

PRE-PRODUCTION ISSUE

SUZUKI OUTBOARD MOTOR

DF140 *FOUR STROKE*

SUPPLEMENTARY SERVICE MANUAL

FOREWORD

This supplementary service manual describes service data and servicing procedures which differ from those of the DF90T/115T “K1” models.

The entire manual should be thoroughly reviewed before any servicing is performed.

NOTE:

- Refer to the DF90T/115T service manual (P/no. 99500-90J00-01E) for details which are not given in this supplementary service manual.
- Use this supplement with the following service manual:
DF90T/115T Service manual (P/no. 99500-90J00-01E)

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GENERAL INFORMATION

*SPECIFICATIONS

* These specifications are subject to change without notice.

Item	Unit	Data	
		DF140T	DF140Z
PRE-FIX		14001F	14001Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in.)	779 (30.7)	
Overall width (side to side)		mm (in.)	481 (18.9)	
Overall height	L	mm (in.)	1611 (63.4)	—
	UL	mm (in.)	1738 (68.4)	
Weight (without engine oil)	L	kg (lbs.)	186.0 (410)	—
	UL	kg (lbs.)	191.0 (421)	
Transom height	L	mm (in. type)	539 (20)	—
	UL	mm (in. type)	666 (25)	

PERFORMANCE

Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min.	5600 – 6200
Idle speed	r/min.	700 ± 50

POWERHEAD

Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in.)	86 (3.39)
Stroke	mm (in.)	88 (3.46)
Total displacement	cm ³ (cu in.)	2044 (124.6)
Compression ratio	: 1	9.7
Spark plug	NGK	BKR6E
Ignition system		Full-transistorized ignition
Fuel supply system		Multi-point sequential electronic fuel injection
Exhaust system		Through prop exhaust
Cooling system		Water cooled
Lubrication system		Wet sump by trochoid pump
Starting system		Electric
Throttle control		Remote control

Item	Unit	Data	
		DF140T	DF140Z

FUEL & OIL

Fuel		Suzuki highly recommends that you use alcohol-free unleaded gasoline with a minimum pump octane rating of 87 ($\frac{R+M}{2}$ method) or 91 (Research method). However, blends of unleaded gasoline and alcohol with equivalent octane content may be used.	
Engine oil		API classification	SE, SF, SG, SH, SJ
		Viscosity rating	SAE10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8) : Oil change only 5.7 (6.0/5.0) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)	
Gearcase oil capacity	ml (US/Imp. oz)	1050 (35.5/37.0)	

BRACKET

Trim angle		PTT system
Number of trim position		PTT system
Maximum tilt angle	degree	75

LOWER UNIT

Reversing system	Gear	
Transmission	Forward-Neutral-Reverse	
Reduction system	Bevel gear	
Gear ratio	12 : 23 (1.92)	
Drive line impact protection	Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)	clockwise	counterclockwise
Propeller	Blade × Diam. (in.) × Pitch (in.)	
	☆ 3 × 13-1/2 × 15	
	☆ 3 × 14 × 17	
	☆ 3 × 14 × 19	
	☆ 3 × 14 × 21	
	☆ 3 × 14 × 23	
	★ 3 × 14 × 18	★ 3 × 14 × 18
	★ 3 × 14 × 20	★ 3 × 14 × 20
	★ 3 × 14 × 22	★ 3 × 14 × 22
	★ 3 × 14 × 24	★ 3 × 14 × 24

☆: Aluminum propeller
★: Stainless steel propeller

4 DF140/140Z [GENERAL INFORMATION]

Item	Unit	Data	
		DF140T	DF140Z

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.24)
2nd reduction gear ratio (Lower unit gear)	12 : 23 (1.92)
Total reduction gear ratio	2.38 ($\frac{36}{29} \times \frac{23}{12}$)

*SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data	
		DF140T	DF140Z

POWERHEAD

Recommended operating range	r/min.	5600 – 6200
Idle speed	r/min.	700 ± 50 (in-gear : 700 ± 50)
**Cylinder compression	kPa (kg/cm ² . psi)	1200 – 1600 (12 – 16, 171 – 228)
**Cylinder compression max. difference between any three cylinders	kPa (kg/cm ² . psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm ² . psi)	440 – 490 (4.5 – 5.0, 64 – 71) at 3000 r/min. (at normal operating temp.)
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8) : Oil change only 5.7 (6.0/5.0) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 143)

** Figures shown are guidelines only, not absolute service limits.

Item	Unit	Data	
		DF140T	DF140Z

CYLINDER HEAD / CAMSHAFT

Cylinder head distortion	Limit	mm (in.)	0.05 (0.002)
Manifold seating faces distortion	Limit	mm (in.)	0.10 (0.004)
Cam height	IN	STD	39.520 – 39.680 (1.5560 – 1.5622)
		Limit	39.420 (1.5520)
	EX	STD	39.320 – 39.480 (1.5480 – 1.5543)
		Limit	39.220 (1.5441)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	0.120 (0.0047)
	5th	STD	0.045 – 0.087 (0.0018 – 0.0034)
		Limit	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	23.000 – 23.021 (0.9055 – 0.9063)
		Limit	23.171 (0.9122)
	5th	STD	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	22.869 (0.9004)
	5th	STD	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	25.844 (1.0175)
Camshaft runout	Limit	mm (in.)	0.10 (0.004)
Cylinder head bore to tappet clearance	STD	mm (in.)	0.025 – 0.066 (0.0010 – 0.0026)
	Limit	mm (in.)	0.150 (0.0059)
Tappet outer diameter	STD	mm (in.)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore	STD	mm (in.)	31.000 – 31.025 (1.2203 – 1.2215)

Item	Unit	Data	
		DF140T	DF140Z

VALVE / VALVE GUIDE

Valve diameter		IN	mm (in.)	33 (1.2992)
		EX	mm (in.)	28 (1.1024)
Tappet clearance (Cold engine condition)	IN	STD	mm (in.)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in.)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		——	15°, 45°, 60°
	EX		——	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in.)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in.)	0.070 (0.0028)
	EX	STD	mm (in.)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in.)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in.)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN,EX	STD	mm (in.)	13.5 (0.5315)
Valve stem outside diameter	IN	STD	mm (in.)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in.)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in.)	0.14 (0.0055)
	EX	Limit	mm (in.)	0.18 (0.0071)
Valve stem runout	IN,EX	Limit	mm (in.)	0.05 (0.0020)
Valve head radial runout	IN,EX	Limit	mm (in.)	0.08 (0.0031)
Valve head thickness	IN	STD	mm (in.)	1.0 (0.0394)
		Limit	mm (in.)	0.7 (0.0276)
	EX	STD	mm (in.)	1.20 (0.0472)
		Limit	mm (in.)	0.7 (0.0276)
Valve seat contact width	IN	STD	mm (in.)	1.1 – 1.3 (0.0433 – 0.0512)
	EX	STD	mm (in.)	1.1 – 1.3 (0.0433 – 0.0512)
Valve spring free length		STD	mm (in.)	42.73 (1.6823)
		Limit	mm (in.)	41.02 (1.6150)
Valve spring tension		STD	N (kg, lbs)	164 – 190 (16.7 – 19.3, 36.7 – 42.5) for 32.6 mm (1.28 in.)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in.)
Valve spring squareness		Limit	mm (in.)	2.0 (0.079)

Item	Unit	Data	
		DF140T	DF140Z

CYLINDER / PISTON / PISTON RING

Cylinder distortion	Limit	mm (in.)	0.05 (0.0020)
Piston to cylinder clearance	STD	mm (in.)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in.)	0.100 (0.0039)
Cylinder bore	STD	mm (in.)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position		mm (in.)	50 (1.969) from cylinder top surface
Piston skirt diameter	STD	mm (in.)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position		mm (in.)	26.5 (1.043) from piston skirt end
Cylinder bore wear	Limit	mm (in.)	0.10 (0.039)
Piston ring end gap	1st	STD	0.20 – 0.35 (0.0079 – 0.0138)
		Limit	0.70 (0.0276)
	2nd	STD	0.35 – 0.50 (0.0138 – 0.0197)
		Limit	1.00 (0.0394)
Piston ring free end gap	1st	STD	Approx. 11.6 (0.4567)
		Limit	9.3 (0.3661)
	2nd	STD	Approx. 11.5 (0.4528)
		Limit	9.2 (0.3622)
Piston ring to groove clearance	1st	STD	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	0.12 (0.0047)
	2nd	STD	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	0.10 (0.0039)
Piston ring groove width	1st	STD	1.22 – 1.24 (0.0480 – 0.0488)
	2nd	STD	1.51 – 1.53 (0.0594 – 0.0602)
	Oil	STD	2.51 – 2.53 (0.0988 – 0.0996)
Piston ring thickness	1st	STD	1.17 – 1.19 (0.0461 – 0.0469)
	2nd	STD	1.47 – 1.49 (0.0579 – 0.0587)
Pin clearance in piston pin hole	STD	mm (in.)	0.006 – 0.017 (0.0002 – 0.0007)
	Limit	mm (in.)	0.040 (0.0016)
Piston pin outside diameter	STD	mm (in.)	20.997 – 21.000 (0.8267 – 0.8268)
	Limit	mm (in.)	20.980 (0.8260)
Piston pin hole diameter	STD	mm (in.)	21.006 – 21.014 (0.8270 – 0.8273)
	Limit	mm (in.)	21.040 (0.8283)
Pin clearance in conrod small end	STD	mm (in.)	0.003 – 0.014 (0.0001 – 0.0006)
	Limit	mm (in.)	0.05 (0.002)
Conrod small end bore	STD	mm (in.)	21.003 – 21.011 (0.8269 – 0.8272)

Item	Unit	Data	
		DF140T	DF140Z

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in.)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in.)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in.)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in.)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in.)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in.)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in.)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in.)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in.)	0.350 (0.0138)
Conrod big end width	STD	mm (in.)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in.)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in.)	0.04 (0.0016)
Crankshaft journal oil clearance	STD	mm (in.)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in.)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in.)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in.)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in.)	0.01 (0.0004)
Crankshaft bearing thickness	STD	mm (in.)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in.)	0.11 – 0.31 (0.0043 – 0.0122)
	Limit	mm (in.)	0.35 (0.0138)
Crankshaft thrust bearing thickness	STD	mm (in.)	2.425 – 2.475 (0.0955 – 0.0974)

Item	Unit	Data	
		DF140T	DF140Z

ELECTRICAL

Ignition timing		Degrees at r/min.	BTDC 5° – BTDC 45°
Over revolution limiter		r/min.	6500
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	1.9 – 2.5
	Secondary	k Ω at 20°C	No.2 – No.3 : 18 – 34 (including H.T.cord and spark plug cap) No.1 – No.4 : 19 – 36 (including H.T.cord and spark plug cap)
High tension cord resistance		k Ω /m at 20°C	Approx.16
Battery charge coil resistance		Ω at 20°C	0.16 – 0.24
Battery charge coil output (12V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in.)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse : 60 Sub fuse : 30
Recommended battery capacity (12V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20°C	11.0 – 16.5
IAC valve resistance		Ω at 20°C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		k Ω at 25°C	1.8 – 2.3
ECM main relay resistance		Ω at 20°C	80 – 120
Starter relay coil resistance		Ω at 20°C	80 – 120
PTT motor relay coil resistance		Ω at 20°C	3.0 – 4.5

STARTER MOTOR

Max. continuous time of use		Sec	30
Motor output		kW	1.4
Brush length	STD	mm (in.)	16.0 (0.63)
	Limit	mm (in.)	12.0 (0.47)
Commutator undercut	STD	mm (in.)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in.)	0.2 (0.008)
Commutator outside diameter	STD	mm (in.)	29 (1.14)
	Limit	mm (in.)	28 (1.10)
Commutator outside diameter difference	STD	mm (in.)	0.05 (0.002)
	Limit	mm (in.)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in.)	9.8 (0.39)
	Limit	mm (in.)	5.0 (0.20)
Commutator outside diameter	STD	mm (in.)	22.0 (0.87)
	Limit	mm (in.)	20.4 (0.80)

SELF-DIAGNOSTIC SYSTEM INDICATION

When the abnormality occurs in a signal from sensor, switch, etc., the "CHECK ENGINE" lamp on the monitor-tachometer flashes (lights intermittently) according to the each code pattern with buzzer sounding.

PRIORITY *	FAILED ITEM	CODE	LAMP FLASHING PATTERN	FAIL-SAFE SYSTEM ACTIVATING
1	MAP sensor 1	3 – 4	on  off	YES
2	CKP sensor	4 – 2	on  off	YES
3	IAC valve/By-pass air screw adjustment	3 – 1	on  off	NO
4	CMP sensor	2 – 4	on  off	YES
5	CTP switch	2 – 2	on  off	NO
6	Cylinder temp. sensor	1 – 4	on  off	YES
7	IAT sensor	2 – 3	on  off	YES
8	MAP sensor 2 (Pressure detect passage)	3 – 2	on  off	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on  off	NO
10	Exhaust manifold temp. sensor	1 – 5	on  off	YES
11	Fuel injector	4 – 3	on  off	NO

* If more than two items fail at once, the self-diagnostic indication appears according to priority order. The indication repeats three times.

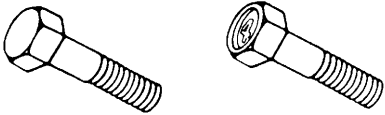
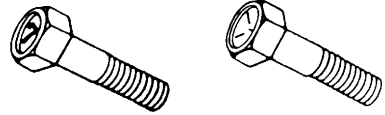
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

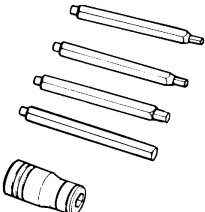
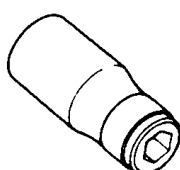
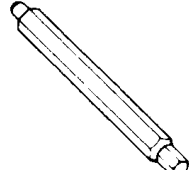
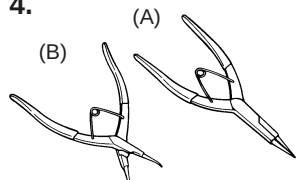
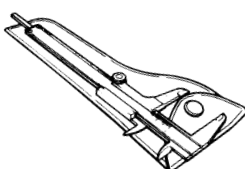
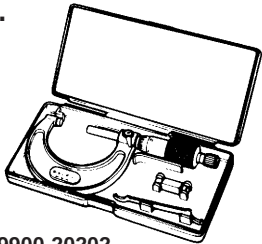
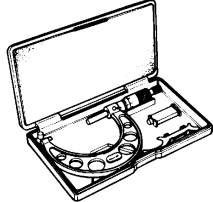
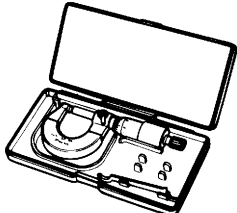
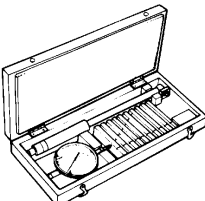
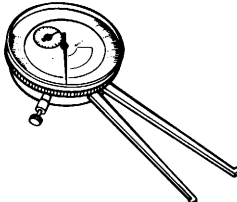
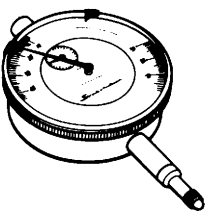
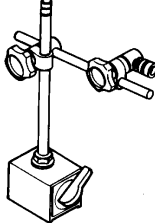
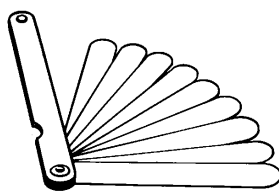
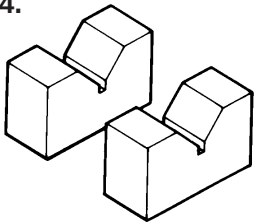
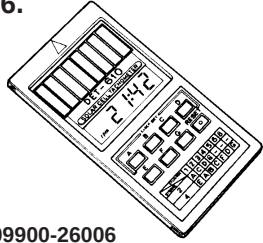
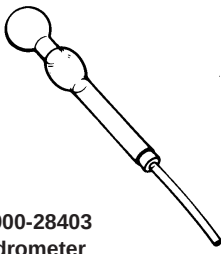
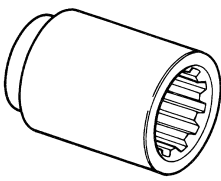
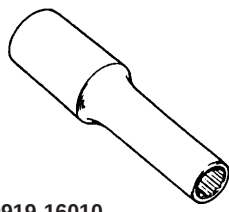
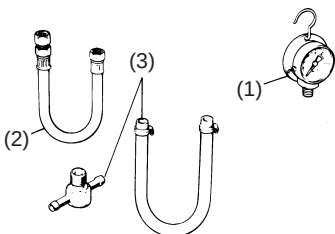
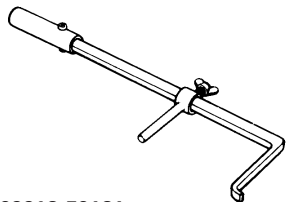
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb-ft
Cylinder head cover bolt		6 mm	11	1.1	7.9
Cylinder head bolt		8 mm	23	2.3	16.6
		10 mm	70	7.0	50.6
Crankcase bolt		8 mm	25	2.5	18.1
		10 mm	56	5.6	40.5
Conrod cap nut		8 mm	40	4.0	29.0
Camshaft housing bolt		6 mm	11	1.1	7.9
Camshaft timing sprocket bolt		10 mm	78	7.8	56.2
Timing chain guide bolt			10	1.0	7.2
Intake manifold bolt/nut		8 mm	23	2.3	16.5
Oil pressure switch		—	13	1.3	9.5
Fuel delivery pipe nut		8 mm	23	2.3	16.5
Fuel delivery pipe plug/union bolt	Upper	12 mm	35	3.5	25.3
	Lower	12 mm	35	3.5	25.3
Fuel return pipe bolt		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Oil filter stand		—	40	4.0	28.9
Engine oil filter		—	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	85	8.5	61.5
	Rear	12 mm	80	8.0	57.8
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt/nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	20	2.0	14.5
Gearcase bolt		10 mm	54	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	20	2.0	14.5
Pinion nut			120	12.0	86.8
Propeller nut		18 mm	55	5.5	40.0

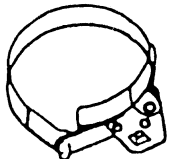
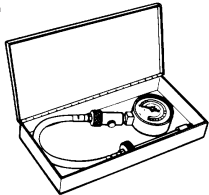
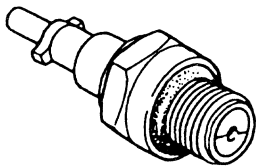
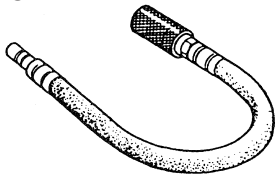
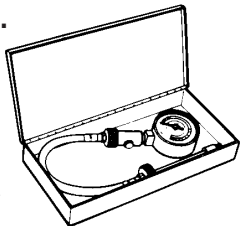
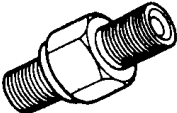
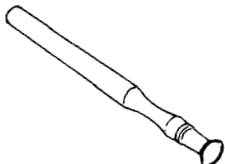
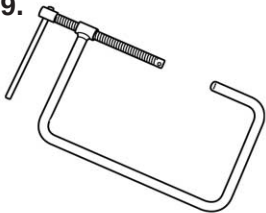
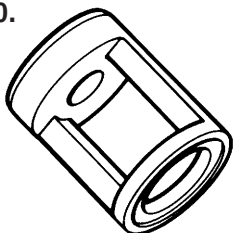
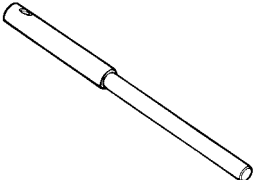
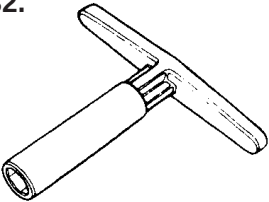
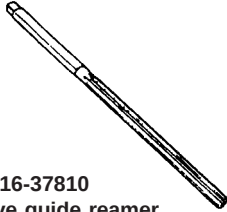
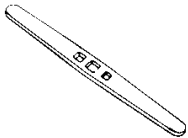
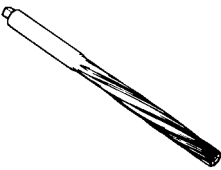
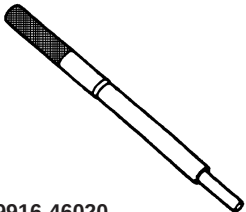
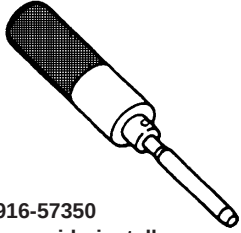
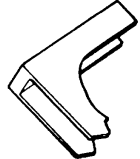
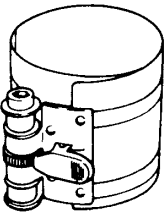
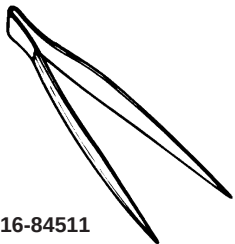
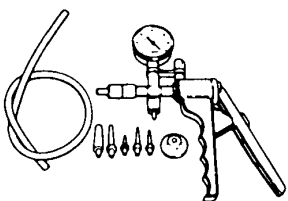
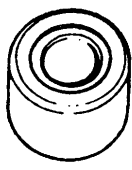
Tightening torque – general bolt**NOTE:**

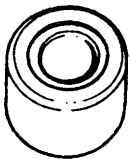
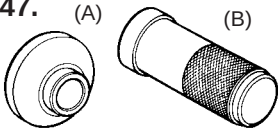
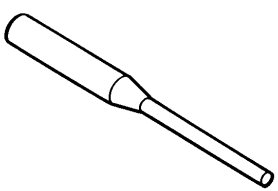
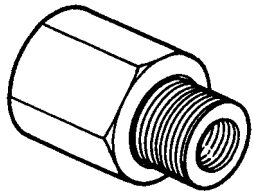
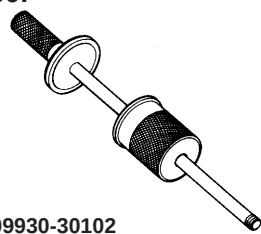
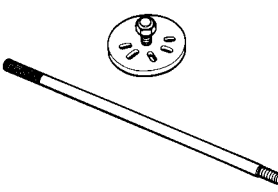
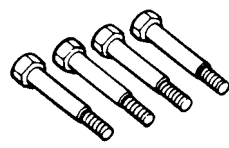
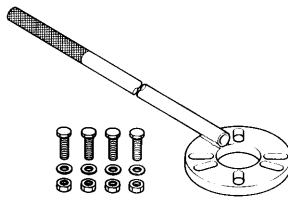
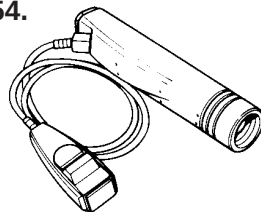
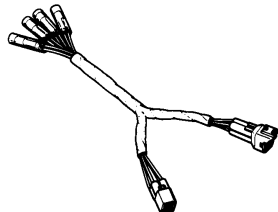
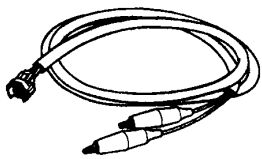
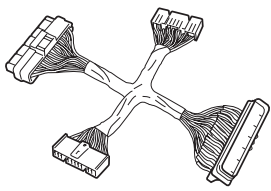
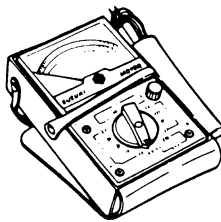
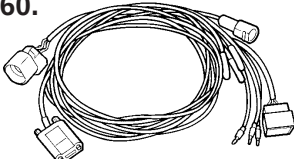
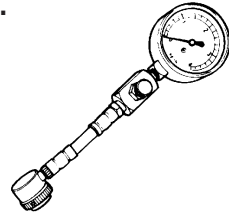
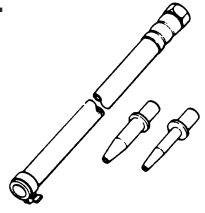
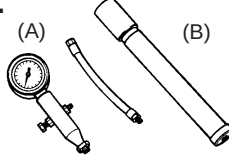
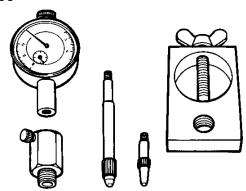
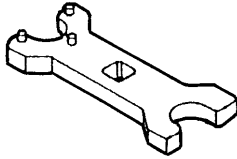
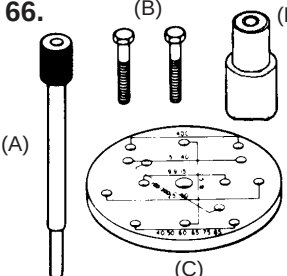
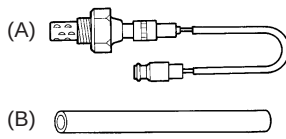
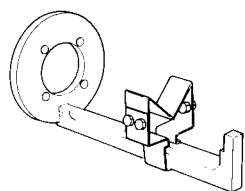
These values are only applicable when torque for a general bolt is not listed in the “Important Fasteners” table.

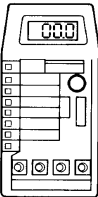
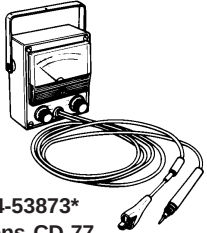
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb-ft
 (Conventional or “4” marked bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
	10 mm	22 – 35	2.3 – 3.5	16.0 – 25.5
 (Stainless steel bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 10	0.6 – 1.0	4.5 – 7.0
	8 mm	15 – 20	1.5 – 2.0	11.0 – 14.5
	10 mm	34 – 41	3.4 – 4.1	24.5 – 29.5
 (7 marked or  marked bolt)	5 mm	3 – 6	0.3 – 0.6	2.0 – 4.5
	6 mm	8 – 12	0.8 – 1.2	6.0 – 8.5
	8 mm	18 – 28	1.8 – 2.8	13.0 – 20.0
	10 mm	40 – 60	4.0 – 6.0	29.0 – 43.5

SPECIAL TOOLS

1.  09900-00410 Hexagon wrench set	2.  09900-00411 Hexagon socket (included in 09900-00410)	3.  09900-00413 (5 mm) 09900-00414 (6 mm) Hexagon bit (included in 09900-00410)	4.  (A) 09900-06107 (B) 09900-06108 Snap ring pliers
5.  09900-20101 (150 mm) 09900-20102 (200 mm) Vernier calipers	6.  09900-20202 Micrometer (25 - 50 mm)	7.  09900-20203 (50 - 75 mm) 09900-20204 (75 - 100 mm) Micrometer	8.  09900-20205 Micrometer (0 - 25 mm)
9.  09900-20508 Cylinder gauge set	10.  09900-20605 Dial calipers (10 - 34 mm)	11.  09900-20606 Dial gauge	12.  09900-20701 Magnetic stand
13.  09900-20803 Thickness gauge	14.  09900-21304 Steel "V" block set	15.  09900-22302 (0.051 - 0.125 mm) 09900-22301 (0.025 - 0.076 mm) Plastigauge	16.  09900-26006 Engine tachometer
17.  09900-28403 Hydrometer	18.  09921-29410 Driveshaft holder	19.  09919-16010 Deep socket wrench	
20. 09912-58413 Fuel pressure gauge set (1) 09912-58442 Fuel pressure gauge (2) 09912-58432 Fuel pressure hose (3) 09912-58490 3-way joint & hose 		21.  09913-50121 Oil seal remover	

22.  09915-47330 Oil filter wrench	23.  09915-64511 Compression gauge	24.  09915-67010 Compression gauge hose attachment	25.  09915-64530 Compression gauge hose
26.  09915-77311 Oil pressure gauge	27.  09915-78211 Oil pressure gauge adapter	28.  09916-10910 Valve lapper	29.  09916-19030 Valve lifter
30.  09916-14910 Valve lifter attachment	31.  Solid pilot (Neway N-120-6.0)	32.  09916-54910 Handle (N-505)	33.  09916-22420 Valve seat cutter (60°) (Neway 114)
34.  09916-20620 Valve seat cutter (45°) (Neway 122)	35.  09916-20610 Valve seat cutter (15°) (Neway 121)	36.  09916-37810 Valve guide reamer (ϕ 6 mm)	37.  09916-34542 Valve guide reamer handle
38.  09916-38210 Valve guide reamer (ϕ 11 mm)	39.  09916-46020 Valve guide remover	40.  09916-57350 Valve guide installer	41.  09916-49040 Tappet holder
42.  09916-77310 Piston ring compressor	43.  09916-84511 Tweezers	44.  09917-47011 Vacuum pump gauge	45.  09917-87810 Valve guide installer attachment

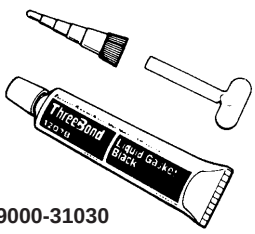
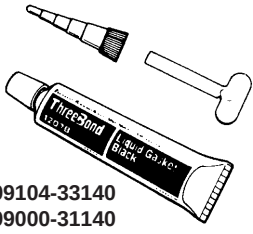
46.  09917-98221 Valve guide stem seal installer attachment	47. (A) (B)  (A) 09922-59410 Propeller shaft housing installer (B) 09922-59420 Housing installer handle	48.  09922-89810 Shift lock pin remover	49.  09930-30161 Propeller shaft remover
50.  09930-30102 Sliding hammer	51.  09930-39411 Flywheel rotor remover	52.  09930-39420 Rotor remover bolt	53.  09930-48720 Flywheel holder
54.  09930-76420 Timing light	55.  09930-89240 4-pin connector test cord	56.  09930-89260 Injector test cord A	57.  09930-89950 44-pin test cord
58.  09930-99320 Digital tester	59.  09900-25002 Pocket tester	60.  09932-79910 Diagnostic harness 09932-89910 SDS adapter	61.  09940-44120 Air pressure gauge
62.  09940-44130 Attachment	63. (A) (B)  (A) 09950-69512 Gearcase oil leakage tester (B) Air pump	64.  09951-09511 Gear adjusting gauge	65.  09944-09420 PTT cylinder cap tool
66. (B) (D)  (A) Pinion bearing installer shaft (B) 01107-08408 Bolt (C) 09951-39914 Pinion bearing plate (D) 09951-19420 Attachment	67. (A) (B)  (A) 18213-74F00 O₂ sensor (B) 18498-99E40 Protector	68.  09951-09010 Shimming gauge	

69.  99954-53008-820* Digital voltmeter	70.  99954-53873* Stevens CD-77 Peak reading voltmeter	71.  99954-53883* Gear oil filler
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NOTE:

* Marked part No. is in U.S. market only.

MATERIALS REQUIRED

SUZUKI OUTBOARD MOTOR GEAR OIL  99000-22540 (400 ml × 24 pcs.)	SUZUKI SUPER GREASE "A"  *99000-25030 99000-25010 (500 g)	WATER RESISTANT GREASE  99000-25160 (250 g)	SUZUKI SILICONE SEAL  99000-31120 (50 g)
SUZUKI BOND "1104"  99000-31030 (100 g)	SUZUKI BOND "1207B"  * 99104-33140 99000-31140 (100 g)	THREAD LOCK "1342"  99000-32050 (50 g)	THREAD LOCK SUPER "1333B"  99000-32020 (50 g)
4-Stroke Motor Oil API : SE, SF, SG, SH, SJ SAE : 10W-40			

NOTE:

* Marked part No. is in U.S. market only.

ENGINE CONTROL

The specifications of engine control system such as ignition and fuel injection systems on model DF140 are basically the same as those on DF90/115.

However, the control specifications on DF140 differ from DF90/115 as shown below.

Idling/Trolling speed

Idling/Trolling engine speed as controlled by IAC system:

- Idling/Trolling engine speed: 700 ± 50 rpm
- IAC duty ratio (at idling/trolling): Approximately 30%

NOTE:

To adjust idling/trolling engine speed manually on DF140, use the same procedure as DF90/115 and adjust the speed to 700 ± 50 rpm with the IAC valve duty set to 30%.

Ignition timing

The ignition timing is controlled within the following range according to the engine operating condition.

- Ignition timing advance range: BTDC $5^\circ - 45^\circ$
- Ignition timing (at idling/trolling): BTDC $10^\circ \pm 5^\circ$

Over revolution limiter

The over-rev detecting speed is as follows:

- DF140: 6500 rpm

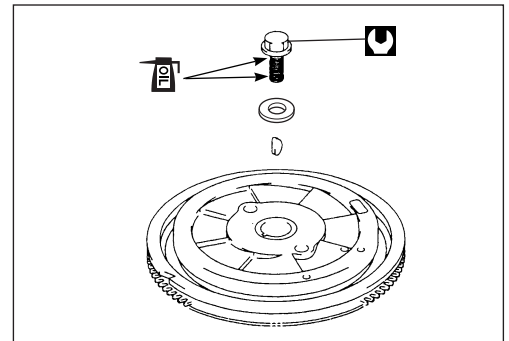
SDS

The database specially provided only for DF140 needs to be added to the Ver. 4 currently used.

FLYWHEEL MAGNETO

When installing the flywheel magneto, apply a small amount of engine oil to the threads and seating face of the magneto bolt for lubrication so that the correct tightening torque specification can be attained securely.

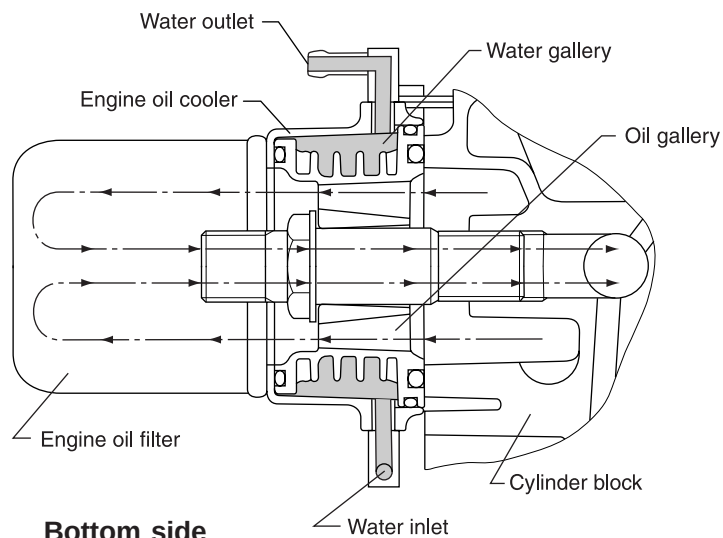
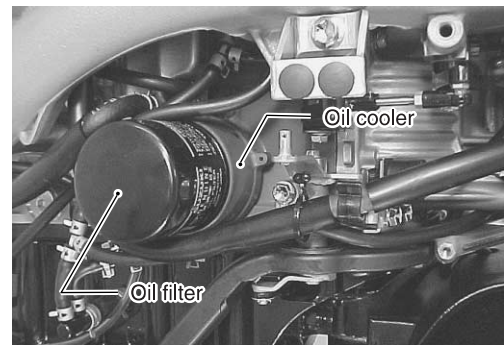
 Flywheel bolt : 245 N·m (24.5 kg·m, 177 lb·ft)



POWER UNIT

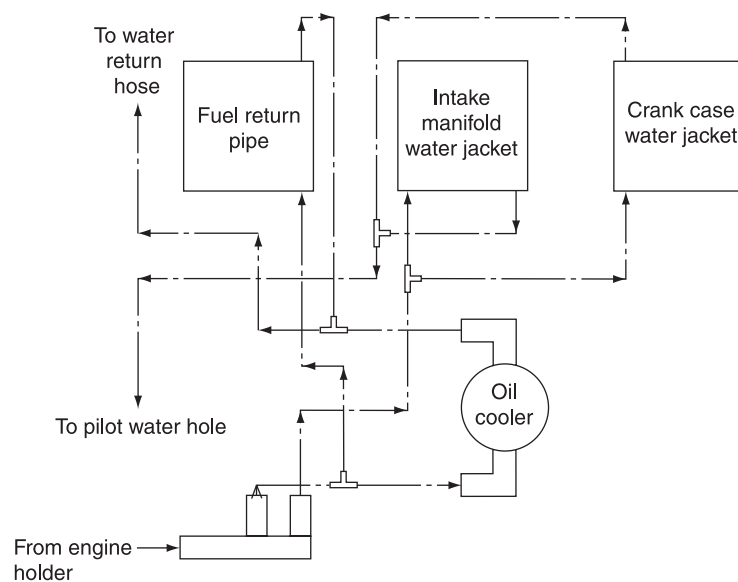
ENGINE OIL COOLER

To keep a engine oil temp. properly and to show its optimum engine performance, a engine oil cooler was installed.
The water flow to cool the engine oil is shown in the figure.



Bottom side

PIPING

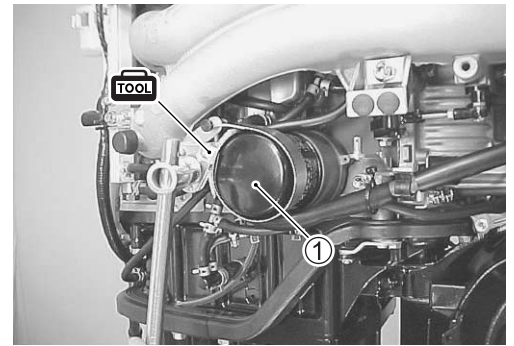


Removal

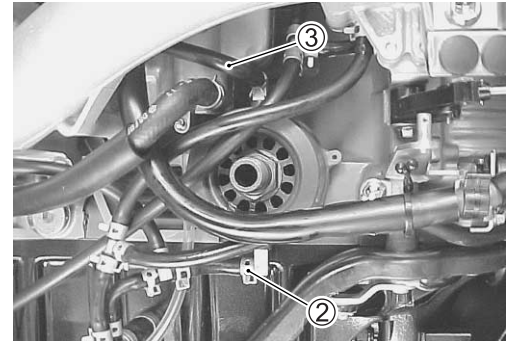
1. Remove the STBD side lower cover.
2. Using oil filter wrench to loosen the oil filter ①, then remove engine oil filter and O-ring.



09915-47330: Oil filter wrench



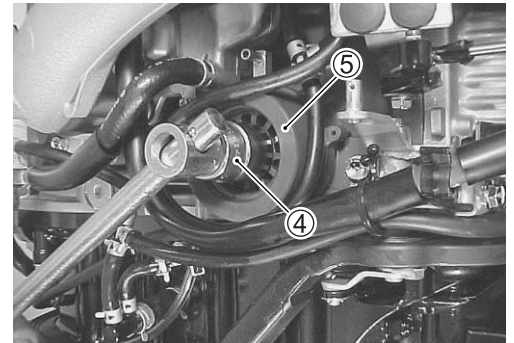
3. Disconnect both inlet ② and outlet ③ water hoses from engine oil cooler.



4. Loosen oil filter stand ④, then remove the oil filter stand and engine oil cooler assembly ⑤.

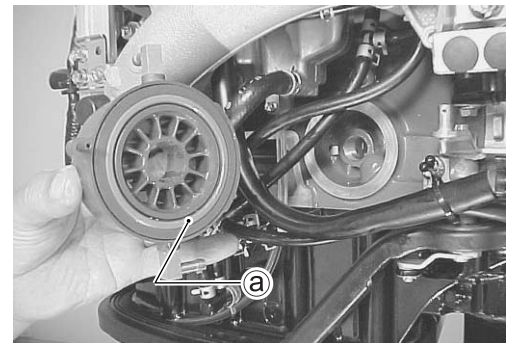
NOTE:

Use socket wrench to loose the oil filter stand.



Installation

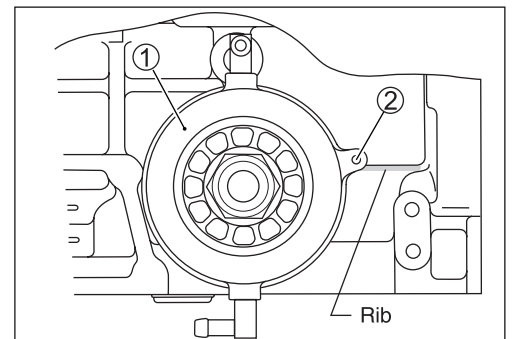
1. Install seal ring @ to oil cooler assembly.



2. Place the engine oil cooler assembly ① to cylinder block.

NOTE:

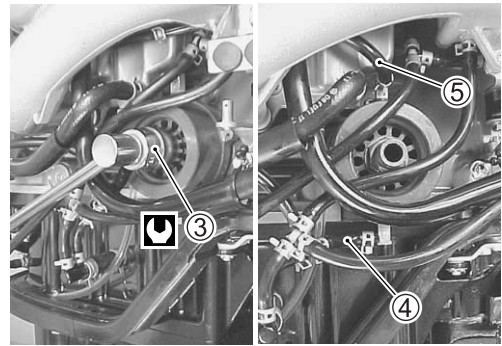
When installing the oil cooler, put a locating pin ② at the surface of rib in the cylinder block as shown in the figure.



3. Install oil filter stand ③, then tighten filter stand to specified torque.

 Oil filter stand: 40 N·m (4.0 kg-m, 29 lb-ft)

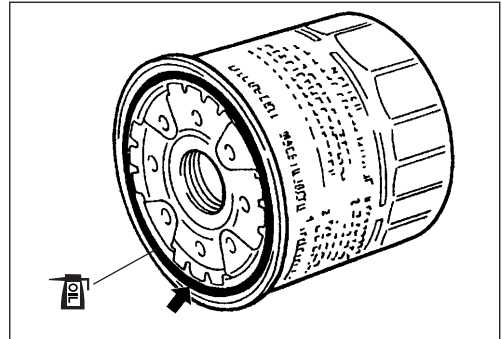
Connect inlet ④ and outlet ⑤ water hoses to each fitting of engine oil cooler.



4. Screw engine oil filter ⑥ on by hand until the filter O-ring contacts the mounting surface.

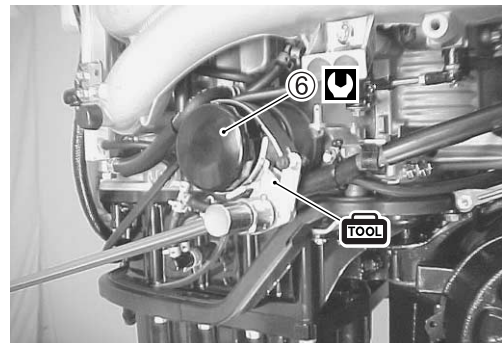
NOTE

Before fitting oil filter, be sure to oil O-ring.



5. Tighten the engine oil filter 3/4 turn from the point of contact with the mounting surface using an oil filter wrench.

 Engine oil filter: 14 N·m (1.4 kg-m, 10 lb-ft), 3/4 turn



CAMSHAFT

The camshaft for DF140 was specially designed.
The height of the cam is different from DF90/115.

- **Cam height**

Standard:

IN. 39.520 – 39.680 mm (1.5560 – 1.5622 in.)

EX. 39.320 – 39.480 mm (1.5480 – 1.5543 in.)

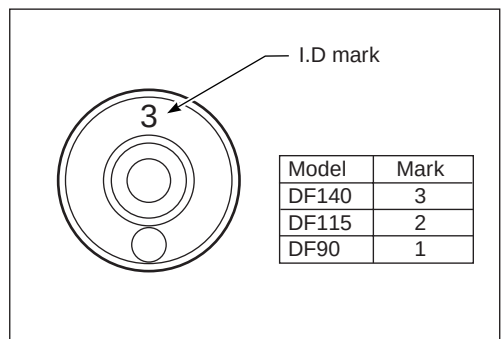
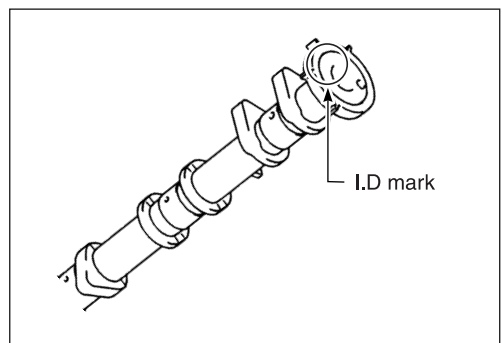
Service limit:

IN. 39.420 mm (1.5520 in.)

EX. 39.220 mm (1.5441 in.)

- **Camshaft identification**

The camshaft is distinguished by the mark at the top of shaft.
DF140 camshaft is marked as shown.



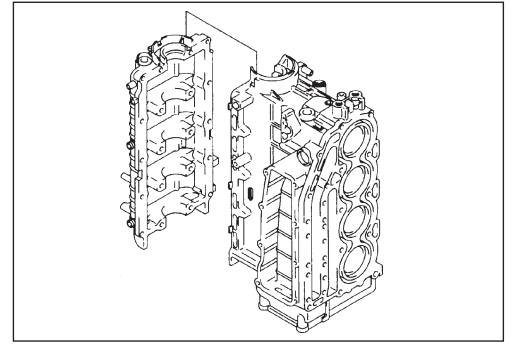
CYLINDER BLOCK

The cylinder bore is different from DF90/115.

The diameter for the cylinder of DF140 has become as the following.

Cylinder bore

Standard: 86.000 – 86.020 mm (3.3858 – 3.3866 in.)



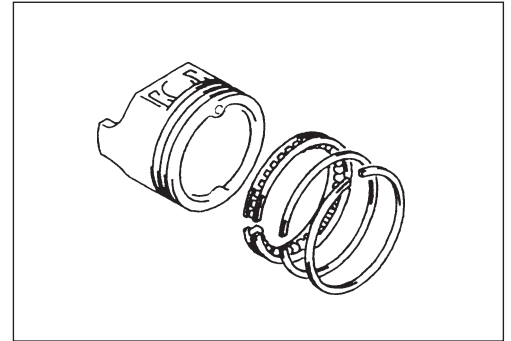
PISTON & PISTON RING

Piston and piston ring diameters are different from DF90/115.

The dimension of piston has become as the following.

Piston skirt diameter

Standard: 85.970 – 85.990 mm (3.3846 – 3.3854 in.)



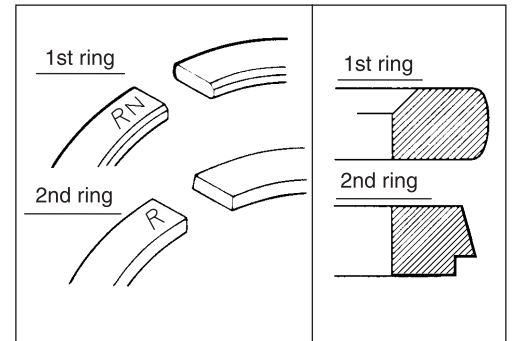
The shape of piston ring is the same as DF90/115.

- 1st ring: Barrel face and nitrogen treatment
- 2nd ring: Taper face with under cut and hard chrome plating

NOTE:

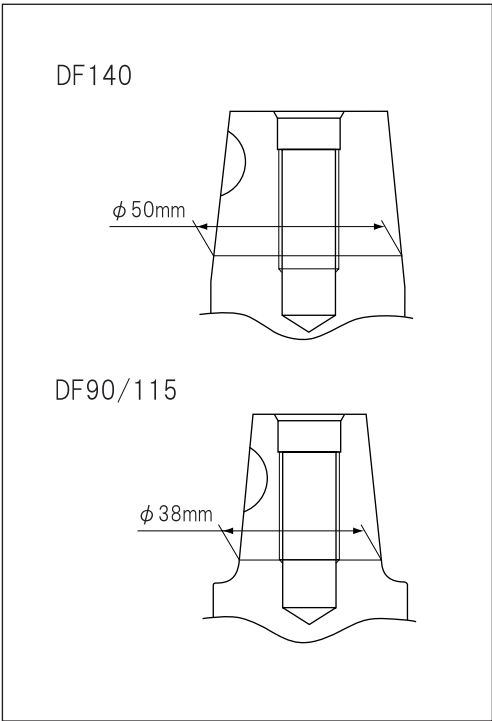
1st ring differs from 2nd ring in shape and color of surface contacting cylinder wall.

Distinguish 1st ring from 2nd ring by referring to figure.



CRANKSHAFT

The crankshaft for DF140 is different from that for DF90/115. To identify the crankshaft for each different model, check for the shape on the upper part of crankshaft (tapered portion). (See right illustrations.)



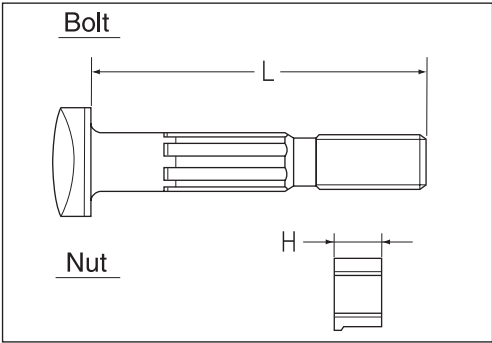
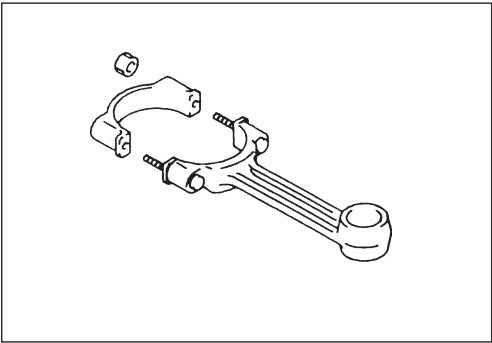
CONROD ASSEMBLY

Conrod bolts and nuts are different between DF140 and DF90/115. However, the conrod and cap of DF90/115 are used for DF140. Because the different conrod bolt is used for DF140, the torque for the conrod cap nuts of DF140 has become as the following.

 **DF140 Conrod cap nut: 40 N·m (4.0 kg-m, 29 lb-ft)**

NOTE:
Refer to table for the identification of the conrod bolt and cap nut.

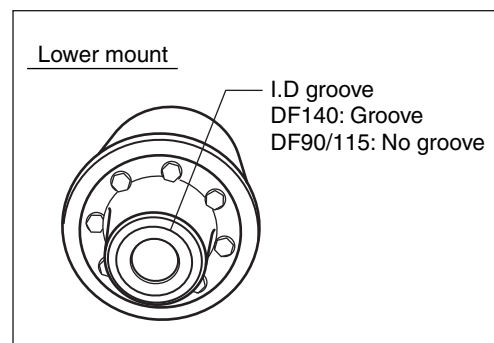
	DF140	DF90/115
Bolt length (L)	48 mm	46 mm
Nut height (H)	9.5 mm	7.5 mm



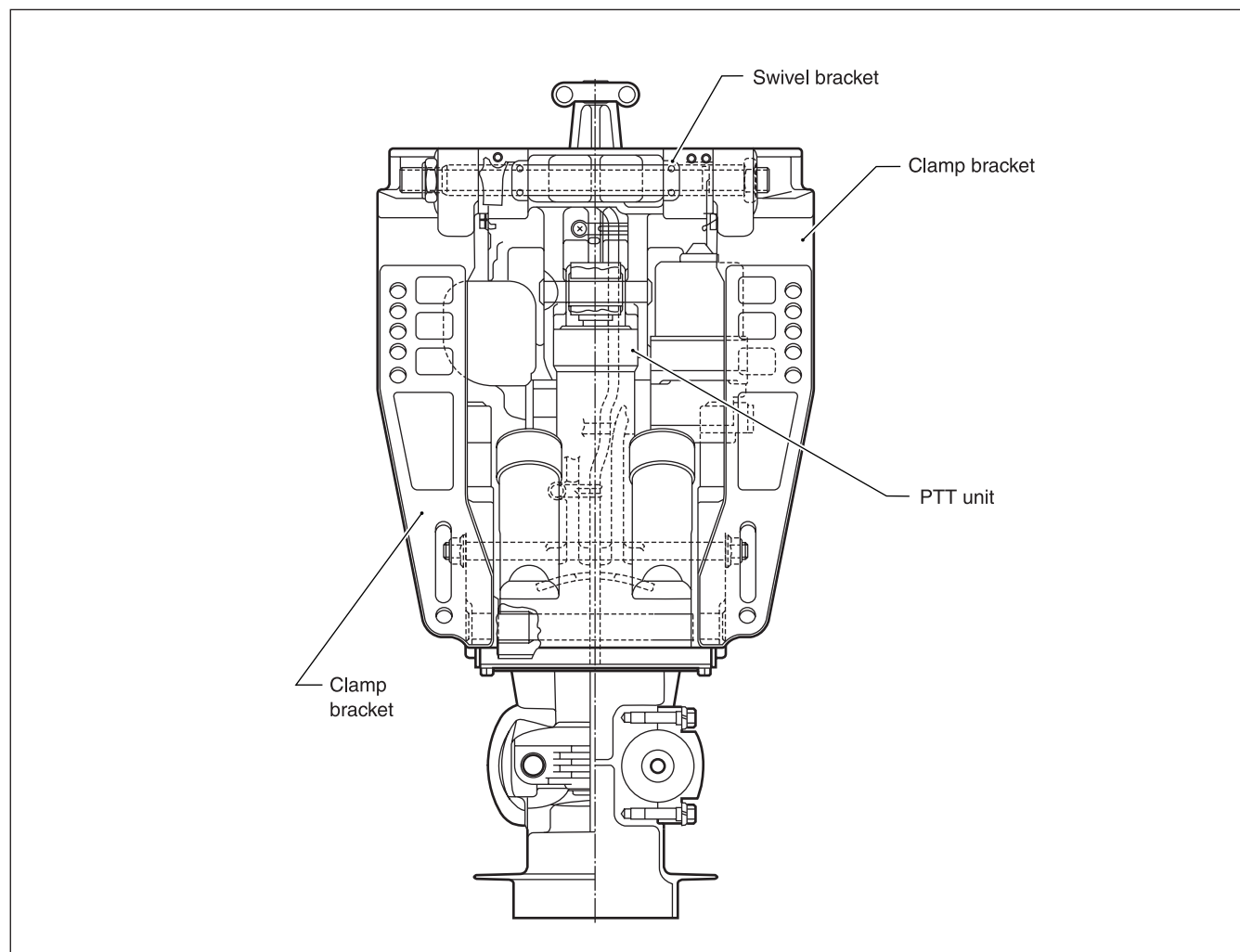
MID UNIT

Main components of DF140 are the same as those of DF90/115, but the followings are different.

- Upper mount and Lower mount are different between DF90/115 and DF140.
DF140 mounts are harder than those of DF90/115.

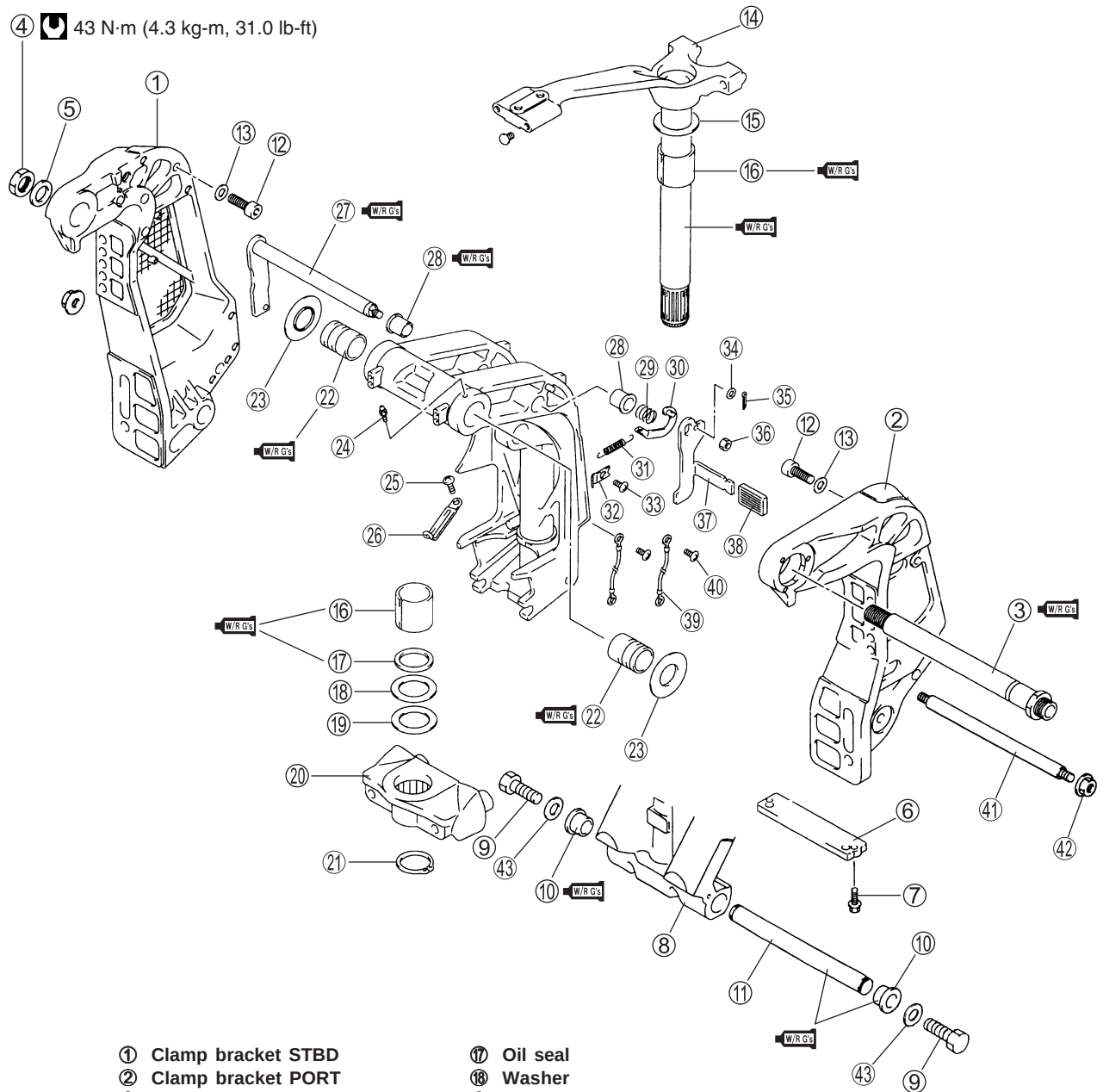


- To equip DF140 with new PTT unit, the swivel and clamp brackets have been modified.



CLAMP BRACKET / SWIVEL BRACKET / STEERING BRACKET

When disassembling or reassembling the components, refer to the construction diagram below.



- ① Clamp bracket STBD
- ② Clamp bracket PORT
- ③ Clamp bracket shaft
- ④ Nut
- ⑤ Washer
- ⑥ Anode
- ⑦ Bolt
- ⑧ (PTT unit)
- ⑨ Bolt
- ⑩ Bush
- ⑪ Lower shaft
- ⑫ Bolt
- ⑬ Washer
- ⑭ Steering bracket
- ⑮ Washer
- ⑯ Bush

- ⑰ Oil seal
- ⑱ Washer
- ⑲ Shim
- ⑳ Lower mount bracket
- ㉑ Circlip
- ㉒ Bush
- ㉓ Washer
- ㉔ Grease nipple
- ㉕ Screw
- ㉖ Clamp
- ㉗ Tilt lock lever
- ㉘ Bush
- ㉙ Spring
- ㉚ Link
- ㉛ Spring
- ㉜ Bracket

- ㉝ Screw
- ㉞ Washer
- ㉟ Pin
- ㊱ Nut
- ㊲ Tilt lock lever PORT
- ㊳ Rubber
- ㊴ Bonding wire
- ㊵ Screw
- ㊶ Tilt pin
- ㊷ Nut
- ㊸ Washer

POWER TRIM AND TILT

PTT unit of DF140 is new design and unit is 3 cylinder (two trim ram, one tilt rod) type.

SERVICE PROCEDURE

OIL LEVEL

To check the oil level:

1. Raised the engine to a full-tilt position.
2. Lower the manual tilt lock lever ①.
3. Remove the oil filler plug ②.
4. If oil can be seen at filler plug level, the unit is full.
5. If oil level is low, refill with the recommended oil.

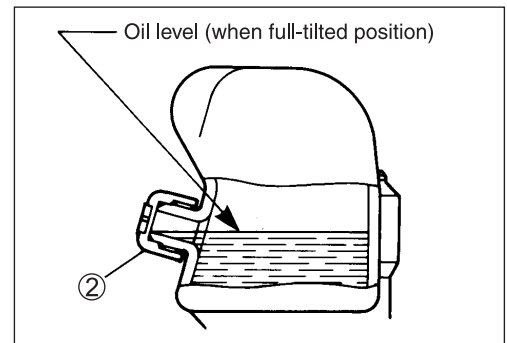
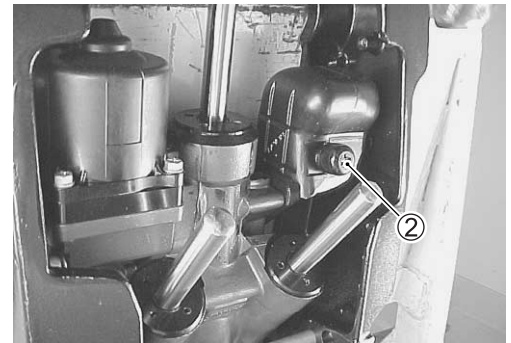
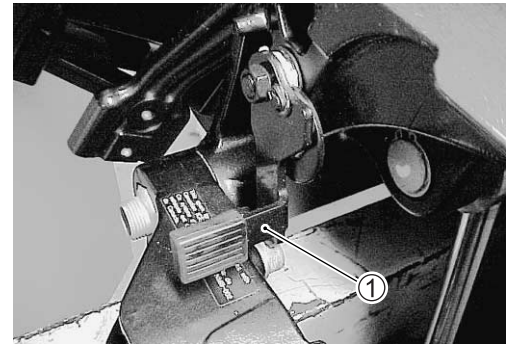
Recommended oil:

Dexron III automatic transmission fluid or equivalent

CAUTION

To ensure consistent pump operation, do not mix different types of oil.

6. Reinstall oil filler plug.



AIR BLEEDING

1. Check that the manual release valve is tightened to the specified torque.

 **Manual release valve: 3.5 N·m (0.36 kg-m, 2.6 lb-ft)**

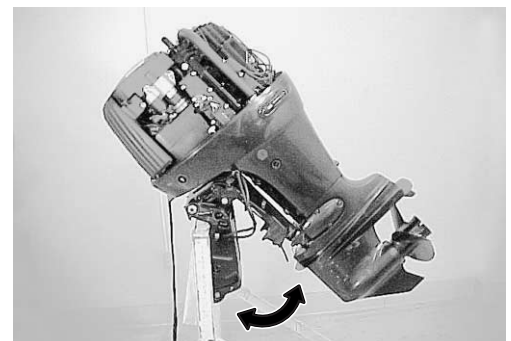
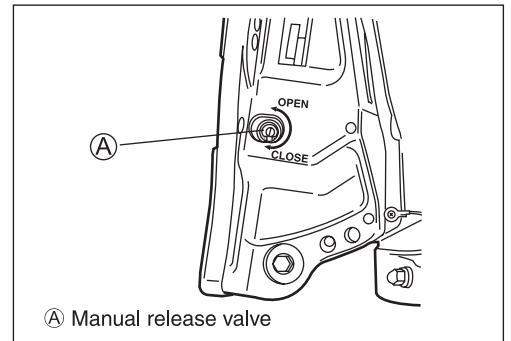
CAUTION

Do not over-tighten manual release valve.

Counterclockwise = open

Clockwise = close

2. Operate the PTT switch, raising and lowering the motor up and down (full tilt position to full trim down position) 4 to 5 times.
3. Check oil level, topping off if necessary.
4. Reinstall oil filler plug.

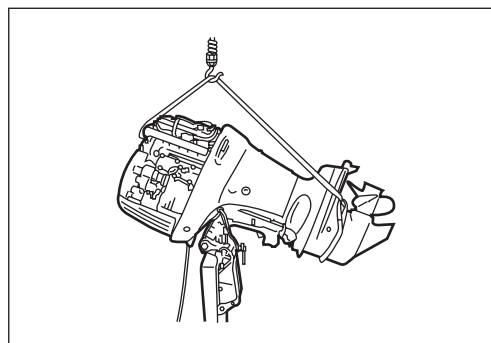


POWER TRIM AND TILT UNIT REMOVAL

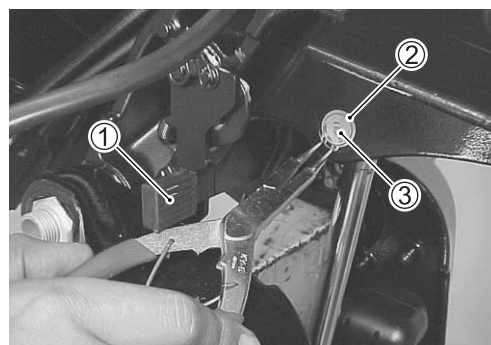
Raise the engine to the full tilt position and lower the manual tilt lock levers ①.

⚠ WARNING

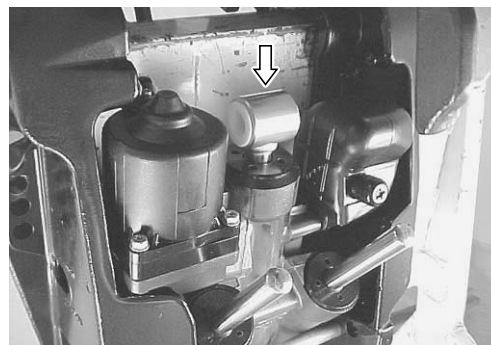
During the following procedures, the engine must be firmly secured and its weight fully supported. (See right)



Remove the tilt rod snap ring ② and push tilt cylinder upper shaft pin ③ out.

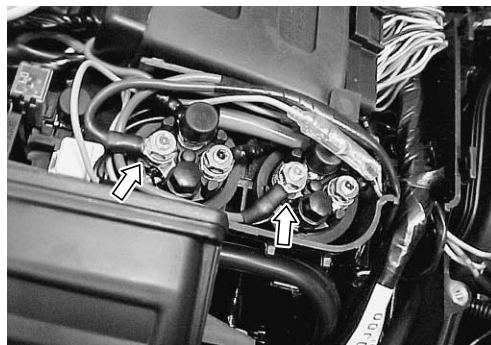


Lower tilt rod to full down position and disconnect the battery cable.



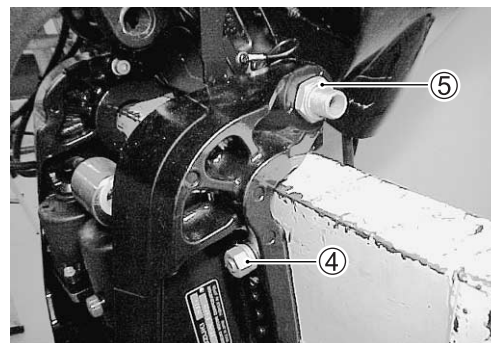
Disconnect the PTT motor cable wire leads (G, Bl) from the PTT relays.

Remove the PTT motor cable from engine lower cover.

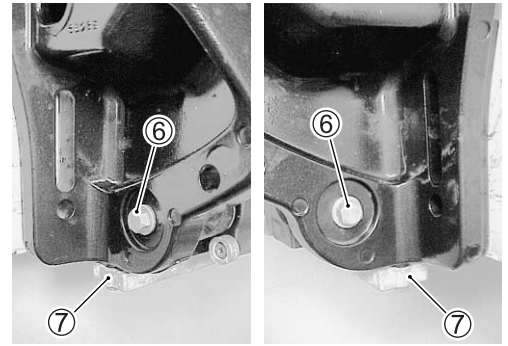


Remove the tilt pin.

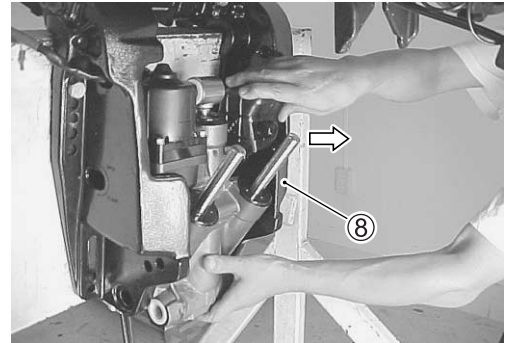
Remove the two STBD motor mounting bolts ④ and the clamp bracket shaft nut ⑤.



Remove the PTT cylinder lower shaft bolts ⑥.
Remove the two (2) bolts and anode ⑦.



Slide the STBD clamp bracket ⑧ off the clamp bracket shaft, then remove the PTT unit.

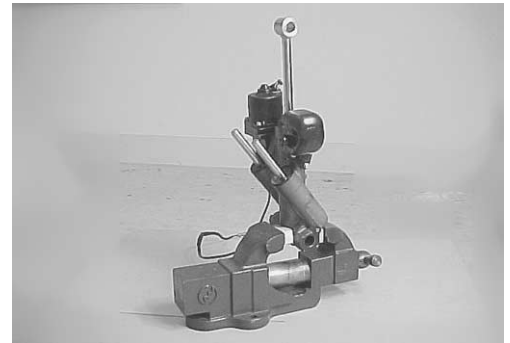


DISASSEMBLY

NOTE:

Before disassembly, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry the PTT body with compressed air.

Place the lower mounting eye of the PTT cylinder in a vise. Tighten the vise only enough to secure the PTT unit, do not over tighten.

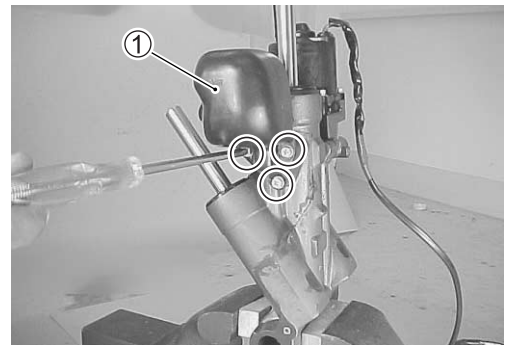


NOTE:

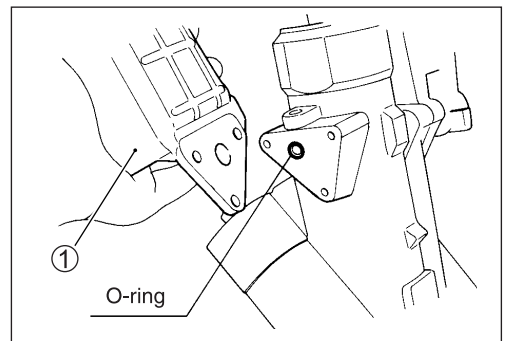
To prevent damage to the PTT cylinder use wood blocks, vise jaw protectors, etc., between the vise jaws and PTT components before tightening vise.

Connect the PTT motor cable leads (G, BI) to battery and operate PTT motor until tilt piston rod is at maximum stroke.
(full-tilt up position)

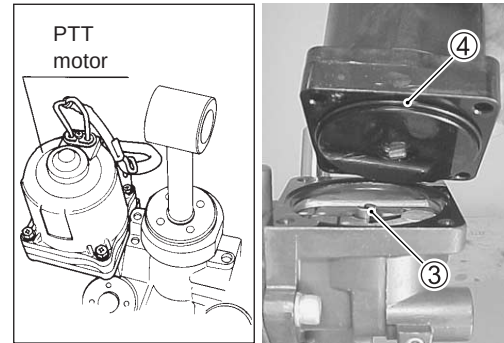
Unscrew the fill plug and drain PTT oil into suitable container.



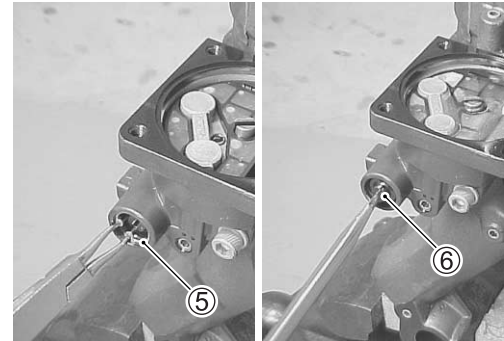
Remove the three (3) screws securing reservoir ①, then detach the reservoir from cylinder body.
Note the position of O-ring and remove it.



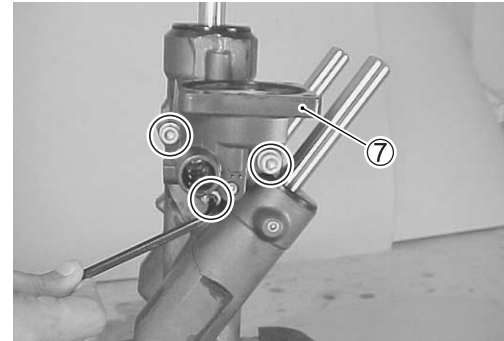
Remove the PTT motor assembly. (See page 33)
Note the position of drive joint ③ and O-ring ④, before removing them.



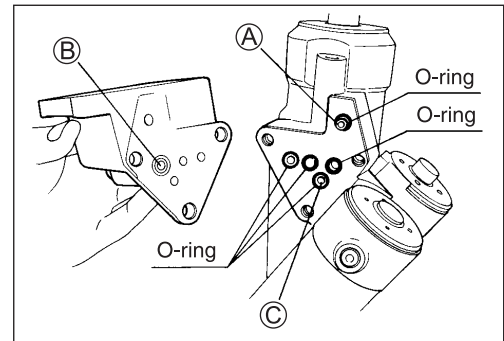
Remove the manual release valve snap ring ⑤, then unscrew the manual release valve ⑥.



Remove the three (3) screws securing the PTT pump case ⑦, then detach the PTT pump case from PTT cylinder body. Note the position of O-rings and orifices collars, before removing them.

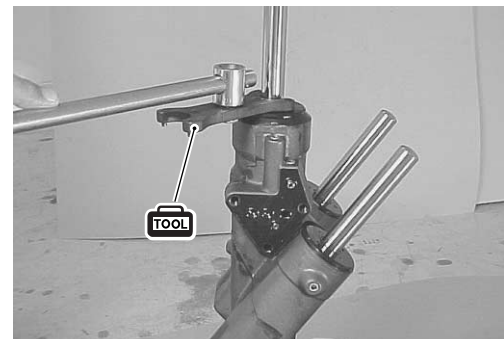


- Ⓐ: Orifice collar (with ball valve)
- Ⓑ: Orifice collar (with filter and ball valve)
- Ⓒ: Orifice collar

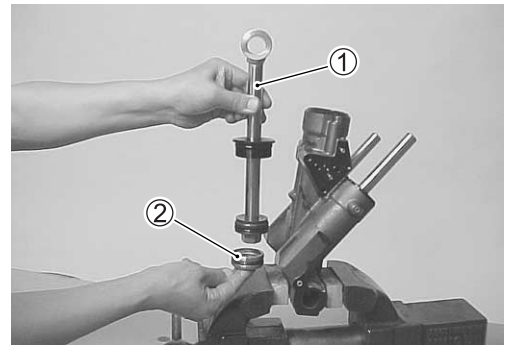


Using special tool, unscrew the PTT cylinder head.

TOOL 09944-09420: PTT cylinder cap tool



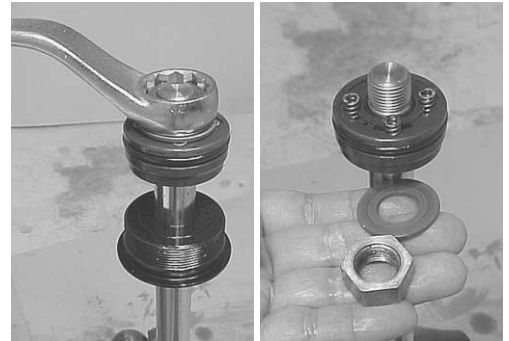
Pull the tilt rod/piston assembly ① out of the cylinder body.
Remove the free piston ② from the cylinder body.



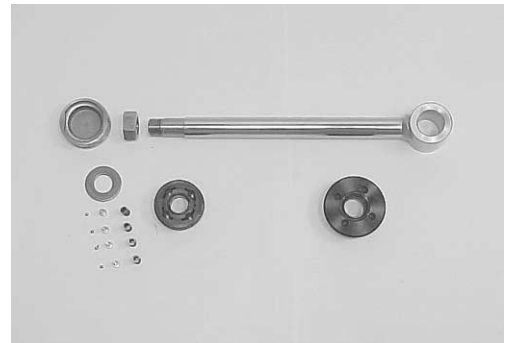
Disassembly of tilt rod/piston assembly

Unscrew the piston retaining nut from the bottom of the tilt rod and remove the washer.

Carefully retain and account for four shock valves, each composed of spring, rod and ball.



Remove the piston assembly and PTT cylinder head from the tilt rod by sliding them down and off the rod end.

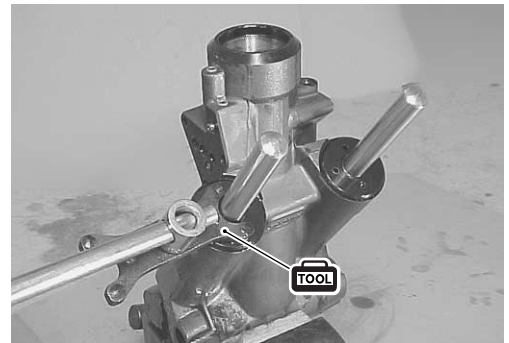


Disassembly of trim rod / piston assembly

Using special tool, unscrew the trim cylinder head.



09944-09420: PTT cylinder cap tool



Pull the trim rod/piston assembly out of the trim cylinder.



CLEANING AND INSPECTING

Thoroughly wash all metal components with cleaning solvent and dry them with compressed air.

Arrange all components on a clean sheet of paper.

NOTE:

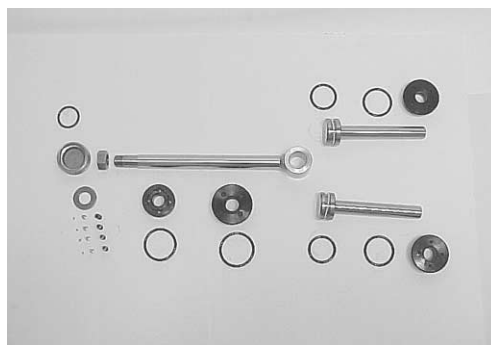
Do not lay PTT components out on a rag, as dirt or lint may be transferred to these items which may cause possible system operating problems.

Inspect tilt rod and trim rod, replace if damaged or bent.

Inspect the surface of tilt rod and trim rod for scores, grooves or roughness.

Slight roughness may be removed with fine emery paper.

A badly scored or grooved rod must be replaced.

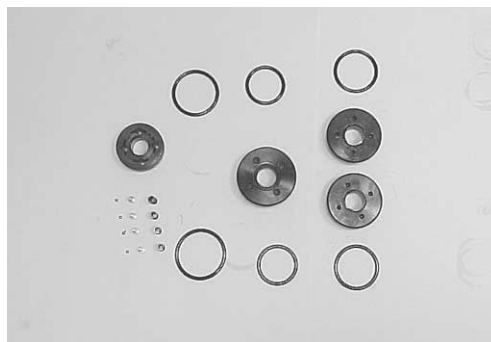


Inspect the PTT cap seal and O-ring.

Replace if cuts, nicks, or excessive wear is found.

NOTE:

It is recommended that the O-ring always be replaced once the tilt/trim cylinder has been disassembled.

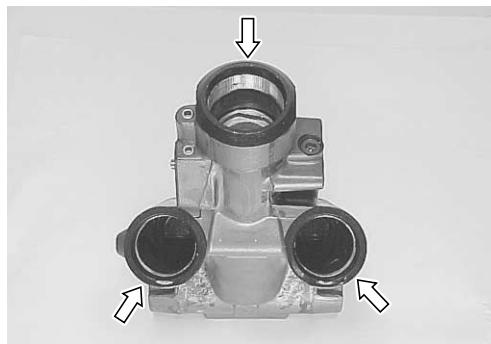


Inspect the shock valves (spring, rod and ball).

Replace if there are any signs of rust or pitting.

Inspect the cylinder bore for evidence of a rough or grooved surface.

Light honing may rectify slight surface roughness or scarring, but a deeply scarred surface will require replacement of the tilt cylinder.



Inspect manual release valve for damage.

Inspect manual release valve O-ring.

Replace if nicked or cut.



REASSEMBLY

Assembly is reverse order of disassembly with special attention to following steps.

CAUTION

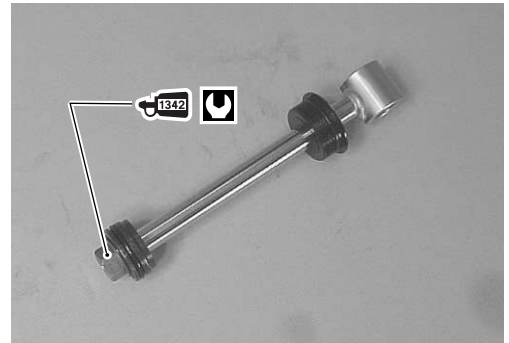
- Do not reuse O-rings after removal, always use new O-rings.
- Lubricate all components and O-rings with PTT fluid before assembly.
- Do not reuse PTT fluid, always refill with new fluid.

TILT ROD

When tightening the piston retaining nut on the tilt rod piston, apply Thread lock 1342 to the threads. Tighten the nut to specified torque.

 99000-32050: Thread Lock 1342

 Piston retaining nut: 100 N·m (10 kg-m, 72 lb-ft)



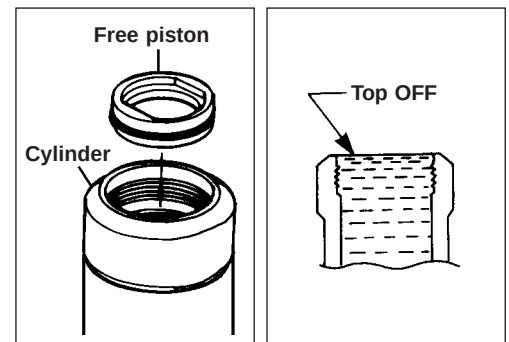
Installing tilt rod / piston

Pour 100 ml of PTT fluid into cylinder.

Insert the free piston into cylinder and push it down to the bottom of the cylinder.

Pour PTT fluid into the cylinder until it is topped off.

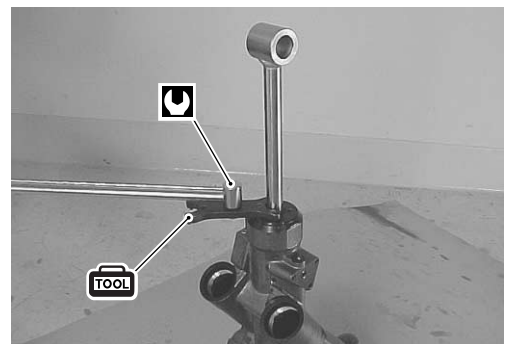
Insert the tilt rod/piston into cylinder and thread the tilt cylinder head by hand until fully seated.



Tighten the cylinder head to specified torque using special tool.

 Tilt cylinder head: 160 N·m (16 kg-m, 115.7 lb-ft)

 09944-09420: PTT cylinder cap tool



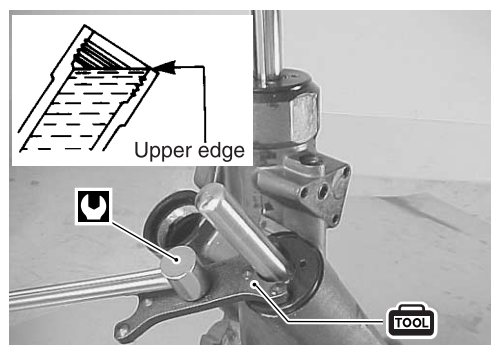
TRIM ROD

Pour PTT fluid into the trim cylinder until it is topped off. Insert the trim rod/piston assembly into cylinder and thread the trim cylinder head by hand until fully seated.

Tighten the trim cylinder head to specified torque using special tool.

 Trim cylinder head: 78 N·m (7.8 kg-m, 56.4 lb-ft)

 09944-09420: PTT cylinder cap tool

**PTT PUMP CASE**

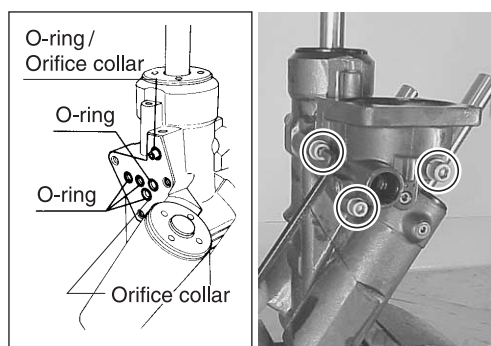
Install five (5) O-rings and orifice collars to PTT cylinder body.

NOTE:

Lubricate O-rings with PTT fluid before installing PTT cylinder body.

Install PTT pump case, then tighten three (3) screws to specified torque.

 PTT pump case screw: 3.5 N·m (0.35 kg-m, 2.5 lb-ft)

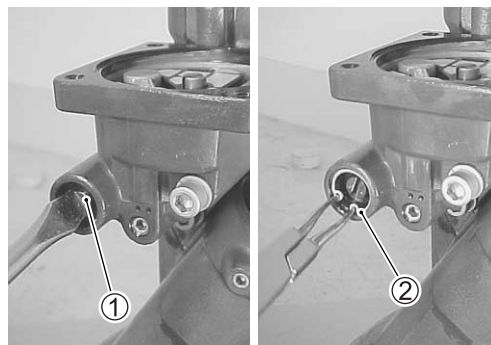
**MANUAL RELEASE VALVE**

Oil and install the manual release valve ①.

Tighten the valve to specified torque.

Install snap ring ②.

 Manual release valve: 3.5 N·m (0.36 kg-m, 2.6 lb-ft)

**PTT MOTOR**

See the PTT Motor Installation section on page 36.

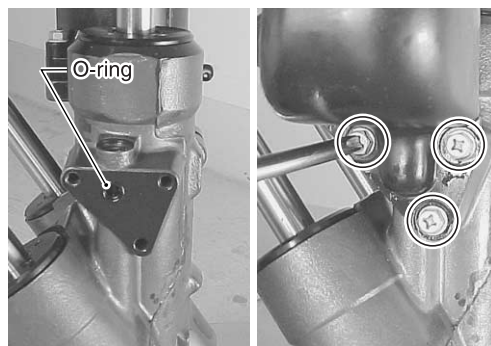
RESERVOIR

Install O-ring and reservoir, then tighten bolts to specified torque.

 Reservoir bolt: 5 N·m (0.5 kg-m, 3.5 lb-ft)

AIR BLEEDING

- Pour recommended PTT fluid in to reservoir until specified level.
- Perform the air bleeding procedure.
For air bleeding, see page 25.



PTT MOTOR

Removal

NOTE:

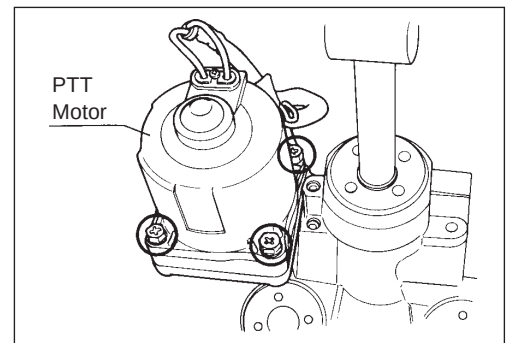
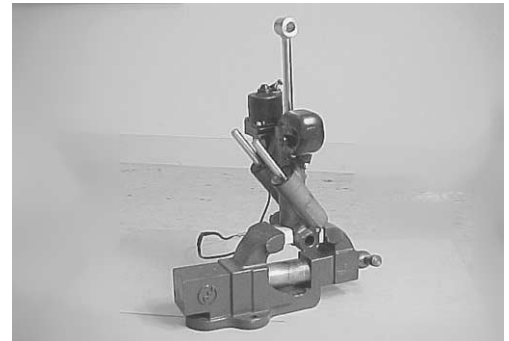
Before removing PTT motor, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry the PTT body with compressed air.

Place the lower mounting eye of the PTT cylinder in a vise. Tighten the vise only enough to secure the PTT unit, do not over tighten.

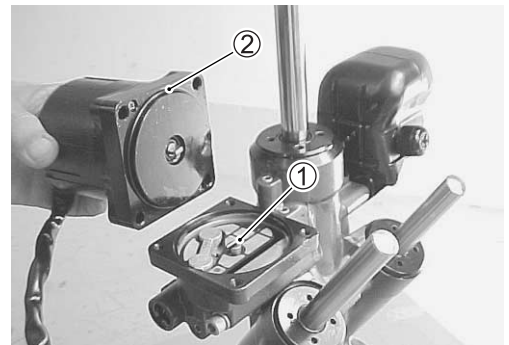
NOTE:

To prevent damage to the PTT cylinder use wood blocks, vise jaw protectors, etc., between the vise jaws and PTT components before tightening vise.

Remove the four (4) screws securing the PTT motor to the PTT pump case.



Detach the PTT motor from PTT pump case. Note the position of drive joint ① and O-ring ② and remove them.

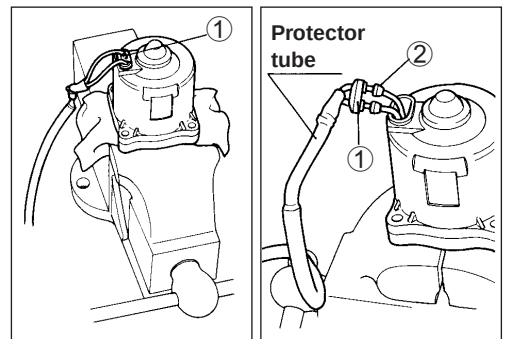


PTT motor Disassembly

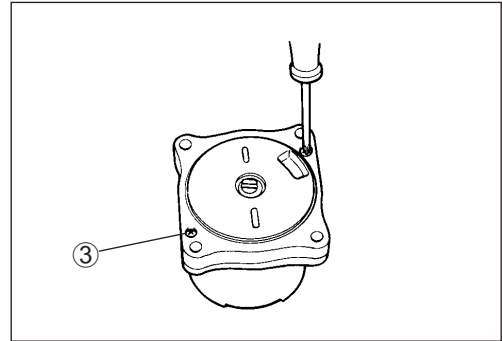
For correct assembly, scribe an alignment mark on the field case and brush holder.

Slide cable protector tube upward.

Remove the screw securing the motor cable holder ①, then slide motor cable holder and grommets ② out as shown in figure.



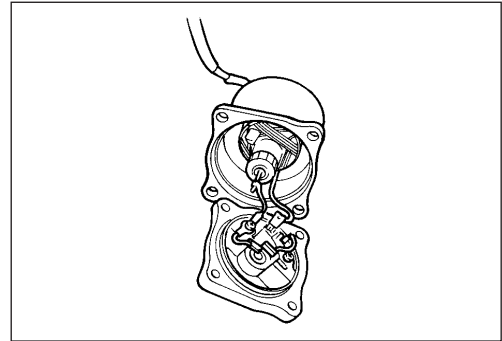
Remove the two (2) screws ③ securing the field case to the brush holder.



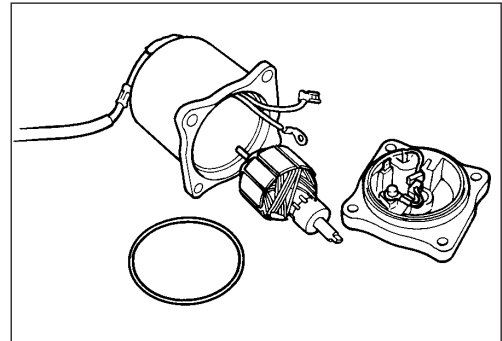
Slide the field case upward and away from the brush holder.

NOTE:

When separating field case from brush holder, proceed by pushing PTT motor cables into brush holder side.



Disconnect PTT motor cables from brush holder.
Remove armature from field case.
Note the position of the O-ring encircling the brush holder.



Inspection

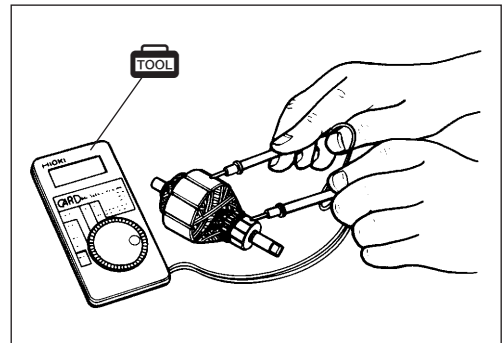
Armature and Commutator

Check for continuity between the commutator and the armature core/shaft.

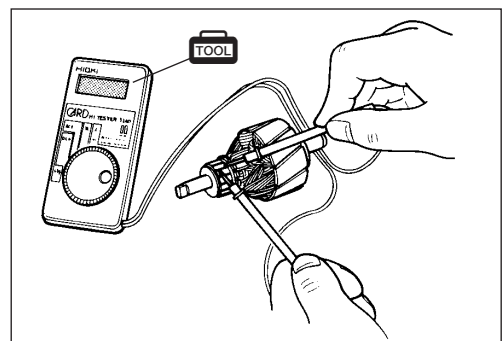
Replace armature if continuity is indicated.

 **09930-99320: Digital tester**

 **Tester range:**  **(Continuity)**



Check continuity between the adjacent commutator segments.
Replace armature if no continuity is indicated.



Inspect the commutator surface.

If surface is gummy or dirty, clean with 400 grit emery paper.

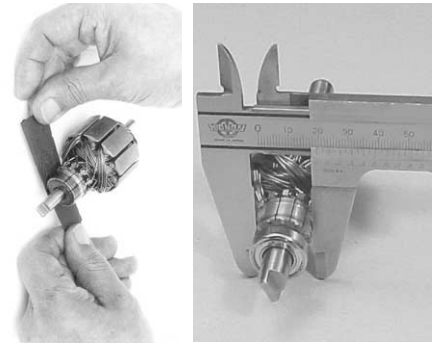
Measure commutator outside diameter.

 **09900-20101: Vernier calipers**

Commutator outside diameter:

Standard 22 mm (0.87 in.)

Service limit 20.4 mm (0.80 in.)



If measurement exceeds service limit, replace armature.

Ensure that the mica (insulator) between the segments is undercut to specified depth.

Commutator undercut:

Standard 1.6 – 1.9 mm (0.06 – 0.07 in.)

Service limit 1.0 mm (0.04 in.)

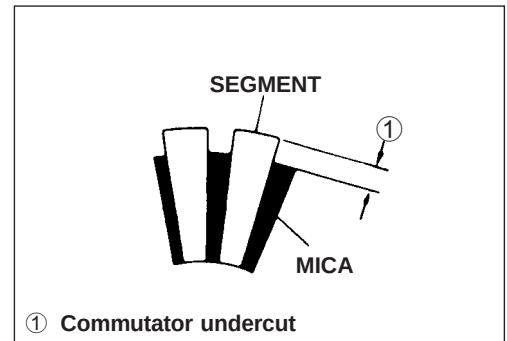
If undercut is less than service limit, cut to specified depth.

NOTE:

Remove all particles of mica and metal using compressed air.

⚠ WARNING

Wear safety glasses when using compressed air.



Brushes

Check the length of each brush.

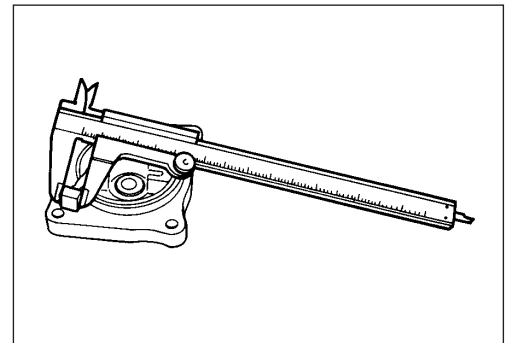
 **09900-20101: Vernier calipers**

Brush length:

Standard 9.8 mm (0.39 in.)

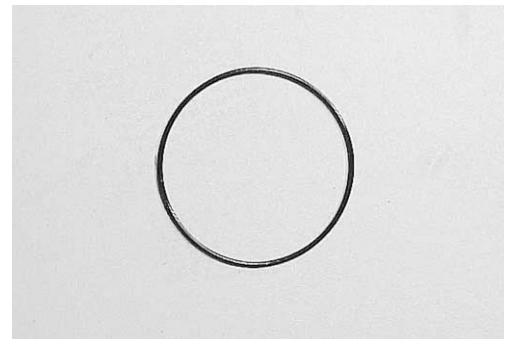
Service limit 5.0 mm (0.20 in.)

If brushes are worn down to the service limit, they must be replaced.



O-ring

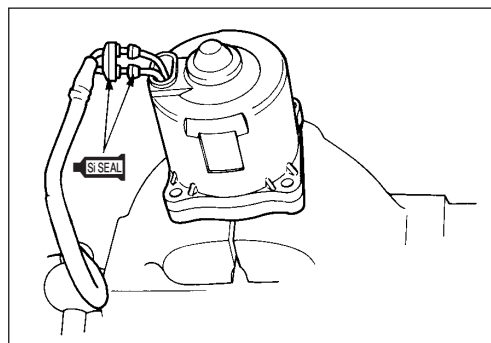
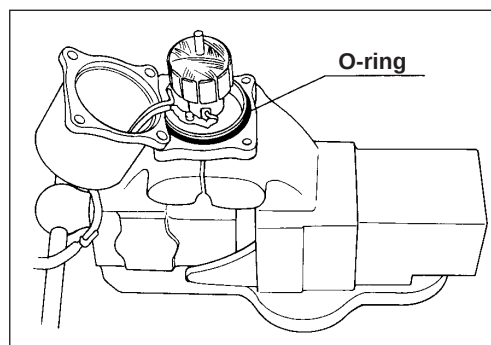
Inspect the O-ring between the PTT motor and PTT pump case. Replace if cuts, nicks or tears are found.



Assembly

Assembly is reverse of disassembly with special attention to following steps.

- Install armature to brush holder first.
When installing the armature, exercise care not to break the brushes.
- Match up previously scribed alignment marks.
- When assembling field case to brush holder, proceed by pulling PTT motor cables out of field case.
- Apply silicone seal to PTT motor cable holder and grommets and install cable holder screw.

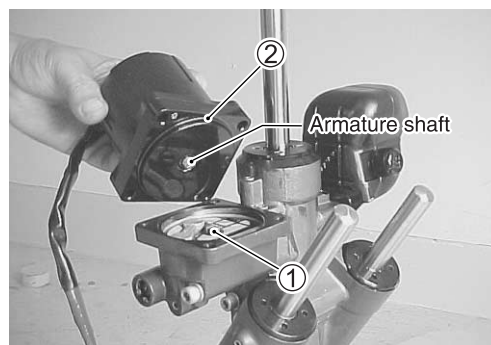
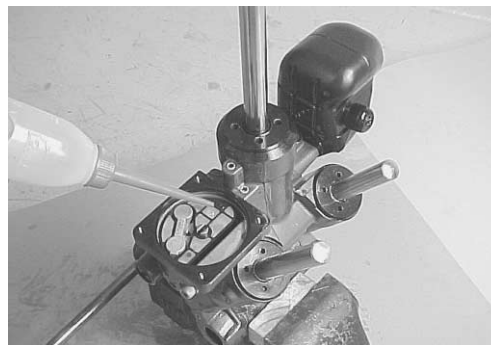


PTT motor installation

Installation is reverse of removal with special attention to following steps.

- Ensure that the drive joint ① is aligned and firmly inserted into the gear pump assembly.
- Fit O-ring ② to PTT motor.
- Check the level of PTT fluid contained in the PTT pump case. If level is low, add recommended PTT fluid until level with mating surface of PTT motor.
- Ensure that the faces of the PTT motor and pump unit are free of dirt or debris.

When attaching the PTT motor to the PTT pump case, ensure that the tip of armature shaft fits firmly into the drive joint ①.



- Tighten the four (4) screws to specified torque.

PTT motor screw: 5 N·m (0.5 kg-m, 3.6 lb-ft)

- Pour recommended PTT fluid into reservoir until specified level.
- Perform the air bleeding procedure.
For air bleeding, see page 25.

INSTALLATION

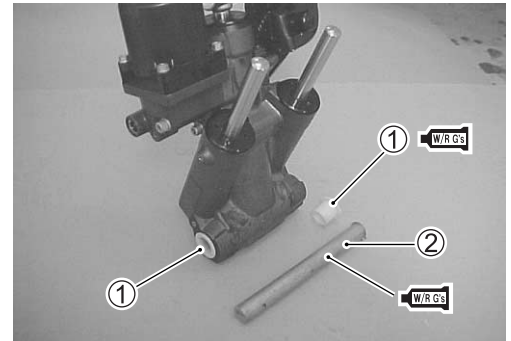
Installation is reverse order of removal with special attention to the following steps.

Lower tilt rod to full down position.

Apply Water Resistant Grease to the tilt cylinder lower shaft and lower shaft bushes.

Install bushes ① and cylinder lower shaft ② to PTT unit.

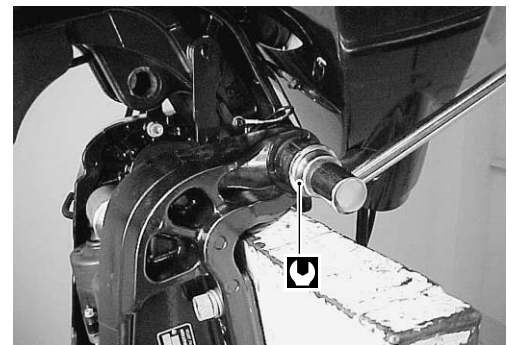
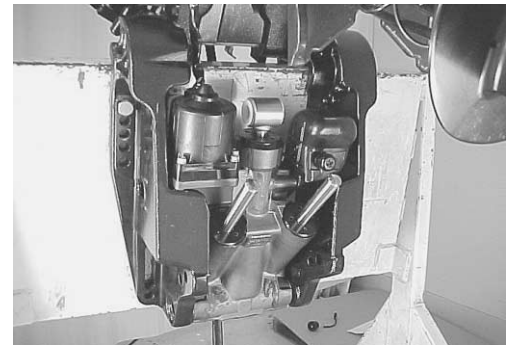
 **99000-25160: Water Resistant Grease**



Place the PTT unit in position, then install the clamp bracket. Tighten the clamp bracket shaft nut to specified torque.

 **Clamp bracket shaft nut:**

43 N·m (4.3 kg-m, 31.0 lb-ft)



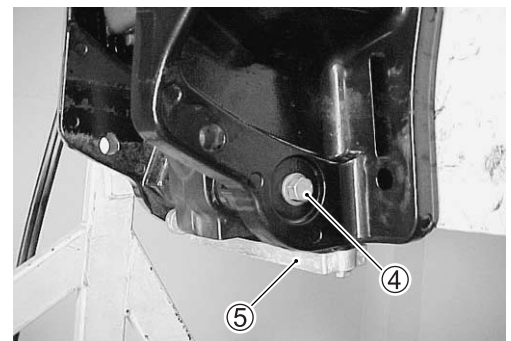
Tighten lower shaft bolts ④, pre-coated with thread lock, to specified torque.

 **99000-32050: Thread Lock 1342**

 **Cylinder lower shaft bolt:**

50 N·m (5.0 kg-m, 36.0 lb-ft)

Install anode ⑤, then tighten bolts securely.



Apply Water Resistant Grease to tilt rod upper bushes ⑥, then install bushes in tilt rod.

Operate the PTT motor to extend the PTT rod upward.

Align the tilt rod with the hole in the swivel bracket as the tilt rod extends.

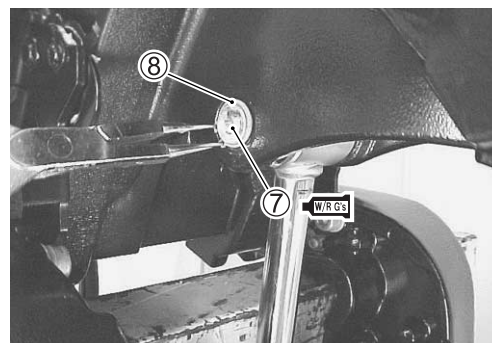
 **99000-25160: Water Resistant Grease**



Apply Water Resistant Grease to the PTT rod upper shaft ⑦, then insert the shaft through the swivel bracket and tilt rod.

 **99000-25160: Water Resistant Grease**

Secure the upper shaft with the snap ring ⑧.

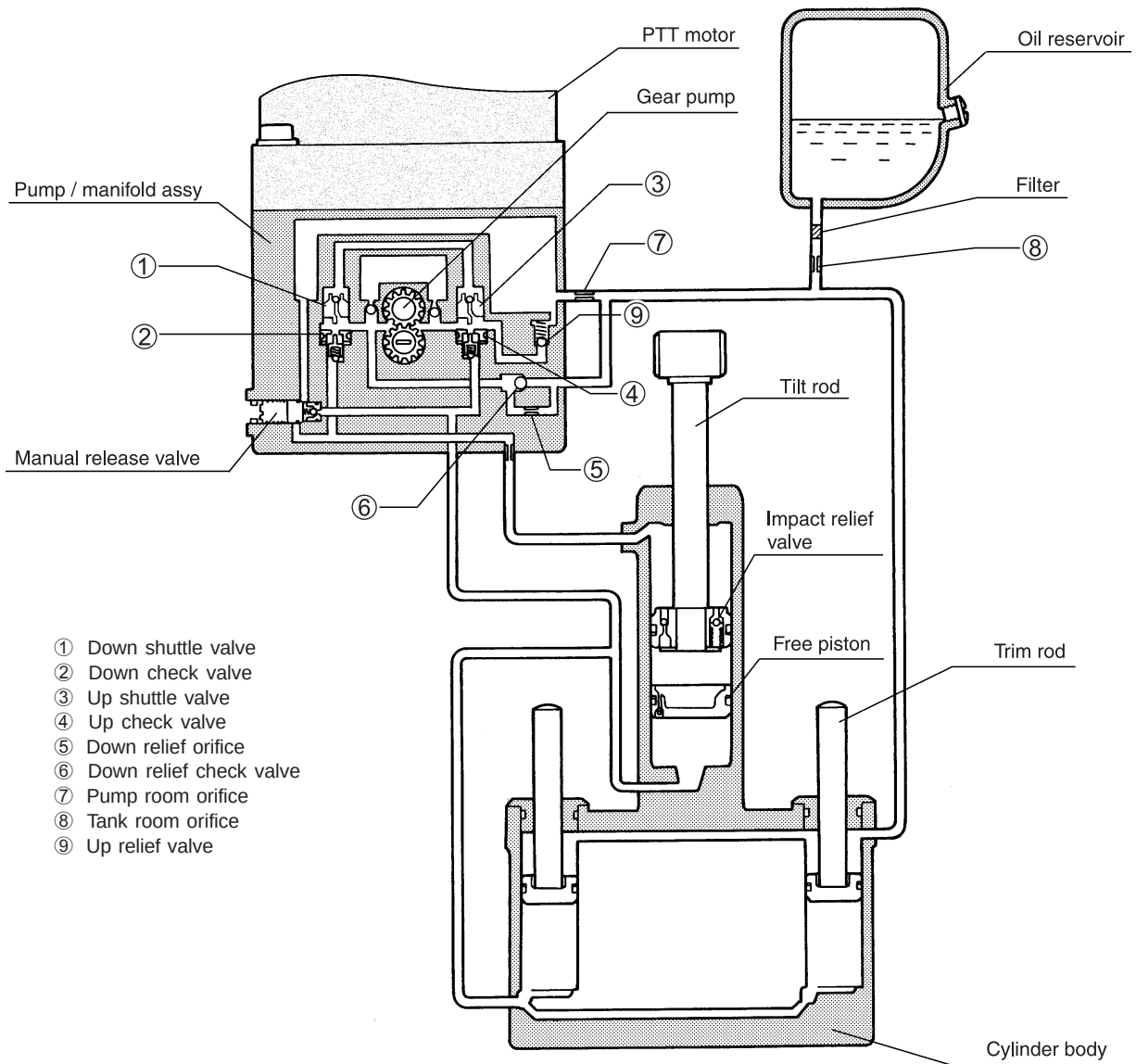


Route the PTT motor cable in through the lower cover and connect the terminals to the PTT relays.

(Cable routing – see the WIRE/HOSE ROUTING section.)



COMPONENT PARTS



* When the manual valve is to be opened, turn the manual release valve to the left about two turns.

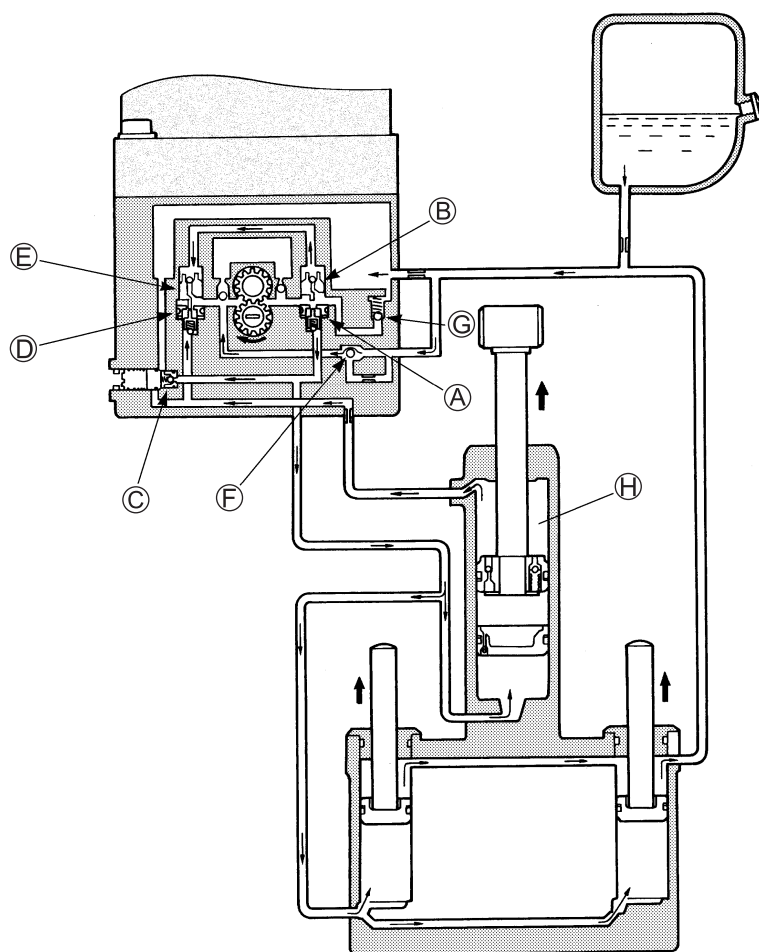
* When the oil level of the system should be checked, inspect the reservoir by placing the motor in the maximum tilt up position.

OPERATION

By motor operation, the geared pump will be driven, and by turning the motor to the right or to the left, oil flow will change its direction, and this causes up and down movements of the piston rod of the tilt cylinder and the trim rod of the trim cylinder.

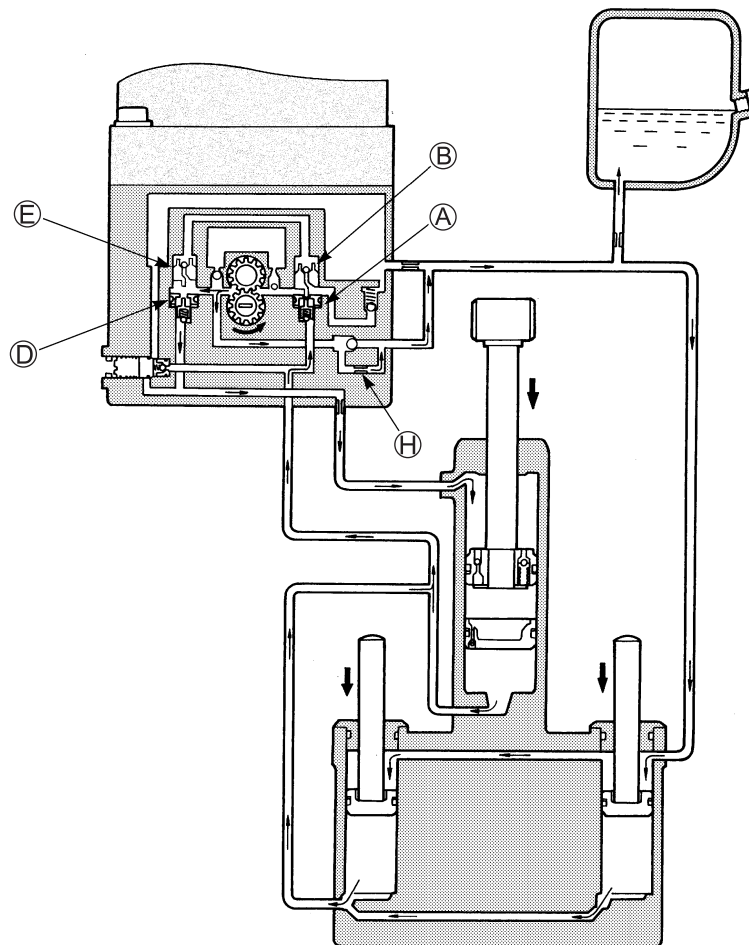
TRIM & TILT UP

- (1) When the PTT switch is operated in the "UP" position, the motor and gear pump will rotate in a clockwise direction.
- (2) Pressurized oil will open "Up" check valve (A) and the oil will flow through "Up" shuttle valve (B) to the "Down" shuttle valve (E). Following operation of valve (E), "Down" check valve (D) will open mechanically.
- (3) Pressurized oil flows through the "Up" check valve (A) to the bottom of the trim and tilt cylinders, thereby pushing the trim and tilt pistons upward.
- (4) Residual oil in the upper area of the tilt cylinder (H) is returned to the pump through "Down" check valve (D).
- (5) Any oil in the area above both trim cylinder pistons will be returned to the reservoir.
- (6) Oil will then flow from the reservoir to the pump to stabilize the balance of the oil volumes.
- (7) When the engine is fully tilted up, oil pressure will correspondingly increase in the lower chamber of the tilt and trim cylinders. But, to protect the PTT unit from excessively high pump pressure, the "Up" relief valve (C) begins to open.



TILT DOWN / TRIM IN

- (1) When the PTT switch is operated in the "DOWN" position, the motor and gear pump will rotate in a counterclockwise direction.
- (2) The oil pressure will open the "Down" check valve ① and oil will be forced through the "Down" shuttle valve ②. When the oil reaches "Up" shuttle valve ③, the "Up" check valve ④ will begin to open mechanically.
- (3) The pressurized oil flows through "Down" check valve ① and then enters the upper area of the tilt cylinder. This thereby forces the tilt rod piston downward.
- (4) When the swivel bracket contacts the trim rams, this pressure forces the trim pistons downward and oil from the reservoir is then able to enter the area above both trim rod pistons.
- (5) Oil from the lower area of the trim and tilt cylinders now returns to the pump through "Up" check valve ④.
- (6) Throughout the tilt action operation range, there is a difference in oil volume between the upper and lower chambers of the tilt cylinder, and any surplus oil is therefore directed to the reservoir by means of the "Down" relief orifice ⑤.
- (7) Throughout trim operation range, oil will be discharged from the bottom of all three cylinders and the pump will only supply oil to the tilt cylinder. Excess oil is then vented to the reservoir through the "Down" relief orifice ⑤.
- (8) To prevent damage from excessive oil pressure when all three rods are fully retracted, this pressure is relieved through the "Down" relief orifice ⑤.

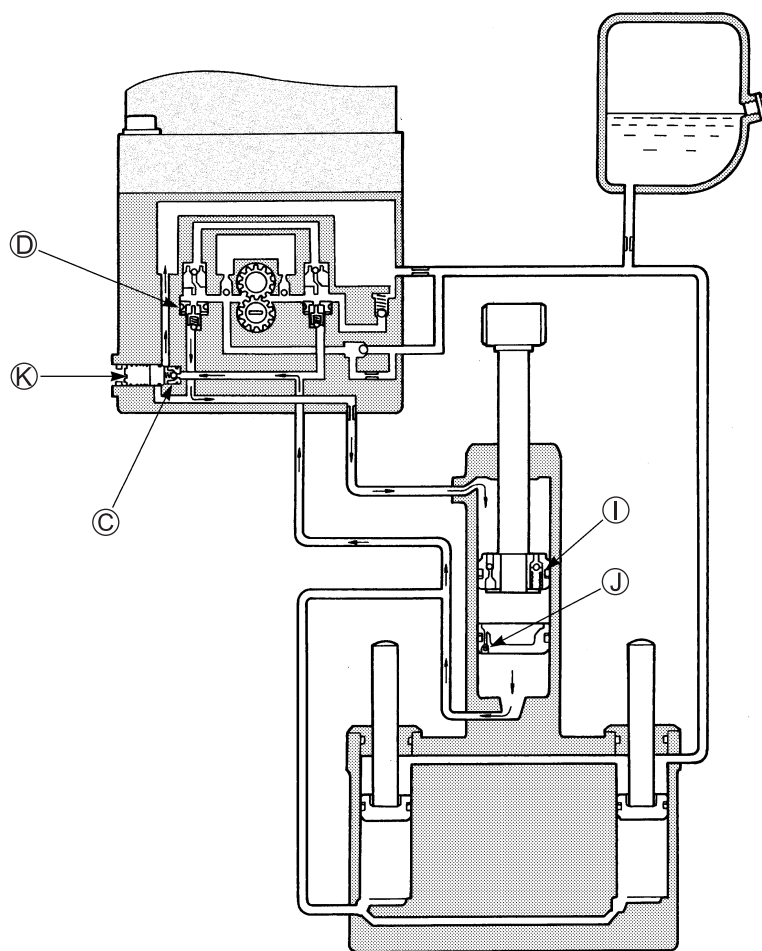


TILT SYSTEM PRESSURE RELIEF

- (1) If engine speed exceeds approx. 1500 RPM when operating in shallow water drive mode, oil pressure will increase underneath the tilt piston. The relief valve ③ (incorporated in the manual release valve ④) will then open.
- (2) The oil below the tilt piston will then flow to the reservoir through the relief valve ③.
- (3) As the power of the engine continues to exert downward force on the tilt piston, this will open “Down” check valve ⑤, thereby allowing oil from the reservoir to flow into the chamber above the tilt piston.
- (4) In this way, high internal pressure is relieved and the engine will slowly tilt downward until it reaches the highest position in the Trim range.

THERMAL EXPANSION RELIEF

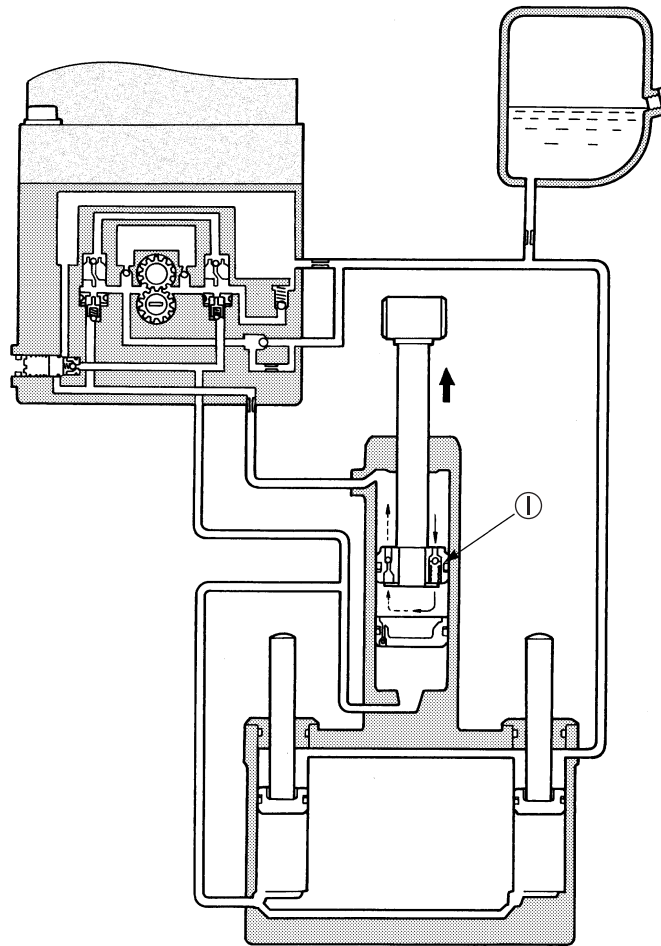
- (1) High ambient temperature will, through thermal expansion, induce a build-up of oil pressure inside the PTT unit.
 - (2) Expansion of the oil and the resulting high pressure will open the relief valve ③, thereby providing unit protection by directing oil back to the reservoir.
- Expanded oil in the tilt cylinder upper chamber will return to reservoir passing through impact relief valve ① ⇒ free piston check valve ② ⇒ thermal relief valve ③.



SHOCK ABSORBER CIRCUIT

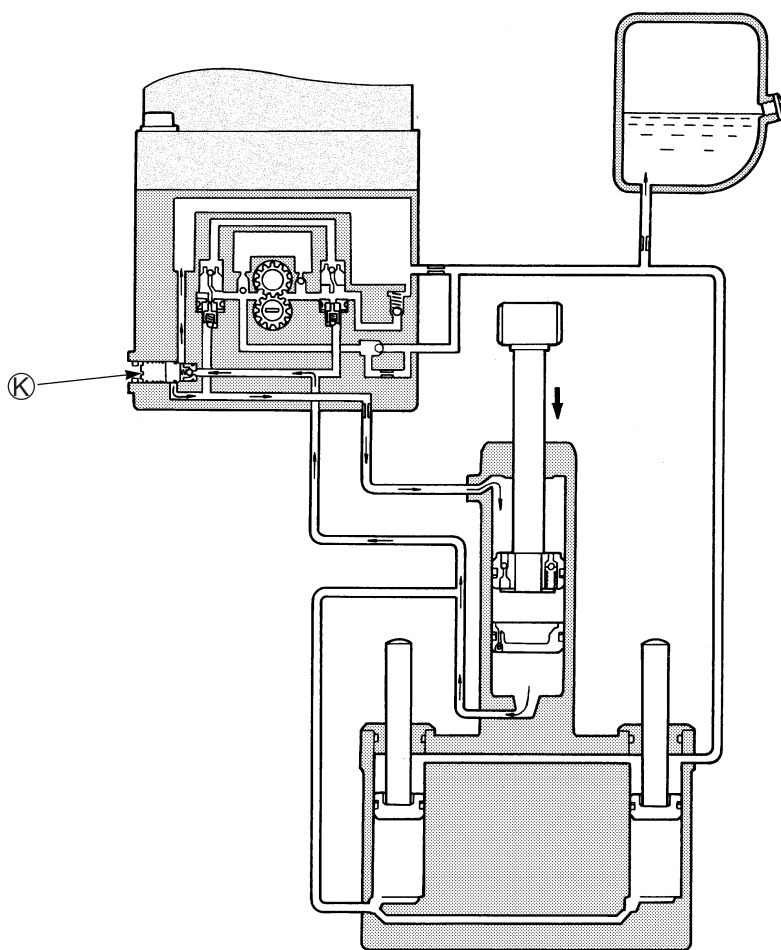
This incorporated safety feature is for protection of the gearcase and prevention of internal PTT pressure build-up in the event of an impact.

- (1) The pressure from a sudden impact will make impact relief valve ① open, allowing oil from the upper area of the tilt cylinder to flow into the area between the tilt rod piston and the free piston. The tilt rod will then extend.
- (2) When the moment of impact has passed, the PTT DOWN switch must be activated to return the engine to within the normal trim range. When the switch is pressed, the oil between the piston and free piston will be directed to the cylinder upper chamber via the return valve below the tilt piston.



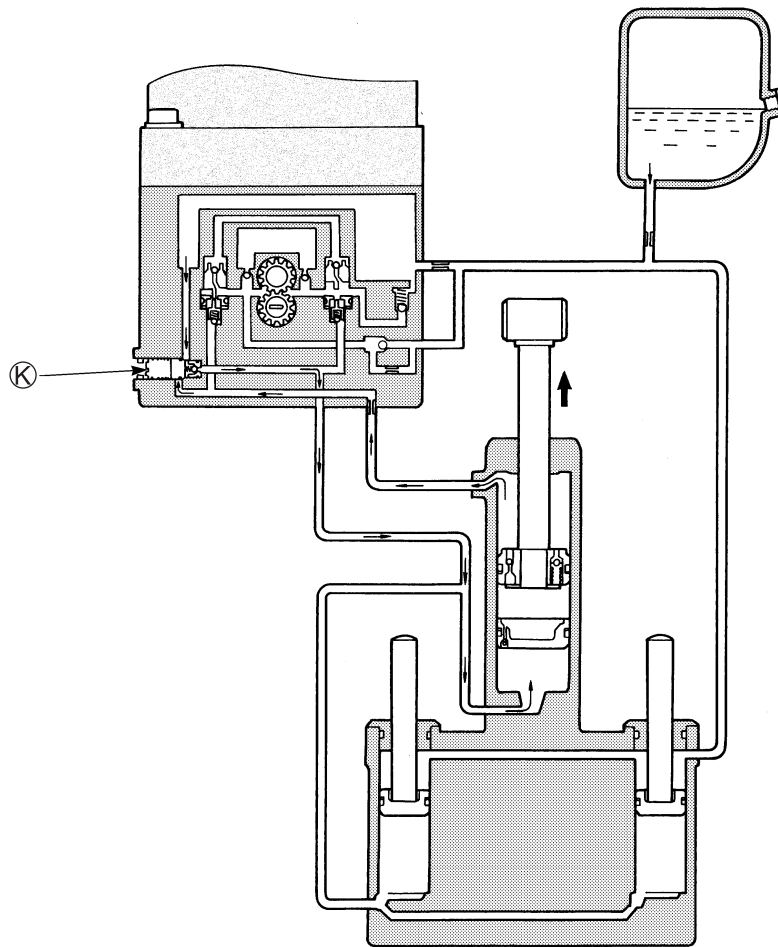
MANUAL RELEASE CIRCUIT (DOWN MODE)

- (1) By opening the manual release valve , the engine can be lowered manually to a running position. Oil underneath the trim and tilt pistons will be directed through this valve into the area above the tilt rod piston.
- (2) The volume of oil flowing from under the trim rod pistons will be larger than the area above the tilt rod piston can accommodate. Excess oil therefore returns through the manual release valve  to the reservoir.



MANUAL RELEASE CIRCUIT (UP MODE)

- (1) With the manual release valve (K) open, the engine can also be raised manually to the fully tilted position.
- (2) Oil from the upper chamber of the tilt cylinder will flow through valve (K) into the lower chamber of the cylinder.
- (3) The upward movement of the piston rod will increase the cylinder area beneath it, thereby allowing oil from the reservoir to flow into this area.



LOWER UNIT

(Normal rotation model)

REMOVAL AND INSTALLATION

Refer to the procedures in DF90/115 service manual.

⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

DISASSEMBLY

Place a drain pan under the oil drain plug.

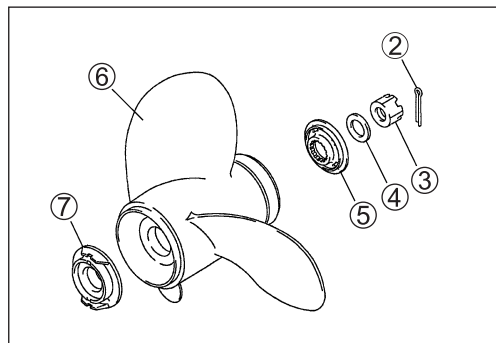
Remove oil drain plug ① first then oil level plug ② and allow gear oil to drain.

Inspect oil for water, contaminants or metal.



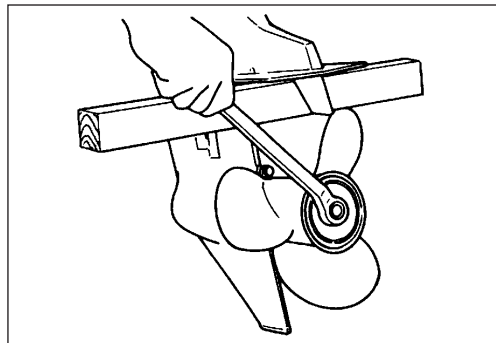
Remove cotter pin ② from propeller nut and remove propeller nut ③.

Remove washer ④, spacer ⑤, propeller ⑥ and stopper ⑦ from the propeller shaft.

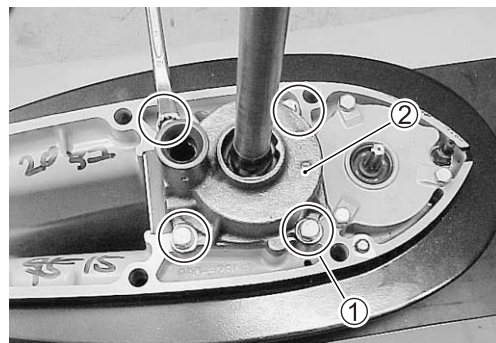


⚠ WARNING

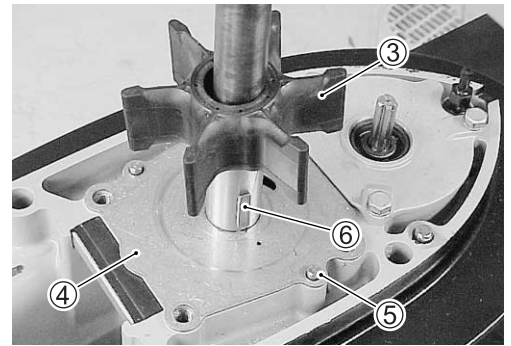
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place.



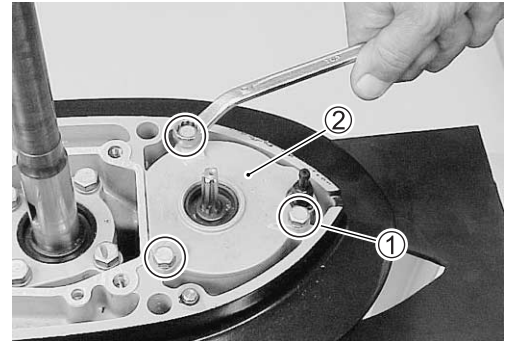
Loosen the four (4) bolts ①, then remove the water pump case ②.



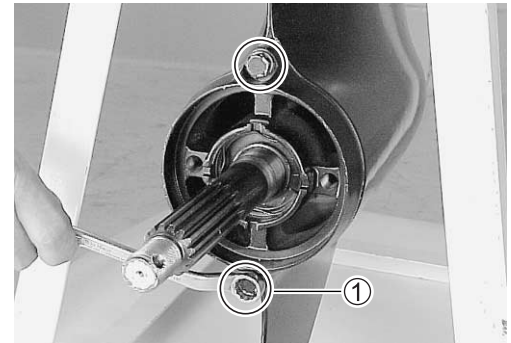
Remove the impeller ③, impeller key ⑥, pump under plate ④ and dowel pins ⑤.
Keep the impeller key ⑥ for reuse and discard the plate gasket.



Remove three (3) bolts ① and shift rod guide housing assembly ②.



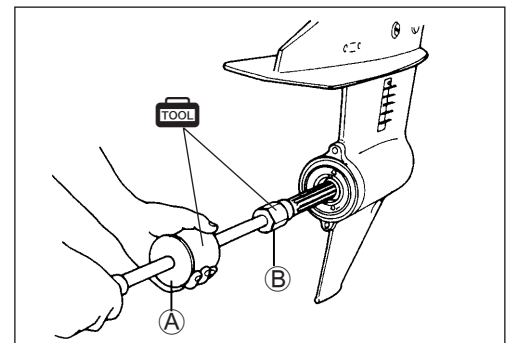
Remove the two (2) bolts ① securing the propeller shaft bearing housing to the gearcase.



Using special tools, draw out the propeller shaft bearing housing.

Remove the propeller shaft and bearing housing assembly.

- TOOL** 09930-30102: (A) Sliding hammer
09930-30161: (B) Propeller shaft remover

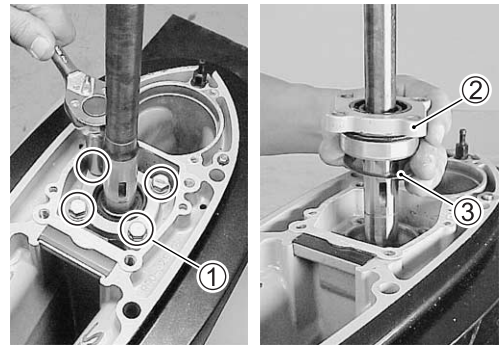


Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.

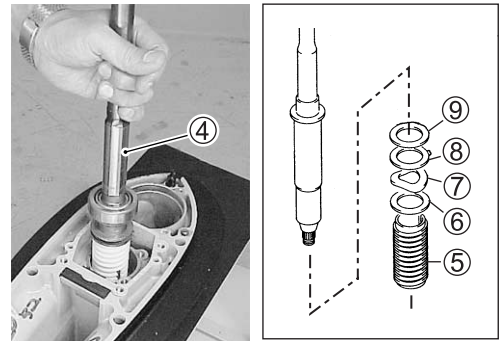
- TOOL** 09921-29410: Driveshaft holder



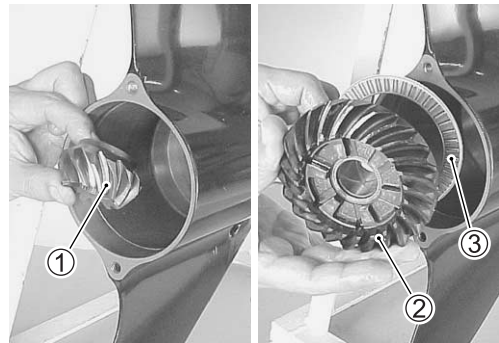
Unscrew the four (4) bolts ① securing driveshaft oil seal housing ②, then remove oil seal housing and pinion shim ③.



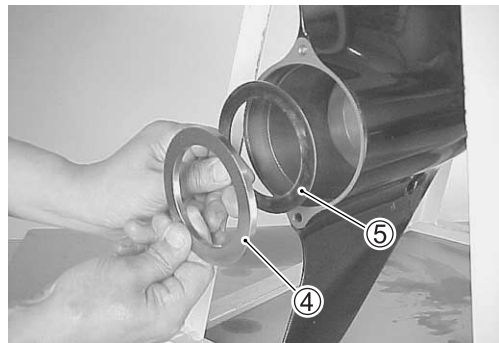
Lift out driveshaft assembly ④.
Remove the driveshaft collar ⑤, washer ⑥, wave washer ⑦, washer (with tab) ⑧ and washer ⑨ from driveshaft.



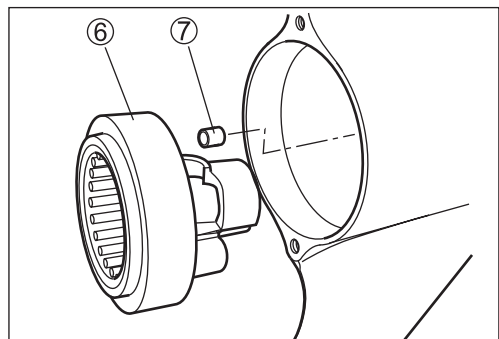
Remove the pinion gear ①.
Remove the forward gear ② and thrust bearing ③.



Remove the bearing thrust washer ④ and back-up shim ⑤.



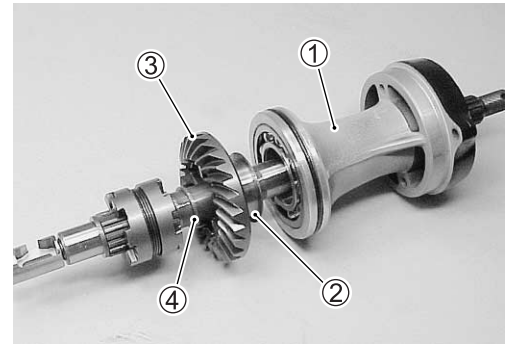
Remove the forward gear bearing housing ⑥.
Account for dowel pin ⑦.



Disassembly of propeller shaft components

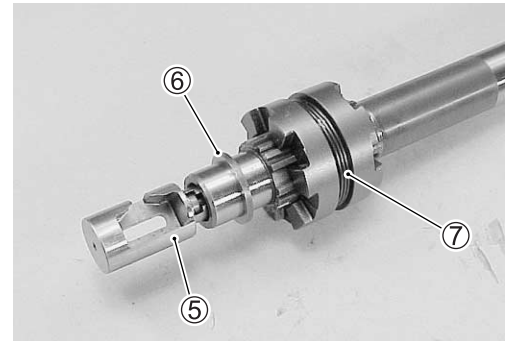
Slide propeller shaft away from reverse gear ③ and bearing housing assembly ①.

Account for the reverse gear back-up shim ② and reverse gear thrust washer ④.



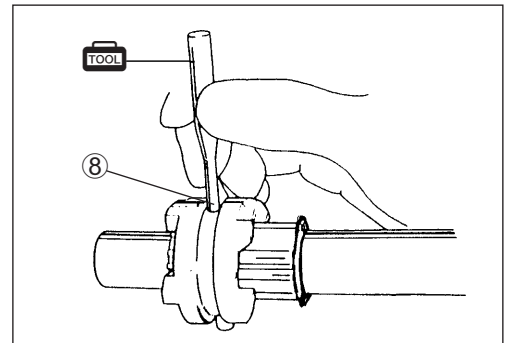
To disassemble propeller shaft components, refer to the following:

- (a) Remove horizontal slider ⑤ and forward gear thrust washer ⑥.
- (b) Remove the spring ⑦ from the clutch dog shifter.

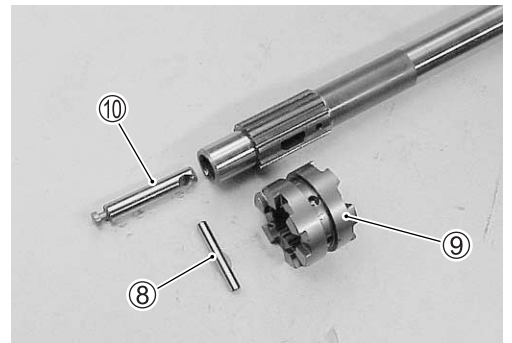


- (c) Use special tool to push the dog pin ⑧ out of the clutch dog shifter.

 **09922-89810: Shift pin remover**

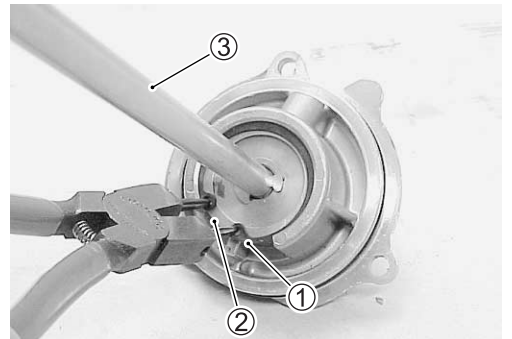


- (d) Remove the clutch dog shifter ⑨ and connector pin ⑩ from propeller shaft.



Disassembly of shift rod components

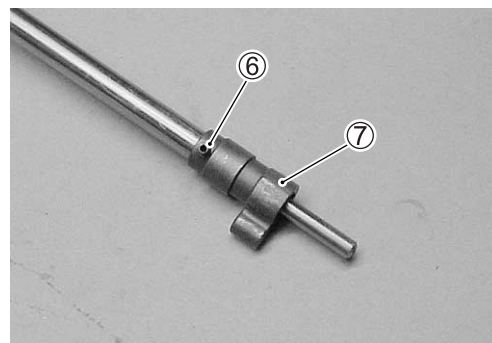
- (a) Remove the circlip ① and washer ②.
- (b) Slide the shift rod ③ out of the shift rod guide housing.



(c) Remove the detent ball ④ and spring ⑤.

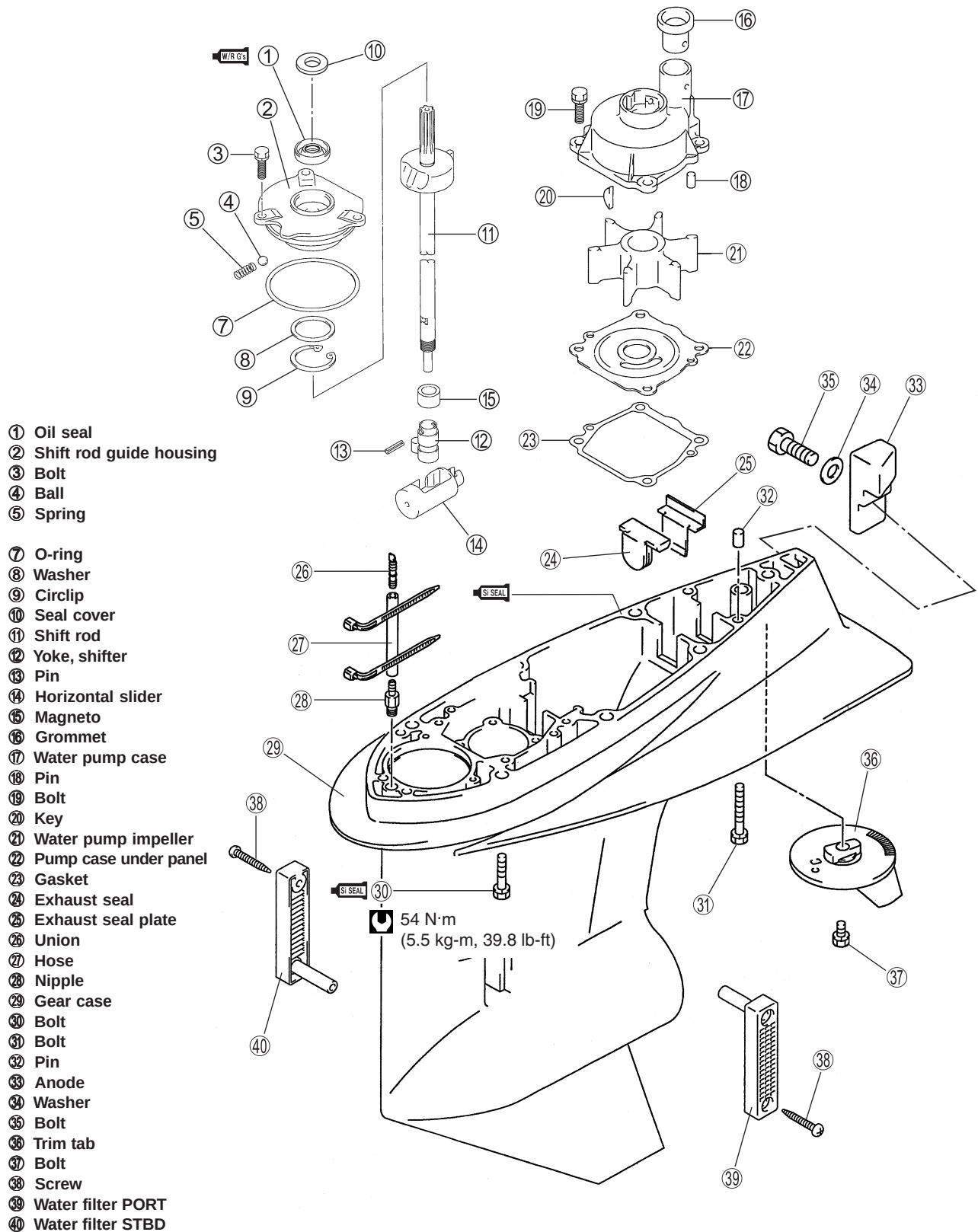


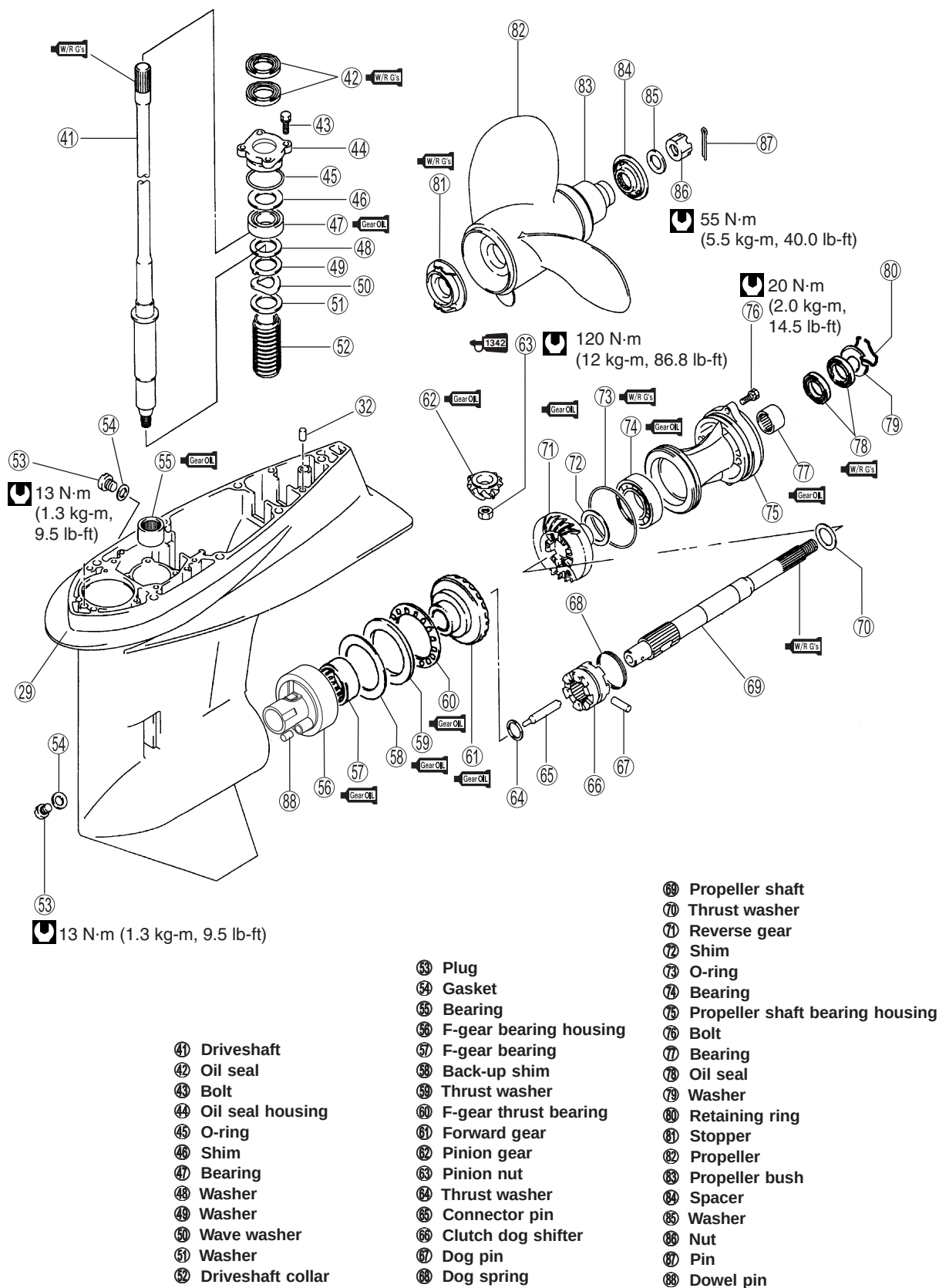
(d) Remove the pin ⑥ and shifter yoke ⑦.



ASSEMBLY

Assembly is reverse of disassembly with special attention to following steps.



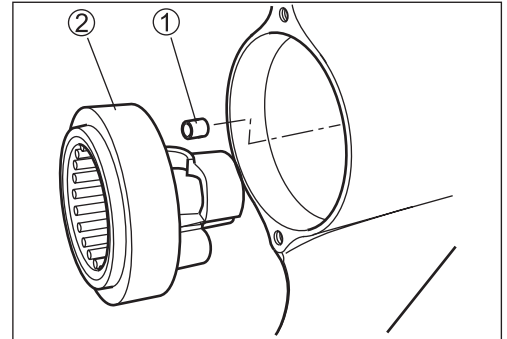


CAUTION

- Make sure that all parts used in assembly are clean and lubricated.
- After assembly, check parts for tightness and smoothness of operation.
- Before final assembly, be absolutely certain that all gear contact, shim adjustments and tolerances are correct.
Failure to correctly adjust these areas will result in lower unit damage.
(See the “GEARS SHIMMING AND ADJUSTMENT” section on page 61.)

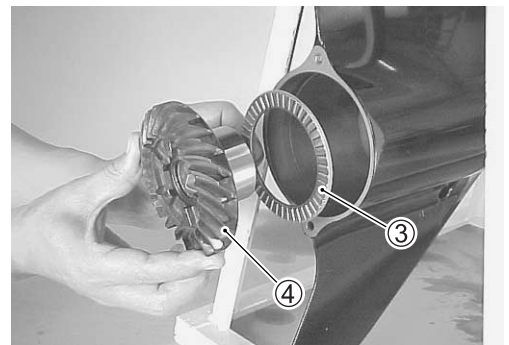
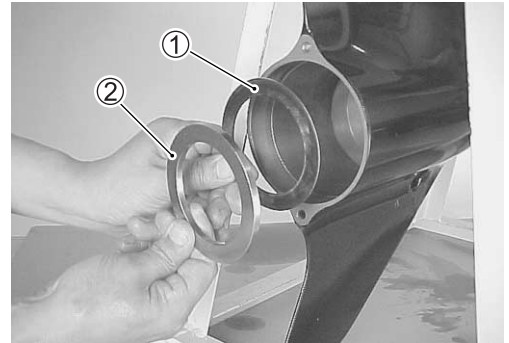
FORWARD GEAR BEARING HOUSING

- Install dowel pin ① and forward gear bearing housing ②.

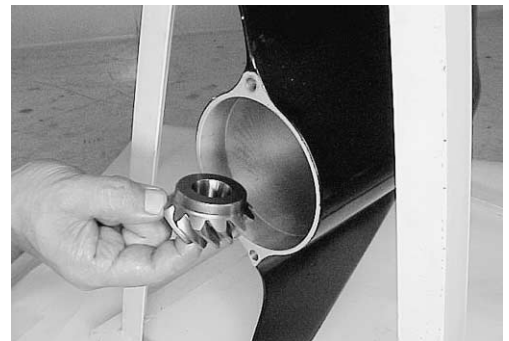
**FORWARD GEAR**

Place the forward gear back-up shim ①, thrust washer ②, forward gear thrust bearing ③ in position, then install forward gear ④.

 99000-22540: Suzuki Outboard Motor Gear Oil

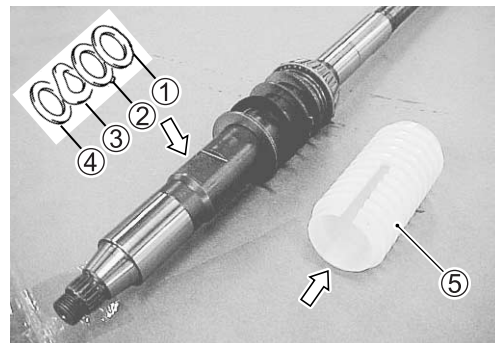
**PINION GEAR**

Place pinion gear in gearcase.



DRIVESHAFT

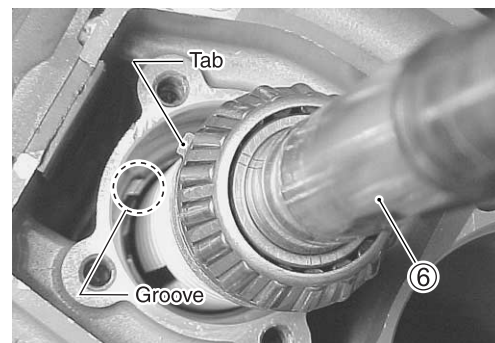
- Assemble the washer ①, washer (with the tab) ②, wave washer ③, washer ④ and driveshaft collar ⑤ to the driveshaft.
- After installing driveshaft collar, fit the convex part of the collar in the concave part of the driveshaft by turning collar.



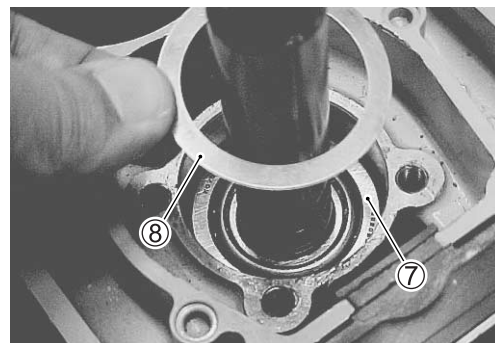
- Lower the driveshaft assembly ⑥ down into the gearcase until the bottom of shaft protrudes through center of pinion.

NOTE:

The washer tab must be located into groove on the gearcase.



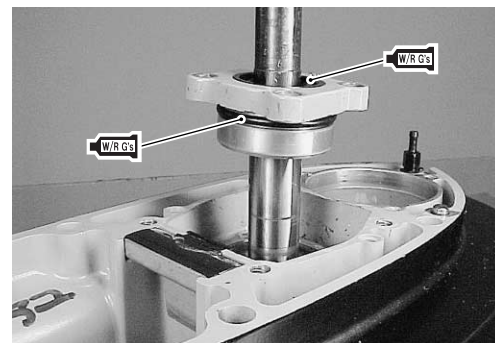
- Install bearing outer race ⑦ and pinion shim ⑧ to driveshaft.

**DRIVESHAFT OIL SEAL HOUSING**

Apply Water Resistant Grease to the driveshaft oil seal.

 **99000-25160: Water Resistant Grease**

Apply Water Resistant Grease to O-ring, then install the O-ring into the groove on the driveshaft oil seal housing.



Install driveshaft oil seal housing on gearcase, then tighten four (4) bolts securely.



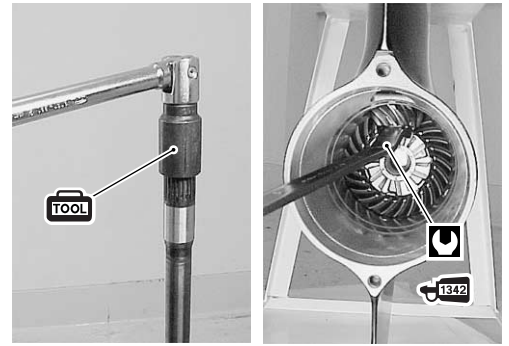
PINION NUT

Apply Thread Lock 1342 to the threads of the pinion nut before threading it onto the driveshaft.
Tighten nut to the specified torque.

 **Pinion nut: 120 N·m (12 kg·m, 86.8 lb·ft)**

 **99000-32050: Thread Lock 1342**

 **09921-29410: Driveshaft holder**

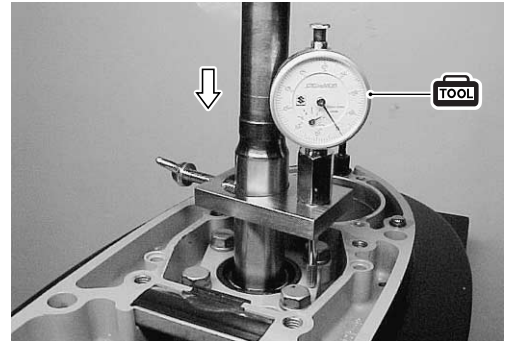


CHECKING DRIVESHAFT THRUST PLAY

Before installing reverse gear, driveshaft thrust play should be checked.

(See the "GEARS-SHIMMING AND ADJUSTMENT/CHECKING DRIVESHAFT THRUST PLAY" section on page 62.)

 **09951-09511: Gear adjusting gauge**

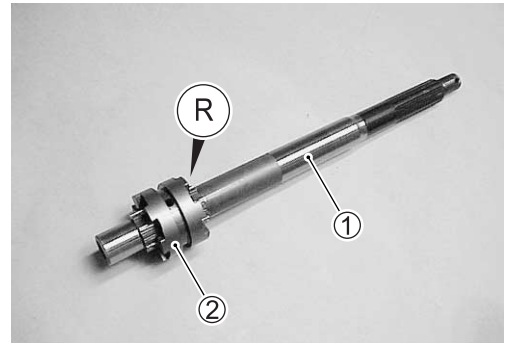


PROPELLER SHAFT

Slide the clutch dog shifter ② onto the propeller shaft ①.

NOTE:

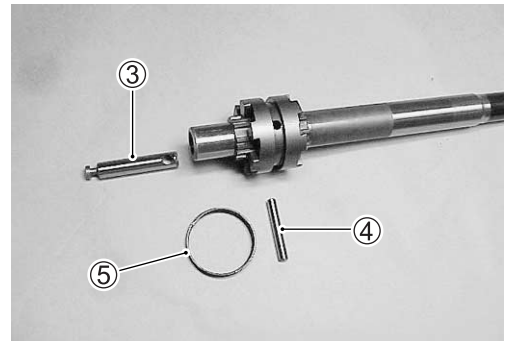
For correct installation the side of the clutch dog shifter which must face towards reverse gear is marked with the letter "R".



Insert the connector pin ③ into propeller shaft.

Align the holes in the shifter dog and connector pin and then slide the dog pin ④ through both dog and connector pin.

Install the dog pin retaining spring ⑤, ensuring that it fits snugly into the groove on the dog shifter.

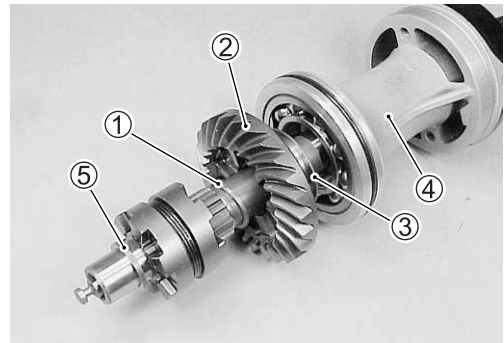


PROPELLER SHAFT / BEARING HOUSING

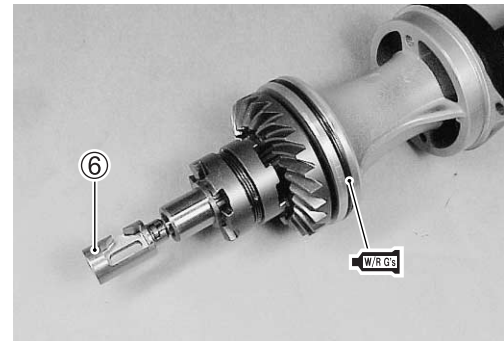
Assemble the propeller shaft in the following sequence: forward thrust washer ⑤, reverse thrust washer ①, reverse gear ②, reverse gear back-up shim ③ and propeller shaft housing ④.

 **99000-25160: Water Resistant Grease**

 **99000-22540: Suzuki Outboard Motor Gear Oil**

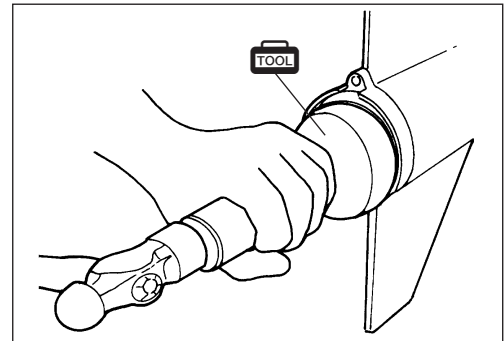


Assemble horizontal slider ⑥ to connector pin.



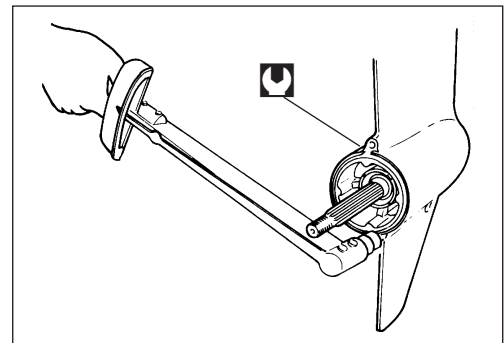
Using special tools, install the propeller shaft and housing assembly in the gear case.

 **09922-59410: Propeller shaft housing installer**
09922-59420: Housing Installer Handle



When the housing is fully seated, tighten both retaining bolts to the specified torque.

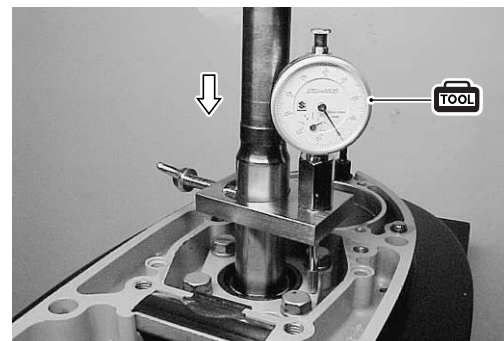
 **Bearing housing bolt: 20 N·m (2.0 kg·m, 14.5 lb·ft)**

**RECHECKING DRIVESHAFT THRUST PLAY**

Recheck the driveshaft thrust play.

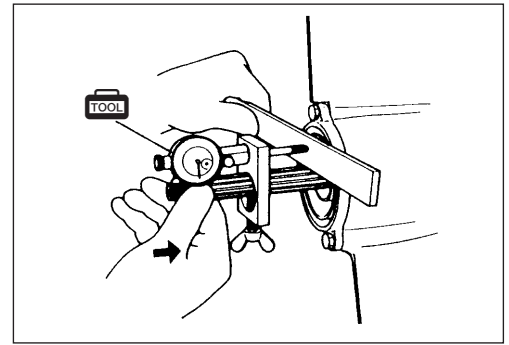
This should not be less than previously checked. If less, reduce the number/thickness of reverse gear back-up shims.

 **09951-09511: Gear adjusting gauge**

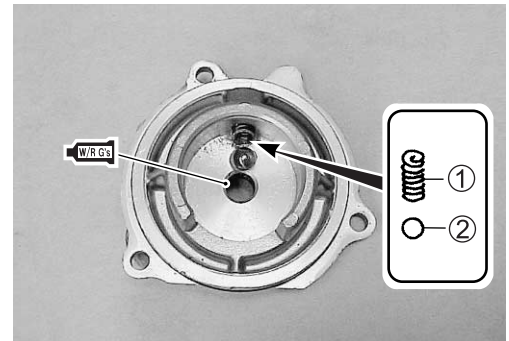


CHECKING PROPELLER SHAFT THRUST PLAY

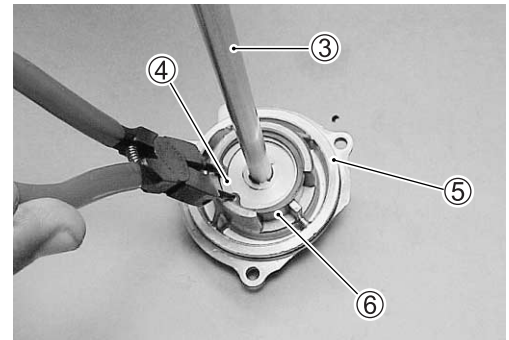
See the "GEARS - SHIMMING AND ADJUSTMENT/CHECKING PROPELLER SHAFT THRUST PLAY" section on page 65.

**SHIFT ROD GUIDE HOUSING**

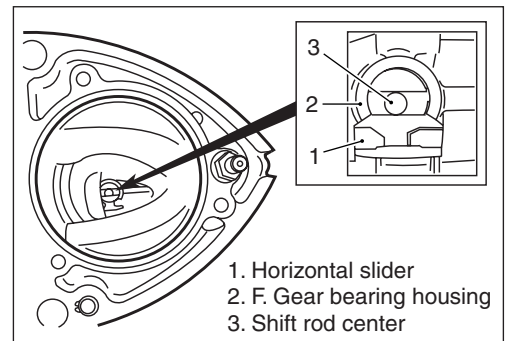
- Install the spring ① and detent ball ② into shift rod guide housing.
- Apply Water Resistant Grease to the shift rod oil seal.



- Install shift rod ③ and washer ④ into the shift rod guide housing ⑤, then secure it with the snap ring ⑥.

**NOTE:**

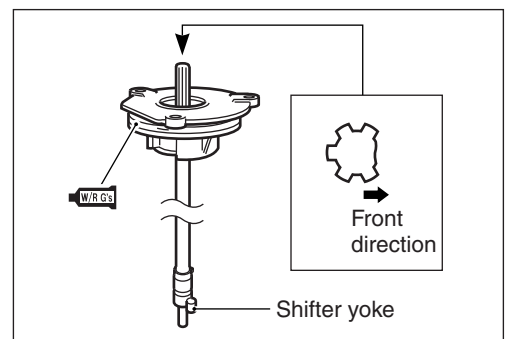
Before install the shift unit (Shift rod guide housing assembly), be sure to put the horizontal slider in the neutral position.



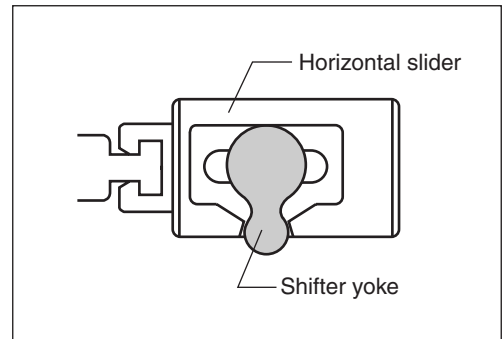
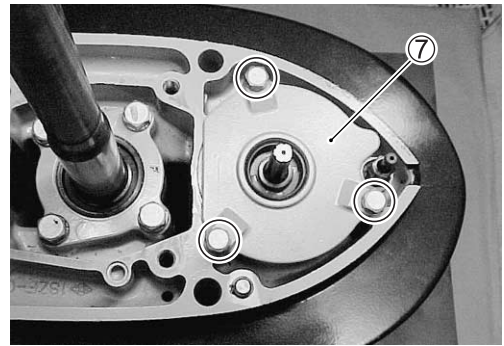
- Apply Water Resistant Grease to the shift rod guide housing O-ring.

NOTE:

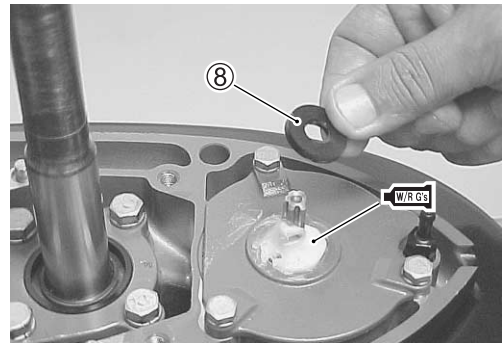
Before install the shift unit (Shift rod guide housing assembly), bring shifter yoke to the neutral position by turning shift rod right or left.



- Install the shift rod guide housing assembly ⑦ by aligning the shifter yoke with the groove in the horizontal slider, then tighten three (3) housing bolts securely.
- Shift the shift rod from Neutral through Forward and Reverse to check proper gear engagement.



- Apply enough Water Resistant Grease on oil seal before putting seal cover ⑧ so that there is no space between them.



LEAKAGE CHECK

Check for leakage of oil seal and O-ring when applying specified pressure inside of the gearcase.

 **09950-69511: Oil leakage tester**
: Air pump

Procedure

1. Install the test tool into the oil level hole.
2. Connect the air pump to the tester.
3. Rotate driveshaft and propeller shaft clockwise several times and then apply specified pressure for the test.

NOTE:

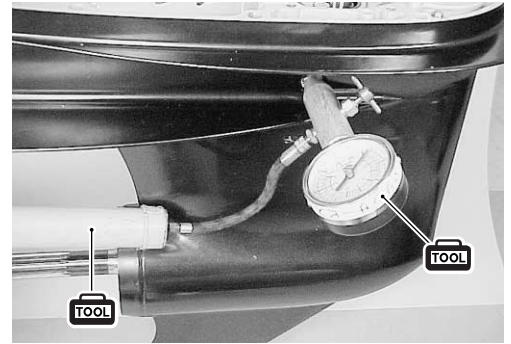
Apply low initial pressure of 20 – 40 kPa, (0.2 – 0.4 kg/cm², 2.8 – 5.7 psi) first, then apply specified pressure.

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

CAUTION

Do not exceed pressure of 110 kPa (1.1kg/cm², 15.6 psi) or damage to oil seals will result.

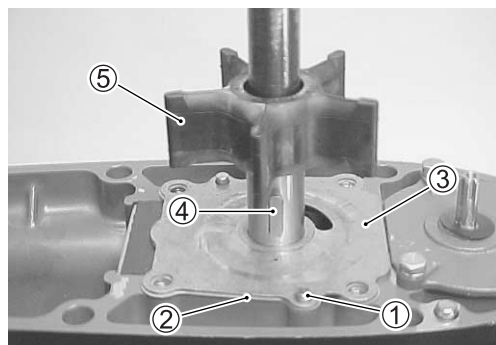
4. Once stabilized, pressure should remain steady for at least 5 min.
If pressure does not fall, sealing performance is correct.



WATER PUMP (Impeller & Case)

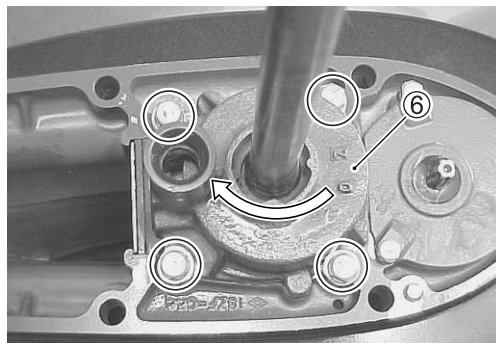
Place the dowel pins ①, under panel gasket ② and under panel ③ into position.

Insert the key ④ in the driveshaft and slide the impeller ⑤ onto driveshaft, ensuring that key and keyway are aligned.



Install the pump case ⑥ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.

Securely tighten the four (4) pump case bolts to the specified torque.



 **Pump case bolt: 20 N·m (2.0 kg-m, 14.5 lb-ft)**

PROPELLER INSTALLATION

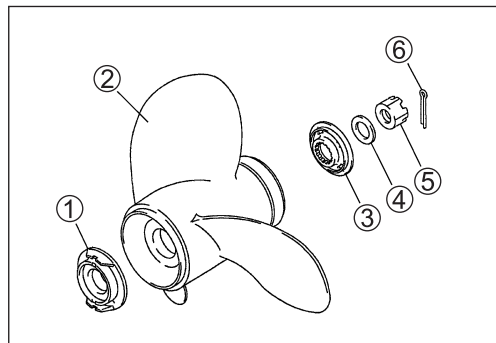
Install propeller stopper ① onto propeller shaft, then slide on the propeller ②.

Fit spacer ③, washer ④ and nut ⑤, then tighten nut to specified torque.

Push cotter pin ⑥ through nut and shaft, then bend to secure.

 **99000-25160: Water Resistant Grease**

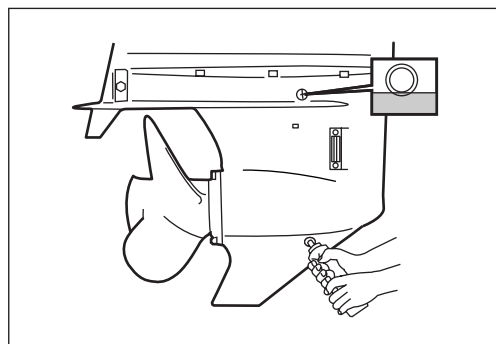
 **Propeller nut: 55 N·m (5.5 kg-m, 40.0 lb-ft)**

**GEAR OIL**

Fill the gearcase with specified gear oil for initial testing and recheck the level after 10 minutes.

Top up if necessary.

 **99000-22540: Suzuki Outboard Motor Gear Oil**

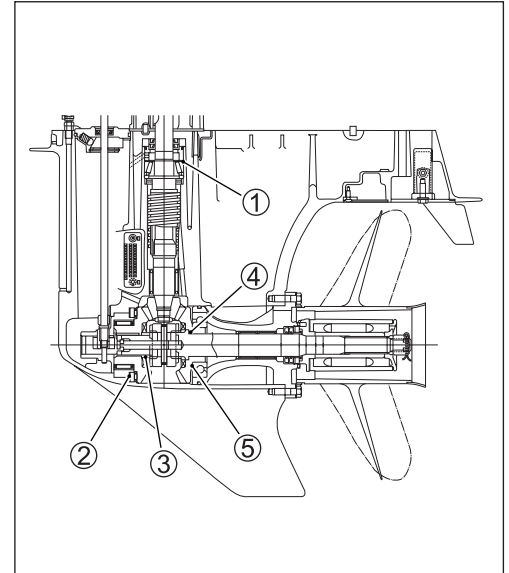


LOWER UNIT GEARS-SHIMMING AND ADJUSTMENT (Normal rotation model)

If lower unit has been rebuilt or has had components replaced, shimming for correct gear contact and backlash will have to be adjusted to ensure smooth, reliable operation of gears.

Shim/Washer & Mounting position

	Numerical index/item	Available thickness (mm)	Design specification Thickness (mm)
①	Pinion gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15	1.0
②	Forward gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00	1.1
③	Forward gear thrust washer	9.0	9.0
④	Reverse gear thrust washer	1.5, 1.7, 1.9, 2.1, 2.3, 2.4, 2.6, 2.7, 2.8	1.5
⑤	Reverse gear back up shim	1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6	1.5



PINION GEAR BACK-UP SHIM ADJUSTMENT

- (1) Position the shimming gauge ① horizontally in a vise and tighten vise securely.

TOOL 09951-09010: Shimming gauge

- (2) Assemble the bearing outer race ①, back-up shim ② and driveshaft oil seal housing ③ to the driveshaft.

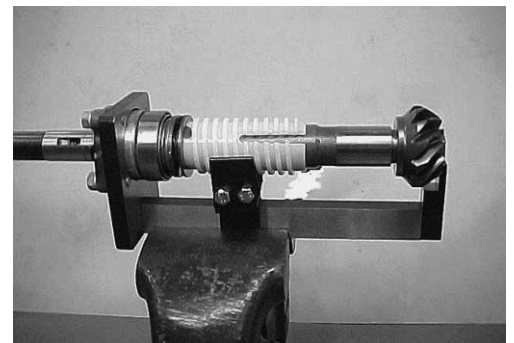
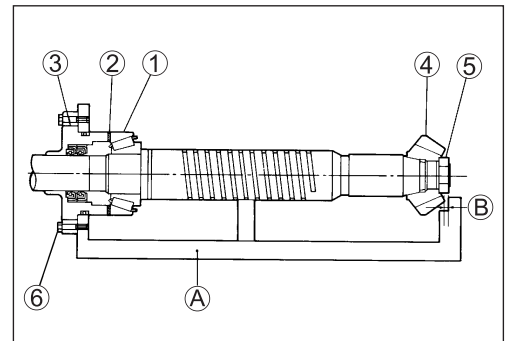
NOTE:

Use a thinner pinion back-up shim ② than the standard shim so that a clearance ⑥ exists.

- (3) Insert the driveshaft through the shimming gauge ① opening and then install pinion gear ④ and nut ⑤ to the driveshaft, tighten pinion nut.

Pinion nut: 120 N·m (12 kg-m, 86.8 lb-ft)

- (4) Install oil seal housing to shimming gauge with bolts ⑥.
(5) Depress and hold driveshaft so that driveshaft bearing is firmly seated in bearing outer race.



- (6) Hold driveshaft against oil seal housing ③ while measuring clearance ⑥ between gauge and flat edge of pinion gear ④ with thickness gauge, measured clearance plus shim ② is the total shim thickness to be used in gear housing reassembly for correct pinion gear position.

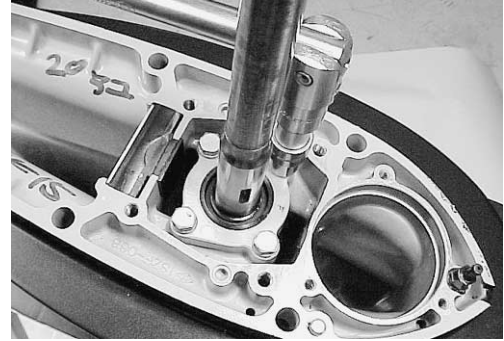
FORWARD GEAR BACK-UP SHIM ADJUSTMENT

Follow the procedure below to adjust forward gear/pinion gear.

Step to prior to adjustment

1. Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. (See page 53 to 55)
Do not install reverse gear at this time.
2. Tighten pinion nut to specified torque.

 **Pinion nut: 120 N·m (12 kg·m, 86.8 lb·ft)**



Checking driveshaft thrust play

1. Affix gear adjusting gauge to drive shaft.

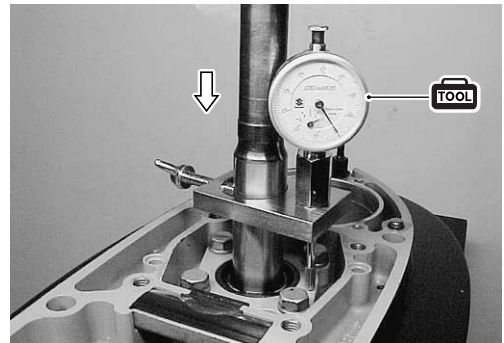
 **09951-09511: Gear adjusting gauge**

2. To check the driveshaft thrust play, push the forward gear inward and fix it by hand.
Slowly push driveshaft downward, then read the maximum play.

Driveshaft thrust play:

Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

- If thrust play is larger than the specified, thickness of forward gear back-up shim must be increased.
- If thrust play is smaller, forward gear back-up shim thickness must be decreased.



Checking and adjusting tooth contact pattern (Pinion and Forward gear)

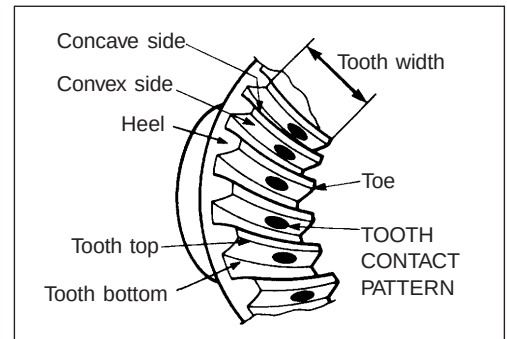
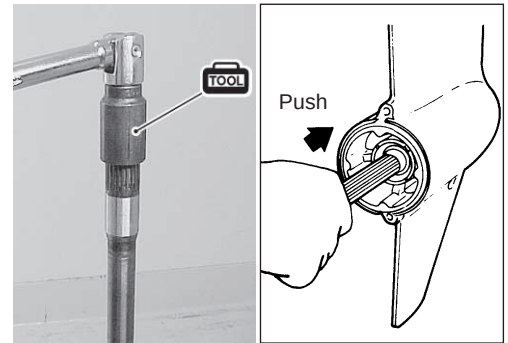
Check tooth contact pattern by using the following procedure:

1. To assess tooth contact, apply a light coat of Prussian Blue on the convex surface of forward gear.

2. Install propeller shaft and housing assembly (minus reverse gear and internal components).
3. Push propeller shaft inward and hold in position.
4. Using driveshaft holder tool, rotate the driveshaft 5 – 6 times.

 09921-29410: Driveshaft holder

5. Carefully pull out propeller shaft and housing to check tooth contact pattern.

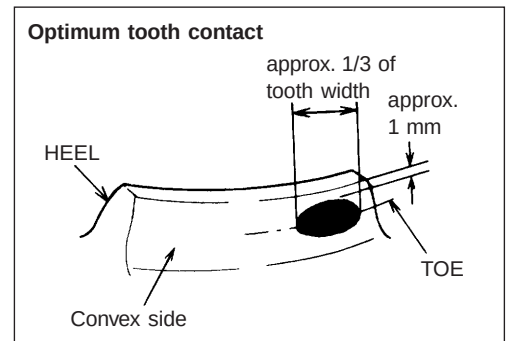


Optimum tooth contact

The optimum tooth contact is shown at right.
A shim adjustment may be necessary to obtain this contact pattern.

CAUTION

The driveshaft thrust play should be checked when increasing or decreasing the thickness of the shim to adjust tooth contact.



Example (1)

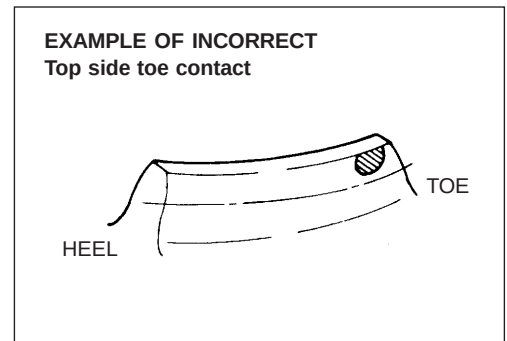
Incorrect topside toe contact:

Correction measures:

- Decrease thickness of forward gear shim.
- (• Slightly increase pinion gear shim thickness.)

CAUTION

Do not set tooth contact in this position (top side toe contact). Damage and chipping of forward and pinion gear may result.



Example (2)

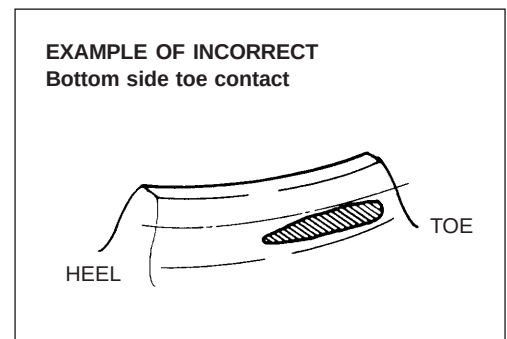
Incorrect bottom side toe contact:

Correction measures:

- Increase thickness of forward gear shim.
- (• Slightly decrease pinion gear shim thickness.)

CAUTION

Do not set tooth contact in this position (bottom side toe contact). Chipping of pinion gear may result.



CHECKING DRIVESHAFT THRUST PLAY

After obtaining optimum tooth contact, driveshaft thrust play should be measured.

1. Affix gear adjusting gauge to driveshaft.

 **09951-09511: Gear adjusting gauge**

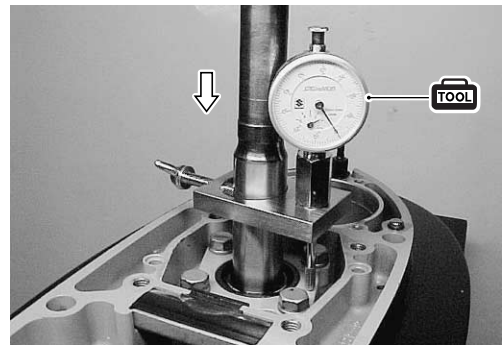
2. Slowly push driveshaft downward.
Read the maximum play. Designate this amount of play as (A).

Driveshaft thrust play:

Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

NOTE:

Driveshaft thrust play (A) must be known to adjust reverse gear shim.

**RECHECKING DRIVESHAFT THRUST PLAY****(Reverse gear back-up shim adjustment)**

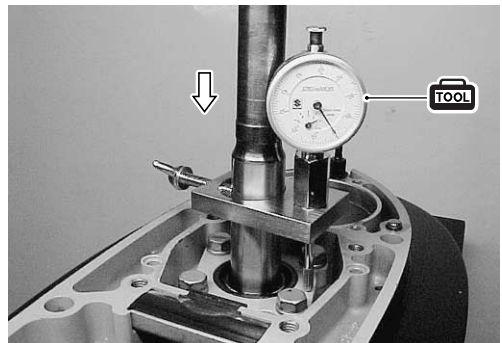
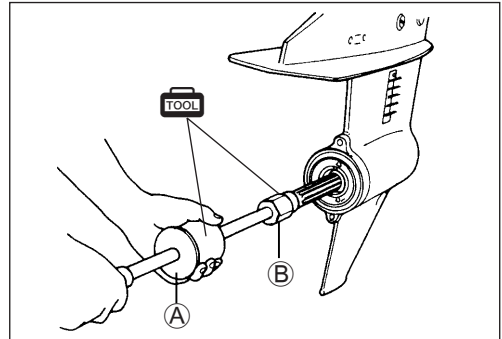
1. After adjusting forward gear tooth contact pattern, correctly assemble propeller shaft, housing assembly, reverse gear and related components (See page 55 to 56).
2. Screw sliding hammer assembly onto propeller shaft and strike a few gentle outward taps.

 **09930-30161: Propeller shaft remover – (B)**
09930-30102: Sliding hammer – (A)

3. Affix gear adjusting gauge to driveshaft.

 **09951-09511: Gear adjusting gauge**

4. Push shaft downward and read maximum play. Designate this measurement as play (B).
5. Compare play (B) to play (A) (page 64).
6. Reverse gear back-up shim adjustment is correct if (B) is equal to (A).
 - If (B) is less than (A), reduce reverse gear back-up shim thickness.



CHECKING PROPELLER SHAFT THRUST PLAY

After adjusting all gear positions, measure the propeller shaft thrust play. If not within the following specification, a shim adjustment is required.

**Propeller shaft thrust play: 0.2 – 0.4 mm
(0.008 – 0.016 in.)**

NOTE:

Maintain the forward gear thrust washer at standard thickness (9.0 mm) and adjust only the reverse gear thrust washer with shim.

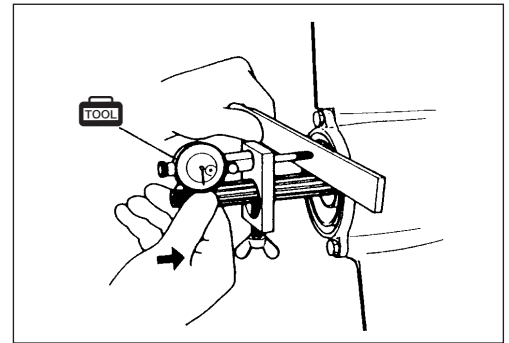
Measurement step:

1. Assemble gear adjusting gauge to the propeller shaft.



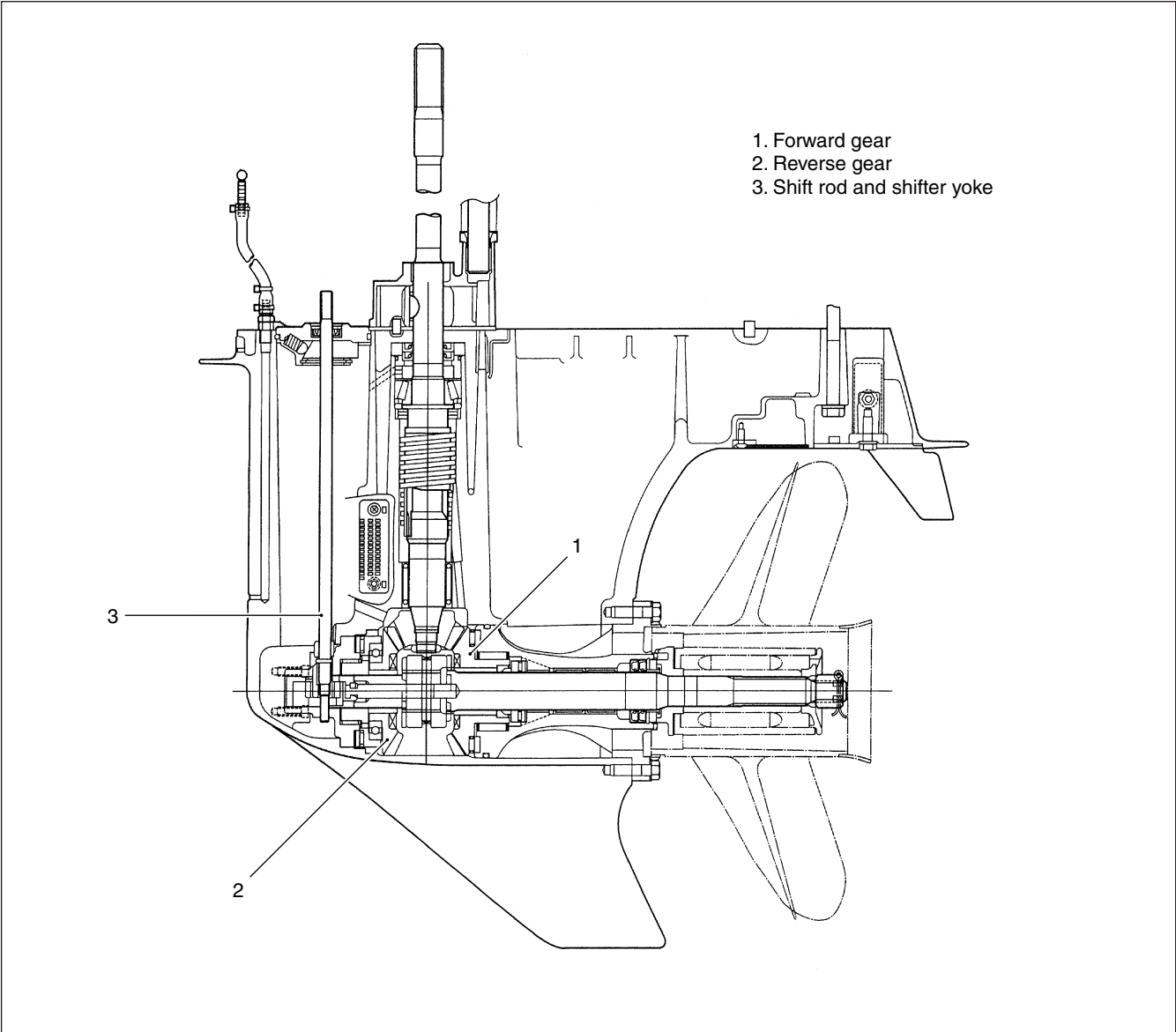
09951-09511: Gear adjusting gauge

2. Push propeller shaft inward.
3. Hold shaft in and set dial gauge pointer to zero.
4. Slowly pull shaft outward and read the maximum thrust play on the dial.
 - If measurement is more than specification, increase reverse gear thrust washer thickness.
 - If measurement is less than specification, reduce reverse gear thrust washer thickness.



COUNTER ROTATION LOWER UNIT (DF140Z model)

The counter rotation unit reverse gear is installed in the position where, in the normal rotation unit, the forward gear is located. Likewise, the counter rotation unit forward gear takes the position of normal rotation unit reverse gear. This change of gear arrangement, however, does not affect the remote control lever operation because the shift rod and shifter yoke have been also modified to operate in the opposite direction.



PROPELLER SELECTION FOR COUNTER ROTATION

For counter-rotation model, newly designed stainless steel propellers are available as follows. Suzuki highly recommend to use the genuine Suzuki counter-rotation propeller for the counter rotation model. In case of twin installation, always use on both engines, the same size normal rotation and counter-rotation propellers.

Blade × Diam. (in.) × Pitch (in.)				
3	×	14	×	18
3	×	14	×	20
3	×	14	×	22
3	×	14	×	24

REMOVAL AND INSTALLATION

Refer to the procedures in DF90/115 service manual.

⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

DISASSEMBLY

Place a drain pan under the oil drain plug.

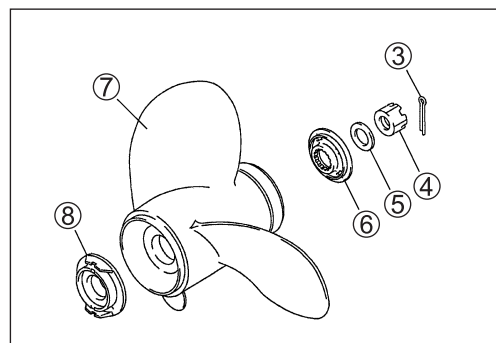
Remove oil drain plug ① first then oil level plug ② and allow gear oil to drain.

Inspect oil for water, contaminates or metal.



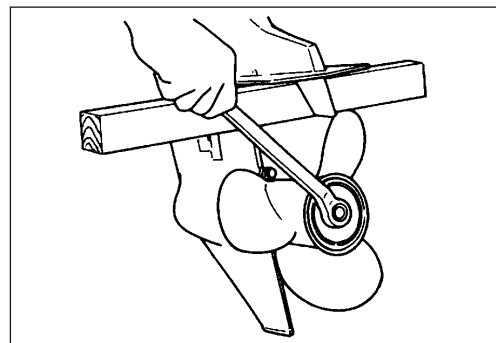
Remove cotter pin ③ from propeller nut and remove propeller nut ④.

Remove washer ⑤, spacer ⑥, propeller ⑦ and stopper ⑧ from the propeller shaft.

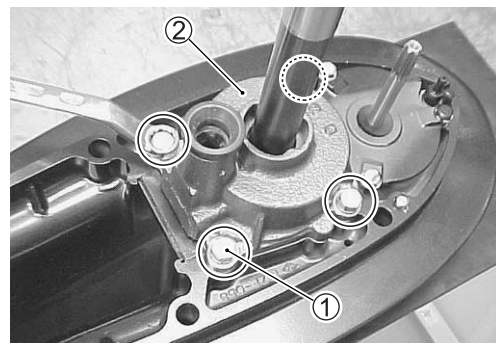


⚠ WARNING

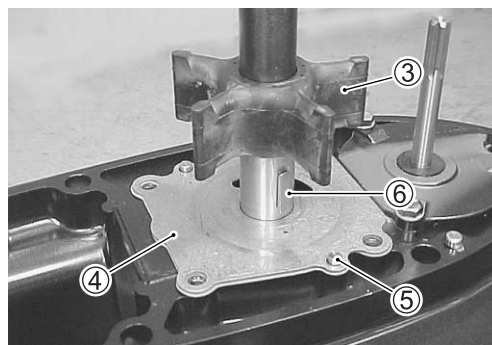
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place.



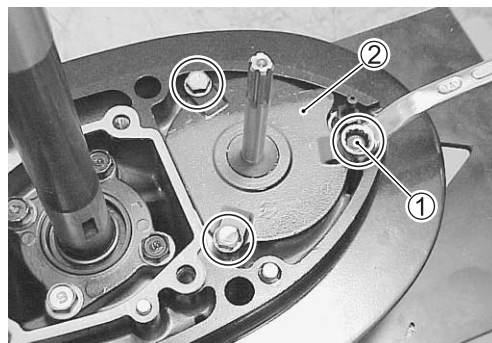
Loosen the four (4) bolts ①, then remove the water pump case ②.



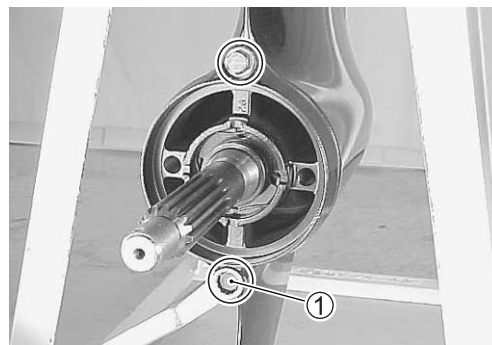
Remove the impeller ③, impeller key ⑥, pump under plate ④ and dowel pins ⑤.
Keep the impeller key ⑥ for reuse and discard the plate gasket.



Remove three (3) bolts ① and shift rod guide housing assembly ②.



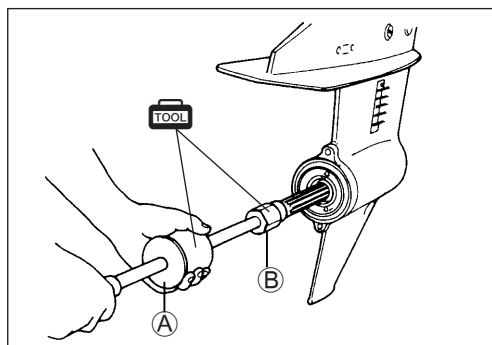
Remove the two (2) bolts ① securing the propeller shaft bearing housing to the gearcase.



Using special tools, draw out the propeller shaft bearing housing.

Remove the propeller shaft and bearing housing assembly.

- TOOL** 09930-30102: (A) Sliding hammer
09930-30161: (B) Propeller shaft remover

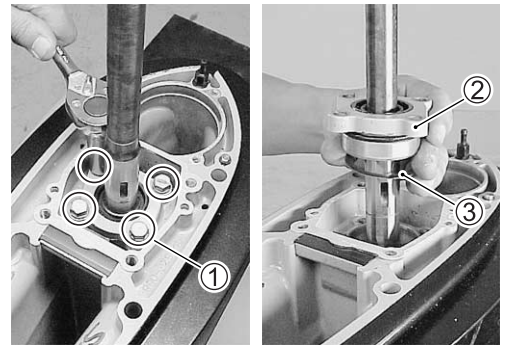


Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.

- TOOL** 09921-29410: Driveshaft holder

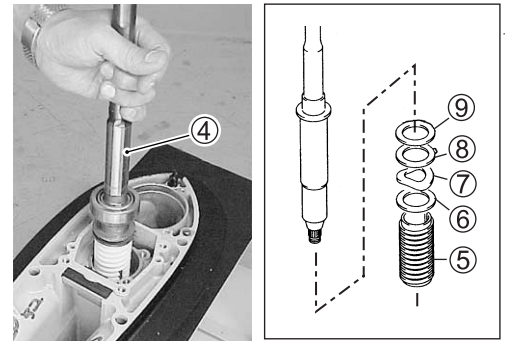


Unscrew the four (4) bolts ① securing driveshaft oil seal housing ②, then remove oil seal housing and pinion shim ③.



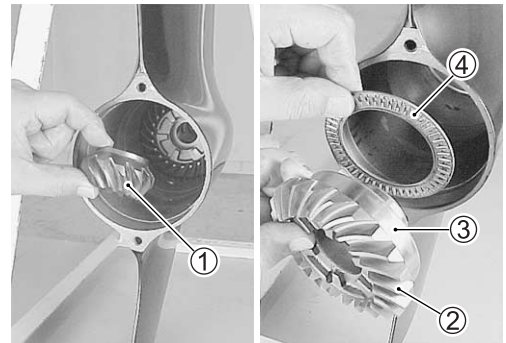
Lift out driveshaft assembly ④.

Remove the driveshaft collar ⑤, washer ⑥, wave washer ⑦, washer (with tab) ⑧ and washer ⑨ from driveshaft.

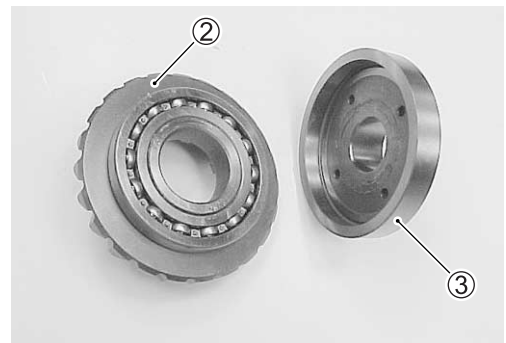


Remove the pinion gear ①.

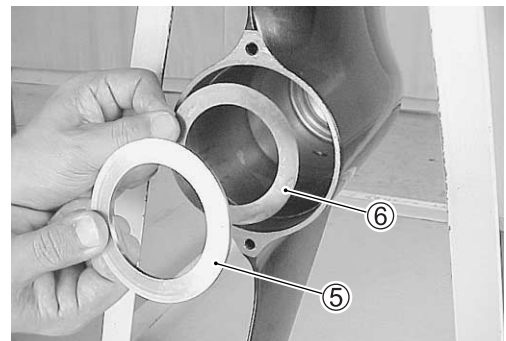
Remove reverse gear ② (with reverse gear retainer ③) and thrust bearing ④.



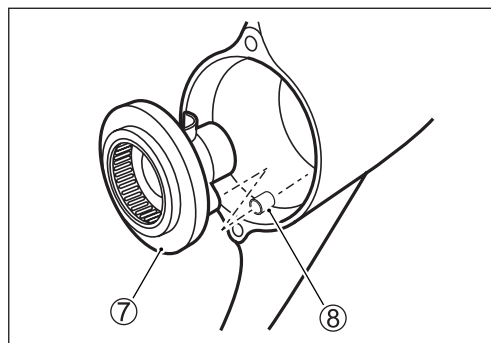
Remove the reverse gear ② from reverse gear retainer ③.



Remove the bearing thrust washer ⑤ and back-up shim ⑥.

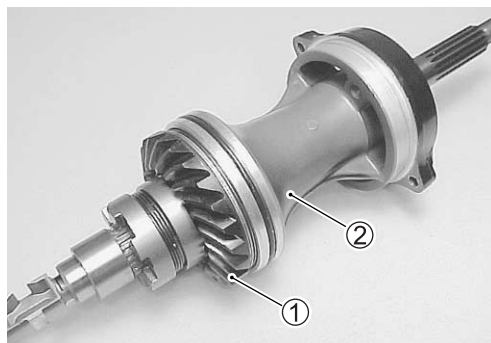


Remove the reverse gear bearing housing ⑦ and dowel pin ⑧.

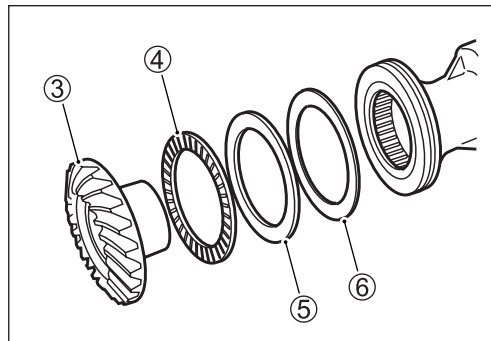


Disassembly of propeller shaft components

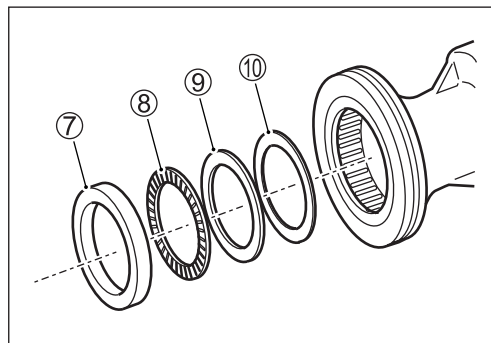
Slide propeller shaft away from forward gear ① and bearing housing assembly ②.



Remove the forward gear ③, forward gear thrust bearing ④, forward gear thrust washer ⑤, forward gear back-up shim ⑥.

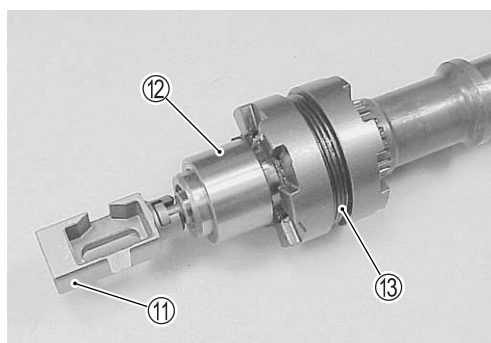


Remove the propeller shaft thrust washer ⑦, propeller shaft thrust bearing ⑧, bearing washer ⑨ and shim ⑩ from propeller shaft bearing housing.



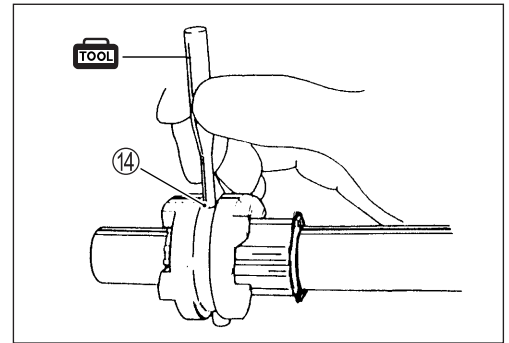
To disassemble propeller shaft components, refer to the following:

- (a) Remove horizontal slider ⑪ and spacer ⑫.
- (b) Remove the spring ⑬ from the clutch dog shifter.

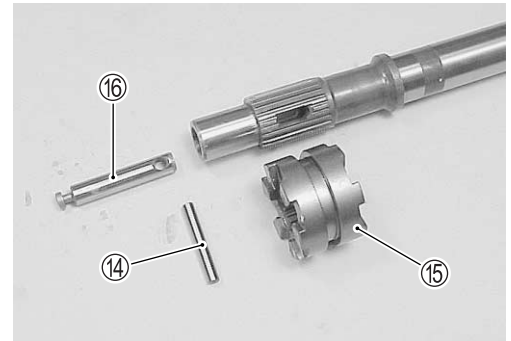


- (c) Use special tool to push the dog pin ⑭ out of the clutch dog shifter.

 09922-89810: Shift pin remover

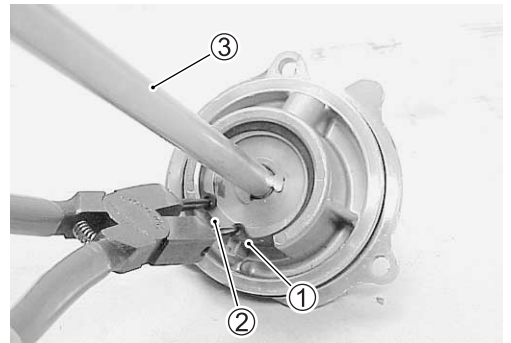


- (d) Remove the clutch dog shifter ⑮ and connector pin ⑯ from propeller shaft.

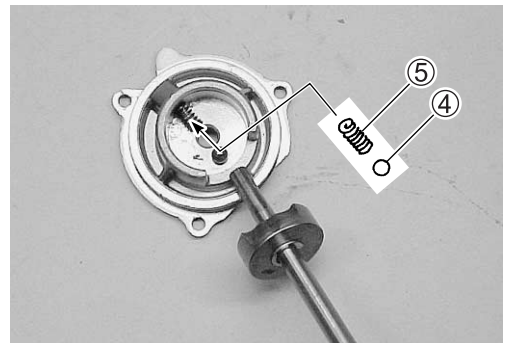


Disassembly of shift rod components

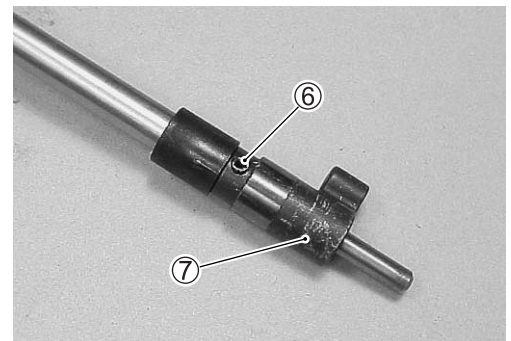
- (a) Remove the circlip ① and washer ②.
(b) Slide the shift rod ③ out of the shift rod guide housing.



- (c) Remove the detent ball ④ and spring ⑤.



- (d) Remove the pin ⑥ and shifter yoke ⑦.



INSPECTION

NOTE:

If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

NOTE:

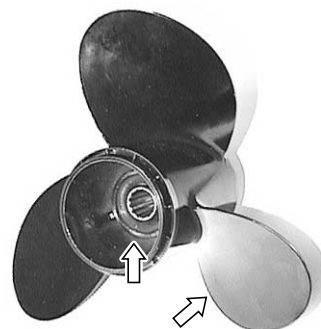
Thoroughly wash all metal components with cleaning solvent and dry with compressed air.

⚠ WARNING

Wear safety glasses when using compressed air.

PROPELLER

- Inspect the propeller for bent, chipped or broken blades. Replace or repair propeller if in damaged condition.
- Inspect propeller bush splines. Replace or repair propeller if splines are worn or damaged.
- Inspect propeller bush for deterioration or slipping. Replace if necessary.



GEARCASE

- Inspect the gearcase. Replace if cracked or damaged.
- Visually check the pinion bearing. Replace if pitted, noisy or rough.

NOTE:

If removal and replacement are required, see the DF90/115 service manual/ "PINION BEARING" section on page 9-7.



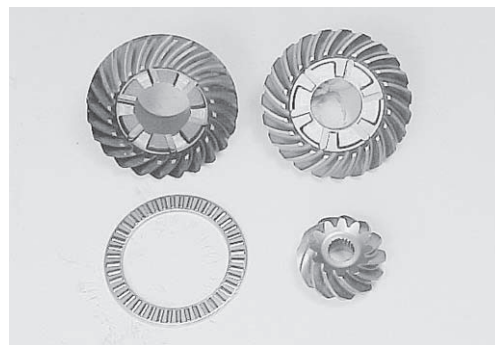
REVERSE GEAR BEARING HOUSING / RETAINER

- Inspect the reverse gear retainer and reverse gear bearing housing. Replace if cracked or damaged.
- Visually check each bearings. Replace if pitted, noisy or rough.



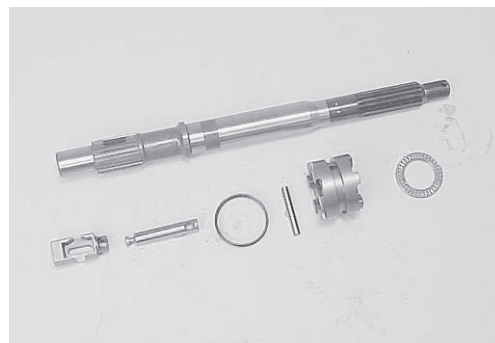
GEAR

- Inspect forward, reverse and pinion gear teeth and engaging dogs.
Replace gears if damaged or worn.
- Inspect forward gear thrust bearing. Replace bearing if pitted, noisy or rough.



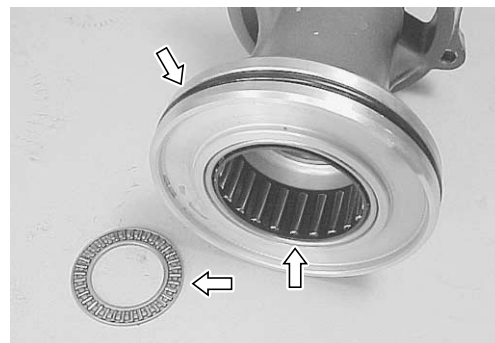
PROPELLER SHAFT COMPONENTS

- Inspect horizontal slider and connector pin.
Replace if wear, damage or other abnormal condition.
- Inspect clutch dog shifter. Replace if chipped, worn or damaged.
- Inspect dog pin. Replace if bent or worn.
- Inspect propeller shaft/splines. Replace if worn, twisted or damaged.
- Inspect thrust bearing. Replace bearing if pitted, noisy or rough.



PROPELLER SHAFT BEARING HOUSING

- Inspect housing. Replace if cracked or damaged.
- Inspect forward gear bearing. Replace bearing if pitted, noisy or rough.
- Inspect bearing. Replace bearing if pitted, noisy or rough.
- Check condition of oil seal and O-ring.
Replace the seals if nicked, cut or worn.



Replacing propeller shaft oil seal

1. Remove the retaining ring ① and washer ②.
2. Extract the seals ③ with oil seal remover.

 **09913-50121: Oil seal remover**

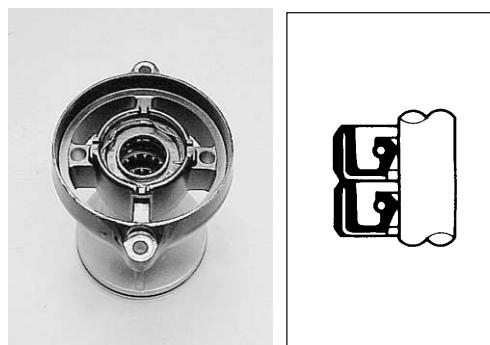
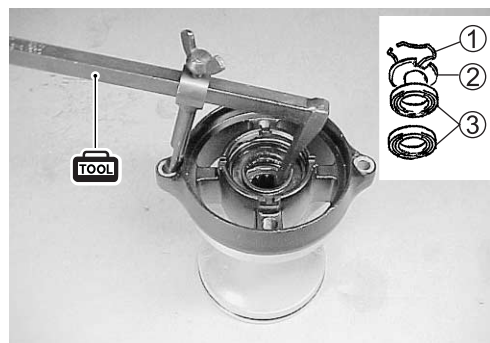
CAUTION

**Do not reuse oil seal once removed.
Always use new oil seal.**

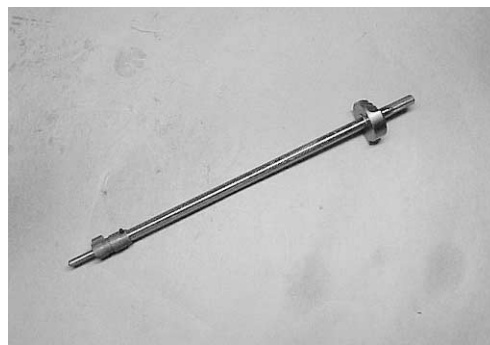
3. Apply Water Resistant Grease to the inner circumference of the housing.
4. Using an oil seal installer, drive the two oil seals (one at a time) into the propeller shaft bearing housing.
The lipped portion of the seal must face towards the propeller.
Apply Water Resistant Grease to the seal lips.

 **99000-25160: Water Resistant Grease**

5. Install washer and retaining ring.

**SHIFT ROD GUIDE HOUSING COMPONENTS**

- Inspect shift rod guide housing. Replace if cracked or damaged.
- Inspect shifter yoke. Replace if wear, damage or other abnormal condition.
- Inspect O-ring. Replace if nicked, cut, torn or swollen.
- Inspect oil seal. Replace if nicked cut or worn.
- Inspect shift rod/splines. Replace if worn, twisted or damaged.
- Inspect detent ball. Replace if wear, damage or other abnormal condition.

**WATER PUMP AND RELATED ITEMS**

- Inspect impeller. Replace if vanes are cut, torn or worn.
- Inspect pump case. Replace if cracked, distorted or corroded.
- Inspect under panel. Replace if cracked, distorted or corroded.



DRIVESHAFT OIL SEAL HOUSING

- Inspect housing. Replace if cracked or damaged.
- Check condition of oil seals. Replace if nicked, cut or worn.
- Inspect O-ring. Replace if worn, nicked or cut.

Replacing driveshaft oil seal

1. With the oil seal remover, draw the two oil seals out of the driveshaft oil seal housing.

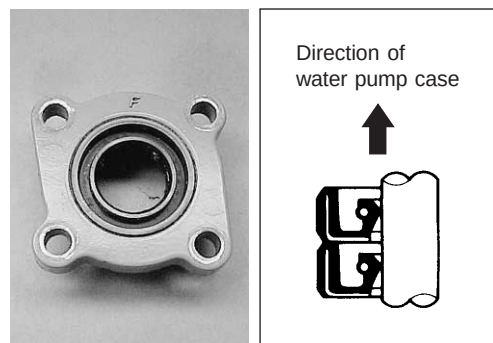
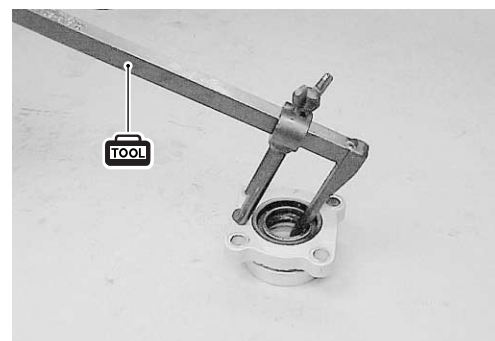
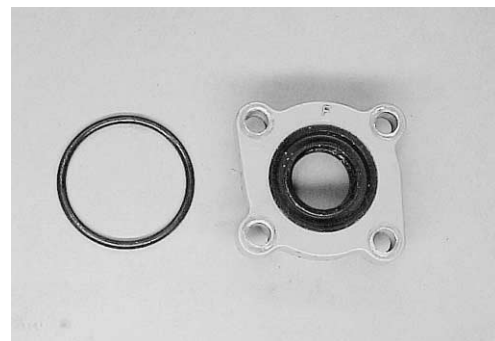
 **09913-50121: Oil seal remover**

2. Apply Water Resistant Grease to the inner circumference of the driveshaft oil seal housing.

 **99000-25160: Water Resistant Grease**

3. Grease the inner lips of the seal.

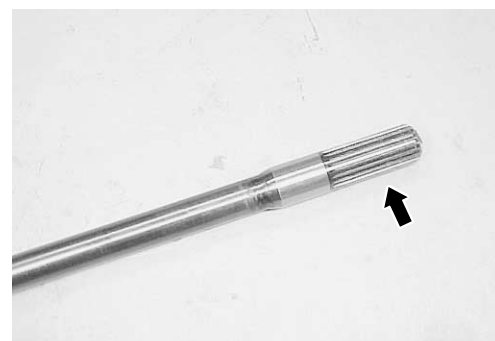
With the lips facing away from driveshaft bearing, place seal in position and drive it into the oil seal housing.



DRIVESHAFT

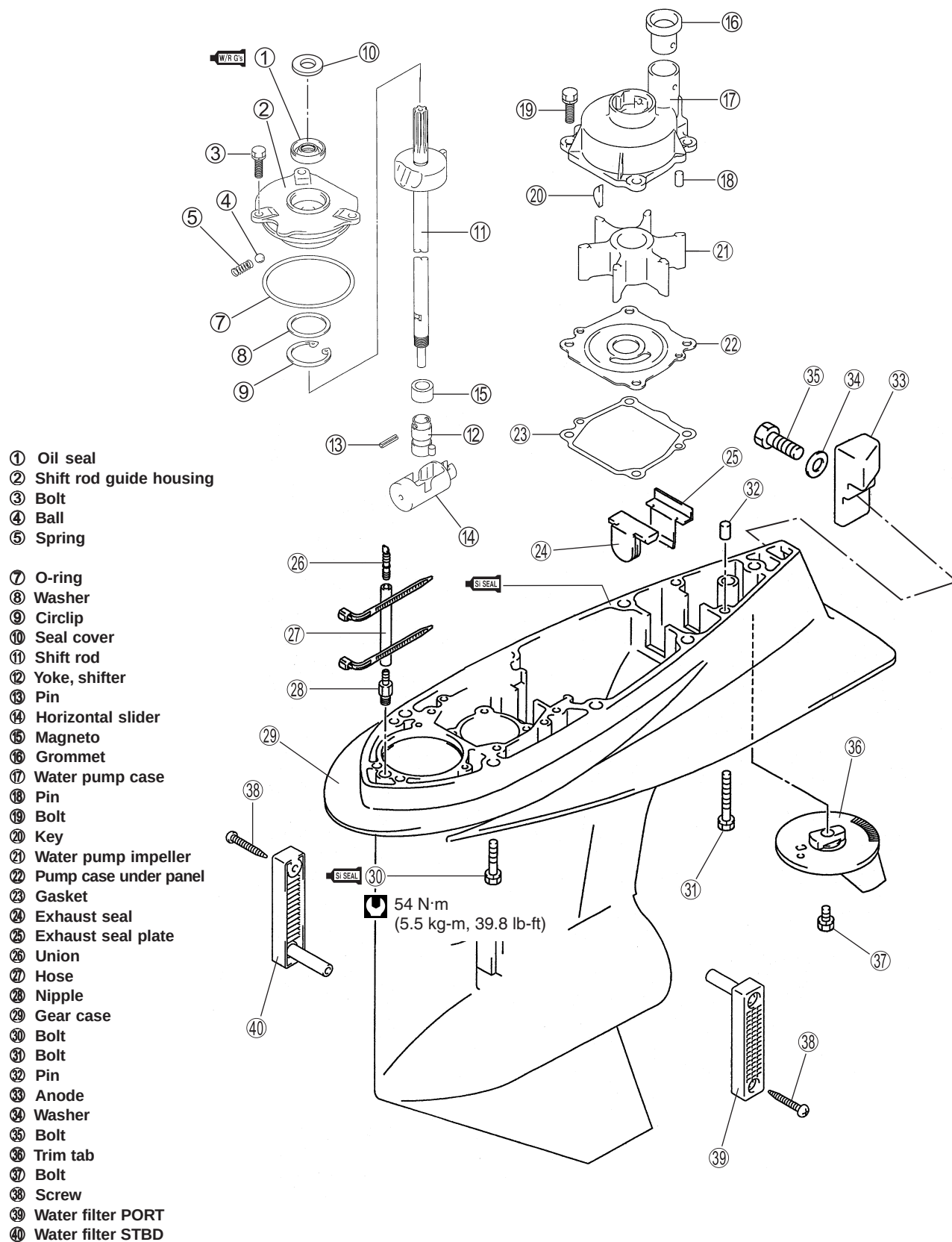
Inspect driveshaft/splines. Replace if worn, twisted or damaged.

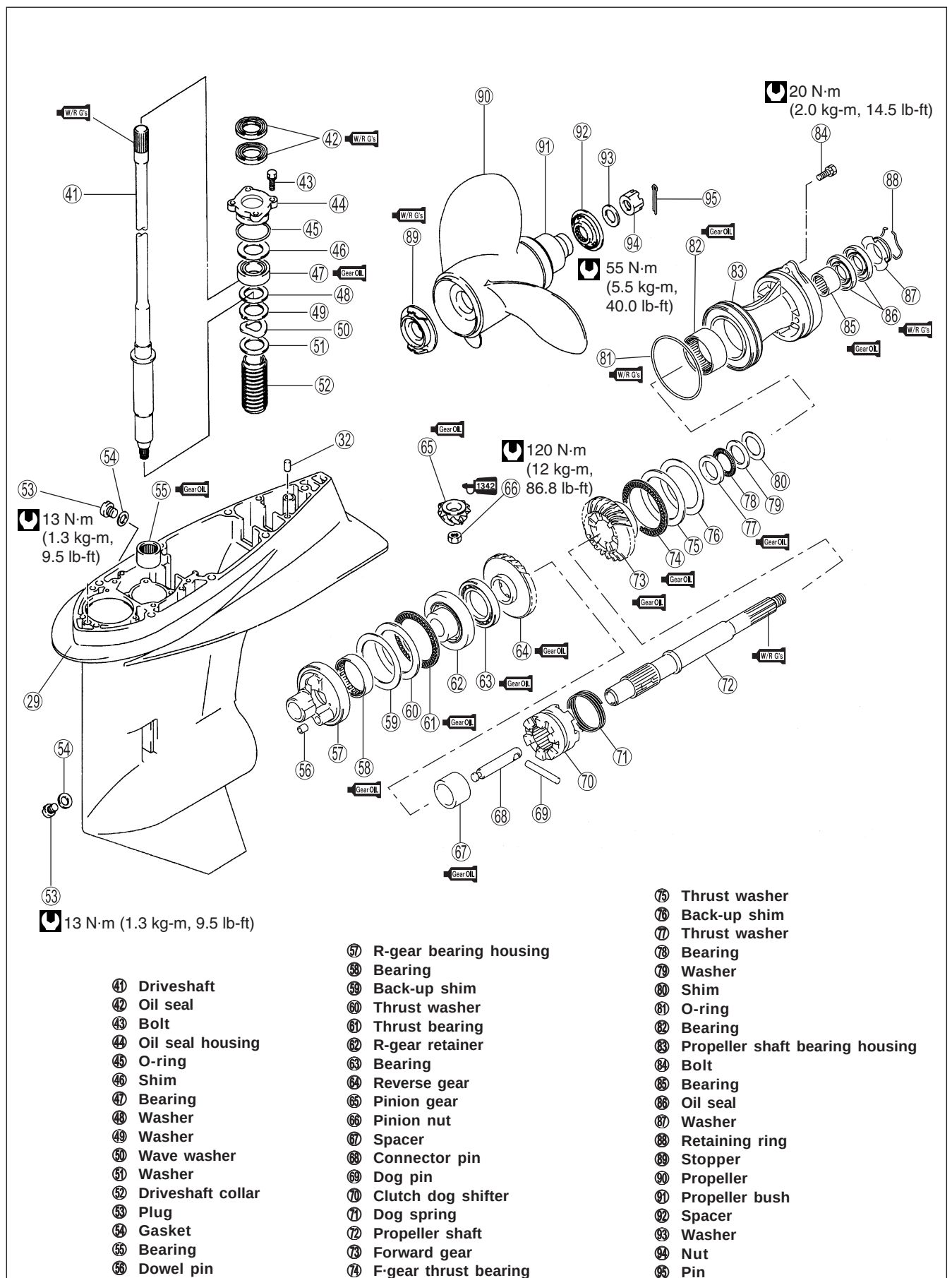
Inspect driveshaft bearing, replace if pitted, noisy or rough.



ASSEMBLY

Assembly is reverse of disassembly with special attention to following steps.



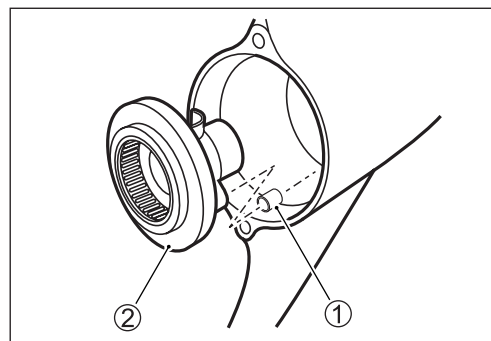


CAUTION

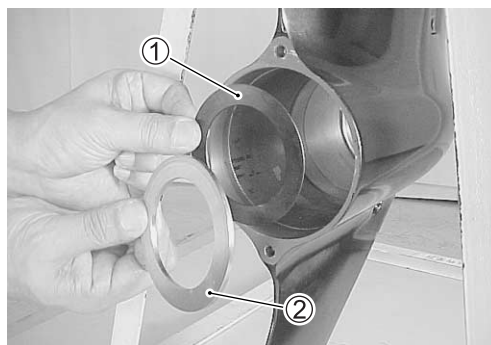
- Make sure that all parts used in assembly are clean and lubricated.
 - After assembly, check parts for tightness and smoothness of operation.
 - Before final assembly, be absolutely certain that all gear contact, shim adjustments and tolerances are correct.
- Failure to correctly adjust these areas will result in lower unit damage.
- (See the "GEARS SHIMMING AND ADJUSTMENT" section on page 86.)

REVERSE GEAR BEARING HOUSING

- Install dowel pin ① and R-gear bearing housing ② in position.

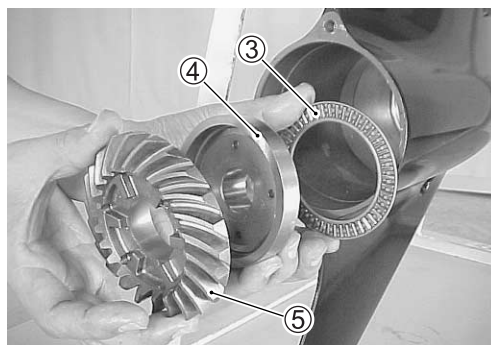
**REVERSE GEAR**

- Place R-gear back-up shim ① and bearing thrust washer ② in position.

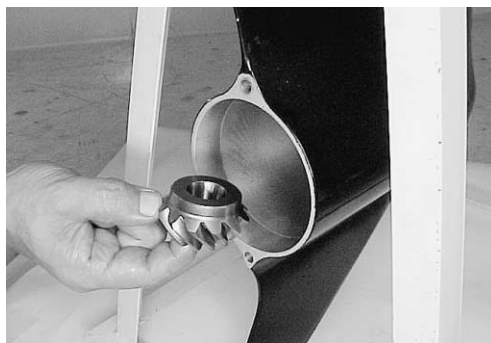


- Assemble the R-gear thrust bearing ③, reverse gear retainer ④ and reverse gear ⑤, then install reverse gear/retainer assembly.

 **99000-22540: Suzuki Outboard Motor Gear Oil**

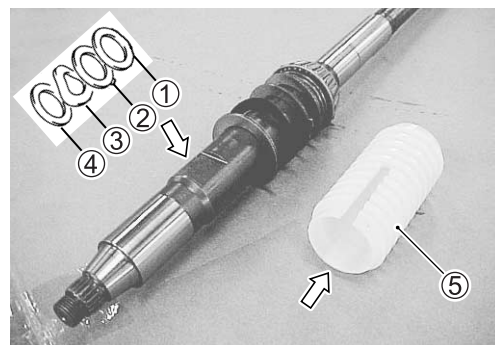
**PINION GEAR**

Place pinion gear in gearcase.



DRIVESHAFT

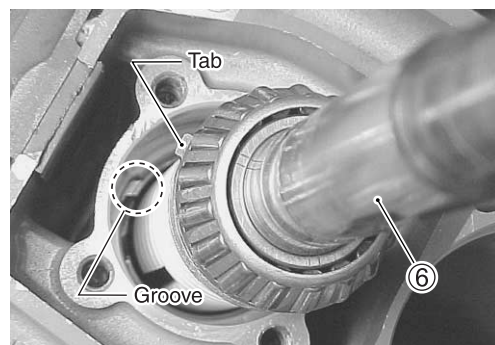
- Assemble the washer ①, washer (with the tab) ②, wave washer ③, washer ④ and driveshaft collar ⑤ to the driveshaft.
- After installing driveshaft collar, fit the convex part of the collar in the concave part of the driveshaft by turning collar.



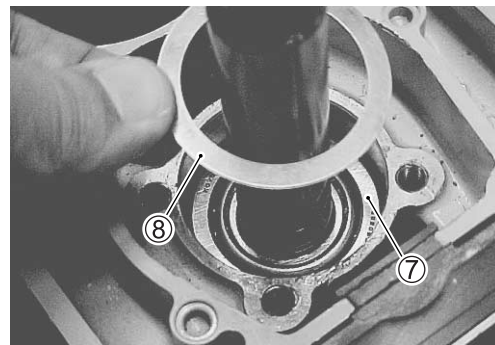
- Lower the driveshaft assembly ⑥ down into the gearcase until the bottom of shaft protrudes through center of pinion.

NOTE:

The washer tab must be located into groove on the gearcase.



- Install bearing outer race ⑦ and pinion shim ⑧ to driveshaft.

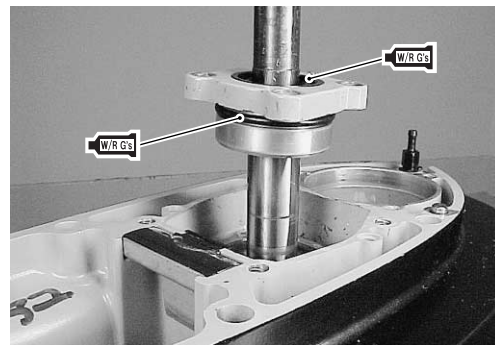


DRIVESHAFT OIL SEAL HOUSING

Apply Water Resistant Grease to the driveshaft oil seal.

 **99000-25160: Water Resistant Grease**

Apply Water Resistant Grease to O-ring, then install the O-ring into the groove on the driveshaft oil seal housing.



Install driveshaft oil seal housing on gearcase, then tighten four (4) bolts securely.



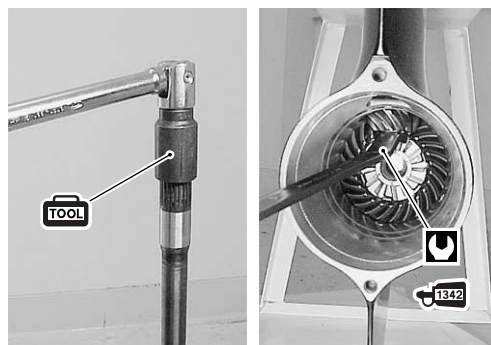
PINION NUT

Apply Thread Lock 1342 to the threads of the pinion nut before threading it onto the driveshaft.
Tighten nut to the specified torque.

 **Pinion nut: 120 N·m (12 kg-m, 86.8 lb-ft)**

 **99000-32050: Thread Lock 1342**

 **09921-29410: Driveshaft holder**

**CHECKING DRIVESHAFT THRUST PLAY**

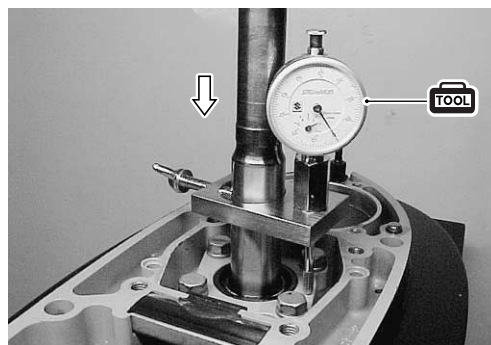
Before installing forward gear, driveshaft thrust play should be checked.

(See the “GEARS-SHIMMING AND ADJUSTMENT/CHECKING DRIVESHAFT THRUST PLAY” section on page 88.)

Driveshaft thrust play:

Approx. 0.8 – 1.2 mm (0.031 – 0.047 in.)

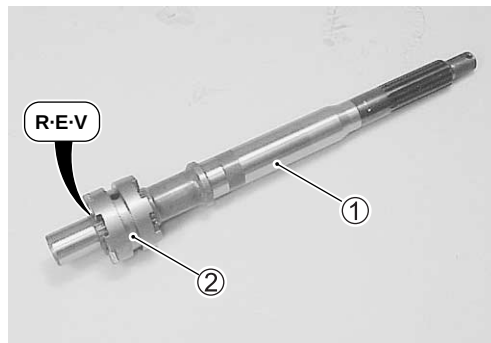
 **09951-09511: Gear adjusting gauge**

**PROPELLER SHAFT**

Slide the clutch dog shifter ② onto the propeller shaft ①.

NOTE:

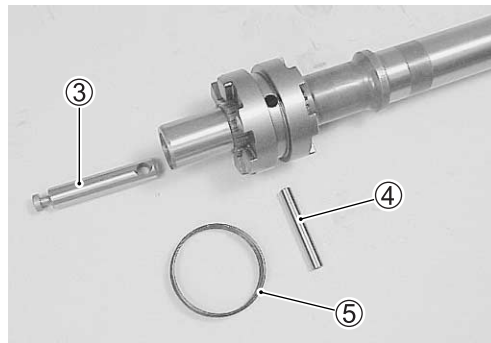
- For correct installation the side of the clutch dog shifter which must face towards reverse gear is marked with the letter “R·E·V”.



Insert the connector pin ③ into propeller shaft.

Align the holes in the shifter dog and connector pin and then slide the dog pin ④ through both dog and connector pin.

Install the dog pin retaining spring ⑤, ensuring that it fits snugly into the groove on the dog shifter.



Install the spacer ⑥ to propeller shaft.



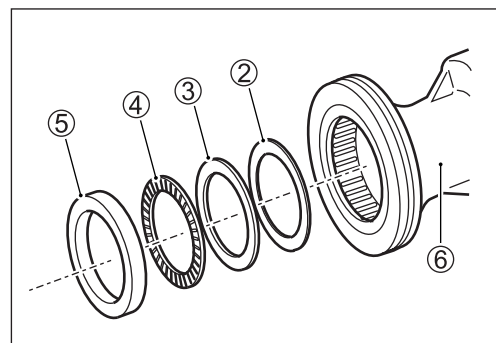
FORWARD GEAR/PROPELLER SHAFT / BEARING HOUSING

- Assemble the propeller shaft in the following sequence:

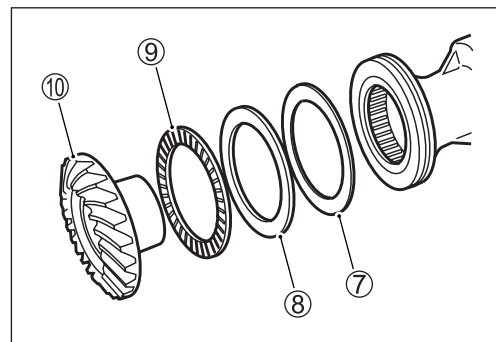
 **99000-25160 : Water Resistant Grease**

 **99000-22540 : Suzuki Outboard Motor Gear Oil**

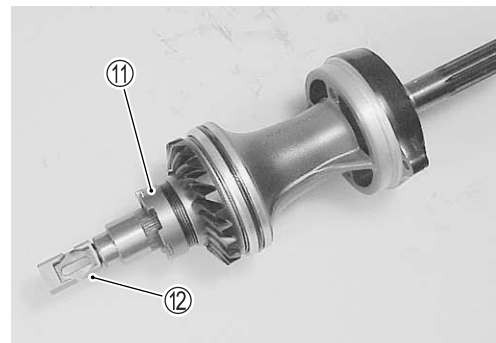
- Apply Water Resistant Grease to O-ring ①, then install the O-ring into the groove on the propeller shaft bearing housing.
- Install shim ②, bearing washer ③, propeller shaft thrust bearing ④, propeller shaft thrust washer ⑤ into propeller shaft bearing housing ⑥.



- Install F-gear back-up shim ⑦, F-gear thrust washer ⑧, F-gear thrust bearing ⑨ and forward gear ⑩ to propeller shaft bearing housing.



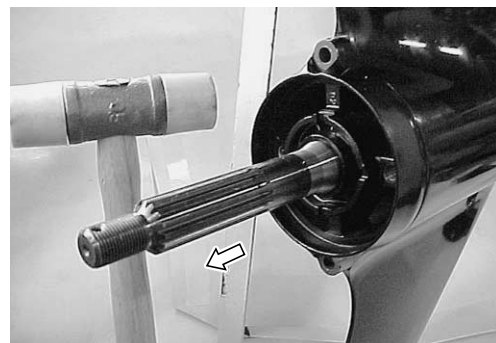
- Slide propeller shaft ⑪ into forward gear and propeller shaft bearing housing.
- Assemble horizontal slider ⑫ to connector pin.



To hold the correct bearing position, pull propeller shaft backward and then install propeller shaft and housing assembly in the gearcase.

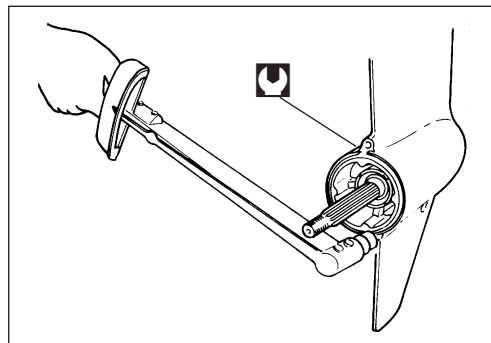
NOTE:

To make the bearing housing fully seated in the gearcase, tap the housing gently with plastic mallet.



When the housing is fully seated, tighten both retaining bolts to the specified torque.

 **Bearing housing bolt: 20 N·m (2.0 kg-m, 14.5 lb-ft)**



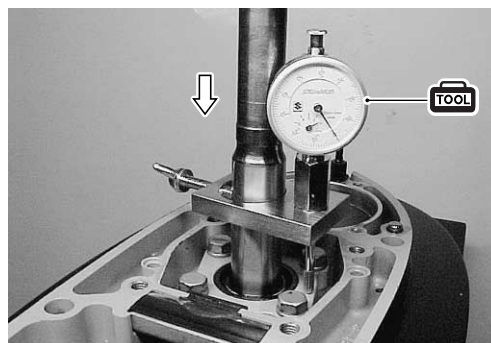
RECHECKING DRIVESHAFT THRUST PLAY

Recheck the driveshaft thrust play.

Driveshaft thrust play:

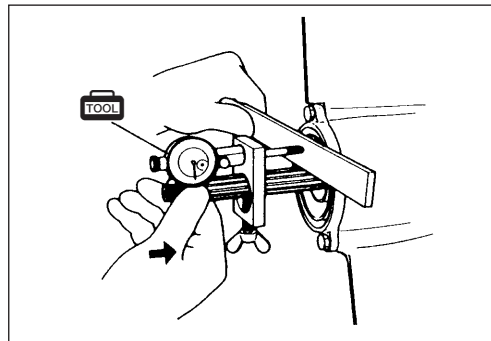
Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

 **09951-09511: Gear adjusting gauge**



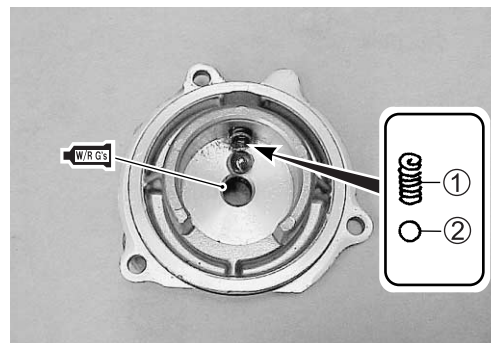
CHECKING PROPELLER SHAFT THRUST PLAY

See the “GEARS - SHIMMING AND ADJUSTMENT/CHECKING PROPELLER SHAFT THRUST PLAY” section on page 91.

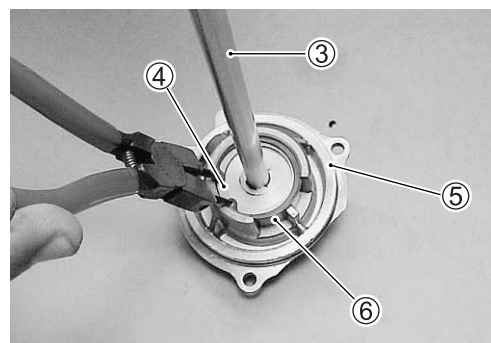


SHIFT ROD GUIDE HOUSING

- Install the spring ① and detent ball ② into shift rod guide housing.
- Apply Water Resistant Grease to the shift rod oil seal.

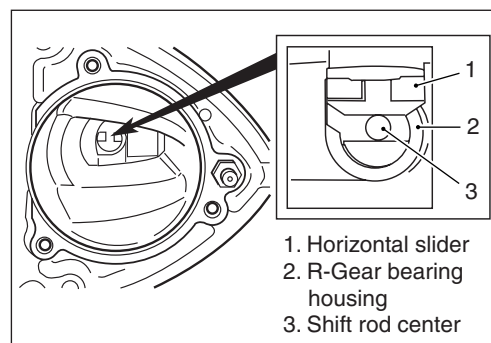


- Install shift rod ③ and washer ④ into the shift rod guide housing ⑤, then secure it with the snap ring ⑥.



NOTE:

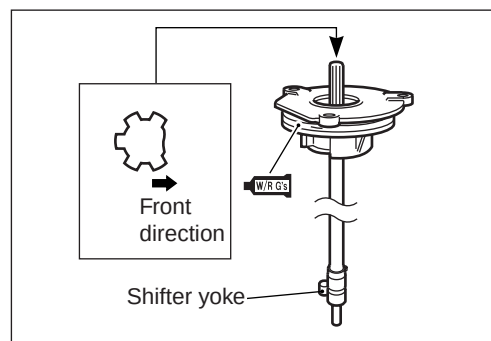
Before install the shift unit (Shift rod guide housing assembly), be sure to put the horizontal slider in the neutral position.



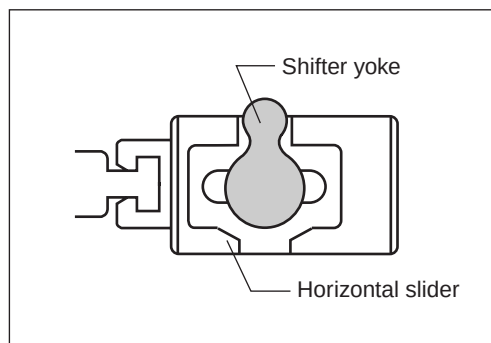
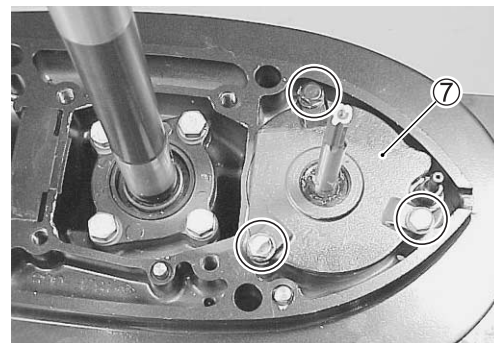
- Apply Water Resistant Grease to the shift rod guide housing O-ring.

NOTE:

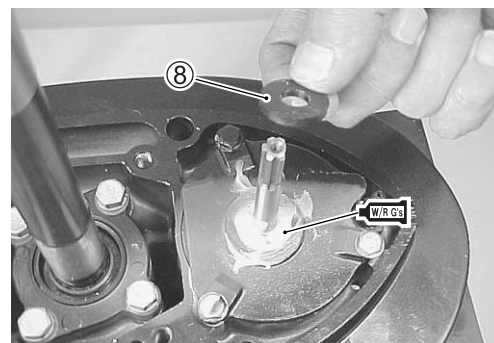
Before install the shift unit (Shift rod guide housing assembly), bring shifter yoke to the neutral position by turning shift rod right or left.



- Install the shift rod guide housing assembly ⑦ by aligning the shifter yoke with the groove in the horizontal slider, then tighten three (3) housing bolts securely.
- Shift the shift rod from Neutral through Forward and Reverse to check proper gear engagement.



- Apply enough Water Resistant Grease on oil seal before putting seal cover ⑧ so that there is no space between them.



LEAKAGE CHECK

Check for leakage of oil seal and O-ring when applying specified pressure inside of the gearcase.

TOOL 09950-69511 : Oil leakage tester
: Air pump

Procedure

1. Install the test tool into the oil level hole.
2. Connect the air pump to the tester.
3. Rotate driveshaft and propeller shaft clockwise several times and then apply specified pressure for the test.

NOTE:

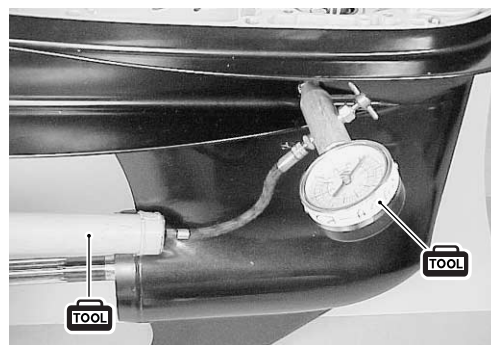
Apply low initial pressure of 20 – 40 kPa, (0.2 – 0.4 kg/cm², 2.8 – 5.7 psi) first, then apply specified pressure.

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

CAUTION

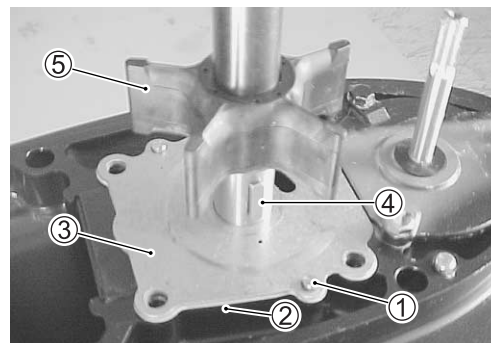
Do not exceed pressure of 110 kPa (1.1kg/cm², 15.6 psi) or damage to oil seals will result.

4. Once stabilized, pressure should remain steady for at least 5 min.
If pressure does not fall, sealing performance is correct.

**WATER PUMP (Impeller & Case)**

Place the dowel pins ①, under panel gasket ② and under panel ③ into position.

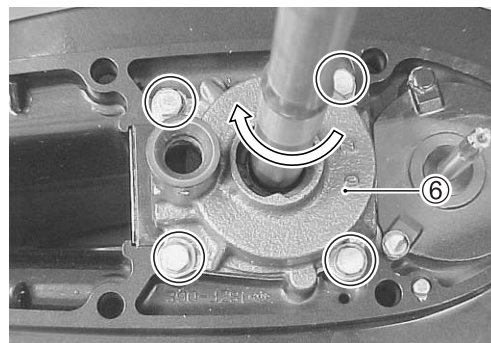
Insert the key ④ in the driveshaft and slide the impeller ⑤ onto driveshaft, ensuring that key and keyway are aligned.



Install the pump case ⑥ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.

Securely tighten the four (4) pump case bolts to the specified torque.

🔧 Pump case bolt: 20 N·m (2.0 kg-m, 14.5 lb-ft)



PROPELLER INSTALLATION

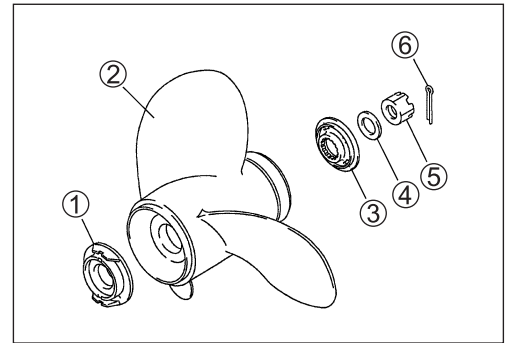
Install propeller stopper ① onto propeller shaft, then slide on the propeller ②.

Fit spacer ③, washer ④ and nut ⑤, then tighten nut to specified torque.

Push cotter pin ⑥ through nut and shaft, then bend to secure.

 **99000-25160: Water Resistant Grease**

 **Propeller nut: 55 N·m (5.5 kg-m, 40.0 lb-ft)**

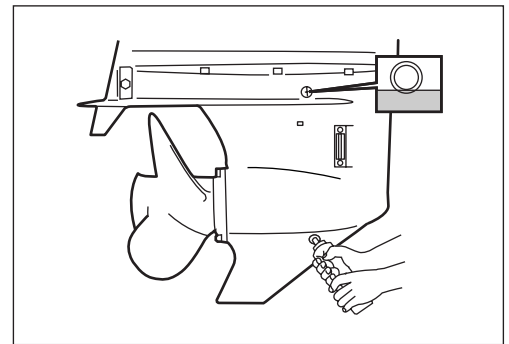


GEAR OIL

Fill the gearcase with specified gear oil for initial testing and recheck the level after 10 minutes.

Top up if necessary.

 **99000-22540: Suzuki Outboard Motor Gear Oil**

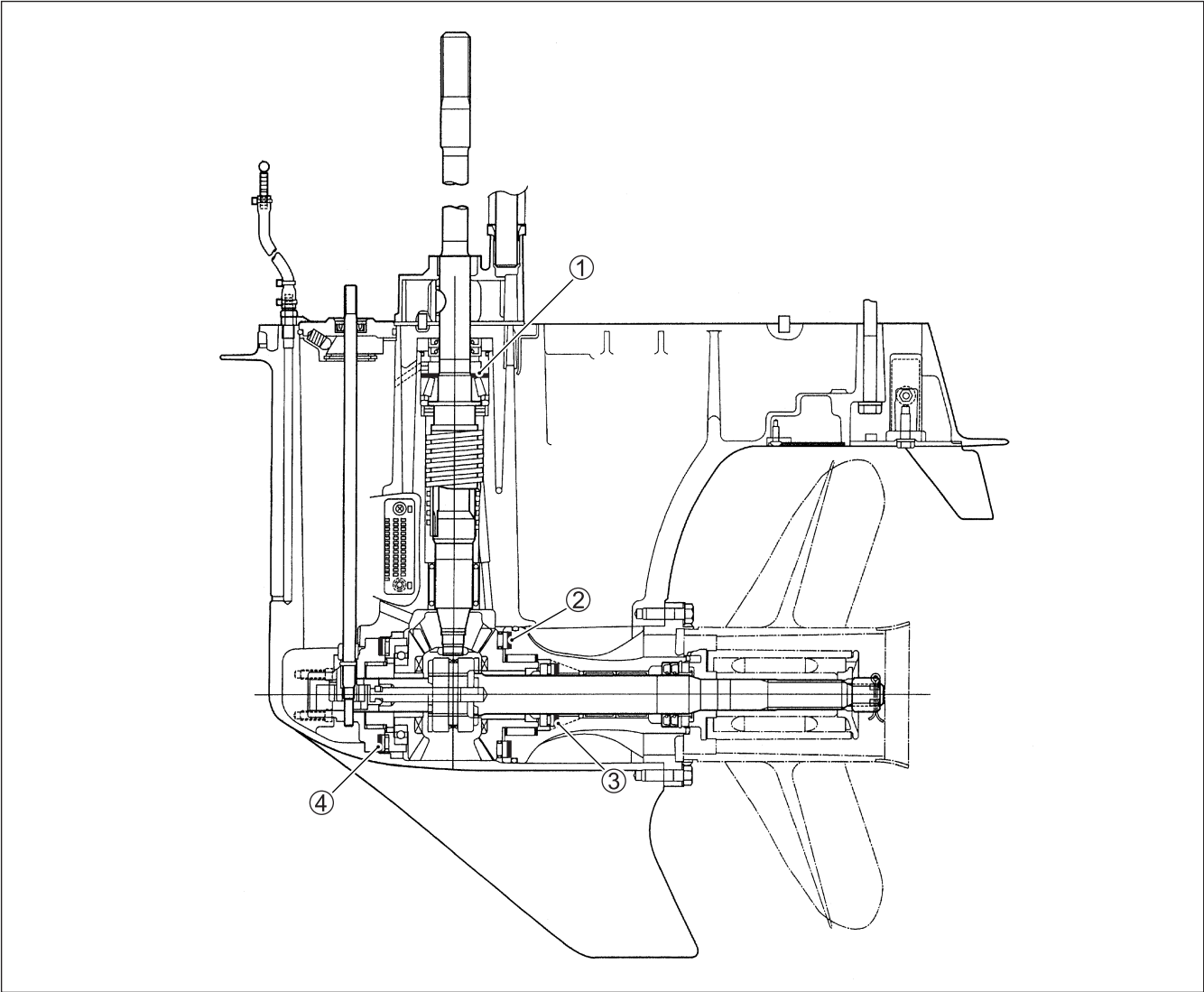


LOWER UNIT GEARS-SHIMMING AND ADJUSTMENT (Counter rotation model)

If lower unit has been rebuilt or has had components replaced, shimming for correct gear contact and backlash will have to be adjusted to ensure smooth, reliable operation of gears.

Shim/Washer & Mounting position

	Numerical index/item	Available thickness (mm)	Design specification Thickness (mm)
①	Pinion gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15	1.0
②	Forward gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00	0.8
③	Propeller shaft thrust shim	0.60, 0.70, 0.80, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15	1.0
④	Reverse gear back up shim	0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4	1.0



PINION GEAR BACK-UP SHIM ADJUSTMENT

- (1) Position the shimming gauge **A** horizontally in a vise and tighten vise securely.

TOOL 09951-09010: Shimming gauge

- (2) Assemble the bearing outer race **①**, back-up shim **②** and driveshaft oil seal housing **③** to the driveshaft.

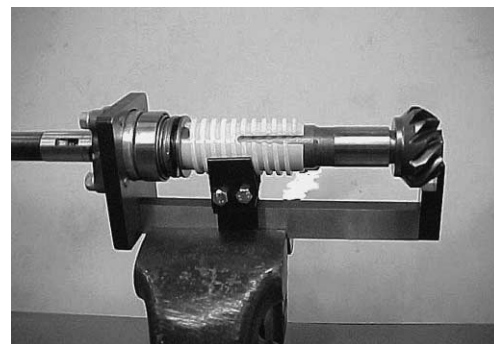
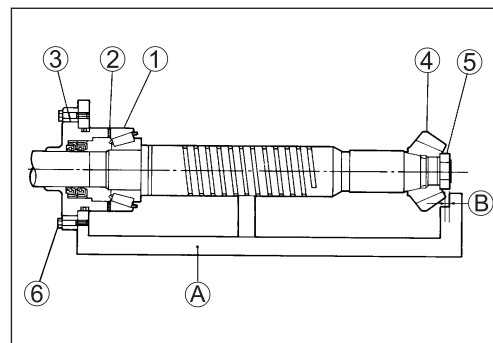
NOTE:

*Use a thinner pinion back-up shim **②** than the standard shim so that a clearance **B** exists.*

- (3) Insert the driveshaft through the shimming gauge **A** opening and then install pinion gear **④** and nut **⑤** to the driveshaft, tighten pinion nut.

Pinion nut: 120 N·m (12 kg-m, 86.8 lb-ft)

- (4) Install oil seal housing to shimming gauge with bolts **⑥**.
 (5) Depress and hold driveshaft so that driveshaft bearing is firmly seated in bearing outer race.
 (6) Hold driveshaft against oil seal housing **③** while measuring clearance **B** between gauge and flat edge of pinion gear **④** with thickness gauge, measured clearance plus shim **②** is the total shim thickness to be used in gear housing reassembly for correct pinion gear position.



REVERSE GEAR BACK-UP SHIM ADJUSTMENT

1. Correctly assemble reverse gear bearing housing, reverse gear thrust bearing, reverse gear retainer, reverse gear, reverse gear spacer, pinion gear, driveshaft assembly/oil seal housing and related components.
2. Tighten pinion nut to specified torque.

 **Pinion nut: 120 N·m (12 kg-m, 86.8 lb-ft)**

3. Install propeller shaft assembly and bearing housing assembly without the forward gear, then tighten bearing housing retaining bolts to the specified torque.
4. Install the special tool to the bearing housing and then attach it to the propeller shaft as shown.

 **09951-98721: Gear holder**

NOTE:

- Before installing special tool, loosen the jam nuts securing the long bolts and then remove the plate from long bolts.
- Screw long bolts into the 10 mm thread on propeller shaft bearing housing.

5. Turn the bolt ① clockwise, and tighten until the propeller shaft can rotate smoothly without play. Do not over tighten.
6. Affix gear adjusting gauge to driveshaft.

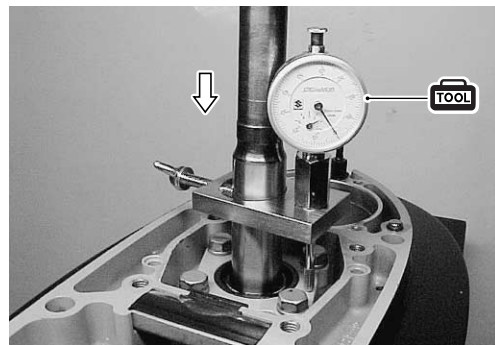
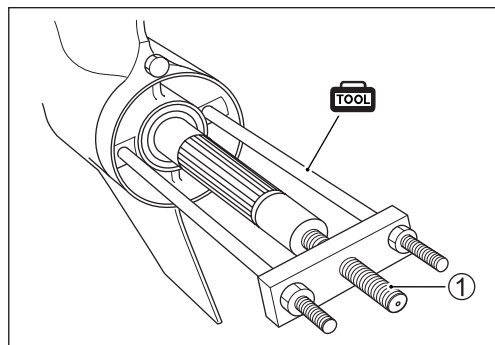
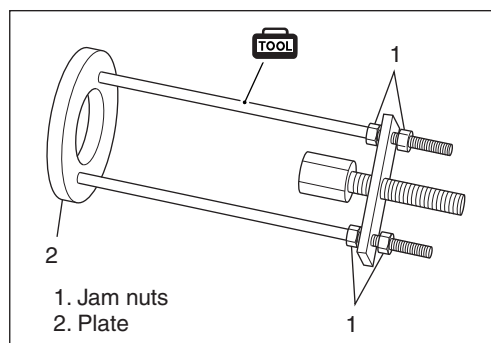
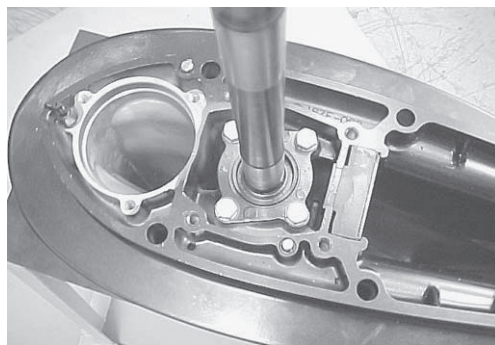
 **09951-09511: gear adjusting gauge**

7. To check the driveshaft thrust play, slowly push driveshaft downward, then read the maximum play.

Driveshaft thrust play:

Approx. 0.8 – 1.2 mm (0.031– 0.047 in.)

- If thrust play is larger than the specified , thickness of reverse gear back-up shim must be increased.
- If thrust play is smaller, reverse gear back-up shim thickness must be decreased.



FORWARD GEAR BACK-UP SHIM ADJUSTMENT

Follow the procedure below to adjust forward gear.

Step to prior to adjustment

1. Correctly assemble reverse gear, driveshaft oil seal housing, driveshaft, pinion gear and related components. (See page 78 – 80)
2. Tighten pinion nut to specified torque.

 **Pinion nut: 120 N·m (12 kg-m, 86.8 lb-ft)**

3. Correctly assemble forward gear, forward gear bearing, propeller shaft, propeller shaft thrust bearing and propeller shaft bearing housing and related components, then install forward gear/propeller shaft/bearing housing assembly into gearcase.
4. Tighten both bearing housing retaining bolts to the specified torque.

NOTE:

- Before installing special tool, loosen the jam nuts securing the long bolts and then remove the plate from long bolts.
 - Screw long bolts into the 10 mm thread on propeller shaft bearing housing.
5. Install the special toll to gearcase and then attach it to the propeller shaft as shown in the illustration.

 **09951-98721: Gear holder**

6. Turn the bolt ① counterclockwise and tighten until the propeller shaft can rotate smoothly without play. Do not over tighten.

Checking driveshaft thrust play

- (a) Affix gear adjusting gauge to driveshaft.

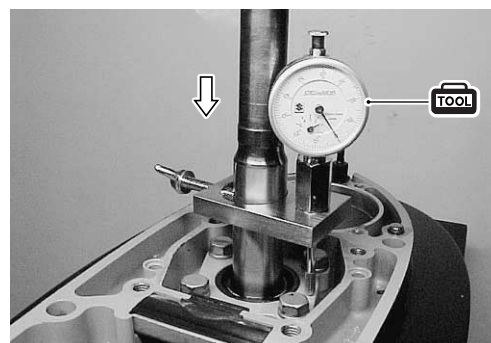
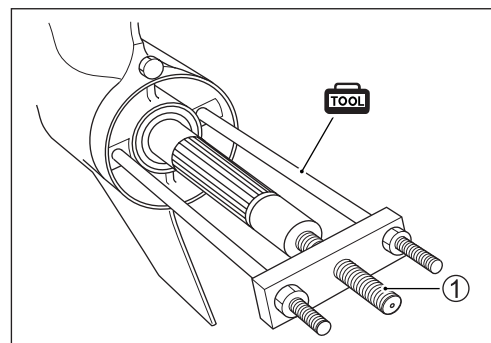
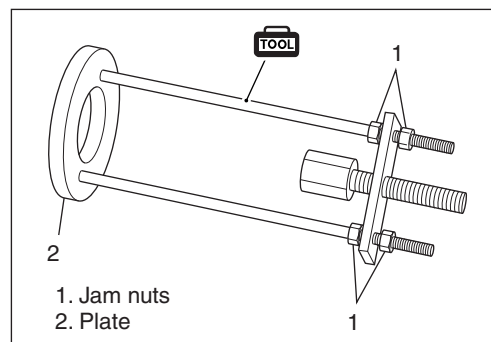
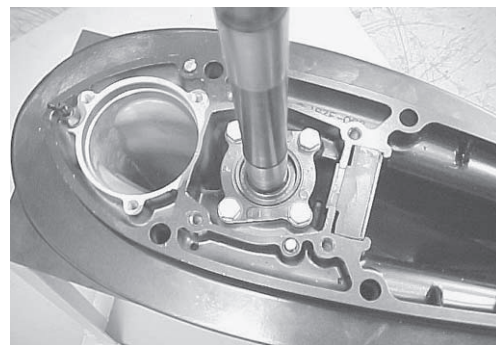
 **09951-09511: Gear adjusting gauge**

- (b) To check the driveshaft thrust play, slowly push driveshaft downward, then read the maximum play

Driveshaft thrust play:

Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

- If thrust play is larger than the specified, thickness of forward gear back-up shim must be increased.
- If thrust play is smaller, forward gear back-up shim thickness must be decreased.

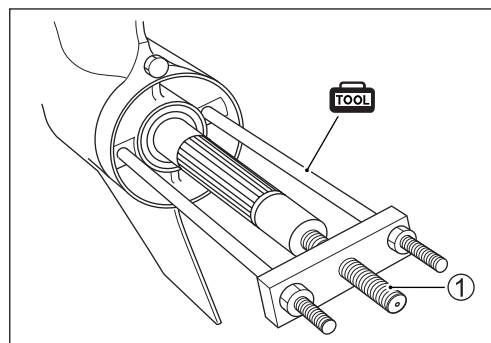


Checking and adjusting tooth contact pattern

(Pinion and Forward gear)

Check tooth contact pattern by using the following procedure:

- (A) To assess tooth contact, apply a light coat of Prussian Blue on the convex surface of forward gear.
- (B) In accordance with step 1 – 6, assemble the lower unit, then install the special tool.
Turn the bolt ① counterclockwise and tighten until the propeller shaft can rotate smoothly without play.
Do not over tighten.



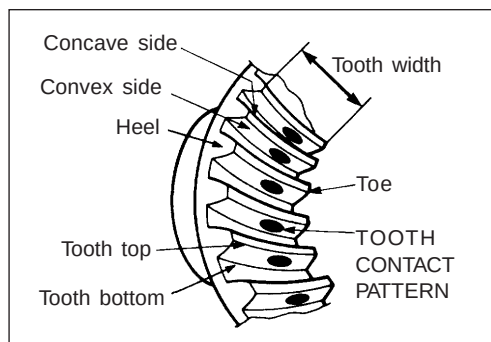
09951-98721: Gear holder

- (C) Using driveshaft holder tool, rotate the driveshaft 5 – 6 times.

09921-29410: Driveshaft holder



- (D) Carefully pull out propeller shaft and housing to check tooth contact pattern.



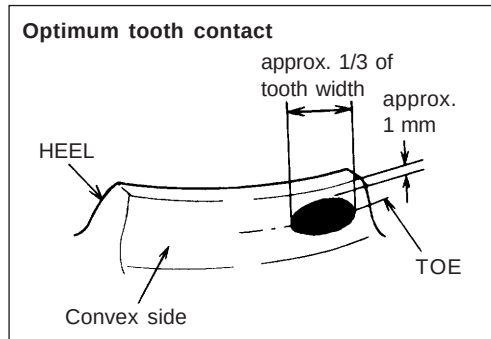
Optimum tooth contact

The optimum tooth contact is shown at right.

A shim adjustment may be necessary to obtain this contact pattern.

CAUTION

The driveshaft thrust play should be checked when increasing or decreasing the thickness of the shim to adjust tooth contact.



Example (1)

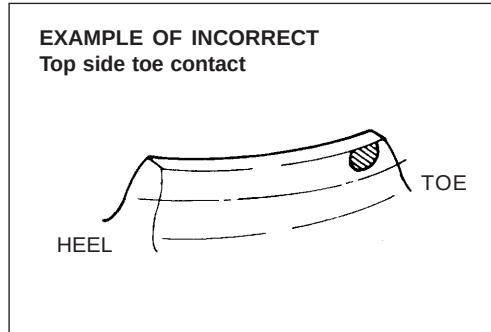
Incorrect topside toe contact:

Correction measures:

- Decrease thickness of forward gear shim.
- (• Slightly increase pinion gear shim thickness.)

CAUTION

Do not set tooth contact in this position (top side toe contact). Damage and chipping of forward and pinion gear may result.



Example (2)

Incorrect bottom side toe contact:

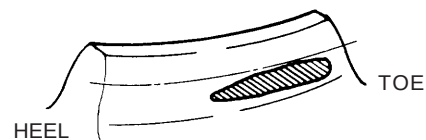
Correction measures:

- Increase thickness of forward gear shim.
- (• Slightly decrease pinion gear shim thickness.)

CAUTION

Do not set tooth contact in this position (bottom side toe contact). Chipping of pinion gear may result.

**EXAMPLE OF INCORRECT
Bottom side toe contact**

**CHECKING PROPELLER SHAFT THRUST PLAY**

After adjusting all gear positions, measure the propeller shaft thrust play. If not within the following specification, a shim adjustment is required.

**Propeller shaft thrust play: 0.2 – 0.4 mm
(0.008 – 0.016 in.)**

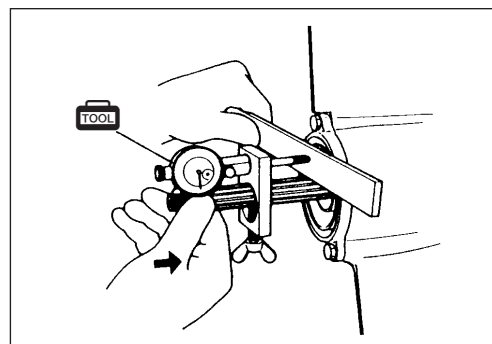
Measurement step:

1. Assemble gear adjusting gauge to the propeller shaft.



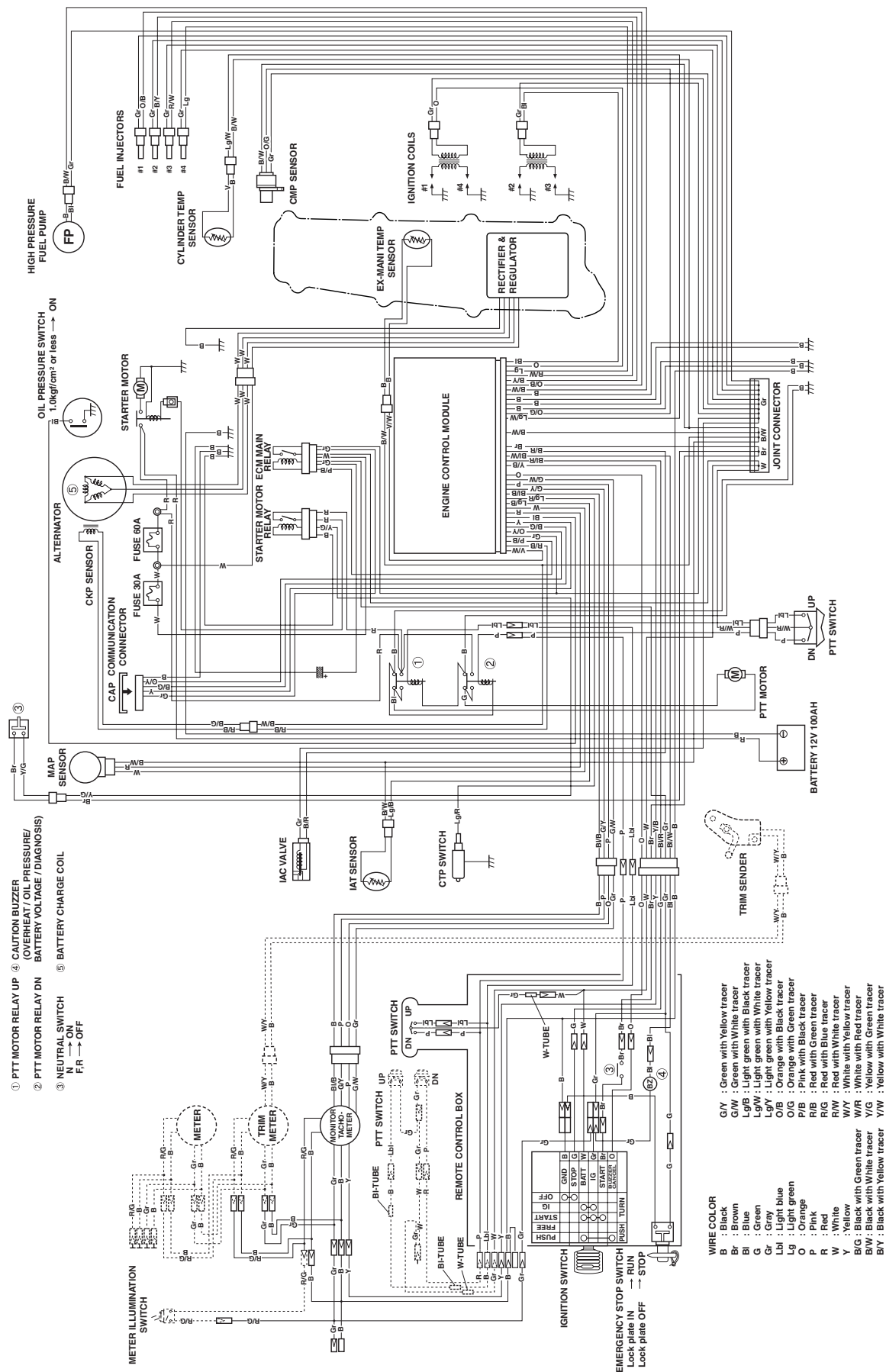
09951-09511: Gear adjusting gauge

2. Push propeller shaft inward.
3. Hold shaft in and set dial gauge pointer to zero.
4. Slowly pull shaft outward and read the maximum thrust play on the dial.
 - If measurement is more than specification, increase propeller shaft thrust shim thickness.
 - If measurement is less than specification, reduce propeller shaft thrust shim thickness.

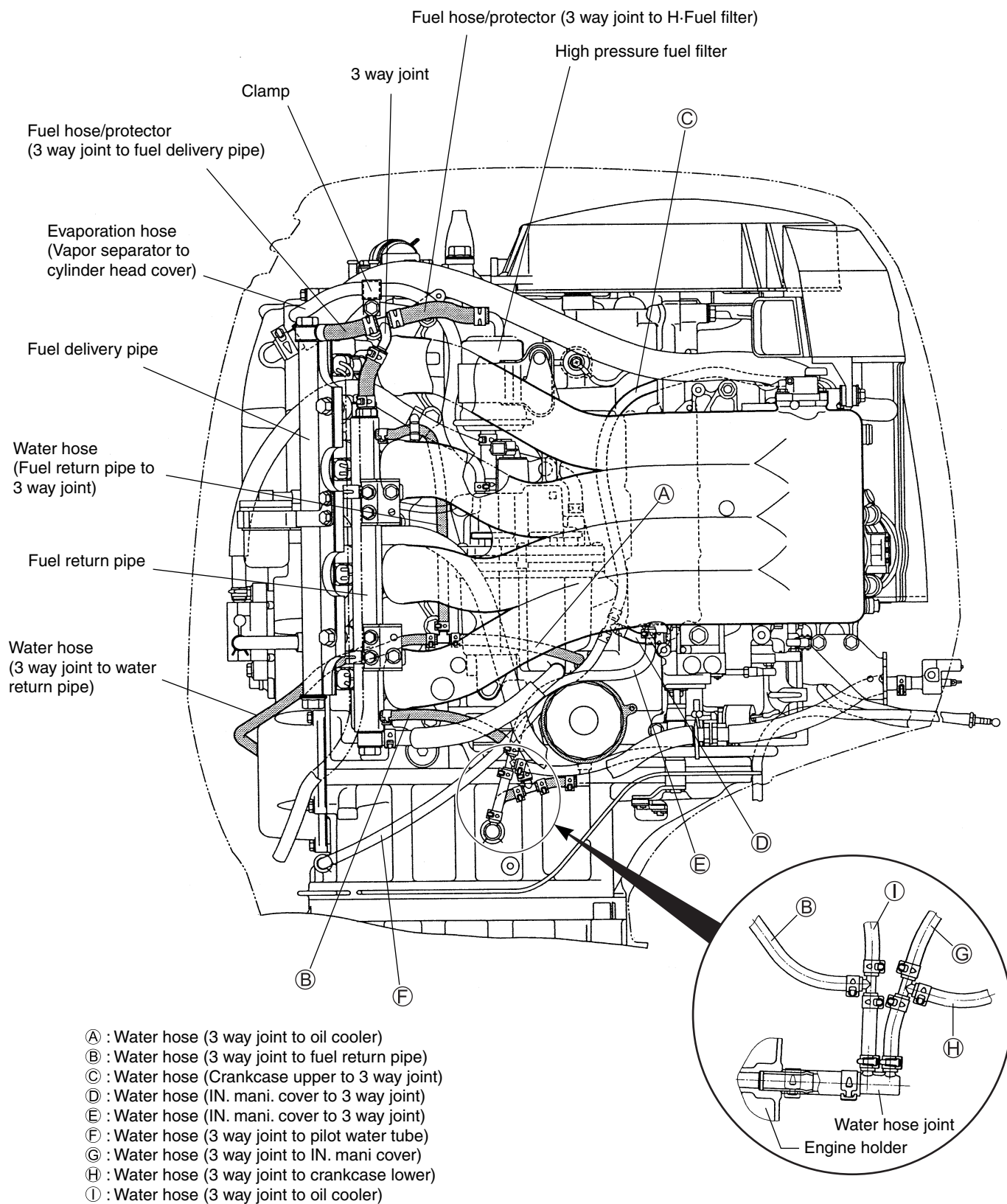


WIRING DIAGRAM

DF140T/140Z



HOSE ROUTING



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