

HIDEA

Outboards

F9.9

SERVICE MANUAL

NOTICE

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

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

WARNINGS, CAUTIONS AND NOTES

Attention is drawn to the various Warnings, Cautions and Notes with distinguished important information in this manual in the following ways.



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

⚠ WARNING

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

CAUTION:

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

NOTE:

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

HOW TO READ DESCRIPTIONS

1. An easy-to-see disassembly illustration is mainly provided for a disassembly job.
2. Numbers are given in the order of a disassembly job in the disassembly illustration.
3. An explanation of jobs and notes is presented in an easy-to-read way by the use of symbol marks. The meanings of the symbol marks are given on the next page.
4. A job instruction chart accompanies the assembly illustration, providing the order of jobs, names of parts, notes in jobs, etc.
5. In addition to the disassembly illustration, "REMOVAL POINTS" is provided to supplement in detail the explanation which does or cannot necessarily cover the main jobs.
6. Jobs necessary before and after those which are not included in the disassembly illustration are explained before the same illustration as related jobs.

- ① Section
- ② Preparation for removal
- ③ Order of removal
- ④ Part name
- ⑤ Q'ty

- ⑥ Remarks
- ⑦ Removal points
- ⑧ Extent of removal
- ⑨ Symbol mark
- ⑩ Exploded diagram

POWER CYLINDER HEAD, VALVE AND CAMSHAFT

CYLINDER HEAD, VALVE AND CAMSHAFT

PREPARATION FOR REMOVAL

- Remove the power unit.
- Remove the following parts:
 - CDI unit
 - Ignition coil
 - Stator assembly
 - Rectifier/regulator
 - Flywheel/magneto
 - Timing belt

Part	Q'ty	Remarks
A	2 Nm (0.2 mkg, 1.4 ft-lb)	
B	8 Nm (0.8 mkg, 5.8 ft-lb)	
C	13 Nm (1.3 mkg, 9.4 ft-lb)	
D	16 Nm (1.6 mkg, 12 ft-lb)	
E	1st: 16 Nm (1.6 mkg, 12 ft-lb) 2nd: 30 Nm (3.0 mkg, 22 ft-lb)	

POWER CYLINDER HEAD, VALVE AND CAMSHAFT

NOTE ON REMOVAL AND REASSEMBLY

- Before servicing, clean the power unit.
- Remove any gasket adhered to the contacting surface.
- Take care not to scratch the contacting surfaces when removing the cylinder and cylinder head.
- For reassembly, the removed parts should be cleaned with solvent, and apply the gear oil to the sliding surfaces.

Extent of removal:

Extent of removal	Order	Part name	Q'ty	Remarks
①	1	Bolt	3	
②	2	Intake manifold	1	
③	3	Bolt	1	
④	4	Head cover	1	
⑤	5	Bolt	6	
⑥	6	Cylinder head	1	Refer to "REMOVAL POINTS".
⑦	7	Bolt	3	
⑧	8	Oil pump assembly	1	
⑨	9	Adjust screw	1	Loosen the screw.
⑩	10	Valve lifter	2	Refer to "REMOVAL POINTS".
⑪	11	Rocker shaft	2	
⑫	12	Rocker arm	4	
⑬	13	Bolt	1	
⑭	14	Driven gear	1	Refer to "REMOVAL POINTS".
⑮	15	Camshaft	1	
⑯	16	Valve cotter	4	
⑰	17	Valve (intake)	2	
⑱	18	Spring retainer	2	Refer to "REMOVAL POINTS".
⑲	19	Valve (exhaust)	2	

REMOVAL POINTS

CYLINDER HEAD

1. Remove:

- Cylinder head ①

NOTE:

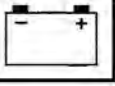
- To remove the cylinder head, insert a bar between the cylinder head and cylinder body, and then separate it.
- Do not to scratch the gasket surfaces by the screw driver.

ROCKER SHAFT

1. Loosen:

- Lock nut ①
- Adjust bolt ②

Valve adjuster:
YB-8035/80690-01311

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

SYMBOLS

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

- ① General Information
- ② Specifications
- ③ Periodic Inspection and Adjustment
- ④ Fuel System
- ⑤ Power Unit
- ⑥ Lower Unit
- ⑦ Bracket Unit
- ⑧ Electrical System
- ⑨ Trouble analysis

Symbols ⑩ to ⑯ indicate specific data:

- ⑩ Special Tool
- ⑪ Specified liquid
- ⑫ Specified grease
- ⑬ Specified engine speed
- ⑭ Specified torque
- ⑮ Specified measurement
- ⑯ Specified electrical value
[Resistance (Ω), Voltage (V),
Electric current (A)]

Symbol ⑰ to ⑳ in an exploded diagram indicate grade of lubricant and location of lubrication point:

- ⑰ Apply Yamaha engine oil
- ⑱ Apply Yamaha gear-case lubricant
- ⑲ Apply molybdenum disulfide oil
- ⑳ Apply water resistant grease (Yamaha marine grease A, Yamaha marine grease)

Symbols ㉑ to ㉔ in an exploded diagram indicate grade of sealing or locking agent, and location of application point:

- ㉑ Apply Gasket Maker®
- ㉒ Apply LOCTITE® No. 271 (Red LOCTITE)
- ㉓ Apply LOCTITE® No. 242 (Blue LOCTITE)
- ㉔ Apply LOCTITE® No. 572

NOTE:

In this manual, the above symbols may not be used in every case.

INDEX

GENERAL INFORMATION	 GEN INFO
SPECIFICATIONS	 SPEC
PERIODIC INSPECTION AND ADJUSTMENT	 INSP ADJ
FUEL SYSTEM	 FUEL
POWER UNIT	 POWR
LOWER UNIT	 LOWR
BRACKET UNIT	 BRKT
ELECTRICAL SYSTEM	 ELEC
TROUBLE ANALYSIS	 TRBL ANLS



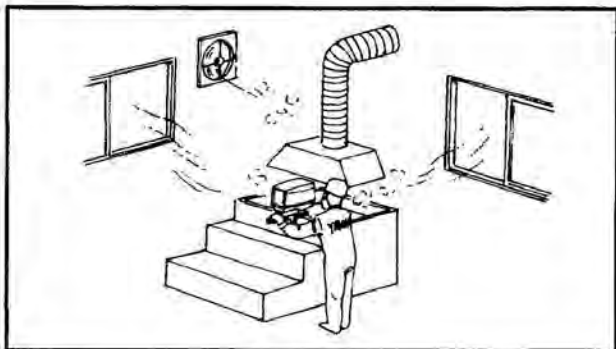
SAFETY WHILE WORKING

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



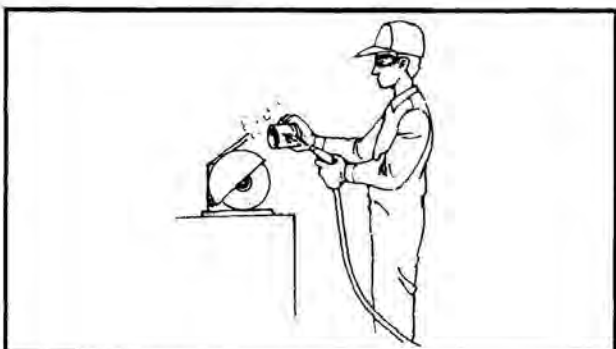
FIRE PREVENTION

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



VENTILATION

Petroleum vapor is heavier than air and if inhaled in large quantities will not support life. Engine exhaust gases are harmful to breathe. When test-running an engine indoors, maintain good ventilation.



SELF-PROTECTION

Protect your eyes with suitable safety spectacles or safety goggles when using compressed air, 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 appropriate to the work you are doing.



OILS, GREASES AND SEALING FLUIDS

Use only genuine Hidea oils, grease and sealing fluids or those recommended by Hidea.



Under normal conditions of use, there should be no hazards from the use of the lubricants mentioned in this manual. However 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 one's 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 special tools that are advised to protect parts from damage. Use the right tool in the right manner – don't improvise.

2. Tightening torque

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



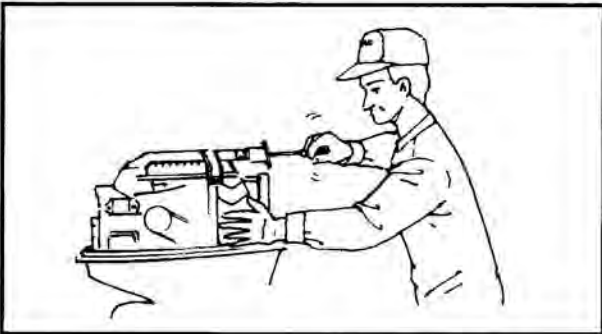
3. Non-reusable items

When reassembling, always use new gaskets, packings, O-rings, oil seals, split-pins and circlips, etc.



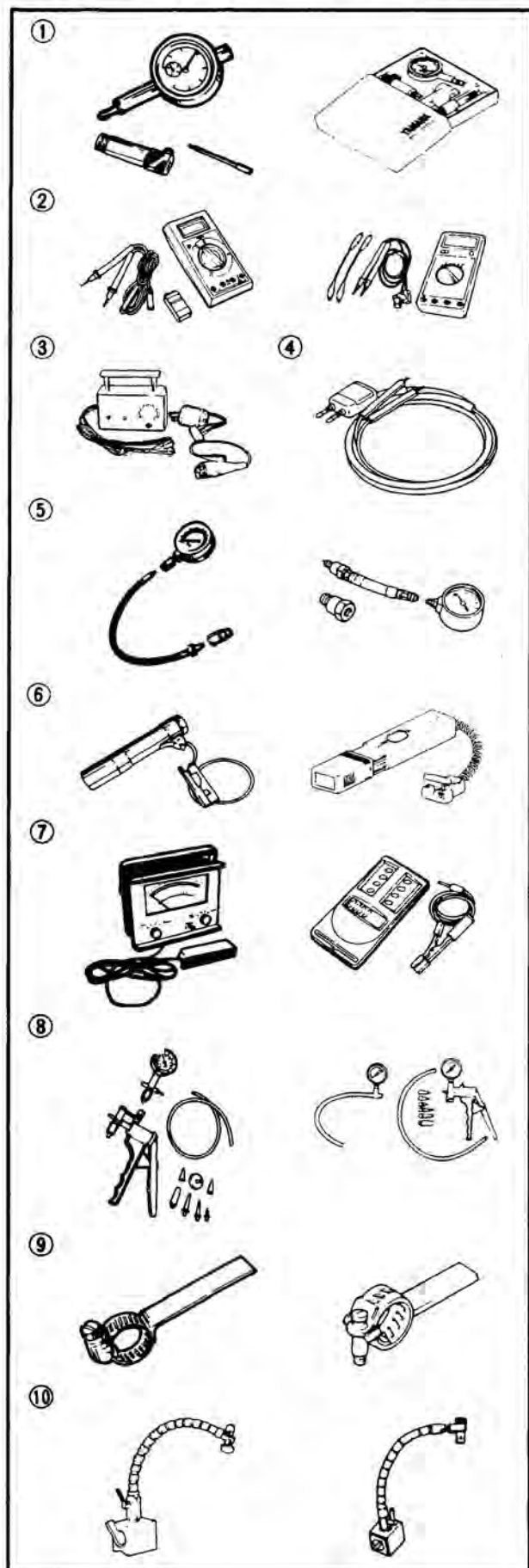
DISASSEMBLY AND ASSEMBLY

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



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

4. Install bearing 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

The use of correct special tools recommended by Hidea will aid the work and enable accurate assembly and tune-up. Improvisations and use of improper tools can cause damage to the equipment.

MEASURING

1. Dial gauge and stand

2. Digital multi meter

3. CDI tester

4. Peak volt adapter

5. Compression gauge

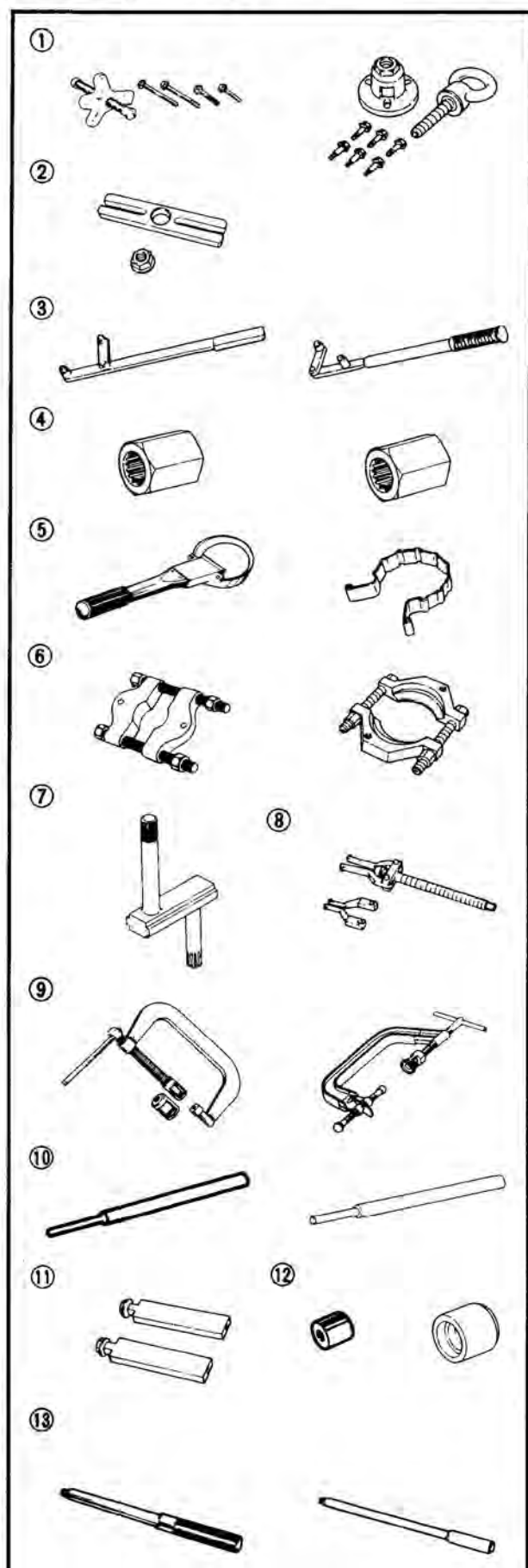
6. Timing light

7. Tachometer

8. Mity Vac

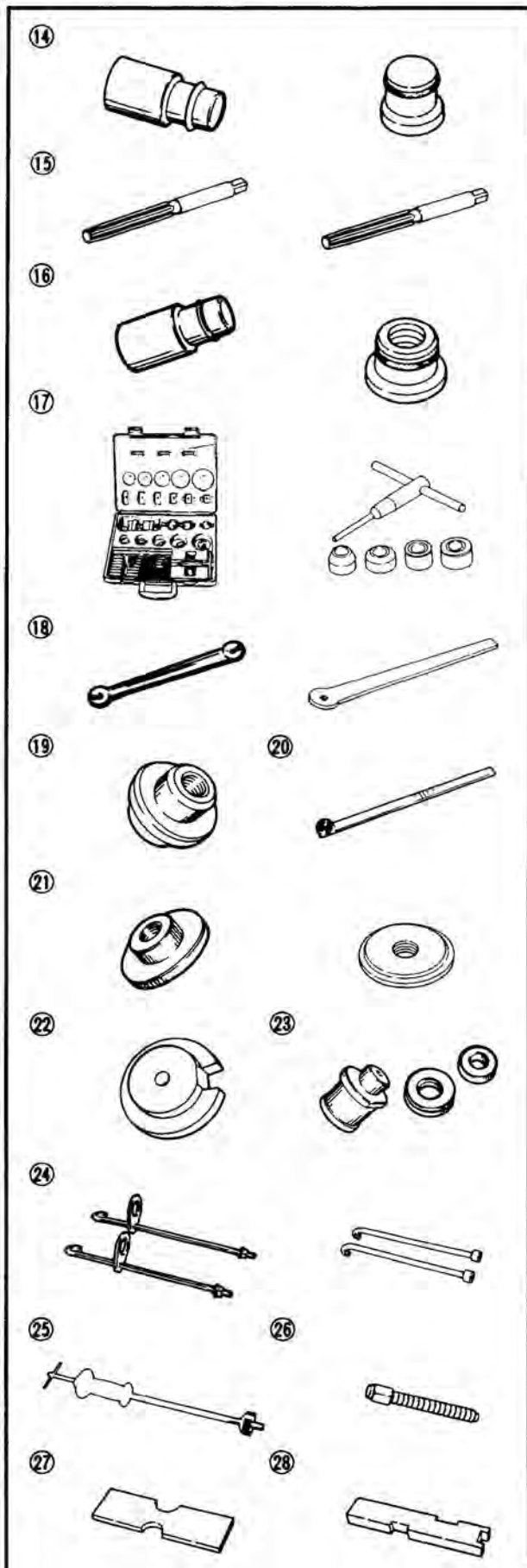
9. Backlash indicator

10. Magnet base



REMOVAL AND INSTALLATION

1. Flywheel puller
2. Stopper guide plate
3. Flywheel holder
4. Drive shaft holder
5. Piston ring installer
6. Bearing separator
7. Shaft holder
8. Bearing puller
9. Valve spring compressor
10. Valve guide remover
11. Stopper guide stand
12. Valve guide installer
13. Drive rod



14. Needle bearing attachment

15. Valve guide reamer

16. Needle bearing attachment

17. Valve seat cutter set

18. Valve adjuster

19. Oil seal installer

20. Pinion nut holder

21. Bearing installer

22. Pinion height gauge

23. Pinion height gauge

24. Bearing housing puller

25. Slide hammer set

26. Center bolt

27. Shimming plate

28. Bearing depth plate



GENERAL SPECIFICATIONS

Item	Unit	Model		
		F9. 9		
Overall length	mm (in)	993 (39.1)		575 (22.6)
Overall width	mm (in)	430 (16.9)		325 (12.8)
Overall height	(S)	1,004 (39.5)		
	(L)	1,131 (44.5)		
	(X)	—		
Boat transom height	(S)	381 (15.0)		
	(L)	508 (20.0)		
	(X)	—		
Weight (without propeller)	(S)	41.5 (91)	43.0 (95)	43.5 (96)
	(L)	42.5 (94)	44.0 (97)	44.5 (98)
	(X)	—		
Maximum output	kW (hp)@rpm	5.9 (8)@5,000		
Speed range at full-throttle	rpm	4,500 ~ 5,500		
Speed range at idling	rpm	950 ± 50		
Speed range at trolling	rpm	850 ± 50		
Maximum fuel consumption		3.3 (0.87/0.73)@5500		
Engine type		4 stroke OHC		
Number of cylinders		2		
Total displacement	cm ³ (cu. in)	232 (14.16)		
Bore and stroke	mm × mm (in × in)	59.0 × 42.4 (2.32 × 1.67)		
Compression ratio		9.3 : 1		
Spark plug		BR6HS		
Number of carburetor		1		
Carburetor starting system		Prime start		
Manifold arrangement		Cross flow		
Exhaust system		Through propeller boss		
Lubrication system		Wet sump		
Ignition system		CDI		
Starting system		Manual starter	Electric starter	
Fuel rating	P.O.N.	86		
Engine oil type	SAE API	10W-30, 10W-40 SE, SF, SE-SF, SE-SF-CC		
Engine oil pan capacity		1.0 (1.06/0.88)		
Gear oil type		Hypoid gear oil		
Gear oil capacity	SAE	90		
	cm ³	185 (6.25/6.51)		
Tilt angle at 12° boat transom	Degree	8, 12, 16, 20		
Tilt-up angle at 12° boat transom	Degree	70		
Shallow water angle	Degree	Tilt angle +20		—
Steering angle (left + right)	Degree	37 + 37		
Gear shift position		F-N-R		
Gear ratio		13 : 27 (2.08)		
Reduction system		Spiral bevel gear		
Propeller direction (rear view)		Clock wise		
Propeller drive system		Spline		

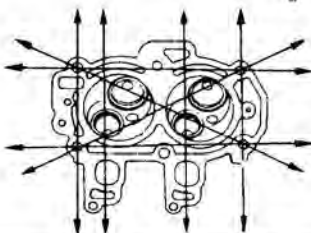
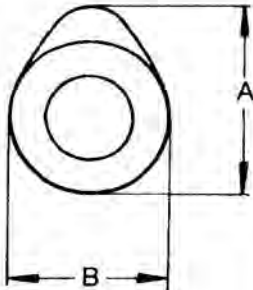
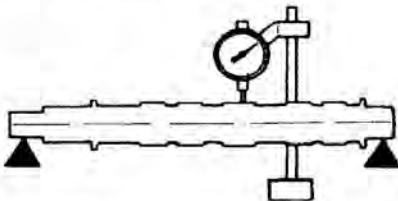


Item	Unit	Model	
		F9. 9	
Overall length	mm (in)	993 (39.1)	575 (22.6)
Overall width	mm (in)	430 (16.9)	325 (12.8)
Overall height	(S) mm (in)	—	1,051 (41.4)
	(L) mm (in)	1,178 (46.4)	
	(X) mm (in)	1,254 (49.4)	
Boat transom height	(S) mm (in)	—	381 (15.0)
	(L) mm (in)	508 (20.0)	
	(X) mm (in)	635 (25.0)	
Weight (without propeller)	(S) kg (lb)	—	44.5 (98)
	(L) kg (lb)	43.5 (96)	45.0 (99)
	(X) kg (lb)	44.0 (97)	45.5 (100)
Maximum output	kW (hp)@rpm	7.3 (9.9)@4,500	
Speed range at full-throttle	rpm	4,000 ~ 5,000	
Speed range at idling	rpm	1,150 ± 50	
Speed range at trolling	rpm	1,000 ± 50	
Maximum fuel consumption		3.3 (0.87/0.73)@5,000	
Engine type		4 stroke OHC	
Number of cylinders		2	
Total displacement	cm ³ (cu. in)	232 (14.16)	
Bore and stroke	mm × mm (in × in)	59.0 × 42.4 (2.32 × 1.67)	
Compression ratio		9.3 : 1	
Spark plug		BR6HS	
Number of carburetor		1	
Carburetor starting system		Prime start	
Manifold arrangement		Cross flow	
Exhaust system		Through propeller boss	
Lubrication system		Wet sump	
Ignition system		CDI	
Starting system		Manual starter	Electric starter
Fuel rating	P.O.N.	86	
Engine oil type	SAE API	10W-30, 10W-40 SE, SF, SE-SF, SE-SF-CC	
Engine oil pan capacity		1.0 (1.06/0.88)	
Gear oil type		Hypoid gear oil	
	SAE	90	
Gear oil capacity	cm ³	320 (10.82/11.26)	
Tilt angle at 12° boat transom	Degree	8, 12, 16, 20	
Tilt-up angle at 12° boat transom	Degree	70	
Shallow water angle	Degree	—	
Steering angle (left + right)	Degree	37 + 37	
Gear shift position		F-N-R	
Gear ratio		13 : 38 (2.92)	
Reduction system		Spiral bevel gear	
Propeller direction (rear view)		Clock wise	
Propeller drive system		Spline	

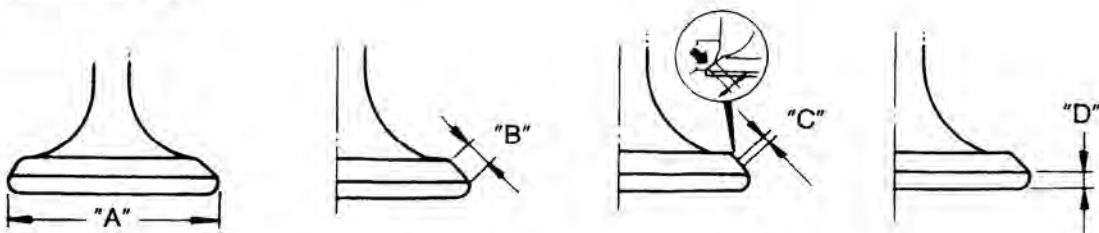
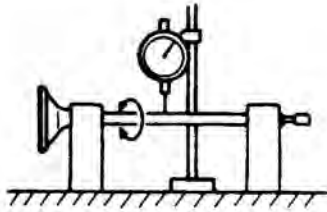


MAINTENANCE SPECIFICATIONS

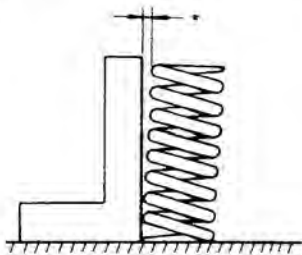
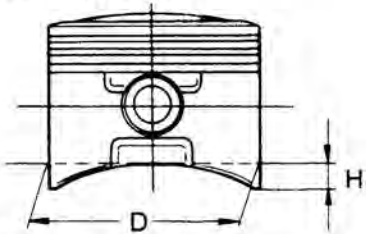
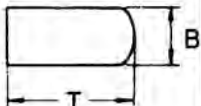
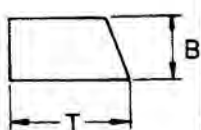
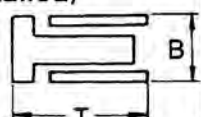
ENGINE

Item	Unit	Model
		F9.9
CYLINDER HEAD: Warp limit 	mm (in)	0.1 (0.004) * Lines indicate straightedge measurement
CYLINDER: Bore size Wear limit Taper limit	mm (in) mm (in) mm (in)	59.00 ~ 59.02 (2.323 ~ 2.324) 59.1 (2.326) 0.08 (0.003)
CAMSHAFT: Cam dimensions Intake "A" Intake "B" Exhaust "A" Exhaust "B"  Camshaft runout limit 	mm (in) mm (in) mm (in) mm (in) mm (in)	24.541 ~ 24.641 (0.966 ~ 0.970) 20.137 ~ 20.237 (0.793 ~ 0.797) 24.578 ~ 24.678 (0.968 ~ 0.972) 20.178 ~ 20.278 (0.794 ~ 0.798) 0.1 (0.004)
CAM BELT: Cam belt type Belt stack	mm (in)	Cogged belt 0 ~ 10 (0 ~ 0.4)

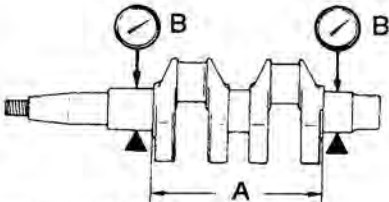
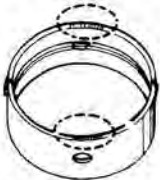
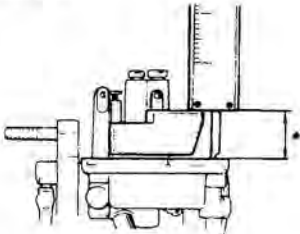


Item		Unit	Model
			F9. 9
VALVE, VALVE SEAT, VALVE GUIDE:			
Valve clearance (cold):	IN.	mm (in)	0.15 ~ 0.20 (0.0059 ~ 0.0079)
	EX.	mm (in)	0.20 ~ 0.25 (0.0079 ~ 0.0098)
Valve dimensions			
			
"A" Head dia.	IN.	mm (in)	25.9 ~ 26.1 (1.020 ~ 1.028)
	EX.	mm (in)	21.9 ~ 22.1 (0.862 ~ 0.870)
"B" Face width	IN.	mm (in)	1.98 ~ 3.11 (0.078 ~ 0.122)
	EX.	mm (in)	1.98 ~ 3.11 (0.078 ~ 0.122)
"C" Seat width	IN.	mm (in)	0.6 ~ 0.8 (0.024 ~ 0.031)
	EX.	mm (in)	0.6 ~ 0.8 (0.024 ~ 0.031)
"D" Margin thickness	IN.	mm (in)	0.5 ~ 0.9 (0.020 ~ 0.035)
	EX.	mm (in)	0.5 ~ 0.9 (0.020 ~ 0.035)
Stem outside dia.	IN.	mm (in)	5.475 ~ 5.490 (0.2156 ~ 0.2161)
	EX.	mm (in)	5.460 ~ 5.475 (0.2150 ~ 0.2156)
Guide inside dia.	IN.	mm (in)	5.500 ~ 5.512 (0.2165 ~ 0.2170)
	EX.	mm (in)	5.500 ~ 5.512 (0.2165 ~ 0.2170)
Stem-to-guide clearance	IN.	mm (in)	0.010 ~ 0.037 (0.0004 ~ 0.0015)
	EX.	mm (in)	0.025 ~ 0.052 (0.0010 ~ 0.0020)
Stem runout limit		mm (in)	0.016 (0.0006)
			



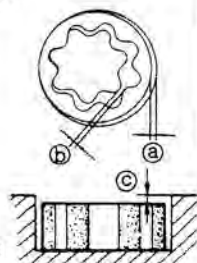
Item		Unit	Model
			F9. 9
VALVE SPRING:			
Set length (valve closed)	IN.	mm (in)	24.4 (0.96)
	EX.	mm (in)	24.4 (0.96)
Compressible forth	IN.	N (kg, lb)	90 ~ 100 (9.0 ~ 10.0, 19.8 ~ 22.0)
(installed)	EX.	N (kg, lb)	90 ~ 100 (9.0 ~ 10.0, 19.8 ~ 22.0)
Tilt limit *	IN.	mm (in)	1.1 (0.043)
	EX.	mm (in)	1.1 (0.043)
			
Direction of winding	IN.		Left hand
	EX.		Left hand
PISTON:			
Piston to cylinder clearance		mm (in)	0.035 ~ 0.065 (0.0014 ~ 0.0026)
Piston side "D"		mm (in)	58.950 ~ 58.965 (2.3209 ~ 2.3215)
Measuring point "H"		mm (in)	10 (0.39)
			
Overize	1st	mm (in)	59.25 (2.333)
	2nd	mm (in)	59.50 (2.343)
PISTON RING:			
Top ring:			
Type			Plain (barrel face)
Dimensions (B × T)		mm (in)	1.5 × 2.3 (0.06 × 0.09)
End gap (installed)		mm (in)	0.15 ~ 0.30 (0.006 ~ 0.012)
Limit		mm (in)	0.50 (0.020)
Side clearance (installed)		mm (in)	0.04 ~ 0.08 (0.002 ~ 0.003)
2nd ring:			
Type			Plain (taper face)
Dimensions (B × T)		mm (in)	1.5 × 2.4 (0.06 × 0.09)
End gap (installed)		mm (in)	0.15 ~ 0.30 (0.006 ~ 0.012)
Limit		mm (in)	0.50 (0.020)
Side clearance (installed)		mm (in)	0.03 ~ 0.07 (0.001 ~ 0.003)
Oil ring:			
Dimensions (B × T)		mm (in)	2.4 × 2.5 (0.09 × 0.10)
End gap (installed)		mm (in)	0.20 ~ 0.70 (0.008 ~ 0.028)



Item	Unit	Model		
		F9. 9		
CONNECTING ROD: Oil clearance (big end)	mm (in)	0.021 ~ 0.045 (0.0008 ~ 0.0018)		
CRANKSHAFT:  Crank width "A" Runout limit "B" Main bearing clearance Crankcase mark-Bearing color 	mm (in) mm (in) mm (in)	123.7 ~ 123.9 (4.87 ~ 4.88) 0.05 (0.002) 0.000 ~ 0.027 (0.0000 ~ 0.0011) A-Blue, B-Black, C-Brown		
CARBURETOR: Stamped mark		6J606 6J710	6G805 6G810 6G820	6G905 6G810 6G920
Main Nozzle	mm (in)	2.2 (0.087)		
Main Jet (M.J.)	#	86 , 82		
Pilot Jet (P.J.)	#	48		
Pilot Screw (turn out) (P.S.)	turns	3-1/2 ± 1	3 ± 1	3-1/2 ± 1
Valve seat size (V.S.)	mm (in)	ø1.2 (0.047)		
Float height*	mm (in)	25.5 ± 1 (1 ± 0.04)		
				
Idling speed	r/min	950 ± 50	1,150 ± 50	950 ± 50
Trolling speed	r/min	850 ± 50	1,000 ± 50	850 ± 50
THERMOSTAT: Valve opening temperature	°C (°F)	58 ~ 62 (136 ~ 144)		
Full open temperature	°C (°F)	70 (158)		
Valve lift (at full open temp.)	mm (in)	3 (0.12)		



Item	Unit	Model
		F9.9
FUEL PUMP:		
Consumption	ℓ/h, r/min	Min 18.0, 2,750
Diaphragm stroke	mm (in)	2.4 (0.0945)
Plunger stroke	mm (in)	5.8 (0.2283)
LUBRICATION SYSTEM:		
Oil filter type:		Steel mesh
Oil pump type:		Trochoid type
Outer rotor to housing ①	mm (in)	0.06 ~ 0.11 (0.0024 ~ 0.0043)
Inner rotor to outer rotor ②	mm (in)	0.02 ~ 0.15 (0.0008 ~ 0.0059)
Rotor to housing ③	mm (in)	0.02 ~ 0.07 (0.0008 ~ 0.0028)
Relief valve operation pressure	kpa (kg/cm ² , psi)	388 ~ 450 (3.88 ~ 4.50, 55.19 ~ 64.00)





LOWER

Item	Unit	Model		
		F9. 9		
GEAR BACKLASH:				
Pinion - forward	mm (in)	0.23 ~ 0.70 (0.009 ~ 0.028)	0.26 ~ 0.77 (0.010 ~ 0.030)	0.23 ~ 0.70 (0.009 ~ 0.028)
Pinion - reverse	mm (in)	0.82 ~ 1.16 (0.032 ~ 0.046)	0.51 ~ 1.02 (0.020 ~ 0.040)	0.82 ~ 1.16 (0.032 ~ 0.046)
Pinion shims	mm	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50	0.10/0.14/0.18/ 0.35/0.50	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50
Forward shims	mm	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50	0.10/0.14/0.18/ 0.50	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50
Reverse shims	mm	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50	0.10/0.14/0.18/ 0.35/0.50	0.10/0.12/0.15/ 0.18/0.30/0.40/ 0.50
PROPELLER:				
HDF9. 9		8 1/2x 8 1/2		

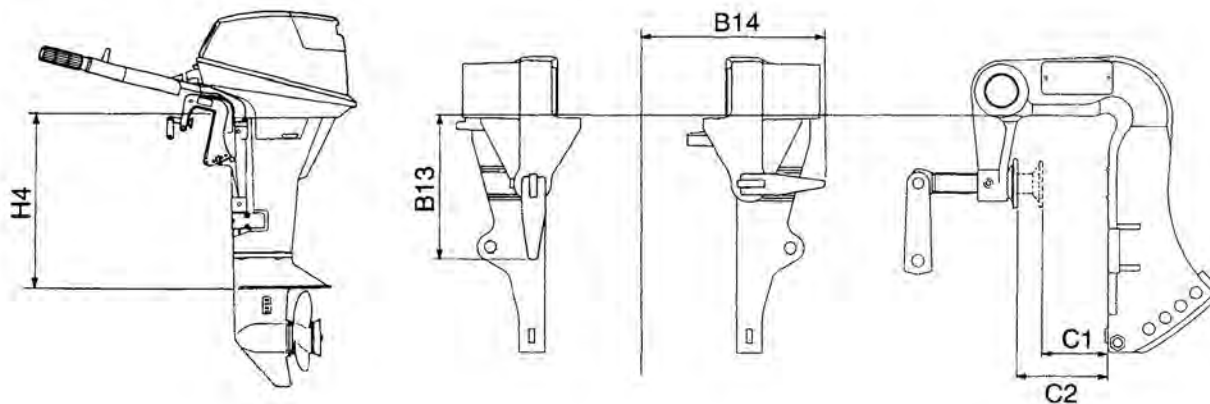


ELECTRICAL

Item	Unit	Model			
		HDF9.9			
IGNITION SYSTEM:					
Ignition timing (full retard)	Degrees	5 ± 3 BTDC			
(full advance)	Degrees	35 ± 3 BTDC			
Piston position	mm (in)	4.78 ± 0.76 (0.188 ± 0.030)			
CDI output peak voltage (minimum):					
(O – B) open	V@cranking	85	95		85
connected	V@cranking	85	90		85
	V@1,500 r/min	195	205		195
	V@3,500 r/min	170	195		170
Charge coil output peak voltage (minimum):					
(Br – L) open	V@cranking	95	100		95
connected	V@cranking	90	150		90
	V@1,500 r/min	205	220		205
	V@3,500 r/min	180	210		180
Pulser coil output peak voltage (minimum):					
(W/R – B) open	V@cranking	3.5	4.0		3.5
connected	V@cranking	2.5	2.5		2.5
	V@1,500 r/min	7.5	7.5		7.5
	V@3,500 r/min	13.0	12.0		13.0
Spark plug gap	mm (in)	0.6 ~ 0.7 (0.024 ~ 0.028)			
IGNITION CONTROL SYSTEM:					
Oil pressure switch (continue)	kPa (kg/cm ² , psi)	0 ± 10 (0 ± 0.1, 0 ± 1.4)			
(discontinue)	kPa (kg/cm ² , psi)	60 ± 10 (0.6 ± 0.1, 8.5 ± 1.4)			
Oil pressure indicator lamp output	V	More than 65			
STARTING SYSTEM:					
Fuse	V - A	12 - 20			
Starter motor					
Output	kW	0.6			
Brush length	mm (in)	9.0 ~ 12.5 (0.35 ~ 0.49)			
Commutator diameter	mm (in)	29.0 ~ 30.0 (1.14 ~ 1.18)			
Commutator under cut	mm (in)	0.2 ~ 0.8 (0.01 ~ 0.03)			
Rating	Sec.	30			
CHARGING SYSTEM:		G – G	G – G	W/G – B	G – G
Lighting coil output	V@cranking	7.5	9.0	8.0	7.5
	V@cranking	8.0	9.0	8.0	8.0
	V@1500 r/min	30	35	30	30
	V@3500 r/min	65	75	65	60
ENRICHMENT CONTROL SYSTEM:					
Valve heater coil resistance at 20°C (68°F)	Ω	0.24 ~ 0.36			



DIMENSION



Symbol (used in diagram)	Unit	Model	
		HDF9.9	
H4	S	432 (17.0)	
	L	559 (22.0)	
	UL	635 (25.0)	—
B13	mm (in)	114 (4.5)	
B14	mm (in)	126 (5.0)	
C1	mm (in)	33 (1.3)	
C2	mm (in)	65 (2.6)	



TIGHTENING TORQUE

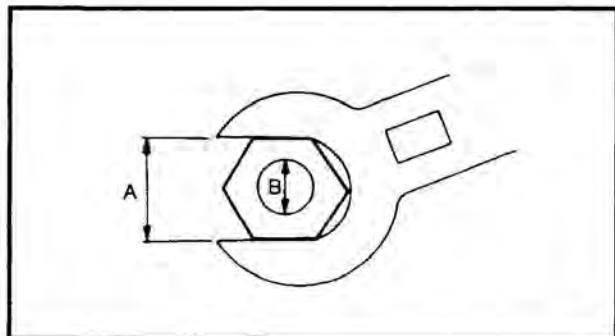
Part to be tightened		Part name	Thread size	Q'ty	Tightening torque			Remarks
					Nm	m • kg	ft • lb	
ENGINE:								
Connecting rod	1st	Bolt	M6	4	6	0.6	4.3	
	2nd				12	1.2	8.7	
Crankcase	1st	Bolt	M6	6	6	0.6	4.3	
	2nd				12	1.2	8.7	
	1st	Bolt	M8	4	15	1.5	11	
	2nd				30	3.0	22	
Cylinder head	1st	Bolt	M8	6	15	1.5	11	
	2nd				30	3.0	22	
Oil element assembly		—	M24	1	8	0.8	5.8	
Exhaust cover		Bolt	M6	7	12	1.2	8.7	
Rock arm adjusting screw		Lock nut	M5	4	8	0.8	5.8	
Drive gear		Nut	M24	1	23	2.3	17	
Driven gear		Bolt	M6	1	13	1.3	9.4	
Flywheel		Nut	M12	1	100	10.0	7.2	
Spark plug		—	M10	2	13	1.3	9.4	
Engine unit mounting		Bolt	M8	6	21	2.1	15	
UPPERCASE AND GEAR CASE:								
Pinion nut		Nut	M8	1	26	2.6	19	
Exhaust guide mounting		Bolt	M6	2	10	1.0	7.2	
Relief valve		—	M14	1	8	0.8	5.8	
Bracket bolt		Nut	M8	1	17	1.7	12	
Steering bracket		Bolt	M6	2	13	1.3	9.4	
Upper side mount rubber		Nut	M8	2	25	2.5	18	
Propeller	HDF9.9	Nut	M10	1	21	2.1	15	
				1	17	1.7	12	
Plug drain		—	M18	1	8	0.8	5.8	
Manifold exhaust mounting		Bolt	M6	2	12	1.2	8.7	
Bottom cowling mounting		Bolt	M8	6	21	2.1	15	



Nut (A)	Bolt (B)	General torque specifications		
		Nm	m • kg	ft • lb
8 mm	M5	5.0	0.5	3.6
10 mm	M6	8.0	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	26
17 mm	M12	43	4.3	31

GENERAL TORQUE SPECIFICATIONS

This chart specifies the torque for tightening standard fasteners with standard clean dry ISO threads at room temperature. Torque specifications for special components or assemblies are given in applicable sections of this manual. To avoid causing warpage, tighten multi-fastener assemblies in a crisscross fashion and in progressive stages until the specified torque is reached.




**PERIODIC SERVICE
MAINTENANCE SCHEDULE**

The following chart may be taken as a helpful guide to the intervals between maintenance procedures.

Item	Remarks	Initial		Every	
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)
Anode	Inspect	○	○	○	
Battery	Check	○ (every 1 month)			
Bolts and nuts	Retighten	○		○	
Carburetor	Clean/Adjust	○		○	
Cooling water passages	Clean		○	○	
Engine oil	Replace	○		○	
Fuel strainer	Inspect/Replace	○	○	○	
Fuel tank	Clean				○
Gear oil	Replace	○		○	
Greasing points	Grease			○	
Idle speed	Adjust			○	
Ignition timing	Check	○		○	
Oil filter	Clean	○		○	
	Replace				○
Outboard motor body	Inspect		○	○	
Propeller	Inspect		○	○	
Spark plug	Clean/Adjust	○	○	○	
Timing belt	Check			○	
Throttle link	Adjust	○		○	
Valve clearance	Measure/Adjust	○		○	

ANODE
1. Inspect:

- Anode
Wear/Damage → Replace.

CAUTION:

Do not paint the anode, or the outboard may be corroded.

2. Clean:

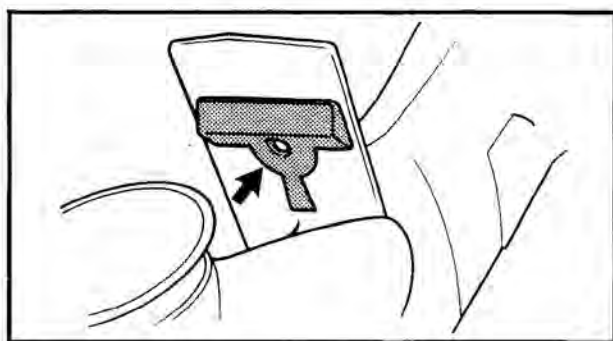
- Anode
Use a wire brush.

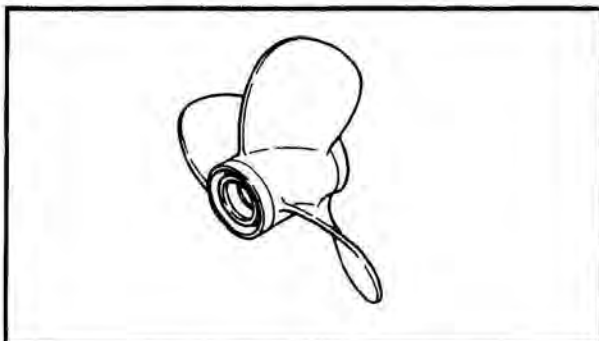
NOTE:

Remove all trace of oil or grease. After cleaning, polish the contact surfaces of the anode mount and re-install.

CAUTION:

Never paint the anode. To ensure good electrical contact, keep the anode contact surface clean of oil or grease.





PROPELLER

1. Inspect:

- Propeller
- Spline

Wear/Damage → Replace.

BATTERY

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.

Always follow these preventive measures:

- Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.

- Wear protective eye gear when handling or working near batteries.

Antidote (EXTERNAL):

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

Antidote (INTERNAL):

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

Batteries generate explosive, hydrogen gas.

Always follow these preventive measures:

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

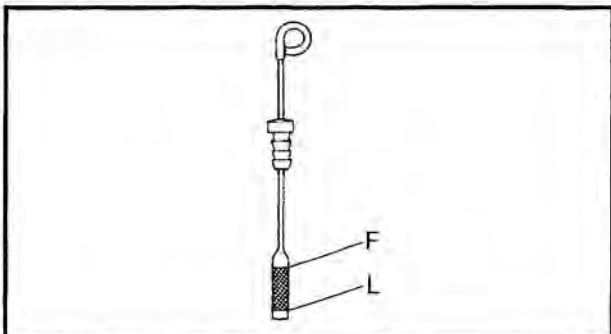
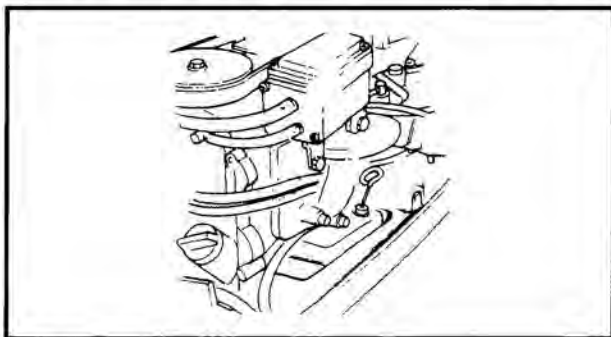
KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:

- Batteries vary among manufacturers. Therefore, the following procedures may not always apply. Consult your battery manufacturer's instructions.
- Disconnect the black negative lead first to prevent the risk of shorting.

1. Inspect:

- Battery fluid level
- Battery fluid specific gravity



ENGINE OIL LEVEL CHECK

1. Place the outboard motor in an upright position.

2. Check:

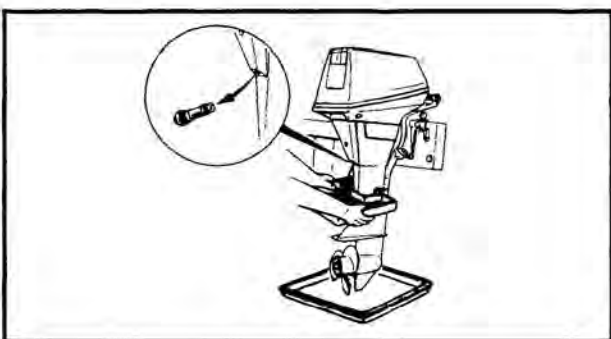
- Engine oil level
Oil level should be between the maximum F and minimum L marks.
Oil level is low → Add oil to proper level.



Recommended oil:
SAE: 10W-30, 10W-40
API: SE, SF, SE-SF, SE-SF-CC

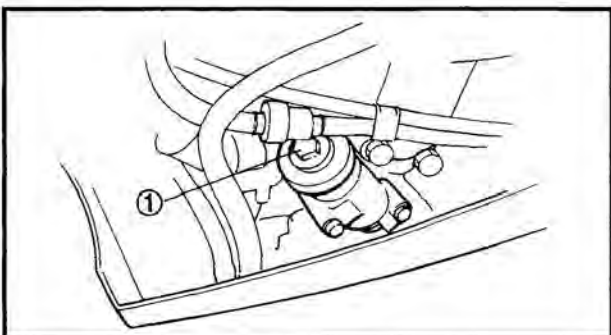
ENGINE OIL REPLACEMENT

1. Place the outboard motor in an upright position.
2. Place a suitable container under the outboard motor.



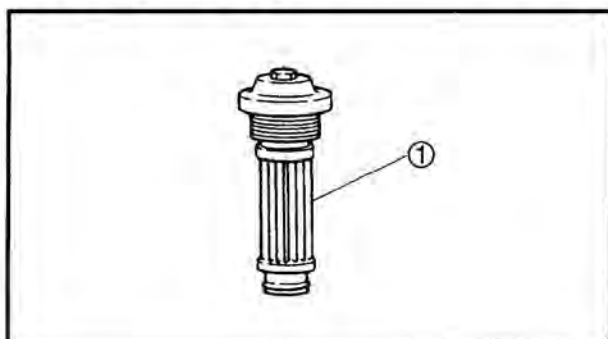
3. Remove:

- Oil filler cap
- Drain bolt
Drain the engine oil.



4. Remove:

- Oil filter assembly ①

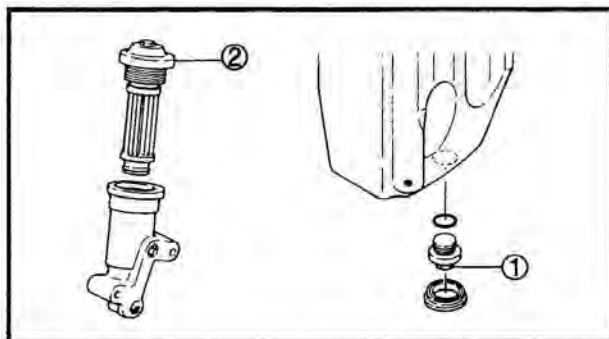


5. Inspect:

- Oil filter element ①
Damage → Replace.
Foul/Clog → Clean.

6. Clean:

- Oil filter element
Blow out dust in the element from the outer surface using compressed air.

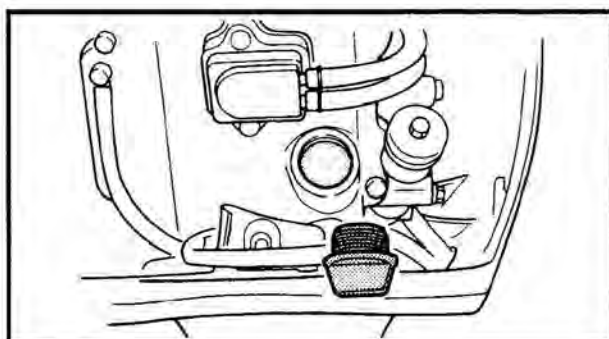


7. Install:

- Drain bolt ①
- Oil filter assembly ②



Drain bolt:
8 Nm (0.8 m • kg, 5.8 ft • lb)
Oil filter assembly:
8 Nm (0.8 m • kg, 5.8 ft • lb)

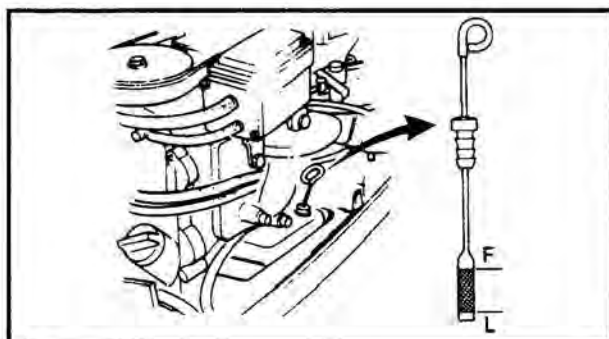


8. Fill:

- Engine oil



Recommended oil:
SAE: 10W-30, 10W-40
API: SE, SF, SE-SF, SE-SF-CC
Oil capacity:
1.0 ℓ (1.06 US qt, 0.88 Imp qt)



9. Check:

- Engine oil level

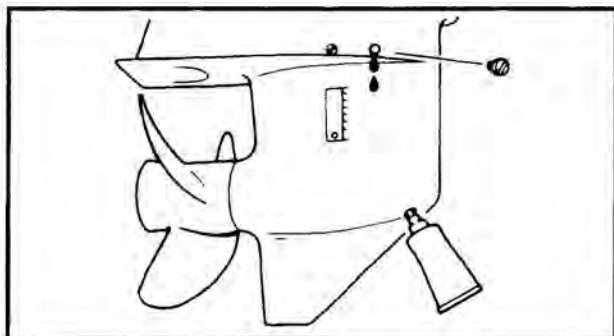
10. Install:

- Oil filler cap

GEAR OIL LEVEL CHECK

1. Place the outboard motor in an upright position.
2. Check:
 - Gear oil level

Oil level is low → Add oil to proper level.



Checking steps:

- Remove the oil drain and oil level plugs.
- Add the gear oil through the oil drain hole until it over flows from the oil level hole.



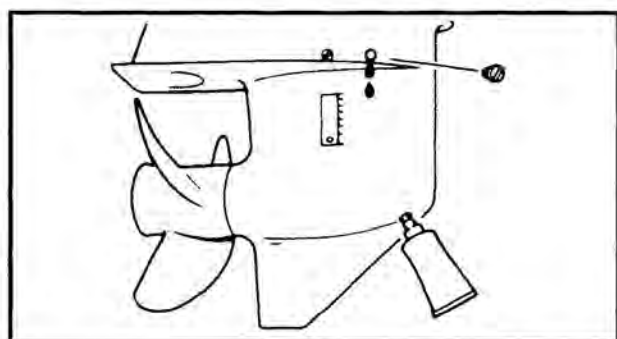
Recommended oil:
Hypoid gear oil (SAE 90)

- Install the oil level plug.
- Install the oil drain plug.

GEAR OIL REPLACEMENT

1. Place the outboard motor in an upright position.
2. Place a suitable container under the outboard motor.
3. Remove:
 - Oil drain plug
 - Oil level plug

Drain the gear oil.



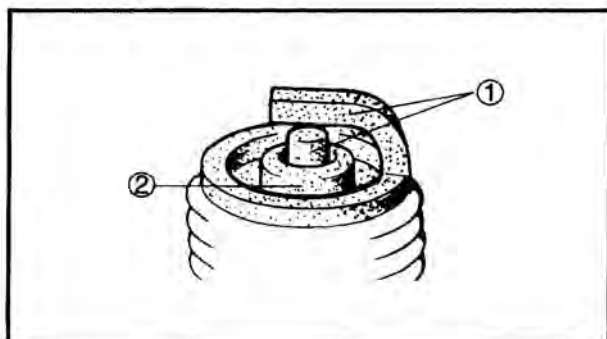
4. Fill:
 - Gear oil



Recommended oil:
Hypoid gear oil (SAE 90)

Oil capacity
HDF9.9 : 220ml

5. Check:
 - Gear oil level
6. Install:
 - Oil level plug
 - Oil drain plug



SPARK PLUG

1. Remove:
 - Spark plug
2. Inspect:
 - Electrode ①
Wear/Damage → Replace.
 - Insulator color ②
Distinctly different color → check the engine condition.



Color guide

Medium to light tan color:
Normal

Whitish color: Lean fuel mixture

Plugged fuel mixture

Air leak

Wrong settings

Blackish color: Excessive idling

Electrical malfunction

rich carburetion

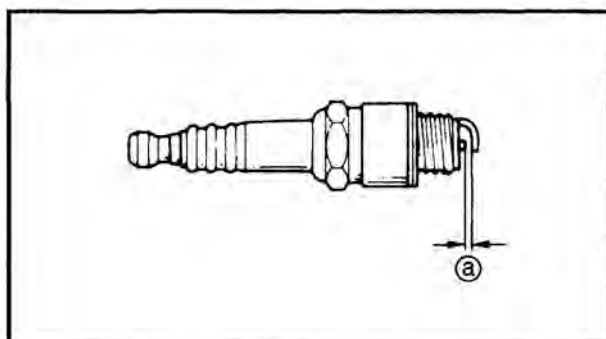
Defective spark plug

3. Clean:
 - Spark plug
Clean the spark plug with a spark plug cleaner or wire brush.
4. Inspect:
 - Spark plug type
Incorrect → Replace.



Standard spark plug:

BR6HS
(HDF9.9)



5. Measure:
 - Spark plug gap ③
Out of specification → Regap.
Use a wire gauge.



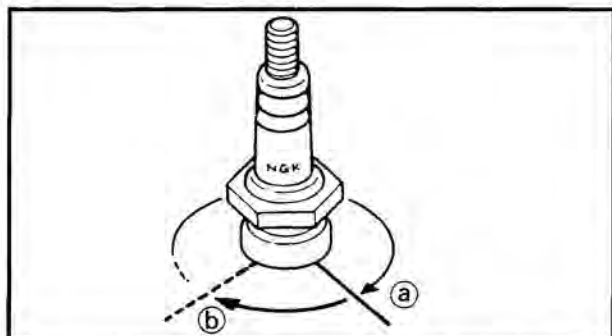
Spark plug gap:

0.6 ~ 0.7 mm (0.024 ~ 0.028 in)

6. Tighten:
 - Spark plug

NOTE:

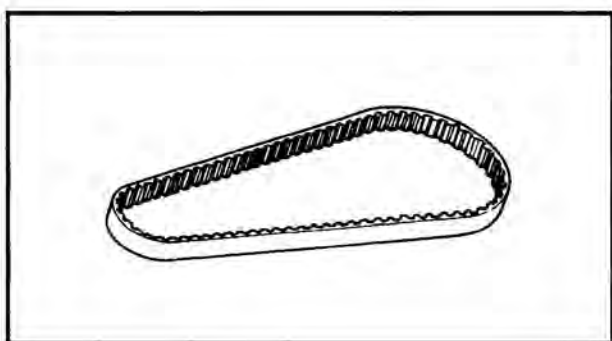
Before installing a spark plug, clean the gasket surface and plug surface. Also it is suggested to apply a thin film of Anti Seize Compound to the spark plug thread to prevent future thread seizure.



Spark plug:
13 Nm (1.3 m • kg, 9.4 ft • lb)

NOTE:

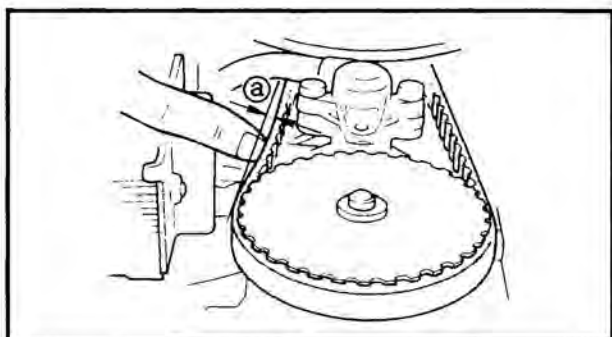
If a torque wrench is not available when you are installing a spark plug, a good estimate of the correct torque is 1/4 to 1/2 turns (b) part finger tight (a). Have the spark plug torqued to the correct valve as soon as possible with a torque wrench.



TIMING BELT

1. Inspect:
 - Timing belt

Wear/Damage → Replace.



2. Check:
 - Timing belt slack (a)

Push the timing belt with your finger.
Out of specification → Replace.

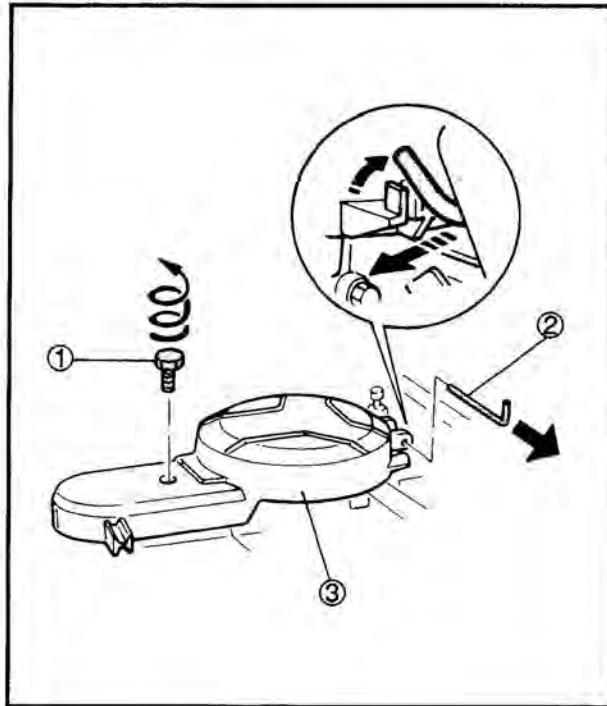


Timing belt slack:
0 ~ 10 mm (0 ~ 0.4 in)

VALVE CLEARANCE ADJUSTMENT

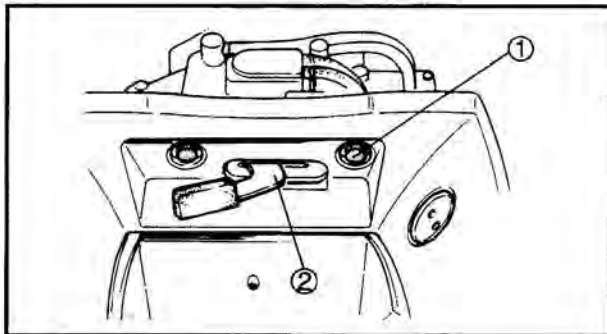
NOTE:

- The valve clearance must be adjusted when the engine is cool to the touch.
- Adjust the valve clearance when the piston is at the Top Dead Center (T.D.C.) on compression stroke.



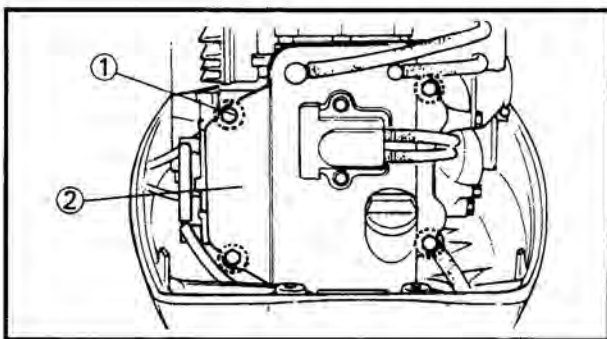
1. Remove:

- Screw ①
- Hinge pin ②
- Flywheel cover ③



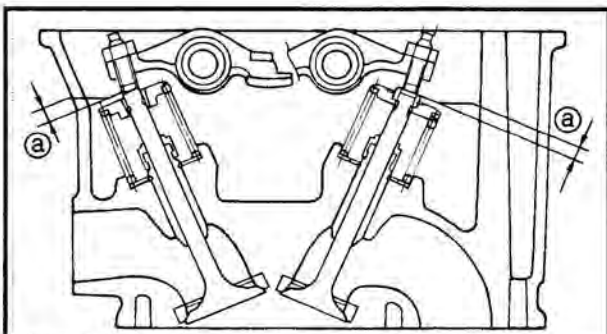
2. Remove:

- Bolt ①
- Clamp lever ②



3. Remove:

- Hose
- Bolt ①
- Cylinder head cover ②



4. Measure:

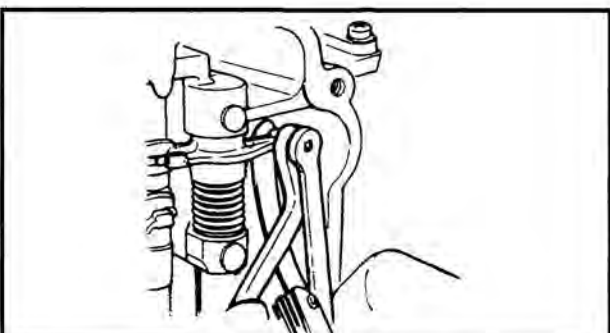
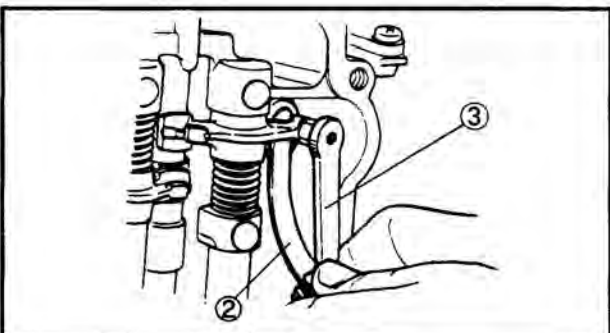
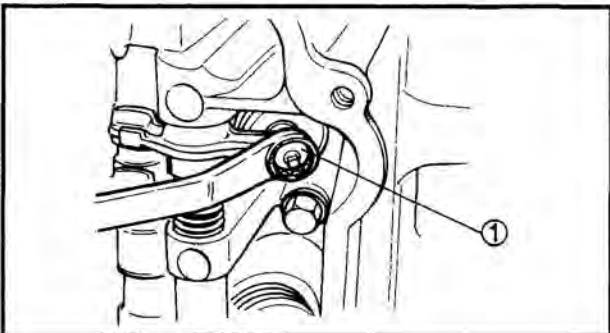
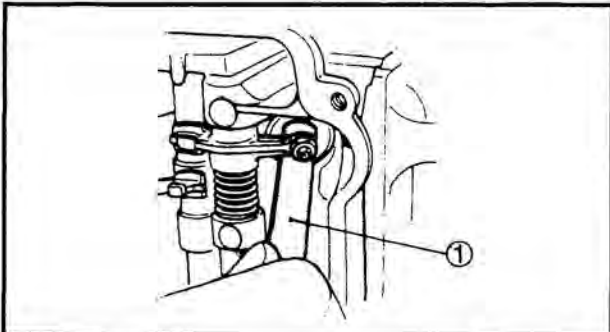
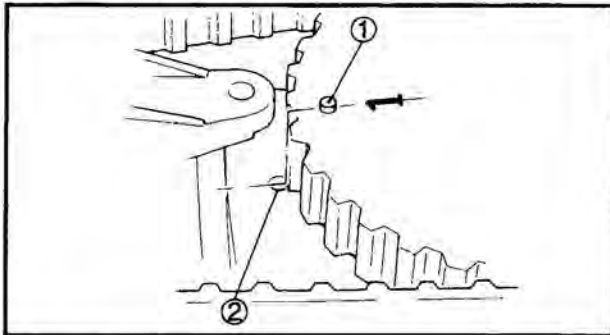
- Valve clearance ①
- Out of specification → Adjust.



Valve clearance (cold):

Intake: 0.15 ~ 0.20 mm
(0.0059 ~ 0.0079 in)

Exhaust: 0.20 ~ 0.25 mm
(0.0079 ~ 0.0098 in)



Measurement steps:

- Turn the crankshaft clockwise.
- Align the "1" on the driven gear ① with the mark on the cylinder head ② when #1 piston is at TDC on compression stroke.

NOTE:

When measuring the valve clearance at the #2 cylinder, turn the driven gear 180° so that the "2" marked on the driven gear aligns with the mark on the cylinder head.

- Measure the valve clearance using a feeler gauge ①.

5. Adjust:

- Valve clearance

Adjustment steps:

- Loosen the lock nut ①.
- Insert the specified feeler gauge ② into the clearance between the valve stem end and the adjust bolt.
- Adjust the adjust bolt using a valve adjuster ③.



Valve adjuster

- Tighten the lock nut with the feeler gauge inserted.

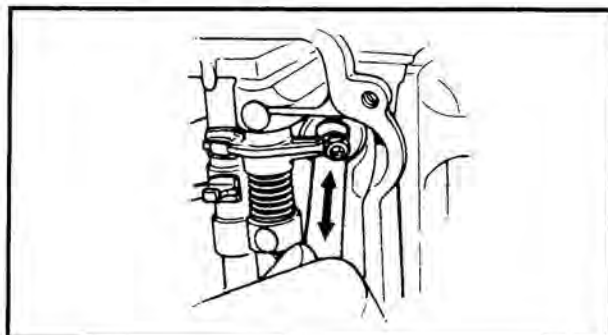


Lock nut:

8 Nm (0.8 m • kg, 5.8 ft • lb)

NOTE:

Lock the adjust bolt so that it does not move.

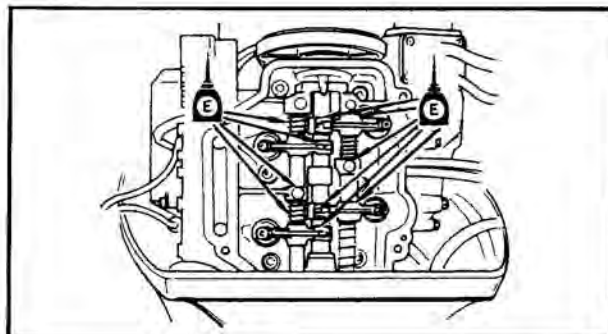


6. Measure:

- Valve clearance
- Out of specification → Readjust.

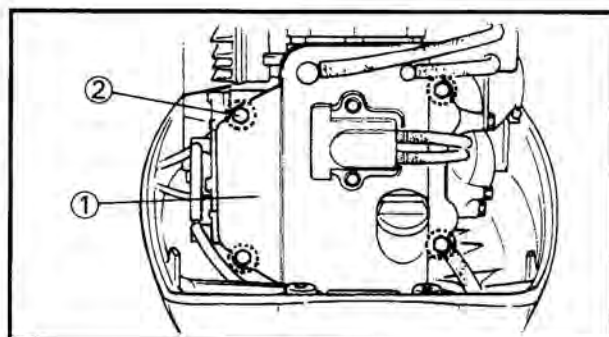
NOTE:

If too loose or too tight, readjust the valve clearance.



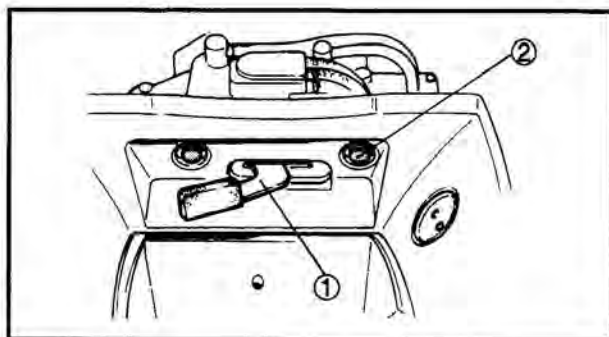
7. Apply:

- Engine oil
- To valve stem and adjust bolt.



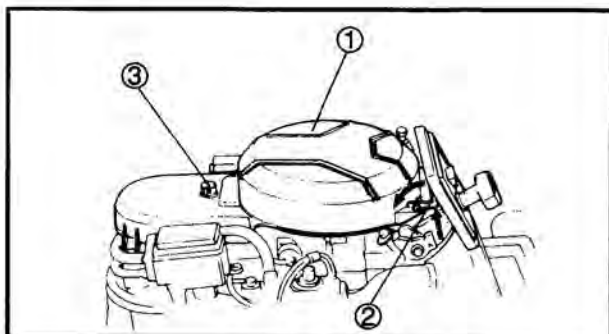
8. Install:

- Seal
- Cylinder head cover ①
- Bolt ②
- Hose



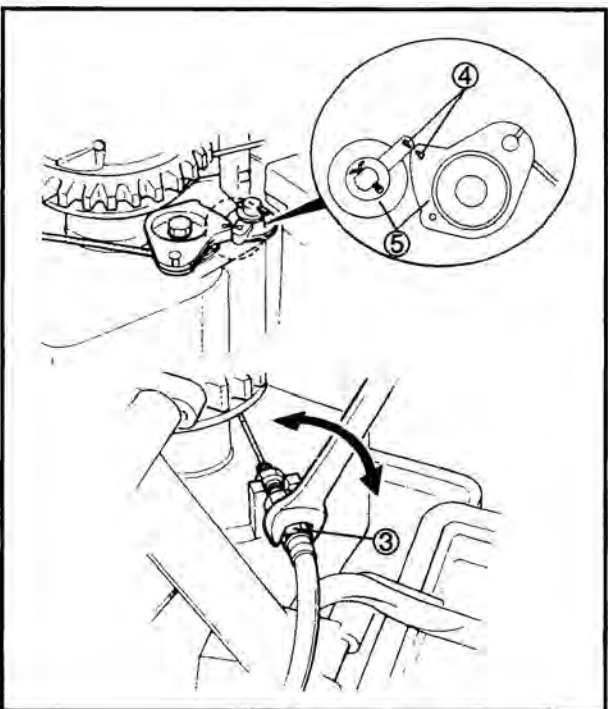
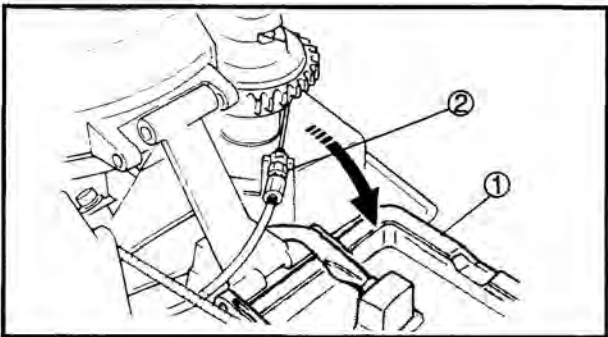
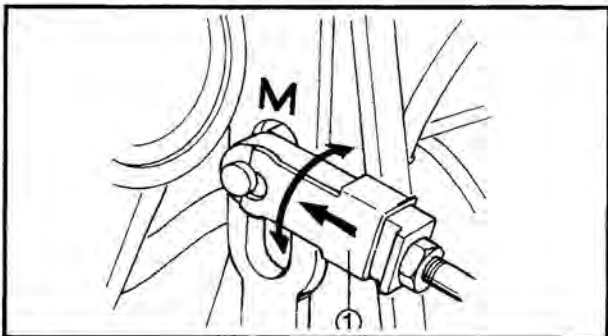
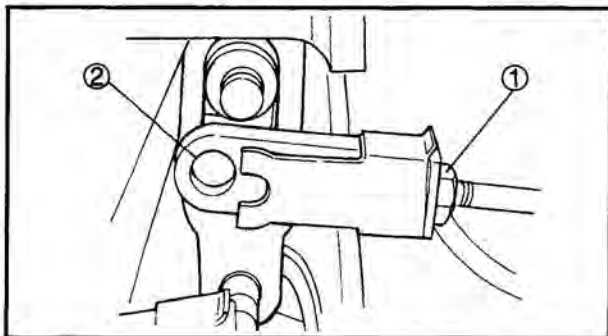
9. Install:

- Clamp lever ①
- Bolt ②



10. Install:

- Flywheel cover ①
- Hinge pin ②
- Collar
- Screw ③



SHAFT CABLE ADJUSTMENT

1. Adjust:

- Shift cable length

Adjustment steps:

- Loosen the lock nut ①.
- Remove the cable end ②.
- Set the shift lever to neutral.
- Set the shift arm to neutral.
- Turn the cable end in or out until adjustment is suitable.
- Fit the cable end to the pin marked with "M" on the shift arm.
- Push the cable end stopper ① to secure the cable end.
- Tighten the lock nut.

START-IN GEAR PROTECTION ADJUSTMENT

1. Check:

- Start-in gear protection operation
Incorrect → Adjust.

2. Adjust:

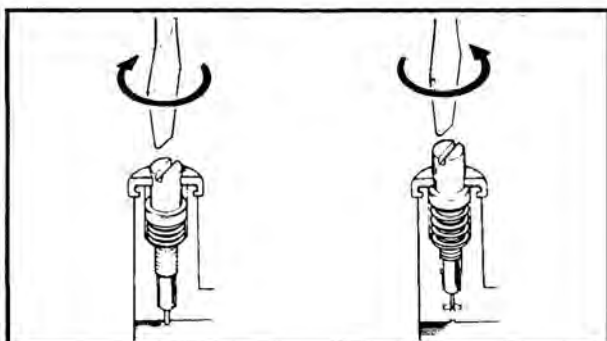
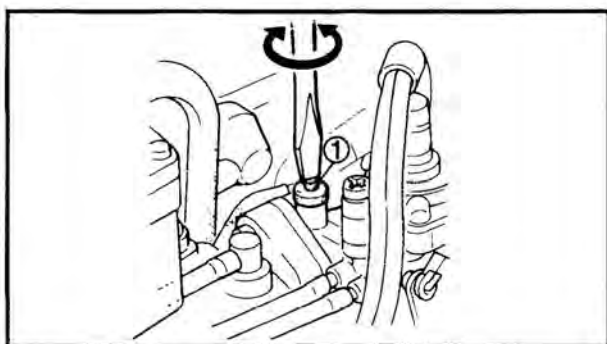
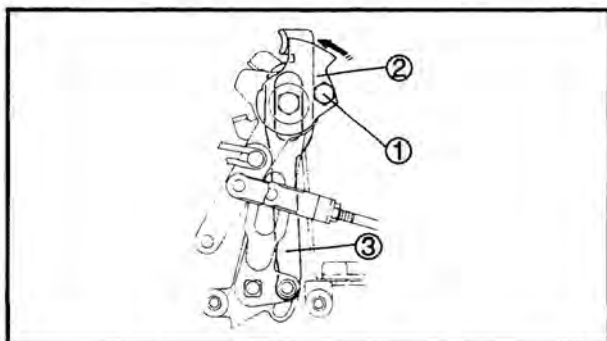
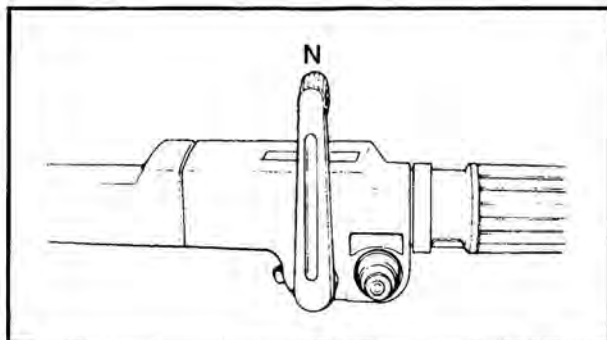
- Start-in gear protection cable length

Adjustment steps:

- Set the shift lever to neutral.
- Remove the hinge pin and throw down the front panel ①.
- Loosen the lock nut ②.
- Adjust the adjuster ③ so that the arrow marks ④ on the lock arms ⑤ align with each other.
- Tighten the lock nut.

NEUTRAL OPENING LIMIT ADJUSTMENT

1. Check:
 - Neutral opening control operation
 - Incorrect → Adjust.



2. Adjust:
 - Accelerator arm position

Adjustment steps:

- Attach the tachometer.



Tachometer

- Set the shift lever to neutral.
- Start the engine.
- Turn the throttle grip so that the engine speed is specified.



Engine speed:

3,200 ± 50 r/min

- Loosen the bolt ①.
- Contact the accelerator arm ② and shift rod link ③.
- Tighten the bolt.

PILOT SCREW ADJUSTMENT

Adjustment steps:

- Screw in the pilot screw ① until it is lightly seated.
- Back out by the specified number of turns.



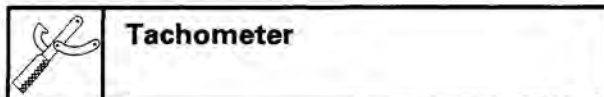
Pilot screw:

HDF9.9

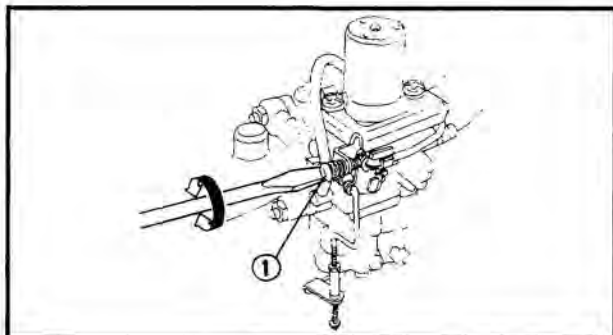
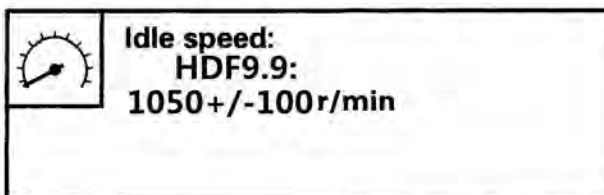
3 ± 1 turns out

IDLE SPEED ADJUSTMENT

1. Start the engine and let it warm up.
2. Attach:
 - Tachometer
 To spark plug lead.



3. Measure:
 - Idle speed
 Out of specification → Adjust.



4. Adjust:
 - Idle speed

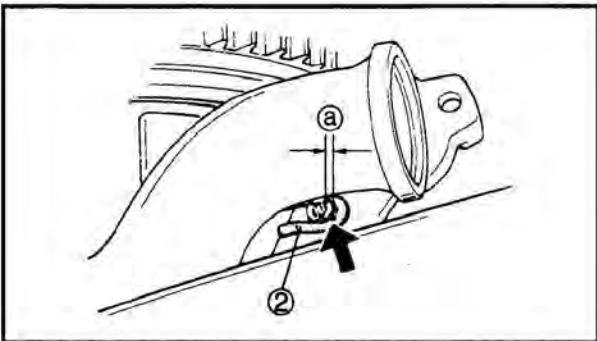
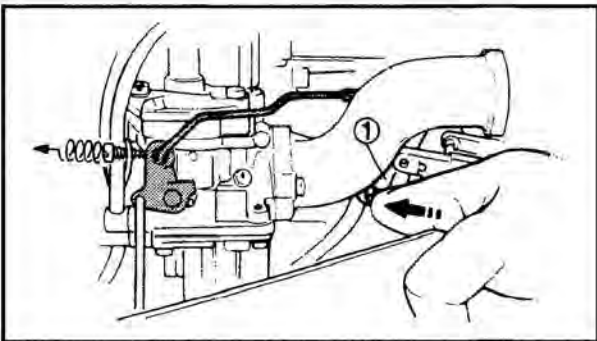
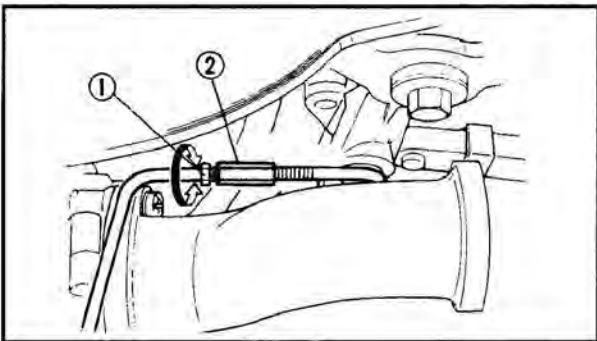
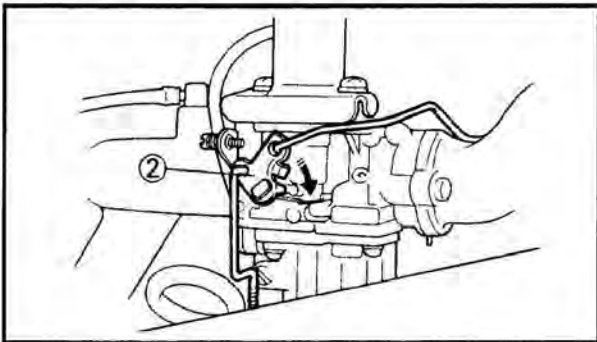
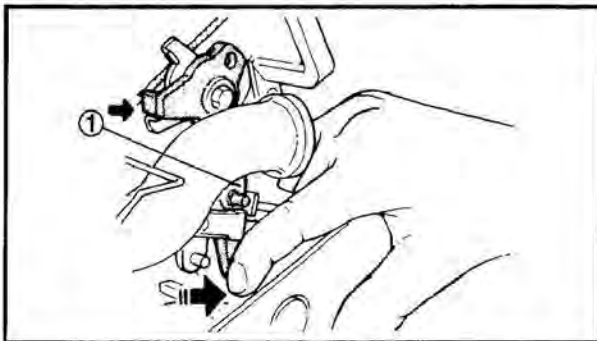
Adjustment steps:

- Turn the throttle stop screw ① in or out until specified idle speed is obtained.

Turning in → Idle speed becomes higher.

Turning out → Idle speed becomes lower.

NOTE: _____
 After adjusting the engine idle speed, the throttle link should be adjusted.



THROTTLE LINK ADJUSTMENT

NOTE:

Engine idling speed should be adjusted properly before adjusting the throttle link.

1. Check:

- Full-open position
Incorrect → Adjust.

Checking steps:

- Pull the accelerator arm ① to the full-open side.
- Check the throttle lever ② to the full-open position.

2. Adjust:

- Throttle link length

Adjustment steps:

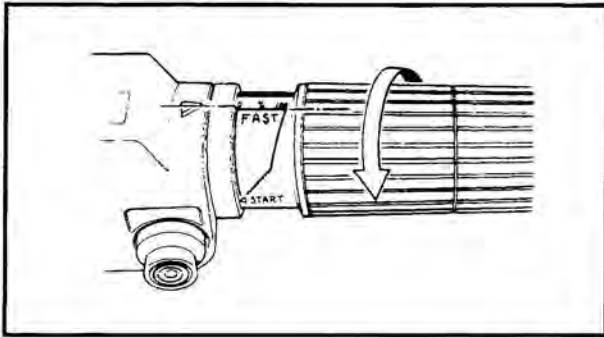
- Loosen the lock nut ①.
- Turn the adjust nut ② in or out until adjustment is suitable.
- Tighten the lock nut.

3. Check:

- Throttle link free play ③
No free play → Replace the throttle link.

Checking steps:

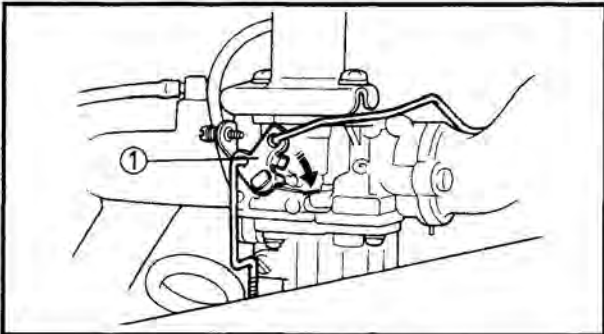
- Push the accelerator arm ① to the full-closed side.
- Make sure the throttle lever is on the full-closed position.
- Check that the throttle link ② has free play on the throttle lever side.



THROTTLE CABLE ADJUSTMENT

NOTE:

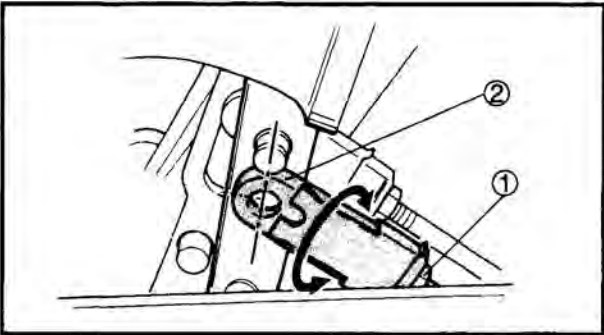
Engine idle speed and throttle link should be adjusted properly before adjusting the throttle cable.

**1. Check:**

- Full-open position
Incorrect → Adjust.

Checking steps:

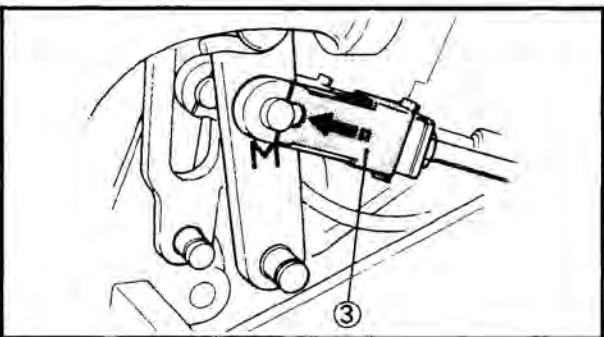
- Turn the throttle grip to the full-open side.
- Check the throttle lever ① to the full-open position.

**2. Adjust:**

- Throttle cable length

Adjustment steps:

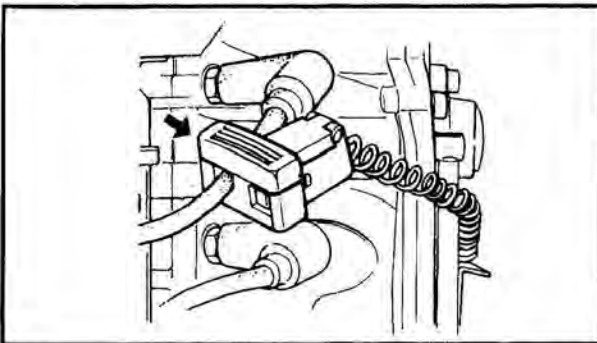
- Loosen the lock nut ①.
- Remove the cable end ②.
- Pull the accelerator arm to the full-open side.
- Turn the cable end in or out until adjustment is suitable.
- Fit the cable end to the pin marked with "M" on the accelerator arm.
- Push the cable end stopper ③ to secure the cable end.
- Tighten the lock nut.



IGNITION TIMING CHECK

NOTE:

Ignition timing is advanced by the CDI unit automatically. Therefore only the checking procedure is shown in this section.



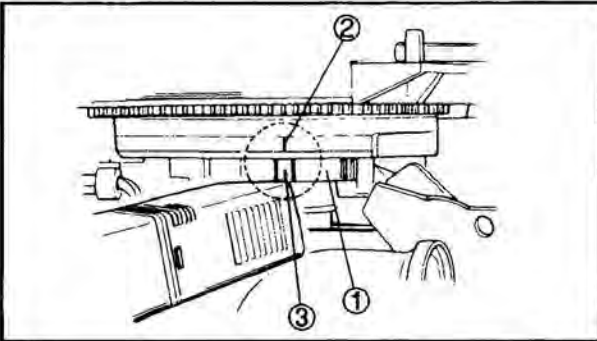
1. Attach:

- Tachometer
 - Timing light
- To spark plug lead for #1 cylinder.



Tachometer

Timing light



2. Check:

- Ignition timing
- Incorrect firing range → Check fly-wheel and/or pickup assembly.

Checking steps:

- Warm up the engine and set it at the specified speed.



Engine speed:

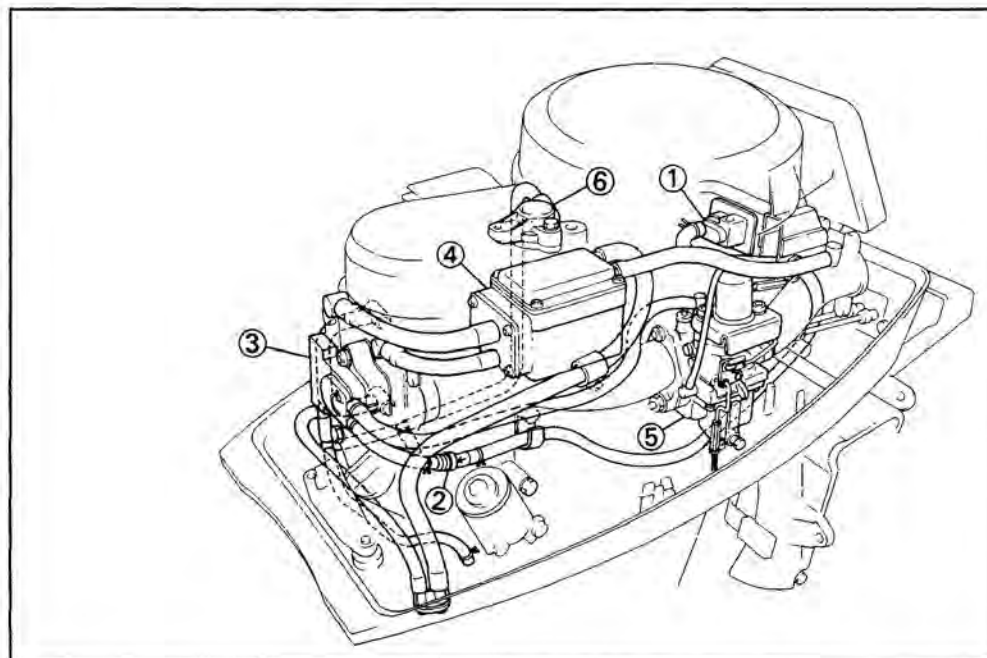
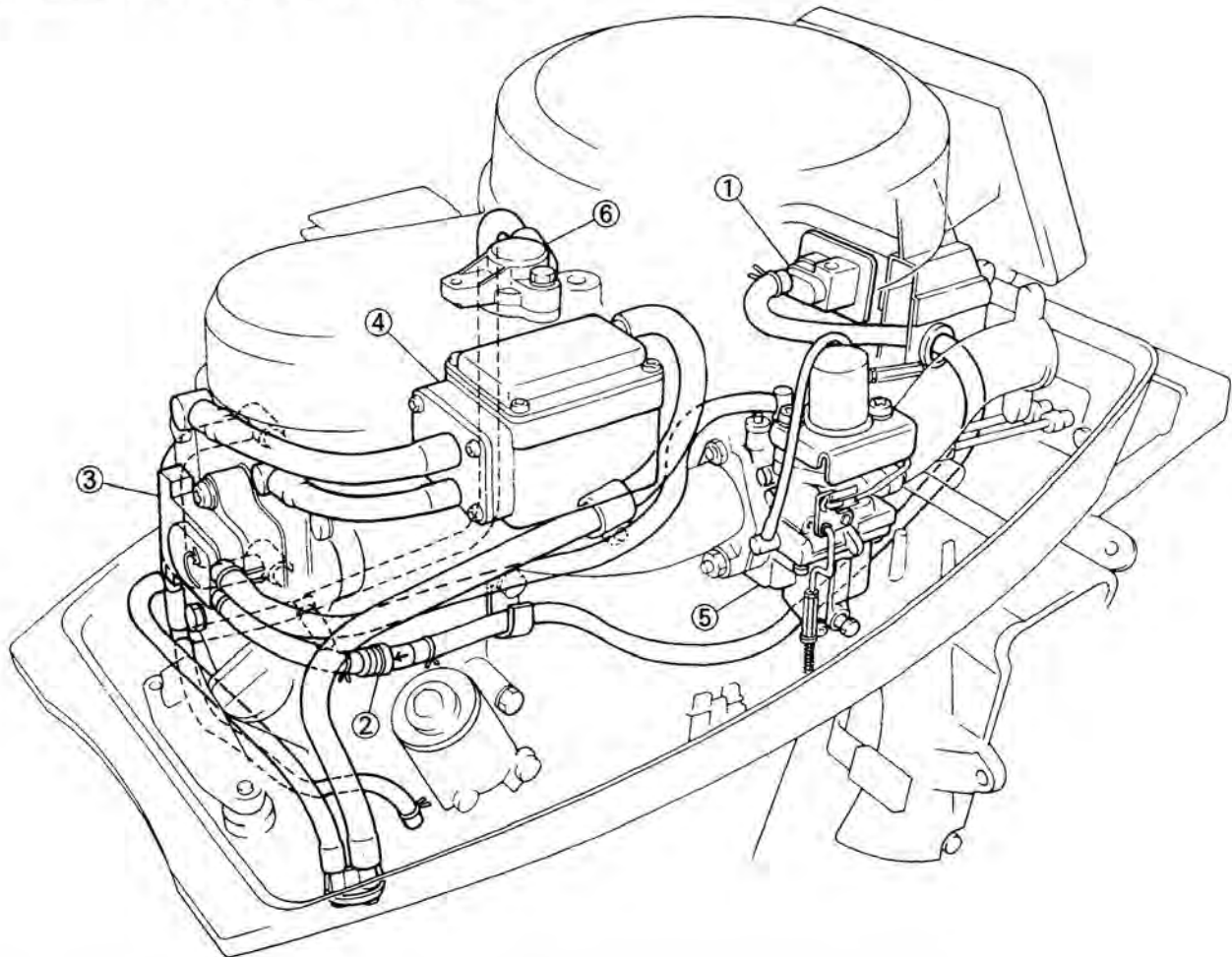
HDF9.9: 1050+/-100 r/min

- Direct the timing light toward the fly-wheel magneto base ①.
- Visually check the stationary pointer ② to verify it is within the required firing range ③ indicated on the flywheel.

FUEL SYSTEM

FUEL LINE LAYOUT

Check that the fuel line is correctly installed.



- ① Fuel join
- ② Fuel strainer
- ③ Fuel pump
- ④ Oil separator
- ⑤ Carburetor
- ⑥ Thermostat cover

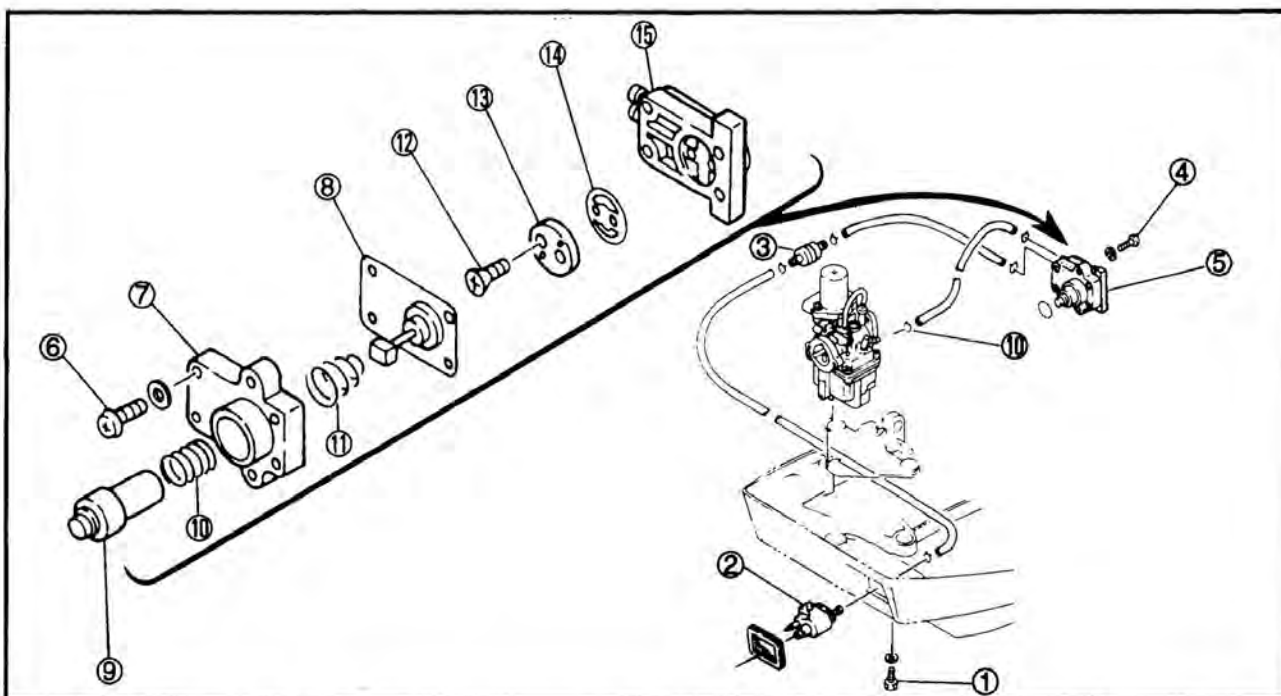


PREPARATION FOR REMOVAL

* Remove the top cowling.

⚠ WARNING

- Gasoline (petrol) is highly flammable and explosive. Handle with special care.
- Failure to check for fuel leakage may result in fire or explosion.



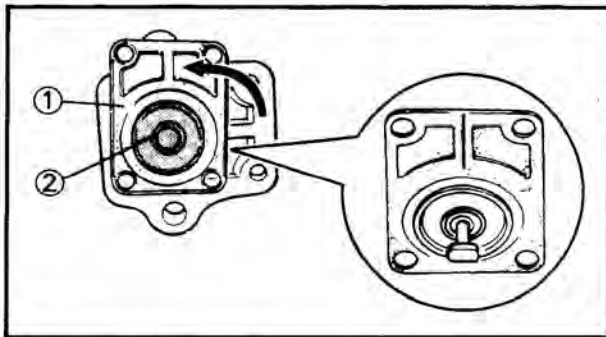
Extent of removal:

① Fuel joint removal

② Fuel pump removal

③ Fuel pump disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Bolt	1	
	2	Fuel joint	1	Disconnect the hose.
	3	Fuel strainer	1	Disconnect the hose.
	4	Screw	2	
	5	Fuel pump	1	Disconnect the hose.
	6	Screw	4	
	7	Pump body	1	
	8	Diaphragm	1	
	9	Plunger	1	
	10	Spring	1	
	11	Diaphragm spring	1	
	12	Screw	2	
	13	Plate	1	
	14	Check valve	1	
	15	Pump cover	1	

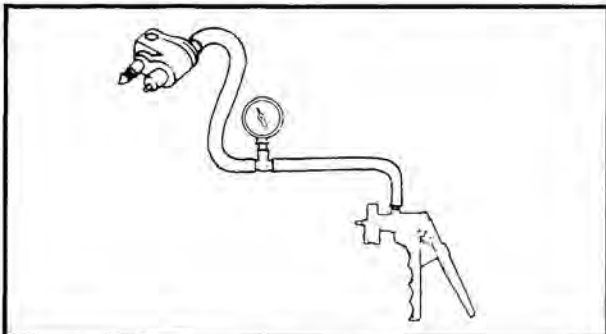


REMOVAL POINTS DIAPHRAGM

1. Remove:
 - Diaphragm ①

CAUTION:

Push the plunger, hold the plate ②, and turn the diaphragm 90°.



INSPECTION FUEL JOINT

1. Measure:
 - Fuel joint operation
Impossible to maintain the specified pressure for 10 sec. → Replace.

Measuring steps:

- Attach the Mity Vac.

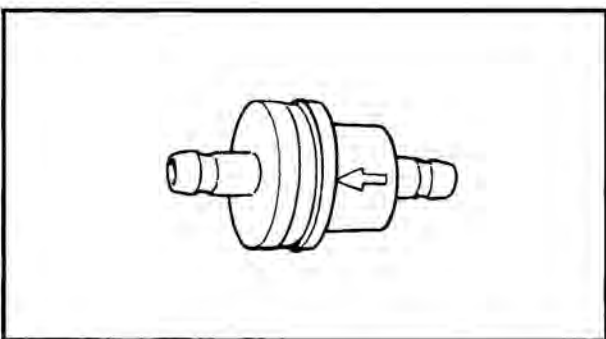


Mity Vac

- Apply the specified pressure.

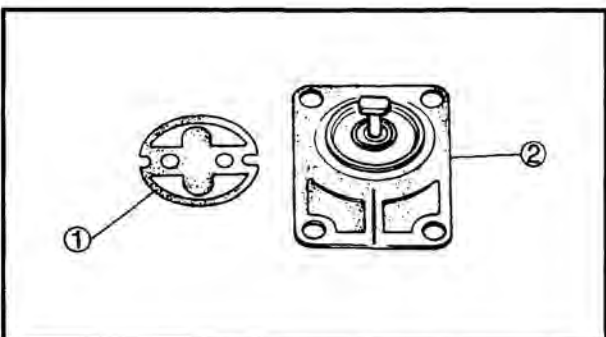


Specified pressure:
50 kPa (0.5 kg/cm², 7.1 psi)



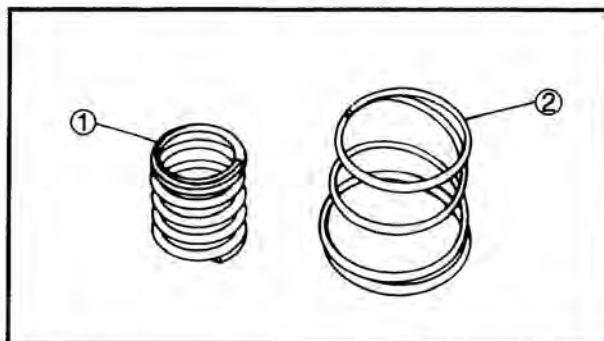
FUEL STRAINER

1. Inspect:
 - Fuel strainer
Crack/Leak/Clog → Replace.



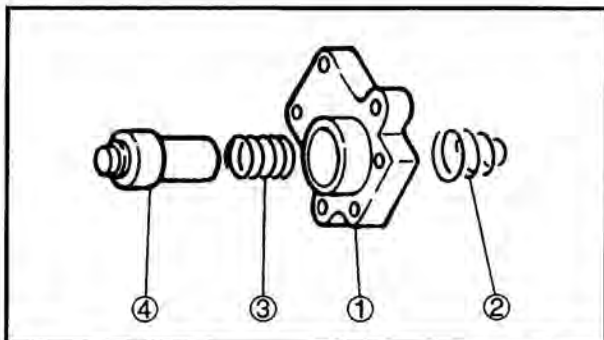
FUEL PUMP

1. Inspect:
 - Check valve ①
 - Diaphragm ②
Damage → Replace.



2. Inspect:

- Spring ①
 - Diaphragm spring ②
- Damage → Replace.

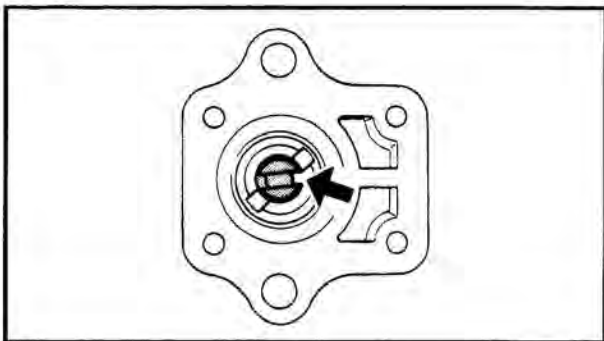


ASSEMBLY AND INSTALLATION

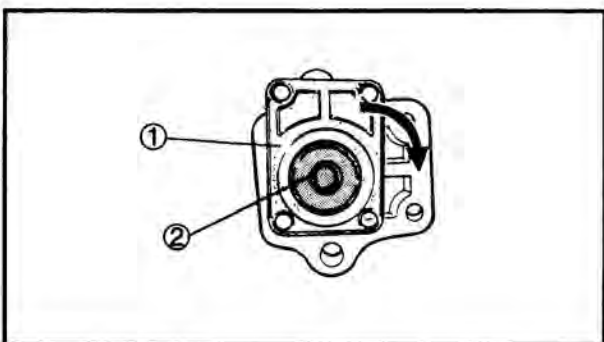
FUEL PUMP

1. Install:

- Pump body ①
- Diaphragm spring ②
- Spring ③
- Plunger ④

**NOTE:**

Align the recess in the plunger with the pump body.

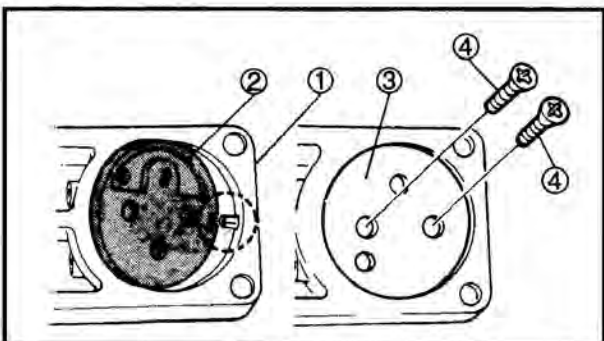


2. Install:

- Diaphragm ①

CAUTION:

Push the plunger, hold the plate ②, and turn the diaphragm 90°.

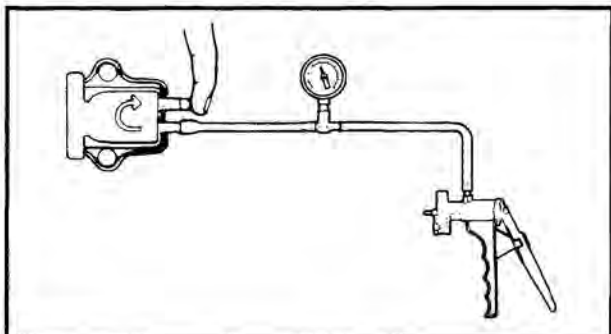
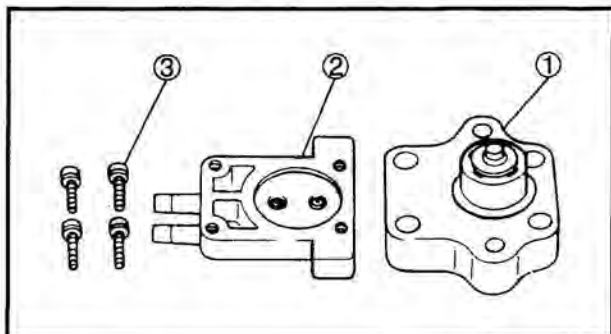


3. Install:

- Pump cover ①
- Check valve ②
- Plate ③
- Screw ④

NOTE:

Align the recess in the check valve and plate with the projection of the pump cover.



4. Install:

- Pump body ①
- Pump cover ②
- Screw ③

NOTE:

After installing, check the smooth movement of the plunger.

5. Measure:

- Fuel pump operation
Impossible to maintain the specified pressure for 10 sec. → Replace.

Measuring steps:

- Attach the Mity Vac to the inlet of the fuel pump.

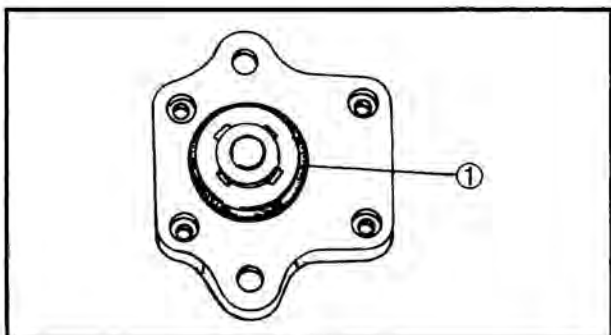
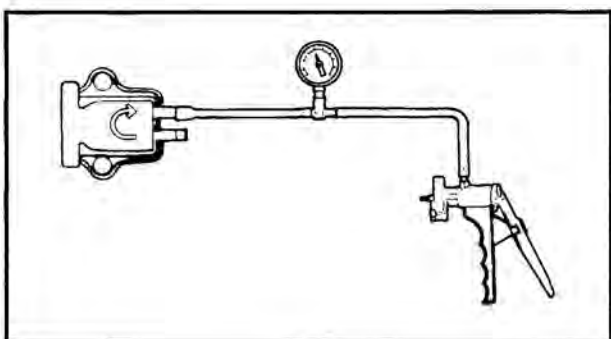


Mity Vac

- Cover the outlet of the fuel pump.
- Apply the specified pressure.



Specified pressure:
50 kPa (0.5 kg/cm², 7.1 psi)



6. Measure:

- Fuel pump operation
Impossible to maintain the specified pressure for 10 sec. → Replace.

Measuring steps:

- Attach the Mity Vac to the outlet.



Mity Vac

- Apply the specified pressure.



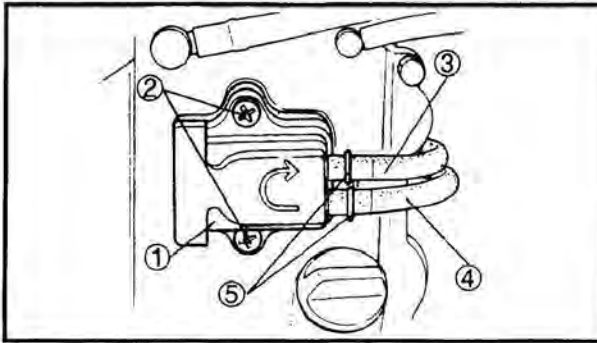
Specified pressure:
50 kPa (0.5 kg/cm², 7.1 psi)

7. Install:

- O-ring ①

NOTE:

Always use a new O-ring.

**8. Install:**

- Fuel pump ①
- Screw ②
- Hose ③
- Hose ④
- Clamp ⑤



CARBURETOR

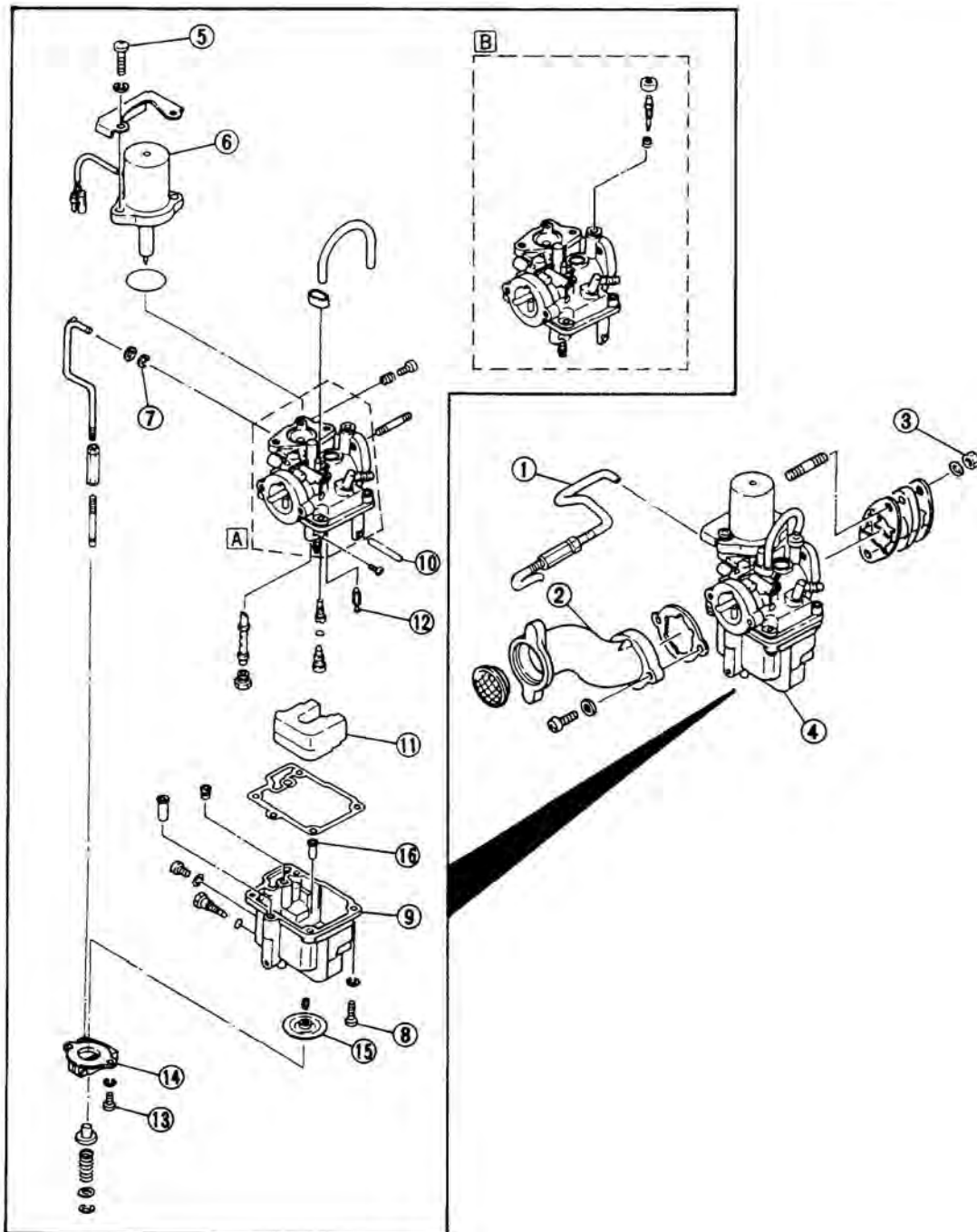
NOTE: _____

⚠ WARNING

- Gasoline (petrol) is highly flammable and explosive. Handle with special care.
- Failure to check for fuel leakage may result in fire or explosion.

PREPARATION FOR REMOVAL

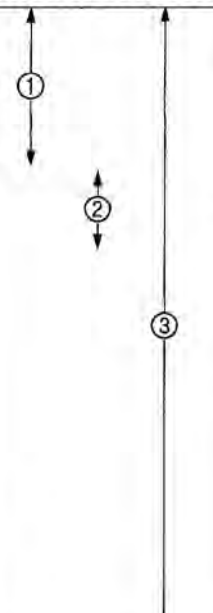
- * Remove the top cowling.
- * Disconnect the wire lead.

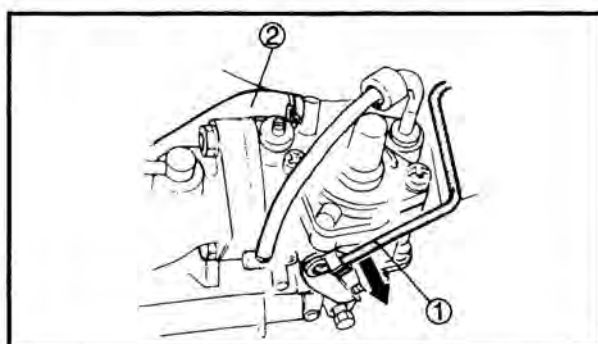


NOTE ON REMOVAL AND REASSEMBLY

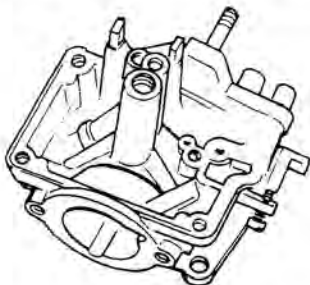
- With the engine mounted, the following parts can be removed.
- Before inspection, the removed parts should be cleaned and blow out all passages and jets with compressed air.
- After removing the carburetor, cover the carburetor joint preventing foreign material from entering.

Extent of removal: ① Carburetor removal ② Electrothermal valve removal
 ③ Carburetor disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Throttle link	1	Disconnect the link lod.
	2	Funnel	1	
	3	Nut	2	
	4	Carburetor	1	
	5	Screw	2	
	6	Electrothermal valve	1	
	7	Clip	1	
	8	Screw	4	
	9	Float chamber	1	
	10	Pin	1	
	11	Float	1	
	12	Needle valve	1	
	13	Screw	2	
	14	Cover	1	
	15	Diaphragm	1	
	16	Filter	1	


**REMOVAL POINTS
JOINT**

1. Disconnect:
- Throttle link ①
 - Fuel hose ②



INSPECTION CARBURETOR BODY

1. Inspect:

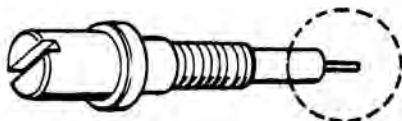
- Carburetor body
Crack/Damage → Replace.
Contamination → Clean.

⚠ WARNING

Protect your eyes with suitable safety spectacles or safety goggles when using compressed air.

NOTE:

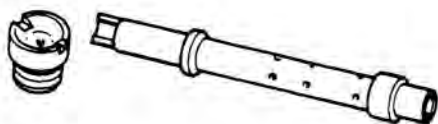
- Use a petroleum based solvent for cleaning. Blow out all passages with compressed air.
- Never use a wire.



PILOT SCREW

1. Inspect:

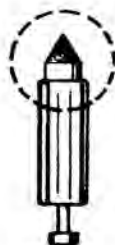
- Pilot screw
Bend/Wear → Replace.



JET AND NOZZLE

1. Inspect:

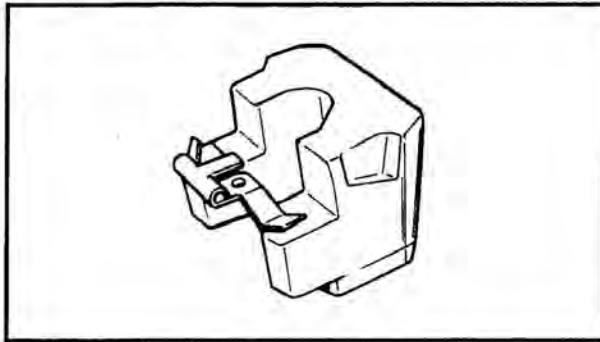
- Main jet
- Pilot jet
- Check valve
- Main nozzle
Contamination → Replace.



NEEDLE VALVE

1. Inspect:

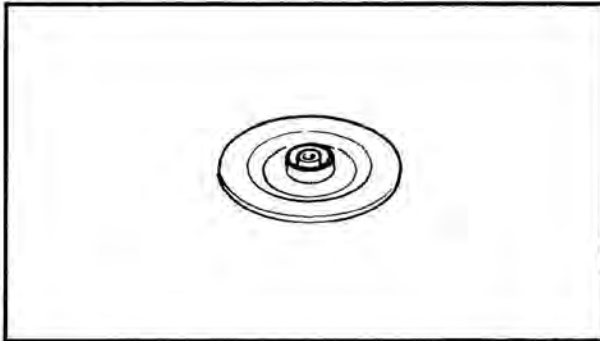
- Needle valve
Grooved wear → Replace.

**FLOAT**

1. Inspect:

- Float

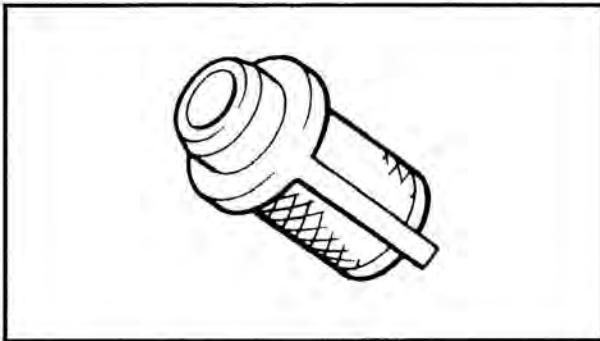
Crack/Damage → Replace.

**DIAPHRAGM**

1. Inspect:

- Diaphragm

Damage → Replace.

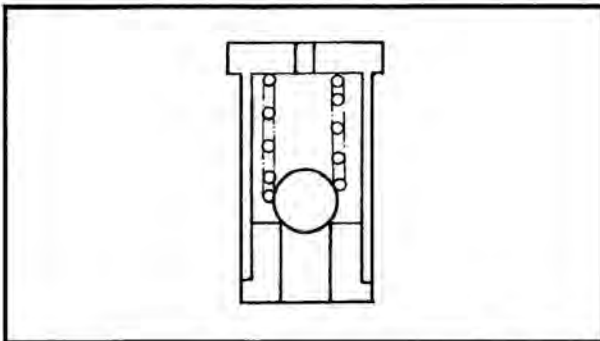
**FILTER**

1. Inspect:

- Filter

Contamination → Clean.

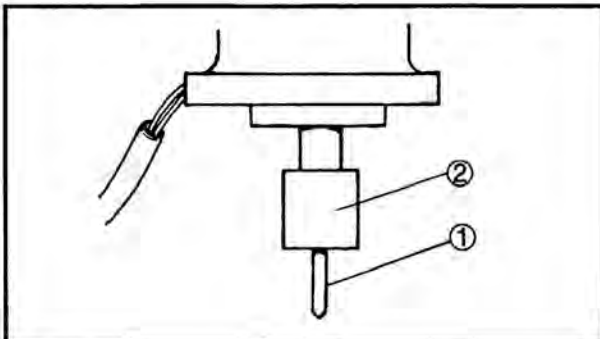
Damage → Replace.

**CHECK VALVE**

1. Inspect:

- Check valve

Damage → Replace.

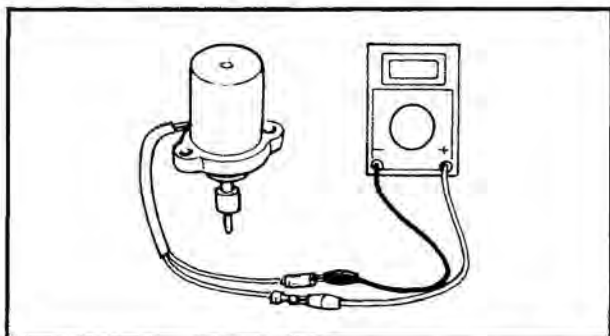
**ELECTROTHERMAL VALVE**

1. Inspect:

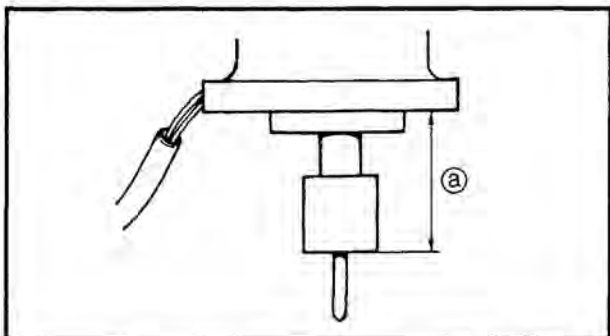
- Needle valve ①

- Piston valve ②

Wear/Damage → Replace.


2. Measure:

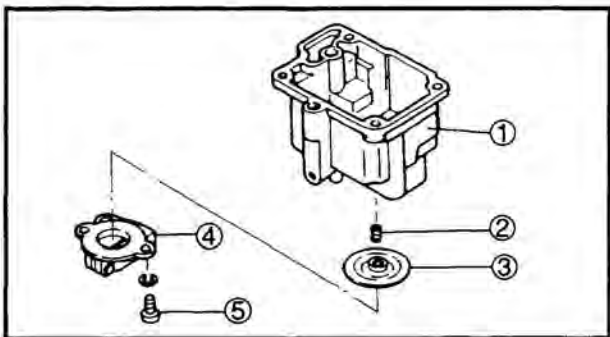
- Electrothermal valve resistance
- Out of specification → Replace.


Electrothermal valve resistance:
Black – Black
4.8 ~ 7.2 Ω at 20°C (68°F)

3. Check:

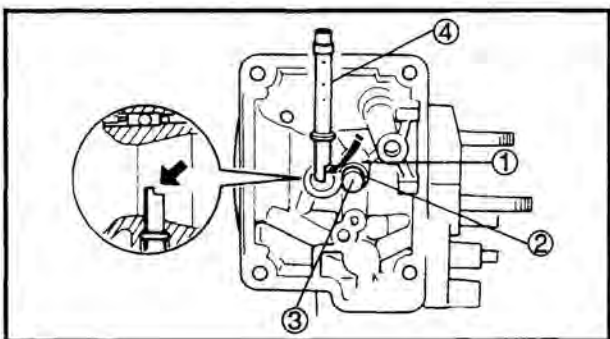
- Piston valve height (a)
- No change → Replace.

Checking steps:

- Connect the 12 V battery.
- Wait for several minutes.
- Check the piston height.


ASSEMBLY AND INSTALLATION
1. Install:

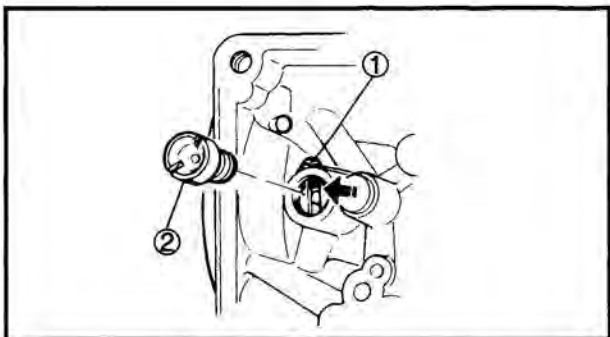
- Float chamber ①
- Spring ②
- Diaphragm ③
- Cover ④
- Screw ⑤


2. Install:

- Pilot jet ①
- O-ring ②
- Seal cap ③
- Main nozzle ④

NOTE:

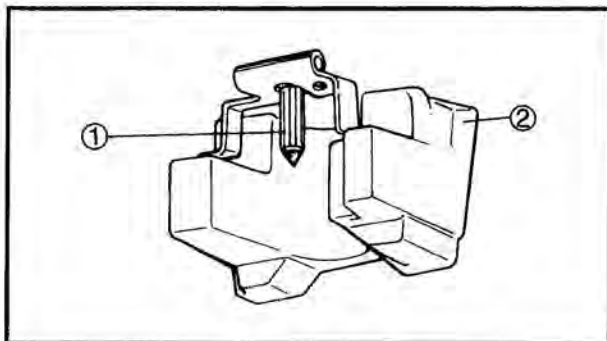
Position the nozzle so that the cutaway of the nozzle faces the intake manifold.


3. Install:

- Screw ①
- Main jet ②

NOTE:

Align the slit in the main nozzle with the screw hole in the carburetor.

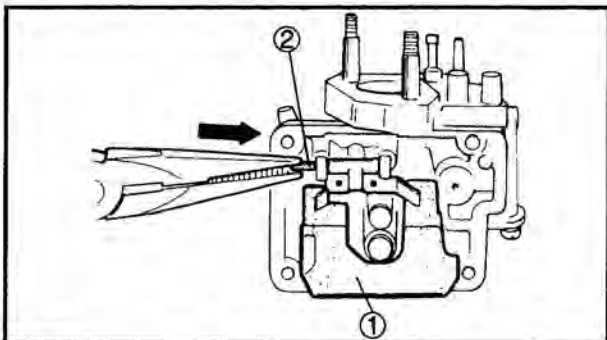


4. Install:

- Needle valve ①
- Float ②

NOTE:

Install the valve into the float hinge.

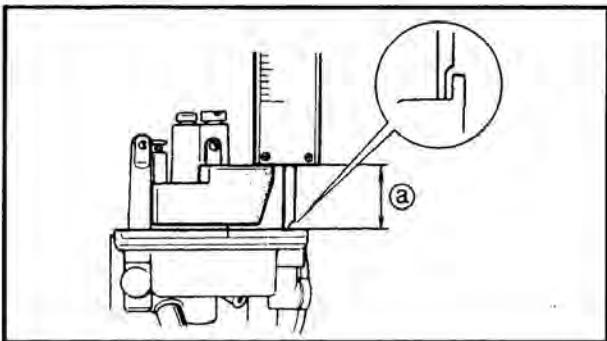


5. Install:

- Float ①
- Pin ②

NOTE:

After installing, check the smooth movement of the float.

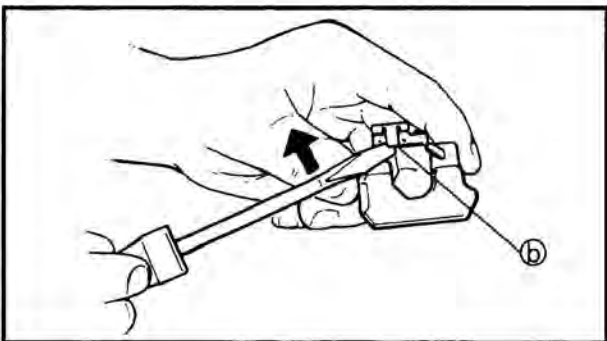


6. Measure:

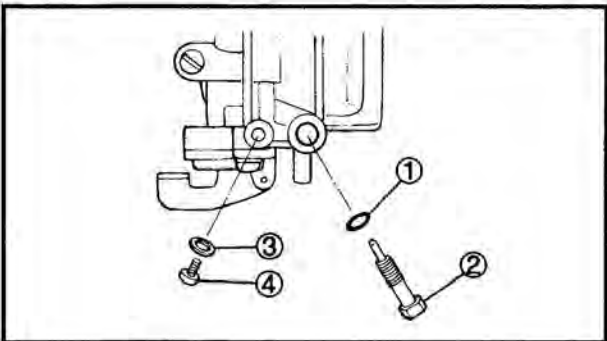
- Float height ①
- Out of specification → Fold the tab ② to adjust float arm height.



Float height:
 $25.5 \pm 1 \text{ mm (1.00} \pm 0.04 \text{ in)}$

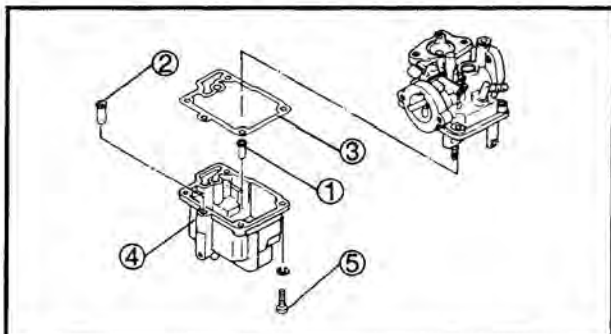
**NOTE:**

The float should be resting on the needle valve, but not compressing the needle valve.

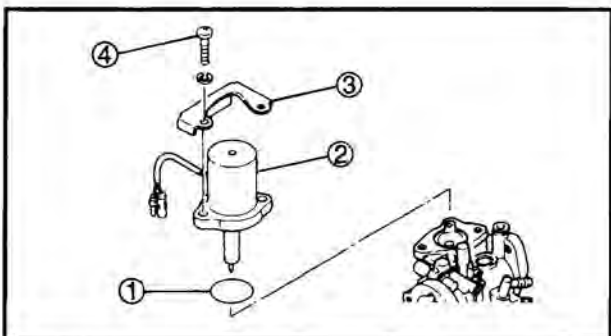


7. Install:

- O-ring ①
- Drain screw ②
- Gasket ③
- Drain screw ④


8. Install:

- Filter ①
- Check valve ②
- Gasket ③
- Float chamber ④
- Screw ⑤


9. Install:

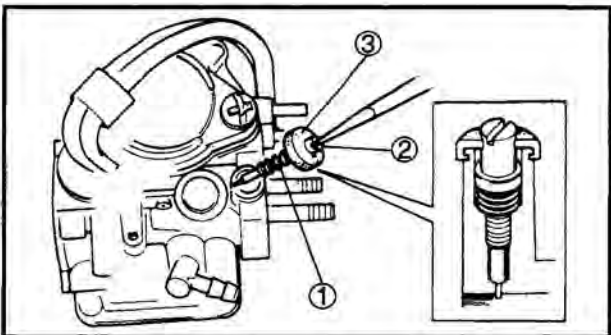
- O-ring ①
- Electrothermal valve ②
- Plate ③
- Screw ④

10. Install:

- Spring ①
- Pilot screw ②
- Seal cap ③

NOTE:

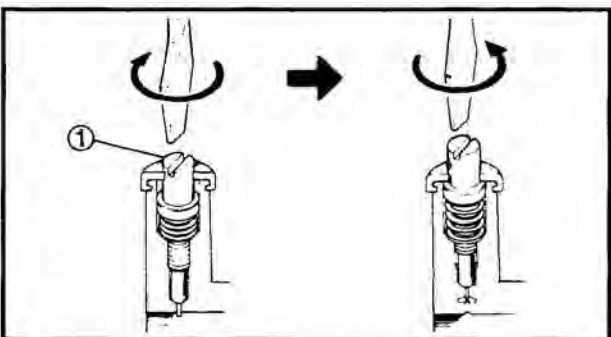
After placing the seal cap on the pilot screw, fit it to the groove in the carburetor.


11. Adjust:

- Pilot screw ①

Adjustment steps:

- Screw in the pilot screw until it is lightly seated.
- Back out by the specified number of turns.


Pilot screw

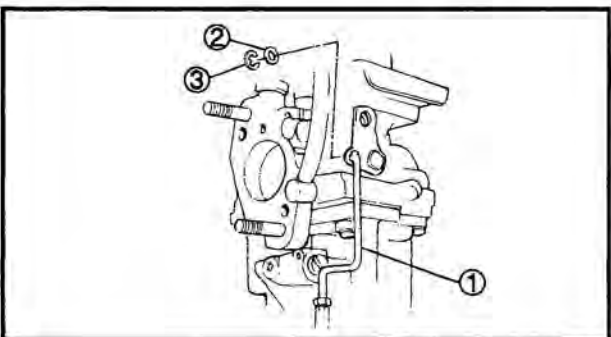
HDF9.9 : 3 ± 1 turns out

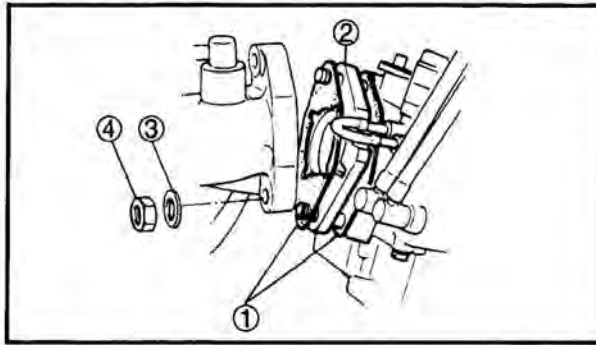
12. Install:

- Rod ①
- Washer ②
- Clip ③

NOTE:

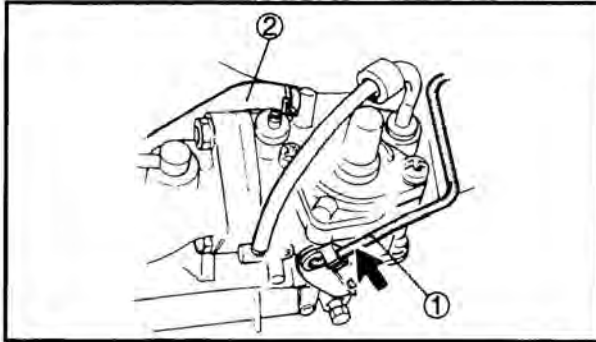
Always use a new clip.





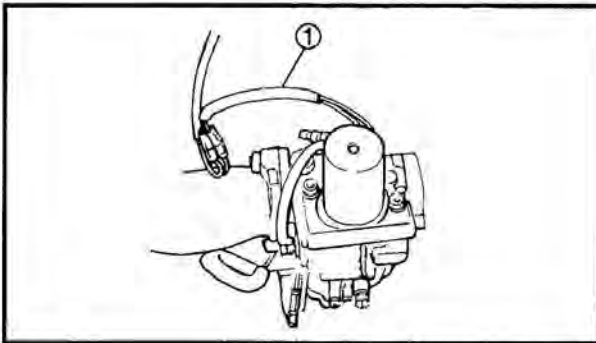
13. Install:

- Gasket ①
- Spacer ②
- Washer ③
- Nut ④



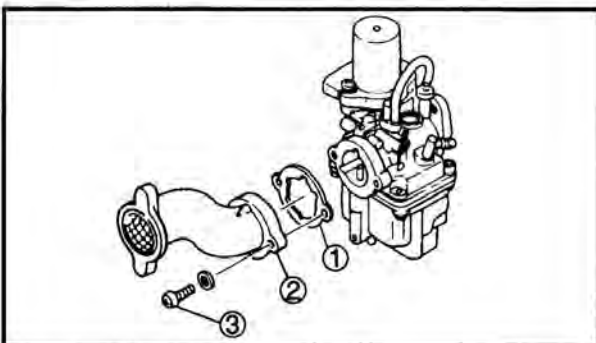
14. Connect:

- Throttle link ①
- Fuel hose ②



15. Connect:

- Wire lead ①



16. Install:

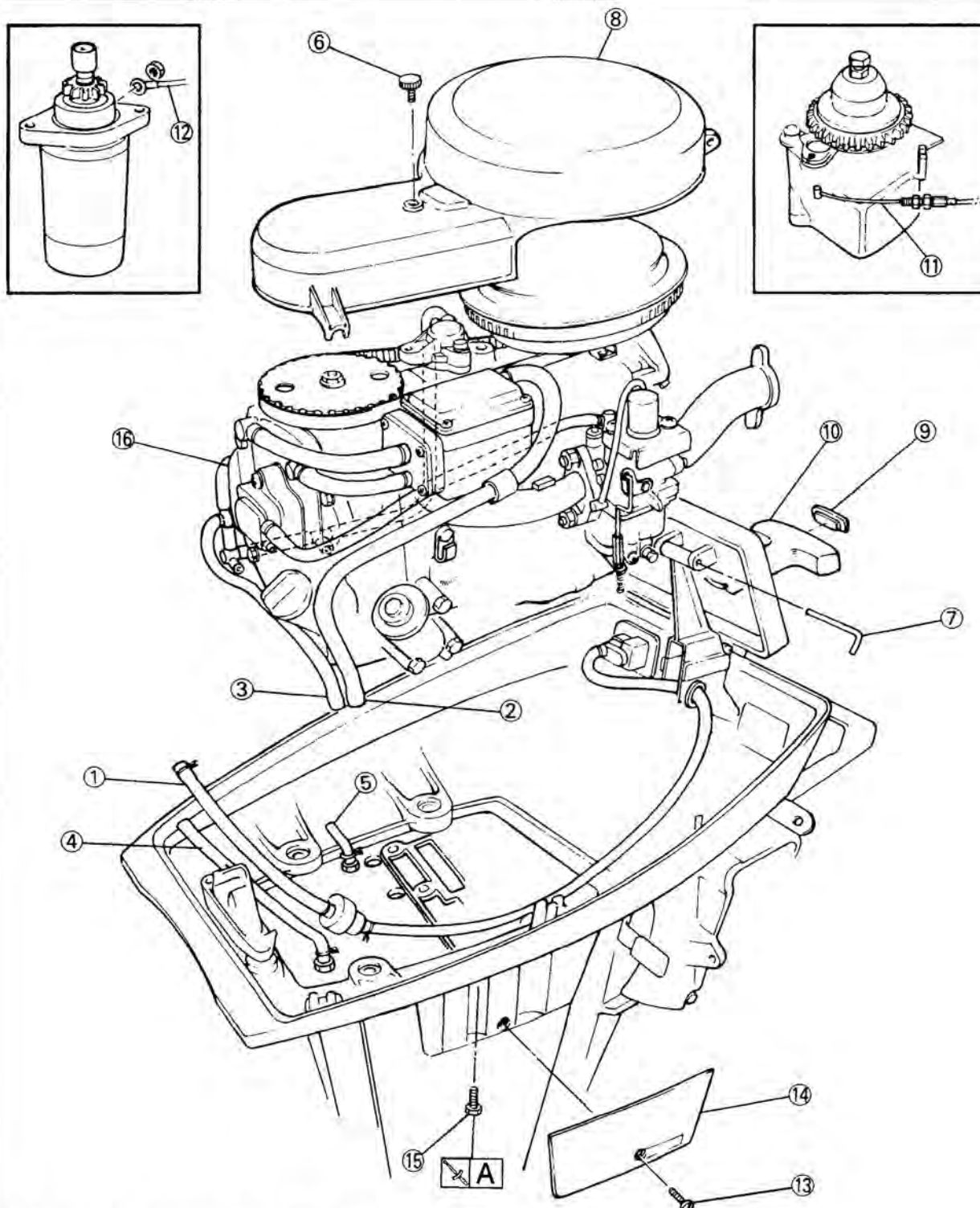
- Gasket ①
- Funnel ②
- Screw ③

17. Adjust:

- Idle speed

**POWER UNIT REMOVAL
PREPARATION FOR REMOVAL**

- * Drain the engine oil.
- * Remove the top cowling.
- * Remove the terminal cover.
- * Disconnect the oil lamp lead.
- * Remove the oil level gauge.
- * Disconnect the stop switch leads.



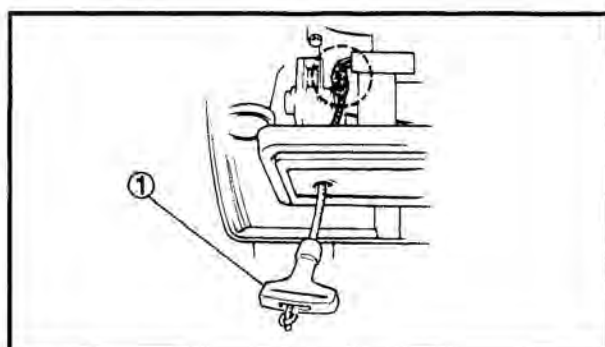
A 21 Nm (2.1 m • kg, 15 ft • lb)


NOTE ON REMOVAL AND REASSEMBLY

- After removing the power unit, protect the lubricating system, including the oil pan and relief valve, from dust and dirt.

Extent of removal: ① Power unit removal

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Fuel hose	1	
	2	Blow by hose	1	
	3	Water hose	1	
	4	Water hose	1	
	5	Water hose	1	
	6	Screw	1	Recoil starter model only Refer to "REMOVAL POINTS".
	7	Hinge pin	1	
	8	Flywheel cover	1	
	9	Grip cover	1	
	10	Starter grip	1	
	11	Neutral starting device cable	1	Electric starter model only
	12	Battery lead	1	
	13	Screw	2	
	14	Apron	2	
	15	Bolt	6	
	16	Power unit	1	

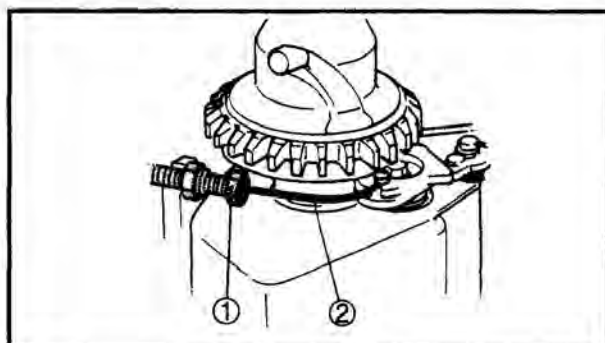

REMOVAL POINTS
STARTER GRIP

1. Remove:

- Starter grip ①

NOTE:

When removing the starter grip, pull out the starter rope and make a knot in the rope so that the rope is not pulled into the starter.

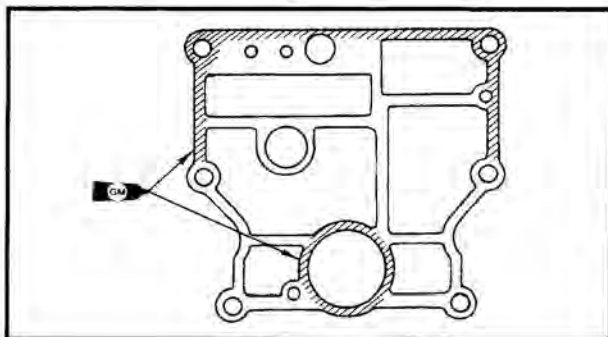

STOP WIRE

1. Remove:

- Lock nut ①
- Start-in gear protection cable ②

NOTE:

Do not remove the stop wire before removing the starter grip, or it is impossible to pull out the starter rope when removing it.



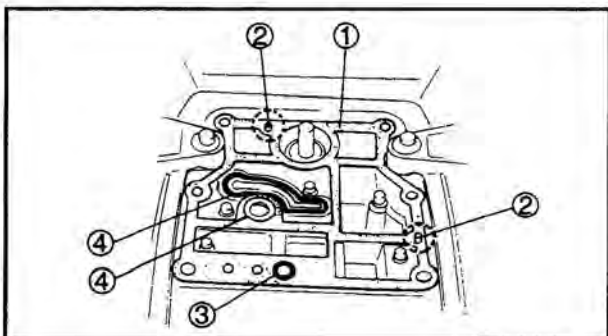
INSTALLATION POWER UNIT

1. Apply:

- Gasket Maker
- Onto both faces of the gasket.

NOTE:

Clean the contacting surface of crankcase.



2. Install:

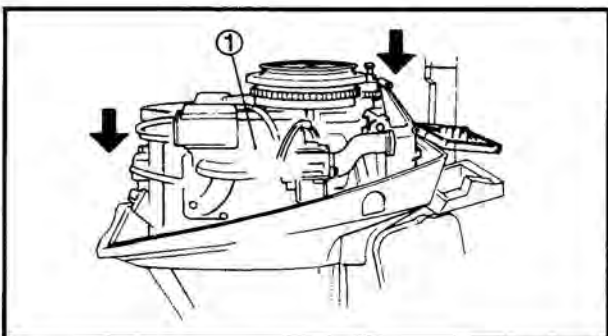
- Gasket ①
- Dowel pin ②
- O-ring ③
- Seal ④

3. Install:

- Power unit ①

NOTE:

- If the crankshaft splines do not mesh with the drive shaft splines, turn the flywheel a little so that they can mesh.
- Use care not to pinch the lead and pipe.

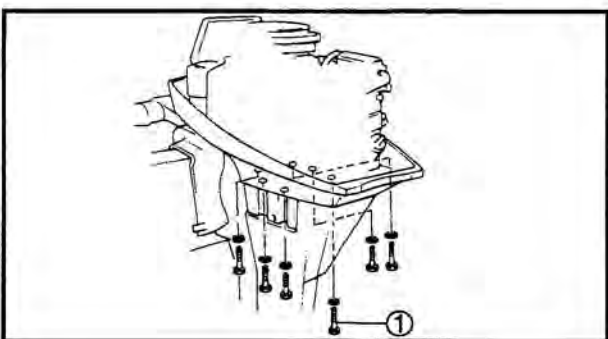


4. Install:

- Bolt ①

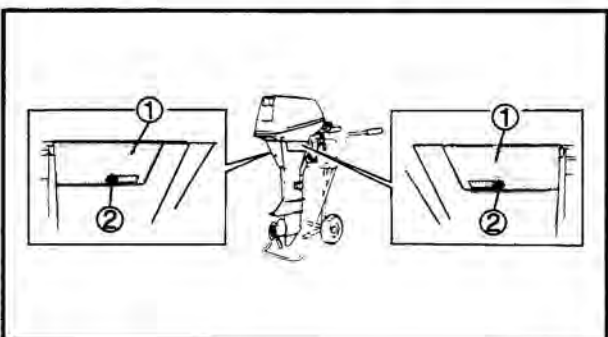


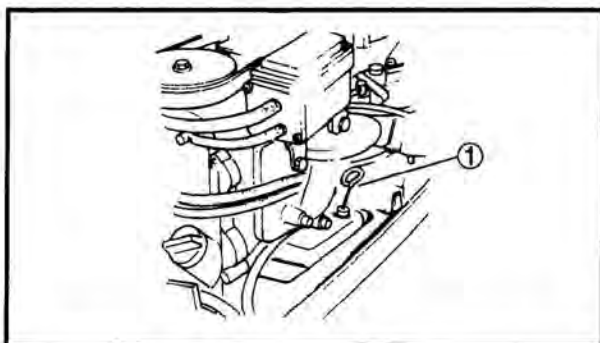
Bolt:
21 Nm (2.1 m • kg, 15 ft • lb)



5. Install:

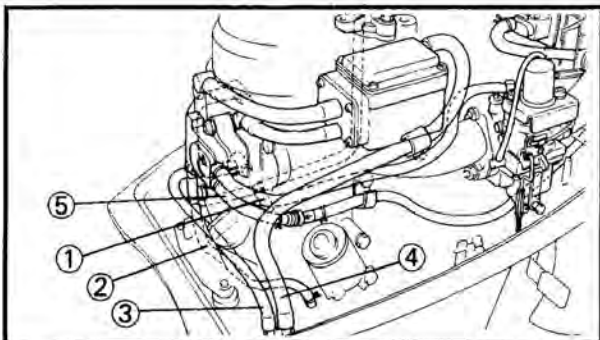
- Apron ①
- Screw ②





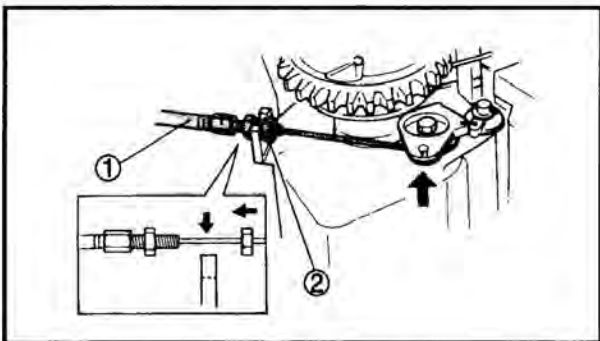
6. Install:

- Oil level gauge ①



7. Connect:

- Water hose ①
- Water hose ②
- Water hose ③
- Blow by hose ④
- Fuel hose ⑤



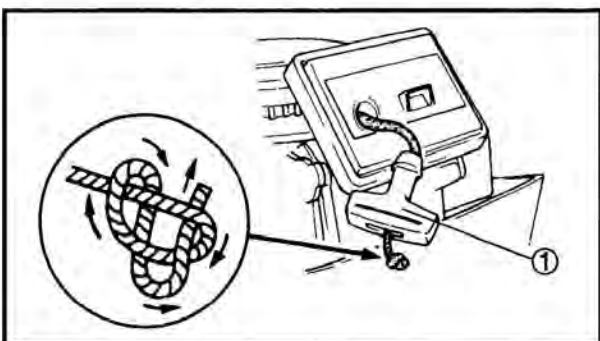
RECOIL STARTER

1. Install:

- Start-in gear protection wire ①
- Lock nut ②

2. Adjust:

- Start-in gear protection cable length

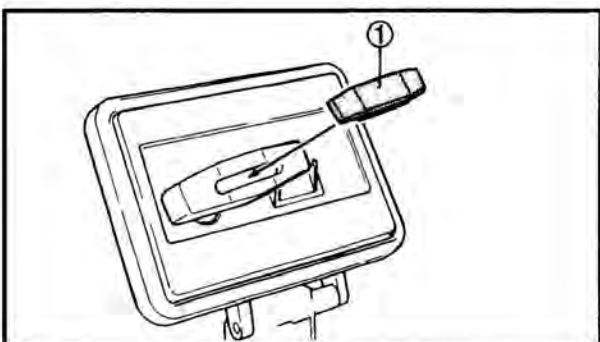


3. Install:

- Starter grip ①

NOTE:

Pass the starter rope through the front panel and starter grip, and make a knot in the end of the rope, then put it into the starter grip.

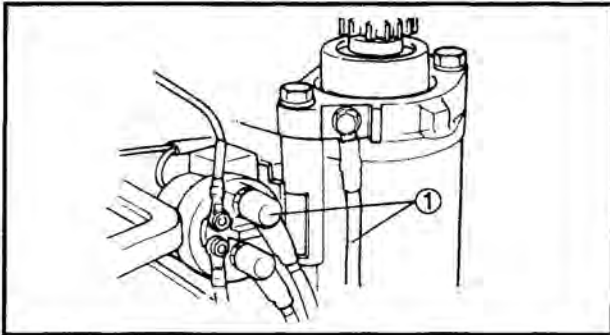


4. Install:

- Grip cover ①

NOTE:

After installing the grip cover, untie the knot, and let the rope wind around the starter.

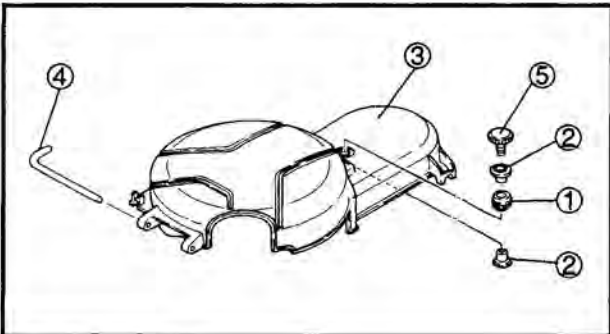

BATTERY LEAD

1. Install:

- Battery lead ①

NOTE:

Connect the battery lead to both of the starter motor and starter relay.


FLYWHEEL COVER

1. Install:

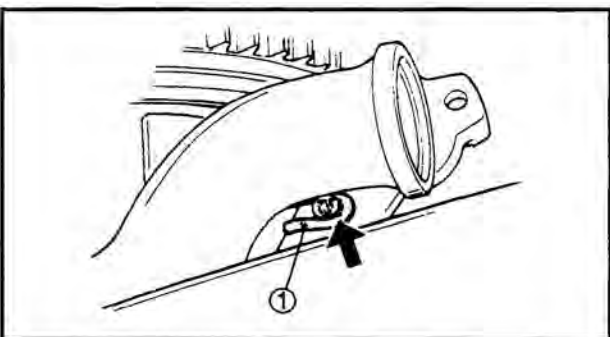
- Grommet ①
- Collar ②
- Flywheel cover ③
- Hinge pin ④
- Screw ⑤

NOTE:

Secure the L-shaped portion to the holder.

2. Install:

- Electrical leads
- Terminal cover
- Screw



3. Connect:

- Throttle link ①

4. Adjust:

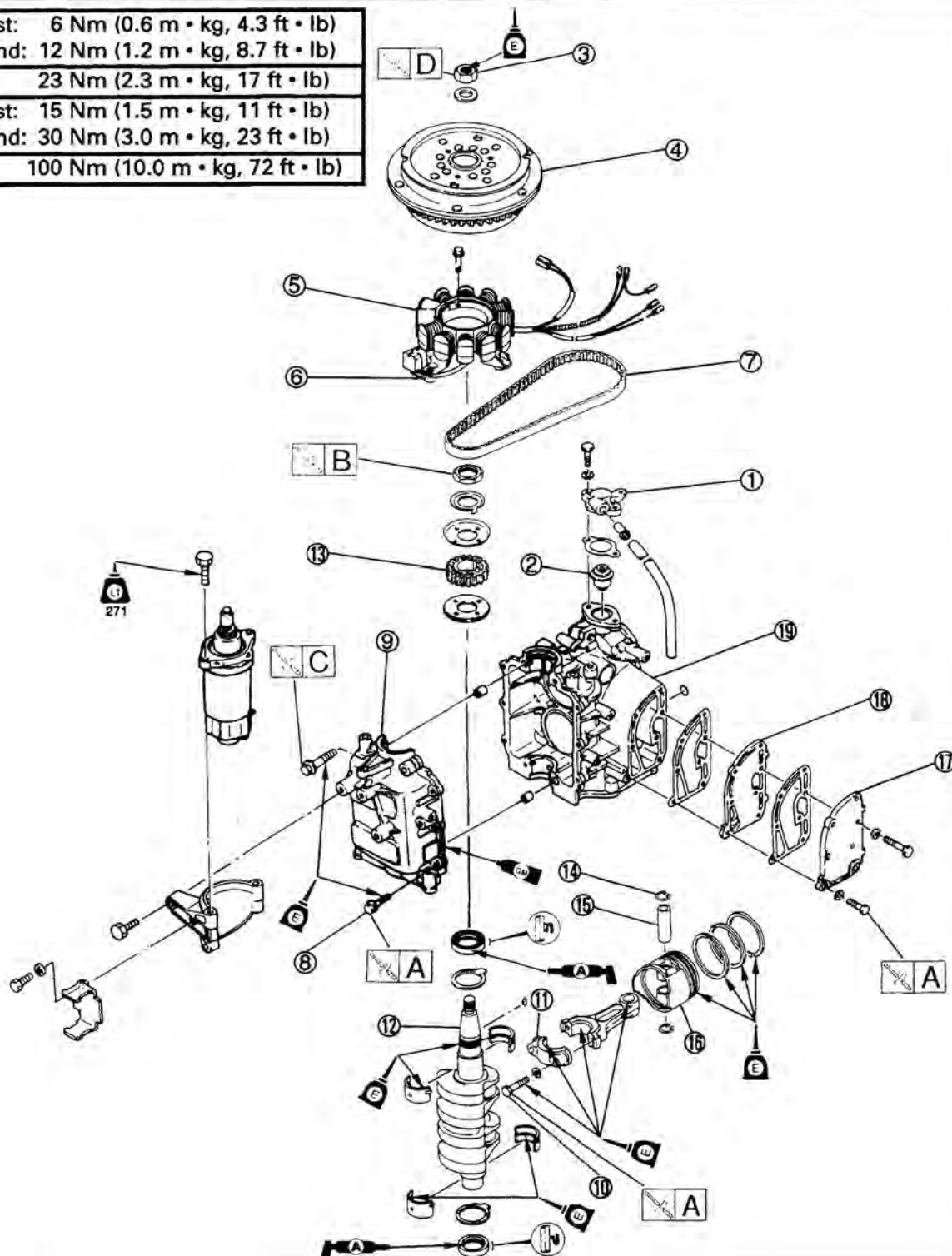
- Throttle link length



CYLINDER, PISTON AND CRANKSHAFT PREPARATION FOR REMOVAL

- * Remove the power unit.
- * Remove the following parts:
 - CDI unit
 - Ignition coil
 - Rectifier regulator

A	1st: 6 Nm (0.6 m • kg, 4.3 ft • lb) 2nd: 12 Nm (1.2 m • kg, 8.7 ft • lb)
B	23 Nm (2.3 m • kg, 17 ft • lb)
C	1st: 15 Nm (1.5 m • kg, 11 ft • lb) 2nd: 30 Nm (3.0 m • kg, 23 ft • lb)
D	100 Nm (10.0 m • kg, 72 ft • lb)

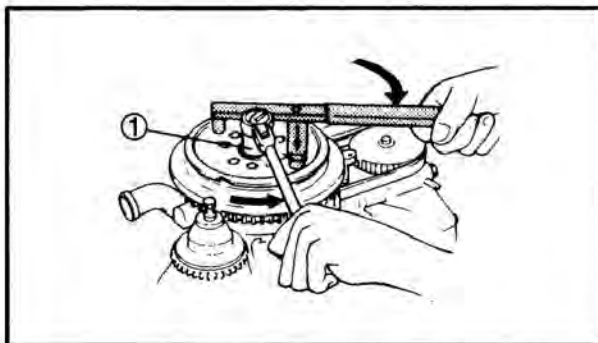



NOTE ON REMOVAL AND REASSEMBLY

- Before servicing, clean the power unit.
- Install the piston and connecting rods in their original cylinders.
- Each connecting rod and its cap should be kept as a set; do not interchange them between cylinders.

Extent of removal: ① Thermostat removal ② Stator assembly removal
 ③ Piston removal ④ Cylinder body disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Thermostat cover	1	Refer to "REMOVAL POINTS".
	2	Thermostat	1	
	3	Nut	1	
	4	Flywheel magneto	1	
	5	Stator assembly	1	
	6	Stator bracket	1	Refer to "REMOVAL POINTS".
	7	Timing belt	1	
	8	Bolt	10	
	9	Crankcase	1	
	10	Bolt	4	
	11	Connecting cap	2	Refer to "REMOVAL POINTS".
	12	Crankshaft	1	
	13	Drive gear	1	
	14	Circlip	4	
	15	Piston pin	2	
	16	Piston	2	
	17	Exhaust cover (outer)	1	
	18	Exhaust cover (inner)	1	
	19	Cylinder body	1	

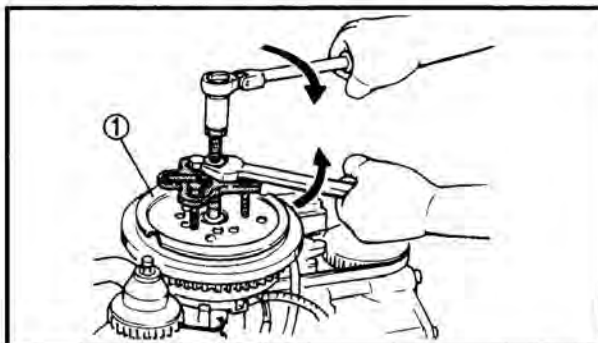

**REMOVAL POINTS
 FLYWHEEL MAGNETO**

1. Remove:

- Nut ①



Flywheel holder

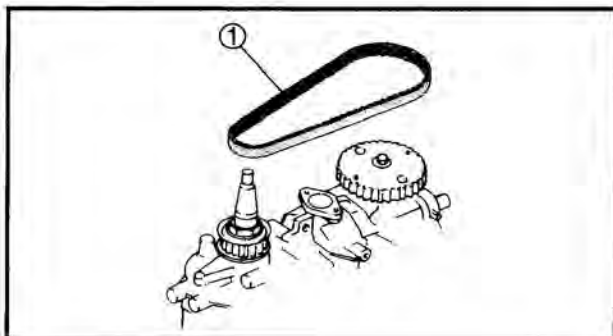


2. Remove:

- Flywheel magneto ①



Flywheel puller

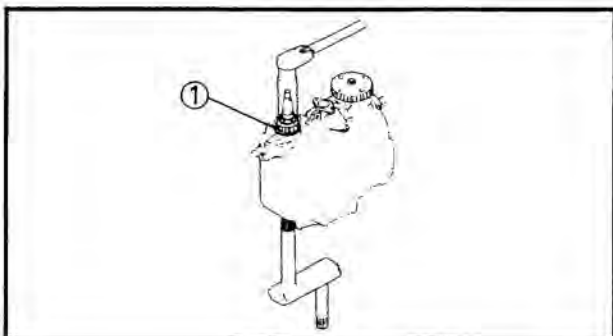


TIMING BELT

1. Remove:
 - Timing belt ①

NOTE:

Remove the timing belt at the driven gear side.



DRIVE GEAR

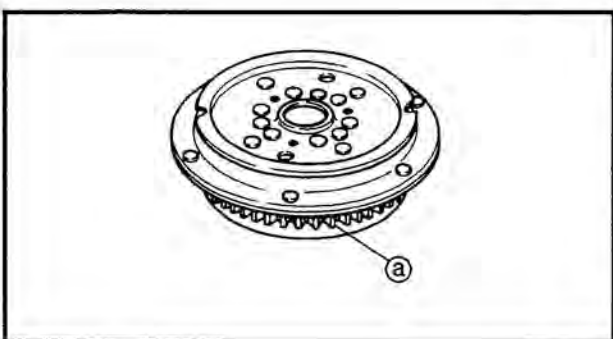
1. Remove:
 - Lock nut
 - Drive gear ①



Shaft holder

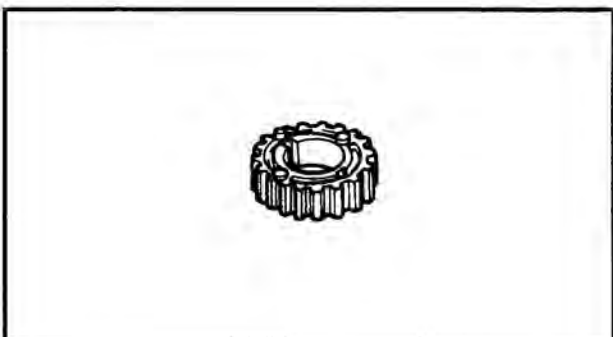
NOTE:

Before removing the lock nut, straighten the lock washer tab.



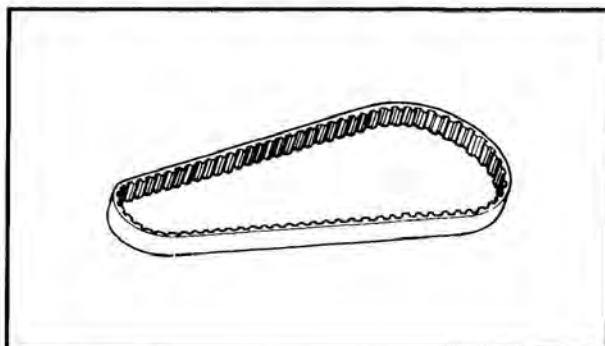
INSPECTION AND REPAIR FLYWHEEL MAGNETO

1. Inspect:
 - Flywheel teeth @
 - Wear/Damage → Replace.

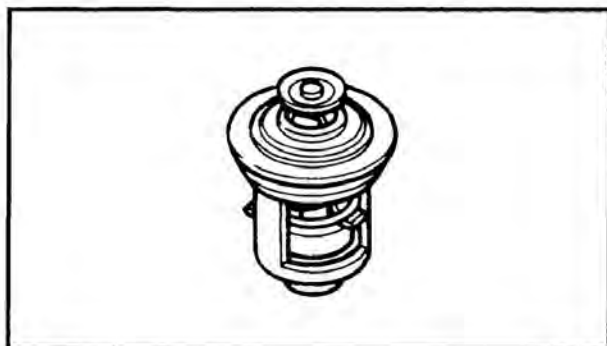


DRIVE GEAR

1. Remove:
 - Drive gear
 - Wear/Damage → Replace.


TIMING BELT
1. Inspect:

- Timing belt
Stretch/Wear/Damage → Replace.

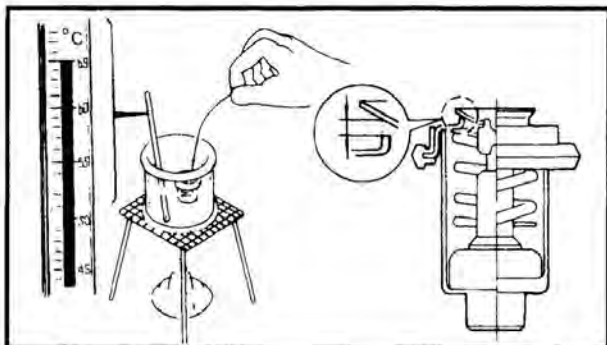

THERMOSTAT
1. Inspect:

- Thermostat
Stick/Damage → Replace.

2. Measure:

- Valve opening temperature
- Valve lift
Out of specification → Replace.

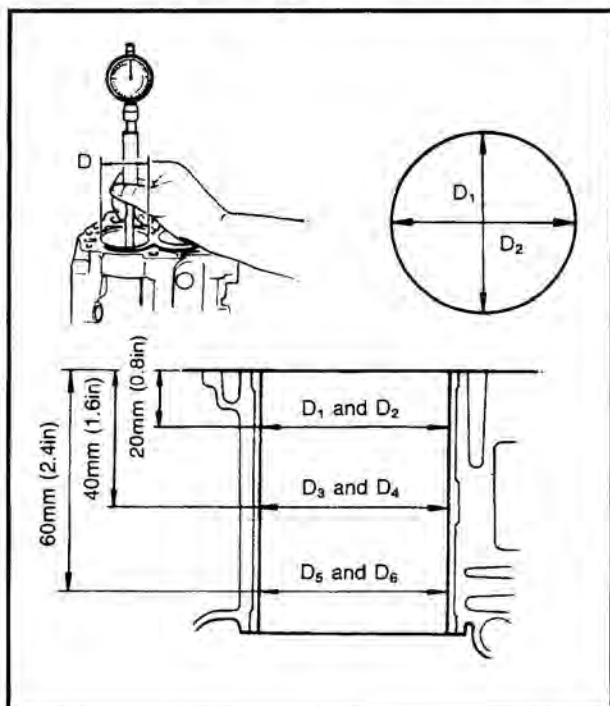
	Water temperature	Valve lift
	Before 58 ~ 62°C (136 ~ 144°F)	0 mm (0 in)
	Above 70°C (158°F)	Min. 3 mm (0.12 in)


Measurement steps:

- Suspend the thermostat in a vessel.
- Place a reliable thermometer in the water.
- Slowly heat the water.
- Observe the thermometer, while continually stirring the water.

CYLINDER
1. Inspect:

- Water jacket
Mineral deposits/Corrosion → Clean.
- Cylinder inner surface
Score marks → Repair or replace.
Use #600 ~ 800 grit wet sandpaper.



2. Measure:

- Cylinder bore "D"

Use cylinder gauge.

Out of specification → Rebore or Replace.

NOTE:

Measure the cylinder bore "D" in parallel. Then, find the average of the measurement.

	Standard	Wear limit
Cylinder bore D:	59.00 ~ 59.02 mm (2.323 ~ 2.324 in)	59.1 mm (2.326 in)
Cylinder taper T:	—	0.08 mm (0.003 in)
D = Maximum Dia (D ₁ ~ D ₆) T = (Maximum D ₁ or D ₂) – Minimum D ₅ or D ₆		



PISTON

1. Inspect:

- Piston wall

Wear/Scratch/Damage → Replace.

2. Measure:

- Piston diameter

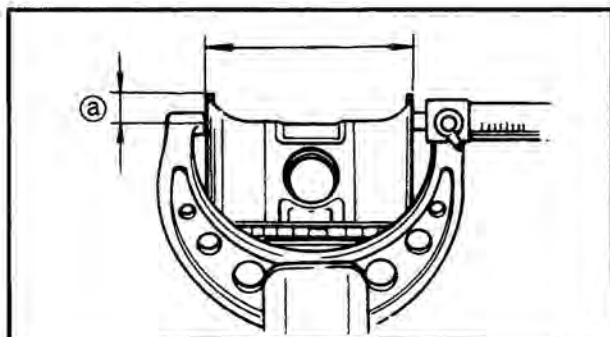
Use a micrometer.

Out of specification → Replace.

	Distance ①	Piston dia.
Standard	10 mm (0.39 in)	58.950 ~ 58.965 mm (2.3209 ~ 2.3215 in)
Oversize 1		59.25 mm (2.333 in)*
2		59.50 mm (2.343 in)

NOTE:

Measure specific distance ① from the bottom edge.




PISTON CLEARANCE
1. Calculate:

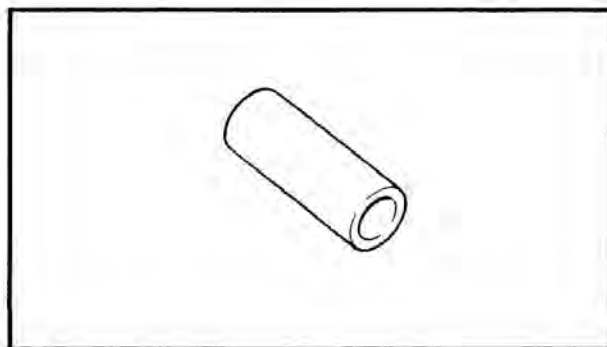
- Piston clearance

Out of specification → Replace piston and piston ring and/or cylinder.

PISTON CLEARANCE	=	CYLINDER BORE	-	PISTON DIAMETER
---------------------	---	------------------	---	--------------------

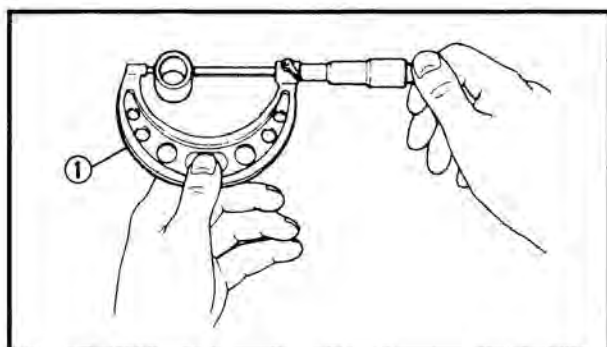


Piston clearance:
0.035 ~ 0.065 mm
(0.0014 ~ 0.0026 in)


PISTON PIN
1. Inspect:

- Piston pin

Signs of heat discoloration → Replace.


2. Measure:

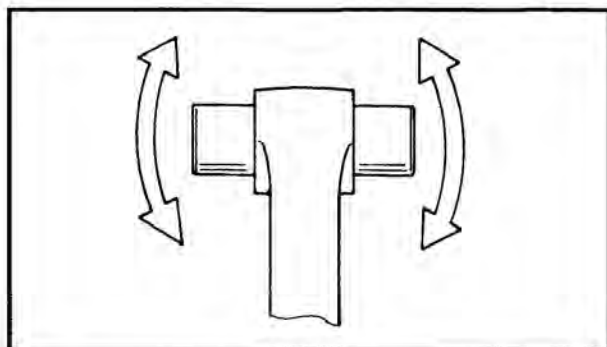
- Piston pin diameter

Use a micrometer ①.

Out of specification → Replace.



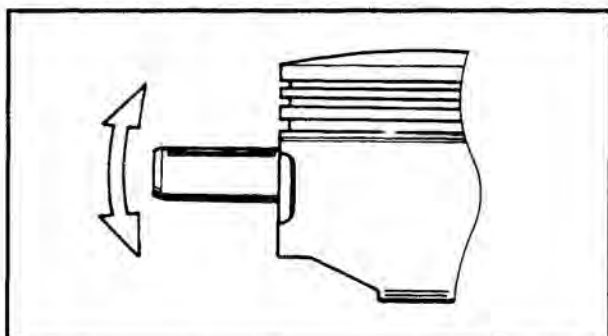
Piston pin diameter:
13.996 ~ 14,000 mm
(0.5510 ~ 0.5512 in)


3. Check:

- Free play (when the piston pin is into small end of connecting rod.)

There should be no noticeable play.

Free play exists → Replace the pin and/or connecting rod as required.



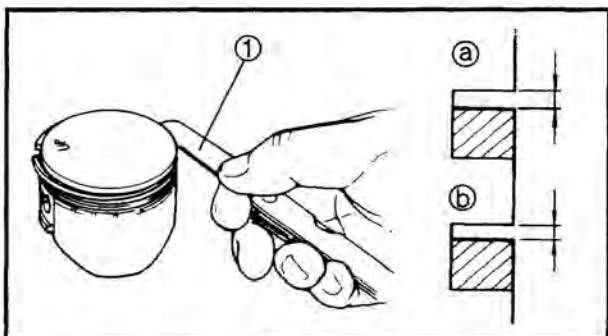
4. Check:

- Free play
(when the piston pin is in the piston)
There should be no noticeable play.
Free play exists → Replace the pin and/or piston.

PISTON RING

1. Measure:

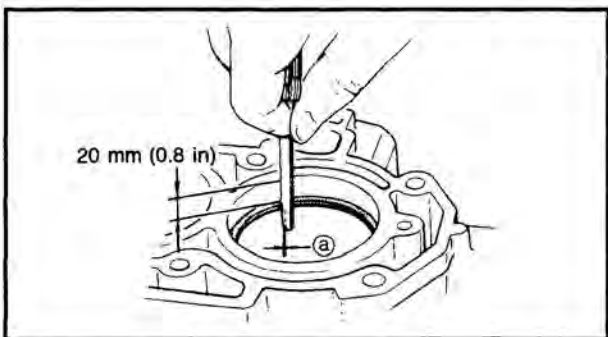
- Side clearance ①, ②
Using a feeler gauge ①.
Out of specification → Replace piston and/or ring.



	Side clearance:
Top ①	0.04 ~ 0.08 mm (0.002 ~ 0.003 in)
2nd ②	0.03 ~ 0.07 mm (0.001 ~ 0.003 in)

2. Measure:

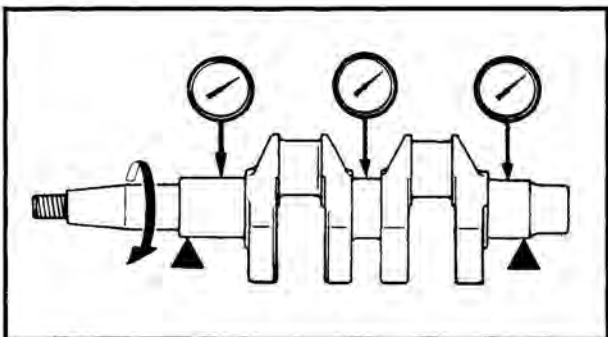
- End gap ③
Using a feeler gauge.
Out of specification → Replace.



	End gap ③:
Top	0.15 ~ 0.30 mm (0.006 ~ 0.012 in)
2nd	0.15 ~ 0.30 mm (0.006 ~ 0.012 in)
Oil	0.20 ~ 0.70 mm (0.008 ~ 0.028 in)

NOTE:

Install the piston ring into the cylinder. Push the ring with the piston crown.

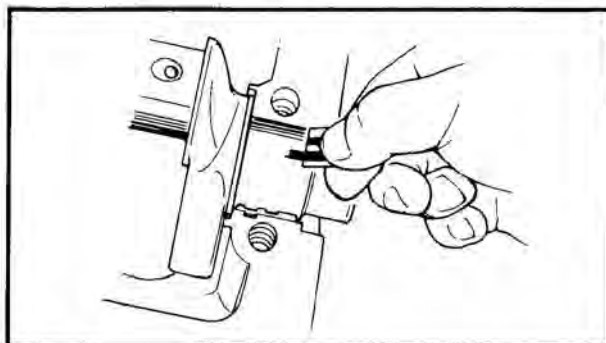


CRANKSHAFT

1. Measure:

- Runout
Use V-blocks and a dial gauge.
Out of specification → Replace.

	Runout: 0.05 mm (0.002 in)
--	---



CRANKSHAFT MAIN BEARING CLEARANCE

1. Measure:

- Oil clearance (main journal)
Out of specification → Replace bearing.



Main bearing clearance:
0.000 ~ 0.027 mm
(0.0000 ~ 0.0011 in)

Measurement steps:

CAUTION:

Do not interchange the bearings. They must be installed in their original positions or the correct oil clearance may not be obtained causing engine damage.

- Clean the bearings, main journals and bearing portions of the crankcase and cylinder body.
- Place the cylinder body on a bench in an upside down position.
- Install half of the bearings ① and crankshaft ② into the cylinder body ③.

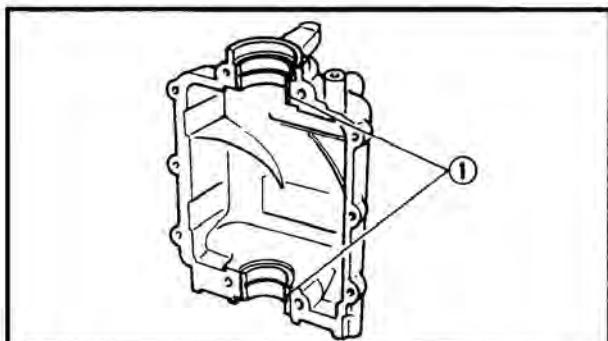
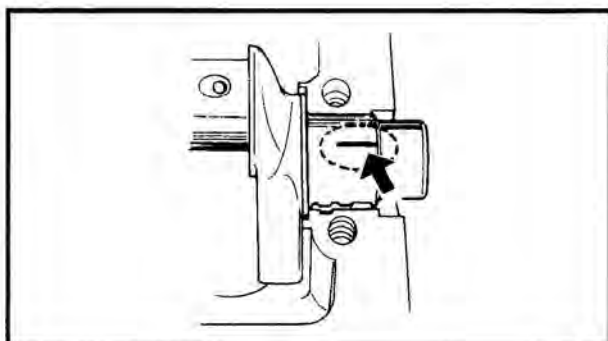
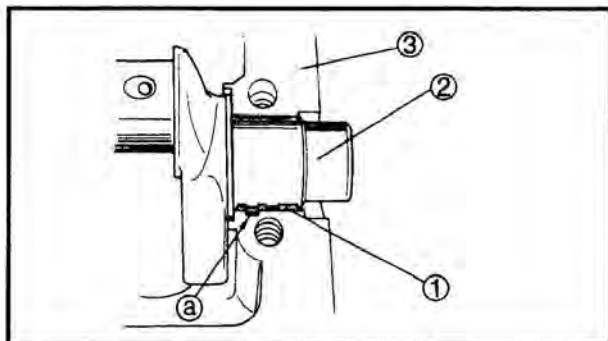
NOTE:

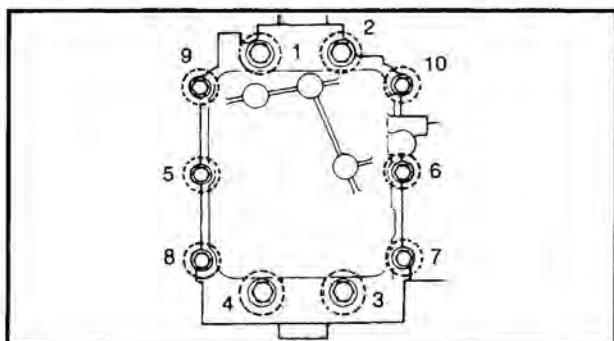
Align the projection ④ of the bearing with the notch in the cylinder body.

- Put a piece of plastigauge onto the crankshaft journal surface.
- Install half of the bearings ① into the crankcase.

NOTE:

- Align the projection of the bearing with the notch in the crankcase.
- Do not turn crankshaft until clearance measurement has been completed.





- Tighten the bolts in sequence and two steps of torque.



Bolt (M8):

1st: 15 Nm (1.5 m • kg, 11 ft • lb)

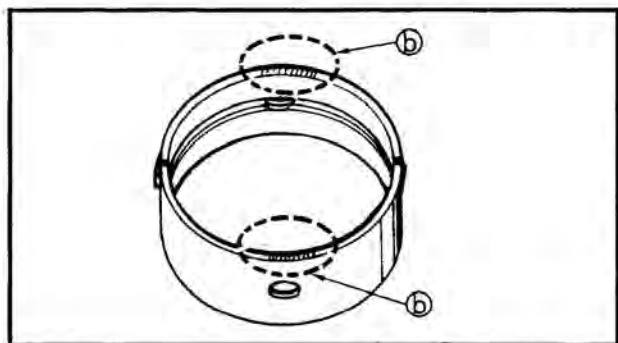
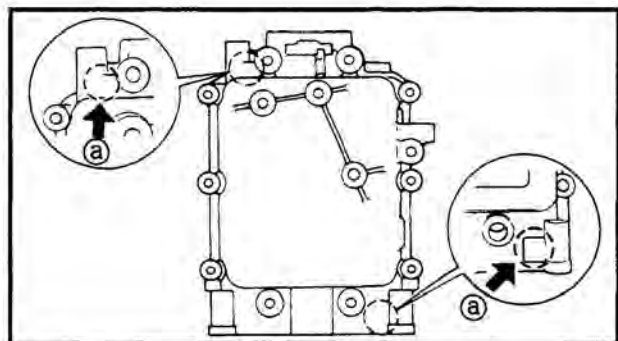
2nd: 30 Nm (3.0 m • kg, 22 ft • lb)

Bolt (M6):

1st: 6 Nm (0.6 m • kg, 4.3 ft • lb)

2nd: 12 Nm (1.2 m • kg, 8.7 ft • lb)

- Remove the bolts and the crankcase.
- Measure the compressed plastigauge width on each main journal.



COMBINATION OF CRANKCASE AND BEARING

1. Crankcase:

Mark (a)	Housing size
A	33.032 ~ 33.040 mm (1.3005 ~ 1.3008 in)
B	33.024 ~ 33.032 mm (1.3002 ~ 1.3005 in)
C	33.016 ~ 33.024 mm (1.2998 ~ 1.3002 in)

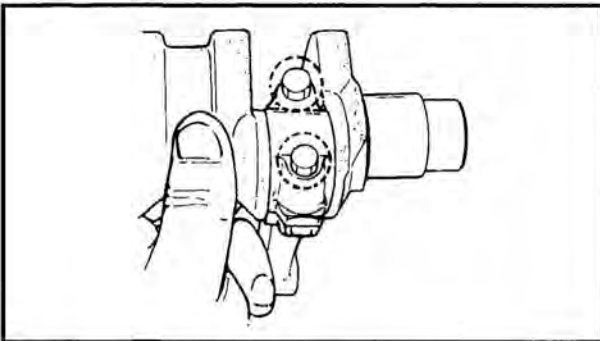
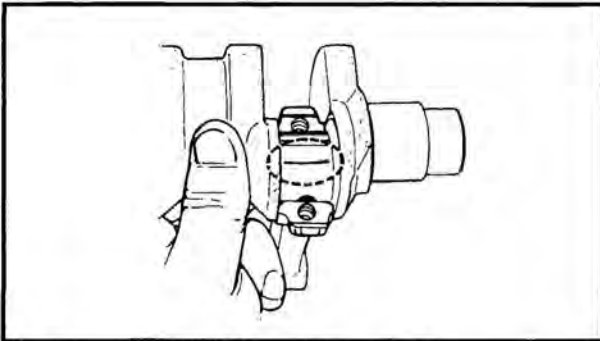
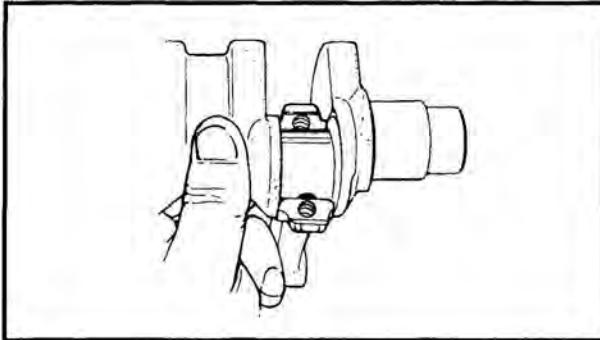
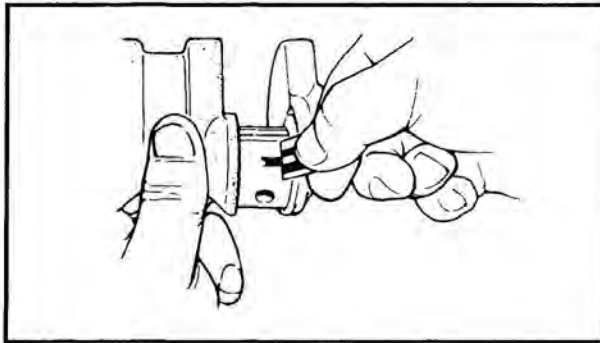
2. Bearing:

Indication (b)	Bearing size
Blue	1.508 ~ 1.512 mm (0.0594 ~ 0.0595 in)
Black	1.504 ~ 1.508 mm (0.0592 ~ 0.0594 in)
Brown	1.500 ~ 1.504 mm (0.0591 ~ 0.0592 in)

3. Combination:

Combine the crankcase and bearing by the following chart.

Crankcase mark	Bearing indication
A	Blue
B	Black
C	Brown



CONNECTING ROD OIL CLEARANCE

1. Measure:

- Oil clearance

Out of specification → Replace connecting rod and cap as a set.



Connecting rod oil clearance:
0.021 ~ 0.045 mm
(0.0008 ~ 0.0018 in)

Measurement steps:

CAUTION:

- Assemble the connecting rod and the cap referring the marking.
- Do not assemble connecting rod and the cap with #1 and #2 together.

- Clean the bearing portions of the connecting rod.
- Install the connecting rod to the crankshaft.
- Put a piece of plastigauge onto the crank pin.
- Install the connecting rod cap.

NOTE:

- Make sure that the "6G803" marks on the connecting rods face toward the fly-wheel side of the crankshaft.
- Do not turn the connecting rod or crankshaft until clearance measurement has been completed.

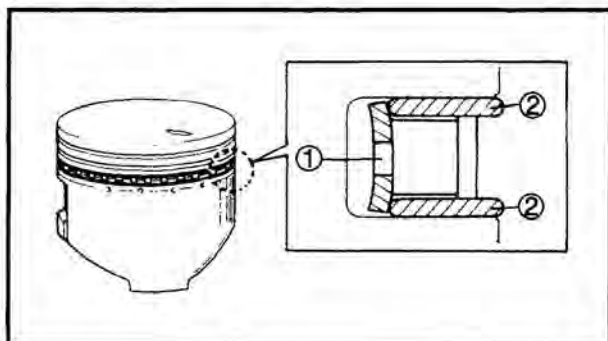
- Tighten the bolts in sequence in two steps of torque.



Bolt (M8):

1st: 6 Nm (0.6 m · kg, 4.3 ft · lb)
2nd: 12 Nm (1.2 m · kg, 8.7 ft · lb)

- Remove the bolts and the connecting rod cap.
- Measure the compressed plastigauge width on each crank pin.



ASSEMBLY AND INSTALLATION PISTON AND CONNECTING ROD

1. Install:

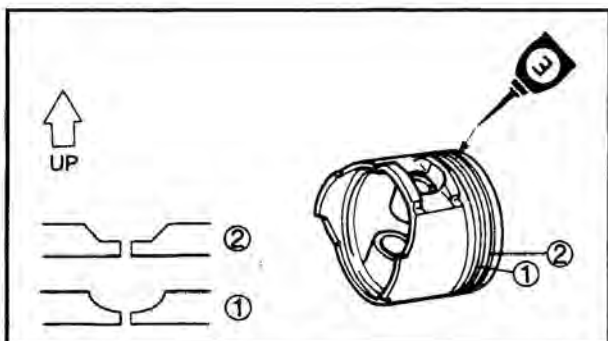
- Expander ring ①
- Side ring ②

2. Install:

- Piston ring (2nd) ①
- Piston ring (top) ②

NOTE:

- Align the piston ring gap with the pin of the piston.
- Oil the pistons and rings liberally.

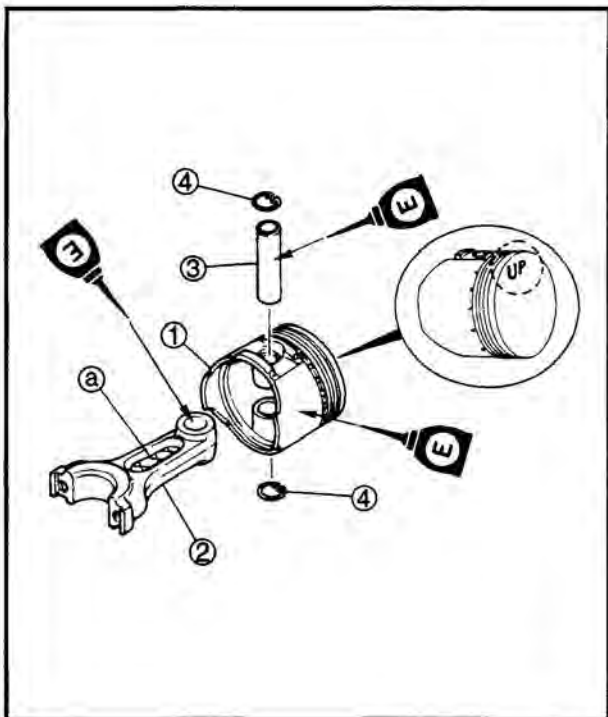


3. Install:

- Piston ①
- Connecting rod ②
- Piston pin ③
- Circlip ④

NOTE:

- Mold mark ㉓ faces in the same direction as the "UP" mark on the piston.
- Always use a new circlip.
- Oil the pistons, piston pins and connecting rods liberally.



CYLINDER AND CRANKCASE

1. Install:

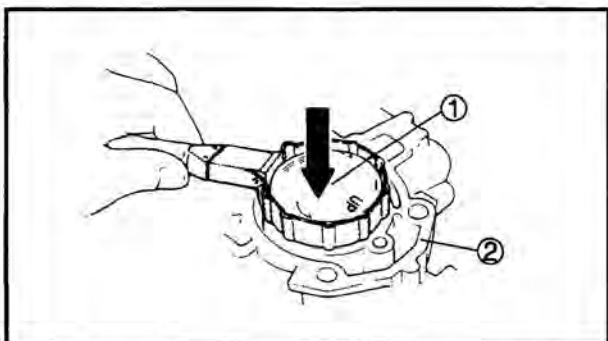
- Piston assembly ①
- Cylinder body ②

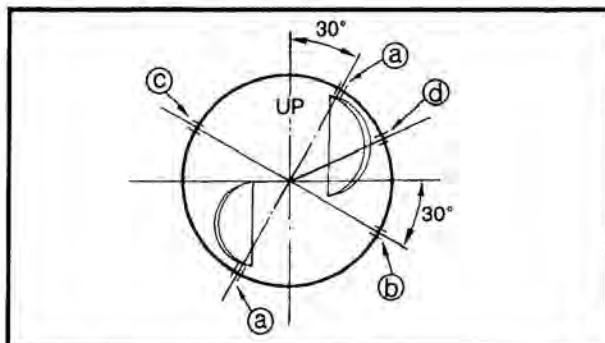


Piston slider

CAUTION:

The piston should be installed with the "UP" mark on the piston crown facing toward the flywheel side.



**NOTE:**

- Position the ring end gaps before inserting the piston.
- Align the piston ring gap (top and 2nd) with the pin of the piston.

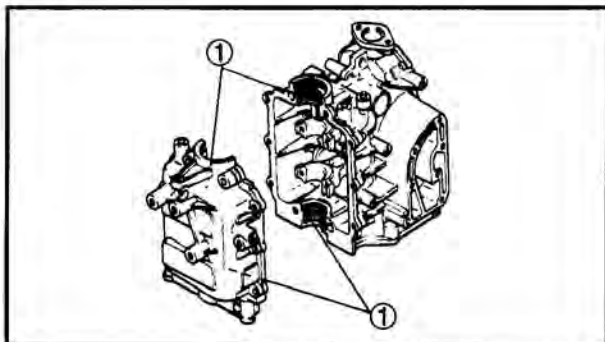
- ① Side rail end gap
- ② Expander ring end gap
- ③ Piston ring (2nd) end gap
- ④ Piston ring (top) end gap

2. Install:

- Crankshaft main bearing ①

NOTE:

Align the projection of the bearings with the notch in the cylinder body and crankcase.

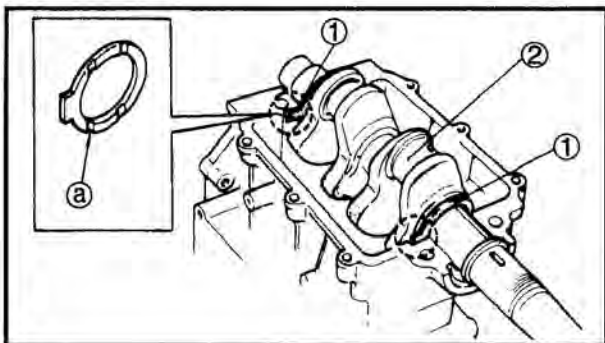


3. Install:

- Thrust plate ①
- Crankshaft ②

NOTE:

- Install the thrust plates so that the oil groove ① side is on the crank side.
- When installing the crankshaft on the cylinder body, be sure to fit the thrust plate tab in the cut of the cylinder body.

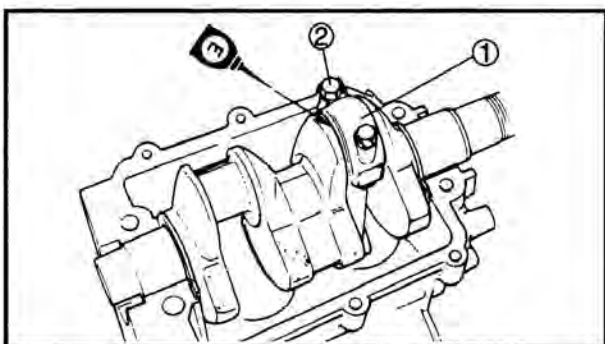


4. Install:

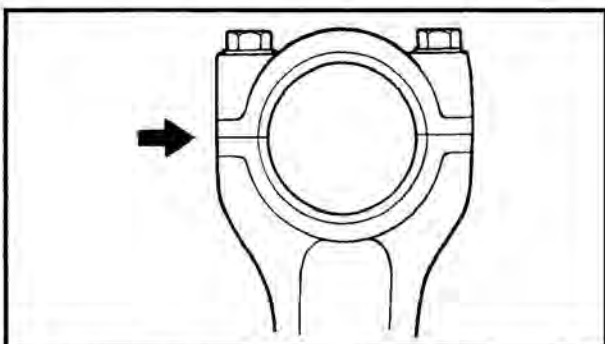
- Connecting cap ①
- Bolt ②

CAUTION:

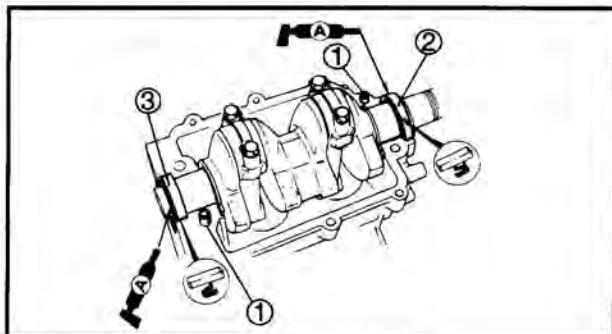
- Assemble the connecting rod and its cap referring the marking.
- Do not assemble connecting rod and cap with #1 and #2 together.

**NOTE:**

Oil the connecting cap and crank pin liberally.

**Bolt:**

- 1st: 6 Nm (0.6 m • kg, 4.3 ft • lb)
- 2nd: 12 Nm (1.2 m • kg, 8.7 ft • lb)

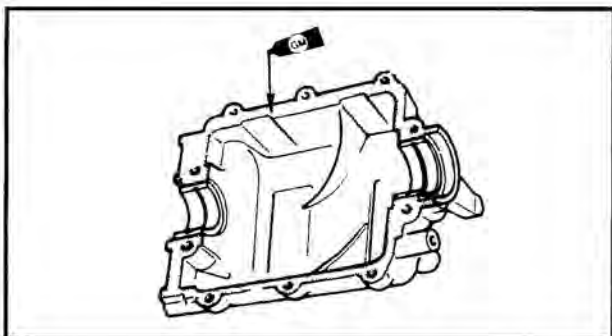


5. Install:

- Dowel pin ①
- Oil seal (upper) ②
- Oil seal (lower) ③

NOTE:

Install the oil seal with its manufacture's marks or numbers facing outward.

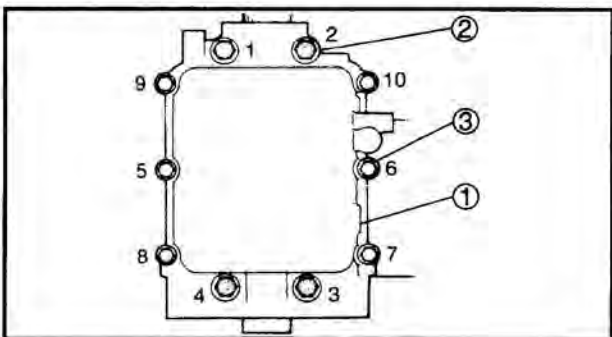


6. Apply:

- Gasket Maker
- Onto the crankcase.

NOTE:

- Clean the contacting surface of the crankcase and cylinder body before applying the Gasket maker.
- Gasket maker should be applied so it does not overflow the contacting surface.



7. Install:

- Crankcase ①
- Bolt (M8) ②
- Bolt (M6) ③

NOTE:

Tighten the bolts in sequence in two steps of torque.



Bolt:

M8 1st:

15 Nm (1.5 m • kg, 11 ft • lb)

2nd:

30 Nm (3.0 m • kg, 22 ft • lb)

M6 1st:

6 Nm (0.6 m • kg, 4.3 ft • lb)

2nd:

12 Nm (1.2 m • kg, 8.7 ft • lb)

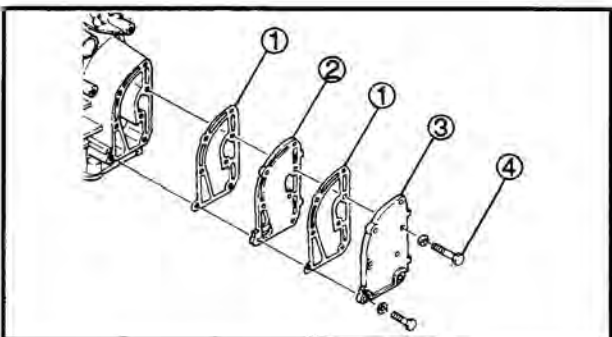
EXHAUST COVER

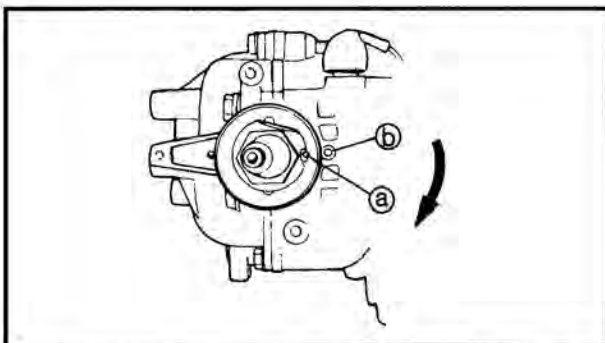
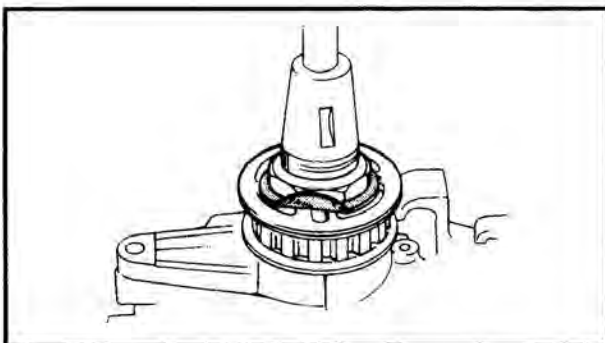
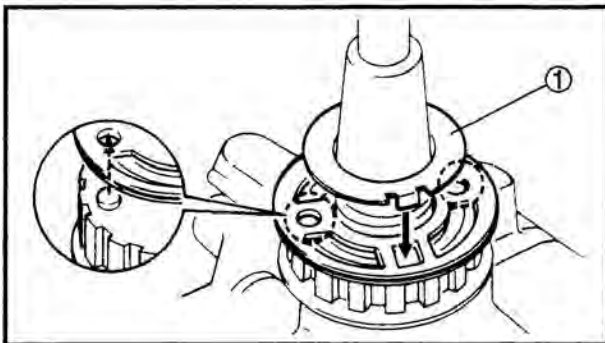
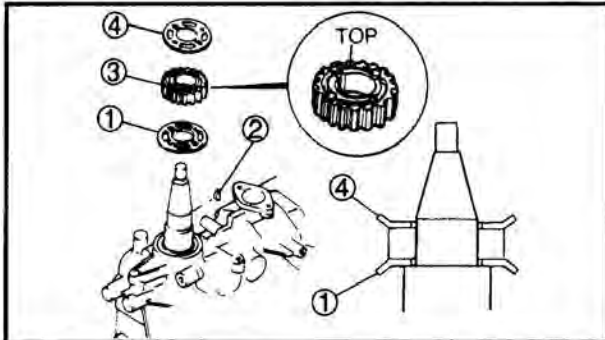
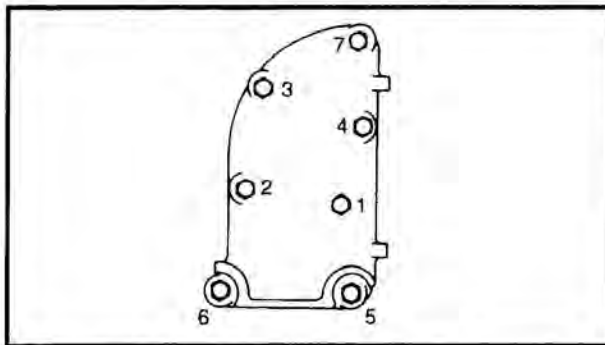
1. Install:

- Gasket ①
- Exhaust cover (inner) ②
- Exhaust cover (outer) ③
- Bolt ④

NOTE:

Tighten the bolts in sequence in two steps of torque.



**TIMING BELT****1. Install:**

- Washer ①
- Woodruff key ②
- Drive gear ③
- Washer ④

NOTE:

- The projections on the drive gear should fit into the holes in the washers.
- "TOP" mark side should face upward.

2. Install:

- Lock washer ①
- Nut

NOTE:

- Insert the projection of the lock washer to be matched with the "TOP" mark.
- After tightening the nut, bend the lock washer over the nut.

**Shaft holder**

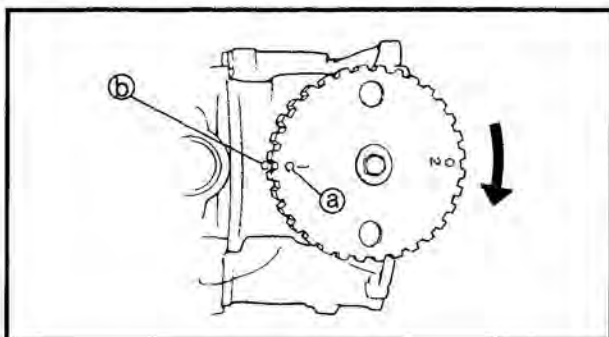
Nut:
23 Nm (2.3 m • kg, 17 ft • lb)

3. Align:

- Drive gear mark (a)
- Cylinder body mark (b)

NOTE:

Turn the crankshaft clockwise.



4. Align:

- Driven gear mark (a)
- Cylinder head mark (b)

NOTE:

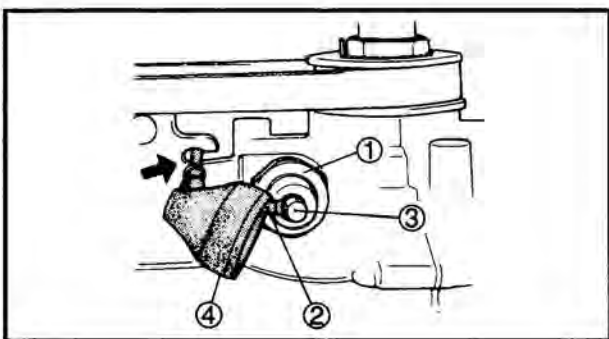
Turn the camshaft clockwise.

5. Install:

- Timing belt (1)

CAUTION:

- Protect the belt from water and oil.
- Do not use an iron lever when installing the belt.
- Use care not to scratch the belt.



OIL PRESSURE SWITCH

1. Install:

- Oil pressure switch (1)



Oil pressure switch:
9 Nm (0.9 m • kg, 6.5 ft • lb)

2. Install:

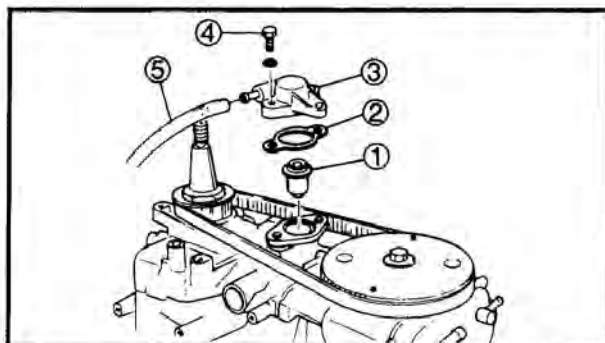
- Switch lead (2)
- Screw (3)
- Cover (4)

NOTE:

Route the switch lead over the recess in the cylinder body.



Screw:
2 Nm (0.2 m • kg, 1.4 ft • lb)



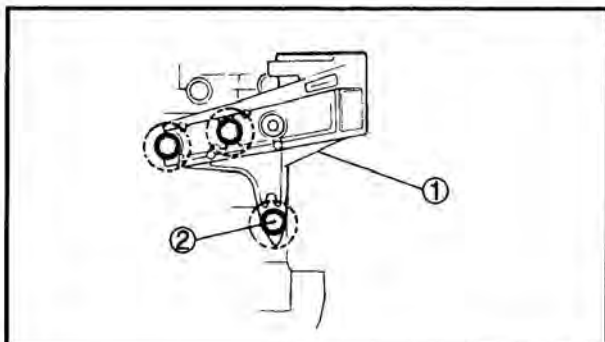
THERMOSTAT

1. Install:

- Thermostat ①
- Gasket ②
- Thermostat cover ③
- Bolt ④
- By-pass hose ⑤

NOTE:

Always use a new gasket.



STARTER MOTOR

1. Install:

- Bracket ①
- Bolt ②

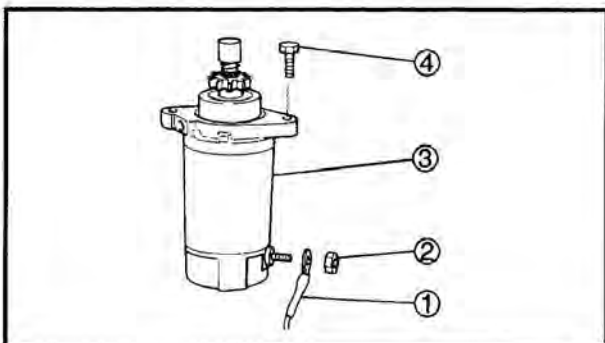
2. Install:

- Battery lead ①
- Nut ②
- Starter motor ③
- Bolt ④



Nut:

4 Nm (0.4 m • kg, 2.9 ft • lb)

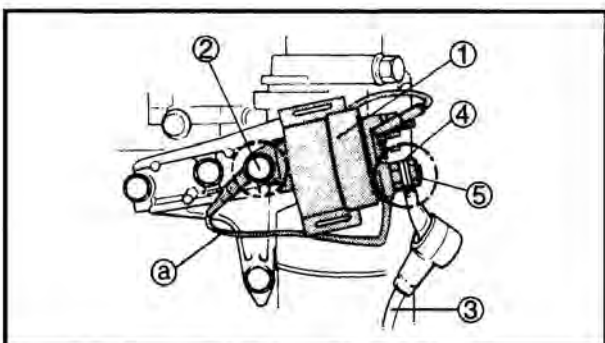


3. Install:

- Relay bracket
- Starter relay assembly ①
- Bolt ②
- Battery lead ③
- Washer ④
- Nut ⑤

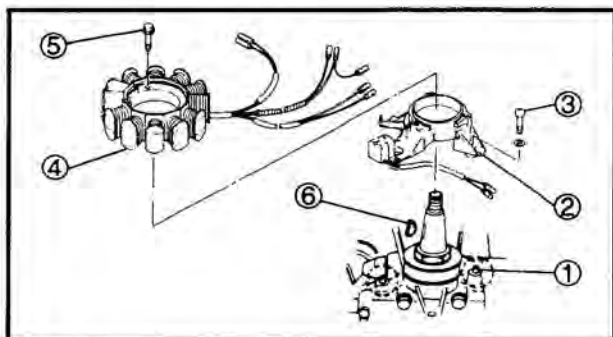
NOTE:

- Secure, together with the starter relay ground lead ⑥.
- Connect the battery lead to both of the starter motor and starter relay.



Nut:

4 Nm (0.4 m • kg, 2.9 ft • lb)



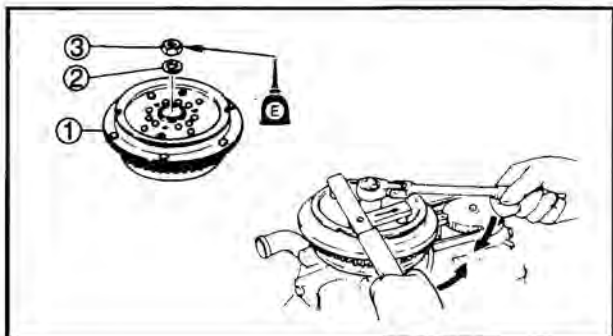
FLYWHEEL MAGNETO

1. Install:

- Dowel pin ①
- Stator bracket ②
- Screw ③
- Stator assembly ④
- Bolt ⑤
- Woodruff key ⑥

2. Install:

- Flywheel magneto ①
- Washer ②
- Nut ③



Flywheel holder



Nut:
100 Nm (10.0 m • kg, 72 ft • lb)



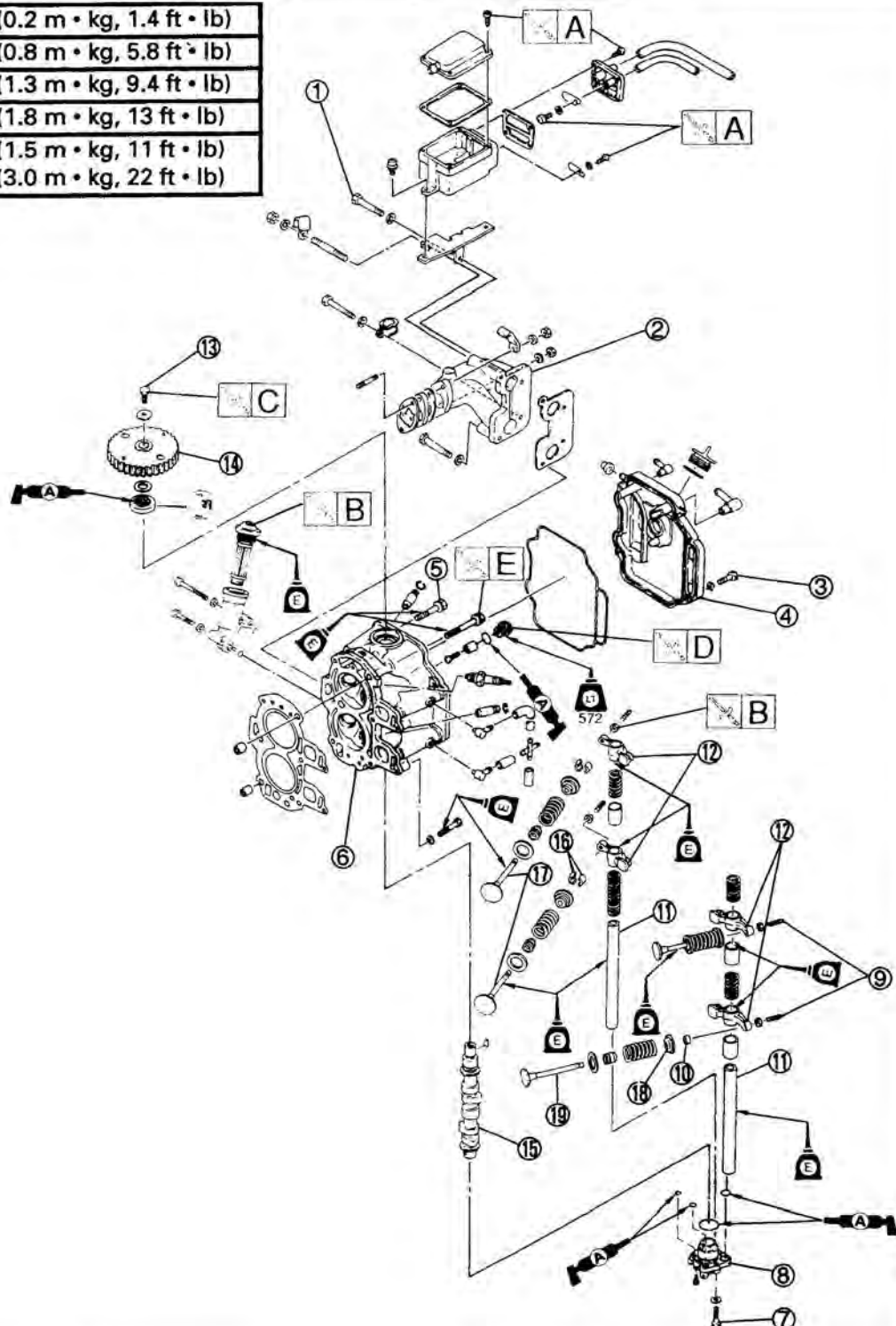
CYLINDER HEAD, VALVE AND CAMSHAFT PREPARATION FOR REMOVAL

* Remove the power unit.

* Remove the following parts:

- CDI unit
- Ignition coil
- Stator assembly
- Rectifier regulator
- Flywheel magneto
- Timing belt

A	2 Nm (0.2 m • kg, 1.4 ft • lb)
B	8 Nm (0.8 m • kg, 5.8 ft • lb)
C	13 Nm (1.3 m • kg, 9.4 ft • lb)
D	18 Nm (1.8 m • kg, 13 ft • lb)
E	1st: 15 Nm (1.5 m • kg, 11 ft • lb) 2nd: 30 Nm (3.0 m • kg, 22 ft • lb)

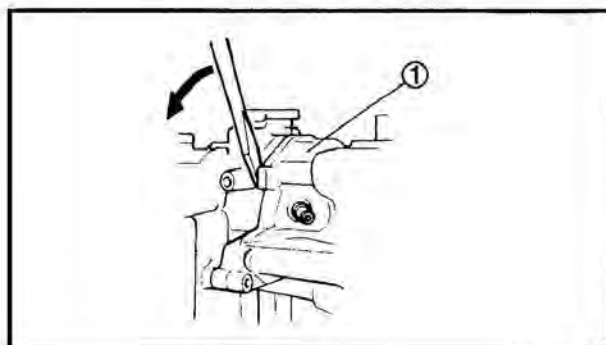



NOTE ON REMOVAL AND REASSEMBLY

- Before servicing, clean the power unit.
- Remove any gasket adhered to the contacting surface.
- Take care not to scratch the contacting surfaces when removing the cylinder and cylinder head.
- For reassembly, clean the removed parts with solvent and apply gear oil to the sliding surfaces.

Extent of removal: ① Intake manifold removal ② Cylinder head removal
③ Oil pump assembly removal ④ Valve disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Bolt	3	
	2	Intake manifold	1	
	3	Bolt	4	
	4	Cylinder head cover	1	
	5	Bolt	8	
	6	Cylinder head	1	Refer to "REMOVAL POINTS".
	7	Bolt	3	
	8	Oil pump assembly	1	
	9	Adjust screw	4	Loosen the screw.
	10	Valve lifter	2	Refer to "REMOVAL POINTS".
	11	Rocker shaft	2	
	12	Rocker arm	4	
	13	Bolt	1	
	14	Driven gear	1	Refer to "REMOVAL POINTS".
	15	Camshaft	1	
	16	Valve cotter	4	
	17	Valve (intake)	2	Refer to "REMOVAL POINTS".
	18	Spring retainer	2	
	19	Valve (exhaust)	2	

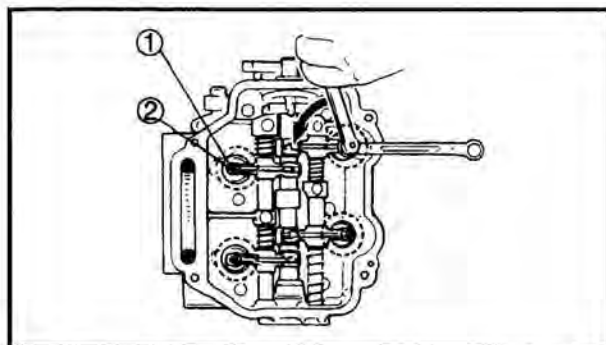

REMOVAL POINTS
CYLINDER HEAD

1. Remove:

- Cylinder head ①

NOTE:

- To remove the cylinder head, insert a screwdriver between the cylinder head and cylinder body, and then separate it.
- Do not to scratch the gasket contact surfaces with the screwdriver.

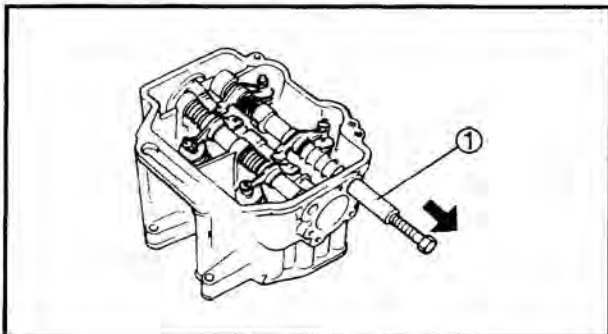

ROCKER SHAFT

1. Loosen:

- Lock nut ①
- Adjust screw ②



Valve adjuster

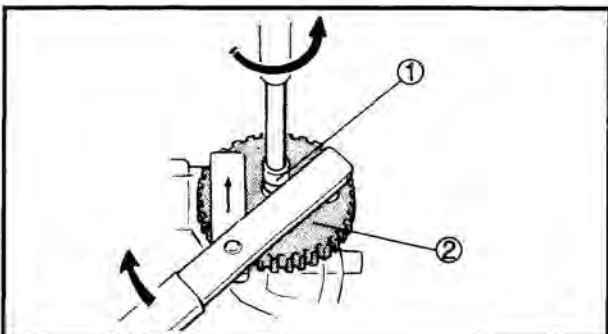


2. Remove:

- Rocker shaft ①

NOTE:

Use M10 bolt to extract the rocker shaft.



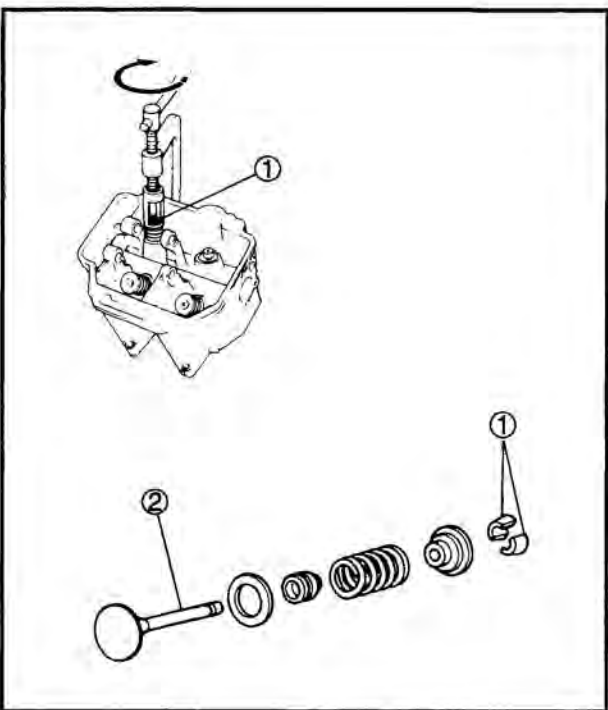
DRIVEN GEAR

1. Remove:

- Bolt ①
- Driven gear ②



Flywheel holder



VALVE

1. Remove:

- Valve cotter ①
- Valve ②



Valve spring compressor

NOTE:

Hold down the valve spring and remove the valve cotter.

2. Remove:

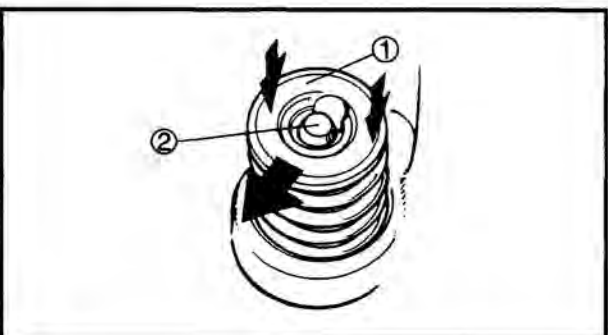
- Valve lifter
- Spring retainer ①
- Valve ②

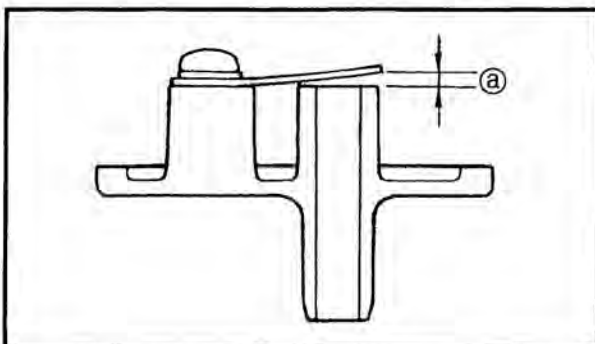


Valve spring compressor

NOTE:

Hold down the valve spring, remove the valve lifter and slide out the retainer.





INSPECTION AND REPAIR

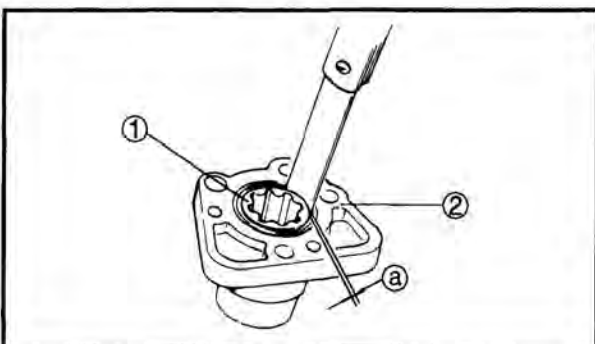
OIL SEPARATOR

1. Measure:

- Reed valve warpage (a)
Out of specification → Replace.



Reed valve warpage limit:
0.2 mm (0.008 in)



OIL PUMP

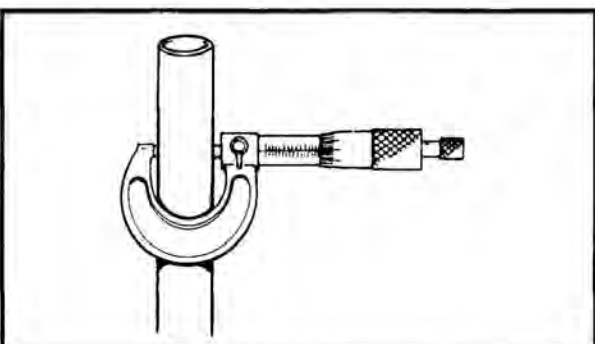
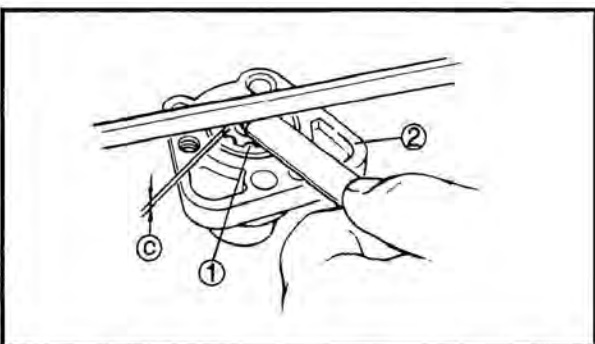
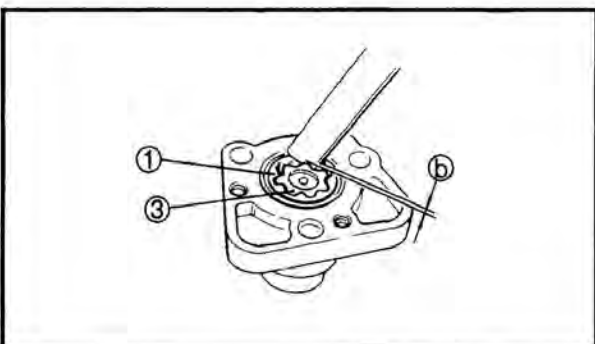
1. Measure:

- Clearance (a)
(between outer rotor ① and pump housing ②)
- Clearance (b)
(between inner rotor ③ and outer rotor ①)
- Clearance (c)
(between outer rotor ① and pump housing ②)
Use a feeler gauge.
Out of specification → Replace oil pump assembly.



Clearance:

(a)	0.06 ~ 0.11 mm (0.0024 ~ 0.0043 in)
(b)	0.02 ~ 0.15 mm (0.0008 ~ 0.0059 in)
(c)	0.02 ~ 0.07 mm (0.0020 ~ 0.0028 in)



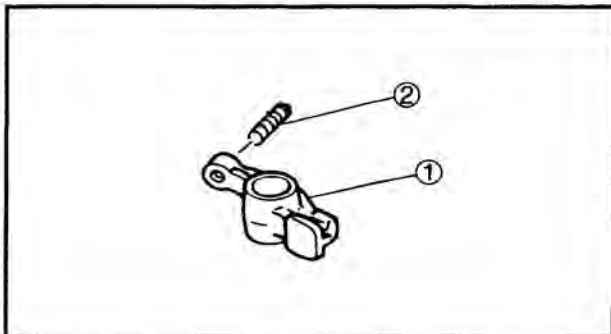
ROCKER SHAFT AND ROCKER ARM

1. Measure:

- Rocker shaft diameter
Out of specification → Replace.

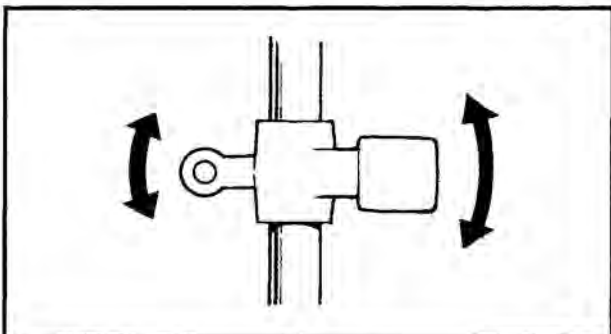


Rocker shaft diameter:
12.941 ~ 12.951 mm
(0.5095 ~ 0.5099 in)



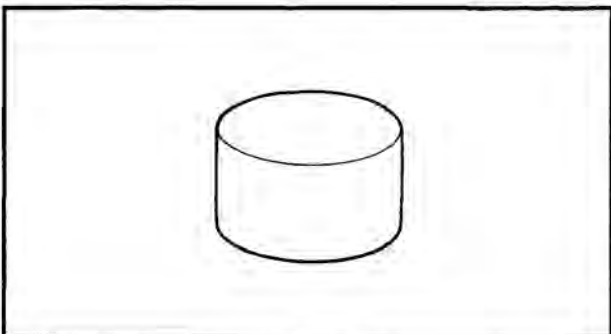
2. Inspect:

- Rocker arm ①
Scratch/Damage → Replace.
- Adjust screw ②
Wear/Damage → Replace.



3. Check:

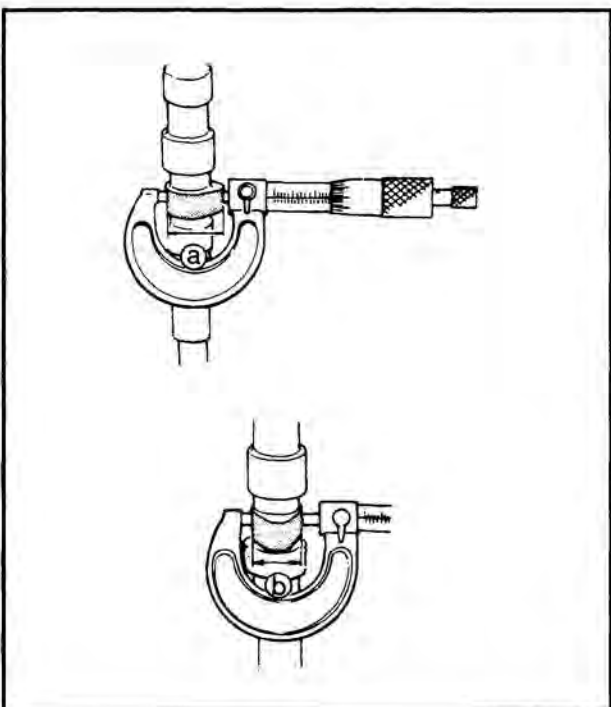
- Free play (when the rocker shaft is in place of the rocker arm)
There should be no noticeable play.
Free play exists → Replace the rocker shaft and/or rocker arm.



VALVE LIFTER

1. Inspect:

- Valve lifter
Scratch/Damage → Replace.



CAMSHAFT

1. Inspect:

- Cam lobes
Pitting/Scratch/Blue discoloration → Replace.

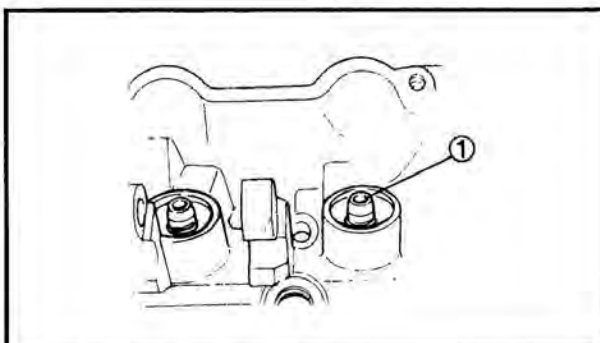
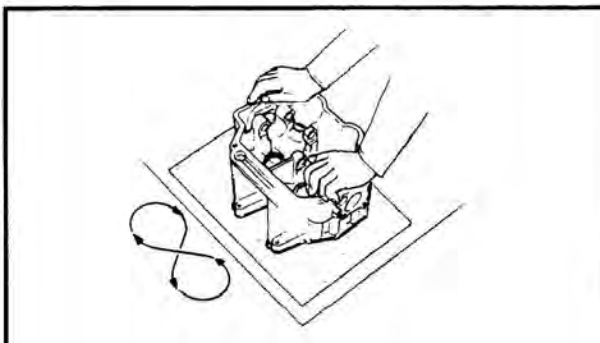
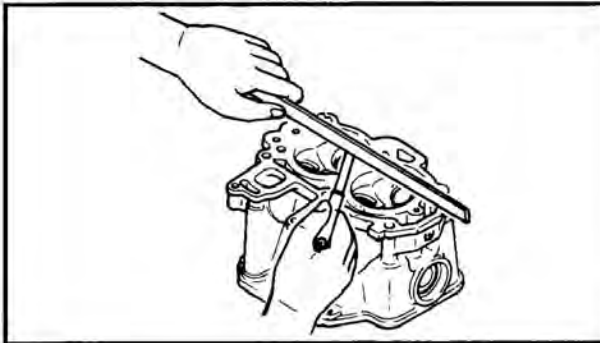
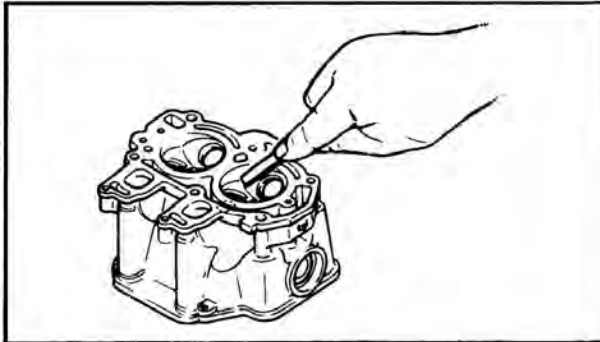
2. Measure:

- Cam lobe length ①
- Cam lobe length ②
Out of specification → Replace.



Cam lobe length:

a	IN	24.541 ~ 24.641 mm (0.966 ~ 0.970 in)
	EX	24.578 ~ 24.678 mm (0.968 ~ 0.972 in)
b	IN	20.137 ~ 20.237 mm (0.793 ~ 0.797 in)
	EX	20.178 ~ 20.278 mm (0.794 ~ 0.798 in)

**CYLINDER HEAD**

1. Inspect:

- Water jacket
Mineral deposits/Corrosion → Clean.
- Combustion chamber
Carbon deposits → Clean.
Use a round scraper.

2. Measure:

- Cylinder head warpage
Use a straightedge and thickness gauge.
Out of specification → Replace the valve


Warpage limit:
 0.1 mm (0.004 in)
Resurfacing steps:

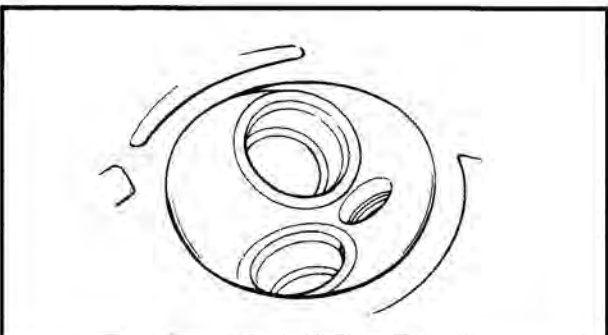
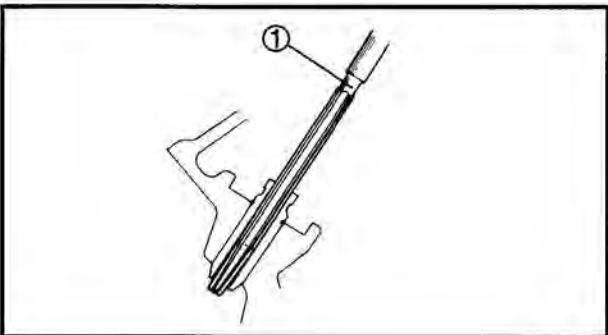
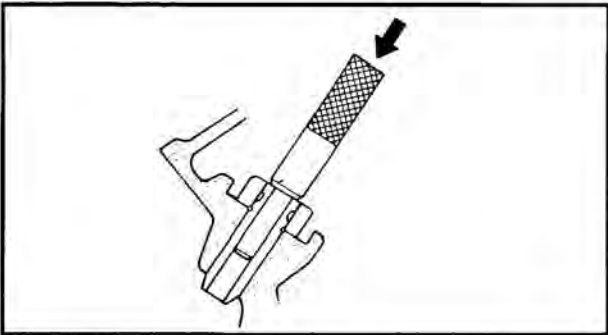
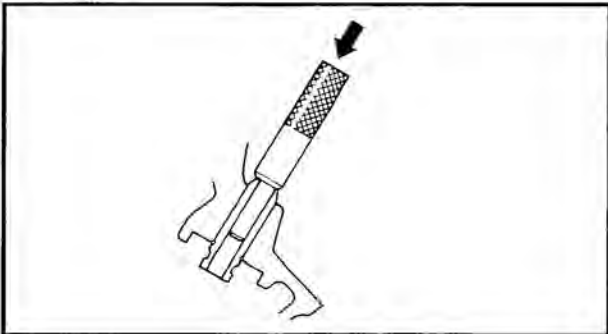
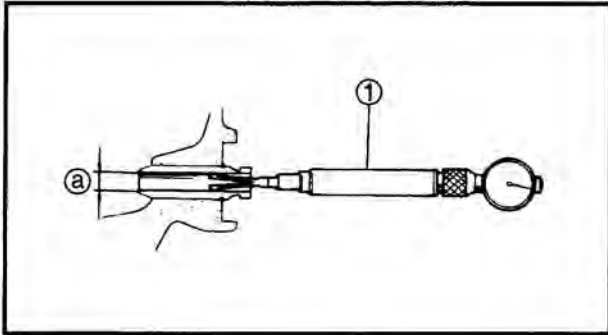
- Place a 400 ~ 600 grit wet sandpaper on the surface plate.
- Resurface the head using a figure-eight sanding pattern.

NOTE:

Rotate the head several times to avoid removing too much material from one side.

3. Inspect:

- Valve guide ①
Wear/Damage → Replace.



4. Measure:

- Valve guide bore (a)
Use a bore gauge (1).
Out of specification → Replace the valve guide.

 Valve guide bore:	
IN	5.500 ~ 5.512 mm
EX	(0.2165 ~ 0.2170 in)

Replacement steps:

NOTE:

Heat the cylinder head in an oven to 200°C (392°F) to ease guide removal and installation and to maintain correct interference fit.

- Remove the valve guide using the valve guide remover.

	Valve guide remover
● Install the circlip and valve guide (new) using the valve guide installer and valve guide remover.	

	Valve guide installer
● After installing the valve guide, bore the valve guide using the valve guide reamer (1) to obtain proper stem-to-guide clearance.	

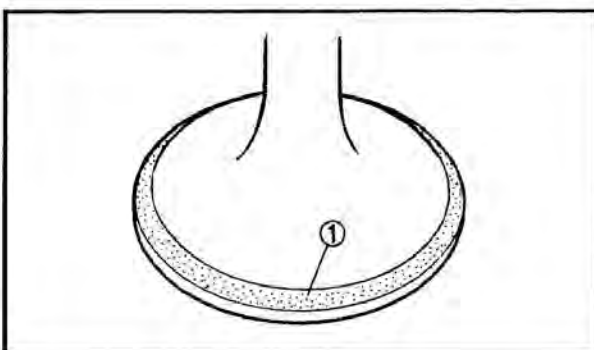
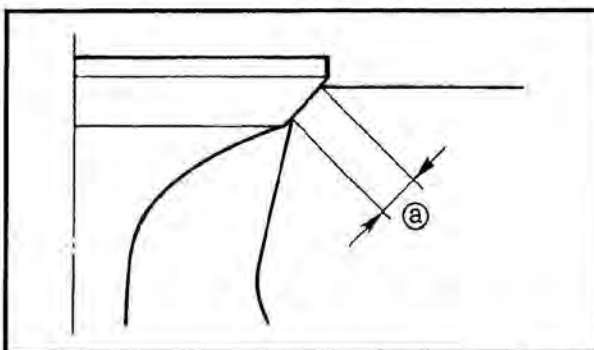
	Valve guide reamer
---	---------------------------

5. Eliminate:

- Carbon deposit
from valve face and valve seat.

6. Inspect:

- Valve seat
Wear/Pitting → Reface the valve seat.



7. Measure:

- Valve seat width ②

Out of specification → Resurface.



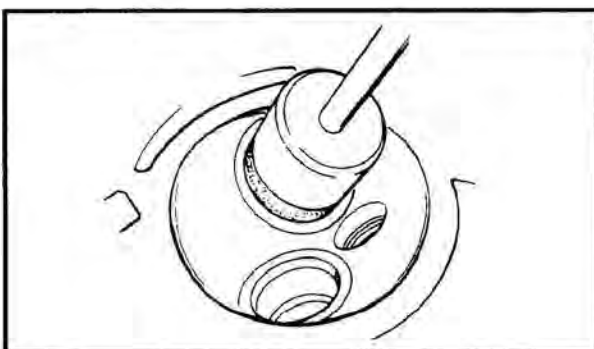
Valve seat width:

IN
EX

0.6 ~ 0.8 mm (0.024 ~ 0.031 in)

Measurement steps:

- Apply the Mechanic's bluing dye ① to the valve face.
- Install the valve into the cylinder head.
- Press the valve through the valve guide onto the valve seat to make a clear pattern.
- Measure the valve seat width. Wherever the valve seat and valve face made contact, bluing will have been removed.



8. Reface:

- Valve seat

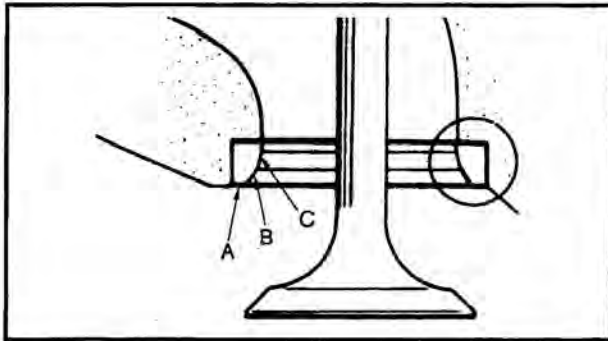
Use a 30°, 45° and 85° valve seat cutter.



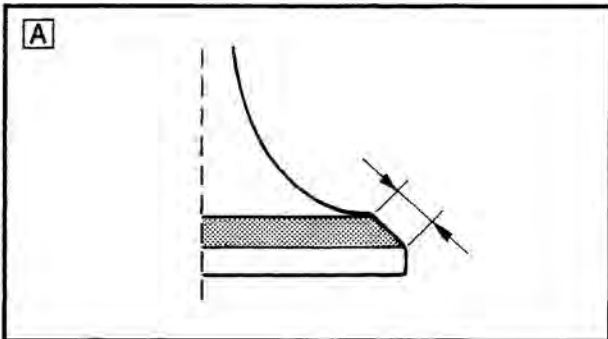
Valve seat cutter set

CAUTION:

When twisting cutter, keep an even downward pressure (4 ~ 5 kg) to prevent chatter marks.



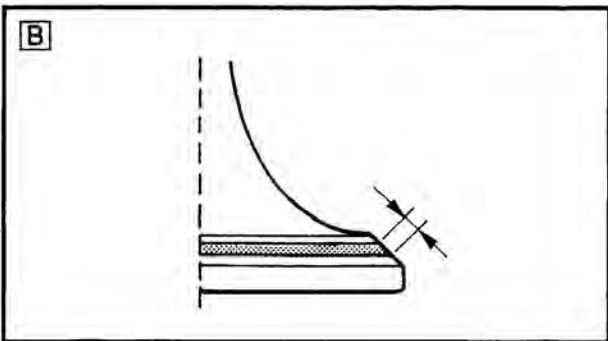
Cut sections as follows	
Section	Cutter
A	85°
B	45°
C	30°



Resurfacing steps:

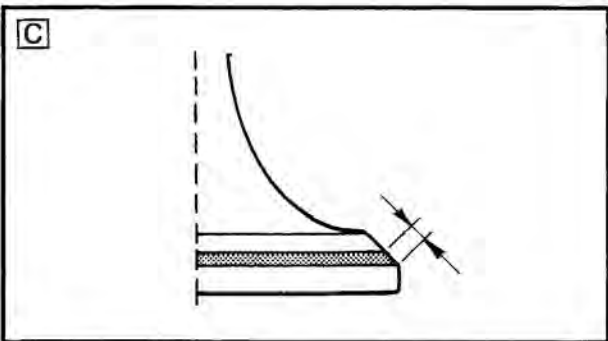
A Valve seat is centered on valve face but it is too wide.

Valve seat cutter set		Desired result
Use lightly	85° cutter	To reduce valve seat width.
	30° cutter	



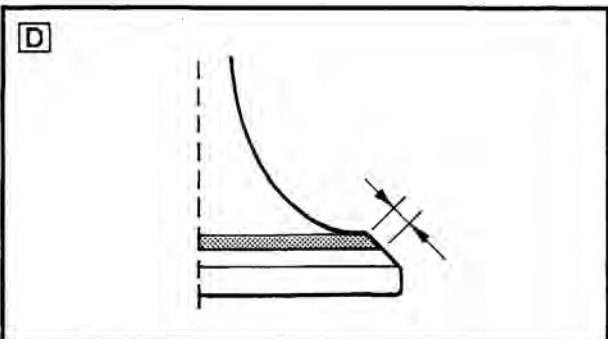
B Valve seat is in middle of the valve face but it is too narrow.

Valve seat cutter set		Desired result
Use	45° cutter	To achieve a uniform valve seat width.



C Valve seat is too narrow and it is near valve margin.

Valve seat cutter set		Desired result
Use	85° cutter, first	To center the seat and to achieve its width.
	45° cutter	



D Valve seat is too narrow and it is located near the bottom edge of the valve face.

Valve seat cutter set		Desired result
Use	30° cutter, first	To center the seat and to increase its width.
	45° cutter	

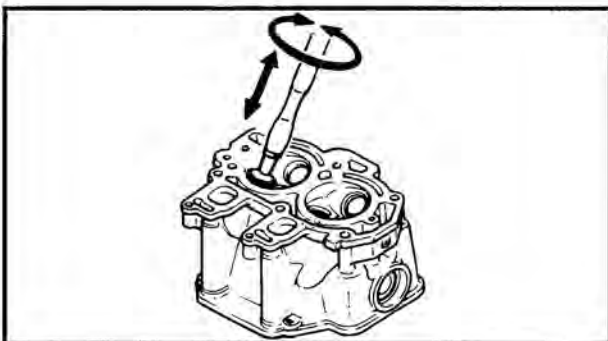
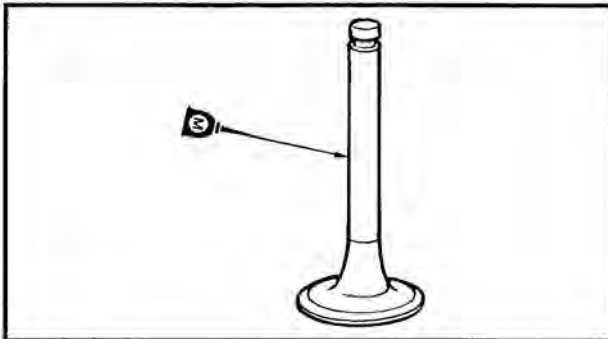
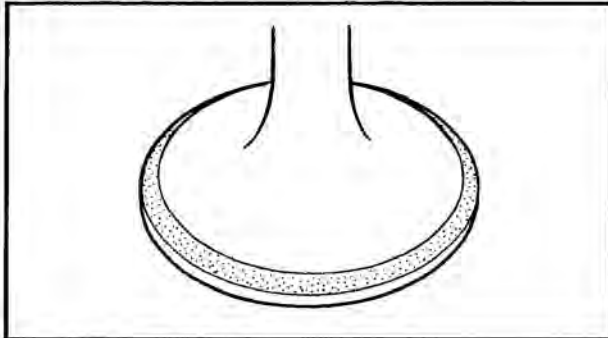


9. Lap:

- Valve face
- Valve seat

NOTE:

After refacing the valve seat or replacing the valve and valve guide, the valve seat and valve face should be lapped.

**Lapping steps:**

- Apply a coarse lapping compound to the valve face.

CAUTION:

Be sure no compound enters the gap between the valve stem and guide.

- Apply a molybdenum disulfide oil to the valve stem.
- Install the valve into the cylinder head.
- Turn the valve until the valve face and valve seat are evenly polished, then clean off all compound.

NOTE:

To obtain the best lapping results, lightly tap the valve seat while rotating the valve back and forth between your hands.

- Apply the fine lapping compound to the valve face and repeat the above steps.

NOTE:

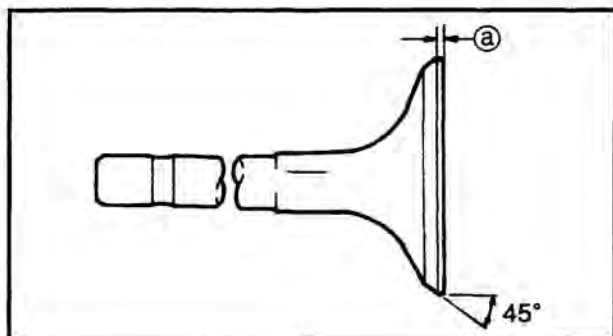
Be sure to clean off all compound from the valve face and valve seat after every lapping operation.

- Apply the Mechanic's bluing dye to the valve face.
- Install the valve into the cylinder head.
- Press the valve through the valve guide and onto the valve seat to mark a clear pattern.
- Measure the valve seat width again. If the valve seat width is out of specification, reface and lap the valve seat.

VALVE

1. Inspect:

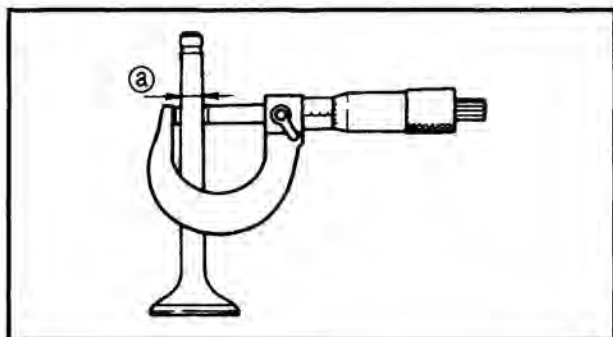
- Valve face
Carbon deposits → Clean.
Pitting/Wear → Grind the face.
- Valve stem end
Mushroom shape or diameter larger than rest of stem → Replace.



2. Measure:

- Margin thickness ^a
Out of specification → Replace.

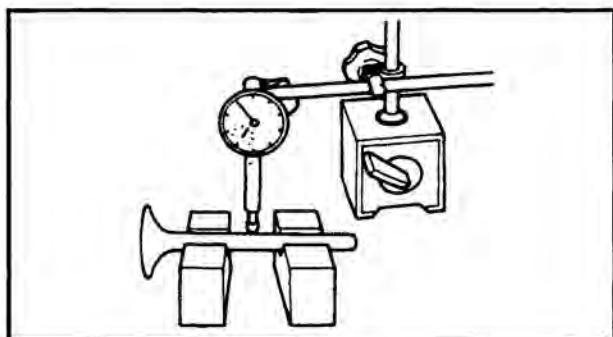
	Margin thickness:
IN	0.5 ~ 0.9 mm (0.020 ~ 0.035 in)
EX	



3. Measure:

- Valve stem diameter ^a
Out of specification → Replace.

	Valve stem diameter:
IN	5.475 ~ 5.490 mm (0.2156 ~ 0.2161 in)
EX	5.460 ~ 5.475 mm (0.2150 ~ 0.2156 in)



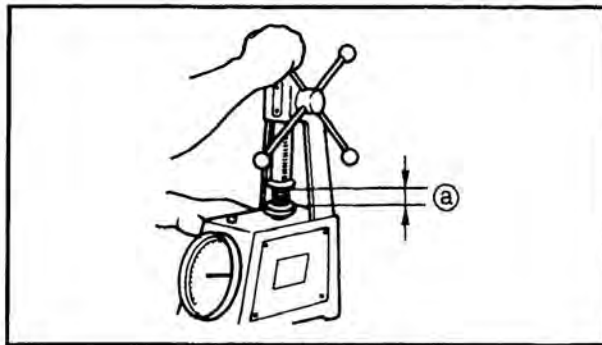
4. Measure:

- Valve stem runout
Out of specification → Replace.

	Stem runout limit:
IN	0.016 mm (0.0006 in)
EX	

NOTE:

- Always replace the guide if the valve is replaced.
- Always replace the oil seal if the valve is removed.

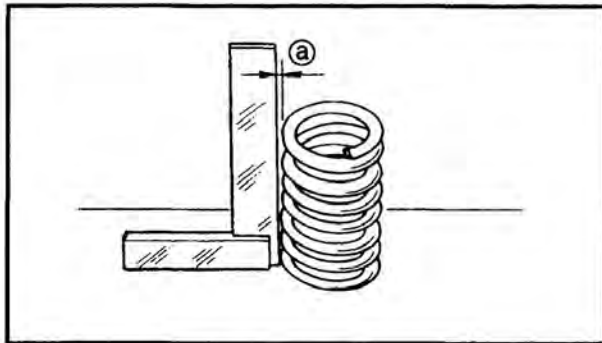


VALVE SPRING

1. Measure:

- Compressed force
Out of specification → Replace.

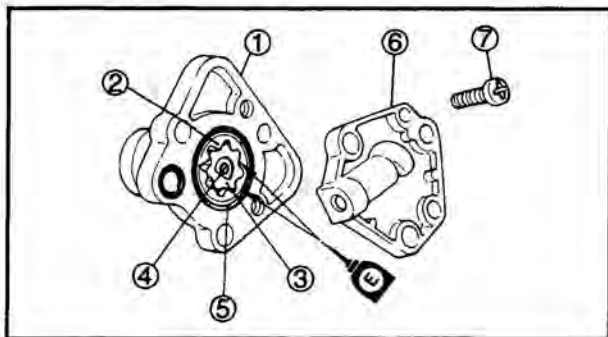
	Compressed force:	
IN EX	Set length ① 24.4 mm (0.96 in)	90 ~ 100 N (9.0 ~ 10.0 kg, 19.8 ~ 22.0 lb)



2. Measure:

- Spring tilt ①
Out of specification → Replace.

	Tilt limit:	
IN EX	1.1 mm (0.043 in)	



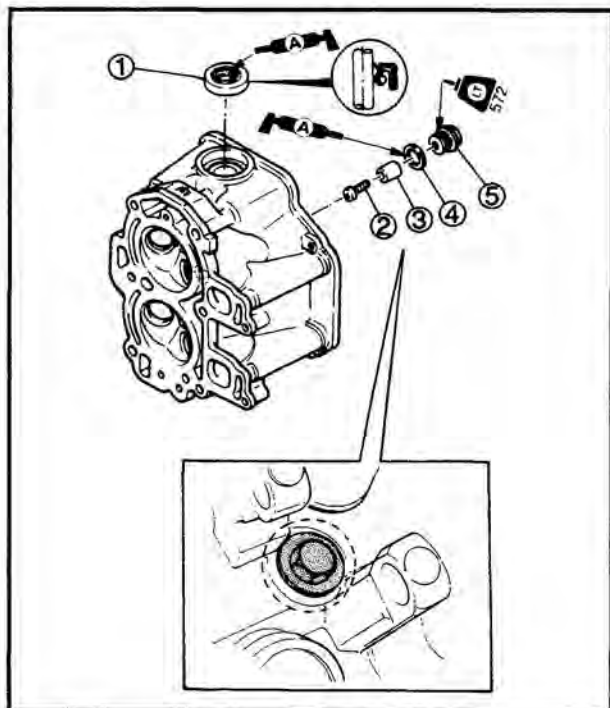
ASSEMBLY AND INSTALLATION OIL PUMP ASSEMBLY

1. Install:

- Pump housing ①
- Outer rotor ②
- Inner rotor ③
- Shaft ④
- O-ring ⑤
- Pump cover ⑥
- Screw ⑦

NOTE:

- Align the shaft with the hole in the inner rotor shaft and insert.
- Oil the rotors liberally before installing the pump cover.



CYLINDER HEAD

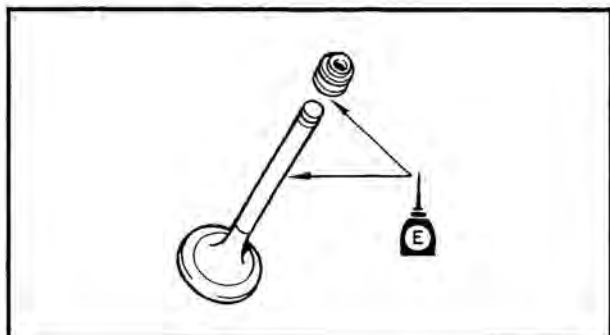
1. Install:

- Oil seal ①
- Screw ②
- Anode ③
- O-ring ④
- Bolt ⑤

NOTE:

Install the oil seal with its manufacture's marks or numbers facing outward.

	Bolt: 18 Nm (1.8 m • kg, 13 ft • lb)
--	---

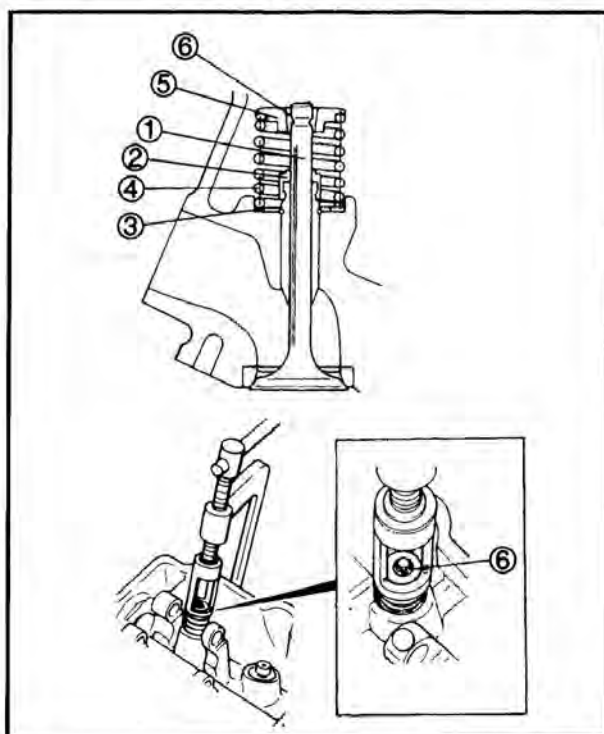


2. Apply:

- Engine oil
Onto valve and oil seal.

NOTE:

Always use a new oil seal.



3. Install:

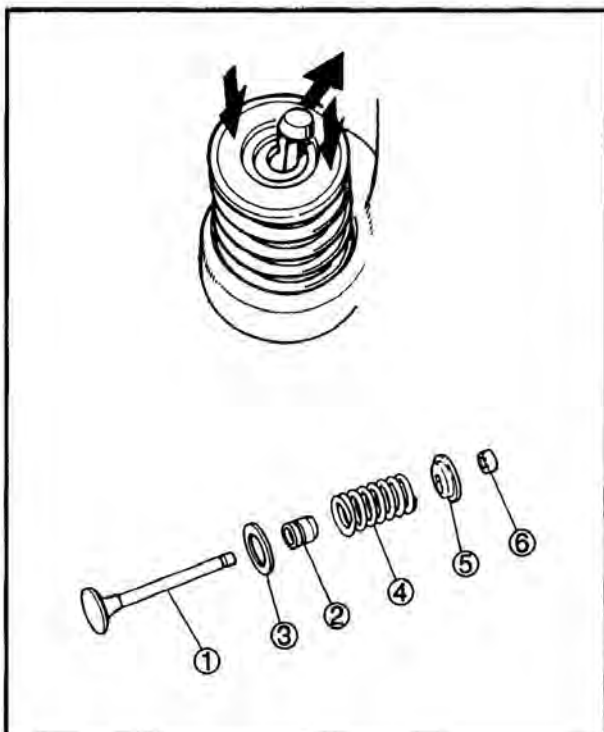
- Valve (intake) ①
- Oil seal ②
- Spring seat ③
- Valve spring ④
- Spring retainer ⑤
- Valve cotter ⑥



Valve spring compressor

NOTE:

- Hold down the valve spring and install the valve cotter.
- Secure the valve cotter onto the valves stem by tapping it lightly with a piece of wood.



4. Install:

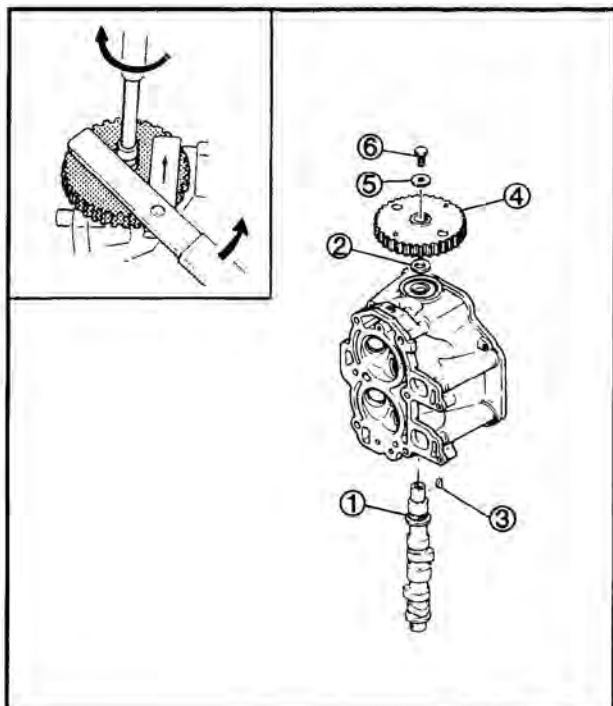
- Valve (exhaust) ①
- Oil seal ②
- Spring seat ③
- Valve spring ④
- Spring retainer ⑤
- Valve lifter ⑥



Valve spring compressor

NOTE:

- Hold down the valve spring and install the spring retainer and slide in the retainer.
- Secure the valve lifter onto the valves stem by tapping it lightly with a piece of wood.



5. Install:

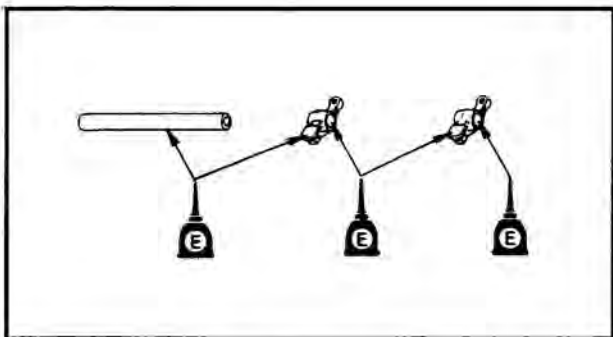
- Camshaft ①
- Washer ②
- Woodruff key ③
- Driven gear ④
- Washer ⑤
- Bolt ⑥



Flywheel holder

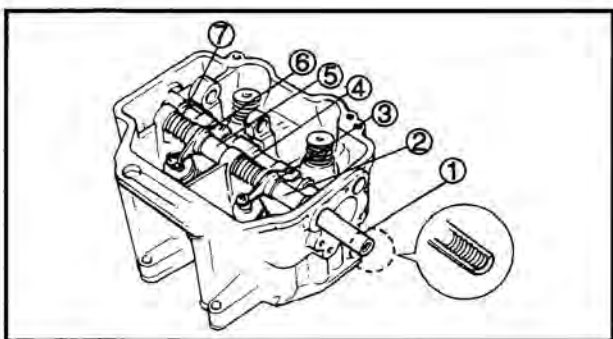


Bolt:
13 Nm (1.3 m • kg, 9.4 ft • lb)



6. Apply:

- Engine oil
- Onto rocker shaft and rocker arm.

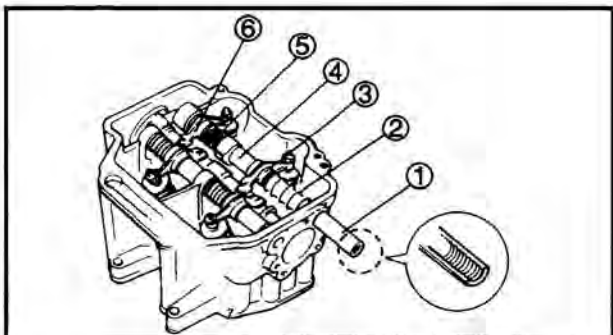


7. Install:

- Rocker shaft (exhaust) ①
- Collar ②
- Rocker arm ③
- Compression spring (short) ④
- Collar ⑤
- Rocker arm ⑥
- Compression spring (short) ⑦

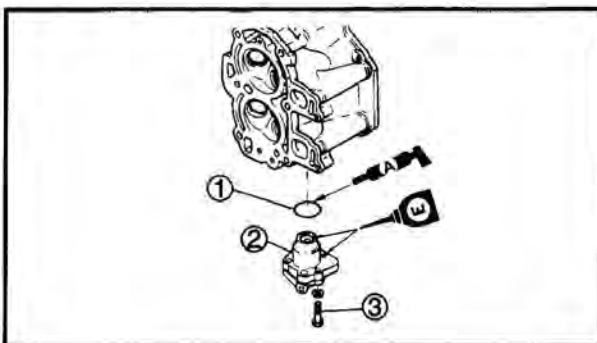
NOTE:

Install the rocker shaft so that the internal thread side is on your side.



8. Install:

- Rocker shaft (intake) ①
- Compression spring (long) ②
- Rocker arm ③
- Collar ④
- Compression spring (short) ⑤
- Rocker arm ⑥

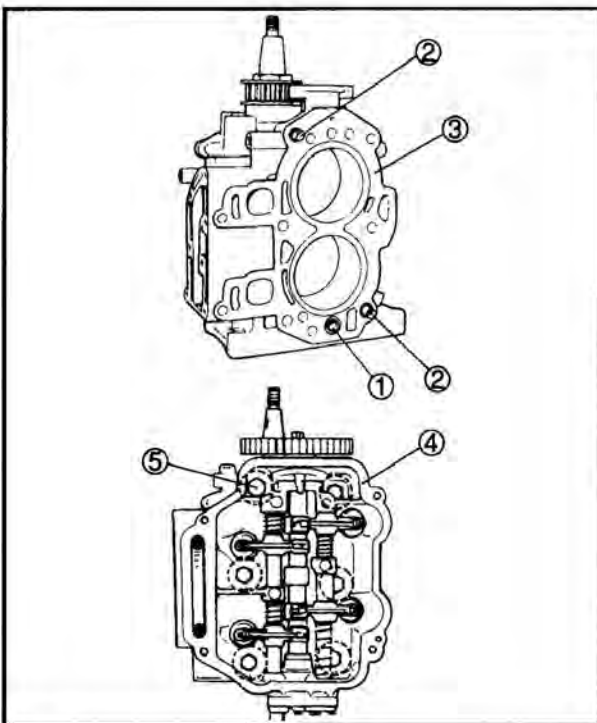


9. Install:

- O-ring ①
- Oil pump assembly ②
- Bolt ③

NOTE:

Align the recess in the oil pump shaft with the camshaft projection.



10. Install:

- O-ring ①
- Dowel pin ②
- Gasket ③
- Cylinder head assembly ④
- Bolt ⑤



Bolt:

M8 1st:

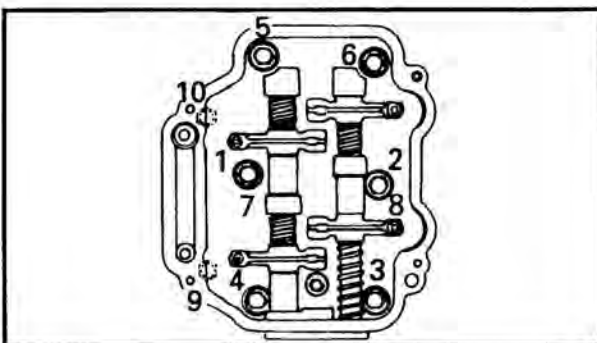
15 Nm (1.5 m • kg, 11 ft • lb)

2nd:

30 Nm (3.0 m • kg, 22 ft • lb)

CAUTION:

When installing the cylinder head on the cylinder body, set the piston at bottom dead center (BDC); otherwise, the piston may butt against valves, thus damaging them.



NOTE:

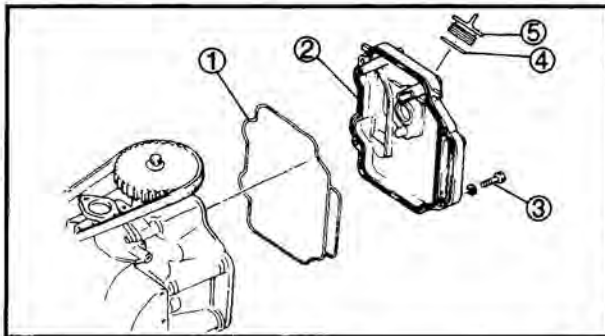
- Apply the engine oil to the thread of each cylinder head fixing bolt and seat surface.
- Tighten the bolts in sequence and two steps of torque.

11. Install:

- Timing belt

12. Adjust:

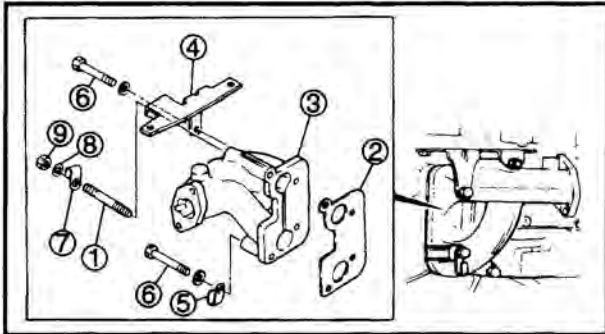
- Valve clearance



CYLINDER HEAD COVER

1. Install:

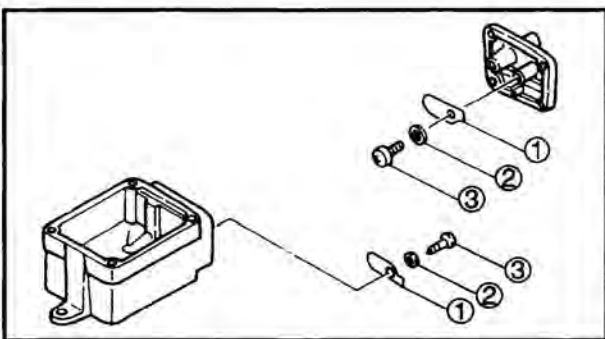
- Seal ①
- Cylinder head cover ②
- Bolt ③
- O-ring ④
- Oil filler cap ⑤



INTAKE MANIFOLD

1. Install:

- Stud bolt ①
- Gasket ②
- Intake manifold ③
- Bracket ④
- Clamp ⑤
- Bolt ⑥
- Clamp ⑦
- Washer ⑧
- Nut ⑨



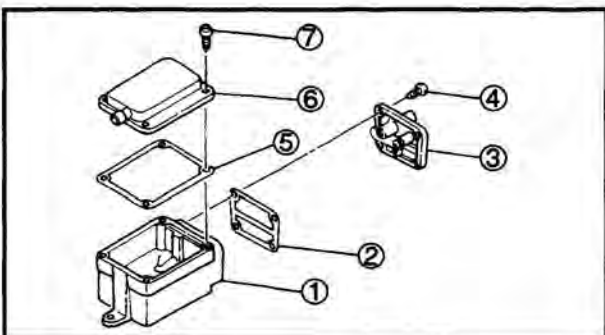
OIL SEPARATOR

1. Install:

- Reed valve ①
- Washer ②
- Screw ③



Screw:
2 Nm (0.2 m • kg, 1.4 ft • lb)



2. Install:

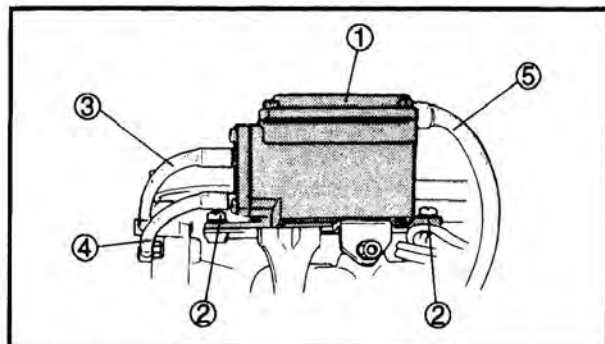
- Oil separator body ①
- Gasket ②
- Breather ③
- Screw ④
- Gasket ⑤
- Cover ⑥
- Screw ⑦

**NOTE:**

Always use a new gasket.

**Screw:**

2 Nm (0.2 m • kg, 1.4 ft • lb)

**3. Install:**

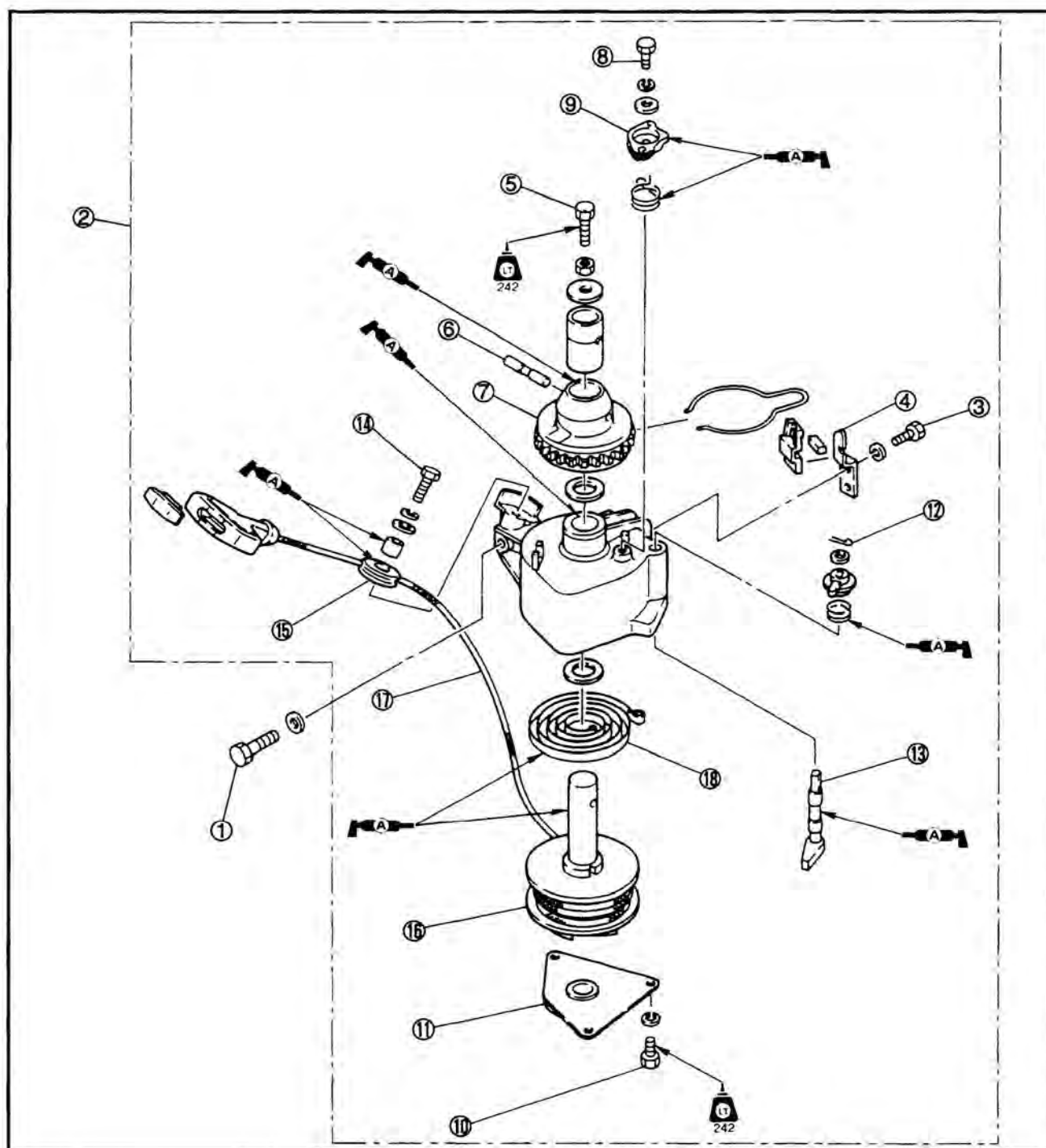
- Oil separator ①
- Screw ②
- Hose (long) ③
- Hose (short) ④
- Hose (breather) ⑤


RECOIL STARTER
PREPARATION FOR REMOVAL

- * Remove the power unit.
- * Remove the flywheel magneto.

⚠ WARNING

- Wear a proper safety goggle and gloves for protecting your eyes and hands.
- Use care, the spiral jumps out and may injure a person.
- When removing the sheave drum, use care so that the spiral spring does not jump out.





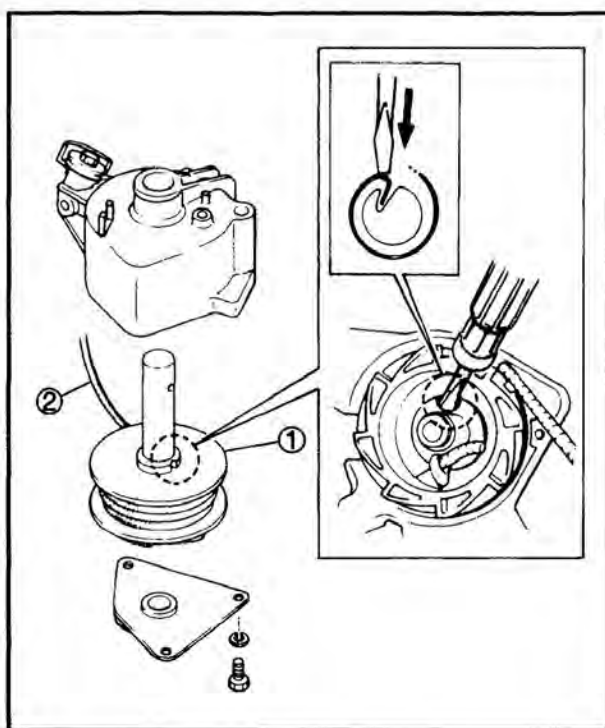
Extent of removal:

① Recoil starter removal

② Starter rope removal

③ Recoil starter disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Bolt	3	
	2	Recoil starter assembly	1	
	3	Bolt	2	
	4	Guide plate	1	
	5	Bolt	1	Loosen the lock nut.
	6	Pin	1	
	7	Pinion	1	
	8	Bolt	1	
	9	Stopper arm	1	
	10	Bolt	3	
	11	Cover	1	
	12	Cotter pin	1	
	13	Drum stopper	1	
	14	Bolt	1	
	15	Roller	1	
	16	Sheave drum	1	Refer to "REMOVAL POINTS".
	17	Starter rope	1	
	18	Spiral spring	1	Refer to "REMOVAL POINTS".



REMOVAL POINTS

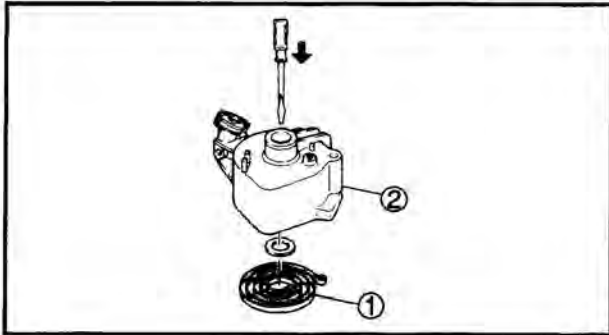
STARTER ROPE

1. Remove:

- Sheave drum ①
- Starter rope ②

NOTE:

Insert a slotted-head screwdriver into the hole in the sheave drum and remove the spiral spring from the sheave drum by pushing the spring.



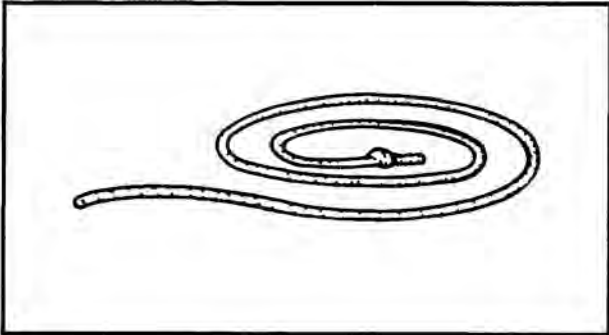
SPIRAL SPRING

1. Remove:

- Spiral spring ①

NOTE:

Hold the starter housing ② with the spiral spring facing downward. Insert a standard-head screw-driver into the hole in the sheave drum shaft and push the spiral spring out.

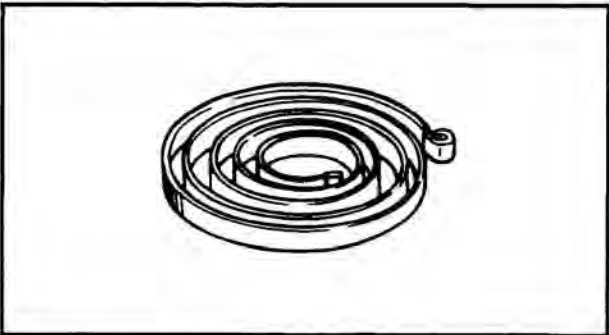


INSPECTION

STARTER ROPE

1. Inspect:

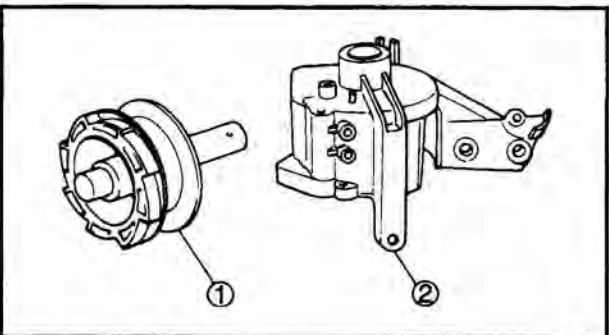
- Starter rope
- Damage → Replace.



SPIRAL SPRING

1. Inspect:

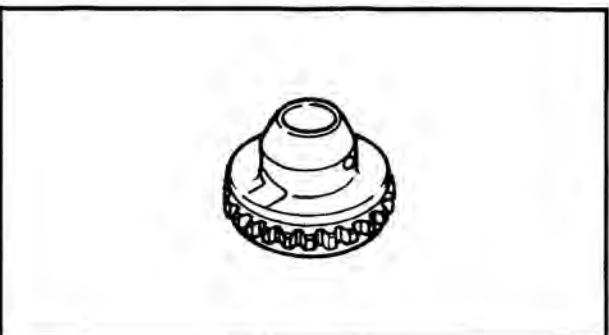
- Spiral spring
- Wear/Damage → Replace.



SHEAVE DRUM AND STARTER HOUSING

1. Inspect:

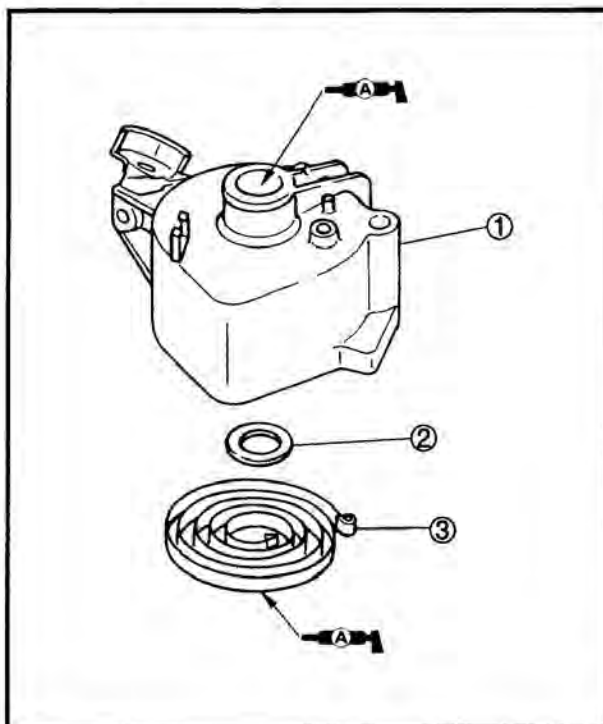
- Sheave drum ①
 - Starter housing ②
- Damage → Replace.



PINION

1. Inspect:

- Pinion
- Damage → Replace.



ASSEMBLY AND INSTALLATION

1. Install:

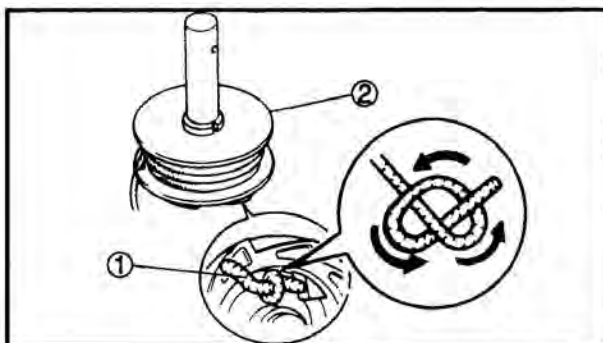
- Starter housing ①
- Thrust washer ②
- Spiral spring ③

NOTE:

1. After installing the new spiral spring, cut the wire holding the spring.
2. When reusing the spiral spring, set the leading end first in the housing and then fit one turn each time. Use special care. The spring can easily come off.

⚠ WARNING

The spiral spring may jump out so use special care.

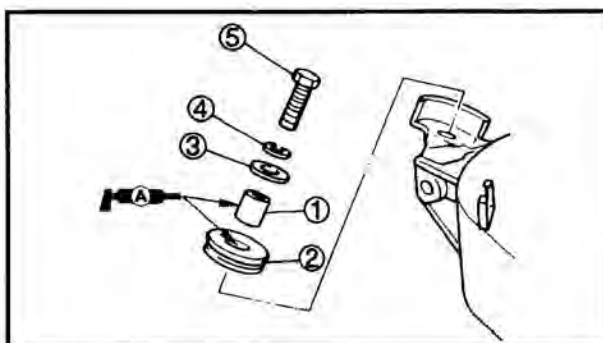


2. Install:

- Starter rope ①
- Sheave drum ②

NOTE:

- Make a knot on one end.
- Pass the rope through the hole in the sheave drum and wind it 5.5 turns around the drum.
- Place the rope in the recess on the drum.

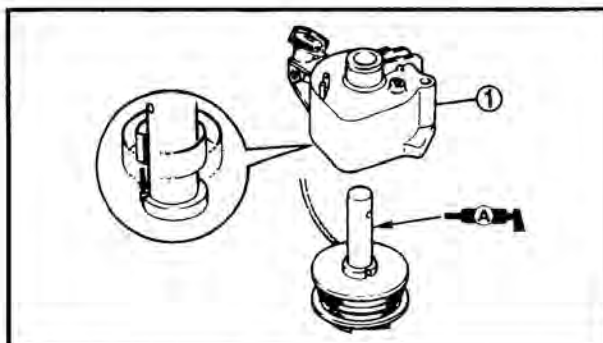


3. Install:

- Bushing ①
- Roller ②
- Washer ③
- Spring washer ④
- Bolt ⑤

NOTE:

After installing, route the starter rope between the starter roller and starter housing.

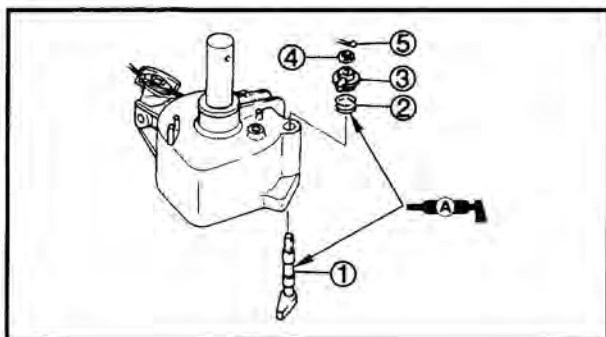


4. Install:

- Starter housing ①

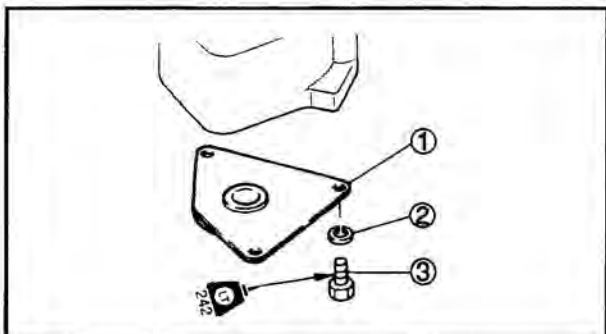
NOTE:

Fit the spiral spring hook into the sheave drum groove.



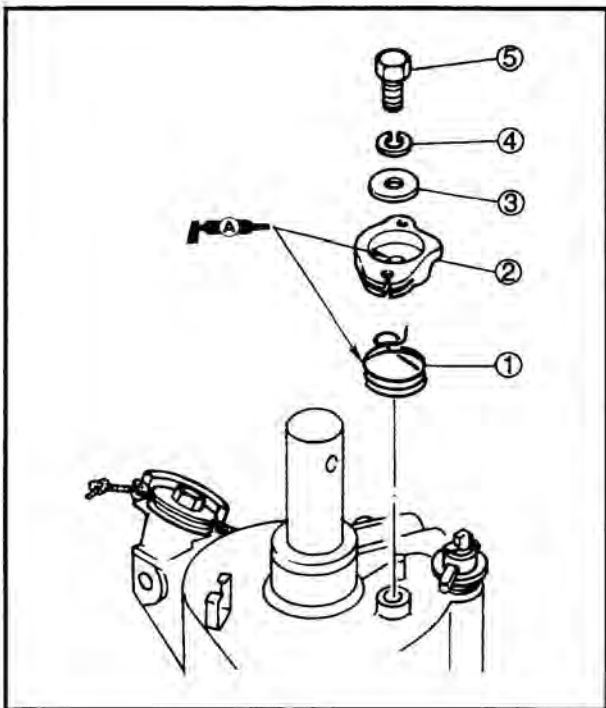
5. Install:

- Drum stopper ①
- Stopper spring ②
- Collar ③
- Washer ④
- Cotter pin ⑤



6. Install:

- Cover ①
- Spring washer ②
- Bolt ③



7. Install:

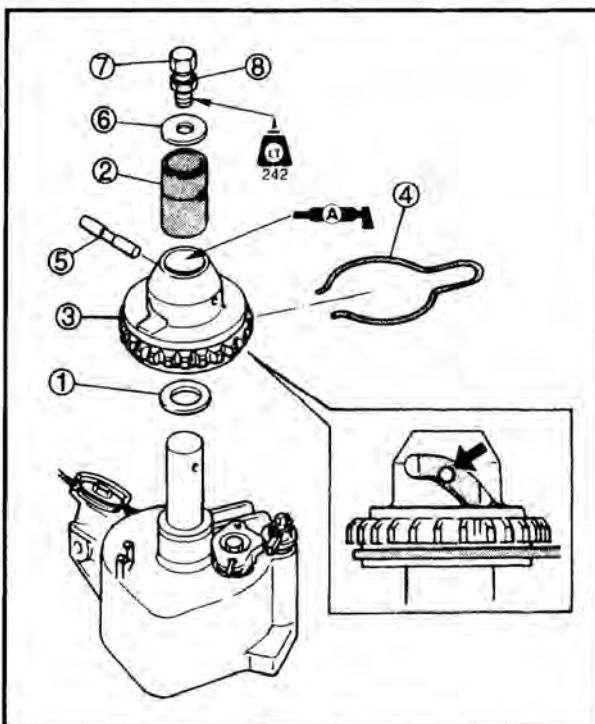
- Arm spring ①
- Stopper arm ②
- Washer ③
- Spring washer ④
- Bolt ⑤

CAUTION:

Firmly hold the rope or the rope will be pulled in.

NOTE:

- Hook the spring onto the starter housing and stopper arm.
- Align the arrow marks on the collar and stopper arm.
- After assembling, wind the rope 4 turns clock-wise around the sheave drum to contract the spring.
- While holding the rope firmly, tie the rope temporarily to the starter roller.

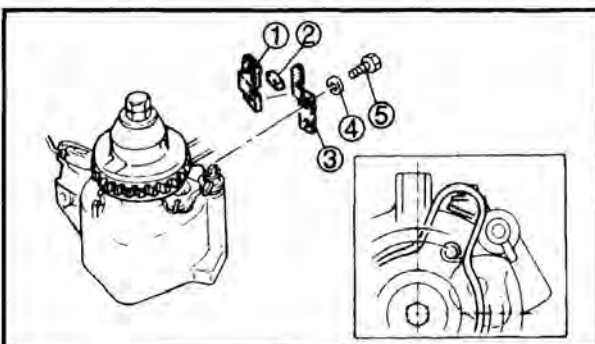


8. Install:

- Washer ①
- Bushing ②
- Pinion ③
- Friction spring ④
- Pin ⑤
- Washer ⑥
- Bolt ⑦
- Lock nut ⑧

CAUTION:

Do not open the spring end gap to fit it or the gap will become large, thus making the spring unusable. It should be fit in the same manner as a piston ring.

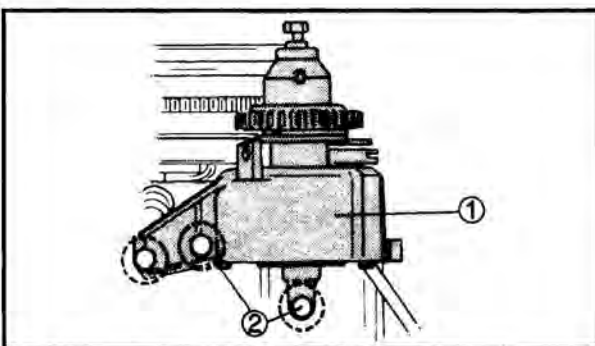


9. Install:

- Protector ①
- Damper ②
- Guide plate ③
- Spring washer ④
- Bolt ⑤

NOTE:

Put the protector into the loop of the friction spring.



10. Install:

- Recoil starter assembly ①
- Bolt ②

11. Install:

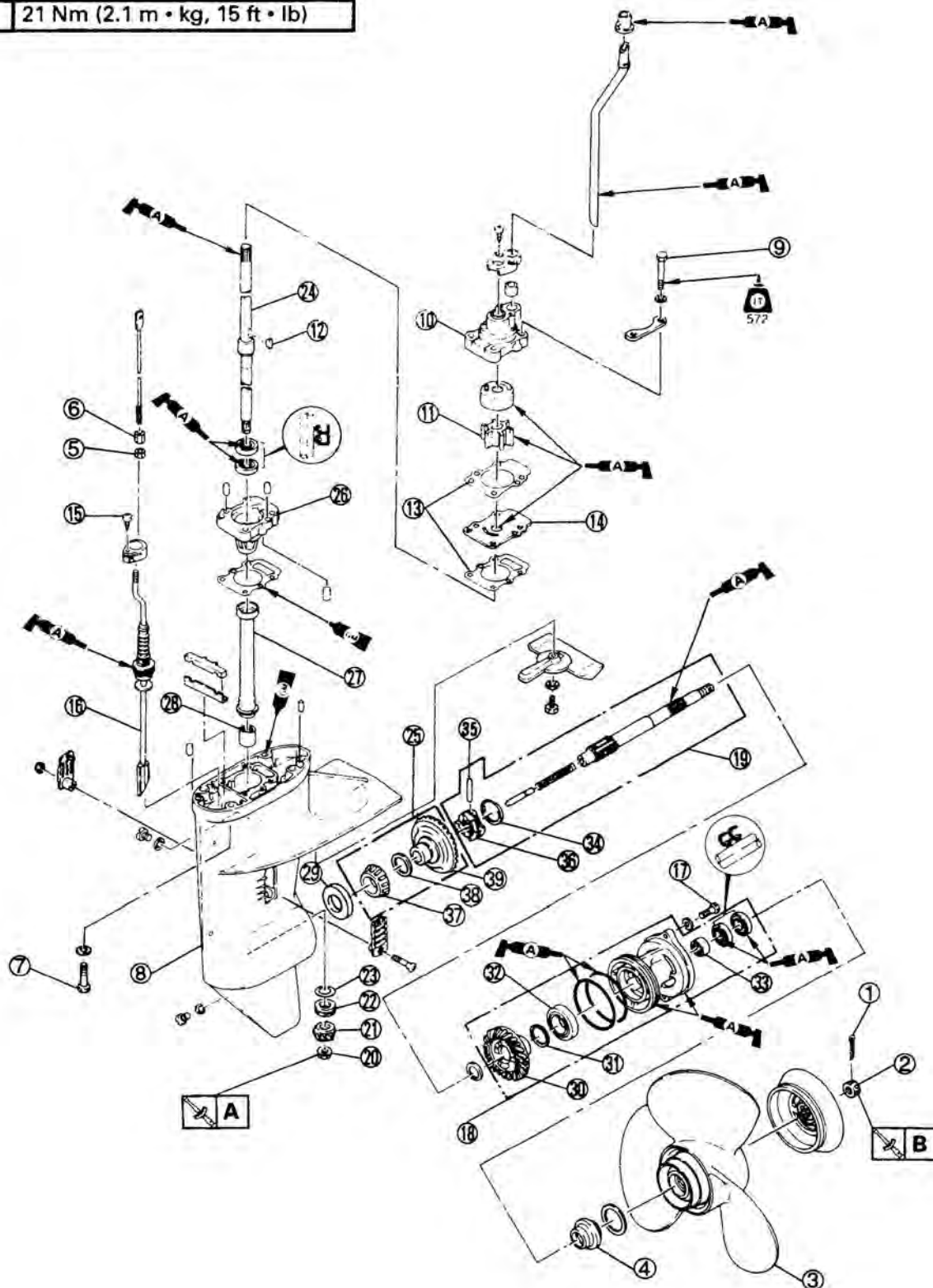
- Start in-gear protection wire

LOWER UNIT

PREPARATION FOR REMOVAL (HDF9.9)

* Drain the gear oil.

A	26 Nm (2.6 m • kg, 19 ft • lb)
B	21 Nm (2.1 m • kg, 15 ft • lb)




NOTE ON REMOVAL AND REASSEMBLY

- Tilt up the engine a little, this provides easier oil draining.
- Remove any gasket adhered to the contacting surface.
- The shim pack will be reused; therefore, use care not to damage when removing.
- For reassembly, the removed parts should be cleaned with solvent.

Extent of removal: ① Lower unit removal ② Impeller remove
 ③ Lower unit disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Cotter pin	1	
	2	Nut	1	
	3	Propeller	1	
	4	Spacer	1	
	5	Lock nut	1	
	6	Nut	1	
	7	Bolt	4	
	8	Lower unit	1	
	9	Bolt	4	
	10	Water pump housing	1	
	11	Impeller	1	
	12	Woodruff key	1	
	13	Gasket	2	
	14	Outer plate	1	
	15	Screw	1	
	16	Shift shaft	1	Refer to "REMOVAL POINTS".
	17	Bolt	2	
	18	Reverse gear complete	1	Refer to "REMOVAL POINTS".
	19	Propeller shaft complete	1	
	20	Nut	1	Refer to "REMOVAL POINTS".
	21	Pinion gear	1	
	22	Thrust bearing	1	
	23	Pinion gear shim	1	
	24	Drive shaft	1	
	25	Forward gear complete	1	
	26	Oil seal housing	1	
	27	Sleeve	1	
	28	Needle bearing	1	Refer to "REMOVAL POINTS".
	29	Bearing outer race	1	Refer to "REMOVAL POINTS".
	30	Reverse gear	1	
	31	Reverse gear shim	1	
	32	Ball bearing	1	Refer to "REMOVAL POINTS".
	33	Needle bearing	1	
	34	Cross pin ring	1	
	35	Cross pin	1	
	36	Dog clutch	1	
	37	Taper roller bearing	1	
	38	Forward gear shim	1	
	39	Forward gear	1	

A	26 Nm (2.6 m • kg, 19 ft • lb)
B	17 Nm (1.7 m • kg, 12 ft • lb)

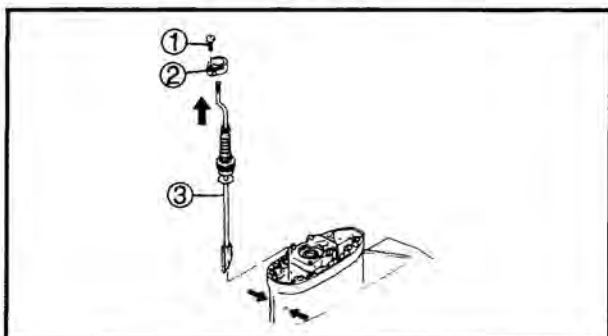



NOTE ON REMOVAL AND REASSEMBLY

- Tilt up the engine a little, this provides easier oil draining.
- Remove any gasket adhered to the contacting surface.
- The shim pack will be reused; therefore, use care not to damage when removing.
- For reassembly, the removed parts should be cleaned with solvent.

Extent of removal: ① Lower unit removal ② Impeller remove
 ③ Lower unit disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Cotter pin	1	
	2	Nut	1	
	3	Propeller	1	
	4	Spacer	1	
	5	Lock nut	1	
	6	Nut	1	
	7	Bolt	4	
	8	Lower unit	1	
	9	Bolt	4	
	10	Water pump housing	1	
	11	Impeller	1	
	12	Woodruff key	1	
	13	Gasket	2	
	14	Outer plate	1	
	15	Screw	1	
	16	Shift shaft	1	Refer to "REMOVAL POINTS".
	17	Bolt	2	
	18	Reverse gear complete	1	Refer to "REMOVAL POINTS".
	19	Propeller shaft complete	1	
	20	Nut	1	Refer to "REMOVAL POINTS".
	21	Pinion gear	1	
	22	Thrust bearing	1	
	23	Pinion gear shim	1	
	24	Drive shaft	1	
	25	Forward gear complete	1	
	26	Oil seal housing	1	
	27	Sleeve	1	
	28	Needle bearing	1	Refer to "REMOVAL POINTS".
	29	Bearing outer race	1	Refer to "REMOVAL POINTS".
	30	Forward gear shim	1	
	31	Reverse gear	1	
	32	Reverse gear shim	1	
	33	Ball bearing	1	Refer to "REMOVAL POINTS".
	34	Needle bearing	1	
	35	Cross pin ring	1	
	36	Cross pin	1	
	37	Dog clutch	1	
	38	Taper roller bearing	1	
	39	Forward gear	1	Refer to "REMOVAL POINTS".



REMOVAL POINTS

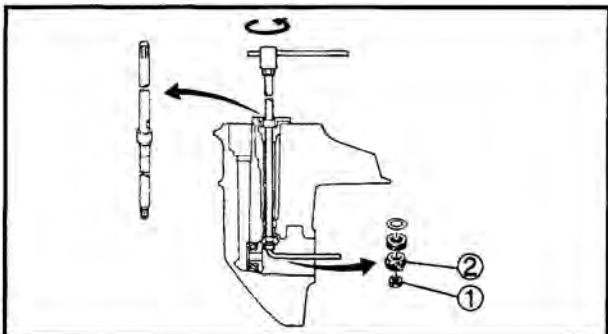
SHIFT SHAFT

1. Remove:

- Screw ①
- Bracket ②
- Shift shaft ③

NOTE:

Push the projections of the bracket evenly (as shown in the illustration) and pull the bracket up.



PINION GEAR

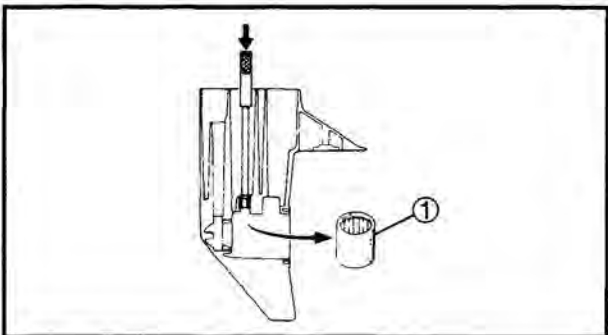
1. Remove:

- Nut ①
- Pinion gear ②



Pinion nut holder

Drive shaft holder



NEEDLE BEARING

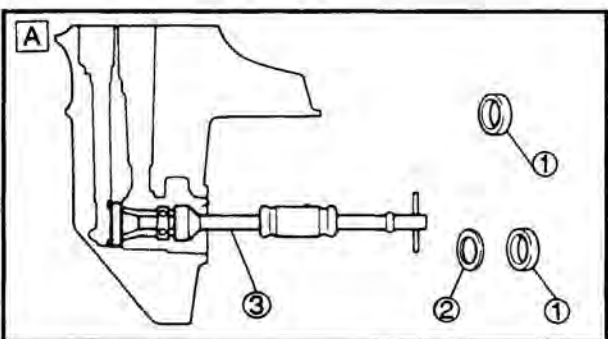
1. Remove:

- Needle bearing ①



Drive rod

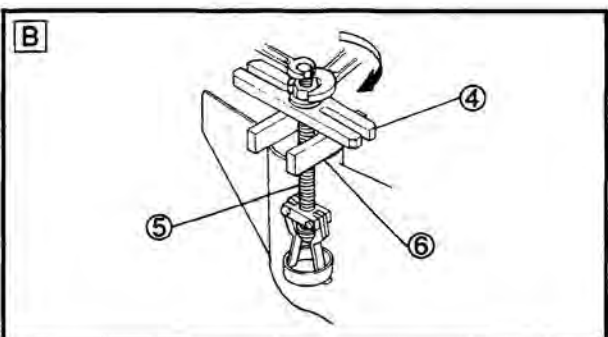
Needle bearing attachment



BEARING OUTER RACE

1. Remove:

- Bearing outer race ①
- Forward gear shim ②



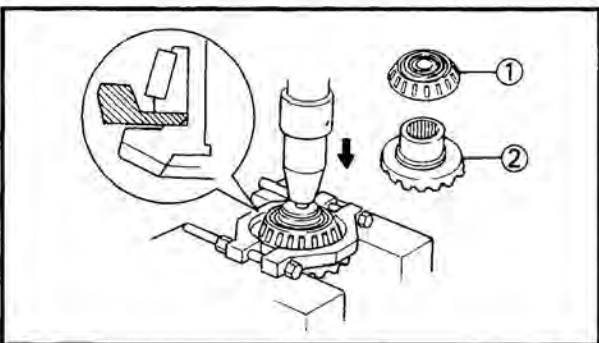
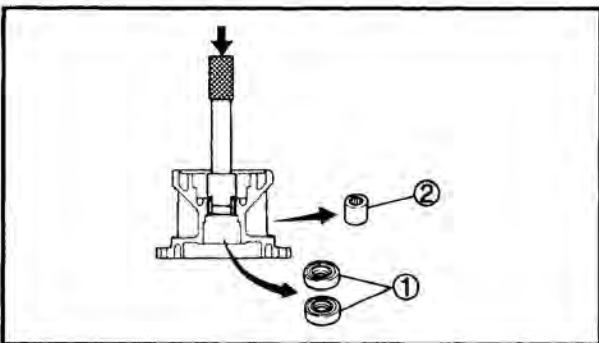
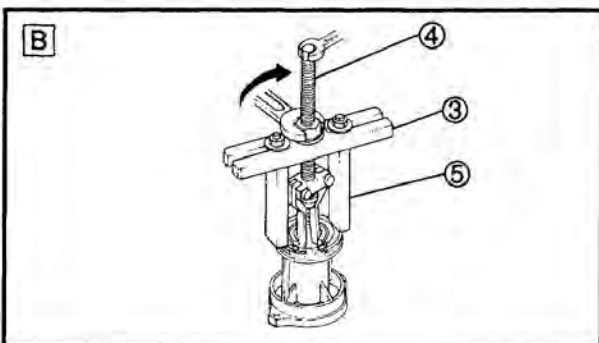
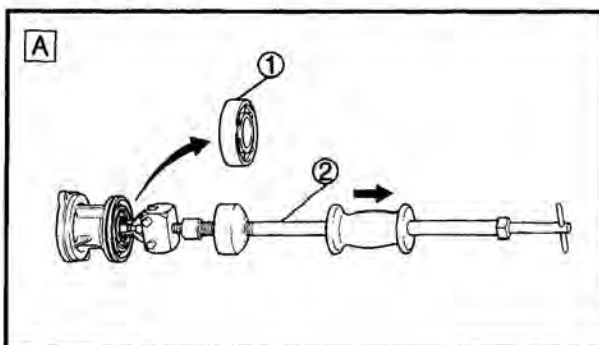
Slide hammer set:

Stopper guide plate: ③

Bearing puller: ④

Stopper guide stand: ⑤

Stopper guide stand: ⑥



REVERSE GEAR COMPLETE

1. Remove:

- Ball bearing ①



Slide hammer set:

..... ②

Stopper guide plate:

..... ③

Bearing puller:

..... ④

Stopper guide stand:

..... ⑤

2. Remove:

- Oil seal ①
- Needle bearing ②



Drive rod

Needle bearing attachment

FORWARD GEAR COMPLETE

(HDF9.9)

1. Remove:

- Taper roller bearing ①
- Forward gear ②



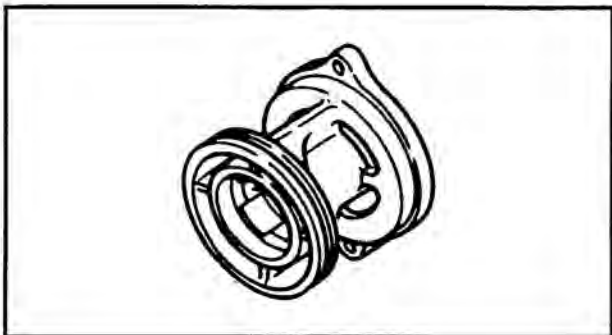
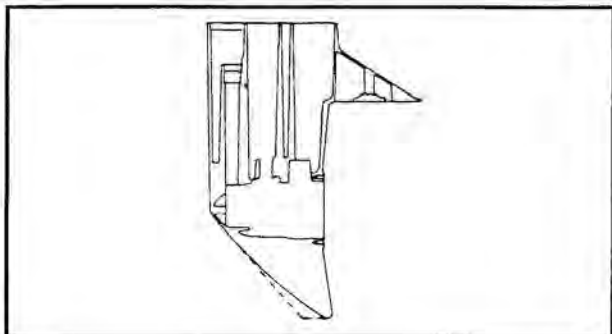
Bearing separator



INSPECTION AND REPAIR

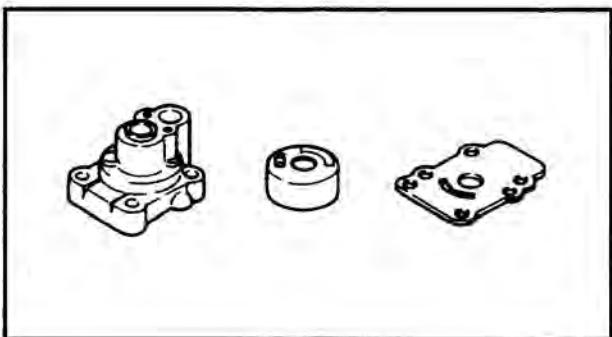
LOWER CASE

1. Clean:
 - Gear case
Use a soft brush and solvent.
2. Inspect:
 - Water passage
Mineral deposits/Corrosion → Clean.
3. Inspect:
 - Lower case
Crack/Damage → Replace.



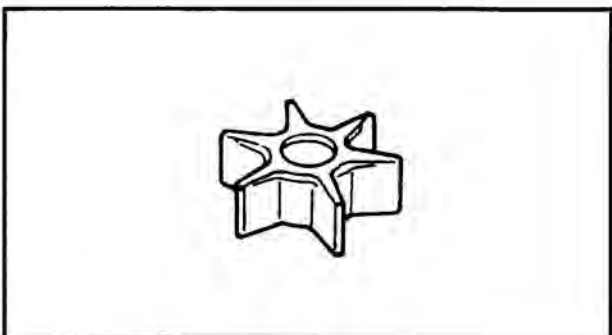
BEARING HOUSING

1. Clean:
 - Bearing housing
Use a soft brush and solvent.
2. Inspect:
 - Bearing housing
Crack/Damage → Replace.



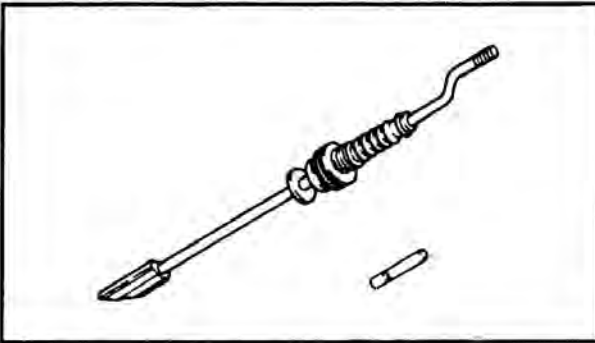
WATER PUMP HOUSING

1. Inspect:
 - Water pump housing
Crack/Damage → Replace.



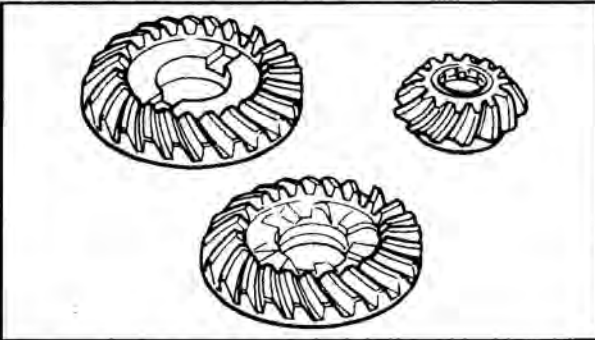
IMPELLER

1. Inspect:
 - Impeller
Crack/Damage → Replace.



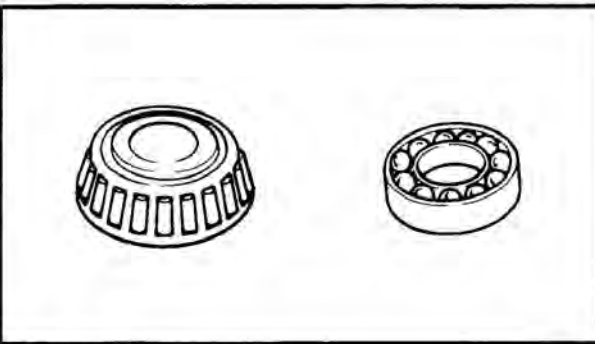
SHIFT SHAFT

1. Inspect:
 - Shift plunger
Wear/Damage → Replace.
2. Inspect:
 - Boot
Break/Damage → Replace.



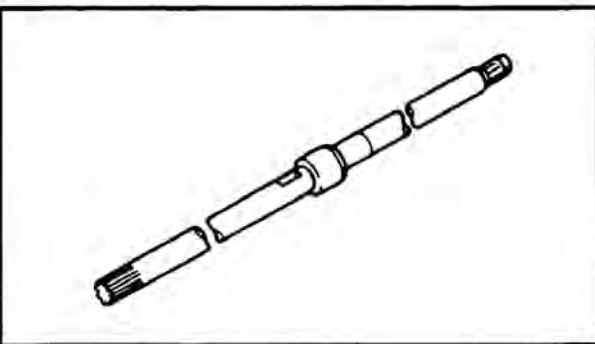
GEAR

1. Inspect:
 - Teeth
 - Dogs
Wear/Damage → Replace.



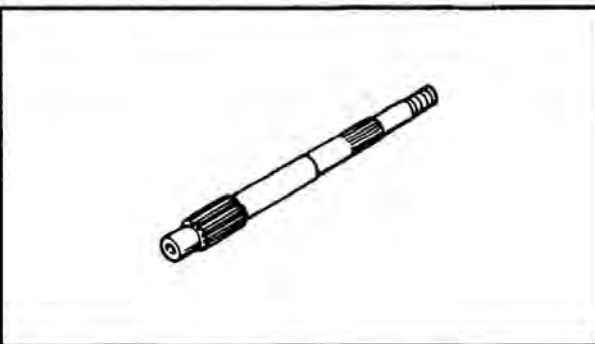
BEARING

1. Inspect:
 - Bearing
Pitting/Rumbling → Replace.



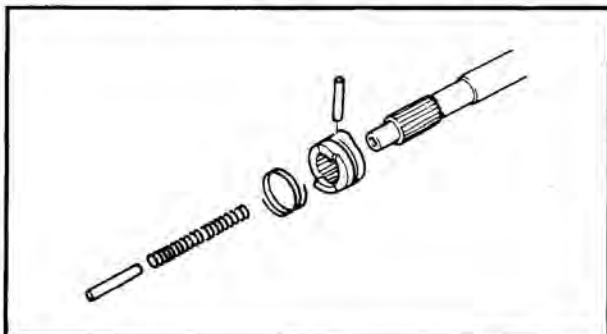
DRIVE SHAFT

1. Inspect:
 - Drive shaft
Wear/Damage → Replace.



PROPELLER SHAFT

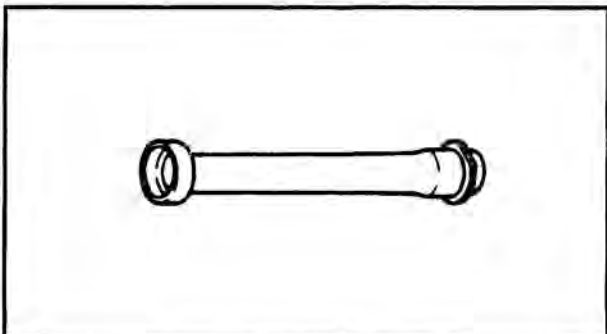
1. Inspect:
 - Propeller shaft
Wear/Damage → Replace.



DOG CLUTCH

1. Inspect:

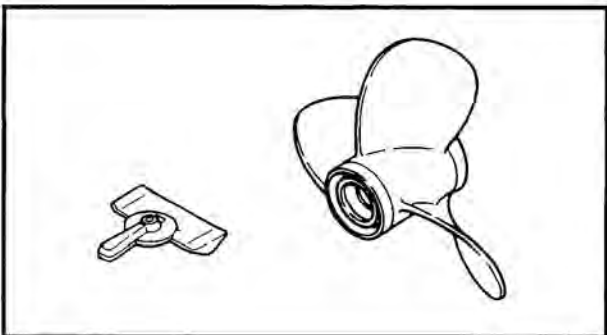
- Dog clutch
- Wear/Damage → Replace.



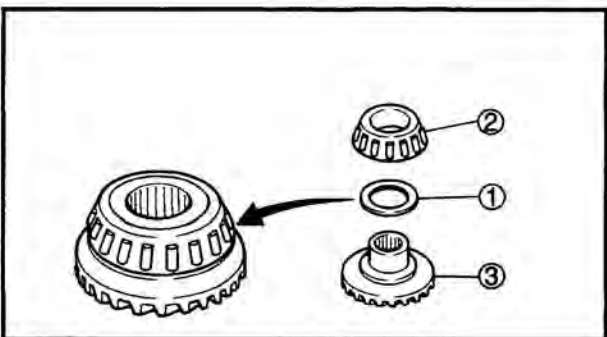
SLEEVE

1. Inspect:

- Sleeve
- Wear/Damage → Replace.



PROPELLER/ANODE



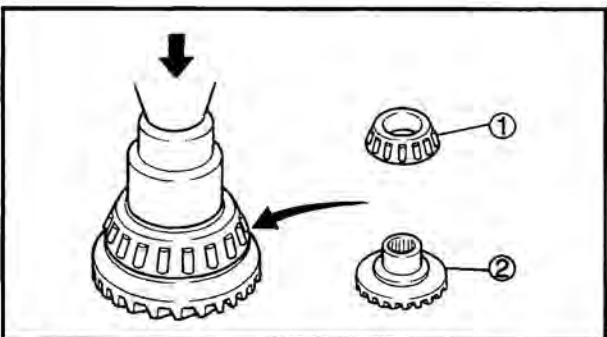
ASSEMBLY AND INSTALLATION FORWARD GEAR

1. Install: (HDF9.9)

- Forward gear shim ①
- Taper roller bearing ②
- Forward gear ③

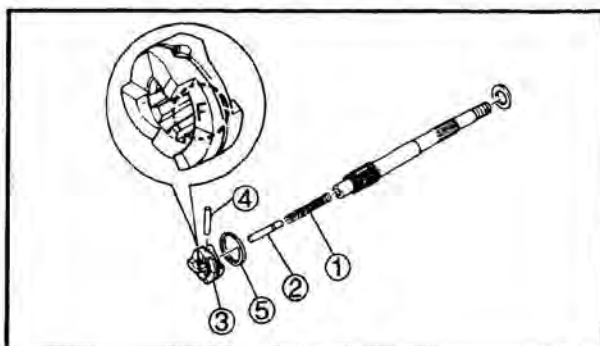
NOTE:

The shim is installed for HDF9.9S/L model only.



1. Install:

- Taper roller bearing ①
- Forward gear ②

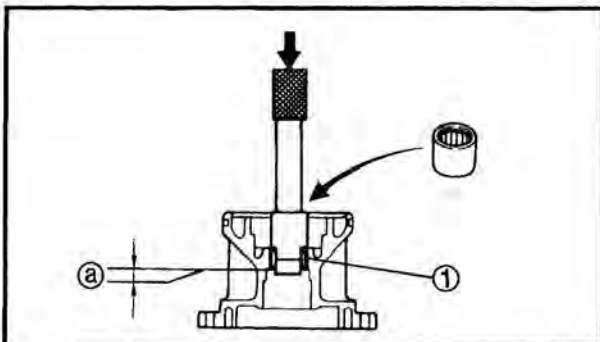
**PROPELLER SHAFT**

1. Install:

- Spring ①
- Plunger ②
- Dog clutch ③
- Cross pin ④
- Cross pin ring ⑤

NOTE:

Install the clutch with the "F" mark toward the forward gear side.

**REVERSE GEAR**

1. Install:

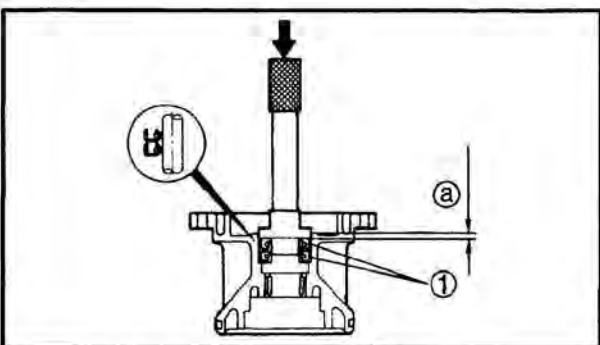
- Needle bearing ①

**Drive rod****Needle bearing attachment****Depth ②:**

HDF9.9 : 0 mm (0 in)

NOTE:

Install the needle bearing with its manufacture's marks or numbers toward the propeller side.



2. Install:

- Oil seal ①

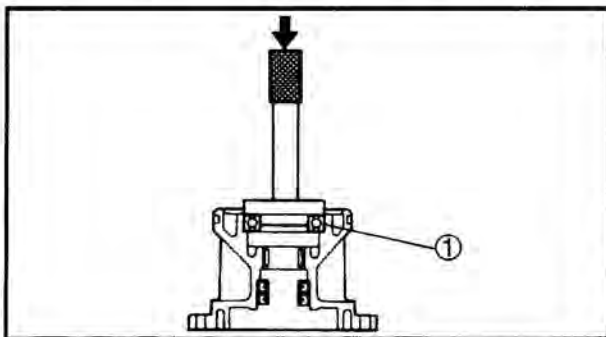
**Oil seal installer****Drive rod****Depth ②:**

HDF9.9 :
4.5 ~ 5.0 mm (0.18 ~ 0.20 in)

LOWR



LOWER UNIT



3. Install:

- Ball bearing ①

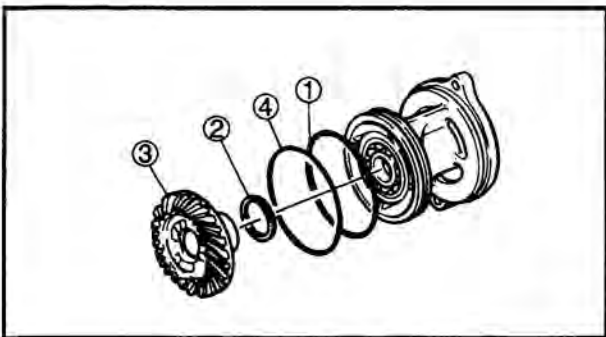


Bearing installer

Drive rod

NOTE:

Install the bearing with its manufacture's marks or numbers facing outward.



4. Install:

- O-ring ①
- Reverse gear shim ②
- Reverse gear ③
- O-ring ④

OIL SEAL HOUSING

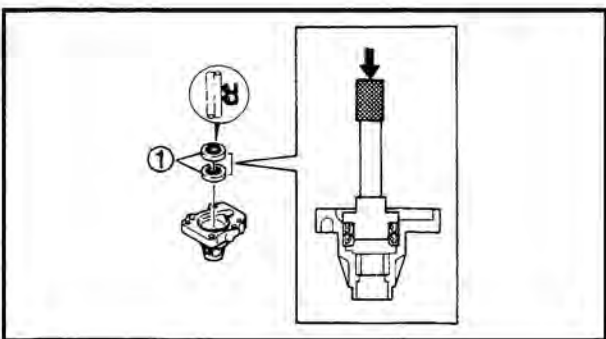
1. Install:

- O-ring ①



Oil seal installer

Drive rod



LOWER CASE

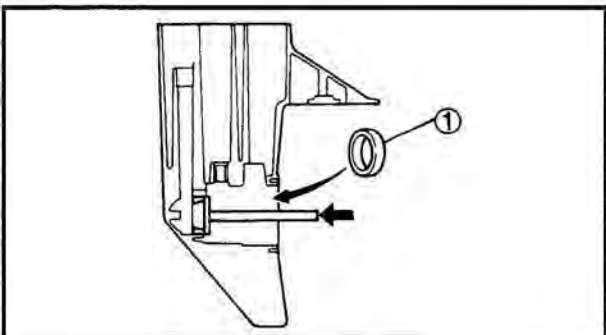
1. Install: (HDF9.9)

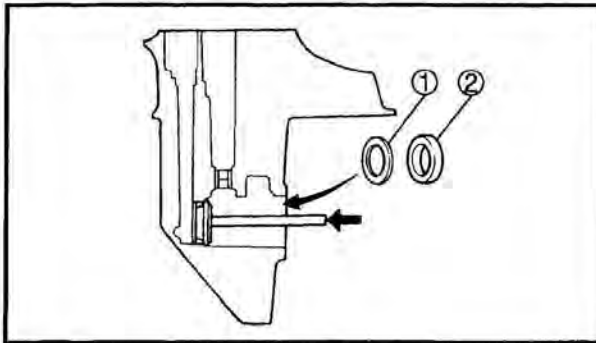
- Bearing outer race ①



Bearing installer

Drive rod:





1. Install: (HDF9.9)

- Forward gear shim ①
- Bearing outer race ②

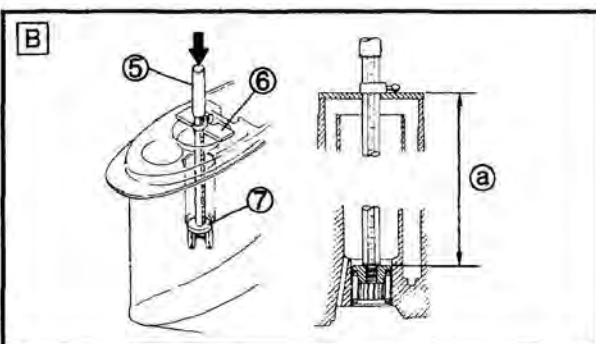
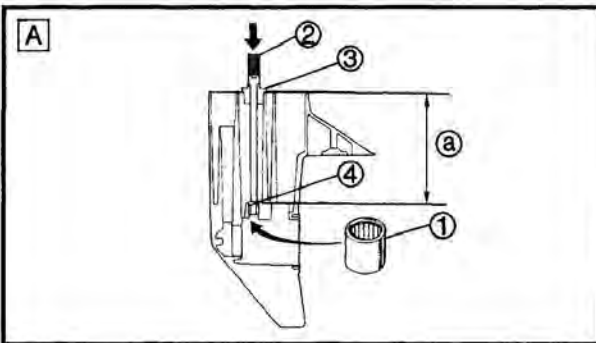


Bearing installer:

Drive rod:

NOTE:

The shim is installed for HDF9.9S/L models only.



2. Install:

- Needle bearing ①



Drive rod:

..... ②

Needle bearing installer:

..... ③

Needle bearing attachment:

..... ④

..... ④

Drive rod:

..... ⑤

Bearing depth plate:

..... ⑥

Needle bearing attachment:

..... ⑦



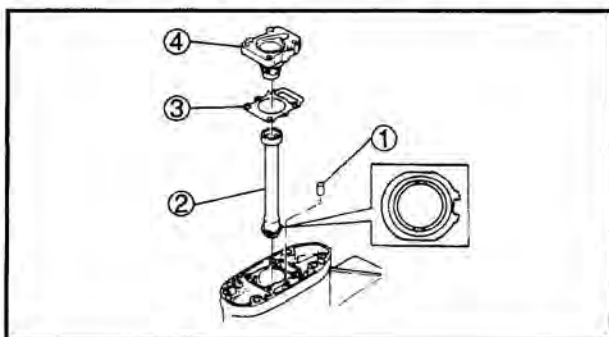
Depth @:

HDF9.9 :

199.6 ~ 200.1 mm
(7.86 ~ 7.88 in)

NOTE:

Install the bearing with its manufacture's marks or numbers facing outward.

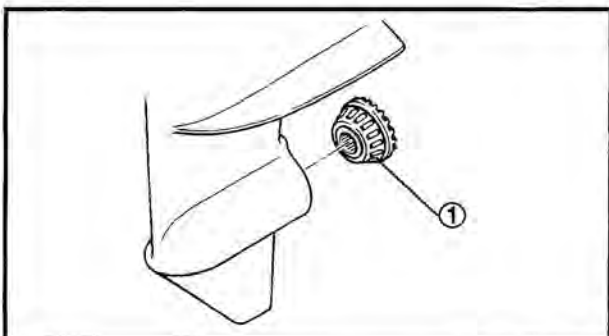


3. Install:

- Dowel pin ①
- Sleeve ②
- Gasket ③
- Oil seal housing ④

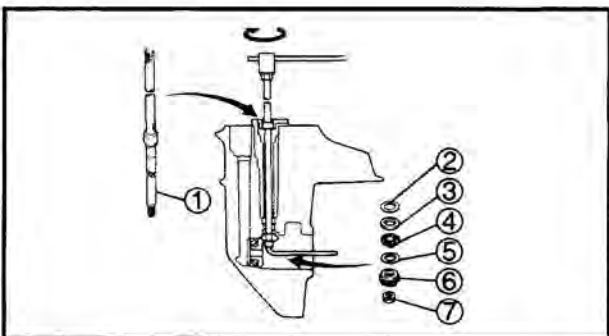
NOTE:

Install the sleeve with projection side back-ward.



4. Install:

- Forward gear complete ①



5. Install:

- Drive shaft ①
- Pinion gear shim ②
- Washer (thick) ③
- Bearing ④
- Washer (thin) ⑤
- Pinion gear ⑥
- Nut ⑦



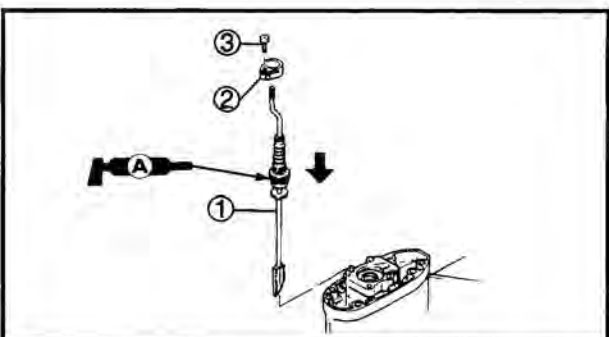
Pinion nut holder

Drive shaft holder



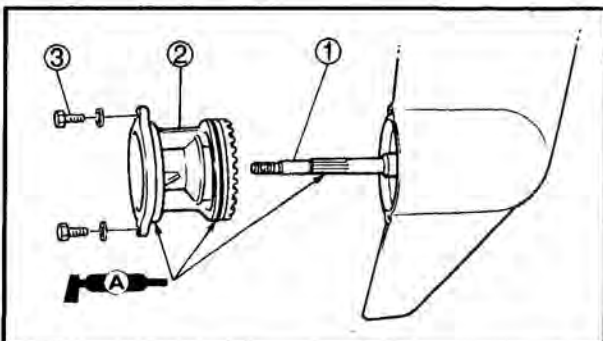
Nut:

26 Nm (2.6 m • kg, 19 ft • lb)



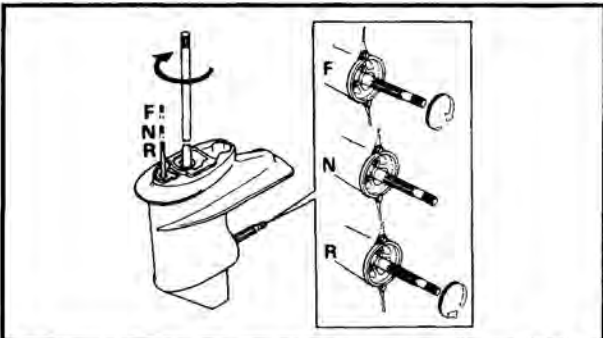
6. Install:

- Shift shaft ①
- Bracket ②
- Screw ③



7. Install:

- Propeller shaft complete ①
- Reverse gear complete ②
- Bolt ③

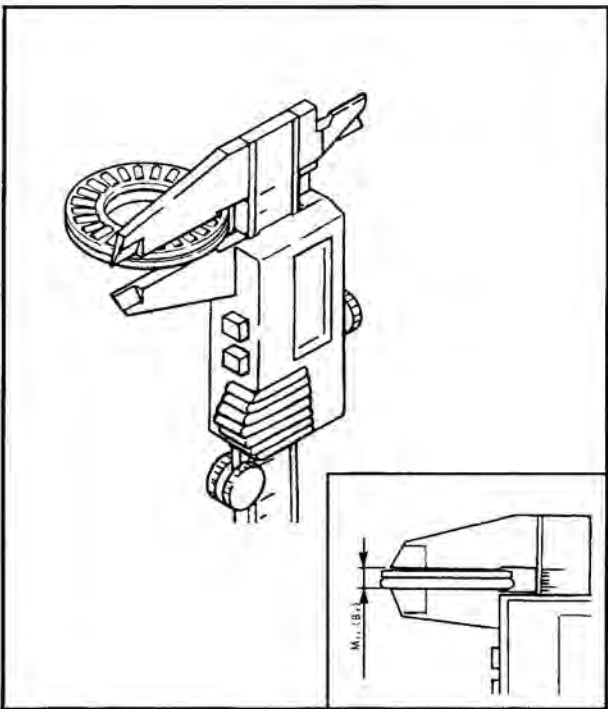
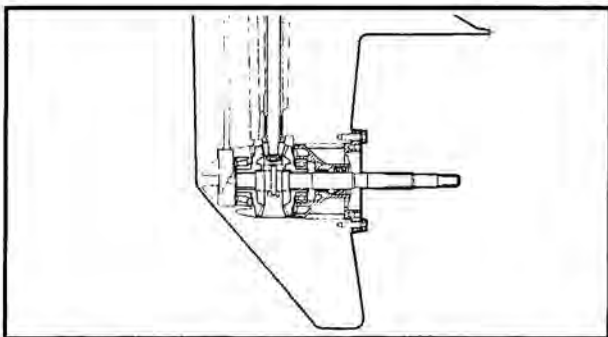


8. Check:

- Shift cam operation
- Unsmooth operation → Repair.

NOTE:

Check that the dog clutch shifts to "Forward", "Neutral" and "Reverse" correctly.



SHIM SELECTION

NOTE:

- When reassembling the lower unit with the original gear case and inner parts, shim selection is not required.
- When replacing the gear case or inner parts, carry out the shim selection.

1. Adjust:

- Pinion shim thickness

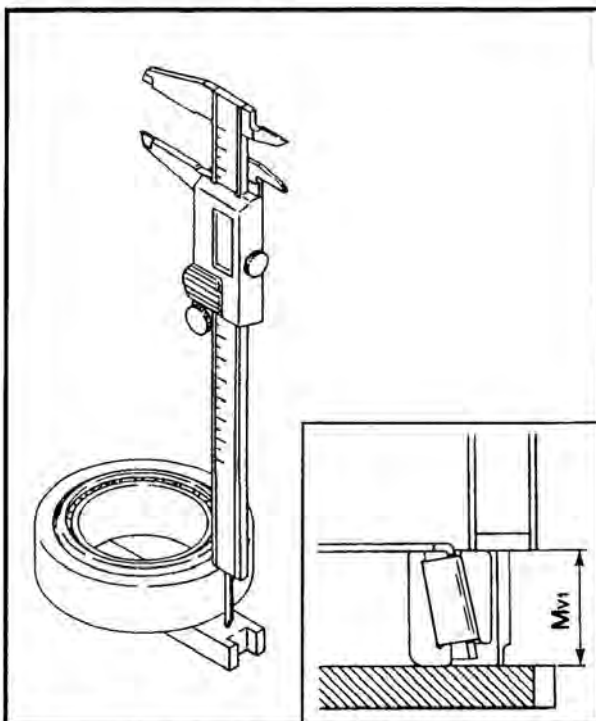
Adjustment steps:

- Measure the thicknesses (Mv3) of bearing and washer.



Digital caliper

- Use the following equation to calculate the pinion shim thickness (T3).



2. Adjust:

- Forward gear shim thickness

Adjustment steps:

- Measure the dimension (Mv1).



Shimming plate

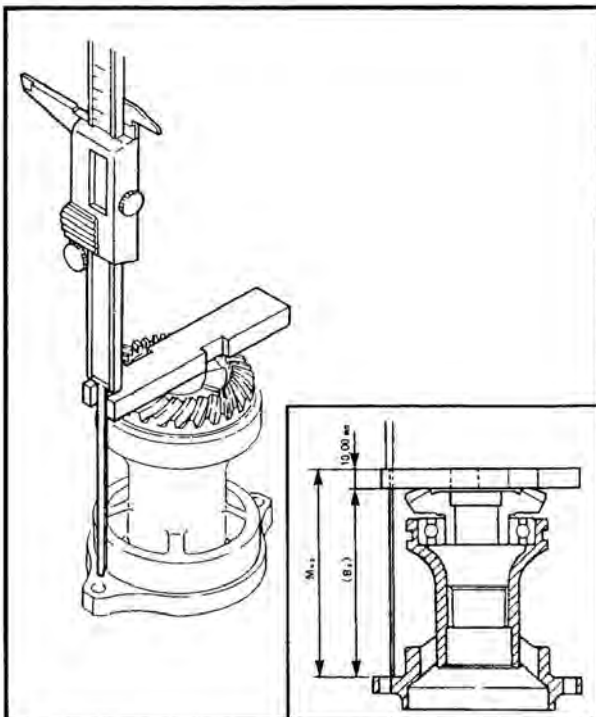
Digital caliper

- Use the following equation to calculate the pinion shim thickness (T1).



HDF9.9 : $T1 = 16.60 - Mv1$
Available shim thickness:

0.10, 0.14, 0.18, 0.35 and 0.50 mm



3. Adjust:

- Reverse gear shim thickness

Adjustment steps:

- Measure the dimension (Mv2).



Shimming plate

Digital caliper

- Use the following equation to calculate the pinion shim thickness (T2).



HDF9.9 : $T2 = 80.57 - Mv2$
Available shim thickness:

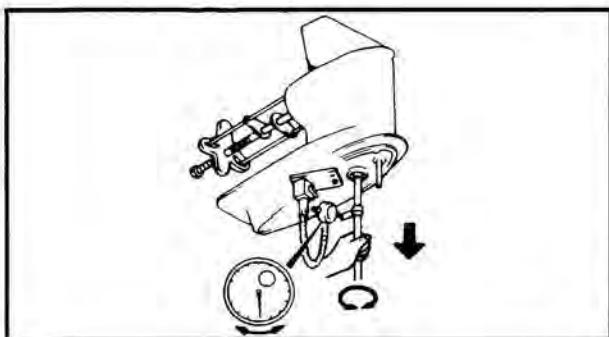
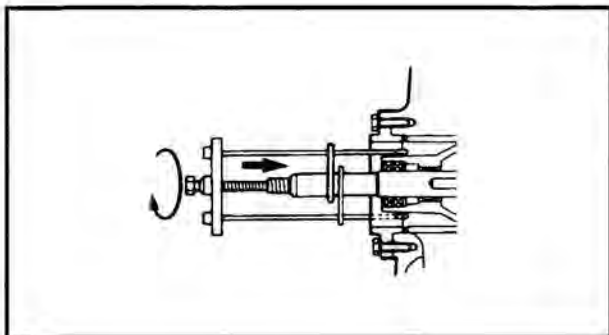
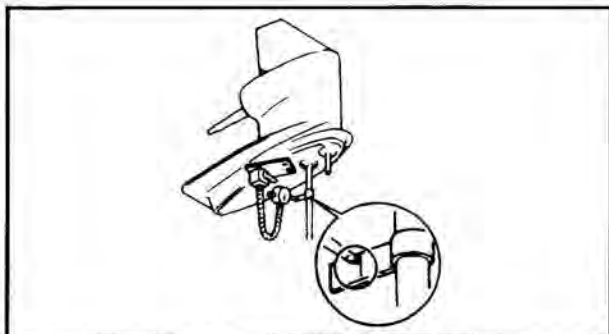
0.10, 0.14, 0.18, 0.35 and 0.50 mm



BACKLASH MEASUREMENT

NOTE:

- Both forward and reverse gear backlash should be measured.
- If both the forward and reverse gear backlash are larger than specified, the pinion may be too high.
- If both the forward and reverse gear backlash are smaller than specified, the pinion may be too low.
- If either of these conditions exists, then check the pinion shim selection.



1. Measure:

- Forward gear backlash
- Out of specification → Adjust.



Backlash:

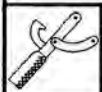
HDF9.9 : 0.26 ~ 0.77 mm

Measurement steps:

- Place the shift shaft in neutral.
- Load the forward gear with the bearing housing puller on the propeller shaft.

NOTE:

Lightly tighten by hand until the pressure of the propeller shaft on the forward gear restricts movement enough to allow backlash measurement.



Bearing housing puller

Universal puller

Stopper guide stand

Center bolt

- Set the lower unit upside down.
- Attach the backlash indicator on the drive shaft.
- Attach the dial gauge on the gear case, and make the dial gauge stem contact the mark on the indicator.



Dial gauge

Magnet base

Backlash indicator

- While pulling the drive shaft downward, slowly turn the drive shaft clockwise and counterclockwise, then measure the backlash when the drive shaft stops at each direction.
- Determine the shims to be added or removed according to the specification.

HDF9.9

Less than 0.26 mm	To be decreased by $(0.51 - \text{measurement})$ 2.5
More than 0.77 mm	To be increased by $(\text{measurement} - 0.51)$ 2.5

Example: (HDF9.9)

If measurement = 0.25 mm

Decrease shim thickness by

$$= (0.51 - 0.25)/2.5$$

$$= 0.26/2.5 = 0.10 \text{ mm}$$

If measurement = 1.26 mm

Increase shim thickness by

$$= (1.26 - 0.51)/2.5$$

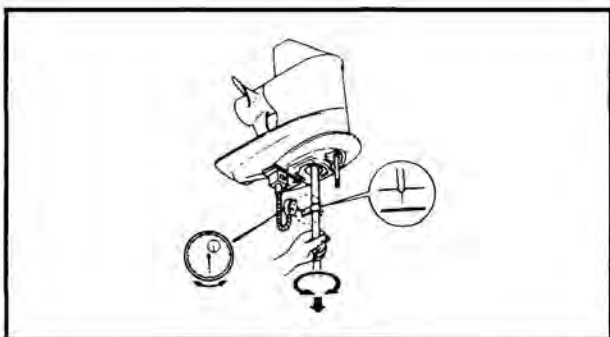
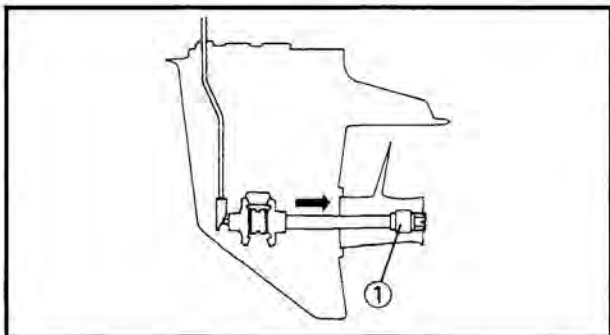
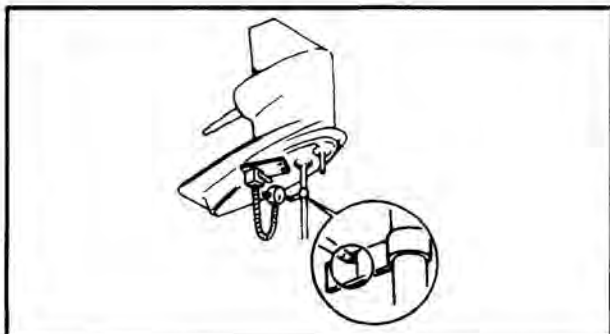
$$= 0.75/2.5 = 0.3 \text{ mm}$$

**Available shim thickness:**

**0.10, 0.14, 0.18, 0.35 and
0.50 mm**

**NOTE:**

Since the smallest shim available is 0.10 mm, if the measurement is between (HDF 9.9) 0.26 and 0.77 mm

**2. Measure:**

- Reverse gear backlash

Out of specification → Adjust.

**Backlash:**

HDF9.9: 0.51 ~ 1.02 mm

Measurement steps:

- Place the shift shaft in neutral.
- Load the reverse gear by installing the propeller without the front side spacer ① and tighten the nut.

NOTE:

Lightly tighten by hand until the pressure of the propeller shaft on the reverse gear restricts movement enough to allow backlash measurement.

- Set the lower unit upside down.
- Attach the backlash indicator on the drive shaft.
- Attach the dial gauge on the gear case, and make the dial gauge stem contact the mark on the indicator.

**Dial gauge****Magnet base****Backlash indicator**



- While pulling the drive shaft downward, slowly turn the drive shaft clockwise and counterclockwise, then measure the backlash when the drive shaft stops at each direction.
- Determine the shims to be added or removed according to the specified.

HDF9.9

Less than
0.82 mm

To be decreased by
 $(0.99 - \text{measurement})$
2.3

More than
1.17 mm

To be increased by
 $(\text{measurement} - 0.99)$
2.3

Example: (HDF9.9)
If measurement = 0.74 mm
Decrease shim thickness by
 $= (0.99 - 0.74)/2.3$
 $= 0.25/2.3 = 0.11 \text{ mm}$
If measurement = 1.79 mm
Increase shim thickness by
 $= (1.79 - 0.99)/2.3$
 $= 0.80/2.3 = 0.35 \text{ mm}$

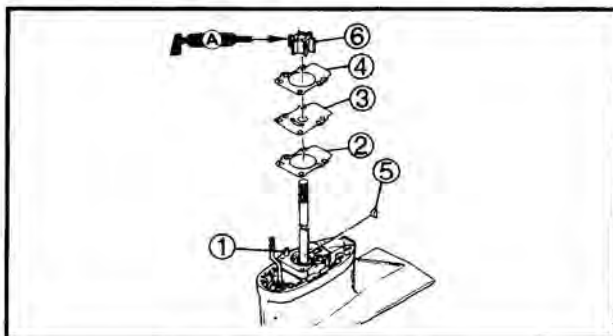


Available shim thickness:

**0.10, 0.14, 0.18, 0.35 and
0.50 mm**

NOTE:

Since the smallest shim available is 0.10 mm, if the measurement is between (HDF 9.9) 0.51 and 1.02 mm



WATER PUMP

1. Install:

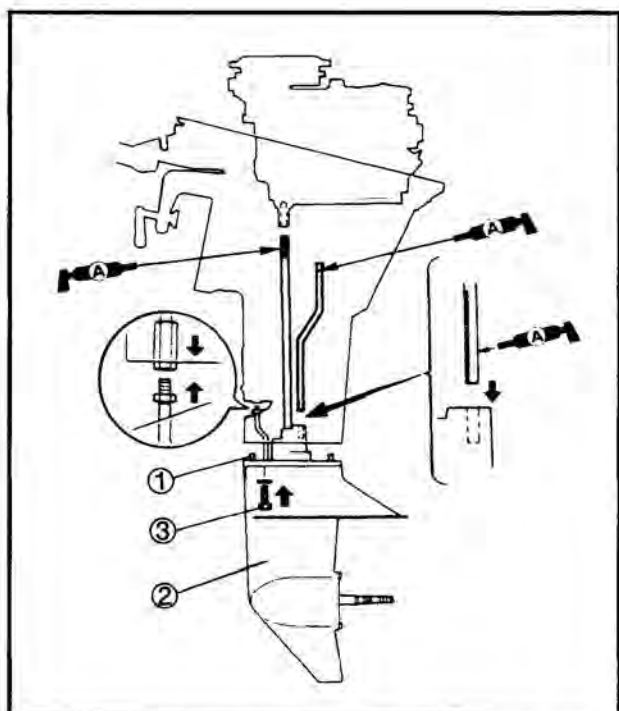
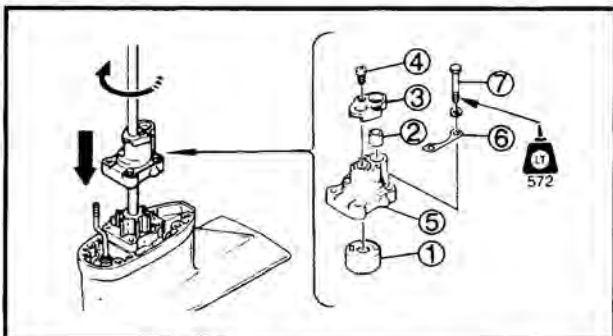
- Dowel pin ①
- Gasket ②
- Outer plate ③
- Gasket ④
- Woodruff key ⑤
- Impeller ⑥

2. Install:

- Insert cartridge ①
- Bushing ②
- Cover ③
- Screw ④
- Water pump housing ⑤
- Plate ⑥
- Bolt ⑦

NOTE:

- Apply the impeller with water resistant grease.
- Turn the drive shaft clockwise, when installing the water pump housing.



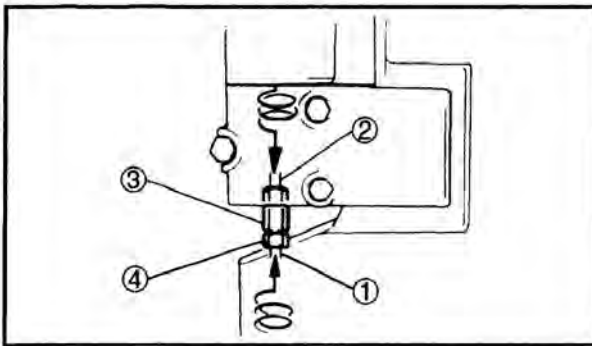
LOWER UNIT

1. Install:

- Dowel pin ①
- Lower unit ②
- Bolt ③

NOTE:

- Set the shift cam to the reverse position.
- Hold the shift rod nut in the lowest position.
- Insert the drive shaft into the crankshaft, insert the water tube into the water seal, and insert the shift rod into the upper casing.

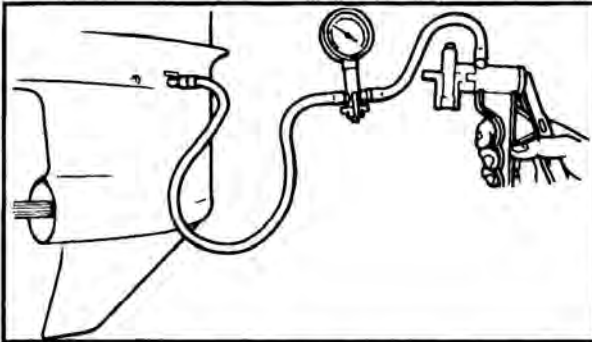


2. Install:

- Shift rod ①
- Shift lever ②
- Nut ③
- Lock nut ④

NOTE:

Install the nut on the shift lever side and screw it in 5 turns.



3. Check:

- Pressure
Impossible to maintain the specified pressure for 10 seconds → Reinstall.

Checking steps:

- Attach the Mity Vac to the oil level hole.

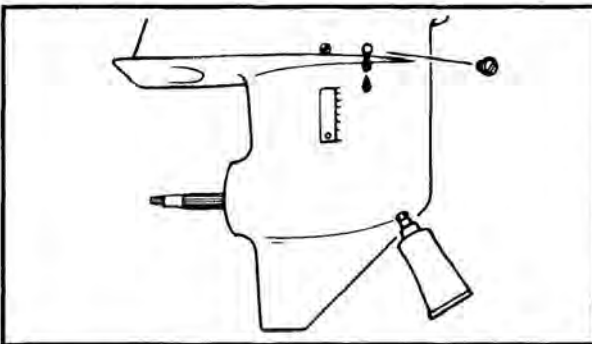


Mity Vac

- Apply the specified pressure.

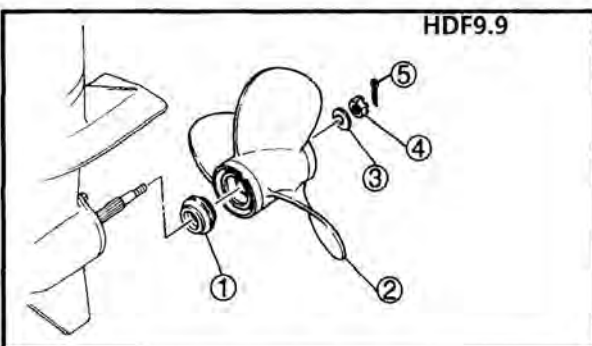


Specified pressure:
100 kPa (1.0 kg/cm², 14.2 psi)



4. Fill:

- Gear oil
Refer to page 3-5.

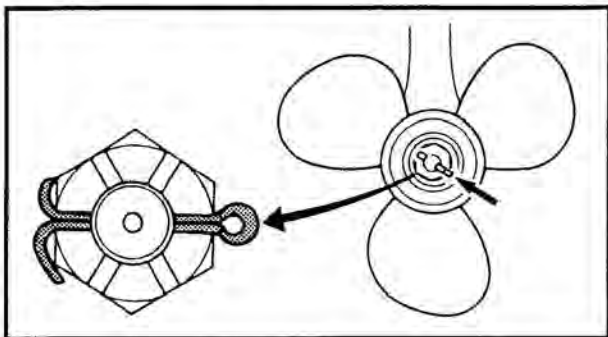


1. Install: (HDF9.9)

- Spacer ①
- Propeller ②
- Washer ③
- Nut ④
- Cotter pin ⑤



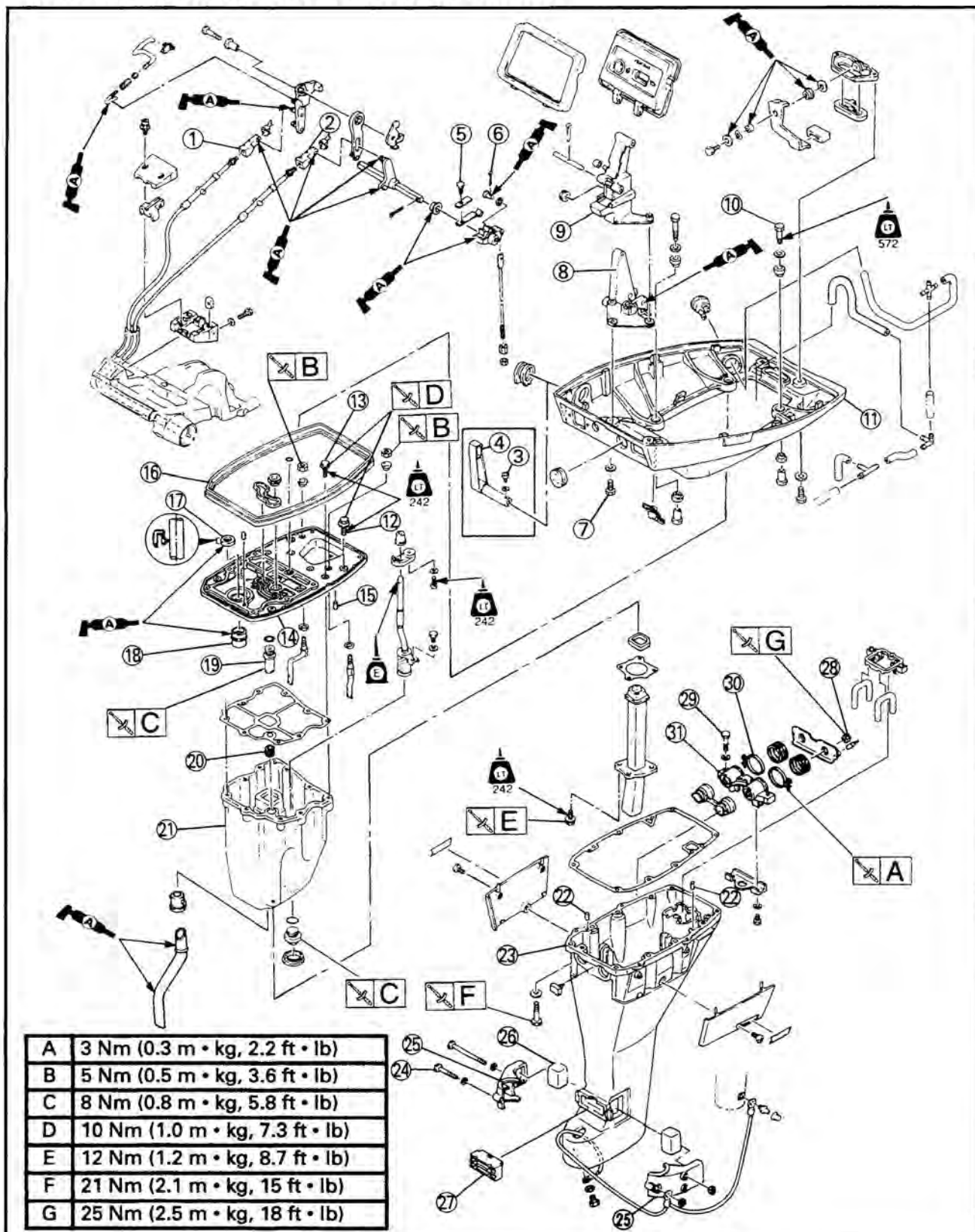
Nut:
13 Nm (1.3 m • kg, 9.4 ft • lb)

**NOTE:**

If the propeller nut does not align with the propeller shaft hole when the nut is tightened to specification, turn it in further so that they align.

UPPER CASING AND BOTTOM COWLING PREPARATION FOR REMOVAL

- * Remove the power unit.
- * Remove the ground lead at the swivel bracket side.

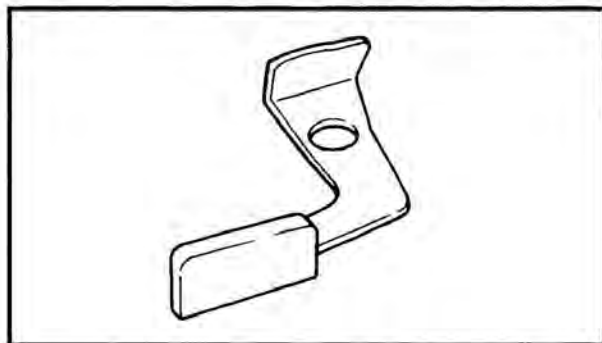


Extent of removal:

- ① Bottom cowling removal
③ Mount rubber removal

- ② Upper casing removal

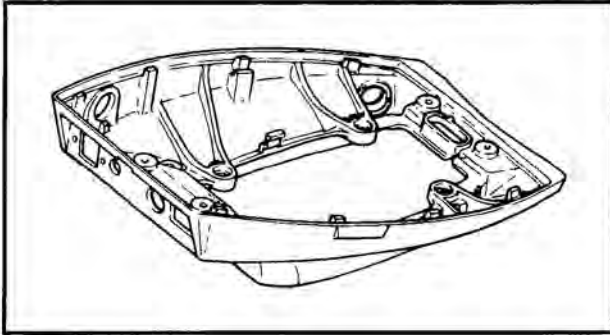
Extent of removal	Order	Part name	Q'ty	Remarks
	1	Cable end (throttle)	1	HDF9.9 models only
	2	Cable end (shift)	1	
	3	Screw	1	
	4	Shift lever	1	
	5	Bolt	1	
	6	Shift rod pin	1	
	7	Bolt	3	
	8	Shift stay	1	
	9	Panel stay	1	
	10	Bolt	4	
	11	Bottom cowling	1	
	12	Bolt	2	
	13	Bolt	9	
	14	Exhaust guide	1	
	15	Dowel pin	2	
	16	Rubber seal	1	
	17	Oil seal	1	
	18	Pipe	1	
	19	Relief valve	1	
	20	Seal	1	
	21	Oil pan	1	
	22	Dowel pin	2	
	23	Upper casing	1	
	24	Bolt	3	
	25	Rubber housing	2	
	26	Mount rubber (side)	2	
	27	Mount rubber (under)	1	
	28	Nut	2	
	29	Bolt	2	
	30	Clamp	2	
	31	Mount rubber (upper)	1	Loosen the screw.



INSPECTION CLAMP LEVER

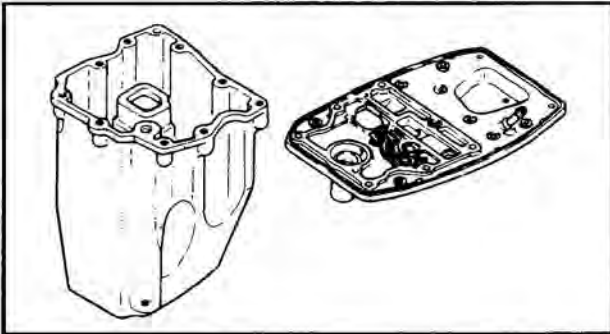
1. Inspect:

- Clamp lever
Wear/Damage → Replace.

**BOTTOM COWLING**

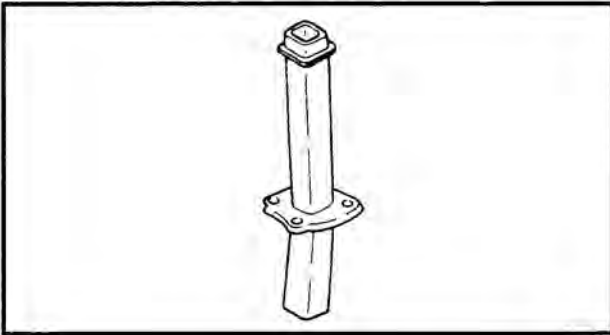
1. Inspect:

- Bottom cowl
Crack/Damage → Replace.

**OIL PAN AND EXHAUST GUIDE**

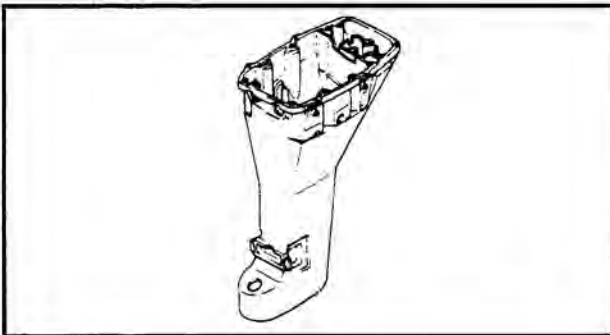
1. Inspect:

- Oil pan
- Exhaust guide
Crack/Damage → Replace.

**EXHAUST MANIFOLD**

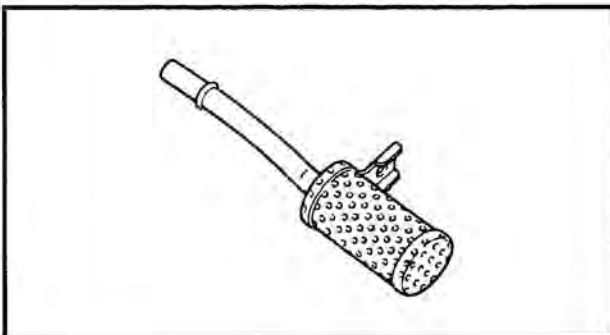
1. Inspect:

- Exhaust manifold
Carbon deposits → Clean,
Crack/Corrosion → Replace.

**UPPER CASING**

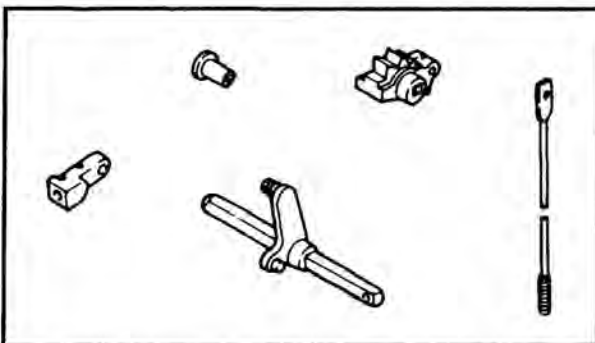
1. Inspect:

- Upper casing
Crack/Damage → Replace.

**OIL STRAINER**

1. Inspect:

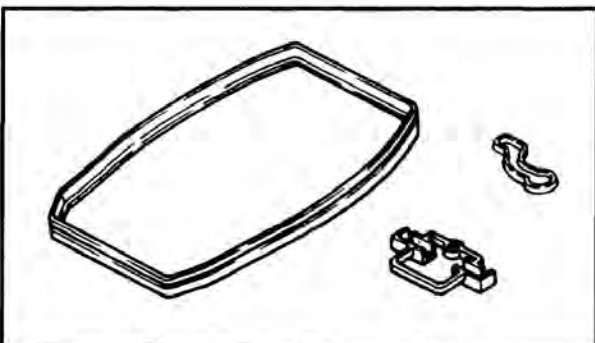
- Oil strainer
Contamination → Clean.
Damage → Replace.

**SHIFT MECHANISM**

1. Inspect:

- Shift rod
- Shift link
- Bushing
- Cable end

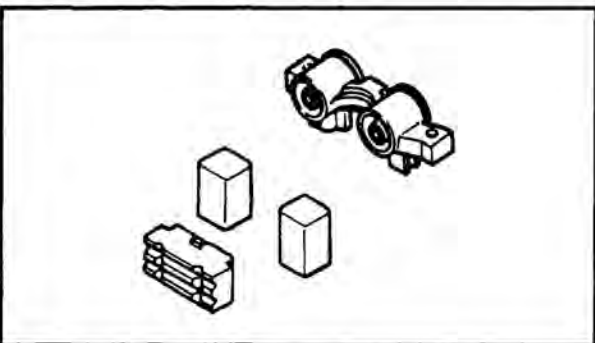
Wear/Damage → Replace.

**SEALING PARTS**

1. Inspect:

- Rubber seal

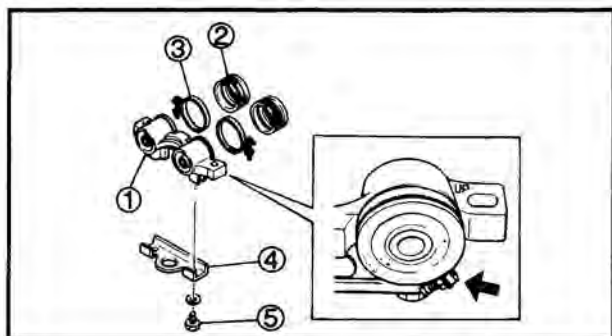
Crack/Damage → Replace.

**MOUNT RUBBER**

1. Inspect:

- Mount rubber

Wear/Damage → Replace.



ASSEMBLY AND INSTALLATION UPPER CASING

1. Install:

- Mount rubber ①
- Rubber seal ②
- Clamp ③
- Plate ④
- Bolt ⑤

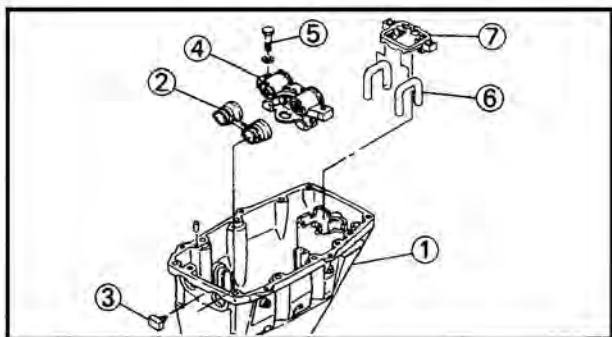
NOTE:

The clamp should be installed with the screwed side facing downward.



Screw:

3 Nm (0.3 m • kg, 2.2 ft • lb)



2. Install:

- Upper casing ①
- Seal ②
- Stopper ③
- Mount rubber ④
- Bolt ⑤
- Hose ⑥
- Seal ⑦

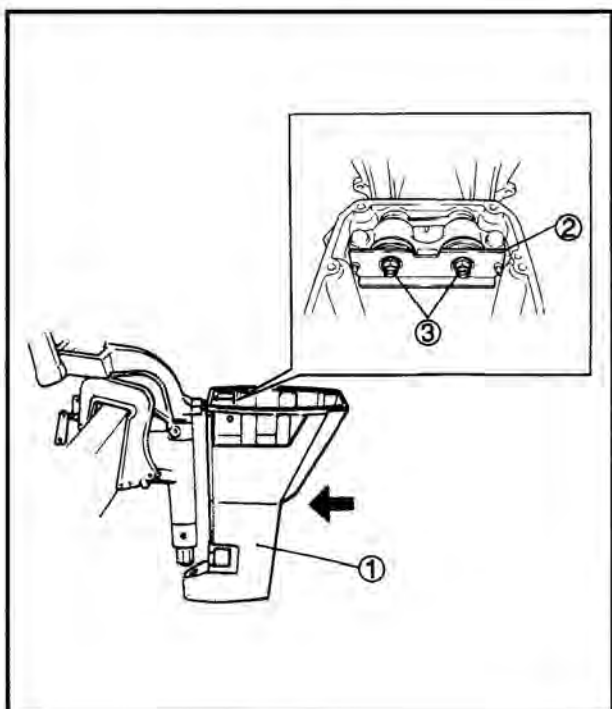
3. Install:

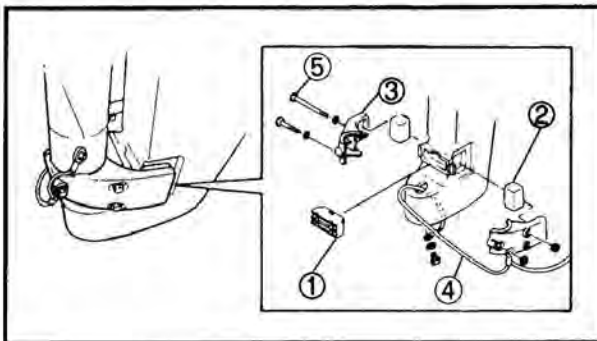
- Upper casing ①
- Bracket ②
- Nut ③



Nut:

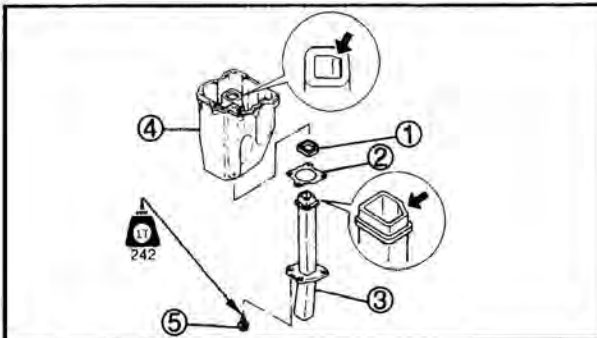
25 Nm (2.5 m • kg, 18 ft • lb)





4. Install:

- Mount rubber (under) ①
- Mount rubber (side) ②
- Rubber housing ③
- Ground lead ④
- Bolt ⑤



5. Install:

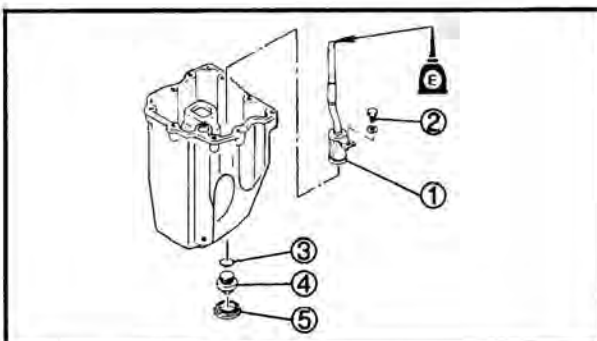
- Seal ①
- Gasket ②
- Exhaust manifold ③
- Oil pan ④
- Bolt ⑤



Bolt:
12 Nm (1.2 m • kg, 8.7 ft • lb)

NOTE:

- Align the exhaust manifold with the oil pan hole.
- Always use a new gasket.

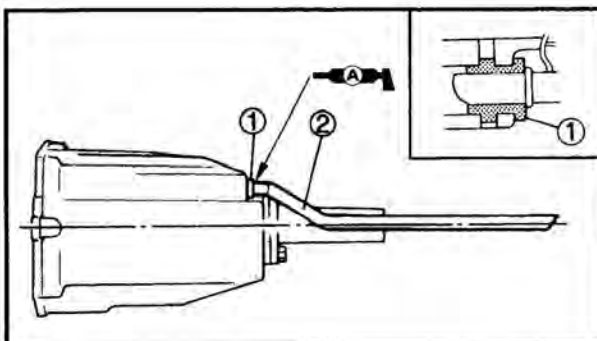


6. Install:

- Oil strainer ①
- Bolt ②
- O-ring ③
- Drain plug ④
- Rubber damper ⑤



Drain plug:
8 Nm (0.8 m • kg, 5.8 ft • lb)

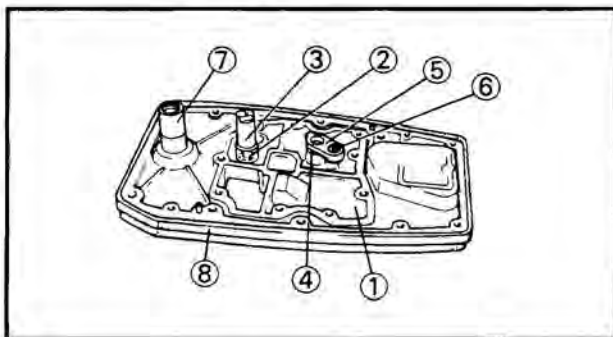


7. Install:

- Grommet ①
- Water tube ②

NOTE:

- Align the hole in the oil pan with the projection in the grommet.
- Install the water tube so its position is not reversed.



8. Install:

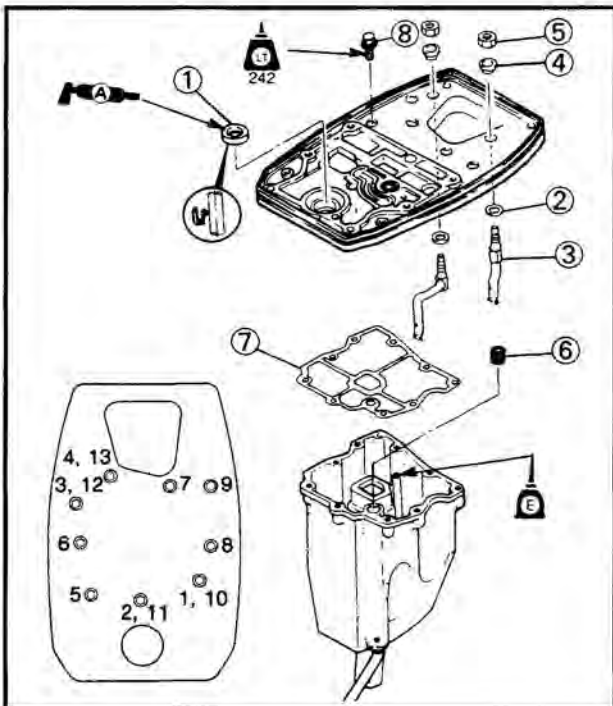
- Exhaust guide ①
- O-ring ②
- Relief valve ③
- Grommet ④
- Pipe guide ⑤
- Screw ⑥
- Pipe ⑦
- Rubber seal ⑧

**Relief valve:**

8 Nm (0.8 m • kg, 5.8 ft • lb)

CAUTION:

Coat the screw with blue LOCTITE® (242).



9. Install:

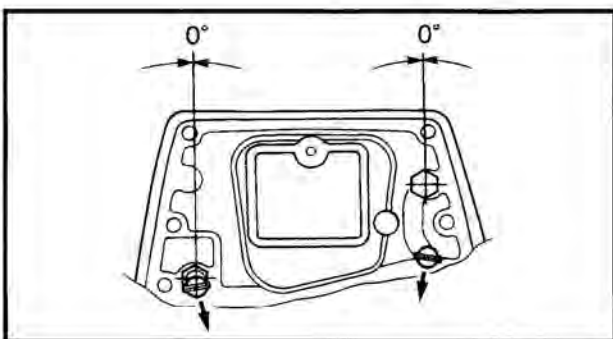
- Oil seal ①
- Washer ②
- Pipe ③
- Bushing ④
- Nut ⑤
- Seal ⑥
- Gasket ⑦
- Bolt ⑧

**Nut:**

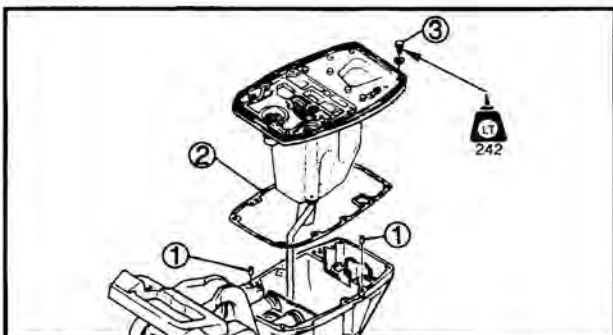
5 Nm (0.5 m • kg, 3.6 ft • lb)

Bolt:

10 Nm (1.0 m • kg, 7.3 ft • lb)

**NOTE:**

- Always use a new oil seal.
- Torque the bolts in the sequence embossed on the exhaust guide.
- Install the pipes with their water discharge end facing the oil pan.

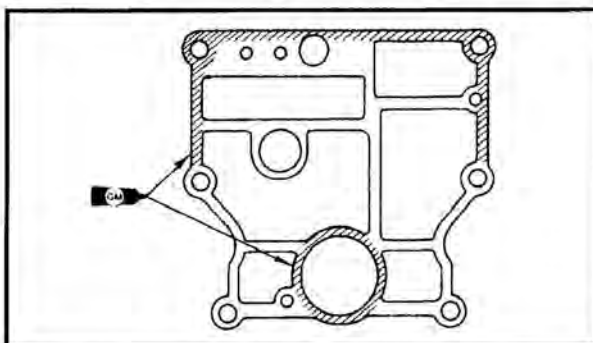


10. Install:

- Dowel pin ①
- Gasket ②
- Bolt ③

NOTE:

Always use a new gasket.

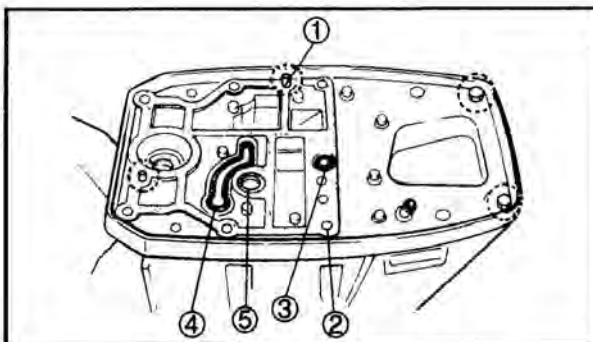


11. Apply:

- Gasket Maker
(onto both face of the gasket)

NOTE:

Clean the contacting surface of the crank-case.

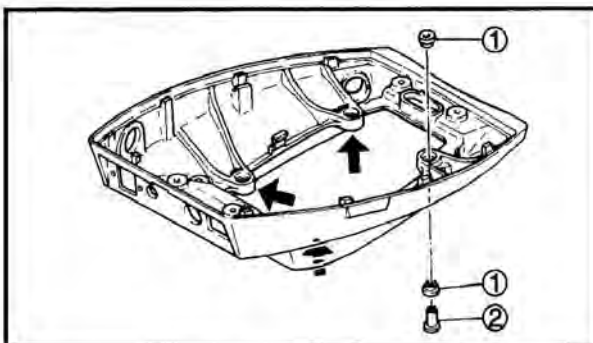


12. Install:

- Dowel pin ①
- Gasket ②
- O-ring ③
- Rubber seal ④
- Rubber seal ⑤

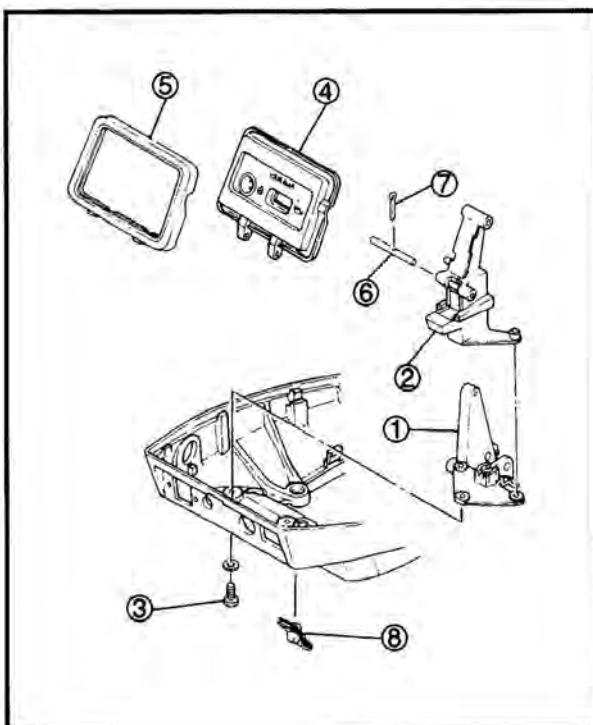
NOTE:

Always use a new gasket.

**BOTTOM COWLING**

1. Install:

- Grommet ①
- Collar ②

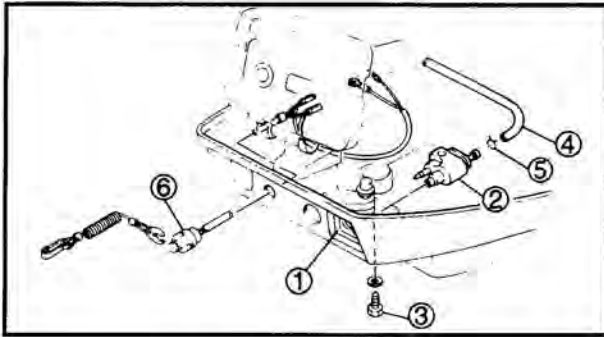


2. Install:

- Shift stay ①
- Panel stay ②
- Bolt ③
- Front panel ④
- Seal rubber ⑤
- Hinge pin ⑥
- Cotter pin ⑦
- Grommet (shift rod) ⑧

NOTE:

Always use a new cotter pin.



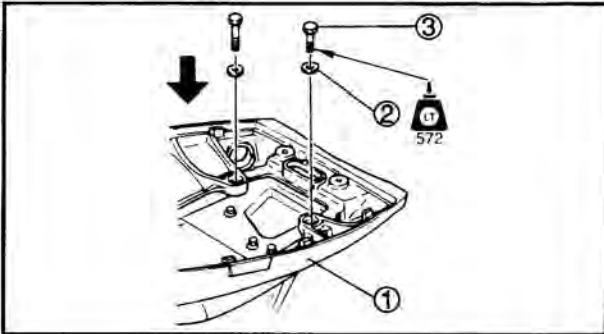
3. Install:

- Grommet ①
- Fuel joint ②
- Bolt ③
- Fuel hose ④
- Clip ⑤
- Engine stop switch ⑥

**Engine stop switch:****4 Nm (0.4 m • kg, 2.9 ft • lb)**

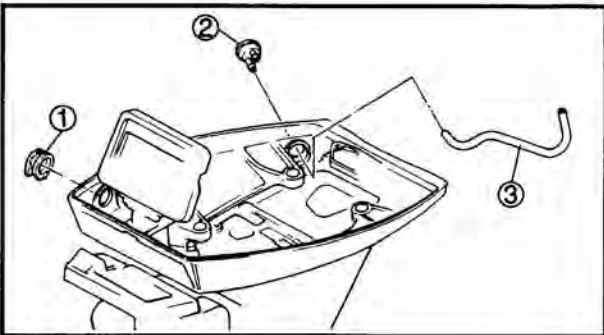
4. Install:

- Bottom cowling ①
- Washer ②
- Bolt ③



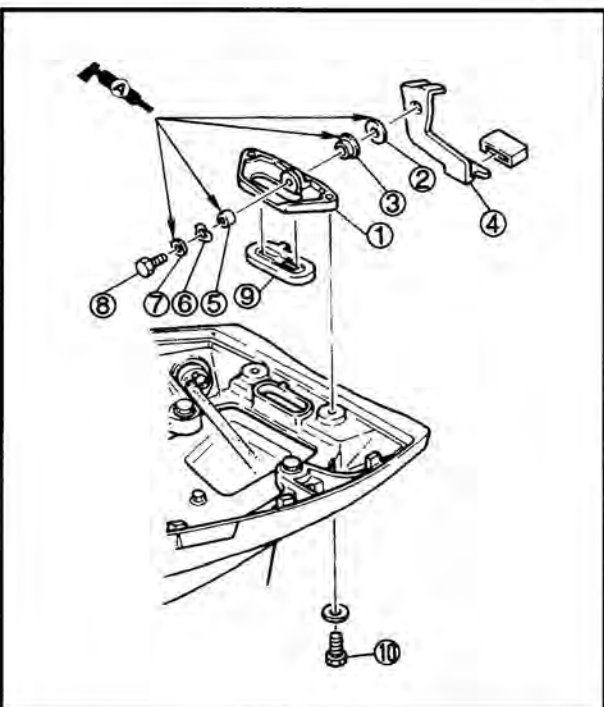
5. Install:

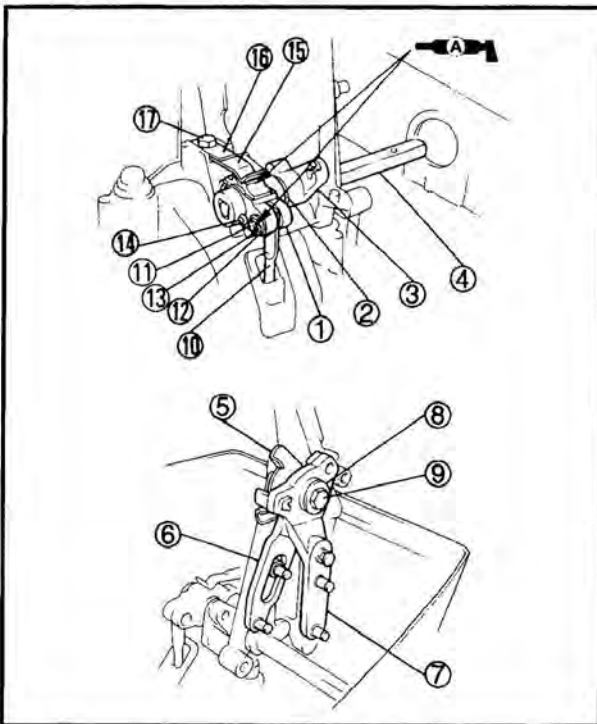
- Grommet (shift shaft) ①
- Grommet ②
- Water hose ③



6. Install:

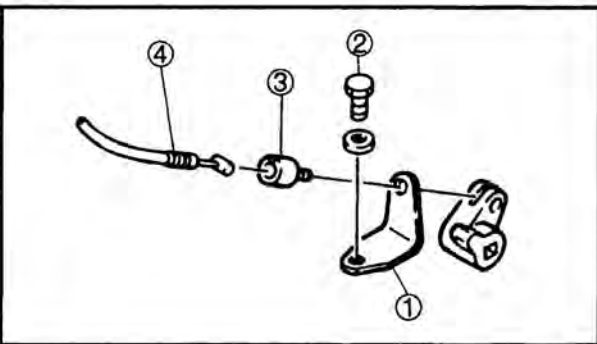
- Lever stay ①
- Washer ②
- Bushing ③
- Clamp lever ④
- Collar ⑤
- Wave washer ⑥
- Washer ⑦
- Bolt ⑧
- Rubber seal ⑨
- Bolt ⑩





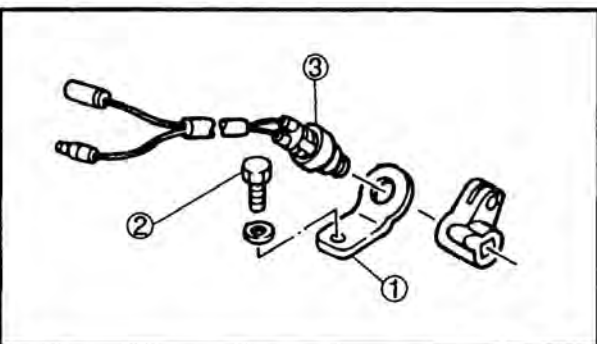
7. Install:

- Shift link ①
- Bushing ②
- Shift lever ③
- Shift arm ④
- Accelerator stopper ⑤
- Shift arm ⑥
- Accelerator arm ⑦
- Bushing ⑧
- Bolt ⑨
- Shift rod ⑩
- Pin ⑪
- Washer ⑫
- Cotter pin ⑬
- Cotter pin ⑭
- Spring ⑮
- Bracket ⑯
- Bolt ⑰



8. Install:

- Stay ①
- Bolt ②
- Guide ③
- Start-in-gear protection wire ④



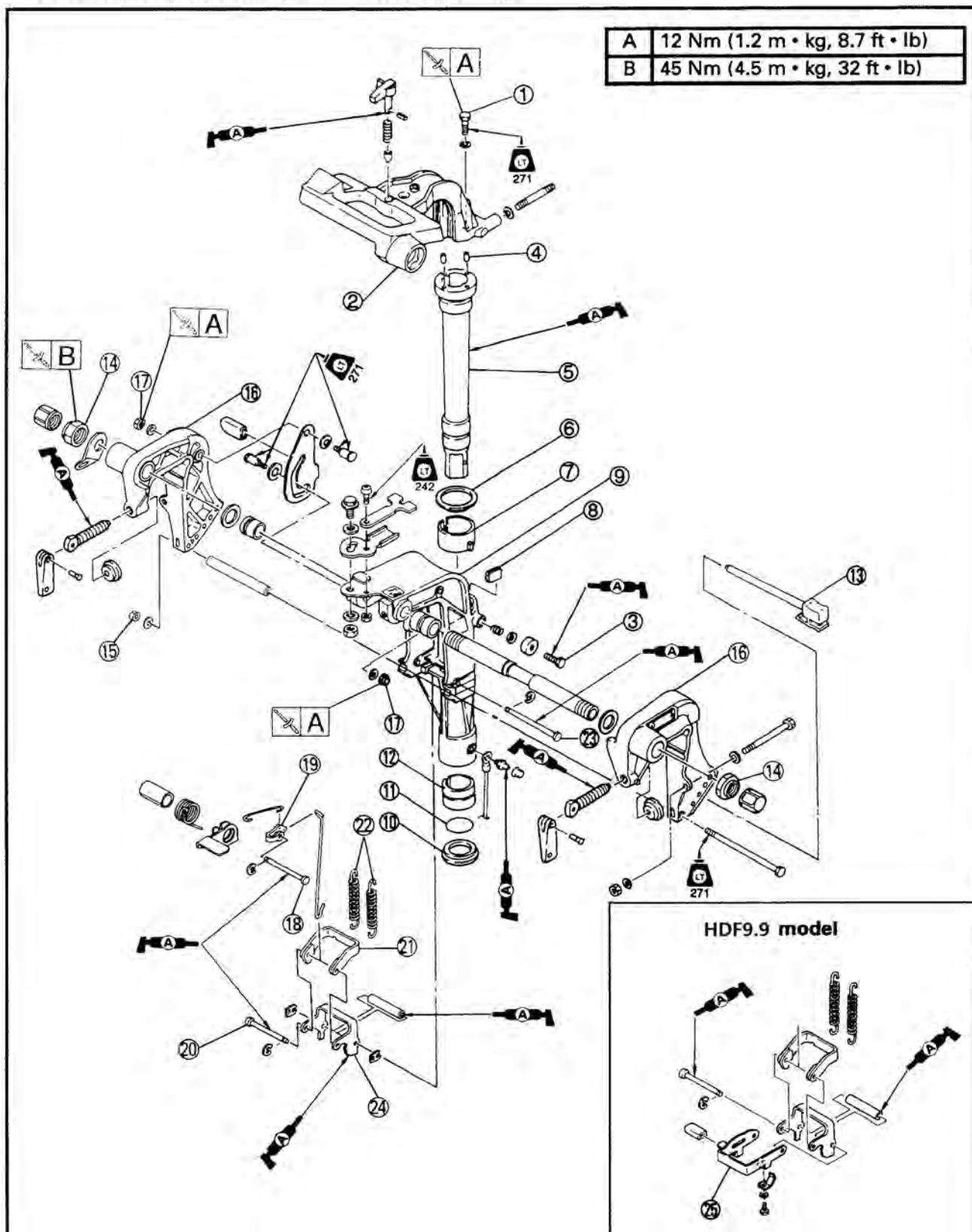
9. Install:

- Stay ①
- Bolt ②
- Neutral switch ③

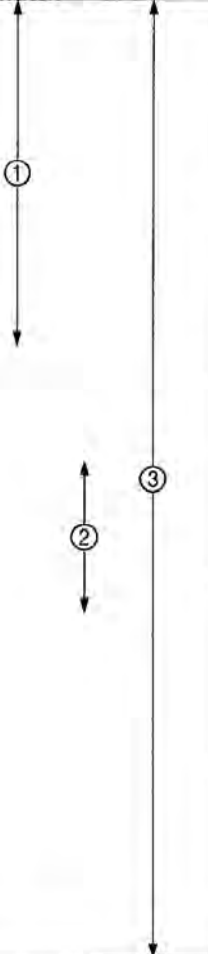
BRACKET UNIT

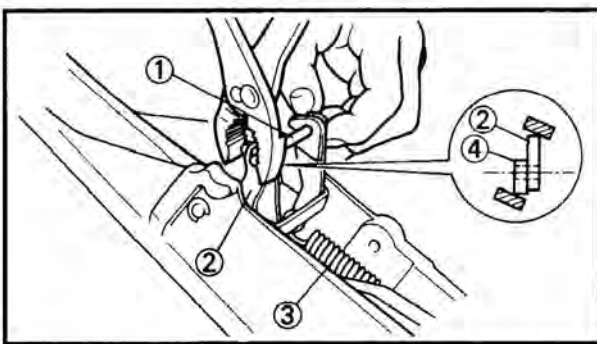
PREPARATION FOR REMOVAL

- * Remove the power unit.
- * Remove the upper casing and bottom cowling.



Extent of removal: ① Swivel bracket removal ② Clamp bracket removal
③ Swivel bracket disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Bolt	2	
	2	Steering bracket	1	
	3	Bolt	1	
	4	Dowel pin	2	
	5	Steering shaft	1	
	6	Washer	1	
	7	Bushing	1	
	8	Friction plate	1	
	9	Swivel bracket	1	
	10	Bushing	1	
	11	O-ring	1	
	12	Bushing	1	
	13	Tilt pin	1	
	14	Nut	2	
	15	Nut (M6)	1	
	16	Clamp bracket	2	
	17	Nut	2	
	18	Pin	1	}
	19	Tilt lever	1	
	20	Pin	1	
	21	Tilt plate (inner)	1	Refer to "REMOVAL POINTS". HDF9.9 models only
	22	Spring	2	
	23	Pin	1	
	24	Tilt plate (outer)	1	
	25	Drive lever	1	



REMOVAL POINTS

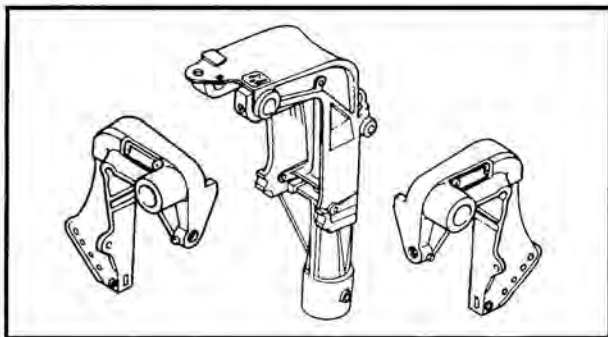
SPRING

1. Remove:

- Clip
- Pin ①
- Tilt plate (inner) ②
- Spring ③

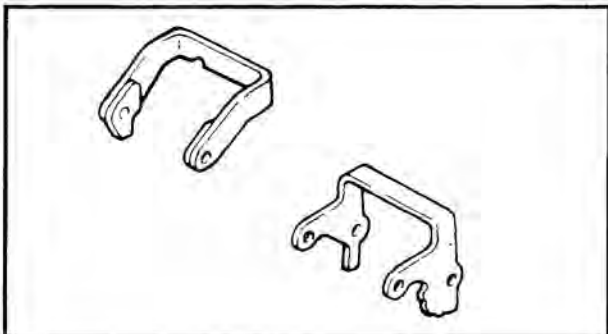
NOTE:

Align the holes of the tilt plate (inner and outer ④), and remove the pin.

**INSPECTION****CLAMP AND SWIVEL BRACKET**

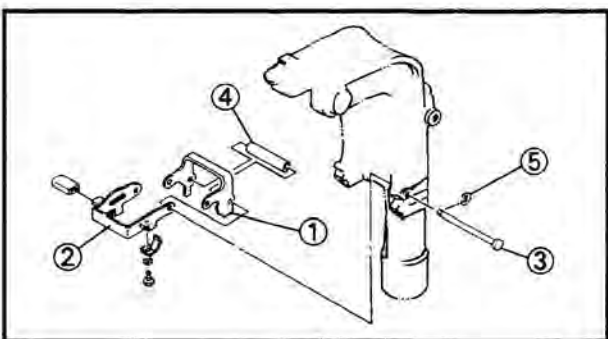
1. Inspect:

- Clamp bracket
 - Swivel bracket
- Crack/Damage → Replace.

**TILT PLATE**

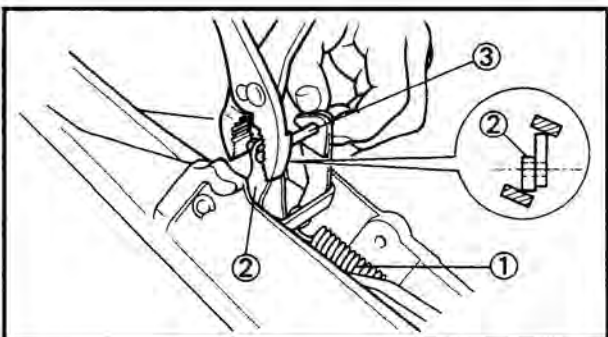
1. Inspect:

- Tilt plate
- Crack/Damage → Replace.

ASSEMBLY AND INSTALLATION

1. Install: (HDF9.9 models)

- Tilt plate (outer) ①
- Drive lever ②
- Pin ③
- Collar ④
- Clip ⑤

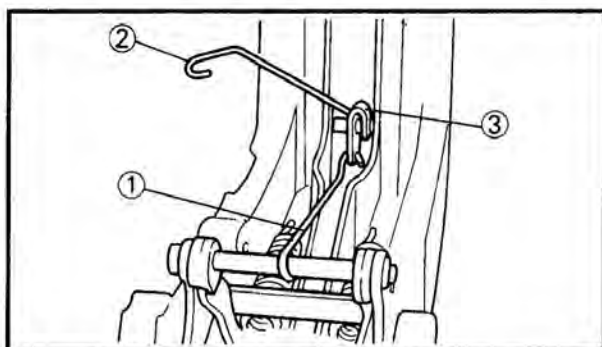


2. Install:

- Spring ①
- Tilt plate (inner) ②
- Pin ③
- Clip

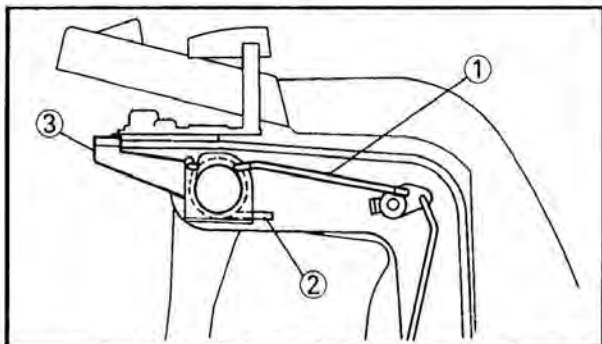
NOTE:

Align the holes of the tilt plate (inner and outer), after installing the pin.



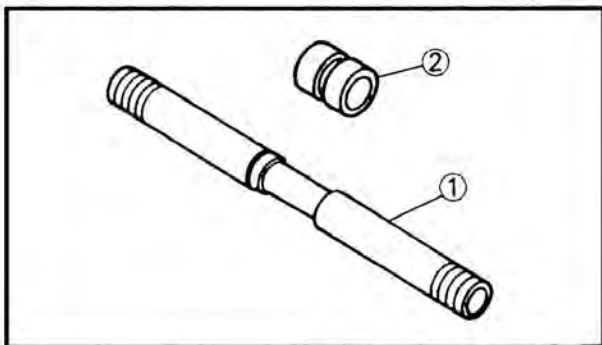
3. Install

- Rod (long) ①
- Rod (short) ②
- Tilt lever ③
- Pin
- Clip



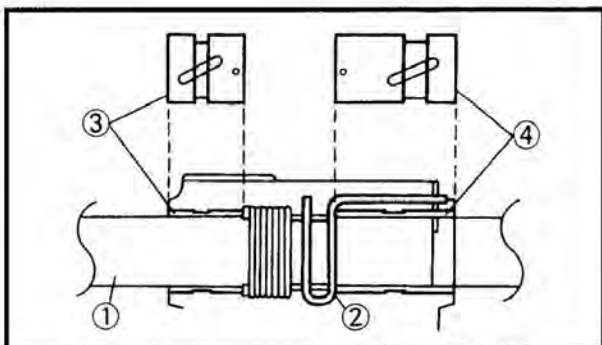
4. Install:

- Rod (short) ①
- Spring ②
- Lever ③



5. Install:

- Clamp bolt ①
- Bushing ②

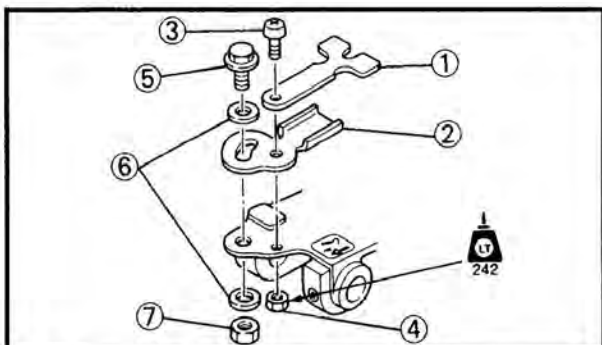


6. Install:

- Clamp bolt ①
- Lever ②
- Bushing (short) ③
- Bushing (long) ④

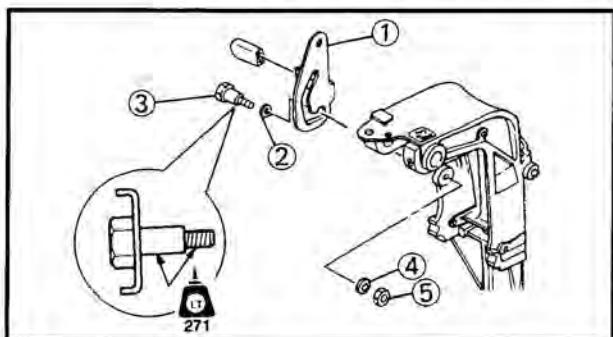
NOTE:

Install the bushings with the punch mark side inward.



7. Install:

- Plate ①
- Control plate ②
- Screw ③
- Nut ④
- Bolt ⑤
- Washer ⑥
- Nut ⑦

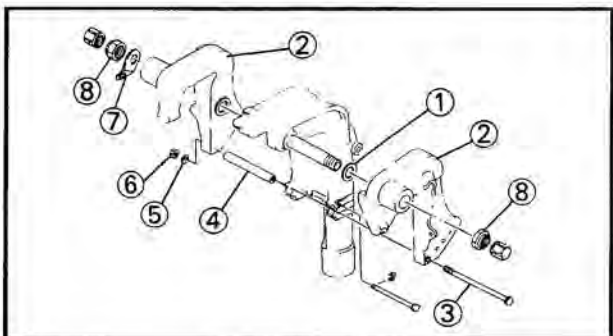


8. Install:

- Lock plate ①
- Washer ②
- Bolt ③
- Washer plate ④
- Nut ⑤



Nut:
12 Nm (1.2 m • kg, 8.7 ft • lb)

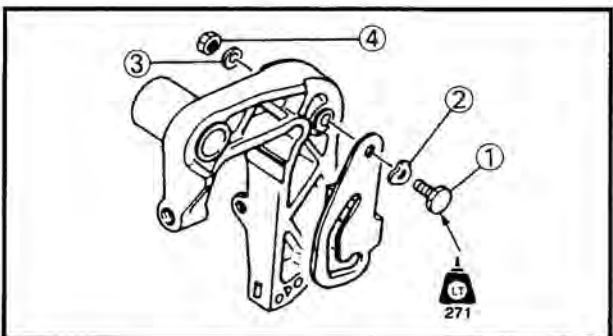


9. Install:

- Washer ①
- Clamp bracket ②
- Bolt ③
- Collar ④
- Washer ⑤
- Nut ⑥
- Plate ⑦
- Nut ⑧



Nut (clamp bolt):
45 Nm (4.5 m • kg, 32.5 ft • lb)



10. Install:

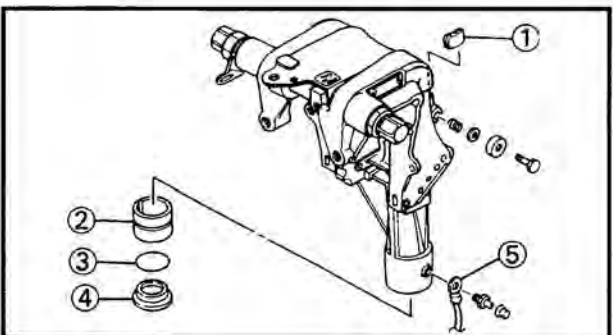
- Bolt ①
- Washer (wave) ②
- Washer plate ③
- Nut ④

11. Install:

- Steering shaft ①
- Pin ②
- Steering bracket ③
- Bolt ④
- Washer ⑤
- Bushing ⑥



Bolt:
13 Nm (1.3 m • kg, 9.4 ft • lb)



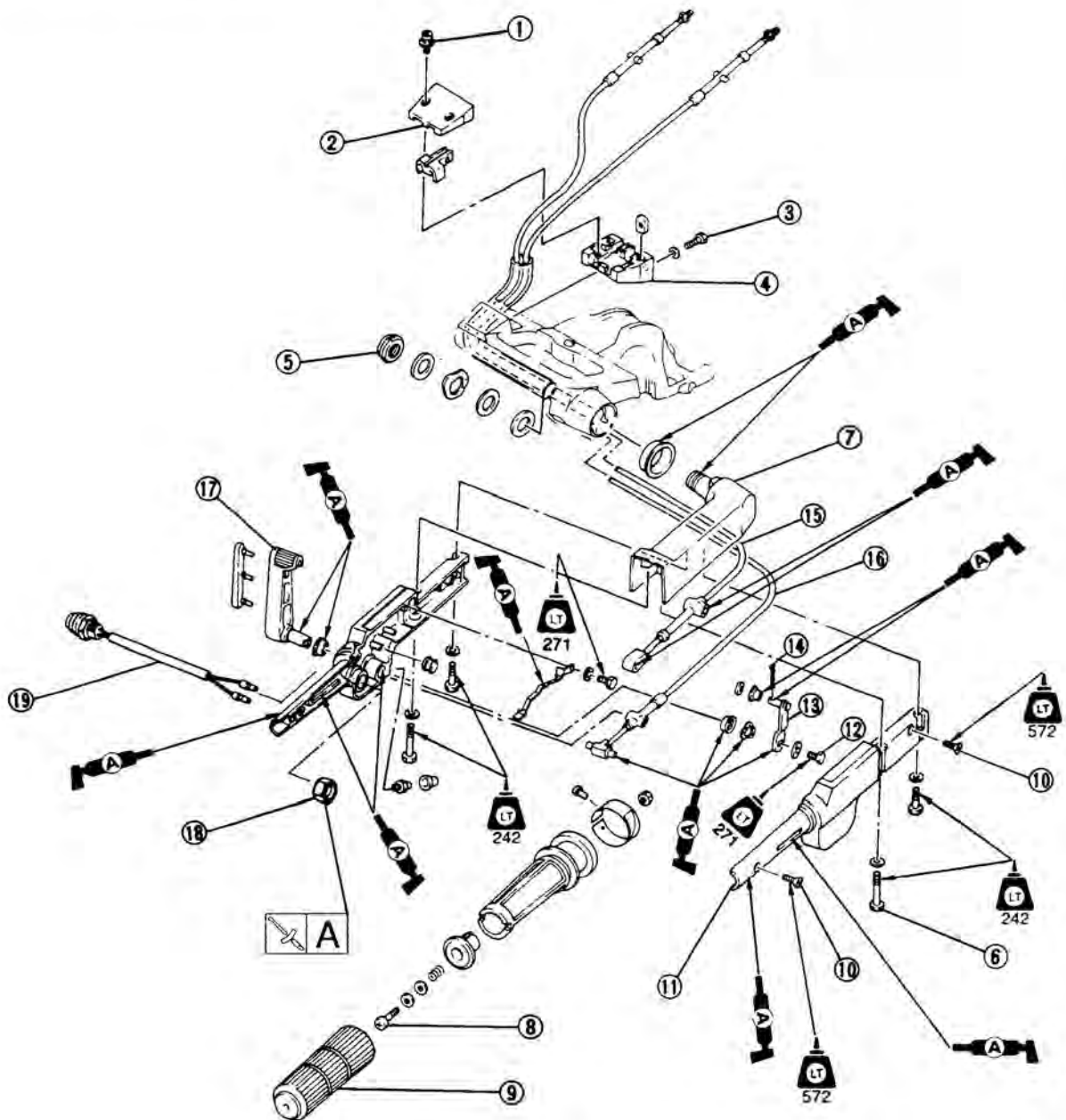
12. Install:

- Friction piece ①
- Bushing ②
- O-ring ③
- Bushing ④
- Ground lead ⑤

STEERING HANDLE PREPARATION FOR REMOVAL

- * Disconnect the control cables at engine side.
- * Disconnect the wire leads.

A 4 Nm (0.4 m • kg, 2.9 ft • lb)



STEERING HANDLE

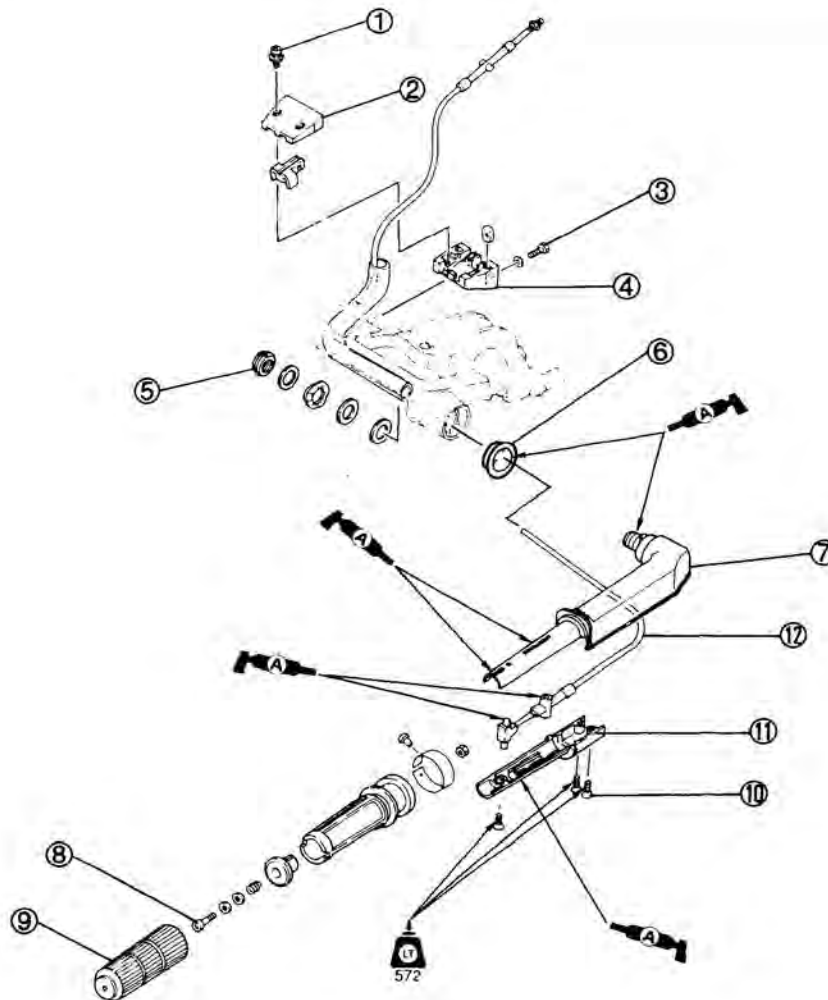
Extent of removal: ① Cable removal

② Steering handle disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Screw	2	Refer to "REMOVAL POINTS".
	2	Fitting plate	1	
	3	Bolt	2	
	4	Bracket	1	
	5	Ring nut	1	
	6	Bolt	4	
	7	Steering handle	1	
	8	Screw	1	
	9	Handle grip	1	
	10	Screw	2	
	11	Steering handle (left)	2	
	12	Bolt	1	
	13	Shift arm	1	
	14	Cotter pin	1	
	15	Shift cable	1	
	16	Throttle cable	1	
	17	Shift lever	1	
	18	Nut	1	
	19	Stop switch	1	

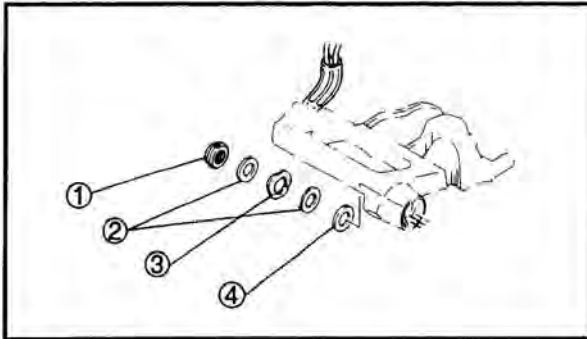
PREPARATION FOR REMOVAL

*** Disconnect the control cables at engine side.**



Extent of removal: ① Cable removal and Steering handle disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Screw	2	Refer to "REMOVAL POINTS".
	2	Fitting plate	1	
	3	Bolt	2	
	4	Bracket	1	
	5	Ring nut	1	
	6	Bushing	1	
	7	Steering handle 1	1	
	8	Screw	1	
	9	Handle grip	1	
	10	Screw	3	
	11	Steering handle 2	1	
	12	Throttle cable	1	



REMOVAL POINTS

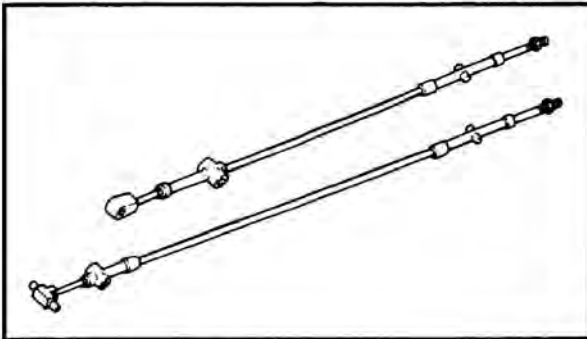
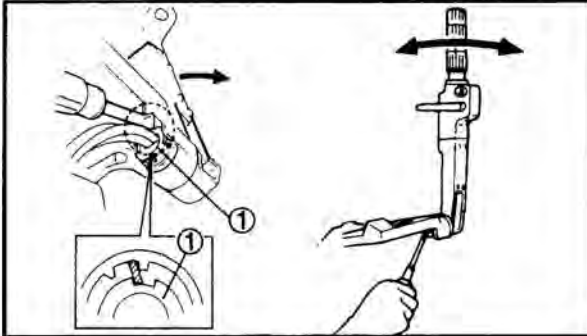
RING NUT

1. Remove:

- Ring nut ①
- Washer ②
- Washer (wave) ③
- Washer (nylon) ④

NOTE:

- Turn the steering handle backward.
- Fit a standard-head screwdriver into the slit in the ring nut.
- Set the screwdriver using the steering bracket as a fulcrum.
- Turn steering handle forward and loosen the ring nut.
- Repeat this operation until the ring nut comes off.

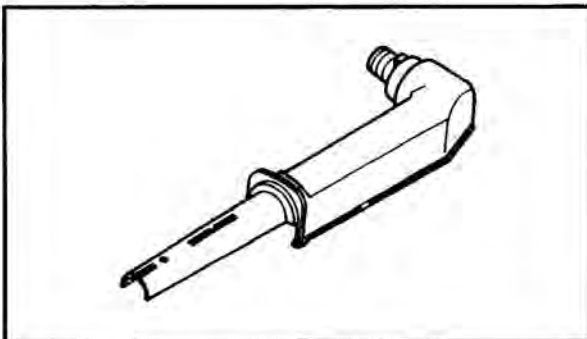


INSPECTION

SHIFT AND THROTTLE CABLES

1. Inspect:

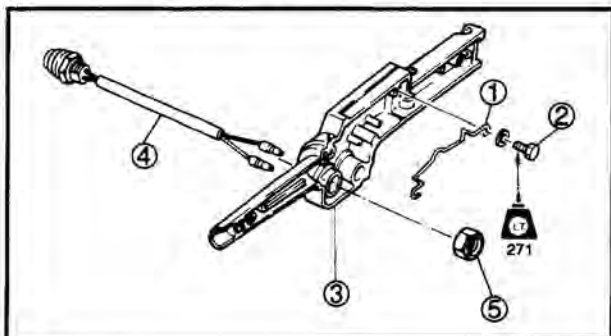
- Shift cable
 - Throttle cable
- Bend/Damage → Replace.
Unsmooth operation → Replace.



STEERING HANDLE

1. Inspect:

- Steering handle
- Crack/Damage → Replace.



ASSEMBLY AND INSTALLATION STEERING HANDLE

1. Install:

- Spring ①
- Bolt ②
- Steering handle (right) ③
- Stop switch ④
- Nut ⑤



Nut:

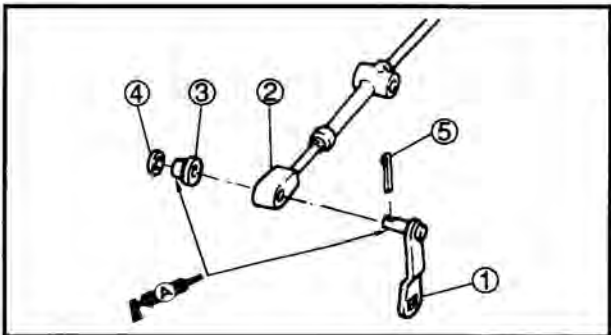
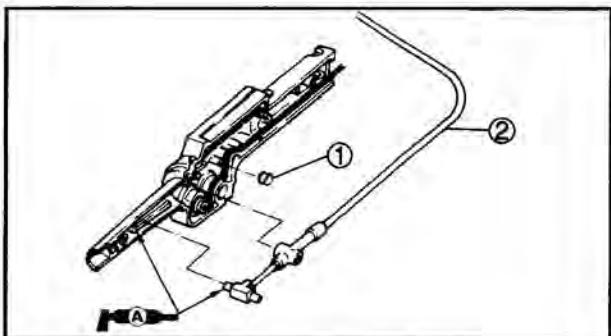
4 Nm (0.4 m • kg, 2.9 ft • lb)

2. Install:

- Grommet ①
- Throttle cable ②

NOTE:

Fit the inner cable end in the groove, and fit the outer cable end into the hole.



3. Install:

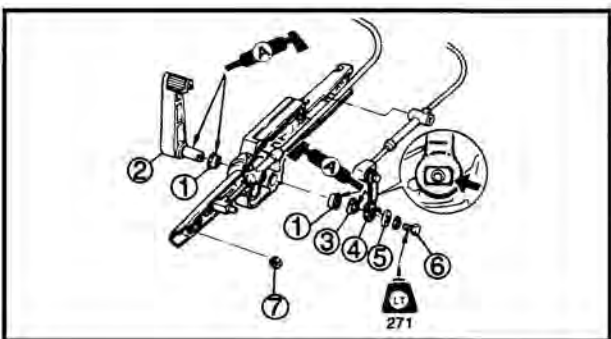
- Shift arm ①
- Shift cable ②
- Collar ③
- Washer ④
- Cotter pin ⑤

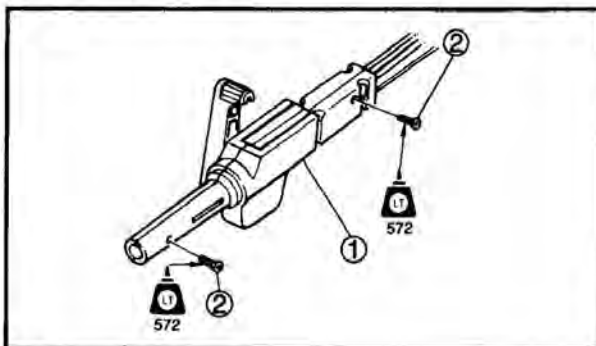
4. Install:

- Bushing ①
- Shift lever ②
- Wave washer ③
- Shift arm ④
- Washer ⑤
- Bolt ⑥
- Nut ⑦

NOTE:

- Align the shift lever shaft end with the hole in the shift arm.
- Fit the shift arm collar to the Neutral position of the spring.



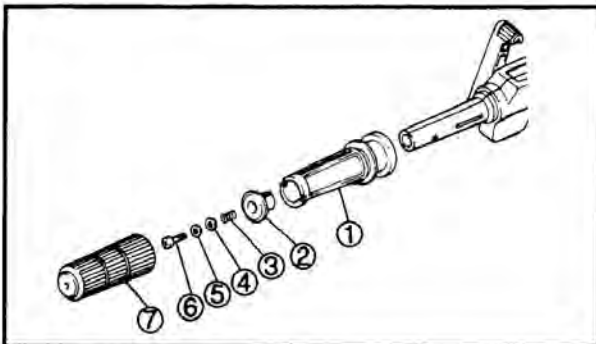


5. Install:

- Steering handle (left) ①
- Screw ②

NOTE:

- When installing steering handle, fit the throttle and shift cables correctly in place.
- After installing the steering handle, make sure that the shift lever operates correctly.

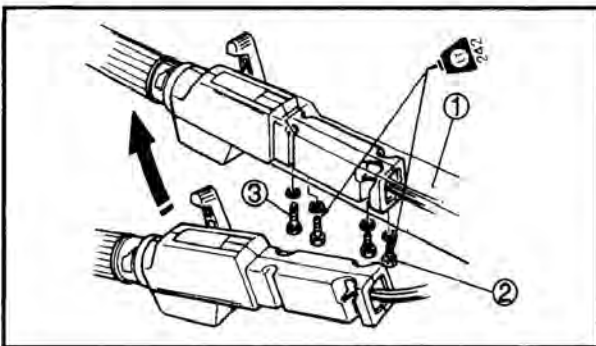


6. Install:

- Steering grip ①
- Friction piece ②
- Spring ③
- Washer ④
- Washer (nylon) ⑤
- Screw ⑥
- Handle grip ⑦

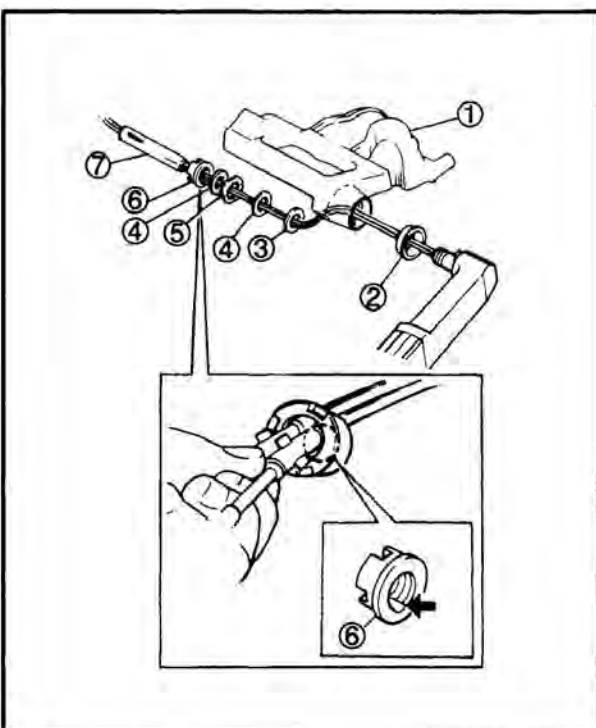
NOTE:

Fit the handle grip correctly.



7. Install:

- Steering handle ①
- Bolt (short) ②
- Bolt (long) ③

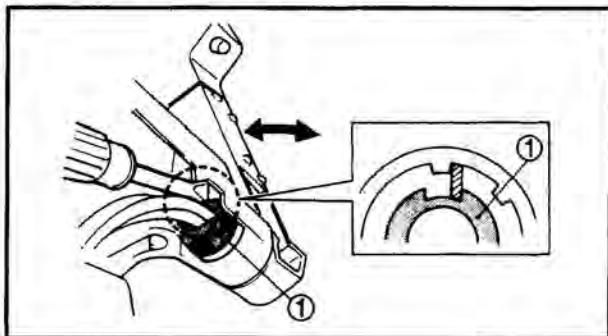


8. Install:

- Steering bracket ①
- Bushing ②
- Washer (nylon) ③
- Washer ④
- Wave washer ⑤
- Ring nut ⑥
- Tube ⑦

NOTE:

Pass the throttle and shift cables and stop switch leads through the steering handle on the steering bracket.

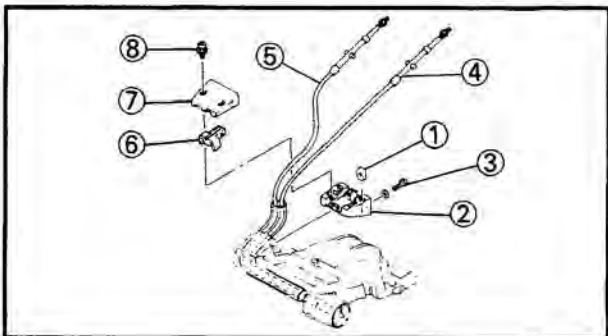


9. Tighten:

- Ring nut ①

NOTE:

Screw in the ring nut by hand until tight and fit a slotted-head screwdriver into the slit in the ring nut. Lock the screwdriver with the steering bracket and tighten the ring nut by moving the steering handle back and forth.



10. Install:

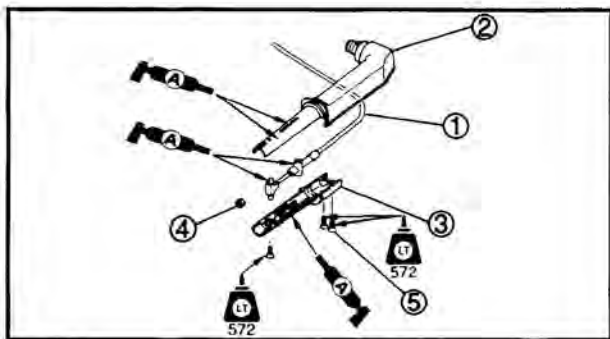
- Nut ①
- Bracket ②
- Bolt ③
- Shift cable ④
- Throttle cable ⑤
- Stopper bracket ⑥
- Fitting plate ⑦
- Screw ⑧

NOTE:

When installing the shift cable, set the shift lever in the forward position.

11. Adjust:

- Throttle cable length

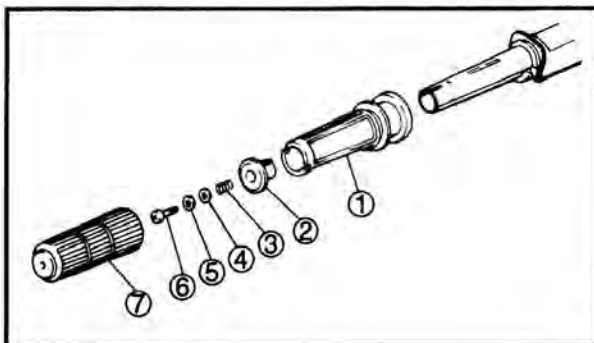
**STEERING HANDLE**

1. Install:

- Throttle cable ①
- Steering handle (upper) ②
- Steering handle (under) ③
- Nut ④
- Screw ⑤

NOTE:

Fit the inner cable end in the groove and fit the outer cable end into the hole.

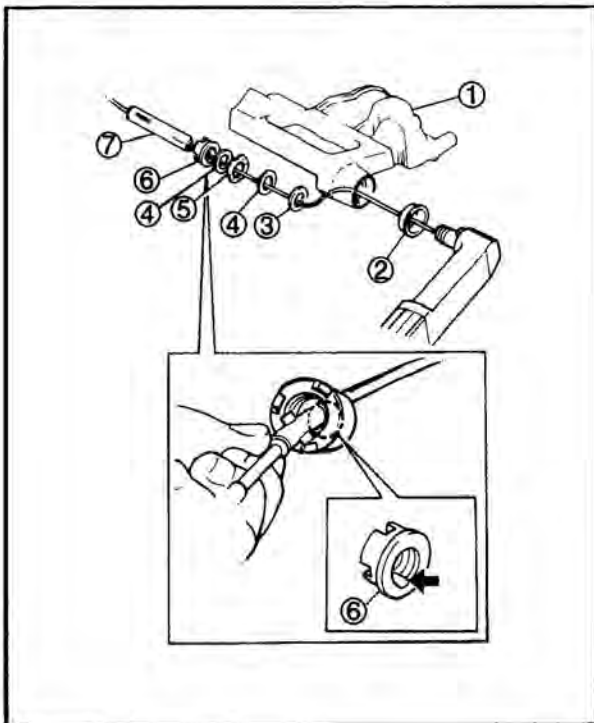


2. Install:

- Steering grip ①
- Friction piece ②
- Spring ③
- Washer ④
- Washer (nylon) ⑤
- Screw ⑥
- Handle grip ⑦

NOTE:

Fit the handle grip correctly.

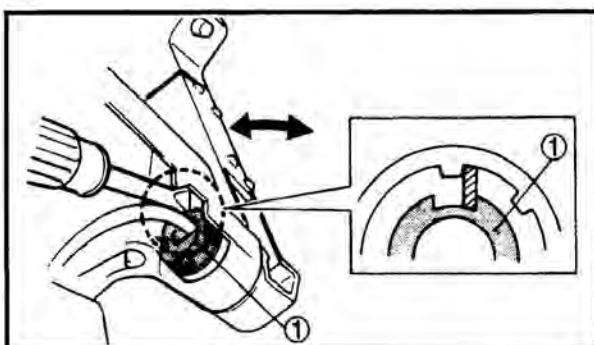


3. Install:

- Steering bracket ①
- Bushing ②
- Washer (nylon) ③
- Washer ④
- Wave washer ⑤
- Ring nut ⑥
- Tube ⑦

NOTE:

Pass the throttle cable through the steering handle on the steering bracket.

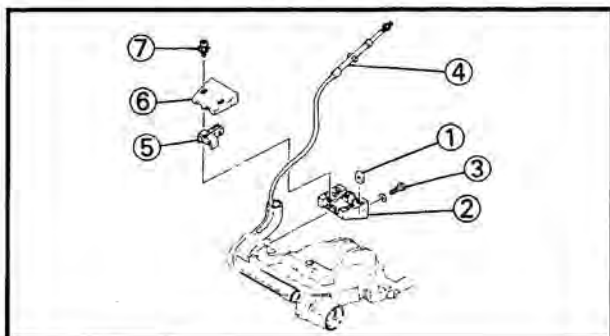


4. Tighten:

- Ring nut ①

NOTE:

Screw in the ring nut by hand until tight and fit a slotted-head screwdriver into the slit in the ring nut. Lock the screwdriver with the steering bracket and tighten the ring nut by moving the steering handle back and forth.

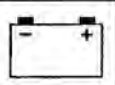


5. Install:

- Nut ①
- Bracket ②
- Bolt ③
- Throttle cable ④
- Stopper bracket ⑤
- Fitting plate ⑥
- Screw ⑦

6. Adjust:

- Throttle cable length

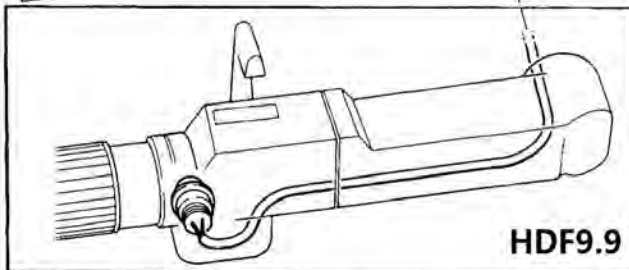
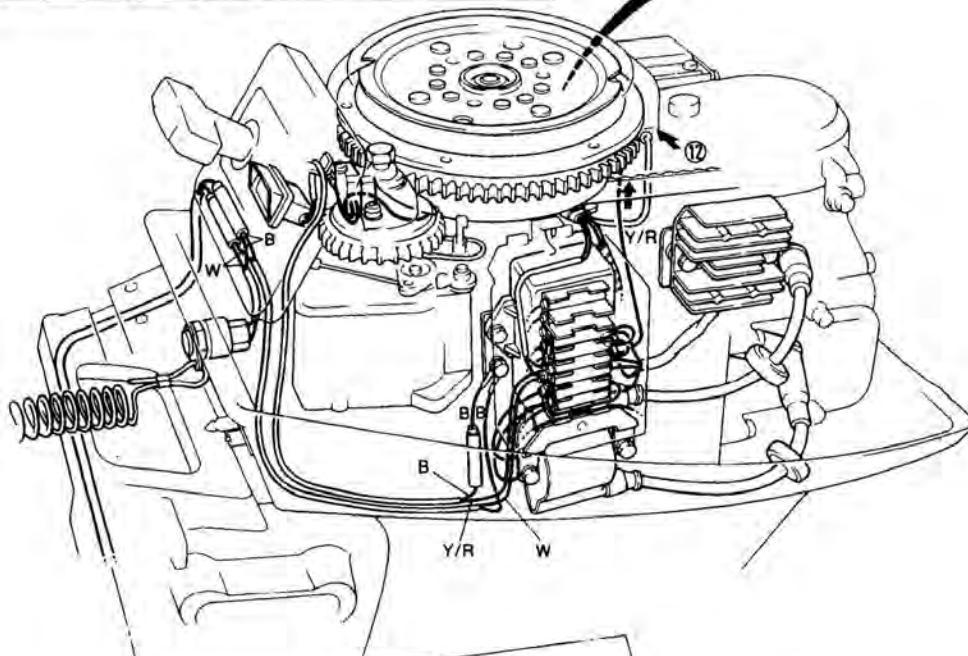
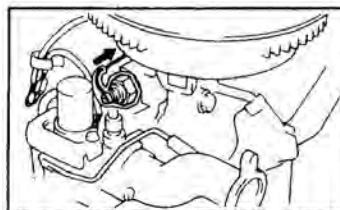
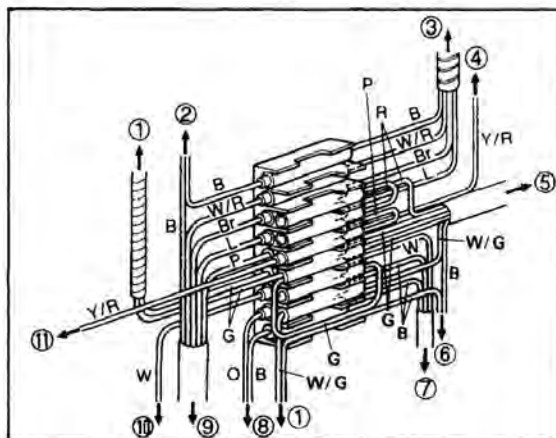

**ELECTRICAL COMPONENTS
MANUAL STARTER MODEL**

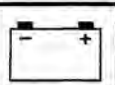
- ① Lighting coil
- ② Ground
- ③ Pulser coil/Charge coil
- ④ Oil-pressure switch
- ⑤ Rectifier regulator
- ⑥ Ground
- ⑦ CDI unit

- ⑧ Ignition coil
- ⑨ CDI unit
- ⑩ Engine stop switch
- ⑪ Oil-pressure indicator-lamp
- ⑫ Electrothermal valve

W/R : White/Red
 Br : Brown
 L : Blue
 B : Black
 W : White
 P : Pink
 Y/R : Yellow/Red

G : Green
 O : Orange
 G/W : Green/White
 R : Red


HDF9.9


ELECTRICAL STARTER MODEL

- | | |
|---------------------------|-------------------------------|
| ① Lighting coil | ⑩ Ignition coil |
| ② Ground | ⑪ CDI unit |
| ③ Fuse holder | ⑫ Engine stop switch |
| ④ Fuse holder | ⑬ Oil-pressure indicator-lamp |
| ⑤ Pulser coil/Charge coil | ⑭ Starter-switch |
| ⑥ Oil-pressure switch | ⑮ Starter relay |
| ⑦ Rectifier regulator | ⑯ Electrothermal valve |
| ⑧ Ground | |
| ⑨ CDI unit | |

W/R : White/Red

G/W : Green/White

Br : Brown

R : Red

L : Blue

B/W : Black/White

B : Black

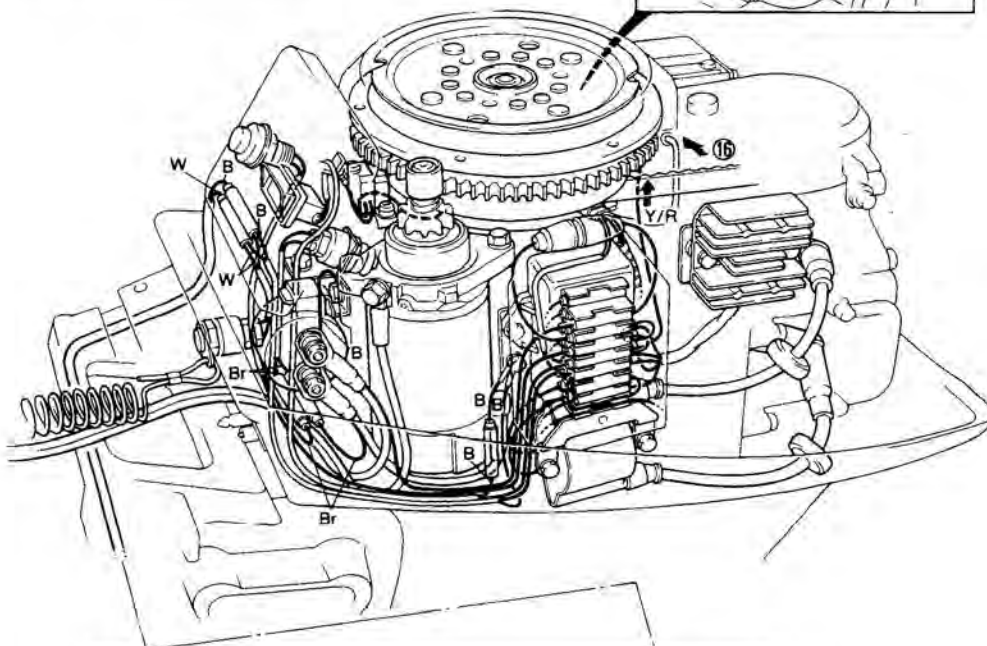
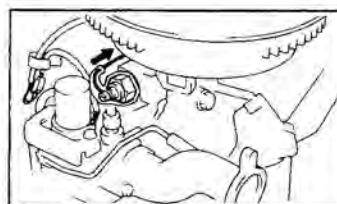
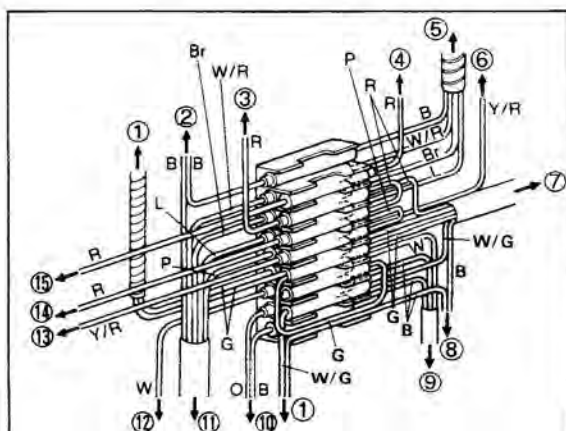
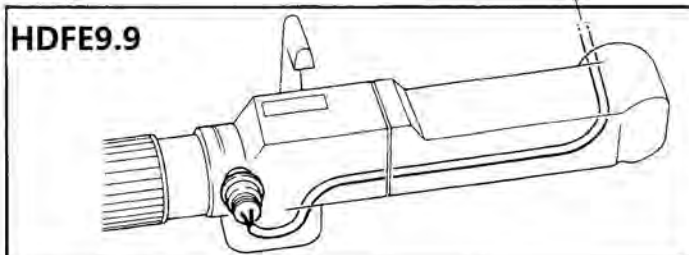
W : White

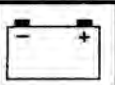
P : Pink

Y/R : Yellow/Red

G : Green

O : Orange


HDFE9.9




- | | |
|---------------------------|------------------------|
| ① Lighting coil | ⑩ Ignition coil |
| ② Ground | ⑪ CDI unit |
| ③ Fuse holder | ⑫ Wiring-harness |
| ④ Fuse holder | ⑬ Starter relay |
| ⑤ Pulser coil/Charge coil | ⑭ Electrothermal valve |
| ⑥ Oil-pressure switch | |
| ⑦ Rectifier regulator | |
| ⑧ Ground | |
| ⑨ CDI unit | |

W/R : White/Red

Br : Brown

L : Blue

B : Black

W : White

P : Pink

Y/R : Yellow/Red

G : Green

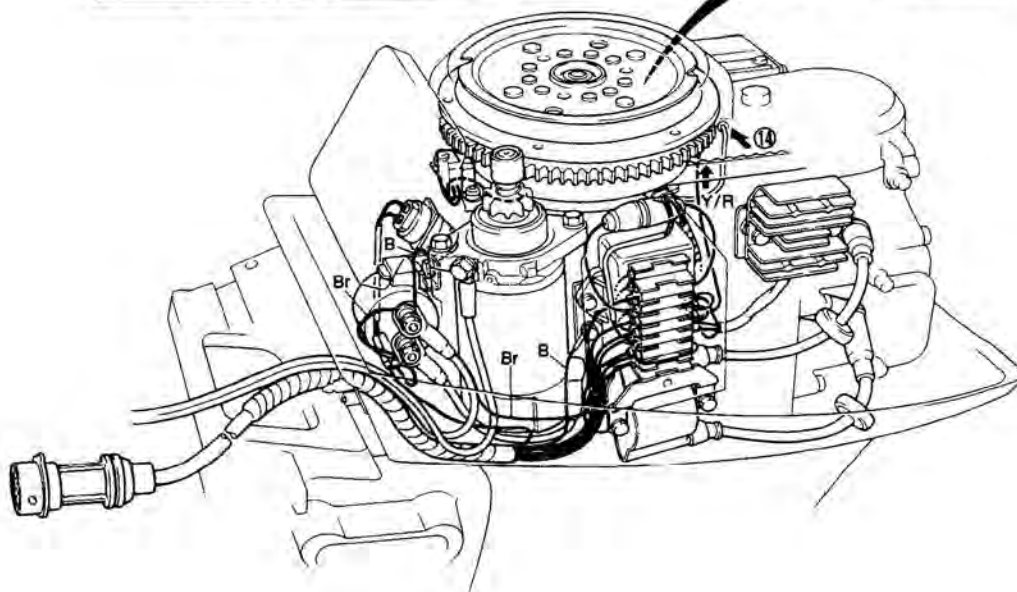
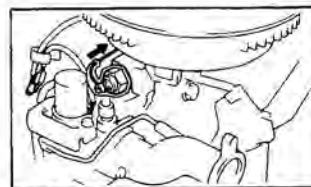
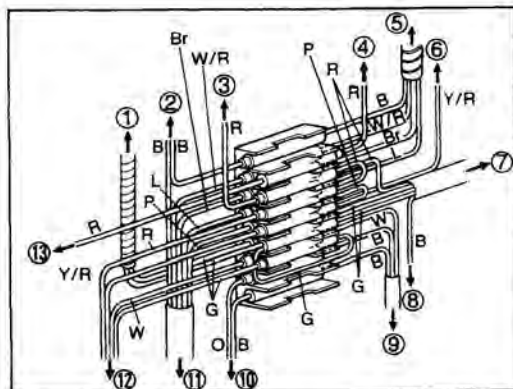
O : Orange

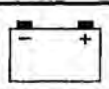
G/W : Green/White

R : Red

B/W : Black/White

Y : Yellow

HDFFE9.9




ELECTRICAL ANALYSIS INSPECTION

CAUTION:

All measuring instruments should be handled with special care or the correct measurement is impossible.

On an instrument powered by dry batteries, they should be checked for voltage periodically and replaced, if necessary.

NOTE:

"○—○" indicates the terminals between which there is a continuity of electricity; i.e., a closed circuit at the respective switch position.

Peak voltage measurement

NOTE:

- The coil output varies greatly at cranking speed.
- Proper readings cannot be found when cranking a cold engine with the spark plugs installed and with a weak battery.



Digital tester

Peak volt adapter

Low resistance measurement

When measuring the resistance of 10 Ω or less using the digital tester, the correct measurement cannot be obtained because of the tester's internal resistance.

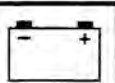
To obtain the correct value, subtract this internal resistance from the displayed measurement.



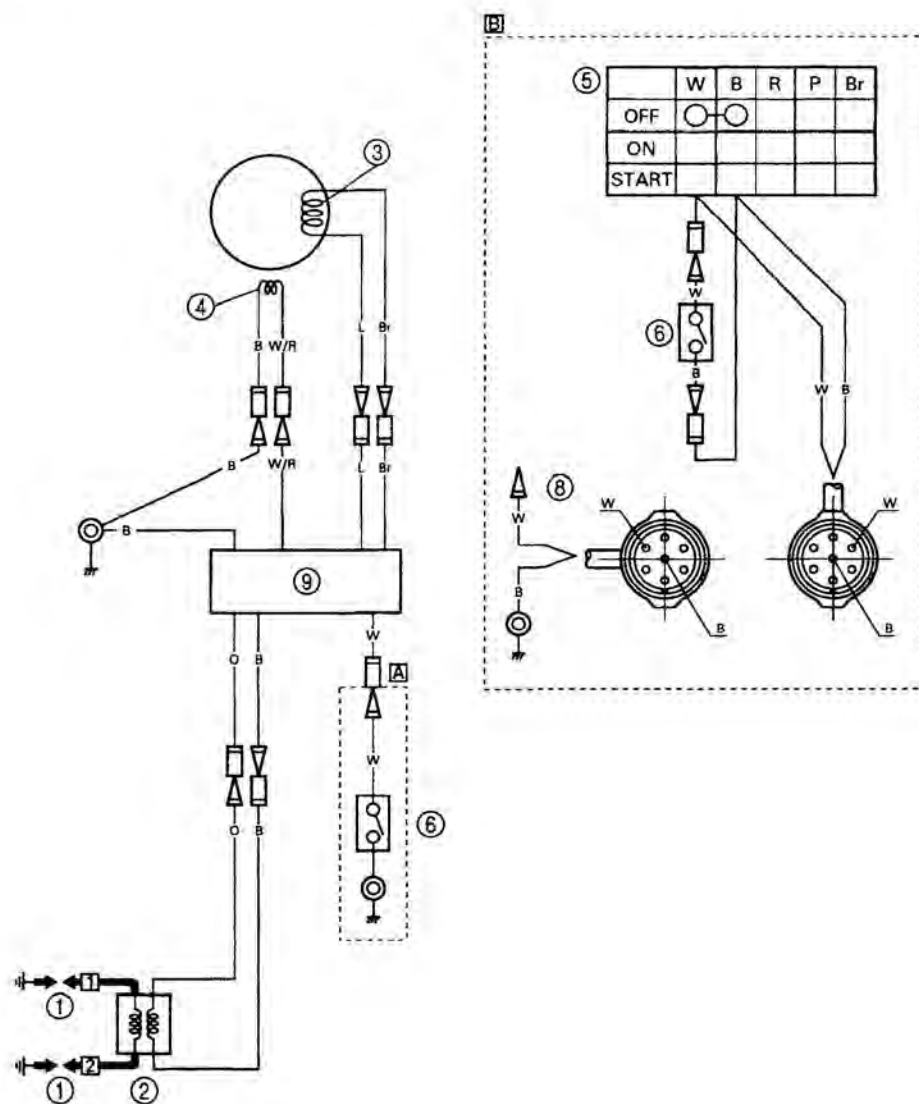
**Correct value =
Displayed measurement –
Internal resistance**

NOTE:

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



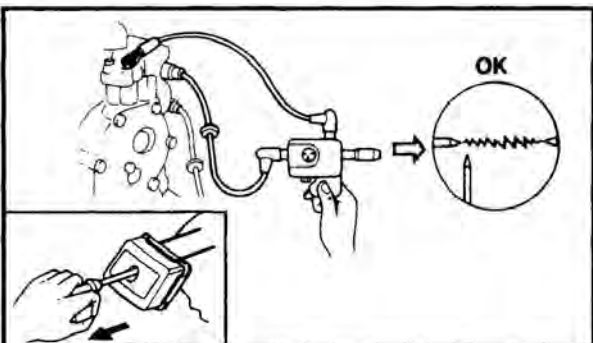
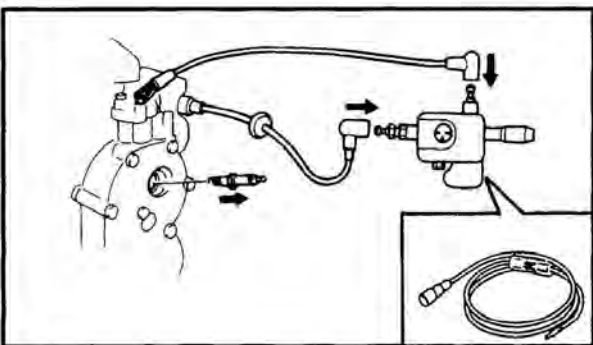
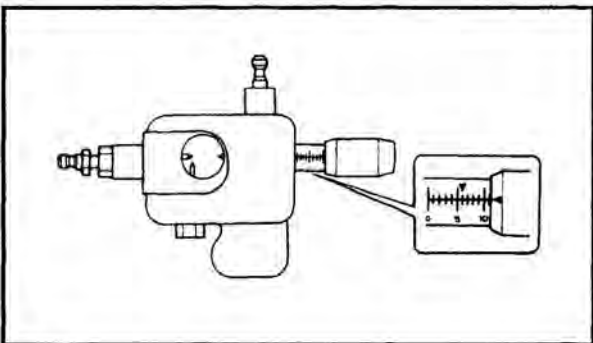
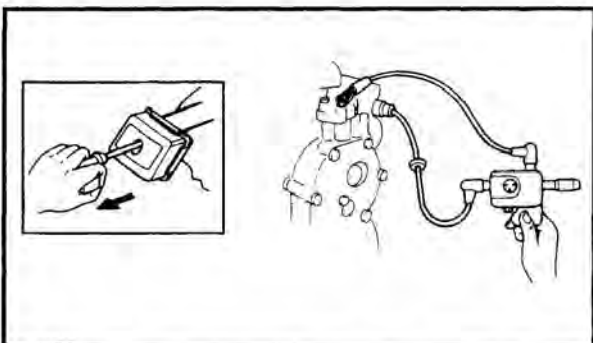
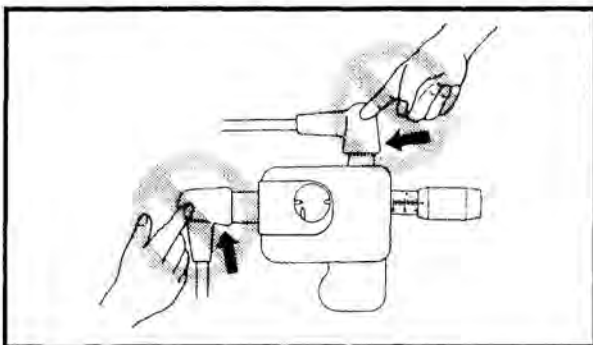
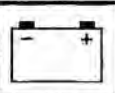
IGNITION SYSTEM WIRING DIAGRAM



- ① Spark plug
- ② Ignition coil
- ③ Charge coil
- ④ Pulser coil
- ⑤ Main switch
- ⑥ Stop switch
- ⑦ Engine stop switch
- ⑧ 7P coupler
- ⑨ CDI unit

- [A] Except for remote control model
- [B] For remote control model

- Br : Brown
- L : Blue
- W/R : White/Red
- B/O : Black/Orange
- B/W : Black/White
- W : White
- B : Black



IGNITION SPARK GAP

⚠ WARNING

- While checking the spark gap, be careful not to touch any connection of lead wires of the "Ignition spark gap tester".
- When doing the spark test, take special care not to allow leakage from the removed plug cap.
- This check is likely to produce sparks, so be sure that no flammable gas or fluid is in the vicinity.

1. Check:

- Ignition spark gap
Out of specification → Peak voltage measurement.



Spark gap:
9 mm (0.35 in)

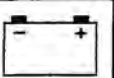
Checking steps:

- Adjust the spark gap to specification by turning the adjusting knob.



Spark gap tester

- Connect the spark-plug cap to the spark gap tester.
- Remove the spark plugs from the engine.
- Crank the engine and check the spark gap through the discharge window.



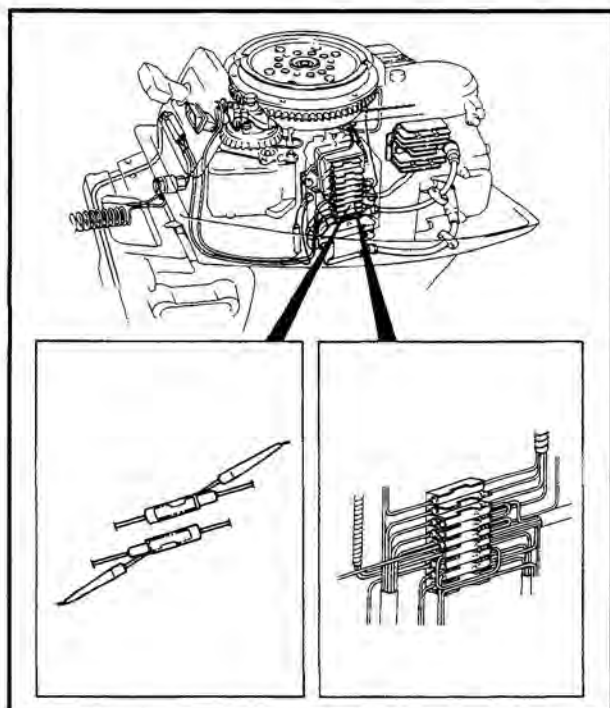
CDI SYSTEM PEAK VOLTAGE

⚠ WARNING

While taking a CDI unit check be careful not to touch any connection of lead wires.

NOTE:

- If there is no spark or the spark is weak, continue with the CDI test.
- If a good spark is obtained, the problem is not with the CDI system, but possibly the spark plug or another component is defective.



1. Measure:

- CDI unit output (test #1)

Below specification → Replace ignition coil.

HDF9.9



CDI output peak voltage:
(minimum)
(O – B)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	95	90	205	195

HDFFE9.9



CDI output peak voltage:
(minimum)
(O – B)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	85	85	195	170

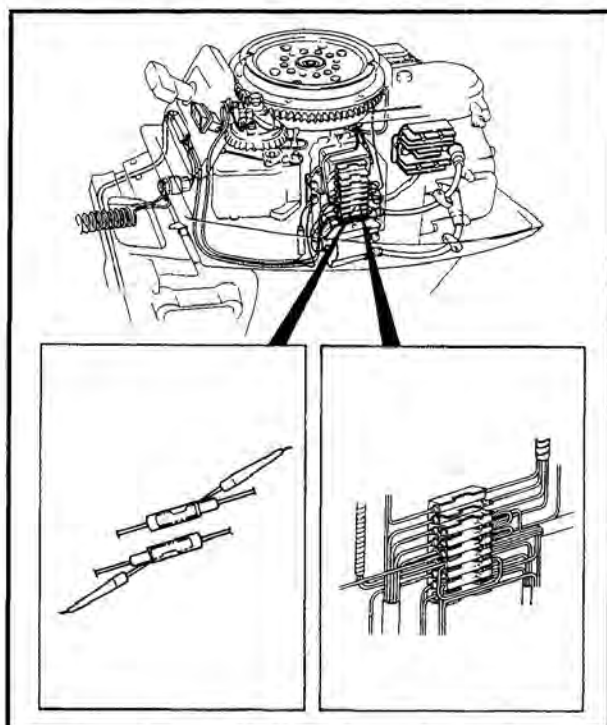
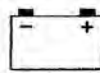
Measurement steps:

- Connect the tester to the CDI unit as shown.
- Set the tester dial to specification.



Range:
 $\bar{V}$

- Crank or start the engine.



2. Measure:

- Charge coil output (test #2)
Below specification → Replace charge coil.

HDF9.9



Charge coil output peak voltage:
(minimum)
(Br – L)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	100	150	220	210

HDFE9.9



Charge coil output peak voltage:
(minimum)
(Br – L)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	95	90	205	180

Measurement steps:

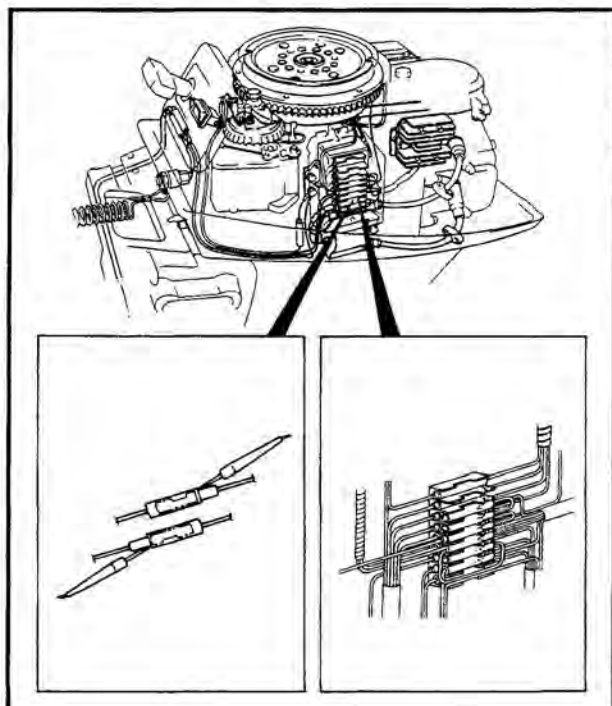
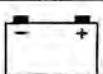
- Connect the tester to the charge coil as shown.
- Set the tester dial to specification.



Range:

$\bar{V}$

- Crank or start the engine.



3. Measure:

- Pulser coil output (test #3)

Beyond specification → Replace CDI unit.

Below specification → Replace pulser coil.

HDF9.9



Pulser coil output peak voltage:
(minimum)
(W/R - B)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	4.0	2.5	7.5	12.0

HDFFE9.9



Pulser coil output peak voltage:
(minimum)
(W/R - B)

r/min	Cranking		1,500	3,500
	Open	Connect		
V	3.5	2.5	7.5	13.0

Measurement steps:

- Connect the tester to the pulser coil as shown.
- Set the tester dial to specification.

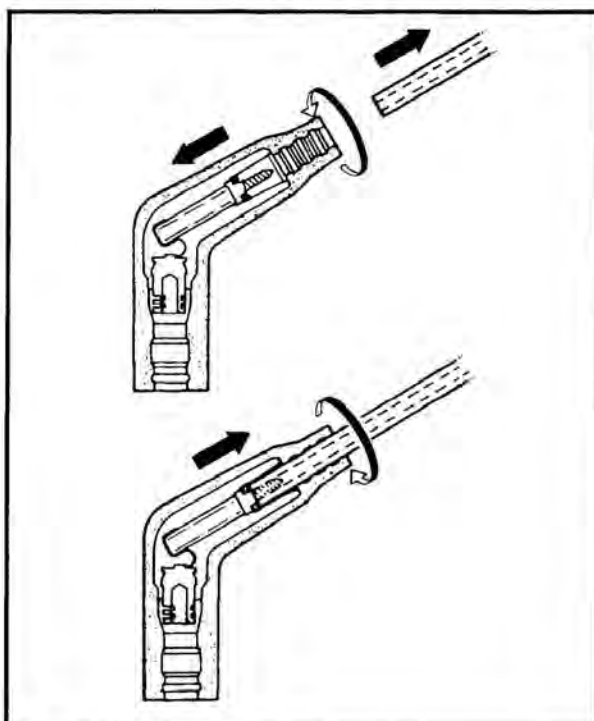
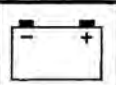


Range:
 $\bar{V}$

- Crank or start the engine.

SPARK PLUG

Refer to "PERIODIC SERVICE"

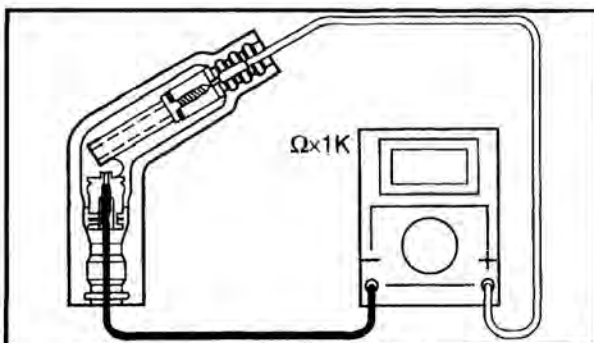
**SPARK PLUG CAP**

1. Inspect:

- Spark plug cap
- Loosen → Tighten.
- Crack/Damage → Replace.

Replacement steps:

- Remove the spark-plug cap by turning the cap counterclockwise.
- Install the spark-plug cap by turning the cap clockwise until it stops.

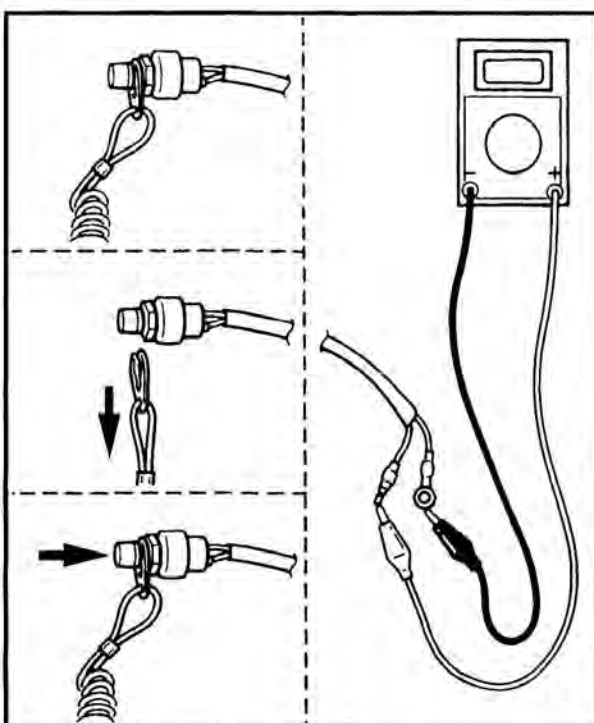


2. Measure

- Spark plug cap resistance
- Out of specification → Replace.



Spark plug cap resistance:
4.0 ~ 6.0 kΩ

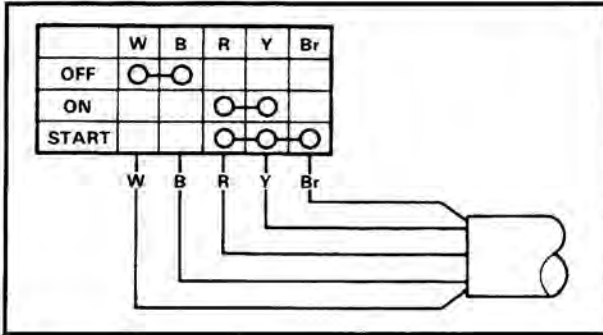
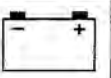
**ENGINE STOP SWITCH**

1. Check:

- Continuity
- Out of specification → Replace.



HDF9.9		Leads color	
		White	Black
	Installed		
	Removed	○	○



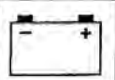
MAIN SWITCH

1. Check:

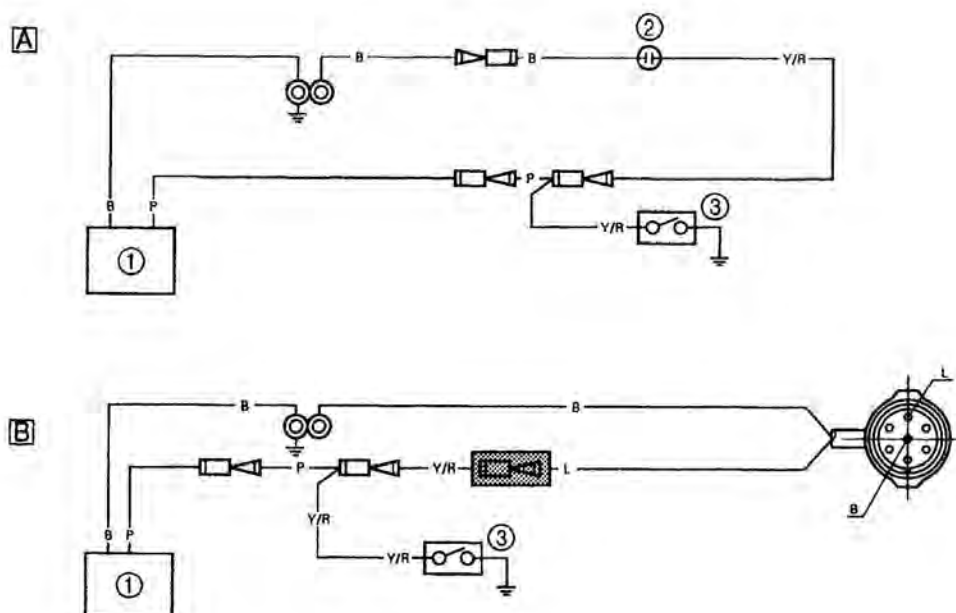
- Continuity

Out of specification → Replace.

	Leads color				
	White	Black	Red	Yellow	Brown
Switch position					
OFF	○	○			
ON			○	○	
START			○	○	○



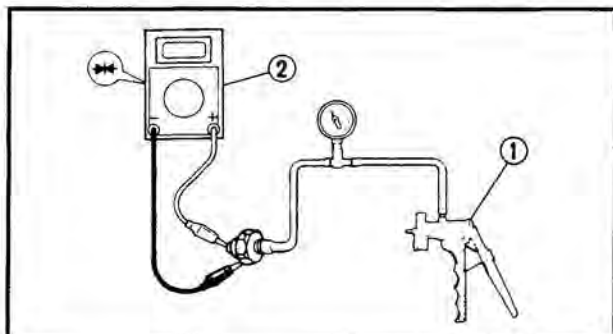
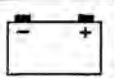
IGNITION CONTROL SYSTEM WIRING DIAGRAM



- ① CDI unit
- ② Oil pressure indicator-lamp
- ③ Oil pressure switch

- A Except for remote model
- B For remote model

B : Black
L : Blue
P : Pink
Y/R : Yellow/Red

**OIL PRESSURE SWITCH**

1. Measure:

- Continuity

Out of specification → Replace.

Measurement steps:

- Connect the Mity Vac ①.
- Connect the tester ②.

**Mity Vac**

- Apply the specified pressure.

**Oil pressure switch:**

0 ± 10 kPa
(0 ± 0.1 kg/cm²,
0 ± 1.4 psi)

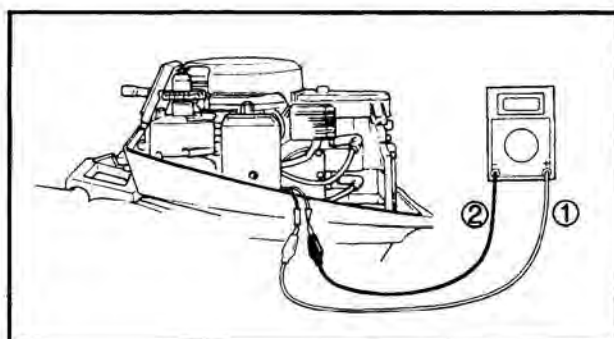
Continuity

60 ± 10 kPa
(0.6 ± 0.1 kg/cm²,
8.5 ± 1.4 psi)

Discontinuity**OIL PRESSURE INDICATOR LAMP**

1. Check:

- Oil pressure indicator lamp operation
- Out of specification → Replace.

**Checking steps:**

- Connect the digital tester for engine side leads.

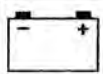
① **Pink lead → Positive terminal**② **Black lead → Negative terminal**

- Start the engine.
- Check the voltage of output.



Output voltage:
More than AC 65V

- Stop the engine.
- Connect the oil pressure indicator lamp to engine side leads.
- Start the engine.
- Check the oil pressure indicator lamp for green indication.

**⚠ WARNING**

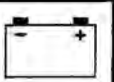
Be careful not to touch the ignition system leads while performing testing. High voltage electric shock may cause injury.

CAUTION:

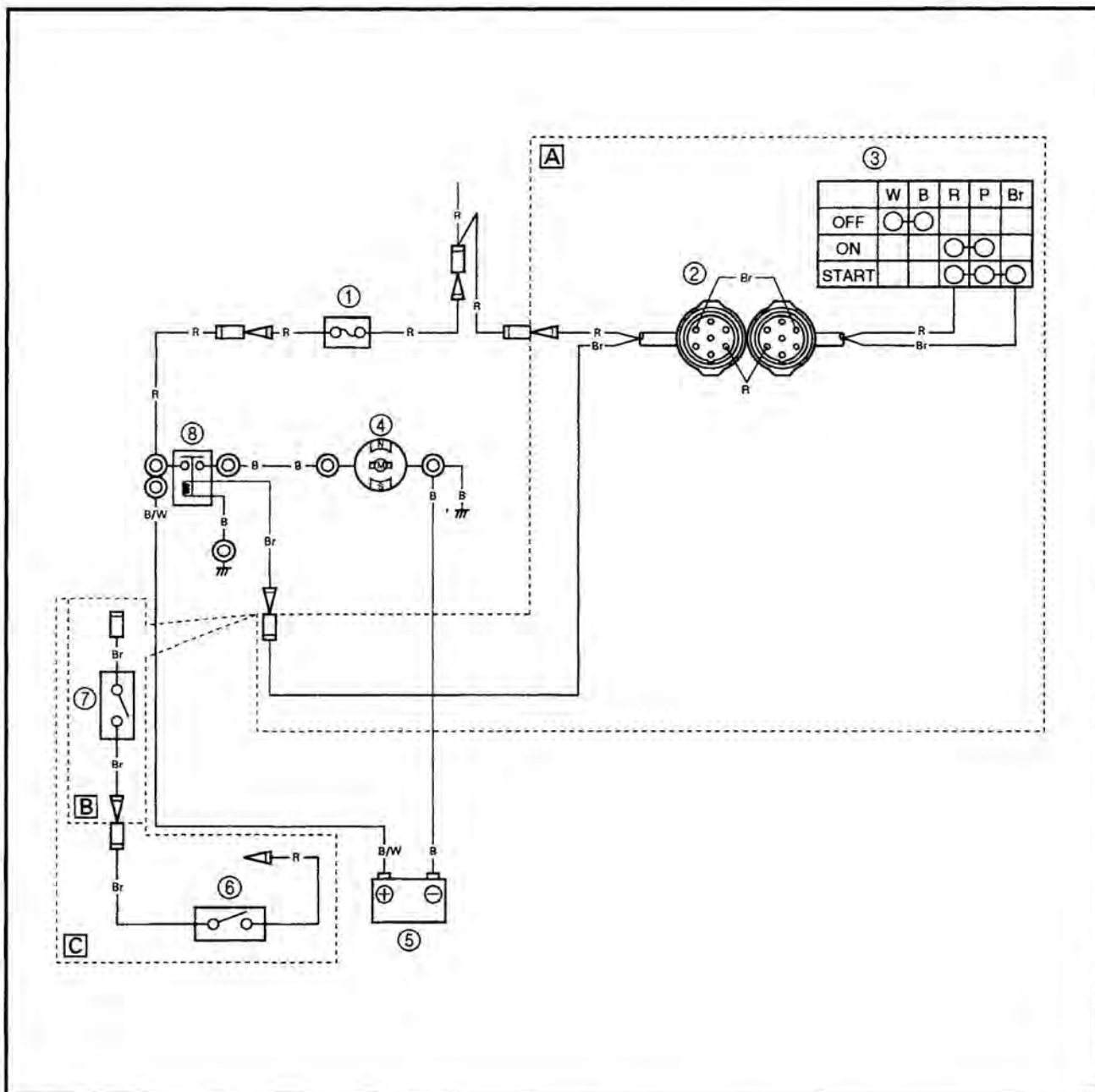
Make the test with the motor placed in a test tank.

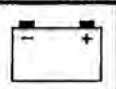
NOTE:

Before testing the oil pressure indicator lamp operation, oil pressure switch should be tested.



**STARTING SYSTEM
WIRING DIAGRAM**



**BATTERY**

Refer to "PERIODIC SERVICE"

FUSE

1. Check:

- Fuse

Blown → Replace.



Fuse rating:
12V - 20 A

WIRING HARNESS

1. Check:

- Continuity

Discontinuity → Replace.

WIRING CONNECTION

1. Check:

- Wiring connection

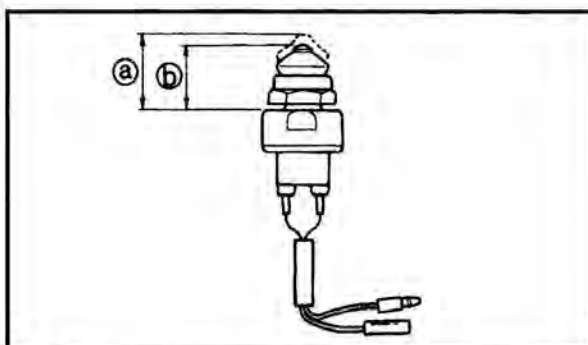
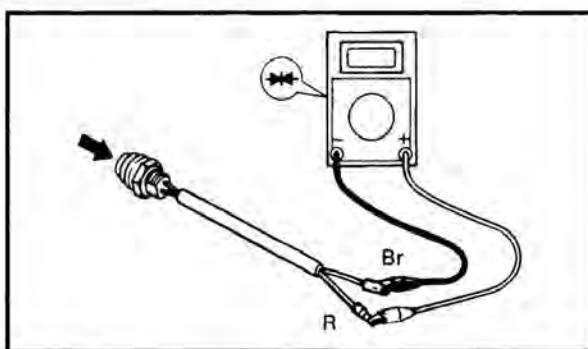
Poor connection → Correct.

ENGINE STOP SWITCH

Refer to "IGNITION SYSTEM".

MAIN SWITCH

Refer to "IGNITION SYSTEM".

**STARTER SWITCH**

1. Check:

- Continuity

Out of specification → Replace.



	Leads color	
	Red	Brown
Free		
Push		

NEUTRAL SWITCH

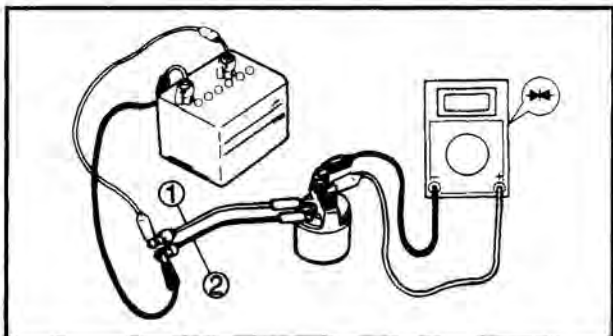
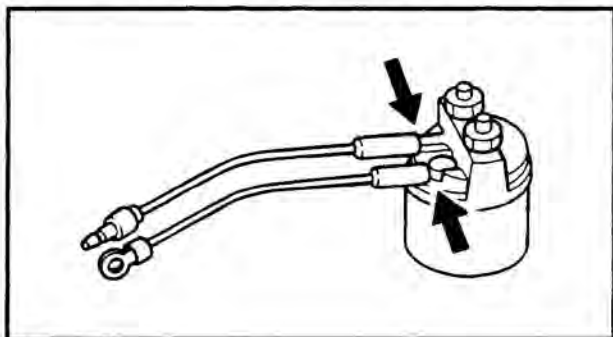
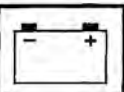
1. Check:

- Continuity

Out of specification → Replace.



	Length	Leads color	
		Brown	Brown
Free a	19.5 ~ 20.5 mm (0.77 ~ 0.81 in)		
Push b	18.5 ~ 19.5 mm (0.73 ~ 0.77 in)		

**STARTER RELAY**

1. Inspect:

- Brown lead terminal
 - Black lead terminal
- Loose → Tighten.

2. Check:

- Relay operation
- Does not function → Replace.

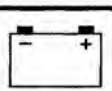
Checking steps:

- Connect the tester between the terminals of the starter relay as shown.
- Connect a 12V battery.

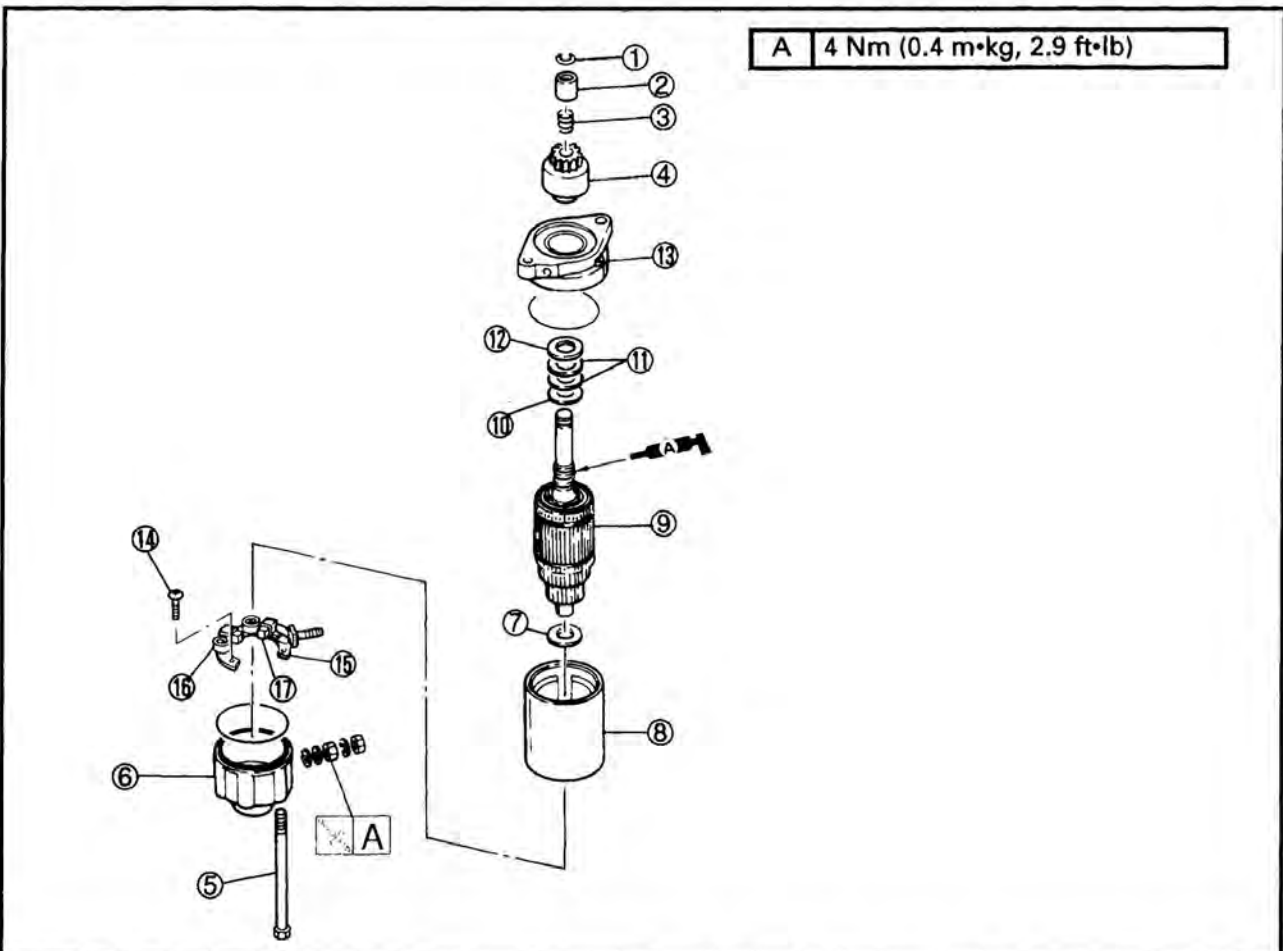
Brown lead ① → Positive terminal

Black lead ② → Negative terminal

- Check that there is continuity between the starter relay terminals.

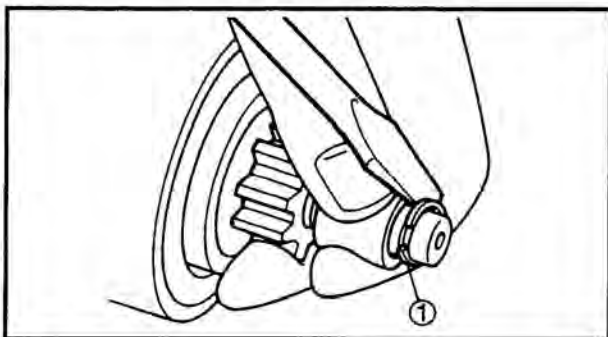
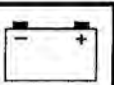


STARTER MOTOR



Extent of removal: ① Starter motor disassembly ② Brush disassembly

Extent of removal	Order	Part name	Q'ty	Remarks
	1	Clip	1	Always use a new circlip Refer to "REMOVAL POINTS".
	2	Pinion stopper	1	
	3	Spring	1	
	4	Pinion	1	
	5	Through bolt	2	
	6	Rear cover	1	t = 0.25 mm
	7	Washer	1	
	8	Stator	1	
	9	Armature	1	t = 2.0 mm
	10	Washer	1	
	11	Washer	1	
	12	Washer	1	t = 0.15 mm
	13	Front cover	1	t = 1.0 mm
	14	Screw	1	
	15	Brush holder	1	
	16	Brush spring	2	
	17	Brush	2	

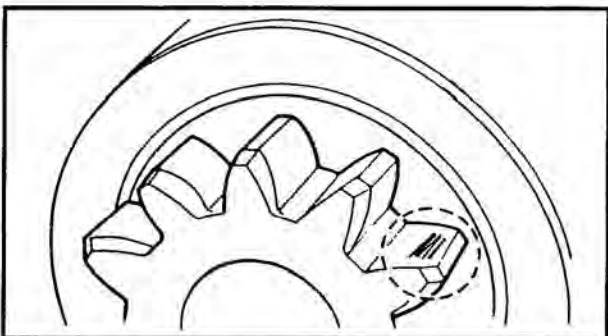
**SERVICE POINTS****Pinion removal**

1. Remove:

- Clip ①

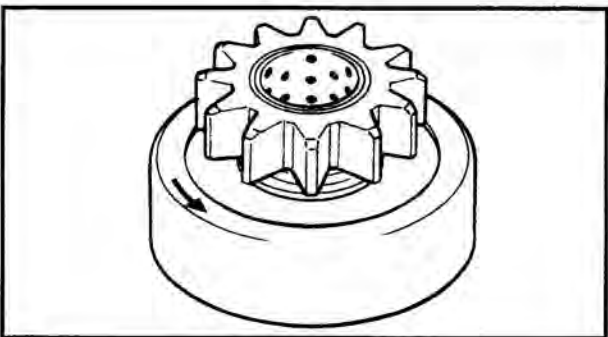
NOTE:

Using a pry-bar, pry off the clip.

**Pinion inspection**

1. Inspect:

- Pinion teeth
Wear/Damage → Replace.

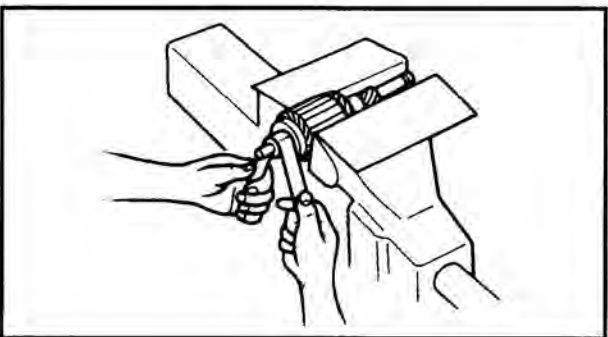


2. Check:

- Clutch movement
Damage → Replace.

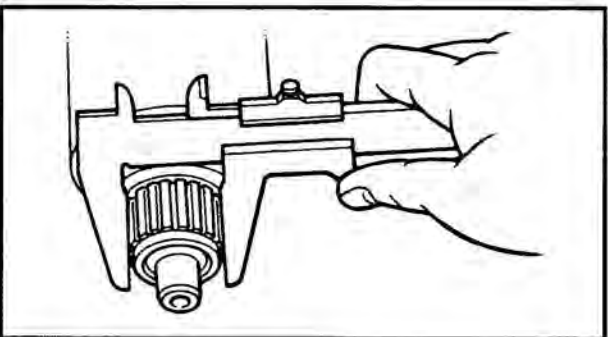
NOTE:

Rotate the pinion clockwise and check that it moves freely. Also, try to rotate the pinion counterclockwise and confirm that it locks.

**Armature inspection**

1. Inspect:

- Commutator
Dirty → Clean with #600 abrasive paper.

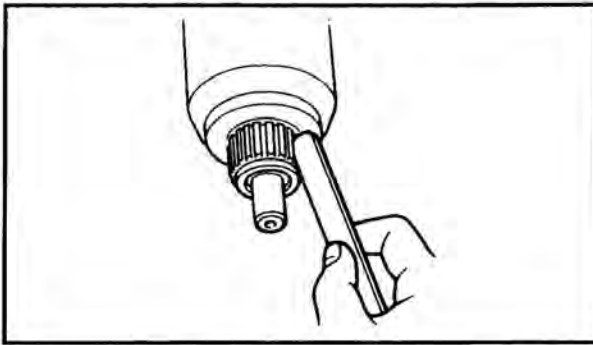
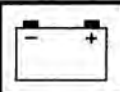


2. Measure:

- Commutator diameter
Out of specification → Replace.



Commutator diameter:
29.0 ~ 30.0 mm (1.14 ~ 1.18 in)

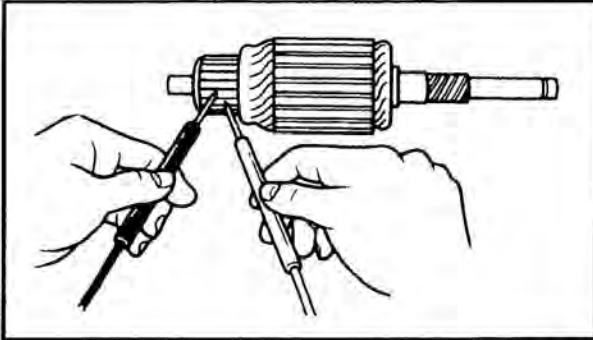


3. Check:

- Commutator under cut
Clog/Dirty → Clean.

NOTE:

Remove all metal particles with compressed air.

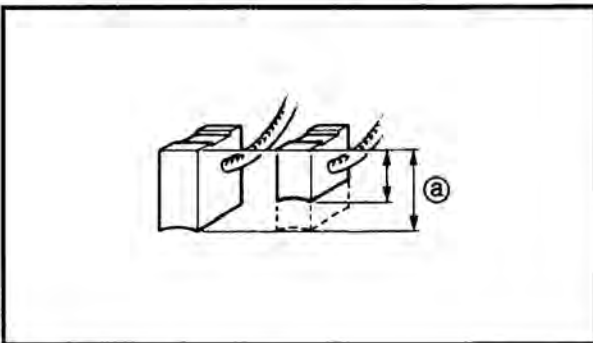
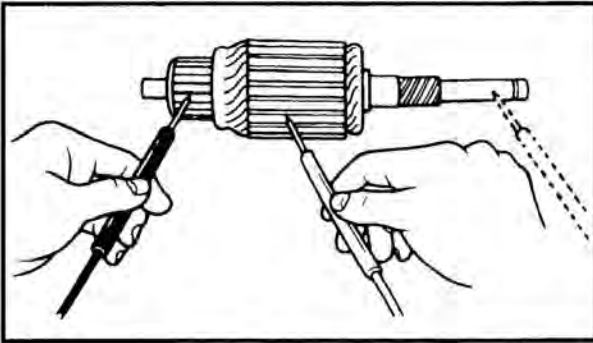


4. Inspect:

- Armature coil continuity
Out of specification → Replace.

**Armature coil continuity:**

Commutator segments	Continuity
Segment - Laminations	Discontinuity
Segment - Shaft	Discontinuity

**Brush holder inspection**

1. Measure:

- Brush length ①
Out of specification → Replace.



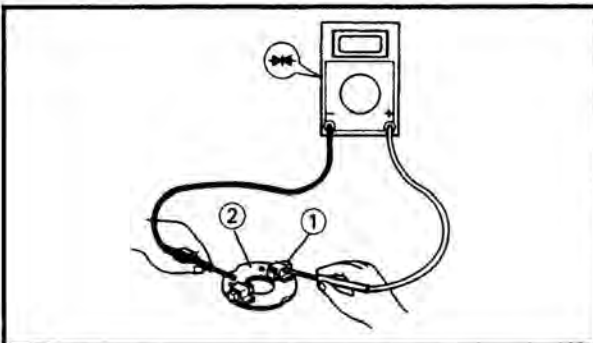
Brush length ①:
9.0 ~ 12.5 mm (0.35 ~ 0.49 in)

2. Check:

- Brush holder continuity
Out of specification → Replace.

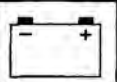
**Brush holder continuity:**

Brush holder ① - Base ②	Discontinuity
-------------------------	---------------

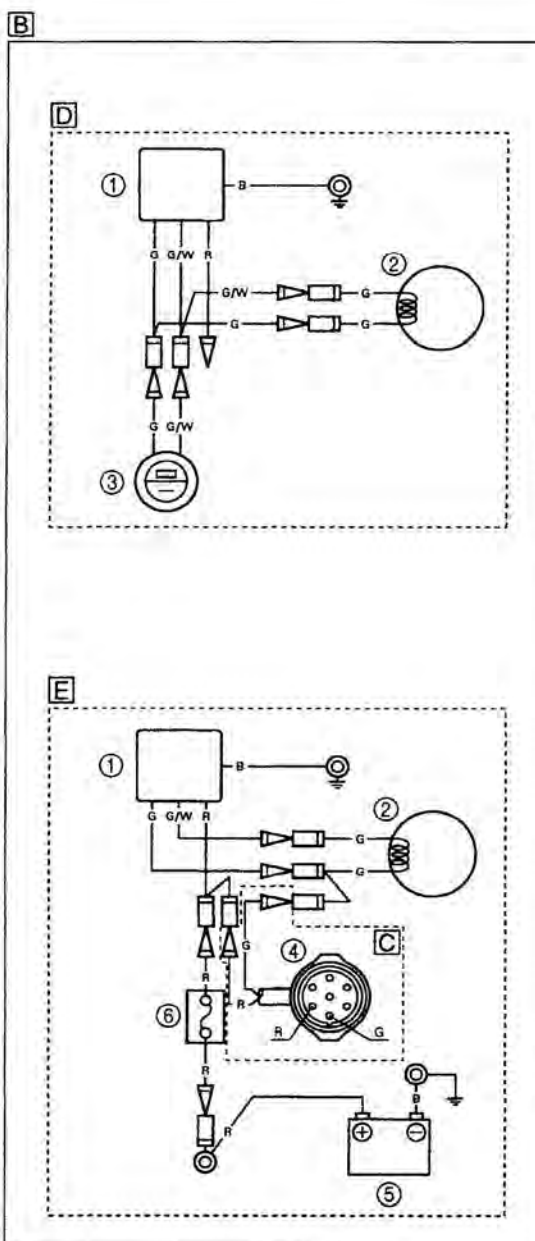
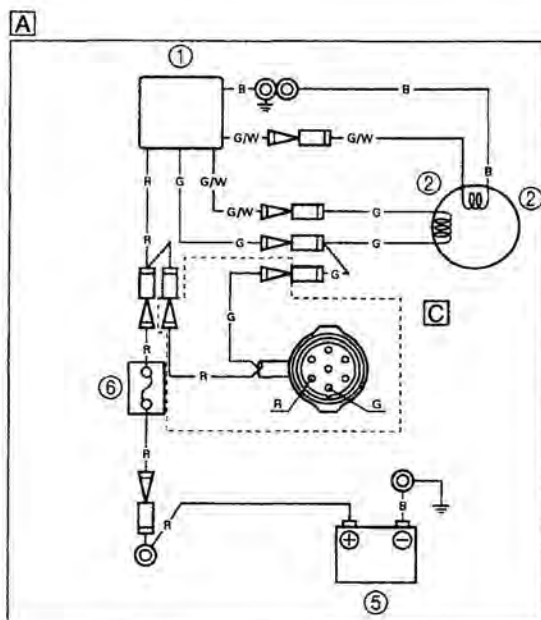
**Cover inspection**

1. Inspect:

- Cover bushing
Wear/Damage → Replace the cover.

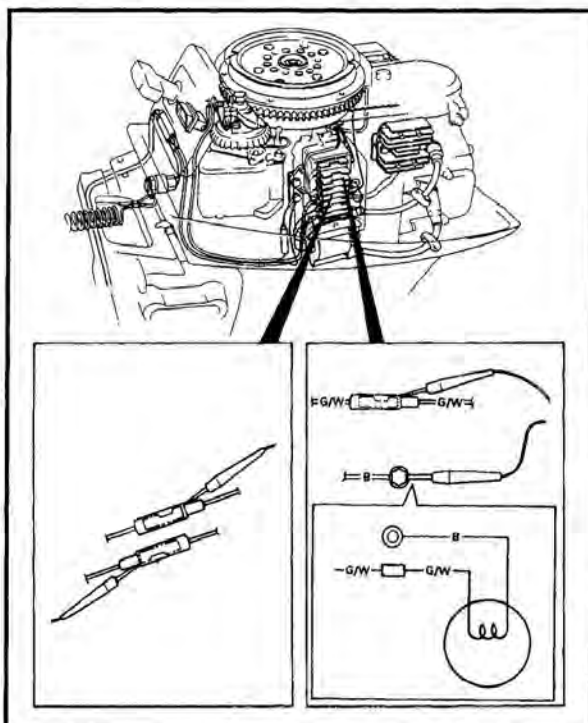
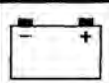


CHARGING SYSTEM WIRING DIAGRAM



- ① Rectifier regulator
- ② Lighting coil
- ③ 2P connector
- ④ 7P coupler
- ⑤ Battery
- ⑥ Fuse

G : Green
 G/W : Green/White
 R : Red
 B : Black



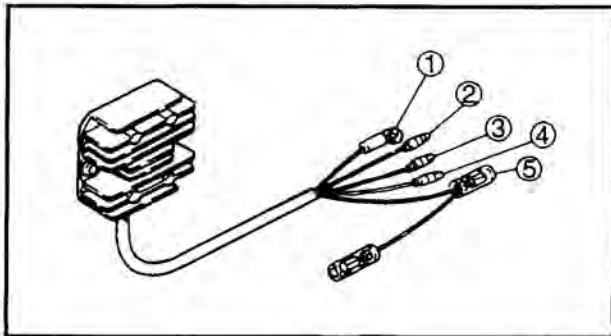
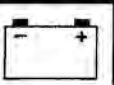
CHARGING SYSTEM PEAK VOLTAGE

1. Measure:

- Lighting coil output
Beyond specification → Rectifier regulator/rectifier measurement.
Below specification → Replace lighting coil.

Lighting coil output peak voltage: (minimum) (G - G)				
r/min	Cranking		1,500	3,500
	Open	Connect		
V	9.0	9.0	35	75

Lighting coil output peak voltage: (minimum) (G/W - B)				
r/min	Cranking		1,500	3,500
	Open	Connect		
V	8.0	8.0	30	65



RECTIFIER REGULATORS

1. Measure:

- Voltage drop

Out of specification → Replace.

Measurement steps:

- Select the function switch of digital tester to Diode inspection mode.
- Measure the voltage drop.

Tester ⊖	Tester ⊕	① Black	② Green/ White	③ Green	④ White/ Green	⑤ Red
① Black			0.50 ~ 0.70	*	0.75 ~ 1.05	*
② Green/White		0.30 ~ 0.50		*	0.30 ~ 0.50	*
③ Green		0.30 ~ 0.50	0.75 ~ 1.05		0.95 ~ 1.25	*
④ White/Green		*	*	*		*
⑤ Red		0.65 ~ 0.85	0.30 ~ 0.50	0.30 ~ 0.50	0.65 ~ 0.85	

* Measured value is not affected by tester leads connection.

TROUBLE ANALYSIS
NOTE:

The following items should be checked before the "Trouble analysis" chart is consulted.

1. The battery is charged and its specific 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 attached to the engine stop switch.
5. The shift position is neutral.
6. Fuel is reaching the carburetor.
7. The rigging and engine settings are correct.
8. Engine is free from any "Hull problem".

TROUBLE ANALYSIS CHART

Problem											Check	
ENGINE WILL NOT START	ROUGH IDLING	ENGINE STALLS	POOR DECELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	OVERHEATING	LOOSE STEERING	LOOSE TILT HOLDING	SHIFTING DIFFICULT	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Related part
											FUEL SYSTEM	
☐		☐			☐							Fuel hose
☐					☐							Fuel joint
☐	☐				☐							Fuel filter
☐					☐							Fuel pump
☐	☐				☐							Carburetor
	☐	☐										● Idle speed
	☐	☐				☐						● Pilot screw
											POWER UNIT	
☐	☐	☐		☐		☐						Spark plug
☐	☐				☐							Compression
☐												Timing belt
☐												Tappet clearance
☐	☐				☐							IN, EX. valve
☐	☐				☐							IN, EX. valve seat
☐												Cylinder head gasket
☐					☐							Piston ring
☐					☐							Piston
						☐						Thermostat
						☐						Water passage

Problem											Check	
ENGINE WILL NOT START	ROUGH IDLING	ENGINE STALLS	POOR DECELERATION	ENGINE WILL NOT STOP	POOR PERFORMANCE	OVERHEATING	LOOSE STEERING	LOOSE TILT HOLDING	SHIFTING DIFFICULT	IRREGULAR WARNING INDICATION	POOR BATTERY CHARGING	Related part
											LOWER UNIT	
☐									☐			Neutral position
☐									☐			Clutch
☐									☐			Gear
					☐	☐						Water inlet
					☐	☐						Water pump
					☐							Propeller shaft
									☐			Shifter/Pin
									☐			Shift cam
									☐			Shift shaft
									☐			Lower case
											BRACKET UNIT	
							☐					Bracket
							☐					Mount rubber
											ELECTRICAL	
☐	☐	☐			☐							Ignition system
☐				☐								Starting system
	☐	☐			☐							Enrichment control system
					☐					☐		Ignition control system

WIRING DIAGRAM

