

IDENTIFICATION SERIAL NUMBER

The outboard motor's serial number is stamped on a label which is attached to the port side of the clamp bracket.

NOTE:

If the serial number label is removed, "VOID" marks will appear on the label.

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

STARTING SERIAL NUMBERS

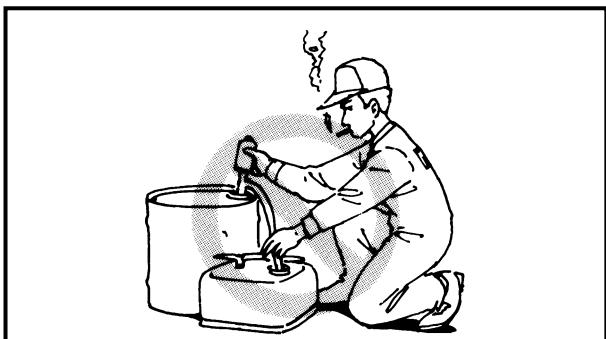
The starting serial number blocks are as follows:

Model name			Approved model code	Starting serial number
World- wide	USA	Canada		
F115AET	F115TR	F115TR	68V	L: 300101 - X: 700101 -
FL115AET	LF115TR	LF115TR	68W	X: 800101 -



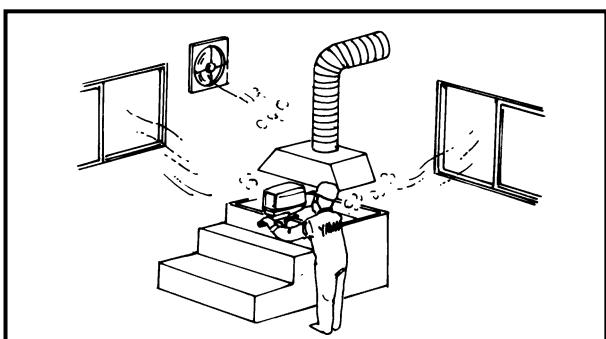
SAFETY WHILE WORKING

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



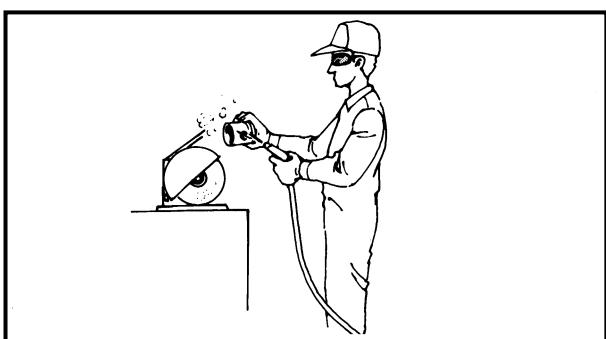
FIRE PREVENTION

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

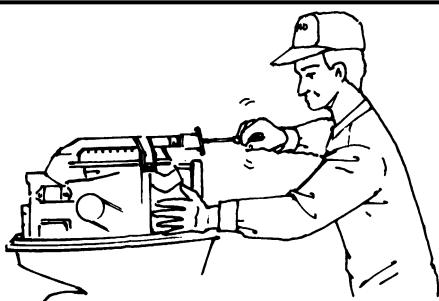
Follow the tightening torque instructions. When tightening bolts, nuts and screws, tighten the large sizes first, and tighten inner-positioned fixings before outer-positioned ones.

**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.



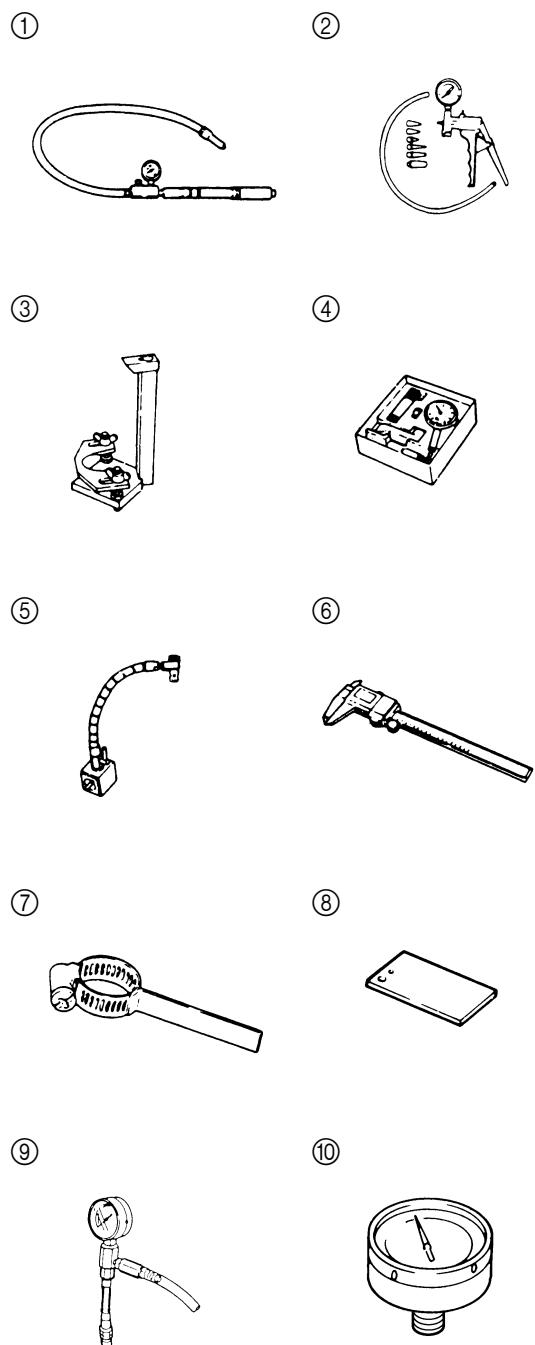
SPECIAL TOOLS

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



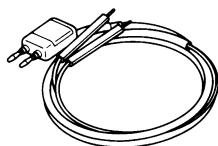
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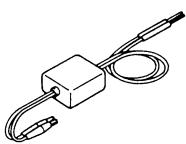
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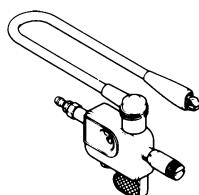
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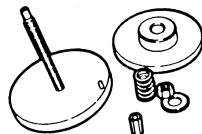
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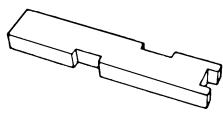
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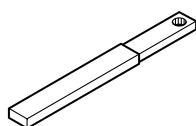
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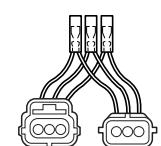
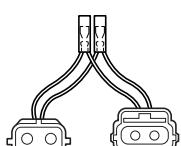
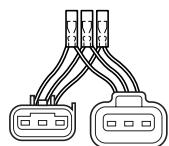
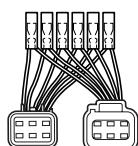
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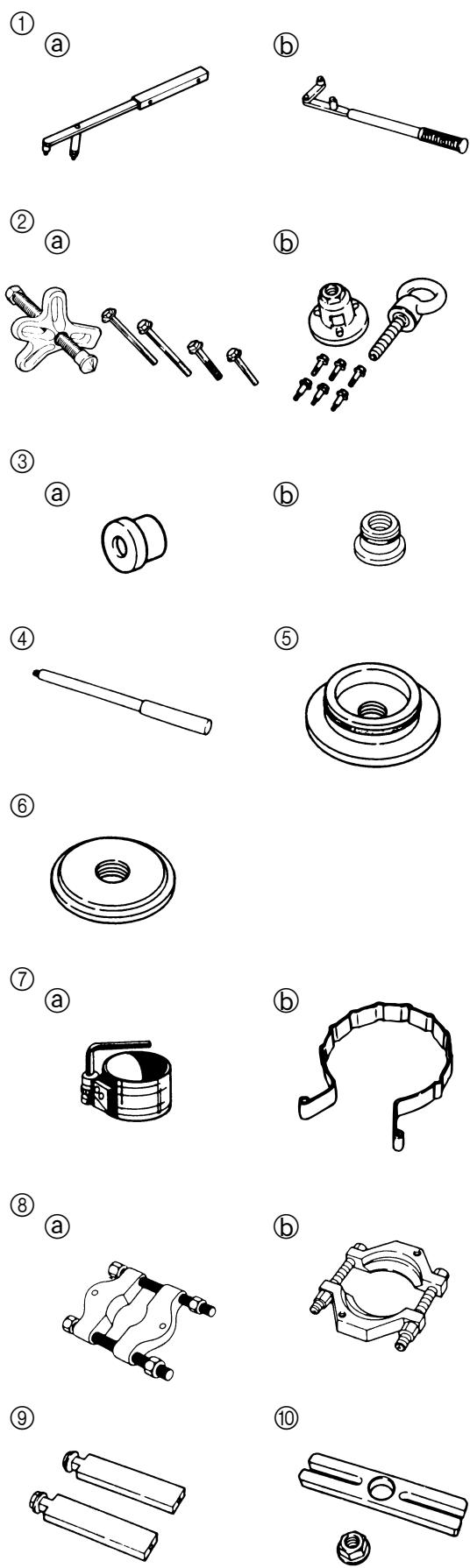
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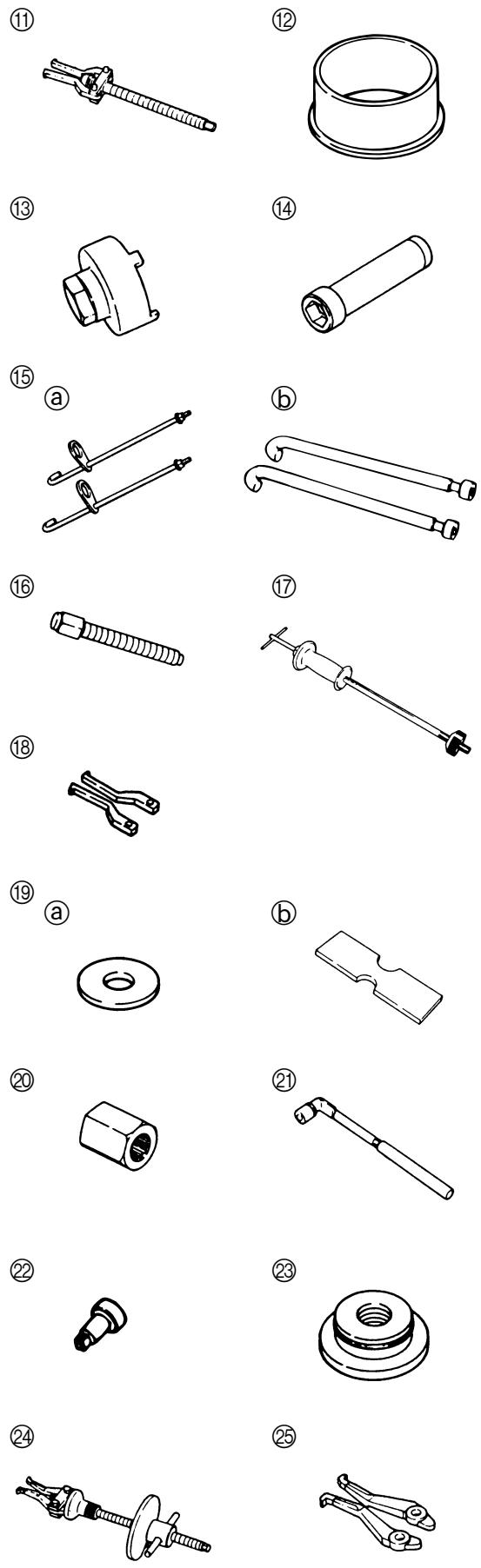


- ⑪ Up-relief valve attachment
P/N. 90890-06773
- Down-relief valve attachment
P/N. 90890-06774
- ⑫ Digital tester
P/N. J-39299
90890-06752
- ⑬ Peak voltage adapter
P/N. YU-39991 a
90890-03169 b
- ⑭ Spark gap tester
P/N. YM-34487 a
90890-06754 b
- ⑮ Shimming gauge
P/N. YB-34446-1, YB-34446-3,
YB-34446-5, 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

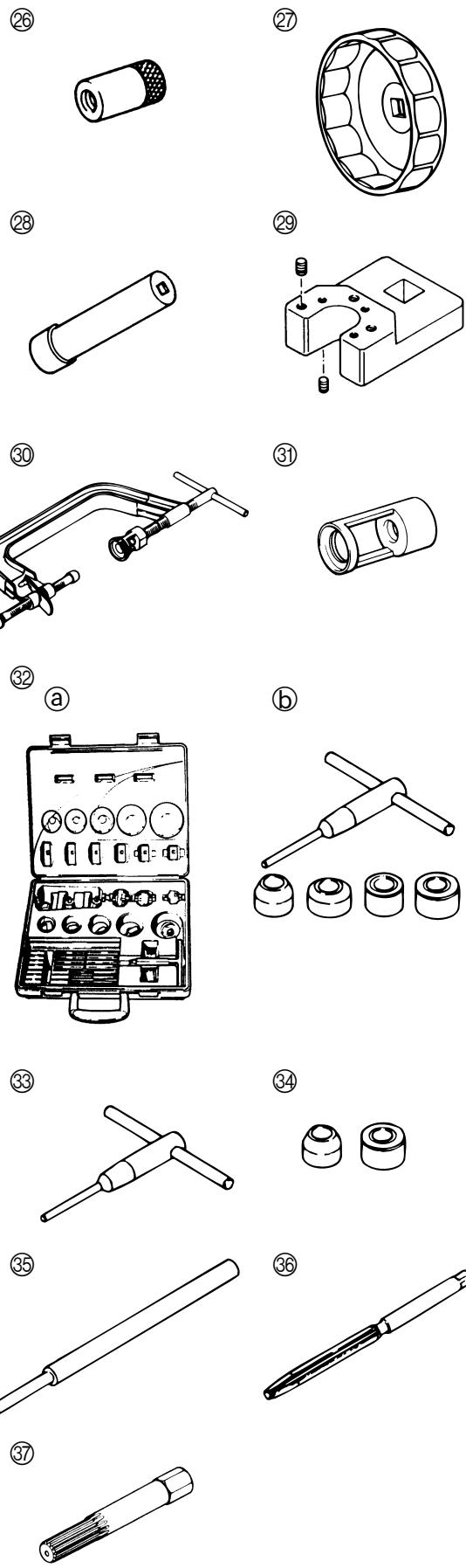


REMOVING AND INSTALLING

- ① Flywheel magnet assembly holder
P/N. YB-06139 a
90890-06522 b
- ② Universal puller
P/N. YB-06117 a
90890-06521 b
- ③ Bearing/oil seal attachment
P/N. YB-06196 a
90890-06653 b
- 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-06430
90890-06630, 90890-06656
- ⑥ Bearing/oil seal attachment
P/N. YB-06199
90890-06620
- ⑦ Piston ring compressor
P/N. YU-33294 a
90890-06530 b
- ⑧ Bearing separator
P/N. YB-06219 a
90890-06534 b
- 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
- ⑬ Ring nut wrench
P/N. YB-34447
90890-06511
- ⑭ Ring nut wrench extension
P/N. 90890-06513
- ⑮ Propeller shaft housing puller
P/N. YB-06207 a
90890-06502 b
- 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 a
90890-06603 b
- 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,
YB-06337, YB-06378
90890-06607, 90890-06608,
90890-06610, 90890-06612,
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



CHAPTER 2 SPECIFICATIONS

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GENERAL SPECIFICATIONS

Item	Unit	Model			
		F115AET	FL115AET		
		F115TR	LF115TR		
		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)	516 (20.3)	—		
(X)	mm (in)	643 (25.3)			
WEIGHT					
(with aluminum propeller) (L)	kg (lb)	192 (422.4)	—		
(X)	kg (lb)	197 (433.4)			
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 @ 5,500 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	kPa (kgf/cm ² , psi)	950 (9.5, 135)			
Fuel system	Electronic fuel injection				
Fuel injection system	Group injection				
Starting system	Electric				
Ignition control system	Microcomputer (TCI)				
Alternator output	12 - 25A				
Spark plugs (NGK)	LFR6A-11				
Cooling system	Water				
Exhaust system	Through propeller boss				
Lubrication system	Wet sump				
Lubrication oil pressure at 65°C (149°F), with low-30 engine oil	kPa (kgf/cm ² , psi) @ 850 r/min	320 (3.2, 45.5)			

SPEC**GENERAL SPECIFICATIONS**

E

Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		F115TR	LF115TR
FUEL AND OIL			
Fuel type		Unleaded regular gasoline	
Fuel rating	*PON RON	86 91	
Engine oil type		4-stroke outboard engine oil	
Engine oil grade	API SAE	SE, SF, SG, SH 10W-30, 10W-40	
Engine oil capacity (with oil filter)	cm ³ (US oz, Imp oz)	4,700 (159, 165)	
(without oil filter)	cm ³ (US oz, Imp oz)	4,500 (152, 158)	
Gear oil type		Hypoid gear oil	
Gear oil grade	API SAE	GL-4 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 capacity	Ah (kC)	70 - 100 (252 - 360)	
Minimum cold cranking performance	A	380	

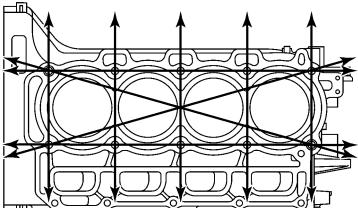
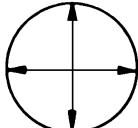
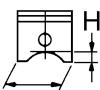
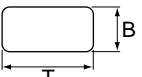
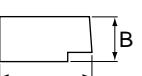
* PON: Pump Octane Number (Research octane + Motor octane)/2

RON: Research Octane Number



MAINTENANCE SPECIFICATIONS

POWER UNIT

Item	Unit	Model	
		F115AET	FL115AET
		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)	
Valve lifter hole inside diameter	mm (in)	28.000 - 28.021 (1.102 - 1.103)	
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)	0.08 (0.003)	
			
PISTONS			
Piston diameter (D)	mm (in)	78.928 - 78.949 (3.1074 - 3.1082)	
		13 (0.51)	
Measuring point (H)	mm (in)	0.070 - 0.080 (0.0028 - 0.0031)	
Piston-to-cylinder clearance <Limit>	mm (in)	0.206 (0.0081)	
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)	
		2.89 - 2.91 (0.114 - 0.115)	
Dimension T	mm (in)	0.15 - 0.30 (0.006 - 0.012)	
End gap	mm (in)	0.02 - 0.08 (0.001 - 0.003)	
Side clearance	mm (in)		
2nd ring			
Dimension B	mm (in)	1.47 - 1.49 (0.058 - 0.059)	
		3.00 - 3.20 (0.118 - 0.126)	
Dimension T	mm (in)	0.70 - 0.90 (0.028 - 0.035)	
End gap	mm (in)	0.03 - 0.07 (0.001 - 0.003)	
Side clearance	mm (in)		

SPEC**MAINTENANCE SPECIFICATIONS**

E

Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		F115TR	LF115TR
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)
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)
Valve lift			
Intake		mm (in)	7.30 (0.287)
Exhaust		mm (in)	6.98 (0.275)
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)	0.1 (0.004)
VALVES			
Face angle			
Intake		Degree	91, 120, 160
Exhaust		Degree	90, 140
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)		mm (in)	29.00 - 29.20 (1.142 - 1.150)
Intake		mm (in)	24.00 - 24.20 (0.945 - 0.953)
Face width (B)		mm (in)	1.98 - 2.40 (0.080 - 0.094)
Intake		mm (in)	2.26 - 2.69 (0.099 - 0.106)
Seat width (C)		mm (in)	1.58 - 1.94 (0.062 - 0.076)
Intake		mm (in)	1.80 - 2.02 (0.071 - 0.080)
Margin thickness (D)		mm (in)	0.8 - 1.2 (0.031 - 0.047)
Intake		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)

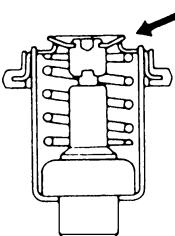
SPEC**MAINTENANCE SPECIFICATIONS**

E

Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		F115TR	LF115TR
Guide inside diameter Intake and exhaust	mm (in)	6.005 - 6.018 (0.2364 - 0.2369)	
Stem-to-guide clearance Intake	mm (in)	0.015 - 0.043 (0.0012 - 0.0011)	
Exhaust	mm (in)	0.030 - 0.058 (0.0018 - 0.0017)	
Stem runout limit	mm (in)	0.03 (0.001)	
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)	42.000 - 41.982 (1.6535 - 1.6528)	
Runout limit	mm (in)	0.03 (0.001)	

SPEC**MAINTENANCE SPECIFICATIONS**

E

Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		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)	50 (122)	
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	

SPEC**MAINTENANCE SPECIFICATIONS**

E

LOWER UNIT

Item	Worldwide USA Canada	Unit	Model	
			F115AET	FL115AET
			F115TR	LF115TR
			F115TR	LF115TR
GEAR BACKLASH				
Pinion - forward gear		mm (in)	0.20 - 0.31 (0.008 - 0.012)	0.15 - 0.30 (0.006 - 0.012)
Pinion - reverse gear		mm (in)	0.50 - 0.73 (0.020 - 0.029)	0.50 - 0.70 (0.020 - 0.028)
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	Worldwide USA Canada	Unit	Model	
			F115AET	FL115AET
			F115TR	LF115TR
			F115TR	LF115TR
IGNITION SYSTEM				
Ignition timing		Degree	4 ATDC - 26 BTDC	
CDI 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.

SPEC**MAINTENANCE SPECIFICATIONS**

E

Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		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	—	
@ 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	582 - 873	
Resistance (O - B)	Ω	800 - 1,200	

* Cranking 1: Open circuit voltage.

Cranking 2: Loaded circuit voltage.

SPEC

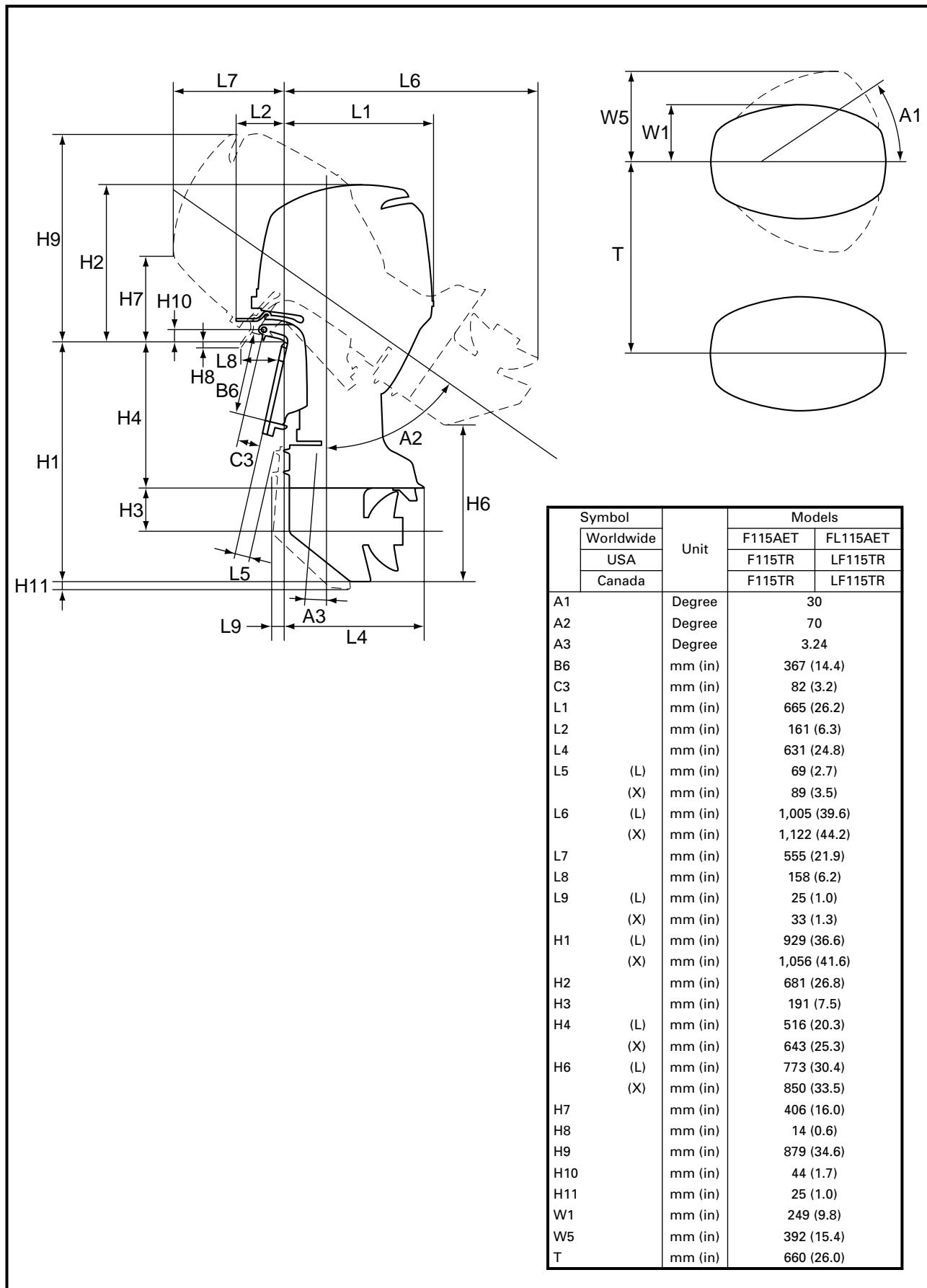
MAINTENANCE SPECIFICATIONS

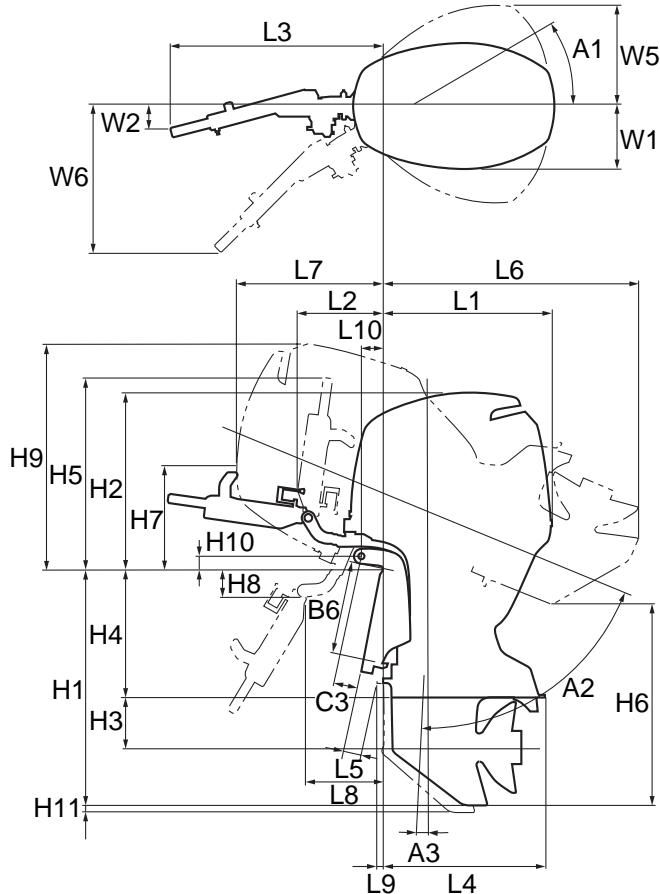
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Item	Unit	Model	
		F115AET	FL115AET
		F115TR	LF115TR
		F115TR	LF115TR
POWER TRIM AND TILT MOTOR			
Fluid type		ATF Dexron II	
Brushes			
Standard length	mm (in)	9.8 (0.39)	
Wear limit	mm (in)	4.8 (0.19)	
Commutator			
Standard diameter	mm (in)	22.0 (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)	

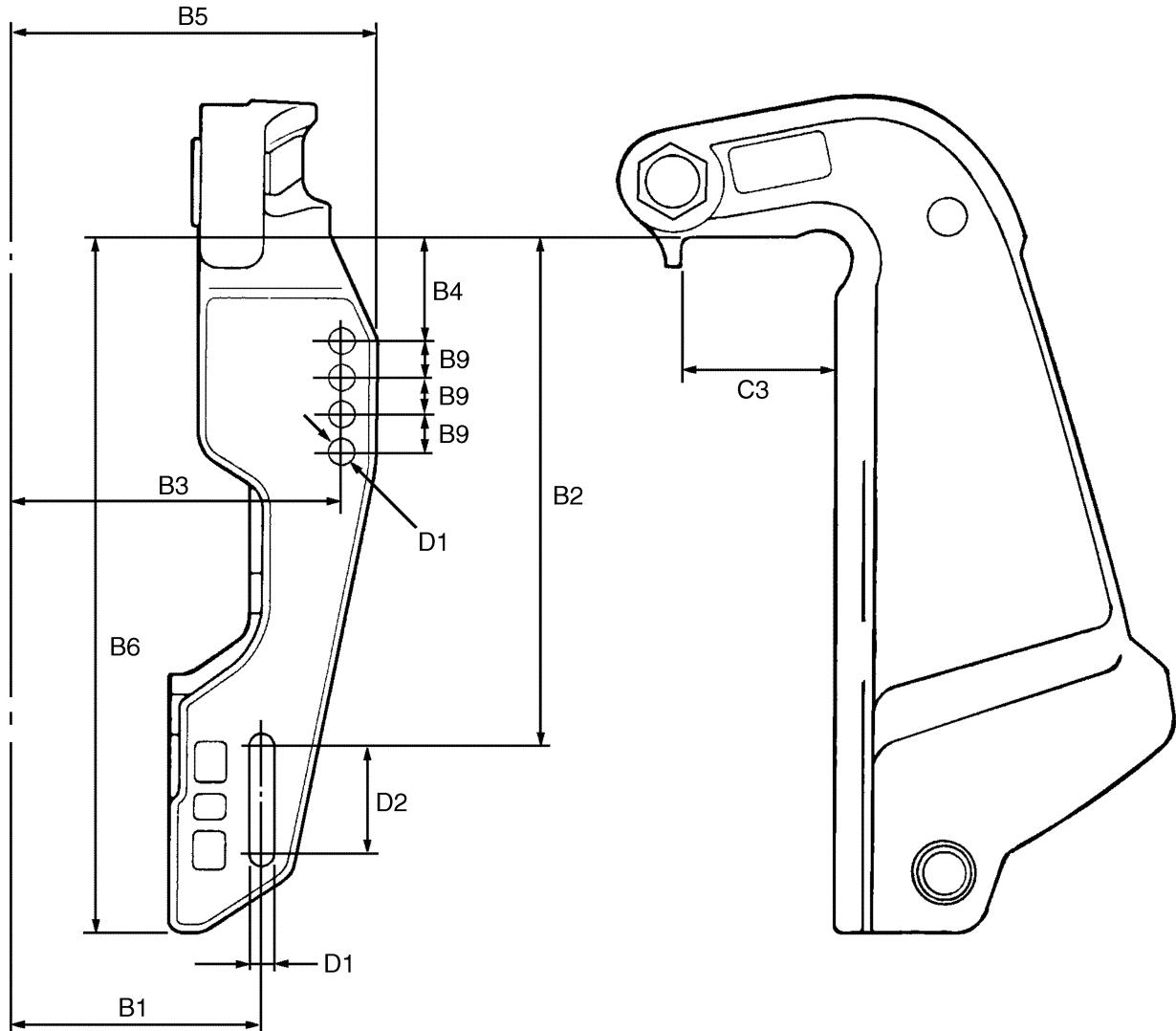


DIMENSIONS





Symbol	Unit	Models	
		F115AET	FL115AET
		F115TR	LF115TR
A1	Degree	30	
A2	Degree	70	
A3	Degree	3.24	
B6	mm (in)	367 (14.4)	
C3	mm (in)	82 (3.2)	
L1	mm (in)	665 (26.2)	
L2	mm (in)	316 (12.4)	
L3	mm (in)	832 (32.8)	
L4	mm (in)	631 (24.8)	
L5	(L) mm (in)	69 (2.7)	
	(X) mm (in)	89 (3.5)	
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)	25 (1.0)	
	(X) mm (in)	33 (1.3)	
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)	406 (16.0)	
H8	mm (in)	105 (4.1)	
H9	mm (in)	879 (34.6)	
H10	mm (in)	44 (1.7)	
H11	mm (in)	25 (1.0)	
W1	mm (in)	249 (9.8)	
W2	mm (in)	93 (3.7)	
W5	mm (in)	392 (15.4)	
W6	mm (in)	574 (22.6)	



Symbol	Unit	Models	
		F115AET	FL115AET
		F115TR	LF115TR
		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)	

SPEC**TIGHTENING TORQUES**

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TIGHTENING TORQUES**SPECIFIED TORQUES**

Part to be tightened	Thread size	Tightening torques		
		Nm	m•kgf	ft•lb
POWER UNIT				
Flywheel magnet assembly	M24	190	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
	2nd		17	1.7
Cylinder head assembly	1st	M8	14	1.4
	2nd		28	2.8
Cylinder head assembly (1.5 mm thread pitch)	1st	M10	15	1.5
	2nd		30	3.0
	3rd		Turn 90°	
Exhaust cover	1st	M6	6	0.6
	2nd		12	1.2
Oil filter	—	—	18	1.8
Oil pressure switch	—	—	8	0.8
Crankcase	1st	M8	14	1.4
	2nd		28	2.8
Crankcase (1.5 mm thread pitch)	1st	M10	19	1.9
	2nd		Turn 60°	
Connecting rod cap	1st	M8	15	1.5
	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

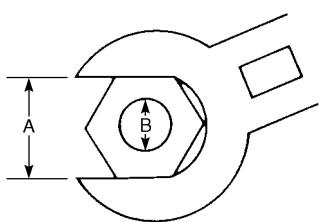
SPEC**TIGHTENING TORQUES**

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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	11	1.1	8.0
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

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MAINTENANCE INTERVAL CHART

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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.

TABELLE FÜR WARTUNGSINTERVALLE

Die nachstehende Tabelle dient als Richtlinie für allgemeine Wartungsintervalle.

Die Wartungsintervalle den Betriebsbedingungen entsprechend anpassen.

Bezeichnung	Anmerkungen	Anfang		Alle		Siehe Seite
		10 Stunden (Einlaufzeit)	50 Stunden (3 Monate)	100 Stunden (6 Monate)	200 Stunden (1 Jahr)	
HAUBENDECKEL						
Haubendeckelsitz	Kontrollieren				○	3-2
KRAFTSTOFFANLAGE						
Kraftstoffleitung	Kontrollieren				○	3-2
Kraftstofffilter	Kontrollieren/ersetzen	○		○	○	3-3
MOTORBLOCK						
Wasser-Undichtigkeit	Kontrollieren	○	○	○		—
Außenseite des Motors	Kontrollieren			○		—
Motoröl	Ersetzen	○		○		3-11
Ölfilter	Ersetzen				○	3-11
Steuerriemen ^{(*)1}	Kontrollieren/ersetzen				○	3-12
Ventilspiel ^{(*)2}	Kontrollieren/einstellen	Alle 400 Stunden (2 Jahre)				3-13
Thermostat	Kontrollieren				○	5-25
Auspuff-Undichtigkeit	Kontrollieren	○	○	○		—
Kühlwasserkanäle ^{(*)3}	Spülen			○		—
STEUERSYSTEM						
Fernbedienungs-Schaltkabel	Kontrollieren/einstellen				○	3-5
Fernbedienungs-Drosselventilkabel	Kontrollieren/einstellen				○	3-6
Drosselventil-Positionssensor	Kontrollieren/einstellen				○	3-7
SERVO-TRIMM UND KIPPEINHEIT						
Servo-Trimm und Kippflüssigkeit	Kontrollieren	○	○	○	○	3-16
ANTRIEBSEINHEIT						
Getriebeöl	Wechseln	○		○		3-18
Undichtigkeit der Antriebseinheit	Kontrollieren				○	3-19
der/die Propeller	Kontrollieren			○		6-3, 6-28
ALLGEMEINES						
Anoden	Kontrollieren/ersetzen				○	3-20
Batterie	Kontrollieren/laden	○			○	3-21
Zündkerzen	Säubern/einstellen/ersetzen	○			○	3-22
Verdrahtungen und Verbindungsstücke	Einstellen/wieder verbinden	○	○	○		—
Schrauben und Muttern ^{(*)4}	Festziehen	○			○	—
Schmierstellen	Schmieren			○		3-25

(*)¹ Sicherstellen, daß der Steuerriemen alle 1.000 Betriebsstunden oder nach 5 Betriebsjahren (was zuerst zutrifft) gewechselt wird.

(*)² Wird gewöhnlich verbleites Benzin verwendet, sollten zusätzlich zu den Punkten auf der obigen Wartungstablette die Motorventile und die damit zusammenhängenden Teile alle 300 Betriebsstunden überprüft werden.

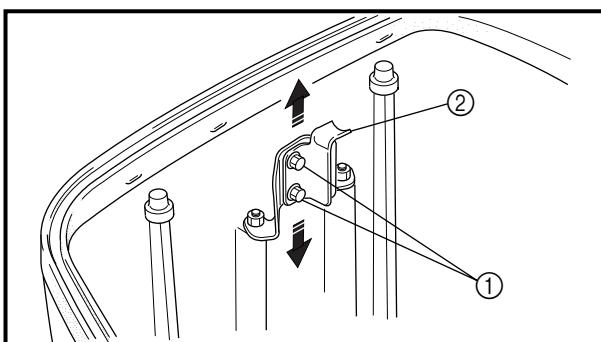
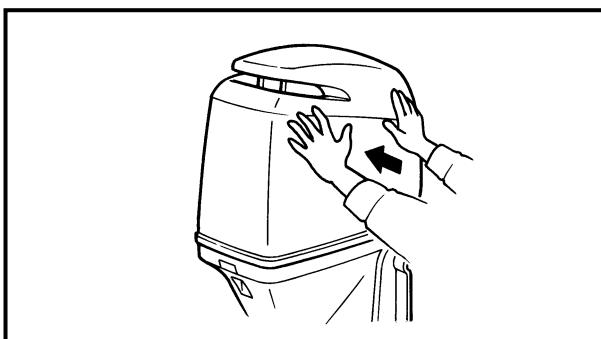
(*)³ Nach dem Betrieb in Salzwasser, trübem oder schlammigem Wasser, sollte der Motor mit frischem Wasser gespült werden.

(*)⁴ Außer den Zylinderkopfschrauben und den Schrauben der Kurbelgehäuse-Lagerzapfen.

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TOP COWLING/FUEL SYSTEM

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TOP COWLING CHECKING THE TOP COWLING FIT

1. Check:

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

2. Adjust:

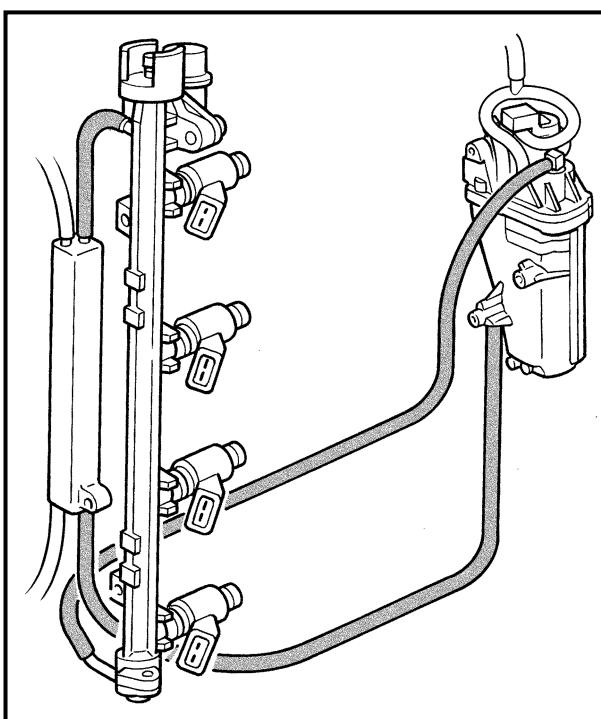
- Top cowling hook position

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: _____

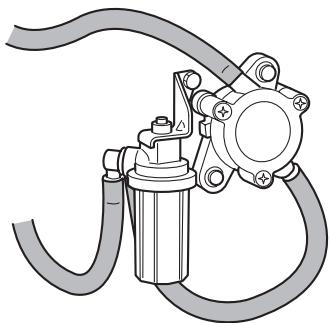
- Moving the latch towards the seal will loosen the top cowling.
- Moving the latch away from the seal will tighten the top cowling.



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.

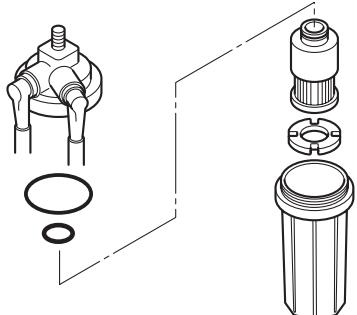


2. Check:

- Plastic locking tie
Loosen → Retighten or replace.

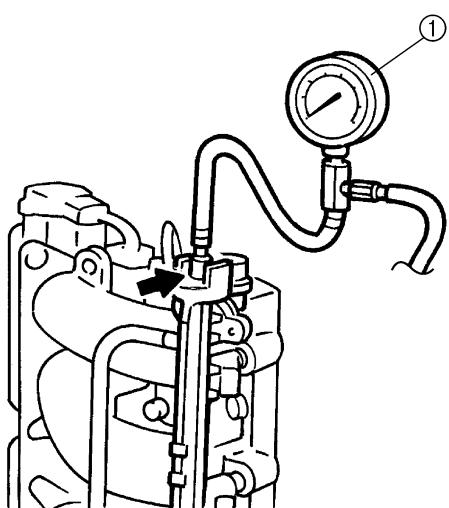
3. Check:

- 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)

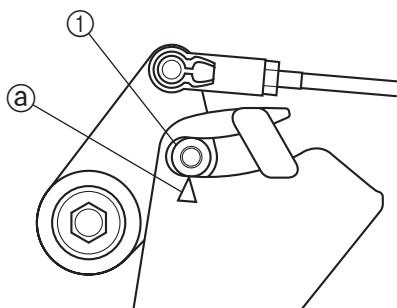
Measuring steps

- (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 ② on the throttle cam aligns with the center of the throttle roller ① as shown.

2. Adjust:

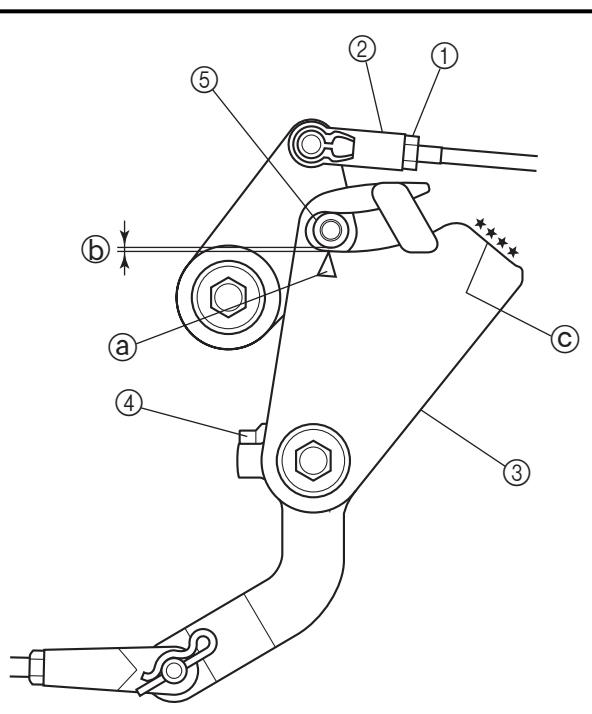
- Throttle body pickup timing

Adjustment steps

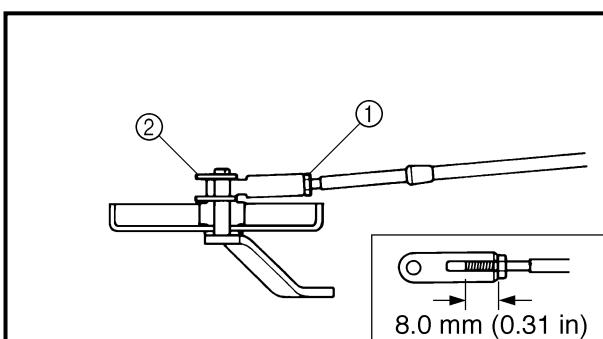
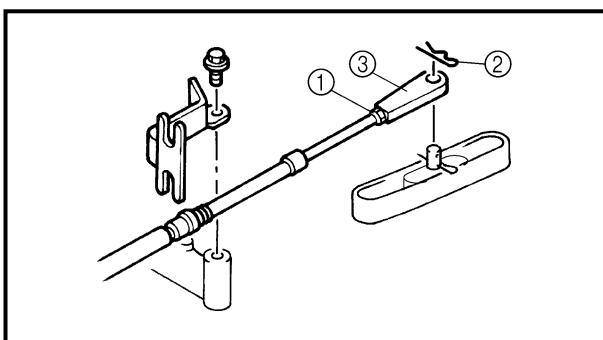
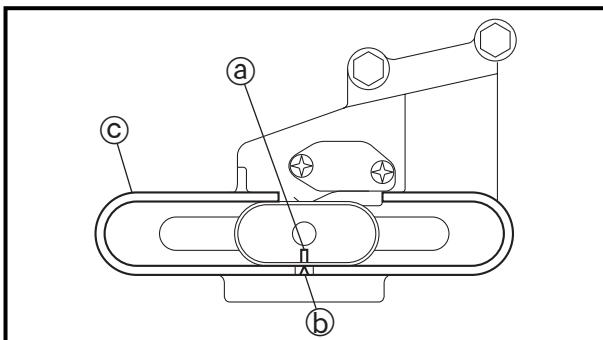
- (1) Loosen the nut ①.
- (2) Remove the throttle joint link rod ②.
- (3) Move the throttle control lever ③ until it contacts the fully-closed stopper ④.

NOTE: _____

Make sure the throttle is fully-closed.



- (4) Align the fully-closed mark ② 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 ⑦ on the accelerator cam.
- (8) Set the throttle to the fully-closed position and check that the fully-closed mark ② 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.

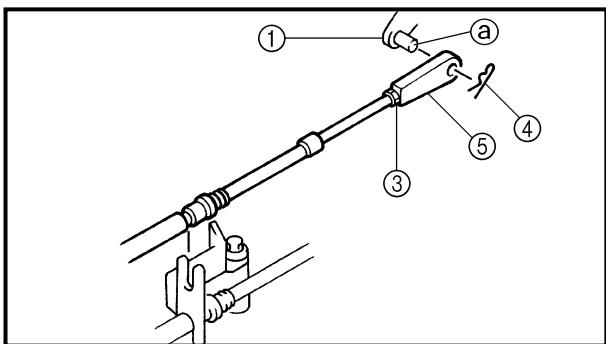
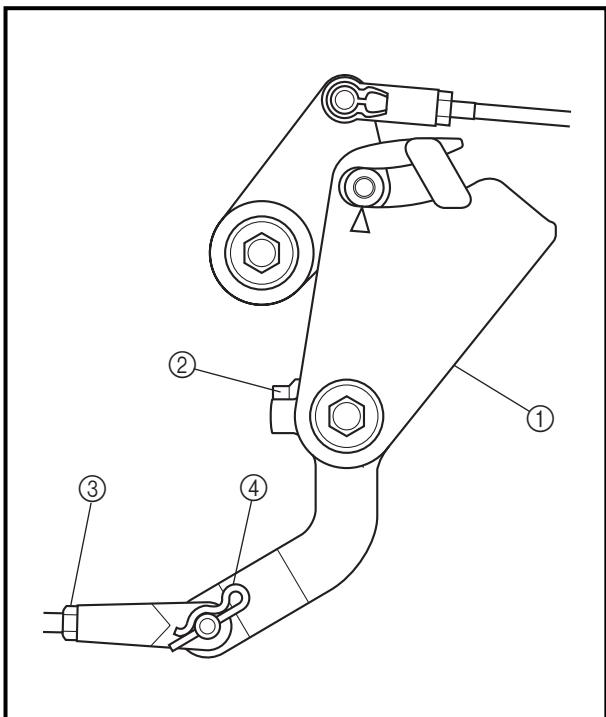
⚠ WARNING

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 ⑥.
- (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.

INSP**CONTROL SYSTEM**

E

ADJUSTING THE THROTTLE POSITION SENSOR**1. Measure:**

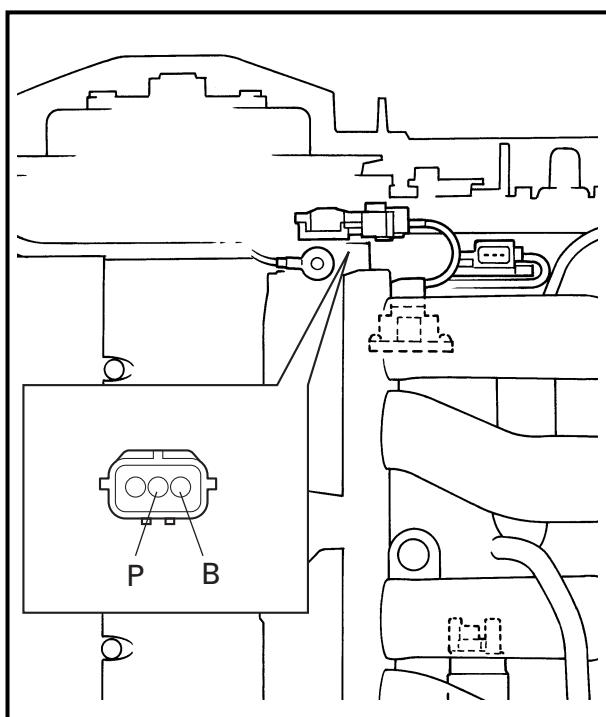
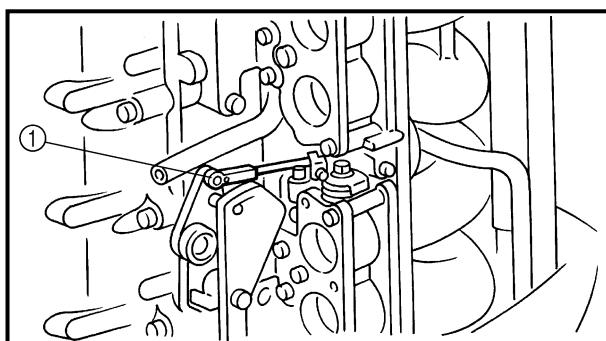
- Throttle position sensor output voltage
Out of specification → Adjust.



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.

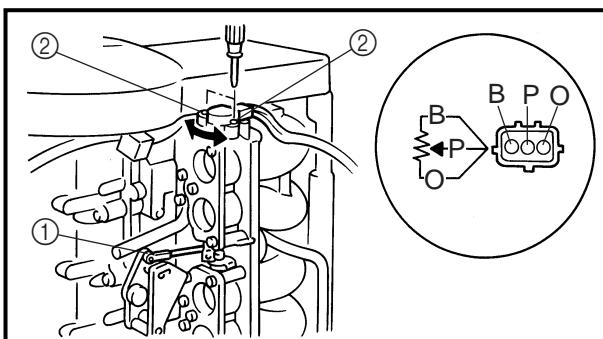
**Measuring steps**

- (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 ± 0.014 V

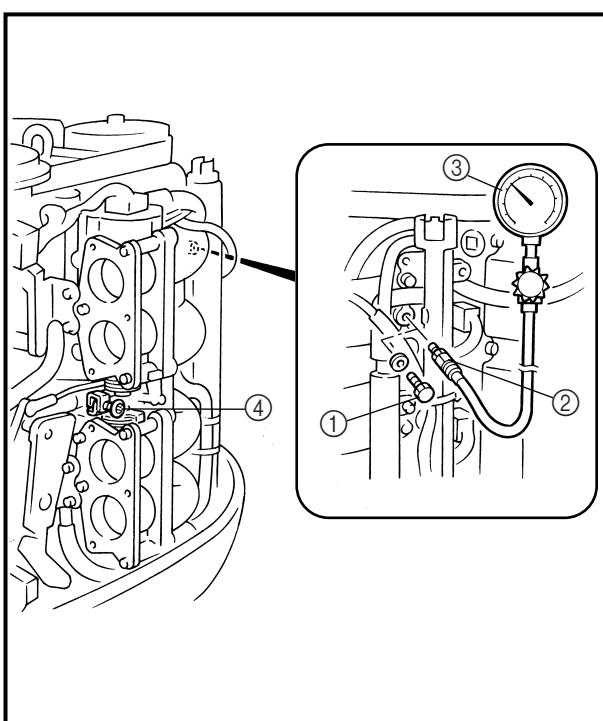
General adjusting tool
Torx T-20 (with a concave in the center)

- (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 ± 50 r/min

INSP**CONTROL SYSTEM**

E

- (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:

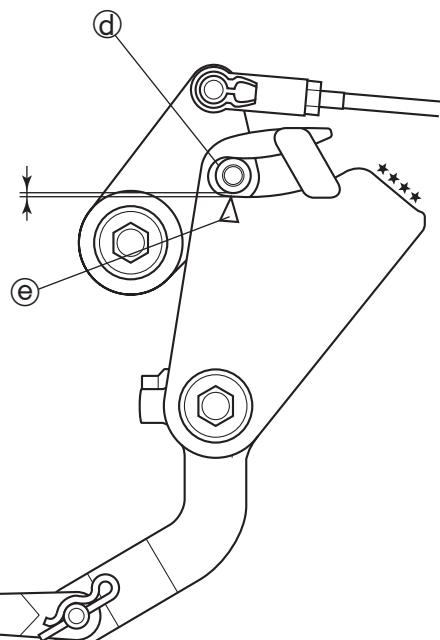
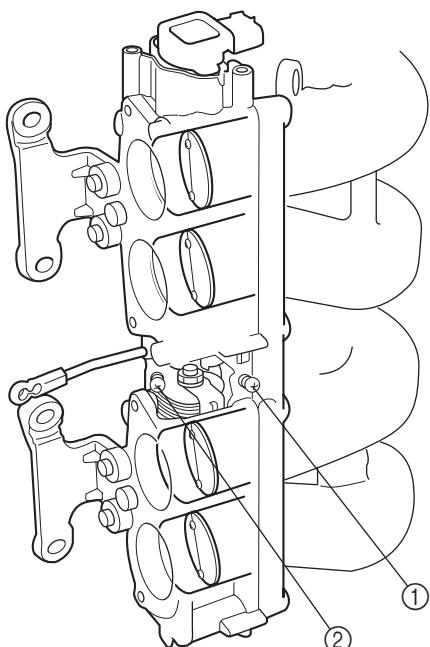
Check results:

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.



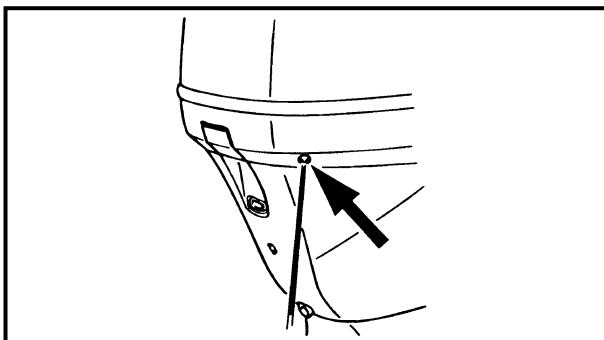
Test harness
90890-06793

- (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 ③ as the mark ④ 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.



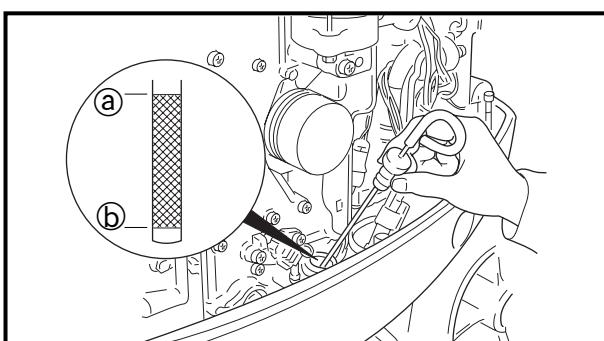
COOLING SYSTEM CHECKING THE COOLING WATER DISCHARGE

Check:

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

Checking steps

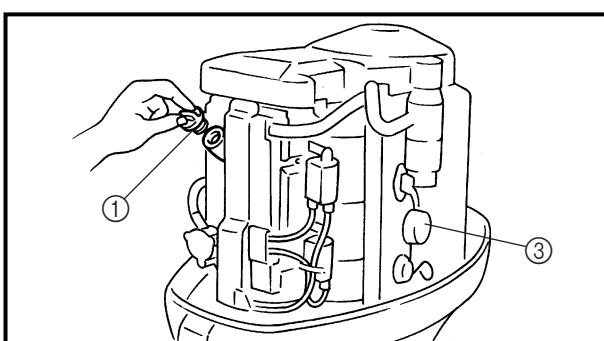
- (1) Place the lower unit in water.
- (2) Start the engine.
- (3) Check that water flows from the cooling water outlet.



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)



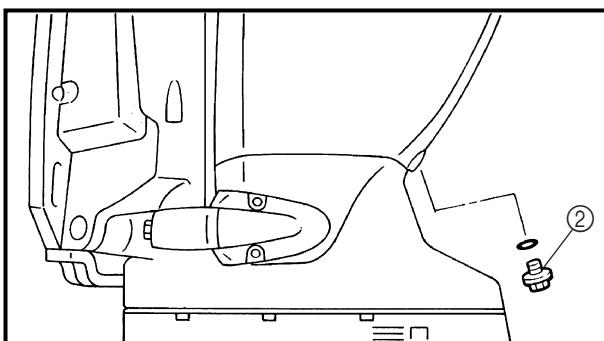
**Oil filter wrench
YU-38411 / 90890-01426**

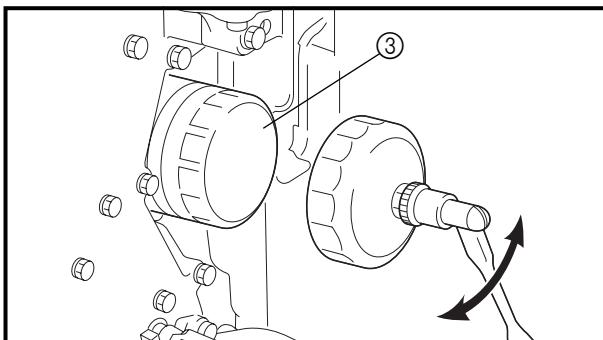
3. Install:

- Drain plug (2)



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



**4. Install:**

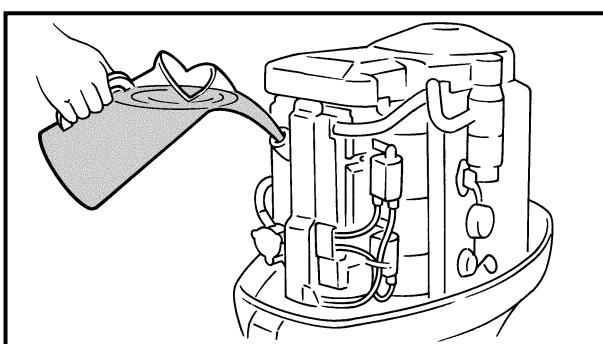
- Oil filter ③

**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 or SH

SAE: 10W-30, 10W-40

Oil quantity

with oil filter

4,700 cm³

(159 US oz, 165 Imp oz)

without oil filter

4,500 cm³

(152 US oz, 158 Imp oz)

6. Install:

- Oil filler cap

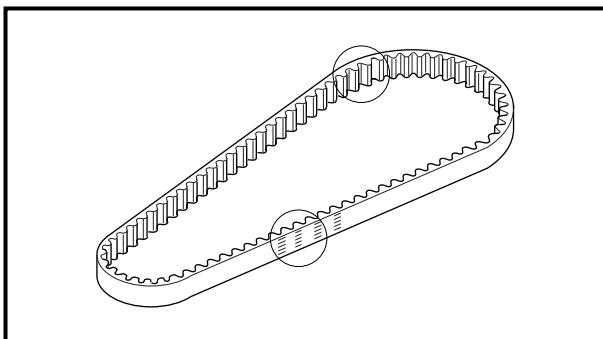
7. Check:

- Engine oil level

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

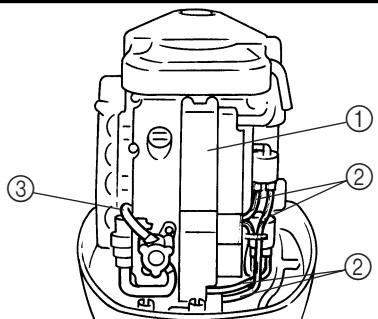
NOTE:

- 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 ④
- Exhaust valve clearance ⑤



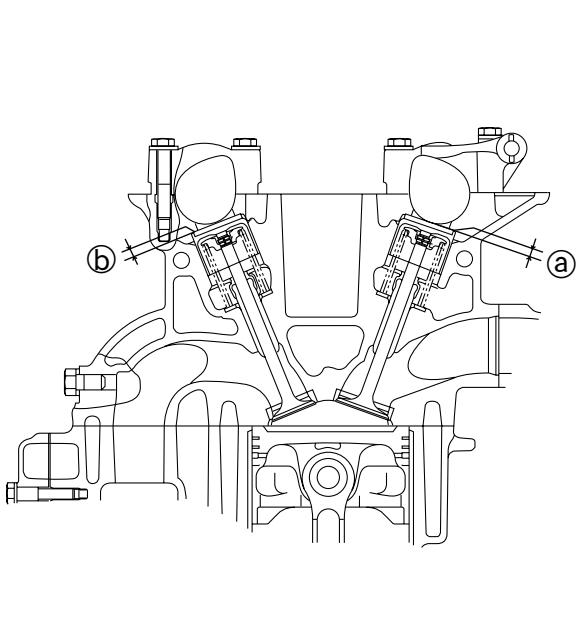
Valve clearance

Intake

$0.20 \pm 0.03 \text{ mm}$
($0.008 \pm 0.001 \text{ in}$)

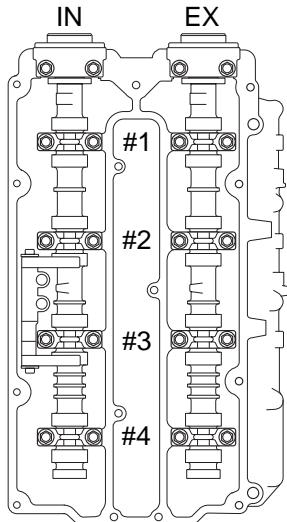
Exhaust

$0.34 \pm 0.03 \text{ mm}$
($0.013 \pm 0.001 \text{ in}$)



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.

INSP**POWER UNIT**

E

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.

**Proper valve pad thickness =
Removed valve pad thickness +
Measured valve clearance –
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.

INSP

POWER UNIT/POWER TRIM AND TILT SYSTEM

E

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

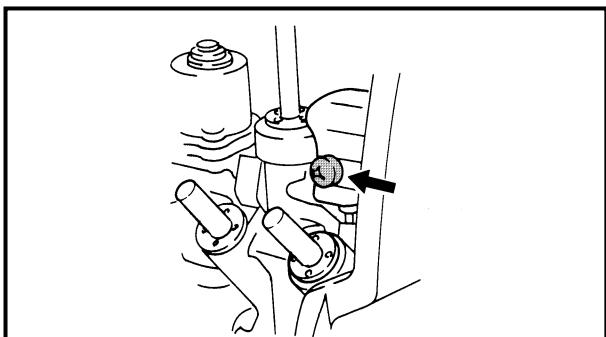
POWER TRIM AND TILT SYSTEM CHECKING THE POWER TRIM AND TILT FLUID LEVEL

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**



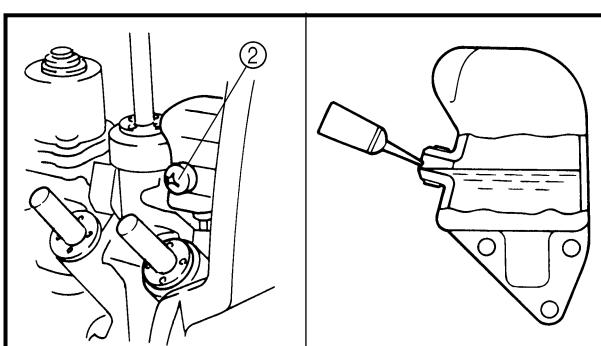
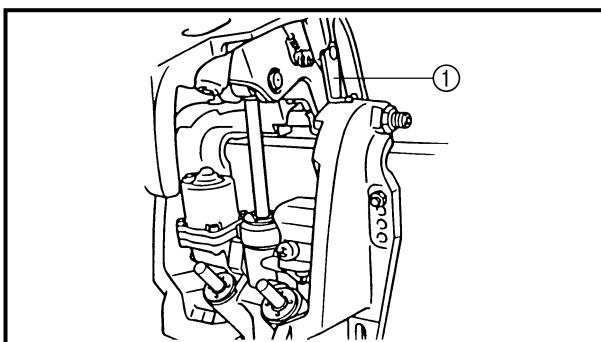
⚠ WARNING

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.

INSP

POWER TRIM AND TILT SYSTEM

E



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:

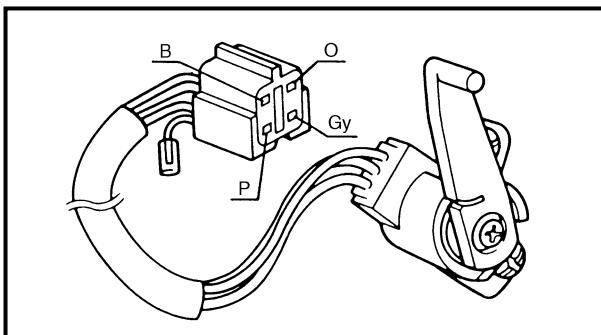
- Trim sensor setting resistance
Out of specification → Adjust.



Trim sensor setting resistance
Pink (P) – Black (B)
 $80 \pm 12 \Omega$ at 20°C (68°F)

Measuring steps

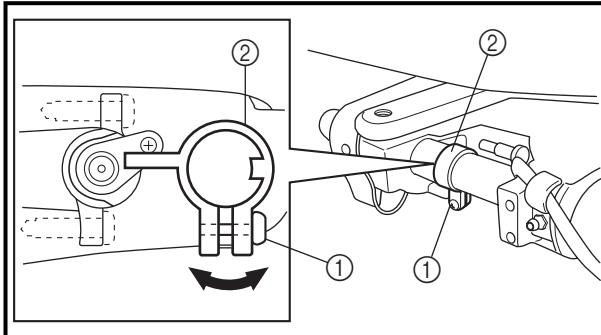
- (1) Fully tilt the outboard down.
- (2) Measure the trim sensor resistance.



**INSP
ADJ**

POWER TRIM AND TILT SYSTEM/LOWER UNIT

E



2. Adjust:

- Trim sensor cam position

Adjusting steps

- Fully tilt the outboard to full trim-in position.
- Loosen the screw ①.
- Adjust the position of the trim sensor cam ② until the specified resistance is obtained.



Trim sensor resistance
Pink (P) – Black (B)
 $80 \pm 12 \Omega$ at 20°C (68°F)

- Tighten the screw.



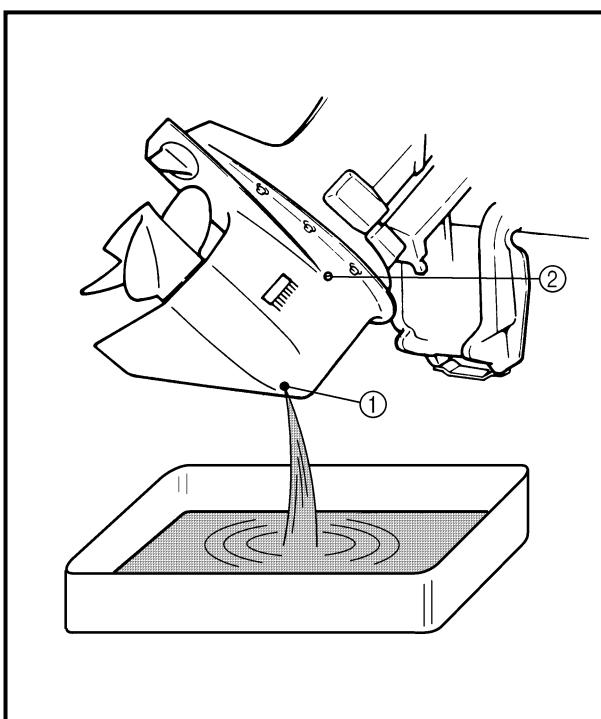
Trim sensor cam screw
2 Nm (0.2 m · kgf, 1.4 ft · lb)

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

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

INSP
ADJ



LOWER UNIT

E

2. Fill:

- Gear oil

(with the specified amount of the recommended gear oil)



Recommended gear oil
GEAR CASE LUBE (USA) or
Hypoid gear oil, SAE 90

Total amount

Regular rotation models

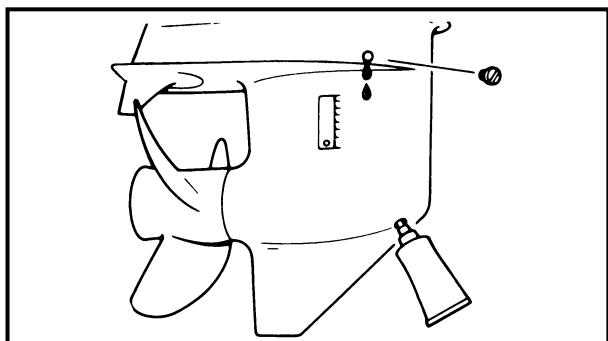
760 cm³

(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)

INSP
ADJ

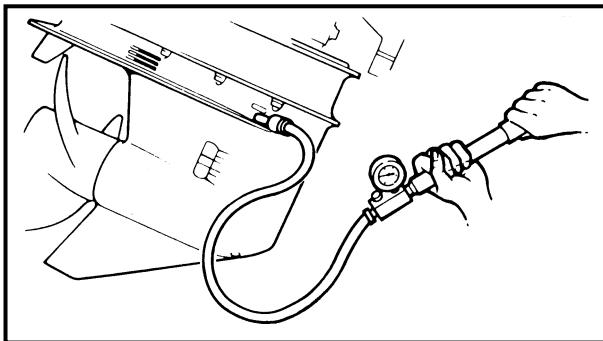
LOWER UNIT/GENERAL

E

CHECKING THE LOWER UNIT (FOR AIR LEAKS)

Check:

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

**Lower unit holding pressure
100 kPa (1.0 kg/cm², 14.2 psi)**

Checking steps

CAUTION:

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

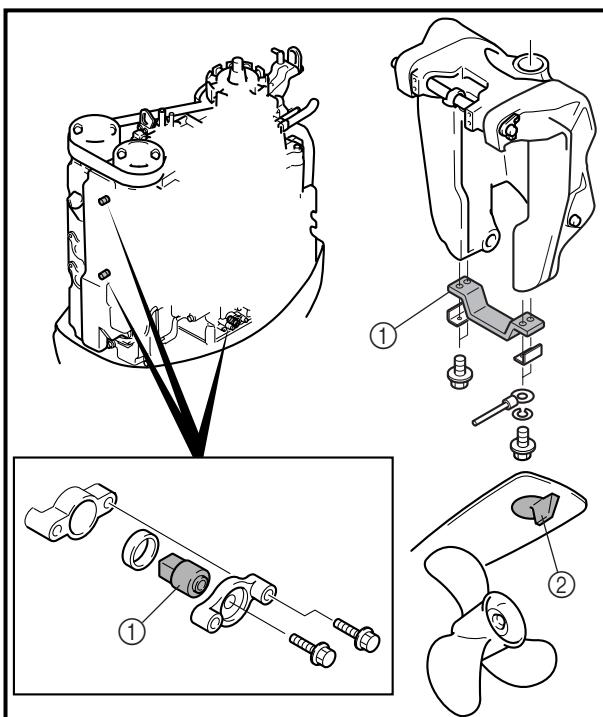
- (1) Remove the gear oil level check screw.
- (2) Install the pressure tester into the check hole.

**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.
-

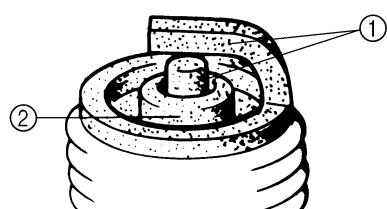


Check:

- 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)



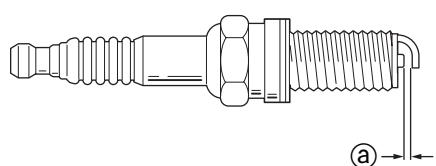
CHECKING THE SPARK PLUGS

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.)

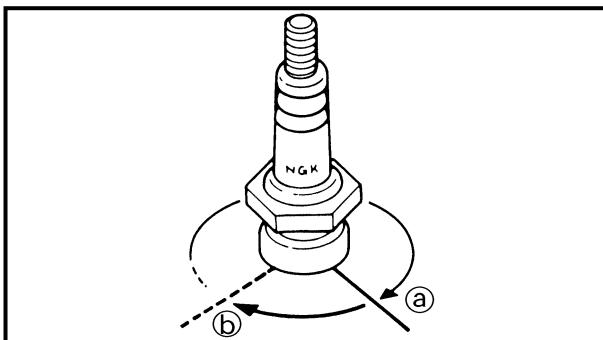


3. Measure:

- 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:

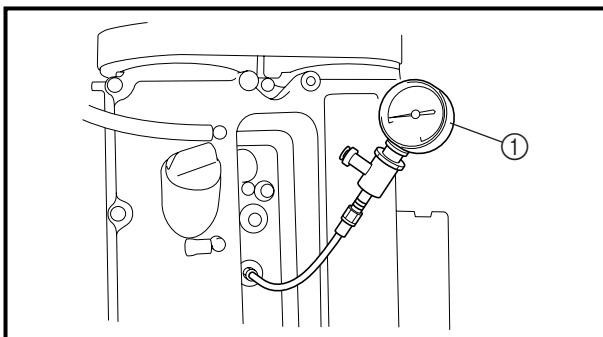
- Spark plug(-s)

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
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:

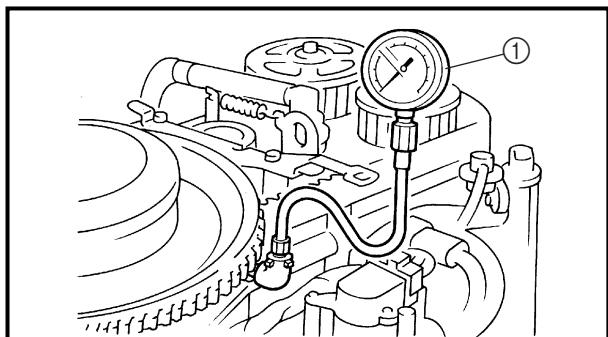
- Oil pressure switch

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.



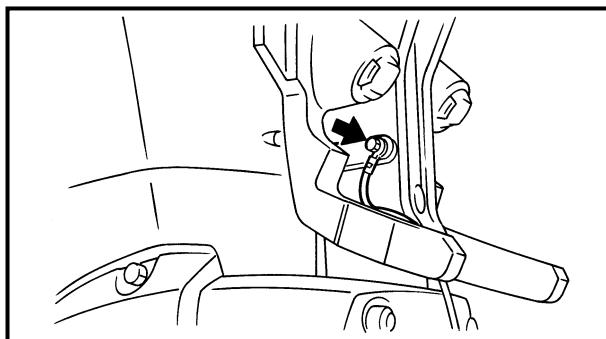
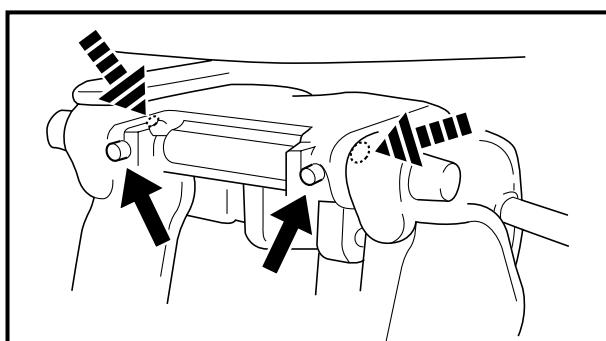
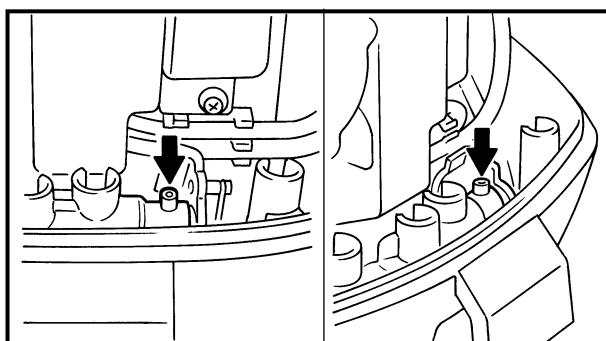
Oil pressure
At idling (55 °C (131 °F))
350 kPa (3.5 kg/cm², 49.8 psi)
or higher

5. Remove:

- Oil pressure gauge

6. Install:

- Oil pressure switch

**LUBRICATION POINTS****1. Apply:**

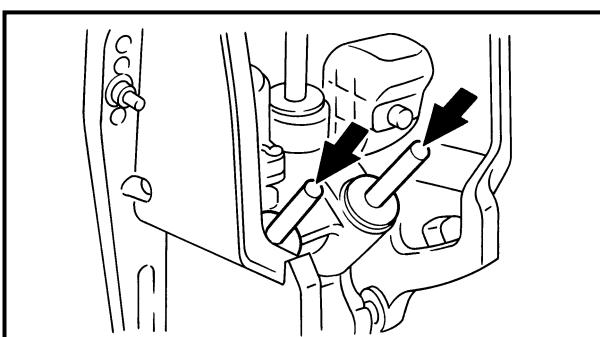
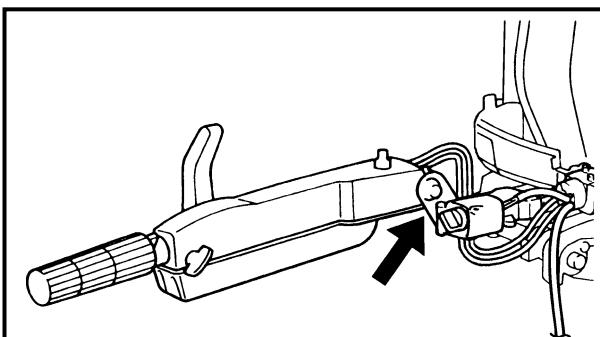
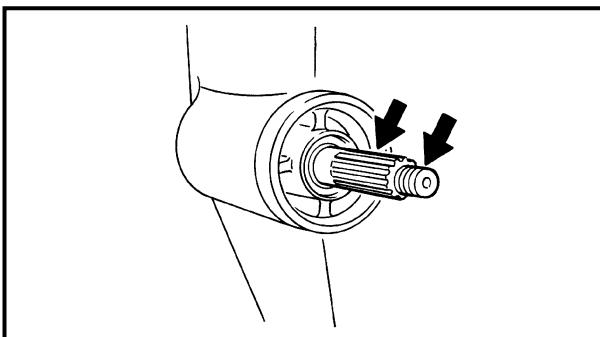
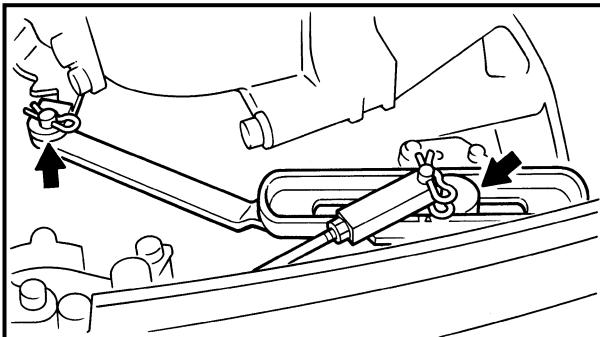
- Water resistant grease

INSP



GENERAL

(E)



2. Apply:

- Corrosion resistant grease



CHAPTER 4

FUEL SYSTEM

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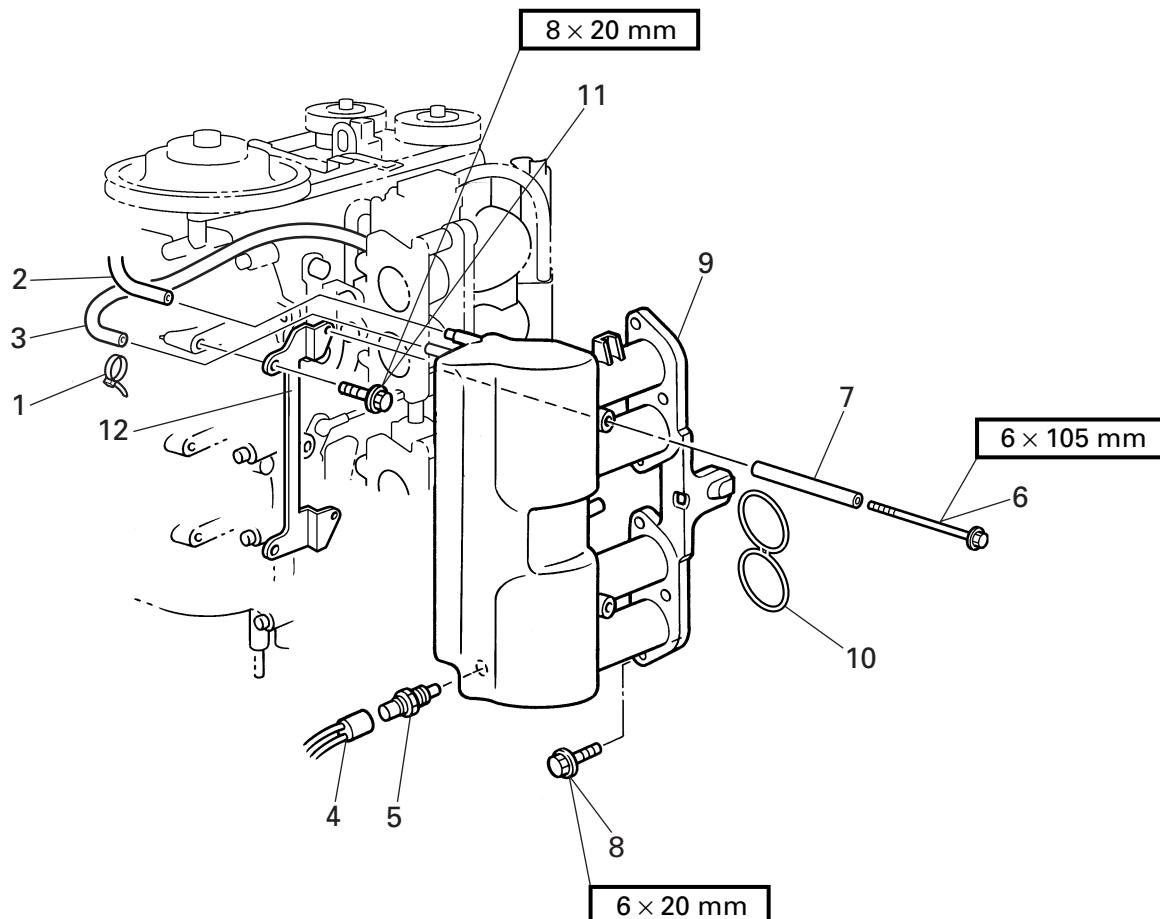


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INTAKE SILENCER

REMOVING/INSTALLING THE INTAKE SILENCER

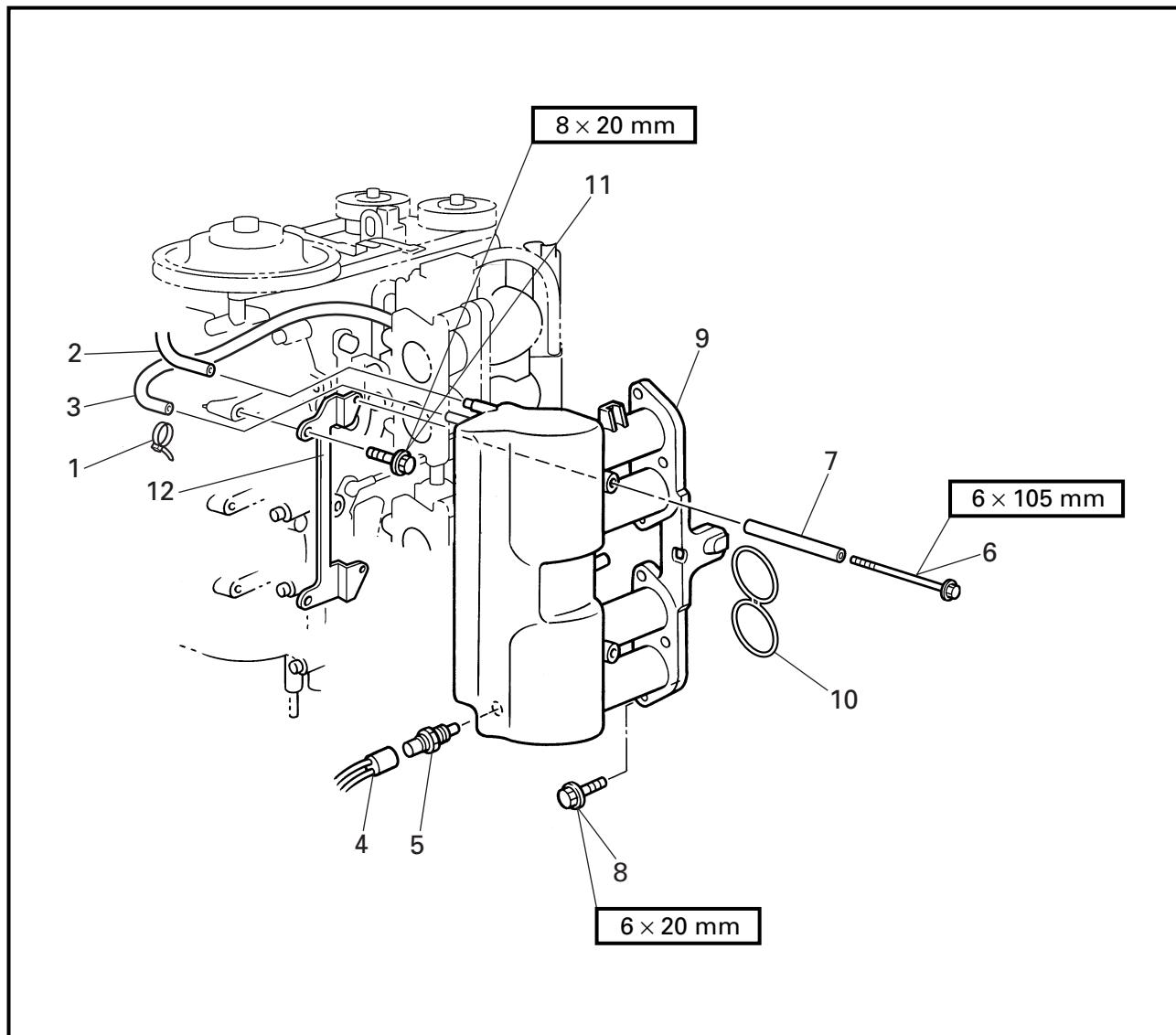


Order	Job/Part	Q'ty	Remarks
	Flywheel cover		Refer to "FLYWHEEL MAGNET ASSEMBLY" on page 5-1.
1	Plastic locking tie	1	Not reusable
2	Hose	1	(cylinder head cover-to-intake silencer)
3	Hose	1	(vapor separator-to-intake silencer)
4	Intake air temperature sensor coupler	1	
5	Intake air temperature sensor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

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FUEL**INTAKE SILENCER**

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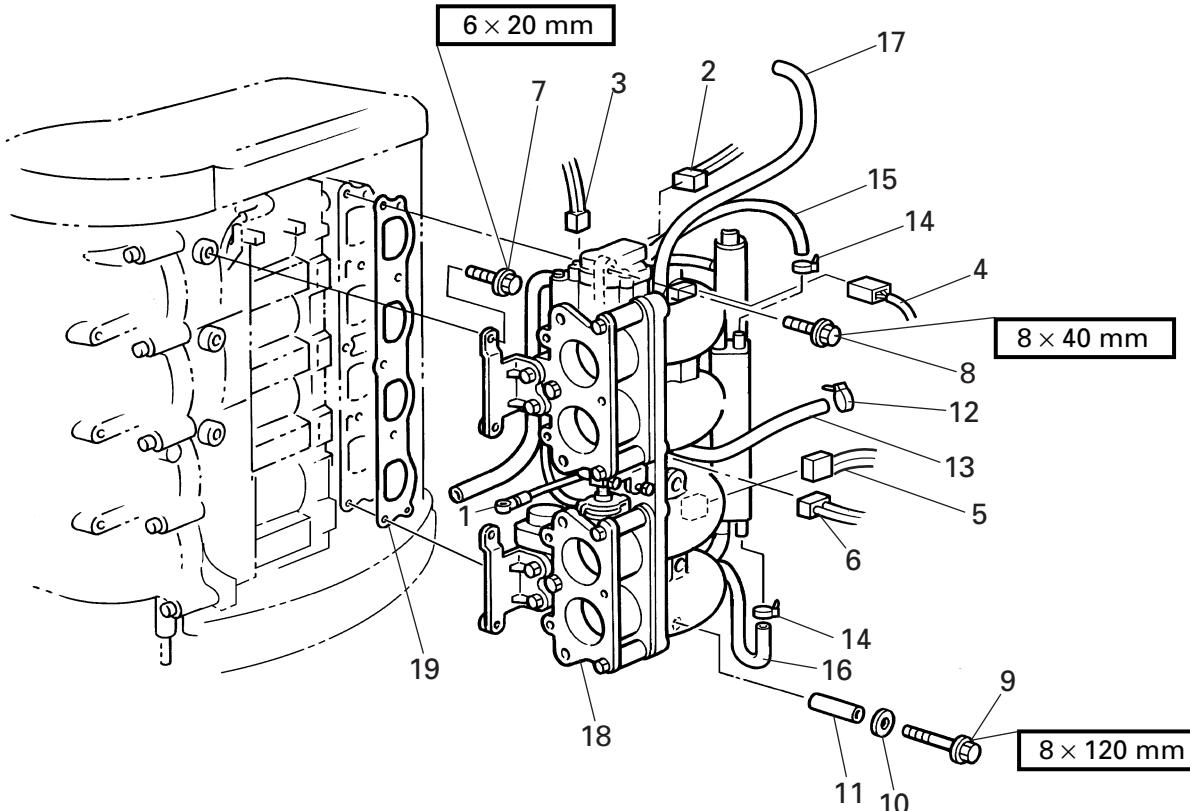


Order	Job/Part	Q'ty	Remarks
7	Collar	2	
8	Bolt	6	
9	Intake silencer	1	
10	O-ring	2	
11	Bolt	2	
12	Bracket	1	For installation, reverse the removal procedure.



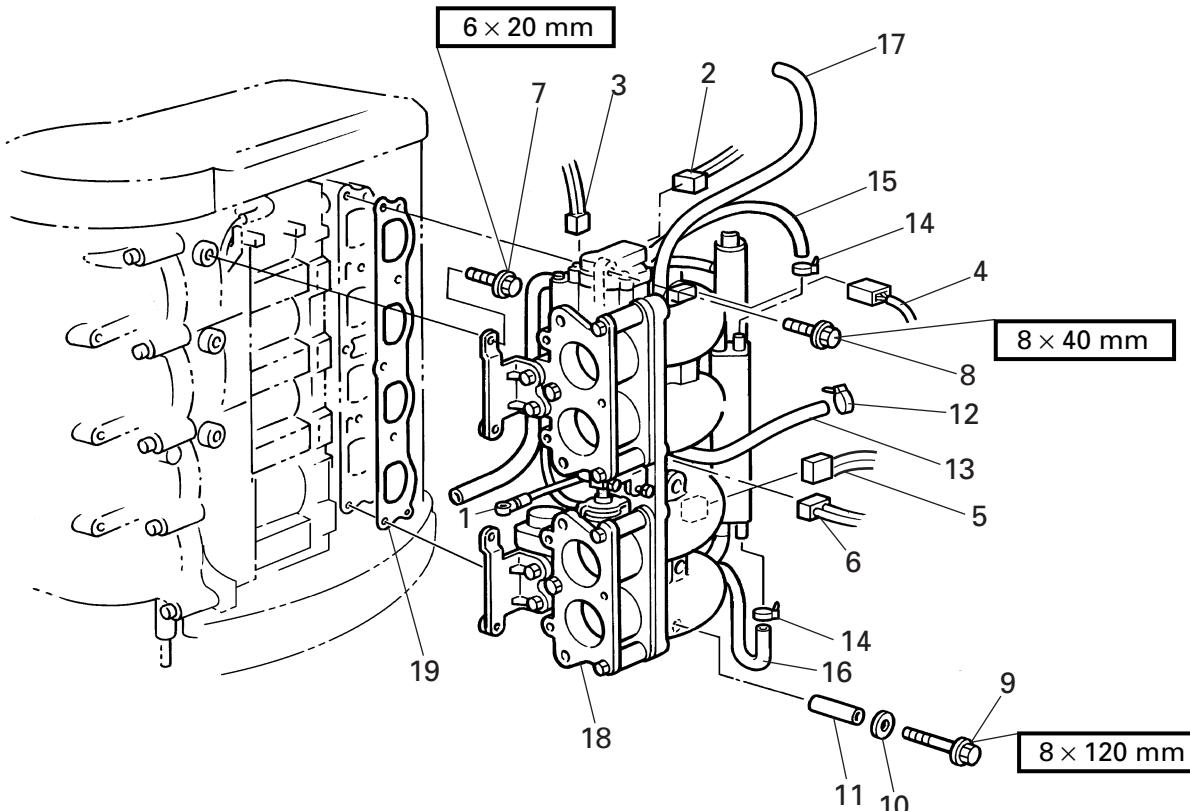
INTAKE ASSEMBLY

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	Atmospheric pressure sensor coupler	1	
5	Fuel injector coupler	4	
6	High-pressure fuel pump coupler	1	
7	Bolt	4	
8	Bolt	4	

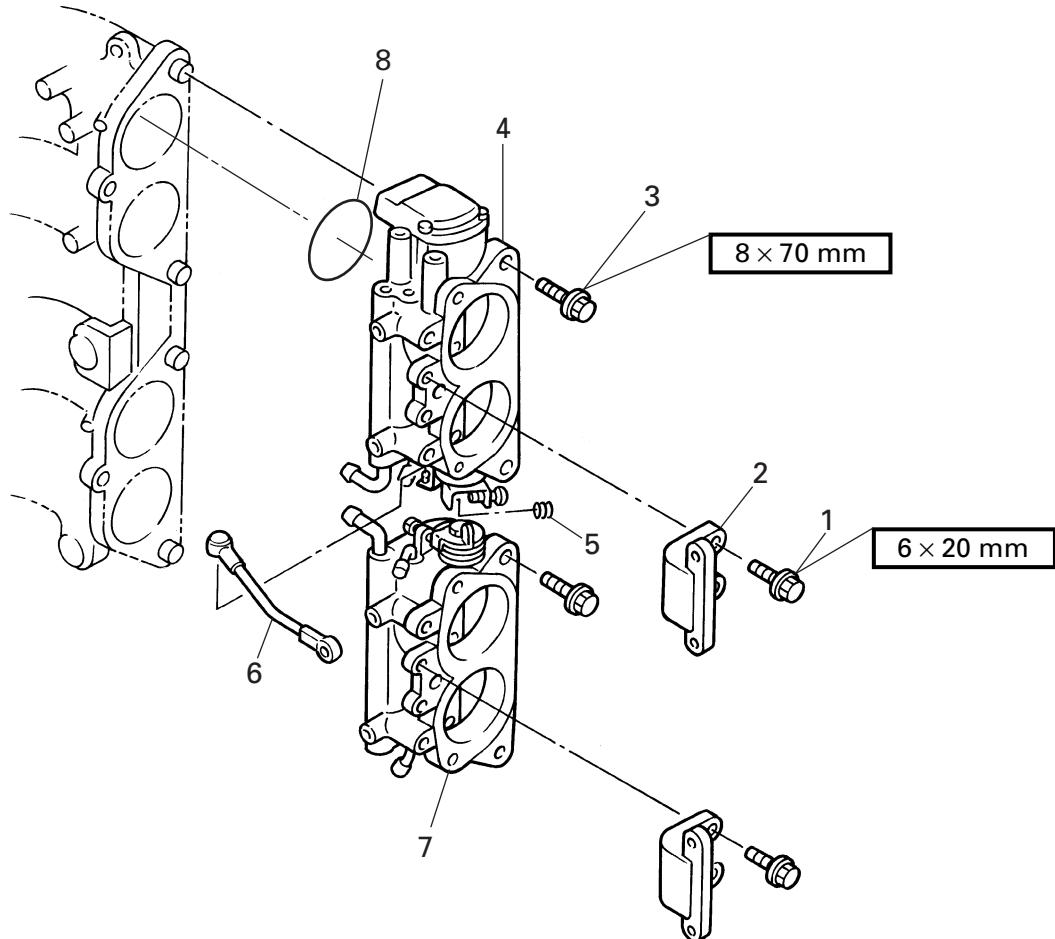
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Order	Job/Part	Q'ty	Remarks
9	Bolt	1	
10	Washer	1	
11	Collar	1	
12	Plastic locking tie	1	Not reusable
13	Fuel inlet hose	1	(fuel pump-to-vapor separator)
14	Hose clamp	2	
15	Water hose	1	(fuel cooler-to-water outlet)
16	Water hose	1	(fuel cooler-to-exhaust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

FUEL**THROTTLE BODY**

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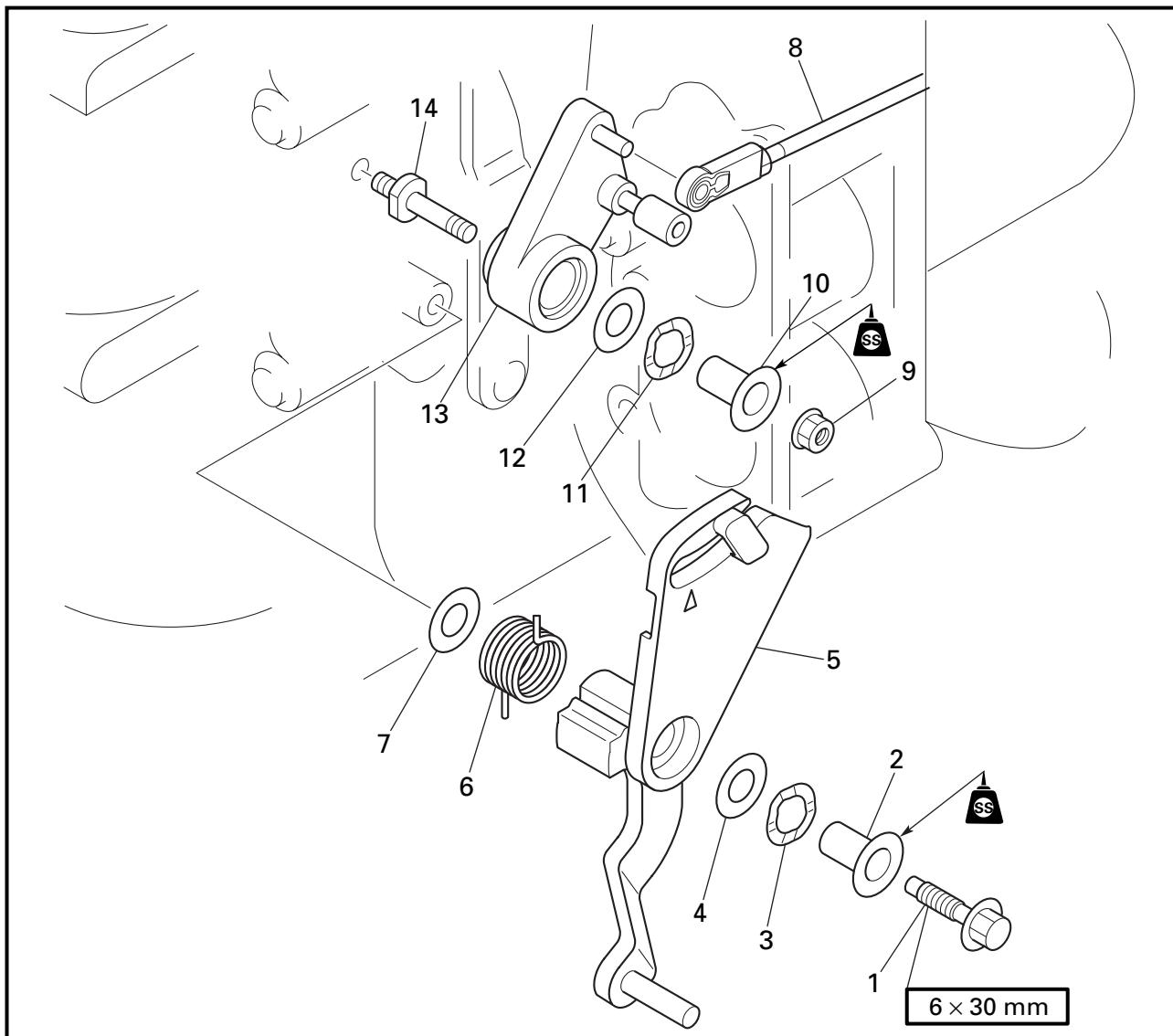
THROTTLE BODY
REMOVING/INSTALLING THE THROTTLE BODY

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 x 48 mm For installation, reverse the removal procedure.



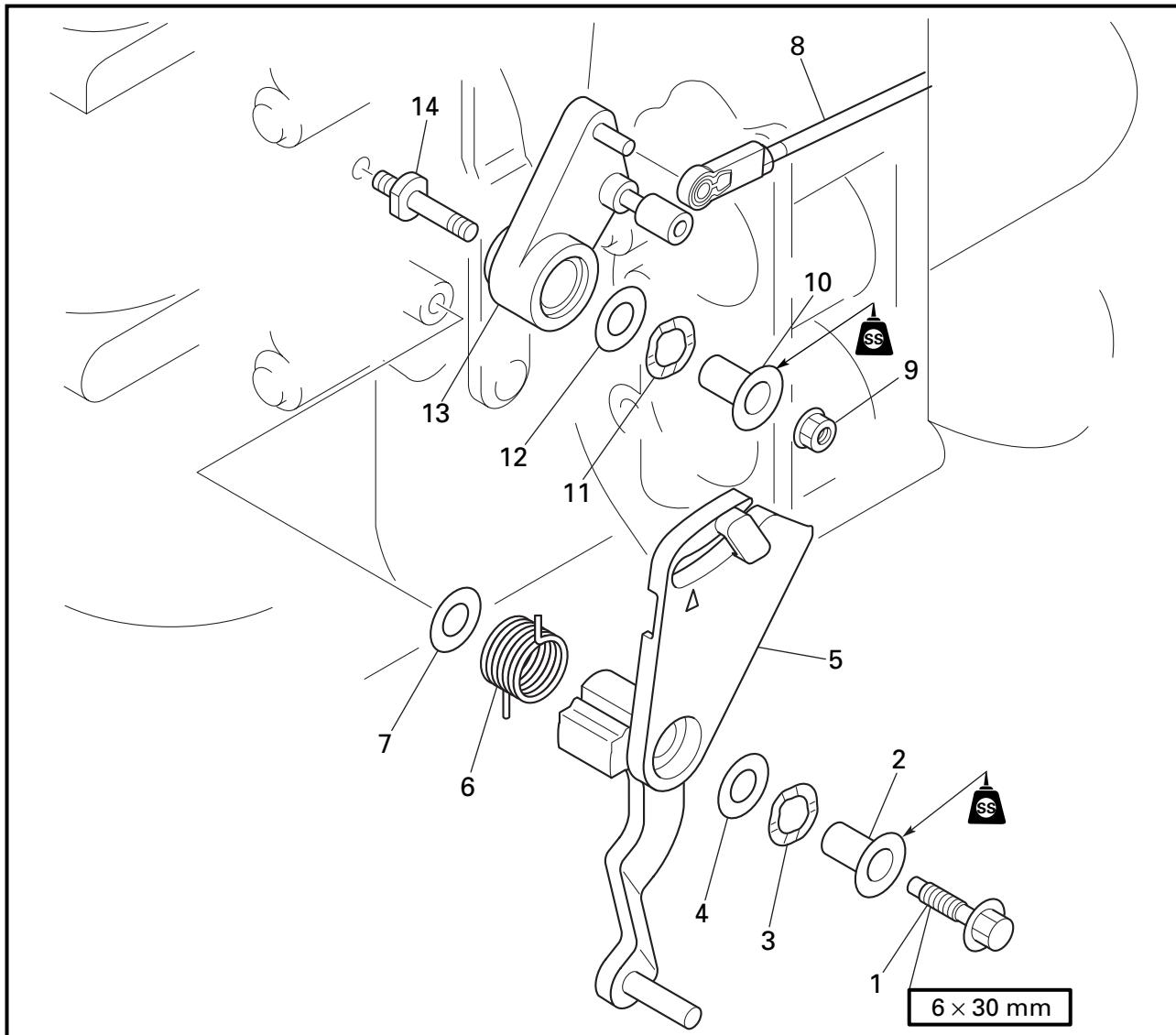
CONTROL UNIT

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	

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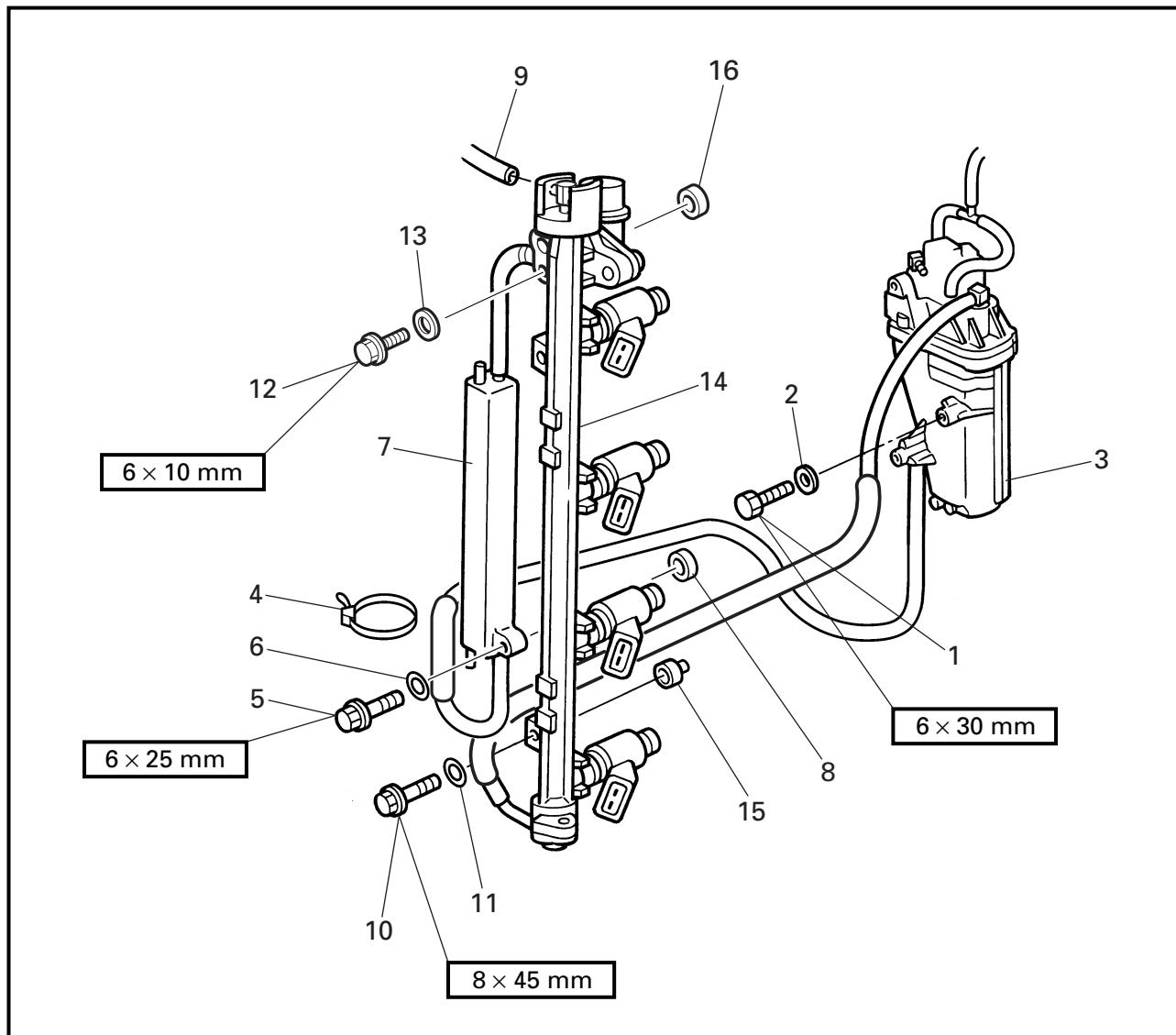


Order	Job/Part	Q'ty	Remarks
8	Throttle joint link rod	1	
9	Nut	1	
10	Collar	1	
11	Wave washer	1	
12	Washer	1	
13	Accelerator cam	1	
14	Stud bolt	1	For installation, reverse the removal procedure.



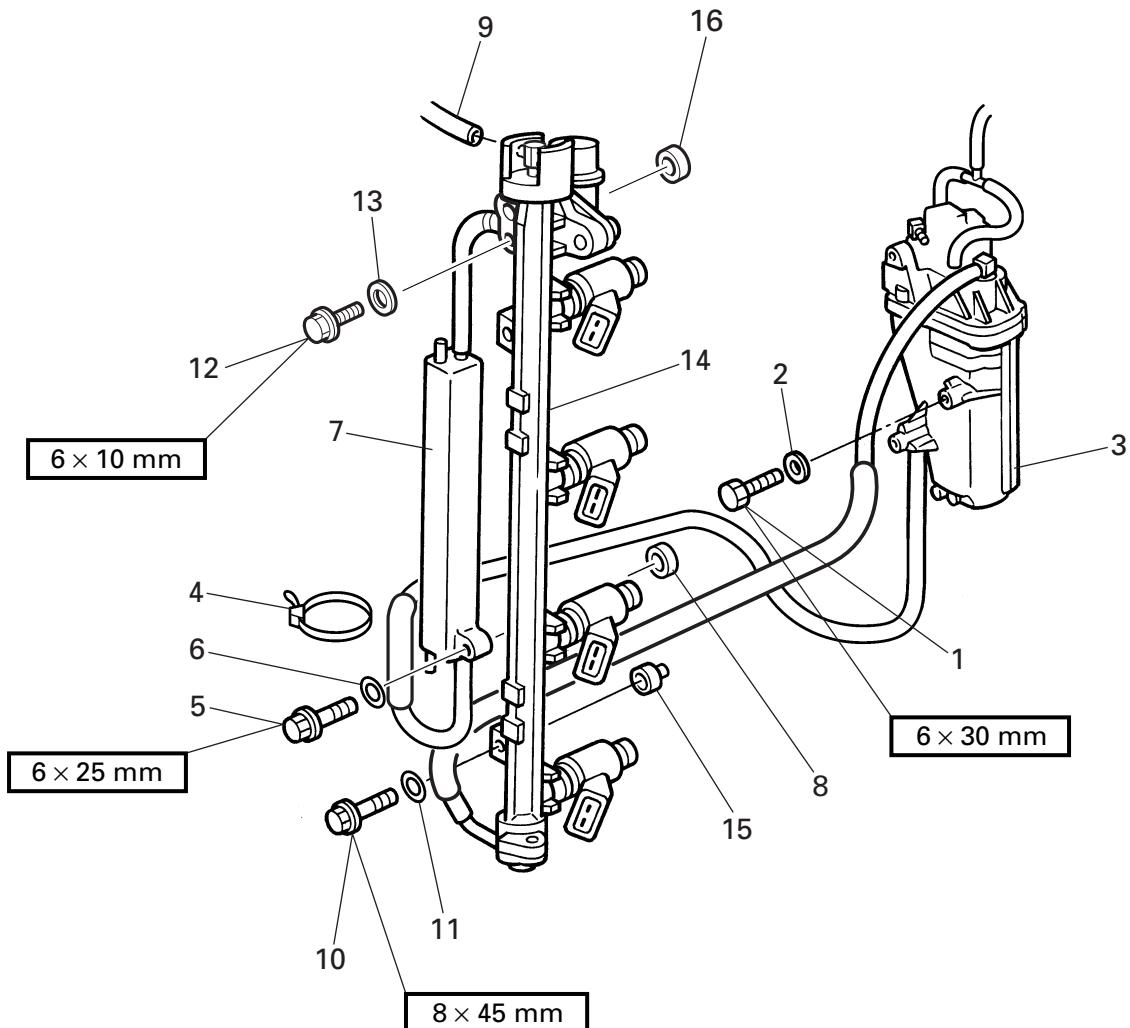
HIGH-PRESSURE FUEL LINE

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	
2	Washer	3	
3	Vapor separator	1	
4	Plastic locking tie	2	Not reusable
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) Install the fuel pressure gauge onto the pressure check valve.

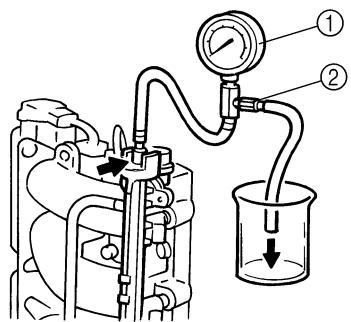


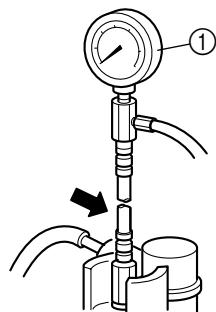
Fuel pressure gauge ①
YB-06766 / 90890-06786

- (2) Place the drain hose into a container.
(3) Open the valve ② and release the pressure.

2. Drain:

- Fuel





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.



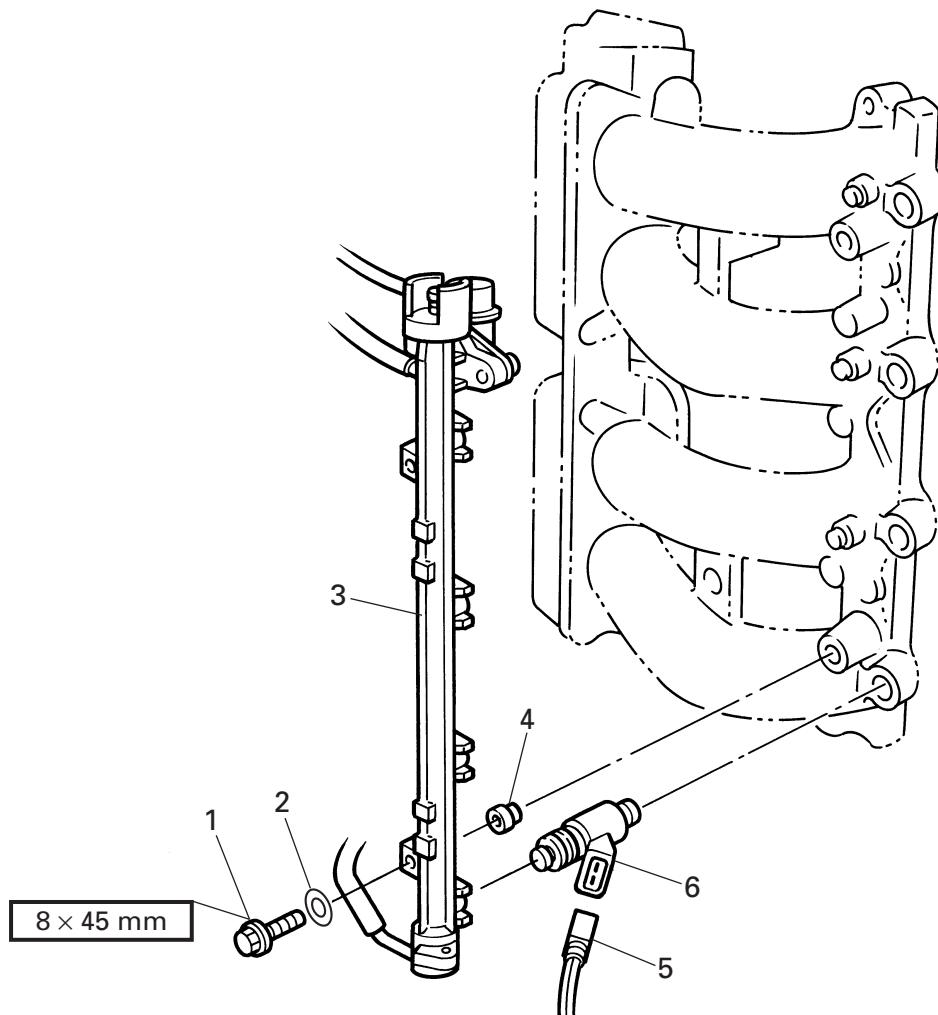
Fuel pressure
Approx.
300 kPa (3.0 kg/cm², 44.1 psi)

(4) Start the engine.

(5) Check the fuel pressure.



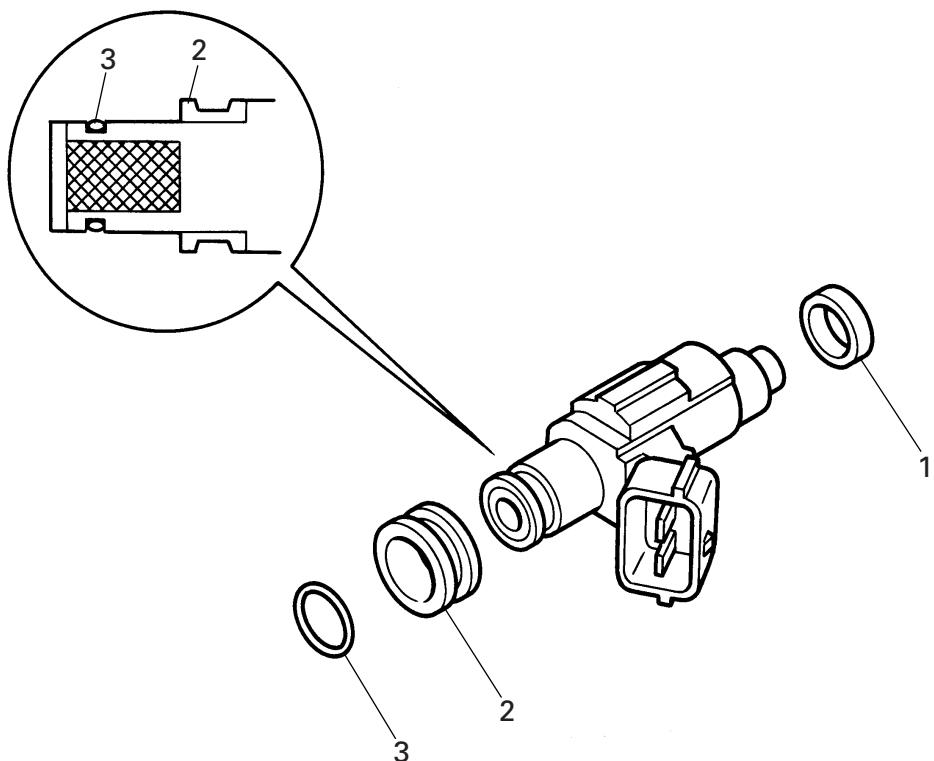
Fuel pressure
Approx.
250 kPa (2.5 kg/cm², 35.6 psi)

**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

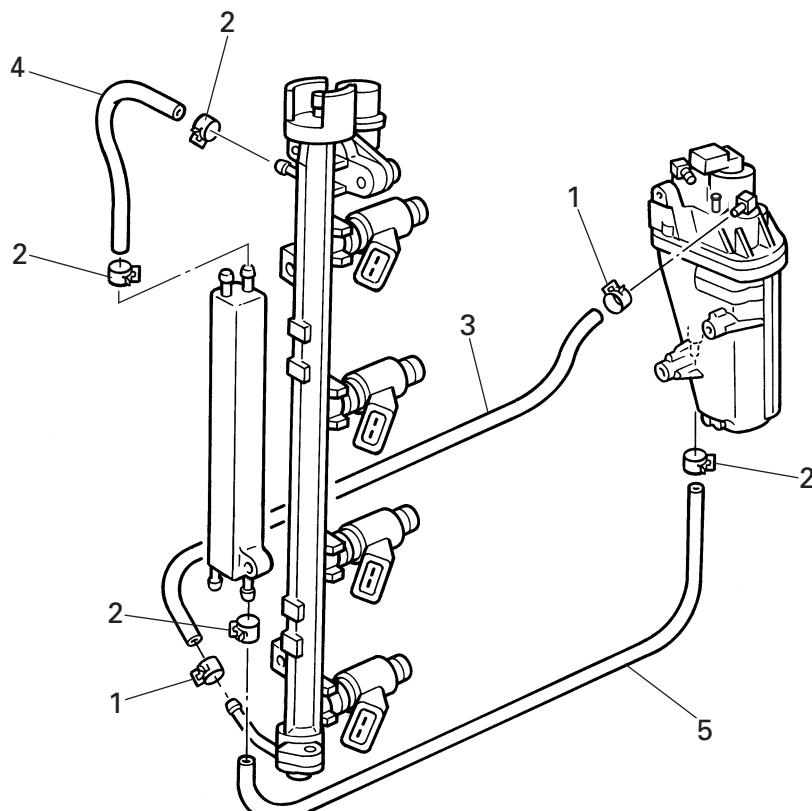


Order	Job/Part	Q'ty	Remarks
1	Rubber seal	1	
2	Rubber damper	1	
3	O-ring	1	2.2 × 7.8 mm For assembly, reverse the disassembly procedure.



FUEL HOSES

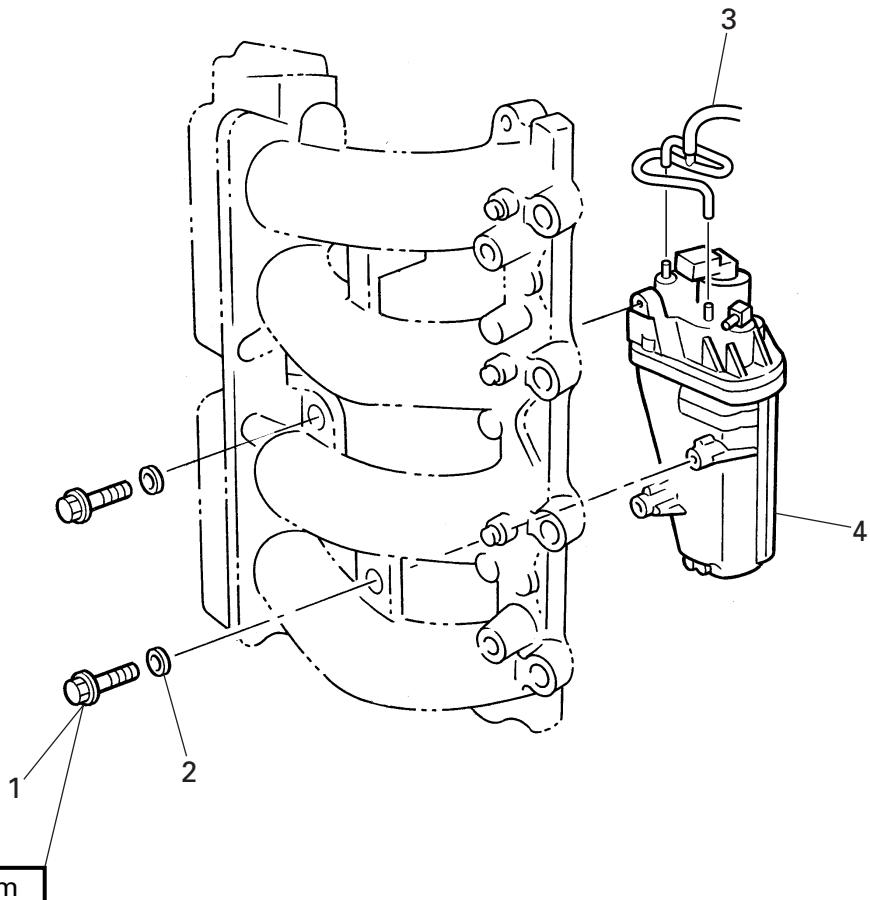
REMOVING/INSTALLING THE FUEL HOSES



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.

FUEL**VAPOR SEPARATOR**

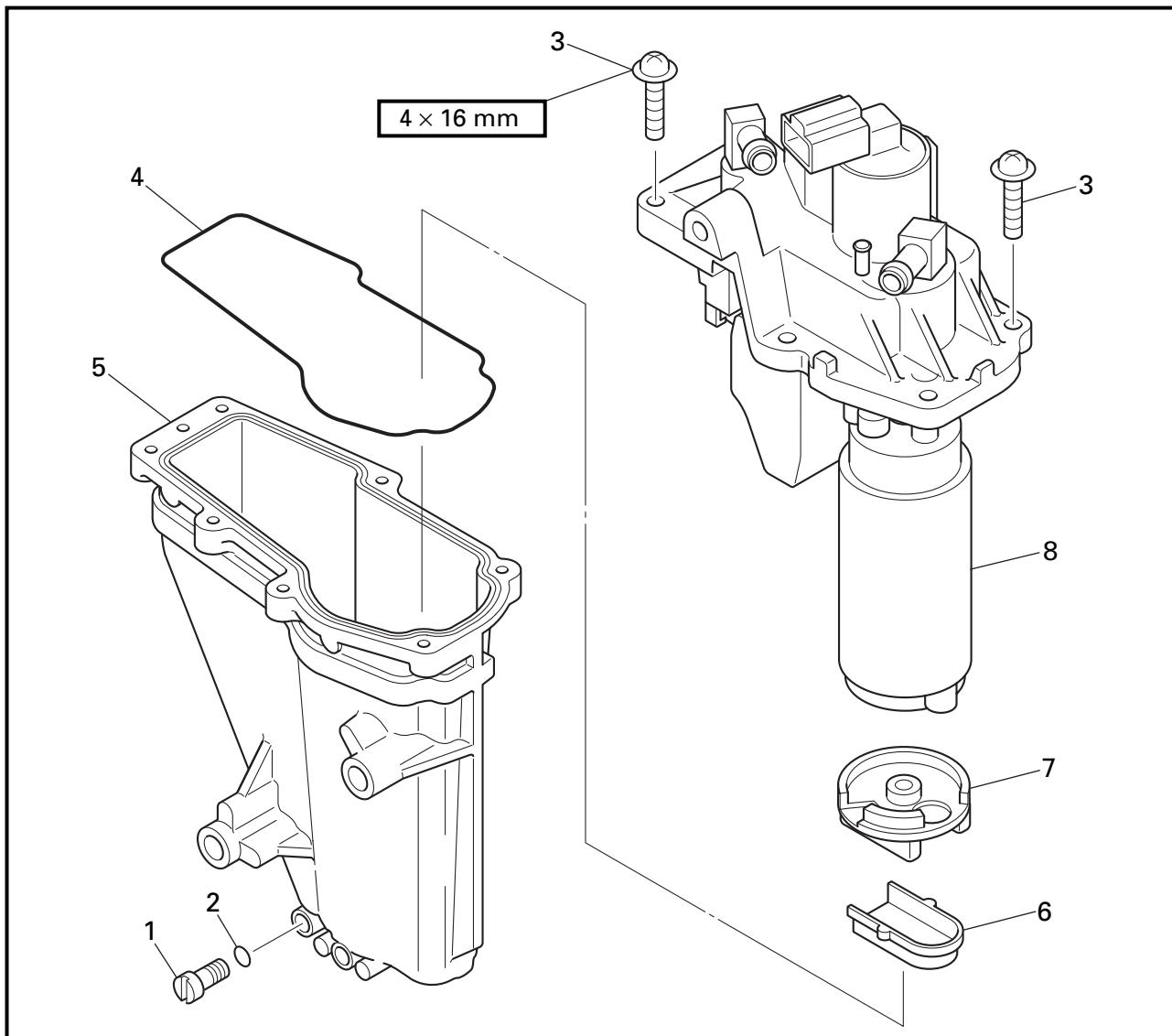
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VAPOR SEPARATOR**REMOVING/INSTALLING THE VAPOR SEPARATOR**

Order	Job/Part	Q'ty	Remarks
1	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.



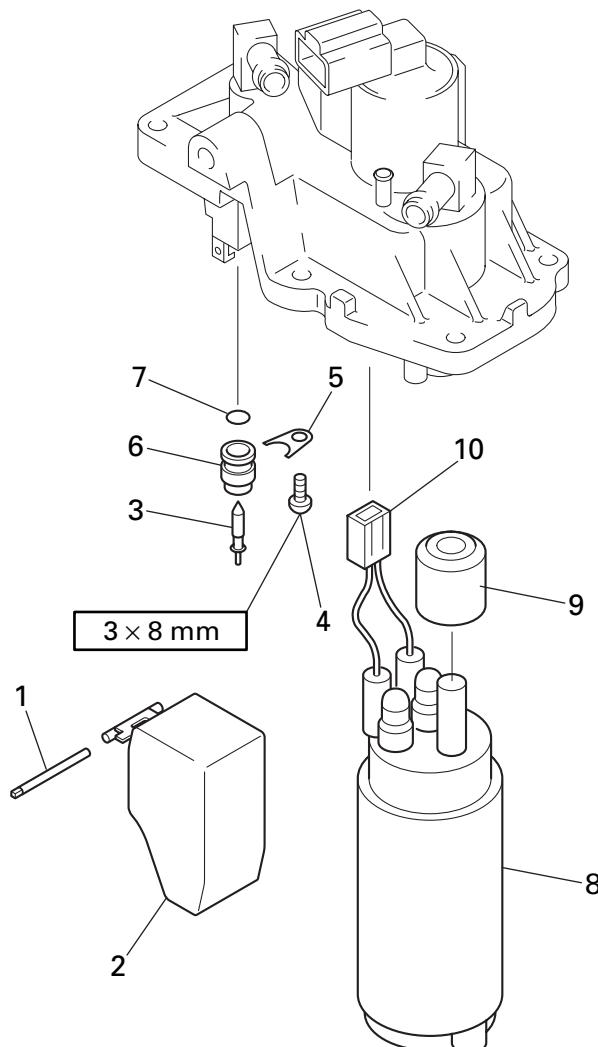
DISASSEMBLING/ASSEMBLING THE VAPOR SEPARATOR



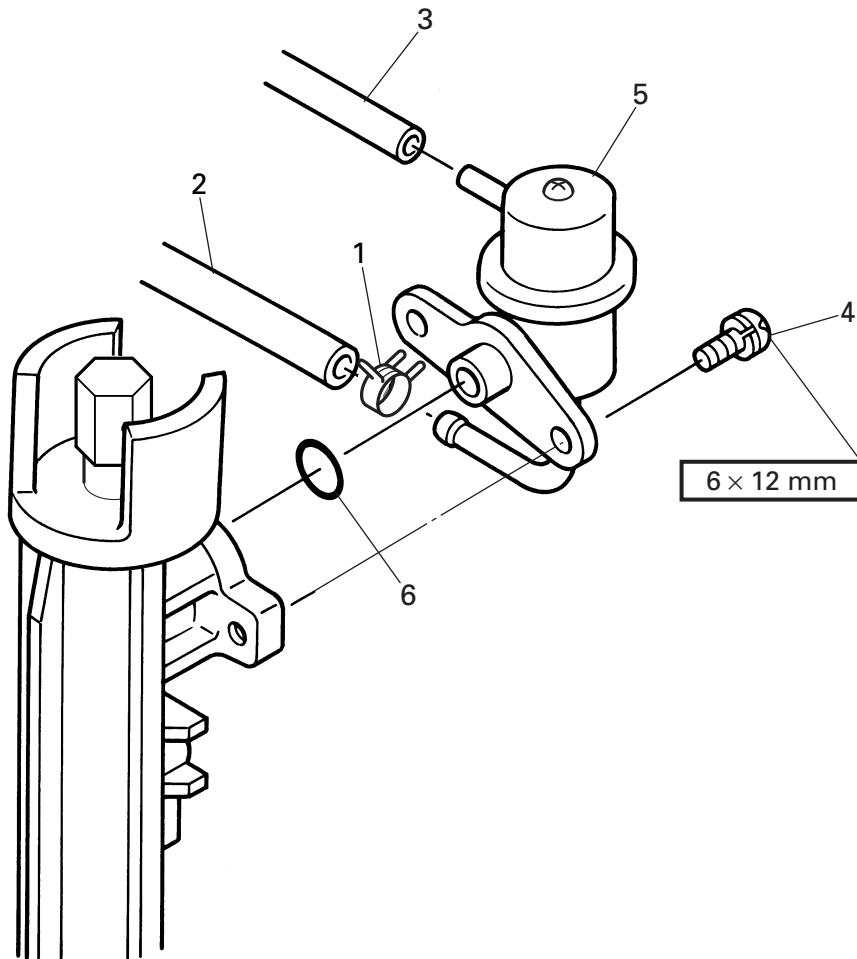
Order	Job/Part	Q'ty	Remarks
1	Drain screw	1	
2	Gasket	1	
3	Screw	7	
4	O-ring	1	
5	Float chamber	1	
6	Holder	1	
7	High-pressure fuel pump filter	1	
8	Vapor separator body	1	For assembly, reverse the disassembly procedure.

FUEL**HIGH-PRESSURE FUEL PUMP**

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**HIGH-PRESSURE FUEL PUMP
DISASSEMBLING/ASSEMBLING THE HIGH-PRESSURE FUEL PUMP**

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

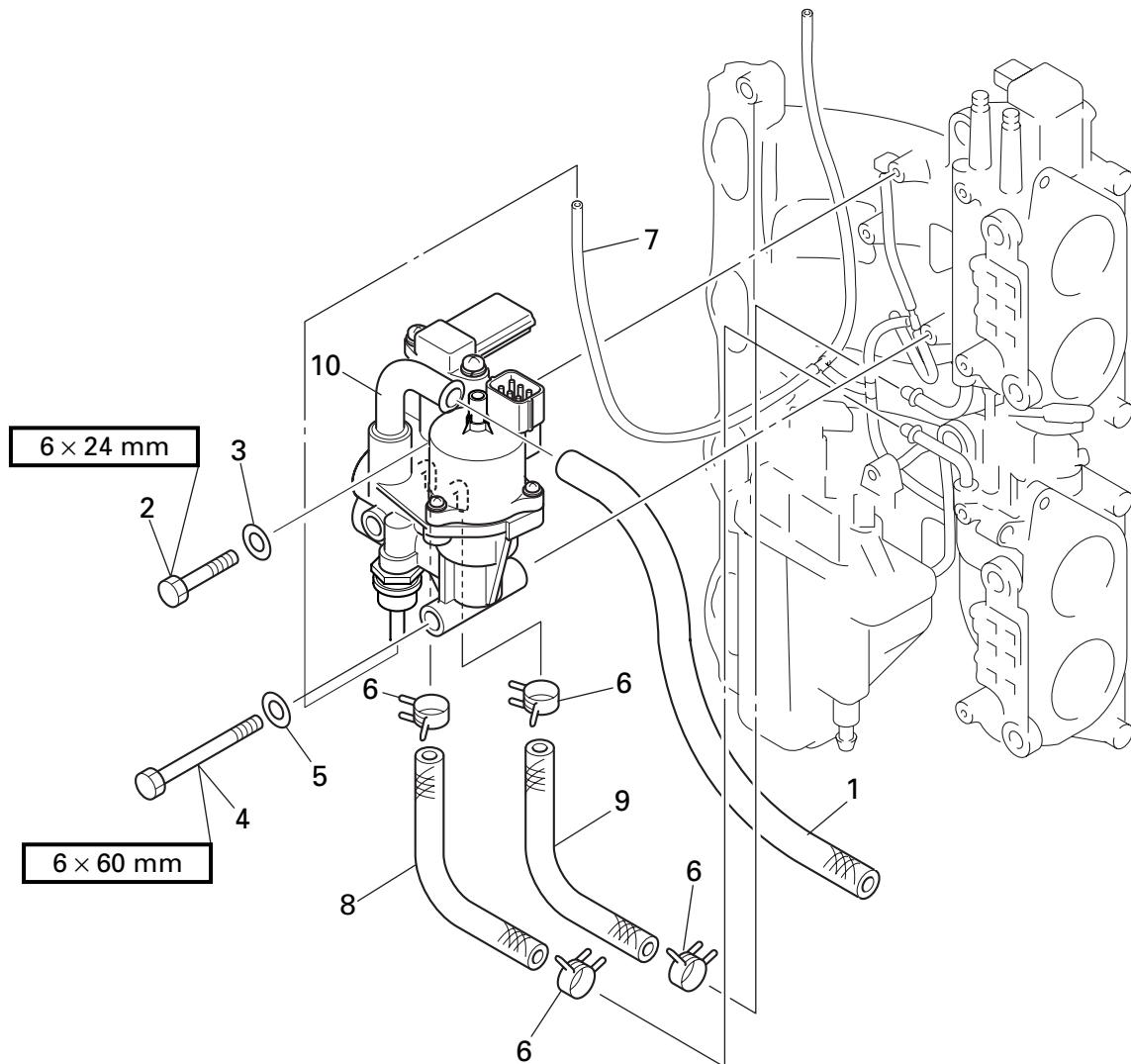
**PRESSURE REGULATOR****REMOVING/INSTALLING THE PRESSURE REGULATOR**

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

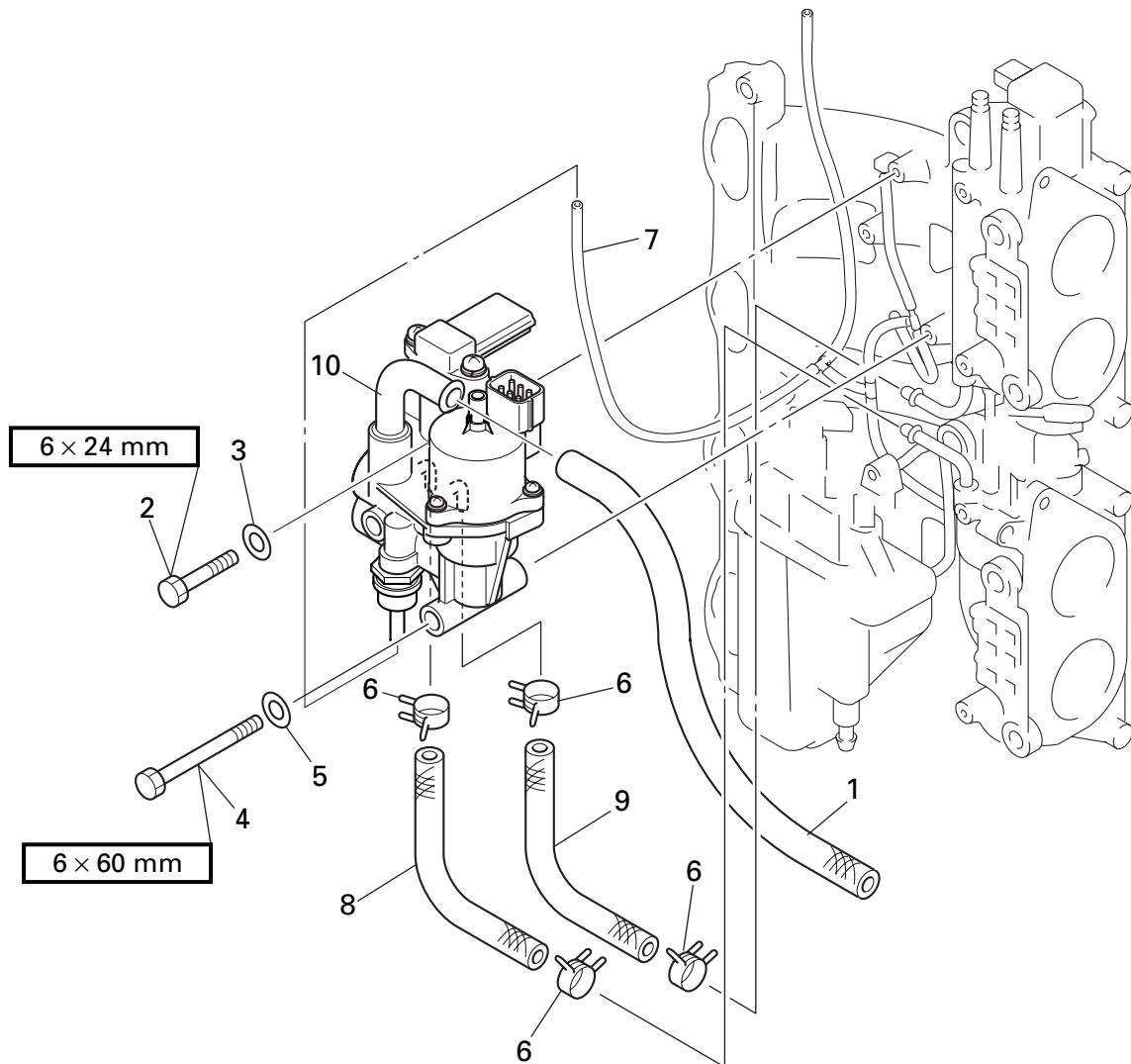


Order	Job/Part	Q'ty	Remarks
	Intake assembly		Refer to "INTAKE ASSEMBLY" on page 4-3.
1	Hose	1	(idle speed control assembly-to-intake silencer)
2	Bolt	1	
3	Washer	1	
4	Bolt	2	
5	Washer	2	
6	Hose clamp	4	

Continued on next page.

FUEL**IDLE SPEED CONTROL ASSEMBLY**

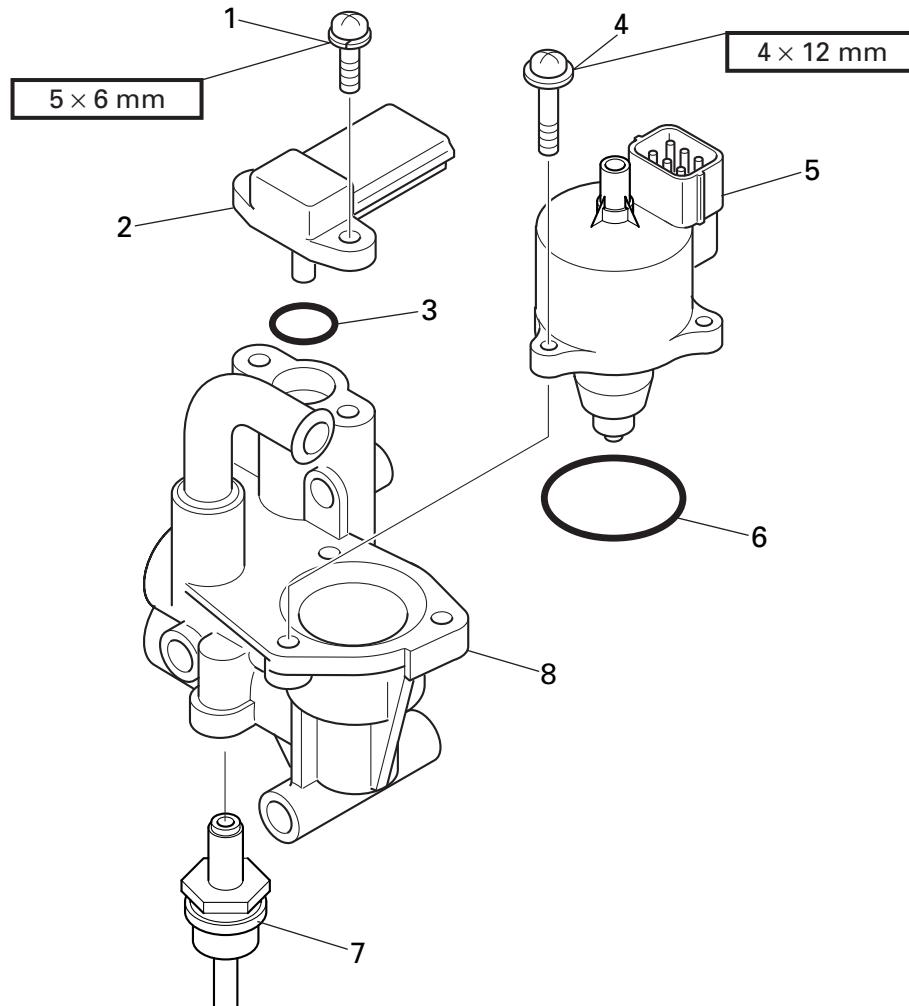
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Order	Job/Part	Q'ty	Remarks
7	Vacuum hose	1	(idle speed control assembly-to-intake manifold)
8	Hose	1	(idle speed control assembly-to-throttle body #2)
9	Hose	1	(idle speed control assembly-to-throttle body #1)
10	Idle speed control assembly	1	For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



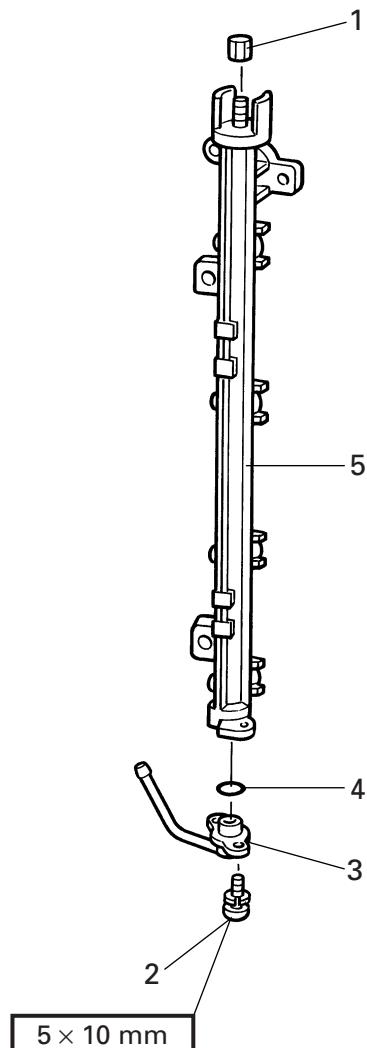
DISASSEMBLING/ASSEMBLING THE IDLE SPEED CONTROL ASSEMBLY



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

FUEL**FUEL RAIL**

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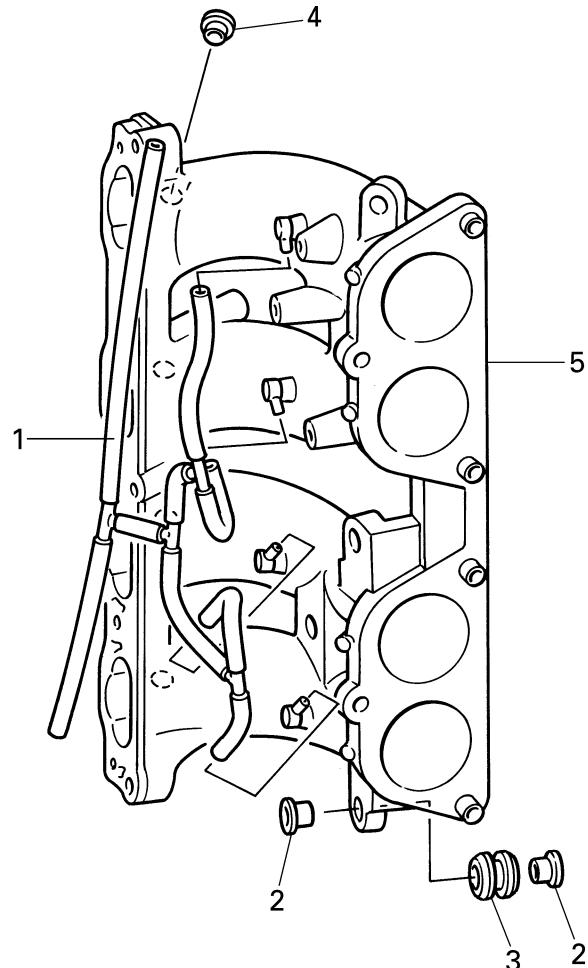
FUEL RAIL**DISASSEMBLING/ASSEMBLING THE FUEL RAIL**

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

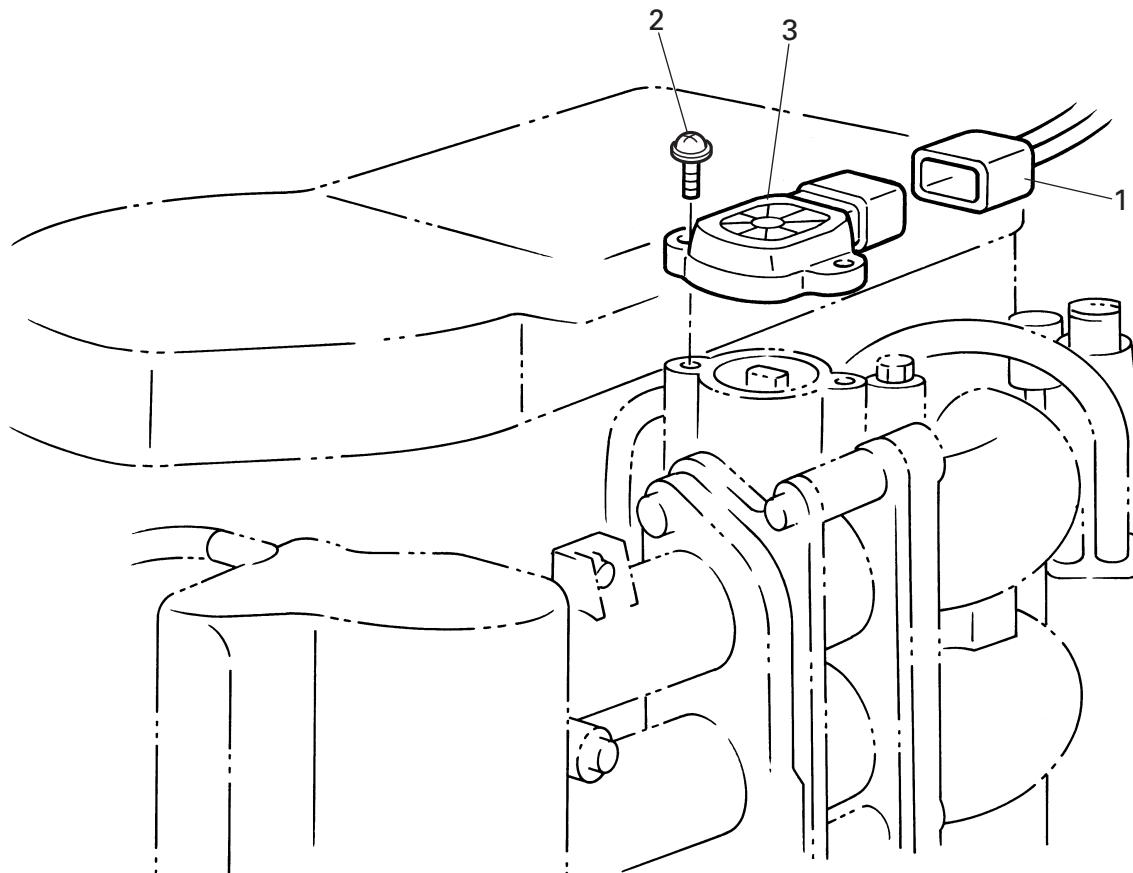
DISASSEMBLING/ASSEMBLING THE INTAKE MANIFOLD



Order	Job/Part	Q'ty	Remarks
	Throttle body High-pressure fuel line Idle speed control assembly		Refer to "THROTTLE BODY" on page 4-5. Refer to "HIGH-PRESSURE FUEL LINE" on page 4-8. 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.

FUEL**THROTTLE POSITION SENSOR**

E

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

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

FUEL



THROTTLE POSITION SENSOR

E

INSTALLING THE THROTTLE POSITION SENSOR

NOTE: _____

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

Install:

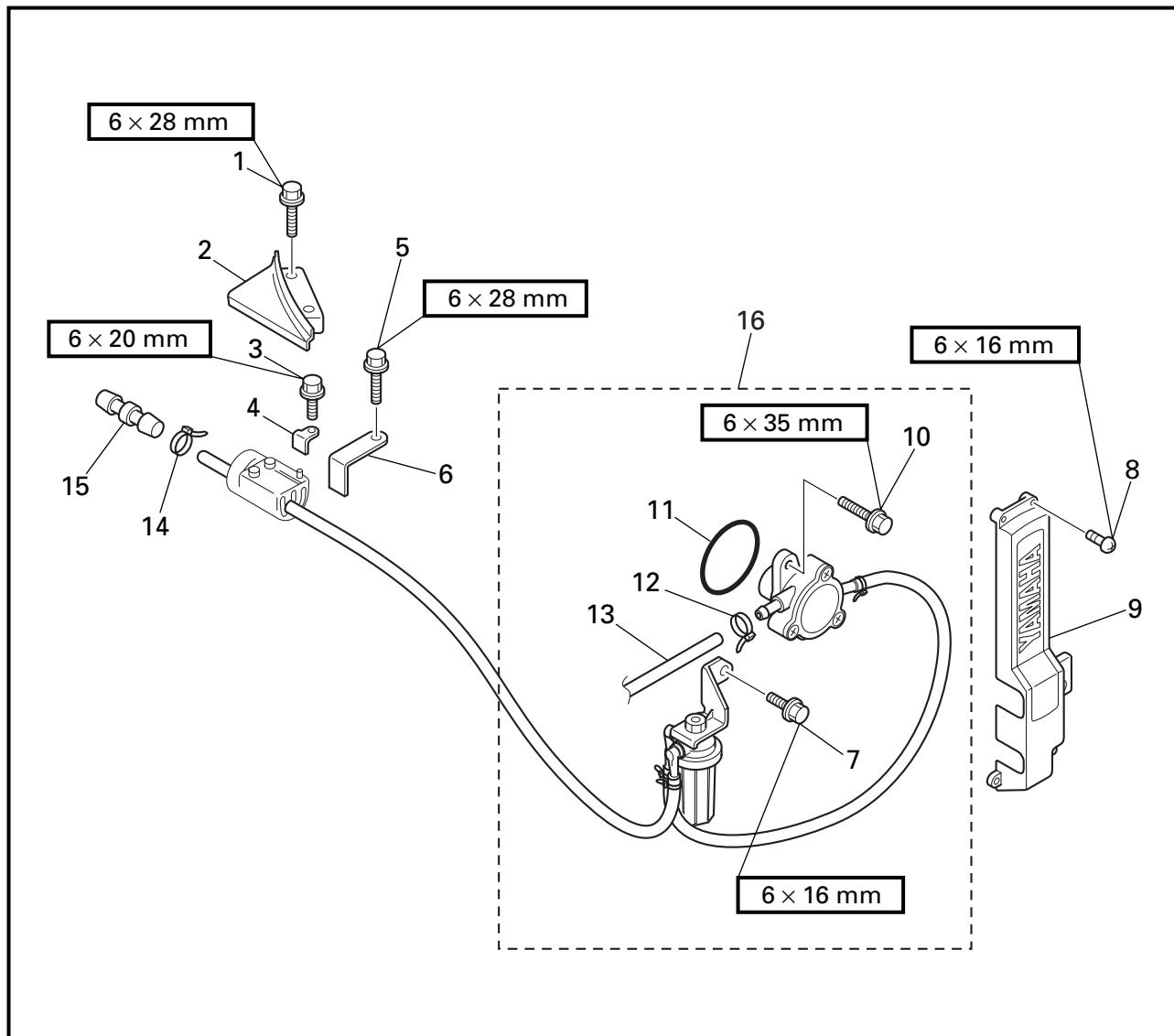
- Throttle position sensor

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



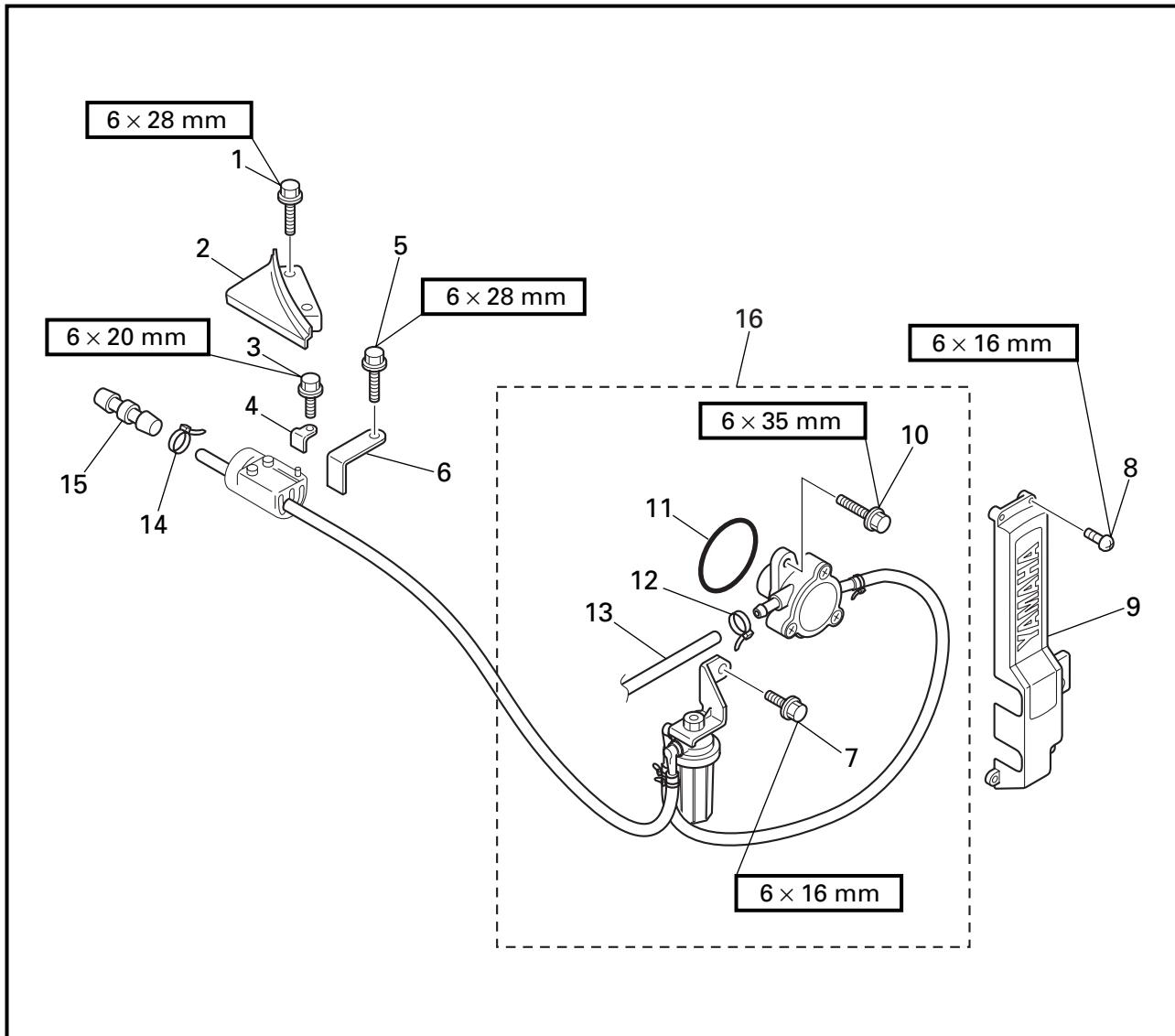
LOW-PRESSURE FUEL LINE

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	

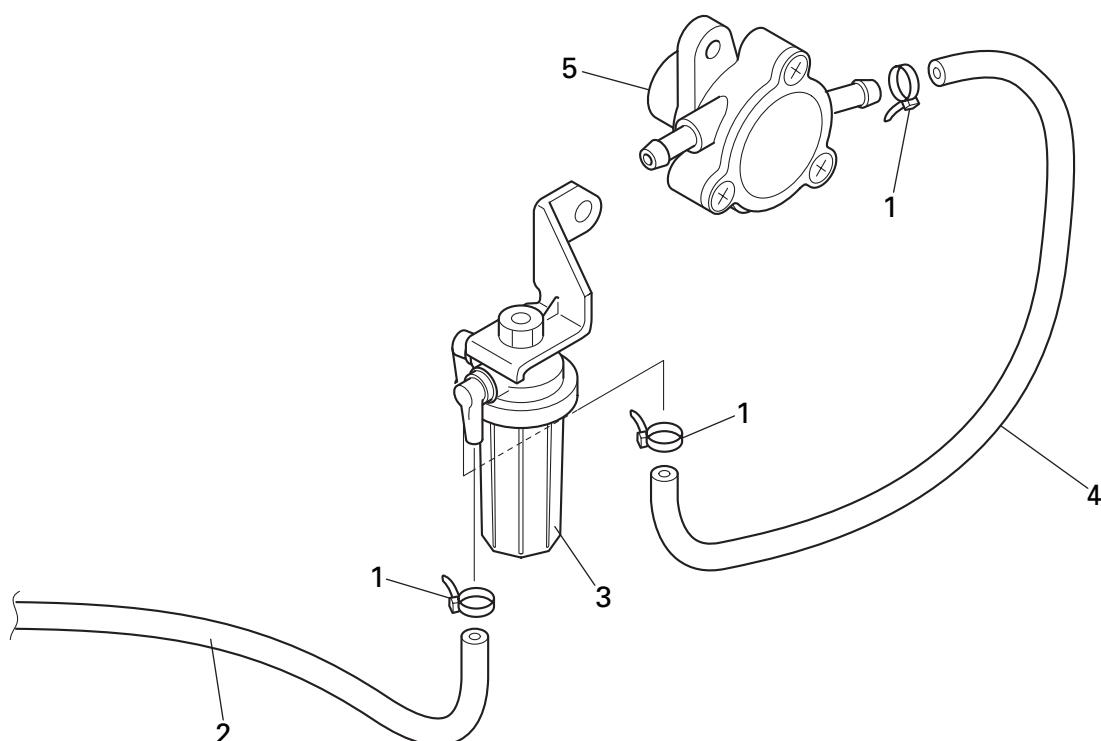
Continued on next page.



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.



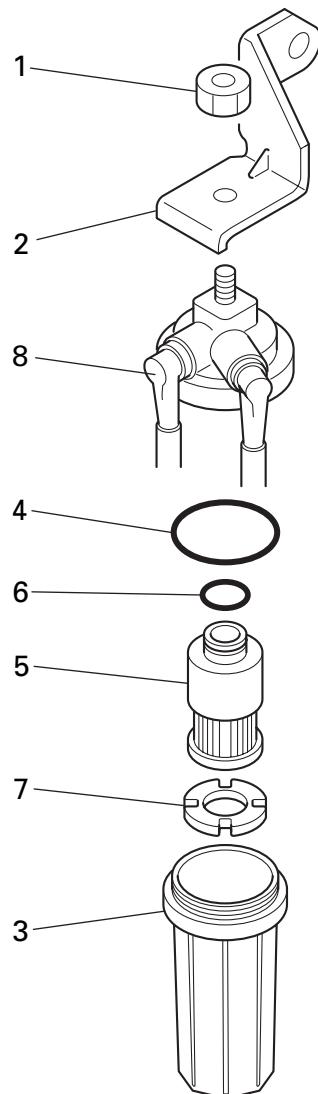
DISASSEMBLING/ASSEMBLING THE LOW-PRESSURE FUEL LINE



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**FUEL FILTER**

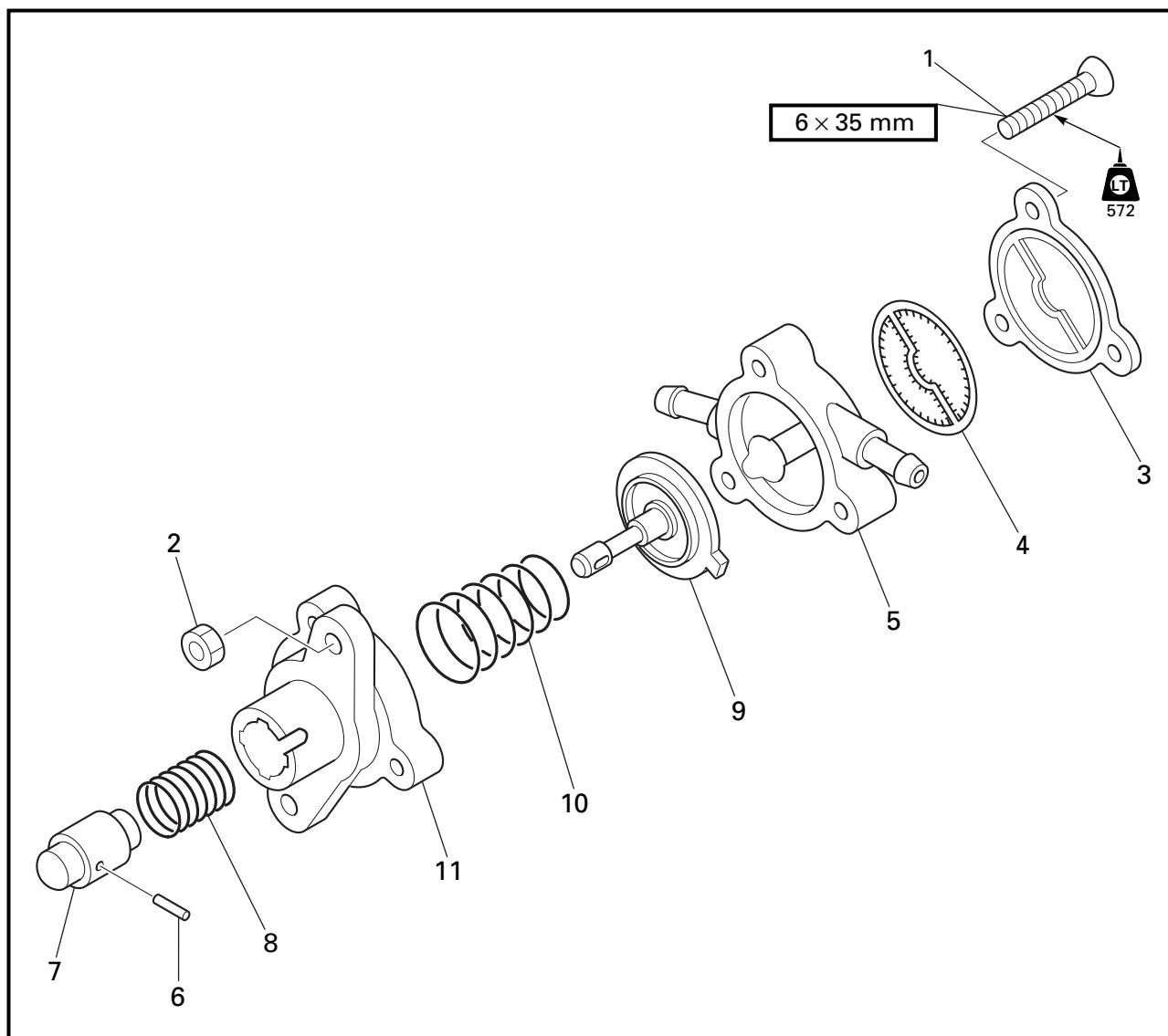
E

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**FUEL PUMP**

E

FUEL PUMP**DISASSEMBLING/ASSEMBLING THE FUEL PUMP**

Order	Job/Part	Q'ty	Remarks
1	Screw	3	
2	Nut	4	
3	Fuel pump cover	1	
4	Gasket	1	Not reusable
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	For assembly, reverse the disassembly procedure.



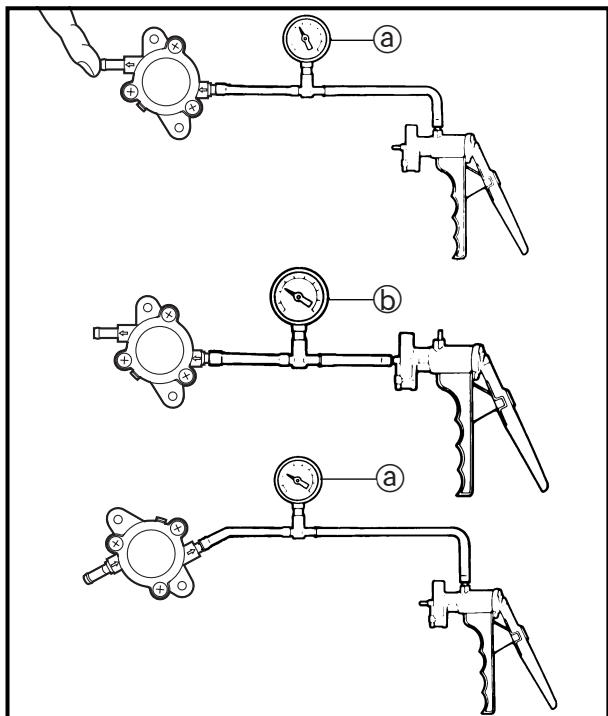
CHECKING THE FUEL PUMPS

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 @
50 kPa (0.5 kg/cm², 7.1 psi)
Fuel pump negative pressure Ⓛ
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

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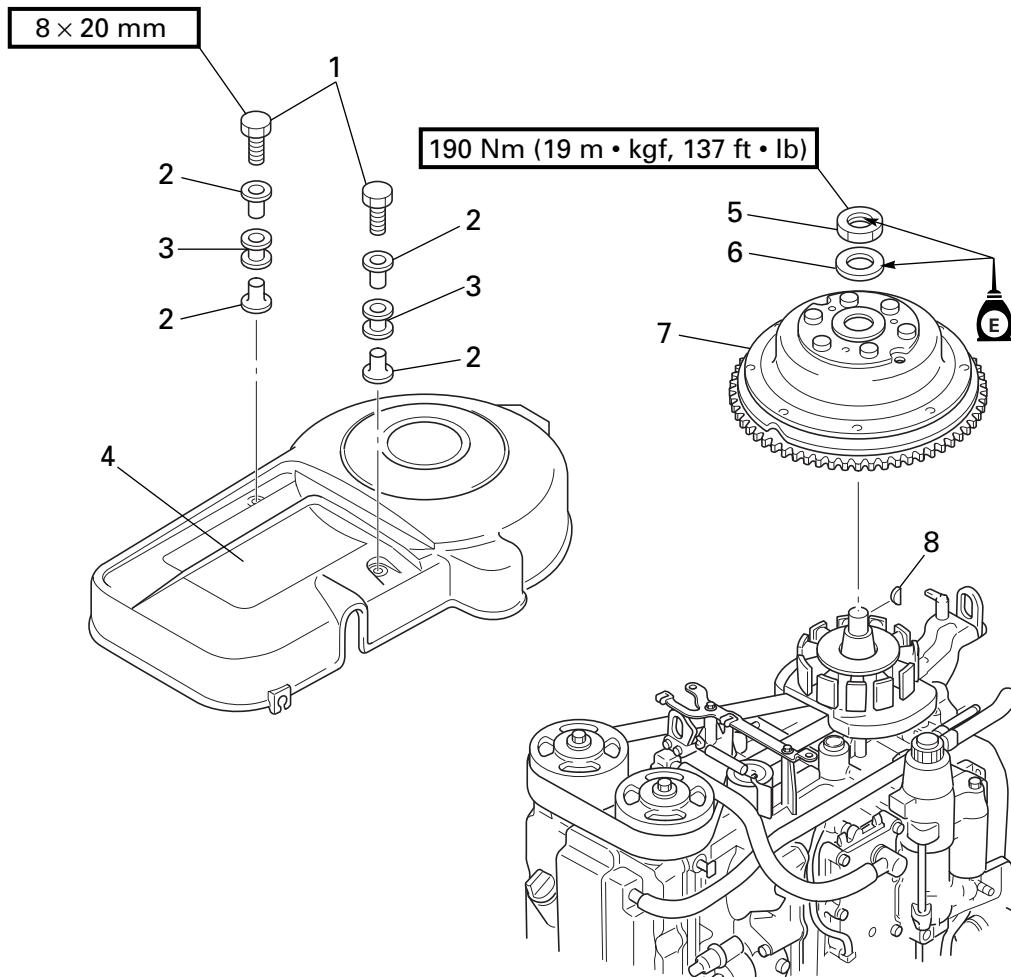
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POWR



FLYWHEEL MAGNET ASSEMBLY

E

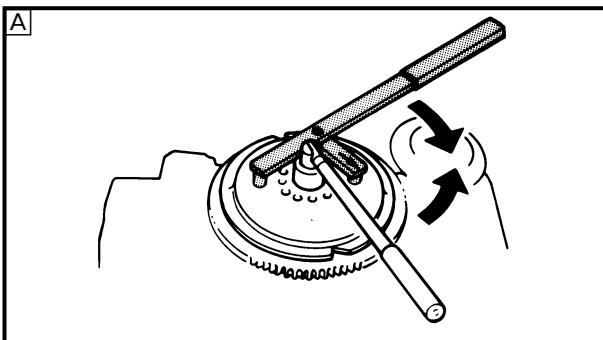
FLYWHEEL MAGNET ASSEMBLY
REMOVING/INSTALLING THE FLYWHEEL MAGNET ASSEMBLY


Order	Job/Part	Q'ty	Remarks
1	Bolt	2	
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	For installation, reverse the removal procedure.

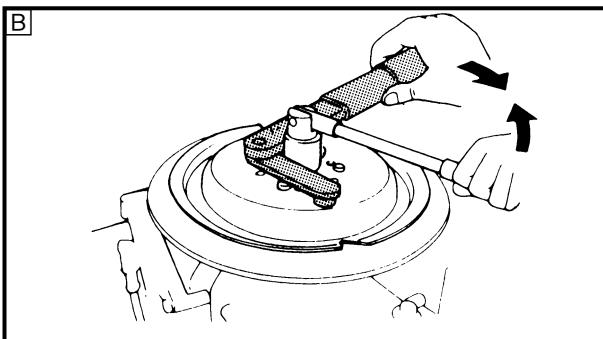
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FLYWHEEL MAGNET ASSEMBLY

E

**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:

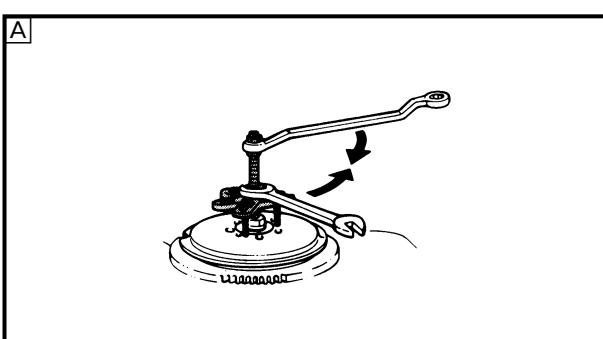
- Flywheel magnet assembly nut



Flywheel magnet assembly holder
YB-06139 / 90890-06522

[A] For USA and Canada

[B] For worldwide

**2. Remove:**

- Flywheel magnet assembly



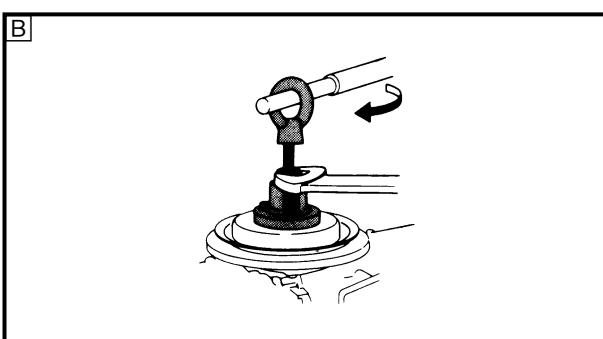
Universal puller
YB-06117 / 90890-06521

[A] For USA and Canada

[B] For worldwide

CAUTION:

- Keep the nut side flush with the crank-shaft 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.

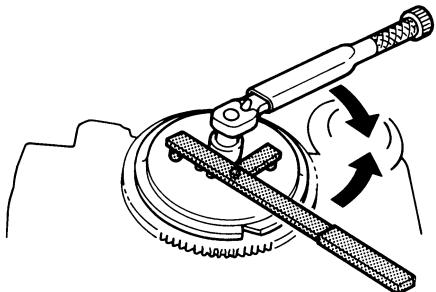


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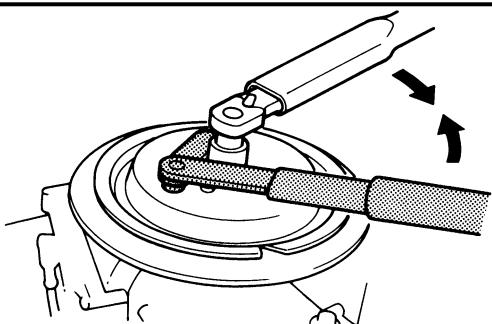
FLYWHEEL MAGNET ASSEMBLY

E

A



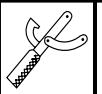
B



INSTALLING THE FLYWHEEL MAGNET ASSEMBLY

Install:

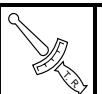
- Flywheel magnet assembly nut



Flywheel magnet assembly holder
YB-06139 / 90890-06522

A For USA and Canada

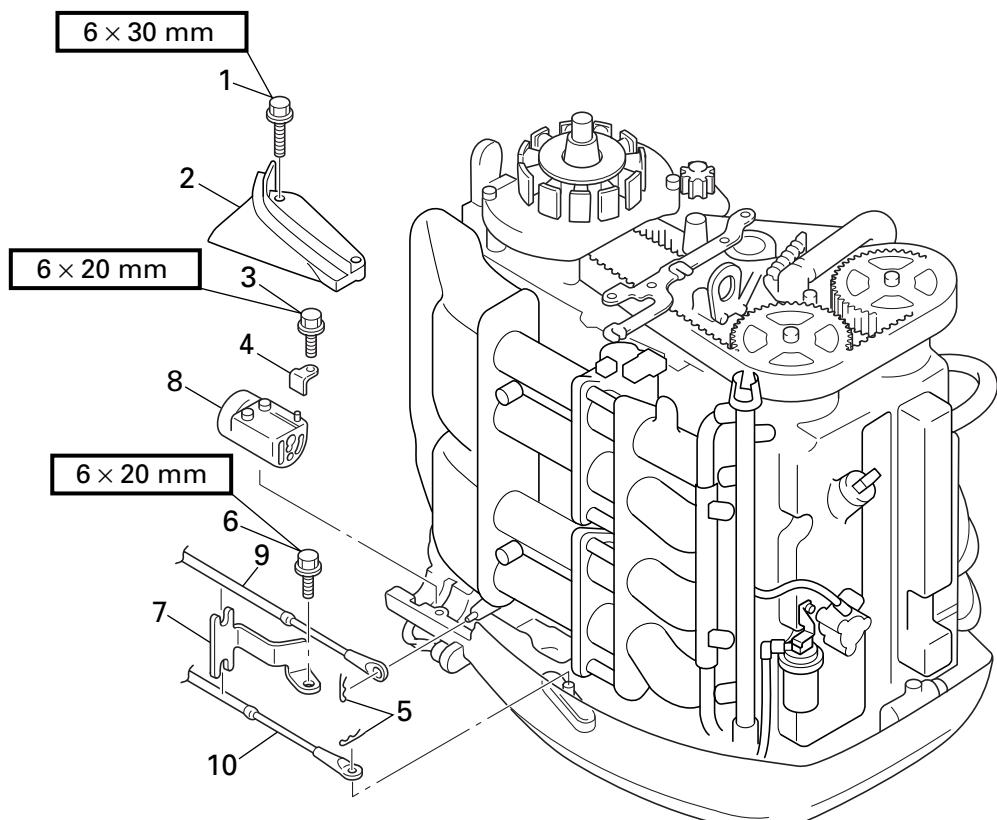
B For worldwide



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

POWER**POWER UNIT**

E

POWER UNIT**DISCONNECTING/CONNECTING THE CONTROL CABLE**

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

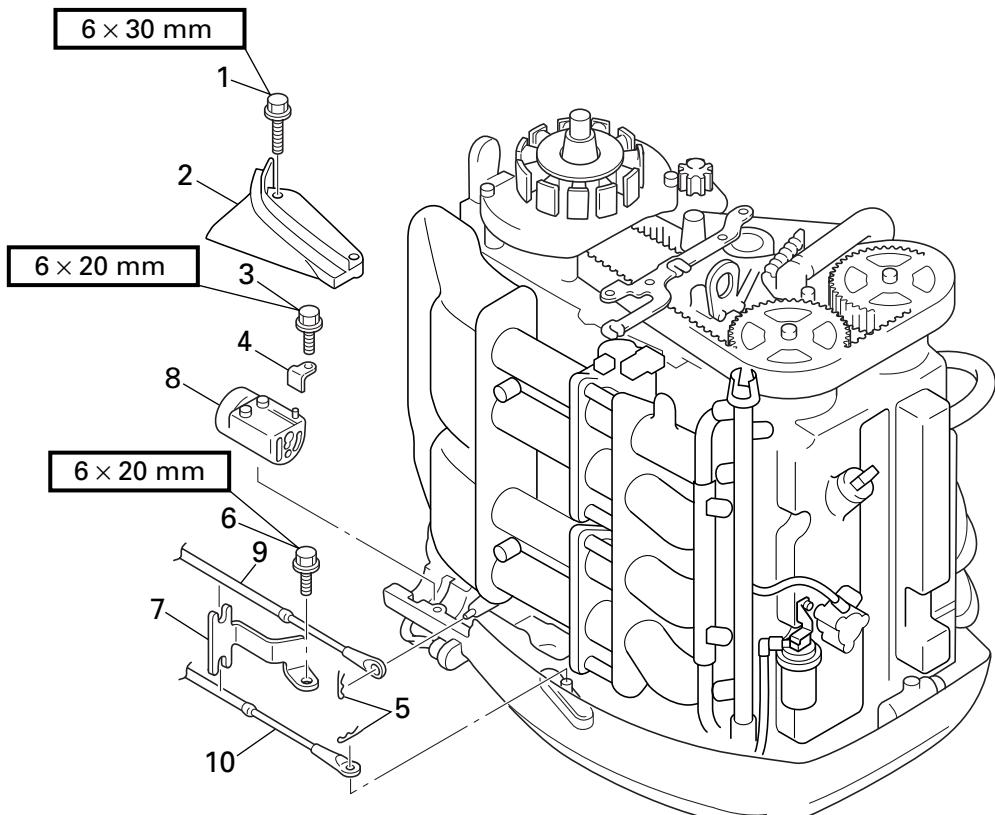
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POWR



POWER UNIT

E



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

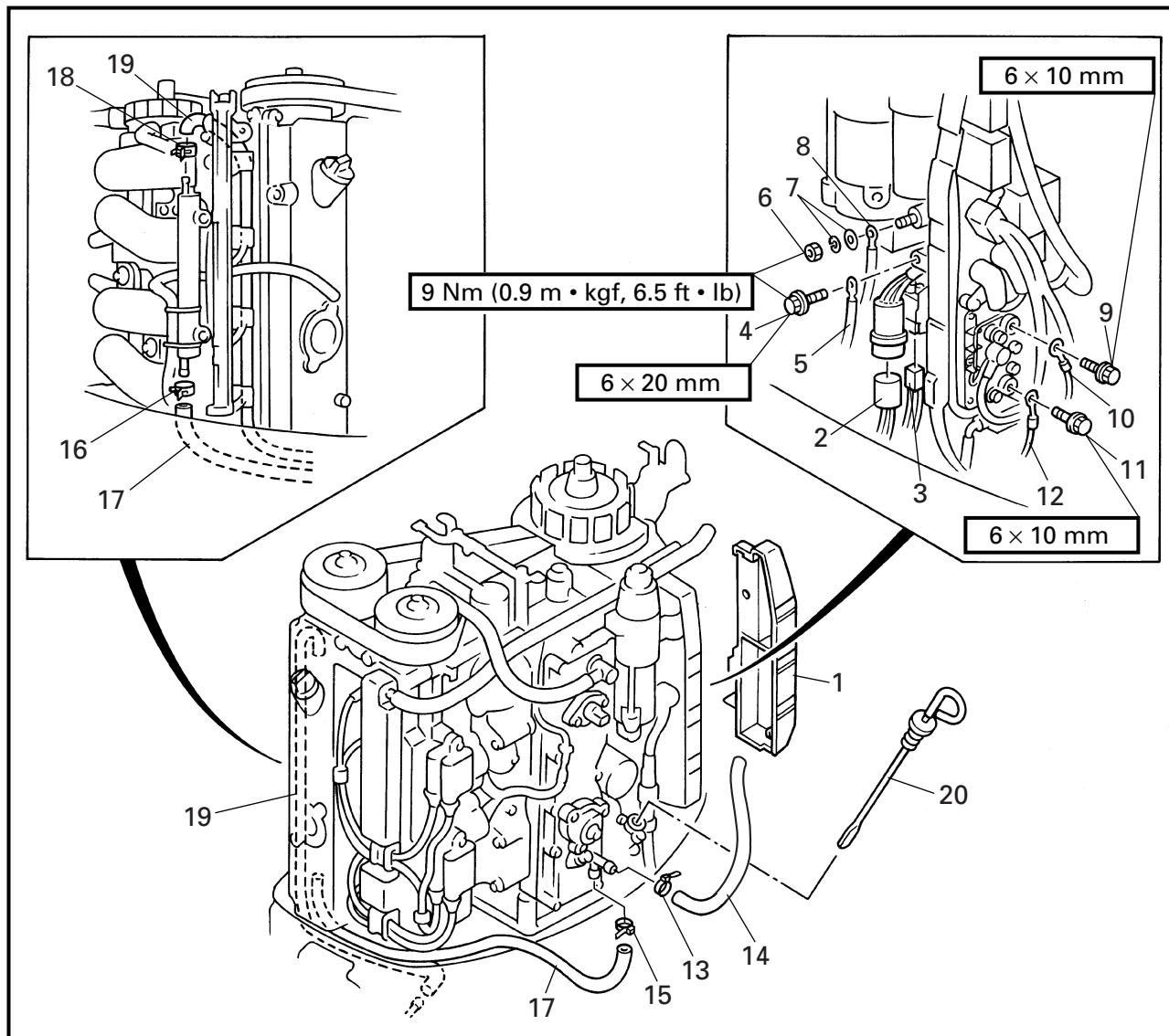
POWR



POWER UNIT

E

DISCONNECTING/CONNECTING THE LEADS



Order	Job/Part	Q'ty	Remarks
1	Junction box cover	1	
2	Wire harness coupler	1	For the remote control box.
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	

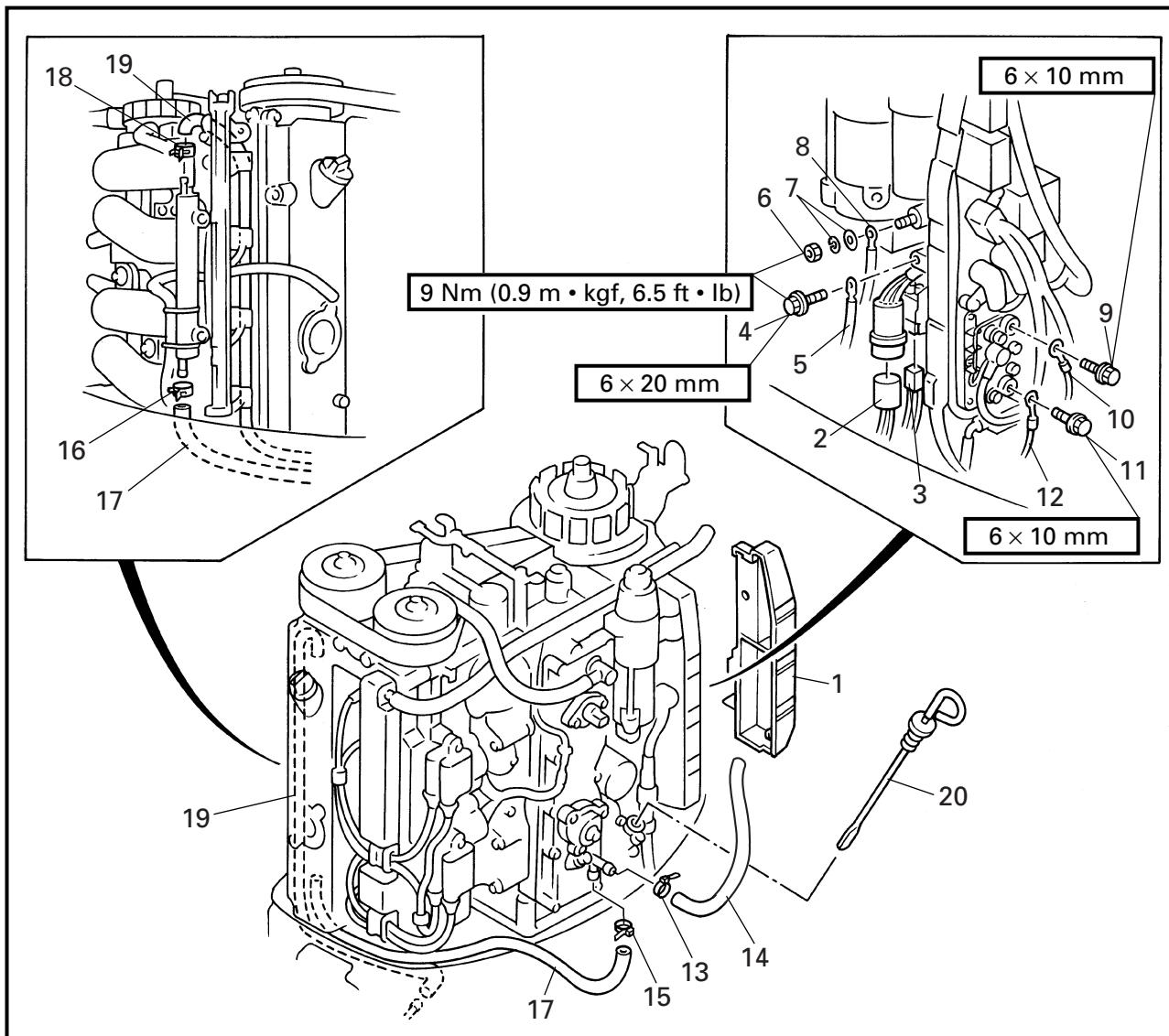
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POWR



POWER UNIT

E



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.

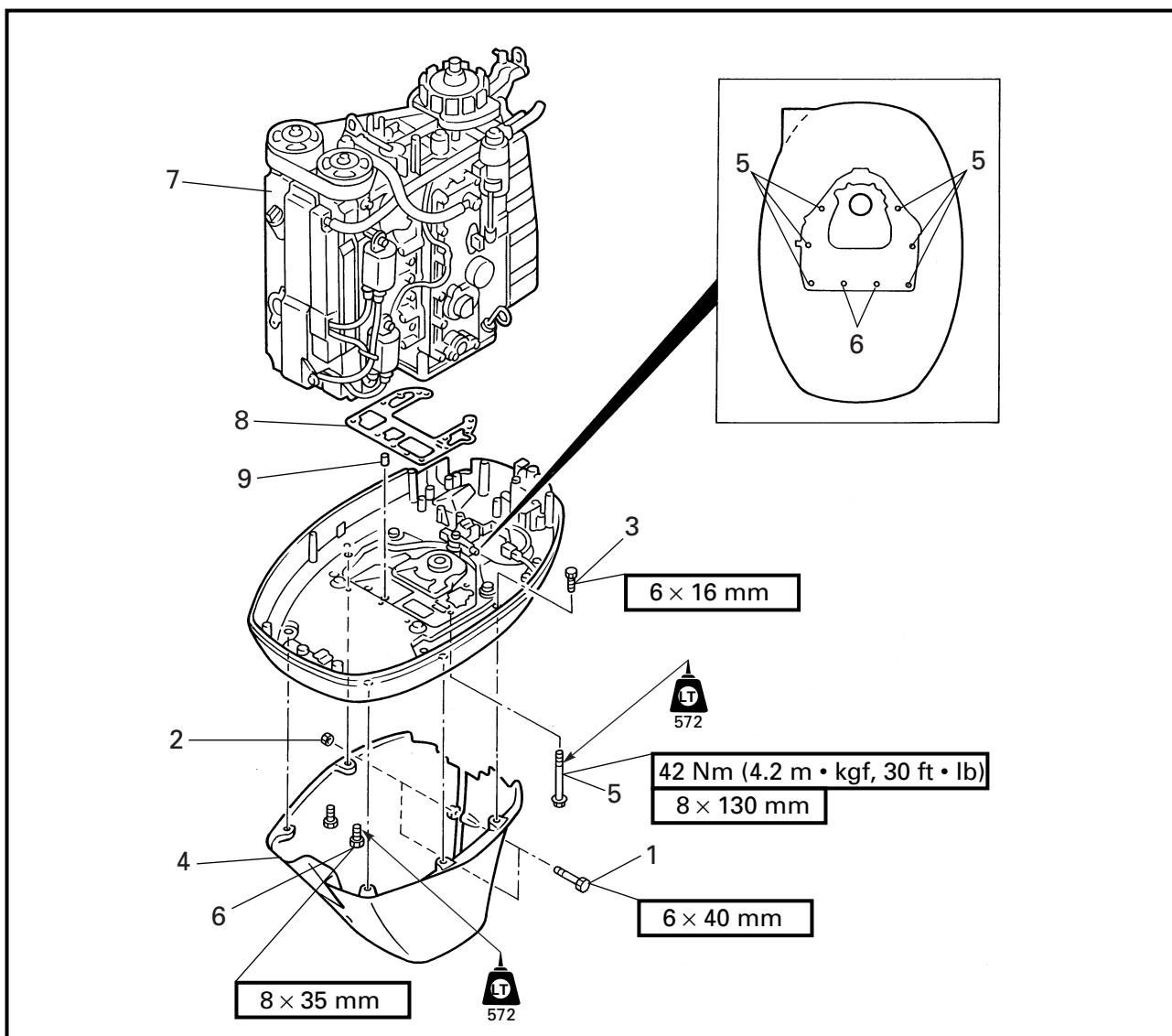
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POWER UNIT

E

REMOVING/INSTALLING THE POWER UNIT



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

POWR

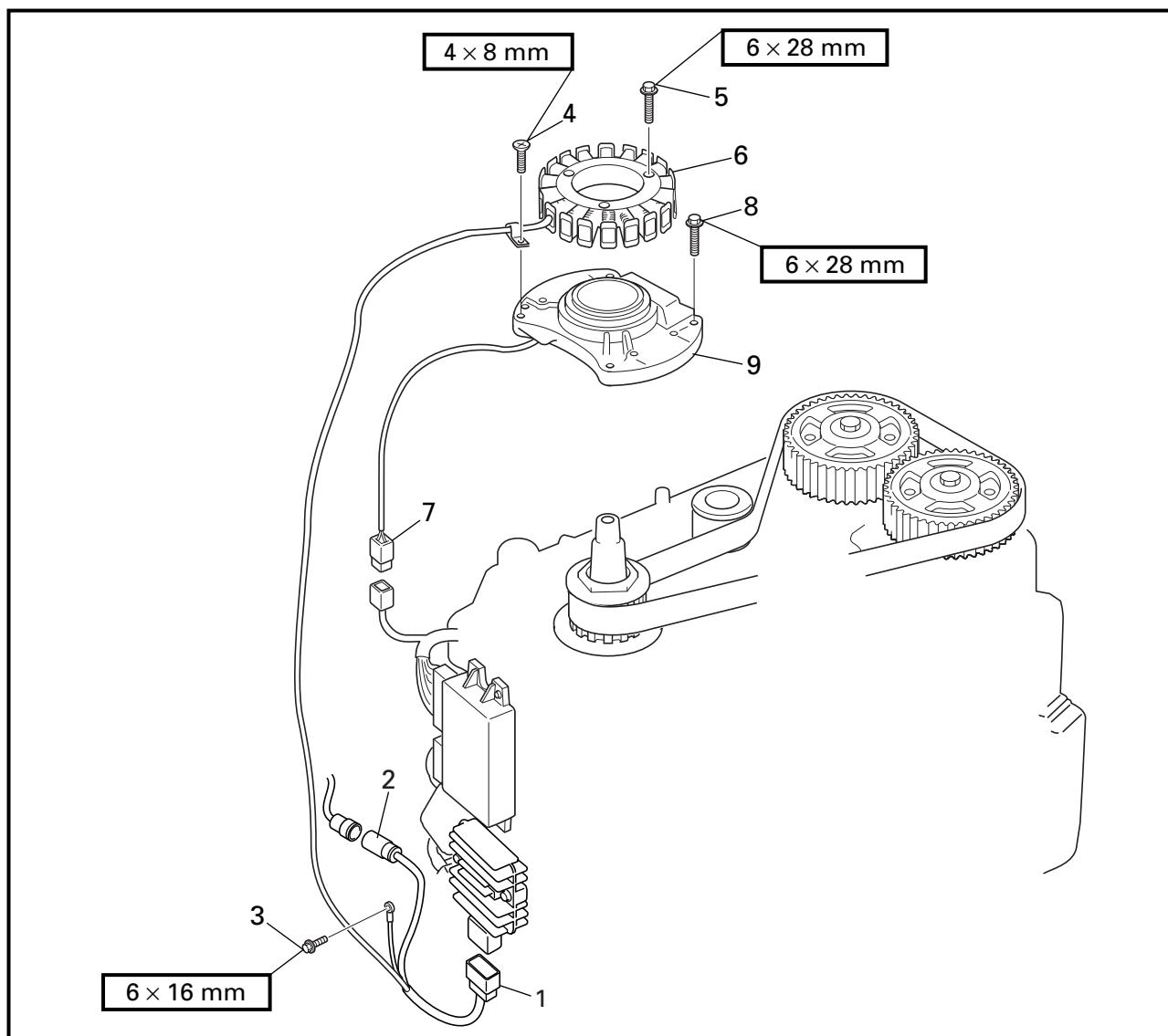


STATOR COIL ASSEMBLY

E

STATOR COIL ASSEMBLY

REMOVING/INSTALLING THE STATOR COIL ASSEMBLY

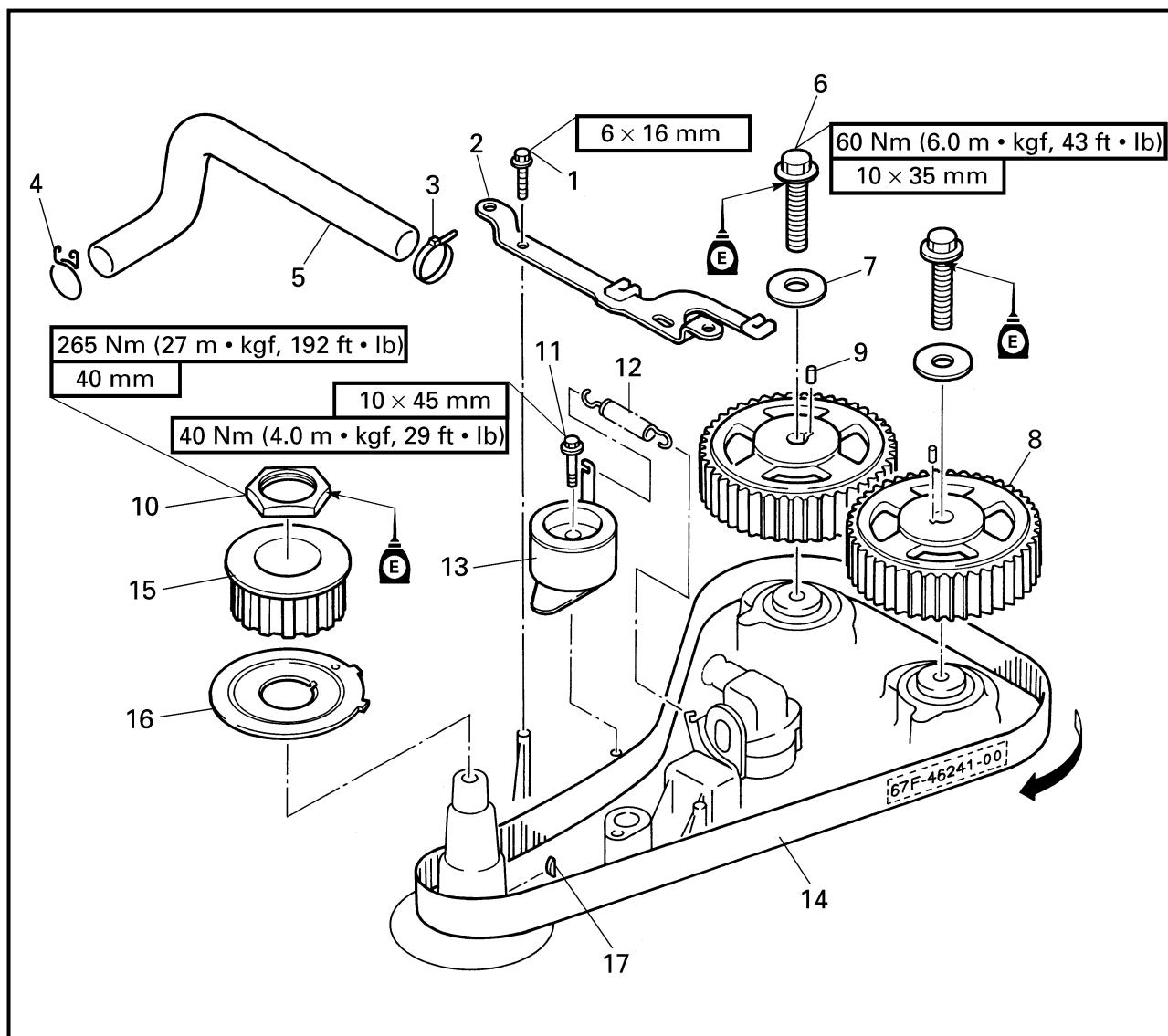


Order	Job/Part	Q'ty	Remarks
	Flywheel magnet assembly		Refer to "FLYWHEEL MAGNET ASSEMBLY" on page 5-1.
1	Stator coil coupler	1	
2	Rectifier/regulator connector	1	
3	Bolt	1	
4	Screw	1	
5	Bolt	3	
6	Lighting coil assembly	1	
7	Pulser coil connector	1	
8	Bolt	4	
9	Base	1	For installation, reverse the removal 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	
2	Flywheel cover bracket	1	
3	Plastic locking tie	1	Not reusable
4	Hose clamp	1	
5	Hose	1	
6	Driven sprocket bolt	2	
7	Washer	2	
8	Driven sprocket	2	

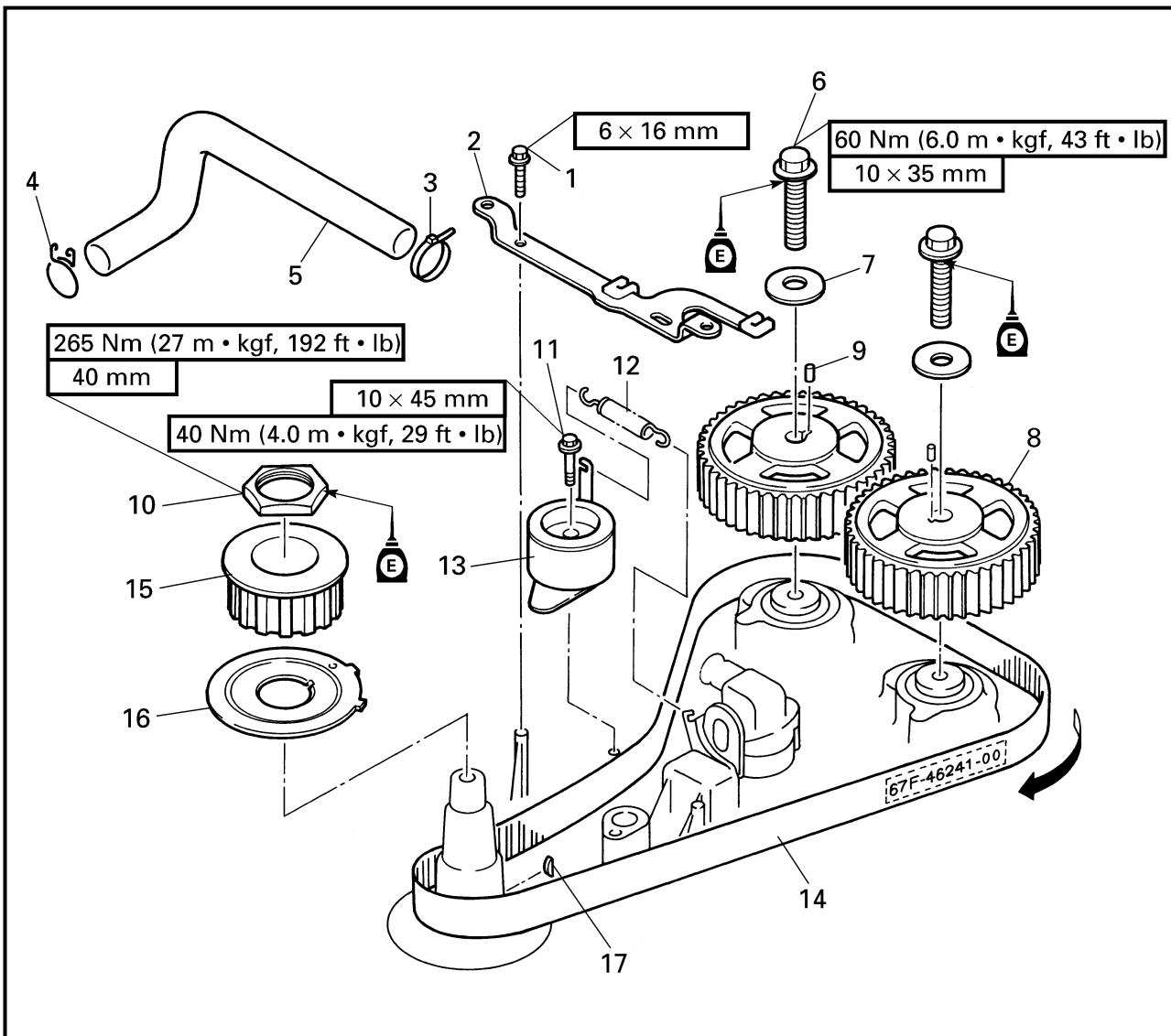
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TIMING BELT

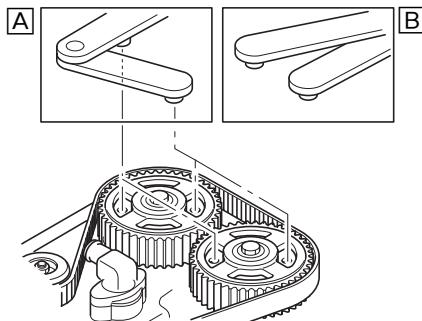
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Order	Job/Part	Q'ty	Remarks
9	Pin	2	
10	Drive sprocket nut	1	
11	Bolt	1	
12	Spring	1	
13	Timing belt tensioner	1	
14	Timing belt	1	
15	Drive sprocket	1	
16	Pick-up rotor	1	
17	Woodruff key	1	
			For installation, reverse the removal procedure.

POWR**TIMING BELT**

E



REMOVING THE DRIVEN SPROCKET

CAUTION:

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

Remove:

- Bolt

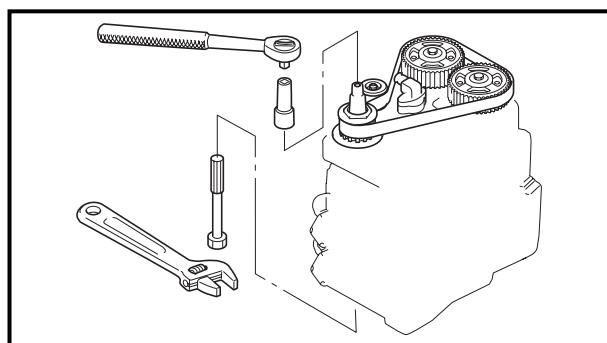


**Flywheel magnet assembly
holder**

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



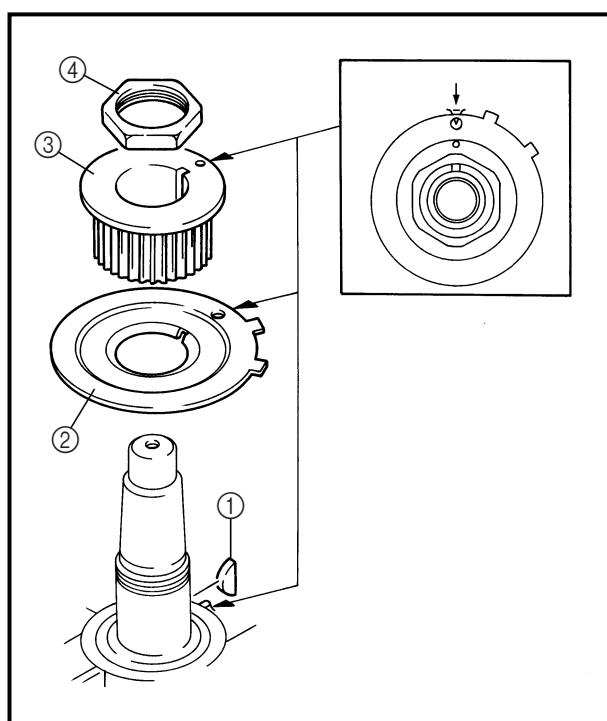
Drive sprocket nut

265 Nm (27.0 m • kgf, 192 ft • lb)



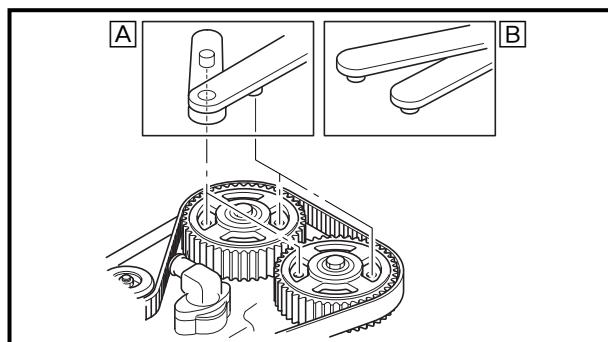
Crankshaft holder

YB-06552 / 90890-06552



POWR**TIMING BELT**

E



INSTALLING THE DRIVEN SPROCKET

Install:

- Driven sprocket bolt



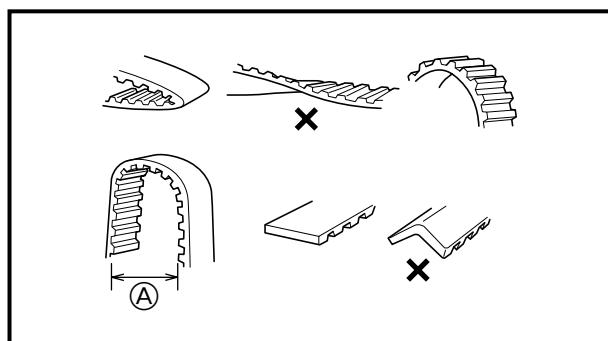
Driven sprocket bolt
60 Nm (6.0 m · kgf, 43 ft · lb)



**Flywheel magnet assembly
holder**
YB-06139 / 90890-06522

A For USA and Canada

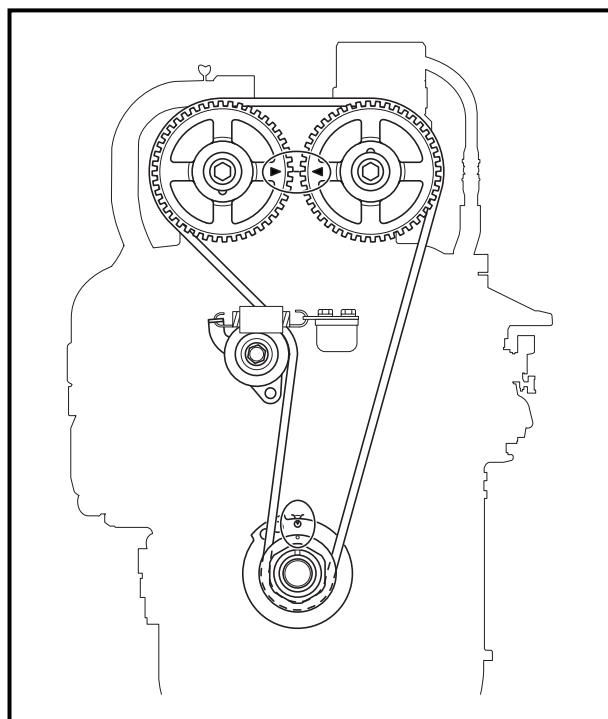
B For worldwide



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.
- **(A) Minimum 25 mm (1.0 in)**



Install:

- Timing belt
- Tensioner

Installation steps

- (1) Align ø6 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.

POWR

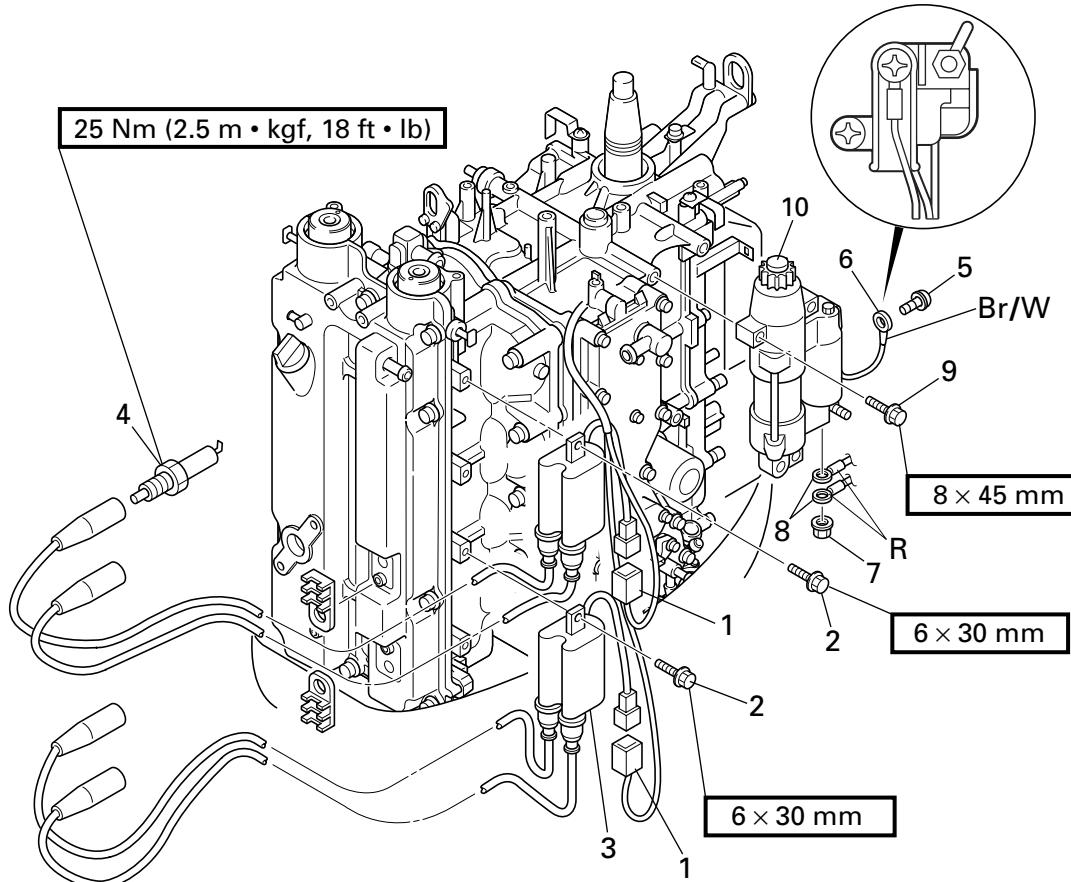


IGNITION COILS AND STARTER MOTOR

E

IGNITION COILS AND STARTER MOTOR

REMOVING/INSTALLING THE IGNITION COILS AND STARTER MOTOR

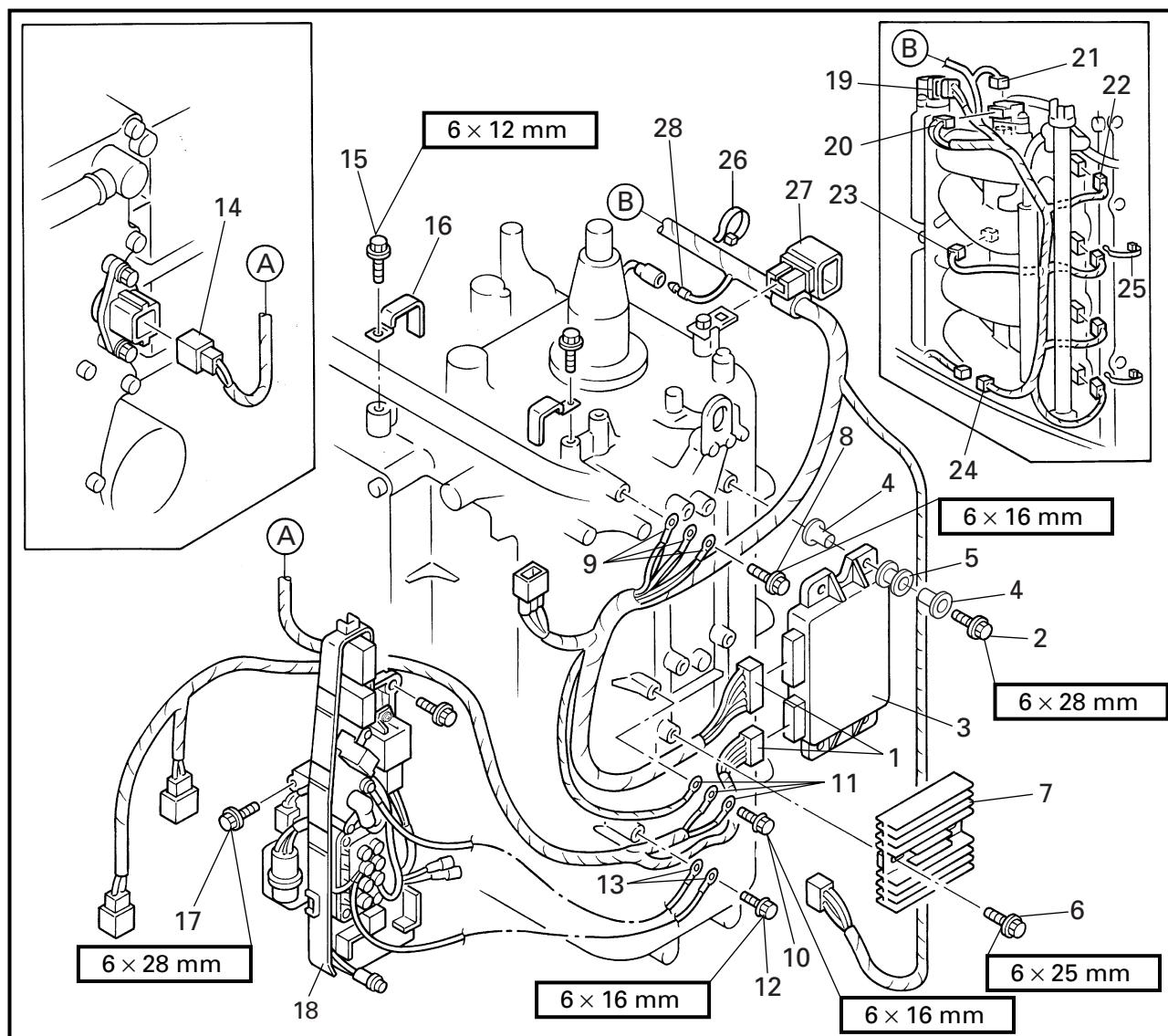


Order	Job/Part	Q'ty	Remarks
1	Ignition coil coupler	2	
2	Bolt	4	
3	Ignition coil	2	
4	Spark plug	4	
5	Screw	1	
6	Relay (magnetic switch) lead	1	
7	Nut	1	
8	Wire harness lead	2	
9	Bolt	3	
10	Starter motor	1	For installation, reverse the removal procedure.



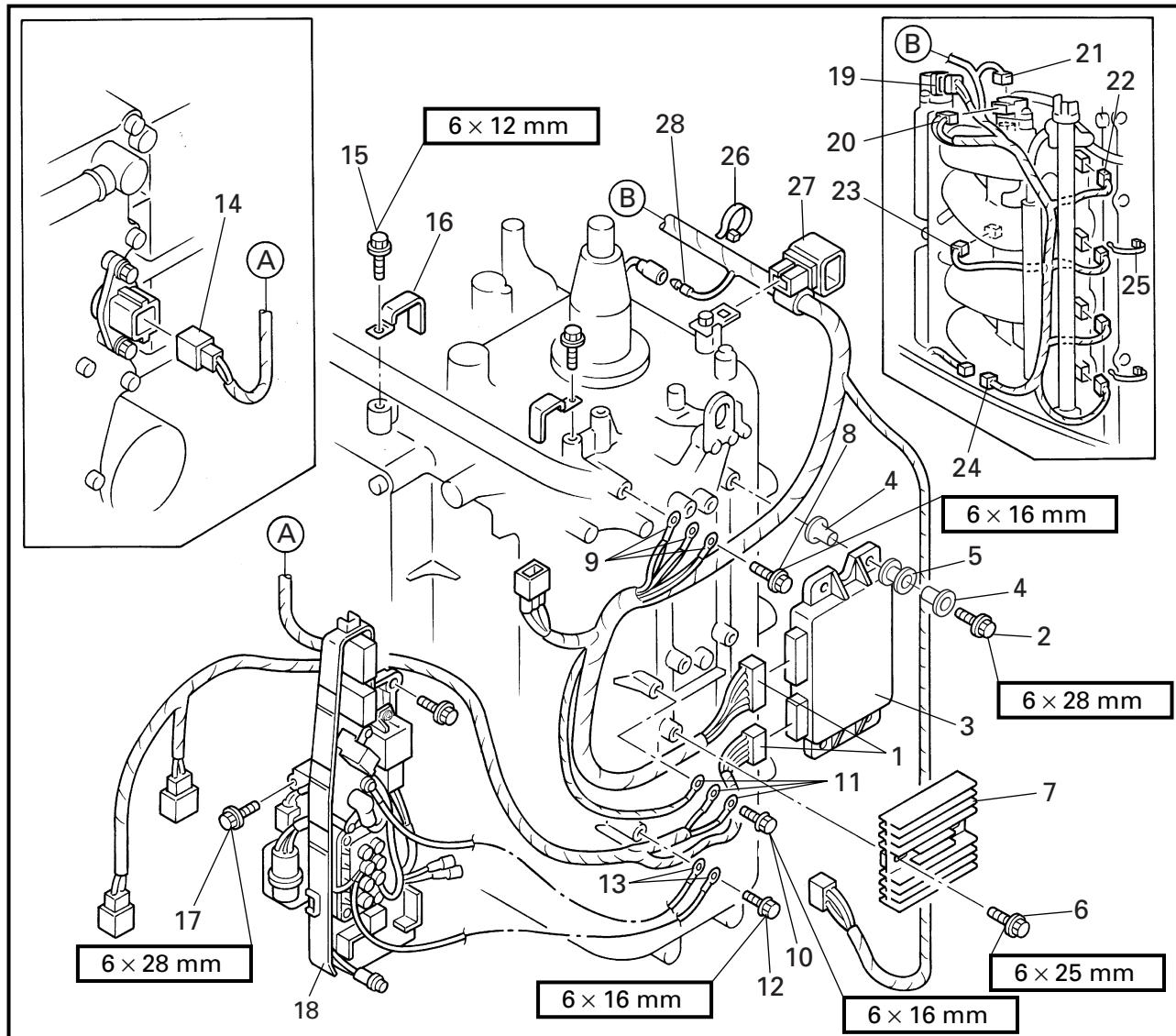
ECM AND JUNCTION BOX ASSEMBLY

REMOVING/INSTALLING THE CDI UNIT AND JUNCTION BOX ASSEMBLY



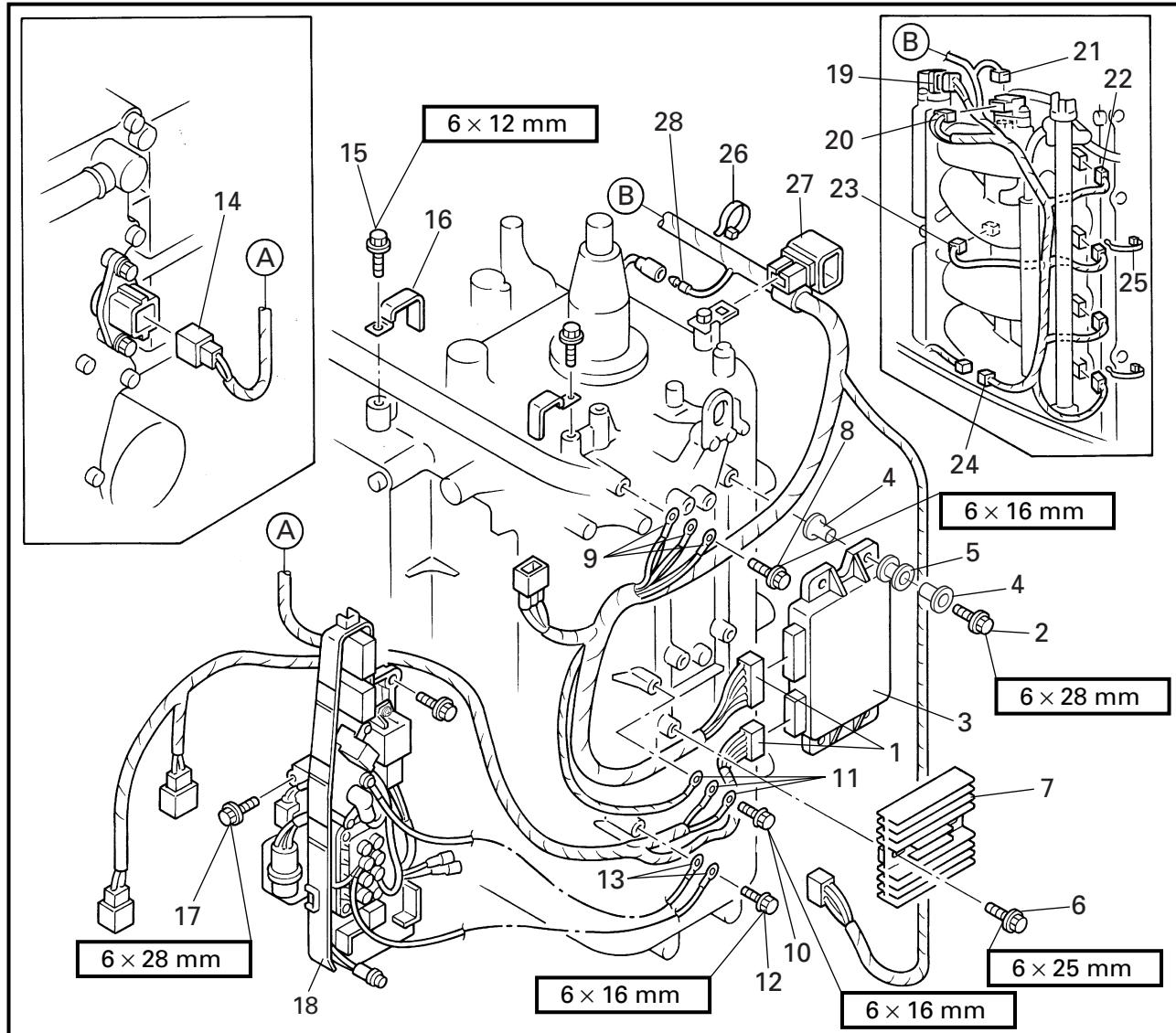
Order	Job/Part	Q'ty	Remarks
1	ECM coupler	2	
2	Bolt	4	
3	ECM	1	
4	Collar	8	
5	Grommet	1	
6	Bolt	2	
7	Rectifier/regulator	1	
8	Bolt	1	
9	Ground lead	2	
10	Bolt	1	
11	Ground lead	3	

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	

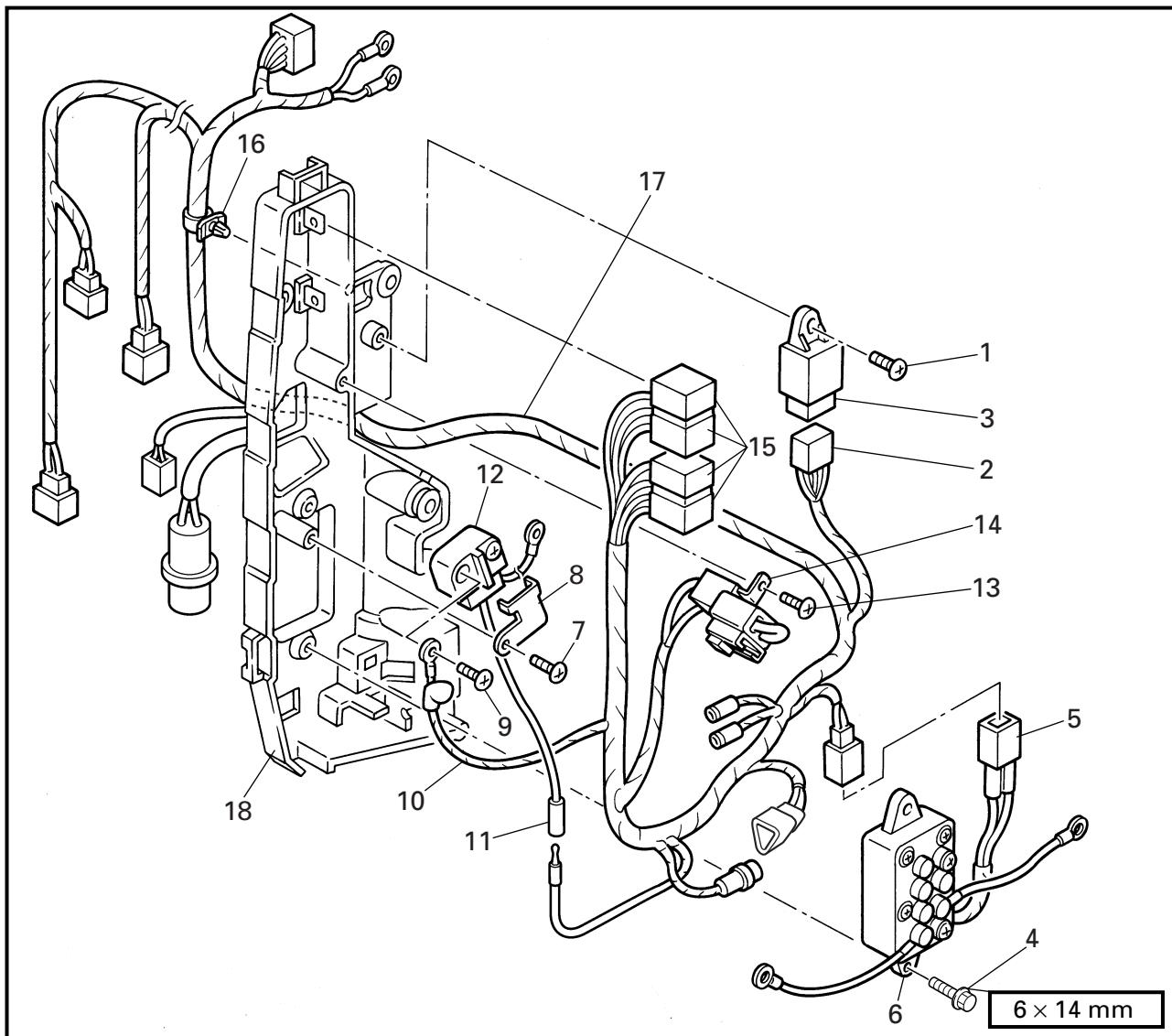
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Order	Job/Part	Q'ty	Remarks
21	Idle speed control valve coupler	1	
22	Fuel injectors coupler	4	
23	High-pressure fuel pump coupler	1	
24	Shift position switch coupler	1	
25	Plastic locking tie	1	Not reusable
26	Plastic locking tie	1	Not reusable
27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



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	

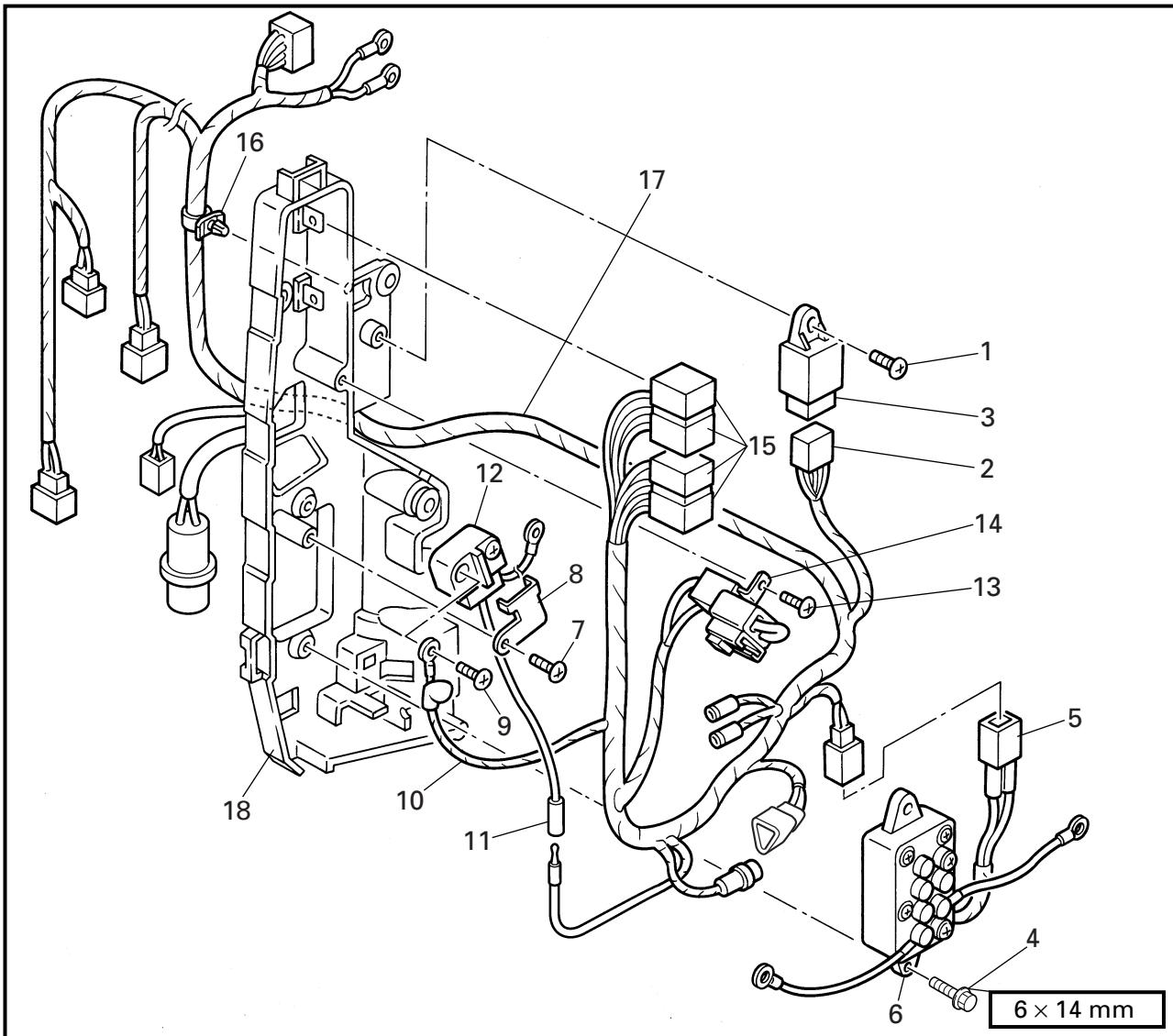
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POWR



ECM AND JUNCTION BOX ASSEMBLY

E



Order	Job/Part	Q'ty	Remarks
10	Positive battery lead	1	
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	For assembly, reverse the disassembly procedure.

POWR

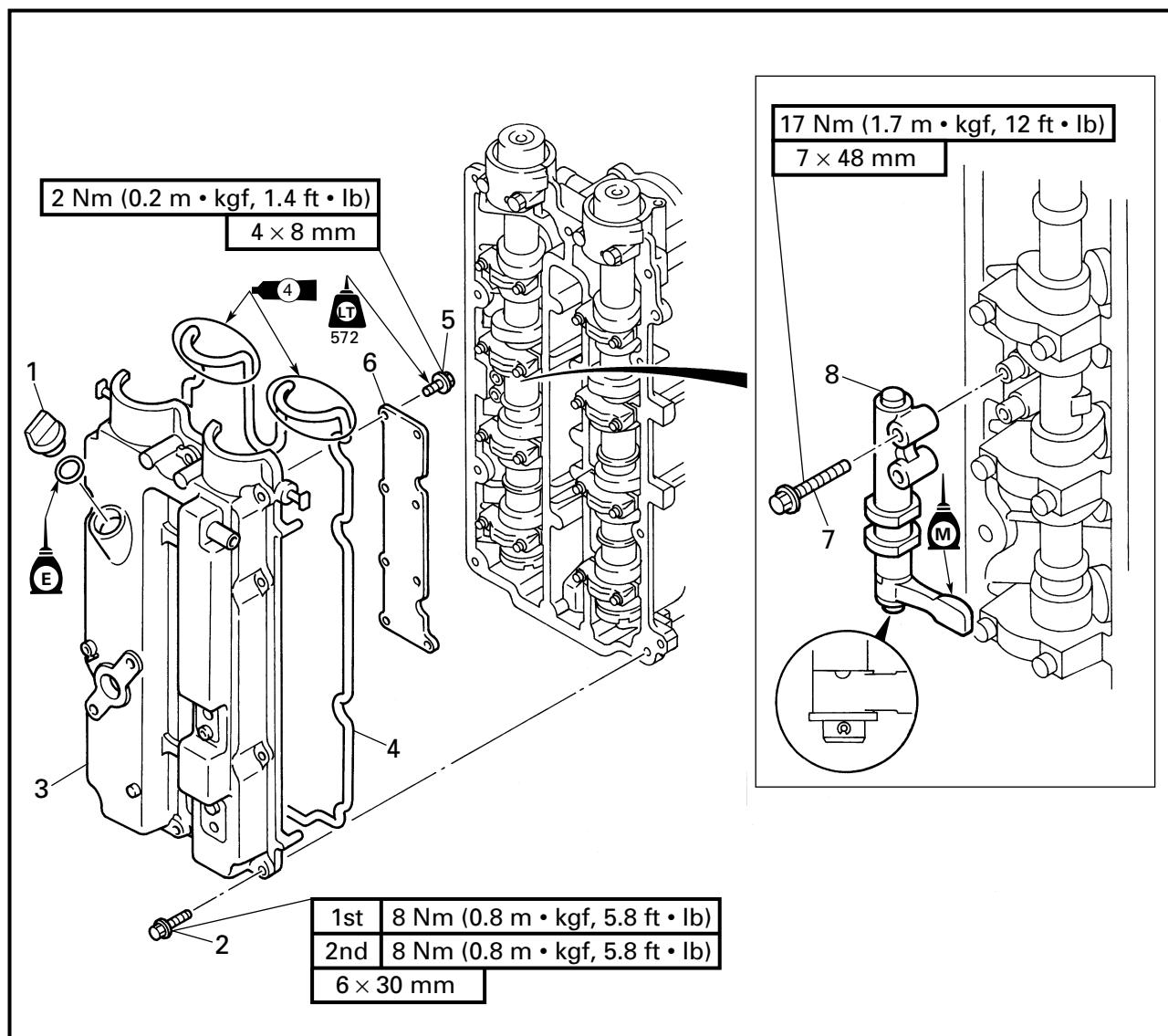


CYLINDER HEAD COVER

E

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.

POWR

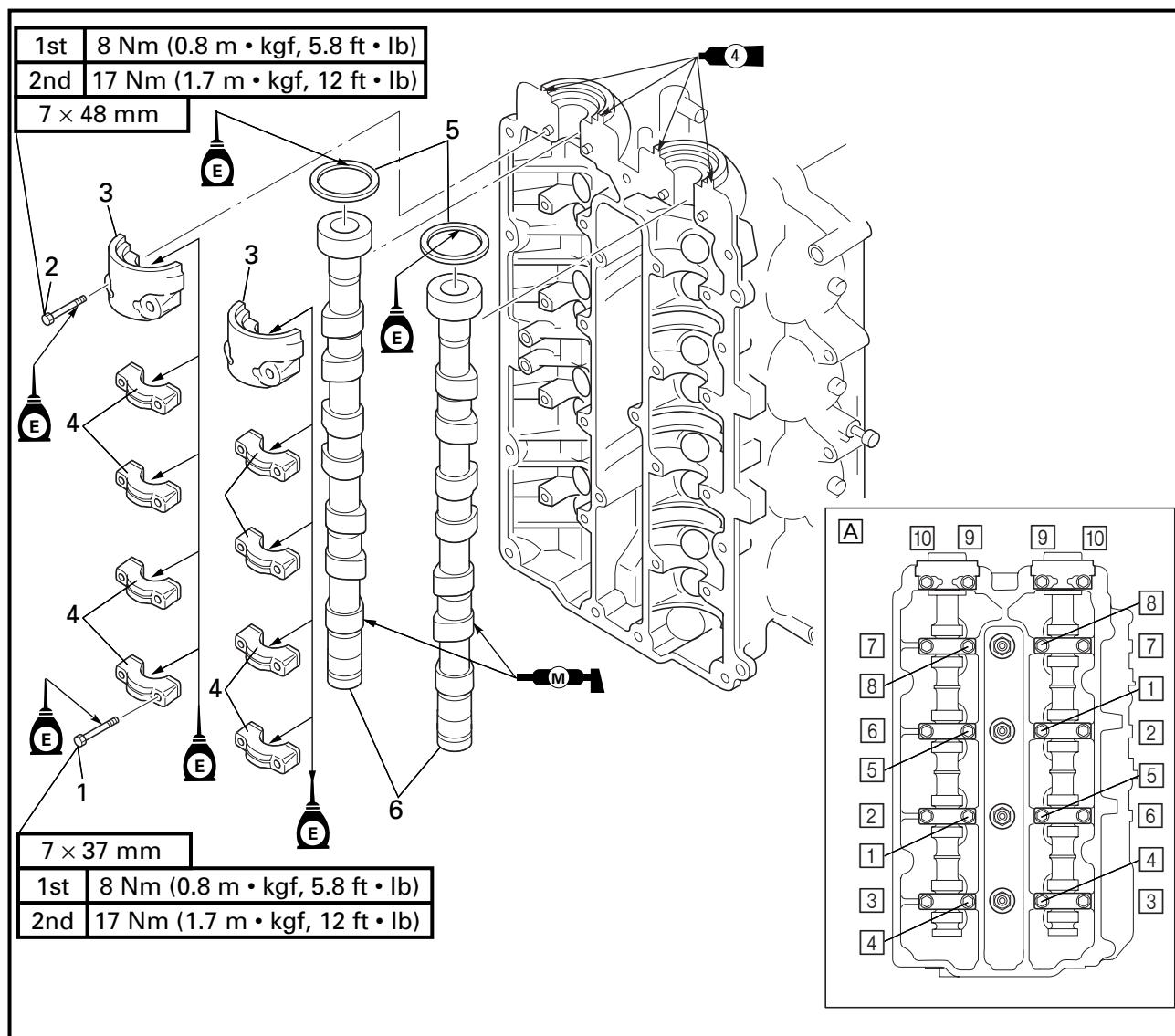


CAMSHAFTS

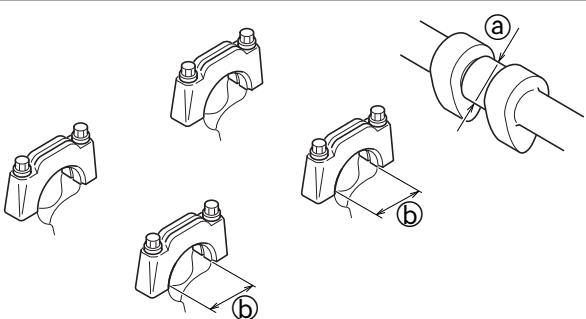
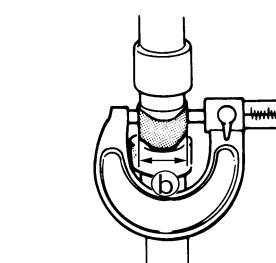
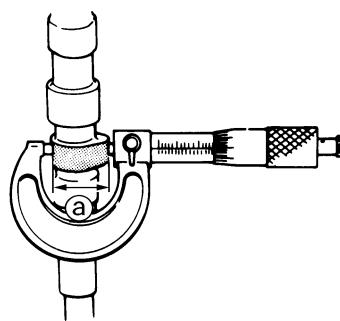
E

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 ④ and ⑤
Out of specification → Replace the camshaft.



Camshaft lobe dimension

- | | |
|-------|----------------------------------------|
| ④ IN: | 37.22 - 37.38 mm
(1.465 - 1.472 in) |
| ⑤ IN: | 29.92 - 30.08 mm
(1.178 - 1.184 in) |
| ④ EX: | 36.90 - 37.06 mm
(1.453 - 1.459 in) |
| ⑤ EX: | 29.92 - 30.08 mm
(1.178 - 1.184 in) |

2. Measure:

- Camshaft journal diameter ④
- Camshaft cap inside diameter ⑤
Out of specification → Replace the camshaft or cylinder head.



Camshaft journal diameter

- ④: 24.96 - 24.98 mm
(0.9827 - 0.9835 in)

Camshaft cap inside diameter

- ⑤: 25.000 - 25.021 mm
(0.984 - 0.985 in)

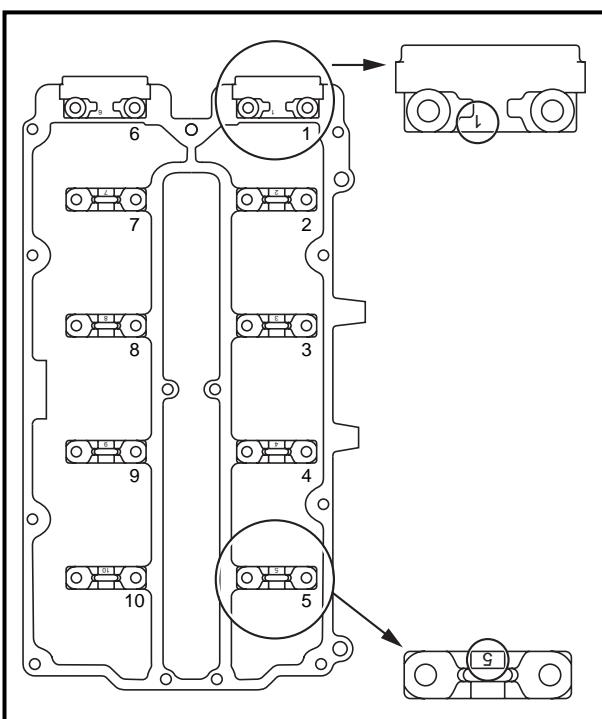
INSTALLING THE CAMSHAFT

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.

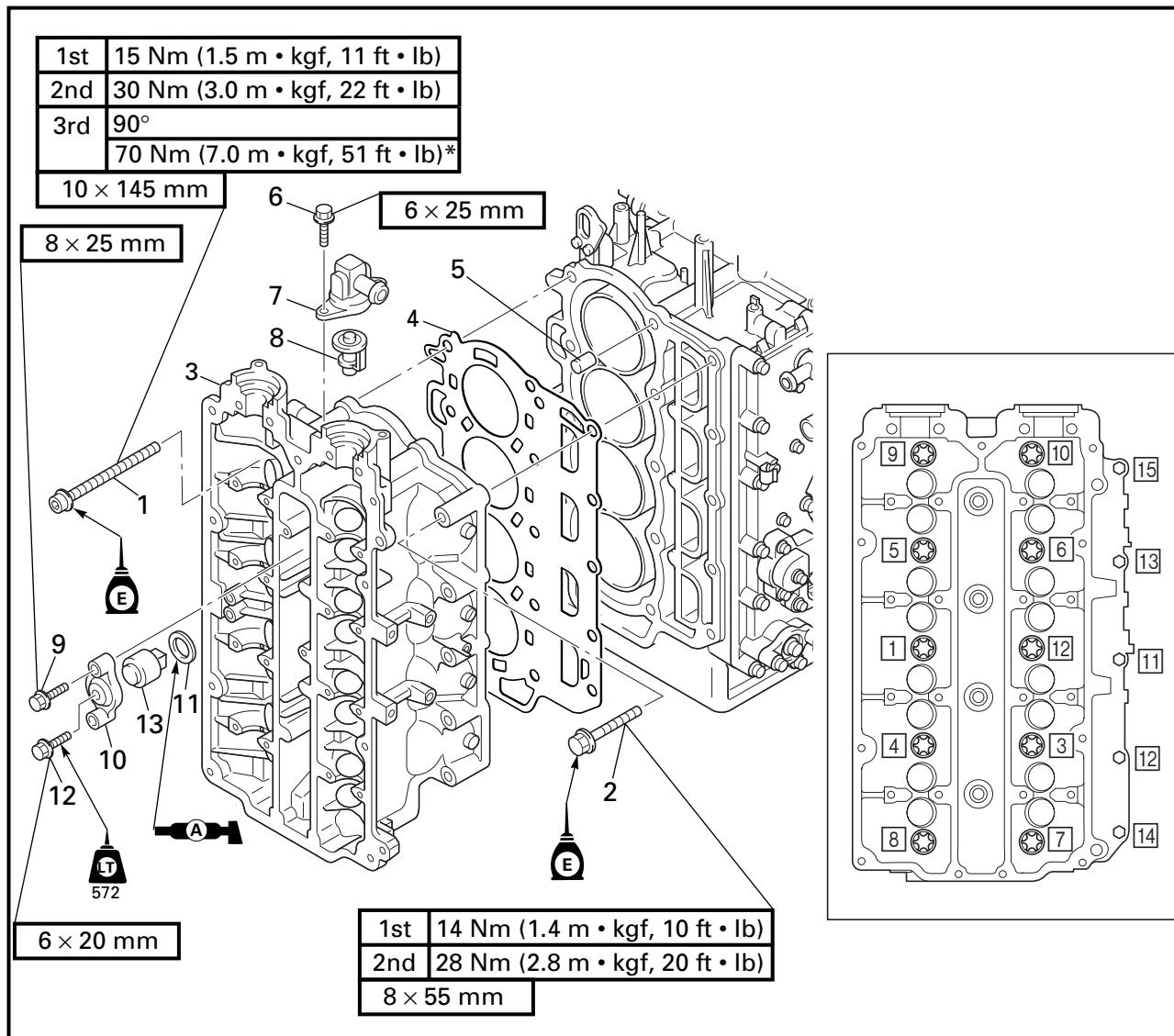


POWR



CYLINDER HEAD ASSEMBLY

E

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)

POWR



CYLINDER HEAD ASSEMBLY

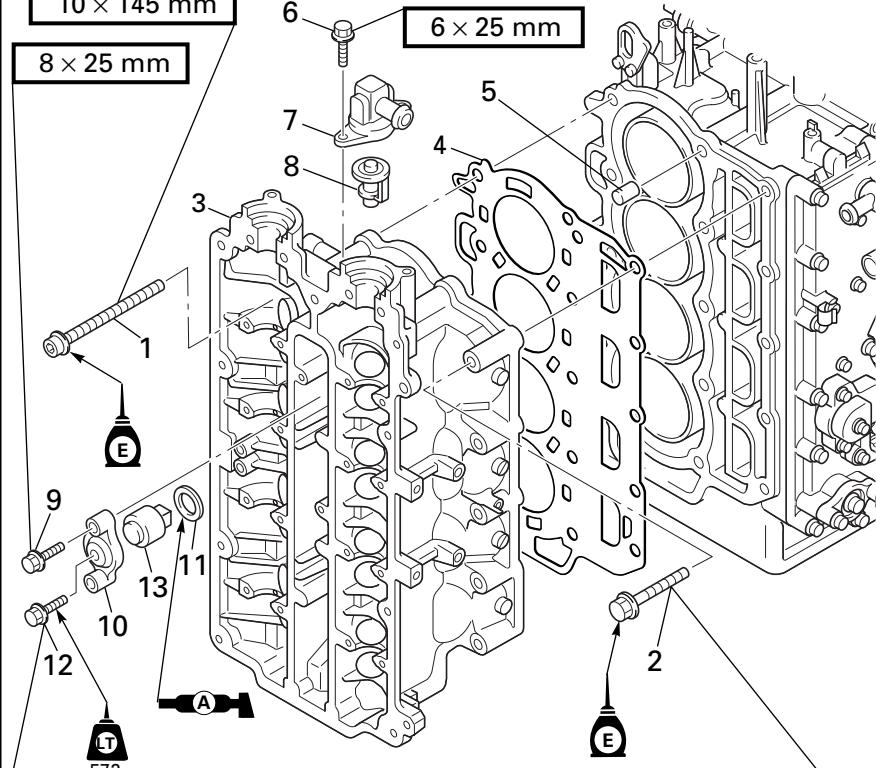
E

1st	15 Nm (1.5 m • kgf, 11 ft • lb)
2nd	30 Nm (3.0 m • kgf, 22 ft • lb)
3rd	90°
	70 Nm (7.0 m • kgf, 51 ft • lb)*

10 × 145 mm

8 × 25 mm

6 × 25 mm

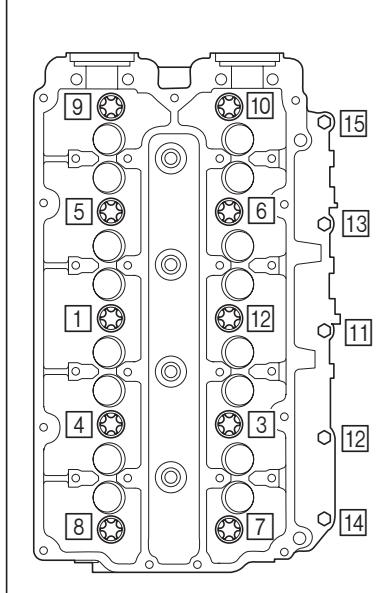


6 × 20 mm

1st 14 Nm (1.4 m • kgf, 10 ft • lb)

2nd 28 Nm (2.8 m • kgf, 20 ft • lb)

8 × 55 mm



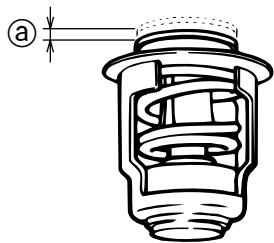
Order	Job/Part	Q'ty	Remarks
6	Bolt	2	
7	Thermostat cover	1	
8	Thermostat	1	
9	Bolt	4	
10	Anode cover	2	
11	O-ring	2	
12	Bolt	2	
13	Anode	2	

For installation, reverse the removal procedure.

POWR

CYLINDER HEAD ASSEMBLY

E



CHECKING THE THERMOSTAT

1. Check:

- Thermostat

Damage/valve does not open → Replace.

2. Measure:

- Valve operating temperature
- Valve lift @

Out of specification → Replace the thermostat.

	Water temperature	Valve lift
	Below 50°C (122°F)	0 mm (0 in)
	Above 60°C (140°F)	Min. 4.3 mm (0.17 in)

Measuring steps

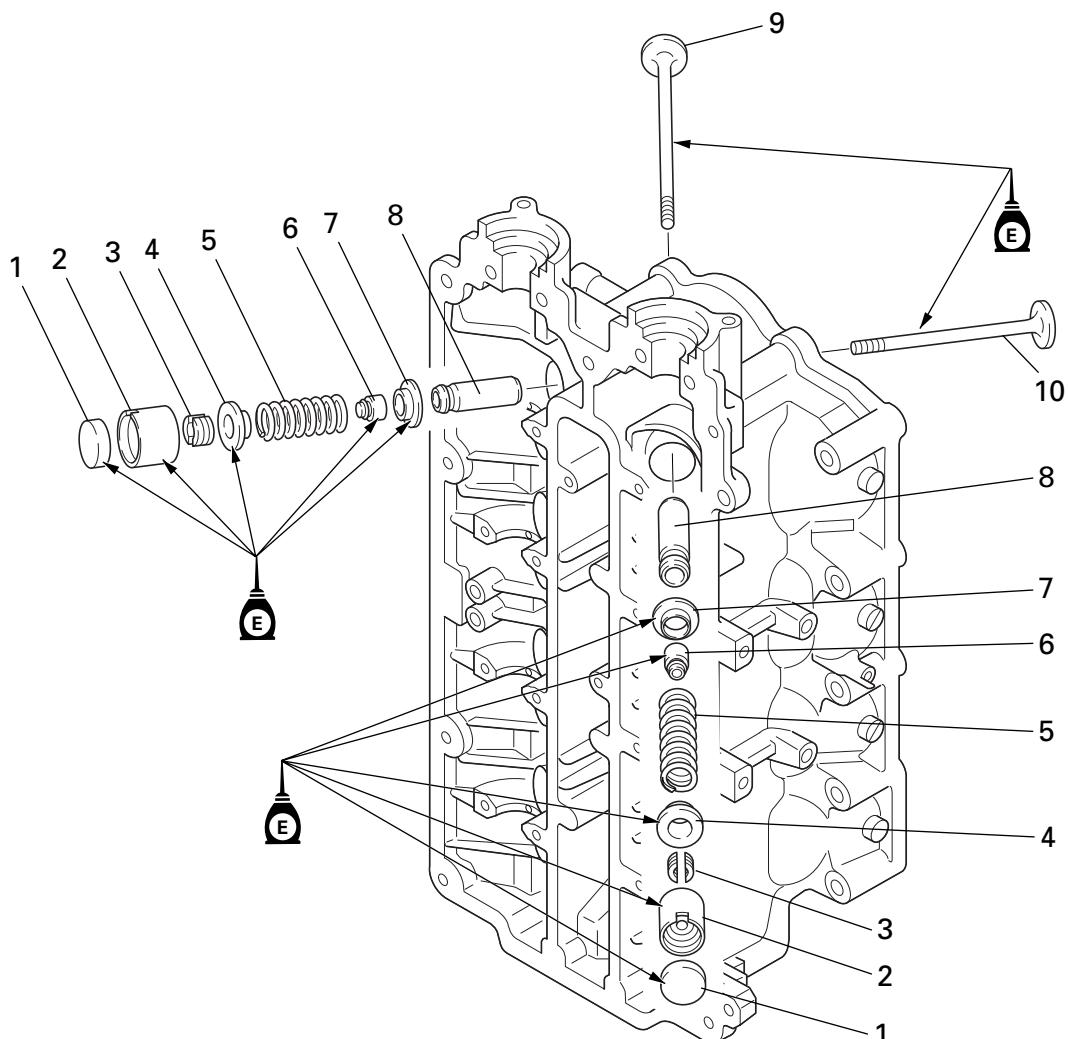
- (1) Suspend the thermostat in a container filled with water.
- (2) Slowly heat the water.
- (3) Place a thermometer in the water.
- (4) While stirring the water, observe the thermometer's indicated temperature.

POWR



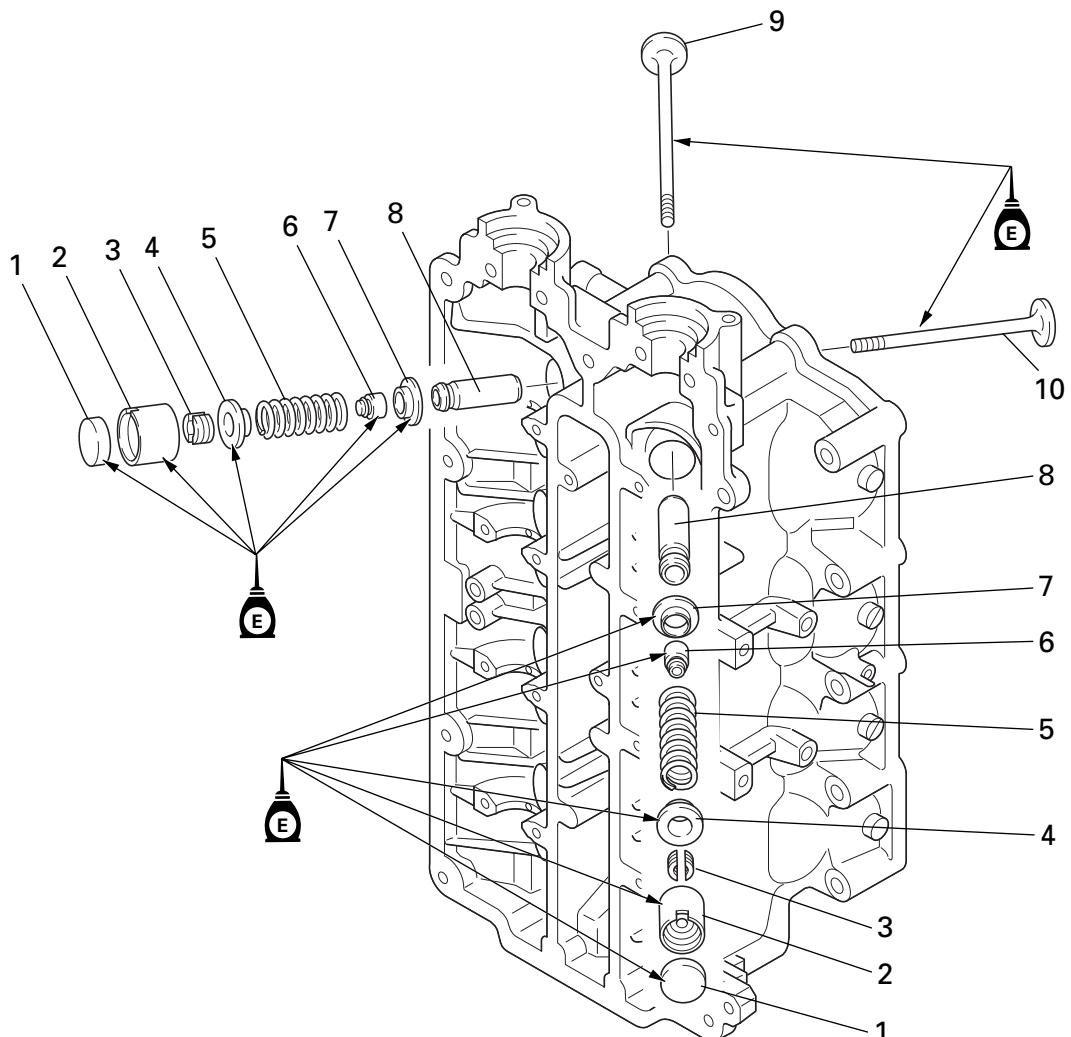
VALVES

E

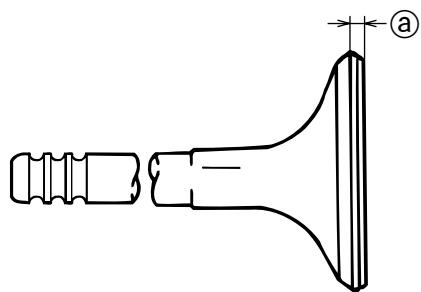
VALVES**REMOVING/INSTALLING THE VALVES**

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	
7	Spring seat	16	
8	Valve guide	16	
9	Intake valve	8	
10	Exhaust valve	8	For installation, reverse the removal procedure.



CHECKING THE VALVE

1. Check:

- Valve
Damage/warpage → Replace.

2. Measure:

- Margin thickness @
Out of specification → Replace.



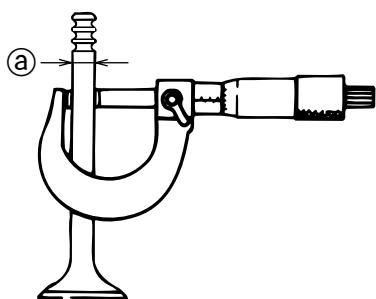
Margin thickness

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 @
Out of specification → Replace.



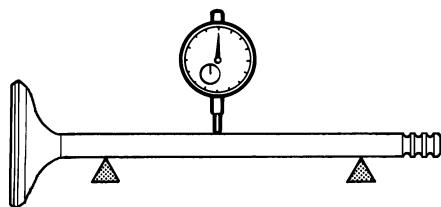
Valve stem diameter

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.



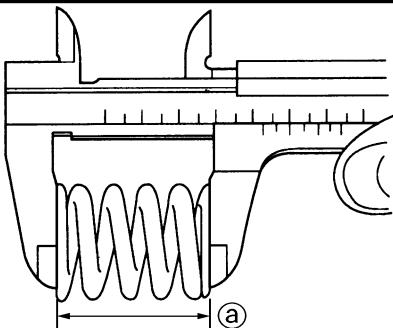
Valve stem runout limit

IN and EX

0.03 mm (0.001 in)

NOTE: _____

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



302-005

CHECKING THE VALVE SPRING

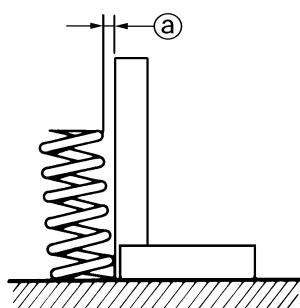
1. Measure:

- Free length @

Out of specification → Replace.



**Free length limit
52.25 mm (2.057 in)**



302-028

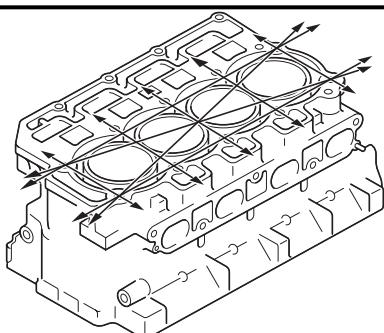
2. Measure:

- Valve spring tilt @

Out of specification → Replace.



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



CHECKING THE CYLINDER HEAD

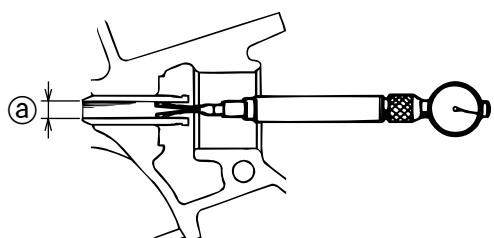
Measure:

- 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 @

Out of specification → Replace the guide.



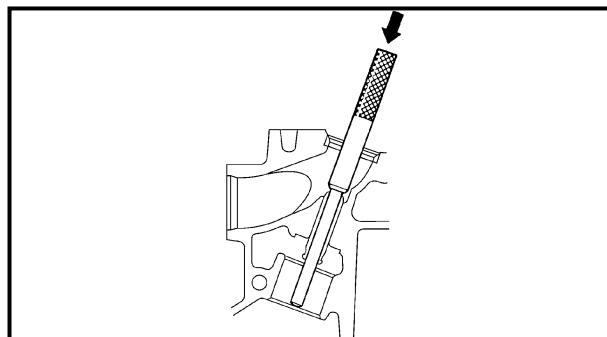
**Valve guide bore
6.005 - 6.018 mm
(0.2364 - 0.2369 in)**

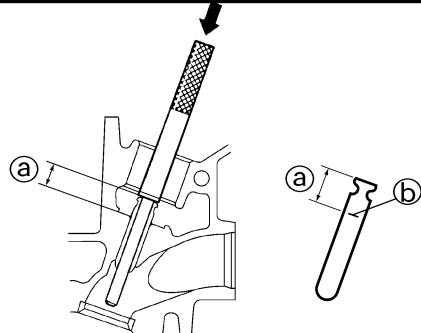
Replacement steps

(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) ④ with the valve guide remover/installer.



**Valve guide position
11.5 mm (0.45 in)**

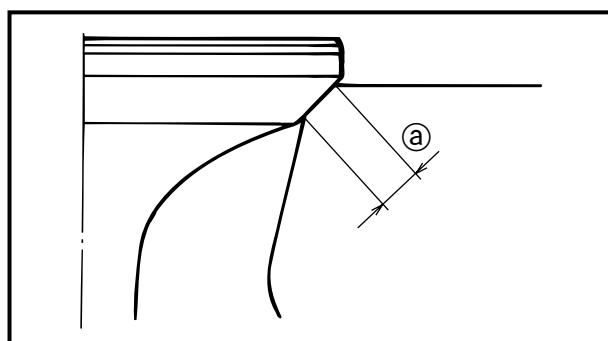
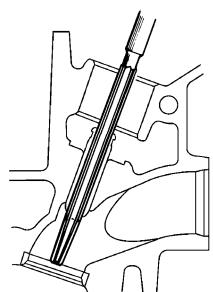
- (3) After installing the valve guide, bore the valve guide with the valve guide reamer.



**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 ⑤ as shown.



CHECKING THE VALVE SEAT

1. Measure:

- Valve seat width ⑥
Out of specification → Reface the valve seat.



**Valve seat width
Intake**
1.58 - 1.94 mm
(0.062 - 0.076 in)
Exhaust
1.80 - 2.02 mm
(0.071 - 0.080 in)

2. Reface:

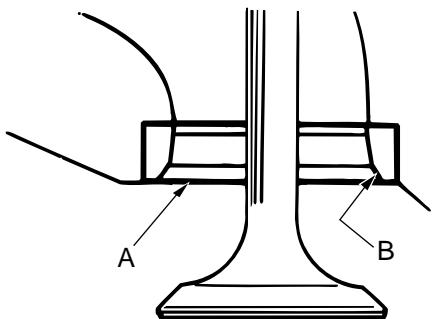
- Valve seat

CAUTION:

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

POWR**VALVES**

E

**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

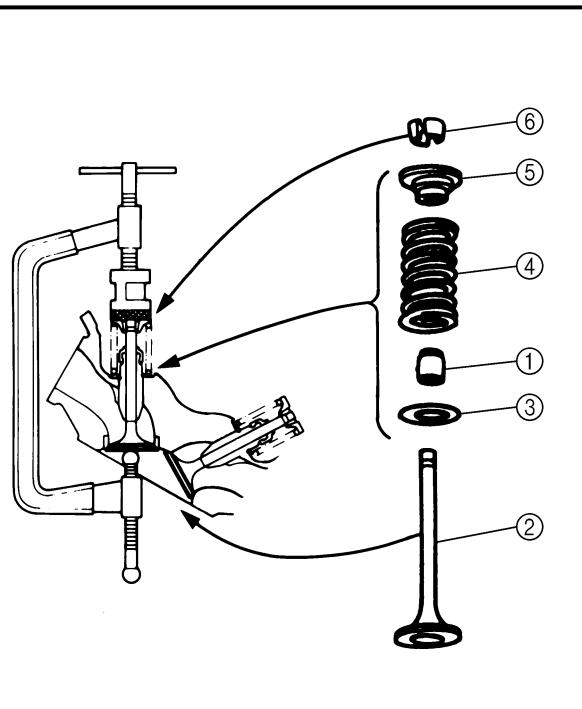
(90°) YB-06556 / 90890-06556

- 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: _____

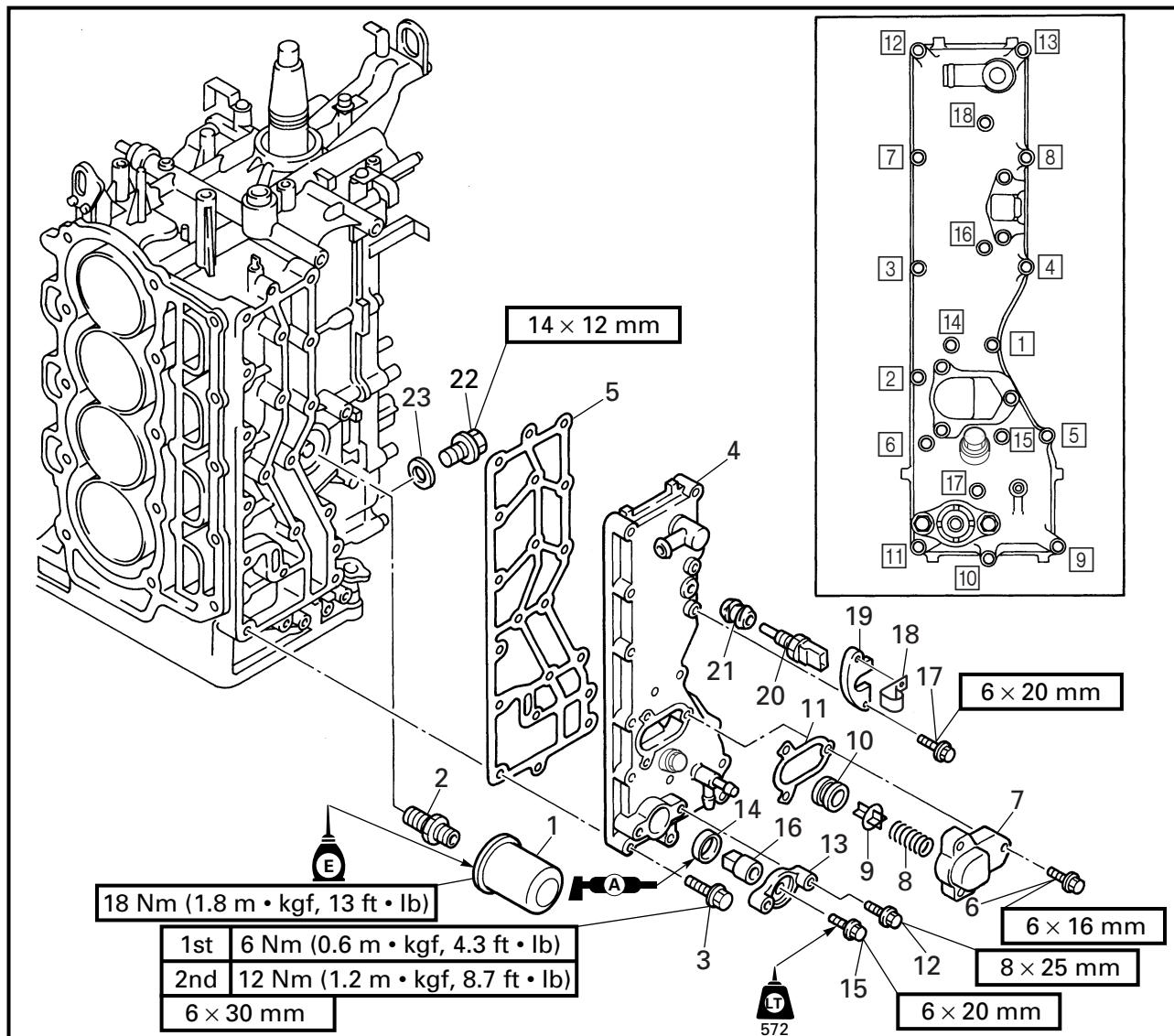
Compress the valve spring with the special tools and install the cotters onto the valve.

POWR



OIL FILTER AND EXHAUST COVER

E

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.
1	Oil filter	1	
2	Oil filter stand	1	
3	Bolt	18	
4	Exhaust cover	1	
5	Gasket	1	Not reusable
6	Bolt	3	
7	Pressure control valve (PCV) cover	1	

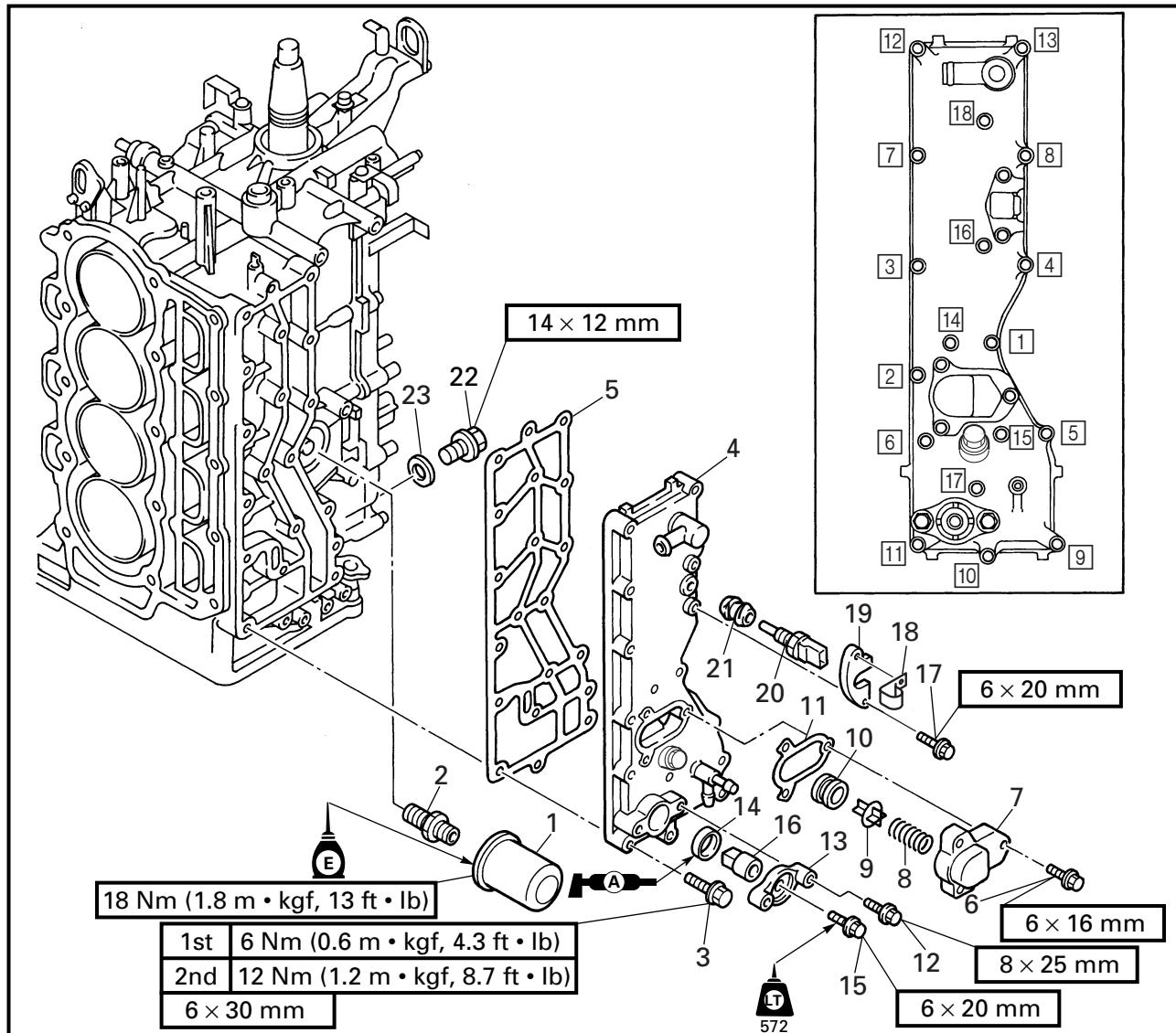
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POWR



OIL FILTER AND EXHAUST COVER

E



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

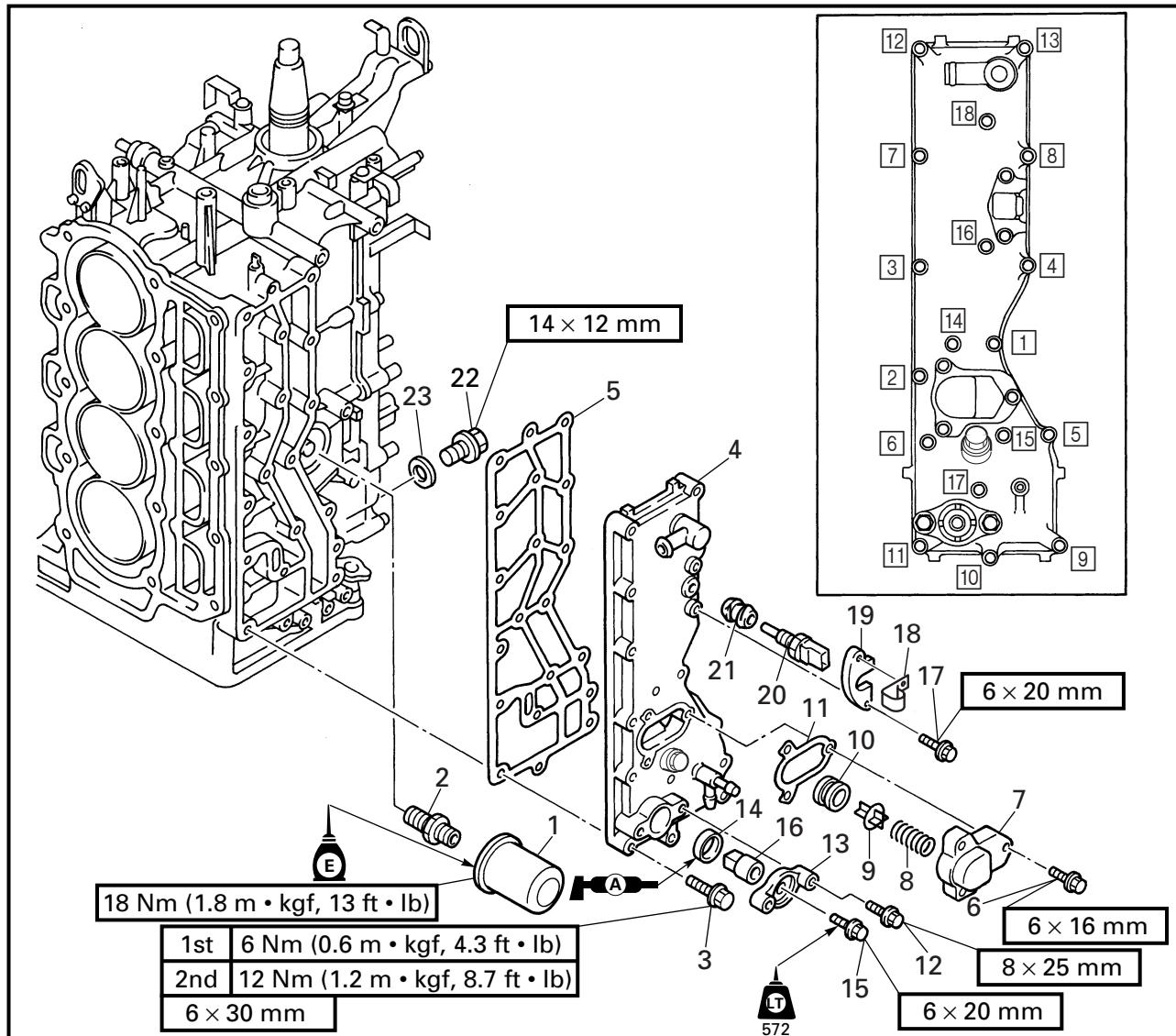
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POWR



OIL FILTER AND EXHAUST COVER

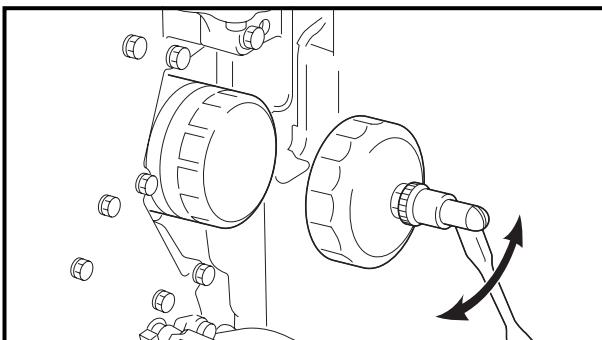
E



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

POWR**OIL FILTER AND EXHAUST COVER**

E

**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.

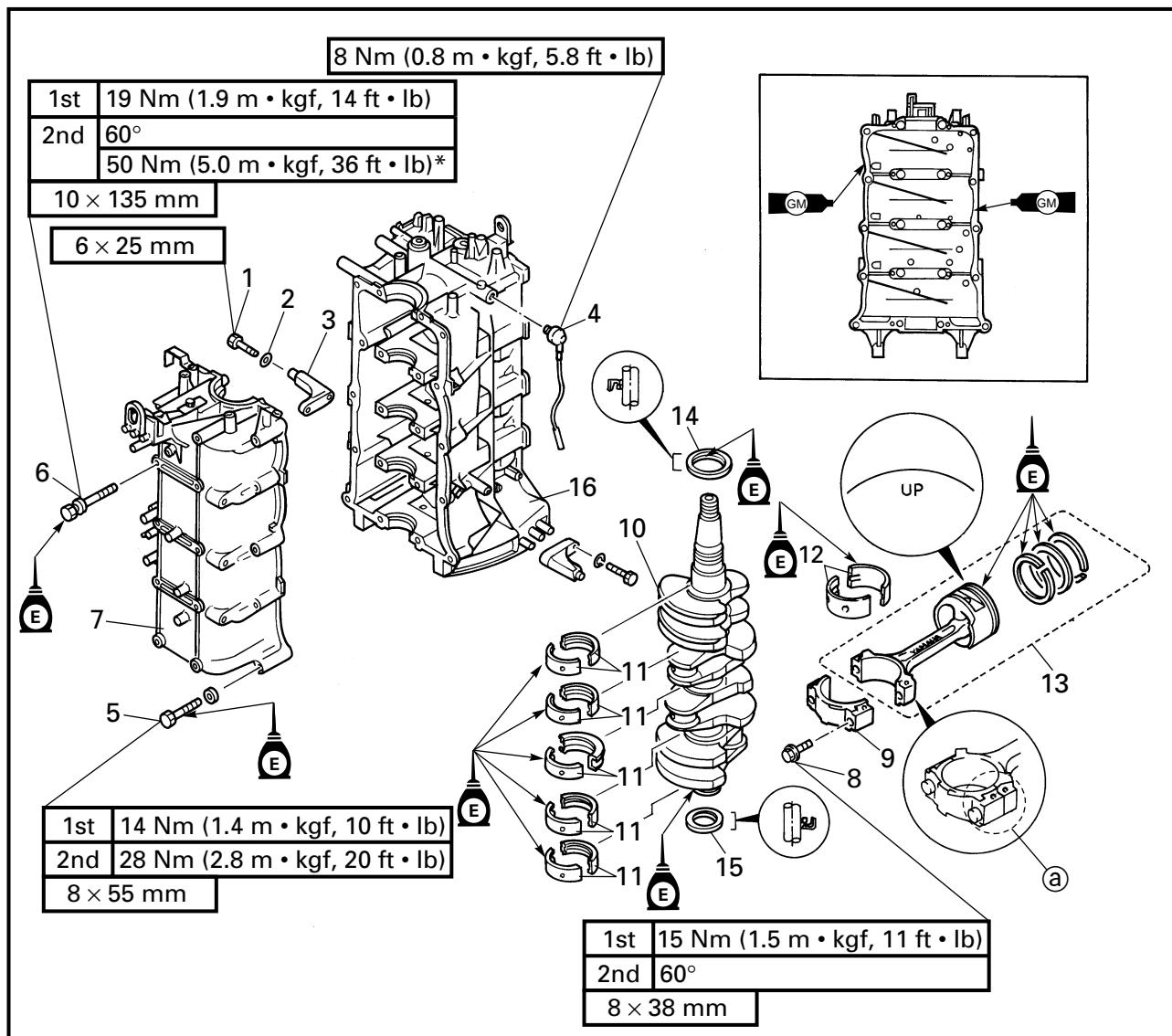
POWR



CRANKSHAFT AND PISTON/ CONNECTING ROD ASSEMBLY

E

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	2	
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	

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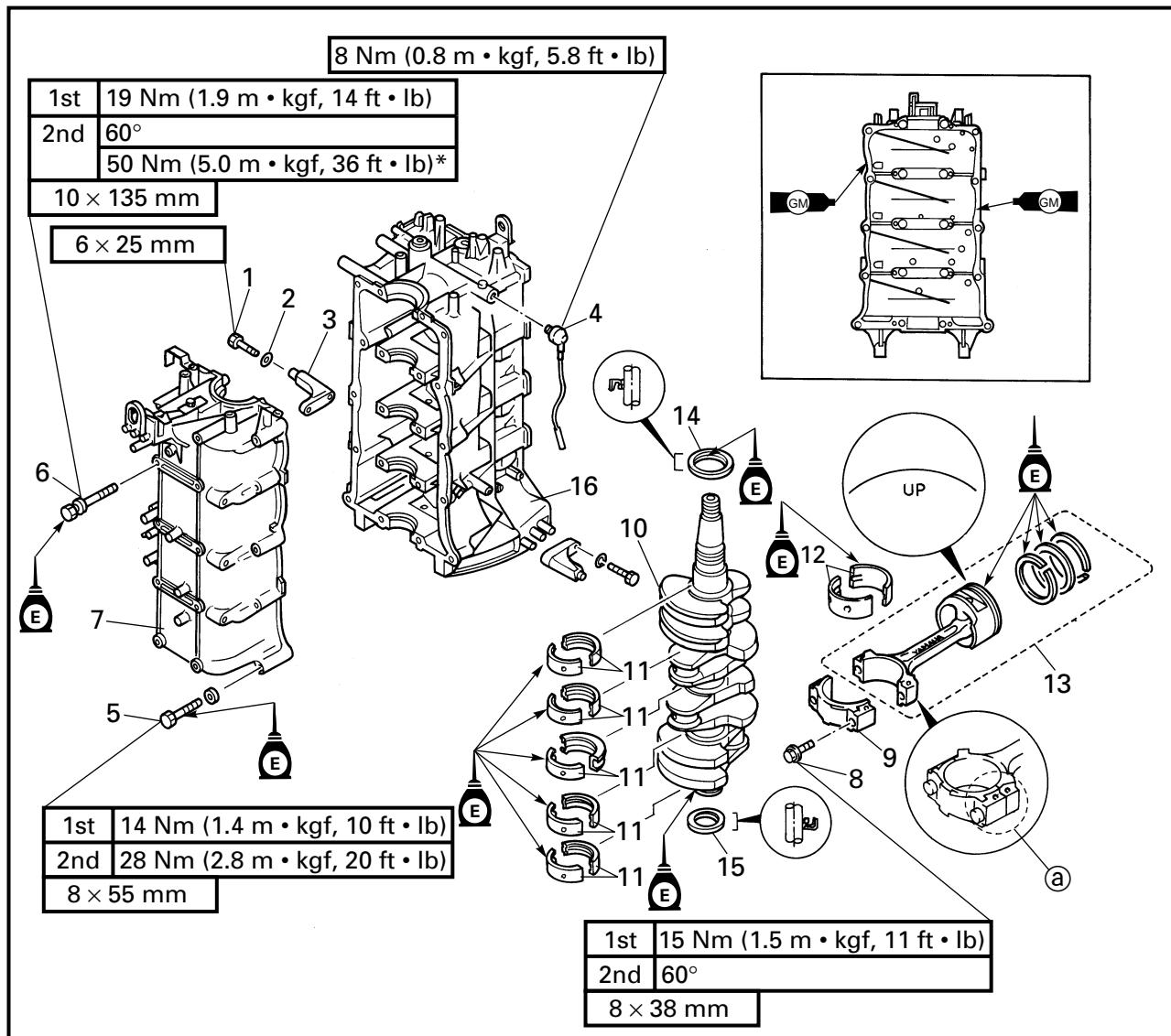
*: Torque value (for reference only)

POWR

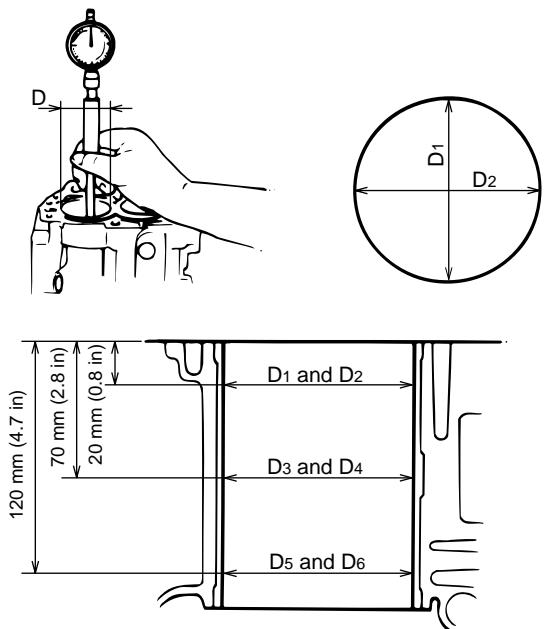


CRANKSHAFT AND PISTON/ CONNECTING ROD ASSEMBLY

E



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

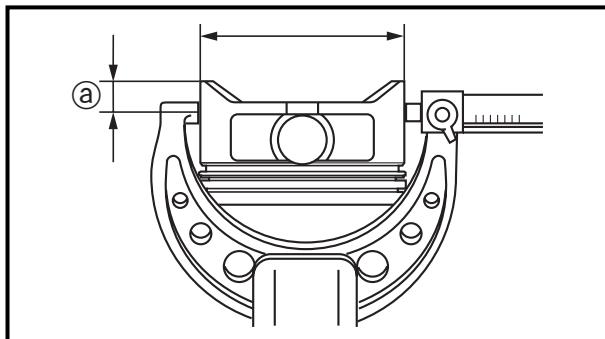
Out of specification → Rebore the cylinder or replace the cylinder block.

	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	—	0.08 mm (0.003 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:

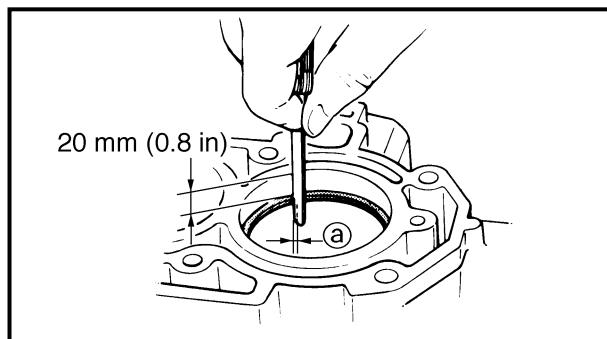
- Piston-to-cylinder clearance

Out of specification → Replace the piston and piston rings, the cylinder block or both.

$$\text{Piston-to-cylinder clearance} = \text{Cylinder bore} - \text{Piston diameter}$$



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



CHECKING THE PISTON RING

1. Measure:

- End gap @

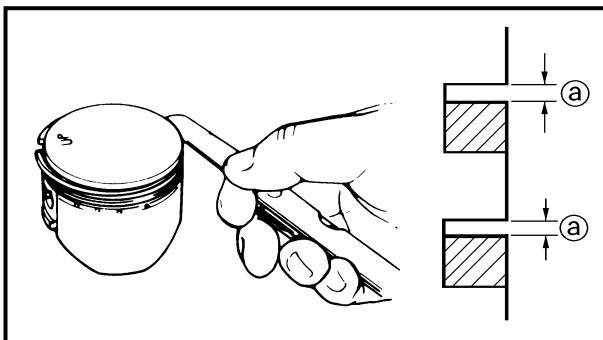
Out of specification → Replace the piston rings as a set.



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 ②

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

**Side clearance****Top ring**

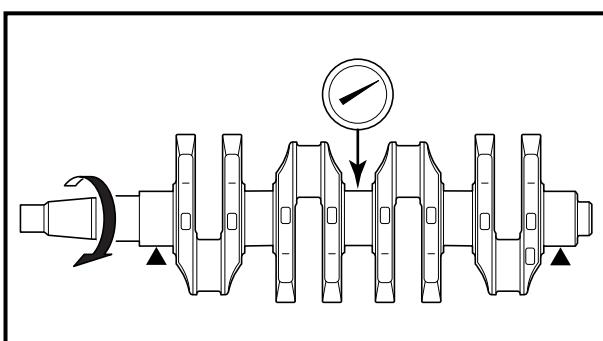
0.02 - 0.08 mm
(0.001 - 0.003 in)

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)

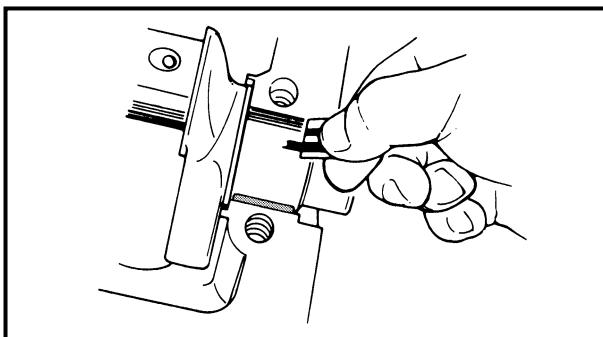
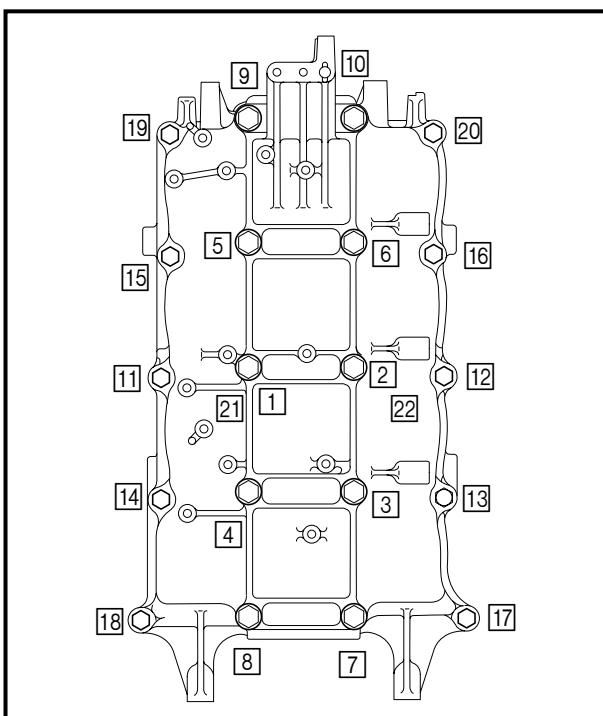
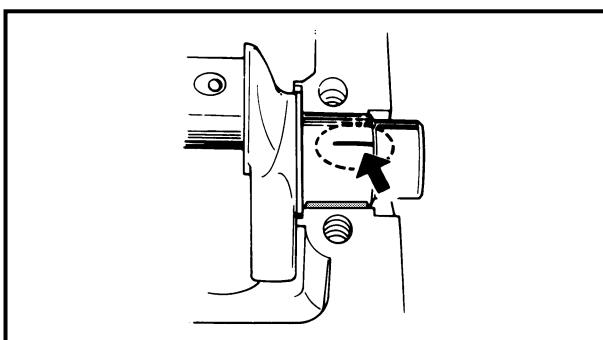
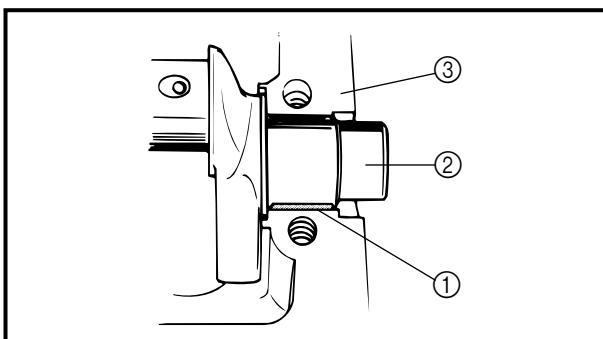
NOTE: _____

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

POWR

CRANKSHAFT AND PISTON/ CONNECTING ROD ASSEMBLY

E



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 = $47.900 + (\text{stamped value}/1000)$

Example: #1 = 92 → 47.992

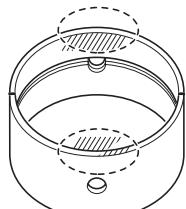
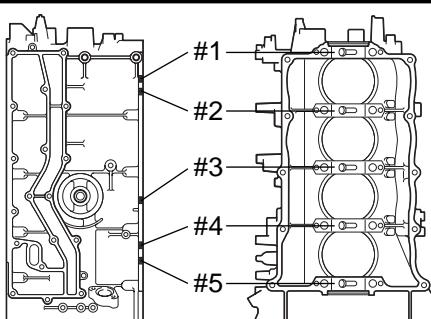
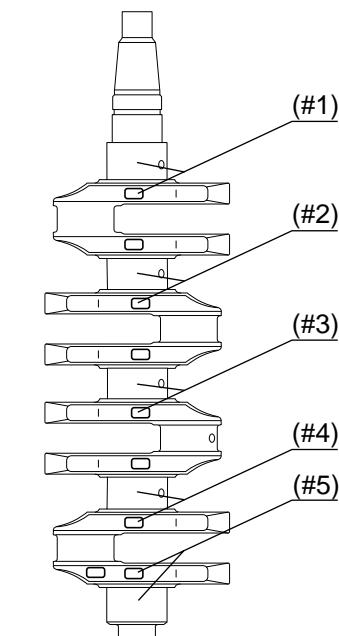
Cylinder block journal diameter = $54.000 + (\text{stamped value}/1000)$

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

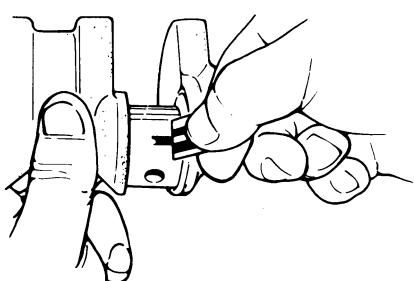
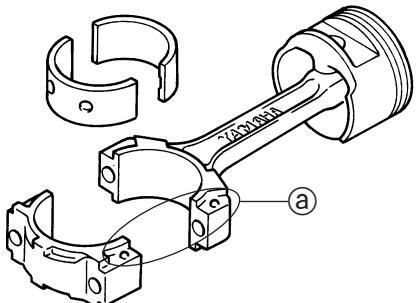
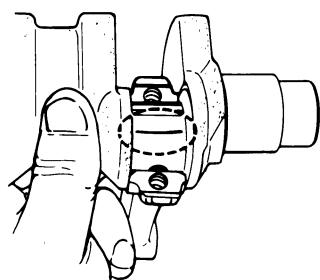
Out of specification → Replace the upper and lower bearings as a set.



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 ② 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 new yellow bearings into the connecting rods and connecting rod caps.
- (2) Put a piece of Plastigauge® onto the crank pin in parallel to the crankshaft.
- (3) 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.

- (4) Apply engine oil onto the threads and seat of the original connecting rod bolts.

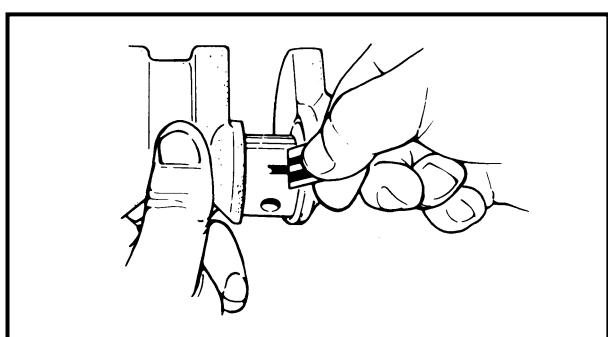
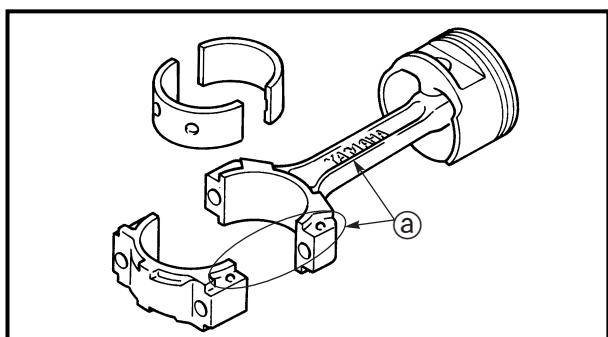
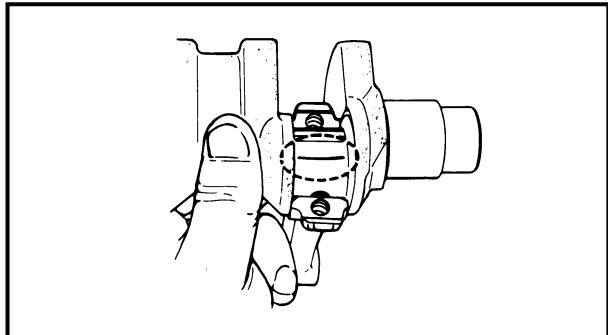
- (5) Tighten the original bolts to the specified torque in two stages.



Bolt

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

- (6) Remove the connecting rod cap.
- (7) Measure the width of the compressed Plastigauge® on each crank pin.
- (8) Select the suitable bearing from the table below according to the measurement values.



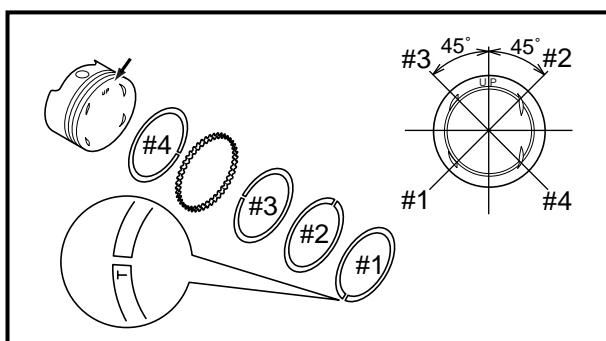

**Connecting rod bearing selection table
(20 °C (68 °F))**

Measurement value using a Plastigauge® (mm)	Upper bearing	Lower bearing
0.025 - 0.031	Yellow	Yellow
0.032 - 0.039	Yellow	Green*
0.040 - 0.046	Green	Green
0.047 - 0.052	Green	Blue*
0.053 - 0.058	Blue	Blue
0.059 - 0.063	Blue	Red*

CAUTION:

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

- (9) If the measurement value is more than the maximum value (0.071 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)

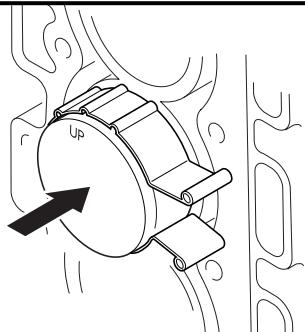
NOTE:

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

POWR

CRANKSHAFT AND PISTON/ CONNECTING ROD ASSEMBLY

E



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

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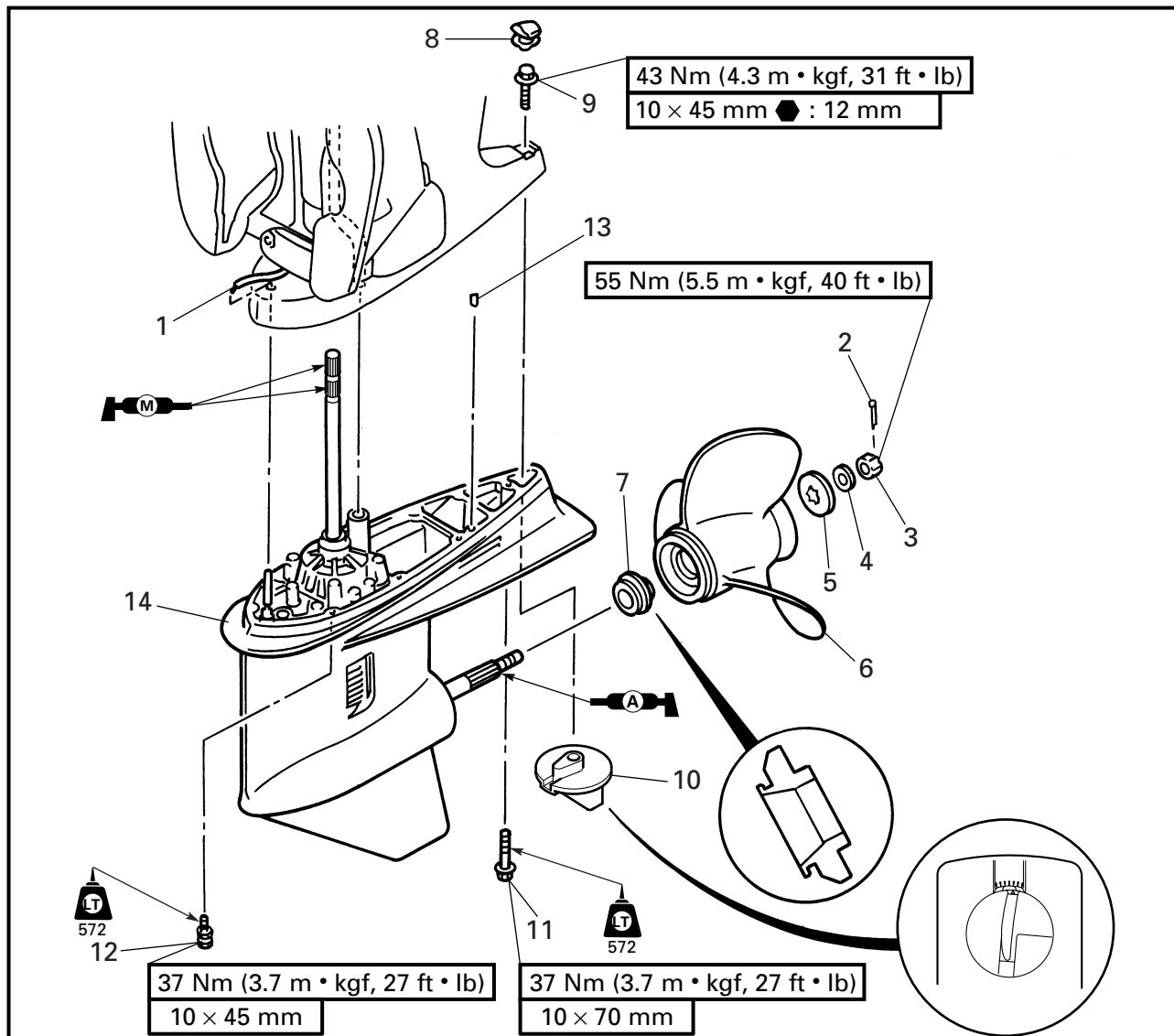
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LOWR**LOWER UNIT (REGULAR ROTATION MODELS)**

E

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


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

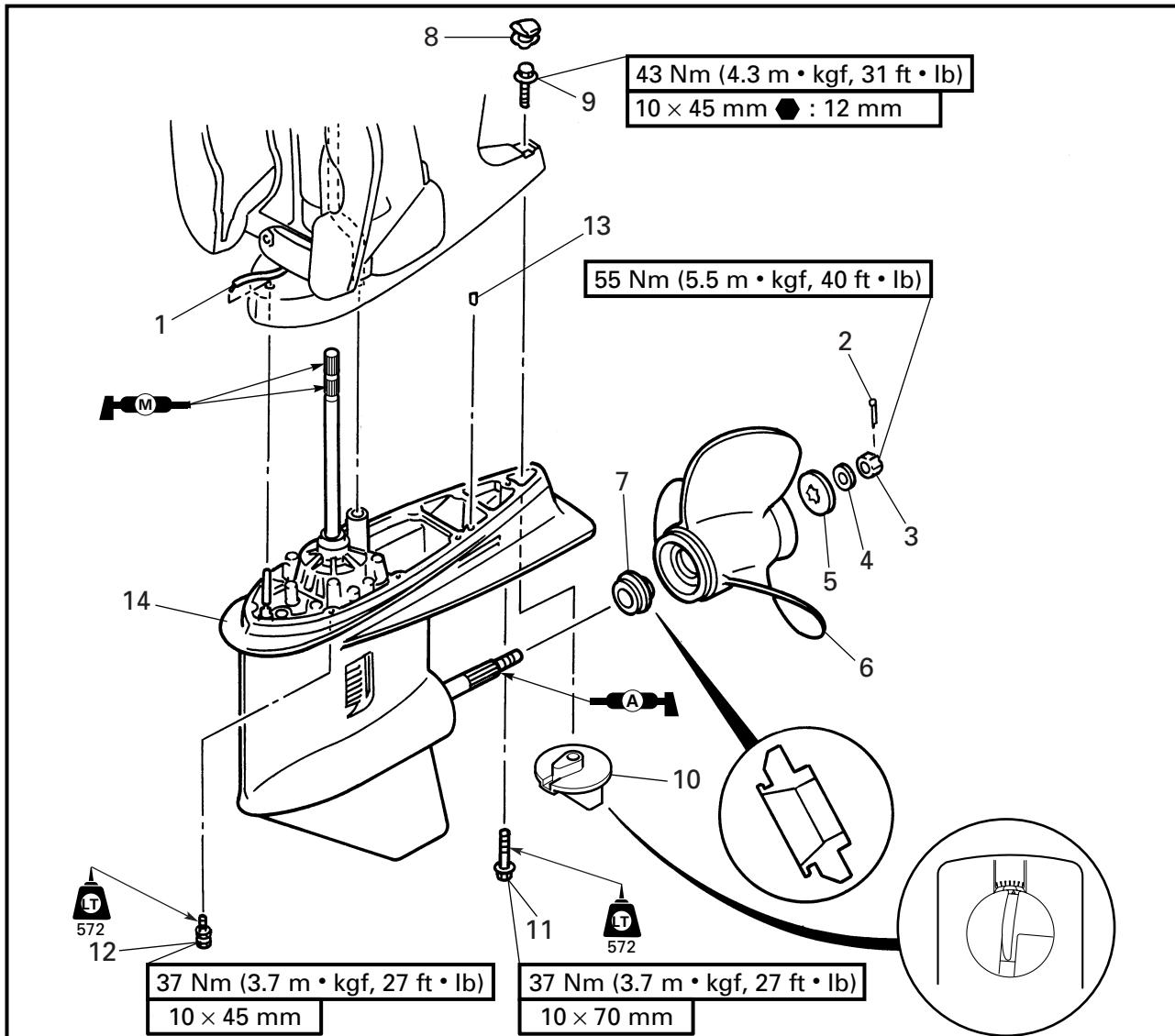
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LOWER UNIT (REGULAR ROTATION MODELS)

E

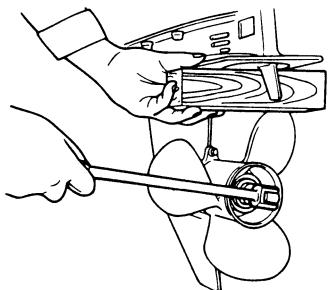


Order	Job/Part	Q'ty	Remarks
8	Grommet	1	
9	Bolt	1	
10	Trim tab	1	
11	Bolt	1	(with washer)
12	Bolt	6	(with washer)
13	Dowel pin	2	
14	Lower unit	1	For installation, reverse the removal procedure.

LOWR

LOWER UNIT (REGULAR ROTATION MODELS)

E



REMOVING THE PROPELLER

Remove:

- Propeller

⚠ WARNING

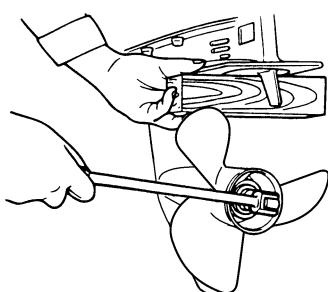
Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the lanyard engine stop switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

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 lanyard engine stop switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

NOTE:

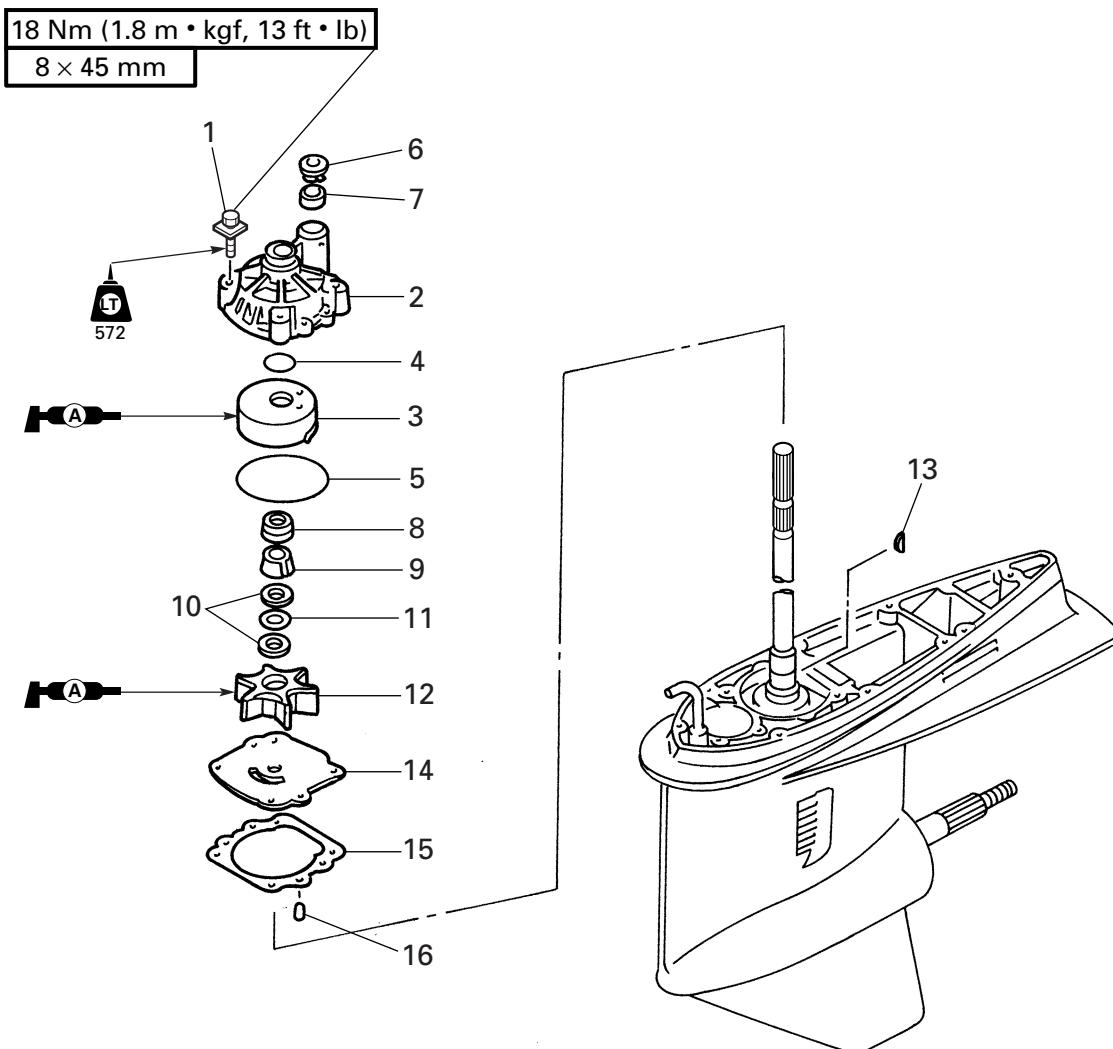
If the groove in the propeller nut is not aligned with the cotter pin hole, tighten the nut further until they are aligned.

LOWR



WATER PUMP (REGULAR ROTATION MODELS)

E

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	

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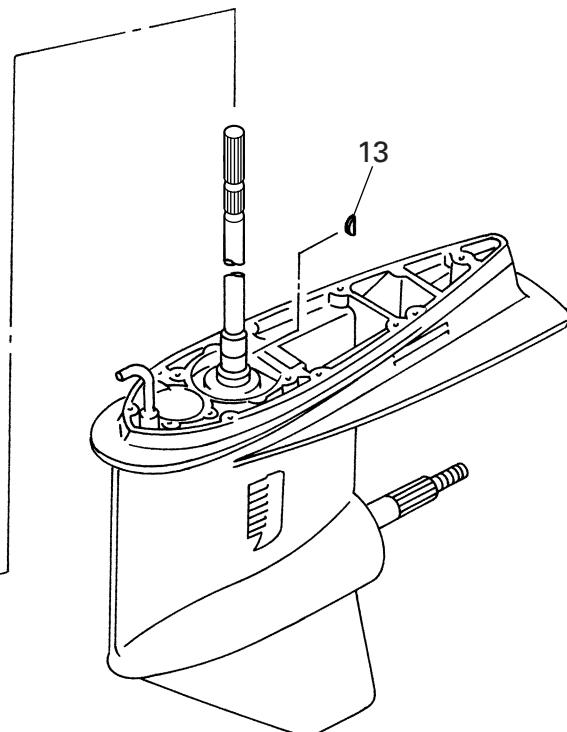
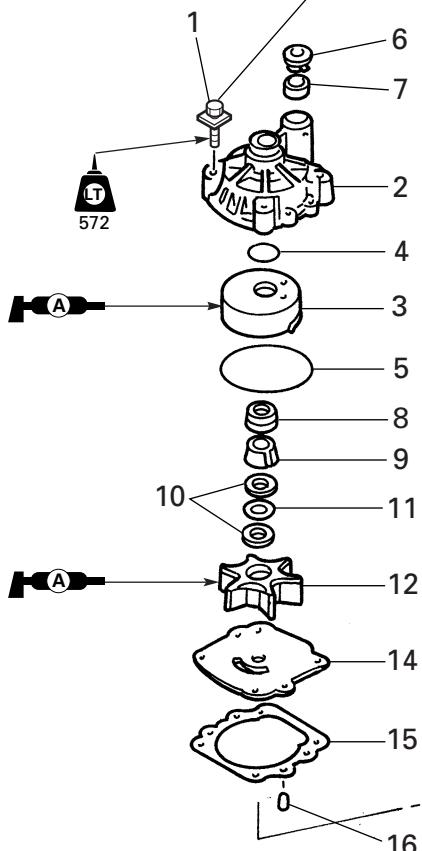


WATER PUMP (REGULAR ROTATION MODELS)

E

18 Nm (1.8 m · kgf, 13 ft · lb)

8 × 45 mm



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

LOWR

WATER PUMP (REGULAR ROTATION MODELS)

E

CHECKING THE IMPELLER HOUSING

Check:

- Impeller housing
- Cracks/damage → Replace.

CHECKING THE IMPELLER AND IMPELLER HOUSING CUP

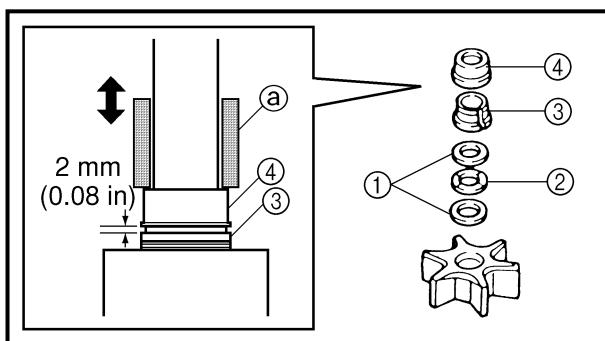
Check:

- 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: _____

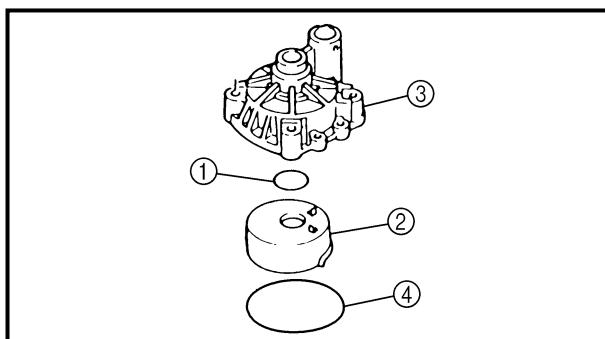
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with some appropriate tool ⑤ that fits over the drive shaft as shown.

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.



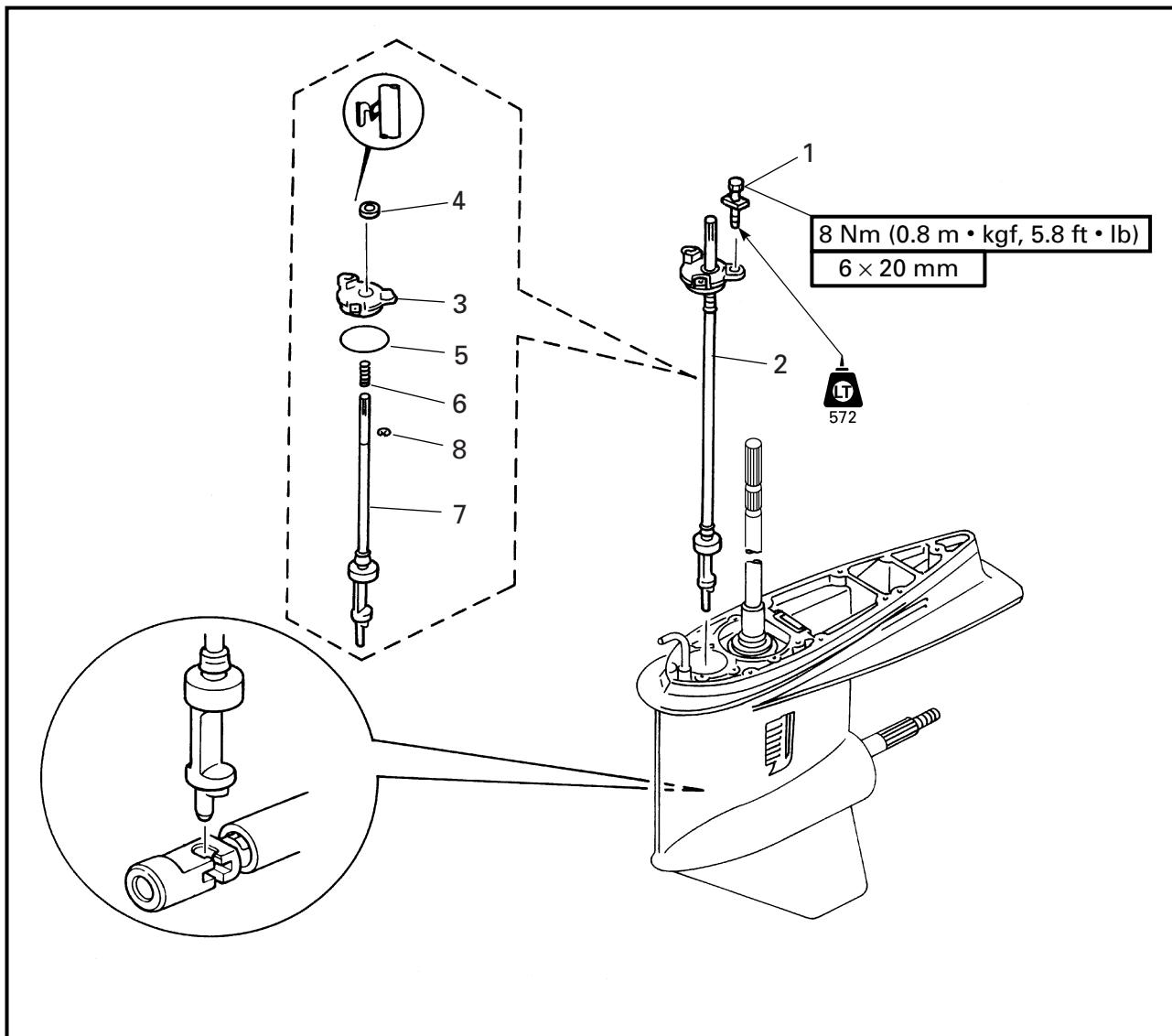
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SHIFT ROD ASSEMBLY (REGULAR ROTATION MODELS)

E

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.

LOWR



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.

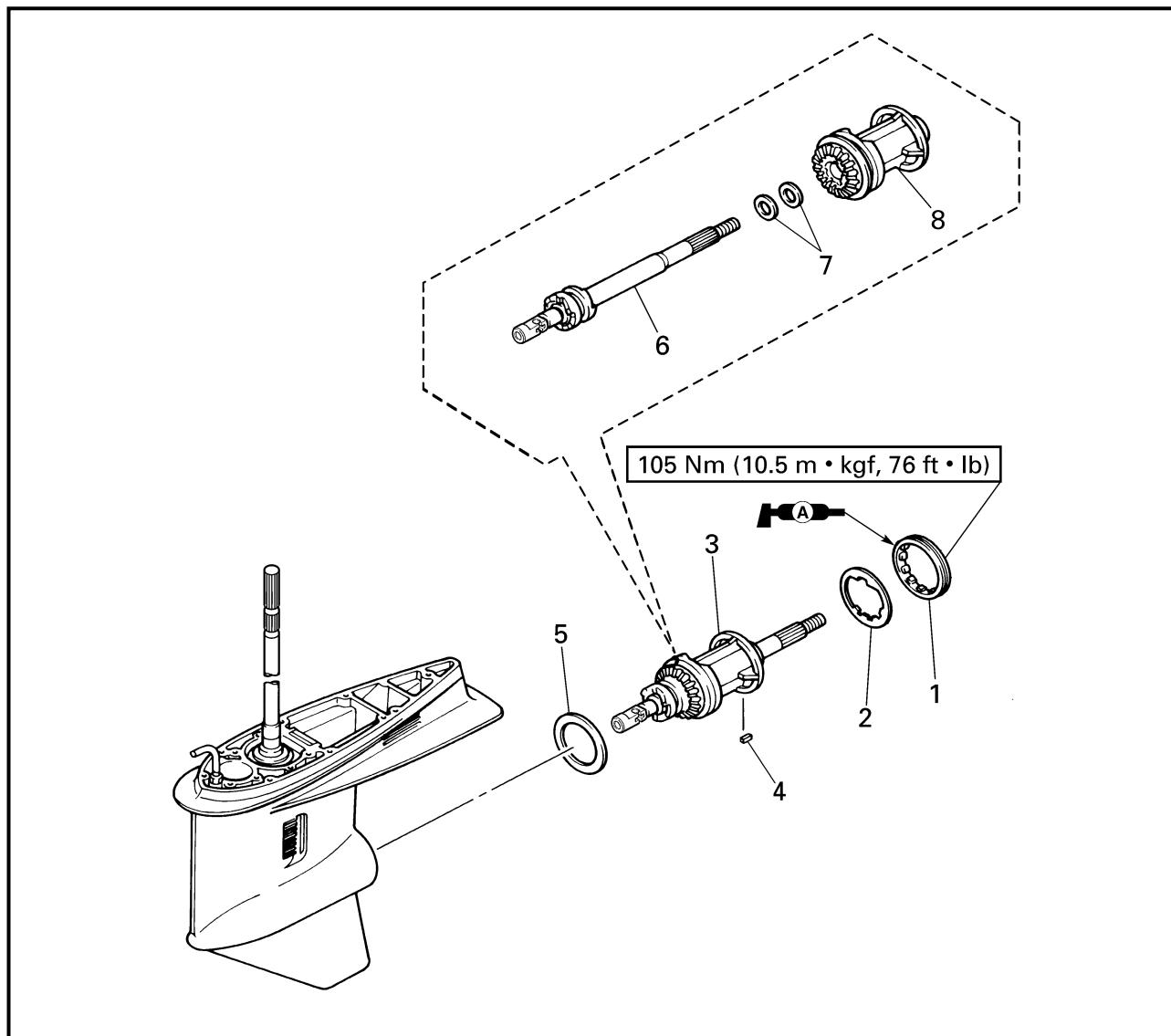
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PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E

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	

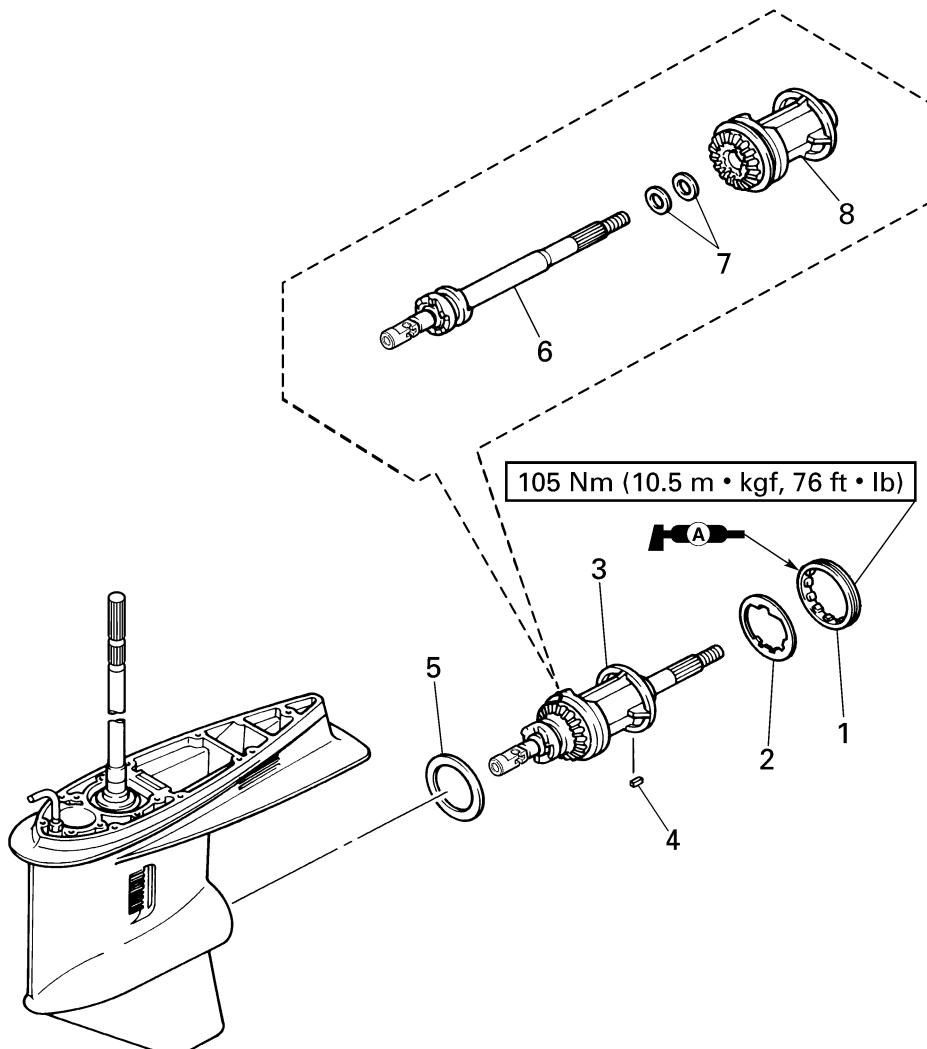
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LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E

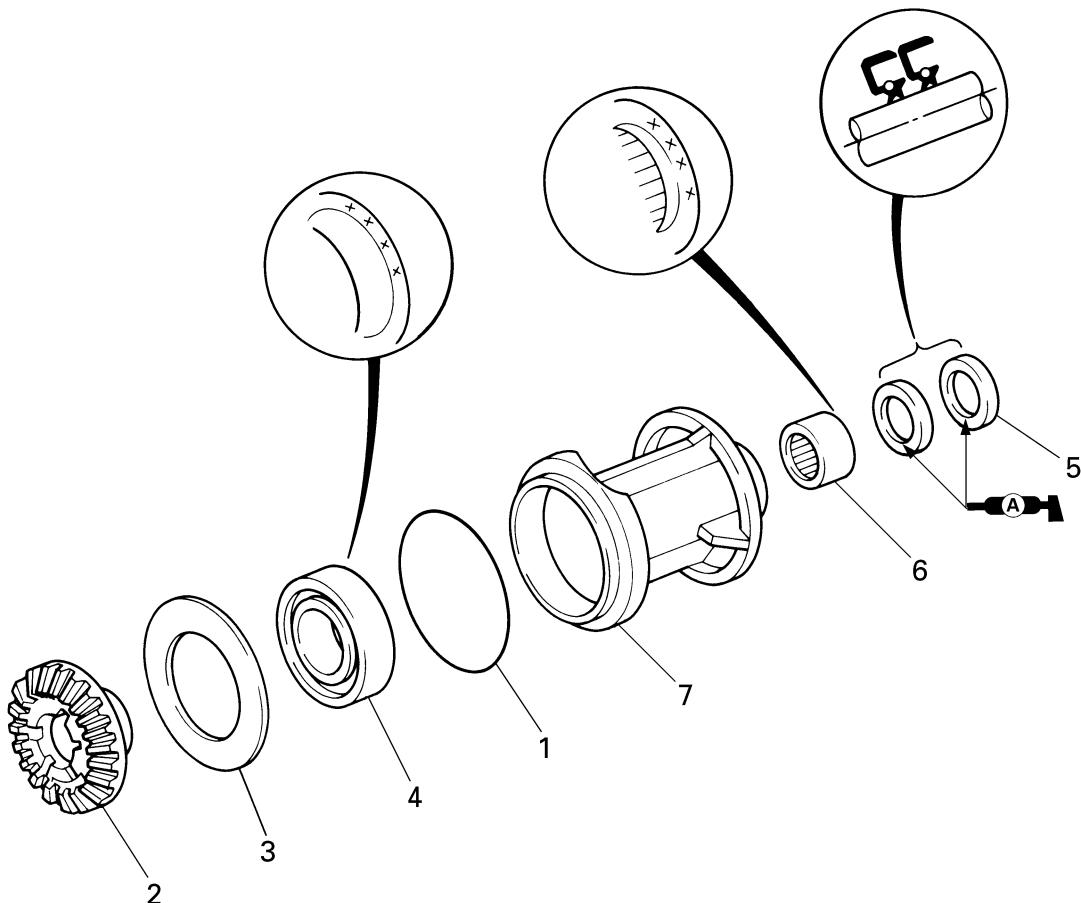


Order	Job/Part	Q'ty	Remarks
5	Reverse gear shim	*	
6	Propeller shaft assembly	1	
7	Washer	2	
8	Propeller shaft housing	1	For installation, reverse the removal procedure.

*: As required

LOWR**PROPELLER SHAFT HOUSING ASSEMBLY
(REGULAR ROTATION MODELS)**

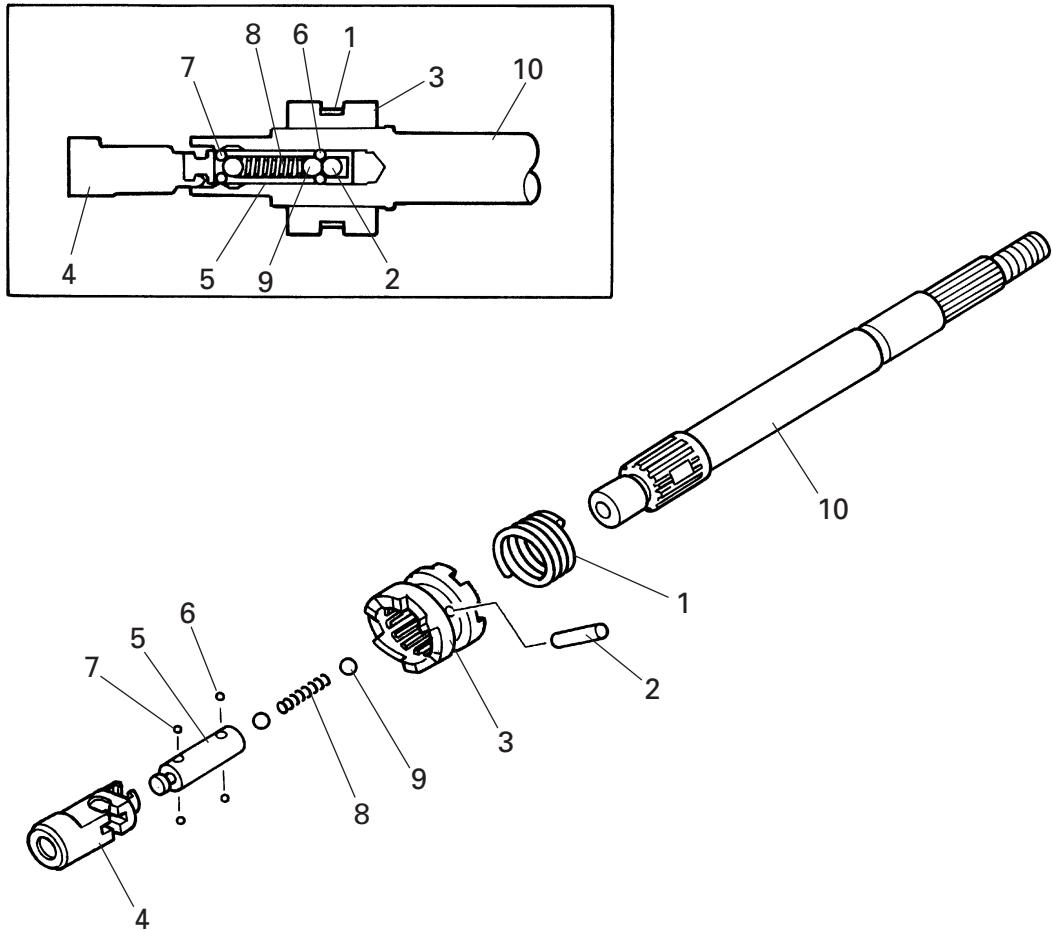
E

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING

Order	Job/Part	Q'ty	Remarks
1	O-ring	1	
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	For assembly, reverse the disassembly procedure.

LOWR**PROPELLER SHAFT HOUSING ASSEMBLY
(REGULAR ROTATION MODELS)**

E

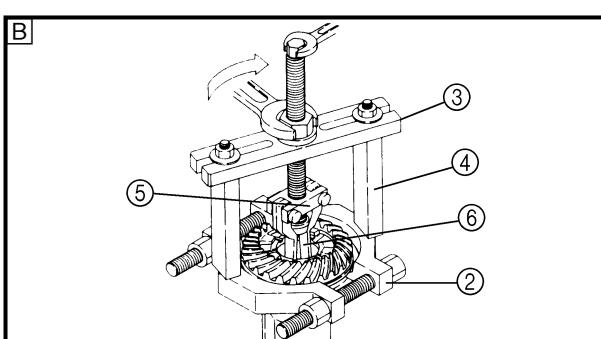
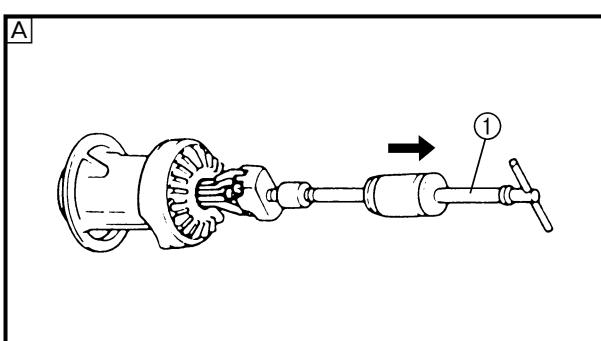
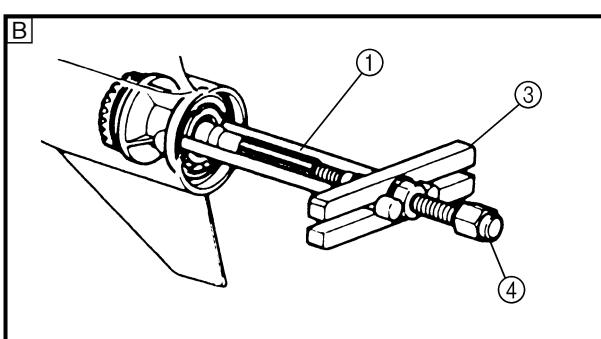
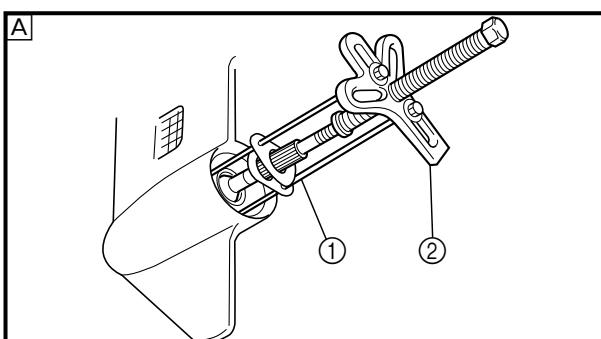
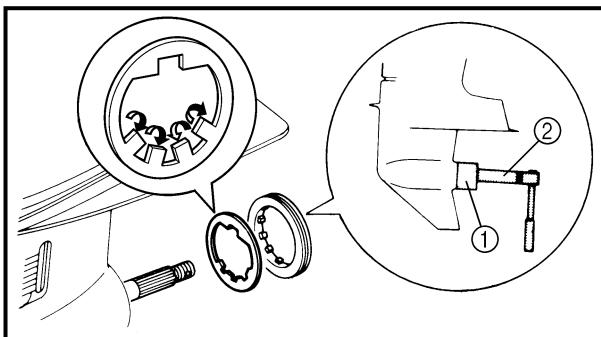
DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT ASSEMBLY

Order	Job/Part	Q'ty	Remarks
1	Spring	1	
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	For assembly, reverse the disassembly procedure.

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E



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

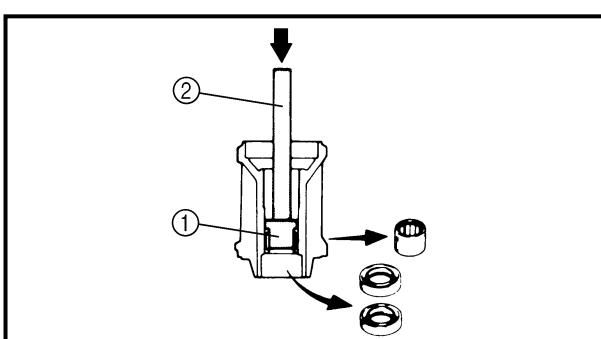
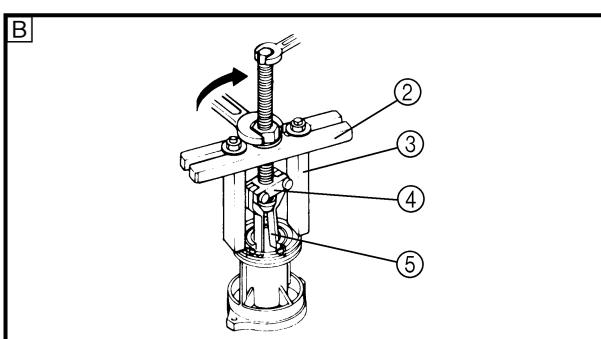
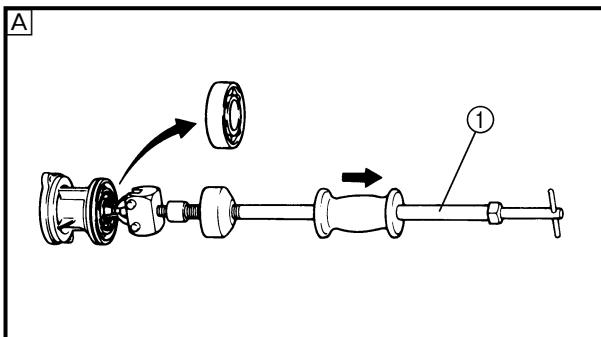
A For USA and Canada

B For worldwide

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E



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.

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E

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

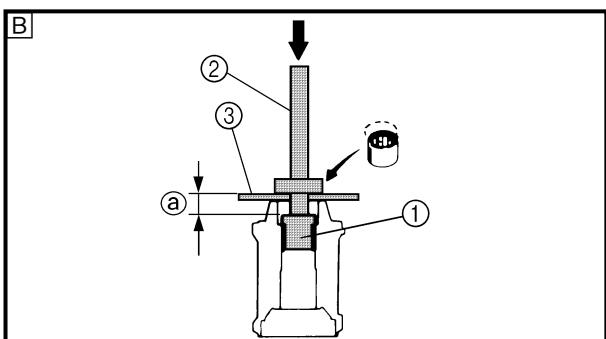
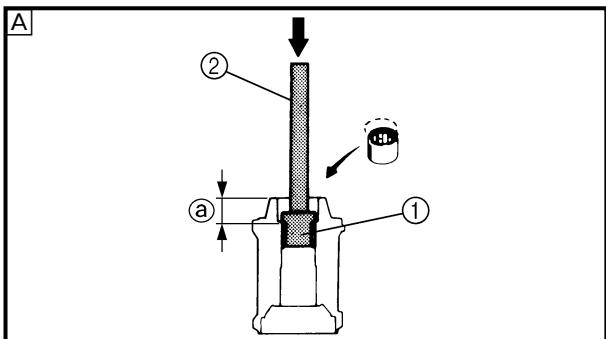
1. Install:

- Needle bearing



**Needle bearing installation
position ④**

**24.75 - 25.25 mm
(0.974 - 0.994 in)**



Bearing/oil seal attachment ①	YB-06196 / 90890-06653
Driver rod	YB-06071 / 90890-06604
Bearing/oil seal depth plate ③	90890-06603

A For USA and Canada

B For worldwide

2. Install:

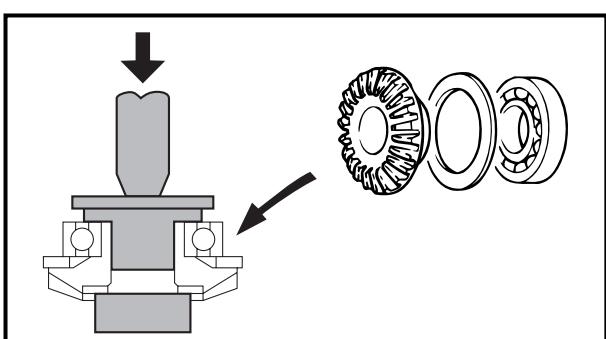
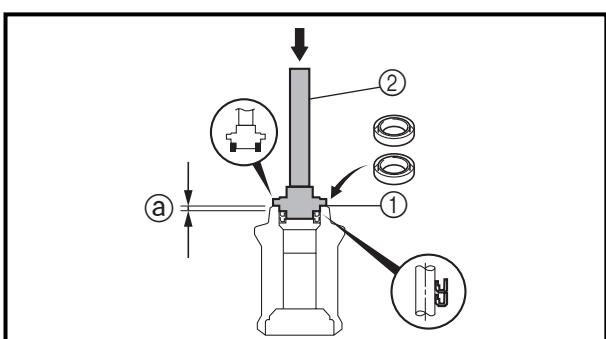
- Oil seal



Oil seal installation position ④
4.75 - 5.25 mm (0.187 - 0.207 in)



Bearing/oil seal attachment ①	YB-06195
Driver rod	YB-06071



ASSEMBLING THE REVERSE GEAR

Install:

- Ball bearing

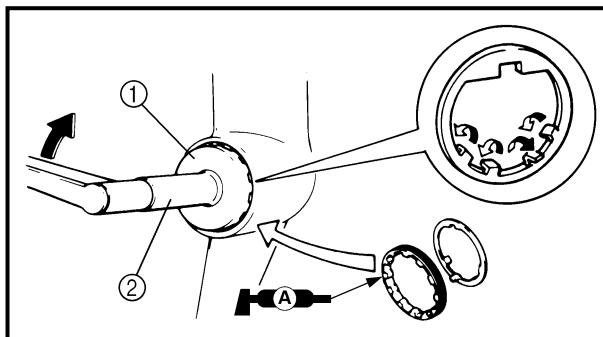


Bearing/oil seal attachment
YB-06200 / 90890-06661

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (REGULAR ROTATION MODELS)

E



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: _____

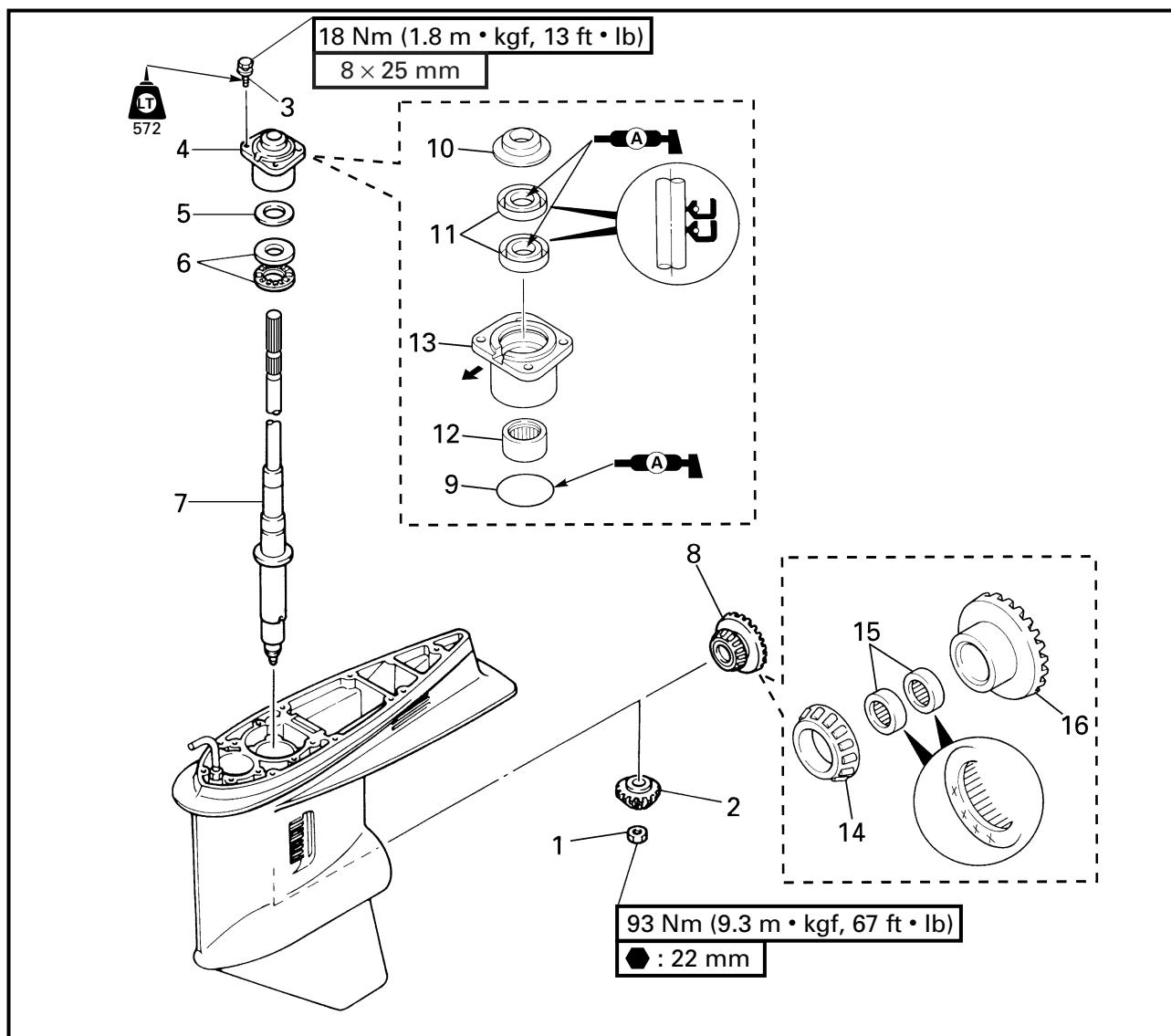
To secure the ring nut, bend one tab into the slot in the ring nut and the other tabs toward the propeller shaft housing assembly.

LOWR



DRIVE SHAFT (REGULAR ROTATION MODELS)

E

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.

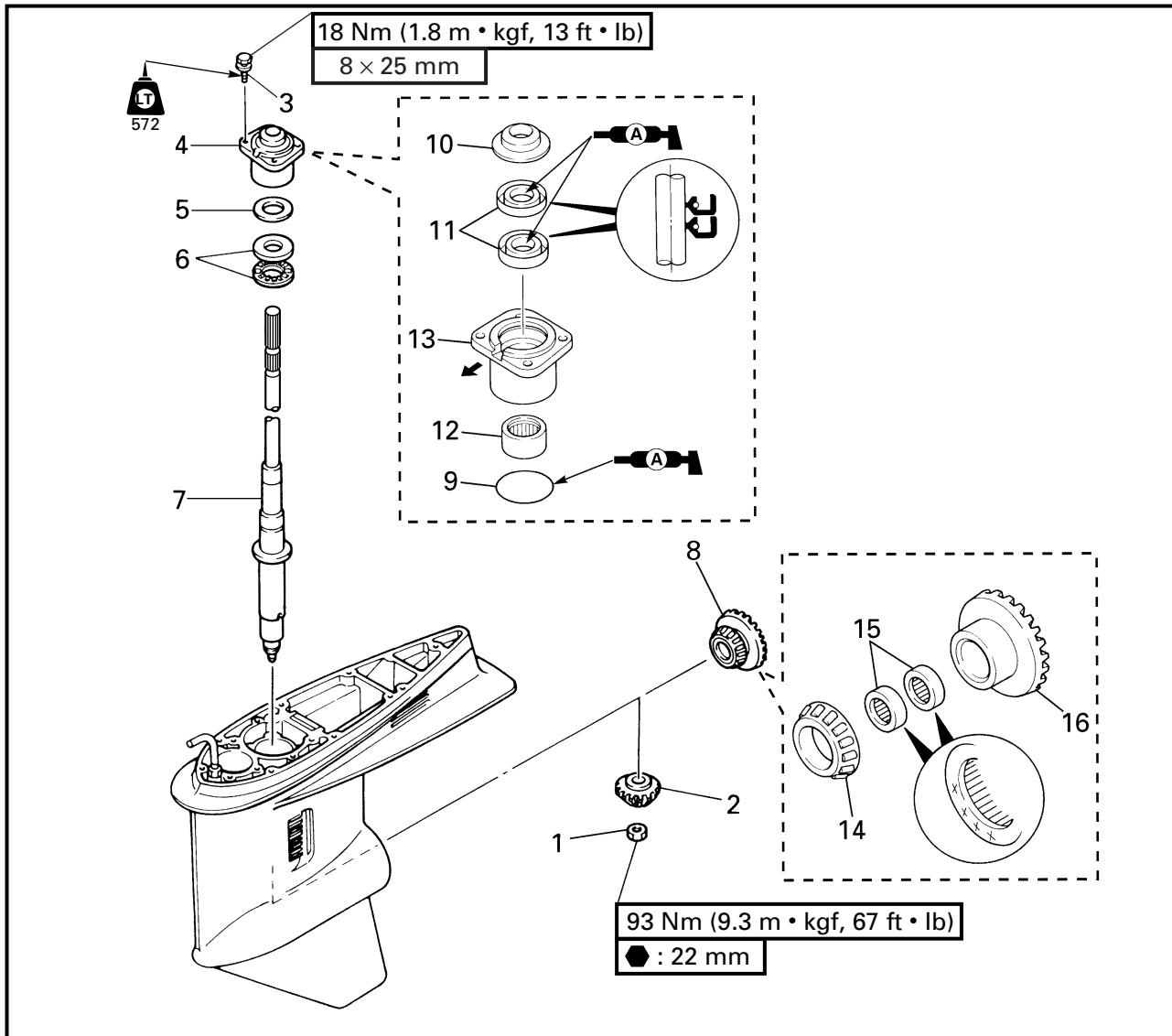
*: As required

LOWR



DRIVE SHAFT (REGULAR ROTATION MODELS)

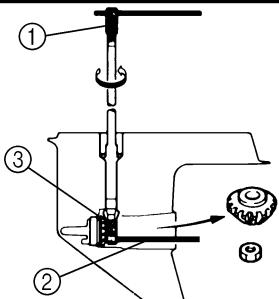
E



Order	Job/Part	Q'ty	Remarks
8	Forward gear assembly	1	
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	Not reusable
15	Needle bearing	1	Not reusable
16	Forward gear	1	For installation, reverse the removal procedure.

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

E

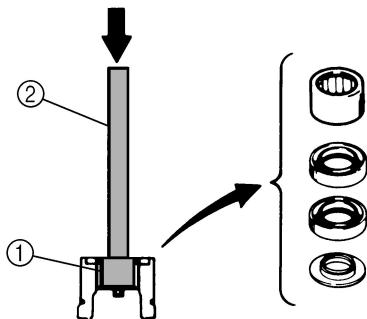
**REMOVING THE DRIVE SHAFT**

Loosen:

- Pinion nut



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

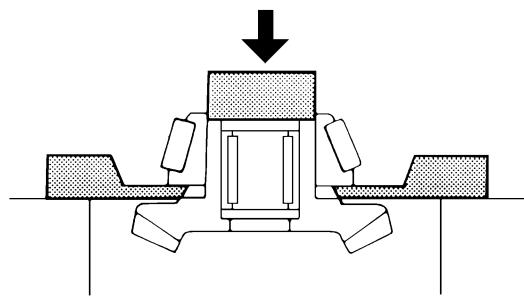
**DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY**

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:

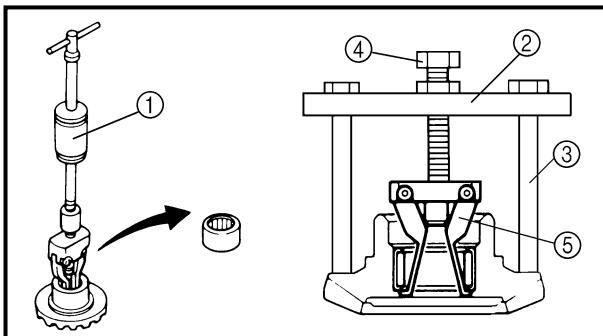
Do not reuse the bearing, always replace it with a new one.

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	



LOWR

DRIVE SHAFT (REGULAR ROTATION MODELS)

E

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

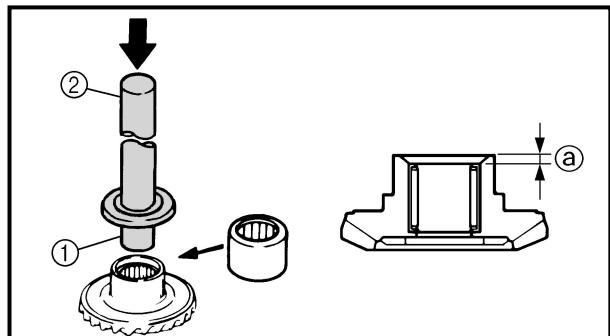
Cracks/damage → Replace.

CHECKING THE BEARINGS

Check:

- Bearings

Pitting/rumbling → Replace.



ASSEMBLING THE FORWARD GEAR ASSEMBLY

1. Install:

- Needle bearing



Needle bearing installation position ④
2.5 - 3.5 mm (0.098 - 0.138 in)

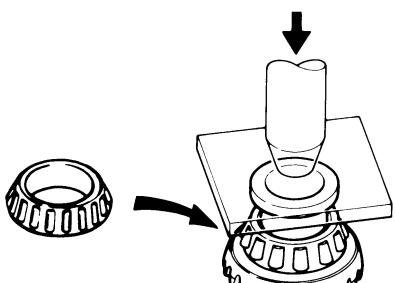


Bearing/oil seal attachment ①
YB-06200 / 90890-06612
Driver rod ②
YB-06071 / 90890-06604

LOWR

DRIVE SHAFT (REGULAR ROTATION MODELS)

E

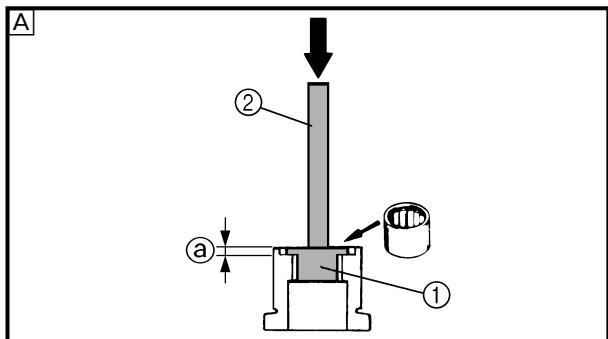


2. Install:

- Tapered roller bearing



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



ASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY

1. Install:

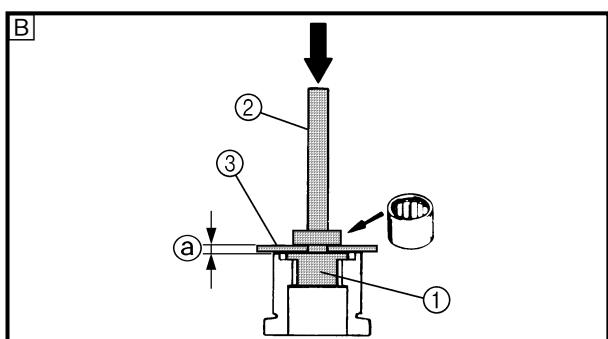
- Needle bearing



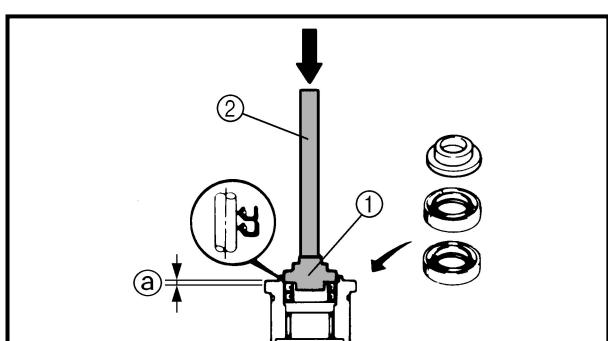
Position @
5.75 - 6.25 mm (0.226 - 0.246 in)



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



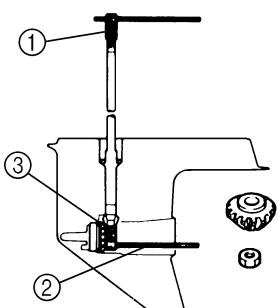
Oil seal installation position @
0.25 - 0.75 mm (0.010 - 0.030 in)



Bearing/oil seal attachment ①
YB-06195 / 90890-06633
Driver rod ②
YB-06071 / 90890-06652

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

E

**INSTALLING THE DRIVE SHAFT**

Tighten:

- Pinion nut

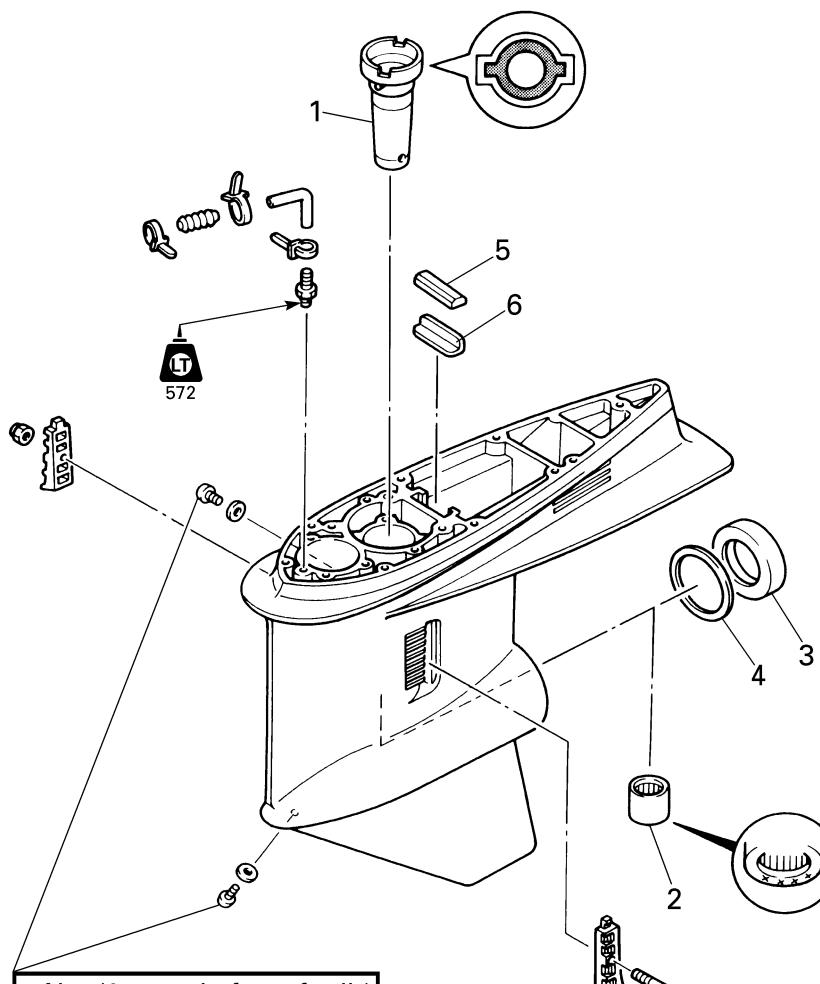
**Drive shaft holder** ①
YB-06151 / 90890-06519**Pinion nut holder** ②
90890-06505**Pinion nut holder attachment .** ③
90890-06507**Pinion nut**
93 Nm (9.3 m • kgf, 67 ft • lb)

LOWR

LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)

E

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



7 Nm (0.7 m · kgf, 5.1 ft · lb)

5 Nm (0.5 m · kgf, 3.7 ft · lb)

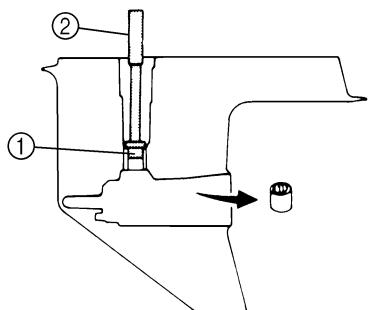
Order	Job/Part	Q'ty	Remarks
	Forward gear		Refer to "DRIVE SHAFT (REGULAR ROTATION MODELS)" on page 6-17.
1	Drive shaft sleeve	1	
2	Needle bearing	1	
3	Tapered roller bearing outer race	1	
4	Forward gear shim	*	
5	Water seal	1	
6	Plate	1	For assembly, reverse the disassembly procedure.

*: As required

LOWR

LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)

E



DISASSEMBLING THE LOWER CASE ASSEMBLY

1. Remove:

- Needle bearing

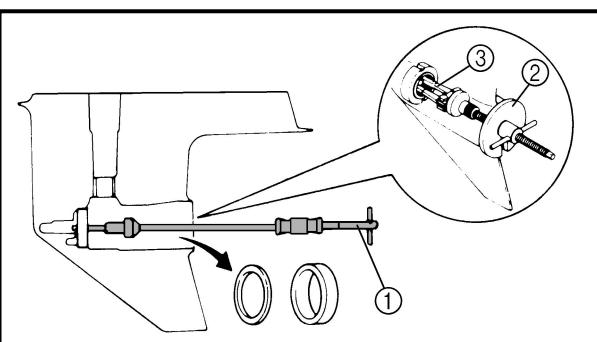


Bearing/oil seal attachment.... ①

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

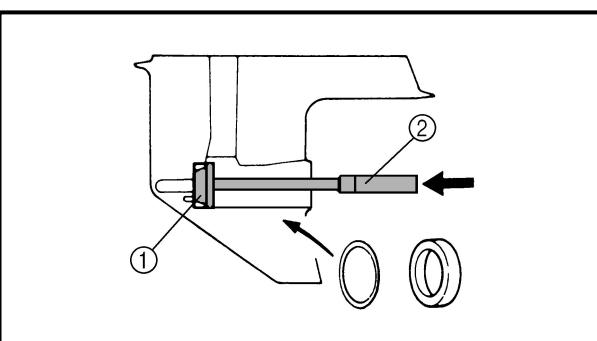
Damage/wear → Replace.

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

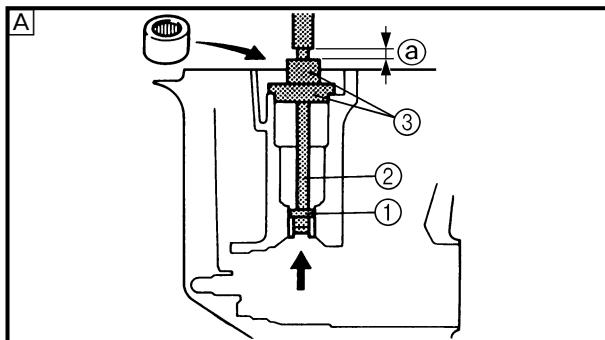
Driver rod ②

YB-06071 / 90890-06605

LOWR

LOWER CASE ASSEMBLY (REGULAR ROTATION MODELS)

E



2. Install:

- Needle bearing

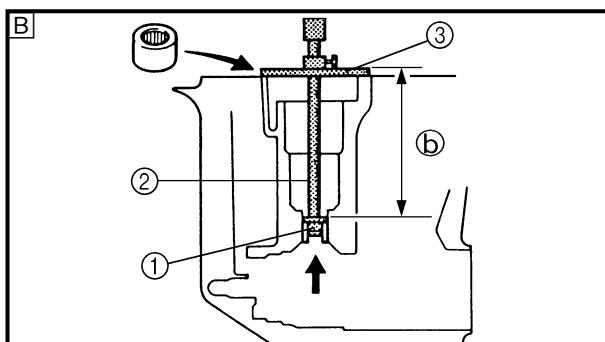


Needle bearing installation position ④

10.0 mm (0.39 in)

Needle bearing installation position ⑤

184.0 mm (7.24 in)



Bearing/oil seal attachment ①

YB-06194 / 90890-06636

Driver rod

YB-06071 / 90890-06602

Bearing/oil seal depth plate ③

YB-06213 / 90890-06603

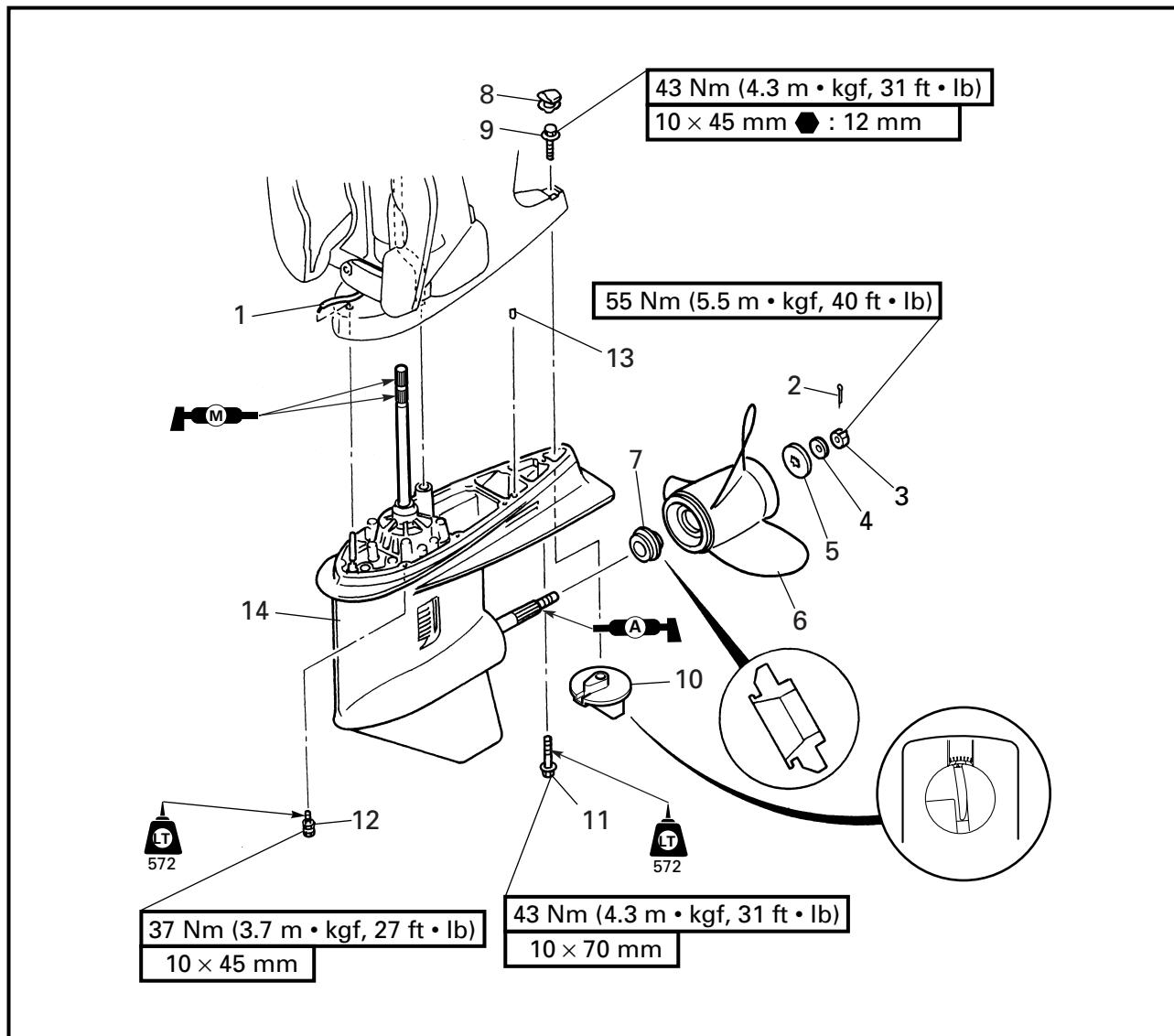
YB-34474

[A] For USA and Canada

[B] For worldwide

LOWR**LOWER UNIT (COUNTER ROTATION MODELS)**

E

LOWER UNIT (COUNTER 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	

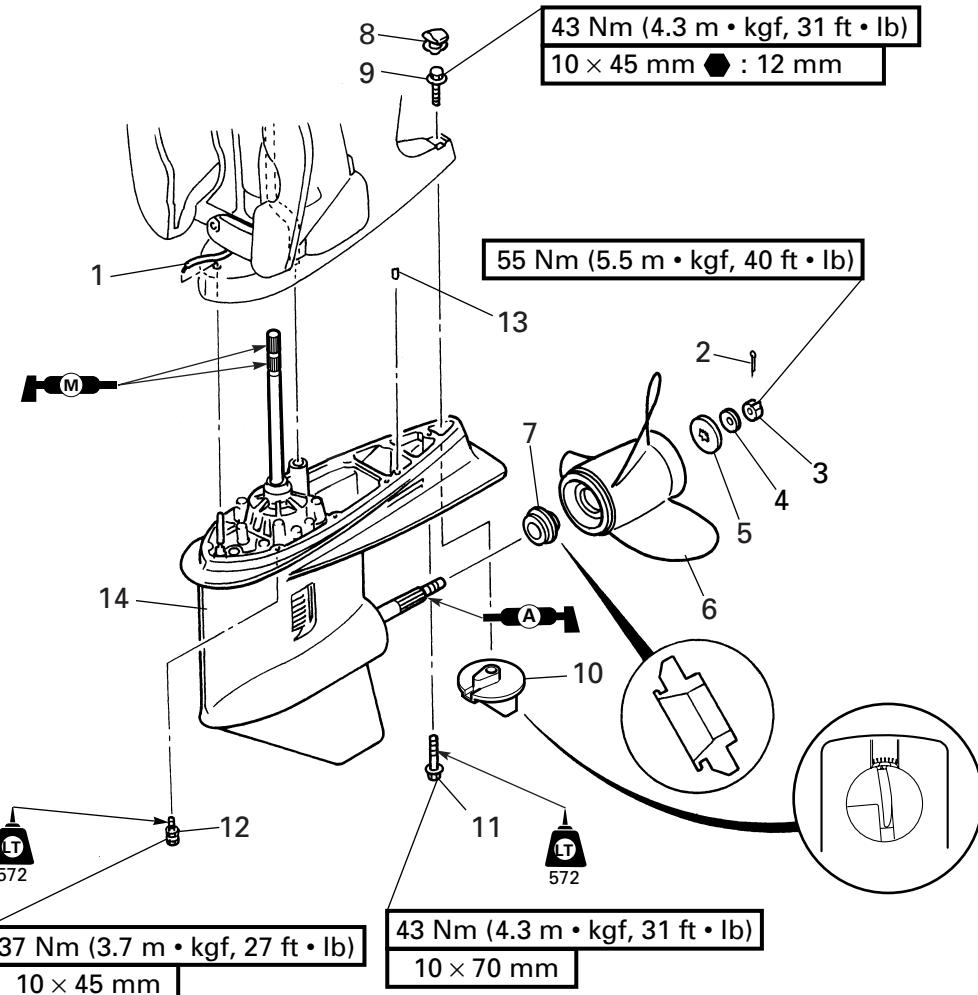
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LOWR



LOWER UNIT (COUNTER ROTATION MODELS)

E

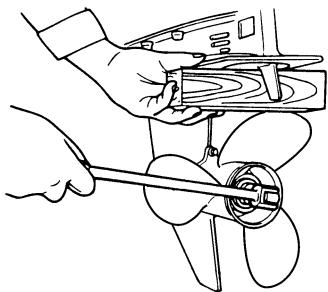


Order	Job/Part	Q'ty	Remarks
8	Grommet	1	
9	Bolt	1	
10	Trim tab	1	
11	Bolt	1	(with washer)
12	Bolt	6	(with washer)
13	Dowel pin	2	
14	Lower unit	1	For installation, reverse the removal procedure.

LOWR

LOWER UNIT (COUNTER ROTATION MODELS)

E



REMOVING THE PROPELLER

Remove:

- Propeller

⚠ WARNING

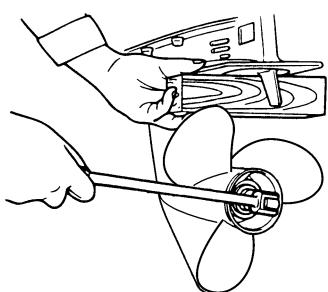
Do not hold the propeller with your hands when removing or installing it. Be sure to remove the battery leads from the batteries and the lanyard engine stop switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

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 lanyard engine stop switch. Put a block of wood between the cavitation plate and propeller to keep the propeller from turning.

NOTE:

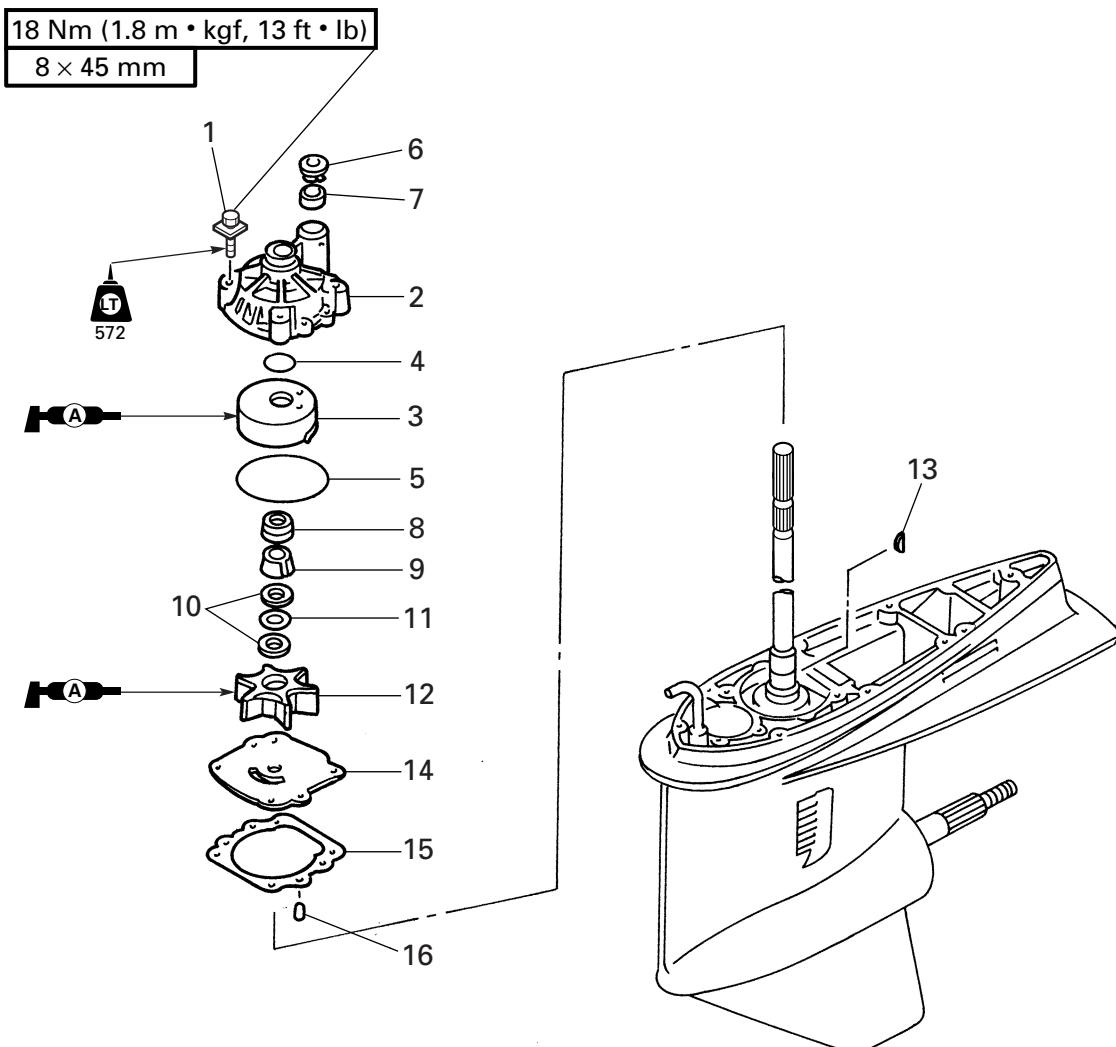
If the groove in the propeller nut is not aligned with the cotter pin hole, tighten the nut further until they are aligned.

LOWR



WATER PUMP (COUNTER ROTATION MODELS)

E

WATER PUMP (COUNTER ROTATION MODELS)
REMOVING/INSTALLING THE WATER PUMP


Order	Job/Part	Q'ty	Remarks
	Lower unit		Refer to "LOWER UNIT (COUNTER ROTATION MODELS)" on page 6-26.
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.

LOWR

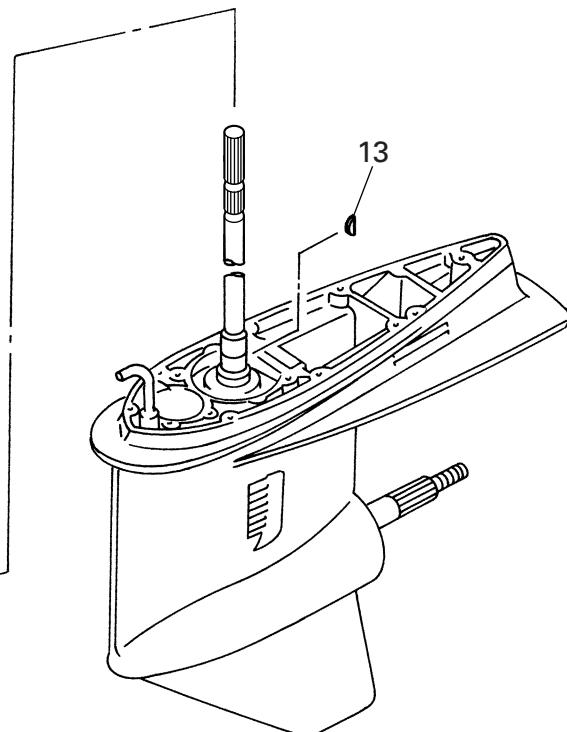
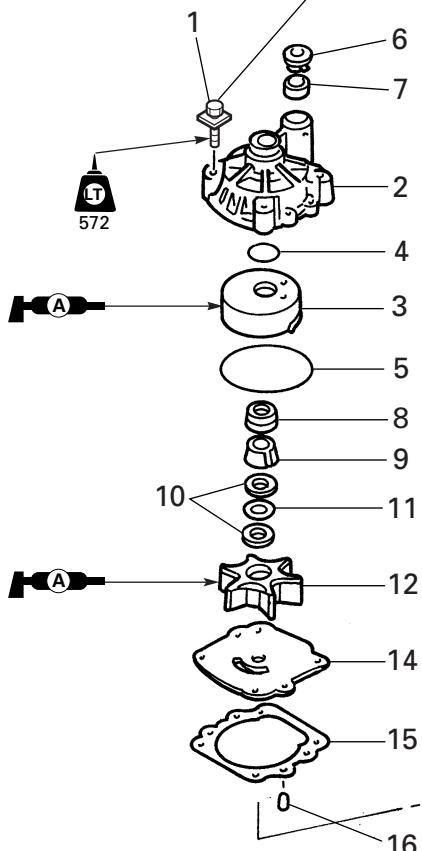


WATER PUMP (COUNTER ROTATION MODELS)

E

18 Nm (1.8 m · kgf, 13 ft · lb)

8 × 45 mm



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

LOWR

WATER PUMP (COUNTER ROTATION MODELS)

E

CHECKING THE IMPELLER HOUSING

Check:

- Impeller housing
- Cracks/damage → Replace.

CHECKING THE IMPELLER AND IMPELLER HOUSING CUP

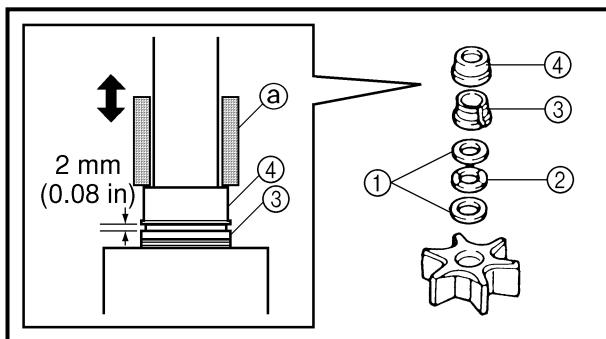
Check:

- 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: _____

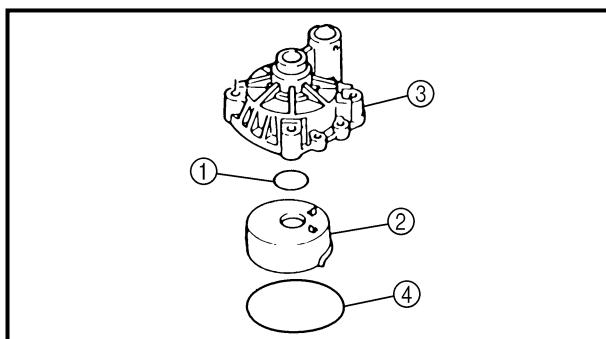
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with some appropriate tool ⑤ that fits over the drive shaft as shown.

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.



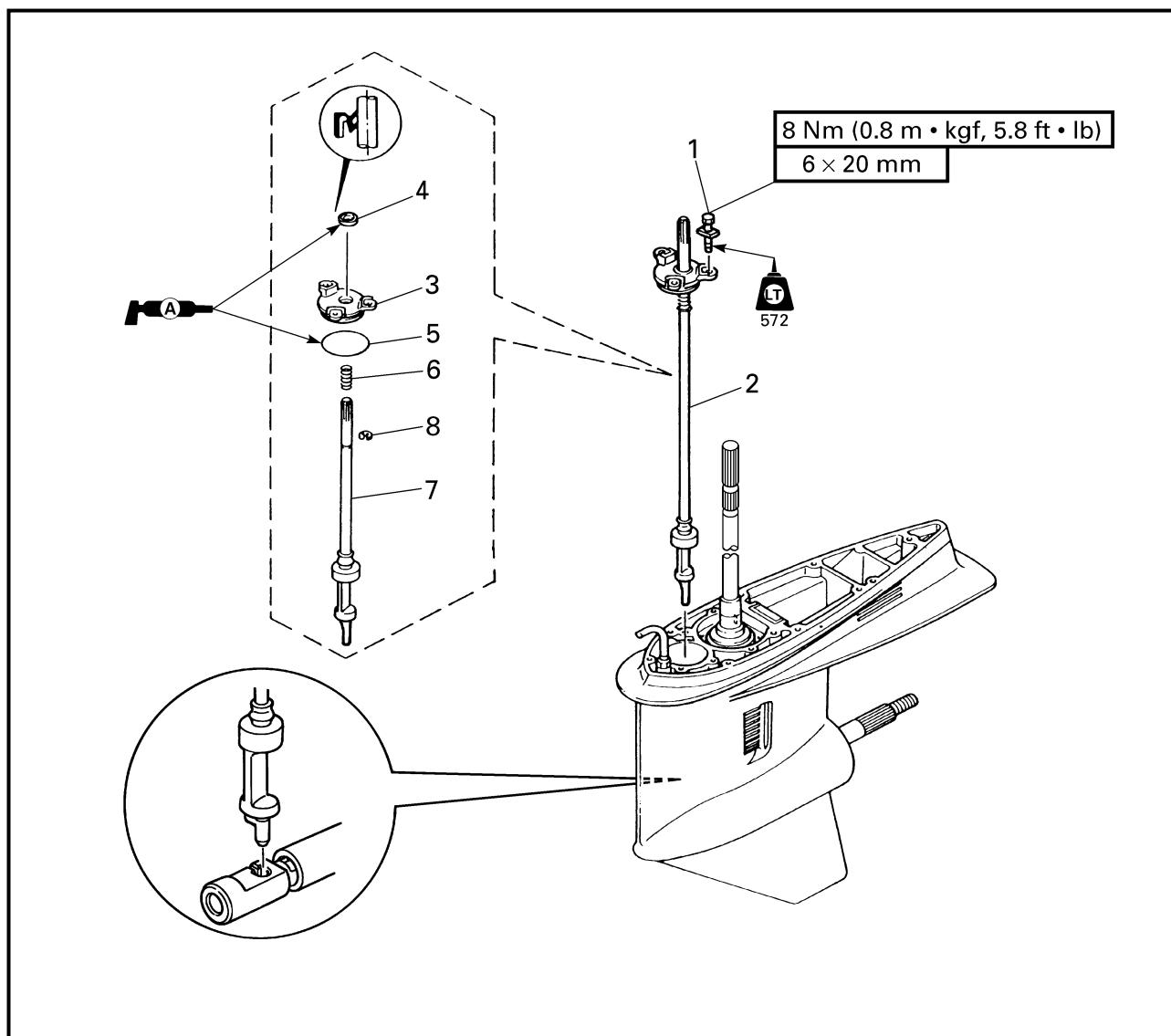
LOWR



SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)

E

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.

LOWR



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.

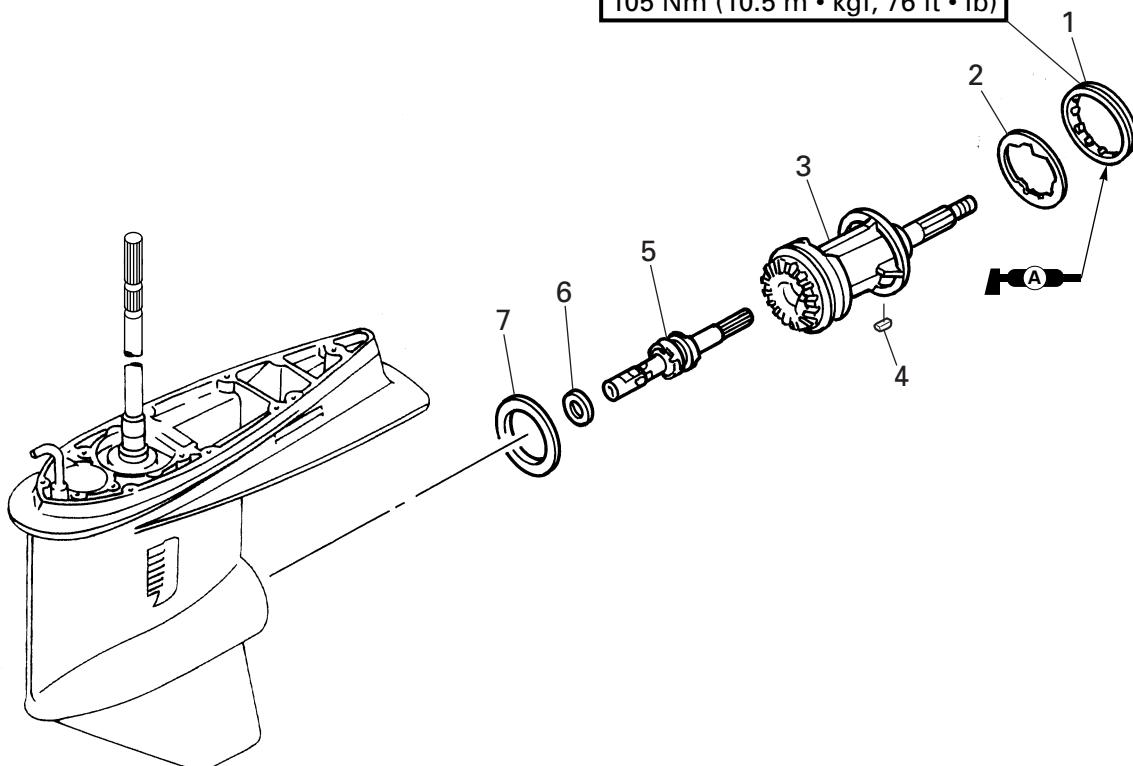
LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS) REMOVING/INSTALLING THE PROPELLER SHAFT HOUSING ASSEMBLY

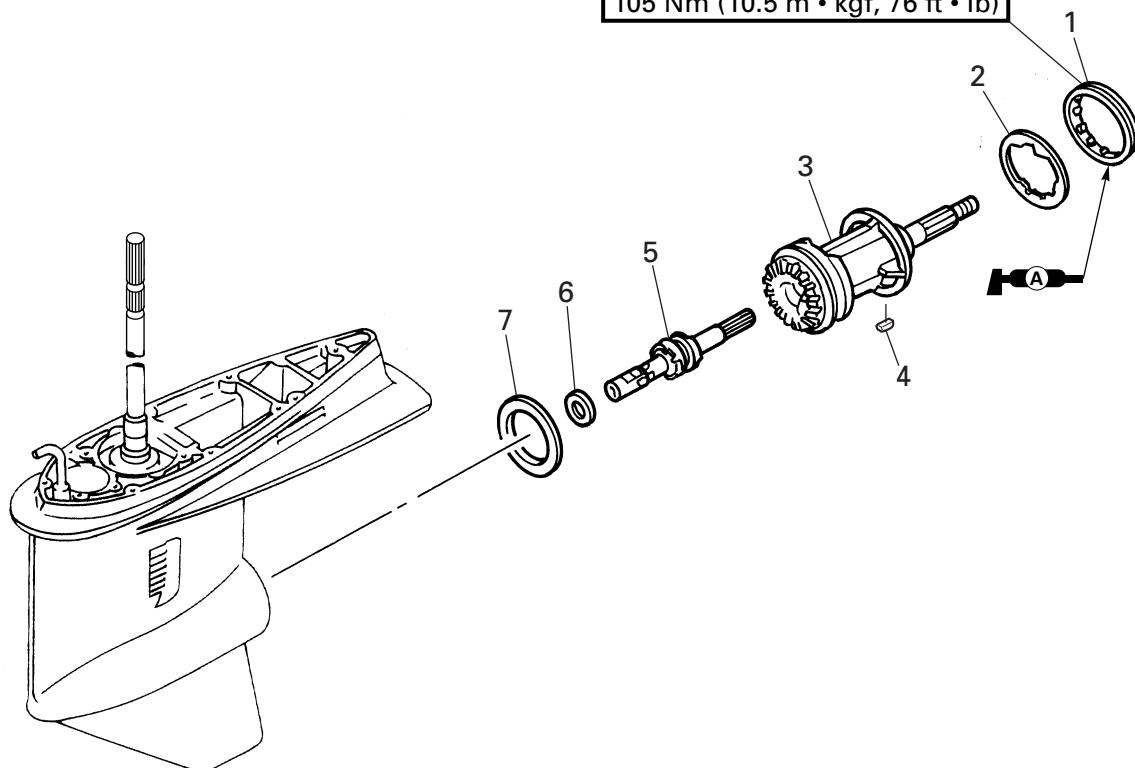


Order	Job/Part	Q'ty	Remarks
	Gear oil		Refer to "CHANGING AND CHECKING THE GEAR OIL" on page 3-18.
	Shift rod assembly		Refer to "SHIFT ROD ASSEMBLY (COUNTER ROTATION MODELS)" on page 6-32.
1	Ring nut	1	
2	Claw washer	1	
3	Propeller shaft housing assembly	1	

Continued on next page.

LOWR**PROPELLER SHAFT HOUSING ASSEMBLY
(COUNTER ROTATION MODELS)**

E



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

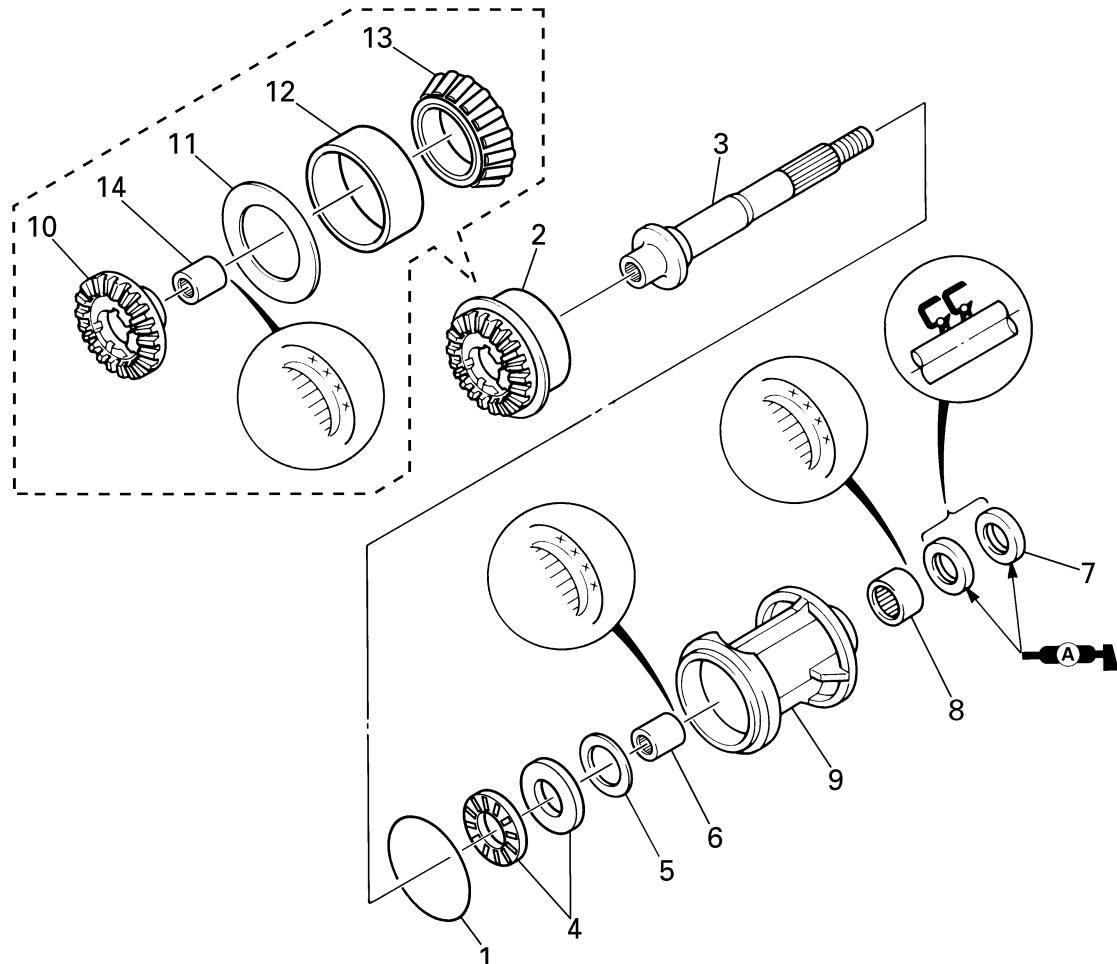
*: As required

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E

DISASSEMBLING/ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	O-ring	1	
2	Forward gear assembly	1	
3	Rear propeller shaft	1	
4	Thrust bearing	1	
5	Propeller shaft shim	*	
6	Needle bearing	1	
7	Oil seal	2	

Continued on next page.

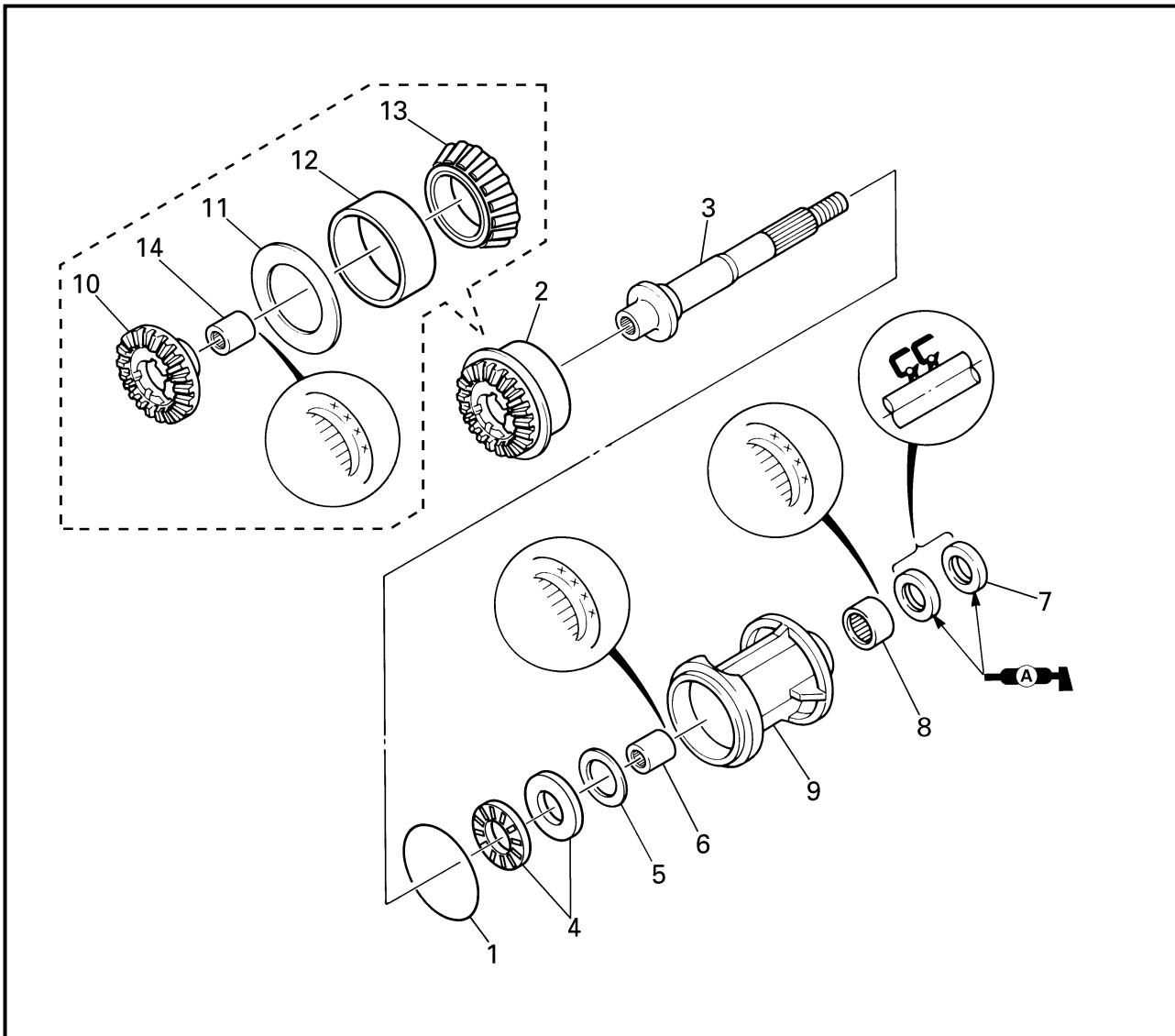
*: As required

LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



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

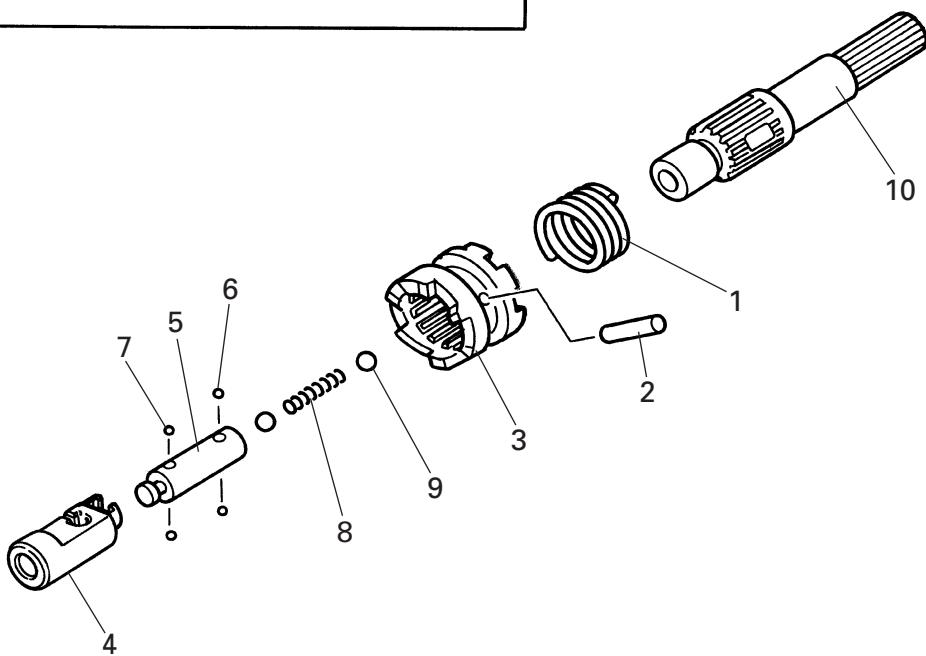
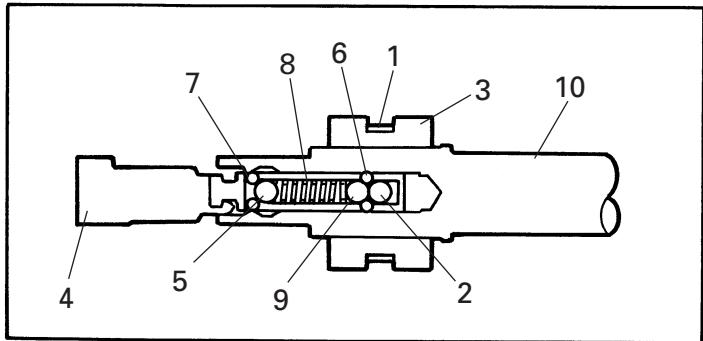
LOWR



PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E

DISASSEMBLING/ASSEMBLING THE FRONT PROPELLER SHAFT ASSEMBLY

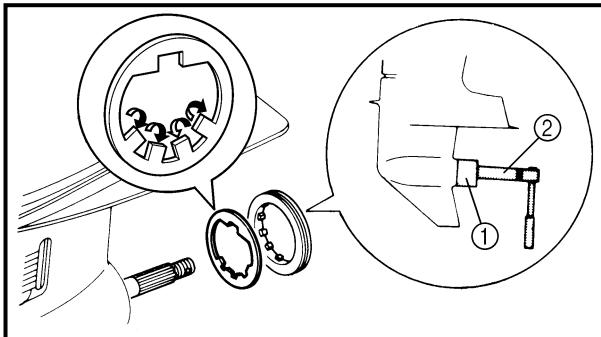


Order	Job/Part	Q'ty	Remarks
1	Spring	1	
2	Pin	1	
3	Dog clutch	1	
4	Shift rod joint	1	
5	Shift rod joint slider	1	
6	Ball	2	
7	Ball	2	
8	Spring	1	
9	Ball	2	
10	Front propeller shaft	1	For assembly, reverse the disassembly procedure.

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



REMOVING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. Straighten:

- Claw washer tabs

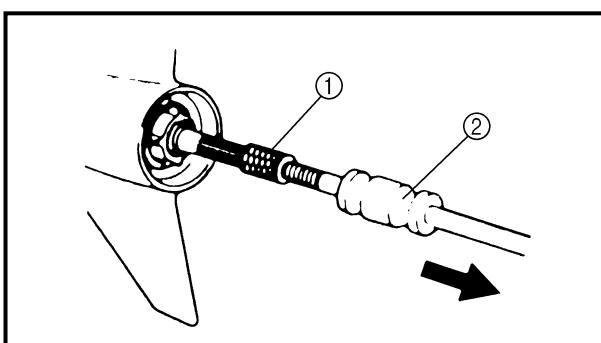
2. Remove:

- Ring nut
- Claw washer



Ring nut wrench ①
YB-34447 / 90890-06511

Ring nut wrench extension ②
90890-06513



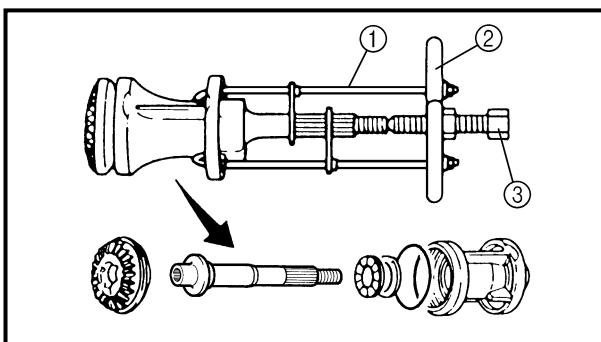
3. Remove:

- Propeller shaft housing assembly



Slide hammer attachment..... ①
YB-06335 / 90890-06514

Slide hammer..... ②
YB-06096 / 90890-06531



REMOVING THE FORWARD GEAR ASSEMBLY

Remove:

- Rear propeller shaft
- Forward gear assembly



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

Universal puller
YB-06117

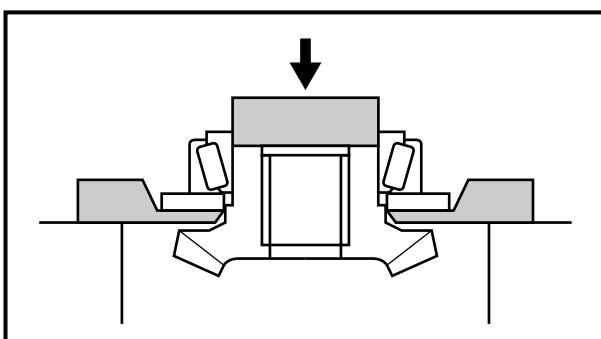
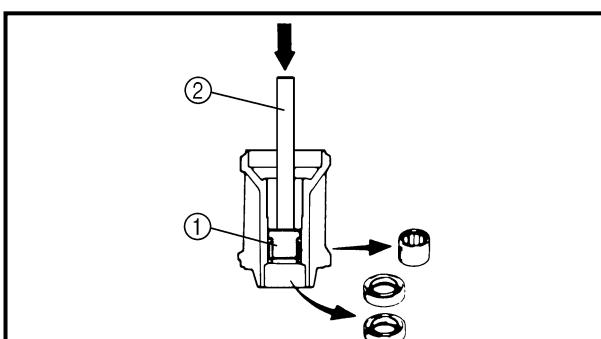
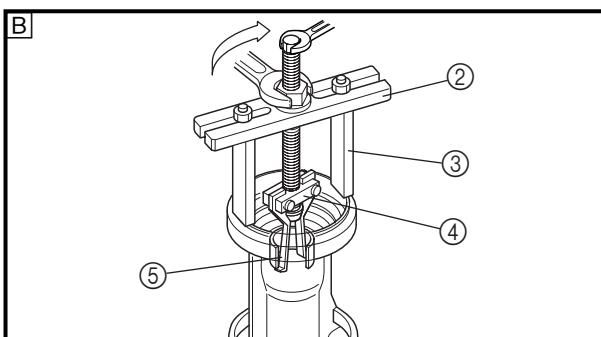
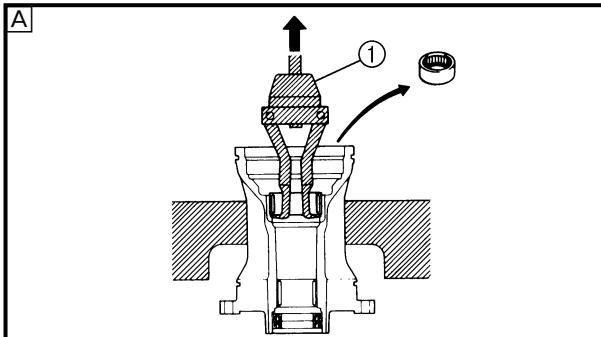
Guide plate..... ②
90890-06501

Center bolt ③
90890-06504

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



DISASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. 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	

A For USA and Canada

B For worldwide

2. Remove:

- Oil seal
- Needle bearing



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

DISASSEMBLING THE FORWARD GEAR ASSEMBLY

1. Remove:

- Tapered roller bearing



Bearing separator	①
YB-06219 / 90890-06534	

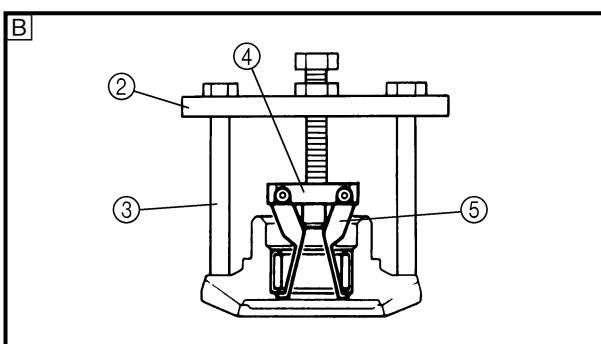
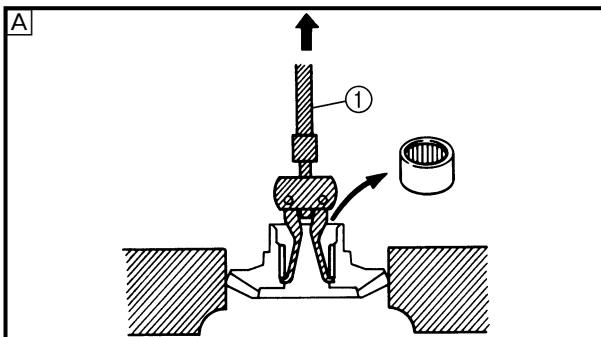
CAUTION:

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

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



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	

[A] For USA and Canada

[B] For worldwide

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 SHAFTS

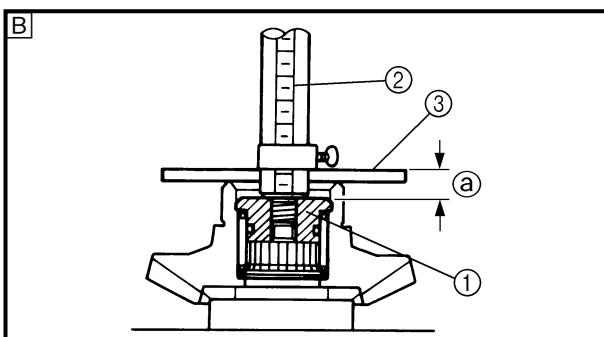
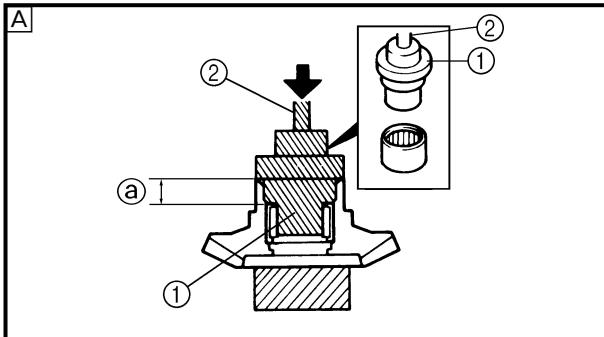
Check:

- Propeller shafts
- Damage/wear → Replace.

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

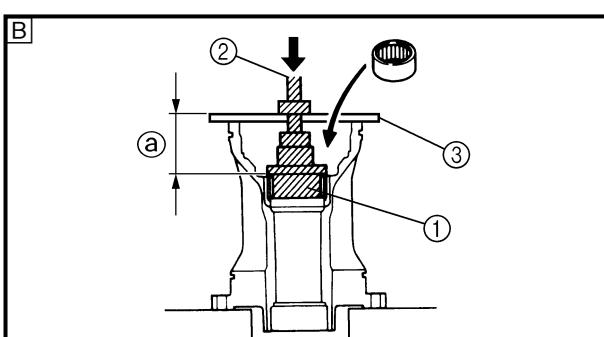
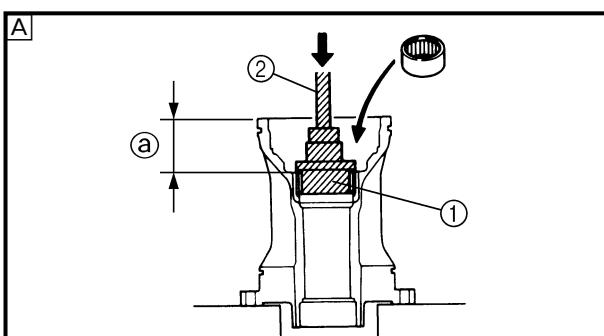
E



ASSEMBLING THE FORWARD GEAR

Install:

- Needle bearing

**Needle bearing installation****position ②****10.25 - 10.75 mm (0.40 - 0.42 in)****Bearing/oil seal attachment ①****YB-06378 / 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**

ASSEMBLING THE PROPELLER SHAFT HOUSING ASSEMBLY

1. Install:

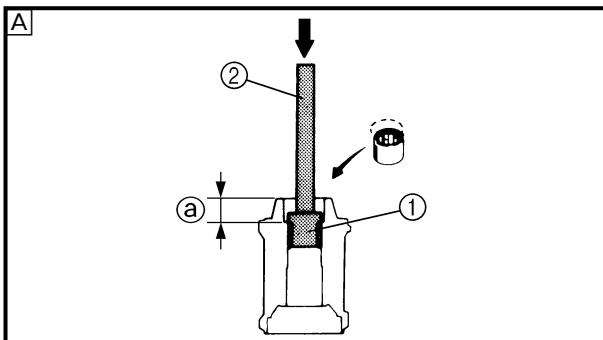
- Needle bearing

**Needle bearing installation****position ②****34.25 - 34.75 mm
(1.348 - 1.368 in)****Bearing/oil seal attachment ①****YB-06337 / 90890-06608****Driver rod ②****YB-06071 / 90890-06604****Bearing/oil seal depth plate ③****90890-06603****A For USA and Canada****B For worldwide**

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



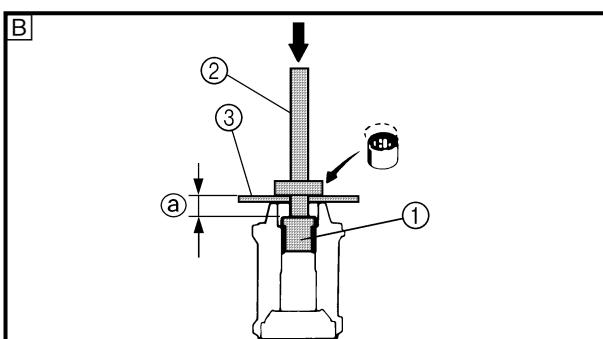
2. Install:

- Needle bearing



Needle bearing installation position @

**24.75 - 25.25 mm
(0.974 - 0.994 in)**



Bearing/oil seal attachment ①

YB-06196 / 90890-06610

Driver rod ②

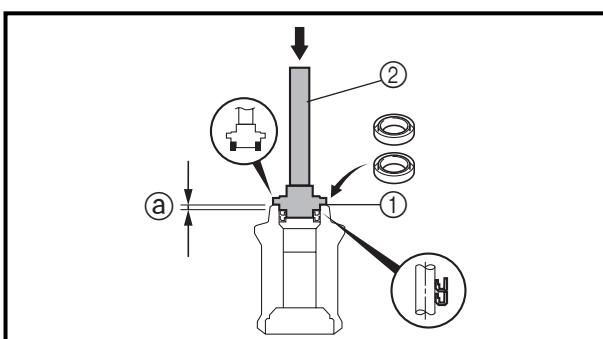
YB-06071 / 90890-06604

Bearing/oil seal depth plate ③

90890-06603

A For USA and Canada

B For worldwide



3. Install:

- Oil seal



Oil seal installation position @

4.75 - 5.25 mm (0.187 - 0.207 in)

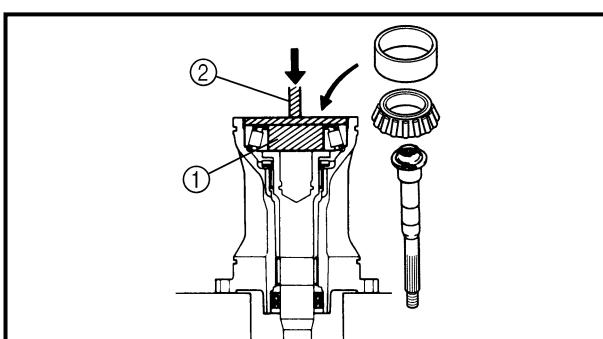


Bearing/oil seal attachment ①

YB-06195

Driver rod ②

YB-06071



INSTALLING THE FORWARD GEAR ASSEMBLY

1. Install:

- Rear propeller shaft
- Tapered roller bearing

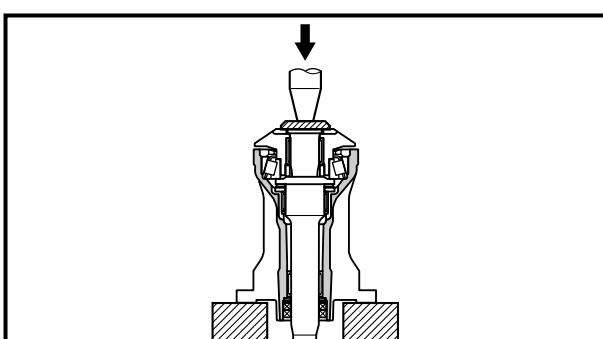


Bearing/oil seal attachment ①

YB-06430 / 90890-06656

Driver rod ②

YB-06071 / 90890-06606



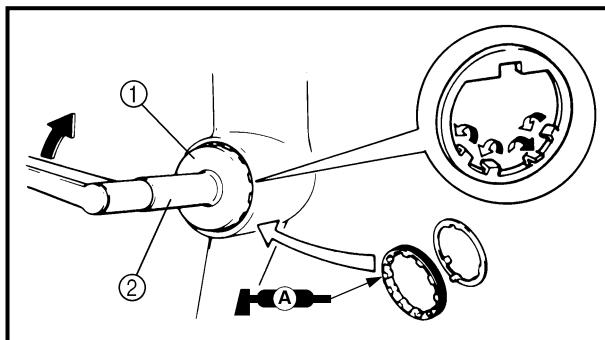
2. Install:

- Thrust washer
- Forward gear

LOWR

PROPELLER SHAFT HOUSING ASSEMBLY (COUNTER ROTATION MODELS)

E



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: _____

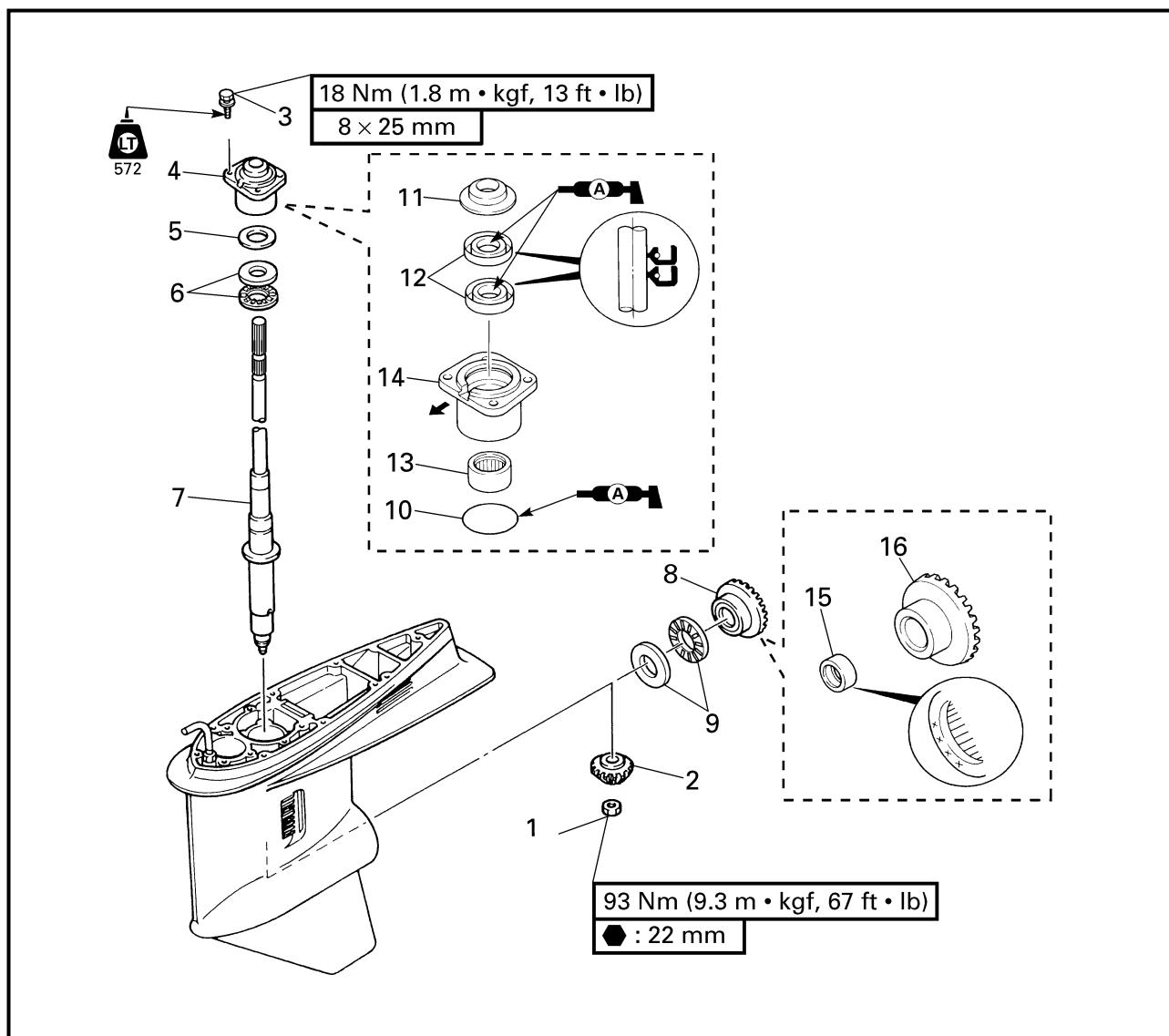
To secure the ring nut, bend one tab into the slot in the ring nut and the other tabs toward the propeller shaft housing assembly.

LOWR



DRIVE SHAFT (COUNTER ROTATION MODELS)

E

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.

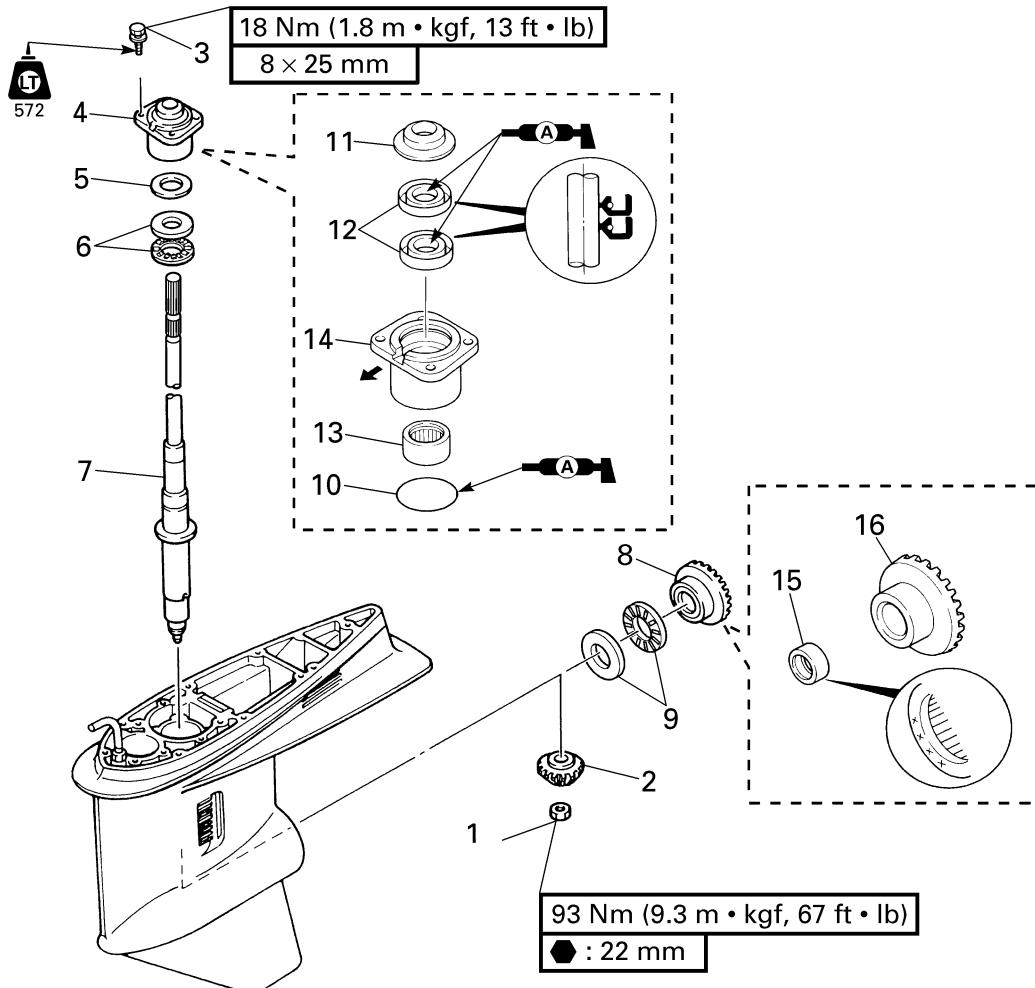
*: As required

LOWR



DRIVE SHAFT (COUNTER ROTATION MODELS)

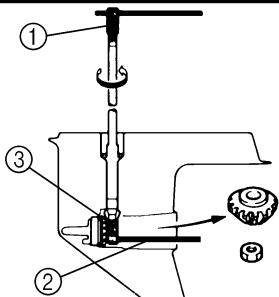
E



Order	Job/Part	Q'ty	Remarks
8	Reverse gear assembly	1	
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	For installation, reverse the removal procedure.

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

E

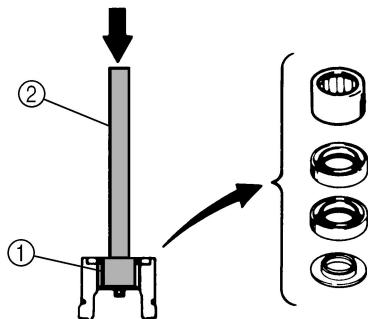
**REMOVING THE DRIVE SHAFT**

Loosen:

- Pinion nut



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

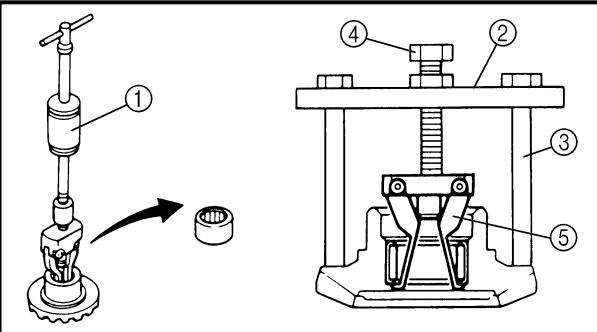
**DISASSEMBLING THE DRIVE SHAFT HOUSING ASSEMBLY**

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.

LOWR

DRIVE SHAFT (COUNTER ROTATION MODELS)

E

CHECKING THE DRIVE SHAFT HOUSING

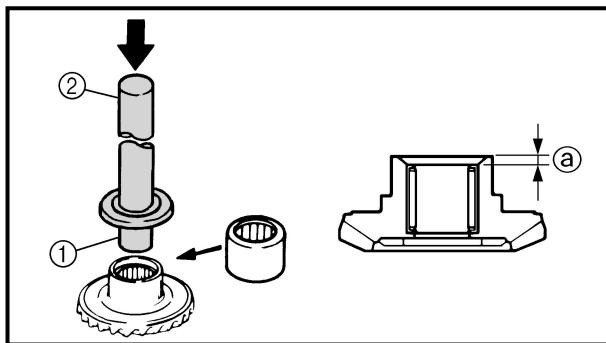
Check:

- Drive shaft housing
Cracks/damage → Replace.

CHECKING THE BEARINGS

Check:

- Bearings
Pitting/rumbling → Replace.



ASSEMBLING THE REVERSE GEAR ASSEMBLY

Install:

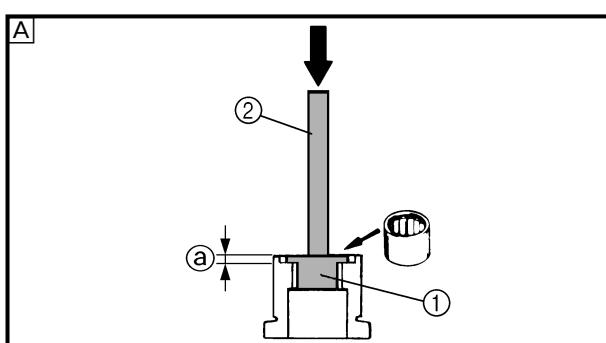
- Needle bearing



Needle bearing installation position ④
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:

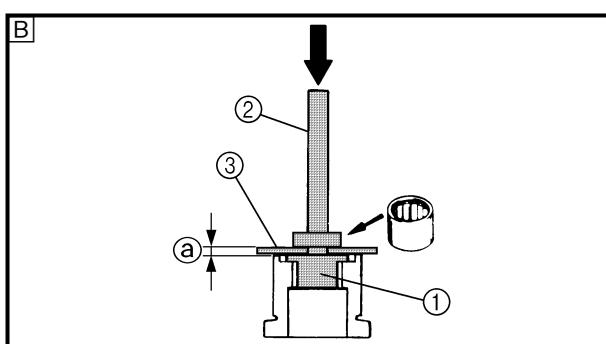
- Needle bearing



Position ④
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



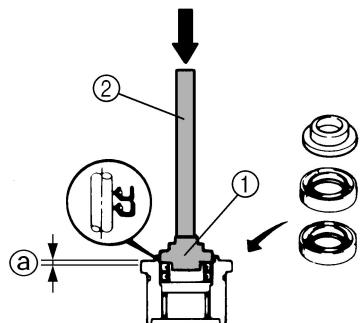
A For USA and Canada

B For worldwide

LOWR

DRIVE SHAFT (COUNTER ROTATION MODELS)

E



2. Install:

- Oil seal

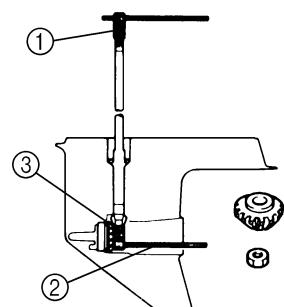


Oil seal installation position ③
0.25 - 0.75 mm (0.010 - 0.030 in)



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



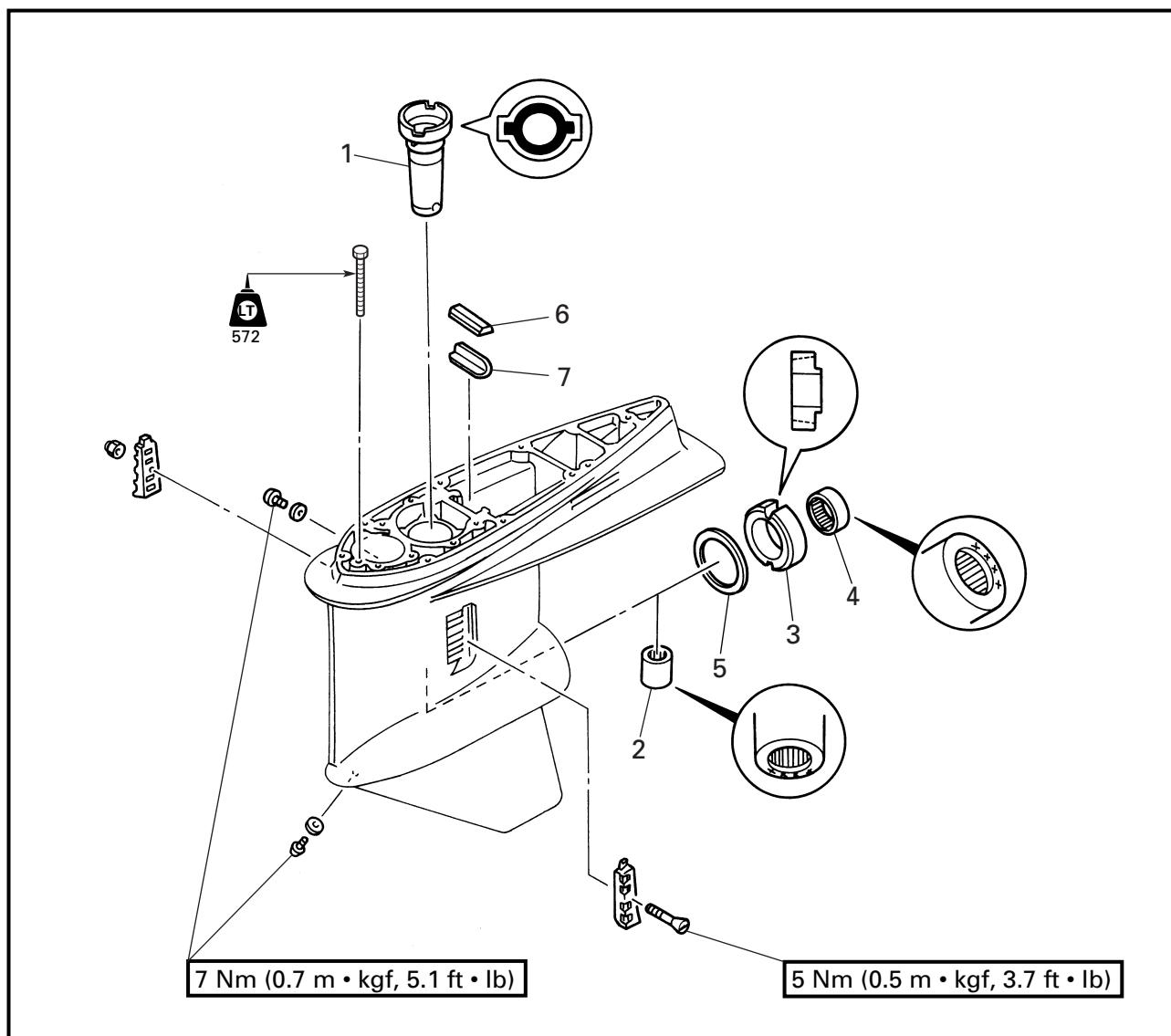
**Pinion nut
93 Nm (9.3 m • kgf, 67 ft • lb)**

LOWR

LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS)

E

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



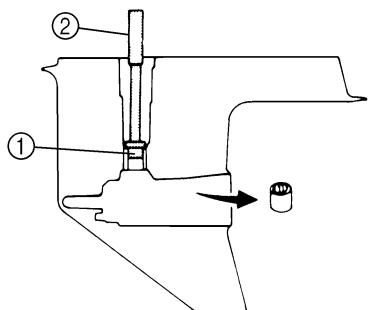
Order	Job/Part	Q'ty	Remarks
	Reverse gear		Refer to "DRIVE SHAFT (COUNTER ROTATION MODELS)" on page 6-45.
1	Drive shaft sleeve	1	
2	Needle bearing	1	
3	Bearing retainer	1	
4	Needle bearing	1	
5	Reverse gear shim	*	
6	Water seal	1	
7	Plate	1	

*: As required

LOWR

LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS)

E



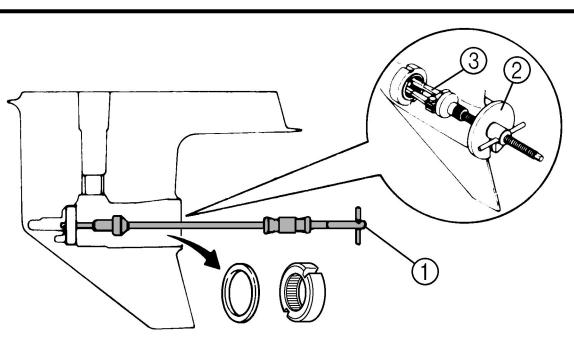
DISASSEMBLING THE LOWER CASE ASSEMBLY

1. Remove:

- Needle bearing



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

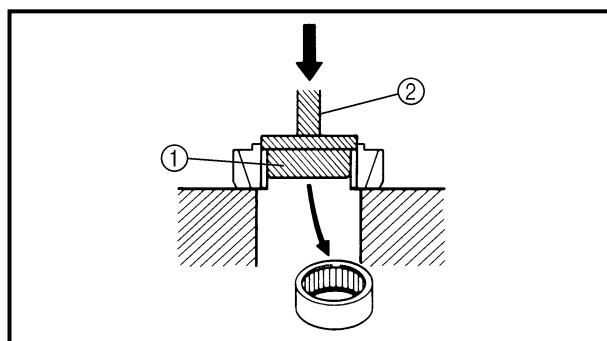


2. Remove:

- 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

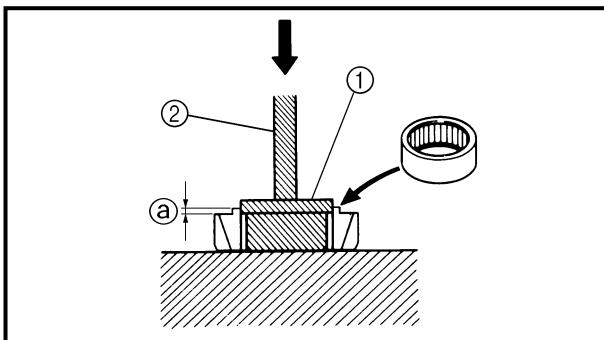
Check:

- Needle bearing
- Pitting/rumbling → Replace.

LOWR

LOWER CASE ASSEMBLY (COUNTER ROTATION MODELS)

E



ASSEMBLING THE LOWER CASE ASSEMBLY

1. Install:

- Needle bearing



Needle bearing installation position ④

0.75 - 1.25 mm (0.030 - 0.049 in)

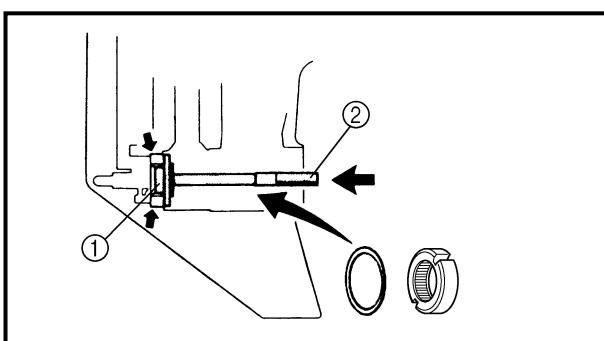


Bearing/oil seal attachment ①

YB-06376 / 90890-06607

Driver rod ②

YB-06071 / 90890-06652



2. Install:

- Bearing retainer

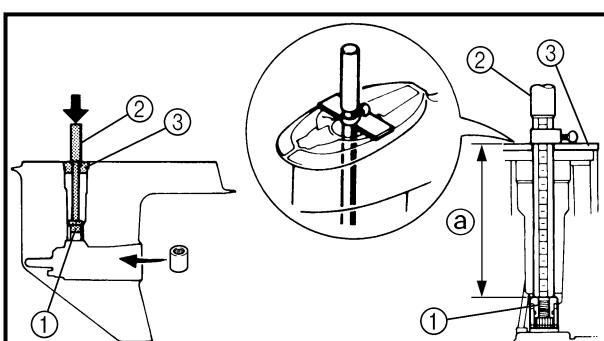


Bearing/oil seal attachment ①

YB-06377 / 90890-06630

Driver rod ②

YB-06071 / 90890-06605



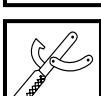
3. Install:

- Needle bearing



Needle bearing installation position ④

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

LOWR

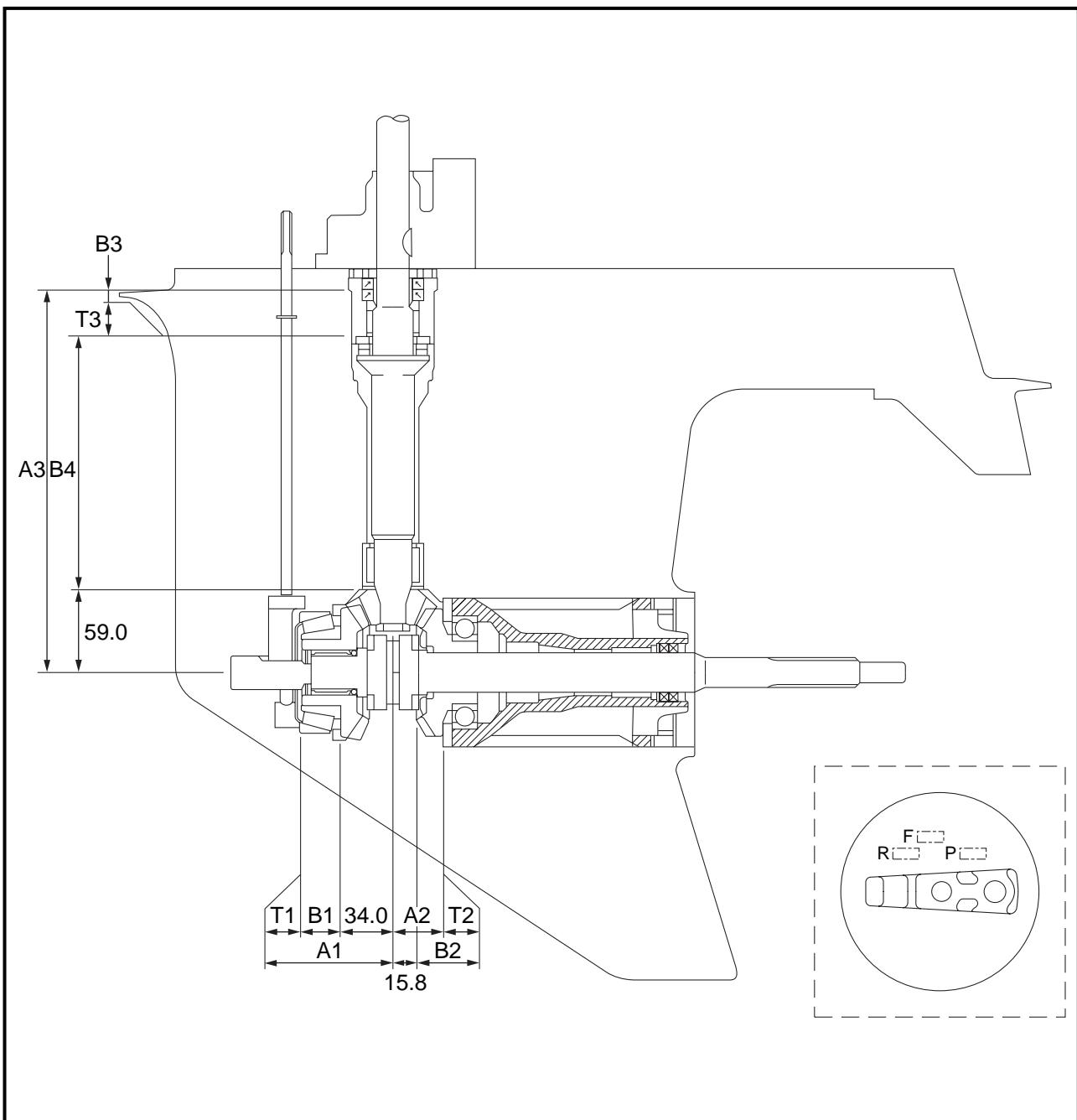
SHIMMING (REGULAR ROTATION MODELS) (FOR USA AND CANADA)

E

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

NOTE:

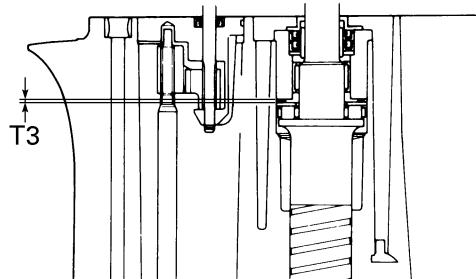
- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required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



LOWR

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

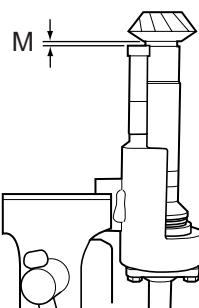
E



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.



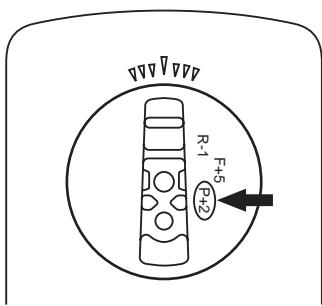
**Specified value (M0) =
1.00 + P/100 mm**

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

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

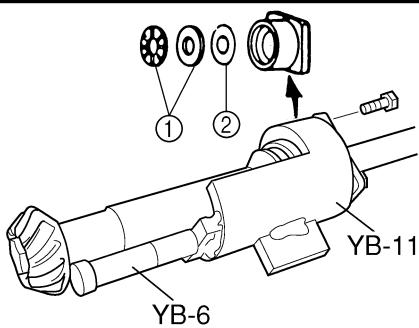
If "P" is "-3", then

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

LOWR

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

E



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



Pinion height gauge
YB-34432-6, -11

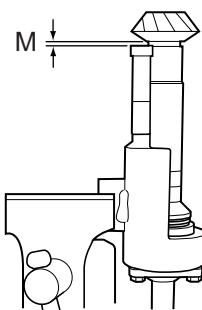
NOTE:

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**

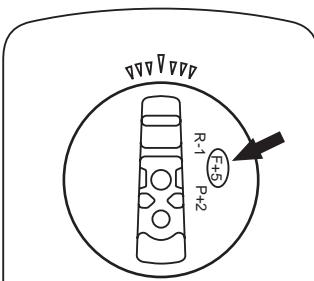
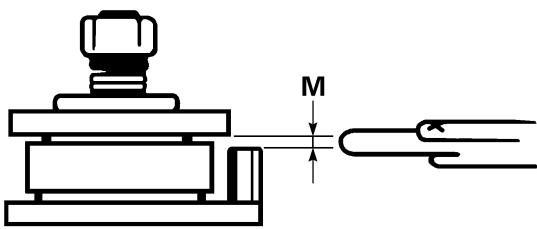
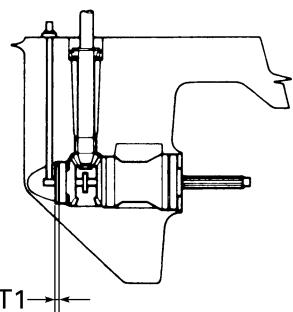
NOTE:

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

LOWR

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

E



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

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

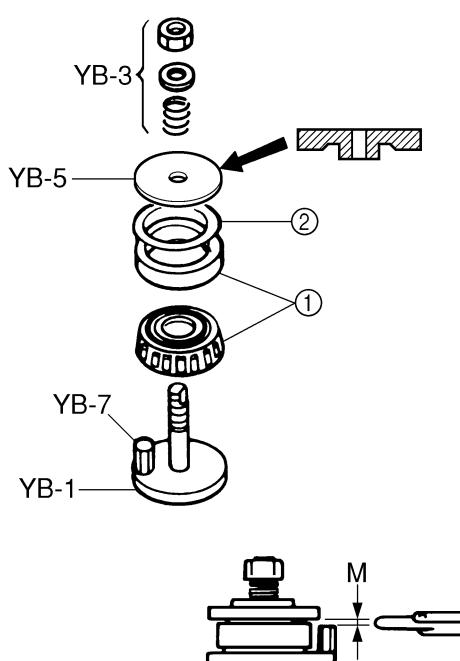
If "F" is "-3", then

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

LOWR

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

E



- (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**

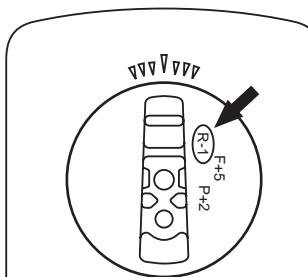
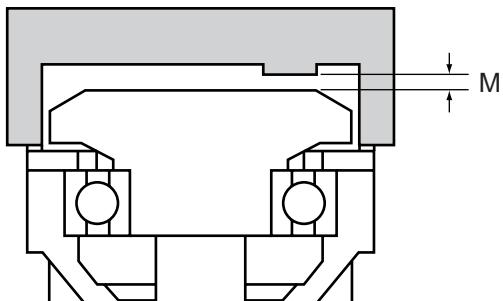
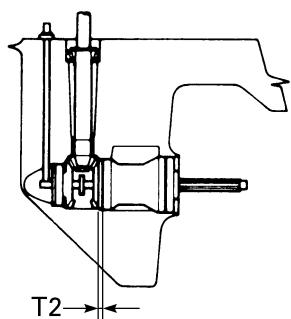
NOTE: _____

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

LOWR

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

E



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

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

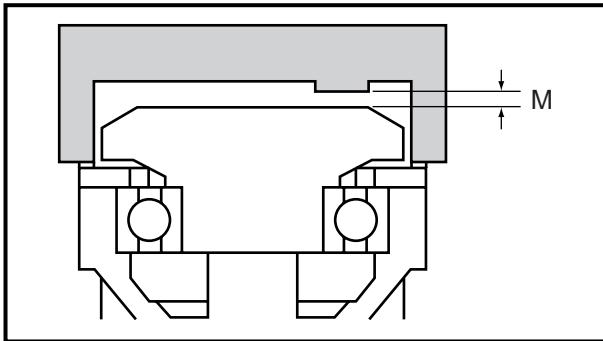
If "R" is "-3", then

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

LOWR

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

E



- (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.

LOWR

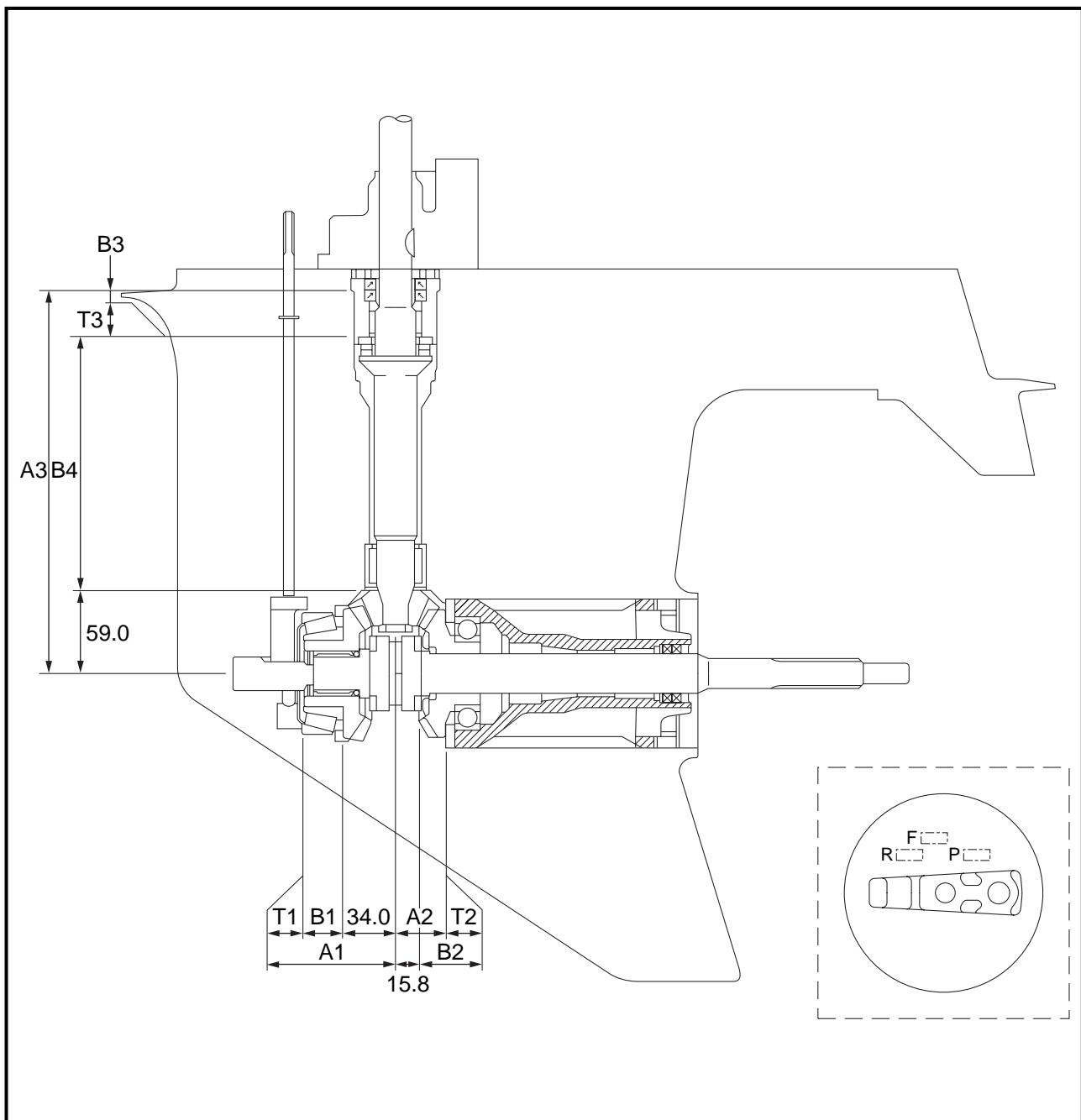
SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

NOTE:

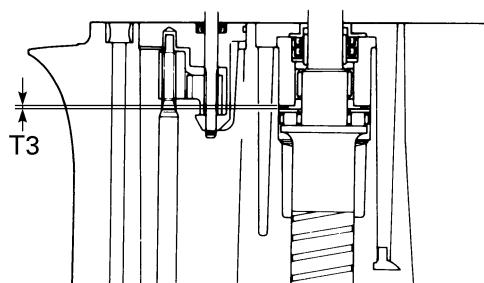
- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required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



LOWR

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E



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).

**NOTE:**

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

(2) Install the pinion and pinion nut.



(3) Install the pinion height gauge.

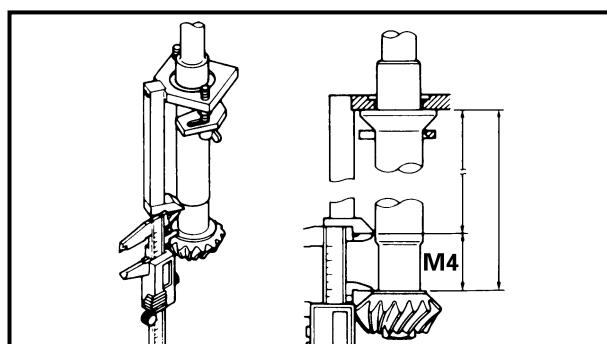
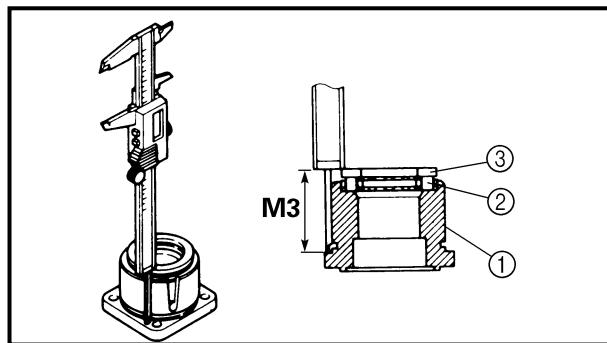
**NOTE:**

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

(4) Measure (M4).

**NOTE:**

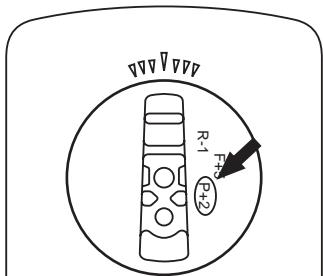
- Measure the clearance between the pinion height gauge and the pinion, as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M4).



LOWR

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E



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



$$\text{Pinion shim thickness (T3)} = 62.5 + P/100 - M3 - M4$$

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

$$\begin{aligned} T3 &= 62.5 + (-5)/100 - 46.85 - 15.12 \text{ mm} \\ &= 62.5 - 0.05 - 46.85 - 15.12 \text{ mm} \\ &= 0.48 \text{ mm} \end{aligned}$$

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

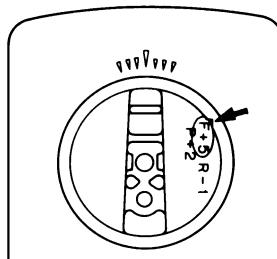
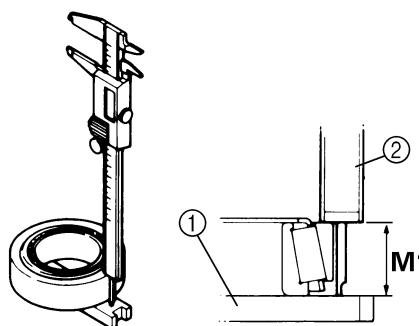
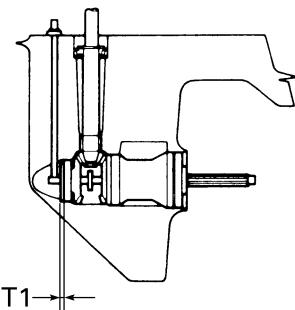
Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08

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

LOWR

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E



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).



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

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.

LOWR



SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E

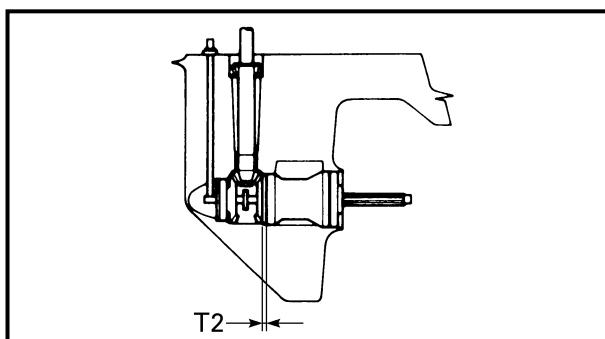
Example:

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

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

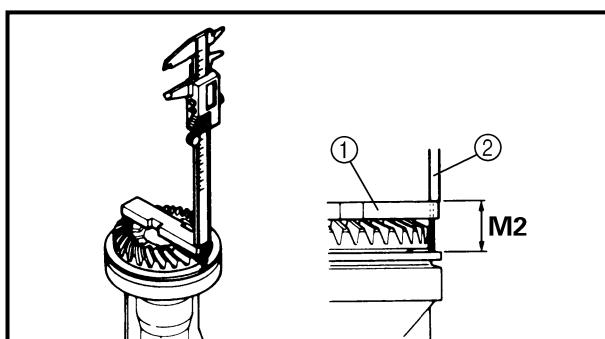
Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08

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
	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).

LOWR

SHIMMING (REGULAR ROTATION MODELS) (FOR WORLDWIDE)

E

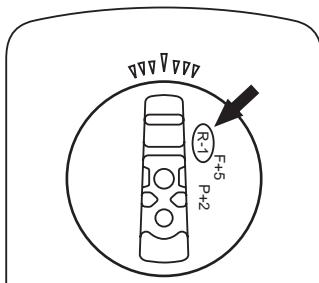
- (2) Calculate the reverse gear shim thickness (T2).



**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

$$\begin{aligned} T2 &= 27.95 - 27.4 - (+2)/100 \text{ mm} \\ &= 27.95 - 27.4 - 0.02 \text{ mm} \\ &= 0.53 \text{ mm} \end{aligned}$$

- (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**

6-65

LOWR**BACKLASH (REGULAR ROTATION MODELS)**

E

**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
0.20 - 0.31 mm (0.008 - 0.012 in)

Measuring steps

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



Shift rod wrench
YB-06052 / 90890-06052

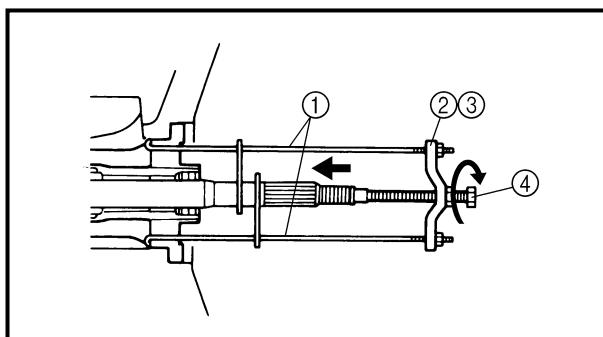
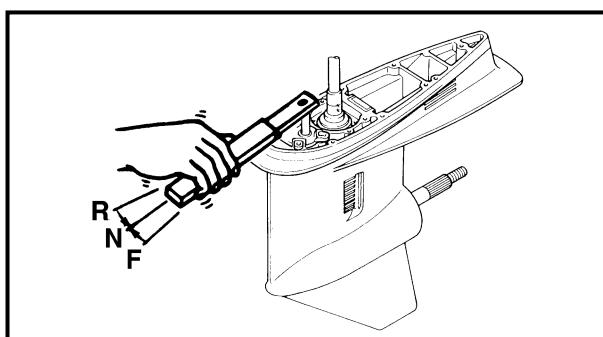
- (2) Install the propeller shaft housing puller so it pushes against the propeller shaft.



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

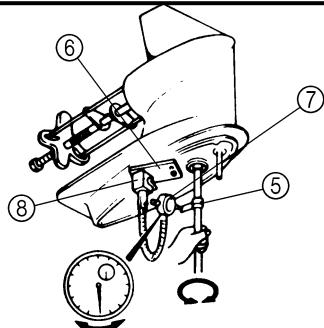


Center bolt
10 Nm (1.0 m • kgf, 7.2 ft • lb)



LOWR**BACKLASH (REGULAR ROTATION MODELS)**

E



- (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 0.20 mm (0.008 in)	To be decreased by (0.26 – M) × 0.58
	More than 0.31 mm (0.012 in)	To be increased by (M – 0.26) × 0.58

M: Measurement

MEASURING THE REVERSE GEAR BACKLASH

1. Measure:

- Reverse gear backlash
Out of specification → Adjust.

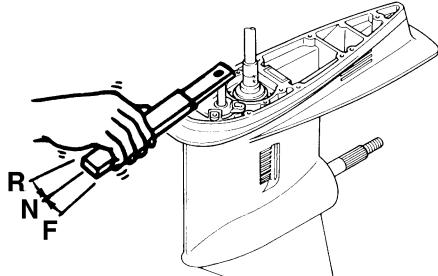


**Reverse gear backlash
0.50 - 0.73 mm (0.020 - 0.029 in)**

LOWR

BACKLASH (REGULAR ROTATION MODELS)

E

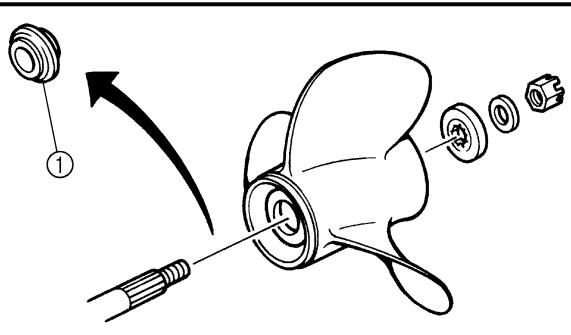


Measuring steps

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



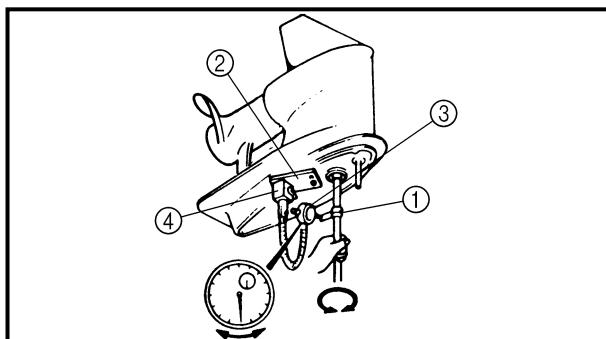
Shift rod wrench
YB-06052 / 90890-06052



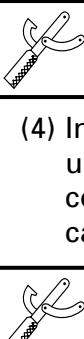
- (2) Load the reverse gear by installing the propeller without the spacer ① and then tighten the propeller nut.



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.

LOWR**BACKLASH (REGULAR ROTATION MODELS)**

E

2. Adjust:

- Reverse gear shim
Remove or add shim(s).

	Reverse gear backlash	Shim thickness
Less than 0.50 mm (0.020 in)	To be increased by $(0.62 - M) \times 0.58$	
More than 0.73 mm (0.029 in)	To be decreased by $(M - 0.62) \times 0.58$	

M: Measurement

LOWR

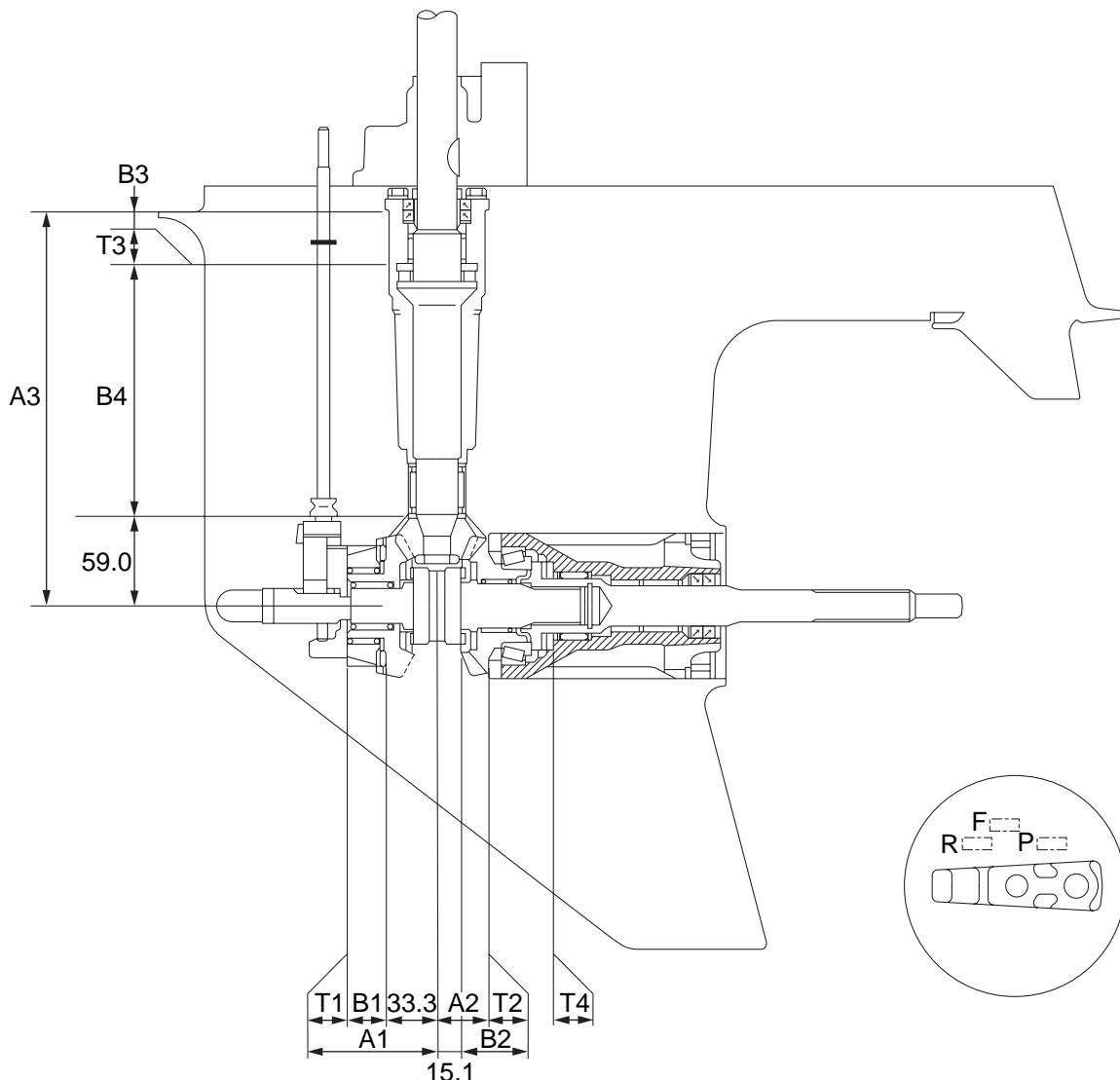
SHIMMING (COUNTER ROTATION MODELS) (FOR USA AND CANADA)

E

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

NOTE:

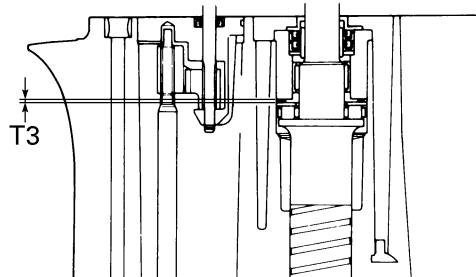
- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required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



LOWR

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

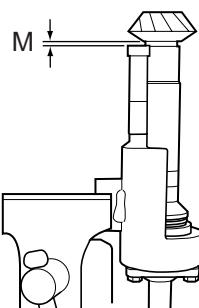
E



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.



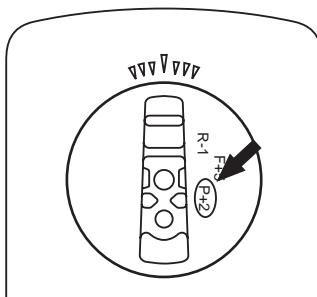
**Specified value (M0) =
1.00 + P/100 mm**

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

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

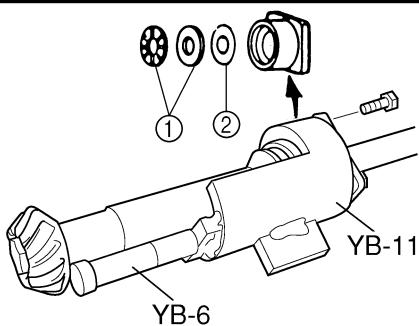
If "P" is "-3", then

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

LOWR

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

E



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



Pinion height gauge
YB-34432-6, -11

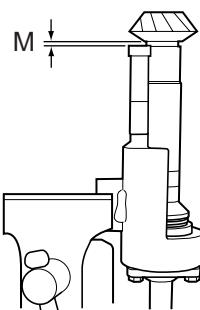
NOTE:

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**

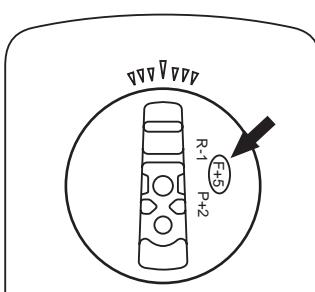
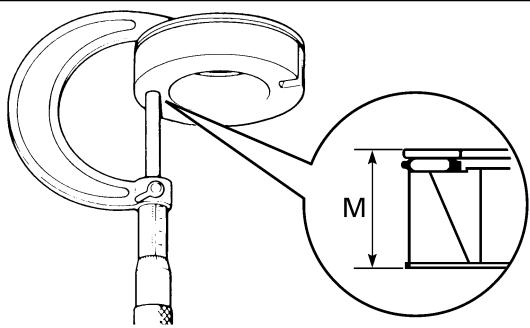
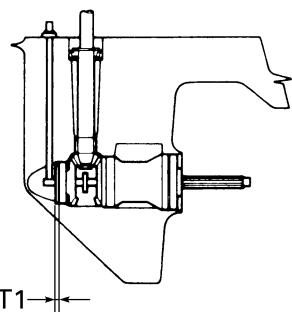
NOTE:

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

LOWR

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

E



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

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

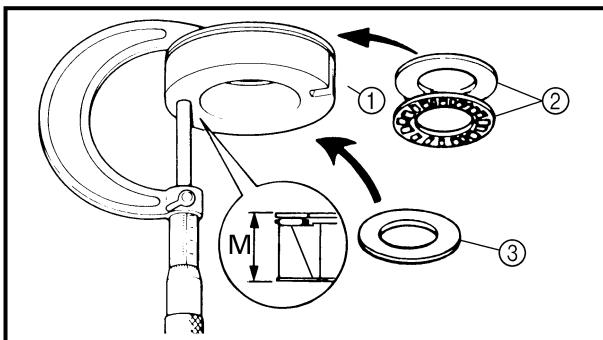
If "F" is "-3", then

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

LOWR

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

E



- (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).

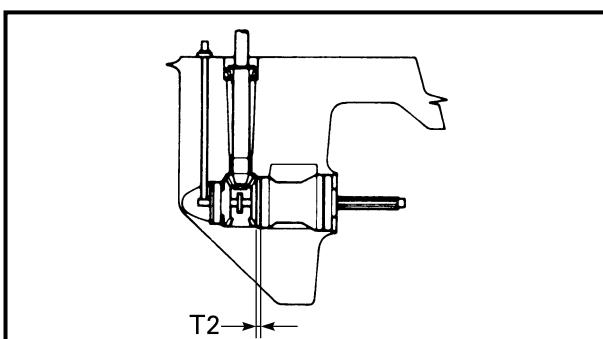
2. Adjust:

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



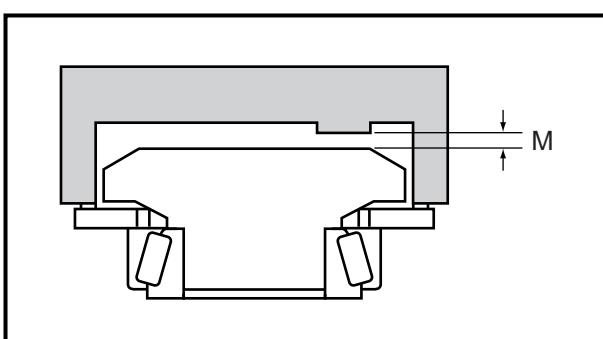
Available shim thickness
**0.10, 0.12, 0.15, 0.18, 0.30, 0.40
and 0.50 mm**

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.

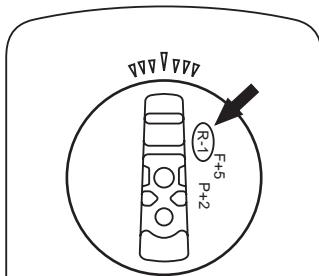


Specified value (M0) =
 $1.10 - R/100$ mm

LOWR

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

E



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

$$M0 = 1.10 - (+5)/100 \text{ mm}$$

$$= 1.10 - 0.05 \text{ mm}$$

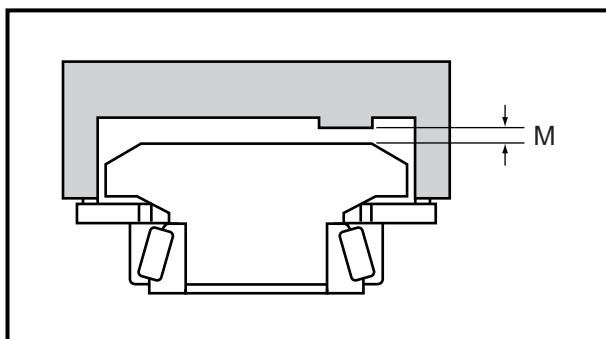
$$= 1.05 \text{ mm}$$

If "R" is "-3", then

$$M0 = 1.10 - (-3)/100 \text{ mm}$$

$$= 1.10 + 0.03 \text{ mm}$$

$$= 1.13 \text{ mm}$$



(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).

LOWR

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

E

2. Adjust:

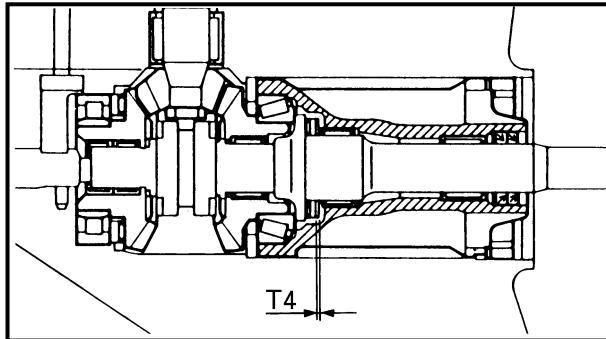
- Shim thickness (T2)
- Remove or add shim(s).



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

NOTE: _____

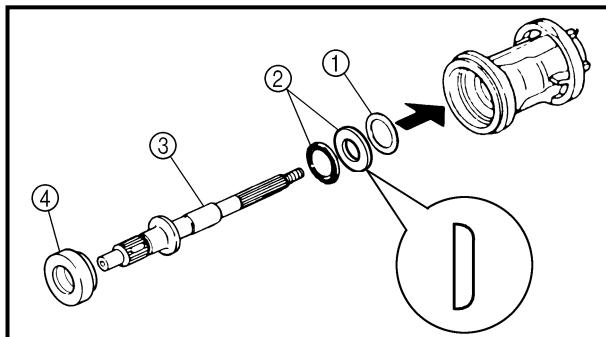
(M0) – (M) should be as close to "0" as possible.



SELECTING THE PROPELLER SHAFT SHIMS

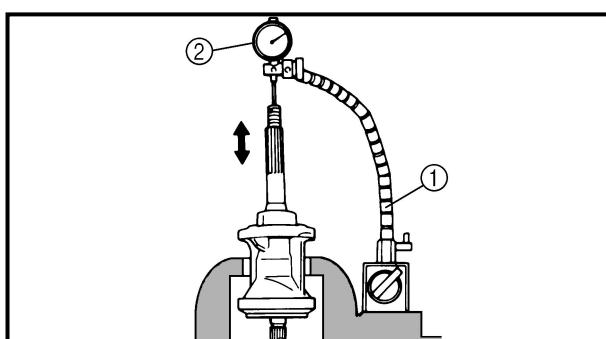
NOTE: _____

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

LOWR

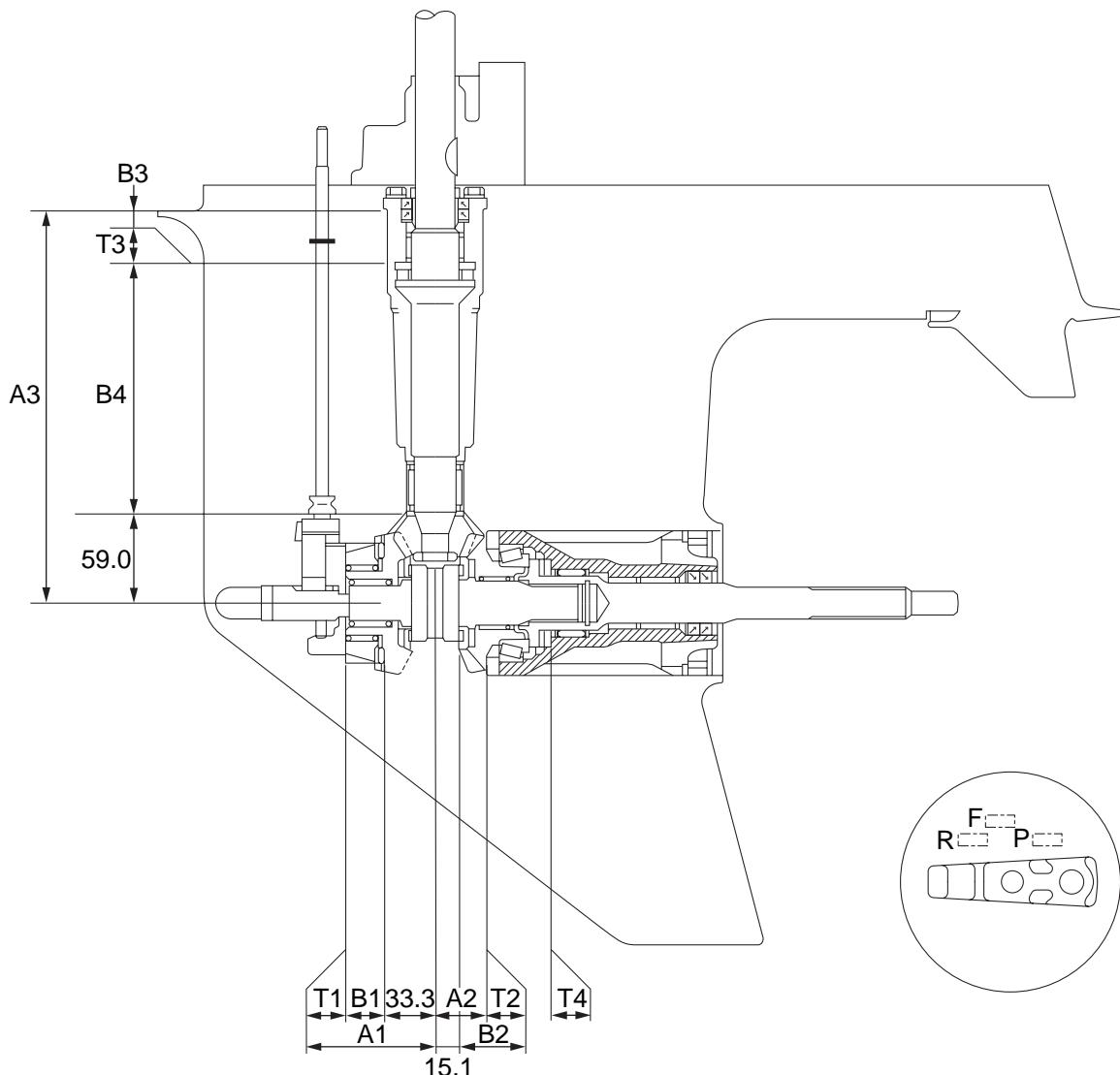
SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

NOTE:

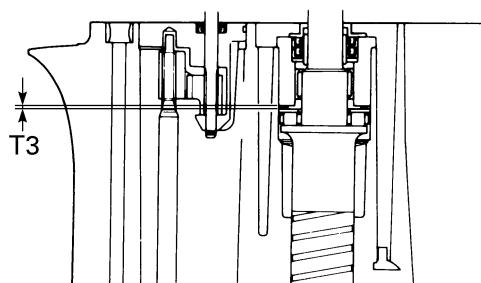
- There is no need to select shims when reassembling with the original case and inner parts.
- Shim calculations are required when reassembling with the original inner parts and a new case (the difference between the original inner parts and the new case).
- Measurements and adjustments are required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



LOWR

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E



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).

**NOTE:**

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

(2) Install the pinion and pinion nut.



(3) Install the pinion height gauge.

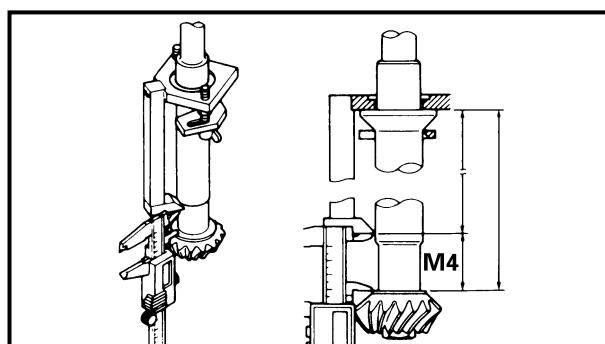
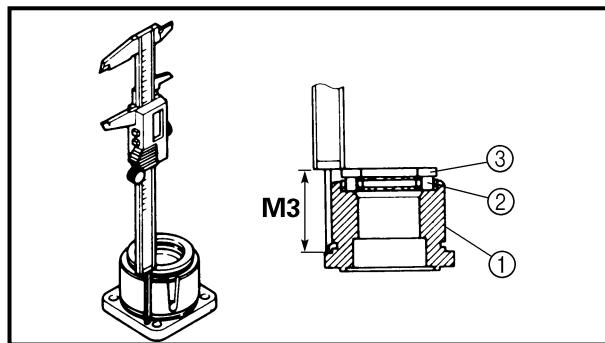
**NOTE:**

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

(4) Measure (M4).

**NOTE:**

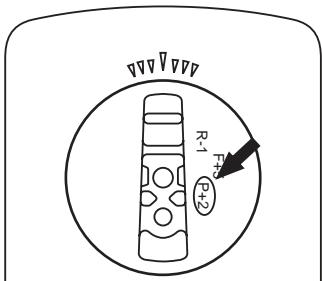
- Measure the clearance between the pinion height gauge and the pinion, as shown.
- Perform the same measurement at three points on the pinion.
- Find the average of the measurements (M4).



LOWR

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E



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



$$\text{Pinion shim thickness (T3)} = 62.5 + P/100 - M3 - M4$$

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

$$\begin{aligned} T3 &= 62.5 + (-5)/100 - 46.85 - 15.12 \text{ mm} \\ &= 62.5 - 0.05 - 46.85 - 15.12 \text{ mm} \\ &= 0.48 \text{ mm} \end{aligned}$$

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

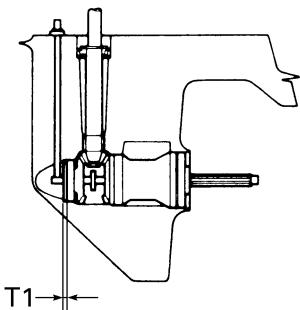
Calculated numeral at 1/100th place		Rounded numeral
More than	or less	
0.00	0.02	0.00
0.02	0.05	0.02
0.05	0.08	0.05
0.08	0.10	0.08

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

LOWR

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E



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

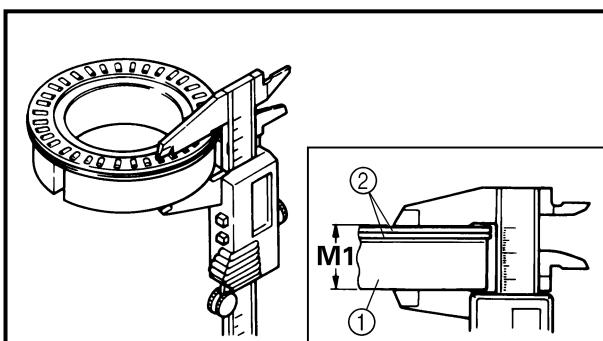
(1) Measure (M1).



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).



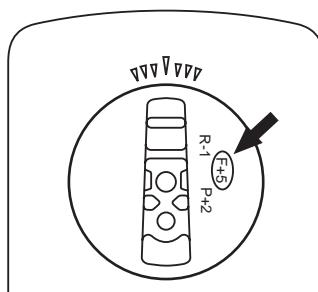
(2) Calculate the reverse gear shim thickness (T1).



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.



LOWR



SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E

Example:

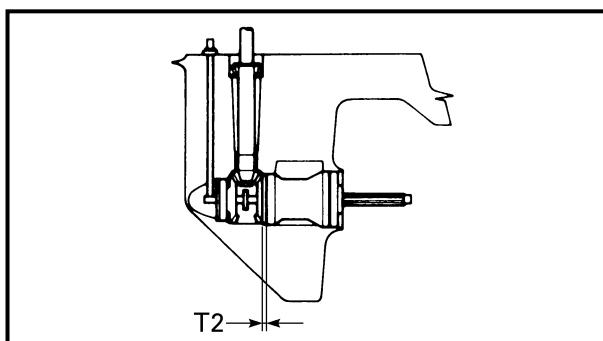
If M1 is "24.80 mm" and F is "+5", then

$$\begin{aligned} T1 &= 25.3 + (+5)/100 - 24.80 \text{ mm} \\ &= 25.3 + 0.05 - 24.80 \text{ mm} \\ &= 0.55 \text{ mm} \end{aligned}$$

(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

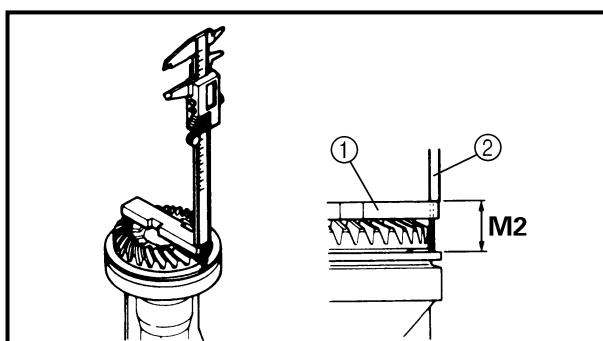
NOTE: _____
 Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.

Select:

- Shim thickness (T2)

Selecting steps

(1) Measure (M2).



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

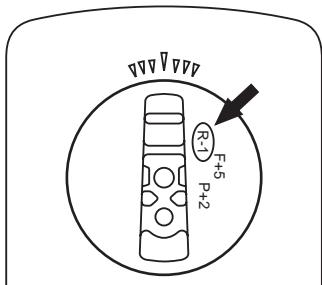
NOTE: _____

- 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).

LOWR

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E



(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

$$\begin{aligned} T2 &= 29.10 - 28.1 - (+2)/100 \text{ mm} \\ &= 29.10 - 28.1 - 0.02 \text{ mm} \\ &= 0.98 \text{ mm} \end{aligned}$$

(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

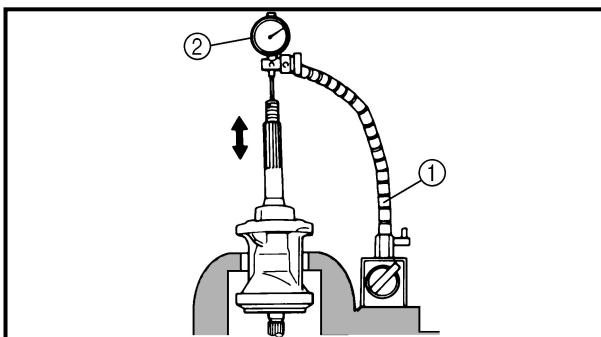
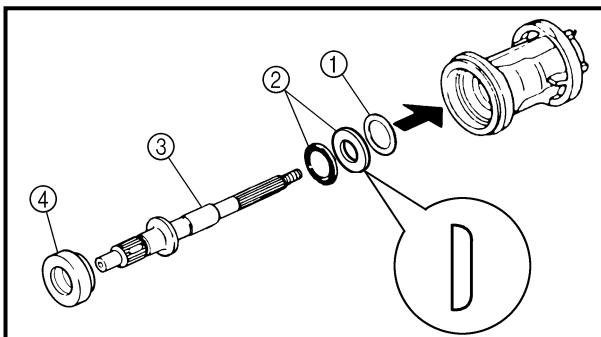
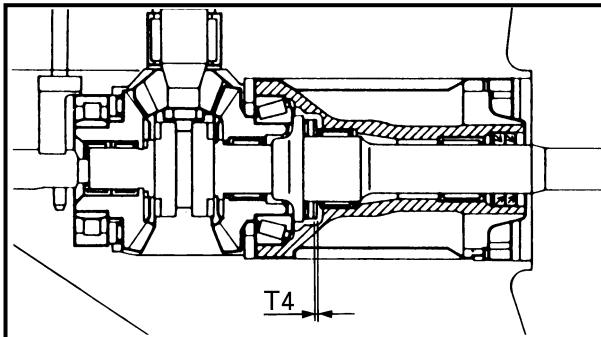


Available shim thickness
 0.10, 0.12, 0.15, 0.18, 0.30, 0.40
 and 0.50 mm

LOWR

SHIMMING (COUNTER ROTATION MODELS) (FOR WORLDWIDE)

E



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
 $0.30 \pm 0.05 \text{ mm}$



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

LOWR**BACKLASH (COUNTER ROTATION MODELS)**

E

**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
0.15 - 0.30 mm (0.006 - 0.012 in)

Measuring steps

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



Shift rod wrench
YB-06052 / 90890-06052

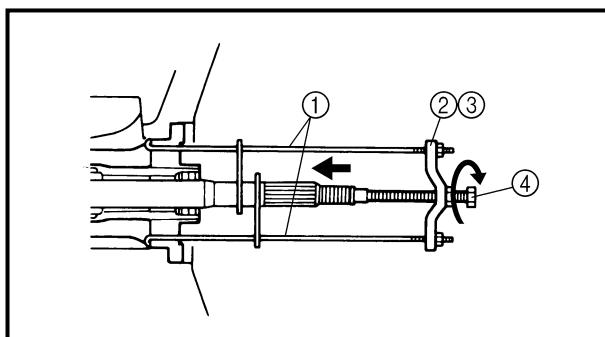
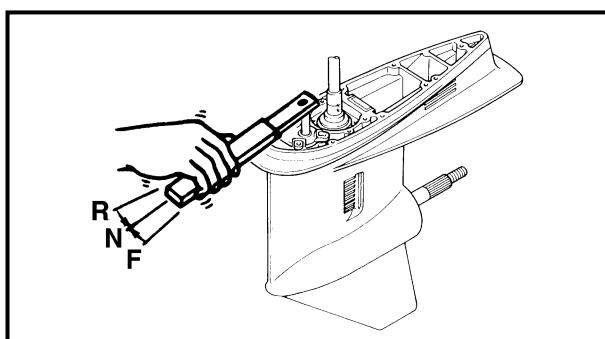
- (2) Install the propeller shaft housing puller so it pushes against the propeller shaft.



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

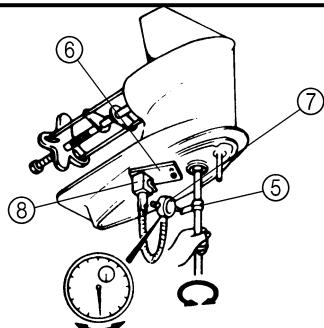


Center bolt
10 Nm (1.0 m • kgf, 7.2 ft • lb)



LOWR**BACKLASH (COUNTER ROTATION MODELS)**

E



- (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 0.15 mm (0.006 in)	To be increased by $(0.23 - M) \times 0.58$
	More than 0.30 mm (0.012 in)	To be decreased by $(M - 0.23) \times 0.58$

M: Measurement

MEASURING THE REVERSE GEAR BACKLASH

1. Measure:

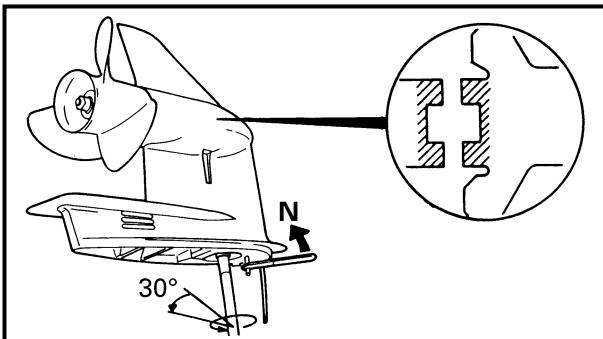
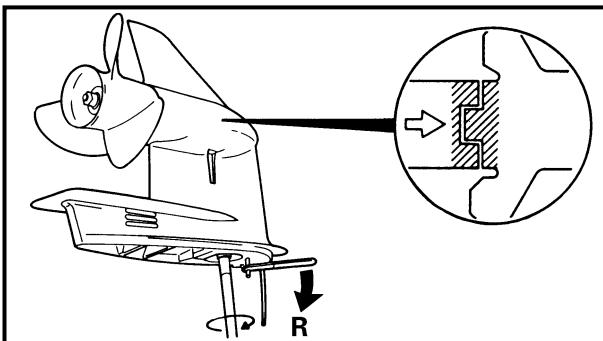
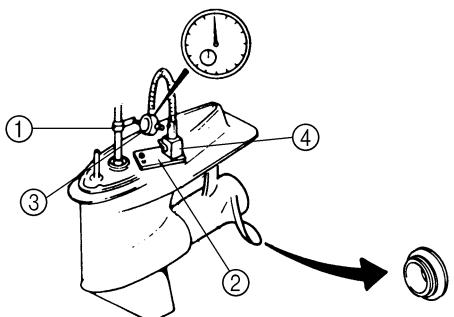
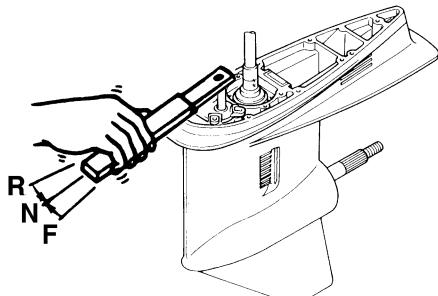
- Reverse gear backlash
Out of specification → Adjust.



**Reverse gear backlash
0.5 - 0.7 mm (0.020 - 0.028 in)**

LOWR**BACKLASH (COUNTER ROTATION MODELS)**

E

**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 and then tighten the propeller nut.



Propeller nut
5 Nm (0.5 m · kgf, 3.6 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 attaching 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) Turn the shift rod into the reverse position with the shift rod wrench.

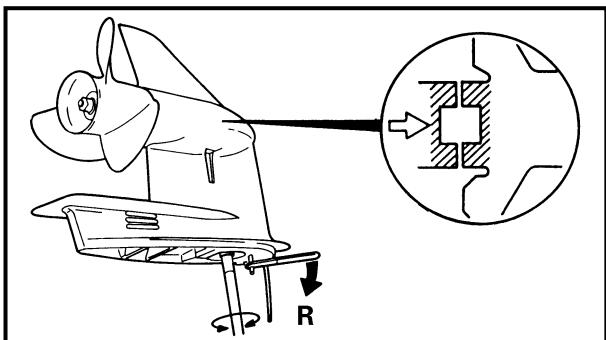
- (7) Turn the drive shaft clockwise until the clutch dog is fully engaged.

- (8) Turn the shift rod into the neutral position with the shift rod wrench.

- (9) Turn the drive shaft counterclockwise approximately 30° more.

LOWR**BACKLASH (COUNTER ROTATION MODELS)**

E



- (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 0.5 mm (0.020 in)	To be decreased by $(0.6 - M) \times 0.58$	
More than 0.7 mm (0.028 in)	To be increased by $(M - 0.6) \times 0.58$	

M: Measurement



CHAPTER 7

BRACKET UNIT

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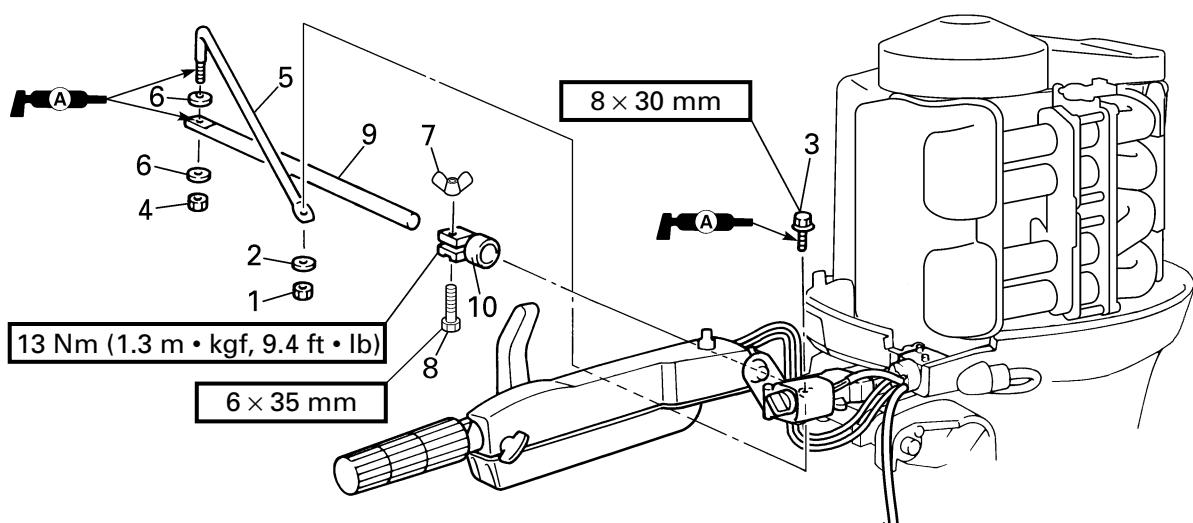
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STEERING HANDLE (OPTION)

E

STEERING HANDLE (OPTION)
REMOVING/INSTALLING THE STEERING FRICTION


Order	Job/Part	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Bolt	1	
4	Nut	1	
5	Link rod	1	
6	Washer	2	
7	Wing nut	1	
8	Bolt	1	
9	Friction rod	1	
10	Friction piece	1	For installation, reverse the removal procedure.

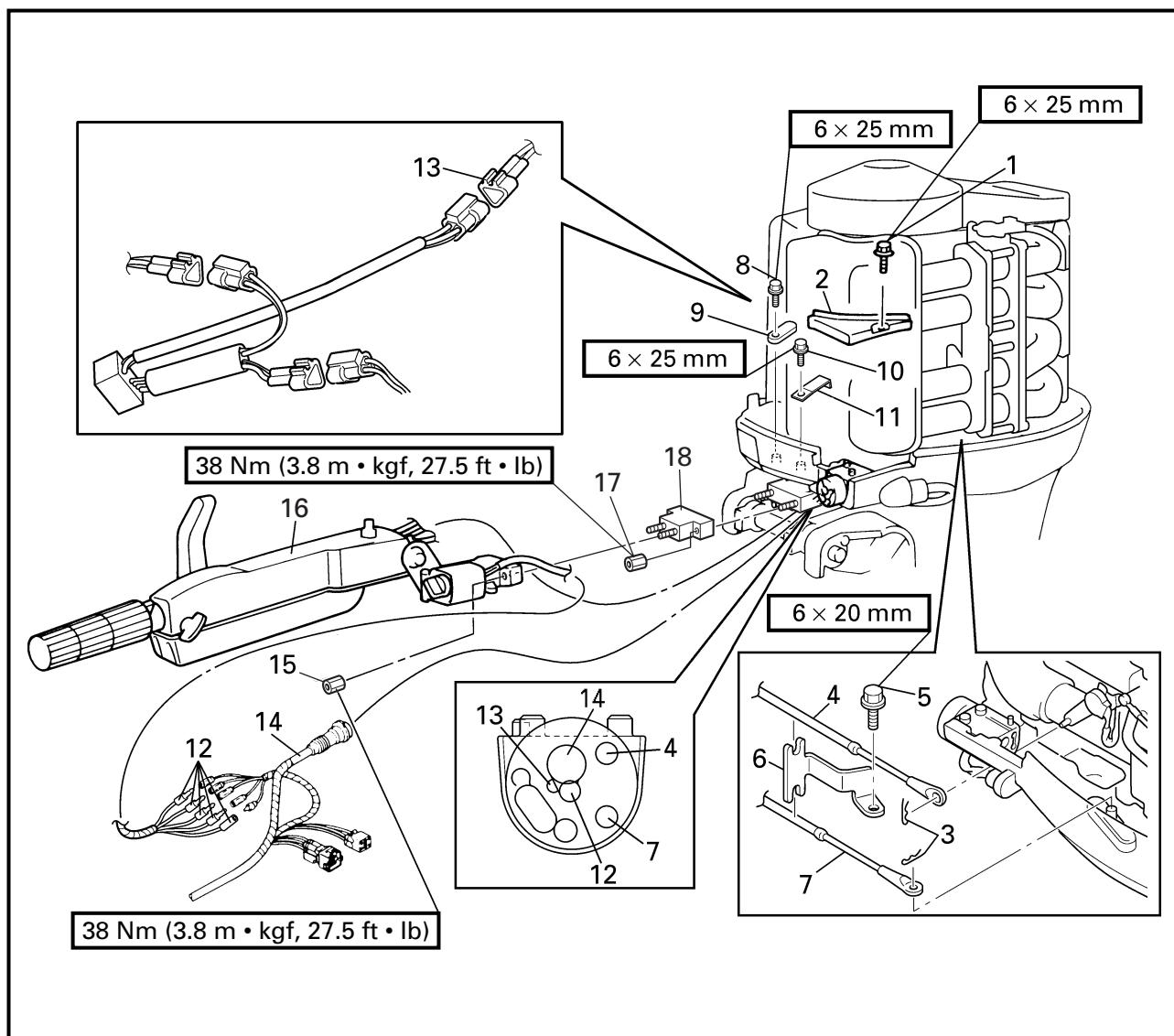
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STEERING HANDLE (OPTION)

E

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	

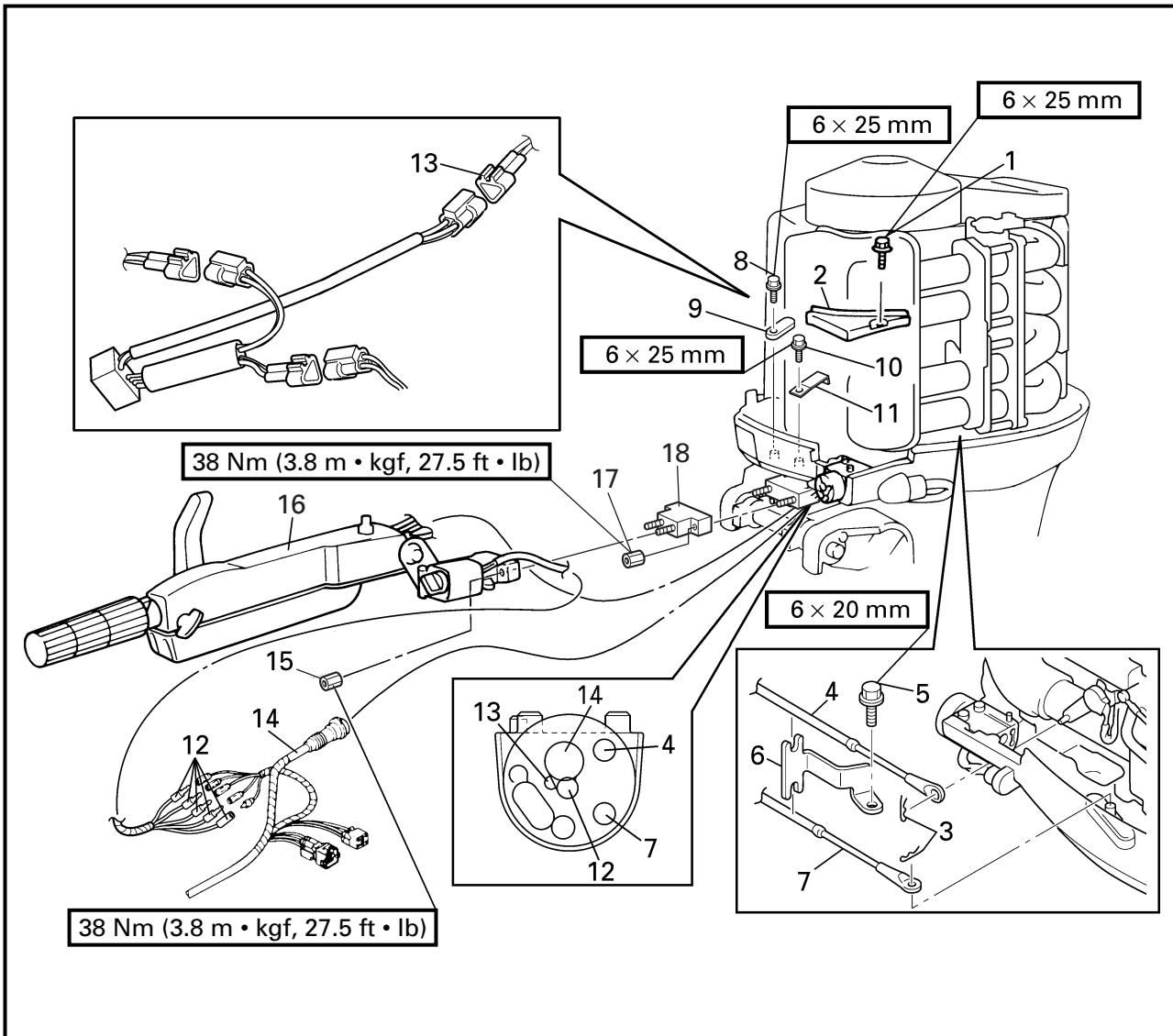
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STEERING HANDLE (OPTION)

E



Order	Job/Part	Q'ty	Remarks
11	Clamp	1	
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	For installation, reverse the removal procedure.

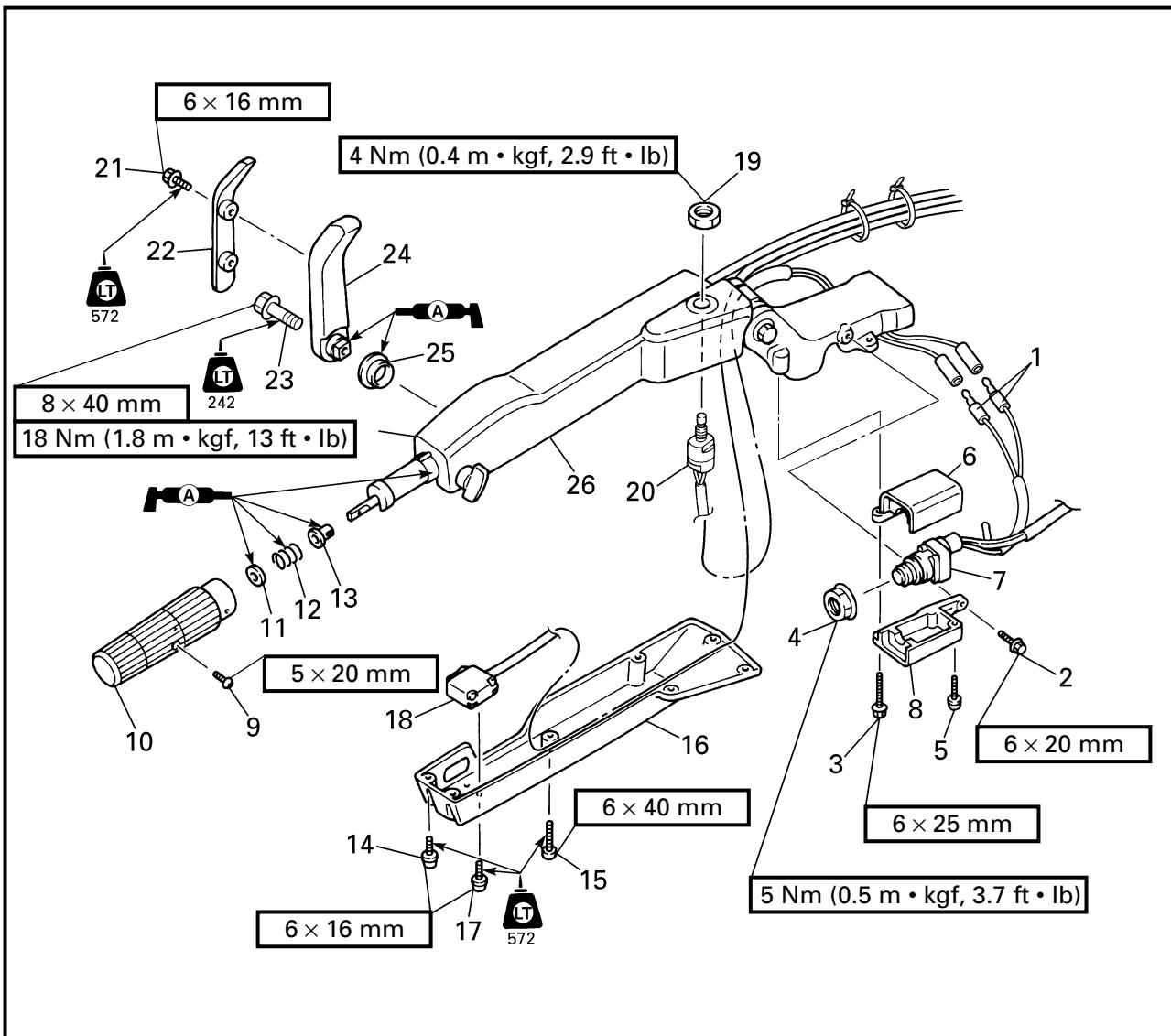
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STEERING HANDLE (OPTION)

E

DISASSEMBLING/ASSEMBLING THE STEERING HANDLE



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

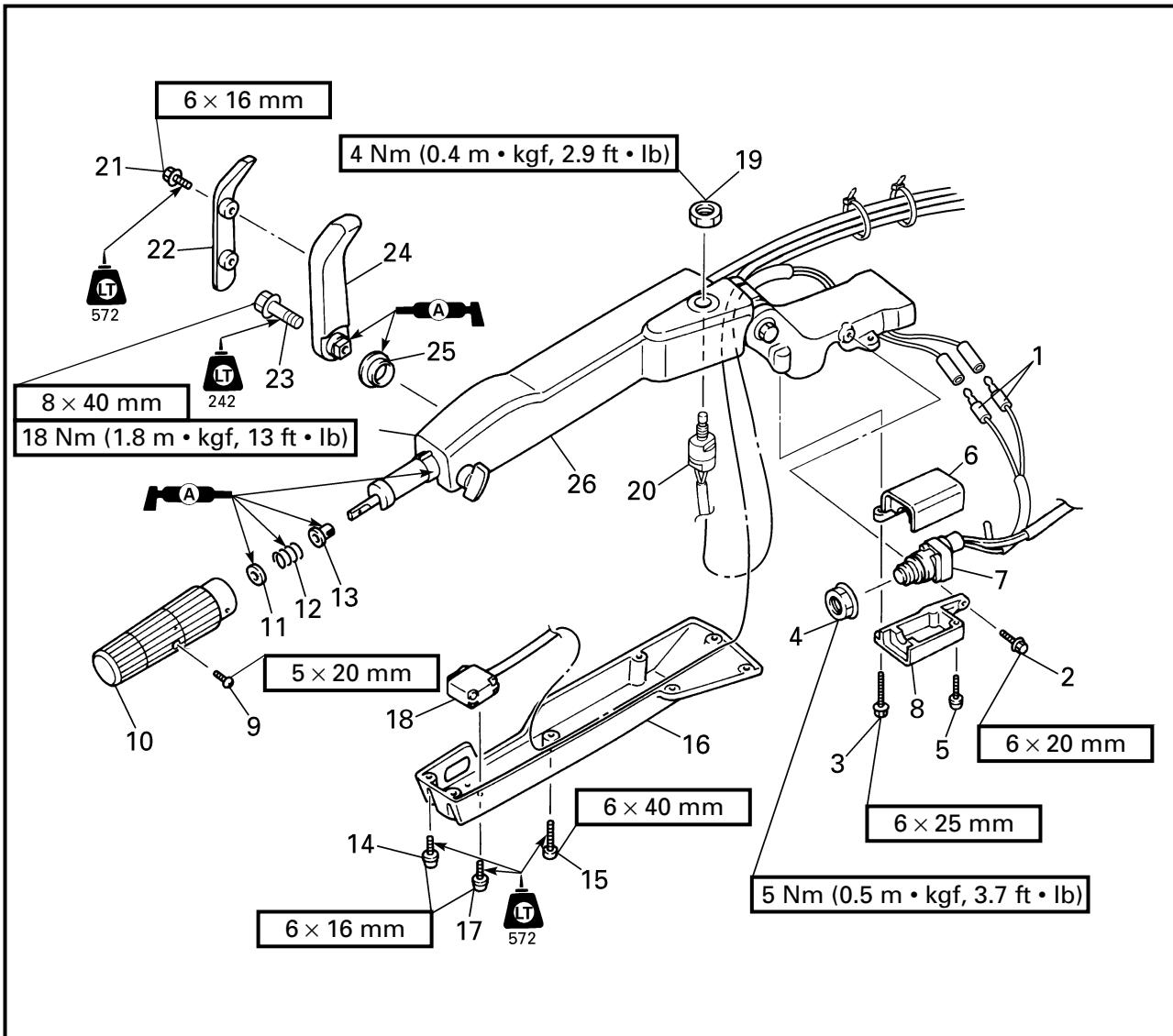
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STEERING HANDLE (OPTION)

E



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	

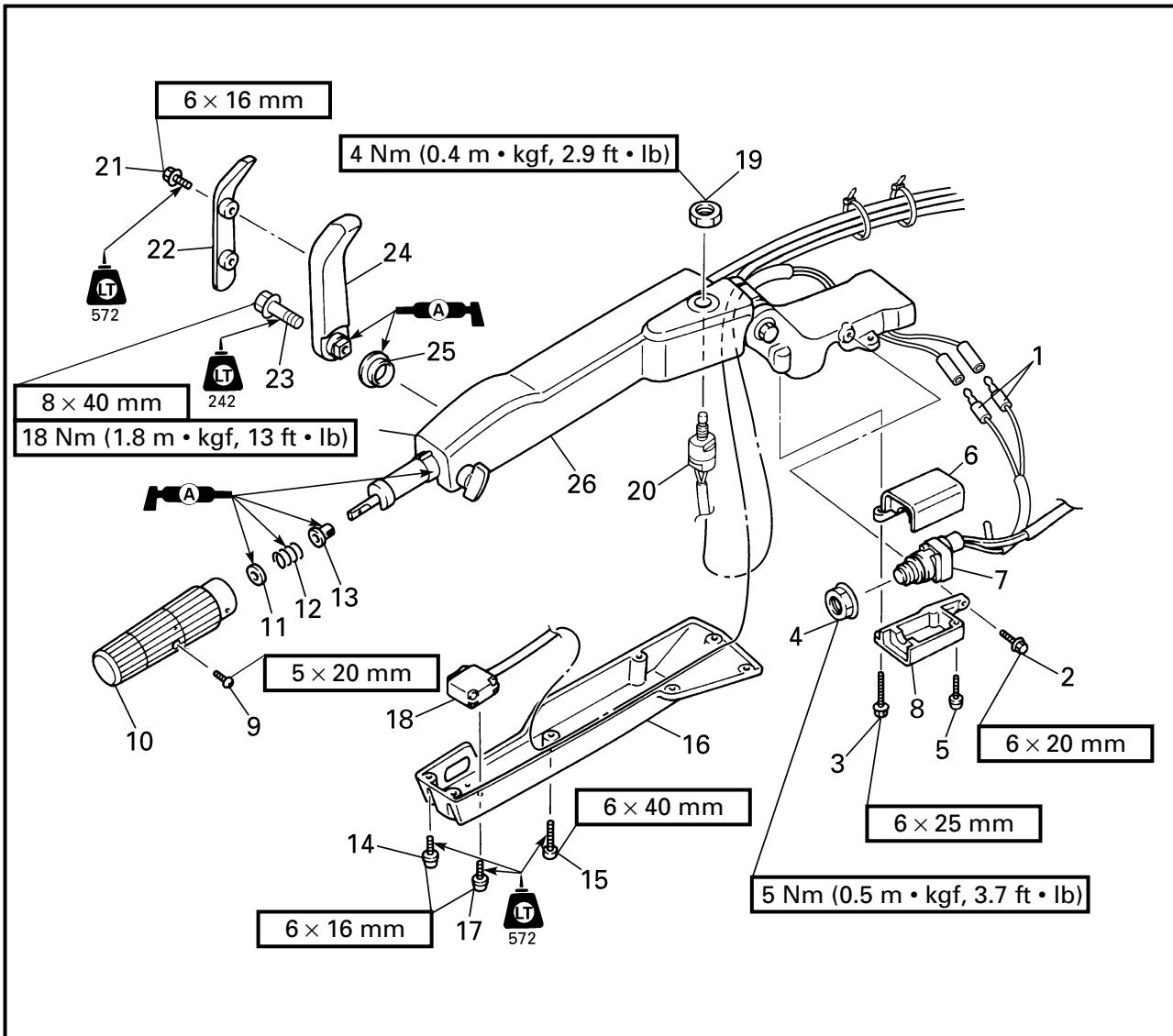
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STEERING HANDLE (OPTION)

E



Order	Job/Part	Q'ty	Remarks
18	Power trim and tilt switch	1	
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	For assembly, reverse the disassembly procedure.

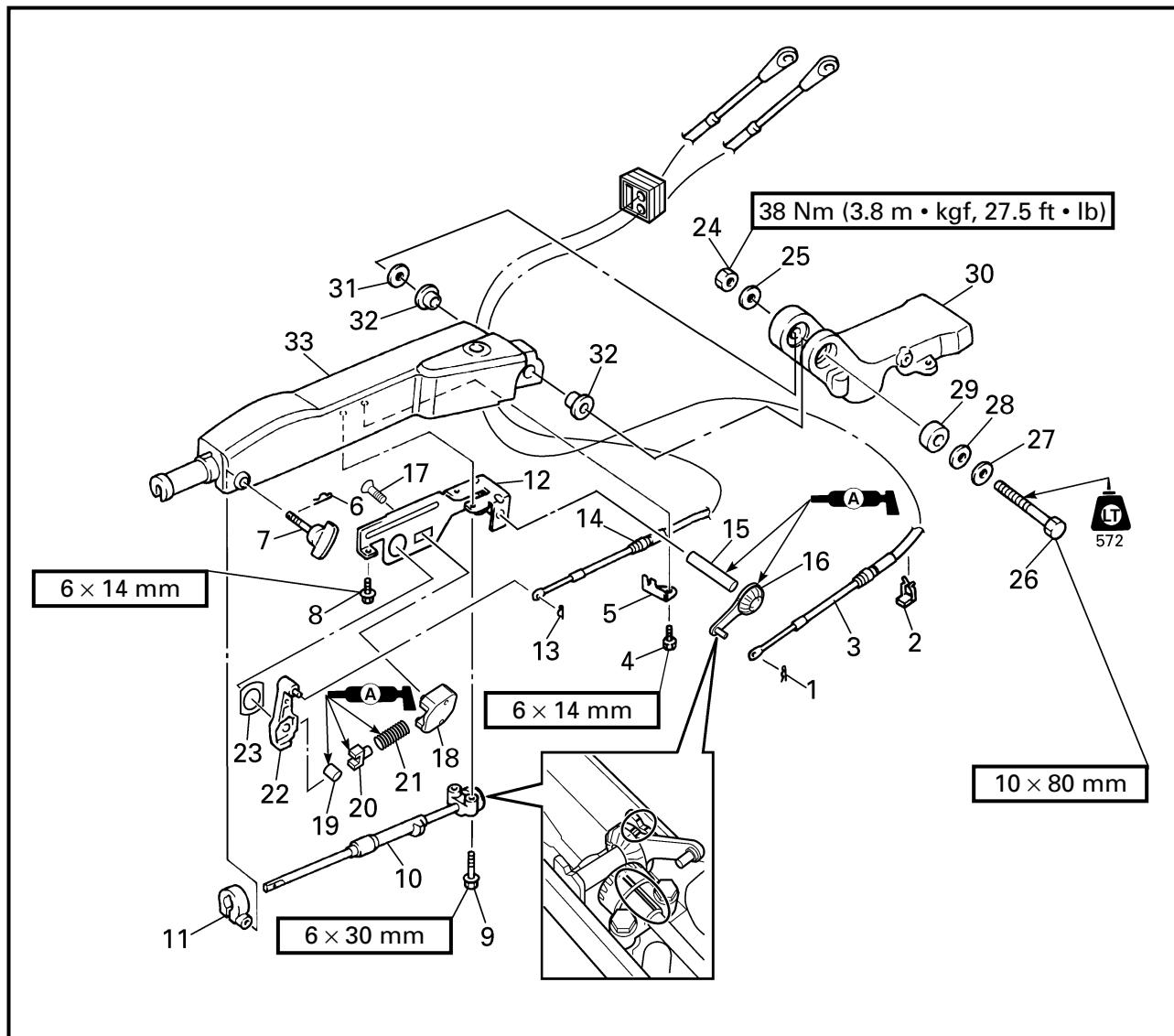
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STEERING HANDLE (OPTION)

E

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	

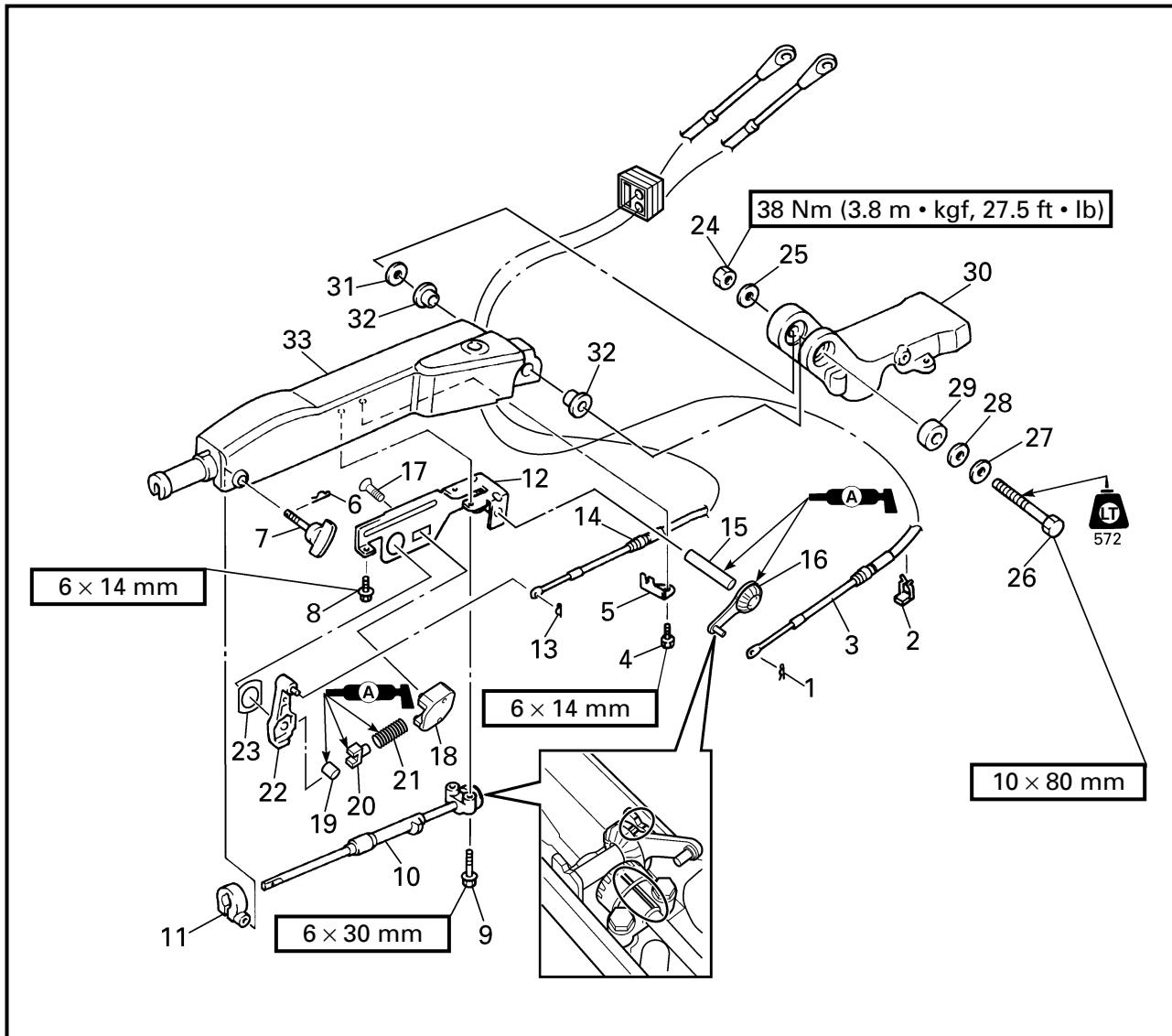
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STEERING HANDLE (OPTION)

E



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	

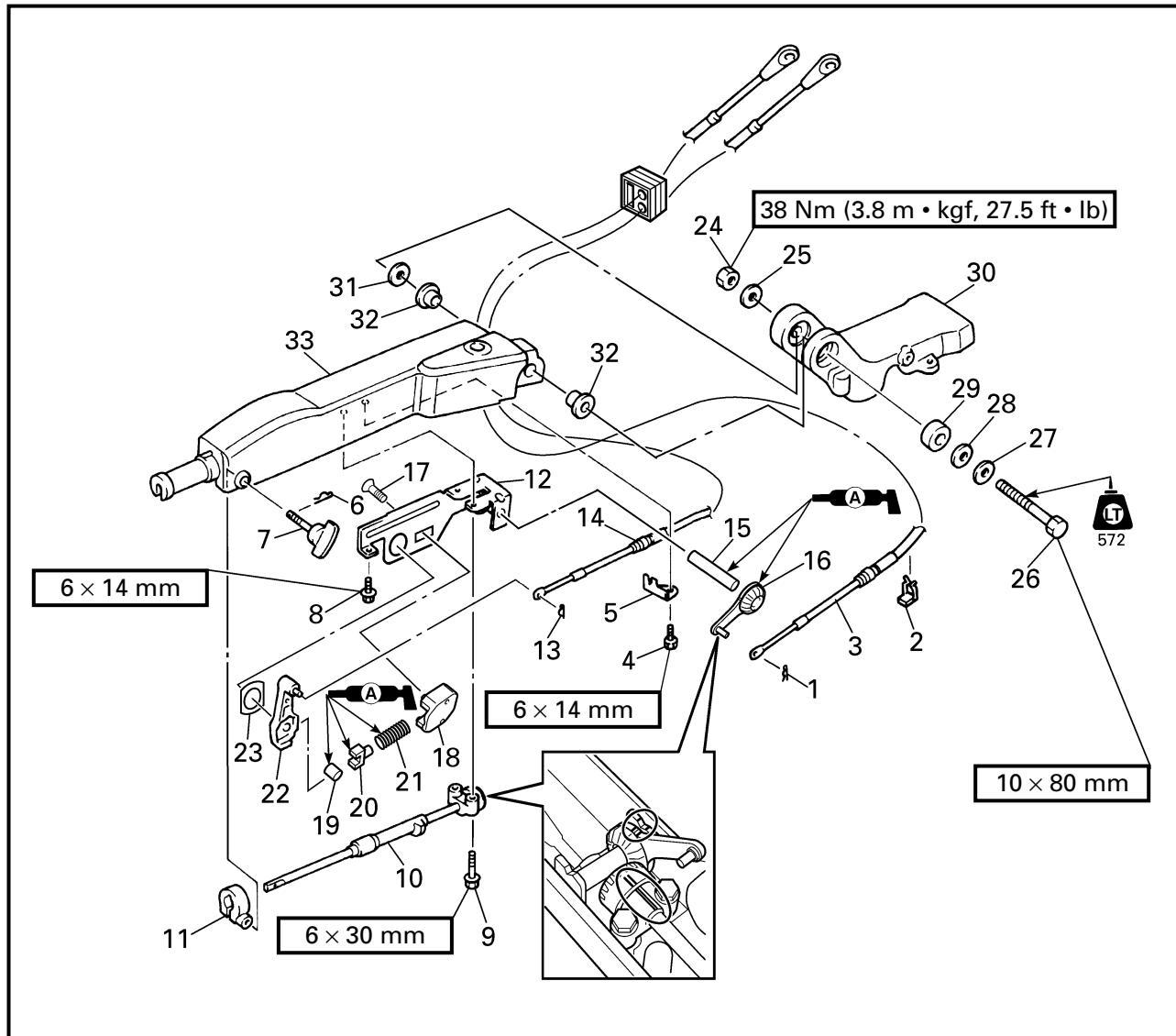
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STEERING HANDLE (OPTION)

E



Order	Job/Part	Q'ty	Remarks
23	Bushing	1	
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	For assembly, reverse the disassembly procedure.

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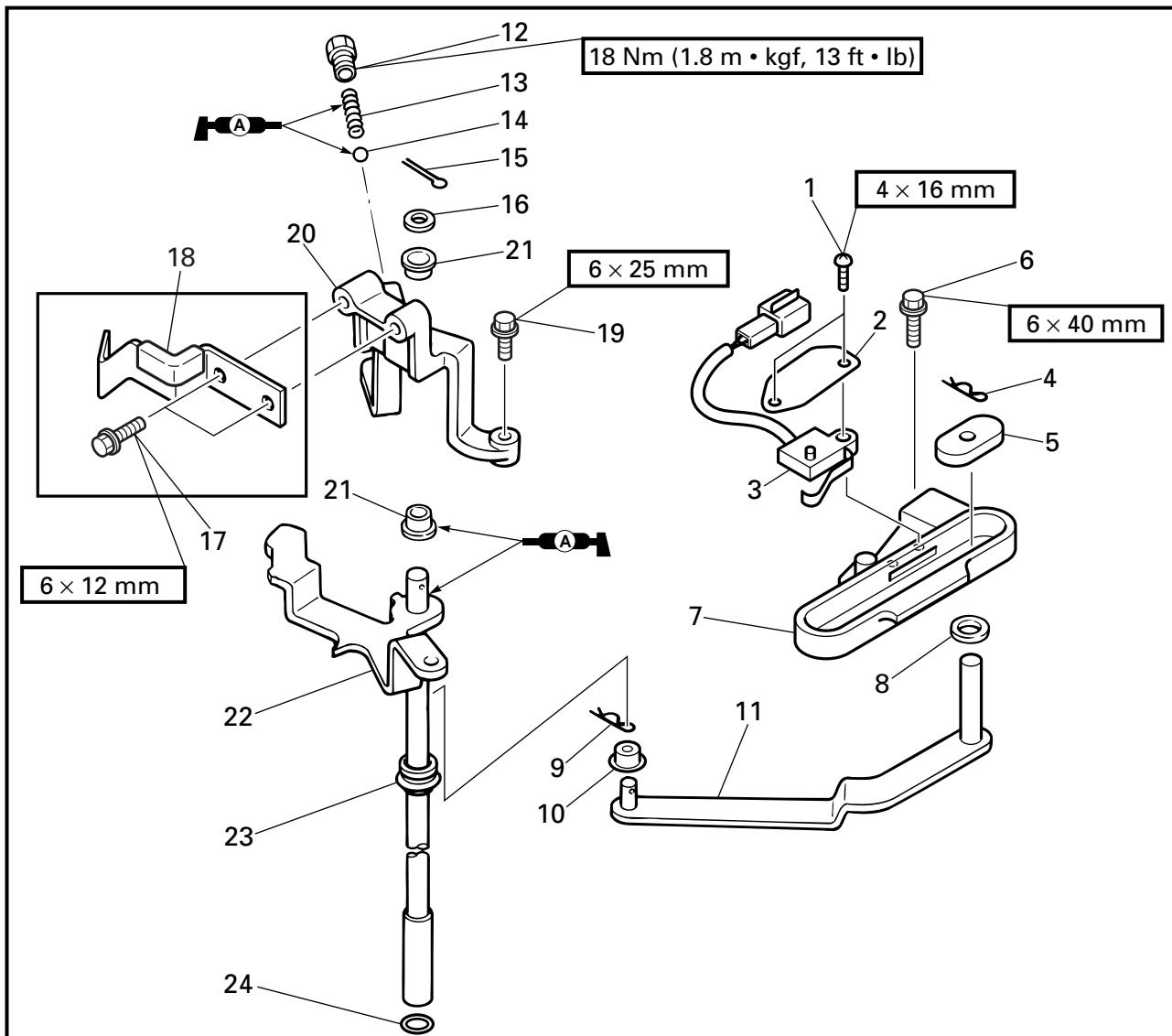


SHIFT ROD ASSEMBLY

E

SHIFT ROD ASSEMBLY

REMOVING/INSTALLING THE SHIFT ROD ASSEMBLY



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

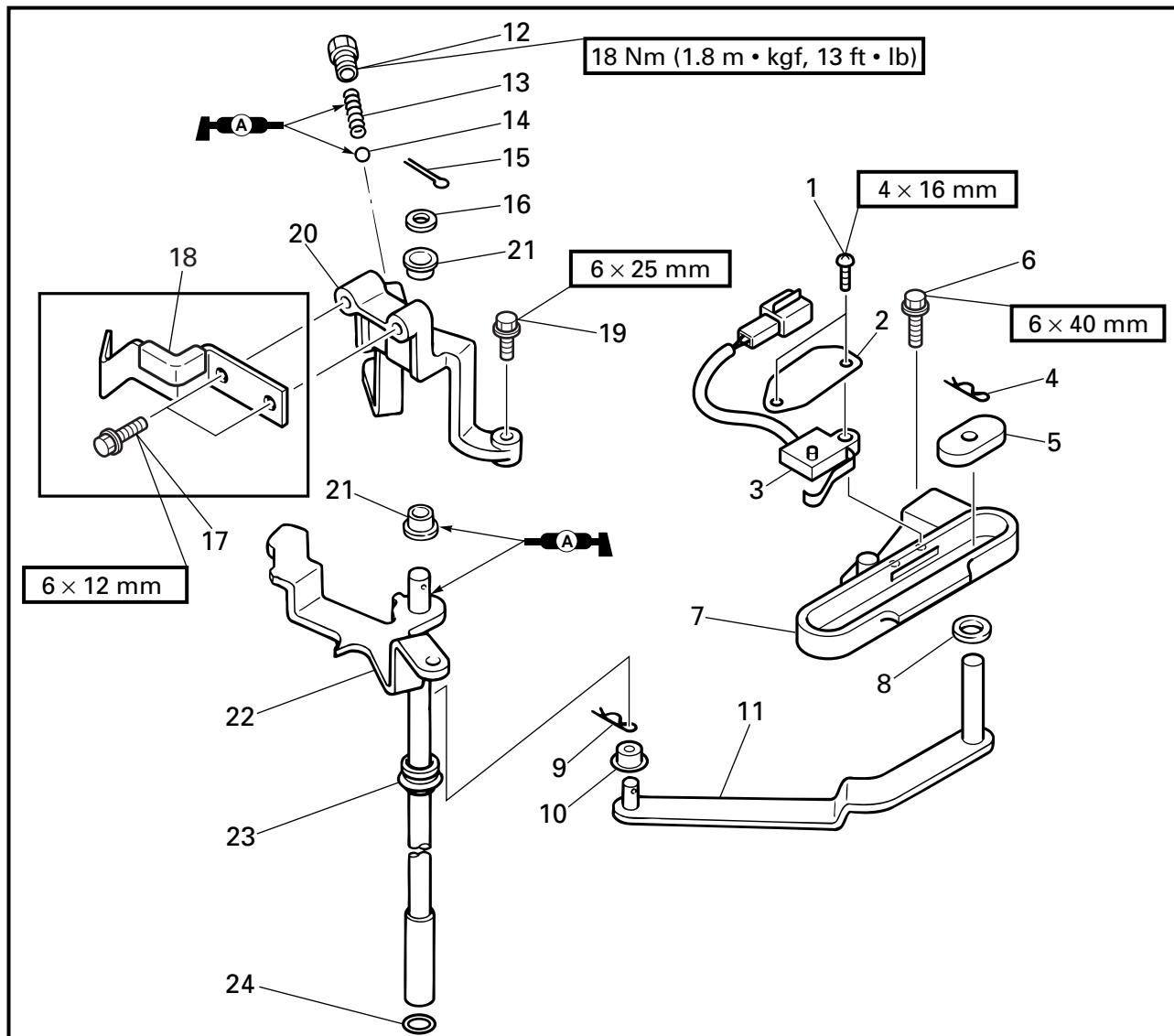
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SHIFT ROD ASSEMBLY

E



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	

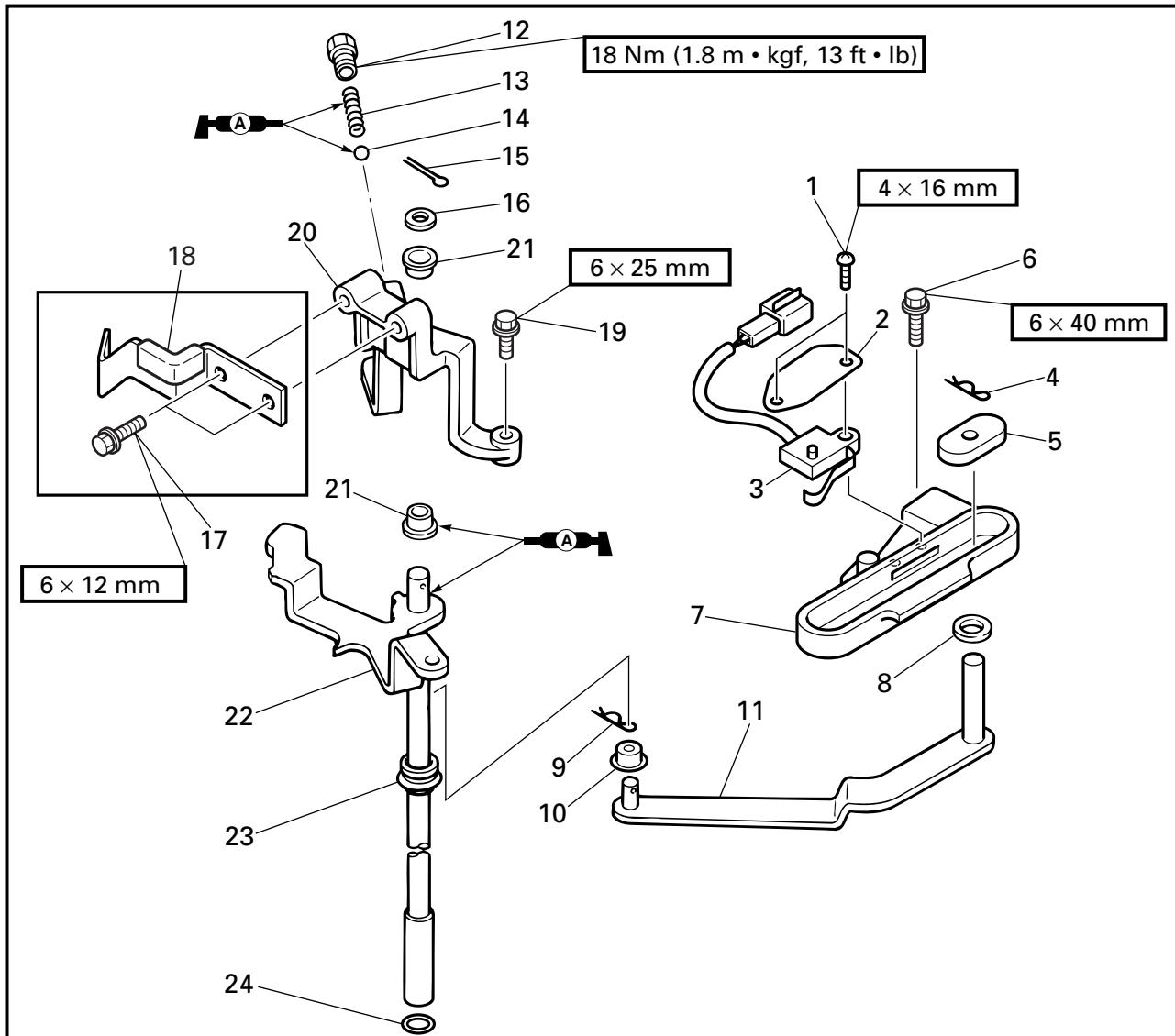
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SHIFT ROD ASSEMBLY

E



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.

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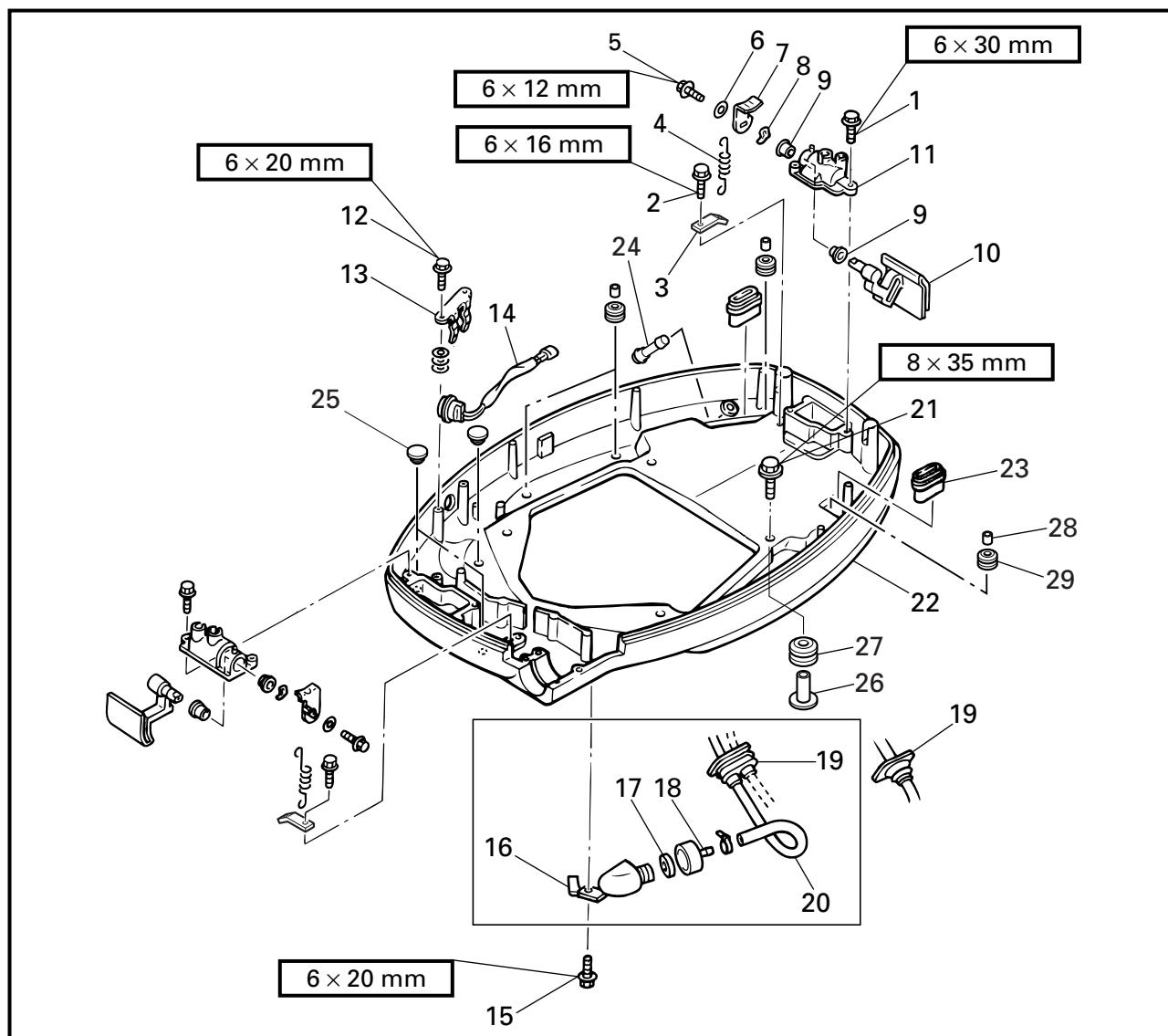


BOTTOM COWLING

E

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	

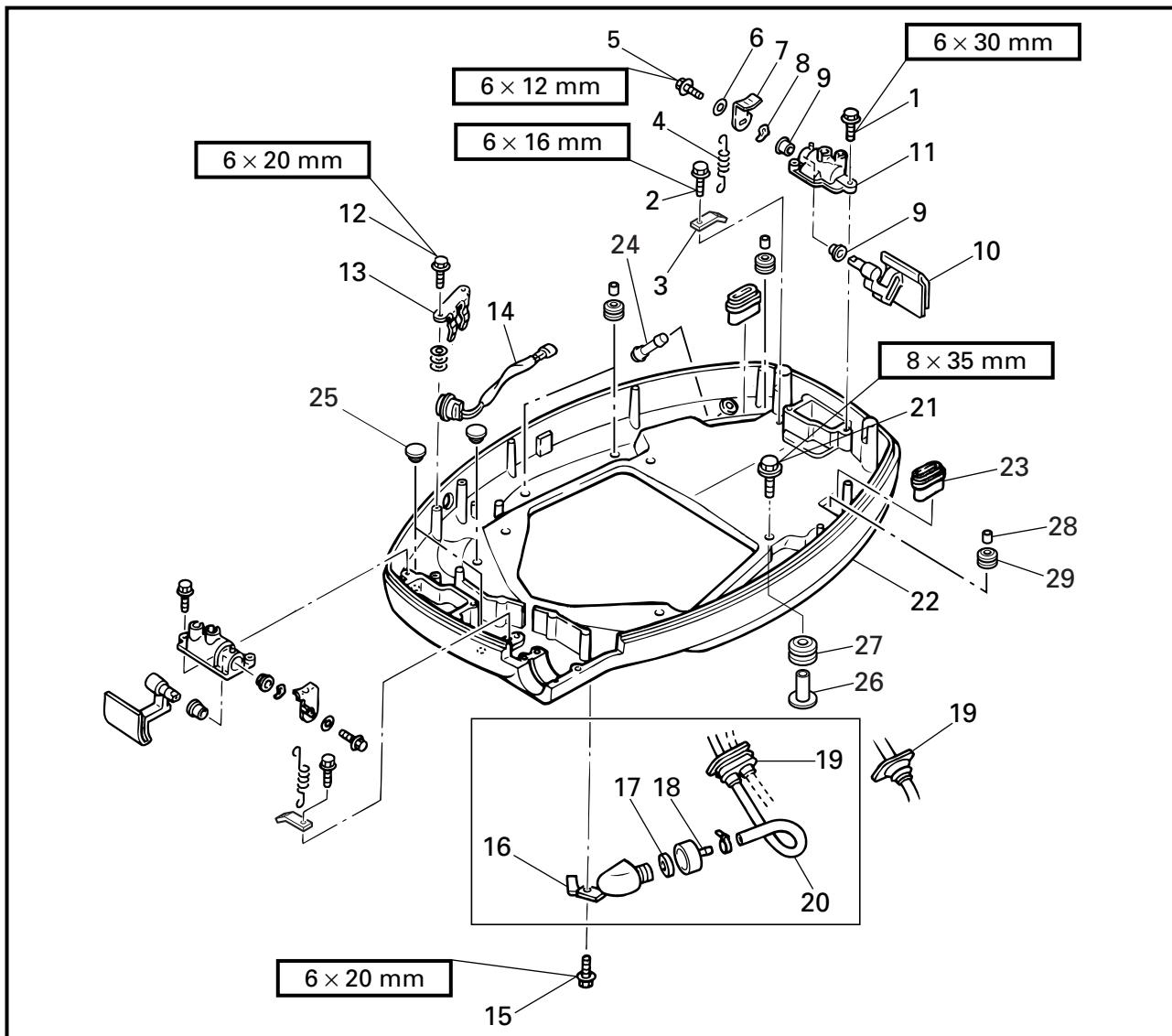
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BOTTOM COWLING

E



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	

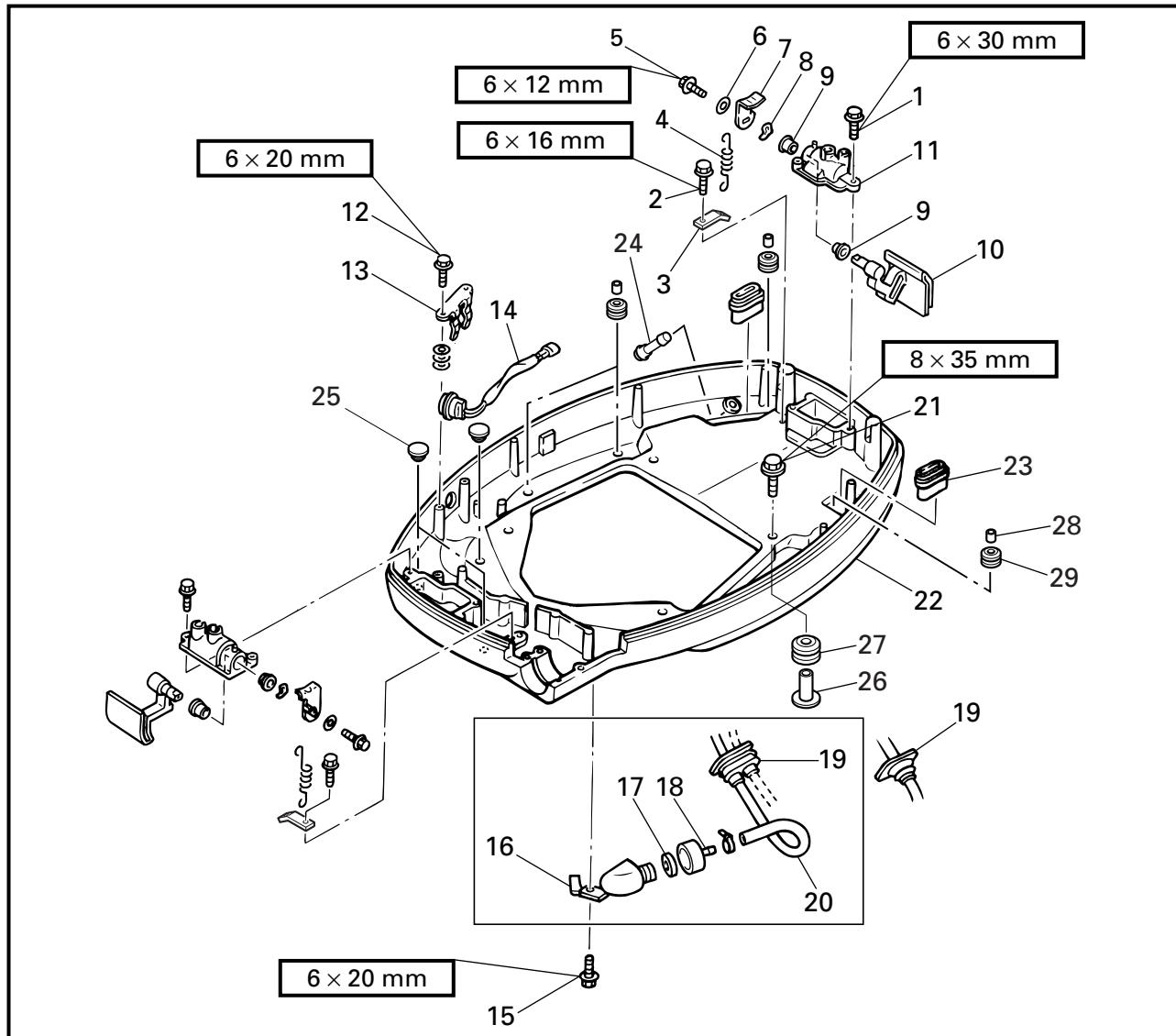
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BOTTOM COWLING

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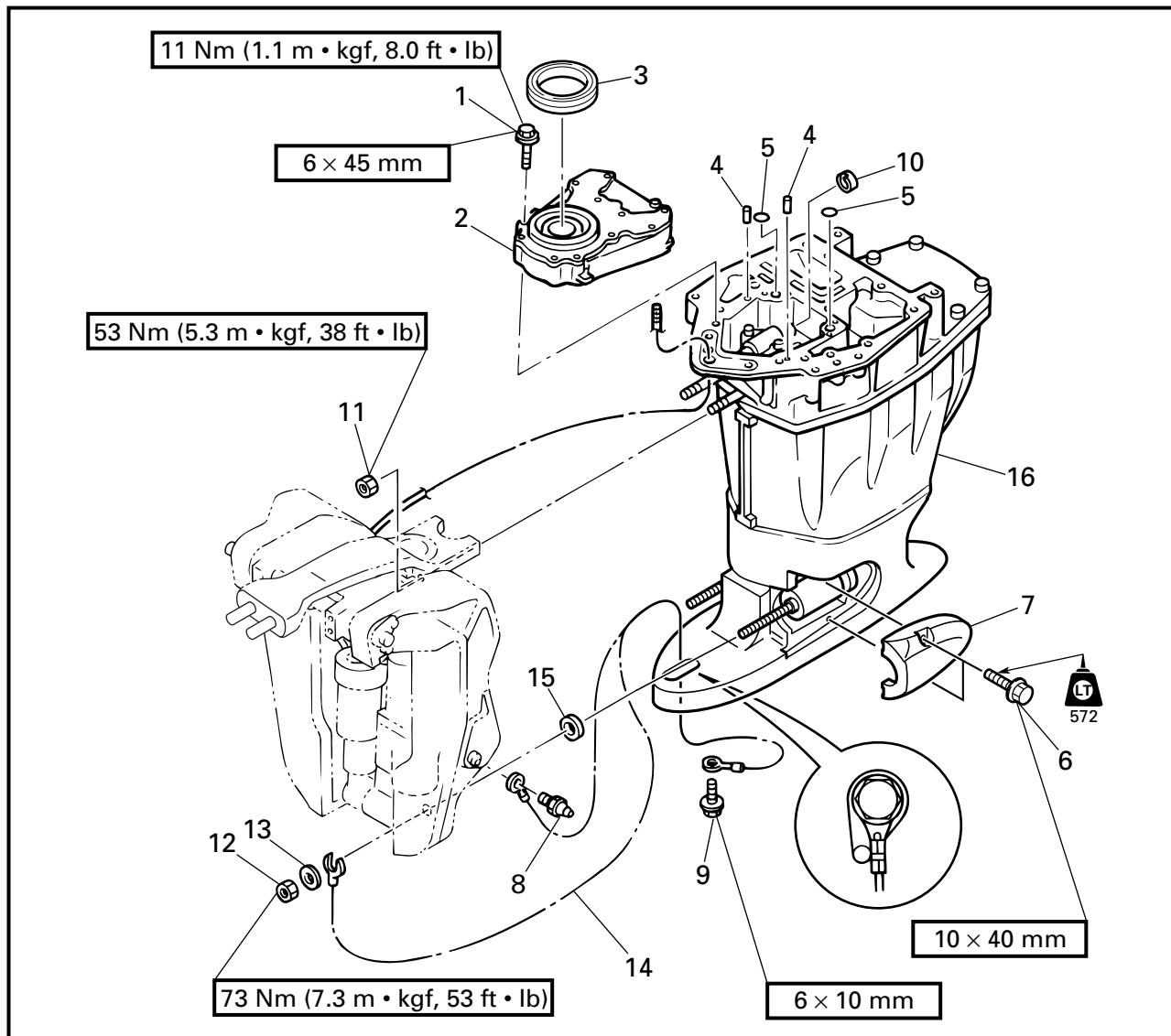
Order	Job/Part	Q'ty	Remarks
20	Hose	1	
21	Bolt	4	
22	Bottom cowling	1	
23	Grommet	2	
24	Water outlet	1	
25	Cap	3	
26	Collar	4	
27	Grommet	4	
28	Collar	4	
29	Grommet	4	
			For installation, reverse the removal procedure.

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UPPER CASE ASSEMBLY

E

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	1	
3	Seal	1	
4	Dowel pin	2	
5	O-ring	2	
6	Bolt	4	

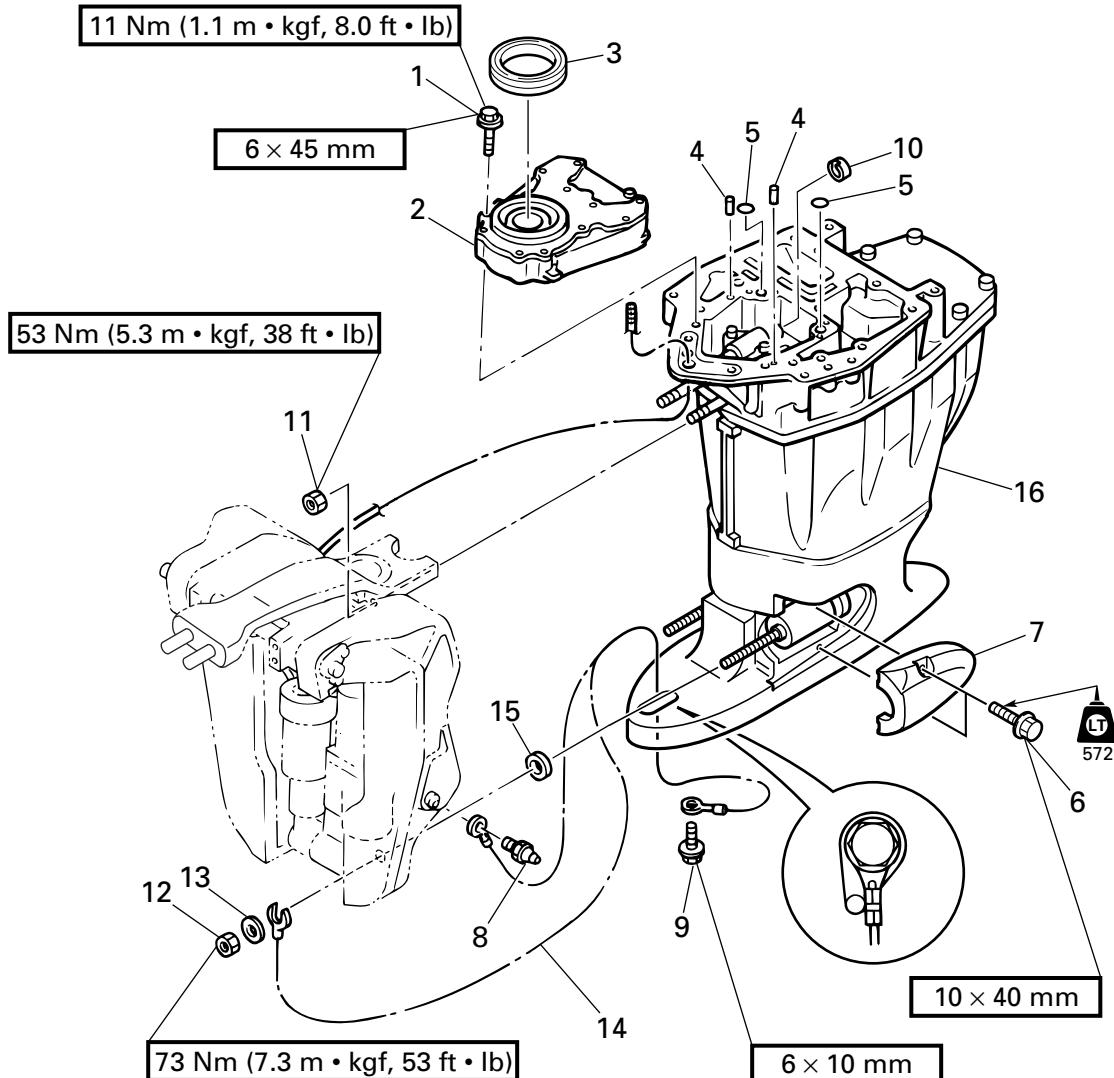
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UPPER CASE ASSEMBLY

E



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.

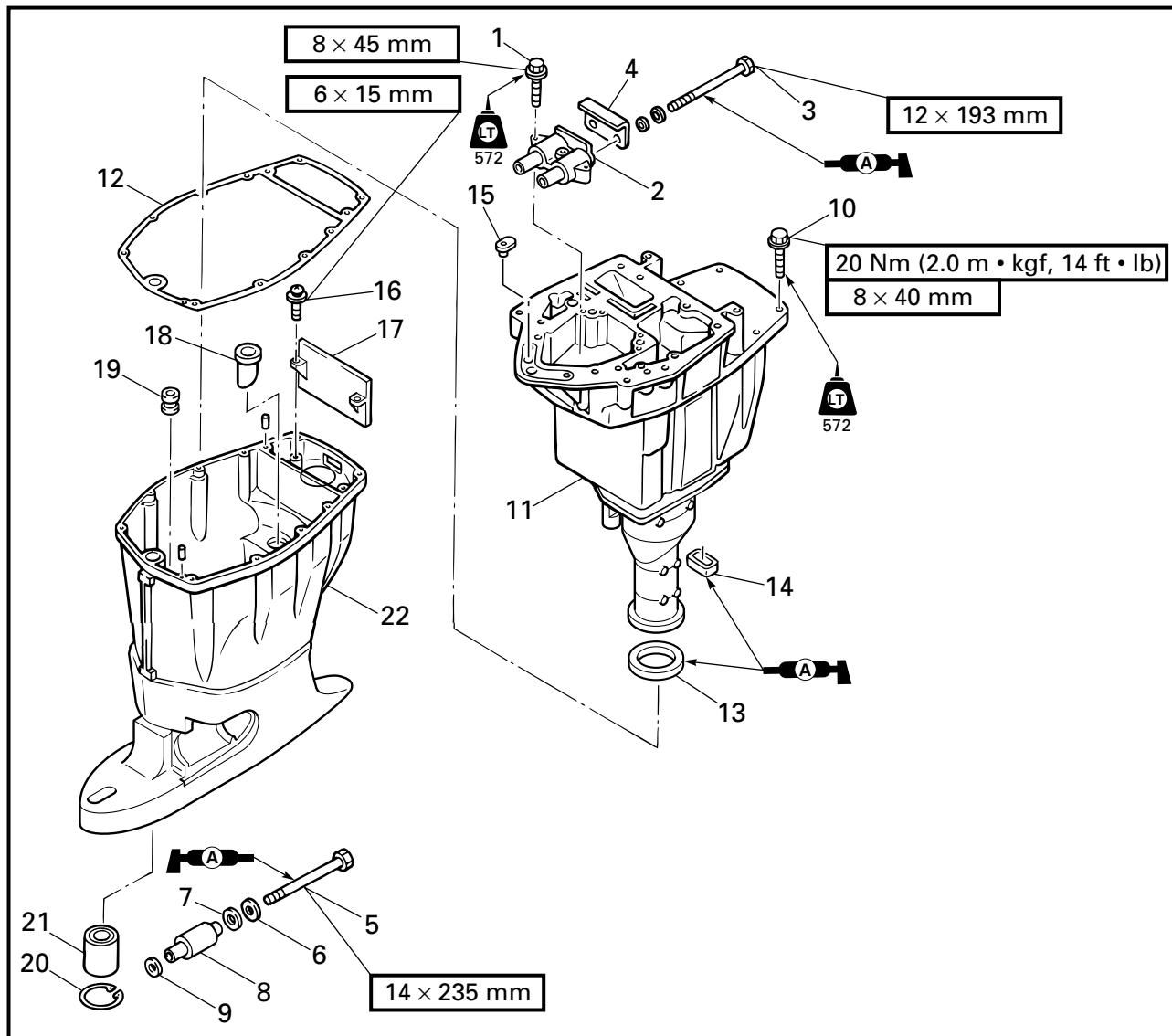
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UPPER CASE ASSEMBLY

E

DISASSEMBLING/ASSEMBLING THE UPPER CASE ASSEMBLY



Order	Job/Part	Q'ty	Remarks
1	Bolt	4	
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	

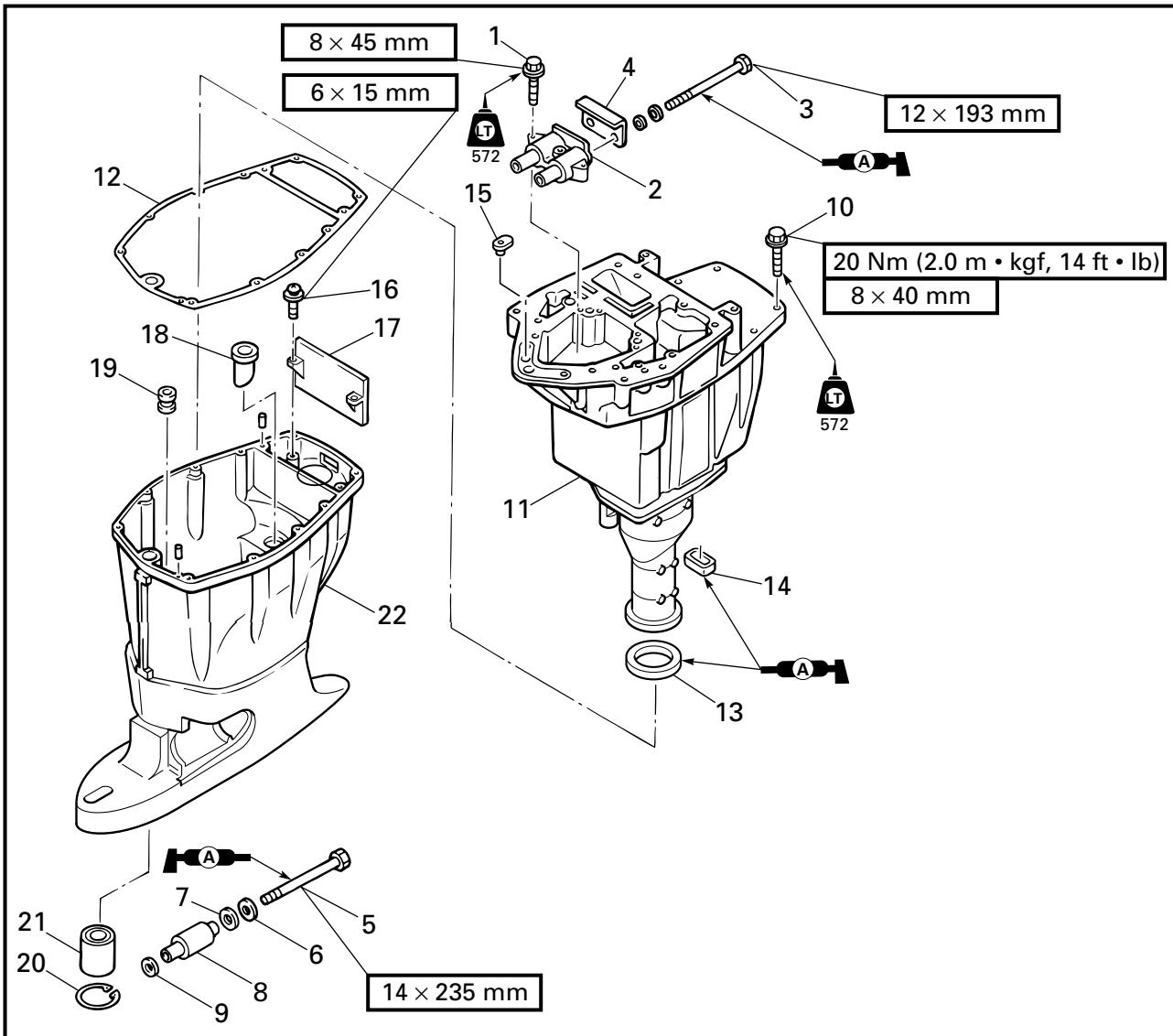
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UPPER CASE ASSEMBLY

E



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

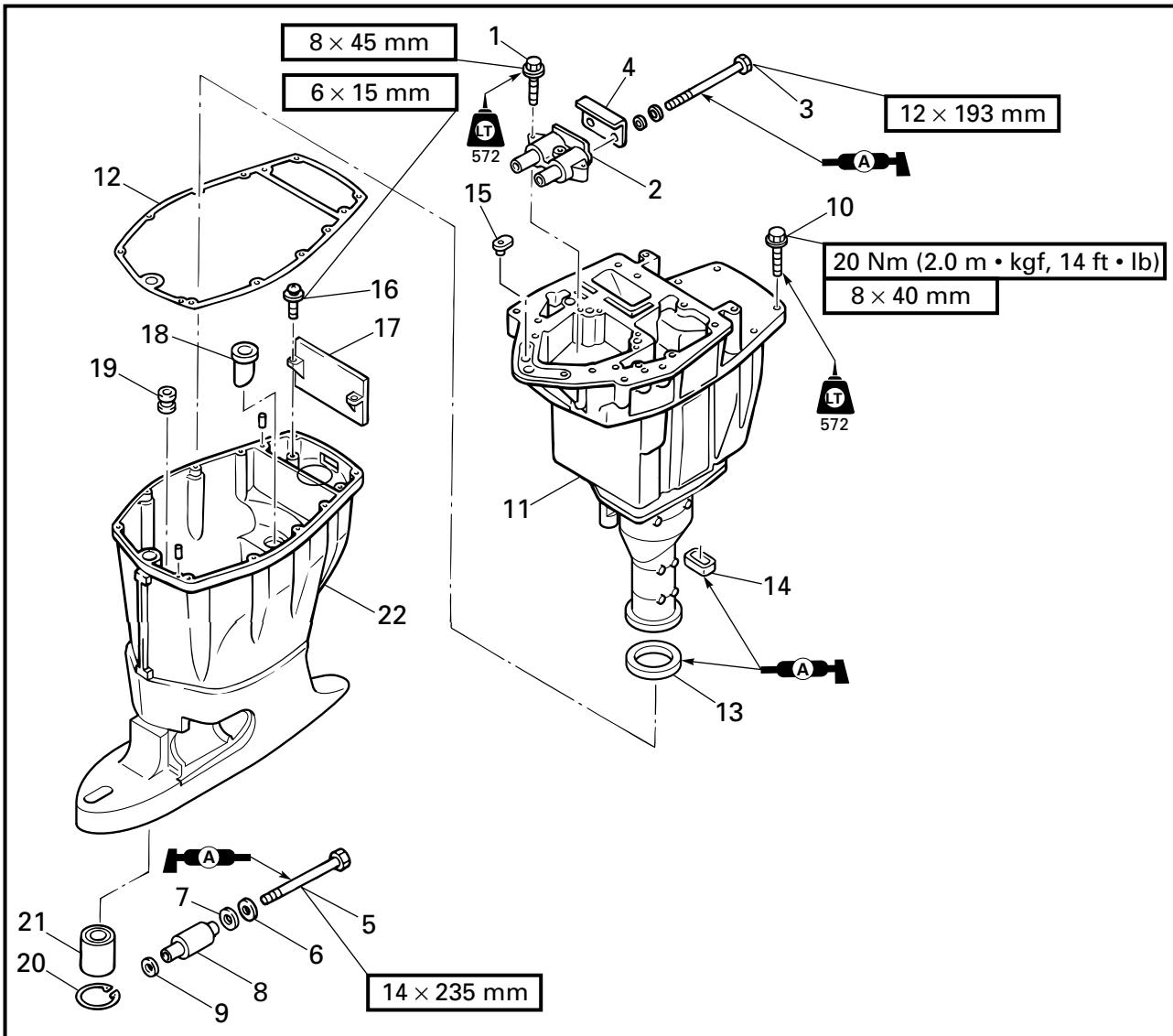
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UPPER CASE ASSEMBLY

E



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

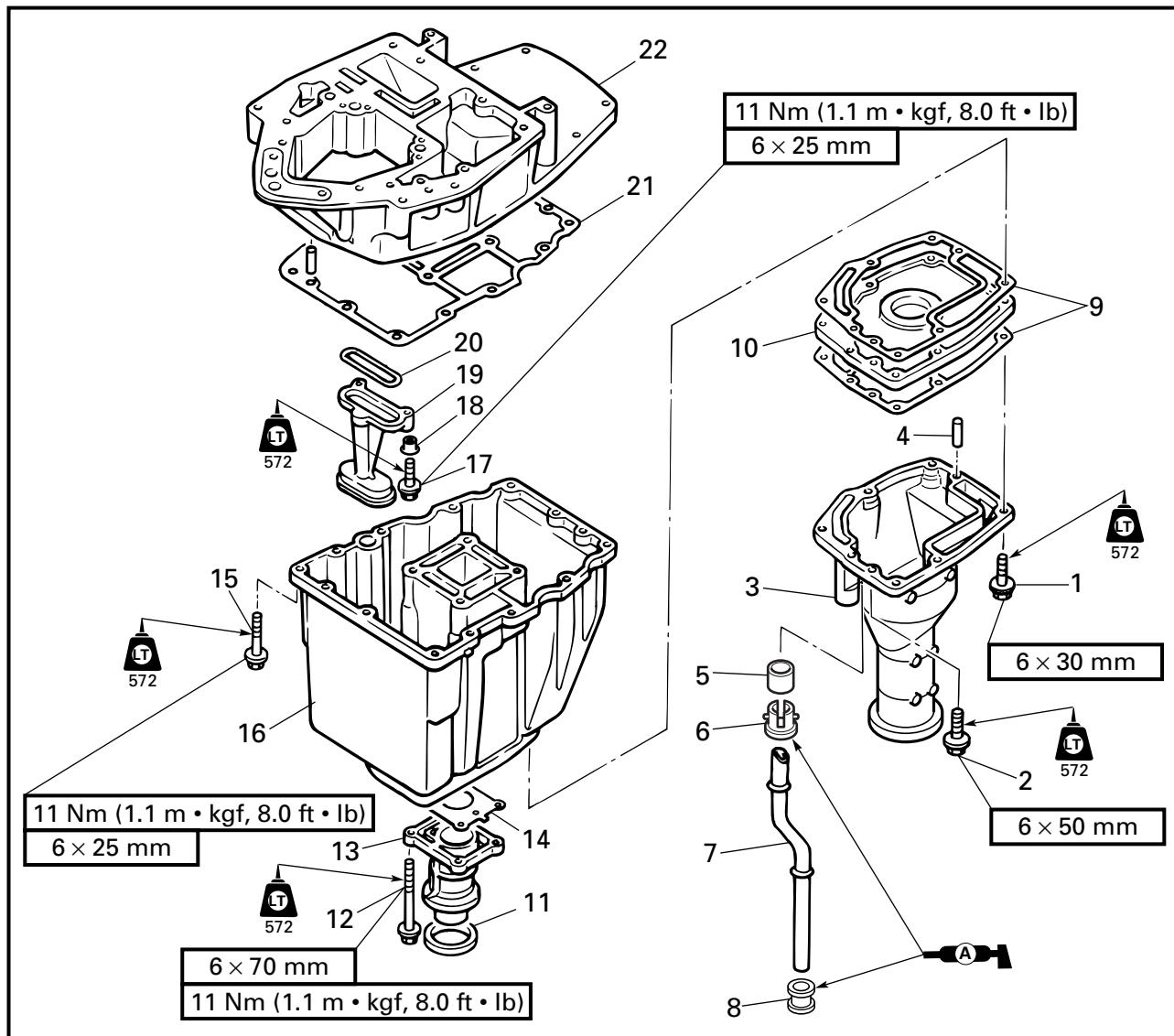
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OIL PAN

E

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	

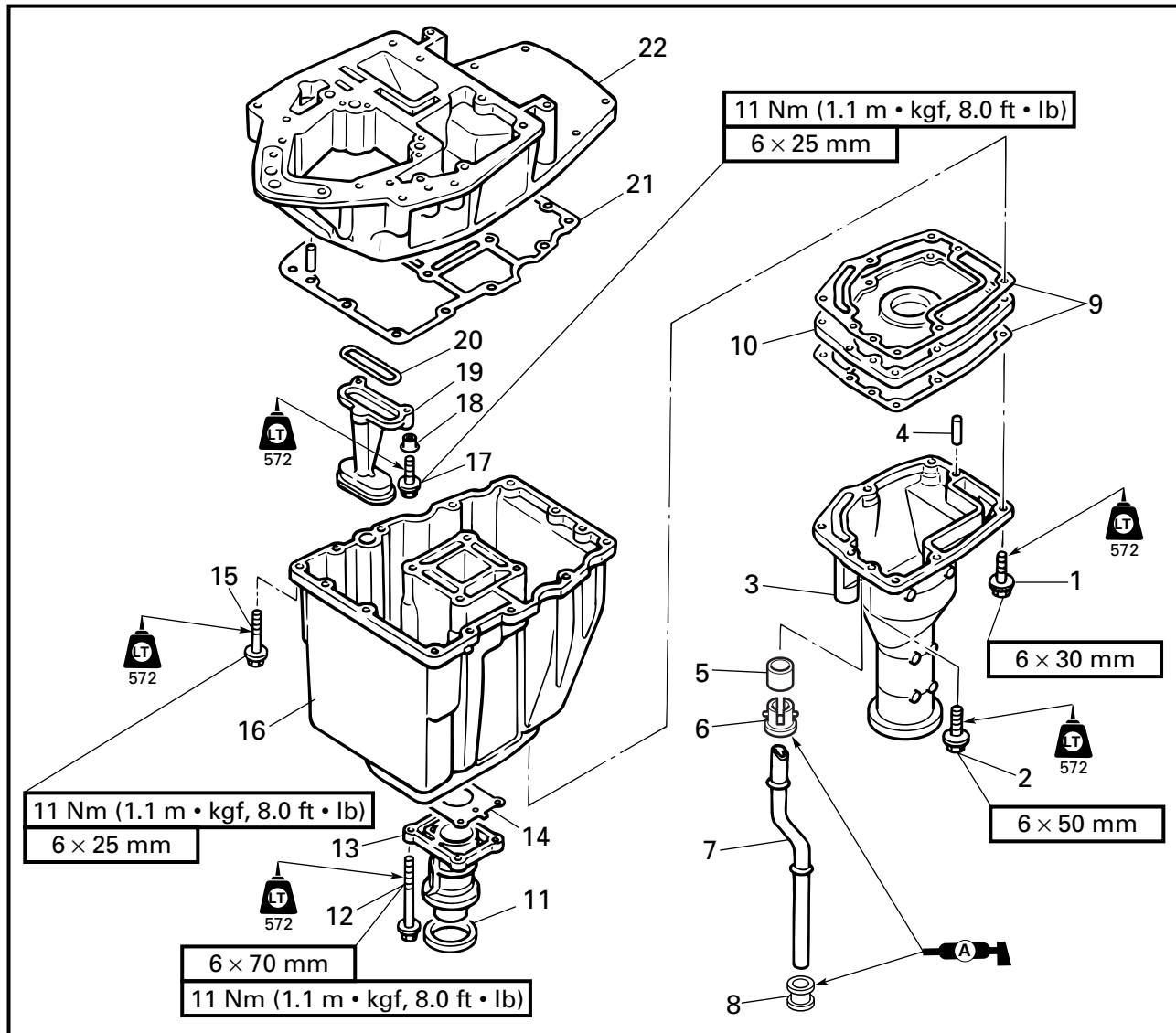
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OIL PAN

E



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	
14	Gasket	1	Not reusable
15	Bolt	12	
16	Oil pan	1	

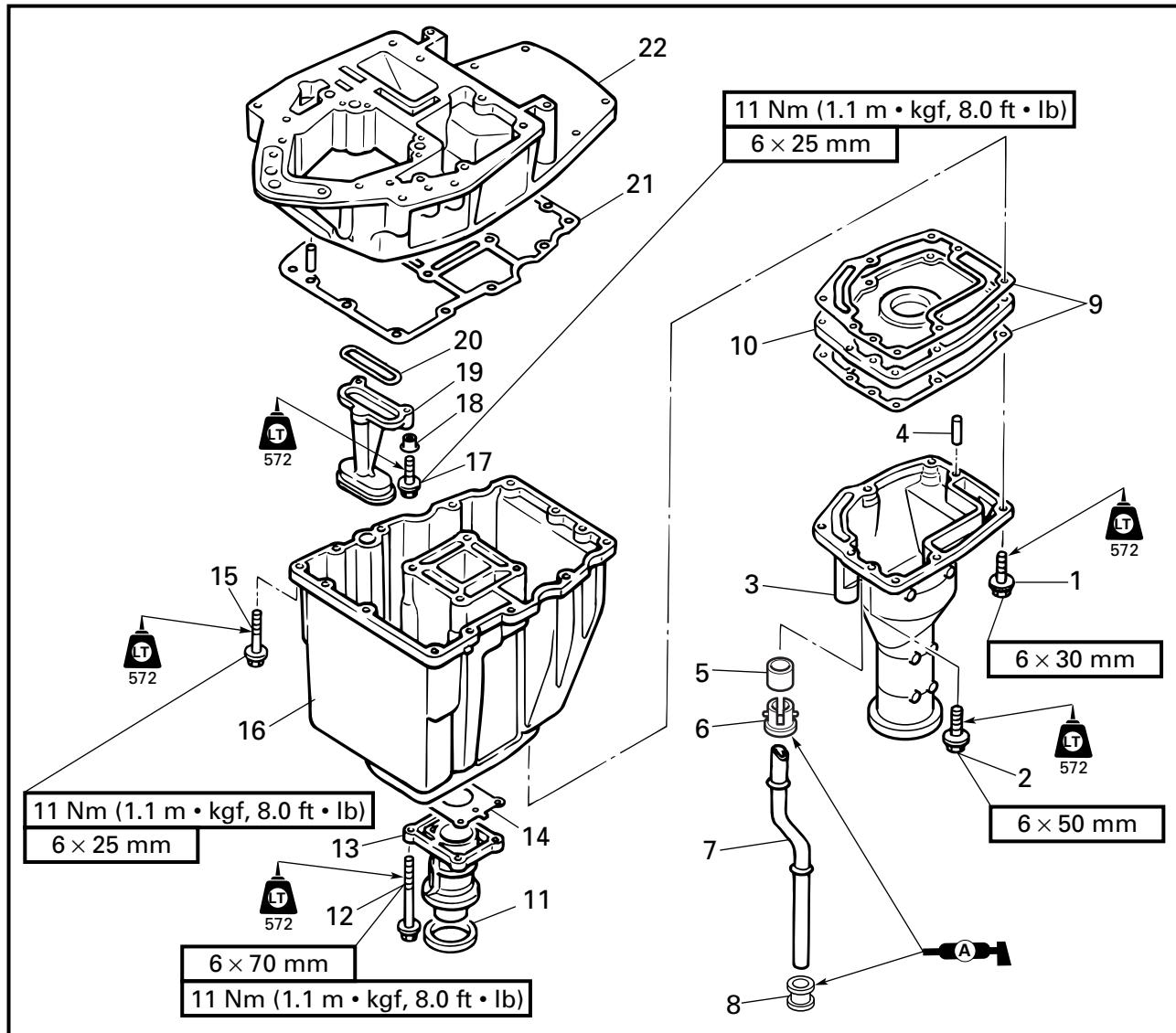
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OIL PAN

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

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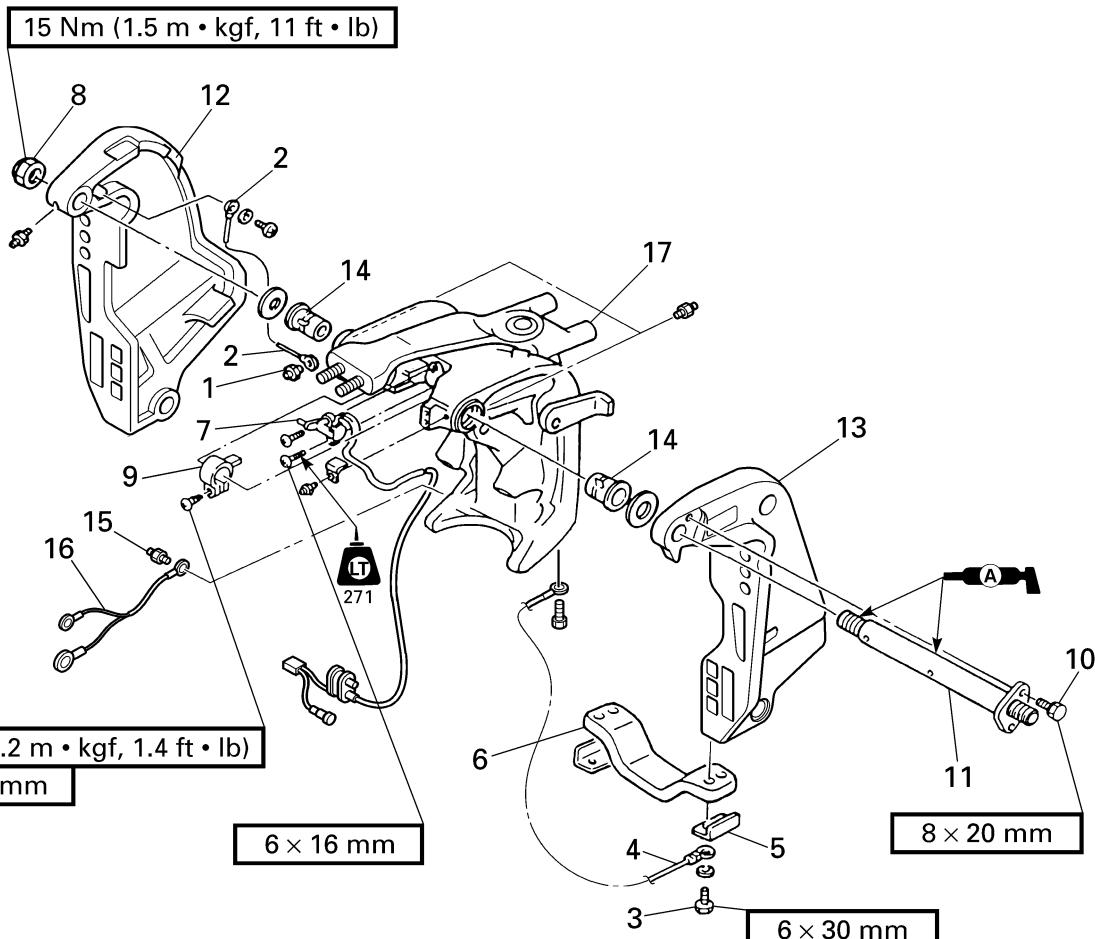


CLAMP BRACKETS

E

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	

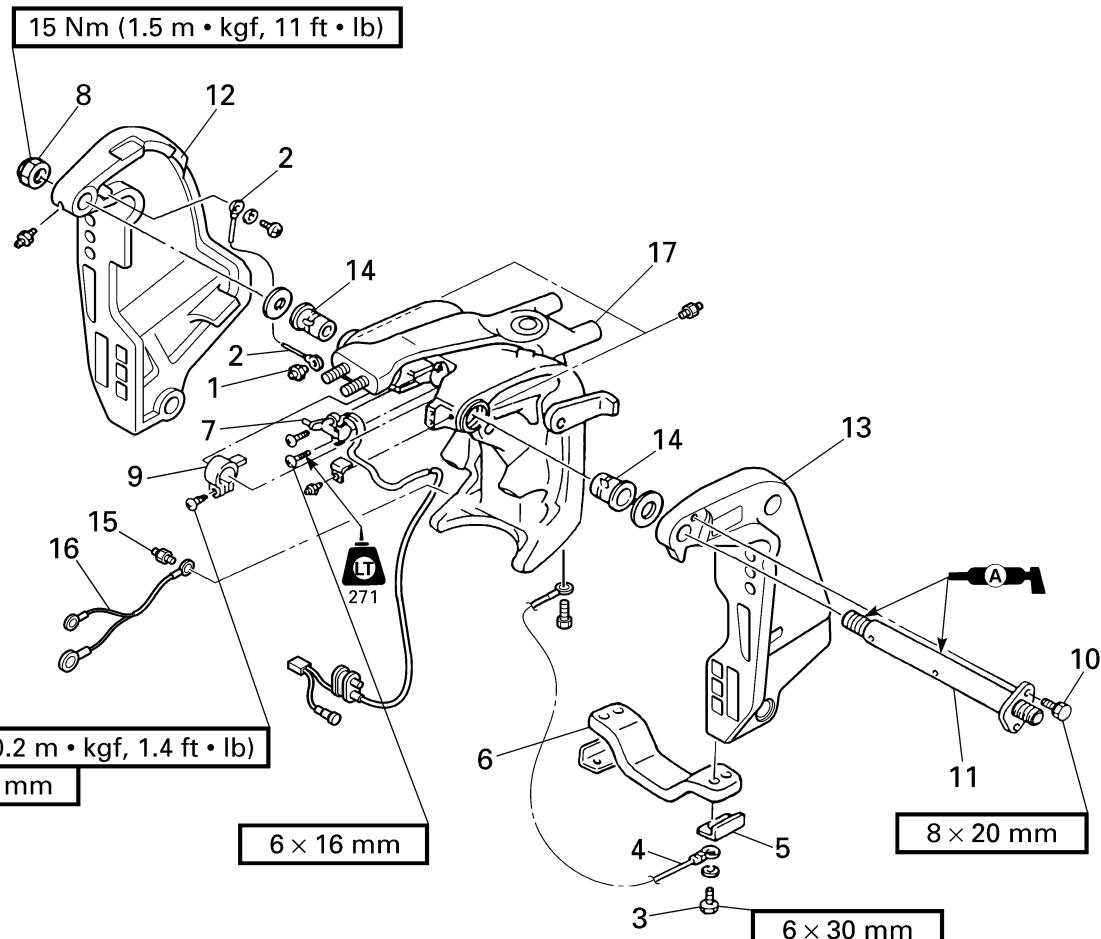
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CLAMP BRACKETS

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Order	Job/Part	Q'ty	Remarks
9	Cam	1	
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	For installation, reverse the removal procedure.

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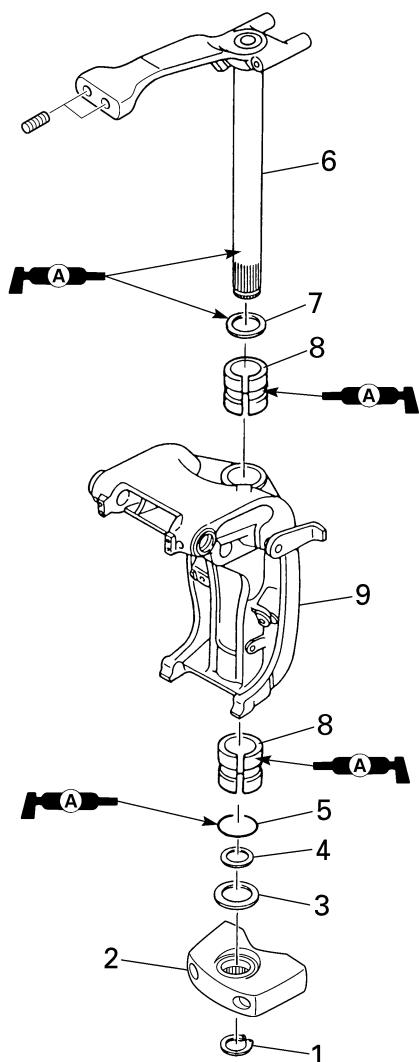


STEERING ARM

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STEERING ARM

REMOVING/INSTALLING THE STEERING ARM



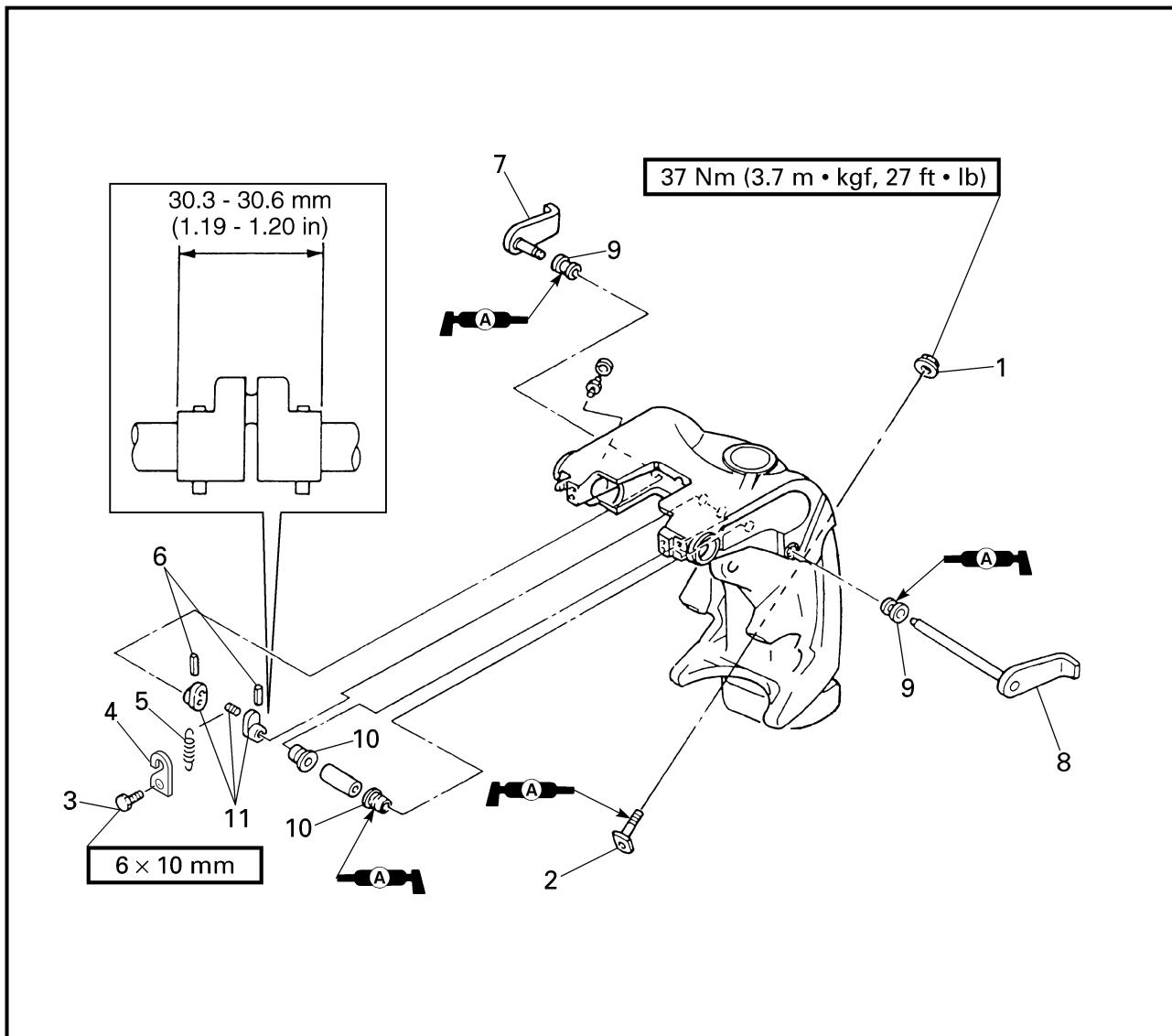
Order	Job/Part	Q'ty	Remarks
	Upper case assembly		Refer to "UPPER CASE ASSEMBLY" on page 7-16.
1	Circlip	1	
2	Steering arm yoke	1	
3	Washer	1	
4	Washer	1	
5	O-ring	1	
6	Steering arm	1	
7	Washer	1	
8	Bushing	2	
9	Swivel bracket assembly	1	For installation, reverse the removal procedure.

BRKT



SWIVEL BRACKET ASSEMBLY

E

SWIVEL BRACKET ASSEMBLY
DISASSEMBLING/ASSEMBLING THE SWIVEL BRACKET ASSEMBLY


Order	Job/Part	Q'ty	Remarks
1	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	

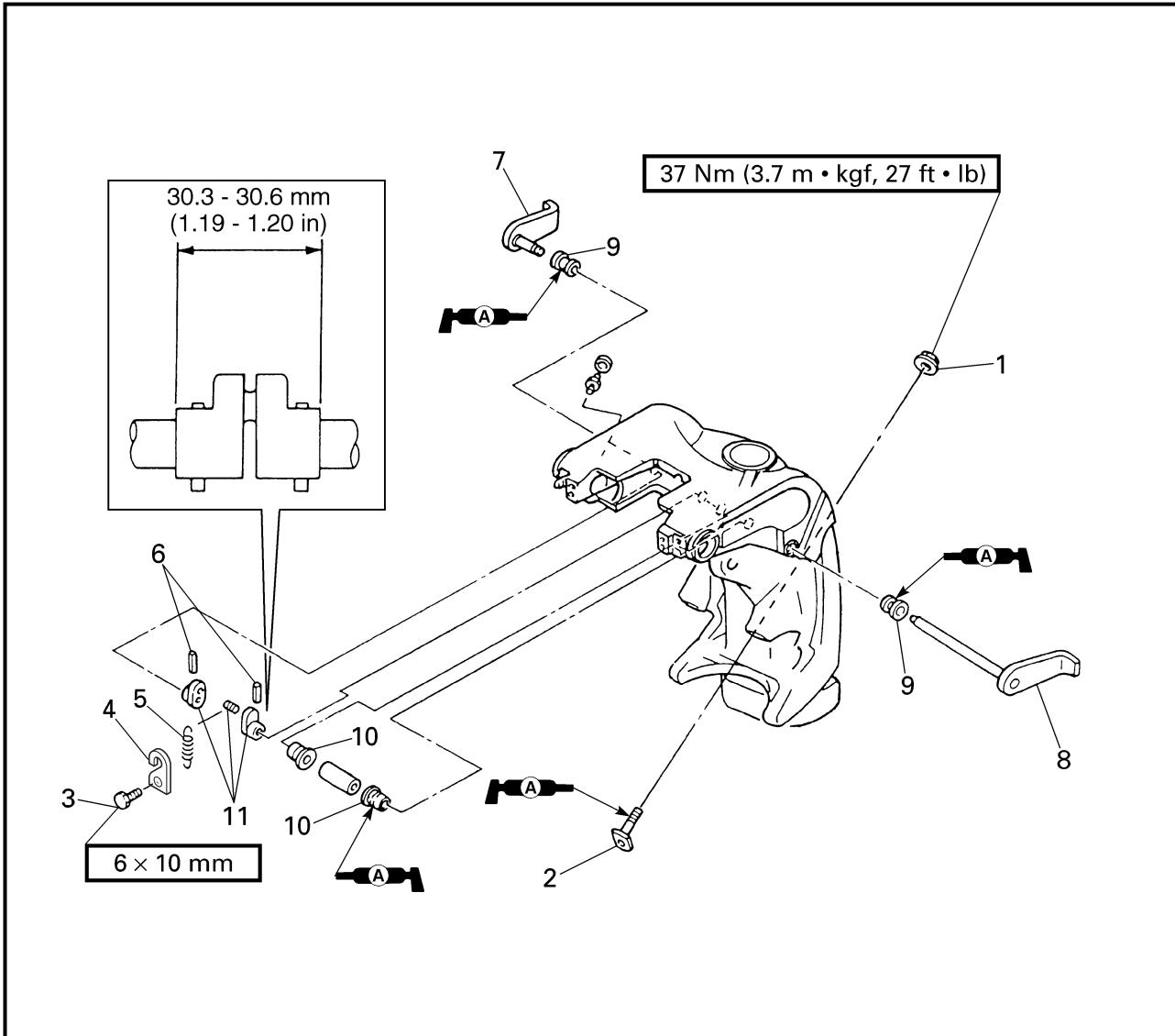
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SWIVEL BRACKET ASSEMBLY

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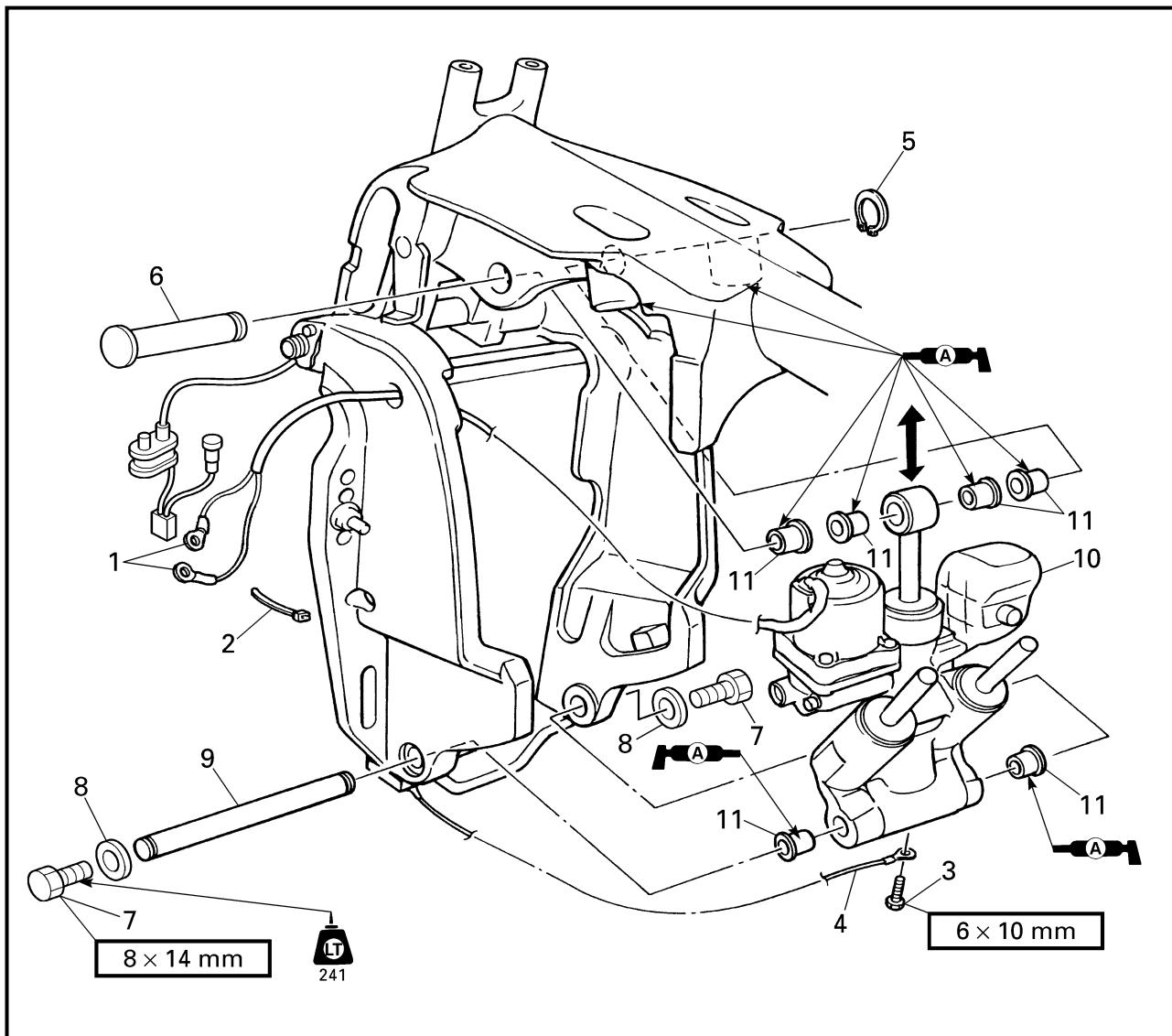
Order	Job/Part	Q'ty	Remarks
7	Starboard tilt stop lever	1	
8	Port tilt stop lever	1	
9	Bushing	2	
10	Bushing	2	
11	Tilt stop lever joint assembly	1	For assembly, reverse the disassembly procedure.

BRKT



POWER TRIM AND TILT UNIT

E

POWER TRIM AND TILT UNIT
REMOVING/INSTALLING THE POWER TRIM AND TILT UNIT


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

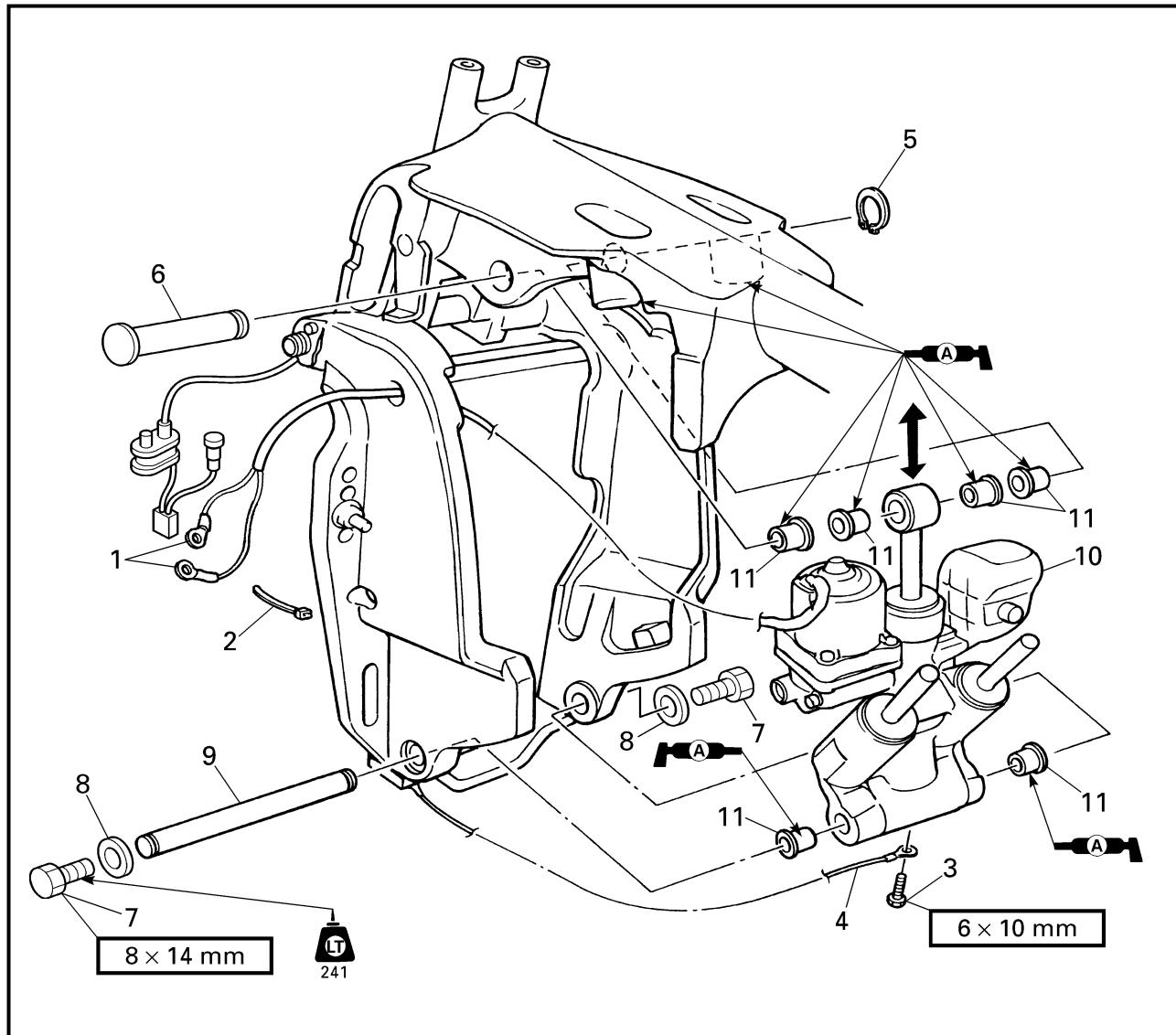
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BRKT



POWER TRIM AND TILT UNIT

E



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

BRKT

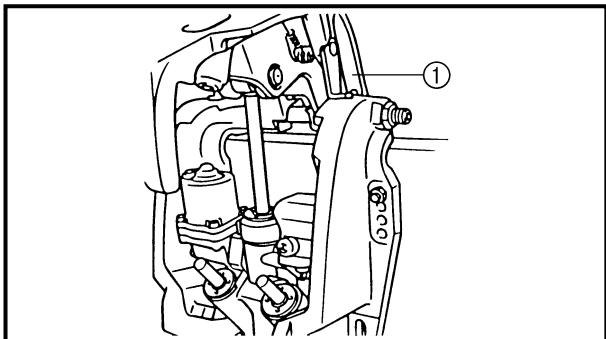
POWER TRIM AND TILT UNIT

E

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:

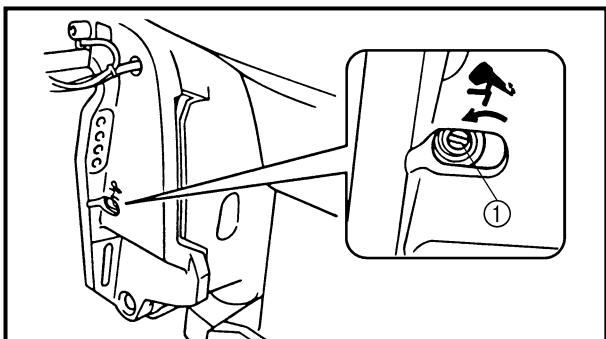
Install the power trim and tilt unit onto the outboard before bleeding.

Bleed:

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

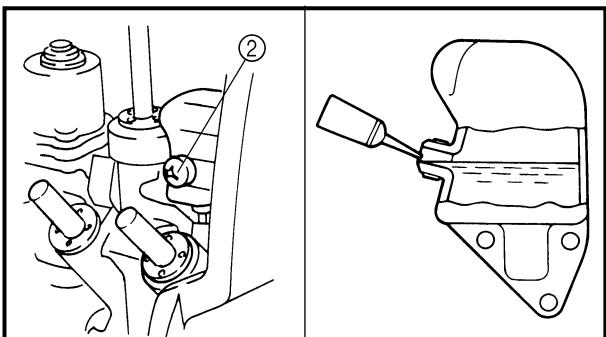
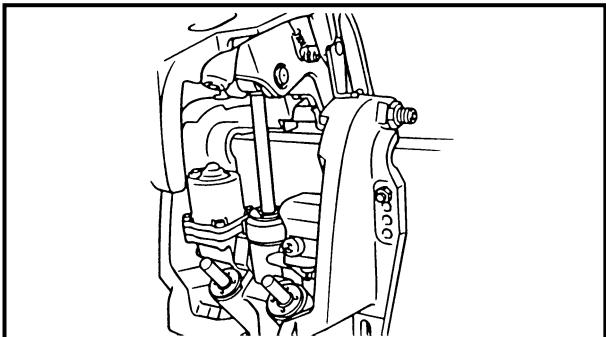
Bleeding steps

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



BRKT**POWER TRIM AND TILT UNIT**

E



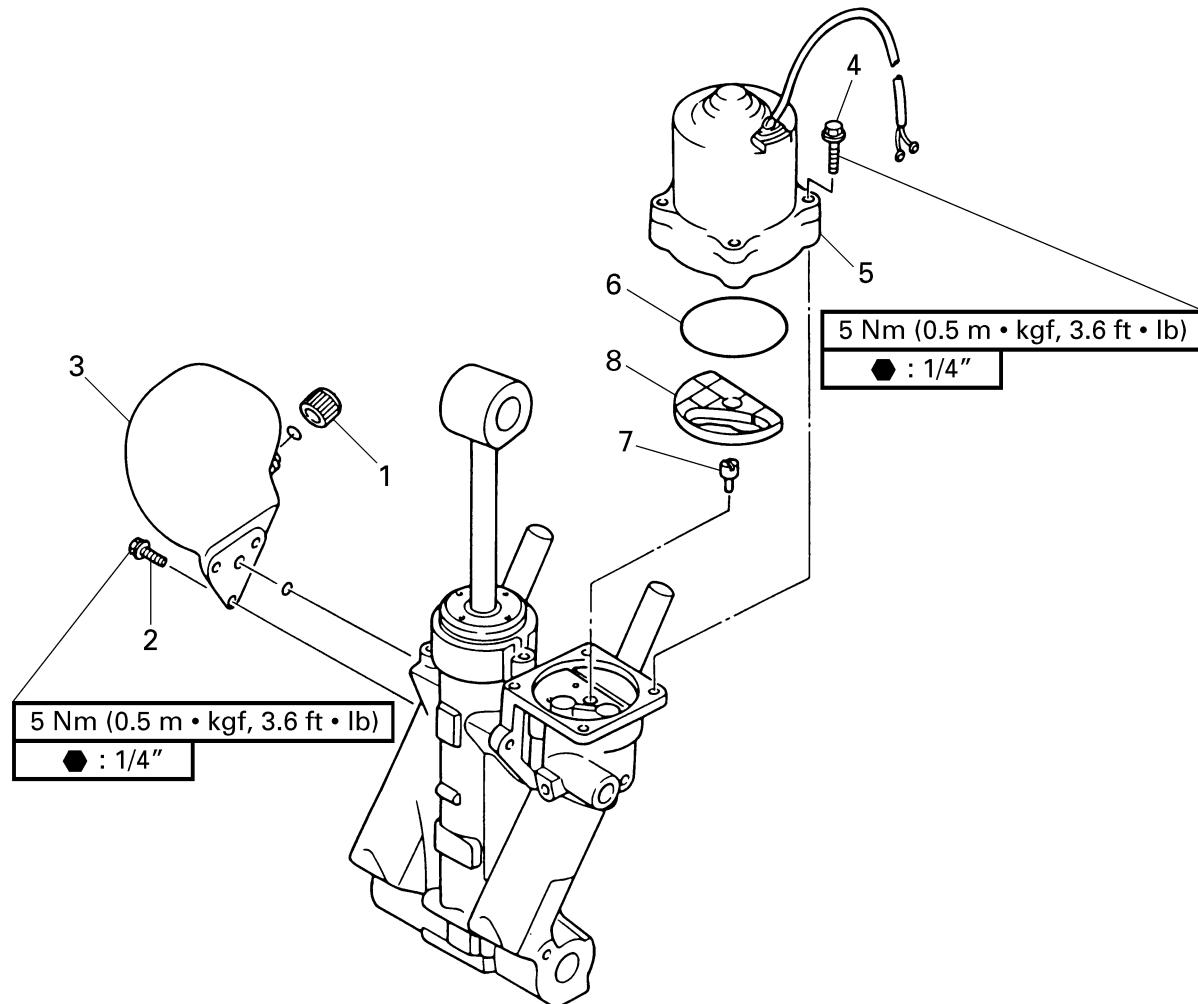
- (3) Tilt up the outboard fully, then release it, and let it lower by its own weight.
- (4) Tighten the manual valve by turning it clockwise.
- (5) Let the power trim and tilt fluid settle for about 5 minutes.
- (6) Push and hold the power trim and tilt switch in the up position until the outboard is 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.

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RESERVOIR AND POWER TRIM AND TILT MOTOR

E

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 spouting out due to internal pressure, the outboard 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 malfunctions if they enter the system.

CHECKING THE RESERVOIR

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

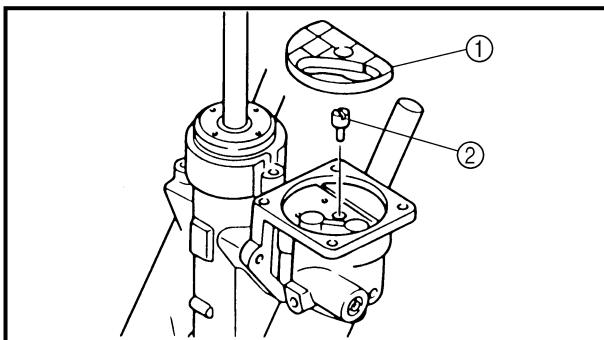
**CHECKING THE GEAR PUMP
HOUSING FILTER**

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

BRKT

RESERVOIR AND POWER TRIM AND TILT MOTOR

E



INSTALLING THE POWER TRIM AND TILT MOTOR

1. Install:

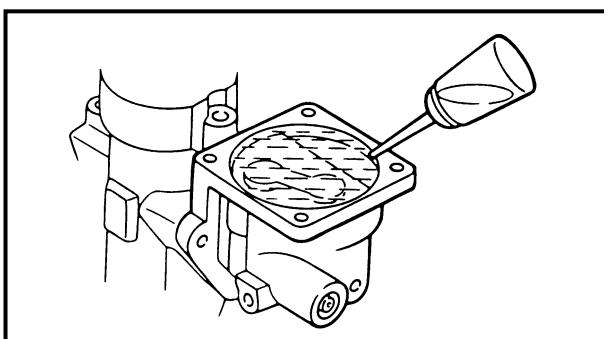
- Gear pump housing filter ①
- Drive pin ②

2. Fill:

- Gear pump housing



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

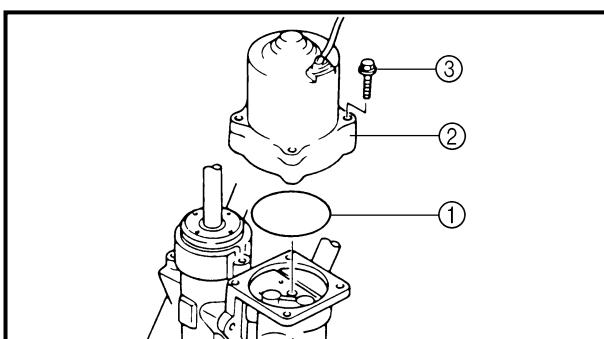


3. Bleed:

- 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 spouting out due to internal pressure, the tilt ram should be kept at full length.

1. Fill:

- Reservoir

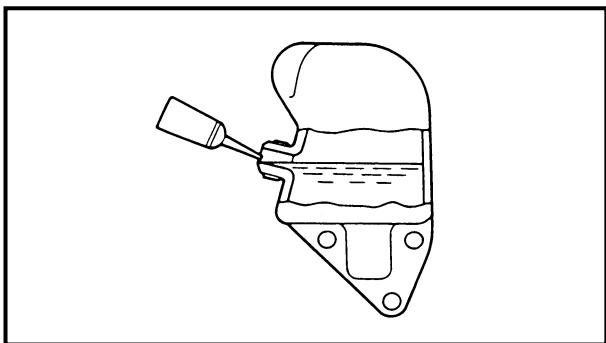


**Recommended power trim and tilt fluid
ATF Dexron II**

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 installing the power trim and tilt unit onto the outboard.

1. Bleed:

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

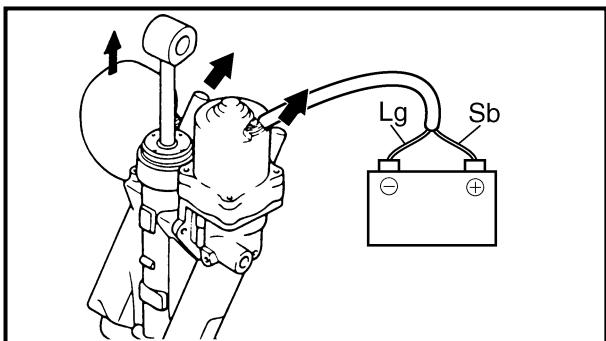
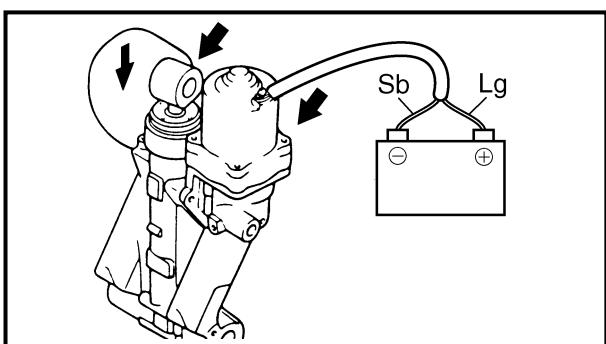
Bleeding steps

- (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:

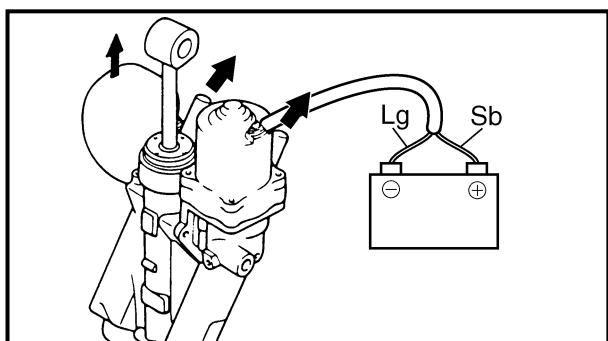
If the rams will not go down, refer to the following.

- 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.

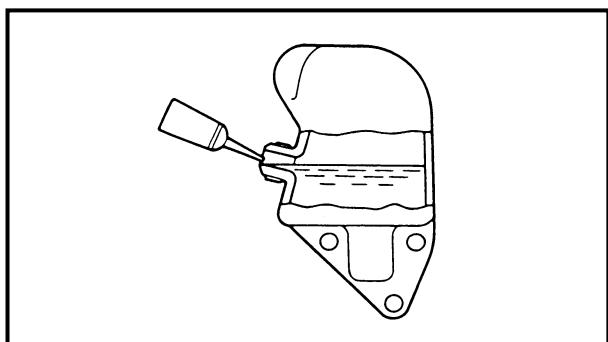




- B. If step A was unsuccessful, connect the leads on the battery terminals and fully compress the tilt ram assembly by hand.
- C. If step B was unsuccessful, loosen the manual valve, compress the trim and tilt ram assemblies fully by hand, and then tighten the manual valve. Then, compress and extend 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

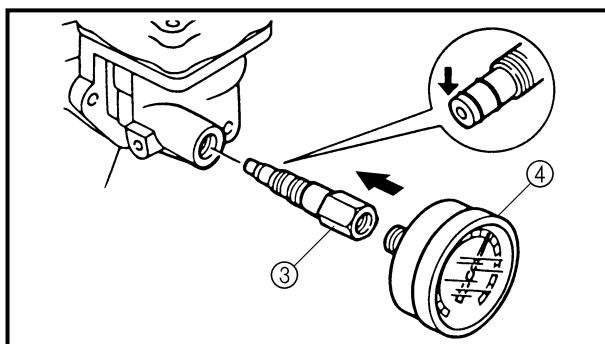
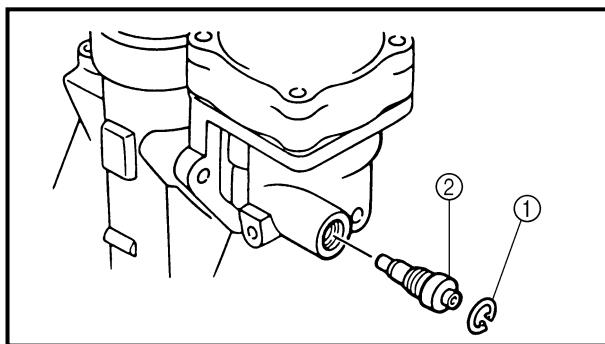
Out of specification → Repair.



**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

- (1) Fully tilt up the power trim and tilt ram assemblies.
- (2) Remove the circlip ①.
- (3) 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



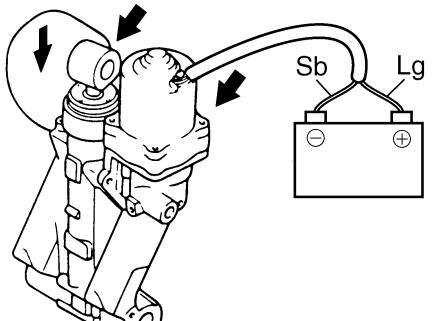
Hydraulic pressure gauge
9 Nm (0.9 m · kgf, 6.5 ft · lb)
Up-relief valve attachment
4 Nm (0.4 m · kgf, 2.9 ft · lb)

NOTE: _____

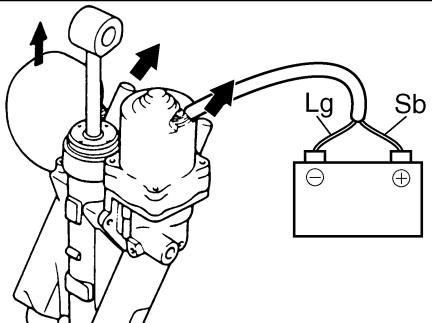
Remove the manual valve and then quickly attach the special tools before any fluid comes out.

BRKT**RESERVOIR AND POWER TRIM AND TILT MOTOR**

E



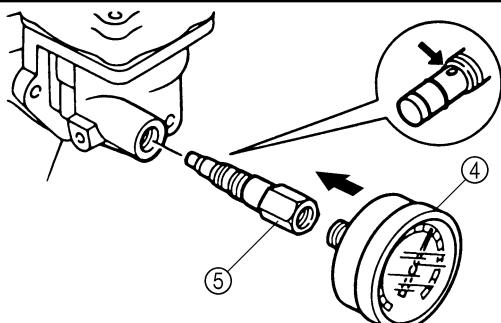
- (4) Connect the leads on the battery terminals in the down position until the power trim and tilt ram assemblies are fully compressed.



- (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)**



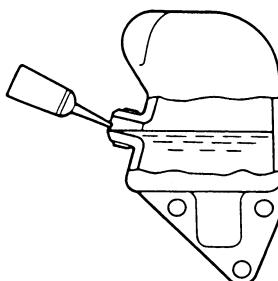
- (6) After measuring the hydraulic pressure, remove the special tools and quickly attach the down-relief valve attachment.



Hydraulic pressure gauge ④
90890-06776
Down-relief valve attachment. ⑤
90890-06774



**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)**



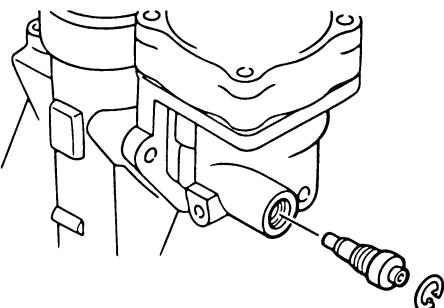
- (7) Remove the reservoir cap and check that fluid is up to the brim as shown. Add fluid if the level is below the brim.

- (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)

BRKT**RESERVOIR AND POWER TRIM AND TILT MOTOR****E**

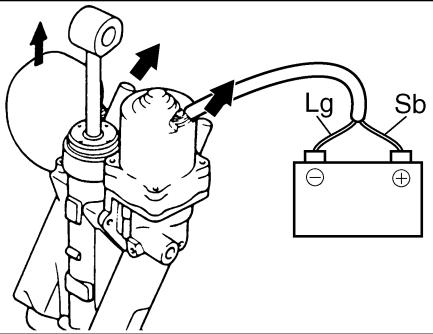
(10) After measuring the hydraulic pressure, connect the leads on the battery terminals in the up position until the power trim and tilt ram assemblies are fully extended.

(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.

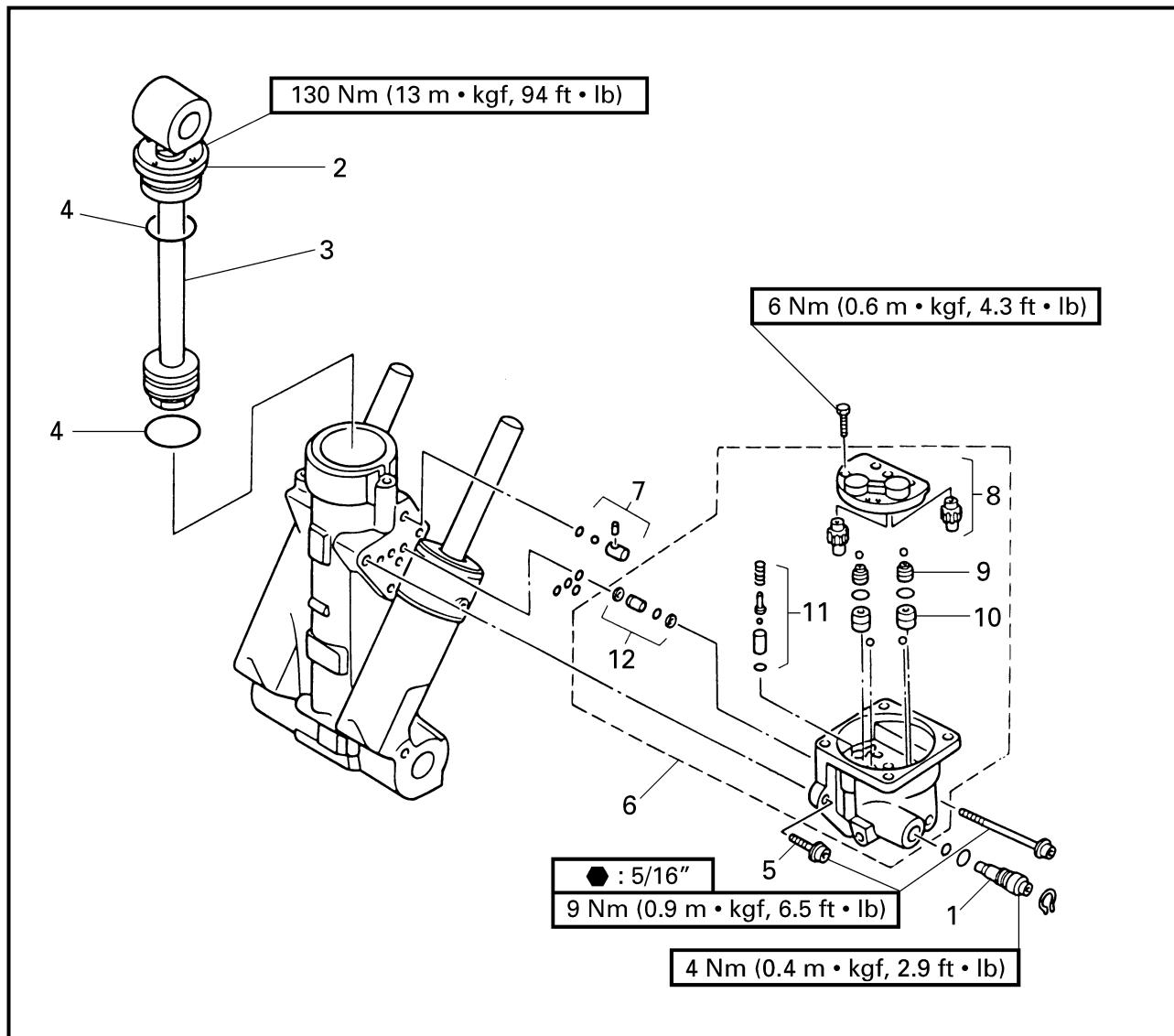


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TILT RAM ASSEMBLY AND GEAR PUMP UNIT

E

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	

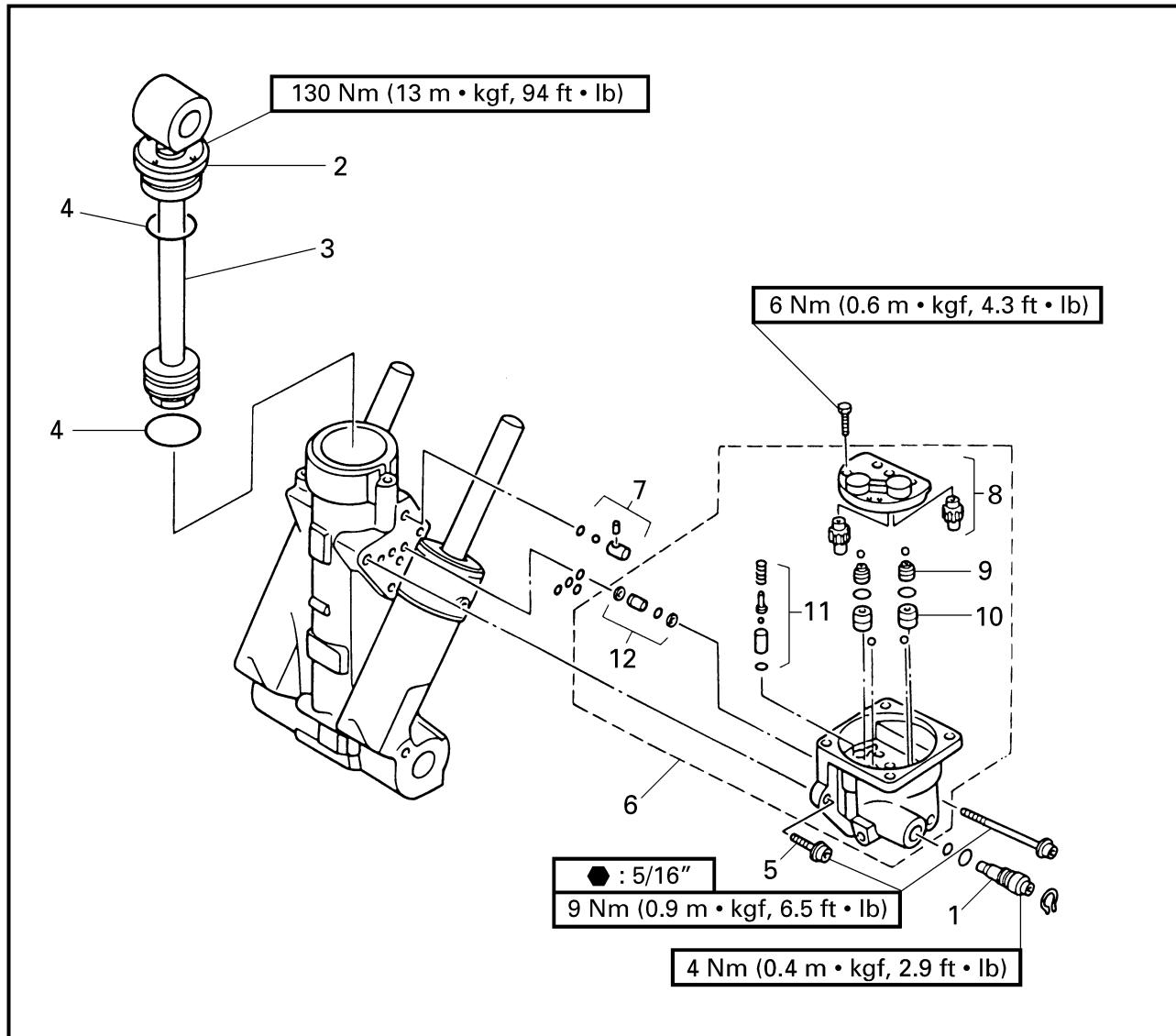
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TILT RAM ASSEMBLY AND GEAR PUMP UNIT

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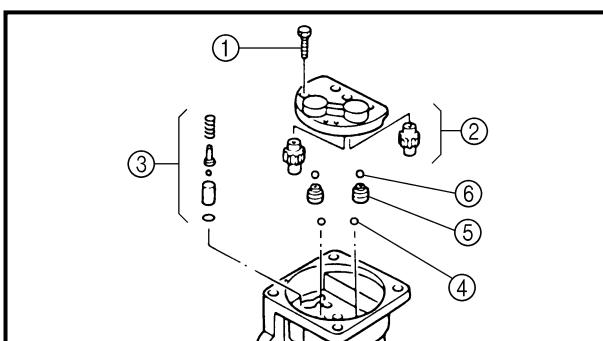
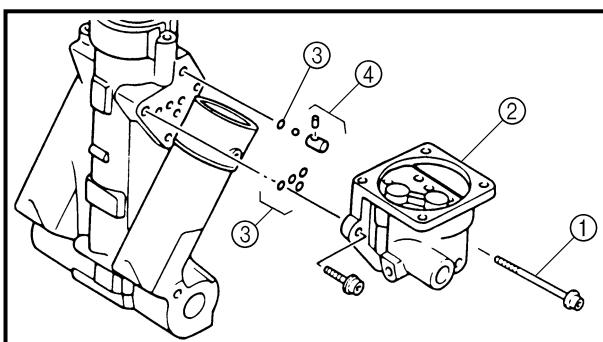
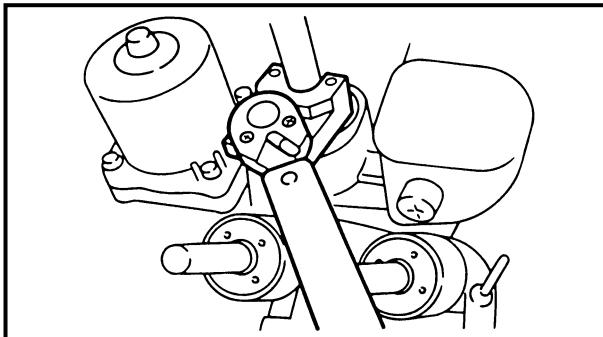


Order	Job/Part	Q'ty	Remarks
7	Check valve assembly	1	
8	Gear pump	1	
9	Shuttle valve	2	
10	Check valve	2	
11	Up-relief valve assembly	1	
12	Down-relief valve assembly	1	For installation, reverse the removal procedure.

BRKT

TIlt RAM ASSEMBLY AND GEAR PUMP UNIT

E



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

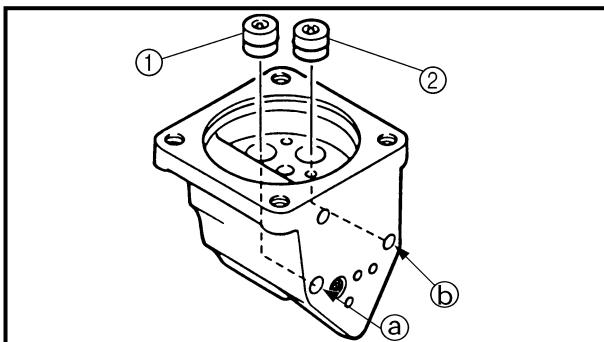
NOTE: _____

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

BRKT

TILT RAM ASSEMBLY AND GEAR PUMP UNIT

E



2. Remove:

- Check valves (1) and (2)

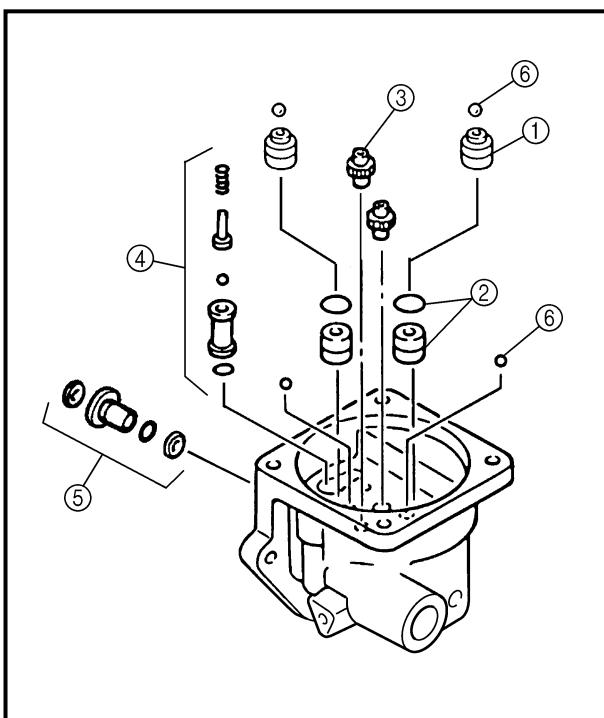
NOTE:

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

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:

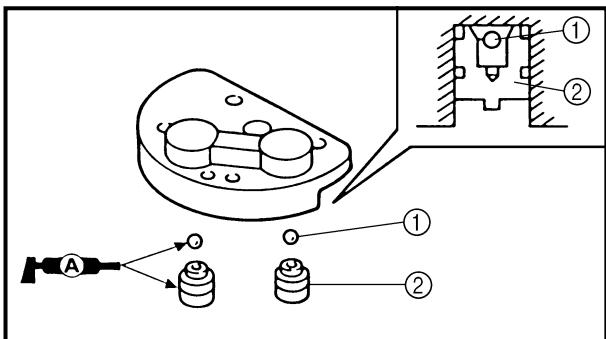
- Shuttle valves (1)
Clogs/damage/wear → Replace.
- Check valve assemblies (2)
Clogs/damage/wear → Replace.
- Pump gears (3)
Damage/wear → Replace the gear pump unit.
- Up-relief valve assembly (4)
Damage/wear → Replace the gear pump unit.
- Down-relief valve assembly (5)
Damage/wear → Replace the gear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

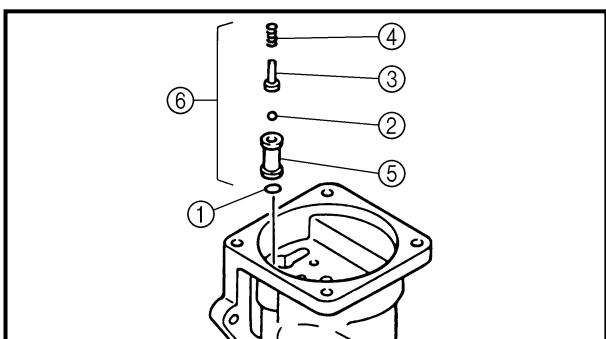


1. Install:

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

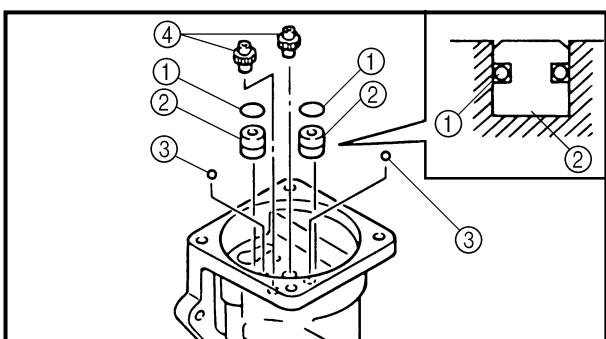
NOTE:

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



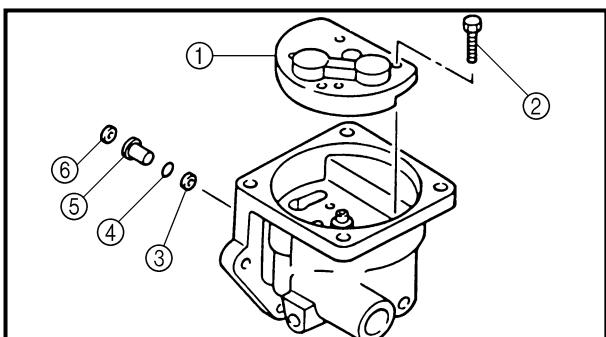
2. Install:

- 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

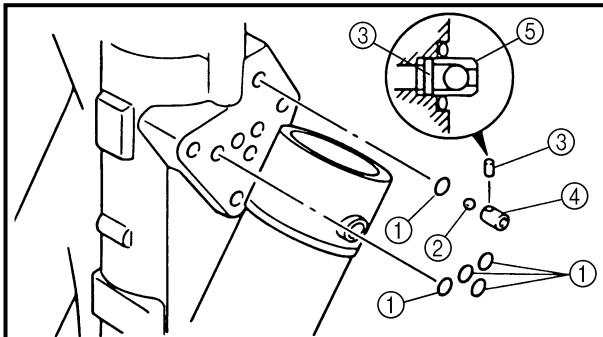
NOTE:

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

BRKT

TILT RAM ASSEMBLY AND GEAR PUMP UNIT

E



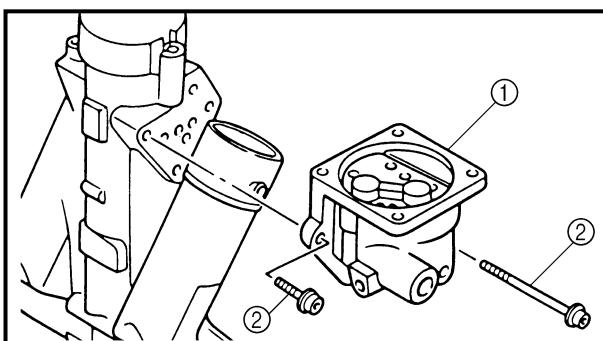
INSTALLING THE GEAR PUMP UNIT

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.



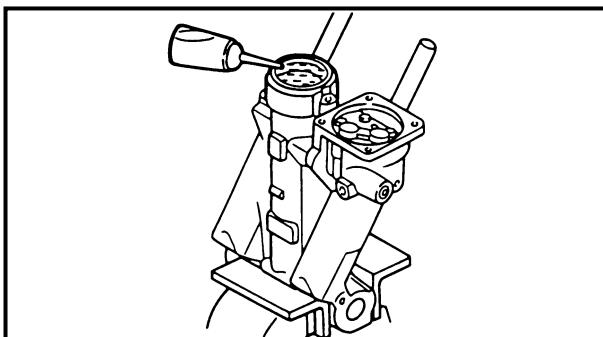
2. Install:

- Gear pump unit ①
- Bolt ②

INSTALLING THE TILT RAM ASSEMBLY

WARNING

To prevent the hydraulic fluid from spouting 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**

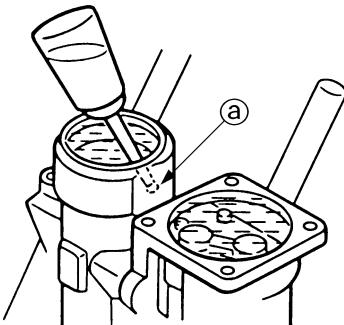
NOTE: _____

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

BRKT

TILT RAM ASSEMBLY AND GEAR PUMP UNIT

E



2. Fill:

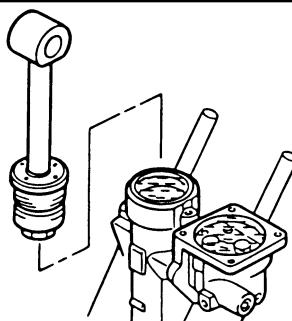
- Gear pump housing



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

NOTE: _____

Add power trim and tilt fluid through the hole **a** until the fluid level is to the top of the gear pump unit.

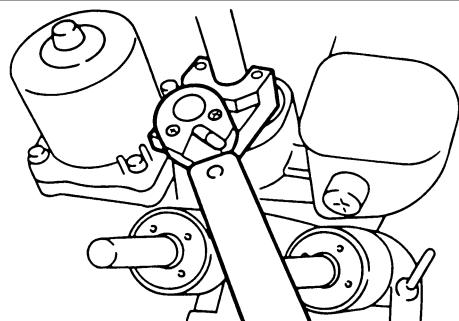


3. Install:

- 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**



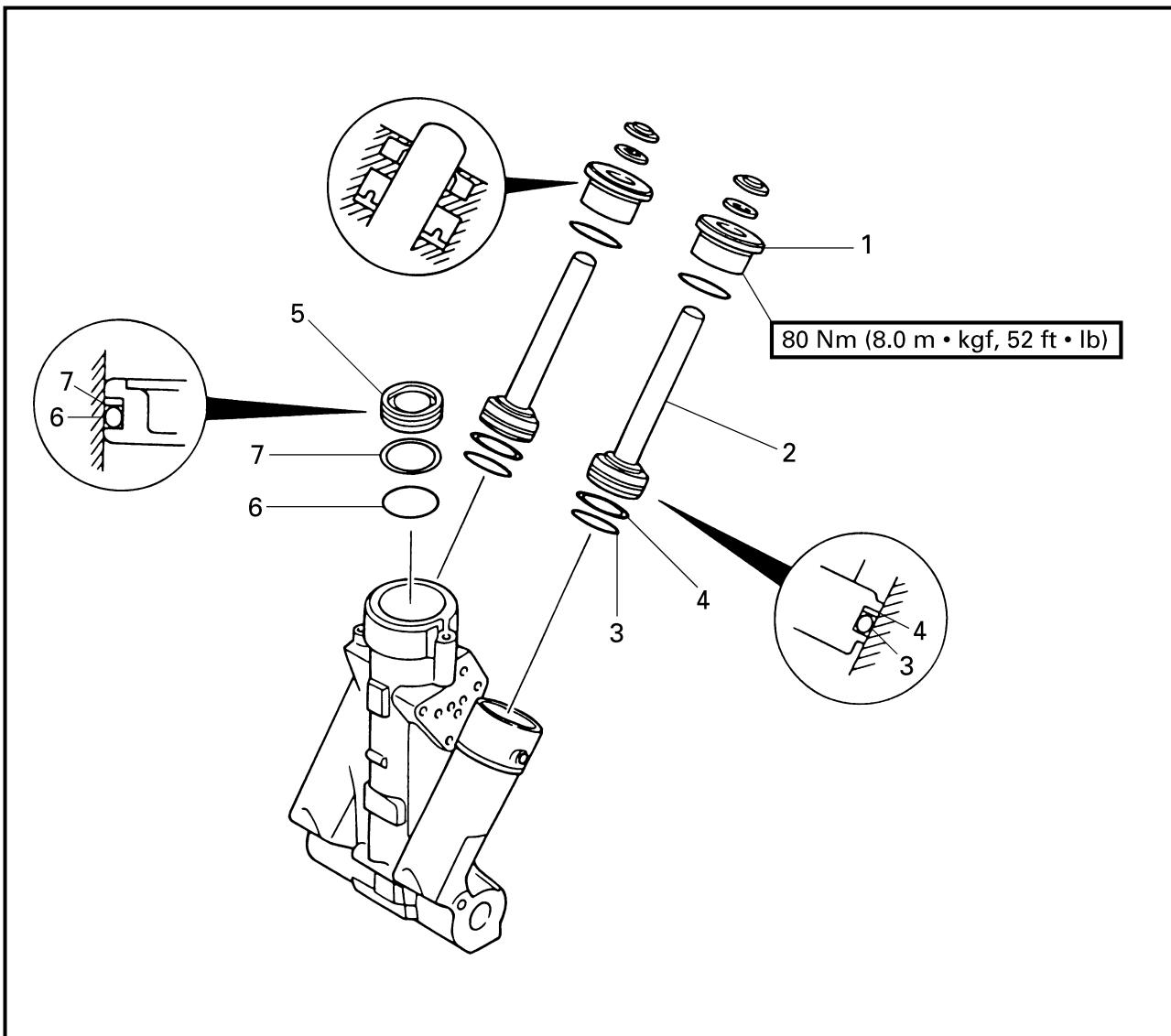
**Tilt ram end screw
130 Nm (13 m · kgf, 94 ft · lb)**

BRKT



TRIM RAM ASSEMBLIES AND FREE PISTON

E

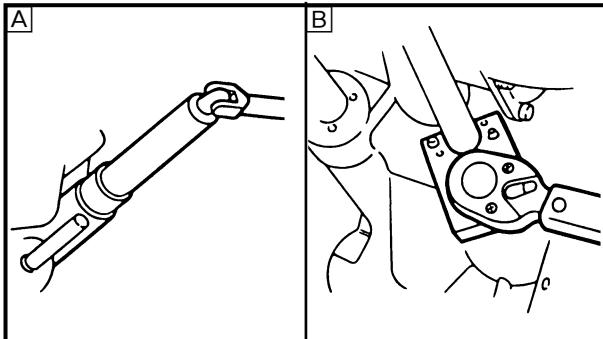
TRIM RAM ASSEMBLIES AND FREE PISTON
REMOVING/INSTALLING THE TRIM RAM ASSEMBLIES AND FREE PISTON


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.

BRKT

TRIM RAM ASSEMBLIES AND FREE PISTON

E



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:

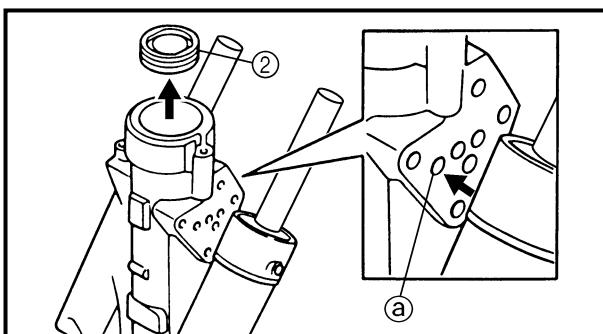
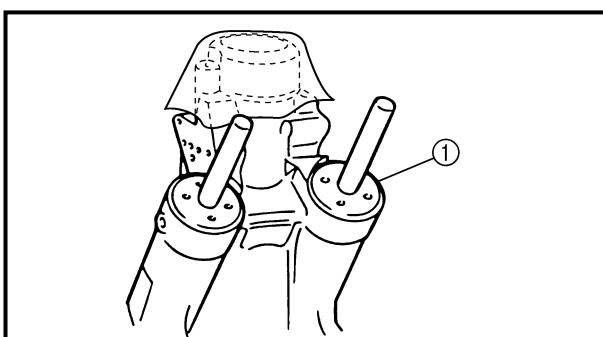
- Free piston ②

⚠ 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 ③.





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.

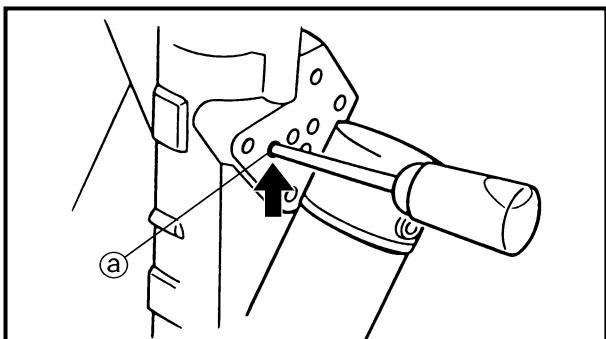
INSTALLING THE FREE PISTON

1. Fill:

- Fluid passages

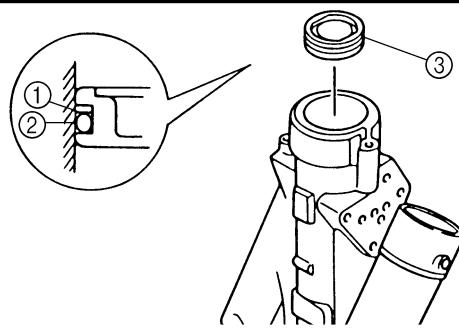


Recommended power trim and
tilt fluid
ATF Dexron II
Quantity
30 cm³ (1.0 US oz, 1.1 Imp oz)



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 ④.



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:

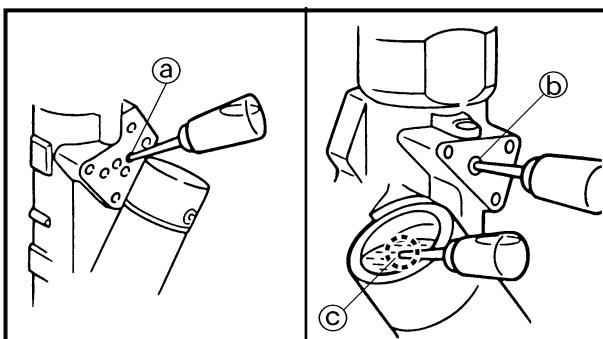
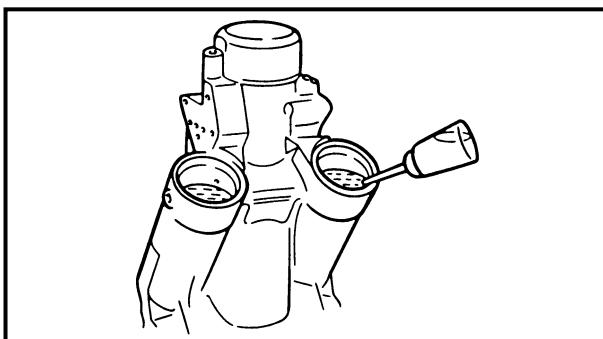
- Fluid passages



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

NOTE: _____

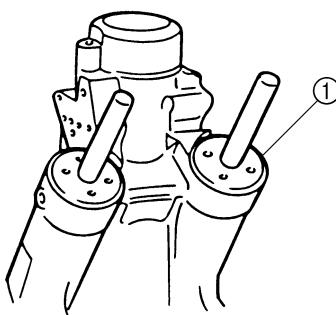
Add power trim and tilt fluid through holes ④, ⑤ and ⑥ until all of the passages are filled.



BRKT

TRIM RAM ASSEMBLIES AND FREE PISTON

E

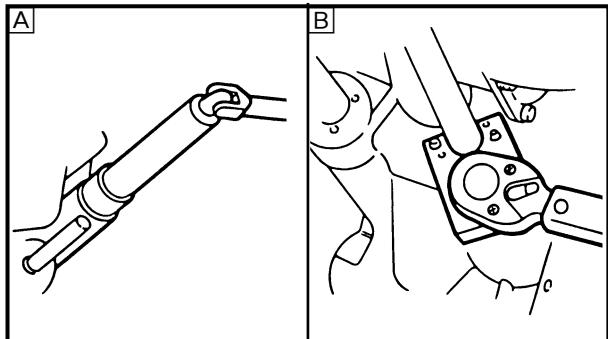


3. Install:

- Trim ram assemblies ①

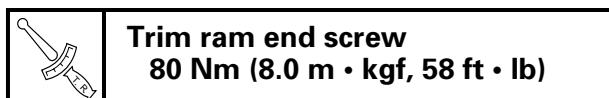
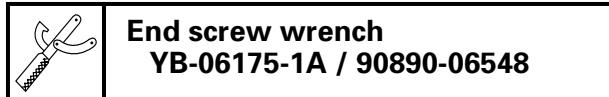
NOTE: _____

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



A For USA and Canada

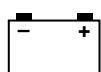
B For worldwide



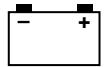
CHAPTER 8

ELECTRICAL SYSTEMS

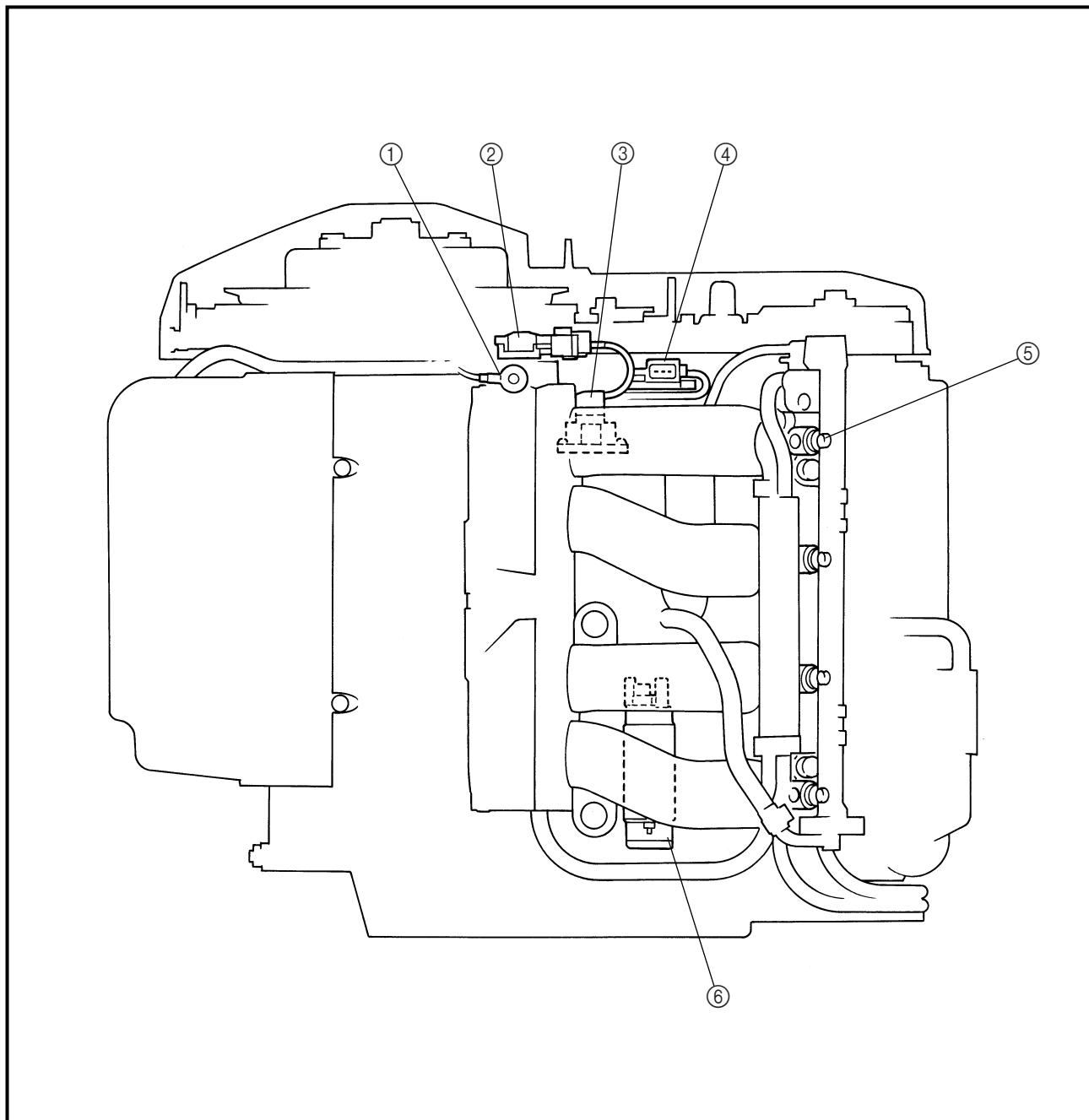
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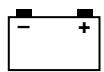
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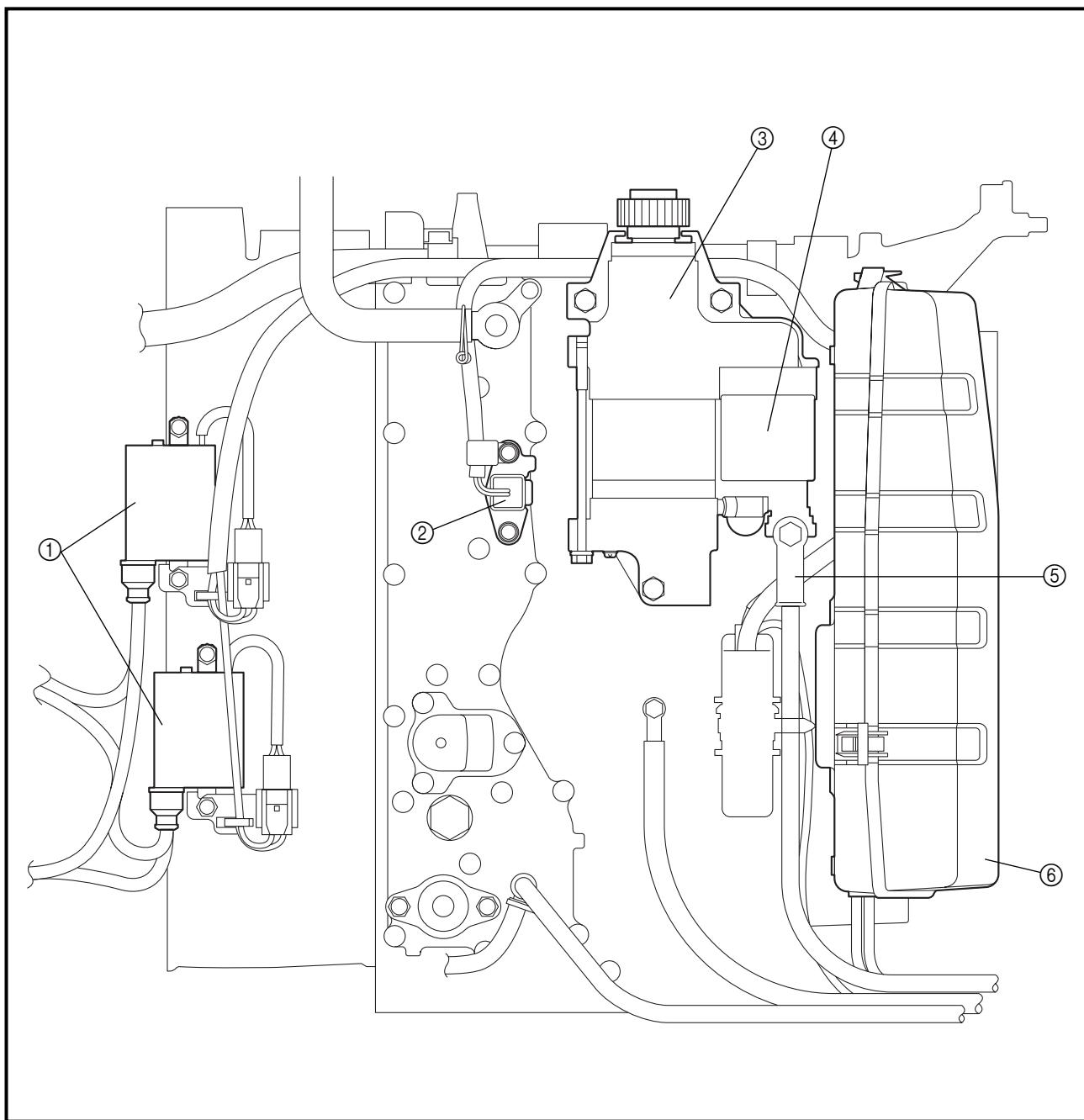
ELECTRICAL COMPONENTS (Port view)



- 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



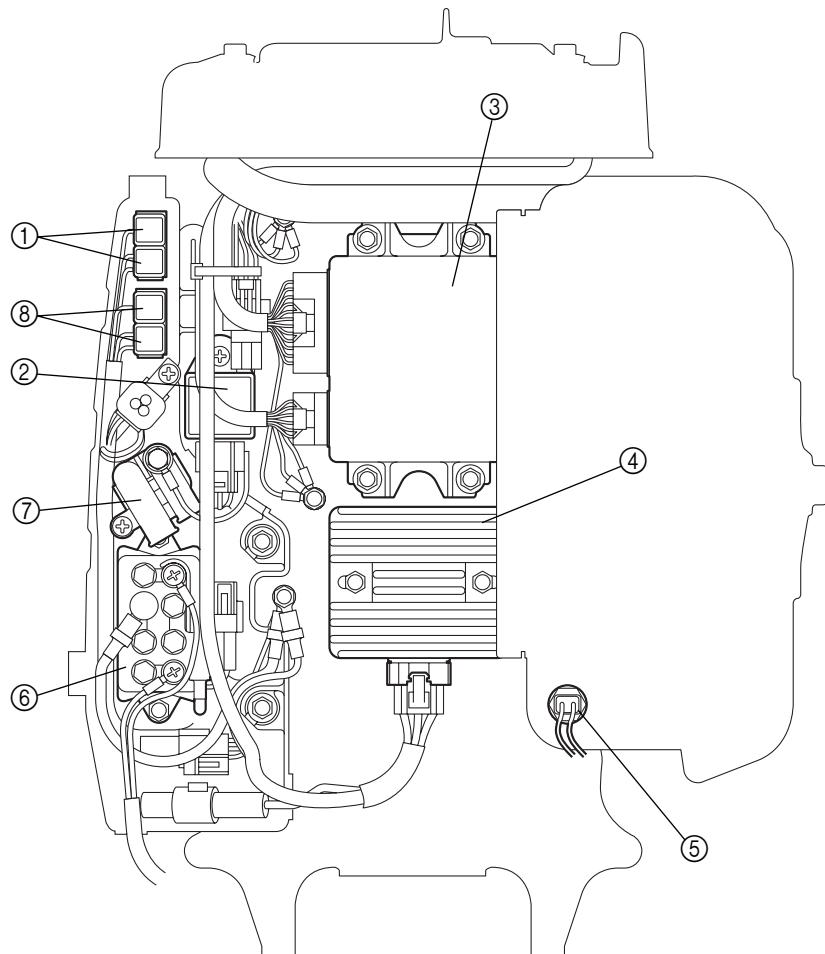
(Starboard view)



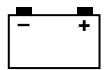
- ① Ignition coil
- ② Engine cooling water temperature sensor
- ③ Starter motor
- ④ Relay (magnetic switch)
- ⑤ Battery lead terminal
- ⑥ Junction box assembly



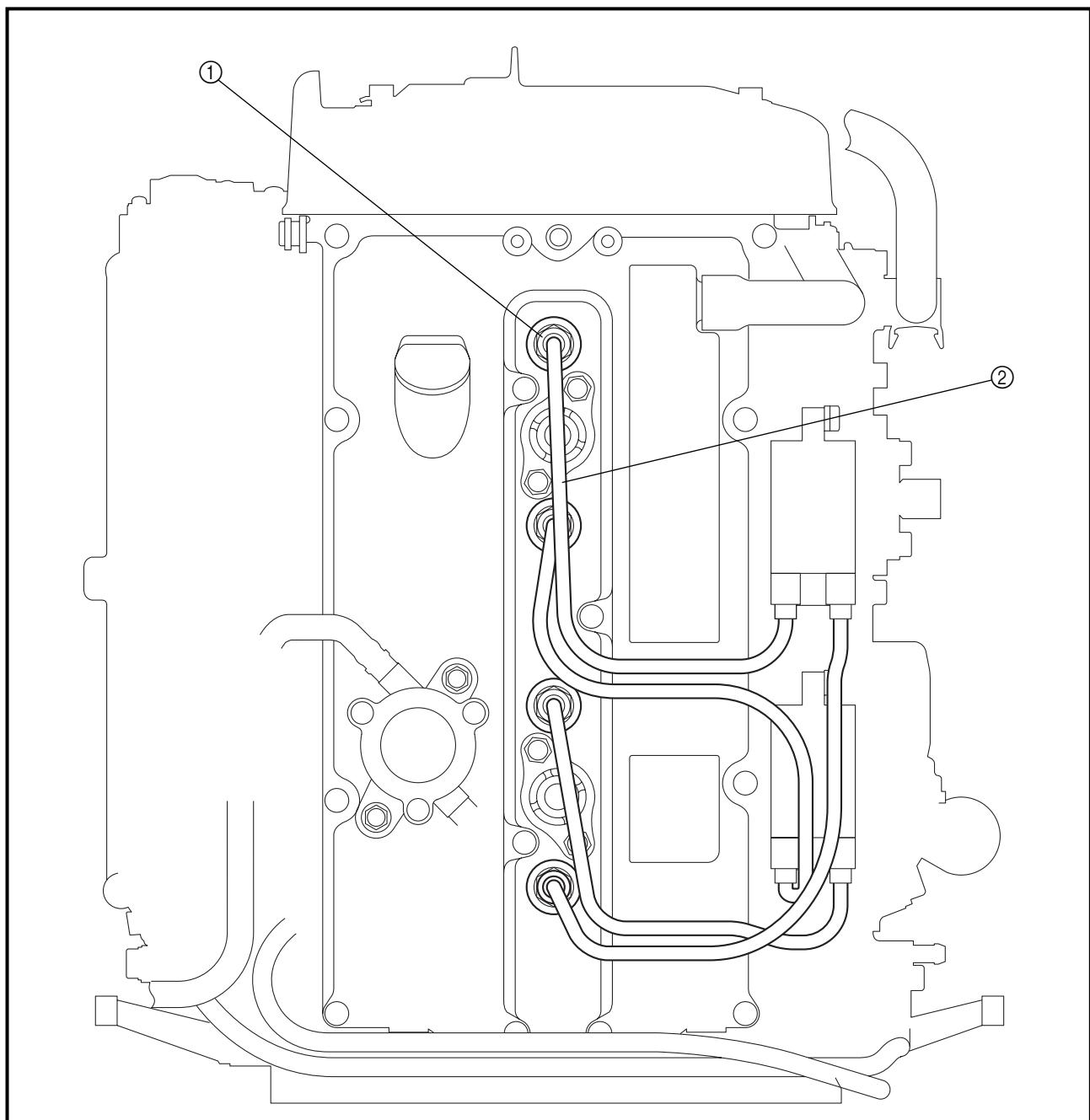
(Front view)



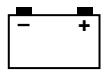
- ① Fuse (30A)
- ② Main relay
- ③ ECM
- ④ Rectifier/regulator
- ⑤ Intake air temperature sensor
- ⑥ Power trim and tilt relay
- ⑦ Starter relay
- ⑧ Fuse (20A)



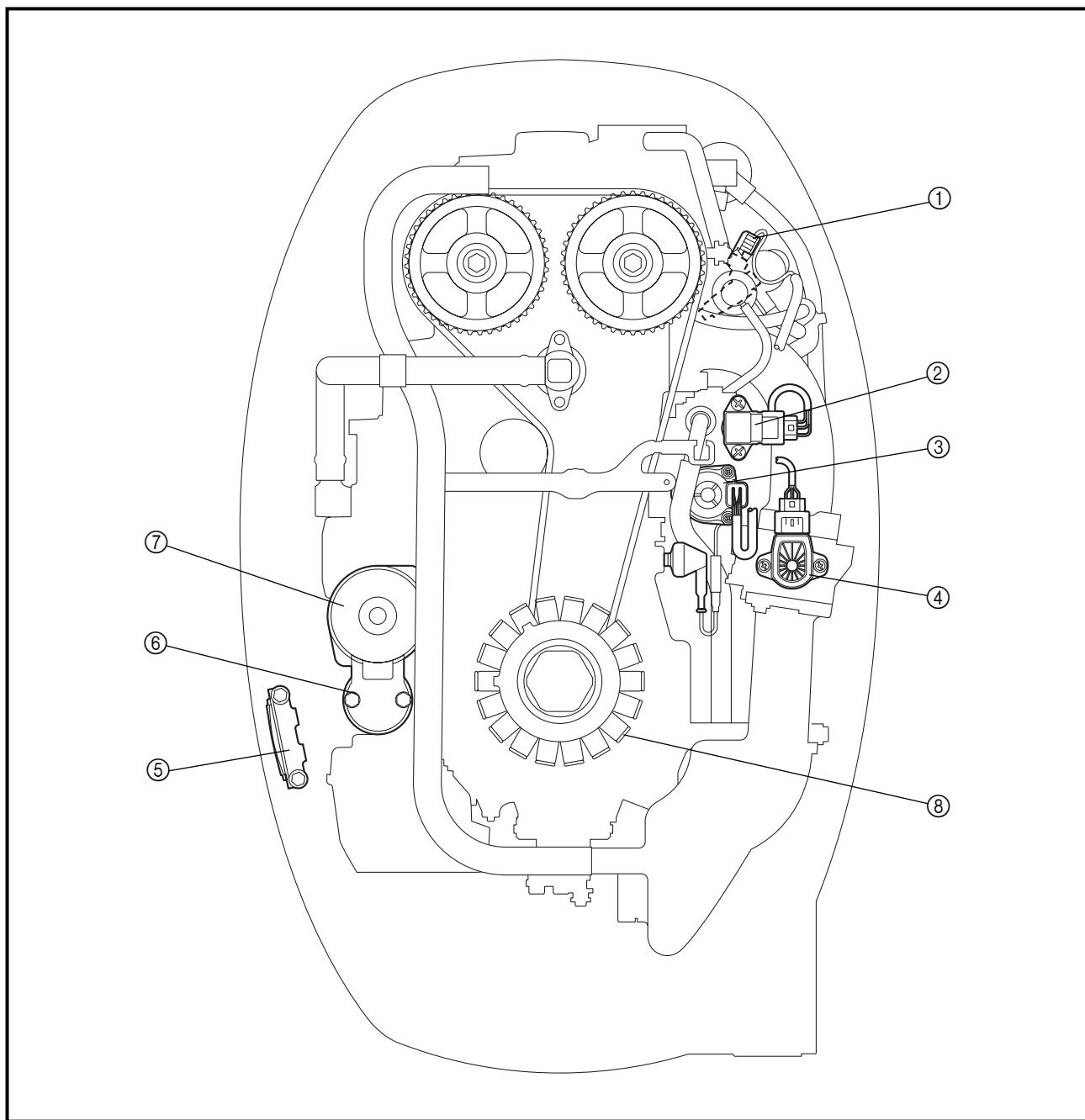
(Aft view)



- ① Spark plug
- ② Spark plug lead



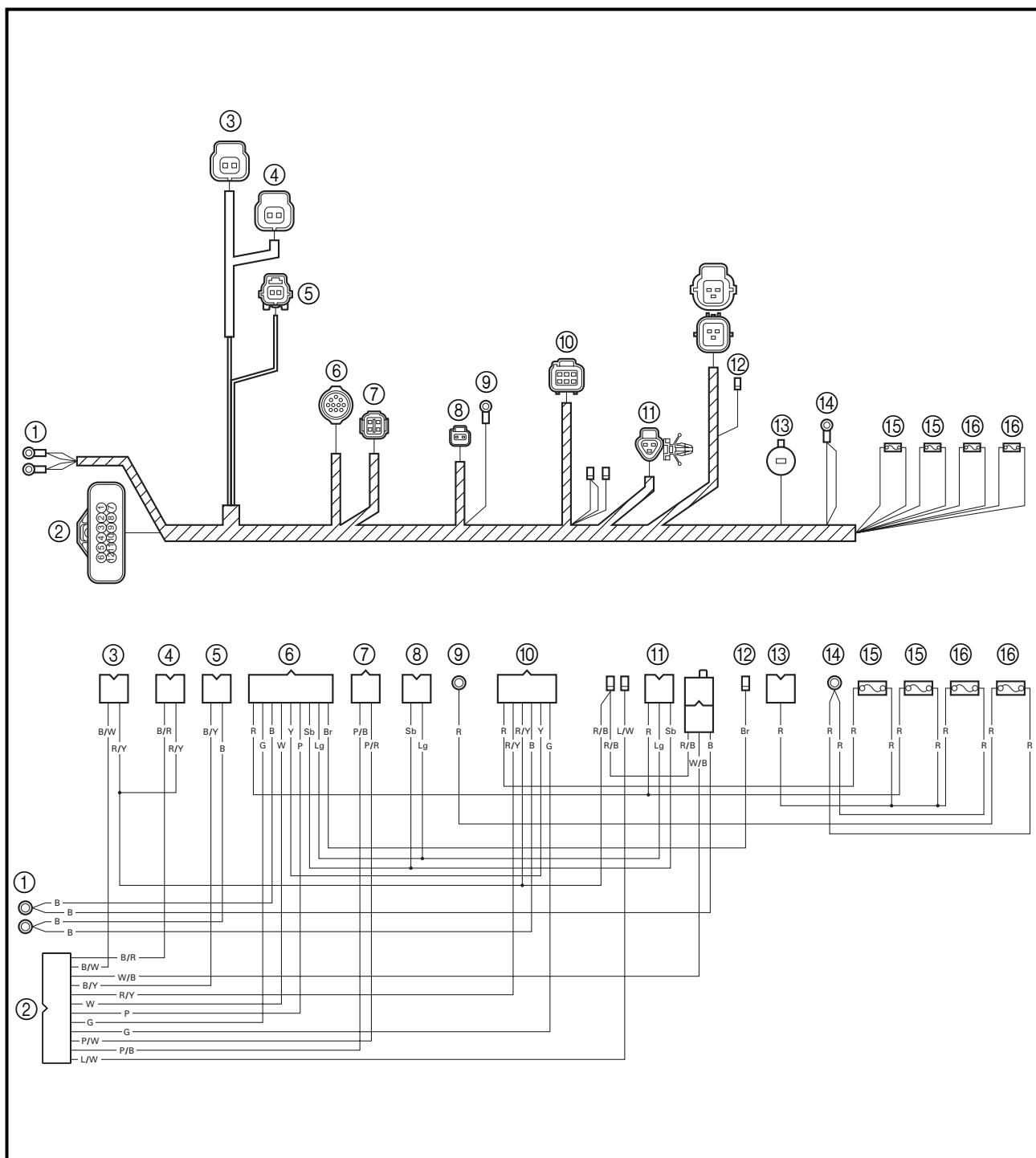
(Top view)



- 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

ELEC**WIRE HARNESS**

E

WIRE HARNESS

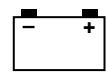
Connect to:

- ① Ground
- ② ECM
- ③ Ignition coil
- ④ Ignition coil
- ⑤ Engine cooling water temperature sensor
- ⑥ Remote control
- ⑦ Warning lamp

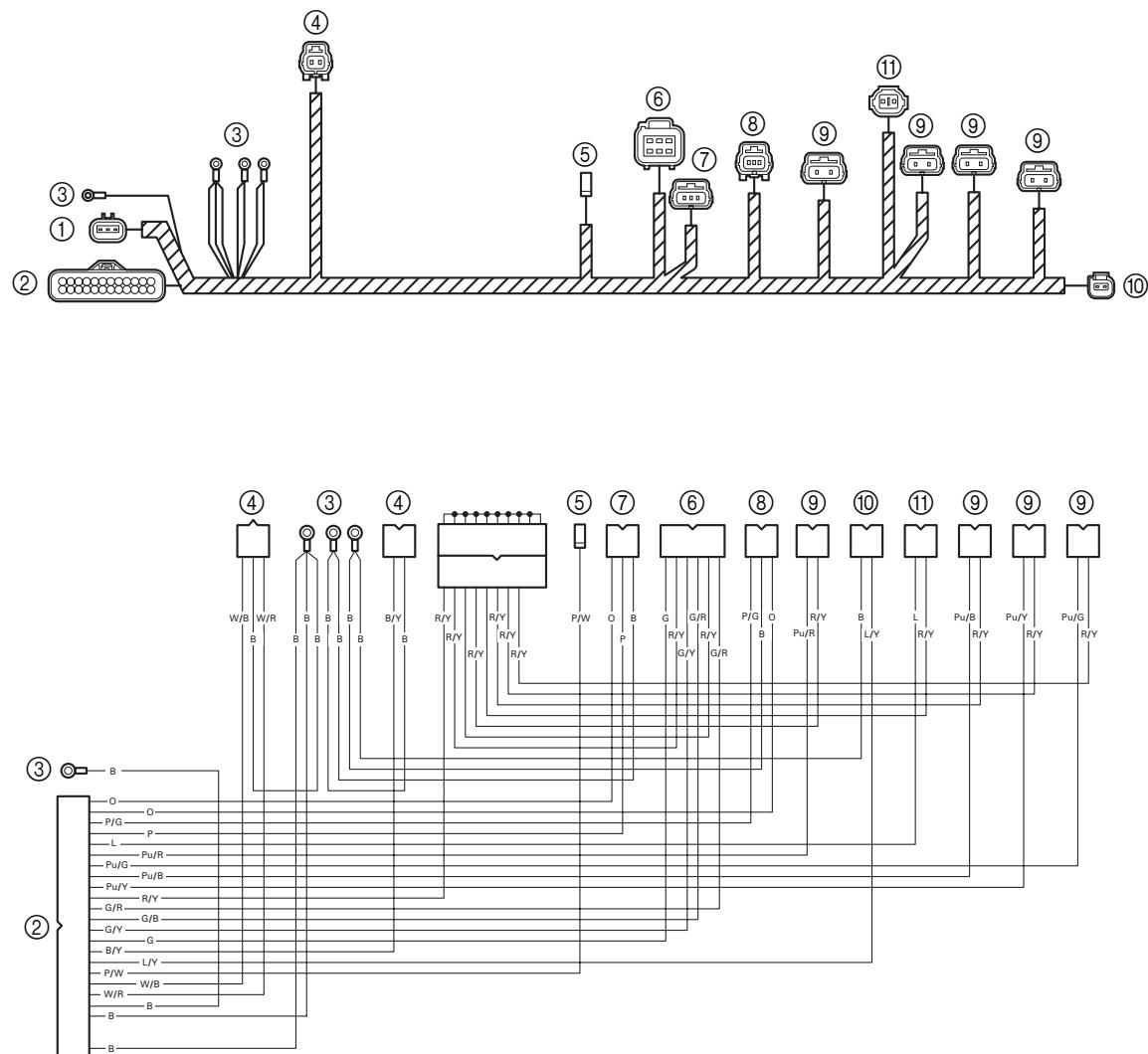
- ⑧ PTT relay
- ⑨ Starter relay
- ⑩ Main relay
- ⑪ Trailer switch
- ⑫ Starter relay
- ⑬ Rectifier/regulator
- ⑭ Starter motor
- ⑮ Fuse 20A
- ⑯ Fuse 30A

- | | |
|-----|-------------|
| B | : Black |
| Br | : Brown |
| G | : 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 |

ELEC**WIRE HARNESS**

E



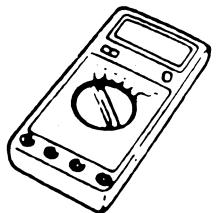
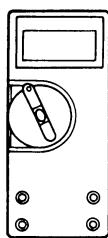
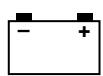
Connect to:

- 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	Pu/B	: Purple/black
P	: Pink	Pu/G	: Purple/green
B/Y	: Black/yellow	Pu/R	: Purple/red
G/B	: Green/black	Pu/Y	: Purple/yellow
G/R	: Green/red	R/Y	: Red/yellow
G/Y	: Green/yellow	W/B	: White/black
L/Y	: Blue/yellow	W/R	: White/red
P/G	: Pink/green		
P/W	: Pink/white		



ELECTRICAL COMPONENTS ANALYSIS DIGITAL CIRCUIT TESTER



Digital tester
J-39299 / 90890-06752

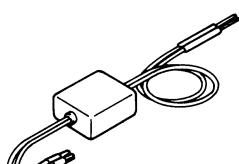
NOTE: _____

"○—○" 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.



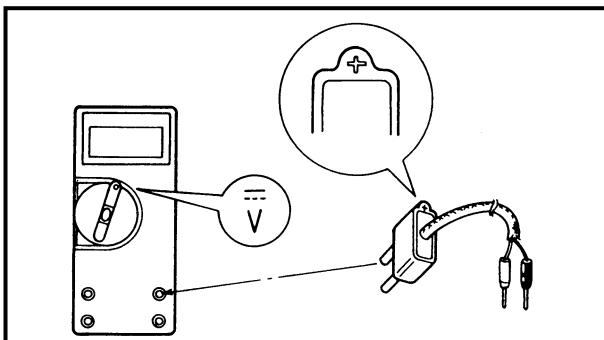
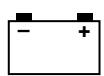
PEAK VOLTAGE ADAPTOR

NOTE: _____

The peak voltage adaptor should be used with the digital circuit tester.

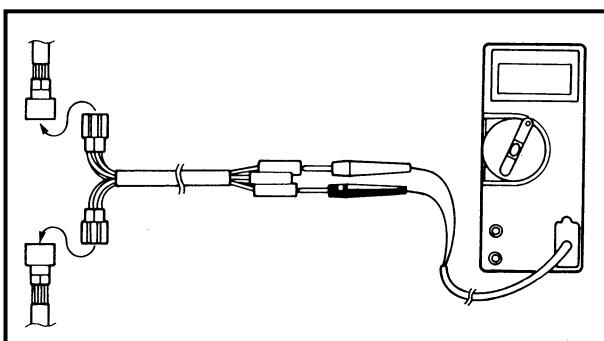


Peak voltage adaptor
YU-39991 / 90890-03169



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.



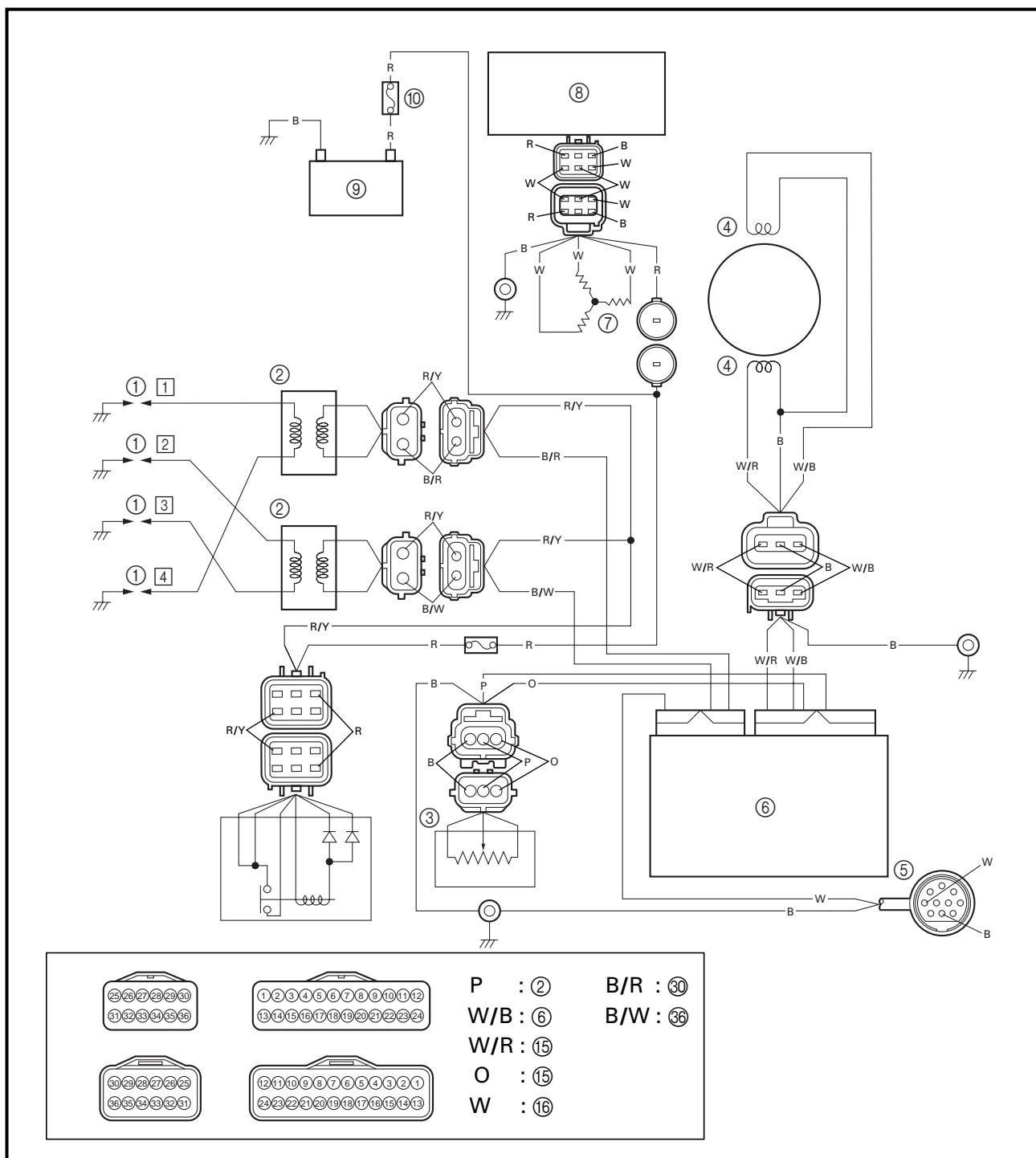
**Correct value
Displayed measurement –
internal resistance**

NOTE: _____

The internal resistance of the digital tester can be obtained by connecting both of its probes.



IGNITION SYSTEM



- 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)

- B : Black
- 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:

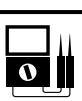
- Fuse holder continuity
No continuity → Check the fuse holder leads.

2. Check:

- Fuse holder lead continuity
No continuity → Replace the fuse holder.
Continuity → Check the fuse.

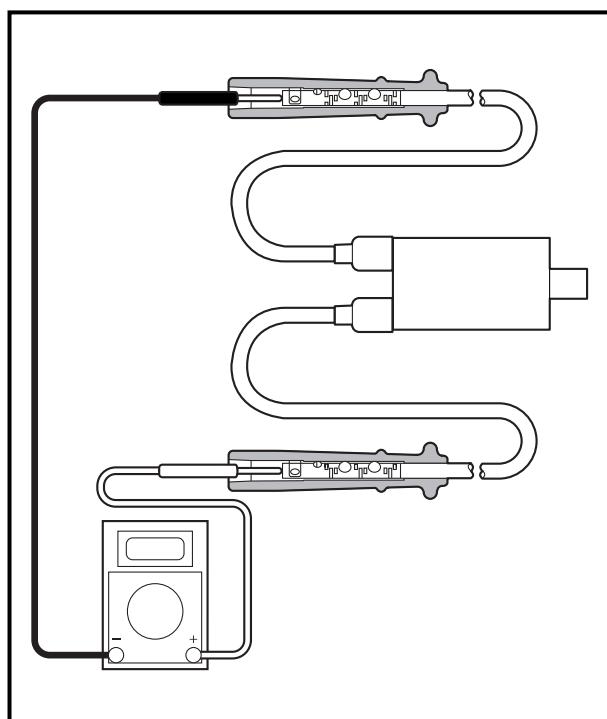
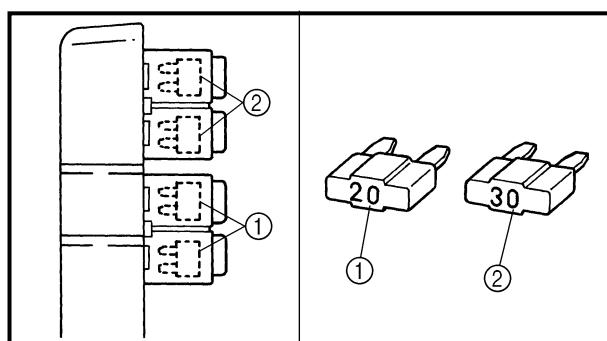
3. Check:

- 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

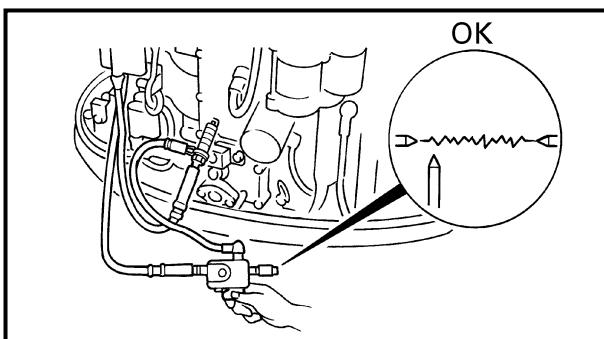
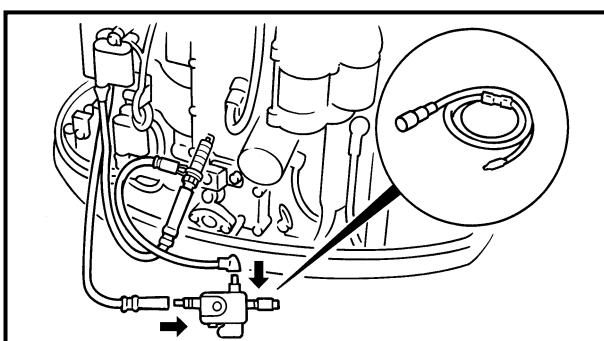
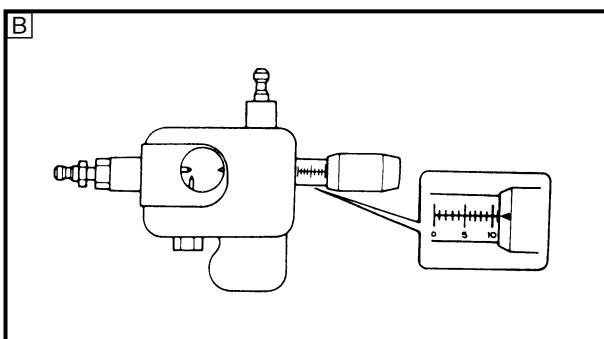
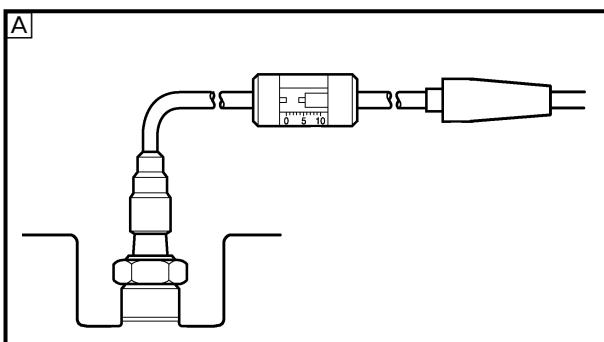
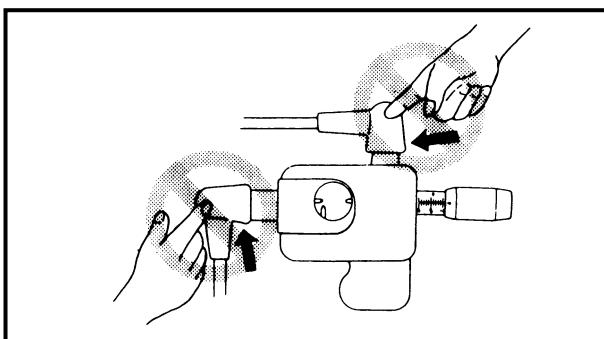
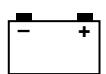
Measure:

- 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

Above specification → Replace the spark plug.

Below specification → Check the ECM output.



**Ignition spark gap
1.0 - 1.1 mm (0.039 - 0.043 in)**

A For USA and Canada

B For worldwide

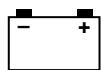
Checking steps

- (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.



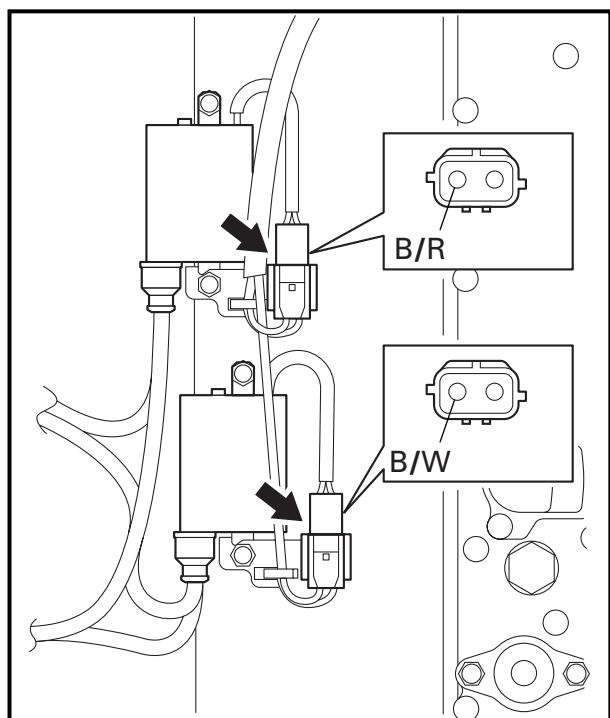
MEASURING THE IGNITION SYSTEM PEAK VOLTAGE

⚠ 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.

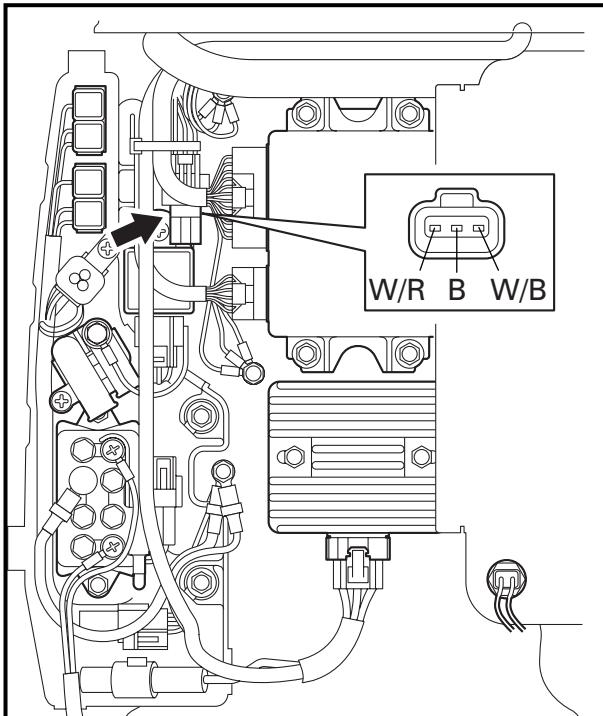
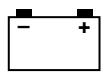


**ECM unit output peak voltage
Black/red (B/R) – Ground
Black/white (B/W) – Ground**

r/min	Circuit	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)

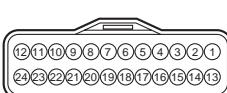
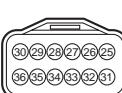
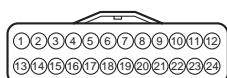
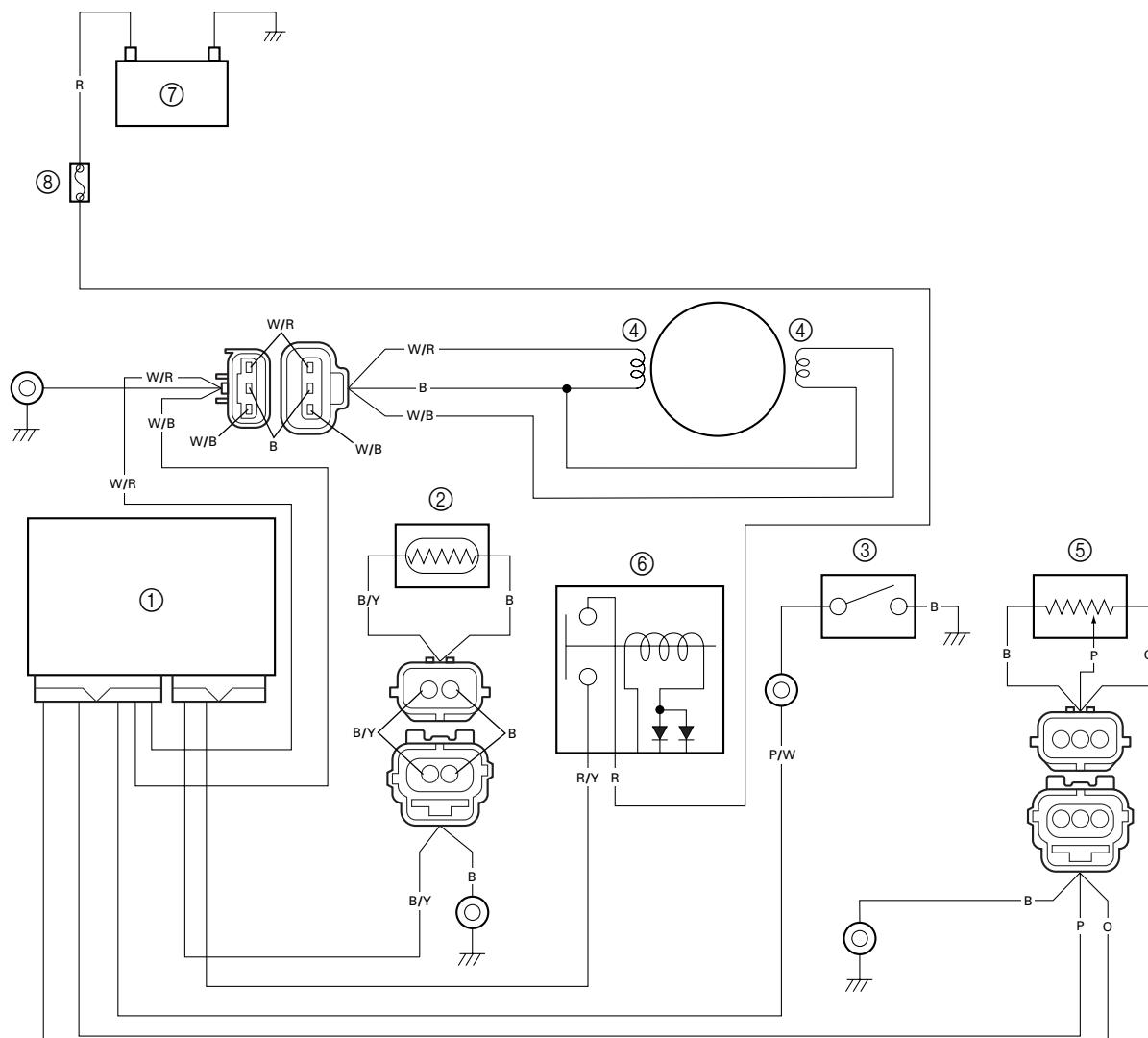
r/min	Circuit	Loaded		
		Cranking	1,500	3,500
V	3.5	3.0	26	44



Test harness (3-pin)
90890-06791

ELEC**IGNITION CONTROL SYSTEM**

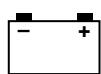
E

IGNITION CONTROL SYSTEM

O : ⑯
P : ②
B/Y : ⑰
P/W : ⑯
R/Y : ⑰
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)

- 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

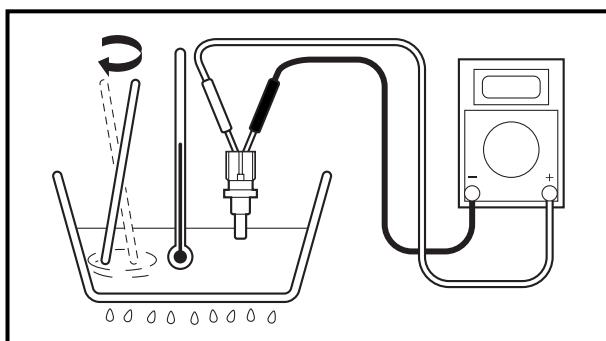
Refer to "CHECKING THE BATTERY" on page 3-21.

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:

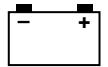
- Engine cooling water temperature sensor resistance
Out of specification → Replace.



Engine cooling water temperature sensor resistance
Black/yellow (B/Y) – Black (B)
 $5\text{ }^{\circ}\text{C}$ ($41\text{ }^{\circ}\text{F}$): $4.62\text{ k}\Omega$
 $20\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F}$): $2.44\text{ k}\Omega$
 $100\text{ }^{\circ}\text{C}$ ($212\text{ }^{\circ}\text{F}$): $0.19\text{ k}\Omega$

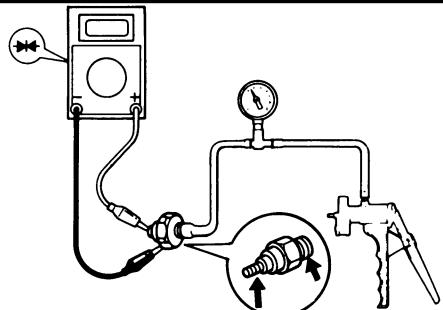
Measuring steps

- (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.

ELEC

IGNITION CONTROL SYSTEM

E



CHECKING THE OIL PRESSURE SWITCH CONTINUITY

Measure:

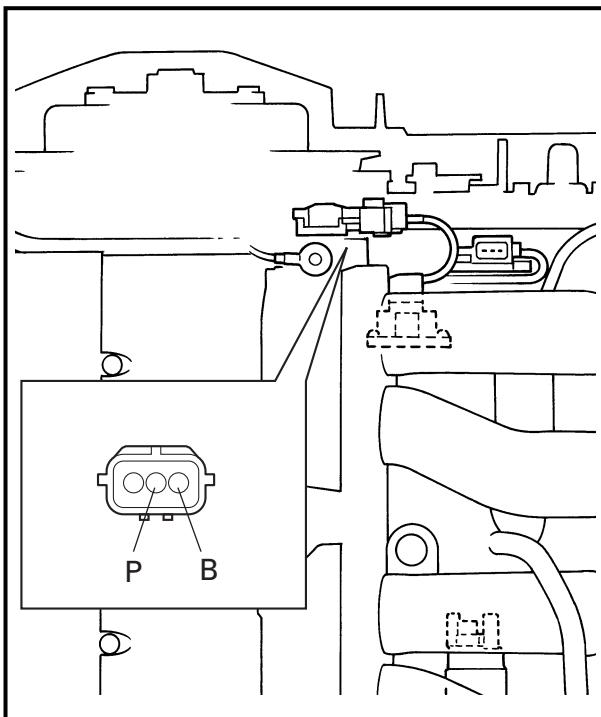
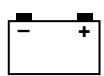
- Oil pressure switch continuity
Out of specification → Replace.



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 ± 0.014 V

Measuring steps

(1) Connect the test harness (3-pin) as shown.



Test harness (3-pin)
90890-06793

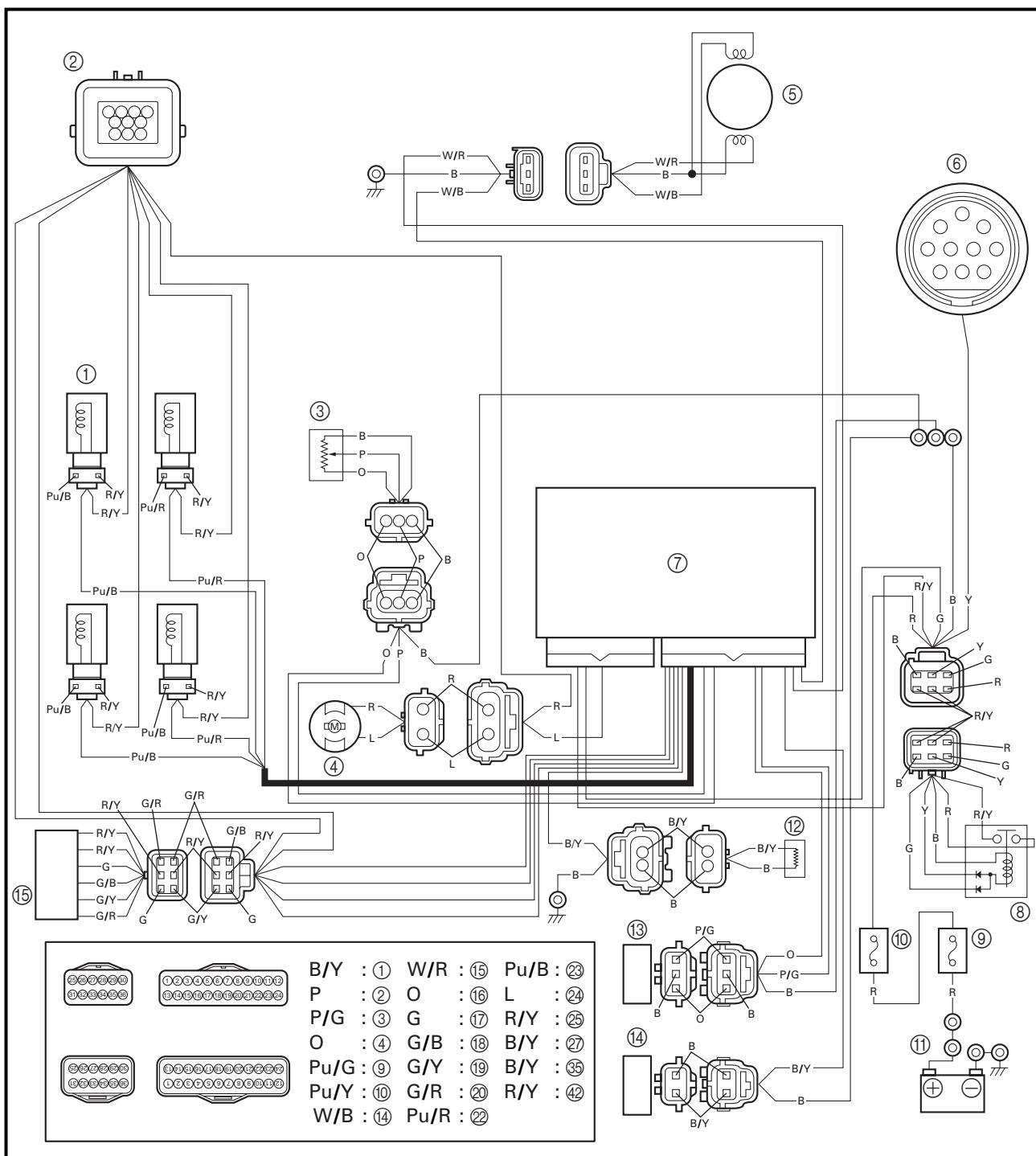
- (2) Connect the battery leads to a 12-V battery.
- (3) Turn the engine switch to the on position.
- (4) Measure the throttle position sensor output voltage.
- (5) Start the engine and measure the output voltage again.

NOTE:

Make sure the throttle position sensor output voltage is within specification when the throttle is fully closed and fully opened.

ELEC**FUEL CONTROL SYSTEM**

E

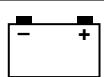
FUEL CONTROL SYSTEM

- 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/R : Green/red

- P/G : Pink/green
- Pu/B : Purple/black
- Pu/R : Purple/red
- R/B : Red/black
- 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

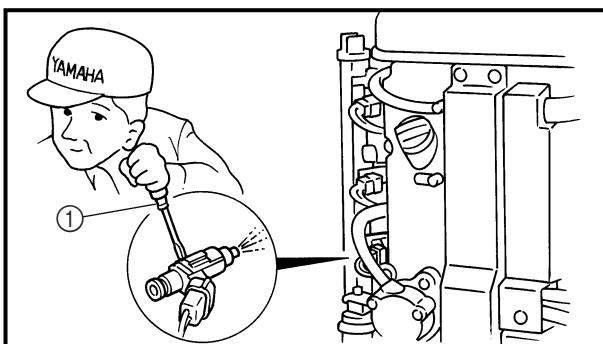
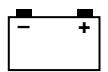
Refer to "CHECKING THE FUSES" on page 8-11.

**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

(1) Start the engine.

(2) Fully close the throttle valves.

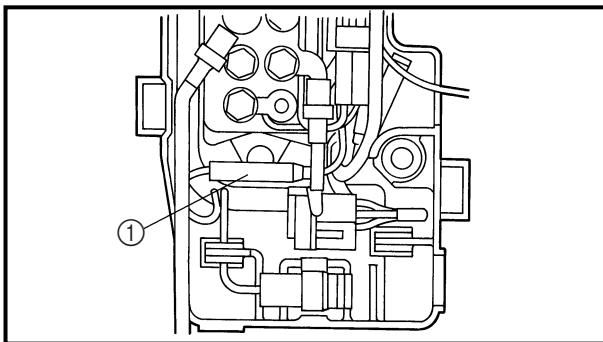
(3) Attach the screwdriver ① onto the fuel injector body and check if all of the fuel injectors have a solenoid valve operating sound.

2. Check:

- High-pressure fuel pump operating sound

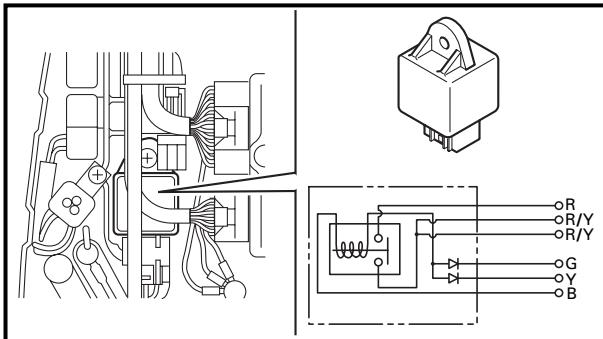
Correct → Replace the fuel injector (no sound).

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.



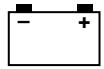
3. Check:

- Main relay continuity

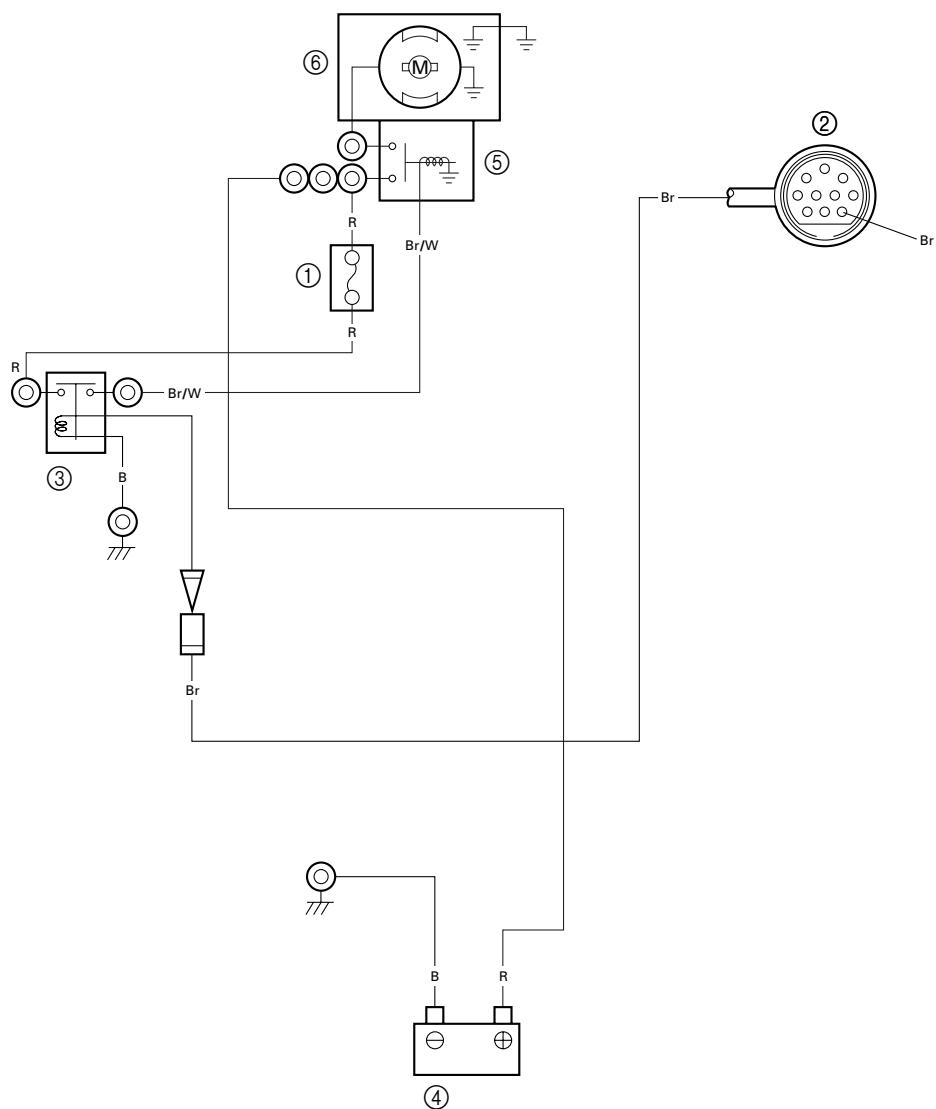
Out of specification → Replace the main relay.

	Engine start switch	Lead color	
		Red (R)	Red/yellow (R/Y)
	OFF		
	ON	○	○

Correct → Replace the high-pressure fuel pump.

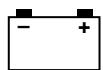
ELEC**STARTING SYSTEM**

E

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

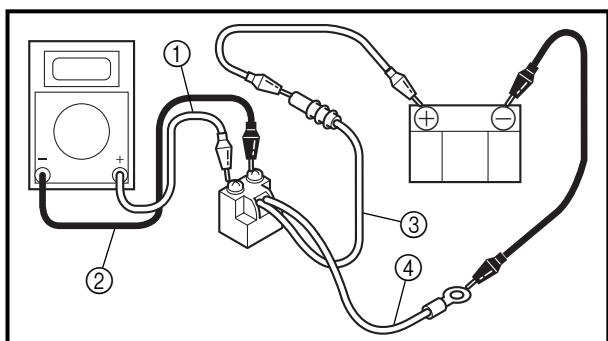
Check:

- Wire harness continuity
No continuity → Replace.

CHECKING THE WIRE CONNECTIONS

Check:

- Wire connections
Poor connection → Properly connect.



CHECKING THE STARTER RELAY

Check:

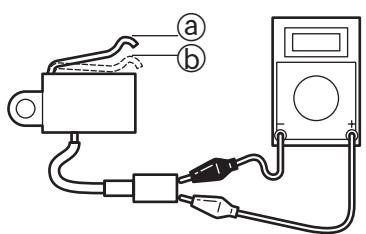
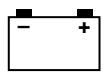
- Starter relay continuity
No continuity → Replace.

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.



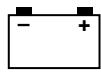
CHECKING THE SHIFT POSITION SWITCH CONTINUITY

Check:

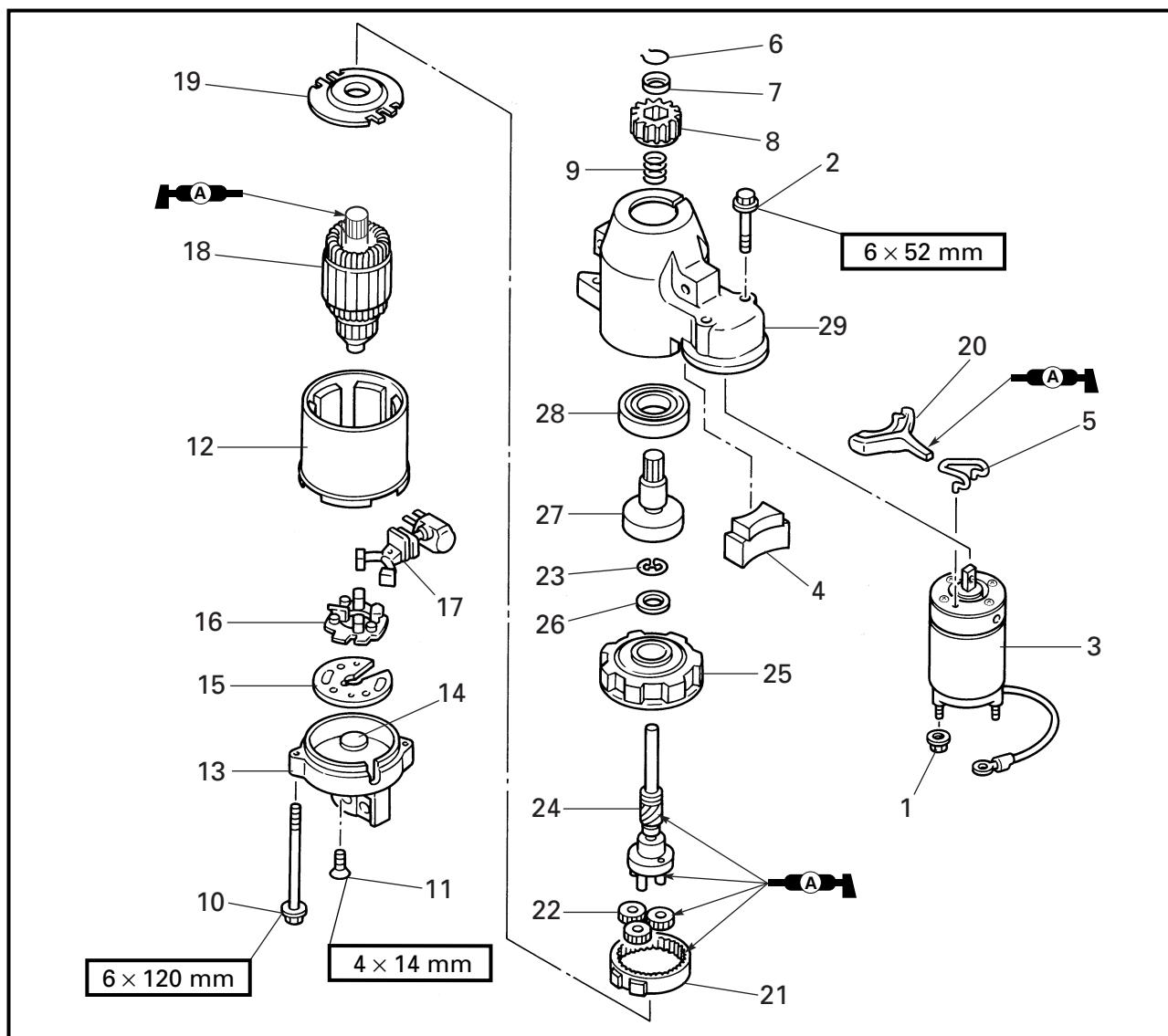
- Continuity

No continuity → Replace.

	Switch position	Lead color	
		Blue/Yellow (L/Y)	Black (B)
(a)	Home position		
(b)	Depressed	○—○	○

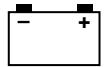
ELEC**STARTER MOTOR**

E

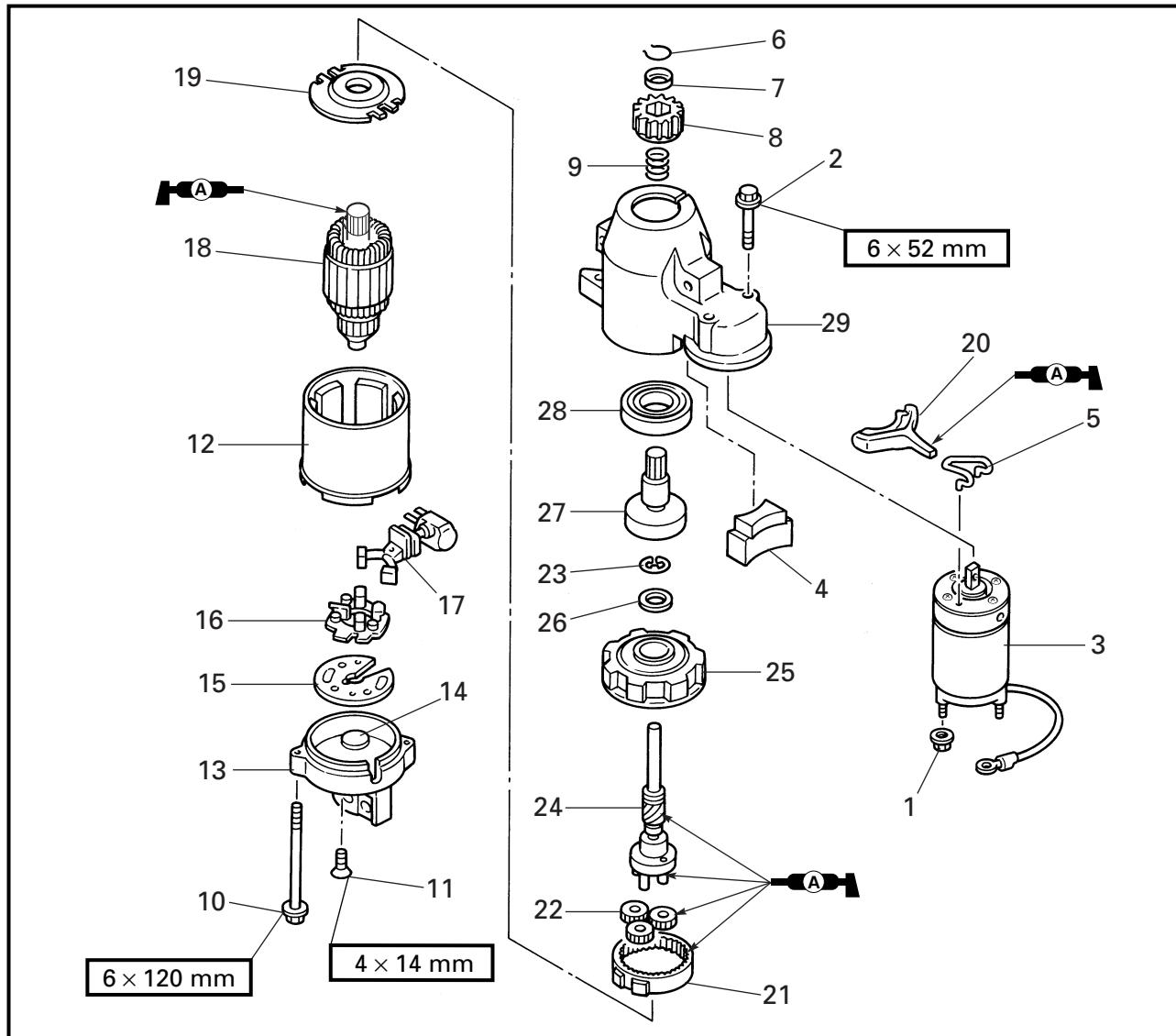
STARTER MOTOR**DISASSEMBLING/ASSEMBLING THE STARTER MOTOR**

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.

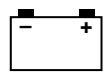
ELEC**STARTER MOTOR**

E

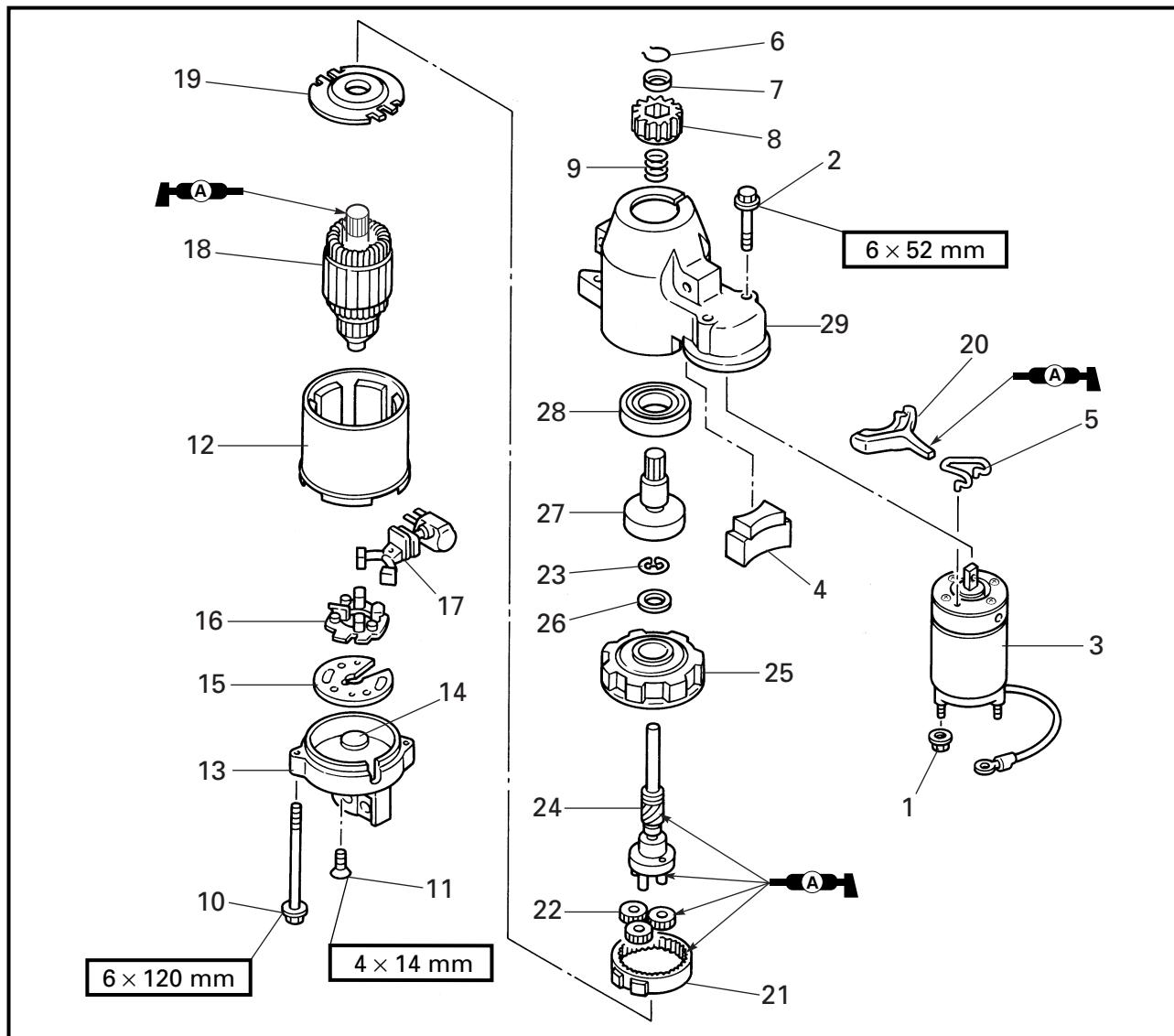


Order	Job/Part	Q'ty	Remarks
10	Bolt	2	
11	Screw	2	
12	Yoke assembly	1	
13	Rear cover	1	
14	Thrust washer	1	
15	Plate	1	
16	Brush holder assembly	1	
17	Brush assembly	1	
18	Armature	1	
19	Center bracket plate	1	

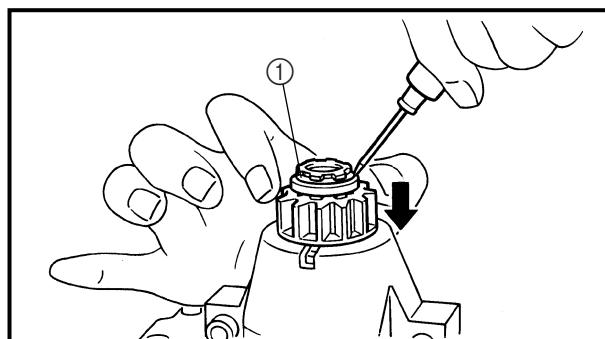
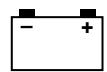
Continued on next page.

ELEC**STARTER MOTOR**

E



Order	Job/Part	Q'ty	Remarks
20	Shift lever	1	
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	For assembly, reverse the disassembly procedure.



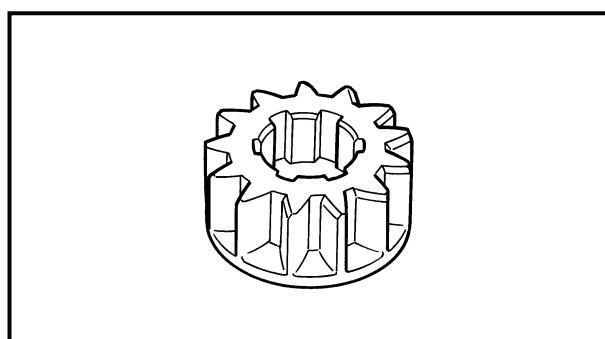
REMOVING THE STARTER MOTOR PINION

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:

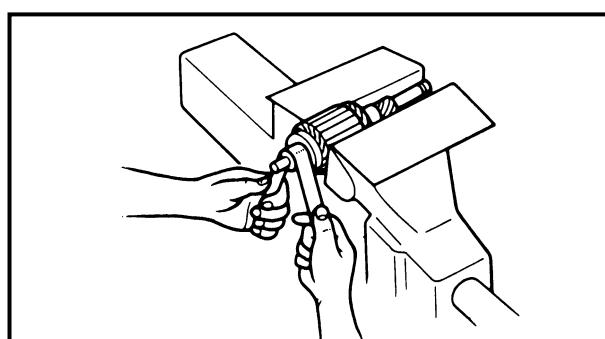
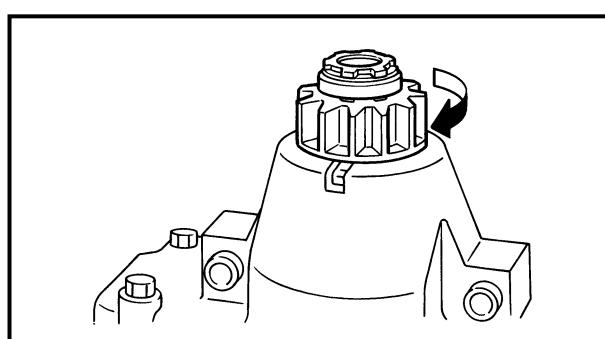
- Starter motor pinion teeth
Damage/wear → Replace.

2. Check:

- Starter motor pinion movement
Incorrect → Replace.

NOTE: _____

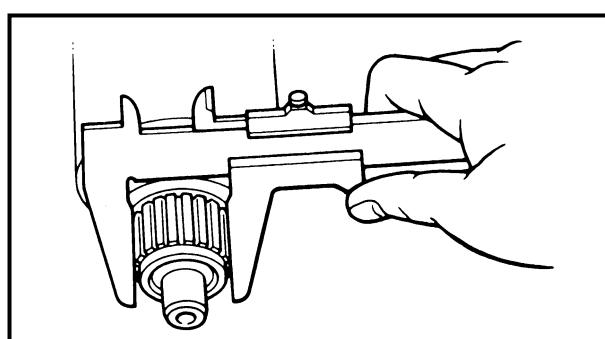
Rotate the starter motor pinion counter-clockwise and make sure it moves smoothly. Also, rotate the starter motor pinion clockwise and make sure it locks.



CHECKING THE ARMATURE

1. Check:

- Commutator
Foreign matter → Clean.
(with 600 grit sandpaper)

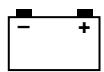


2. Measure:

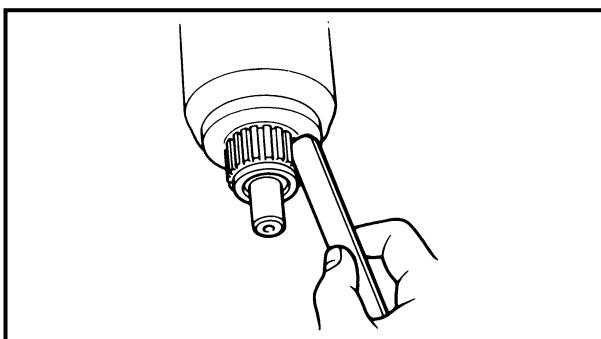
- Commutator diameter
Out of specification → Replace.



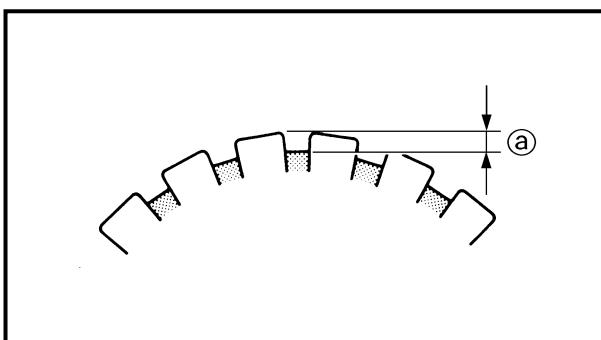
**Commutator diameter limit
28.0 mm (1.10 in)**

ELEC**STARTER MOTOR**

E

**3. Check:**

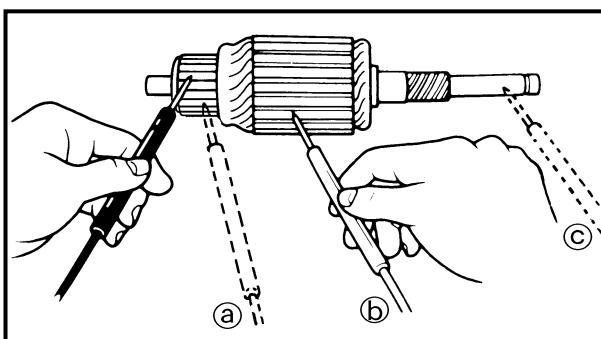
- Commutator undercut
Dirt/foreign matter → Clean.
(with compressed air)

**4. Measure:**

- Commutator undercut ①
Out of specification → Replace the armature.



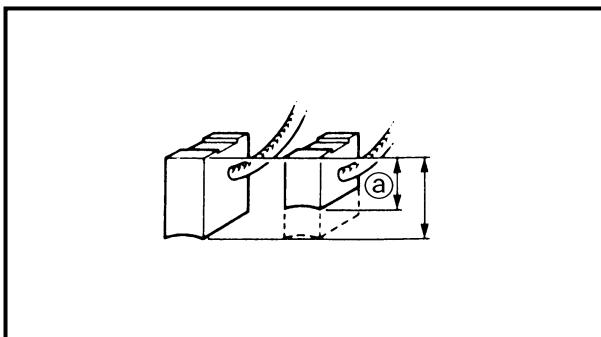
Commutator undercut limit
0.2 mm (0.01 in)

**5. Check:**

- Armature continuity
Out of specification → Replace.

**Armature continuity**

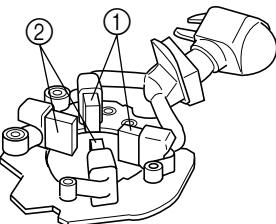
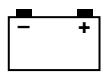
Commutator segments ①	Continuity
Segment – Armature core ②	No continuity
Segment – Armature shaft ③	No continuity

**MEASURING THE BRUSHES****1. Measure:**

- Brush length
Out of specification → Replace the brush assembly.



Brush length limit ①
9.5 mm (0.37 in)



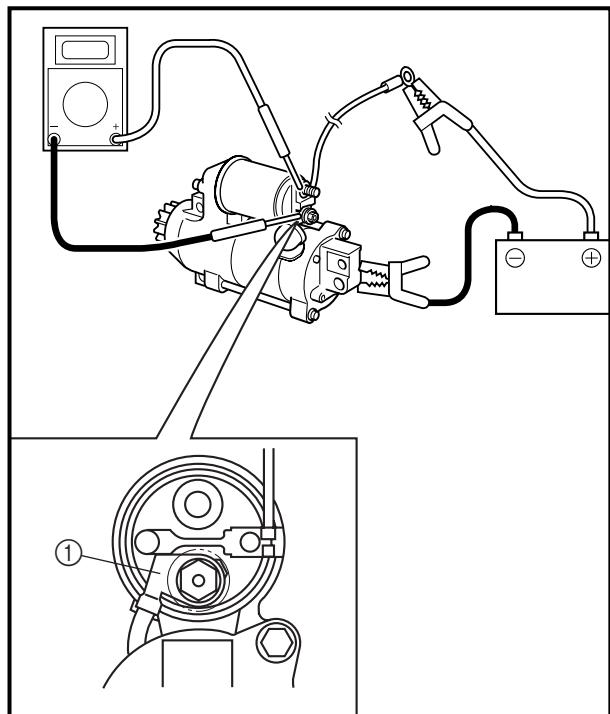
2. Check:

- 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:

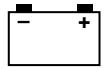
Do not connect the battery for more than one second. Otherwise, the magnetic switch relay may be damaged.

- (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.

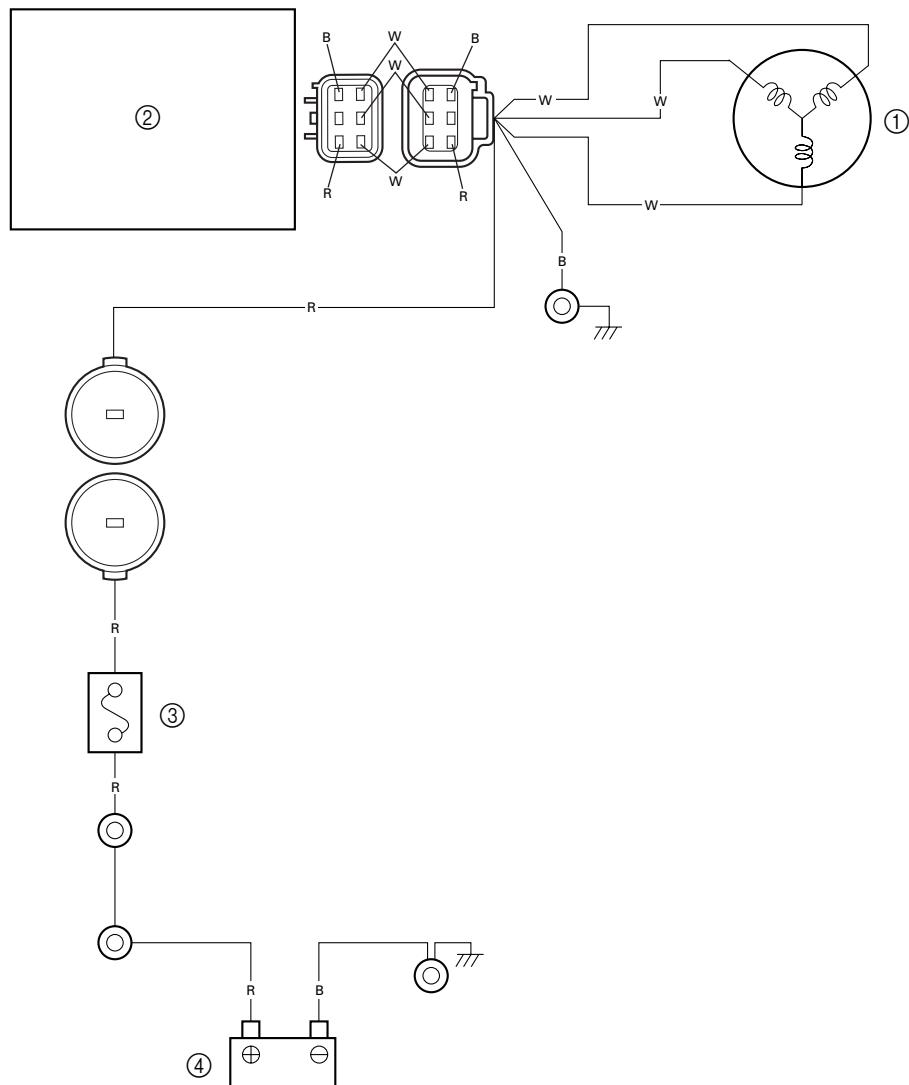
NOTE:

The starter motor pinion should be pushed out while the magnetic switch is on.

- (7) Install the terminal to the magnetic switch relay.

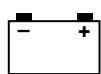
ELEC**CHARGING SYSTEM**

E

CHARGING SYSTEM

- ① Stator coil
- ② Rectifier/regulator
- ③ Fuse (30A)
- ④ Battery

B : Black
R : Red
W : White

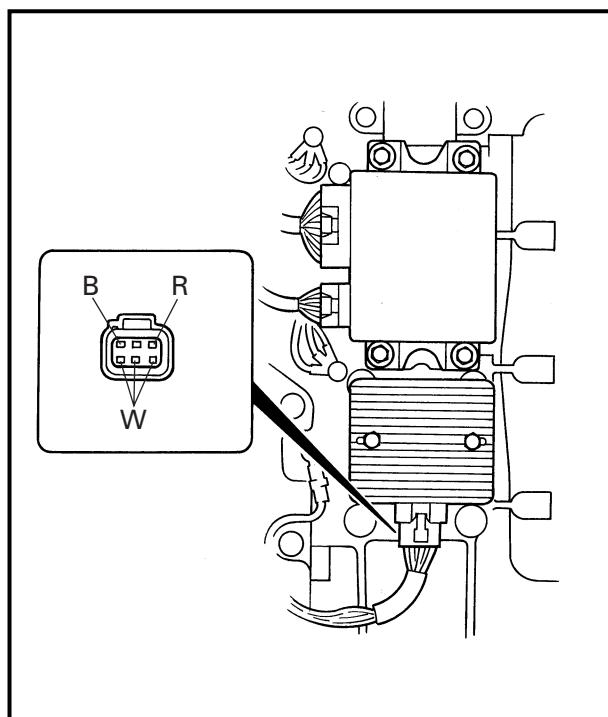


CHECKING THE FUSES

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:

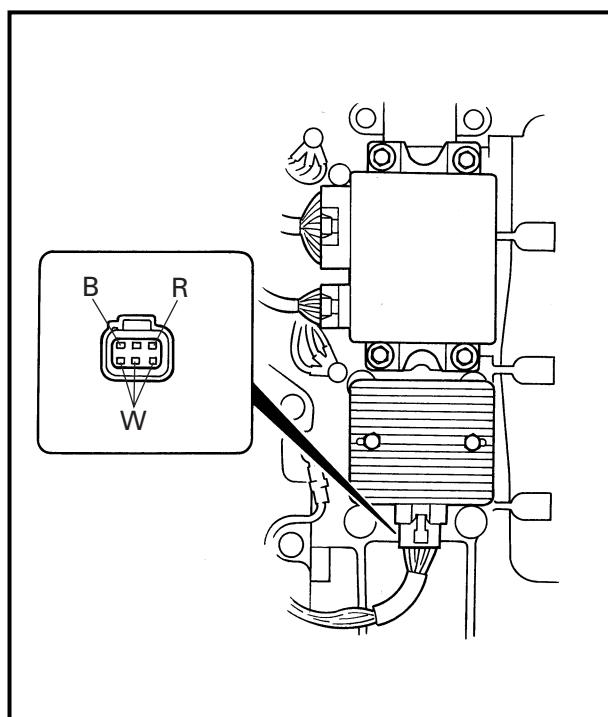
- Lighting coil output peak voltage

Measure with the rectifier/regulator output wire (red) disconnected.

Below specification → Replace the lighting coil.

	Lighting coil output peak voltage White (W) – White (W)			
r/min	Circuit	Loaded	Circuit	
	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

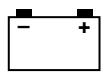
Measure:

- Rectifier/regulator output peak voltage

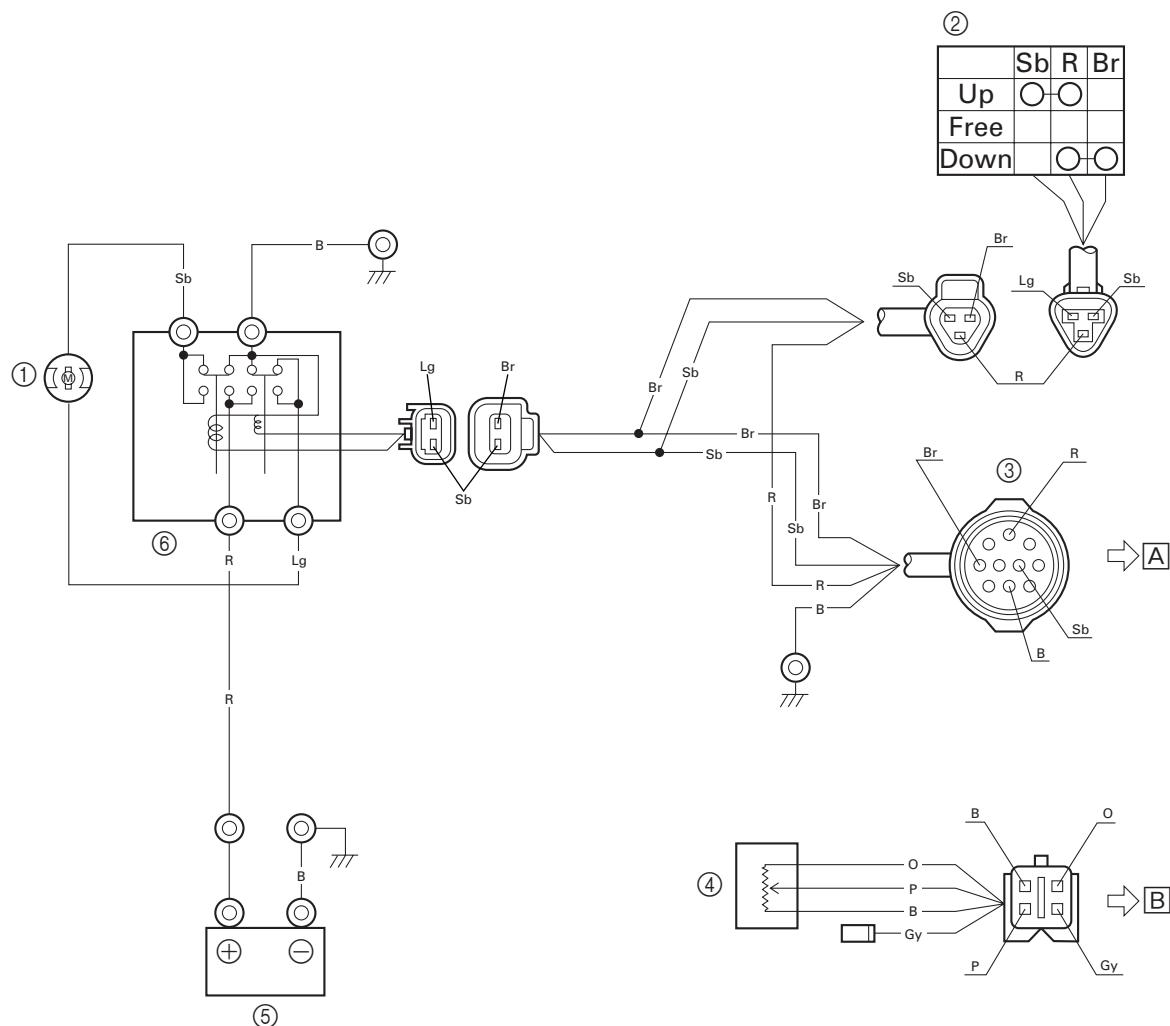
Below specification → Replace the rectifier/regulator.

	Rectifier/regulator output peak voltage Red (R) – Black (B)			
r/min	Circuit	Loaded		
	Cranking		1,500	3,500
V	—	—	12.5	13.0

	Test harness (6-pin) 90890-06790			
--	---------------------------------------------	--	--	--

ELEC**POWER TRIM AND TILT SYSTEM**

E

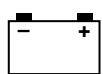
POWER TRIM AND TILT SYSTEM

- 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
- Br : Brown
- Gy : Gray
- Lg : Light green
- O : Orange

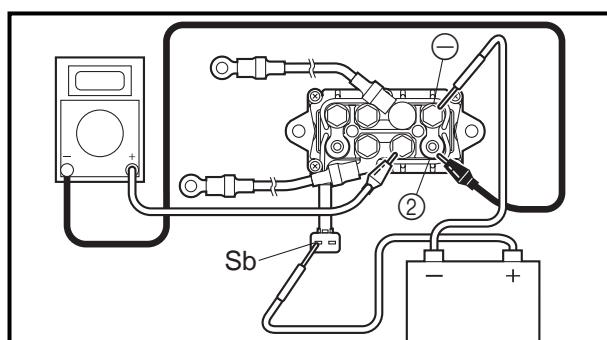
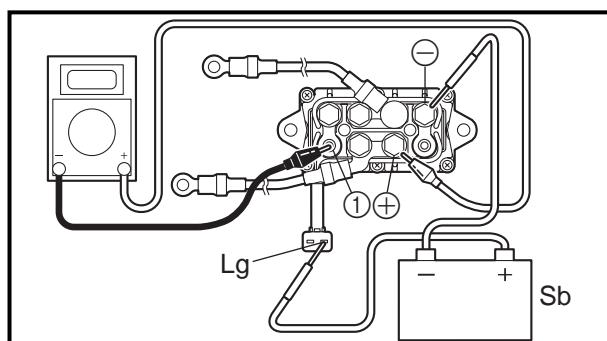
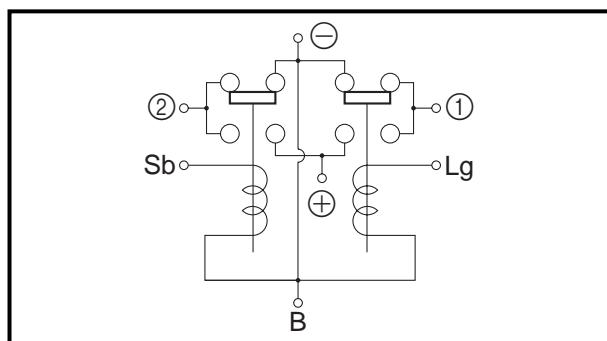
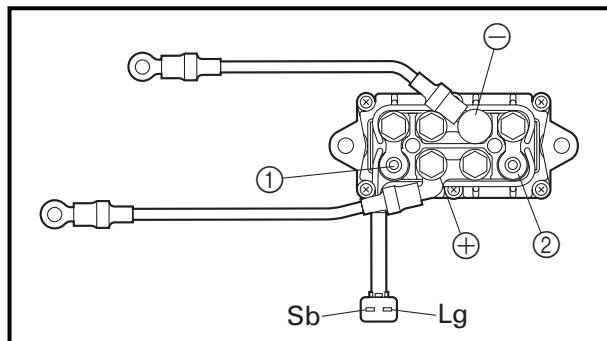
- P : Pink
- R : Red
- Sb : Sky blue
- R/W : Red/white
- P/B : Pink/black

[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 \ominus Terminal ② – Terminal \ominus	Continuity
Terminal ① – Terminal \oplus Terminal ② – Terminal \oplus	No continuity

2. Check:

- Power trim and tilt relay operation
No continuity → Replace.

Checking steps

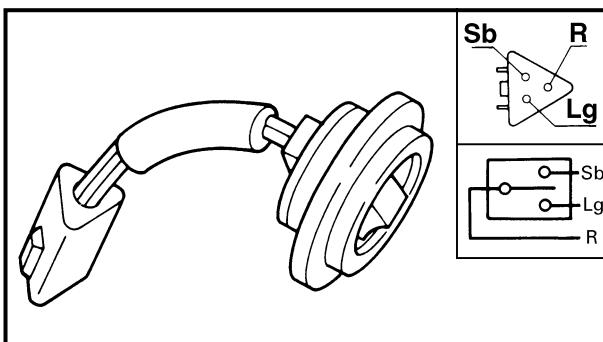
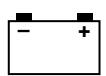
- Connect the digital tester between power trim and tilt relay terminals ① and \oplus .
- Connect a 12-V battery as shown.

**Light green (Lg) lead → Positive terminal
Terminal \ominus → 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 \oplus and ②.
- Connect a 12-V battery as shown.

**Sky blue (Sb) lead → Positive terminal
Terminal \ominus → Negative terminal**

- Check that there is continuity between the power trim and tilt relay terminals.

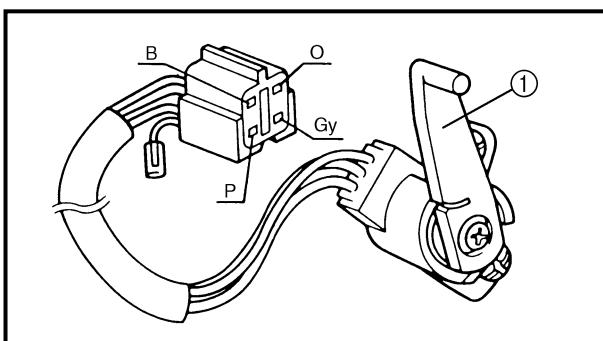


CHECKING THE TRAILER SWITCH CONTINUITY

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

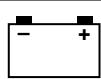
Measure:

- Trim sensor resistance
Out of specification → Replace.

	Trim sensor resistance
	Pink (P) – Black (B) 582 - 873 Ω at 20 °C (68 °F)
	Orange (O) – Black (B) 800 - 1,200 Ω at 20 °C (68 °F)

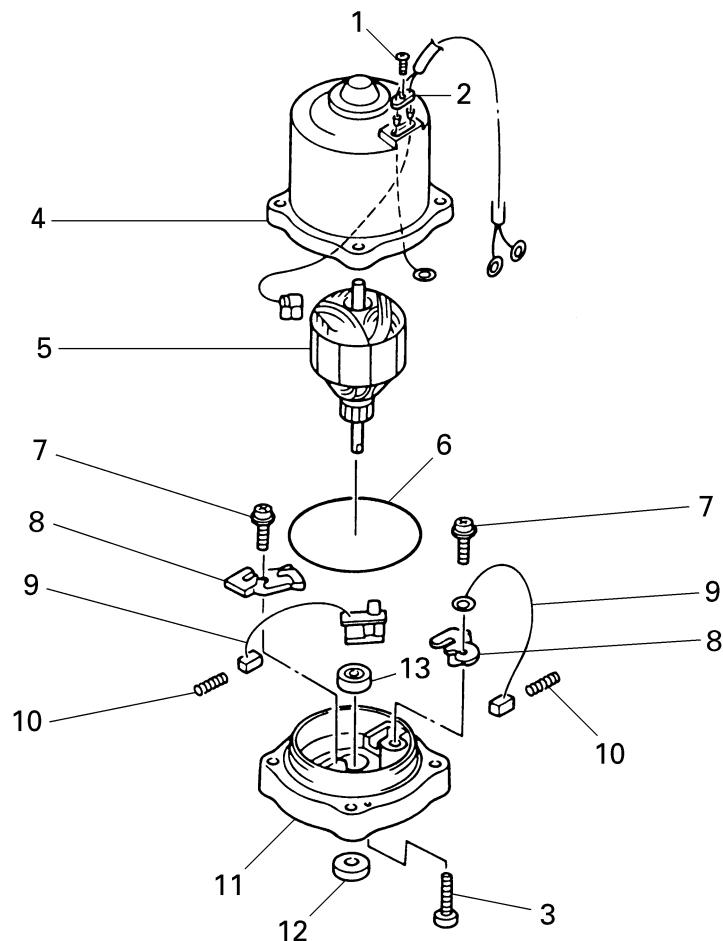
NOTE: _____

Turn the lever ① and measure the resistance as it gradually changes.



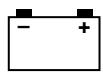
POWER TRIM AND TILT MOTOR

DISASSEMBLING/ASSEMBLING THE POWER TRIM AND TILT MOTOR

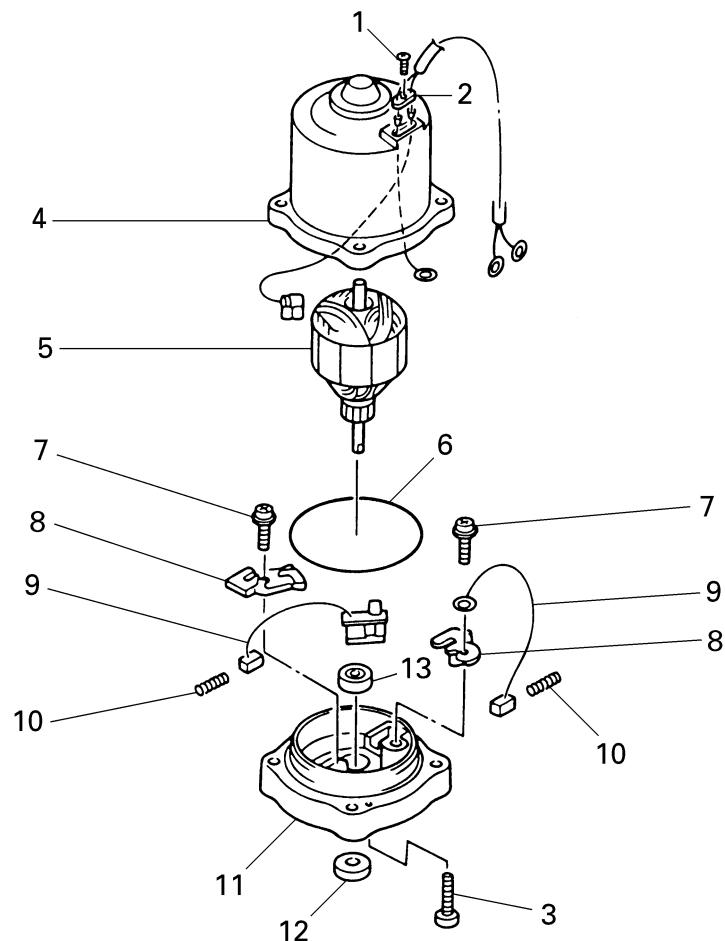


Order	Job/Part	Q'ty	Remarks
	Power trim and tilt motor		Refer to "RESERVOIR AND POWER TRIM AND TILT MOTOR" on page 7-33.
1	Screw	1	
2	Lead holder	1	
3	Screw	2	
4	Stator	1	
5	Armature	1	
6	O-ring	1	
7	Screw	2	

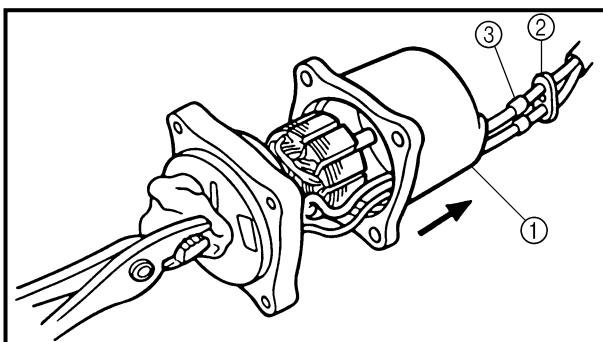
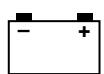
Continued on next page.

ELEC**POWER TRIM AND TILT MOTOR**

E



Order	Job/Part	Q'ty	Remarks
8	Brush holder	2	
9	Brush	2	
10	Spring	2	
11	Lower cover	1	
12	Oil seal	1	
13	Bearing	1	For assembly, reverse the disassembly procedure.



REMOVING THE STATOR

Remove:

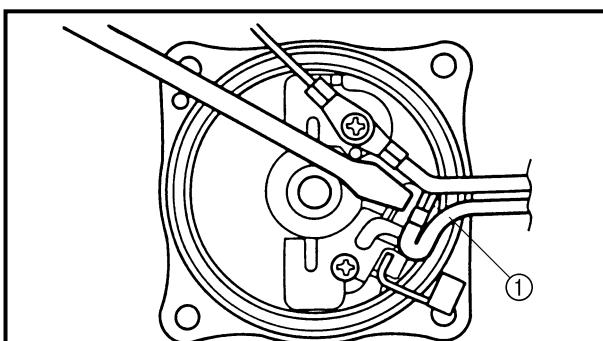
- Stator ①

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.



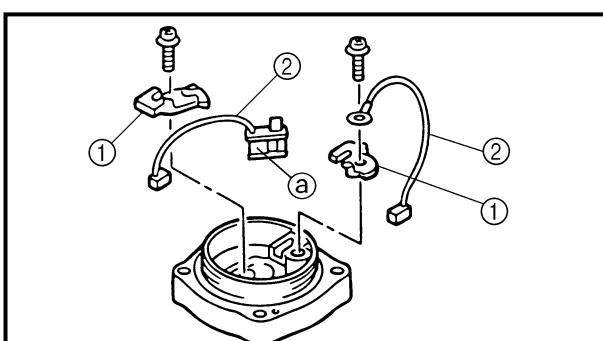
REMOVING THE BRUSH

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.

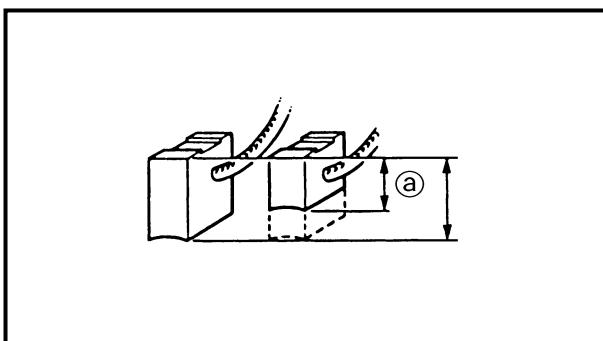


2. Remove:

- Brush holders ①
- Brushes ②

CAUTION:

Do not touch the bimetal ③; touching it may affect the operation of the breaker.



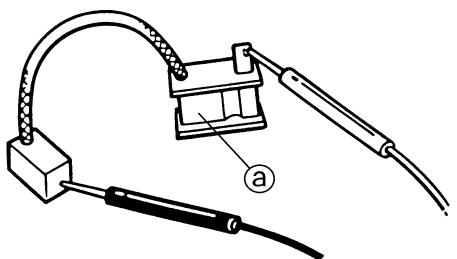
CHECKING THE BRUSH

1. Measure:

- Brush length ④
- Out of specification → Replace.



**Brush length
4.8 mm (0.19 in)**

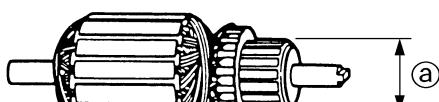


2. Check:

- Brush continuity
No continuity → Replace.

CAUTION:

Do not touch the bimetal **a; touching it may affect the operation of the breaker.**

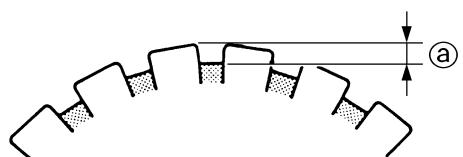
**CHECKING THE ARMATURE**

1. Measure:

- Commutator diameter **a**
Out of specification → Replace.



**Commutator diameter limit
21.0 mm (0.83 in)**

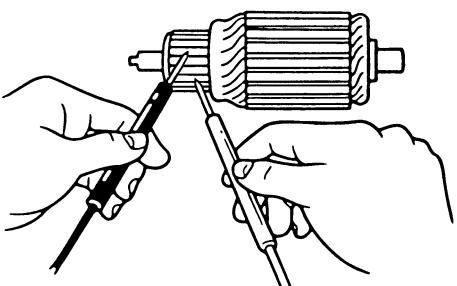


2. Measure:

- Commutator undercut **a**
Out of specification → Replace the armature.



**Commutator undercut limit
0.85 mm (0.03 in)**



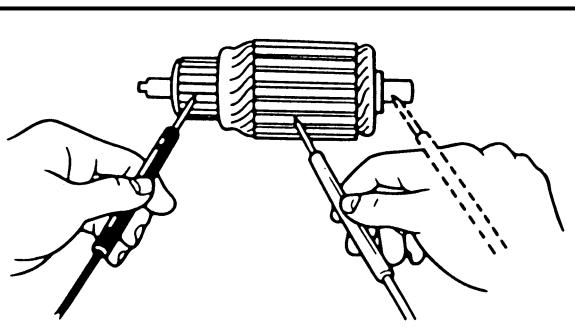
3. Check:

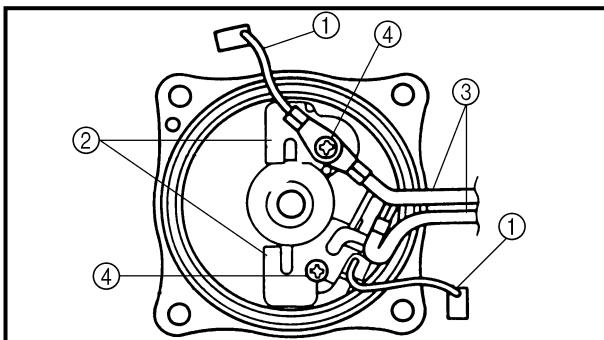
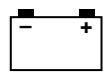
- Armature continuity
Out of specification → Replace.



Armature continuity

Commutator segments	Continuity
Segment-laminations	No continuity
Segment-shaft	No continuity





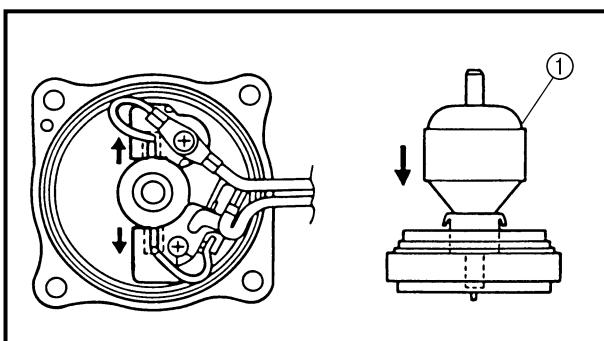
INSTALLING THE BRUSH

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.



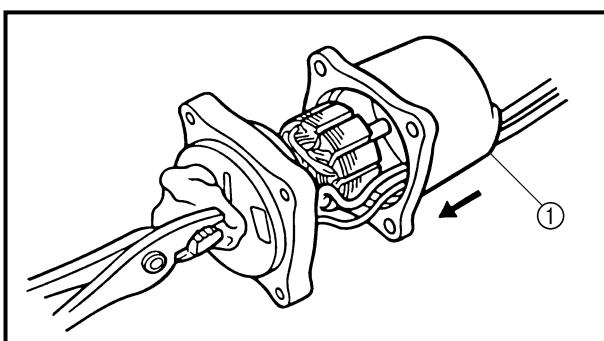
INSTALLING THE ARMATURE

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:

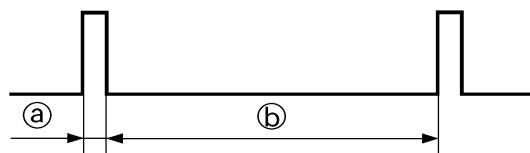
The following items should be checked before the "TROUBLE ANALYSIS CHART" is consulted.

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 lanyard is installed onto the engine stop 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

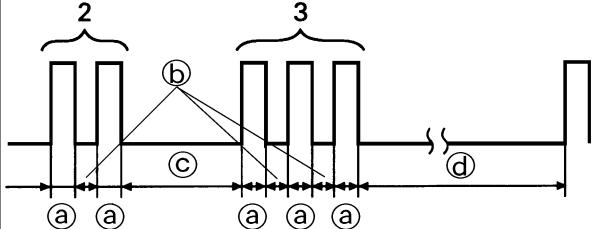
Trouble mode														Check elements				
ENGINE WILL NOT START	HARD STARTING	ROUGH IDLING	HIGH IDLING	ENGINE STALLS	POOR ACCELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	LIMITED ENGINE SPEED	OVERHEATING	LOW OIL PRESSURE	LOOSE STEERING	LOOSE TILT HOLDING	TILT MOTOR WILL NOT RUN	HARD SHIFTING	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Relative part	Reference chapter
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																		
○							○							• Lanyard switch	—			
○														• Main relay	8			
○	○	○	○	○	○	○								• High-pressure fuel pump resistor	8			
	○	○	○											• Intake air pressure sensor	8			
	○	○	○											• Intake air temperature sensor	8			
	○	○	○										○	• Engine cooling water temperature sensor	8			
		○	○		○		○							• Throttle position sensor	8			
		○	○											• Idle speed control assembly	4			



SELF-DIAGNOSIS

DIAGNOSIS CODE INDICATION

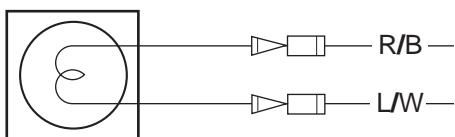
1. Normal condition
(no defective part or irregular processing is found)
Single flash is given every 4.95 seconds.
① : Light on, 0.33 second
② : Light off, 4.95 seconds



2. Trouble code indication

Example: The illustration indicates code number 23.

- ① : Light on, 0.33 second
- ② : Light off, 0.33 second
- ③ : Light off, 1.65 seconds
- ④ : Light off, 4.95 seconds



DIAGNOSIS THE ELECTRONIC CONTROL SYSTEM

1. Install:

- Diagnostic indicator



Warning lamp
6Y5-83536-10 (socket)
6Y5-83517-00 (valve)

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 33 - 44 indicated → Replace the CDI unit.

TROUBLE SHOOTING FOR ELECTRIC FUEL INJECTION

Items	Symptoms
1. Poor starting/ Engine will not start	<ol style="list-style-type: none">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.
	<ol style="list-style-type: none">1. Check the high-pressure fuel lines.<ol style="list-style-type: none">1) Check for fuel line leaks2) Check the fuel pressure3) Check the operation of the fuel injector4) Check the diagnosis cordFuel pressure is out of specification<ul style="list-style-type: none">① Check the 20-A fuse② Check the main relay③ Check the high-pressure fuel pump operation④ Check the main relay drive's ECM output⑤ Check the pressure regulator2. Check the ignition system.<ol style="list-style-type: none">1) Check the wire harness2) Check the ignition spark3) Check the ignition coil4) Check the ECM output peak voltage5) Check the pulser coil output peak voltage

Items	Symptoms
3. Erratic engine speed	<p>1. The engine is started, but will not run smoothly. The engine speed drops during acceleration.</p> <p>1. Check the high-pressure fuel lines.</p> <p>1) Check for fuel line leaks</p> <p>2) Check the fuel pressure</p> <p>3) Check the operation of the fuel injector</p> <p>4) Check the diagnosis cord</p> <p>Fuel pressure is out of specification</p> <p>① Check the 20-A fuse</p> <p>② Check the main relay</p> <p>③ Check the high-pressure fuel pump operation</p> <p>④ Check the main relay drive's ECM output</p> <p>⑤ Check the pressure regulator</p>
	<p>2. Check the ignition system.</p> <p>1) Check the wire harness</p> <p>2) Check the ignition spark</p> <p>3) Check the ignition coil</p> <p>4) Check the ECM output peak voltage</p> <p>5) Check the pulser coil output peak voltage</p>
	<p>3. Check the ignition timing.</p> <p>1) Check the diagnosis cords</p> <p>① Check the pulser coil diagnosis cord</p> <p>② Check the engine cooling water temperature sensor diagnosis cord</p> <p>③ Check the intake air temperature sensor diagnosis cord</p>