TOHATSU OUTBOARD MOTOR

M120A/M140A

SERVICE MANUAL

OCT 1990

CONTENTS

1 SPECIFICATIONS

Model				M120A	M140A
Dimensions	Total length		mm (inch)	Approx. 747 (29.4)	
	Total width		mm (inch)	Approx. 390 (15.3)	
	Total height		mm (inch)	Transom L: Approx. 1,560 (61.4)	
				Transom UL: Approx. 1,687 (66.4)	
Transaom height			mm (inch)	L: 517 (20.3) UL: 644 (25.3)	
Weight			kg (lbs)	L: Approx. 158 (348.3) UL: Approx. 161 (354.9)	
Performance	Max. output		kW (PS)	88.3 (120)	103 (140)
	Full speed operation range		RPM	5,200 – 5,700	
	Fuel oil consumption at full throttle			Approx. 50 liter/hr (13.2 gal/hr)	Approx. 58 liter/hr (15.32 gal/hr)
Engine	Number of cylinder			4	
	Bore & stroke		mm (inch)	88 × 72.7 (3.46 × 2.86)	
	Displacement		cc (cu. inch)	1,768.8 (107.94)	
	Lubrication			Auto mixing system	
	Fuel			Premium (super) gasoline with pump posted octane rating of over 89 (research octane rating of 91)	
	Engine oil			Tohatsu genuine 2-cylcle Engine Oil: SUPER GOLD	
	Mixing ratio (Auto mixing system)			50:1 – 120:1	
	Oil tank			Integral tank (capacity 6.5 liters 1.7 gals)	
	Cooling system			Pressurized system cooling (by rubber impeller)	
	Cooling water temperature control			Thermostat (with pressure relief valve)	
	Intake system			Reed valve	
	Scavenging system			Schnürle 5 ports	
	Starting system			Electric starter motor (12V 1.0 kW)	
	Ignition system			Contact pointless CD ignition type magneto	
	Alternator			12V 330W	
	Rectifier			Three phase full wave rectification with voltage regulator	
	Spark plugs			NGK B8HS-10 or CHAMPION L78C (gap 1mm)	
	Number of carburetor			4 in series	
	Engine rotation			Clockwise	
	Ignition timing			ATDC 10° – BTDC 17.5°	ATDC 10° – BTDC 20°
	Trolling RPM			550 – 750	
Lower Unit	Trim stage			5 (8° – 24°)	
	Tilt up angle			Approx. 76°	
	Max. steering angle			Approx. 60° (using drag link)	
	Power trim and tilt			Manifold type (3 cylinders with shock absorber)	
	Shifting system			Dog clutch (F-N-R)	
	Gear ratio			13:26	
	Exhaust system			Through propeller hub	
Others	Operation			Remote control	
	Fuel supply from tank			Fuel line with primer bulb	
	Standard propeller			A 19	
	Multi-purpose meter (standard equipment)	Tachometer		Poles (4·6·12) selecting type (M120A/M140A have 12 poles)	
		Trm, guage			
		Oil guage			
		Temperature guage			
	Remote control box			RC 5E type with : warning buzzer { low oil level, overheating, low water pressure } : neutral lock : neutral switch : safety switch : lever friction adjuster : terminal for accessory : main switch	

Model		M120A	M140A
Others	Engine protection devices	• High speed ESG (over revolving prevention device) • Mid-speed ESG (activated by low water pressure or low engine oil levels at less than 1.5 liters (0.36 US.gal)) • Overheating sensor • Engine speed detector water pressure sensor • Engine oil level sensor and alarm (activated by engine oil levels of 3 liters (0.79 US. gal) and 1.5 liters (0.36 US. gal) respectively) • Engine oil filter (oil-water separator type) • Engine knocking sensor (M140A only) • Power trim and tilt assembly return function equipped with shock absorbers	
Optional parts	Propeller (Number of blades x diameter x pitch in inches)	A11 (3 × 14.0 × 9.4) A13 (3 × 13.6 × 12.4) A15 (3 × 13.5 × 14.6) A17 (3 × 13.5 × 15.7) A19 (3 × 12.9 × 18.0) A21 (3 × 13.0 × 20.3) A23 (3 × 13.0 × 21.8) A25 (3 × 13.0 × 24.5)	
	Hour meter		
	Fuel guage		
	Speedometer	50 MPH kit B, 70 MPH kit B	
	Water pressure guage		
	Water temperature guage		
	Voltage meter		
	Drive cleaner kit		
	Tie-bar kit for dual motor (mounting)		
	Twin remote control box kit		
	Binnacle mounted remote control box		

2 PRECAUTIONS DURING DISASSEMBLY AND RE-ASSEMBLY

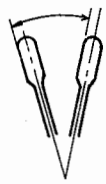
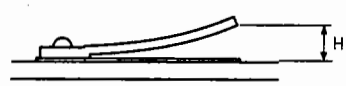
① Secure the outboard motor to a work stand during repairs.
② Take care not to damage the painted surfaces or the adjacent faces of the cylinders and crank cases, etc.
③ After disassembly, replace packings, gaskets, O-rings, oil seals, spring pins, snap rings, and locking plates, replace also any bolts fouled with screw locking agent.
④ Always replace parts with genuine TOHATSU parts, and apply TOHATSU genuine oil.
⑤ Always use the proper tools and follow the correct procedures.
⑥ Pay special attention to the markings on parts when disassembling, and make simple identification marks on un-marked parts for easier re-assembly.
⑦ Clean disassembled parts and inspect for wear and damage.
⑧ When re-assembling, pay careful attention to details such as the precise fitting of parts, airtightness, avoiding obstruction of oil and grease supply holes, gaskets, packings, wiring and piping. For parts which use many nuts and bolts, systematically tighten diagonally opposite nuts and bolts, starting with large guage bolts and ending with small guage bolts. Work from the inside to the outside to ensure tightening the bolts securelv.
⑨ When inserting oil seals, be careful not to damage the lips and make sure the seals face in the correct direction.
Apply only specified grease to the lips.
⑩ When applying liquid packing material, be careful to use the proper thickness and quantity. If the quantity is too great the excess may overflow (exude) or get into the case and cause, adverse effects. Read the direcitons carefully before using adhesives.

3 SERVICING DATA

(1) Standard Values

Part		Item	Standard value, Type, Number, etc.	
Engine	Piston	Max. diameter (external diameter measured 23 mm above the lower edge of the piston skirt)	87.89 – 87.91 mm (3.460 – 3.461 inch)	
		Piston clearance	0.08 – 0.12 mm (0.003149 – 0.004724 inch)	
	Piston ring	Ring gap (top, second and third rings)	0.25 – 0.40 mm (0.00984 – 0.01574 inch)	
	Crank shaft	Deflection	Less than 0.03 mm with both ends supported	
	Reed valve	Lift height	9.2 – 9.4 mm (0.3622 – 0.370 inch)	
	Connecting rod	Side gap (small end)	0.2 – 0.55 mm (0.00787 – 0.02165 inch)	
	Engine block	Compression (Measaured on a warm engine operating of full throttle. Spark plugs removed.)	Approx. 882.5 kPa (90 kg/cm² 128 P.S.I.)	
Fuel	Carburetor	Setting mark	M140AA	M120AA
		Venturi diameter	32	32
		Main jet (MJ)	#162	#162
		Main air jet (MAJ)	#160	#160
		Main nozzle (MN)	φ3.8	φ3.8
		Slow jet (SJ)	#75	#75
		Slow air jet (SAJ)	#70	#70
		Throttle opening (at full throttle)	77 degrees	52.5 degrees
		Pilot screw (to be turned counter-clockwise)	1-5/8 ± 1/4 turns	1-5/8 × 1/4 turns
		Float valve seat diameter	φ1.6	
		Oil level (measured at the float edge)	19.5 ± 3.0 mm (0.7677 – 0.118 inch)	
		Air vent	Outer	
		Choke valve leak hole (diameter)	#1:φ6 mm, #2: φ3 mm, #3: φ3 mm, #4: φ3 mm	
		Trolling speed (RPM)	550 – 750	
Cooling	Thermostat	Temperature control Valve opens at: Valve opens fully at:	Wax type with pressure relief valve 60°C (104°F) 70°C (158°F)	
Driving	Bevel gear	Backlash	0.08 – 0.16 mm (0.003149 – 0.006296 inch)	
Electrical parts	Magneto	Ignition	CD ignition	
		Ignition timing	M140A: ATDC10° ± 1° – BTDC20° ± 1° M120A: ATDC10° ± 1° – BTDC17.5° ± 1°	
		Firing order	#1 – #3 – #2 – #4	
		Spark	10 mm (0.3937") or greater at 500RPM (measured with TOHATSU genuine spark tester)	
		Spark plugs	NGK B8HS 10 or CHAMPION L-78C (gap 1 mm)	
		Spark plug gap	0.9 – 1.0 mm (0.0354 – 0.0394 inch)	
		Lighting output Lighting coil resistance	12V 330W Over 12A at 1,500 RPM 26 ± 1.5A at 5,500 RPM 0.35 ± 20% ohm	
		Pulser coil resistance	220 ± 15% ohm	
		Charge coil resistance	300 ± 15% ohm	
		High speed ESG limiting speed Low speed ESG limiting speed	5,000±250 RPM 2,800±400 RPM	
	Ignition coil	Primary coil resistance Secondary coil resistance	0.21 ± 15% ohm 3.2 ± 15% ohm	
	Starter motor	Battery	12V 70AH – 100AH	
		Output Clutch Brush length (wear limit) Commutator undercut (wear limit) Commutator external dimension (wear limit)	1.0 kW Overrunning clutch 14 – 15 mm (12 mm, 0.472 inch) 0.5 – 0.8 mm (0.2 mm, 0.00787 inch) 33 mm (32 mm, 1.26 inch)	
	Rectifier	Conductivity	One way	
	Fuse	Rating	20A	
	Water pressure sensor	Working water pressure	Activated by water pressure of 29.4 ± 0.98 kPa (0.3 ± 0.01 kg/cm²) or lower.	

(2) Repair Limits

Part	Repair Item	Repair Limits	Correction Procedure/Precision
Spark plug	Plug gap	1.2 mm (0.0472 inch) or greater	0.9 – 1.0 mm (0.0354 – 0.03937 inch) Replace plugs if electrode wear is extreme.
Water pressure sensor	Working water pressure	If the switch does not turn off at 29.42 ± 0.98 kPa (0.3 ± 0.01 kg/cm², 0.1023 lb/in²) after being pressurized from zero (In a depressurized state the cut off pressure wil vary.)	Gradually pressurize from zero and adjust with the adjusting screw so that the switch turns off at 29.42 ± 0.98 kPa (0.3 ± 0.01 kg/cm²).
Cylinder (cylinder head)	Adjacent faces of cylinder and cylinder head	Scratches or distortion on contacting surfaces of 0.03 mm (0.00118 inch) or greater.	Repair on a fraise or surface table with #240 to #400 emery-paper so that no gas leaks.
	Cylinder lining	When there are deep scratches or scuffing in the cylinder linings which cannot be repaired with #400 to #600 emery-paper or when the difference in damage on the cylinder linings between the maximum and minimum wear is of 0.06 mm (0.000236 inch) or greater.	Re-bore or hone 88.5±0.01mm (3.484± 0.000394 inch) paying attention to the ports chamfering, re-chamfering if insufficient. Use oversized pistons and piston rings after re-boring or honing.
Piston ring	Piston ring end gap	0.8 mm (0.0315 inch) or greater	Replace. Cylinder liner wear must be within service limits.
Connecting rod	Deflection of small end 	2 mm (0.0787 inch) or greater.	Replace crank shaft assembly.
Crank shaft	Crank shaft deflection	0.05 mm (0.00197 inch) or greater with both ends supported.	Less than 0.03 mm (0.00118 inch) with both ends supported.
Reed valve stopper	Lift height (H)	 Other than H = 9.2 – 9.4 mm (0.362–0.370 inch)	Repair to H = 92 – 9.4 mm. Replace with new one, if its deformation is too large.
Reed valve	Inspect for ineffective sealing, wear & damage	Excessive wear or damage of the valve seat surface	Replace entire set.
Pump impeller, liner, guide plate	Wear, cracking of lips	Wear, cracking or damage to outer tip and surface of the lips.	Replace entire set.
Oil seal	Irregular noise or damage	When there is wear, deterioraiton or damage of lip or if the difference between the inner diameter and outer diameter of the shaft becomes less than 0.5 mm (0.0197 inch).	Replace.
Engine block	Compression	When the difference in compression between cylinders is extremely high.	Replace with over size piston after boring or honing or replace the block.
		When compression is much higher than standard value.	Remove carbon on piston crown and cylinder head. Clean exhaust bypass.

(3) Sealing Agents

Sealing Adhesive Lubrication Oil	1342N 3M	1373N 3M	G17 3M	3M anaerobic adhesive 1741	1104I 3M	Insulating grease	Low temperature grease	Tohatsu genuine grease	Cup grease	Tohatsu genuine engine oil	Tohatsu genuine gear oil	Silicon-oil compound	1107. 3M		
Piston										○					Apply to ring groove, piston pin hole.
Piston pin										○					Apply to outer surface.
Piston ring										○					
Cylinder lining										○					Apply to inner wall.
Small end bearing										○					Apply to rotating parts.
Big end bearing										○					Apply to rotating parts.
Main bearing										○					Apply to rotating parts.
Small end bearing washer										○					
Big end bearing washer										○					
Seal ring										○					
Guide plate O-ring							○								
Main bearing upper oil seal									○						Apply to lip.
Crank case head O-ring										○					
Crank shaft lower oil seal									○						Apply to lip.
Drive shaft oil seal									○						Apply to lip.
Oil pump drive gear										○					
Oil pump driven gear										○					
Cylinder and crank case adjacent faces					○										Do not use more grease than needed.
Engine base gasket													○		Apply to both faces.
Guide plate							○ sliding part								Apply to sliding part, O-ring groove.
Pulser coil assembly		*○					○								Apply to sliding part, * ball joint.
Spark plug cap			○									○			Apply to spark plug, high tension cord contact.
Advancer arm							○								Apply to sliding parts.
Throttle cam							○								Apply to sliding parts.
Shift arm							○								Apply to sliding parts.
Ball joint cap							○								Apply to sliding parts.
Cable pin nut	○														Apply to threaded parts.
Cable joint (clutch arm)								○							Apply to sliding parts.
Air silencer fitting bolt	○														When reusing bolt with screw locking agent.
Overheating sensor												○			Apply between sensor and cylinder head.
Starter motor					termi		*○		**○						
Starter motor solenoid switch						○									Apply to teminals.
Power trim & tilt solenoid switch						○									Apply to terminals.
Silencer cover gasket					○										Apply to both faces.
Ball joint C	○														Apply to thread.

*terminals **Apply lighty to pinion.

Sealing / Adhesive / Lubrication Oil	1342N 3M	1373N 3M	G17 3M	3M anaerobic adhesive 1741	1104I 3M	Insulating grease	Low temperature grease	Tohatsu genuine grease	Cup grease	Tohatsu genuine engine oil	Tohatsu genuine gear oil	Silicon-oil compound	1107 3M		
Shift assist assembly	○														Apply to thread.
Manual choke lever								○							Apply to sliding part.
Gear B nut	○														Apply to thread after degreasing.
Propeller shaft housing								○							Apply to in low portions.
Ditto O-ring								○							
Propeller shaft oil seal								○							Apply to lip.
Propeller shaft								○							Apply to spline.
Propeller stopper								○							Apply to tapered part.
Propeller thrust holder								○							Apply to spline.
Drive shaft needle bearing A										○					Apply when pressing to install.
Lower water pump case								○							In low portions.
Ditto O-ring								○							
Ditto oil seal								○							Apply ot lip.
Pump case bolt								○							Apply to lower neck.
Water tube								○							Apply to upper part.
Ditto upper seal rubber												○			Apply to inner surface.
Ditto lower seal rubber			○ fit to pump case									○	inner surface		
Ditto guide rubber								○							Apply to total surface
Pump case								○							Apply thinly on inner surface
Pump case and liner					○										Apply thinly except to hole on top of liner.
Gear case plate screw	○														Thread
Exhaust housing grommet			○ or ○												Fitting face
Idle port grommet			○ or ○												
Trim tab mounting bolt								○							
Drive shaft										○					Engine side spline
Shift lever shaft holder fitting bolt	○														Thread
Cam rod bushing								○							Total surface
Ditto O-ring 1.9 – 6.8											○				
Ditto O-ring 3.5 – 27.7								○							
Ditto stopper bolt								○							Below neck
Gear oil in gear case											○				Approx. 900cc
Shift assist assembly	○														
Gear case bolt	○														Below neck
Extension housing bolt	○														Below neck
Propeller shaft housing bolt	○														Below neck
Splash pan fitting bolt	○														Thread
Splash pan seal rubber				○											
Splash pan set rubber				○											

fit to pump case or or

Sealing / Adhesive / Lubrication Oil	1342N 3M	1373N 3M	G17 3M	3M anaerobic adhesive 1741	1104I 3M	Insulating grease	Low temperature grease	Tohatsu genuine grease	Cup grease	Tohatsu genuine engine oil	Tohatsu genuine gear oil	Silicon-oil compound	1107 3M		
Bracket bolt								○							Fill with grease. Apply to inner surface.
Ditto cap								○							Inner surface
Stern bracket washer								○							Both faces
Swivel bracket								○							Fill with grease.
Steering shaft								○							Sliding parts
Ditto bushing								○							Sliding parts
Ditto sealing								○							
Thrust plate								○							Sliding parts
Upper mounting bolt	○	Thread						(○)							
Lower mounting bolt		○	Thread					(○)							
Mounting bracket								○	Outer surface						Spline
Tilt stopper								○	Outer surface						Sliding parts
Filler lid hinge								○							Sliding parts
Hook lever								○							Sliding parts
Ditto bushing								○							
Hook lever seal ring								○							
Upper motor cover seal rubber			○												Fitting face
Filler lid seal rubber			○												
Shift lever shaft holder								○							Apply to sliding parts and a little into inner surfaces.
Power trim and tilt trim receiver (H1220)								○							Apply to head.
Power trim and tilt upper cylinder pin								○							
Power trim and tilt assembling bolt								○							Below neck thread
Power trim and tilt sensor cam bolt	○														
Power trim and tilt oil														○	Use specified oil.
Drag link								○							Sliding parts
Remote control box								○							Sliding parts

(Note) When used re-using bolts coated with locking agent, degrease the thread (male & female) and apply adhesive (3M 1342 N).

Strength Comparison Table

3M Screw Locking Agent	Lock tite	Strength of adhesive
1373N, 1375N	648	strong
1361N, 1324N	271	moderate
1342N, 1344N	242	weak

(4) Tightening torque

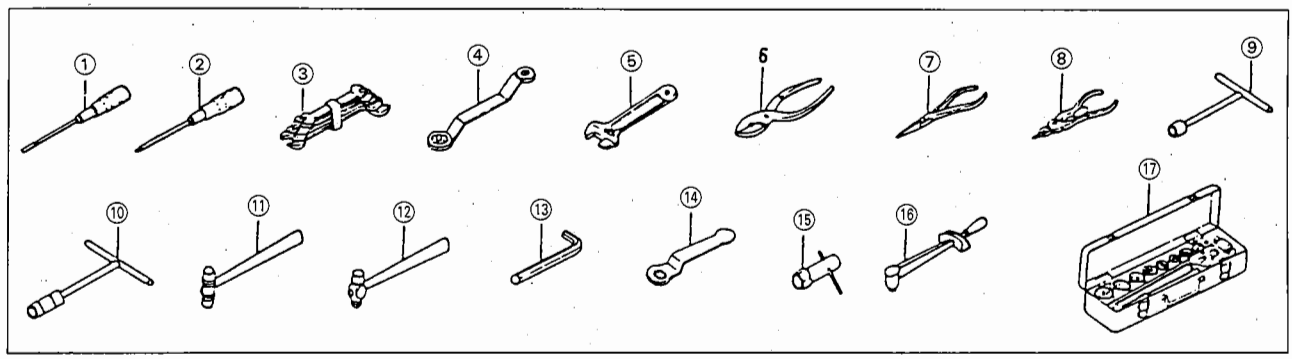
Item		Initial tightening torque			Final tightening torque		
		N — m	kg — m	lbs — ft	N — m	kg — m	lbs — ft
Cylinder head		12.74 to 16.66	1.3 to 1.7	9.39 to 12.29	29.4 to 34.3	3.0 to 3.5	21.68 to 25.59
Cylinder head cover		2.94 to 3.92	0.2 to 0.3	1.45 to 2.17	3.92 to 5.88	0.4 to 0.6	2.89 to 4.34
Crank case dia. 8 mm		11.76 to 14.70	1.2 to 1.5	8.67 to 10.84	23.52 to 25.48	2.4 to 2.6	17.34 to 18.79
Crank case dia. 10 mm		16.66 to 22.54	1.7 to 2.3	12.29 to 16.62	37.24 to 41.16	3.8 to 4.2	27.46 to 30.35
Exhaust cover dia. 8 mm		5.88 to 7.84	0.6 to 0.8	4.34 to 5.78	12.74 to 14.70	1.3 to 1.5	9.39 to 10.3
Exhaust cover dia. 6 mm		3.92 to 5.88	0.4 to 0.6	2.89 to 4.34	8.82 to 10.78	0.9 to 1.1	6.50 to 7.95
Magneto nut					245 to 264.6	25 to 27	180.8 to 195.2
Spark plug					24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Drive shaft housing					37.2 to 41.1	3.8 to 4.2	27.48 to 30.37
Bevel gear B nut					98.0 to 117.6	10 to 12	72.3 to 86.77
Bracket nut					23.52 to 25.48	2.4 to 2.6	17.35 to 18.80
Upper mounting rubber bolt					37.2 to 41.1	3.8 to 4.2	27.48 to 30.37
Lower mounting rubber nut					29.4 to 34.3	3.0 to 3.5	21.68 to 25.29
Gear case mounting bolt dia. 8 mm					23.52 to 25.48	2.4 to 2.6	17.34 to 18.79
Gear case mounting bolt dia. 10 mm					37.2 to 41.1	3.8 to 4.2	27.48 to 30.37
Propeller nut					29.4 to 39.2	3.0 to 4.0	21.69 to 28.92
Ball joint C					2.94 to 4.9	0.3 to 0.5	2.17 to 3.62
Shift lever shaft bolt holder					5.88 to 7.84	0.6 to 0.8	4.34 to 5.78
Engine knocking sensor					10.78 to 14.7	1.1 to 1.5	7.95 to 10.85
Air silencer cover bolt					2.94 to 4.9	0.3 to 0.5	2.17 to 3.62
Electric bracket cover bolt					2.94 to 4.9	0.3 to 0.5	2.17 to 3.62
Other bolts and nuts	M4				1.27 to 1.76	0.13 to 0.18	0.94 to 1.30
	M5				2.65 to 3.53	0.27 to 0.36	1.95 to 2.60
	M6				4.61 to 6.27	0.47 to 0.64	3.40 to 4.62
	M8				11.17 to 15.09	1.14 to 1.54	8.24 to 11.13
	M10				12.74 to 30.58	1.30 to 3.12	9.39 to 22.55

4 TOOLS AND MEASURING EQUIPMENT FOR DISASSEMBLY AND SERVICE

The following tools and measuring equipment are necessary for servicing Tohatsu outborad motors. Be sure to disassemble with the special tools when so indicated.

For instructions on usage, refer to the section entitled "USE OF SPECIAL TOOLS".

(1) General Tools



① Screwdriver	(200 mm)	⑨ Adjustable wrench	(300 mm)	⑪ Plastic hammer	
	(150 mm)	⑥ Pliers		⑫ Hammer	
	(100 mm)	⑦ Radio pliers		⑬ Hexagonal rod wrench	(6 mm)
② Philips screwdriver	(200 mm)	⑧ Clip pliers		Allen key	(8 mm)
	(150 mm)	⑨ T-shaped box wrench	(8 mm)	⑭ Plug wrench	(21 mm)
	(100 mm)		(10 mm)	⑮ Torque wrench	
③ Wrench set	(set of 6)		(13 mm)	⑯ Socket wrench set	
④ Off-set wrench	(10 × 13)		(17 mm)		
	(14 × 17)	⑩ T-shaped universal wrench	(10 mm)		
	(21 × 23)		(13 mm)		
			(14 mm)		
			(17 mm)		

(2) Compression gauge

(3) Test propeller

(4) Measuring tools

The following tools are all commercially available.

Tachometer	Tohatsu tachometer or a tachometer for 600 ~ 6,000rpm
Electric tester	(HIOKI 3000 with battery 1.5V)
Slide calipers	(M1 type slide calipers, 300mm)
Micrometer	(0.01 scale, external micrometer) (m
Cylinder gauge	(50 ~ 100mm cylinder gauge)
Ring gauge	(88ϕ)
Dial gauge	(0.01 scale, dial gauge)
Gap gauge	(Measurable from 0.04–0.3)
V block	
Surface plate	(630 × 400)

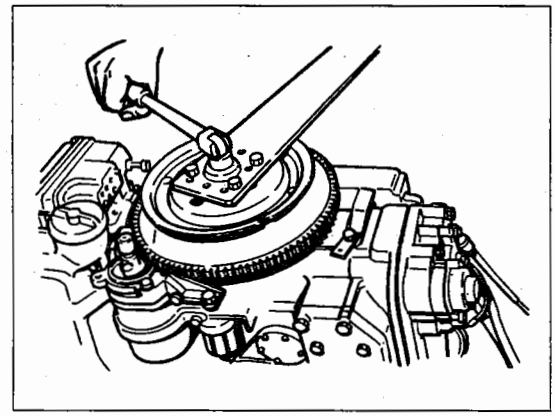
Dial gauge magnet base or dial gauge stand

5 USE OF SPECIAL TOOLS

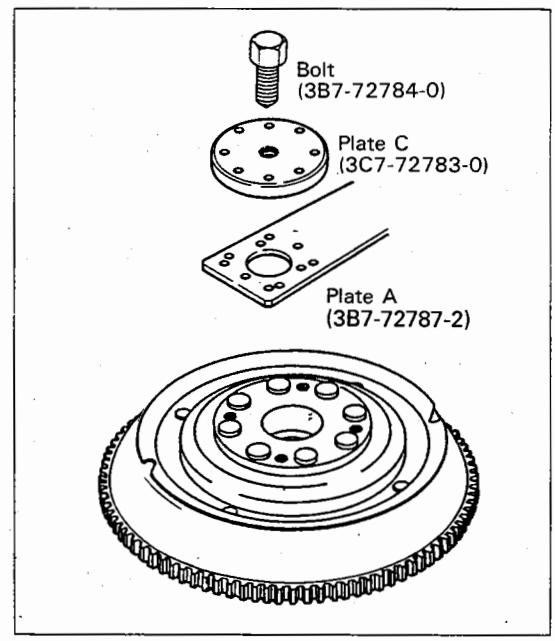
(1) To Remove the flywheel

a. Removal of flywheel nut
Fix the flywheel puller assembly with the hexagonal holed bolt (M8 × 25) and remove the magneto with socket wrench 30.

NOTE: Magneto nut is turned clockwise to tighten. Only use specified bolts, or coil plate assembly electrical components may be damaged.



b. Removal of flywheel
Install plate A and plate C to Flywheel using M8 × 40, tighten with a 19 socket wrench, and remove the flywheel.
Only use specified bolts, or coil plate assembly electrical components may be damaged.



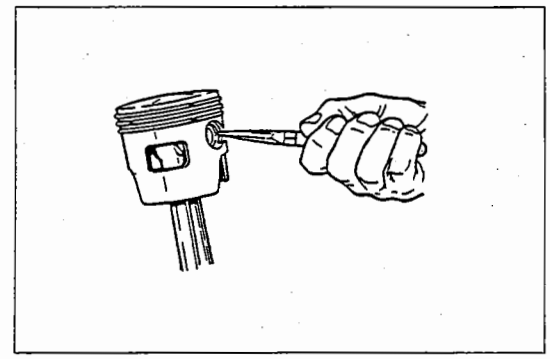
(2) Installtion of flywheel

To install the flywheel magneto, first check if the magneto key is inserted. Then install the flywheel, insert the magneto washer, and tighten the nut. Install the flywheel puller assembly on the flywheel magneto and tighten with the specified torque 245 to 264.6 N-m (25 to 27 kg-m, 180.8 to 195.2 lbs-ft.).

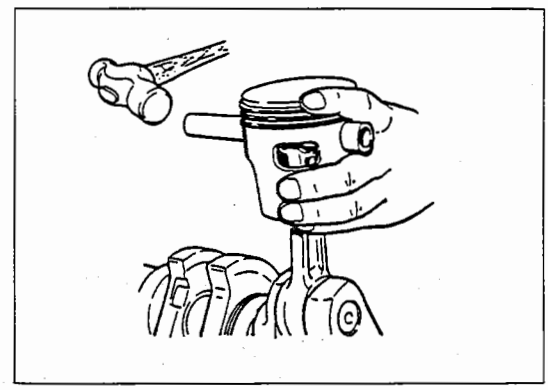
NOTE: (i) Remove grease completely from the crank shaft and tapered part of the magneto.
(ii) Apply oil to the thread.

(3) Disassembly and assembly of piston pin

a. Disassembly
Remove the piston pin clips from both sides.



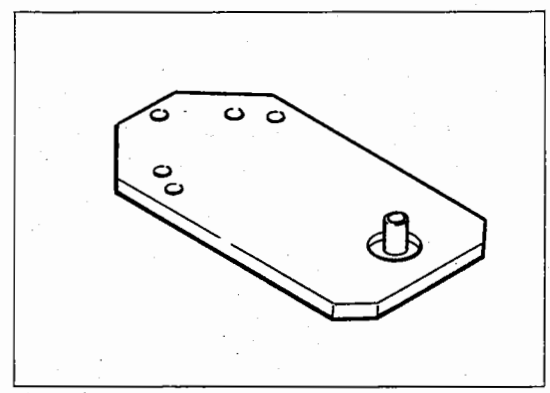
Place piston pin tool (353-72215-0) against the piston pin and tap lightly with a hammer to remove. Hold the piston by hand and be careful that the connecting rod is not bent.
(Take care not to hit the small end bearing washer.)



b. Assembly
To insert the piston pin, insert the small end bearing into the connecting rod, insert the side washers into both sides, lightly tap the tip of the piston tool with a hammer to insert, and finally install the piston pin clips.
(Always use new piston pin clips.)

(4) Power head stand

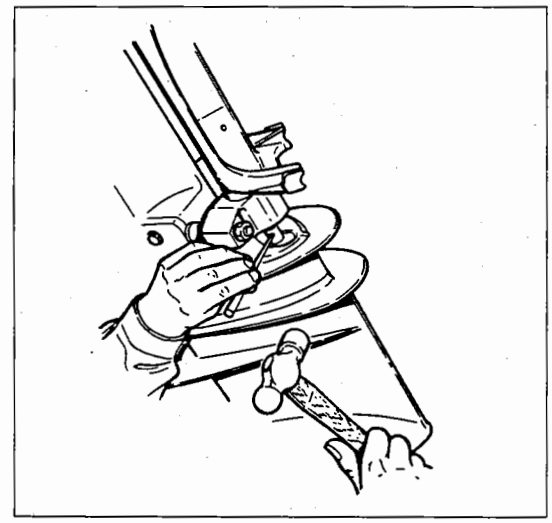
(353-72247-1 common for M70A_2)
Use the power head stand when removing the power unit from the outboard motor and disassembling or assembling on a work table.
Secure the power head stand in the vice, position the cylinders engine base with the contacting surface on the stand and fix with M10 Pitch 1.25 bolts.



(5) Spring pin tool

a. Use spring pin tool A (369-72217-0) to remove the spring pin.

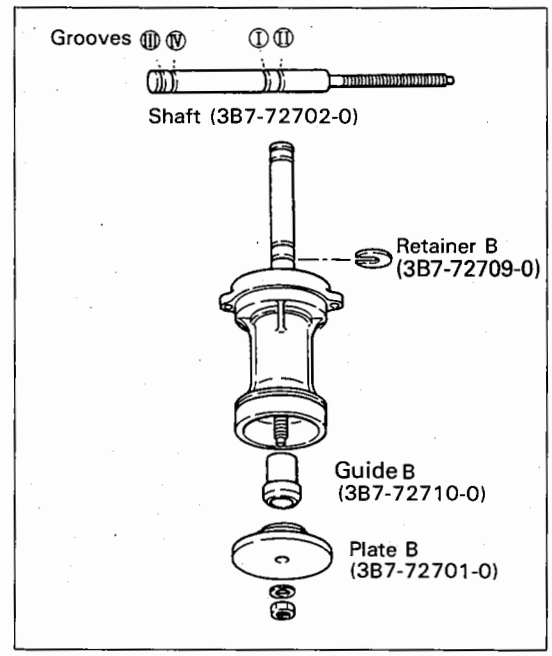
b. Use spring pin tool B (369-72218-0) to insert the spring pin.
NOTE: (i) Always replace spring pins which have been removed.
(ii) After mounting, set so that each pin protrudes by the same amount.

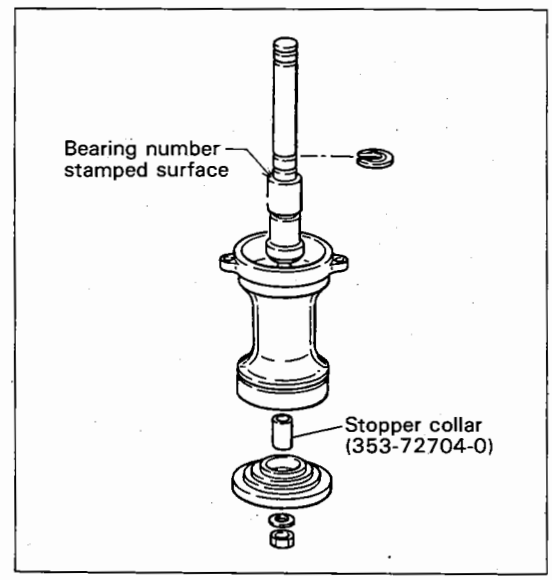


(6) Propeller shaft housing needle roller bearing puller

a. Removal of needle roller bearing
1) Remove the oil seal and propeller shaft housing.
2) Remove bearing C by heating the propeller shaft housing.
3) Insert the shaft (3B7-72702-0) into the needle roller bearing.
4) Attach retainer B (3B7-72709-0) to shaft groove (II). Set the V-shaped groove surface of retainer B on the bearing side.
5) Install guide B (3B7-72710) and plate B (3B7-72701-0) to the shaft and remove the needle roller bearing.

b. Installation of needle roller bearing
1) Attach retainer B to shaft groove (I).
2) Set the needle roller bearing, install guide B, and insert the propeller shaft housing from the propeller side.
3) Attach the stopper collar (353-72704-0) and plate B from the gear side of the propeller shaft housing.
4) Install retainer B so that its flat side faces away from the bearing.

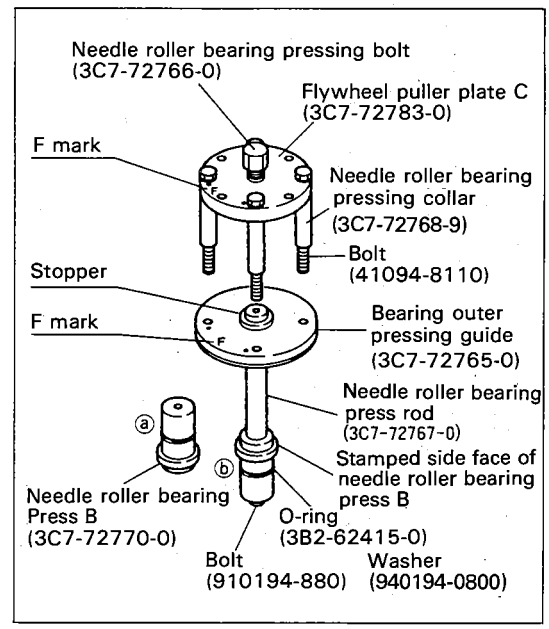


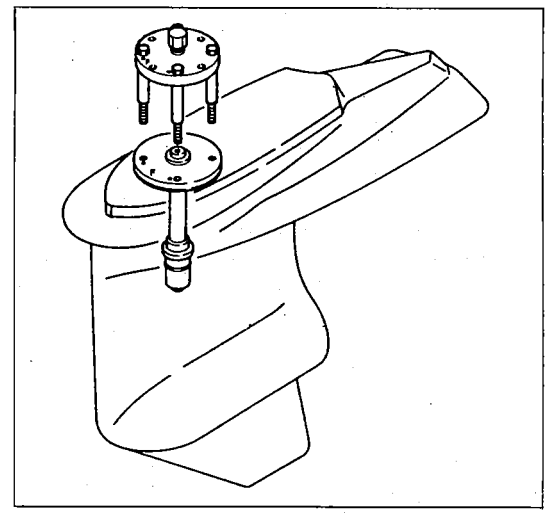


(7) Gear case needle roller bearing

a. Removal of needle roller bearing
   1) Remove the drive shaft and lower water pump case.
   2) Install the guide on the rod and attach the needle roller bearing press B with the bolt and the washer. Install the needle roller bearing press B referring to the drawing right.
   3) Install the bearing outer pressing guide and the flywheel puller plate C so that the F marks on their surfaces to the front face of the gear case. Set the needle roller bearing pressing collars between the bearing outer pressing guide and the flywheel puller plate C.
   4) Tighten the needle roller bearing pressing bolt.

b. Installation of the needle roller bearing
   1) Install the needle roller bearing press B to the needle roller bearing pressing rod. Refer to the drawing right.
   2) Connct the needle roller bearing to the needle roller bearing press B so that the stamped side faces the needle roller bearing press B.
   3) Screw the needle roller bearing pressing bolts until the stopper touches the bearing outer pressing guide.

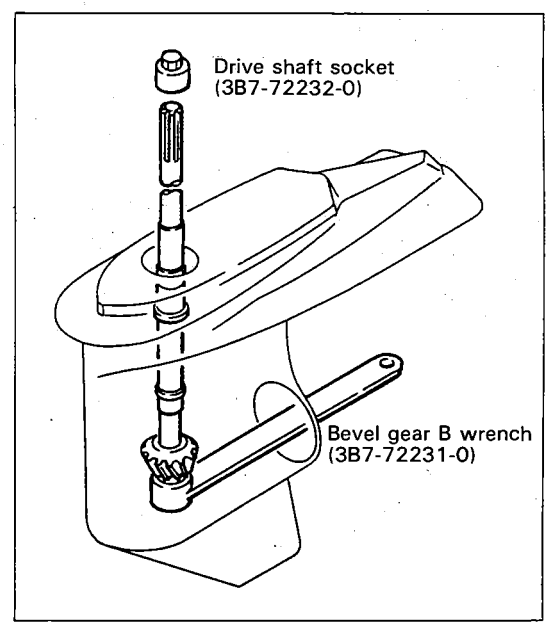




(8) Bevel gear B nut

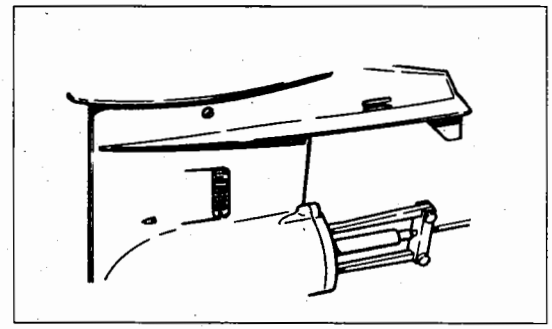
a. Removal of bevel gear B nut
   Fix the bevel gear B nut in the gear case with the bevel gear B wrench and rotate the drive shaft socket attached to the drive shaft spline to remove.

b. Installation of bevel gear B nut
   1) Remove all grease from the drive shaft screw and the bevel gear B nut.
   2) Apply screw lock (Three bond 1342) to the screw.
      NOTE: Do not apply more screw lock than necessary.
   3) Fix the bevel gear B nut with the wrench and tighten the drive shaft socket to the specified torque.
      Tightening torque: 10~12 kg-m



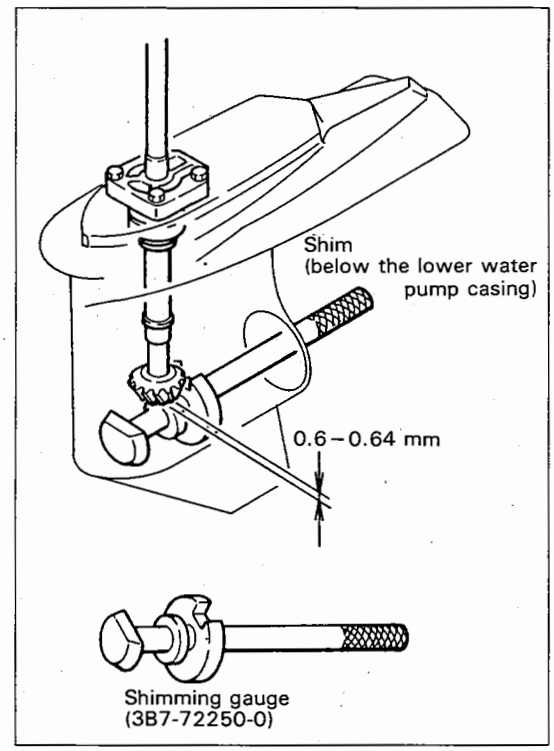
(9) Propeller shaft housing

a. Removal of propeller shaft housing
Remove the propeller shaft housing installation bolt, set the housing puller and tighten.



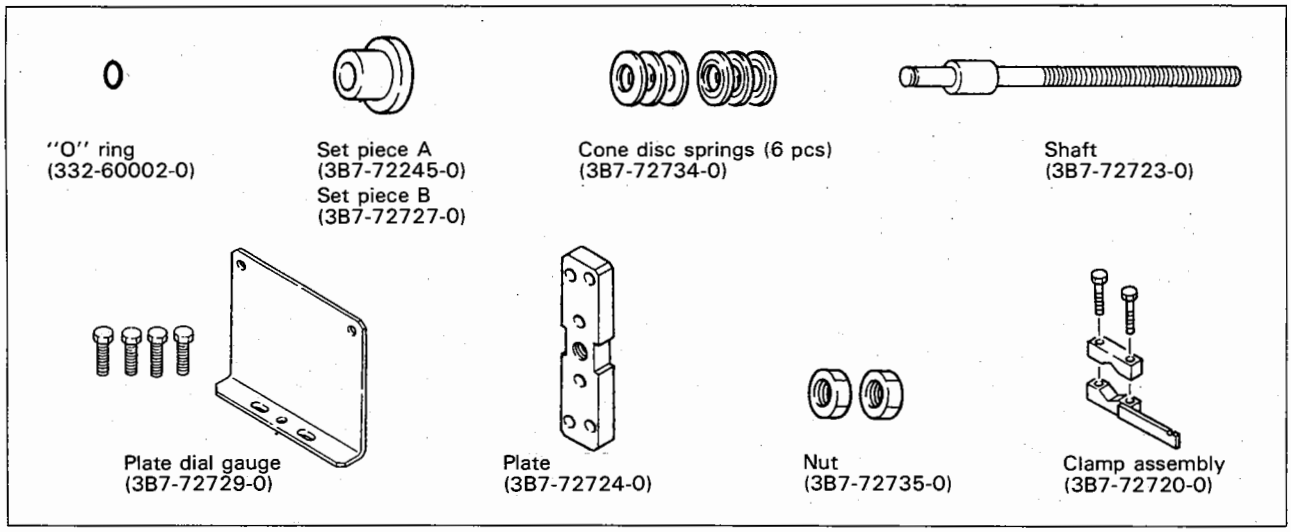
(10) Shimming gauge (3B7-72250-0)

a. Install the drive shaft assembly on the gear case. Install the lower pump case and fix. (Use M8 × 30 and plain washer 8.)
b. Install bevel gear B on the drive shaft with the nut (tightening torque: 10 ~ 12 kg-m).
c. Insert the shimming gauge into the gear case and set so that the tapered surface of the gauge is in contact with the tapered surface of the bevel gear A bearing outer race.
d. Measure the gap between the gear B end and the shimming gauge with the feeler gauge.
(When measuring, lift the drive shaft upward to eliminate looseness.)
Gap: 0.6 ~ 0.64 mm
If the gap is not as specified, insert a shim into the bottom of the lower pump case to adjust.



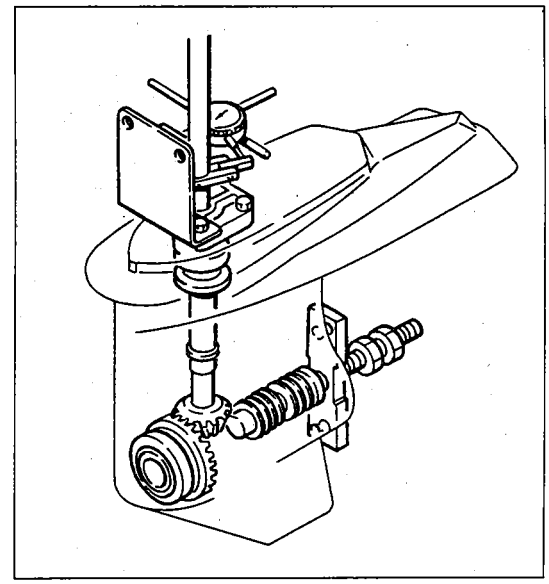
(11) Backlash

a. Backlash measuring tool

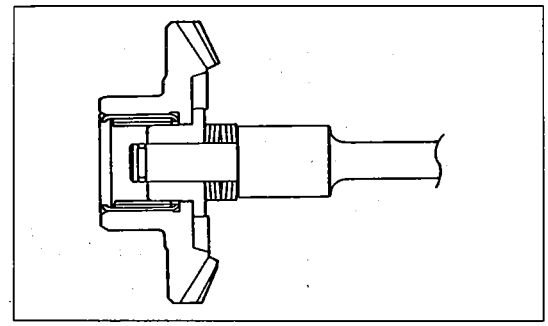


b. Measurement of backlash between gears A and B
   1) Ascertain the position of the gear B.
   2) Attach gear A and bearing A.
   3) Insert the conical disc springs (3B7-72734-0) onto the shaft (3B7-72723-0) 6 pcs.
   4) Insert the "O"-ring (332-60002-0) onto the shaft and insert the set piece A (3B7-72245-0).
   5) Insert the shaft into the gear case and fix it with the plate (3B7-72724-0).
   6) Tighten the shaft until the drive shaft begins to rotate.
   7) Tighten the shaft another 1/2 revolution (180°) from the point at which the drive shaft starts rotating.
   8) Install the clamp assembly (345-72721-0) on the drive shaft. (Bringing it as near as possible to the lower pump case.)
   9) Install the dial gauge plate for dial gauge (3B7-72729-0) on the gear case.
      Note: Precise backlash may not be obtained with a new gear. In this case, repeatedly loosen and tighten the shaft (3B7-72723-0) at least three times and measure the backlash.
   10) Set the dial gauge, lift the drive shaft, and rotate it clockwise and counter-clockwise to read the deflection of the gauge.

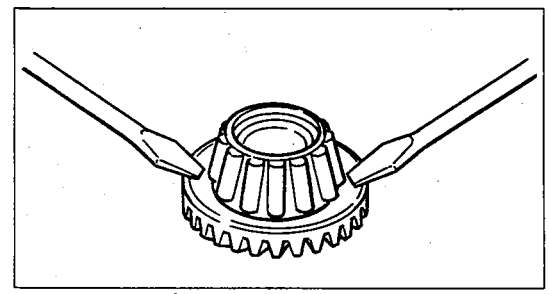
       Correct dial gauge reading range: 0.24 to 0.48 mm
       If the deflection is not within this range, insert a shim in gear A and adjust.



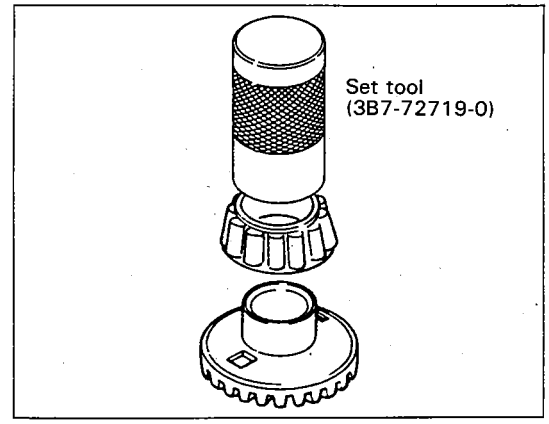
Setting of the conical disc spring



When replacing the bevel gear A shim, insert screwdrivers into the notches of gear A to isolate gear A and the bearing section.



When inserting bearing A into gear A, use the set tool (3B7-72719-0) and press in without inclining bearing A to gear A.



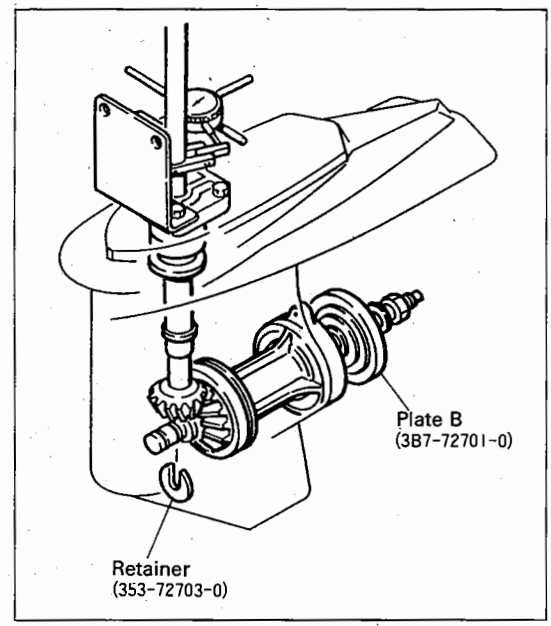
c. Adjustment of backlash between gears B and C
   1) Ascertain the position of gear B.
   2) Remove gear A.
   3) Install gear C on the propeller housing and insert the shaft.
   4) Insert set piece B into the shaft and insert retainer A into groove (IV).
      Install so that the side of set piece B with small steps and the side of retainer A without the V-shaped groove face the propeller side.
   5) Put plate B through the shaft.
      Set plate B so that the side with small steps faces the gear.
   6) Insert the gear case and secure with the propeller shaft housing bolt.
   7) Install the clamp assemblies on the drive shaft.
   8) Tighten the nut on the shaft with your fingers.
   9) Fix the clamp assemblies by hand and tighten the nut further approximately 1/4 turn (90°).
   10) Lift the drive shaft upward, rotate it both ways, and read the deflection on the dial gauge. Set the dial gauge against the notch on the clamp assembly.

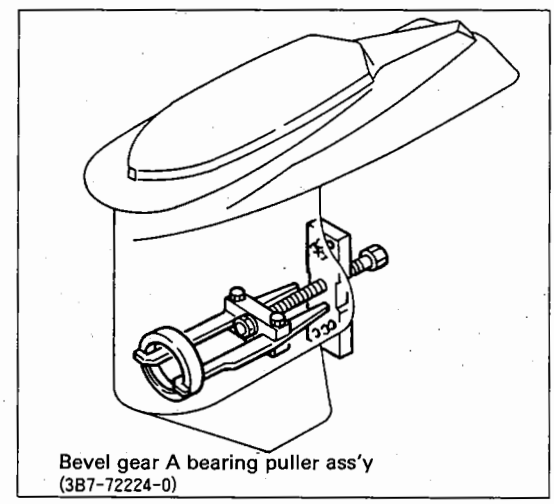
      Correct dial guage reading range: 0.24 ~ 0.48 mm

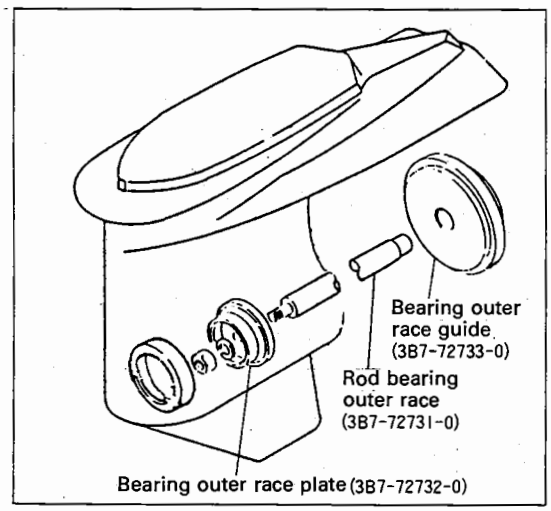
      If the deflection is not within this range, insert a shim in gear C and adjust.

      After adjusting the backlash, check for looseness in the forward/rear direction in the propeller shaft with the gear case assembly, properly assembled.
      The looseness should be within about 0.2 ~ 0.3 mm. Select one of the bevel gear C washers accordingly.
      3 types of C washers: 2.8 t, 3.0 t, 3.2 t

d. Bearing outer race
   1) Removal of bevel gear A bearng outer race.
   2) Installation of bevel gear A bearing outer race. Use the bearing tool kit to set the outer race in the gear case.



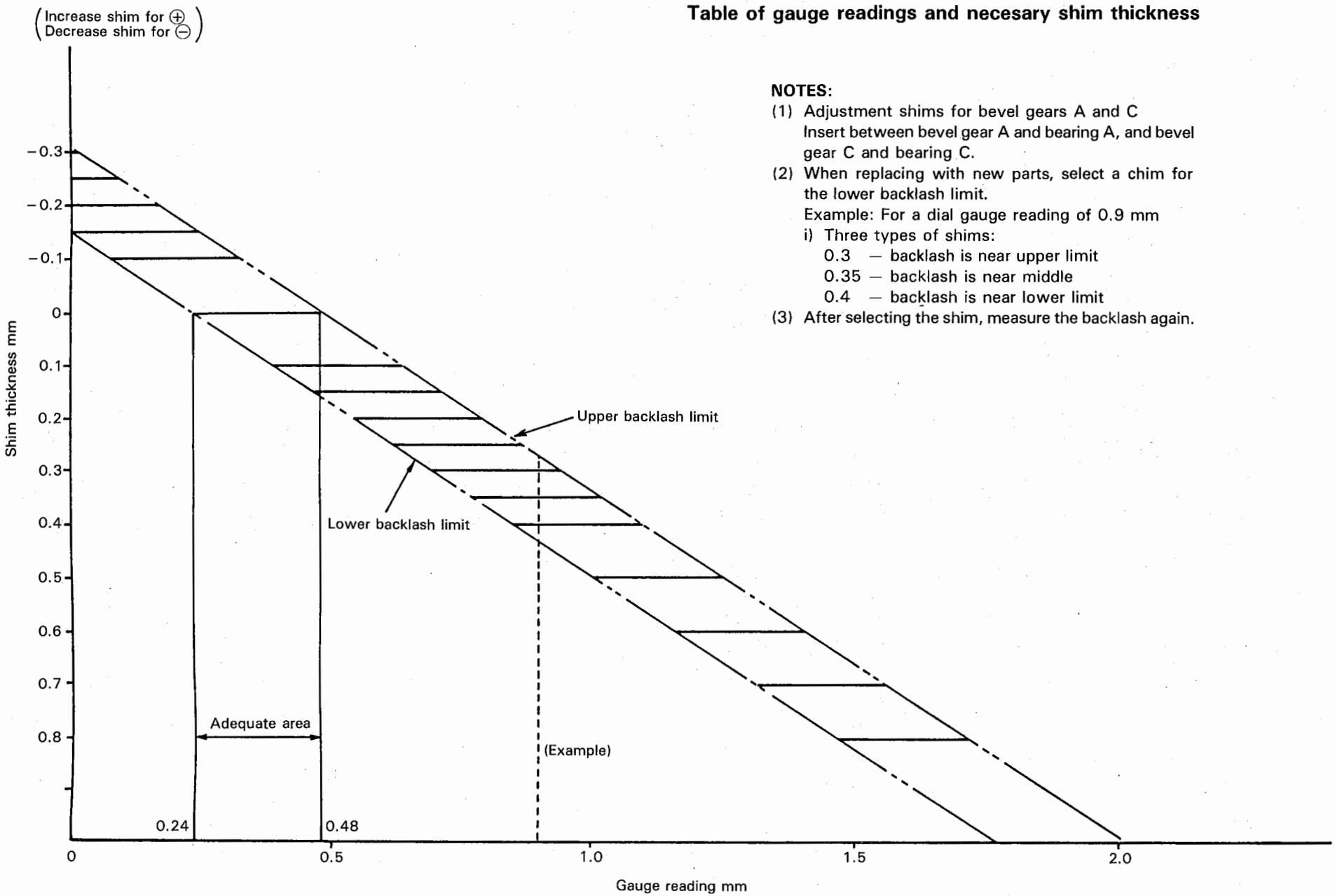




e. Adjustment shims table for backlash

Backlash gauge reading mm	Actual backlash mm	Necessary shim + increase − decrease mm
0 ~ 0.02	0 ~ 0.01	−0.3
0 ~ 0.10	0 ~ 0.03	−0.25
0 ~ 0.17	0 ~ 0.06	−0.2
0.01 ~ 0.25	0.003 ~ 0.08	−0.15
0.09 ~ 0.33	0.03 ~ 0.11	−0.1
0.24 ~ 0.48	0.08 ~ 0.16	0
0.39 ~ 0.68	0.13 ~ 0.21	+0.1
0.47 ~ 0.71	0.16 ~ 0.24	+0.15
0.55 ~ 0.79	0.18 ~ 0.26	+0.2
0.62 ~ 0.86	0.21 ~ 0.29	+0.25
0.70 ~ 0.94	0.23 ~ 0.31	+0.3
0.78 ~ 1.02	0.26 ~ 0.34	+0.35
0.86 ~ 1.10	0.29 ~ 0.37	+0.4
1.01 ~ 1.25	0.34 ~ 0.42	+0.5
1.16 ~ 1.40	0.39 ~ 0.47	+0.6
1.32 ~ 1.56	0.44 ~ 0.52	+0.7
1.47 ~ 1.71	0.49 ~ 0.57	+0.8

Table of gauge readings and necesary shim thickness



NOTES:

(1) Adjustment shims for bevel gears A and C
Insert between bevel gear A and bearing A, and bevel gear C and bearing C.

(2) When replacing with new parts, select a chim for the lower backlash limit.
Example: For a dial gauge reading of 0.9 mm
i) Three types of shims:
0.3 — backlash is near upper limit
0.35 — backlash is near middle
0.4 — backlash is near lower limit

(3) After selecting the shim, measure the backlash again.

6 REMOVAL, DISASSEMBLY AND RE-ASSEMBLY OF POWER UNIT

(1) Removal of power unit

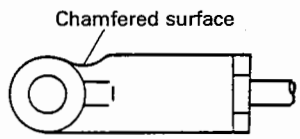
a. Remove the power cables.
- Ground cable (between the lower motor cover and the cylinder block) ①
- Battery positive and negative cables ②, ③
- 8P wire harness coupler ④
- 1P (red/yellow) wire harness coupler ⑤
- Terminal connecters (pink and blue) ⑥
- Three cables for powered trim and tilt ⑦
- Three terminal connecters for powered trim and tilt switch installed on Lower motor cover ⑧
- Trim sensor 3P coupler ⑨
- Trim sensor arm terminal ⑩

b. Remove pipes
- Fuel pipe ⑪
- Pilot water check pipe ⑫

c. Remove splash pan
Remove splash pan by taking out the four fitting bolts.

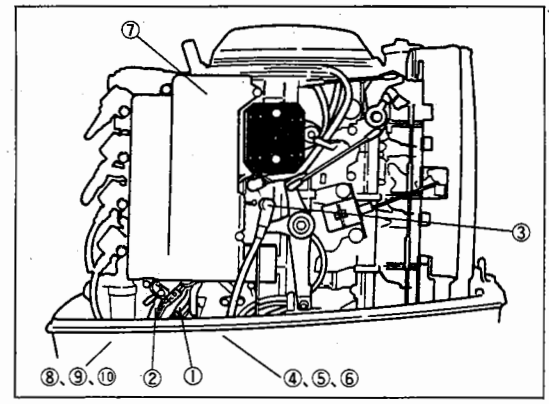
d. Remove the eight, drive shaft housing mounting bolts.
When re-installing the power unit, be sure to use the two longer mounting bolts in the front.

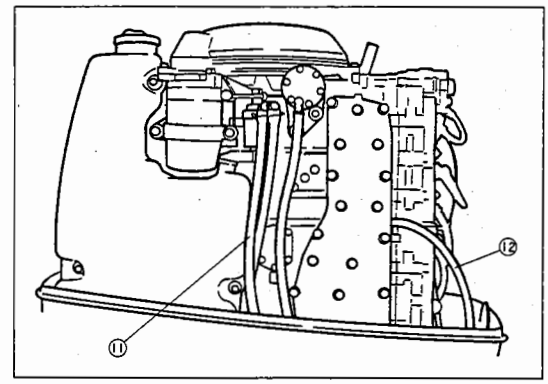
e. Disconnect the shift assist case
Note: fitting length L = approx. 24 mm (0.945 inch)

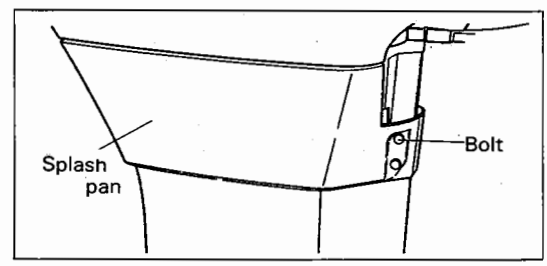


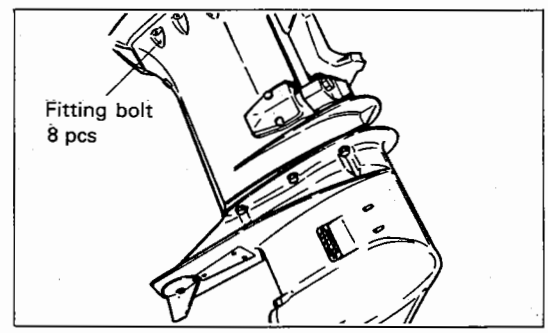
Remarks

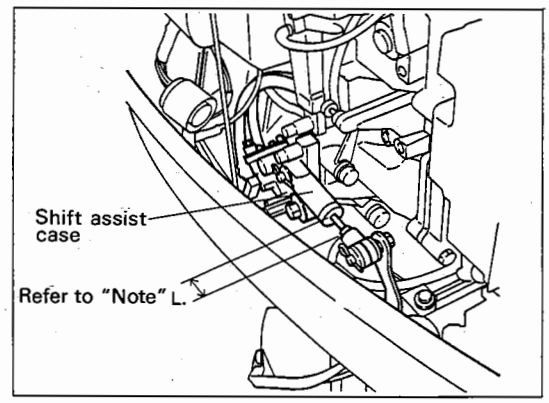
When connecting the shift assist, position it so that the chamfered surface faces upwards.







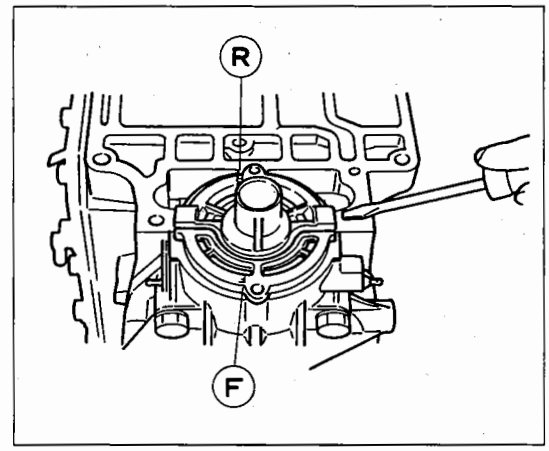




(2) Lower crank case head

Insert a screwdriver into the pinch groove and remove the lower crank case head.

Note: The mark faces the F — toward carburetor and the mark faces the R — toward cylinder.

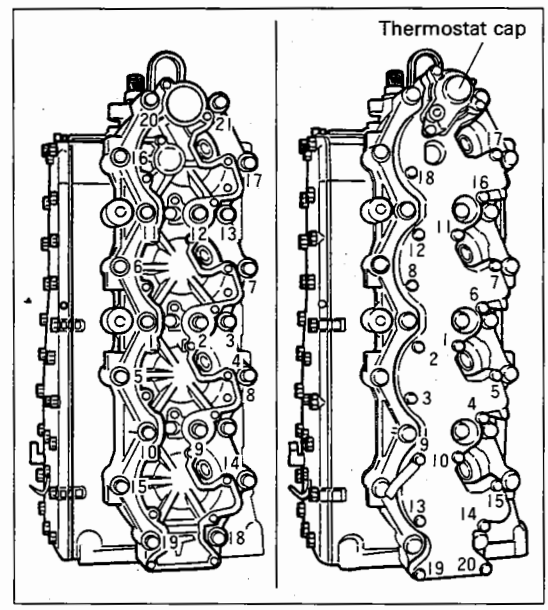


(3) When mounting the lower crank case head, pay attention to the F & R marks.

(4) Cylinder head

Loosen the cylinder head bolts starting with the highest embossed number and work down.

Tighten the cylinder head bolts in the ascending order of the embossed numbers.



Tightening torque

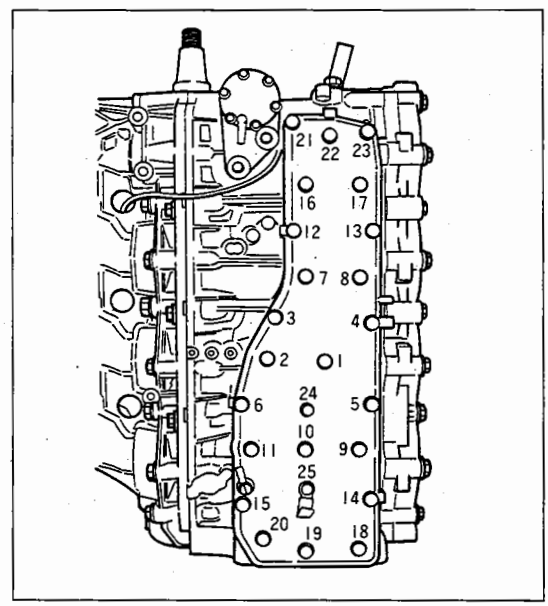
		Cylinder head	Cylinder head cover
Initial tightening	N — m	12.74 to 16.66	1.96 to 2.94
	kg — m	1.3 to 1.7	0.2 to 0.3
	lb — ft	9.39 to 12.29	1.45 to 2.17
Final tightening	N — m	29.4 to 34.3	3.92 to 5.88
	kg — m	3.0 to 3.5	0.4 to 0.6
	lb — ft	21.69 to 25.31	2.89 to 4.34

(5) Exhaust cover

Loosen the exhaust cover bolts starting with the highest embossed number and work down.

Set a screwdriver against the notch in the cover and remove.

Tighten the exhaust cover bolts in the ascending order of the embossed numbers.

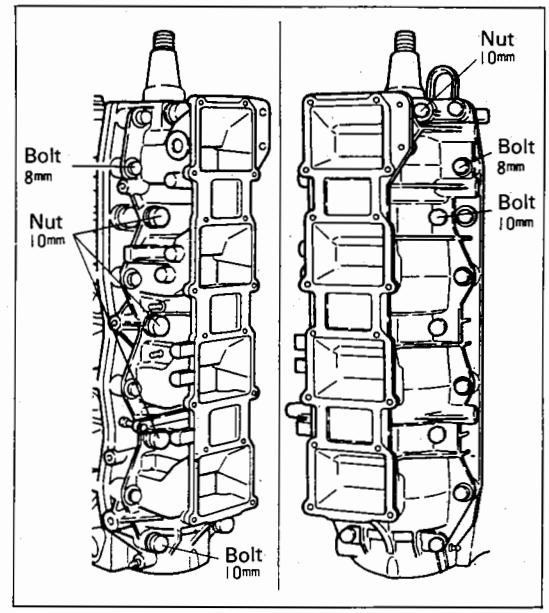


Tightening torque

		Bolt No. 1 to No. 23	Bolt No. 24 and No. 25
Initial tightening	N — m	5.88 to 7.84	3.92 to 5.88
	kg — m	0.6 to 0.8	0.4 to 0.6
	lb — ft	4.34 to 5.78	2.89 to 4.34
Final tightening	N — m	5.88 to 14.7	8.82 to 10.78
	kg — m	1.3 to 1.5	0.9 to 1.1
	lb — ft	9.39 to 10.85	6.51 to 7.95

(6) Crank case

To remove the crank case, first loosen the M8 bolts starting with those furthest from the center of the crank case and work in. Then loosen the M10 bolts, again starting with those furthest from the center of the crank case and working in.
When tightening the crank case bolts, start with the M10 bolts nearest to the center and work out. Then tighten the M8 bolts from the center and work out.



① M10 bolt tightening torque

Initial tightening	N – m	16.66 to 22.54
	kg – m	1.7 to 2.3
	lb – ft	12.29 to 16.63
Final tightening	N – m	37.24 to 41.16
	kg – m	3.8 to 4.2
	lb – ft	27.48 to 30.37

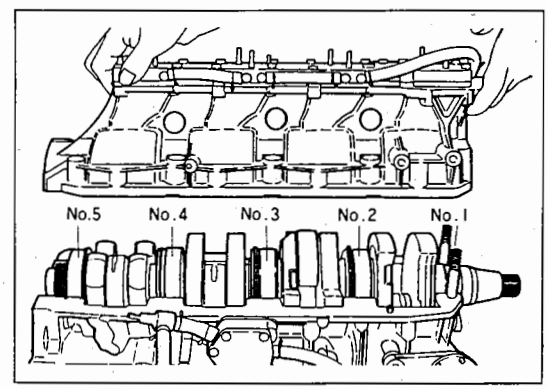
② M8 bolt tightening torque

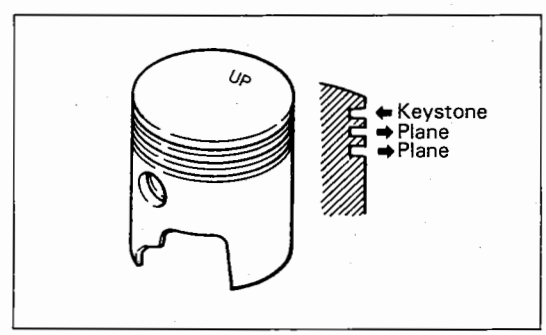
Initial tightening	N – m	11.76 to 14.70
	kg – m	1.2 to 1.5
	lb – ft	8.68 to 10.85
Final tigetening	N – m	23.52 to 25.48
	kg – m	2.4 to 2.6
	lb – ft	8.68 to 18.80

Note: Pay attention to the dowel pin positions on the bottom of the cylinder block when assembling the crank case.
Sockets for the dowel pins are located on both the right and left of the crank case.

(7) Crank assembly

a. Hold both sides of the crank assembly and lift it a little.
b. Lightly tap the cylinder block with a soft hammer and remove the crank assembly from the cylinder block.
c. Pay attention to the dowel pin positions. When installing the crank shaft assembly, match the dowel pins on the cylinder block to the dowel pin sockets in the bearings (No. 1, No. 2, No. 3, No. 4). Set dowel pin of No. 5 bearing to the groove in the adjacent surface of crank case. Set sealing ring edges to crank case side.
d. Piston
The top piston ring is of the keystone type, the second and the third rings are of the plane type.
Be sure to assemble the pistons so the UP mark on the top face the flywheel.



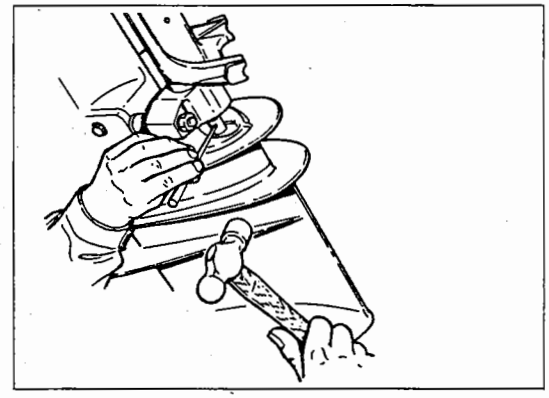


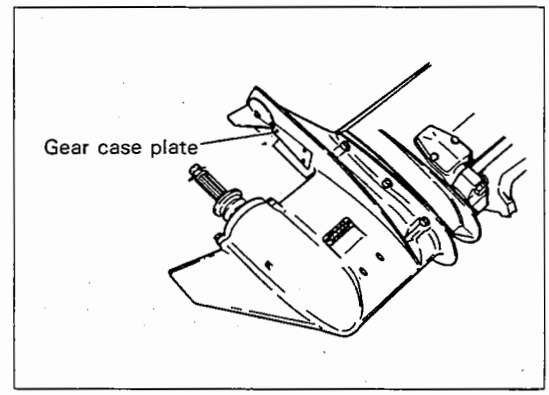
7 GEAR CASE

(1) Remove the shift cam shaft spring pin

(2) Removal of the gear case

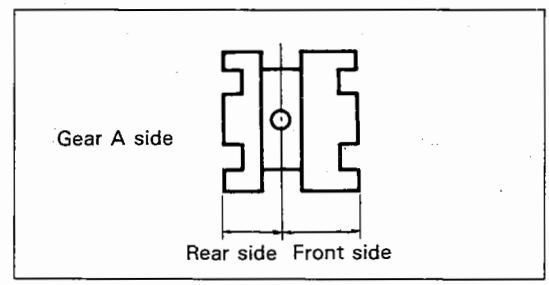
a. Remove the gear case plate located under the cavitation plate and take out the internal coupling bolt.
b. Remove the 6 gear case mounting bolts.
NOTE: To assemble, first install two bolts in the locations marked B to position the gear case, finally install the remaining bolts. Before re-using these bolts, degrease and apply screw locking agent.





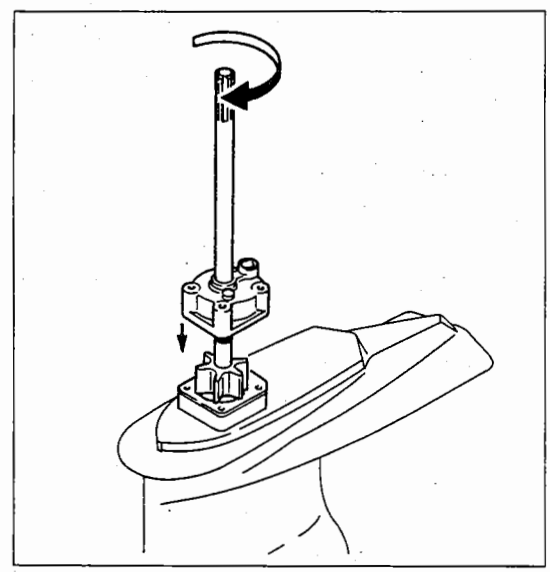
(3) Clutch

Install so that the narrowest claw (measured from the center of the clutch pin) faces gear A.



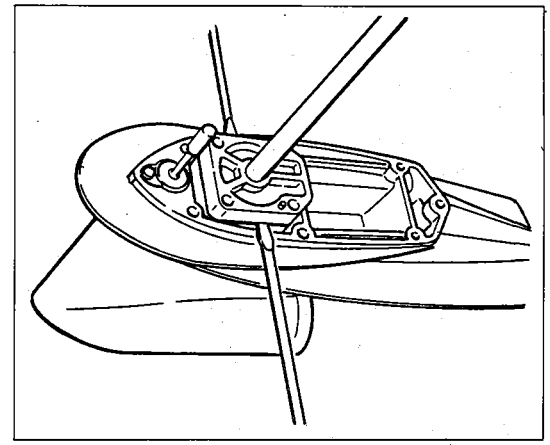
(4) Water pump

To install the water pump, rotate the drive shaft clockwise and attach the upper water pump case to the impeller.
Caution: If the drive shaft is rotated counterclockwise, the impeller will bend in the wrong direction and may be damaged.



(5) Removal of the lower water pump case

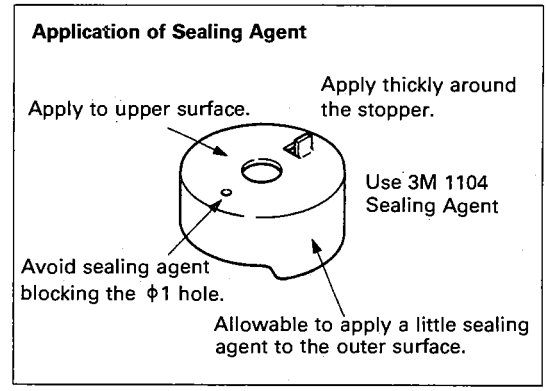
Insert screw drivers into the notches on both sides of the case to remove.



(6) Replacement of the water pump liner

Apply sealing agent (3M 1104) to the top of the liner when placing it in the water pump casing. This prevents air being drawn into the system.

Note: 1. Use a thicker layer of sealing agent around the stopper.
2. Be careful that sealing agent does not clog the ϕ1 hole on the top of the liner.

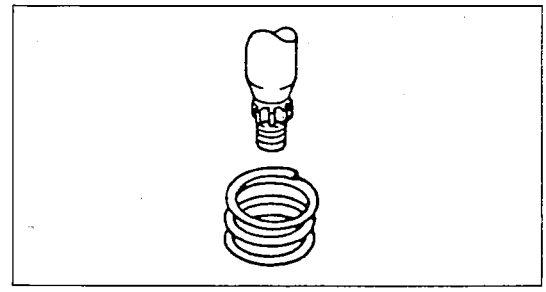


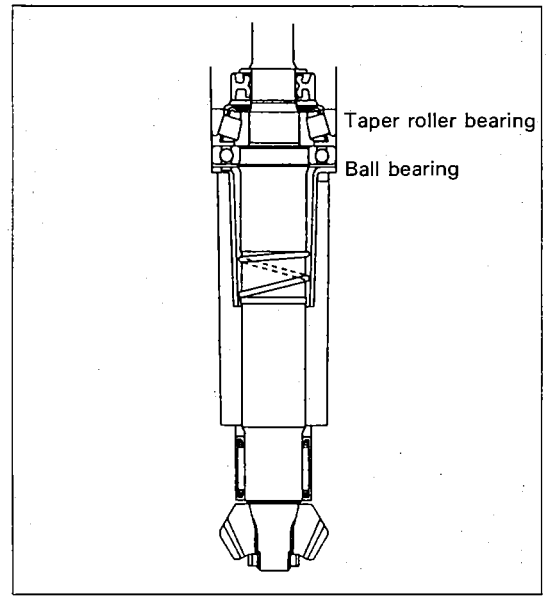
(7) Drive shaft spring

The drive shaft spring facilitates the supply of lubricating oil to the tapered roller bearings under the lower water pump housing.

Install the drive shaft spring so that the wide end of the spring faces the gears and the narrow end faces the bearings.

Be sure to install the drive shaft spring in the specified position. If it is installed too high, the supply of oil to the bearings may be insufficient.



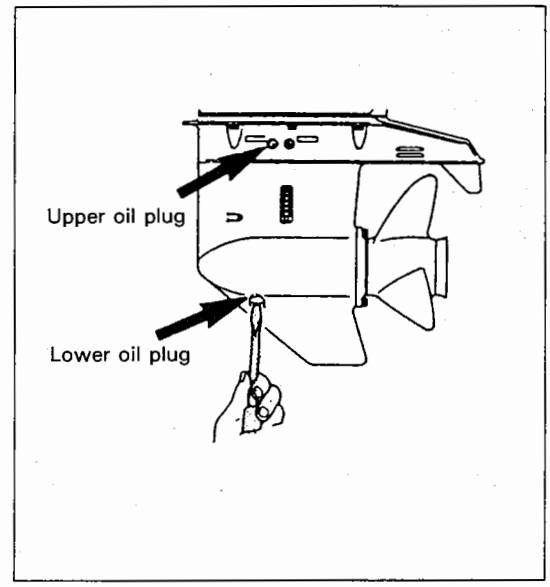


(8) Gear oil

Remove the upper and lower oil plugs to drain the gear oil.

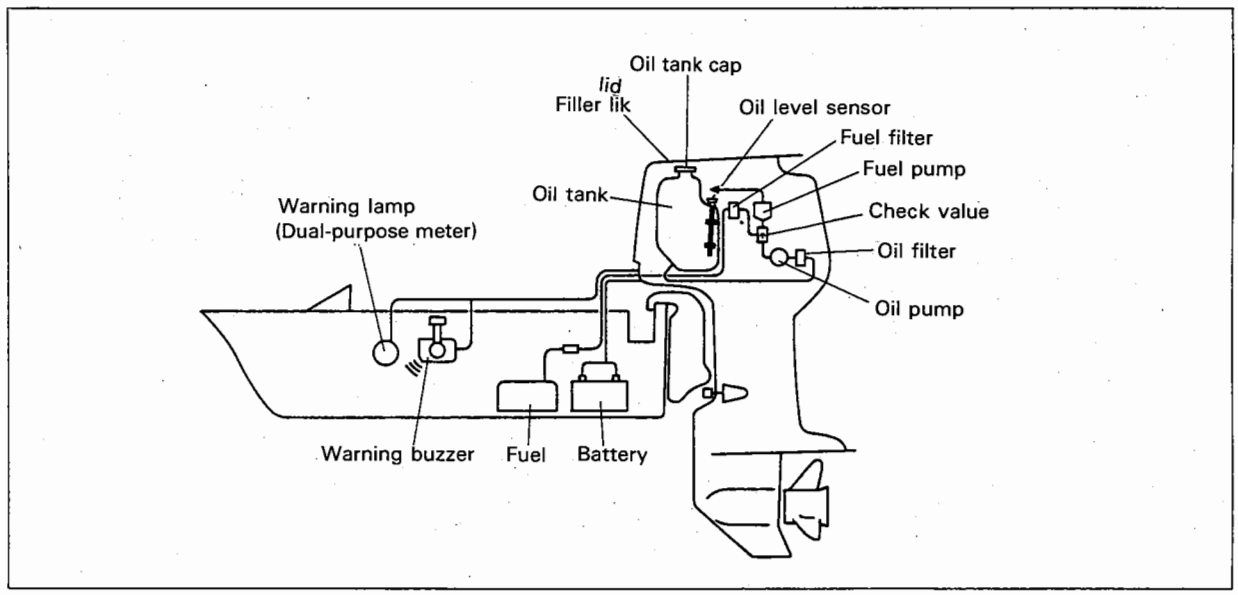
To add gear oil, remove the upper and lower oil plugs and insert the nozzle of the gear oil tube into the lower plug hole. When oil overflows from the upper plug hole, replace the upper plug and tighten. Finally, replace the plug in the lower plug hole.

Use approximately 900cc (30.405 Fl. Oz) of AP1 GL5 or SAE #80 (or SAE #80W) gear oil.



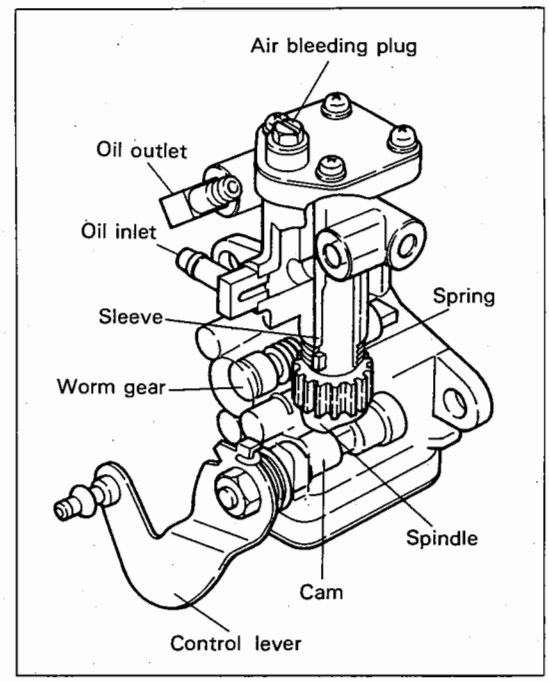
8 AUTO MIXING SYSTEM

(1) System design



(2) System function

This system feeds the engine oil and the fuel oil to the engine separately. The engine oil is automatically fed to the engine from the oil tank by the oil pump.



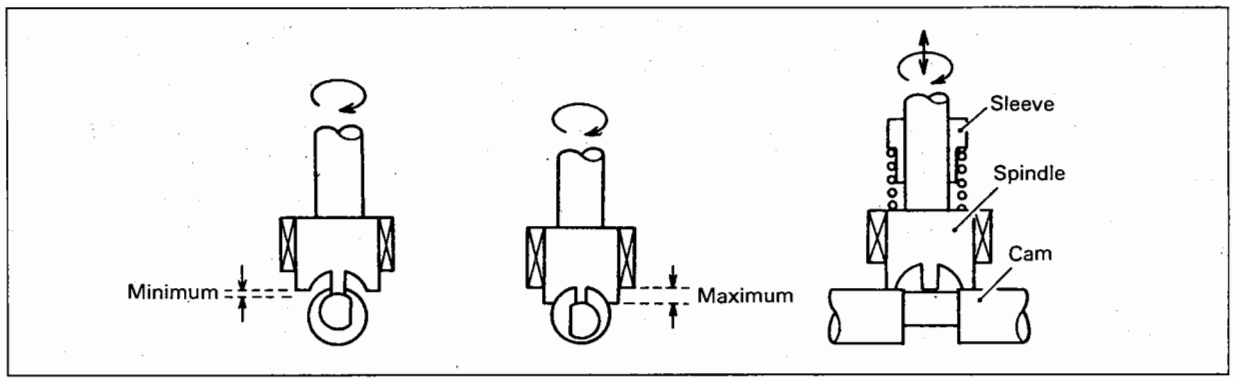
(3) Oil pump

1) Structure

This is a plunger type oil pump.

The spindle is driven by a worm gear. The cam at the bottom of the spindle gear is linked to the piston and forces feeding. The oil flow is regulated by changing the stroke of the spindle with the cam which is linked to the control lever. (See diagram below.)

Furthermore, the rotation of the worm gear also changes according to the engine speed, so there is double control of the oil flow.



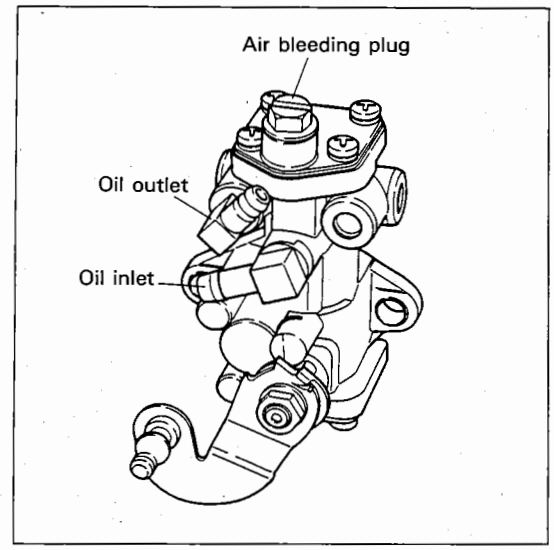
(4) Bleeding air from the oil system

Always bleed the air from the oil system of a new outboard motor and whenever the motor runs cut of oil.

a. Bleeding air from between the oil tank and oil pump
   1) Fill the oil tank with engine oil.
   2) Loosen the air bleeding plug.
   3) Bleed the air from the oil pipe and oil filter.
   4) Check that there is no more air, then replace the air bleeding plug.

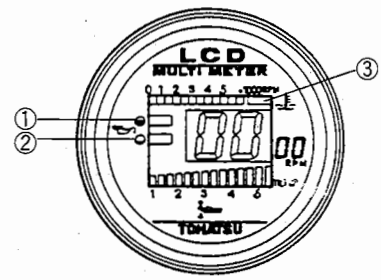
b. Bleeding air from between the oil pump and intake manifold
   1) Start the engine and let it idle.
   2) Continue idling until there is no air remaining in the transparent oil pipe.

NOTE: When starting a new outboard motor, add engine oil at 50:1 mixture in the fuel tank, in addition to the engine oil in the oil tank.

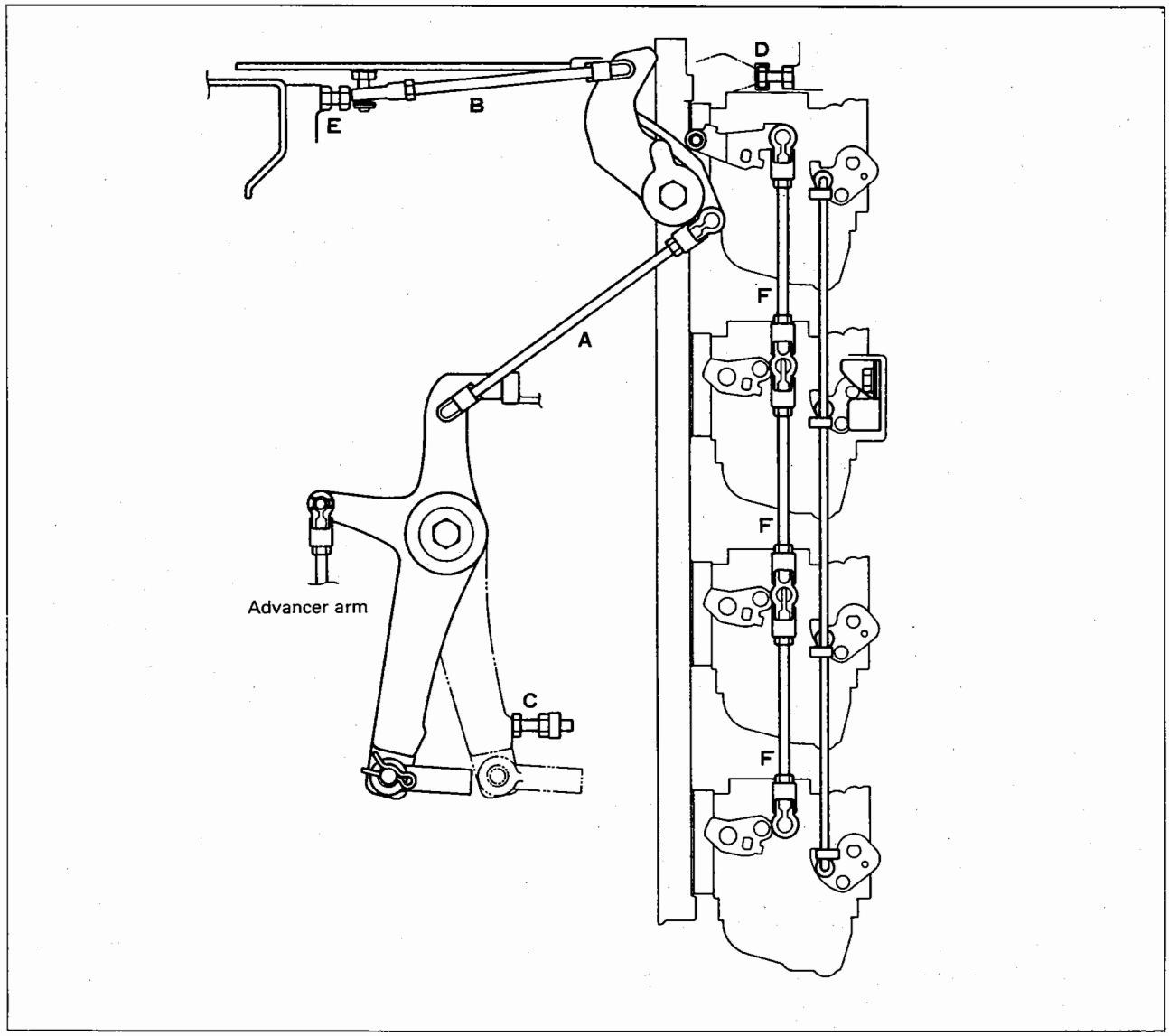


(5) Cautions and inspection of the auto mixing system

No.	Part	Caution/Inspection
1	Engine oil	Use Tohatsu genuine engine oil. If not available, anotehr Marine Engine Manufacturer's outboard motor oil with NMMA(BIA) certified TC-W or TC-WII must be used. **CAUTION:** Do not mix different brands of oil. The TOHATSU AUTOMIXING SYSTEM is equipped with an engine oil filter assembly located between the Integral engine oil tank and the engine oil pump. The mixing of different brands of oil or different kinds of oil even of the same brand may cause jelling (gel), resulting in blockage of oil filter screens. This may lead to serious engine damage due to the lack of powerhead lubrication.
2	Oil pump "O"-ring	◦ Check the "O"-ring upon assembly. ◦ Apply oil.
3	Oil pipe	◦ Clip securely at the point of insertion. ◦ Clamp at specified places. ◦ Do not bend or bring the pipe into contact with sharp edges. ◦ Remove all air from the pipe.
4	Oil tank cap	◦ Check that the auto air vent functions properly.
5	Oil link rod	◦ Apply grease to ball joint. ◦ Check that the rod is correctly secured.
6	Oil level sensor	◦ Check that the sensor functions correctly.
7	Oil filter	◦ Ensure the filter is free of water, dirt and gel.
8	Alarm device	◦ Check that the oil level indicator lamps (① and ②) in the multi-purpose meter lights are not shining. ◦ Check function of buzzer (for engine over heating, low cooling water pressure ③ and low engine oil level at ②. ◦ Check that the buzzer(s) for overheating, low water pressure and low oil level function correctly.



9 LINK ADJUSTMENT

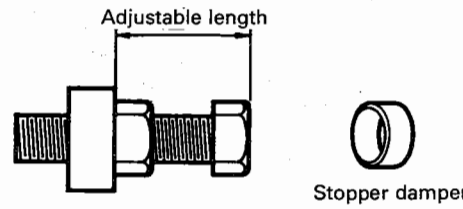


(1)

a. Length of links A and B
A (Throttle link): 158 mm
B (Ignition timing link): 127 mm
Check that the throttle is fully opened when the advancer arm is at maximum speed. Use link B for fine adjustment.

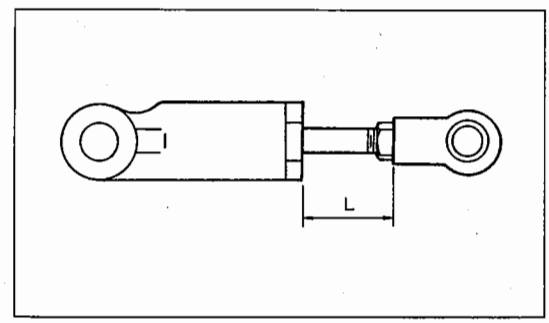
b. Length of stopper D
M140A ..... Regulate the ignition timing with stopper D to make B.T.D.C. 20° at full throttle. (D = 18 mm, 0.708 inch)
M120A ..... Regulate the ignition timing with stopper D to make B.T.D.C. 20° at full throttle. (D=18 mm, 0.708 inch)
Do not forget to install the stopper damper when adjusting.

c. Length of high speed side stopper C
M140A ..... C = 14 mm, 0.551 inch
M120A ..... C = 18 mm, 0.708 inch



d. Stopper E
Regulate the ignition timing with stopper E to make A.T.D.C. 10° when the throttle is fully closed. Use throttle link A for fine adjustment so that at full throttle the advancer arm is in contact with high speed side stopper C.

e. Shift assist assembly
Length of L ..... Approx. 24 mm (Approx. 0.787 inch)



(2) Carburetor tuning

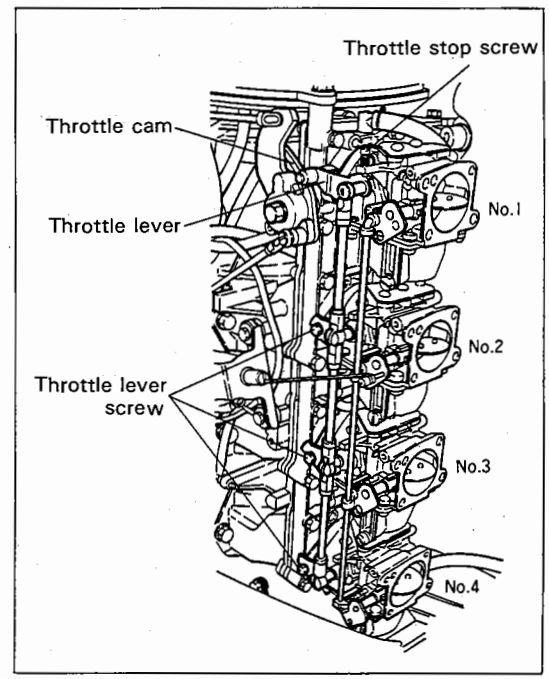
a. Throttle link rod F
Length of rod F . 110 mm (4.33 inch) (distance between ball joint centers)
Apply grease to ball joints.

b. Synchronizing carburetors
1) Turn the throttle lever screws of the #2, #3 and #4 carburetors clockwise and turn the sub screw counter-clockwise to loosen.
2) Loosen the #1 carburetor throttle stop screw completely so that the throttle valve is fully closed.

Note: Check that the throttle lever roller is free from the throttle cam. If the roller touches the throttle cam, detach the throttle link rods A & B to fully close the throttle.

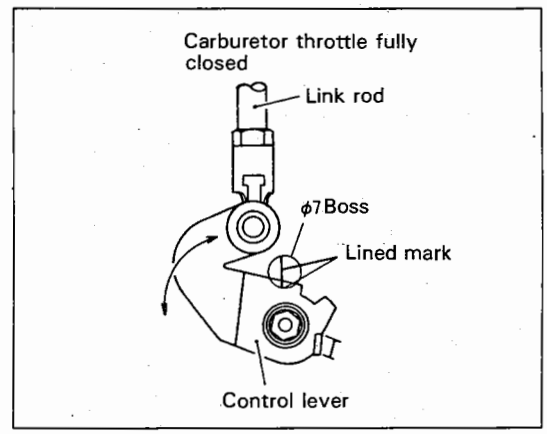
3) Turn the #2 carburetor throttle lever screw counter-clockwise to tighten while pushing the throttle lever down to close the butterfly valve. (Tighten the throttle lever first and tighten the sub screw second.)
4) Tighten the throttle lever screws and the sub screws of #3 and #4 carburetors in the same manner.
5) Turn the throttle stop screw clockwise and adjust so that the throttle valve opening is approximately 5°.

c. Pilot screw adjustment
1) After thoroughly warming the engine, adjust the carburetors to find the setting at which the engine speed increases the most when each pilot screw is opened 1-5/8 ± 1/4 turns.
2) Open the pilot screw another 1/8 turn (from the position at which engine speed increases the most) to give the setting for when the engine is cold.
3) Adjust the throttle stop screw for the specified engine speed.
specified trolling speed ..... 550 to 750 rpm
(reference: idling speed ..... 700 to 850 rpm)



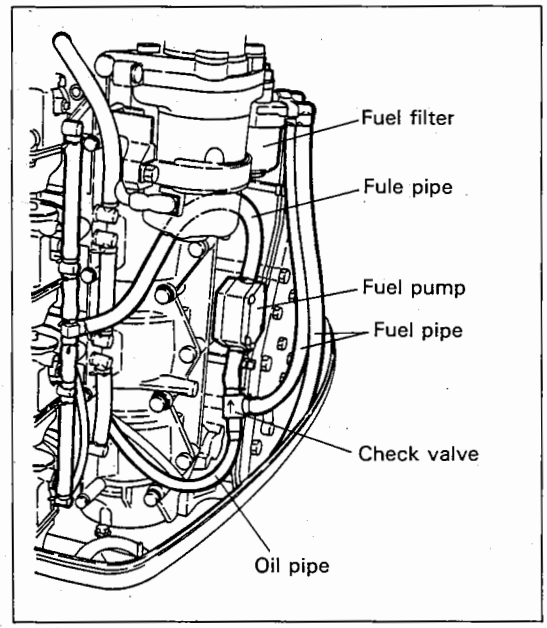
(3) Oil pump aperture adjustment

a. Adjust the link rod length so that the lined mark on the control lever matches the mark on the 7 mm boss when the carburetor throttle is fully closed (idling position).
NOTE: Adjust the oil pump aperture after adjusting the carburetor and ignition timing.



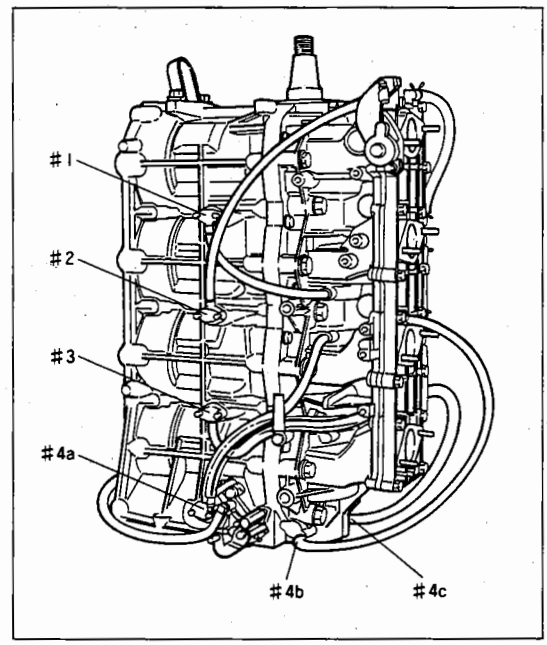
(4) Oil line check valve

There is a check valve between the oil pump and the fuel pump.
Install so that the arrow on the check valve faces the fuel pump.
(The arrow mark indicates the direction of oil flow.)



(5) Oil recirculation

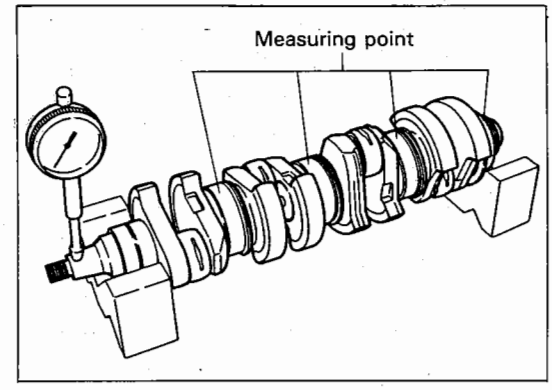
Oil is recirculated uniformly to the cylinders to prevent mixed oil from stagnating, and to improve lubrication.
Connect the recirculation hoses as follows:
#1 Check valve → #2 Crank case
#2 Check valve → #1 Crank case
#3 Check valve → #4c Crank case
#4a Check valve → #3 Crank case
#4b Crank case → #3 Manifold



10 INSPECTION OF PARTS

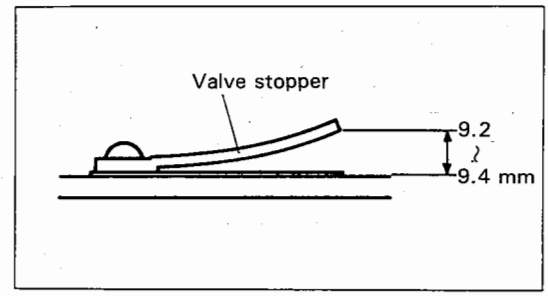
(1) Crank shaft

The crank shaft deflection should be less than 0.05 mm with both ends supported.
Measure with the bearings installed on both ends of the crank shaft.



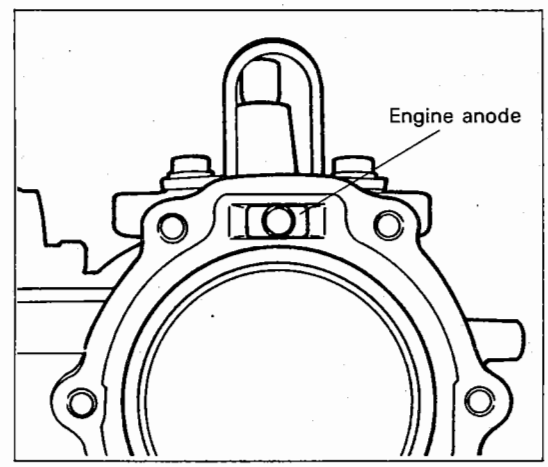
(2) Reed valve

Adjust the reed valve stopper so that the lift height of the reed valve is 9.2 – 9.4 mm (0.362 – 0.370 inch).



(3) Engine anode

Check the engine anode installed in the cylinder block water jacket for wear.



11 INSPECTION OF ELECTRICAL PARTS

(1) Flywheel magneto

Measure coil resistance with an electric testing meter. If the resistance changes when the coil leads are twisted or pulled lightly, the leads may be partially severed.

CAUTION

The battery of the electric testing meter must be less than 3 volts, D.C. or electrical parts in the C.D. unit may be damaged.

Part name	Lead to be connected to testing meter	Resistance
a. Alternator	black/white — black/white (three points)	0.325 ohm ± 20%
b. Exciter coil	white/green — pink	300 ohm ± 15%
c. Pulser coil	white/red — black	220 ohm ± 15%
	white/black — black	220 ohm ± 15%
	white/blue — black	220 ohm ± 15%
d. Ignition coil		
primary coil	black/white — black	0.21 ohm ± 15%
secondary coil	high tension cables — black	3.2 Kohm ± 15%

(2) Rectifier

Testing meter negative lead (black) \ Testing meter positive lead (red)	red	black/white	black/white	black/white	black
red		not conductive	not conductive	not conductive	not conductive
black/white	conductive (15 ohm)		not conductive	not conductive	not conductive
black/white	conductive (15 ohm)	not conductive		not conductive	not conductive
black/white	conductive (15 ohm)	not conductive	not conductive		not conductive
black	conductive (60 ohm)	conductive (15 ohm)	conductive (15 ohm)	conductive (15 ohm)	

As measured with a HIOKI model 3000 testing meter.

NOTE:

- Disconnect all leads when measuring.
- The resistance value shown in ( ) is approximate and was measured using the 1Ω (ohm) range of the electric testing meter.

(3) Engine knocking sensor

Resistance rating between the sensor terminal and the crank case: 560 kohm

(4) Engine knocking controller

Below are the standard values measured at room temperature of 20°C (68°F) with the HIOKI model 3000 testing meter.

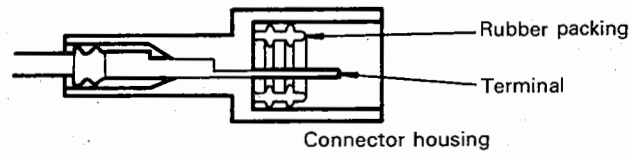
Testing meter negative laed (black)	Testing meter positive lead (red)					
	pink	red	pink/blue	brown/white	black
pink		∞	500 Kohm	500 Kohm	400 Kohm
red	500 Kohm		*150 Kohm	*200 Kohm	*18 Kohm
pink/blue	1 mega ohm	∞		150 Kohm	38 Kohm
brown/white	1 mega ohm	∞	150 Kohm		50 Kohm
black	400 Kohm	∞	20 Kohm	50 Kohm	

*Initially the testing meter will register a smaller value than that shown in the chart. After a short delay it will show the specified reading.

Resistance values may vary with the kind of testing meter used.

(5) CD unit

1) Do not disconnect or short circuit the coil base leads or CD unit leads while the engine is running.
2) Do not change the installation position of the CD unit.
3) Do not touch the spark plugs and high voltage cables leading to the spark plugs with your hand while the engine is running, as the voltage and current are high.
4) When checking the spark of one spark plug, always keep the other three plugs in contact with the engine or the CD unit may be damaged.
5) Disconnect the coil plate leads and CD unit leads when measuring cylinder compression.
6) Check if the rubber packing is installed correctly when re-connecting water-proofed 2 pin and 3 pin connectors.



Standard values for the CD unit

Testing meter: Tohatsu recommended tester (HIOKI model 3000), range kΩ

Testing meter negative lead (black)	Testing meter positive lead (red)																				
	B (LA106)	B (LA106)	B/W (1)	B/W (2)	B/W (3)	B/W (4)	SB	L	Y	W	BR	BP/W	P/L	R	R/W	W/R	W/B	W/L	W/Y	B	OR	W/G
B (LA106)		4.2	4.2	4.2	4.2	11	∞	*6	0.4	12	7.5	∞	∞	12	9	9	9	9	0	12	4
B/W (1)	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
B/W (2)	∞	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
B/W (3)	∞	∞	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
B/W (4)	∞	∞	∞	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
SB	∞	∞	∞	∞	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L	*30	*60	*70	*70	*70	*60		*60	*30	*100	*80	∞	∞	*60	*50	*50	*50	*50	*30	*100	*60
Y	∞	∞	∞	∞	∞	4	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
W	0.4	4.6	4.8	4.8	4.6	12	∞	6.5		12	8	∞	∞	13	9	9	9	9	0.4	13	4.6
BR	*80	*100	*100	*100	*100	*150	∞	*100	*80		*150	∞	∞	*150	*90	*90	*90	*90	*80	*150	*100
BR/W	18	40	40	40	40	30	∞	34	19	70		∞	∞	32	34	34	34	34	18	80	38
P/L	45	70	80	80	80	90	∞	60	50	100	90		∞	90	60	60	60	60	45	100	70
R/Y	*22	*60	*70	*70	*60	*50	∞	*22	*22	*100	*90	∞		70	*45	*45	*45	*45	*22	*150	*60
R/W	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞		∞	∞	∞	∞	∞	∞	∞
W/R	8.5	16	16	16	16	28	∞	*20	9	28	20	∞	∞	28		18	18	18	8.5	30	16
W/B	8.5	16	16	16	16	28	∞	*20	9	28	20	∞	∞	28	18		18	18	8.5	30	16
W/L	8.5	16	16	16	16	28	∞	*20	9	28	20	∞	∞	28	18	18		18	8.5	30	16
W/Y	8.5	16	16	16	16	28	∞	*20	9	28	20	∞	∞	28	18	18	18		8.5	30	16
B	0	4.2	4.2	4.2	4.2	11	∞	*6	0.4	12	7.5	∞	∞	12	9	9	9	9		12	4
QR	*60	*90	*90	*90	*90	*100	∞	*100	*60	4	*100	∞	∞	*100	*70	*70	*70	*70	*60		*90
W/G	*60	*90	*90	*90	*90	*100	∞	*100	*60	4	*100	∞	∞	*100	*70	*70	*70	*70	*60	*150	

(6) Testing the CD unit

1) The Black/Yellow lead must be connected when measuring.
2) In the case of standard values marked * in the table, the testing meter will initially register a smaller value, but after a short delay, it will show the specified reading.
3) Resistance values may vary with the kind of testing meter used.
4) Be sure to re-connect each lead securely after checking the CD unit, especially the Red/Yellow lead.
5) Color of lead

B:	balck	BR:	brown
L:	blue	OR:	orange
R:	red	SB:	sky blue
W:	white	Y:	yellow
B/W:	balck/white	BR/W:	brown/white
P/L:	pink/blue	R/W:	red/white
W/B:	white/black	W/L:	white/blue
W/Y:	white/yellow	W/G:	white/green

CAUTION

If the Red/Yellow lead is not properly connected the following problems may occur.

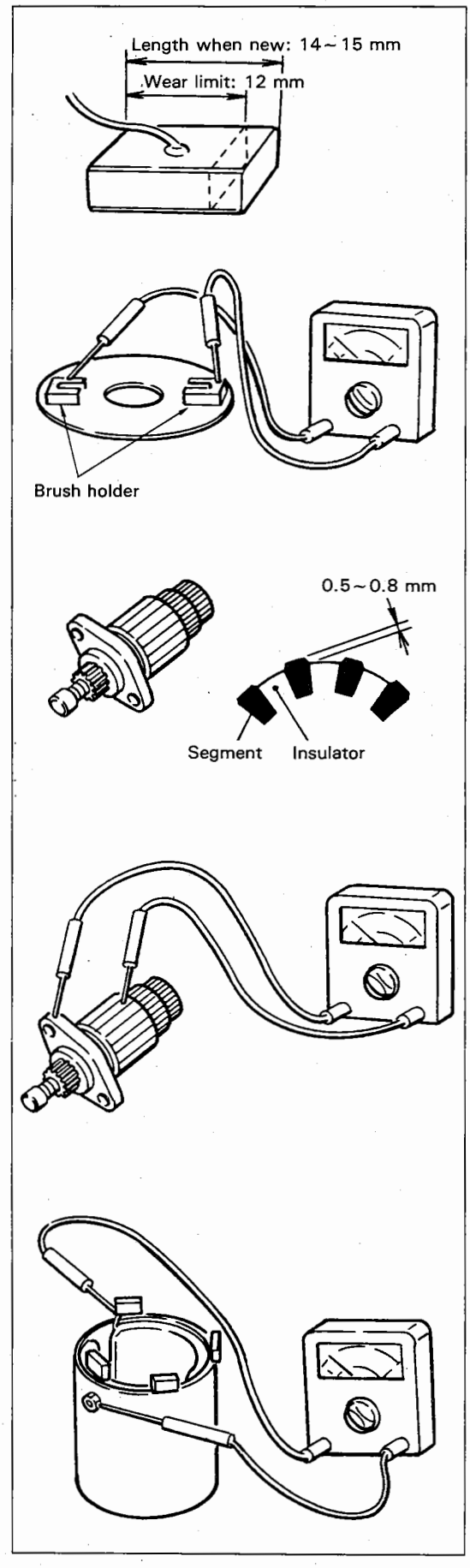
A. The multi-purpose meter will not show the engine revolution speed.
B. The probability of the engine seizing due to overheating will increase as over advanced ignition will cause abnormal combustion. In addition, various safety devices and warning signals will not function properly making the prevention of engine overheating impossible.

(7) Starter motor

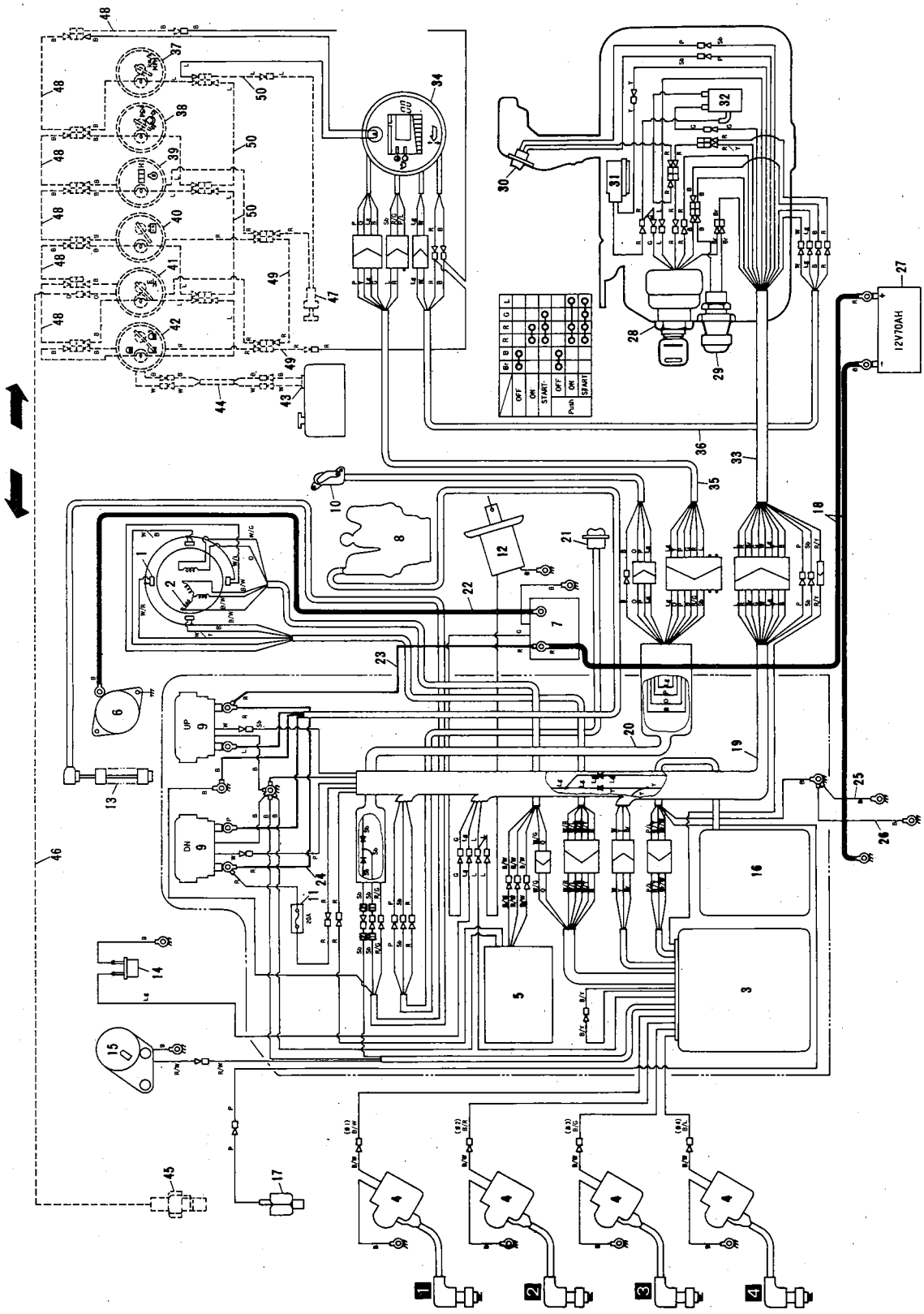
a. Brush and spring
   1) Check the extent of brush wear.
      Replace if the brush length is 12mm or less.
   2) Check the insulation between brush holders.
      If electricity is conducted, clean and insulate or replace them.
   3) Brush spring tension
      Replace if the brush spring tension is reduced.

b. Armature
   1) Measure the armature insulator depth.
      If the depth is less than 0.5 to 0.8mm, or misshapen, repair with a hacksaw blade to restore the specified depth.
   2) If the armature has carbon or other dirt on it, remove with #500~#600 emery paper.
   3) Check the armature's insulation.
      If electricity is conducted, replace the motor assembly.

c. Field coil
   1) Check for damaged field coils.
      Connect the tester to the coil terminals and check for conductivity.
   2) Check for conductivity between the coil terminals and ground wire.
      If conductive, insulation is defective, so replace the field coils.
   3) Check for conductivity between the field coil terminals and yoke.
      If conductive, insulation is defective, so replace the field coils.



12 WIRING DIAGRAM



(1) Explanation of Remarks

Remark 1

The lead is exclusive to the M120A/M140A. Miss-connection may cuase the engine trouble

Remark 2

1) Remote Control Box RC5E is the exclusive to the M120A/140A. The RC5E is not interchabgeable with the RC3 series used with other models of outboard motor (eg. the M90A).
2) If you use a binnacle mount or a side mount remote control box, use all the lead wires of Cord Assembly B.

Remark 3

If the multi-purpose meter functions abnormally, improper connection of the red/yellow lead in Remark 1 is most probable.

Remark 4

Check that the rubber packing is installed correctly when re-connecting the water-proofed 2 pin and 3 pin connectors.

Remark 5

The negative battery cable must not be connected directly to other grounding leads.

Remark 6

The grounding lead is to be connected to the starter bracket.

Color of lead

B	Black
Br	Brown
G	Green
L	Blue
Lg	Light Green
O	Orange
P	Pink
R	Red
Sb	Sky Blue
W	White
Y	Yellow

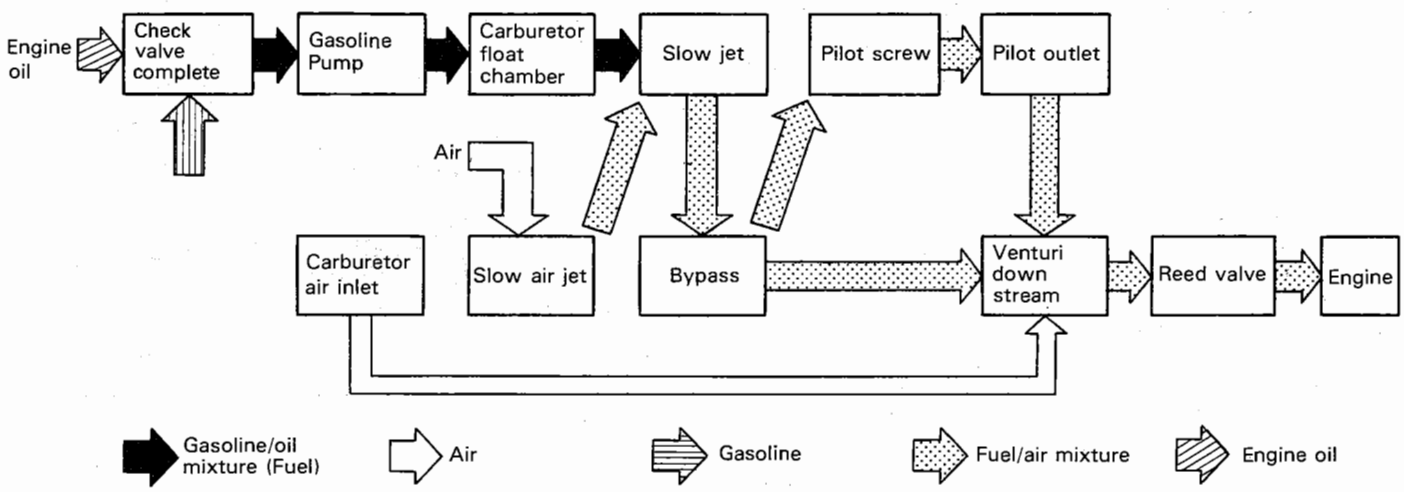
(2) Explanation of numbers

1. Pulser coil assembly
2. Alternator assembly
3. C.D. unit
4. Ignition coil
5. Rectifier assembly
6. Starter motor
7. Starter solenoid
8. Power trim & tilt
9. Solenoid switch, power trim & tilt
10. Trim sender
11. Fuse wire
12. Choke solenoid
13. Oil level sensor
14. Overheat sensor
15. Water pressure switch
16. Engine knocking control unit (M140A only)
17. Engine knocking sensor (M140A only)
18. Battery cable
19. Cable harness A
20. Cable harness C
21. Power trim & tilt switch B
22. Starter cord
23. Cable A, solenoid switch
24. Cable B, solenoid switch
25. Ground cable
26. Ground cable
27. Battery (Generally available) 12V 70AH to 12V 100AH
28. Ignition switch
29. Safety switch
30. Power trim & tilt switch
31. Overheat buzzer
32. Neutral switch
33. Cable harness B
34. Multi-purpose meter
35. Meter cable assembly
36. Meter lead wire B
37. Speedometer (optional)
38. Water pressure gauge (optional)
39. Hour meter (optional)
40. Voltmeter (optional)
41. Water temperature gauge (optional)
42. Fuel gauge (optional)
43. Fuel gauge sensor unit (optional)
44. Fuel gauge cable (optional)
45. Water temperature sensor (optional)
46. Water temperature lead wire (optional)
47. Meter lamp switch (optional)
48. Assist cable, black (optional)
49. Assist cable, red (optional)
50. Assist cable, blue (optional)

13 CARBURETOR

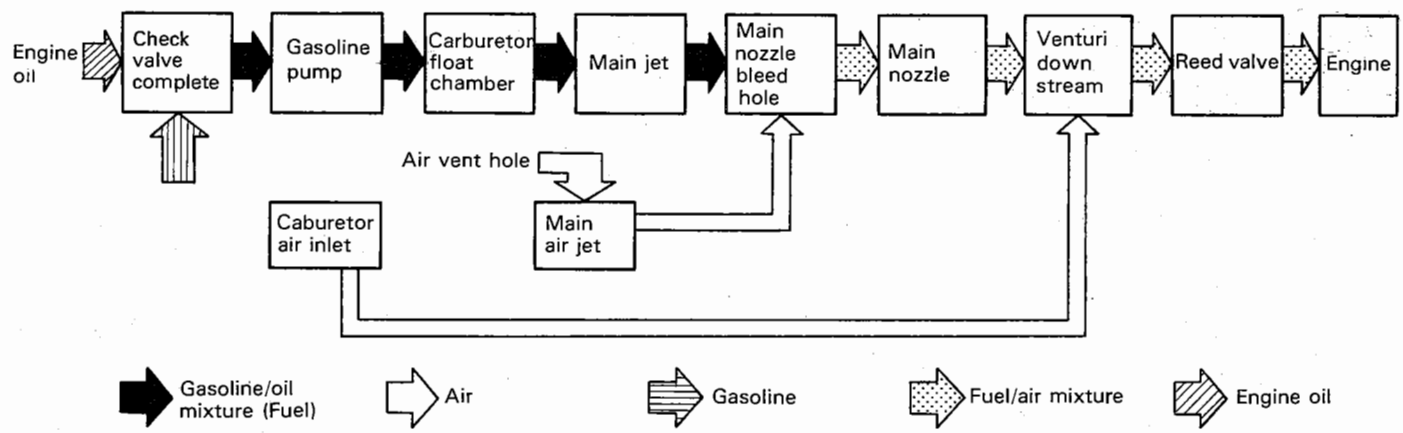
(1) Pilot system, Idling system

Flow of fuel (gasoline and engine oil mixture) and air for starting and idling.



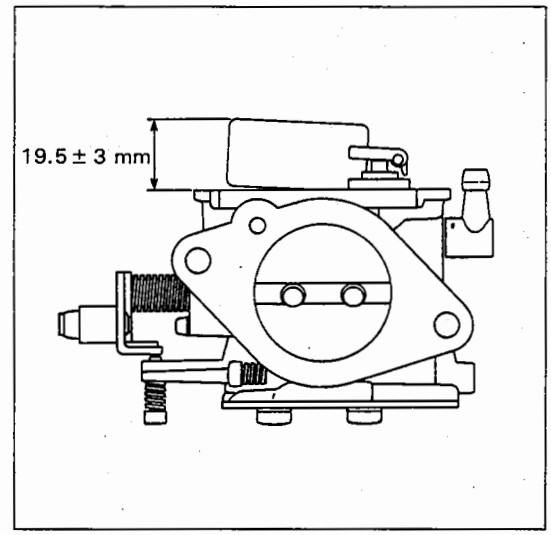
(2) Main system

Flow of fuel (gasoline and engine oil mixture) and air at medium speeds and above.



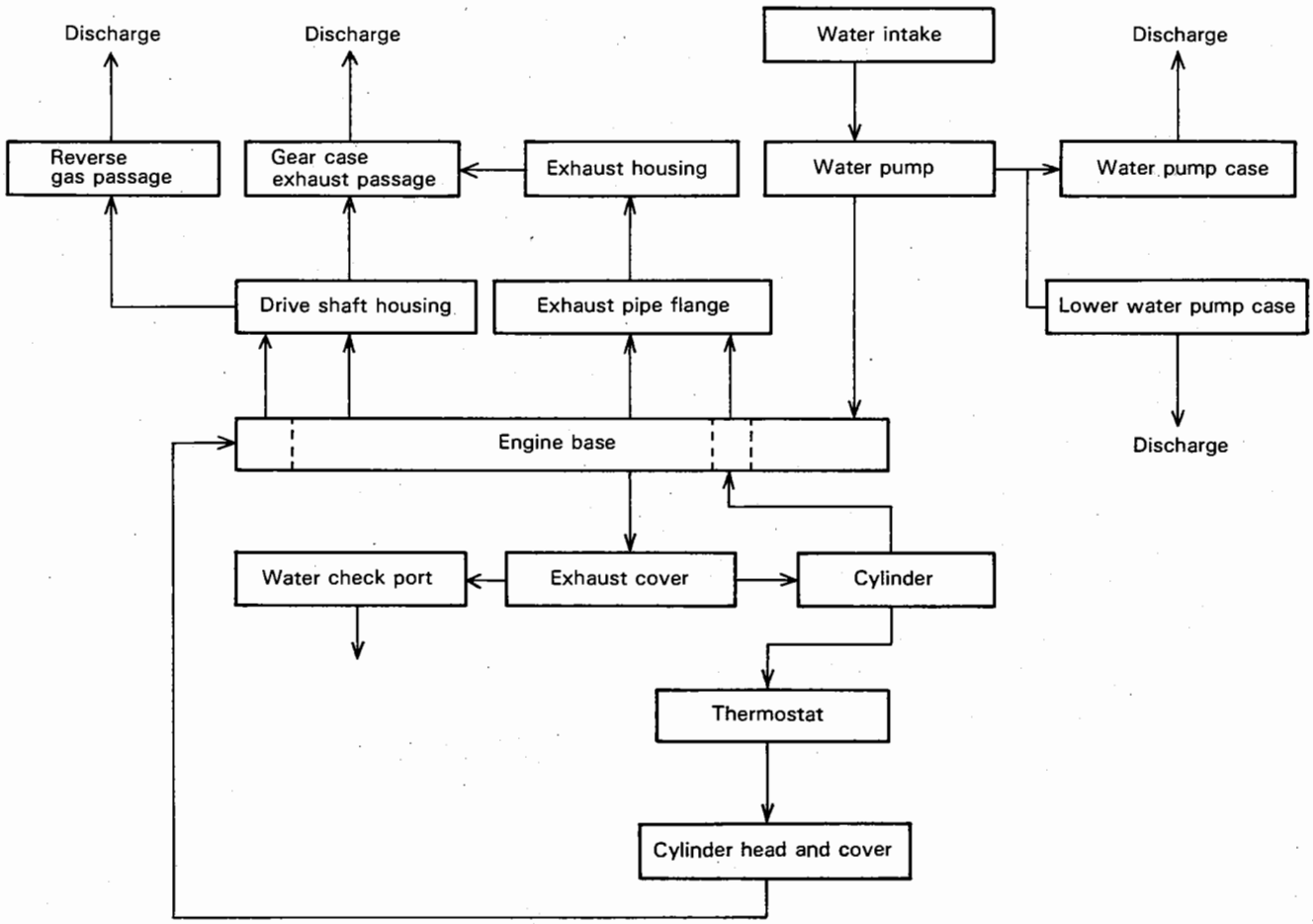
(3) Float height

To obtain the center of the float, measure the height from the float tip to the float chamber surface.
Standard float height: 19.5 ± 3 mm
(measured at the edge of the float)



14 COOLING SYSTEM

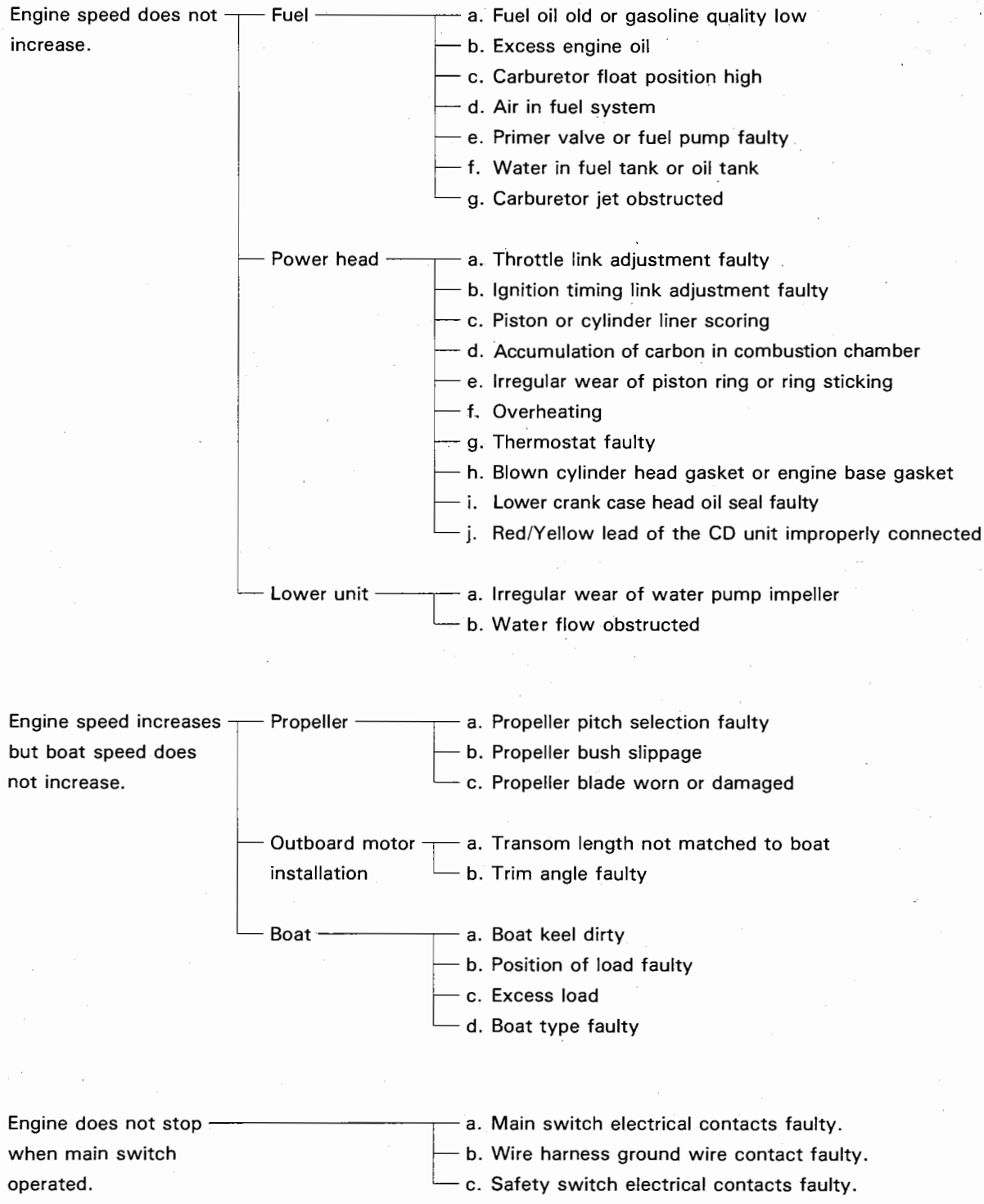
Schematic showing the circulation of coolant.

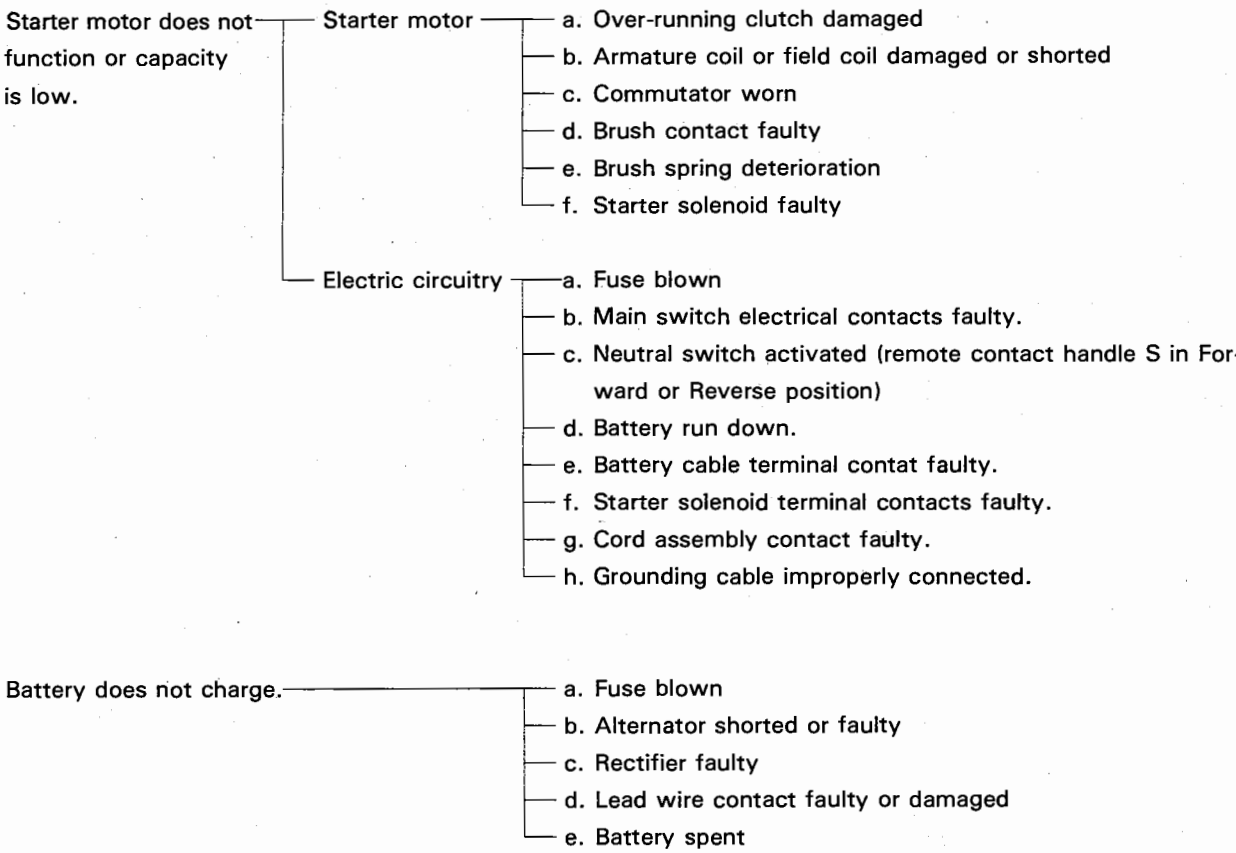


15 TROUBLESHOOTING

- Engine does not start.
  - Fuel
    - a. Fuel tank empty
    - b. Fuel system connection faulty or obstructed
    - c. Air in fuel system
    - d. Carburetor pilot screw adjustment faulty
    - e. Carburetor system obstructed, needle valve operation faulty
    - f. Choke valve operation faulty
    - g. Carburetor and ignition time synchronization faulty
    - h. Reed valve faulty
    - i. Gasoline or engine oil quality faulty
  - Electric
    - a. Battery dead
    - b. Main switch faulty
    - c. Lead wire terminal contact faulty
    - d. Charging coil or trigger coil faulty
    - e. CD unit or ignition coil faulty
    - f. Ignition timing adjustment faulty
    - g. High voltage cable loose, electricity leaking
    - h. Spark plug faulty
    - i. Safety switch disconnected, shifted to F or R
  - Power head
    - a. Compression low
    - b. Crank case poorly sealed (blown gasket)

- Idling speed faulty or engine revolution does not continue.
  - Fuel
    - a. Little fuel in tank
    - b. Fuel system connection faulty
    - c. Air in fuel system
    - d. Water in fuel tank or oil tank
    - e. Fuel pump or primer valve faulty or reed valve faulty
    - f. Carburetor overflow (flooded)
    - g. Pilot screw adjustment faulty
    - h. Choke valve closed
    - i. Carburetor synchronization faulty
  - Electric
    - a. Trigger coil or charging coil faulty
    - b. CD unit or ignition coil faulty
    - c. Spark plug dirty or damaged
  - Power head
    - a. Blown cylinder head gasket or engine base gasket
    - b. Water entering from lower crank case


Engine speed does not increase.
Fuel
a. Fuel oil old or gasoline quality low
b. Excess engine oil
c. Carburetor float position high
d. Air in fuel system
e. Primer valve or fuel pump faulty
f. Water in fuel tank or oil tank
g. Carburetor jet obstructed
Power head
a. Throttle link adjustment faulty
b. Ignition timing link adjustment faulty
c. Piston or cylinder liner scoring
d. Accumulation of carbon in combustion chamber
e. Irregular wear of piston ring or ring sticking
f. Overheating
g. Thermostat faulty
h. Blown cylinder head gasket or engine base gasket
i. Lower crank case head oil seal faulty
j. Red/Yellow lead of the CD unit improperly connected
Lower unit
a. Irregular wear of water pump impeller
b. Water flow obstructed
Engine speed increases but boat speed does not increase.
Propeller
a. Propeller pitch selection faulty
b. Propeller bush slippage
c. Propeller blade worn or damaged
Outboard motor installation
a. Transom length not matched to boat
b. Trim angle faulty
Boat
a. Boat keel dirty
b. Position of load faulty
c. Excess load
d. Boat type faulty
Engine does not stop when main switch operated.
a. Main switch electrical contacts faulty.
b. Wire harness ground wire contact faulty.
c. Safety switch electrical contacts faulty.


Starter motor does not function or capacity is low.
Starter motor
a. Over-running clutch damaged
b. Armature coil or field coil damaged or shorted
c. Commutator worn
d. Brush contact faulty
e. Brush spring deterioration
f. Starter solenoid faulty
Electric circuitry
a. Fuse blown
b. Main switch electrical contacts faulty.
c. Neutral switch activated (remote contact handle S in Forward or Reverse position)
d. Battery run down.
e. Battery cable terminal contat faulty.
f. Starter solenoid terminal contacts faulty.
g. Cord assembly contact faulty.
h. Grounding cable improperly connected.

Battery does not charge.
a. Fuse blown
b. Alternator shorted or faulty
c. Rectifier faulty
d. Lead wire contact faulty or damaged
e. Battery spent

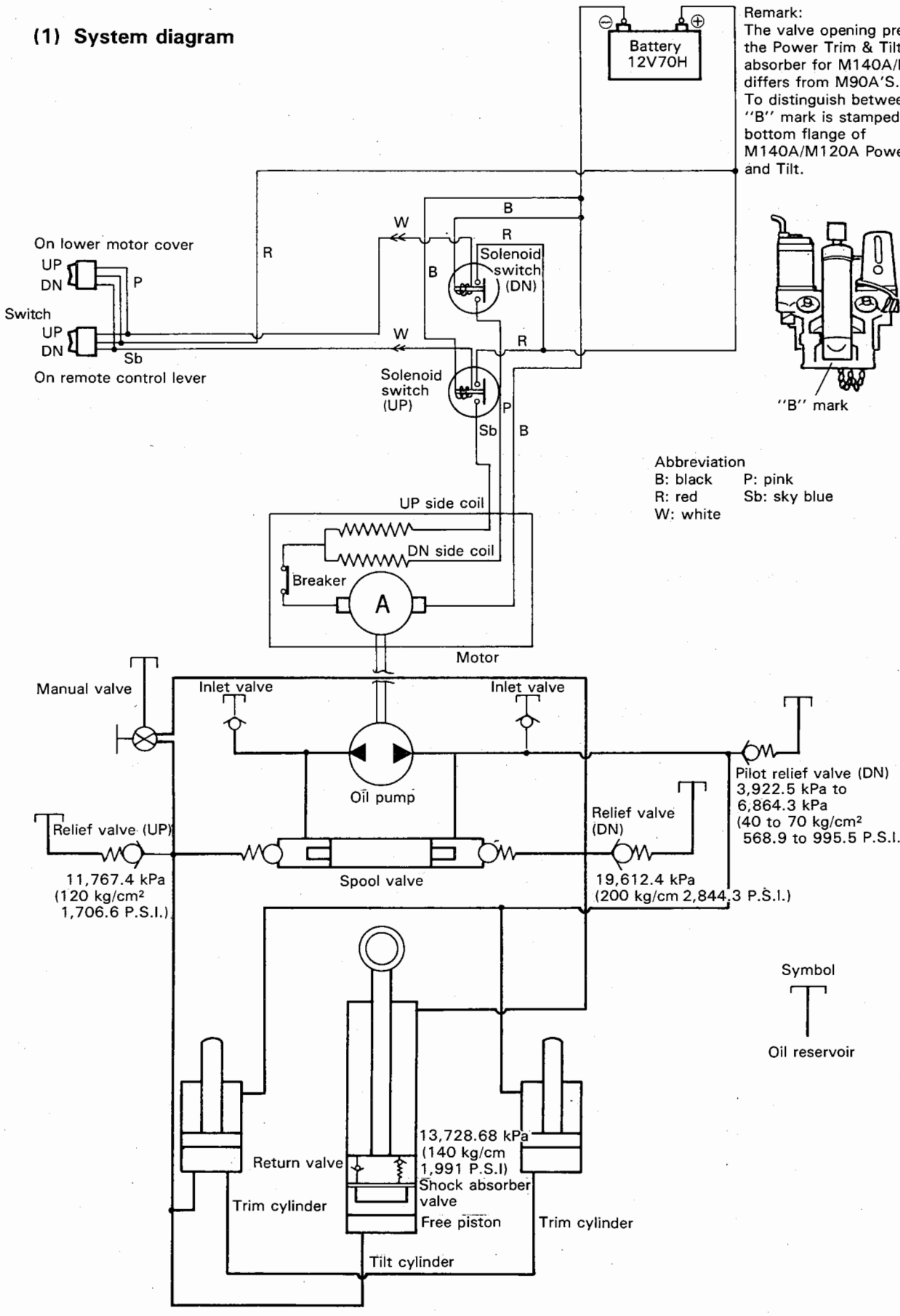
16 PERIODIC INSPECTION OF THE OUTBOARD MOTOR

Inspection	Procedure	10 hours or 1 month	50 hours or 3 months	100 hours or 6 months	Remarks
1. Retightening of nuts and bolts	• Cylinder head, cylinder head cover, exhaust cover, carburetor, inlet manifold, crank case, oil pump, magneto nut, starter motor, drive shaft housing, gear case, propeller shaft housing, propeller nut, mounting rubber, etc.	○	○		Refer to tightening torque table for retightening torque.
2. Gear oil	• Check for water or metallic powder when adding or changing. • If flooded with water or when the amount of oil added is irregularly high, inspect and repair the gear case.	○ change	○ Replenish		Change oil every 200 hours, 1 year, or before prolonged storage inspect before season.
3. Spark plugs	• Repair, clean, or replace if electrode wear causes an increase gap carbon deposits.	○	○		NGK B8HS10 CHAMPION L78C Gap 0.9~1.0 mm
4. Fuel system	• Check fuel tank, fuel pipe, fuel filter, fuel connector, fuel pump. Also remove internal dirt and water, and check for fuel leakage, air intake, damage, insufficient clipping.	○	○		Replace fuel pipe every 2 years.
5. Carburetor	• Remove internal dirt and water and clean with washing liquid and air. • Check for wear of float valve.			○	If float valve wear is great, replace or repair with carburetor repair kit.
6. Grease up	• Propeller shaft, bracket bolt, steering shaft, power T/T steering upper pin, tilt stopper, drag link, sliding parts, clutch mechanism, throttle mechanism, carburetor, ball joint cap, starter motor pinion, hook lever.		○		Refer to sealing, adhesive, and lubrication table.
7. Compression	• Measure the cylinder compression with a compression gauge. Standard — approx. 882.5 kPa (approx. 9.0 kg/cm^2) (approx. 128 P.S.I.)		○		Measure at full throttle on a warm engine.
8. Water filter	• Remove dirt, shells, seaweed, etc. and clean.	○			
9. Water flow	• Remove incrustation and dirt from water pump, pump impeller, water pipe, cylinder, cylinder head, head cover, thermostat, exhaust cover, engine base, and exhaust pipe passages.			○	If water pump is damaged or worn, repair with repair kit.
10. Carbon deposit	• Cylinder head, piston crown, cylidner exhaust passage (including exhaust bypass), inner exhaust cover, engine base, exhaust pipe, piston ring groove.			○	Be careful not to scratch the surface of the cylinder head, piston crown, and ring groove.
11. Electrical wiring	• Loose connections, damaged wires, insulation and sealing grommet.	○		○	

Inspection	Procedure	10 hours or 1 month	50 hours or 3 months	100 hours or 6 months	Remarks
12. Ignition timing, throttle link mechanism	• With throttle fully closed: ATDC 10° ± 1° At full throttle M140A: BTDC 20° ± 1° M120A: BTDC 17.5° ± 1° • Shaking in ball joint cap, looseness in lock nuts, bending of link rods, shaking of rod snaps.	○		○	If there is shaking in the ball joint cap or rod snaps, replace.
13. Idling adjustment	• After synchronizing 4-series carburetor for the first time, open the PS 15/8 ± 1/4 turns, for engine speed at F clutch of 700 to 850 rpm.	○	○		After warming up.
14. Power trim and tilt oil level	• Tilt up, set tilt stopper, remove oil plug, and check that oil is below oil plug hole. Check for leakage and/or damage to pipes. If level is low, add with specified oil.	○		○	Oil (ATF oil) Example: Shell Dexron-II Esso ATF Mobil DTE #22, etc.
15. Function of power trim and tilt manual valve	• Loosen manual valve and check that tilting up and down are possible.			○	
16. Function of power trim and tilt	• Check function of trim, tilt for shallow water running.	Inspect each time used.			
17. Oil system	• Remove dirt and/or water from oil tank, oil pump, oil filter and check valve. Check for oil leakage, damage, defective clips.	○		○	Replace check valve every 2 years.
18. Anode Trim tab Cylinder head Stern bracket	• Check for corrosion and wear. Replace if wear is 30% or greater.	Inspect every time used.			Every year
19. Cooling system	• Check for discharge of water from the inspeciton hole, and plastic or dirt in water intake (water filter).	Inspect every time used.			
20. Control box	• Check the function of key switch, safety switch, free acclerator lever, control lever, buzzer.	Inspect every time used.			
21. Boat installation bolts	• Check for loose nuts and bolts.	Inspect every time used.			
22. Drag link	• Check for loose nuts and bolts, shaking, grease.	Inspect every time used.			

17 POWER TRIM AND TILT

(1) System diagram

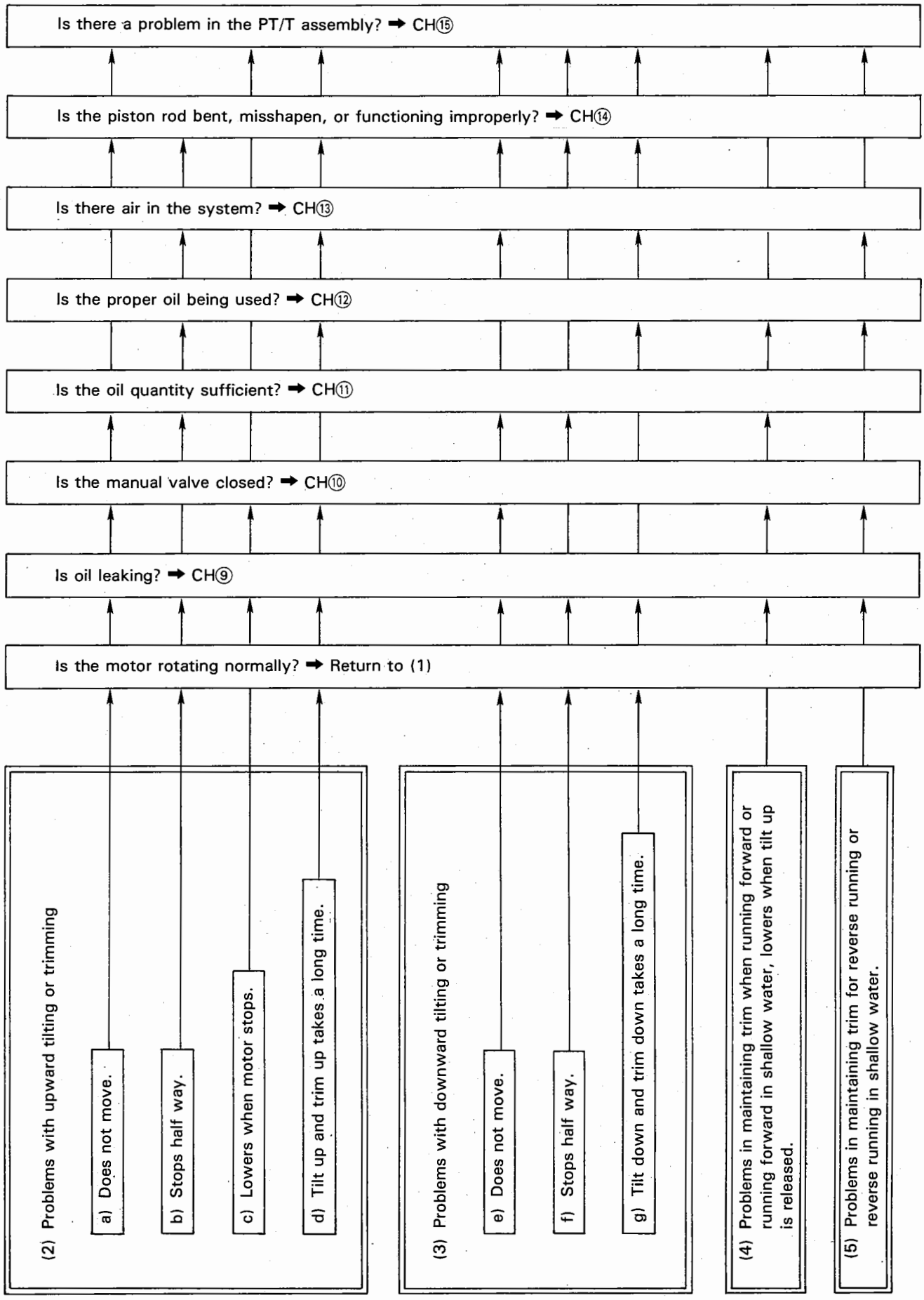


(2) Power trim and tilt troubleshooting

1) Description of problem and checks

(1) Motor does not rotate, power is low, or rotation is abnormal.

- Is the main switch at "ON"?
- Is a cable disconnected? ➡ CH①
- Is the breaker in the "OFF" position? ➡ CH②
- Is there a broken fuse? ➡ CH③
- Is the battery capacity and charge sufficient? ➡ CH④
- Is the battery capacity insufficient because it is being used for other things?
- Is wiring proper? ➡ CH⑤
- Are there problems with the switches? ➡ CH⑥
- Does the motor rotate when connected directly to the battery? ➡ CH⑦
- Check for leaks, short circuits, or damage in the wiring and check the electric circuit. ➡ CH⑧


Is there a problem in the PT/T assembly? ➡ CH⑮
Is the piston rod bent, misshapen, or functioning improperly? ➡ CH⑭
Is there air in the system? ➡ CH⑬
Is the proper oil being used? ➡ CH⑫
Is the oil quantity sufficient? ➡ CH⑪
Is the manual valve closed? ➡ CH⑩
Is oil leaking? ➡ CH⑨
Is the motor rotating normally? ➡ Return to (1)
(2) Problems with upward tilting or trimming
a) Does not move.
b) Stops half way.
c) Lowers when motor stops.
d) Tilt up and trim up takes a long time.
(3) Problems with downward tilting or trimming
e) Does not move.
f) Stops half way.
g) Tilt down and trim down takes a long time.
(4) Problems in maintaining trim when running forward or running forward in shallow water, lowers when tilt up is released.
(5) Problems in maintaining trim for reverse running or reverse running in shallow water.

2) Checks

CH① Is a cable disconnected?

- Is the battery cable connected to the battery?
- Are the cables connected securely?

CH② Is the breaker in the "OFF" position?

- Touch the motor. If it is hot, the braker may be activated. Let it cool for at least 3 minutes.

CH③ Is there a broken fuse?

- Open the engine cover and check the fuses in the electric bracket.

CH④ Is the battery capacity and charging sufficient?

- A battery of 12V, 70AH or greater should be used.
- Check the specific gravity of the battery electrolyte. If it is 1.22 (20°C) or less, charge the battery.
- Check that the starter motor rotates. It should rotate.

CH⑤ Is wiring proper?

- Check for any miswiring using the wiring diagram.

CH⑥ Are there problems with the switches?

- Inspect the main switch — Operate the other equipment (choke solenoid, starter motor, buzzer). Check that they operate properly.
  Also use a tester to check the conductivity between the red leads. Electricity should flow when the switch is on.
- PT/T switch — Disconnect the white lead wire from the solenoid switch in the engine's electric bracket, and touch the terminal directly to the terminal board of the red lead. If the PT/T assembly works, the PT/T switch is defective (both up and down).
  Also use a tester to check the conductivity of the PT/T switch.
  Press UP. Electricity should flow between the red lead and the sky blue lead.
  Press down. Electricity should flow between the red lead and the pink lead.
- Solenoid switch
  Disconnect the same white lead as above and touch it directly to the terminal board of the red lead. A clicking sound should be heard.
  Next check the conductivity between board terminals. Electricity should flow when the solenoid relay switch is on. (NOTE: Disconnect the red lead before checking.) If one side is judged OK, switch to the other.

CH⑦ **Does the motor rotate when connected directly to the battery?**

- Disconnect the PT/T assembly blue and pink leads from the solenoid switch terminal board and touch the terminals separately to the red lead terminal. Should move up when the blue terminal is touching and down when the pink terminal is touching.
- Bring the PT/T assembly leads through the engine cover and touch the terminals directly to the battery terminals. If the motor does not turn, it is defective.

CH⑧ **Check for leaks, short circuits, or damage in the wiring and check the electric circuit.**

- Check the conductivity and for short circuits, especially in the leads.
- Also check for damage to switch leads.

CH⑨ **Is oil leaking?**

- Look outside to see if oil is leaking.
  Slight leaks are hard to find, so operate the PT/T assembly and check for oil floating on the water.
- If the oil tube nut is loose, tighten it.
  (Tightening torque: 11.17 N·m to 15.1 N·m, 1.14 to 1.54 kg-m, 8.2 to 11.1 ft-Lb)
- If oil is leaking from the PT/T assembly or cylinder, there is breakage, or assembly is wrong. Disassemble and inspect, and if necessary replace.
  NOTE: Replace the O ring after disassembling the oil tube.

CH⑩ **Is the manual valve closed?**

- Try tightening the manual valve.
  Direction: Clockwise torque: 1.96 N·m to 2.94 N·m (0.2 kg-m to 0.3 kg-m, 17 in. lbs. to 26 in. lbs)

CH⑪ **Is the oil quantity sufficient?**

- Check the oil level.
  Proper oil level — oil must reach the oil plug hole when the engine is tilted up with all piston rods fully extended.
  NOTE: When the quantity of oil is insufficient and oil is added, be sure to bleed the air then recheck the oil level.
  Refer to CH⑬ for the air bleeding instructions.
- If tilting up is impossible when it is almost empty:
  Open the manual valve and tilt up manually, then apply the tilt stopper so that the engine does not lower.
  Check for oil leakage.
  Add oil up to the bottom of the oil plug hole, operate the PT/T assembly a little in the tilt up direction, and tilt up in steps while pouring in the oil. Close the manual valve to keep air out. When the motor is tilted up, release the tilt stopper, bleed the air, check the oil level, check the tilt up and down operations, and if necessary bleed the air and check the oil level.
- The normal total oil quantity: 730 cc (24.6 fl-oz)
  NOTE: For PT/T assembly position when supplying oil, see page 54.

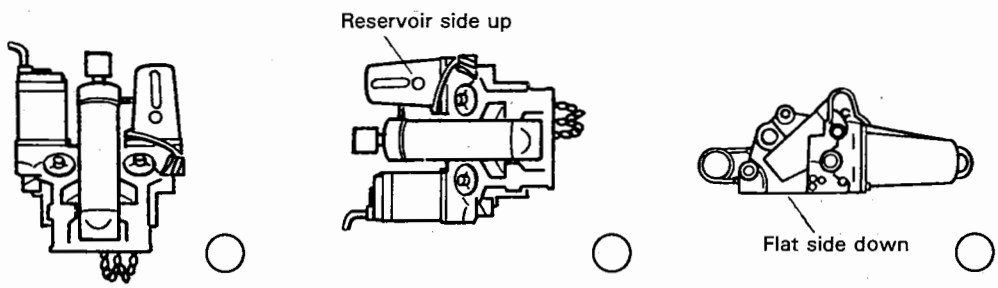
CH⑫ **Is the proper oil being used?**

- Only use the specified oil.
  (The oil used in this engine is Nihon Sekiyu AFT Dexron.)
  Specified oil: Automatic transmission fluid (conforming to GM standards)
  Mobil: Mobil DTE #22
  Mobil: ATF 220
  Esso: Esso automatic transmission fluid
  Shell: Shell dextron II
  Shell terrace oil #22, K22

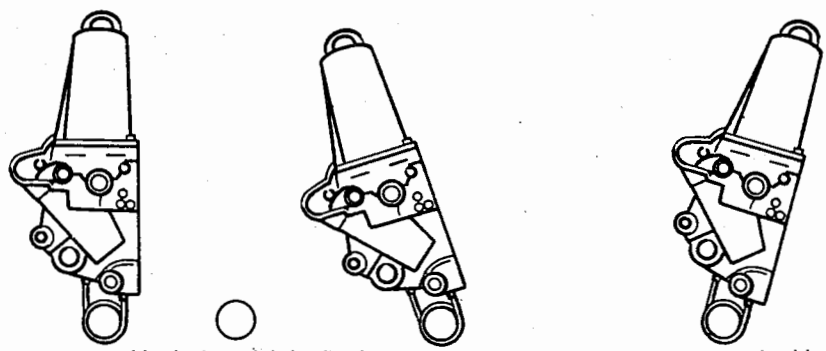
CH⑬ **Is there air in the system?**

- If the PT/T assembly is operated with air inside, muffled sounds can be heard.
- Air bleeding procedure (close the oil plug while bleeding air.)
  Open the manual valve and repeatedly tilt up and down manually at least 4 times. Finally perform power tilt up and check the oil level.
- If air is deep inside.
  This air cannot easily be bled at once, so wait several days before bleeding.
  NOTE: Be careful for standing position not to let air in.

The following shows the storing positions so that air will not enter (in the opposite positions air will enter).



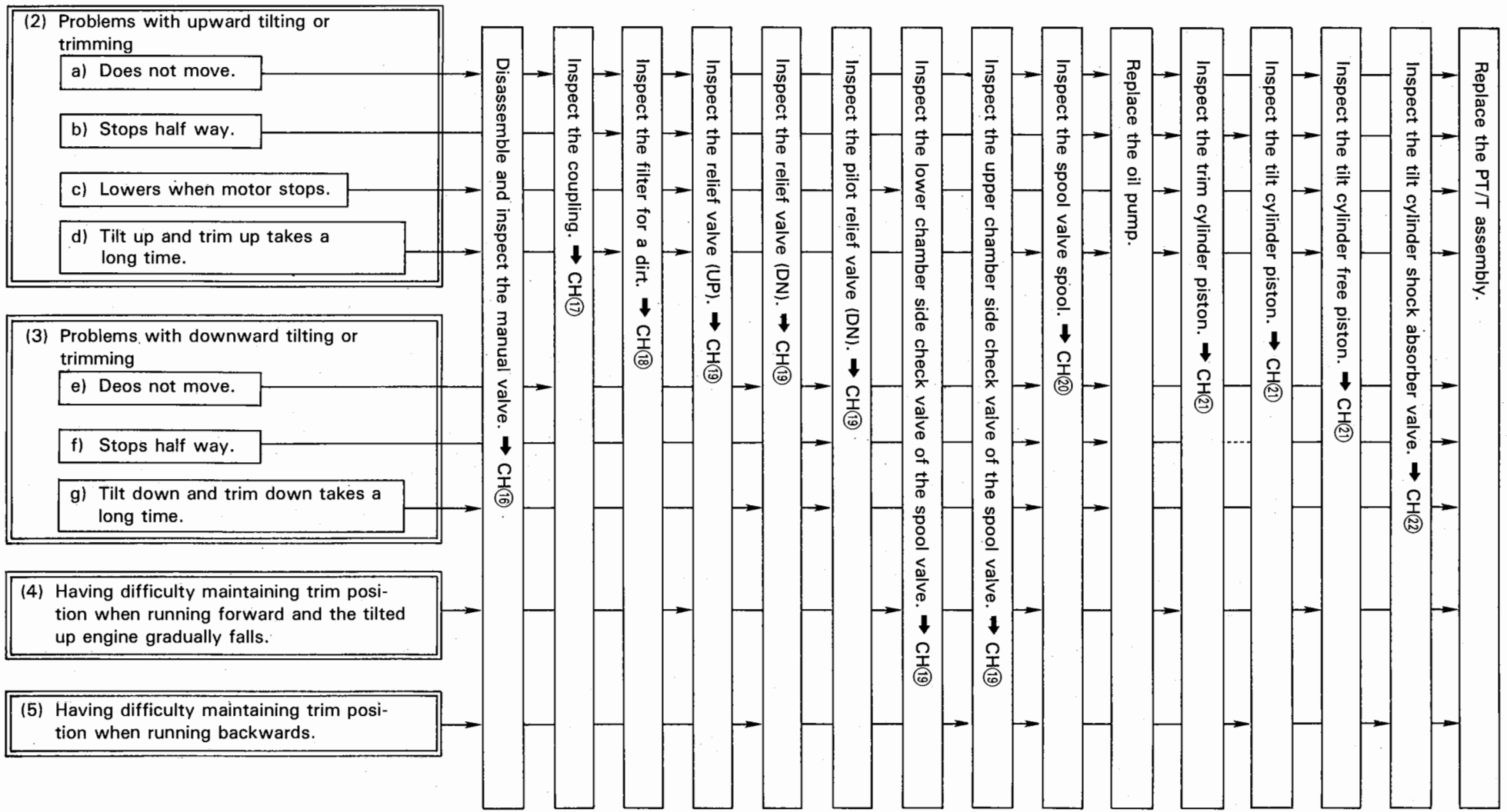
The position for adding oil in CH⑪ is as follows:



CH⑭ **Is the piston rod bent, misshappen, or functioning improperly?**

- Open the manual valve, tilt up and down manually, and check that operation is smooth.
- Check by sight.

CH⑮ Is there a problem in the PT/T assembly? ..... The inspection differs according to the problem. Refer to the following.



NOTE:

1. Use the exclusive stand (special tool) when disassembling the PT/T assembly.
2. When disassembling, tilt up (with piston rod extended), open the manual valve, then leave for a while until the inner pressure reaches 0.
3. When removing parts, take care that oil does not squirt out into your eyes or onto your clothes.
4. Open the reservoir tank oil plug and remove the oil, then remove the motor and reservoir tank.

CH⑯ **Disassemble and inspect the manual valve.**

- Damage to manual valve end surface
- Damage to "O" ring
- Damage to seal washer (especially rubber seal)
- Damage to bottom surface of valve mounting hole

NOTE: Be careful that the seal washer is positioned properly when assembling.

CH⑰ **Inspect the coupling.**

Remove the motor and inspect the coupling.

- Is it disconnected?
- Is it damaged?

CH⑱ **Inspect the filter for dirt.**

Remove the motor and filter and clean.

CH⑲ **Inspect the relief valves and check valves.**

- Deterioration or bending of spring
- Damage to valve seat
- Damage or wear of valve (ball)
- Smooth operation — Catching on dirt, etc. (push the ball by hand and check return.)
- For the UP relief valve, also inspect filter for dirt.
- Damage to "O" ring

CH⑳ **Inspect spool of the spool valve.**

- Smooth operation (move by pushing lightly by hand.)
- Damage or wear of backup ring

CH㉑ **Inspect the cylinder pistons.**

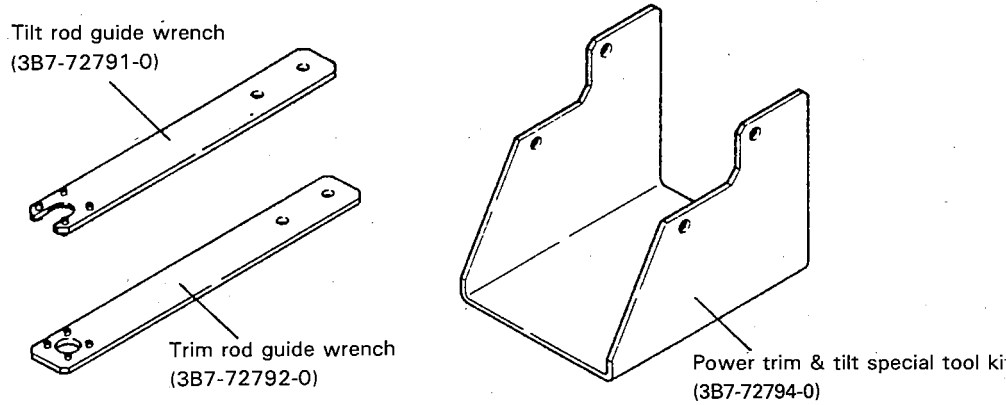
- Damage or wear of "O" ring and backup ring
- Damage to piston sliding surface of cylinder

CH㉒ **Inspect the tilt cylinder shock absorber valve.**

Disassemble the piston.

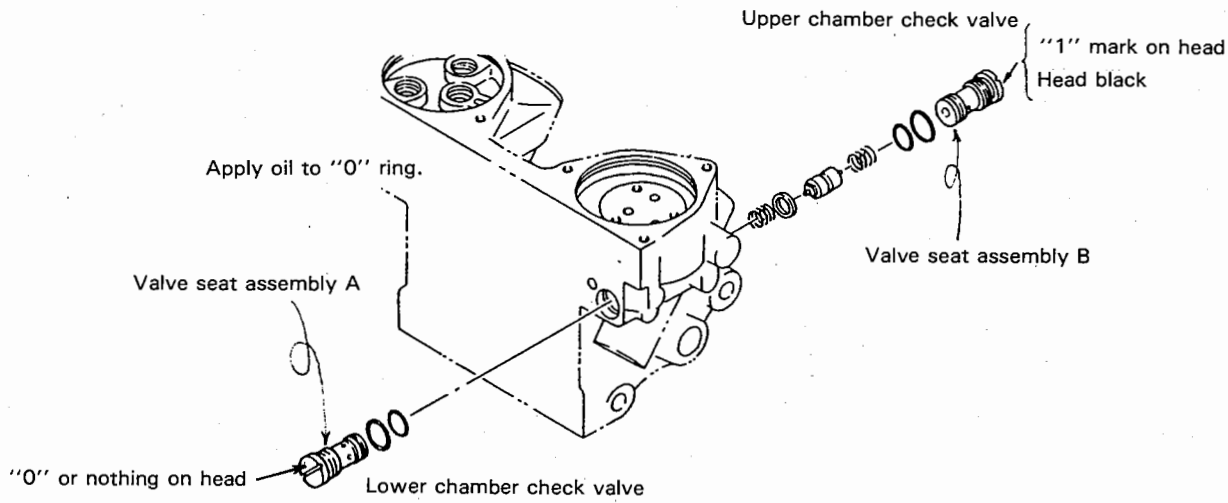
- Deterioration or damage to spring
- Damage to valve (ball)
- Damage to valve seat
- Dirt

3) Precautions during disassembly and re-assembly of the Power Trim and Tilt
Use the special tool kit for the power trim and tilt when disassembling and re-assembling.

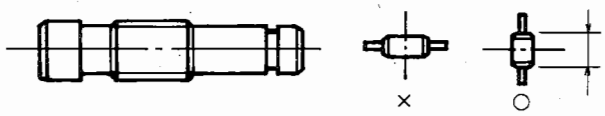


(1) Before disassembling, tilt up (with piston rod extended), open the manual valve, then leave the power trim and tilt for a while until the inner pressure reaches zero. It is very dangerous to open the manual valve entirely with the engine tilted down, due to the discharge of compressed oil.
(2) Open the oil plug of the reservoir tank and drain the oil.
(3) When removing parts, take care that oil does not splashing your eyes.
(4) Before re-assembling, clean the all parts so that no dirt foreign substances enter the system.

2. Assembly
   (1) Oil pump assembly (internal parts cannot be disassembled)
   Bolt tightening torque:
   4.9 N·m to 5.39 N·m
   (0.5 kg·m to 0.55 kg·m
   3.62 ft·lb to 3.97 ft·lb)
   "O" ring — Apply oil.
   (2) Relief valve (UP)
   Tightening torque:
   11.76 N·m to 13.72 N·m
   (1.2 kg·m to 1.4 kg·m
   8.67 ft·lb to 10.12 ft·lb)
   "O" ring — Apply oil.
   (3) Relief valve (DN)
   Tightening torque:
   11.76 N·m to 13.72 N·m
   (1.2 kg·m to 1.4 kg·m
   8.67 ft·lb to 10.12 ft·lb)
   "O" ring — Apply oil.
   (4) Pilot relief valve (DN)
   Tightening torque:
   11.776 N·m to 13.72 N·m
   (1.2 kg·m to 1.4 kg·m
   8.67 ft·lb to 10.12 ft·lb)
   "O" ring — Apply oil.
   (5) Spool valve
   Apply oil to the outer surface and backup spring. There are two types of check valves, one for the upper chamber, and one for the lower chamber. Be careful not to confuse these. (See drawing below.)
   Check valve tightening torque: 8.82 N·m to 10.78 N·m (0.9 kg·m to 1.1 kg·m, 6.51 ft·lb to 7.95 ft·lb)



(6) Manual valve
Be careful to assemble the seal washer, spring and inner collar in the correct order. (Refer to the parts list.)
Assemble the seal washer in the correct direction (if tightened on its side it will break).



Tightening torque:
1.96 N·m to 2.94 N·m
(0.2 kg·m to 0.3 kg·m
17.4 in·lb to 26.0 in·lb)
O ring — apply oil

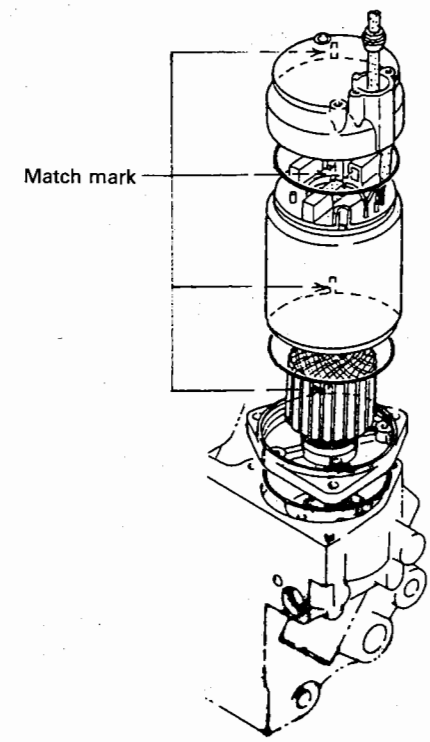
(7) Piston sub assembly, trim
Apply oil to O ring, backup ring and outer surface of piston.

(8) Rod guide sub assembly, trim
Tightening torque:
68.6 kg·m to 88.2 N·m
(7 kg·m to 9 kg·m
50.6 ft·lb to 65.1 ft·lb)
O ring — Apply oil.
Oil seal — Apply grease.

(9) Cylinder assembly, tilt
Apply grease to shaft and outer surface of bushing.
Replace "O" ring and oil tube nut.
Screw in oil tube nut two or three turns with your fingers then tighten using a spanner (using a spanner from the beginning will make it crooked).
Oil tube nut tightening torque:
10.78 N·m to 12.7 N·m
(1.1 kg·m to 1.3 kg·m
8.33 ft·lb to 9.34 ft·lb)
Apply oil to free piston "O" ring, backup ring, and outer piston surface.
Apply oil to piston rod assembly "O" ring and backup ring.
Apply oil to rod guide "O" ring.
Rod guide tightening torque:
78.4 N·m to 117.6 N·m
(8 kg·m to 12 kg·m
57.8 ft·lb to 86.8 ft·lb)

(10) Motor
Through bolt tightening torque:
Screw (for cord outlet seal plate) tightening toqeue:
3.43 N·m to 4.41 N·m
(0.35 kg·m to 0.45 kg·m
30.4 ft·lb to 39 ft·lb)
Line up marks when assembling armature and yoke compressor
Bolt (for motor assembly) tightening torque:
4.9 N·m to 6.8 N·m
(0.5 kg·m to 0.7 kg·m
43.4 ft·lb to 60.8 ft·lb)

(11) Oil reservoir
Bolt tightening torque:
4.9 N·m to 6.8 N·m
(0.5 kg·m to 0.7 kg·m
43.4 ft·lb to 60.8 ft·lb)
Apply oil to "O" ring
Oil plug tightening torque:
2.94 N·m to 4.9 N·m
(0.3 kg·m to 0.5 kg·m
26.0 ft·lb to 43.4 ft·lb)

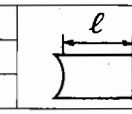


(4) Power Trim and Tilt Service Data

1. Pump assembly

Oil pump	Geared pump
Relief valve (UP) opening pressure	11,767 to 13,728 kPa (120 to 140 kg/cm^2, 1,706 to 1,991 psi)
Relief valve (DN) opening pressure	17,651 to 25,496 kPa (180 to 260 kg/cm^2, 2,560 to 3,697 psi)
Pilot relief valve (DN) opening pressure	3,922 to 6,864 kPa (40 to 70 kg/cm^2, 569 to 995 psi)
Spool check valve upper chamber opening pressure	235 kPa (2.4 kg/cm^2, 34 psi)
Spool check valve lower chamber opening pressure	117.7 kPa (1.2 kg/cm^2, 17 psi)
Oil capacity	730 cc (24.66 fl. oz)
Oil	Nippon Sekiyu ATF DEXRON
Oil filter	150-mesh

2. Motor

Rated time	60 sec	
Rated voltage	12V (DC)	
Output	0.3 kW	
Direction of rotation	Forward, reverse convertible	
Breaker	DC sensor type	
Activation	40 to 120 sec (52A)	
Reset	Within 35 sec.	
Commutator standard outer diameter	28 mm (1.102 inch)	
Usage limit	27 mm (1.063 inch)	
Brush standard dimensions (1 on diagram)	11.5 mm (0.453 inch)	
Usage limit	5.5 mm (0.216 inch)	
Replacement dimensions	7.5 mm (0.295 inch)	
Armature shaft core deflection standard value	0.15 mm or less	
Usage limit	0.15 mm or greater	
Field coil standard resistance	0.050 Ω (pink — blue)	

3. Trim cylinder

Piston diameter	38 mm (1.50 inch)
Piston rod diameter	16 mm (0.63 inch)
Stroke	69 mm (2.72 inch)

4. Tilt cylinder

Piston diameter	45 mm (1.77 inch)
Piston rod diameter	19 mm (0.75 inch)
Stroke	131 mm (6.16 inch)
Shock absorber valve opening pressure	12,258 to 15,200 kPa (125 to 155 kg/cm^2, 1,778 to 2,204 psi)

5. Switch

Control box (P type)	Single pole double throw paddles locker switch (3 A)
Panel (F type)	Single pole double throw paddles toggle switch (20 A)

6. Solenoid switches (UP and DN)

Rated voltage	12V (DC)
Rated time	30 sec (at 100 A)
Excitation current	3 A or less
Excitation coil standard resistance	5.2 Ω

7. Tightening torques

PT/T assembly mounting bolt	22.54 to 30.58 N·m (2.30 to 3.12 kg·m, 16.6 to 22.6 ft·lb)
Oil plug	2.94 to 4.9 N·m (0.3 to 0.5 kg·m, 26 to 44 in·lb)
Manual valve	1.96 to 2.94 N·m (0.2 to 0.3 kg·m, 17 to 26 in·lb)
Oil tube nut	10.78 to 12.74 N·m (1.1 to 1.3 kg·m, 7.96 to 9.4 ft·lb)

Motor	Through bolt	3.43 to 4.41 N·m (0.35 to 0.45 kg·m, 30.4 to 39 in·lb)
	Seal plate (cord outlet) screw	3.43 to 4.41 N·m (0.35 to 0.45 kg·m, 30.4 to 39 in·lb)
	Motor assembly mounting bolt	4.9 to 6.86 N·m (0.5 to 0.7 kg·m, 43.4 to 60.8 in·lb)
Oil reservoir mounting bolt		4.9 to 6.86 N·m (0.5 to 0.7 kg·m, 43.4 to 60.8 in·lb)

Pump	Oil pump mounting bolt	4.9 to 5.39 N·m (0.5 to 0.55 kg·m, 43.4 to 47.7 in·lb)
	Relief valve assembly (UP)	11.76 to 13.72 N·m (1.2 to 1.4 kg·m, 8.68 to 10.13 ft·lb)
	Relief valve assembly (up)	11.76 to 13.72 N·m (1.2 to 1.4 kg·m, 8.68 to 10.13 ft·lb)
	Pilot relief valve assembly (DN)	11.76 to 13.72 N·m (1.2 to 1.4 kg·m, 8.68 to 10.13 ft·lb)
	Spool check valve assembly	8.82 to 10.78 N·m (0.9 to 1.1 kg·m, 6.51 to 7.96 ft·lb)
Trim rod guide		68.6 to 88.2 N·m (7 to 9 kg·m, 50.6 to 65.1 ft·lb)
Tilt rod guide		78.4 to 117.6 N·m (8 to 12 kg·m, 57.9 to 86.8 ft·lb)
Tilt piston rod fixing nut		78.4 to 117.6 N·m (8 to 12 kg·m, 57.9 to 86.8 ft·lb)

Switches	PT/T switch (P type) fitting screw	0.49 to 0.78 N·m (0.05 to 0.08 kg·m, 4.3 to 6.9 in·lb)

8. "O" rings (standard dimensions) Line diameter — Inner diameter

Oil plug	P-9	1.9—8.8 mm (0.075—0.346 inch)
Oil reservoir	A-03	1.78—69.6 mm (0.070—2.740 inch)
Motor assembly	A-03	1.78—69.6 mm (0.070—2.740 inch)
Motor	S-70	2.0—69.5 mm (0.079—2.736 inch)
Through bolt	P-5	1.9—4.8 mm (0.075—0.189 inch)
Pump asembly outlet passage	S-7	1.5—6.5 mm (0.059—0.256 inch)
Manual valve	S-10	1.5—9.5 mm (0.059—0.374 inch)
	P-18	2.4—17.8 mm (0.094—0.701 inch)
Relief valve assembly (UP)	S-11.2	1.5—10.7 mm (0.059—0.421 inch)
Relief valve assembly (DN)	P-9	1.9—8.8 mm (0.075—0.346 inch)
Pilot relief valve assembly (DN)	S-9	1.5—8.5 mm (0.059—0.335 inch)
Spool check valve	P-15	2.4—14.8 mm (0.094—0.583 inch)
	S-14	1.5—13.5 mm (0.059—0.531 inch)
Trim rod guide	P-39	3.5—38.7 mm (0.138—1.524 inch)
	P-16	2.4—15.8 mm (0.094—0.622 inch)
Trim piston	P-32	3.5—31.7 mm (0.138—1.248 inch)
Tilt rod guide	S-45	2.0—44.5 mm (0.079—1.752 inch)
Tilt piston	P-39	3.5—38.7 mm (0.138—1.524 inch)
Free piston	P-39	3.5—38.7 mm (0.138—0.524 inch)
Oil tube	P-5	1.9—4.8 mm (0.075—0.189 inch)

9. Spring (standard value) — Line diameter — Outer diameter — Free length

Spring, brush	0.55—7—18.5 mm (0.0216—0.276—0.728 inch)
Spring, manual brush	1.2—11.5—6 mm (0.0472—0.453—0.236 inch)
Spring, spool	1.0—10.2—10.5 mm (0.0394—0.402—0.413 inch)
Spring, relief valve (DN)	0.8—6.1—13 mm (0.0315—0.240—0.512 inch)
Spring, pilot relief valve	1.4—6.7—12.4 m (0.0551—0.264—0.488 inch)
Spring, shock absorber valve	1.4—6.8—16.3 mm (0.0551—0.268—0.642 inch)
Spring, spool	1.0—10.2—10.5 mm (0.0394—0.402—0.413 inch)

10. Steel ball (standard diameter) — Diameter

Relief valve	3.969 mm (5/32 inch)
Pilot relief valve	3.175 mm (1/8 inch)
Shock absorber valve	3.969 mm (5/32 inch) using number: two

11. Spring seat (standard height)

Pilot relief valve (DN)	11.2 mm (0.441 inch)
Shock absorber valve	13 mm (0.512 inch)

12. Oil seal — Inner diameter — Outer diameter — Thickness

Motor	8—18—4.5 mm (0.315—0.709—0.177 inch)
Trim rod guide dust seal	15.2—24—4.5 mm (0.598—0.945—0.177 inch)
Tilt rod guide dust seal	18.2—27—4.5 mm (0.717—1.063—0.177 inch)

13. Backup ring — Inner diameter — Outer diameter — Thickness

Tilt piston	3.9—45—1.25 mm (1.535—1.772—0.0492 inch)
Free piston	3.9—45—1.25 mm (1.535—1.772—0.0492 inch)
Trim piston	3.2—38—1.25 mm (1.260—1.496—0.0492 inch)
Spool valve	9—12—1.25 mm (0.354—0.472—0.0492 inch)

14. Seal washer — Inner diameter — Outer diameter — Thickness

Manual valve	4.3—11.5—1.6 mm (0.169—0.453—0.063 inch)

15. Others

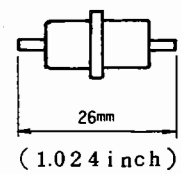
Inner collar (manual valve)	Thickness: 9.5 mm (0.374 inch)
Spool	Total length: 26 mm (1.024 inch)

(I) Periodic Inspection

Inspection	Procedure	Frequency
1. Oil leakage	◦ Inspect by sight. ◦ When small and difficult to judge, operate PT/T assembly and check for oil floating on water. ◦ If oil tube nut is loose, tighten. (Torque: 10.78 to 12.74 N·m 1.1 to 1.3 kg·m 7.96 to 9.40 ft·lb)	◦ Upon purchase ◦ 10 hours or 1 month ◦ 50 hours or 3 months ◦ Every 200 hours or 1 season
2. Damaged or misshapen oil tube	◦ Inspect by sight. ◦ For severe misshape or damage, replace.	◦ Upon purchase ◦ When damage occurs
3. Loose oil tube nut	◦ Retighten. (Torque: 10.78 to 12.74 N·m 1.1 to 1.3 kg·m 7.96 to 9.4 ft·lb)	◦ Upon purchase ◦ Every 200 hours or 1 season
4. Loose PT/T mounting bolt	◦ Retighten. (Torque: 22.54 to 30.58 N·m 2.30 to 3.12 kg·m 16.6 to 22.6 ft·lb)	◦ Upon purchase ◦ Every 200 hours or 1 season
5. Bent piston rod, bent upper cylinder pin, lost or misshapen E ring	◦ Inspect by sight.	◦ Upon purchase ◦ Every 200 hours or 1 season ◦ After collision
6. Oil level Specified oil Air bleeding	◦ Oil level should reach the lower surface of oil plug hole when tilted up (piston rods fully extended). ◦ After adding oil, bleed air then recheck oil level. See troubleshooting CH⑫. See troubleshooting CH⑫.	◦ Upon purchase ◦ 10 hours or 1 month ◦ 50 hours or 3 months ◦ Every 200 hours or 1 season
7. Manual valve operation	◦ Open manual valve and manually move up and down. (**NOTE:** Tightening torque: 1.96 to 2.94 N·m 0.2 to 0.3 kg·m 17 to 26 in·lb)	◦ Upon purchase ◦ Every 200 hours or once a season

(II) Disassembly and Inspection

Part	Inspection	Standard Value	Replacement Limit
1. Motor			
1) Amature assembly	① Shaft core deflection	0.15 mm (0.0059 inch) or less	0.15 mm (0.0059 inch) or more
	② Commutator outer diameter	28 mm (1.102 inch)	27 mm (1.063 inch) or less
	③ Faulty coil insulation Resistance between commutator and shaft	With 500V megatester over 1 MΩ	Less than 1MΩ
2) Yoke compressor	① Damaged field coil Standard resistance Blue terminal — + side brush Pink terminal — + side brush Blue terminal — pink terminal	 0.030 Ω 0.030 Ω 0.050 Ω	
	② Faulty thermal breaker (Conductivity at both ends)		Faulty conductivity
	③ Damaged ground cable Black terminal — (−) side brush		Faulty conductivity
	④ Insulation of cable and field coil Resistance between all terminals — yoke	0.1 MΩ or greater with 500V megatester	
3) Brush	① Brush wear ② Damaged brush spring	11.5 mm (0.453 inch) Line diameter — outer diameter — free length 0.55—7—18.5 mm (0.0216—0.276—0.728 inch)	7.5 mm (0.295 inch)
4) O ring	Damaged	Line diameter — inner diameter 2.0—69.5 mm (0.075—2.736 inch)	
5) O ring through bolt	Damaged	Line diameter — inner diameter 1.9—4.8 mm (0.075—0.189 inch)	
2. Pump			
1) Filter B	Blockage due to foreign substances Damaged		
2) Coupling	Damaged		
3) "O" ring	Damaged	Line diameter — inner diameter 1.78—69.6 mm (0.070—2.740 inch) 1.5—6.5 mm (0.059—0.256 inch)	
4) Oil seal	Damaged or worn lip	Inner diameter — outer diameter — thickness 8—18-4.5 mm (0.315—0.709—0.177 inch)	
3. Manual valve			
1) Manual valve	Worn or damaged tip		
2) "O" ring	Damaged	Line diameter — inner diameter 1.5— 9.5 mm (0.059—0.374 inch)	
3) "O" ring	Damaged	Line diameter — inner diameter 2.4— 17.8 mm (0.094—0.701 inch)	
4) Washer, seal	Damaged rubber lip Worn plate	Inner diameter — outer diameter — thickness 4.3—11.5—1.6 mm (0.169-0.453—0.063 inch)	
5) Spring	Damaged, cracked	Line diameter — outer diameter — free length 1.2—11.5—6 mm (0.0472—0.453—0.236 inch)	
6) Collar, inner	Damaged, worn	Thickness 9.5 mm (0.374 inch)	

Part	Inspection	Standard Value	Replcement Limit
4. Relief valve (UP, DN, pilot — DN)			
1) Spring	Deterioration, damage	Line diameter — outer diameter — free length	
	UP	0.8—6.1—13 mm (0.0315—0.240—0.512 inch)	
	DN	1.4—6.7—12.4 mm	
	Pilot DN	(0.0551—0.264—0.488 inch)	
2) Valve seat	Damaged		
3) Valve (ball)	Damaged or worn	Diameter	
	UP	×	
	DN	3.969 mm (5/32 inch)	
	Pilot DN	3.175 mm (1/8 inch)	
4) Filter (UP only)	Jammed		
5) "O" ring	Damaged	Line diameter — inner diameter 1.5—10.7 mm (0.059—0.421 inch) 1.9—8.8 mm (0.075—0.346 inch) 1.5—8.5 mm (0.059—0.335 inch)	
5. Spool valve			
1) Valve seat Assembly A-B	Deteriorated or damaged spring Damaged valve seat Damaged or worn valve (ball) Smooth operation		
2) "O" ring	Damaged	Line diameter — inner diameter 2.4—14.8 mm (0.094—0.583 inch) 1.5—13.5 mm (0.059—0.531 inch)	
3) Spring	Damage or deterioration	Line diameter — outer diameter — free length 1.0—10.2—10.5 (0.0394—0.402—0.413 inch)	
4) Spool	Bent or damaged projection	 (1.024 inch)	
5) Backup ring	Damaged or worn		
6. Reservoir tank			
1) "O" ring Oil plug	Damaged	Line diameter — inner diameter 1.9—8.8 mm (0.075—0.346 inch)	
2) "O" ring Reservoir tank		1.78—69.6 mm (0.070—2.740 inch)	
7. Tilt cylinder			
1) "O" ring Oil tube nut	Damaged	Line diameter — inner diameter 1.9—4.8 mm (0.075—0.189 inch)	Replace after disassembly.
2) Rod guide Compressor			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 2.0—44.5 mm (0.079—1.752 inch)	
b. Dust seal	Damaged or worn	Inner diameter — outer diameter — height 18.2—27—4.5 mm (0.717—1.063—0.177 inch)	

Part	Inspection	Standard Value	Replcement Limit
3) Piston rod assembly			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch)	
b. Backup ring	Damaged or worn	Inner diameter — outer diameter — thickness 39—38.7—1.25 mm (1.535—1.772—0.049 inch)	
c. Shcok absorber	Damaged seat surface Deteriorated or damaged spring	Line diameter — outer diameter — free length 1.4—6.8—6.3 mm (0.0552—0.268—0.2480 inch)	
	Damaged or worn valve (ball)	Diameter 3.97 mm (5/32 inch)	
4) Free piston			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch)	
b. Backup ring	Damaged or worn	Inner diameter — outer diameter — thickness 39—45—1.25 mm (1.535—1.772—0.049 inch)	
8. Trim cylinder			
1) Rod guide sub assembly			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch) 2.4—15.8 mm (0.094—0.622 inch)	
2) Piston rod			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—31.7 mm (0.138—1.248 inch)	
b. Backup ring	Damaged or worn	Inner diameter — outer diameter thickness 32—38—1.25 mm (1.260—1.496—0.0492 inch)	

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