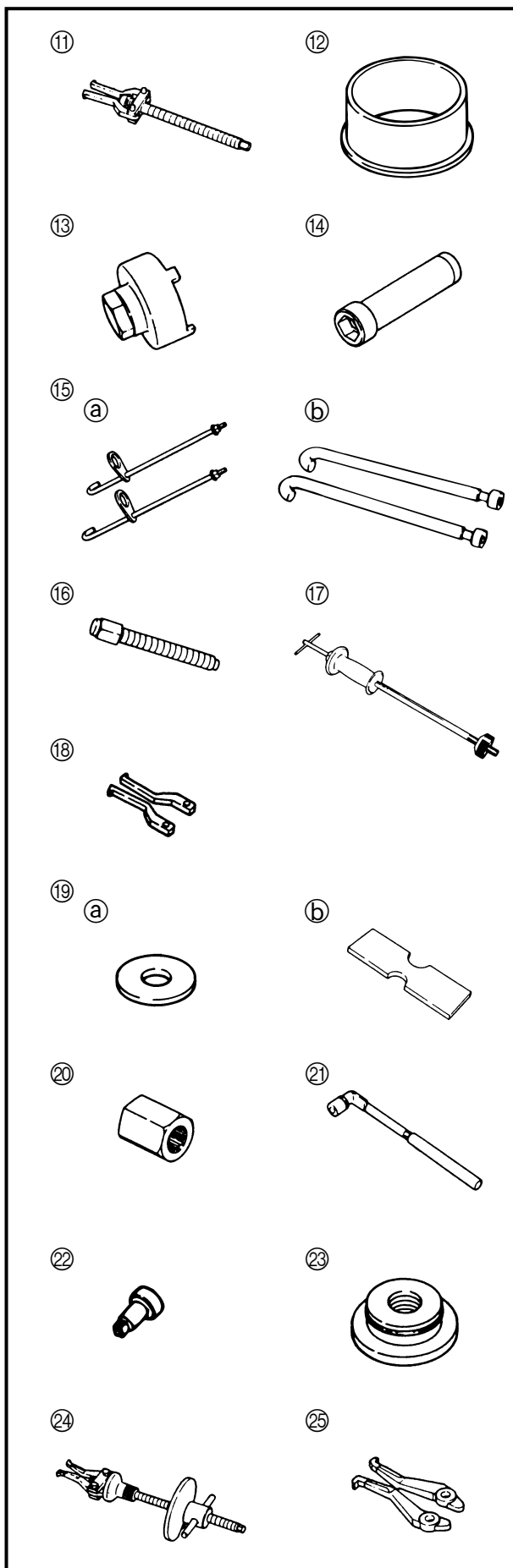


- 11 Up-relief valve attachment
P/N. 90890-06773
Down-relief valve attachment
P/N. 90890-06774
- 12 Digital tester
P/N. J-39299
90890-06752
- 13 Peak voltage adapter
P/N. YU-39991 a
90890-03169 b
- 14 Spark gap tester
P/N. YM-34487 a
90890-06754 b
- 15 Shimming gauge
P/N. YB-34446-1, YB-34446-3,
YB-34446-5, YB-34446-7
- 16 Shimming gauge
P/N. YB-34468-2
- 17 Shimming plate
P/N. 90890-06701
- 18 Shift rod wrench
P/N. YB-06052
90890-06052
- 19 Test harness
P/N. 90890-06790, 90890-06791,
90890-06792, 90890-06793

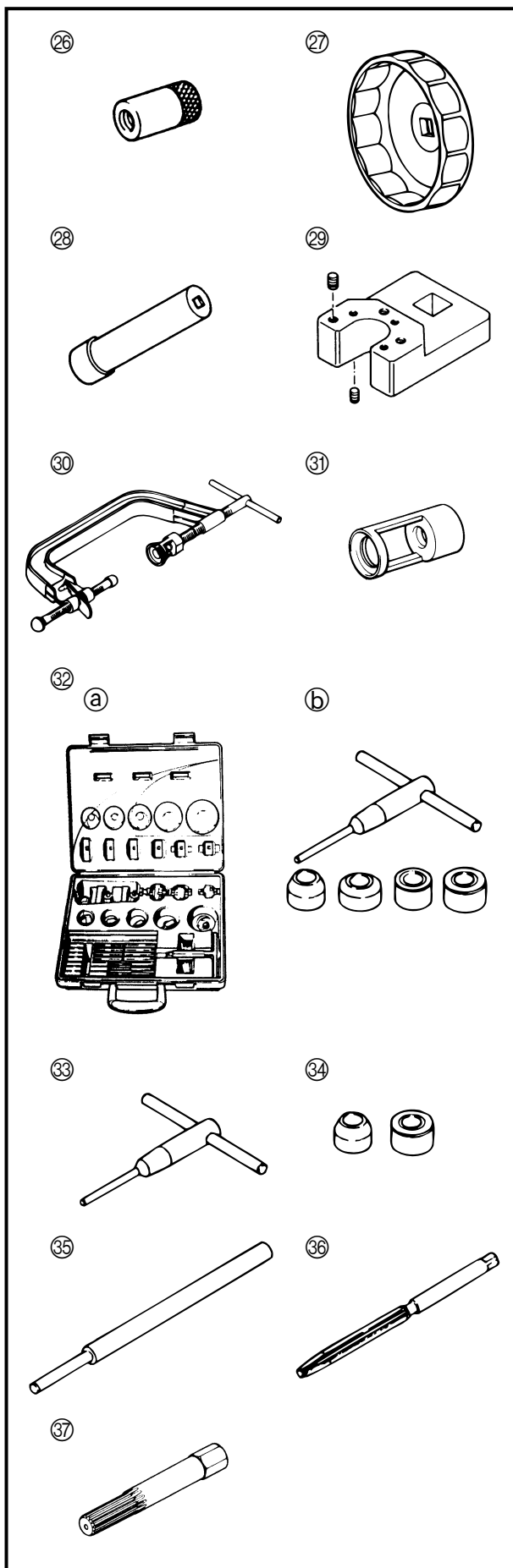


REMOVING AND INSTALLING

- ① Flywheel magnet assembly holder
P/N. YB-06139 ①
90890-06522 ②
- ② Universal puller
P/N. YB-06117 ①
90890-06521 ②
- ③ Bearing/oil seal attachment
P/N. YB-06196 ①
90890-06653 ②
- ④ Driver rod
P/N. YB-06071
90890-06602, 90890-06604,
90890-06605, 90890-06606,
90890-06652
- ⑤ Bearing/oil seal attachment
P/N. YB-06377
90890-06630
- ⑥ Bearing/oil seal attachment
P/N. YB-06199
90890-06620
- ⑦ Piston ring compressor
P/N. YU-33294 ①
90890-06530 ②
- ⑧ Bearing separator
P/N. YB-06219 ①
90890-06534 ②
- ⑨ Guide plate stand
P/N. 90890-06538
- ⑩ Guide plate
P/N. 90890-06501



- ⑪ Bearing puller
P/N. 90890-06535
- ⑫ Bearing/oil seal attachment
P/N. 90890-06661, 90890-06640
- ⑬ Ring nut wrench
P/N. YB-34447, YB-06578
90890-06511, 90890-06578
- ⑭ Ring nut wrench extension
P/N. 90890-06513
- ⑮ Propeller shaft housing puller
P/N. YB-06207 ①
90890-06502 ②
- ⑯ Center bolt
P/N. 90890-06504
- ⑰ Slide hammer
P/N. YB-06096
90890-06531
- ⑱ Small universal claws
P/N. 90890-06536
- ⑲ Bearing/oil seal depth plate
P/N. YB-06213, YB-34474 ①
90890-06603 ②
- ⑳ Drive shaft holder
P/N. YB-06151
90890-06519
- ㉑ Pinion nut holder
P/N. 90890-06505
- ㉒ Pinion nut holder attachment
P/N. 90890-06507
- ㉓ Bearing/oil seal attachment
P/N. YB-06194, YB-06195,
YB-06200, YB-06376
90890-06607, 90890-06610,
90890-06612, 90890-06633,
90890-06636
- ㉔ Bearing puller
P/N. 90890-06523
- ㉕ Large universal claws
P/N. 90890-06532



- 26

Slide hammer attachment

P/N. YB-06335

90890-06514

27

Oil filter wrench

P/N. YU-38411

90890-01426

28

End screw wrench

P/N. YB-06175-1A

29

End screw wrench

P/N. YB-06548

90890-06548

30

Valve spring compressor

P/N. YM-01253

90890-04019

31

Valve spring compressor adapter (ø22 mm)

P/N. YB-06554

90890-06554

32

Valve seat cutter set

P/N. YM-91043-C..... (a)

90890-06803 (b)

33

Valve seat cutter holder (ø6 mm)

P/N. YB-06553

90890-06553

34

Valve seat cutter

P/N. YB-06555 (45° - 30 mm)

YB-06556 (90° - 30 mm)

90890-06555 (45° - 30 mm)

90890-06556 (90° - 30 mm)

35

Valve guide remover (ø5.9 mm)

P/N. YM-4064-A

90890-04064

36

Valve guide reamer (ø6 mm)

P/N. YM-04066

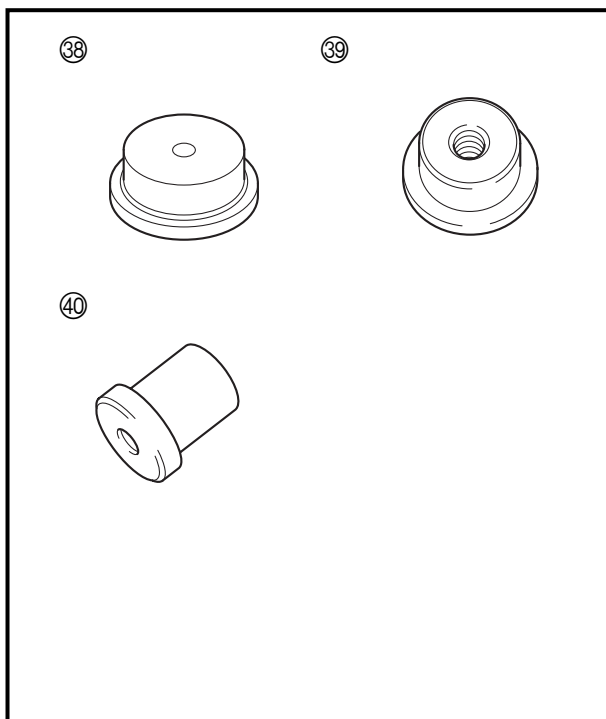
90890-04066

37

Crankshaft holder

P/N. YB-06552

90890-06552



- ③⑧ Bearing installer
P/N. YB-41446
- ③⑨ Bearing cup installer
P/N. YB-06167
- ④⑩ Roller bearing installer/remover
P/N. YB-06432-1A

CHAPTER 2

SPECIFICATIONS

GENERAL SPECIFICATIONS.....

2-1

MAINTENANCE SPECIFICATIONS.....

2-3

POWER UNIT.....

2-3

LOWER UNIT.....

2-7

ELECTRICAL

2-7

DIMENSIONS

2-10

TIGHTENING TORQUES

2-13

SPECIFIED TORQUES

2-13

GENERAL TORQUES

2-15

GENERAL SPECIFICATIONS

Item	Unit	Model	
		F115TR	LF115TR
DIMENSION			
Overall length	mm (in)	825 (32.5)	
Overall width	mm (in)	498 (19.6)	
Overall height			
(L)	mm (in)	1,609 (63.3)	—
(X)	mm (in)	1,736 (68.3)	
Boat transom height			
(L)	mm (in)	508 (20.0)	—
(X)	mm (in)	635 (25.0)	
WEIGHT			
(without propeller)			
(L)	kg (lb)	183 (403)	—
(X)	kg (lb)	188 (414)	
PERFORMANCE			
Maximum output	kW (hp) @ 5,500 r/min	84.6 (115)	
Full throttle operating range	r/min	5,000 - 6,000	
Maximum fuel consumption	L (US gal, Imp gal)/hr @ 6,000 r/min	38 (10.0, 8.4)	
POWER UNIT			
Type		In-line, 4 stroke, DOHC, 16 valves	
Number of cylinders		4	
Displacement	cm ³ (cu. in)	1,741 (106.2)	
Bore × stroke	mm (in)	79.0 × 88.8 (3.11 × 3.50)	
Compression ratio		9.7	
Minimum compression pressure ^(*1)	kPa (kgf/cm ² , psi)	950 (9.5, 135)	
Fuel system		Electronic fuel injection	
Fuel injection system		Fuel injection	
Starting system		Electric	
Ignition control system		TCI	
Alternator output	V, A	12, 25	
Spark plugs (NGK)		LFR6A-11	
Cooling system		Water	
Exhaust system		Through propeller boss	
Lubrication system		Wet sump	

(*) Measuring conditions:

Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.

The figures are reference only.



Item	Unit	Model	
		F115TR	LF115TR
Lubrication oil pressure ^(*1) at 55°C (131°F)	kPa (kgf/cm ² , psi) @ idling	350 (3.5, 49.8)	
FUEL AND OIL			
Fuel type		Unleaded regular gasoline	
Fuel rating	PON ^(*2) RON	86 91	
Engine oil type		4-stroke motor oil	
Engine oil grade	API SAE	SE, SF, SG, SH, or SJ 10W-30 or 10W-40	
Engine oil capacity (with oil filter)	L (US qt, Imp qt)	4.5 (4.76, 3.96)	
(without oil filter)	L (US qt, Imp qt)	4.3 (4.55, 3.78)	
Gear oil type		GEAR CASE LUBE	
Gear oil grade	SAE	90	
Gear oil total quantity	cm ³ (US oz, Imp oz)	760 (25.7, 26.8)	715 (24.2, 25.2)
BRACKET			
Trim angle (at 12° boat transom)	Degree	-4 - 16	
Tilt-up angle	Degree	70	
Steering angle	Degree	30 + 30	
DRIVE UNIT			
Gear shift positions		F-N-R	
Gear ratio		2.15 (28/13)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (rear view)		Clockwise	Counterclockwise
Propeller mark		K	KL
ELECTRICAL			
Battery minimum capacity ^(*3)			
CCA/SAE	A	380	
MCA/ABYC	A	502	
RC/SAE	Minute	124	

(*1) The figures are reference only.

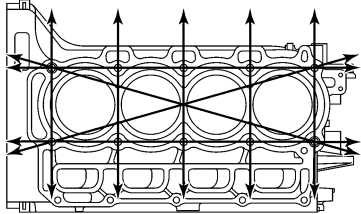
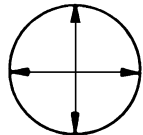
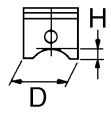
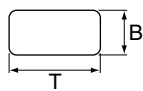
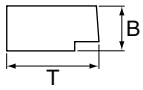
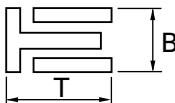
(*2) PON: Pump Octane Number =
(RON + Motor Octane Number)/2
RON: Research Octane Number

(*3) CCA: Cold Cranking Ampere
MCA: Marine Cranking Ampere
ABYC: American Boat and Yacht Council
SAE: Society of Automotive Engineers
RC: Reserve Capacity



MAINTENANCE SPECIFICATIONS

POWER UNIT

Item	Unit	Model	
		F115TR	LF115TR
CYLINDER HEADS			
Warpage limit 	mm (in)	0.1 (0.004)	
(lines indicate straightedge position)			
Camshaft journal inside diameter	mm (in)	25.000 - 25.021 (0.984 - 0.985)	
CYLINDERS			
Bore size 	mm (in)	79.000 - 79.020 (3.110 - 3.111)	
Taper limit	mm (in)	0.08 (0.003)	
Out-of-round limit	mm (in)	0.05 (0.002)	
PISTONS			
Piston diameter (D) 	mm (in)	78.928 - 78.949 (3.1074 - 3.1082)	
Measuring point (H)	mm (in)	13 (0.51)	
Piston-to-cylinder clearance	mm (in)	0.070 - 0.080 (0.0028 - 0.0031)	
<Limit>	mm (in)	0.13 (0.005)	
Oversize piston diameter	mm (in)	79.25 (3.120)	
PISTON PINS			
Outside diameter	mm (in)	17.997 - 18.000 (0.7085 - 0.7087)	
PISTON RINGS			
Top ring			
Dimension B 	mm (in)	1.17 - 1.19 (0.046 - 0.047)	
Dimension T	mm (in)	2.80 - 3.00 (0.110 - 0.118)	
End gap	mm (in)	0.15 - 0.30 (0.006 - 0.012)	
Side clearance	mm (in)	0.04 - 0.08 (0.002 - 0.003)	
2nd ring			
Dimension B 	mm (in)	1.47 - 1.49 (0.058 - 0.059)	
Dimension T	mm (in)	3.00 - 3.20 (0.118 - 0.126)	
End gap	mm (in)	0.70 - 0.90 (0.028 - 0.035)	
Side clearance	mm (in)	0.03 - 0.07 (0.001 - 0.003)	
Oil ring			
Dimension B 	mm (in)	2.38 - 2.48 (0.094 - 0.098)	
Dimension T	mm (in)	2.40 (0.094)	
End gap	mm (in)	0.20 - 0.70 (0.008 - 0.028)	
Side clearance	mm (in)	0.03 - 0.15 (0.001 - 0.006)	

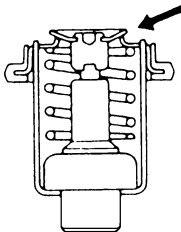


Item	Unit	Model	
		F115TR	LF115TR
CAMSHAFTS			
Intake (A)	mm (in)	37.22 - 37.38 (1.465 - 1.472)	
Exhaust (A)	mm (in)	36.90 - 37.06 (1.453 - 1.459)	
Intake and exhaust (B)	mm (in)	29.92 - 30.08 (1.178 - 1.184)	
Camshaft journal diameter	mm (in)	24.96 - 24.98 (0.9827 - 0.9835)	
Camshaft journal oil clearance	mm (in)	0.020 - 0.061 (0.0008 - 0.0024)	
Maximum camshaft runout	mm (in)	0.03 (0.0012)	
VALVES			
Valve clearance (cold)			
Intake	mm (in)	0.20 ± 0.03 (0.008 ± 0.001)	
Exhaust	mm (in)	0.34 ± 0.03 (0.013 ± 0.001)	
Head diameter (A)			
Intake	mm (in)	29.0 - 29.2 (1.14 - 1.15)	
Exhaust	mm (in)	24.0 - 24.2 (0.94 - 0.95)	
Face width (B)			
Intake	mm (in)	2.00 - 2.43 (0.079 - 0.096)	
Exhaust	mm (in)	2.28 - 2.71 (0.090 - 0.107)	
Seat width (C)			
Intake	mm (in)	1.2 - 1.6 (0.047 - 0.063)	
Exhaust	mm (in)	1.2 - 1.6 (0.047 - 0.063)	
Margin thickness (D)			
Intake	mm (in)	0.8 - 1.2 (0.031 - 0.047)	
Exhaust	mm (in)	1.0 - 1.4 (0.039 - 0.055)	
Stem diameter			
Intake	mm (in)	5.975 - 5.990 (0.2352 - 0.2358)	
Exhaust	mm (in)	5.960 - 5.975 (0.2346 - 0.2352)	
Guide inside diameter			
Intake and exhaust	mm (in)	6.000 - 6.018 (0.2362 - 0.2369)	
Stem-to-guide clearance			
Intake	mm (in)	0.015 - 0.043 (0.0006 - 0.0017)	
Exhaust	mm (in)	0.030 - 0.058 (0.0012 - 0.0023)	
Stem runout limit	mm (in)	0.01 (0.0004)	



Item	Unit	Model	
		F115TR	LF115TR
VALVE SPRINGS			
Free length	mm (in)	53.20 (2.094)	
Minimum free length	mm (in)	52.25 (2.057)	
Tilt limit	mm (in)	2.6 (0.10)	
VALVE LIFTERS			
Valve lifter outside diameter	mm (in)	27.965 - 27.980 (1.1010 - 1.1016)	
Valve-lifter-to-cylinder-head clearance	mm (in)	0.020 - 0.056 (0.0008 - 0.0022)	
VALVE PADS			
Valve pad thickness (in 0.025 mm increments)	mm (in)	2.000 - 3.300 (0.0787 - 0.1299)	
CONNECTING RODS			
Small-end inside diameter	mm (in)	17.965 - 17.985 (0.7073 - 0.7081)	
Big-end inside diameter	mm (in)	45.025 - 45.045 (1.7726 - 1.7734)	
Big-end oil clearance	mm (in)	0.025 - 0.031 (0.0010 - 0.0012)	
Big-end bearing thickness			
Yellow	mm (in)	1.502 - 1.508 (0.0591 - 0.0593)	
Green	mm (in)	1.508 - 1.514 (0.0593 - 0.0596)	
Blue	mm (in)	1.514 - 1.520 (0.0596 - 0.0598)	
Red	mm (in)	1.520 - 1.526 (0.0598 - 0.0601)	
CRANKSHAFT			
Crankshaft journal			
Diameter	mm (in)	47.984 - 48.000 (1.8891 - 1.8898)	
Minimum diameter	mm (in)	47.972 (1.8887)	
Crankshaft pin			
Diameter	mm (in)	41.982 - 42.000 (1.6528 - 1.6535)	
Runout limit	mm (in)	0.03 (0.001)	



Item	Unit	Model	
		F115TR	LF115TR
CRANKCASE			
Crankcase main journal inside diameter	mm (in)	54.023 - 54.042 (2.1269 - 2.1276)	
Crankshaft journal oil clearance	mm (in)	0.024 - 0.044 (0.0009 - 0.0017)	
Upper crankcase main journal bearing thickness			
Green	mm (in)	2.992 - 2.999 (0.1178 - 0.1181)	
Blue	mm (in)	2.999 - 3.006 (0.1181 - 0.1183)	
Red	mm (in)	3.006 - 3.013 (0.1183 - 0.1186)	
Lower crankcase main journal bearing thickness			
Yellow	mm (in)	3.010 - 3.017 (0.1185 - 0.1188)	
Green	mm (in)	3.017 - 3.024 (0.1188 - 0.1191)	
Blue	mm (in)	3.024 - 3.031 (0.1191 - 0.1193)	
Red	mm (in)	3.031 - 3.038 (0.1193 - 0.1196)	
No. 3 main journal bearing thickness			
Green	mm (in)	2.992 - 2.999 (0.1178 - 0.1181)	
Blue	mm (in)	2.999 - 3.006 (0.1181 - 0.1183)	
Red	mm (in)	3.006 - 3.013 (0.1183 - 0.1186)	
OIL PUMP			
Discharge at 100 °C (212 °F), with 10W-30 engine oil	L (US gal, Imp gal)/min @ 1,000 r/min	5.9 (1.56, 1.30)	
Pressure	kPa (kgf/cm ² , psi)	118 (1.18, 16.78)	
Relief valve opening pressure	kPa (kgf/cm ² , psi)	490 (4.90, 69.69)	
THERMOSTATS			
Opening temperature	°C (°F)	48 - 52 (118 - 126)	
Full-open temperature	°C (°F)	60 (140)	
			
Valve open lower limit	mm (in)	4.3 (0.17)	
ENGINE SPEED			
Idling speed	r/min	750 ± 50	



LOWER UNIT

Item	Unit	Model	
		F115TR	LF115TR
GEAR BACKLASH			
Pinion - forward gear	mm (in)	0.19 - 0.53 (0.007 - 0.021)	0.31 - 0.66 (0.012 - 0.026)
Pinion - reverse gear	mm (in)	0.86 - 1.26 (0.034 - 0.050)	0.86 - 1.21 (0.034 - 0.048)
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Reverse gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	

ELECTRICAL

Item	Unit	Model	
		F115TR	LF115TR
IGNITION SYSTEM			
Ignition timing	Degree	4 ATDC - 20 BTDC	
ECM unit (B/R, B/W – B)			
Output peak voltage lower limit			
@ cranking 1	V		5.0
@ cranking 2	V		122
@ 1,500 r/min	V		242
@ 3,500 r/min	V		245
Pulser coil (W/R, W/B – B)			
Output peak voltage lower limit			
@ cranking 1	V		3.5
@ cranking 2	V		3.0
@ 1,500 r/min	V		26
@ 3,500 r/min	V		44
IGNITION CONTROL SYSTEM			
Engine cooling water temperature sensor			
Resistance (B/Y – B)			
@ 5°C (41°F)	kΩ		4.62
@ 20°C (68°F)	kΩ		2.44
@ 100°C (212°F)	kΩ		0.19
Throttle position sensor			
Output voltage (P – B)	V	0.732 ± 0.014	

* Cranking 1: Open circuit voltage.
Cranking 2: Loaded circuit voltage.



Item	Unit	Model	
		F115TR	LF115TR
STARTING SYSTEM			
Fuse 1	V-A	12-20	
Fuse 2	V-A	12-30	
STARTER MOTOR			
Type		Sliding gear	
Output	kW	1.4	
Rating	Second	30	
Brushes			
Standard length	mm (in)	15.5 (0.61)	
Wear limit	mm (in)	9.5 (0.37)	
Commutator			
Standard diameter	mm (in)	29.0 (1.14)	
Wear limit	mm (in)	28.0 (1.10)	
Mica			
Standard undercut	mm (in)	0.5 - 0.8 (0.02 - 0.03)	
Wear limit	mm (in)	0.2 (0.01)	
CHARGING SYSTEM			
Lighting coil (W – W)			
Output peak voltage lower limit			
@ cranking 1	V	9.3	
@ cranking 2	V	7.4	
@ 1,500 r/min	V	37 (open circuit voltage)	
@ 3,500 r/min	V	89 (open circuit voltage)	
Rectifier/regulator (R – B)			
Output peak voltage lower limit			
@ cranking 1	V	—	
@ cranking 2	V	7.5	
@ 1,500 r/min	V	12.5	
@ 3,500 r/min	V	13.0	
POWER TRIM AND TILT SYSTEM			
Trim sensor			
Resistance (P – B)	Ω	9 - 378.8	

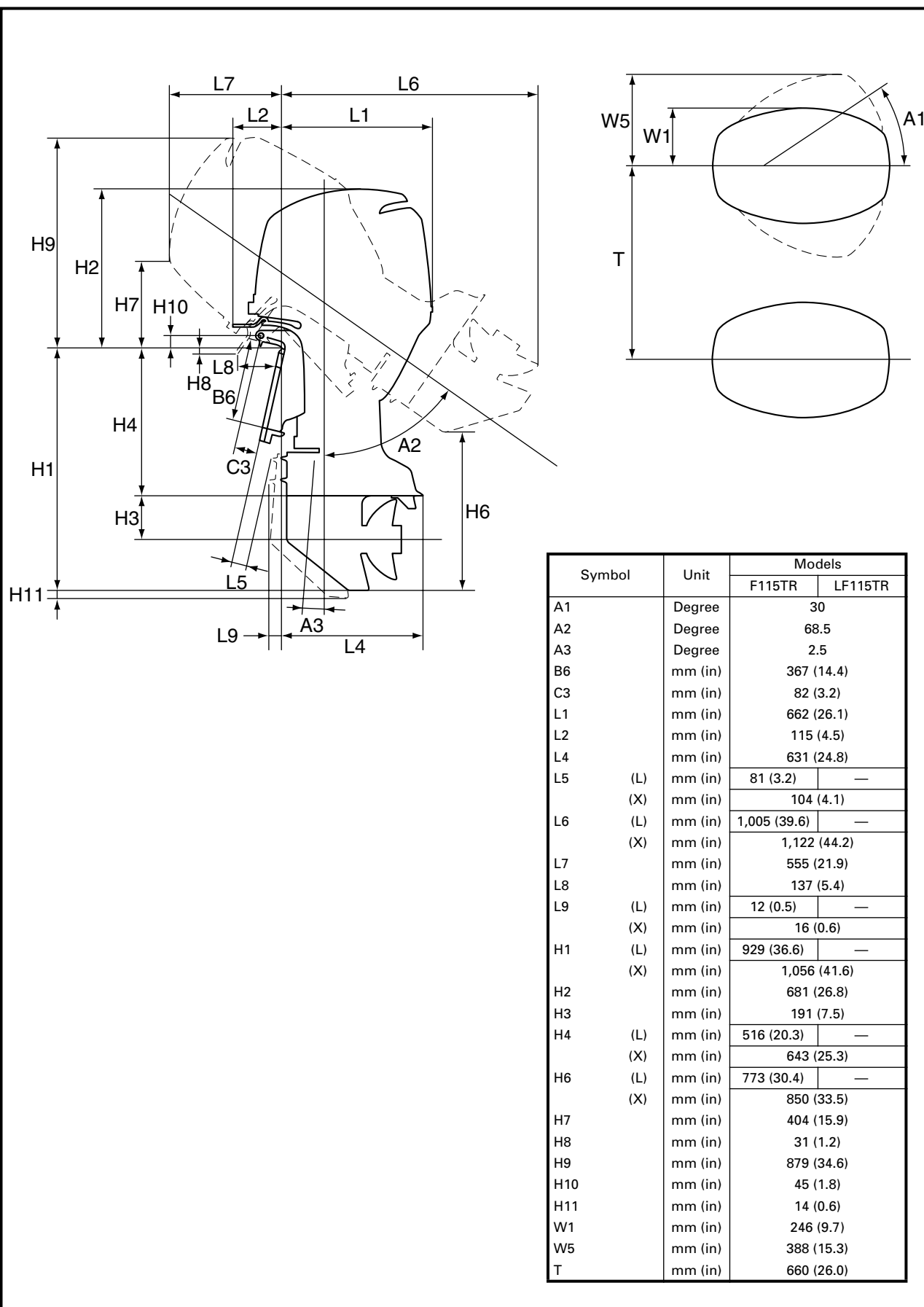
* Cranking 1: Open circuit voltage.
Cranking 2: Loaded circuit voltage.

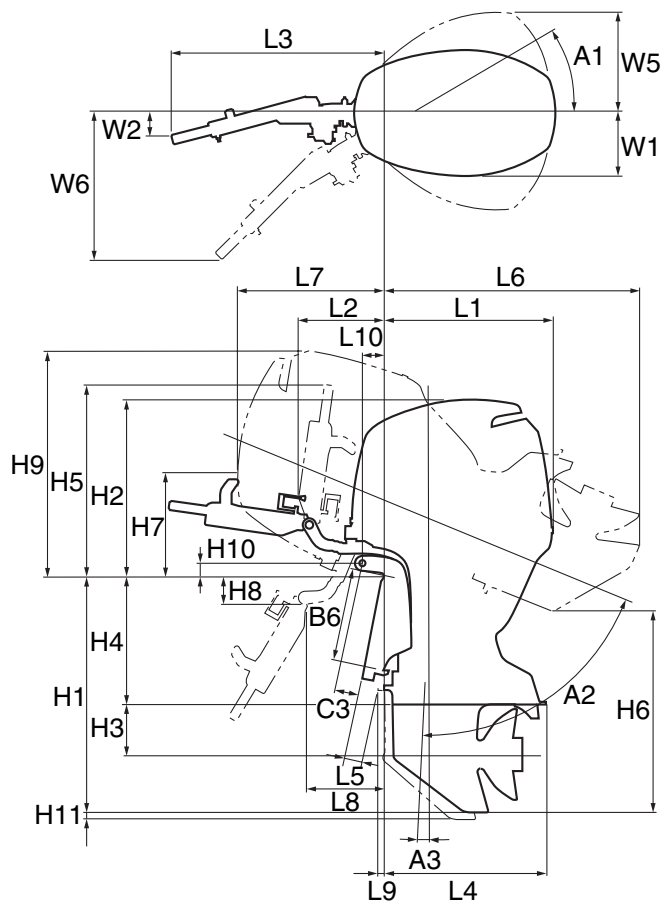


Item	Unit	Model	
		F115TR	LF115TR
POWER TRIM AND TILT MOTOR			
Fluid type		ATF Dexron II	
Brushes			
Standard length	mm (in)	9.8 (0.39)	
Wear limit	mm (in)	4.8 (0.19)	
Commutator			
Standard diameter	mm (in)	22.0 (0.87)	
Wear limit	mm (in)	21.0 (0.83)	
Mica			
Standard undercut	mm (in)	1.35 (0.05)	
Wear limit	mm (in)	0.85 (0.03)	

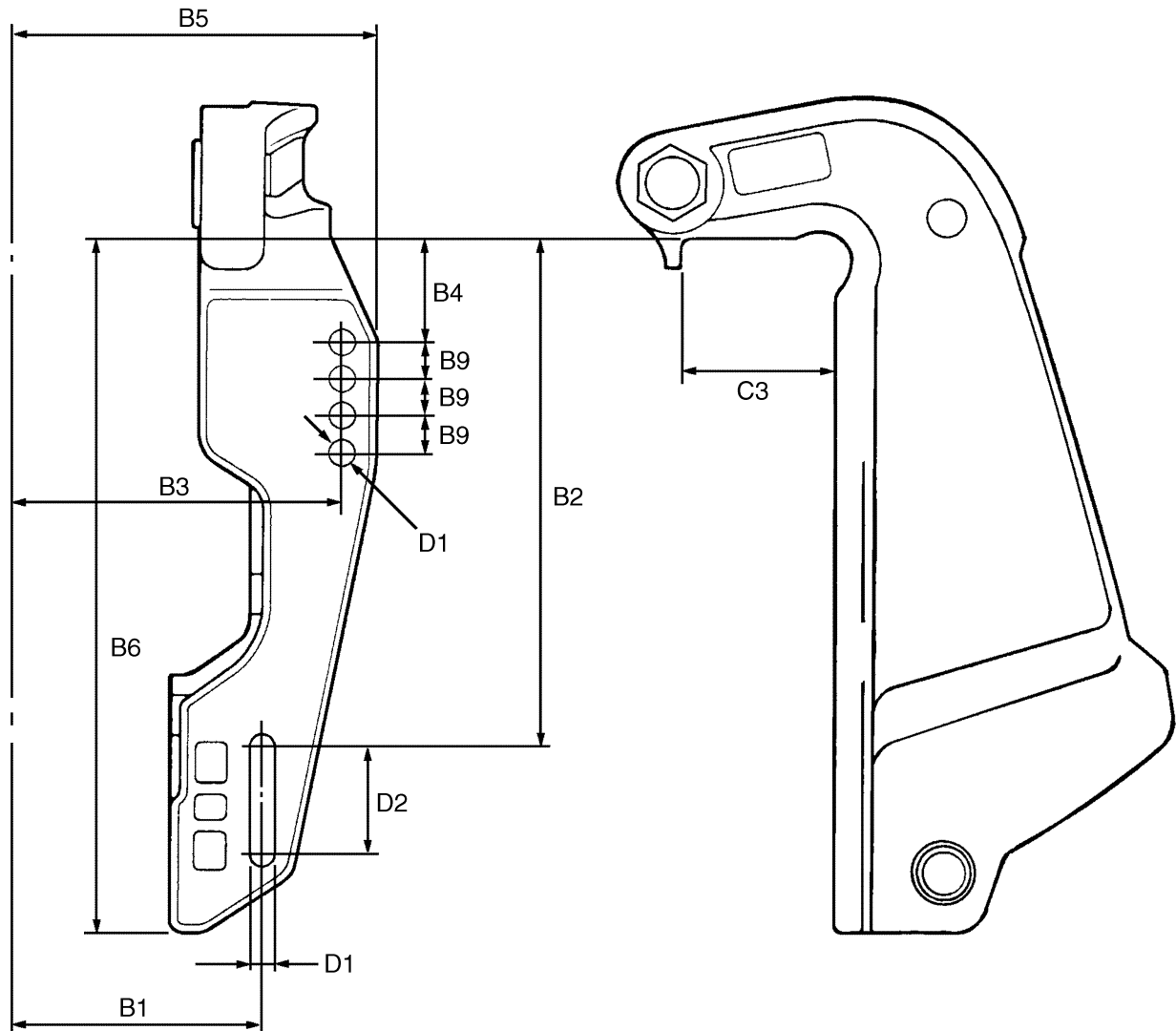


DIMENSIONS





Symbol	Unit	Models	
		F115TR	LF115TR
A1	Degree	30	
A2	Degree	68.5	
A3	Degree	2.5	
B6	mm (in)	367 (14.4)	
C3	mm (in)	82 (3.2)	
L1	mm (in)	662 (26.1)	
L2	mm (in)	316 (12.4)	
L3	mm (in)	832 (32.8)	
L4	mm (in)	631 (24.8)	
L5	(L) mm (in)	81 (3.2)	—
	(X) mm (in)	104 (4.1)	—
L6	(L) mm (in)	1,005 (39.6)	—
	(X) mm (in)	1,122 (44.2)	—
L7	mm (in)	555 (21.9)	
L8	mm (in)	294 (11.6)	
L9	(L) mm (in)	12 (0.5)	—
	(X) mm (in)	16 (0.6)	—
H1	(L) mm (in)	929 (36.6)	—
	(X) mm (in)	1,056 (41.6)	—
H2	mm (in)	681 (26.8)	
H3	mm (in)	191 (7.5)	
H4	(L) mm (in)	516 (20.3)	—
	(X) mm (in)	643 (25.3)	—
H6	(L) mm (in)	773 (30.4)	—
	(X) mm (in)	850 (33.5)	—
H7	mm (in)	404 (15.9)	
H8	mm (in)	105 (4.1)	
H9	mm (in)	879 (34.6)	
H10	mm (in)	45 (1.8)	
H11	mm (in)	14 (0.6)	
W1	mm (in)	246 (9.7)	
W2	mm (in)	93 (3.7)	
W5	mm (in)	388 (15.3)	
W6	mm (in)	574 (22.6)	



Symbol	Unit	Models	
		F115TR	LF115TR
B1	mm (in)	125.4 (4.9)	
B2	mm (in)	254 (10.0)	
B3	mm (in)	163.5 (6.4)	
B4	mm (in)	50.8 (2.0)	
B5	mm (in)	180 (7.1)	
B6	mm (in)	367 (14.4)	
B9	mm (in)	18.5 (0.7)	
C3	mm (in)	82 (3.2)	
D1	mm (in)	13 (0.5)	
D2	mm (in)	55.5 (2.2)	

TIGHTENING TORQUES

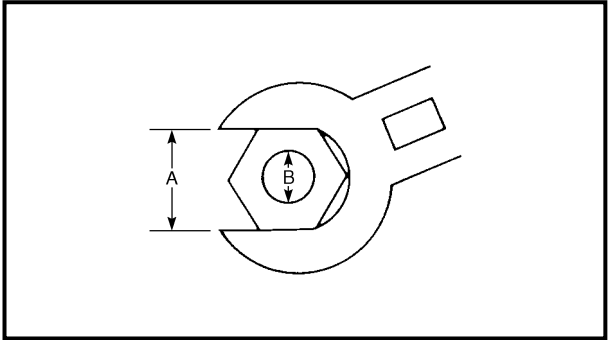
SPECIFIED TORQUES

Part to be tightened		Thread size	Tightening torques		
			Nm	m•kgf	ft•lb
POWER UNIT					
Flywheel magnet assembly		M24	186	19	137
Positive battery lead		M8	9	0.9	6.5
Power unit mount		M8	42	4.2	30
Driven sprocket		M10	60	6.0	43
Drive sprocket		M40	265	27	192
Timing belt tensioner		M10	40	4.0	29
Spark plug		M14	25	2.5	18
Cylinder head cover		M6	8	0.8	5.8
Breather cover		M4	2	0.2	1.4
Fuel pump bracket assembly		M7	17	1.7	12
Camshaft cap	1st	M7	8	0.8	5.8
	2nd		17	1.7	12
Cylinder head assembly	1st	M8	14	1.4	10
	2nd		28	2.8	20
Cylinder head assembly (1.5 mm thread pitch)	1st	M10	15	1.5	11
	2nd		30	3.0	22
	3rd		Turn 90°		
Exhaust cover	1st	M6	6	0.6	4.3
	2nd		12	1.2	8.7
Oil filter		—	18	1.8	13
Oil pressure switch		—	8	0.8	5.8
Crankcase	1st	M8	14	1.4	10
	2nd		28	2.8	20
Crankcase (1.5 mm thread pitch)	1st	M10	19	1.9	14
	2nd		Turn 60°		
Connecting rod cap	1st	M8	15	1.5	11
	2nd		Turn 60°		
LOWER UNIT					
Propeller		M18	55	5.5	40
Trim tab		M10	43	4.3	31
Lower unit		M10	37	3.7	27
Impeller housing		M8	18	1.8	13
Shift rod assembly		M6	8	0.8	5.8
Ring nut		M101.5	105	10.5	76
Drive shaft housing assembly		M8	18	1.8	13
Pinion nut		M16	93	9.3	67
Gear oil drain screw		—	7	0.7	5.1
Gear oil level check screw		—	7	0.7	5.1



Part to be tightened	Thread size	Tightening torques		
		Nm	m•kgf	ft•lb
BRACKET UNIT				
Friction piece	—	13	1.3	9.4
Steering handle assembly	—	38	3.8	27.5
Main switch assembly	—	5	0.5	3.7
Engine stop lanyard switch	—	4	0.4	2.9
Shift lever	M8	18	1.8	13
Steering handle bracket	M10	38	3.8	27.5
Shift rod detent mechanism screw	—	18	1.8	13
Oil pump	M6	10	1.0	7.2
Upper mount	M12	53	5.3	38
Lower mount	M14	73	7.3	53
Muffler assembly	M8	20	2.0	14
Exhaust manifold	M6	11	1.1	8.0
Oil pan	M6	11	1.1	8.0
Oil strainer	M6	11	1.1	8.0
Clamp bracket	M22	15	1.5	11
Cam	—	2	0.2	1.4
Trim stopper	—	37	3.7	27
POWER TRIM AND TILT UNIT				
Power trim and tilt reservoir	1/4"	5	0.5	3.6
Power trim and tilt motor	1/4"	5	0.5	3.6
Manual valve	—	4	0.4	2.9
Tilt ram end screw	—	130	13	94
Gear pump unit	5/16"	9	0.9	6.5
Gear pump	—	6	0.6	4.3
Trim ram end screw	—	80	8.0	52

Nut (A)	Bolt (B)	General torque specifications		
		Nm	m•kgf	ft•lb
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



GENERAL TORQUES

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

CHAPTER 3

PERIODIC INSPECTIONS AND ADJUSTMENTS

MAINTENANCE INTERVAL CHART	3-1
TOP COWLING	3-2
CHECKING THE TOP COWLING FIT	3-2
FUEL SYSTEM	3-2
CHECKING THE FUEL LINE	3-2
CHECKING THE FUEL FILTER	3-3
MEASURING THE FUEL PRESSURE (HIGH-PRESSURE FUEL LINE)	3-3
CONTROL SYSTEM	3-4
CHECKING AND ADJUSTING THE THROTTLE BODY PICKUP TIMING	3-4
ADJUSTING THE SHIFT CABLE	3-5
ADJUSTING THE THROTTLE CABLE	3-6
ADJUSTING THE THROTTLE POSITION SENSOR	3-7
SYNCHRONIZING THE THROTTLE VALVES	3-8
ADJUSTING THE THROTTLE POSITION SENSOR (WHEN DISASSEMBLING OR REPLACING THE THROTTLE BODY)	3-10
COOLING SYSTEM	3-11
CHECKING THE COOLING WATER DISCHARGE	3-11
POWER UNIT	3-11
CHECKING THE ENGINE OIL LEVEL	3-11
REPLACING THE ENGINE OIL/OIL FILTER	3-11
CHECKING THE TIMING BELT	3-12
ADJUSTING THE VALVE CLEARANCE	3-13
POWER TRIM AND TILT SYSTEM	3-16
CHECKING THE POWER TRIM AND TILT FLUID LEVEL	3-16
ADJUSTING THE TRIM SENSOR CAM	3-17

LOWER UNIT	3-18
CHECKING THE GEAR OIL LEVEL	3-18
CHANGING AND CHECKING THE GEAR OIL	3-18
CHECKING THE LOWER UNIT (FOR AIR LEAKS)	3-20
 GENERAL	 3-20
CHECKING THE ANODES.....	3-20
CHECKING THE BATTERY.....	3-21
CHECKING THE SPARK PLUGS.....	3-22
COMPRESSION PRESSURE MEASUREMENT	3-23
OIL PRESSURE MEASUREMENT	3-24
LUBRICATION POINTS.....	3-25

MAINTENANCE INTERVAL CHART

Use the following chart as a guide to general maintenance intervals.

Dependant on operating conditions, adjust the maintenance intervals accordingly.

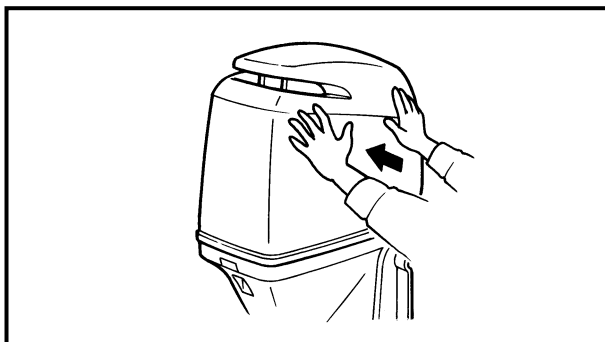
Item	Remarks	Initial		Every		Refer to page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
TOP COWLING						
Top cowling fit	Check				○	3-2
FUEL SYSTEM						
Fuel line	Check				○	3-2
Fuel filter	Check/replace	○		○		3-3
POWER UNIT						
Water leakage	Check	○	○	○		—
Motor exterior	Check			○		—
Engine oil	Replace	○		○		3-11
Oil filter	Replace				○	3-11
Timing belt ^(*1)	Check/replace				○	3-12
Valve clearance ^(*2)	Check/adjust	Every 400 hours (2 years)				3-13
Thermostat	Check				○	5-25
Exhaust leakage	Check	○	○	○		—
Cooling water passage ^(*3)	Flush			○		—
CONTROL SYSTEM						
Remote control shift cable	Check/adjust				○	3-5
Remote control throttle cable	Check/adjust				○	3-6
Throttle position sensor	Check/adjust				○	3-7
POWER TRIM AND TILT UNIT						
Power trim and tilt fluid	Check	○	○	○	○	3-16
LOWER UNIT						
Gear oil	Change	○		○		3-18
Lower unit leakage	Check				○	3-20
Propeller(s)	Check			○		6-3, 6-28
GENERAL						
Anodes	Check/replace				○	3-20
Battery	Check/charge	○			○	3-21
Spark plugs	Clean/adjust/ replace	○			○	3-22
Wiring and connectors	Adjust/reconnect	○	○	○		—
Bolts and nuts ^(*4)	Tighten	○			○	—
Lubrication points	Grease			○		3-25

(*1) Be sure replace the timing belt after every 1,000 hours or 5 years (whichever comes first) of operation.

(*2) If leaded gasoline is usually used, engine valves and related parts should be inspected after every 300 hours of operation in addition to the items on the maintenance chart above.

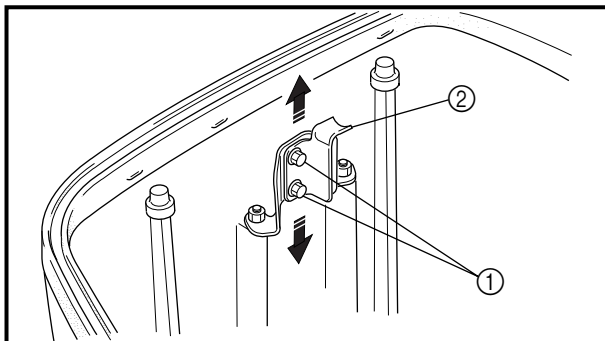
(*3) The engine should be flushed with fresh water after operating in salt, turbid or muddy water.

(*4) Except for the cylinder head bolts and crankcase journal bolts.



TOP COWLING CHECKING THE TOP COWLING FIT

1. Check:
 - Top cowling fitting
Loose/unlatched → Adjust the top cowling hook.



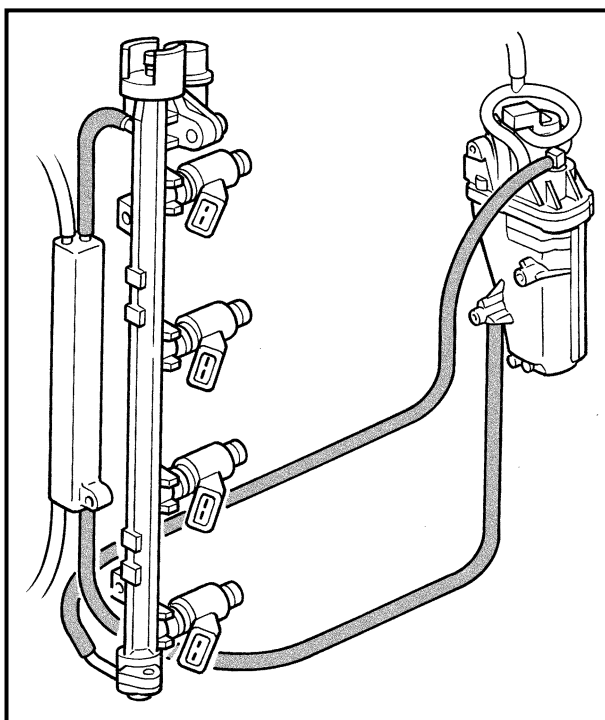
2. Adjust:
 - Top cowling hook position

Adjustment steps

- (1) Loosen the bolts ①.
- (2) Move the top cowling hook ② either up or down slightly (only a few millimeters).
- (3) Secure the bolts.
- (4) Check the top cowling fitting and repeat the adjustment if necessary.

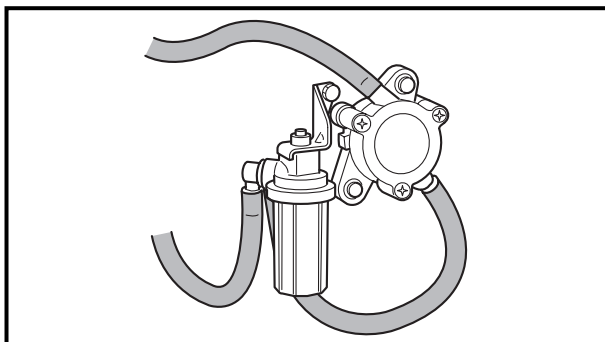
NOTE: _____

- Moving the latch towards the seal will loosen the top cowling.
- Moving the latch away from the seal will tighten the top cowling.

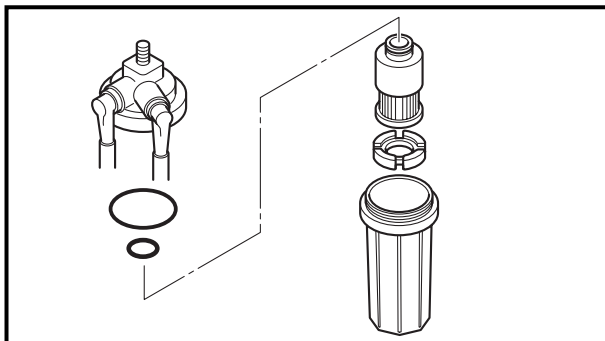


FUEL SYSTEM CHECKING THE FUEL LINE

1. Check:
 - High-pressure fuel line
Cracks/damage/leaks → Replace.
Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8.

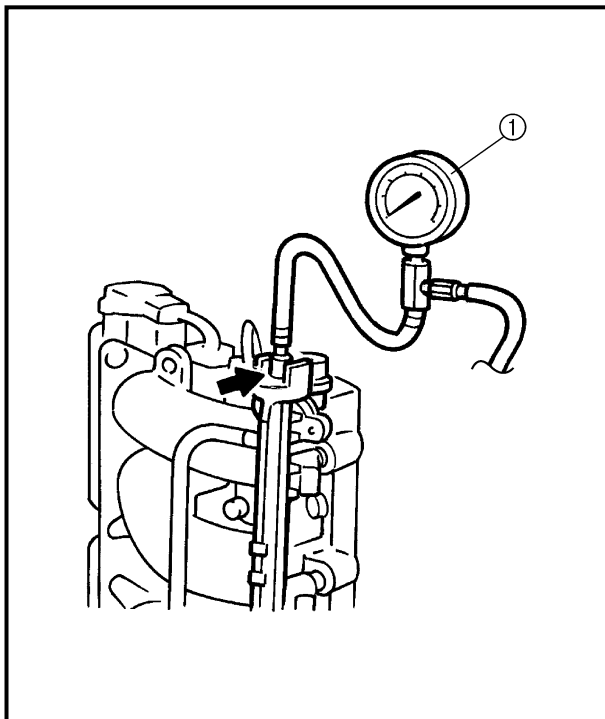


2. Check:
 - Plastic locking tie
Loosen → Retighten or replace.
3. Check:
 - Low-pressure fuel line
Cracks/damage/leaks → Replace.
Refer to “LOW-PRESSURE FUEL LINE” on page 4-26.



CHECKING THE FUEL FILTER

- Check:
- Fuel filter element
 - Fuel filter cup
Clogs/cracks/leaks → Replace.
Foreign matter → Clean.
Refer to “FUEL FILTER” on page 4-29.



MEASURING THE FUEL PRESSURE (HIGH-PRESSURE FUEL LINE)

- Measure:
- Fuel pressure (high-pressure fuel line)
Out of specification → Check the high-pressure fuel line.



**Fuel pressure
(high-pressure fuel line)**
300 kPa (3.0 kg/cm², 44.1 psi)

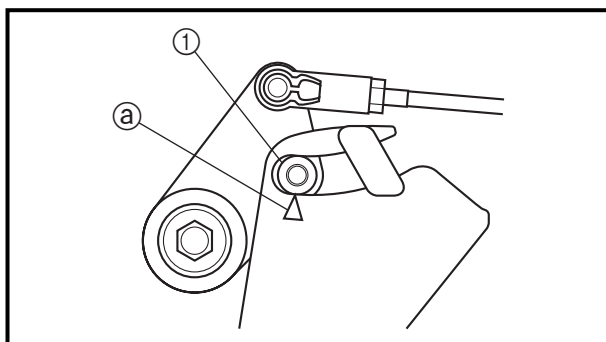
Measuring steps

- (1) Install the fuel pressure gauge onto the pressure check valve.



Fuel pressure gauge ①
YB-06766 / 90890-06786

- (2) Turn the main switch to on, and then measure the fuel pressure.



CONTROL SYSTEM

CHECKING AND ADJUSTING THE THROTTLE BODY PICKUP TIMING

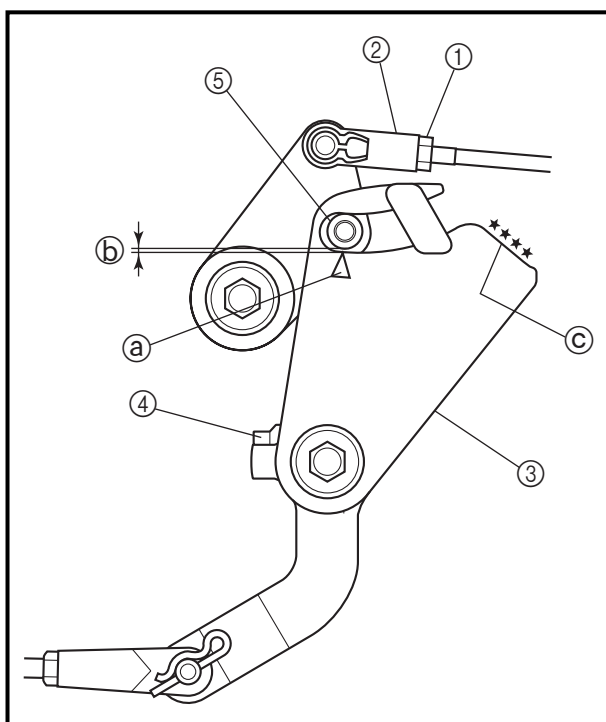
1. Check:

- Throttle body pickup timing

Incorrect → Adjust.

Checking steps

- (1) Turn the throttle control lever to the full retard position.
- (2) Check that the mark ① on the throttle cam aligns with the center of the throttle roller ① as shown.



2. Adjust:

- Throttle body pickup timing

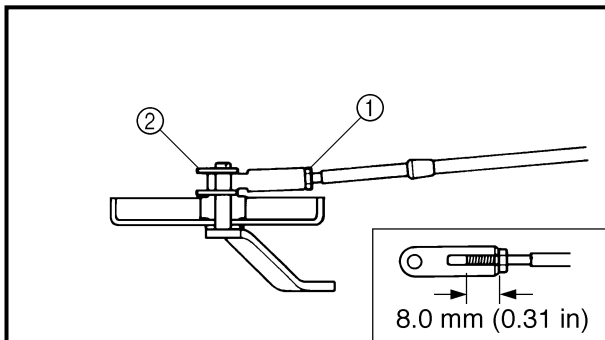
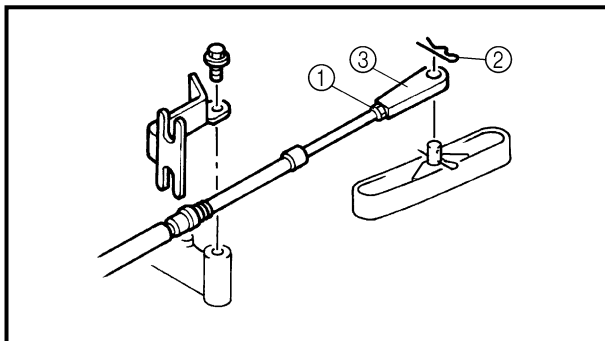
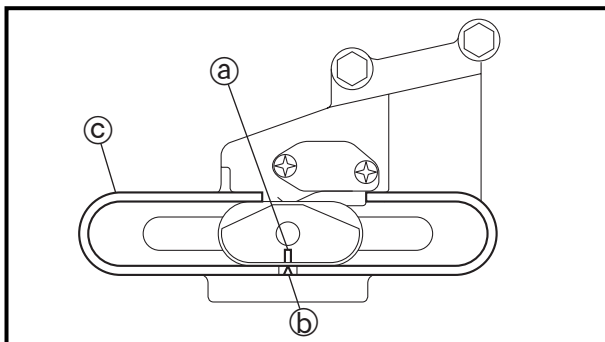
Adjustment steps

- (1) Loosen the nut ①.
- (2) Remove the throttle joint link rod ②.
- (3) Move the throttle control lever ③ until it contacts the fully-closed stopper ④.

NOTE:

Make sure the throttle is fully-closed.

- (4) Align the fully-closed mark ① on the throttle control lever ③ with the center of the throttle roller ⑤ as shown.
- (5) Adjust the length of the throttle joint link rod until ⑥ is 0.5 mm.
- (6) Tighten the nut and install the throttle joint link rod onto the throttle control lever.
- (7) Move the throttle control lever to check that the throttle valve opens and closes smoothly. Also, make sure the throttle roller aligns with the fully-open position ③ on the accelerator cam.
- (8) Set the throttle to the fully-closed position and check that the fully-closed mark ① aligns with the center of the throttle roller.



ADJUSTING THE SHIFT CABLE

1. Check:
 - Shift operation
Incorrect → Adjust.
2. Adjust:
 - Shift cable joint position

Adjustment steps

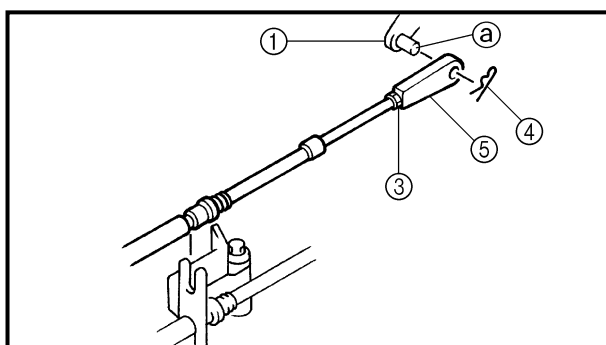
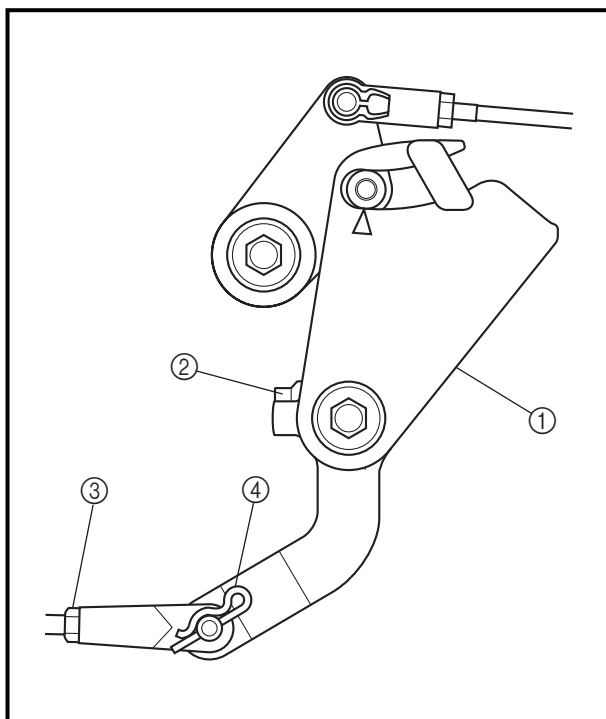
- (1) Align the mark (a) on the bushing with the mark (b) on the bracket (C).
- (2) Loosen the locknut (1) and remove the clip (2).
- (3) Remove shift cable joint (3) from the set pin.
- (4) Position the remote control lever in the neutral position.
- (5) Adjust the position of the shift cable joint until it aligns with the set pin.

⚠ WARNING

The shift cable joint must be screwed in at least 8 mm (0.31 in).

- (6) Install the shift cable joint onto the set pin.
- (7) Install the clip and tighten the locknut.
- (8) Move the remote control lever to the forward, neutral, and reverse positions and make sure it shifts smoothly and correctly. If the shifting operation is unsmooth or incorrect, repeat the above procedure.

3. Check:
 - Shift operation
Unsmooth operation → Repair.



ADJUSTING THE THROTTLE CABLE

1. Check:

- Fully closed position
Incorrect → Adjust.

Checking steps

- (1) Fully close the throttle.
- (2) Check that the throttle control lever ① touches the fully-closed stopper ②.

2. Adjust:

- Throttle cable joint position

Adjustment steps

- (1) Contact the throttle control lever ① with the fully-closed stopper ②.
- (2) Loosen the locknut ③ and remove the clip ④.
- (3) Remove throttle cable joint ⑤ from the set pin ②.
- (4) Position the remote control lever in the neutral position.
- (5) Adjust the position of the throttle cable joint until it aligns with the set pin.

⚠ WARNING

The throttle cable joint must be screwed in at least 8 mm (0.31 in).

- (6) Install the throttle cable joint onto the set pin.
- (7) Install the clip and tighten the locknut.
- (8) Open and close the throttle (at the remote control) several times and make sure the throttle valves open and close smoothly and correctly. If the throttle operation is unsmooth or incorrect, repeat the above procedure.

ADJUSTING THE THROTTLE POSITION SENSOR

1. Measure:

- Throttle position sensor output voltage

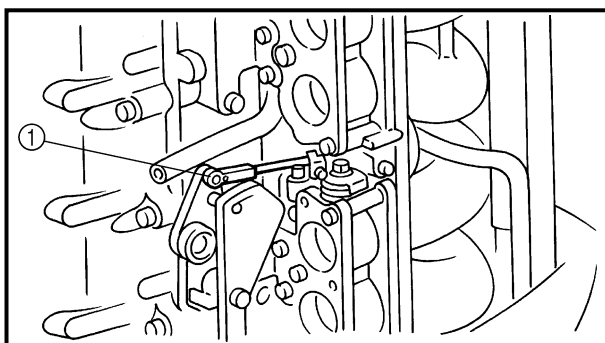
Out of specification → Adjust.



Throttle position sensor output voltage (pink (P) – black (B))
 0.732 ± 0.014 V

NOTE:

- Be sure to adjust the throttle valve's opening before measuring the throttle position sensor output voltage.
- When measuring the throttle position sensor output voltage, set the digital tester to the manual range.

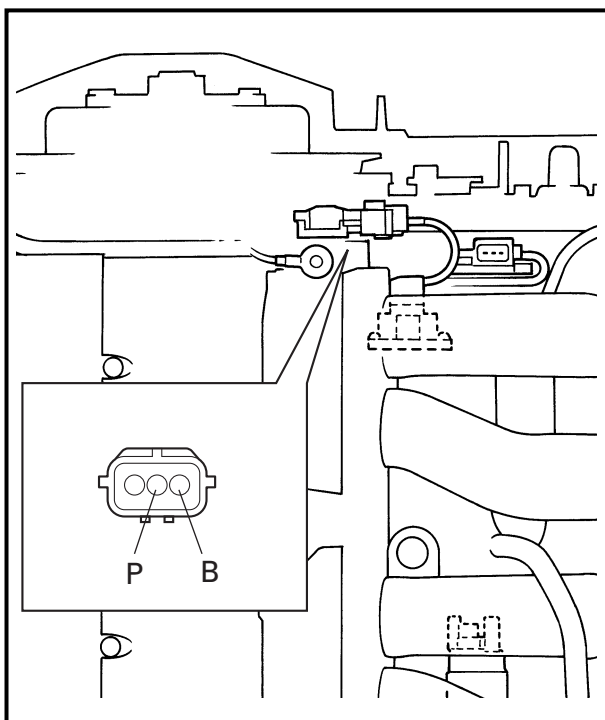


Measuring steps

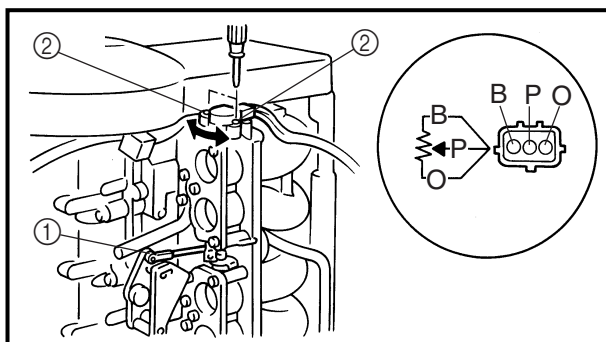
- (1) Remove the intake silencer. Refer to "INTAKE ASSEMBLY" on page 4-3.
- (2) Disconnect the throttle joint link rod ① at the throttle body.
- (3) Check the throttle valve.
- (4) Connect the test harness (3-pin) as shown.



Test harness (3-pin)
90890-06793



- (5) Connect the digital tester probes to the test harness (3-pin) as shown.
- (6) Turn the engine start switch on.
- (7) Measure the output voltage.
- (8) Install the intake silencer.
- (9) Start the engine and measure the output voltage again.



2. Adjust:
- Throttle position sensor

Adjustment steps

- (1) Loosen the screws ②.
- (2) Adjust the position of the throttle position sensor until the specified output voltage is obtained.



Throttle position sensor output voltage (pink (P) – black (B))
 $0.732 \pm 0.014 \text{ V}$

General adjusting tool

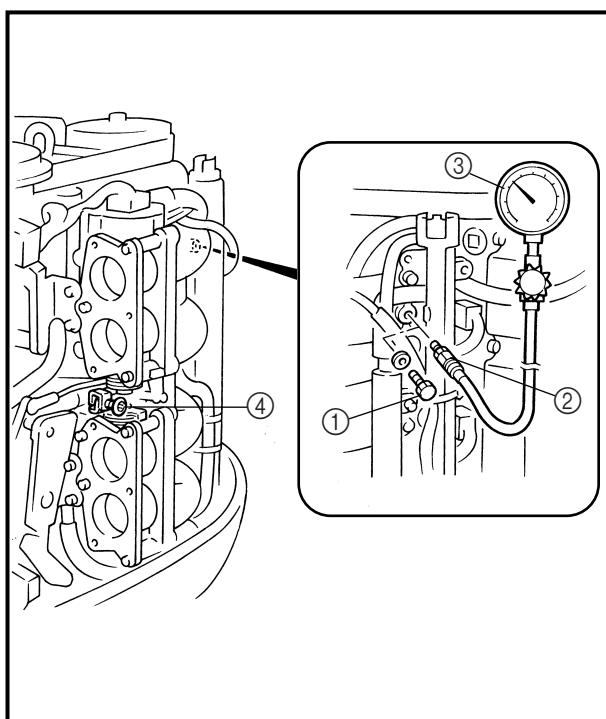
Torx T-20 (with a concave in the center)

- (3) Tighten the screws.
- (4) Connect the throttle joint link rod ①.

SYNCHRONIZING THE THROTTLE VALVES

CAUTION:

Do not adjust the throttle valve when it is operating properly. Excess adjustment may cause poor engine performance.



Adjustment steps

- (1) Remove all of the blind plugs ①.
- (2) Connect the adaptors ② and vacuum gauge ③ to the intake manifold assembly as shown.



Vacuum gauge set
YU-08030 / 90890-03094

- (3) Start the engine and allow it to warm up for several minutes.
- (4) Connect the tachometer to the spark plug lead of cylinder #1.



Tachometer
YU-08036-A / 90890-06760



Engine idling speed
 $750 \pm 50 \text{ r/min}$

- (5) Check the vacuum pressure of all cylinders.
- (6) Turn the synchronizing screw ④ so the vacuum pressure of cylinder #3 or #4 is within 30 mmHg (40 mbar, 1.18 inHg) based of the vacuum pressure of cylinder #1 or #2.

Tighten	Vacuum pressure increases.
Loosen	Vacuum pressure decreases.

General adjusting tool
Torx T-25 (with a concave in the center)

Example 1:

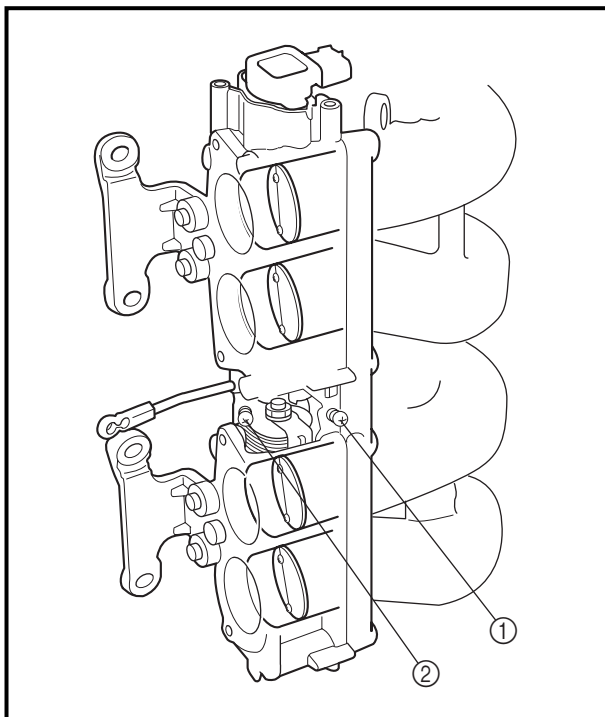
Check results:

Cylinder #1	360 mmHg (480 mbar, 14.2 inHg)	Adjust the difference of the vacuum pressure between cylinders #1 and #4 within 30 mmHg (40 mbar, 1.18 inHg).
Cylinder #2	350 mmHg (467 mbar, 13.8 inHg)	
Cylinder #3	310 mmHg (413 mbar, 12.2 inHg)	
Cylinder #4	300 mmHg (400 mbar, 11.8 inHg)	

Example 2:

Check results:

Cylinder #1	360 mmHg (480 mbar, 14.2 inHg)	Adjust the difference of the vacuum pressure between cylinders #2 and #4 within 30 mmHg (40 mbar, 1.18 inHg).
Cylinder #2	350 mmHg (467 mbar, 13.8 inHg)	
Cylinder #3	390 mmHg (520 mbar, 15.4 inHg)	
Cylinder #4	400 mmHg (533 mbar, 15.8 inHg)	



ADJUSTING THE THROTTLE POSITION SENSOR (WHEN DISASSEMBLING OR REPLACING THE THROTTLE BODY)

Adjusting steps

- (1) Install the intake assembly with the intake silencer removed.
- (2) Disconnect the throttle position sensor coupler.
- (3) Install the test harness to the throttle position sensor coupler.

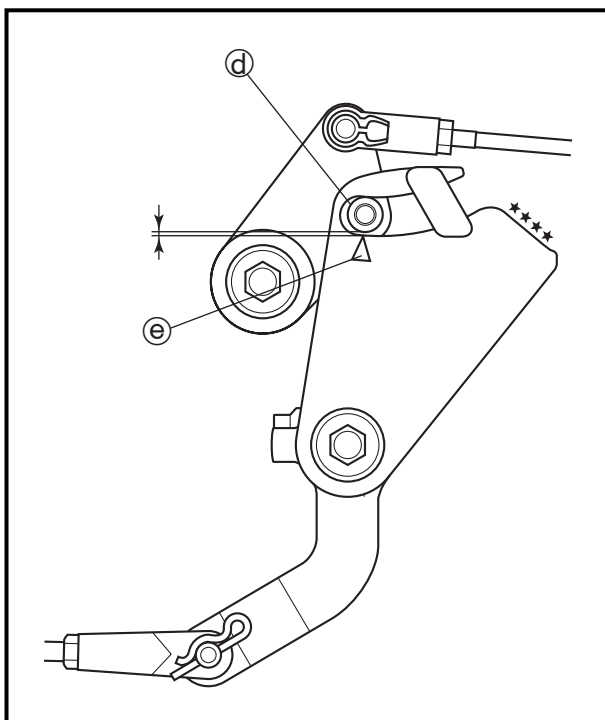


Test harness
90890-06793

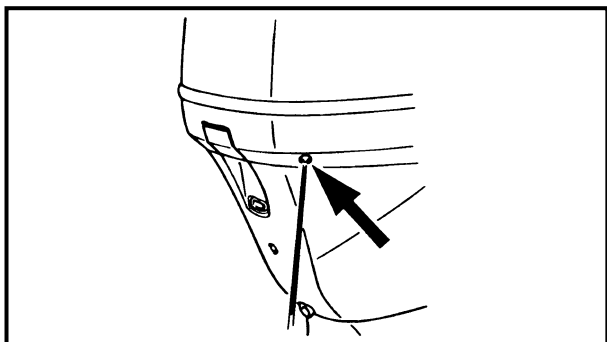
- (4) Connect the digital circuit tester.



Digital tester
J-39299 / 90890-06752



- (5) Turn the main switch to on.
- (6) Loosen the synchronizing screw and fully open the lower side throttle valve (#3, 4).
- (7) Loosen the idling screw ① and fully close the upper side throttle valve (#1, 2).
- (8) Adjust the position of the throttle position sensor until the output voltage is 0.7 ± 0.01 V and operate the throttle valve several times.
- (9) Record the value.
- (10) Slowly tighten the synchronizing screw ② until the recorded value is changed.
- (11) Slowly tighten the idling screw until 0.032 ± 0.004 V increase over the recorded value.
- (12) Operate the throttle valve several times.
- (13) Install the throttle roller ④ as the mark ⑤ aligns with center of the throttle roller and check that the output voltage is not change.
- (14) Install the intake silencer.
- (15) Start the engine.
- (16) If the output voltage of the throttle position sensor is not within 0.732 ± 0.014 V, adjust the throttle position sensor.
- (17) Check that the throttle valve is synchronized.



COOLING SYSTEM

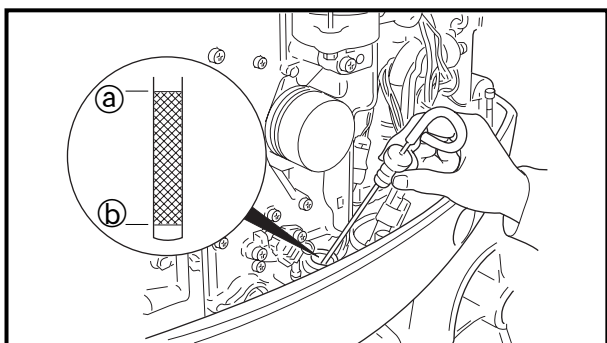
CHECKING THE COOLING WATER DISCHARGE

Check:

- Cooling water discharge
No discharge → Clean and check the cooling water passage.

Checking steps

- (1) Place the lower unit in water.
- (2) Start the engine.
- (3) Check that water flows from the cooling water outlet.

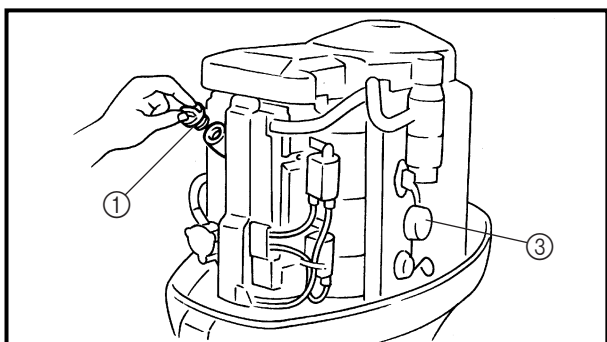


POWER UNIT

CHECKING THE ENGINE OIL LEVEL

Check:

- Engine oil level
Above (a) → Check for fuel in the engine oil.
Below (b) → Add engine oil so that the level is between (a) and (b).



REPLACING THE ENGINE OIL/OIL FILTER

1. Remove:

- Oil filler cap (1)
- Drain plug (2)

2. Remove:

- Oil filter (3)



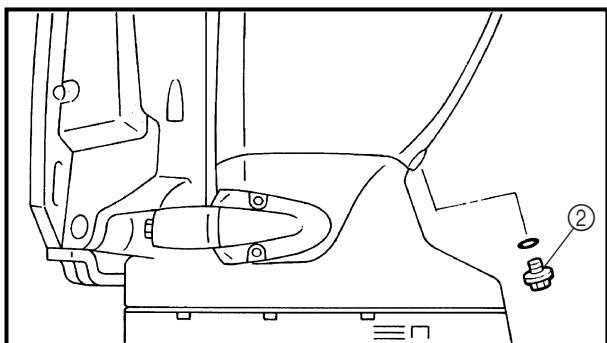
Oil filter wrench
YU-38411 / 90890-01426

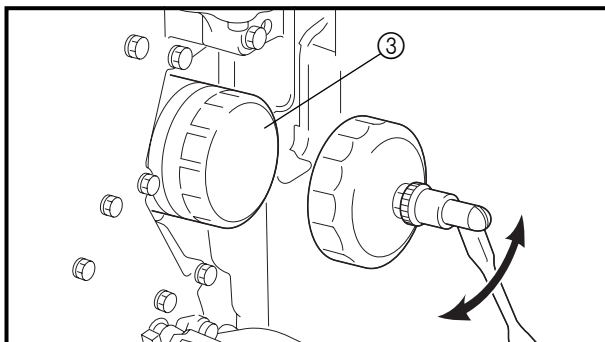
3. Install:

- Drain plug (2)



Drain plug
28 Nm (2.8 m • kgf, 20 ft • lb)





4. Install:

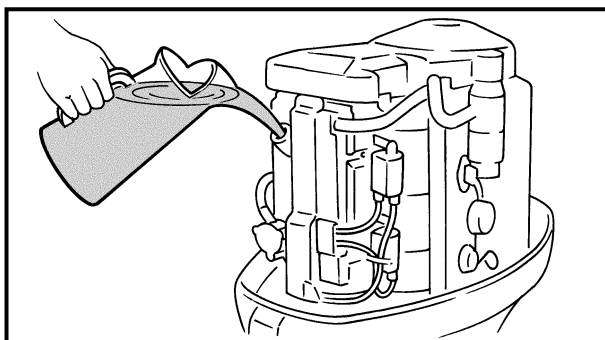
- Oil filter ③



Oil filter
18 Nm (1.8 m • kgf, 13.3 ft • lb)

NOTE:

Lubricate the rubber seal with engine oil before installation.



5. Add:

- Engine oil



Recommended engine oil
4 stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40

Oil quantity
with oil filter
4.5 L (4.76 US qt, 3.96 Imp qt)
without oil filter
4.3 L (4.55 US qt, 3.78 Imp qt)

6. Install:

- Oil filler cap

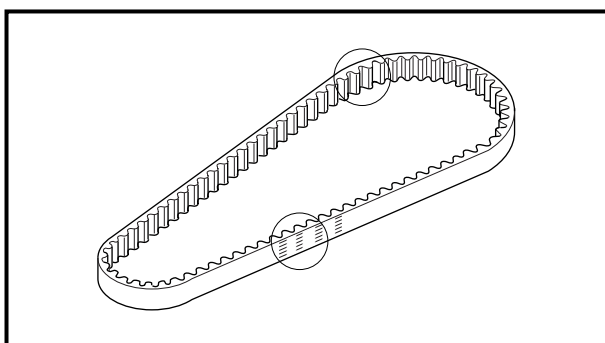
7. Check:

- Engine oil level

Refer to "CHECKING THE ENGINE OIL LEVEL" on page 3-11.

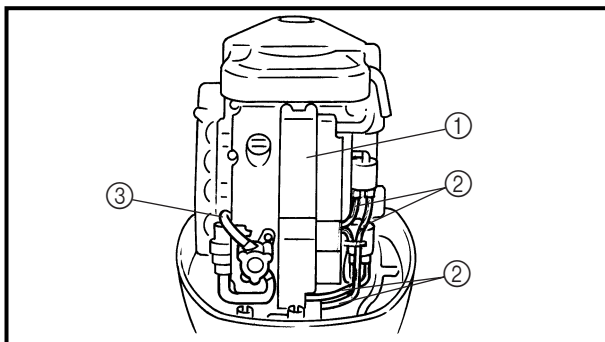
NOTE:

- Run the engine for several minutes and then check the engine oil level.
- If the engine oil is still not within the proper level, add/drain as needed.


CHECKING THE TIMING BELT

Check:

- Timing belt
Wear/damage → Replace.

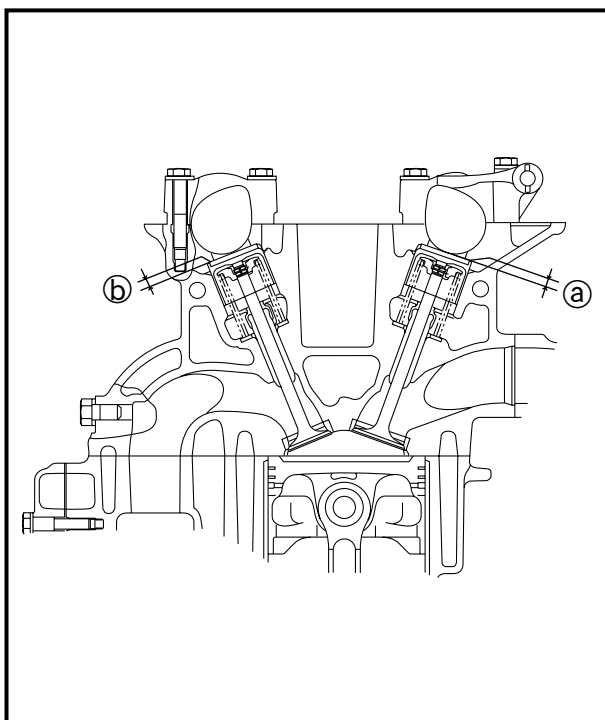


ADJUSTING THE VALVE CLEARANCE

NOTE:

Valve clearance adjustment should be made on a cold engine, at room temperature.

1. Remove:
 - Flywheel magnet cover
 - Spark plug cap cover ①
2. Disconnect:
 - Spark plug leads ②
 - Fuel hoses ③
 - Ventilation hose
 - Vacuum hose
3. Loosen:
 - Timing belt tensioner
4. Remove:
 - Timing belt
 - Driven sprockets
 - Cylinder head cover
 - Spark plugs
5. Install:
 - Driven sprockets
 - Timing belt
6. Tighten:
 - Timing belt tensioner
7. Measure:
 - Intake valve clearance ①
 - Exhaust valve clearance ②



Valve clearance

Intake

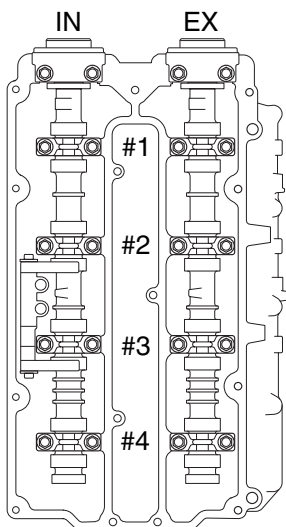
0.20 ± 0.03 mm
(0.008 ± 0.001 in)

Exhaust

0.34 ± 0.03 mm
(0.013 ± 0.001 in)

NOTE:

If any valve clearance is out of specification, record its measurement.


Measurement steps

- (1) Turn the flywheel magneto clockwise until cylinder #1's piston is at TDC.
- (2) Measure the intake valve clearance for cylinders #1 and #2.
- (3) Measure the exhaust valve clearance for cylinders #1 and #3.
- (4) Turn the flywheel magneto 360° clockwise.
- (5) Measure the intake valve clearance for cylinders #3 and #4.
- (6) Measure the exhaust valve clearance for cylinders #2 and #4.

8. Loosen:

- Timing belt tensioner

9. Remove:

- Timing belt
- Driven sprockets
- Camshaft caps
- Camshafts

Refer to "POWER UNIT" on page 5-4.

10. Adjust:

- Valve clearance

NOTE:

- Do not mix the valve train parts (i.e., valve pads, camshaft caps, camshafts). Keep them organized in their proper groups (e.g., cylinder #1 parts kept together).
- Install the removed parts in their original positions. If valve train parts are installed in the wrong position, proper valve adjustments are impossible.

Adjustment steps

- (1) Insert a thin screwdriver into the notch in the valve lifter.
- (2) Carefully pry up the valve pad and remove it.
- (3) Measure the thickness removed valve pad with a micrometer.
- (4) Select a proper replacement valve pad by calculating its thickness with the following formula.

$$\text{Proper valve pad thickness} = \text{Removed valve pad thickness} + \text{Measured valve clearance} - \text{Specified valve clearance}$$

- (5) Install the proper valve pad into the valve lifter.

NOTE: _____

- Measure the thickness of the new valve pad with a micrometer because the thickness number is not indicated on the pad.
- Lubricate the valve pad with molybdenum disulfide grease.
- Perform the above procedure for all valves whose clearances are out of specification.

11. Install:

- Camshafts
- Camshaft caps
- Driven sprockets
- Timing belt

12. Tighten:

- Timing belt tensioner

Refer to "POWER UNIT" on page 5-4.

13. Recheck:

- Valve clearance

NOTE: _____

If any valve clearance is still out of specification, repeat all of the valve clearance adjustment steps until the specified clearance is obtained.

14. Loosen:
 - Timing belt tensioner
15. Remove:
 - Driven sprockets
 - Timing belt
16. Tighten:
 - Timing belt tensioner
17. Install:
 - Cylinder head cover
 - Driven sprockets
 - Timing belt
 - Spark plugs
18. Connect:
 - Vacuum hose
 - Ventilation hose
 - Fuel hoses
 - Spark plug leads
19. Install:
 - Spark plug cap cover
 - Flywheel magneto cover

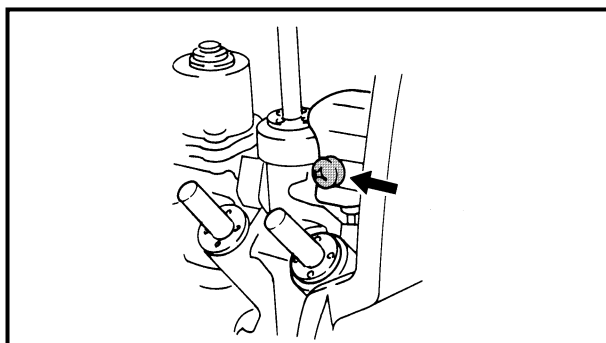
POWER TRIM AND TILT SYSTEM CHECKING THE POWER TRIM AND TILT FLUID LEVEL

Check:

- Power trim and tilt fluid level
Level is low → Add power trim and tilt fluid to the proper level.

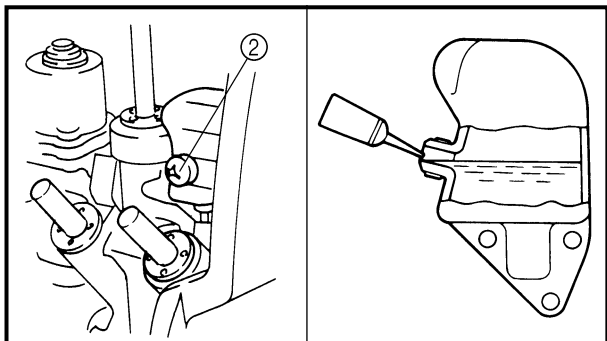
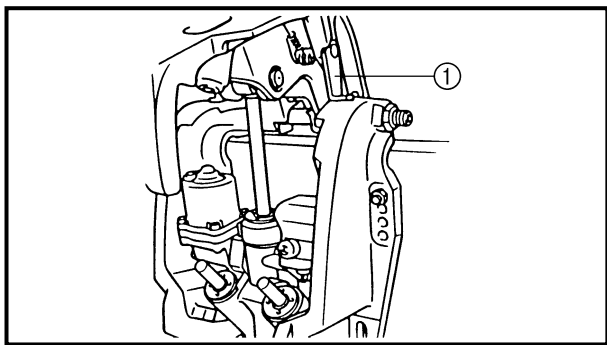


**Recommended power trim and
tilt fluid**
ATF Dexron II



⚠ WARNING

When removing the power trim and tilt reservoir cap, the power trim and tilt fluid may spurt out due to internal pressure. Therefore, fully tilt up the outboard (the tilt ram assembly fully extended) and then slowly remove the power trim and tilt reservoir cap.



Checking steps

- (1) Tilt the outboard all the way up and lock it with the tilt stop levers ①.

⚠ WARNING

After tilting up the outboard, be sure to support it with the tilt stop levers.

Otherwise, the outboard could suddenly lower if the power trim and tilt unit should lose fluid pressure.

- (2) Remove the reservoir cap ② and check the fluid level.

NOTE:

The fluid level should be directly below the check hole as shown.

- (3) Add power trim and tilt fluid if needed, and then install the reservoir cap.



Reservoir cap
8 Nm (0.8 m • kgf, 5.8 ft • lb)

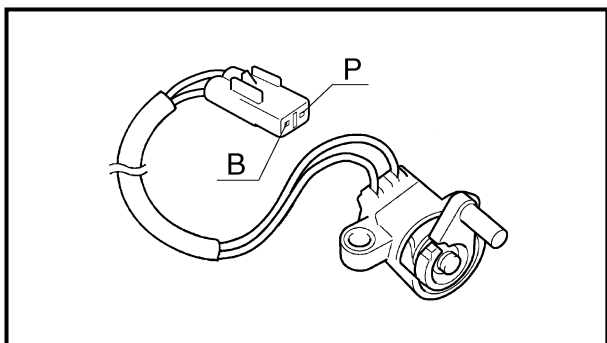
ADJUSTING THE TRIM SENSOR CAM

1. Measure:

- Trim sensor setting resistance
- Out of specification → Adjust.

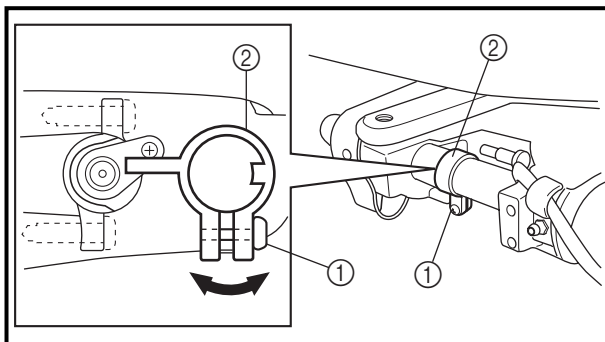


Trim sensor setting resistance
Pink (P) – Black (B)
 $10 \pm 1 \, \Omega$ at 20 °C (68 °F)



Measuring steps

- (1) Fully tilt the outboard down.
- (2) Measure the trim sensor resistance.



2. Adjust:

- Trim sensor cam position

Adjusting steps

- (1) Fully tilt the outboard down.
- (2) Loosen the screw ①.
- (3) Adjust the position of the trim sensor cam ② until the specified resistance is obtained.



Trim sensor resistance
Pink (P) – Black (B)
9 – 378.8 Ω at 20 °C (68 °F)

- (4) Tighten the screw.



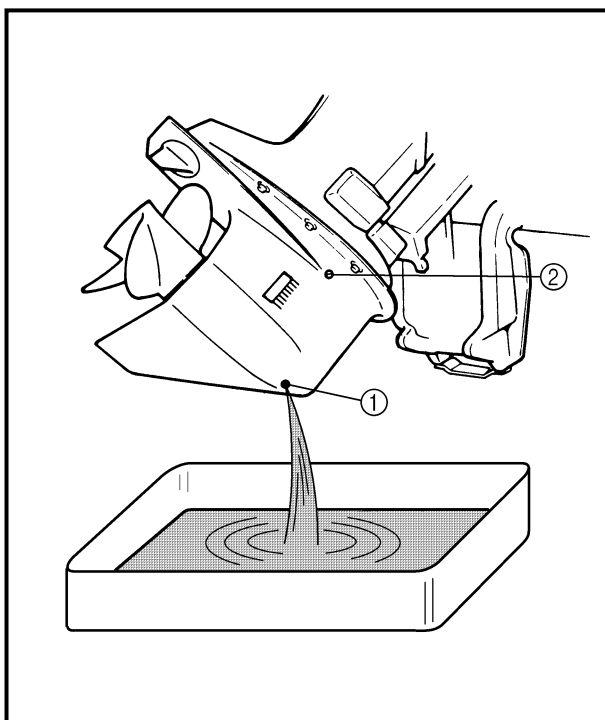
Trim sensor cam screw
2 Nm (0.2 m • kgf, 1.4 ft • lb)

LOWER UNIT

CHECKING THE GEAR OIL LEVEL

Check:

- Gear oil level
 Level is low → Add gear oil to the proper level.



CHANGING AND CHECKING THE GEAR OIL

1. Check:

- Gear oil
 Milky oil → Replace the oil seal.
 Slag oil → Check the gears, bearings, and clutch dog.

Checking steps

- (1) Tilt up the outboard slightly.
- (2) Place a container under the gear oil drain screw ①.
- (3) Remove the gear oil drain screw and gear oil level check screw ②.

2. Fill:

- Gear oil
(with the specified amount of the recommend gear oil)

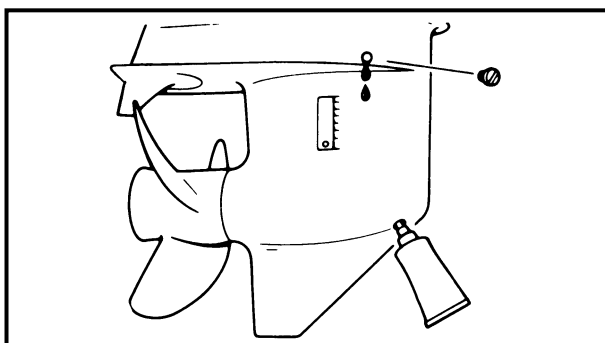


Recommended gear oil
GEAR CASE LUBE
SAE: 90

Total amount

Regular rotation models
760 cm³
(25.7 US oz, 26.8 Imp oz)

Counter rotation models
715 cm³
(24.2 US oz, 25.2 Imp oz)



Filling steps

- (1) Place the outboard in an upright position.
- (2) Insert the gear oil tube into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.
- (3) Install the gear oil level check screw and then quickly install the gear oil drain screw.



Gear oil level check screw
7 Nm (0.7 m • kgf, 5.1 ft • lb)
Gear oil drain screw
7 Nm (0.7 m • kgf, 5.1 ft • lb)

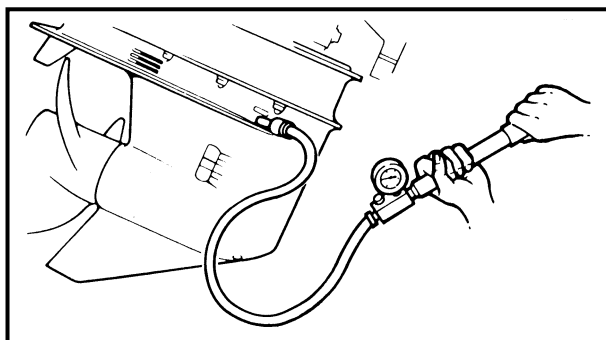
CHECKING THE LOWER UNIT (FOR AIR LEAKS)

Check:

- Lower unit holding pressure
Pressure drops → Check the seals and components.



Lower unit holding pressure
70 kPa (0.7 kg/cm², 10.0 psi)



Checking steps

CAUTION:

Do not overpressurize the lower unit.
Excessive pressure may damage the oil seals.

- (1) Remove the gear oil level check screw.
- (2) Install the pressure tester into the check hole.



Pressure tester
YB-35956 / 90890-06762

- (3) Apply the specified pressure.

NOTE:

The lower unit should hold the specified pressure for 10 seconds.

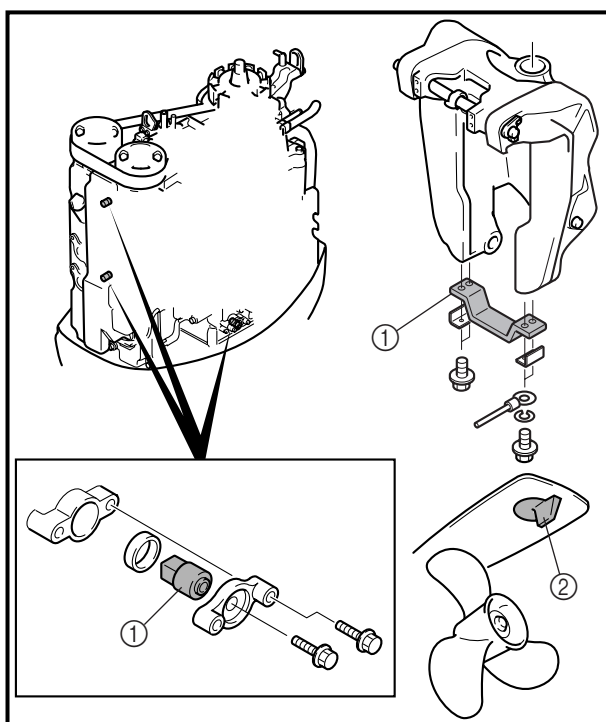
GENERAL CHECKING THE ANODES

Check:

- Anodes ①
 - Trim tab ②
- Scales → Clean.
Grease/oil → Clean.
Excessive wear → Replace.

CAUTION:

Do not oil, grease or paint the anode, or it will not operate properly.



CHECKING THE BATTERY

⚠ WARNING

Battery electrolytic fluid is dangerous; it contains sulfuric acid and therefore is poisonous and highly caustic.

Always follow these preventive measures:

- Avoid bodily contact with electrolytic fluid as it can cause severe burns or permanent eye injury.
- Wear protective eye gear when handling or working near batteries.

Antidote (EXTERNAL):

- SKIN - Flush with water.
- EYES - Flush with water for 15 minutes and get immediate medical attention.

Antidote (INTERNAL):

- Drink large quantities of water or milk followed by milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.

Batteries also generate explosive hydrogen gas; therefore, you should always follow these preventive measures:

- Charge batteries in a well-ventilated area.
- Keep batteries away from fire, sparks, or open flames (e.g., welding equipment, lighted cigarettes, etc.).
- DO NOT SMOKE when charging or handling batteries.

KEEP BATTERIES AND ELECTROLYTIC FLUID OUT OF REACH OF CHILDREN.

NOTE:

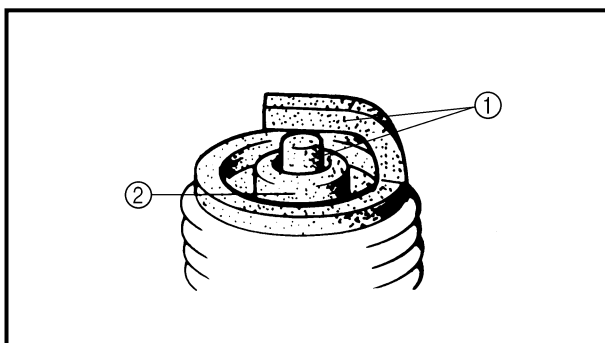
- Batteries vary among manufacturers. Therefore, the following procedures may not always apply. Consult your battery manufacturer's instructions.
- First, disconnect the negative lead, then the positive lead.

Check:

- Electrolyte level
Below the minimum level mark → Add distilled water to the proper level.
- Electrolyte specific gravity
Less than specification → Recharge the battery.



Electrolyte specific gravity
1.280 at 20°C (68°F)



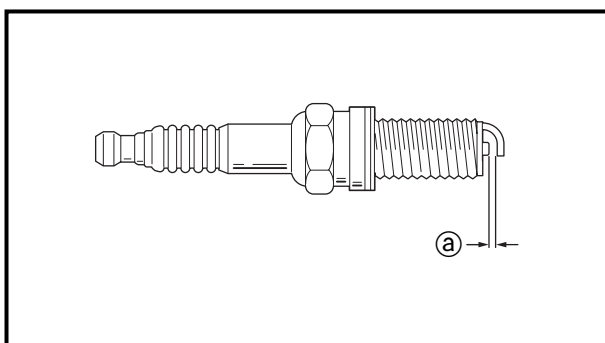
CHECKING THE SPARK PLUGS

1. Check:

- Electrodes ①
Cracks/excessive wear → Replace.
- Insulator color ②
Distinctly different color → Check the engine condition.

2. Clean:

- Spark plug
(with a spark plug cleaner or wire brush.)

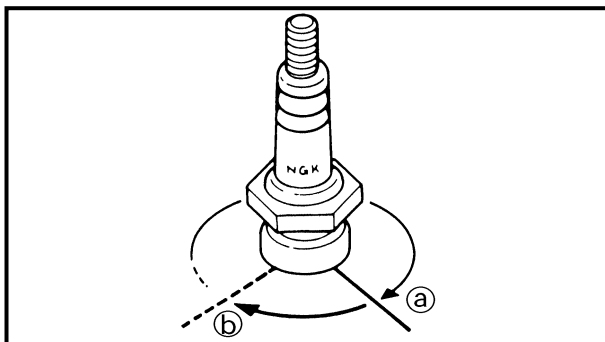


3. Measure:

- Spark plug gap ③
Out of specification → Regap.



Spark plug gap
1.0 - 1.1 mm (0.039 - 0.043 in)



4. Tighten:
 - Spark plug



Spark plug
25 Nm (2.5 m • kgf, 18 ft • lb)

NOTE:

- Before installing the spark plug, clean the gasket surface and spark plug surface. Also, it is suggested to apply a thin film of anti-seize compound to the spark plug threads to prevent thread seizure.
- If a torque wrench is not available, a good estimate of the correct tightening torque is to finger tighten ① the spark plug and then tighten it another 1/4 to 1/2 of a turn ②.

COMPRESSION PRESSURE MEASUREMENT

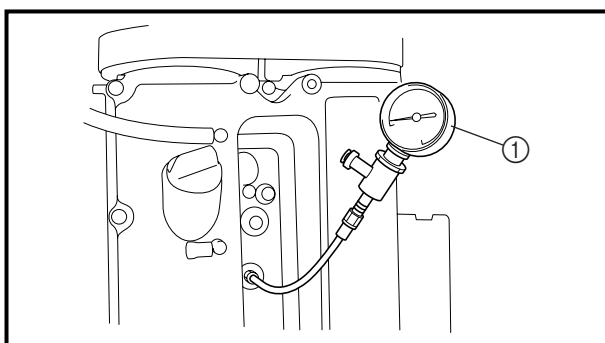
CAUTION:

Before removing a spark plug, use compressed air to blow away dirt accumulated in the spark plug well to prevent it from falling into the cylinder that is being tested.

1. Check:
 - Valve clearance
Out of specification → Adjust.
Refer to “ADJUSTING THE VALVE CLEARANCE” on page 3-13.
2. Warm-up:
 - Engine
3. Remove:
 - Spark plug(-s)
4. Install:
 - Compression gauge ①
(into the spark plug hole)

NOTE:

Use a compression gauge that is used for automobiles.



5. Measure:

- Compression pressure

Below minimum compression pressure → Inspect valve clearance, valve face, valve seat, piston rings, cylinder sleeve, piston, cylinder head gasket and cylinder head.


**Compression pressure
(reference data)**
Minimum

950 kPa (9.5 kg/cm², 135 psi)

Measurement steps

- (1) Remove the lock plate from the engine stop lanyard switch on the remote control box.
- (2) With the throttle wide open, crank the engine setting the main switch in the START position until the reading on the compression gauge stabilizes.

6. Remove:

- Compression gauge

7. Install:

- Spark plug(-s)

OIL PRESSURE MEASUREMENT
1. Warm-up:

- Engine

2. Remove:

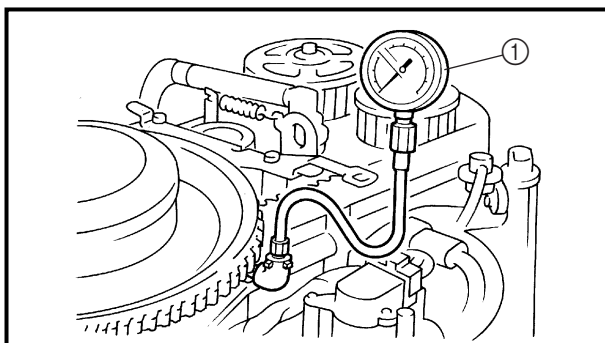
- Oil pressure switch

3. Install:

- Oil pressure gauge ①
(into the oil pressure switch hole)

NOTE:

Use a pressure gauge with the range of 0 to 10 kg/cm² and an adopter with a PT 1/4 thread.



4. Measure:

- Oil pressure

Out of specification → Check the oil pump, oil suction pipe and oil strainer.


**Oil pressure
(reference data)**

At idling (55 °C (131 °F))

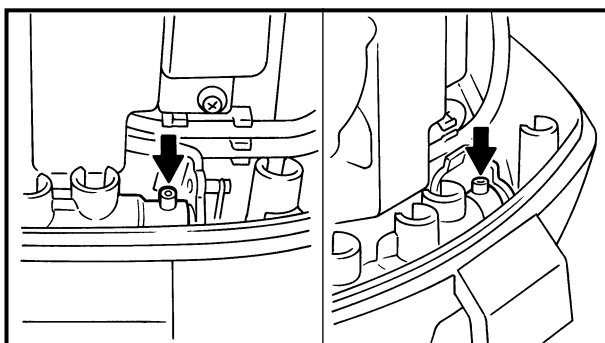
**350 kPa (3.5 kg/cm², 49.8 psi)
or higher**

5. Remove:

- Oil pressure gauge

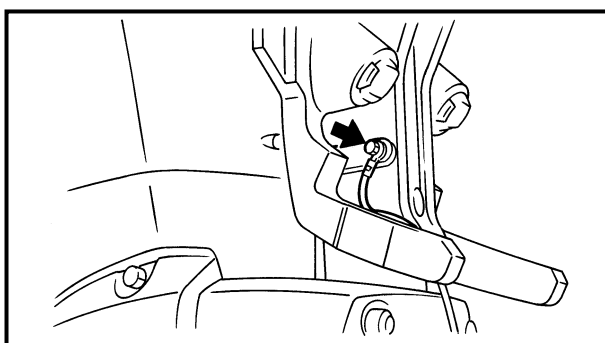
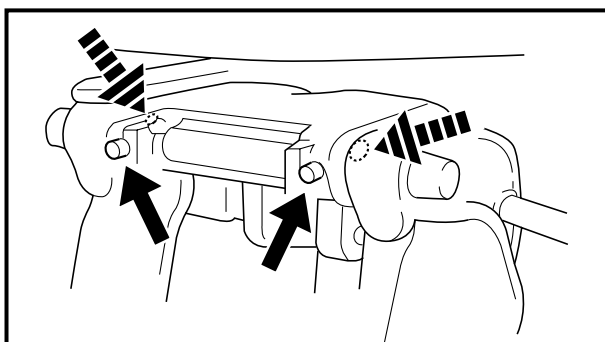
6. Install:

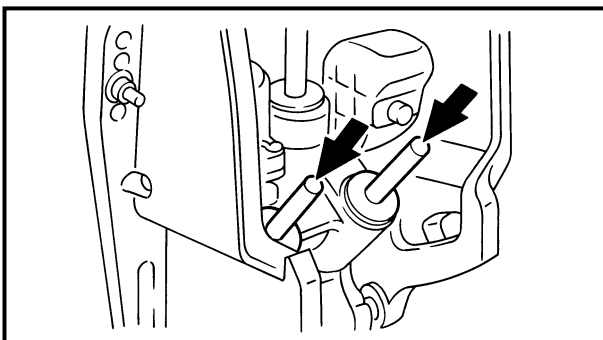
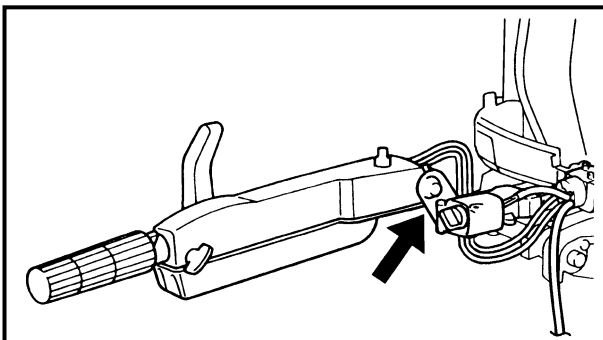
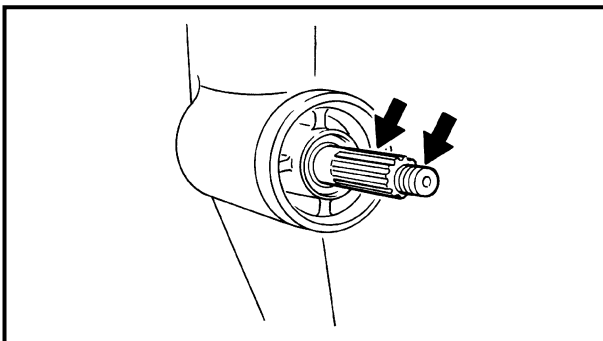
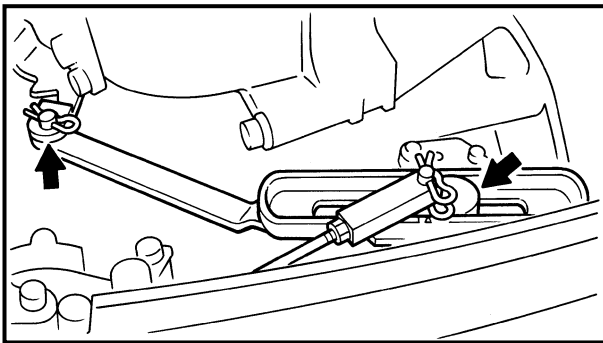
- Oil pressure switch


LUBRICATION POINTS

1. Apply:

- Water resistant grease





2. Apply:
- Corrosion resistant grease

CHAPTER 4

FUEL SYSTEM

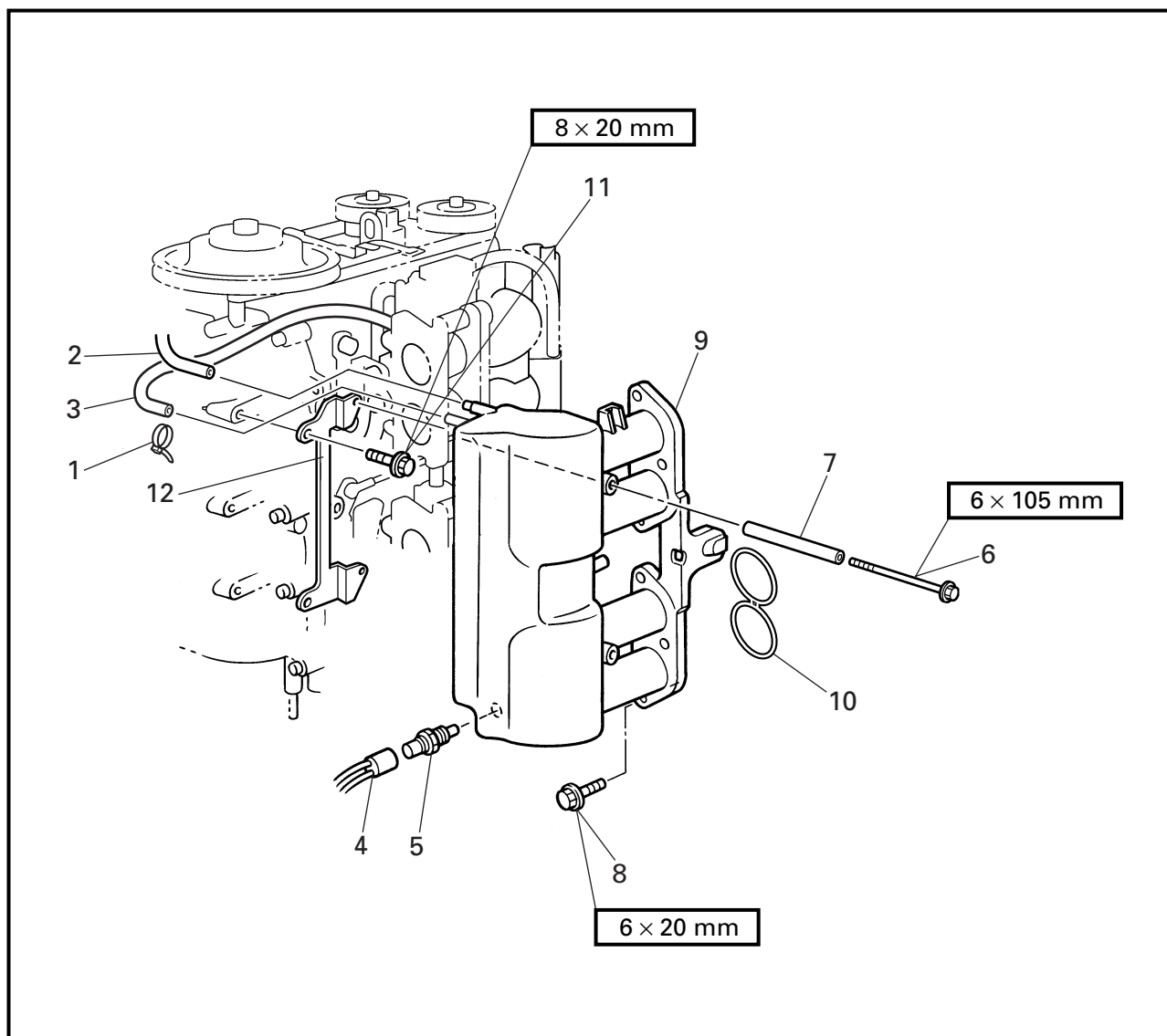
INTAKE SILENCER	4-1
REMOVING/INSTALLING THE INTAKE SILENCER.....	4-1
INTAKE ASSEMBLY	4-3
REMOVING/INSTALLING THE INTAKE ASSEMBLY	4-3
THROTTLE BODY	4-5
REMOVING/INSTALLING THE THROTTLE BODY	4-5
CONTROL UNIT	4-6
REMOVING/INSTALLING THE CONTROL UNIT	4-6
HIGH-PRESSURE FUEL LINE	4-8
REMOVING/INSTALLING THE HIGH-PRESSURE FUEL LINE	4-8
REDUCING THE FUEL PRESSURE (HIGH-PRESSURE FUEL LINE)	4-10
CHECKING THE PRESSURE REGULATOR.....	4-11
FUEL INJECTORS	4-12
REMOVING/INSTALLING THE FUEL INJECTORS	4-12
DISASSEMBLING/ASSEMBLING THE FUEL INJECTORS	4-13
FUEL HOSES	4-14
REMOVING/INSTALLING THE FUEL HOSES	4-14
VAPOR SEPARATOR	4-15
REMOVING/INSTALLING THE VAPOR SEPARATOR	4-15
DISASSEMBLING/ASSEMBLING THE VAPOR SEPARATOR	4-16
HIGH-PRESSURE FUEL PUMP	4-17
DISASSEMBLING/ASSEMBLING THE HIGH-PRESSURE FUEL PUMP	4-17
PRESSURE REGULATOR	4-18
REMOVING/INSTALLING THE PRESSURE REGULATOR	4-18

IDLE SPEED CONTROL ASSEMBLY	4-19
REMOVING/INSTALLING THE IDLE SPEED CONTROL ASSEMBLY..	4-19
DISASSEMBLING/ASSEMBLING THE IDLE SPEED CONTROL ASSEMBLY.....	4-21
 FUEL RAIL	 4-22
DISASSEMBLING/ASSEMBLING THE FUEL RAIL.....	4-22
 INTAKE MANIFOLD.....	 4-23
DISASSEMBLING/ASSEMBLING THE INTAKE MANIFOLD	4-23
 THROTTLE POSITION SENSOR	 4-24
REMOVING/INSTALLING THE THROTTLE POSITION SENSOR	4-24
INSTALLING THE THROTTLE POSITION SENSOR	4-25
 LOW-PRESSURE FUEL LINE	 4-26
REMOVING/INSTALLING THE LOW-PRESSURE FUEL LINE.....	4-26
DISASSEMBLING/ASSEMBLING THE LOW-PRESSURE FUEL LINE.....	4-28
 FUEL FILTER	 4-29
DISASSEMBLING/ASSEMBLING THE FUEL FILTER.....	4-29
 FUEL PUMP	 4-30
DISASSEMBLING/ASSEMBLING THE FUEL PUMP	4-30
CHECKING THE FUEL PUMPS	4-31

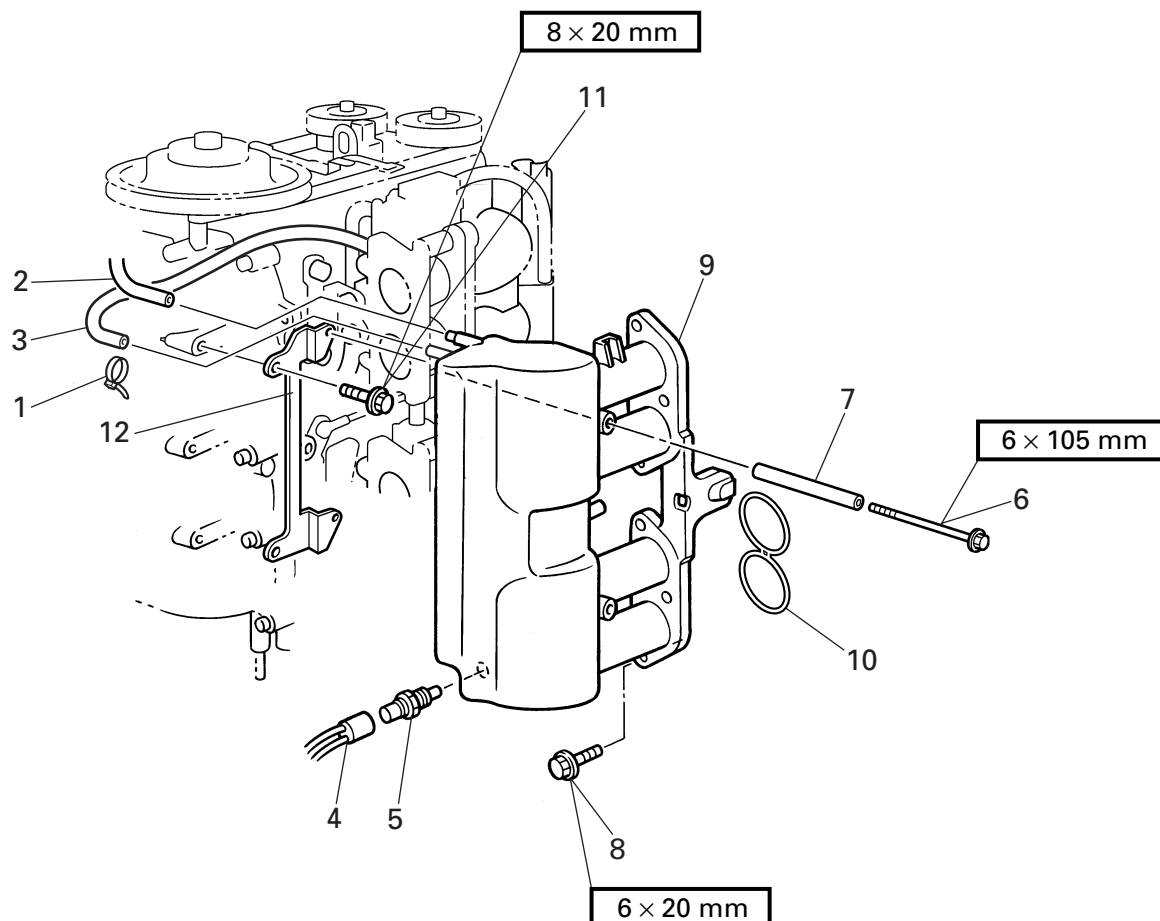


INTAKE SILENCER

REMOVING/INSTALLING THE INTAKE SILENCER



Order	Job/Part	Q'ty	Remarks
	Flywheel cover		Refer to "FLYWHEEL MAGNET ASSEMBLY" on page 5-1.
1	Plastic locking tie	1	Not reusable
2	Hose	1	(cylinder head cover-to-intake silencer)
3	Hose	1	(vapor separator-to-intake silencer)
4	Intake air temperature sensor coupler	1	
5	Intake air temperature sensor	1	
6	Bolt	2	
Continued on next page.			

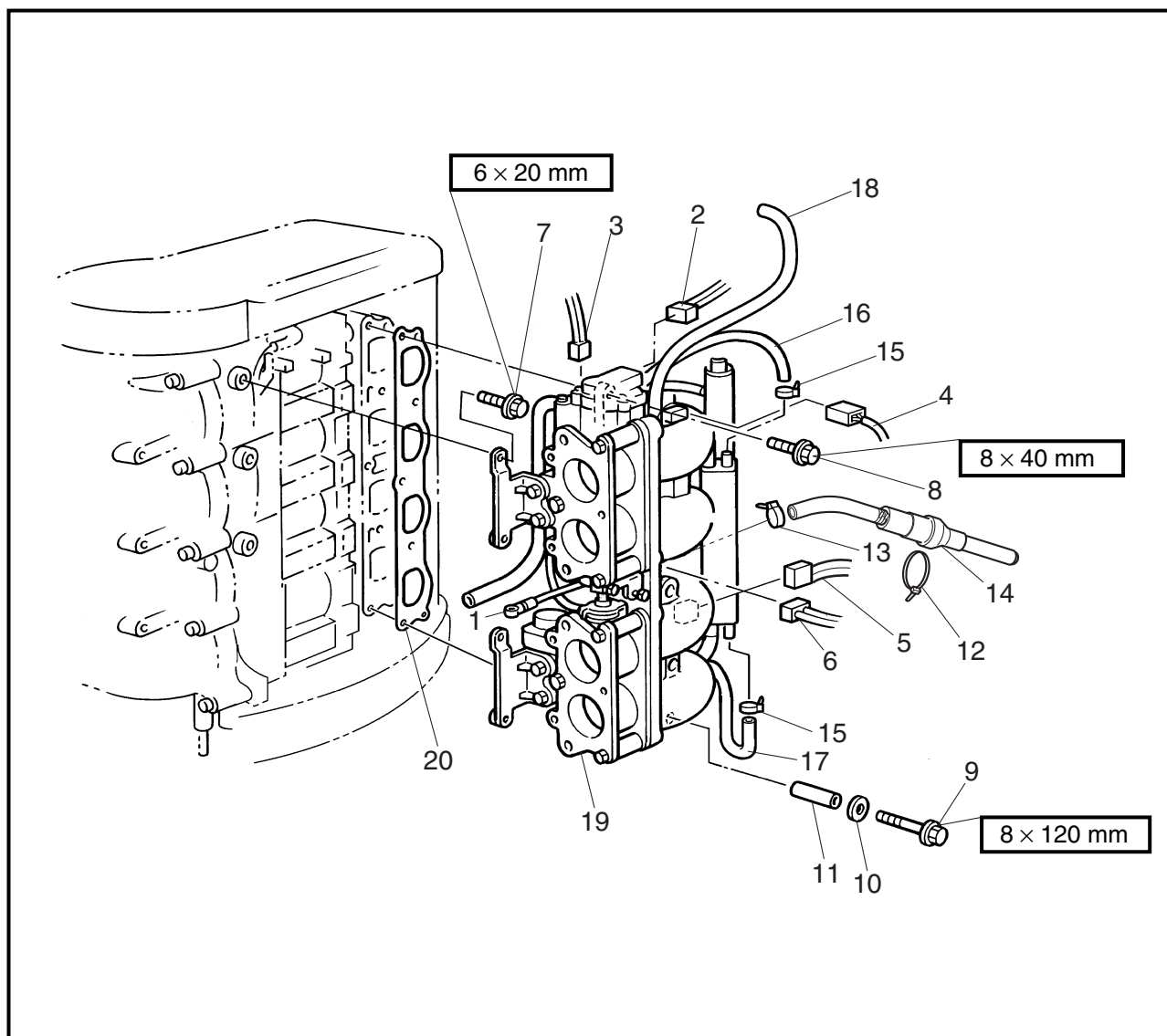


Order	Job/Part	Q'ty	Remarks
7	Collar	2	For installation, reverse the removal procedure.
8	Bolt	6	
9	Intake silencer	1	
10	O-ring	2	
11	Bolt	2	
12	Bracket	1	



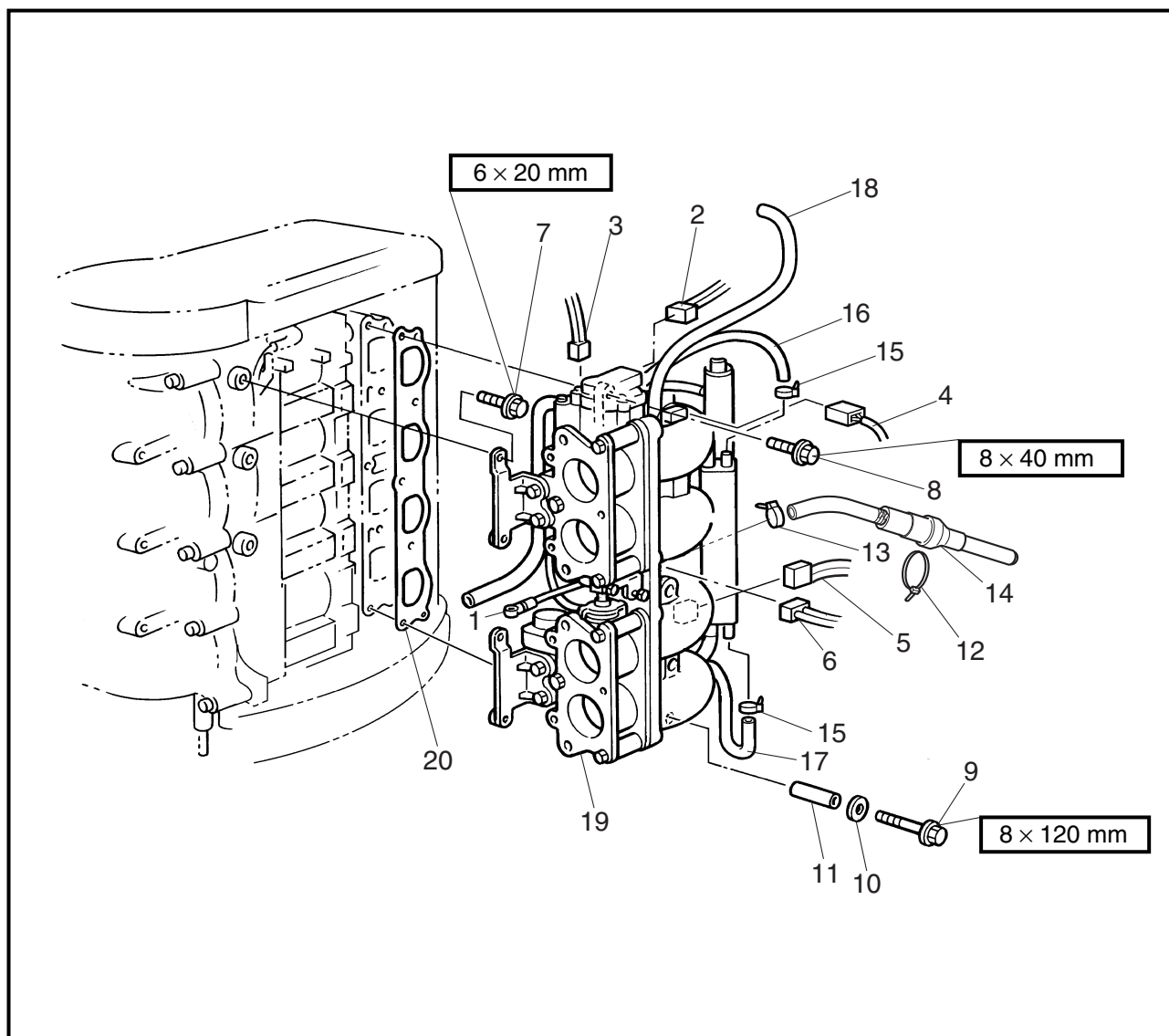
INTAKE ASSEMBLY

REMOVING/INSTALLING THE INTAKE ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Intake silencer		Refer to "INTAKE SILENCER" on page 4-1.
1	Throttle joint link rod	1	
2	Throttle position sensor coupler	1	
3	Idle speed control valve coupler	1	
4	Intake air pressure sensor coupler	1	
5	Fuel injector coupler	4	
6	High-pressure fuel pump coupler	1	
7	Bolt	4	
8	Bolt	4	
9	Bolt	1	

Continued on next page.

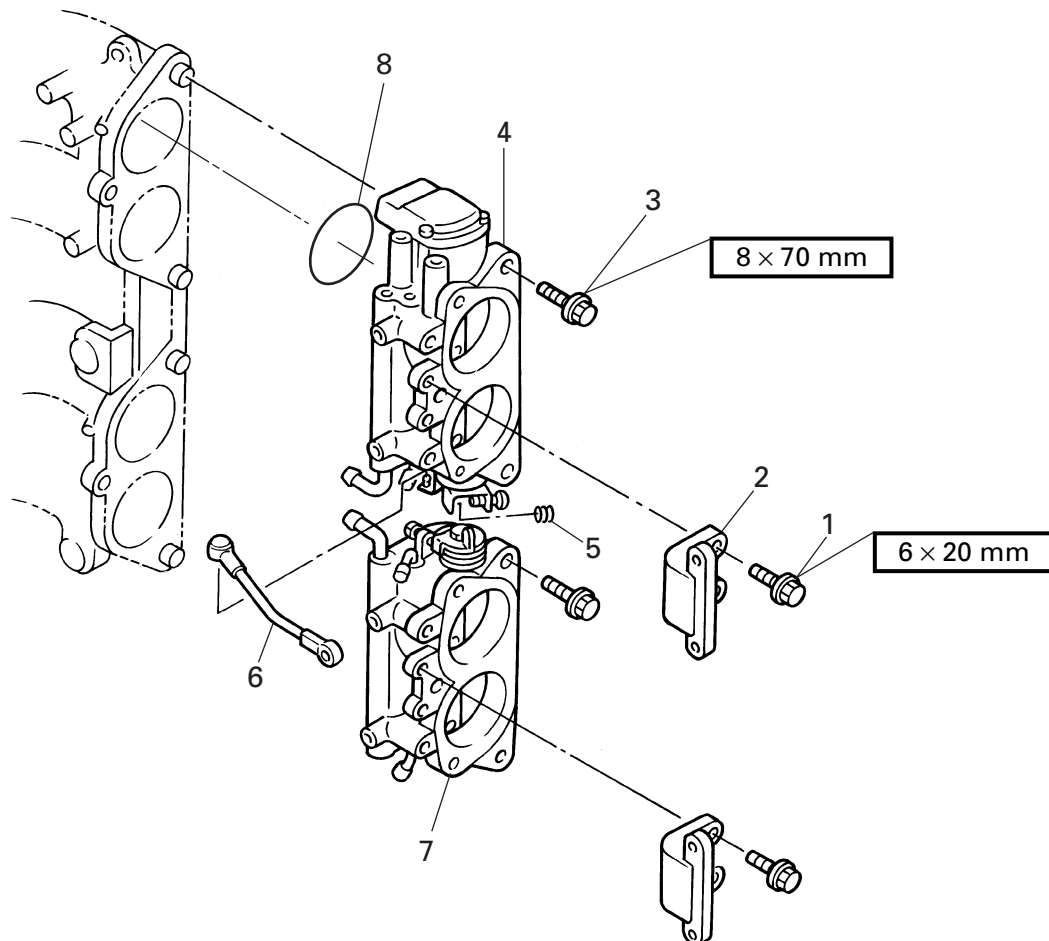


Order	Job/Part	Q'ty	Remarks
10	Washer	1	
11	Collar	1	
12	Plastic locking tie	1	Not reusable
13	Hose clamp	1	
14	Fuel filter assembly	1	
15	Hose clamp	2	
16	Water hose	1	(fuel cooler-to-water outlet)
17	Water hose	1	(fuel cooler-to-exhaust cover)
18	Hose	1	
19	Intake assembly	1	
20	Gasket	1	Not reusable
For installation, reverse the removal procedure.			



THROTTLE BODY

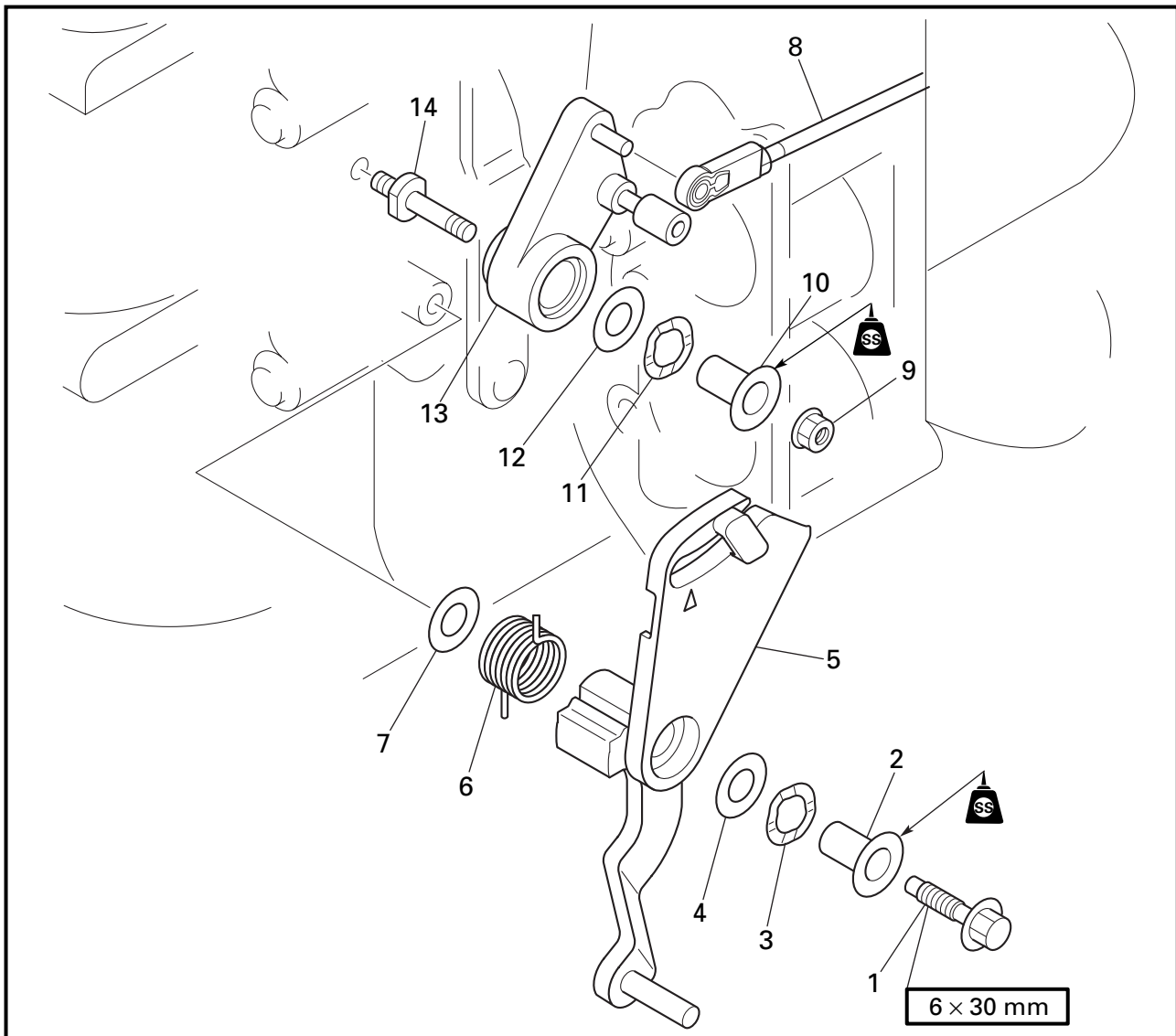
REMOVING/INSTALLING THE THROTTLE BODY



Order	Job/Part	Q'ty	Remarks
	Intake assembly		Refer to "INTAKE ASSEMBLY" on page 4-3.
1	Bolt	4	
2	Bracket	2	
3	Bolt	6	
4	Throttle body #1	1	
5	Spring	1	
6	Throttle joint link rod	1	
7	Throttle body #2	1	
8	O-ring	4	2.46 × 48 mm For installation, reverse the removal procedure.

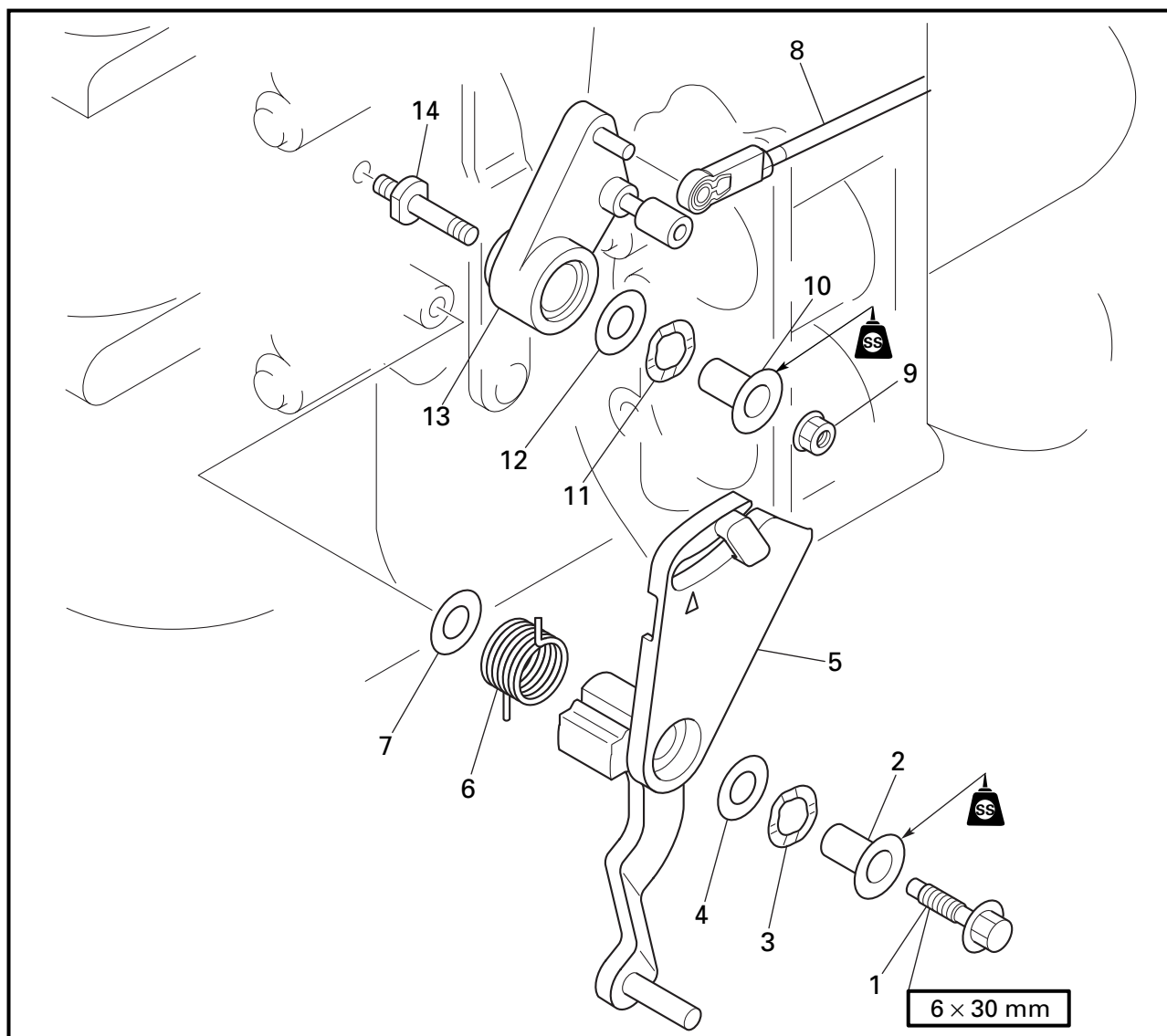
CONTROL UNIT

REMOVING/INSTALLING THE CONTROL UNIT



Order	Job/Part	Q'ty	Remarks
	Intake silencer		Refer to "INTAKE SILENCER" on page 4-1.
1	Bolt	1	
2	Collar	1	
3	Wave washer	1	
4	Washer	1	
5	Throttle control lever	1	
6	Spring	1	
7	Washer	1	
Continued on next page.			

Continued on next page.

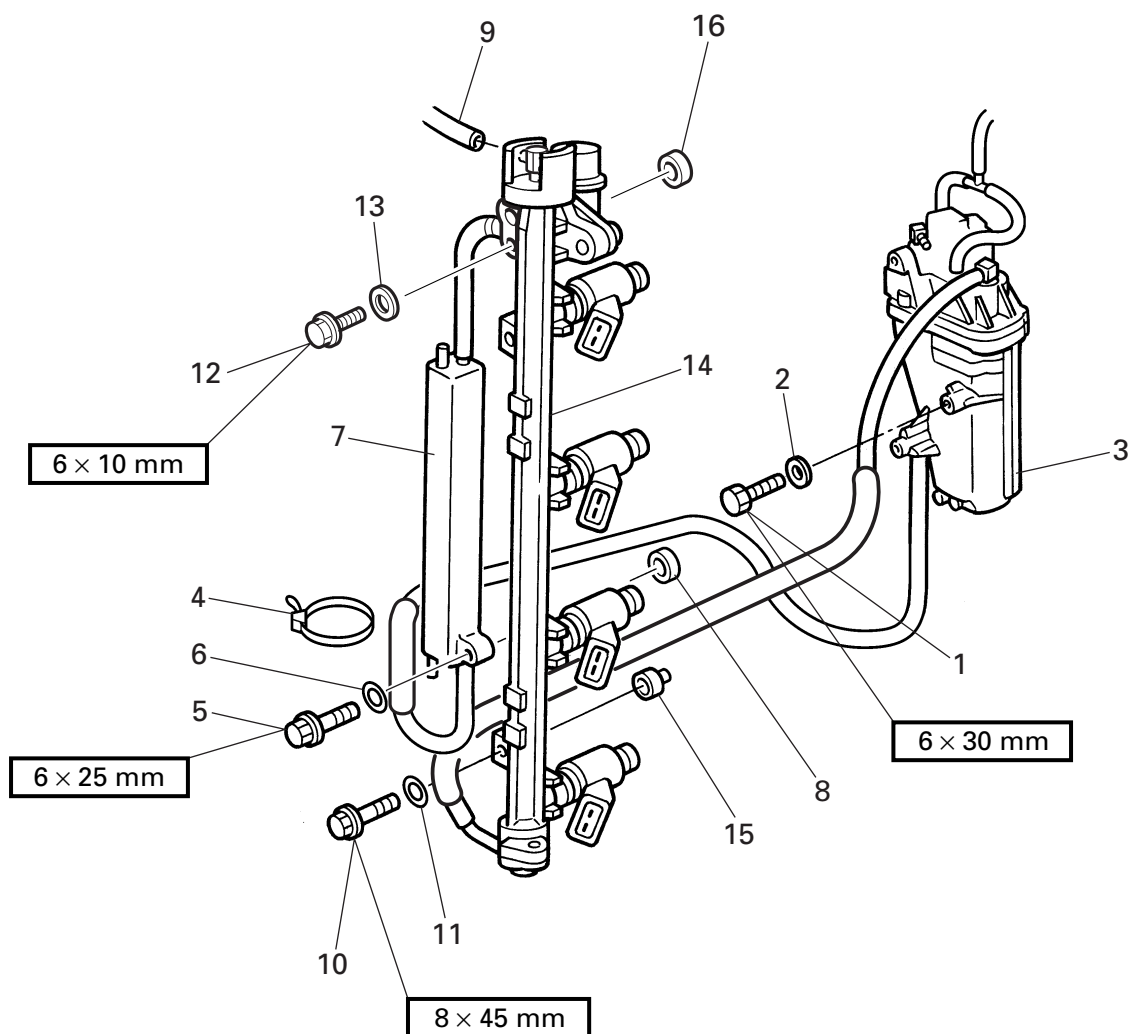


Order	Job/Part	Q'ty	Remarks
8	Throttle joint link rod	1	
9	Nut	1	
10	Collar	1	
11	Wave washer	1	
12	Washer	1	
13	Accelerator cam	1	
14	Stud bolt	1	
			For installation, reverse the removal procedure.

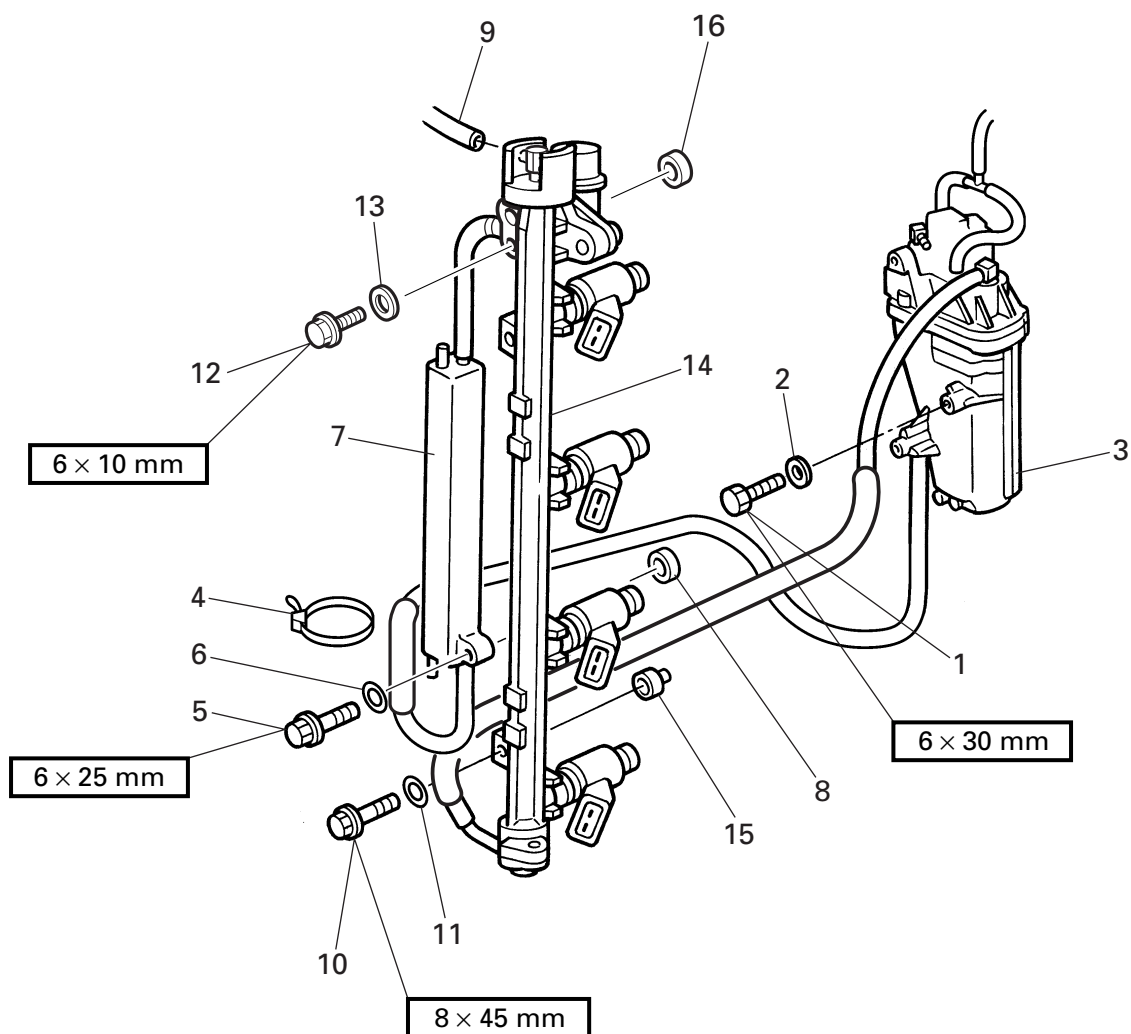


HIGH-PRESSURE FUEL LINE

REMOVING/INSTALLING THE HIGH-PRESSURE FUEL LINE



Order	Job/Part	Q'ty	Remarks
	Intake assembly		Refer to "INTAKE ASSEMBLY" on page 4-3.
1	Bolt	3	Not reusable
2	Washer	3	
3	Vapor separator	1	
4	Plastic locking tie	2	
5	Bolt	2	
6	Washer	2	
7	Fuel cooler	1	
8	Collar	2	
Continued on next page.			



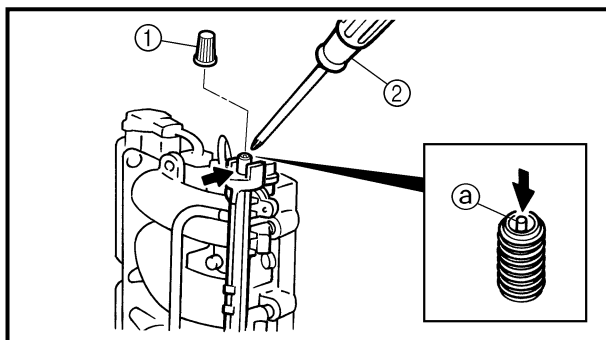
Order	Job/Part	Q'ty	Remarks
9	Hose	1	(intake manifold-to-pressure regulator)
10	Bolt	2	
11	Washer	2	
12	Bolt	1	
13	Washer	1	
14	Fuel rail	1	
15	Collar	2	
16	Collar	1	
For installation, reverse the removal procedure.			



REDUCING THE FUEL PRESSURE (HIGH-PRESSURE FUEL LINE)

⚠ WARNING

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



1. Reduce:

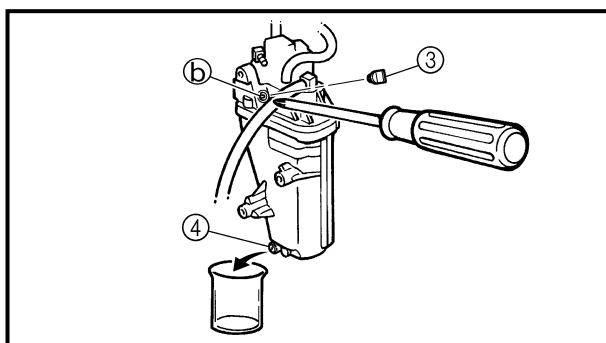
- Fuel pressure (high-pressure fuel line)

Reducing steps

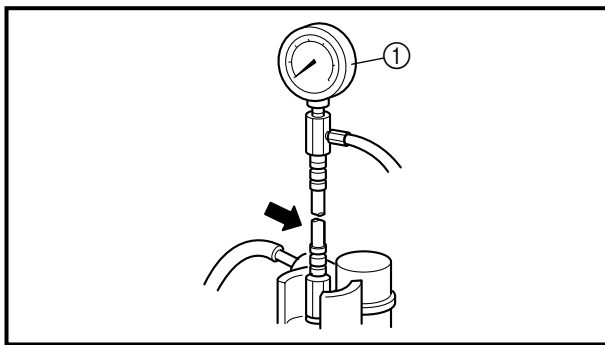
- (1) Remove the cap ①.
- (2) Cover the pressure check valve ② of the fuel rail with a rag, and then press in the valve using a thin screwdriver ② to release the fuel pressure.

⚠ WARNING

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



- (3) Remove the cap ③, and then press in the valve ⑥ using a thin screwdriver ②.
- (4) Place a container under the vapor separator, and then drain the fuel from the separator by removing the drain screw ④.



CHECKING THE PRESSURE REGULATOR

Check:

- Pressure regulator
Faulty → Replace the pressure regulator.

Checking steps

- (1) Install the fuel pressure gauge onto the pressure check valve.



Fuel pressure gauge ①
YB-06766 / 90890-06786

- (2) Main switch to on.
- (3) Check the fuel pressure.



Fuel pressure
Approx.
300 kPa (3.0 kg/cm², 44.1 psi)

- (4) Start the engine.
- (5) Check the fuel pressure.

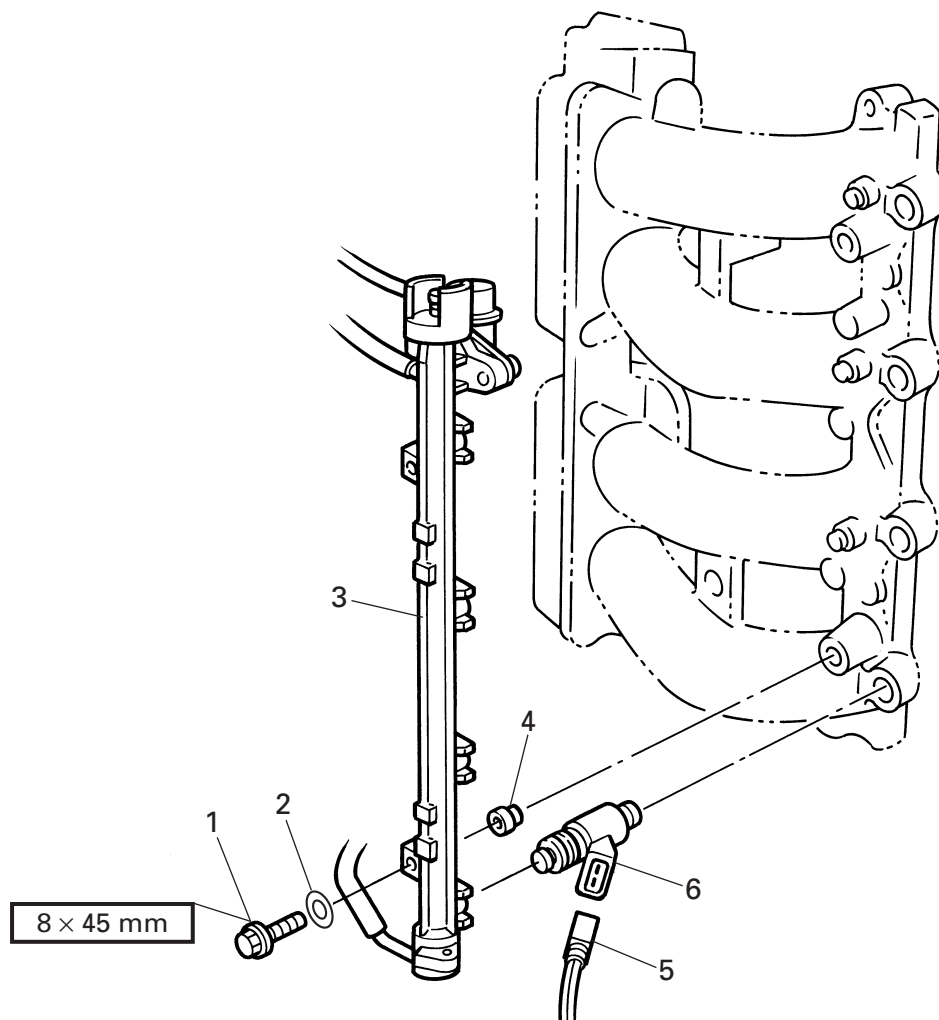


Fuel pressure
Approx.
250 kPa (2.5 kg/cm², 35.6 psi)



FUEL INJECTORS

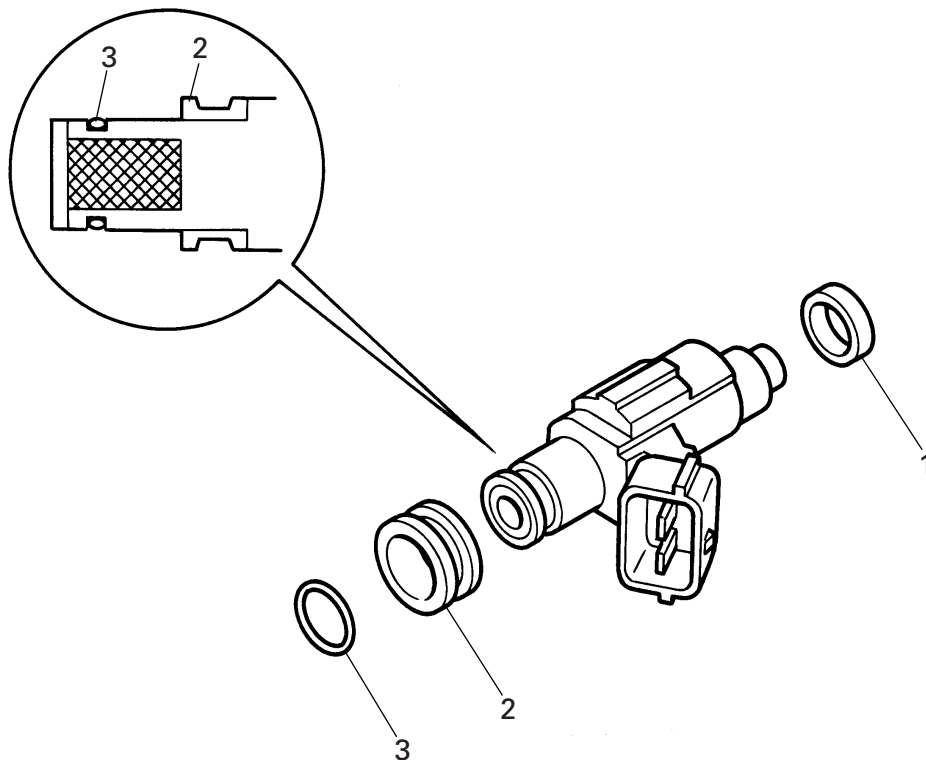
REMOVING/INSTALLING THE FUEL INJECTORS



Order	Job/Part	Q'ty	Remarks
	High-pressure fuel line		Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8. Before performing the following procedure, reduce the fuel pressure (high-pressure fuel line).
1	Bolt	2	
2	Washer	2	
3	Fuel cooler	1	
4	Collar	2	
5	Fuel injector coupler	4	
6	Fuel injector	4	
			For installation, reverse the removal procedure.



DISASSEMBLING/ASSEMBLING THE FUEL INJECTORS

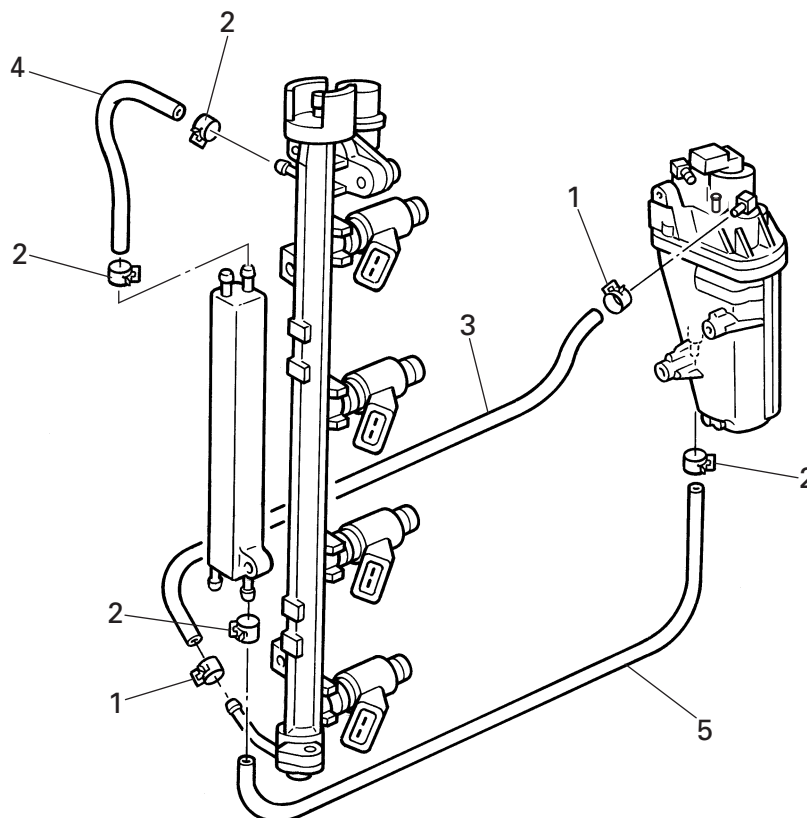


Order	Job/Part	Q'ty	Remarks
1	Rubber seal	1	2.2 × 7.8 mm For assembly, reverse the disassembly procedure.
2	Rubber damper	1	
3	O-ring	1	

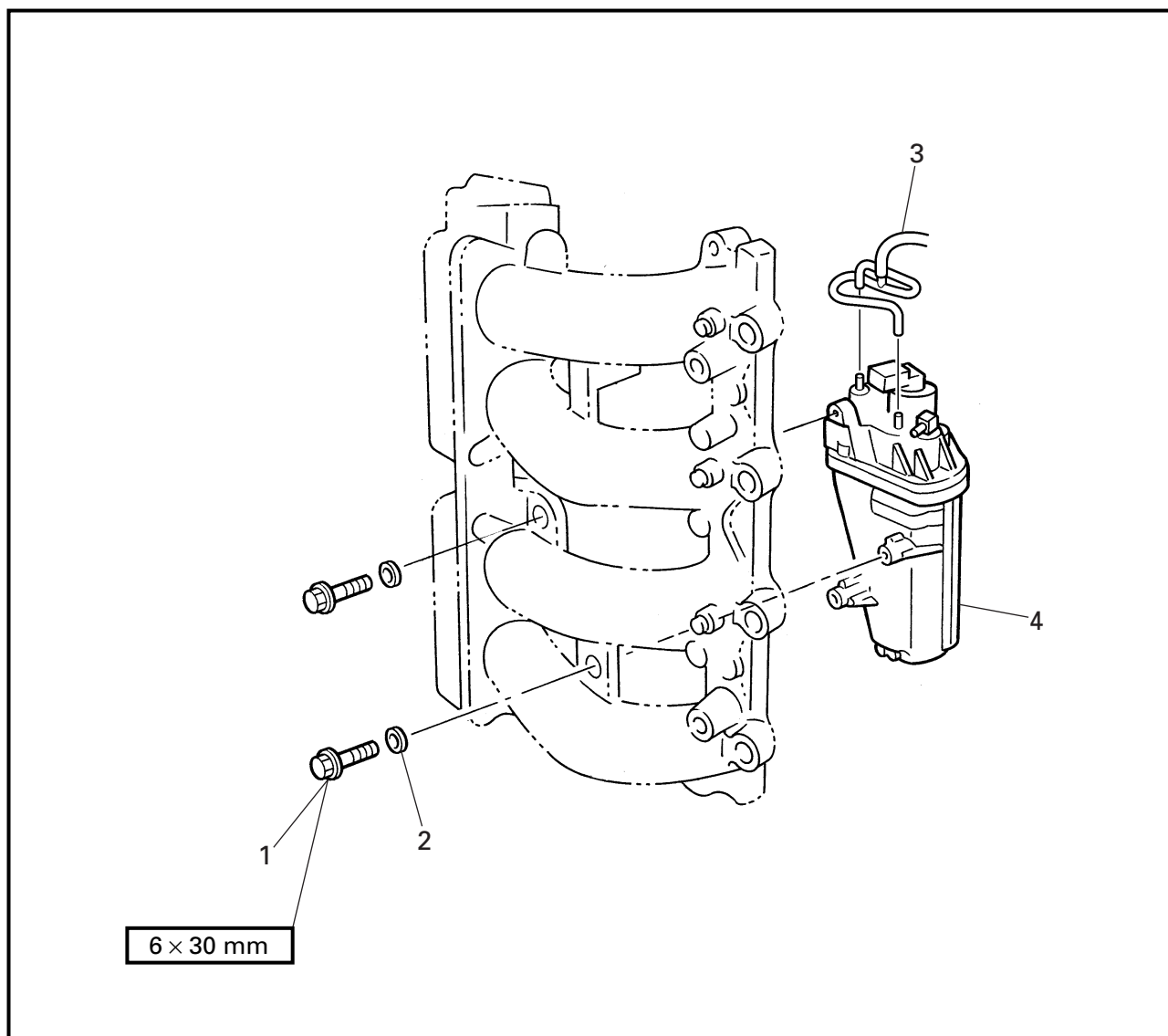


FUEL HOSES

REMOVING/INSTALLING THE FUEL HOSES



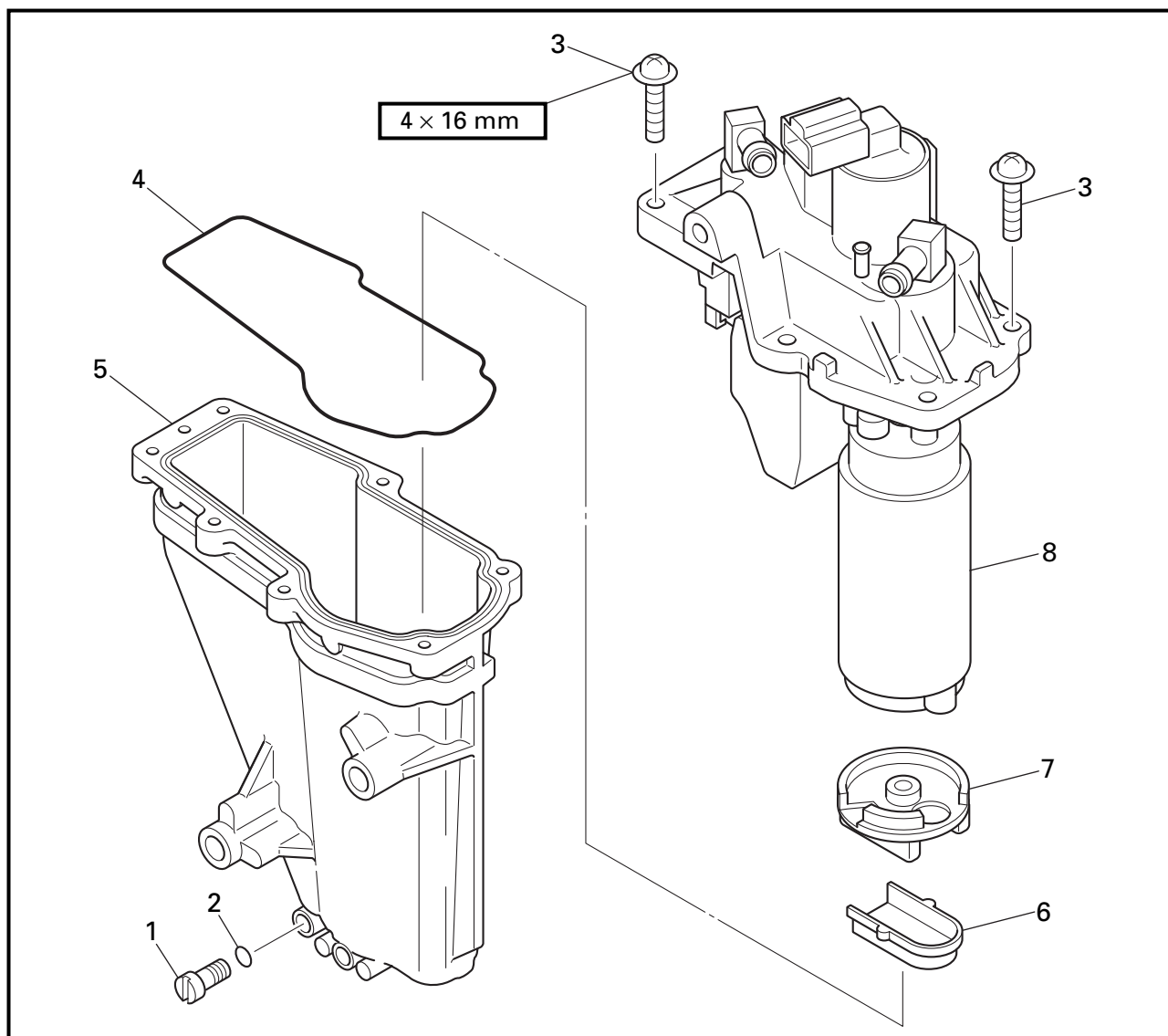
Order	Job/Part	Q'ty	Remarks
	High-pressure fuel line		Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8. Before performing the following procedure, reduce the fuel pressure (high-pressure fuel line).
1	Hose clamp	2	Not reusable
2	Hose clamp	4	
3	Fuel hose	1	(vapor separator-to-fuel rail)
4	Fuel hose	1	(pressure regulator-to-fuel cooler)
5	Fuel hose	1	(fuel cooler-to-vapor separator)
			For installation, reverse the removal procedure.

**VAPOR SEPARATOR****REMOVING/INSTALLING THE VAPOR SEPARATOR**

Order	Job/Part	Q'ty	Remarks
	Fuel hoses		Refer to "FUEL HOSES" on page 4-14.
1	Bolt	3	
2	Washer	3	
3	Hose	1	(vapor separator-to-intake silencer)
4	Vapor separator	1	For installation, reverse the removal procedure.



DISASSEMBLING/ASSEMBLING THE VAPOR SEPARATOR

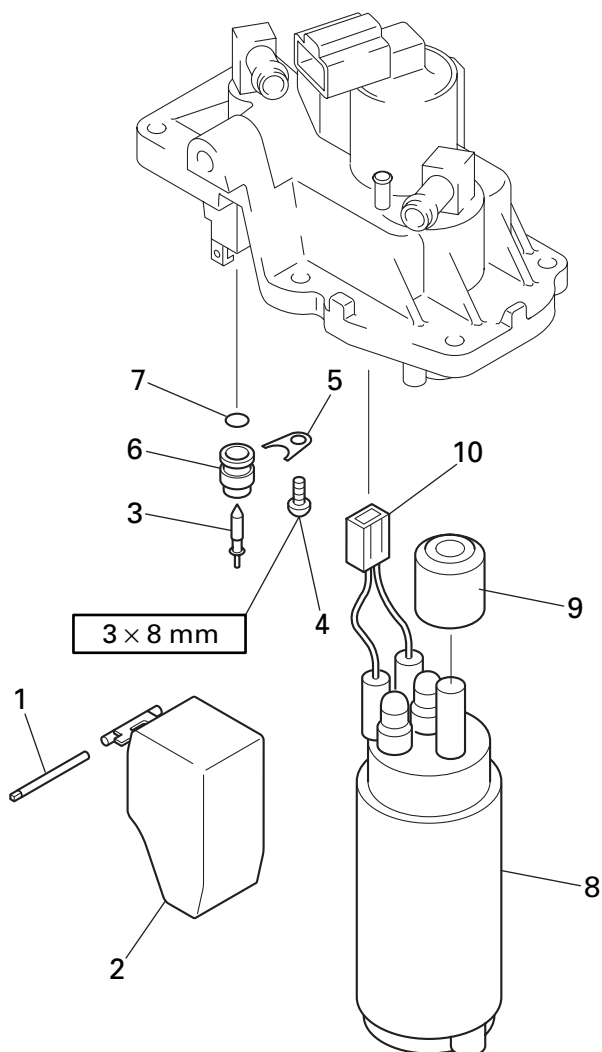


Order	Job/Part	Q'ty	Remarks
1	Drain screw	1	For assembly, reverse the disassembly procedure.
2	Gasket	1	
3	Screw	7	
4	O-ring	1	
5	Float chamber	1	
6	Holder	1	
7	High-pressure fuel pump filter	1	
8	Vapor separator body	1	



HIGH-PRESSURE FUEL PUMP

DISASSEMBLING/ASSEMBLING THE HIGH-PRESSURE FUEL PUMP

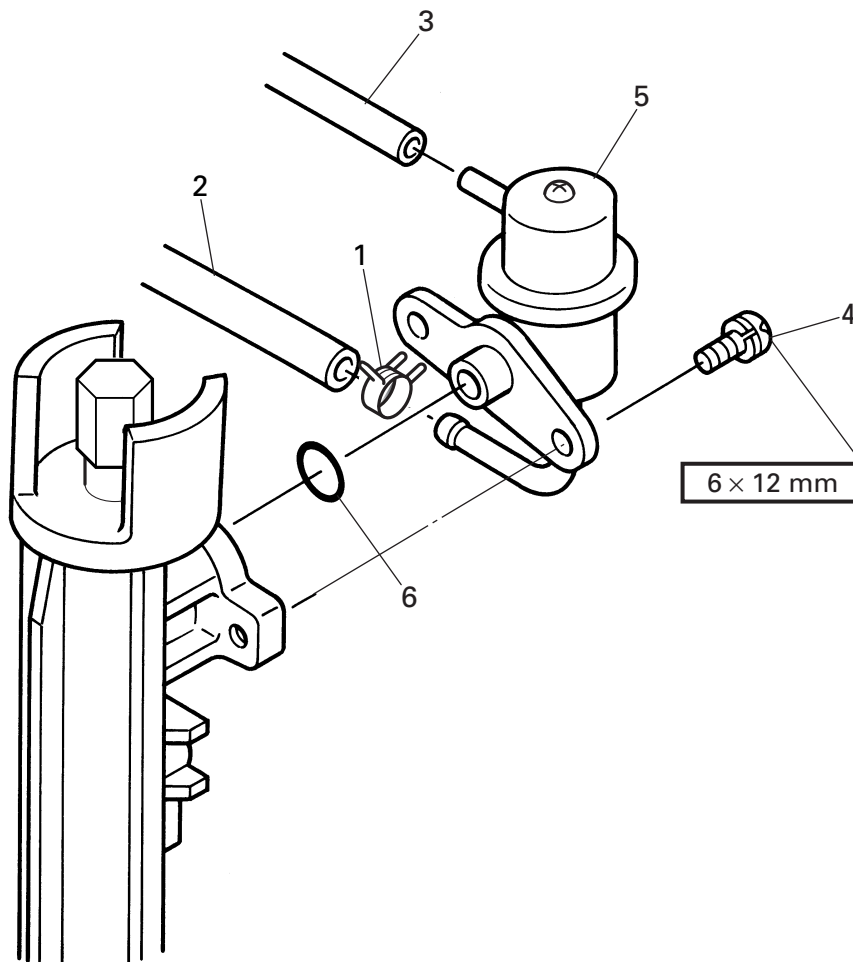


Order	Job/Part	Q'ty	Remarks
1	Float pin	1	1.35 × 7 mm
2	Float	1	
3	Needle valve	1	
4	Screw	1	
5	Retainer	1	
6	Collar	1	
7	O-ring	1	
8	High-pressure fuel pump	1	For assembly, reverse the disassembly procedure.
9	Grommet	1	
10	High-pressure fuel pump connector	1	



PRESSURE REGULATOR

REMOVING/INSTALLING THE PRESSURE REGULATOR

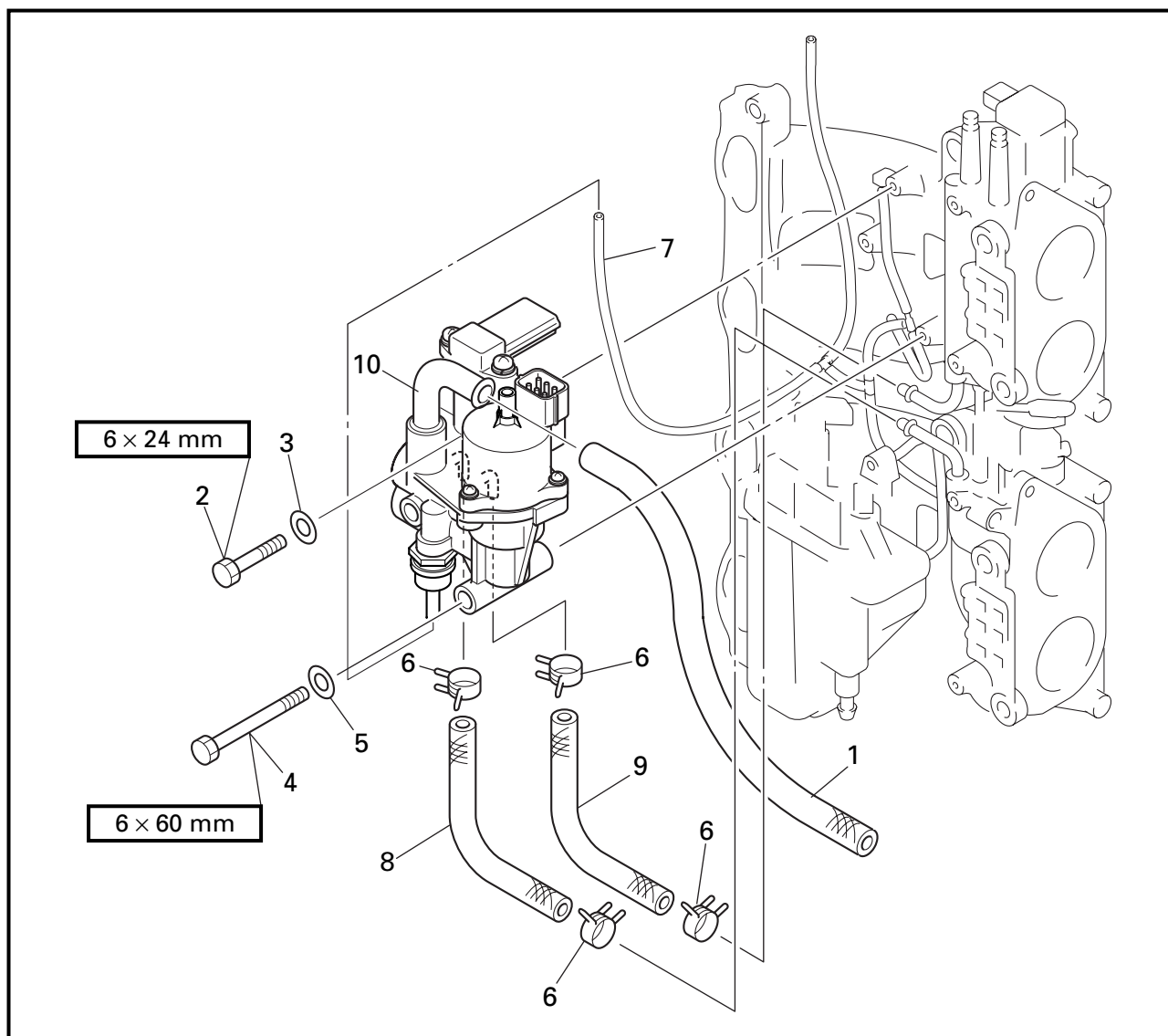


Order	Job/Part	Q'ty	Remarks
	Fuel rail		Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8. Before performing the following procedure, reduce the fuel pressure (high-pressure fuel line)
1	Hose clamp	1	
2	Hose	1	(fuel cooler-to-pressure regulator)
3	Hose	1	(intake manifold-to-pressure regulator)
4	Screw	2	
5	Pressure regulator	1	
6	O-ring	1	1.8 x 8 mm For installation, reverse the removal procedure.



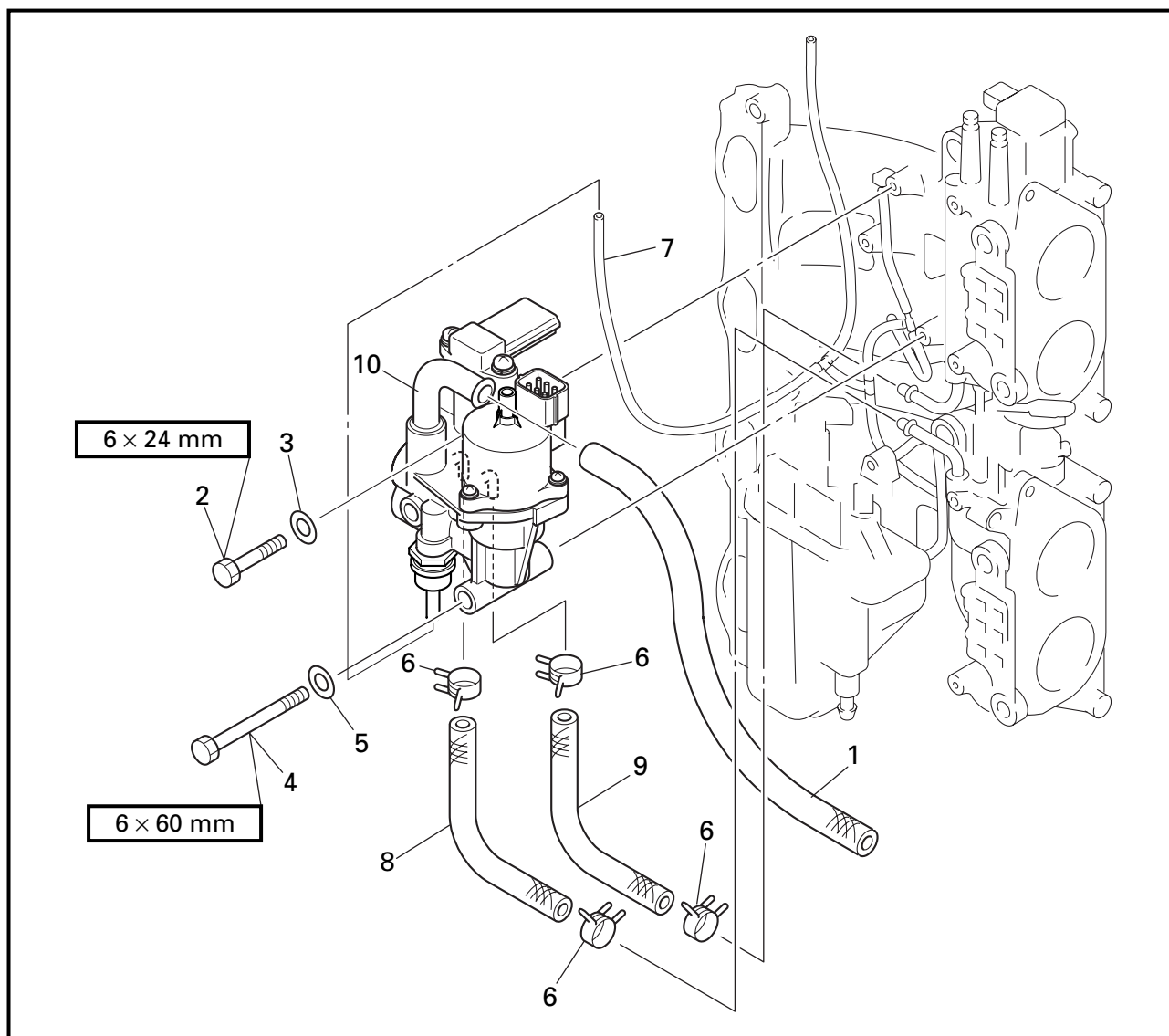
IDLE SPEED CONTROL ASSEMBLY

REMOVING/INSTALLING THE IDLE SPEED CONTROL ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Intake assembly		Refer to "INTAKE ASSEMBLY" on page 4-3.
1	Hose	1	(idle speed control assembly-to-intake silencer)
2	Bolt	1	
3	Washer	1	
4	Bolt	2	
5	Washer	2	
6	Hose clamp	4	

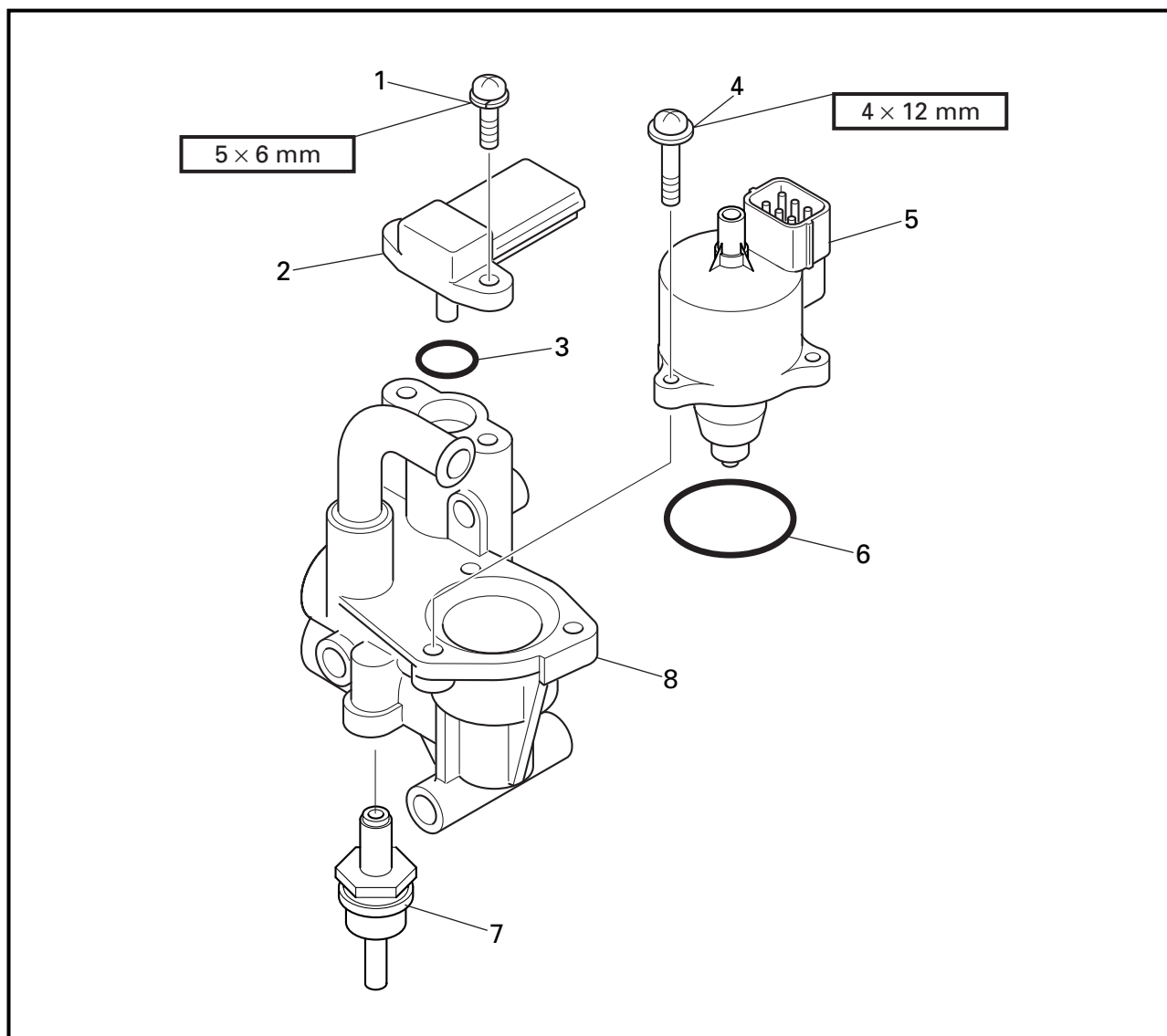
Continued on next page.



Order	Job/Part	Q'ty	Remarks
7	Vacuum hose	1	(idle speed control assembly-to-intake manifold)
8	Hose	1	(idle speed control assembly-to-throttle body #2)
9	Hose	1	(idle speed control assembly-to-throttle body #1)
10	Idle speed control assembly	1	For installation, reverse the removal procedure.



DISASSEMBLING/ASSEMBLING THE IDLE SPEED CONTROL ASSEMBLY

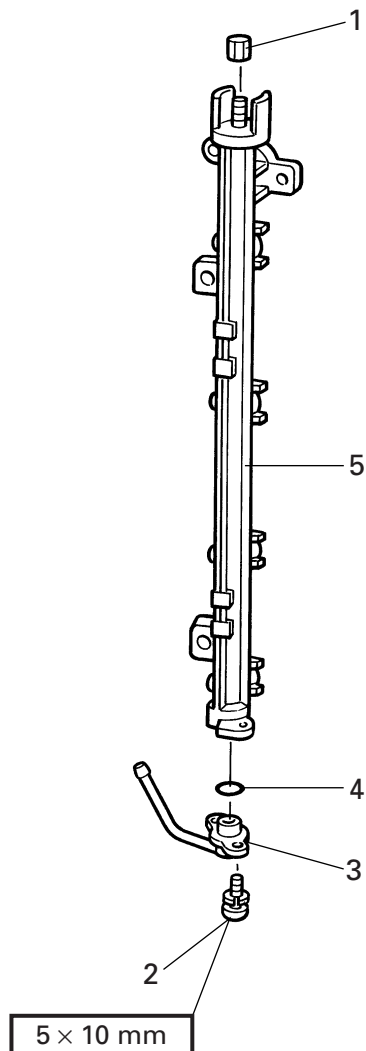


Order	Job/Part	Q'ty	Remarks
1	Screw	2	
2	Pressure sensor	1	
3	O-ring	1	1.9 × 14.8 mm
4	Screw	3	
5	Idle speed control	1	
6	O-ring	1	2 × 29 mm
7	Filter	1	
8	Idle speed control body	1	
For assembly, reverse the disassembly procedure.			



FUEL RAIL

DISASSEMBLING/ASSEMBLING THE FUEL RAIL

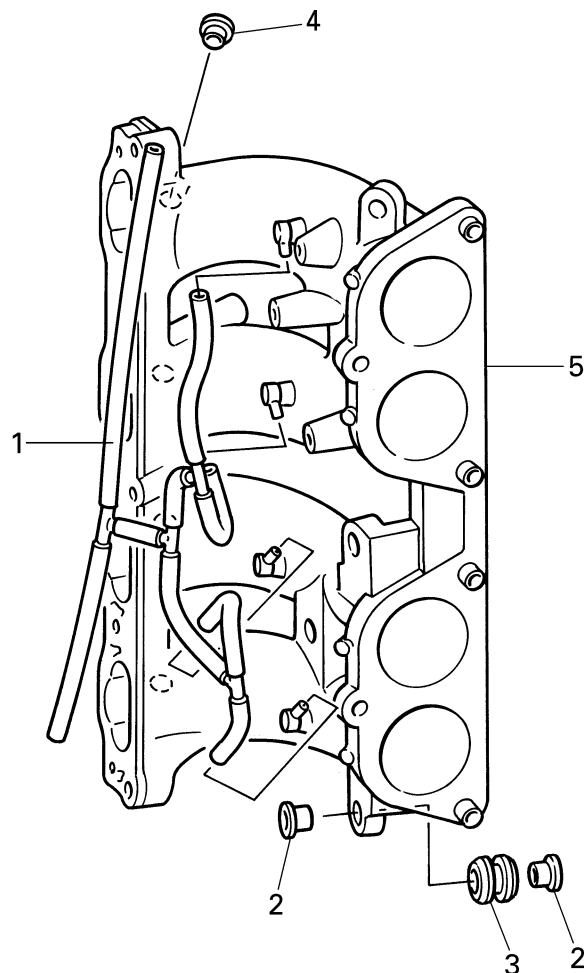


Order	Job/Part	Q'ty	Remarks
	Fuel injectors		Refer to "FUEL INJECTORS" on page 4-12.
	Fuel hoses		Refer to "FUEL HOSES" on page 4-14.
	Pressure regulator		Refer to "PRESSURE REGULATOR" on page 4-18.
1	Cap	1	
2	Screw	2	
3	Fuel rail joint	1	
4	O-ring	1	2.4 × 12 mm
5	Fuel rail	1	
			For assembly, reverse the disassembly procedure.

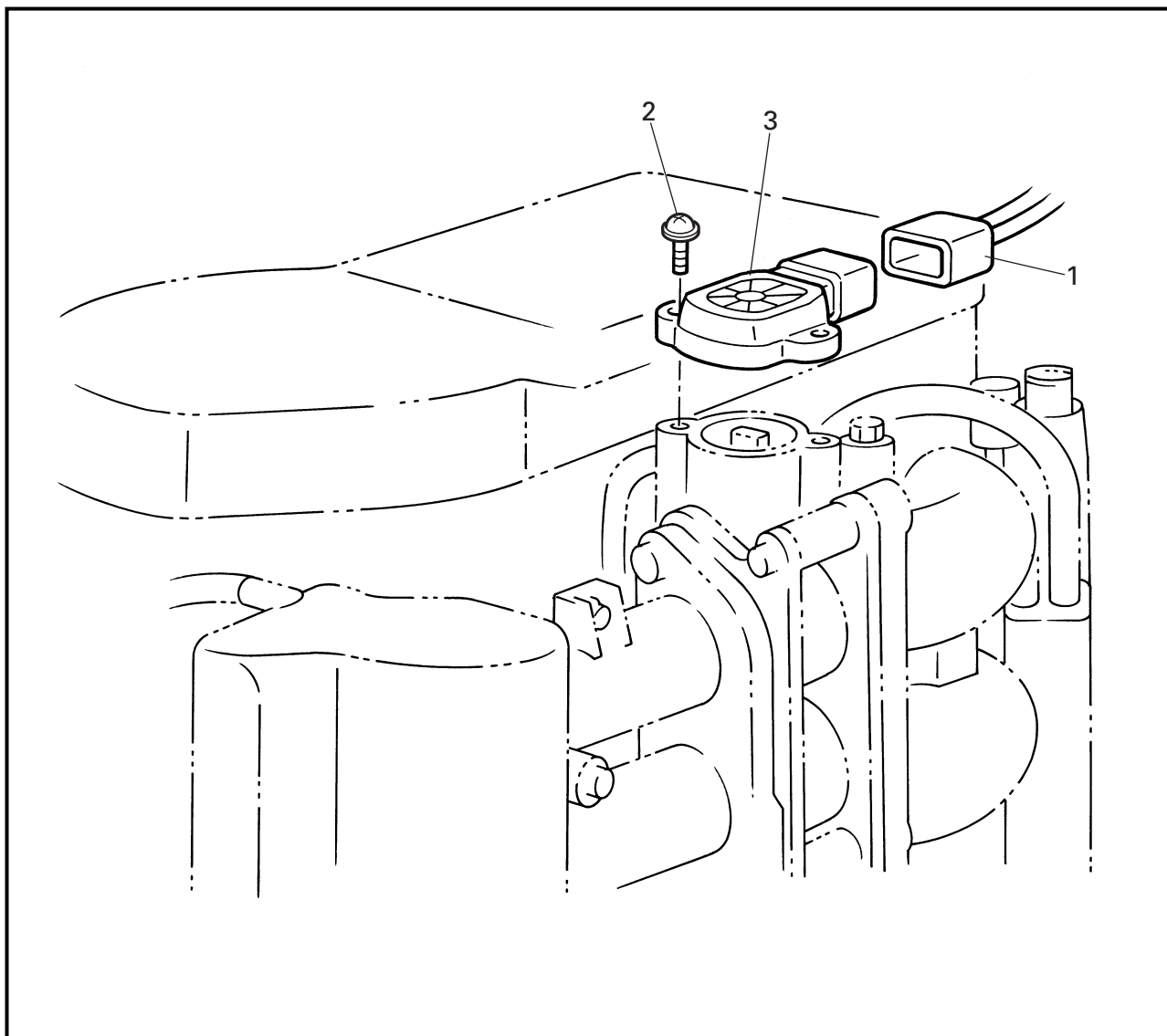


INTAKE MANIFOLD

DISASSEMBLING/ASSEMBLING THE INTAKE MANIFOLD



Order	Job/Part	Q'ty	Remarks
	Throttle body		Refer to "THROTTLE BODY" on page 4-5.
	High-pressure fuel line		Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8.
	Idle speed control assembly		Refer to "IDLE SPEED CONTROL ASSEMBLY" on page 4-19.
1	Hose	1	(pressure regulator-to-intake manifold-to-idle speed control assembly)
2	Collar	6	
3	Grommet	3	
4	Rubber seal	4	
5	Intake manifold	1	
			For assembly, reverse the disassembly procedure.

**THROTTLE POSITION SENSOR****REMOVING/INSTALLING THE THROTTLE POSITION SENSOR**

Order	Job/Part	Q'ty	Remarks
1	Throttle position sensor connector	1	For installation, reverse the removal procedure.
2	Screw	2	
3	Throttle position sensor	1	



**INSTALLING THE THROTTLE
POSITION SENSOR****NOTE:** _____

During installation, make sure the throttle position sensor is properly adjusted.

Install:

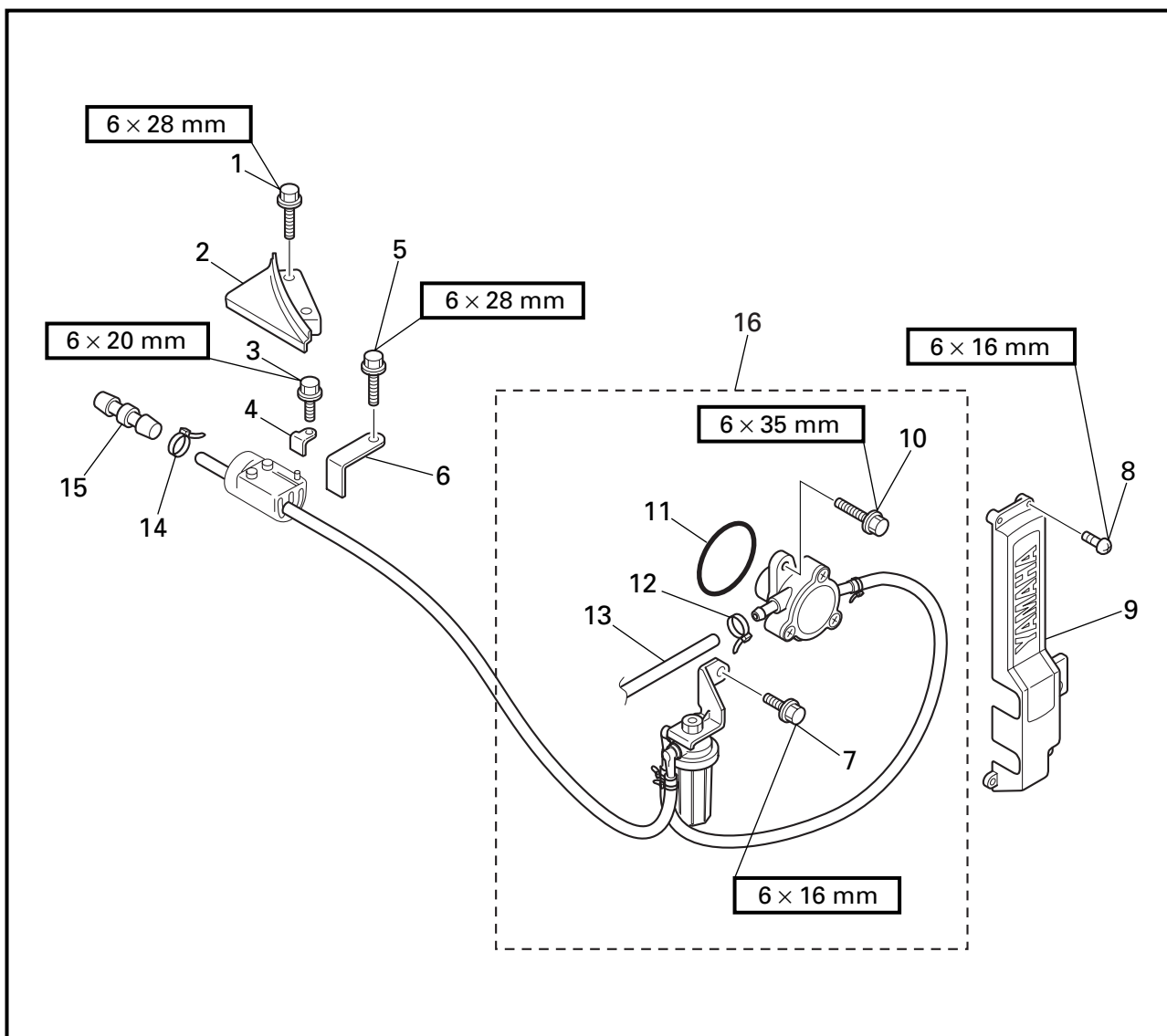
- Throttle position sensor

Refer to "ADJUSTING THE THROTTLE POSITION SENSOR" on page 3-7.



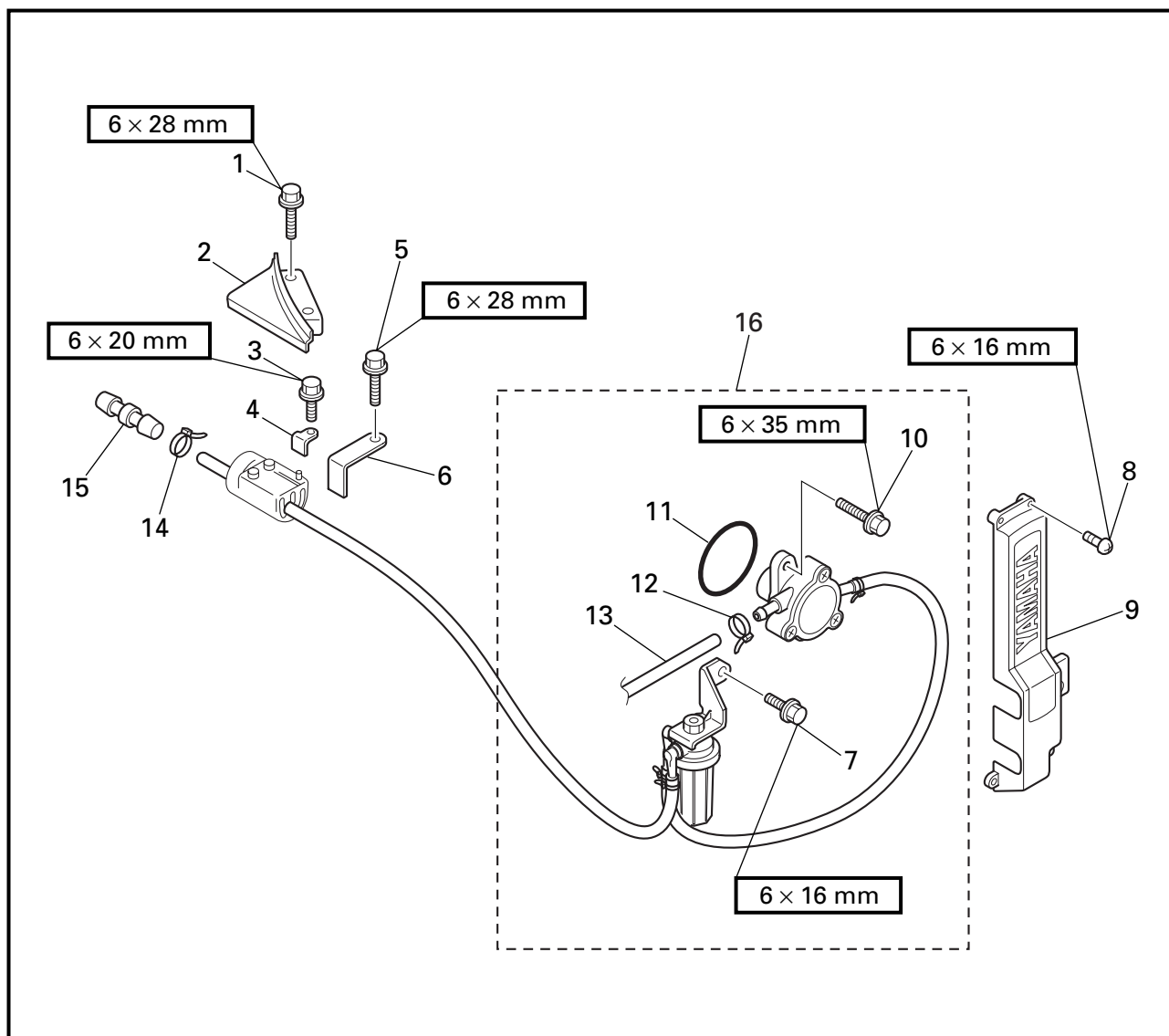
LOW-PRESSURE FUEL LINE

REMOVING/INSTALLING THE LOW-PRESSURE FUEL LINE



Order	Job/Part	Q'ty	Remarks
1	Bolt	2	
2	Grommet retaining plate	1	
3	Bolt	1	
4	Plate	1	
5	Bolt	1	
6	Clamp plate	1	
7	Bolt	1	
8	Screw	5	
9	Plug cover	1	

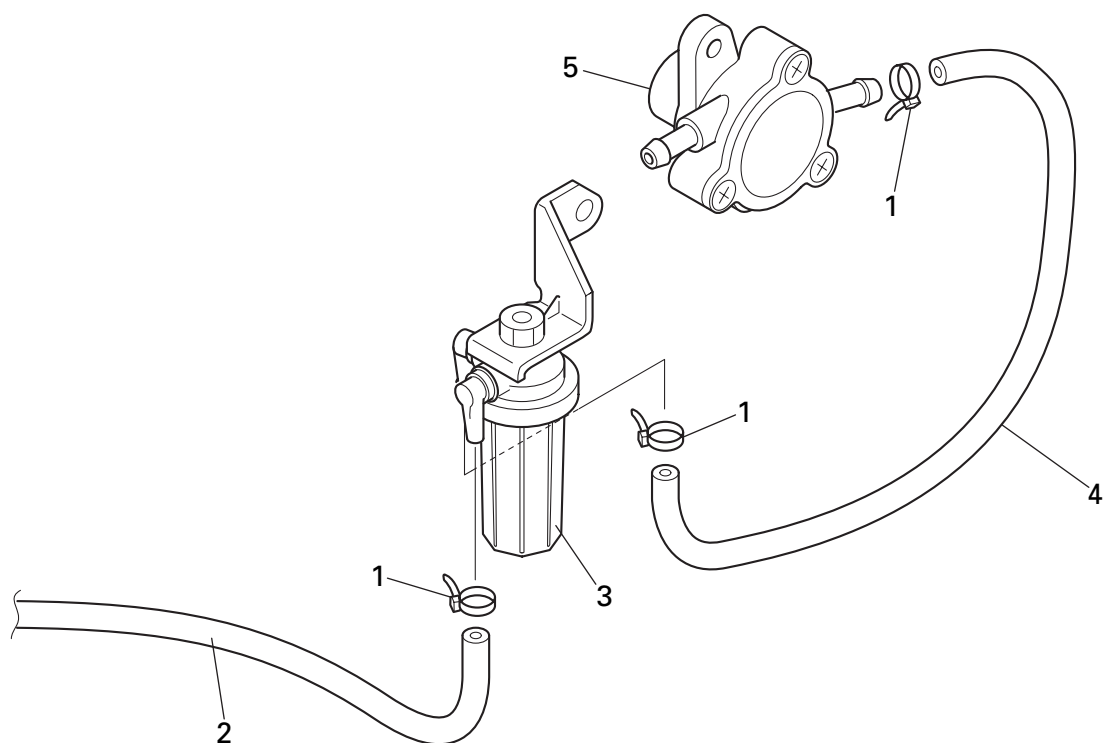
Continued on next page.



Order	Job/Part	Q'ty	Remarks
10	Bolt	2	
11	O-ring	1	3.1 × 29.4 mm
12	Plastic locking tie	1	Not reusable
13	Hose	1	
14	Plastic locking tie	1	Not reusable
15	Fuel hose joint	1	
16	Low-pressure fuel line	1	For installation, reverse the removal procedure.



DISASSEMBLING/ASSEMBLING THE LOW-PRESSURE FUEL LINE

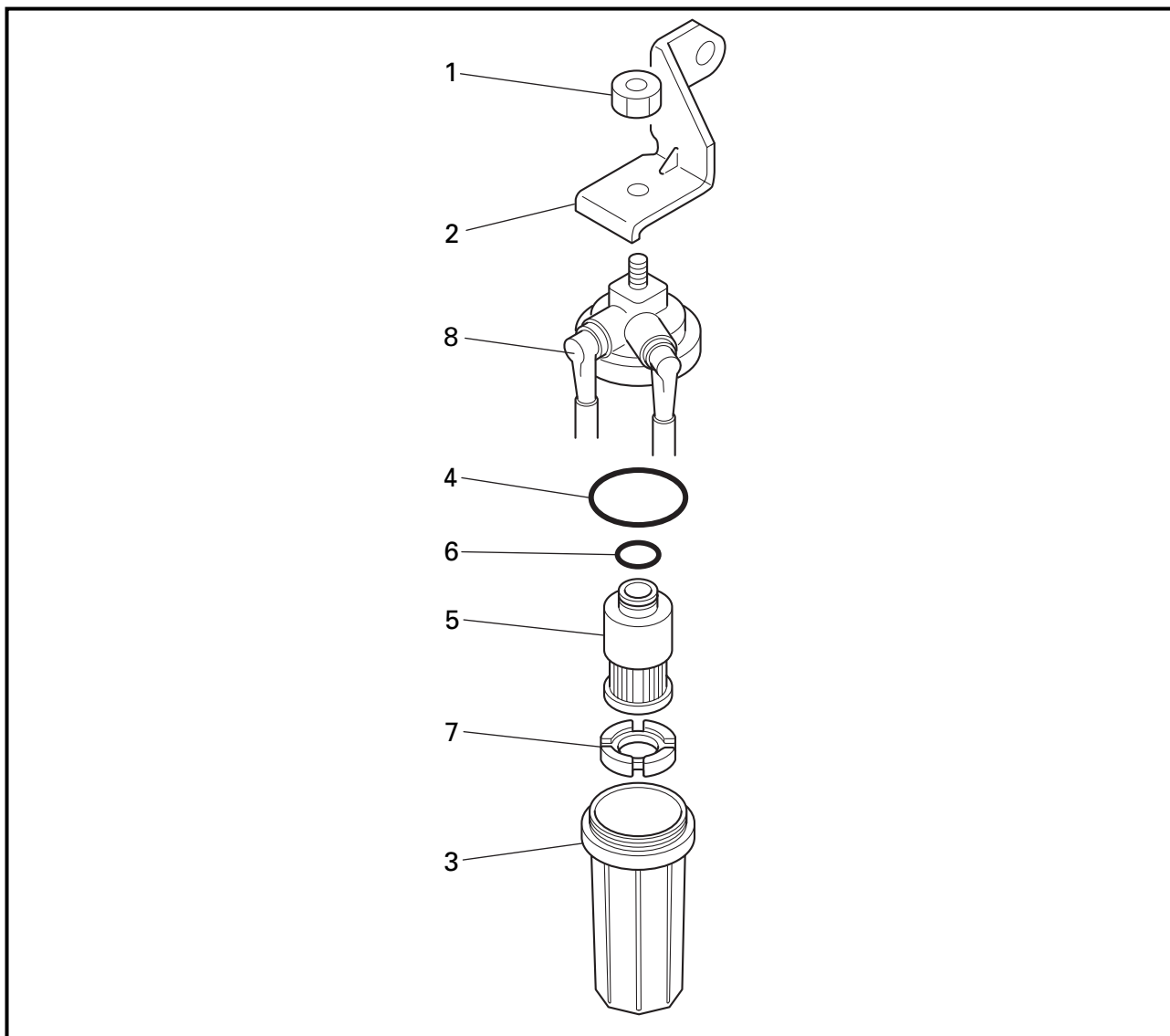


Order	Job/Part	Q'ty	Remarks
1	Plastic locking tie	4	Not reusable
2	Fuel hose	1	(hose joint-to-fuel filter)
3	Fuel filter	1	
4	Fuel hose	1	(fuel pump-to-fuel filter)
5	Fuel pump	1	
			For assembly, reverse the disassembly procedure.



FUEL FILTER

DISASSEMBLING/ASSEMBLING THE FUEL FILTER

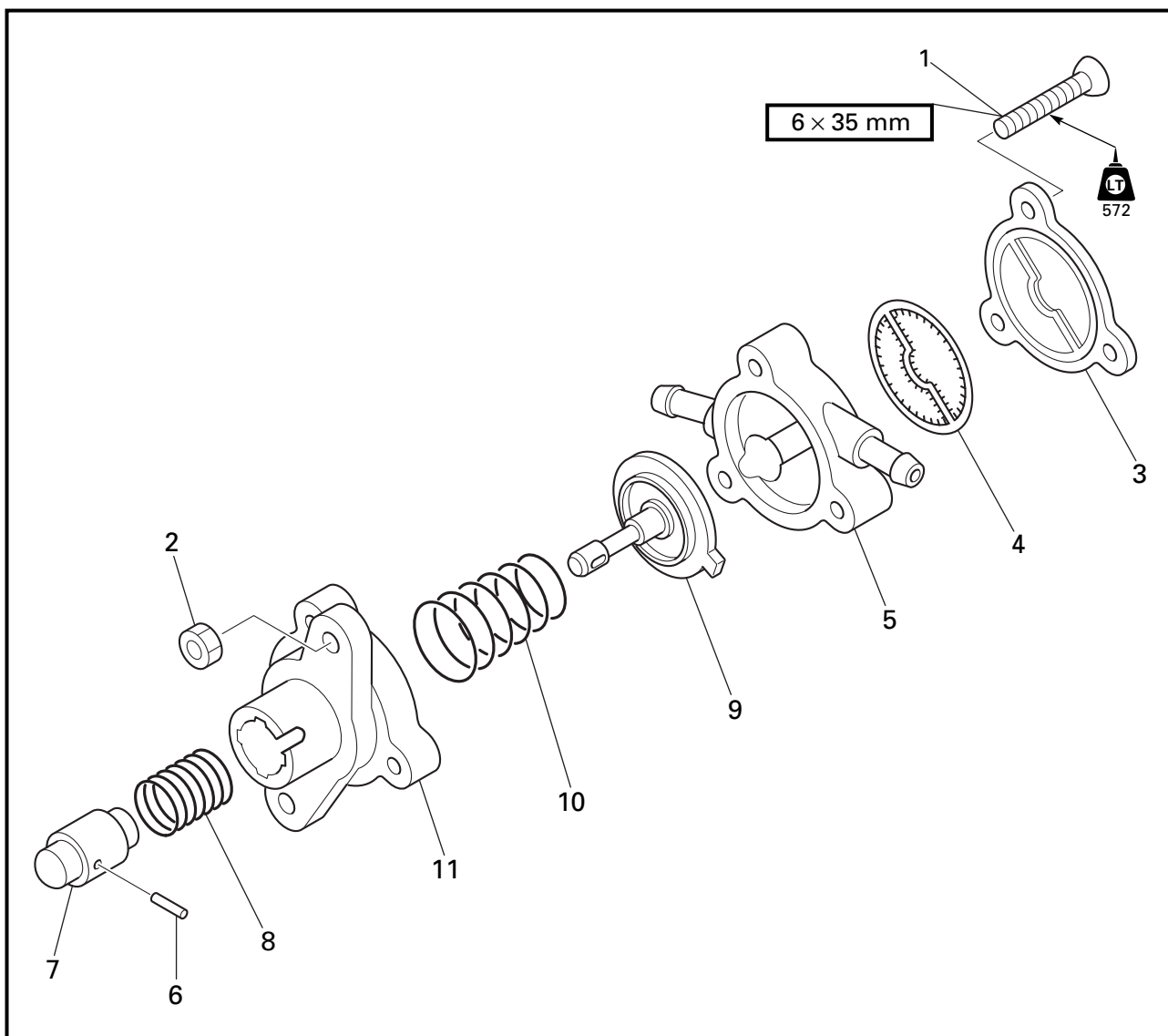


Order	Job/Part	Q'ty	Remarks
1	Nut	1	
2	Fuel filter bracket	1	
3	Fuel filter cup	1	
4	O-ring	1	2.0 × 32.2 mm Not reusable
5	Fuel filter element	1	
6	O-ring	1	1.5 × 13.5 mm Not reusable
7	Float	1	
8	Fuel filter cap	1	
For assembly, reverse the disassembly procedure.			



FUEL PUMP

DISASSEMBLING/ASSEMBLING THE FUEL PUMP



Order	Job/Part	Q'ty	Remarks
1	Screw	3	Not reusable For assembly, reverse the disassembly procedure.
2	Nut	2	
3	Fuel pump cover	1	
4	Gasket	1	
5	Fuel pump body	1	
6	Pin	1	
7	Plunger	1	
8	Spring	1	
9	Diaphragm	1	
10	Spring	1	
11	Fuel pump cover	1	



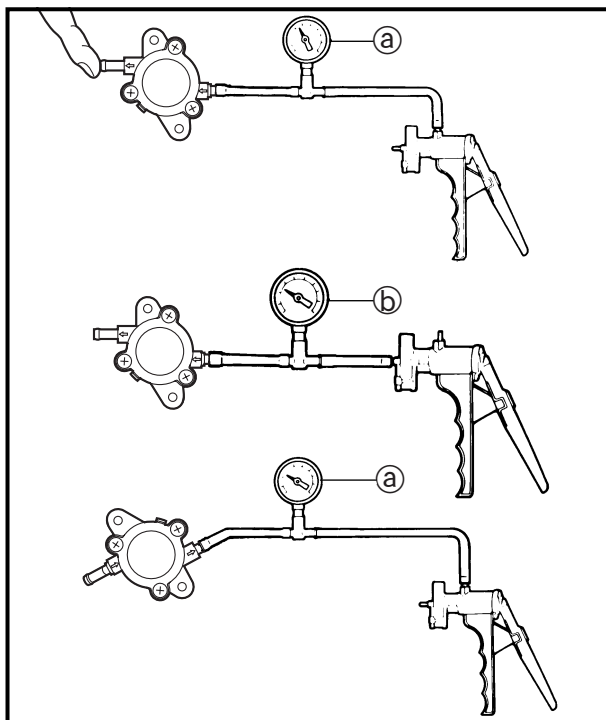
CHECKING THE FUEL PUMPS

1. Check:

- Diaphragm
 - Fuel pump valves
- Damage → Replace.

2. Check:

- Fuel pump
- Reverse air flow → Replace.



Checking steps

NOTE:

Do not overpressurize the fuel pump. Excessive pressure may cause air to leak out.

- (1) Install the Mity vac onto the fuel pump as shown.



Mity vac
YB-35956 / 90890-06756

- (2) Apply the specified pressure with the Mity vac.



Fuel pump pressure ^a
50 kPa (0.5 kg/cm², 7.1 psi)
Fuel pump negative pressure ^b
30 kPa (0.3 kg/cm², 4.3 psi)

NOTE:

- Make sure no air comes out of the opposite side of the fuel pump.
- To eliminate any gaps between the fuel pump valves and the fuel pump body, and to ensure a better seal, make sure the inside of the fuel pump is wet (i.e., with gas).

CHAPTER 5

POWER UNIT

FLYWHEEL MAGNET ASSEMBLY

5-1

REMOVING/INSTALLING THE FLYWHEEL MAGNET ASSEMBLY

5-1

REMOVING THE FLYWHEEL MAGNET ASSEMBLY

5-2

INSTALLING THE FLYWHEEL MAGNET ASSEMBLY

5-3

POWER UNIT

5-4

DISCONNECTING/CONNECTING THE CONTROL CABLE

5-4

DISCONNECTING/CONNECTING THE LEADS

5-6

REMOVING/INSTALLING THE POWER UNIT

5-8

STATOR COIL ASSEMBLY

5-9

REMOVING/INSTALLING THE STATOR COIL ASSEMBLY.....

5-9

TIMING BELT

5-10

REMOVING/INSTALLING THE TIMING BELT

5-10

REMOVING THE DRIVEN SPROCKET

5-12

REMOVING/INSTALLING THE DRIVE SPROCKET.....

5-12

INSTALLING THE DRIVEN SPROCKET.....

5-13

INSTALLING THE TIMING BELT

5-13

IGNITION COILS AND STARTER MOTOR.....

5-14

REMOVING/INSTALLING THE IGNITION COILS AND
STARTER MOTOR.....

5-14

ECM AND JUNCTION BOX ASSEMBLY.....

5-15

REMOVING/INSTALLING THE CDI UNIT AND
JUNCTION BOX ASSEMBLY

5-15

DISASSEMBLING/ASSEMBLING THE JUNCTION BOX
ASSEMBLY.....

5-18

CYLINDER HEAD COVER.....

5-20

REMOVING/INSTALLING THE CYLINDER HEAD COVER

5-20

CAMSHAFTS

5-21

REMOVING/INSTALLING THE CAMSHAFTS.....

5-21

CHECKING THE CAMSHAFT.....

5-22

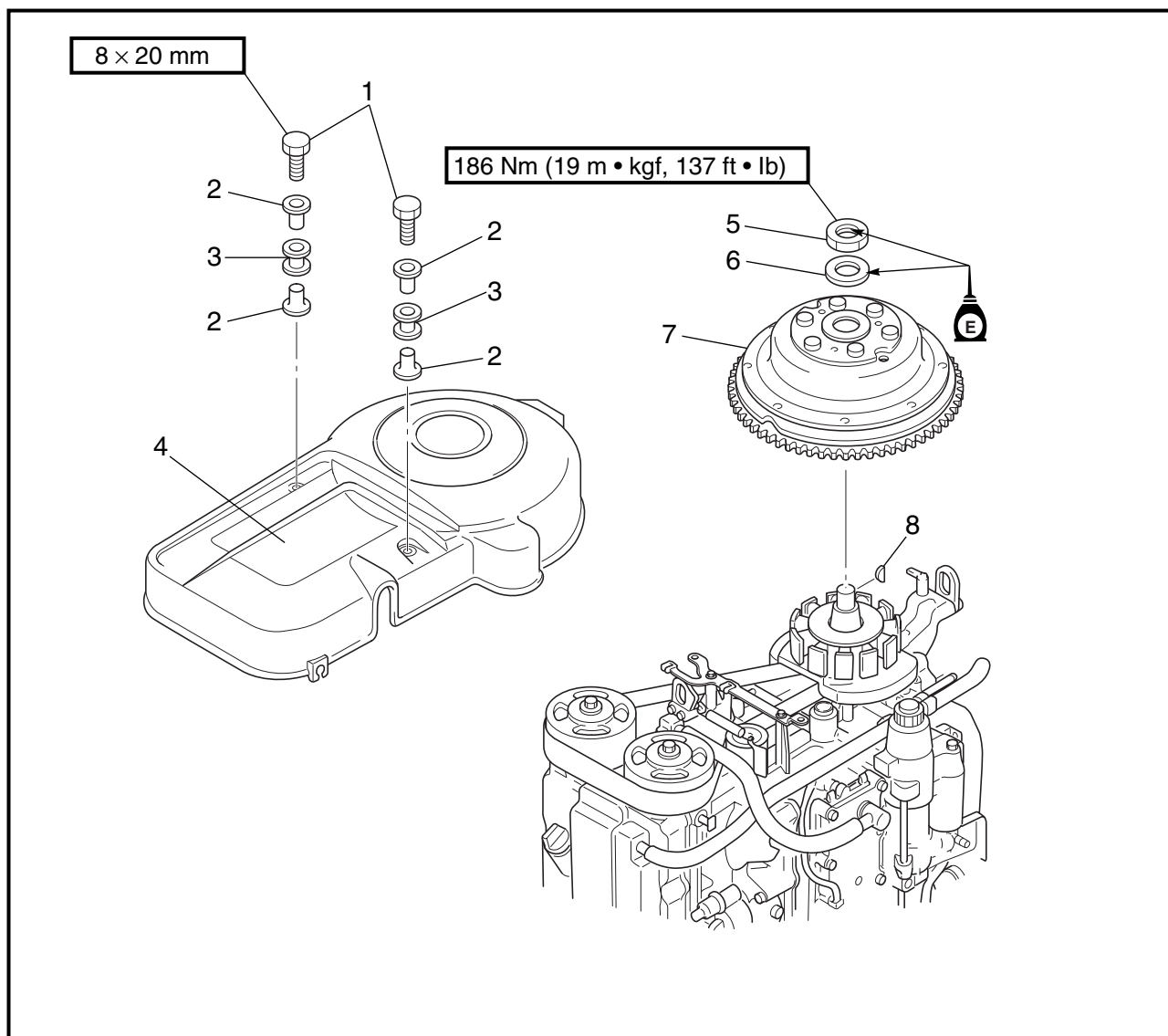
INSTALLING THE CAMSHAFT.....

5-22

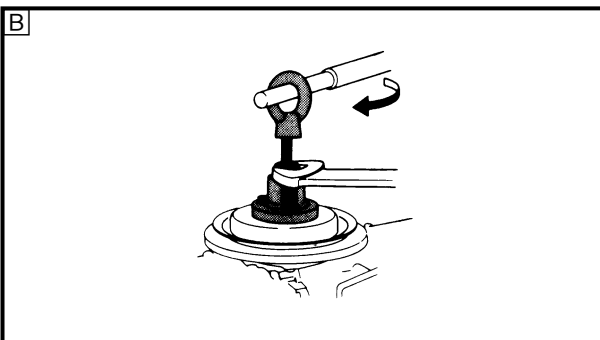
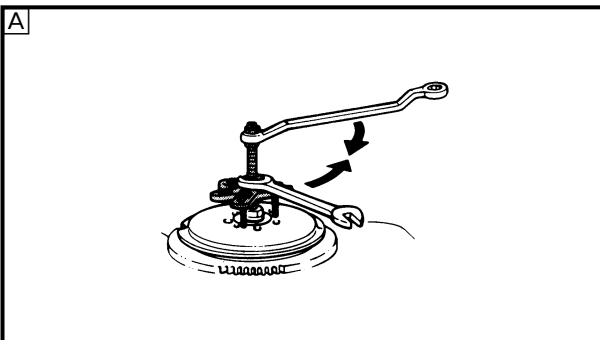
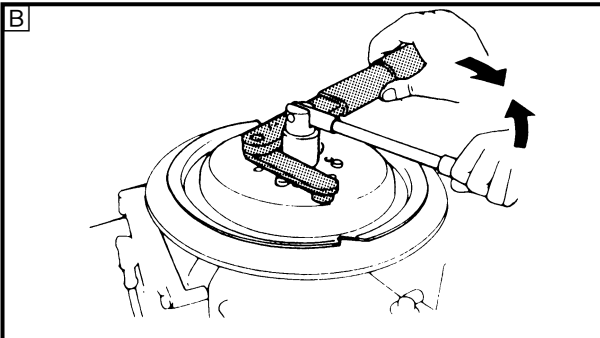
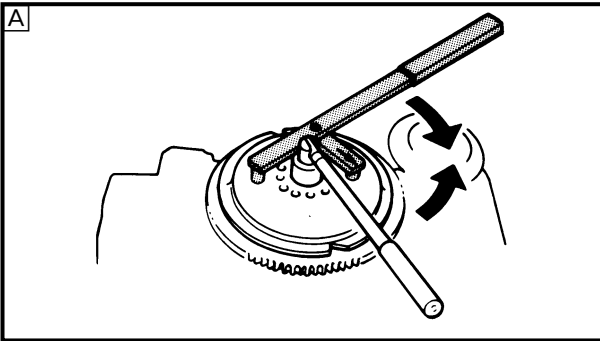
CYLINDER HEAD ASSEMBLY	5-23
REMOVING/INSTALLING THE CYLINDER HEAD ASSEMBLY.....	5-23
CHECKING THE THERMOSTAT	5-25
 VALVES.....	 5-26
REMOVING/INSTALLING THE VALVES	5-26
CHECKING THE VALVE	5-28
CHECKING THE VALVE SPRING.....	5-29
CHECKING THE CYLINDER HEAD	5-29
CHECKING THE VALVE GUIDE	5-29
CHECKING THE VALVE SEAT	5-30
INSTALLING THE VALVE	5-31
 OIL FILTER AND EXHAUST COVER.....	 5-32
REMOVING/INSTALLING THE OIL FILTER AND EXHAUST COVER..	5-32
INSTALLING THE OIL FILTER	5-35
 CRANKSHAFT AND PISTON/CONNECTING ROD ASSEMBLY.....	 5-36
REMOVING/INSTALLING THE CRANKSHAFT AND PISTON/ CONNECTING ROD ASSEMBLY.....	5-36
CHECKING THE CYLINDER BLOCK	5-38
CHECKING THE PISTON.....	5-38
CALCULATING THE PISTON-TO-CYLINDER CLEARANCE.....	5-39
CHECKING THE PISTON RING.....	5-39
CHECKING THE CRANKSHAFT.....	5-40
CHECKING THE MAIN-BEARING OIL CLEARANCE	5-40
CHECKING THE CONNECTING ROD BIG-END OIL CLEARANCE.....	5-43
INSTALLING THE PISTON RING.....	5-46
INSTALLING THE PISTON.....	5-47

FLYWHEEL MAGNET ASSEMBLY

REMOVING/INSTALLING THE FLYWHEEL MAGNET ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Bolt	2	For installation, reverse the removal procedure.
2	Collar	4	
3	Grommet	2	
4	Flywheel cover	1	
5	Flywheel magnet nut	1	
6	Washer	1	
7	Flywheel magnet assembly	1	
8	Woodruff key	1	



CAUTION:

The major load should be applied in the direction of the arrows. If the load is not applied as shown, the flywheel holder may easily slip off.

REMOVING THE FLYWHEEL MAGNET ASSEMBLY

1. Remove:

- Flywheel magnet assembly nut



Flywheel magnet assembly holder
YB-06139 / 90890-06522

A For USA and Canada

B For worldwide

2. Remove:

- Flywheel magnet assembly



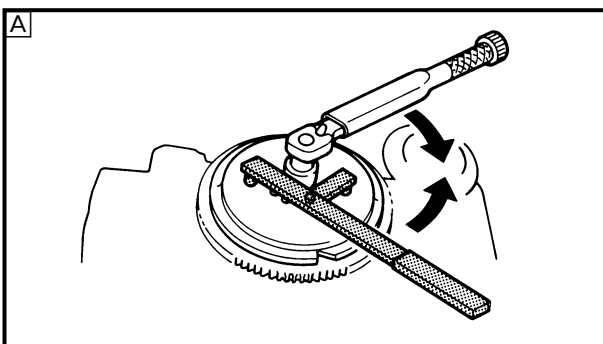
Universal puller
YB-06117 / 90890-06521

A For USA and Canada

B For worldwide

CAUTION:

- Keep the nut side flush with the crankshaft end until the flywheel magnet assembly comes off the tapered portion of the crankshaft.
- To prevent damage to the engine or tools, screw in the universal-puller set-bolts evenly and completely so that the universal-puller plate is parallel to the flywheel magnet assembly.



INSTALLING THE FLYWHEEL MAGNET ASSEMBLY

Install:

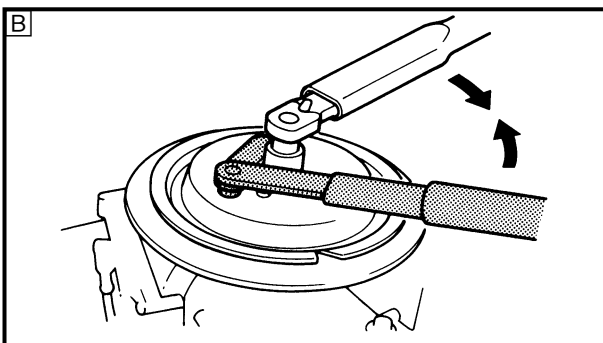
- Flywheel magnet assembly nut



Flywheel magnet assembly holder
YB-06139 / 90890-06522

A For USA and Canada

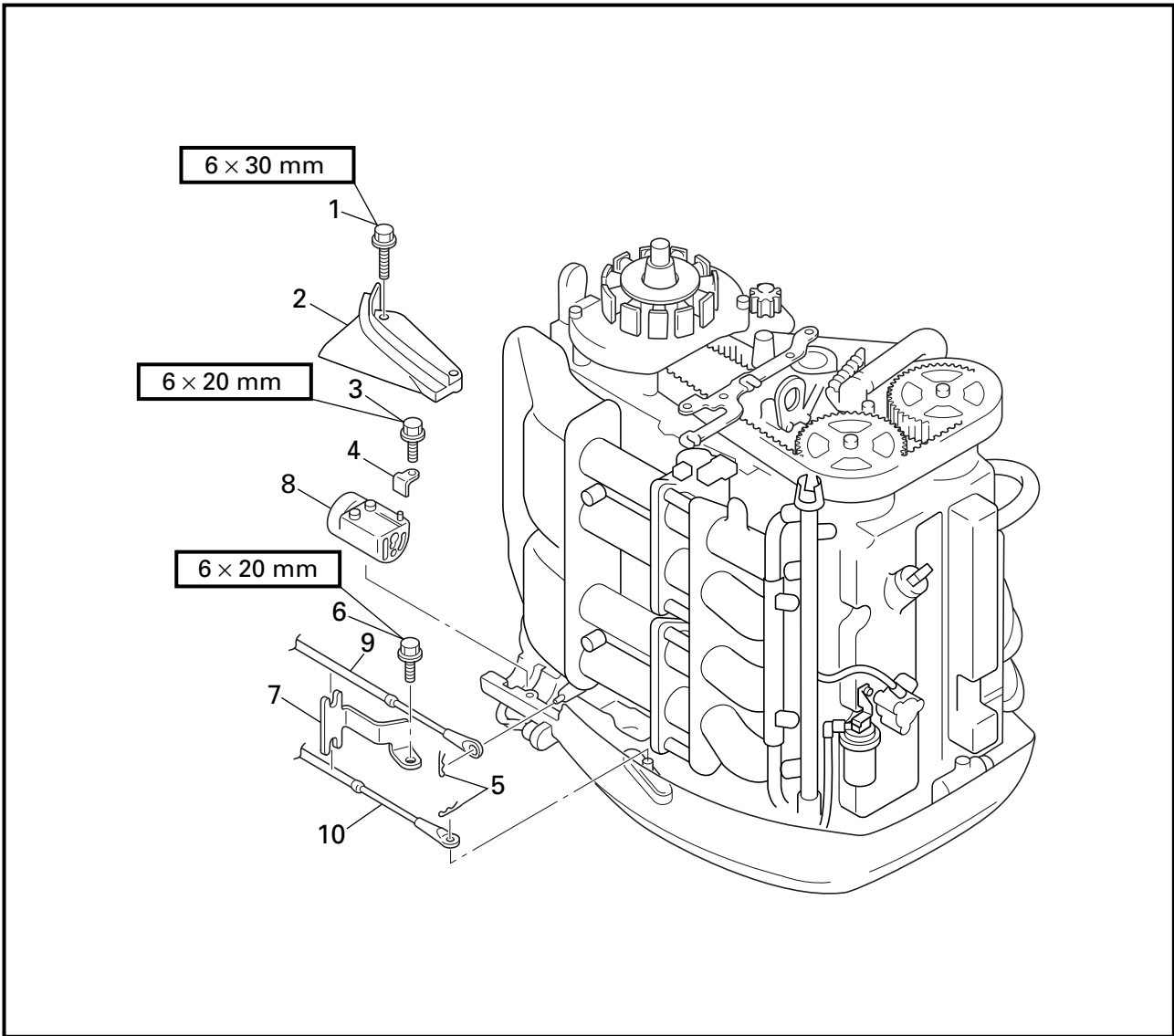
B For worldwide



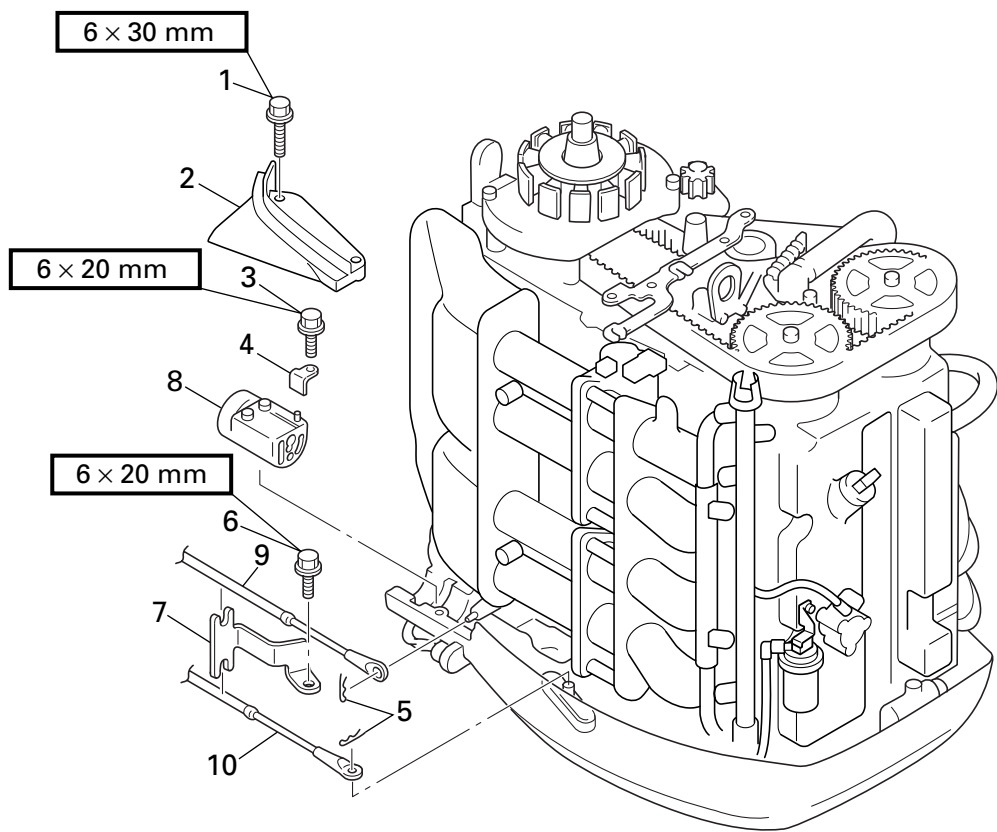
Flywheel magnet assembly nut
186 Nm (19.0 m • kgf, 137 ft • lb)

POWER UNIT

DISCONNECTING/CONNECTING THE CONTROL CABLE

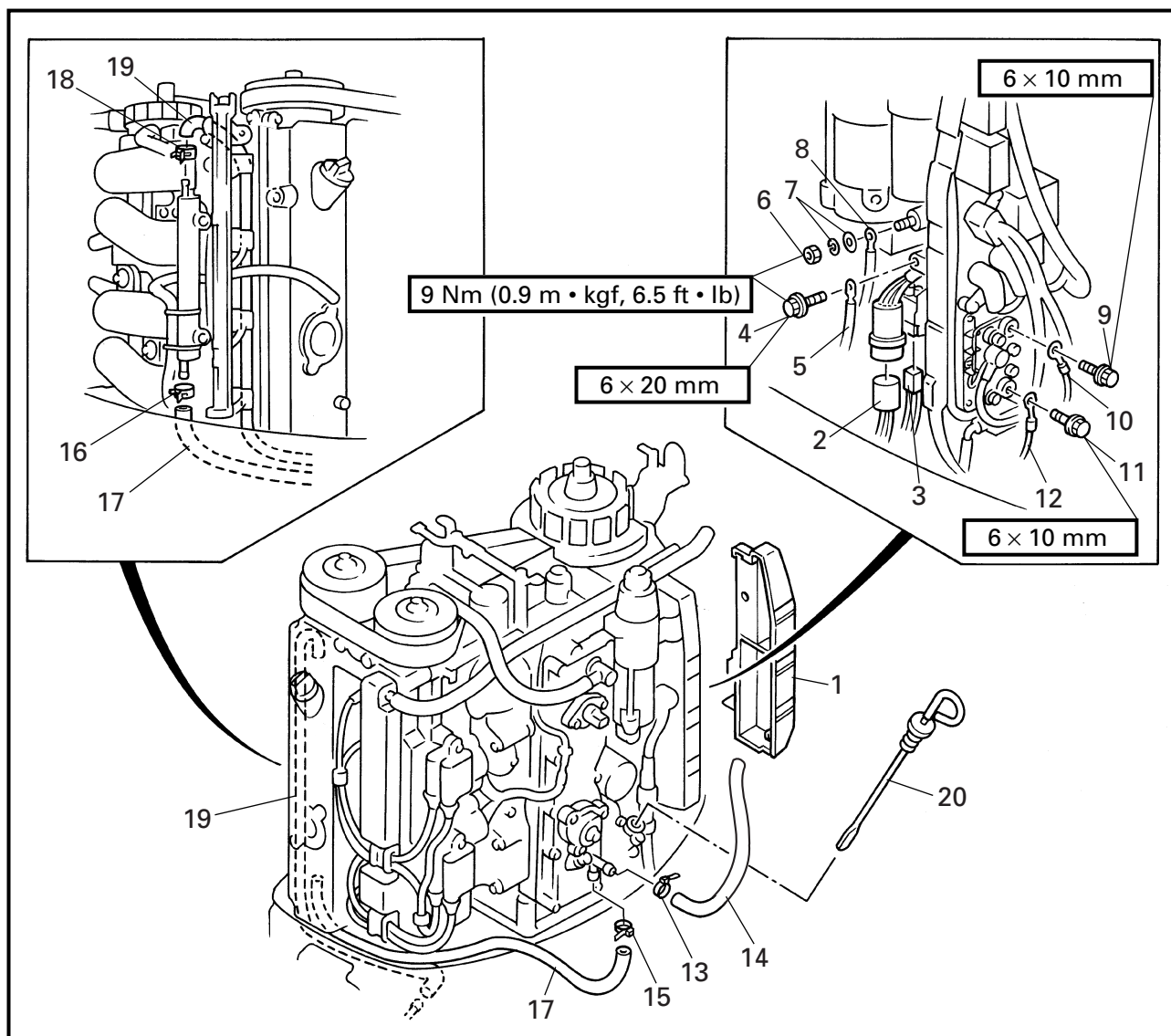


Order	Job/Part	Q'ty	Remarks
	Battery leads		Disconnect the leads form the battery terminals. Refer to "LOW-PRESSURE FUEL LINE" on page 4-26.
	Low-pressure fuel line		
1	Bolt	2	
2	Grommet retaining plate	1	
3	Bolt	1	
4	Hose locating plate	1	
5	Clip	2	
			Continued on next page.

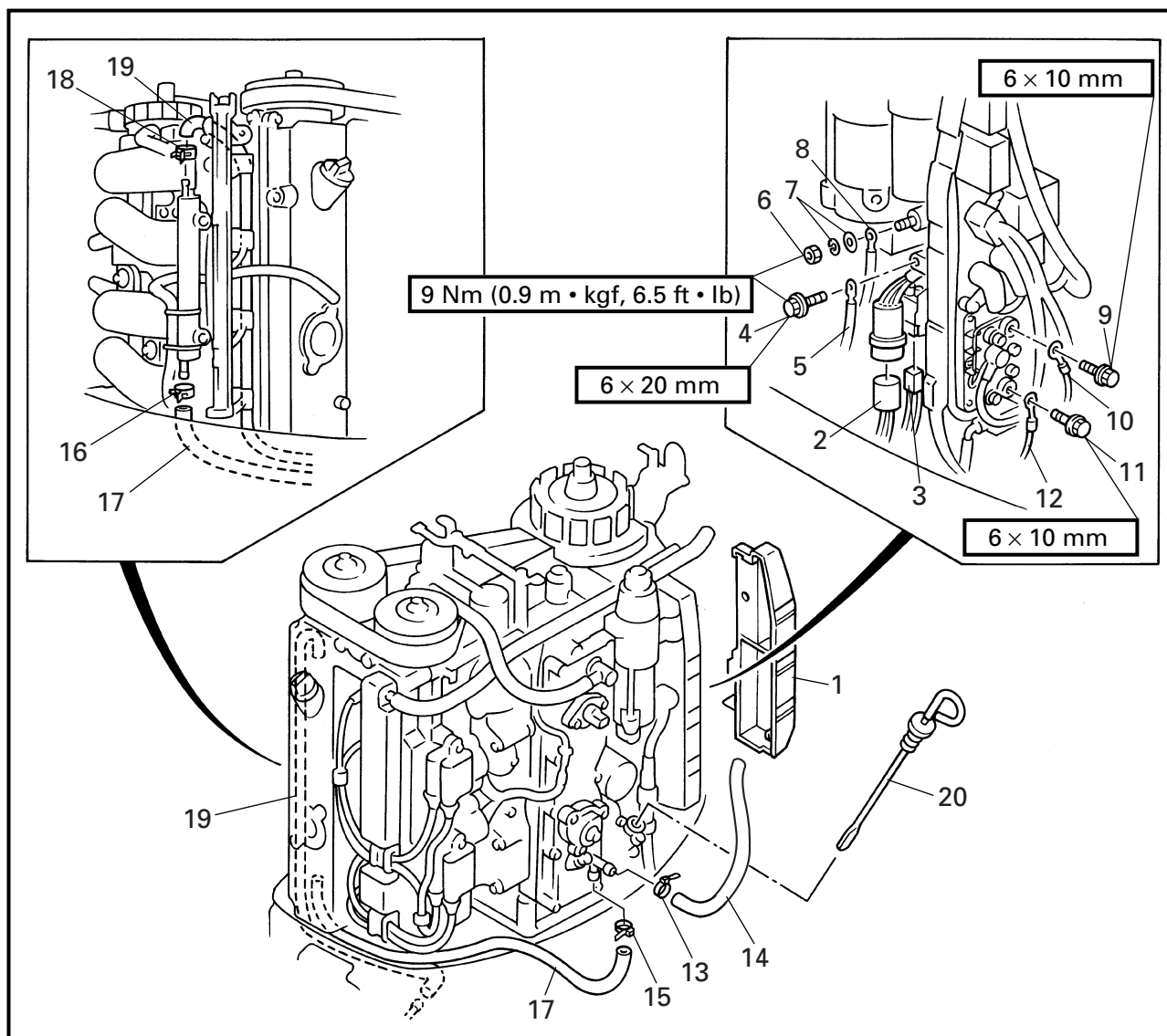


Order	Job/Part	Q'ty	Remarks
6	Bolt	1	For installation, reverse the removal procedure.
7	Cable clamp	1	
8	Grommet	1	
9	Throttle control cable	1	
10	Shift control cable	1	

DISCONNECTING/CONNECTING THE LEADS

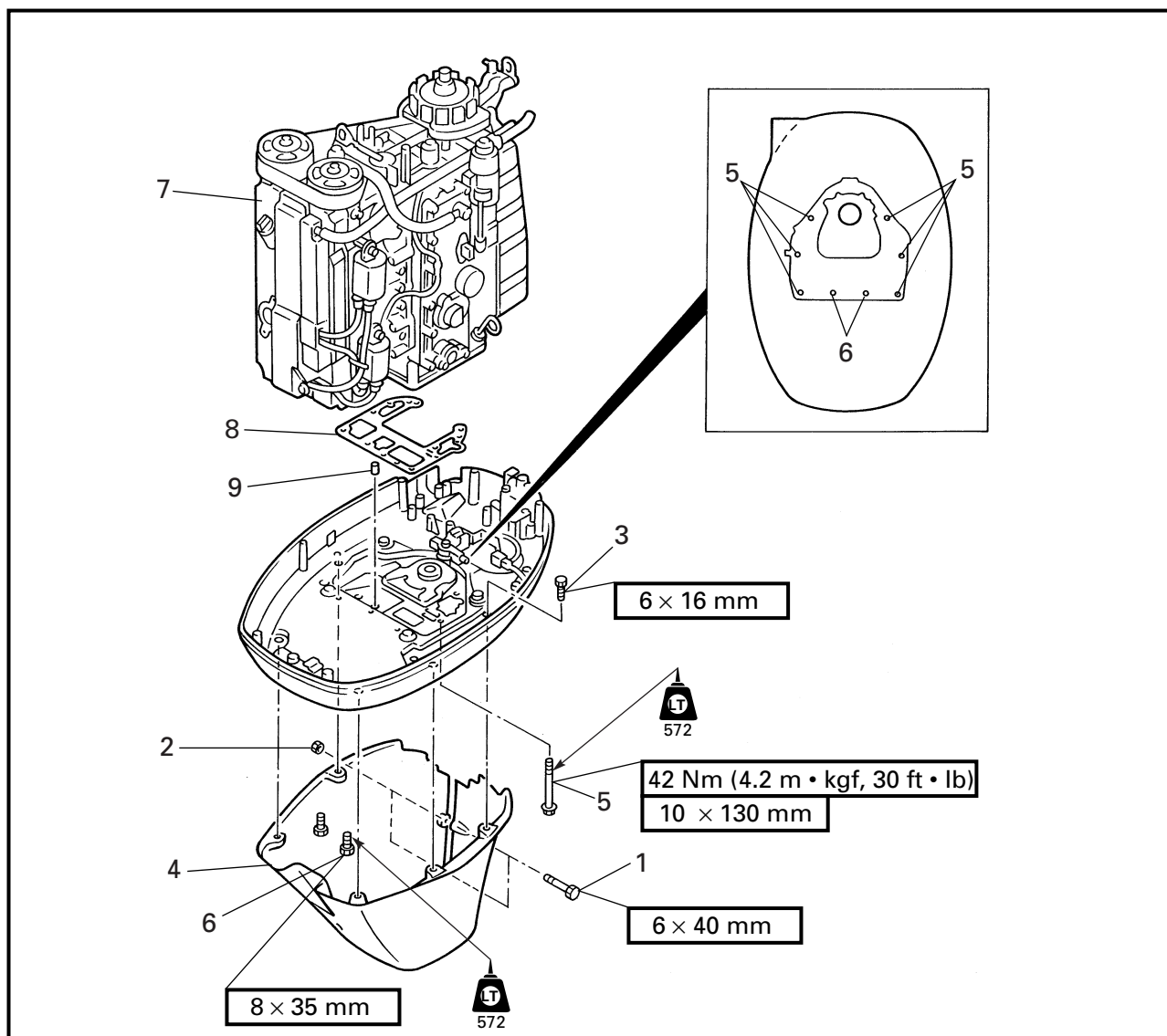


Order	Job/Part	Q'ty	Remarks
1	Junction box cover	1	For the remote control box.
2	Wire harness coupler	1	
3	Warning lamp coupler	1	
4	Bolt	1	
5	Negative battery lead	1	
6	Nut	1	
7	Washer	2	
8	Positive battery lead	1	
9	Bolt	1	
10	PTT motor lead (sky blue)	1	
11	Bolt	1	
			Continued on next page.



Order	Job/Part	Q'ty	Remarks
12	PTT motor lead (light green)	1	
13	Plastic locking tie	1	Not reusable
14	Flushing water hose	1	(exhaust cover-to-hose joint)
15	Plastic locking tie	1	Not reusable
16	Hose clamp	1	
17	Pilot water hose	1	(fuel cooler-to-exhaust cover)
18	Hose clamp	1	
19	Pilot water hose	1	(fuel cooler-to-water outlet)
20	Oil level dipstick	1	
			For installation, reverse the removal procedure.

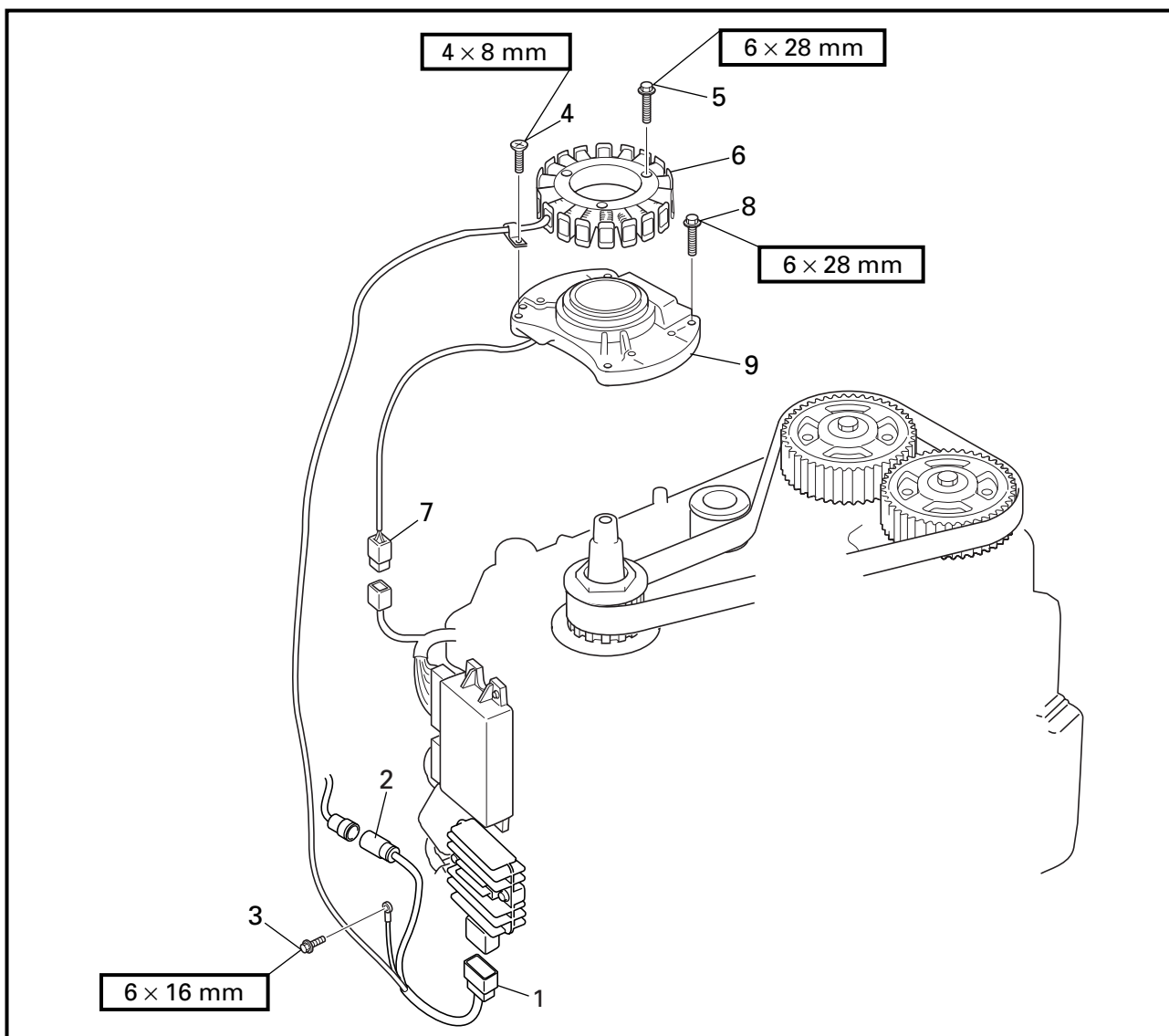
REMOVING/INSTALLING THE POWER UNIT



Order	Job/Part	Q'ty	Remarks
1	Bolt	2	Not reusable For installation, reverse the removal procedure.
2	Nut	2	
3	Bolt	5	
4	Apron	1	
5	Bolt	6	
6	Bolt	2	
7	Power unit	1	
8	Gasket	1	
9	Dowel pin	2	

STATOR COIL ASSEMBLY

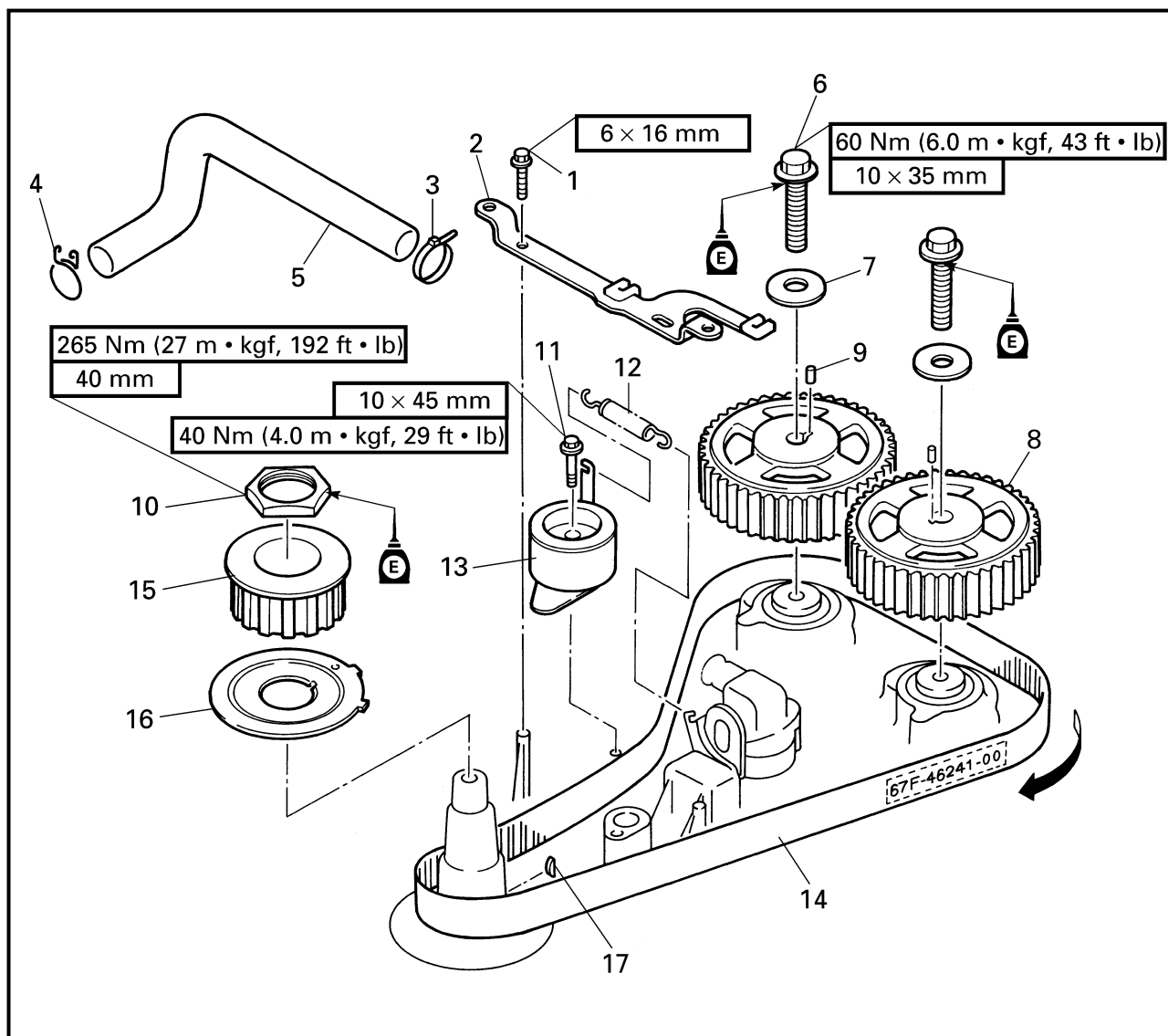
REMOVING/INSTALLING THE STATOR COIL ASSEMBLY



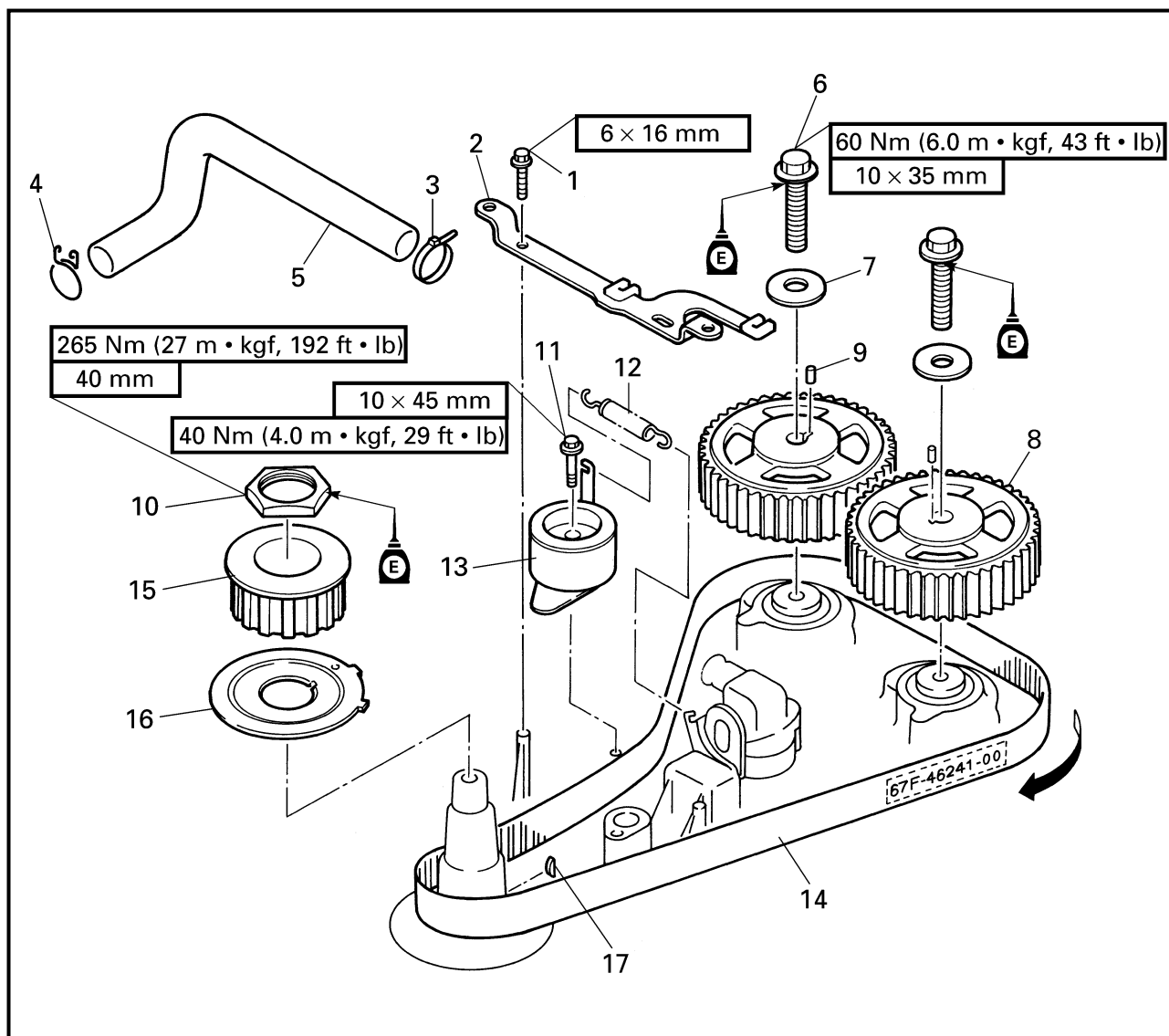
Order	Job/Part	Q'ty	Remarks
	Flywheel magnet assembly		Refer to "FLYWHEEL MAGNET ASSEMBLY" on page 5-1.
1	Stator coil coupler	1	
2	Rectifier/regulator connector	1	
3	Bolt	1	
4	Screw	1	
5	Bolt	3	
6	Lighting coil assembly	1	
7	Pulser coil connector	1	
8	Bolt	4	
9	Base	1	
			For installation, reverse the removal procedure.

TIMING BELT

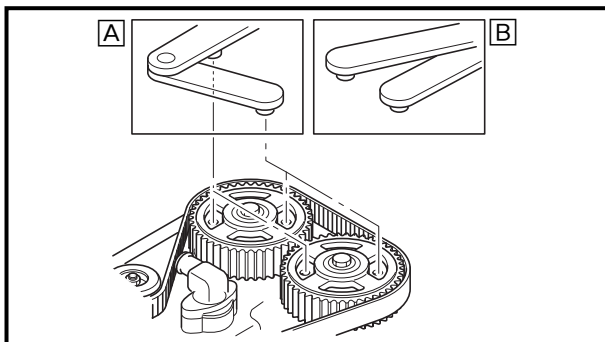
REMOVING/INSTALLING THE TIMING BELT



Order	Job/Part	Q'ty	Remarks
	Stator coil assembly		Refer to "STATOR COIL ASSEMBLY" on page 5-9.
1	Bolt	2	Not reusable
2	Flywheel cover bracket	1	
3	Plastic locking tie	1	
4	Hose clamp	1	
5	Hose	1	
6	Driven sprocket bolt	2	
7	Washer	2	
8	Driven sprocket	2	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
9	Pin	2	
10	Drive sprocket nut	1	
11	Bolt	1	
12	Spring	1	
13	Timing belt tensioner	1	
14	Timing belt	1	
15	Drive sprocket	1	
16	Pick-up rotor	1	
17	Woodruff key	1	
			For installation, reverse the removal procedure.



REMOVING THE DRIVEN SPROCKET

CAUTION:

Make sure cylinder #1's position is at TDC before removal.

Remove:

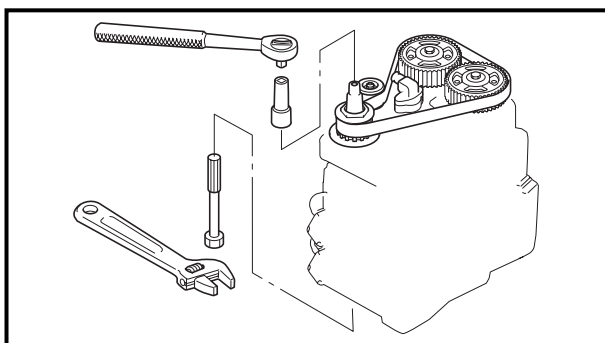
- Bolt



Flywheel magnet assembly holder
YB-06139 / 90890-06522

A For USA and Canada

B For worldwide



REMOVING/INSTALLING THE DRIVE SPROCKET

1. Remove:

- Nut



Crankshaft holder
YB-06552 / 90890-06552

NOTE:

A deep socket (●: 46 mm, 76 mm deep) is required for this service.

2. Install:

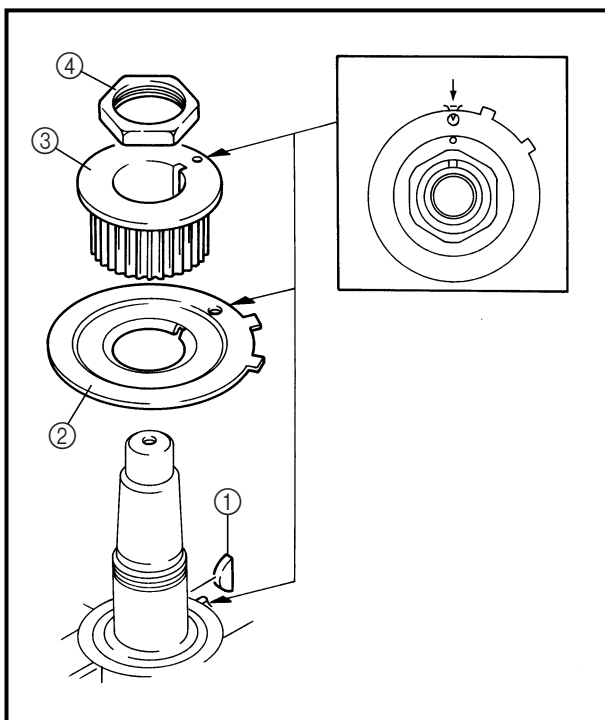
- Woodruff key ①
- Pick-up rotor ②
- Drive sprocket ③
- Drive sprocket nut ④

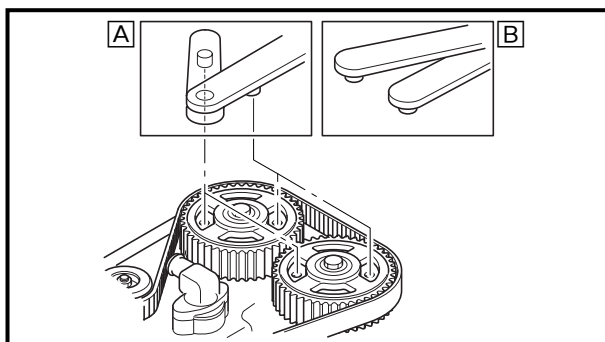


Drive sprocket nut
265 Nm (27.0 m • kgf, 192 ft • lb)



Crankshaft holder
YB-06552 / 90890-06552





INSTALLING THE DRIVEN SPROCKET

Install:

- Driven sprocket bolt



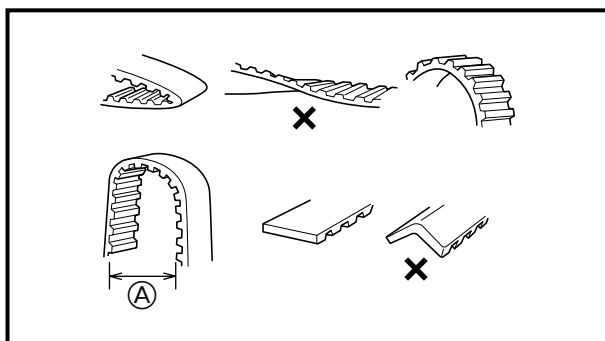
Driven sprocket bolt
60 Nm (6.0 m • kgf, 43 ft • lb)



Flywheel magnet assembly holder
YB-06139 / 90890-06522

A For USA and Canada

B For worldwide



INSTALLING THE TIMING BELT

CAUTION:

- Never forcefully twist, turn inside out, or bend the timing belt.
- Do not let oil or grease get onto the timing belt.
- Ⓐ Minimum 25 mm (1.0 in)

Install:

- Timing belt
- Tensioner

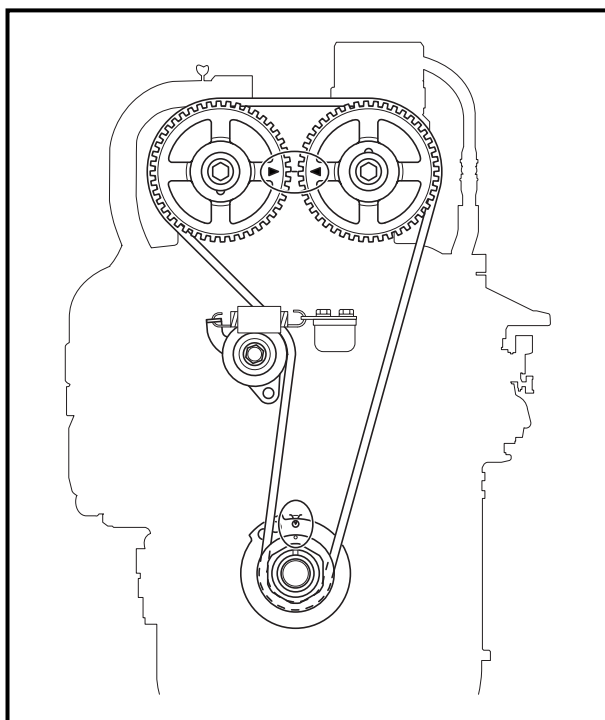
Installation steps

- (1) Align $\varnothing 6$ hole on the pickup rotor with the notch in the cylinder block.
- (2) Align the marks "▼" on the driven sprockets with the top edge of the cylinder head.
- (3) Install the timing belt onto the driven sprockets and drive sprocket.
- (4) Install the tensioner.



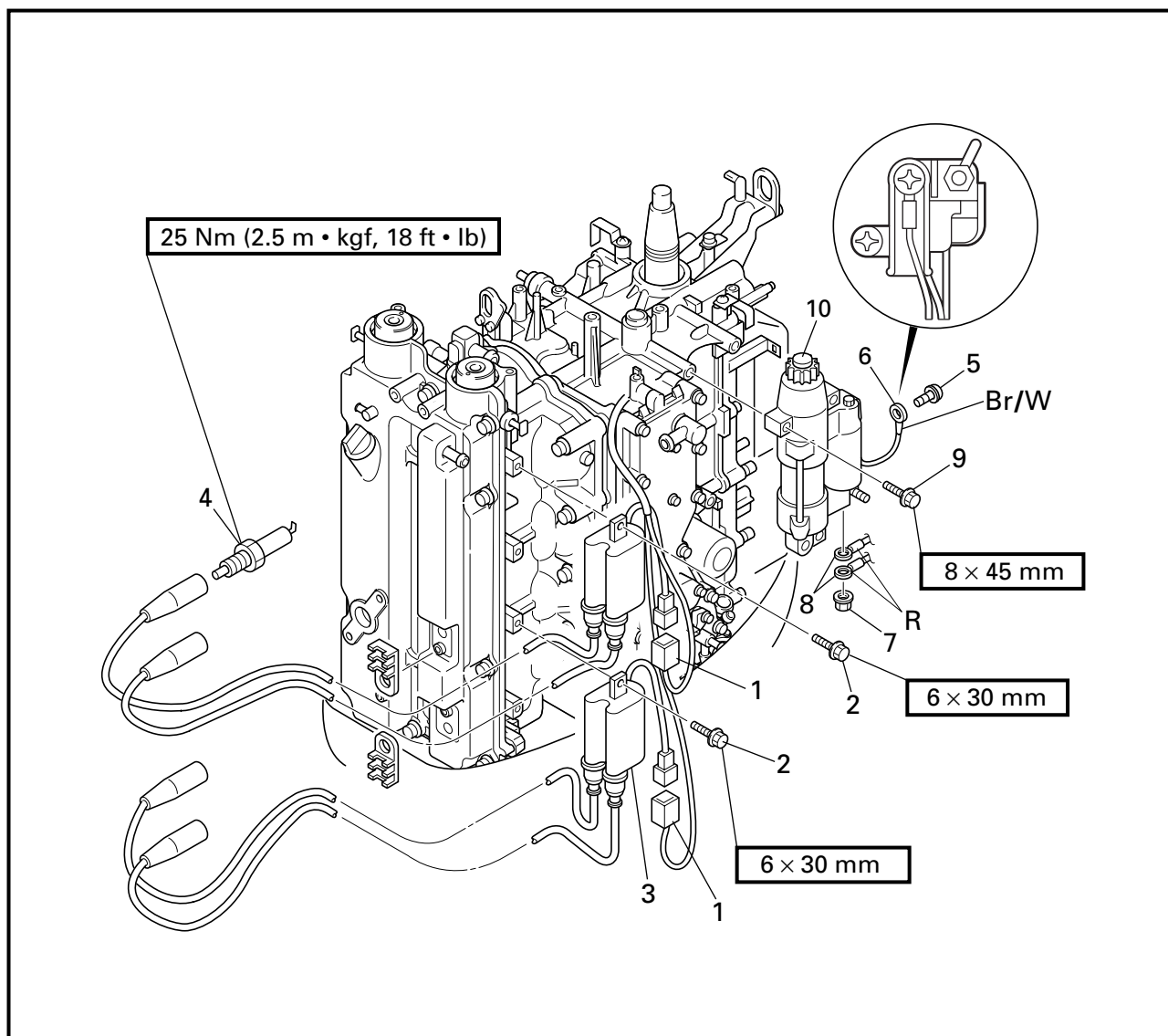
Tensioner bolt
40 Nm (4.0 m • kgf, 29 ft • lb)

- (5) Turn the crankshaft clockwise two times and make sure the drive sprocket and driven sprockets are correctly aligned with the marks.



IGNITION COILS AND STARTER MOTOR

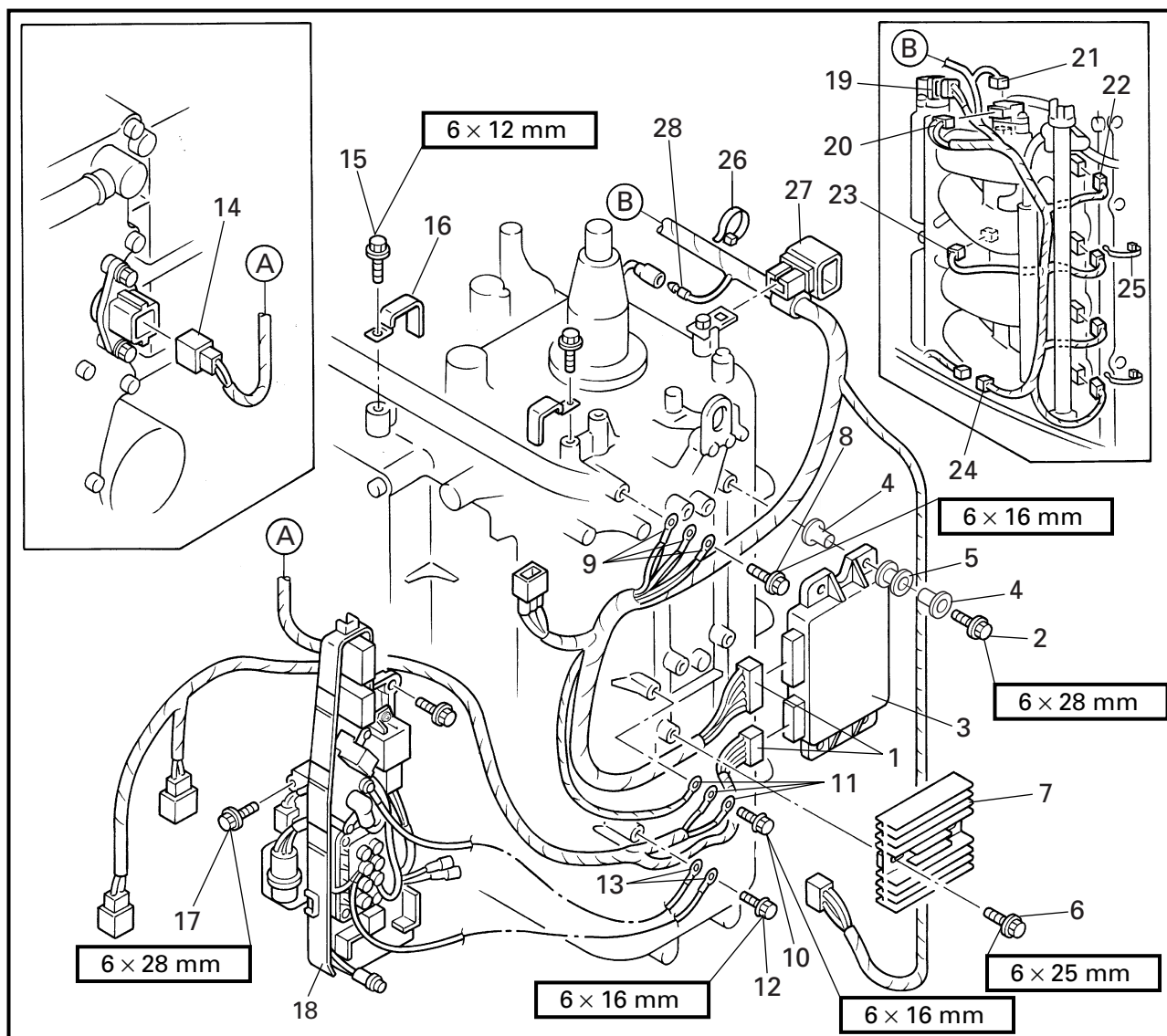
REMOVING/INSTALLING THE IGNITION COILS AND STARTER MOTOR



Order	Job/Part	Q'ty	Remarks
1	Ignition coil coupler	2	For installation, reverse the removal procedure.
2	Bolt	4	
3	Ignition coil	2	
4	Spark plug	4	
5	Screw	1	
6	Relay (magnetic switch) lead	1	
7	Nut	1	
8	Wire harness lead	2	
9	Bolt	3	
10	Starter motor	1	

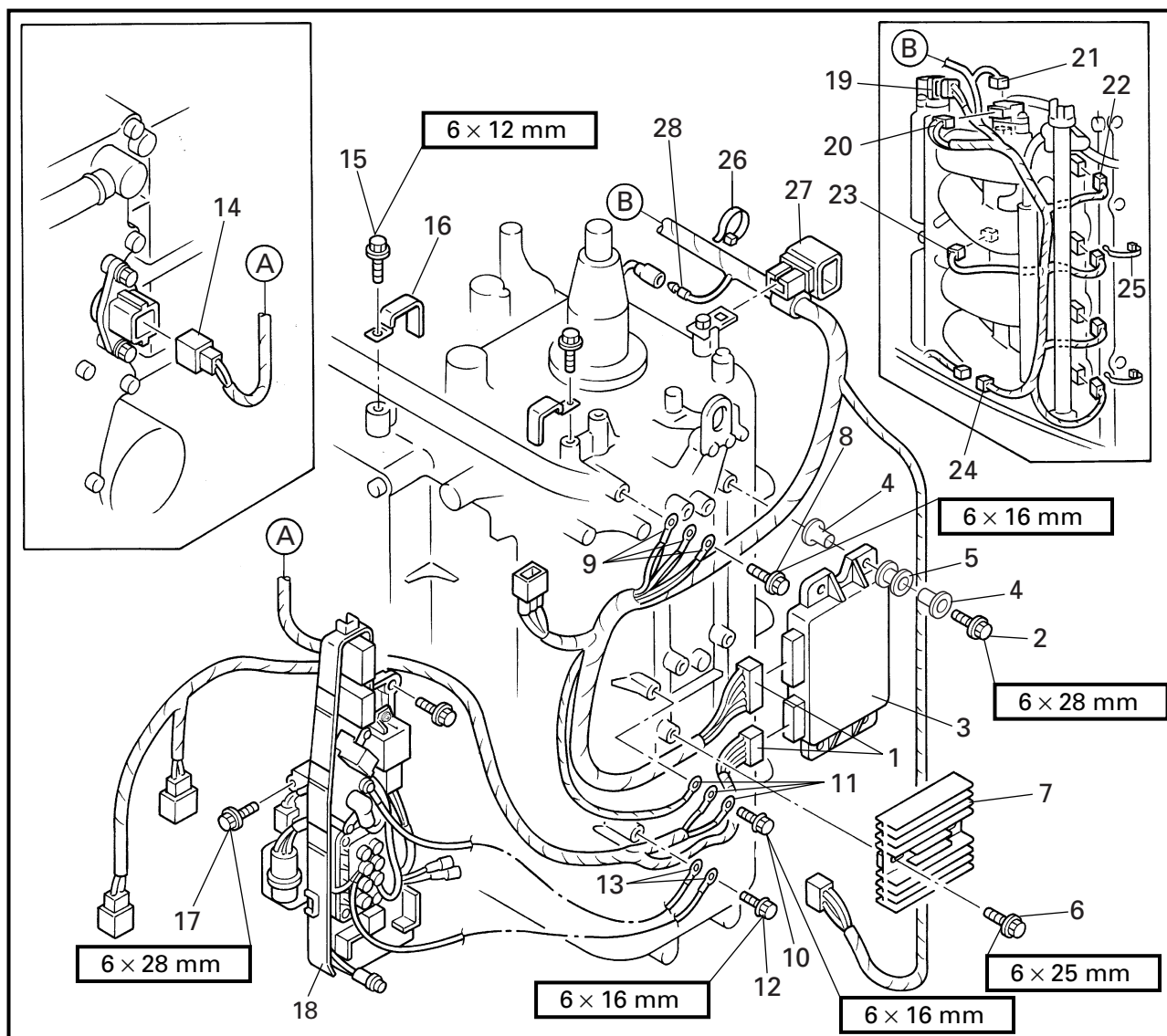
ECM AND JUNCTION BOX ASSEMBLY

REMOVING/INSTALLING THE CDI UNIT AND JUNCTION BOX ASSEMBLY



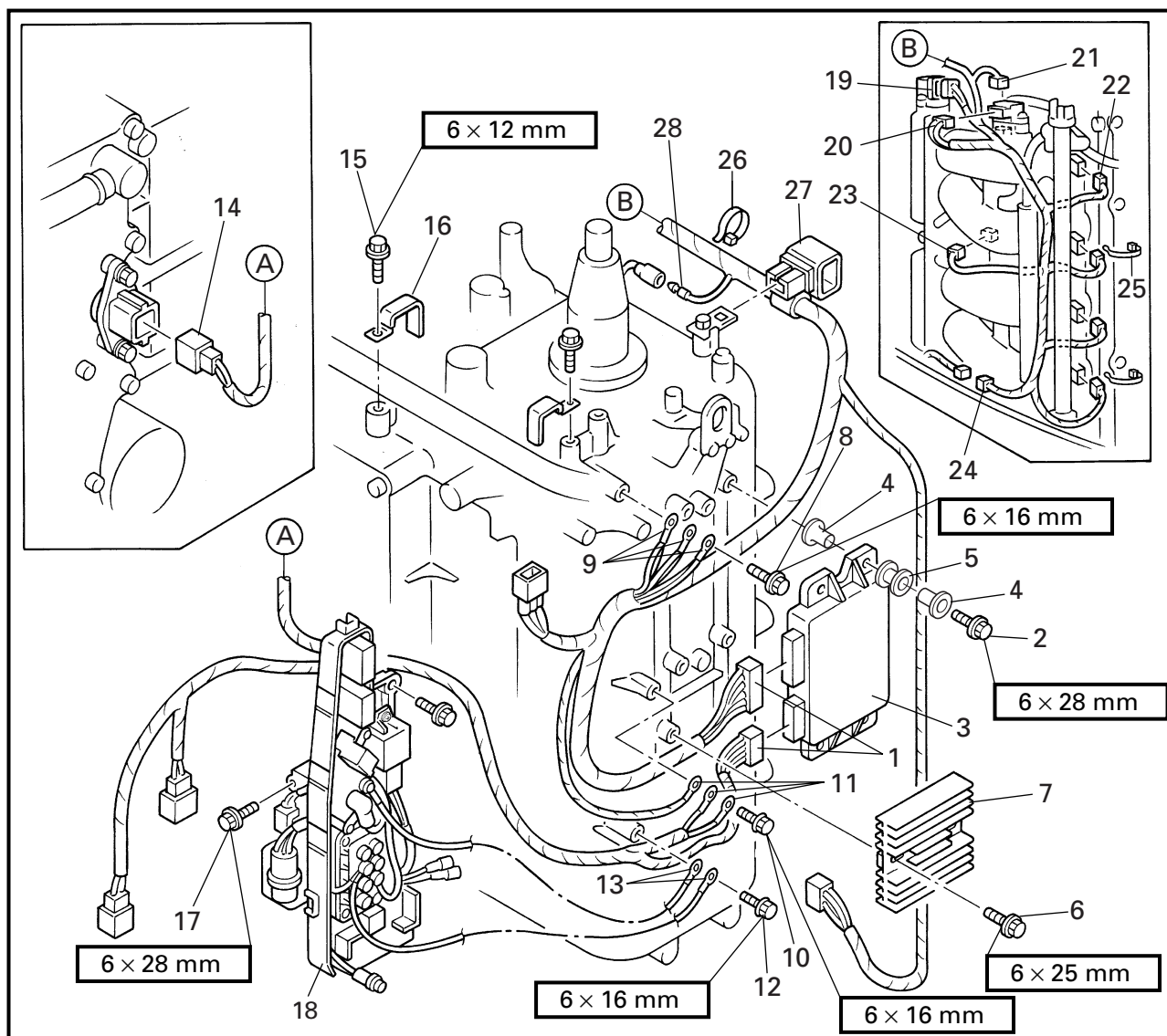
Order	Job/Part	Q'ty	Remarks
1	ECM coupler	2	
2	Bolt	4	
3	ECM	1	
4	Collar	8	
5	Grommet	1	
6	Bolt	2	
7	Rectifier/regulator	1	
8	Bolt	1	
9	Ground lead	2	
10	Bolt	1	
11	Ground lead	3	

Continued on next page.



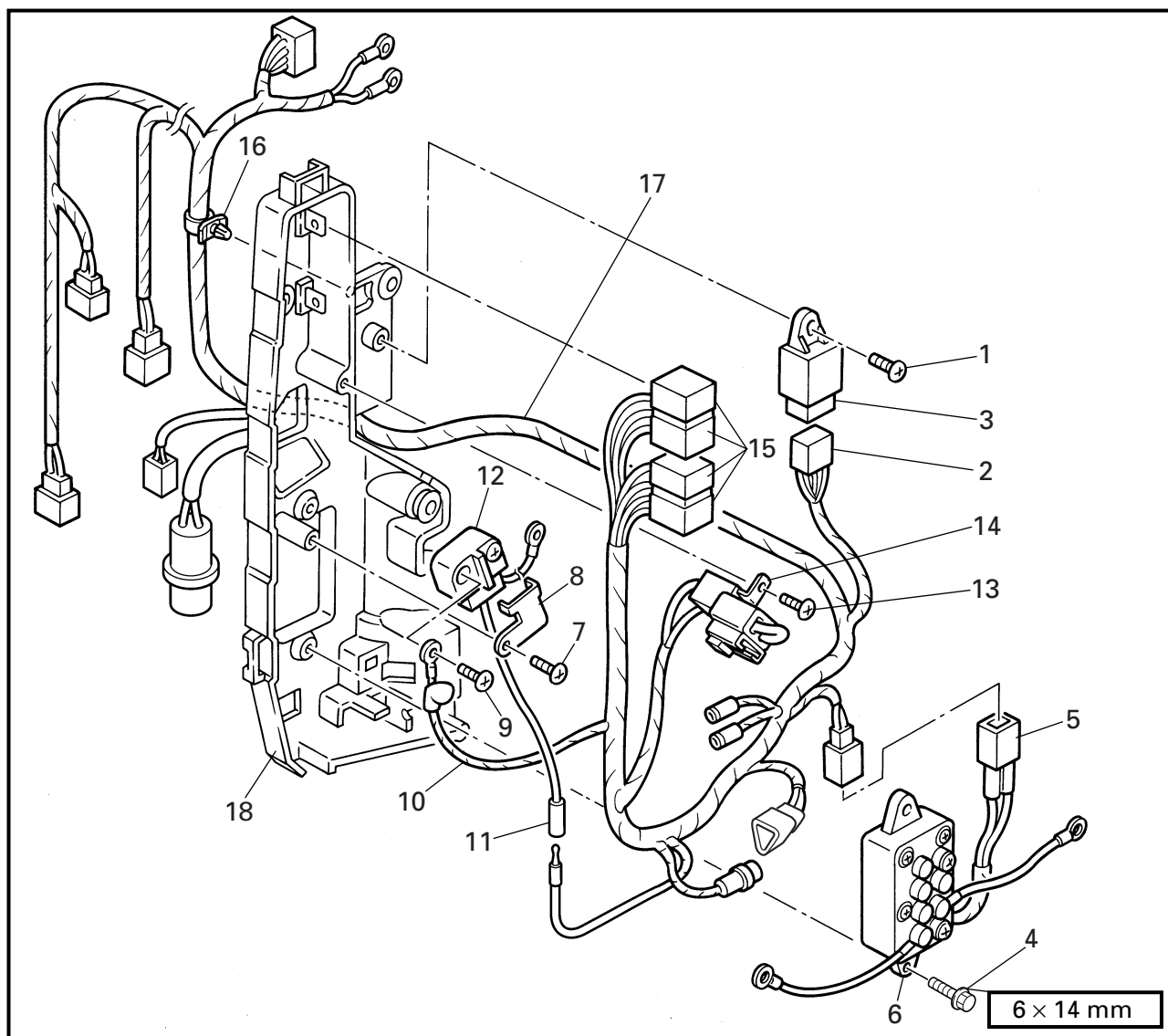
Order	Job/Part	Q'ty	Remarks
12	Bolt	1	
13	Ground lead	2	
14	Water temperature sensor coupler	1	
15	Bolt	2	
16	Clamp	2	
17	Bolt	5	
18	Junction box assembly	1	
19	Throttle position sensor coupler	1	
20	Intake air pressure sensor coupler	1	

Continued on next page.

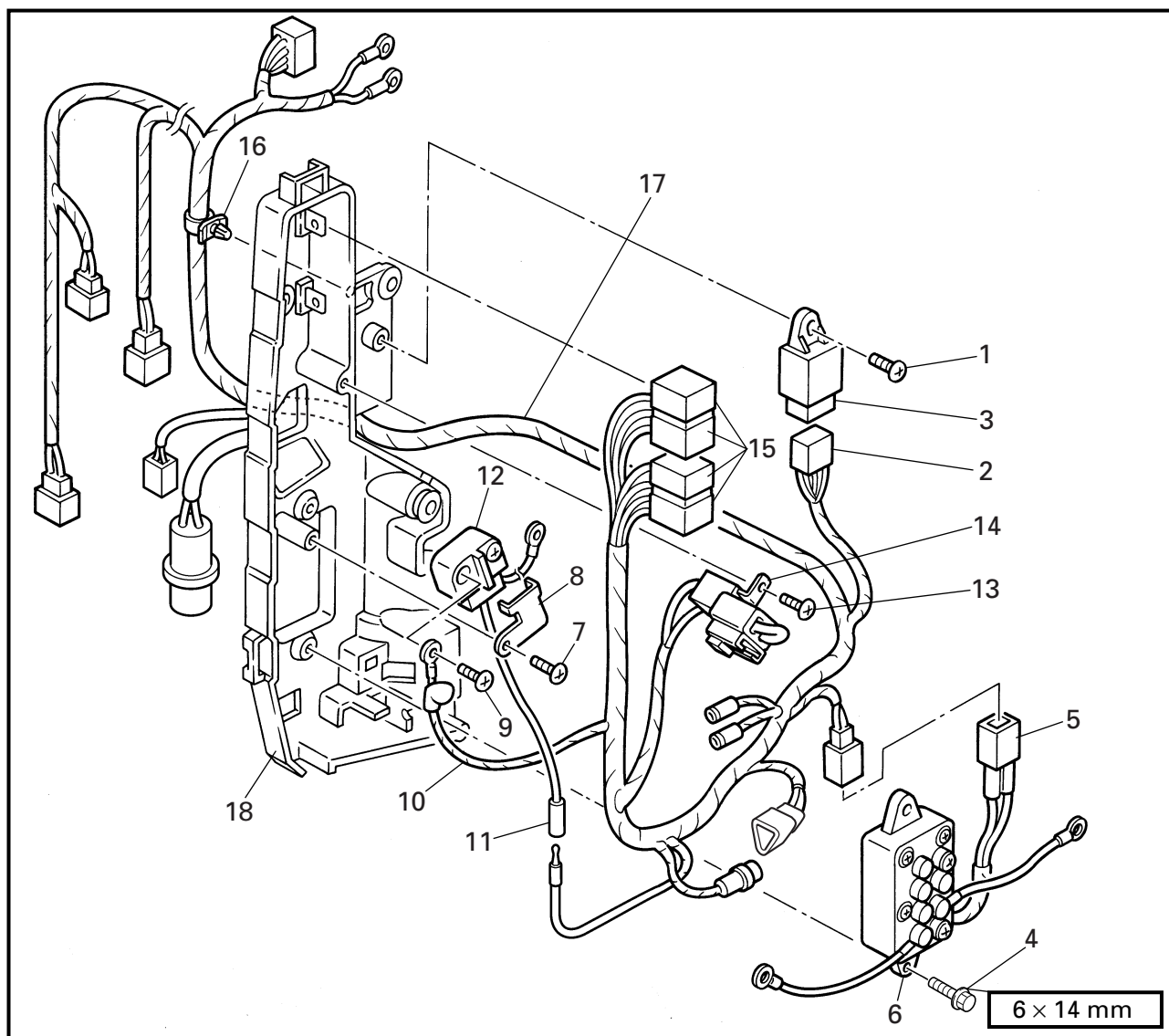


Order	Job/Part	Q'ty	Remarks
21	Idle speed control valve coupler	1	Not reusable Not reusable For installation, reverse the removal procedure.
22	Fuel injectors coupler	4	
23	High-pressure fuel pump coupler	1	
24	Shift position switch coupler	1	
25	Plastic locking tie	1	
26	Plastic locking tie	1	
27	Connector	1	
28	Oil pressure switch coupler	1	

DISASSEMBLING/ASSEMBLING THE JUNCTION BOX ASSEMBLY



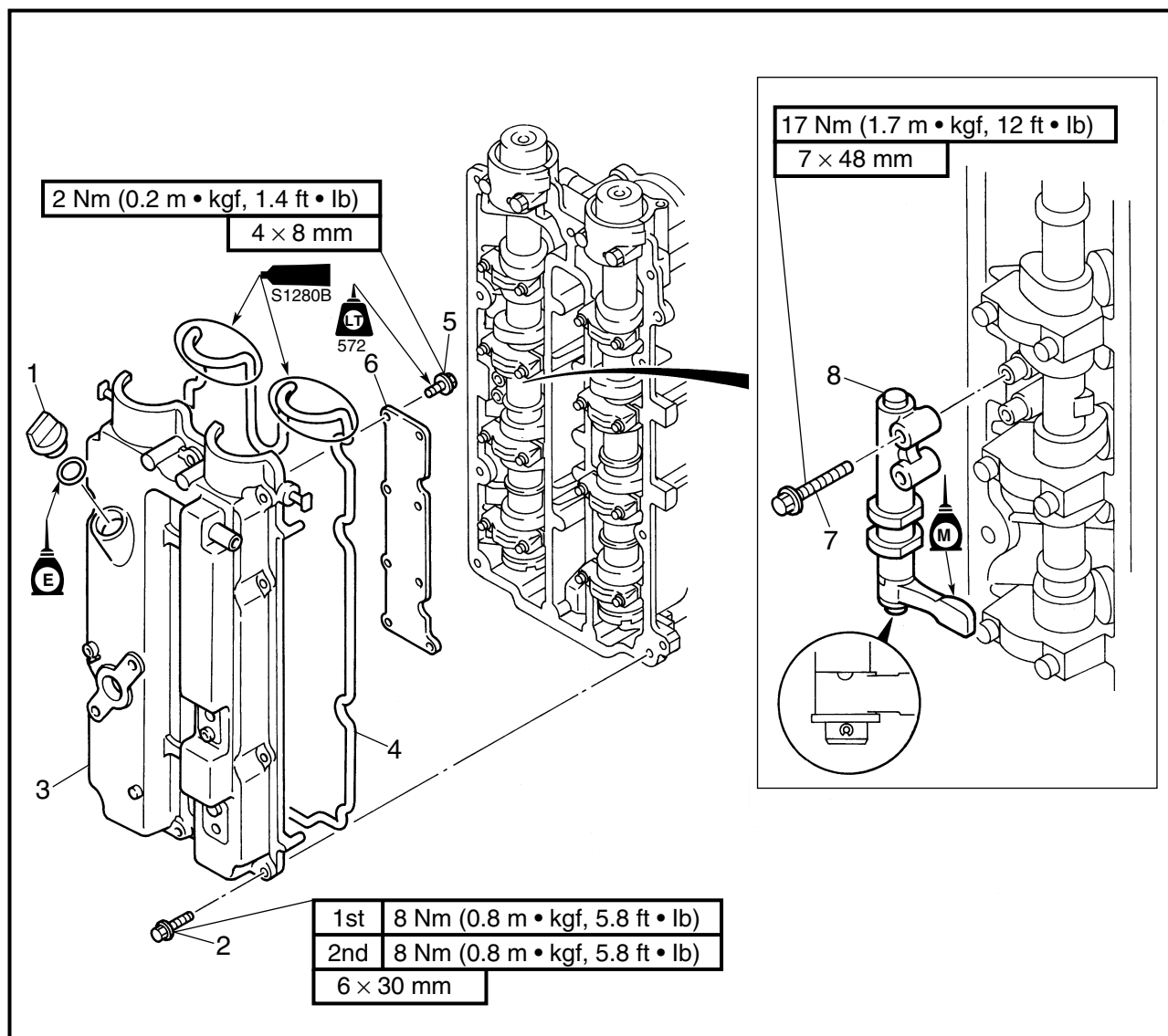
Order	Job/Part	Q'ty	Remarks
1	Screw	1	
2	Main relay coupler	1	
3	Main relay	1	
4	Bolt	2	
5	PTT relay coupler	1	
6	PTT relay	1	
7	Screw	1	
8	Plate	1	
9	Screw	1	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
10	Positive battery lead	1	For assembly, reverse the disassembly procedure.
11	Starter relay coupler	1	
12	Starter relay	1	
13	Screw	1	
14	Diagnostic coupler	1	
15	Fuse holder	4	
16	Clip	1	
17	Wire harness	1	
18	Junction box	1	

CYLINDER HEAD COVER

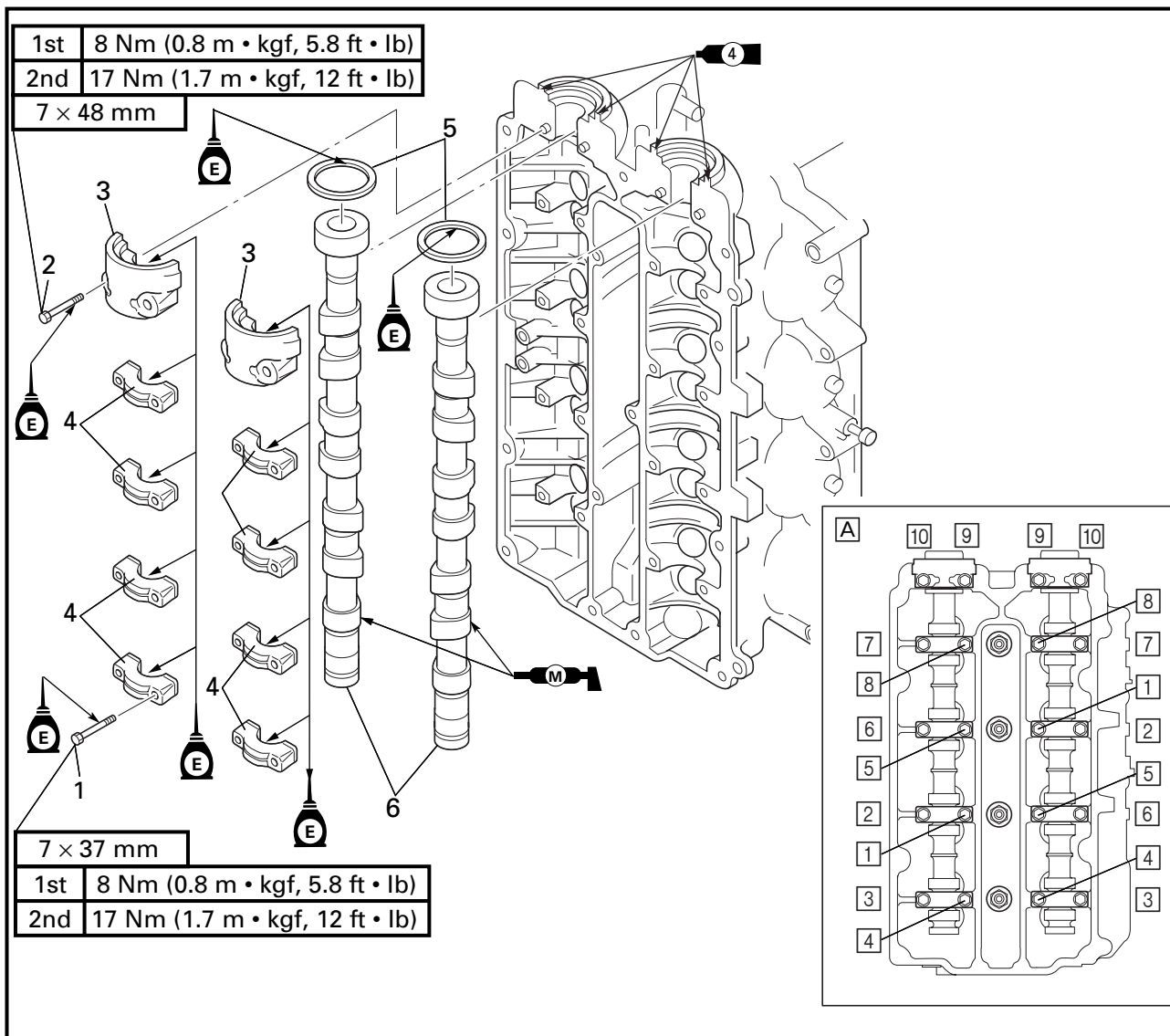
REMOVING/INSTALLING THE CYLINDER HEAD COVER



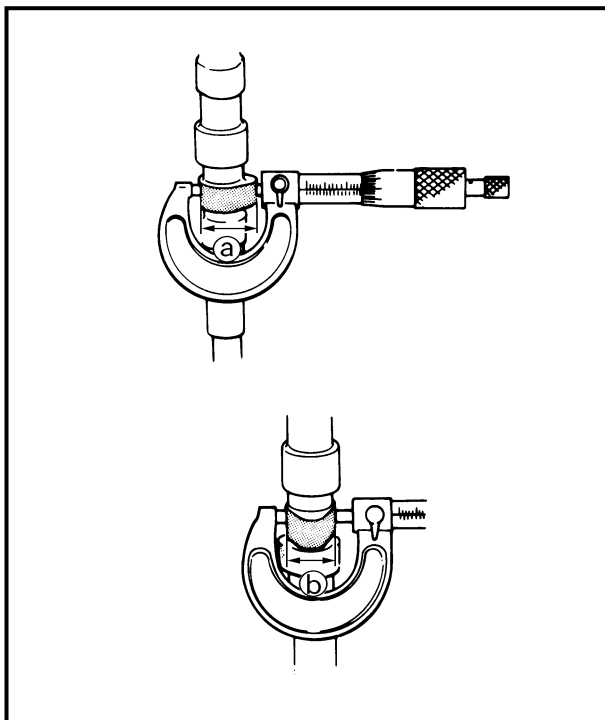
Order	Job/Part	Q'ty	Remarks
	Timing belt and driven sprockets		Refer to "TIMING BELT" on page 5-10.
1	Oil filler cap	1	
2	Bolt	14	
3	Cylinder head cover	1	
4	Rubber gasket	1	
5	Screw	8	
6	Breather cover	1	
7	Bolt	2	
8	Fuel pump bracket assembly	1	
			For installation, reverse the removal procedure.

CAMSHAFTS

REMOVING/INSTALLING THE CAMSHAFTS



Order	Job/Part	Q'ty	Remarks
	Cylinder head cover		Refer to "CYLINDER HEAD COVER" on page 5-20.
1	Bolt	16	
2	Bolt	4	
3	Camshaft cap	2	
4	Camshaft cap	8	
5	Oil seal	2	
6	Camshaft	2	
			For installation, reverse the removal procedure.



CHECKING THE CAMSHAFT

1. Measure:

- Camshaft lobe dimensions ① and ②
- Out of specification → Replace the camshaft.



Camshaft lobe dimension

- ① IN: 37.22 - 37.38 mm (1.465 - 1.472 in)
- ② IN: 29.92 - 30.08 mm (1.178 - 1.184 in)
- ① EX: 36.90 - 37.06 mm (1.453 - 1.459 in)
- ② EX: 29.92 - 30.08 mm (1.178 - 1.184 in)

2. Measure:

- Camshaft journal diameter ③
- Camshaft cap inside diameter ④
- Out of specification → Replace the camshaft or cylinder head.

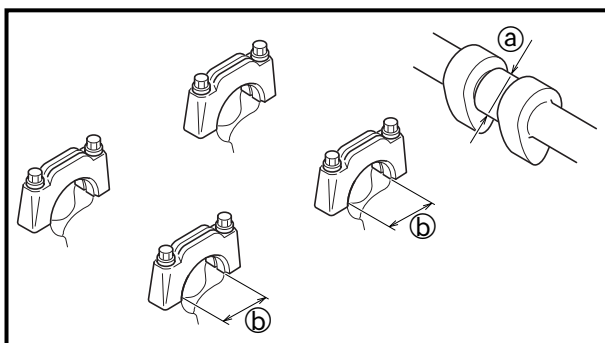


Camshaft journal diameter

- ③: 24.96 - 24.98 mm (0.9827 - 0.9835 in)

Camshaft cap inside diameter

- ④: 25.000 - 25.021 mm (0.984 - 0.985 in)



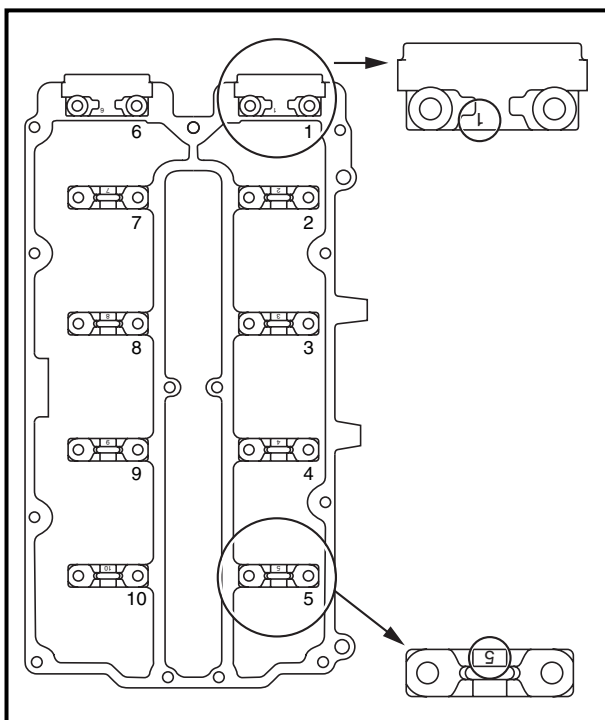
INSTALLING THE CAMSHAFT

Install:

- Camshaft
- Camshaft cap

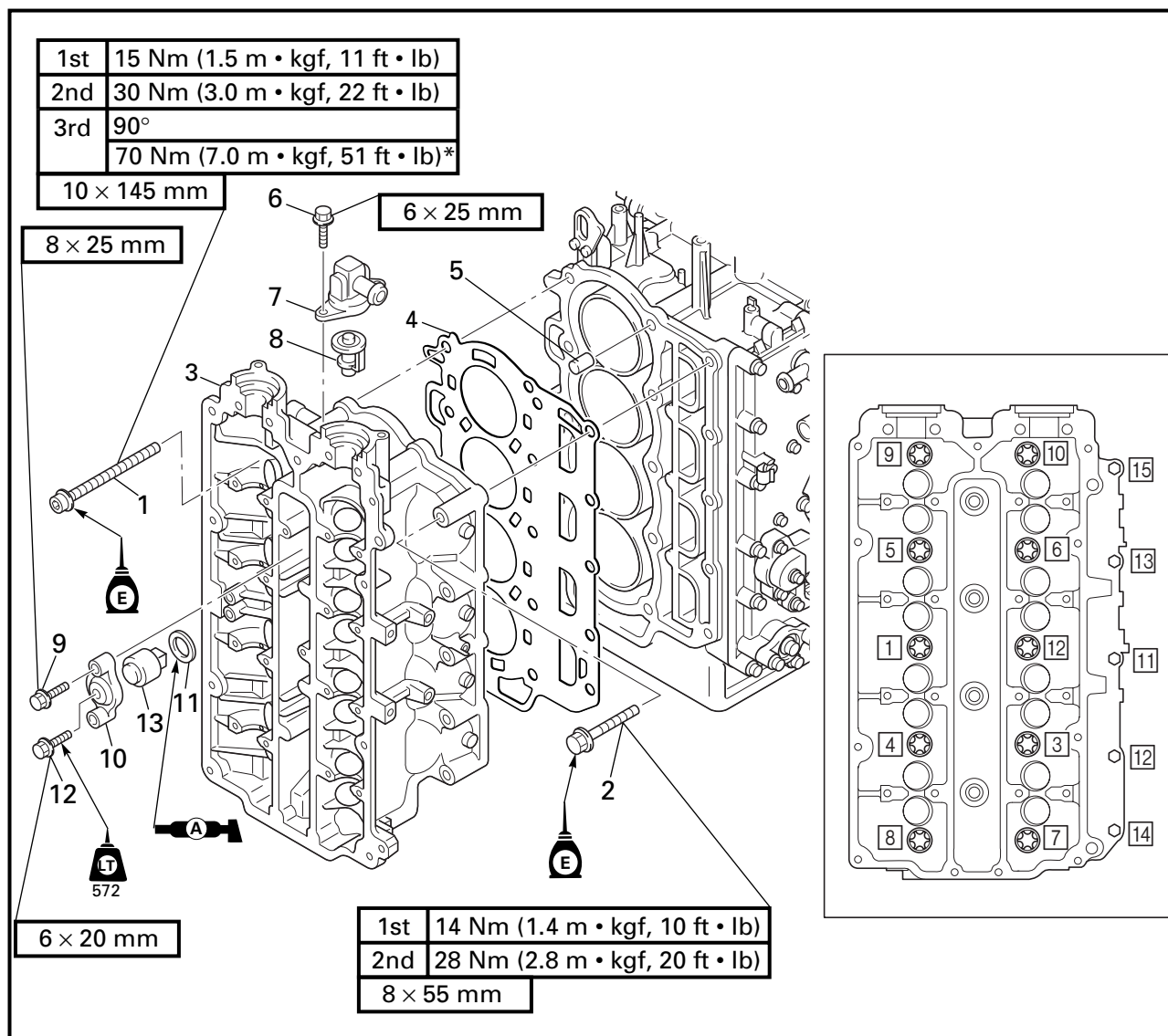
Installation steps

- (1) Before installing the exhaust and intake camshafts, turn the crankshaft until cylinder #1's piston is at TDC on the compression stroke.
- (2) Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.



CYLINDER HEAD ASSEMBLY

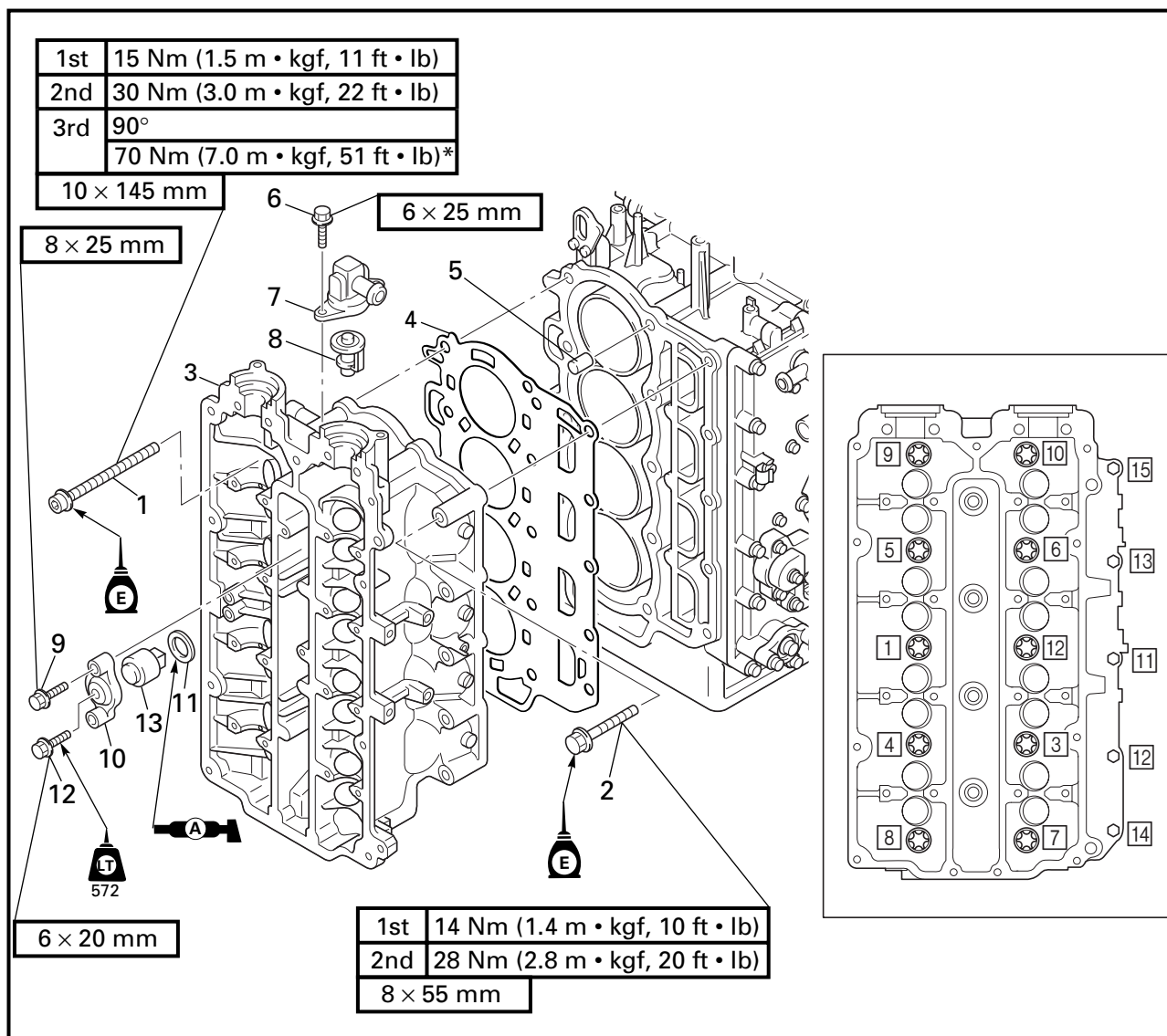
REMOVING/INSTALLING THE CYLINDER HEAD ASSEMBLY



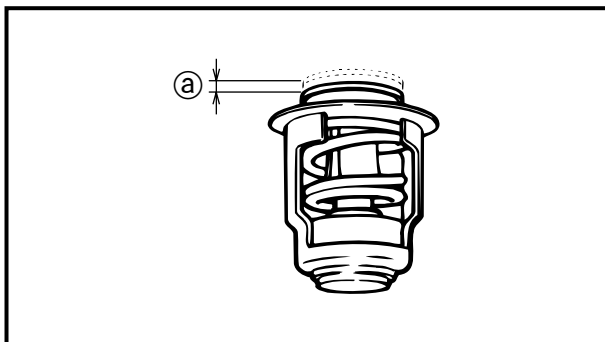
Order	Job/Part	Q'ty	Remarks
	Camshafts Intake assembly		Refer to "CAMSHAFTS" on page 5-21. Refer to "INTAKE ASSEMBLY" on page 4-3.
1	Bolt (1.5 mm thread pitch)	10	
2	Bolt	5	
3	Cylinder head assembly	1	
4	Gasket	1	Not reusable
5	Dowel pin	2	

Continued on next page.

*: Torque value (for reference only)



Order	Job/Part	Q'ty	Remarks
6	Bolt	2	
7	Thermostat cover	1	
8	Thermostat	1	
9	Bolt	4	
10	Anode cover	2	
11	O-ring	2	
12	Bolt	2	
13	Anode	2	
For installation, reverse the removal procedure.			

**CHECKING THE THERMOSTAT**

1. Check:

- Thermostat

Damage/valve does not open →

Replace.

2. Measure:

- Valve operating temperature

- Valve lift (a)

Out of specification → Replace the thermostat.

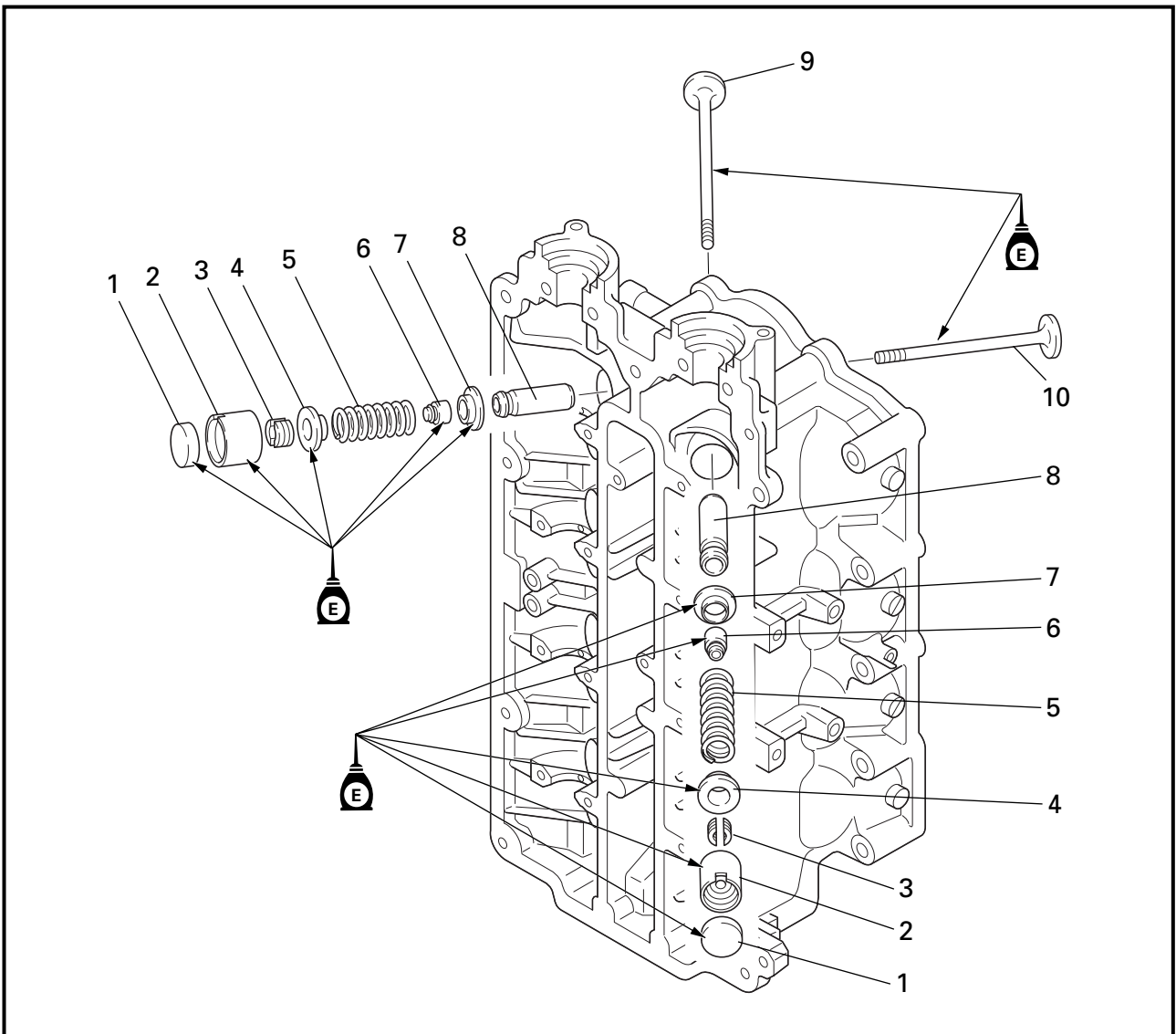
	Water temperature	Valve lift
	Below 48 - 52°C (118 - 126°F)	0 mm (0 in)
	Above 60°C (140°F)	Min. 4.3 mm (0.17 in)

Measuring steps

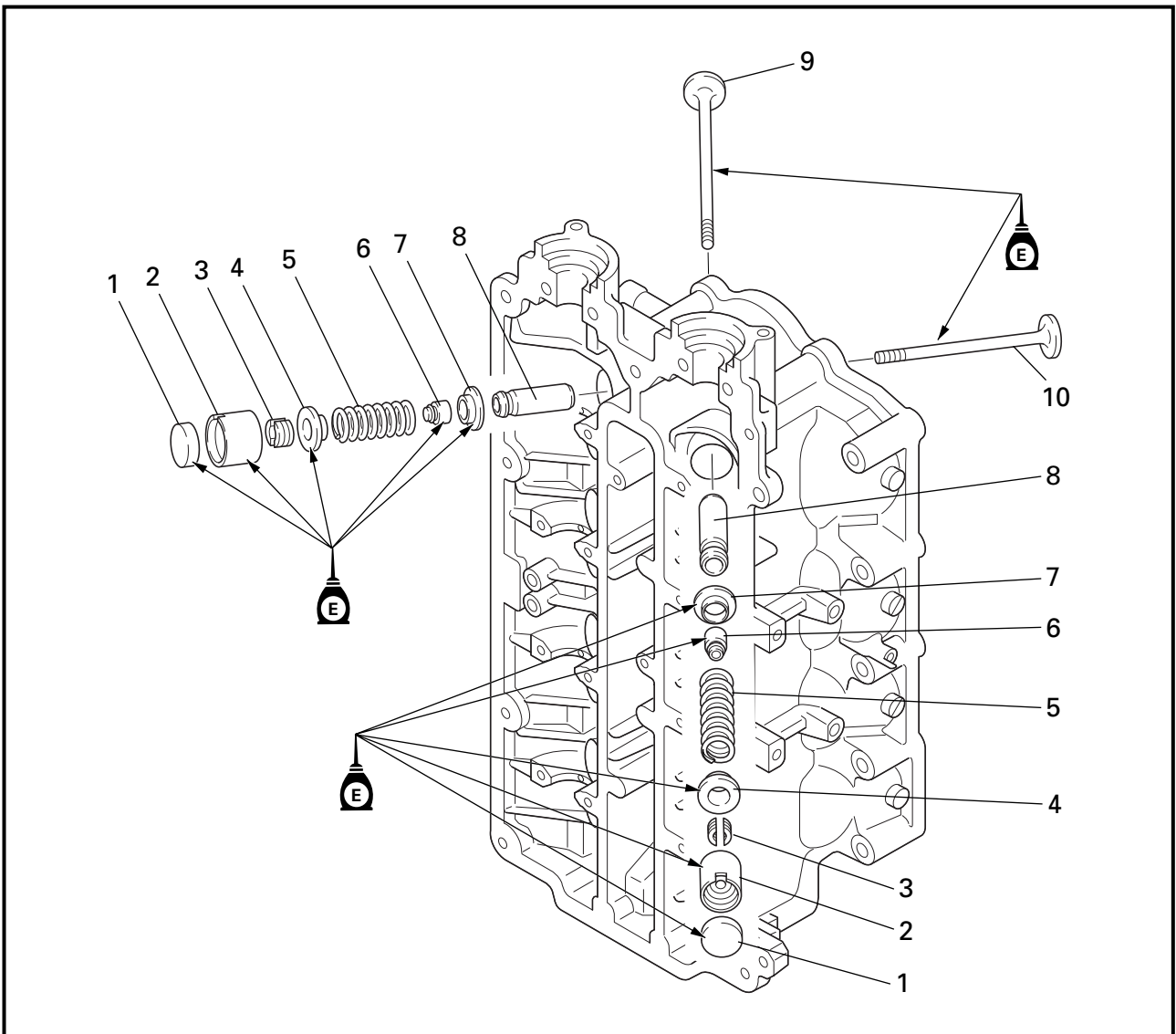
- (1) Suspend the thermostat in a container filled with water.
- (2) Slowly heat the water.
- (3) Place a thermometer in the water.
- (4) While stirring the water, observe the thermometer's indicated temperature.

VALVES

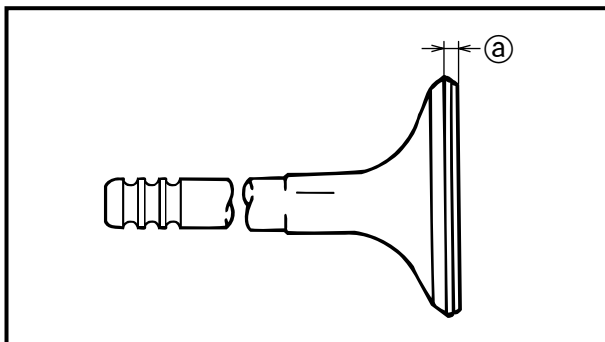
REMOVING/INSTALLING THE VALVES



Order	Job/Part	Q'ty	Remarks
	Camshaft and cylinder head assembly		Refer to "CAMSHAFTS" on page 5-21 and "CYLINDER HEAD ASSEMBLY" on page 5-23.
1	Valve pad	16	
2	Valve lifter	16	
3	Valve cotter	32	
4	Spring retainer	16	
5	Valve spring	16	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
6	Valve stem seal	16	For installation, reverse the removal procedure.
7	Spring seat	16	
8	Valve guide	16	
9	Intake valve	8	
10	Exhaust valve	8	



CHECKING THE VALVE

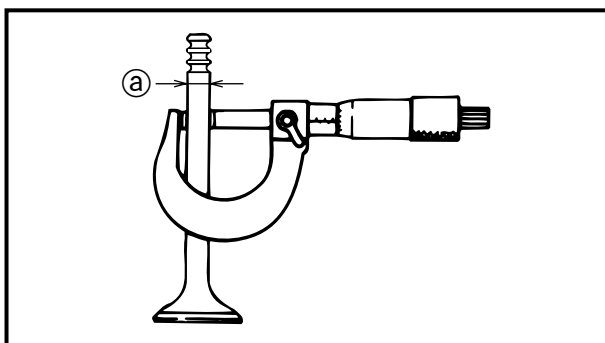
1. Check:
 - Valve
Damage/warpage → Replace.
2. Measure:
 - Margin thickness **a**
Out of specification → Replace.



Margin thickness

IN: 0.8 - 1.2 mm
(0.031 - 0.047 in)

EX: 1.0 - 1.4 mm
(0.039 - 0.055 in)



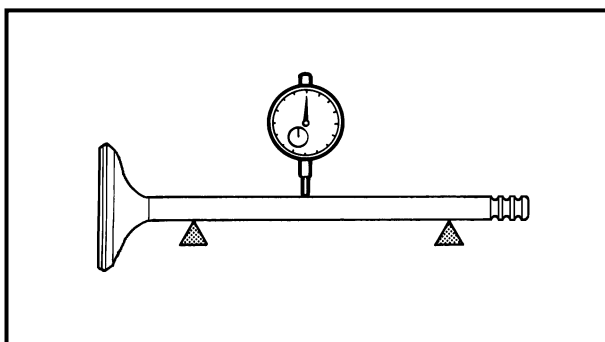
3. Measure:
 - Valve stem diameter **a**
Out of specification → Replace.



Valve stem diameter

IN: 5.975 - 5.990 mm
(0.2352 - 0.2358 in)

EX: 5.960 - 5.975 mm
(0.2346 - 0.2352 in)



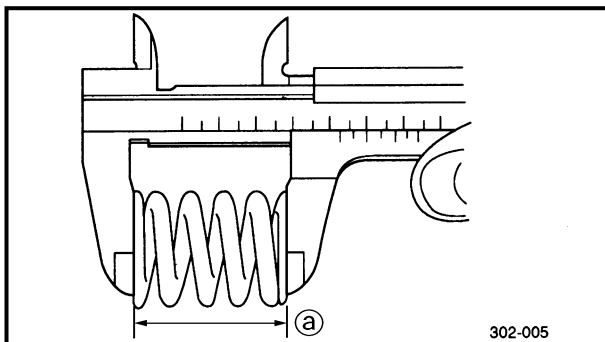
4. Measure:
 - Valve stem runout
Out of specification → Replace.



Valve stem runout limit

IN and EX
0.01 mm (0.0004 in)

NOTE: _____
The valve guide, valve seal, and valve
should be replaced as a set.



CHECKING THE VALVE SPRING

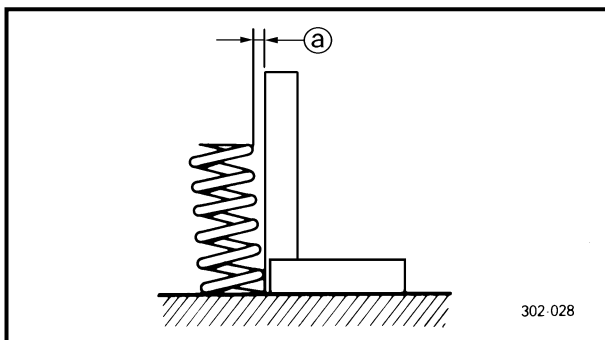
1. Measure:

- Free length ①

Out of specification → Replace.



Free length limit
52.25 mm (2.057 in)



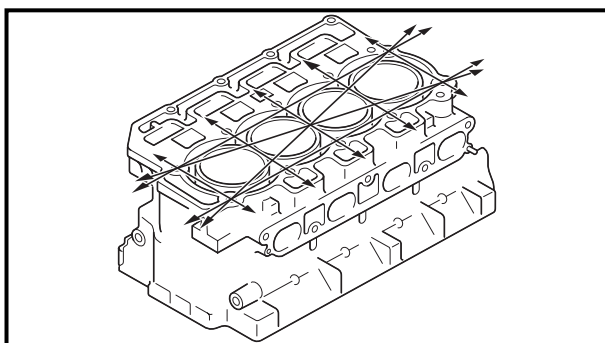
2. Measure:

- Valve spring tilt ①

Out of specification → Replace.



Valve spring tilt limit
IN and EX
2.6 mm (0.10 in)



CHECKING THE CYLINDER HEAD

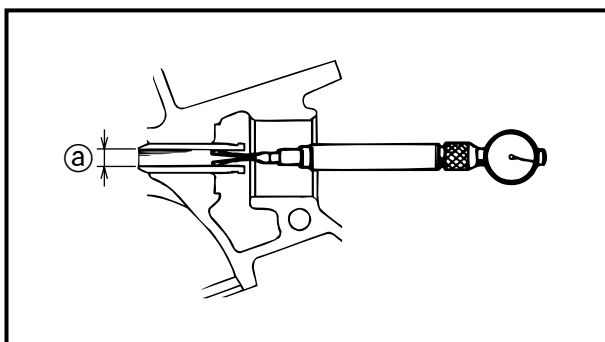
Measure:

- Cylinder head warpage

Out of specification → Reface or replace.



Warpage limit
0.1 mm (0.004 in)



CHECKING THE VALVE GUIDE

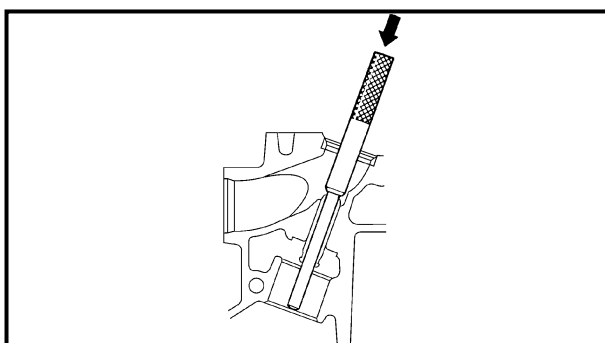
Measure:

- Valve guide bore ①

Out of specification → Replace the guide.



Valve guide bore
6.000 - 6.018 mm
(0.2362 - 0.2369 in)

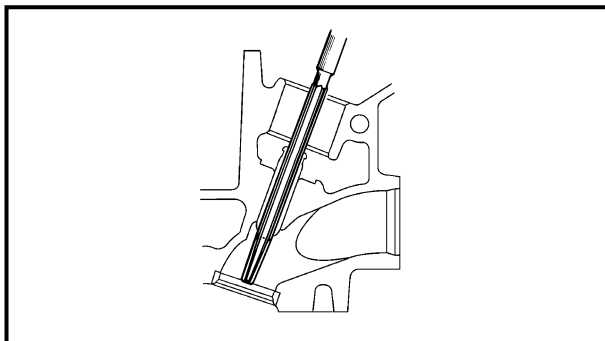
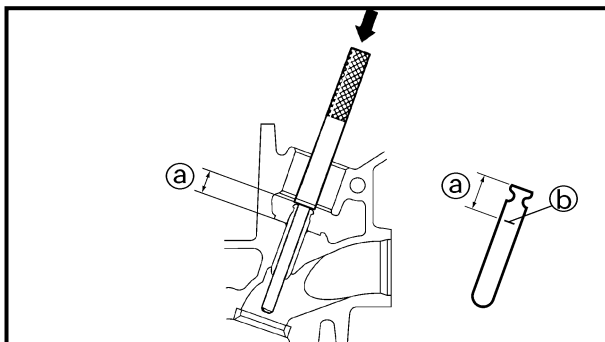


Replacement steps

- (1) Remove the valve guide with the valve guide remover/installer.



Valve guide remover
YM-4064-A / 90890-04064



- (2) Install the new valve guide to the specified position (from the top of the valve guide bore as shown) ① with the valve guide remover/installer.



Valve guide position
11.5 mm (0.45 in)

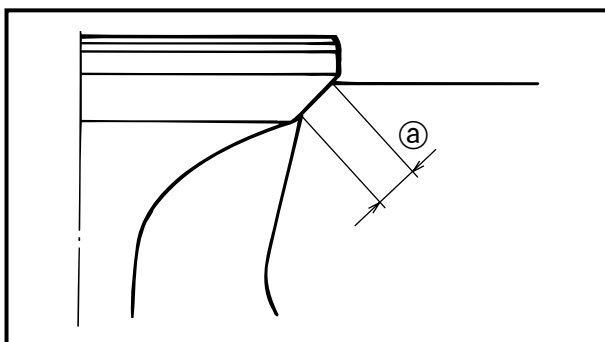
- (3) After installing the valve guide, bore the valve guide with the valve guide reamer.



Valve guide reamer
YM-04066 / 90890-04066

NOTE:

- Heat the cylinder head in an oven to 200°C (392°F) to ease valve guide removal and installation, and to maintain the correct interference fit.
- Before installing the valve guide, mark its installation position ② as shown.



CHECKING THE VALVE SEAT

1. Measure:

- Valve seat width ①
Out of specification → Reface the valve seat.



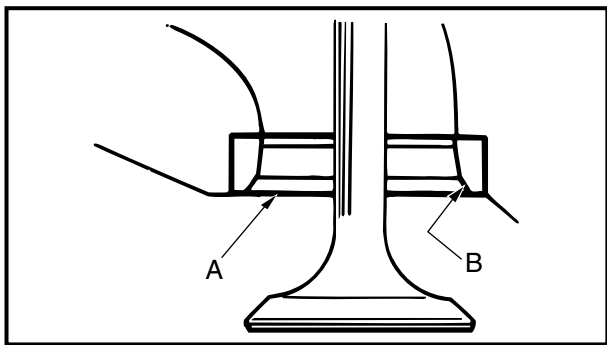
Valve seat width
Intake
1.2 - 1.6 mm
(0.047 - 0.063 in)
Exhaust
1.2 - 1.6 mm
(0.047 - 0.063 in)

2. Reface:

- Valve seat

CAUTION:

To prevent chatter marks, turn the valve seat cutter while an even, downward pressure (4 - 5 kg).



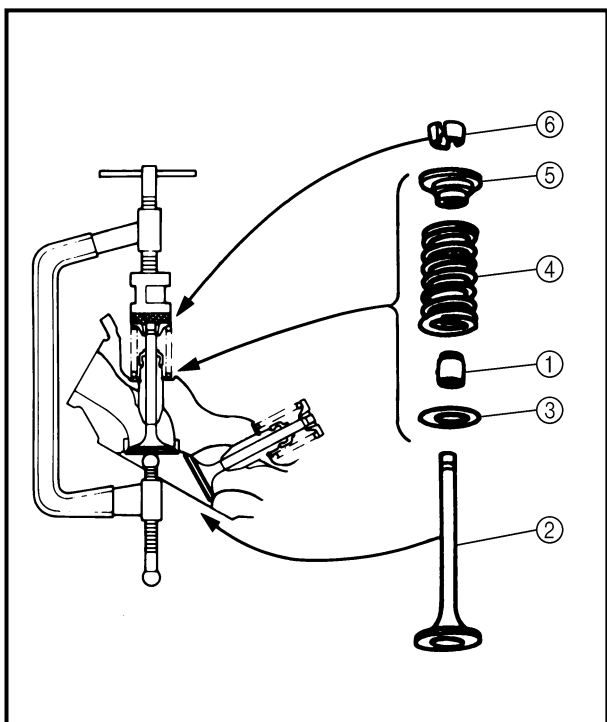
Valve seat cutter set
YM-91043-C / 90890-06803
Valve seat cutter holder
YB-06553 / 90890-06553
Valve seat cutter
(45°) YB-06555 / 90890-06555
(90°) YB-06556 / 90890-06556

- Refer to the following chart to determine the appropriate valve seat cutter.

Valve seat area	Valve seat cutter
A	90°
B	45°

NOTE: _____

After refacing the valve seat or replacing the valve and valve guide, lap the valve seat and valve face.



INSTALLING THE VALVE

1. Install:
 - Valve stem seal ①
 - Valve ②
 - Spring seat ③
 - Valve spring ④
 - Spring retainer ⑤
2. Install:
 - Valve cotter ⑥



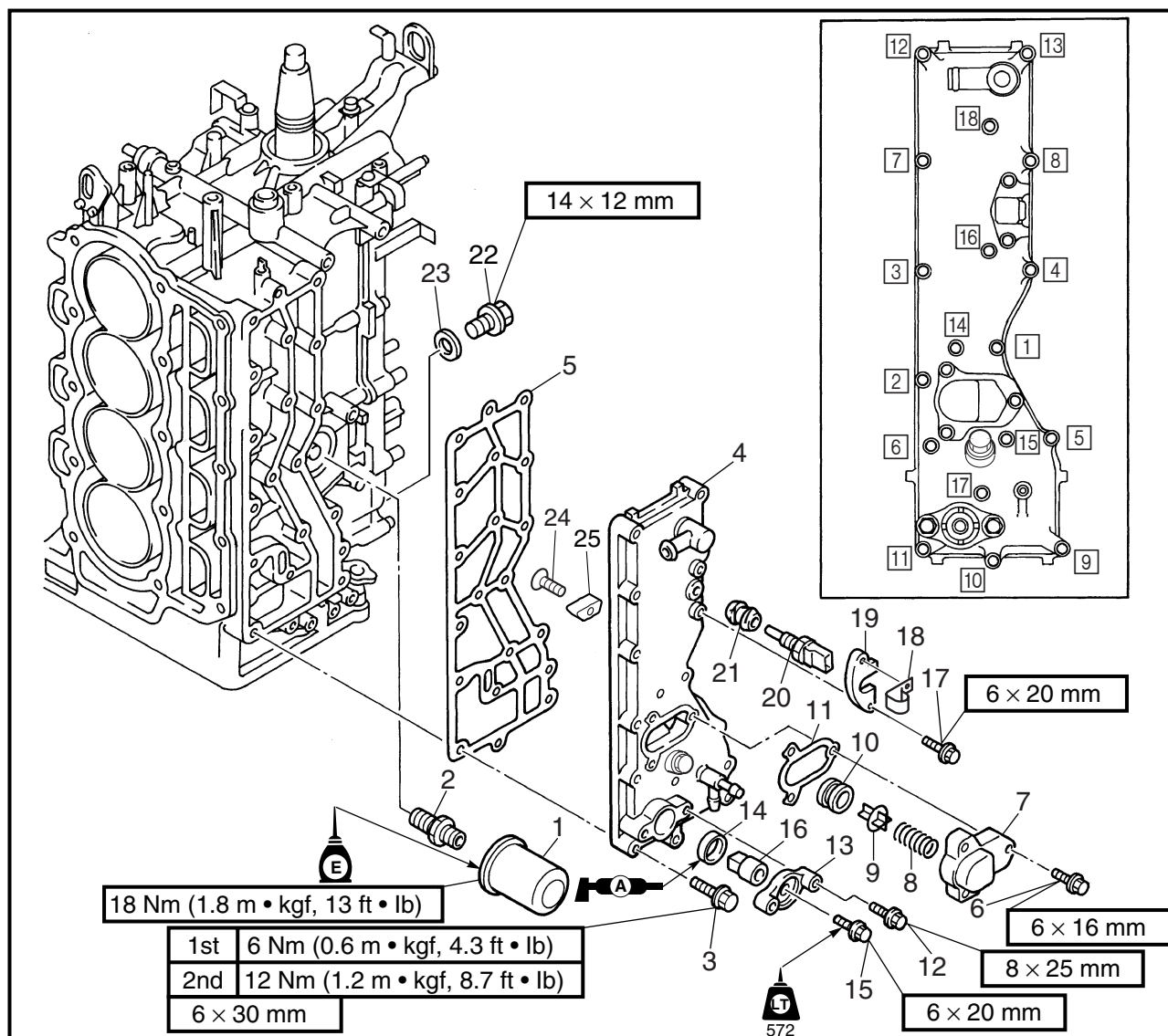
Valve spring compressor
YM-01253 / 90890-04019
Valve spring compressor adapter
YB-06554 / 90890-06554

NOTE: _____

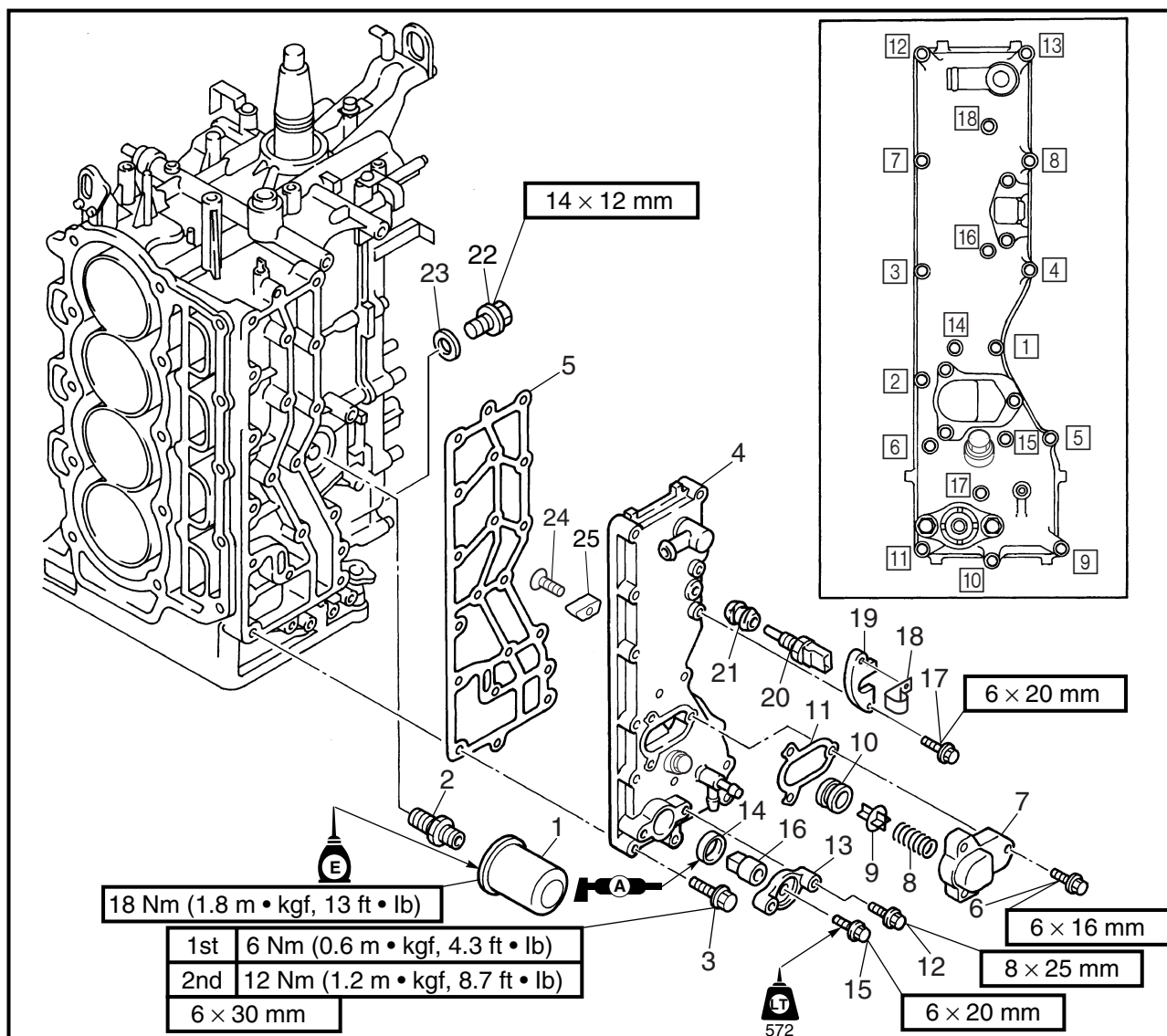
Compress the valve spring with the special tools and install the cotters onto the valve.

OIL FILTER AND EXHAUST COVER

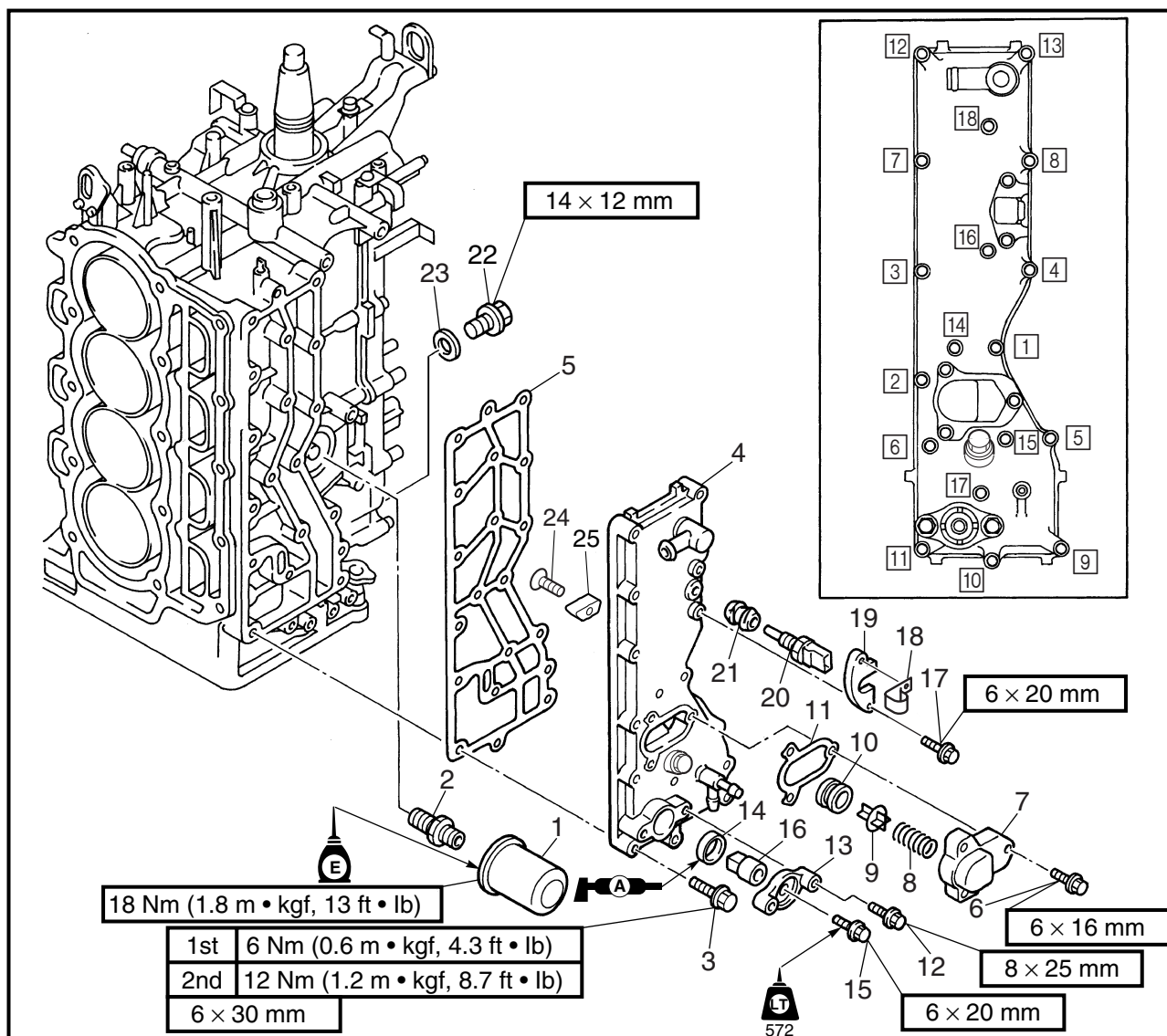
REMOVING/INSTALLING THE OIL FILTER AND EXHAUST COVER



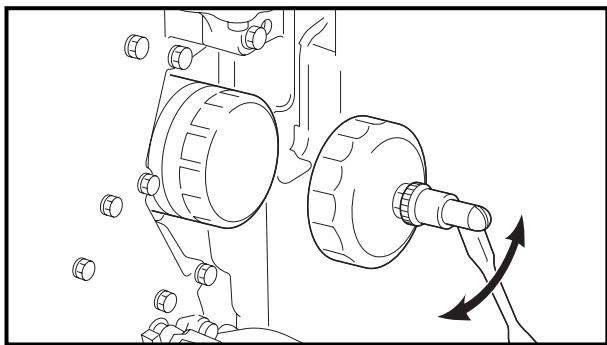
Order	Job/Part	Q'ty	Remarks
	Camshafts and cylinder head assembly		Refer to "CAMSHAFTS" on page 5-21 and "CYLINDER HEAD ASSEMBLY" on page 5-23. Not reusable <



Order	Job/Part	Q'ty	Remarks
8	Spring	1	Face the longer side towards the cylinder block. Not reusable
9	Pressure control valve (PCV)	1	
10	Grommet	1	
11	Gasket	1	
12	Bolt	2	
13	Anode cover	1	
14	O-ring	1	
15	Bolt	1	
16	Anode	1	



Order	Job/Part	Q'ty	Remarks
17	Bolt	2	Not reusable
18	Metal clamp	1	
19	Engine temperature sensor retainer	1	
20	Engine temperature sensor	1	
21	Gasket	1	
22	Drain plug	1	
23	Washer	1	
24	Screw	3	
25	Anode	3	
			For installation, reverse the removal procedure.

**INSTALLING THE OIL FILTER**

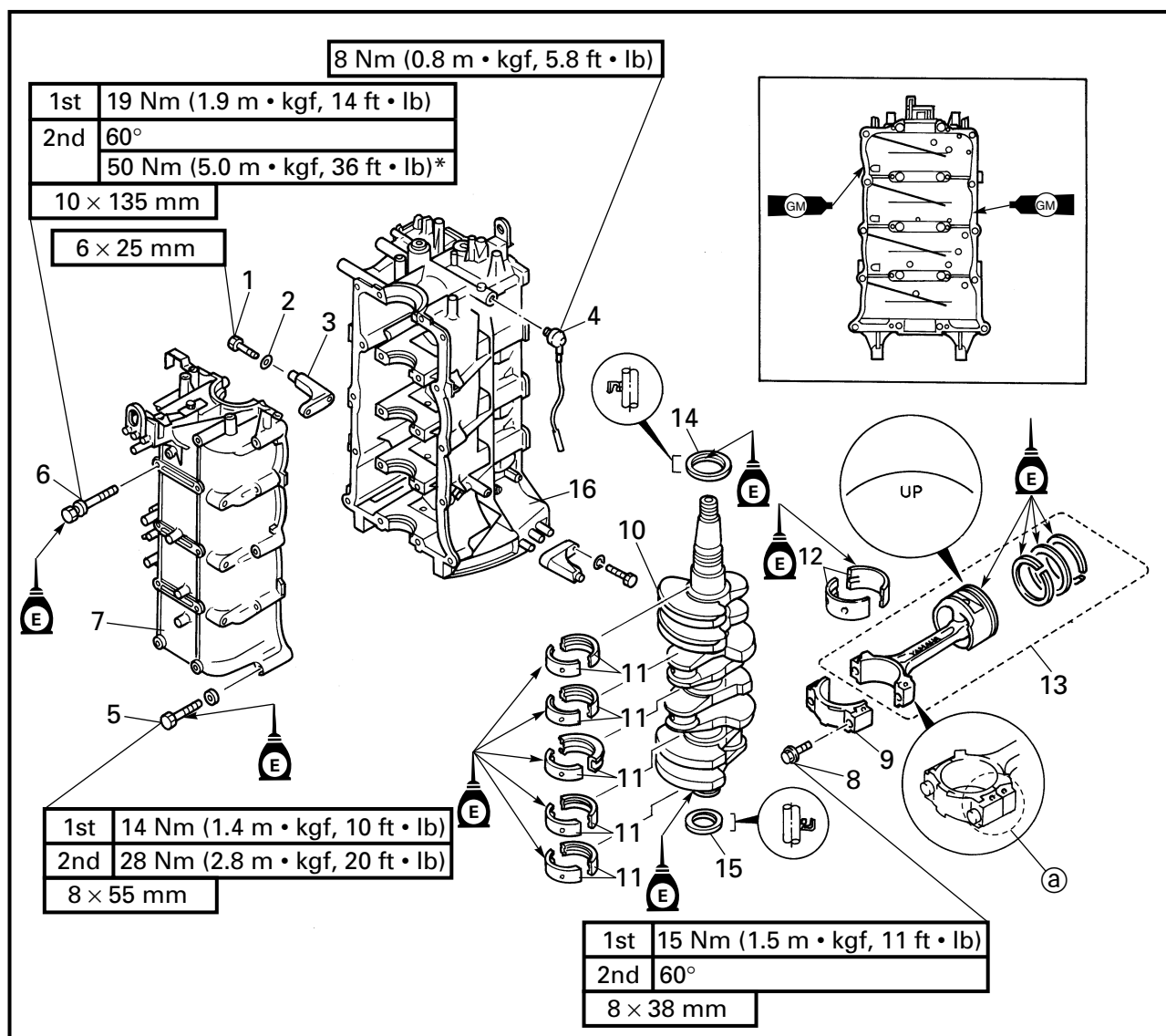
Install:

- Oil filter

**Oil filter**
18 Nm (1.8 m • kgf, 13 ft • lb)**Oil filter wrench**
YU-38411 / 90890-01426

Refer to “REPLACING THE ENGINE OIL/OIL FILTER” on page 3-11.

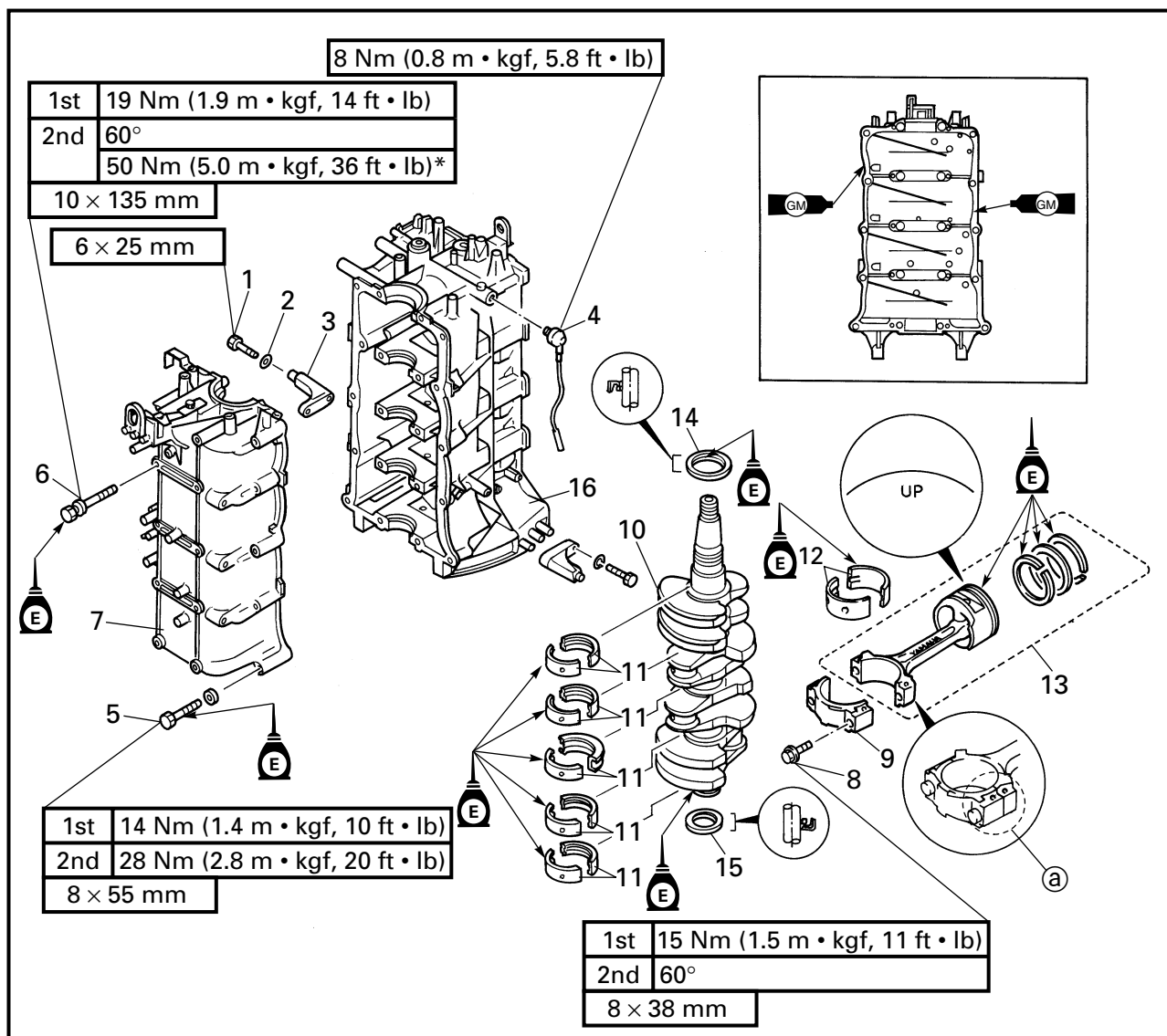
**CRANKSHAFT AND PISTON/CONNECTING ROD ASSEMBLY
REMOVING/INSTALLING THE CRANKSHAFT AND PISTON/CONNECTING ROD
ASSEMBLY**



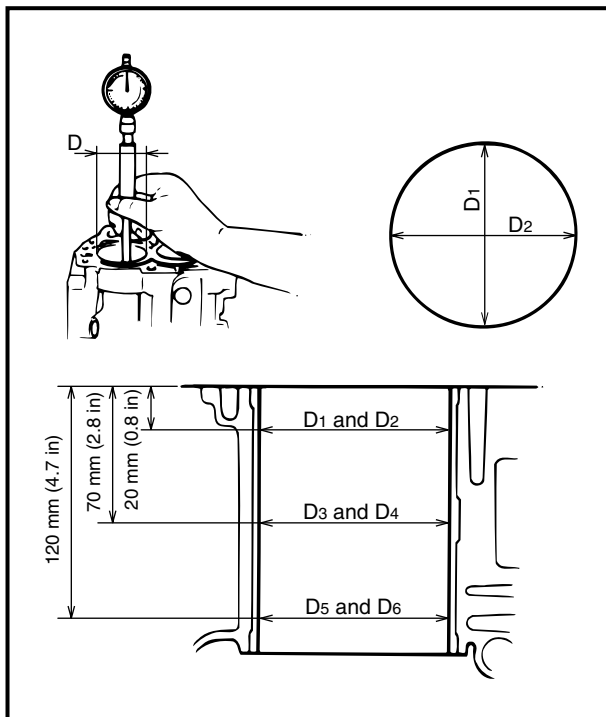
Order	Job/Part	Q'ty	Remarks
	Oil filter and exhaust cover		Refer to "OIL FILTER AND EXHAUST COVER" on page 5-32.
1	Bolt	4	
2	Washer	2	
3	Bracket	2	
4	Oil pressure switch	1	
5	Bolt	10	
6	Bolt (1.5 mm thread pitch)	10	
7	Crankcase	1	

Continued on next page.

*: Torque value (for reference only)



Order	Job/Part	Q'ty	Remarks
8	Connecting rod bolt	8	Not reusable
9	Connecting rod cap	4	
10	Crankshaft	1	
11	Main bearing	5	
12	Big end bearing	4	
13	Piston/connecting rod assembly	4	
14	Oil seal	1	
15	Oil seal	1	
16	Cylinder block	1	
			For installation, reverse the removal procedure.



CHECKING THE CYLINDER BLOCK

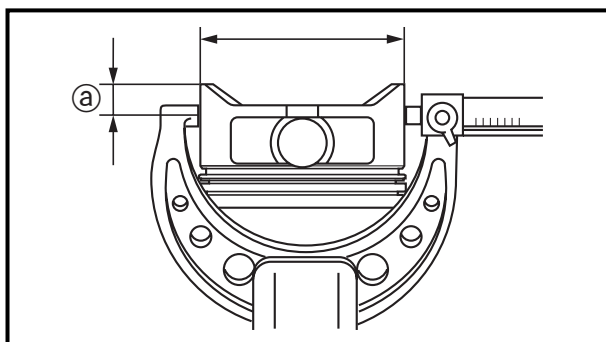
Measure:

- Cylinder bore
- Out of specification → Rebore the cylinder or replace the cylinder block.

	Standard	Wear limit
Cylinder bore "D"	79.000 - 79.020 mm (3.110 - 3.111 in)	—
Taper limit "T"	—	0.08 mm (0.003 in)
Out of round limit	—	0.05 mm (0.002 in)
D = Maximum Dia. (D₁ - D₆) T = (maximum D₁ or D₂) - (minimum D₅ or D₆)		

NOTE:

Measure the cylinder bore in parallel and at a right angle to the crankshaft. Then, average the measurements.



CHECKING THE PISTON

Measure:

- Piston diameter
- Out of specification → Replace the piston.

	Distance a	Piston diameter
Standard	13 mm (0.51 in)	78.928 - 78.949 mm (3.1074 - 3.1082 in)
Oversize piston diameter Oversize 1: + 0.25 mm (0.001 in)		

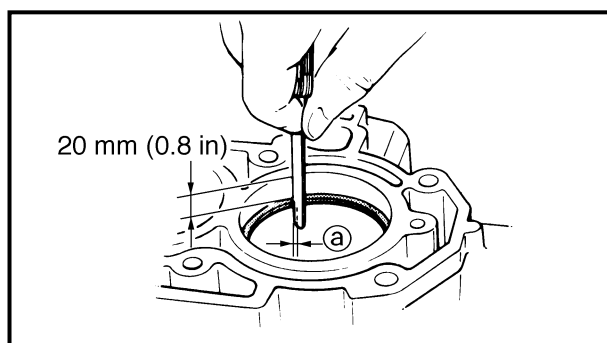
CALCULATING THE PISTON-TO-CYLINDER CLEARANCE

Calculate:

- Piston-to-cylinder clearance
Out of specification → Replace the piston and piston rings, the cylinder block or both.

Piston-to-cylinder clearance	=	Cylinder bore	-	Piston diameter
------------------------------	---	---------------	---	-----------------

	Piston-to-cylinder clearance 0.070 - 0.080 mm (0.0028 - 0.0031 in)
---	---



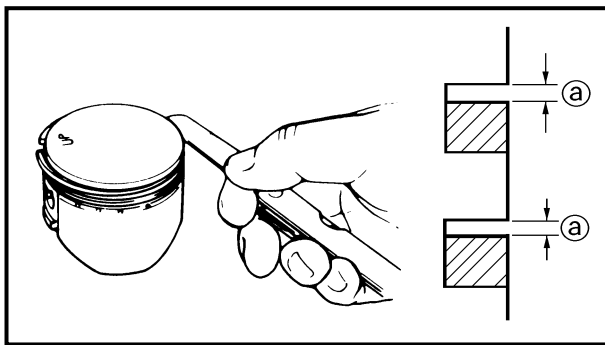
CHECKING THE PISTON RING

1. Measure:

- End gap **a**
Out of specification → Replace the piston rings as a set.

	End gap (installed) Top ring 0.15 - 0.30 mm (0.006 - 0.012 in) 2nd ring 0.70 - 0.90 mm (0.028 - 0.035 in) Oil ring 0.20 - 0.70 mm (0.008 - 0.028 in)
---	---

NOTE: _____
 Push the piston ring into the cylinder with the piston crown.



2. Measure:

- Side clearance ①

Out of specification → Replace the piston and piston rings as a set.



Side clearance

Top ring

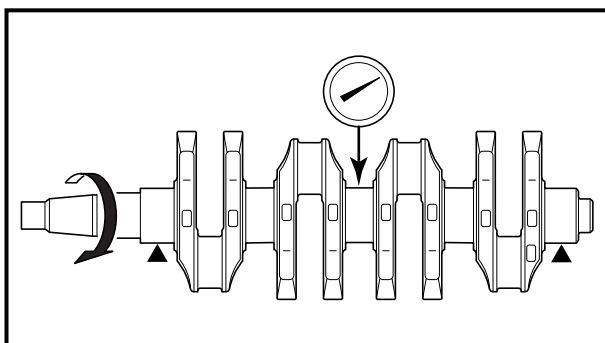
0.04 - 0.08 mm
(0.002 - 0.003 in)

2nd ring

0.03 - 0.07 mm
(0.001 - 0.003 in)

Oil ring

0.03 - 0.15 mm
(0.001 - 0.006 in)



CHECKING THE CRANKSHAFT

Measure:

- Crankshaft journal diameter
- Crank pin diameter
- Crankshaft runout

Out of specification → Replace the crankshaft.



Crankshaft journal diameter limit

47.972 mm (1.8887 in)

Crankshaft runout limit

0.03 mm (0.001 in)

CHECKING THE MAIN-BEARING OIL CLEARANCE

1. Measure:

- Main-bearing oil clearance

Out of specification → Replace the upper and lower bearings as a set.



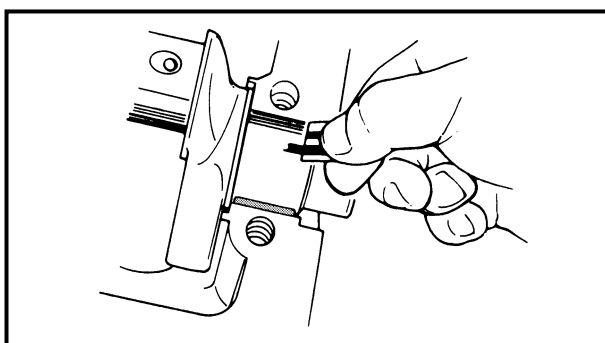
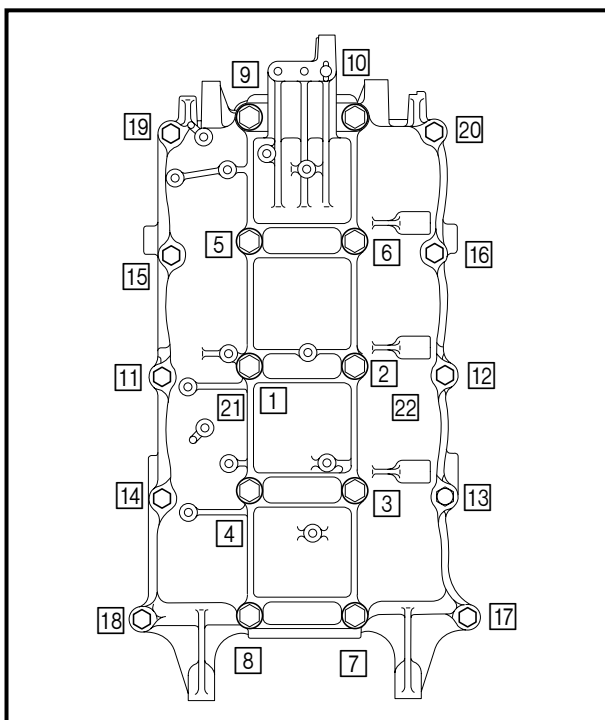
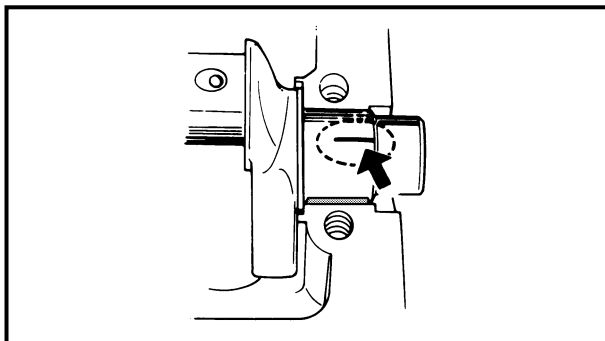
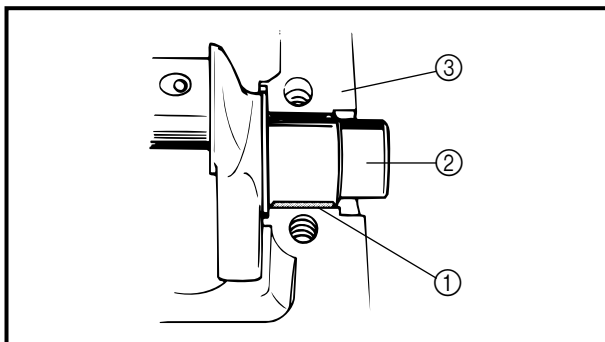
Main-bearing oil clearance

0.024 - 0.044 mm

(0.0009 - 0.0017 in)

NOTE:

Measure the main-bearing oil clearance at room temperature (20 °C (68 °F)).



Measuring steps

CAUTION:

Install the bearings in their original positions. Incorrect oil clearance measurements can lead to engine damage.

- (1) Clean the bearings, main journals, and bearing portions of the crankcase and cylinder block.
- (2) Place the cylinder block upside down on a bench.
- (3) Install half of the bearings ① and the crankshaft ② into the cylinder block ③.
- (4) Put a piece of Plastigauge® on each main journal in parallel to the crankshaft.

NOTE:

Do not put the Plastigauge® over the oil hole in the main journal of the crankshaft.

- (5) Install the other half of the bearings into the crankcase.
- (6) Install the crankcase onto the cylinder block.
- (7) Apply engine oil on to the threads and seat of the crankcase bolts.
- (8) Tighten the bolts to the specified torque in two steps in the order shown in the illustration.

NOTE:

Do not move the crankshaft until the main-bearing oil clearance measurement has been completed.



Bolt (M8)

1st: 14 Nm (1.4 m • kgf, 10 ft • lb)

2nd: 28 Nm (2.8 m • kgf, 20 ft • lb)

Bolt (M10)

1st: 19 Nm (1.9 m • kgf, 14 ft • lb)

2nd: 60°

50 Nm

(5.0 m • kgf, 36 ft • lb)*

- (9) Remove the crankcase.
- (10) Measure the width of the compressed Plastigauge® on each main journal.

* Torque valve (for reference only)

2. Adjust:
 - Main-bearing oil clearance

NOTE: _____
Adjust the main-bearing oil clearance at room temperature (20°C (68 °F)).

Adjusting steps

CAUTION:

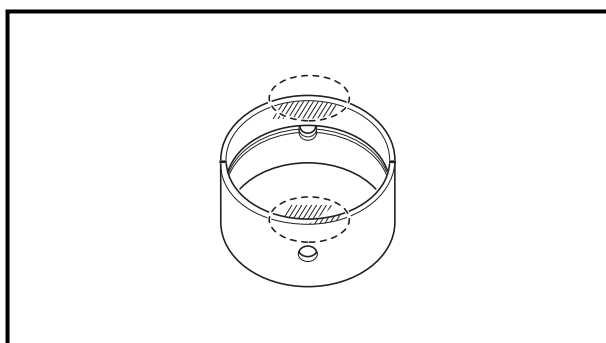
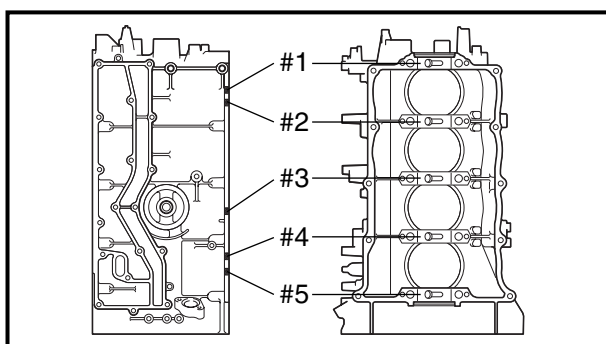
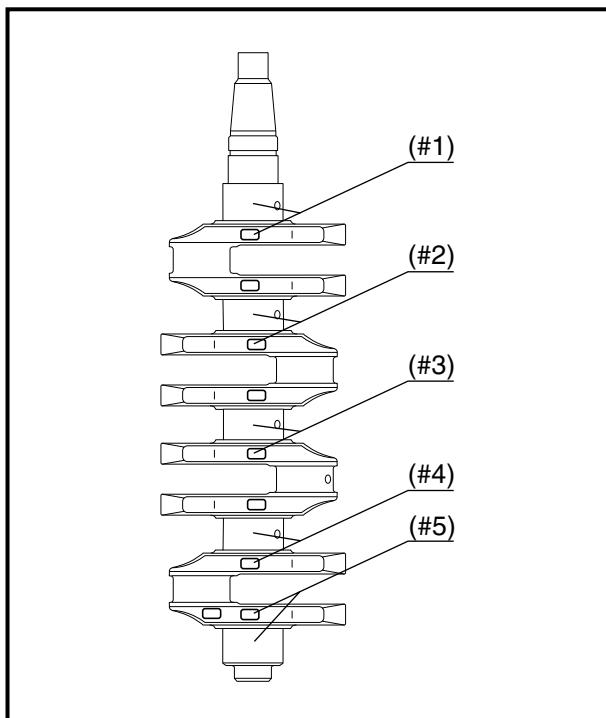
Remove any oil or dust from the cylinder block and crankcase bearing mounting surfaces.

NOTE: _____
The cylinder block journal diameters (#1 - #5) and the crankshaft journal diameters, (#1 - #5) can be determined by the stamped value as described below.
Crankshaft journal diameter = 47.900 + (stamped value/1000)
Example: #1 = 92 → 47.992
Cylinder block journal diameter = 54.000 + (stamped value/1000)
Example: #1 = 32 → 54.032

- (1) Subtract the crankshaft journal diameters (#1 - #5) from the cylinder block journal diameters (#1 - #5).
- (2) Select the suitable bearing from the table below according to the calculated values.

Crankshaft bearing selection table
(20 °C (68 °F))

Cylinder block journal diameters – crankshaft journal diameters (mm)	Bearing (cylinder side)/thrust bearing	Bearing (crankcase side)
6.023 - 6.026	Green	Yellow*
6.027 - 6.034	Blue	Green*
6.035 - 6.042	Blue	Blue
6.043 - 6.049	Red	Blue*
6.050 - 6.058	Red	Red



CAUTION:

The (*) mark indicates that the color of the upper and lower bearings are different. Install the main-bearings in the middle of the cylinder block and crankcase journal so they do not block the oil holes.

NOTE:

Crankshaft bearing #3 is a thrust bearing.

- (3) If the difference between the cylinder block journal diameter and crankshaft journal diameter is more than the maximum value (6.058 mm), replace the crankshaft, cylinder block, or both.

CHECKING THE CONNECTING ROD BIG-END OIL CLEARANCE

CAUTION:

- Mark the original connecting rod bolts so they are not confused with the new bolts.
- Do not reuse the original connecting rod bolts during assembly, only use them when measuring and adjusting the oil clearance.
- Before assembly, remove any small metal particles from the big- end mating surface and also thoroughly clean it.

1. Measure:

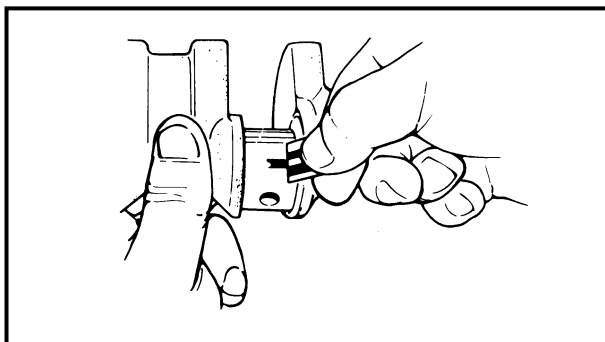
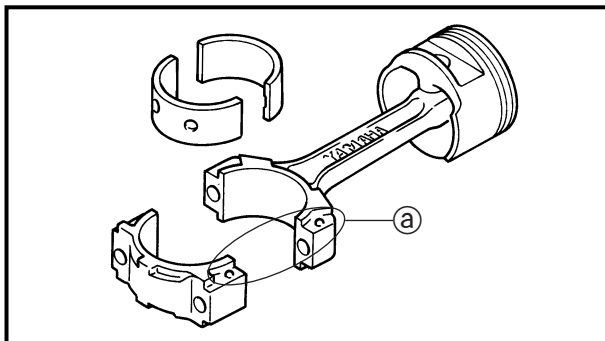
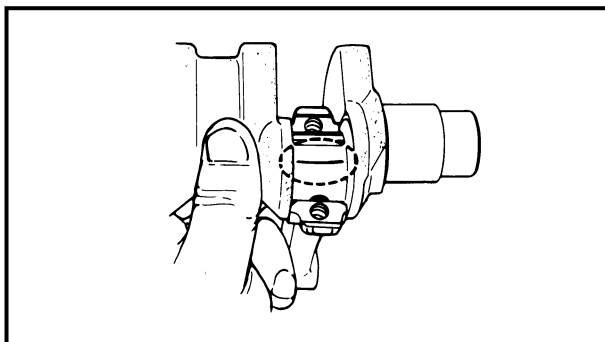
- Big-end oil clearance
Out of specification → Replace the upper and lower bearings as a set.



Big-end oil clearance
0.025 - 0.031 mm
(0.0010 - 0.0012 in)

NOTE:

Measure the big-end oil clearance at room temperature (20 °C (68 °F)).



Measuring steps

CAUTION:

Install the bearings in their original positions. Incorrect oil clearance measurements can lead to engine damage.

- (1) Clean the bearings and bearing portions of the connecting rod.
- (2) Install the upper half of the bearing into the connecting rod and the lower half into the connecting rod cap.
- (3) Put a piece of Plastigauge® onto the crank pin in parallel to the crankshaft.
- (4) Assemble the connecting rod onto the crank pin.

NOTE:

- Make sure the projections ① and "YAMAHA" mark on the connecting rod faces towards the flywheel side.
- Do not move the crankshaft until the big-end oil clearance measurement has been completed.

- (5) Apply engine oil onto the threads and seat of the original connecting rod bolts.
- (6) Tighten the original bolts to the specified torque in two stages.



Bolt

1st: 15 Nm
(1.5 m • kgf, 11 ft • lb)
2nd: 60°

- (7) Remove the connecting rod cap.
- (8) Measure the width of the compressed Plastigauge® on each crank pin.

2. Adjust:
 - Big-end oil clearance

NOTE: _____

Adjust the big-end oil clearance at room temperature (20 °C (68 °F)).

Adjusting steps

CAUTION: _____

Remove any oil or dust from the connecting-rod-bearing mounting surfaces.

- (1) Install the connecting rod cap to the connecting rod.
- (2) Tighten the original bolts to the specified torque in two stages.



Bolt:
1st: 15 Nm (1.5 m • kg, 11 ft • lb)
2nd: 60°

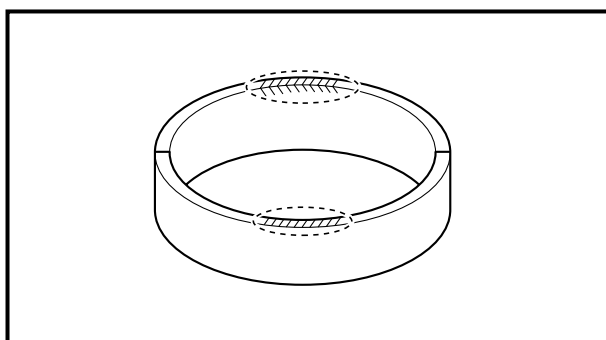
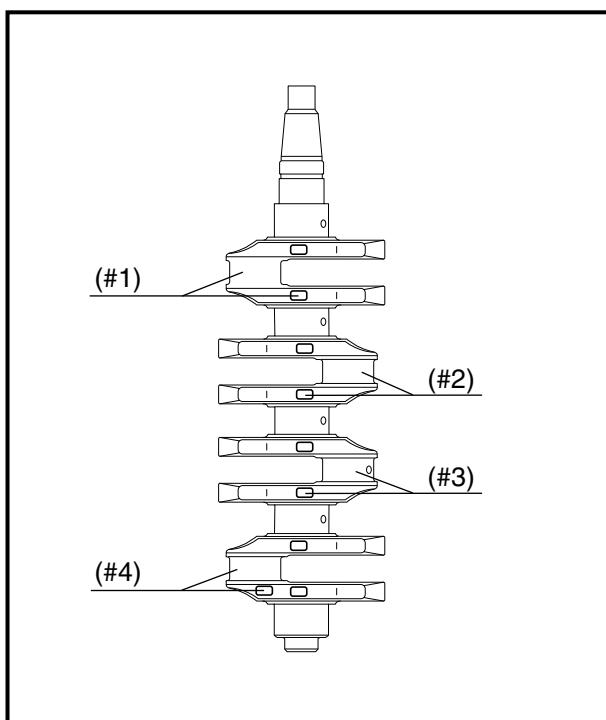
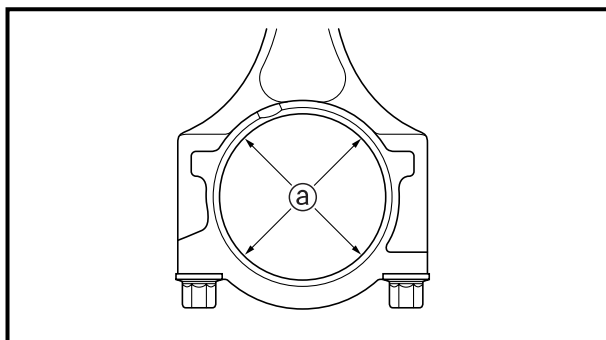
- (3) Measure the connecting rod big end diameter ①.
- (4) The crank pin diameters (#1 ~ #4) can be determined by the stamped value as described below.

NOTE: _____

Crank pin diameter = 41.900 +
(stamped value/1,000)

Example: #1 = 92 → 41.992

- (5) Subtract the crank pin diameters (#1 ~ #4) from the connecting rod big end diameters (#1 ~ #4).
- (6) Select the suitable bearing from the table below according to the calculated values.



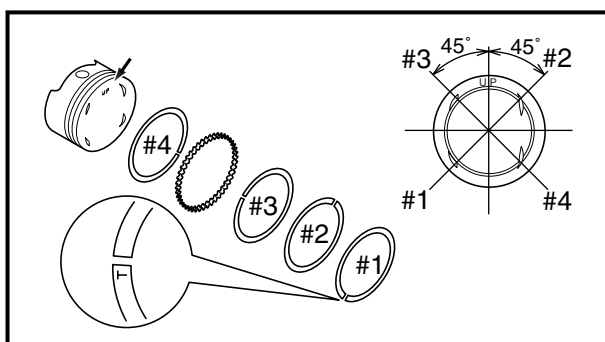
**Connecting rod bearing selection table
(20 °C (68 °F))**

Connecting rod big end diameters – crank pin diameters (mm)	Upper bearing	Lower bearing
3.025 ~ 3.031	Yellow	Yellow
3.032 ~ 3.039	Yellow	Green*
3.040 ~ 3.046	Green	Green
3.047 ~ 3.052	Green	Blue*
3.053 ~ 3.058	Blue	Blue
3.059 ~ 3.063	Blue	Red*

CAUTION:

The (*) mark indicates that the color of the upper and lower bearings are different.

- (7) If the measurement value is more than the maximum value (3.063 mm), replace the crankshaft, connecting rod, or both.



INSTALLING THE PISTON RING

CAUTION:

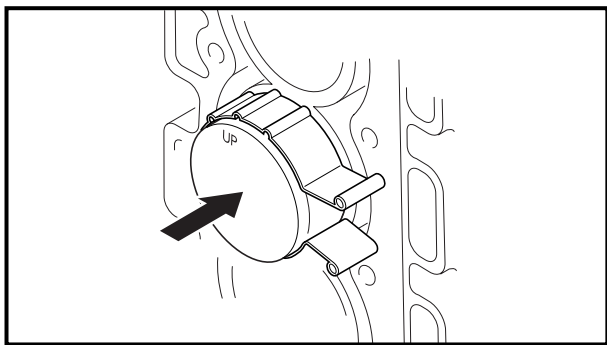
- Do not scratch the piston or break the piston rings.
- After installing the piston rings, check that they move smoothly.

Install:

- Oil ring (#3 and #4)
- 2nd ring (#2)
- Top ring (#1)

NOTE:

- Offset the piston-ring end gaps as shown.
- Piston rings should be replaced as a set.

**INSTALLING THE PISTON****CAUTION:**

Install the piston with the "UP" mark on the piston crown facing towards the fly-wheel side.

Install:

- Piston



Piston ring compressor
YU-33294 / 90890-06530

CHAPTER 6

LOWER UNIT

LOWER UNIT (REGULAR ROTATION MODELS)

6-1

REMOVING/INSTALLING THE LOWER UNIT

6-1

REMOVING THE PROPELLER

6-3

CHECKING THE PROPELLER.....

6-3

INSTALLING THE PROPELLER.....

6-3

WATER PUMP (REGULAR ROTATION MODELS).....

6-4

REMOVING/INSTALLING THE WATER PUMP.....

6-4

CHECKING THE IMPELLER HOUSING

6-6

CHECKING THE IMPELLER AND IMPELLER HOUSING CUP.....

6-6

CHECKING THE WOODRUFF KEY

6-6

INSTALLING THE IMPELLER AND IMPELLER HOUSING.....

6-6

SHIFT ROD ASSEMBLY (REGULAR ROTATION MODELS)

6-7

REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY

6-7

REMOVING THE SHIFT ROD ASSEMBLY

6-8



PROPELLER SHAFT HOUSING ASSEMBLY

(REGULAR ROTATION MODELS)	6-9
REMOVING/INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY	6-9
DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING	6-11
DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT ASSEMBLY	6-12
REMOVING THE PROPELLER SHAFT HOUSING ASSEMBLY	6-13
DISASSEMBLING THE PROPELLER SHAFT HOUSING	6-13
CHECKING THE REVERSE GEAR	6-14
CHECKING THE BEARING	6-14
CHECKING THE PROPELLER SHAFT HOUSING	6-14
CHECKING THE DOG CLUTCH	6-15
CHECKING THE PROPELLER SHAFT	6-15
ASSEMBLING THE PROPELLER SHAFT HOUSING	6-15
ASSEMBLING THE REVERSE GEAR	6-15
INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY	6-16

DRIVE SHAFT (REGULAR ROTATION MODELS)	6-17
REMOVING/INSTALLING THE DRIVE SHAFT	6-17
REMOVING THE DRIVE SHAFT	6-19
DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY	6-19
DISASSEMBLING THE FORWARD GEAR ASSEMBLY	6-19
CHECKING THE PINION	6-20
CHECKING THE DRIVE SHAFT	6-20
CHECKING THE DRIVE SHAFT HOUSING	6-20
CHECKING THE BEARINGS	6-20
ASSEMBLING THE FORWARD GEAR ASSEMBLY	6-20
ASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY	6-21
INSTALLING THE DRIVE SHAFT	6-22

LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)	6-23
DISASSEMBLING/ASSEMBLING THE LOWER CASE ASSEMBLY	6-23
DISASSEMBLING THE LOWER CASE ASSEMBLY	6-24
CHECKING THE DRIVE SHAFT SLEEVE	6-24
CHECKING THE NEEDLE BEARING.....	6-24
ASSEMBLING THE LOWER CASE ASSEMBLY	6-24
 LOWER UNIT (COUNTER ROTATION MODELS)	6-26
REMOVING/INSTALLING THE LOWER UNIT	6-26
REMOVING THE PROPELLER	6-28
CHECKING THE PROPELLER.....	6-28
INSTALLING THE PROPELLER.....	6-28
 WATER PUMP (COUNTER ROTATION MODELS)	6-29
REMOVING/INSTALLING THE WATER PUMP.....	6-29
CHECKING THE IMPELLER HOUSING	6-31
CHECKING THE IMPELLER AND IMPELLER HOUSING CUP.....	6-31
CHECKING THE WOODRUFF KEY	6-31
INSTALLING THE IMPELLER AND IMPELLER HOUSING	6-31
 SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)	6-32
REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY	6-32
REMOVING THE SHIFT ROD ASSEMBLY	6-33



PROPELLER SHAFT HOUSING ASSEMBLY

(COUNTER ROTATION MODELS).....	6-34
REMOVING/INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY.....	6-34
DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY.....	6-36
DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT ASSEMBLY.....	6-38
REMOVING THE PROPELLER SHAFT HOUSING ASSEMBLY.....	6-39
REMOVING THE PROPELLER SHAFT ASSEMBLY.....	6-39
DISASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY.....	6-40
DISASSEMBLING THE FORWARD GEAR ASSEMBLY	6-40
CHECKING THE FORWARD GEAR.....	6-41
CHECKING THE BEARING.....	6-41
CHECKING THE PROPELLER SHAFT HOUSING.....	6-41
CHECKING THE DOG CLUTCH	6-41
CHECKING THE PROPELLER SHAFT.....	6-41
ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY	6-42
INSTALLING THE PROPELLER SHAFT ASSEMBLY	6-43
INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY.....	6-44

DRIVE SHAFT (COUNTER ROTATION MODELS) 6-45

REMOVING/INSTALLING THE DRIVE SHAFT 6-45

REMOVING THE DRIVE SHAFT 6-47

DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY 6-47

DISASSEMBLING THE REVERSE GEAR 6-47

CHECKING THE PINION 6-47

CHECKING THE DRIVE SHAFT..... 6-47

CHECKING THE DRIVE SHAFT HOUSING 6-48

CHECKING THE BEARINGS 6-48

ASSEMBLING THE REVERSE GEAR ASSEMBLY..... 6-48

ASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY 6-48

INSTALLING THE DRIVE SHAFT..... 6-49

LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS) 6-50

DISASSEMBLING/ASSEMBLING THE LOWER CASE ASSEMBLY 6-50

DISASSEMBLING THE LOWER CASE ASSEMBLY 6-51

CHECKING THE DRIVE SHAFT SLEEVE 6-51

CHECKING THE NEEDLE BEARING..... 6-51

ASSEMBLING THE LOWER CASE ASSEMBLY 6-52

SHIMMING (REGULAR ROTATION MODELS)
(FOR USA AND CANADA) 6-53

SELECTING THE PINION SHIMS 6-54

SELECTING THE FORWARD GEAR SHIMS 6-56

SELECTING THE REVERSE GEAR SHIMS..... 6-58

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE) 6-60

SELECTING THE PINION SHIMS 6-61

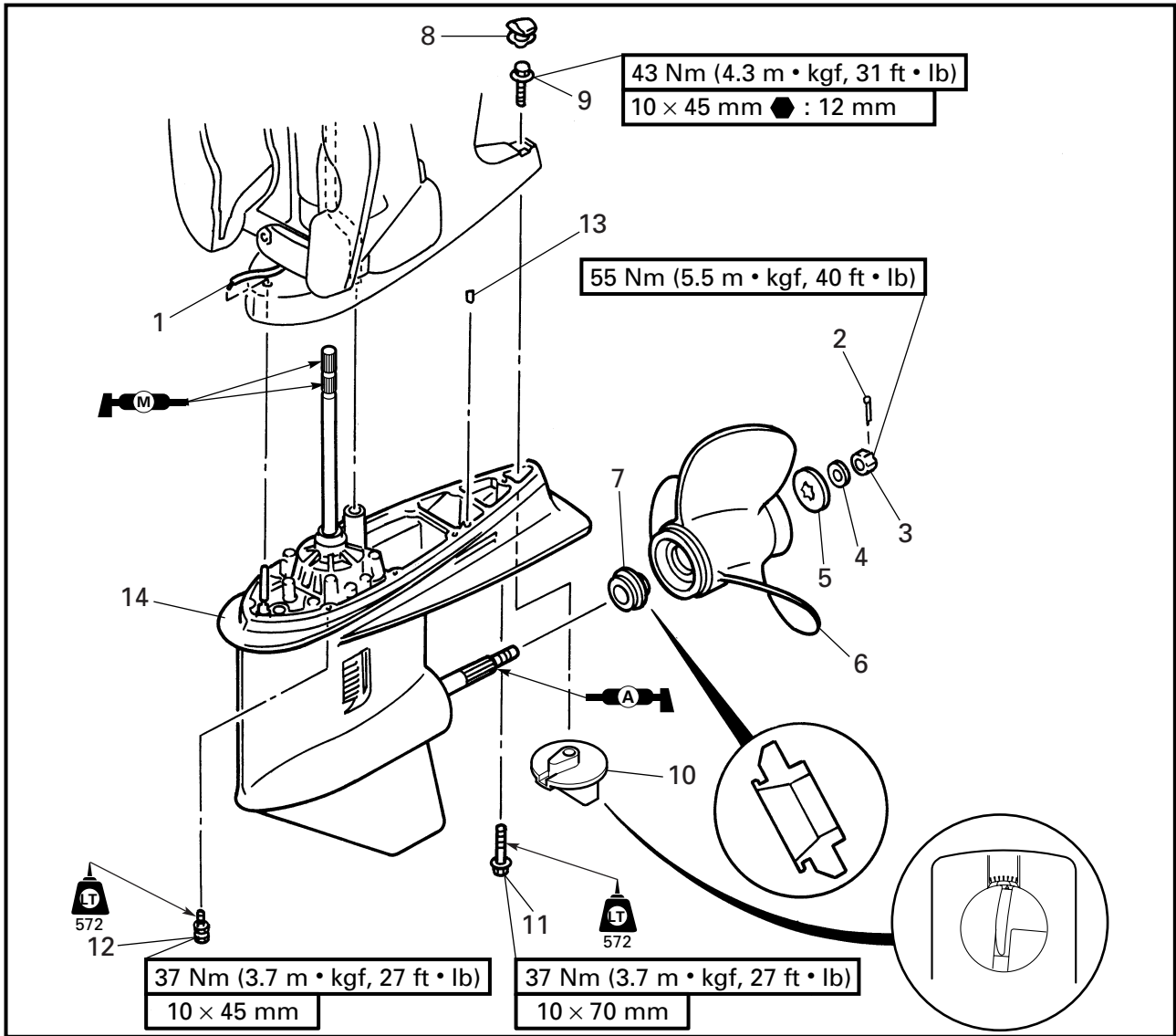
SELECTING THE FORWARD GEAR SHIMS 6-63

SELECTING THE REVERSE GEAR SHIM 6-64

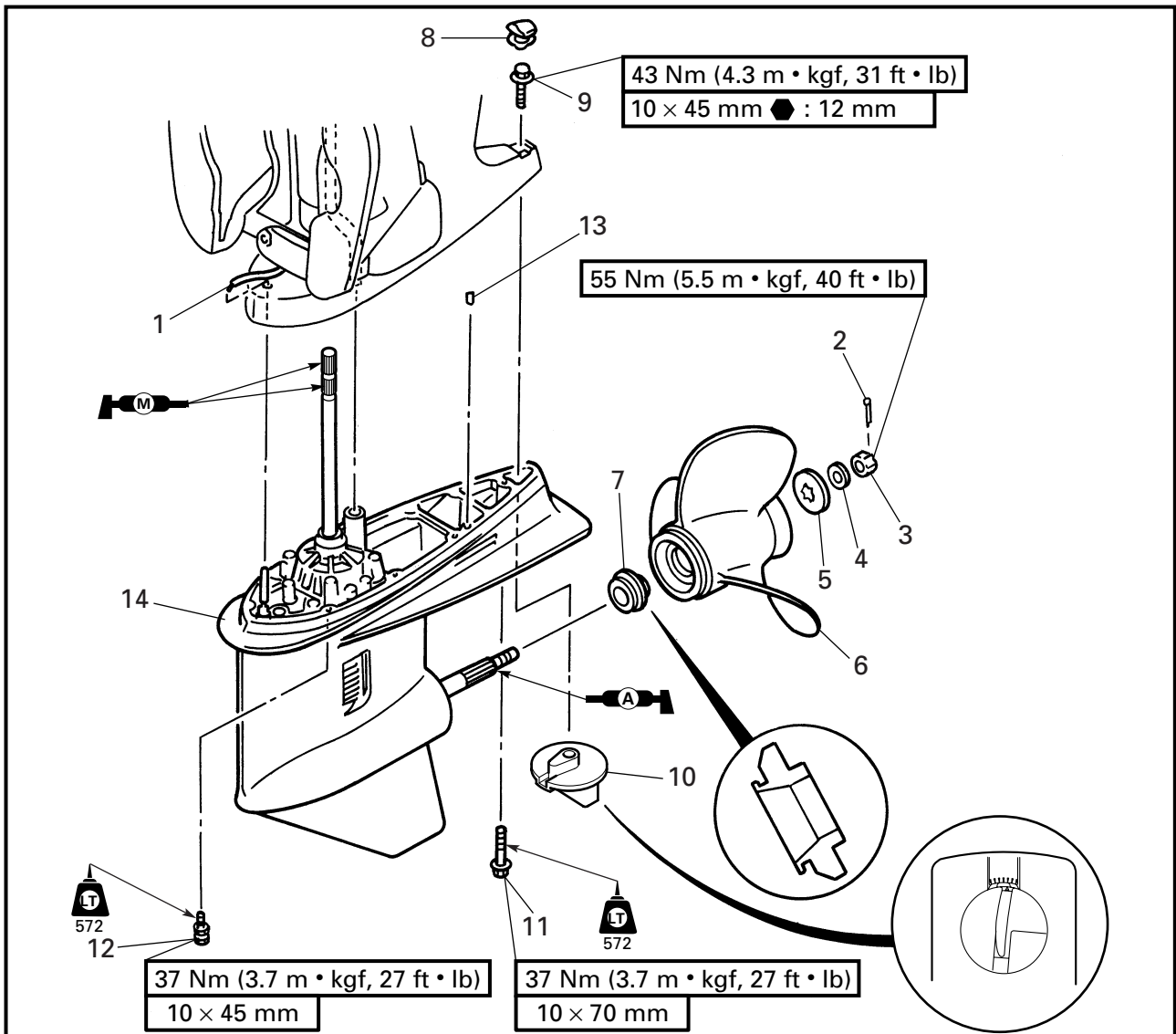
BACKLASH (REGULAR ROTATION MODELS)	6-66
MEASURING THE FORWARD GEAR BACKLASH	6-66
MEASURING THE REVERSE GEAR BACKLASH.....	6-67
 SHIMMING (COUNTER ROTATION MODELS)	
(FOR USA AND CANADA)	6-70
SELECTING THE PINION SHIMS	6-71
SELECTING THE REVERSE GEAR SHIMS.....	6-73
SELECTING THE FORWARD GEAR SHIMS	6-74
SELECTING THE PROPELLER SHAFT SHIMS.....	6-76
 SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)	6-77
SELECTING THE PINION SHIMS	6-78
SELECTING THE REVERSE GEAR SHIMS.....	6-80
SELECTING THE FORWARD GEAR SHIMS	6-81
SELECTING THE PROPELLER SHAFT SHIMS.....	6-83
 BACKLASH (COUNTER ROTATION MODELS)	6-84
MEASURING THE FORWARD GEAR BACKLASH	6-84
MEASURING THE REVERSE GEAR BACKLASH.....	6-85

LOWER UNIT (REGULAR ROTATION MODELS)

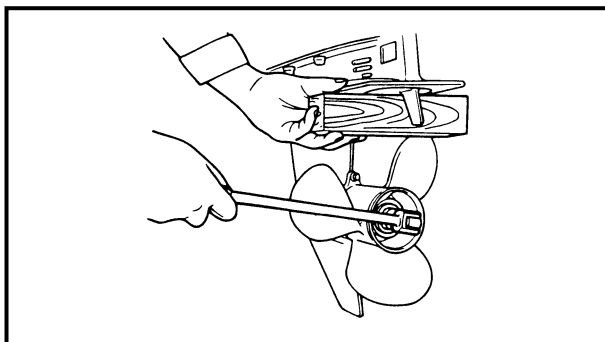
REMOVING/INSTALLING THE LOWER UNIT



Order	Job/Part	Q'ty	Remarks
1	Speedometer hose	1	
2	Cotter pin	1	
3	Propeller nut	1	
4	Washer	1	
5	Washer	1	
6	Propeller	1	
7	Spacer	1	
			Continued on next page.



Order	Job/Part	Q'ty	Remarks
8	Grommet	1	
9	Bolt	1	
10	Trim tab	1	
11	Bolt	1	(with washer)
12	Bolt	6	(with washer)
13	Dowel pin	2	
14	Lower unit	1	
For installation, reverse the removal procedure.			



REMOVING THE PROPELLER

Remove:

- Propeller

⚠ WARNING

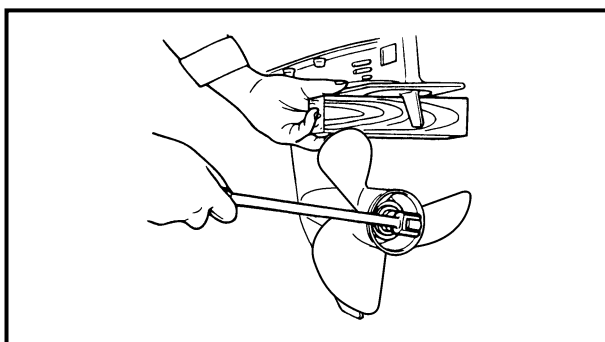
Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the engine stop lanyard from the engine stop lanyard switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

CHECKING THE PROPELLER

Check:

- Blades
- Splines

Cracks/damage/wear → Replace.



INSTALLING THE PROPELLER

Install:

- Propeller

⚠ WARNING

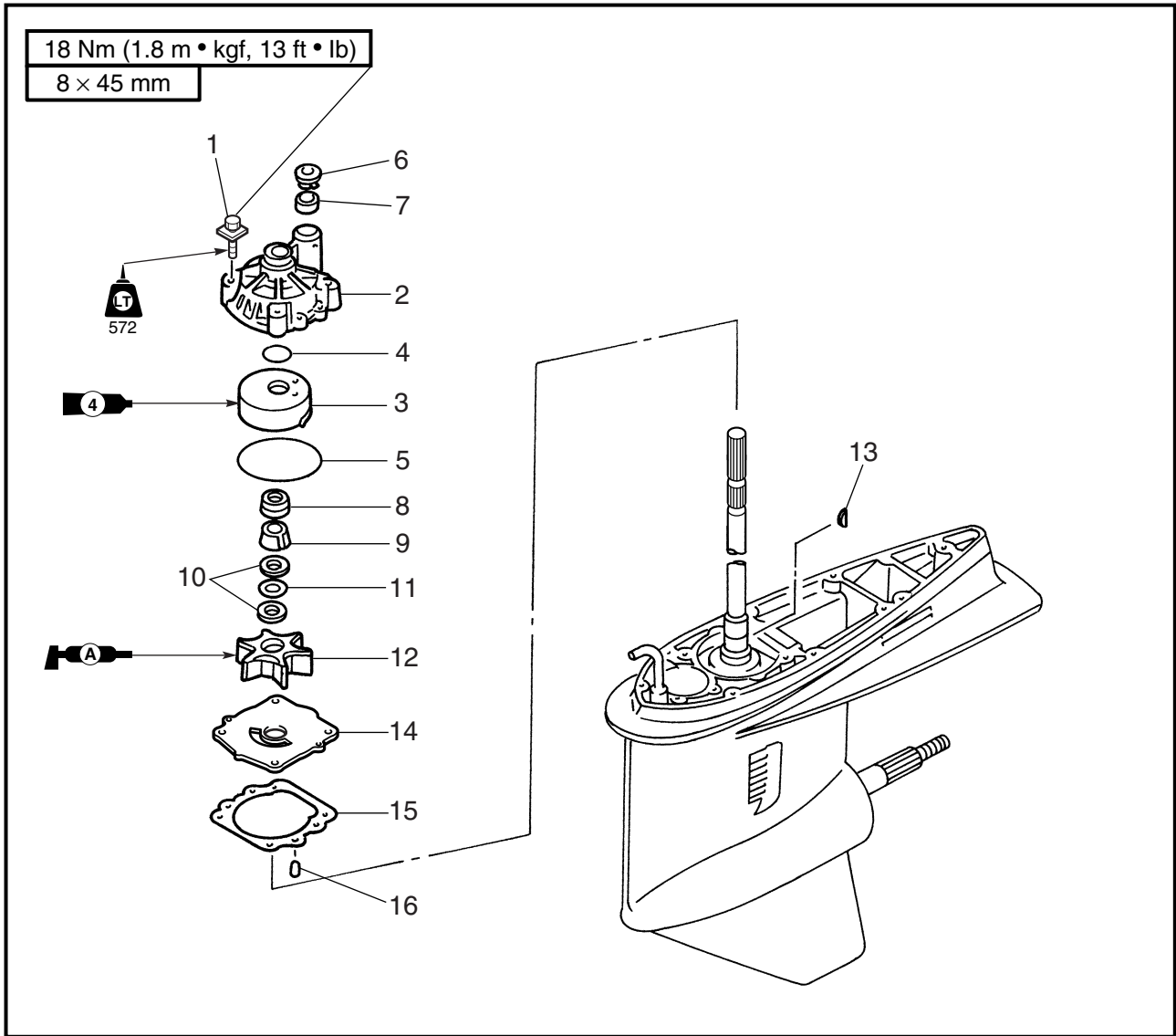
Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the engine stop lanyard from the engine stop lanyard switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

NOTE:

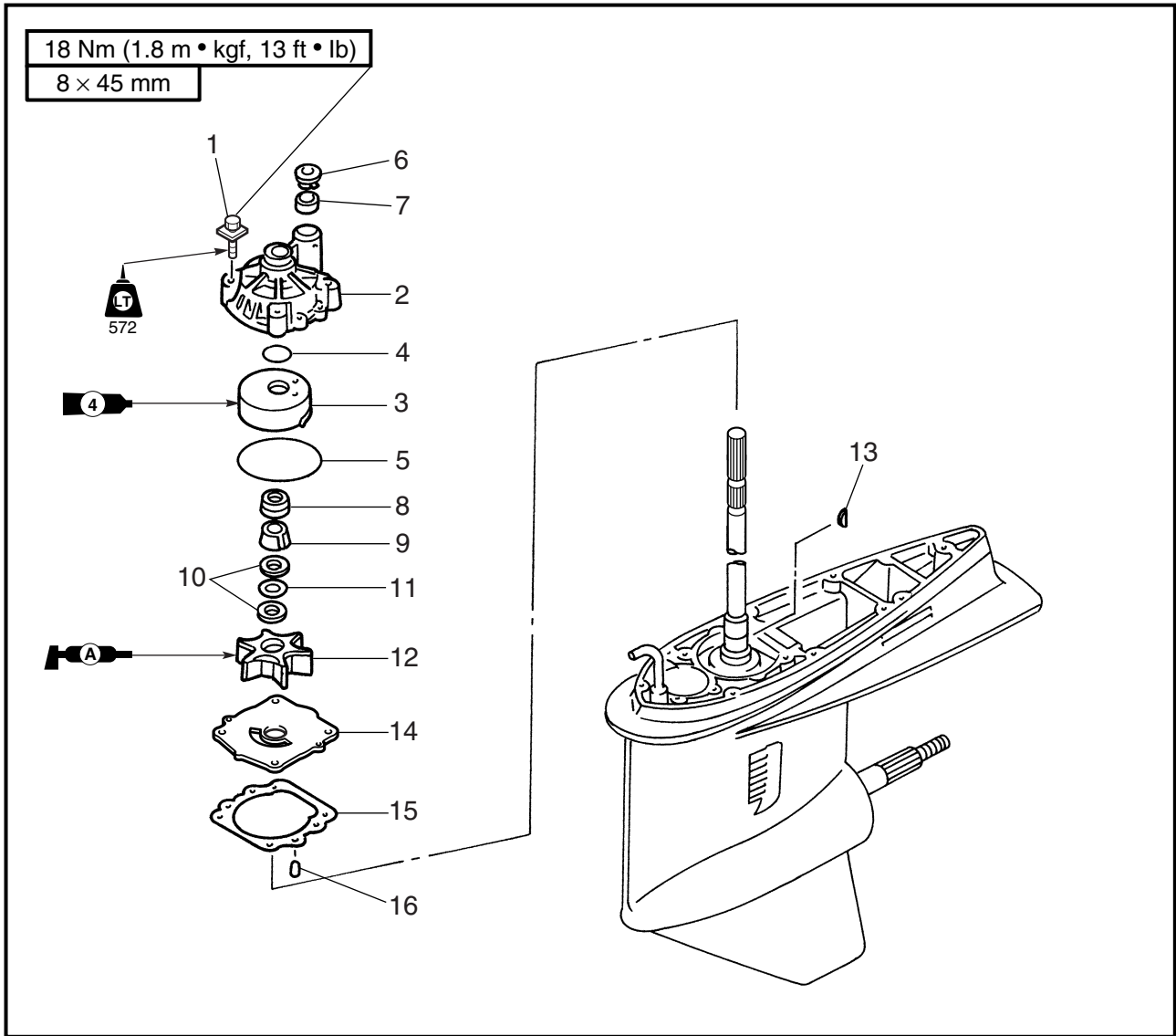
If the groove in the propeller nut is not aligned with the cotter pin hole, tighten the nut further until they are aligned.

WATER PUMP (REGULAR ROTATION MODELS)

REMOVING/INSTALLING THE WATER PUMP



Order	Job/Part	Q'ty	Remarks
	Lower unit		Refer to "LOWER UNIT (REGULAR ROTATION MODELS)" on page 6-1.
1	Bolt	4	
2	Impeller housing	1	
3	Impeller housing cup	1	
4	O-ring	1	
5	O-ring	1	
6	Grommet	1	
7	Spacer	1	
8	Collar	1	
			Continued on next page.



Order	Job/Part	Q'ty	Remarks
9	Spacer	1	Not reusable For installation, reverse the removal procedure.
10	Washer	2	
11	Wave washer	1	
12	Impeller	1	
13	Woodruff key	1	
14	Impeller plate	1	
15	Gasket	1	
16	Dowel pin	2	

CHECKING THE IMPELLER HOUSING

Check:

- Impeller housing
- Cracks/damage → Replace.

CHECKING THE IMPELLER AND IMPELLER HOUSING CUP

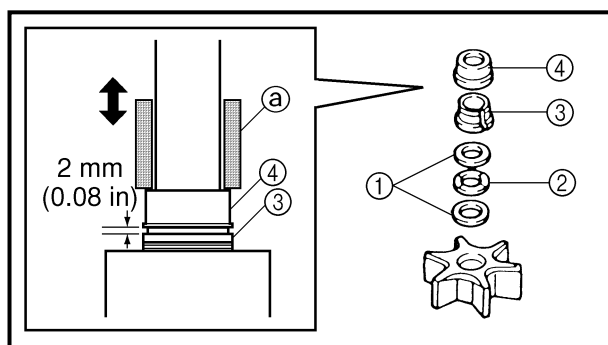
Check:

- Impeller
- Impeller housing cup
- Cracks/damage → Replace any defective parts.

CHECKING THE WOODRUFF KEY

Check:

- Woodruff key
- Damage/wear → Replace.



INSTALLING THE IMPELLER AND IMPELLER HOUSING

1. Install:

- Washers ①
- Wave washer ②
- Spacer ③
- Collar ④

NOTE:

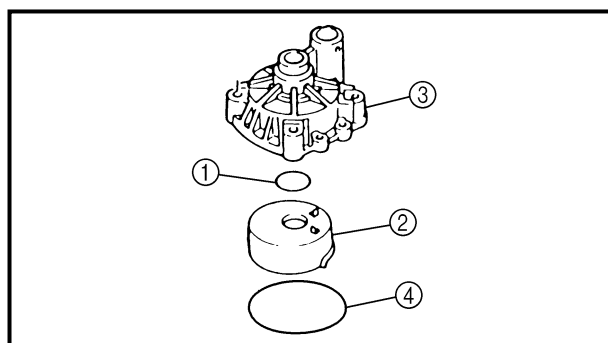
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with some appropriate tool ⑥ that fits over the drive shaft as shown.

2. Install:

- O-ring ①
- Impeller housing cup ②
- Impeller housing ③
- O-ring ④

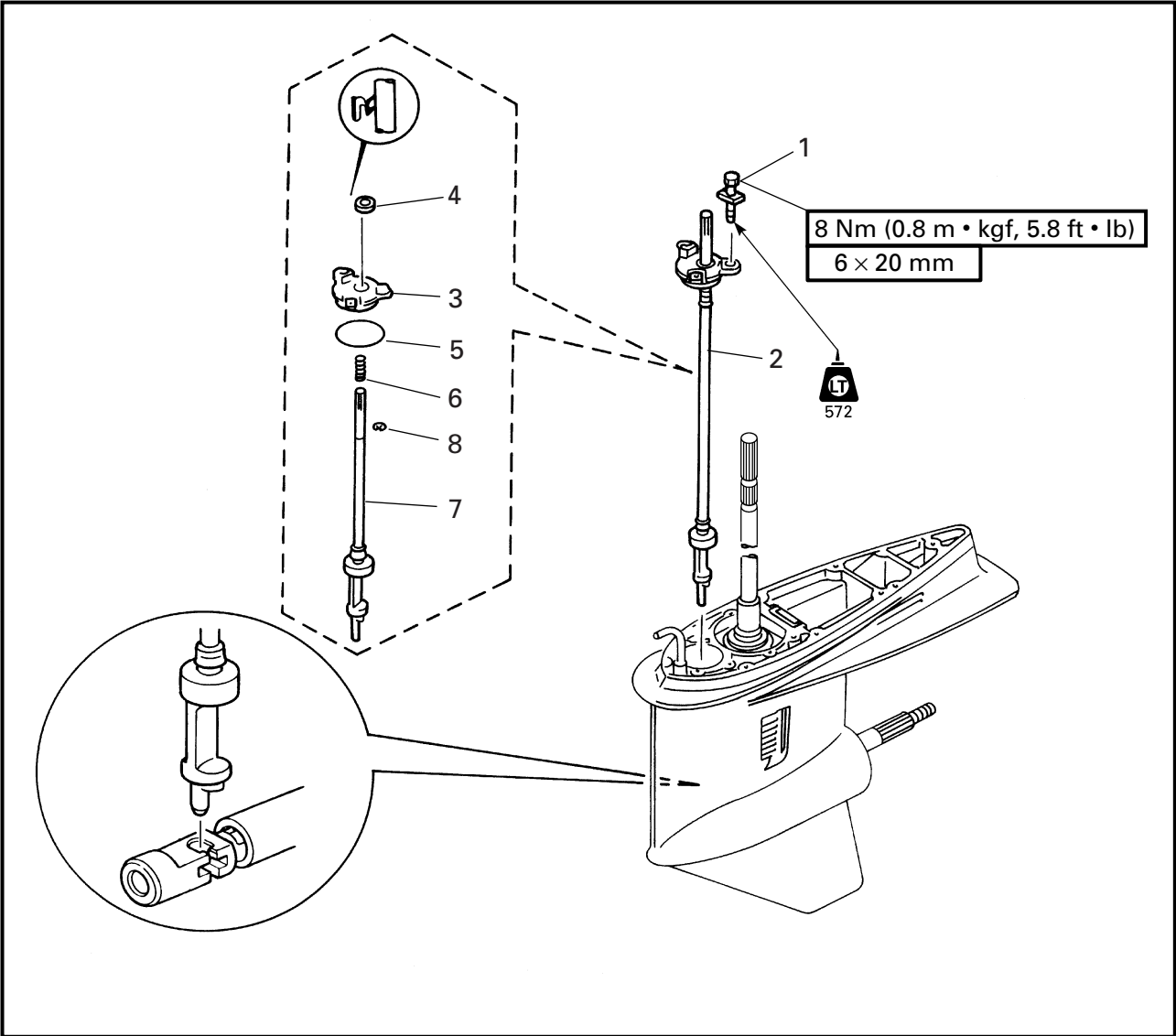
NOTE:

- When installing the impeller housing cup, align its projection with the hole in the impeller housing.
- When installing the water pump housing, turn the drive shaft clockwise.



SHIFT ROD ASSEMBLY (REGULAR ROTATION MODELS)

REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Impeller plate		Refer to "WATER PUMP (REGULAR ROTATION MODELS)" on page 6-4.
1	Bolt	3	(with washer)
2	Shift rod assembly	1	
3	Oil seal housing	1	
4	Oil seal	1	
5	O-ring	1	
6	Spring	1	
7	Shift rod	1	
8	Circlip	1	
			For installation, reverse the removal procedure.



SHIFT ROD ASSEMBLY (REGULAR ROTATION MODELS)

E

REMOVING THE SHIFT ROD ASSEMBLY

Remove:

- Shift rod assembly

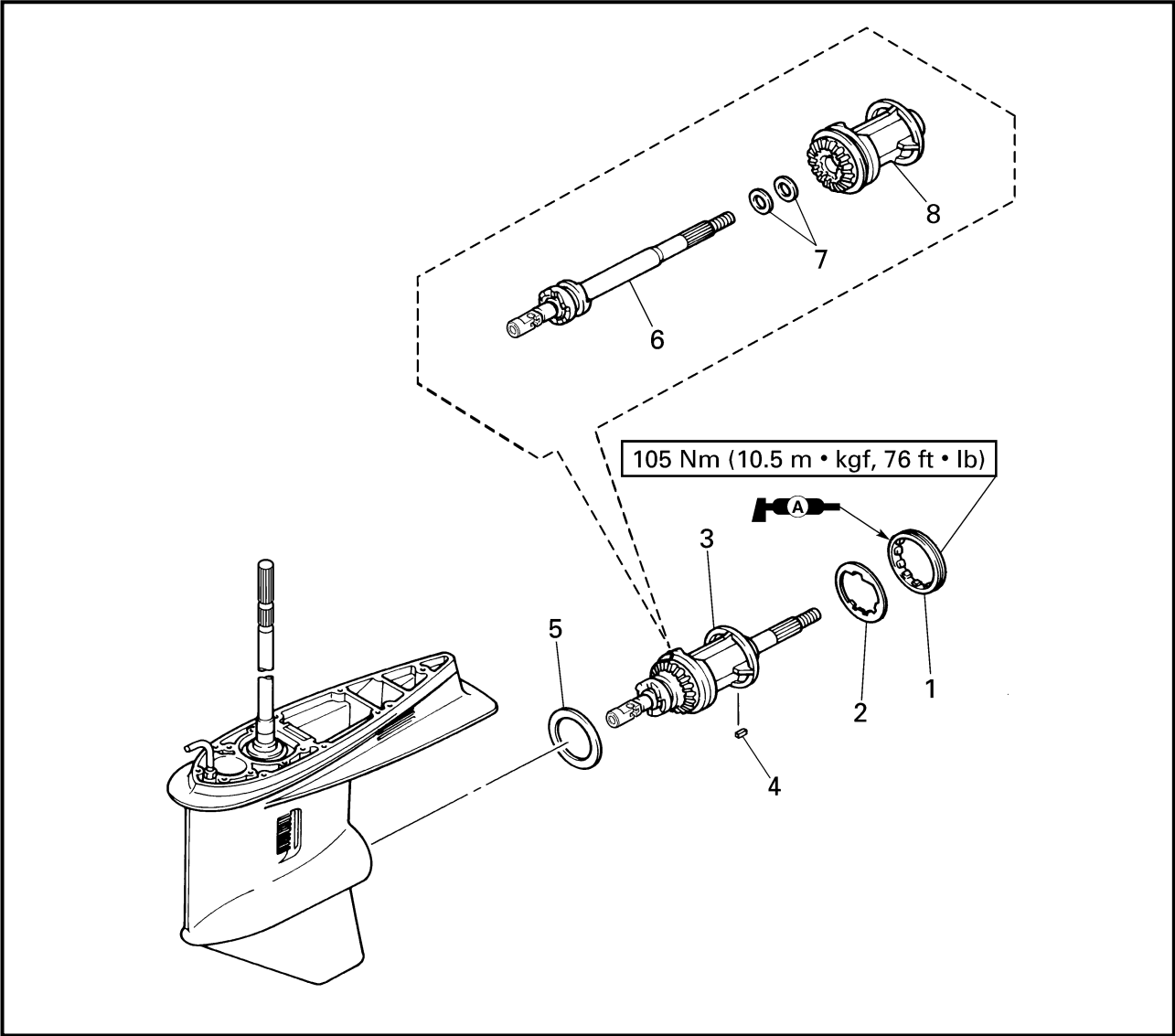
NOTE: _____

Remove the shift rod assembly when the shift rod is in the neutral position.

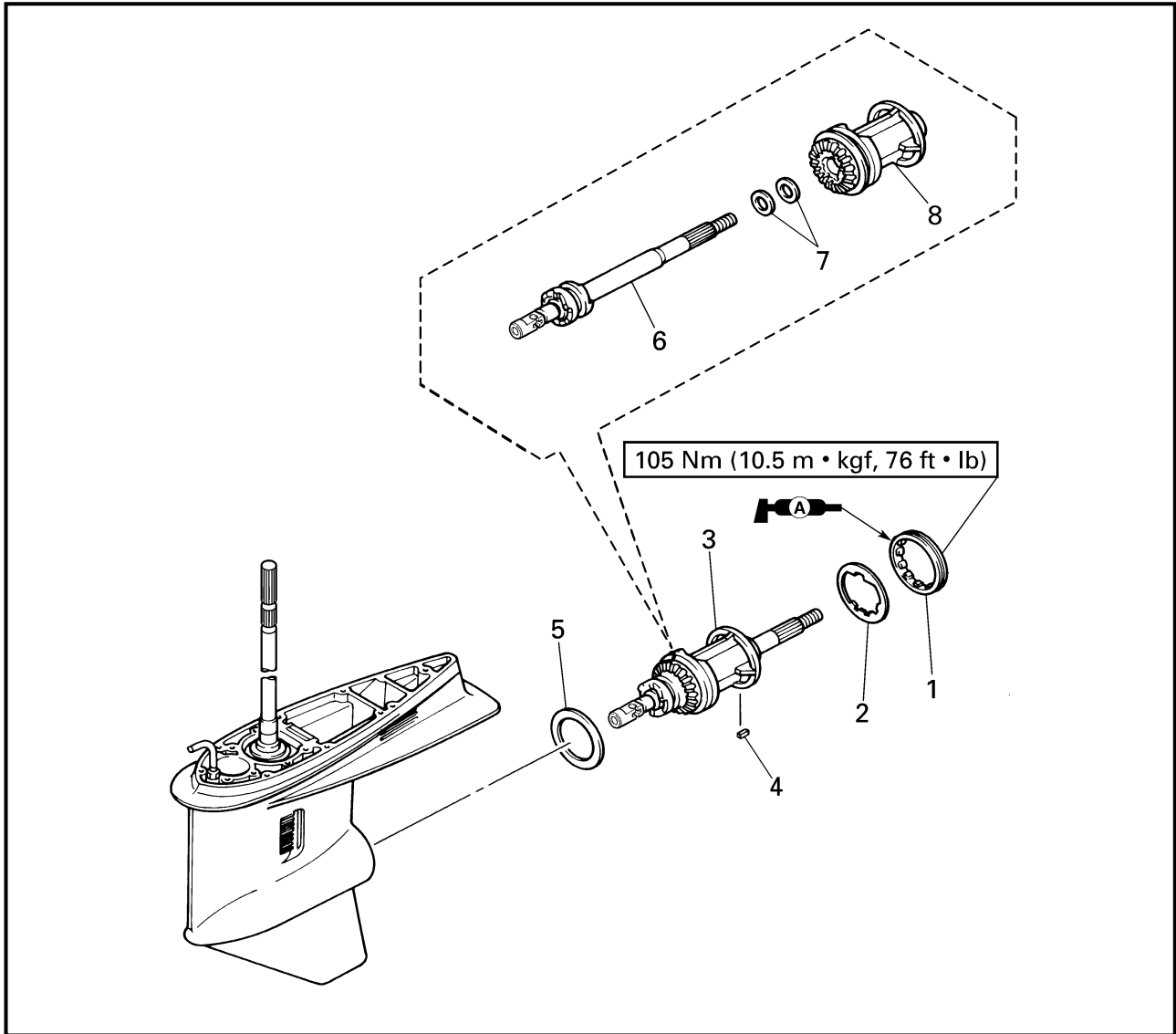
PROPELLER SHAFT HOUSING ASSEMBLY

(REGULAR ROTATION MODELS)

REMOVING/INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY



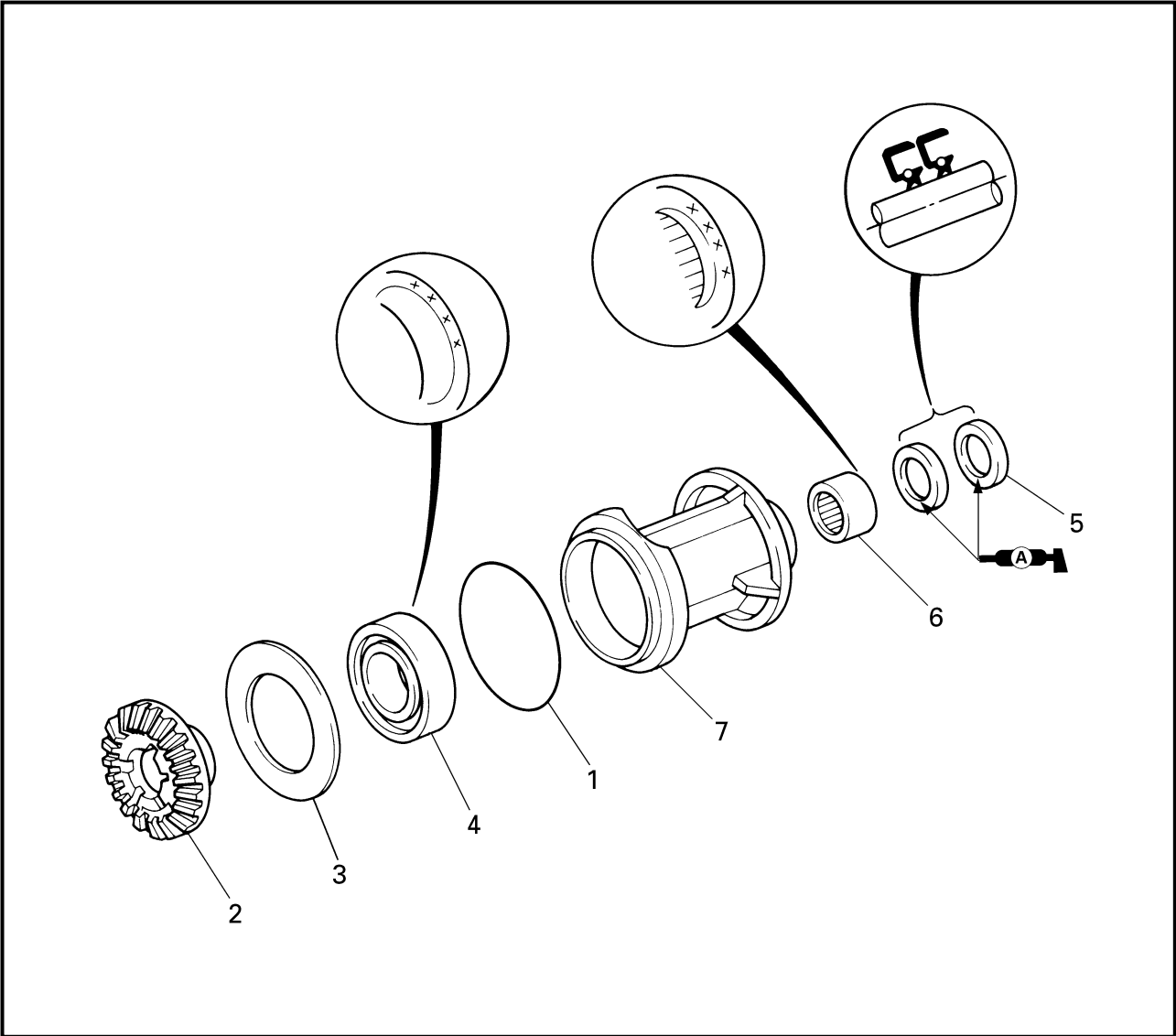
Order	Job/Part	Q'ty	Remarks
	Gear oil		Refer to "CHECKING THE GEAR OIL LEVEL" on page 3-18.
	Shift rod assembly		Refer to "SHIFT ROD ASSEMBLY (REGULAR ROTATION MODELS)" on page 6-7.
1	Ring nut	1	
2	Claw washer	1	
3	Propeller shaft housing assembly	1	
4	Straight key	1	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
5	Reverse gear shim	*	For installation, reverse the removal procedure.
6	Propeller shaft assembly	1	
7	Washer	2	
8	Propeller shaft housing	1	

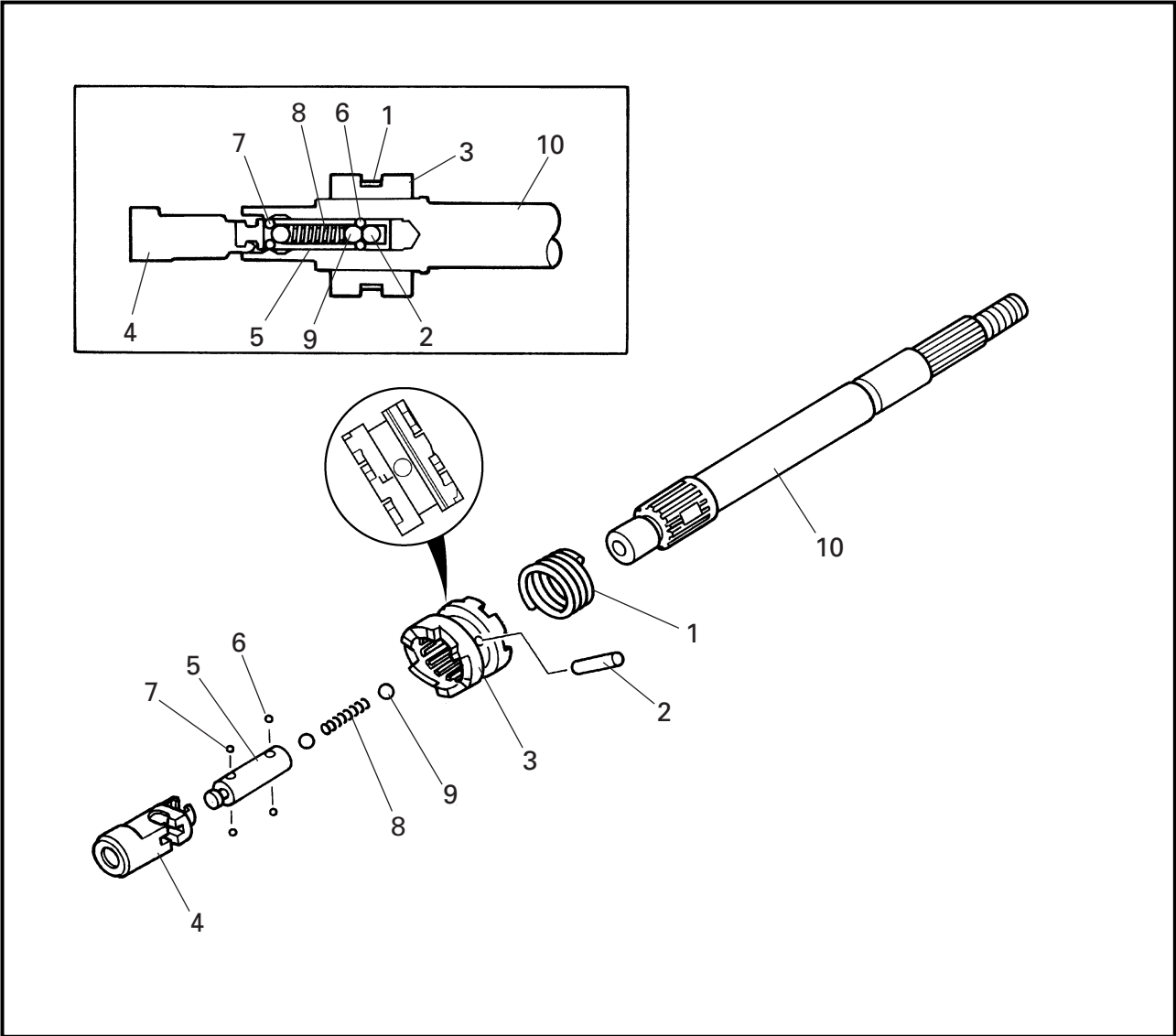
*: As required

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING

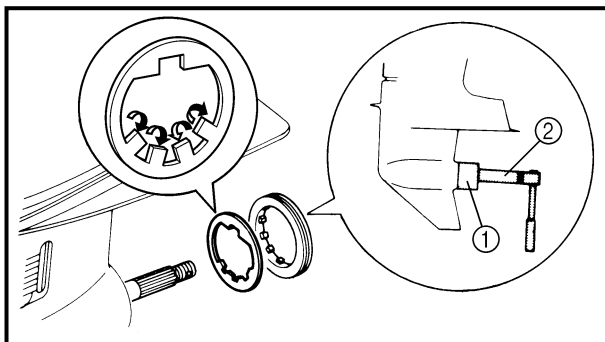


Order	Job/Part	Q'ty	Remarks
1	O-ring	1	For assembly, reverse the disassembly procedure.
2	Reverse gear	1	
3	Thrust washer	1	
4	Ball bearing	1	
5	Oil seal	2	
6	Needle bearing	1	
7	Propeller shaft housing	1	

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Spring	1	For assembly, reverse the disassembly procedure.
2	Pin	1	
3	Dog clutch	1	
4	Shift rod joint	1	
5	Shift rod joint slider	1	
6	Ball	2	
7	Ball	2	
8	Spring	1	
9	Ball	2	
10	Propeller shaft	1	



REMOVING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. Straighten:
 - Claw washer tabs
2. Remove:
 - Ring nut
 - Claw washer

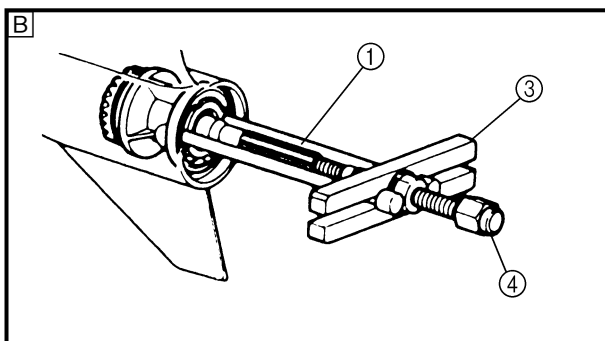
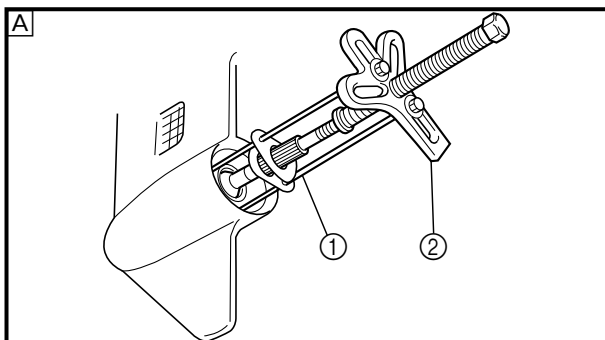


Ring nut wrench ①
YB-34447 / 90890-06511
Ring nut wrench extension ②
90890-06513

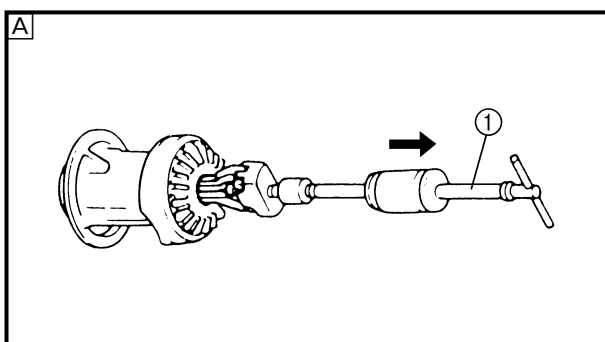
3. Remove:
 - Propeller shaft housing assembly



Propeller shaft housing puller . ①
YB-06207 / 90890-06502
Universal puller..... ②
YB-06117
Guide plate..... ③
90890-06501
Center bolt ④
90890-06504



- A** For USA and Canada
B For worldwide

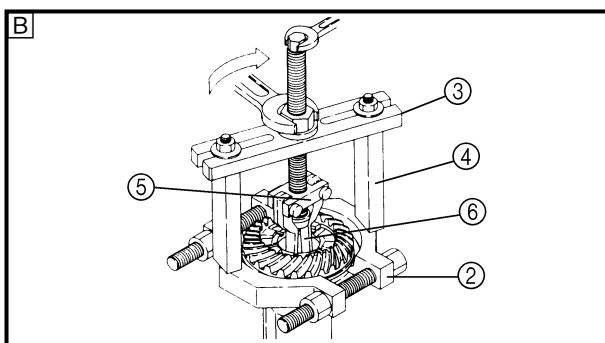


DISASSEMBLING THE PROPELLER SHAFT HOUSING

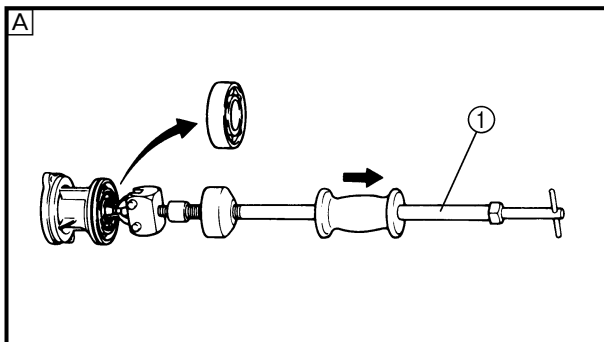
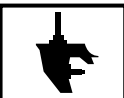
1. Remove:
 - Reverse gear



Slide hammer..... ①
YB-06096
Bearing separator..... ②
90890-06534
Guide plate..... ③
90890-06501
Guide plate stand ④
90890-06538
Bearing puller..... ⑤
90890-06535
Small universal claws ⑥
90890-06536



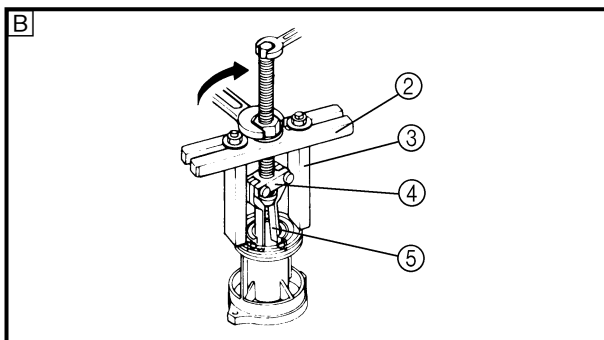
- A** For USA and Canada
B For worldwide



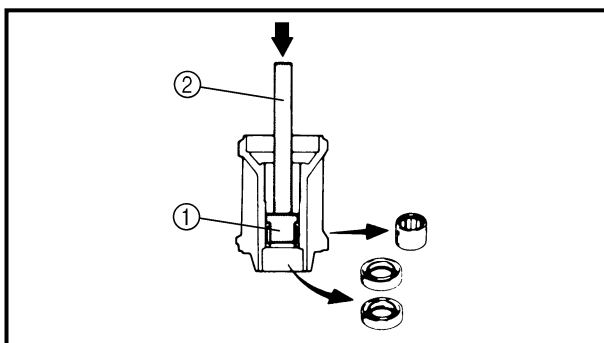
2. Remove:
- Ball bearing



Slide hammer.....	①
YB-06096	
Guide plate.....	②
90890-06501	
Guide plate stand	③
90890-06538	
Bearing puller.....	④
90890-06535	
Small universal claws	⑤
90890-06536	



- A** For USA and Canada
B For worldwide



3. Remove:
- Oil seal
 - Needle bearing



Bearing/oil seal attachment	①
YB-06196 / 90890-06653	
Driver rod	②
YB-06071 / 90890-06652	

CHECKING THE REVERSE GEAR

Check:

- Teeth
- Dogs

Wear/damage → Replace the reverse gear.

CHECKING THE BEARING

Check:

- Bearing

Pitting/rumbling → Replace.

CHECKING THE PROPELLER SHAFT HOUSING

Check:

- Propeller shaft housing

Cracks/damage → Replace.

CHECKING THE DOG CLUTCH

Check:

- Dog clutch
- Damage/wear → Replace.

CHECKING THE PROPELLER SHAFT

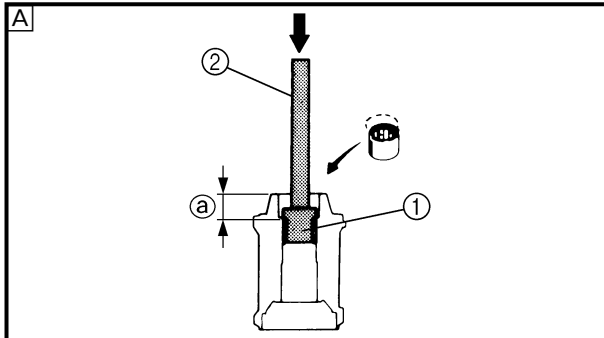
Check:

- Propeller shaft
- Damage/wear → Replace.

ASSEMBLING THE PROPELLER SHAFT HOUSING

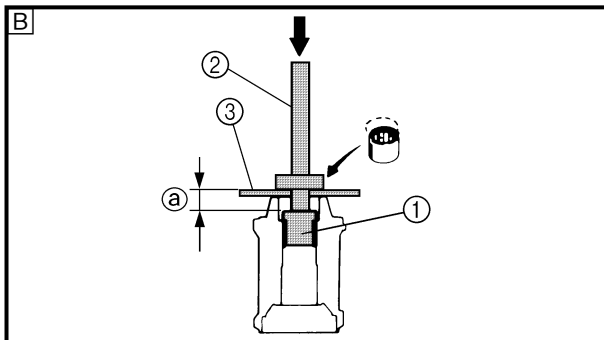
1. Install:

- Needle bearing



Needle bearing installation position ①

24.75 - 25.25 mm
(0.974 - 0.994 in)



Bearing/oil seal attachment ①
YB-06196 / 90890-06653

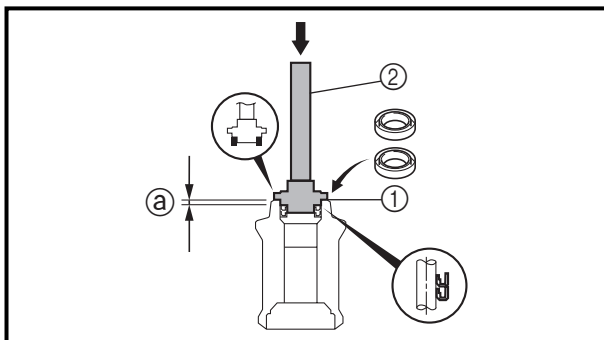
Driver rod ②
YB-06071 / 90890-06604

Bearing/oil seal depth plate ③
90890-06603

- A For USA and Canada
- B For worldwide

2. Install:

- Oil seal



Oil seal installation position ①

4.75 - 5.25 mm (0.187 - 0.207 in)

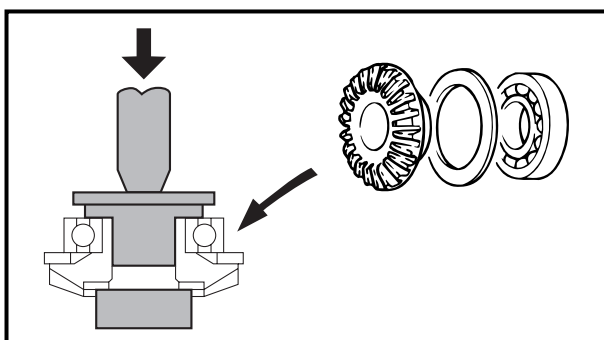
Bearing/oil seal attachment ①
YB-06195

Driver rod ②
YB-06071

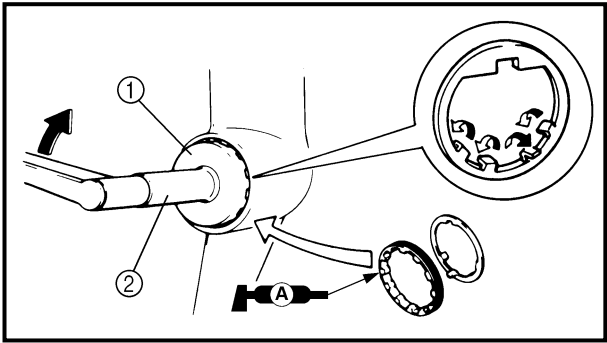
ASSEMBLING THE REVERSE GEAR

Install:

- Ball bearing



Bearing/oil seal attachment
YB-06200 / 90890-06661



INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY

- Install:

 - Propeller shaft housing assembly
 - Claw washer
 - Ring nut

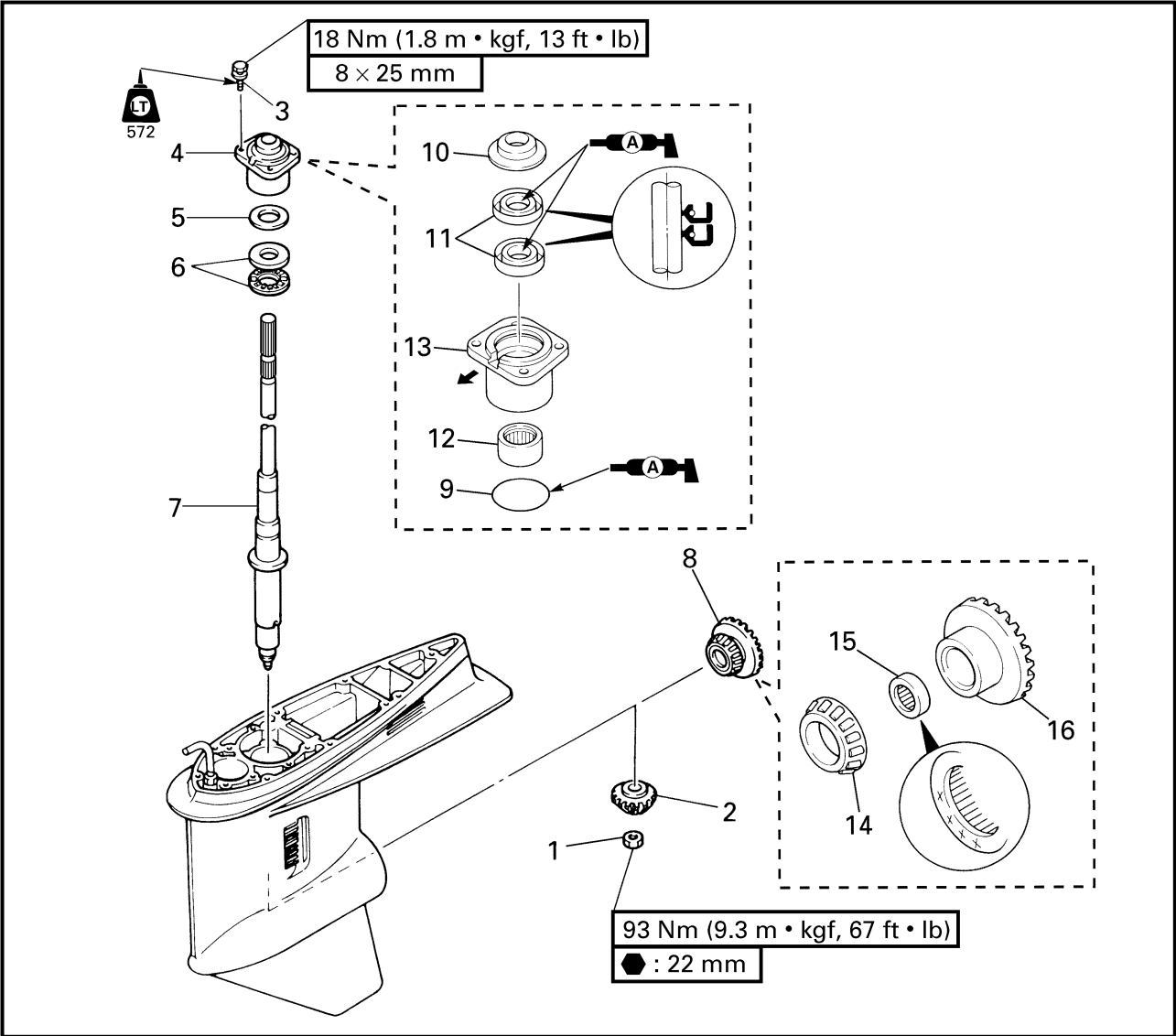
	Ring nut wrench	①
	YB-34447 / 90890-06511	
	Ring nut wrench extension	②
	90890-06513	

NOTE:

To secure the ring nut, bend one tab into the slot in the ring nut and the other tabs toward the propeller shaft housing assembly.

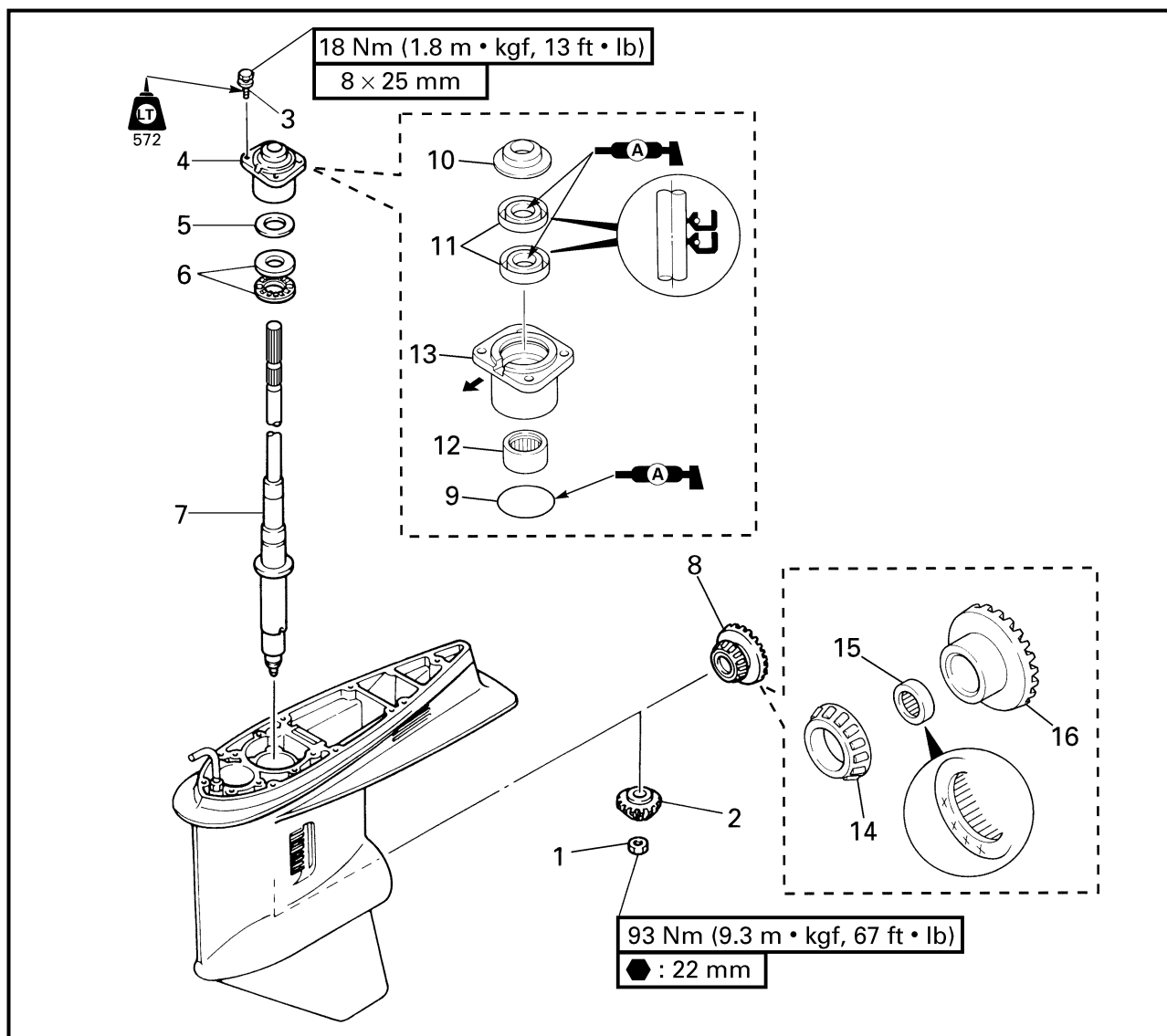
DRIVE SHAFT (REGULAR ROTATION MODELS)

REMOVING/INSTALLING THE DRIVE SHAFT

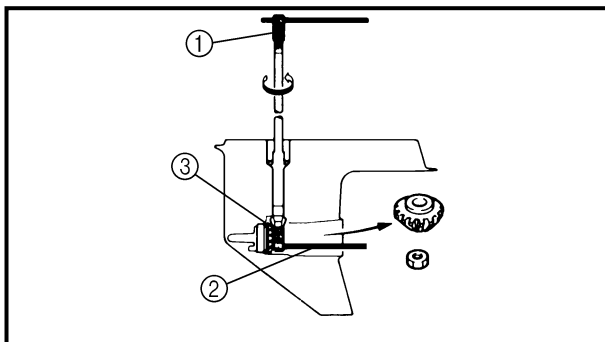


Order	Job/Part	Q'ty	Remarks
	Propeller shaft housing assembly		Refer to "PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)" on page 6-9.
1	Nut	1	
2	Pinion	1	
3	Bolt	4	(with washer)
4	Drive shaft housing assembly	1	
5	Pinion shim	*	
6	Thrust bearing	1	
7	Drive shaft	1	
Continued on next page.			

*: As required



Order	Job/Part	Q'ty	Remarks
8	Forward gear assembly	1	Not reusable Not reusable For installation, reverse the removal procedure.
9	O-ring	1	
10	Oil seal cover	1	
11	Oil seal	2	
12	Needle bearing	1	
13	Drive shaft housing	1	
14	Tapered roller bearing	1	
15	Needle bearing	1	
16	Forward gear	1	



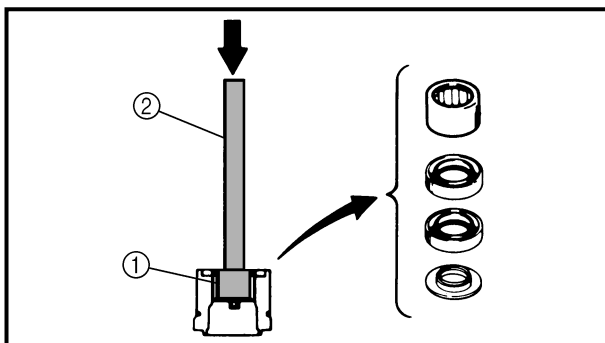
REMOVING THE DRIVE SHAFT

Loosen:

- Pinion nut



- | | |
|--------------------------------|---|
| Drive shaft holder | ① |
| YB-06151 / 90890-06519 | |
| Pinion nut holder | ② |
| 90890-06505 | |
| Pinion nut holder attachment . | ③ |
| 90890-06507 | |



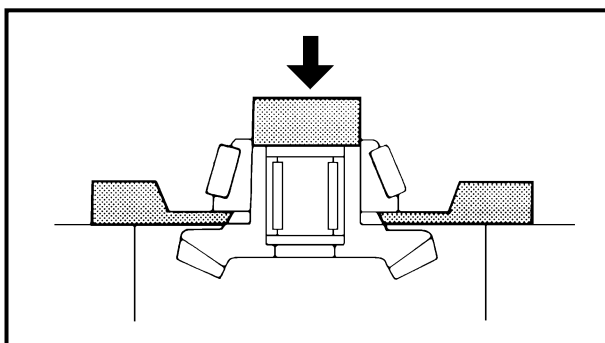
DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY

Remove:

- Needle bearing



- | | |
|----------------------------------|---|
| Bearing/oil seal attachment | ① |
| YB-06196 / 90890-06610 | |
| Driver rod | ② |
| YB-06071 / 90890-06652 | |



DISASSEMBLING THE FORWARD GEAR ASSEMBLY

1. Remove:

- Tapered roller bearing



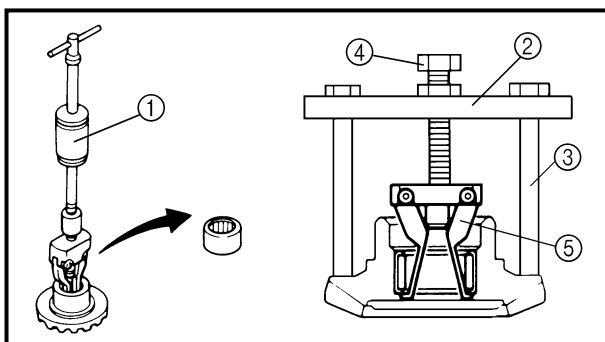
- | | |
|------------------------|--|
| Bearing separator | |
| YB-06219 / 90890-06534 | |

CAUTION:

Do not reuse the bearing, always replace it with a new one.

2. Remove:

- Needle bearing



- | | |
|-----------------------------|---|
| Slide hammer..... | ① |
| YB-06096 | |
| Guide plate..... | ② |
| 90890-06501 | |
| Guide plate stand | ③ |
| 90890-06538 | |
| Bearing puller..... | ④ |
| 90890-06535 | |
| Small universal claws | ⑤ |
| 90890-06536 | |

CHECKING THE PINION

- Check:
- Teeth
- Damage/wear → Replace.

CHECKING THE DRIVE SHAFT

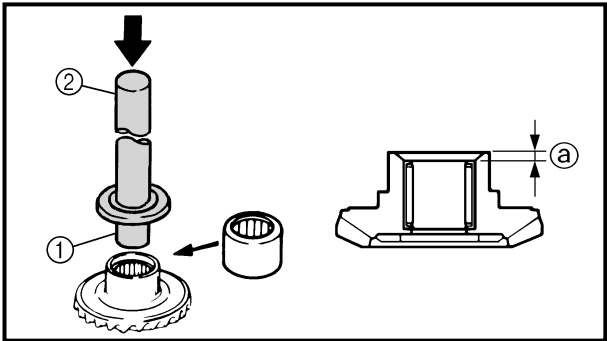
- Check:
- Drive shaft
- Damage/wear → Replace.

CHECKING THE DRIVE SHAFT HOUSING

- Check:
- Drive shaft housing
- Cracks/damage → Replace.

CHECKING THE BEARINGS

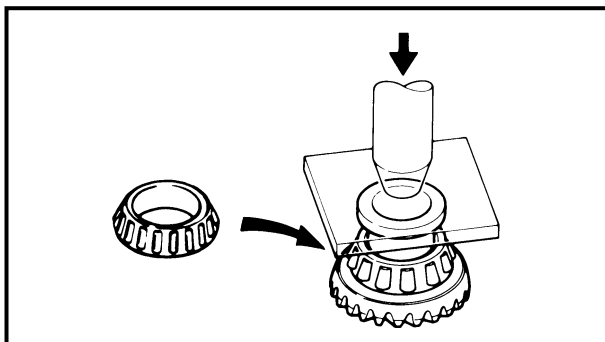
- Check:
- Bearings
- Pitting/rumbling → Replace.



ASSEMBLING THE FORWARD GEAR ASSEMBLY

1. Install:
- Needle bearing

	Needle bearing installation position ① 2.5 - 3.5 mm (0.098 - 0.138 in)
	Bearing/oil seal attachment ① YB-06200 / 90890-06612 Driver rod ② YB-06071 / 90890-06604

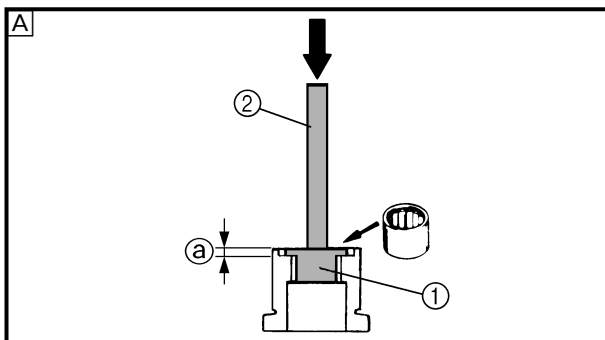


2. Install:

- Tapered roller bearing



Bearing/oil seal attachment
YB-06200 / 90890-06661



ASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY

1. Install:

- Needle bearing



Position ①
5.75 - 6.25 mm (0.226 - 0.246 in)



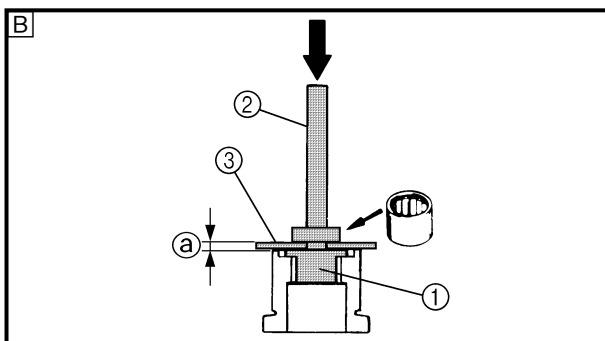
Bearing/oil seal attachment ①
YB-06196 / 90890-06610

Driver rod ②

YB-06071 / 90890-06604

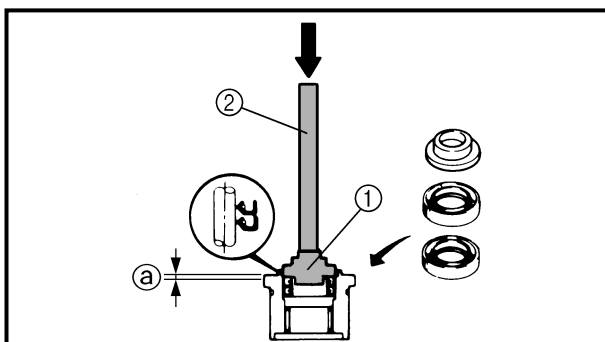
Bearing/oil seal depth plate ③

90890-06603



A For USA and Canada

B For worldwide



2. Install:

- Oil seal



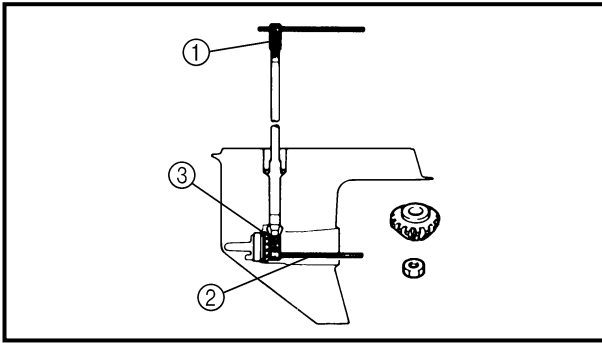
Oil seal installation position ①
0.25 - 0.75 mm (0.010 - 0.030 in)



Bearing/oil seal attachment ①
YB-06195 / 90890-06633

Driver rod ②

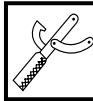
YB-06071 / 90890-06652



INSTALLING THE DRIVE SHAFT

Tighten:

- Pinion nut



Drive shaft holder ①

YB-06151 / 90890-06519

Pinion nut holder ②

90890-06505

Pinion nut holder attachment . ③

90890-06507



Pinion nut

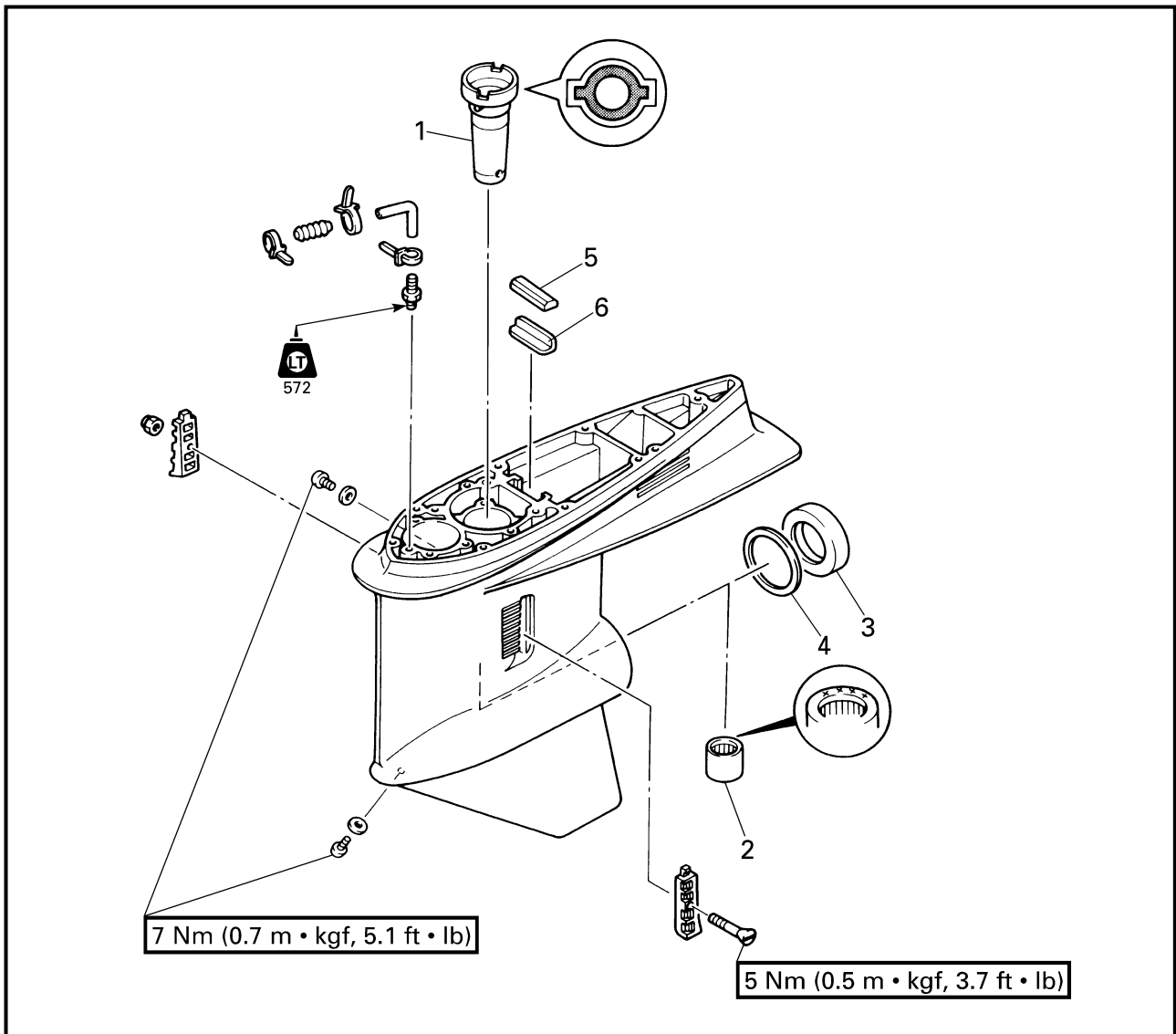
93 Nm (9.3 m • kgf, 67 ft • lb)



LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)

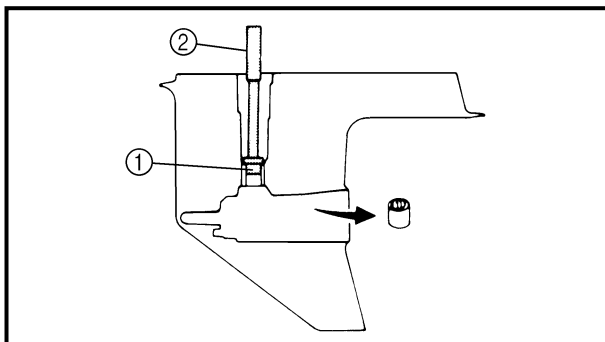
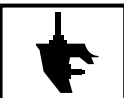
E

LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS) DISASSEMBLING/ASSEMBLING THE LOWER CASE ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Forward gear		Refer to "DRIVE SHAFT (REGULAR ROTATION MODELS)" on page 6-17.
1	Drive shaft sleeve	1	
2	Needle bearing	1	
3	Tapered roller bearing outer race	1	
4	Forward gear shim	*	
5	Water seal	1	
6	Plate	1	
			For assembly, reverse the disassembly procedure.

*: As required

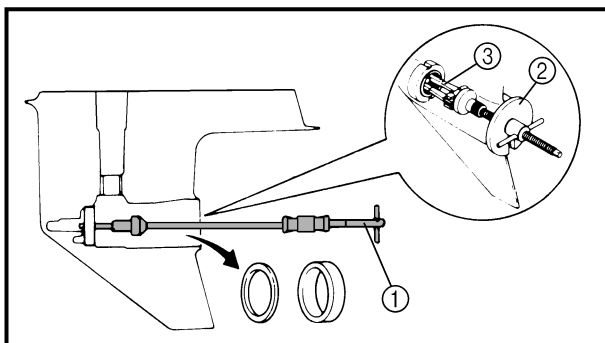


DISASSEMBLING THE LOWER CASE ASSEMBLY

1. Remove:
 - Needle bearing



Bearing/oil seal attachment ①
YB-06194 / 90890-06636
Driver rod ②
YB-06071 / 90890-06605



2. Remove:
 - Tapered roller bearing outer race



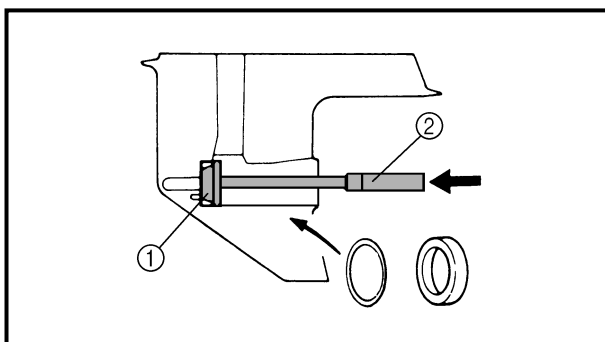
Slide hammer..... ①
YB-06096
Bearing puller..... ②
90890-06523
Large universal claws..... ③
90890-06532

CHECKING THE DRIVE SHAFT SLEEVE

- Check:
- Drive shaft sleeve
- Damage/wear → Replace.

CHECKING THE NEEDLE BEARING

- Check:
- Needle bearing
- Pitting/rumbling → Replace.



ASSEMBLING THE LOWER CASE ASSEMBLY

1. Install:
 - Tapered roller bearing outer race

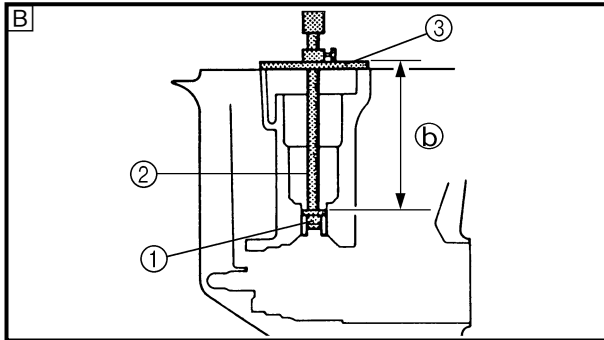
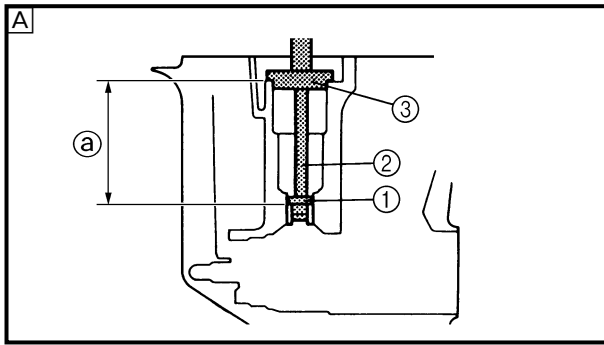


Bearing/oil seal attachment ①
YB-06199 / 90890-06620
Driver rod ②
YB-06071 / 90890-06605



LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)

E



2. Install:

- Needle bearing



Needle bearing installation position ①

168 ± 0.25 mm (6.61 ± 0.01 in)

Needle bearing installation position ②

184.0 mm (7.24 in)



Bearing/oil seal attachment ①

YB-06194 / 90890-06636

Driver rod ②

YB-06071 / 90890-06602

Bearing/oil seal depth plate ③

YB-06213 / 90890-06603

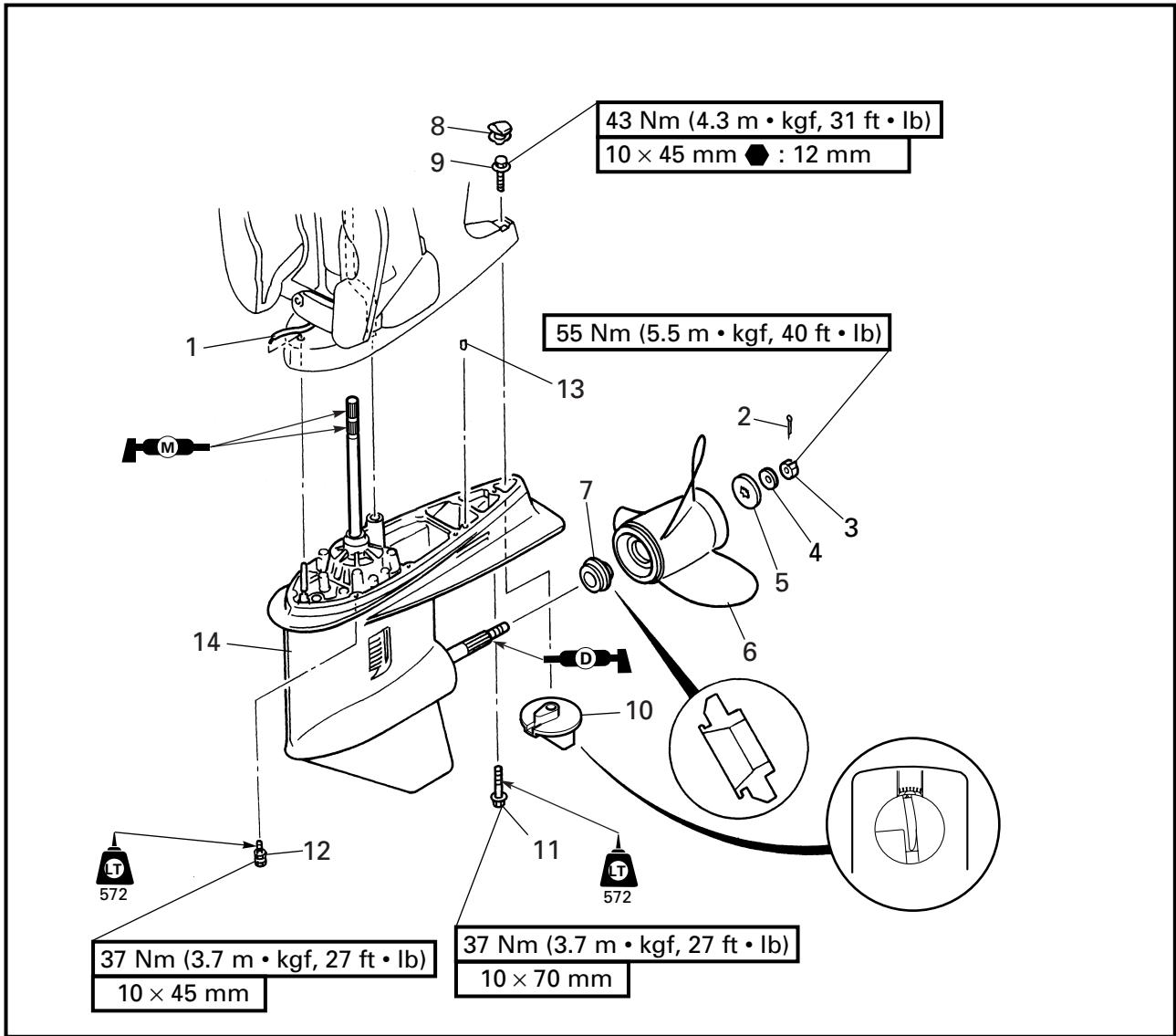
YB-34474

A For USA and Canada

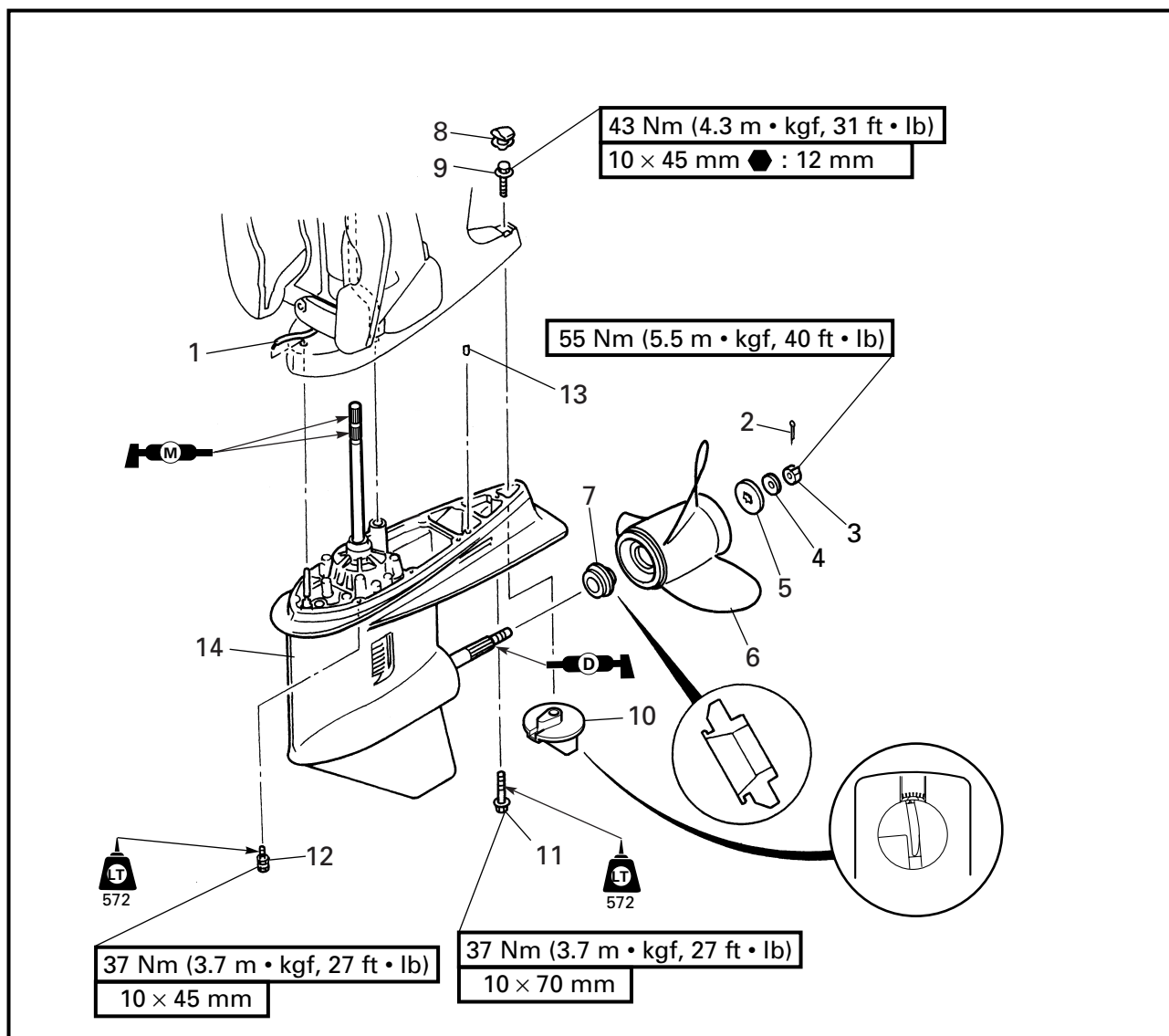
B For worldwide

LOWER UNIT (COUNTER ROTATION MODELS)

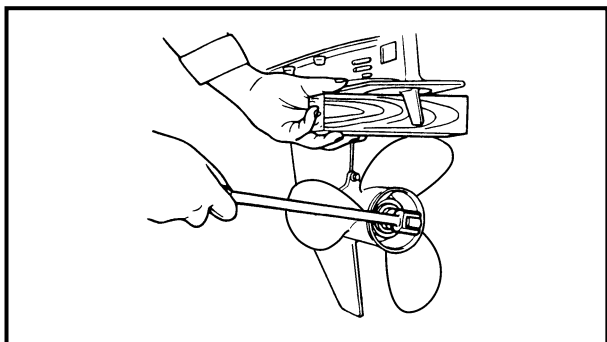
REMOVING/INSTALLING THE LOWER UNIT



Order	Job/Part	Q'ty	Remarks
1	Speedometer hose	1	Continued on next page.
2	Cotter pin	1	
3	Propeller nut	1	
4	Washer	1	
5	Washer	1	
6	Propeller	1	
7	Spacer	1	



Order	Job/Part	Q'ty	Remarks
8	Grommet	1	
9	Bolt	1	
10	Trim tab	1	
11	Bolt	1	(with washer)
12	Bolt	6	(with washer)
13	Dowel pin	2	
14	Lower unit	1	
			For installation, reverse the removal procedure.



REMOVING THE PROPELLER

Remove:

- Propeller

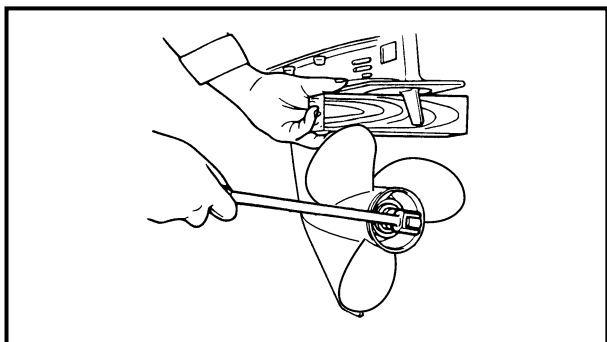
⚠ WARNING

Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the engine stop lanyard from the engine stop lanyard switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

CHECKING THE PROPELLER

Check:

- Blades
 - Splines
- Cracks/damage/wear → Replace.



INSTALLING THE PROPELLER

Install:

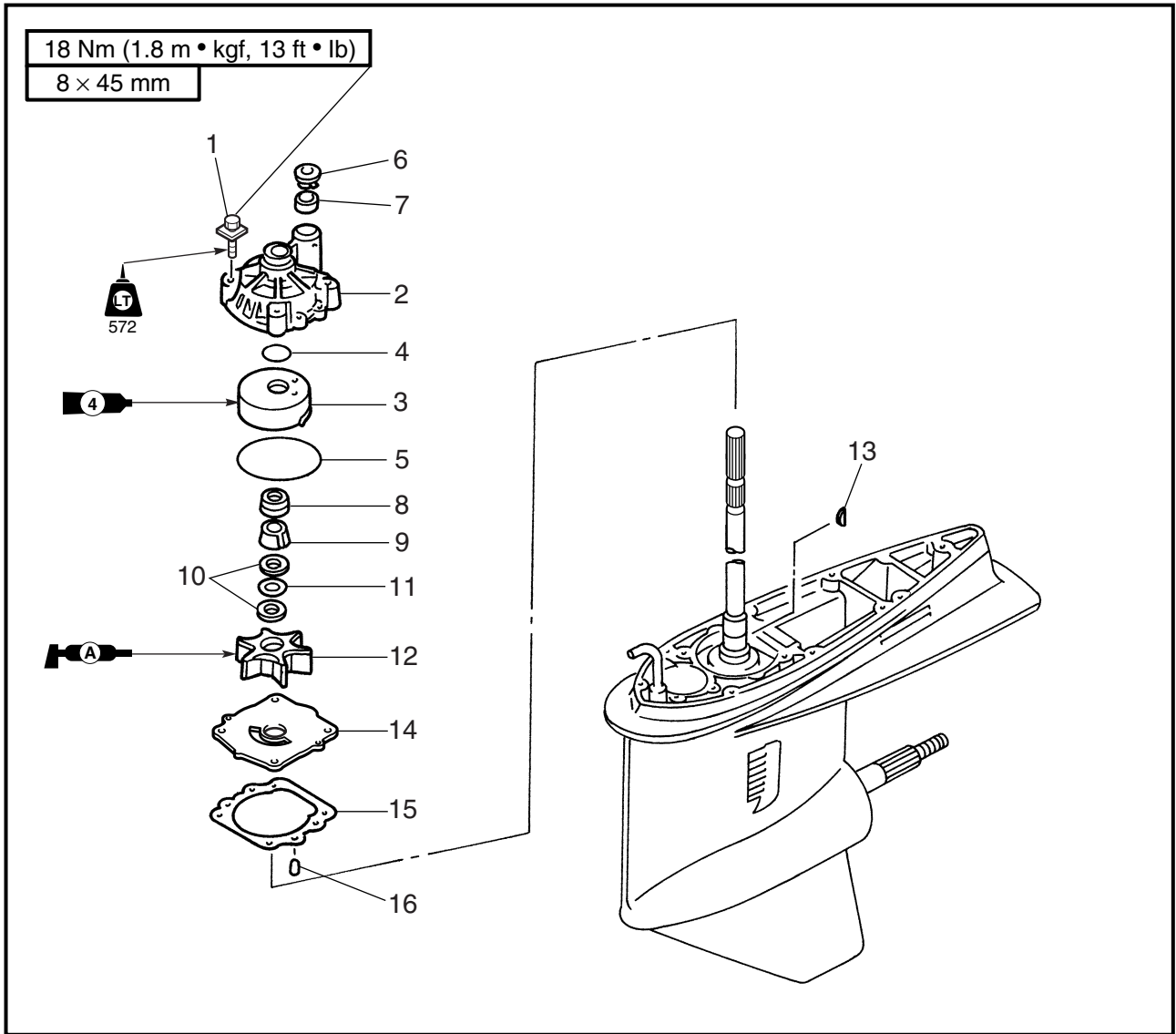
- Propeller

⚠ WARNING

Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the engine stop lanyard from the engine stop lanyard switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

NOTE:

If the groove in the propeller nut is not aligned with the cotter pin hole, tighten the nut further until they are aligned.



Order	Job/Part	Q'ty	Remarks
9	Spacer	1	Not reusable For installation, reverse the removal procedure.
10	Washer	2	
11	Wave washer	1	
12	Impeller	1	
13	Woodruff key	1	
14	Impeller plate	1	
15	Gasket	1	
16	Dowel pin	2	

CHECKING THE IMPELLER HOUSING

Check:

- Impeller housing
Cracks/damage → Replace.

CHECKING THE IMPELLER AND IMPELLER HOUSING CUP

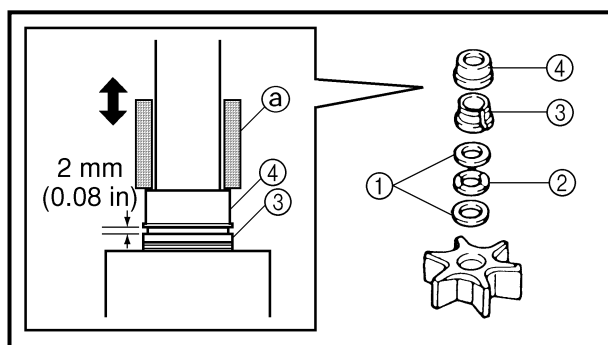
Check:

- Impeller
- Impeller housing cup
Cracks/damage → Replace any defective parts.

CHECKING THE WOODRUFF KEY

Check:

- Woodruff key
Damage/wear → Replace.



INSTALLING THE IMPELLER AND IMPELLER HOUSING

1. Install:

- Washers ①
- Wave washer ②
- Spacer ③
- Collar ④

NOTE:

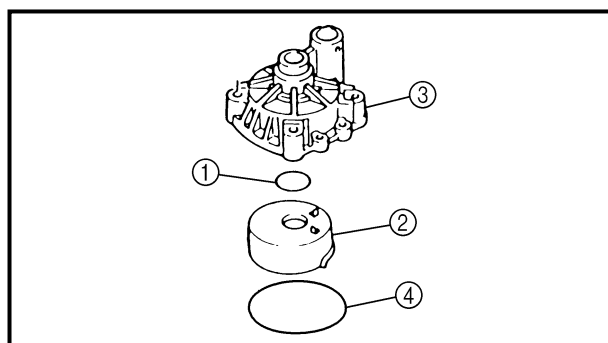
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with some appropriate tool (a) that fits over the drive shaft as shown.

2. Install:

- O-ring ①
- Impeller housing cup ②
- Impeller housing ③
- O-ring ④

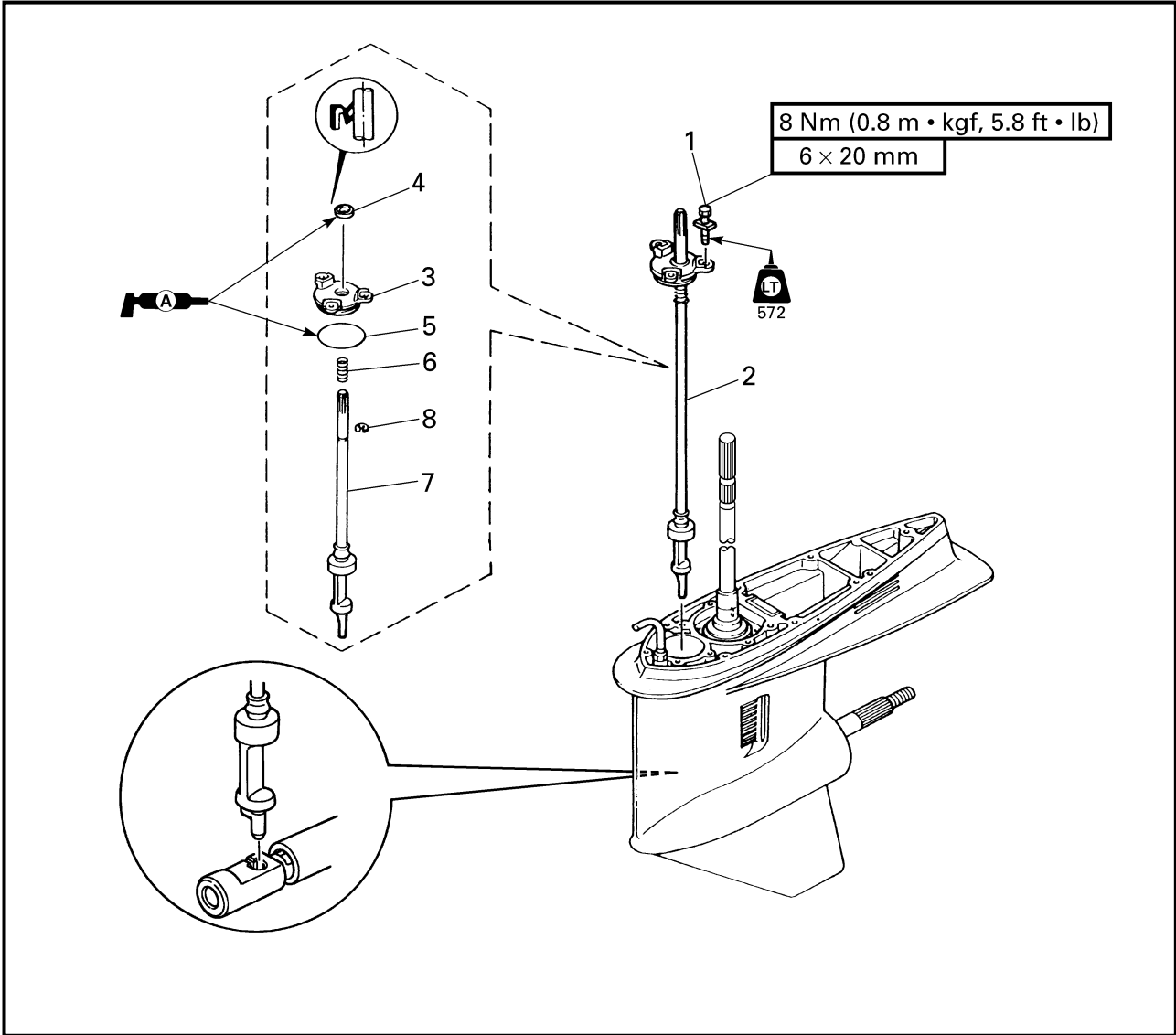
NOTE:

- When installing the impeller housing cup, align its projection with the hole in the impeller housing.
- When installing the water pump housing, turn the drive shaft clockwise.



SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)

REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Impeller plate		Refer to "WATER PUMP (COUNTER ROTATION MODELS)" on page 6-29.
1	Bolt	3	(with washer)
2	Shift rod assembly	1	
3	Oil seal housing	1	
4	Oil seal	1	
5	O-ring	1	3.1 × 49.4 mm
6	Spring	1	
7	Shift rod	1	
8	Circlip	1	
			For installation, reverse the removal procedure.



SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)

E

REMOVING THE SHIFT ROD ASSEMBLY

Remove:

- Shift rod assembly

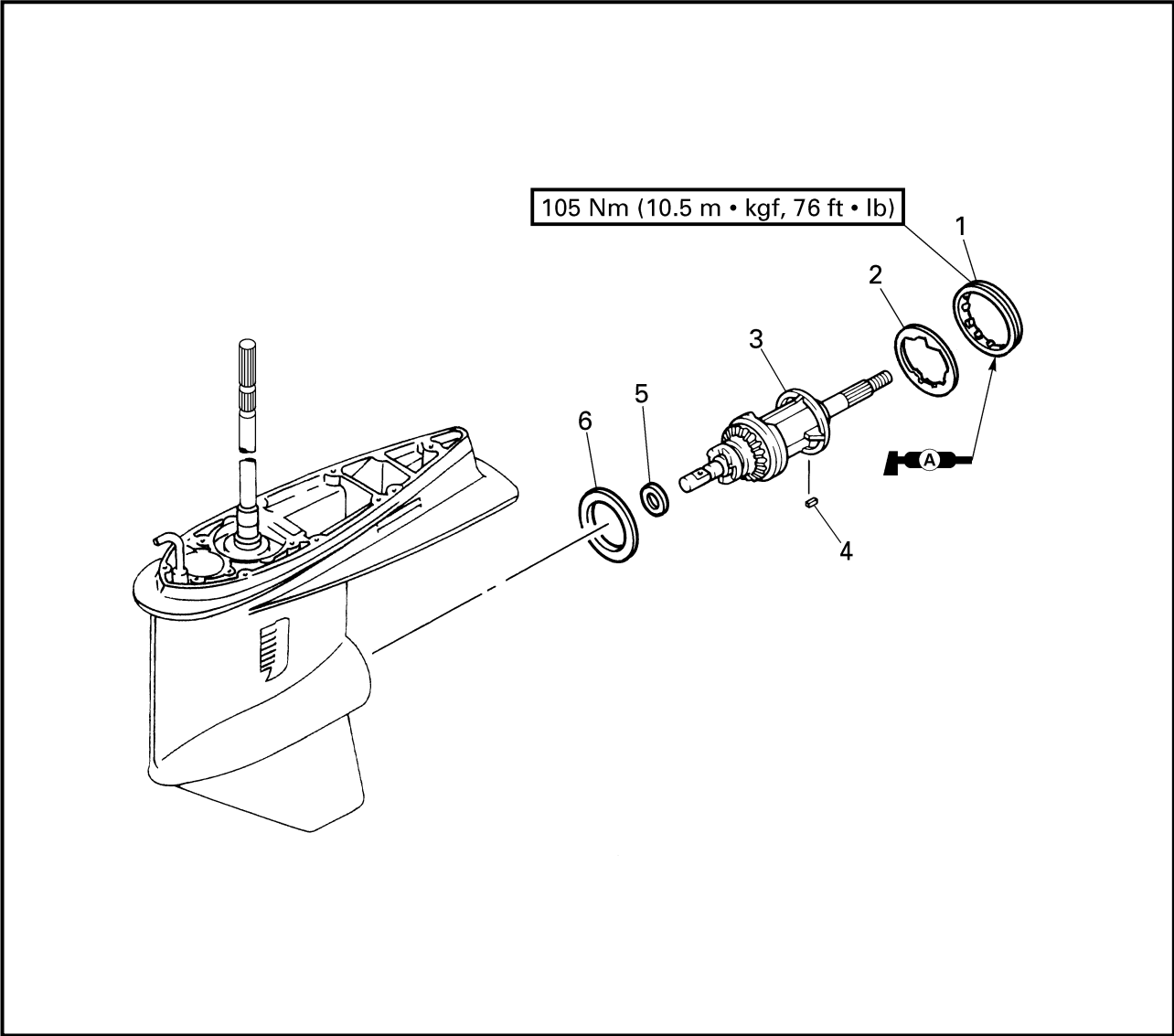
NOTE: _____

Remove the shift rod assembly when the shift rod is in the neutral position.

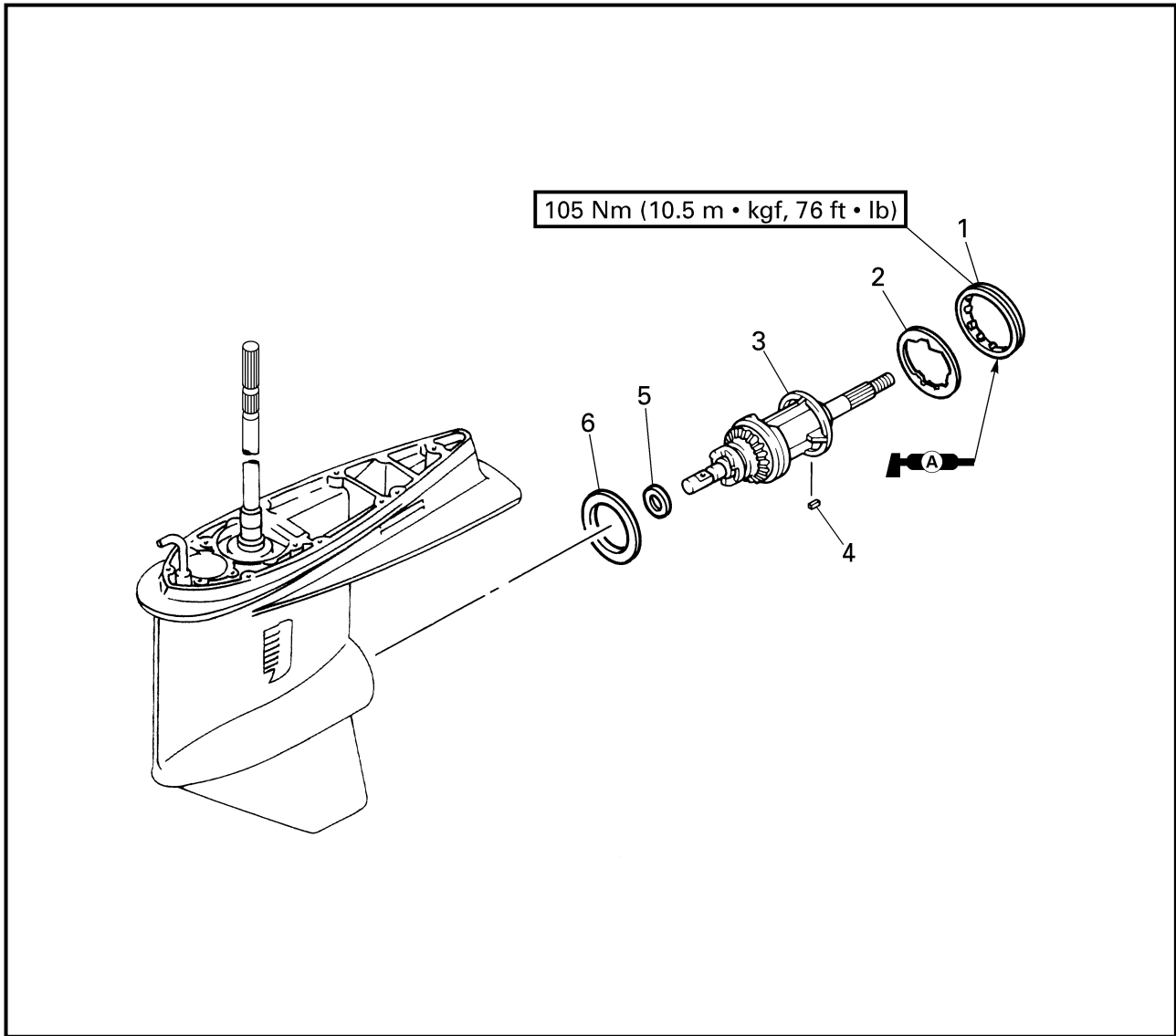
PROPELLER SHAFT HOUSING ASSEMBLY

(COUNTER ROTATION MODELS)

REMOVING/INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY



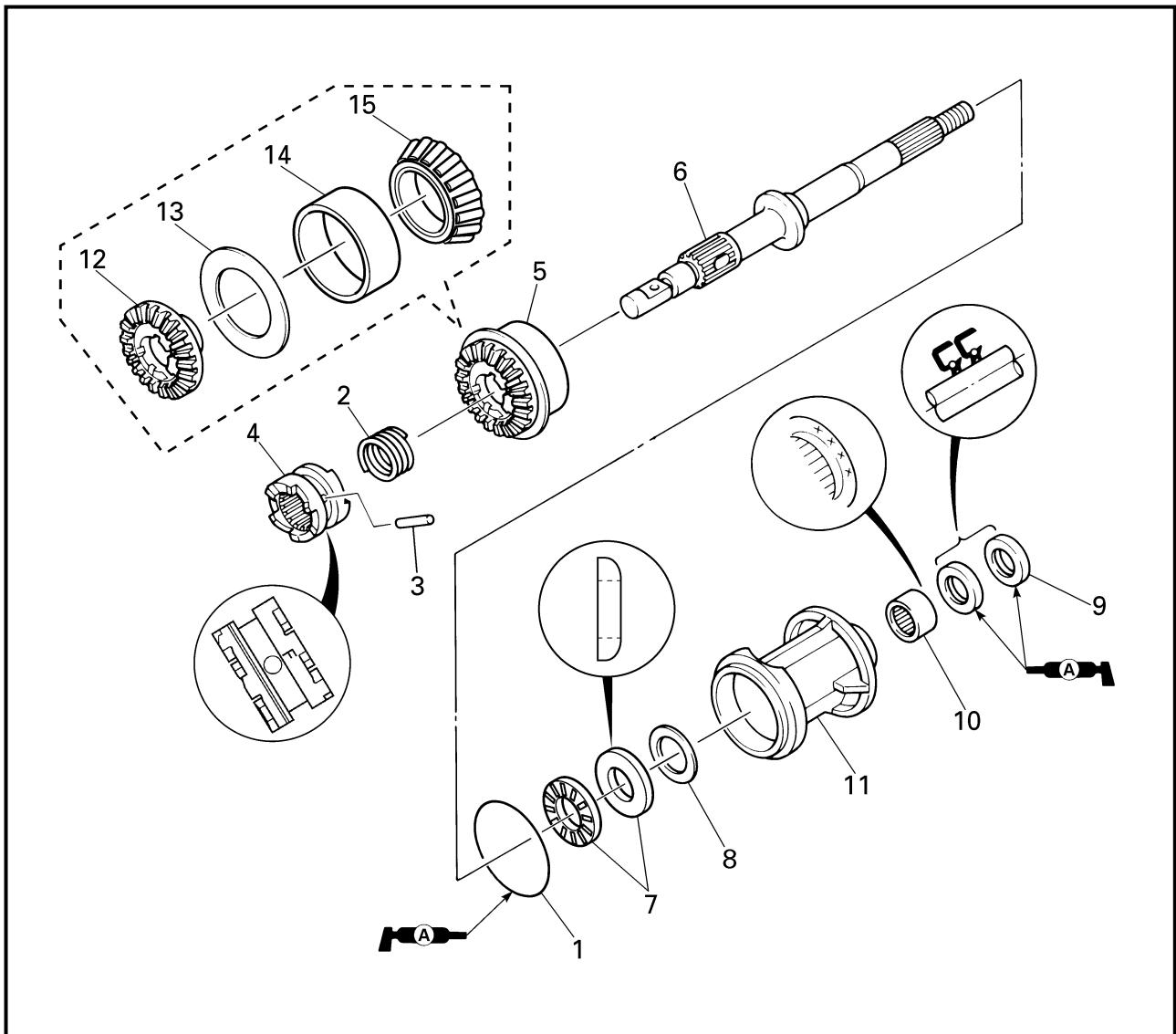
Order	Job/Part	Q'ty	Remarks
	Gear oil		Refer to "CHANGING AND CHECKING THE GEAR OIL" on page 3-18.
	Shift rod assembly		Refer to "SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)" on page 6-32.
1	Ring nut	1	
2	Claw washer	1	
3	Propeller shaft housing assembly	1	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
4	Straight key	1	For installation, reverse the removal procedure.
5	Thrust washer	1	
6	Forward gear shim	*	

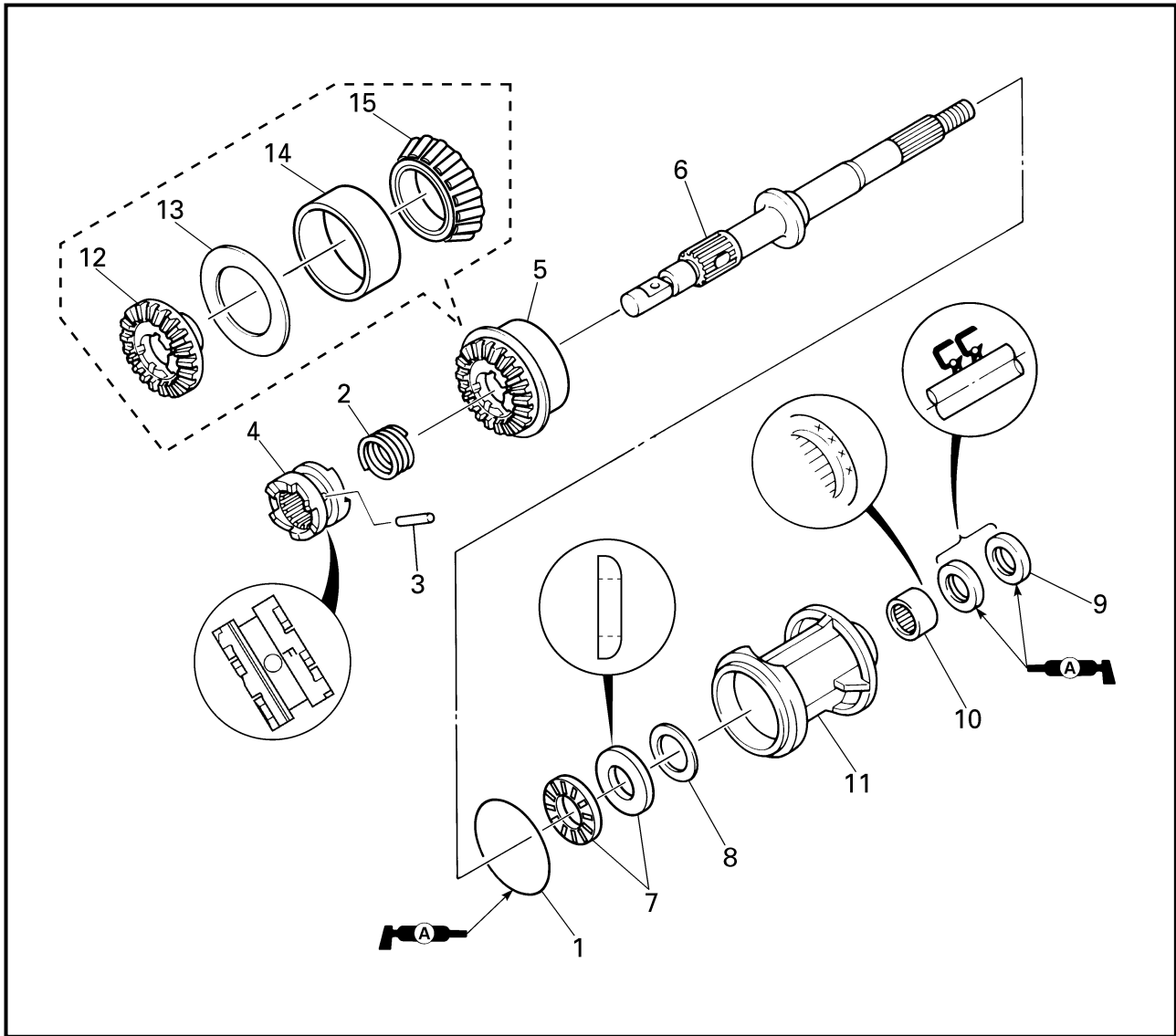
*: As required

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY



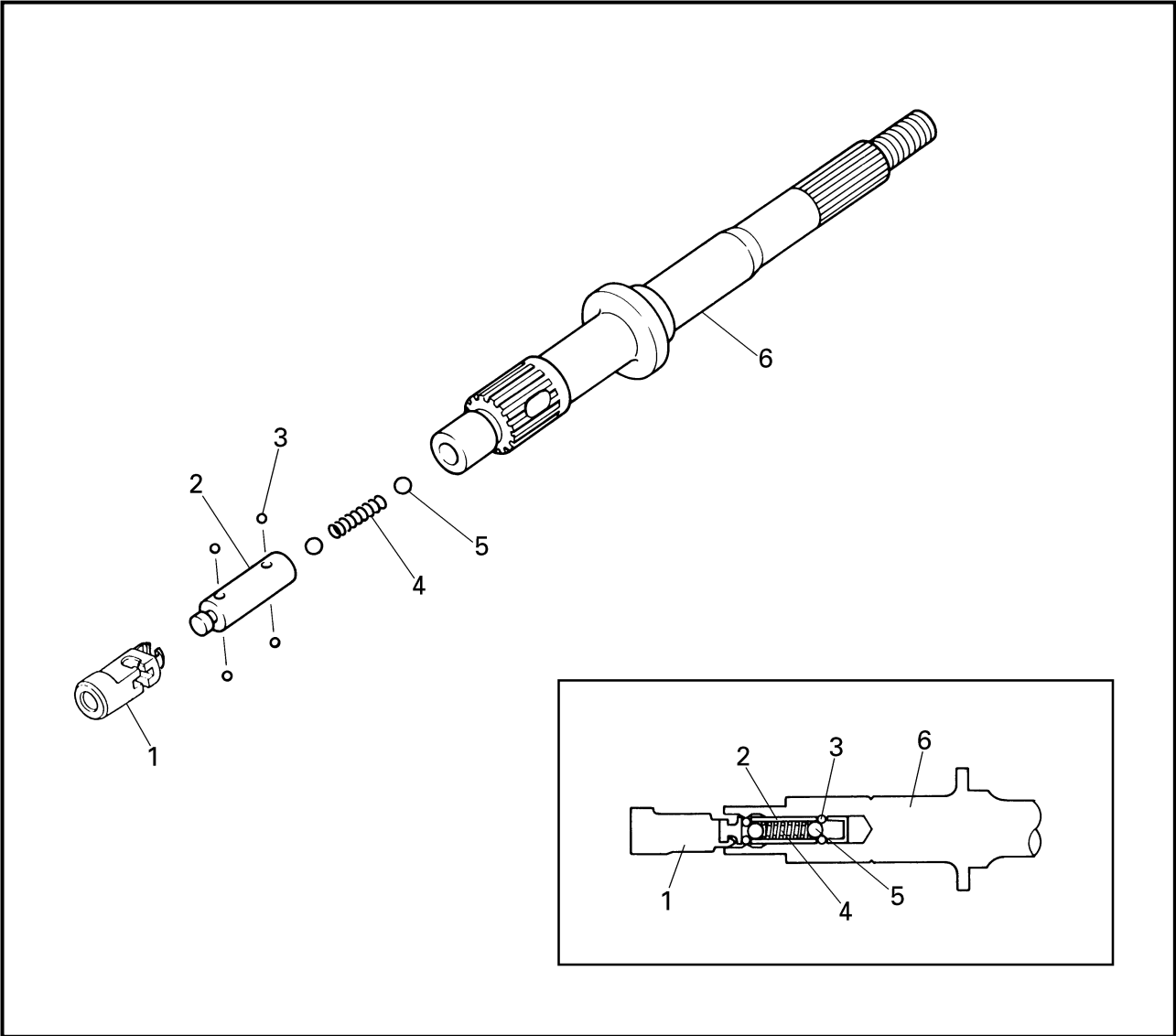
Order	Job/Part	Q'ty	Remarks
1	O-ring	1	
2	Spring	1	
3	Pin	1	
4	Dog clutch	1	
5	Forward gear assembly	1	
6	Propeller shaft assembly	1	
7	Thrust bearing	1	
8	Propeller shaft shim	*	
			Continued on next page.

*: As required

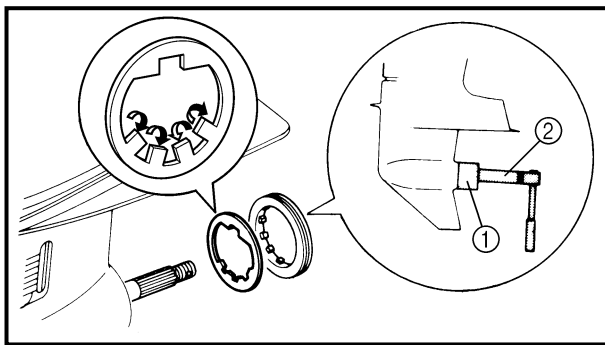


Order	Job/Part	Q'ty	Remarks
9	Oil seal	2	Not reusable For assembly, reverse the disassembly procedure.
10	Needle bearing	1	
11	Propeller shaft housing	1	
12	Forward gear	1	
13	Thrust washer	1	
14	Tapered roller bearing outer race	1	
15	Tapered roller bearing	1	

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Shift rod joint	1	For assembly, reverse the disassembly procedure.
2	Shift rod joint slider	1	
3	Ball	4	
4	Spring	1	
5	Ball	2	
6	Propeller shaft	1	

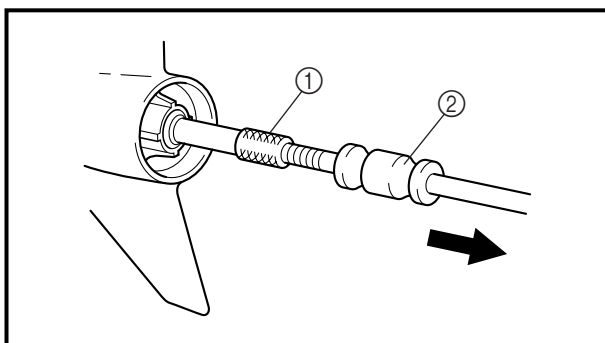


REMOVING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. Straighten:
 - Claw washer tabs
2. Remove:
 - Ring nut
 - Claw washer



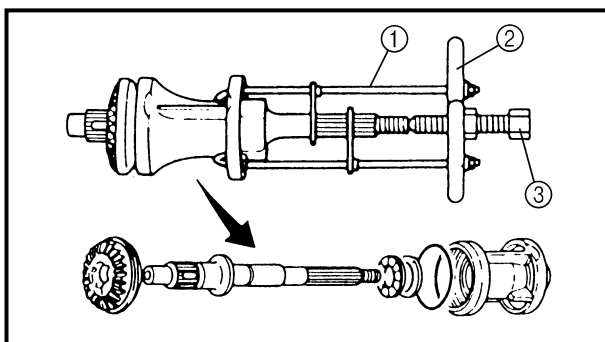
Ring nut wrench ①
YB-34447 / 90890-06511
Ring nut wrench extension ②
90890-06513



3. Remove:
 - Propeller shaft housing assembly
 - Straight key
 - Forward gear shim(s)



Slide hammer attachment..... ①
YB-06335 / 90890-06514
Slide hammer..... ②
YB-06096 / 90890-06531



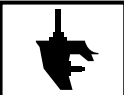
REMOVING THE PROPELLER SHAFT ASSEMBLY

- Remove:
- Propeller shaft assembly
 - Forward gear assembly



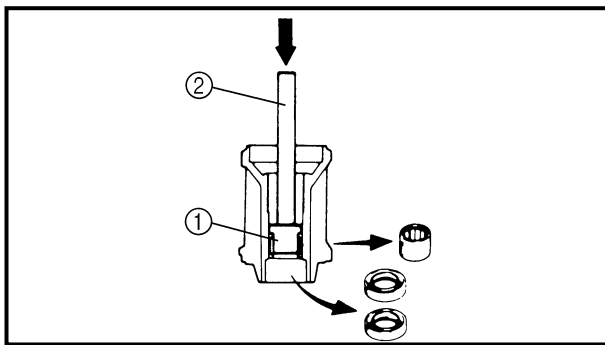
Propeller shaft housing puller . ①
YB-06207 / 90890-06502
Universal puller..... ②
YB-06117
Guide plate..... ②
90890-06501
Center bolt ③
90890-06504

LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



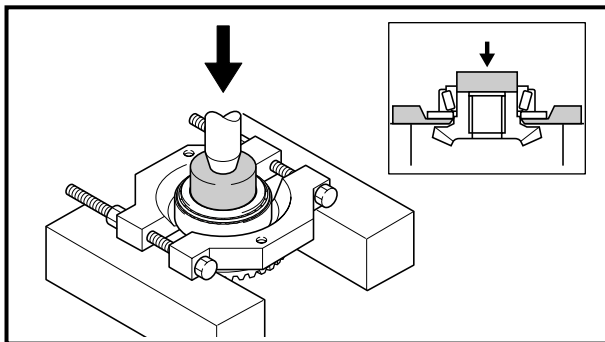
DISASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY

Remove:

- Oil seals
- Needle bearing



Bearing/oil seal attachment ①
YB-06196 / 90890-06653
Driver rod ②
YB-06071 / 90890-06652



DISASSEMBLING THE FORWARD GEAR ASSEMBLY

Remove:

- Tapered roller bearing



Bearing separator
YB-06219 / 90890-06534

CAUTION:

**Do not reuse the bearing, always replace it
with a new one.**



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E

CHECKING THE FORWARD GEAR

Check:

- Teeth
- Dogs

Damage/wear → Replace.

CHECKING THE BEARING

Check:

- Bearing

Pitting/rumbling → Replace.

CHECKING THE PROPELLER SHAFT HOUSING

Check:

- Propeller shaft housing

Cracks/damage → Replace.

CHECKING THE DOG CLUTCH

Check:

- Dog clutch

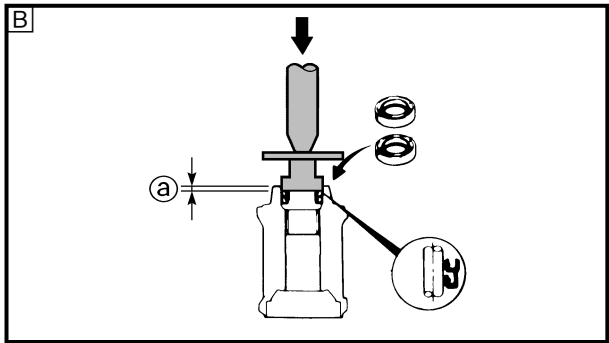
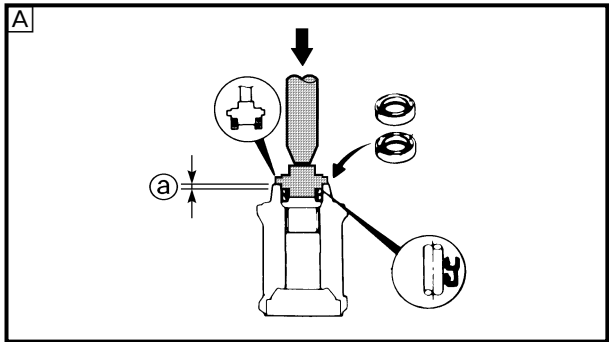
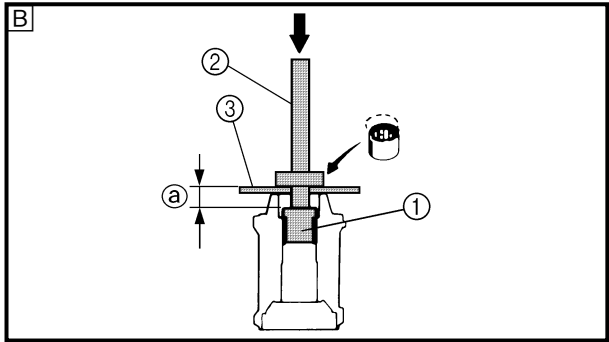
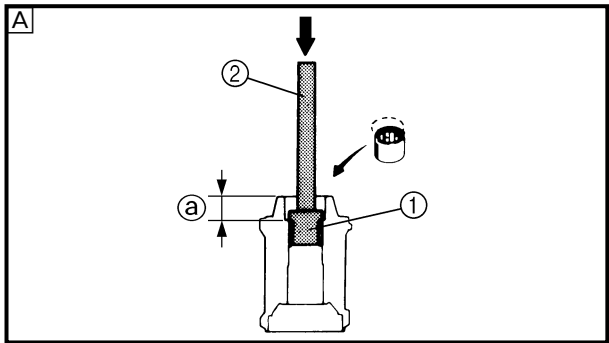
Damage/wear → Replace.

CHECKING THE PROPELLER SHAFT

Check:

- Propeller shaft

Damage/wear → Replace.



ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. Install:
- Needle bearing



Needle bearing installation position ①
 24.75 - 25.25 mm
 (0.974 - 0.994 in)



Bearing/oil seal attachment ①
YB-06196 / 90890-06610
Driver rod ②
YB-06071 / 90890-06604
Bearing/oil seal depth plate ③
90890-06603

- A For USA and Canada

B For worldwide

2. Install:
- Needle bearing
3. Install:
- Oil seal



Oil seal installation position ①
 4.75 - 5.25 mm (0.187 - 0.207 in)



Bearing/oil seal attachment
YB-06195 / 90890-06640

- A For USA and Canada

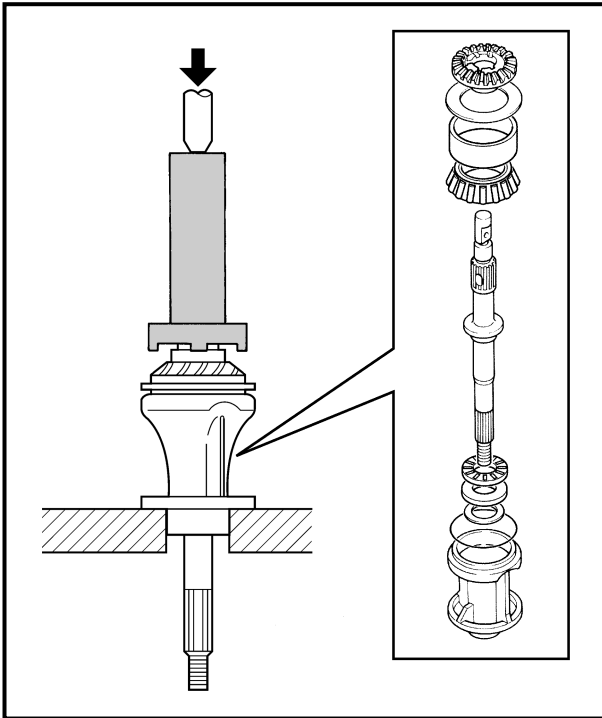
B For worldwide

LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



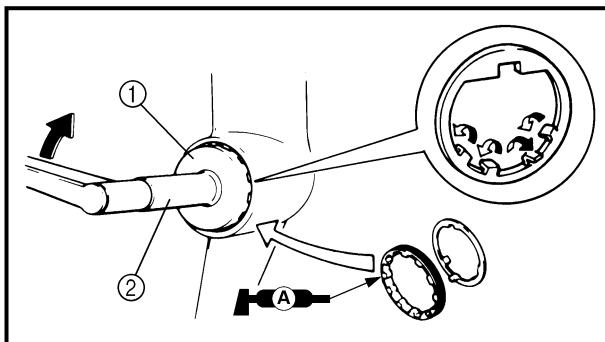
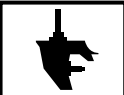
INSTALLING THE PROPELLER SHAFT ASSEMBLY

Install:

- Forward gear assembly
- Propeller shaft assembly



Ring nut wrench
YB-06578 / 90890-06578



INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY

Install:

- Forward gear shim(s)
- Propeller shaft housing assembly
- Straight key
- Claw washer
- Ring nut



Ring nut wrench ①

YB-34447 / 90890-06511

Ring nut wrench extension ②

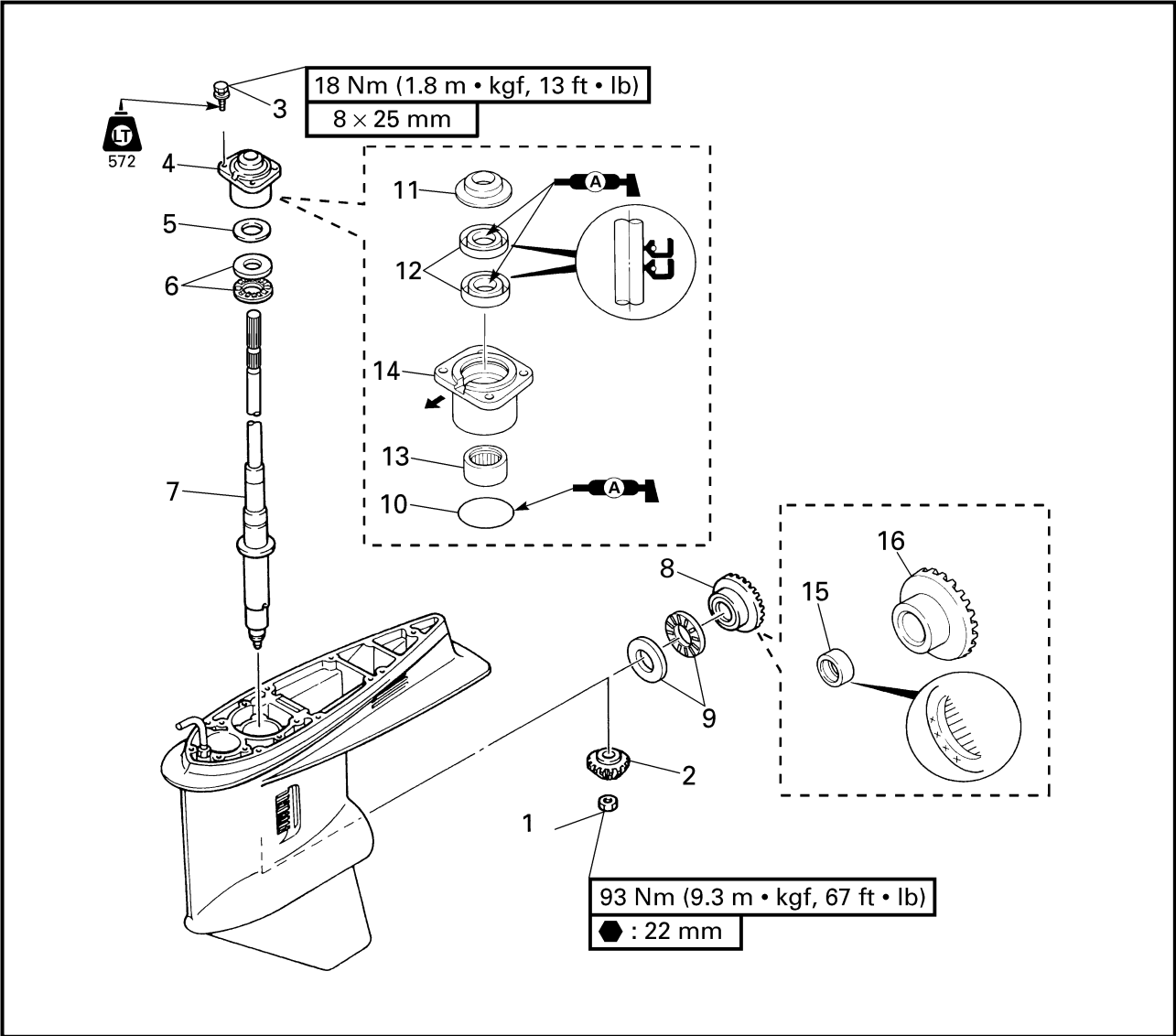
90890-06513

NOTE:

To secure the ring nut, bend one tab into the slot in the ring nut and the other tabs toward the propeller shaft housing assembly.

DRIVE SHAFT (COUNTER ROTATION MODELS)

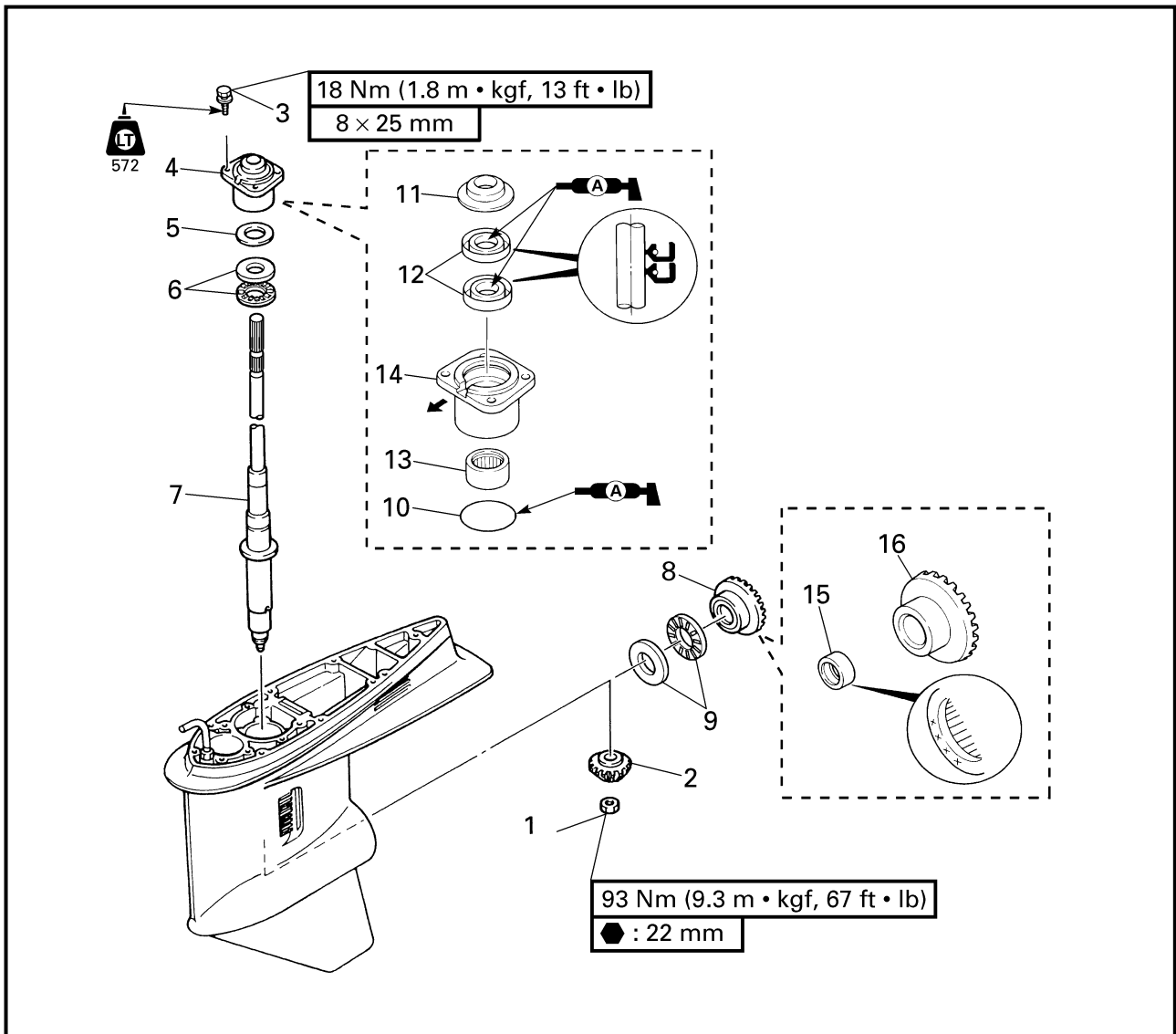
REMOVING/INSTALLING THE DRIVE SHAFT



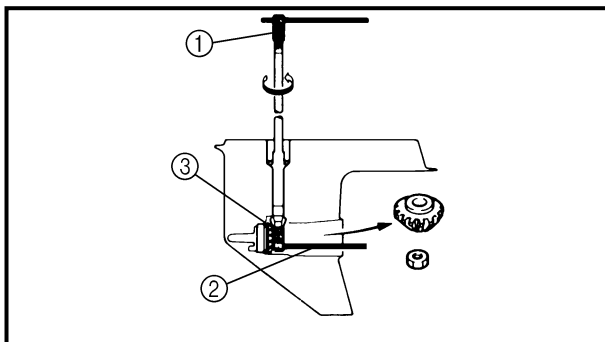
Order	Job/Part	Q'ty	Remarks
	Propeller shaft housing assembly		Refer to "PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)" on page 6-34.
1	Nut	1	
2	Pinion	1	
3	Bolt	4	(with washer)
4	Drive shaft housing assembly	1	
5	Pinion shim	*	
6	Thrust bearing	1	
7	Drive shaft	1	

Continued on next page.

*: As required



Order	Job/Part	Q'ty	Remarks
8	Reverse gear assembly	1	For installation, reverse the removal procedure.
9	Thrust bearing	1	
10	O-ring	1	
11	Oil seal cover	1	
12	Oil seal	2	
13	Needle bearing	1	
14	Drive shaft housing	1	
15	Needle bearing	1	
16	Reverse gear	1	



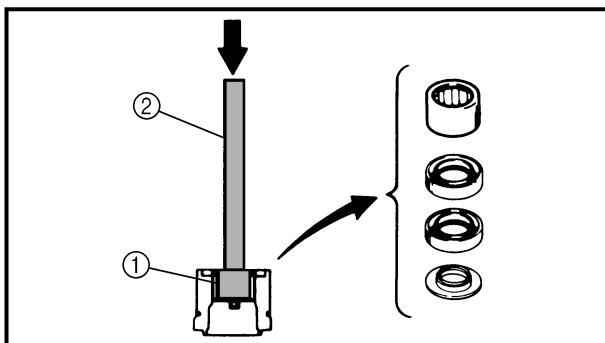
REMOVING THE DRIVE SHAFT

Loosen:

- Pinion nut



- Drive shaft holder ①
YB-06151 / 90890-06519
- Pinion nut holder ②
90890-06505
- Pinion nut holder attachment . ③
90890-06507



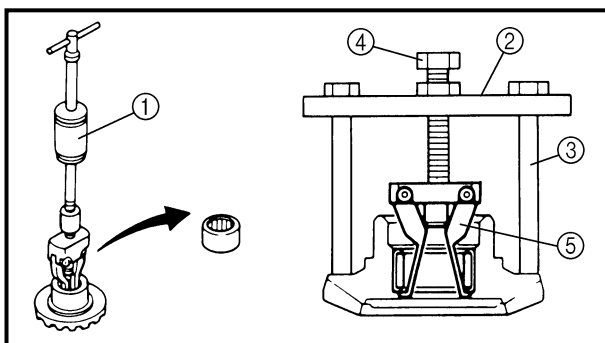
DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY

Remove:

- Needle bearing



- Bearing/oil seal attachment ①
YB-06196 / 90890-06610
- Driver rod ②
YB-06071 / 90890-06652



DISASSEMBLING THE REVERSE GEAR

Remove:

- Needle bearing



- Slide hammer..... ①
YB-06096
- Guide plate..... ②
90890-06501
- Guide plate stand ③
90890-06538
- Bearing puller..... ④
90890-06535
- Small universal claws ⑤
90890-06536

CHECKING THE PINION

Check:

- Teeth

Damage/wear → Replace.

CHECKING THE DRIVE SHAFT

Check:

- Drive shaft

Damage/wear → Replace.

CHECKING THE DRIVE SHAFT HOUSING

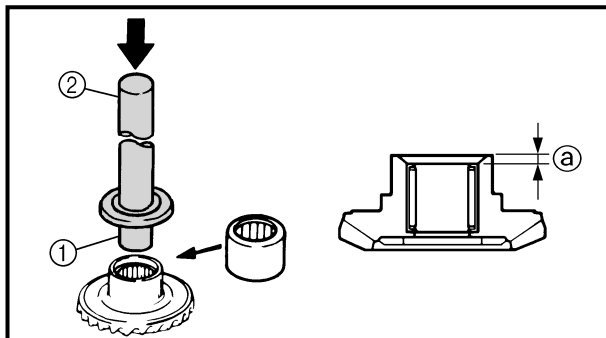
Check:

- Drive shaft housing
Cracks/damage → Replace.

CHECKING THE BEARINGS

Check:

- Bearings
Pitting/rumbling → Replace.



ASSEMBLING THE REVERSE GEAR ASSEMBLY

Install:

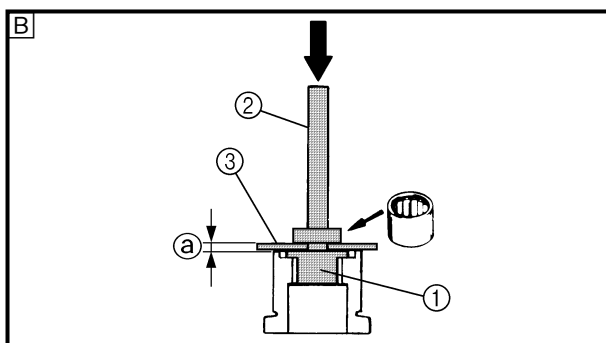
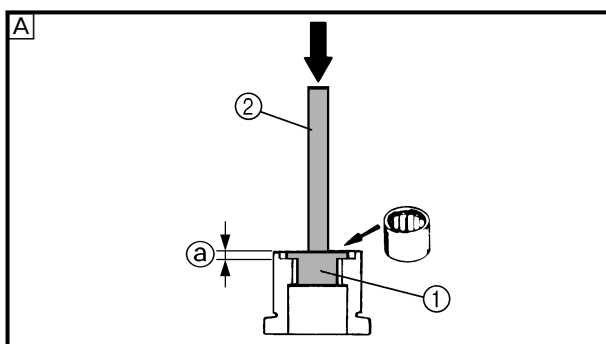
- Needle bearing



Needle bearing installation position ①
2.5 - 3.5 mm (0.098 - 0.138 in)



Bearing/oil seal attachment ①
YB-06200 / 90890-06612
Driver rod ②
YB-06071 / 90890-06604



ASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY

1. Install:

- Needle bearing

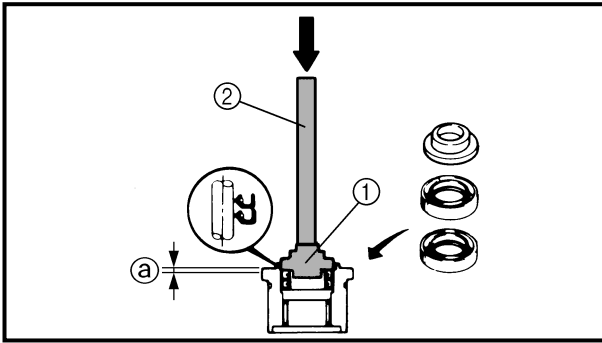


Position ①
5.75 - 6.25 mm (0.226 - 0.246 in)



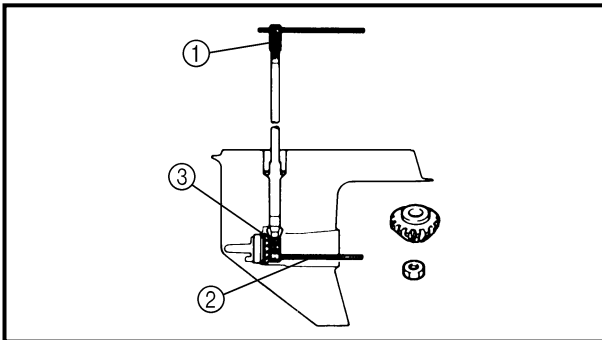
Bearing/oil seal attachment ①
YB-06196 / 90890-06610
Driver rod ②
YB-06071 / 90890-06604
Bearing/oil seal depth plate ③
90890-06603

- A** For USA and Canada
B For worldwide

LOWR**DRIVE SHAFT (COUNTER ROTATION MODELS)****E**

2. Install:

- Oil seal

**Oil seal installation position ①**
0.25 - 0.75 mm (0.010 - 0.030 in)**Bearing/oil seal attachment ①**
YB-06195
Driver rod ②
YB-06071**INSTALLING THE DRIVE SHAFT**

Tighten:

- Pinion nut

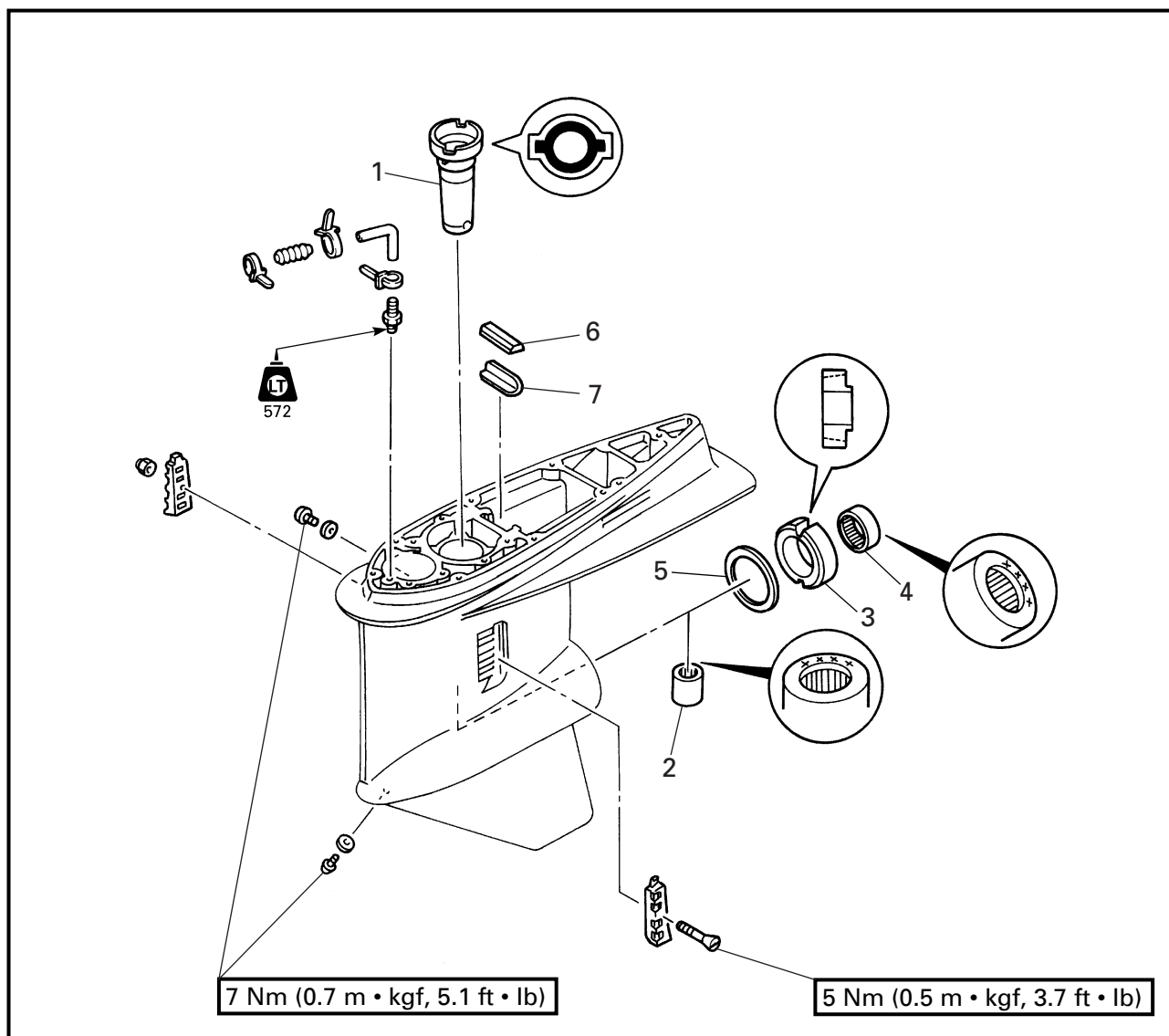
**Drive shaft holder ①**
YB-06151 / 90890-06519
Pinion nut holder ②
90890-06505
Pinion nut holder attachment . ③
90890-06507**Pinion nut**
93 Nm (9.3 m • kgf, 67 ft • lb)



LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS)

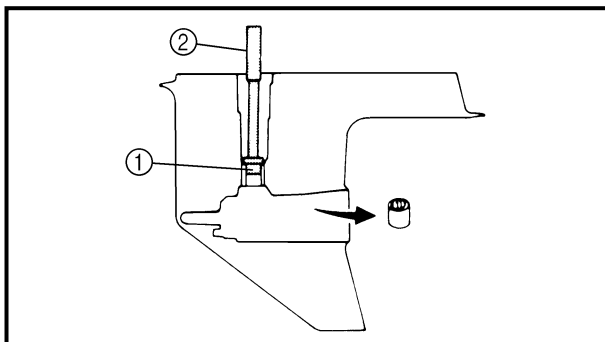
E

LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS) DISASSEMBLING/ASSEMBLING THE LOWER CASE ASSEMBLY



Order	Job/Part	Q'ty	Remarks
	Reverse gear		Refer to "DRIVE SHAFT (COUNTER ROTATION MODELS)" on page 6-45.
1	Drive shaft sleeve	1	
2	Needle bearing	1	
3	Bearing retainer	1	
4	Needle bearing	1	
5	Reverse gear shim	*	
6	Water seal	1	
7	Plate	1	
			For assembly, reverse the disassembly procedure.

*: As required

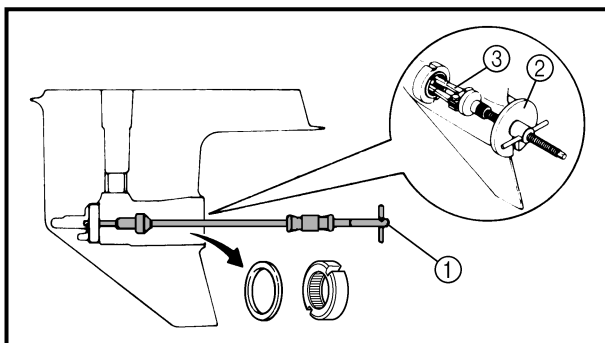


DISASSEMBLING THE LOWER CASE ASSEMBLY

1. Remove:
- Needle bearing



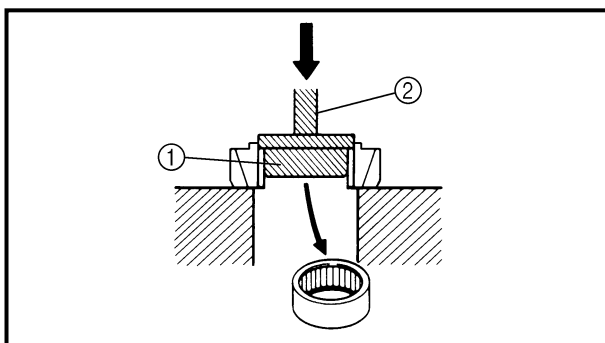
Bearing/oil seal attachment ①
YB-06194 / 90890-06636
Driver rod ②
YB-06071 / 90890-06605



2. Remove:
- Roller bearing



Slide hammer ①
YB-06096
Bearing puller ②
90890-06523
Large universal claws ③
90890-06532



3. Remove:
- Needle bearing



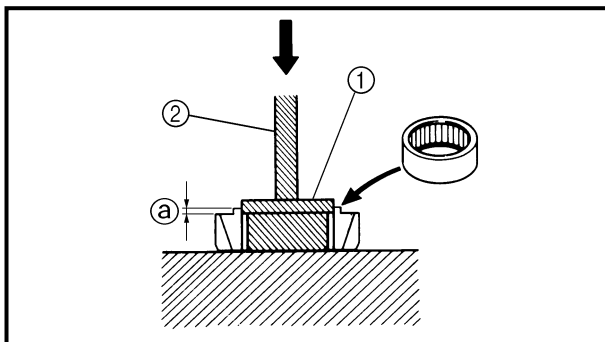
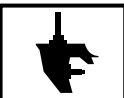
Bearing/oil seal attachment ①
YB-06376 / 90890-06607
Driver rod ②
YB-06071 / 90890-06652

CHECKING THE DRIVE SHAFT SLEEVE

- Check:
- Drive shaft sleeve
 Damage/wear → Replace.

CHECKING THE NEEDLE BEARING

- Check:
- Needle bearing
 Pitting/rumbling → Replace.



ASSEMBLING THE LOWER CASE ASSEMBLY

1. Install:

- Needle bearing



Needle bearing installation position ①

0.75 - 1.25 mm (0.030 - 0.049 in)

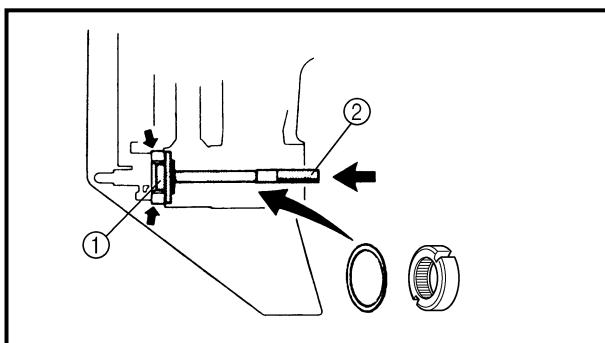


Bearing/oil seal attachment ①

YB-06376 / 90890-06607

Driver rod ②

YB-06071 / 90890-06652



2. Install:

- Bearing retainer

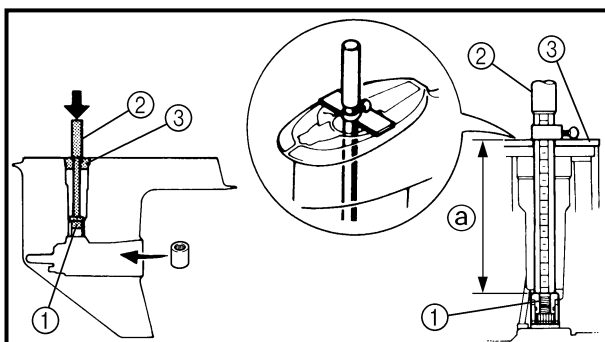


Bearing/oil seal attachment ①

YB-06377 / 90890-06630

Driver rod ②

YB-06071 / 90890-06605



3. Install:

- Needle bearing



Needle bearing installation position ①

184.0 mm (7.24 in)



Bearing/oil seal attachment ①

YB-06194 / 90890-06636

Driver rod ②

YB-06071 / 90890-06602

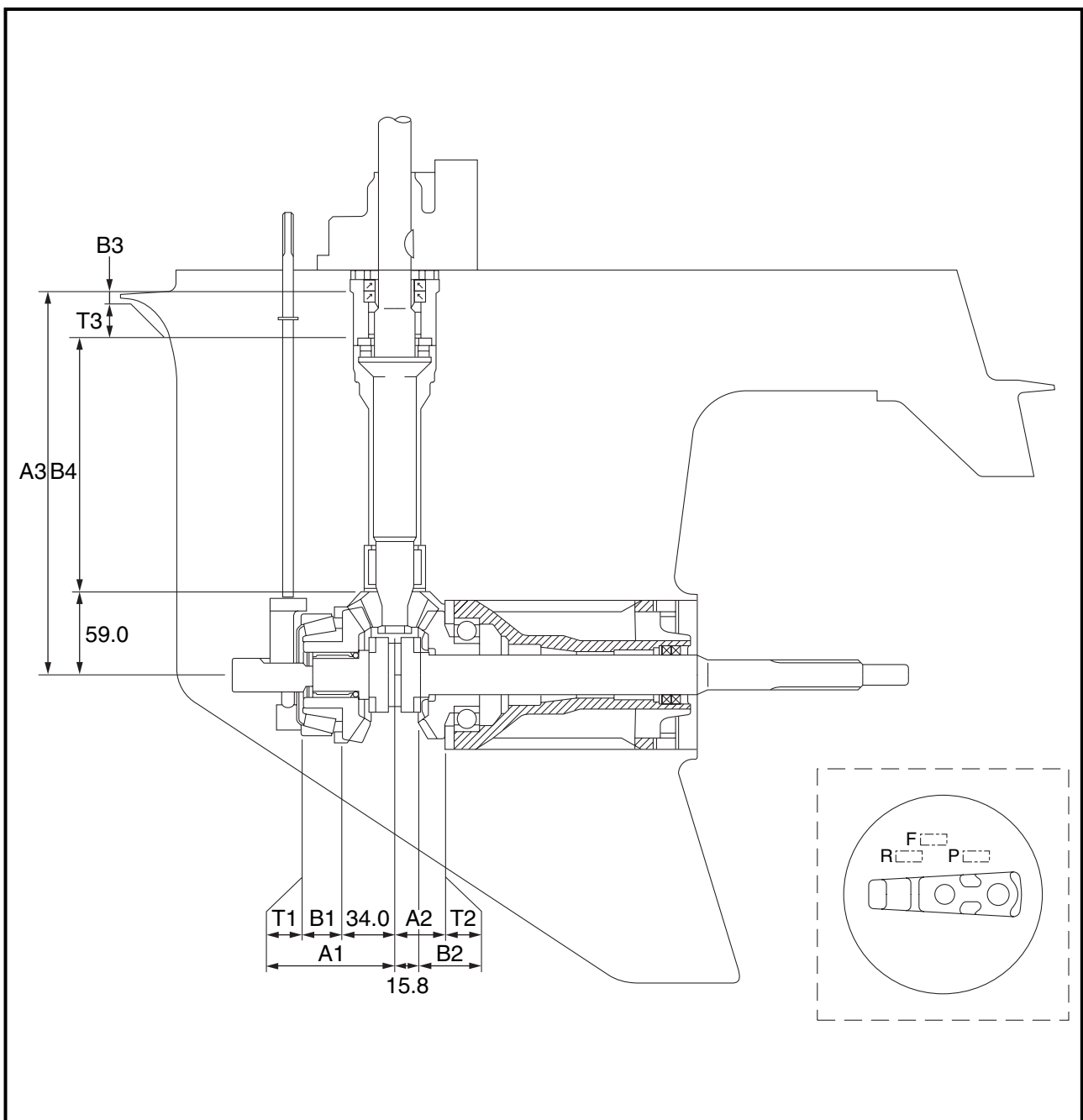
Bearing/oil seal depth plate ③

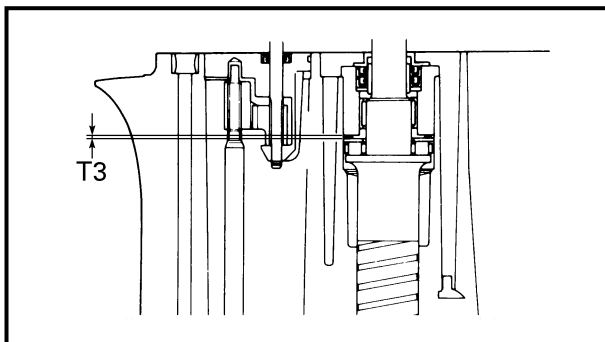
YB-34474 / 90890-06603

SHIMMING (REGULAR ROTATION MODELS) (FOR USA AND CANADA)

NOTE:

- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required when replacing the inner part(s).

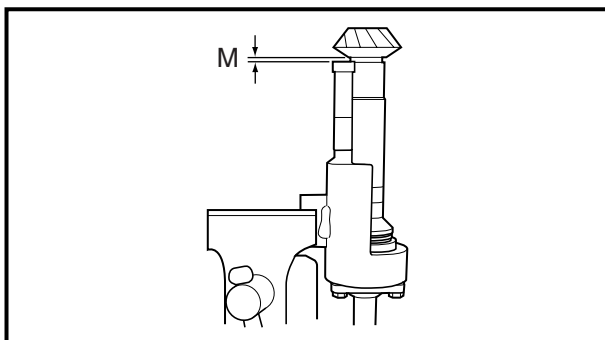




SELECTING THE PINION SHIMS

NOTE:

Find the shim thickness (T3) by selecting shims until the specified value (M0) is obtained with the special tool.



1. Measure:

- Specified measurement (M)

Out of specified value (M0) → Adjust.



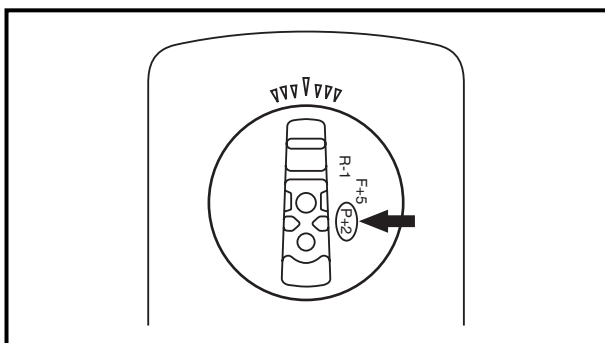
Specified value (M0) =
 $1.00 + P/100$ mm

Measuring steps

(1) Calculate the specified value (M0).

NOTE:

"P" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "P" mark is missing or unreadable, assume a "P" value of "0", and check the backlash when the unit is assembled.



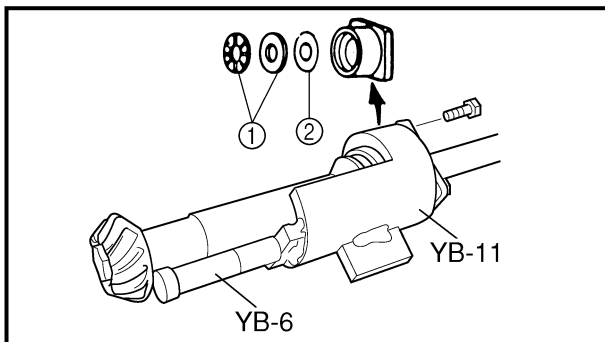
Example:

If "P" is "+5", then

$$\begin{aligned} M0 &= 1.00 + (+5)/100 \text{ mm} \\ &= 1.00 + 0.05 \text{ mm} \\ &= 1.05 \text{ mm} \end{aligned}$$

If "P" is "-3", then

$$\begin{aligned} M0 &= 1.00 + (-3)/100 \text{ mm} \\ &= 1.00 - 0.03 \text{ mm} \\ &= 0.97 \text{ mm} \end{aligned}$$



(2) Install the pinion height gauge, drive shaft, thrust bearing ①, and shim(s) ②.



Pinion height gauge
YB-34432-6, -11

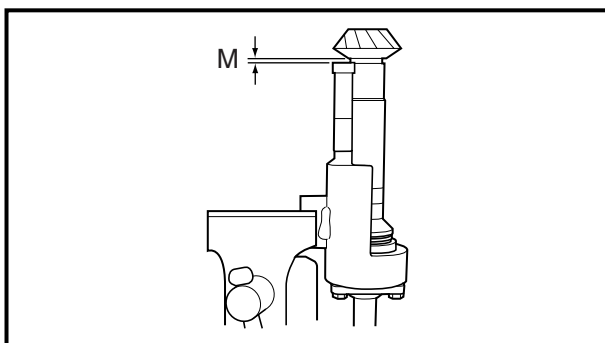
NOTE:

If the original shim(s) is unavailable, start with a 0.50-mm shim.

(3) Install the pinion and pinion nut.



Pinion nut
93 Nm (9.3 m • kgf, 67 ft • lb)



(4) Measure the specified measurement (M).

NOTE:

- Measure the clearance between the pinion height gauge and the lower surface of the pinion as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M).

2. Adjust:

- Shim thickness (T3)

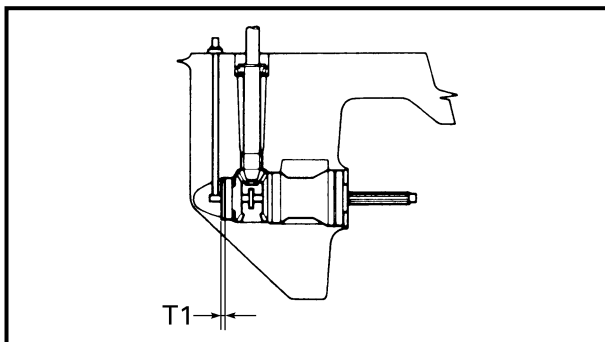
Remove or add shim(s).



Available shim thickness
0.10, 0.12, 0.15, 0.18, 0.30, 0.40
and 0.50 mm

NOTE:

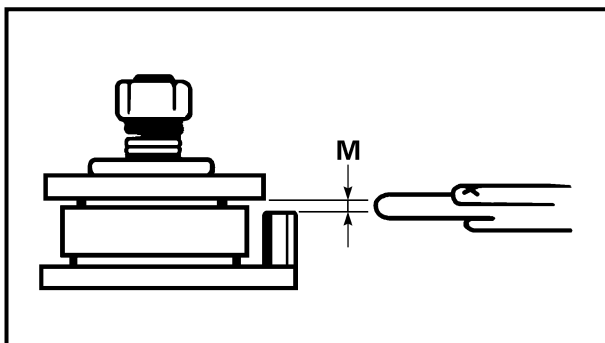
(M0) – (M) should be as close to “0” as possible.



SELECTING THE FORWARD GEAR SHIMS

NOTE:

Find the shim thickness (T1) by selecting shims until the specified value (M0) is obtained with the special tool.



1. Measure:

- Specified measurement (M)

Out of specified value (M0) → Adjust.



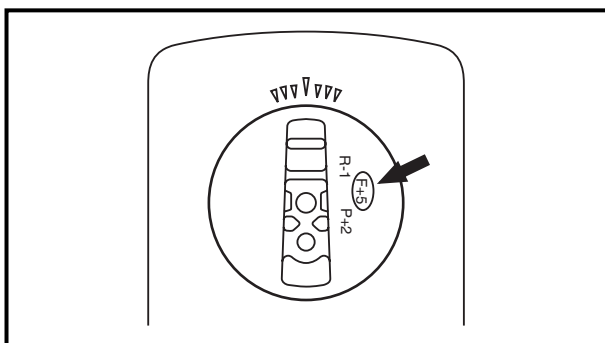
Specified value (M0) =
 $1.80 + F/100$ mm

Measuring steps

(1) Calculate the specified value (M0).

NOTE:

"F" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "F" mark is missing or unreadable, assume an "F" value of "0", and check the backlash when the unit is assembled.



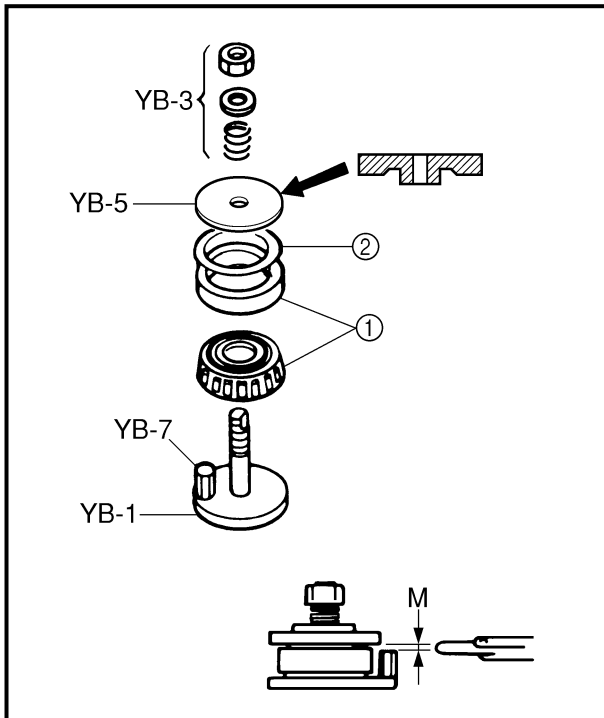
Example:

If "F" is "+5", then

$$\begin{aligned} M0 &= 1.80 + (+5)/100 \text{ mm} \\ &= 1.80 + 0.05 \text{ mm} \\ &= 1.85 \text{ mm} \end{aligned}$$

If "F" is "-3", then

$$\begin{aligned} M0 &= 1.80 + (-3)/100 \text{ mm} \\ &= 1.80 - 0.03 \text{ mm} \\ &= 1.77 \text{ mm} \end{aligned}$$



(2) Install the shimming gauge, bearing (1), and shim(s) (2).



**Shimming gauge
YB-34446-1, -3, -5, -7**

NOTE:

If the original shim(s) is unavailable, start with a 0.50-mm shim.

(3) Measure the specified measurement (M).

2. Adjust:

- Shim thickness (T1)

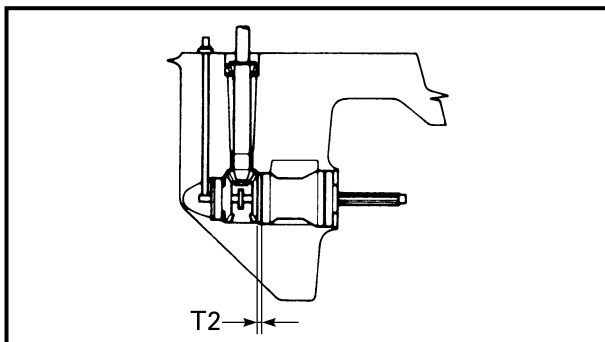
Remove or add shim(s).



**Available shim thickness
0.10, 0.12, 0.15, 0.18, 0.30, 0.40
and 0.50 mm**

NOTE:

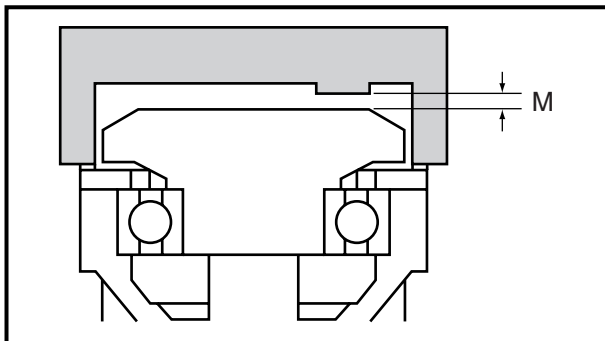
(M0) – (M) should be as close to “0” as possible.



SELECTING THE REVERSE GEAR SHIMS

NOTE:

Find the shim thickness (T2) by selecting shims until the specified value (M0) is obtained with the special tool.



1. Measure:

- Specified measurement (M)

Out of specified value (M0) → Adjust.



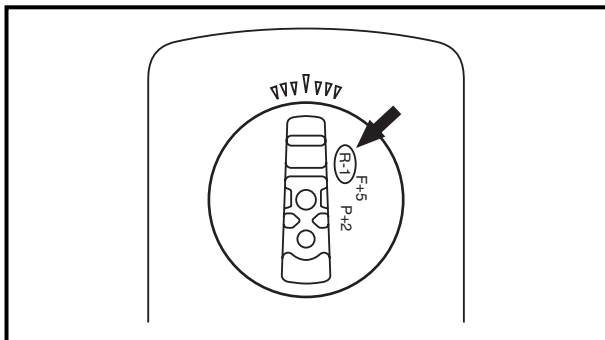
Specified value (M0) =
1.80 – R/100 mm

Measuring steps

(1) Calculate the specified value (M0).

NOTE:

“R” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “R” mark is missing or unreadable, assume an “R” value of “0”, and check the backlash when the unit is assembled.



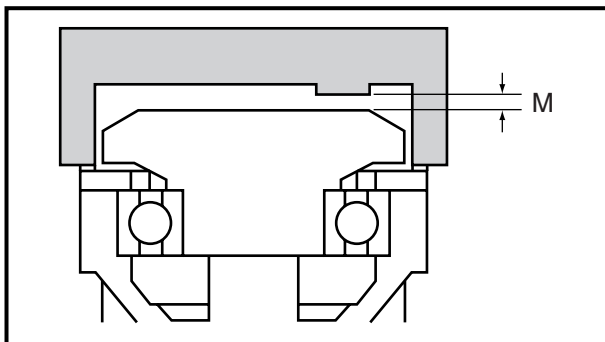
Example:

If “R” is “+5”, then

$$\begin{aligned} M0 &= 1.80 - (+5)/100 \text{ mm} \\ &= 1.80 - 0.05 \text{ mm} \\ &= 1.75 \text{ mm} \end{aligned}$$

If “R” is “-3”, then

$$\begin{aligned} M0 &= 1.80 - (-3)/100 \text{ mm} \\ &= 1.80 + 0.03 \text{ mm} \\ &= 1.83 \text{ mm} \end{aligned}$$



- (2) Install the shimming gauge, bearing, thrust washer, reverse gear, and shim(s).



**Shimming gauge
YB-34468-2**

NOTE:

- If the original shim(s) is unavailable, start with a 0.50-mm shim.
- Turn the reverse gear assembly a few times until the gear and bearing are horizontal.

- (3) Measure the specified measurement (M).

2. Adjust:

- Shim thickness (T2)
Remove or add shim(s).



**Available shim thickness
0.10, 0.12, 0.15, 0.18, 0.30, 0.40
and 0.50 mm**

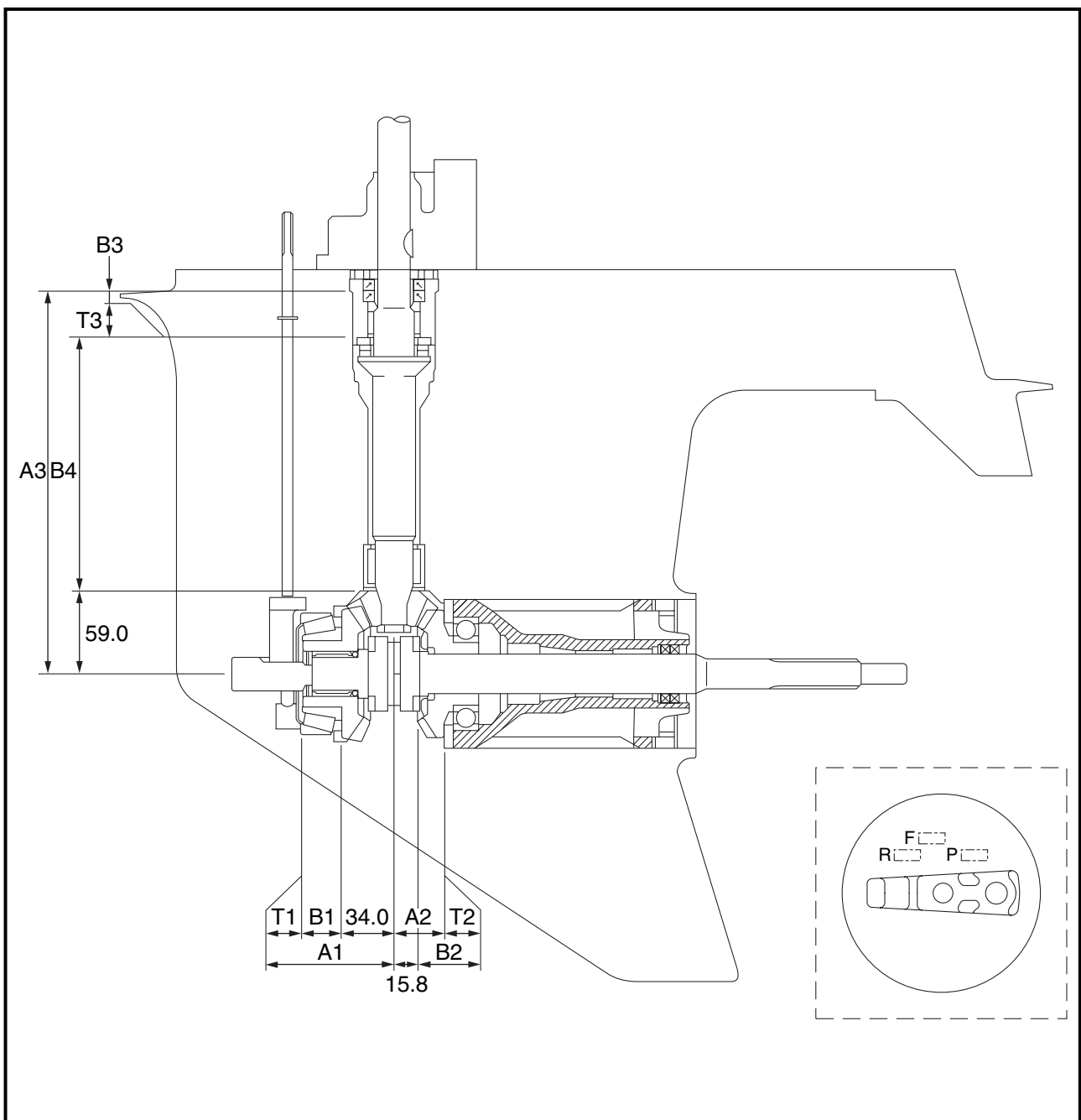
NOTE:

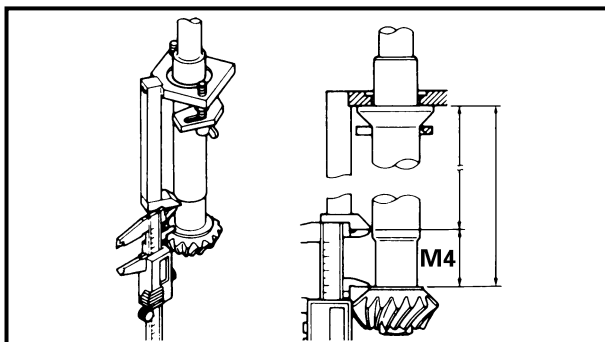
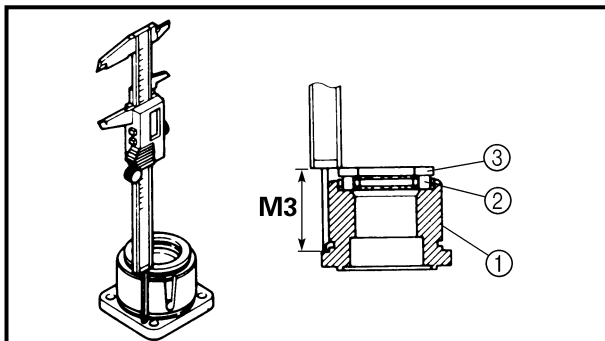
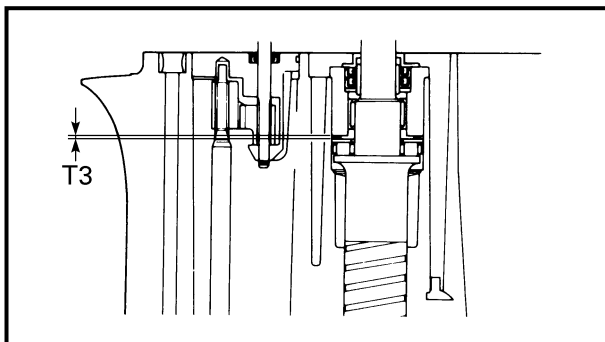
(M0) – (M) should be as close to “0” as possible.

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

NOTE:

- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required when replacing the inner part(s).





SELECTING THE PINION SHIMS

NOTE:

Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.

Select:

- Shim thickness (T3)

Selecting steps

(1) Measure (M3).



Digital caliper
90890-06704

NOTE:

Install the bearing housing ①, thrust bearing ②, and washer ③.

(2) Install the pinion and pinion nut.



Pinion nut
93 Nm (9.3 m • kgf, 67 ft • lb)

(3) Install the pinion height gauge.



Pinion height gauge
90890-06702

NOTE:

After the wing nuts contact the fixing plate, tighten them another 1/4 of a turn.

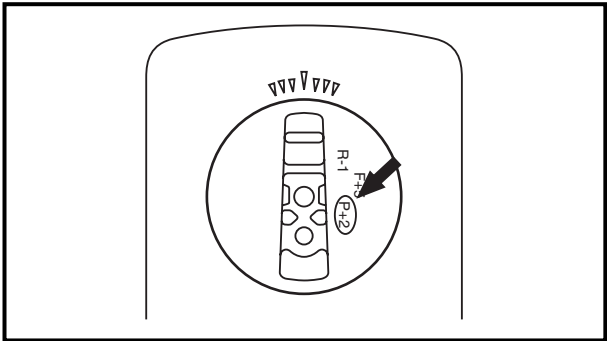
(4) Measure (M4).



Digital caliper
90890-06704

NOTE:

- Measure the clearance between the pinion height gauge and the pinion, as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M4).



(5) Calculate the pinion shim thickness (T3).



Pinion shim thickness (T3) =

$$62.5 + P/100 - M3 - M4$$

NOTE: _____

“P” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “P” mark is missing or unreadable, assume a “P” value of “0”, and check the backlash when the unit is assembled.

Example:

If M3 is “46.85 mm”, M4 is “15.12 mm” and P is “-5”, then

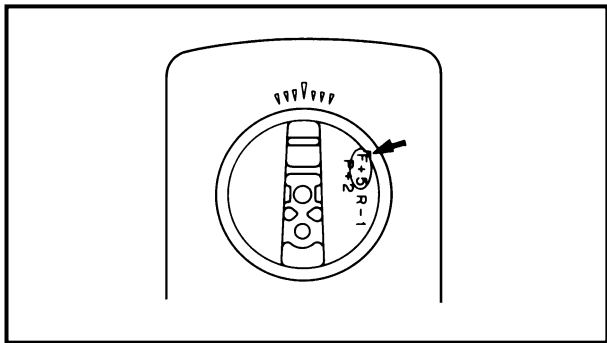
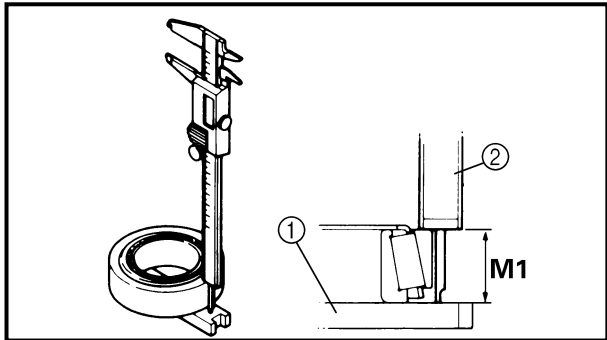
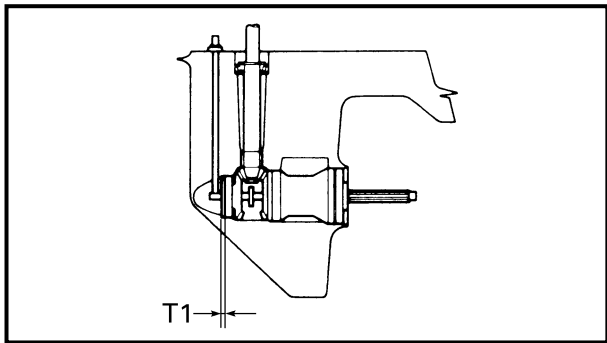
$$T3 = 62.5 + (-5)/100 - 46.85 - 15.12 \text{ mm}$$

$$= 62.5 - 0.05 - 46.85 - 15.12 \text{ mm}$$

$$= 0.48 \text{ mm}$$

(6) Select the pinion shim(s) (T3).

Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08
Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm		



SELECTING THE FORWARD GEAR SHIMS

NOTE: _____

Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.

- Select:
- Shim thickness (T1)

Selecting steps

(1) Measure (M1).

	Shimming plate ①
	90890-06701
	Digital caliper ②
	90890-06704

NOTE: _____

- Turn the roller bearing outer race two or three times so the rollers seat. Then, measure the height of the bearing, as shown.
- Perform the same measurement at three points on the roller bearing outer race.
- Find the average of the measurements (M1).

(2) Calculate the forward gear shim thickness (T1).

	Forward gear shim thickness (T1)
	$(T1) = 24.6 + F/100 - M1$

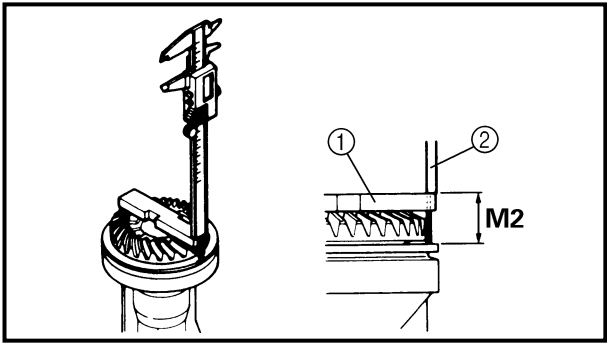
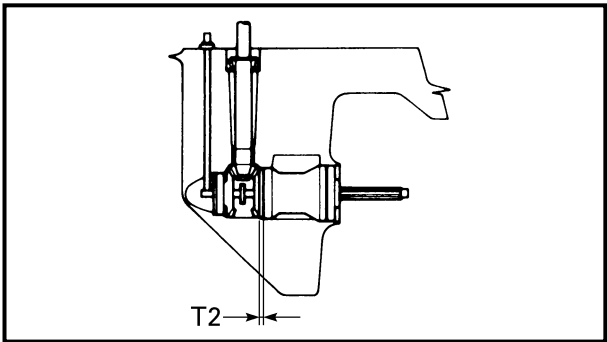
NOTE: _____

“F” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “F” mark is missing or unreadable, assume an “F” value of “0”, and check the backlash when the unit is assembled.

Example:
 If M1 is "24.10 mm" and F is "+5", then
 $T1 = 24.6 + (+5)/100 - 24.10 \text{ mm}$
 $= 24.6 + 0.05 - 24.10 \text{ mm}$
 $= 0.55 \text{ mm}$

(3) Select the forward gear shim(s) (T1).

Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08
 Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm		



SELECTING THE REVERSE GEAR SHIM

NOTE: _____
 Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.

- Select:
- Shim thickness (T2)

Selecting steps
 (1) Measure (M2).

	Shimming plate ①
	Digital caliper ②
	90890-06701
	90890-06704

NOTE: _____

- Measure the height of the gear as shown.
- Perform the same measurement at three points on the gear.
- Find the average of the measurements (M2).

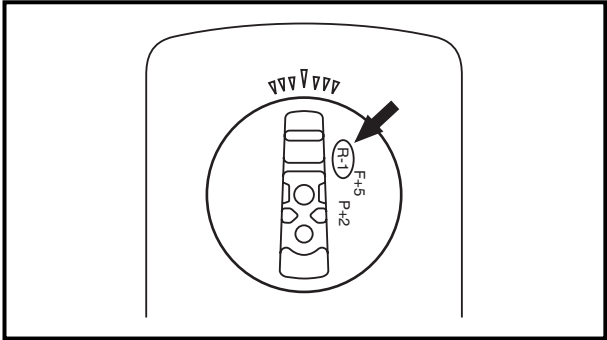
(2) Calculate the reverse gear shim thickness (T2).



Reverse gear shim thickness
(T2) = M2 – 27.4 – R/100

NOTE: _____

“R” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “R” mark is missing or unreadable, assume a “R” value of “0”, and check the backlash when the unit is assembled.



Example:
If M2 is “27.95 mm”, R is “+2”, then
T2 = 27.95 – 27.4 – (+2)/100 mm
= 27.95 – 27.4 – 0.02 mm
= 0.53 mm

(3) Select the reverse gear shim(s) (T2).

Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.02
0.02	0.05	0.05
0.05	0.08	0.08
0.08	0.10	0.10
		Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm

BACKLASH
(REGULAR ROTATION MODELS)

- NOTE:
- Do not install the water pump components when measuring the backlash.
 - Measure both the forward and reverse gear backlashes.
 - If both the forward and reverse gear backlashes are larger than specification, the pinion may be too high.
 - If both the forward and reverse gear backlashes are smaller than specification, the pinion may be too low.

MEASURING THE FORWARD GEAR BACKLASH

1. Measure:
- Forward gear backlash
- Out of specification → Adjust.



Forward gear backlash
0.19 - 0.53 mm (0.007 - 0.021 in)

Measuring steps

- (1) Set the shift rod into the neutral position.



Shift rod wrench
YB-06052 / 90890-06052

- (2) Install the propeller shaft housing puller so it pushes against the propeller shaft.



Propeller shaft housing puller . ①
YB-06207 / 90890-06502

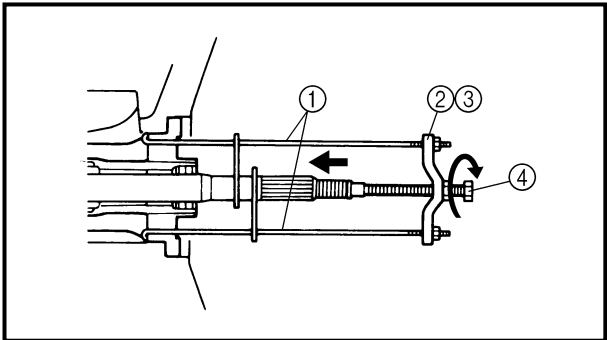
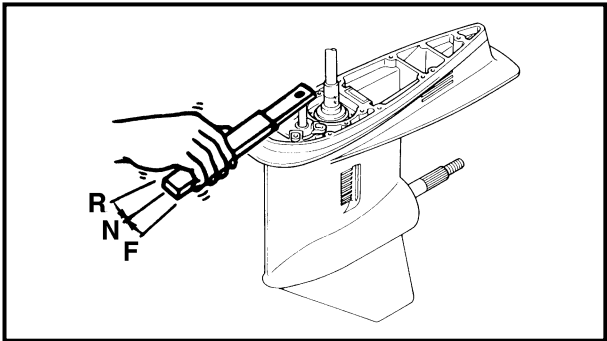
Universal puller..... ②
YB-06117 / 90890-06521

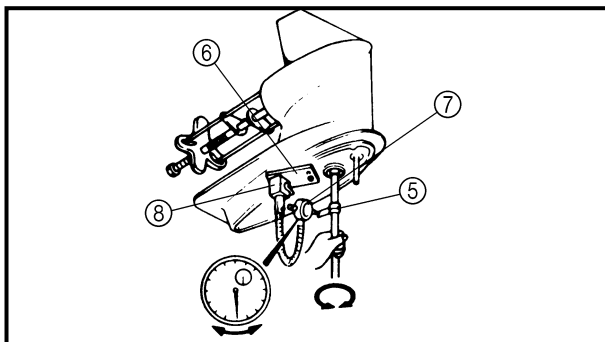
Guide plate..... ③
90890-06501

Center bolt ④
90890-06504



Center bolt
10 Nm (1.0 m • kgf, 7.2 ft • lb)





- (3) Install the backlash indicator onto the drive shaft (on the 22.4 mm (0.88 in) diameter portion of the drive shaft).



Backlash indicator ⑤
YB-06265 / 90890-06706

- (4) Install the dial gauge onto the lower unit and have the dial gauge plunger contact the mark on the backlash indicator.



Magnetic base attaching plate ⑥
YB-07003 / 90890-07003
Dial gauge set ⑦
YU-03097 / 90890-01252
Magnetic base..... ⑧
YU-34481 / 90890-06705

- (5) Set the lower unit upside down.
(6) Slowly turn the drive shaft clockwise and counterclockwise. When the drive shaft stops in each direction, measure the backlash.

2. Adjust:

- Forward gear shim

Remove or add shim(s).

 Forward gear backlash	Shim thickness
Less than 0.19 mm (0.007 in)	To be decreased by $(0.36 - M) \times 0.58$
More than 0.53 mm (0.021 in)	To be increased by $(M - 0.36) \times 0.58$

M: Measurement

MEASURING THE REVERSE GEAR BACKLASH

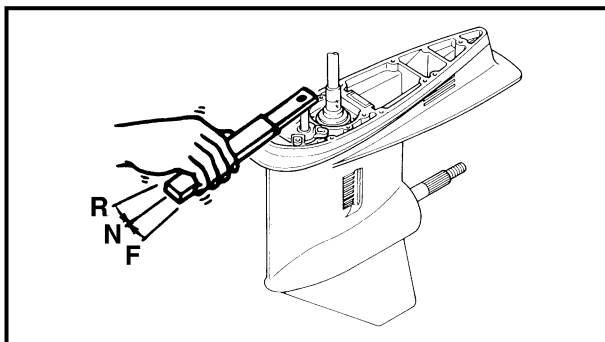
1. Measure:

- Reverse gear backlash

Out of specification → Adjust.



Reverse gear backlash
0.86 - 1.26 mm (0.034 - 0.050 in)

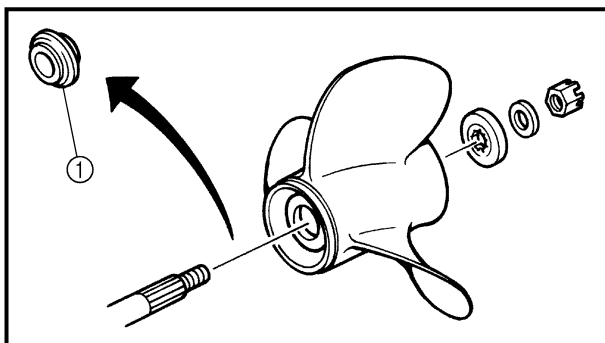


Measuring steps

- (1) Set the shift rod into the neutral position.



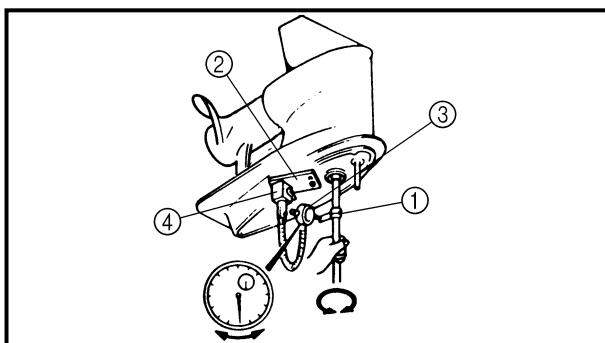
Shift rod wrench
YB-06052 / 90890-06052



- (2) Load the reverse gear by installing the propeller without the spacer ① and then tighten the propeller nut.



Propeller nut
10 Nm (1.0 m • kgf, 7.2 ft • lb)



- (3) Install the backlash indicator onto the drive shaft (on the 22.4 mm (0.88 in) diameter portion of the drive shaft).



Backlash indicator ①
YB-06265 / 90890-06706

- (4) Install the dial gauge onto the lower unit and have the dial gauge plunger contact the mark on the backlash indicator.



Magnetic-base plate ②
YB-07003 / 90890-07003
Dial gauge set ③
YU-03097 / 90890-01252
Magnetic base ④
YU-34481 / 90890-06705

- (5) Set the lower unit upside down.
- (6) Slowly turn the drive shaft clockwise and counterclockwise. When the drive shaft stops in each direction, measure the backlash.

2. Adjust:

- Reverse gear shim

Remove or add shim(s).

	Reverse gear backlash	Shim thickness
	Less than 0.86 mm (0.034 in)	To be increased by $(1.06 - M) \times 0.58$
	More than 1.26 mm (0.050 in)	To be decreased by $(M - 1.06) \times 0.58$

M: Measurement



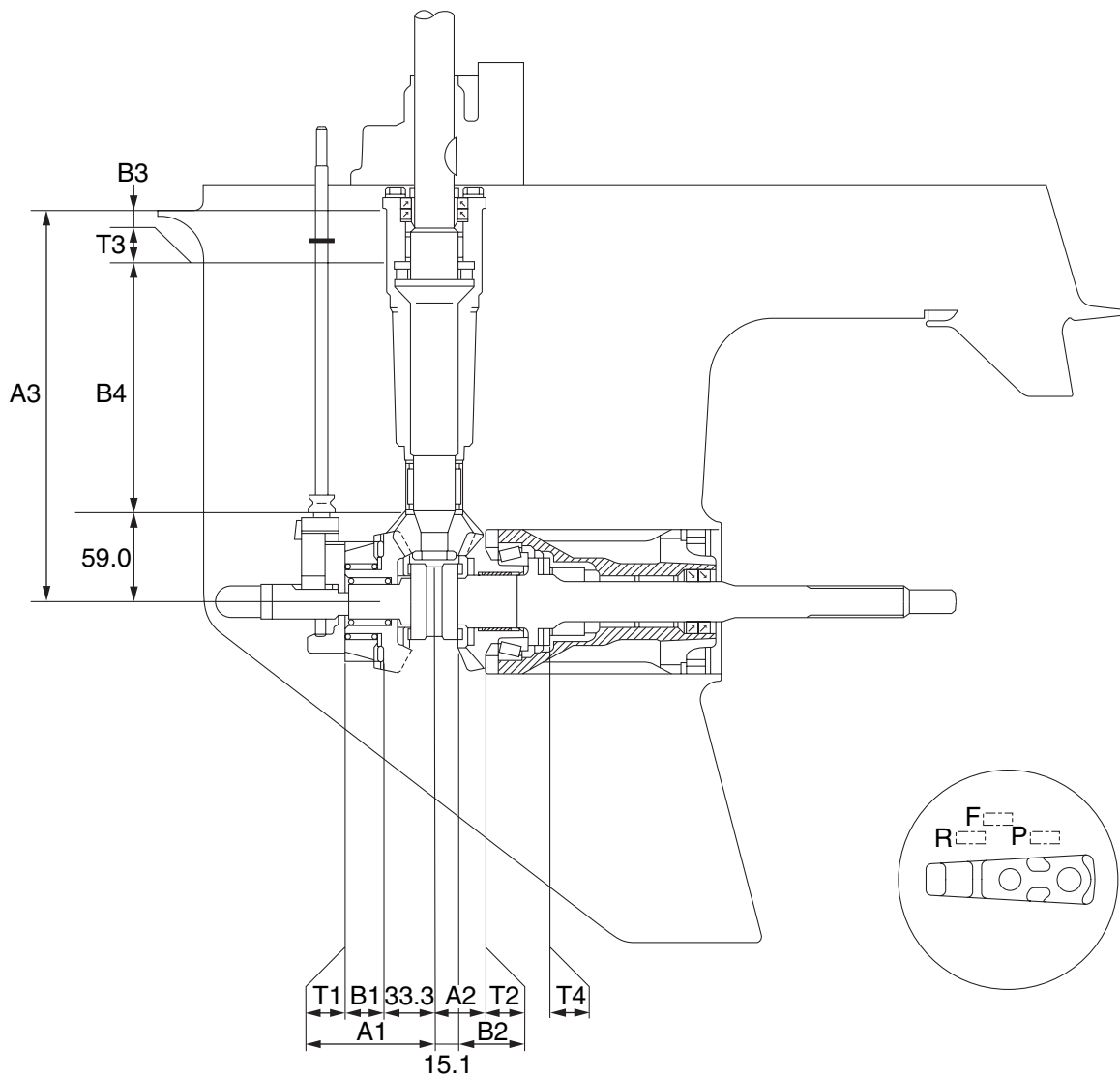
SHIMMING (COUNTER ROTATION MODELS) (FOR USA AND CANADA)

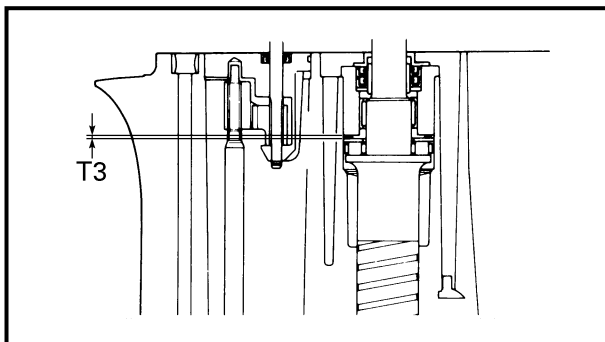
E

SHIMMING (COUNTER ROTATION MODELS) (FOR USA AND CANADA)

NOTE:

- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required when replacing the inner part(s).

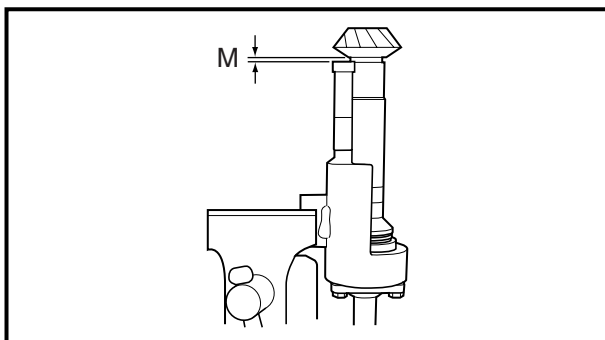




SELECTING THE PINION SHIMS

NOTE:

Find the shim thickness (T3) by selecting shims until the specified measurement (M) is obtained with the special tool.



1. Measure:

- Specified measurement (M)

Out of specified value (M0) → Adjust.



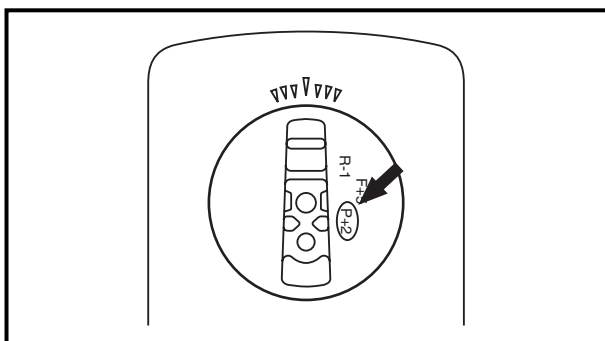
Specified value (M0) =
 $1.00 + P/100$ mm

Measuring steps

(1) Calculate the specified value (M0).

NOTE:

"P" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "P" mark is missing or unreadable, assume a "P" value of "0", and check the backlash when the unit is assembled.



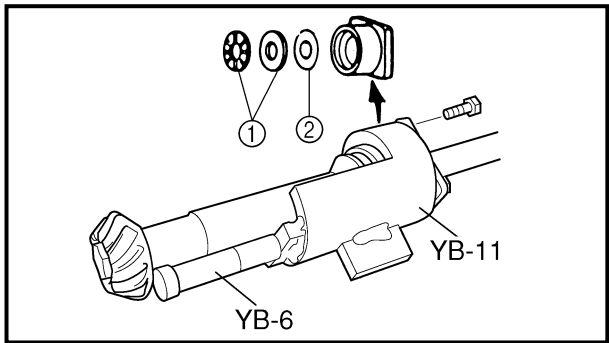
Example:

If "P" is "+5", then

$$\begin{aligned} M0 &= 1.00 + (+5)/100 \text{ mm} \\ &= 1.00 + 0.05 \text{ mm} \\ &= 1.05 \text{ mm} \end{aligned}$$

If "P" is "-3", then

$$\begin{aligned} M0 &= 1.00 + (-3)/100 \text{ mm} \\ &= 1.00 - 0.03 \text{ mm} \\ &= 0.97 \text{ mm} \end{aligned}$$



(2) Install the pinion height gauge, drive shaft, thrust bearing ①, and shim(s) ②.



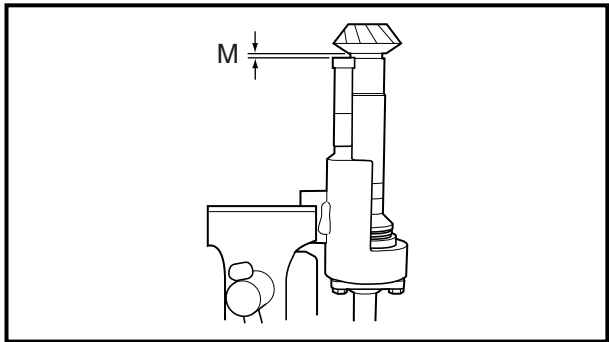
Pinion height gauge
YB-34432-6, -11

NOTE: _____
 If the original shim(s) is unavailable, start with a 0.50-mm shim.

(3) Install the pinion and pinion nut.



Pinion nut
93 Nm (9.3 m • kgf, 67 ft • lb)



(4) Measure the specified measurement (M).

NOTE: _____

- Measure the clearance between the pinion height gauge and the lower surface of the pinion as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M).

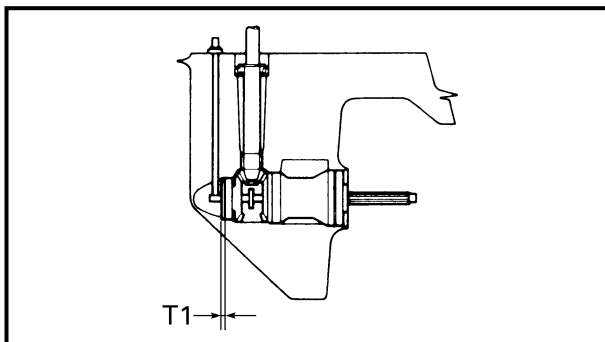
2. Adjust:

- Shim thickness (T3)
 Remove or add shim(s).



Available shim thickness
0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm

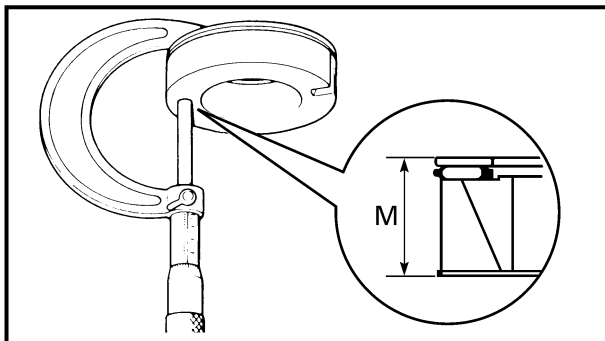
NOTE: _____
 (M0) – (M) should be as close to “0” as possible.



SELECTING THE REVERSE GEAR SHIMS

NOTE:

Find the shim thickness (T1) by selecting shims until the specified value (M0) is obtained with the special tool.



1. Measure:

- Specified measurement (M)

Out of specified value (M0) → Adjust.



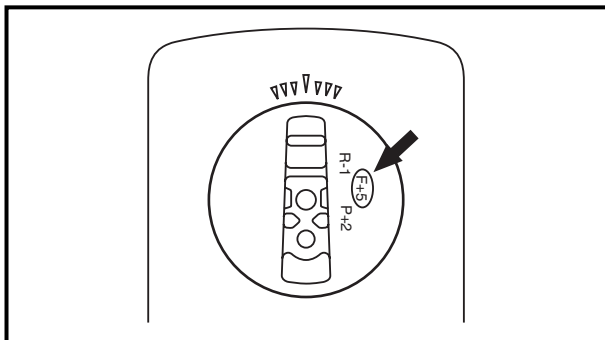
Specified value (M0) =
 $25.30 + F/100$ mm

Measuring steps

(1) Calculate the specified value (M0).

NOTE:

"F" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "F" mark is missing or unreadable, assume an "F" value of "0", and check the backlash when the unit is assembled.



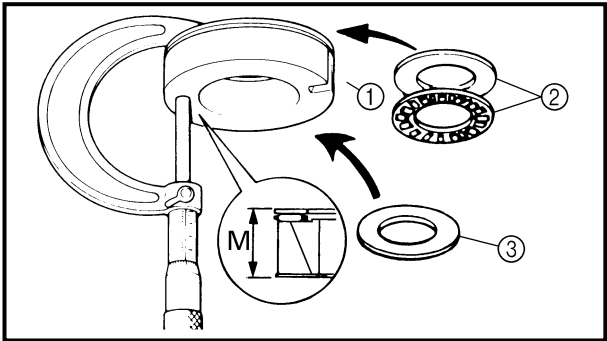
Example:

If "F" is "+5", then

$$\begin{aligned} M0 &= 25.30 + (+5)/100 \text{ mm} \\ &= 25.30 + 0.05 \text{ mm} \\ &= 25.35 \text{ mm} \end{aligned}$$

If "F" is "-3", then

$$\begin{aligned} M0 &= 25.30 + (-3)/100 \text{ mm} \\ &= 25.30 - 0.03 \text{ mm} \\ &= 25.27 \text{ mm} \end{aligned}$$



(2) Install the roller bearing ①, thrust bearing ②, and shim(s) ③.

NOTE: _____
If the original shim(s) is unavailable, start with a 0.50-mm shim.

(3) Measure the specified measurement (M).

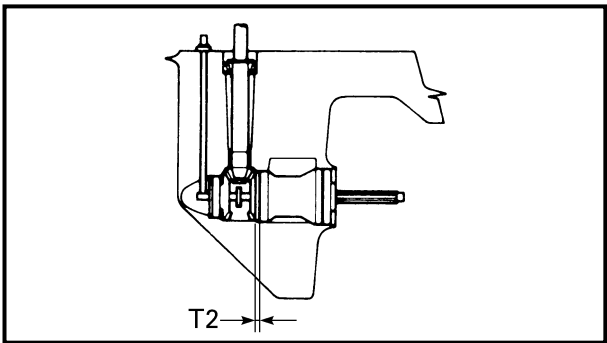
2. Adjust:
- Shim thickness (T1)
- Remove or add shim(s).



Available shim thickness

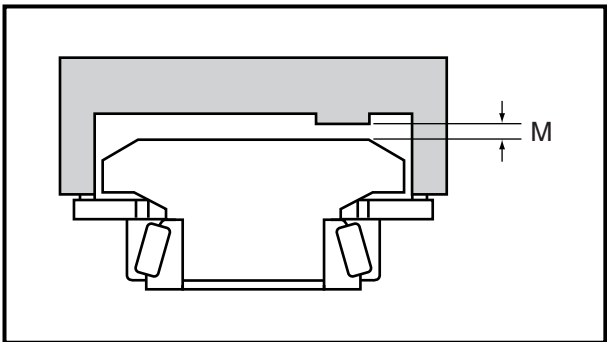
0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm

NOTE: _____
(M0) – (M) should be as close to “0” as possible.



SELECTING THE FORWARD GEAR SHIMS

NOTE: _____
Find the shim thickness (T2) by selecting shims until the specified value (M0) is obtained with the special tool.

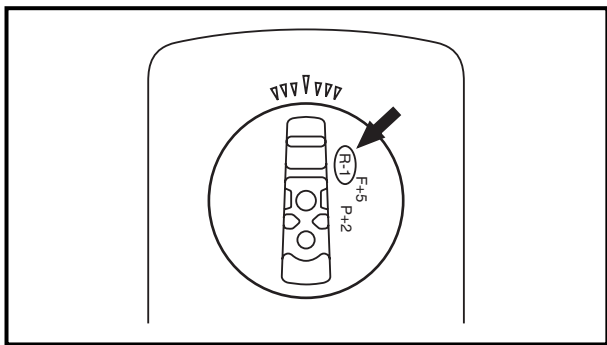


1. Measure:
- Specified measurement (M)
- Out of specified value (M0) → Adjust.



Specified value (M0) =

$1.10 - R/100$ mm



Measuring steps

(1) Calculate the specified value (M0).

NOTE:

"R" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "R" mark is missing or unreadable, assume an "R" value of "0", and check the backlash when the unit is assembled.

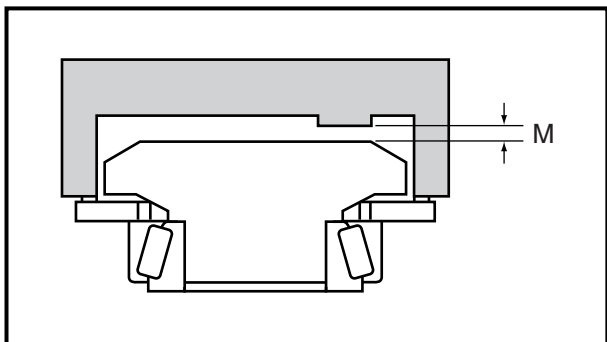
Example:

If "R" is "+5", then

$$\begin{aligned} M0 &= 1.10 - (+5)/100 \text{ mm} \\ &= 1.10 - 0.05 \text{ mm} \\ &= 1.05 \text{ mm} \end{aligned}$$

If "R" is "-3", then

$$\begin{aligned} M0 &= 1.10 - (-3)/100 \text{ mm} \\ &= 1.10 + 0.03 \text{ mm} \\ &= 1.13 \text{ mm} \end{aligned}$$



(2) Install the shimming gauge, bearing, thrust washer, forward gear, and shim(s).



**Shimming gauge
YB-34468-2**

NOTE:

- If the original shim(s) is unavailable, start with a 0.50-mm shim.
- Turn the forward gear assembly a few times until the gear and bearing are horizontal.

(3) Measure the specified measurement (M).

2. Adjust:
- Shim thickness (T2)
- Remove or add shim(s).

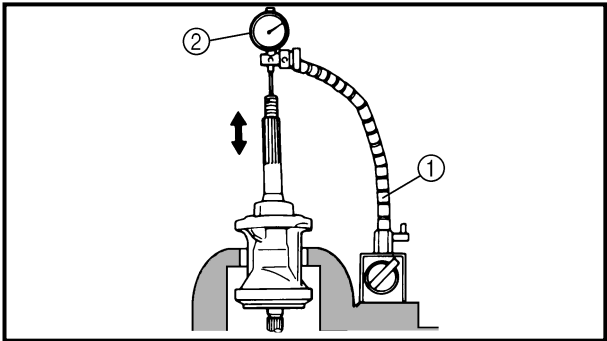
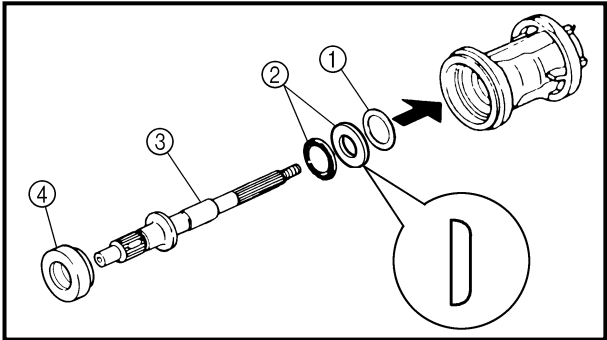
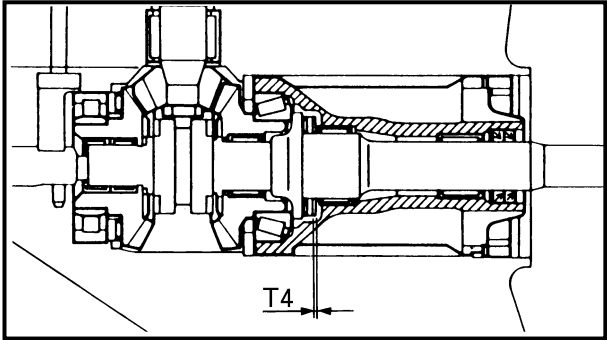


Available shim thickness

0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm

NOTE:

(M0) – (M) should be as close to “0” as possible.



SELECTING THE PROPELLER SHAFT SHIMS

NOTE:

Find the shim thickness (T4) by selecting shims until the specified measurement is obtained with the special tool.

1. Install:
- Shim(s) ①
 - Thrust bearing ②
 - Propeller shaft ③
 - Tapered roller bearing ④

2. Measure:
- Propeller shaft free play
- Out of specification → Adjust.



Propeller shaft free play

0.30 ± 0.05 mm



Magnetic base..... ①

YU-34481 / 90890-06705

Dial gauge set ②

YU-03097 / 90890-01252

3. Adjust:
- Propeller shaft free play
- Remove or add shim(s).



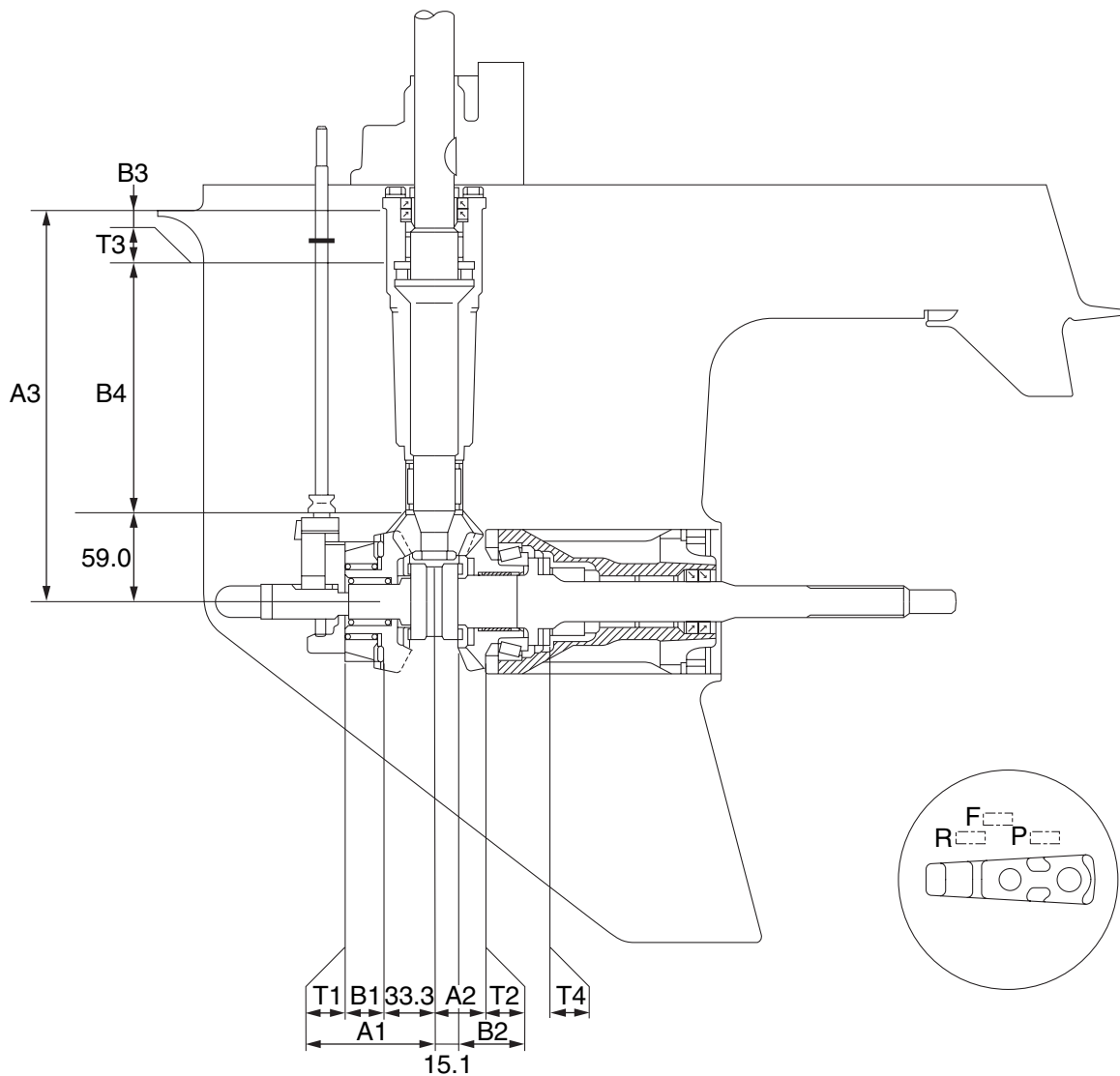
Available shim thickness

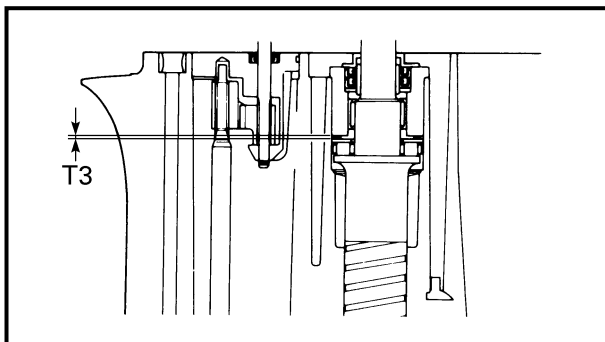
0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

NOTE:

- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required when replacing the inner part(s).





SELECTING THE PINION SHIMS

NOTE:

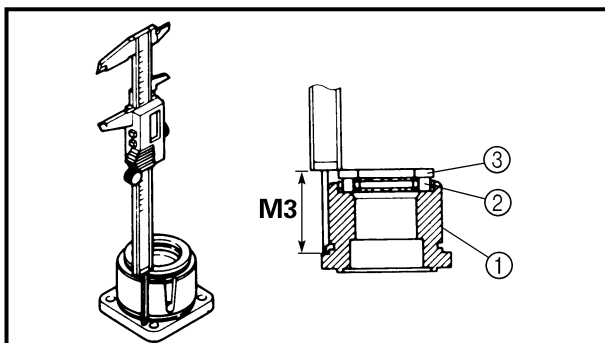
Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.

Select:

- Shim thickness (T3)

Selecting steps

(1) Measure (M3).



Digital caliper
90890-06704

NOTE:

Install the bearing housing ①, thrust bearing ②, and washer ③.

(2) Install the pinion and pinion nut.



Pinion nut
93 Nm (9.3 m • kgf, 67 ft • lb)

(3) Install the pinion height gauge.

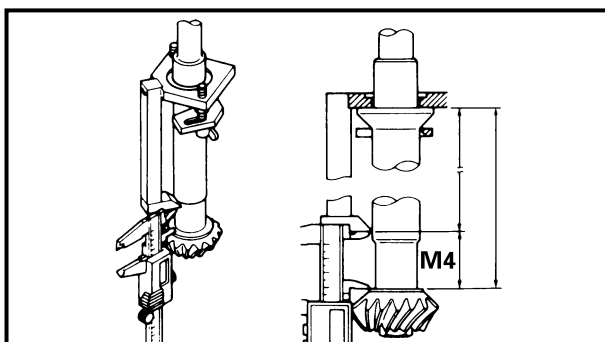


Pinion height gauge
90890-06702

NOTE:

After the wing nuts contact the fixing plate, tighten them another 1/4 of a turn.

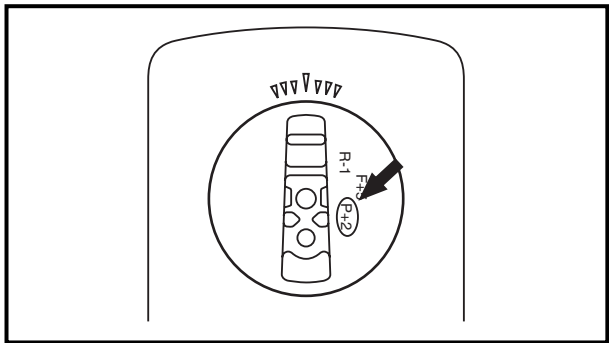
(4) Measure (M4).



Digital caliper
90890-06704

NOTE:

- Measure the clearance between the pinion height gauge and the pinion, as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M4).



(5) Calculate the pinion shim thickness (T3).



Pinion shim thickness (T3) =

$62.5 + P/100 - M3 - M4$

NOTE: _____

“P” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “P” mark is missing or unreadable, assume a “P” value of “0”, and check the backlash when the unit is assembled.

Example:

If M3 is “46.85 mm”, M4 is “15.12 mm” and P is “-5”, then

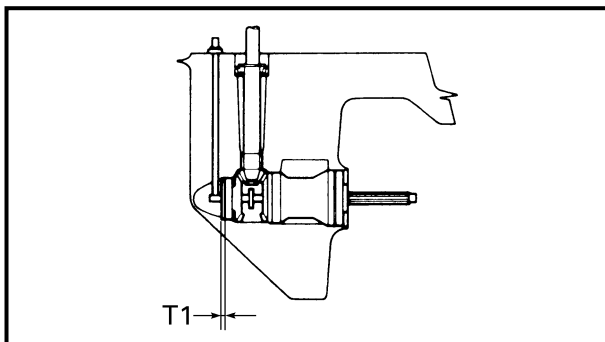
$$T3 = 62.5 + (-5)/100 - 46.85 - 15.12 \text{ mm}$$

$$= 62.5 - 0.05 - 46.85 - 15.12 \text{ mm}$$

$$= 0.48 \text{ mm}$$

(6) Select the pinion shim(s) (T3).

Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08
 Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm		



SELECTING THE REVERSE GEAR SHIMS

NOTE:

Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.

Select:

- Shim thickness (T1)

Selecting steps

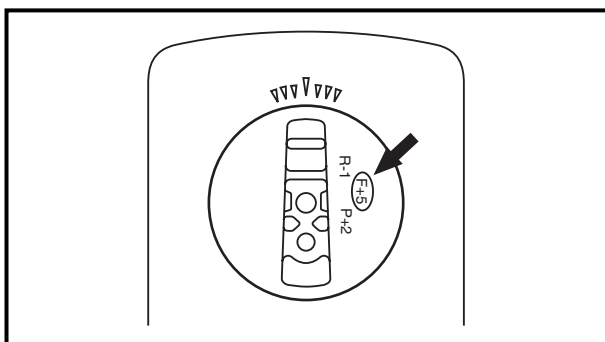
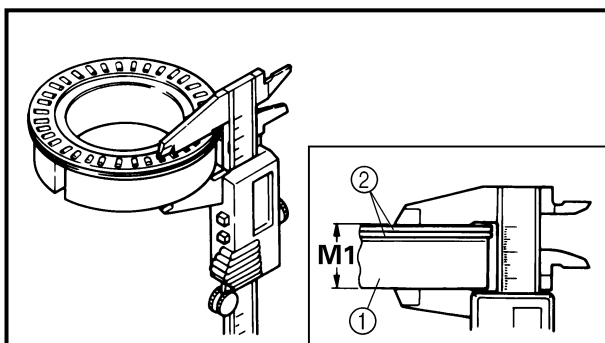
(1) Measure (M1).



Digital caliper
90890-06704

NOTE:

- Measure the combined thickness of the roller bearing ① and thrust bearing ②.
- Turn the roller bearing outer race two or three times so the rollers seat. Then, measure the height of the bearing, as shown.
- Perform the same measurement at three points on the roller bearing outer race.
- Find the average of the measurements (M1).



(2) Calculate the reverse gear shim thickness (T1).



Reverse gear shim thickness (T1)
(T1) = 25.3 + F/100 - M1

NOTE:

"F" is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the "F" mark is missing or unreadable, assume an "F" value of "0", and check the backlash when the unit is assembled.

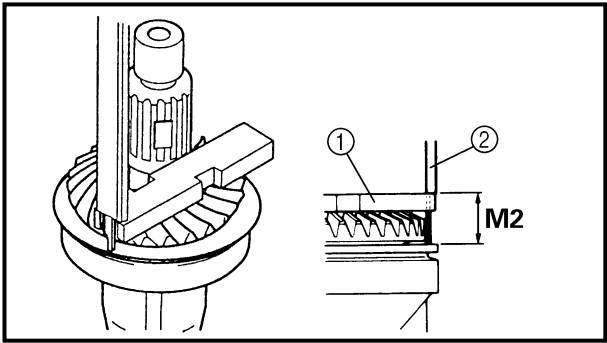
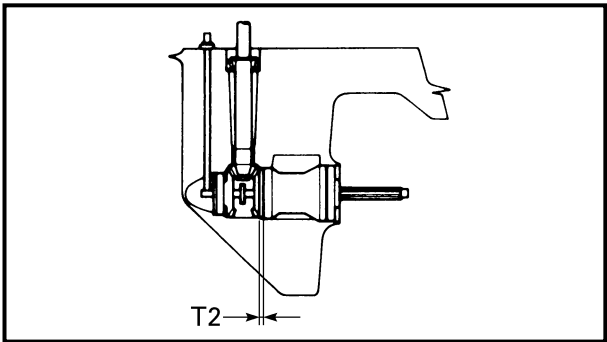
Example:
 If M1 is "24.80 mm" and F is "+5", then
 $T1 = 25.3 + (+5)/100 - 24.80 \text{ mm}$
 $= 25.3 + 0.05 - 24.80 \text{ mm}$
 $= 0.55 \text{ mm}$

(3) Select the reverse gear shim(s).

Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08



Available shim thickness
 0.10, 0.12, 0.15, 0.18, 0.30, 0.40
 and 0.50 mm



SELECTING THE FORWARD GEAR SHIMS

NOTE: _____
 Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.

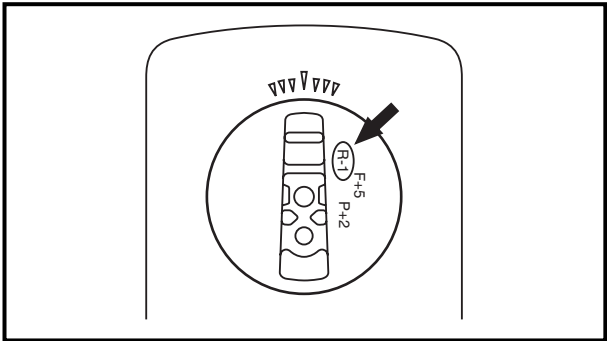
- Select:
- Shim thickness (T2)

Selecting steps
 (1) Measure (M2).

	Shimming plate ①
	90890-06701
	Digital caliper ②
	90890-06704

NOTE: _____

- Measure the height of the gear as shown.
- Perform the same measurement at three points on the gear.
- Find the average of the measurements (M2).



(2) Calculate the forward gear shim thickness (T2).



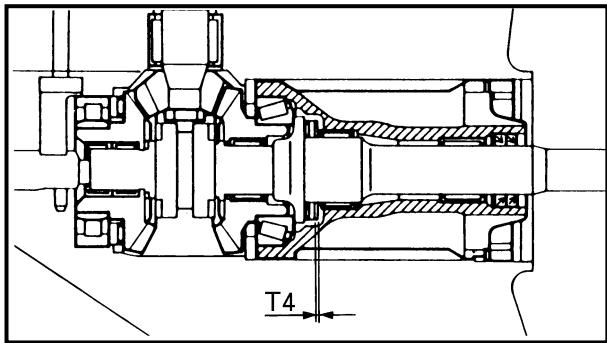
Forward gear shim thickness (T2) = M2 – 28.1 – R/100

NOTE: _____
 “R” is the deviation of the lower case dimension from standard. It is stamped on the trim tab mounting surface of the lower case in 0.01-mm units. If the “R” mark is missing or unreadable, assume a “R” value of “0”, and check the backlash when the unit is assembled.

Example:
 If M2 is “29.10 mm”, R is “+2”, then
 $T2 = 29.10 - 28.1 - (+2)/100 \text{ mm}$
 $= 29.10 - 28.1 - 0.02 \text{ mm}$
 $= 0.98 \text{ mm}$

(3) Select the forward gear shim(s) (T2).

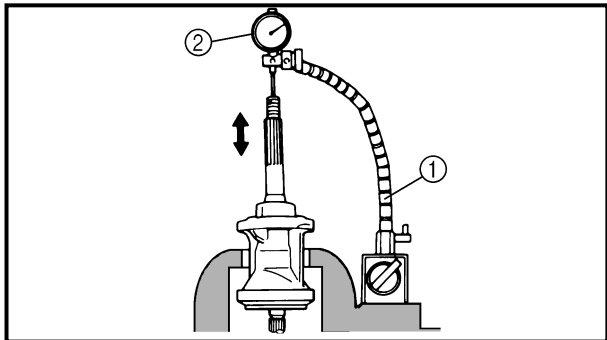
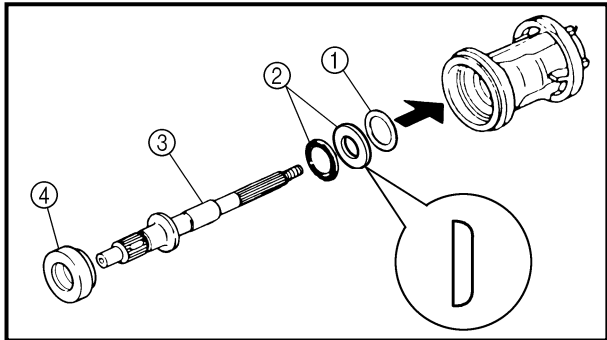
Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.02
0.02	0.05	0.05
0.05	0.08	0.08
0.08	0.10	0.10
		Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm



SELECTING THE PROPELLER SHAFT SHIMS

NOTE:

Find the shim thickness (T4) by selecting shims until the specified measurement is obtained with the special tool.



1. Install:
- Shim(s) ①
 - Thrust bearing ②
 - Propeller shaft ③
 - Tapered roller bearing ④

2. Measure:
- Propeller shaft free play
- Out of specification → Adjust.

	Propeller shaft free play 0.30 ± 0.05 mm
	Magnetic base..... ① YU-34481 / 90890-06705 Dial gauge set ② YU-03097 / 90890-01252

3. Adjust:
- Propeller shaft free play
- Remove or add shim(s).

	Available shim thickness 0.10, 0.12, 0.15, 0.18, 0.30, 0.40 and 0.50 mm
---	--

BACKLASH (COUNTER ROTATION MODELS)

- NOTE:**

 - Do not install the water pump components when measuring the backlash.
 - Measure both the forward and reverse gear backlashes.
 - If both the forward and reverse gear backlashes are larger than specification, the pinion may be too high.
 - If both the forward and reverse gear backlashes are smaller than specification, the pinion may be too low.

MEASURING THE FORWARD GEAR BACKLASH

1. Measure:

 - Forward gear backlash

Out of specification → Adjust.



Forward gear backlash
0.31 - 0.66 mm (0.012 - 0.026 in)

Measuring steps

- (1) Set the shift rod into the neutral position.



Shift rod wrench
YB-06052 / 90890-06052

- (2) Install the propeller shaft housing puller so it pushes against the propeller shaft.



Propeller shaft housing puller . ①
YB-06207 / 90890-06502

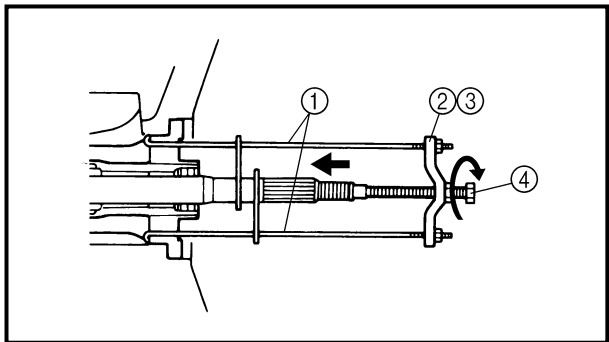
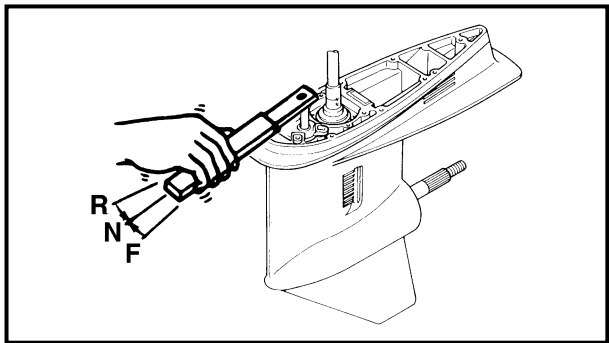
Universal puller..... ②
YB-06117 / 90890-06521

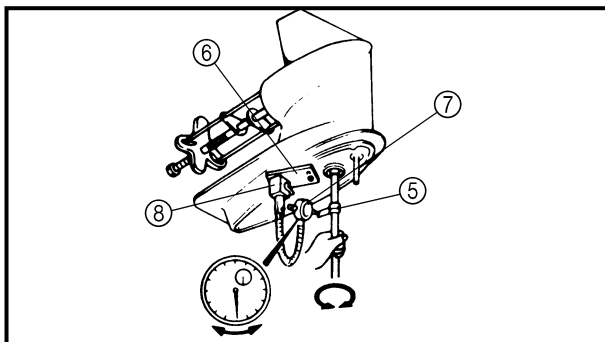
Guide plate..... ③
90890-06501

Center bolt ④
90890-06504



Center bolt
10 Nm (1.0 m • kgf, 7.2 ft • lb)





- (3) Install the backlash indicator onto the drive shaft (on the 22.4 mm (0.88 in) diameter portion of the drive shaft).



Backlash indicator ⑤
YB-06265 / 90890-06706

- (4) Install the dial gauge onto the lower unit and have the dial gauge plunger contact the mark on the backlash indicator.



Magnetic base attaching plate ⑥
YB-07003 / 90890-07003
Dial gauge set ⑦
YU-03097 / 90890-01252
Magnetic base..... ⑧
YU-34481 / 90890-06705

- (5) Set the lower unit upside down.
(6) Slowly turn the drive shaft clockwise and counterclockwise. When the drive shaft stops in each direction, measure the backlash.

2. Adjust:

- Forward gear shim

Remove or add shim(s).

 Forward gear backlash	Shim thickness
Less than 0.31 mm (0.012 in)	To be increased by $(0.49 - M) \times 0.58$
More than 0.66 mm (0.026 in)	To be decreased by $(M - 0.49) \times 0.58$

M: Measurement

MEASURING THE REVERSE GEAR BACKLASH

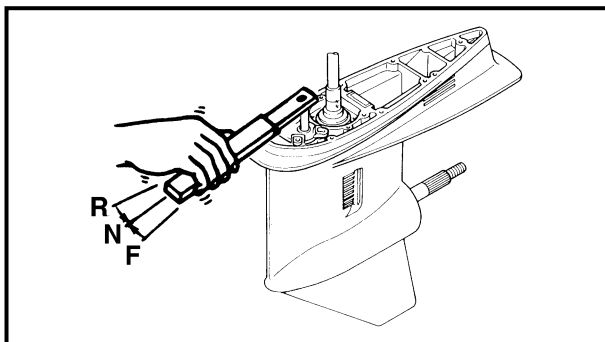
1. Measure:

- Reverse gear backlash

Out of specification → Adjust.



Reverse gear backlash
0.86 - 1.21 mm (0.034 - 0.048 in)

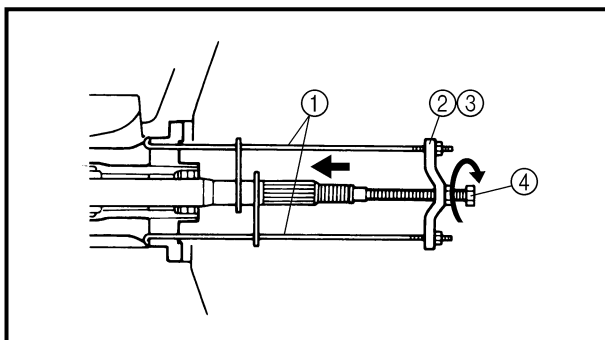


Measuring steps

- (1) Set the shift rod into the neutral position.



Shift rod wrench
YB-06052 / 90890-06052



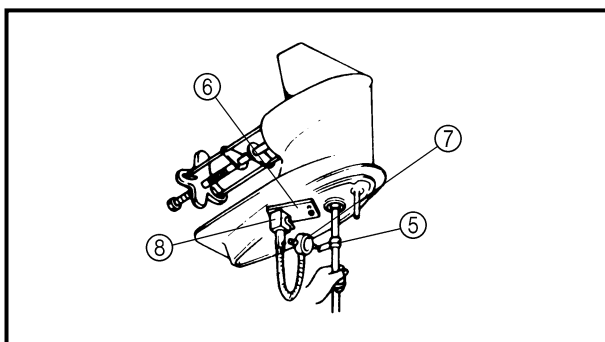
- (2) Install the propeller shaft housing puller so it pushes against the propeller shaft.



Propeller shaft housing puller . ①
YB-06207 / 90890-06502
Universal puller..... ②
YB-06117
Guide plate..... ③
90890-06501
Center bolt ④
90890-06504



Center bolt
10 Nm (1.0 m • kgf, 7.2 ft • lb)



- (3) Install the backlash indicator onto the drive shaft (on the 22.4 mm (0.88 in) diameter portion of the drive shaft).



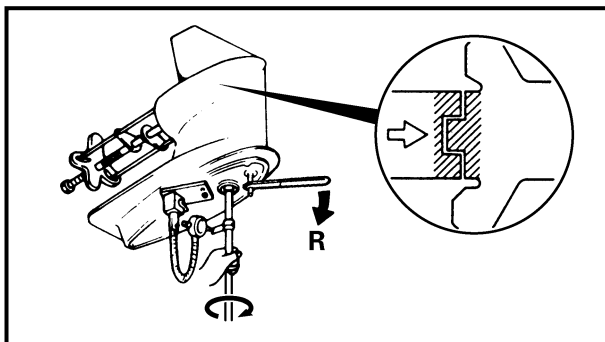
Backlash indicator ⑤
YB-06265 / 90890-06706

- (4) Install the dial gauge onto the lower unit and have the dial gauge plunger contact the mark on the backlash indicator.

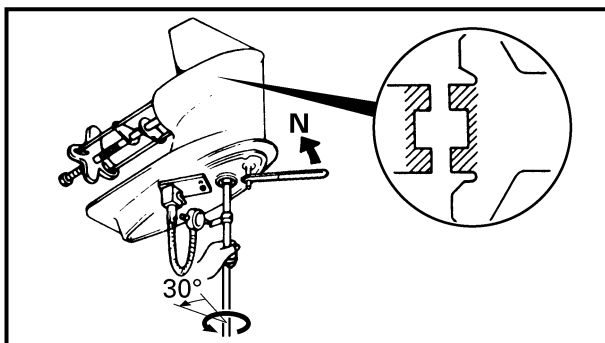


Magnetic base attaching plate..... ⑥
YB-07003 / 90890-07003
Dial gauge set..... ⑦
YU-03097 / 90890-01252
Magnetic base..... ⑧
YU-34481 / 90890-06705

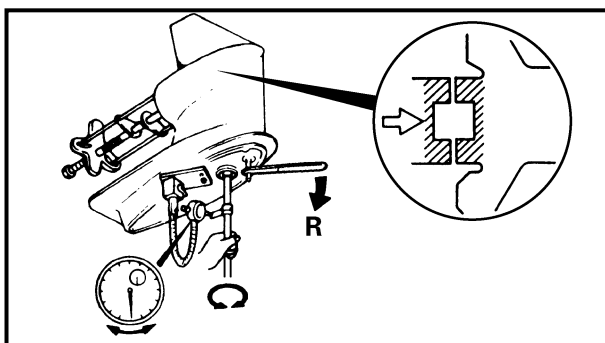
- (5) Set the lower unit upside down.



- (6) Turn the shift rod into the reverse position with the shift rod wrench.
- (7) Turn the drive shaft clockwise until the clutch dog is fully engaged.



- (8) Turn the shift rod into the neutral position with the shift rod wrench.
- (9) Turn the drive shaft counterclockwise approximately 30° more.



- (10) Turn the shift rod into the reverse position with the shift rod wrench.
- (11) Slowly turn the drive shaft clockwise and counterclockwise. When the drive shaft stops in each direction, measure the backlash.

NOTE: _____

When measuring the reverse gear backlash, turn the shift rod wrench towards the reverse position with force.

2. Adjust:

- Reverse gear shim

Remove or add shim(s).

 Reverse gear backlash	Shim thickness
Less than 0.86 mm (0.034 in)	To be decreased by $(1.0 - M) \times 0.58$
More than 1.21 mm (0.048 in)	To be increased by $(M - 1.0) \times 0.58$

M: Measurement

CHAPTER 7

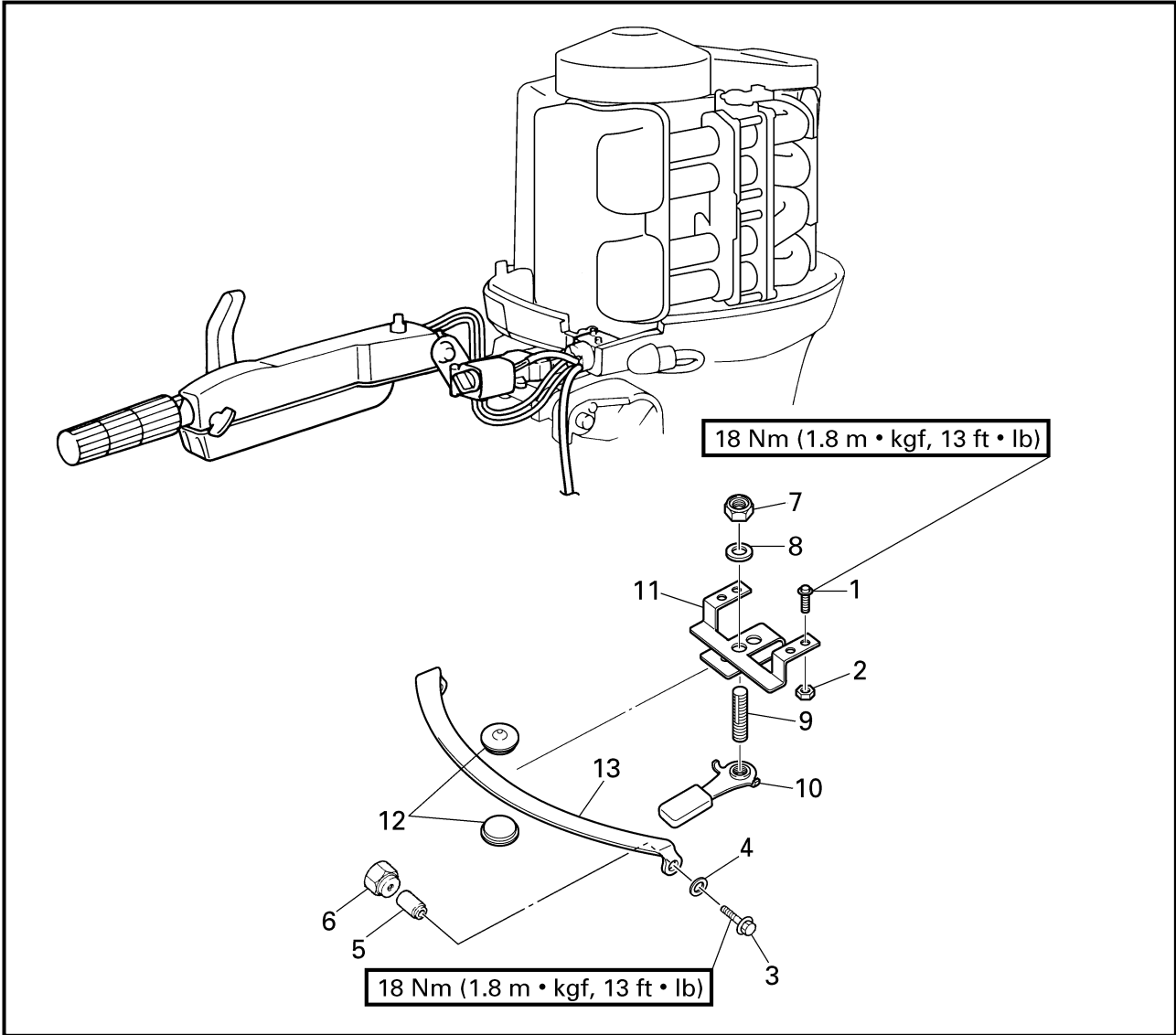
BRACKET UNIT

STEERING HANDLE (OPTION)	7-1
REMOVING/INSTALLING THE STEERING FRICTION.....	7-1
REMOVING/INSTALLING THE STEERING HANDLE	7-2
DISASSEMBLING/ASSEMBLING THE STEERING HANDLE.....	7-4
DISASSEMBLING/ASSEMBLING THE STEERING HANDLE	
SUB ASSEMBLY	7-7
 SHIFT ROD ASSEMBLY	7-10
REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY	7-10
 BOTTOM COWLING	7-13
REMOVING/INSTALLING THE BOTTOM COWLING	7-13
 UPPER CASE ASSEMBLY	7-16
REMOVING/INSTALLING THE UPPER CASE ASSEMBLY	7-16
DISASSEMBLING/ASSEMBLING THE OIL PUMP	7-17-1
DISASSEMBLING THE OIL PUMP ASSEMBLY	7-17-2
CHECKING THE OIL PUMP ASSEMBLY.....	7-17-2
ASSEMBLING THE OIL PUMP ASSEMBLY	7-17-2
DISASSEMBLING/ASSEMBLING THE UPPER CASE ASSEMBLY	7-18
 OIL PAN	7-21
DISASSEMBLING/ASSEMBLING THE OIL PAN	7-21
 CLAMP BRACKETS	7-24
REMOVING/INSTALLING THE CLAMP BRACKETS.....	7-24
 STEERING ARM	7-26
REMOVING/INSTALLING THE STEERING ARM.....	7-26
 SWIVEL BRACKET ASSEMBLY	7-27
DISASSEMBLING/ASSEMBLING THE SWIVEL BRACKET	
ASSEMBLY	7-27
 POWER TRIM AND TILT UNIT	7-29
REMOVING/INSTALLING THE POWER TRIM AND TILT UNIT	7-29
REMOVING THE POWER TRIM AND TILT UNIT	7-31
BLEEDING THE POWER TRIM AND TILT UNIT	7-31

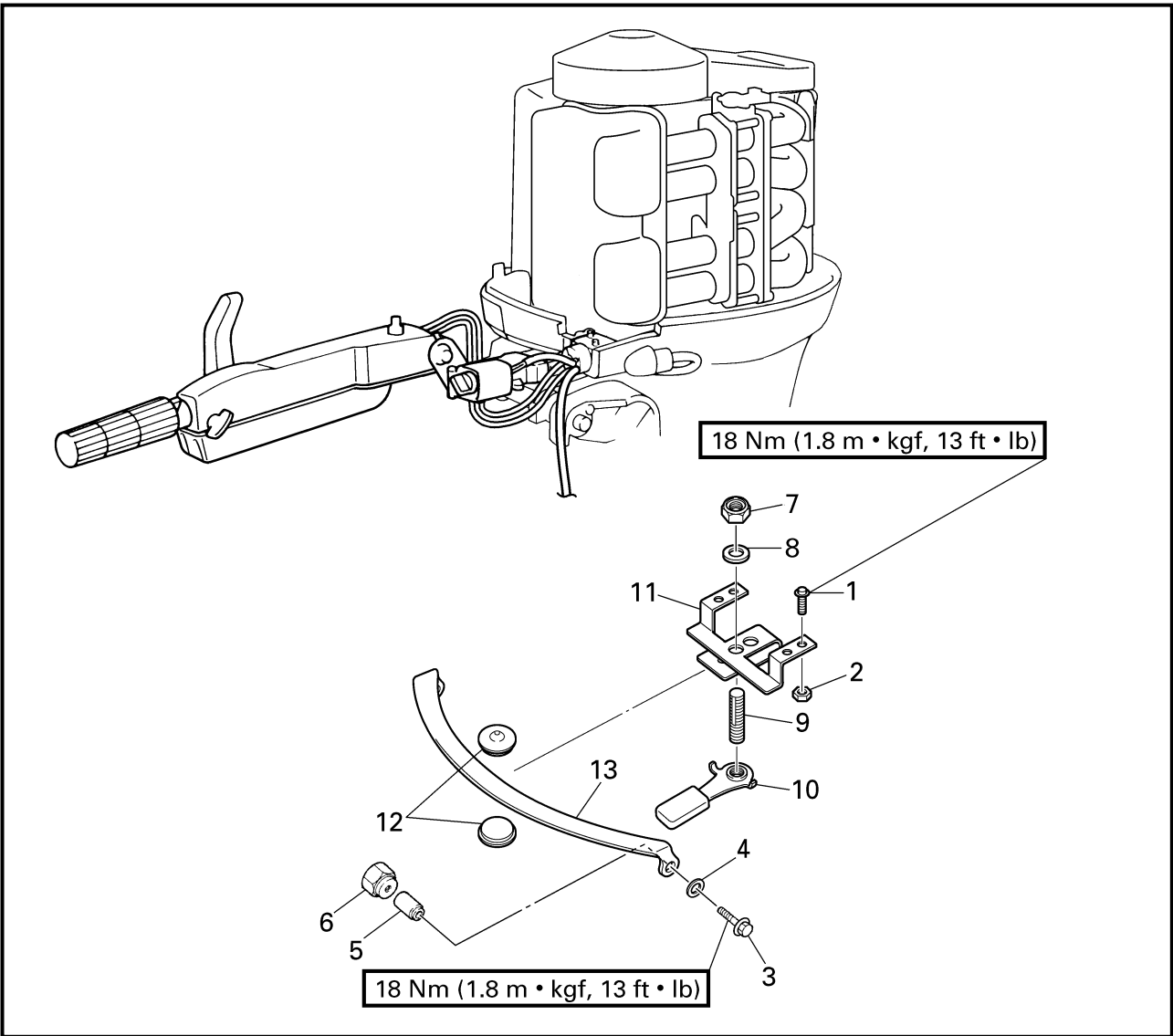
RESERVOIR AND POWER TRIM AND TILT MOTOR	7-33
REMOVING/INSTALLING THE RESERVOIR AND POWER TRIM AND TILT MOTOR.....	7-33
CHECKING THE RESERVOIR.....	7-34
CHECKING THE GEAR PUMP HOUSING FILTER	7-34
INSTALLING THE POWER TRIM AND TILT MOTOR.....	7-35
FILLING THE RESERVOIR.....	7-36
BLEEDING THE POWER TRIM AND TILT UNIT	7-36
MEASURING THE HYDRAULIC PRESSURE	7-38
 TILT RAM ASSEMBLY AND GEAR PUMP UNIT	 7-41
REMOVING/INSTALLING THE TILT RAM ASSEMBLY AND GEAR PUMP UNIT	7-41
REMOVING THE TILT RAM END SCREW	7-43
REMOVING THE GEAR PUMP UNIT	7-43
DISASSEMBLING THE GEAR PUMP UNIT	7-43
CHECKING THE TILT RAM	7-44
CHECKING THE GEAR PUMP UNIT.....	7-44
ASSEMBLING THE GEAR PUMP UNIT	7-45
INSTALLING THE GEAR PUMP UNIT.....	7-46
INSTALLING THE TILT RAM ASSEMBLY	7-46
 TRIM RAM ASSEMBLIES AND FREE PISTON	 7-48
REMOVING/INSTALLING THE TRIM RAM ASSEMBLIES AND FREE PISTON	7-48
REMOVING THE TRIM RAM END SCREWS	7-49
REMOVING THE FREE PISTON.....	7-49
CHECKING THE TRIM RAMS	7-50
CHECKING THE FREE PISTON.....	7-50
CHECKING THE TRIM RAM CYLINDERS	7-50
INSTALLING THE FREE PISTON.....	7-50
INSTALLING THE TRIM RAMS	7-51

STEERING HANDLE (OPTION)

REMOVING/INSTALLING THE STEERING FRICTION

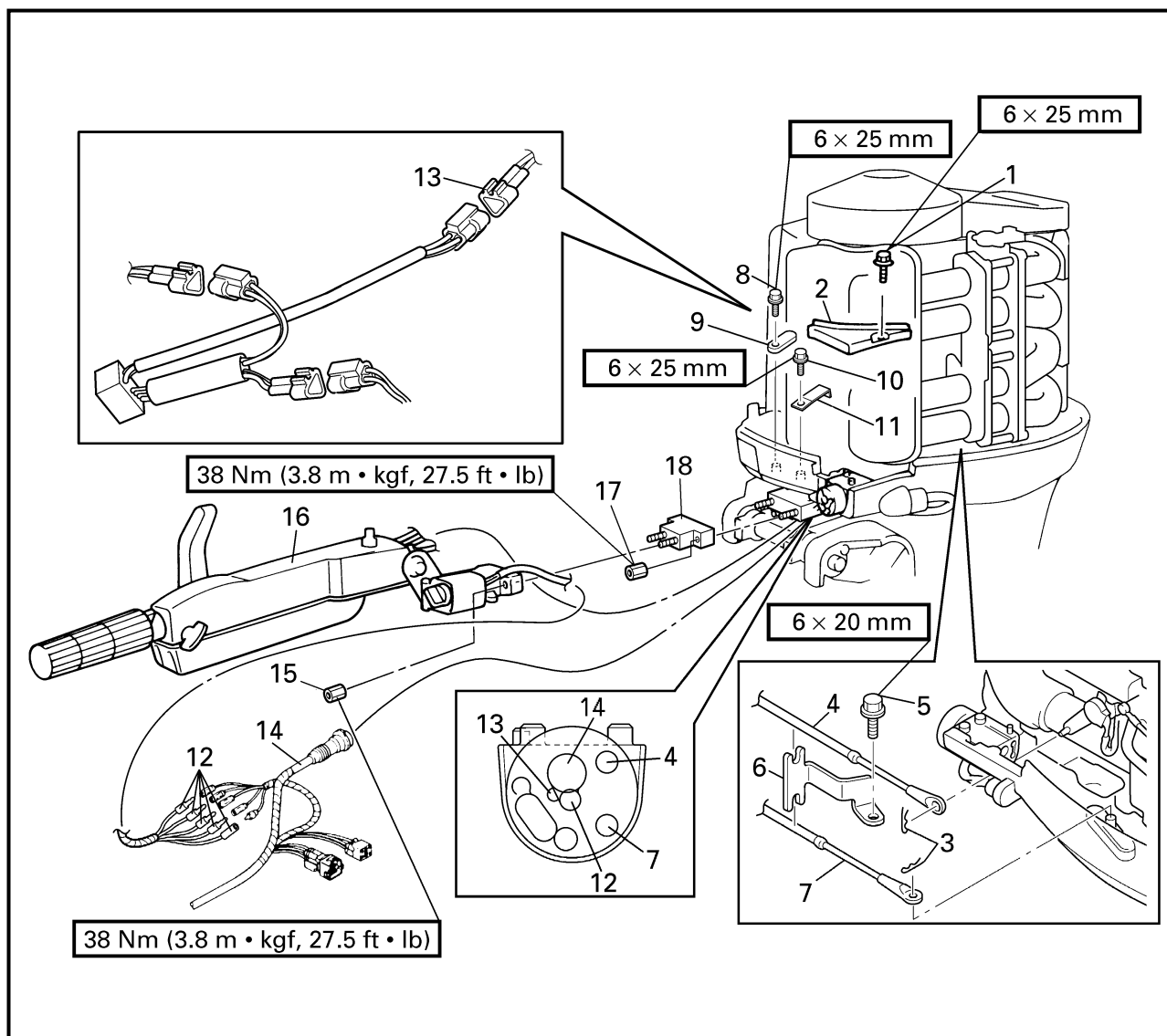


Order	Job/Part	Q'ty	Remarks
1	Bolt	2	Continued to next page.
2	Nut	2	
3	Bolt	2	
4	Washer	2	
5	Collar	2	
6	Nut	2	
7	Nut	1	



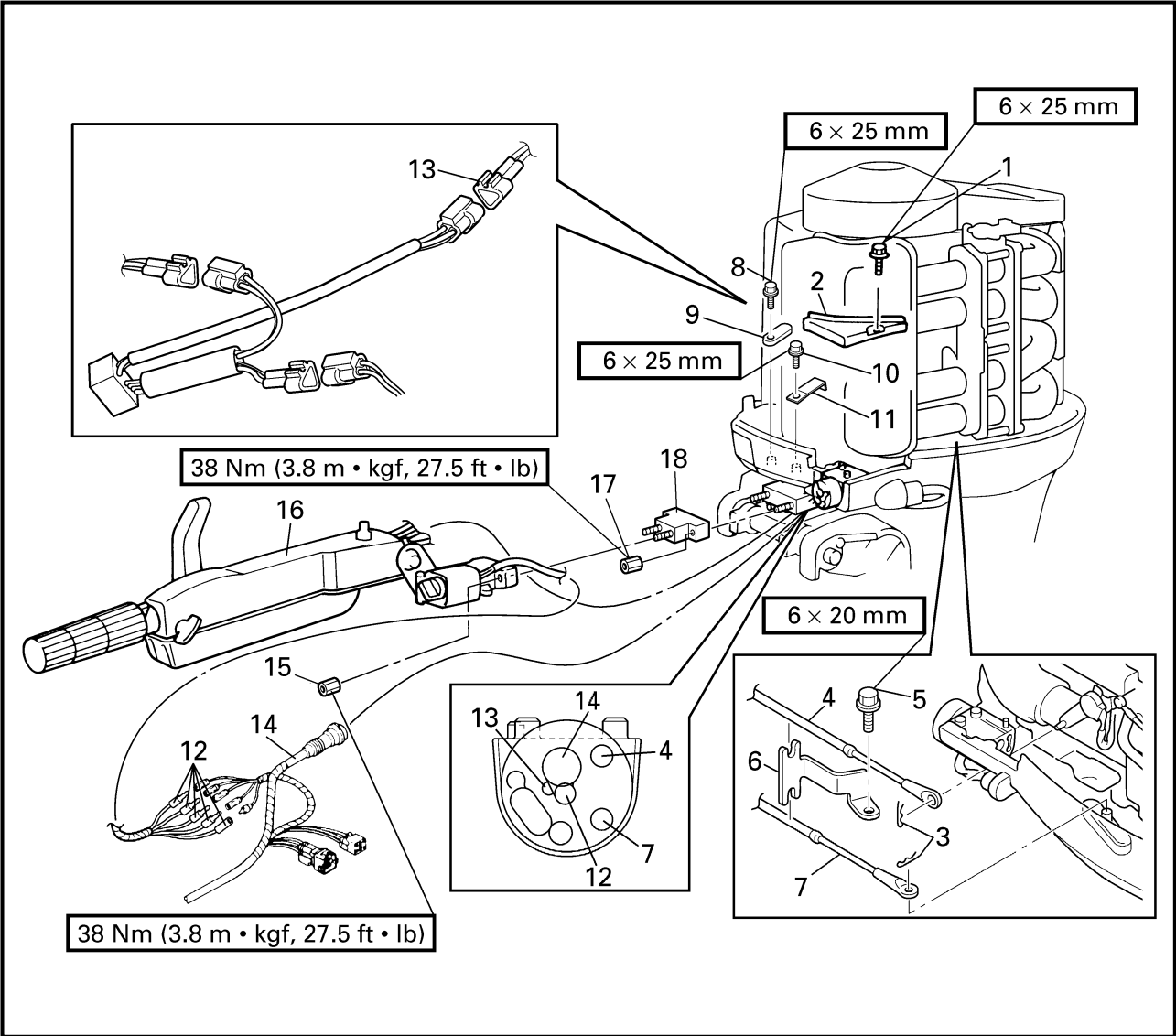
Order	Job/Part	Q'ty	Remarks
8	Washer	1	For installation, reverse the removal procedure.
9	Steering lock shaft	1	
10	Steering lock knob	1	
11	Bracket	1	
12	Friction piece	2	
13	Friction plate	1	

REMOVING/INSTALLING THE STEERING HANDLE



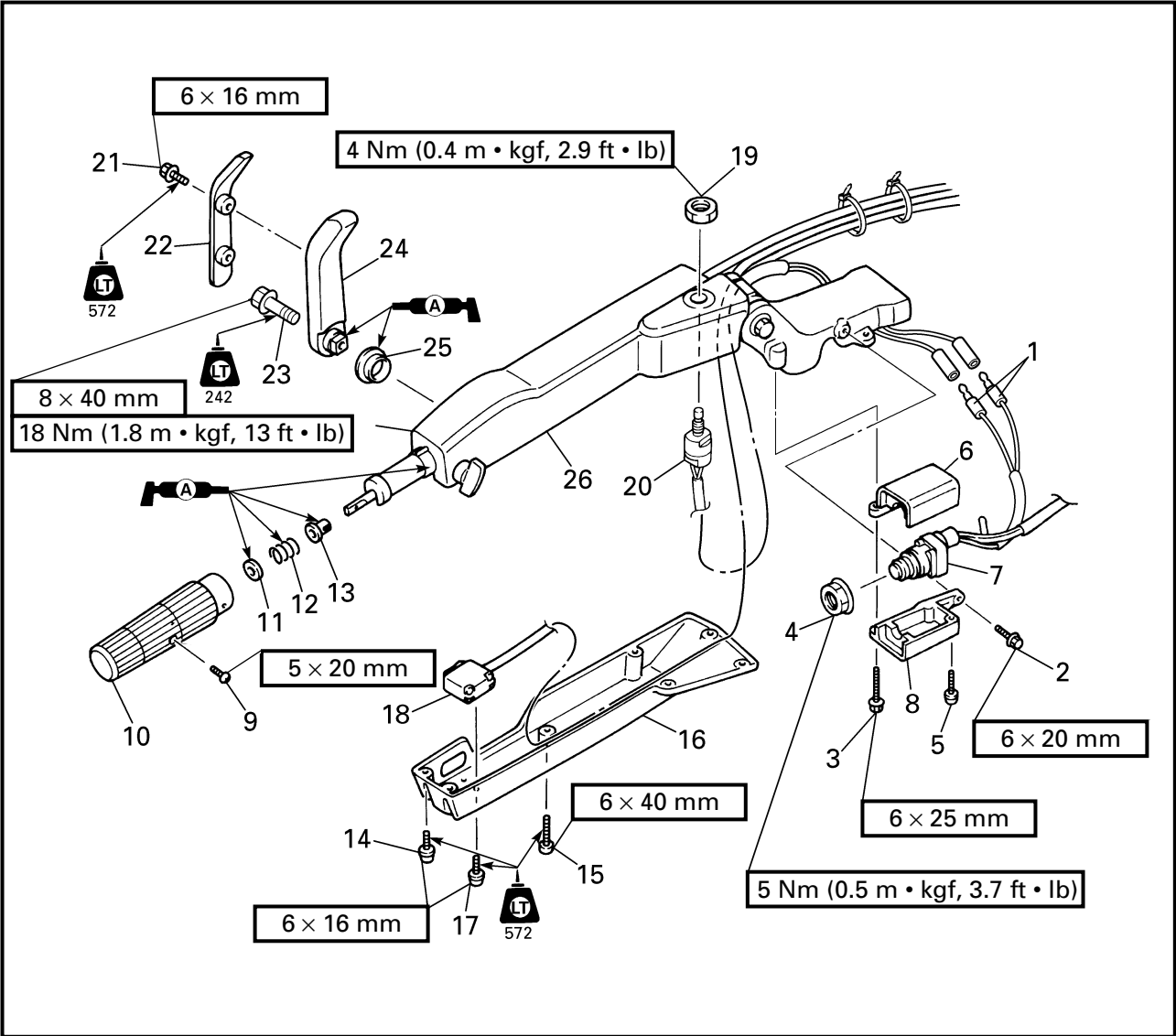
Order	Job/Part	Q'ty	Remarks
1	Bolt	2	
2	Fitting plate	1	
3	Clip	2	
4	Throttle cable	1	
5	Bolt	1	
6	Cable clamp	1	
7	Shift cable	1	
8	Bolt	1	
9	Plate	1	
10	Bolt	1	
			Continued on next page.

Continued on next page.

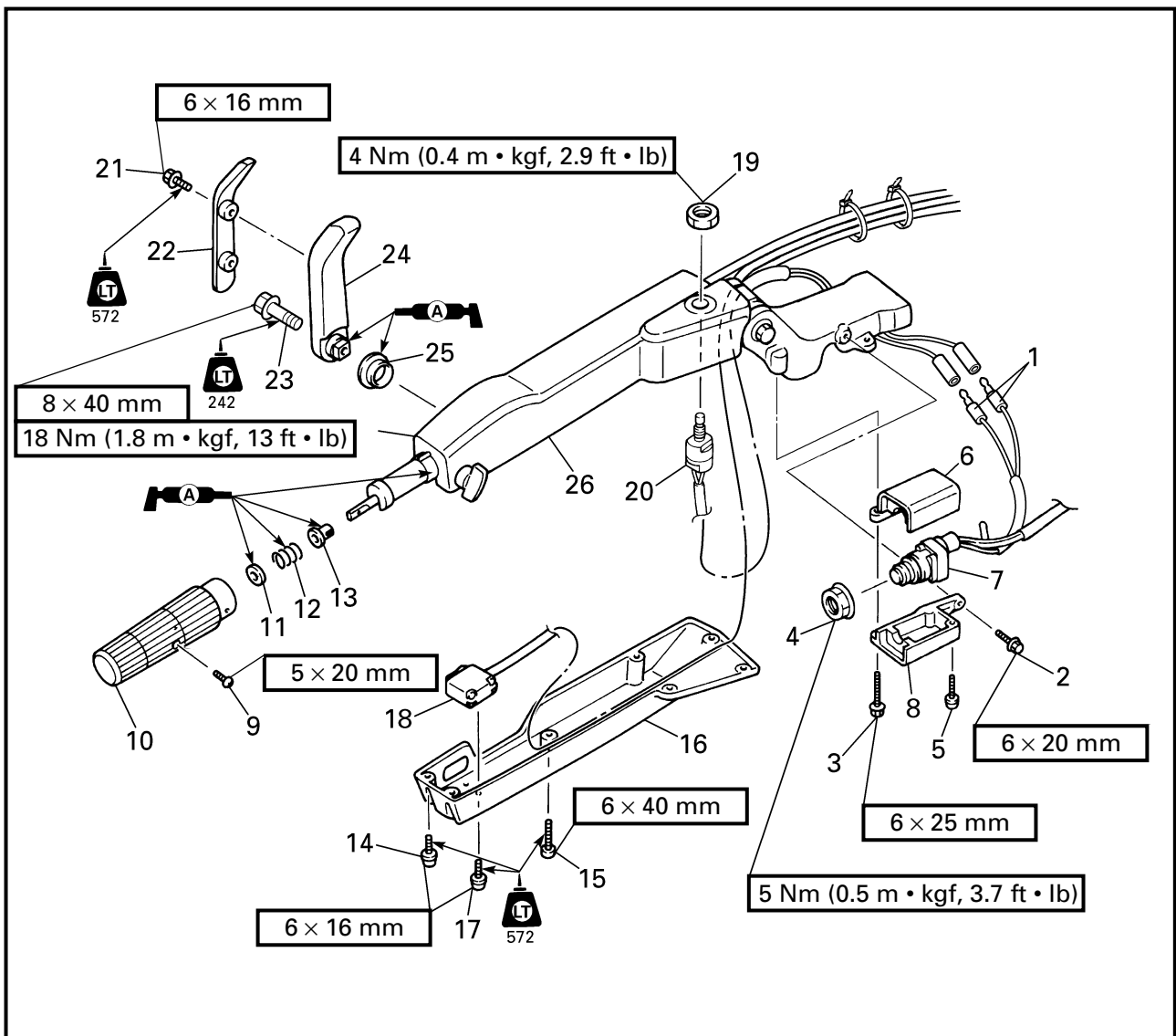


Order	Job/Part	Q'ty	Remarks
11	Clamp	1	For installation, reverse the removal procedure.
12	Main switch leads	5	
13	Trailer/PTT switch coupler	1	
14	Extension, wire harness	1	
15	Nut	2	
16	Steering handle assembly	1	
17	Nut	2	
18	Bracket	1	

DISASSEMBLING/ASSEMBLING THE STEERING HANDLE

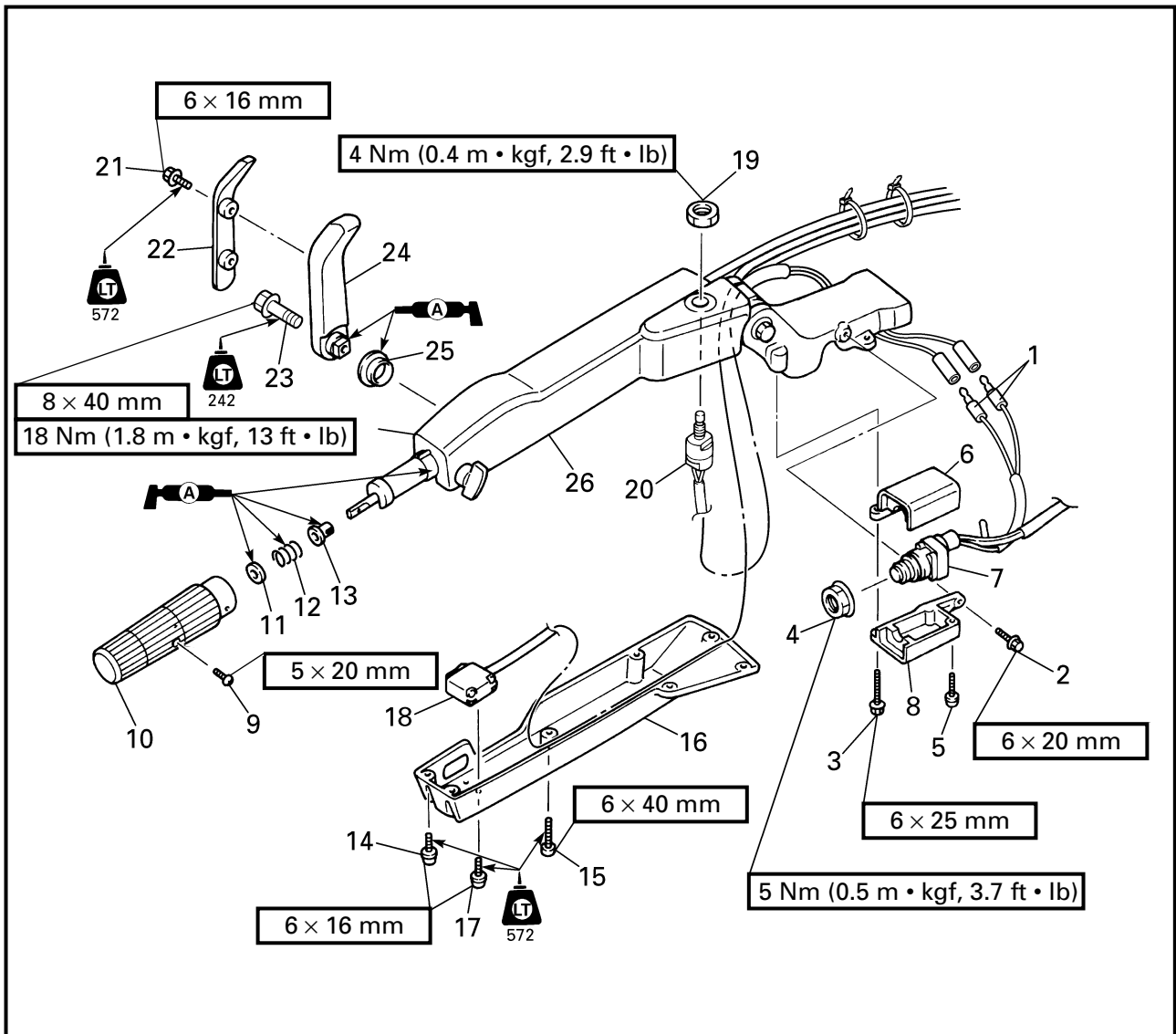


Order	Job/Part	Q'ty	Remarks
1	Engine stop lanyard switch leads	2	Continued on next page.
2	Bolt	1	
3	Bolt	1	
4	Nut	1	
5	Screw	1	
6	Cover	1	
7	Main switch assembly	1	
8	Holder	1	



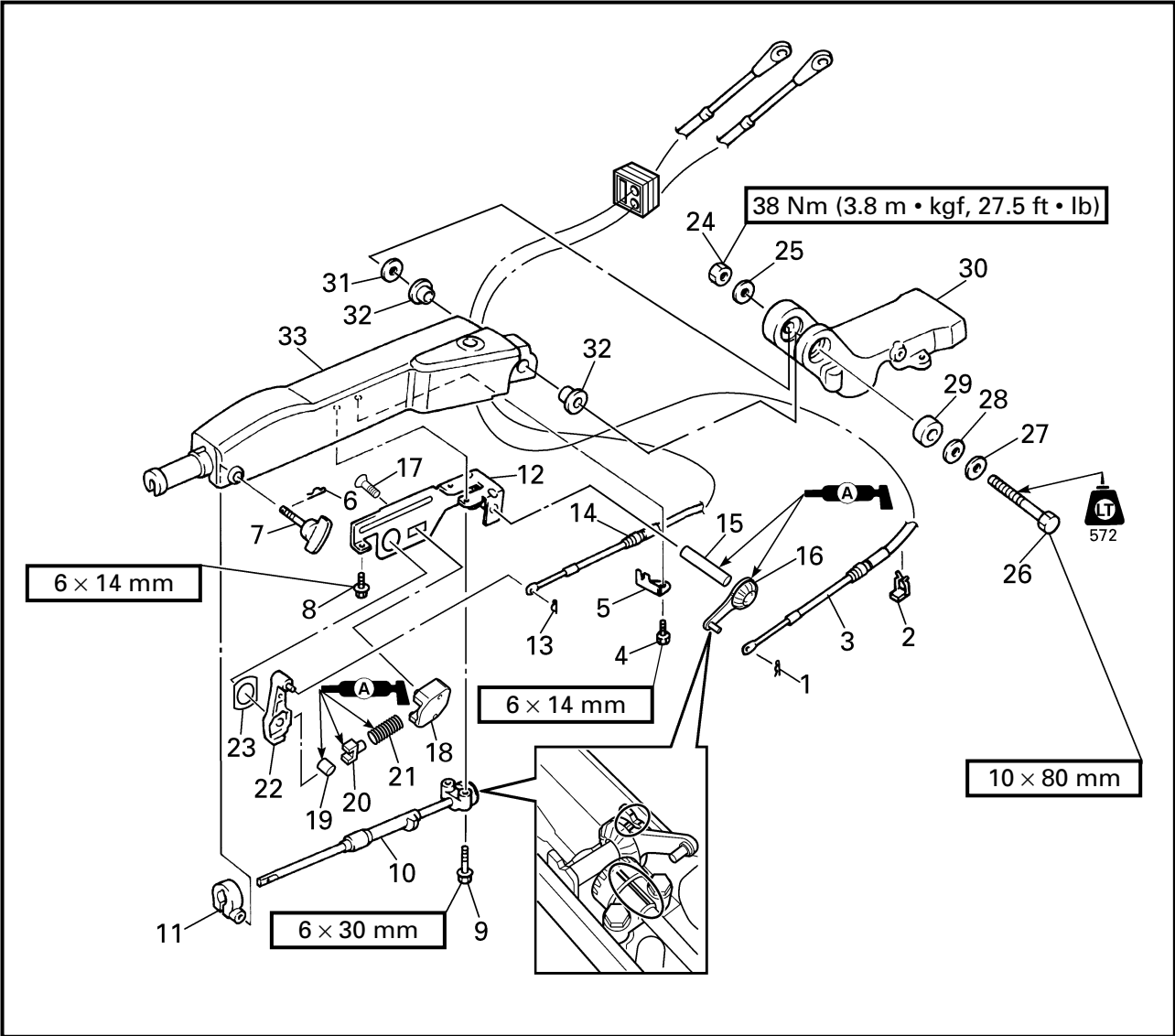
Order	Job/Part	Q'ty	Remarks
9	Screw	1	
10	Throttle grip	1	
11	Washer	1	
12	Spring	1	
13	Bushing	1	
14	Screw	5	
15	Screw	2	
16	Cover	1	
17	Screw	2	

Continued on next page.

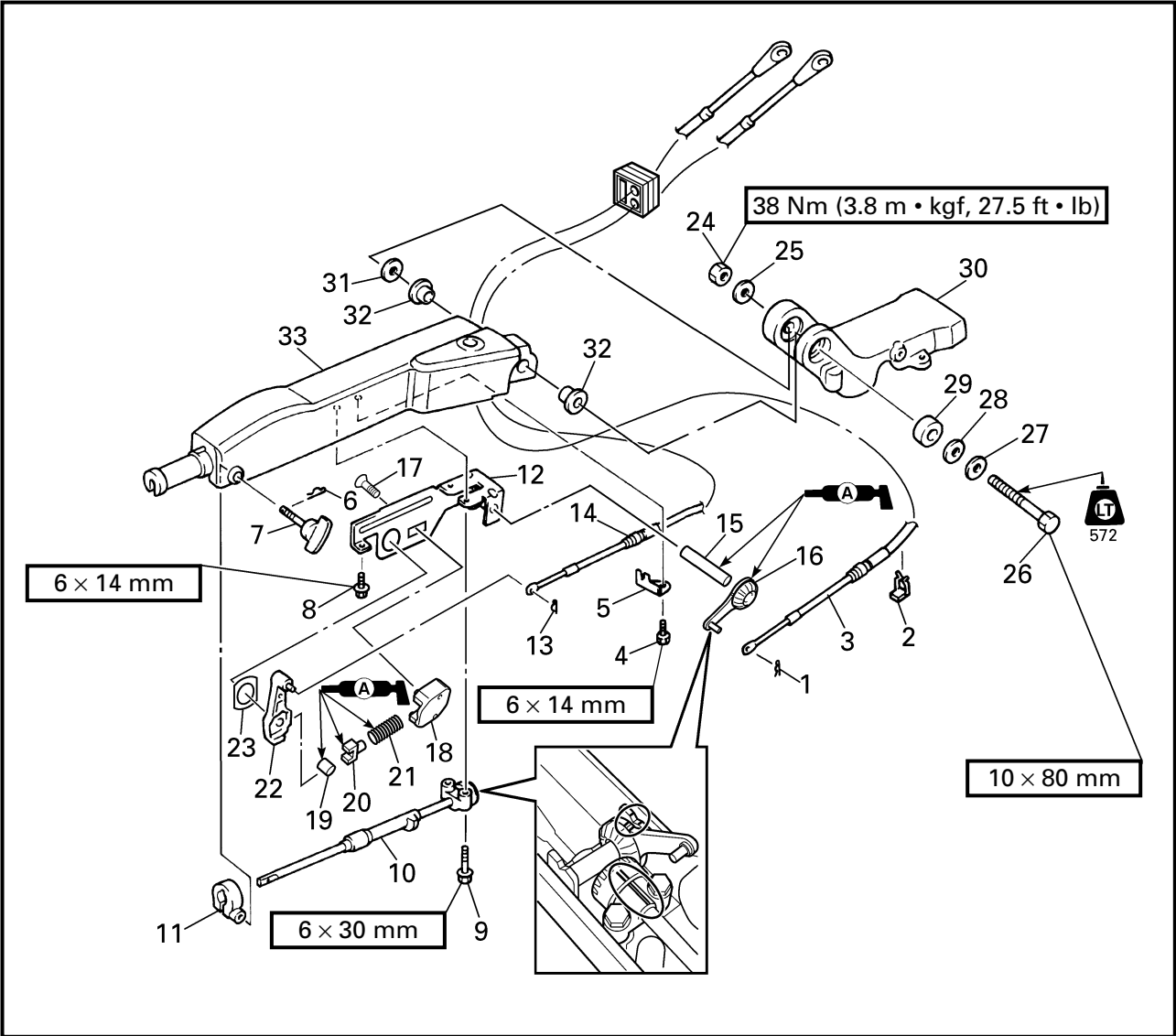


Order	Job/Part	Q'ty	Remarks
18	Power trim and tilt switch	1	For assembly, reverse the disassembly procedure.
19	Nut	1	
20	Engine stop lanyard switch	1	
21	Screw	2	
22	Shift lever cover	1	
23	Bolt	1	
24	Shift lever	1	
25	Bushing	1	
26	Steering handle sub assembly	1	

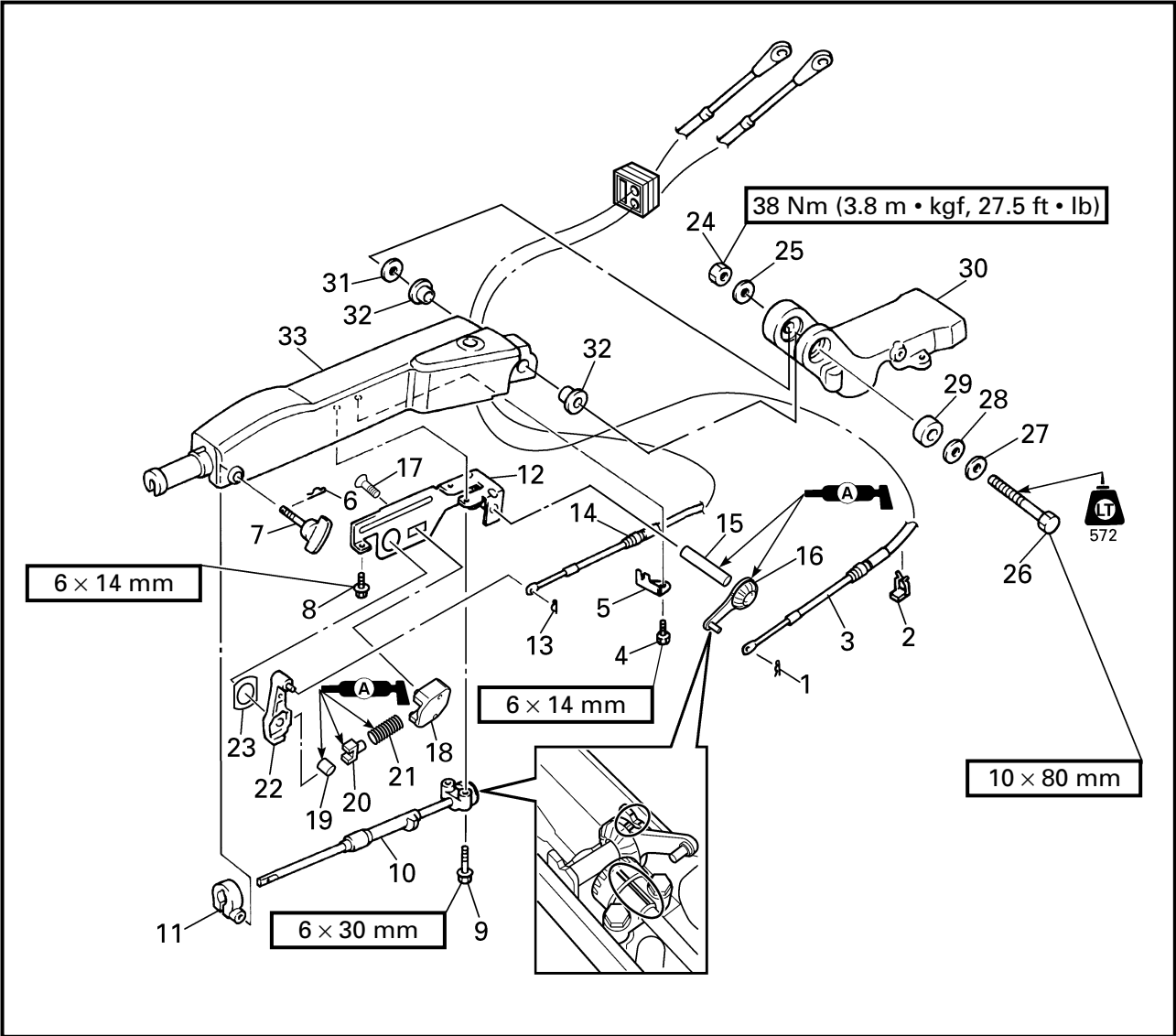
DISASSEMBLING/ASSEMBLING THE STEERING HANDLE SUB ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Clip	1	
2	Cable clamp	1	
3	Throttle cable (short)	1	
4	Bolt	1	
5	Shift cable bracket	1	
6	Cotter pin	1	
7	Friction adjusting knob	1	
8	Bolt	1	
9	Bolt	2	
10	Throttle shaft	1	
11	Friction piece	1	
Continued on next page.			



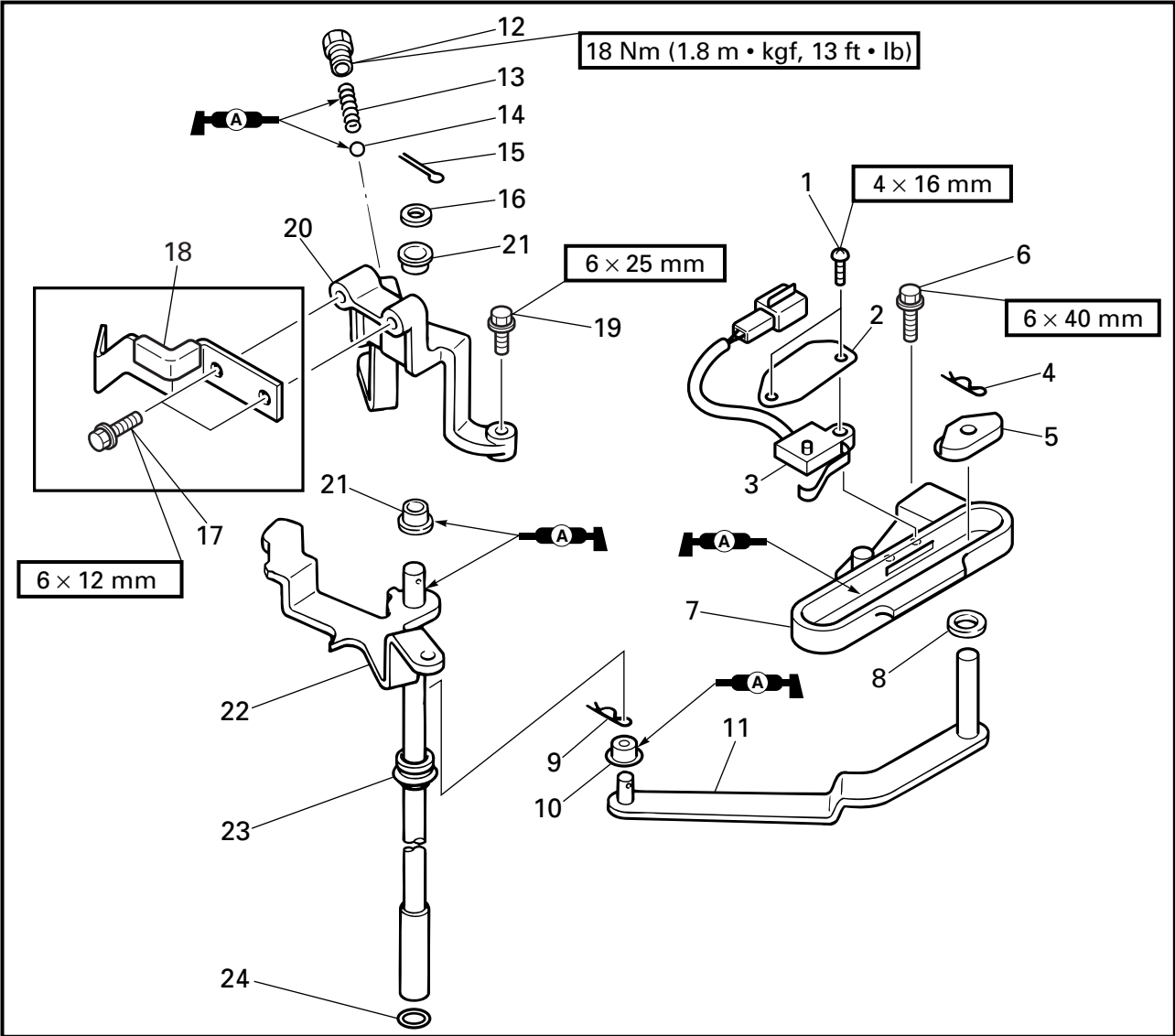
Order	Job/Part	Q'ty	Remarks
12	Frame	1	
13	Clip	1	
14	Shift cable (long)	1	
15	Throttle arm shaft	1	
16	Throttle arm	1	
17	Screw	2	
18	Spring housing	1	
19	Roller	1	
20	Actuator	1	
21	Spring	1	
22	Shift arm	1	
Continued on next page.			



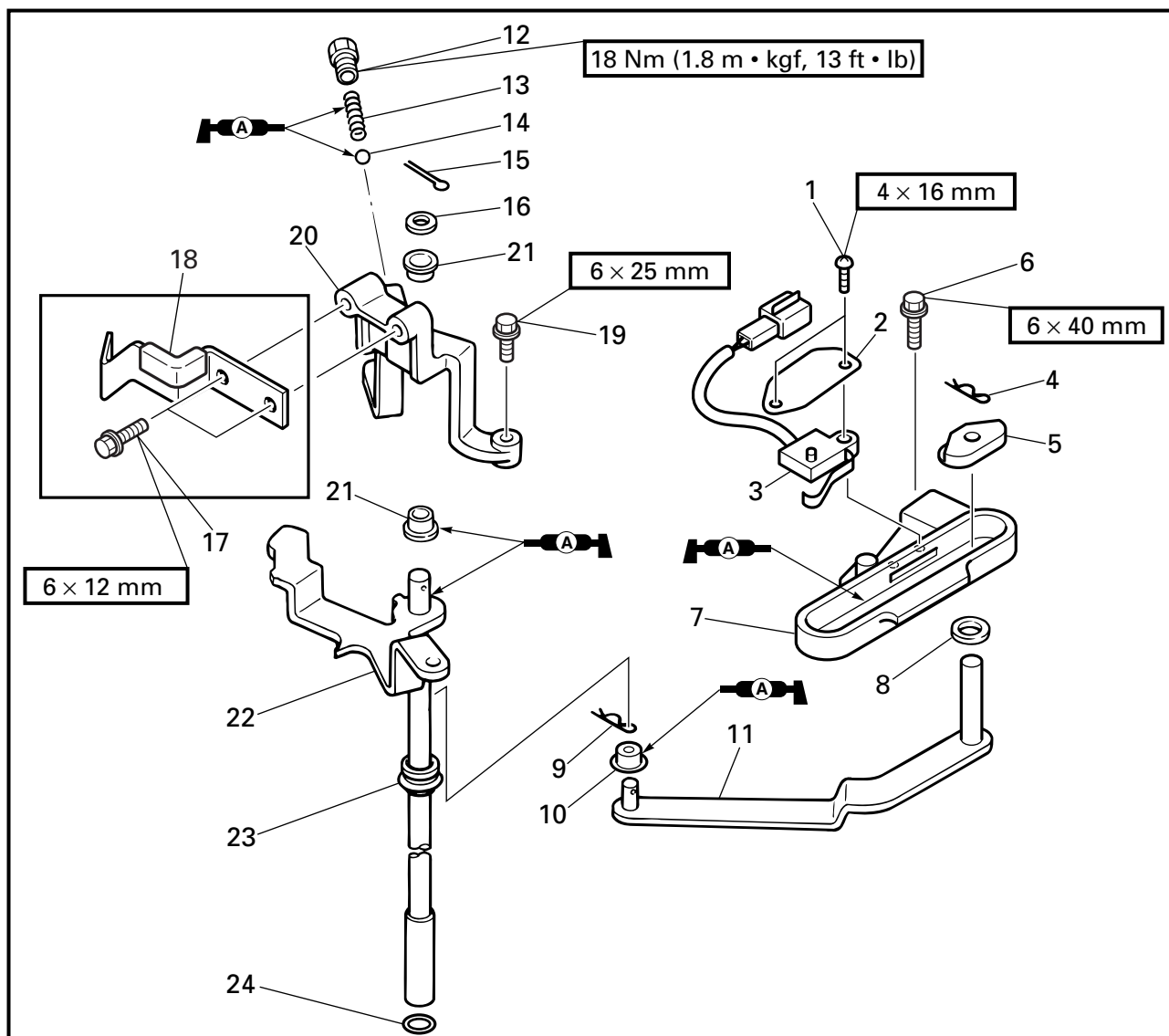
Order	Job/Part	Q'ty	Remarks
23	Bushing	1	For assembly, reverse the disassembly procedure.
24	Nut	1	
25	Washer	1	
26	Bolt	1	
27	Washer	1	
28	Wave washer	1	
29	Collar	1	
30	Bracket	1	
31	Washer	1	
32	Bushing	2	
33	Steering handle	1	

SHIFT ROD ASSEMBLY

REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY

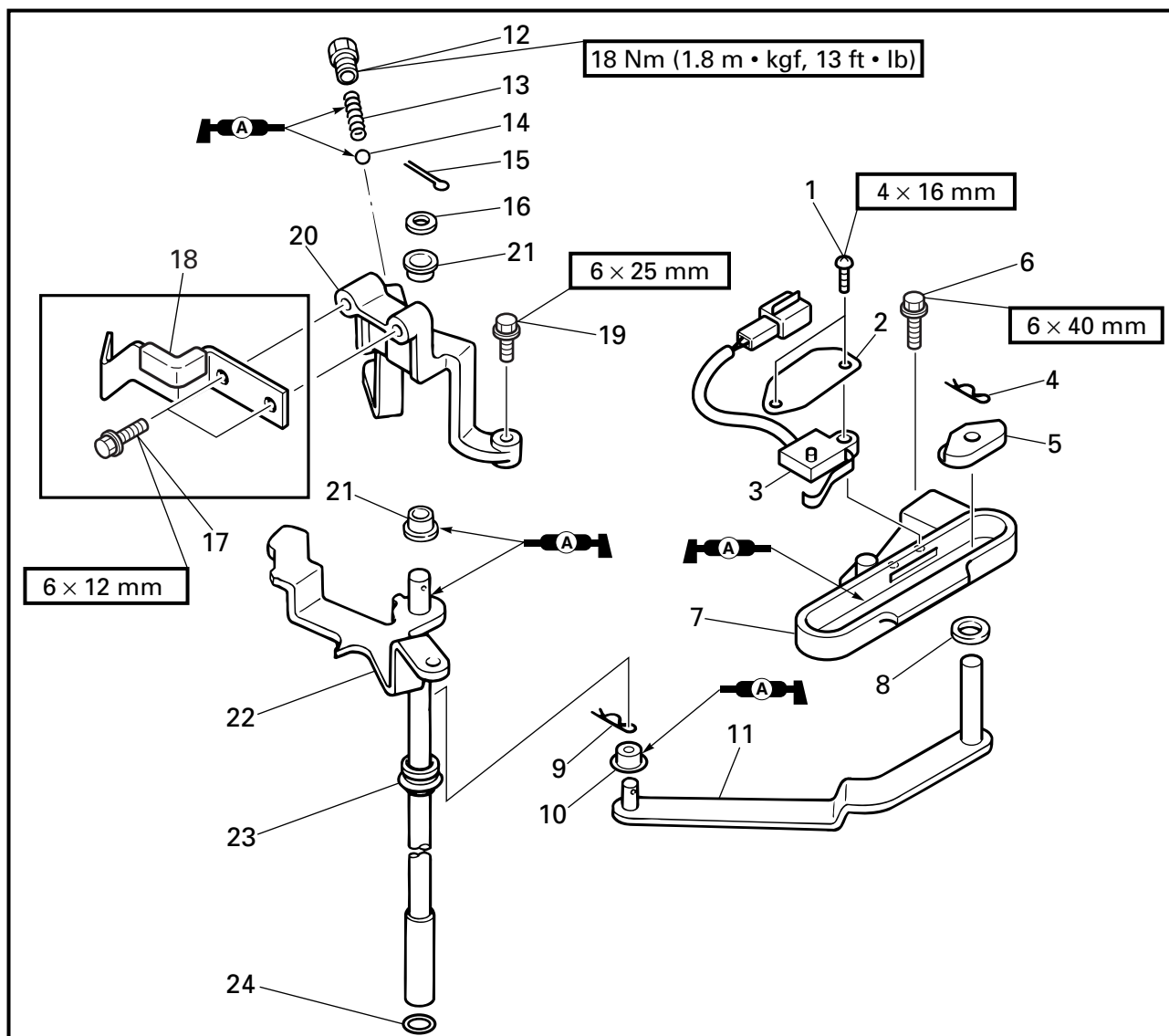


Order	Job/Part	Q'ty	Remarks
	Power unit assembly		Refer to "POWER UNIT" on page 5-4.
1	Screw	2	
2	Plate	1	
3	Shift position switch	1	
4	Clip	1	
5	Bushing	1	
6	Bolt	2	
7	Shift bracket	1	Continued on next page.



Order	Job/Part	Q'ty	Remarks
8	Washer	1	
9	Clip	1	
10	Bushing	1	
11	Shift rod lever	1	
12	Bolt	1	
13	Spring	1	
14	Ball	1	
15	Cotter pin	1	
16	Washer	1	

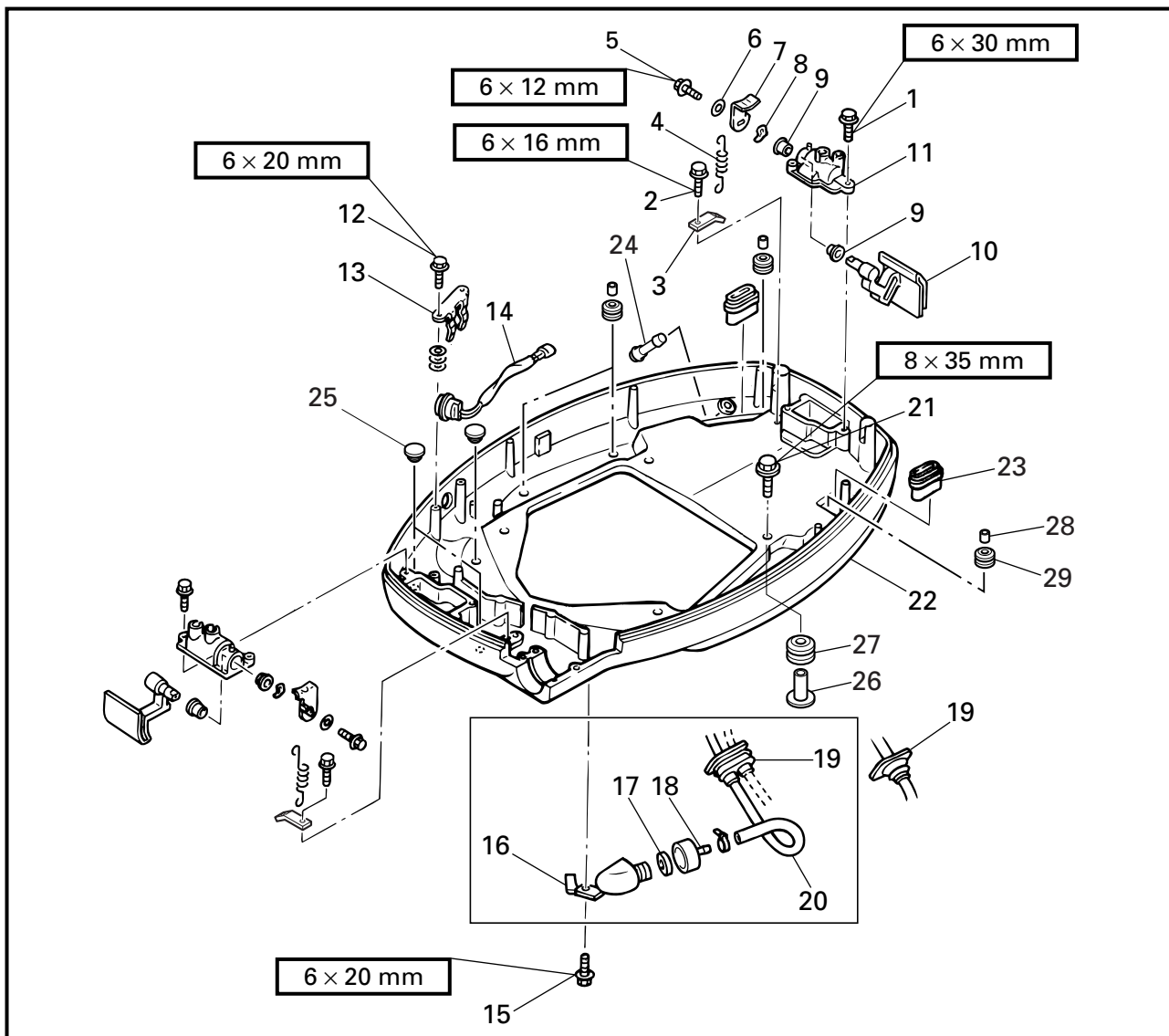
Continued on next page.



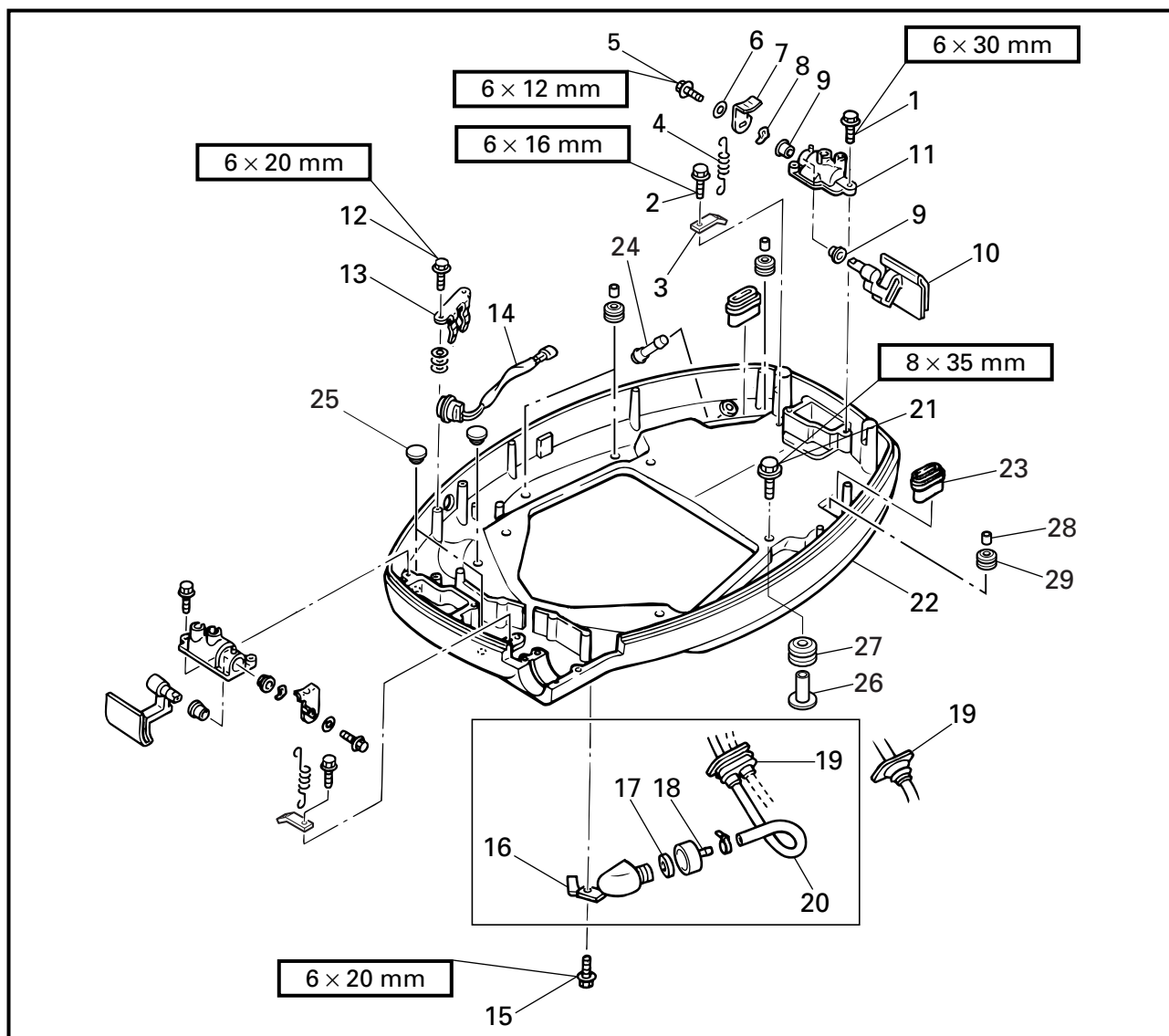
Order	Job/Part	Q'ty	Remarks
17	Bolt	2	
18	Bracket	1	
19	Bolt	2	
20	Shift rod bracket	1	
21	Bushing	2	
22	Shift rod	1	
23	Grommet	1	
24	O-ring	1	
For installation, reverse the removal procedure.			

BOTTOM COWLING

REMOVING/INSTALLING THE BOTTOM COWLING

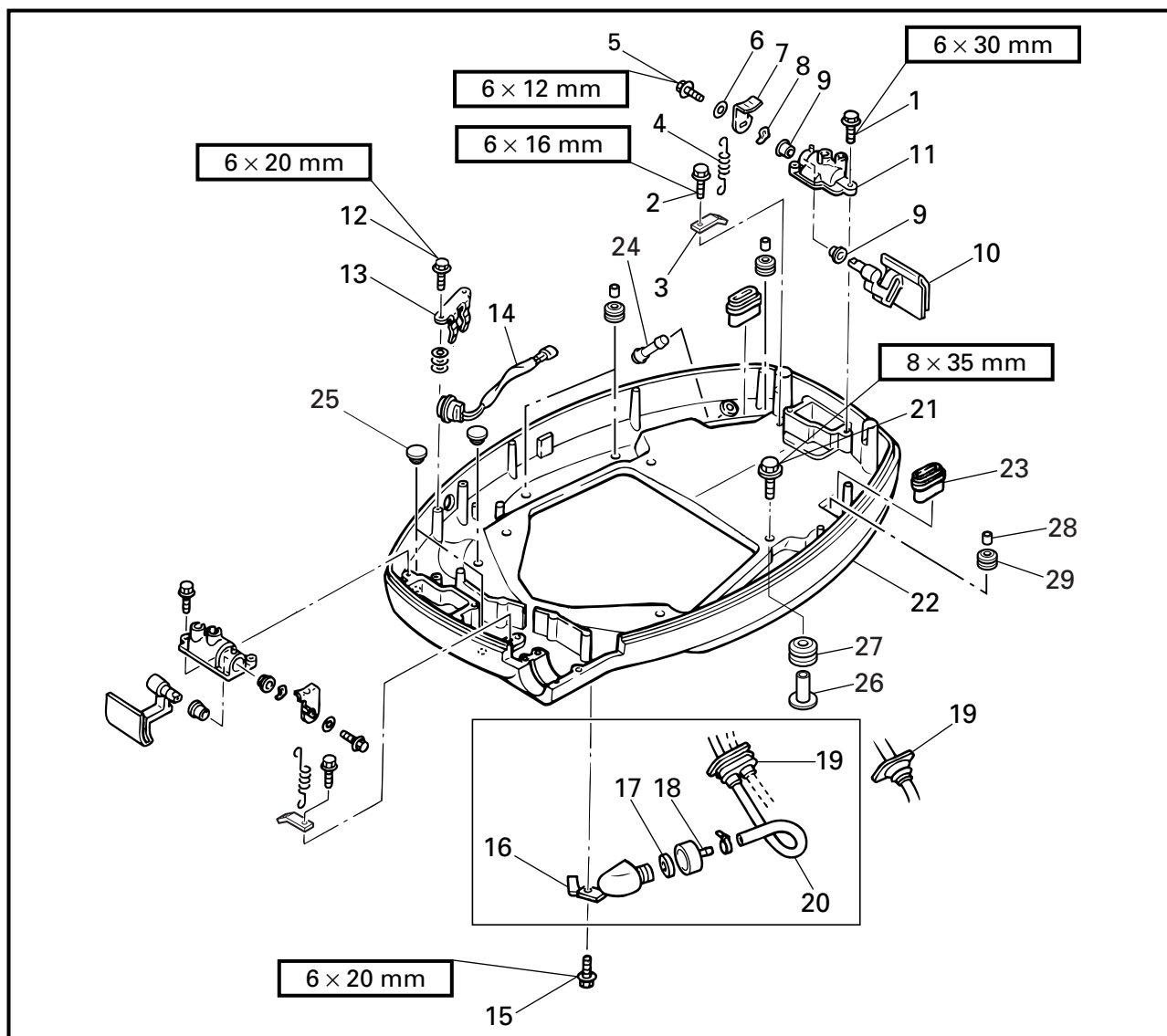


Order	Job/Part	Q'ty	Remarks
	Power unit		Refer to "POWER UNIT" on page 5-4.
1	Bolt	4	
2	Bolt	2	
3	Spring hook	2	
4	Spring	2	
5	Bolt	2	
6	Washer	2	
7	Clamp lever	2	
8	Wave washer	2	
9	Bushing	4	
10	Clamp lever	2	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
11	Clamp plate	2	
12	Bolt	2	
13	Bracket	1	
14	Trailer switch	1	
15	Bolt	1	
16	Adaptor	1	For water hose and PTT lead It differs on specification 17 to 21
17	Gasket	1	
18	Hose joint	1	
19	Grommet	1	

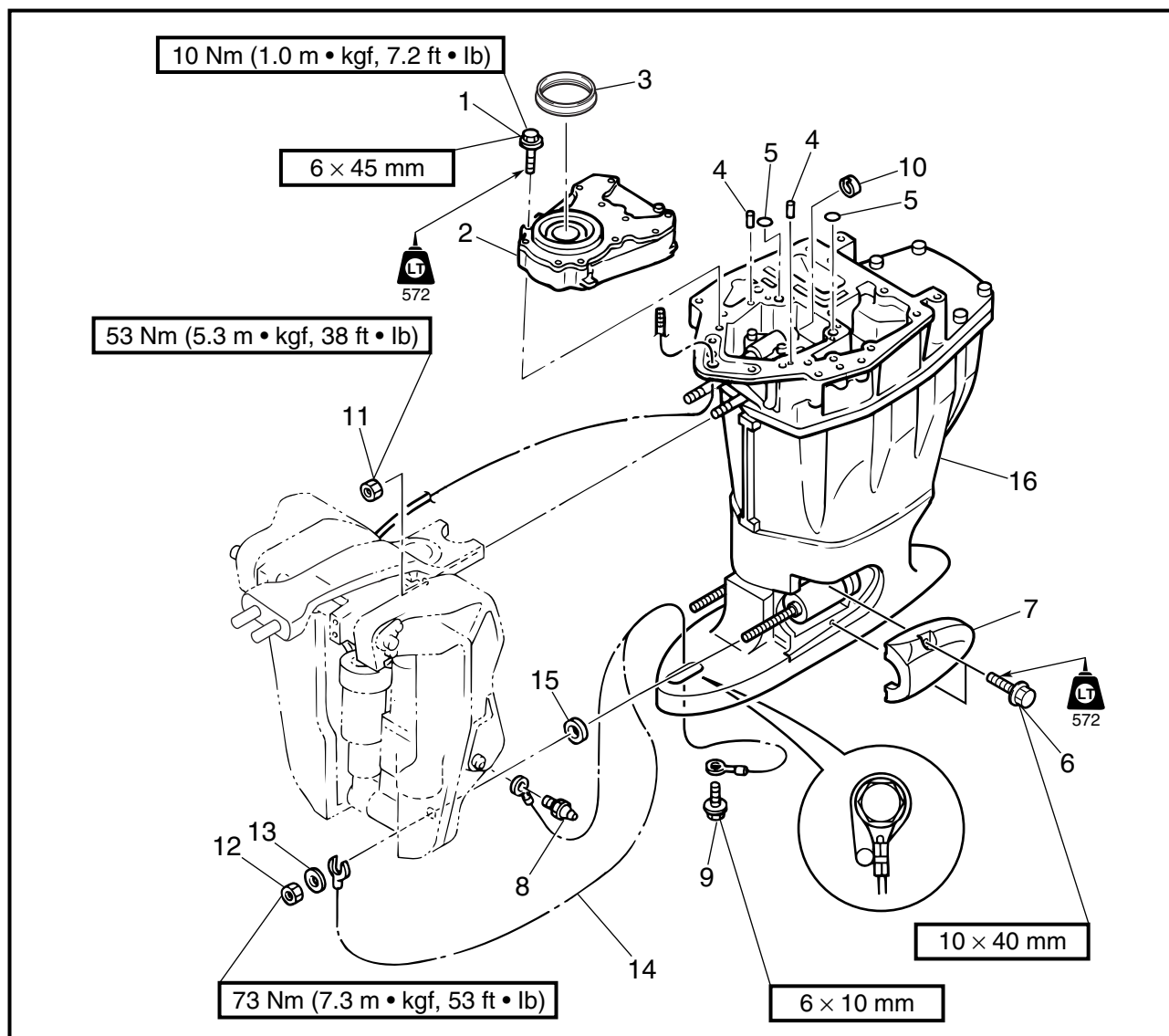
Continued on next page.



Order	Job/Part	Q'ty	Remarks
20	Hose	1	For installation, reverse the removal procedure.
21	Bolt	4	
22	Bottom cowling	1	
23	Grommet	2	
24	Water outlet	1	
25	Cap	3	
26	Collar	4	
27	Grommet	4	
28	Collar	4	
29	Grommet	4	

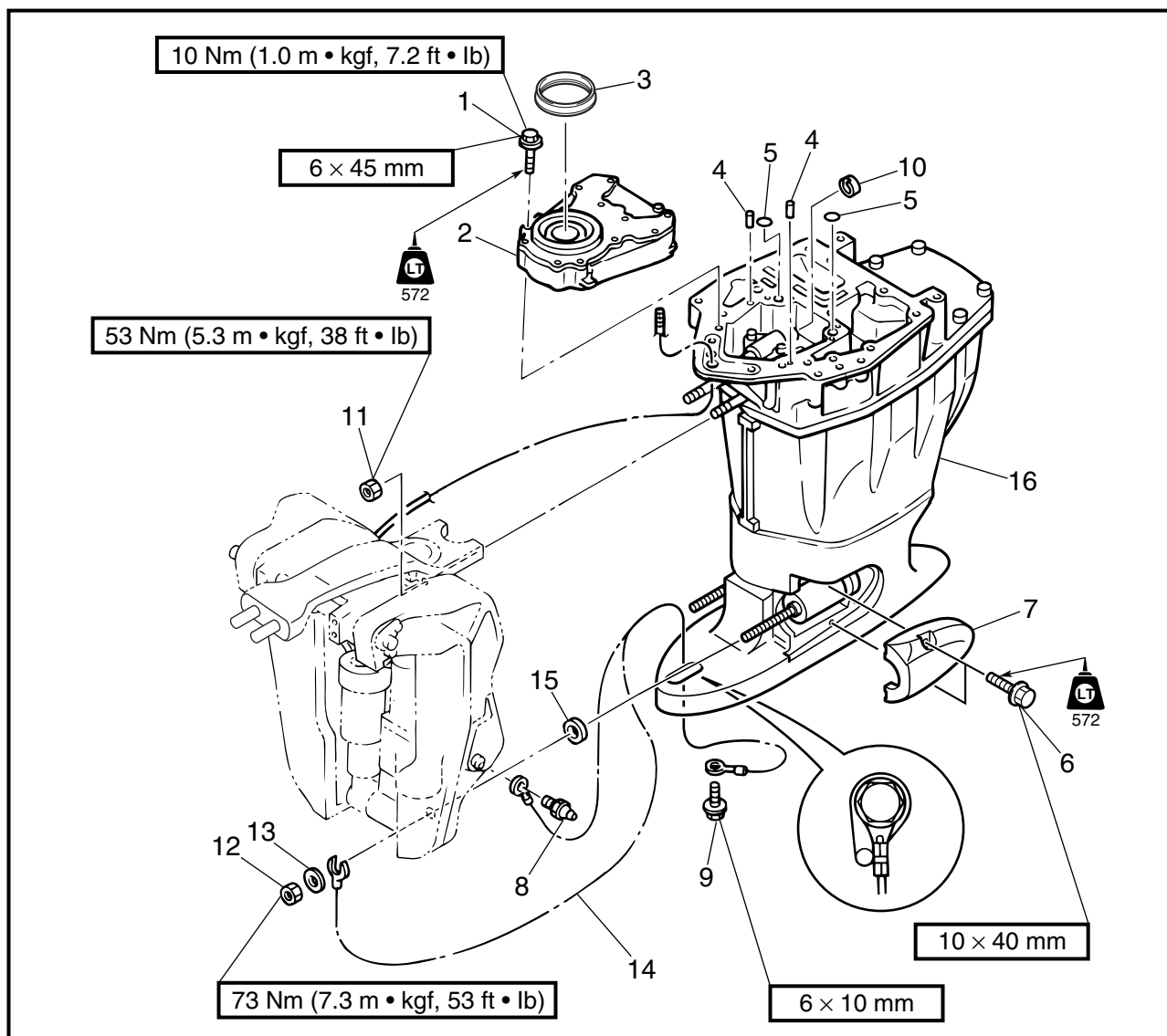
UPPER CASE ASSEMBLY

REMOVING/INSTALLING THE UPPER CASE ASSEMBLY



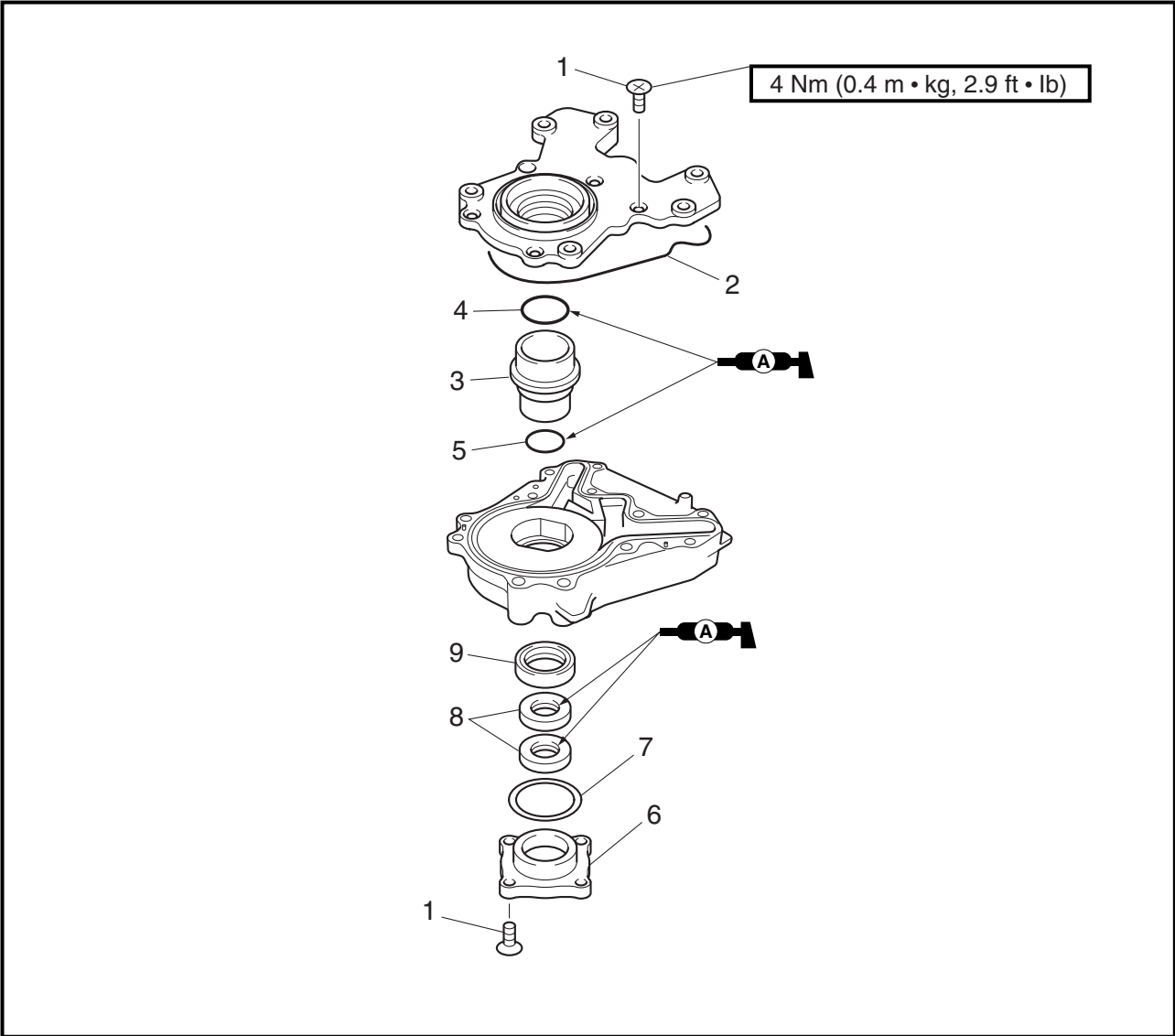
Order	Job/Part	Q'ty	Remarks
	Lower unit		Refer to "LOWER UNIT (REGULAR ROTATION MODELS)" on page 6-1 and "LOWER UNIT (COUNTER ROTATION MODELS)" on page 6-26.
	Bottom cowling		Refer to "BOTTOM COWLING" on page 7-13.
1	Bolt	6	
2	Oil pump assembly	1	
3	Seal	1	
4	Dowel pin	2	
5	O-ring	2	
6	Bolt	4	

Continued on next page.

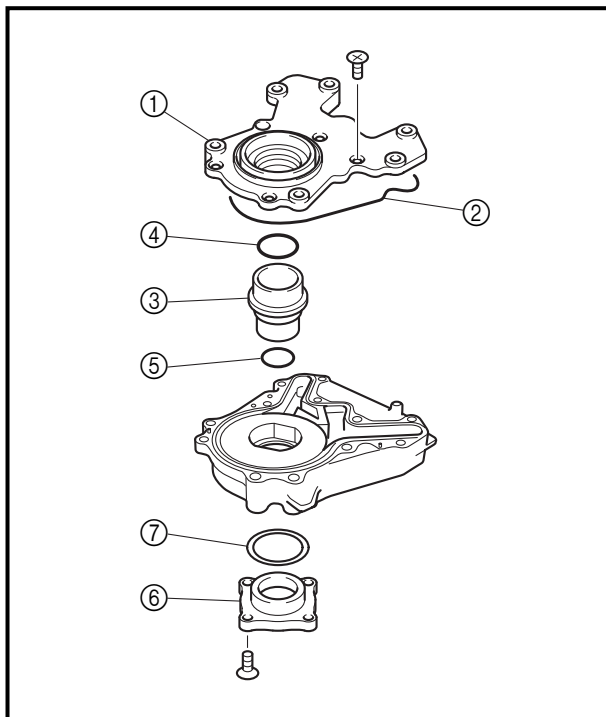


Order	Job/Part	Q'ty	Remarks
7	Lower mount cover	2	
8	Grease nipple	1	
9	Bolt	1	
10	Damper	2	
11	Nut	2	
12	Nut	2	
13	Washer	2	
14	Ground lead	1	
15	Washer	2	
16	Upper case assembly	1	
			For installation, reverse the removal procedure.

DISASSEMBLING/ASSEMBLING THE OIL PUMP



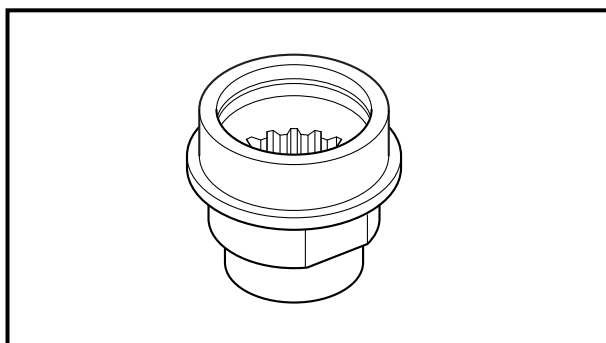
Order	Job/Part	Q'ty	Remarks
1	Screw	10	Not reusable
2	Gasket	1	
3	Shaft	1	
4	O-ring	1	
5	O-ring	1	
6	Housing	1	Not reusable
7	Gasket	1	
8	Oil seal	2	
9	Oil seal	1	For assembly, reverse the disassembly procedure.



DISASSEMBLING THE OIL PUMP ASSEMBLY

1. Remove:

- Cover ①
- Gasket ②
- Shaft ③
- O-ring ④
- O-ring ⑤
- Housing ⑥
- Gasket ⑦



CHECKING THE OIL PUMP ASSEMBLY

1. Check:

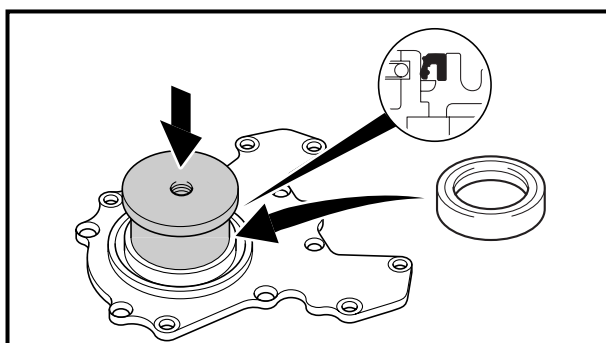
- Shaft
Cracks/wear → Replace.

2. Check:

- Oil seals
- O-rings
Tears → Replace.

3. Check:

- Oil passage
Dirt/residue → Clean.



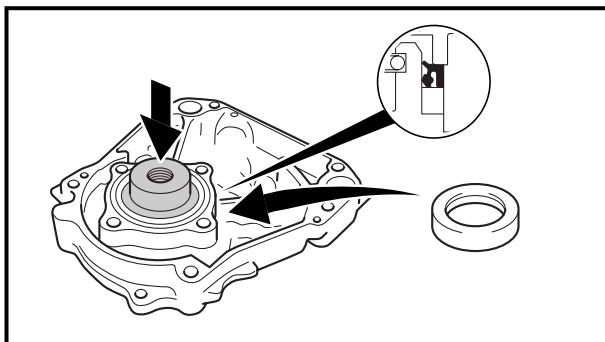
ASSEMBLING THE OIL PUMP ASSEMBLY

1. Install:

- Oil seal



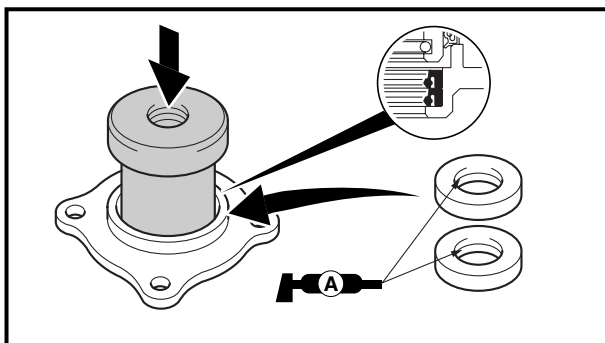
Bearing installer:
YB-41446



2. Install:
- Oil seal



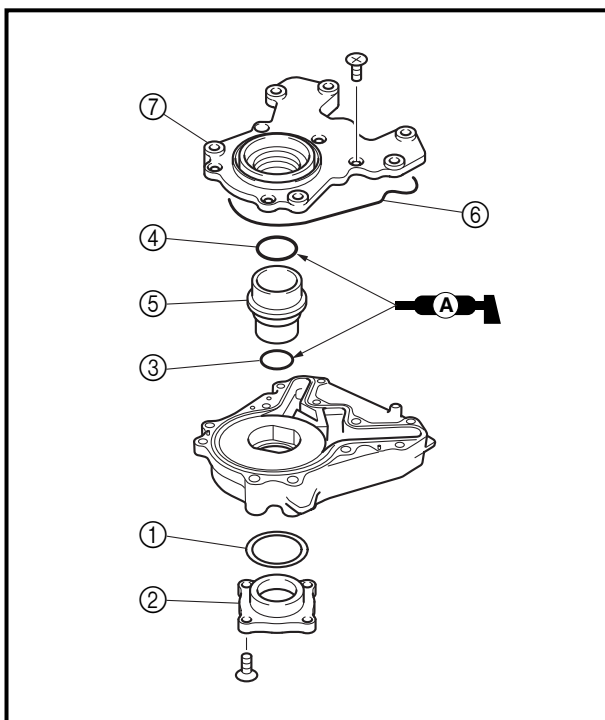
Bearing cup installer:
YB-06167



3. Install:
- Oil seals



Roller bearing installer/remover:
YB-06432-1A



4. Install:
- Gasket ①
 - Housing ②
 - O-ring ③
 - O-ring ④
 - Shaft ⑤
 - Gasket ⑥
 - Cover ⑦

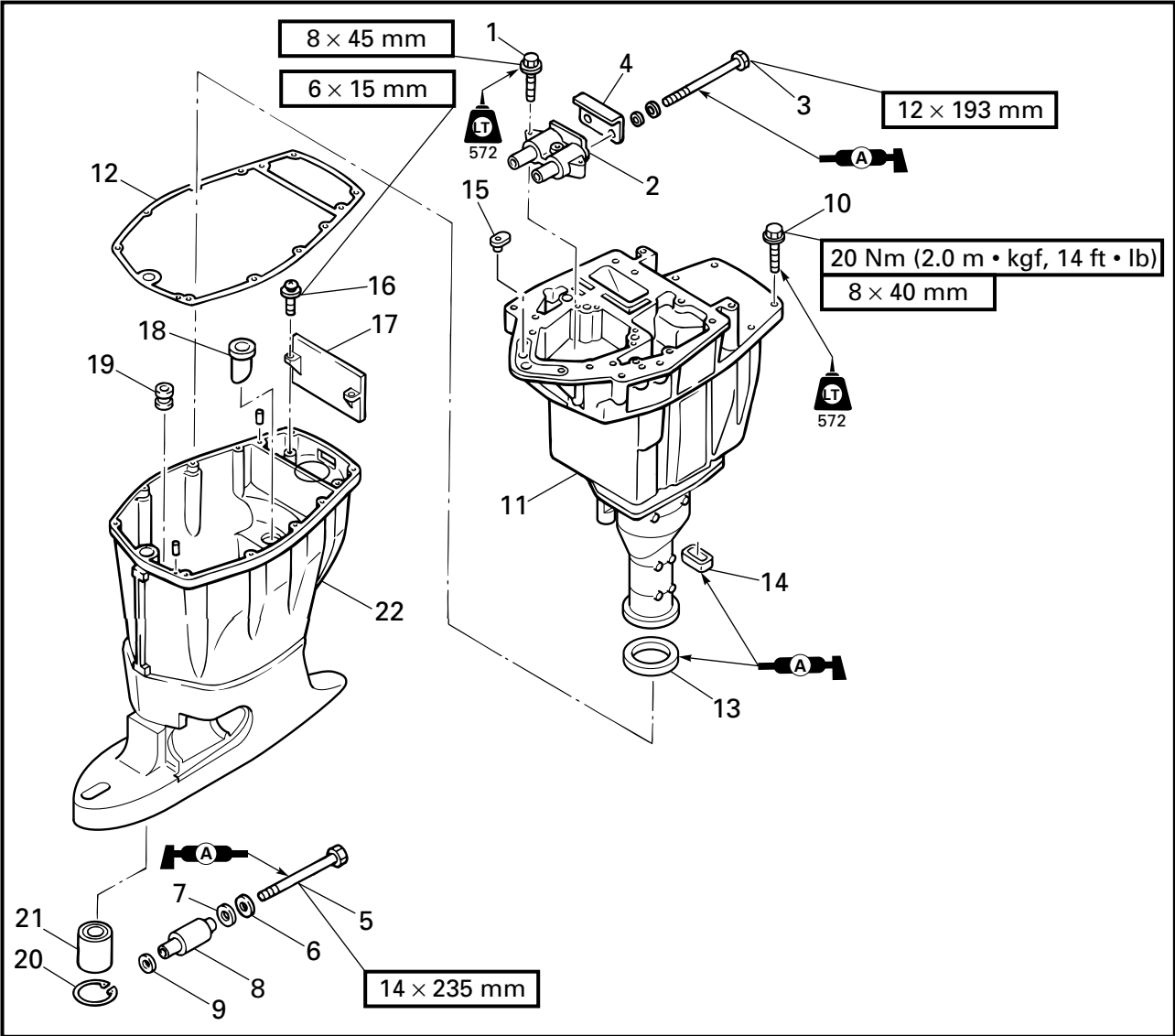


Screw:
4 Nm (0.4 m • kg, 2.9 ft • lb)

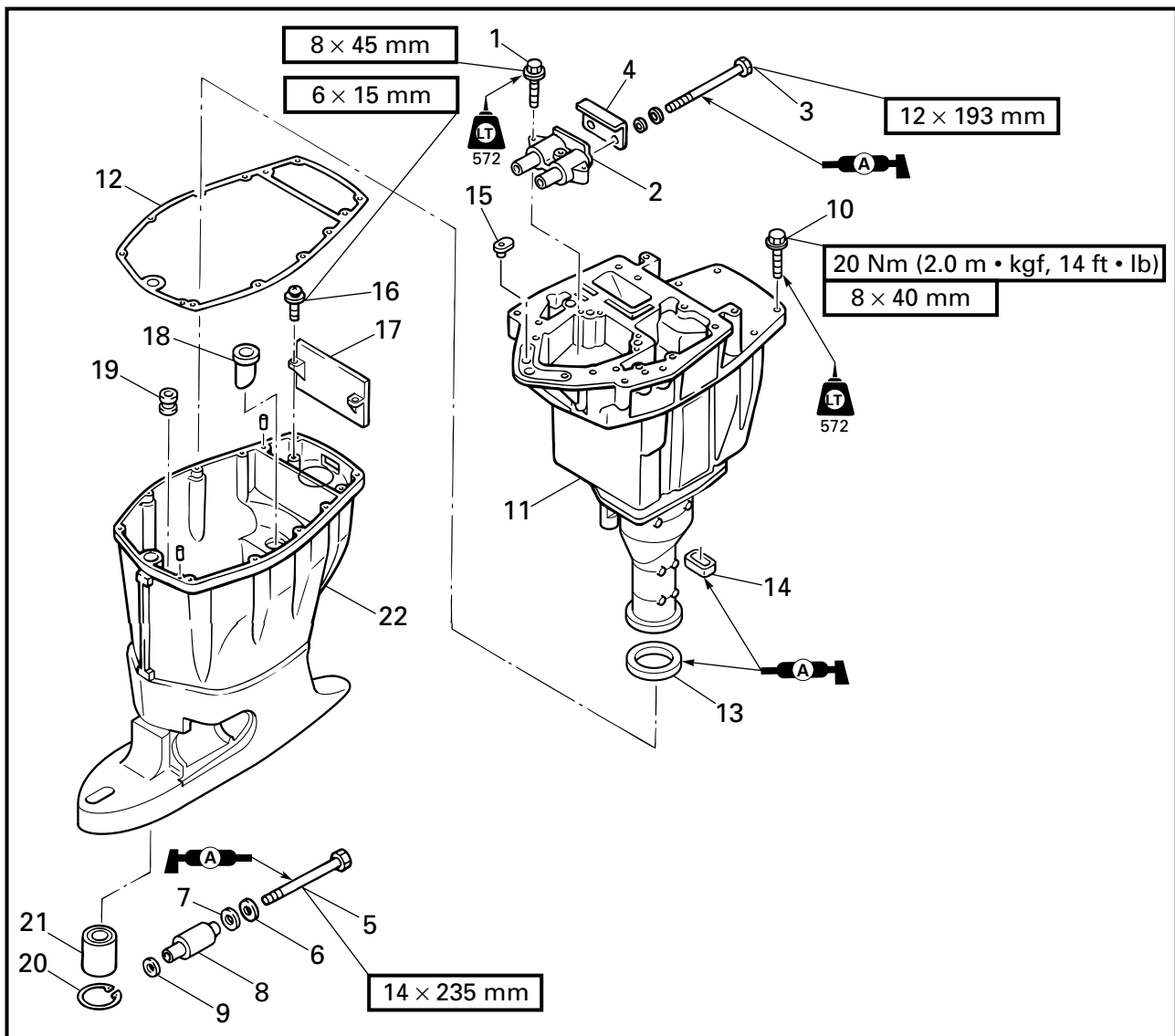
NOTE:

When installing the oil pump assembly onto the upper case assembly, pour a small amount of engine oil into the oil inlet or oil outlet of the oil pump assembly.

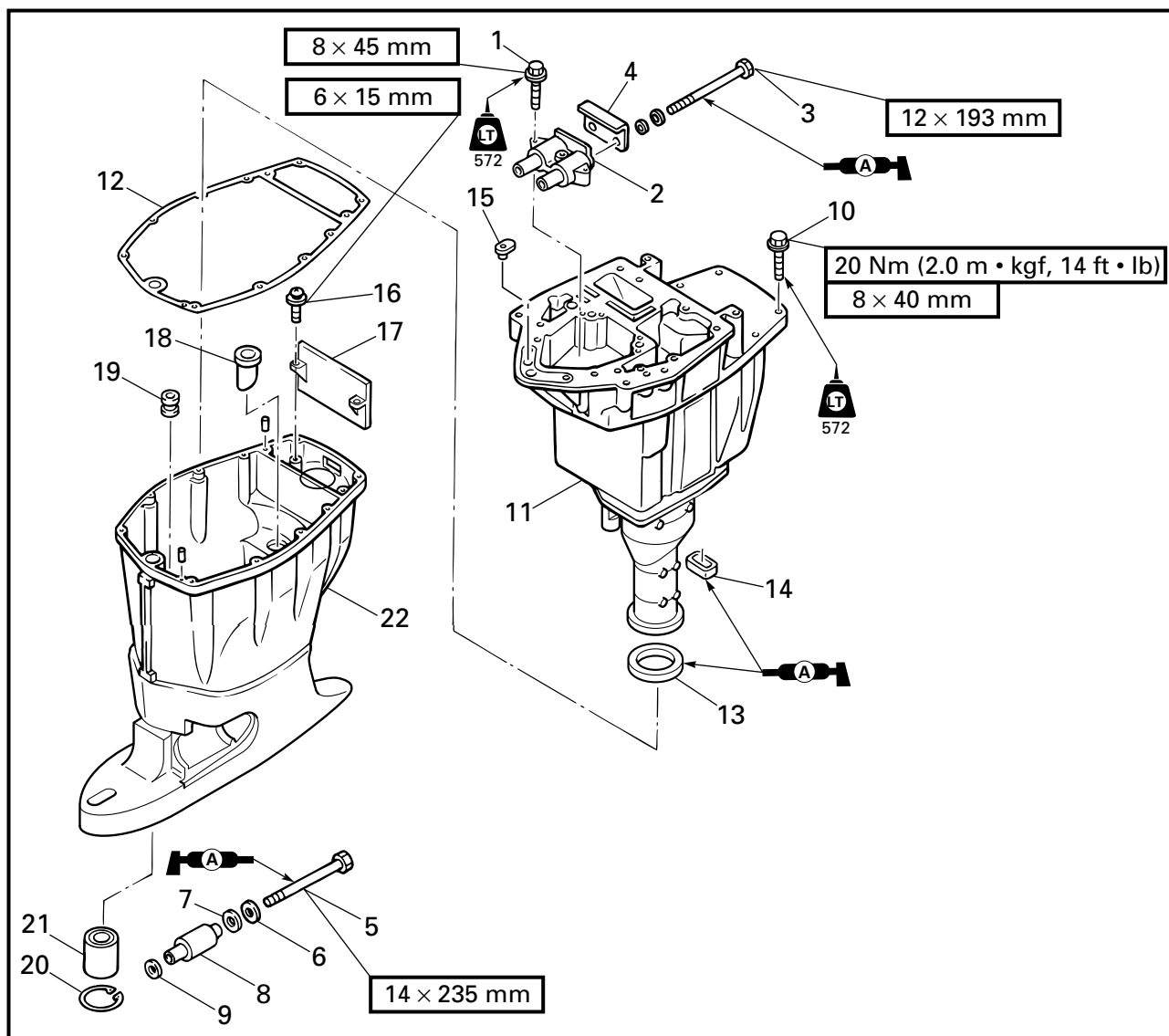
DISASSEMBLING/ASSEMBLING THE UPPER CASE ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Bolt	3	
2	Upper mount rubber	1	
3	Bolt	2	
4	Plate	1	
5	Bolt	2	
6	Washer	2	
7	Rubber	2	
8	Lower mount rubber	2	
9	Washer	2	
Continued on next page.			



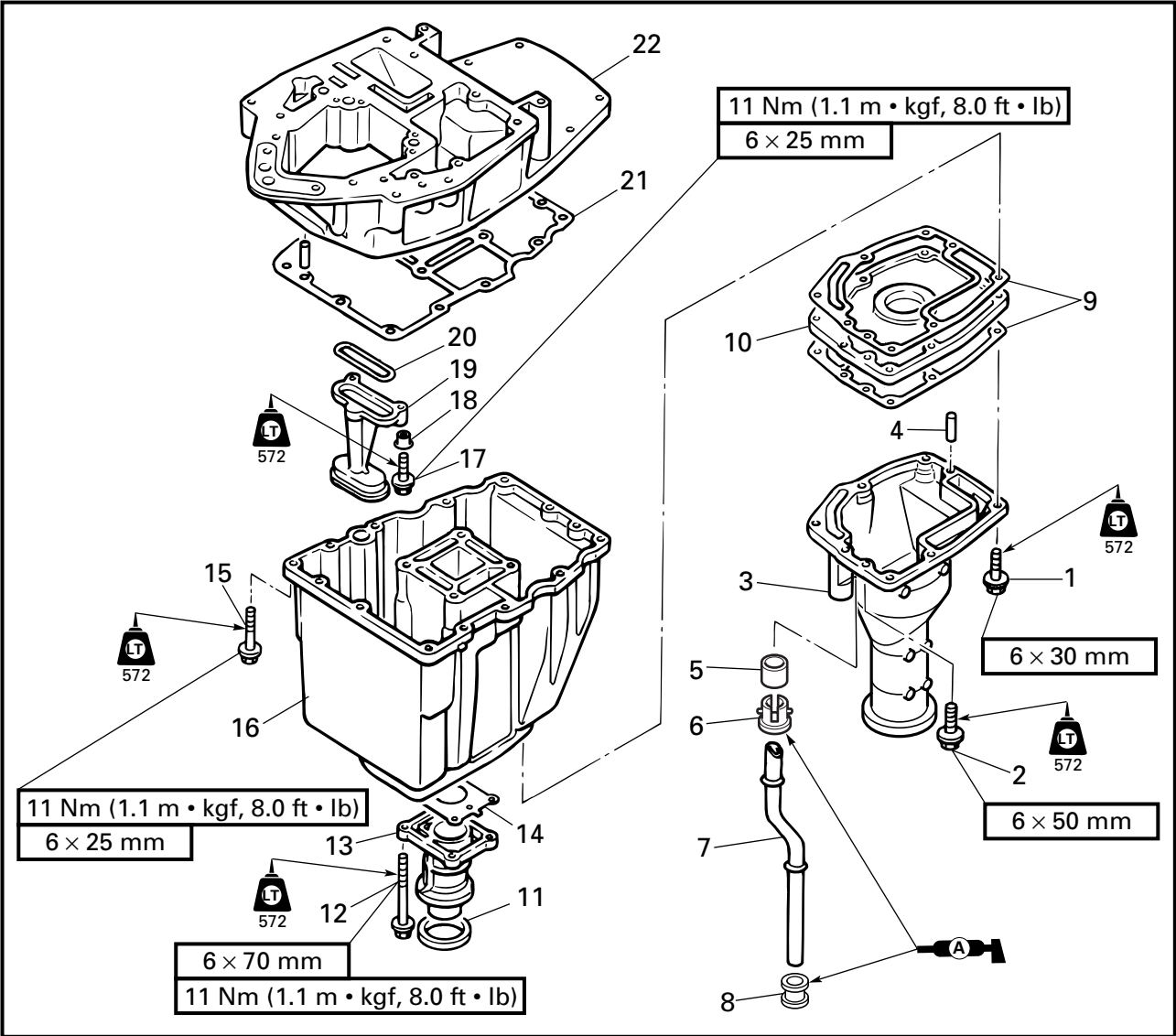
Order	Job/Part	Q'ty	Remarks
10	Bolt	4	Not reusable
11	Muffler assembly	1	
12	Gasket	1	
13	Rubber gasket	1	
14	Rubber seal	1	
15	Grommet	1	
16	Screw	2	
17	Baffle plate	1	
18	Damper	1	
			Continued on next page.



Order	Job/Part	Q'ty	Remarks
19	Grommet	1	For assembly, reverse the disassembly procedure.
20	Circlip	1	
21	Drive shaft bushing	1	
22	Upper case	1	

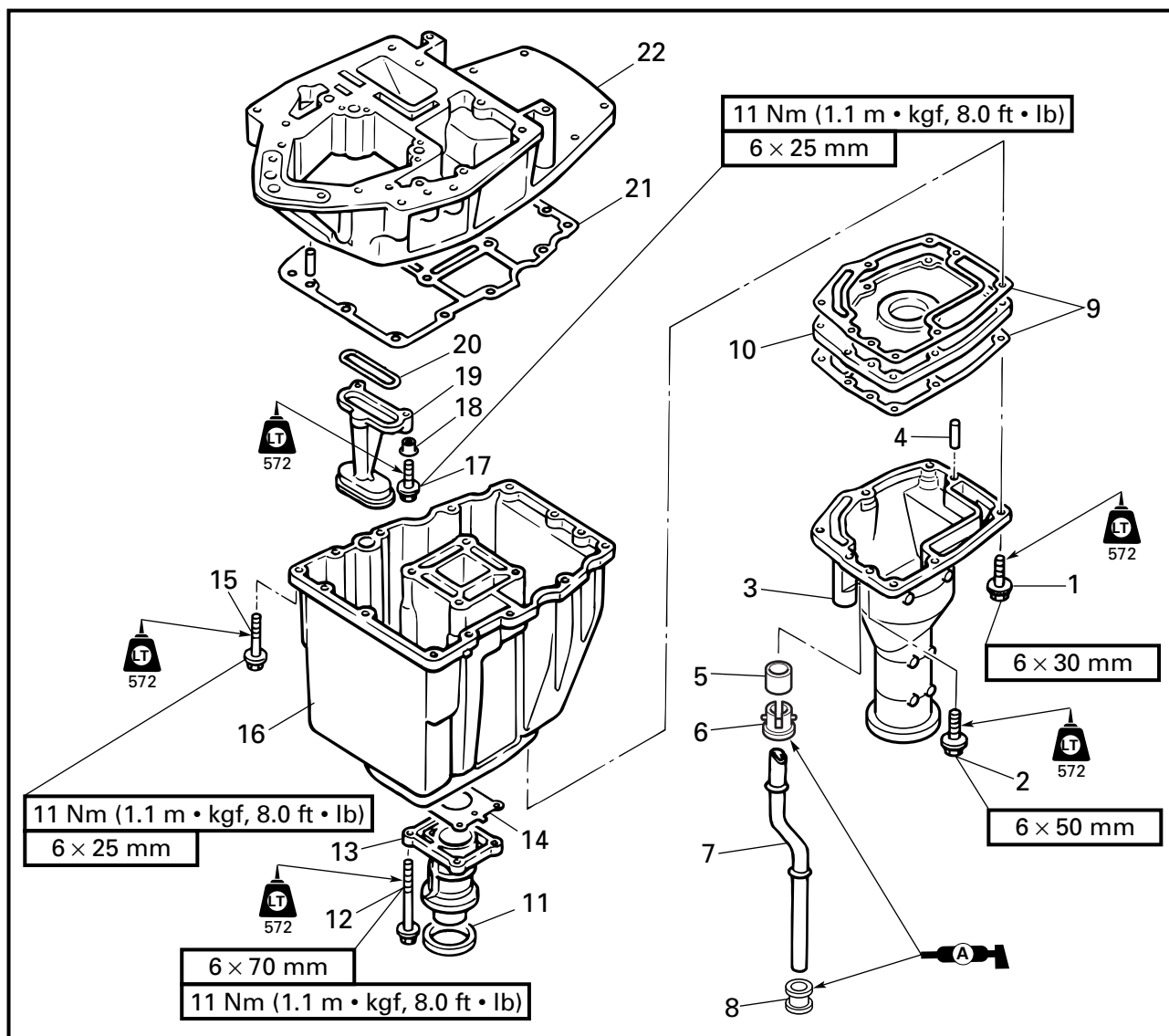
OIL PAN

DISASSEMBLING/ASSEMBLING THE OIL PAN



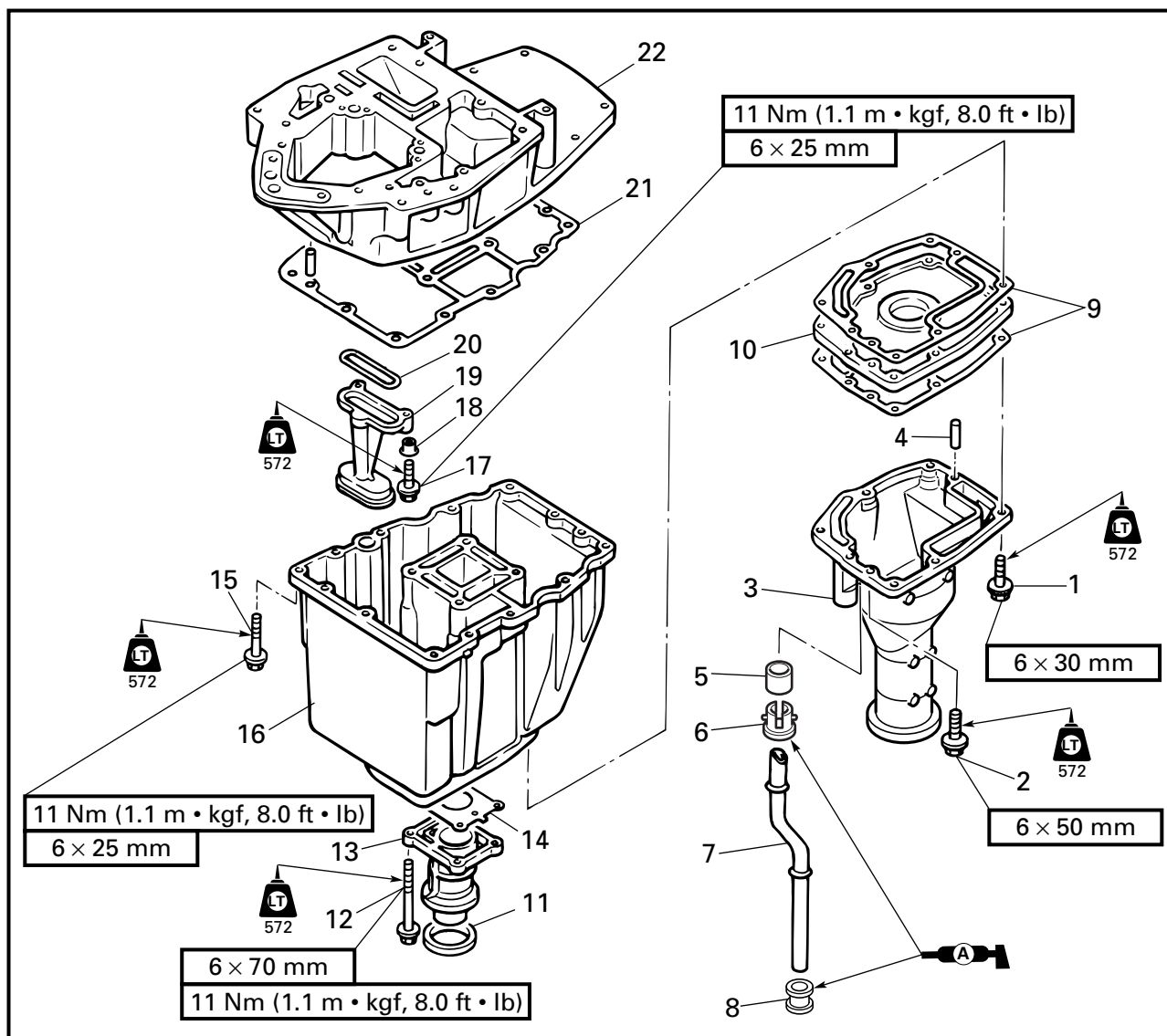
Order	Job/Part	Q'ty	Remarks
1	Bolt	6	
2	Bolt	1	
3	Muffler	1	
4	Dowel pin	2	
5	Spacer	1	
6	Grommet	1	
7	Water pipe	1	
8	Rubber seal	1	

Continued on next page.



Order	Job/Part	Q'ty	Remarks
9	Exhaust manifold gasket	2	Not reusable
10	Plate	1	
11	Exhaust seal	1	
12	Bolt	4	
13	Exhaust manifold	1	Not reusable
14	Gasket	1	
15	Bolt	12	
16	Oil pan	1	

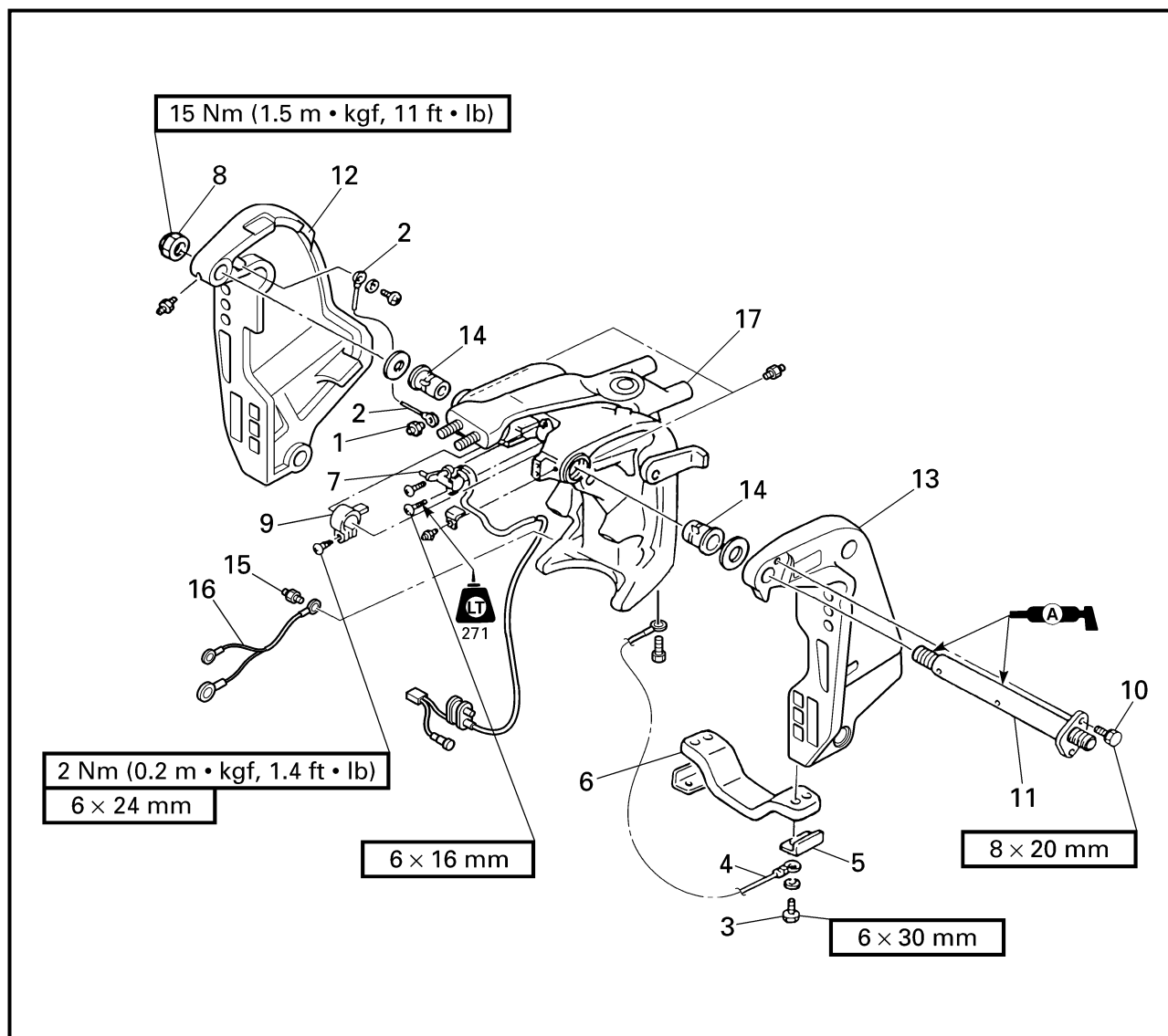
Continued on next page.



Order	Job/Part	Q'ty	Remarks
17	Bolt	3	Not reusable Not reusable For assembly, reverse the disassembly procedure.
18	Collar	3	
19	Oil strainer	1	
20	Rubber gasket	1	
21	Gasket	1	
22	Exhaust guide	1	

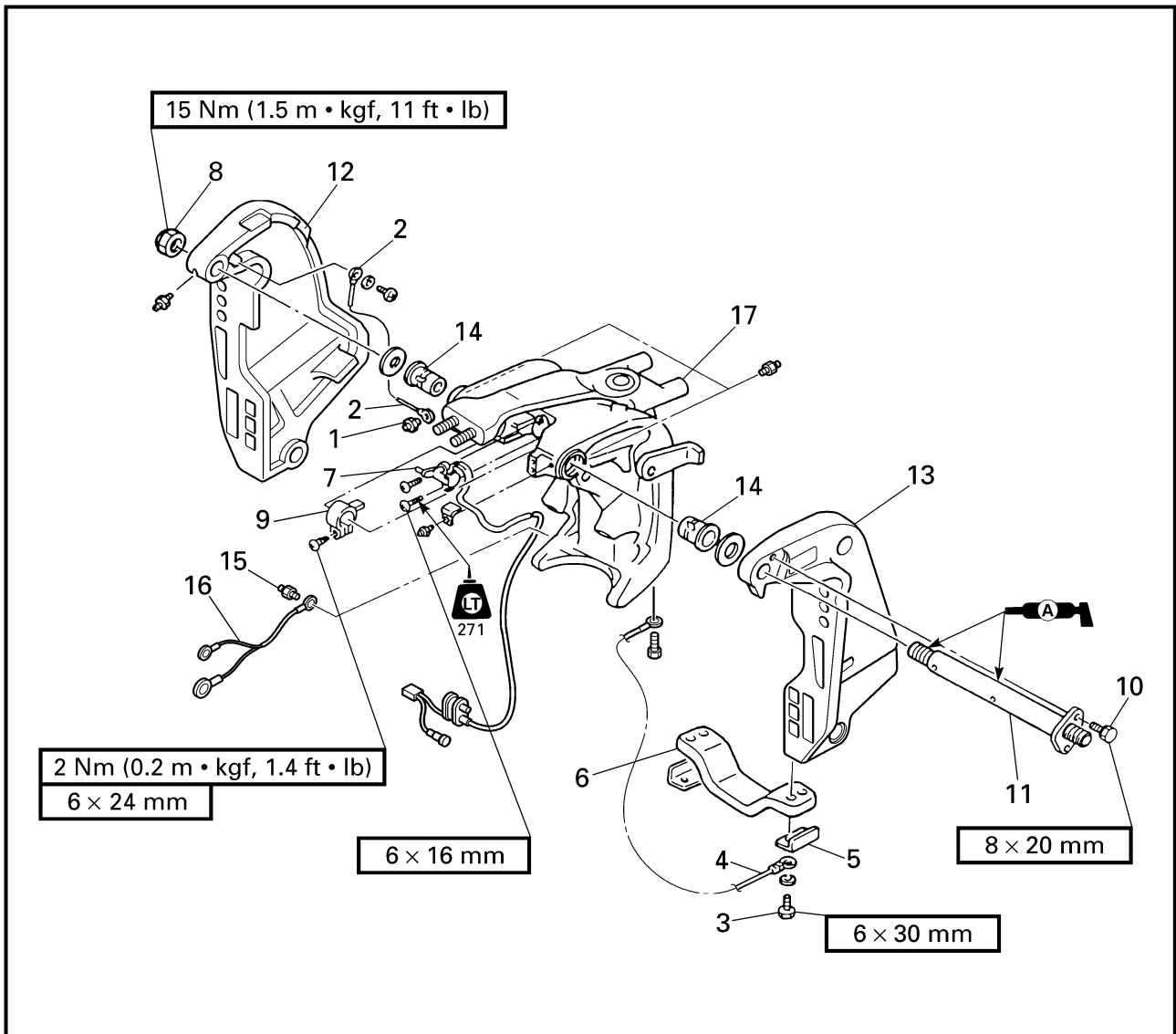
CLAMP BRACKETS

REMOVING/INSTALLING THE CLAMP BRACKETS



Order	Job/Part	Q'ty	Remarks
	Upper case assembly		Refer to "UPPER CASE ASSEMBLY" on page 7-16.
1	Grease nipple	4	
2	Ground lead	1	
3	Bolt	4	
4	Ground lead	1	
5	Anode bracket	2	
6	Anode	1	
7	Trim sensor	1	
8	Self-locking nut	1	

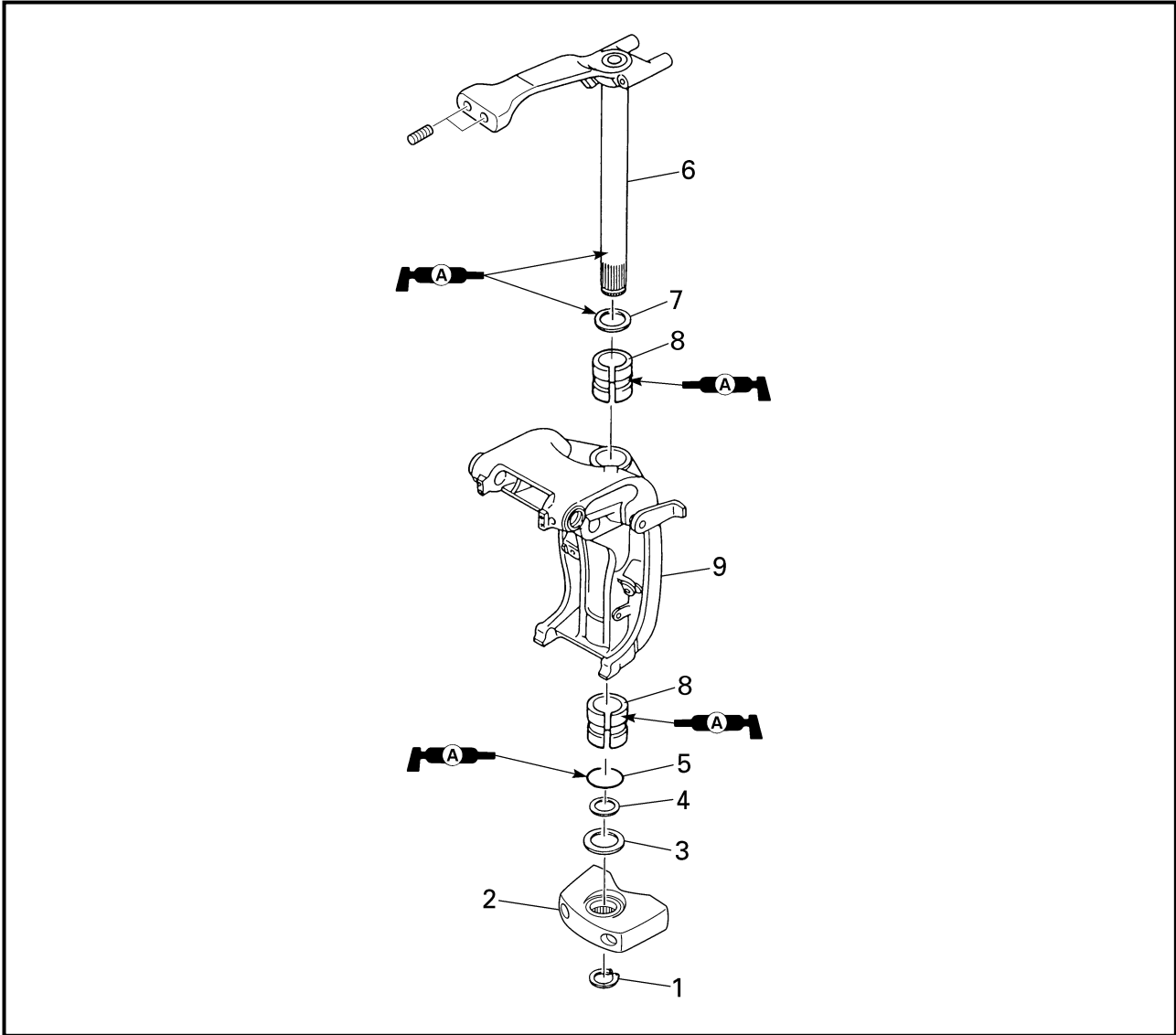
Continued on next page.



Order	Job/Part	Q'ty	Remarks
9	Cam	1	For installation, reverse the removal procedure.
10	Bolt	2	
11	Clamp bracket bolt	1	
12	Starboard clamp bracket	1	
13	Port clamp bracket	1	
14	Bushing	2	
15	Grease nipple	1	
16	Ground lead	1	
17	Swivel bracket assembly	1	

STEERING ARM

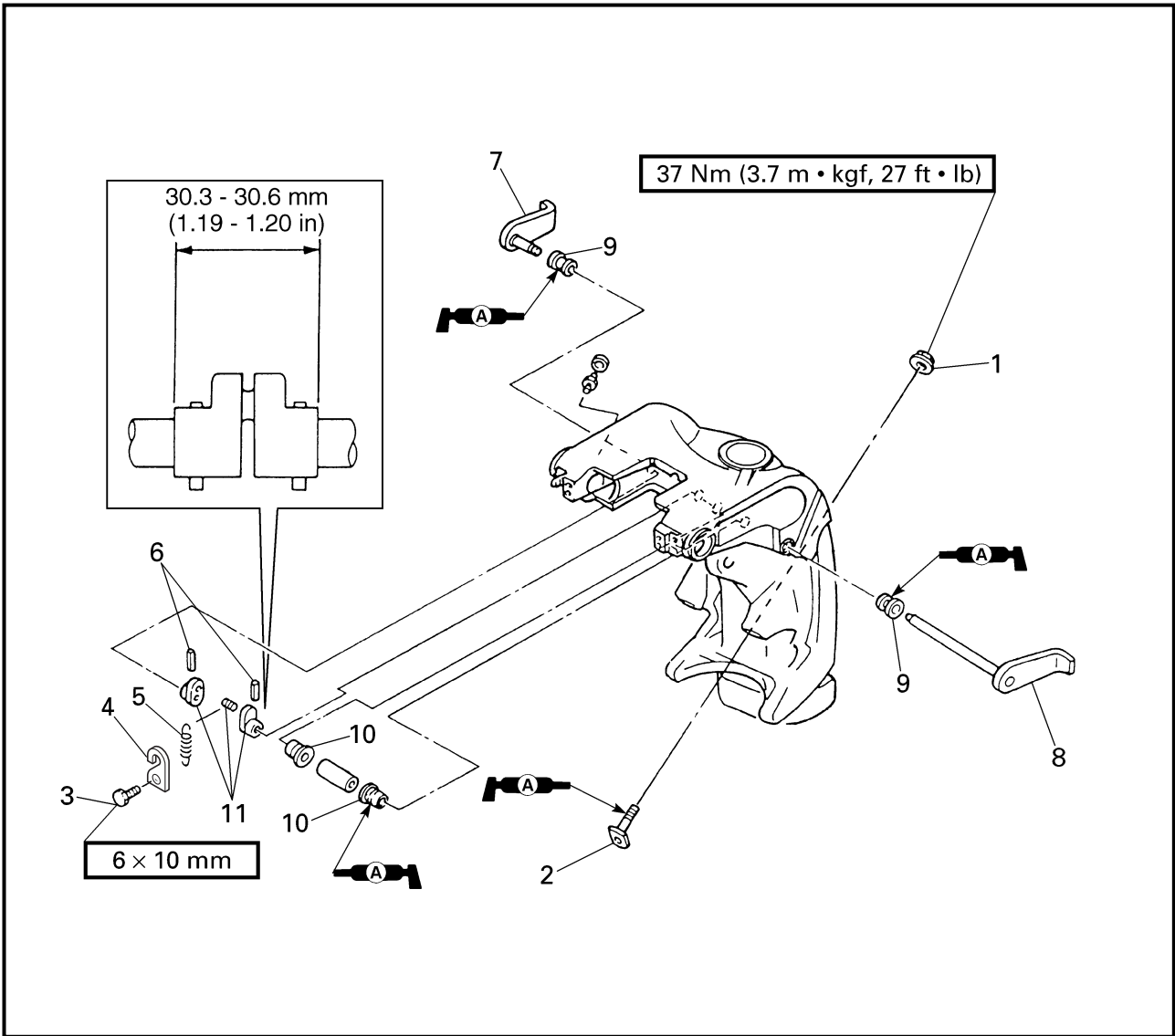
REMOVING/INSTALLING THE STEERING ARM



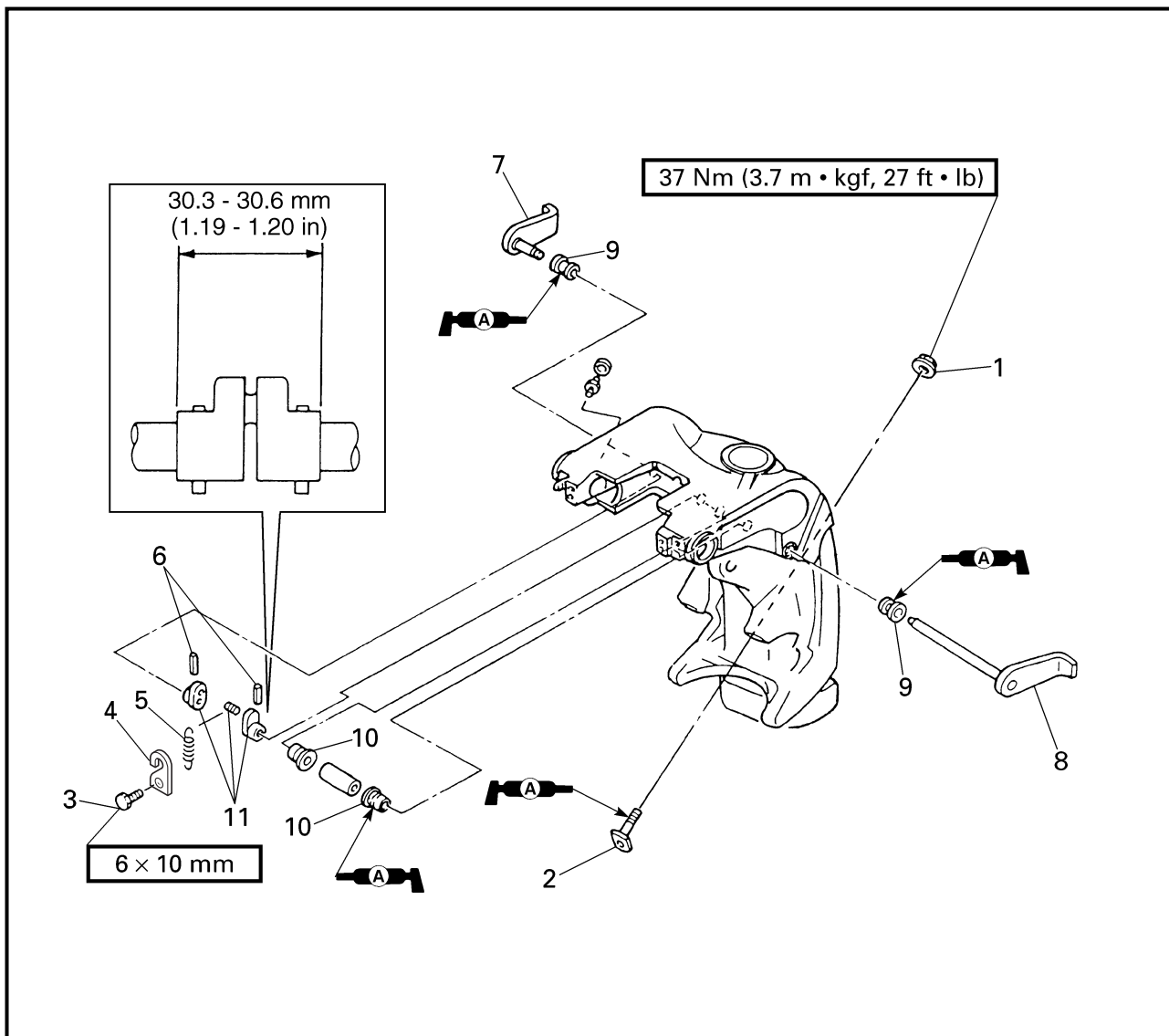
Order	Job/Part	Q'ty	Remarks
	Upper case assembly		Refer to "UPPER CASE ASSEMBLY" on page 7-16.
1	Circlip	1	
2	Steering arm yoke	1	
3	Washer	1	
4	Washer	1	
5	O-ring	1	
6	Steering arm	1	
7	Washer	1	
8	Bushing	2	
9	Swivel bracket assembly	1	
			For installation, reverse the removal procedure.

SWIVEL BRACKET ASSEMBLY

DISASSEMBLING/ASSEMBLING THE SWIVEL BRACKET ASSEMBLY



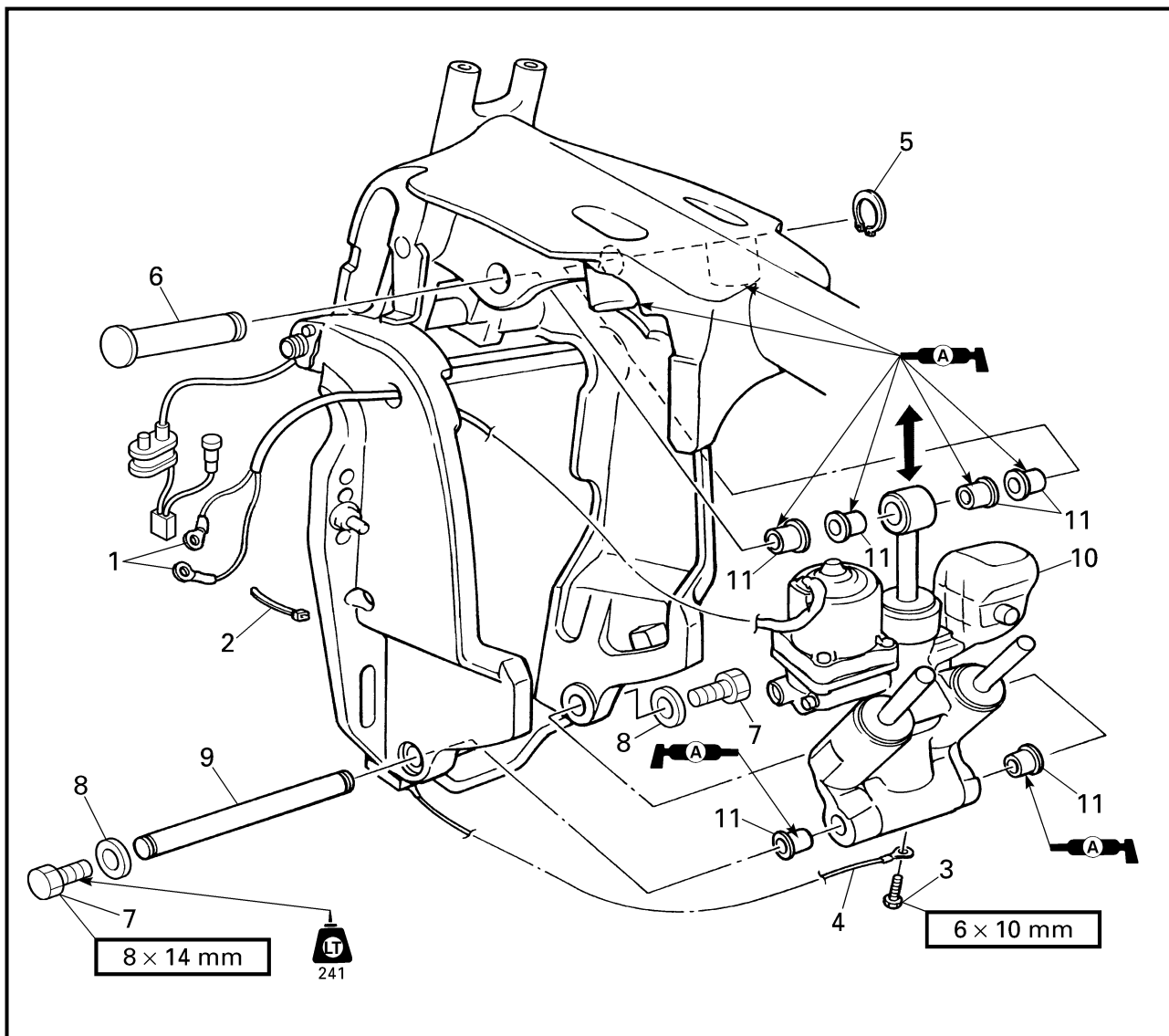
Order	Job/Part	Q'ty	Remarks
	Steering arm		Refer to "STEERING ARM" on page 7-26.
1	Nut	2	
2	Trim stopper	2	
3	Bolt	1	
4	Spring holder	1	
5	Spring	1	
6	Pin	2	Continued on next page.



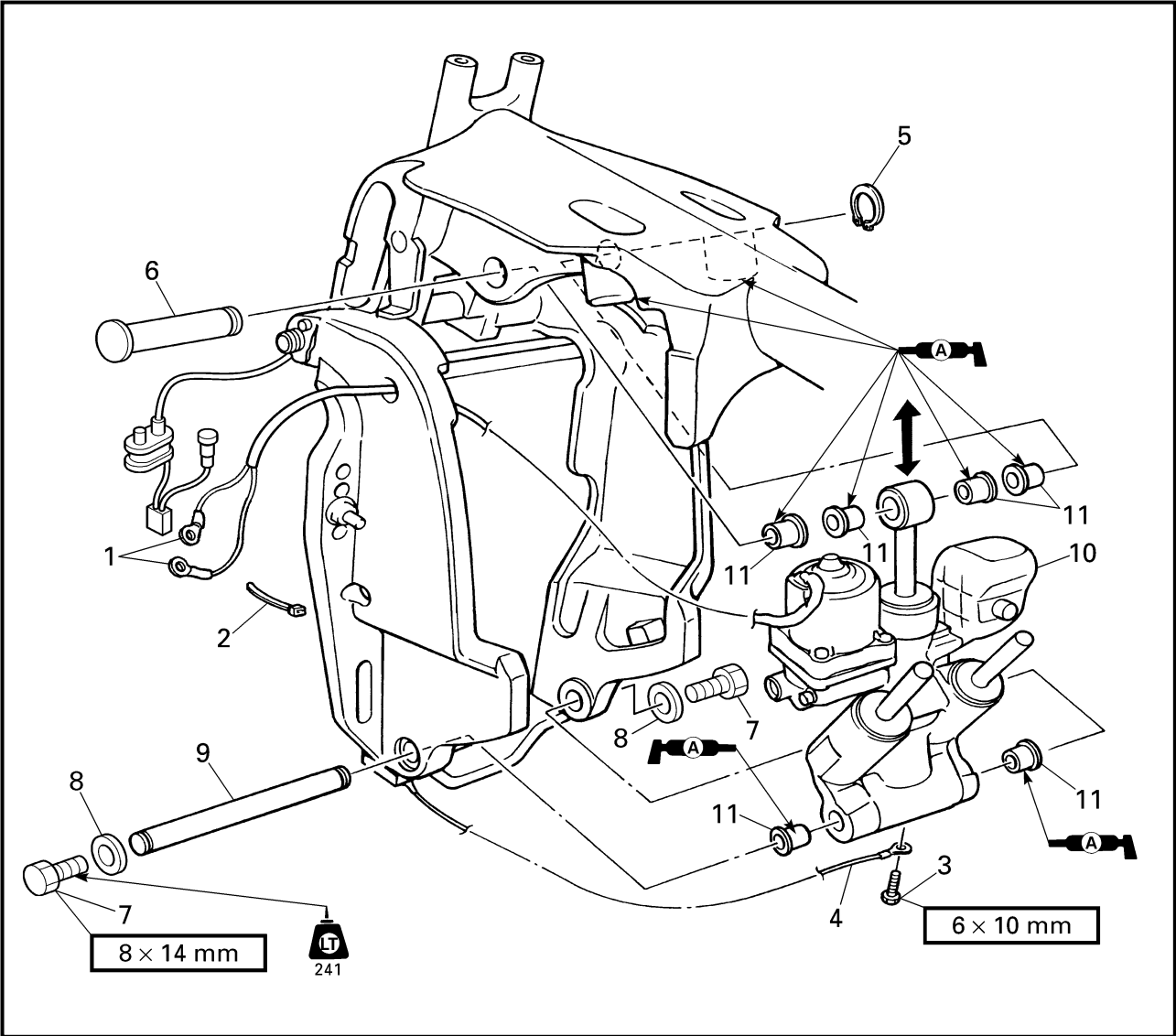
Order	Job/Part	Q'ty	Remarks
7	Starboard tilt stop lever	1	For assembly, reverse the disassembly procedure.
8	Port tilt stop lever	1	
9	Bushing	2	
10	Bushing	2	
11	Tilt stop lever joint assembly	1	

POWER TRIM AND TILT UNIT

REMOVING/INSTALLING THE POWER TRIM AND TILT UNIT



Order	Job/Part	Q'ty	Remarks
	Tilt up the outboard		Not reusable Continued on next page.
1	Power trim and tilt lead	2	
2	Plastic locking tie	3	
3	Bolt	1	
4	Ground lead	1	
5	Circlip	1	
6	Upper mounting pin	1	



Order	Job/Part	Q'ty	Remarks
7	Bolt	2	For installation, reverse the removal procedure.
8	Washer	2	
9	Lower mounting pin	1	
10	Power trim and tilt unit	1	
11	Collar	6	

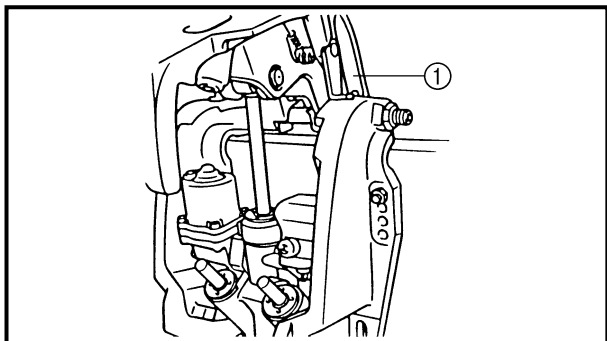


REMOVING THE POWER TRIM AND TILT UNIT

⚠ WARNING

After tilting up the outboard, be sure to support it with the tilt stop levers.

Otherwise, the outboard could suddenly lower if the power trim and tilt unit should lose fluid pressure.



NOTE:

Tilt up the outboard and then turn the tilt stop levers ① to support it.

Remove:

- Power trim and tilt unit

NOTE:

Slightly lower the tilt ram assembly and then remove the power trim and tilt unit.

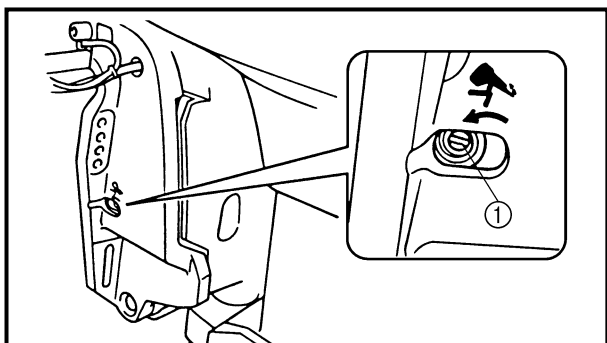
BLEEDING THE POWER TRIM AND TILT UNIT

NOTE:

Install the power trim and tilt unit onto the outboard before bleeding.

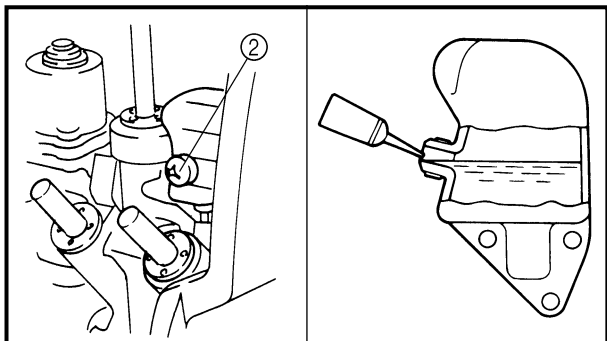
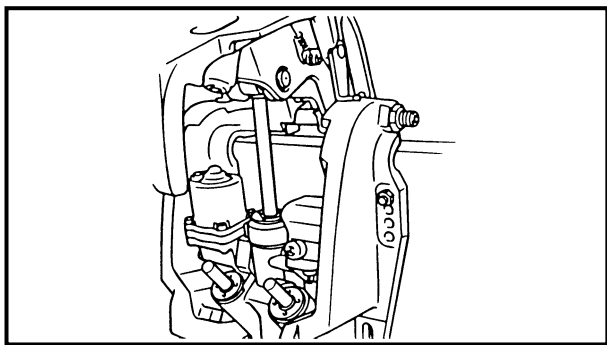
Bleed:

- Air bubbles
(from the power trim and tilt unit)



Bleeding steps

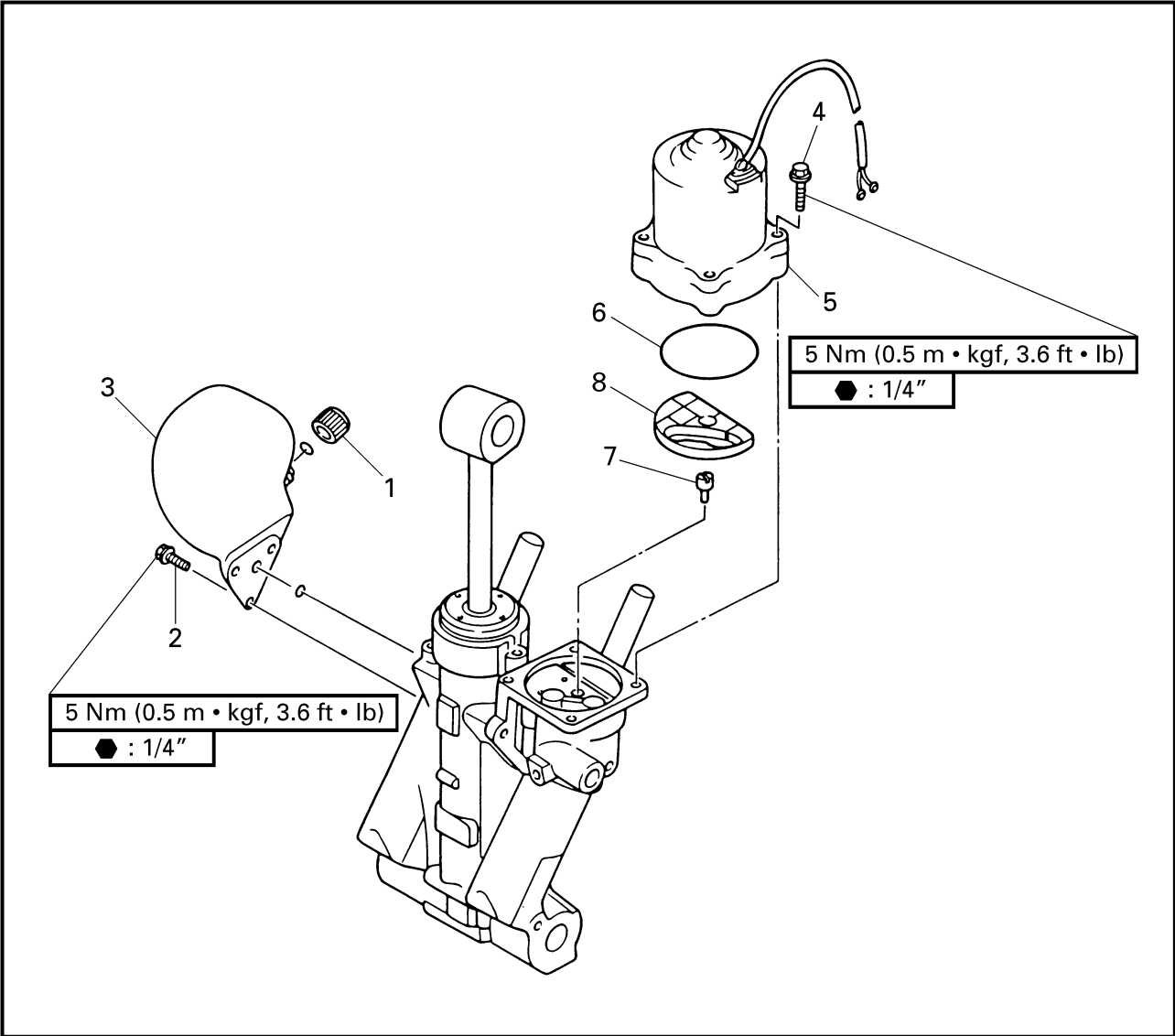
- (1) Connect the battery leads to the battery.
- (2) Loosen the manual valve ① by turning it counterclockwise until it stops.



- (3) Tilt up the outboard fully, then release it, and let it lower by its own weight.
- (4) Tighten the manual valve by turning it clockwise.
- (5) Let the power trim and tilt fluid settle for about 5 minutes.
- (6) Push and hold the power trim and tilt switch in the up position until the outboard is fully tilted up.
- (7) Turn the tilt stop levers to support the outboard. Then, let the power trim and tilt fluid settle for about 5 minutes.
- (8) Remove the reservoir cap ② and check that fluid is up to the brim as shown. Add fluid if the level is below the brim.
- (9) Install the power trim and tilt reservoir cap.
- (10) Repeat the above steps two or three times until the power trim and tilt fluid is at the correct level.

RESERVOIR AND POWER TRIM AND TILT MOTOR

REMOVING/INSTALLING THE RESERVOIR AND POWER TRIM AND TILT MOTOR



Order	Job/Part	Q'ty	Remarks
	Power trim and tilt unit		Refer to "POWER TRIM AND TILT UNIT" on page 7-29.
1	Reservoir cap	1	
2	Bolt	3	
3	Reservoir	1	
4	Bolt	4	
5	Power trim and tilt motor	1	
6	O-ring	1	
7	Drive pin	1	
8	Gear pump housing filter	1	
			For installation, reverse the removal procedure.

⚠ WARNING

- To prevent the hydraulic fluid from spurt-
ing out due to internal pressure, the out-
board should be kept fully tilted up (the
tilt rod at full length).
- After removing the power trim and tilt
motor or reservoir, do not push the tilt
ram down. This may cause hydraulic fluid
to spurt out from the port.

CAUTION:

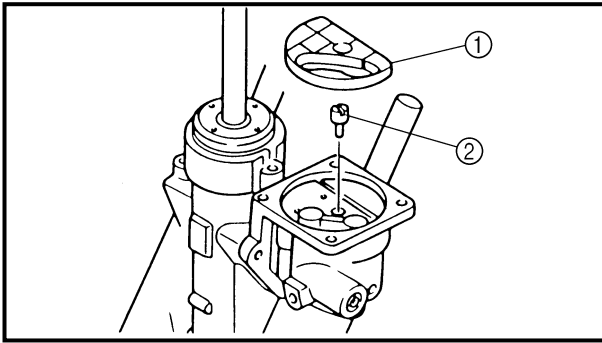
Do not wipe hydraulic system components
with rags, paper, tissues, or the like, as
fibers from such material will cause mal-
functions if they enter the system.

CHECKING THE RESERVOIR

1. Drain:
 - Power trim and tilt fluid
2. Check:
 - Reservoir
Cracks/damage/leaks → Replace.

**CHECKING THE GEAR PUMP
HOUSING FILTER**

- Check:
- Gear pump housing filter
Damage/tears → Replace.
Foreign matter → Clean.



INSTALLING THE POWER TRIM AND TILT MOTOR

1. Install:

- Gear pump housing filter ①
- Drive pin ②

2. Fill:

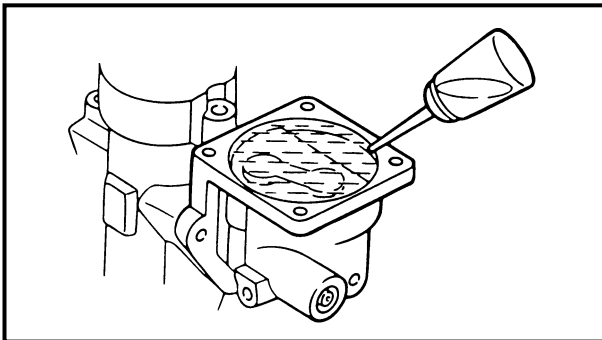
- Gear pump housing



Recommended power trim and tilt fluid
ATF Dexron II

NOTE:

Add power trim and tilt fluid until it reaches the top of the gear pump housing.

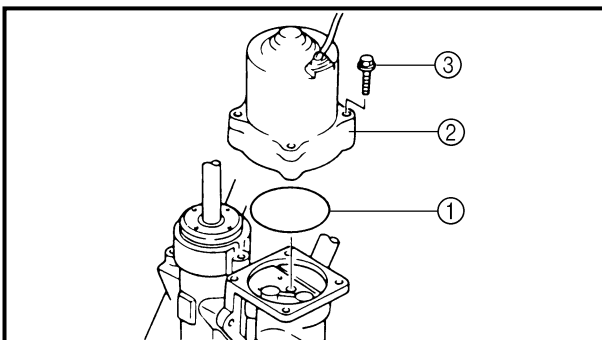


3. Bleed:

- Air bubbles

NOTE:

- Remove all of the air bubbles with a syringe or suitable tool as shown.
- Turn the gear pump gears with a screwdriver and then remove any air between the gear teeth.



4. Install:

- O-ring ①
- Power trim and tilt motor ②
- Bolt ③

NOTE:

Align the armature shaft with the recess in the drive pin.



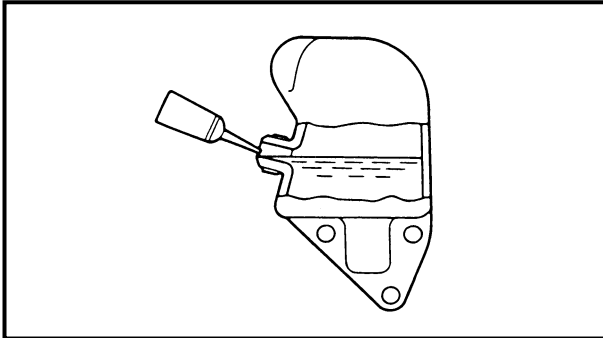
FILLING THE RESERVOIR

⚠ WARNING

To prevent the hydraulic fluid from spurt-
ing out due to internal pressure, the tilt
ram should be kept at full length.

1. Fill:

- Reservoir



**Recommended power trim and
tilt fluid**
ATF Dexron II

2. Check:

- Power trim and tilt fluid level

Level is low → Add power trim and tilt
fluid to the proper level.

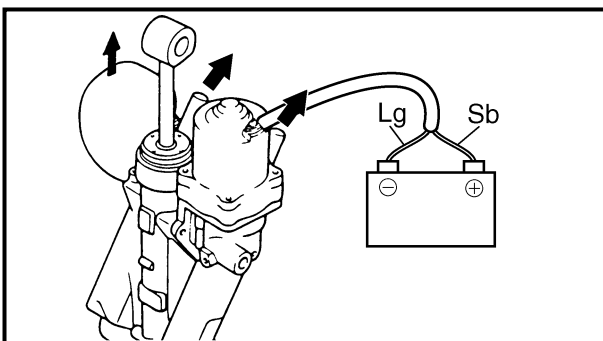
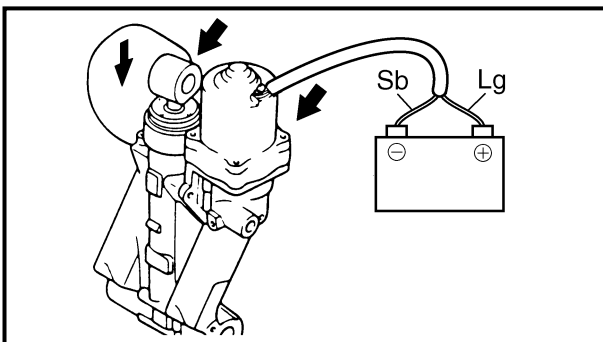
BLEEDING THE POWER TRIM AND TILT UNIT

NOTE:

This bleeding must be done before install-
ing the power trim and tilt unit onto the out-
board.

1. Bleed:

- Air bubbles
(from the power trim and tilt unit)



Bleeding steps

- (1) Set the power trim and tilt unit upright.
- (2) Connect the leads of the power trim and tilt on the battery terminals until the trim and tilt ram assemblies are fully compressed.

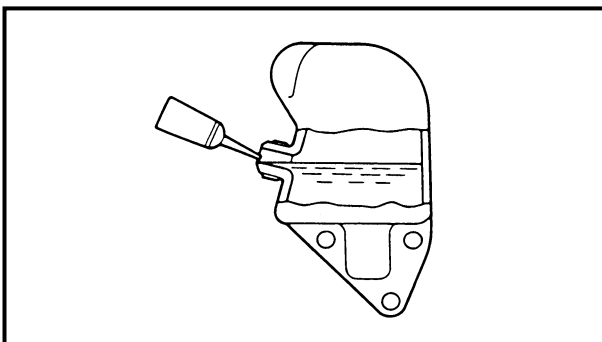
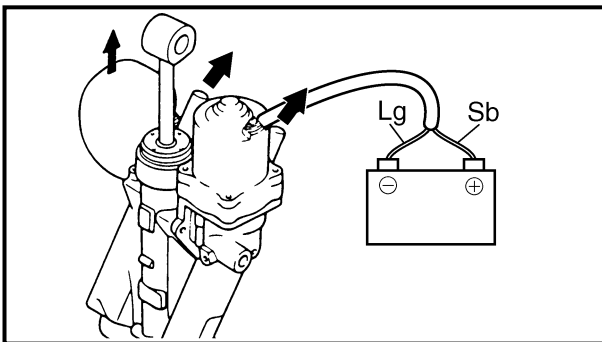
NOTE:

If the rams will not go down, refer to the fol-
lowing.

- A. Connect the leads of the power trim and tilt on the battery terminals until the trim and tilt ram assemblies are fully extended. Then, reverse the leads on the battery terminals until the trim and tilt ram assemblies are fully compressed.



- B. If step A was unsuccessful, connect the leads on the battery terminals and fully compress the tilt ram assembly by hand.
- C. If step B was unsuccessful, loosen the manual valve, compress the trim and tilt ram assemblies fully by hand, and then tighten the manual valve. Then, compress and extend the trim and tilt ram assemblies by connecting the leads on the battery terminals in the up and down positions.
- D. If step C was unsuccessful, disassemble, check, and correct any problems with the power trim and tilt unit.



- (3) Connect the leads on the battery terminals in the up position until the trim and tilt ram assemblies are fully extended.
- (4) Remove the power trim and tilt reservoir cap and check that fluid is up to the brim as shown. Add power trim and tilt fluid if the level is below the brim.
- (5) Repeat the above steps two or three times until the fluid is at the correct level.

2. Check:

- Power trim and tilt unit operation
Unsmooth operation → Bleed the power trim and tilt unit again.

MEASURING THE HYDRAULIC PRESSURE

Check:

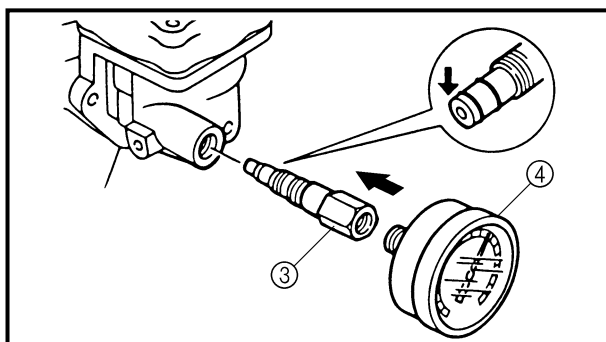
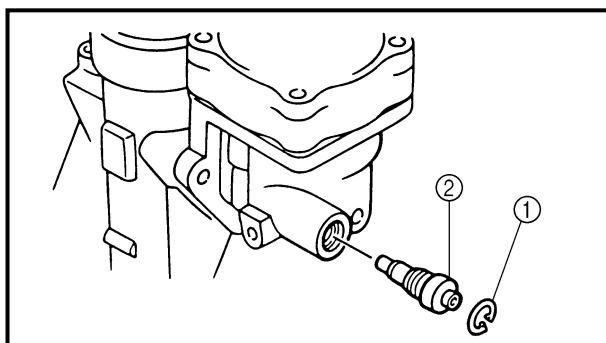
- Hydraulic pressure
- Out of specification → Repair.



Hydraulic pressure
(with the power trim and tilt ram
assemblies fully extended)
9.8 - 11.8 MPa
(100 - 120 kg/cm²)
(with the power trim and tilt ram
assemblies fully compressed)
5.9 - 8.8 MPa (60 - 90 kg/cm²)

NOTE:

Before measuring the hydraulic pressure, bleed the power trim and tilt unit.



Measuring steps

- Fully tilt up the power trim and tilt ram assemblies.
- Remove the circlip ①.
- Remove the manual valve ② and install the up-relief valve attachment and hydraulic pressure gauge and tighten them to the specified torque.



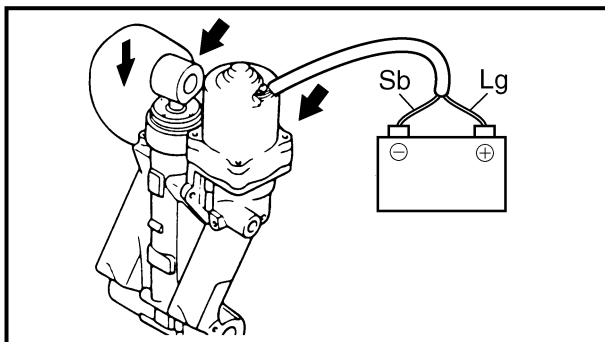
Up-relief valve attachment..... ③
90890-06773
Hydraulic pressure gauge ④
90890-06776



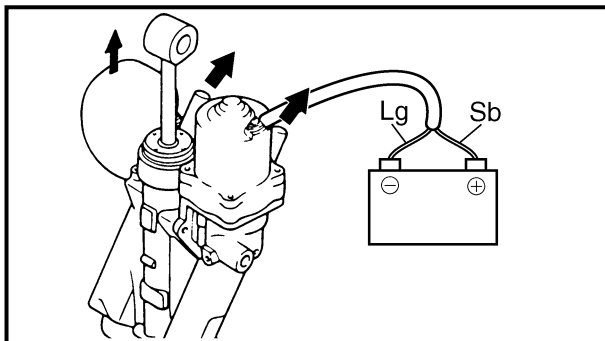
Hydraulic pressure gauge
9 Nm (0.9 m • kgf, 6.5 ft • lb)
Up-relief valve attachment
4 Nm (0.4 m • kgf, 2.9 ft • lb)

NOTE:

Remove the manual valve and then quickly attach the special tools before any fluid comes out.



- (4) Connect the leads on the battery terminals in the down position until the power trim and tilt ram assemblies are fully compressed.

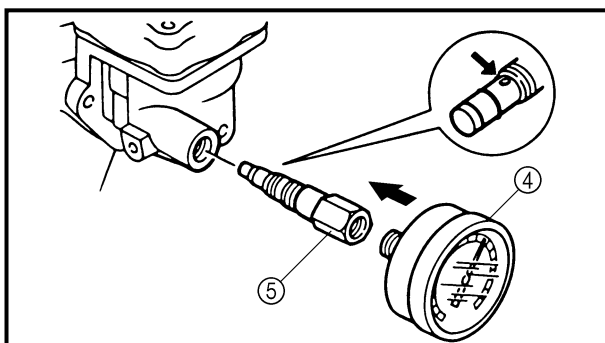


- (5) Connect the leads on the battery terminals in the up position until the power trim and tilt ram assemblies are fully extended. Then, measure the hydraulic pressure.



**Hydraulic pressure
(with the power trim and tilt ram
assemblies fully extended)**

**9.8 - 11.8 MPa
(100 - 120 kg/cm²)**



- (6) After measuring the hydraulic pressure, remove the special tools and quickly attach the down-relief valve attachment.



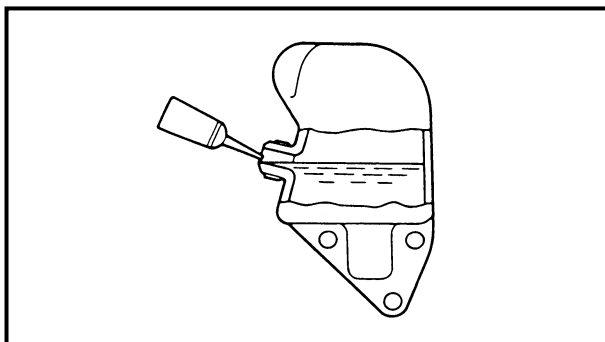
Hydraulic pressure gauge ④

Down-relief valve attachment. ⑤



**Hydraulic pressure gauge
9 Nm (0.9 m • kgf, 6.5 ft • lb)**

**Down-relief valve attachment
4 Nm (0.4 m • kgf, 2.9 ft • lb)**

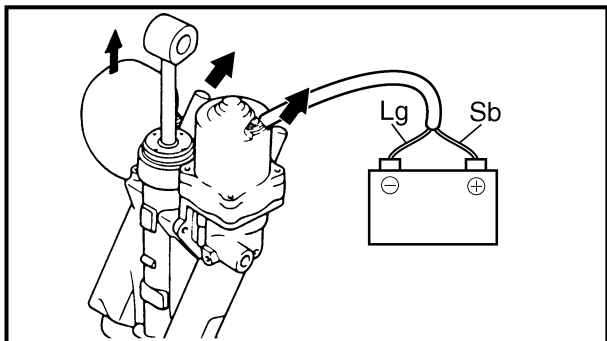
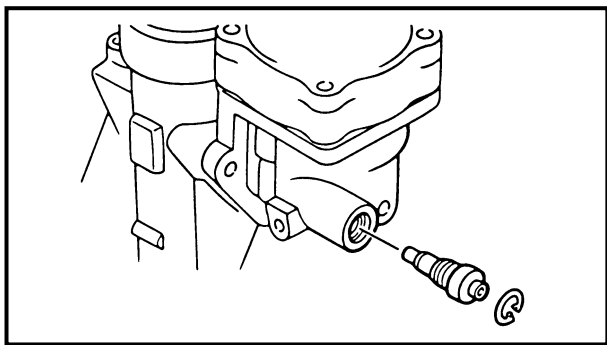


- (7) Remove the reservoir cap and check that fluid is up to the brim as shown. Add fluid if the level is below the brim.
(8) Install the reservoir cap.
(9) Connect the leads on the battery terminals in the down position until the power trim and tilt ram assemblies are fully compressed. Then, measure the hydraulic pressure.



**Hydraulic pressure
(with the power trim and tilt ram
assemblies fully compressed)**

5.9 - 8.8 MPa (60 - 90 kg/cm²)



(10) After measuring the hydraulic pressure, connect the leads on the battery terminals in the up position until the power trim and tilt ram assemblies are fully extended.

(11) Remove the special tools.

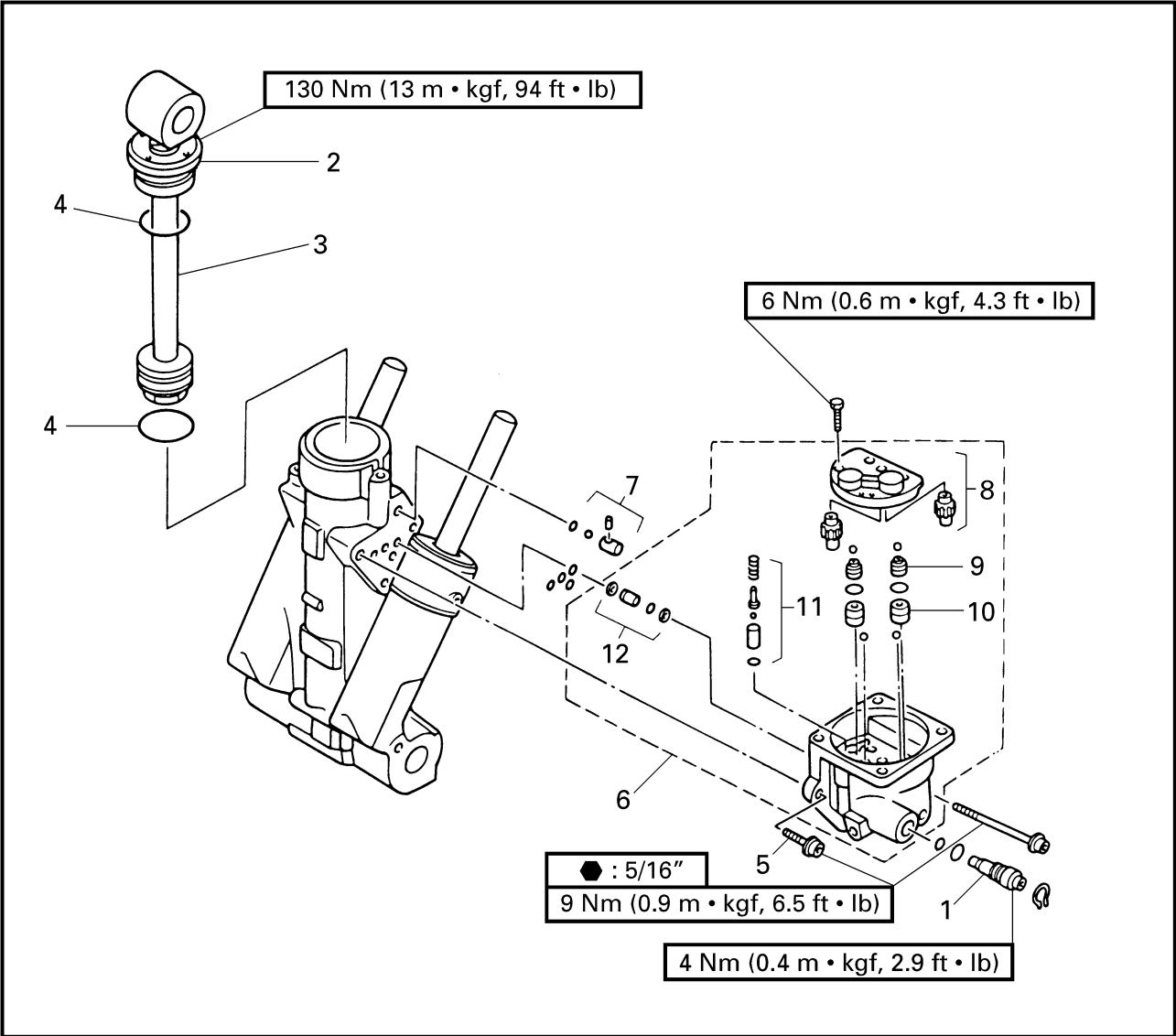
(12) Install the manual valve and circlip.

NOTE:

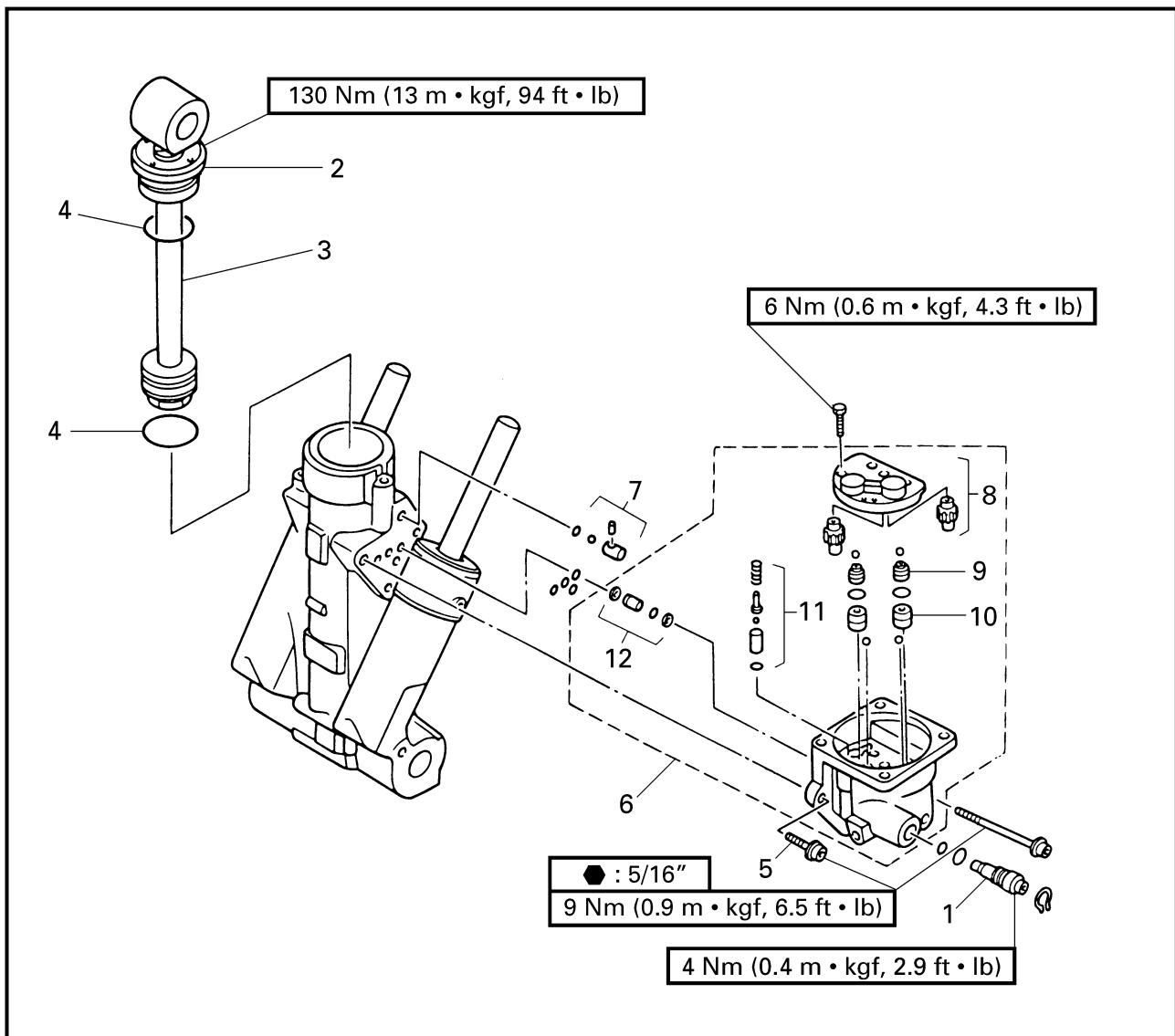
After measuring the hydraulic pressure, bleed the power trim and tilt unit.

TILT RAM ASSEMBLY AND GEAR PUMP UNIT

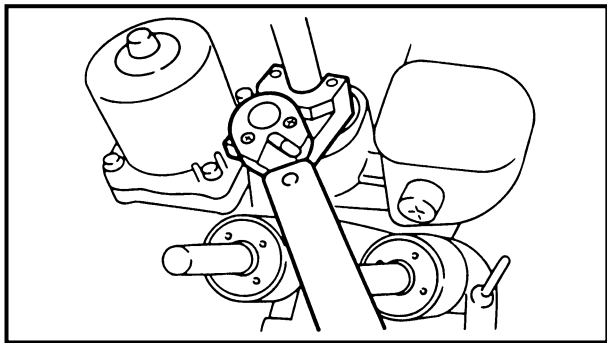
REMOVING/INSTALLING THE TILT RAM ASSEMBLY AND GEAR PUMP UNIT



Order	Job/Part	Q'ty	Remarks
	Reservoir and power trim and tilt motor		Refer to "RESERVOIR AND POWER TRIM AND TILT MOTOR" on page 7-33.
1	Manual valve	1	
2	Tilt ram end screw	1	
3	Tilt ram assembly	1	
4	O-ring	2	
5	Bolt	3	
6	Gear pump unit	1	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
7	Check valve assembly	1	For installation, reverse the removal procedure.
8	Gear pump	1	
9	Shuttle valve	2	
10	Check valve	2	
11	Up-relief valve assembly	1	
12	Down-relief valve assembly	1	



REMOVING THE TILT RAM END SCREW

Loosen:

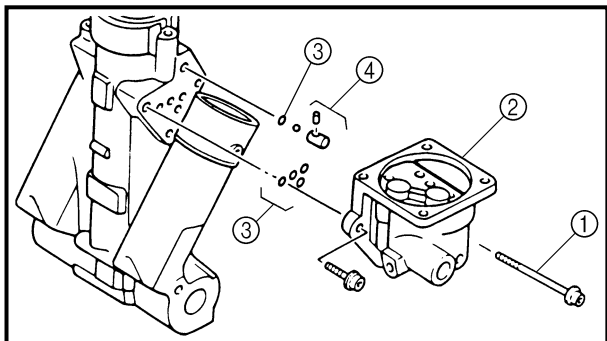
- Tilt ram end screw



End screw wrench
YB-06548 / 90890-06548

NOTE:

Hold the power trim and tilt unit in a vise using aluminum plates on both sides.



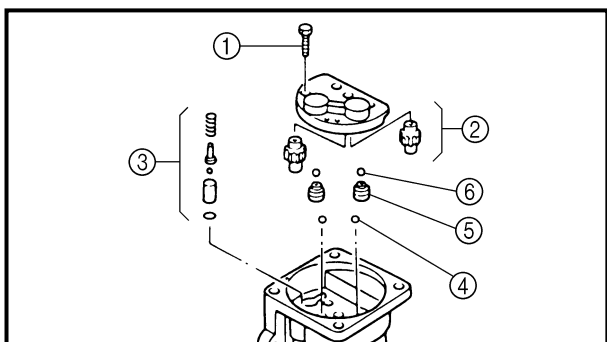
REMOVING THE GEAR PUMP UNIT

Remove:

- Bolt ①
- Gear pump unit ②
- O-ring ③
- Check valve ④

NOTE:

Place a container under the power trim and tilt unit.



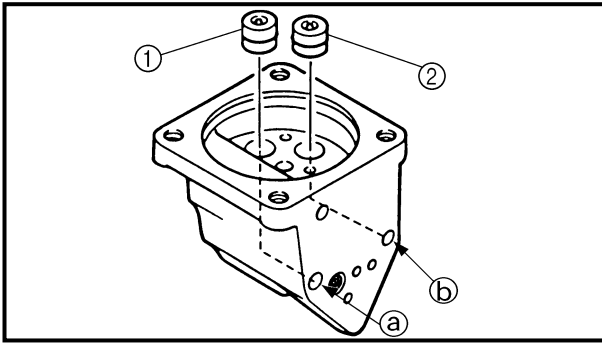
DISASSEMBLING THE GEAR PUMP UNIT

1. Remove:

- Bolt ①
- Pump gear ②
- Up-relief valve assembly ③
- Ball (4.76 mm/0.187 in) ④
- Shuttle valve ⑤
- Ball (3.18 mm/0.125 in) ⑥

NOTE:

When removing the pump gears, note their original direction and position for proper assembly.



2. Remove:

- Check valves ① and ②

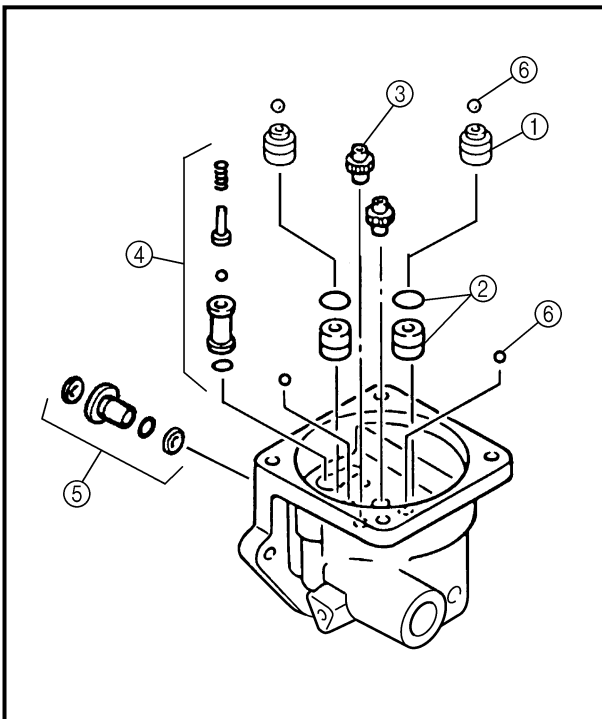
NOTE:

To remove the check valves, cover the gear pump housing with a clean cloth and then blow compressed air through holes ① and ②.

CHECKING THE TILT RAM

Check:

- Tilt ram
Excessive scratches → Replace.
Bends/excessive corrosion → Replace.
Rust → Polish.
(with 400 - 600 grit sandpaper)



CHECKING THE GEAR PUMP UNIT

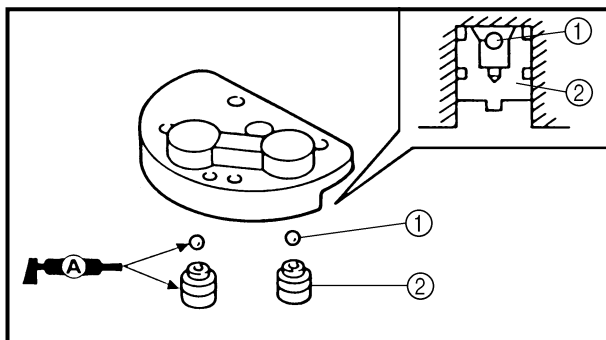
Check:

- Shuttle valves ①
- Check valve assemblies ②
Clogs/damage/wear → Replace.
- Pump gears ③
Damage/wear → Replace the gear pump unit.
- Up-relief valve assembly ④
- Down-relief valve assembly ⑤
Damage/wear → Replace the gear pump unit.
- Balls ⑥
Damage/wear → Replace.

ASSEMBLING THE GEAR PUMP UNIT

CAUTION:

Install all components in their original direction and position for proper assembly and operation.

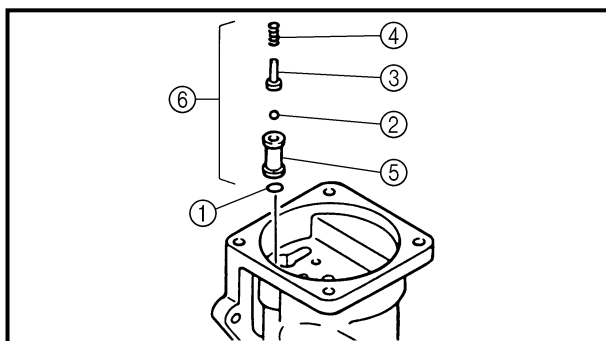


1. Install:

- Balls (3.18 mm/0.125 in) ①
- Shuttle valves ②

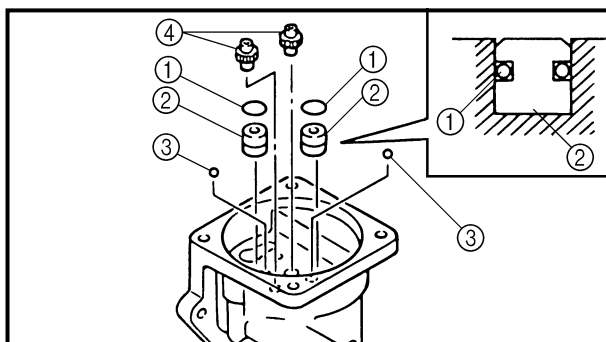
NOTE:

Apply grease to the balls to prevent them from falling out of the gear pump.



2. Install:

- O-ring ①
- Ball (3.18 mm/0.125 in) ②
- Up-relief valve pin ③
- Spring ④
- Up-relief valve ⑤
- Up-relief valve assembly ⑥

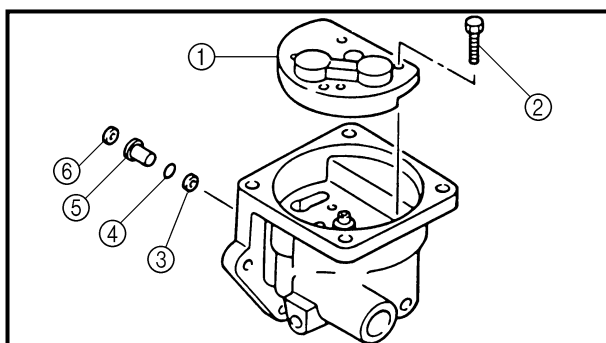


3. Install:

- O-rings ①
- Check valves ②
- Balls (4.76 mm/0.187 in) ③
- Pump gears ④

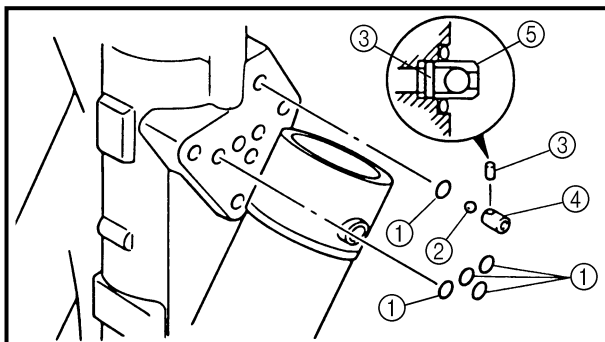
4. Install:

- Gear pump ①
- Bolt ②
- Filter ③
- O-ring ④
- Down-relief valve ⑤
- Filter ⑥



NOTE:

Tighten the bolts evenly and make sure the pump gears turn smoothly.



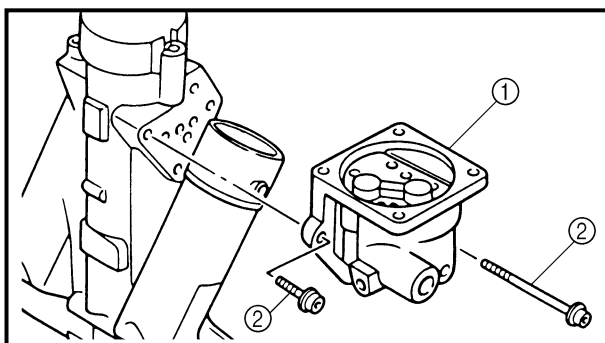
INSTALLING THE GEAR PUMP UNIT

1. Install:

- O-rings ①
- Ball ②
- Pin ③
- Check valve ④
- Check valve assembly ⑤

NOTE:

When installing the check valve assembly, make sure the pin is on the tilt ram cylinder side as shown.



2. Install:

- Gear pump unit ①
- Bolt ②

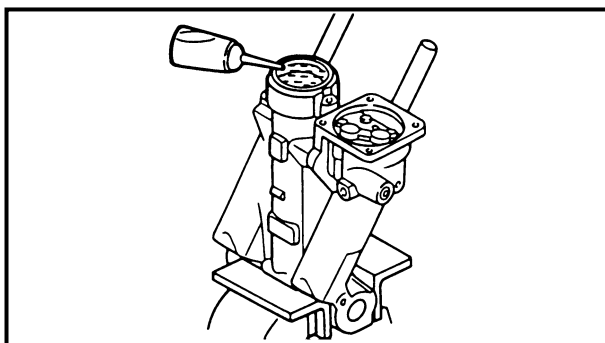
INSTALLING THE TILT RAM ASSEMBLY

⚠ WARNING

To prevent the hydraulic fluid from spurt-ing out due to internal pressure, the tilt ram should be kept at full length.

1. Fill:

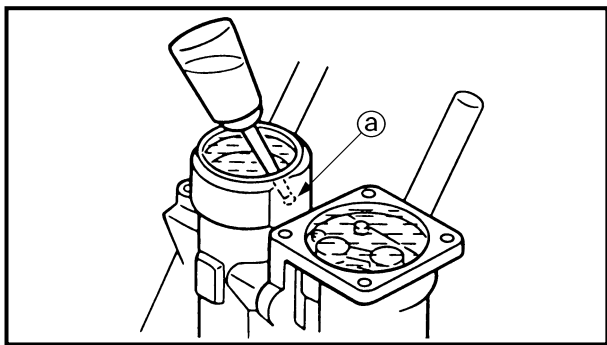
- Tilt ram cylinder



Recommended power trim and tilt fluid
ATF Dexron II

NOTE:

Hold the power trim and tilt unit in a vise using aluminum plates on both sides.



2. Fill:

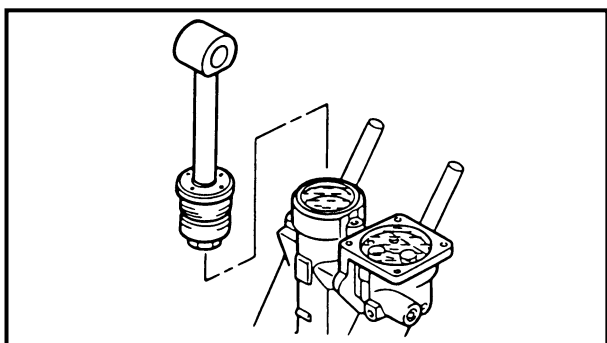
- Gear pump housing



Recommended power trim and tilt fluid
ATF Dexron II

NOTE:

Add power trim and tilt fluid through the hole ① until the fluid level is to the top of the gear pump unit.

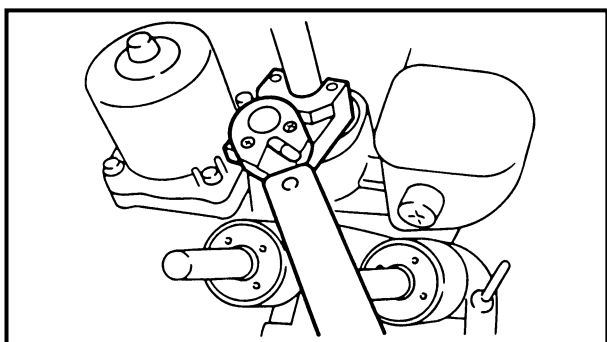


3. Install:

- Tilt ram assembly

NOTE:

Place the tilt ram end screw at the bottom of the tilt ram and install the tilt ram assembly into the tilt ram cylinder.



4. Tighten:

- Tilt ram end screw



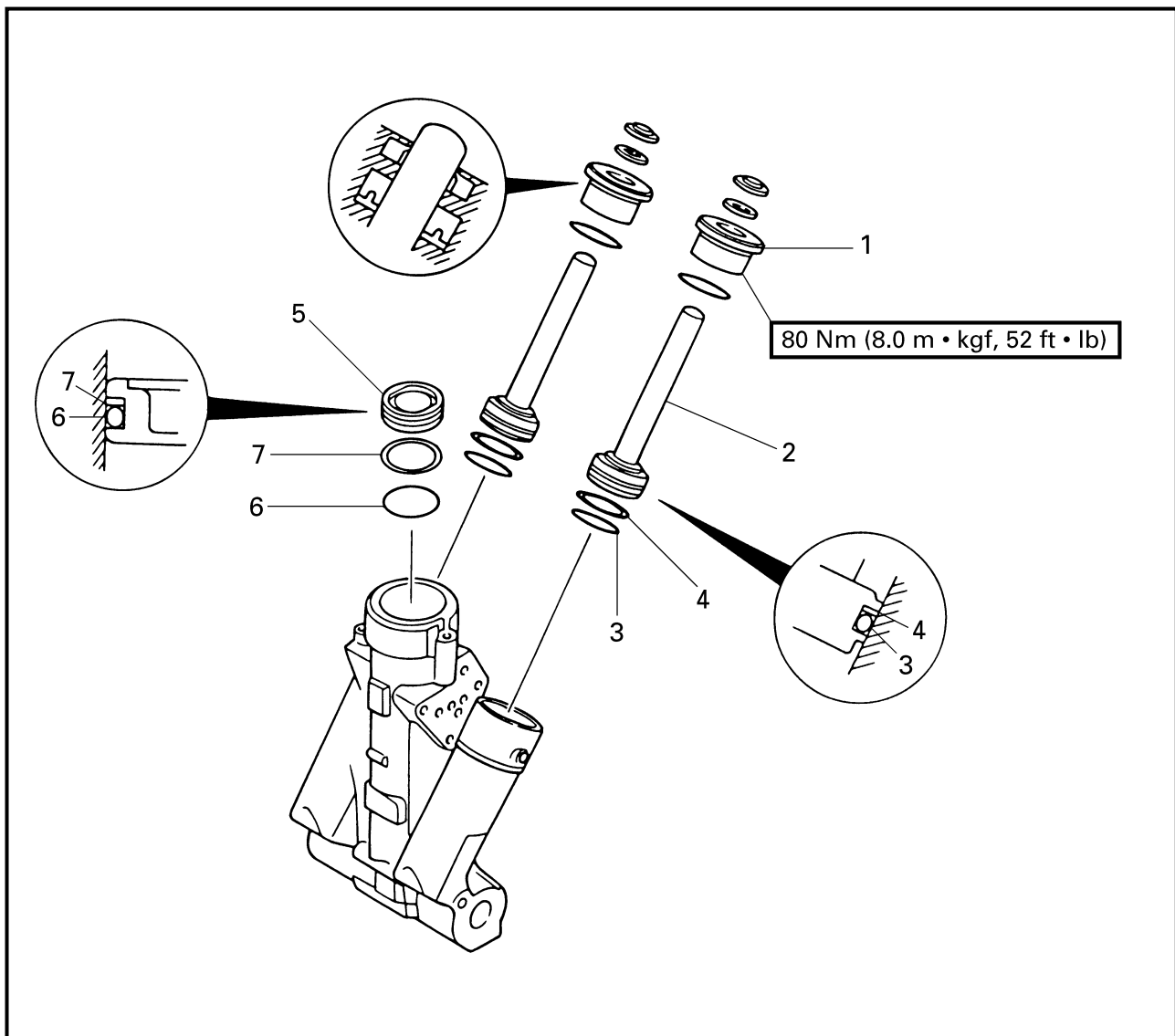
End screw wrench
YB-06548 / 90890-06548



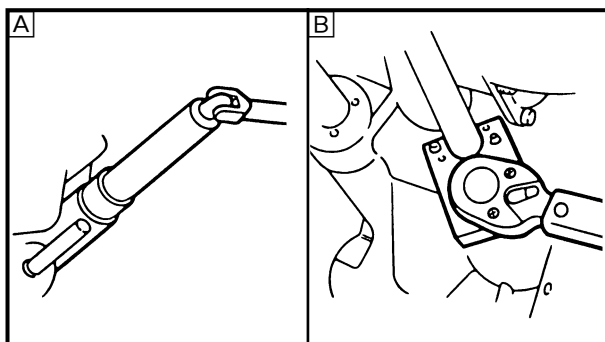
Tilt ram end screw
130 Nm (13 m • kgf, 94 ft • lb)

TRIM RAM ASSEMBLIES AND FREE PISTON

REMOVING/INSTALLING THE TRIM RAM ASSEMBLIES AND FREE PISTON



Order	Job/Part	Q'ty	Remarks
	Tilt ram assembly and gear pump unit		Refer to "TILT RAM ASSEMBLY AND GEAR PUMP UNIT" on page 7-41.
1	Trim ram end screw	2	
2	Trim ram	2	
3	O-ring	2	
4	Seal ring	2	
5	Free piston	1	
6	O-ring	1	
7	Piston ring	1	For installation, reverse the removal procedure.



REMOVING THE TRIM RAM END SCREWS

Loosen:

- Trim ram end screw



End screw wrench
YB-06175-1A / 90890-06548

A For USA and Canada

B For worldwide

NOTE:

Hold the power trim and tilt unit in a vise using aluminum plates on both sides.

REMOVING THE FREE PISTON

1. Drain:

- Power trim and tilt fluid

NOTE:

After removing the trim ram assemblies, drain the fluid from the power trim and tilt unit.

2. Install:

- Trim ram assemblies ①

NOTE:

Finger-tighten the trim ram assemblies and then cover the tilt cylinder openings with a clean cloth.

3. Remove:

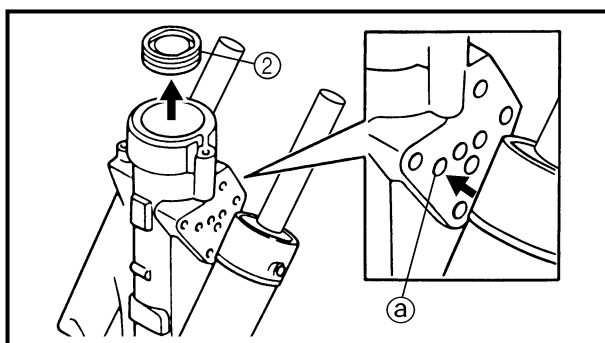
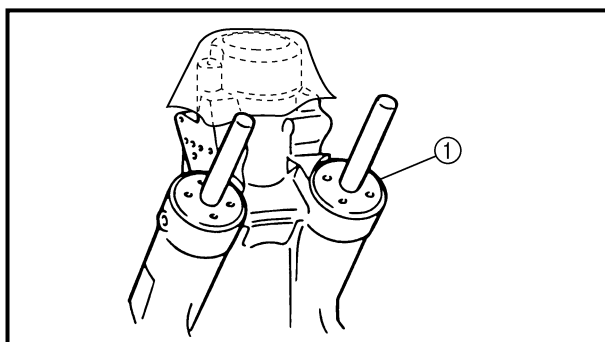
- Free piston ②

⚠ WARNING

Never look into the tilt cylinder opening because the free piston and hydraulic fluid may be expelled out forcefully.

NOTE:

Remove the free piston by blowing compressed air through the hole ②.



CHECKING THE TRIM RAMS

Check:

- Trim ram
Excessive scratches → Replace.
Bends/excessive corrosion → Replace.
Rust → Polish.
(with 400 - 600 grit sandpaper)

CHECKING THE FREE PISTON

Check:

- Free piston
Excessive scratches → Replace.

CHECKING THE TRIM RAM CYLINDERS

Check:

- Trim ram cylinder
Cracks/excessive scratches → Replace the power trim and tilt unit.

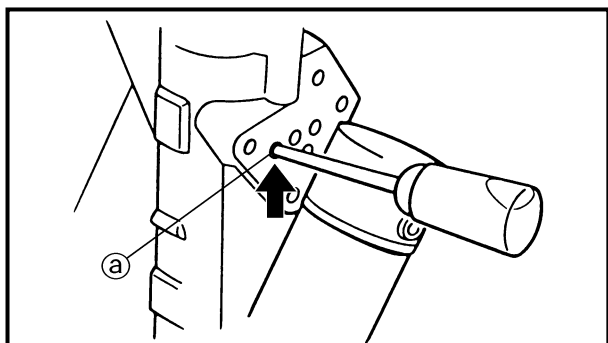
INSTALLING THE FREE PISTON

1. Fill:

- Fluid passages

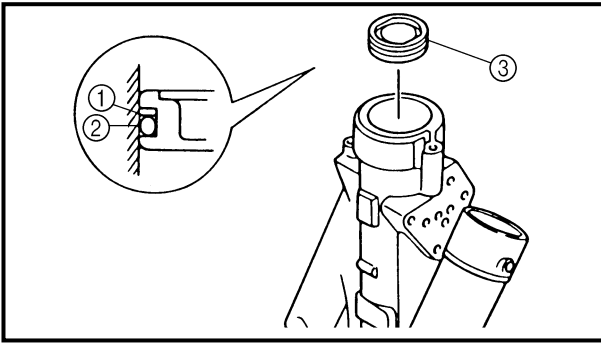


Recommended power trim and tilt fluid
ATF Dexron II
Quantity
30 cm³ (1.0 US oz, 1.1 Imp oz)



NOTE:

- Hold the power trim and tilt unit in a vise using aluminum plates on both sides.
- Add power trim and tilt fluid through the hole ①.



2. Install:

- Piston ring ①
- O-ring ②
- Free piston ③

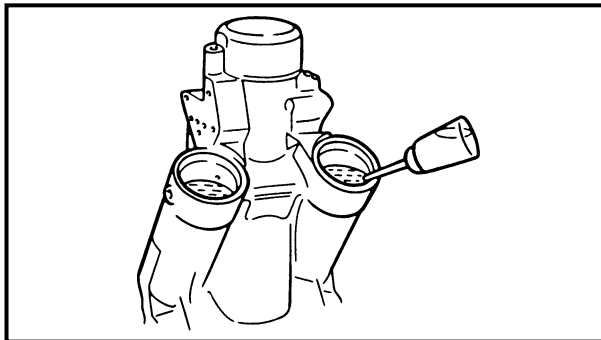
NOTE:

Push the free piston into the tilt ram cylinder until it bottoms out.

INSTALLING THE TRIM RAMS

⚠ WARNING

Do not push the trim rams down while installing them into the trim ram cylinders. Otherwise, the hydraulic fluid may spurt out from the unit.



1. Fill:

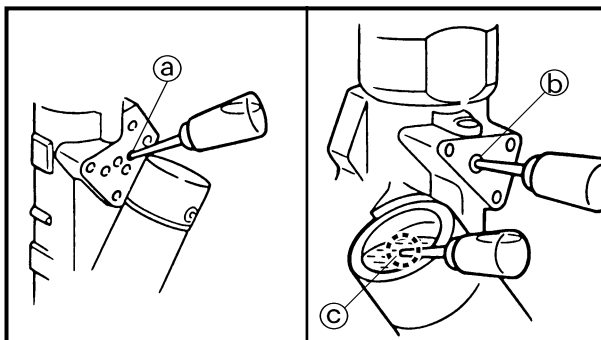
- Trim ram cylinders



Recommended power trim and tilt fluid
ATF Dexron II

NOTE:

Hold the power trim and tilt unit in a vise using aluminum plates on both sides.



2. Fill:

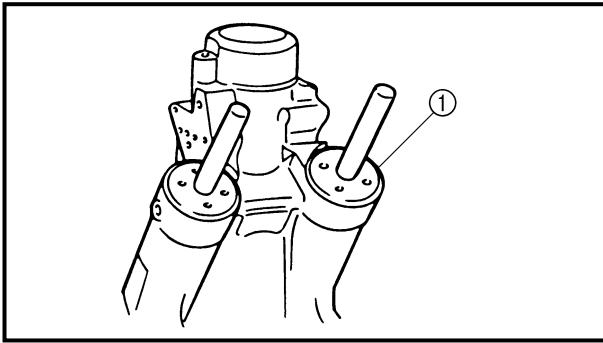
- Fluid passages



Recommended power trim and tilt fluid
ATF Dexron II

NOTE:

Add power trim and tilt fluid through holes ①, ② and ③ until all of the passages are filled.

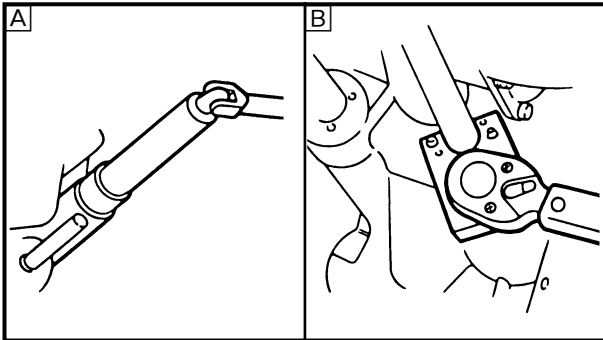


3. Install:

- Trim ram assemblies ①

NOTE:

Place each trim ram end screw at the bottom of each trim ram and install them into the trim ram cylinders.



4. Tighten:

- Trim ram end screw



End screw wrench
YB-06175-1A / 90890-06548



Trim ram end screw
80 Nm (8.0 m • kgf, 58 ft • lb)

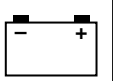
A For USA and Canada

B For worldwide

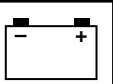
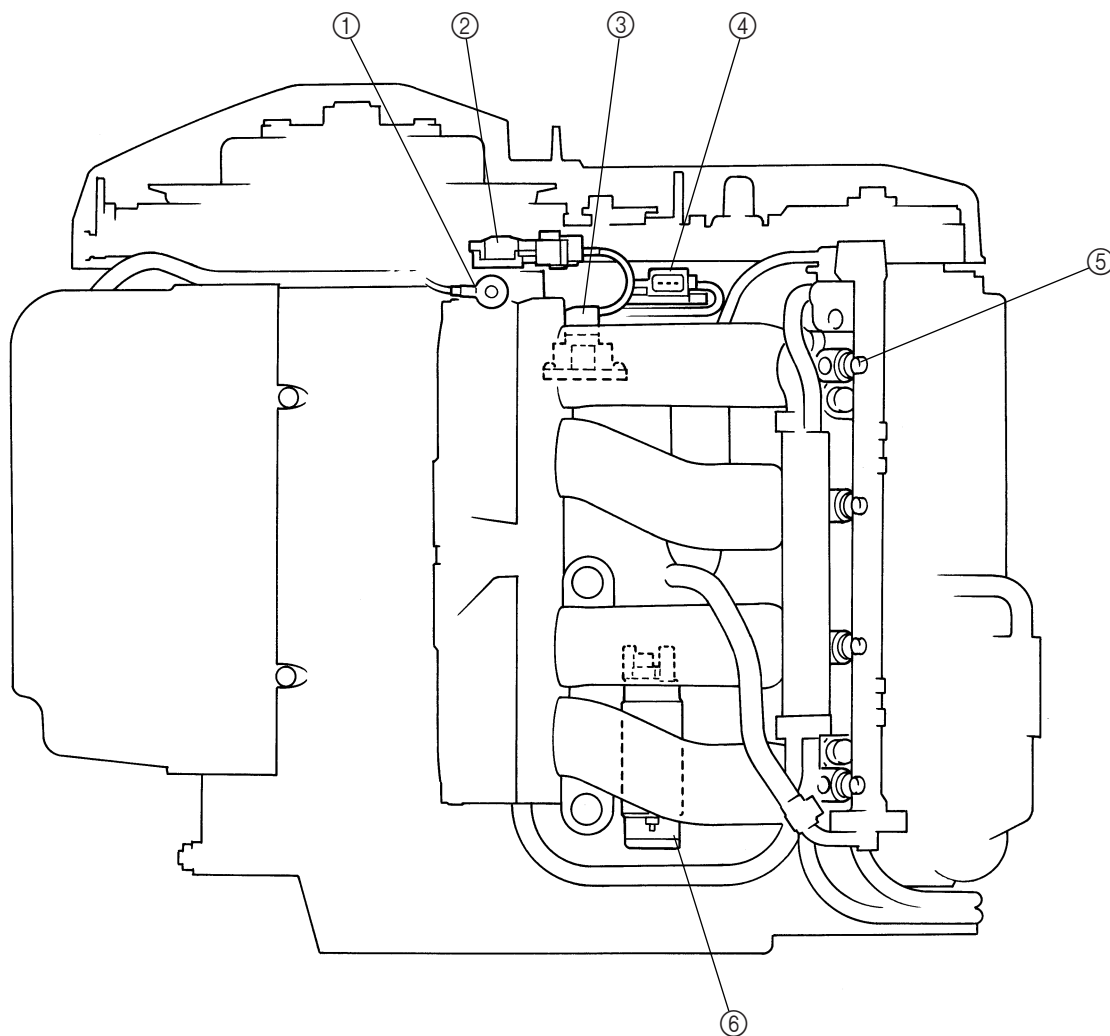
CHAPTER 8

ELECTRICAL SYSTEMS

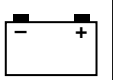
ELECTRICAL COMPONENTS.....	8-1
(Port view)	8-1
(Starboard view)	8-2
(Front view)	8-3
(Aft view)	8-4
(Top view).....	8-5
 WIRE HARNESS	 8-6
 ELECTRICAL COMPONENTS ANALYSIS	 8-8
DIGITAL CIRCUIT TESTER.....	8-8
MEASURING THE PEAK VOLTAGE.....	8-8
PEAK VOLTAGE ADAPTOR.....	8-8
MEASURING A LOW RESISTANCE.....	8-9
 IGNITION SYSTEM.....	 8-10
CHECKING THE BATTERY.....	8-11
CHECKING THE FUSES	8-11
MEASURING THE IGNITION COIL ASSEMBLY	8-11
CHECKING THE IGNITION SPARK GAP	8-12
MEASURING THE IGNITION SYSTEM PEAK VOLTAGE	8-13
 IGNITION CONTROL SYSTEM	 8-15
CHECKING THE BATTERY.....	8-16
CHECKING THE FUSES	8-16
MEASURING THE PULSER COIL OUTPUT PEAK VOLTAGE.....	8-16
MEASURING THE ENGINE COOLING WATER TEMPERATURE SENSOR RESISTANCE	8-16
CHECKING THE OIL PRESSURE SWITCH CONTINUITY.....	8-17
MEASURING THE THROTTLE POSITION SENSOR	8-18
 FUEL CONTROL SYSTEM.....	 8-19
CHECKING THE BATTERY.....	8-20
CHECKING THE FUSES	8-20
MEASURING THE ENGINE COOLING WATER TEMPERATURE SENSOR RESISTANCE	8-20
MEASURING THE THROTTLE POSITION SENSOR	8-20
CHECKING THE FUEL INJECTORS.....	8-21



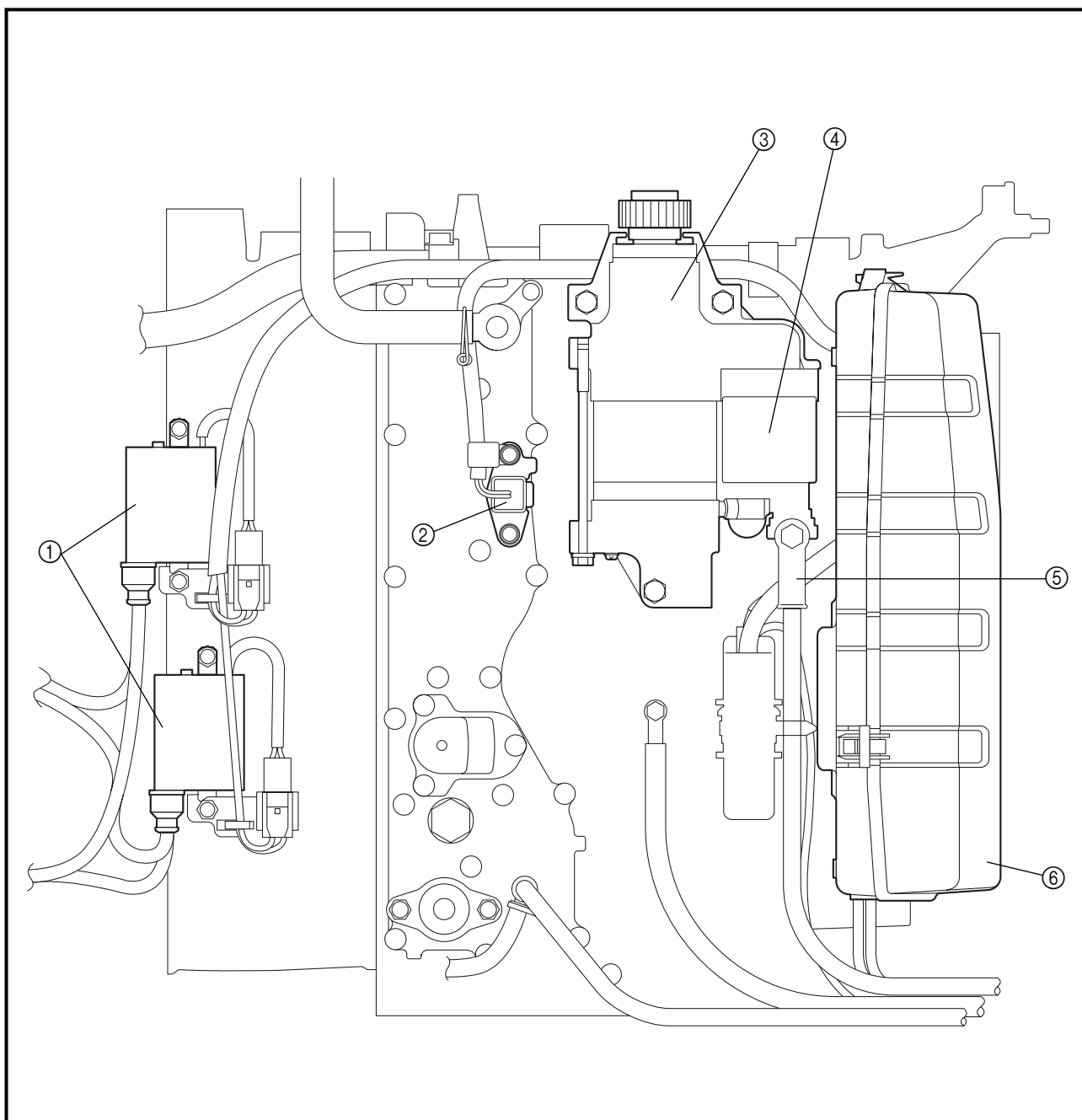
STARTING SYSTEM.....	8-22
CHECKING THE BATTERY.....	8-23
CHECKING THE FUSES.....	8-23
CHECKING THE WIRE HARNESS CONTINUITY.....	8-23
CHECKING THE WIRE CONNECTIONS.....	8-23
CHECKING THE STARTER RELAY.....	8-23
CHECKING THE SHIFT POSITION SWITCH CONTINUITY.....	8-24
 STARTER MOTOR.....	 8-25
DISASSEMBLING/ASSEMBLING THE STARTER MOTOR.....	8-25
REMOVING THE STARTER MOTOR PINION.....	8-28
CHECKING THE STARTER MOTOR PINION.....	8-28
CHECKING THE ARMATURE.....	8-28
MEASURING THE BRUSHES.....	8-29
CHECKING THE MAGNETIC SWITCH RELAY.....	8-30
 CHARGING SYSTEM.....	 8-31
CHECKING THE FUSES.....	8-32
CHECKING THE BATTERY.....	8-32
MEASURING THE LIGHTING COIL OUTPUT PEAK VOLTAGE.....	8-32
MEASURING THE RECTIFIER/REGULATOR OUTPUT PEAK VOLTAGE.....	8-32
 POWER TRIM AND TILT SYSTEM.....	 8-33
CHECKING THE BATTERY.....	8-34
CHECKING THE POWER TRIM AND TILT RELAY.....	8-34
CHECKING THE TRAILER SWITCH CONTINUITY.....	8-35
MEASURING THE TRIM SENSOR RESISTANCE.....	8-35
 POWER TRIM AND TILT MOTOR.....	 8-36
DISASSEMBLING/ASSEMBLING THE POWER TRIM AND TILT MOTOR.....	8-36
REMOVING THE STATOR.....	8-38
REMOVING THE BRUSH.....	8-38
CHECKING THE BRUSH.....	8-38
CHECKING THE ARMATURE.....	8-39
INSTALLING THE BRUSH.....	8-40
INSTALLING THE ARMATURE.....	8-40
INSTALLING THE STATOR.....	8-40

**ELECTRICAL COMPONENTS****(Port view)**

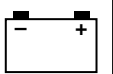
- ① Oil pressure switch
- ② Throttle position sensor
- ③ Idle speed control valve
- ④ Intake air pressure sensor
- ⑤ Fuel injector
- ⑥ High-pressure fuel pump



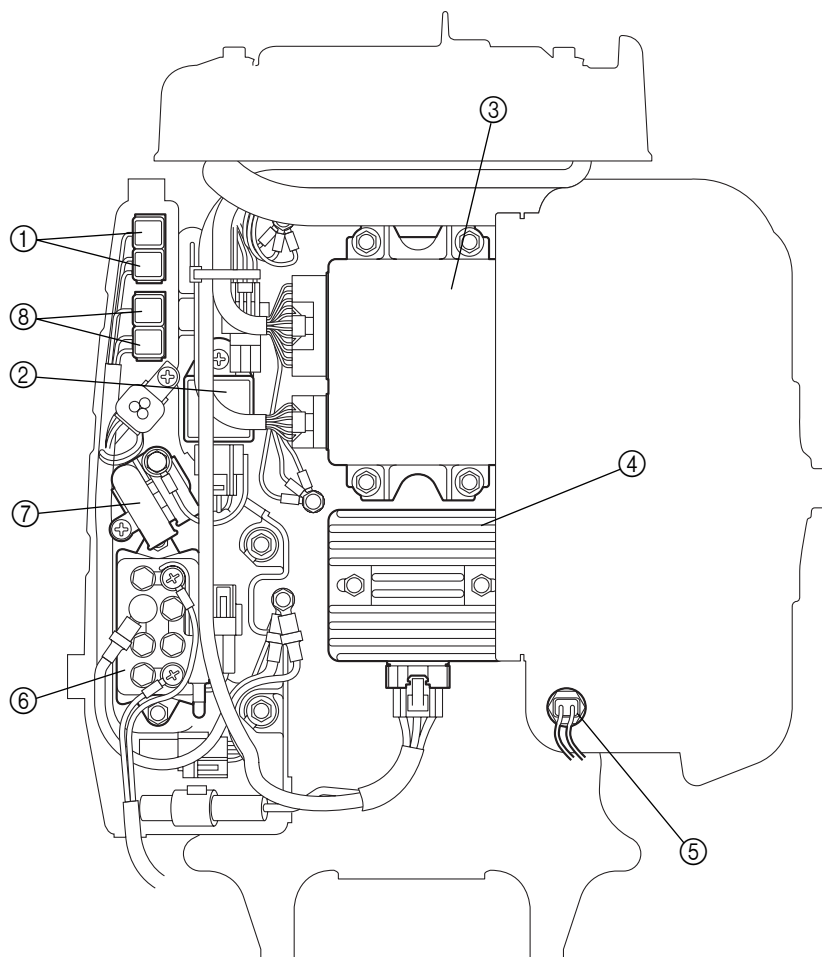
(Starboard view)



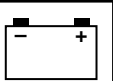
- ① Ignition coil
- ② Engine cooling water temperature sensor
- ③ Starter motor
- ④ Relay (magnetic switch)
- ⑤ Battery lead terminal
- ⑥ Junction box assembly



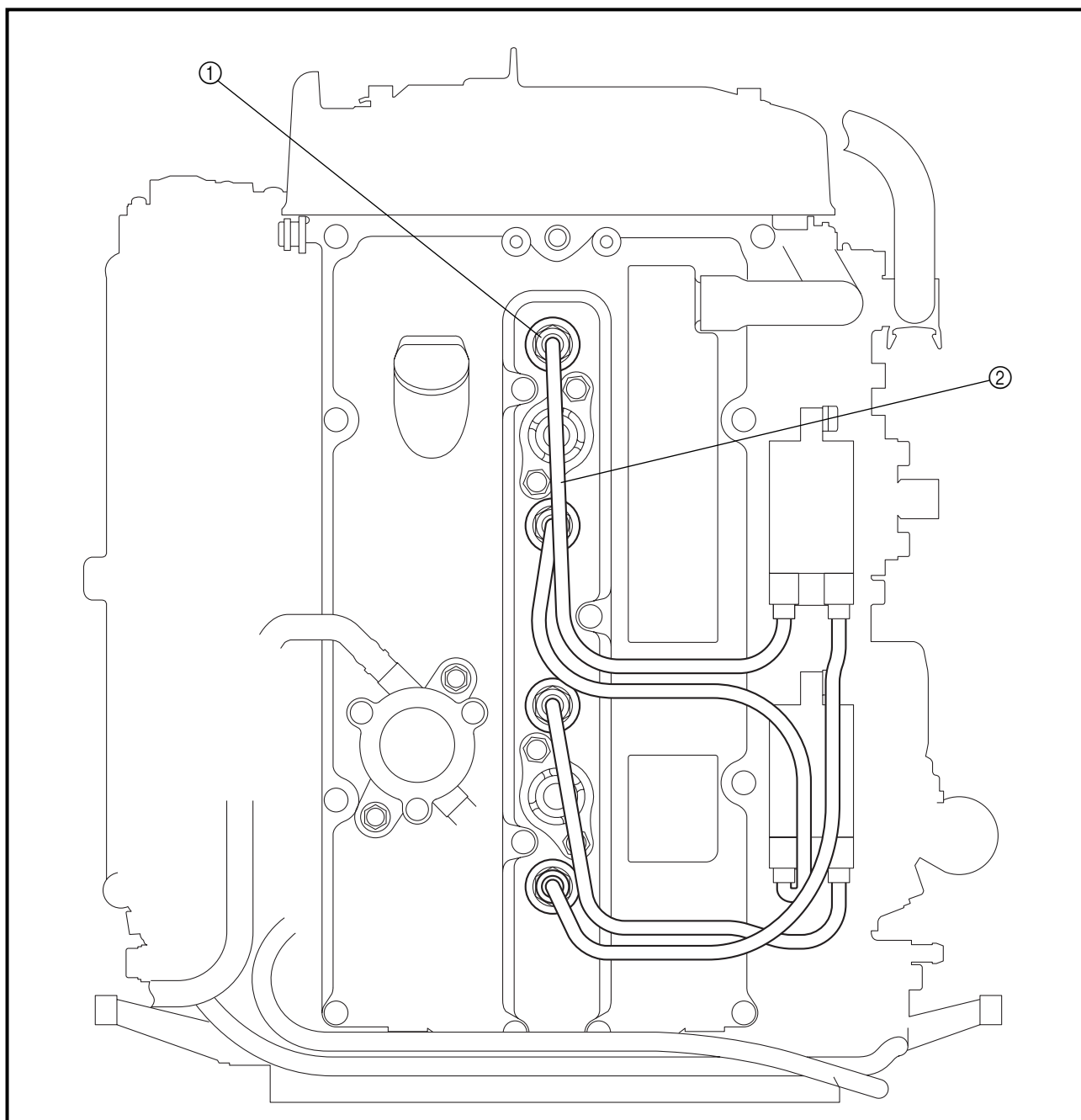
(Front view)



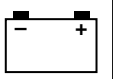
- ① Fuse (30A)
- ② Main relay
- ③ ECM
- ④ Rectifier/regulator
- ⑤ Intake air temperature sensor
- ⑥ Power trim and tilt relay
- ⑦ Starter relay
- ⑧ Fuse (20A)



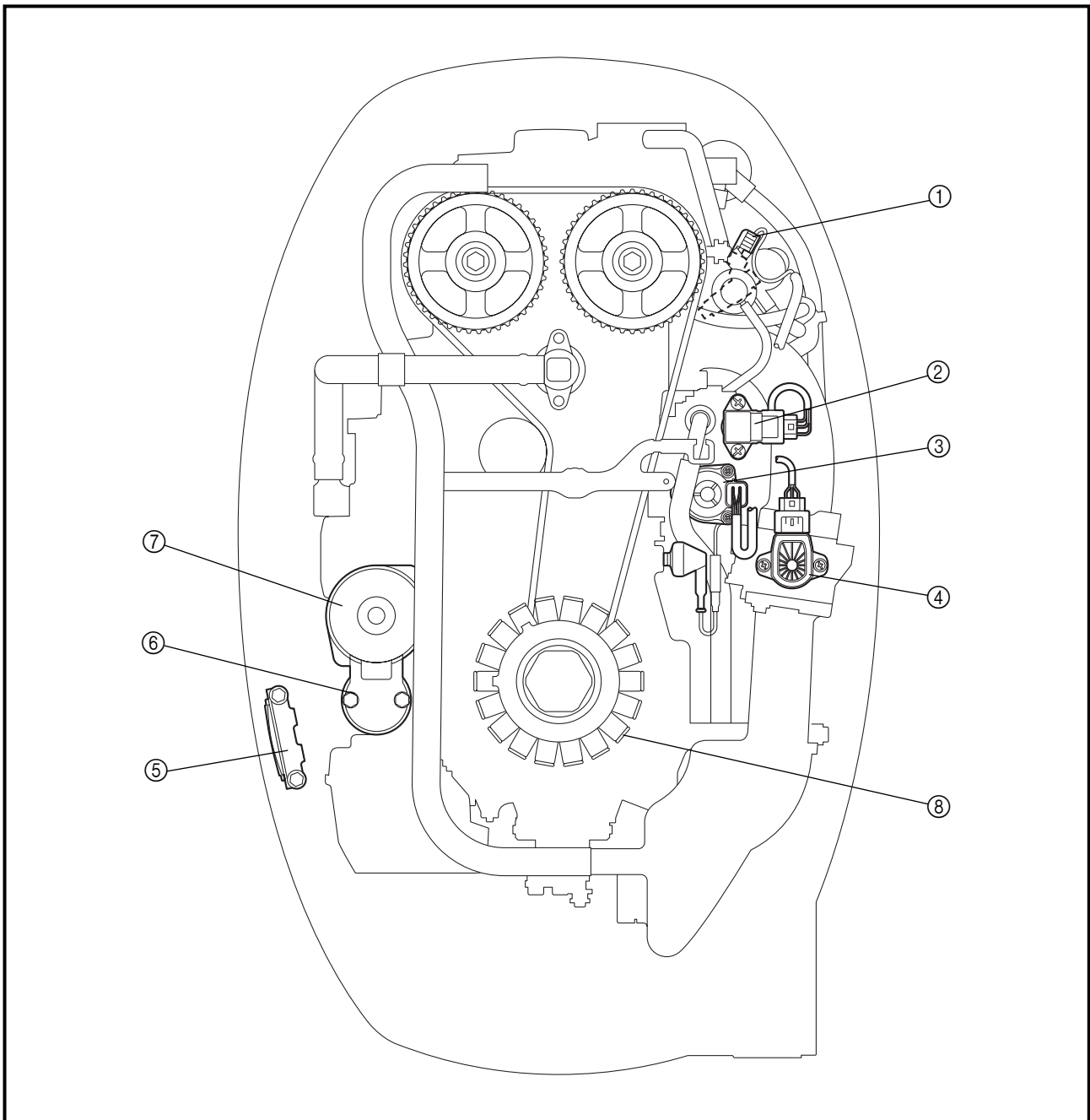
(Aft view)



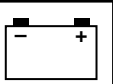
- ① Spark plug
- ② Spark plug lead



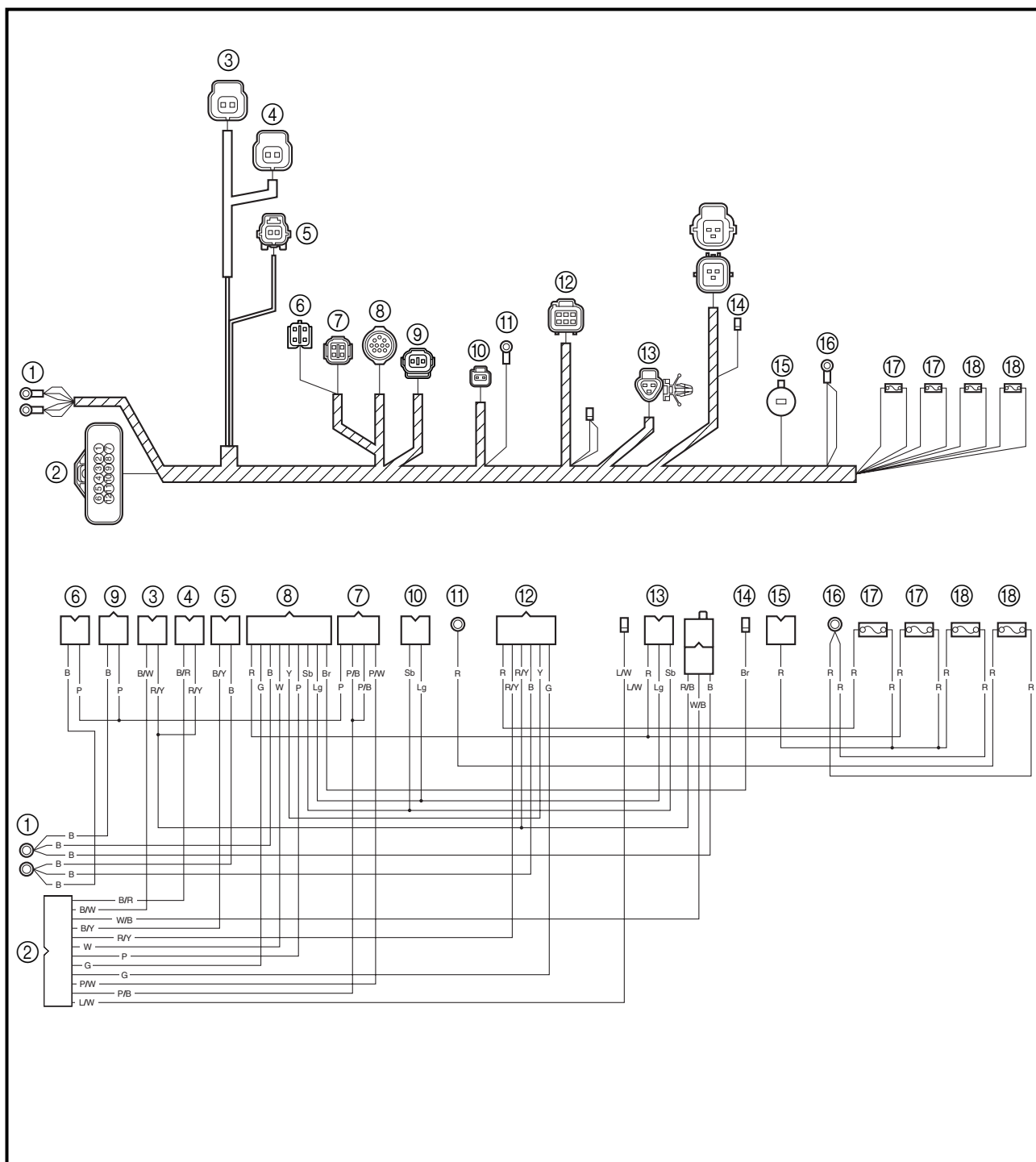
(Top view)



- ① Fuel injector
- ② Intake air pressure sensor
- ③ Idle speed control valve
- ④ Throttle position sensor
- ⑤ Trailer switch
- ⑥ Relay (magnetic switch)
- ⑦ Starter
- ⑧ Lighting coil



WIRE HARNESS



Connect to:

① Ground

② ECM

③ Ignition coil

④ Ignition coil

⑤ Engine cooling water temperature sensor

⑥ Trim meter

⑦ Trim sensor

⑧ Remote control

⑨ Warning lamp

⑩ PTT relay

⑪ Starter relay

⑫ Main relay

⑬ Trailer switch

⑭ Starter relay

⑮ Rectifier/regulator

⑯ Starter motor

⑰ Fuse 20A

⑱ Fuse 30A

B : Black

Br : Brown

G : Green

Lg : Light green

P : Pink

R : Red

Sb : Sky blue

W : White

Y : Yellow

B/R : Black/red

B/W : Black/white

B/Y : Black/yellow

L/W : Blue/white

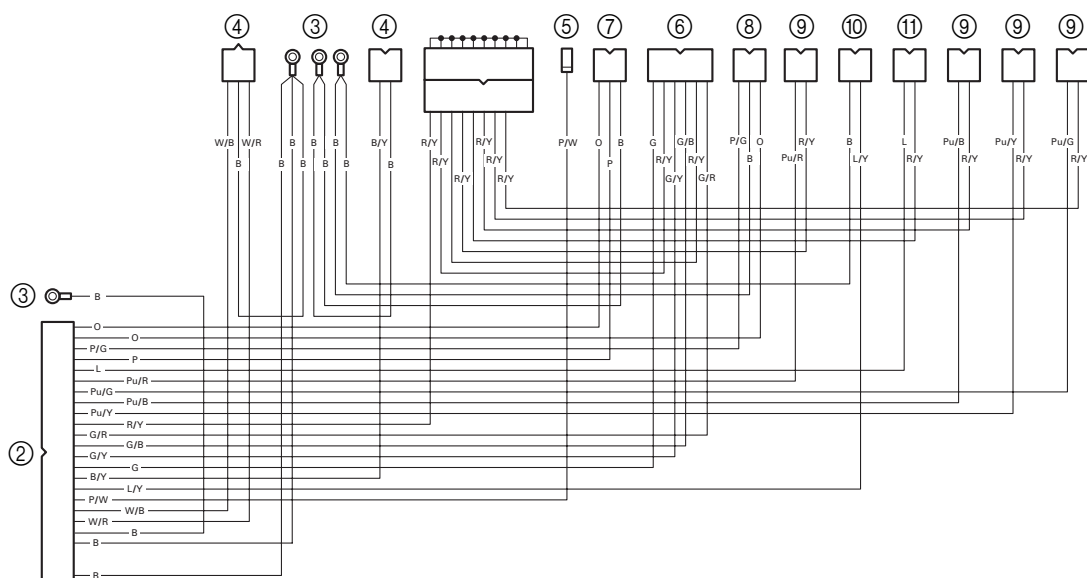
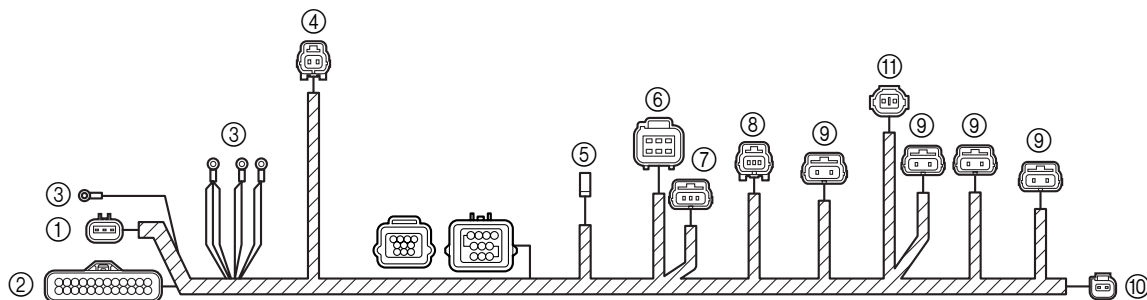
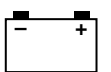
P/B : Pink/black

P/W : Pink/white

R/B : Red/black

R/Y : Red/yellow

W/B : White/black



Connect to:

① Pulser coil

② ECM

③ Ground lead

④ Intake air temperature sensor

⑤ Oil pressure switch

⑥ Idle speed control valve

⑦ Throttle position sensor

⑧ Intake air pressure sensor

⑨ Fuel injectors

⑩ Shift position switch

⑪ High-pressure fuel pump

B : Black

G : Green

L : Blue

O : Orange

P : Pink

B/Y : Black/yellow

G/B : Green/black

G/R : Green/red

G/Y : Green/yellow

L/Y : Blue/yellow

P/G : Pink/green

P/W : Pink/white

Pu/B : Purple/black

Pu/G : Purple/green

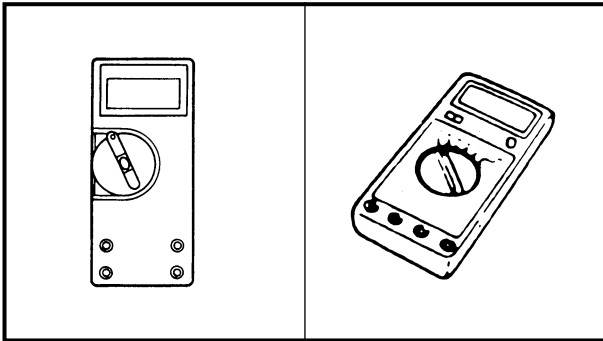
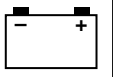
Pu/R : Purple/red

Pu/Y : Purple/yellow

R/Y : Red/yellow

W/B : White/black

W/R : White/red



ELECTRICAL COMPONENTS ANALYSIS

DIGITAL CIRCUIT TESTER



Digital tester
J-39299 / 90890-06752

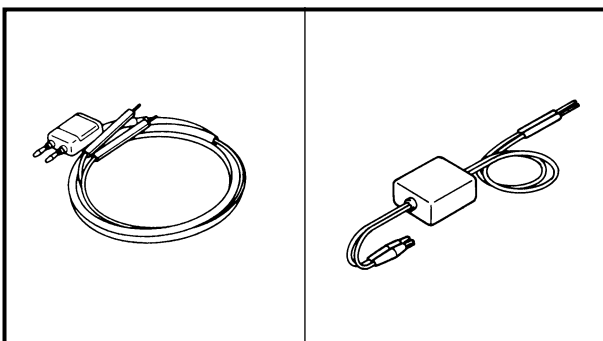
NOTE:

"○—○" indicates a continuity of electricity which means a closed circuit at the respective switch position.

MEASURING THE PEAK VOLTAGE

NOTE:

- When checking the condition of the ignition system it is useful to know the peak voltage.
- Cranking speed is dependant on many factors (e.g., fouled or weak spark plugs, a weak battery). If one of these is defective, the peak voltage will be lower than specification.
- If the peak voltage measurement is not within specification the engine will not operate properly.



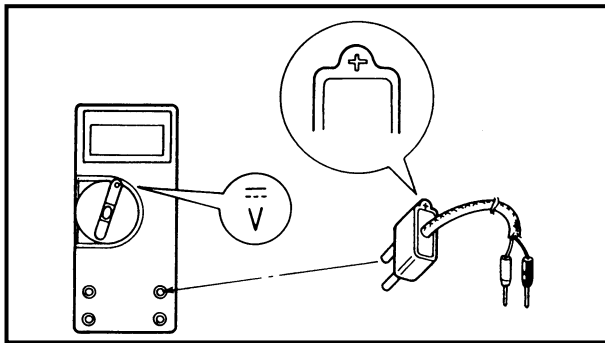
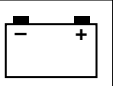
PEAK VOLTAGE ADAPTOR

NOTE:

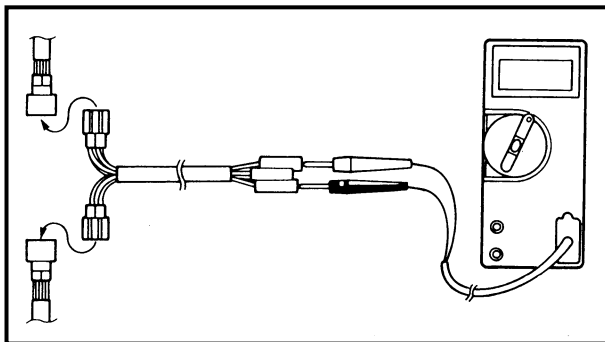
The peak voltage adaptor should be used with the digital circuit tester.



Peak voltage adaptor
YU-39991 / 90890-03169

**NOTE:**

- When measuring the peak voltage, set the selector to the DC voltage mode.
- Make sure the peak voltage adaptor leads are properly installed in the digital tester.
- Make sure the positive pin (the "+" mark facing up as shown) on the peak voltage adaptor is installed into the positive terminal of the digital tester.
- The test harness is needed for the following tests.

**Measuring steps**

- (1) Disconnect the coupler connections.
- (2) Connect the test harness between the couplers.
- (3) Connect the peak voltage adaptor probes to the connectors which are being checked.
- (4) Start or crank the engine and observe the measurement.

MEASURING A LOW RESISTANCE

When measuring a resistance of $10\ \Omega$ or less with the digital tester, the correct measurement cannot be obtained because of the tester's internal resistance.

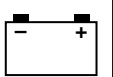
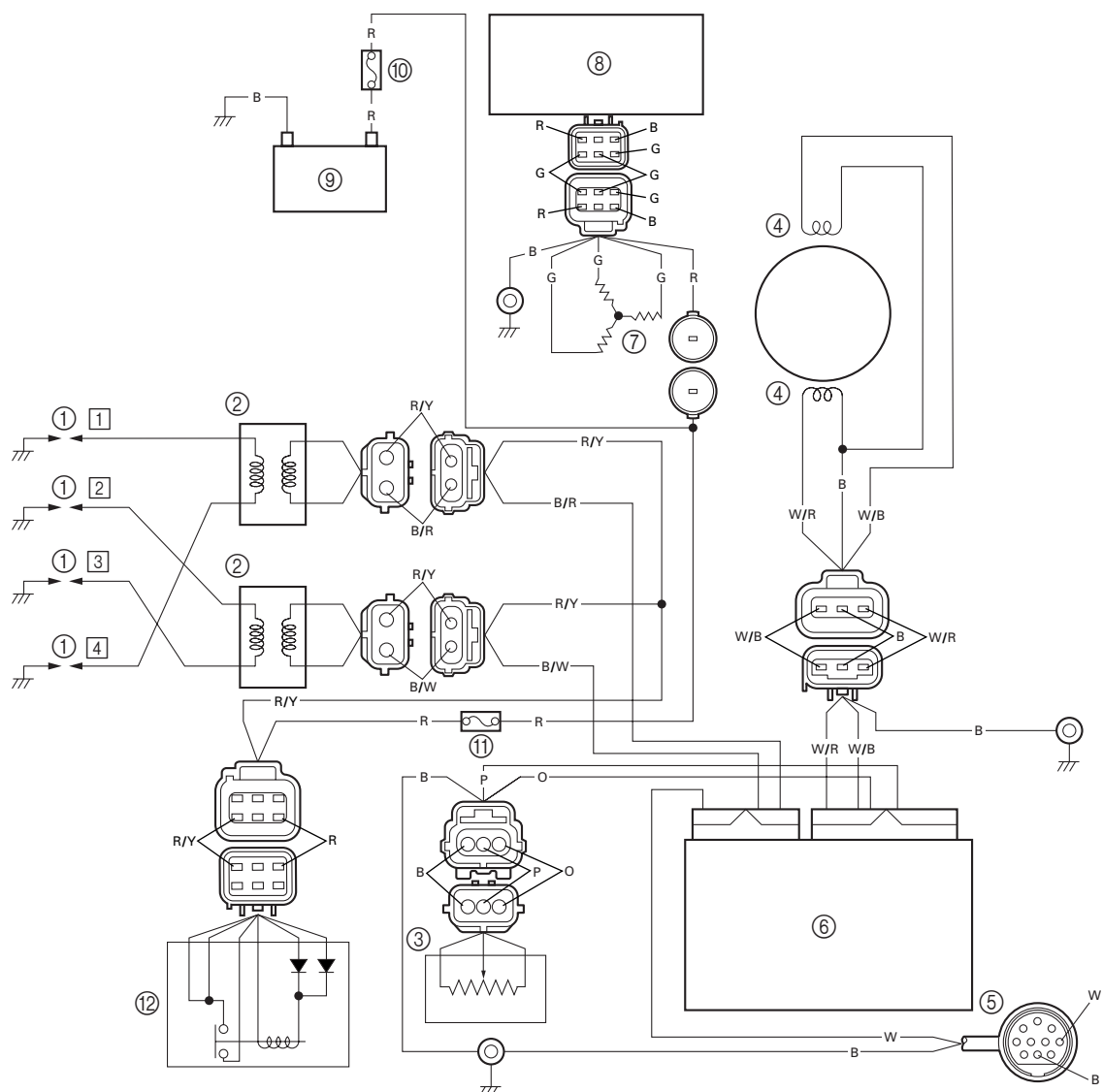
To obtain the correct value, subtract the internal resistance from the displayed measurement.



Correct value
Displayed measurement –
internal resistance

NOTE:

The internal resistance of the digital tester can be obtained by connecting both of its probes.


IGNITION SYSTEM


P : ②
 W/B : ⑭
 W/R : ⑮
 O : ⑯
 W : ⑳

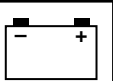
B/R : ⑳
 B/W : ㉔



- ① Spark plugs
- ② Ignition coils
- ③ Throttle position sensor (TPS)
- ④ Pulser coils
- ⑤ 10P coupler
- ⑥ ECM
- ⑦ Lighting coil
- ⑧ Rectifier/regulator

- ⑨ Battery
- ⑩ Fuse (30A)
- ⑪ Fuse (20A)
- ⑫ Main relay
- B : Black
- G : Green
- O : Orange
- P : Pink

- R : Red
- W : White
- B/R : Black/red
- B/W : Black/white
- R/Y : Red/yellow
- W/B : White/black
- W/R : White/red



CHECKING THE BATTERY

Refer to "CHECKING THE BATTERY" on page 3-21.

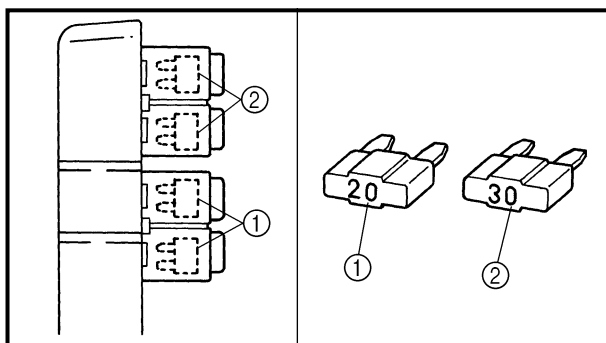
CHECKING THE FUSES

1. Check:

- Fuse holder continuity
No continuity → Check the fuse holder leads.

2. Check:

- Fuse holder lead continuity
No continuity → Replace the fuse holder.
Continuity → Check the fuse.



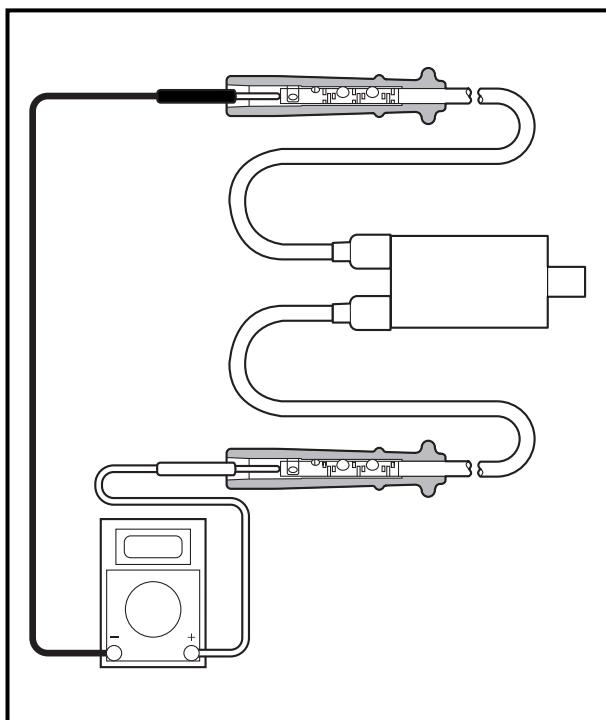
3. Check:

- Fuse continuity
No continuity → Replace.
- Fuse rating
Out of specification → Replace.



Fuse rating

- ①: 12 V - 20 A
- ②: 12 V - 30 A



MEASURING THE IGNITION COIL ASSEMBLY

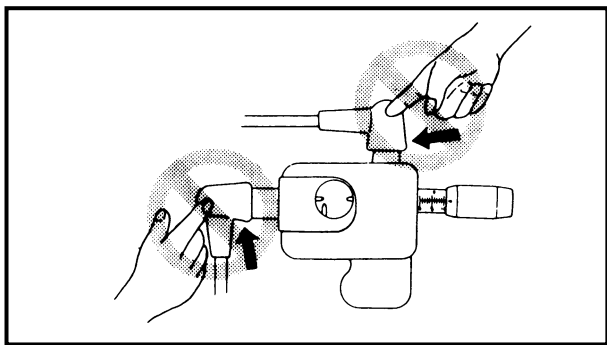
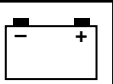
Measure:

- Ignition coil assembly resistance
Out of specification → Replace.



Ignition coil assembly resistance

- 18.97 - 35.23 kΩ
(For cylinder No. 1, 4)
- 18.55 - 34.45 kΩ
(For cylinder No. 2, 3)



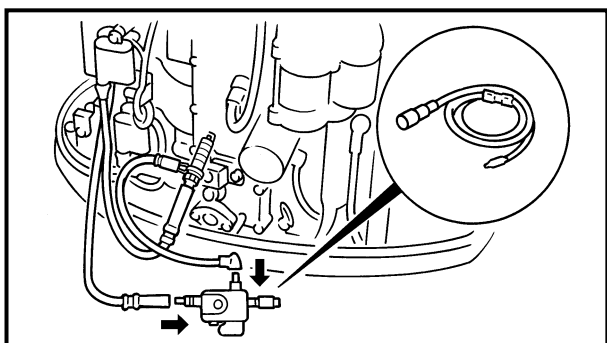
CHECKING THE IGNITION SPARK GAP

⚠ WARNING

- Do not touch any of the connections of the spark gap tester lead wires.
- Do not let sparks leak out of the removed spark plug cap.
- Keep flammable gas or liquids away, since this test can produce sparks.

Check:

- Ignition spark gap
Spark is weak → Check the ignition system.

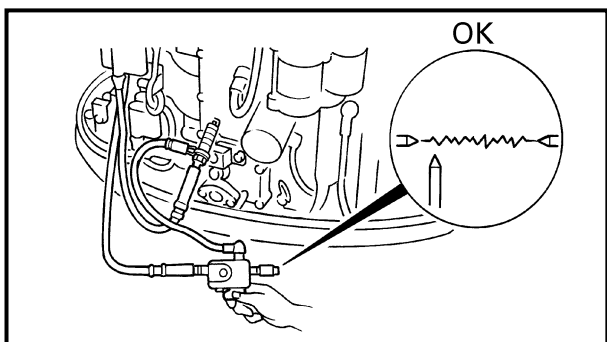


Checking steps

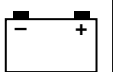
- (1) Remove the spark plugs from the engine.
- (2) Connect a spark plug cap to the spark gap tester.
- (3) Set the spark gap length on the adjusting knob.



Spark gap tester
YM-34487 / 90890-06754



- (4) Crank the engine and observe the spark through the discharge window of the spark gap tester.



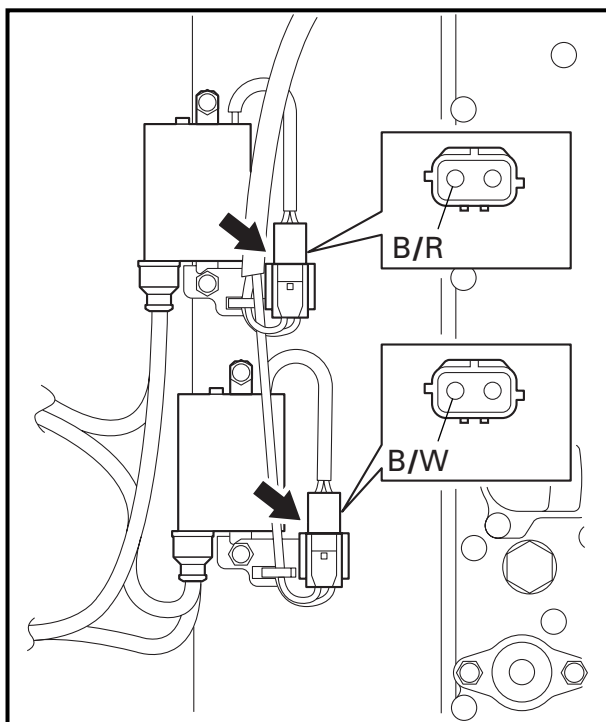
MEASURING THE IGNITION SYSTEM PEAK VOLTAGE

⚠ WARNING

When checking the peak voltage do not touch any of the connections of the digital tester lead wires.

NOTE:

- If there is no spark or the spark is weak, continue with the ignition system test.
- If a good spark is obtained, the problem is not with the ignition system, but possibly with the spark plug(s) or another component.



1. Measure:

NOTE:

- The peak voltage adaptor should be used with the digital circuit tester.
- When measuring the peak voltage, set the selector to the DC voltage mode.



Peak voltage adaptor
YU-39991 / 90890-03169

- ECM unit output peak voltage
Below specification → Check the wire harness.
Correct the wire harness → Replace the ECM unit.

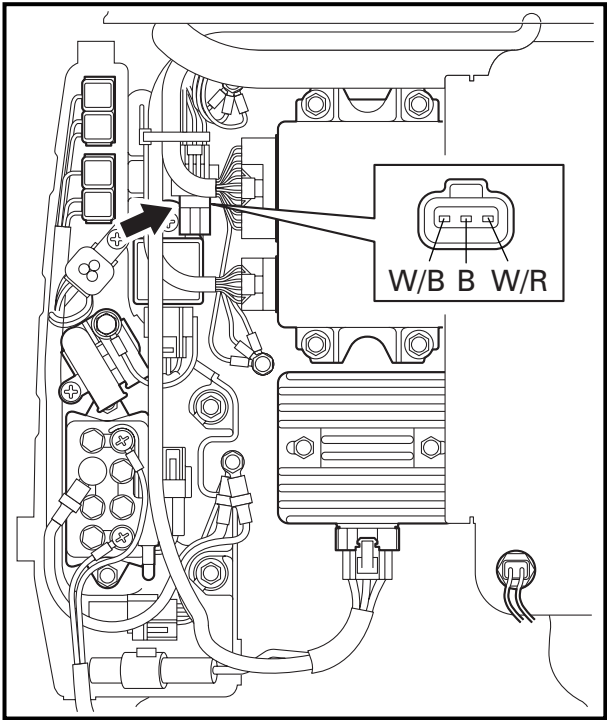


ECM unit output peak voltage
Black/red (B/R) – Ground
Black/white (B/W) – Ground

r/min	Unloaded		Loaded	
	Cranking		1,500	3,500
V	5.0	122	242	245

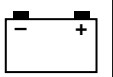


Test harness (2-pin)
90890-06792

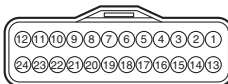
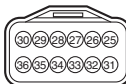
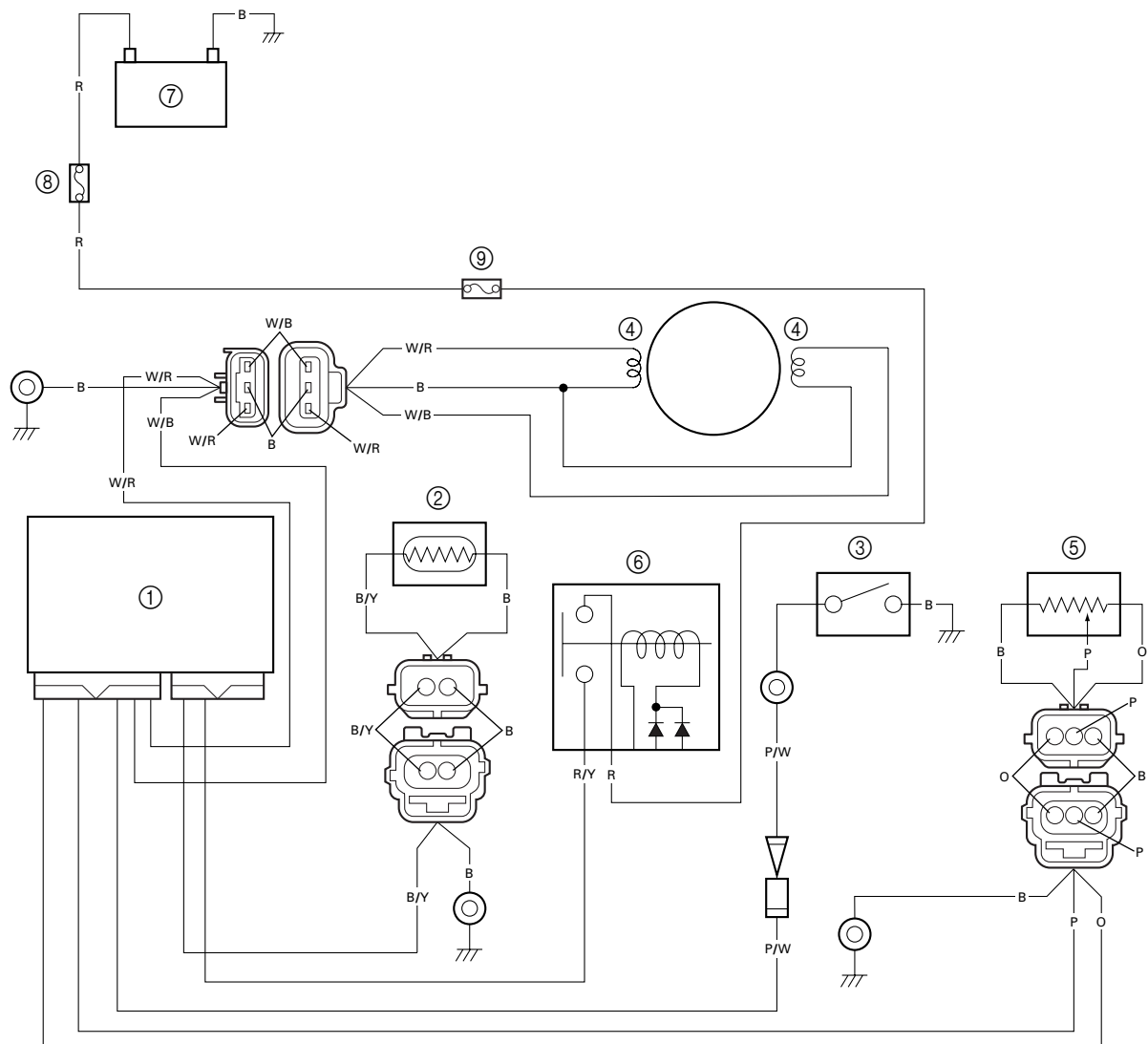


2. Measure:
- Pulser coil output peak voltage
- Below specification → Replace the pulser coil.

 Pulser coil output peak voltage White/black (W/B) – Black (B) White/red (W/R) – Black (B)				
r/min	Unloaded	Loaded		
	Cranking	1,500	3,500	
V	3.5	3.0	26	44
 Test harness (3-pin) 90890-06791				



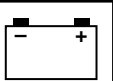
IGNITION CONTROL SYSTEM



O : 16
 P : 2
 B/Y : 27
 P/W : 6
 R/Y : 25
 W/B : 14
 W/R : 15

- ① ECM
- ② Engine cooling water temperature sensor
- ③ Oil pressure switch
- ④ Pulser coils
- ⑤ Throttle position sensor (TPS)
- ⑥ Main relay
- ⑦ Battery
- ⑧ Fuse (30A)
- ⑨ Fuse (20A)

B : Black
 O : Orange
 P : Pink
 R : Red
 B/Y : Black/yellow
 P/W : Pink/white
 R/Y : Red/yellow
 W/B : White/black
 W/R : White/red



CHECKING THE BATTERY

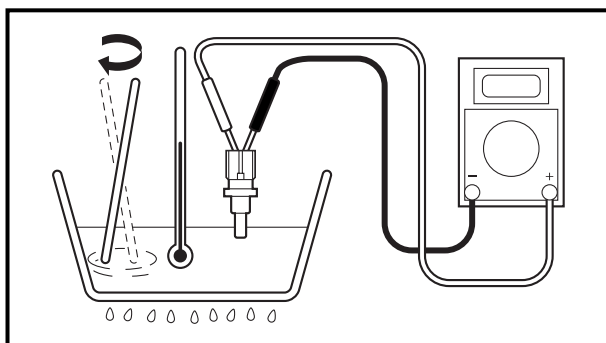
Refer to "CHECKING THE BATTERY" on page 3-21.

CHECKING THE FUSES

Refer to "CHECKING THE FUSES" on page 8-11.

MEASURING THE PULSER COIL OUTPUT PEAK VOLTAGE

Refer to "MEASURING THE IGNITION SYSTEM PEAK VOLTAGE" on page 8-13.



MEASURING THE ENGINE COOLING WATER TEMPERATURE SENSOR RESISTANCE

Measure:

- Engine cooling water temperature sensor resistance

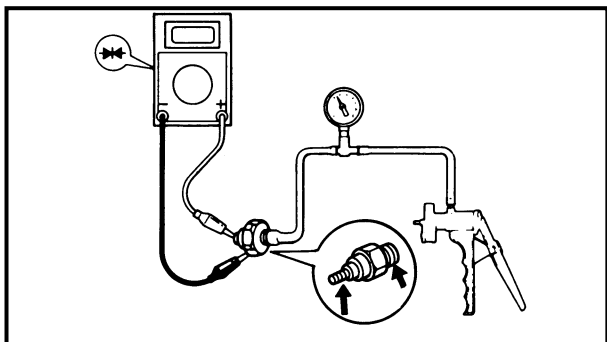
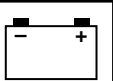
Out of specification → Replace.



Engine cooling water temperature sensor resistance
Black/yellow (B/Y) – Black (B)
 5 °C (41 °F): 4.62 kΩ
 20 °C (68 °F): 2.44 kΩ
 100 °C (212 °F): 0.19 kΩ

Measuring steps

- (1) Place the engine cooling water temperature sensor in a container filled with water.
- (2) Place a thermometer in the water.
- (3) Slowly heat the water.
- (4) Measure the resistance when the specified temperature is reached.



CHECKING THE OIL PRESSURE SWITCH CONTINUITY

Measure:

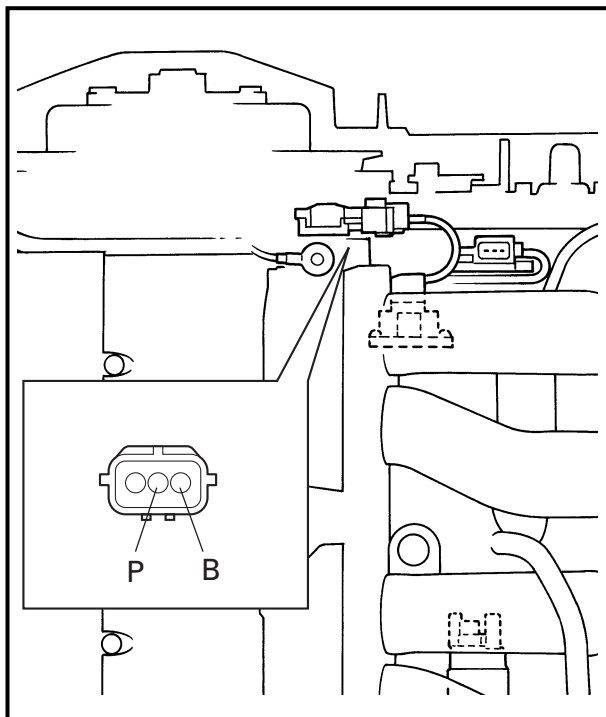
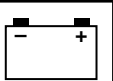
- Oil pressure switch continuity
- Out of specification → Replace.



Mity vac
YB-35956 / 90890-06756



Oil pressure switch continuity
pressure
150 kPa (1.5 kg/cm², 21.33 psi)
and below



MEASURING THE THROTTLE POSITION SENSOR

NOTE:

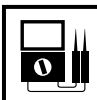
When measuring the output voltage, set the selector to the DC voltage mode.

Measure:

- Throttle position sensor output voltage

Out of specification → Adjust the throttle position sensor.

Refer to "ADJUSTING THE THROTTLE POSITION SENSOR" on page 3-7.



Throttle position sensor output voltage

Pink (P) – Black (B)
 $0.732 \pm 0.014 \text{ V}$

Measuring steps

- (1) Connect the test harness (3-pin) as shown.

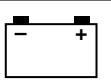


Test harness (3-pin) 90890-06793

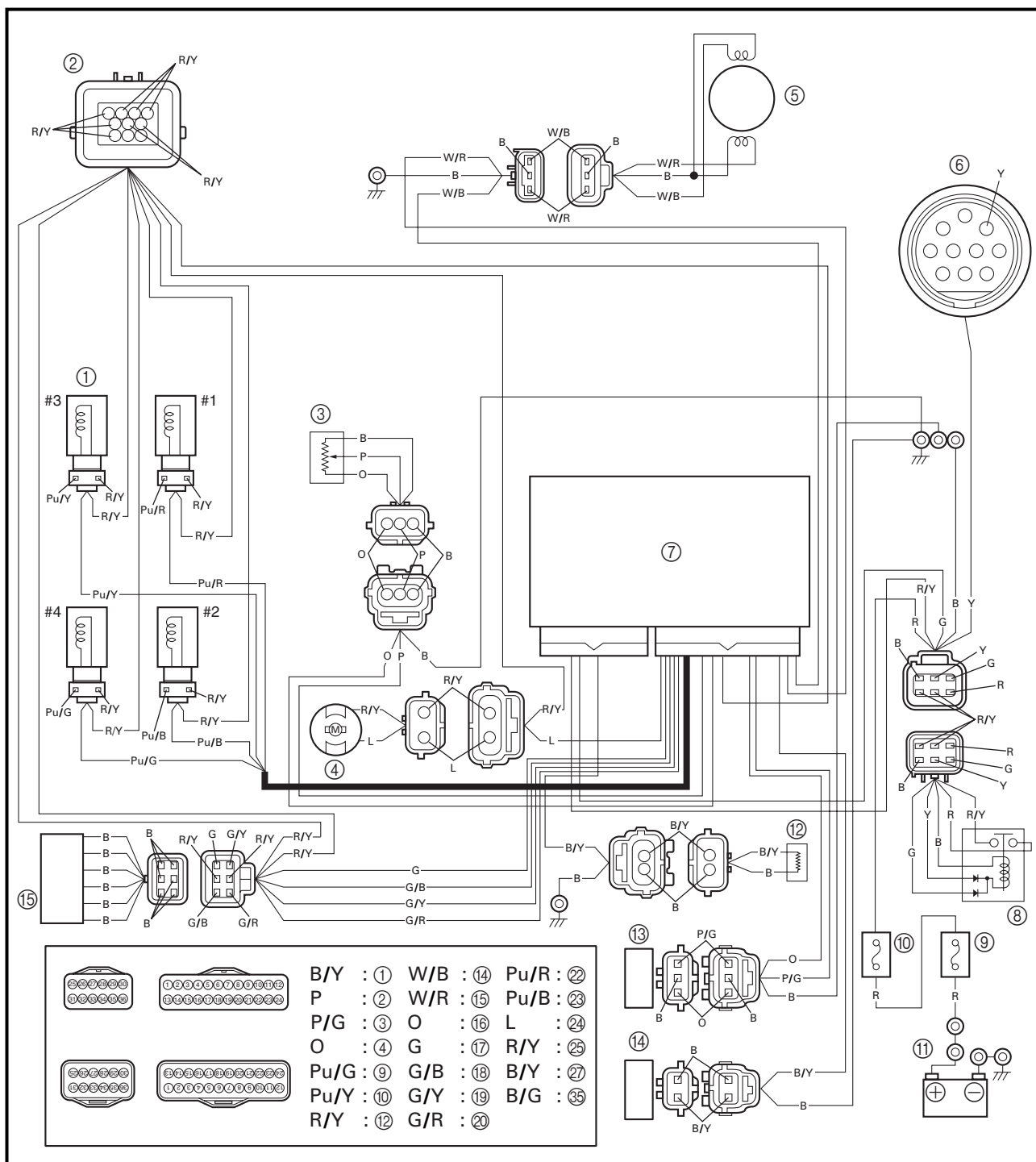
- (2) Connect the battery leads to a 12-V battery.
- (3) Turn the engine switch to the on position.
- (4) Measure the throttle position sensor output voltage.
- (5) Start the engine and measure the output voltage again.

NOTE:

Make sure the throttle position sensor output voltage is within specification when the throttle is fully closed and fully opened.



FUEL CONTROL SYSTEM

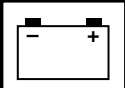


- ① Fuel injectors
- ② Joint connector
- ③ Throttle position sensor
- ④ High-pressure fuel pump
- ⑤ Pulser coil
- ⑥ 10P connector
- ⑦ ECM
- ⑧ Main relay
- ⑨ Fuse (30A)

- ⑩ Fuse (20A)
- ⑪ Battery
- ⑫ Engine cooling water temperature sensor
- ⑬ Intake air pressure sensor
- ⑭ Intake air temperature sensor
- ⑮ Idle speed control valve

- B : Black
- G : Green
- L : Blue
- O : Orange
- P : Pink
- R : Red
- Y : Yellow
- B/Y : Black/yellow
- G/B : Green/black
- G/R : Green/red

- G/Y : Green/yellow
- P/G : Pink/green
- Pu/B : Purple/black
- Pu/G : Purple/green
- Pu/R : Purple/red
- Pu/Y : Purple/yellow
- R/Y : Red/yellow
- W/B : White/black
- W/R : White/red

**CHECKING THE BATTERY**

Refer to "CHECKING THE BATTERY" on page 3-21.

CHECKING THE FUSES

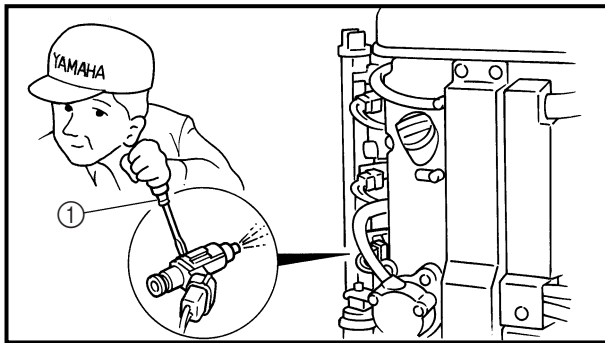
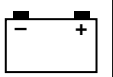
Refer to "CHECKING THE FUSES" on page 8-11.

**MEASURING THE ENGINE COOLING
WATER TEMPERATURE SENSOR
RESISTANCE**

Refer to "MEASURING THE ENGINE COOLING WATER TEMPERATURE SENSOR RESISTANCE" on page 8-16.

**MEASURING THE THROTTLE
POSITION SENSOR**

Refer to "MEASURING THE THROTTLE POSITION SENSOR" on page 8-18.



CHECKING THE FUEL INJECTORS

1. Check:

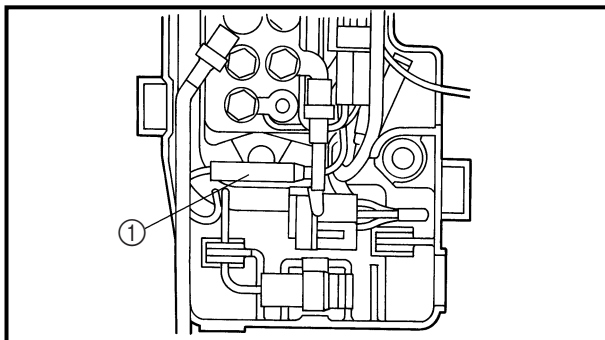
- Fuel injector operating sound
No sound (no fuel is being sprayed) → Check the high-pressure fuel pump.

Checking steps

- Start the engine.
- Fully close the throttle valves.
- Attach the screwdriver ① onto the fuel injector body and check if all of the fuel injectors have a solenoid valve operating sound.

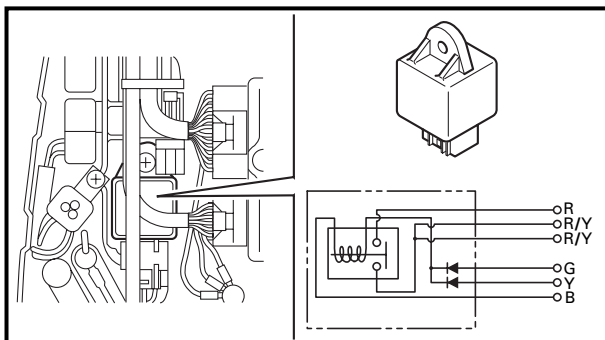
2. Check:

- High-pressure fuel pump operating sound
Correct → Replace the fuel injector (no sound).
No sound → Check the main relay.



NOTE:

- The high-pressure fuel pump should sound when the engine start switch is turned on.
- Disconnect the Brown (Br) starter relay lead ① to prevent the engine from starting.

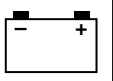


3. Check:

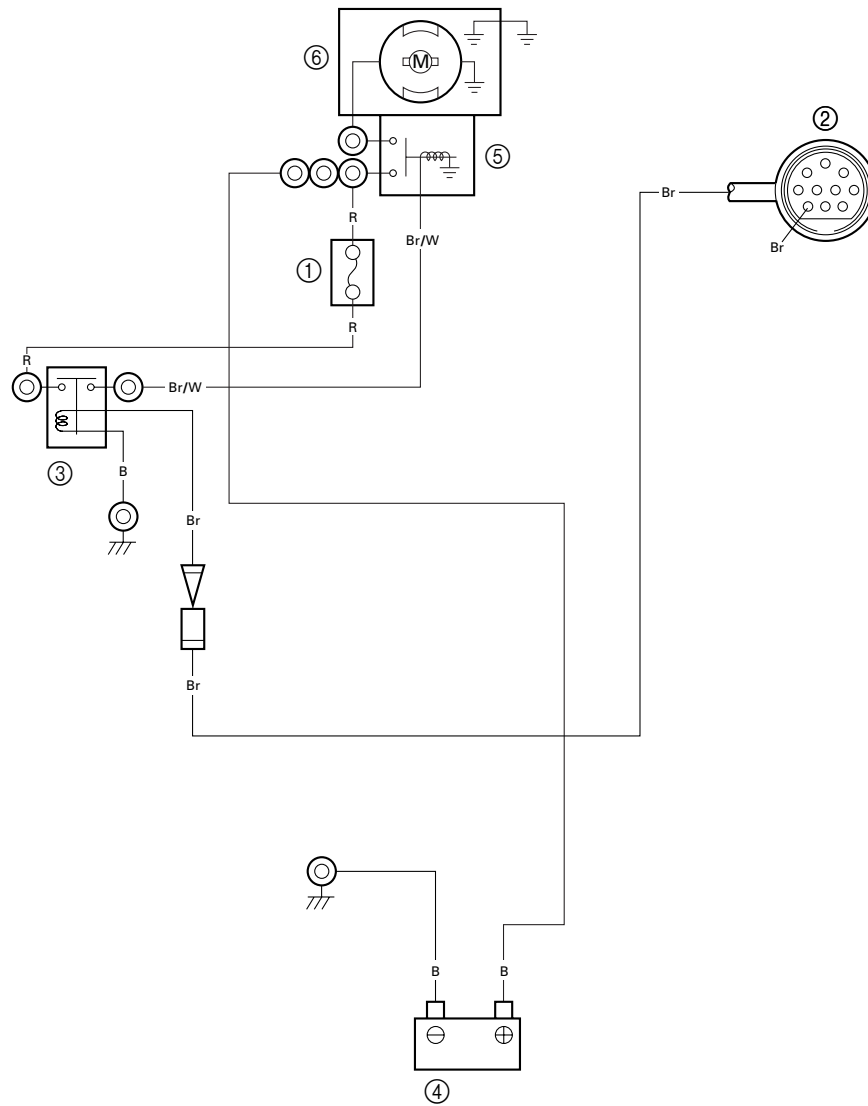
- Main relay continuity
Out of specification → Replace the main relay.

Engine start switch	Lead color	
	Red (R)	Red/yellow (R/Y)
OFF		
ON	○	○

Correct → Replace the high-pressure fuel pump.

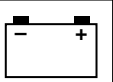


STARTING SYSTEM



- ① Fuse (30A)
- ② 10P connector
- ③ Starter relay
- ④ Battery
- ⑤ Relay (magnetic switch)
- ⑥ Starter motor

B : Black
 Br : Brown
 R : Red
 Br/W : Brown/white



CHECKING THE BATTERY

Refer to "CHECKING THE BATTERY" on page 3-21.

CHECKING THE FUSES

Refer to "CHECKING THE FUSES" on page 8-11.

CHECKING THE WIRE HARNESS CONTINUITY

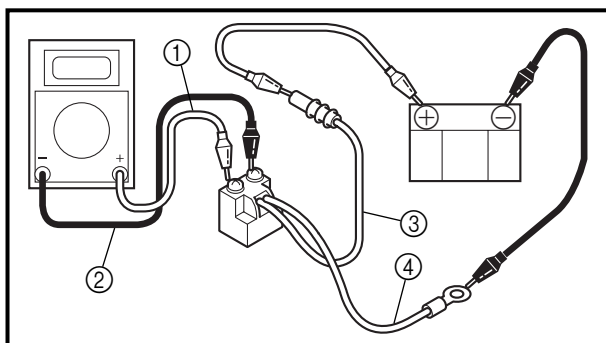
Check:

- Wire harness continuity
No continuity → Replace.

CHECKING THE WIRE CONNECTIONS

Check:

- Wire connections
Poor connection → Properly connect.



CHECKING THE STARTER RELAY

Check:

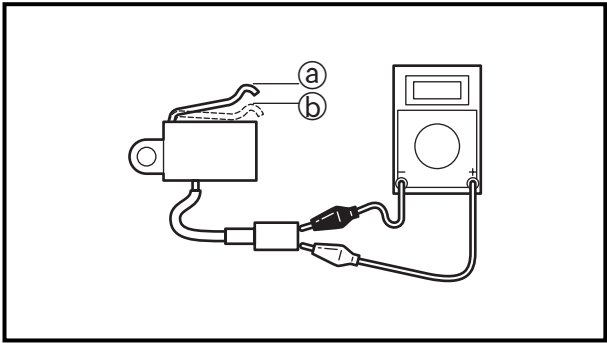
- Starter relay continuity
No continuity → Replace.

Checking steps

- (1) Connect the tester and battery between the starter relay terminals.

Positive digital tester probe ① → Starter relay terminal
Negative digital tester probe ② → Starter relay terminal
Positive battery terminal → Brown lead ③
Negative battery terminal → Black lead ④

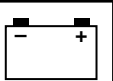
- (2) Check that there is continuity between the starter relay terminals.



CHECKING THE SHIFT POSITION SWITCH CONTINUITY

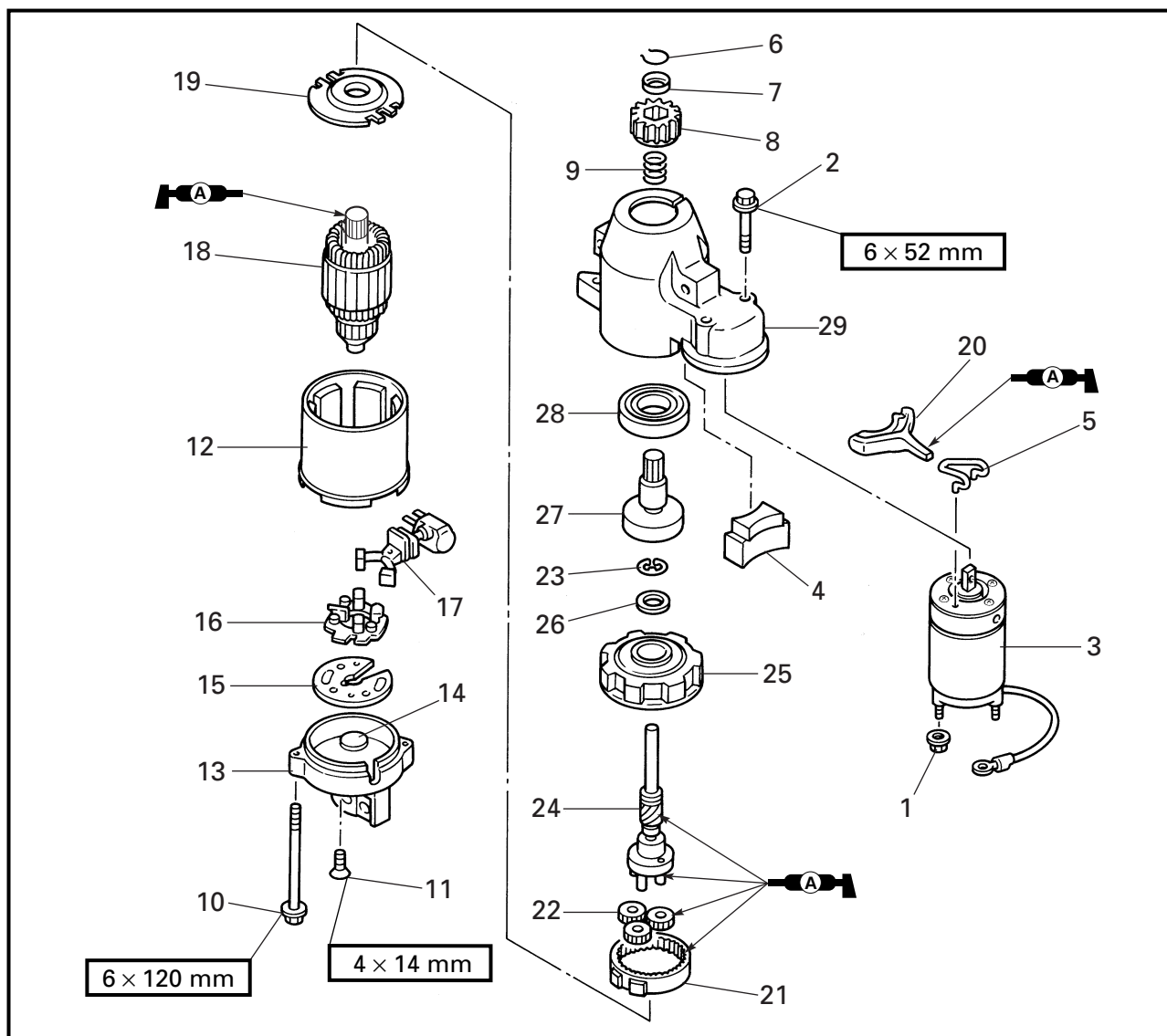
- Check:
- Continuity
- No continuity → Replace.

	Switch position	Lead color	
		Blue/Yellow (L/Y)	Black (B)
Ⓐ	Home position		
Ⓑ	Depressed		



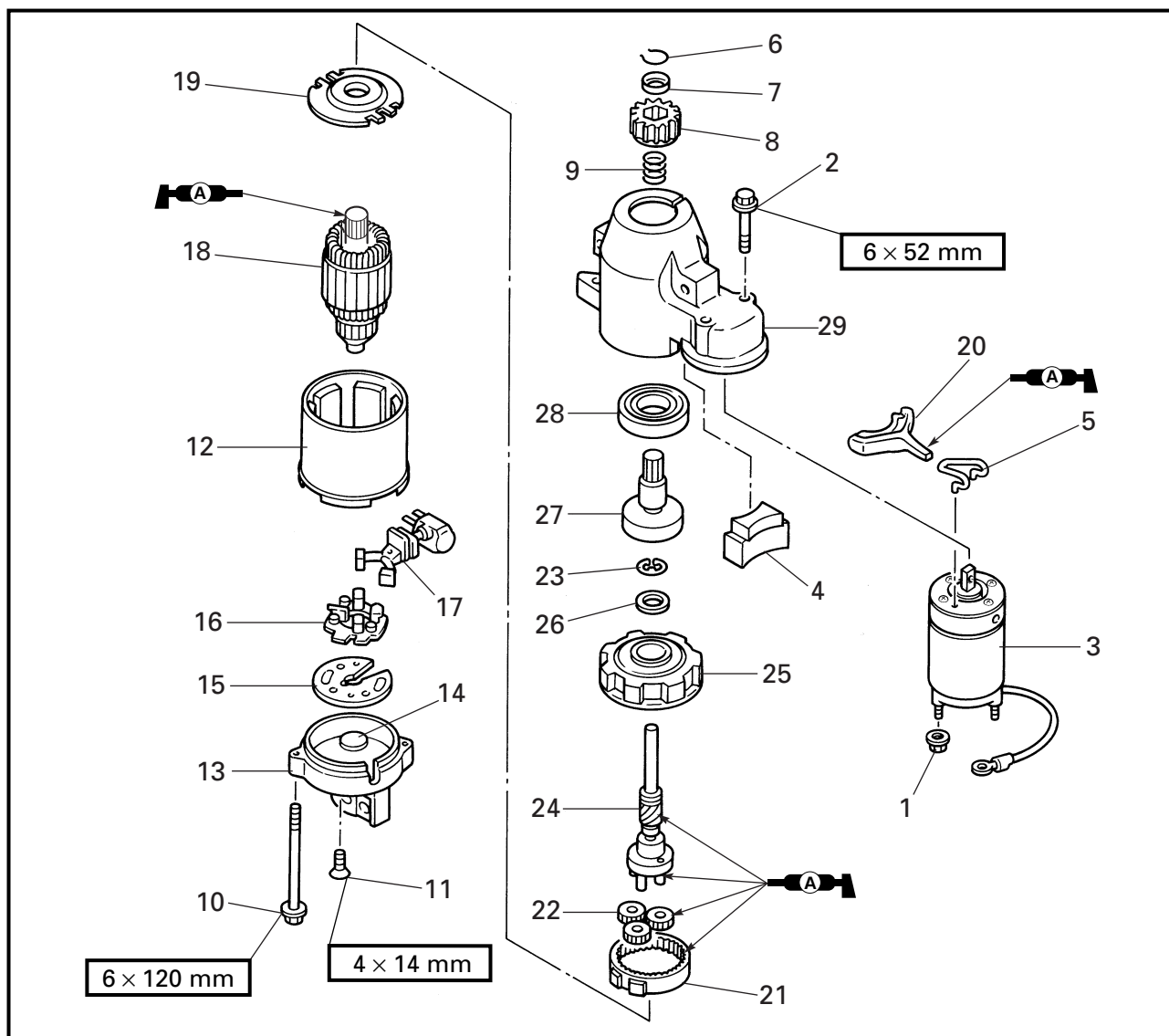
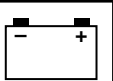
STARTER MOTOR

DISASSEMBLING/ASSEMBLING THE STARTER MOTOR

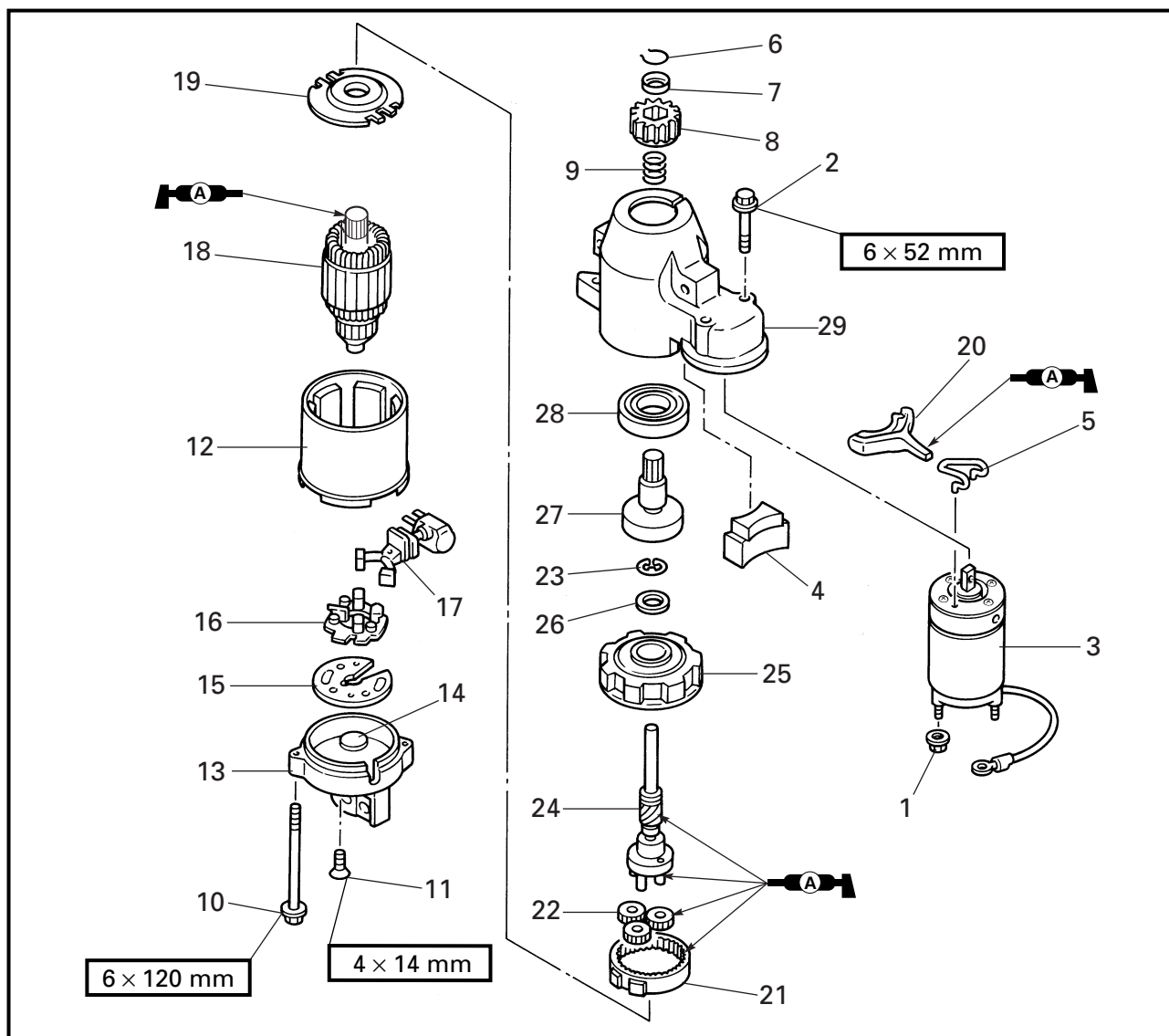
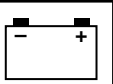


Order	Job/Part	Q'ty	Remarks
	Starter motor		Refer to "IGNITION COILS AND STARTER MOTOR" on page 5-14.
1	Nut	1	
2	Bolt	2	
3	Relay (magnetic switch)	1	
4	Rubber dust	1	
5	Spring	1	
6	Starter motor pinion clip	1	
7	Starter motor pinion stopper	1	
8	Starter motor pinion	1	
9	Spring	1	

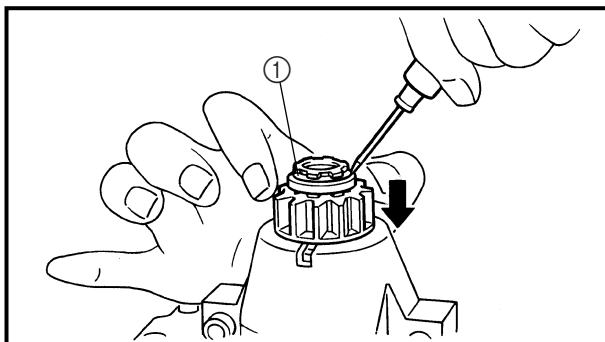
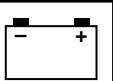
Continued on next page.



Order	Job/Part	Q'ty	Remarks
10	Bolt	2	
11	Screw	2	
12	Yoke assembly	1	
13	Rear cover	1	
14	Thrust washer	1	
15	Plate	1	
16	Brush holder assembly	1	
17	Brush assembly	1	
18	Armature	1	
19	Center bracket plate	1	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
20	Shift lever	1	For assembly, reverse the disassembly procedure.
21	Outer ring gear	1	
22	Planetary gear	3	
23	E-ring	1	
24	Pinion shaft	1	
25	Center bracket	1	
26	Thrust washer	1	
27	Clutch assembly	1	
28	Bearing	1	
29	Housing	1	



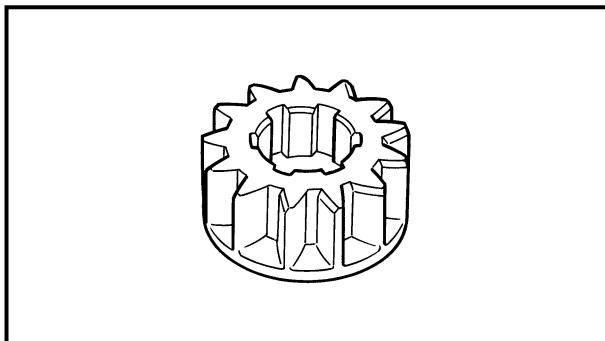
REMOVING THE STARTER MOTOR PINION

Remove:

- Clips ①

NOTE:

Slide the pinion gear down as shown and then remove the clips ① with a thin screw driver.



CHECKING THE STARTER MOTOR PINION

1. Check:

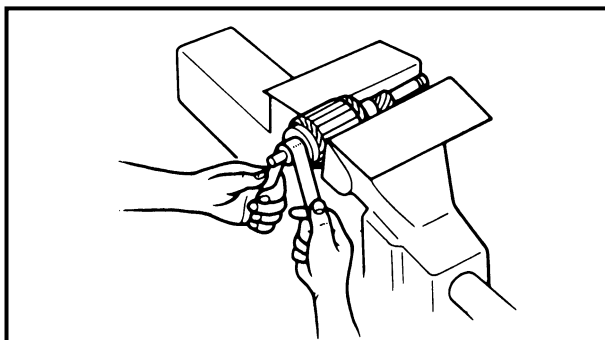
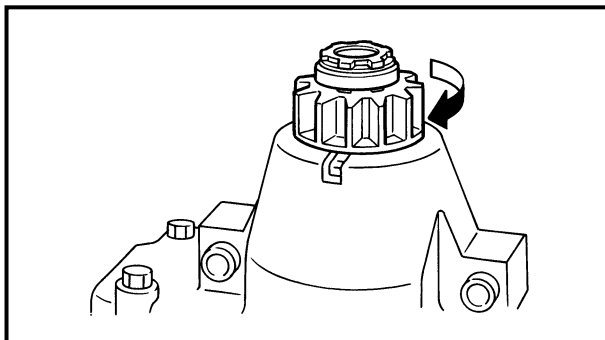
- Starter motor pinion teeth
Damage/wear → Replace.

2. Check:

- Starter motor pinion movement
Incorrect → Replace.

NOTE:

Rotate the starter motor pinion counter-clockwise and make sure it moves smoothly. Also, rotate the starter motor pinion clockwise and make sure it locks.



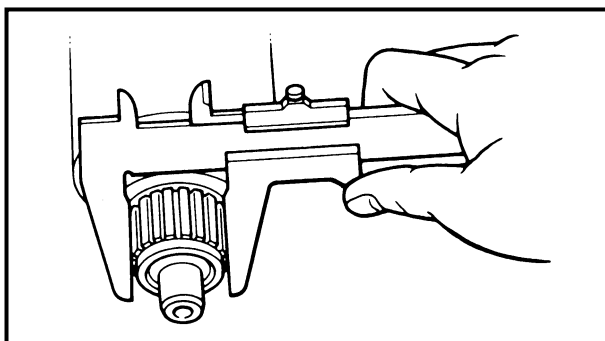
CHECKING THE ARMATURE

1. Check:

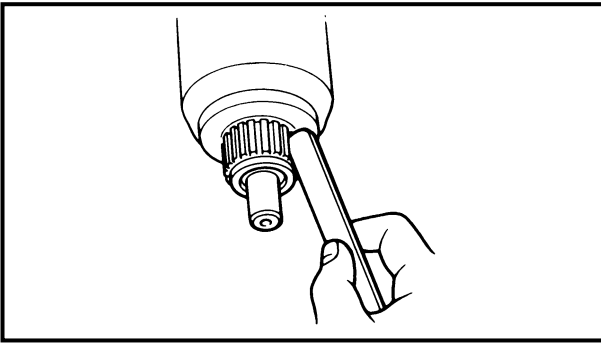
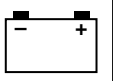
- Commutator
Foreign matter → Clean.
(with 600 grit sandpaper)

2. Measure:

- Commutator diameter
Out of specification → Replace.

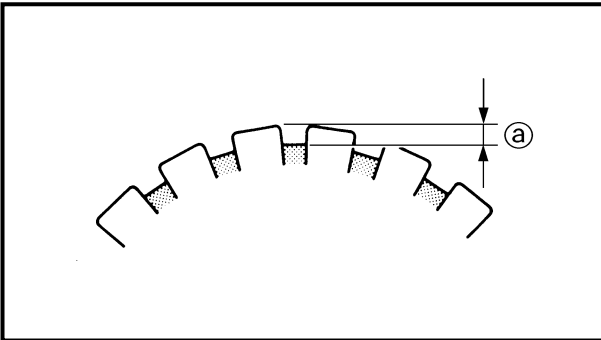


Commutator diameter limit
28.0 mm (1.10 in)



3. Check:

- Commutator undercut
Dirt/foreign matter → Clean.
(with compressed air)

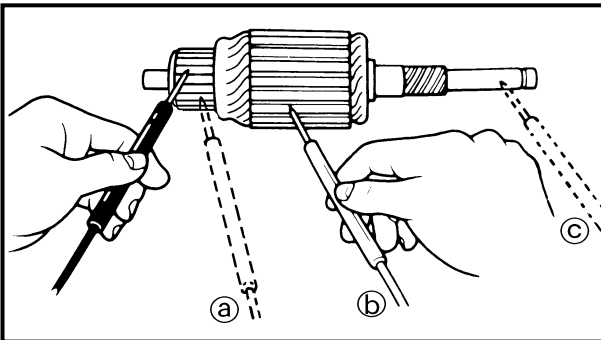


4. Measure:

- Commutator undercut (a)
Out of specification → Replace the armature.



Commutator undercut limit
0.2 mm (0.01 in)



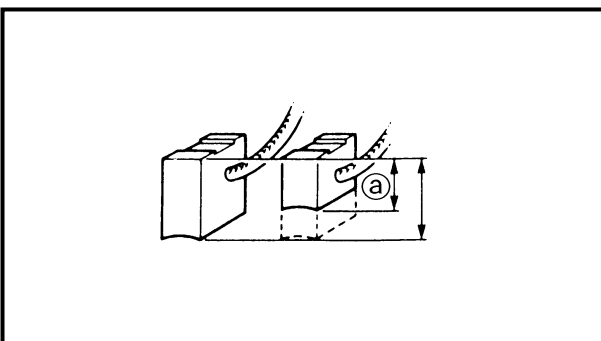
5. Check:

- Armature continuity
Out of specification → Replace.



Armature continuity

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



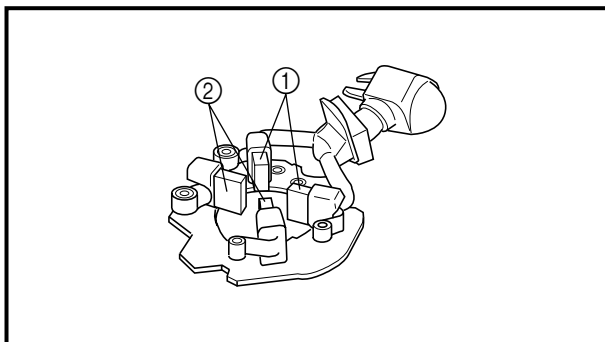
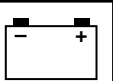
MEASURING THE BRUSHES

1. Measure:

- Brush length
Out of specification → Replace the brush assembly.



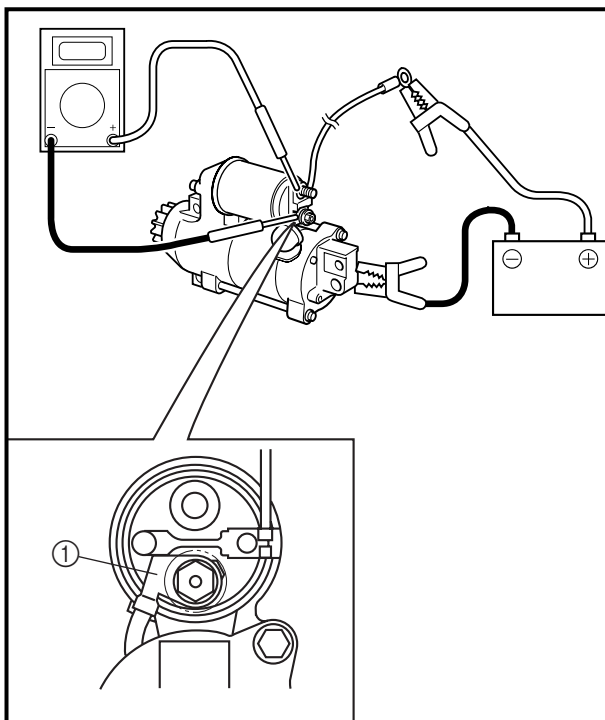
Brush length limit (a)
9.5 mm (0.37 in)



2. Check:

- Brush assembly continuity
Out of specification → Replace the brush assembly.

 Brush assembly continuity	
Brush ① – Brush ②	No continuity



CHECKING THE MAGNETIC SWITCH RELAY

Check:

- Magnetic switch relay continuity
Out of specification → Replace.

Checking steps

- (1) Remove the terminal ① from the magnetic switch relay.

NOTE:

Remove the terminal to prevent the pinion gear from turning.

- (2) Connect the tester leads between the magnetic switch relay terminals as shown.
- (3) Connect the Brown/white (Br/W) lead to the positive battery terminal.
- (4) Connect the starter motor body to the negative battery terminal.

CAUTION:

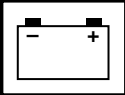
Do not connect the battery for more than one second. Otherwise, the magnetic switch relay may be damaged.

- (5) Check that there is continuity between the magnetic switch relay terminals.
- (6) Check that there is no continuity after the Br/W lead is removed.

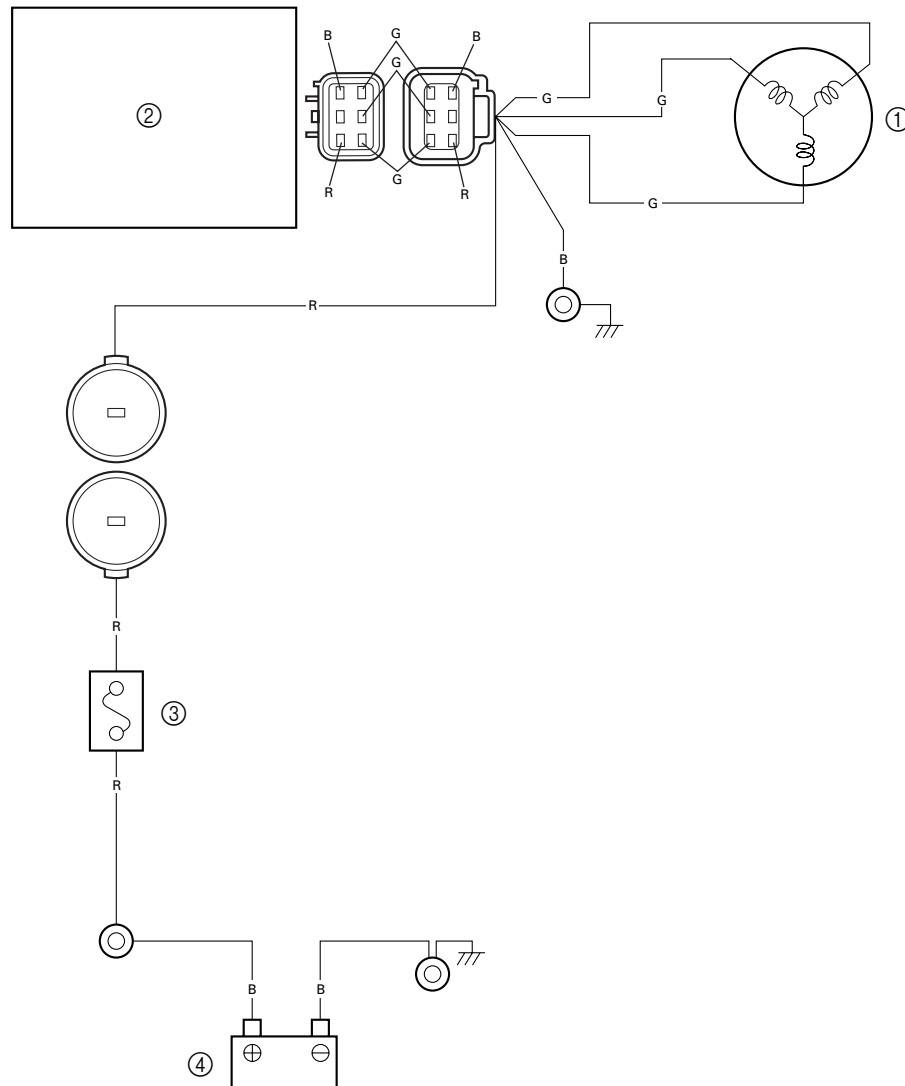
NOTE:

The starter motor pinion should be pushed out while the magnetic switch is on.

- (7) Install the terminal to the magnetic switch relay.

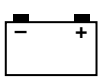


CHARGING SYSTEM



- ① Stator coil
- ② Rectifier/regulator
- ③ Fuse (30A)
- ④ Battery

B : Black
G : Green
R : Red

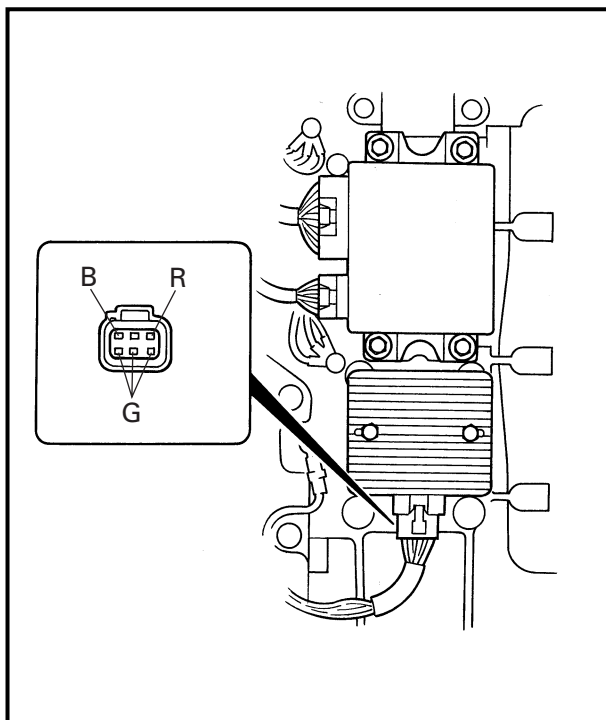


CHECKING THE FUSES

Refer to "CHECKING THE FUSES" on page 8-11.

CHECKING THE BATTERY

Refer to "CHECKING THE BATTERY" on page 3-21.

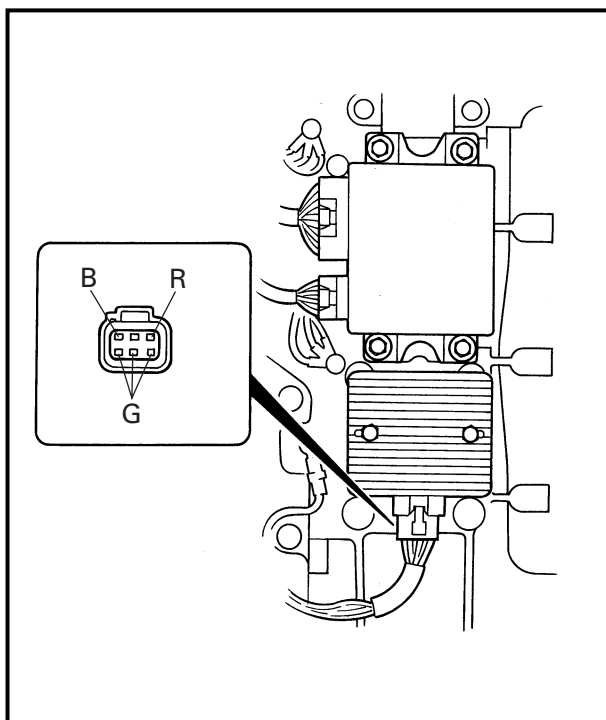


MEASURING THE LIGHTING COIL OUTPUT PEAK VOLTAGE

Measure:

- Lighting coil output peak voltage
Measure with the rectifier/regulator output wire (red) disconnected.
Below specification → Replace the lighting coil.

	Lighting coil output peak voltage Green (G) – Green (G)			
	r/min	Unloaded	Loaded	Unloaded
		Cranking		1,500 3,500
V		9.3	7.4	37 89
Test harness (6-pin) 90890-06790				

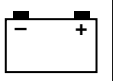


MEASURING THE RECTIFIER/REGULATOR OUTPUT PEAK VOLTAGE

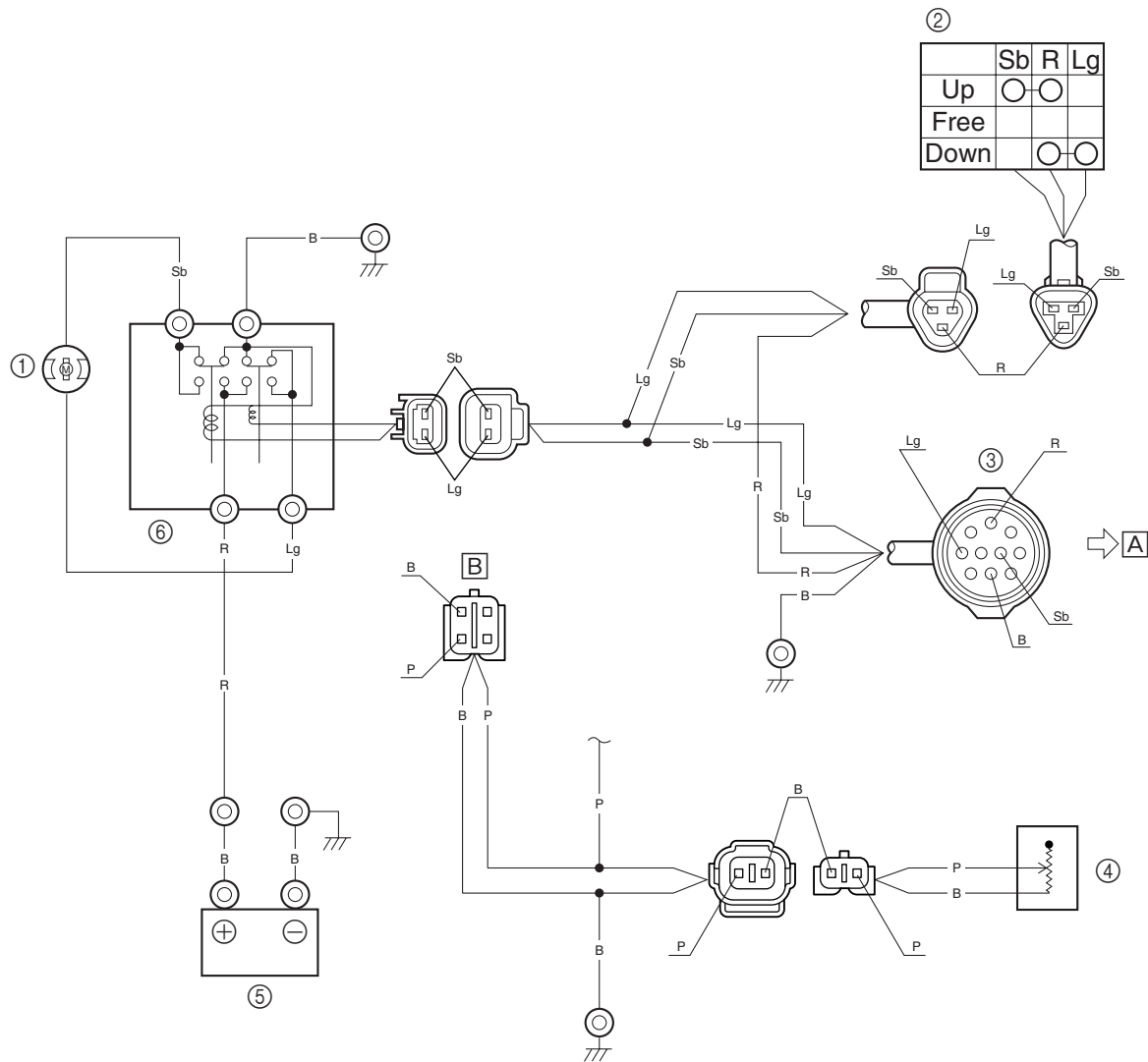
Measure:

- Rectifier/regulator output peak voltage
Below specification → Replace the rectifier/regulator.

	Rectifier/regulator output peak voltage Red (R) – Black (B)			
	r/min	Unloaded	Loaded	
		Cranking		1,500 3,500
V		—	7.5	12.5 13.0
Test harness (6-pin) 90890-06790				



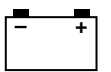
POWER TRIM AND TILT SYSTEM



- ① Power trim and tilt motor
- ② Trailer switch
- ③ 10P connector
- ④ Trim sensor
- ⑤ Battery
- ⑥ Power trim and tilt relay

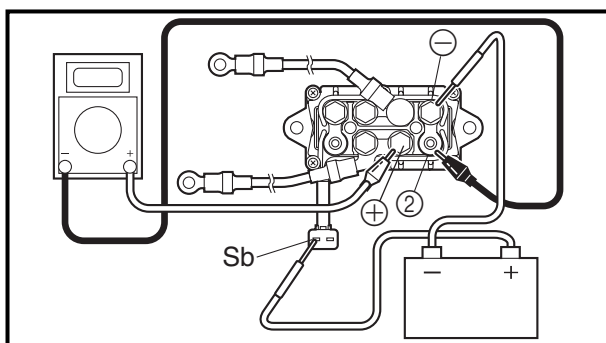
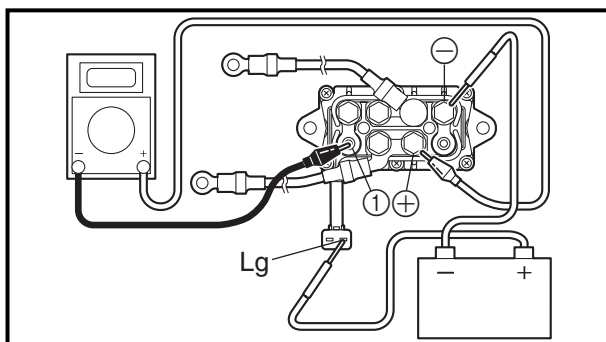
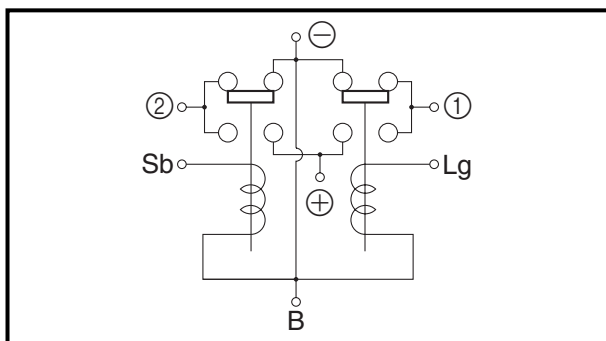
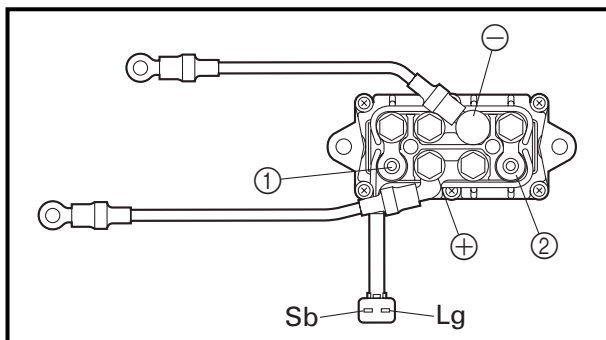
B : Black
 Lg : Light green
 P : Pink
 R : Red
 Sb : Sky blue

- [A] To remote control
- [B] To trim meter



CHECKING THE BATTERY

Refer to "CHECKING THE BATTERY" on page 3-21.



CHECKING THE POWER TRIM AND TILT RELAY

1. Check:

- Power trim and tilt relay continuity
Out of specification → Replace.

 Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ⊖ Terminal ② – Terminal ⊖	Continuity
Terminal ① – Terminal ⊕ Terminal ② – Terminal ⊕	No continuity

2. Check:

- Power trim and tilt relay operation
No continuity → Replace.

Checking steps

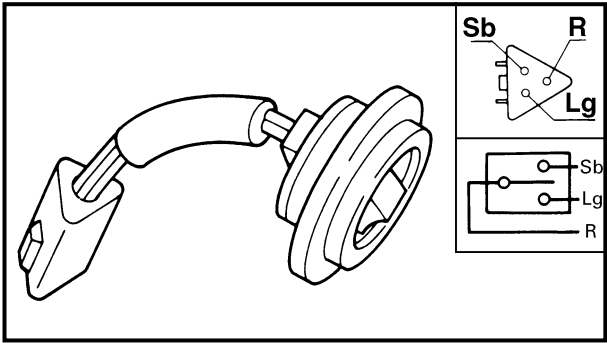
- Connect the digital tester between power trim and tilt relay terminals ① and ⊕.
- Connect a 12-V battery as shown.

Light green (Lg) lead → Positive terminal
Terminal ⊖ → Negative terminal

- Check that there is continuity between the power trim and tilt relay terminals.
- Connect the digital tester between power trim and tilt relay terminals ⊕ and ②.
- Connect a 12-V battery as shown.

Sky blue (Sb) lead → Positive terminal
Terminal ⊖ → Negative terminal

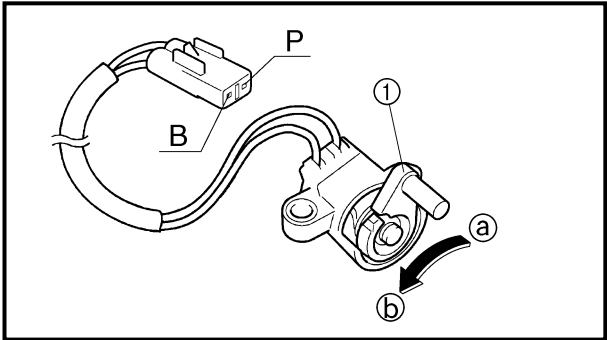
- Check that there is continuity between the power trim and tilt relay terminals.



CHECKING THE TRAILER SWITCH CONTINUITY

- Check:
- Trailer switch continuity
- Out of specification → Replace.

	Switch position	Lead color		
		Skyblue (Sb)	Red (R)	Light green (Lg)
	Up			
	Free			
	Down			



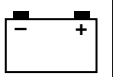
MEASURING THE TRIM SENSOR RESISTANCE

- Measure:
- Trim sensor resistance
- Out of specification → Replace.

	Trim sensor resistance Pink (P) – Black (B) 238.8 - 378.8 Ω at 20 °C (68 °F) ① 9 - 11 Ω at 20 °C (68 °F) ②
--	---

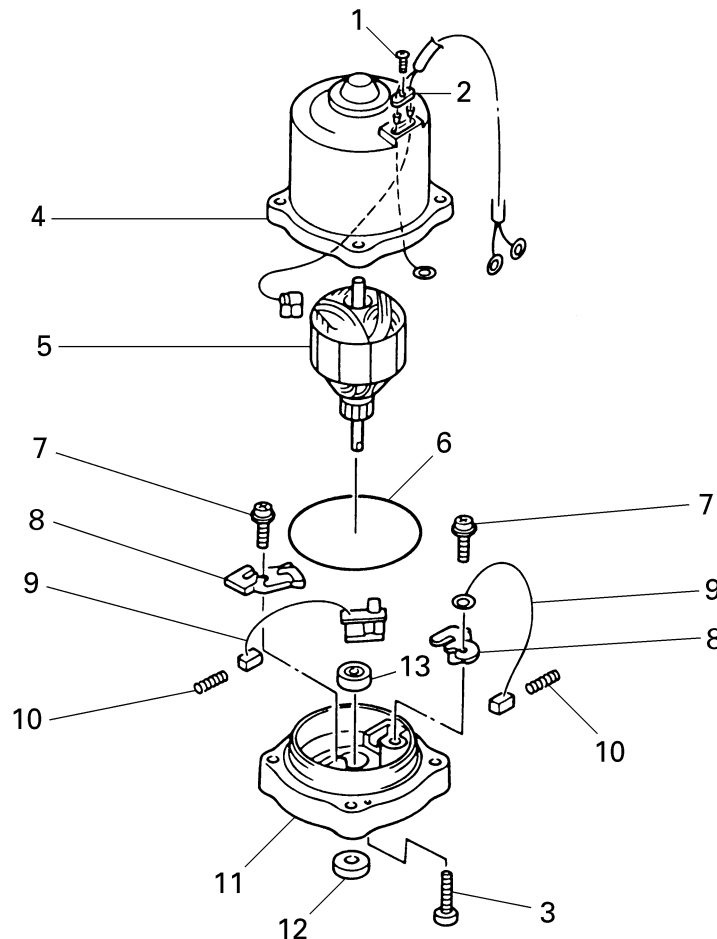
NOTE: _____

Turn the lever ① and measure the resistance as it gradually changes.

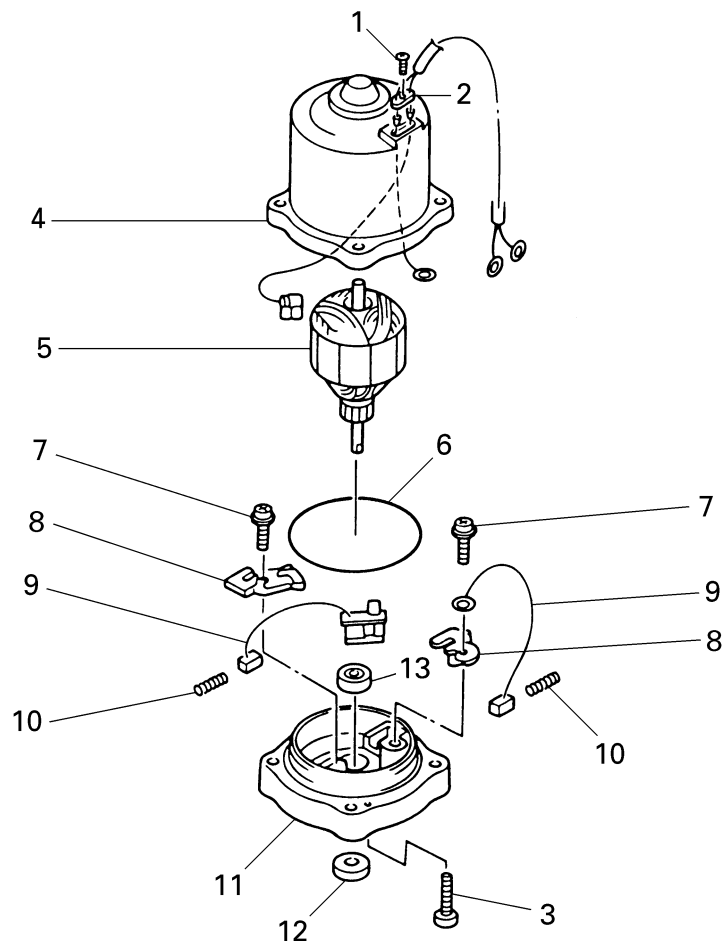


POWER TRIM AND TILT MOTOR

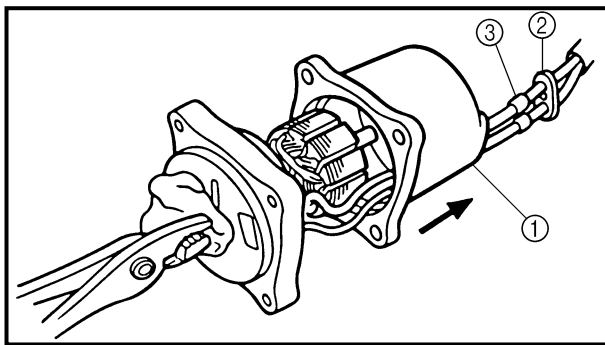
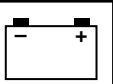
DISASSEMBLING/ASSEMBLING THE POWER TRIM AND TILT MOTOR



Order	Job/Part	Q'ty	Remarks
	Power trim and tilt motor		Refer to "RESERVOIR AND POWER TRIM AND TILT MOTOR" on page 7-33.
1	Screw	1	
2	Lead holder	1	
3	Screw	2	
4	Stator	1	
5	Armature	1	
6	O-ring	1	
7	Screw	2	
Continued on next page.			



Order	Job/Part	Q'ty	Remarks
8	Brush holder	2	For assembly, reverse the disassembly procedure.
9	Brush	2	
10	Spring	2	
11	Lower cover	1	
12	Oil seal	1	
13	Bearing	1	



REMOVING THE STATOR

Remove:

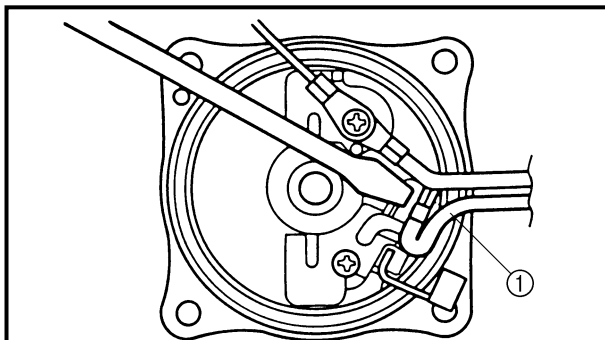
- Stator ①

CAUTION:

- Keep the power trim and tilt motor leads inside the stator.
- Do not allow grease or oil to contact the commutator.

NOTE:

- Remove the lead holder ② and rubber spacer ③ from the stator and slide them towards the leads.
- Hold the end of the armature shaft with a clean cloth and pull off the stator.



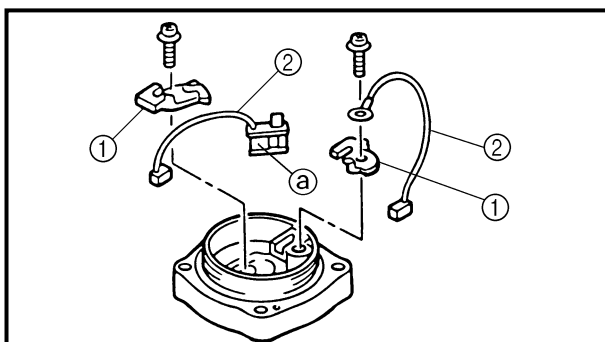
REMOVING THE BRUSH

1. Remove:

- Sky blue power trim and tilt motor lead ①

NOTE:

Hold the brush with a screwdriver as shown. Then, disconnect the sky blue lead.

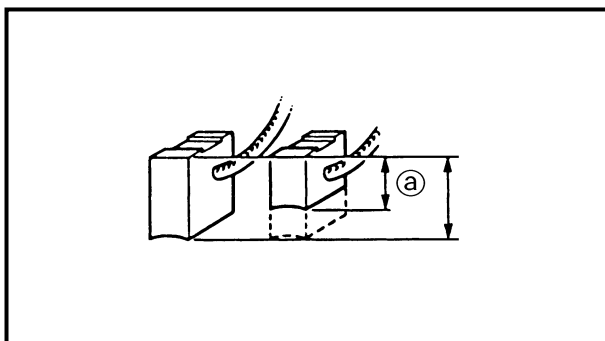


2. Remove:

- Brush holders ①
- Brushes ②

CAUTION:

Do not touch the bimetal ③; touching it may affect the operation of the breaker.



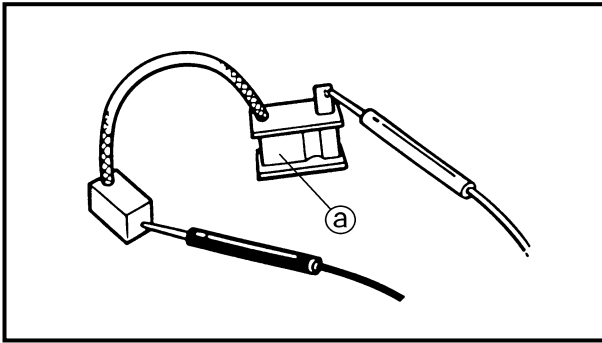
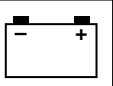
CHECKING THE BRUSH

1. Measure:

- Brush length ③
- Out of specification → Replace.



Brush length
4.8 mm (0.19 in)

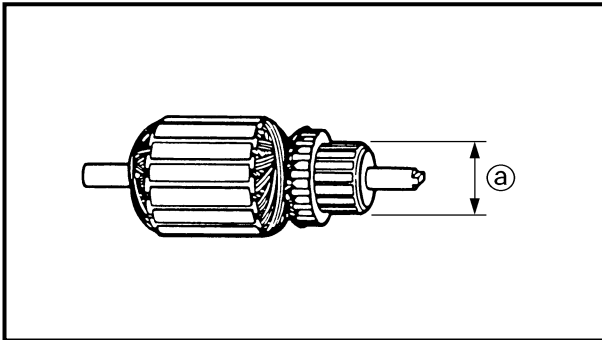


2. Check:

- Brush continuity
- No continuity → Replace.

CAUTION:

Do not touch the bimetal ①; touching it may affect the operation of the breaker.

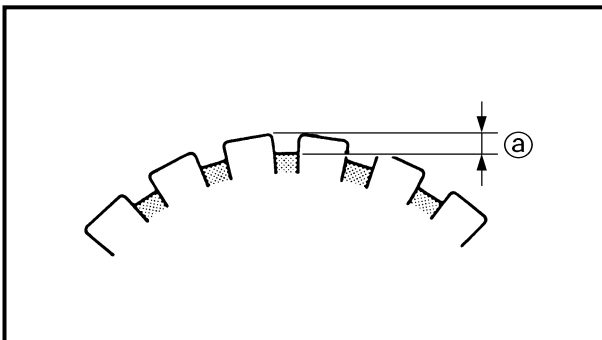
**CHECKING THE ARMATURE**

1. Measure:

- Commutator diameter ①
- Out of specification → Replace.



Commutator diameter limit
21.0 mm (0.83 in)

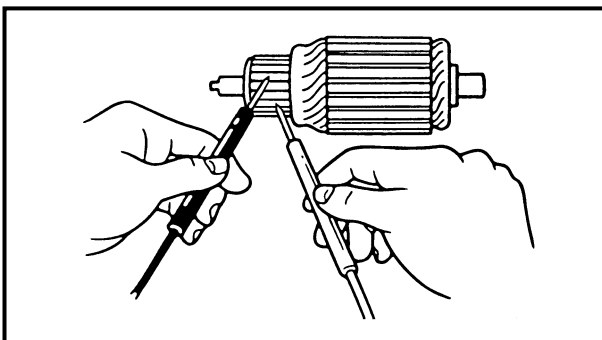


2. Measure:

- Commutator undercut ①
- Out of specification → Replace the armature.



Commutator undercut limit
0.85 mm (0.03 in)

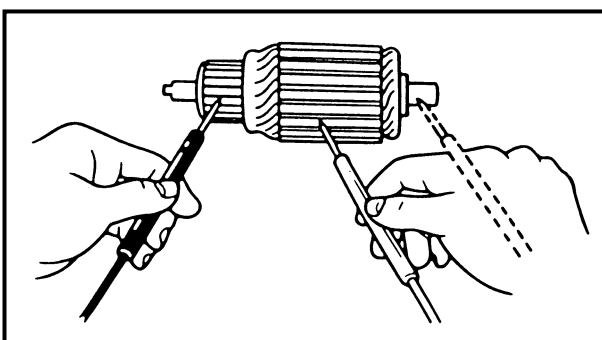


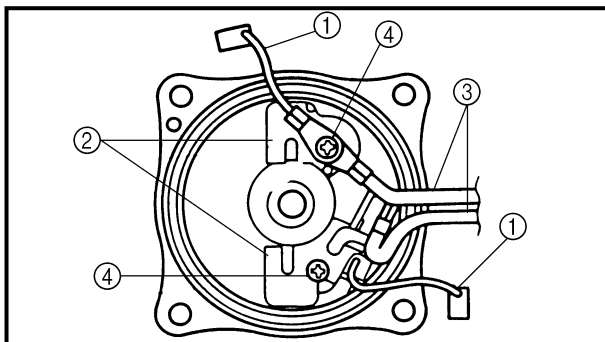
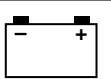
3. Check:

- Armature continuity
- Out of specification → Replace.

**Armature continuity**

Commutator segments	Continuity
Segment-laminations	No continuity
Segment-shaft	No continuity





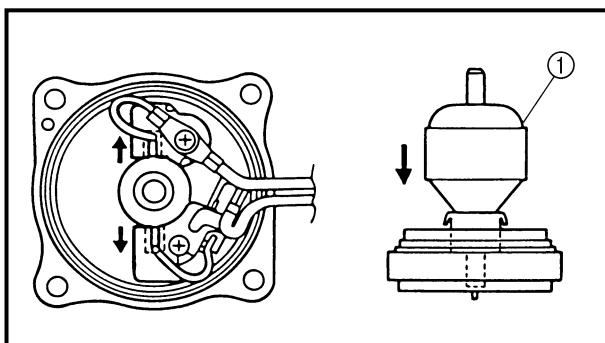
INSTALLING THE BRUSH

Install:

- Brushes ①
- Brush holders ②
- Power trim and tilt motor leads ③
- Screw ④

CAUTION:

Do not touch the bimetal; touching it may affect the operation of the breaker.



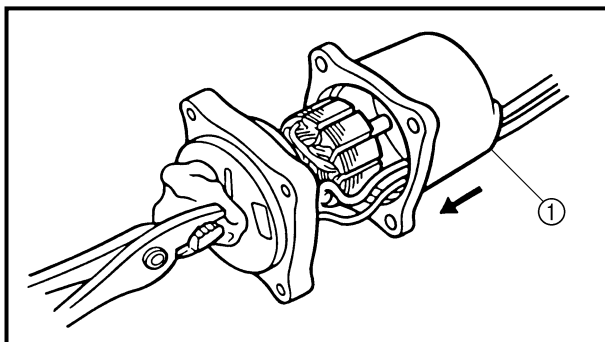
INSTALLING THE ARMATURE

Install:

- Armature ①

NOTE:

Push the brushes into the holder and then install the armature.



INSTALLING THE STATOR

Install:

- Stator ①

NOTE:

Place a clean cloth over the end of the armature shaft and carefully push the armature into the stator with a pair of pliers as shown.

CHAPTER 9

TROUBLE ANALYSIS

TROUBLE ANALYSIS	9-1
TROUBLE ANALYSIS CHART	9-1
 SELF-DIAGNOSIS	9-5
DIAGNOSIS CODE INDICATION	9-5
DIAGNOSIS THE ELECTRONIC CONTROL SYSTEM	9-5
 TROUBLE SHOOTING FOR ELECTRIC FUEL INJECTION	9-7

TROUBLE ANALYSIS

NOTE:

The following items should be checked before the "TROUBLE ANALYSIS CHART" is consulted.

1. The battery is charged and its specified gravity is within specification.
2. There are no incorrect wiring connections.
3. Wiring connections are properly secured and are not rusty.
4. The engine stop lanyard is installed onto the engine stop lanyard switch.
5. The shift position is in neutral.
6. Fuel is reaching the vapor separator.
7. The rigging and engine setting are correct.
8. The engine is free from any "Hull problem".

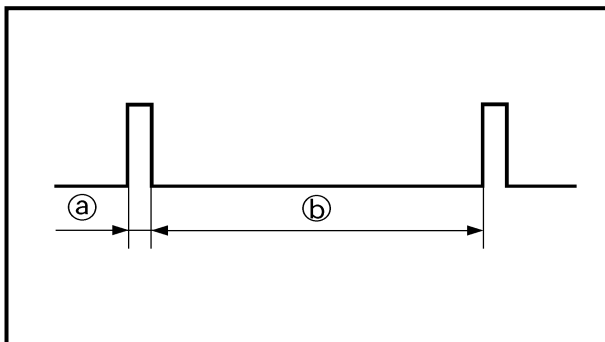
TROUBLE ANALYSIS CHART

Trouble mode																Check elements		
ENGINE WILL NOT START	HARD STARTING	ROUGH IDLING	HIGH IDLING	ENGINE STALLS	POOR ACCELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	LIMITED ENGINE SPEED	OVERHEATING	LOW OIL PRESSURE	LOOSE STEERING	LOOSE TILT HOLDING	TILT MOTOR WILL NOT RUN	HARD SHIFTING	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Relative part	Reference chapter
																FUEL SYSTEM		
																Low-pressure fuel line		
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Fuel line	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Fuel filter	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Fuel pump	4
																High-pressure fuel line		
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Vapor separator	4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• High-pressure fuel pump	4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• High-pressure fuel line	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Fuel injectors	4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Link adjustment	3

Trouble mode																Check elements		
ENGINE WILL NOT START	HARD STARTING	ROUGH IDLING	HIGH IDLING	ENGINE STALLS	POOR ACCELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	LIMITED ENGINE SPEED	OVERHEATING	LOW OIL PRESSURE	LOOSE STEERING	LOOSE TILT HOLDING	TILT MOTOR WILL NOT RUN	HARD SHIFTING	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Relative part	Reference chapter
																POWER UNIT		
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Compression	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cylinder head gaskets	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cylinder block	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Crankcase	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Piston rings	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Pistons	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Bearings	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Thermostat	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Water passages	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Valve(s) and valve seat(s)	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Valve clearance adjusting shim(s)	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Camshaft(s)	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Timing belt	5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Oil pump	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	• Engine oil	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Oil filter	3
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Oil pressure switch	8
																LOWER UNIT		
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Neutral position	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Dog clutch	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Gears	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Water inlets	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Water pump	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Propeller shaft(s)	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Shift rod joint/pin	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Shift cam	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Shift shaft	6
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Lower case	6

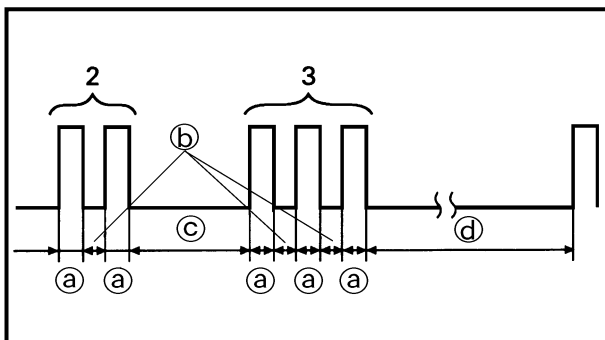
Trouble mode															Check elements			
ENGINE WILL NOT START	HARD STARTING	ROUGH IDLING	HIGH IDLING	ENGINE STALLS	POOR ACCELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	LIMITED ENGINE SPEED	OVERHEATING	LOW OIL PRESSURE	LOOSE STEERING	LOOSE TILT HOLDING	TILT MOTOR WILL NOT RUN	HARD SHIFTING	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Relative part	Reference chapter
															BRACKET UNIT			
											○						Bracket	7
											○						Rubber mount	7
														○			Shift rod	7
															POWER TRIM AND TILT UNIT			
												○					Fluid level	3
												○					Relief valve	7
												○					Fluid passages	—
													○				Power trim and tilt motor	7
															ELECTRICAL			
															Ignition system			
○	○	○		○	○		○										• Pulser coils	8
○			○			○	○	○									• ECM	8
○	○				○		○										• Ignition coils	8
○	○	○	○	○	○	○	○										• Spark plugs	3
															Ignition/fuel control system			
○						○											• Engine stop lanyard switch	—
○																	• Main relay	8
○	○	○	○	○	○												• High-pressure fuel pump resistor	8
	○	○	○														• Intake aie pressure sensor	8
	○	○	○														• Intake air temperature sensor	8
	○	○	○												○		• Engine cooling water temperature sensor	8
		○	○		○		○										• Throttle position sensor	8
		○	○														• Idle speed control assembly	4

Trouble mode																Check elements		
ENGINE WILL NOT START	HARD STARTING	ROUGH IDLING	HIGH IDLING	ENGINE STALLS	POOR ACCELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	LIMITED ENGINE SPEED	OVERHEATING	LOW OIL PRESSURE	LOOSE STEERING	LOOSE TILT HOLDING	TILT MOTOR WILL NOT RUN	HARD SHIFTING	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Relative part	Reference chapter
☐	☐					☐												
																Starting system		
☐	☐					☐											• Engine start switch	—
☐																	• Shift position switch	8
☐																	• Starter relay	8
☐																	• Starter motor	8
																Charging system		
																☐	• Lighting coil	8
																☐	• Rectifier/regulator	8
																☐	• Fuses	8
☐		☐		☐												☐	• Battery leads	—
☐														☐		☐	• Battery	—
																Power trim and tilt system		
													☐				• Trailer switch	8
													☐				• Power trim and tilt relay	8

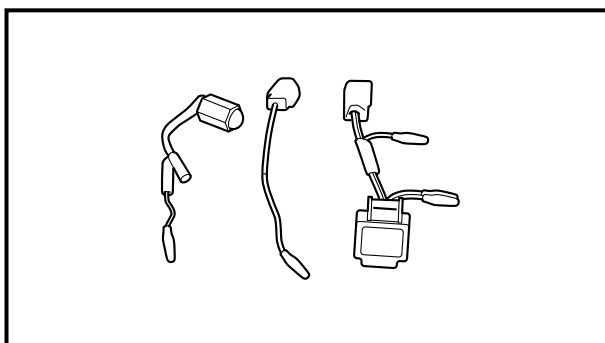


SELF-DIAGNOSIS DIAGNOSIS CODE INDICATION

1. Normal condition
(no defective part or irregular processing is found)
Single flash is given every 4.95 seconds.
 a : Light on, 0.33 second
 b : Light off, 4.95 seconds



2. Trouble code indication
Example: The illustration indicates code number 23.
 a : Light on, 0.33 second
 b : Light off, 0.33 second
 c : Light off, 1.65 seconds
 d : Light off, 4.95 seconds



DIAGNOSIS THE ELECTRONIC CONTROL SYSTEM

1. Install:
 - Diagnostic indicator

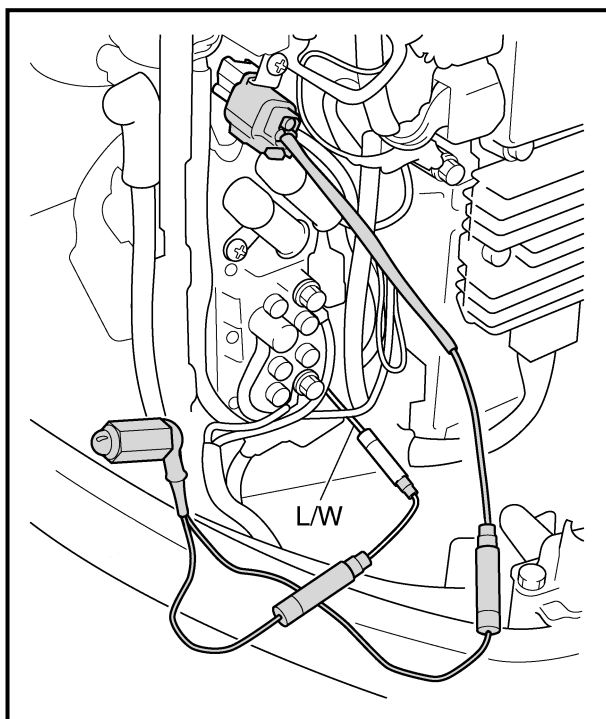


**Diagnostic test lead
YB-06795**

NOTE:

When performing this diagnosis, all of the electrical wires must be properly connected.

2. Check:
 - Diagnosis code
 Code 1 is indicated → Normal.
 Code 13 - 29 indicated → Check the applicable parts.
 Code 37 - 59 indicated → Microcomputer processing information.



Checking steps

- (1) Remove the diagnosis connector (3-pins) cap.
- (2) Connect the special tools to the out-board motor as shown.
- (3) Start the engine and let it idle.
- (4) Check the diagnostic indicator's flash pattern to determine if there are any malfunctions.

NOTE:

When more than one problem is detected, the diagnostic tester's light flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Diagnosis code chart

Code	Symptoms
1	Normal
13	Incorrect pick-up coil input signal
15	Incorrect engine cooling water temperature sensor input signal
18	Incorrect throttle position sensor input signal
19	Incorrect battery positive voltage
23	Incorrect intake air temperature sensor input signal
28	Incorrect shift position switch
29	Incorrect intake air pressure sensor input signal (out of normal operating range)
37 - 59	Microcomputer processing information
(37)	Intake passage air leakage
(44)	Engine stop lanyard switch control operating
(49)	Ignition timing is being slightly corrected (when starting a cold engine)
(59)	Memory data over written abnormally

TROUBLE SHOOTING FOR ELECTRIC FUEL INJECTION

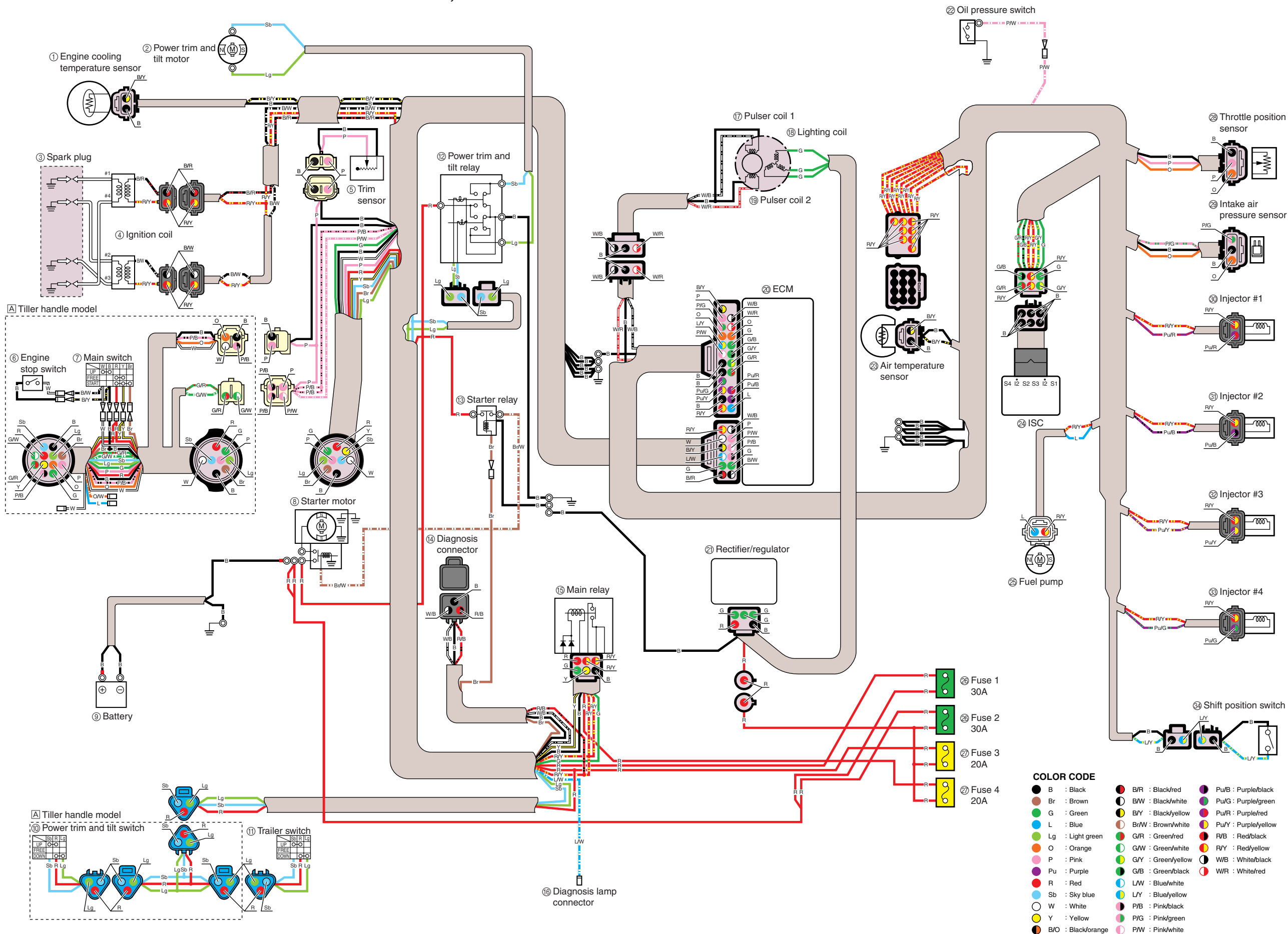
Items	Symptoms
1. Poor starting/ Engine will not start	1. No firing. The starter motor cranks the engine, but no firing is generated in the cylinder. 2. The firing is generated in the cylinder, but the engine soon stops. 3. Start-up time is too long. The engine will not start-up easily.
	1. Check the high-pressure fuel lines. 1) Check for fuel line leaks ↓ 2) Check the fuel pressure ↓ 3) Check the operation of the fuel injector ↓ 4) Check the diagnosis cord Fuel pressure is out of specification ① Check the 20-A fuse ② Check the main relay ③ Check the high-pressure fuel pump operation ④ Check the main relay drive's ECM output ⑤ Check the pressure regulator

Items	Symptoms
2. Erratic idling speed	1. The engine speed is not constant when idling. 2. The engine stalls when the throttle lever is pulled back. 3. The engine stalls when the throttle lever is opened or during outboard operation.
	1. Check the high-pressure fuel lines. 1) Check for fuel line leaks ↓ 2) Check the fuel pressure → Fuel pressure is out of specification ↓ 3) Check the operation of the fuel injector ↓ 4) Check the diagnosis cord ① Check the 20-A fuse ② Check the main relay ③ Check the high-pressure fuel pump operation ④ Check the pressure regulator 2. Check the ignition system. 1) Check the wire harness ↓ 2) Check the ignition spark ↓ 3) Check the ignition coil ↓ 4) Check the ECM output peak voltage ↓ 5) Check the pulser coil output peak voltage 3. Check the ignition timing. 1) Check the diagnosis cords → ① Check the pulser coil diagnosis cord ② Check the engine cooling water temperature sensor diagnosis cord ③ Check the intake air temperature sensor diagnosis cord

Items	Symptoms
3. Erratic engine speed	1. The engine is started, but will not run smoothly. The engine speed drops during acceleration. 1. Check the high-pressure fuel lines. 1) Check for fuel line leaks ↓ 2) Check the fuel pressure → Fuel pressure is out of specification ↓ 3) Check the operation of the fuel injector ↓ 4) Check the diagnosis cord ① Check the 20-A fuse ② Check the main relay ③ Check the high-pressure fuel pump operation ④ Check the main relay drive's ECM output ⑤ Check the pressure regulator 2. Check the ignition system. 1) Check the wire harness ↓ 2) Check the ignition spark ↓ 3) Check the ignition coil ↓ 4) Check the ECM output peak voltage ↓ 5) Check the pulser coil output peak voltage 3. Check the ignition timing. 1) Check the diagnosis cords ① Check the pulser coil diagnosis cord ② Check the engine cooling water temperature sensor diagnosis cord ③ Check the intake air temperature sensor diagnosis cord

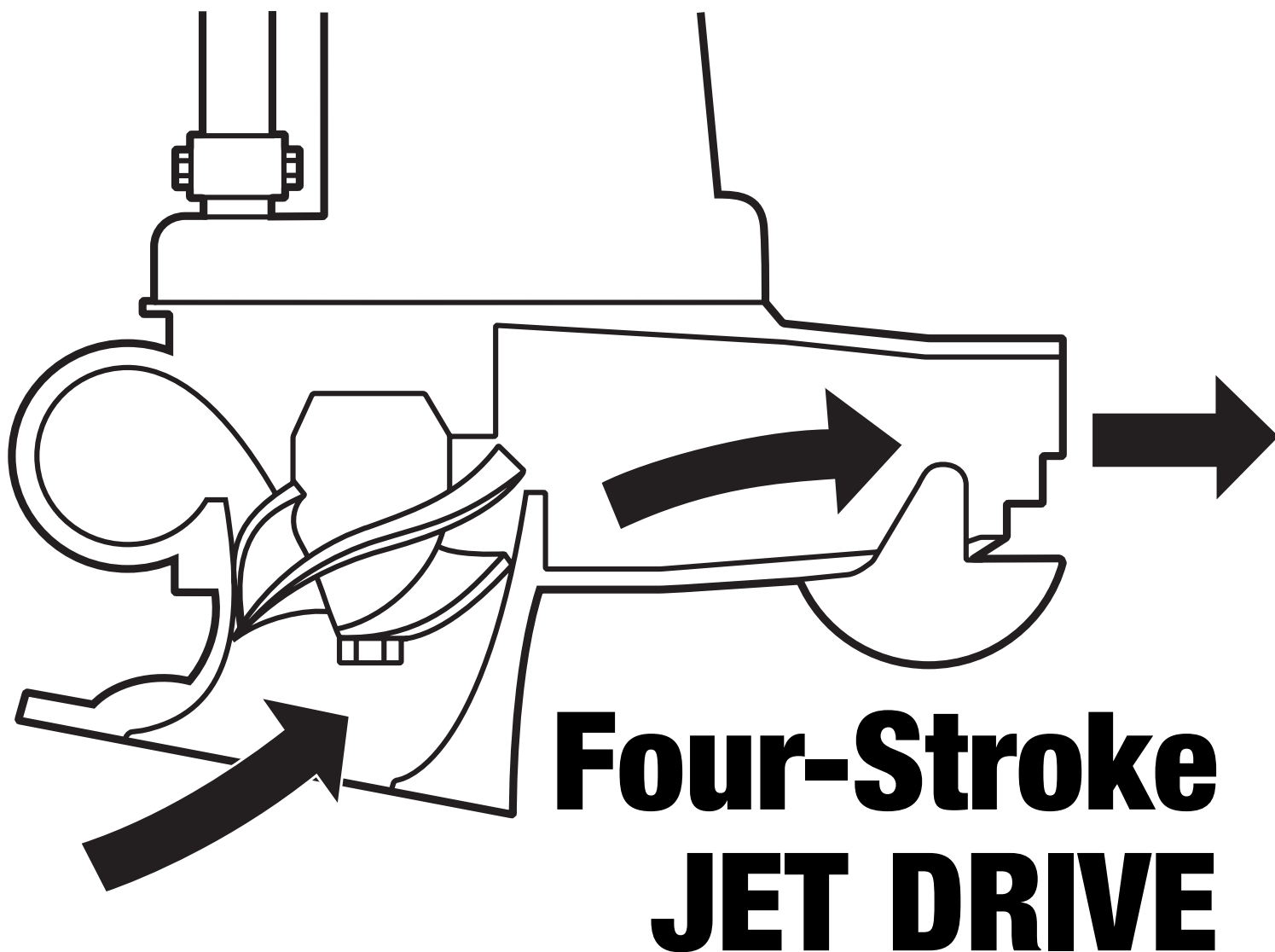
WIRING DIAGRAM

F115TR, LF115TR





Printed in USA
Oct. 2003 – × 1 CR
(E)



Four-Stroke JET DRIVE

Operation and Service Manual

Four-Stroke Jet Drive Operation and Service Manual

©2002 by Yamaha Motor Corporation, U.S.A.
September 2002

All rights reserved. Any reprinting
or unauthorized use
without written permission of
Yamaha Motor Corporation, U.S.A.
is expressly prohibited.
Printed in U.S.A.

*Specifications, features and options are subject to
change without notice.*

02-467

TABLE OF CONTENTS

INTRODUCTION	1
FEATURES AND ADVANTAGES	2
LOCATION OF MAIN COMPONENTS	2
MODEL IDENTIFICATION AND SERIAL NUMBERS	3
ENGINE MOUNTING	4
MOUNTING HEIGHT	4
TEST RUNNING	4
TRANSOM ELEVATORS	4
ANTI-CAVITATION PLATES	4
OPERATING INSTRUCTIONS	6
SHIFTING	6
REMOTE CONTROL	6
STEERING	6
SHALLOW WATER OPERATION	6
INTAKE BLOCKAGE	8
MOORING	8
THROTTLE USE	8
TILT AND TRIM USE	8
MAINTENANCE, LUBRICATION, AND STORAGE	8
GENERAL	8
BEARING LUBRICATION	8
IMPELLER CLEARANCE SETTING	8
LINKAGE ADJUSTMENT	8
SALT WATER OPERATION	8
STORAGE	9
ADJUSTMENTS	9
SHIFT CAM ASSEMBLY WITH NEUTRAL ADJUSTMENT	9
NEUTRAL ADJUSTMENT OF ALL MODELS	9
TRIM	10
IDLE	10
PERFORMANCE TIPS	10
OVERHAUL PROCEDURES	11
F40MJH & F40EJR (F40) 4-STROKE 3-CYLINDER	
PARTS LIST	14
ASSEMBLY INSTRUCTIONS	16
TILLER STEERING SHIFT CABLE PARTS LIST	18
TILLER STEERING SHIFT CABLE ASSEMBLY	19
F60 4-STROKE 4-CYLINDER	
PARTS LIST	20
ASSEMBLY INSTRUCTIONS	22
TILLER STEERING SHIFT CABLE PARTS LIST	24
TILLER STEERING SHIFT CABLE ASSEMBLY	25
F90 4-STROKE 4-CYLINDER	
PARTS LIST	26
ASSEMBLY INSTRUCTIONS	28

TILLER STEERING SHIFT CABLE PARTS LIST	30
TILLER STEERING SHIFT CABLE ASSEMBLY	31
F115 4-STROKE 4-CYLINDER	
PARTS LIST	26
ASSEMBLY INSTRUCTIONS	28
SPECIFICATIONS	37
LIMITED WARRANTY	39
TILLER HANDLE TEMPLATES	41

INTRODUCTION

This Four-Stroke Jet Drive Operation and Service Manual is designed to be used in conjunction with your Yamaha Outboard Motor Owner's and Service Manuals. It contains operating instructions as well as service and maintenance information that applies specifically to Yamaha Jet Drives. Refer to your Outboard Owner's and Service Manuals regarding general operating and service information.

The related Outboard Owner's and Service Manuals refer to horsepower rating for Yamaha's propeller-driven models. The actual performance output of Yamaha's Jet Drive models cannot be positively rated because the output varies with type of hull, load, forward speed, and the angle of planing achieved. Generally, the industry standard for determining the performance level of a jet-driven outboard is that its output is approximately 70% of that of a propeller-driven unit with the same powerhead.

This Operation and Service Manual covers several Yamaha Jet Drive models. Where there are model-year differences, references are made to applicable models. In addition, references are made throughout the manual to the model designation (which includes the engine's prop-shaft model horsepower) or to the engine's configuration. The following chart explains the corresponding designations:

4-Stroke

Engine Horsepower Model Designation	Engine Configuration	Jet Drive Model Designation
F40	3-cylinder	30
F60	4-cylinder	40
F90	4-cylinder	65
F115	4-cylinder	80

Read both this manual and your Outboard Motor manual before attempting to put your Yamaha Jet Drive Outboard Motor into service. You should be familiar with all the control positions, and know where each control is set during operation.

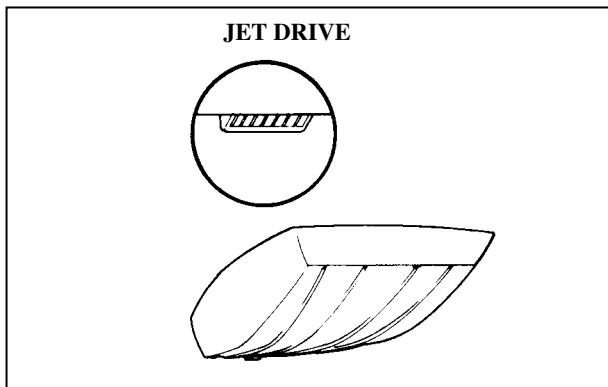
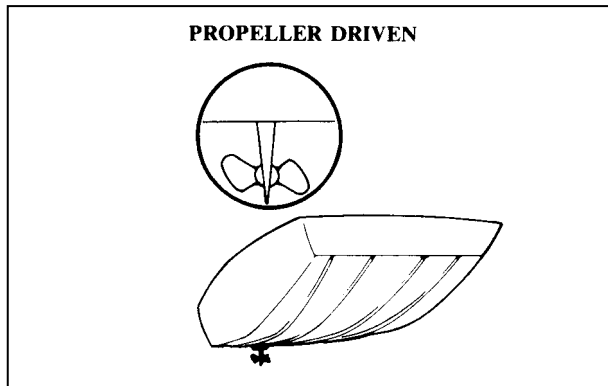
FEATURES AND ADVANTAGES

Your Yamaha Jet Drive Outboard Motor was specifically designed to allow boating in locations where a propeller-driven craft is unable to operate, such as in ankle-deep water, white-water rapids, over sand bars, shoals, etc.

Because there is no propeller housing extending below the hull, your Yamaha Jet Drive allows passage over obstructions that would damage a regular outboard.

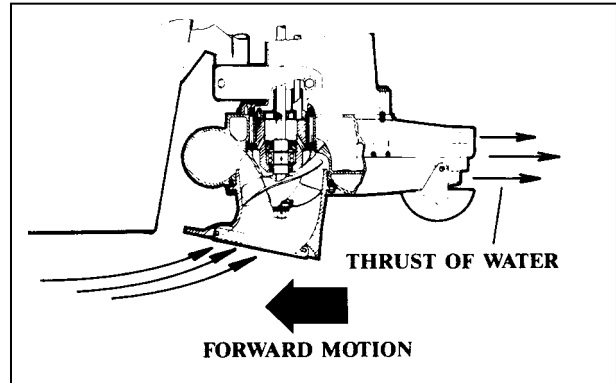
Shore landings are made easier because you don't have to tilt the motor.

A "fish's eye view" gives a further comparison of the difference between a propeller-driven boat and a jet drive.

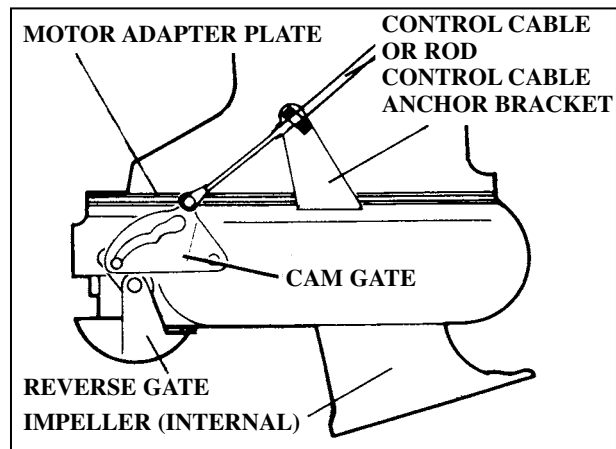
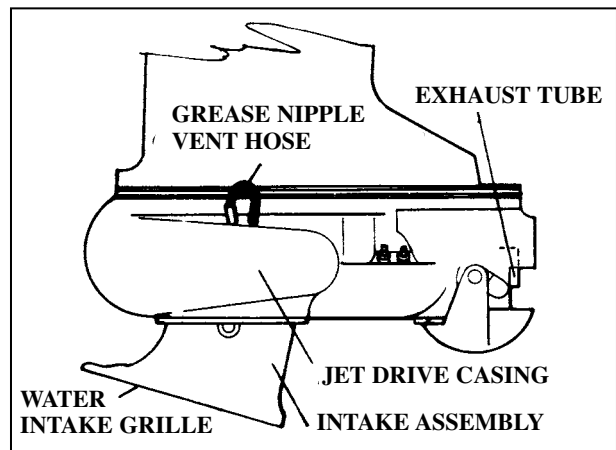


Your Yamaha Jet Drive's simple design offers reliable operation with minimal moving parts. Water is drawn into the unit through the intake grille by an impeller, driven directly by the engine drive shaft. The water is then forced at high pressure through an outlet nozzle that is directed away from the stern of the boat. This action creates an opposite force, similar to that of a jet engine, and drives the boat forward. When the boat reaches planing speed, the jet drive discharges water freely into the air and only the intake grille touches the water. To

obtain reverse, a gate is swung into position over the outlet, directing the pressure stream in the opposite direction, thus creating a reverse thrust to propel the boat backwards. Conventional controls are used for throttle, shifting, and steering.



LOCATION OF MAIN COMPONENTS



MODEL IDENTIFICATION AND SERIAL NUMBERS

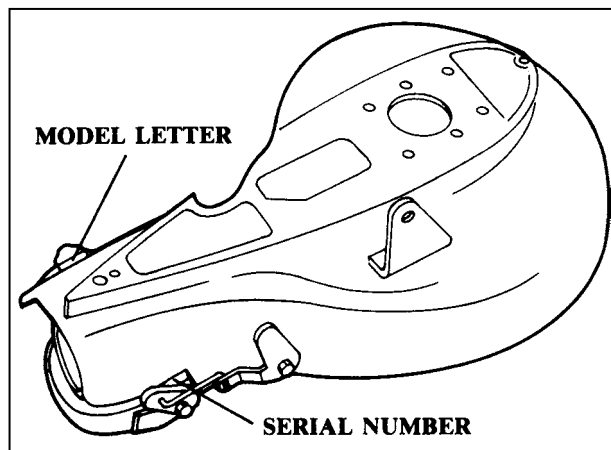
OUTBOARD IDENTIFICATION

See your Yamaha Outboard Motor Owner's Manual for outboard and motor identification number locations.

JET DRIVE IDENTIFICATION

The Jet Drive Model Letter is stamped on the rear, port-side casing. The Jet Drive Serial Number is stamped on the starboard side of the casing.

NOTE: The outboard motor and jet-drive unit model and serial numbers are important when you need to have service performed or place an order for parts. For easy reference, please record these numbers on the inside front cover of this manual, and also on the inside front cover of your Yamaha Outboard Motor Owner's Manual.



APPLICATION AND SIZING

HULL SELECTION

Best performance is obtained by selecting a light, shallow-draft hull, with a relatively flat (5° angle, or less), wide bottom. Vee or Multi-Vee hulls are not recommended (additional drag would be placed on the Jet Drive's water intake housing) because of their greater tendency to produce cavitation. Aluminum boats are preferred because of their light weight and durability. These boats typically have optimum hull shapes, too.

As a rule, the bottom width for your jet drive should be at least 48", and the centerline length at least 13'.

NOTE: Transom height is especially critical for jet-driven outboards, which are usually mounted 6" to 7" higher than propeller-driven outboards; therefore, it is advisable to use a full transom with your Jet Drive.

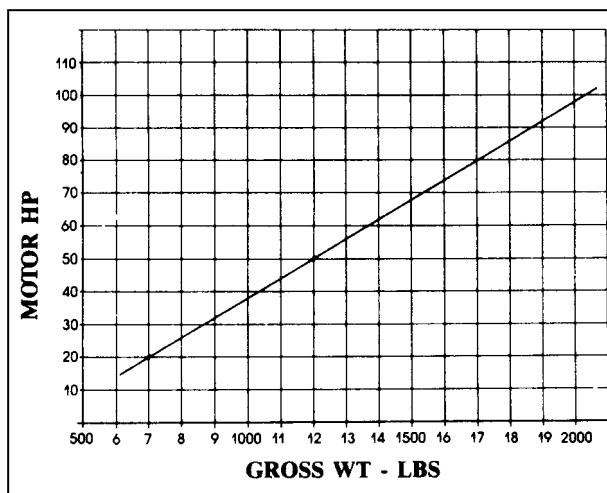
MOTOR SELECTION

MOTOR SIZING

A boat operating at slow speed requires considerably more depth than one that is planing on the surface of the water. It is important, therefore, to use sufficient horsepower, and to not overload your boat beyond its ability to plane.

The accompanying graph is based on experience obtained with sled-type boats, using an outboard-style jet. Gross weights shown include the motor, hull, fuel, passengers, and all gear. For a given horsepower, loading beyond the listed limits will obviously give reduced performance.

Conversely, slight overpowering, based upon anticipated load, will result in quicker planing, reduced throttle settings for a given speed, and, subsequently, increased efficiency of operation.



NOTE: The performance output levels of jet-driven outboards do not reflect true performance compared to propeller-driven outboards of the same powerhead horsepower. The Jet-Driven model is usually figured to have an output level equal to 70% of the propeller-driven model. Keep in mind that boat loading, weight, and hull configuration can significantly affect the performance of your Jet Drive outboard.

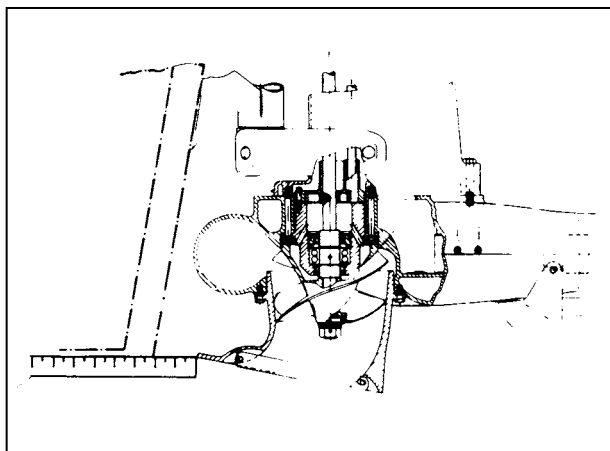
ENGINE MOUNTING

MOUNTING HEIGHT

Your Yamaha Jet Drive must be mounted 6" to 7" higher on the transom than propeller-driven outboards. Therefore, optimum mounting for 15" shafts is on a 20" transom; and for 20" shafts, a 25" transom.

The positioning of motor height is important and must be done carefully. One-quarter inch above the optimum location will allow air to enter the pump and will result in cavitation and power loss. Too low a setting will result in unnecessary drag, water spray, and reduction in speed.

The initial height setting is accomplished by placing a yardstick or other straightedge against the boat bottom (not the keel). The top of the leading edge of the water intake is adjusted to line up with the top edge of the straightedge.



TEST RUNNING

CAUTION:

When starting your motor for the first time, make sure water comes out the small hole at the rear, starboard side of the motor, just below the powerhead. If no water exits within a short period of time, shut off the motor and consult your dealer.

After making the initial motor-height setting, it is time to test-run the boat. If cavitation occurs (air enters the pump, which causes loss of thrust and motor overrevving), then you must lower the engine 1/4" at a time until smooth operation is obtained.

If smooth operation is obtained with the initial setting, you should raise the motor in 1/4" steps until cavitation does occur. Then lower the motor 1/4", and mark and lock that location. This height setting will never need to be changed, regardless of the load being carried.

CAUTION:

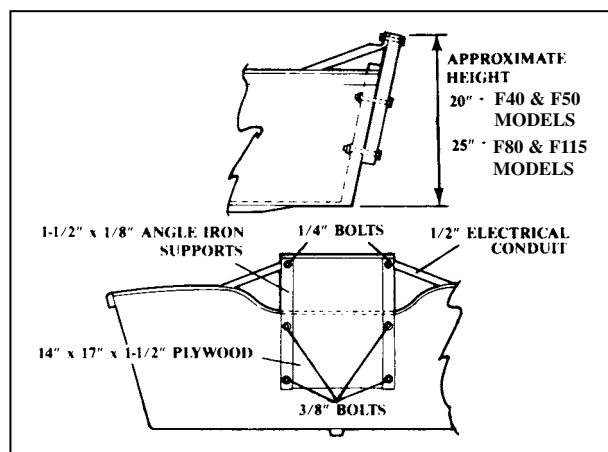
Slight cavitation on sharp turns or in rough water is acceptable, but excessive cavitation is harmful to both motor and pump, and should be avoided.

The motor tilt pin should be set so the engine is in a vertical position when the boat is planing. If the boat rides bow-high, or tends to be stern heavy, tilt the motor down one step. This will point the jet stream lower, giving added lift to the stern.

NOTE: If the tilt angle is changed, then the motor height must be rechecked.

TRANSOM ELEVATORS

In some applications, an elevated transom may be required for proper motor height. When using a bolted-on bracket, set the intake height 1/2" below the bottom of the boat in order to obtain the widest range of adjustability, as shown.



1. Glue two pieces of 3/4" exterior plywood together, using waterproof glue. Clamp or nail.
2. Bolt to transom at height shown. Use zinc-plated hardware, with flat washers on both sides.

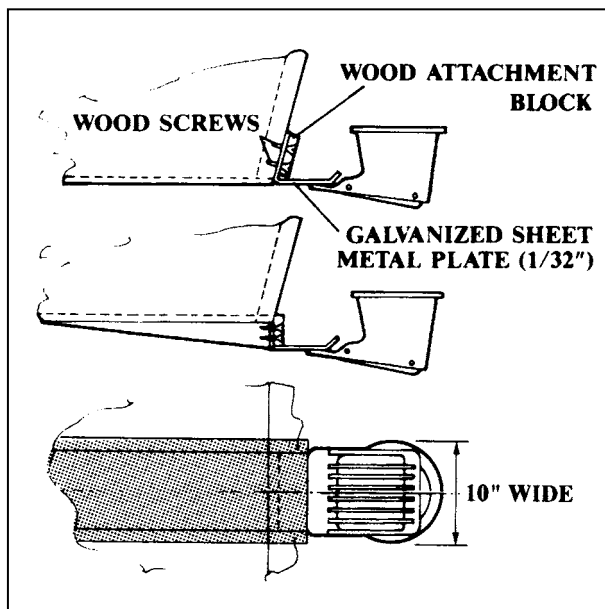
3. Make two diagonal braces from 1/2" electrical conduit. Flatten each end in a vise, and drill 1/4" holes in them. Determine the position and angle of the forward bend. Attach the braces to the boat in a solid location, such as to the seats or gunwales. Avoid attachment to flexible aluminum panels.

ANTI-CAVITATION PLATES

To reduce spray, or to further reduce cavitation in rough water, a 1/32"-thick metal plate can be installed to block the entrance of air into the water in front of the jet pump's intake scoop. Installation of this plate will also allow a slightly higher motor-mounting point (which, of course, will reduce drag).

The position for proper mounting is shown in the first part of the accompanying illustration.

An alternate mounting position for the plate (with the plate attached to a keel or wedge), for use in "white water," is shown in the second and third parts of the illustration. The third part shows the width of the plate, as well as the width of the drop-bottom wedge that positions the intake in more solid water. This installation, however, reduces shallow-water capabilities and should be used only when necessary.



CAUTION:

After one of these procedures is undertaken, the motor height and tilt settings should be checked, and reset as necessary, to avoid excessive cavitation that could lead to impeller damage.

NOTE: Either of the above modifications should utilize only marine-grade woods; silicon-base, waterproofing sealing compounds (between components and around screws); and marine-grade paints. Remember, once you adopt one of these modifications, if removed or changed, damage may result to your hull if precautions are not taken to fill and/or waterproof any holes.

OPERATING INSTRUCTIONS

SHIFTING

⚠ WARNING

The impeller is always engaged and produces a certain amount of thrust while the motor is running. “Neutral” is achieved when the reverse gate is in a middle position that balances forward and reverse thrust. Since the Neutral position on the shift control may not precisely balance the thrust, be sure to secure the boat to the dock or beach the bow of the boat during cold starts to avoid the possibility of being thrown off balance as the motor starts.

Except for low-speed maneuvering, do not use the reverse gate to slow or stop the boat; this will cause the motor to kick up and out of the water, similar to hitting a submerged object in a propeller-driven craft.

REMOTE CONTROL

When using a remote control with a fast-idle feature, the throttle can be advanced with the transmission in Neutral for cold engine starts. When using this fast-idle starting feature, the shift cam may not immediately engage when the throttle is returned to the Neutral position due to water pressure action on the reverse gate. After the motor has warmed up for 30 seconds or so, stop the motor, move the throttle lever through the shifting mode until the cam has engaged, place it in Neutral, and restart the motor. Subsequent warm starts in Neutral will not require this operation.

STEERING

Experiment with steering your boat in an open area before attempting downstream river running. Remember when running downstream, your speed relative to the shore is the boat's speed added to the speed of the river. You may find quick response to the helm, but due to its relatively flat-bottomed hull and lack of skeg, your boat will tend to skid in turns. You must start your turns early and use sufficient power to maintain steering control.

⚠ WARNING

If you attempt too tight a turn, at too high a speed, your boat could spin out, or even roll over.

Running upstream is easier, as the river speed is subtracted from the boat's speed, and the shore doesn't go by as fast. You can throttle back and maneuver your way through tight areas with good control. At narrow and potentially rough or dangerous passages, you should stop and study the layout. Look downstream so you will recognize it on the return trip. Once through a bad spot, you may wish to run down and travel back up the same stretch to memorize the course you find to be the best.

If you are not sure of a tight area on a downstream run, it is better to drift through on the oars with the motor tipped up, or work the boat through on a rope.

SHALLOW WATER OPERATION

The life of both impeller and water intake housing can be greatly increased by avoiding the intake of sand and gravel. Intake suction, acting on the bottom, will cause your jet drive to work like a dredge when the intake comes within 2 or 3 inches of the bottom. It is best to shut off the motor and drift up to the shore when landing, and to shove off with an oar when leaving. You can idle through areas less than 1-foot deep, but there should be more than 1 foot of water under the boat when opening the throttle for cruising or planing.

Once planing, boat speed will prevent sucking in gravel. While great suction exists at the water intake, your boat passes over the bottom so quickly that before rocks, sand, and debris have time to lift, the boat is past the disturbed area.

While boating in particularly shallow areas, remember that running on a full plane will make the boat ride higher in the water. This can allow you to travel through areas that might be impossible to traverse at slow speeds. Be sure you know the type of river bottom before attempting this, however, in case the boat hits bottom or runs aground. You should attempt planing only in areas where the bottom is sand or gravel. If you hit bottom where there are large underwater obstacles or sharp rocks, you may damage the boat and motor.

If you do run aground, shut the motor off immediately and drag the boat to deeper water. Occasionally, when running aground, a small rock may lodge between the impeller and

intake housing wall, and the motor will come to a stop. Neither starter motor nor starter rope will be able to turn it over. To remove the jam, you can remove the six screws holding the water intake housing to free the rock or, remove the motor cover and carefully rotate the flywheel counterclockwise.

⚠ WARNING

Be sure to remove the spark plug wires before attempting to turn the flywheel.

NOTE: Your jet drive is equipped with a key to protect it in the event of a rock jam. See “IMPELLER CLEARANCE SETTING” in “MAINTENANCE.”

CAUTION:

Do not attempt to use a wrench on the flywheel locknut to rotate the flywheel backward because you may loosen the nut. Proper tightening, while afloat, without the proper tools is not possible, and major damage to your motor could occur.

NOTE: Gravel passing through the pump will wear and round off the leading edges of the impeller blades. For maximum performance, file these edges occasionally to keep them as sharp as when new. See “IMPELLER” in “MAINTENANCE.”

INTAKE BLOCKAGE

Occasionally, when either holding or proceeding slowly upstream in a fast-moving, shallow area, you will lose power. This is usually caused by suction holding flat rocks, lily pads, paper, or other debris against the intake grille and restricting water intake. If you quickly stop the motor and restart it, this sort of material will fall away and full power will be restored. If, however, rocks have been jammed between the grille bars, with the motor off, they must be removed by prying them out with a suitable tool.

MOORING

If you tie your boat up at a sandy beach, where the action of waves causes the boat to rise and fall, be sure to tip the motor up out of the water. Failure to do this will result in the buildup of sand inside the intake housing, around the impeller. It is advisable to tie the boat up and shut off the motor any time it is likely to be idled for a sustained period of time.

THROTTLE USE

As with any outboard, you will get maximum economy by not running at full throttle. Running at one-third to one-half throttle, with the boat at a steep angle, leaving a large wake, will also waste fuel.

TILT AND TRIM USE

It is important for you to learn how to use the Power Trim and Tilt function properly, on those models equipped with this feature.

The Power Trim and Tilt function is convenient for use while drifting, and when operating at low throttle in very shallow areas. When under power, however, the engine should not be trimmed out in an effort to gain speed as is done with conventional propeller-drive motors.

When planing, the engine drive shaft should be either vertical or tucked under, toward the boat in order to provide a good scoop angle for the water intake grille. Tilting the motor outward, beyond a vertical position, reduces the scoop angle and can cause impeller slippage, as well as cavitation burns on the impeller blades.

Manual-tilt models should be adjusted with the tilt pin to provide a vertical engine position while under plane. See “TEST RUNNING.”

MAINTENANCE, LUBRICATION, AND STORAGE

GENERAL

Occasionally, check all mounting bolts, intake screws, linkage connections, etc., to be sure they are tight.

BEARING LUBRICATION

The need for frequent lubrication of your Yamaha Jet Drive Outboard cannot be overemphasized. **We recommend lubrication after each day's use and every 10 hours of operation. Make greasing a regular part of your cleanup.** Use only Yamalube Marine Grease, or NLG1 No. 1-rated greases with a suitable grease gun.

The bearing lubrication fitting is located at the top-left-front of the jet drive casing. It is capped with a fitting on the end of the excess-grease exit hose. Pump in enough grease to just fill the hose. To remove the hose from the fitting, press the end cap upward and toward the casing; to refit it, press the hose end cap over the fitting.

Every 30~40 hours, pump in enough extra grease to purge any moisture. The texture of the old grease coming out of the hose will provide you with an indication of conditions inside the bearing housing. A gradual increase in moisture content indicates seal wear. **If the grease begins to turn a dark, dirty gray, the bearing(s) and seals should be inspected and replaced as necessary.** Some discoloration of the grease is normal during the break-in period on a new set of seals.

IMPELLER CLEARANCE SETTING

If the impeller clearance between the impeller edge and the water intake casing wall exceeds about 1/32" (usually due to wear from operation in water with a sand or gravel bottom), the clearance can be adjusted. There are shim washers underneath the impeller. Move one or more shims from underneath to on top of the impeller. This locates the impeller further into the tapered casing to reduce the clearance. Be sure to grease the shaft hole in the impeller, the key, sleeve, and shaft threads any time it becomes necessary to remove the impeller.

See the Assembly Instructions for your model later in this manual for more detailed instructions.

NOTE: Your jet drive is equipped with a shear key to protect it in the event of a rock jam. This key can be located by removing the water intake housing and the drive shaft nut. The key holds the jet drive impeller on the drive shaft. This is similar to that on a propeller drive. After replacing the key, draw the shaft nut up tight (17 ft-lb) to remove any play between the impeller and shaft. Note the position of the impeller shim washers, and replace them in the same order as removed.

LINKAGE ADJUSTMENT

Occasionally, check the adjustment of the shift linkage. In "Forward," the reverse gate should be firmly locked. This will eliminate rattle and prevent wave action from accidentally shifting the gate into reverse. (See "ADJUSTMENTS" for the proper procedures.)

SALT WATER OPERATION

Both aluminum and stainless steel have been extensively used in the construction of your jet drive. These and other materials have been either treated or are inherently resistant to corrosion. In addition, the intake grille, special key, and exhaust tube are galvanized to further minimize corrosion. It is still recommended, when not in use, the motor be tipped up so the jet drive casing is out of the water.

CAUTION:

If your jet drive is used in salt water more than fresh water, remove all mounting hardware, and grease it at least once every six months. Failure to do this may result in the hardware being difficult, if not impossible, to remove at a later date.

NOTE: To facilitate removal of an impeller that has frozen to the drive shaft, use a hammer and a block of wood, and tap the impeller blades in the direction of engine rotation. This will release the shear key.

ADDED NOTE: A slightly distorted shear key may be reused.

STORAGE

Consult your Outboard Owner's Manual for preparing the motor part of your jet drive for storage. In addition, clean and grease all hardware. Remove and refit the jet drive impeller, greasing the bore, key, and plastic sleeve.

ADJUSTMENTS

SHIFT CAM ASSEMBLY WITH NEUTRAL ADJUSTMENT

A shift mechanism has been incorporated that includes an adjustable shift cam. When properly adjusted and in the neutral position, the forward thrust of the jet-driven outboard will be negligible.

NEUTRAL ADJUSTMENT OF ALL MODELS

- Loosen the inner pivot bolt for the shift cam.
- Using a light finger pressure on the gate, move the gate toward reverse until the cam roller is nested in the neutral notch of the cam. Holding the gate in this position, rotate the eccentric until the gate clears the underside of the nozzle hood by the width of the clearance gauge. Keep the high lift side of the eccentric facing in the upper side of the circle during this adjustment. Tighten the bolt to lock the hex cam eccentric in this position. Torque to 8~9 ft-lb. Recheck the setting.

CLEARANCE GAUGES-FULL SIZE	
TRACE AND CUT OUT TO USE TO SET ECCENTRIC FOR NEUTRAL POSITION.	
#1173 LARGE SERIES 2-1/2" EXHAUST PIPE	15/32"
#1176 MEDIUM SERIES 2" EXHAUST PIPE	9/16"

- Adjust the shift cable ends and the cable anchor bracket on the jet drive so the roller is in the neutral nest when the shift handle is in neutral. Tighten both the cable and nuts.

- Shift to forward. The roller should be at the end of the slot in the cam so the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.

If the forward lock condition is not met, readjust the cable positions, giving less importance to the roller position in neutral.

- If the neutral position is too far out of adjustment, the tendency for the gate to move toward reverse, under water pressure, will put tension on the cable while in neutral. In some remote control boxes, this makes it difficult to re-engage the shift mode with the motor running in the high-speed idle, cold-starting setting. It is then necessary to stop the motor, operate the shift handle to engage the shifting pin, and then restart the motor.

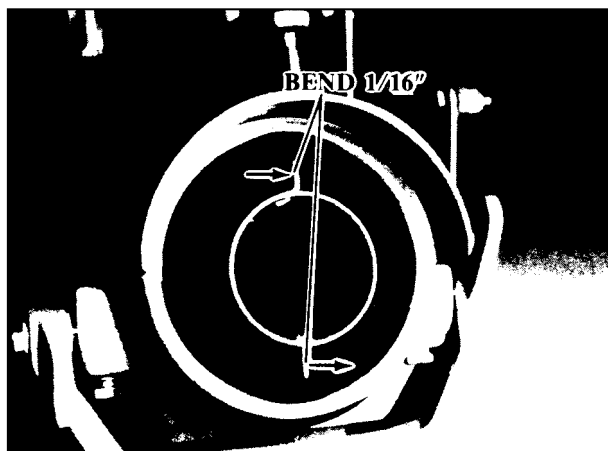
CAUTION:

If not properly adjusted, the reverse gate can be engaged by forward motion of the boat. This will cause the engine to kick up and out of the water, similar to hitting a submerged object in a propeller-driven craft.

Do not be concerned if, after proper linkage and cable adjustments, the reverse gate does not fully close when the shifter is operated; water pressure will close it all the way during normal operation.

TRIM

On some applications, your boat may tend to pull to starboard. This condition can easily be corrected by bending the trailing edge of the flow-straightening fins located at the top and bottom of the exhaust tube 1/16" toward the starboard side of the motor.



IDLE

In most cases, the stock idle adjustment will produce an acceptable neutral. However, since neutral is a balance between forward and reverse forces, some slight creeping of the boat may occur at idle. A minor idle-speed adjustment should correct this tendency.

PERFORMANCE TIPS

Here are some pointers for obtaining maximum performance from Jet Drive outboards:

1. Keep the leading edges of the impeller sharp. Edges that have been blunted by gravel beyond 1/32" tend to break up the water. This results in slippage and engine overspeeding.
2. Keep the grille bars parallel to prevent large rocks or other debris from entering the impeller, causing damage or possibly lodging in the nozzle.
3. Select as light a hull as possible for the intended use.
4. Keep the boat bottom smooth and free of dents. This will reduce drag and air entrapment.
5. The optimum bottom width is 48 to 60 inches. Beyond 60", the boat rides so high that air is allowed to enter the pump. This is likely in choppy water particularly when running with the wind. Less than 48", on the other hand, can make it difficult to reach a plane with a heavy load.
6. A slight vee in the boat bottom gives better steering and helps to keep solid water in the pump. A 3" drop at centerline on a 60" bottom is enough. Beyond that, shallow draft is sacrificed.
7. The power trim is useful to bring a heavy load on plane. Tipping the engine under points the jet stream down, which helps lift the stern. After reaching a plane, trim the engine out until the jet stream is horizontal (the engine driveshaft is vertical).

CAUTION:

Do not trim the engine out beyond horizontal, so the jet stream points up into the air or the bow lifts. This will reduce the ram angle on the water intake and will cause severe cavitation burns on the impeller blades.

Power trim is also useful when running slowly in shallow water, such as when backing off the beach. In these conditions, the engine can be tilted back 15° to 20°, reducing the tendency to pick up gravel. Keep your eye on the cooling water pilot hole to make sure the engine is getting water.

8. Stainless steel impellers are available. They can extend life in areas where it is difficult to avoid gravel intake.

If you have trouble locating these impellers on the market, contact your Yamaha Outboard Dealer.

If you experience difficulty removing the impeller, remember the impeller doesn't corrode with the shaft. To prevent this there is a delrin® sleeve separating them. What can happen, however, is that the driving torque causes the flat on the shaft to "cam" or wedge the key in the impeller.

To relieve this wedging, rotate the impeller on the shaft until the keyway in the impeller is perpendicular to the flat on the shaft. This can be done with a soft hammer on a block of wood, or by using a C-clamp on one blade and bumping that.

The impeller is now free to pull it. If necessary, use two wood levers, about 3/4" x 1-1/2" x 12", wedged under the blades against the housing flanges to assist with removing the impeller.

9. Some larger displacement jet drives can experience a performance problem above 4500 rpm up to 5500 rpm. On affected units, there may be little or no change in boat speed, only increased noise. This may be impeller cavitation. This can happen if the impeller liner is pushed too far into the foot.

Look into the jet from the bottom of the foot. If the liner is pushed too far in, you'll notice a lip that the water is going around. To correct the problem, remove the grates and grind down this lip to make a smooth path for the water.

OVERHAUL PROCEDURES

NOTE: It is recommended that these procedures be performed by only your authorized Yamaha Outboard Motor Dealer.

DISASSEMBLY

Refer to "ASSEMBLY AND INSTALLATION," and reverse the procedures outlined there.

BEARING HOUSING

1. Remove the large beveled circlip from the bearing housing. Gently warm the housing with a torch until it is just too hot to comfortably touch.

CAUTION:

Do not apply too much heat, because the seals may be damaged.

2. Holding the drive shaft vertically, bump the impeller end of the shaft against a wooden block until the housing slides down off the bearings.
3. Note the direction of thrust faces of the bearing(s), and press the bearing(s) off the drive shaft. Leave the round thrust ring on the shaft, unless it is damaged. Remove the seals from the bearing housing and upper seal housing. Clean all parts thoroughly and remove all burrs.

NOTE: The inner seals are located on both sides by spiral seal-retaining rings that must be removed prior to extraction of the inner seals.

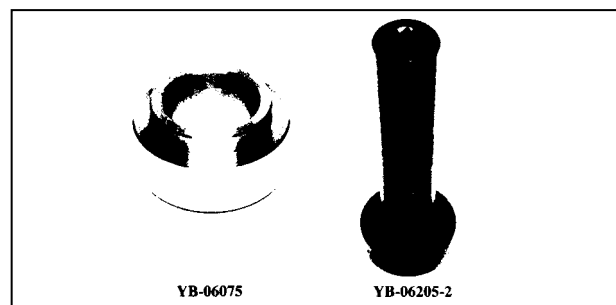
FOR F40 AND F60 MODELS ONLY:

4. Before pressing on the collar, first, install the coated thrust washer with the gray teflon coating facing the bearing. Note the direction of the thrust face, and press the new bearing onto the shaft, **pressing against the inner race only**. Press against the thrust ring, locking it in its groove.

FOR F90 AND F115 MODELS ONLY:

Using Yamaha special tool #YB-06075, note the direction of the thrust faces, and press the new bearings on the shaft, **pressing against the inner races only**. Press against the thrust ring, locking it in its groove. (See the illustrations on the next page.)

5. To install the seals, install the inner seal retainer ring first. Place a light film of grease on each surface before pressing in the seals. The round spring of each seal faces outward.



6. Install the outer seal retaining rings before pressing in the outer seals; align the notched ends of the retaining ring to straddle the small vent hole drilled in the ring groove.
7. Grease all seal lips. Fill the cavity around the spring in the seals with grease and install the outer seals.
8. Grease the two O-rings and install them in their grooves in the upper seal housing. Apply a thin film of grease inside the housing bore to ease entry of the bearing(s) and O-rings.

FOR F40 AND F60 MODELS ONLY:

- Slip the bearing housing over the shaft. Heat the housing slightly again. **It is important to slide the housing on squarely, and to not use a hammer, or in any way apply impact loads to the balls.** If you use a hand press, **press only against the outer race of the bearing.** Only a light press is needed if everything is lined up properly.

FOR F90 AND F115 MODELS ONLY:

Slip the bearing housing over the shaft. Support the bearings and drive shaft, using Yamaha special tool #YB-06205-2. Heat the the housing slightly again. **It is important to slide the housing on squarely, and to not use a hammer, or in any way apply impact loads to the balls.** If you use a hand press, **press only against the outer race of the bearings.** Only a light press is needed if everything is lined up properly.

NOTE: When using a special tool #YB-06205-2, the housing will slide on only part way; therefore, remove the tool, slide the seal housing into place as a spacer, reinstall the tool, and continue pressing the housing until it fully bottoms out; remove the seal housing assembly.

10. FOR F40 AND F60 MODELS ONLY:

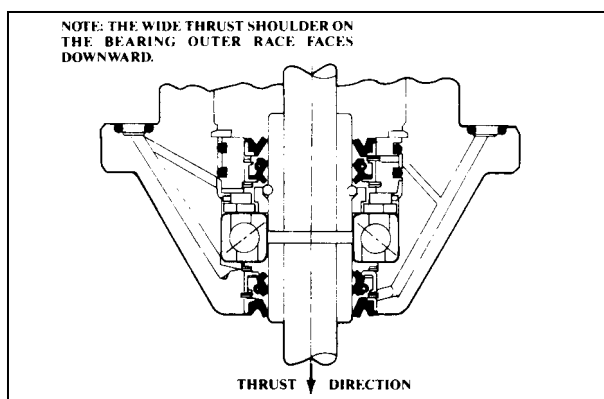
Install the spacer washer.

FOR F90 AND F115 MODELS ONLY:

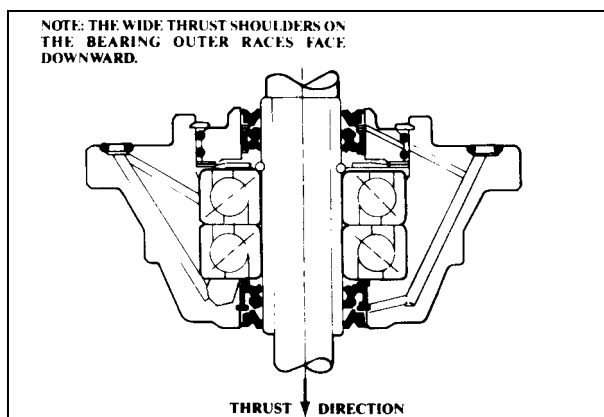
Install the backup washer against the upper bearing, **with the dished center section facing upward.**

- Install the upper seal housing assembly being careful not to damage the O-rings as they pass the snap ring groove. Only finger pressure should be necessary here.
- Install the beveled circlip **bevel-side upward.**
- Fit the drive shaft assembly into the jet drive casing, and fill with grease, using the grease gun supplied with the jet drive. If using a hand-lever gun, pump very slowly avoiding build up of internal grease pressure and damaging either the seals or the housing.

F40 & F60 MODELS



F90 & F115 MODELS



REASSEMBLY

To re-assemble your jet drive, follow the assembly procedures in "ASSEMBLY AND INSTALLATION."

LINER REPLACEMENT

F40/F60

- Remove the intake assembly from the jet drive casing by removing the six bolts holding it in place.
- Remove and discard the two bolts holding the liner inside the intake assembly.
- Lift out the old liner. If needed, use a hammer and a long drift inserted through the intake grille to tap on the bottom edge of the old liner to help loosen it.
- Insert the new liner, being careful to align the holes in the liner with the holes in the intake assembly. Use a soft hammer, if needed, to tap the liner into place.

5. Install two new 1/4-20 x 5/8" bolts to hold the liner in place. Grease the bolt threads first, then tighten the bolts to 11 ft-lb.
6. Use a grinder, if needed, to remove any part of the bolts that protrude inside the liner. Sand or file off any burrs in the liner/bolt area.

CAUTION:

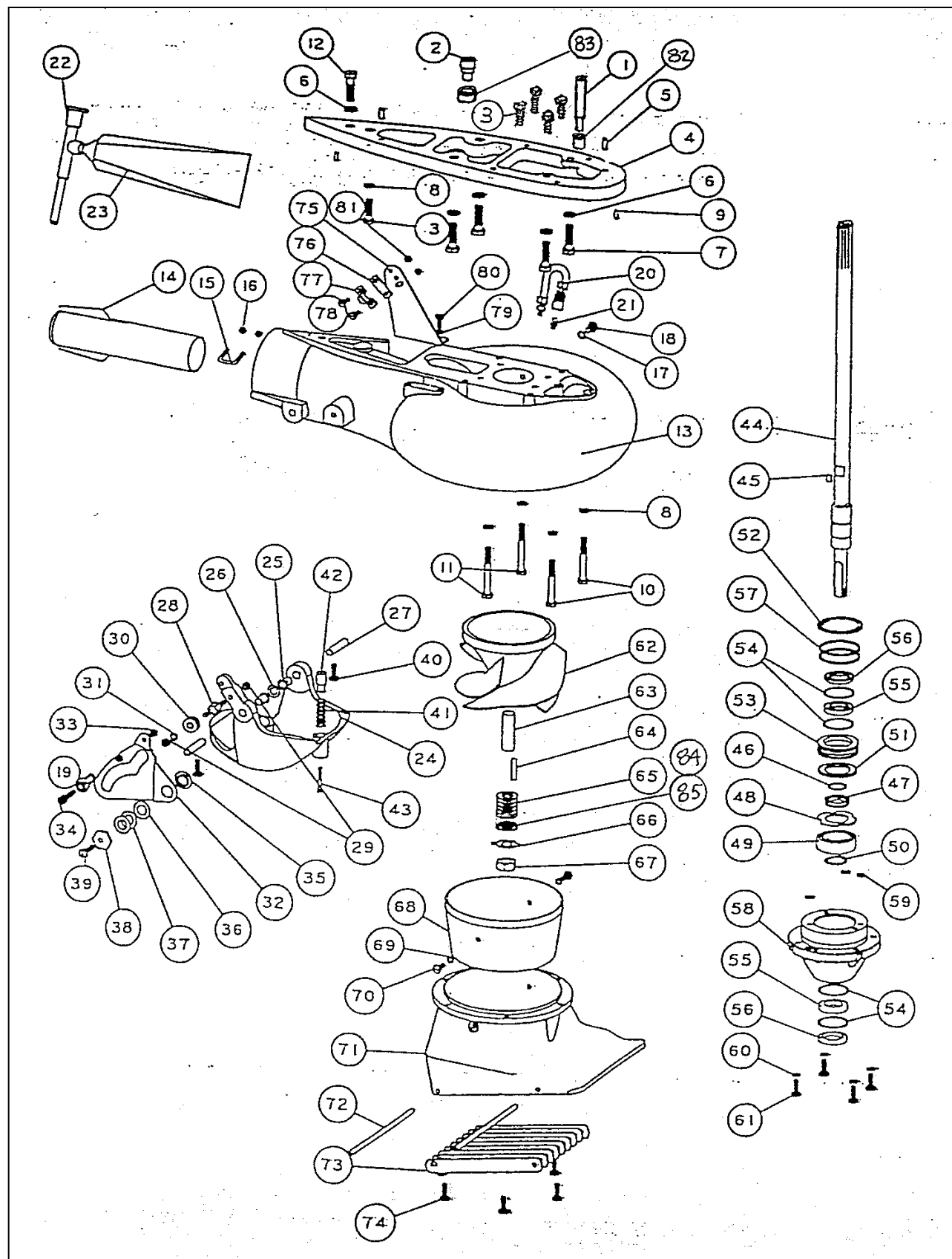
The impeller can be damaged if the liner is not smooth inside in the mounting bolt area.

7. Reinstall the intake assembly temporarily with two bolts, then check clearance **between the liner and the impeller. It should be 1/32"**. If necessary, move shims above or below the impeller as described in the Assembly Instructions on Page 16 (F40) or Page 22 (F60) to achieve the proper clearance.
8. Remove the six mounting bolts **again, grease the threads, then reinstall them. Tighten the bolts to 9 ft-lb.**

F90/F115

1. Remove the six nuts holding the intake assembly to the jet drive casing. Remove the intake assembly.
2. The liner is held in place by a 1/8"-thick flange. Lift the old liner out of the intake assembly and install the new one.
3. Reinstall the intake assembly temporarily with two nuts, then check clearance *between the liner and the impeller. It should be 1/32"*. If necessary, move shims above or below the impeller as described in the Assembly Instructions on Page 28 (F90) or Page 34 (F115) to achieve the proper clearance.
8. Remove the six mounting nuts again, grease the threads of the studs, then reinstall them. Tighten the nuts to 12 ft-lb.

F40 PARTS LIST
4-STROKE 3-CYLINDER



F40 PARTS LIST

4-STROKE 3-CYLINDER

REF NO	DESCRIPTION	QTY.
1	Shift Rod Guide	1
2	Water Tube Ext. AJ	1
3	Bolt Hex Hd M8 1.25 x 30mm	5
4	Adapter Plate AJ	1
5	Dowel Pin 6 x 16mm	2
6	Washer Spring Lock M10	5
7	Bolt Hex Hd M10 1.25 x 35mm	4
8	Washer Spring Lock 5/16	5
9	Dowel Pin 3/16 x 1/2	2
10	Bolt Hex Hd 5/16-18 x 2-1/2	2
11	Bolt Hex Hd 5/16-18 x 2-3/4	2
12	Bolt Hex Hd 3/8-16 x 1-1/2	1
	Volute with Gate AJ	
13	Volute with Exhaust Tube AJ	1
14	Exhaust Tube Ass'y Medium 2	1
15	Clip Exhaust Tube 1	1
16	Nyloc 10-32	2
17	Washer Fiber 3/8	1
18	Bolt Hex Hd 3/8-16 x 1/2	1
19	Ball End 1/4 x 10-32 Cable	1
20	Lube Hose Ass'y	1
21	Zirc Fitting 1/4-28	1
22	Grease Gun	1
23	Grease 10 oz. Tube	1
24	Reverse Gate, Medium	1
25	Nyliner 3/8 1D x 11/16	2
26	Spring Gate Pivot 3/8	1
27	Pin Gate Pivot 3/8 Medium	2
28	Shaft Roller	1
29	Nyloc 1/4-28	2
30	Roller Ass'y	1
31	1/4 Washer	1
32	Shift Cam Medium	1
33	Nyloc 1/4-20	1
34	Bolt Hex Hd 1/4-20 x 3/4	1
35	Bushing C	1
36	Washer Cam	1
37	Shim-Cam	2
38	Cam Eccentric Drilled	1
39	Bolt Hex Hd 1/4-20 x 1 Patch	1
40	Bolt Hex Hd 1/4-20 x 3/4 Patch	2
41	Spring Gate Bumper	1
42	Gate Bumper	1
43	Fil Hd Slotted 10-32 x 1-1/4 patch	1

SIZE	TORQUE
1/4-20 (M6)	8-9 Ft-lbs.
5/16-18 (M8)	12 Ft-lbs.
3/8-16 (M10)	22 Ft-lbs.

REF NO	DESCRIPTION	QTY.
44	Shaft Only, AJS-43, 14T 24 9/16 LG	1
	Shaft Assy Complete, AJS-43, 14T 2/1275 Key	
44	Shaft Only, AJL-43, 14T 29 9/16 LG	1
	Shaft Assy Complete, AJL-43, 14T w/1275 Key	
45	Key, Tee Water Pump	1
46	Shaft Bearing Thrust Ring	1
47	Collar Backfit	1
48	Thrust Washer	1
49	Bearing	1
50	Truarc	1
51	Spacer	
52	Truarc	1
53	Upper Seal Carrier w/Seals & O-Rings	1
54	Spirolox	4
55	Seal Inner	2
56	Seal Outer	2
57	O-Ring 3/32 x 1-15/16 x 2-1/8	2
58	Bearing Carrier w/Seals & O-Rings AJ	1
59	O-Ring 1/16 x 5/16 x 7/16	3
60	Washer Spring Lock 1/4	4
61	Bolt Hex Hd 1/4-20 x 3/4	4
62	Impeller 6-1/8 w/36 Sleeve	1
63	Shaft Sleeve Plastic Medium	1
64	Impeller Tee Key 1/2 Round	1
65	Shim Washer Medium	7
66	Nutkeeper Med/Pkg 2 per bag	1
67	Shaft Nut 5/8-18 Brass	1
	Intake Ass'y 6-1/8 w/Grill & liner	
68	Liner 6-1/8 w/Hardware	1
69	Washer Spring Lock 1/4	2
70	Bolt Hex Hd 1/4-20 x 5/8	2
71	Intake Painted Only	1
72	Grill Rod	2
73	Grill Bar Medium	9
74	Bolt Hex Hd 1/4-20 x 3/4	6
	Bracket Ass'y Morse w/Clamp & Hdwr	
75	Bracket Cable Support	1
76	Shim Morse	1
77	Clamp Chrys	1
78	Fil Hd Slotted 10-24 x 5/8	2
79	1/4 Washer	2
80	Bolt Hex Hd 1/4-20 x 5/8	2
81	Nyloc 10-24	2
82	Cushion-Shift Rod Guide	1
83	Spacer-Water Tube	1
84	Rubber Washer	1
85	Cup	1
	Note: Flush Screw & Washer Metric	
17	Washer Fiber M8	1
18	Bolt Hex Hd M8 1.25 x 12	1

F40 ASSEMBLY INSTRUCTIONS

1. Place the engine on the transom of your boat, so it is mounted vertically, in the normal fashion.
2. Install the jet drive shaft assembly into the spiral pump housing locking it in place with the four 1/4-20 x 3/4" bolts and lock washers. Use grease on the threads. Tighten to 8 ft-lb.
3. Insert the clear plastic 1/2" long x 3/8" dia. sleeve in the 3/8" hole in the main housing, just ahead of the cooling water pump.

CAUTION:

The 4-stroke jet unit must use a newly designed water pump housing which is supplied by Yamaha. Failure to use this housing will result in engine damage.

Install the water pump assembly using only the 4-stroke water pump housing on top of the stainless steel plate. Use four M8 x 30mm bolts and the special steel washers under the bolt heads. **Be sure also, to install the water pump impeller drive key and dowel pins.** Grease the threads. Before tightening the bolts, press the 3-7/8" long x 1/2" dia. plastic shift rod guide into the clear plastic sleeve, through the stainless steel plate, until it bottoms. Tighten the bolts.

4. Remove the plastic water tube guide and rubber sleeve from the outlet of the cooling pump. Install the 5/8" dia. x 1/4" long plastic spacer in the outlet, followed by the rubber sleeve and the brass water tube extension. If there is a burr on the end of the motor cooling tube, file it smooth so the O-ring inside the water tube extension will slide on.

5. The large 3/4" adapter plate is attached to the exhaust housing to hold the jet drive. Two 6 x 16mm dowels locate the plate, four M10 x 35mm bolts with lock washers and one M8 x 30mm bolt with lock washer secure it. Grease the threads.
6. Next, attach the jet-drive unit to the motor. Use two 5/16-18" x 2-1/2" bolts (front), two 5/16-18" x 2-3/4" bolts (rear) from below with lockwashers, one 3/8-16" x 1-1/2" bolt and lockwasher, above rear, inside the motor mid-section and two 3/16" x 1/2" dowel pins.

Grease the bolt threads, drive shaft spline (generously), and rubber water tube pilot. Guide the jet drive unit into place. Tighten the five bolts.

7. Next, install the impeller. Grease the shaft threads, key and impeller bore. Place the plastic sleeve inside the impeller, hold the key in the nose of the impeller with your forefinger and slide onto the driveshaft. Install the seven shim washers, rubber washer, cup and nut retainer on the shaft, up against the impeller, and bring the nut up snug by hand. **Be careful the retainer does not fall into the thread groove and jam the nut.**

Place the water intake in position and secure with two bolts. Observe the clearance between the impeller blade edge and the intake liner. Then, remove the intake.

When, after use in sand and gravel, the blade clearance becomes more than about 1/32" between the impeller edge and the water intake liner, one or more of the stainless steel shim washers can be transferred from the bottom stack to the top of the impeller. This moves the impeller down into the tapered casing to reduce the clearance.

NOTE: Shims should not be used above the impeller on new installations, where no wear has occurred, unless the blade clearance exceeds 1/32". Insufficient blade clearance will do more harm than good from any performance gains it might provide.

When the impeller clearance is satisfactory, bump the nut up snug with a wrench. If the ears of the retainer do not line up with the flats on the nut, spin the nut off, turn the retainer over and tighten the nut again. In one of these two positions, you will have alignment and can fold the ears up against the nut to retain it. The flat in the retainer is angled to the ears to allow for this.

8. Place the intake casing in position with the lower end at the rear and tighten the six 1/4-20" x 3/4" hex head bolts. **No lock-washers are used.**
9. If your jet drive was ordered for use with a steering tiller handle, see "Shift Cable Assembly."
10. If your motor is equipped for remote controls, proceed as follows:

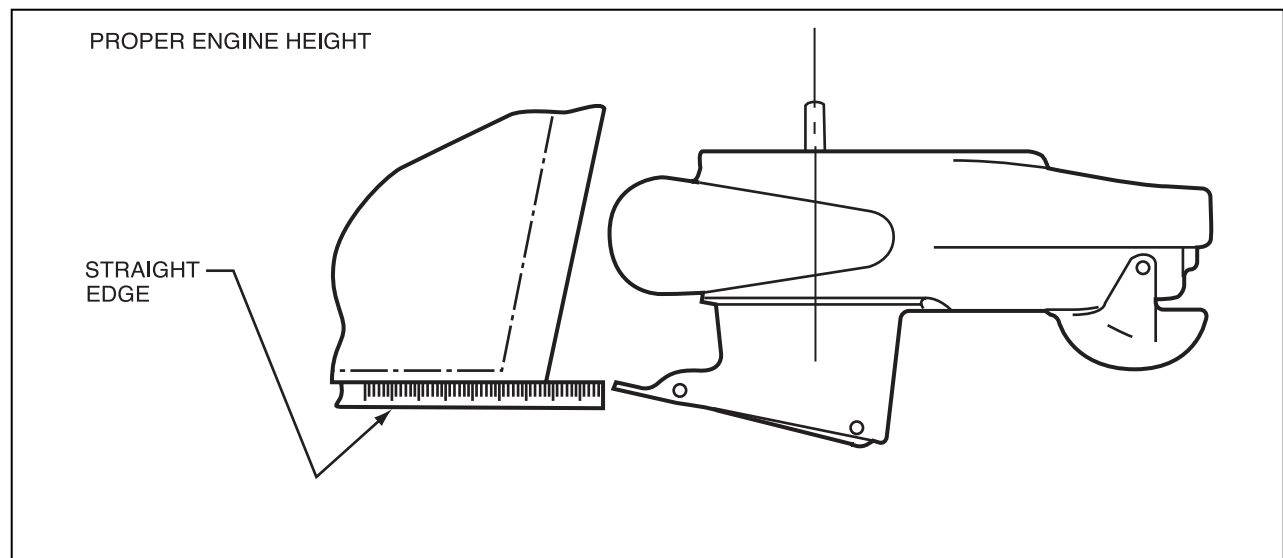
Attach the shift cable and cable anchor bracket to the jet drive. With the shift handle and the reverse gate in forward, with the cam roller at the end of the slot, adjust the cable end and/or cable anchor position to this condition. Shift to reverse and back to forward. The roller should be at the end of the cam slot so the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.

If this forward lock condition is not met, re-adjust the cable positions.

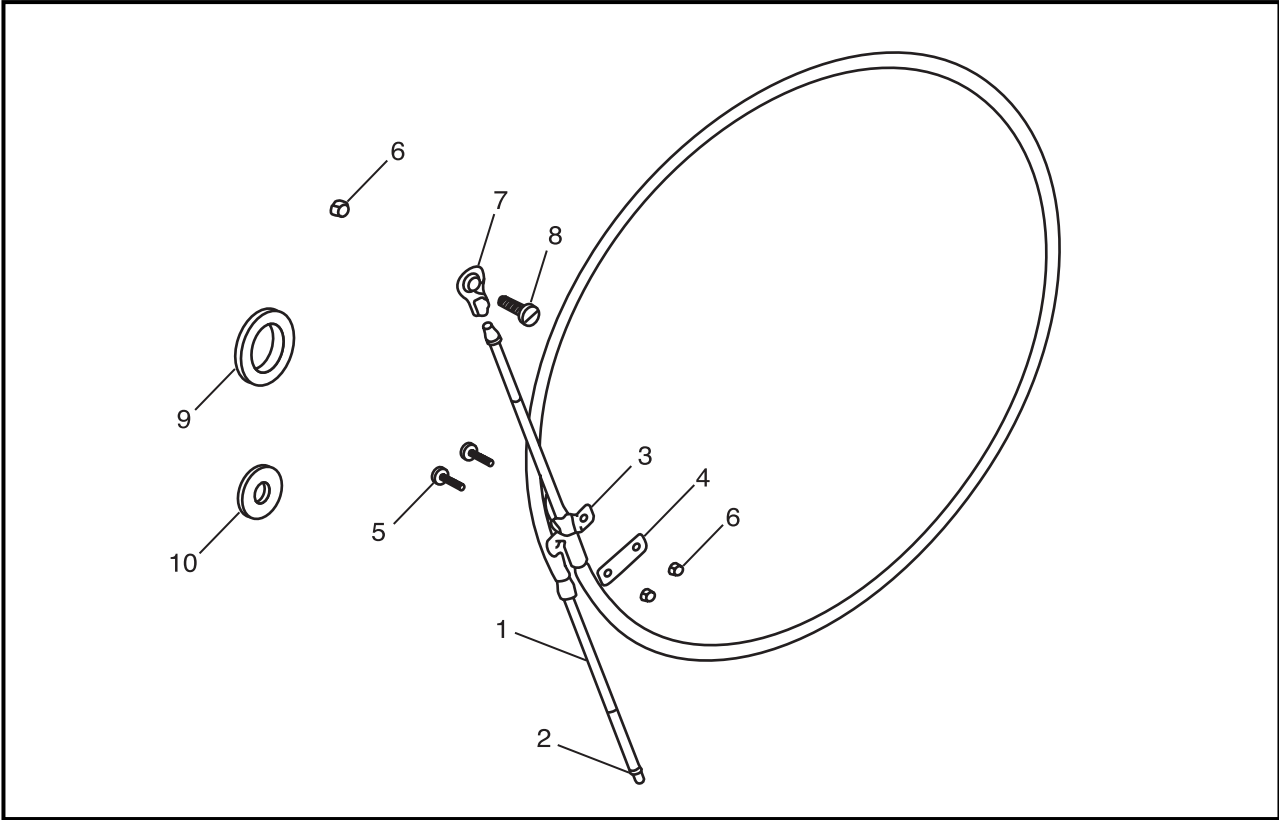
11. Refer to "Engine Mounting" on page 5 to finish installation.

CAUTION:

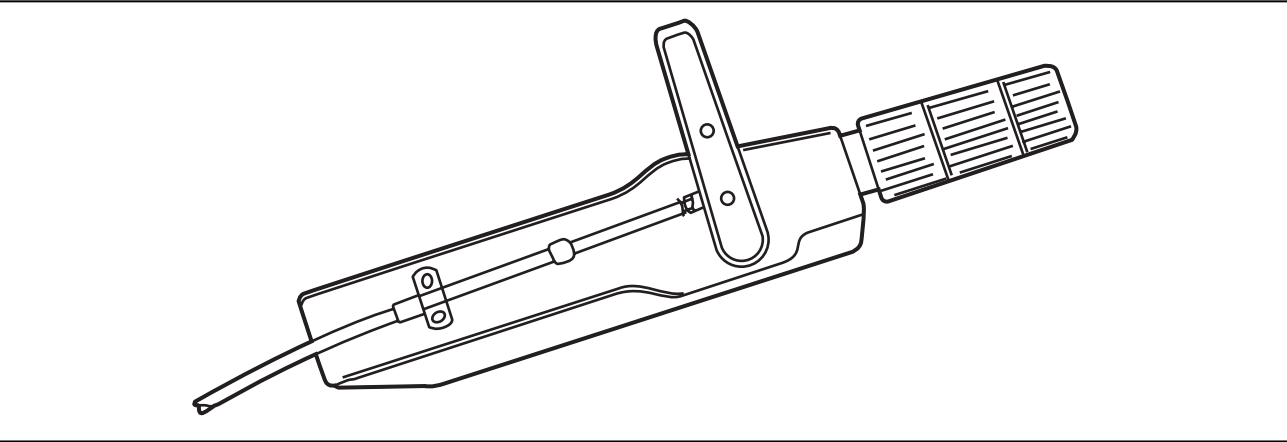
When starting the engine for the first time, watch to see that cooling water comes out of the small hole at the rear side of engine just below the powerhead. This is to check your assembly of the cooling water pump and its connections.



F40
SHIFT CABLE ASSEMBLY – TILLER STEERING



REF.	DESCRIPTION	QTY.
1	Cable 4' Mor 33C Supreme AJS	1
2	Cable 4-1/2' Mor 33C Supreme - AJL	1
3	Clamp Chrys	1
4	Shim Morse	1
5	Fil Hd Slotted 10-32 x 1-1/4	2
6	Nyloc 10-32	3
7	Ball End #10 x 10 - 32 Cable	1
8	Screw Hex Hd 10-32 x 3/4 Mod	1
9	Shim Washer Large	1
10	Shim Washer Small	1



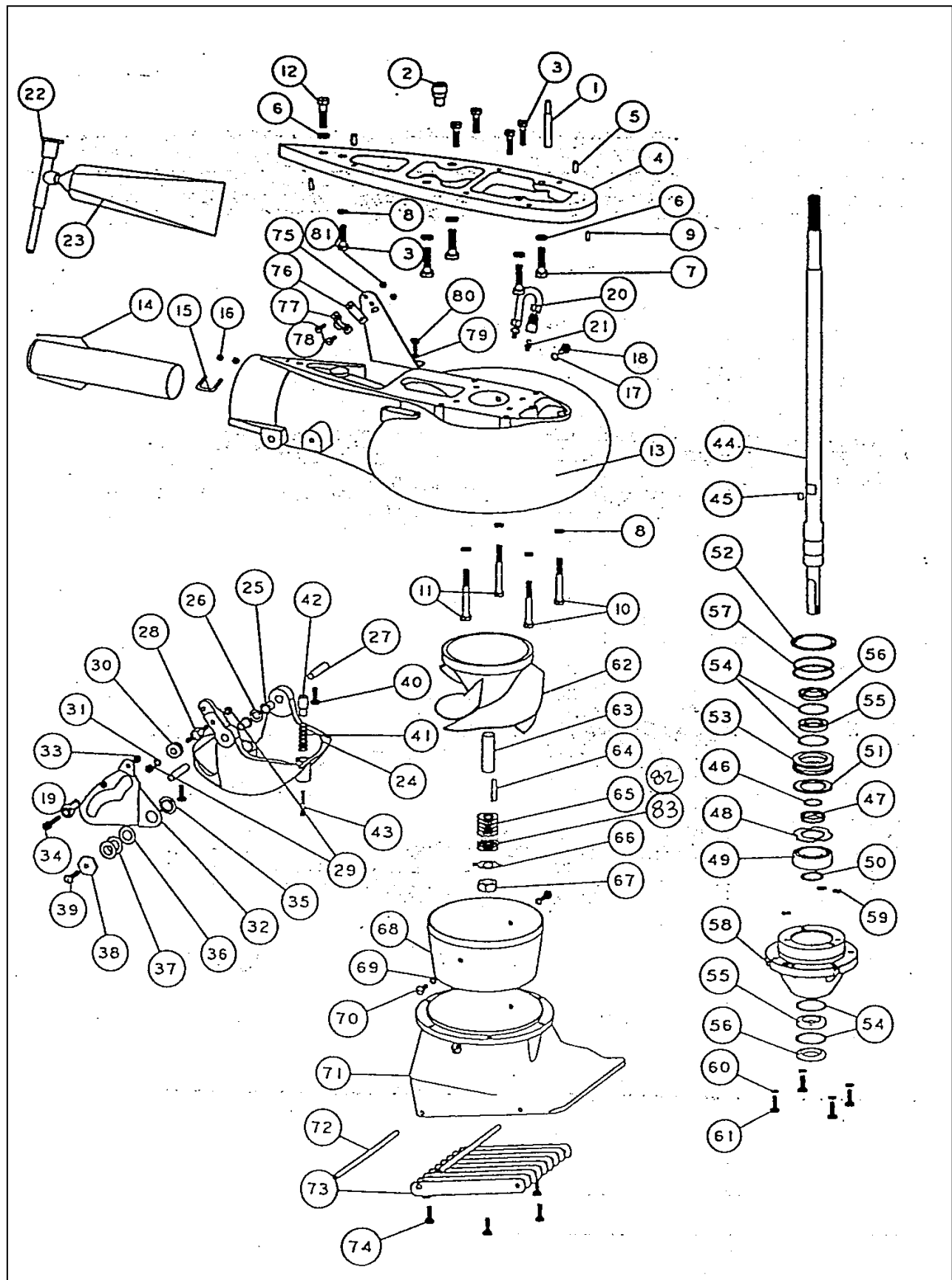
F40 TILLER STEERING – SHIFT CABLE ASSEMBLY

1. Remove the plastic covers from the shift handle and the steering arm. Remove the shift handle.
2. Cut out the template for the shift handle and the cable anchor position on the steering arm.(See page 40)
3. Fold the cable anchor pattern along the dotted lines and place it on the steering arm with the fork up inside, straddling the threaded boss. Tape in position.
4. Place the shift handle pattern over the handle boss. Tape in position. Center punch the three hole locations and drill through using a 3/16" drill. The holes in the steering arm are long, reaching through the threaded boss itself.
5. Attach the ball rod end to the shift handle and tighten the thin-head hex screw and lock nut. Remove the flanged plastic bushing, place the 1/16" thick spacer washer on the handle and replace the flanged bushing. Place the smaller 1/16" thick spacer over the square driver and install the handle.
6. Thread the shift cable all the way into the shift handle rod end. Attach the cable body to the steering arm using the shim, U-clamp, two #10-32 x 1-1/4" screws and lock nuts.
7. Attach the lower end of the cable to the jet drive, with the ball rod end threaded on the cable, as far as it will go, and the cable anchor bracket slid forward and locked. Twist the cable in the U-clamp, so the cable rests against the motor cowling. Tighten the clamp screws.
8. Place the shift handle in forward, solidly in the detent. **The reverse gate cam roller must be at the end of the slot in the cam.** If these conditions are not met, slide the cable anchor bracket on the jet drive and/or adjust the threaded rod end on the cable.
9. Shift to reverse and back to forward. Do not be concerned if the gate does not reach reverse. There is clearance at this position and water pressure will close the gate.
10. In forward, with the roller at the end of the cam slot, the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.
11. Lock the nuts on the cable against the rod ends to complete the adjustment and install the plastic covers.

CAUTION:

You must return the throttle to idle before shifting.

F60 PARTS LIST
4-STROKE 4 -CYLINDER



F60 PARTS LIST
4-STROKE 4-CYLINDER

REF NO	DESCRIPTION	QTY.
1	Shift Rod Guide AJ	1
2	Water Tube Ext, AJ	1
3	Bolt Hex Hd M8 1.25 x 30mm	5
4	Adapter Plate AJ	1
5	Dowel Pin 6 x 16 mm	2
6	Washer Spring Lock M10	5
7	Bolt Hex Hd M10 1.25 x 35mm	4
8	Washer Spring Lock 5/16	5
9	Dowel Pin 3/16 x 1/2	2
10	Bolt Hex Hd 5/16-18 x 2-1/2	2
11	Bolt Hex Hd 5/16-18 x 2-3/4	2
12	Bolt Hex Hd 3/8-16 x 1-1/2	1
	Volute with Gate AJ	
13	Volute w/Exhaust Tube AJ	1
14	Exhaust Tube Ass'y Medium 2	1
15	Clip Exhaust Tube 1	1
16	Nyloc 10-32	2
17	Washer Fiber 3/8	1
18	Bolt Hex Hd 3/8-16 x 1/2	1
19	Ball End 1/4 x 10-32 Cable	1
20	Lube Hose Ass'y	1
21	Zirc Fitting 1/4-28	1
22	Grease Gun	1
23	Grease 10 oz. Tube	1
24	Reverse Gate, Medium	1
25	Nyliner 3/8 1D x 11/16	2
26	Spring Gate Pivot 3/8	1
27	Pin Gate Pivot 3/8 Medium	2
28	Shaft Roller	1
29	Nyloc 1/4-28	2
30	Roller Ass'y	1
31	1/4 Washer	1
32	Shift Cam Medium	1
33	Nyloc 1/4-20	1
34	Bolt Hex Hd 1/4-20 x 3/4	1
35	Bushing Cam	1
36	Washer Cam	1
37	Shim Cam	2
38	Cam Eccentric Drilled	1
39	Bolt Hex Hd 1/4-20 x 1 Patch	1
40	Bolt Hex Hd 1/4-20 x 3/4 Patch	2
41	Spring Gate Bumper	1
42	Gate Bumper	1
43	Fil Hd Slotted 10-32 x 1-1/4 Patch	1
44	Shaft Only, AJS, 14T 25-1/36 LG	1
	Shaft Ass'y Complete, AJS, 14T W/1275 Key	
44	Shaft Only, AJL, 14T 30-1/16 LG	1
	Shaft Ass'y Complete, AJL, 14T W/1275 Key	
44	Shaft Only, AJL, 14T 4-Stroke	1
	Shaft Ass'y Complete, AJL, 14T, 4-Stroke	
44	Shaft Only, AJL, 16T, 4-Stroke	1
	Shaft Ass'y Complete AJL, 16T, 4-Stroke	
45	Key, Tee Water Pump	1
46	Shaft Bearing Thrust Ring	1
47	Collar Backfit	1
48	Thrust Washer	1

REF NO	DESCRIPTION	QTY.
49	Bearing	1
50	Truarc	1
51	Spacer	1
52	Truarc	1
53	Upper Sel Carrier w/Seals & O-Rings	1
54	Spirolox	4
55	Seal Inner	2
56	Seal Outer	2
57	O-Ring 3/32 x 1-15/16 x 2-1/8	2
58	Bearing Carrier w/Seals & O-Rings AJ	1
59	O-Ring 1/16 x 5/16 x 7/16	3
60	Washer Spring Lock 1/4	4
61	Bolt Hex Hd 1/4-20 x 3/4	4
62	Impeller 6-1/8 w/36 Sleeve Full 8.23	1
63	Shaft Sleeve Plastic Medium	1
64	Impeller Tee Key 1/2 Round	1
65	Shim Washer Medium	7
66	Nutkeeper Med/Pkg 2 per bag	1
67	Shaft Nut 5/8-18 Brass	1
	Intake Ass'y 6-1/8 w/Grill & Liner	
68	Liner 6 1/8 w/Hardware	1
69	Washer Spring Lock 1/4	2
70	Bolt Hex Hd 1/4-20 x 5/8	2
71	Intake Painted Only	1
72	Grill Rod	2
73	Grill Bar Medium	9
74	Bolt Hex Hd 1/4-20 x 3/4	6
	Bracket Ass'y Morse w/Clamp & Hardware	
75	Bracket Cable Support	1
76	Shim Morse	1
77	Clamp Chrys	1
78	Fil Hd Slotted 10-24 x 5/8	2
79	1/4 Washer	2
80	Bolt Hex Hd 1/4-20 x 5/8	2
81	Nyloc 10-24	2
82	Rubber Washer	1
83	Cup	1
	NOTE: Flush Screw & Washer (metric on blue volutes.)	
17	Washer Fiber M8	1
18	Bolt Hex Hd M8 1.25 x 12	1

SIZE	TORQUE
1/4-20 (M6)	8-9 Ft-lbs.
5/16-18 (M8)	12 Ft-lbs.
3/8-16 (M10)	22 Ft-lbs.

F60 ASSEMBLY INSTRUCTIONS

1. Place the engine on the transom of your boat, so it is mounted vertically, in the normal fashion.
2. Install the jet drive shaft assembly into the spiral pump housing locking it in place with the four 1/4-20 x 3/4" bolts and lock washers. Use grease on the threads.

CAUTION:

Yamaha has designed a new water pump housing that must be used on the 4-stroke engine. Failure to use this housing will result in engine failure.

3. Install the water pump assembly using only the 4-stroke water pump housing on top of the gasket and stainless steel plate. Use four M8 x 30mm bolts and the special steel washers under the bolt heads. **Be sure to install the water pump impeller drive key and dowel pins.** Grease the threads.
4. Install the plastic shift rod guide in the spline of the shift rod and the brass water tube extension onto the copper water tube. If there is a burr on the end of the water tube, file it smooth so the O-ring inside the water tube extension will slide on.
5. The large 3/4" adapter plate is attached to the exhaust housing to hold the jet drive. Two 6 x 16mm dowels locate the plate, four M10 x 35mm bolts with lock washers and one M8 x 30mm bolt with lock washer secure it. Grease the bolt threads.
6. Next, attach the jet drive to the motor. Use two 5/16-18 x 2-1/2 bolts (front), two 5/16-18 x 2-3/4 bolts (rear) from below with lock washers, one 3/8-16 x 1-1/2 bolt and lockwasher, above rear, inside the motor mid-section, and two 3/16 x 1/2 dowel pins.
Grease the bolt threads, driveshaft spline, and rubber water tube pilot generously. Guide the jet into place. Tighten the five bolts.

7. Next, install the impeller. Grease the shaft threads, key and impeller bore. Place the plastic sleeve inside the impeller, hold the key in the nose of the impeller with your forefinger and slide onto the driveshaft. Install the eight shim washers and nut retainer on the shaft, up against the impeller, and bring the nut up snug by hand. **Be careful that the retainer does not fall into the thread groove and jam the nut.**

Place the water intake in position and secure with two bolts. Observe the clearance between the impeller blade edge and the intake liner. Then, remove the intake.

When, after use in sand and gravel, the blade clearance becomes more than about 1/32" between the impeller edge and the water intake liner, one or more of the stainless steel shim washers can be transferred from the bottom stack to the top of the impeller. This moves the impeller down into the tapered casing to reduce the clearance.

Shims should not be used above the impeller on new installations, where no wear has occurred, unless the blade clearance exceeds 1/32". Insufficient blade clearance will do more harm than good from any performance gains it might provide.

When the impeller clearance is satisfactory, bump the nut up snug with a wrench. If the ears of the retainer do not line up with the flats on the nut, spin the nut off, turn the retainer over and tighten the nut again. In one of these two positions you will have alignment and can fold the ears up against the nut to retain it. The flat in the retainer is angled to the ears to allow for this.

8. Place the intake casing in position with the lower end at the rear and tighten the six nuts. **No lock washers are used.** Grease the threads.

9. If your jet drive was ordered for use with a steering tiller handle, see “Shift Cable and Handle Assembly Instructions.”

10. If your motor is equipped for remote controls, proceed as follows:

Attach the shift cable and cable anchor bracket to the jet drive.

Using a light finger pressure on the gate, move the gate toward reverse until the cam roller is nested in the neutral notch of the cam.

Adjust the shift cable end and the cable anchor bracket on the jet drive, such that the roller is in the neutral notch when the shift handle is in neutral. Tighten hardware.

Shift to forward. The roller must be at the end of the cam slot so the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.

If this forward lock condition is not met, re-adjust the cable positions, giving less importance to the roller position in neutral.

11. If the neutral position is too far out of adjustment, the tendency of the gate to move toward reverse, under water pressure, will put tension on the cable in neutral. In some remote control boxes, this makes it difficult to re-engage the shift mode with the motor running in the high speed idle, cold start setting. It is then necessary to stop the motor, operate the shift handle to engage the shifting pin and then restart the motor.

Proper cable adjustment will prevent this problem but it is most important that the forward locking condition be met if a compromise is to be made.

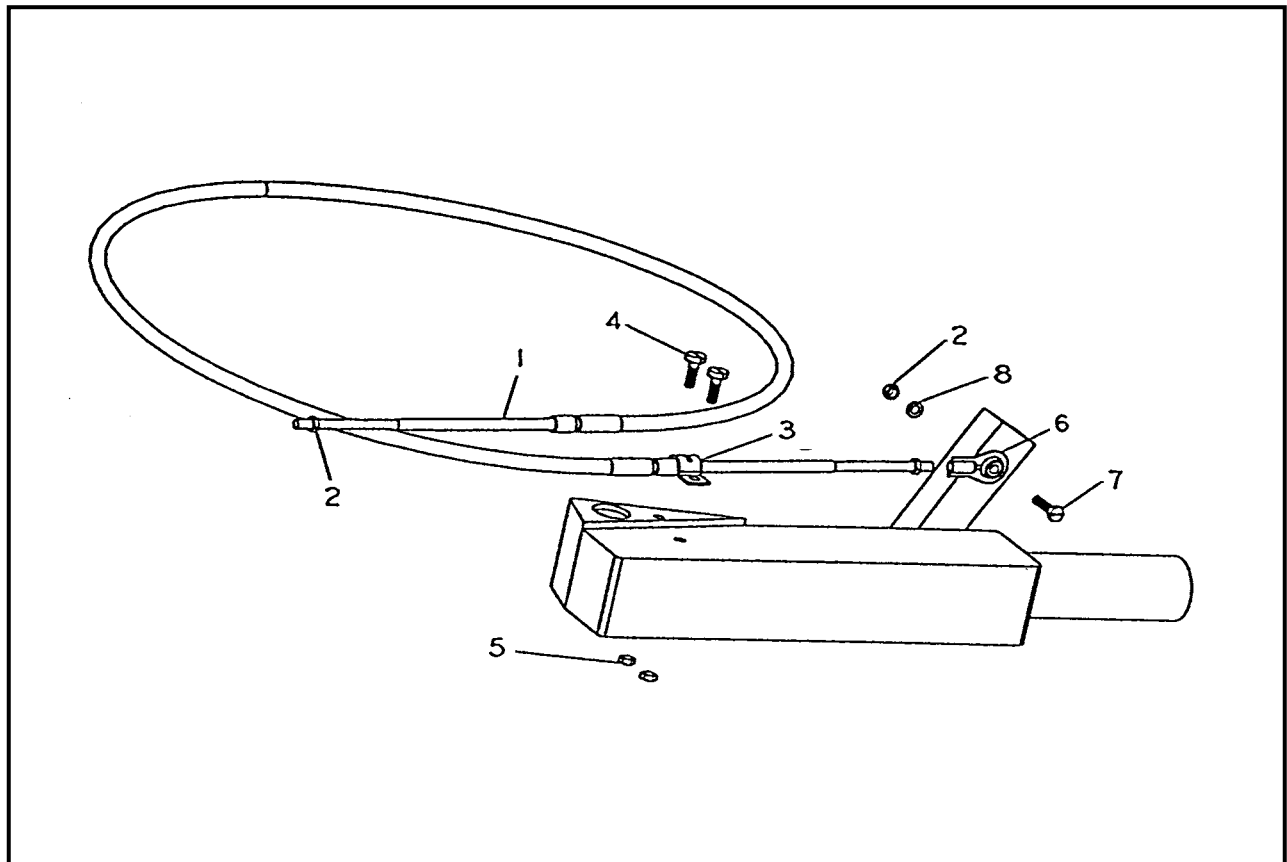
12. Refer to “Engine Mounting” on page 5 to finish installation.

CAUTION:

When starting the engine for the first time, watch to see that cooling water comes out of the small hole at the rear side of engine just below the powerhead. This is to check your assembly of the cooling water pump and its connections.

The cooling system can be flushed by removing the slotted screw next to the grease fitting. A hose coupling is available from a Yamaha Outboard Dealer. Turn on the water gently, start the motor, set the idle and watch for cooling water at the tell tale. Adjust water pressure if needed. Replace the screw after flushing.

F60 TILLER STEERING – SHIFT CABLE PARTS LIST



REF.	DESCRIPTION	QTY.
1	Cable 4' Mor 33C Supreme Short	1
1	Cable 5' Mor 33C Supreme Long	1
2	Hex Nut 10-32 Jam	3
3	Clamp Chrys	1
4	Fil Hd Slotted 10-24 x 5/8	2
5	Nyloc 10-24	2
6	Ball End No. 10 x 10-32 Cable	1
7	Bolt Hex Hd 10-32 x 3/4	1
8	Washer Spring Lock No. 10	1

F60 TILLER STEERING – SHIFT CABLE ASSEMBLY

1. Cut out the drilling template on page 41, including the large centering hole. Fold the template to fit the raised section on the handle.

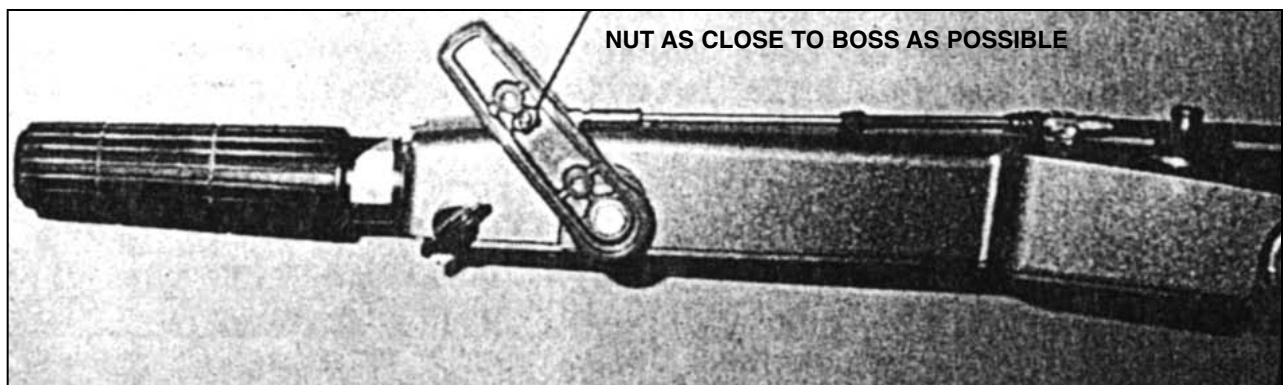
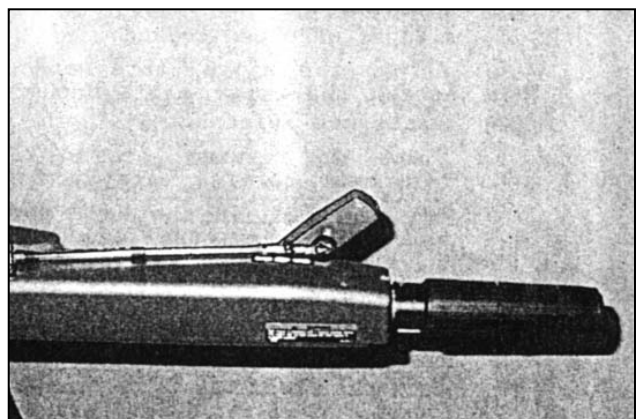
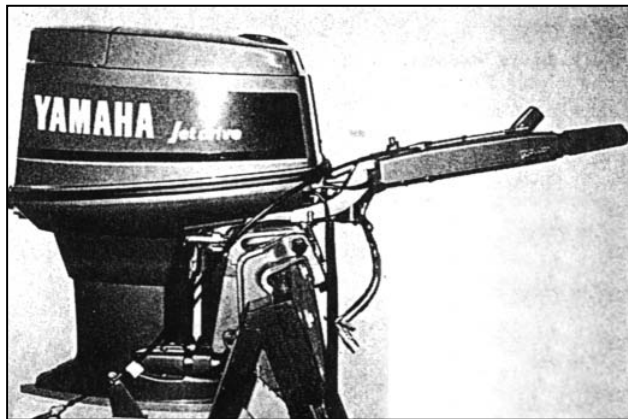
Place the template on the steering handle, holding it in place with masking tape at each end. Remove the plastic cover under the handle. Center punch the two hole locations and drill through using a 3/16" drill. Remove the template.

2. Remove the plastic cover from the shift handle. Center punch for a 3/16" hole on the centerline of the handle and as close to the threaded boss as possible while still being able to get the #10-32 nut inside, with the hex flat against the boss. Drill through.
3. Attach the lower end of the cable to the jet drive with the terminal end threaded on the cable as far as it will go and the cable bracket slid forward and locked.
4. Attach the upper cable anchor to the handle using the two #10-24 x 5/8" screws and nylock nuts.

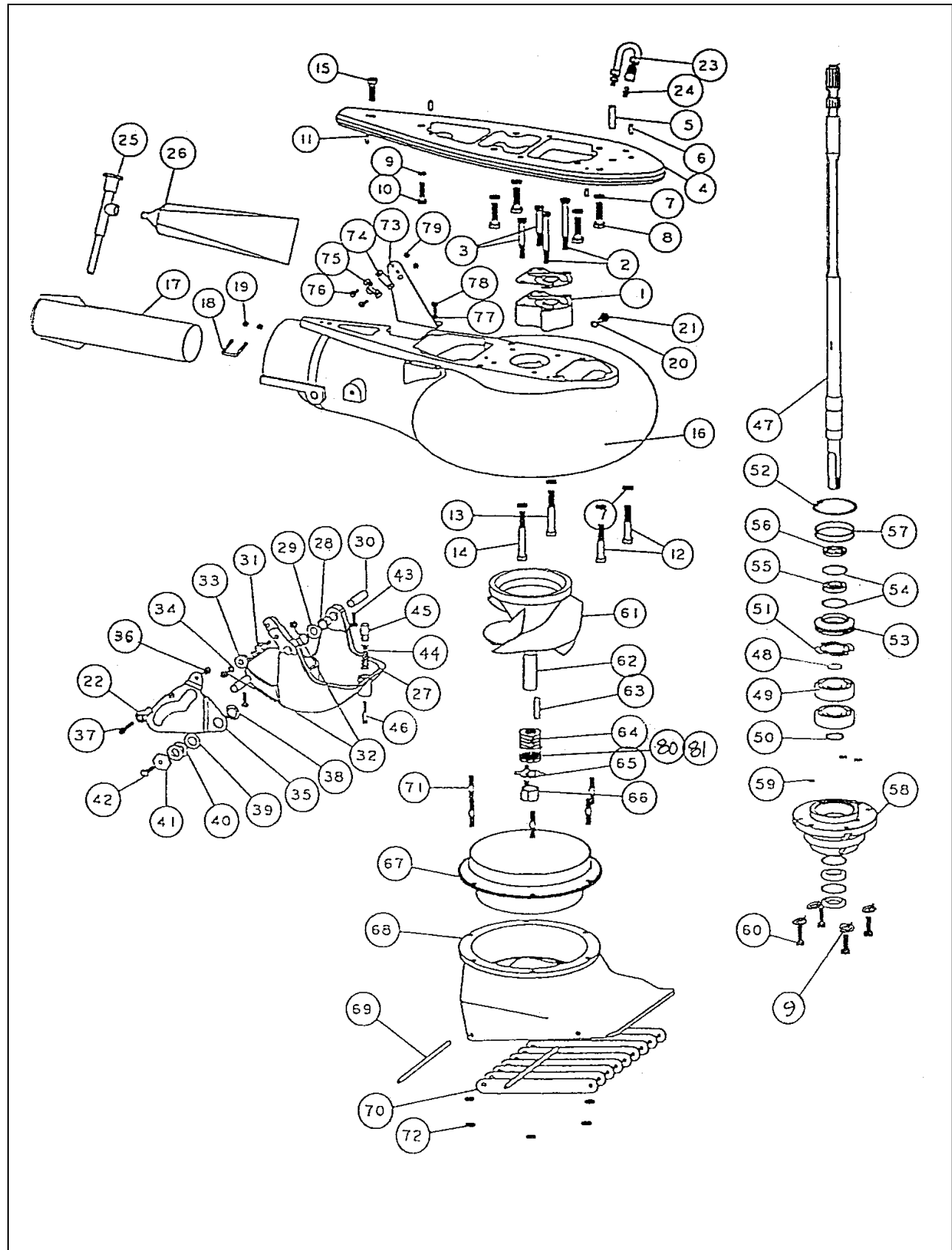
5. Place the reverse gate in forward with the cam roller at the end of the slot in the cam. Place the shift handle in forward, solidly in the detent. Adjust the ball rod end to reach this position. Install the hex #10-32 x 3/4" bolt, star lock washer, and nut.
6. Shift to reverse and forward. The cam roller should be at the end of the slot in the cam such that the gate cannot be forcibly rotated toward reverse. Pull on the gate to verify this. Readjust the rod end position, if necessary, to satisfy this condition. Lock the jam nut and install the plastic covers on the handle and tiller arm.

CAUTION:

You must return the throttle to idle before shifting.



F90 PARTS LIST
4-STROKE 4-CYLINDER



F90 PARTS LIST
4-STROKE 4-CYLINDER

REF NO	DESCRIPTION	QTY.
1	Pump Adapter, Y	1
2	Bolt Hex Hd 5/16-18 x 3-1/2	2
3	Bolt Hex Hd 5/16-18 x 2-1/2	2
4	Adapter Plate Y	1
5	Shift Guide Y	1
6	Dowel Pin 6 x 16mm	2
7	Washer Spring Lock M10	8
8	Bolt Hex Hd M10-1.25 x 35mm	4
9	Washer Spring Lock 5/16	9
10	Bolt Hex Hd M8 - 1.25 x 30mm	1
11	Dowel Pin 3/16 x 1/2	2
12	Bolt Hex Hd 3/18-16 x 2-1/4	2
13	Bolt Hex Hd 3/8-16 x 2-3/4	2
14	Bolt hex Hd 3/8-16 x 3	1
15	Bolt Hex Hd 3/8-16 x 1-1/4	1
	Volute with Gate Y	
16	Volute with Exhaust Tube Y	1
17	Exhaust Tube Ass'y Large 2-1/2	1
18	Clip Exhaust Tube 1-3/8	1
19	Nyloc 10-32	2
20	Washer Fiber M8	1
21	Bolt Hex Hd M8 x 1.25 x 12mm	1
22	Ball End 1/4 x 10-32 Cable	1
23	Lube Hose Ass'y	1
24	Zirc Fitting 1/4-28	1
25	Grease Gun	1
26	Grease, 10 oz. Tube No. 630-AA	1
27	Reverse Gate Large	1
28	Nyliner 1/2 ID x 13/16	2
29	Spring Gate Pivot 1/2	2
30	Pin Gate Pivot 1/2 Large	2
31	Shaft Roller	1
32	Nyloc 1/4-28	2
33	Roller Ass'y	1
34	1/4 Washer	1
35	Shift Cam Large	1
36	Nyloc 1/4-20	1
37	Bolt Hex Hd 1/4-20 x 3/4	1
38	Bushing Cam	1
39	Washer Cam	1
40	Shim-Cam	2
41	Cam Eccentric Drilled	1

REF NO	DESCRIPTION	QTY.
42	Bolt Hex Hd 1/4-20 x 1 Patch	1
43	Bolt Hex Hd 1/4-20 x 3/4 Patch	2
44	Spring Gate Bumper	1
45	Gate Bumper	1
46	Fil Hd Slotted 10-32 x 1-1/4 Patch	1
	Shaft Ass'y. Complete, Y100-4 18T 5/16	
47	Shaft Only, Y100-4 18T	1
48	Shaft Bearing Thrust Ring	1
49	Bearing	2
50	Truarc	1
51	Backup Washer	1
52	Truarc	1
53	Upper Seal Carrier WSeals & O-Rings	1
54	Spirolox	4
55	Seal Inner	2
56	Seal outer	2
57	O-Ring 3/32 x 2-5/16 x 2-1/2	2
58	Bearing Carrier w/Seals & O-Rings 5/16	1
59	O-Ring 1/16 x 5/16 x 7/16	3
60	Bolt Hex Hd 5/16-18 x 1 Patch	4
61	Impeller 7-3/8 w/136 Sleeve	1
62	Shaft Sleeve Plastic Large	1
63	Impeller Tee Key 1/2 round	1
64	Shim Washer Large	7
65	Nut Keeper Large/Pkg. 2 per bag	1
66	Shaft Nut 3/4-16 Brass	1
	Intake Ass'y Flanged with Grill Liner	
67	Liner 7-3/8 Flanged	1
68	Intake Painted Only	1
69	Grill Rod	2
70	Grill Bar Large	9
71	Stud-Intake Large	6
72	Nyloc 5/16-18	6
	Bracket Ass'y Morse w/Clamp & Hdwr	
73	Bracket Cable Support	1
74	Shim Morse	1
75	Clamp Chrys	1
76	Fil Hd Slotted 10-24 x 5/8	2
77	1/4 Washer	2
78	Bolt Hex Hd 1/4-20 x 5/8	2
79	Nyloc 10-24	2
80	Rubber Washer	1
81	Cup	1

SIZE	TORQUE
1/4-20 (M6)	8-9 Ft-lbs.
5/16-18 (M8)	12 Ft-lbs.
3/8-16 (M10)	22 Ft-lbs.

F90 ASSEMBLY INSTRUCTIONS

1. Place the engine on the transom of your boat so it is mounted vertically, in the normal fashion.
2. Install the jet drive shaft assembly into the spiral pump housing, locking it in place with the four 5/16-18 x 1" bolts with lock washers (apply grease to the threads). Torque to 12 ft-lb.

CAUTION:

The 4-stroke jet unit must use a newly designed water pump housing which is supplied by Yamaha. Failure to use this housing will result in engine failure.

3. Install the 1-3/8" thick aluminum adapter and stainless steel plate, with the gaskets and dowel pins. Install the water pump assembly using these special 4-stroke water pump housing on top of the stainless-steel plate. Use four M8 x 30mm bolts (apply grease to the threads) and the special steel washers under the bolt heads. Be sure to install the water pump drive key. Before tightening the bolts, press the 3-7/8" long x 1/2" plastic shift rod guide into the clear plastic sleeve, through the stainless-steel plate, until it bottoms. Torque the bolts to 12 ft-lb.
4. The large 3/4" adapter plate is attached to the exhaust housing to hold the jet drive. A 3/8" x 1-1/2" pin in front of the plate guides the disconnected shift rod. Two 6 x 16mm dowels locate the plate, four M10 x 35mm bolts with lockwashers and one M8 x 30mm bolt with lockwasher secure it, 22 ft-lbs. Grease bolt threads and the end of the pin where it slides in the shift rod.
5. Next, attach the jet drive to the motor. Two 3/16" x 1/2" dowel pins center the jet drive on the adapter plate. Four 3/8-16" bolts and lock washers from below and one 3/8-16" x 1-1/4" bolt from above/rear, are used. Select the lower bolt lengths to suit the different counter bore depths, so all bolts enter the adapter plate the same depth.

Grease the bolt threads, driveshaft spline, and rubber water tube pilot generously.

Guide the jet into place. Tighten the five bolts.

6. Next, install the impeller. Grease the shaft threads, key and impeller bore. Place the plastic sleeve inside the impeller, hold the key in the nose of the impeller with your forefinger and slide onto the driveshaft. Install the eight shim washers and nut retainer on the shaft, up against the impeller, and bring the nut up snug by hand. **Be careful that the retainer does not fall into the thread groove and jam the nut.**

Place the water intake in position and secure with two bolts. Observe the clearance between the impeller blade edge and the intake liner. Then, remove the intake.

Shims should not be used above the impeller on new installations, where no wear has occurred, unless the blade clearance exceeds 1/32". Insufficient blade clearance will do more harm than good from any performance gains it might provide.

When, after use in sand and gravel, the blade clearance becomes more than about 1/32" between the impeller edge and the water intake liner, one or more of the stainless steel shim washers can be transferred from the bottom stack to the top of the impeller. This moves the impeller down into the tapered casing to reduce the clearance.

Bump the nut with a wrench. If the ears of the retainer do not line up with the flats on the nut, spin the nut off, turn the retainer over and tighten the nut again. In one of these positions, you will have alignment and can fold the ears up against the nut to retain it. The flat in the retainer is angled to the ears to allow for this.

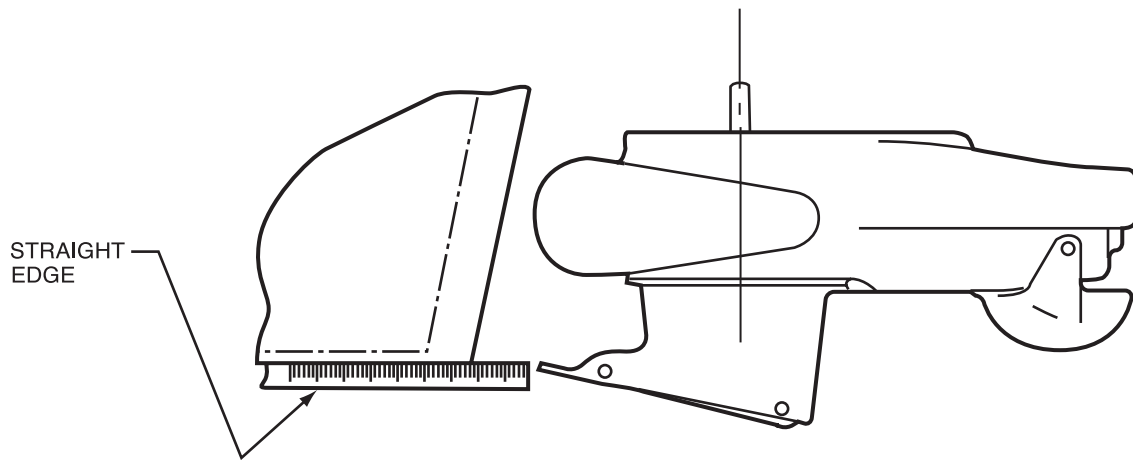
7. Place the intake casing in position, with the lower end at the rear, and tighten the six nuts. No lockwashers are used. Grease the threads. Tighten to 12 ft-lb.
8. Attach the shift cable and cable anchor bracket to the jet drive. With the shift handle and the reverse gate in forward, **with the cam roller at the end of the slot**, adjust the cable end and/or cable anchor position to this condition. **Shift to reverse and back to forward. The roller should be at the end of the cam slot so the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.**
If this forward lock condition is not met, readjust the cable positions.
9. Refer to "Engine Mounting" on page 5 to finish installation.

CAUTION:

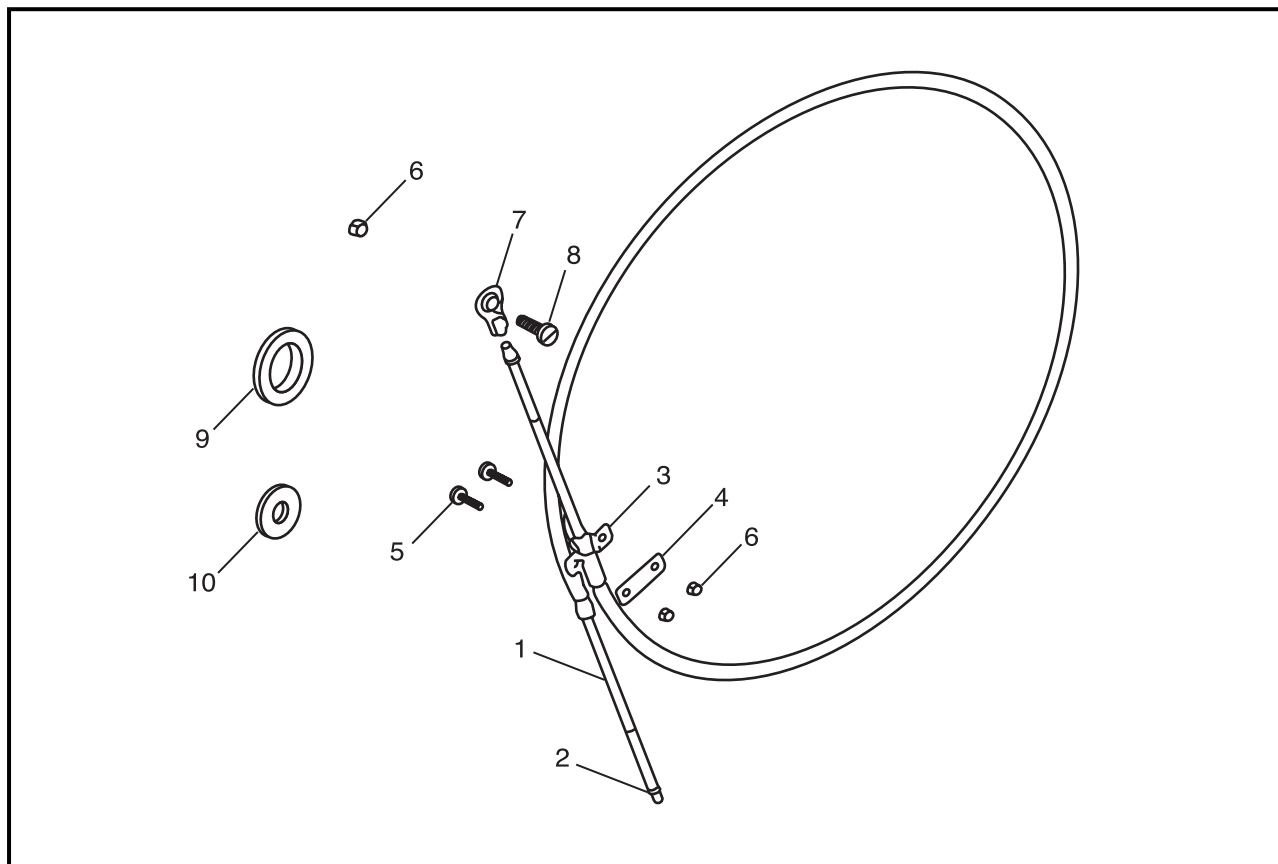
When starting the engine for the first time, watch to see that cooling water comes out of the small hole at the rear side of engine just below the powerhead. This is to check your assembly of the cooling water pump and its connections.

The cooling system can be flushed by removing the slotted screw next to the grease fitting. A hose coupling is available from a Yamaha Outboard Dealer. Turn on the water gently, start the motor, set to idle and watch for cooling water at the tell tale. Adjust water pressure, if needed. Replace the screw after flushing.

SETTING ENGINE HEIGHT



F90 TILLER STEERING – SHIFT CABLE ASSEMBLY



REF.	DESCRIPTION	QTY.
1	Cable 5' Mor 33C Supreme	1
2	Hex Nut 10-32 Jam	2
3	Clamp Chrys	1
4	Shim Morse	1
5	Fil Hd Slotted 10-32 x 1-1/4	2
6	Nyloc 10-32	3
7	Ball End #10 x 10 - 32 Cable	1
8	Screw Hex Hd 10-32 x 3/4 Mod	1
9	Shim Washer Large	1
10	Shim Washer Small	1

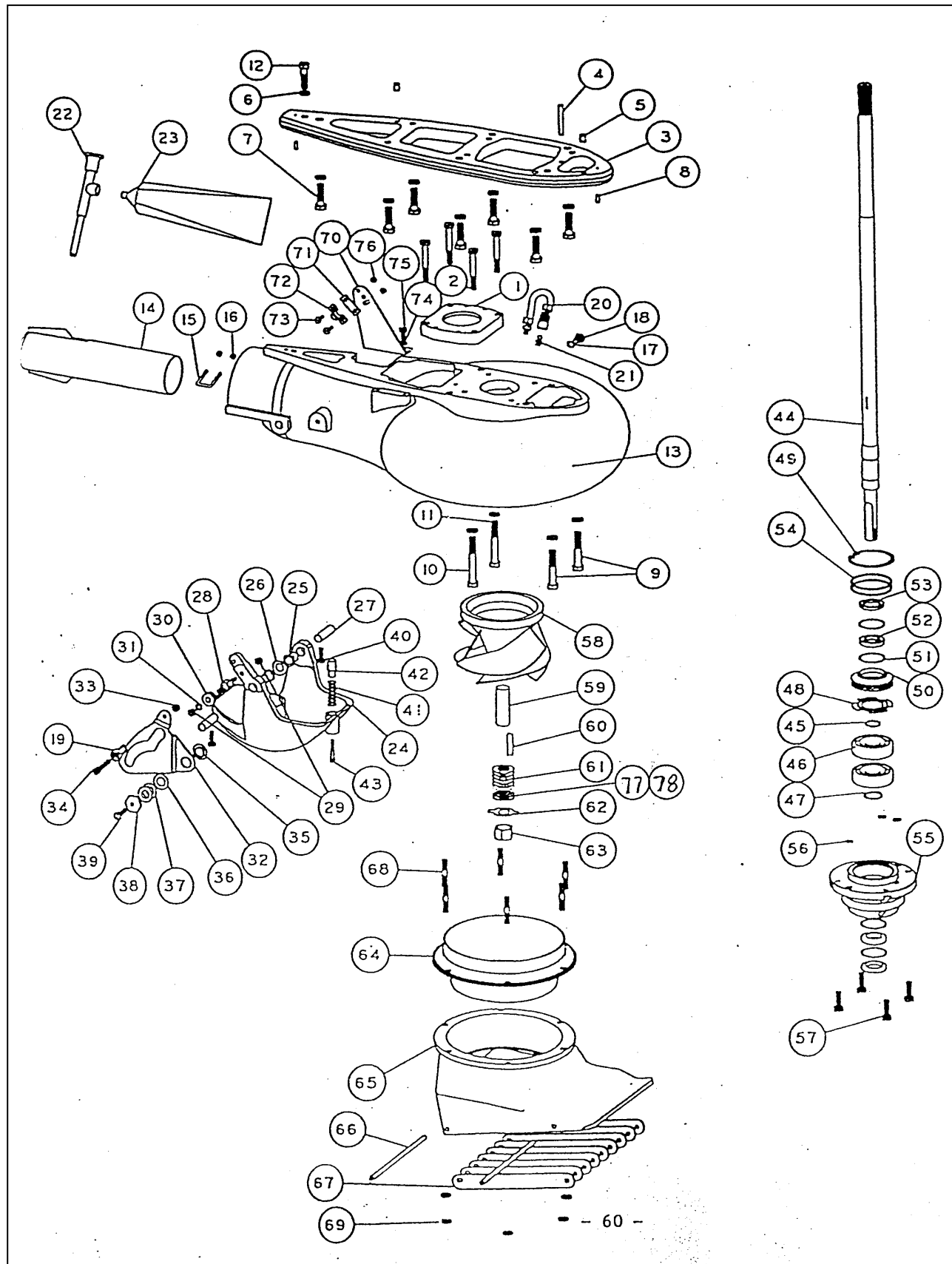
F90 TILLER STEERING – SHIFT CABLE ASSEMBLY

1. Remove the plastic covers from the shift handle and the steering arm. Remove the shift handle.
2. Cut out the template for the shift handle and the cable anchor position on the steering arm. (See page 41)
3. Fold the cable anchor pattern along the dotted lines and place it on the steering arm with the fork up inside, straddling the threaded boss. Tape in position.
4. Place the shift handle pattern over the handle boss. Tape in position. Center punch the three hole locations and drill through using a 3/16" drill. The holes in the steering arm are long, reaching through the threaded boss itself.
5. Attach the ball rod end to the shift handle and tighten the thin-head hex screw and lock nut. Remove the flanged plastic bushing, place the 1/16" thick spacer washer on the handle and replace the flanged bushing. Place the smaller 1/16" thick spacer over the square driver and install the handle.
6. Thread the shift cable all the way into the shift handle rod end. Attach the cable body to the steering arm using the shim, U-clamp, two #10-32 x 1-1/4" screws and lock nuts.
7. Attach the lower end of the cable to the jet drive, with the ball rod end threaded on the cable, as far as it will go, and the cable anchor bracket slid forward and locked. Twist the cable in the U-clamp, so the cable rests against the motor cowling. Tighten the clamp screws.
8. Place the shift handle in forward, solidly in the detent. **The reverse gate cam roller must be at the end of the slot in the cam.** If these conditions are not met, slide the cable anchor bracket on the jet drive and/or adjust the threaded rod end on the cable.
9. Shift to reverse and back to forward. Do not be concerned if the gate does not reach reverse. There is clearance at this position and water pressure will close the gate.
10. In forward, with the roller at the end of the cam slot, the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.
11. Lock the nuts on the cable against the rod ends to complete the adjustment and install the plastic covers.

CAUTION:

You must return the throttle to idle before shifting.

F115 PARTS LIST
4-STROKE 4-CYLINDER



F115 PARTS LIST
4-STROKE 4-CYLINDER

REF NO	DESCRIPTION	QTY.
1	Pump Adapter AA	1
2	Bolt Hex Hd 5/16-18 x 2-1/2	4
3	Adapter Plate AA	1
4	Shift Rod Guide AA-Rod	1
5	Dowel Pin 8 x 12m	2
6	Washer Spring Lock M10	12
7	Bolt Hex Hd M10-1.25 x 35mm	7
8	Dowel Pin 3/16 x 1/2	2
9	Bolt Hex Hd 3/8-16 x 2-1/4	2
10	Bolt Hex Hd 3/8-16 x 2-3/4	1
11	Bolt Hex Hd 3/8-16 x 3	1
12	Bolt Hex Hd 3/8-16 x 1-1/2	1
	Volute with Gate AA	
13	Volute with Exhaust Tube AA	1
14	Exhaust Tube Ass'y Large 2-1/2	1
15	Clip Exhaust Tube 1-3/8	1
16	Nyloc 10-32	2
17	Washer fiber M8	1
18	Bolt Hex Hd M8 1.25 x 12MM	1
19	Ball End 1/4 x 10-32 Cable	1
20	Lube Hose Ass'y	1
21	Zirc Fitting 1/4-28	1
22	Grease Gun	1
23	Grease 10 oz. Tube	1
24	Reverse Gate Large	1
25	Nyliner 1/2 ID x 13/16	2
26	Spring Gate Pivot 1/2	1
27	Pin Gate Pivot 1/2 Large	2
28	Shaft Roller	1
29	Nyloc 1/4-28	2
30	Roller Ass'y	1
31	1/4 Washer	
32	Shift Cam Large	1
33	Nyloc 1/4-20	1
34	Bolt Hex Hd 1/4-20 x 3/4	1
35	Bushing Cam	1
36	Washer Cam	1
37	Shim - Cam	2
38	Cam Eccentric Drilled	1
39	Bolt Hex Hd 1/4-20 x 1 Patch	1
40	Bolt Hex Hd 1/4-20 x 3/4 Patch	2
41	Spring Gate Bump	2
42	Gate Bumper	1
43	Fil Hd Slotted 10-32 x 1-1/4 Patch	
	Shaft Ass'y Complete	
44	Shaft Only, AAX, 20T 35-11/16 LG	1
	Shaft Ass'y Complete, AA4,6 20T-5/16	
44	Shaft Only, AAX, 20T 35-11/16 LG	1
44	Shaft Ass'y Complete, AAX, 20T-5/16	
44	Shaft Only, AA115-4 18T 31 9/16 LG	1
	Shaft Ass'y Complete, AA115-4 18T-5/16	
45	Shaft Bearing Thrust Ring	1
46	Bearing	2
47	Truarc	1
48	Backup Washer	1
49	Truarc	1

REF NO	DESCRIPTION	QTY.
50	Upper Seal Carrier W/Seals & O-Rings	1
51	Spirolox RR-150S	4
52	Seal Inner	2
53	Seal Outer	2
54	O-Ring 3/32 x 2 5/16 x 2-1/2	2
55	Bearing Carrier w/Seals & O-Rings 5/16	1
56	O-Ring 1/16 x 5/16 x 7/16	3
57	Bolt Hex Hd 5/16-18 x 1 Patch	4
58	Impeller 7-3/8D w/136 Sleeve V-4	1
58	Impeller 4 Blade w/136 Sleeve V-6	1
58	Impeller 7 3/8	1
59	Shaft Sleeve Plastic Large	1
60	Impeller Tee Key 1/2 Round	1
61	Shim Washers	7
62	Nutkeeper (2 per bag)	1
63	Shaft Nut 3/4-16 Brass	1
	Intake Ass'y Flanged w/Grill Bar & Liner	
64	Liner 7-3/8 Flanged	1
65	Intake Painted Only	1
66	Grill Rod	2
67	Grill Bar Large	9
68	Stud - Intake Large	6
69	Nyloc 5/16-18	6
	Bracket Ass'y Morse w/Clamp & Hdwr	
70	Bracket Cable Support	1
71	Shim Morse	1
72	Clamp Chrys	1
73	Fil Hd Slotted 10-24 x 5/8	2
74	Washer Spring Lock 5/16	8
75	Bolt Hex Hd 1/4-20 x 5/8	2
76	Nyloc 10-24	2
77	Rubber Washer	1
78	Cup	1

SIZE	TORQUE
1/4-20 (M6)	8-9 Ft-lbs.
5/16-18 (M8)	12 Ft-lbs.
3/8-16 (M10)	22 Ft-lbs.

F115 ASSEMBLY INSTRUCTIONS

1. Place the engine on the transom of your boat, so it is mounted vertically, in the normal fashion.
2. Install the jet drive shaft assembly into the spiral pump housing, locking it in place with the four 5/16-18 x 1" bolts and lock washers. Use grease on the threads. Tighten to 15 ft-lb.

CAUTION:

The F115 4-stroke must use a newly designed water pump housing and cartridge for jet application. Failure to use the new housing and cartridge will result in engine failure.

3. Install the water pump assembly on top of the 3/4" thick aluminum adapter and stainless steel plate. Use the specially designed water pump housing and cartridge. No gaskets are used over or under the aluminum adapter. **Be sure to install the water pump impeller drive key removed from the propeller drive.** Lock in place using four 5/16-18" x 2-1/2" bolts and lock washers. Grease the threads. Tighten to 10 ft-lb.
4. The large 3/4" adapter plate is attached to the exhaust housing to hold the jet drive. A 1/4" x 2" plastic shift rod guide in front of the plate guides the disconnected shift rod. Two 8 x 12mm dowels locate the plate, seven M10 x 34mm bolts with lockwashers secure it. Grease the bolt threads and the end of the pin where it slides in the shift rod. Tighten to 22 ft-lb.
5. Next, attach the jet drive to the motor. Two 3/16" x 1/2" dowel pins center the jet drive on the adapter plate. Four 3/8-16 bolts from below and one 3/8-16" x 1-1/2" bolt from above rear with lock washers are used. Select the lower bolt lengths to suit the different counter bore depths so all bolts enter the adapter plate the same depth. The upper rear bolt is reached through the trim tab opening in the motor exhaust housing.

Grease the bolt threads, driveshaft spline, and rubber water tube pilot generously. Guide the jet into place. Tighten to 22 ft-lb.

6. Next, install the impeller. Grease the shaft threads, key and impeller bore. Place the plastic sleeve inside the impeller, hold the key in the nose of the impeller with your forefinger and slide onto the driveshaft. Install the seven shim washers, rubber washer and cup and nut retainer on the shaft, up against the impeller, and bring the nut up snug by hand. **Be careful that the retainer does not fall into the thread groove and jam the nut.**

Place the water intake in position and secure with two bolts. Observe the clearance between the impeller blade edge and the intake liner. Then, remove the intake.

NOTE: Shims should not be used above the impeller on new installations, where no wear has occurred, unless the blade clearance exceeds 1/32". Insufficient blade clearance will do more harm than good from any performance gains it might provide.

Then, bump the nut up snug with a wrench. If the ears of the retainer do not line up with the flats on the nut, spin the nut off, turn the retainer over and tighten the nut again. In one of these two positions, you will have alignment and can fold the ears up against the nut to retain it. The flat in the retainer is angled to the ears to allow for this.

When, after use in sand and gravel, the blade clearance becomes more than about 1/32" between the impeller edge and the water intake liner, one or more of the stainless steel shim washers can be transferred from the bottom stack to the top of the impeller. This moves the impeller down into the tapered casing to reduce the clearance.

7. Place the intake casing in position, with the lower end at the rear, and tighten the six nuts. No lockwashers are used. Grease the threads. Tighten to 12 ft-lb.
8. Attach the shift cable and cable anchor bracket to the jet drive.

CAUTION:

If your motor is a 115HP 4-Stroke, two cables will be attached to the cable anchor bracket and roller cam, to provide neutral start protection. The outer cable comes from the remote control box to operate the reverse gate. It does not enter the motor housing. The shorter inner cable enters the motor housing to operate the neutral start safety switch and is driven by the movement of the reverse gate if tiller handle is installed. The neutral start switch prevents starting the motor in forward or reverse and the remote model neutral switch is removed (see 9* below).

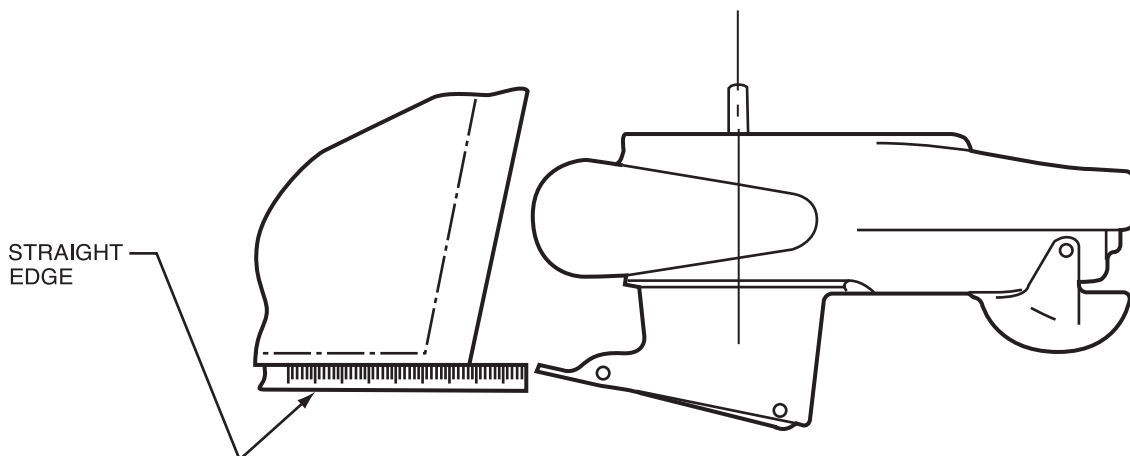
If the F115 model you have has the engine's shift switch and plate removed, the harness for the switch leading from the ECU must be capped off with part # 68V-82582-10. Failure to install this cap may lead to performance problems or hard starting due to the ECU recognizing a code 28 (open switch problem).

9. With the shift handle and the reverse gate in forward, with the cam roller at the end of the slot, adjust the cable and/or cable anchor position to this condition. **Shift to reverse and back to forward. The roller should be at the end of the cam slot so the gate cannot be forcibly rotated toward reverse. Pull on the gate by hand to verify this.**

If this forward lock condition is not met, readjust the cable positions.

- 9* **Shift to neutral and adjust the cable end in the motor housing so the neutral start switch is activated.** Check adjustment coming from both forward and reverse to compensate free play in cable linkage. **(115HP 4-Stroke only.)**
10. Refer to "Engine Mounting" on page 5 to finish installation.

SETTING MOTOR HEIGHT



CAUTION:

When starting the engine for the first time, watch to see that the cooling water comes out of the small hole at the rear side of the engine just below the powerhead. This is to check your assembly of the cooling water pump and its connections.

CAUTION:

F115

It is important on high horsepower installations to mount the motor at the correct height and to use the power tilt properly.

Power tilt is convenient for drifting and when operating at low throttle in very shallow areas. When under power, however, the engine should not be tilted out, in an effort to gain speed, as is done with propellers.

The engine driveshaft should be vertical when planing or tilted toward the boat in order to provide a scooping angle on the water intake grille. Tilting the motor out beyond a vertical position reduces the scoop angle and can cause impeller slippage and cavitation burns on the impeller blades.

When running in a bay, lake or wide river in windy conditions, (particularly when running with the wind), the jet can suck in air when crossing the wave crests. This will result in overspeeding and cause severe strain on the driveshaft when the engine is suddenly brought back to normal speed, as the impeller once again grabs solid water.

If your boat is used frequently under these conditions, the engine height should be set lower than normal to minimize overspeeding. Running at reduced throttle will help when winds are strong. You can also experiment with a plate extending from the hull bottom to the top of the leading edge of the water intake (See page 6). This tends to reduce air intake as well as to reduce spray.

SPECIFICATIONS – FOUR-STROKE JET DRIVE MODELS

ITEM/MODEL	UNITS	F40MJH	F60TJR	F90TJR
DIMENSIONS				
Boat Transom Height	mm (in.)	508 (20)	508 (20)	635 (25.0)
Weight	kg (lb.)	92 (203)	115 (254)	177 (391)
PERFORMANCE				
Full Throttle	rpm	5000 ~ 6000	5000 ~ 6000	5000 ~ 6000
Maximum Output	BHP/rpm	40/5500	60/5500	90/5500
Idle speed	rpm	750 ~ 850	750 ~ 850	750 ~ 850
ENGINE				
Type		Four-Stroke	Four-Stroke	Four-Stroke
Number of Cylinders		3	4	4
Bore and Stroke	mm	65 x 75	63 x 75	79.0 x 81.4
	in.	2.55 x 2.95	2.48 x 2.95	3.11 x 3.20
Total Piston Displacement	cc (cu. in.)	747 (44.8)	935 (57.1)	1,596 (97.39)
Cooling System		Water	Water	Water
Ignition System		CDI	CDI	CDI
Spark Plug	NGK	DPR6EA-9	DPR6EA-9	LFR5A-11
Spark Plug Gap	mm	0.9	0.9	1.1
	in.	0.035	0.035	0.043
DRIVE UNIT				
Gear Shifting		Fwd/Neut/Rev	Fwd/Neut/Rev	Fwd/Neut/Rev
Gear Ratio		1:1 Direct	1:1 Direct	1:1 Direct
Impeller Clearance	mm	0.790	0.790	0.790
(Minimum)	in.	0.031	0.031	0.031
LUBRICATION				
Bearing Grease		Yamalube Marine Grease	Yamalube Marine Grease	Yamalube Marine Grease
Interval		Every 10 hrs., after each use, and prior to storage.	Every 10 hrs., after each use, and prior to storage.	Every 10 hrs., after each use, and prior to storage.

SPECIFICATIONS – FOUR-STROKE JET DRIVE MODELS

ITEM/MODEL	UNITS	F115TJR
DIMENSIONS		
Boat Transom Height	mm (in.)	635 (25.0)
Weight	kg (lb.)	188 (415)
PERFORMANCE		
Full Throttle	rpm	5000 ~ 6000
Maximum Output	BHP/rpm	115/5500
Idle speed	rpm	650 ~ 750
ENGINE		
Type		Four-Stroke
Number of Cylinders		4
Bore and Stroke	mm	79.0 x 88.8
	in.	3.11 x 3.50
Total Piston Displacement	cc (cu. in.)	1,741 (106.2)
Cooling System		Water
Ignition System		CDI
Spark Plug	NGK	LFR5A-11
Spark Plug Gap	mm	1.1
	in.	0.043
DRIVE UNIT		
Gear Shifting		Fwd/Neut/Rev
Gear Ratio		1:1 Direct
Impeller Clearance	mm	0.790
(Minimum)	in.	0.031
LUBRICATION		
Bearing Grease		Yamalube Marine Grease
Interval		Every 10 hrs., after each use, and prior to storage.

YAMAHA MOTOR CORPORATION, U.S.A. FOUR-STROKE JET DRIVE OUTBOARD MOTOR THREE YEAR LIMITED WARRANTY

Yamaha Motor Corporation, U.S.A. hereby warrants that new Yamaha four-stroke Jet Drive outboard motors will be free from defects in material and workmanship for the period of time stated herein, subject to certain stated limitations.

PERIOD OF WARRANTY. Any new Yamaha four-stroke Jet Drive outboard motor purchased and registered with Yamaha Motor Corporation, U.S.A. for pleasure use in the United States will be warranted against defects in material or workmanship for a period of three (3) years from the date of purchase, subject to exclusions noted herein. Any Yamaha Jet Drive outboard motor purchased and utilized for commercial applications will be warranted for a period of one (1) year from the date of purchase, subject to exclusions noted herein. Yamaha peripheral equipment included with the motor, such as gauges, fuel tanks, and hoses, remote control boxes, and wiring external from the motor unit, will be warranted for one (1) year from the date of purchase of either pleasure or commercial use. Replacement parts used in warranty repairs will be warranted for the balance of the applicable warranty period.

The second and third year of warranty (if applicable) shall be limited to covering the cost of parts and labor for major components only. The major components covered are:

Power Unit Section

- Power Head
- Intake Manifold
- Carburetor Assembly and its Related Components
- Fuel Injection System and its Related Components
- Fuel and Oil Pump Assemblies

Lower Unit Section

- Exhaust System
- Upper Casing

Bracket Section

- Bracket System
- Power Trim and Tilt Assembly

Also covered during the second year of warranty is:

- Jet Drive Pump Assembly

WARRANTY REGISTRATION. To be eligible for warranty coverage, the Jet Drive outboard motor must be registered with Yamaha Motor Corporation, U.S.A. Warranty registration can be accomplished by any authorized Yamaha Outboard Motor Dealer. Upon receipt of the registration, an Owner's Warranty Card will be sent by Yamaha to the registered purchaser.

OBTAINING REPAIRS UNDER WARRANTY. To receive repairs under this warranty, a valid Owner's Warranty Card must be presented to an authorized Yamaha Outboard Motor Dealer.

During the period of warranty, any authorized Yamaha outboard dealer will, free of charge, repair or replace, at Yamaha's option, any parts adjudged defective by Yamaha due to faulty workmanship or material from the factory. All replaced parts will become the property of Yamaha Motor Corporation, U.S.A.

CUSTOMER'S RESPONSIBILITY. Under the terms of this warranty, the customer will be responsible for ensuring that the Jet Drive outboard motor is properly operated, maintained, and stored as specified in the applicable Owner's Manual.

The owner of the Jet Drive outboard motor shall give notice to an authorized Yamaha Outboard Motor Dealer of any and all apparent defects within ten (10) days of discovery and make the motor available at that time for inspection and repairs at the dealer's place of business.

GENERAL EXCLUSIONS FROM WARRANTY. This warranty will not cover the repair of damage if the damage is a result of abuse or neglect of the product. Examples of abuse and neglect include, but are not limited to:

1. Racing or competition use, modification of original parts, abnormal strain.
2. Lack of proper maintenance and off-season storage as described in the Owner's Manual; installation of parts or accessories that are now equivalent in design and quality genuine Yamaha parts.
3. Operation of the motor at an rpm other than specified; use of lubricants or oils that are not suitable for outboard motor use.
4. Damage as a result of accidents, collisions, contact with foreign materials, or submersion.
5. Growth of marine organism on motor surfaces.
6. Normal deterioration.

SPECIFIC PARTS EXCLUDED FROM WARRANTY. Parts replaced due to normal wear or routine maintenance such as oil, spark plugs, shear pins, Jet Drive impellers and liners, fuel and oil filters, brushes for the starter motor and power tilt motor, water pump impellers, and anodes, are not covered by warranty.

Charges for removal of the motor from a boat and transporting the motor to and from an authorized Yamaha Outboard Motor Dealer are excluded from warranty coverage.

Specific parts excluded from warranty are:

- Jet Drive Impeller
- Jet Drive Liner
- Bearings which are water-damaged as a result of improper maintenance

Specific parts excluded from the second and third year of warranty (if applicable) are:

- Top and Bottom Cowling
- Electric Components (other than ignition system)
- Rubber Components (such as hoses, tubes, rubber seals, fittings, and clamps)

Specific parts excluded from the third year of warranty are:

- Jet Drive Pump Assembly

TRANSFER OF WARRANTY. Transfer of the warranty from the original purchaser to any subsequent purchaser is possible by having the motor inspected by an authorized Yamaha Outboard Motor Dealer and requesting the dealer to submit a change of registration to Yamaha Motor Corporation, U.S.A. within ten (10) days of the transfer.

YAMAHA MOTOR CORPORATION, U.S.A. MAKES NO OTHER WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE OBLIGATIONS AND TIME LIMITS STATED IN THIS WARRANTY ARE HEREBY DISCLAIMED BY YAMAHA MOTOR CORPORATION, U.S.A. AND EXCLUDED FROM THIS WARRANTY.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. ALSO EXCLUDED FROM THIS WARRANTY ARE ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING LOSS OF USE. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE EXCLUSION MAY NOT APPLY TO YOU.

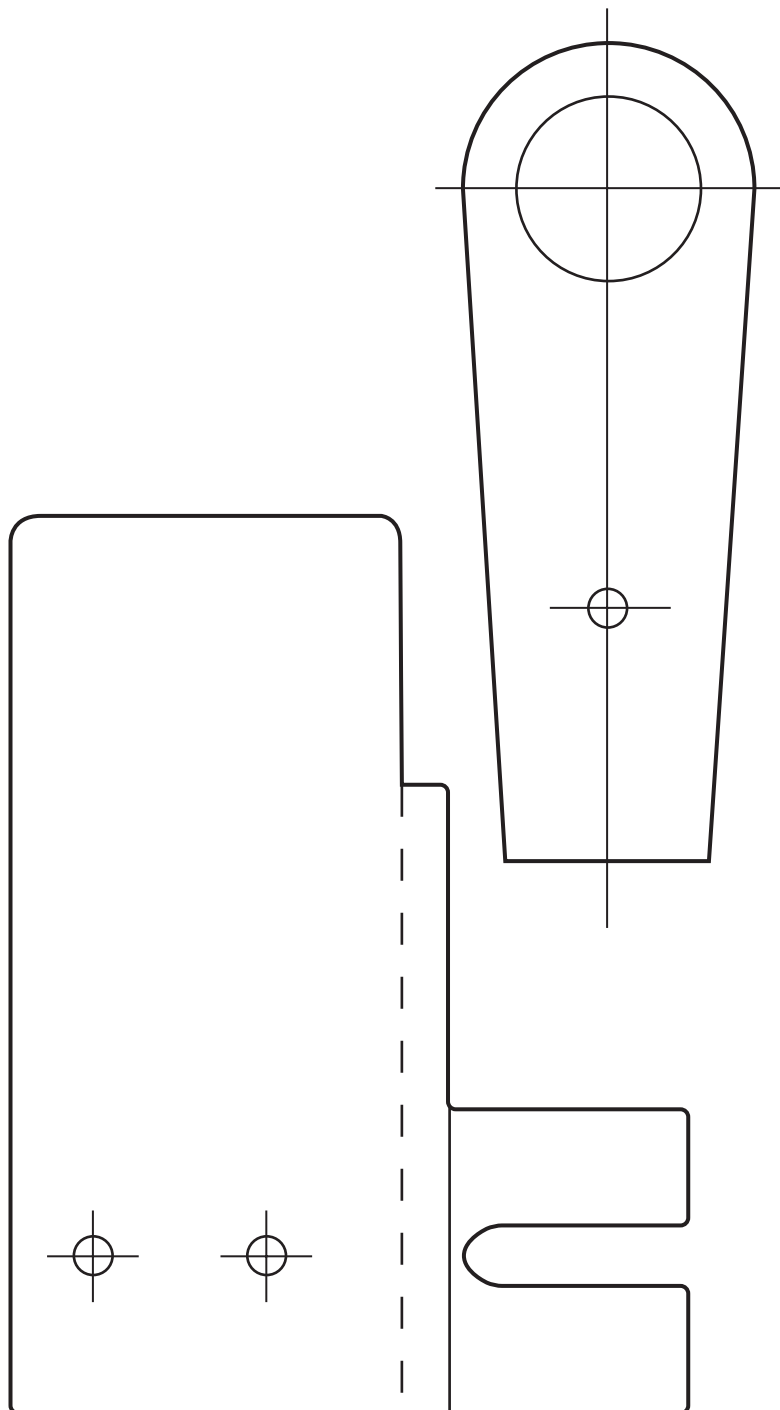
THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

Effective Date 06/01
LIT-18790-4J-02
06/01

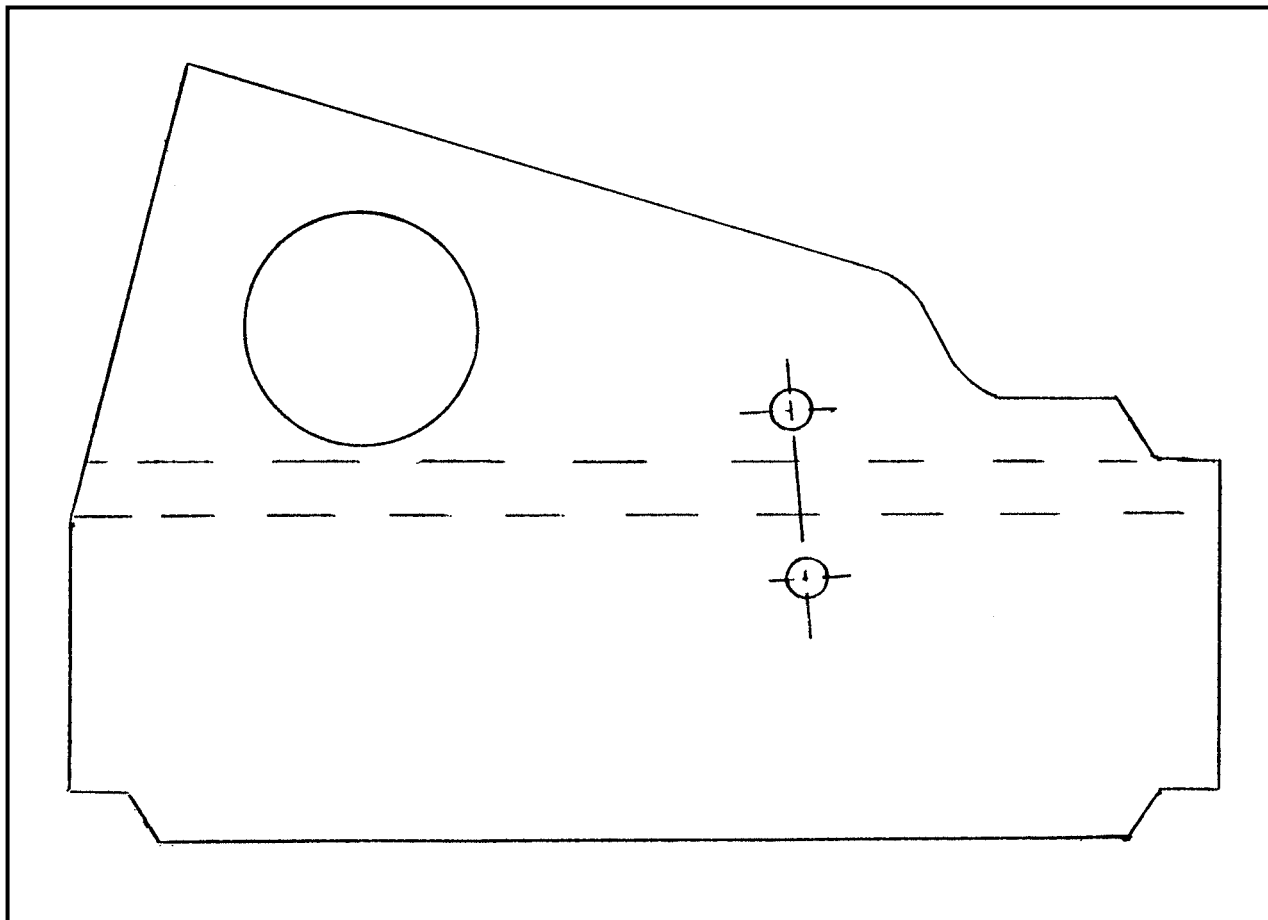
YAMAHA MOTOR CORPORATION, U.S.A.
Post Office Box 6555
Cypress, California 90630

F40 TILLER HANDLE TEMPLATE (See page 20 for instructions)

F90 TILLER HANDLE TEMPLATE (See page 32 for instructions)



F60 TILLER HANDLE TEMPLATE (See page 26 for instructions)





LIT-18619-00-02

©2002 Yamaha Motor Corporation, U.S.A. Printed in U.S.A.