SUZUKI OUTBOARD MOTOR

DF 40
DF 50 FOUR STROKE

SERVICE MANUAL

99500-87J03-01E

FOREWORD

This manual contains an introductory description on SUZUKI Outboard motor DF40/50 and procedures for the inspection, service and overhaul of its main components.
General knowledge information is not included.

Please read the GENERAL INFORMATION section to familiarize yourself with basic information concerning this motor. Read and refer to the other sections in this manual for information regarding proper inspection and service procedures.

This manual will help you better understand this outboard motor so that you may provide your customers with optimum and quick service.

- *This manual has been prepared using the latest information available at the time of publication.*
  If a modification has been made since then, differences may exist between the content of this manual and the actual outboard motor.
- *Illustrations in this manual are used to show the basic principles of operation and work procedures and may not represent the actual outboard motor in exact detail.*
- *This manual is intended for use by technicians who already possess the basic knowledge and skills to service SUZUKI outboard motors. Persons without such knowledge and skills should not attempt to service an outboard engine by relying on this manual only.*
  Instead, please contact your nearby authorized SUZUKI outboard motor dealer.

⚠ WARNING

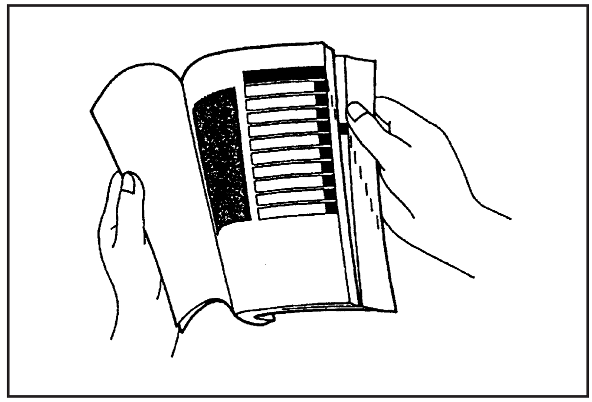
Apprentice machanics or do-it-yourself mechanics that don't have the proper tools and equipment may not be able to properly perform the services described in this manual. Improper repair may result in injury to the mechanic and may render the engine unsafe for the boat operator and passengers.

GROUP INDEX

SUZUKI MOTOR CORPORATION

Marine & Power Products Division

HOW TO USE THIS MANUAL



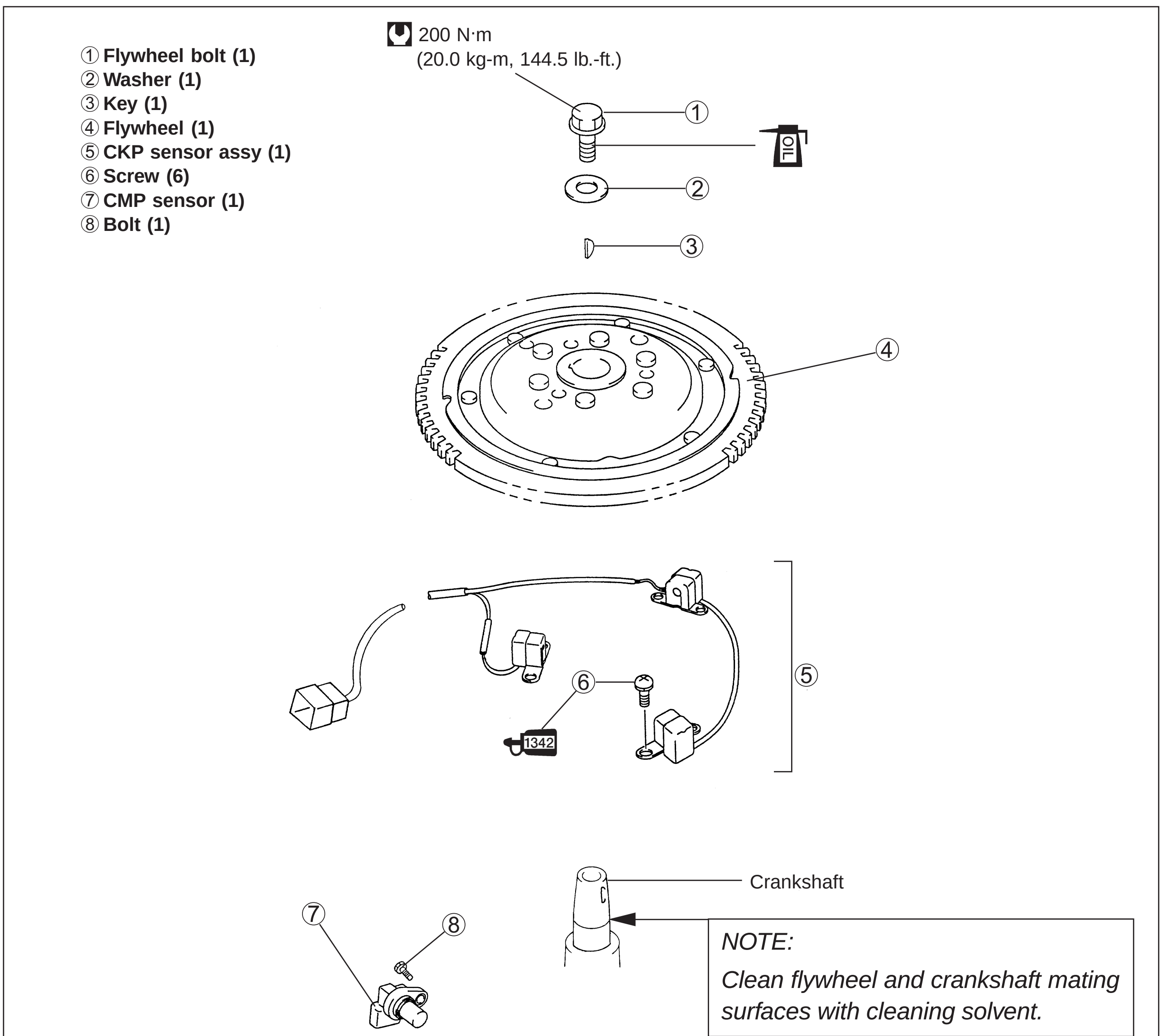
TO LOCATE WHAT YOU ARE LOOKING FOR:

1. The text of this manual is divided into sections.
2. The section titles are listed on the previous page in a GROUP INDEX. Select the section you wish to reference.
3. Holding the manual as shown at the right will allow you to find the first page of the section easily.
4. The first page of each section lists a table of contents to easily locate the item and page you need.

COMPONENT PARTS AND IMPORTANT ITEM ILLUSTRATIONS

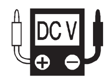
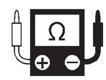
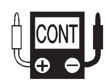
Under the name of each system or unit, an exploded view is provided with work instructions and other service information such as the tightening torque, lubrication and locking agent points.

Example :



SYMBOL

Listed in the table below are the symbols indicating instructions and other important information necessary for proper servicing. Please note the definition for each symbol. You will find these symbols used throughout this manual. Refer back to this table if you are not sure of any symbol(s) meanings.

SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Torque control required. Data beside it indicates specified torque.		Apply THREAD LOCK “1342”.
	Apply oil. Use engine oil unless otherwise specified.		Apply THREAD LOCK SUPER “1333B”.
	Apply SUZUKI OUTBOARD MOTOR GEAR OIL.		Measure in DC voltage range.
	Apply SUZUKI SUPER GREASE “A”.		Measure in resistance range.
	Apply SUZUKI WATER RESISTANT GREASE.		Measure in continuity test range.
	Apply SUZUKI BOND “1104”.		Use peak voltmeter “Stevens CD-77”.
	Apply SUZUKI BOND “1207B”.		Use special tool.
	Apply SUZUKI SILICONE SEAL.		

GENERAL INFORMATION

CONTENTS

WARNING/CAUTION/NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the symbol and the words WARNING, CAUTION and NOTE have special meanings. Pay special attention to the messages highlighted by these signal words.

⚠ WARNING

Indicates a potential hazard that could result in death or injury.

CAUTION

Indicates a potential hazard that could result in motor damage.

NOTE:
Indicates special information to make maintenance easier or instructions clearer.

Please note, however, that the warnings and cautions contained in this manual cannot possibly cover all potential hazards relating to the servicing, or lack of servicing, of the outboard motor. In addition to the WARNING and CAUTION stated, you must also use good judgement and observe basic mechanical safety principles.

GENERAL PRECAUTIONS

⚠ WARNING

- **Proper service and repair procedures are important for the safety of the service mechanic and the safety and reliability of the outboard motor.**
- **To avoid eye injury, always wear protective goggles when filing metals, working on a grinder, or doing other work, which could cause flying material particles.**
- **When 2 or more persons work together, pay attention to the safety of each other.**
- **When it is necessary to run the outboard motor indoors, make sure that exhaust gas is vented outdoors.**
- **When testing an outboard motor in the water and on a boat, ensure that the necessary safety equipment is on board. Such equipment includes : flotation aids for each person, fire extinguisher, distress signals, anchor, paddles, bilge pump, first-aid kit, emergency starter rope, etc.**
- **When working with toxic or flammable materials, make sure that the area you work in is well-ventilated and that you follow all of the material manufacturer's instructions.**
- **Never use gasoline as a cleaning solvent.**
- **To avoid getting burned, do not touch the engine, engine oil or exhaust system during or shortly after engine operation.**
- **Oil can be hazardous. Children and pets may be harmed from contact with oil. Keep new and used oil away from children and pets. To minimize your exposure to oil, wear a long sleeve shirt and moisture-proof gloves (such as dishwashing gloves) when changing oil. If oil contacts your skin, wash thoroughly with soap and water. Launder any clothing or rags if wet with oil. Recycle or properly dispose of used oil.**
- **After servicing fuel, oil/engine cooling system and exhaust system, check all lines and fittings related to the system for leaks.**
- **Carefully adhere to the battery handling instructions laid out by the battery supplier.**

CAUTION

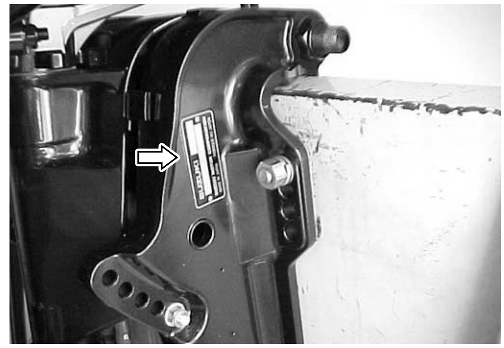
- **If parts replacement is necessary, replace the parts with Suzuki Genuine Parts or their equivalent.**
- **When removing parts that are to be reused, keep them arranged in an orderly manner so that they may be reinstalled in the proper order and orientation.**
- **Be sure to use special tools when instructed.**
- **Make sure that all parts used in assembly are clean and also lubricated when specified.**
- **When use of a certain type of lubricant, bond, or sealant is specified, be sure to use the specified type.**
- **When removing the battery, disconnect the negative cable first and then the positive cable. When reconnecting the battery, connect the positive cable first and then the negative cable.**
- **When performing service to electrical parts, if the service procedures do not require using battery power, disconnect the negative cable at the battery.**
- **Tighten cylinder head and case bolts and nuts, beginning with larger diameter and ending with smaller diameter, Always tighten from inside to outside diagonally, to the specified tightening torque.**
- **Whenever you remove oil seals, gaskets, packing, O-rings, locking washers, locking nuts, cotter pins, circlips, and certain other parts as specified, always replace them with new. Also, before installing these new parts, be sure to remove any left over material from the mating surfaces.**
- **Never reuse a circlip. When installing a new circlip, take care not to expand the end gap larger than required to slip the circlip over the shaft. After installing a circlip, always ensure that it is completely seated in its groove and securely fitted.**
- **Use a torque wrench to tighten fasteners to the torque values when specified. Remove grease or oil from screw / bolt threads unless a lubricant is specified.**
- **After assembly, check parts for tightness and operation.**

- **To protect the environment, do not unlawfully dispose of used motor oil, other fluids, and batteries.**
- **To protect the Earth’s natural resources, properly dispose of used motor parts.**

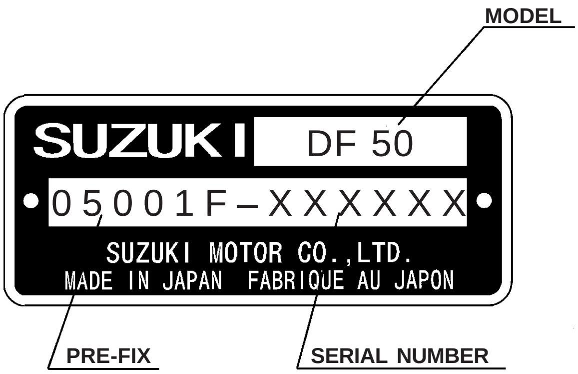
IDENTIFICATION NUMBER LOCATION

MODEL PRE-FIX SERIAL NUMBER

The MODEL, PRE-FIX and SERIAL NUMBER of motor are stamped on a plate attached to the clamp bracket.

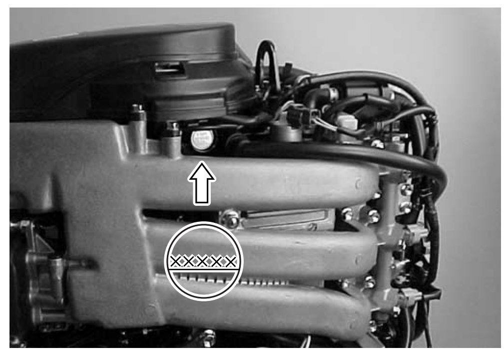


Example



ENGINE SERIAL NUMBER

A second engine serial number plate is pressed into a boss on the cylinder block .



FUEL AND OIL

GASOLINE RECOMMENDATION

Suzuki highly recommends that you use alcohol - free unleaded gasoline with a minimum pump octane rating of 87 (R+M / 2 method) or 91 (Research method). However, blends of unleaded gasoline and alcohol with equivalent octane content may be used.

Allowable maximum blend of a single additive (not combination) :

5% Methanol, 10% Ethanol, 15% MTBE

CAUTION

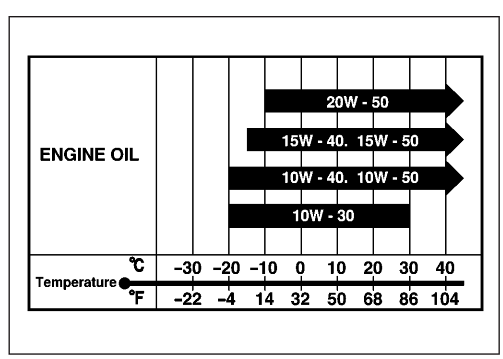
If leaded gasoline is used, engine damage may result. Use only unleaded gasoline.

ENGINE OIL

Use only oils that are rated SE, SF, SG, SH, or SJ under the API (American Petroleum Institute) classification system.

The viscosity rating should be SAE 10W-40.

If an SAE 10W-40 motor oil is not available, select an alternative according to the chart at right.



ENGINE BREAK-IN

The first 10 hours are critically important to ensure correct running of either a brand new motor or a motor that has been reconditioned or rebuilt. How the motor is operated during this time will have direct bearing on its life span and long-term durability.

Break-in period : 10 hours

WARM-UP RECOMMENDATION

Allow sufficient idling time (more than 5 minutes) for the engine to warm up after cold engine starting .

THROTTLE RECOMMENDATION

NOTE:
Avoid maintaining a constant engine speed for an extended period at any time during the engine break-in by varying the throttle position occasionally.

1. FIRST 2 HOURS
   For first 15 minutes, operate the engine in-gear at idling speed.
   During the remaining 1 hour and 45 minutes, operate the engine in-gear at less than 1/2 (half) throttle (3000 r/min).

NOTE:
The throttle may be briefly opened beyond the recommended setting to plane the boat, but must be reduced to the recommended setting immediately after planning.

2. NEXT 1 HOUR
   Operate the engine in-gear at less than 3/4 (three-quarter) throttle (4000 r/min).

3. LAST 7 HOURS
   Operate the engine in-gear at desired engine speed.
   However, do not operate continuously at full throttle for more than 5 minutes.

PROPELLERS

An outboard motor is designed to develop its rated power within a specified engine speed range. The maximum rated power delivered by the DF40 / 50 T models is shown below.

Recommended full throttle speed range	**DF40**	**5200-5800 r / min**
	DF50	**5900-6500 r / min**

If the standard propeller fails to meet the above requirement, use another pitch propeller to hold the engine speed within the range specified above.

Propeller selection chart

Blade	×	Diam. (in.)	×	Pitch (in.)
3	×	11- 1/2	×	9 (S900)
3	×	11- 1/2	×	10 (S1000)
3	×	11- 1/2	×	11 (S1100)
3	×	11- 5/8	×	12 (S1200)
3	×	11- 1/2	×	13 (S1301, SS1300)
3	×	11- 3/8	×	14 (S1400, SS1400)
3	×	11- 1/4	×	15 (S1500)
3	×	11- 1/8	×	16 (S1600, SS1600)
3	×	11	×	17 (S1700)

SPECIFICATIONS

Item		Unit	Data	
			DF40T	DF50T
PRE-FIX			04001F	05001F

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	756 (29.8)
Overall width (side to side)		mm (in)	382 (15.0)
Overall height	S	mm (in)	1263 (49.7)
	L	mm (in)	1390 (54.7)
Weight (without engine oil)	S	kg (lbs)	106 (234)
	L	kg (lbs)	109 (240)
Transom height	S	mm (in. type)	401 (15)
	L	mm (in. type)	528 (20)

PERFORMANCE

Maximum output	kW (PS)	29.4 (40)	36.8 (50)
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx. 850)	

POWERHEAD

Engine type		4-stroke DOHC
Number of cylinders		3
Bore	mm (in)	71.0 (2.80)
Stroke	mm (in)	68.6 (2.70)
Total displacement	cm^3 (cu in)	815 (49.7)
Compression ratio	: 1	10
Spark plug	NGK	DCPR6E
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	
		DF40T	DF50T

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 10W-40
Engine oil amounts	L (US/Imp. qt)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	610 (20.6/21.5)

BRACKET

Trim angle		PTT system
Number of trim position		PTT system
Maximum tilt angle	degree	73°

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	11 : 25 (2.27)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in.) × Pitch (in.)
	3 × 11-1/2 × 9 (S900)
	3 × 11-1/2 × 10 (S1000)
	3 × 11-1/2 × 11 (S1100)
	3 × 11-5/8 × 12 (S1200)
	3 × 11-1/2 × 13 (S1301, SS1300)
	3 × 11-3/8 × 14 (S1400, SS1400)
	3 × 11-1/4 × 15 (S1500)
S : Aluminum propeller	3 × 11-1/8 × 16 (S1600, SS1600)
SS : Stainless steel propeller	3 × 11 × 17 (S1700)

These specifications are subject to change without notice.

SERVICE DATA

Item	Unit	Data	
		DF40T	DF50T

POWERHEAD

Item	Unit	DF40T	DF50T
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx.850)	
**Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1600 (13 – 16, 185 – 228)	
**Cylinder compression max. difference between any two cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)	
**Engine oil pressure	kPa (kg/cm^2, psi)	300 – 380 (3.0 – 3.8, 43 – 54) at 4000 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)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change	
Thermostat operating temperature	°C (°F)	48 – 52 (118 – 126)	

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

Item			Unit	Data DF40T	Data DF50T

ENGINE OIL PUMP

Radial clearance		Limit	mm (in)	0.31 (0.012)	
Side clearance		Limit	mm (in)	0.15 (0.006)	

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	mm (in)	37.530–37.690 (1.4776–1.4839)	38.230–38.390 (1.5051–1.5114)
		Limit	mm (in)	37.430 (1.4736)	38.130 (1.5012)
	EX	STD	mm (in)	37.740–37.900 (1.4858–1.4921)	37.740–37.900 (1.4858–1.4921)
		Limit	mm (in)	37.640 (1.4819)	37.640 (1.4819)
Camshaft journal oil clearance		STD	mm (in)	0.045 – 0.087 (0.0018 – 0.0034)	
		Limit	mm (in)	0.120 (0.0047)	
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)	
		Limit	mm (in)	23.171 (0.9122)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.934 – 22.955 (0.9029 – 0.9037)	
		Limit	mm (in)	22.784 (0.8970)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.062 (0.0010 – 0.0024)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	26.959 – 26.975 (1.0614 – 1.0620)	
Cylinder head bore		STD	mm (in)	27.000 – 27.021 (1.0630 – 1.0638)	

Item			Unit	Data	
				DF40T	DF50T

VALVE / VALVE GUIDE

Item			Unit	DF40T / DF50T
Valve diameter	IN		mm (in)	24.6 (0.97)
	EX		mm (in)	21.5 (0.85)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)
	EX	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)
Valve seat angle	IN		degree	30°, 45°
	EX		degree	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)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN,EX	STD	mm (in)	11.0 (0.43)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem end length	IN,EX	Limit	mm (in)	3.20 (0.126)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	EX	Limit	mm (in)	0.18 (0.007)
Valve stem runout	IN,EX	Limit	mm (in)	0.05 (0.002)
Valve head radial runout	IN,EX	Limit	mm (in)	0.08 (0.003)
Valve head thickness	IN	STD	mm (in)	1.0 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.15 (0.045)
		Limit	mm (in)	0.5 (0.02)
Valve seat contact width	IN	STD	mm (in)	1.80 – 2.20 (0.071 – 0.087)
	EX	STD	mm (in)	1.65 – 2.05 (0.065 – 0.081)
Valve spring free length		STD	mm (in)	33.1 (1.30)
		Limit	mm (in)	31.8 (1.25)
Valve spring tension		STD	N (kg, lbs)	97 – 113 (9.7–11.3, 21.4–24.9) for 28.5 mm (1.12 in)
		Limit	N (kg, lbs)	89 (8.9, 19.6) for 28.5 mm (1.12 in)
Valve spring sequareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF40T	DF50T

CYLINDER / PISTON / PISTON RING

Item			Unit	DF40T	DF50T
Cylinder distortion		Limit	mm (in)	0.060 (0.0024)	
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)	71.000 – 71.020 (2.7953 – 2.7961)	
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface	
Piston skirt diameter		STD	mm (in)	70.970 – 70.990 (2.7941 – 2.7949)	
Piston measuring position			mm (in)	19 (0.7) from piston skirt end	
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)	
Piston ring end gap	1st	STD	mm (in)	0.10 – 0.25 (0.004 – 0.010)	
		Limit	mm (in)	0.70 (0.028)	
	2nd	STD	mm (in)	0.25 – 0.40 (0.010 – 0.016)	
		Limit	mm (in)	1.00 (0.039)	
Piston ring free end gap	1st	STD	mm (in)	Approx. 7.5 (0.30)	
		Limit	mm (in)	6.0 (0.24)	
	2nd	STD	mm (in)	Approx. 11.0 (0.43)	
		Limit	mm (in)	8.8 (0.35)	
Piston ring to groove clearance	1st	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)	
		Limit	mm (in)	0.10 (0.004)	
	2nd	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)	
		Limit	mm (in)	0.10 (0.004)	
Piston ring groove width	1st	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)	
	2nd	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)	
	Oil	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)	
Piston ring thickness	1st	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)	
	2nd	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)	
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.018 (0.0002 – 0.0007)	
		Limit	mm (in)	0.040 (0.0016)	
Piston pin outside diameter		STD	mm (in)	17.996 – 18.000 (0.7085 – 0.7087)	
		Limit	mm (in)	17.980 (0.7079)	
Piston pin hole diameter		STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)	
		Limit	mm (in)	18.040 (0.7102)	
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.015 (0.0001 – 0.0006)	
		Limit	mm (in)	0.050 (0.0020)	
Conrod small end bore		STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)	

Item		Unit	Data DF40T	Data DF50T

CRANKSHAFT / CONROD

Item		Unit	DF40T / DF50T
Conrod small end inside diameter	STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)
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)	41.000 – 41.018 (1.6142 – 1.6149)
Crank pin outside diameter	STD	mm (in)	37.982 – 38.000 (1.4954 – 1.4961)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.486 – 1.502 (0.0585 – 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 (0.002)
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)	49.000 – 49.018 (1.9291 – 1.9298)
Crankshaft journal outside diameter	STD	mm (in)	44.982 – 45.000 (1.7709 – 1.7717)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.999 – 2.015 (0.0787 – 0.0793)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.470 – 2.520 (0.0972 – 0.0992)

LOWER UNIT

Design specification thickness for shim & washer

Pinion gear back-up shim	mm (in)	1.0 (0.04)
Forward gear back-up shim	mm (in)	1.0 (0.04)
Forward gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear back-up shim	mm (in)	1.0 (0.04)

Item		Unit	Data	
			DF40T	DF50T

ELECTRICAL

Item		Unit	DF40T	DF50T
Ignition timing		Degrees at r/min	BTDC 0° – BTDC 32°	BTDC 0° – BTDC 25°
Over revolution limiter		r/min	6500	7000
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	8.1 – 11.1	
Battery charge coil resistance		Ω at 20°C	0.56 – 0.84	
Battery charge coil output (12V)		Watt	216	
Standard spark plug	Type	NGK	DCPR 6E	
	Gap	mm (in)	0.8 – 0.9 (0.031 – 0.035)	
Fuse amp. rating		A	Main fuse : 30 Fuel pump fuse : 15	
Recommended battery capacity (12V)		Ah (kC)	70 (252) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	21.5 – 32.3	
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 motor relay resistance		Ω at 20°C	3.5 – 5.1	
PTT motor relay resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

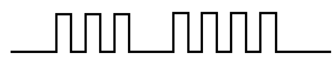
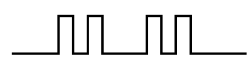
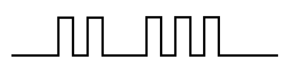
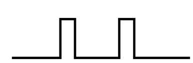
Item		Unit	Data
Max. continuous time of use		Sec.	30
Motor output		kW	0.9
Brush length	STD	mm (in)	17.0 (0.67)
	Limit	mm (in)	10.0 (0.39)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	33.0 (1.30)
	Limit	mm (in)	32.0 (1.26)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)
Pinion to ring gear gap	STD	mm (in)	3.0 – 5.0 (0.12 – 0.20)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	4.8 (0.19)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	21.0 (0.83)

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 	NO
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 (Sensor hose)	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

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

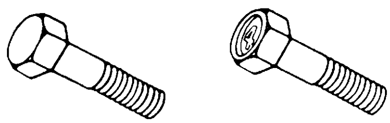
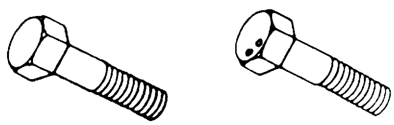
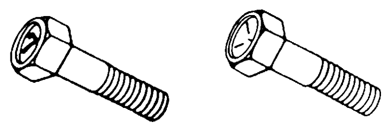
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

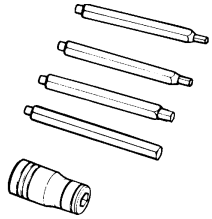
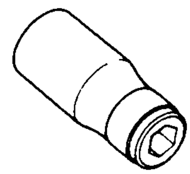
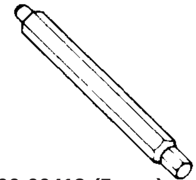
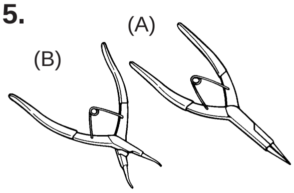
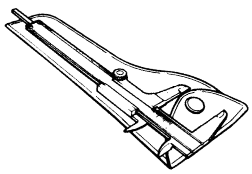
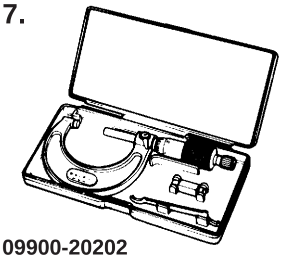
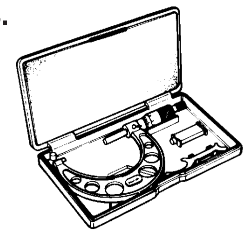
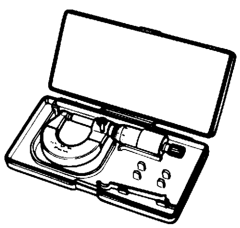
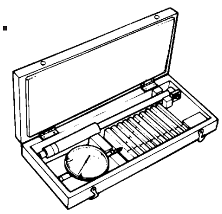
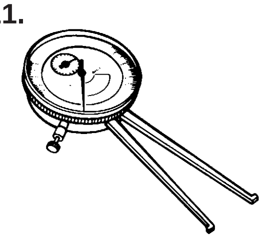
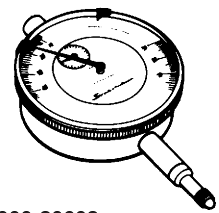
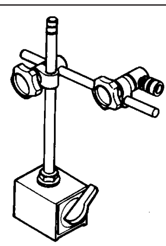
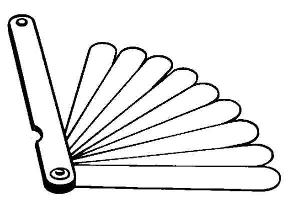
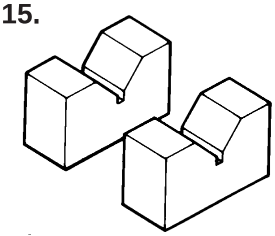
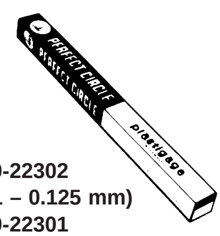
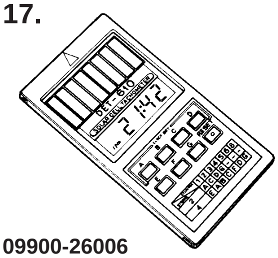
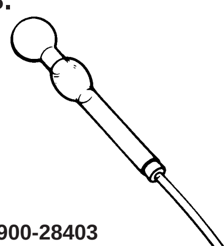
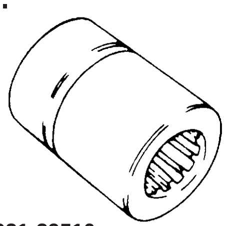
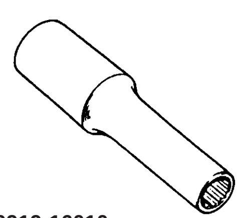
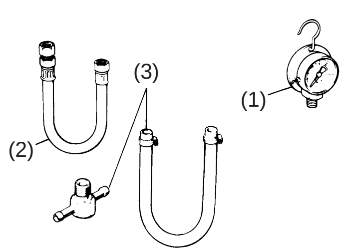
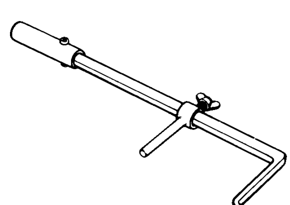
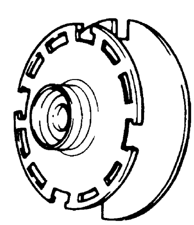
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft.
Cylinder head cover bolt		6 mm	10	1.0	7.0
Cylinder head bolt		10 mm	60	6.0	43.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	53	5.3	38.5
Conrod cap nut		8 mm	35	3.5	25.5
Camshaft housing bolt		6 mm	10	1.0	7.0
Camshaft timing sprocket bolt		6 mm	10	1.0	7.0
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		6 mm	11	1.1	8.0
		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Intake manifold fuel main gallery	3-way joint bolt	6 mm	10	1.0	7.0
	Upper/lower plug	——	35	3.5	25.5
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	200	20.0	144.5
Starter motor mounting bolt		8 mm	23	2.3	16.5
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt/nut		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		10 mm	40	4.0	29.0
Upper mount cover bolt		8 mm	23	2.3	16.5
Lower mount nut	Front	12 mm	60	6.0	43.5
	Rear	12 mm	40	4.0	29.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case nut		6 mm	8	0.8	6.0
Gearcase bolt		8 mm	23	2.3	16.5
Propeller shaft bearing housing bolt		8 mm	17	1.7	12.5
Pinion nut		12 mm	50	5.0	36.0
Propeller nut		18 mm	55	5.5	40.0

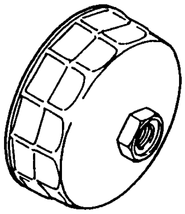
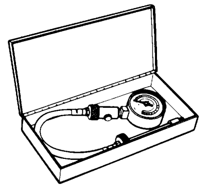
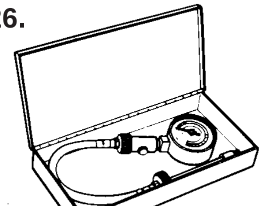
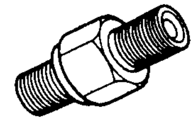
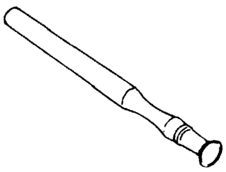
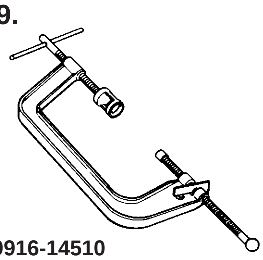
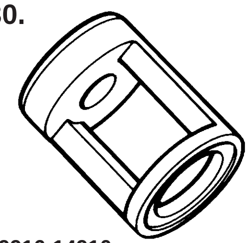
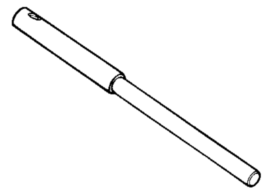
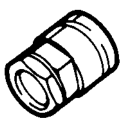
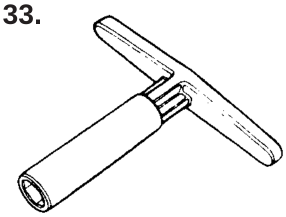
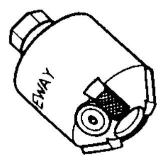
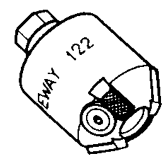
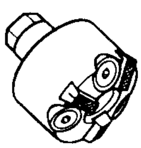
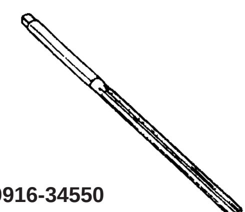
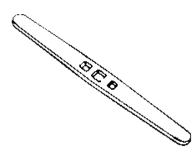
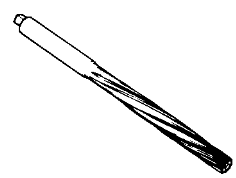
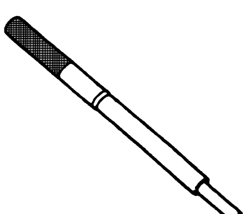
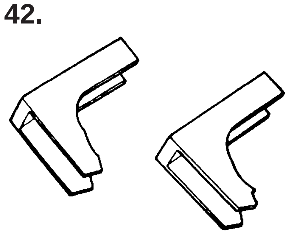
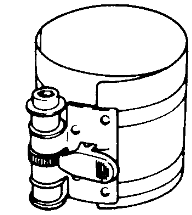
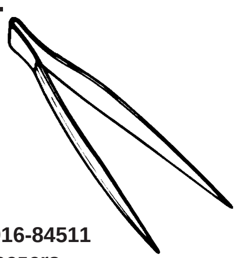
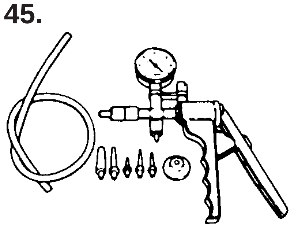
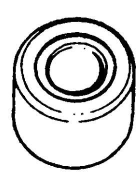
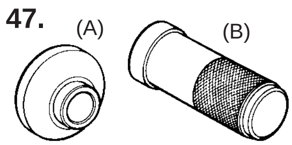
Tightening torque – general bolt

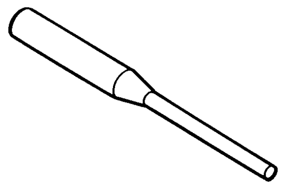
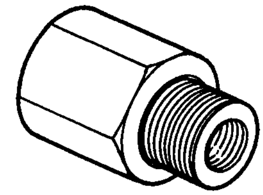
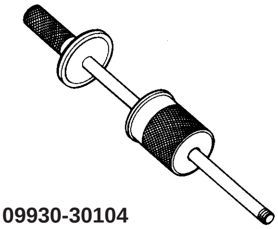
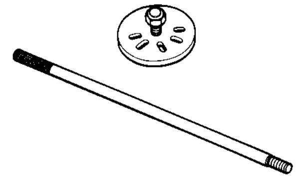
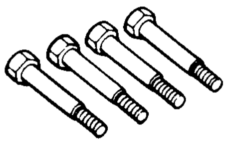
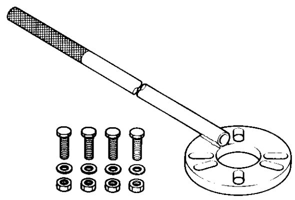
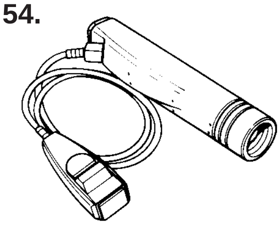
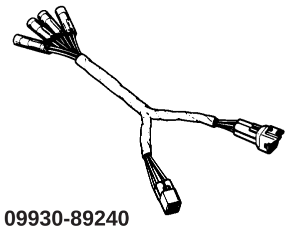
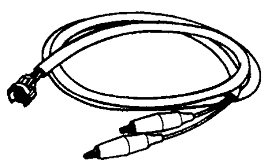
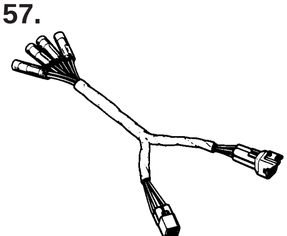
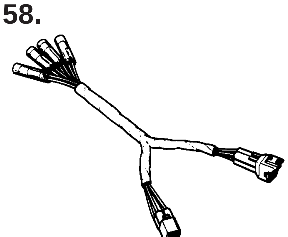
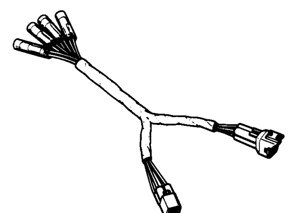
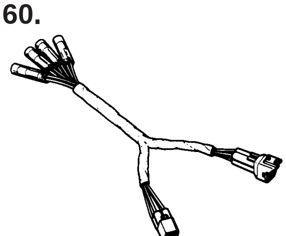
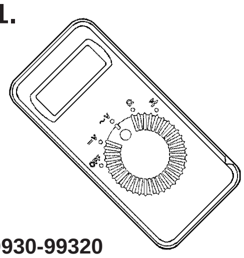
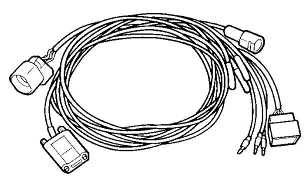
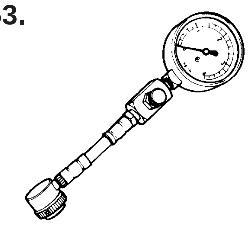
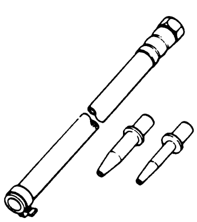
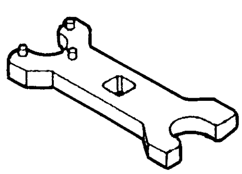
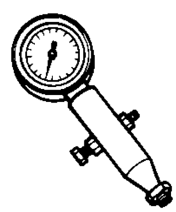
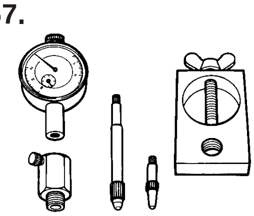
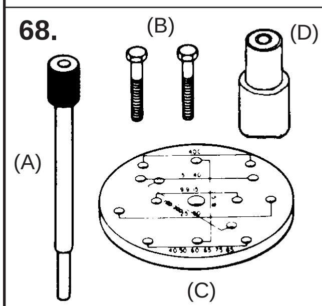
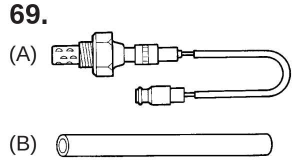
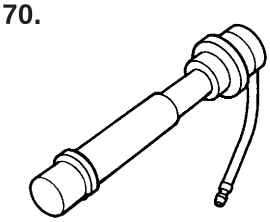
NOTE:
These values are only applicable when torque for a general bolt is not listed in the "Important Fasteners" table.

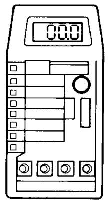
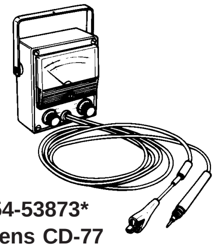
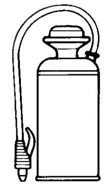
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb.-ft.
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
(Conventional or "4" marked bolt)	10 mm	22 – 35	2.3 – 3.5	16.0 – 25.5
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 10	0.6 – 1.0	4.5 – 7.0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

SPECIAL TOOLS

1.	**2.**  **09900-00410** **Hexagon wrench set**	**3.**  **09900-00411** **Hexagon socket** **(included in 09900-00410)**	**4.**  **09900-00413 (5 mm)** **09900-00414 (6 mm)** **Hexagon bit** **(included in 09900-00410)**
5.  **(A) 09900-06107** **(B) 09900-06108** **Snap ring pliers**	**6.**  **09900-20101 (150 mm)** **09900-20102 (200 mm)** **Vernier calipers**	**7.**  **09900-20202** **Micrometer (25 – 50 mm)**	**8.**  **09900-20203** **Micrometer (50 – 75 mm)**
9.  **09900-20205** **Micrometer (0 – 25 mm)**	**10.**  **09900-20508** **Cylinder gauge set** **(40 – 80 mm)**	**11.**  **09900-20605** **Dial calipers (10 – 34 mm)**	**12.**  **09900-20602** **Dial gauge**
13.  **09900-20701** **Magnetic stand**	**14.**  **09900-20803** **Thickness gauge**	**15.**  **09900-21304** **Steel "V" block set**	**16.**  **09900-22302** **(0.051 – 0.125 mm)** **09900-22301** **(0.025 – 0.076 mm)** **Plastigauge**
17.  **09900-26006** **Engine tachometer**	**18.**  **09900-28403** **Hydrometer**	**19.**  **09921-29510** **Driveshaft holder**	**20.**  **09919-16010** **Deep socket wrench**
21. **(1) 09912-58442** **Fuel pressure gauge** **(2) 09912-58432** **Fuel pressure hose** **(3) 09912-58490** **3-way joint & hose**		**22.**  **09913-50121** **Oil seal remover**	**23.**  **09914-79410** **Test wheel**

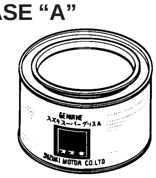
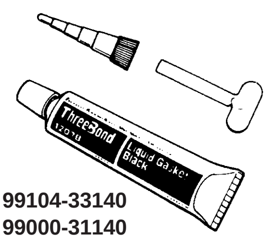
24.  **09915-47340** **Oil filter wrench**	**25.**  **09915-64512** **Compression gauge** **09915-63210** **Adaptor**	**26.**  **09915-77310** **Oil pressure gauge**	**27.**  **09915-78211** **Oil pressure gauge adapter**
28.  **09916-10911** **Valve lapper**	**29.**  **09916-14510** **Valve lifter**	**30.**  **09916-14910** **Valve lifter attachment**	**31.**  **09916-24450** **Solid pilot (N-100-5.52)**
32.  **09916-24440** **Handle adaptor** **(N-503-1)**	**33.**  **09916-54910** **Handle (N-505)**	**34.**  **09916-20630** **Valve seat cutter** **(Neway 126)**	**35.**  **09916-20620** **Valve seat cutter** **(Neway 122)**
36.  **09916-20610** **Valve seat cutter** **(Neway 121)**	**37.**  **09916-34550** **Valve guide reamer** **(ϕ 5.5 mm)**	**38.**  **09916-34542** **Valve guide reamer handle**	**39.**  **09916-37320** **Valve guide reamer** **(ϕ 10.5 mm)**
40.  **09916-44310** **Valve guide remover**	**41.**  **09916-57330** **Valve guide installer**	**42.**  **09916-67010** **Tappet holder**	**43.**  **09916-77310** **Piston ring compressor**
44.  **09916-84511** **Tweezers**	**45.**  **09917-47011** **Vacuum pump gauge**	**46.**  **09917-87010** **Valve guide installer attachment**	**47.**  **(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.**  09930-30104 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.**  09930-89910 4-pin connector test cord	**58.**  09930-89920 6-pin connector test cord	**59.**  09930-89930 8-pin connector test cord
60.  09930-89940 12-pin connector test cord	**61.**  09930-99320 Digital tester	**62.**  09932-79910 Diagnostic harness	**63.**  09940-44121 Air pressure gauge
64.  09940-44130 Attachment	**65.**  09944-08711 PTT cylinder cap tool	**66.**  09950-69512 Gearcase oil leakage tester	**67.**  09951-09511 Gear adjusting gauge
68.  	Pinion bearing installer and remover (A) 09951-59910 Pinion bearing installer shaft (B) 01500-08403 Bolt (C) 09951-39914 Pinion bearing plate (D) 09951-19431 Attachment	**69.**  (A) 18213-74F00 O_2 sensor (B) 18498-99E70 Protector	**70.**  09930-88720 H·T cord adapter

71.	72.	73 .
		
99954-53008-820* **Digital voltmeter**	**99954-53873*** **Stevens CD-77** **Peak reading voltmeter**	**99954-53883*** **Gear oil filler**

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

MATERIALS REQUIRED

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

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

PERIODIC MAINTENANCE

CONTENTS

PERIODIC MAINTENANCE SCHEDULE

The chart below lists the recommended intervals for all the required periodic service work necessary to keep the motor operating at peak performance and economy.
Maintenance intervals should be judged by number of hours or months, whichever comes first.

NOTE:
More frequent servicing should be performed on outboard motors that are used under severe conditions.

PERIODIC MAINTENANCE CHART

Interval / Item to be serviced	Initial 20 hrs. or 1 month	Every 50 hrs. or 3 months	Every 100 hrs. or 6 months	Every 200 hrs. or 12 months
Spark plug	—	—	I	R
Breather Hose & Fuel line	I	I	I	I
	Replace every 2 years			
Engine oil	R	—	R	R
Gear oil	R	—	R	R
Lubrication	—	I	I	I
Anodes & Bonding wires	—	I	I	I
Battery	—	I	I	I
Fuel mixture check (O_2 feedback)	Perform every 2 years.			
Engine oil filter	R	—	—	R
Low pressure fuel filter	—	I	I	I
	Replace every 400 hours or 2 years.			
High pressure fuel filter	Replace every 1000 hours.			
Ignition timing	—	—	—	I
Idle Speed	I	—	—	I
Tappet clearance	I	—	—	I
Water pump	—	—	—	I
Water pump impeller	—	—	—	R
Propeller nut & pin	I	—	I	I
Bolt & Nuts	T	—	T	T

I : Inspect and clean, adjust, lubricate, or replace, if necessary **T :** Tighten **R :** Replace

MAINTENANCE AND TUNE-UP PROCEDURES

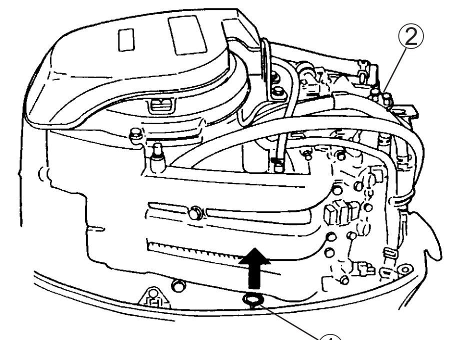
This section describes the servicing procedures for each of the periodic maintenance requirements.

ENGINE OIL / ENGINE OIL FILTER

ENGINE OIL LEVEL CHECK

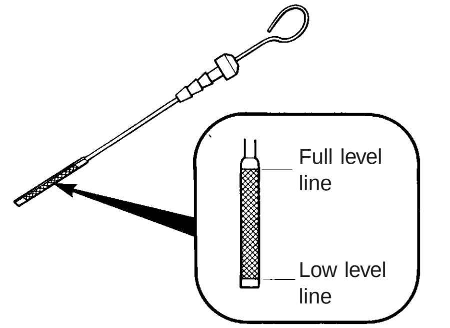
Inspect oil level before every use.

(1) Place the outboard motor upright on a level surface.
(2) Remove the motor cover.
(3) Remove the oil level dipstick and wipe it clean.
(4) Insert it fully into the dipstick hole, then remove it to check oil level.



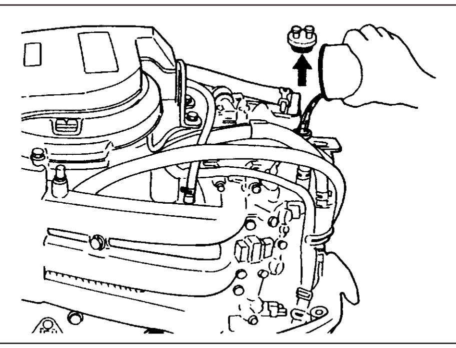
①Oil level dipstick
②Oil filler cap

(5) Oil level should be between the full level line (Max.) and low level line (Min.)



If the level is low, add recommended oil to full level line.

Recommended oil :
- **4 stroke motor oil**
- **API classification SE, SF, SG, SH, SJ.**
- **Viscosity rating SAE 10 W-40.**



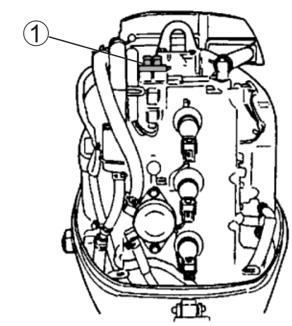
ENGINE OIL CHANGE / ENGINE OIL FILTER REPLACEMENT

ENGINE OIL **Change initially after 20 hours (1 month) and every 100 hours (6 months) thereafter.**

ENGINE OIL FILTER **Replace initially after 20 hours (1 month) and every 200 hours (12 months) thereafter.**

NOTE:
- *Engine oil should be changed while the engine is warm.*
- *When replacing the engine oil filter, change engine oil at the same time.*

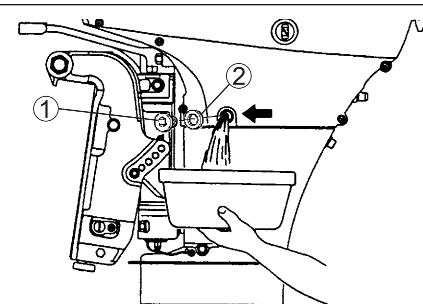
1. Place the outboard motor upright on a level surface.
2. Remove the oil filler cap.



①Oil filler cap

3. Place a container under the engine oil drain plug.

4. Remove the engine oil drain plug and gasket to drain engine oil.



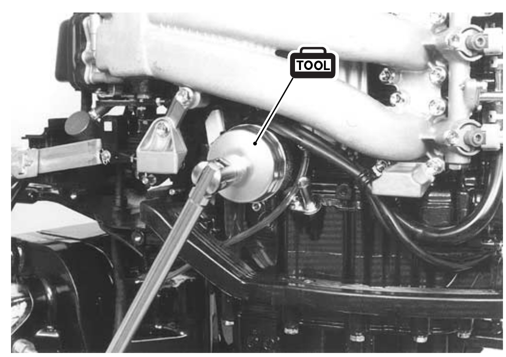
①Oil drain plug ②Gasket

5. ENGINE OIL FILTER REPLACEMENT

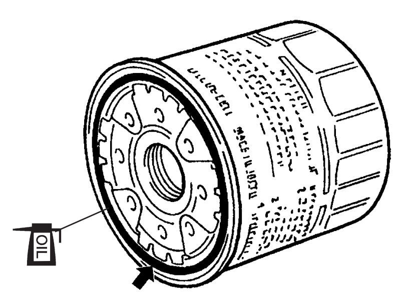
NOTE:
For engine oil change only, go to step 6.

To replace the engine oil filter :
(1) Remove the PORT side lower cover. (See page 7-1)
(2) Using oil filter wrench, loosen the oil filter.

TOOL 09915-47340 : Oil filter wrench

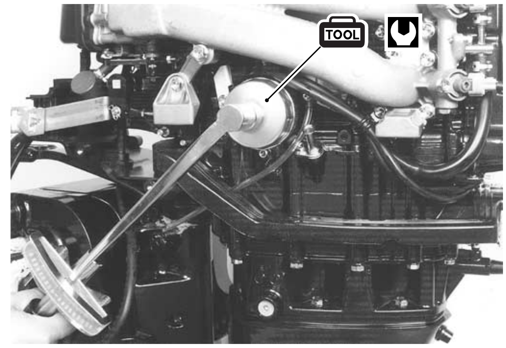


NOTE:
Before fitting new oil filter, be sure to oil O-ring.



(3) Screw new filter on by hand until the filter O-ring contacts the Mounting surface.

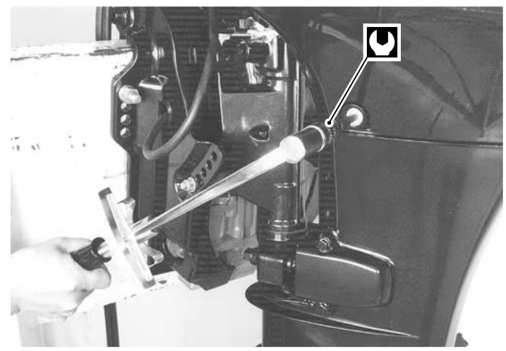
(4) Tighten the filter 3/4 turn from the point of contact with the mounting surface using an oil filter wrench.



Engine oil filter : 14 N · m (1.4 kg-m, 10.0 lb.-ft.), 3/4 turn.

(5) Install the PORT side lower cover.

6. Install the gasket and the oil drain plug.
   Tighten the engine oil drain plug to the specified torque.

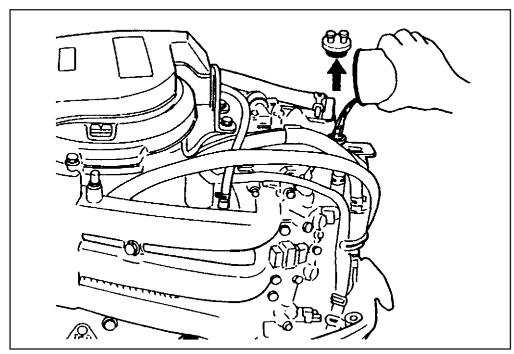


Engine oil drain plug : 13N · m (1.3 kg-m, 9.5 lb.-ft.)

CAUTION

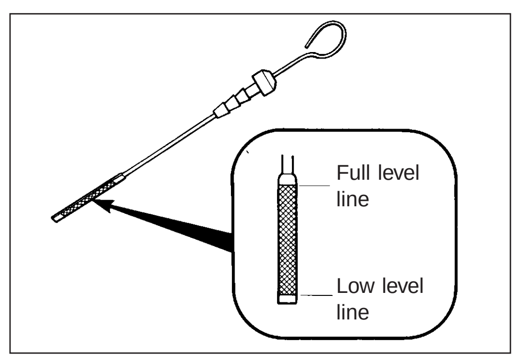
Do not re-use gasket. Always replace with a new gasket.

7. Pour recommended engine oil into the oil filler opening, then install the oil filler cap.



Engine oil amounts
Oil change only : 2.2L (2.3 / 1.9 US / Imp. qt)
Oil filter change : 2.4L (2.5 / 2.1 US / Imp. qt)

8. Start the engine and allow it to run for several minutes at idle speed.
   Check oil filter for oil leakage.
   Turn off the engine and wait for approx. two minutes, then re-check the engine oil level.

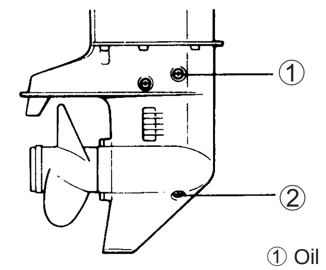


GEAR OIL

Change initially after 20 hours (1 month) and every 100 hours (6 months) thereafter.

(1) Place the outboard motor upright on a level surface.
(2) Place a container under the lower unit.

(3) Remove the lower gear oil drain plug before the gear oil level plug and drain the gear oil.

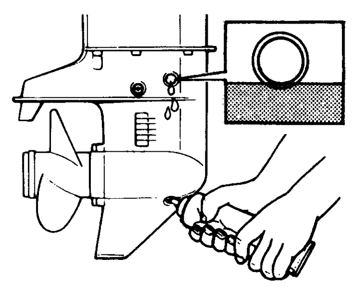


① Oil level plug
② Oil drain plug

(4) Fill with the recommended gear oil through the oil drain hole until oil just starts to flow out from the oil level hole.

Gear oil amount : 610 ml (20.6 / 21.5 US / Imp. oz)

Recommended oil :
Suzuki Outboard Motor Gear Oil or SAE # 90
Hypoid gear oil



(5) Install the oil level plug before removing the oil filler tube from the drain hole.

(6) Install the oil drain plug.

CAUTION

Do not re-use gaskets. Always use a new gasket.

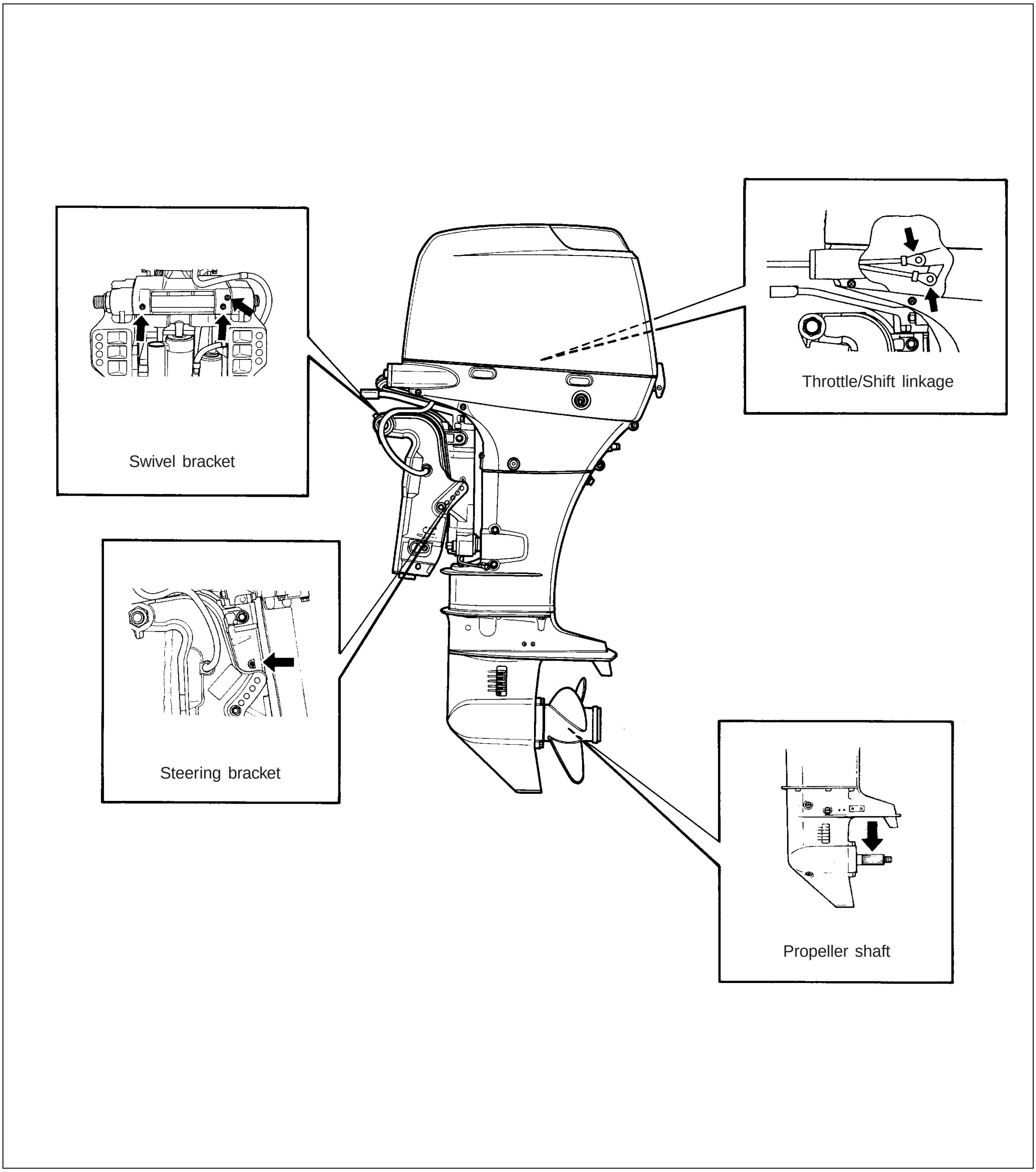
NOTE:
To avoid insufficient injection of gear oil, check the oil gear level 10 minutes after doing the procedure in the step (6). If the oil level is low, slowly inject the gear oil up to the correct level.

LUBRICATION

Inspect every 50 hours (3 months).

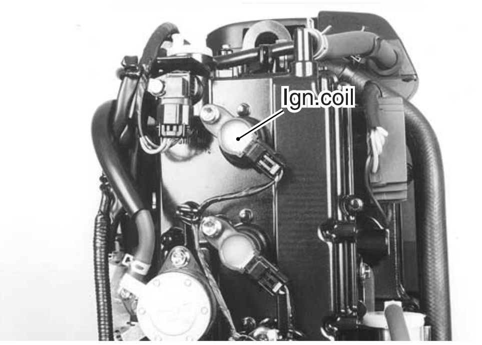
Apply Suzuki Water Resistant Grease to the following points.

W/R G's **99000-25160 : Water Resistant Grease**



SPARK PLUG

- **Inspect every 100 hours (6 months).**
- **Replace every 200 hours (12 months).**



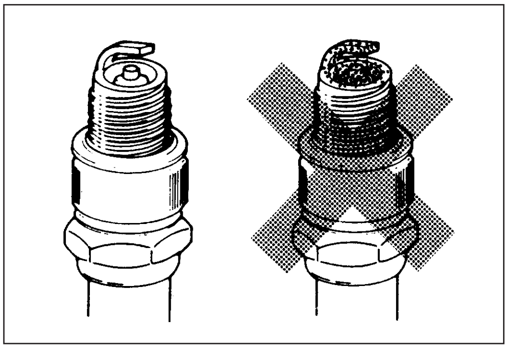
Standard spark plug : NGK DCPR6E

CAUTION

Only resistor (R) type spark plugs must be used with this engine. Using a non-resistor spark pligs will cause ignition and fuel injection system malfunctions.

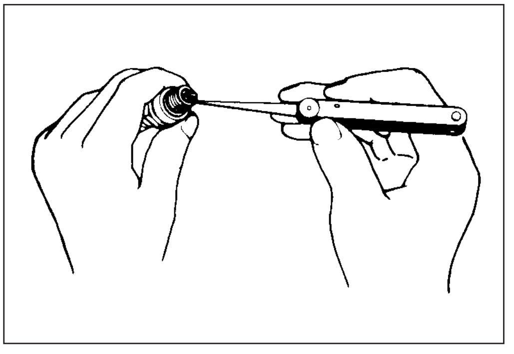
CARBON DEPOSIT

Check for a carbon deposit on the spark plug bases.
If carbon is present, remove it with a spark plug cleaning machine or by carefully using a pointed tool.



SPARK PLUG GAP

Use a thickness gauge to measure for correct spark plug gap. Adjust to within the specified range if the gap is out of specification.

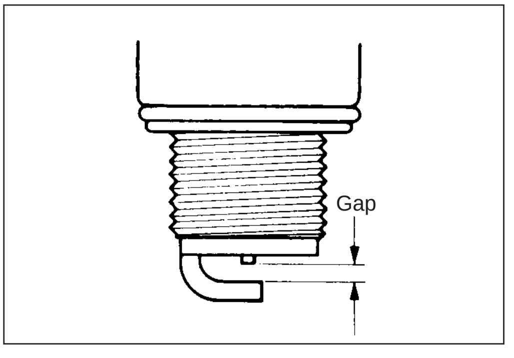


Spark plug gap : 0.8 – 0.9 mm (0.031 – 0.035 in.)

TOOL **09900-20803 : Thickness gauge**

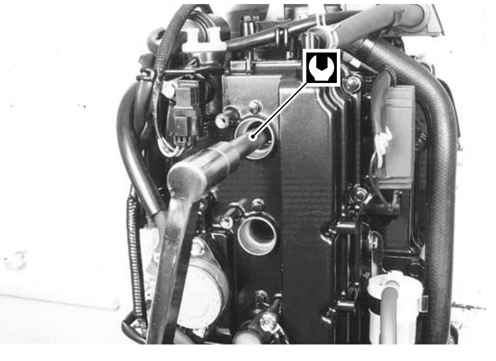
CONDITION OF ELECTRODE

Check the electrode for a worn or burnt condition.
If it is extremely worn or burnt, replace the spark plug.
Also, be sure to replace the plug if it has a broken insulator, damaged thread, etc.



CAUTION

Confirm the thread size and reach when replacing the plug. If the reach is too short, carbon will be deposited on the threaded portion of the plug hole resulting in possible engine damage.



Spark plug : 18 N · m (1.8 kg-m, 13.0 lb.-ft.)

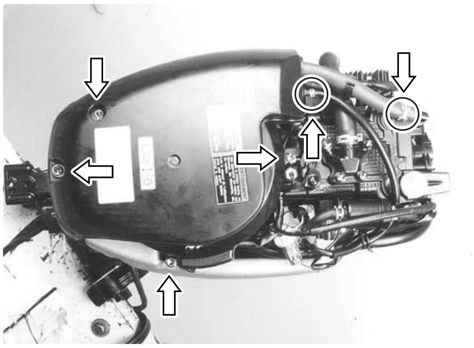
TAPPET CLEARANCE

Inspect initially after 20 hours (1 month) and every 200 hours (12 months) thereafter

The tappet clearance specification is the same for both intake and exhaust valves.
Too small a tappet clearance may reduce engine power, too large a tappet clearance increases valve noise and hastens valve and seat wear.
When the tappets are set to the specified clearance, the engine will run without excessive noise from the valve mechanism and will deliver full power. In this engine, the tappet clearance is increased or decreased by replacing the shim disc, made of a special wear resistant material, fitted to the top of the tappet.
The shim discs are easy to remove and refit.
Tappet clearance adjustment must be checked and adjusted:
- at the time of periodic inspection
- when the valve mechanism is serviced
- when the camshafts are disturbed by removing them for inspection

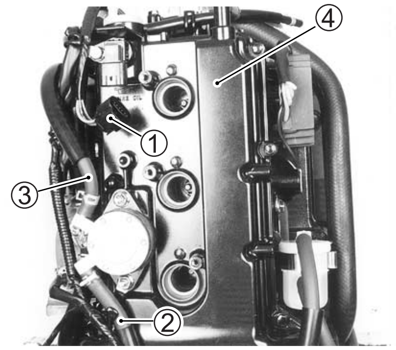
CHECKING AND ADJUSTING TAPPET CLEARANCE

(1) Remove following parts :
- Engine side lower cover (see page 7-1)
- Flywheel cover
- Ignition coils
- Spark plugs

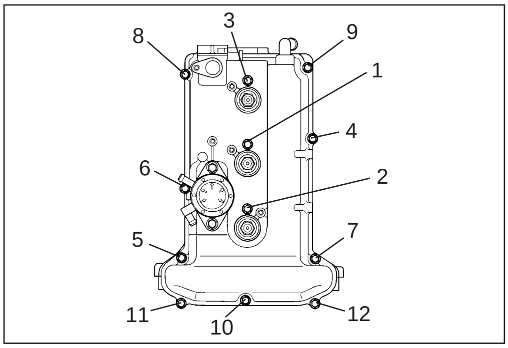


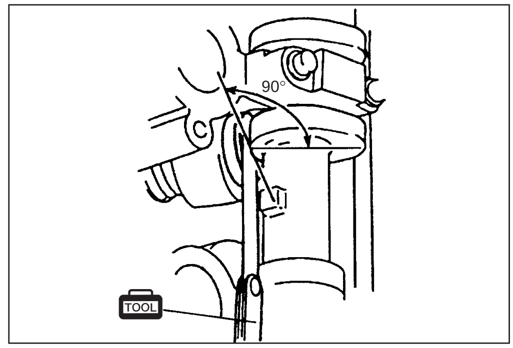
(2) Disconnect camshaft sensor lead ①.

(3) Remove fuel hose (intake and outlet)②·③ from low fuel pump.



(4) Remove the twelve bolts securing the cylinder head cover ④ to the cylinder head and remove cylinder head cover.





(5) Rotate crankshaft clockwise to bring cam nose vertical to shim surface.

(6) Measure tappet clearances by inserting thickness gauge between cam and shim surface.

Tappet clearance (cold engine condition) :
IN. : 0.18 – 0.24 mm (0.007 – 0.009 in.)
EX. : 0.18 – 0.24 mm (0.007 – 0.009 in.)

TOOL **09900-20803 : Thickness gauge**

CAUTION

Rotate crankshaft clockwise to prevent water pump impeller damage.

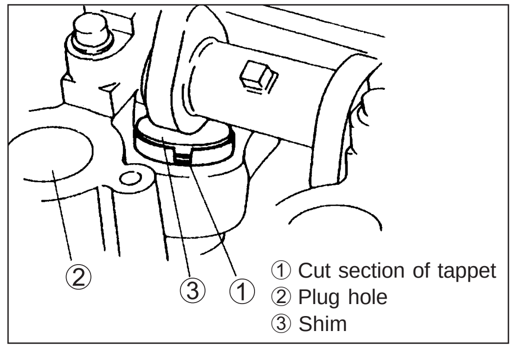
NOTE:
- *Rotate crankshaft and measure clearance for each tappet respectively by bringing cam nose vertical to shim surface.*
- *All tappet clearances can be measured during two turns of crankshaft.*

(7) If out of specification, adjust tappet clearance by changing shim.

ADJUSTMENT

Tappet clearances are adjusted by replacing tappet shim.

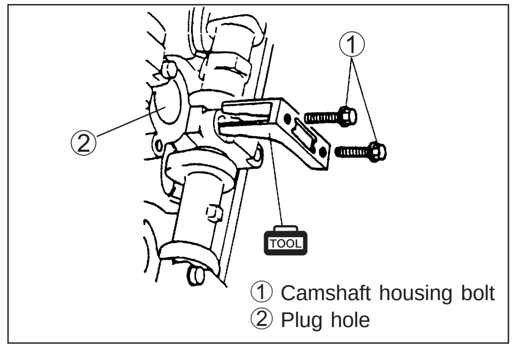
(1) Close valve and turn tappet cut-away toward inside as shown in figure.



① Cut section of tappet
② Plug hole
③ Shim

(2) Rotate crankshaft to open (lift up) the valve and then remove camshaft housing bolts where the shim to be replaced.

(3) Install special tool with camshaft housing bolts as shown in figure.

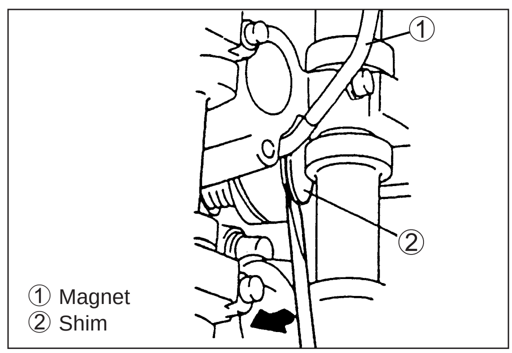


① Camshaft housing bolt
② Plug hole

TOOL **09916-67010 : Tappet holder**

NOTE:
Index mark "IN" on the tappet holder is for intake side, while "EX" is for exhaust side.

(4) Rotate top of cam 90 degree clockwise and remove shim from cut-away at tappet.
(Two tappets can be adjusted at the same time)

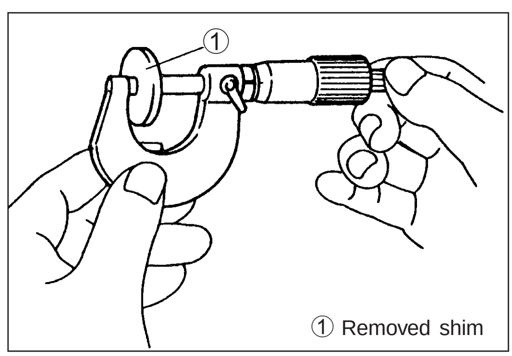


① Magnet
② Shim

CAUTION

- **Do not put your finger between camshaft and tappet while the tappet is being held with the tappet holder.**
- **Use a magnet to remove and install shim.**
- **When installing shim, identification mark on the shim must face towards tappet side.**

(5) After removing shim, measure thickness of original shim and determine correct thickness of shim for proper tappet clearance as calculated by the following formula.



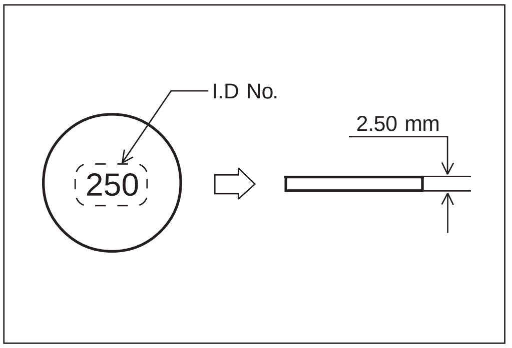
① Removed shim

TOOL **09900-20205 : Micrometer**

A = B + (C – 0.20 mm)

A : Correct thickness of shim for proper tappet clearance (mm)
B : Thickness of original shim (mm)
C : Original tappet clearance (mm)

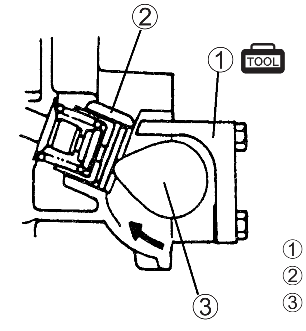
I.D No.	Thickness (mm)	I.D No.	Thickness (mm)	I.D No.	Thickness (mm)
218	2.18	246	2.46	274	2.74
220	2.20	248	2.48	276	2.76
222	2.22	250	2.50	278	2.78
224	2.24	252	2.52	280	2.80
226	2.26	254	2.54	282	2.82
228	2.28	256	2.56	284	2.84
230	2.30	258	2.58	286	2.86
232	2.32	260	2.60	288	2.88
234	2.34	262	2.62	290	2.90
236	2.36	264	2.64	292	2.92
238	2.38	266	2.66	294	2.94
240	2.40	268	2.68	296	2.96
242	2.42	270	2.70	298	2.98
244	2.44	272	2.72	300	3.00



(6) Install shim. Identification number must face towards tappet.

(7) Rotate crankshaft to be open (lift up) valve.

(8) Remove tappet holder ① and tighten camshaft housing bolts to the specified torque.

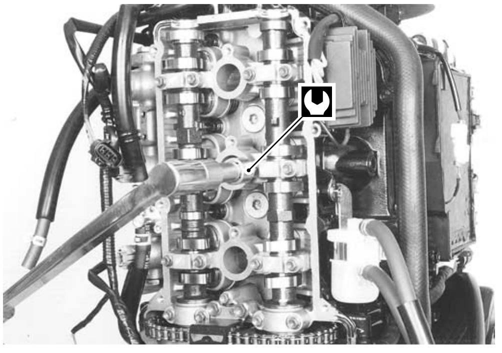


① Special tool
② Tappet
③ Camshaft

Camshaft housing bolt :

10 N · m (1.0 kg-m, 7.0 lb.- ft.)

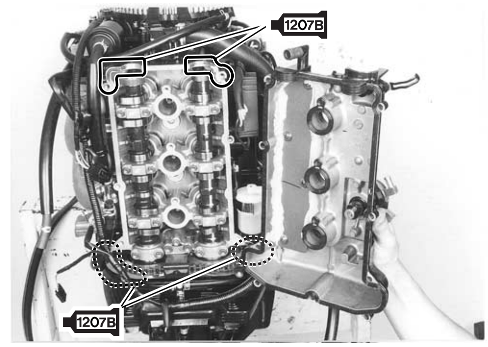
(9) Recheck tappet clearance.



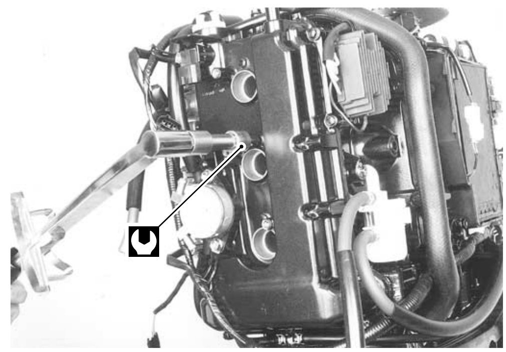
NOTE:
After completing tappet clearance adjustment and securing camshaft housing bolts, inspect tappet clearance again.

INSTALLATION

After checking and adjusting all tappet clearances, install the cylinder head cover. Installation is reverse order of removal.
(See page 6-8)



Cylinder head cover bolts :
10 N · m (1.0 kg-m, 7.0 lb.-ft.)



TAPPET SHIM SELECTION CHART

Shim I.D. No.	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300
Present shim size (mm) / Tappet clearance (mm)	2.18	2.20	2.22	2.24	2.26	2.28	2.30	2.32	2.34	2.36	2.38	2.40	2.42	2.44	2.46	2.48	2.50	2.52	2.54	2.56	2.58	2.60	2.62	2.64	2.66	2.68	2.70	2.72	2.74	2.76	2.78	2.80	2.82	2.84	2.86	2.88	2.90	2.92	2.94	2.96	2.98	3.00
0.00 – 0.04										218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282
0.05 – 0.09								218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286
0.10 – 0.14					218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292
0.15 – 0.17			218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296
0.18 – 0.24	SPECIFIED CLEARANCE / NO ADJUSTMENT REQUIRED																																									
0.25 – 0.29	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300			
0.30 – 0.34	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300						
0.35 – 0.39	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300								
0.40 – 0.44	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300											
0.45 – 0.49	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300													
0.50 – 0.54	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300																
0.55 – 0.59	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300																		
0.60 – 0.64	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300																					
0.65 – 0.69	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300																							
0.70 – 0.74	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300																										
0.75 – 0.79	274	276	278	280	282	284	286	288	290	292	294	296	298	300																												
0.80 – 0.84	280	282	284	286	288	290	292	294	296	298	300																															
0.85 – 0.89	284	286	288	290	292	294	296	298	300																																	
0.90 – 0.94	290	292	294	296	298	300																																				
0.95 – 0.99	294	296	298	300																																						

1. Measure tappet clearance “Engine cold”.
2. Measure present shim size.
3. Match clearance in vertical column with present shim size in horizontal column

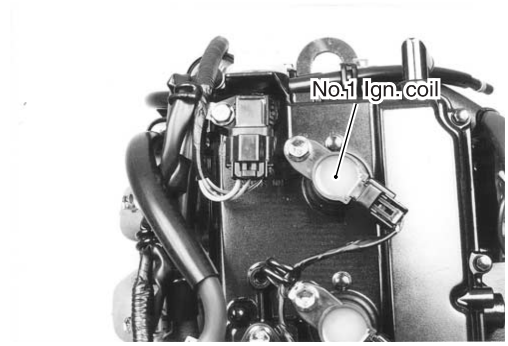
[EXAMPLE]
Tappet clearance is — 0.35 mm
Present shim size — 2.40 mm
Shim size to be used — 2.56 mm

IDLE SPEED

Inspect initially after 20 hours (1 month) and every 200 hours (12 months) thereafter.

NOTE:
- *Before checking idle speed, the engine should be allowed to warm up.*
- *Check and / or adjust idle speed after engine speed has stabilized.*

(1) Remove bolt and No.1 ignition coil.

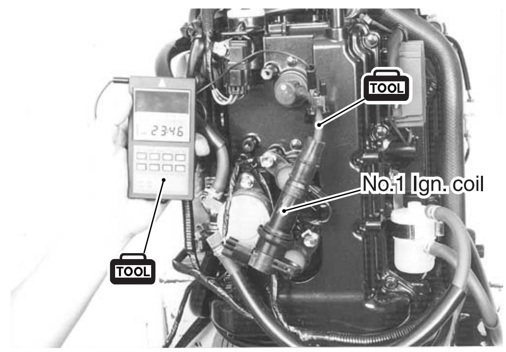


(2) Connect special tool (H · T cord with plug cap adapter) between No.1 ignition coil and spark plug.

TOOL **09930-88720 : H · T cord with plug cap adapter**

(3) Start engine.

(4) Attach engine tachometer to the special tool.

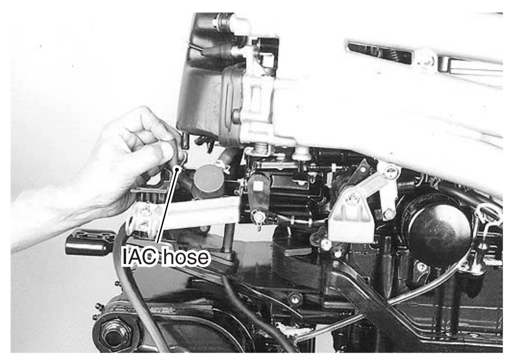


TOOL **09900-26006 : Engine tachometer**

(5) Check engine speed.
Idle speed (in neutral gear) : 800 – 900 r / min

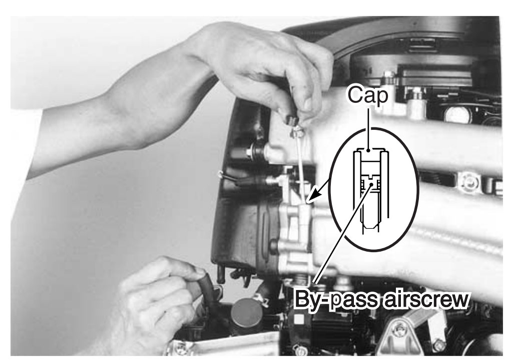
ADJUSTMENT :
If the idle speed is out of specification, adjust it as follows :

(6) Remove IAC hose from silencer case.



(7) To stop the air flow from the IAC passage, pinch the IAC valve hose closed.

(8) Adjust the engine speed to approx. 800 r / min. by turning the by-pass air screw.



Turning air screw clockwise :
Engine speed will decrease.
Turning air screw counterclockwise :
Engine speed will increase.

(9) Release pinch, allowing air to the IAC valve, and recheck if engine speed is stable at 800 – 900 r / min.

NOTE:
The idling / trolling speed of 800 – 900 r / min. is controlled by the IAC (idle air control) system.
If the engine speed does not return to specification, the IAC passage (including the IAC hose and silencer) may be clogged or the IAC system may not operating correctly.
See the "IDLE AIR CONTROL SYSTEM" section, 3-20.

NOTE:
Trolling speed (in-gear idle speed) is the same as idle speed.

(10) Reinstall parts removed earlier.

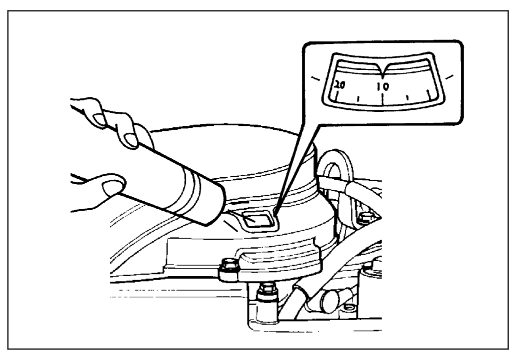
IGNITION TIMING

Inspect every 200 hours (12 months)

NOTE:
Before checking the ignition timing, make sure idle speed is adjusted within the specification.

(1) Start the engine.

(2) Attach the timing light cord to the No.1 ignition coil primary wire .

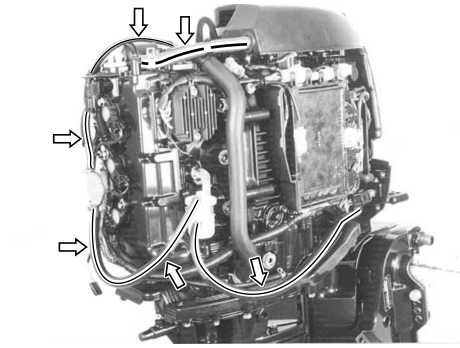


TOOL **09930-76420 : Timing light**

(3) Check the ignition timing while operating the engine at 1000 r / min.

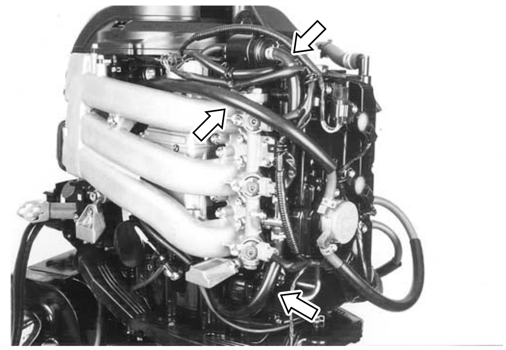
Ignition timing : Approx. BTDC 7° at 1000 r / min.

BREATHER AND FUEL LINE

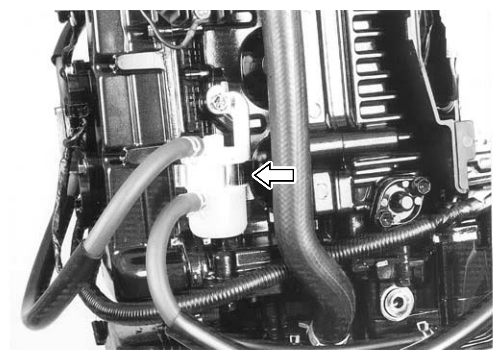


- **Inspect initially after 20 hours (1 month) and every 50 hours (3 months) thereafter.**
- **Replace every 2 year.**

If leakage, cracks, swelling or other damage is found, replace the breather line and / or fuel line.



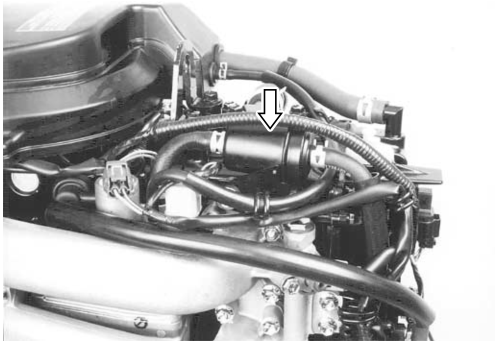
LOW PRESSURE FUEL FILTER



- **Inspect every 50 hours (3 months).**
- **Replace every 400 hours or 2 years.**

If water accumulation, sediment, leakage, cracks, or other damage is found, replace the fuel filter.

HIGH PRESSURE FUEL FILTER



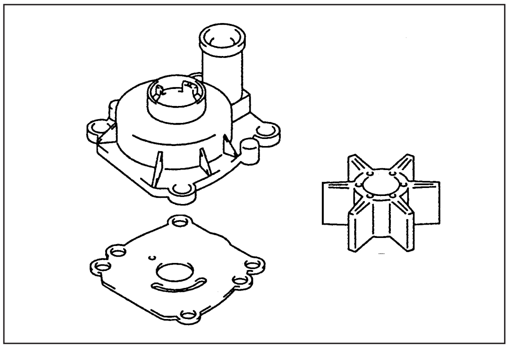
Replace every 1000 hours.

SUZUKI recommends that the high pressure fuel filter be replaced every 1000 operating hours.

WATER PUMP / WATER PUMP IMPELLER

WATER PUMP
Inspect every 200 hours (12 months).

Inspect case and under panel.
Replace If wear, cracks, distortion or corrosion is found.



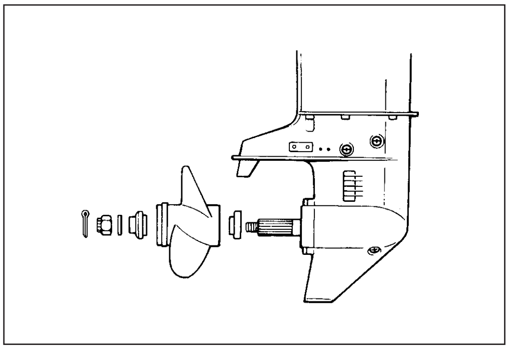
WATER PUMP IMPELLER
Replace every 200 hours (12 months).

Inspect water pump impeller.
Replace if vanes are cut, torn or worn.

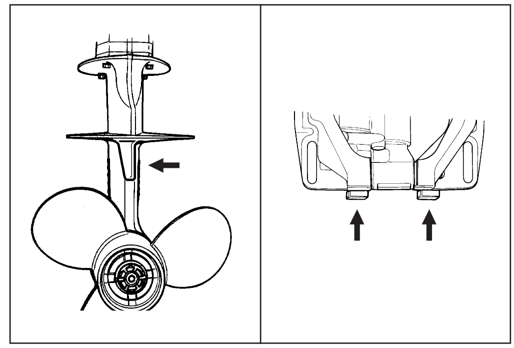
PROPELLER / NUT / COTTER PIN

Inspect initially after 20 hours (1 month) and every 100 hours (6 months) thereafter.

- Inspect the propeller for bent ,chipped or broken blades. Replace propeller if damage noticeably affects operation.
- Inspect propeller splines. Replace propeller if splines are worn or damaged.
- Inspect propeller bush for slippage. Replace if necessary.
- Make sure the propeller nut and cotter pin are installed securely.



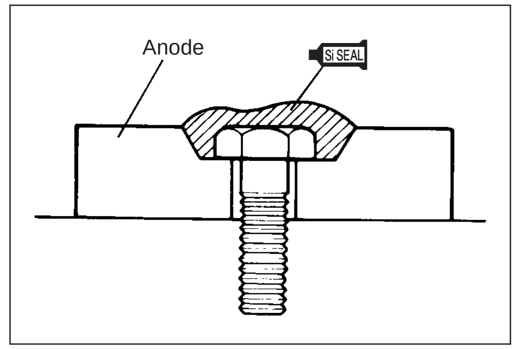
ANODES AND BONDING WIRES



Inspect every 50 hours (3 months).

ANODES

If 2/3 of the zinc anode has corroded away, replace the anode.



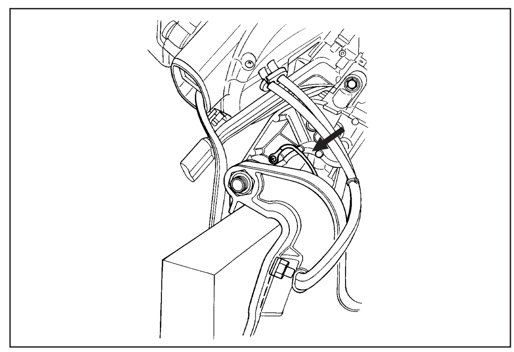
CAUTION

Never paint the anode.

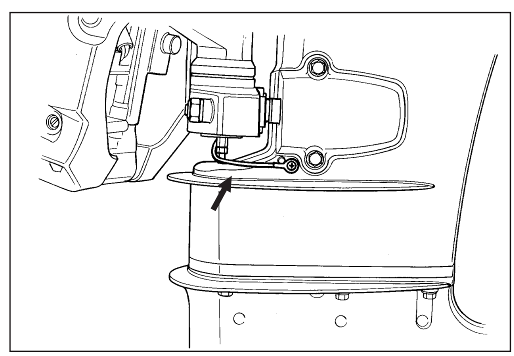
NOTE:
The anode securing bolt should be covered with Suzuki Silicone Seal.

Si SEAL 99000-31120 : Suzuki Silicone Seal

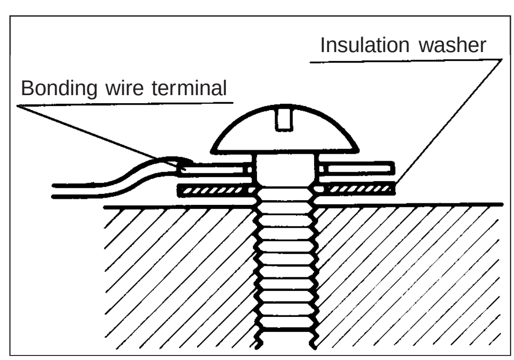
BONDING WIRES



- If breakage or other damage is found on the wire, replace the wire.
- If rust, corrosion, or other damage is found on terminal, clean with cleaning solvent or replace the wire.



NOTE:
The insulation washer must be installed between the terminal and the motor body.



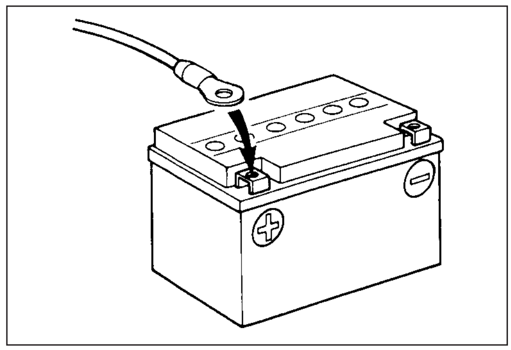
BATTERY

Inspect every 50 hours (3 months)

⚠ WARNING

- **Never expose battery to open flame or electric spark as batteries generate gas, which is flammable and explosive.**
- **Battery acid is poisonous and corrosive. Avoid contact with eyes, skin, clothing, and painted surfaces. If battery acid comes in contact with any of these, flush immediately with large amounts of water. If acid contacts the eyes or skin, get immediate medical attention.**
- **Batteries should always be kept out of reach of children.**
- **When checking or servicing the battery, disconnect the negative (black) cable. Be careful not to cause a short circuit by allowing metal objects to contact the battery posts and the motor at the same time.**
- **Wear approved eye protection.**

Recommended battery :
12 V 70 Ah (252 kC) or larger

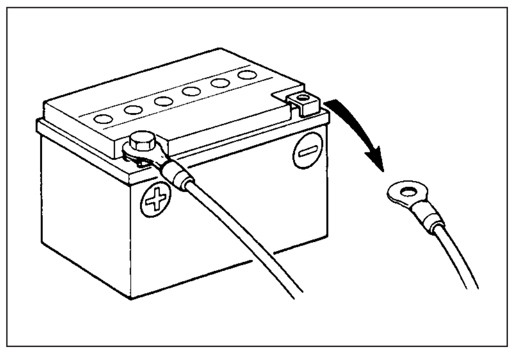


CONNECTING BATTERY

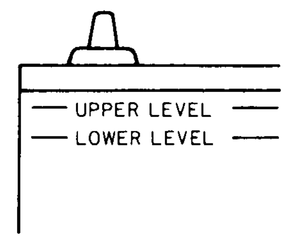
Upon completion of connection, lightly apply grease to the battery terminals.

How to connect :
(1) Connect the positive (+) terminal first.
(2) Connect the negative (–) terminal second.

How to disconnect :
(1) Disconnect the negative (–) terminal first.
(2) Disconnect the positive (+) terminal second.



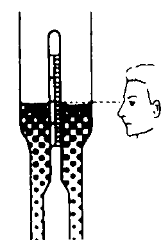
BATTERY SOLUTION LEVEL CHECK
Battery solution level should be between the UPPER level and LOWER level.
If the level is low, add distilled water only.



CAUTION

Once the battery has been initially serviced, NEVER add diluted sulfuric acid, or you will damage the battery. Follow the battery manufacture's instructions for specific maintenance procedures.

BATTERY SOLUTION GRAVITY CHECK
Measure the gravity of battery solution using a hydrometer.



Battery solution gravity : 1.28 at 20°C

TOOL **09900-28403 : Hydrometer**

BOLT AND NUTS

Inspect initially after 20 hours (1 month) and every 100 hours (6 months) thereafter

Check that all bolt and nuts listed below are tightened to their specified torque.

ITEM	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb.-ft.
Cylinder head cover bolt	6 mm	10	1.0	7.0
Intake manifold bolt / nut	6 mm	11	1.1	8.0
	8 mm	23	2.3	16.5
Flywheel bolt	16 mm	200	20.0	144.5
ECM ground bolt	6 mm	10	1.0	7.0
Power unit mount bolt	8 mm	23	2.3	16.5
	10 mm	50	5.0	36.0
Clamp bracket shaft nut	22 mm	43	4.3	31.0
Gearcase bolt	8 mm	23	2.3	16.5
Propeller nut	18 mm	55	5.5	40.0

FUEL MIXTURE CHECK (O_2 FEEDBACK)

Perform every 2 years.

CAUTION

Before performing a fuel mixture check (O_2 feedback), the outboard motor must be checked to be sure that it is free of any trouble codes or operational problems.

NOTE:
See "O_2 FEEDBACK SYSTEM" section on page 3-32 before starting O_2 feedback operation.

There are two methods available for performing the O_2 feedback operation :

(a) Using a personal computer and the Suzuki Diagnostic System software.
(Suzuki recommends using this method as it is possible to monitor the feedback condition.)

(b) Using the diagnostic harness without a personal computer.

Refer to the " Suzuki Diagnostic System operation manual" for the "a" method procedure.

The "b" method procedure is as follows :

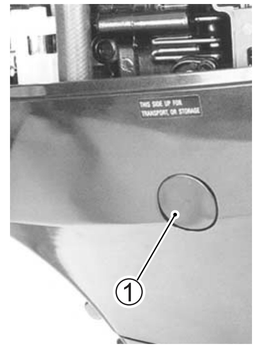
⚠ WARNING

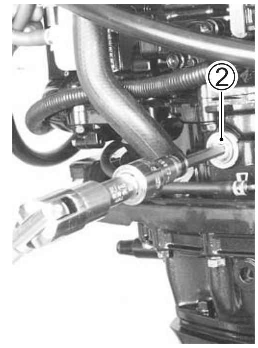
To prevent any sudden boat movement, the boat must be securely moored to the dock while the test wheel equipped engine is running in gear during the feedback test procedure.

1. Remove propeller and install a test wheel.

TOOL **09914-79410 : Test wheel**

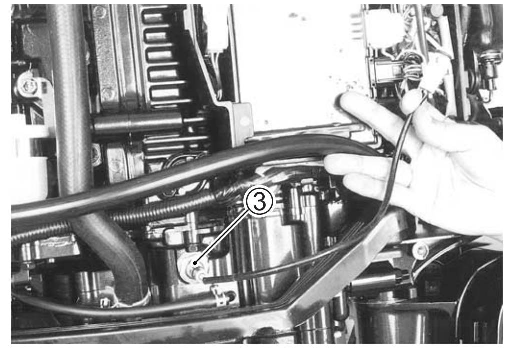
2. Remove grommet ① and stbd.lower side cover.
   (See page 7-1)





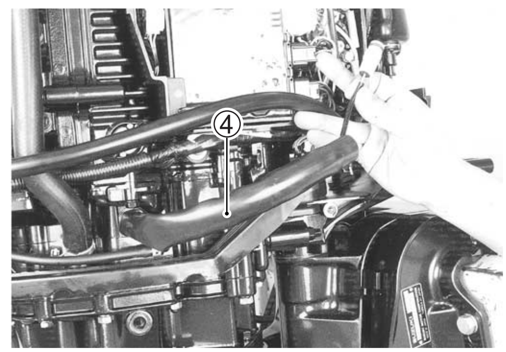
3. Remove plug ② from oil pump case and install the O_2 sensor ③ and protector sleeve ④.

TOOL **18213-74F00 : O_2 sensor**
18498-99E40 : Protector sleeve

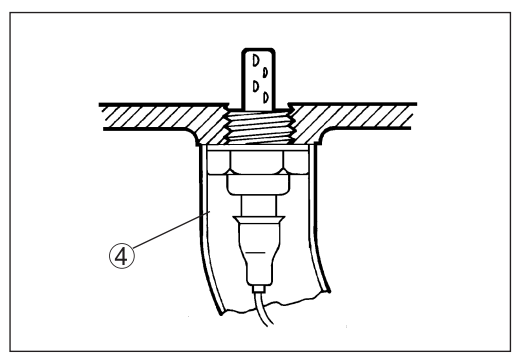


CAUTION

> **The O_2 sensor used for the feedback test procedure must be in proper working order and installed securely.**
> **If either sensor or installation is improper, the O_2 feedback operation will be performed incorrectly and could possibly result in engine operating problems.**

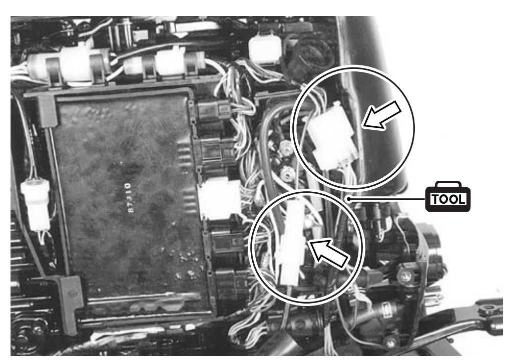


NOTE:
- *The O_2 sensor is NOT WATERPROOF. Cover O_2 sensor with the protector sleeve to protect from water spray.*
- *Cut off the protector (P/N 18498-99E40) to a length of 20 – 30 cm (7.8 – 11.8 in.). The O2 sensor must be completely covered as shown.*



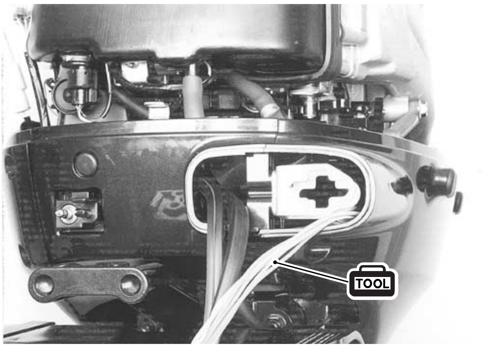
4. Connect the diagnostic harness to both O_2 sensor and engine harness connectors.

TOOL **09932-79910 : Diagnostic harness**

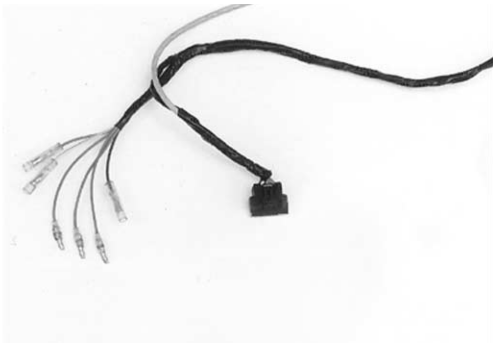


5. Install stbd.side lower cover.

NOTE:
Route the diagnostic harness through clearance between remote control cable holder plate and side cover.



6. Make sure none of the six diagnostic harness single lead wire connectors (located next to the diagnostic adapter plug) are connected.

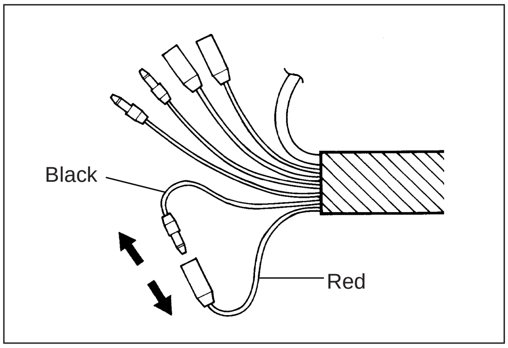


7. Install motor cover.

8. Warm up the engine until it is stable at idle speed, then shift into forward.

NOTE:
The O_2 feedback operation must be performed under engine load.
Do not perform the O_2 feedback operation using warm-up lever without first shifting into forward gear.

9. Connect one of the diagnostic harnesses single Black lead wires and the single Red lead wire together.



NOTE:
If engine stalls when doing step "9", raise engine speed to slightly higher than trolling before repeating step "9".

10. Adjust engine speed to 2500±100 r/min (ZONE 1) and hold for a minimum of 20 seconds.
    - If buzzer sounds for approx.3 seconds, the feedback operation at this ZONE was successfully finished.
      Go to next step (ZONE 2).
    - If no buzzer sounds within approx.2 minutes, the feedback operation at this ZONE failed.
      Ignore this ZONE and proceed to next step (ZONE 2).

11. Repeat the procedure in step “10” at 3500±100 r/min (ZONE 2).

12. Repeat the procedure in step “10” at 4500±100r/min (ZONE 3).

13. If the feedback operation at any ZONE failed, repeat the feedback operation at that ZONE.

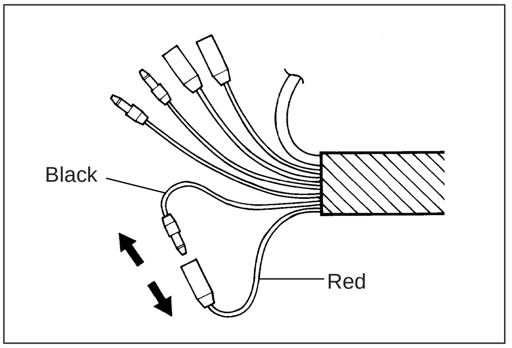
14. Return the throttle to a full closed position only after the feedback operation at all ZONEs has been successfully finished.

NOTE:
Do not close throttle fully for more than 10 seconds while feedback operation is being performed.
This will cause the O_2 feedback operation to finish with incomplete data.

15. Approximately 10 seconds after closing the throttle, the buzzer will sound as follows:
    - If the total feedback operation was successfully finished, a series of short (0.5 sec.) buzzer sounds will be heard.
    - If the total feedback operation failed, a series of long (3 sec.) buzzer sounds will be heard.

16. When finished with the O_2 feedback operation, disconnect the diagnostic harness Black and Red lead wires.

17. If retrying feedback operation , repeat procedure used in steps “6” and “9” through “16”.



NOTE:
Repeat the O_2 feedback operation with a new O_2 sensor if :

- *The total feedback operation finished without returning the throttle to a fully closing position.*
- *The total feedback operation failed repeatedly.*

CAUTION

The O_2 sensor is only used when performing the O_2 feedback operation.
After O_2 feedback operation is completed the original plug must be installed in the oil pump case.

18. Assembly is reverse order of disassembly.

OIL PRESSURE

Oil pressure (at normal operating temp.):
300 - 380 kPa (3.0 - 3.8 kg/cm^2, 43 - 54 psi.)
at 4000 r / min.

NOTE:
The figure shown above is a guideline only, not an absolute service limit.

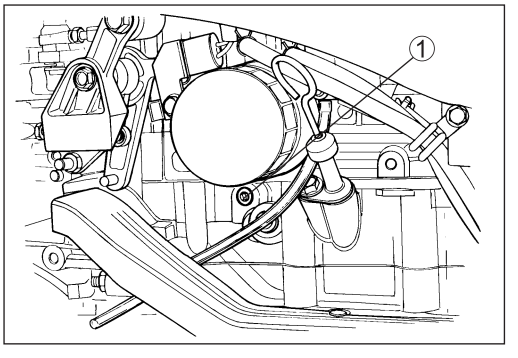
If oil pressure is lower or higher than specification, the following causes may be considered.
(See page 6-66 for oil passage locations)

Low oil pressure
- Clogged oil filter
- Leakage from oil passages
- Defective oil pump
- Defective oil pressure regulator
- Damage O-ring
- Combination of above items.

High oil pressure
- Using an engine oil of too high viscosity
- Clogged oil passage
- Clogged oil pressure regulator
- Combination of above items

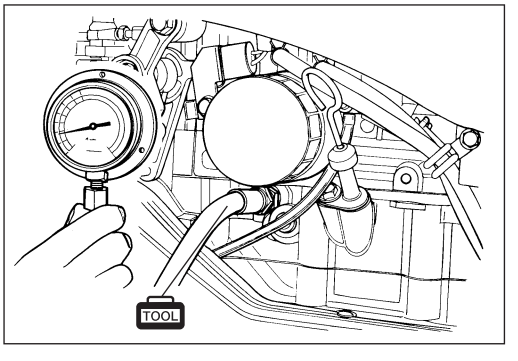
TEST PROCEDURE

(1) Check the engine oil level.
(2) Remove the PORT side lower cover.
(3) Remove the plug① for oil pressure service port.



(4) Install the oil pressure gauge in place of service port.

TOOL **09915-77310 : Oil pressure gauge**
09915-78211 : Oil pressure gauge adapter

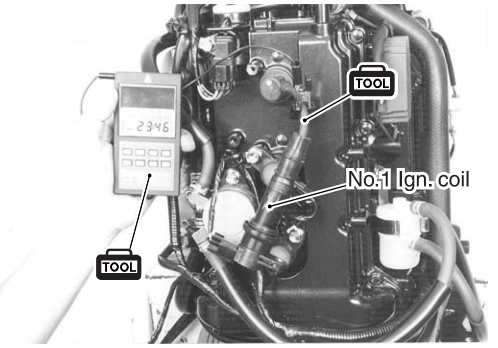


(5) Remove bolt and No.1 ignition coil.
(6) Connect special tool (H · T cord with plug cap adapter) between No.1 ignition coil and spark plug.

TOOL **09930-88720 : H · T cord with plug cap adapter**

(7) Attach engine tachometer to the special tool.

TOOL **09900-26006 : Engine tachometer**



(8) Start the engine and warm up engine as follow :

Summer : 5 min. at 2000 r / min.
Winter : 10 min. at 2000 r / min.

(9) After warming up, shift into forward gear and increase the engine speed to 4000 r / min. then compare the pressure indicated on the gauge to specifications.

(10) After testing, reinstall parts removed earlier. (plug, side lower cover, etc.)

CYLINDER COMPRESSION

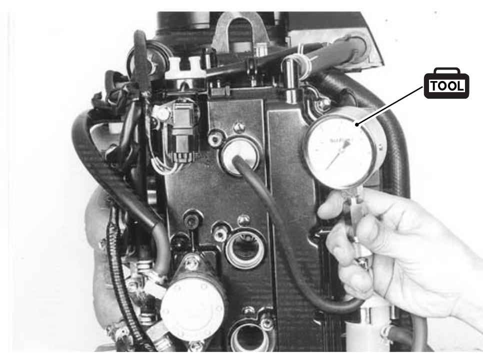
Cylinder compression :
Standard : 1300 – 1600 kPa (13 - 16 kg / cm^2, 185 – 228 psi.)
Max. difference between any two cylinders : 100kPa (1.0 kg / cm^2, 14 psi.)

NOTE:
Figures shown are guidelines only, not absolute service limits.

Low compression pressure can indicate one or more of the following :
- Excessively worn cylinder wall
- Worn piston or piston rings
- Stuck piston rings
- Poor seating of valves
- Ruptured or otherwise damaged cylinder head gasket

TEST PROCEDURE

(1) Start engine and allow to warm up, then shut engine off.
(2) Remove the STBD / PORT engine side lower cover.
(3) Remove all spark plugs.
(4) Install the compression gauge into the plug hole.



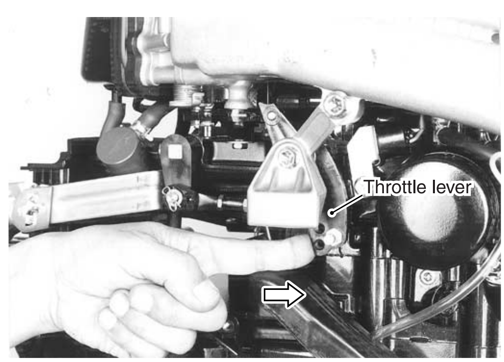
TOOL **09915-64512 : Compression gauge**
09915-63210 : Compression gauge adaptor

(5) Disconnect the safety lanyard (switch plate) from the emergency stop switch.

⚠ WARNING

Disconnect the safety lanyard from the emergency stop switch prior to cranking the engine.
This will prevent any residual fuel discharged from the cylinders being ignited by a spark discharge from the ignition coil.

(6) Disconnect the remote control throttle cable from the throttle lever.
(7) Move and hold the throttle lever in the full-open position.
(8) While cranking the engine with the starter motor, note the maximum compression pressure reading on the gauge for each cylinder.



(9) Reinstall parts removed earlier. (spark plug, side lower cover, etc.)

ENGINE CONTROL SYSTEM

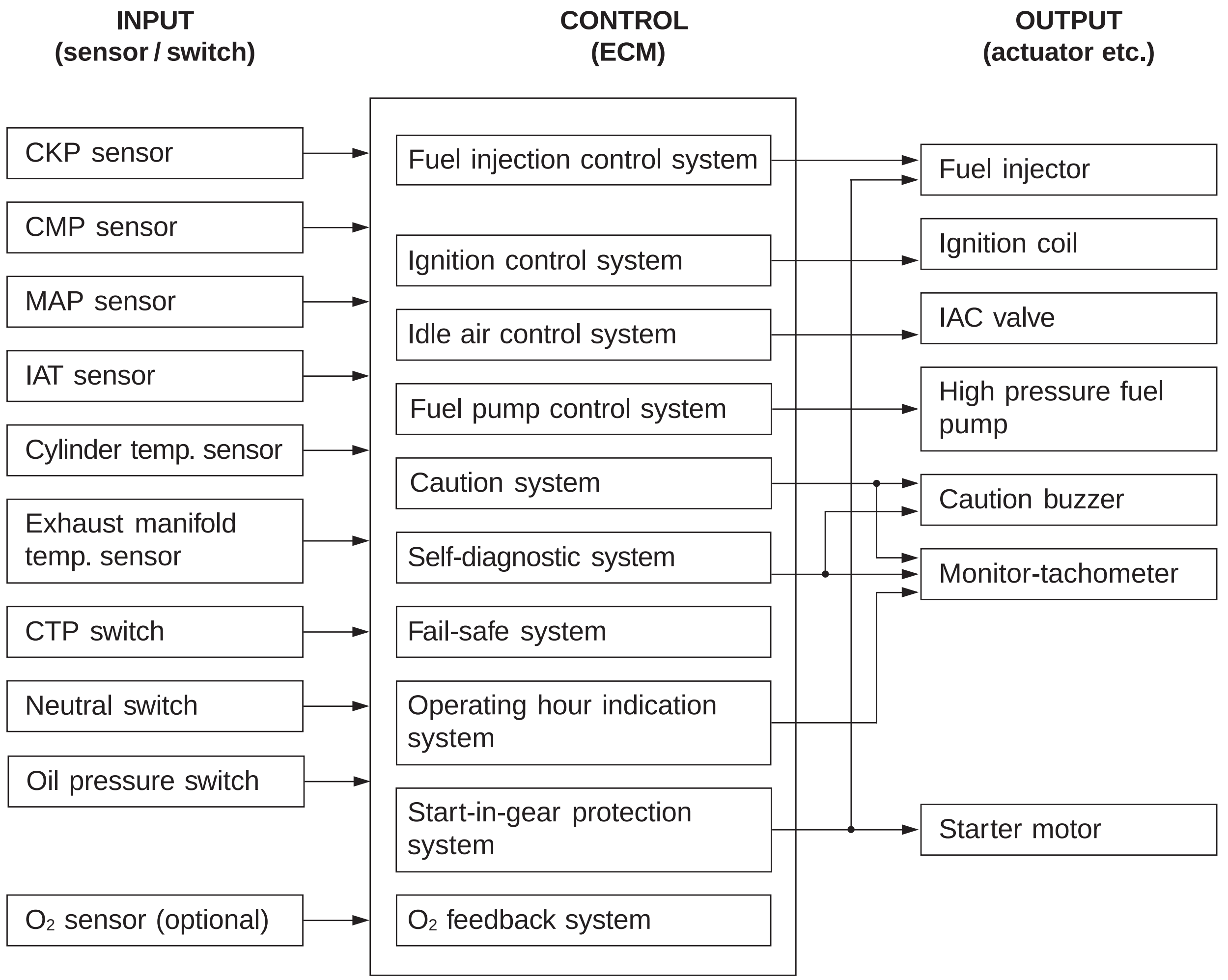
3

CONTENTS

ENGINE CONTROL SYSTEM STRUCTURE

The DF40 / DF50 models employ an integrated control system which performs the control functions for fuel injection, ignition, idle / trolling speed (idle air), etc. through the ECM (Engine control module).

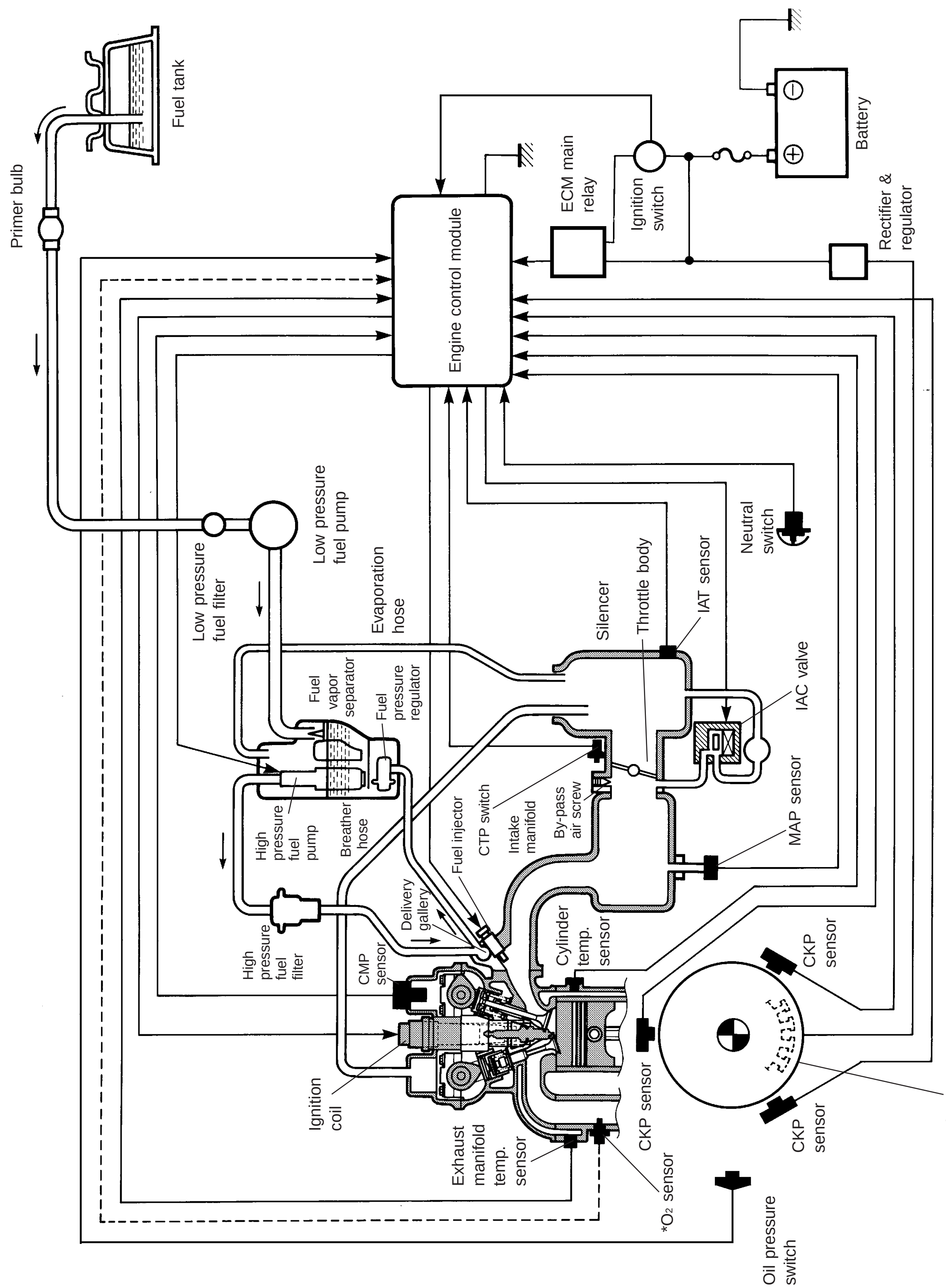
SYSTEM STRUCTURE 1



[Abbreviation]

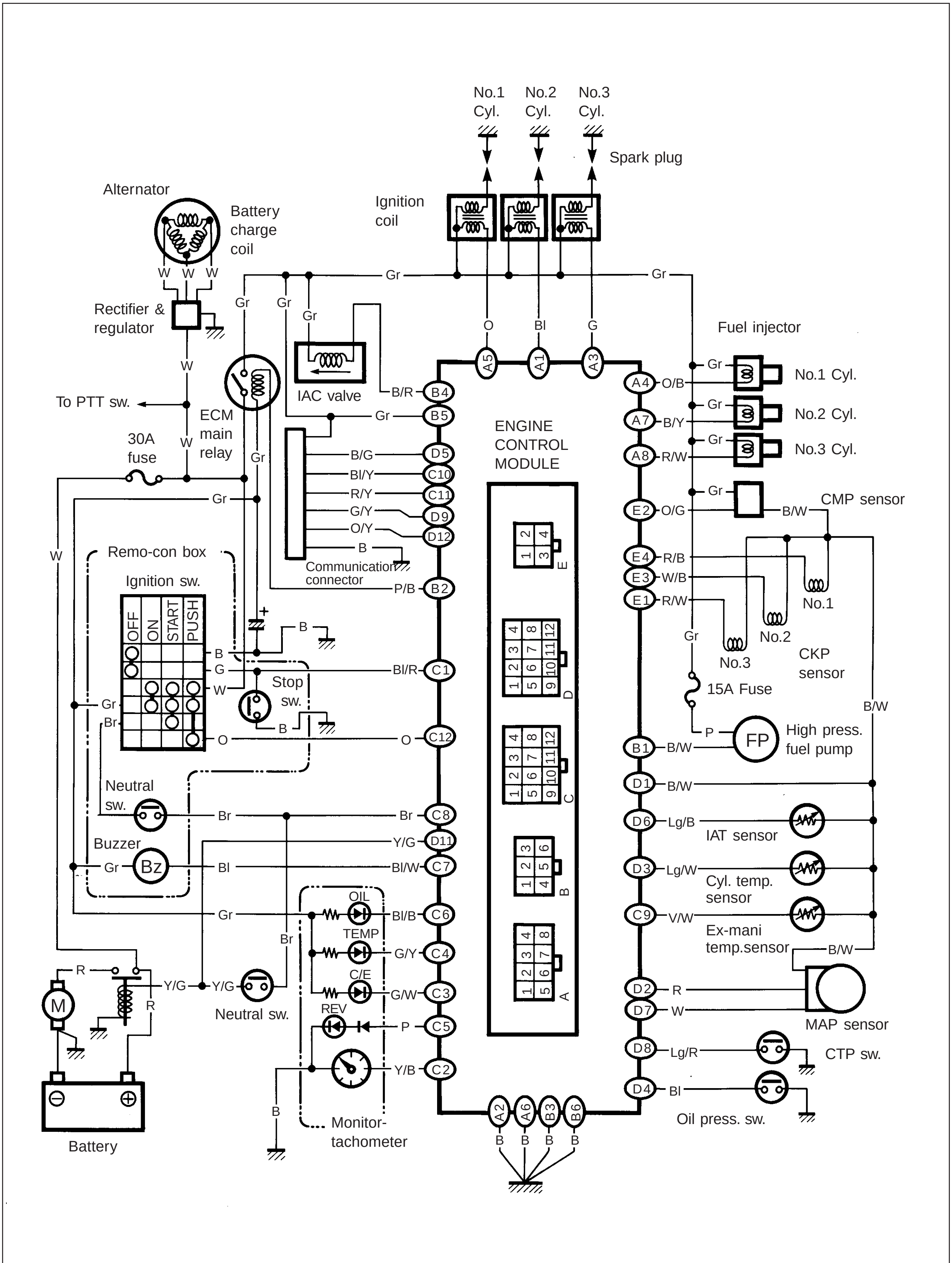
ECM (Engine control module)
CKP (Crankshaft position)
CMP (Camshaft position)
MAP (Manifold absolute pressure)
IAT (Intake air temperature)
CTP (Closed throttle position)
IAC (Idle air control)

SYSTEM STRUCTURE 2



* : O_2 Sensor must be installed when performing "O_2 feedback operation" only.

WIRING DIAGRAM FOR ENGINE CONTROL



COMPONENTS FOR SYSTEM CONTROL

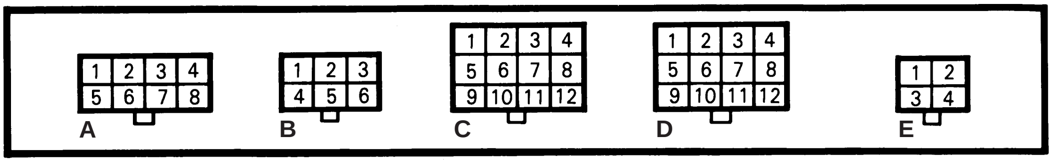
ENGINE CONTROL MODULE (ECM)

The ECM sends signals to control the actuators based on the information inputs from each sensor / switch. Major controls are as follows:

NAME OF CONTROL	DESCRIPTION
Fuel injection control	• Controls fuel injection amount and timing.
Ignition control	• Controls ignition timing.
Idle air control	• Controls idling/trolling speed by adjusting intake air amount through IAC valve.
Fuel pump control	• Controls high pressure fuel pump drive.
Caution system control	• Informs operator of abnormal engine condition. • Controls engine speed.
Self-diagnostic system control	• Informs operator of sensor / switch malfunction.
Fail-safe system control	• Allows operation during sensor/ switch malfunction.
Operating hour indication system control	• Informs operator of total operating time in units of 50 hours.
Start-in-gear protection system control	• Prevents engine start when shift is positioned in forward or reverse.
O_2 feedback system control	• Controls and performs O_2 feedback operation using optional O_2 sensor.

NOTE:
The information related to the Caution system, Self-Diagnostic System, Operating hour indication system and O_2 feedback system are retained in ECM memory.

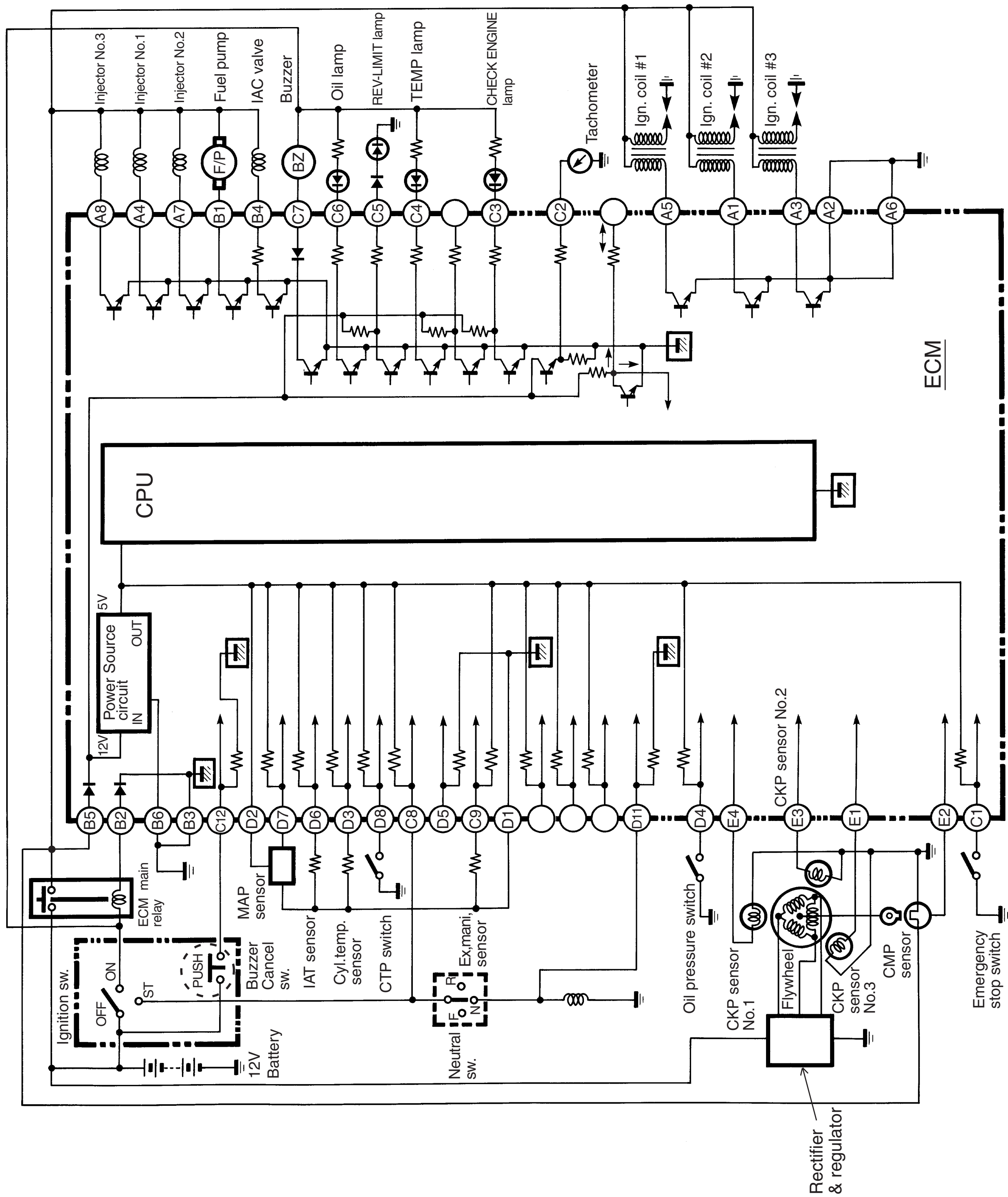
ECM CONNECTORS / TERMINALS LAYOUT



ECM CIRCUITS

TERMINAL	WIRE COLOR	CIRCUIT
A1	Bl	No.2 Ignition (–)
A2	B	Ground for power source
A3	G	No.3 Ignition (–)
A4	O/B	No.1 Fuel injector (–)
A5	O	No.1 Ignition (–)
A6	B	Ground for power source
A7	B/Y	No.2 Fuel injector (–)
A8	R/W	No.3 Fuel injector (–)
B1	B/W	Fuel pump (–)
B2	P/B	Ground for ECM main relay
B3	B	Ground for ECM
B4	B/R	IAC valve solenoid (–)
B5	Gr	ECM power source
B6	B	Ground for ECM
C1	Bl/R	Emergency stop switch
C2	Y/B	Tachometer
C3	G/W	CHECK ENGINE lamp
C4	G/Y	TEMP lamp
C5	P	REV-LIMIT lamp
C6	Bl/B	OIL lamp
C7	Bl/W	Buzzer
C8	Br	Neutral switch
C9	V/W	Ex-manifold temperature sensor
C10	Bl/Y	PC communication
C11	R/Y	PC communication
C12	O	Buzzer cancel
D1	B/W	Ground for sensors
D2	R	Power source for MAP sensor
D3	Lg/W	Cylinder temperature sensor
D4	Bl	Oil pressure switch
D5	B/G	O_2 feed-back / PC communication
D6	Lg/B	IAT sensor
D7	W	MAP sensor
D8	Lg/R	CTP switch
D9	G/Y	PC communication
D10	—	—
D11	Y/G	Engine start switch (signal)
D12	O/Y	PC communication
E1	R/W	CKP sensor No.3
E2	O/G	CMP sensor
E3	W/B	CKP sensor No.2
E4	R/B	CKP sensor No.1

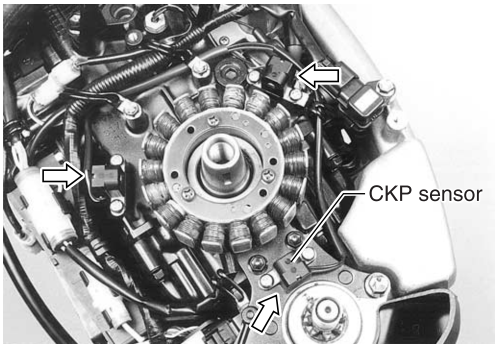
ECM INTERNAL STRUCTURE



SENSOR AND SWITCH

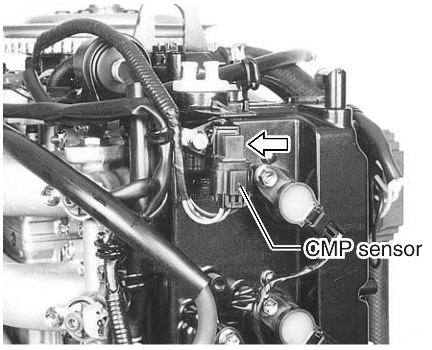
CKP (Crankshaft Position) SENSOR

There are three (3) CKP sensors installed below the flywheel rotor.
When the reluctor bar on the flywheel passes the sensors, a signal (voltage pulse) is generated and sent to the ECM.
This is the fundamental signal used to judge the engine speed and crankshaft angle.

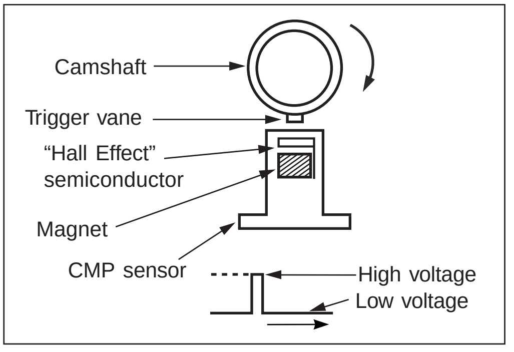


CMP (Camshaft Position) SENSOR

A CMP sensor mounted on the cylinder head cover and a reluctor bar pressed onto the end of the intake camshaft are used to detect piston position. The signal from this sensor is received by the ECM which uses it to determine sequential fuel injection control.

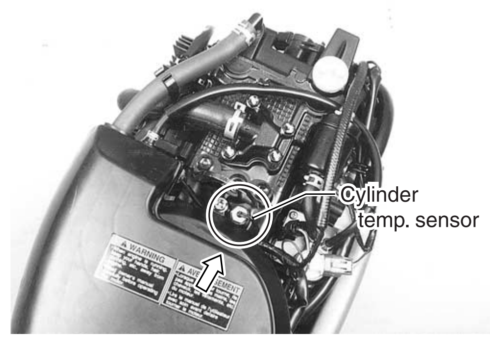


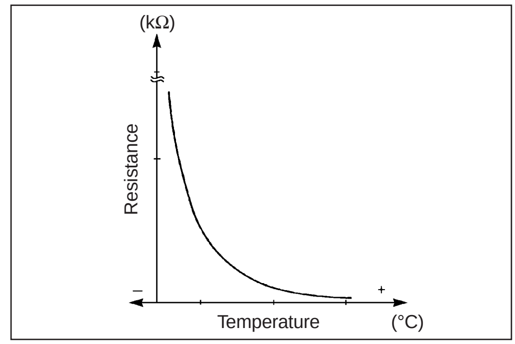
The CMP sensor contains a “Hall Effect” semiconductor and a magnet. The semiconductor generates a voltage in proportion to the line of magnetic force passed through it. When the single trigger vane on the camshaft reluctor aligns with the sensor’ internal magnet, a large amount of magnetic force is generated allowing a high voltage to pass through the semiconductor. When the trigger vane moves away from the sensor, no magnetic force is generated and low voltage passes through the semiconductor.
These generated voltages are rectified to create “ON” (high voltage) & “OFF” (low voltage) signals for ECM. The “ON” voltage signal indicates the position of #1 piston. The position of #2 and #3 pistons, “OFF” signal, follow in firing sequence order based on the now established position of #1 piston.



CYLINDER TEMPERATURE SENSOR

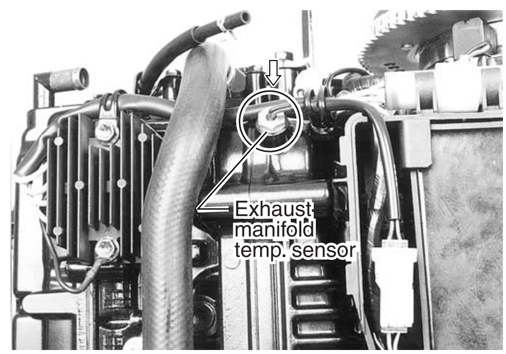
The cylinder temperature sensor is installed on the cylinder (top side) and used to detect the cylinder temperature.
This is a thermistor type sensor (resistance of which changes depending on the temperature) and inputs a signal to the ECM as a voltage value. This input signal is used to compensate the fuel injection time duration, ignition timing, etc.
This sensor is also used to detect engine over-heat as the ECM detects both the temperature and temperature change gradient (temperature rise Vs time).





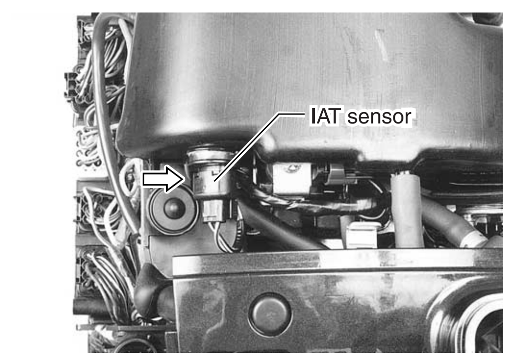
EXHAUST MANIFOLD TEMPERATURE SENSOR

The exhaust manifold temperature sensor is installed on the exhaust manifold and used to detect the exhaust manifold temperature. This sensor is the same type as the cylinder temperature sensor, and inputs a signal to the ECM as a voltage value. This input signal is used to detect engine over-heat.



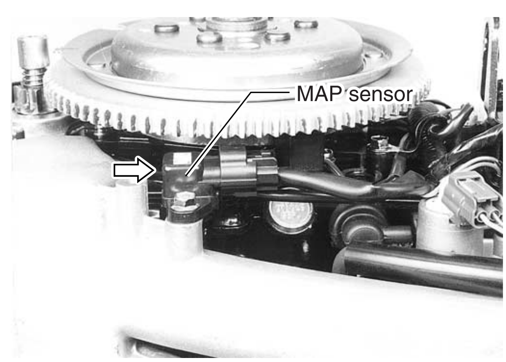
IAT (Intake Air Temperature) SENSOR

The IAT sensor is installed on the bottom of the air silencer and used to detect the intake air temperature.
This sensor is the same type as the cylinder temperature sensor, and inputs a signal to the ECM as a voltage value.
This input signal is used to compensate the fuel injection time duration.



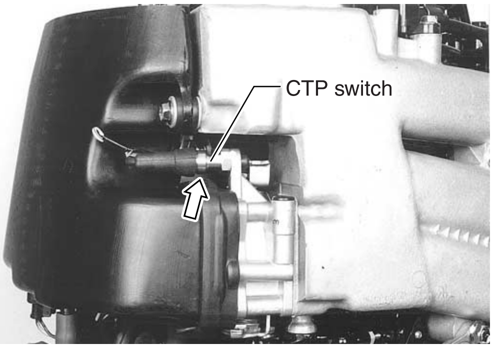
MAP (Manifold Absolute Pressure) SENSOR

The MAP sensor is installed on the intake manifold and used to detect the intake manifold pressure. It also detects the barometric pressure before starting the engine. This sensor inputs the intake manifold pressure to the ECM as a voltage value. This input signal is used as the fundamental signal to determine the fuel injection time duration, ignition timing, etc.



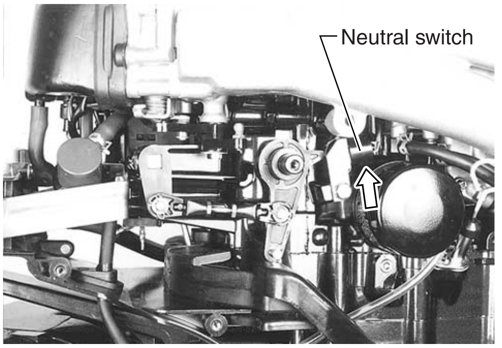
CTP (Closed Throttle Position) SWITCH

The CTP switch is installed on the top of throttle body and used to detect whether the throttle is fully closed or not.
This switch inputs the signal to the ECM. The ECM detects the throttle position and determines the control modes for various control system (idle air control, ignition timing control, etc.).



NEUTRAL SWITCH

The neutral switch is installed on the cylinder block (PORT side) and used to detect the shift position.
This switch is “ON” in neutral and “OFF” in forward or reverse.
The ECM detects shift position and performs the following controls :



- Fuel injection is not performed when the shift is in forward or reverse at the time of engine start.
  (Start-in-gear protection. See page 3-31)

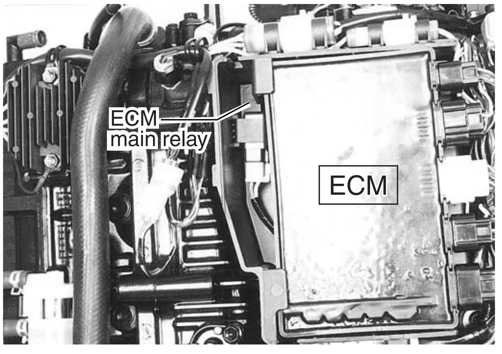
- When the shift is in neutral, fuel injection is controlled so that the engine speed does not exceed 3000 r/min.

- When the shift is in neutral, if the engine speed exceeds 1200 r/min, the ignition timing is fixed at BTDC 9°.

- For two seconds after shifting into forward or reverse from neutral, the IAC valve is controlled so that intake air increases to prevent unstable engine idle or stalling.

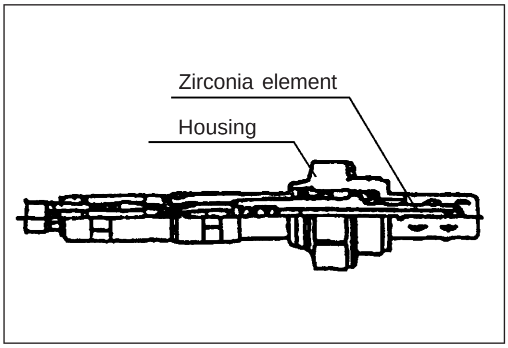
ECM MAIN RELAY

The ECM main relay is installed in the electric parts holder.
When energized by the turning ignition switch ON, it forms the circuit which supplies battery voltage to the ECM, injector, ignition coil, IAC valve, CMP sensor and high pressure fuel pump.



O_2 SENSOR (Optional item)

The O_2 sensor is installed in the exhaust manifold only when the O_2 feedback operation is performed.
This sensor is a zirconia element (platinum plated) the output voltage of which changes depending on the oxygen concentration. The voltage change reflects the concentration of the oxygen in the exhaust gas and is used to perform the O_2 feedback operation.



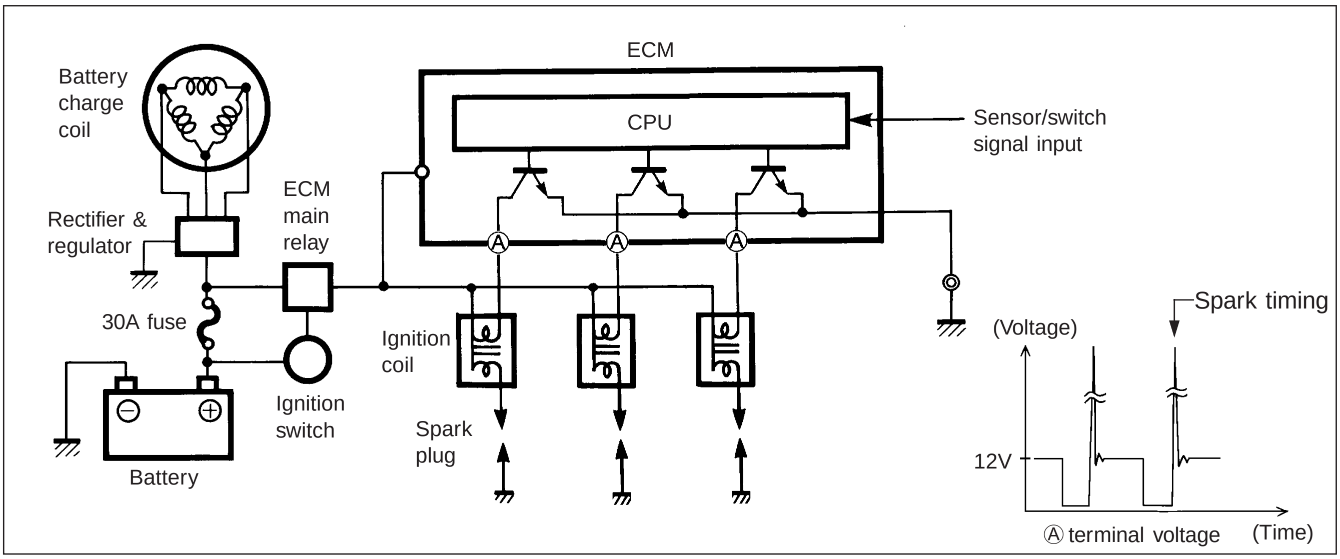
The terminal voltage change (0 – 1 V) is dependent on the concentration of oxygen in the exhaust gas.
This detected voltage value therefore represents the oxygen concentration. The terminal voltage decreases when the oxygen concentration is high, and increases when it is low.

NOTE:
As the zirconia element is not conductive below 250°C, the O_2 sensor will not function properly until the engine is at normal operating temperature.

NOTE:
Zirconia element
The zirconia element produces a potential difference (voltage) when there is a difference in the oxygen concentration of the gases which contact the two sides of the element.
Since the inner surface of the zirconia element (inside the sensor) is exposed to atmospheric air and the outer surface exposed to the exhaust gas, there is a difference in oxygen concentration on each side and thus a difference in the potential generated.

IGNITION SYSTEM

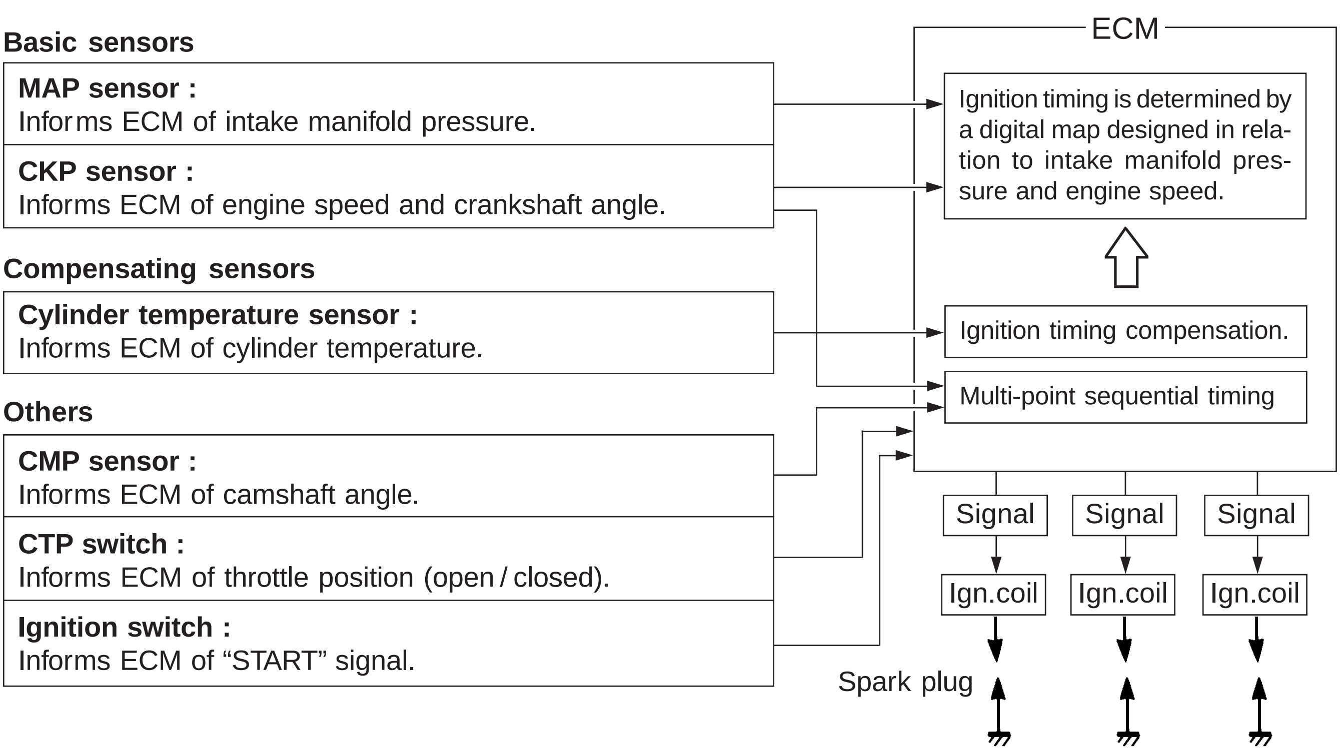
The ignition system used by the DF40/DF50 is a fully transistorized, electronic microcomputer timing advanced type.
On this system, power is totally supplied from the battery with the ECM controlling all ignition timing functions.
The ignition system is composed of the ignition coil, spark plug and components for system control (ECM, sensor,switch etc.)
When the ignition switch is "ON", battery voltage (12V) is applied to the circuit as shown in the illustration.
At the calculated time of ignition, the transistor in the ECM turns "OFF", breaking the ground circuit.
In this way, a mutual induction high voltage occurs in the ignition coil secondary side and spark is generated.



IGNITION CONTROL SYSTEM

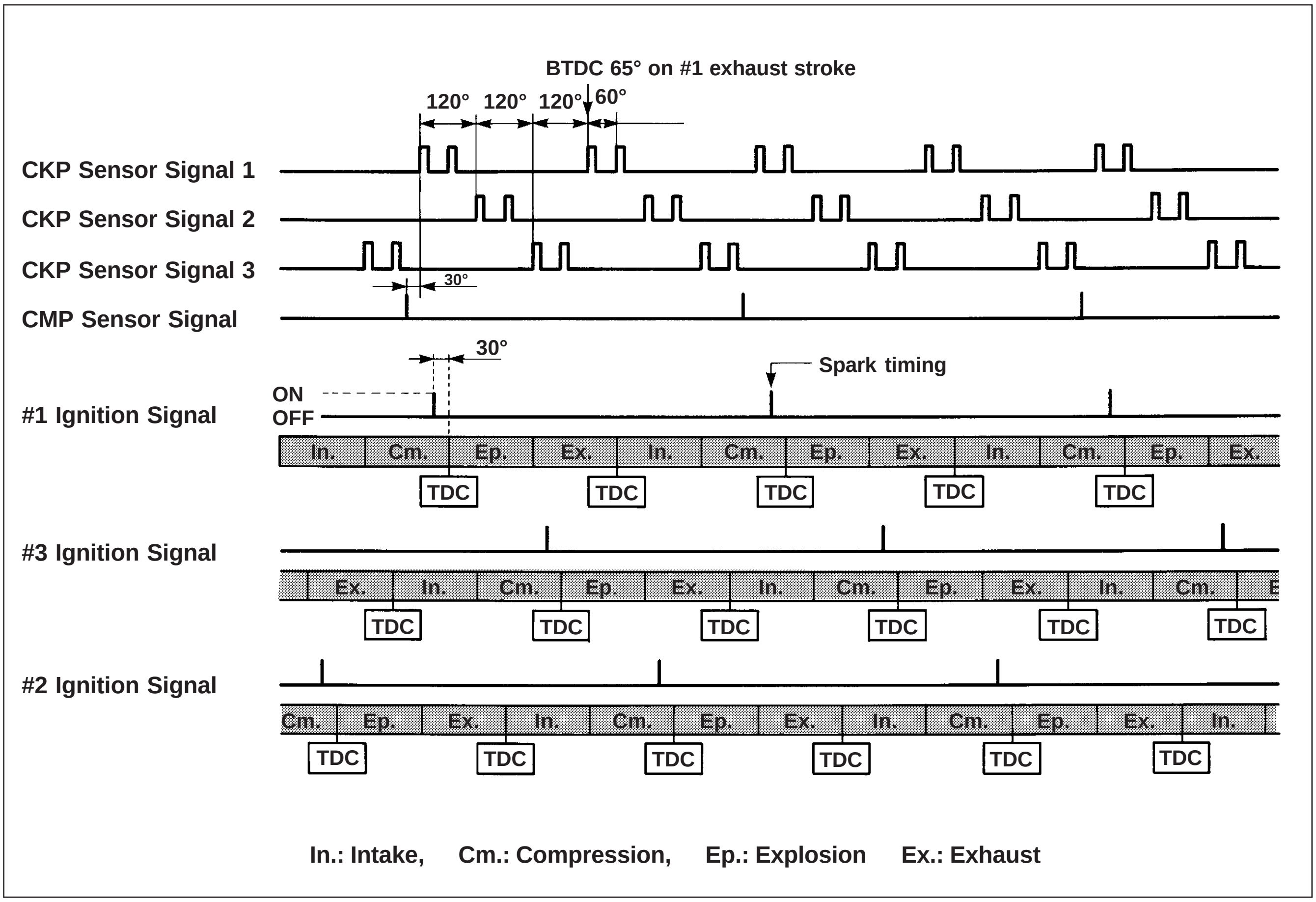
OUTLINE

Sensors at specific points on the engine monitor current engine conditions and send signals to the ECM. Based on these signals, the ECM determines the optimum ignition timing and releases voltage to the ignition coils.



IGNITION TIMING CHART

The following chart is an example for ignition at BTDC30°.



CONTROL MODE

WHEN CRANKING :

The ignition timing is fixed at BTDC 7° until the engine starts.

WHEN IDLING / TROLLING :

The ignition timing is controlled to within the range of BTDC 5° to 13° to provide stable engine operation at the specified idling / trolling speed.

When the shift lever is in neutral, if engine speed exceeds 1200 r / min , ignition timing remains fixed at BTDC 9°.

WHEN RUNNING (NORMAL OPERATION) :

The ignition timing ranges between BTDC 0° – 32° (DF40) or 25° (DF50), depending on current engine operating conditions.

WHEN DECELERATING :

When the throttle valve is closed suddenly, turning the CTP switch “ON”, ignition timing is delayed for a programmed duration to prevent engine stalling or unstable running.

SPECIFICATION

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	DF 40 : BTDC 0° – 32°, DF 50 : BTDC 0° – 25°
Firing order	1 – 3 – 2

ELECTRONIC FUEL INJECTION SYSTEM

The fuel injection system used by the DF40/50 is a speed-density, multi-point, sequential, electronic fuel injection type.

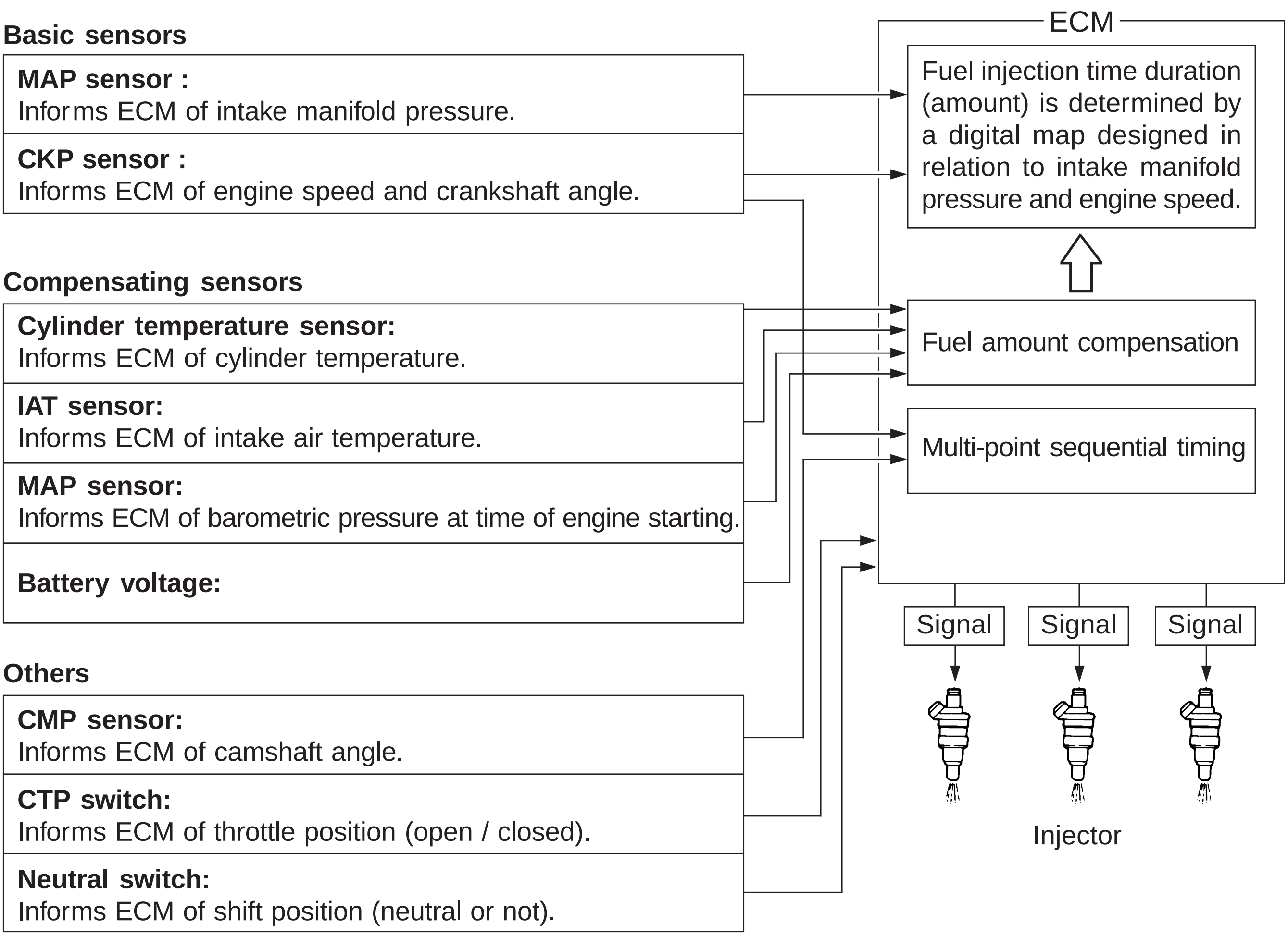
The fuel injection system is composed of the fuel line components, air intake components , and components for system control (ECM,sensors, switches, etc.).

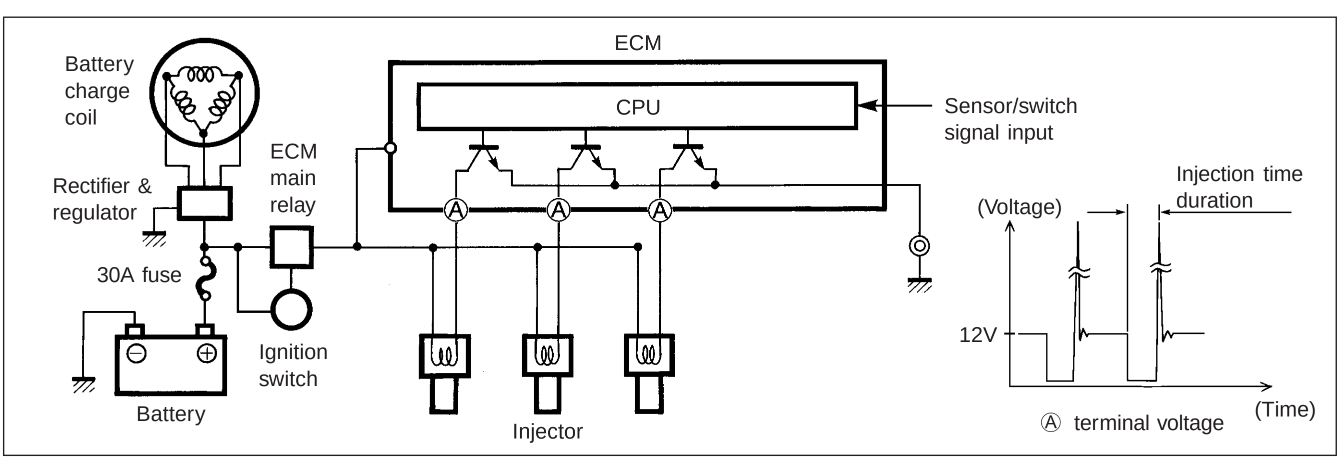
FUEL INJECTION CONTROL SYSTEM

OUTLINE

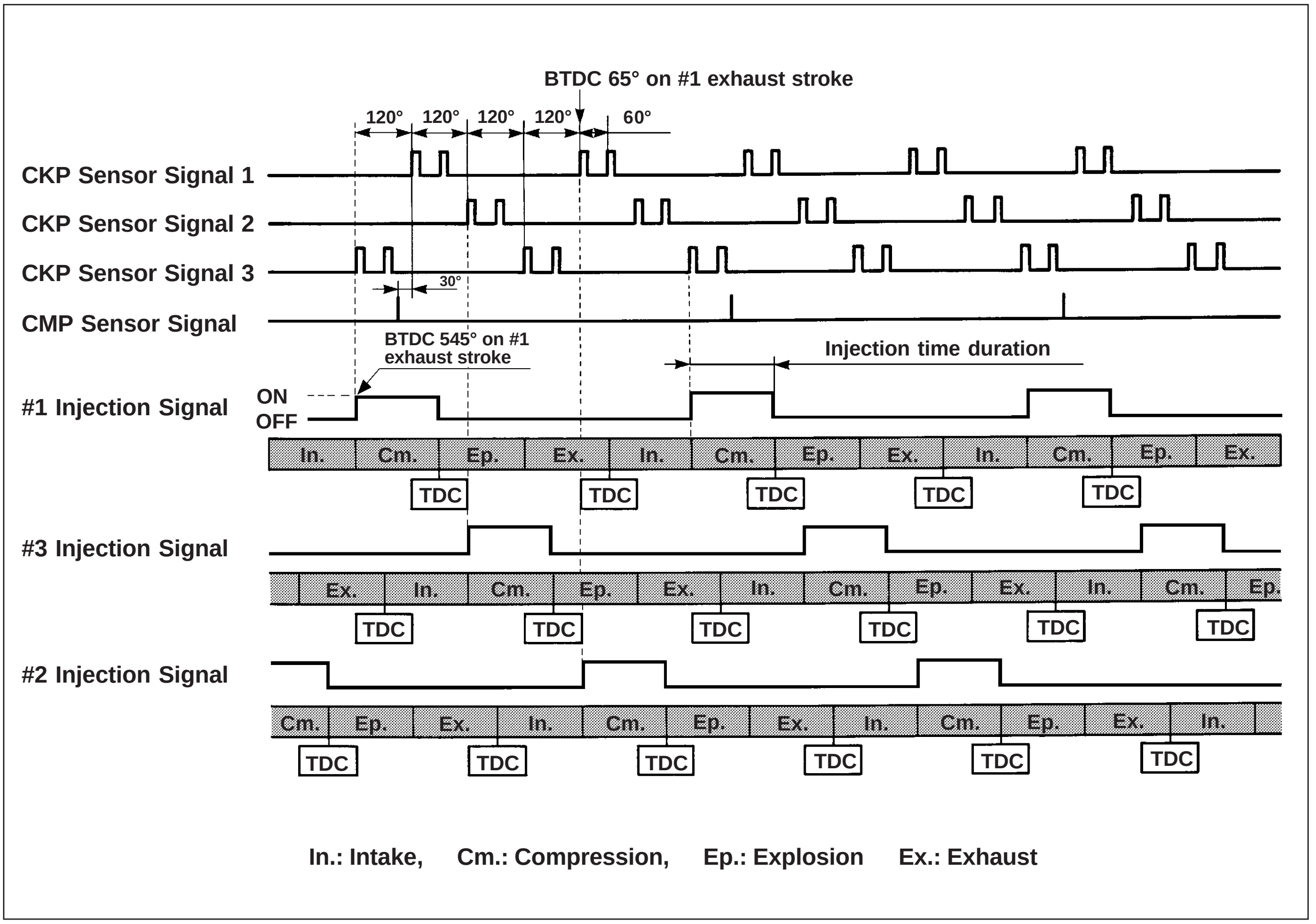
The sensors monitor current engine condition and send signals to the ECM. Based on these signals, the ECM determines the optimum fuel injection time duration (fuel amount) and fuel injection timing (multi- point sequential timing) and controls the injector operating signals accordingly.

Fuel injection start timing is set at BTDC 545° on exhaust stroke constant.





FUEL INJECTION TIMING CHART



CONTROL MODE

BEFORE START :

When the ignition switch is turned “ON”, the ECM receives a MAP sensor signal, indicating the static barometric pressure of the intake manifold, which is used to compensate the fuel injection map for altitude.

WHEN CRANKING :

Fuel is simultaneously injected to all cylinders every time any piston is positioned at compression stroke.

AFTER START (FAST-IDLE FUNCTION):

The fuel injection amount is controlled to increase until the timer, set according to cylinder temperature at the time of engine start, expires.

WHEN IDLING / TROLLING :

The fuel injection amount is controlled to maintain a stable engine speed at the specified idle / trolling rpm.

WHEN ACCELERATING :

The fuel injection amount is controlled to increase.

WHEN DECELERATING :

The fuel injection amount is controlled to decrease.

The fuel injection is also cut off on very rapid engine deceleration.

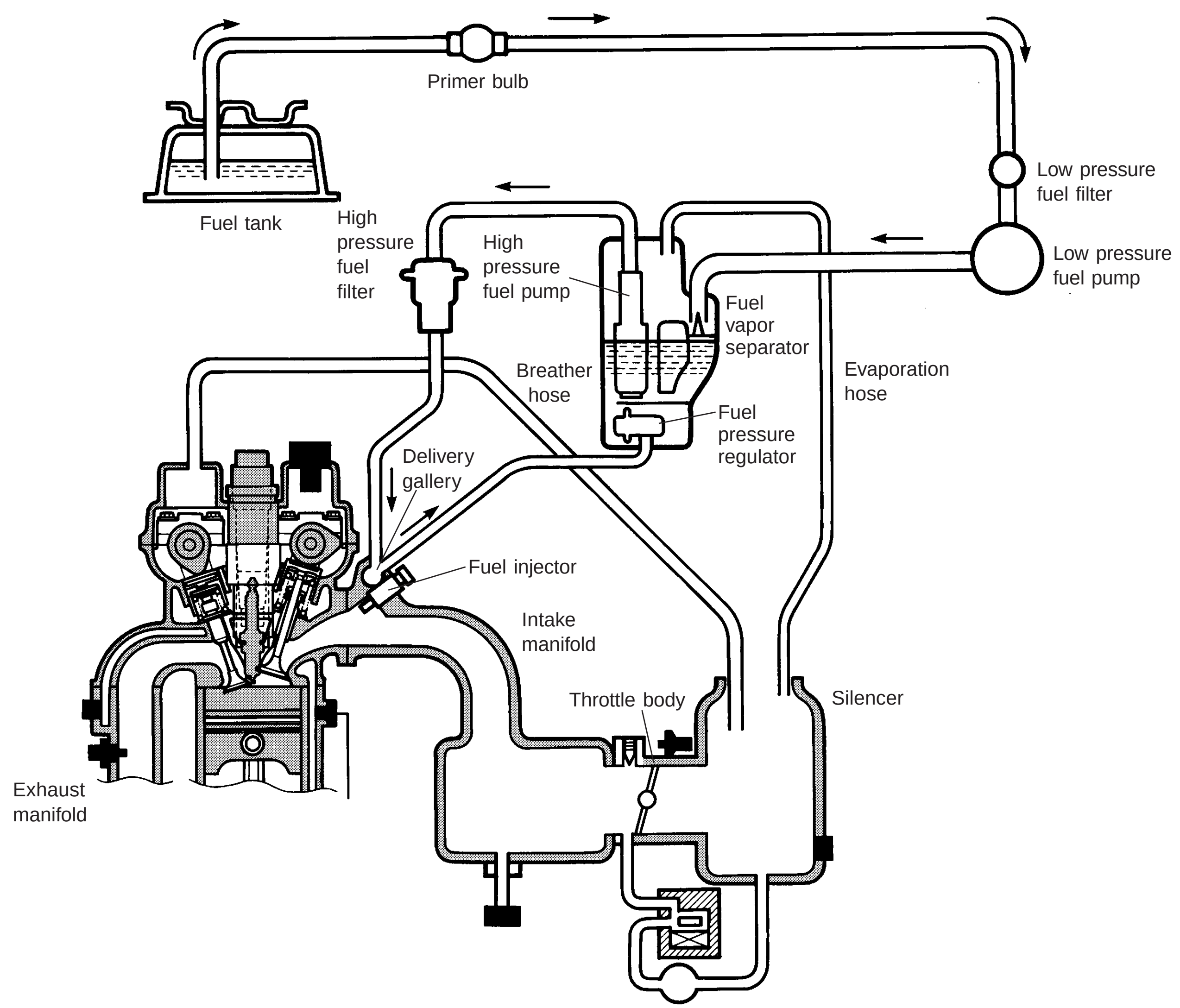
FUEL DELIVERY SYSTEM COMPONENTS

The fuel delivery system is composed of the low pressure line components (fuel tank, filter , pump etc.), fuel vapor separator, high pressure fuel pump, high pressure fuel filter, fuel pressure regulator (located in the fuel vapor separator), fuel injector and hoses.

Fuel is supplied through the primer bulb, low pressure fuel filter, and low pressure pump to the fuel vapor separator.
Fuel flow from the fuel vapor separator is pressurized by the high pressure fuel pump and supplied through the high pressure fuel filter and fuel delivery gallery to the fuel injectors.
The pressure regulator maintains fuel pressure in the feed line between the high pressure fuel pump and fuel injector.
This pressure , maintained at a constant level, is higher than the pressure in the vapor separator chamber.

When fuel feed line pressure exceeds vapor separator chamber pressure by more than approx. 255 kPa (2.55 kg/cm^2, 36.3 psi.), the valve in the fuel pressure regulator will open and return the excess fuel to the vapor separator chamber.

Pressurized fuel enters into the intake ports through the fuel injector based on the sequential signals supplied from the ECM.

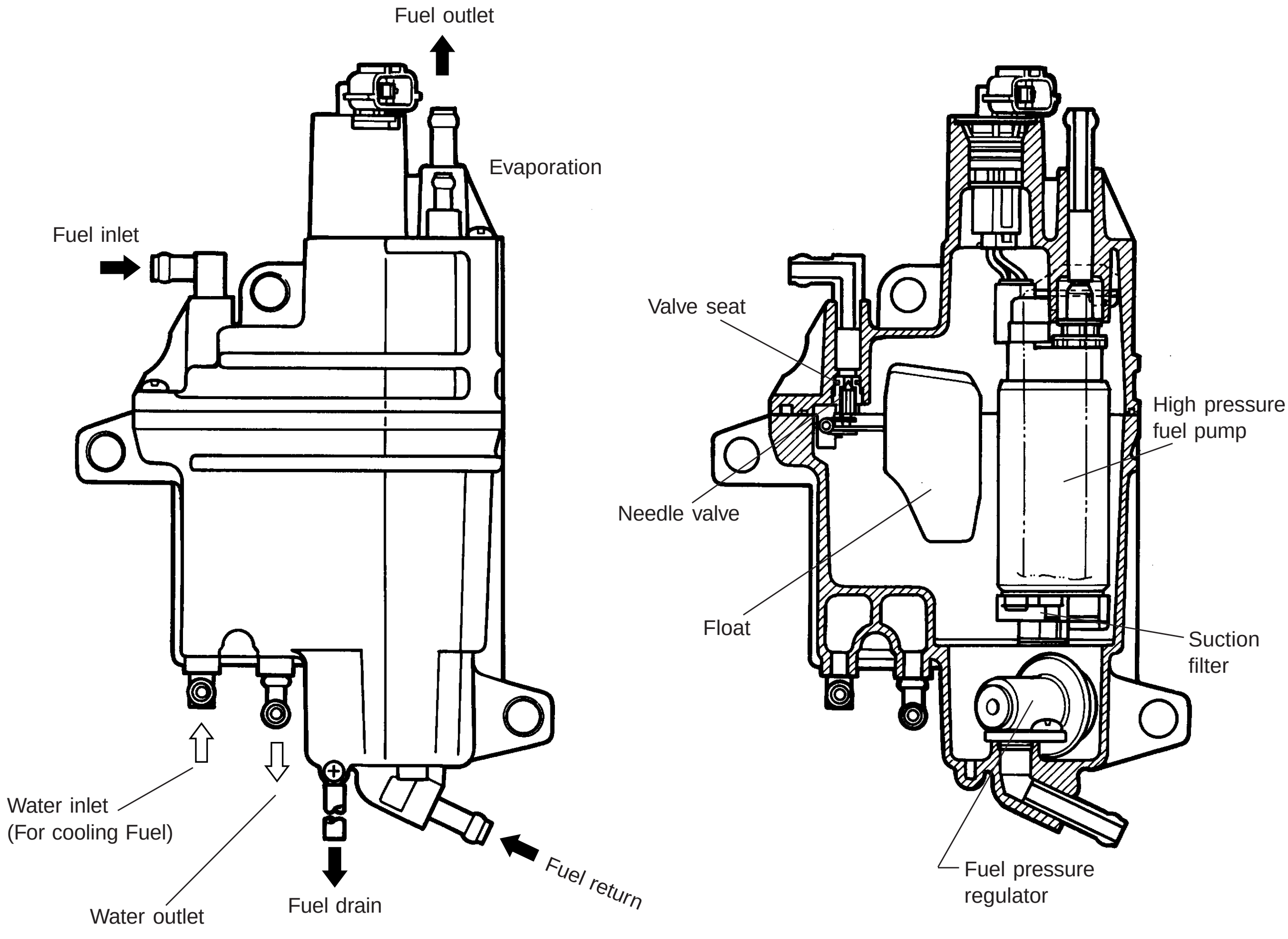


FUEL VAPOR SEPARATOR

The fuel vapor separator incorporates a float system that maintains a constant fuel level inside the separator chamber.
As the fuel level decreases, fuel flows into the vapor separator from the low pressure fuel pump.
The function of this unit is to separate vapors from fuel delivered by the low pressure fuel pump or fuel returned from the fuel pressure regulator.
This vapor is routed through the evaporation hose connecting the vapor separator cover to the air inlet cover over the flywheel.

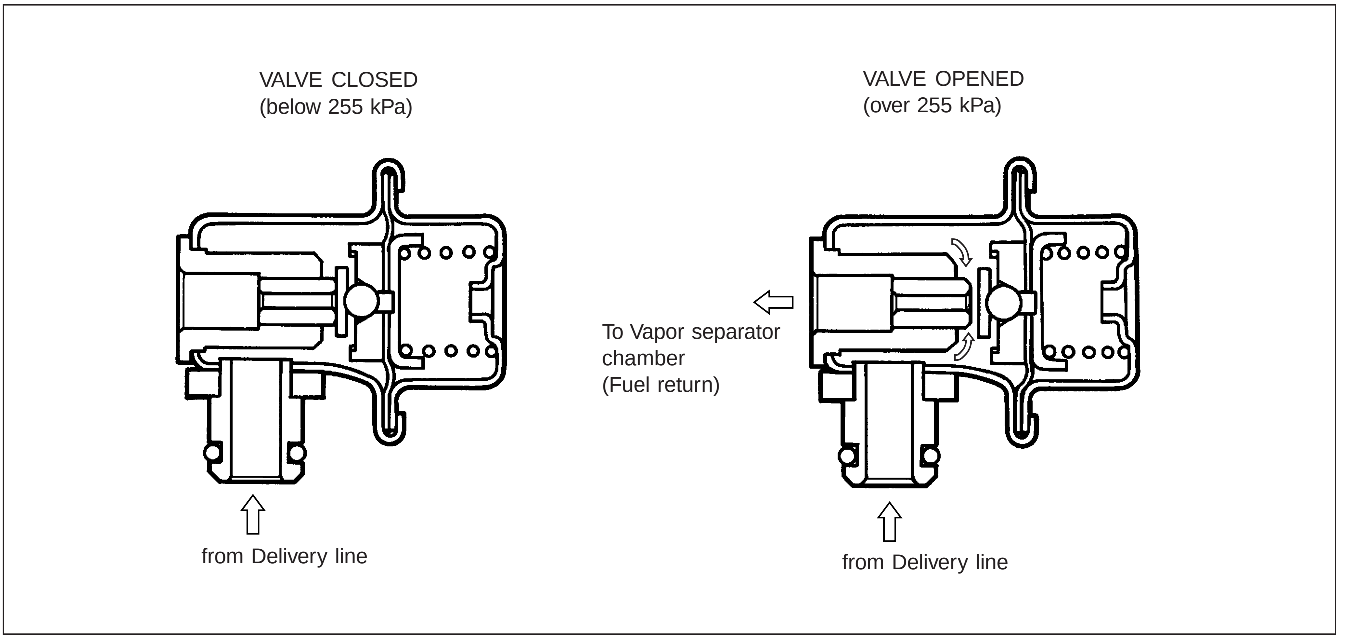
HIGH PRESSURE FUEL PUMP

The high pressure fuel pump is an “integral” type in which the pump mechanism is located within the fuel vapor separator.
To supply the optimum fuel amount, the pump is driven by the duty cycle signal from ECM.



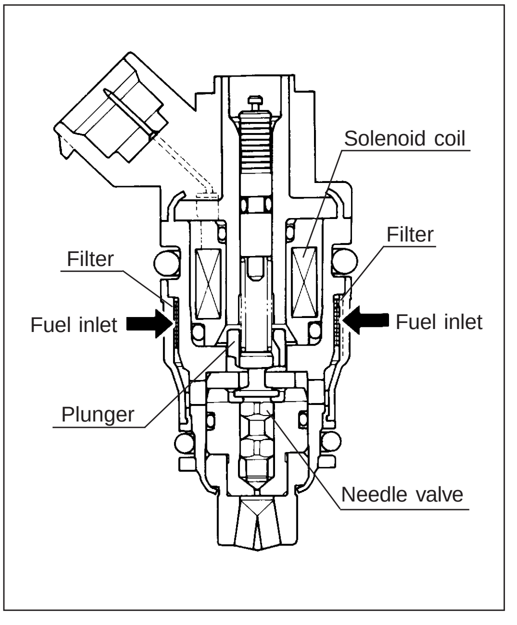
FUEL PRESSURE REGULATOR

The fuel pressure regulator is located in vapor separator.
The regulator' function in the system is to maintain a constant fuel pressure relative to the injector while the engine is operating.
The regulator diaphragm chamber is open to the vapor separator chamber to keep the pressure balanced.
Fuel pressure, adjusted by the regulator, is constantly maintained higher than the pressure in vapor separator chamber by approx. 255 kPa (2.55 kg/cm^2, 36.3 psi.).
By-pass fuel is returned back to the fuel vapor separator chamber.



FUEL INJECTOR

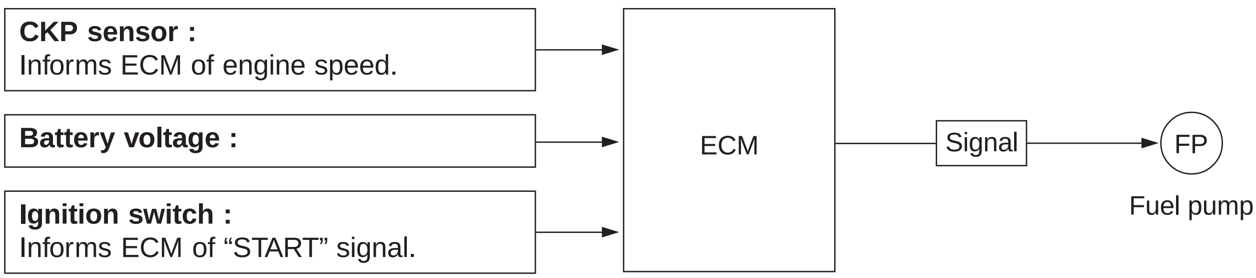
The fuel injector is an electromagnetic valve operated by a signal from the ECM.
When the injection signal is supplied to the fuel injector, the solenoid coil is energized pulling up the plunger.
This opens the injector needle valve and injects fuel.
Because the fuel pressure is kept constant, the amount of fuel injected is determined by the amount of time (duration) the valve is open.

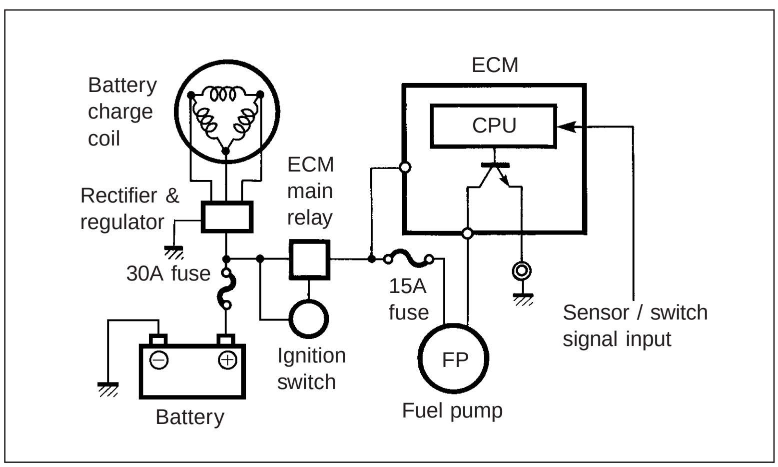


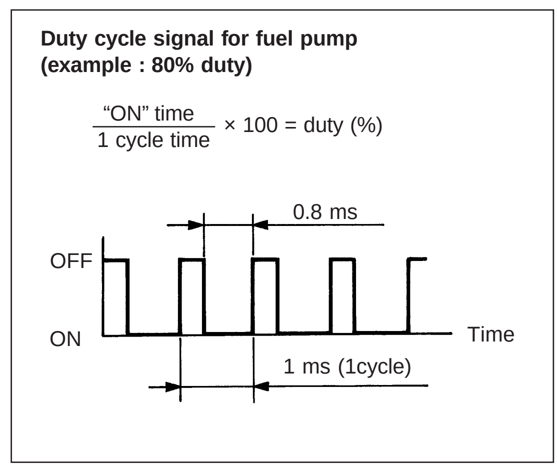
FUEL PUMP CONTROL SYSTEM

OUTLINE

To supply the optimum fuel amount, the ECM controls the fuel pump drive duty cycle, a repeated ON/ OFF signal, at a specified rate (1000 times a second).
Based on engine speed and battery voltage, the ECM determines the optimum duty (repeating "ON" time rate within a cycle) and sends this signal to the fuel pump.







CONTROL MODE

BEFORE START :
For 3 seconds after ignition switch is turned "ON", the pump is controlled to operate at 100% duty in order to initially pressurize the high pressure line.

WHEN CRANKING :
The pump is controlled to operate at 100% duty.

WHEN RUNNING (NORMAL OPERATION) :
The pump is controlled to operate at 80 – 90% duty based on the current engine speed and battery voltage.

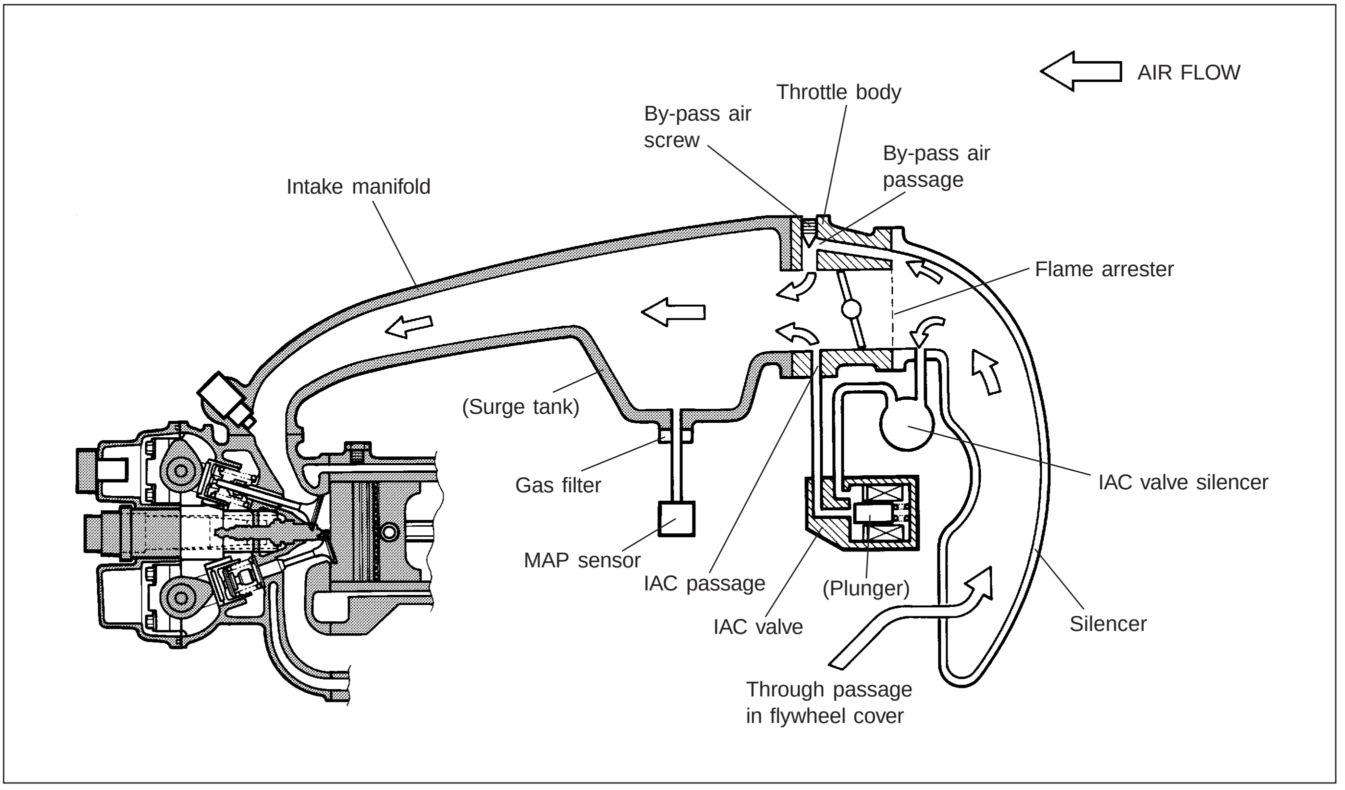
AIR INTAKE COMPONENTS

Air, after entering through the silencer, passes through the throttle body and flows into the surge tank where it is then distributed to the cylinder intake manifold.

Intake manifold pressure, monitored by the MAP sensor, is an indirect measure of the intake air amount.

When the throttle is fully closed, the main supply of intake manifold air necessary to sustain engine idle passes through the by-pass air passage.

To maintain engine idle speed at specification, the ECM controlled IAC valve supplies a regulated amount of additional air through the IAC (idle air control) passage.

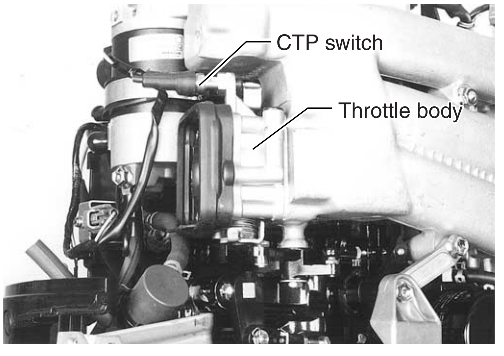


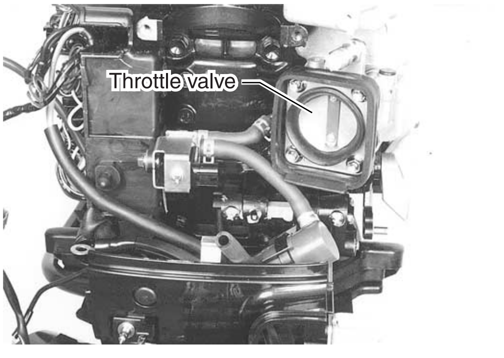
THROTTLE BODY

The throttle body assembly consists of the main bore, throttle valve, by-pass air passage, IAC passages, by-pass air screw and CTP switch.

The throttle body adjusts the intake air amount with the throttle valve which is connected to the throttle / linkage lever.

The CTP (closed throttle position) switch installed on the top of throttle body informs of throttle valve position.





NOTE:

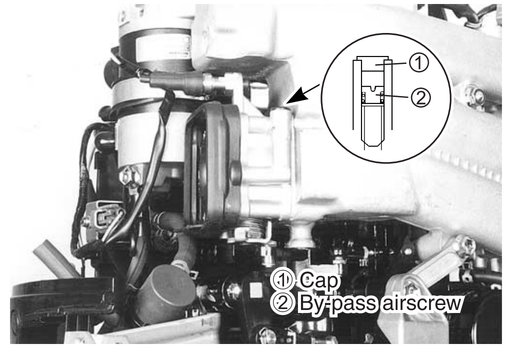
Do not try to adjust or remove any of the throttle body component parts (CTP switch, throttle valve, throttle / linkage lever, etc.).

These components have been factory adjusted to precise specifications.

BY-PASS AIR SCREW / PASSAGE

Since the throttle valve is almost fully closed when idling/ trolling, the main flow of air necessary to maintain idling / trolling speed passes through the by-pass air passage.

The by-pass air adjustment screw controls the flow of air through the passage and provides a means of partially adjusting the total amount of air necessary for idling / trolling.



NOTE:

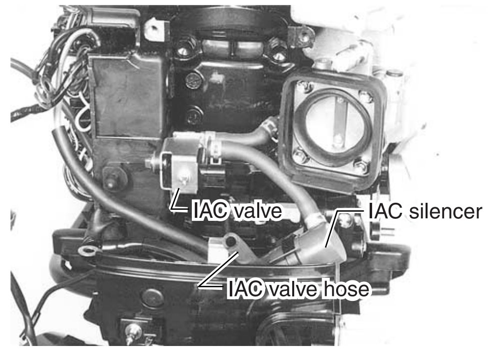
See page 2-14 for the by-pass air screw adjustment procedure.

IAC VALVE / PASSAGE

The IAC valve is a solenoid plunger type mounted on the electrical parts holder.

Its purpose is to control the amount of intake air flowing from the IAC passage.

The IAC valve is driven by the duty cycle signal from the ECM.



IDLE AIR CONTROL SYSTEM

OUTLINE

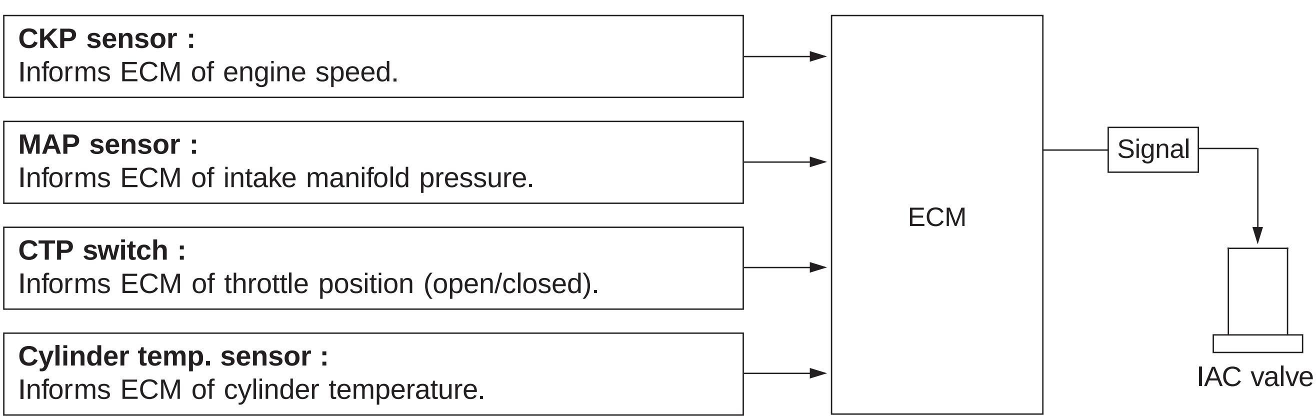
The ECM controls the duty cycle signal of the IAC valve to regulate a portion of the intake air flow to the intake manifold.

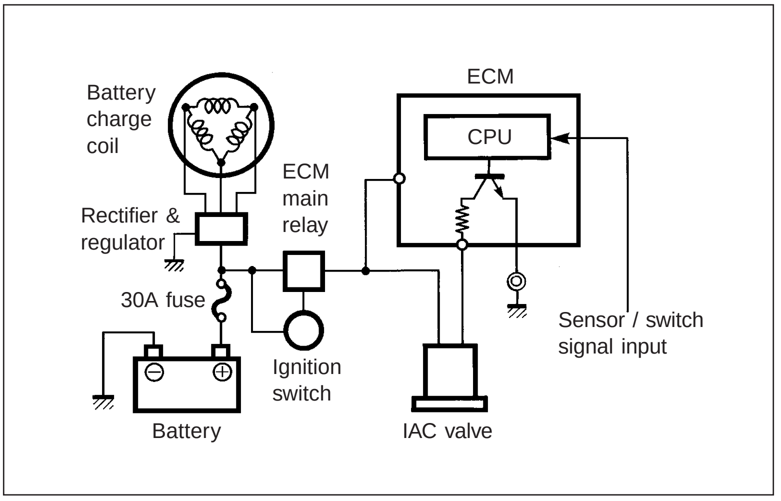
This system is used for the following purposes:

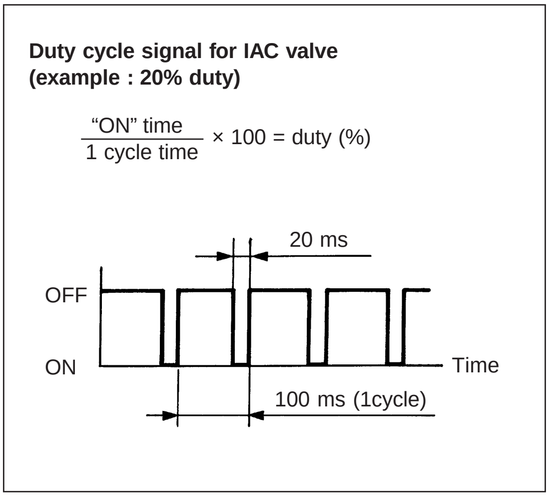
- To keep idling / trolling at the specified speed.
- To improve driveability when decelerating.
  (Dash-pot effect)
- To improve engine starting and warm-up performance.
  (Fast-idle function)

The sensors / switch shown below monitor current engine condition and send signals to the ECM. Based on these signals, the ECM determines the optimum duty cycle (repeating "ON" time rate within a cycle).

A repeating ON/OFF signal at a specified rate (10 times a second) is then sent to the IAC valve.







CONTROL MODE

BEFORE START:
The IAC valve is always closed when engine is not running. (0% duty)

WHEN CRANKING :
The IAC valve is controlled to operate at 100% duty.

AFTER START (FAST-IDLE FUNCTION) :
The IAC valve is controlled to operate at 100% duty until the timer, which was set according to cylinder temperature at cranking, expires.

WHEN IDLING / TROLLING :
The IAC valve is controlled so that the engine speed is stable at the idling / trolling speed specified.
During this period, the IAC valve has a duty cycle of approx. 20% but will vary slightly as idling / trolling conditions change.

WHEN RUNNING (NORMAL OPERATION) :
The IAC valve is controlled to operate at 20 – 100% duty, which depends on the current engine conditions.

WHEN DECELERATING (DASH-POT EFFECT):
When the throttle valve is suddenly returned to full close and the CTP switch signal changes to “ON”, the IAC valve operates at a controlled gradual return to idle / troll operating duty to prevent engine stalling or unstable running.

NOTE:
Due to the limited intake air flow from the IAC passage and in order to effectively use both the “Dash-pot effect” and “Fast-idle function”, the by-pass air screw must be adjusted to provide IAC valve operation at 20 ± 5% duty at the engine idling / trolling specification.
See page 2-14 for the by-pass air screw adjustment procedure.

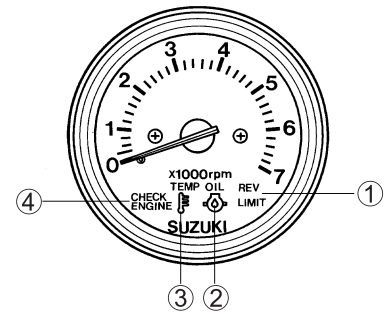
CAUTION SYSTEM

The following four caution systems alert the operator when an abnormality occurs on the engine.

- **OVER-REVOLUTION CAUTION**
- **LOW OIL PRESSURE CAUTION**
- **OVERHEAT CAUTION**
- **LOW BATTERY VOLTAGE CAUTION**

CAUTION TYPE	CAUTION LAMP	CAUTION BUZZER	OVER-REV LIMITER (3000 r/ min)
Over-revolution	Yes ①	No	Yes
Low oil pressure	Yes ②(①)	Yes	Yes
Overheat	Yes ③(①)	Yes	Yes
Low battery voltage	Yes ④	Yes	No

MONITOR-TACHOMETER



① "REV LIMIT" lamp
② "OIL" lamp
③ "TEMP" lamp
④ "CHECK ENGINE" lamp

OVER-REVOLUTION CAUTION SYSTEM

CONDITION:

When the engine speed exceeds 6500 r/min(DF40) or 7000 r/min (DF50), the ECM initiates an intermittent fuel injection signal to provide a 6500 r/min or 7000 r/min maximum. (Over-revolution limiter)

ACTION:

Engine speed	Automatically reduced to approx. 3000 r/min by intermittent fuel injection signal.
Caution lamp	"REV-LIMIT" lamp lights continuously.
Caution buzzer	No buzzer sounds.

RESET :

Close throttle to reduce engine speed below approx. 3000 r/min for one second.

LOW OIL PRESSURE CAUTION SYSTEM

CONDITION :

Immediate activation of system when the oil pressure switch turns “ON” due to an engine oil pressure drop below 100 kPa (1.0 kg / cm^2, 14 psi.).

ACTION :

Engine speed	Automatically reduced to approx. 3000 r/min by intermittent fuel injection signal if the system is activated at 3000 r/min or higher.
Caution lamp	“ OIL ” lamp lights continuously. “ REV-LIMIT ” lamp lights continuously during engine speed rev-limiter activation.
Caution buzzer	Sounds in a series of long (1.5 sec.) beeps.

RESET :

Stop engine and check engine oil level. Refill engine oil to the correct level if below the low oil mark.
If the engine oil level is correct, the following causes may be considered:

- Improper oil viscosity.
- Malfunctioning oil pressure switch.
- Clogged oil strainer or oil filter.
- Worn oil pump relief valve.
- Oil leakage from the oil passage.
- Excessive wear / damage of oil pump

NOTE:
The low oil pressure caution system is reset when the oil pressure is restored to over 1.0kg/cm^2 with approx. 3000 r/min or less engine speed operation.
However, the engine must be stopped and checked immediately once the system is activated.

OVERHEAT CAUTION SYSTEM

CONDITION 1 (Maximum temperature)

Immediate activation of system when :

- Cylinder temperature reaches 121°C
- Exhaust manifold temperature reaches 121°C

CONDITION 2 (Temp. rise Vs Time)

Immediate activation of system when :

- The average temperature difference during three consecutive 10 second measurement periods of the cylinder temperature sensor at engine speeds of 500 r/min or higher exceeds the limits as shown below.

Temperature range	Temperature difference
60 °C ~ 94 °C	1.6 °C
95 °C ~	0.9 °C

- The average temperature difference during three consecutive 10 second measurement periods of the exhaust manifold temperature sensor at engine speeds of 500 r/min or higher exceeds the limits shown below.

Temperature range	Temperature difference
80 °C ~ 94 °C	14.4 °C
95 °C ~	1.4 °C

ACTION :

Engine speed	Automatically reduced to approx. 3000 r/min by intermittent fuel injection signal if the system is activated at 3000 r/min or higher.
Caution lamp	“TEMP” lamp lights continuously. “REV- LIMIT” lamp lights continuously during engine speed limiter activation.
Caution buzzer	Sounds in a series of long (1.5 sec.) beeps.

RESET :

Close throttle to reduce engine speed below approx. 3000 r/min.

When cylinder temperature drops below the limits as shown below, the system resets. However, the system may be activated again unless the cause for overheat (such as insufficient water) is removed.

Caution cause	Reset temperature
Condition 1 (Maximum temperature)	Approx. 65 °C
Condition 2 (Temperature rise Vs Time)	Approx. 70 °C

LOW BATTERY VOLTAGE CAUTION SYSTEM

CONDITION :

System is activated when battery voltage decreases to less than 9 volts for 30 seconds.

ACTION:

Engine speed	No engine speed limiter is activated.
Caution lamp	“CHECK ENGINE” lamp lights continuously.
Caution buzzer	Sounds in a series of long (1.5 sec.) beeps.

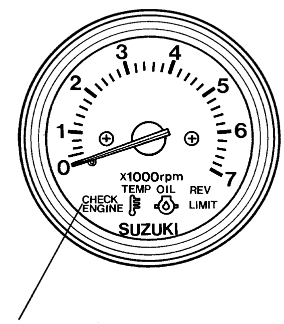
RESET:

This caution system is automatically reset when battery voltage increases to more than 9 volts. Refrain from using electrical equipment requiring high amperage such as hydraulic trim tabs, hydraulic jack plate, etc. after this caution is activated.

SELF-DIAGNOSTIC SYSTEM

The self-diagnostic system alerts the operator when an abnormality occurs in a signal from sensor, switch, etc.
When the system is activated, the “CHECK ENGINE” lamp flashes (lights intermittently) according to each code pattern along with a buzzer sound.
When engine is running, the buzzer sounds a series of short (0.2 sec.) beeps.
When engine is not running, the buzzer sounds according to each code pattern, but not simultaneous with the lamp flash.
The buzzer sound, activated by the self-diagnostic system, can be temporally canceled by pushing the ignition key in.

MONITOR-TACHOMETER



“CHECK ENGINE” lamp

PRIORITY / CODE / PATTERN FOR SELF-DIAGNOSTIC SYSTEM OPERATION

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	NO **[**NOTE1**]**
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 (Sensor hose)	3 – 2	on off	NO
9	Rectifier & regulator (Over-charging) **[**NOTE 2**]**	1 – 1	on off	NO
10	Exhaust manifold temp. sensor	1 – 5	on off	YES

NOTE:
- *If more than two items fail at once, the self- diagnostic indication appears according to priority order. The indication repeats three times.*
- *If the failed item remains, the self-diagnostic indication appears again after turning the ignition switch "ON".*
- *After correcting failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running.*
- *For cylinder temp. sensor, exhaust manifold temp. sensor or IAT sensor the self-diagnostic indication will be canceled after corrective action by turning the ignition switch "ON".*
  (The ECM will require 10 – 20 seconds after turning the ignition switch "ON" to cancel the self-diagnostic indication.)

NOTE 1:
- *No spark or injection signal will be supplied to the cylinder corresponding to the faild CKP sensor.*
- *If two or more CKP sensors have failed at the same time, the engine will stop.*

NOTE 2 :
The self-diagnostic indication may be canceled by turning ignition switch "ON" because the ECM detects only battery voltage, not charging output. Under this condition the buzzer will not sound a 1-1 code.
However, if the rectifier & regulator have failed, the self-diagnostic indication will again appear after starting the engine.

CONDITION FOR SELF-DIAGNOSTIC SYSTEM OPERATION

FAILED ITEM	CONDITION
MAP sensor 1	• No signal (With engine running) • Receiving an out of range "37 – 860 mmHg (0.20 – 4.53V)" signal (With engine running)
CKP sensor	• No signal from any CKP sensors while receiving 8 signals from other CKP sensors. • No signal from any CKP sensors while receiving 6 signals from CMP sensor.
IAC valve / By-pass air screw adjustment	• IAC valve operates at 90% duty or higher when CTP switch is "ON" **[**NOTE 1**]**
CMP sensor	• No signal while receiving 12 signals from CKP sensors
CTP switch	• Receiving "ON" signal when engine speed is 2500 r/ min or higher and intake manifold pressure is 300 mmHg or higher.
Cylinder temp. sensor	• No signal • Receiving an out of range "– 46 to +170 °C (0.10 – 4.63V)" signal
IAT sensor	• No signal • Receiving an out of range "– 46 to +169 °C (0.04 – 4.46V)" signal
MAP sensor 2 (Sensor hose)	• Receiving unchanging signal regardless engine speed change **[**NOTE 2**]**
Rectifier & regulator (Over-charging)	• Receiving 16 volts or higher signal
Exhaust manifold temp, sensor	• No signal • Receiving an out of range "– 46 to +170 °C (0.10 – 4.63V)" signal

NOTE 1:
This condition will be caused by IAC valve failure or incorrect by-pass air screw adjustment. If IAC valve is always closed or by-pass air is too low, the ECM controls the IAC valve duty to increase to maintain the idling/ trolling speed specified.
Conversely, if IAC valve is always opened or by -pass air is too high, the ECM controls the IAC valve duty to decrease to maintain the idling / trolling speed specified.

NOTE 2:
This condition will be caused by disconnected, kinked or clogged MAP sensor hose or clogged inlet manifold gas filter.

FAIL-SAFE SYSTEM

The fail-safe system is closely related to the self-diagnostic system.
When an abnormality occurs in a sensor signal, the ECM ignores the out-of-range signal and assumes a pre-programmed value for the failed sensors.
This allows the engine to continue running under the fail-safe condition.

PRE-PROGRAMMED VALUE FOR FAIL-SAFE SYSTEM

FAILED ITEM	PRE-PROGRAMMED VALUE
MAP sensor 1	• 319 – 475 mmHg (Correspond to approx. 750 – 4000 r/min) [NOTE 1]
CMP sensor	• Fuel Injection: 1 simultaneous injection for all cylinders per 2 crankshaft rotations • Ignition Timing: Fixed at BTDC 5° ignition timing
Cylinder temp. sensor	60 °C (140 °F)
IAT sensor	45 °C (113 °F)
Exhaust manifold temp. sensor	60 °C (140 °F)

NOTE:
There is no back-up system for the ECM itself. The engine will stop if it has failed.

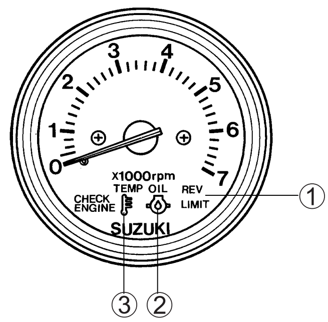
NOTE 1:
This value will change according to the current engine speed.

OPERATING HOUR INDICATION SYSTEM

When the ignition switch is initially turned “ON” (from “OFF”), the ECM tests the caution system by turning on all four lamps in the monitor-tachometer and sounding the caution buzzer for an initial two seconds.
For the next three seconds, the ECM indicates the total operating hours, in units of 50 hours, using a combination of the tachometer needle and three lamps (except for “CHECK ENGINE” lamp).

NOTE:
The total operating hours displayed are those of actual engine operation, not ignition switch “ON” time.

MONITOR-TACHOMETER



① “REV LIMIT” lamp
② “OIL” lamp
③ “TEMP” lamp

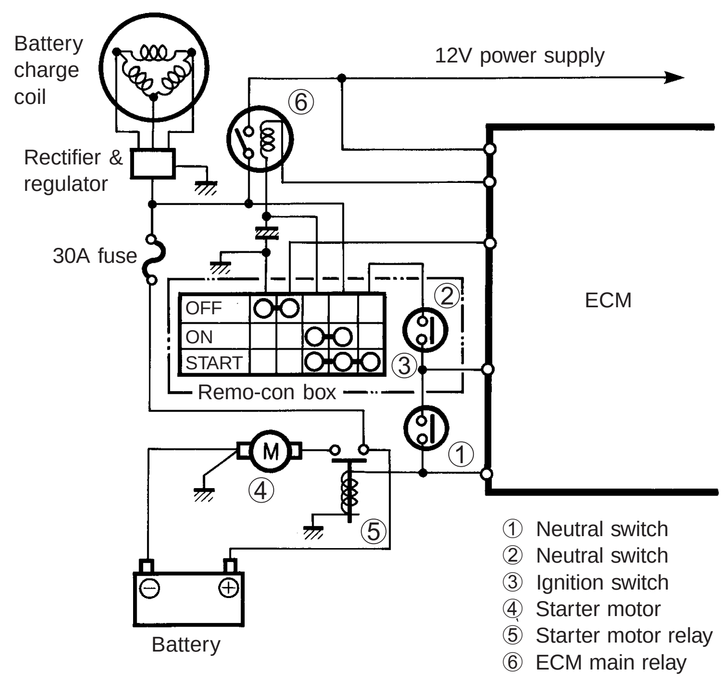
CHART OF TOTAL OPERATING HOURS INDICATION

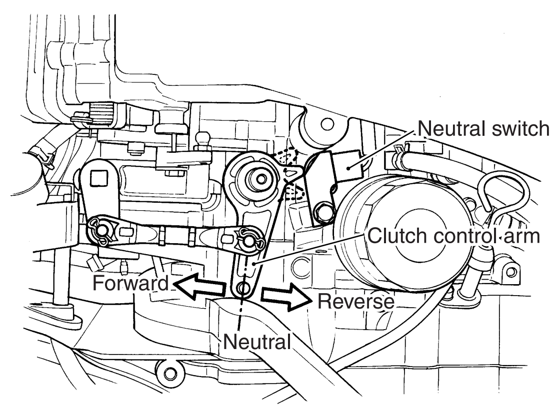
TOTAL OPERATING HOURS	MONITOR-TACHOMETER INDICATION			
	“REV-LIMIT” lamp①	“OIL” lamp②	“TEMP” lamp③	Needle indication
0 (h)–	off	off	off	0 rpm
50 (h)–	flash	off	off	0 rpm
100 (h)–	on	off	off	1000 rpm
150 (h)–	flash	off	off	1000 rpm
200 (h)–	on	off	off	2000 rpm
250 (h)–	flash	off	off	2000 rpm
300 (h)–	on	off	off	4000 rpm
350 (h)–	flash	flash	off	0 rpm
400 (h)–	on	on	off	1000 rpm
450 (h)–	flash	flash	off	1000 rpm
500 (h)–	on	on	off	2000 rpm
550 (h)–	flash	flash	off	2000 rpm
600 (h)–	on	on	off	4000 rpm
650 (h)–	flash	flash	flash	0 rpm
700 (h)–	on	on	on	1000 rpm
750 (h)–	flash	flash	flash	1000 rpm
800 (h)–	on	on	on	2000 rpm
850 (h)–	flash	flash	flash	2000 rpm
900 (h)–	on	on	on	4000 rpm
950 (h)–	flash	off	flash	0 rpm
1000 (h)–	on	off	on	1000 rpm
1050 (h)–	flash	off	flash	1000 rpm
1100 (h)–	on	off	on	2000 rpm
1150 (h)–	flash	off	flash	2000 rpm
1200 (h)–	on	off	on	4000 rpm

START- IN- GEAR PROTECTION SYSTEM

A switch to detect neutral gear position is located on the cylinder block (PORT side) and operated by the clutch control arm.
This ON / OFF type switch is “ON” in neutral and “OFF” in forward or reverse.
On starting the engine, the ECM detects the shift position using the neutral switch. When the neutral switch is “OFF”, the ECM does not send a signal for injector operation.
This neutral switch is also used to regulate the starter motor circuit. The engine will not start, even by emergency rope, with the shift in the forward or reverse position.

SHIFT POSITION	NEUTRAL SWITCH	OPERATION			
		Fuel injector	Ignition	Fuel pump	Starter motor
Neutral	ON	Yes	Yes	Yes	Yes
Forward / Reverse	OFF	No	Yes	Yes	No



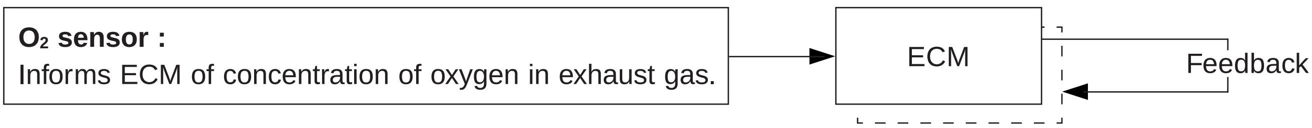


O_2 FEEDBACK SYSTEM

After extended usage, the engine components may become deteriorated or worn out.

This might make the A / F (air / fuel mixture ratio) incorrect which could affect exhaust emissions. To correct the A/F, an O_2 sensor is temporally installed to the exhaust manifold. This sensor is used to measure the concentration of oxygen in the exhaust gas at engine speeds of 2500, 3500 and 4500 r/ min.

The ECM uses the input data from the O_2 sensor to correct the compensation coefficient of the fuel injection duration map within the ECM itself.



NOTE:

See the "FUEL MIXTURE CHECK (O_2 FEEDBACK)" section on page 2-21 for the O_2 feedback operation procedure.

INSPECTION

PRECAUTION ON SYSTEM INSPECTION

WARNING

To prevent an unexpected engine start, perform the following before proceeding with any CRANKING tests.
- **When performing tests not related to fuel injector operation :**
  - **Disconnect all fuel injector wire connectors.**
- **When performing tests related to fuel injector operation :**
  - **Relieve fuel pressure in line.** **(See page 5-2.)**
  - **Disconnect high pressure fuel pump wire connector located on fuel vapor separator.**

CAUTION

- **Always turn ignition switch "OFF" and disconnect battery cables when wires are being disconnected or connected.**
- **Hold and pull connector pieces when disconnecting. Do not pull wires.**

NOTE:
- *The self-diagnostic code memory in ECM will remain even if battery is disconnected.*
- *As each terminal voltage is affected by battery voltage, use a full-charged battery.*
- *Make sure all ground points have good electrical contact.*
- *Make sure all wires/cables are securely connected.*

INSPECTION FOR ECM CIRCUIT VOLTAGE

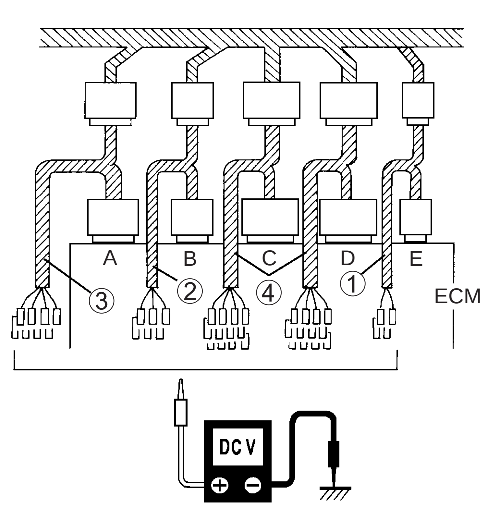
CAUTION

ECM cannot be bench checked. It is strictly prohibited to connect any tester (voltmeter or ohmmeter) to an ECM separated from the engine wiring harness.

TOOL **09930-89910 : 4-pin test cord – ①**
09930-89920 : 6-pin test cord – ②
09930-89930 : 8-pin test cord – ③
09930-89940 : 12-pin test cord – ④
09930-99320 : Digital tester

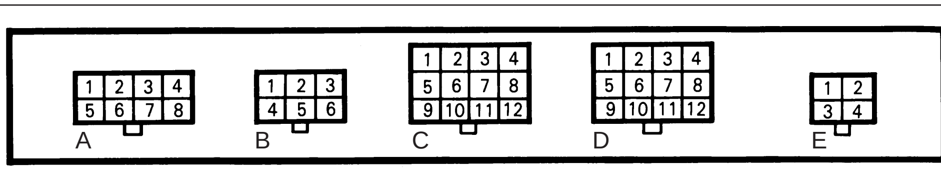
DC V **Tester range : ⎓ V (DC voltage)**

(1) Connect the test cord ①,②,③ or ④ between ECM and wire harness as shown.
(2) Turn ignition switch ON.
(3) Connect the tester probe ⊖ (Black) to body ground, and measure voltage according to the "CIRCUIT VOLTAGE TABLE".



CIRCUIT VOLTAGE TABLE

TER-MINAL	WIRE COLOR		CIRCUIT	STANDARD VOLTAGE	CONDITION / REMARKS
	ENGINE	TEST CORD			
A1	Bl	Bl	No.2 Ignition (–)	Approx. 12V	Ignition switch ON
A2	B	G	Ground for power source	—	—
A3	G	B/W	No.3 Ignition (–)	Approx. 12V	Ignition switch ON
A4	O/B	B/R	No.1 Fuel injector (–)	Approx. 12V	Ignition switch ON
A5	O	O	No.1 Ignition (–)	Approx. 12V	Ignition switch ON
A6	B	B	Ground for power source	—	—
A7	B/Y	B/Y	No.2 Fuel injector (–)	Approx. 12V	Ignition switch ON
A8	R/W	Lg	No.3 Fuel injector (–)	Approx. 12V	Ignition switch ON
B1	B/W	R/W	Fuel pump (–)	Approx. 0V	For 3 sec. after ignition switch ON
					While engine cranking
				Approx. 12V	Other than above (Ignition switch ON)
B2	P/B	P/B	Ground for ECM main relay	—	—
B3	B	G	Ground for ECM	—	—
B4	B/R	O/B	IAC valve solenoid (–)	Approx. 12V	Ignition switch ON
B5	Gr	Gr	ECM power source	Approx. 12V	Ignition switch ON
B6	B	B	Ground for ECM	—	—
C1	Bl/R	B/W	Emergency stop switch	Approx. 5V	Ignition switch ON, plate IN
				Approx. 0V	Ignition switch ON, plate OUT
C2	Y/B	R	Tachometer	—	—
C3	G/W	Lg/W	CHECK ENGINE lamp	—	—
C4	G/Y	Bl	TEMP lamp	—	—
C5	P	B/G	REV-LIMIT lamp	—	—
C6	Bl/B	Lg/B	OIL lamp	—	—
C7	Bl/W	W	Buzzer	—	—
C8	Br	Lg/R	Neutral switch	Approx. 0V	Ignition switch ON, shift into NEUTRAL
				Approx. 5V	Ignition switch ON, shift into FORWARD or REVERSE
C9	V/W	G/Y	Ex-manifold temperature sensor	0.10 – 4.63V	Ignition switch ON
C10	Bl/Y	B/R	PC communication	—	—
C11	R/Y	Y/G	PC communication	—	—
C12	O	O/Y	Buzzer cancel	Approx. 12V	Ignition switch ON, key pushed
				Approx. 0V	Ignition switch ON, key not pushed
D1	B/W	B/W	Ground for sensors	—	—
D2	R	R	Power source for MAP sensor	Approx. 5V	Ignition switch ON
D3	Lg/W	Lg/W	Cylinder temperature sensor	0.10 – 4.63V	Ignition switch ON
D4	Bl	Bl	Oil pressure switch	Approx. 5V	While engine running
				Approx. 0V	Other than above (Ignition switch ON)
D5	B/G	B/G	O2 feedback/PC communication	—	—
D6	Lg/B	Lg/B	IAT sensor	0.04 – 4.46V	Ignition switch ON
D7	W	W	MAP sensor	0.20 – 4.53V	Ignition switch ON
D8	Lg/R	Lg/R	CTP switch	Approx. 5V	Ignition switch ON, throttle not fully closed
				Approx. 0V	Ignition switch ON, throttle fully closed
D9	G/Y	G/Y	PC communication	—	—
D10	—	B/R	—	—	—
D11	Y/G	Y/G	Engine start switch (signal)	6 – 12V	While engine cranking
				Approx. 0V	Other than above (Ignition switch ON)
D12	O/Y	O/Y	PC communication	—	—
E1	R/W	B	CKP sensor No.3	—	—
E2	O/G	O/G	CMP sensor	Approx. 0.3V or 5V	Ignition switch ON
E3	W/B	W/B	CKP sensor No.2	—	—
E4	R/B	R/B	CKP sensor No.1	—	—



INSPECTION FOR RESISTANCE

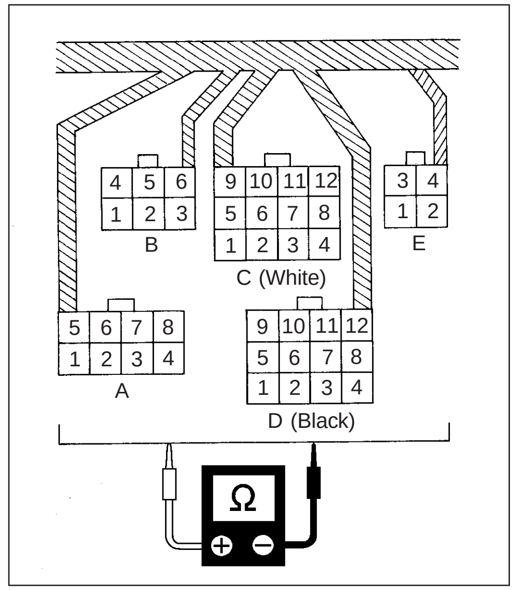
09930-99320 : Digital tester

Tester range : Ω (Resistance)

NOTE:

Make sure ignition switch is always OFF when measuring resistance.

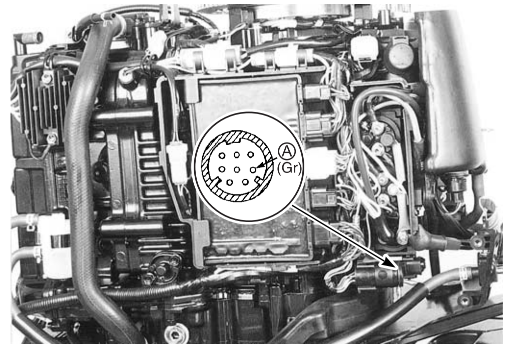
(1) Disconnect battery cables from battery.
(2) Disconnect all wires from ECM.
(3) Connect the tester probes to terminal of wire harness side, and measure resistance according to the “RESISTANCE TABLE”.



RESISTANCE TABLE

ITEM	TERMINAL FOR TESTER PROBE CONNECTION	STANDARD RESISTANCE (at 20°C)
CKP sensor No.1	E4 (R/B) to D1 (B/W)	168 – 252 Ω
CKP sensor No.2	E3 (W/B) to D1 (B/W)	
CKP sensor No.3	E1 (R/W) to D1 (B/W)	
Ignition coil No.1 (Primary)	A5 (O) to B5 (Gr)	1.9 – 2.5 Ω
Ignition coil No.2 (Primary)	A1 (Bl) to B5 (Gr)	
Ignition coil No.3 (Primary)	A3 (G) to B5 (Gr)	
Ignition coil No.1 (Secondary)	B5 (Gr) to No.1 spark plug cap	8.1 – 11.1 kΩ
Ignition coil No.2 (Secondary)	B5 (Gr) to No.2 spark plug cap	
Ignition coil No.3 (Secondary)	B5 (Gr) to No.3 spark plug cap	
Fuel injector No.1	A4 (O/B) to B5 (Gr)	11.0 – 16.5 Ω
Fuel injector No.2	A7 (B/Y) to B5 (Gr)	
Fuel injector No.3	A8 (R/W) to B5 (Gr)	
IAC valve	B4 (B/R) to B5 (Gr)	21.5 – 32.3 Ω
IAT sensor	D6 (Lg/B) to D1 (B/W)	0°C (32°F) : 5.3 – 6.6 kΩ 25°C (77°F) : 1.8 – 2.3 kΩ 50°C (122°F) : 0.73 – 0.96 kΩ 75°C (135°F) : 0.33 – 0.45 kΩ (Thermistor characteristic)
Cylinder temperature sensor	D3 (Lg/W) to D1 (B/W)	
Ex-mani. temperature sensor	C9 (V/W) to D1 (B/W)	
ECM main relay	B2 (P/B) to TerminalⒶ [NOTE1]	80 – 120 Ω
Starter motor relay	D11 (Y/G) to Ground	3.5 – 5.1 Ω

NOTE1:
Disconnect remote control wire harness, and connect tester probe to terminal Ⓐ (Gray wire).

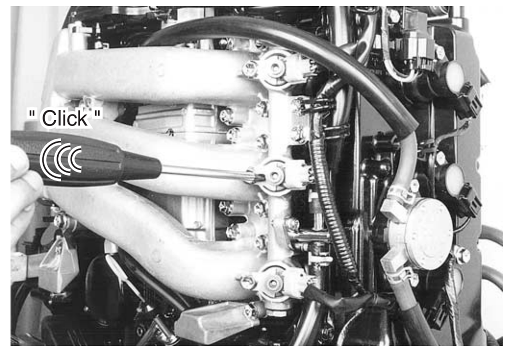


OTHER INSPECTION

FUEL INJECTOR OPERATING SOUND (CRANKING)

(1) Touch a sound scope or long blade screw driver to fuel injector body as shown.
(2) Crank engine and check for injector operating sound.

Injector operating sound : "Click"



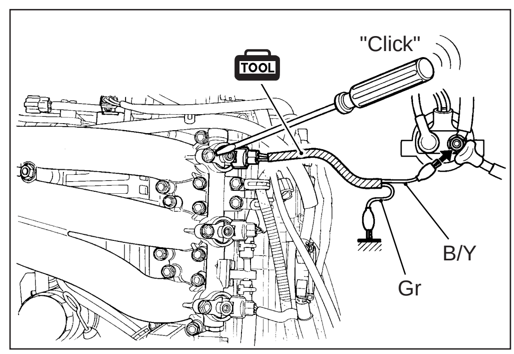
FUEL INJECTOR OPERATING SOUND (INDIVIDUAL)

(1) Disconnect fuel injector wire, and connect the test cord.

TOOL **09930-89260 : Injector test cord A**

(2) Connect Gray wire to body ground.
(3) Momentarily touch Black/Yellow wire to starter motor relay right terminal (connected to battery positive (+) terminal), and check for injector operating sound.

Injector operating sound : "Click"



CAUTION

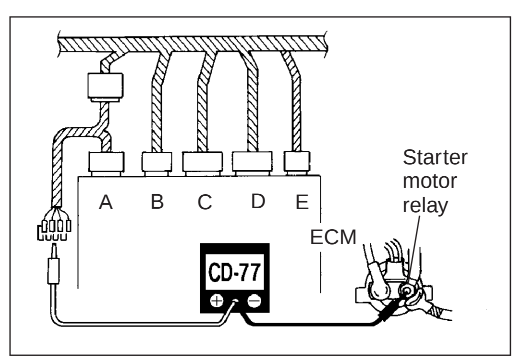
Connecting fuel injector to battery positive for more than a few seconds may cause injector overheating and possible injector solenoid failure.

FUEL INJECTOR OPERATING SIGNAL

TOOL **09930-89930 : 8-pin test cord**

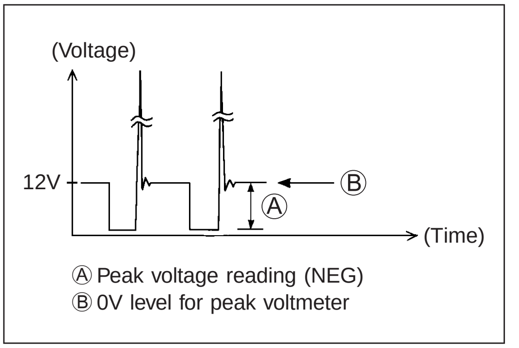
CD77 **Peak voltmeter Stevens CD-77**
Tester range : NEG50

(1) Connect the test cord as shown, then turn ignition switch ON.
(2) Connect the tester probe ⊖ (Black) to starter motor relay right terminal (connected to battery positive (+) terminal) as shown.



(3) Connect the tester probe ⊕ (Red) to each terminal.

Injector	Terminal	Wire color	
		Engine	Test cord
No.1	A4	O/B	B/R
No.2	A7	B/Y	B/Y
No.3	A8	R/W	Lg



(4) Crank engine and measure voltage.

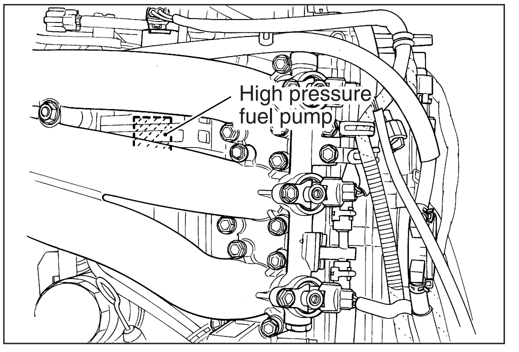
Fuel injector operating signal : 6 – 10 V

FUEL PUMP 3 SEC. OPERATING SOUND

Turn ignition switch ON and check for fuel pump operating sound.

Fuel pump operating sound :
Sounds for approx. 3 seconds only

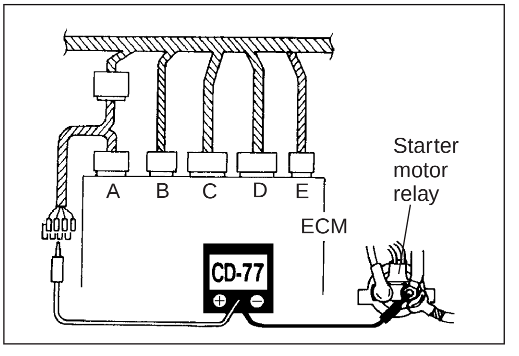
NOTE:
Fuel pump operating sound is low because pump is in fuel vapor separator. If you cannot hear clearly, use a sound scope or long blade screw driver.



IGNITION COIL OPERATING SIGNAL

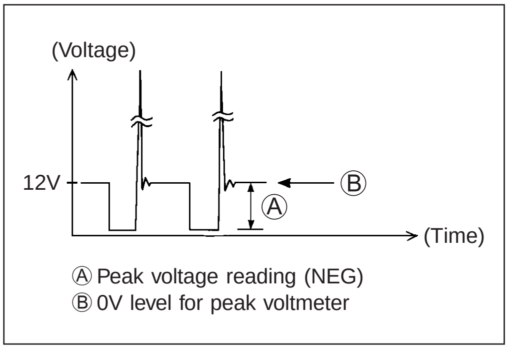
09930-89930 : 8-pin test cord

Peak voltmeter Stevens CD-77
Tester range : NEG50



(1) Connect the test cords as shown, then turn ignition switch ON.
(2) Connect the tester probe ⊖ (Black) to starter motor relay right terminal (connected to battery positive (+) terminal) as shown.
(3) Connect the tester probe ⊕ (Red) to each terminal.

Ignition coil	Terminal	Wire color	
		Engine	Test cord
No.1	A5	O	O
No.2	A1	Bl	Bl
No.3	A3	G	B/W

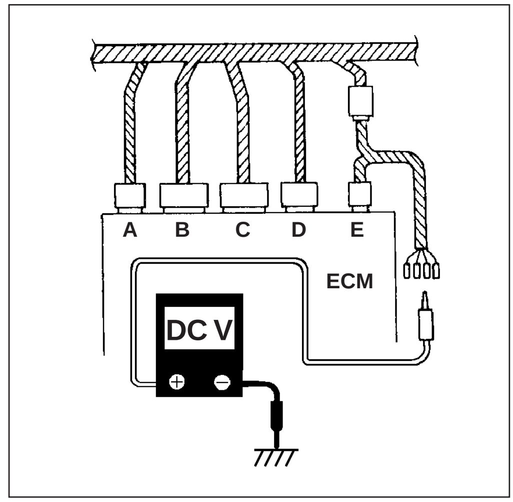


(4) Crank engine and measure voltage.

Ignition coil operating signal : 6 – 10 V

CMP SENSOR SIGNAL

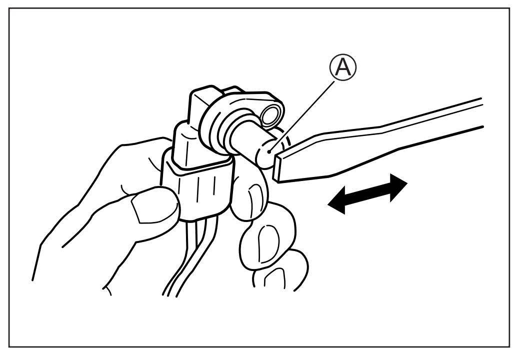
09930-89910 : 4-pin test cord
09930-99320 : Digital tester
Tester range : ⎓ V (DC voltage)



(1) Rremote CMP sensor from engine. (See page 3-48)
(2) Connect the test cord as shown, then turn ignition switch ON.
(3) Connect the tester probe (+) (Red) to terminal.

Terminal	Wire color	
	Engine	Test cord
E2	O/G	O/G

(4) Connect the tester probe (–) (Black) to body ground.
(5) Measure voltage when steel tip of a screwdriver is brought near and then pulled away from sensor tip Ⓐ.



CMP sensor signal : Approx. 0.3 V or 5 V

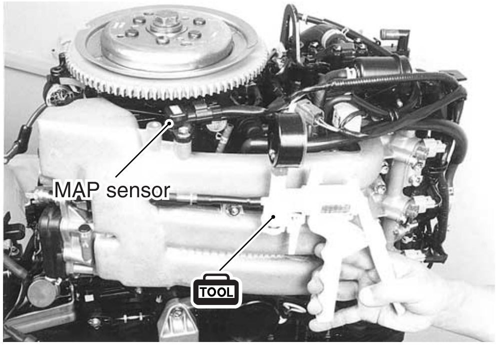
NOTE:
Two signal voltages mentioned above (0.3 V or 5 V) will change by repeating movement of screwdriver.

MAP SENSOR OUTPUT VOLTAGE CHANGE

09917-47011 : Vaccum pump gauge
09930-89940 : 12-pin test cord
09930-99320 : Digital tester

Tester range : ⎓ V (DC voltage)

(1) Disconnect MAP sensor hose from gas filter (surge tank) side.
(2) Connect the gauge to MAP sensor hose end as shown.
(3) While applying negative pressure to MAP sensor, measure "D7" terminal voltage. (See page 3-33 and 3-34 for procedure.)



MAP sensor output voltage change :

Negative pressure kPa (kg/cm^2, mm Hg)	0 (0, 0)	40 (0.4, 300)	80 (0.8, 600)
"D7" terminal voltage (V)	4.00	2.42	0.84

(at 1013 hPa barometric pressure)

CTP SWITCH

09930-99320 : Digital tester

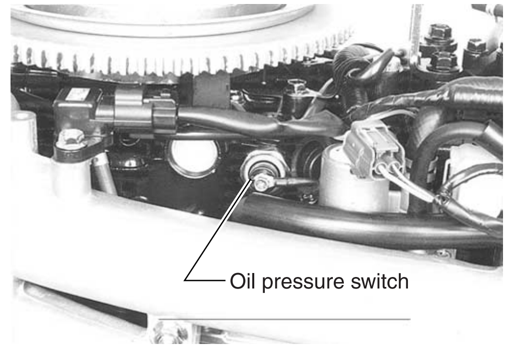
Tester range : (Continuity)

(1) Disconnect CTP switch wire.
(2) Check continuity between CTP switch terminal and body ground.

CTP switch function :

Throttle position	Continuity
Fully closed (switch contact in)	Yes
Not fully closed (switch contact out)	No

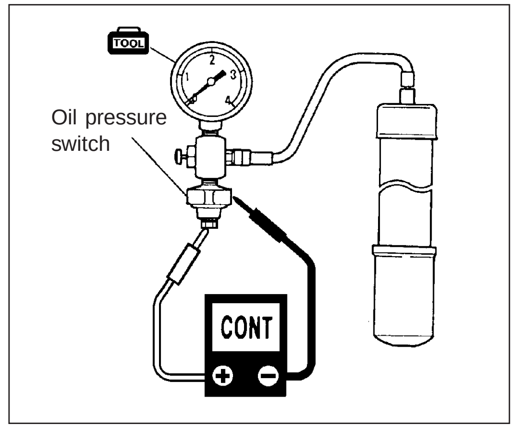
OIL PRESSURE SWITCH



09940-44121 : Air pressure gauge
: Air pump
09930-99320 : Digital tester

Tester range : (Continuity)

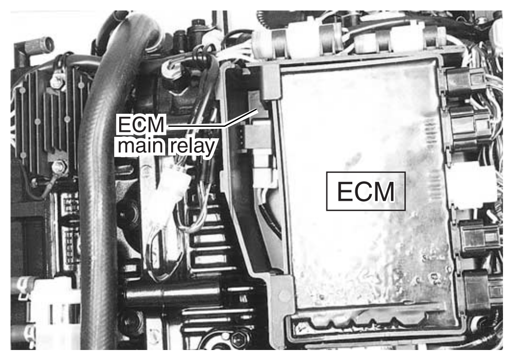
(1) Remove oil pressure switch. (See page 3-50.)
(2) Connect the gauge and pump as shown.
(3) While applying pressure to oil pressure switch, check continuity.



Oil pressure switch function :

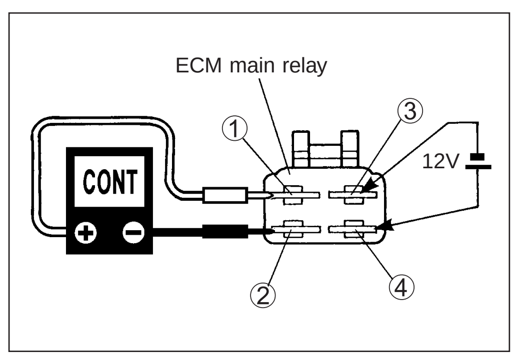
Pressure kPa (kg/cm^2)	Continuity
Less than 70 – 130 (0.7 – 1.3)	Yes
70 – 130 (0.7 – 1.3) or over	No

ECM MAIN RELAY



09930-99320 : Digital tester
Tester range : (Continuity)

(1) Disconnect ECM main relay from wire.
(2) Check continuity between terminal ① and ② each time 12V is applied. Connect positive (+) side to terminal ④, and negative (–) side to terminal ③.



ECM main relay function :

12 V power	Continuity
Applied	Yes
Not applied	No

CAUTION

Be careful not to touch 12 V power supply wires to each other or with other terminals.

TROUBLESHOOTING

⚠ WARNING

Before starting troubleshooting, read and follow the "PRECAUTION ON SYSTEM INSPECTION" section on page 3-33.

In this section, troubleshooting procedures are based on the assumption that "low pressure fuel system" and "mechanical components (power unit, lower unit, etc.)" are normal.

NOTE:
For troubleshooting of "Starter motor will not run", see page 4-7.

CHART1 : SELF-DIAGNOSTIC CODE "3-4"

START

< Ignition switch "ON" >
Check "D2" terminal voltage.
Is result OK? (See page 3-34.)

NO → ECM failure

YES ↓

< Ignition switch "ON" >
Check "D7" terminal voltage.
Is result OK? (See page 3-34.)

NO → MAP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART2 : SELF-DIAGNOSTIC CODE "4-2"

START

< Ignition switch "OFF" >
Check CKP sensor resistance.
Is result OK? (See page 3-35.)

NO → CKP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
- *It will be possible to start engine if one CKP sensor has failed.*
- *No spark or injection signal will be supplied to the cylinder corresponding to the faild CKP sensor.*

CHART3 : SELF-DIAGNOSTIC CODE “3-1”

START

< Ignition switch “OFF” >
Check IAC valve resistance.
Is result OK? (See page 3-35.)

NO → IAC valve failure

YES ↓

< Ignition switch “ON” >
Check “B4” terminal voltage.
Is result OK? (See page 3-33.)

NO → ECM failure

YES ↓

Possible cause :
- Incorrect by-pass air screw adjustment
- IAC valve failure (mechanical)
- IAC passage failure (clogged hose/silencer, etc.)
- ECM failure
- Wire continuity/connection failure

CHART4 : SELF-DIAGNOSTIC CODE “2-4”

START

< Ignition switch “ON”, cranking >
Check CMP sensor signal.
Is result OK? (See page 3-38.)

NO → CMP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
It will be possible to start engine if CMP sensor has failed.

CHART5 : SELF-DIAGNOSTIC CODE “2-2”

START

< Ignition switch “ON” >
Check “D8” terminal voltage.
Is result OK? (See page 3-34.)

NO → CTP switch failure
[NOTE1]

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE1:
In this case, CTP switch will be in “always ON” condition. (“D8” terminal voltage will be 0V always regardless throttle position.)

CHART6 : SELF-DIAGNOSTIC CODE “1-4”

START

< Ignition switch “OFF” >
Check cylinder temp. sensor resistance.
Is result OK? (See page 3-35.)

NO → Cylinder temp. sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART 7 : SELF-DIAGNOSTIC CODE “2-3”

START

< Ignition switch “OFF” >
Check IAT sensor resistance.
Is result OK? (See page 3-35.)

NO → IAT sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART8 : SELF-DIAGNOSTIC CODE “3-2”

START

< Individual check >
Check MAP sensor hose is in good condition/connection.
Is result OK?

NO → MAP sensor hose failure

YES ↓

< Ignition switch “ON” >
Check MAP sensor output voltage change.
Is result OK? (See page 3-39.)

NO → MAP sensor failure

YES ↓

Possible cause :
- Gas filter failure (clogged, etc.)
- ECM failure
- Wire continuity/connection failure

CHART9 : SELF-DIAGNOSTIC CODE “1-1”

START

< Individual check >
Check rectifier & regulator resistance. [NOTE1]
Is result OK? (See page 4-3.)

NO → Rectifier & regulator failure

YES ↓

< Engine running >
Check “B5” terminal voltage at idle speed. (See page 3-34.)
Is result 16 V or over?

YES → Rectifier & regulator failure

NO ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
This self-diagnostic code indication may be canceled by turning ignition switch ON because ECM detects battery voltage.

NOTE1:
It is difficult to check rectifier & regulator completely. Before replacing with new one, check if its ground point has good electrical contact.

CHART10 : SELF-DIAGNOSTIC CODE “1-5”

START

< Ignition switch “OFF” >
Check exhaust manifold temp. sensor resistance.
Is result OK? (See page 3-35.)

NO → Exhaust manifold temp. sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART11 : ENGINE CRANKED, BUT NOT START (OR STOPS SHORTLY AFTER STARTING)

Before starting this troubleshooting, make sure that :
- **There is no self-diagnostic code indication.**
- **Emergency stop switch plate is set in place.**
- **15A fuse is good.**

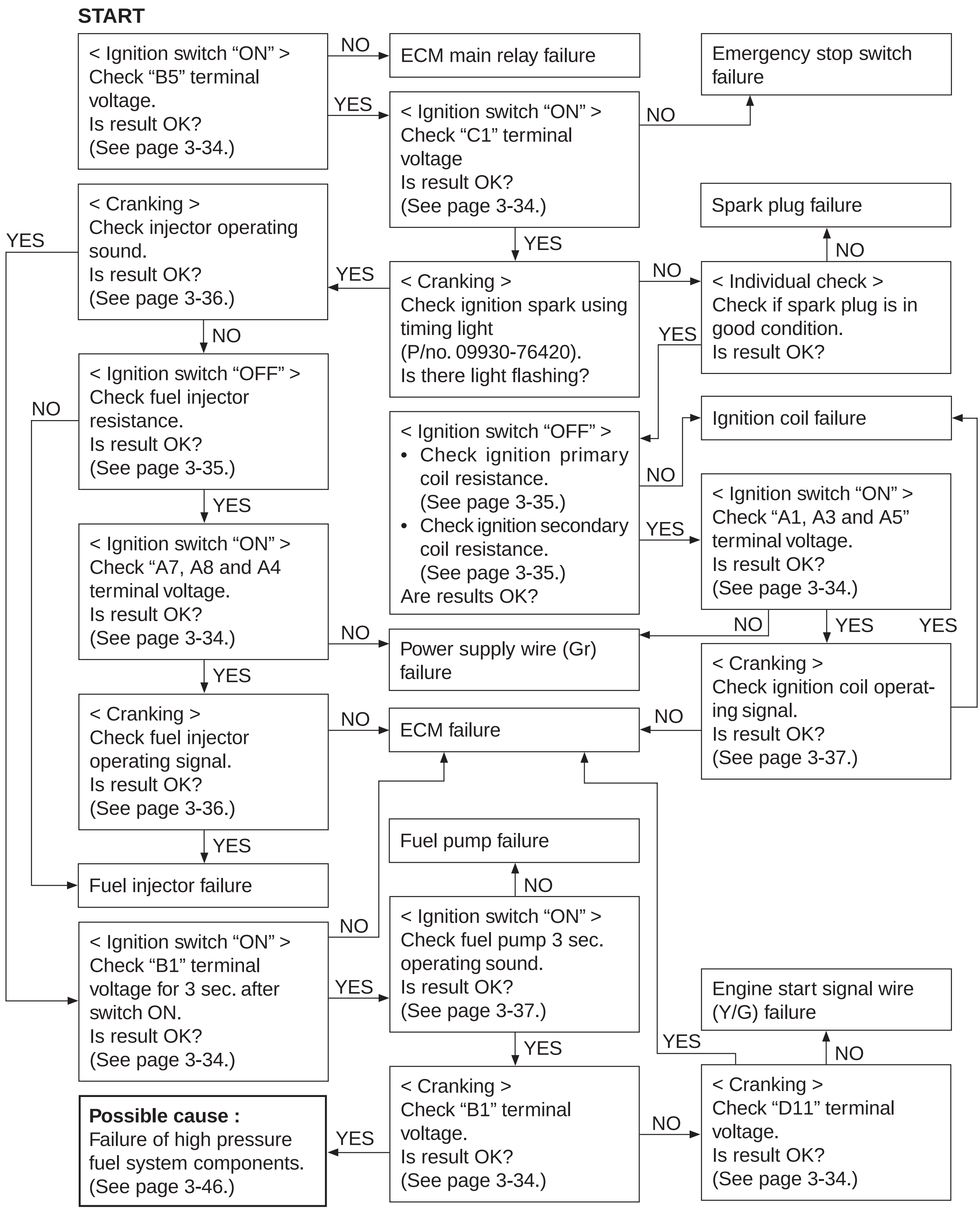
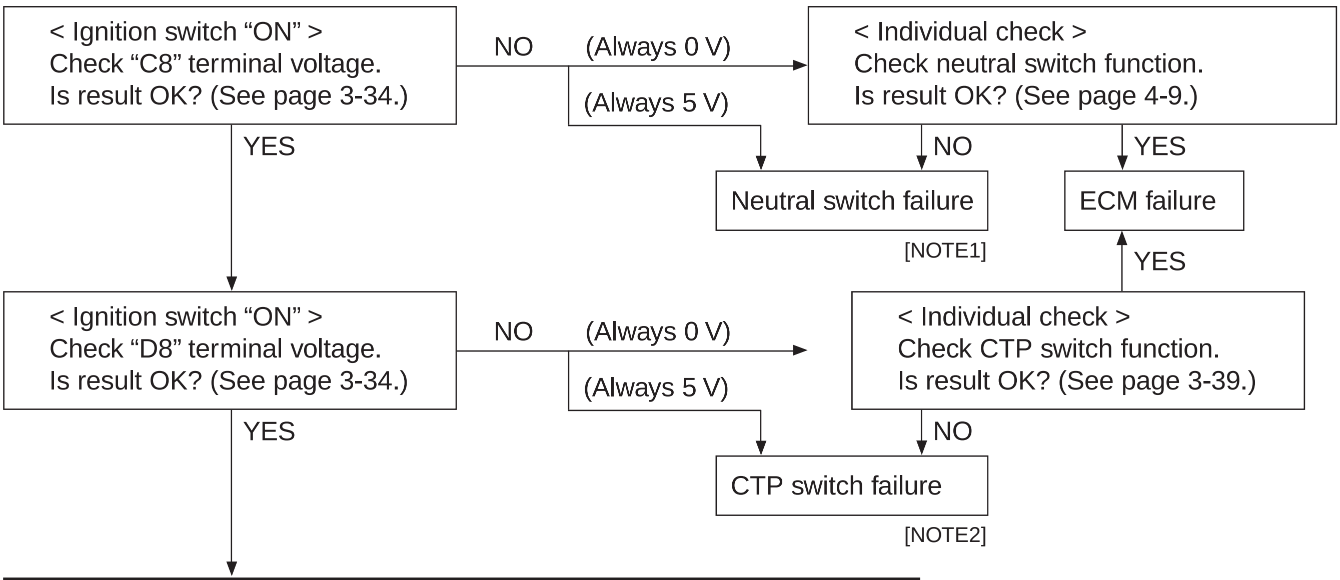


CHART12 : UNSTABLE IDLING / TROLLING (OR ENGINE TENDS TO STALL)

Before starting this troubleshooting, make sure that :
- **There is no self-diagnostic code indication.**

START



Possible cause :
- Incorrect by-pass air screw adjustment [NOTE3]
- IAC valve failure [NOTE3]
- IAC passage failure (clogged hose / silencer, etc.) [NOTE3]
- Spark plug failure
- Ignition coil failure
- ECM failure
- Wire continuity / connection failure
- Failure of high pressure fuel system components :
  - Fuel injector (clog, stuck valve, etc.)
  - Fuel pressure regulator (incorrect regulated pressure, etc.)
  - Fuel pump (clogged suction filter, leakage in tank, etc.)
  - Fuel filter (clog, etc.)
  - Hose (clog, kink, leakage, etc.)

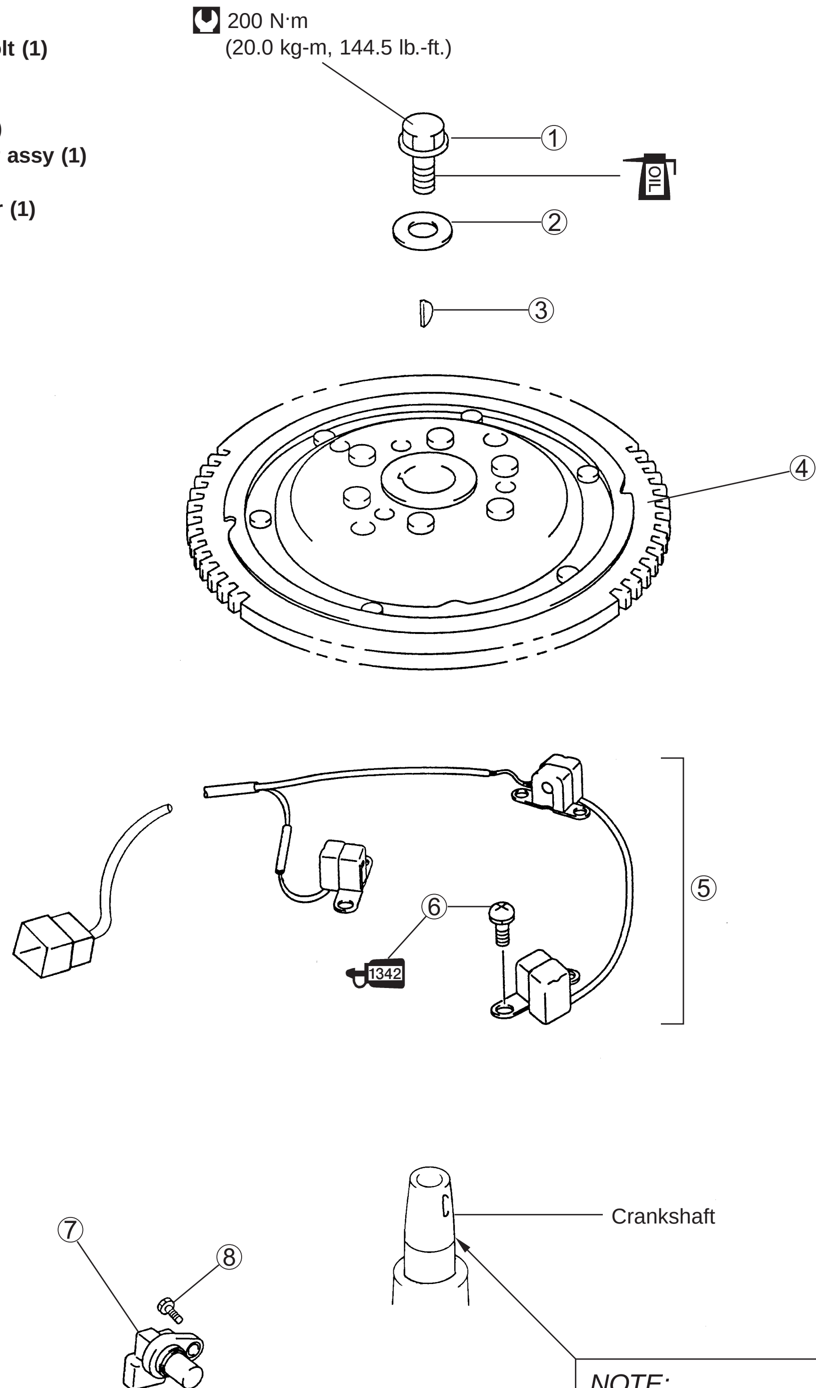
NOTE1:
If neutral switch has failed (while engine running), engine will tend to stall when shifting into gear.
If neutral switch has failed as “always ON”, engine speed is limited to 3000 r/min by intermittent fuel injection and ignition timing is fixed at BTDC9 °.
If neutral switch has failed as “always OFF”, engine cannot be cranked.

NOTE2:
If CTP switch has failed, engine will tend to stall when decelerating.

NOTE3:
- *The self-diagnostic code “3-1” may not be indicated because IAC valve condition depends on ECM control. (See page 3-28.)*
- *If IAC valve has failed, “Fast-idle function (warm-up mode)” won’t operate.*

REMOVAL / INSTALLATION
FLYWHEEL / CKP SENSOR / CMP SENSOR

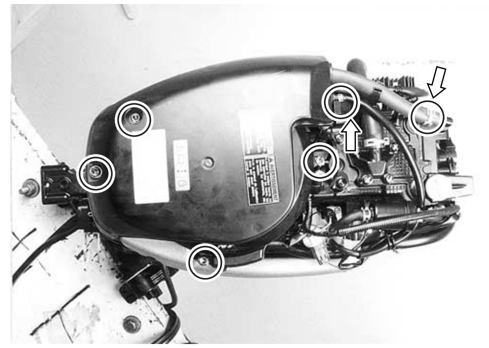
① **Flywheel bolt (1)**
② **Washer (1)**
③ **Key (1)**
④ **Flywheel (1)**
⑤ **CKP sensor assy (1)**
⑥ **Screw (6)**
⑦ **CMP sensor (1)**
⑧ **Bolt (1)**



NOTE:
Clean flywheel and crankshaft mating surfaces with cleaning solvent.

REMOVAL

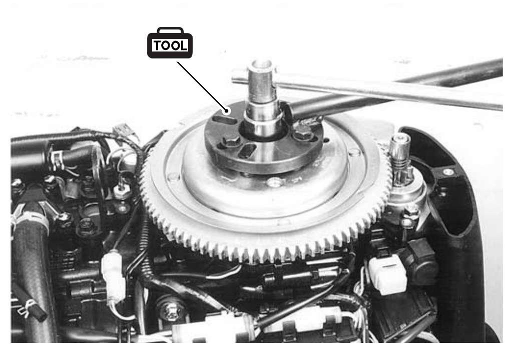
Prior to removing Flywheel :
- **Disconnect battery cables from battery.**



1. Remove flywheel cover.
2. Loosen flywheel bolt 2 – 3 turns.

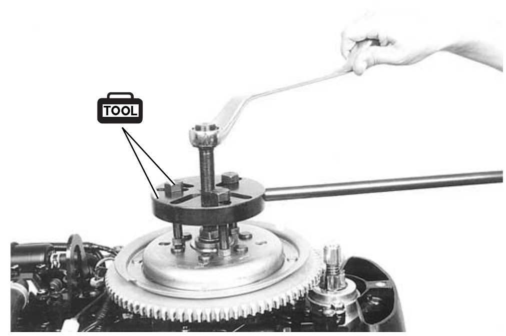
TOOL **09930-48720 : Flywheel holder**

NOTE:
Do not remove flywheel bolt at this time.
This bolt prevents damage to the crankshaft when using flywheel remover tools.

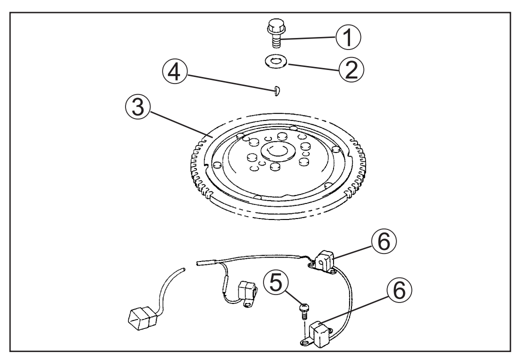


3. Using special tools, loosen flywheel from crankshaft.

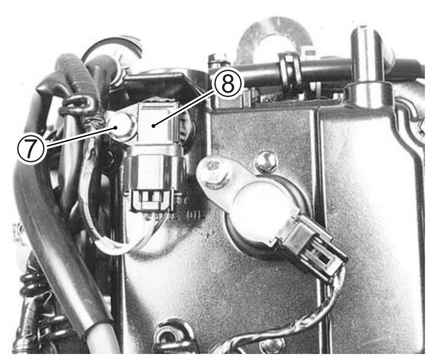
TOOL **09930-39411 : Flywheel remover**
09930-39420 : Flywheel remover bolt



4. Remove flywheel bolt ①, washer ②, flywheel ③ and key ④.
5. Remove screws ⑤ and CKP sensors ⑥, then disconnect CKP sensor connector.

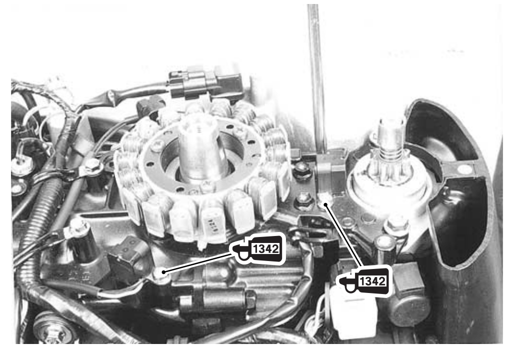


6. Disconnect CMP sensor connector.
   Remove bolt ⑦ and CMP sensor ⑧.



INSTALLATION

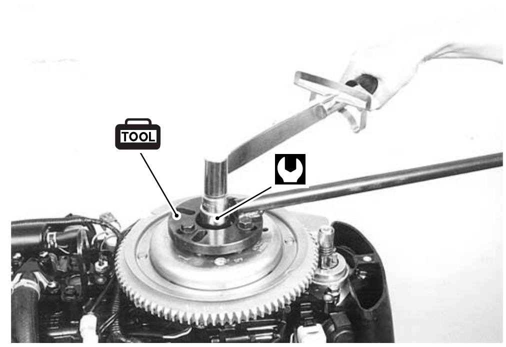
Installation is reverse order of removal with special attention to the following steps.



CKP sensors

Apply Thread Lock 1342 to the sensor mounting screws.

1342 **99000-32050 : Thread Lock 1342**



Flywheel

- Clean flywheel and crankshaft mating surfaces with cleaning solvent.
- Apply engine oil lightly to flywheel bolt before installing.
- Tighten flywheel bolt to specified torque.

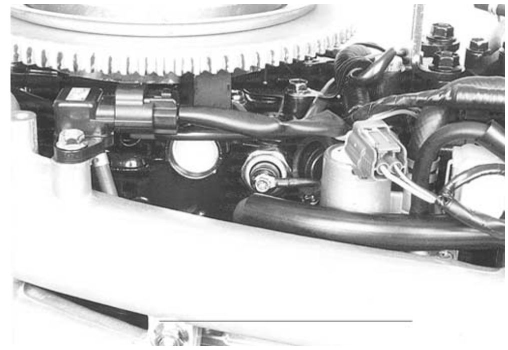
TOOL **09930-48720 : Flywheel holder**

Flywheel bolt : 200 N · m (20.0 kg-m, 144.5 lb.- ft.)

OIL PRESSURE SWITCH

REMOVAL

Remove flywheel cover.
Loosen screw and disconnect blue lead wire from switch.

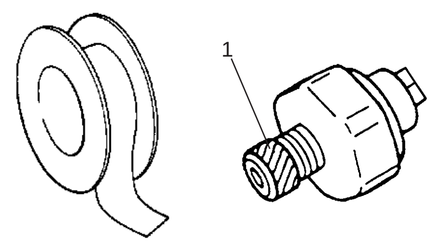


Remove oil pressure switch from cylinder block.

INSTALLATION

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

- Before installing oil pressure switch, wrap screw threads with sealing tape then tighten switch to specified torque.



1. Sealing tape

NOTE:
Cut off any excess sealing tape from switch threads before installation.

Oil pressure switch : 13 N · m (1.3kg-m, 9.5 lb.-ft.)

- Start engine and check oil pressure switch for oil leakage. Reseal switch if oil leakage is found.

ELECTRICAL

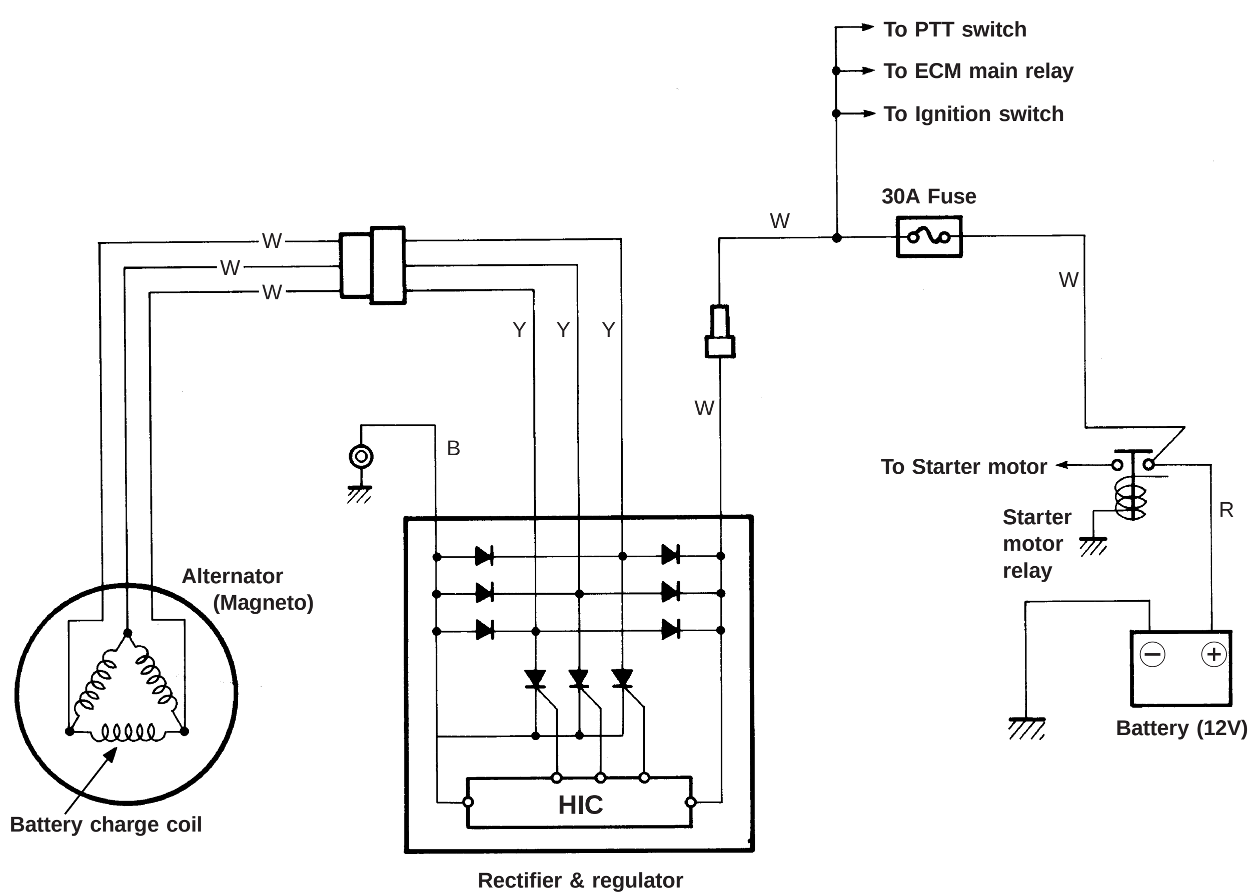
CONTENTS

BATTERY CHARGING SYSTEM

OUTLINE

The battery charging system circuit is illustrated below.
It is composed of the BATTERY CHARGE COIL, RECTIFIER & REGULATOR and BATTERY.
The three phase AC current generated from battery charge coil is converted by the rectifier & regulator into regulated DC current which is used to charge the battery.

OUTPUT	216 W
REGULATED VOLTAGE	14.5 – 15.5 V



INSPECTION

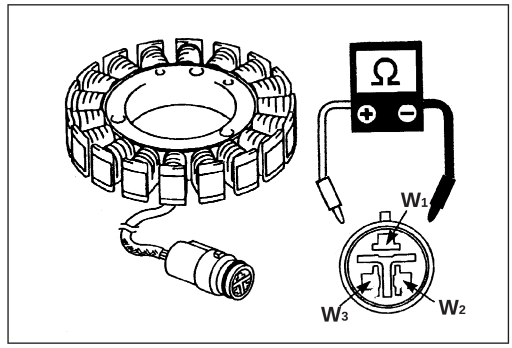
BATTERY CHARGE COIL

Measure battery charge coil resistance.

09930-99320 : Digital tester

Tester range : Ω (Resistance)

1. Disconnect battery charge coil leads from rectifier & regulator.
2. Measure resistance between leads in the combinations shown.



Battery charge coil resistance :

Terminal for tester probe connection	Resistance
White 1 to White 2	0.56 – 0.84 Ω
White 2 to White 3	
White 3 to White 1	

If measurement exceeds specification, replace battery charge coil.

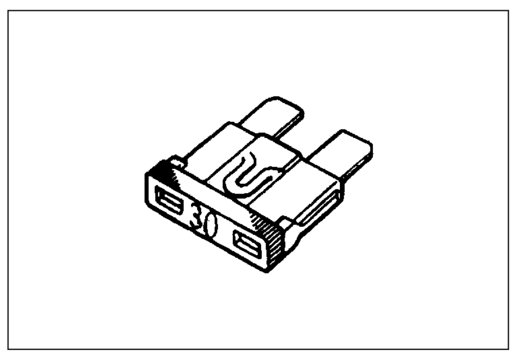
FUSE CASE / FUSE

09930-99320 : Digital tester

Tester range : (Continuity)

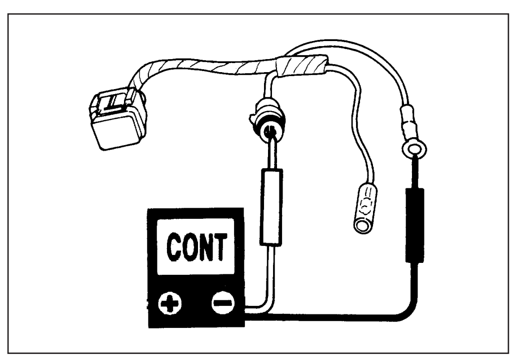
Fuse

1. Remove the fuse from fuse case.
2. Inspect fuse and replace with a new 30-amp fuse if needed.



Fuse case

1. Disconnect all wires of fuse case.
2. Check continuity between White lead wire with plate terminal and the other two white lead wires.



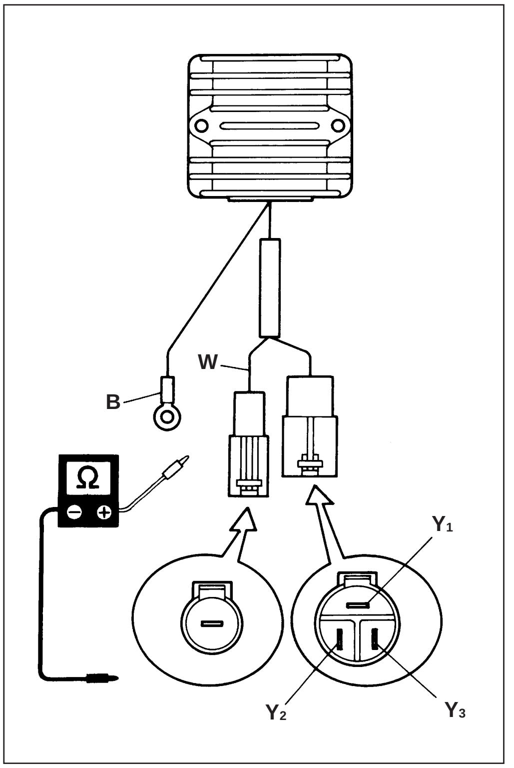
Tester range : (Continuity)

If no continuity is indicated, replace fuse case.

RECTIFIER & REGULATOR

09930-99320 : Digital tester
Tester range : Ω (Resistance)

1. Disconnect all lead wires of rectifier & regulator.
2. Measure resistance between leads in the combinations shown.



NOTE:
The values given below are for a SUZUKI digital tester.
As thyristors, diodes, etc. are used inside this rectifier & regulator, the resistance values will differ when an ohmmeter other than SUZUKI digital tester is used.

Rectifier & regulator resistance :

Unit : MΩ

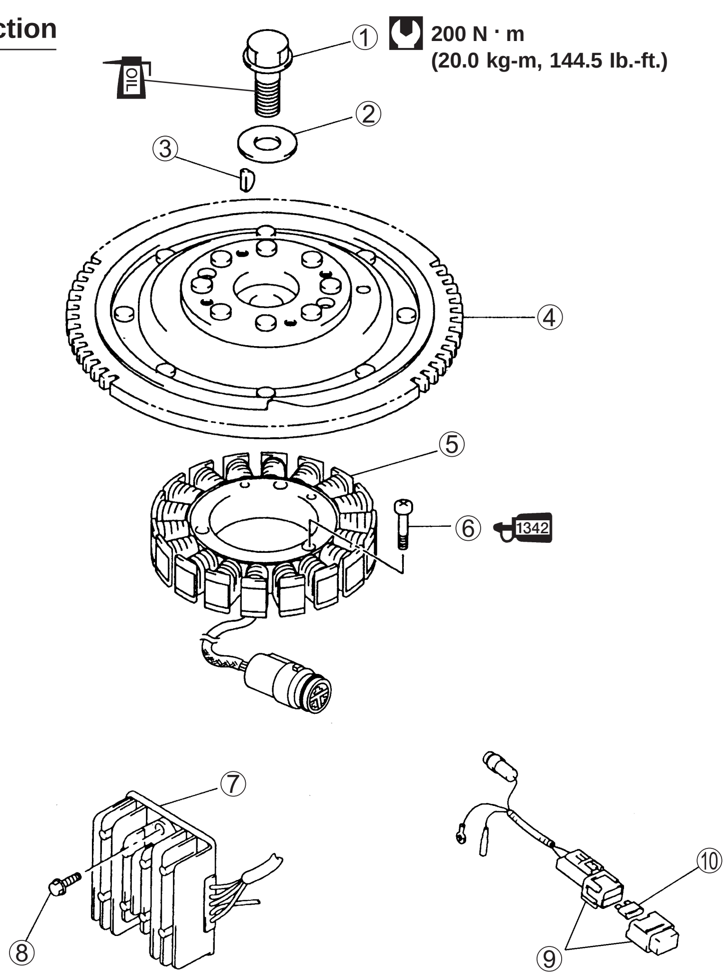
		Tester probe ⊕ (Red)				
		Black	**White**	**Yellow 1**	**Yellow 2**	**Yellow 3**
Tester probe ⊖ (Black)	**Black**		0.F	0.F	0.F	0.F
	White	9 – 14		7 – 11	8 – 13	7.5 – 11.5
	Yellow 1	6 – 9	0.F		0.F	0.F
	Yellow 2	6 – 9	0.F	0.F		0.F
	Yellow 3	6 – 9	0.F	0.F	0.F	

0.F : Infinity

If measurement exceeds specification, replace rectifier & regulator.

REMOVAL / INSTALLATION

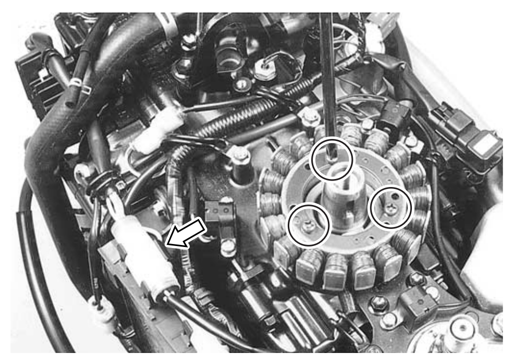
System construction



① Bolt (1)
② Washer (1)
③ Key (1)
④ Flywheel (1)
⑤ Battery charge coil (1)
⑥ Screw (3)
⑦ Rectifier & regulator (1)
⑧ Bolt (2)
⑨ Fuse case (1)
⑩ 30A fuse (1)

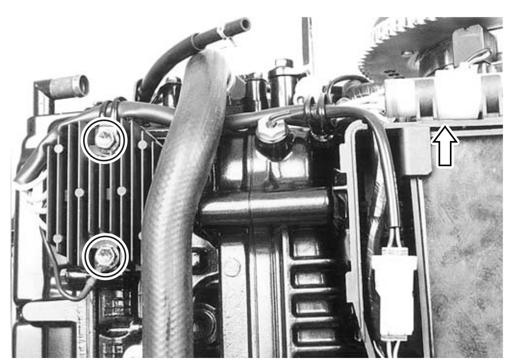
REMOVAL

Prior to removing electrical parts : **• Disconnect battery cables from battery.**



Battery charge coil

- Remove flywheel. (See page 3-48.)
- Remove three screws securing the battery charge coil.
- Disconnect battery charge coil lead wire connector from rectifier & regulator.

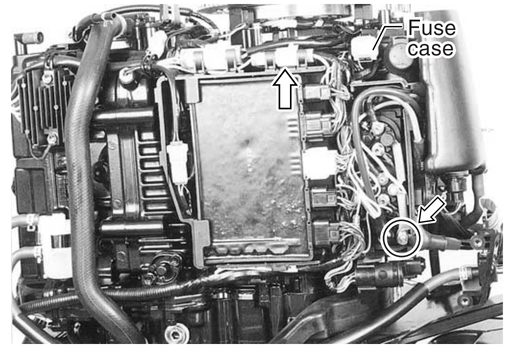


Rectifier & regulator

- Remove two bolts securing the Rectifier & regulator.
- Disconnect lead wire connectors.

Fuse case

- Disconnect fuse case lead wires from engine wiring harness and starter motor relay terminal.



INSTALLATION

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

- **Battery charge coil**
  - Apply Thread Lock 1342 to the coil securing screws.

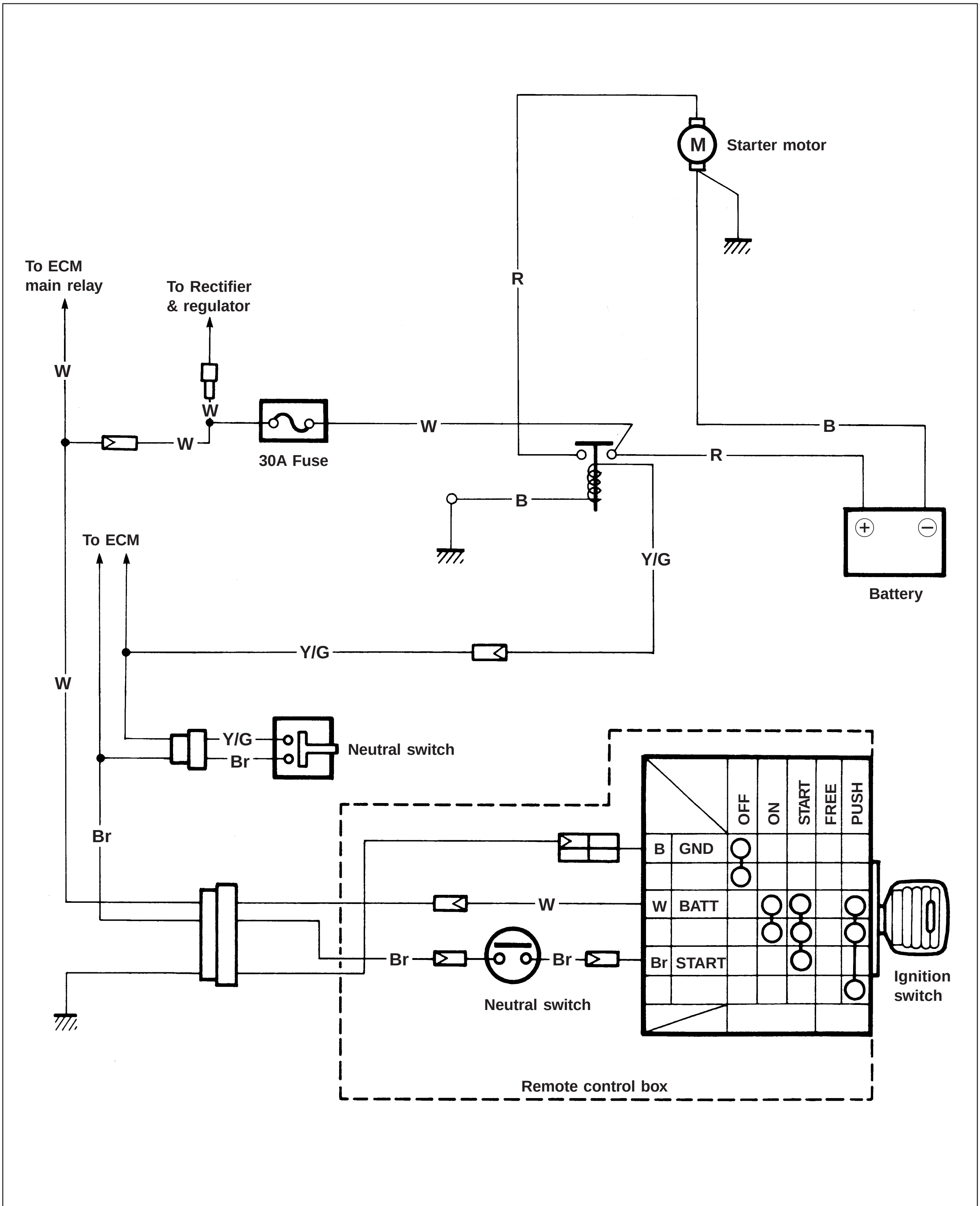
99000-32050 : Thread Lock 1342

- **Wire routing**
  - Check wire routing. (See page 10-1 to 10-4)

ELECTRIC STARTER SYSTEM

OUTLINE

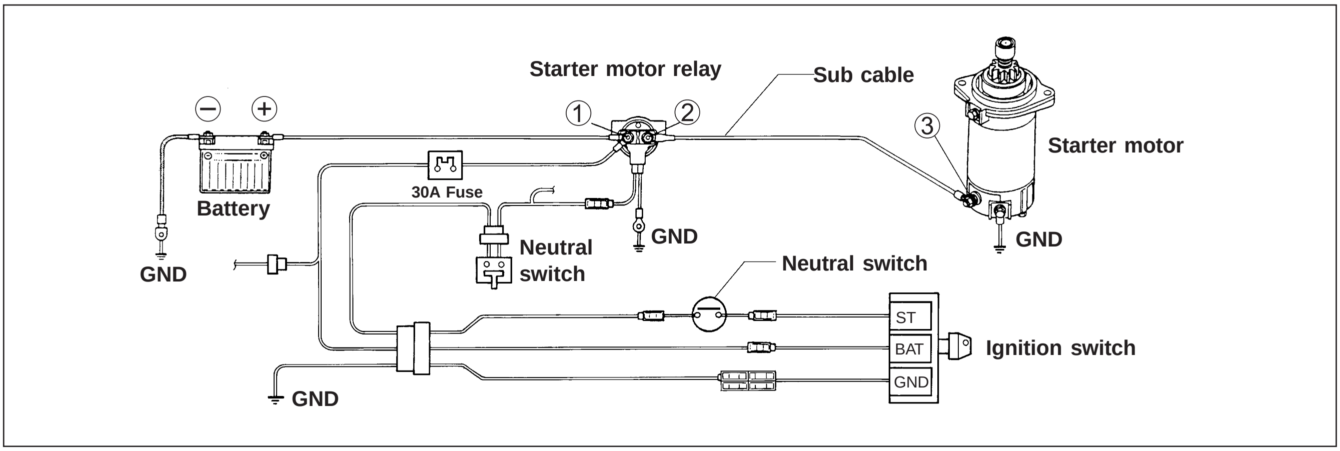
The circuit of the electric starter system is illustrated below.
This circuit is mainly composed of Battery, Starter motor, Relay, Neutral switches and Ignition switch.



TROUBLESHOOTING

NOTE:
Before troubleshooting the electric starter system, make sure of the following :
- *Battery is fully charged.*
- *All cables / wires are securely connected.*
- *Shift is in “NEUTRAL” position.*

Circuit check schematic



Starter motor will not run.

↓

Check for relay “click” sound when turning ignition switch to “START”.
Is there “click” sound?

- NO → Measure voltage at terminal①. It must be above 12V. Is result OK?
  - NO → Battery cable failure
  - YES → Check 30A fuse and fuse case. (See page 4-2.) Is result OK?
    - NO → 30A fuse or fuse case failure
    - YES → Check ignition switch function. (See page 4-8.) Is result OK?
      - NO → Ignition switch failure
      - YES → Check function of both neutral switches. (See page 4-9.) Is result OK?
        - NO → Neutral switch failure
        - → Starter motor relay failure
- YES → Measure voltage at terminal② with ignition switch at “START”. It must be above 12 V. Is result OK?
  - NO → Starter motor relay failure
  - YES → Measure voltage at terminal③ with ignition switch at “START”. It must be above 12 V. Is result OK?
    - YES → Starter motor failure
    - NO → Sub cable failure

Starter motor failure: Check starter motor. (See page 4-14.)

Sub cable failure

Starter motor relay failure: Check starter motor relay. (See page 4-10.)

INSPECTION
IGNITION SWITCH

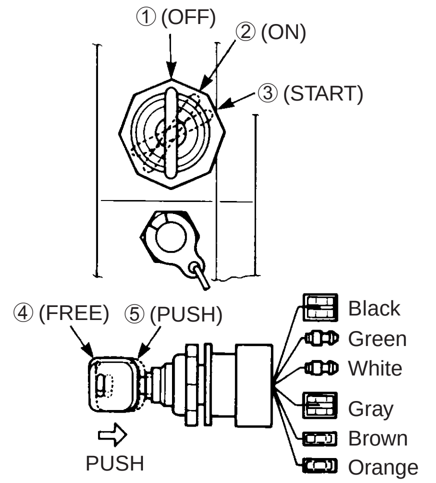
09930-99320 : Digital tester
Tester range : (Continuity)

1. Disconnect the ignition switch from remo-con box wiring harness.
2. Check continuity between wiring leads at the key positions shown in the chart.

Key Position	Switch Lead Wires					
	Black	Green	White	Gray	Brown	Orange
① OFF	○	○				
② ON			○	○		
③ START			○	○	○	
④ FREE						
⑤ PUSH			○			○

○——○ : Continuity

If out of specification, replace ignition switch.

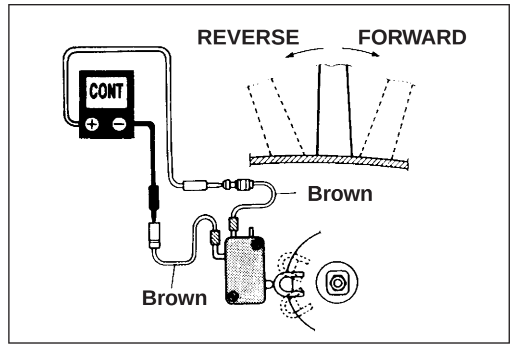


NEUTRAL SWITCH

Check for continuity / infinity of the neutral switch.

09930-99320 : Digital tester

Tester range : (Continuity)

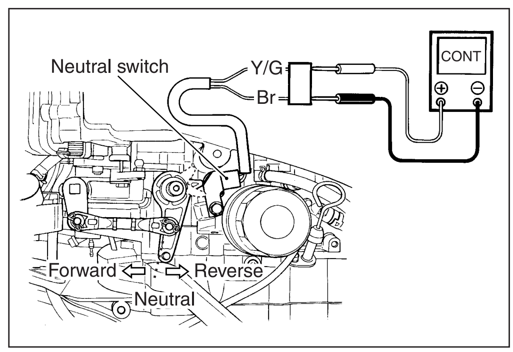


Neutral switch in remo-con box

1. Disconnect neutral switch lead wire from ignition switch and remo-con box wiring lead.
2. Check continuity / infinity between switch brown wire leads while operating remo-con handle.

Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity

If out of specification, replace neutral switch.



Neutral switch on cylinder block

1. Disconnect neutral switch lead wires.
2. Check continuity / infinity between Yellow / Green and Brown lead wires while operating remo-con handle.

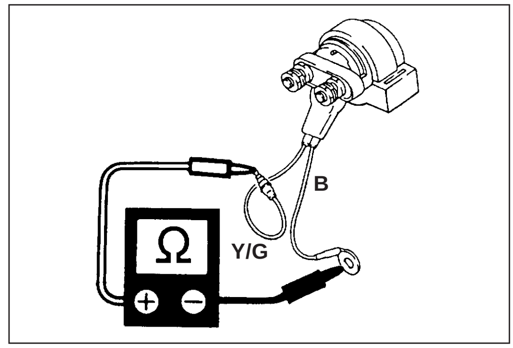
Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity

If out of specification, replace neutral switch.

NOTE:
After installing neutral switch, check for proper correct function by operating remo-con handle.

STARTER MOTOR RELAY

Two methods can be used to test starter motor relay.



TOOL 09930-99320 : Digital tester

Method 1

1. Disconnect all cables / lead wires from starter motor relay.
2. Measure resistance between relay wiring leads.

Tester range : Ω (Resistance)

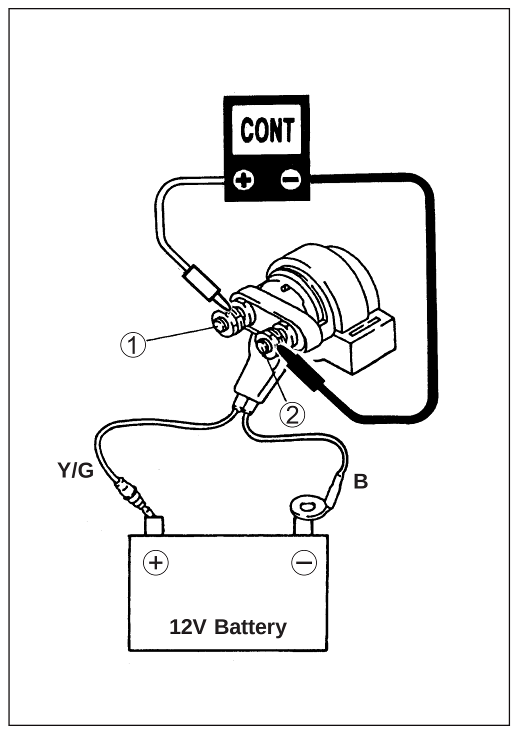
Tester probe connection	
Red ⊕	**Black ⊖**
Yellow / Green	**Black**

Starter motor relay solenoid coil resistance :
3.5 – 5.1 Ω

If measurement exceeds specification, replace starter motor relay.

Method 2

Connect the wiring leads of the relay to battery (12V) and check relay operation.



Tester range : (Continuity)

1. Disconnect all cables / wires from starter motor relay.
2. Connect Yellow /Green wire to positive⊕ terminal, and Black wire to negative⊖ terminal of battery.

When 12V applied : Continuity between relay terminal ① and ②.

3. Disconnect wiring leads from battery.

No voltage applied : No continuity between relay terminal ① and ②.

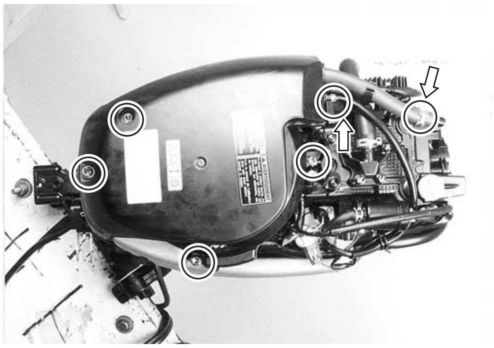
If out of specification, replace starter motor relay.

STARTER MOTOR

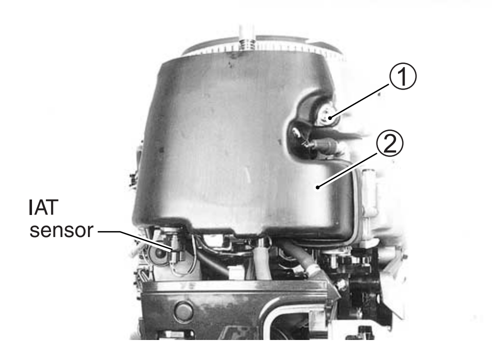
REMOVAL

Prior to removing starter motor :
• Disconnect battery cables from battery.

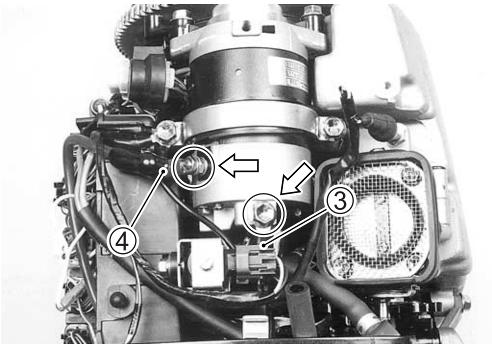
1. Remove four bolts and flywheel cover.



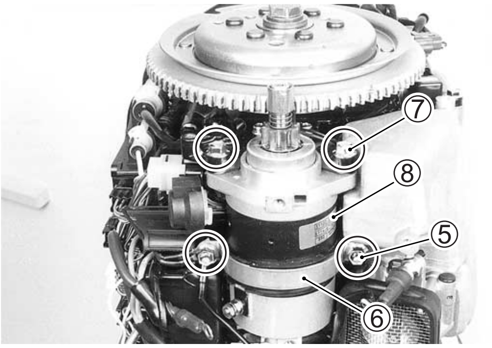
2. Remove bolt ① and silencer case ②.
3. Disconnect lead wire connector from IAT (Intake air temperature) sensor.



4. Remove bolt and negative ⊖ battery cable ③.
5. Remove starter motor sub cable ④.



6. Remove two bolts ⑤ and starter motor band ⑥.
7. Remove two bolts ⑦ and starter motor ⑧.

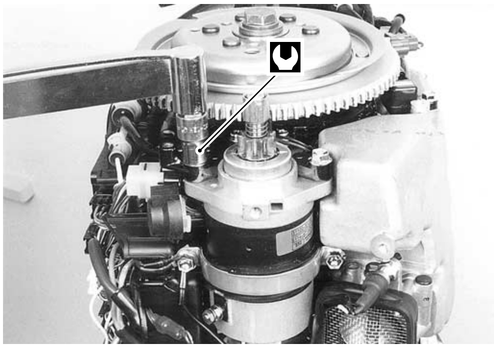


INSTALLATION

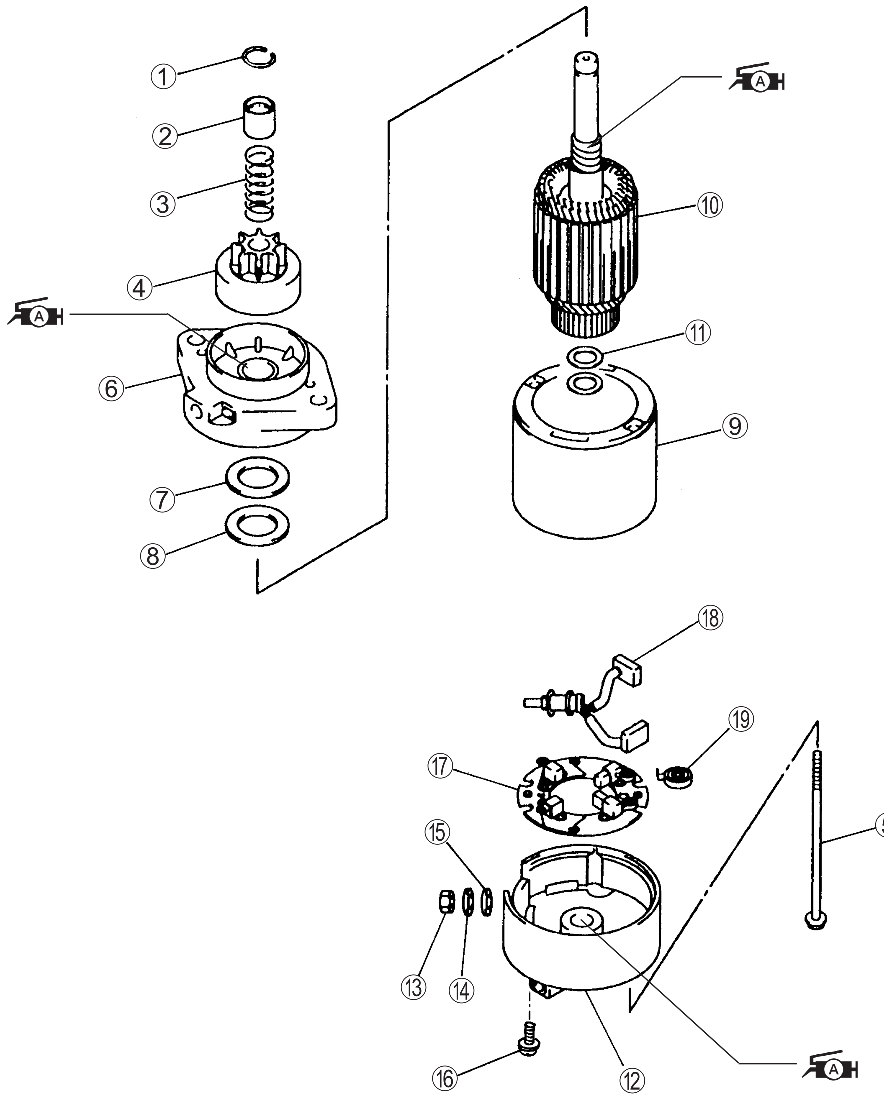
Installation is reverse order of removal with special attention to the following steps.

• Install starter motor and tighten starter motor mounting bolts securely.

Starter motor mounting bolt :
23 N · m (2.3 kg-m, 16.5 lb.-ft.)

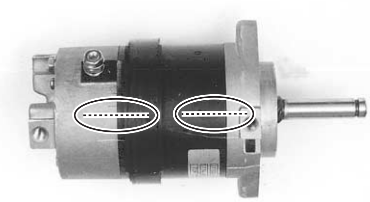


① Stopper ring
② Pinion stopper (1)
③ Spring (1)
④ Pinion (1)
⑤ Bolt (2)
⑥ Front cover (1)
⑦ Washer
⑧ Washer
⑨ Stator (1)
⑩ Armature (1)
⑪ Washer
⑫ Rear cover (1)
⑬ Nut (1)
⑭ Washer (1)
⑮ Washer (1)
⑯ Screw
⑰ Brush holder
⑱Brush
⑲Brush spring



DISASSEMBLY

NOTE:
For correct assembly, scribe an alignment mark on the front cover, stator and rear cover.

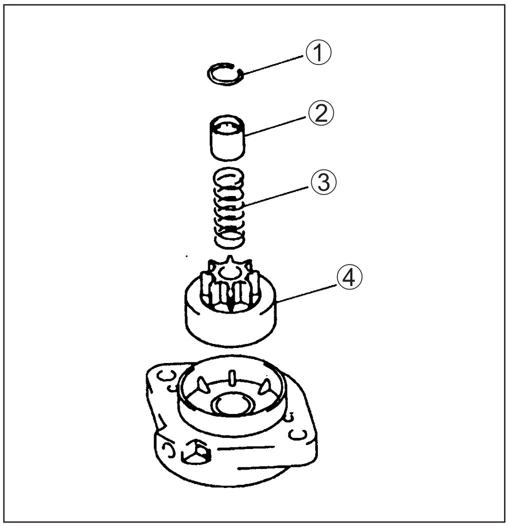


Push down the pinion stopper ②, remove stopper ring ①.
Remove pinion stopper ②, spring ③, and pinion ④.

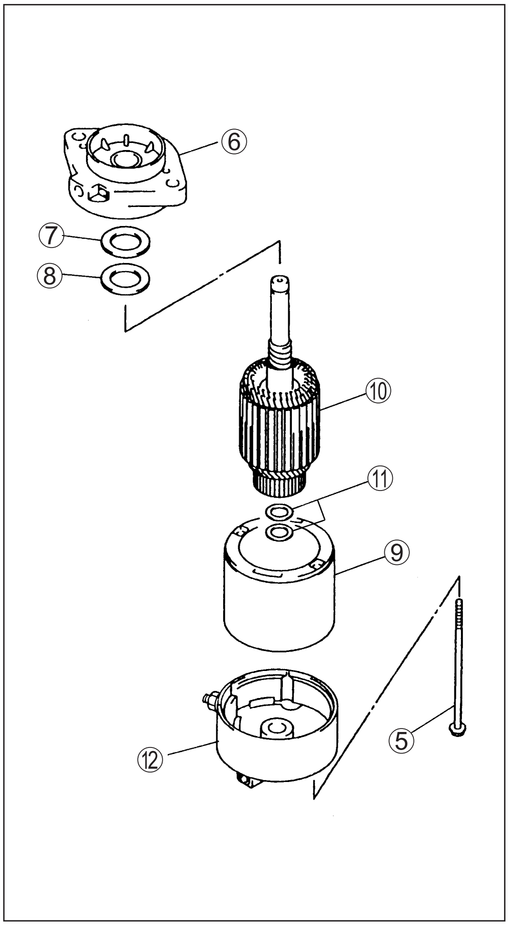
⚠ WARNING

Wear safety grasses when disassembling and assembling stopper ring.

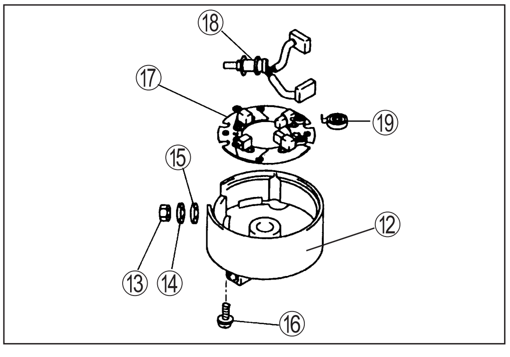
NOTE:
Using a screw-driver, pry off the stopper ring.



Remove two bolts ⑤.
Remove following parts :
- Front cover ⑥
- Washer ⑦,⑧
- Stator ⑨
- Armature ⑩
- Washer ⑪
- Rear cover ⑫



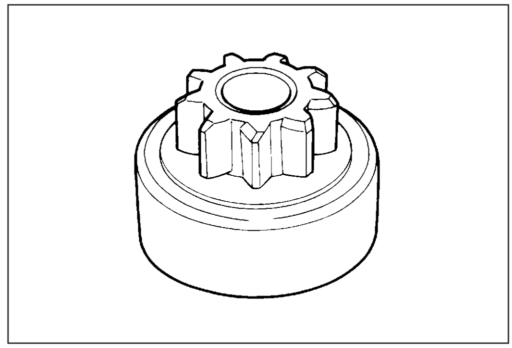
Remove the nut ⑬, washer ⑭ and ⑮ from rear cover ⑫.
Remove two screws ⑯ and brush holder assembly ⑰ (with brush ⑱ and brush spring ⑲).



INSPECTION & SERVICING

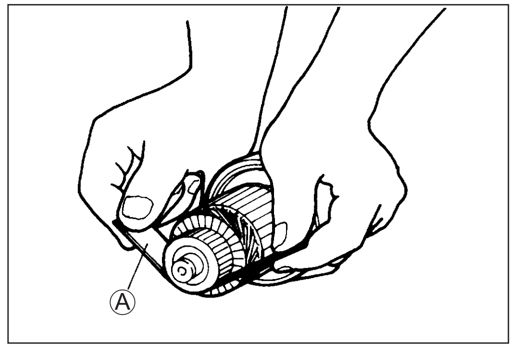
Pinion

Inspect pinion.
Replace pinion if damaged or worn.

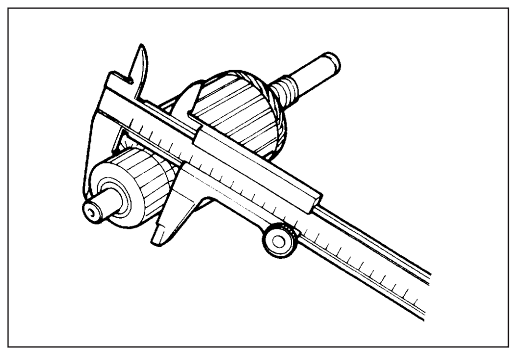


Armature and Commutator

Inspect the commutator surface.
If surface is gummy or dirty, clean with 400 grade emery paper Ⓐ.



Measure commutator outside diameter.



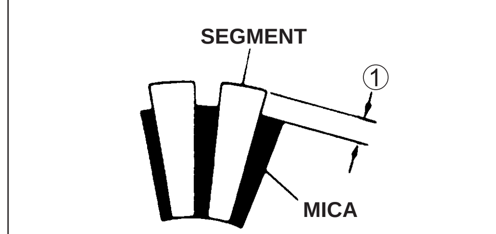
TOOL **09900-20101 : Vernier calipers**

Commutator outside diameter:

Standard : 33.0mm (1.30 in.)
Service limit : 32.0mm (1.26 in.)

If measurement exceeds service limit, replace armature.

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



①. undercut

Commutator undercut:

Standard : 0.5 – 0.8mm (0.02 – 0.03 in.)
Service limit : 0.2 mm (0.01in.)

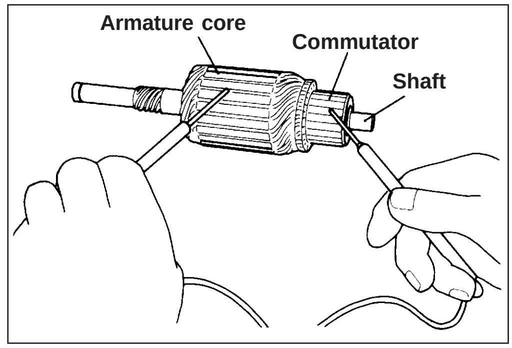
If measurement exceeds service limit, cut to specified depth.

NOTE:
Remove all particles of mica and metal using compressed air.

⚠ WARNING

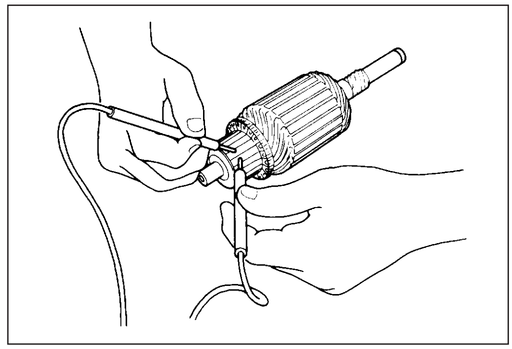
Wear safety grasses when using compressed air.

Check for continuity between the commutator and the armature core / shaft.
Replace armature if continuity is indicated.



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

09930-99320 : Digital tester
Tester range : (Continuity)

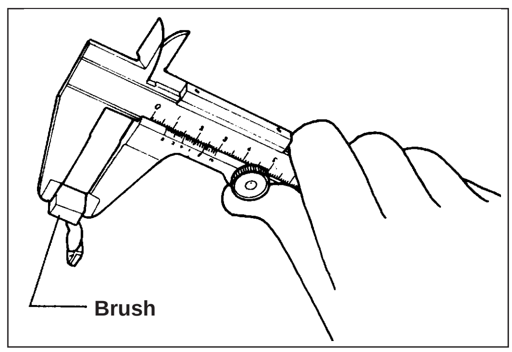


BRUSHES
Check the length of each brush.

09900-20101 : Vernier calipers

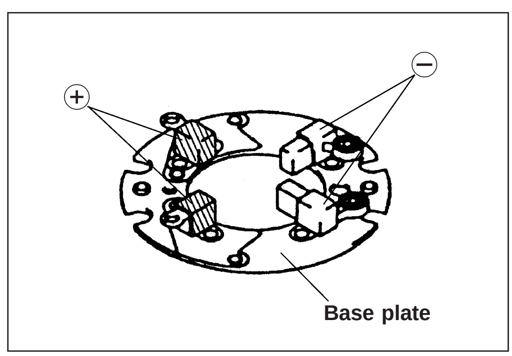
Brush length:
Standard : 17.0 mm (0.67 in.)
Service limit : 10.0 mm (0.39 in.)

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



BRUSH HOLDER
Check brush holder continuity.

09930-99320 : Digital tester
Tester range : (Continuity)



Brush holder continuity :

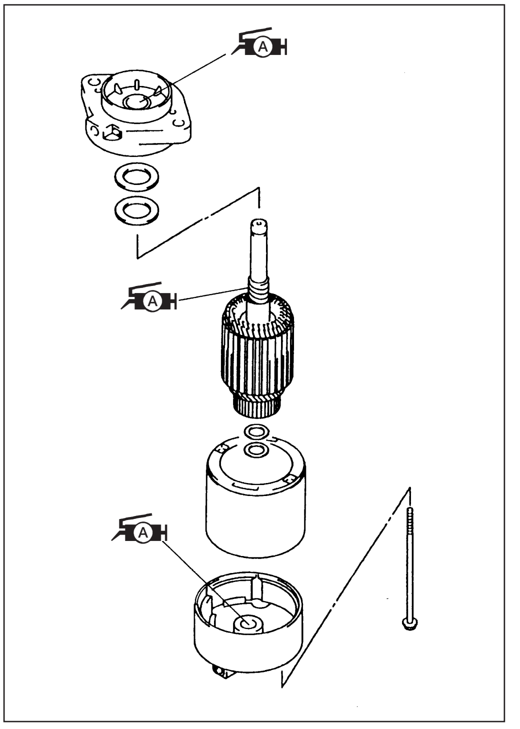
Tester probe connection	Continuity
Brush holder positive ⊕ to Brush holder negative ⊖	No
Brush holder positive ⊕ to Base plate (ground)	No

ASSEMBLY

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

CAUTION

When installing armature, exercise care to avoid breaking brushes.



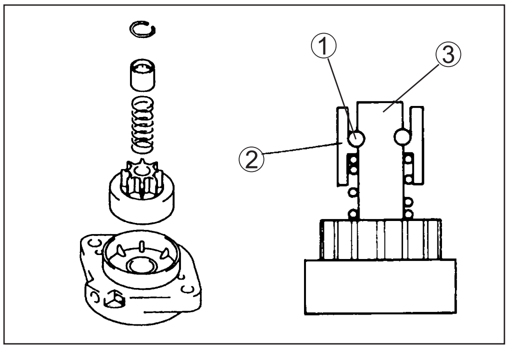
Apply grease to armature shaft and shaft holes.

99000-25010 : Suzuki Super Grease "A"

Align front cover, stator and rear cover with alignment lines scribed earlier and assemble starter.

WARNING

Wear safety grasses when disassembling and reassembling stopper ring.



Install pinion , spring , pinion stopper and stopper ring.

NOTE:
Make sure stopper ring ① fit tightly in pinion stopper ② and armature shaft ③.

MONITOR-TACHOMETER

INSPECTION

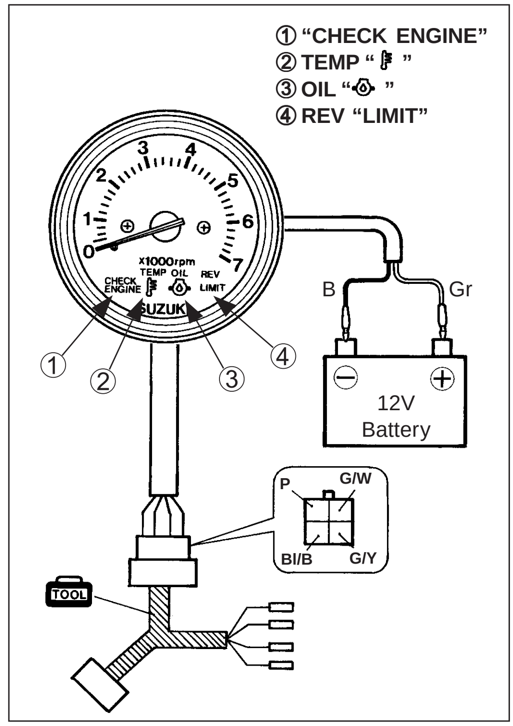
MONITOR LAMP CHECK

(1) Connect the test cord as shown.

TOOL 09930-89240 : 4-pin test cord

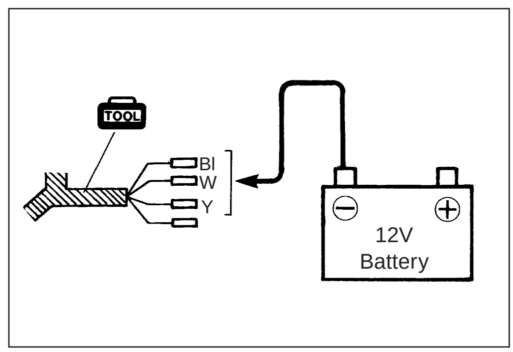
NOTE:
This check can be performed without the test cord (P/no. 09930-89240). If it is not available, directly connect battery to terminal of meter.

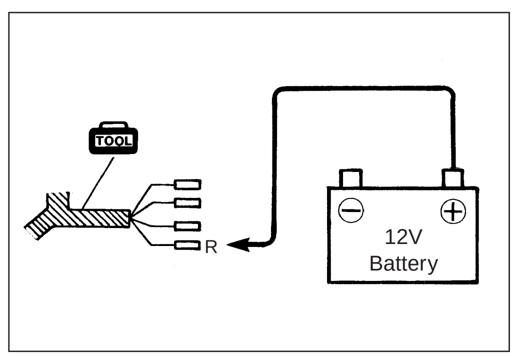
(2) Apply 12V power to meter. Connect Gray wire to positive (+) terminal, and Black wire to negative (–) terminal of battery.



(3) Check if lamp lights when connecting battery to test cord terminal as shown.

Battery terminal	Terminal for battery connection		Lighting lamp
	Test cord	Meter	
Negative (–)	Bl	G/W	Lamp ①
Negative (–)	W	G/Y	Lamp ②
Negative (–)	Y	Bl/B	Lamp ③
Positive (+)	R	P	Lamp ④





Monitor lamp check:
If out of specification, replace monitor-tachometer.

FUEL SYSTEM

CONTENTS

5

PRECAUTION ON FUEL SYSTEM SERVICE

GENERAL PRECAUTION

⚠ WARNING

Gasoline is extremely flammable and toxic. Always observe the following precautions when working around gasoline or servicing the fuel system.

- **Disconnect battery cables except when battery power is required for servicing / inspection.**
- **Keep the working area well ventilated and away from open flame (such as gas heater) or sparks.**
- **Do not smoke or allow anyone else to smoke near the working areas.**
  Post a "NO SMOKING" sign.
- **Keep a fully charged CO_2 fire extinguisher and readily available for use.**
- **Always use appropriate safety equipment and wear safety glasses when working around pressurized fuel system.**
- **To avoid potential fire hazards, do not allow fuel to spill on hot engine parts or on operating electrical components.**
- **Wipe up fuel spills immediately.**

⚠ WARNING

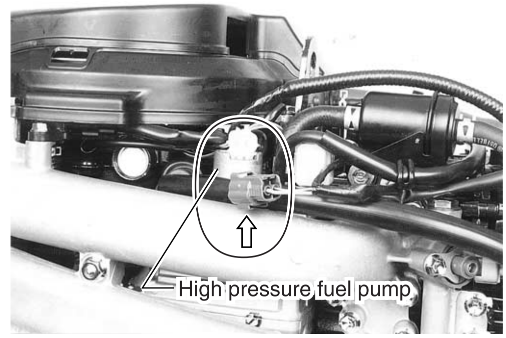
The components after the high pressure fuel pump remain pressurized at all times.
To protect against fuel spray, relieve fuel line pressure before disconnecting or removing components.

FUEL PRESSURE RELIEF PROCEDURE

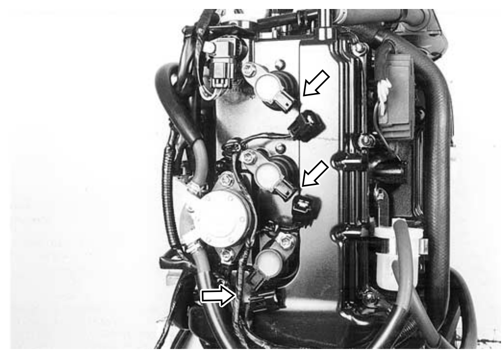
After making sure that engine is cold, relieve fuel pressure as follows.

1. Turn OFF ignition switch.

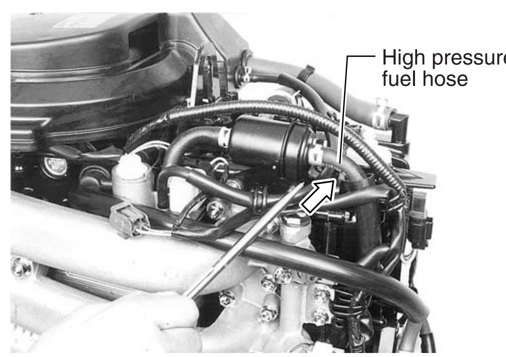
2. Disconnect high pressure fuel pump lead wire connector at high pressure fuel pump.



3. Disconnect the ignition coil primary lead wire connector from all ignition coils.
4. Crank the engine 5 – 10 times (3 seconds each time) to dissipate fuel pressure in lines.



5. Make sure fuel pressure has been removed by pinching high pressure fuel hose with finger tips (line should feel soft without pressure).
6. Upon completion of servicing, connect ignition coil primary wire and fuel pump wire.



FUEL LINE

REMOVAL / INSTALLATION

Pay special attention to the following steps when removing or installing fuel hoses.

⚠ WARNING

The components after the high pressure fuel pump remain pressurized at all times.
To protect against fuel spray, relieve fuel line pressure before disconnecting or removing components.

CAUTION

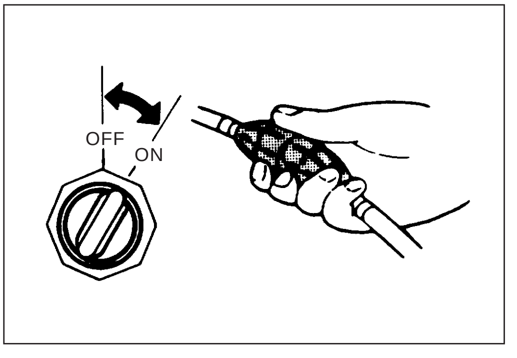
- **Do not over bend (kink) or twist hoses when installing.**
- **When installing hose clamps, position tabs to avoid contact with other parts.**
- **Be sure hoses do not contact rods, levers or other components with engine either operating or at rest.**
- **Extreme care should be taken not to cut, abrade or cause any other damage to hoses.**
- **Use care not to excessively compress hoses when tightening clamps.**

NOTE:
- *Check fuel hose routing. (See page 10-7 and 10-9)*
- *Check for fuel leakage.*

FUEL LEAKAGE CHECK PROCEDURE

After performing any fuel system service, always be sure there is not fuel leakage by checking as follows.

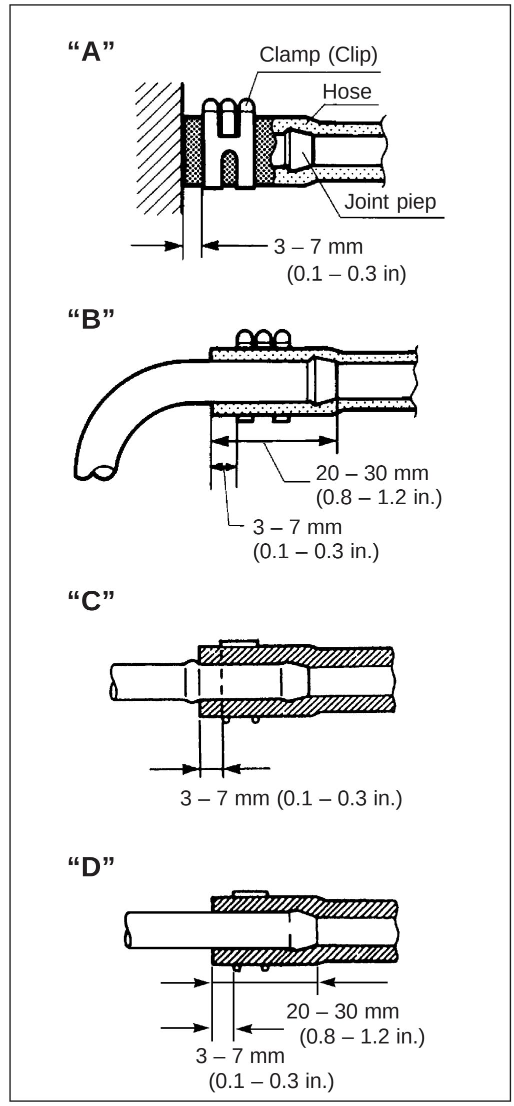
1. Squeeze fuel primer bulb until you feel resistance.
2. Turn ignition switch “ON” for 3 seconds(to operate fuel pump), then turn it “OFF”.
   Repeat this (ON and OFF) procedure 3 or 4 times to pressurize the fuel system.
3. Once pressurized, check all connections and components for any signs of leakage.



FUEL HOSE CONNECTION

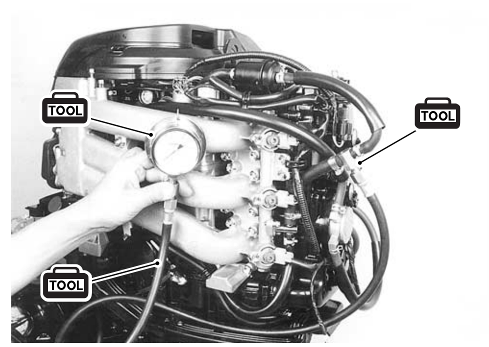
Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly by referring to the figure.

- For type “A” (short barbed end) pipe, hose must completely cover pipe.
- For type “B” (bent end) pipe, hose must cover straight part of pipe by 20 – 30mm (0.8 – 1.2in.).
- For type “C” pipe, hose must fit up against flanged part of pipe.
- For type “D” pipe, hose must cover pipe by 20 – 30mm (0.8 – 1.2 in.).



FUEL PRESSURE INSPECTION

1. Relieve fuel pressure in fuel feed line. (See page 5-2)

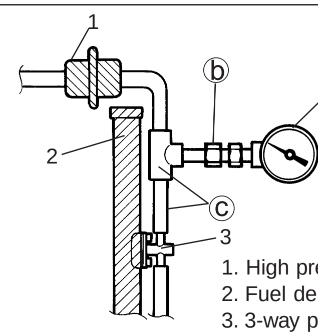


2. Connect special tools (pressure gauge, pressure hose & pressure joint) between fuel feed hose and 3-way joint pipe as shown in figure.
   Clamp hose securely to ensure no leaks occur during checking.

TOOL 09912-58442 : Pressure gauge – ⓐ
09912-58432 : Fuel pressure hose – ⓑ
09912-58490 : Fuel pressure joint – ⓒ

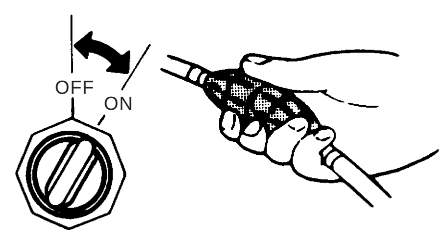
CAUTION

A small amount of fuel may be released when the fuel feed hose is disconnected.
Place container under the fuel feed hose or 3-way pipe with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place fuel soaked cloth in an approved container.



1. High pressure fuel filter
2. Fuel delivery gallery
3. 3-way pipe

3. Squeeze fuel primer bulb until you feel resistance.
   Turn ignition switch “ON” for 3 seconds (to operate fuel pump), then turn it “OFF”.
   Repeat this (“ON” and “OFF”) procedure 3 or 4 times to pressurize the fuel system and then check fuel pressure.



4. Measure fuel pressure in line at cranking or idle speed operation.

Fuel pressure : Approx. 255 kPa
(2.55 kg/cm², 36.3 psi.)

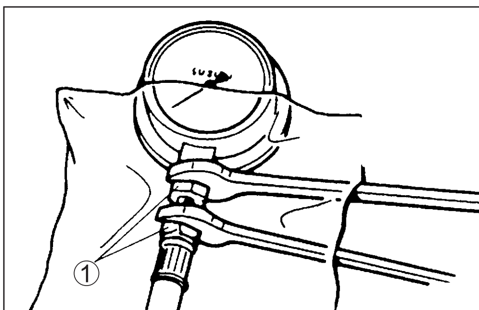
5. Stop engine and wait 5 minutes.

6. Check residual fuel pressure in line.

Residual fuel pressure:
200 kPa (2.0 kg/cm² , 28.4 psi) or higher

CAUTION

As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place container under joint to catch fuel.**
- **Cover joint with rag and loosen joint nut slowly to gradually release fuel pressure.**



① Joint nut

7. After checking fuel pressure, remove fuel pressure gauge.

8. Reconnect fuel line.

9. With engine not running and ignition switch “ON”, check fuel system for leaks.

FUEL VAPOR SEPARATOR / HIGH PRESSURE FUEL PUMP

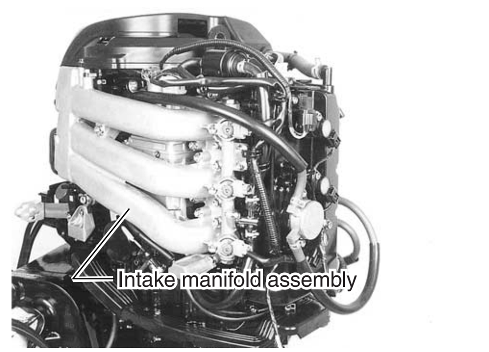
REMOVAL / INSTALLATION

Removal

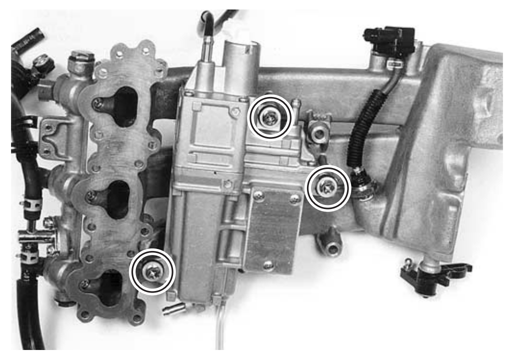
⚠ WARNING

The components after the high pressure fuel pump remain pressurized at all times.
To protect against fuel spray, relieve fuel line pressure before disconnecting or removing components.

- Remove intake manifold assembly.
  (See page 6-1)



- Remove three bolts and fuel vapor separator assembly from intake manifold.

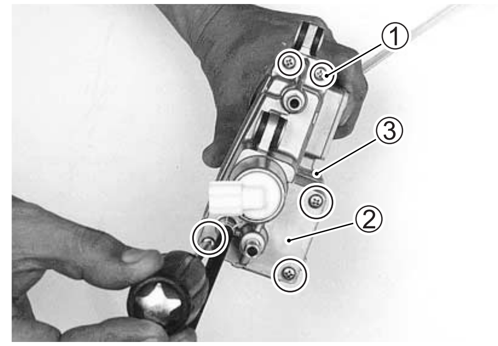


Installation

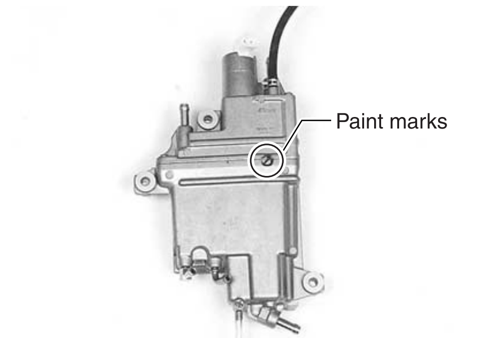
Installation is reverse order of removal.
See page 6-2 for installation of intake manifold assembly.

DISASSEMBLY

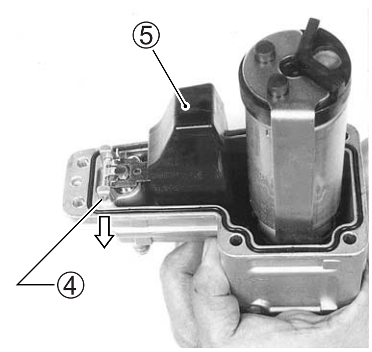
Remove five screws ①.
Remove separator cover ② with high pressure fuel pump from separator case ③.



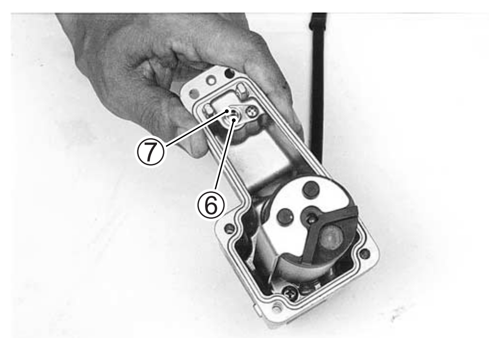
NOTE:
Separator cover and case are a set.
Make sure paint marks on both items are matched when assembling.



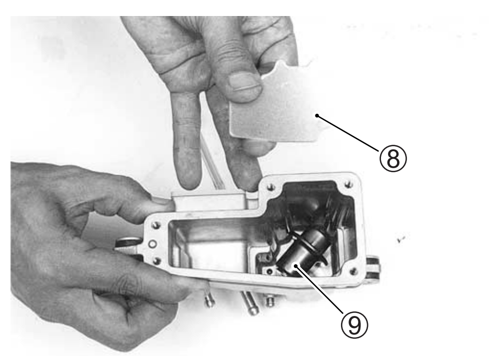
Remove float pin ④ and float ⑤.



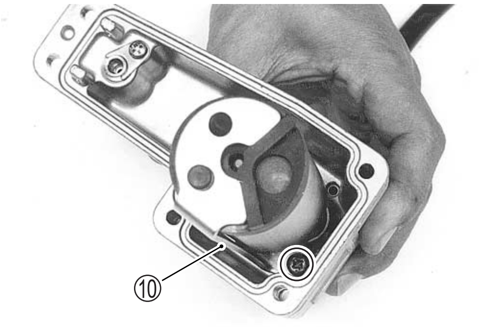
Remove needle valve ⑥, screw, plate and valve seat ⑦.



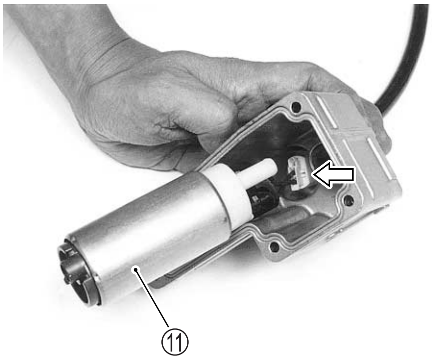
Remove plate ⑧.
Remove screw and fuel pressure regulator ⑨ from separator case.



Remove screw and pump bracket ⑩.



Remove high pressure fuel pump ⑪ from separator cover and then disconnect pump lead wire connector.

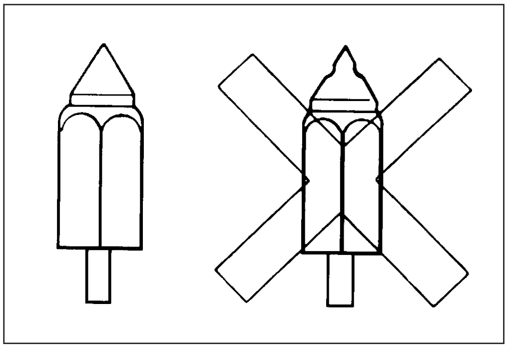


INSPECTION

NOTE:
If cracks, excessive wear or other damage is found on any component, replace component.

Needle valve / Valve seat

Check needle valve and valve seat.
If grooved or damaged, replace valve and seat.
If dirt is found, clean.

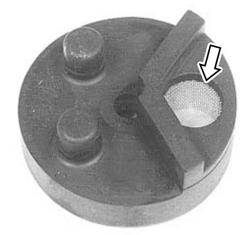


Float

Check float.
If cracked or damaged, replace float.

Filter

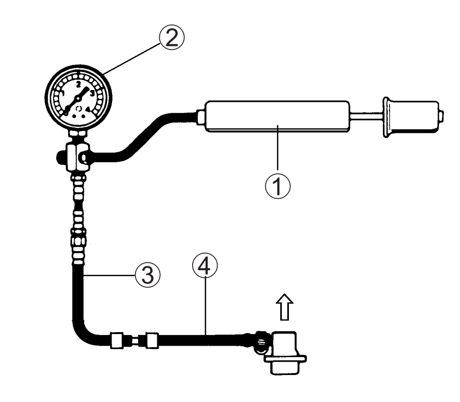
Check pump suction filter.
If clogged or damaged, clean or replace filter.



Fuel pressure regulator

Check fuel pressure regulator operation.

TOOL
: Hand air pump ①
09940-44120 : Air pressure gauge ②
09940-44130 : Attachment ③
09912-58490 : Hose ④



1. Connect special tools to inlet side of regulator as shown.
2. Pump air into regulator using pump ① until air is released through outlet side.
3. Note pressure on gauge when air is released.

Regulator operating pressure :

240 – 270 kPa (2.4 – 2.7 kg/cm^2, 34.1 – 38.4 psi.)

If measurement exceeds specification, replace regulator.

ASSEMBLY

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

Float / Float pin

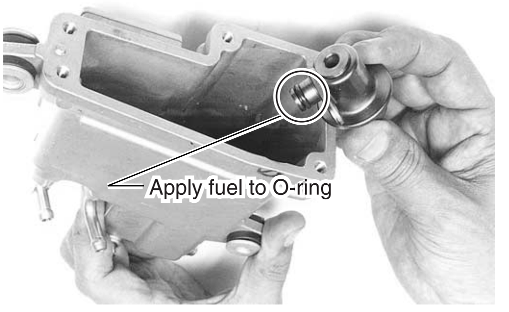
Install float and float pin.

NOTE:
After assembling, check for smooth and free float movement.

Fuel pressure regulator

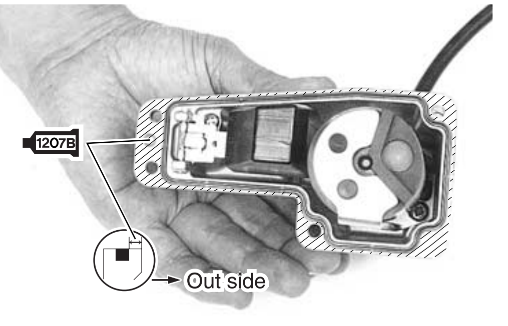
Install fuel pressure regulator and tighten screw securely.

NOTE:
Apply fuel to O-ring before installing regulator.



Separator cover / Separator case

Apply Suzuki Bond evenly to only the outside mating surface of separator cover as shown.

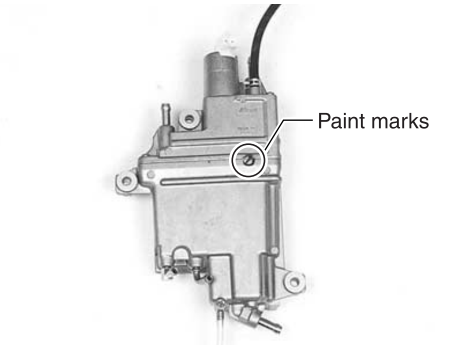


CAUTION **99000-31140 : Suzuki Bond 1207B**

NOTE:
- *Clean mating surfaces before applying bond.*
- *Do not apply bond to o-ring, groove and inside mating surface.*

Install separator case and tighten screws securely.

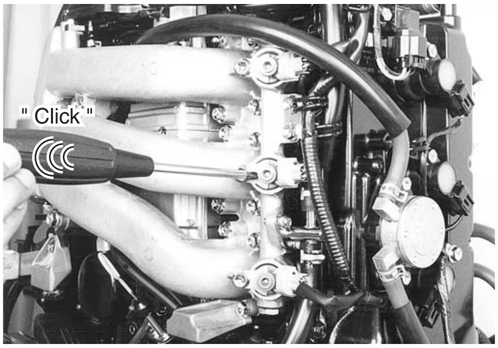
NOTE:
Separator cover and case are a set.
Make sure paint marks on both items are matched when assembling.



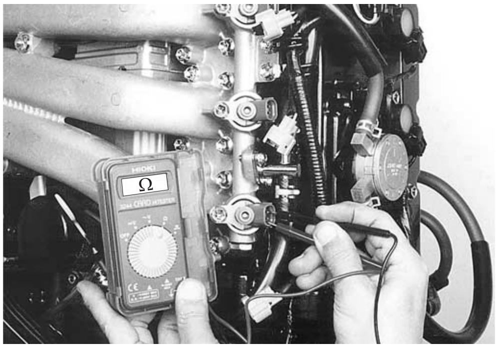
FUEL INJECTOR

INSPECTION

1. Using sound scope or equivelent, check operating sound of fuel injector when engine is running or cranking.
   The injector operating sound cycle should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector.



2. Disconnect lead wire connector from fuel injector.
3. Connect digital tester between terminals of injector and check resistance.



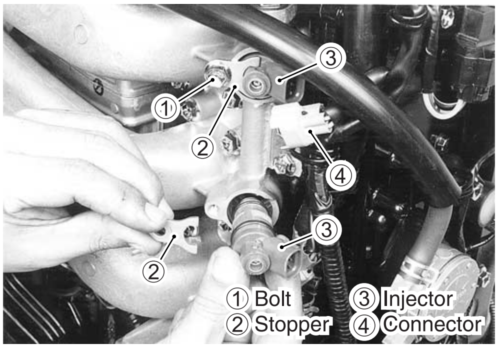
09930-99320 : Digital tester
Tester range : Ω (Resistance)

Fuel injector resistance : 11.0 – 16.5 Ω
If out of specification, replace fuel injector.

4. Connect lead wire connector to fuel injector securely.

REMOVAL

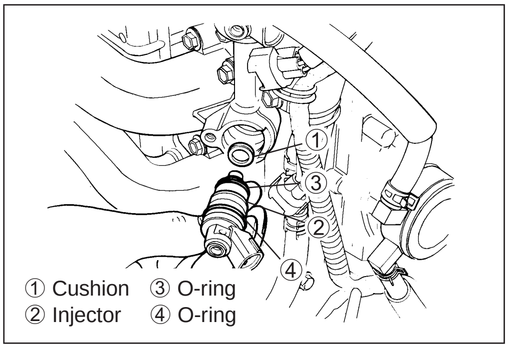
1. Relieve fuel pressure according to procedure described on page 5-2.
2. Disconnect lead wire connectors from each injector.
3. Remove the screw securing the fuel injector stopper.
4. Remove fuel injector stopper and fuel injector.



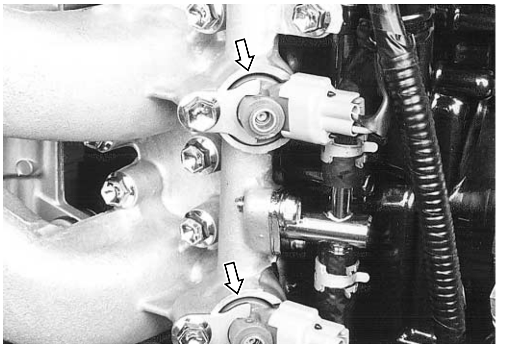
CAUTION

A small amount of fuel may be released when the fuel injector is removed from intake manifold.
Place a shop cloth under fuel injector before removal to absorb any fuel released.
Dispose of fuel soaked cloth in appropriate container.

INSTALLATION



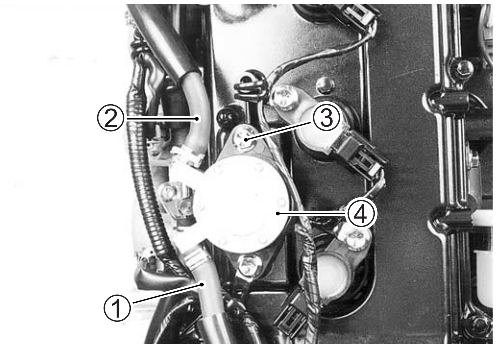
1. Use care when installing to prevent any O-ring damage.
2. Always replace injector cushion with new.
   Assemble cushion to fuel injector.
3. Apply thin coat of fuel to injector O-rings before installing injector into intake manifold.
4. Install injector stopper and tighten stopper screw securely.
5. Connect lead wire connector to injector securely.

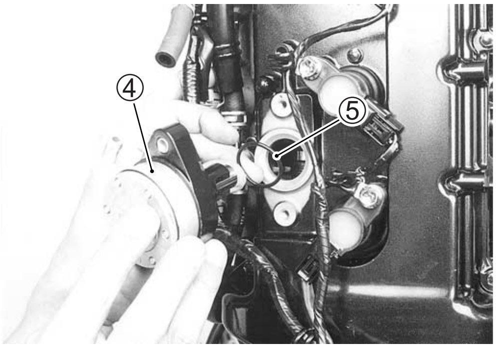


6. Turn ignition switch “ON” for 3 seconds (to operate fuel pump), then turn it “OFF”.
   Repeat this (ON and OFF) procedure 3 or 4 times to pressurize the fuel system.
   Check for fuel leaks around fuel injector.

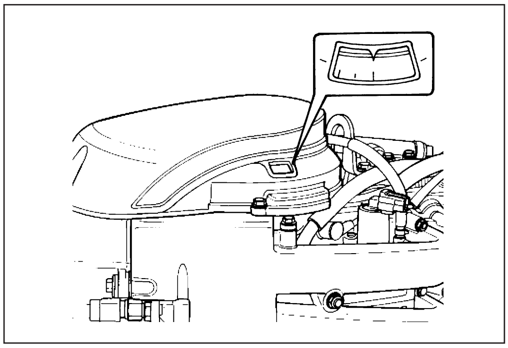
LOW PRESSURE FUEL PUMP
REMOVAL / INSTALLATION
REMOVAL

1. Disconnect inlet hose ① and outlet hose ② from low pressure fuel pump.
2. Remove two bolts ③.
3. Remove fuel pump ④ and O-ring ⑤.





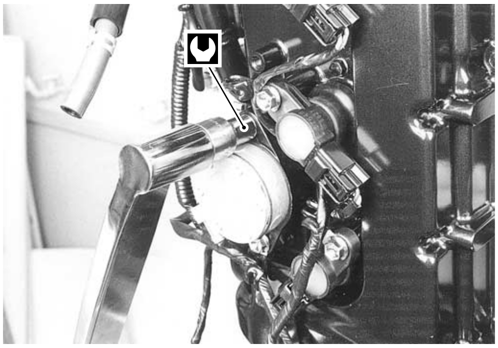
INSTALLATION
Installation is reverse order of removal with special attention to the following steps.



CAUTION

- **Before installing fuel pump, rotate the crankshaft to bring No.1 (top cylinder) piston to Top Dead Center on compression stroke.**
- **Discard O-rings after removal. always use new O-ring to ensure proper sealing.**

Low pressure fuel pump bolt :
10 N · m (1.0 kg-m, 7.0 lb.-ft.)



DISASSEMBLY / REASSEMBLY

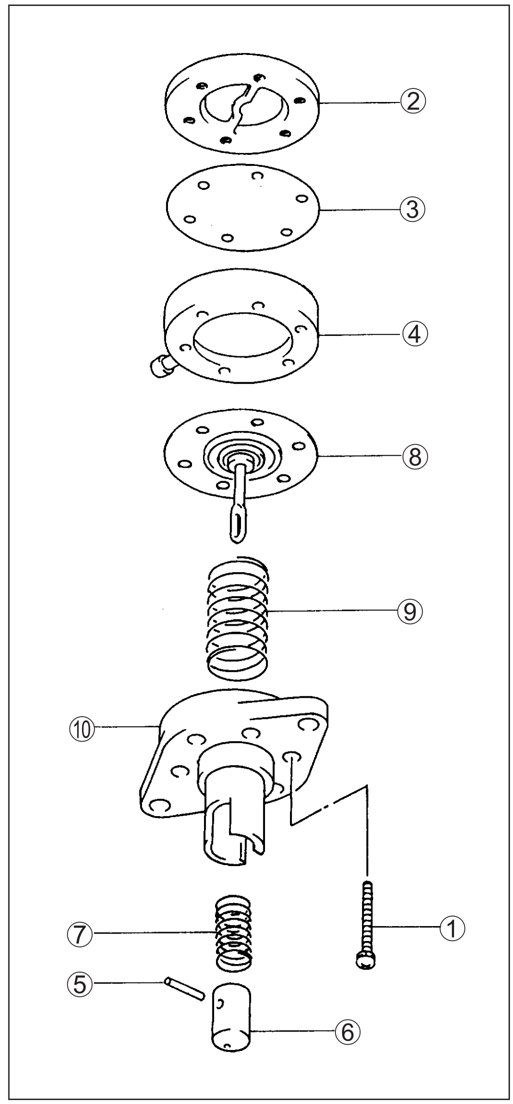
DISASSEMBLY

NOTE:
For correct assembly, scribe an alignment mark on each part of fuel pump.

Remove six screws ① and remove in sequence the outer plate ②, diaphragm ③ and valve body ④.

Turn piston ⑥ until pin ⑤ comes out through cutaway of pump body ⑩.

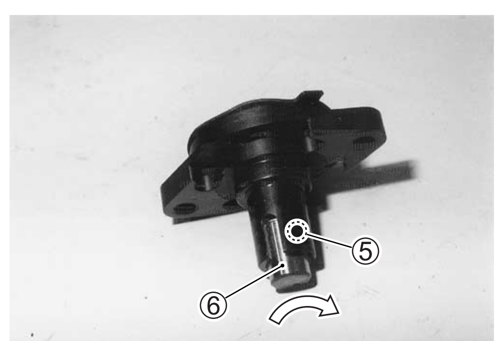
Remove following parts :
- Pin ⑤
- Piston ⑥
- Spring ⑦
- Diaphragm ⑧
- Spring ⑨



ASSEMBLY

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

NOTE:
After connecting diaphragm rod ⑧ to piston ⑥ with pin ⑤, align the six diaphragm holes to pump body holes by turning piston ⑥ and diaphragm ⑧ together. Turning them together prevents the pin from coming out through pump body ⑩ cutaway.



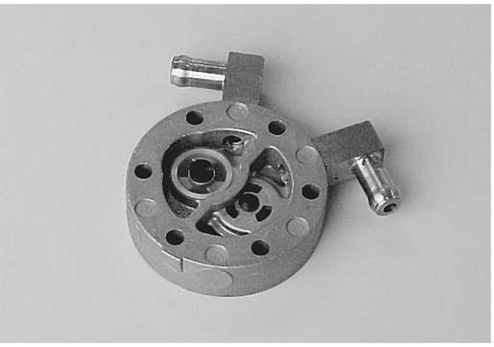
INSPECTION

Diaphragm

Inspect all diaphragms. If distortion, tears, or other damage is found, replace diaphragms.

Check-valves

Inspect the fuel pump check valves. If tears, distortion or damage is found, replace fuel pump.



Pump body

Inspect each fuel pump body and outer plate.

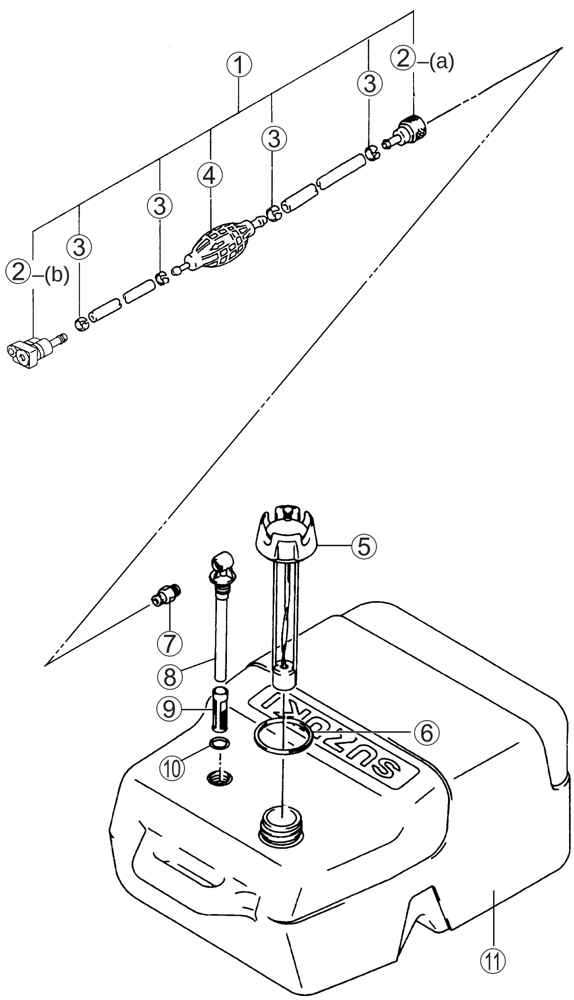
If cracks, nicks, distortion or damage is found, replace fuel pump.

FUEL TANK

DISASSEMBLY / REASSEMBLY

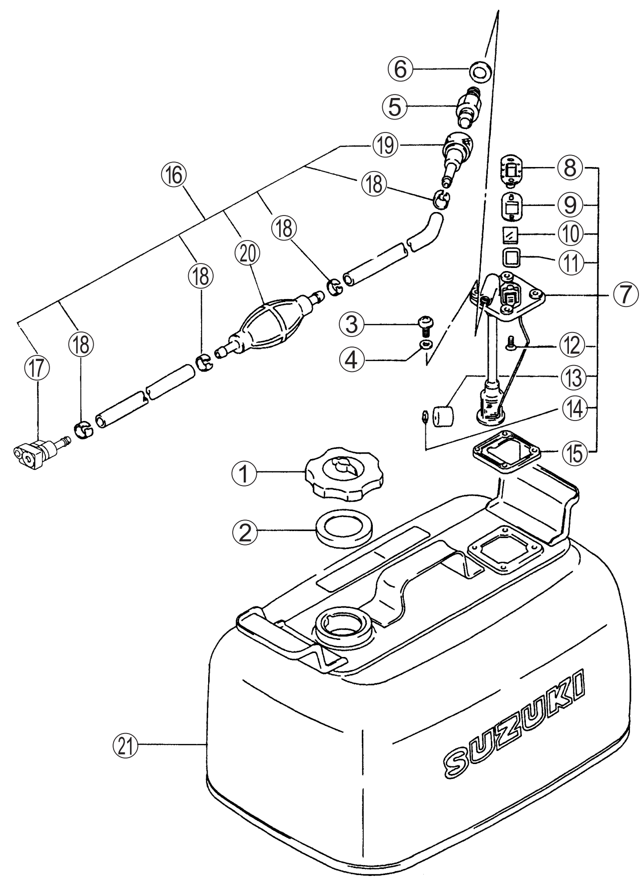
When disassembly or reassembling fuel tank, refer to the construction diagram below.

Plastic tank



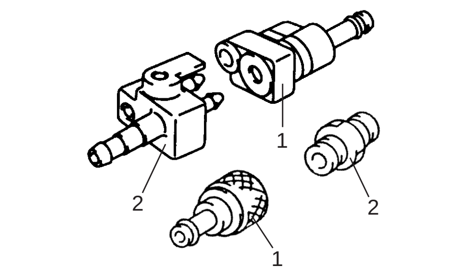
① Fuel hose assy (1)
[②–(a), Connector
②–(b), Connector]
[③ Clip (4)]
[④ Primer bulb (1)]
⑤ Tank cap (1)
⑥ Gasket (1)
⑦ Connector plug (1)
⑧ Outlet (1)
⑨ Filter (1)
⑩ O-ring (1)
⑪ Fuel tank (1)

Steel tank



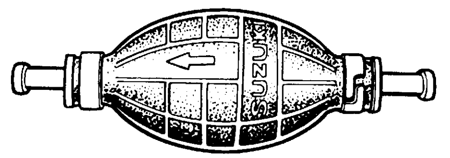
① Tank cap (1)
② Gasket (1)
③ Screw (4)
④ Gasket (4)
⑤ Connector plug (1)
⑥ Gasket (1)
⑦ Fuel gauge assy (1)
[⑧ Cover (1)]
[⑨ Gasket (1)]
[⑩ Lens (1)]
[⑪ Gasket (1)]
[⑫ Screw (2)]
[⑬ Float (1)]
[⑭ Push nut (1)]
[⑮ Gasket (1)]
⑯ Fuel hose assy (1)
[⑰ Connector (1)]
[⑱ Clip (4)]
[⑲ Connector (1)]
[⑳ Primer bulb (1)]
[㉑ Fuel tank (1)]

INSPECTION



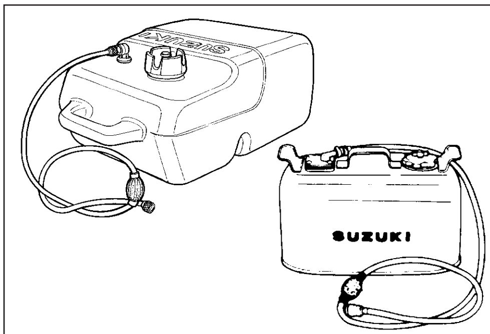
1. Connector 2. Connector plug

Fuel connector
Inspect fuel connector. If leakage,deterioration or other damage is found, replace fuel connector.

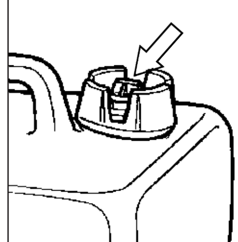


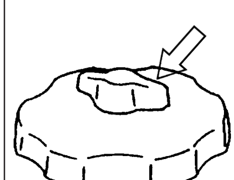
Fuel primer bulb
Inspect fuel primer bulb. If cracks, leakage, or deterioration is found, replace primer bulb.
If check valve function is defective, replace primer bulb.

Fuel hose
Inspect fuel hose. If cuts, cracks, leakage, tears or deterioration is found, replace fuel hose.



Fuel tank
Inspect fuel tank. if cracks, leakage or deterioration is found, replace fuel tank.
If water or other contamination is found, drain and clean fuel tank.





Tank cap
Check that the fuel tank vent opens and relieves internal tank pressure properly.
Replace tank cap if vent is suspect.

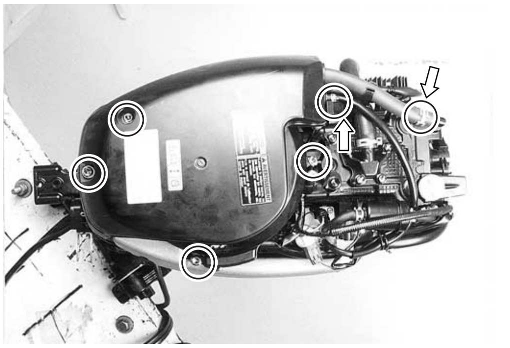
POWER UNIT

CONTENTS

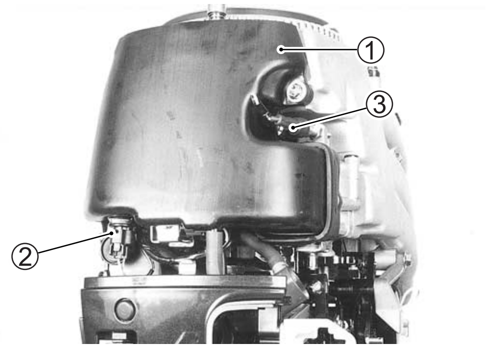
INTAKE MANIFOLD ASSEMBLY

REMOVAL

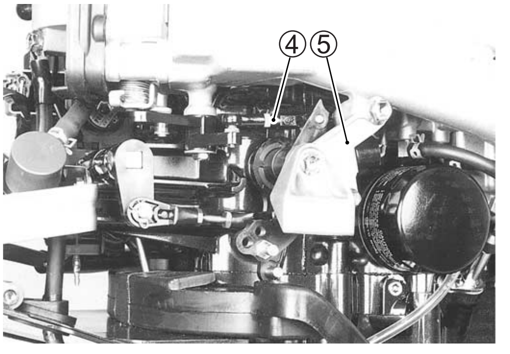
Before removing intake manifold :
- **Relieve fuel pressure. (See page 5-2)**
- **Disconnect battery cables from battery.**
- **Remove both side covers. (See page 7-1)**



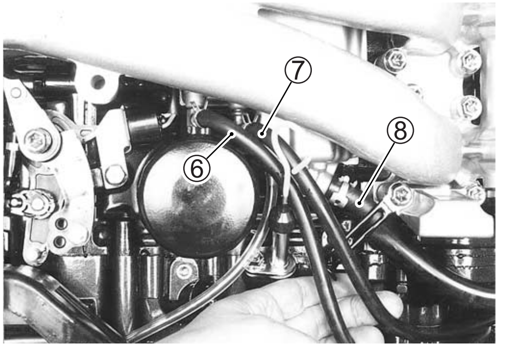
1. Remove flywheel cover and breather hose.
   Remove evaporation hose from flywheel cover.



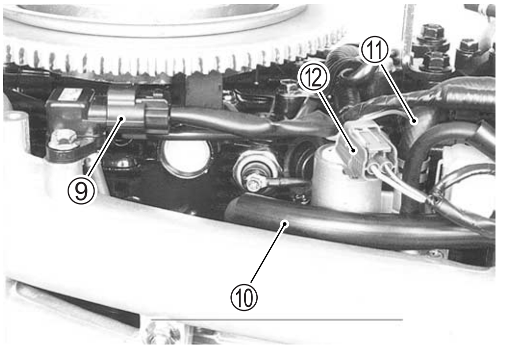
2. Remove silencer case ① and disconnect lead wire connector ② from IAT sensor.
3. Disconnect lead wire connector ③ from CTP switch.



4. Remove throttle rod ④ from throttle body.
5. Remove bolts and side cover holder ⑤.

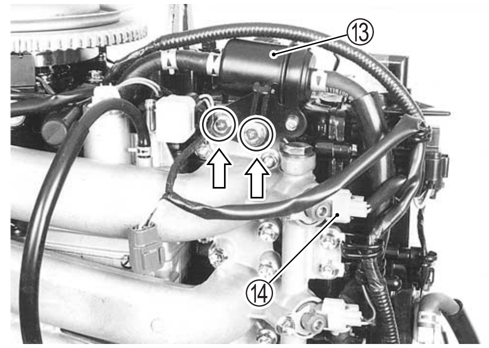


6. Remove water inlet hose ⑥ and outlet hose ⑦ from vapor separator.
7. Place a suitable container under the vapor separator, then disconnect fuel return hose ⑧ from vapor separator.

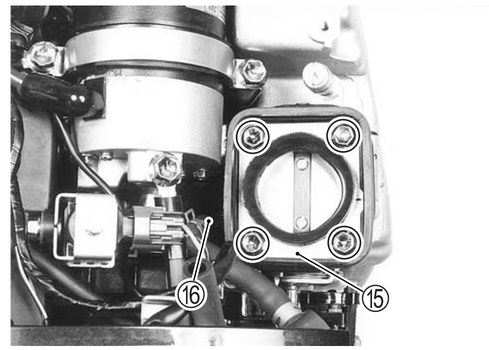


8. Disconnect MAP sensor lead wire connector ⑨ at MAP sensor.
   Disconnect low pressure fuel inlet hose ⑩ from vapor separator.
9. Disconnect high pressure fuel outlet hose ⑪ from vapor separator.
   Disconnect high pressure fuel pump lead wire connector ⑫ at high pressure fuel pump.

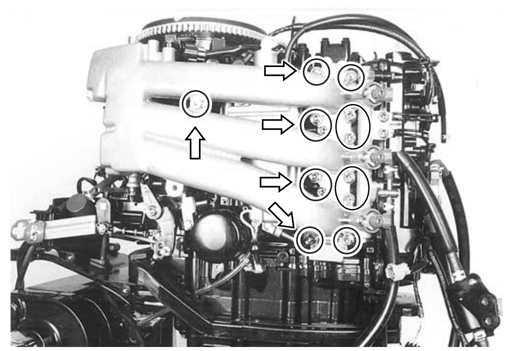
10. Remove two bolts and high pressure fuel filter ⑬.
11. Disconnect lead wire connectors ⑭ from all fuel injectors.



12. Remove four (4) bolts and Throttle body ⑮.
    Remove IAC valve hose ⑯ from Throttle body.



13. Remove bolts and nuts, and then remove intake manifold assembly ⑰.



INSTALLATION

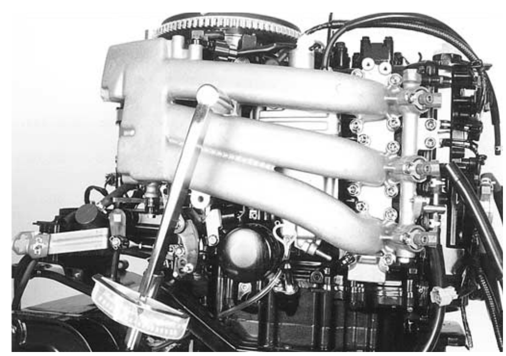
Installation is reverse order of removal with special attention to the following steps.

CAUTION

Do not re-use gasket once removed. Always use a new gasket.

- Apply the bond to both mating surfaces of the intake manifold gasket.

1207B **99000-31140 : Suzuki Bond 1207B**



- Tighten bolts and nuts securely.

Intake manifold bolt & nut :

6 mm	**11N · m (1.1 kg-m, 8.0 lb.-ft.)**
8 mm	**23N · m (2.3 kg-m, 16.5 lb.-ft.)**

- Check to ensure that all removed parts are back in place.

Checking

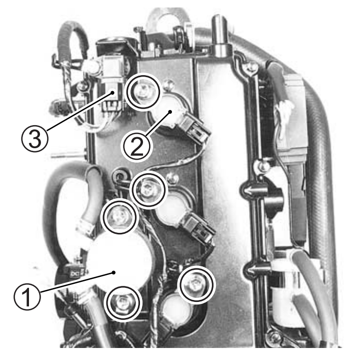
- Check fuel and water hose routing. (See page 10-7 to 10-9)
- Check wire routing (See page 10-1 to 10-6)
- Check for fuel leakage. (See page 5-3)
- Check for water leakage.

POWER UNIT

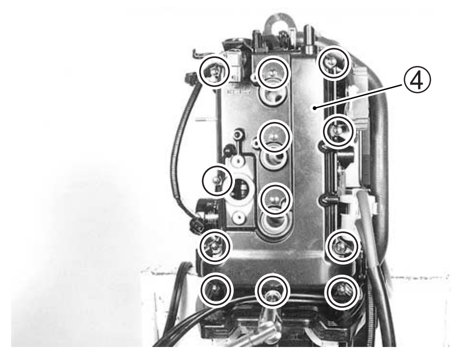
REMOVAL

Before removing power unit :
- **Drain engine oil.**
- **Remove intake manifold assembly. (See page 6-1)**

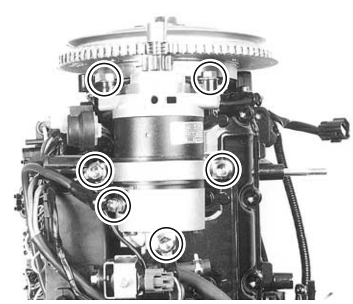
Remove two bolts and low pressure fuel pump ①.
Disconnect ignition coil connectors.
Remove the bolt securing the ignition coil ②.
Remove all ignition coils ② and spark plugs.
Disconnect CMP sensor connector ③.



Remove the twelve (12) cylinder head cover bolts, and then remove cylinder head cover ④.

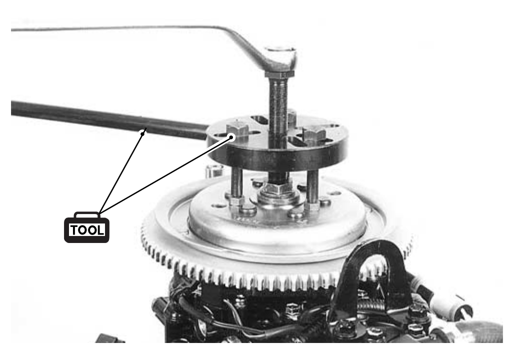


Remove starter motor. (See page 4-11)

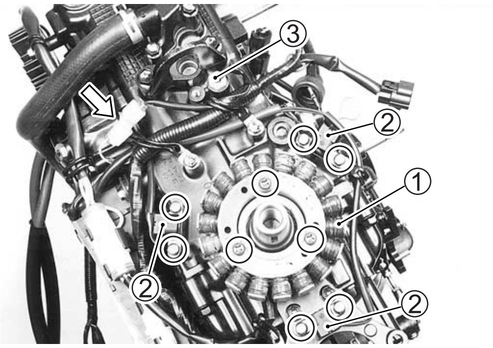


Remove flywheel. (See page 3-48)

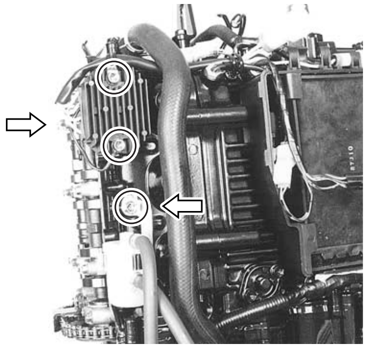
TOOL **09930-48720 : Flywheel holder**
09930-39411 : Flywheel remover
09930-39420 : Flywheel remover bolt



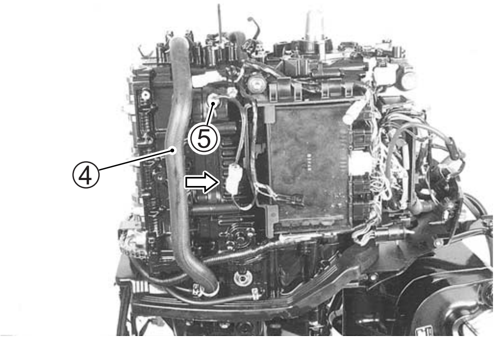
Remove battery charge coil ①. (See page 4-4)
Disconnect CKP sensor connector and remove sensors ②.
Disconnect cylinder temperature sensor connector and remove sensor ③.



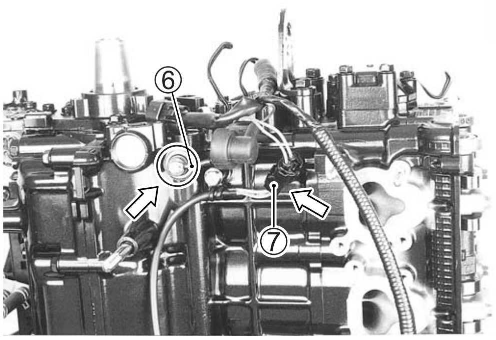
Remove two bolts and rectifier & regulator.
Remove bolt and low pressure fuel filter bracket.



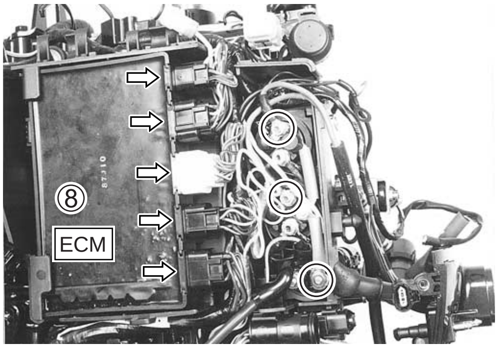
Disconnect water hose ④ from thermostat cover and engine holder.
Disconnect exhaust manifold temperature sensor connector and remove sensor ⑤.



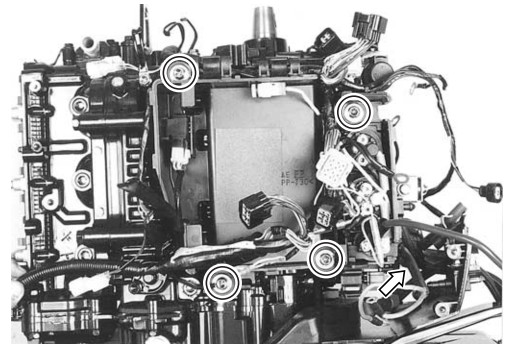
Loosen screw and disconnect oil pressure switch lead wire ⑥.
Disconnect neutral switch lead connector wire ⑦.



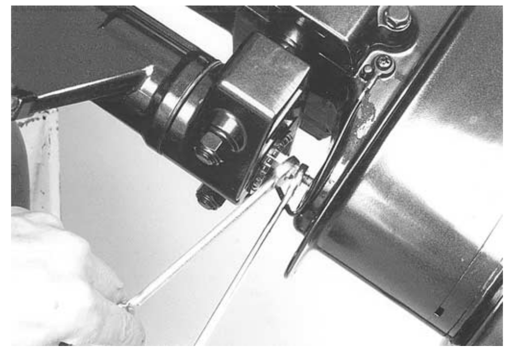
Disconnect all engine wiring harness connectors from ECM, then remove ECM ⑧.
Disconnect the PTT motor cable wire leads (G, Bl) from the PTT relays.
Remove positive (+) battery cable from starter motor relay.



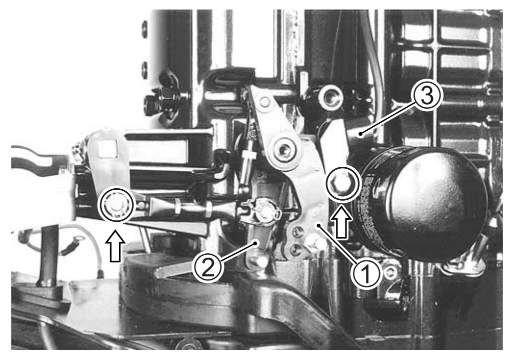
Remove four bolts and electric part holder.
Remove IAC valve silencer.



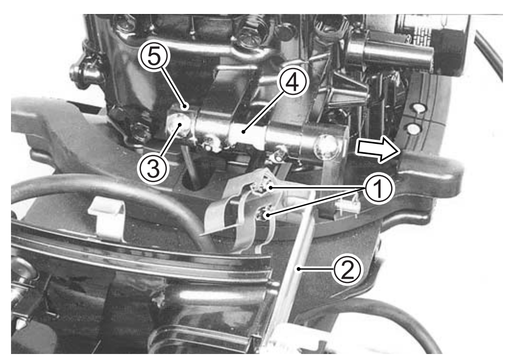
Disconnect clutch rod from shift rod by loosening lock nut and turnbuckle.



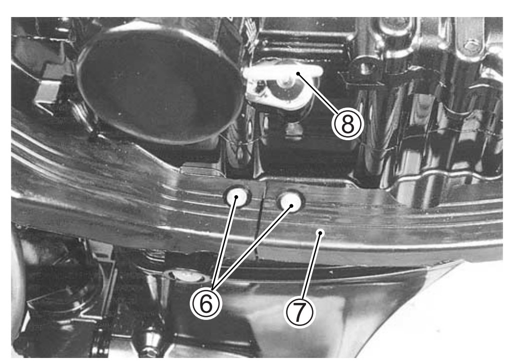
Remove throttle control lever ① and clutch control lever ②.
Remove bolt and neutral switch ③ with bracket.



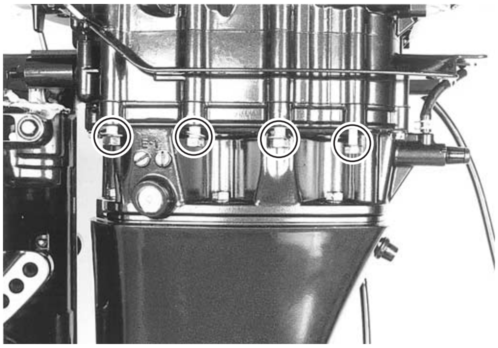
Remove two bolts ① securing front panel bracket ②.
Remove screw ③ and clutch lever shaft ④.
Remove clutch rod arm ⑤ from crankcase .

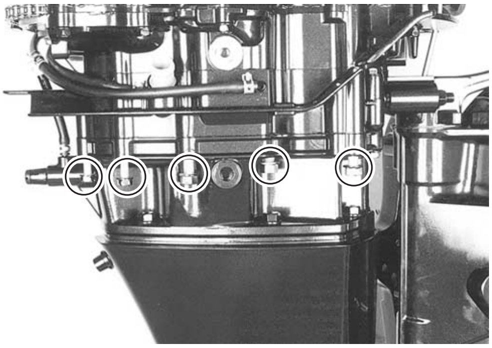


Remove pin ⑥ and side cover seal ⑦.
Remove oil level dipstick ⑧.



Remove eight bolts and nut.
Lift up and remove power unit from engine holder.





INSTALLATION

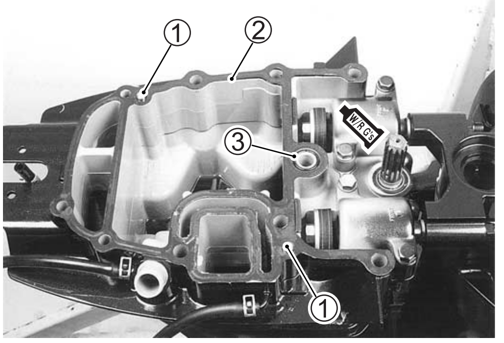
Installation is reverse order of removal with special attention to the following steps.

CAUTION

Do not re-use gasket and o-ring.   **Always replace with new parts.**

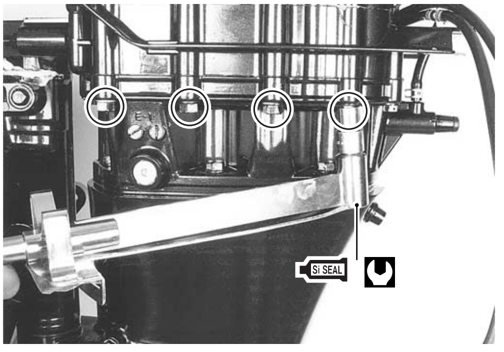
POWER UNIT

Install dowel pins ①, gasket ② and O-ring ③.
Apply Suzuki Water Resistant Grease to driveshaft splines.



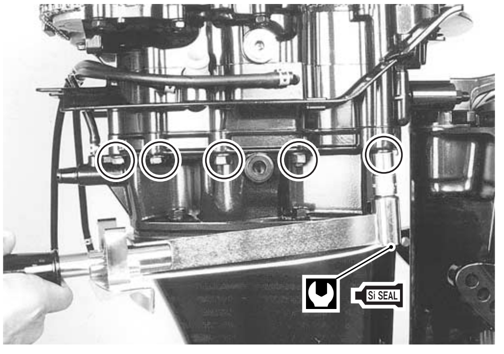
W/R G's **99000-25160 : Suzuki Water Resistant Grease**

Lower the power unit onto engine holder.



NOTE:
Rotate crankshaft to aid alignment of driveshaft and crankshaft splines.

Apply Suzuki Silicone Seal to power unit mounting bolts and tighten bolts and nut to specified torque.



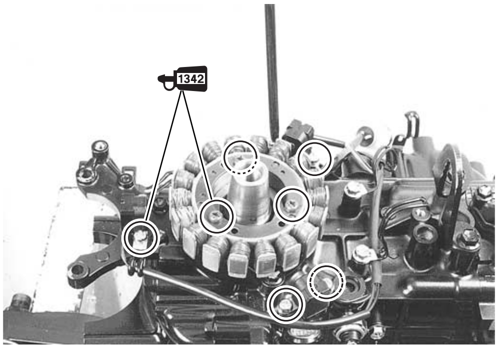
Si SEAL **99000-31120 : Suzuki Silicone Seal**

Power unit mounting bolt and nut :

8 mm	**23 N · m (2.3kg-m, 16.5 lb.-ft.)**
10 mm	**50 N · m (5.0kg-m, 36.0 lb.-ft.)**

FLYWHEEL

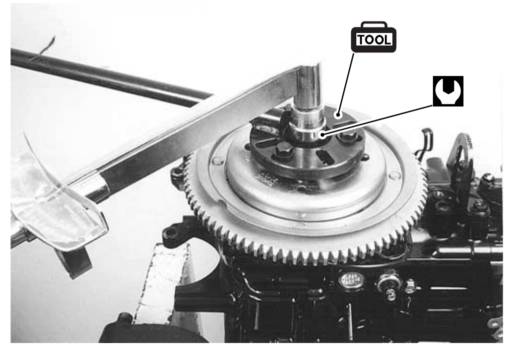
Install battery charge coil. (See page 4-5)
Install CKP sensors. (See page 3-49)



Install flywheel and tighten flywheel bolt to specified torque. (See page 3-49)

TOOL 09930-48720 : Flywheel holder

Flywheel bolt : 200 N · m (20.0 kg-m, 144.5 lb.-ft.)

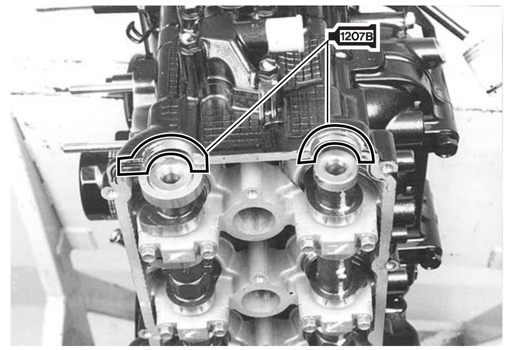


CYLINDER HEAD COVER

NOTE:
Before installing cylinder head cover, check tappet clearance. (See page 2-8)

Apply Suzuki Bond to area as shown in figure.

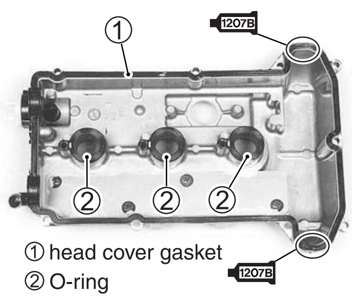
1207B 99000-31140 : Suzuki Bond No. 1207B



CAUTION

Do not re-use gasket and o-ring once removed. **Always use new parts.**

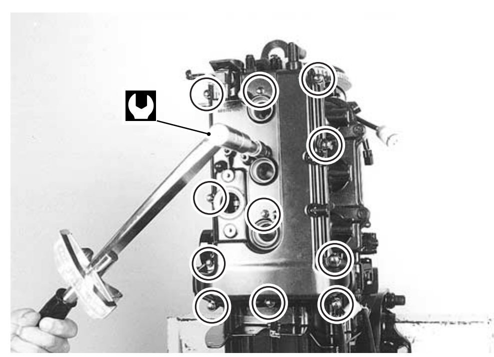
NOTE:
Be sure to check all parts for wear or any damage before installation and replace any found defective.



① head cover gasket
② O-ring

Install cylinder head cover to cylinder head and tighten cover bolts to specified torque.

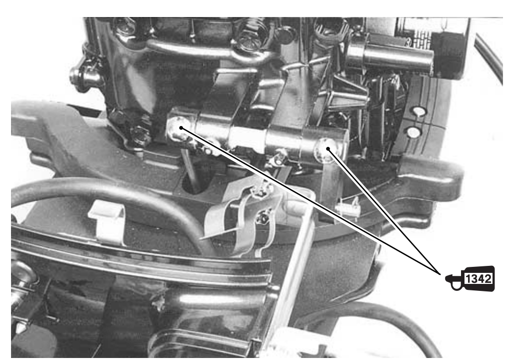
Cylinder head cover bolt :
10 N · m (1.0kg-m, 7.0 lb.-ft.)



NOTE:
Use care when installing cylinder head cover.
Be certain cylinder head cover gasket and O-rings remain in their correct position.

Apply Thread Lock 1342 to the screws securing clutch shaft arms to the clutch shaft.

1342 99000-32050 Thread Lock 1342



INTAKE MANIFOLD

Install intake manifold assembly.
(See page 6-2)

FINAL ASSEMBLY CHECK

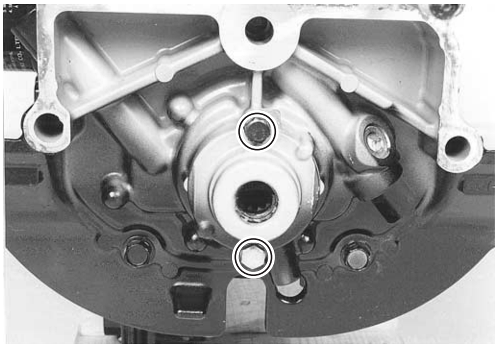
Perform the following checks to ensure proper and safe operation of the repaired unit.

- All parts removed have been returned to their original positions .
- Lower unit gear engagement is properly adjusted. (See page 9-22)
- Fuel and water hose routing match's service manual illustration. (See page 10-7 to 10-9)
- Wire routing match's service manual illustration. (See page 10-2 to 10-6)
- No fuel leakage is evident when fuel system is pressurized. (See page 5-3)
- No water leakage is evident during final test running.

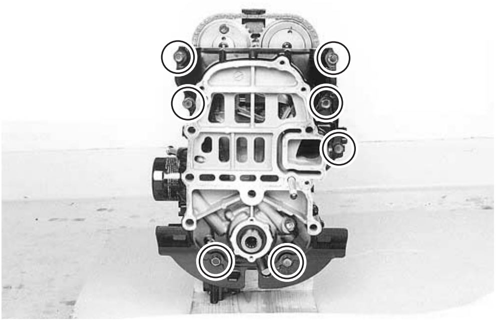
OIL PUMP / CASE

REMOVAL

1. Remove the power unit.
   (see page 6-3 to 6-6)
2. Remove the two (2) bolts securing the under oil seal housing to oil pump case, then remove the under oil seal housing.

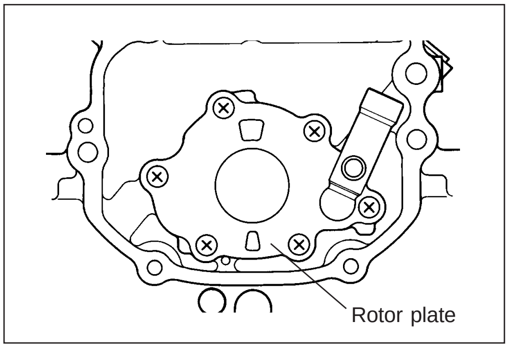


3. Remove the seven (7) bolts securing the oil pump case to cylinder block, then remove oil pump case with oil pump.

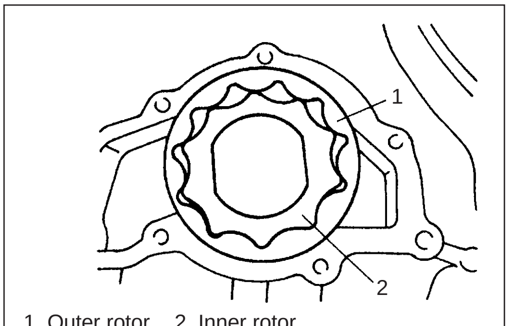


DISASSEMBLY

1. Remove the screws securing oil pump rotor plate to the oil pump case, then remove the oil pump rotor plate.



2. Take out inner rotor and outer rotor.

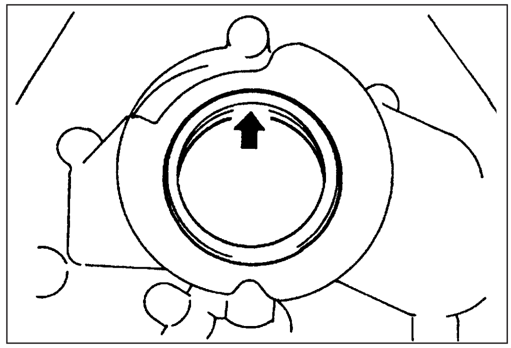


1. Outer rotor 2. Inner rotor

INSPECTION

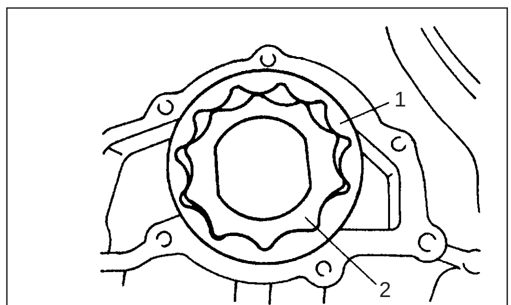
Oil seal

Check oil seal lip for wear or other damage.
Replace as necessary.



Oil pump components

Check outer and inner rotors, rotor plate and oil pump case for excessive wear or damage.
Replace as necessary.



1. Outer rotor 2. Inner rotor

MEASURING PUMP COMPONENTS

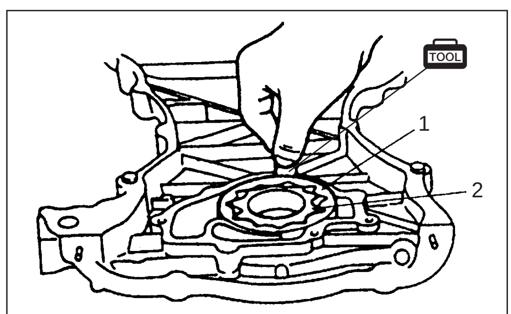
Radial clearance

Using a feeler gauge, measure radial clearance between outer rotor and case.

Radial clearance :

Service limit : 0.31 mm (0.012 in.)

If measurement is not within specifications, replace the outer rotor and/or case.



1. Outer rotor 2. Inner rotor

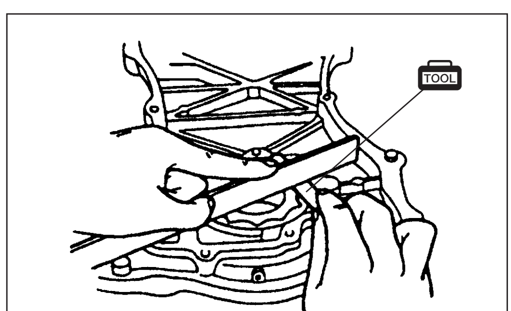
Side clearance

Using straightedge and feeler gauge, measure side clearance.

Side clearance

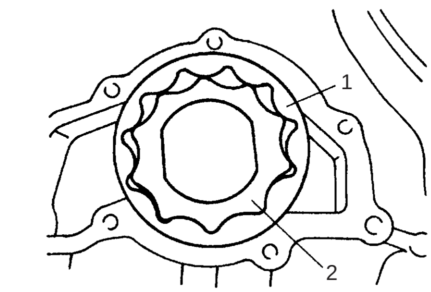
Service limit : 0.15 mm (0.006 in.)

If measurement is not within specifications, replace the outer rotor and/or pump case.



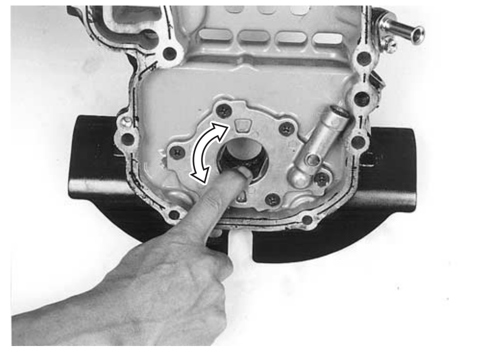
ASSEMBLY

(1) Wash, clean and then dry all disassembled parts.
(2) Apply thin coat of engine oil to inner and outer rotors, oil seal lip and inside surfaces of oil pump case and plate.
(3) Install outer and inner rotor to pump case.



1. Outer rotor 2. Inner rotor

(4) Install outer plate.
Tighten six (6) screws securely.
After mounting the outer plate, check to be sure that each rotor turns smoothly by hand.

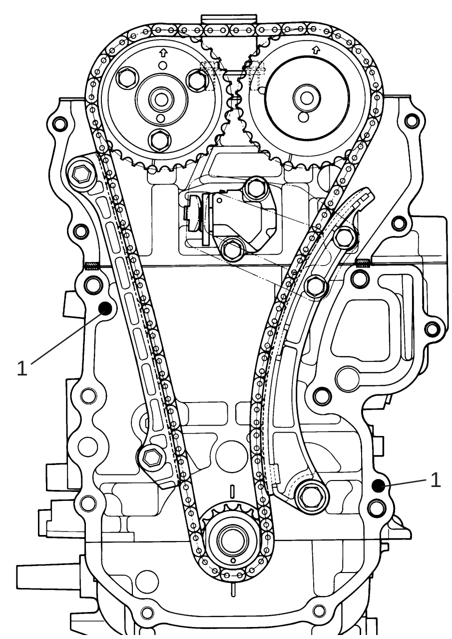


INSTALLATION

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

1. Check for proper timing chain installation.
(see page 6-20)

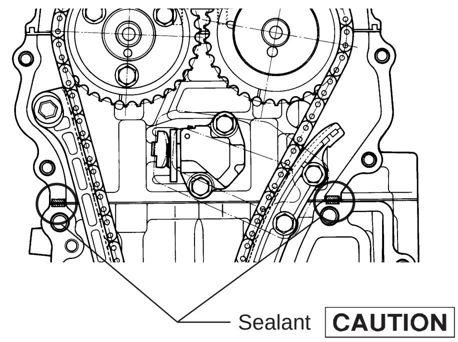
2. Install two (2) dowel pins to cylinder block.
Before fitting the pump case, oil the oil seal lip.



1. Dowel pin

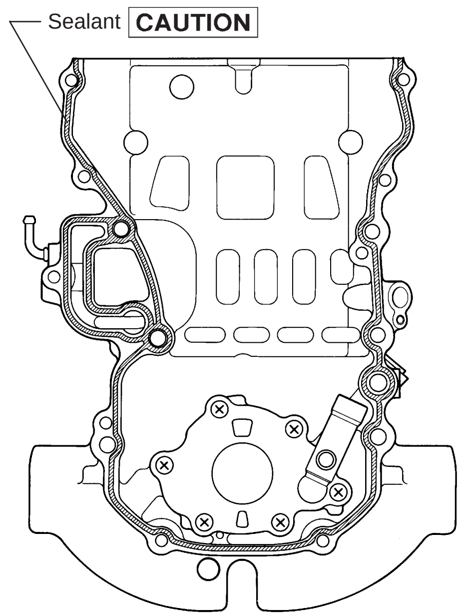
3. Apply sealant to areas as shown in figure.

CAUTION 99000-31140 : Suzuki Bond 1207B



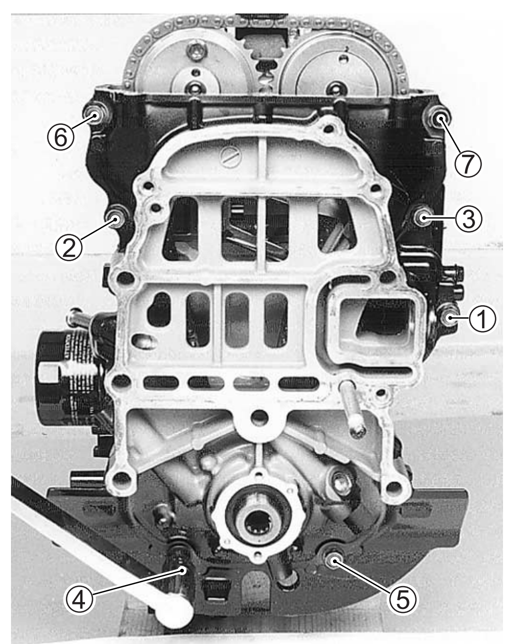
4. Apply a continuous bead of sealant to oil pump case mating surface as shown in figure.

CAUTION 99000-31140 : Suzuki Bond 1207B



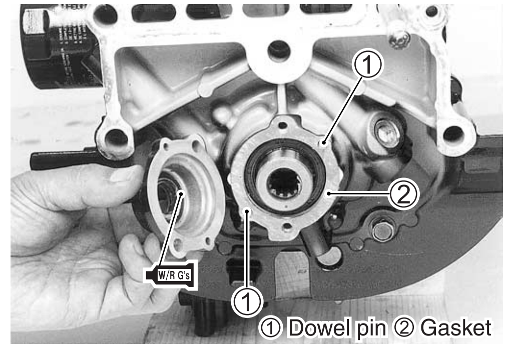
5. Install oil pump case to cylinder block and tighten seven (7) bolts securely.

NOTE:
- *When installing oil pump case be sure position of oil pump inner rotor matchs with crankshaft.*
- *Tighten bolts in the indicated order.*



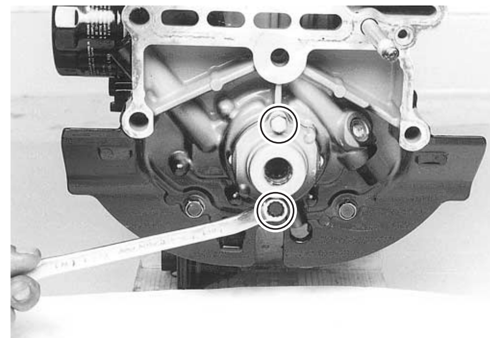
6. Install dowel pin and gasket to oil pump case.
7. Apply grease to oil seal lip.

W/R G's 99000-25160 : Water Resistant Grease



① Dowel pin ② Gasket

8. Install under oil seal housing and tighten bolts.

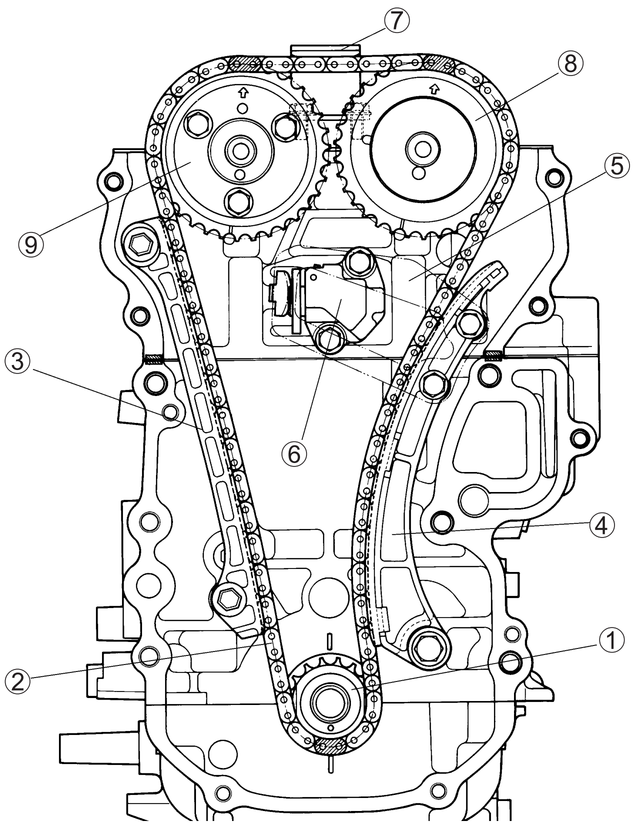


TIMING CHAIN / TENSIONER

REMOVAL

Prior to this service work :

- **remove the power unit. (see page 6-3 to 6-6)**
- **remove the oil pump case. (see page 6-10)**



① Crankshaft / timing sprocket
② Timing chain
③ Timing chain guide No.1
④ Timing chain tensioner
⑤ Timing chain tensioner link
⑥ Timing chain tensioner adjuster
⑦ Timing chain guide No.2
⑧ Exhaust camshaft w/timing sprocket
⑨ Intake camshaft and timing sprocket

1. Turn the crankshaft in its normal running direction (Ⓡ direction) until No.1 cylinder reaches top dead center.

NOTE :
To bring No.1 cylinder top dead center, align mark Ⓢ on the crankshaft with mark ⓐ on the crank case.

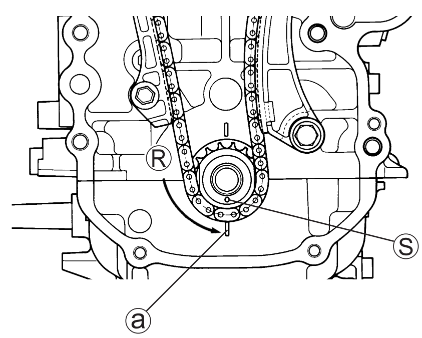
CAUTION

When timing chain has been removed, never turn crankshaft or camshaft.

2. Remove the bolts and timing chain tensioner link ⑤.

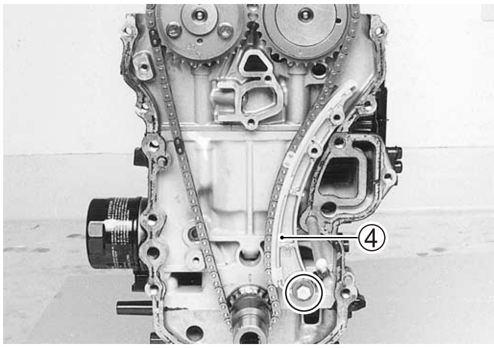
3. Remove the bolts and tensioner adjuster ⑥.

4. Remove the bolts and timing chain guide No.1 ③.

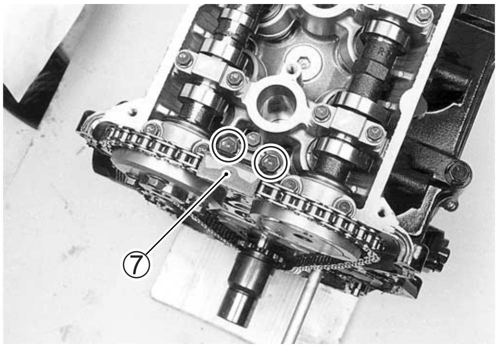


ⓐ: Match mark on crank case
Ⓢ: Match mark on crank shaft
Ⓡ: Engine normal running direction

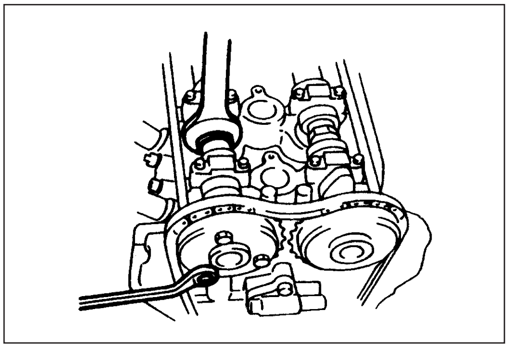
5. Remove the bolt and timing chain tensioner ④.



6. Remove the bolts and timing chain guide No.2 ⑦.

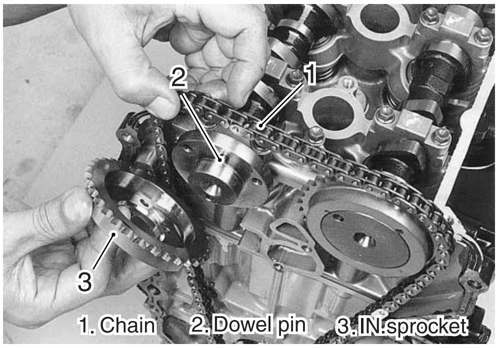


NOTE:
Hold camshaft by placing a wrench on the hexagon area of the camshaft.



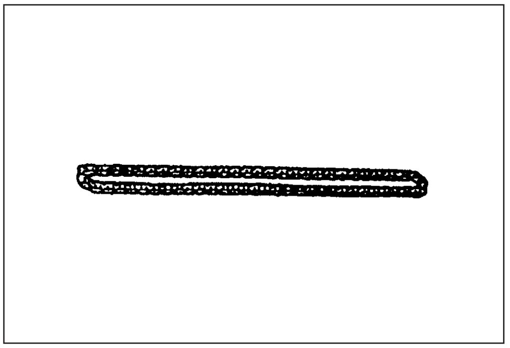
7. Remove the three(3) bolts securing the intake timing sprocket to camshaft.

8. Remove the intake timing sprocket, dowel pin and timing chain.



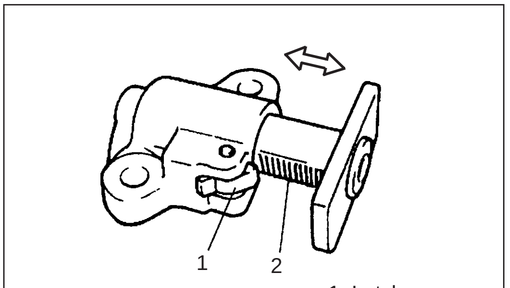
INSPECTION

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



Timing chain

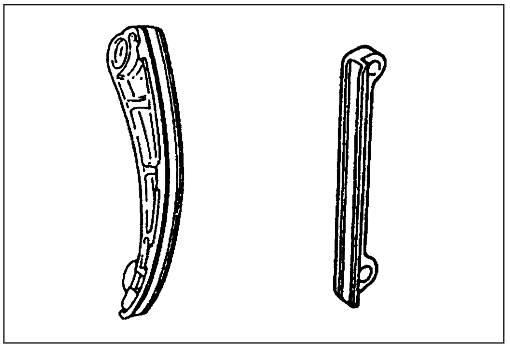
Inspect timing chain.
Replace if worn or damaged.



1. Latch
2. Tooth surface

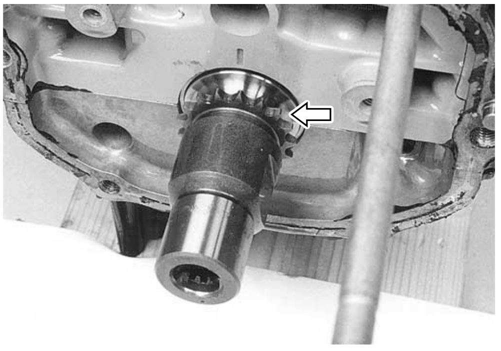
Tensioner adjuster

Inspect tensioner adjuster for smooth operation.
Replace if faulty.



Timing chain tensioner / chain guide

Check shoe for wear or damage.

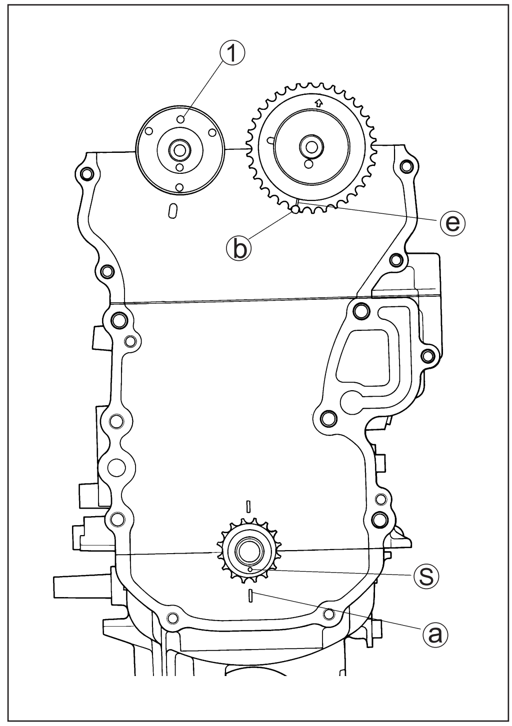


Timing sprocket

Check teeth of sprocket for wear or damage.

INSTALLATION

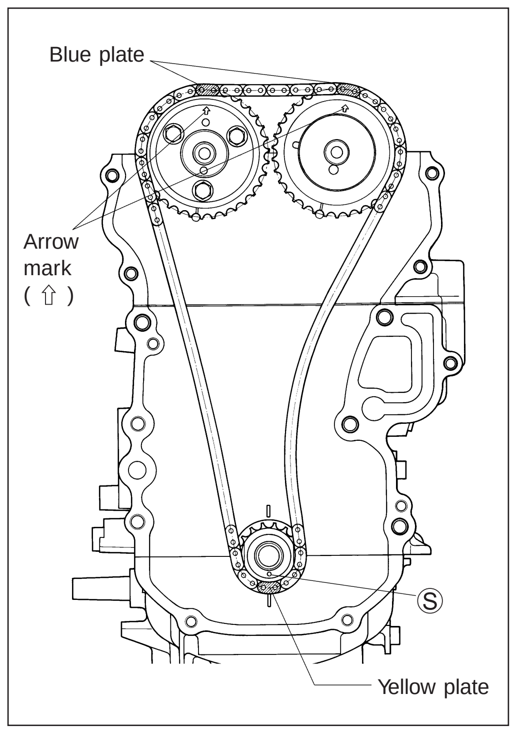
Installation is reverse of removal with special attention to following steps.



(1) Align crankshaft timing mark Ⓢ with timing mark ⓐ on crankcase as shown in figure by turning crankshaft.

(2) Install dowel pin ① in intake camshaft.
Then turn the camshaft to position the dowel pin at the top, as shown in figure.

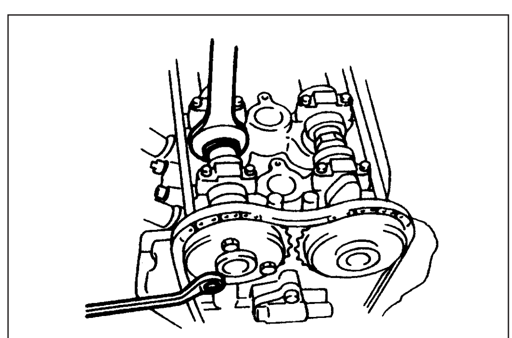
Check that mark ⓔ on exhaust camshaft timing sprocket aligns with timing mark ⓑ on cylinder head as shown in figure.



(3) Install timing chain by aligning blue plate of timing chain and arrow on exhaust camshaft timing sprocket as shown in figure.
Install timing chain by aligning yellow plate of timing chain and crankshaft timing mark Ⓢ as shown in figure.

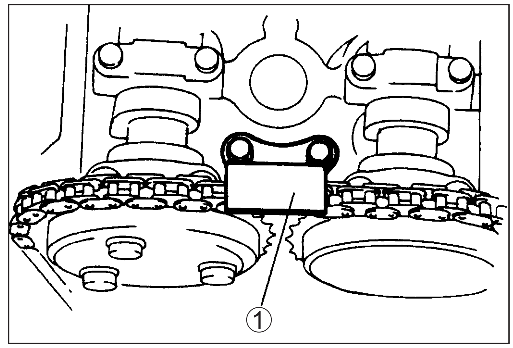
(4) Bring blue plate of timing chain into alignment with arrow mark on intake camshaft timing sprocket, then install intake cam timing sprocket to intake camshaft.
Tighten sprocket bolts to specified torque.

Camshaft timing sprocket bolt :
10 N · m (1.0 kg-m, 7.0 lb.-ft.)

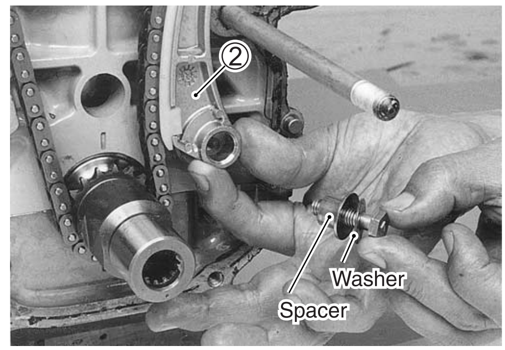


NOTE:
Hold the camshaft by placing a wrench on the hexagon area of the shaft.

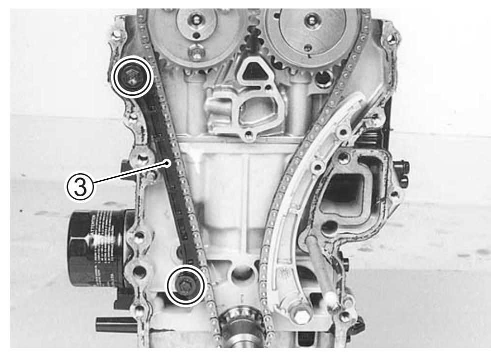
(5) Install timing chain guide No.2 ①.



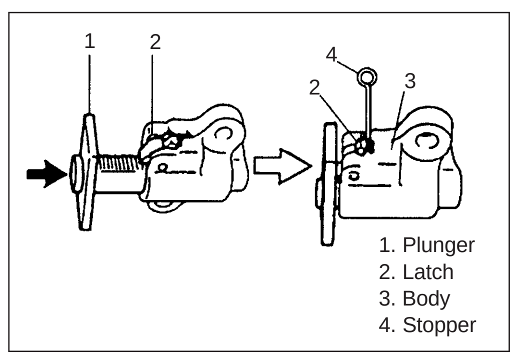
(6) Insert spacer into chain tensioner.
Install chain tensioner ② as shown in figure.
Apply oil to chain tensioner.



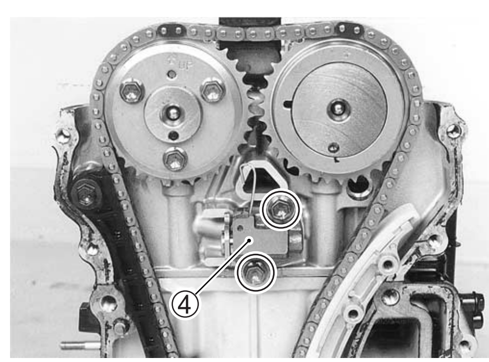
(7) Install timing chain guide No.1 ③.



(8) With latch of tensioner adjuster returned and plunger pushed back into body, insert stopper into latch and body.
After inserting stopper, check to make sure that plunger will not come out.

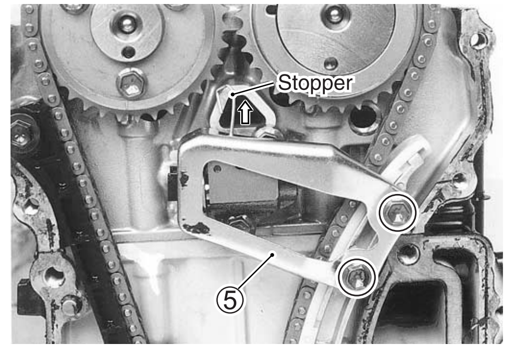


(9) Install timing chain tensioner adjuster ④.
Apply engine oil to timing chain.

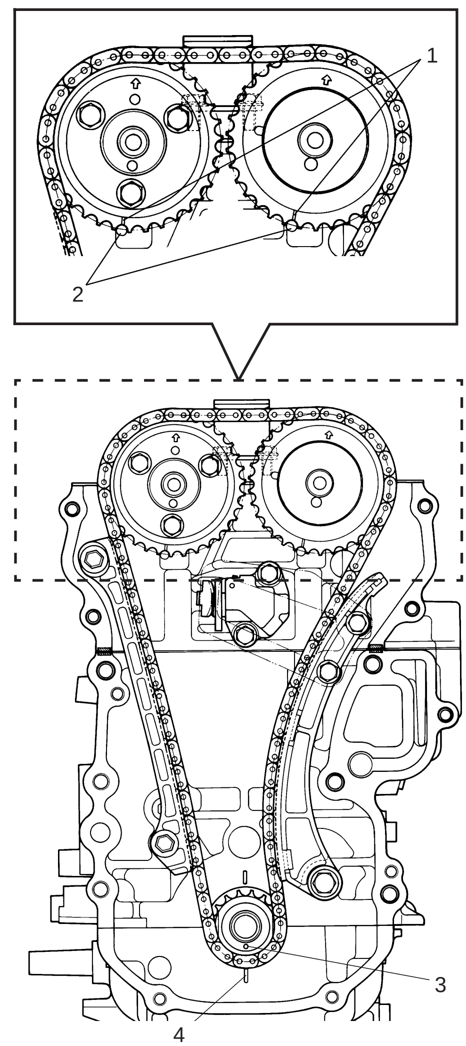


(10) Install timing chain tensioner link ⑤.

(11) Pull out stopper from adjuster.



(12) Turn crankshaft normal running direction 2 revolutions and check that match marks are aligned as shown in figure.



1. Match mark (slit) on camshaft sprocket
2. Match mark (rib) on cylinder head
3. Match mark on crank shaft
4. Match mark on crankcase

(13) Install oil pump case.
(See page 6-12)
(14) Install under oil seal housing.
(See page 6-14)

CYLINDER HEAD ASSEMBLY

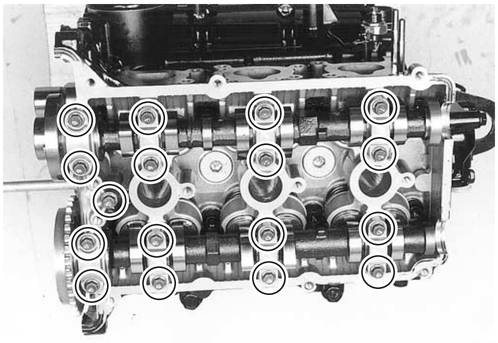
(Cylinder head / valve / camshaft)

REMOVAL

Prior to removing cylinder head :

• Remove the power unit.
(see page 6-3 to 6-6)

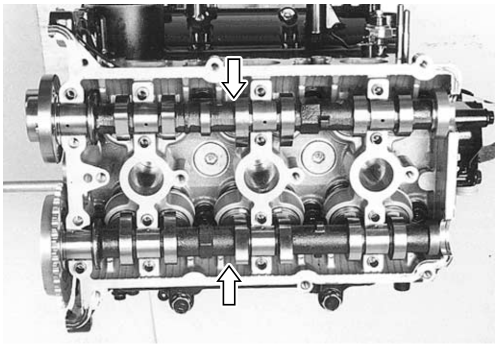
• Remove the timing chain.
(see page 6-15 to 6-16)

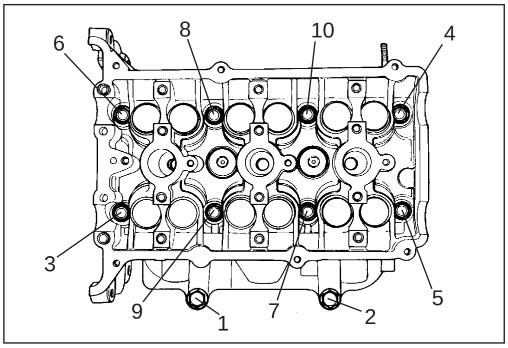


1. Remove the bolts securing the camshaft housing to cylinder head, then remove each camshaft housing.

NOTE:
For ease of assembly, note position of each individual camshaft housing.

2. Remove intake and exhaust camshafts.





3. Loosen ten (10) cylinder head bolts in the order indicated in figure and remove them.
4. Remove cylinder head assembly and head gasket.

NOTE:
Use a special tool (10mm deep socket wrench) when loosening the cylinder head bolts.

TOOL **09919-16010 : Deep socket wrench (10 mm)**

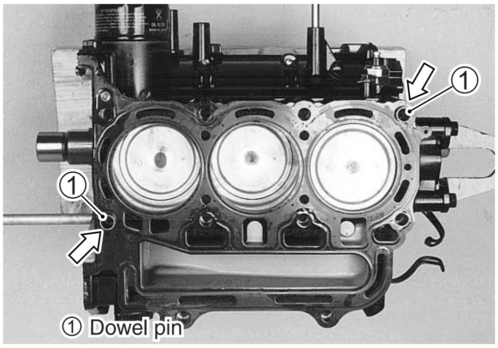
INSTALLATION

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

CAUTION

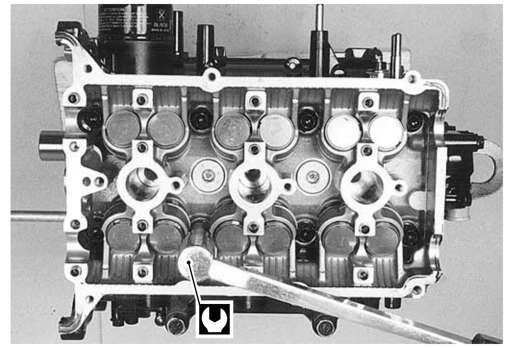
Do not re-use gasket. Always use a new gasket.

1. Insert the dowel pins and place a new cylinder head gasket into position on the cylinder.



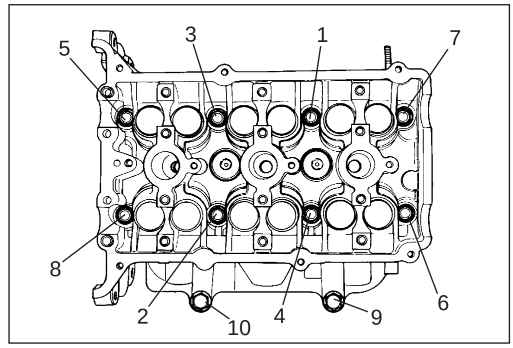
① Dowel pin

2. Position cylinder head on cylinder.



3. Apply engine oil to cylinder head bolts and tighten them gradually as follows.

   (a) Tighten all bolts to 30 N · m (3.0 kg-m, 21.5 lb.-ft.) according to numerical order in figure.
   (b) Loosen all bolts to 0 N · m (0 kg-m, 0 lb.-ft.) according to reverse order in figure.
   (c) Again tighten all bolts to 30 N · m (3.0 kg-m, 21.5 lb.-ft.) according to numerical order in figure.
   (d) Finally tighten all bolts to specified torque according to numerical order in figure.

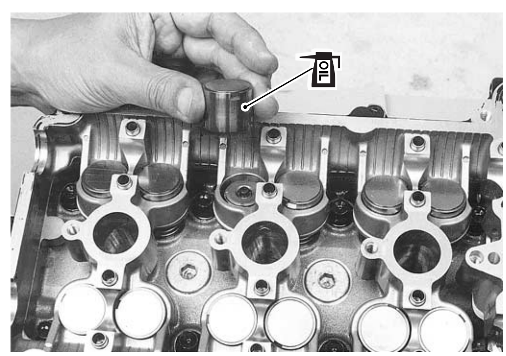


Cylinder head bolt : 60 N · m (6.0 kg-m, 43.5 lb.-ft.)

NOTE:
Use special tool (10mm deep socket wrench) when tighten the cylinder head bolt.

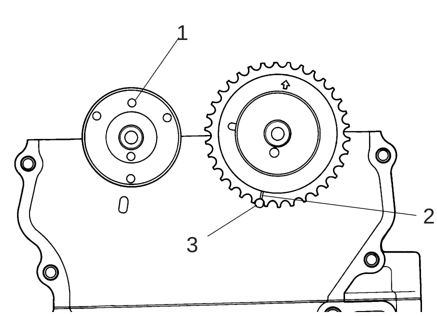
TOOL **09919-16010 : Deep socket wrench (10 mm)**

4. Apply engine oil around tappets and install.
5. Install tappet shims.



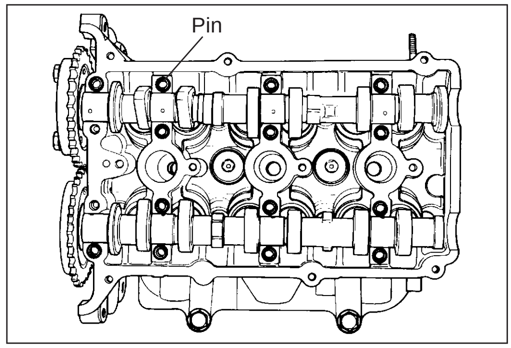
6. Apply engine oil to the surface of each camshaft lobe and journal, then install them as shown in figure.

NOTE:
Before installing camshafts, turn crankshaft until No.1 cylinder reaches top dead center. (see page 6-15)



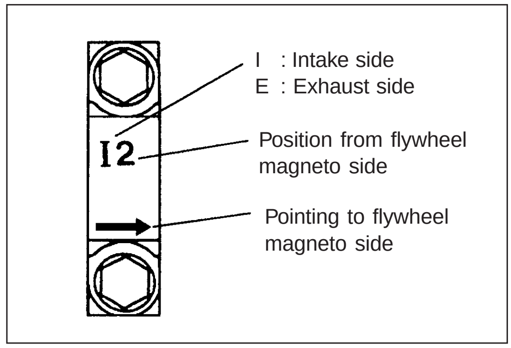
1. Dowel pin hole
2. Match mark (slit)
3. Match mark (rib)

7. Install camshaft housing pins as shown in figure.



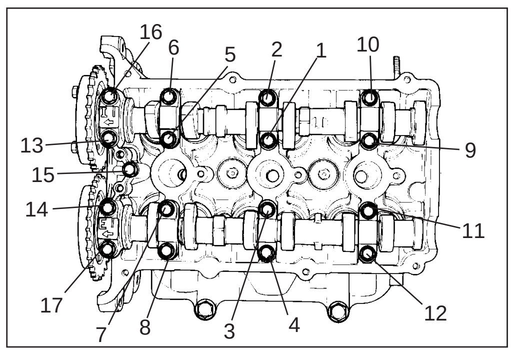
8. Check position of camshaft housing.
   - Embossed marks are provided on each camshaft housing indicating position and direction of installation.

   Install housings as indicated by these marks.



9. Apply engine oil to housing bolts.

10. Lightly seat all housing bolts at first.
    Following numerical order in figure, tighten bolts to 1/3 of specified torque, then 2/3 of specified torque and finally to full specified torque.



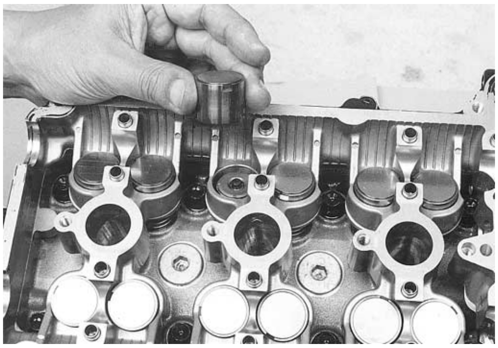
Camshaft housing bolt : 10 N · m (1.0 kg-m, 7.0 lb.-ft.)

11. Install timing chain. (see page 6-18)

12. Adjust tappet clearance. (see page 2-8)

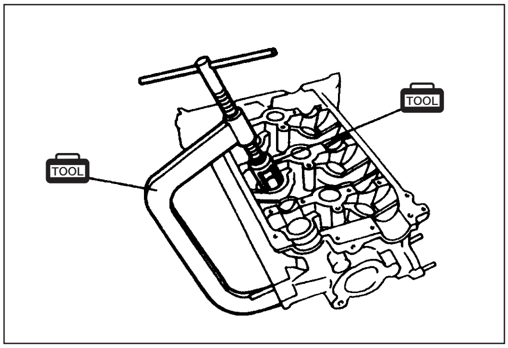
DISASSEMBLY

1. Remove tappets with shims.

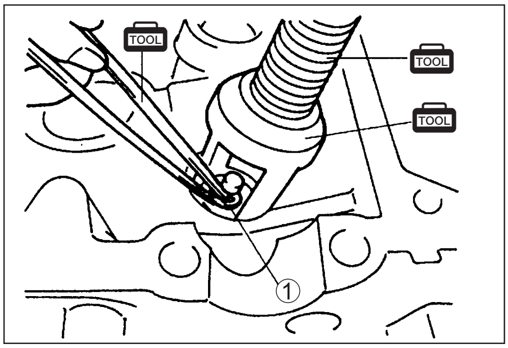


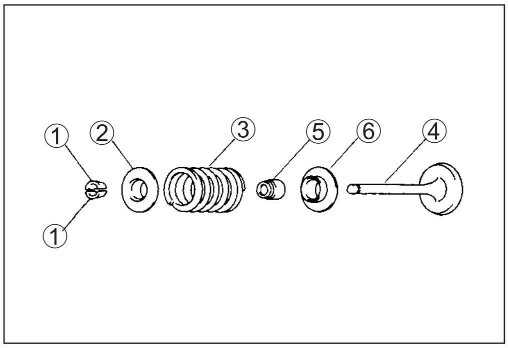
2. Using valve lifter and attachment, remove valve cotters ① while compressing valve spring.

TOOL **09916-14510 : Valve lifter**
09916-14910 : Attachment
09916-84511 : Tweezers



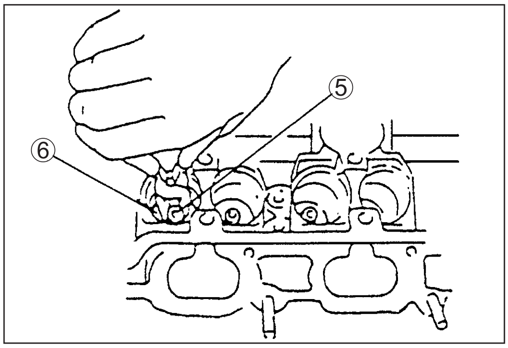
3. Remove valve spring retainer ②, valve spring ③ and valve ④.





4. Remove valve stem seal ⑤ and valve spring seat ⑥.

NOTE:
Reassemble each valve and valve spring in their original positions.

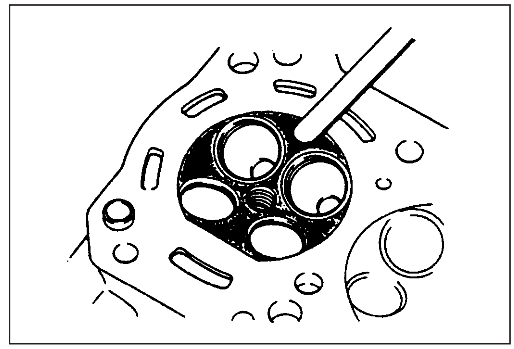


INSPECTION / SERVICING

NOTE:
If cracks, excessive wear or other damage is found on any component, replace component.

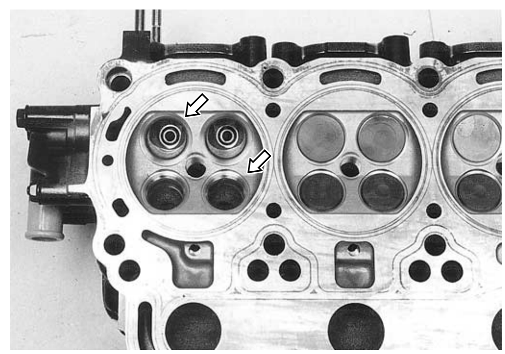
CYLINDER HEAD

Remove all carbon from combustion chambers.



NOTE:
- *Do not use any sharp edged tool to scrape carbon off cylinder head or its components.*
- *Be careful not to scuff or nick metal surfaces when decarboning.*

Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.

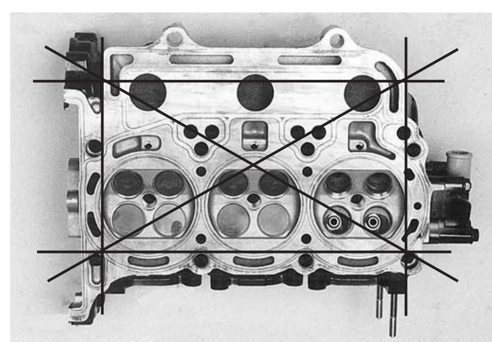


Valve seat

Check valve seat, if cracks or other damage is found, replace cylinder head.

Cylinder head distortion

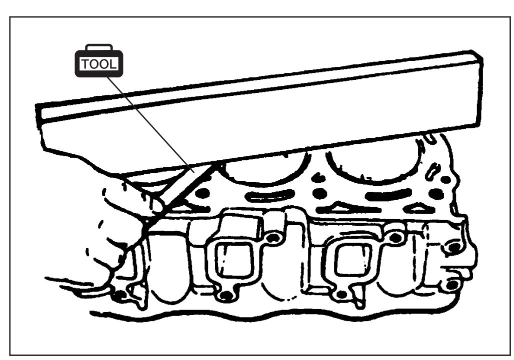
Using a straightedge and thickness gauge, measure cylinder head distortion (gasket surface) at a total of six (6) locations as shown.



TOOL **09900-20803 : Thickness gauge**

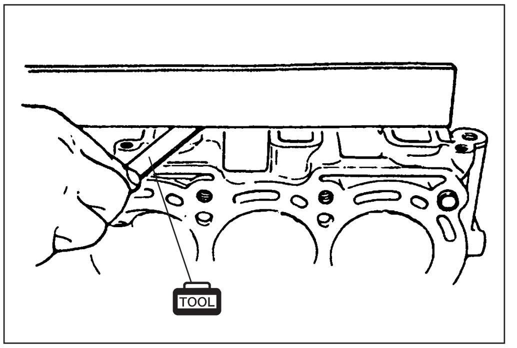
Cylinder head distortion
Service limit : 0.05 mm (0.002 in.)

If measurement exceeds service limit, resurface or replace cylinder head.



NOTE:
Cylinder head can be resurfaced, using a surface plate and #400 grit wet sandpaper.
Move the cylinder head in a figure eight pattern when sanding.

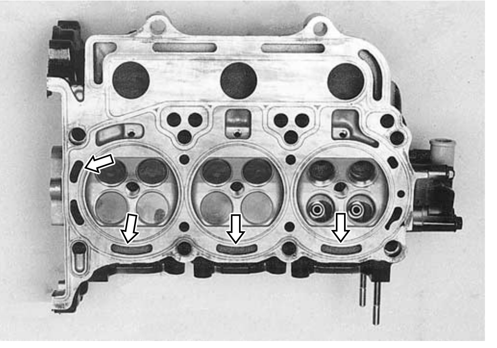
Manifold seating faces distortion
Using a straightedge and thickness gauge, check cylinder head to manifold seating faces.



Manifold seating faces distortion
Service limit : 0.10 mm (0.004 in.)

If measurement exceeds service limit, resurface or replace cylinder head.

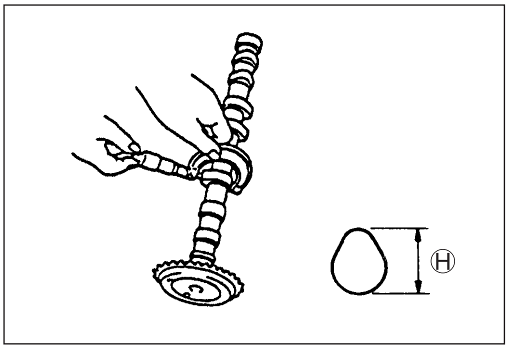
Water jackets
Check water jackets. If clogged or obstructed, clean water jackets.



CAMSHAFT

Cam face
Inspect cam face for scratches and wear.

Cam wear
Using micrometer, measure cam height Ⓗ.



TOOL **09900-20202 : Micrometer**

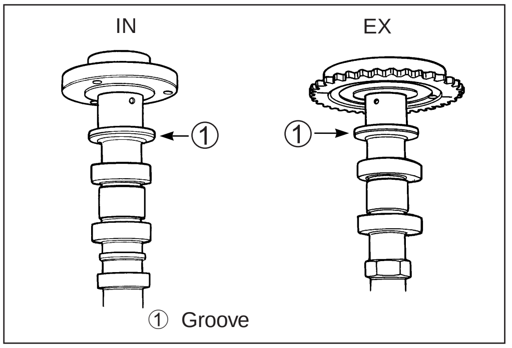
Cam height
Standard:
DF40 IN 37.530 – 37.690 mm (1.4776 – 1.4839 in.)
EX 37.740 – 37.900 mm (1.4858 – 1.4921 in.)
DF50 IN 38.230 – 38.390 mm (1.5051 – 1.5114 in.)
EX 37.740 – 37.900 mm (1.4858 – 1.4921 in.)

Service limit
DF40 IN 37.430 mm (1.4736 in.)
EX 37.640 mm (1.4819 in.)
DF50 IN 38.130 mm (1.5012 in.)
EX 37.640 mm (1.4819 in.)

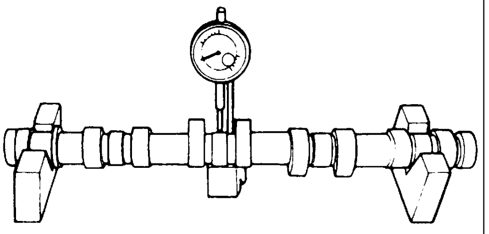
If measurement exceeds service limit, replace camshaft.

Camshaft identification
DF40 and DF50 camshafts differ as indicated below.

Model	Identification Groove
DF40	No groove
DF50	Groove



Camshaft runout
Position camshaft between two "V" blocks and measure runout using a dial gauge.

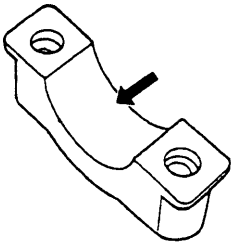


TOOL **09900-20602 : Dial gauge**
09900-21304 : "V" block set
09900-20701 : Magnetic stand

Camshaft runout
Service limit : 0.10 mm (0.004 in.)

If measurement exceeds service limit, replace camshaft.

CAMSHAFT JOURNAL
Check camshaft journals and camshaft housing for pitting, scratches, wear or damage.
If any of the above conditions are found, replace camshaft or cylinder head with housing.

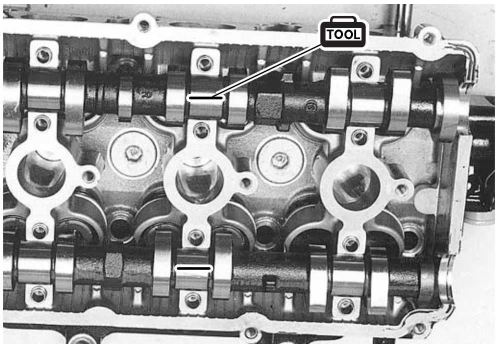


NOTE:
Camshaft housing and cylinder head must be replaced as a set.

Camshaft journal oil clearance

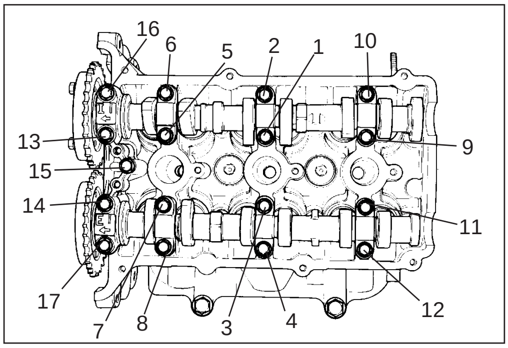
Check journal oil clearance using Plastigauge as follows.

1. Clean housing and camshaft journals.
2. Install camshaft to cylinder head.
3. Place Plastigauge across the full width of camshaft journal (parallel to camshaft).



TOOL **09900-22302 : Plastigauge**

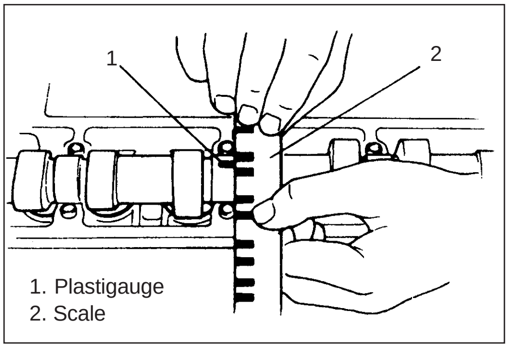
4. Install camshaft housing. Tighten housing bolts in 3 steps (1/3 of specification, 2/3 of specification, full torque specification) in the indicated order.



Camshaft housing bolt : 10 N · m (1.0 kg-m, 7.0 lb.-ft.)

NOTE:
Do not rotate camshaft while Plastigauge is installed.

5. Remove camshaft housing.
6. Using scale on Plastigauge envelope, measure Plastigauge at its widest point.

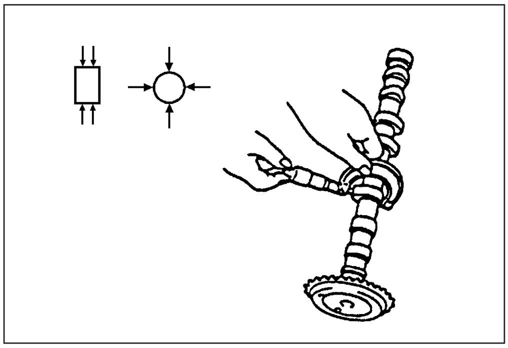


1. Plastigauge
2. Scale

Camshaft journal oil clearance
Standard : 0.045 – 0.087 mm (0.0018 – 0.0034 in.)
Service limit : 0.120 mm (0.0047 in.)

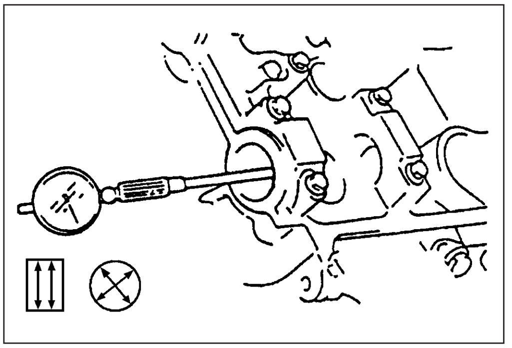
If journal oil clearance exceeds the service limit, measure camshaft journal (outside dia.) and camshaft housing (inner dia.). Based on measurements, replace camshaft and / or cylinder head with camshaft housing.

TOOL **09900-20205 : Micrometer**



Camshaft journal outside diameter
Standard : 22.934 – 22.955 mm (0.9029 – 0.9037 in.)
Service limit : 22.784 mm (0.8970 in.)

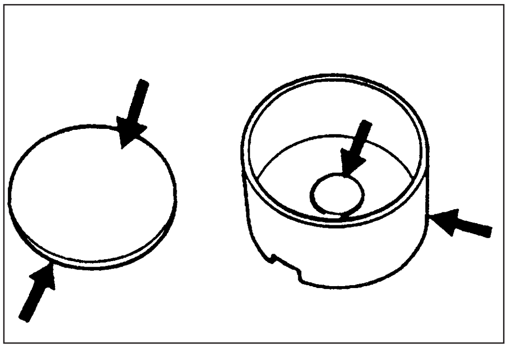
Camshaft journal (housing) inside diameter
Standard : 23.000 – 23.021 mm (0.9055 – 0.9063 in.)
Service limit : 23.171 mm (0.9122 in.)



TAPPET / TAPPET SHIM

Wear of tappet and shim

Check tappet and shim for pitting,scratches, or damage.
If any above conditions are found, replace component.



Measure cylinder head bore and tappet outside diameter to determine cylinder head to tappet clearance.

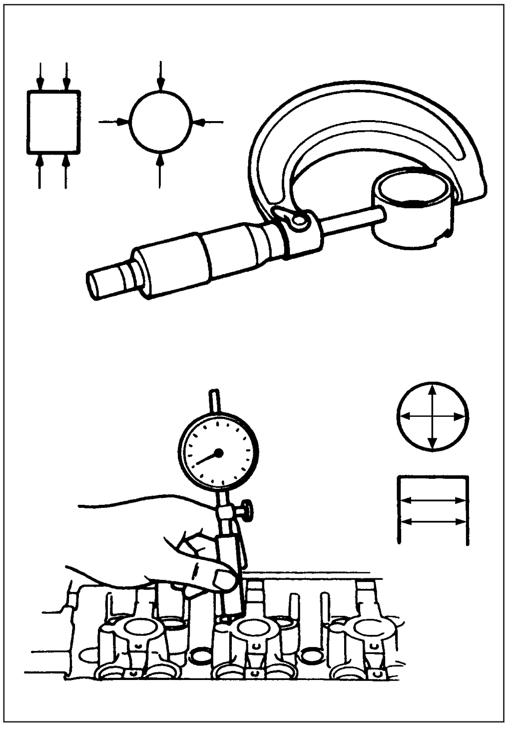
TOOL **09900-20202 : Micrometer**

If measurement exceeds service limit, replace tappet or cylinder head.

Cylinder head bore to tappet clearance
Standard : 0.025 – 0.062 mm (0.0010 – 0.0024 in.)
Service limit : 0.150 mm (0.0059 in.)

Tappet outer diameter
Standard : 26.959 – 26.975 mm (1.0614 – 1.0620 in.)

Cylinder head bore
Standard : 27.000 – 27.021 mm (1.0630 – 1.0638 in.)



VALVE / VALVE GUIDE

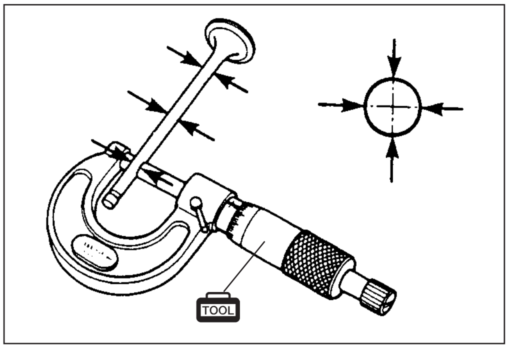
Valve guide to valve stem clearance

Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check guide to stem clearance. Be sure to take readings at more than one place along the length of each stem and guide.

TOOL **09900-20205 : Micrometer**

Valve stem outside diameter

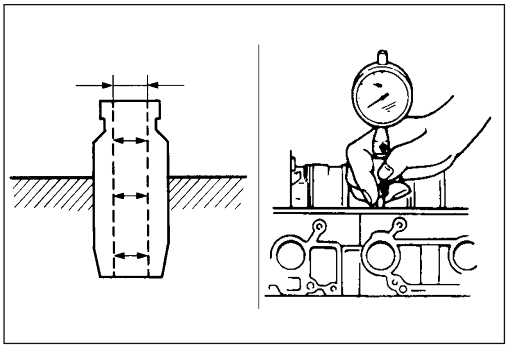
Using micrometer, measure valve stem outside diameter.



Valve stem outside diameter
Standard:
IN 5.465 – 5.480 mm (0.2152 – 0.2157 in.)
EX 5.440 – 5.455 mm (0.2142 – 0.2148 in.)

Valve guide inside diameter

Using a small bore gauge, measure valve guide inside diameter.



Valve guide inside diameter
Standard :
IN 5.500 – 5.512 mm (0.2165 – 0.2170 in.)
EX 5.500 – 5.512 mm (0.2165 – 0.2170 in.)

Valve guide to valve stem clearance

Valve guide to valve stem clearance
Standard :
IN 0.020 – 0.047 mm (0.0008 – 0.0019 in.)
EX 0.045 – 0.072 mm (0.0018 – 0.0028 in.)

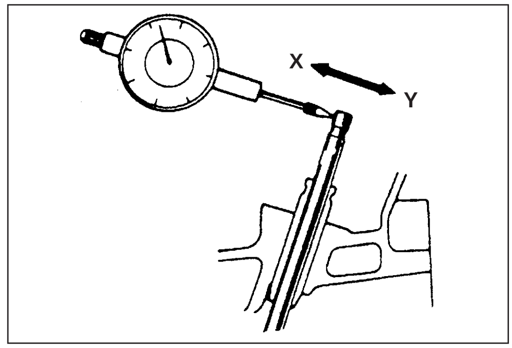
Service limit :
IN 0.070 mm (0.0028 in.)
EX 0.090 mm (0.0035 in.)

If measurement exceeds service limit, replace valve and / or valve guide.

NOTE:
For valve guide replacement, see “VALVE GUIDE REPLACEMENT” section on page 6-35.

Valve stem end deflection

If unable to measure valve guide inside diameter, check "Valve stem end deflection".



09900-20602 : Dial gauge
09900-20701 : Magnetic stand

Measure valve stem end deflection as follows :

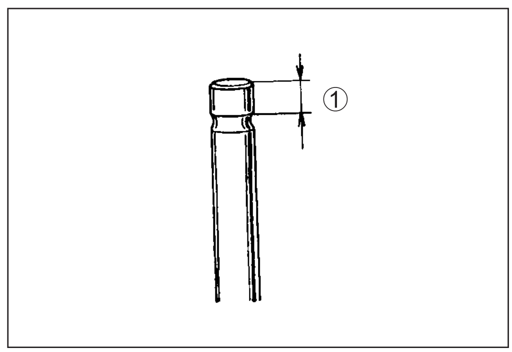
(1) Install valve into valve guide.
(2) Position valve head at approx. 5mm away from valve seat.
(3) Move stem end in the direction "X – Y", and measure deflection.

Valve stem end deflection
Service limit :
IN 0.14 mm (0.006 in.)
EX 0.18 mm (0.007 in.)

If measurement exceeds service limit, replace valve.
If measurement still exceeds service limit with new valve, replace valve guide.

Valve stem end length

Inspect valve stem end face for pitting and wear.
If pitting or wear is found, valve stem end may be resurfaced.
Use caution when resurfacing, do not grind away stem end chamfer.
When chamfer has been worn away, replace valve.

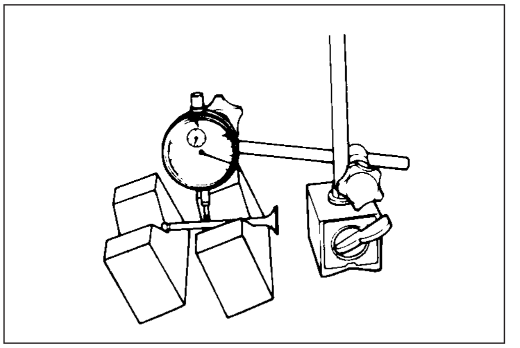


09900-20101 : Vernier calipers

Valve stem end length ①
Service limit : 3.20 mm (0.126 in.)

Valve stem runout

Measure valve stem runout.



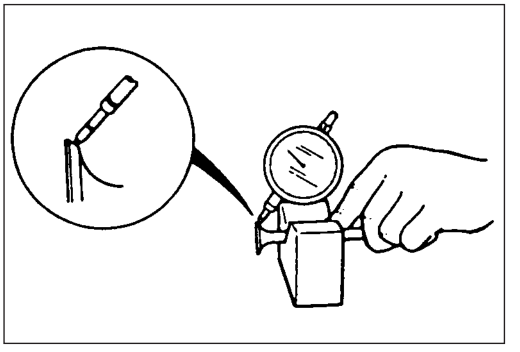
TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand
09900-21304 : "V" block set

Valve stem runout
Service limit : 0.05 mm (0.002 in.)

If measurement exceeds service limit, replace valve.

Valve head radial runout

Measure valve head radial runout.



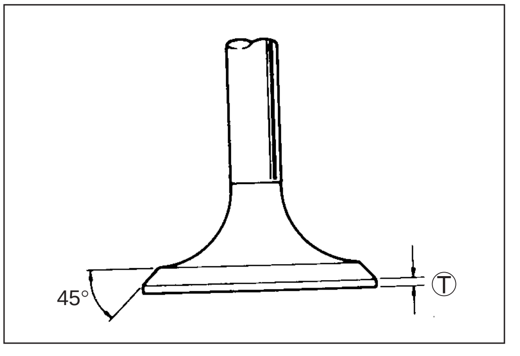
TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand
09900-21304 : "V" block set

Valve head radial runout
service limit : 0.08 mm (0.003 in.)

If measurement exceeds service limit, replace valve.

Valve head thickness

Measure thickness Ⓣ of valve head.



TOOL **09900-20101 : Vernier calipers**

Valve head thickness
Standard :

IN	**1.0 mm (0.04 in.)**
EX	**1.15 mm (0.045 in.)**

Service limit :

IN	**0.7 mm (0.03 in.)**
EX	**0.5 mm (0.02 in.)**

If measurement exceeds service limit, replace valve.

Valve seat contact width

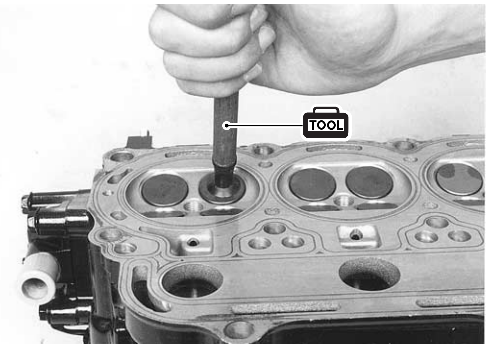
Measure valve seat contact width as follows :

(1) Remove all carbon from valve and seat.

(2) Coat valve seat evenly with Prussian blue (or equivalent)

(3) Install valve into valve guide.

(4) Put valve lapper on valve.

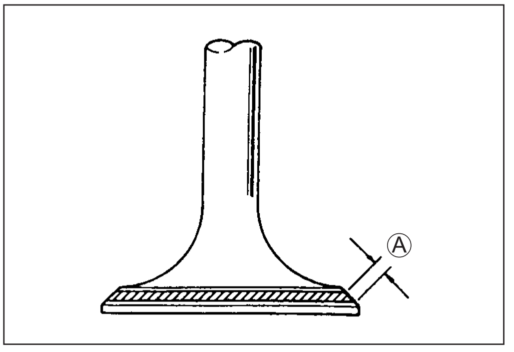


TOOL **09916-10911 : Valve lapper**

(5) Rotate valve while gently tapping valve contact area against seat.

(6) Continuously pattern on valve seating face with Prussian blue.

(7) Measure valve seat contact width Ⓐ.



TOOL **09900-20101 : Vernier calipers**

Valve seat contact width Ⓐ

Standard :

IN	**1.80 – 2.20 mm (0.071 – 0.087 in.)**
EX	**1.65 – 2.05 mm (0.065 – 0.081 in.)**

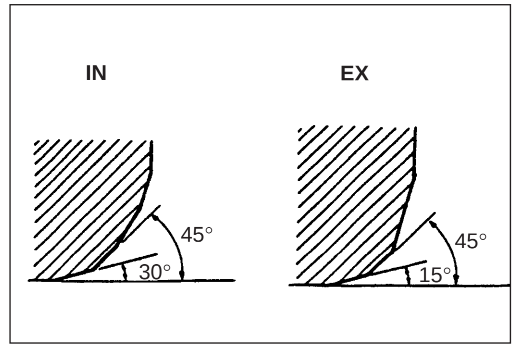
If measurement exceeds specification, repair valve seat.

NOTE:
For valve seat repair, see "Valve seat servicing" section on page 6-34.

VALVE SEAT SERVICING

If valve seat contact width is out of specification, reface valve seat as follows :

- **Valve seat angle**
  - **Intake side : 30°, 45°**
  - **Exhaust side : 15°, 45°**



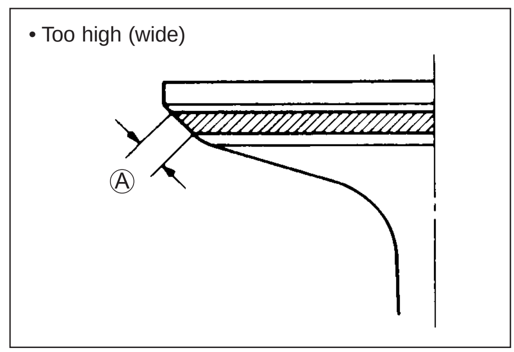
TOOL **09916-20620 : Valve seat cutter (NEWAY122) 45°**
09916-20610 : Valve seat cutter (NEWAY121) 15°
09916-20630 : Valve seat cutter (NEWAY 126) 30°
09916-24440 : Handle adaptor (N-503-1)
09916-24450 : Solid pilot (N-100-5.52)
09916-54910 : Handle (N-505)

NOTE:
Turn cutter clockwise, never counterclockwise.

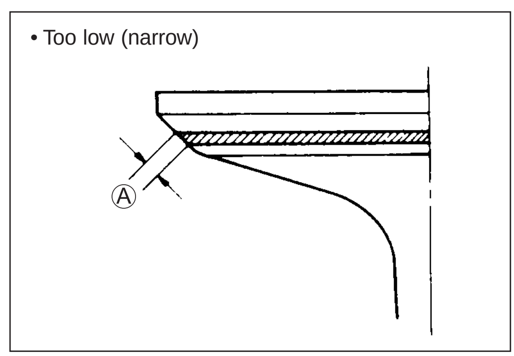
(1) Remove all carbon from valve and valve seat.

(2) Using 45° angle cutter, reface valve seat.

(3) Check valve seat contact width Ⓐ.
See the “Valve seat contact width” section on page 6-33.



(4) If width Ⓐ is too high (or wide), reface valve seat using small angle cutter (Intake side : 30°, Exhaust side : 15°).
If width Ⓐ is too low (or narrow), reface valve seat using 45° angle cutter.

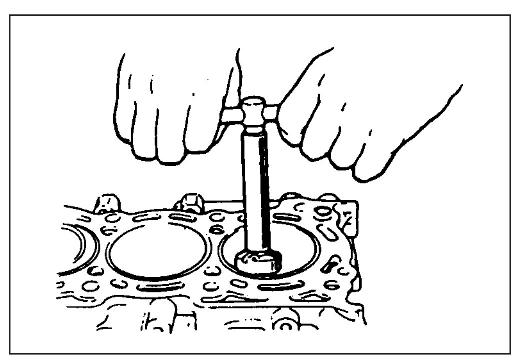


(5) Clean up any burrs using 45° angle cutter very lightly.

CAUTION

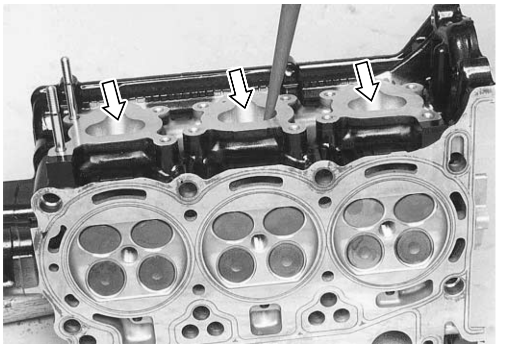
Grind seat areas minimally only.
Do not grind more than necessary.

(6) Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.



(7) Recheck valve seat contact width Ⓐ.

NOTE:
Clean and assemble cylinder head and valve components.
Fill intake and exhaust ports with solvent to check for leaks between valve seat and valve.
If any leaks occur , inspect valve seat and face for burrs or other things that could prevent valve from sealing.

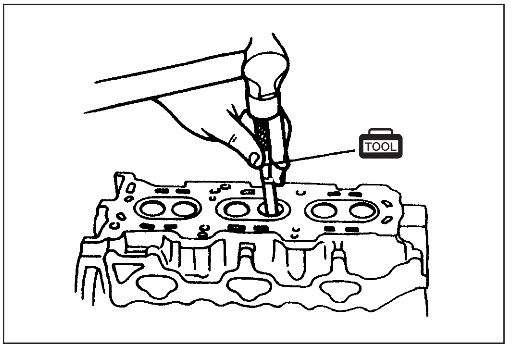


VALVE GUIDE REPLACEMENT

CAUTION

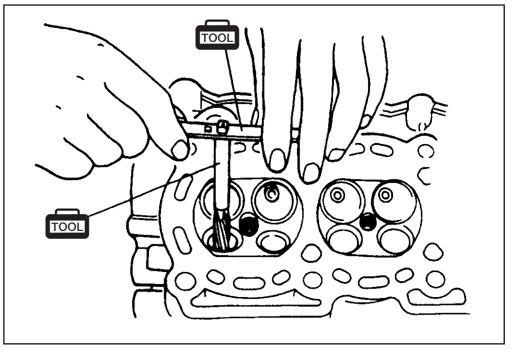
Be careful not to damage cylinder head when replacing valve guide.

(1) Using valve guide remover, drive valve guide out from combustion chamber side towards valve spring side.
TOOL **09916-44310 : Valve guide remover**



NOTE:
Do not reuse valve guide once it has been removed.
Always use a new valve guide (oversize) when assembling.

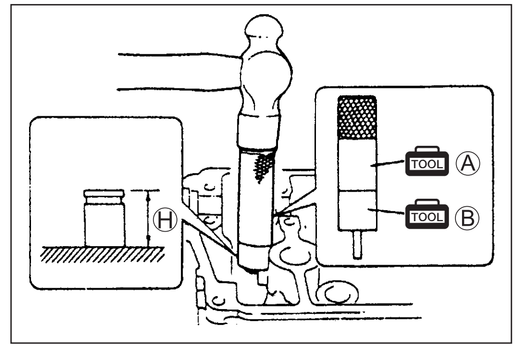
(2) Ream valve guide hole with ϕ10.5 mm reamer to true hole and remove burrs.



TOOL **09916-37320 : Valve guide reamer (ϕ10.5mm)**
09916-34542 : Reamer handle

NOTE:
Turn reamer clockwise, never counterclockwise.

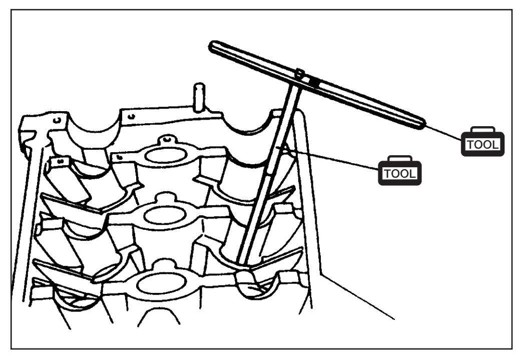
(3) Install valve guide to cylinder head.
- Heat cylinder head to a temperature of 80 – 100°C (176 – 212°F).
  Apply heat uniformly so that head will not be distorted.
- Use special tools to drive new valve guide into hole.
  Drive in new valve guide until special tool (valve guide installer attachment) contacts cylinder head.
- After installing, check valve guide protrusion Ⓗ.



TOOL **09916-57330 : Valve guide installer handle Ⓐ**
09917-87010 : Valve guide installer attachment Ⓑ

Valve guide protrusion Ⓗ
standard :
IN & EX 11.0 mm (0.43 in.)

(4) Ream valve guide bore with ϕ5.5mm reamer.



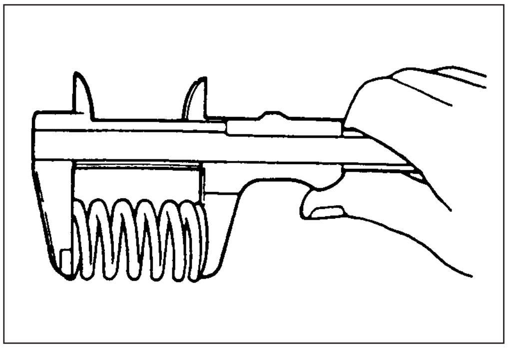
TOOL **09916-34550 : Valve guide reamer (ϕ5.5mm)**
09916-34542 : Reamer handle

NOTE:
Clean and oil valve guide bore after reaming.

VALVE SPRING

Valve spring free length

Check spring strength by measuring free length.



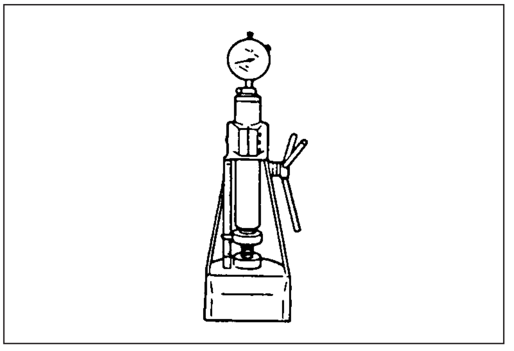
09900-20101 : Vernier calipers

Valve spring free length
Standard :
IN & EX 33.1 mm (1.30 in.)
Service limit :
IN & EX 31.8 mm (1.25 in.)

If lower than service limit, replace valve spring.

Valve spring preload

Measure valve spring preload.



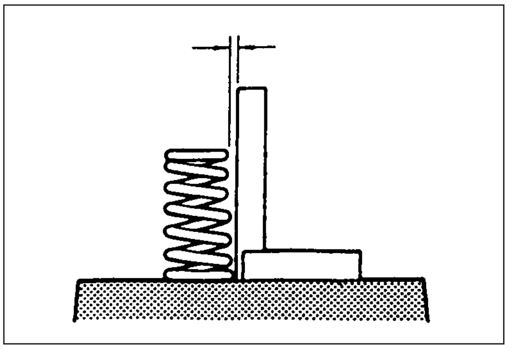
09900-20101 : Vernier calipers

Valve spring preload
Standard :
IN & EX   97 – 113 N (9.7 – 11.3 kg , 21.4 – 24.9 lbs.) for 28.5 mm (1.12 in.)
Service limit :
IN & EX   89 N (8.9 kg, 19.6 lbs.) for 28.5mm (1.12 in.)

If lower than service limit, replace valve spring.

Valve spring squareness

Use a square and surface plate to check each spring for squareness (clearance between end of valve spring and square).



09900-20101 : Vernier calipers

Valve spring squareness
Service limit :
IN & EX 2.0 mm (0.08 in.)

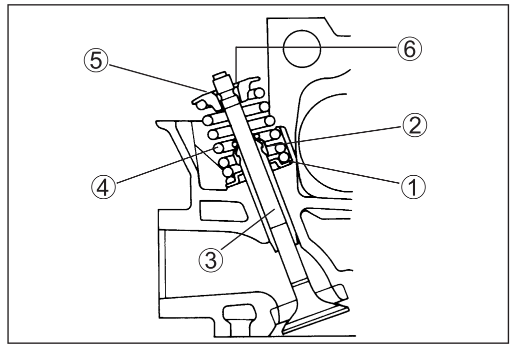
If measurement exceeds service limit, replace valve spring.

REASSEMBLY

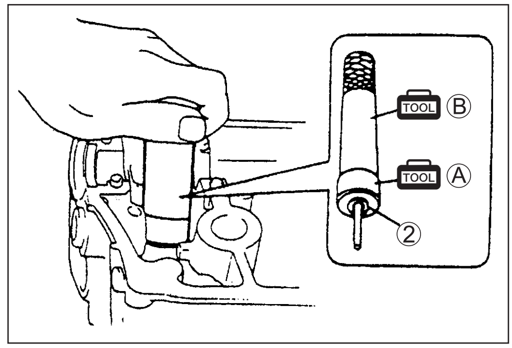
Reassemble in reverse order of disassembly paying special attention to the following steps.

VALVE

Install valve spring seat ① to cylinder head.



After applying engine oil to stem seal ② and spindle of special tool (Installer attachment), fit stem seal to spindle.
Then, pushing special tool by hand, install stem seal to valve guide.
Check to be sure that seal is properly fixed to valve guide.

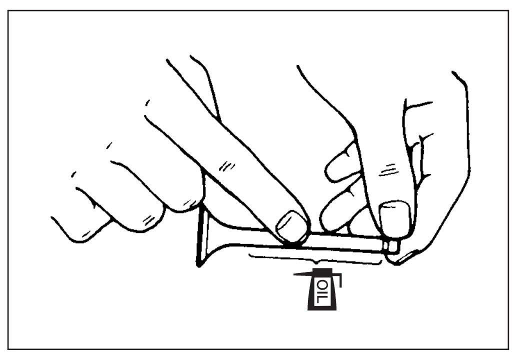


TOOL **09917-87010 : Installer attachment Ⓐ**
09916-57330 : Installer handle Ⓑ

CAUTION

Do not reuse stem seal once removed.
Always install new seal.

Apply engine oil to stem seal, valve guide bore and valve stem.

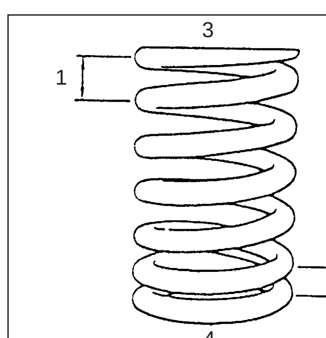


Install valve ③ to valve guide.

NOTE:
Reassemble each valve and valve spring to their original position.

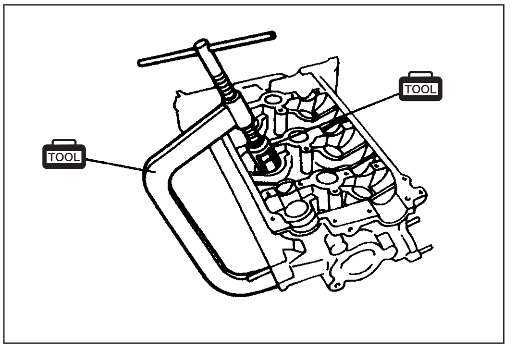
Install valve spring ④, and valve retainer ⑤.

NOTE:
Set valve spring in place with narrow spiral area facing valve seat.



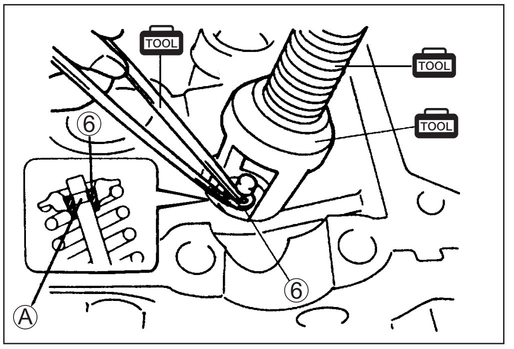
1. Large-pitch
2. Small-pitch
3. Valve spring retainer side
4. Valve spring seat side

Hold valve spring compressed with special tool and install valve cotters ⑥.



Make sure valve cotters are properly seated in groove Ⓐ.

TOOL **09916-14510 : Valve lifter**
09916-14910 : Attachment
09916-84511 : Tweezers

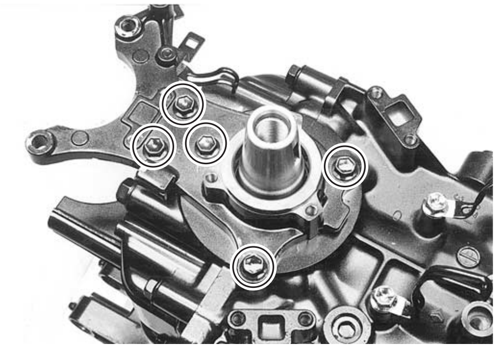


CYLINDER / CRANKSHAFT / PISTON

DISASSEMBLY

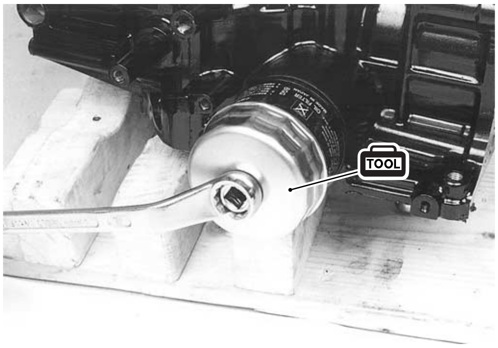
Before performing service work in this section :
- **Remove power unit (see page 6-3 to 6-6)**
- **Remove timing chain (see page 6-15 to 6-16)**
- **Remove cylinder head (see page 6-21)**

Remove the five (5) bolts securing the upper oil seal housing to cylinder, then remove the oil seal housing.

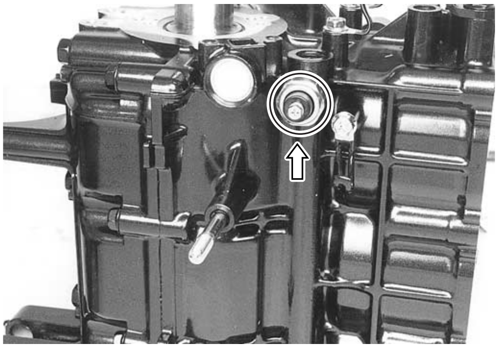


Remove oil filter.

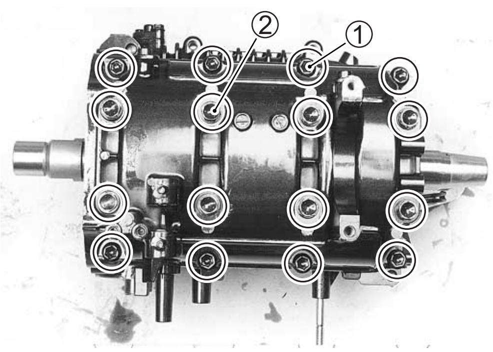
TOOL **09915-47340 : Oil filter wrench**



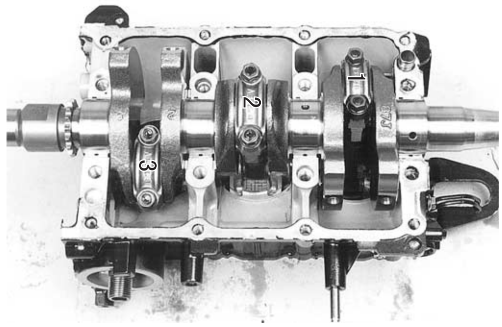
Remove oil pressure switch.



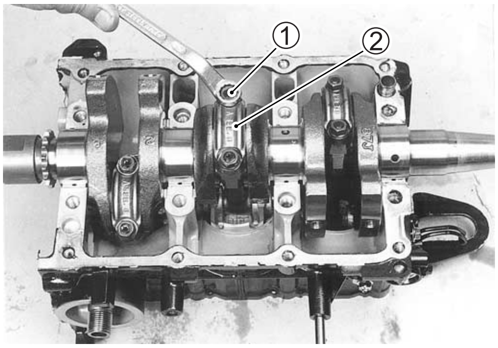
Remove eight (8) bolts ①.
Remove eight (8) bolts ②.
Remove crankcase from cylinder block.



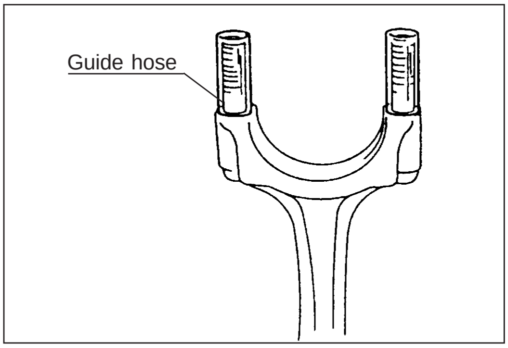
NOTE:
For proper assembly, mark cylinder number on all pistons, conrods, and conrod caps, using quick drying paint.



Remove all conrod cap nuts ① and conrod caps ②.

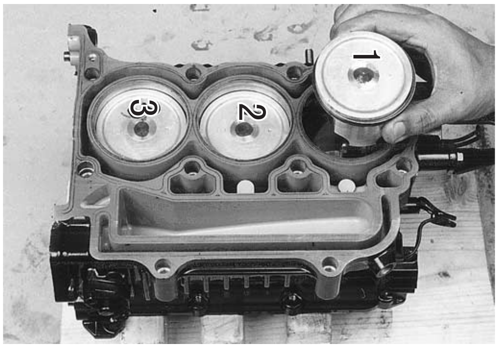


NOTE:
To prevent damage to crank pin and cylinder walls, install a piece of hose over threads of rod bolts.



Remove crankshaft.

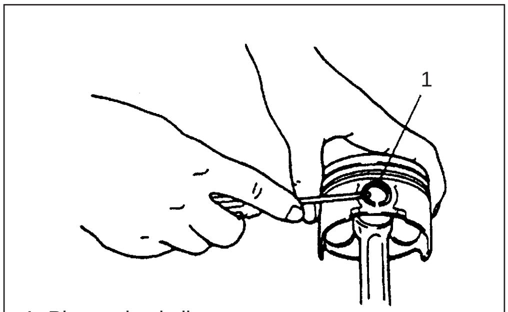
Mark cylinder number on pistons using quick dry paint.
Push piston (with conrod) out through the top of cylinder bore.



NOTE:
- *To prevent damage to piston rings, decarbon top of cylinder bore wall before removing piston.*
- *Reassemble each conrod cap to its original position after removing piston from bore.*

Remove two compression rings (top and 2 nd) and oil ring from piston.

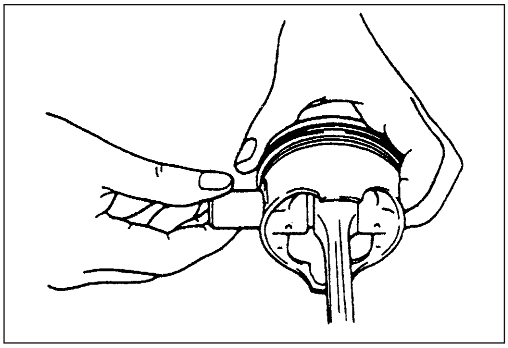
Mark cylinder number on conrod using quick dry paint.
Remove piston pin circlips as shown.



1. Piston pin circlip

Remove piston pin from conrod.

NOTE:
Reassemble each piston, piston pin and conrod in their original combination and position.

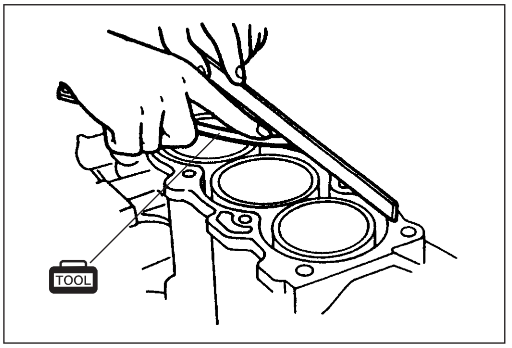


INSPECTION / SERVICING

NOTE:
If cracks, excessive wear or other damage is found on any component, replace component.

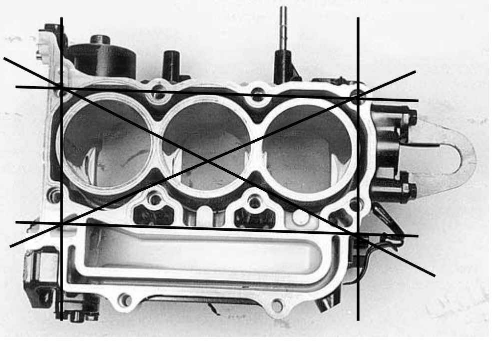
CYLINDER

- **Cylinder distortion**
  Using a straightedge and thickness gauge, measure cylinder distortion (gasketed surface) at a total of six (6) locations as shown.



TOOL **09900-20803 : Thickness gauge**

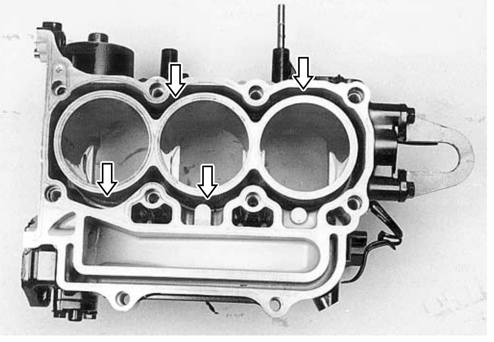
Cylinder distortion
Service limit : 0.060 mm (0.0024 in.)



If measurement exceeds service limit, resurface or replace cylinder.

NOTE:
Cylinder can be resurfaced, using a surface plate and # 400 grit wet sand paper.
Use a figure eight sanding pattern when resurfacing.

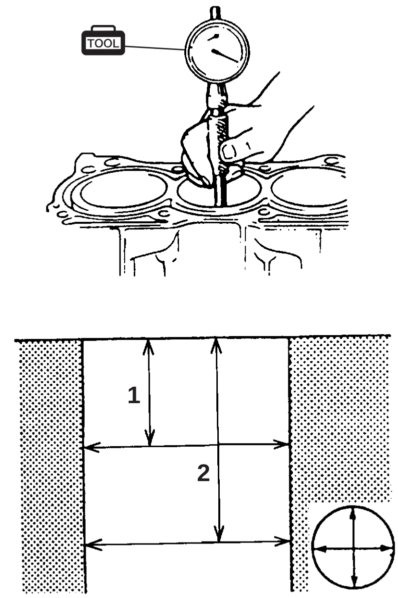
- **Water jackets**
  Check water jackets.
  If clog or obstruction is found, clean water jacket.



- **Cylinder bore**
  Inspect cylinder walls for scratches, roughness, or ridges which indicate excessive wear.
  If cylinder bore is very rough or deeply scratched, or ridged, rebore cylinder and use oversize piston.

- **Cylinder bore wear (difference)**
  Using cylinder gauge, measure cylinder bore in both axial (vertical line, following crankshaft) and transverse (horizontal line across crankshaft) directions at two positions as shown in figure.

09900-20508 : Cylinder gauge set



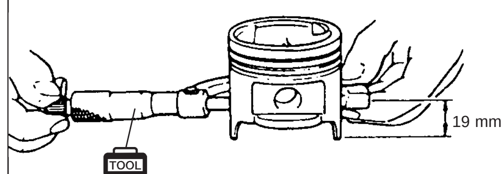
1. 50 mm (1.96 in.)
2. 90 mm (3.54 in.)

Check for following :
- Difference between measurements at the two positions (taper).
- Difference between axial and transverse measurement (out-of-round).

Cylinder bore wear (difference)
Service limit : 0.10 mm (0.039 in.)
If measurement exceeds service limit, rebore or replace cylinder.

PISTON TO CYLINDER CLEARANCE

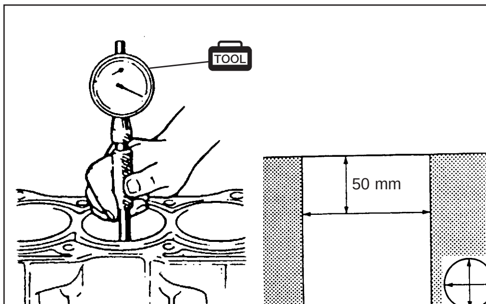
(1) Measure the piston diameter at a point 19mm (0.748 in.) above the piston skirt at a right angle to the piston pin bore.



09900-20203 : Micrometer

Piston skirt diameter
Standard : 70.970 – 70.990 mm (2.7941 – 2.7949 in.)

(2) Measure the cylinder bore at 50mm (1.969 in.) below the cylinder head gasket surface at a right angle to the crankshaft pin.



09900-20508 : Cylinder gauge set

Cylinder bore
Standard : 71.000 – 71.020 mm (2.7953 – 2.7961 in.)

(3) Calculate the piston / cylinder clearance
(Clearance equals difference between piston diameter and cylinder bore measurements).

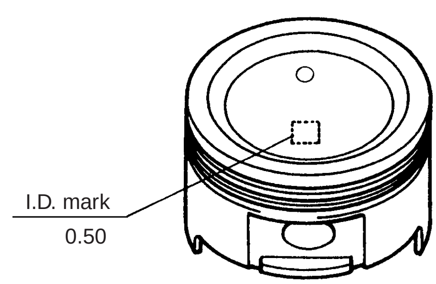
Piston to cylinder clearance
Standard : 0.020 – 0.040 mm (0.0008 – 0.0016 in.)
Service limit : 0.100 mm (0.0039 in.)

If clearance exceeds service limit, replace piston and / or cylinder or rebore cylinder.

Identification of oversize piston / piston ring
Oversize piston / piston ring are marked as shown below.

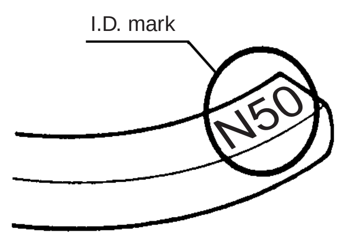
- **Piston**

Oversize	I.D. mark
0.50 mm	0.50



- **1st & 2nd Piston ring**

Oversize	I.D. mark	
	1st ring	2nd ring
0.50 mm	N50	2N50

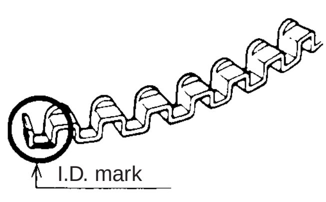


1st, 2nd ring

- **Oil ring**

Oversize	I.D. mark
0.50 mm	Blue paint

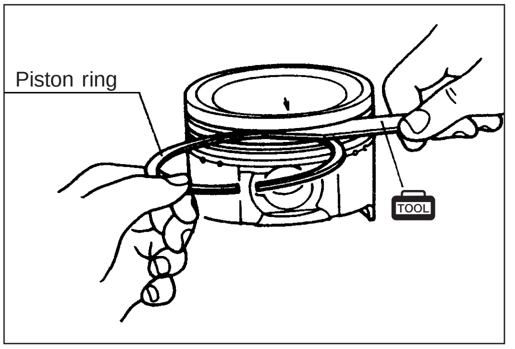
NOTE:
Oversize oil ring rails have no I.D. mark to distinguish size.
Oil ring outer diameter must be measured to determine size.



Oil ring spacer

PISTON

- Inspect piston for faults, cracks or other damage.
  Damaged or faulty piston(s) should be replaced.



- **Piston ring to groove clearance**
  Before checking, piston grooves must be clean, dry and free of carbon.
  Fit piston ring into piston groove, and measure clearance between ring and ring groove using thickness gauge.

TOOL **09900-20803 : Thickness gauge**

Piston ring to groove clearance
Standard:
1 st 0.02 – 0.06 mm (0.001 – 0.002 in.)
2 nd 0.02 – 0.06 mm (0.001 – 0.002 in.)
Service limit :
1 st 0.10 mm (0.004 in.)
2 nd 0.10 mm (0.004 in.)

If measurement exceeds service limit, replace piston and / or piston ring.

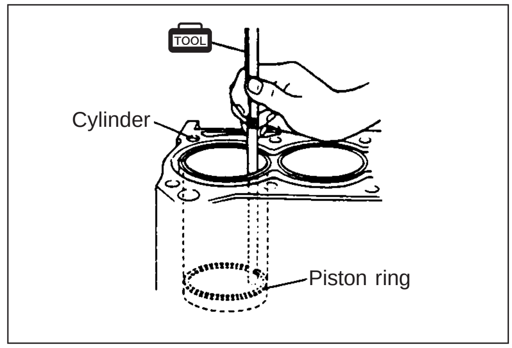
Piston ring groove width
Standard :
1 st 1.01 – 1.03 mm (0.040 – 0.041 in.)
2 nd 1.01 – 1.03 mm (0.040 – 0.041 in.)
Oil 1.51 – 1.53 mm (0.059 – 0.060 in.)

Piston ring thickness
Standard :
1 st 0.97 – 0.99 mm (0.038 – 0.039 in.)
2 nd 0.97 – 0.99 mm (0.038 – 0.039 in.)

PISTON RING

Piston ring end gap

Measure piston ring end gap with piston ring in the lowest position of cylinder bore.



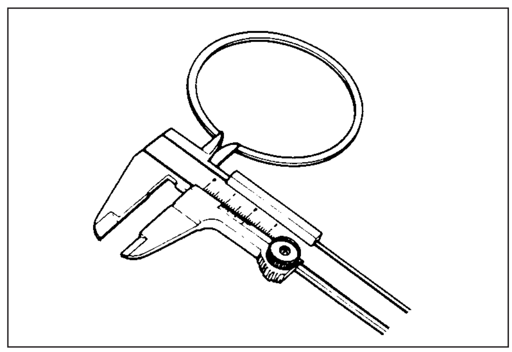
TOOL **09900-20803: Thickness gauge**

Piston ring end gap
Standard:
1 st 0.10 – 0.25 mm (0.004 – 0.010 in.)
2 nd 0.25 – 0.40 mm (0.010 – 0.016 in.)
Service limit :
1 st 0.70 mm (0.028 in.)
2 nd 1.00 mm (0.039 in.)

If measurement exceeds service limit, replace piston ring.

Piston ring free end gap

Measure piston ring free end gap using vernier calipers.



TOOL **09900-20101 : Vernier calipers**

Piston ring free end gap
Standard :
1 st Approx. 7.5 mm (0.30 in.)
2 nd Approx. 11.0 mm (0.43 in.)
Service limit :
1 st 6.0 mm (0.24 in.)
2 nd 8.8 mm (0.35 in.)

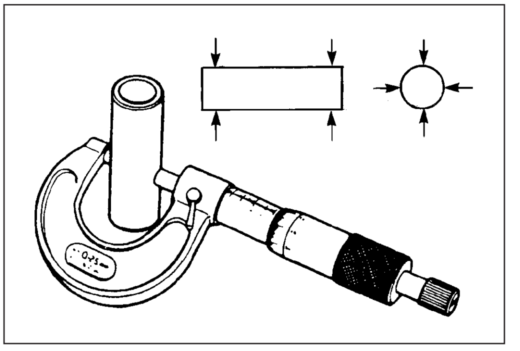
If measurement exceeds service limit, replace piston ring.

PISTON PIN

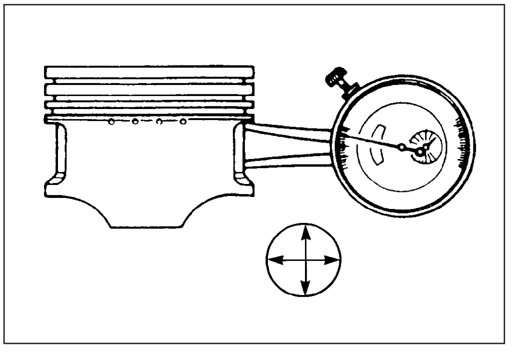
Check piston pin, conrod small end bore and piston pin hole for wear or damage.
If badly worn or damaged, replace component.

Piston pin clearance

- Check the piston pin clearance in the conrod small end. Replace the conrod if its small end is badly worn or damaged or if clearance exceeds service limit.

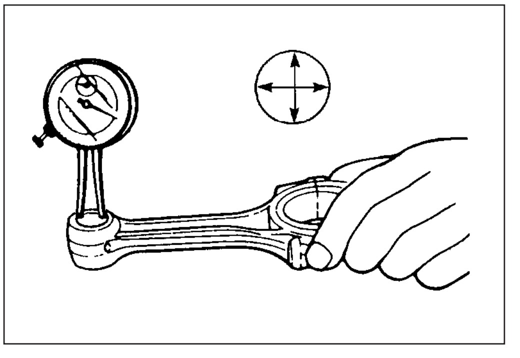


TOOL **09900-20205 : Micrometer**
09900-20605 : Dial calipers



Piston pin outside diameter
Standard : 17.996 – 18.000 mm (0.7085 – 0.7087 in.)
Service limit : 17.980 mm (0.7079 in.)

Piston pin hole diameter
Standard : 18.006 – 18.014 mm (0.7089 – 0.7092 in.)
Service limit : 18.040 mm (0.7102 in.)



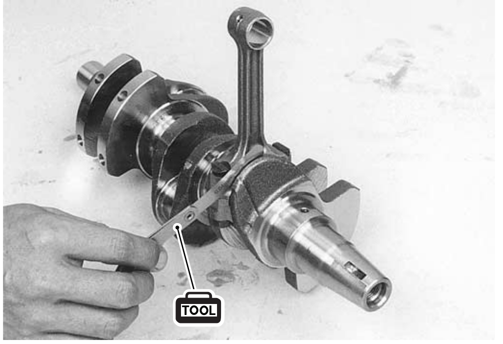
Conrod small end bore
Standard : 18.003 – 18.011 mm (0.7088 – 0.7091 in.)

Pin clearance in piston pin hole
Standard : 0.006 – 0.018 mm (0.0002 - 0.0007 in.)
Service limit : 0.040 mm (0.0016 in.)

Pin clearance in conrod small end
Standard : 0.003 – 0.015 mm (0.0001 – 0.0006 in.)
Service limit : 0.050 mm (0.0020 in.)

CONROD BIG END SIDE CLEARANCE

Measure conrod big end side clearance with conrod installed on crank pin as shown.



TOOL **09900-20803 : Thickness gauge**

Conrod big end side clearance
Standard : 0.100 – 0.250 mm (0.0039 – 0.0098 in.)
Service limit : 0.350 mm (0.0138 in.)

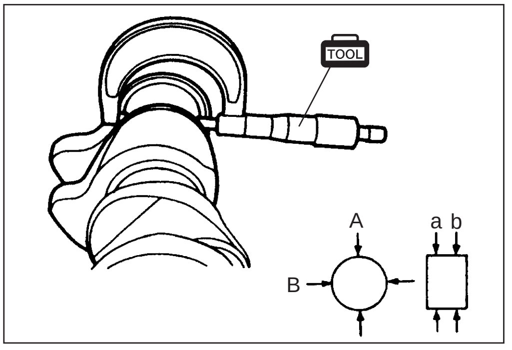
If measurement exceeds service limit, replace conrod and /or crankshaft.

Conrod big end width
Standard : 21.950 – 22.000 mm (0.8642 – 0.8661 in.)

Crank pin width
Standard : 22.100 – 22.200 mm (0.8700 – 0.8740 in.)

CRANK PIN

Inspect crank pin for uneven wear or damage.
Measure crank pin for out - of - round or taper with micrometer.
If crank pin is damaged, out - of - round or taper is out of service limit, replace crankshaft.



TOOL **09900-20202 : Micrometer**

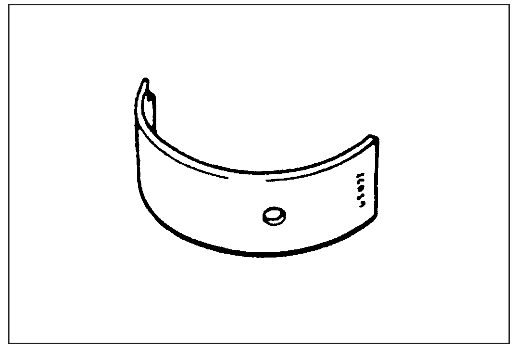
Out - of - round : A – B
Taper : a – b

Out-of-round and taper
Service limit : 0.010mm (0.0004 in.)

Crank pin diameter
Standard : 37.982 – 38.000 mm (1.4954 – 1.4961 in.)

CONROD BEARING

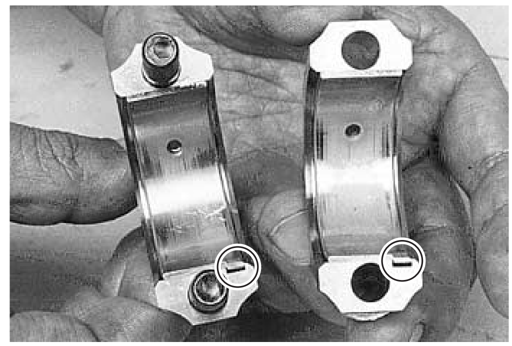
Inspect bearing shell for proper contact pattern and signs of fusion, pitting, burning or flaking.
Bearing shells found in defective condition must be replaced.



Conrod big end oil clearance

Check conrod big end oil clearance as follows :

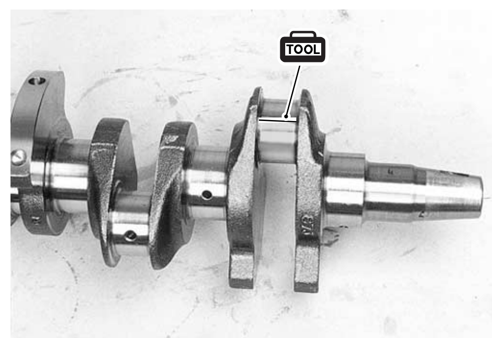
(1) Clean surface of conrod, conrod cap, conrod bearing, and crank pin.



(2) Install conrod bearing onto conrod and conrod cap.

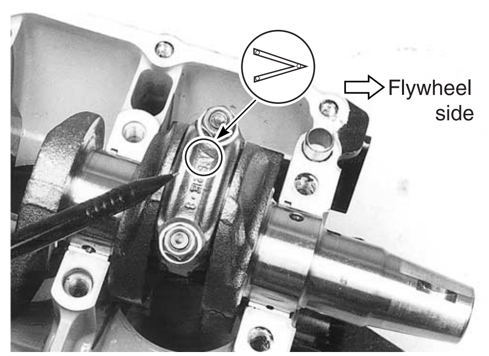
NOTE:
- *Reassemble each bearing and conrod cap to their original position.*
- *Do not apply oil to bearing.*

(3) Place a piece of Plastigauge on crank pin parallel to crankshaft. Avoiding placing Plastigauge over oil hole.



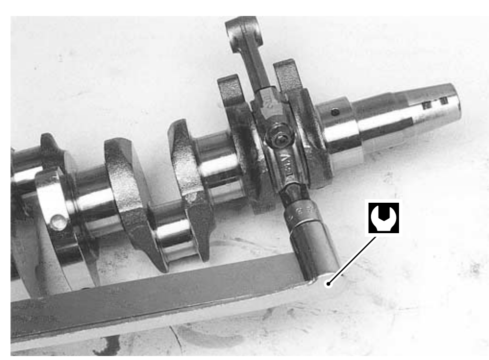
TOOL **09900-22301 : Plastigauge**

(4) Install conrod cap (with bearing) to conrod with the arrow mark on cap toward flywheel side.



(5) Apply engine oil to conrod bolts and tighten nut in two steps.

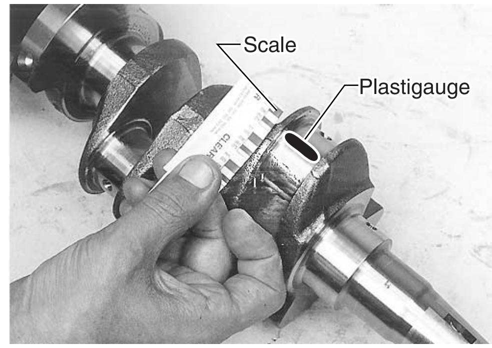
Conrod cap nut :
1 st step 18 N · m (1.8 kg-m, 13.0 lb.-ft.)
2 nd step 35 N · m (3.5 kg-m, 25.5 lb.-ft.)



NOTE:
Do not rotate conrod with Plastigauge in place.

(6) Remove conrod and conrod cap from crank pin.

(7) Using scale on Plastigauge envelope, measure Plastigauge width at its widest point.



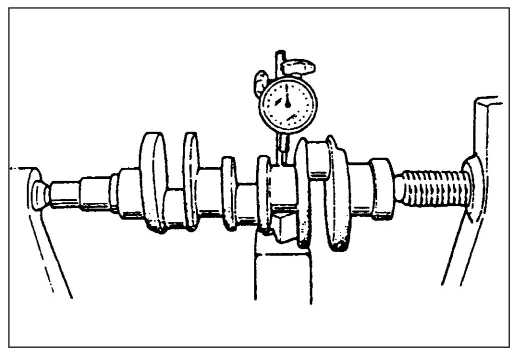
Conrod big end oil clearance
Standard : 0.020 – 0.040 mm (0.0008 – 0.0016 in.)
Service limit : 0.065 mm (0.0026 in.)

If measurement exceeds service limit, replace conrod bearing.

CRANKSHAFT

■ **Crankshaft center journal runout**

Using a dial gauge, measure runout at center journal.



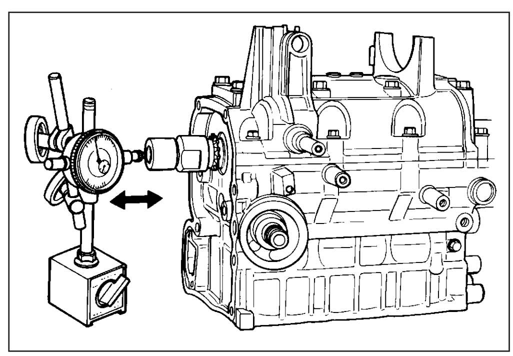
TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand

Crankshaft center journal runout
Service limit : 0.04 mm (0.0016 in.)

If measurement exceeds service limit, replace crankshaft.

■ **Crankshaft thrust play**

Measure thrust play with crankshaft, thrust bearing, journal bearing and crankcase/cylinder block assembled in a normal manner.
Tighten crankcase bolts to specified torque.



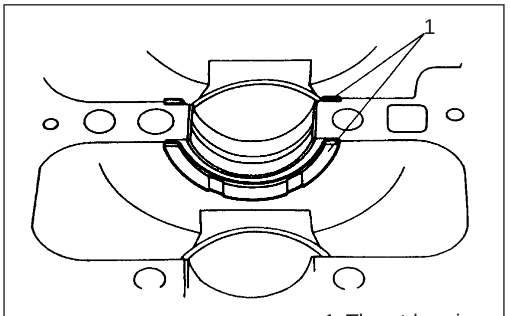
Crankcase bolt :
8 mm 25 N · m (2.5 kg-m, 18.0 lb.-ft.)
10 mm 53 N · m (5.3 kg-m, 38.5 lb.-ft.)

Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

Crankshaft thrust play
Standard : 0.11 – 0.31 mm (0.004 – 0.012 in.)
Service limit : 0.35 mm (0.014 in.)

If measurement exceeds service limit, replace crankshaft thrust bearing.

Crankshaft thrust bearing thickness
Standard : 2.470 – 2.520 mm (0.0972 – 0.0992 in.)



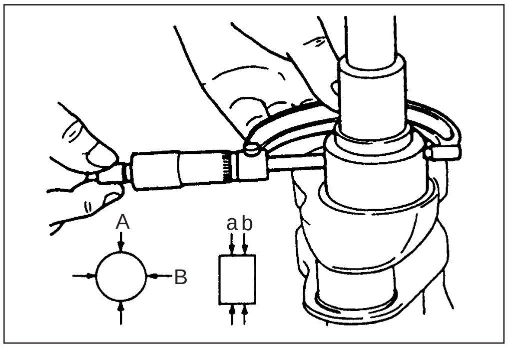
1. Thrust bearing

■ **Out - of - round and taper (uneven wear) of journals**

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both).

This difference, if any, is determined by taking micrometer readings.

If any journal is badly damaged or if measurements exceed service limit, replace crankshaft.



TOOL **09900-20202 : Micrometer**

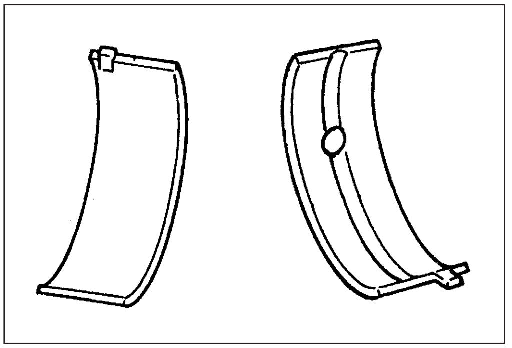
Out - of - round : A – B
Taper : a – b

Out - of - round and taper
Service limit : 0.010 mm (0.0004 in.)

Crankshaft journal outside diameter
Standard : 44.982 – 45.000 mm (1.7709 – 1.7717 in.)

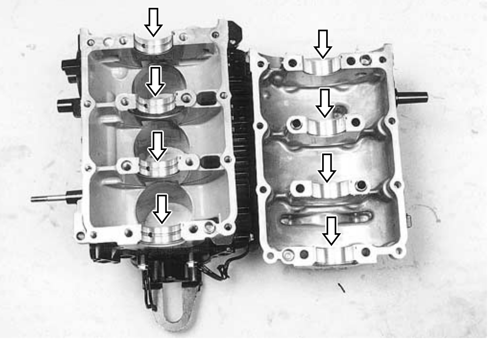
CRANKSHAFT MAIN BEARING

Check bearings for pitting, scratches, wear or damage.
If any improper condition is found, replace both upper and lower halves.
Always replace both bearing halves, never replace only one half of a bearing set.



CRANKSHAFT JOURNAL OIL CLEARANCE

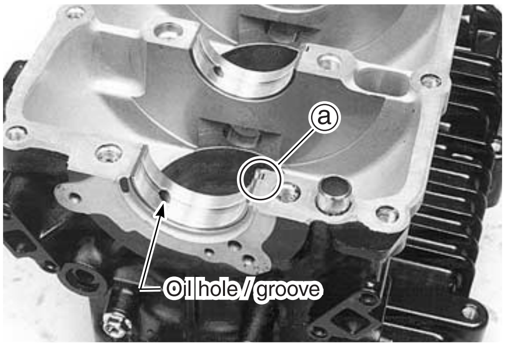
Check clearance using Plastigauge according to the following procedure.



NOTE:
Assemble each bearing in its original position before checking clearance.

(1) Clean surface of bearing holder (crankcase, and cylinder), bearing, and main bearing journal.

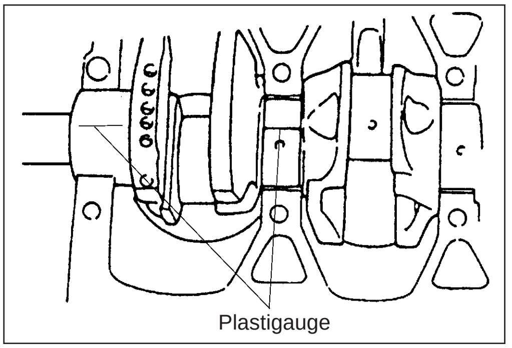
(2) Install main bearing to cylinder and crankcase.



NOTE:
- *Align the tab ⓐ of bearing with notch in cylinder and crankcase.*
- *Do not apply engine oil to bearing.*
- *Install the bearing half with oil hole / groove to cylinder side.*

(3) Install crankshaft to cylinder.

(4) Place a piece of Plastigauge across full width of bearing (parallel to crankshaft) on journal.
Do not place Plastigauge over oil hole.



TOOL **09900-22301 : Plastigauge**

NOTE:
Do not rotate crankshaft while Plastigauge is installed.

(5) Assemble crankcase to cylinder.

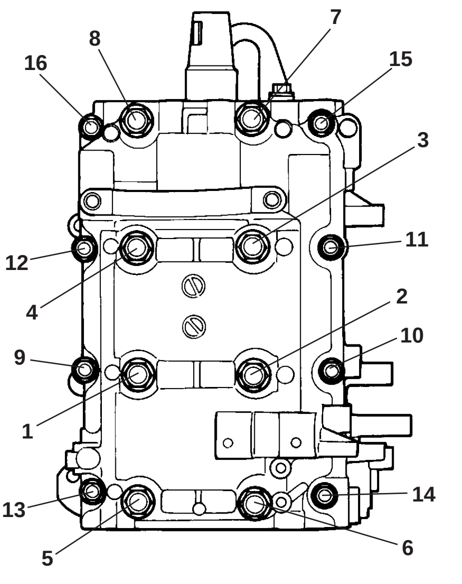
(6) Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three(3) steps following the order indicated below.

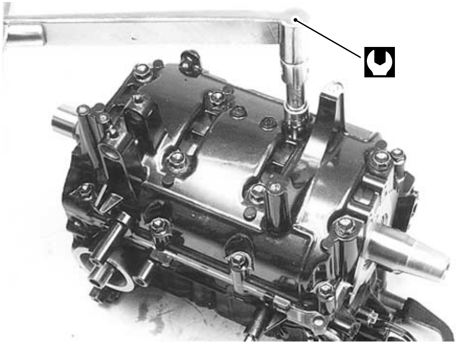
Crankcase bolt:

1st step	**8 mm**	**5 N · m (0.5 kg-m, 3.5 lb.-ft.)**
	10 mm	**11 N · m (1.1 kg-m, 8.0 lb.-ft.)**
2nd step	**8 mm**	**20 N · m (2.0 kg-m, 14.5 lb.-ft.)**
	10 mm	**43 N · m (4.3 kg-m, 31.0 lb.-ft.)**
Final step	**8 mm**	**25 N · m (2.5 kg-m, 18.0 lb.-ft.)**
	10 mm	**53 N · m (5.3 kg-m, 38.5 lb.-ft.)**

NOTE:
Crankcase must be torqued to specification in order to assure proper compression of Plastigauge and accurate reading of clearance.

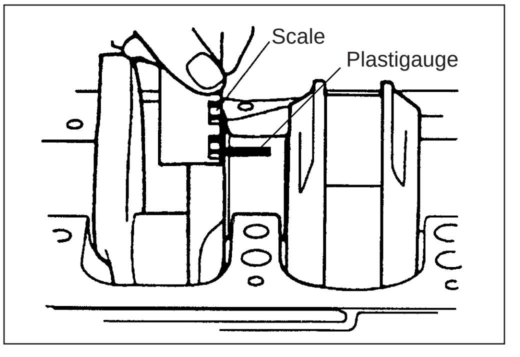
Tightening order





(7) Remove crankcase from cylinder.

(8) Using scale on Plastigauge envelope, measure Plastigauge width at its widest point.



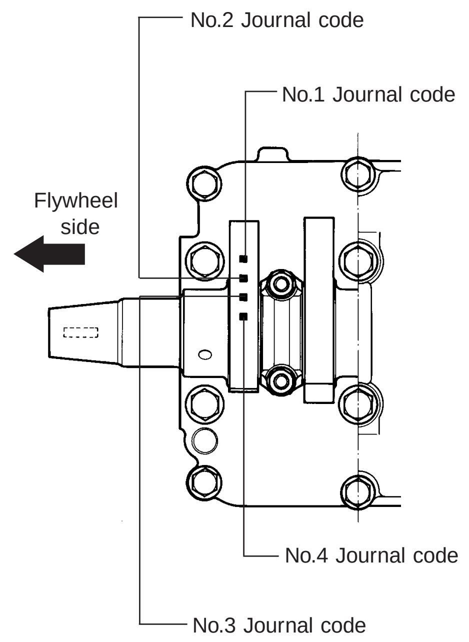
Crankshaft journal oil clearance
Standard : 0.020 – 0.040 mm (0.0008 – 0.0016 in.)
Service limit : 0.065 mm (0.0026 in.)

If measurement exceeds service limit, replace crankshaft main bearing.

NOTE:
For bearing replacement, see the "SELECTION OF MAIN BEARING" section on page 6-55.

SELECTION OF MAIN BEARING

Whenever a bearing requires replacement, select a new bearing according to following procedure.

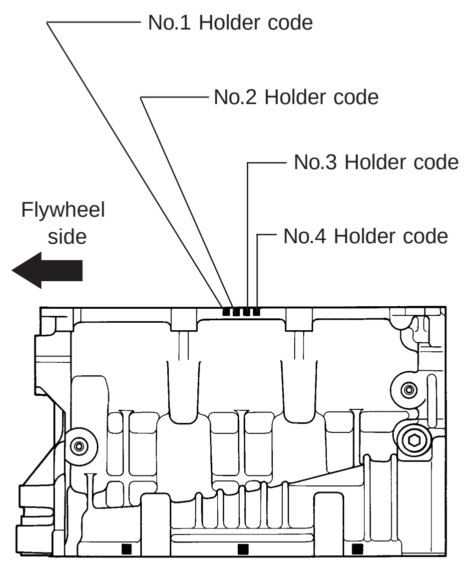


(1) First check journal diameter.

As shown in figure, upper (flywheel side) crank web of No.1 cylinder has four (4) stamped code numerals.

The numerals (1 , 2 & 3) represent the journal diameters shown below.

Numeral stamped	Journal diameter
1	44.994 – 45.000 mm (1.7714 – 1.7717 in.)
2	44.988 – 44.994 mm (1.7712 – 1.7714 in.)
3	44.982 – 44.988 mm (1.7709 – 1.7712 in.)



(2) Next, check bearing holder inside diameter without bearing.

As shown in figure, the STBD side of cylinder block has four (4) stamped codes letters.

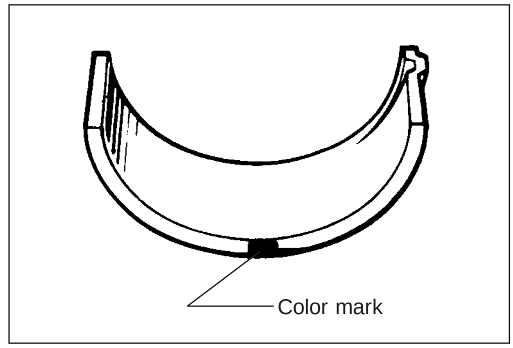
The letters (A, B & C) represent the bearing holder inside diameters shown below.

Code	Crank bearing holder inside diameter (w / o bearing)
A	49.000 – 49.006 mm (1.9291 – 1.9294 in.)
B	49.006 – 49.012 mm (1.9294 – 1.9296 in.)
C	49.012 – 49.018 mm (1.9296 – 1.9298 in.)

(3) There are five (5) main bearings available, each of differing thickness.

To distinguish them, a color mark is painted at the position indicated in figure.

Each color represents the following thickness measured at the center of the bearing.



Color mark	Bearing thickness
Green	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Black	2.002 – 2.006 mm (0.0788 – 0.0790 in.)
No Color mark	2.005 – 2.009 mm (0.0789 – 0.0790 in.)
Yellow	2.008 – 2.012 mm (0.0790 – 0.0792 in.)
Blue	2.011 – 2.015 mm (0.0792 – 0.0793 in.)

(4) Select crankshaft main bearing referring the below table.

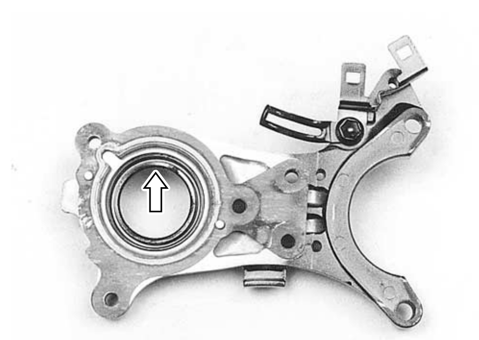
		Numeral stamped on crank web (journal outside diameter)		
		1	**2**	**3**
Code stamped on cylinder block (Bearing holder inside diameter)	**A**	Green	Black	No Color
	B	Black	No Color	Yellow
	C	No Color	Yellow	Blue

NOTE:

Measure crankshaft journal oil clearance again after installing new bearings selected. (see page 6-53)

OIL SEAL

Inspect condition. If cracked, cut or damaged, replace.



REASSEMBLY

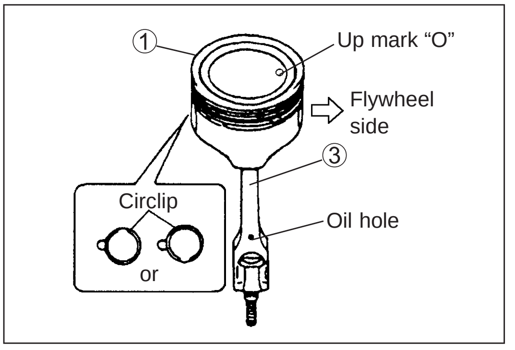
Assembly is reverse order of disassembly paying special attention to the following steps.

CAUTION

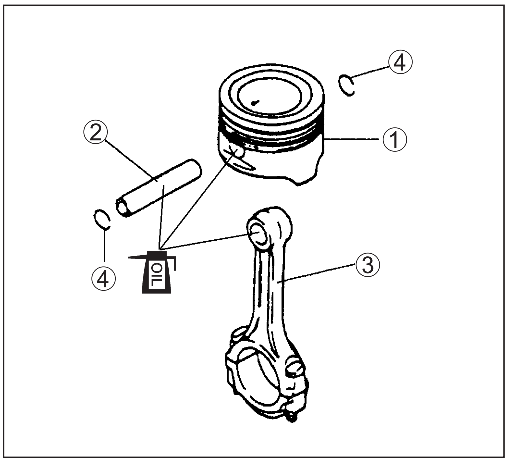
If original components are not replaced, each piston, piston pin and conrod is to be assembled and installed in its original order and position.

PISTON TO CONROD

Apply engine oil to piston pin ②, piston pin bore and conrod ③.
Fit conrod ③ to piston ① as shown in figure and insert piston pin ② through piston and conrod.
Install piston pin circlips ④.



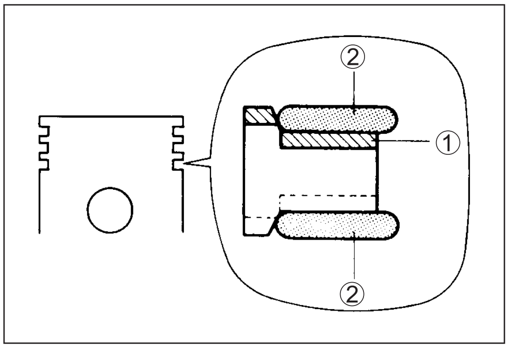
NOTE:
- *Make sure conrod is installed in the direction shown.*
- *Circlip should be installed with gap facing either up or down as shown in figure.*
- *Always use new piston pin circlip.*



PISTON RING TO PISTON

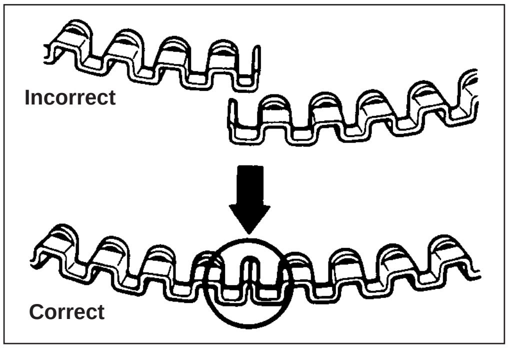
■ **Oil ring**

- Apply engine oil to piston rings.
- Install spacer ① first, then side rails ② to piston.



CAUTION

When installing spacer, do not allow ends to overlap in groove.

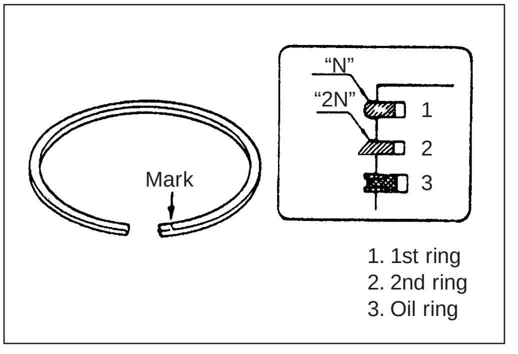


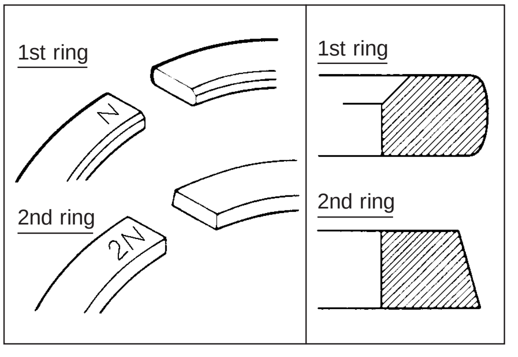
■ **1st ring and 2nd ring**

- Apply engine oil to piston ring.
- Install 2nd ring and 1st ring to piston.

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.
- *As indicated in figure, 1st and 2nd ring are marked, "N" or "2N".*
  When installing these piston rings, the marked side of each ring must face towards top of piston.

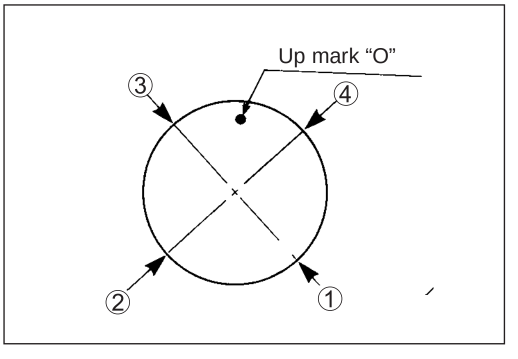




■ **Ring gap direction**

Position rings so that their gaps are staggered at approximately 90 degree angles as shown.

① 1st ring ③ 2nd ring
② Oil ring lower side rail ④ Oil ring upper side rail

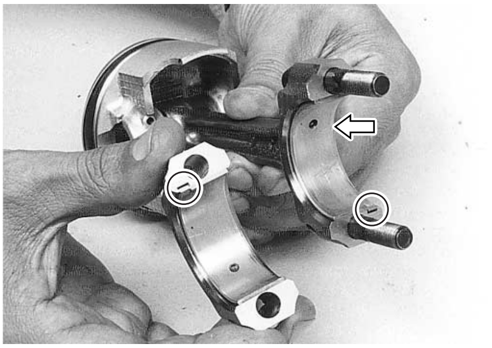


CAUTION

Failure to stagger piston ring gaps may result in crankcase oil dilution.

PISTON TO CYLINDER

Install conrod bearing to conrod and conrod cap.

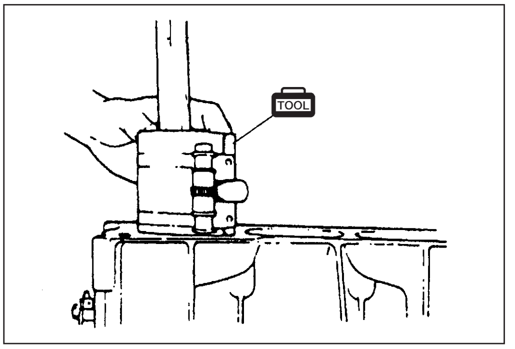


CAUTION

- **Assemble each conrod bearing to its original position.**
- **Do not apply oil between conrod and bearing or between bearing cap and bearing.**

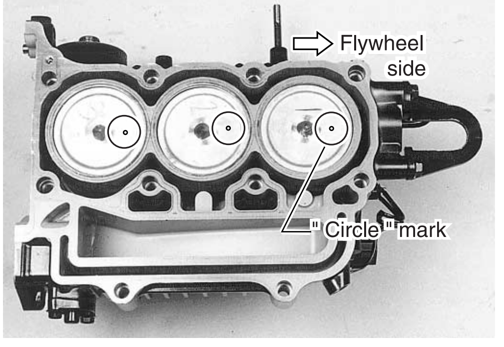
Apply engine oil to piston and cylinder walls.

Insert piston and conrod assembly into cylinder bore from cylinder head side using special tool.



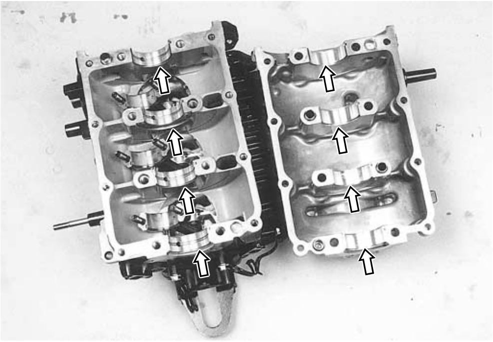
TOOL **09916-77310 : Piston ring compressor**

NOTE:
Position the "circle" mark on piston head to flywheel side.



CRANKSHAFT TO CYLINDER

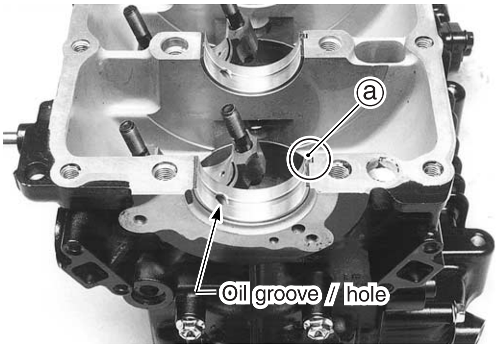
Install crankshaft main bearings in cylinder and crankcase.
Apply engine oil to bearings.



CAUTION

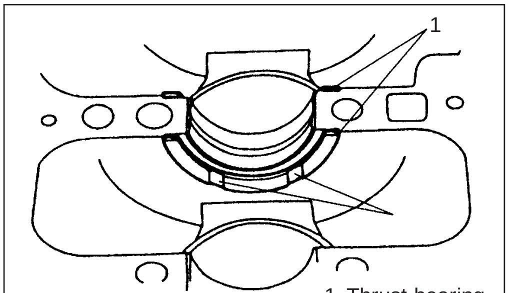
- **Assemble each bearing to its original position.**
- **Assemble main bearing half containing oil groove / hole to cylinder block.**
  Assemble the half without oil groove to crankcase.
- **Do not apply oil between crank bearing holder and crank main bearing.**

NOTE:
Align bearing tab ⓐ with notch in cylinder and crankcase.



Thrust bearing

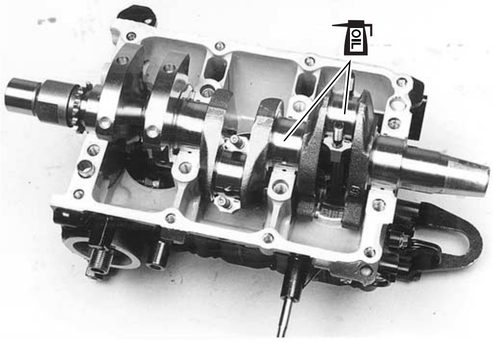
Apply engine oil to thrust bearing and install in cylinder block between the No.2 and No.3 cylinders.
Oil groove sides of thrust bearing must face towards crank webs.



1. Thrust bearing
2. Oil groove

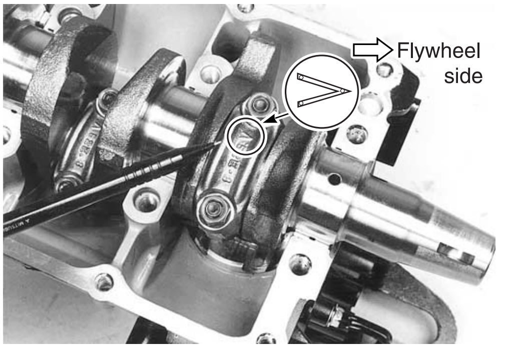
Crankshaft

Apply engine oil to crank pin and crankshaft main journal and install crankshaft in cylinder.



CONROD CAP

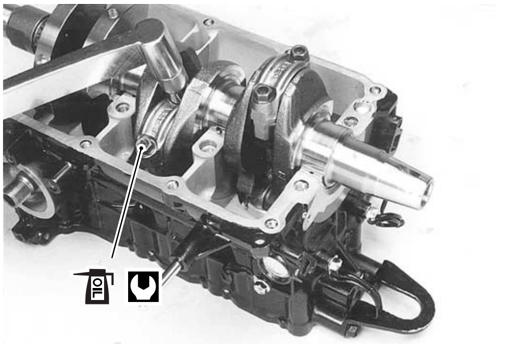
Apply engine oil to crank pin and conrod bearing.
Install conrod cap (with bearing) to conrod with arrow mark on cap toward flywheel side.



CAUTION

Reassemble each conrod cap to its original position.

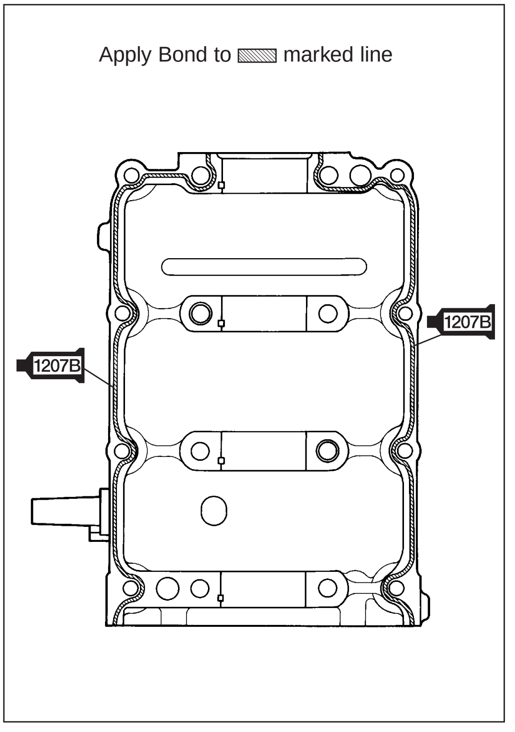
Apply engine oil to conrod bolts.
Tighten conrod cap nuts in two steps.



Conrod cap nut :
1st step 18 N · m (1.8 kg-m, 13.0 lb.-ft.)
2nd step 35 N · m (3.5 kg-m, 25.5 lb.-ft.)

CRANKCASE TO CYLINDER

Clean mating surface of cylinder and crankcase.
Apply SUZUKI BOND to mating surface of crankcase as shown.

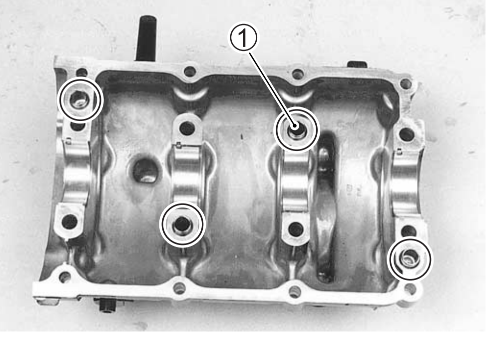


CAUTION

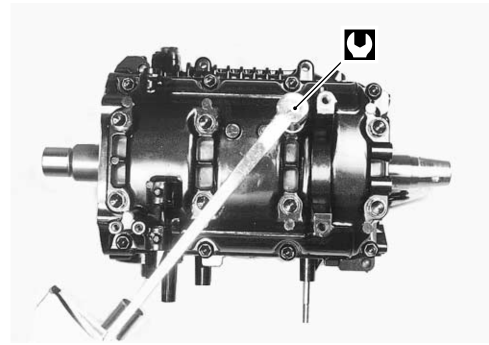
Apply bond to mating surface only.
Do not allow bond to contact surface of bearing.

99000-31140 : Suzuki Bond 1207B

Install four (4) dowel pins ①.



Install crankcase to cylinder.
Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three (3) steps following the order indicated below.

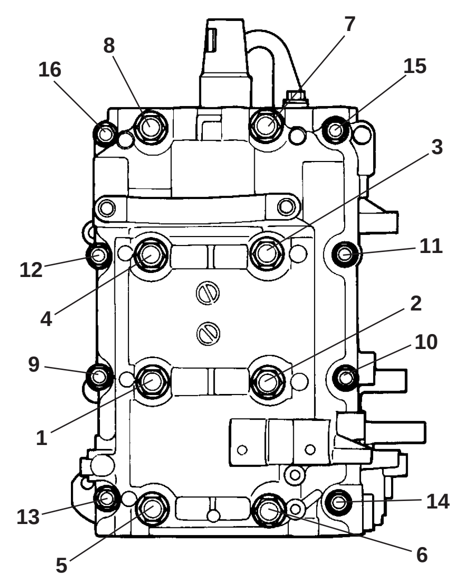


NOTE:
After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

Crankcase bolt

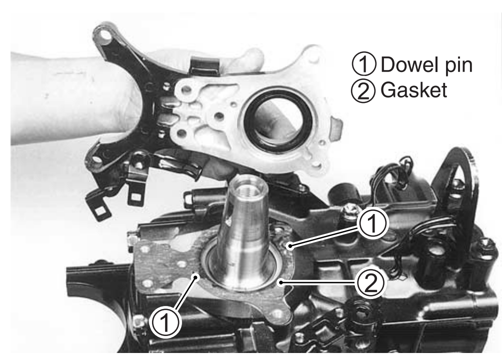
1st step	**8 mm**	**5 N · m (0.5 kg-m, 3.5 lb.-ft.)**
	10 mm	**11 N · m (1.1 kg-m, 8.0 lb.-ft.)**
2nd step	**8 mm**	**20 N · m (2.0 kg-m, 14.5 lb.-ft.)**
	10 mm	**43 N · m (4.3 kg-m, 31.0 lb.-ft.)**
Final step	**8 mm**	**25 N · m (2.5 kg-m, 18.0 lb.-ft.)**
	10 mm	**53 N · m (5.3 kg-m, 38.5 lb.-ft.)**

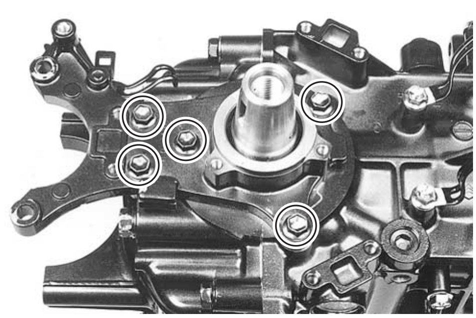
Tightening order



UPPER OIL SEAL HOUSING

Apply engine oil to lip area of upper oil seal.
Install upper oil seal housing and secure with bolts.





CYLINDER HEAD
Install cylinder head. (see page 6-21 to 6-23)

TIMING CHAIN
Install timing chain. (see page 6-18 to 6-20)

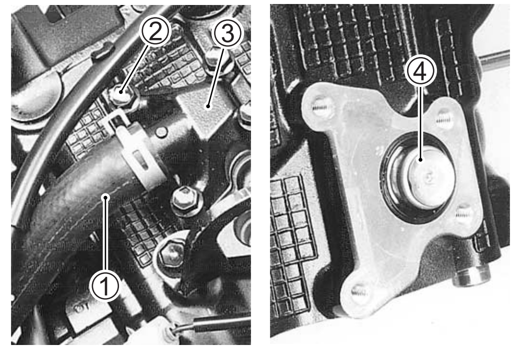
OIL PUMP CASE
Install oil pump case. (see page 6-12 to 6-14)

POWER UNIT
Install power unit. (see page 6-7 to 6-9)

THERMOSTAT

REMOVAL

- Disconnect water hose ① from thermostat cover.
- Remove the four (4) bolts ② securing the thermostat cover, then remove the cover ③ and thermostat ④.



INSPECTION

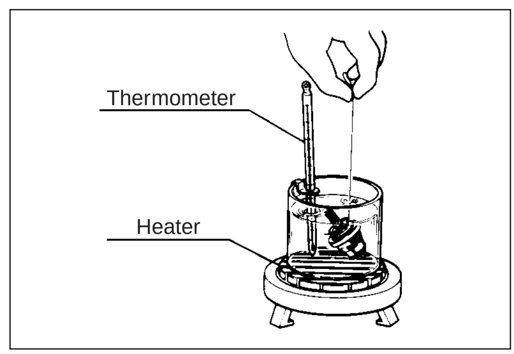
- If salt deposits, corrosion, wear or other damage is found, clean or replace.

- **Thermostat operation**
  Check thermostat opening temperature as follows :

  - Insert a length of thread between thermostat valve / body and suspend thermostat in a container filled with water.

  - Place thermometer in container and heat water.
    Observe water temperature when thermostat valve opens and releases thread.

  Thermostat operating temperature
  Standard : 48 – 52 °C (118 – 126 °F)

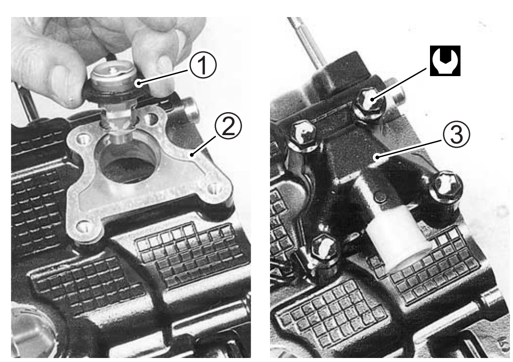


INSTALLATION

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

- Assemble thermostat ①, gasket ② and thermostat cover ③ to cylinder head block and secure with bolts.

Thermostat cover bolt : 10 N·m (1.0 kgf-m, 7.0 lb.-ft.)

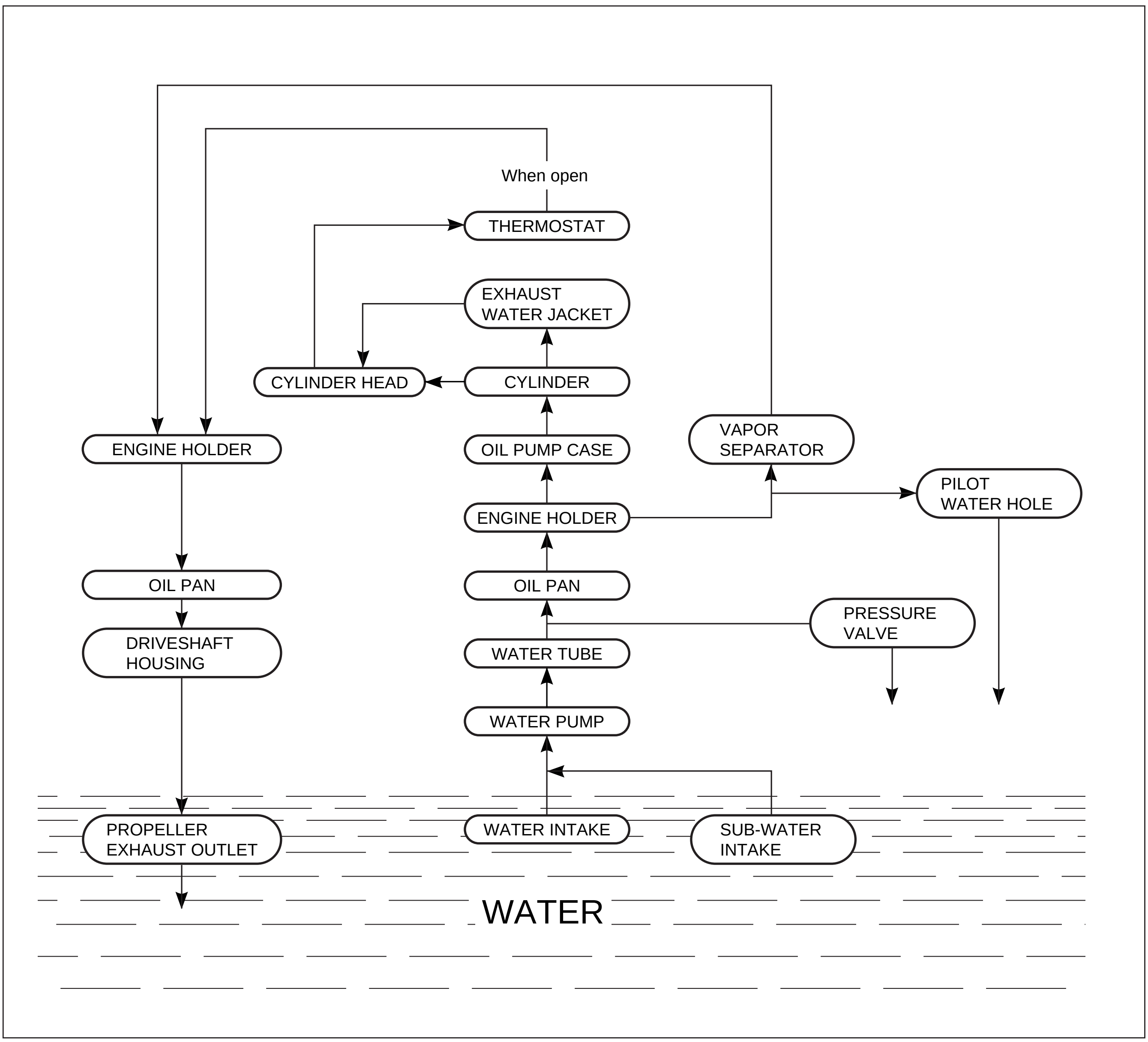


OPERATION

WATER COOLING SYSTEM

The water cooling system includes the lower unit water pump, lower unit to power unit water supply tube, oil pan water pressure valve, power unit water passages and thermostat.
This system cools both the power unit and exhaust and is shown in schematic from below.
If overheating occurs, the components of the cooling system must be inspected for blockage, corrosion build-up or component damage.

Component inspection	Refer to page
Water pump / Impeller	9-9
Water tube	7-5
Thermostat	6-64
Water pressure valve	7-5
Cylinder head	6-26
Cylinder block	6-43



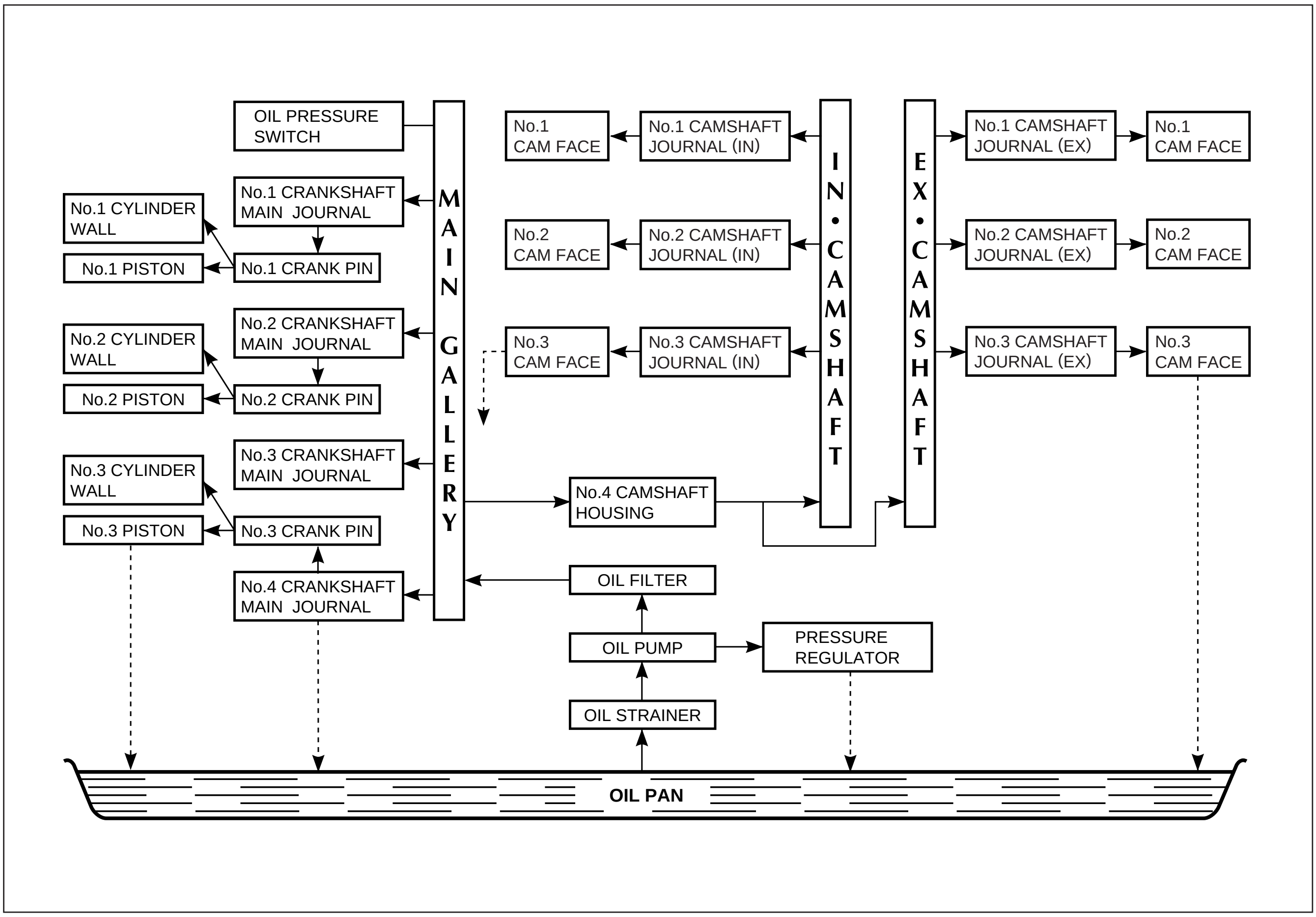
ENGINE LUBRICATION SYSTEM

A crankshaft driven trochoid type pump provides engine oil to all power unit components requiring lubrication. Oil from the oil pan is drawn through the oil strainer and passed through a spin-on type oil filter before entering the main oil gallery.

A pressure regulator (relief valve) is positioned between the oil pump and oil filter to maintain oil pressure at a constant level.

From the main gallery, oil flow is directed through either drilled internal passages or by splash method to those surfaces requiring lubrication.

ENGINE OIL LUBRICATION CHART



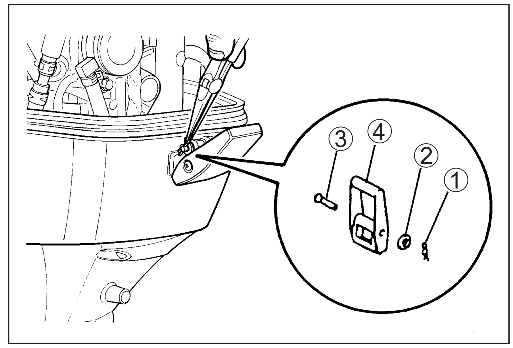
MID UNIT

CONTENTS

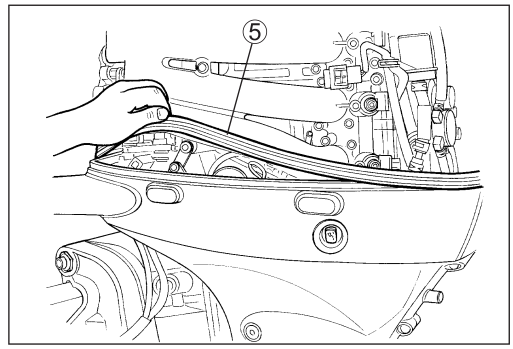
ENGINE SIDE COVER

REMOVAL

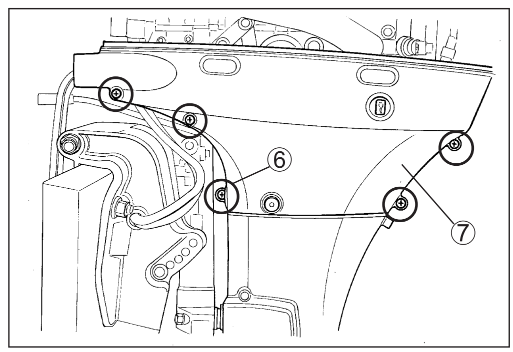
Remove snap pin ①, washer ②, pin ③ and fastener ④.



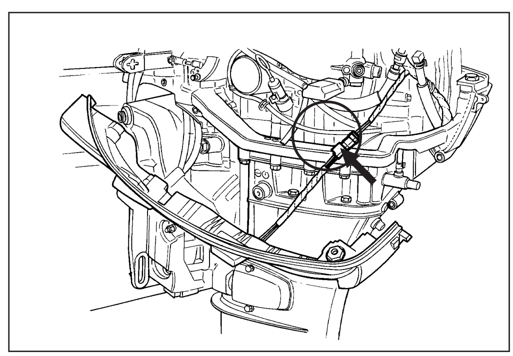
Remove side cover seal ⑤.



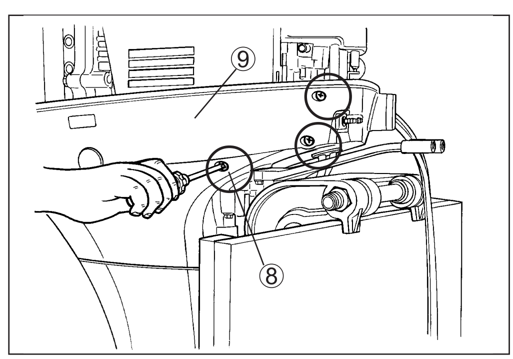
Remove five screws ⑥ and PORT side cover ⑦.



Disconnect PTT switch lead connector.



Remove three screws ⑧ and STBD side cover ⑨.



INSTALLATION

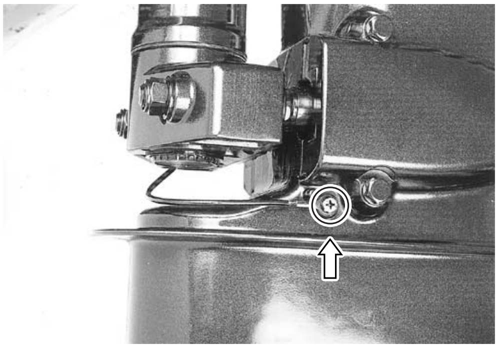
Installation is reverse order of removal.

DRIVESHAFT HOUSING AND OIL PAN

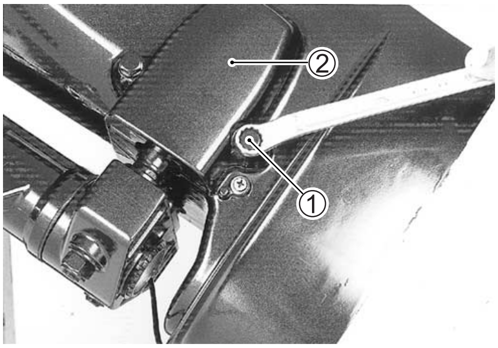
REMOVAL

Remove power unit. (See pages 6-3 to 6-6)
Remove lower unit. (See pages 9-1)

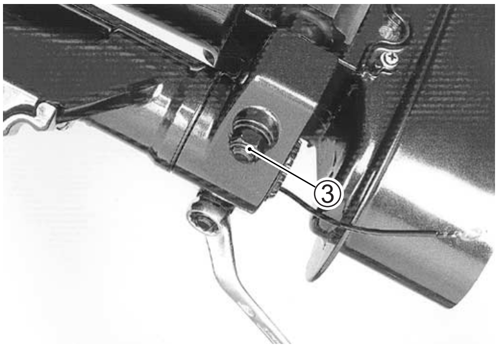
Remove screw and bonding wire from driveshaft housing.



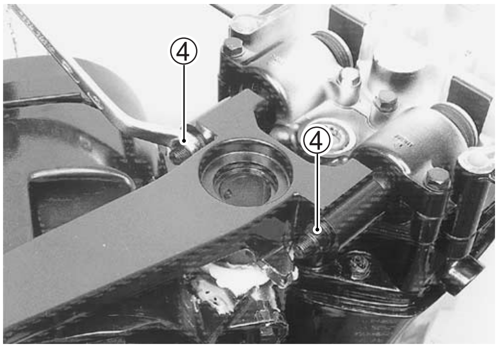
Unscrew the lower mount cover bolts ① and remove PORT/STBD lower mount covers ②.



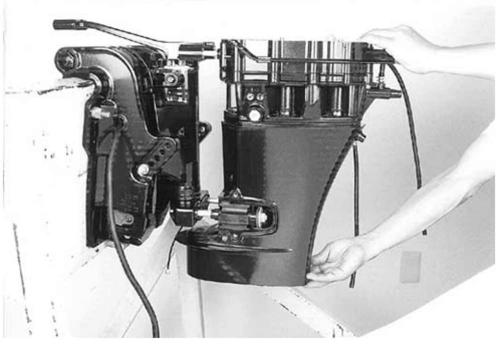
Remove two lower mount nuts ③.



Remove two upper mount nuts ④ and washers.

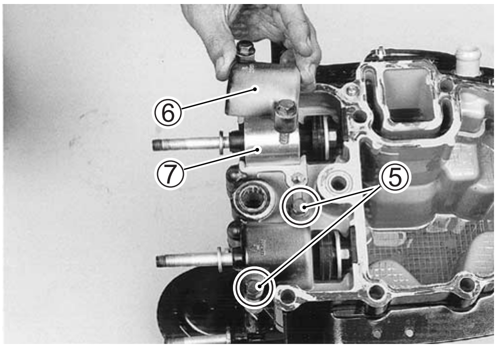


Remove driveshaft housing with oil pan.

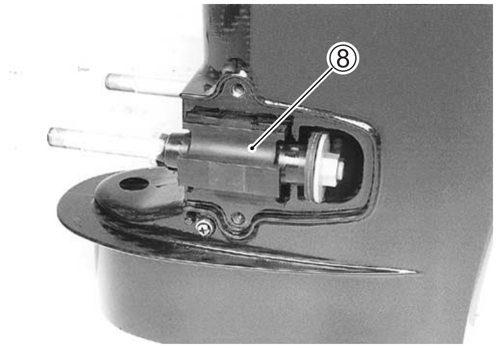


Remove bolts ⑤ and upper mount cover ⑥.
Note the different length and placement of the bolts.

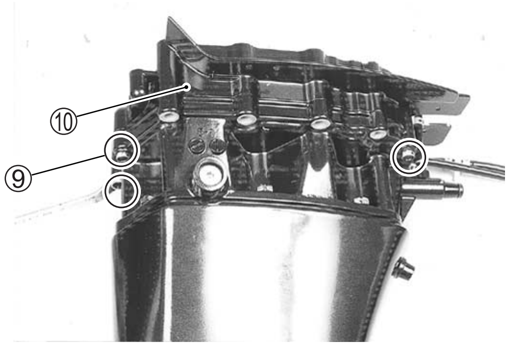
Remove upper mount assembly ⑦.



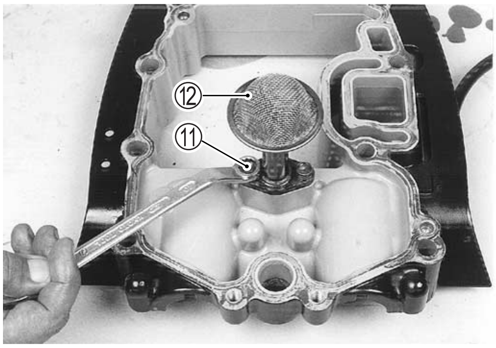
Remove lower mount assembly ⑧.



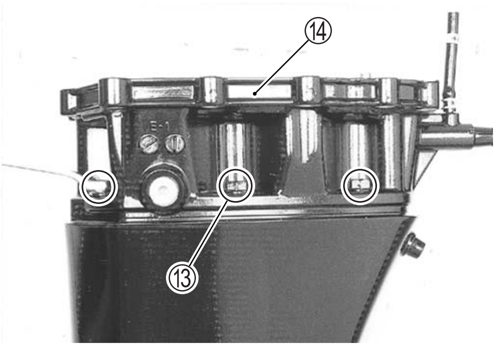
Remove three bolts ⑨ and engine holder ⑩.



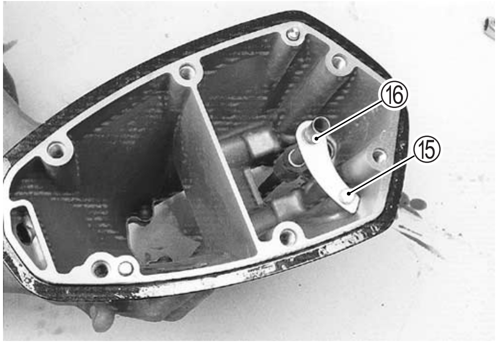
Remove bolts ⑪ and oil strainer ⑫.



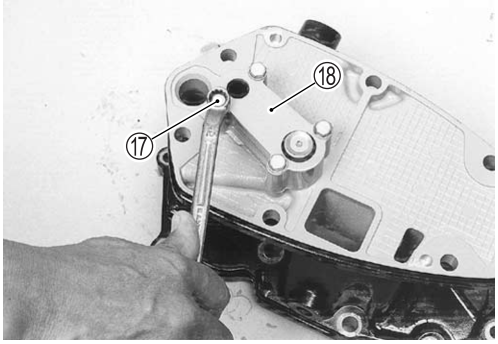
Remove six bolts ⑬ and oil pan ⑭.

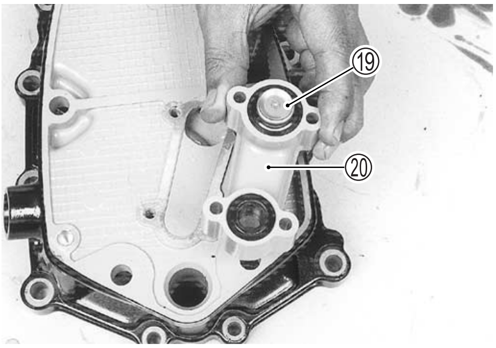


Remove bolt ⑮ and water tube ⑯.



Remove bolts ⑰, water pressure valve cover ⑱, pressure valve ⑲ and valve case ⑳.

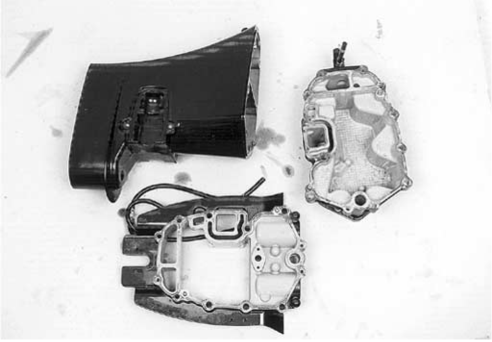




INSPECTION

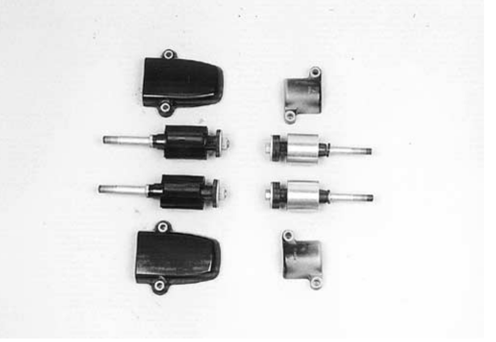
NOTE:
If any component is found to be excessively worn, cracked, defective or damaged in any way, it must be replaced.

Mid unit component
Check oil pan, driveshaft housing, engine holder and mount covers.
If cracks, defects or other damage is found, replace it.



Mount

Check upper and lower mount.
If excessive wear, corrosion, or other damage is found, replace mount.



Water tube

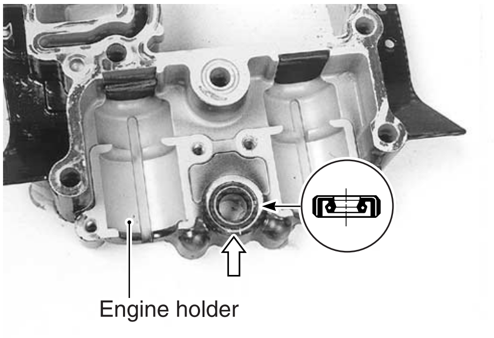
Check water tube.
If a clog or obstruction is found, clean water tube.
If cracks, corrosion or other damage is found, replace water tube.

Check water tube grommet.
If excessive wear or other damage is found, replace grommet.

Oil seal

Check driveshaft upper oil seal for leakage or damage.
If cracks, cuts or other damage is found, replace seal.

NOTE:
Install oil seal with lip (spring side) facing downward.

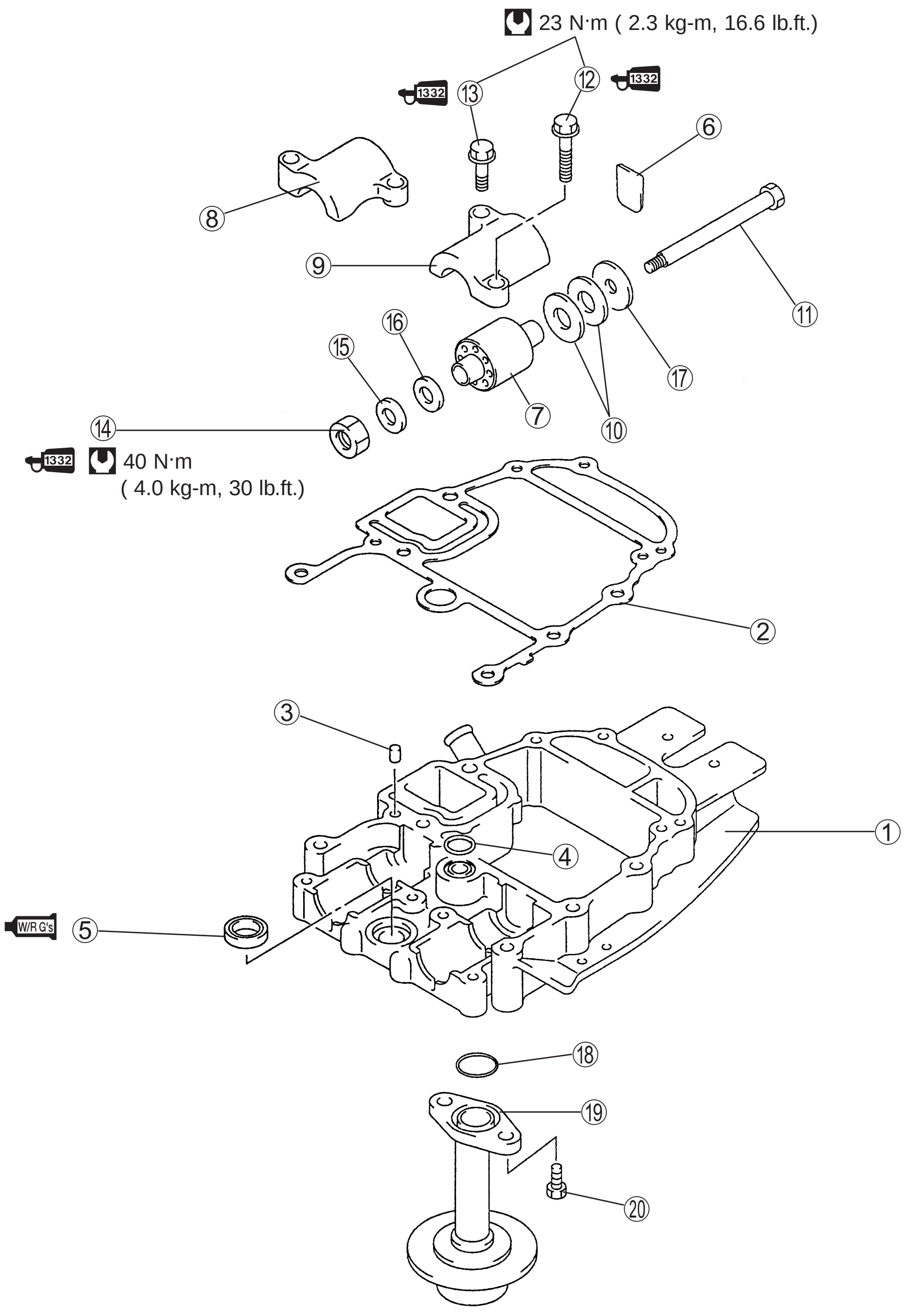


Water pressure valve

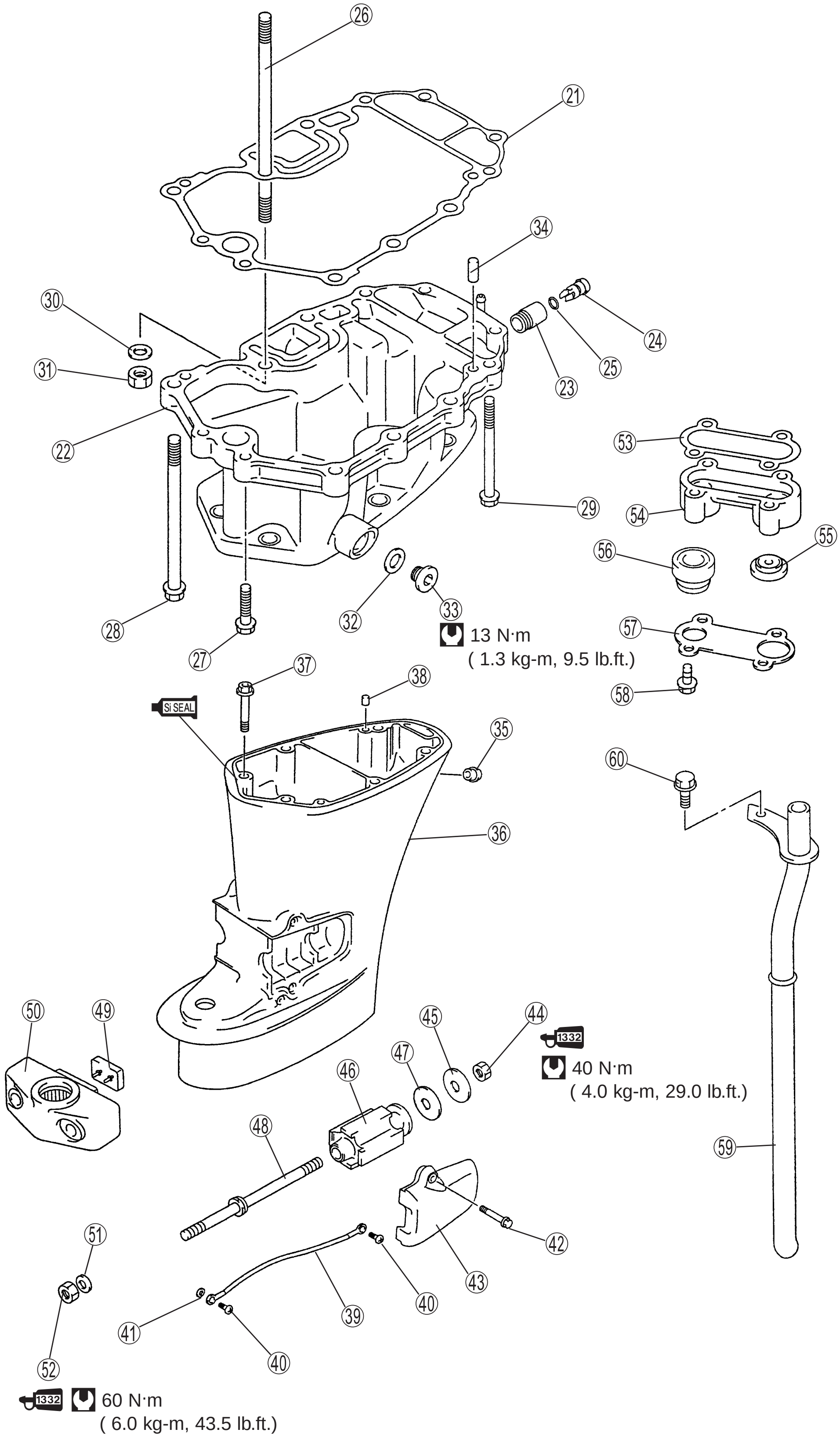
If salt deposits, corrosion, wear, or other damage is found, clean or replace.

ASSEMBLY

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



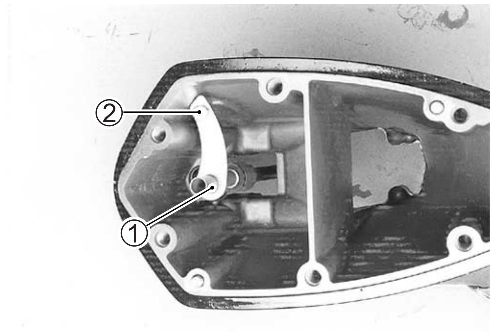
① Engine holder	⑪ Upper mount bolt
② Gasket	⑫ Mount cover bolt
③ Pin	⑬ Mount cover bolt
④ O-ring	⑭ Nut
⑤ Oil seal	⑮ Washer
⑥ Upper thrust mount	⑯ Washer
⑦ Upper mount	⑰ Washer
⑧ Upper mount cover, STBD	⑱ O-ring
⑨ Upper mount cover, PORT	⑲ Oil strainer
⑩ Upper thrust stopper	⑳ Bolt



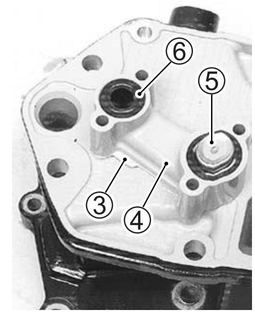
21 Gasket
22 Oil pan
23 Water indicator tube
24 Cover
25 O-ring
26 Stud bolt
27 Bolt
28 Bolt
29 Bolt
30 Washer
31 Nut
32 Gasket
33 Plug
34 Pin
35 Exhaust pipe
36 Driveshaft housing
37 Bolt
38 Pin
39 Bonding wire
40 Screw
41 Insulation washer
42 Bolt
43 Lower mount cover
44 Nut
45 Washer
46 Lower mount
47 Damper
48 Lower mount bolt
49 Lower thrust mount
50 Lower mount bracket
51 Washer
52 Nut
53 Gasket
54 Water pressure valve case
55 Water pressure valve
56 Grommet
57 Cover
58 Bolt
59 Water tube
60 Bolt

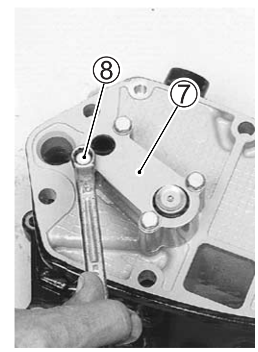
OIL PAN TO DRIVESHAFT HOUSING

Install water tube ①, then tighten bolt ②.



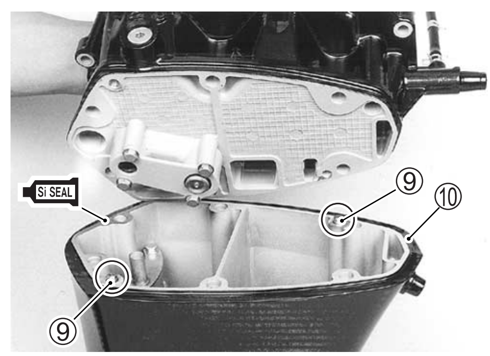
Place the gasket ③, water pressure valve case ④, pressure valve ⑤, and water tube grommet ⑥ into position.
Install pressure valve cover ⑦, then securely tighten the four (4) valve cover bolts ⑧.



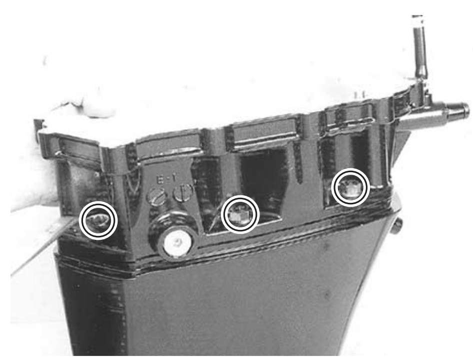


Install two dowel pins ⑨ to driveshaft housing ⑩.
Apply sealant to mating surfaces of driveshaft housing and oil pan.

Si SEAL 99000-31120 : Suzuki Silicone Seal

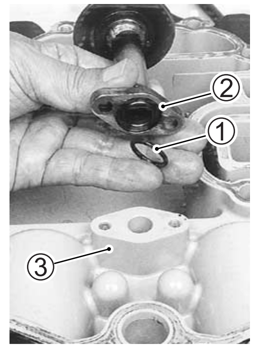


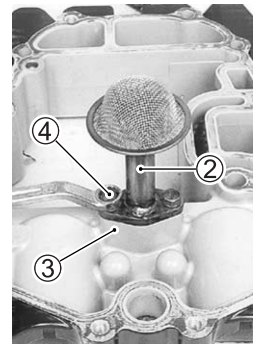
Install oil pan ⑪ to driveshaft housing, then tighten six (6) bolts ⑫ securely.



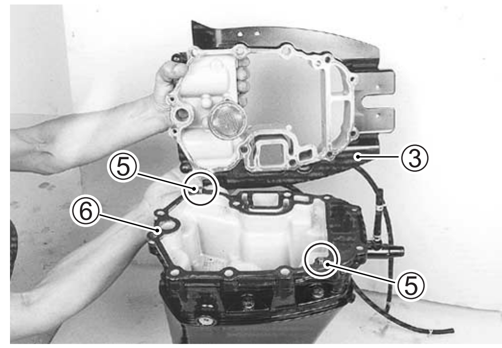
ENGINE HOLDER TO OIL PAN

Install O-ring ① and oil strainer ② to engine holder ③, then tighten bolts ④ securely.





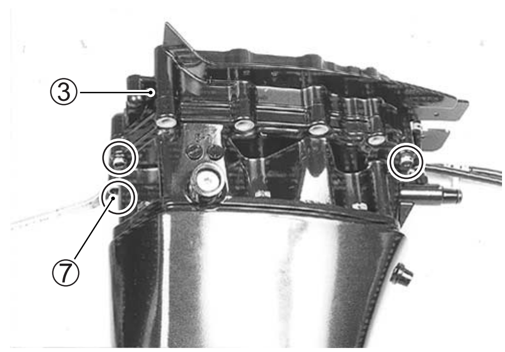
Install dowel pin ⑤ and gasket ⑥ to oil pan.



CAUTION

Do not re-use gasket. Always assemble with a new gasket.

Install engine holder ③ to oil pan, then gently tighten it temporarily with engine holder bolts ⑦.

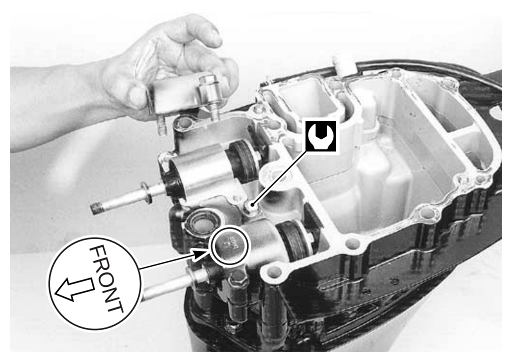


NOTE:
When installing power unit, tighten engine holder bolts to specified torque.
(See page 7-11)

UPPER AND LOWER MOUNT

Upper mount and mount cover

Install upper mount.
Install upper mount cover with the lettered mark "FRONT" facing forward. Tighten bolt, pre-coated with thread lock, to specified torque.

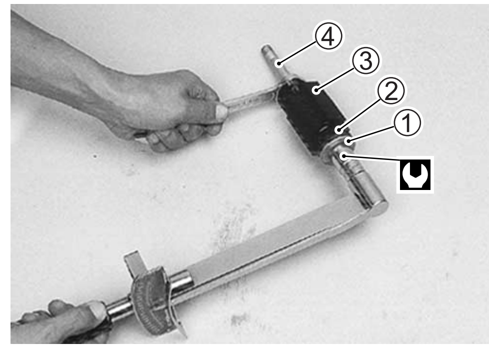


1342 **99000-32050 : Thread lock "1342"**

Upper mount cover bolt :
23 N · m (2.3 kg-m, 16.5 lb.-ft.)

Lower mount

Assemble these items in the following sequence :
place washer ①, stopper ② and lower mount ③ on lower mount bolt ④.
Tighten lower mount rear nut, pre-coated with thread lock, to specified torque.



1342 99000-32050 : Thread Lock "1342"

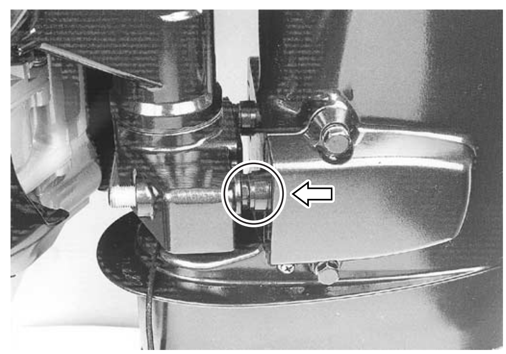
Lower mount (rear) nut :
40 N · m (4.0 kg-m, 29.0 lb.-ft.)

Place lower mount into driveshaft housing.
Install lower mount cover to driveshaft housing.
At this time only lightly tighten the bolts to temporarily hold it in place.

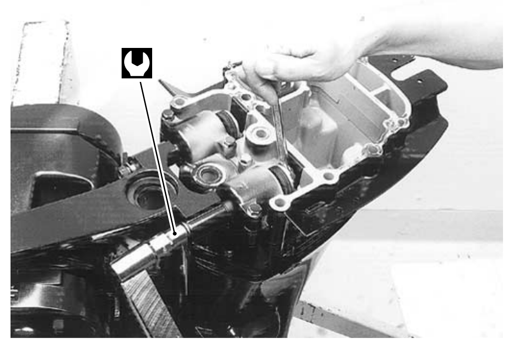
DRIVESHAFT HOUSING / OIL PAN

Install driveshaft housing / oil pan to steering bracket.

NOTE:
When installing the driveshaft housing / oil pan assembly, be sure lower mount hex head bolt properly fits into the lower mount bracket groove.



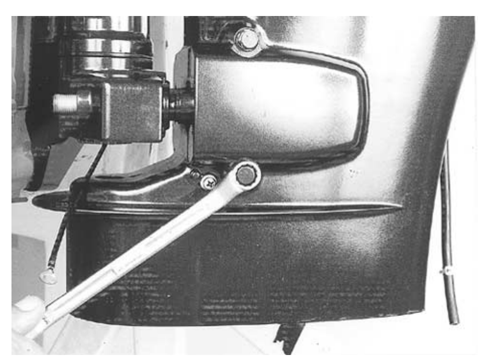
Install upper mount nuts. Tighten nuts, pre-coated with thread lock, to specified torque.



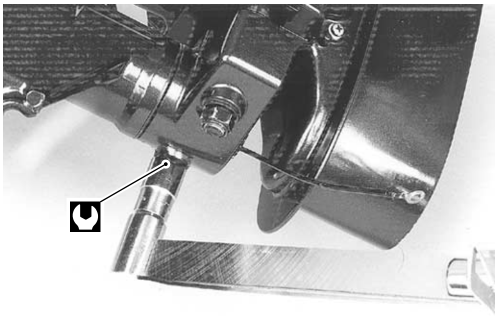
1342 99000-32050 : Thread Lock "1342"

Upper mount nut : 40 N · m (4.0 kg-m, 30.0 lb.-ft.)

Tighten lower mount cover bolts securely.



Install lower mount front nuts. Tighten nuts, pre-coated with thread lock, to specified torque.



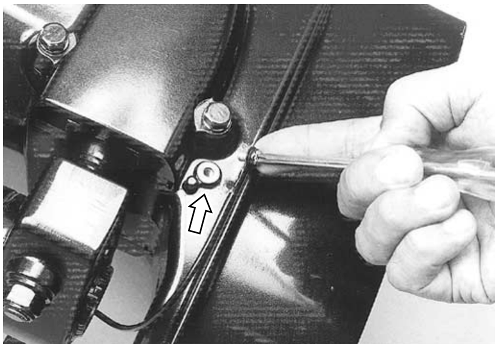
1342 99000-32050 : Thread Lock “1342”

Lower mount front nut :

60 N · m (6.0 kg-m, 43.5 lb.-ft.)

BONDING WIRE

Reattach bonding wire to driveshaft housing.
Tighten screw securely.



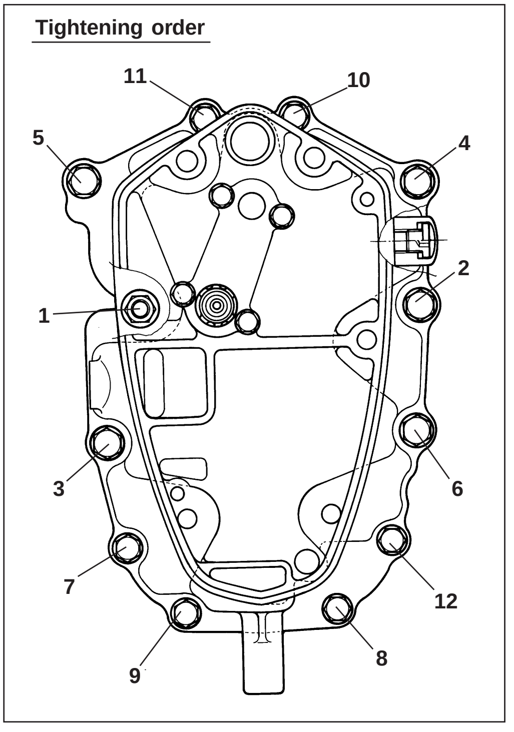
NOTE:
Insulation washer must be installed between the bonding wire terminal and housing.

POWER UNIT

Install power unit. (See page 6-7 to 6-9)
Tighten power unit mounting bolts and engine holder bolts to specified torque.

Power unit mounting bolt & Engine holder bolt :

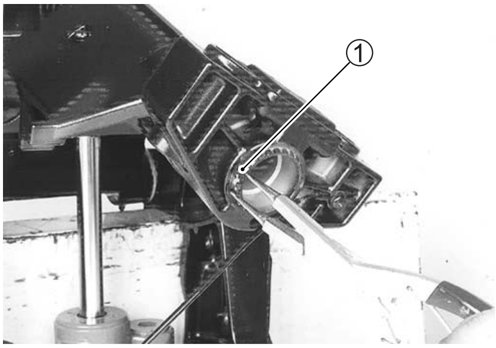
8 mm 23 N · m (2.3 kg-m, 16.5 lb.-ft.)
10 mm 50 N · m (5.0 kg-m, 36.0 lb.-ft.)



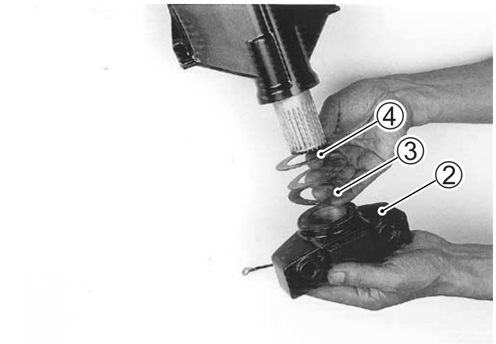
SWIVEL BRACKET, STEERING BRACKET AND CLAMP BRACKET

REMOVAL

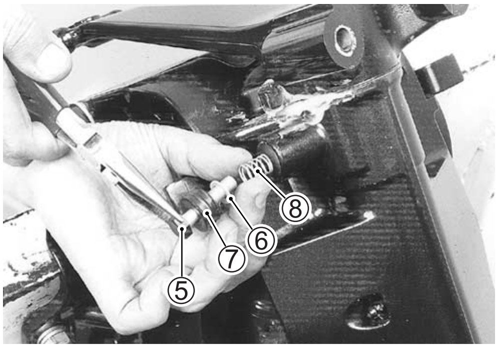
Remove driveshaft housing / oil pan.
(See page 7-2)



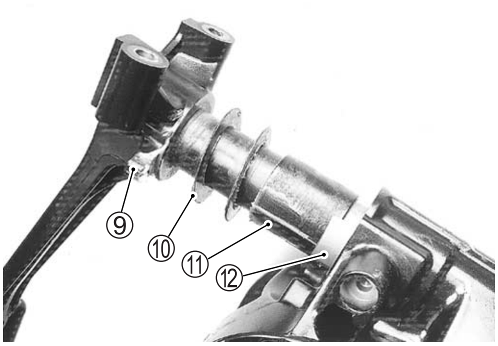
Remove circlip ①.



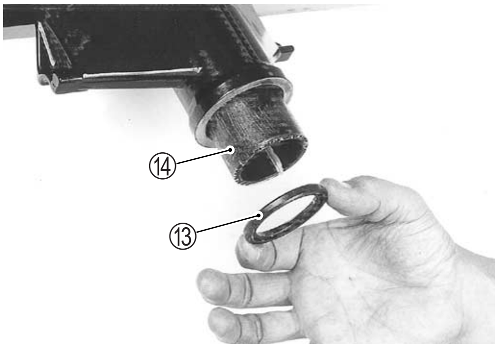
Remove lower mount bracket ②, shim ③, and washer ④ from the steering shaft.



Remove steering adjuster bolt ⑤, washer ⑥, adjuster cover ⑦ and spring ⑧.

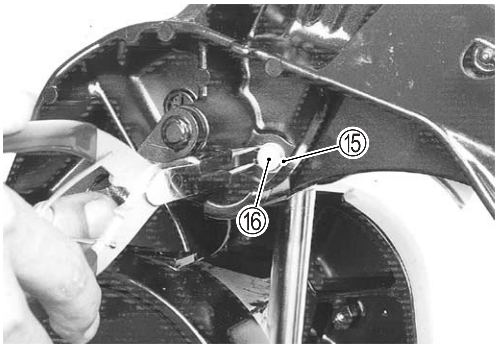


Lift steering bracket ⑨ upward to remove from swivel bracket. Remove washer ⑩, upper bush ⑪, and steering adjuster ⑫ from bracket.



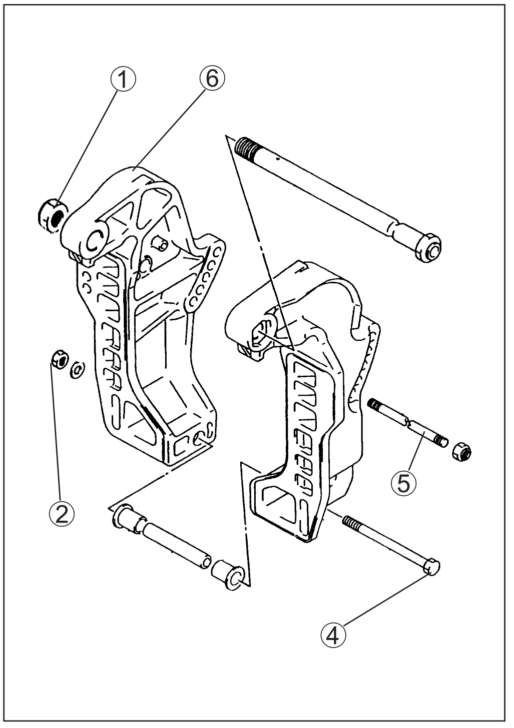
Remove swivel bracket seal ⑬ and lower bush ⑭.

Remove circlip ⑮ and push out tilt cylinder upper rod ⑯.

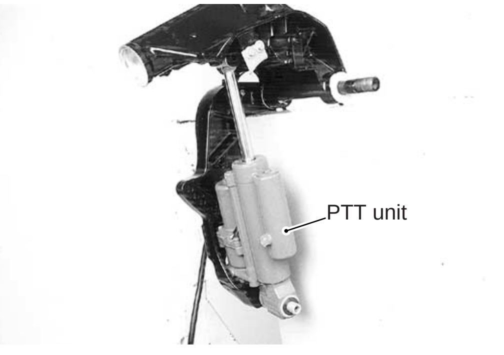


Remove nut ① from clamp bracket shaft.
Remove tilt cylinder lower shaft nut ② and lower shaft bolt ④.
Remove tilt pin ⑤.

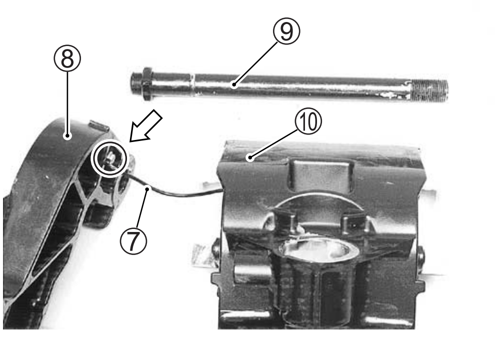
Slide STBD clamp bracket ⑥ off clamp bracket shaft.



Remove the PTT unit assembly.



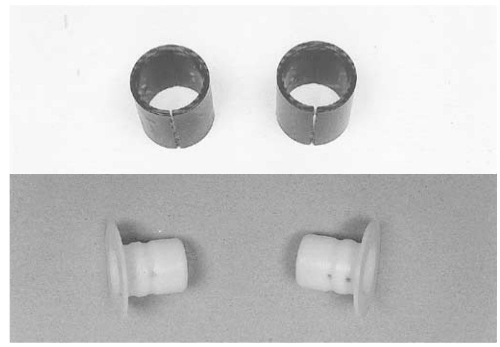
Remove bonding wire ⑦ from PORT clamp bracket.
Pull PORT clamp bracket ⑧ outward to remove clamp bracket and bracket shaft ⑨ from swivel bracket ⑩.
Remove bushings from each side of swivel bracket.



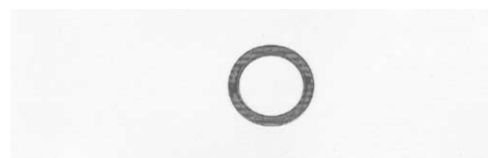
INSPECTION

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

BUSHINGS
Check all bushings.
If excessive wear or other damage is found, replace bushing.
If bushing fit is loose when installing, replace bushing.

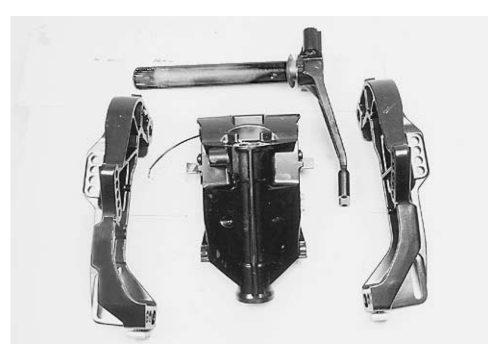


OIL SEAL
Check swivel bracket seal.
If excessive wear or other damage is found, replace seal.



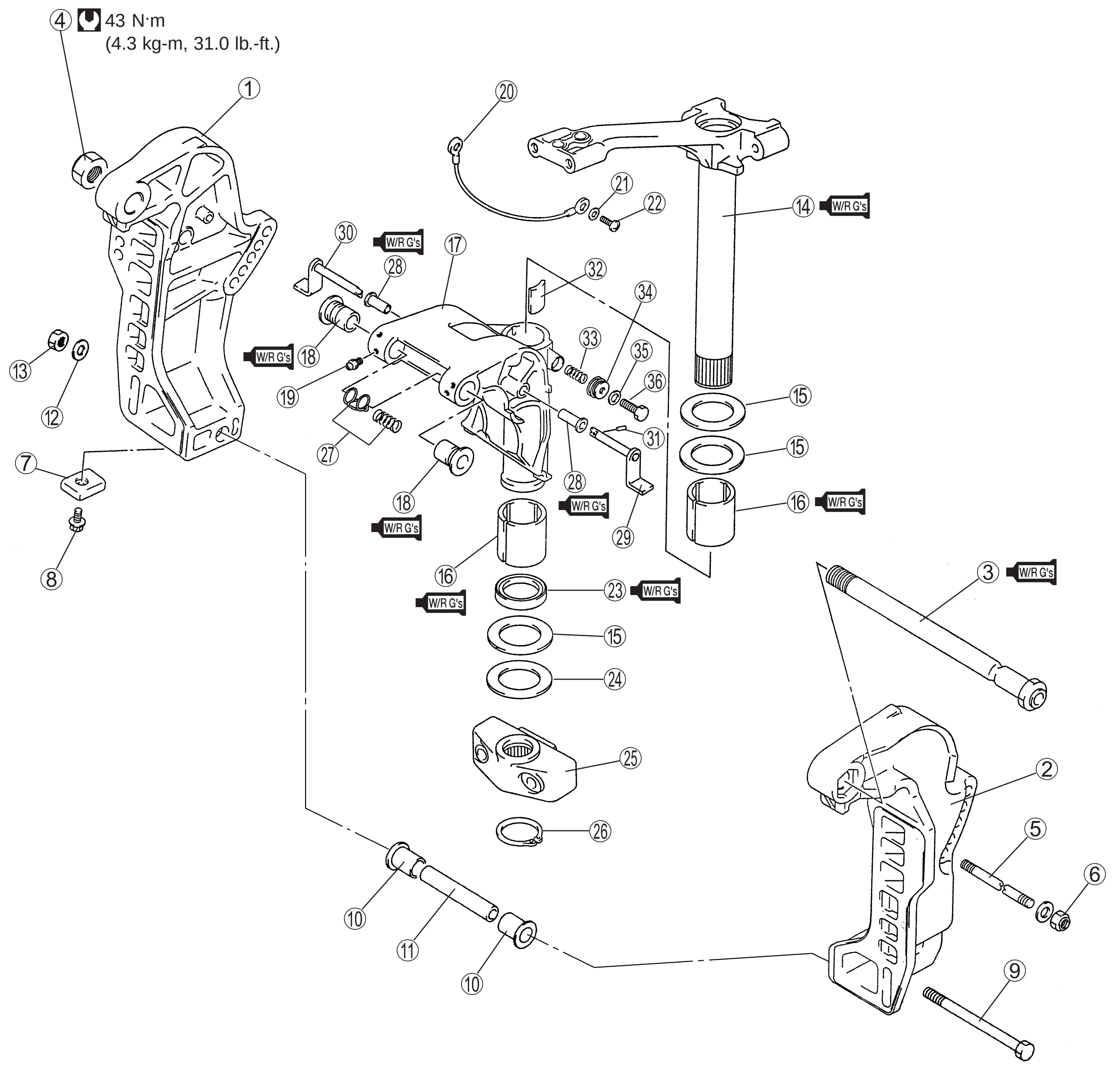
CLAMP BRACKET SHAFT
Check clamp bracket shaft.
If clamp bracket shaft is bend or twisted, replace shaft.

BRACKET
Check clamp brackets, steering bracket and swivel bracket.
If cracks or other damage is found, replace bracket (s).



REASSEMBLY

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



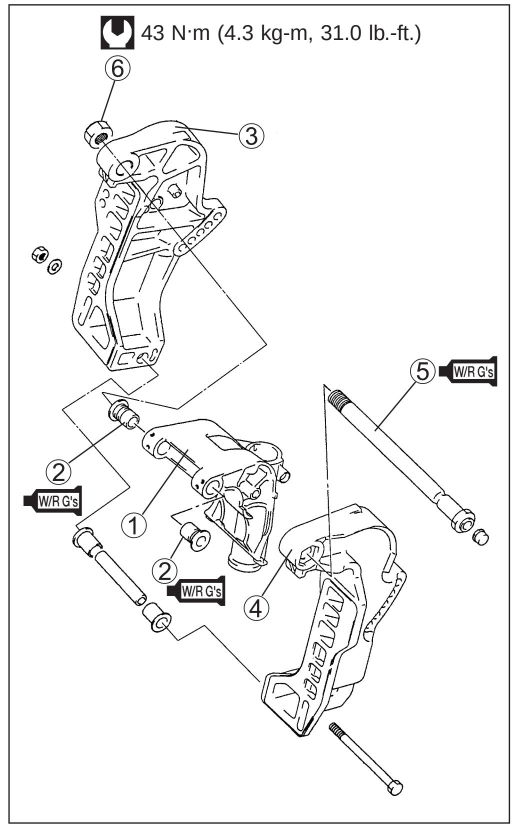
① Clamp bracket STBD
② Clamp bracket PORT
③ Clamp bracket shaft
④ Nut
⑤ Tilt lock pin
⑥ Nut
⑦ Anode
⑧ Bolt
⑨ Tilt cylinder lower bolt
⑩ Bush
⑪ Tilt cylinder lower shaft
⑫ Washer
⑬ Nut
⑭ Steering bracket
⑮ Washer
⑯ Bush
⑰ Swivel bracket
⑱ Bush
⑲ Grease nipple
⑳ Bonding wire
㉑ Washer
㉒ Screw
㉓ Oil seal
㉔ Shim
㉕ Lower mount bracket
㉖ Circlip
㉗ Tilt lock spring assy
㉘ Bush
㉙ Tilt lock lever. PORT
㉚ Tilt lock lever. STBD
㉛ Pin
㉜ Steering adjuster
㉝ Spring
㉞ Cover
㉟ Washer
㊱ Bolt

CLAMP BRACKET

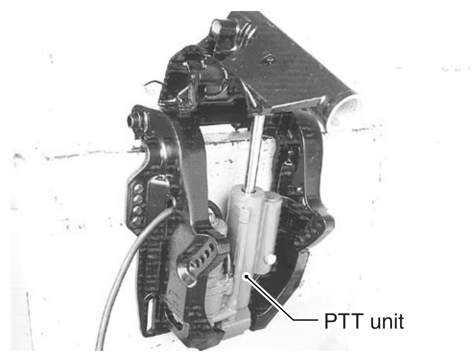
Insert PORT and STBD bushings ② into the swivel bracket ①.
Install clamp bracket ③, ④ and clamp bracket shaft ⑤ to swivel bracket ①.
Install clamp bracket shaft nut ⑥. Leave nut loose for easier installation of PTT unit.

W/R G's **99000-25160 : Suzuki Water Resistant Grease**

NOTE:
Before installing clamp bracket to swivel bracket, apply grease to clamp bracket shaft and bushings.



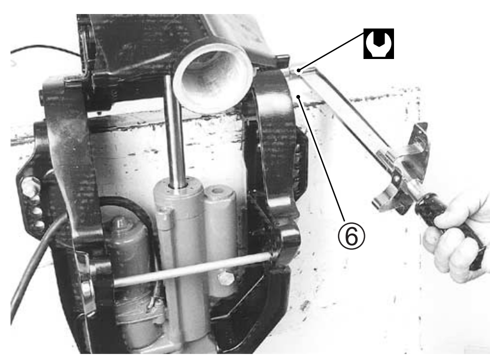
Install PTT unit assembly, lower shaft and bushings in position between clamp brackets.
(See "INSTALLATION" in POWER TRIM & TILT section for PTT unit installation.)



Tighten clamp bracket shaft nut ⑥ to specified torque.

Clamp bracket shaft nut :

43 N · m (4.3 kg-m, 31.0 lb.-ft.)



STEERING BRACKET

Apply Water Resistant Grease to steering bracket shaft.

99000-25160 : Suzuki Water Resistant Grease

NOTE:

Apply grease to bushings, oil seal lip and pilot shaft portion of steering bracket.

Install upper bushing ①, steering adjuster ② and washer ③ to swivel bracket.

NOTE:

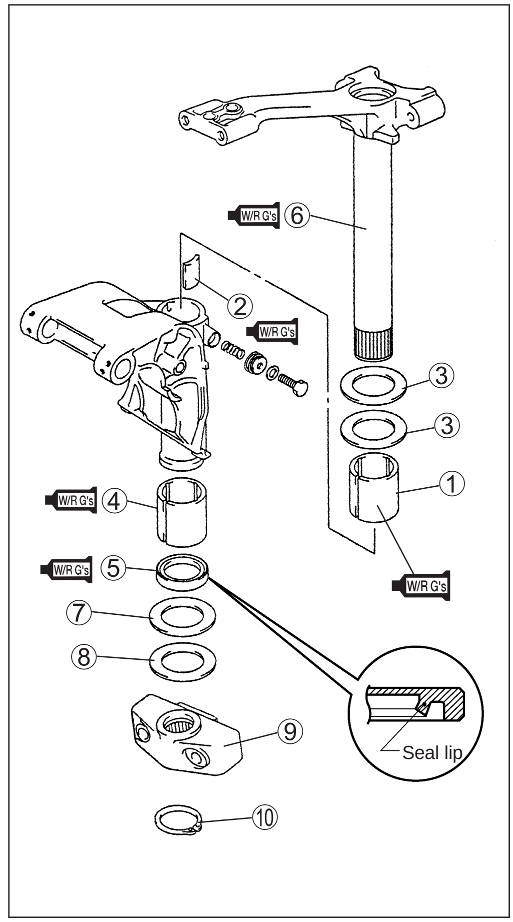
Be certain that steering adjuster ② is placed between upper bushing ① and swivel bracket casing.

Install lower bushing ④ and swivel bracket seal ⑤ to swivel bracket.

NOTE:

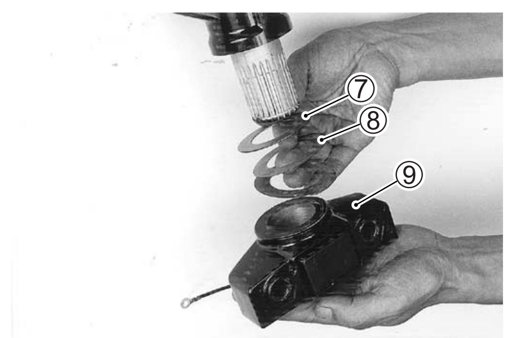
Install seal ⑤ with lip (spring side) facing downward.

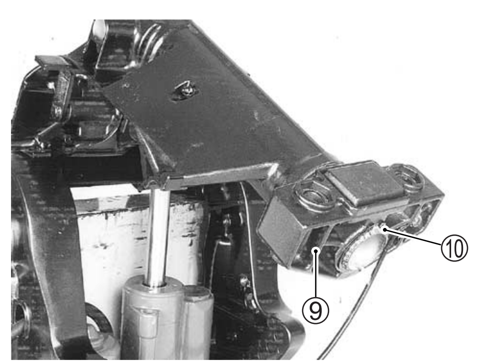
Install steering bracket ⑥ to swivel bracket.



LOWER MOUNT BRACKET

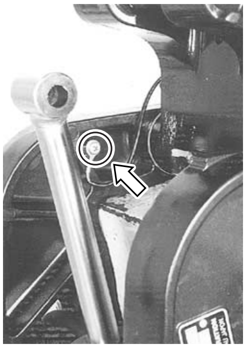
Install washer ⑦ and shim ⑧, and then slide the lower mount bracket ⑨ upward on the splines until it contacts the shim.
Install circlip ⑩ to retain bracket.

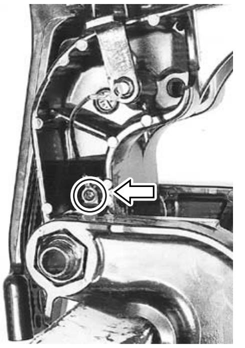




BONDING WIRE

Reattach bonding wire to clamp bracket and swivel bracket, then tighten screw securely.



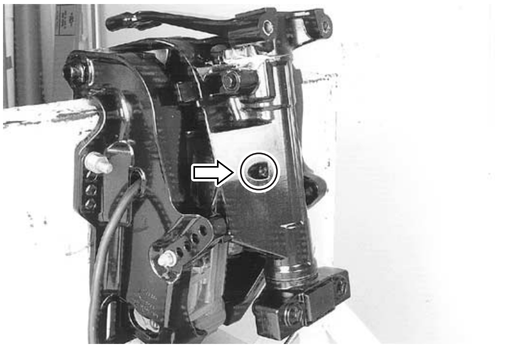


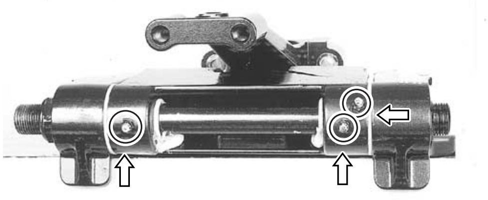
NOTE:

The insulation washer must be installed between the bonding wire terminal and bracket.

LUBRICATION

After completing reassembly of the mid unit, apply grease through each grease nipple.



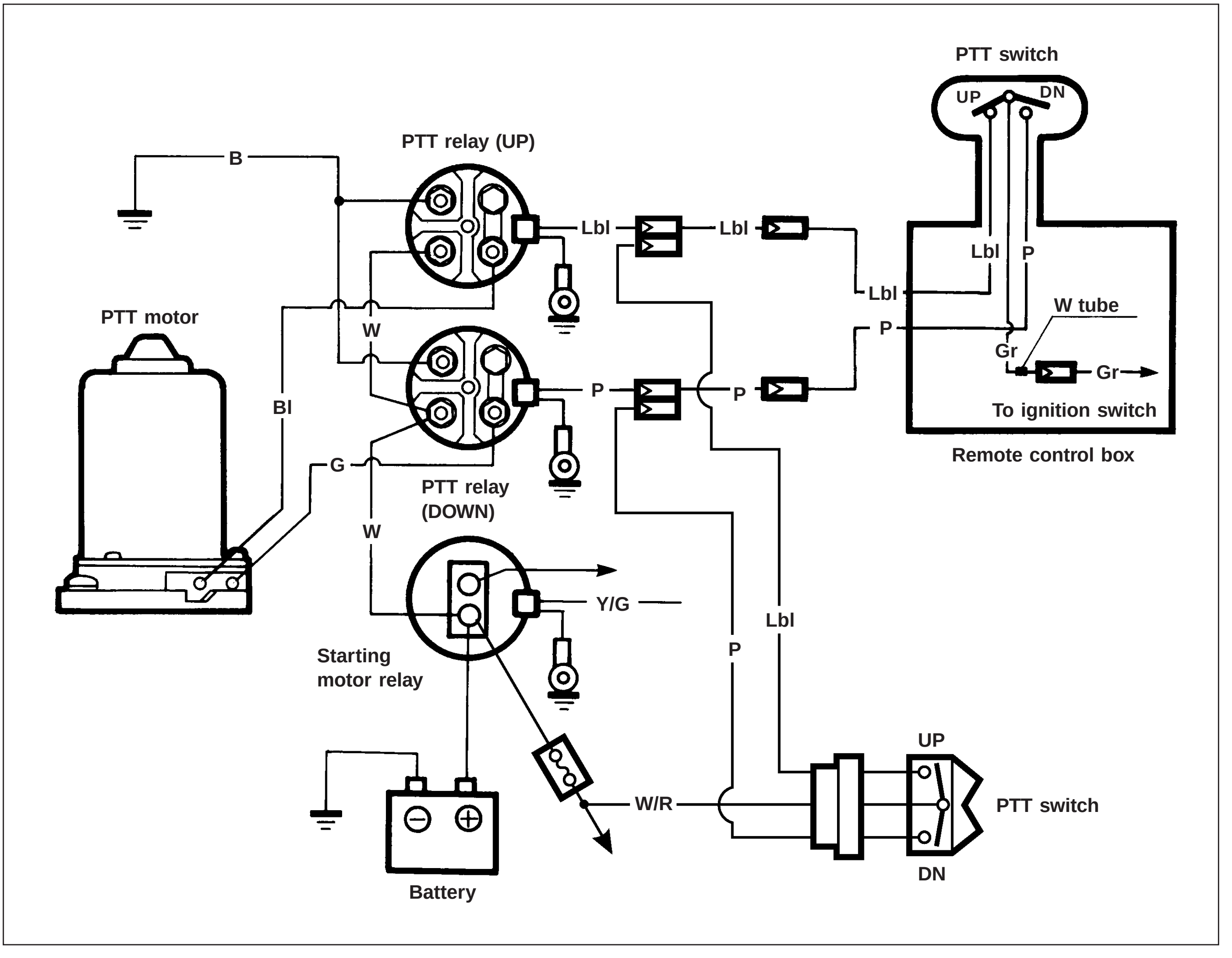


W/R G's **99000-25160 : Suzuki Water Resistant Grease**

POWER TRIM AND TILT

CONTENTS

SYSTEM WIRING DIAGRAM

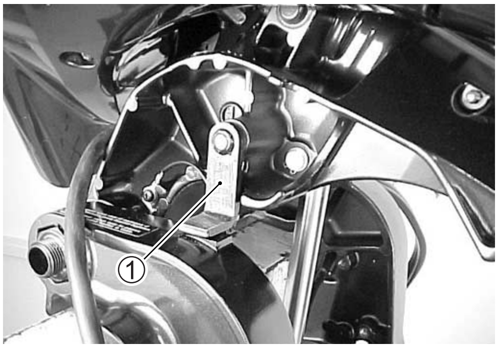


SERVICE PROCEDURE

OIL LEVEL

To check the oil level :

1. The motor should be raised 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.

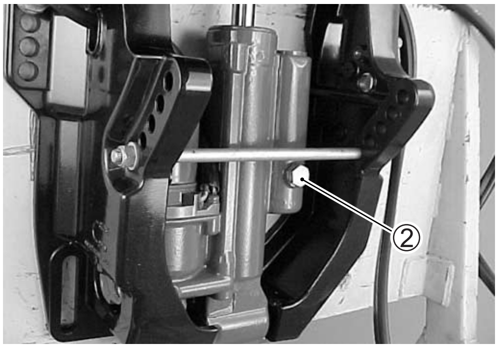


Recommended oil :

Dexron Ⅲ automatic transmission fluid or equivalent

CAUTION

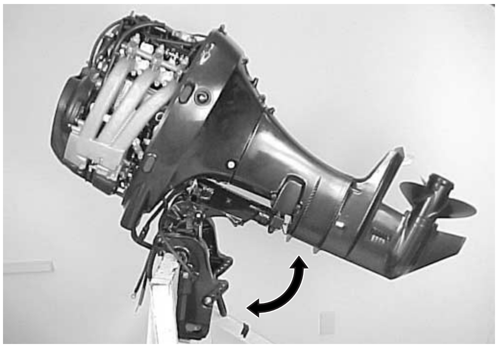
To ensure consistent pump operation, do not mix different types of oil.



6. Reinstall oil filler plug.

AIR BLEEDING

1. Open manual release valve before performing air bleeding.
2. Manually raise and lower engine (full up to full down) 5-6 times.
3. Check oil level, topping off if necessary.
4. Reinstall oil filler plug.



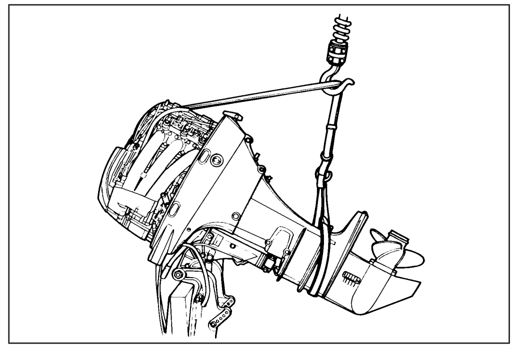
POWER TRIM AND TILT UNIT

REMOVAL

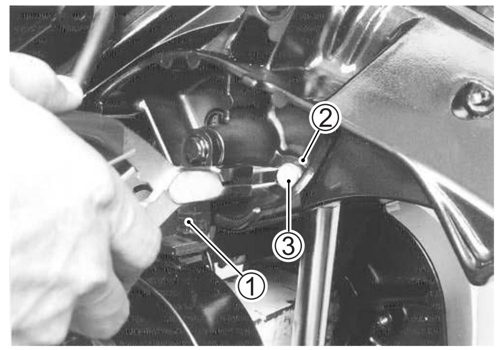
Tilt engine fully up and lower the manual tilt lock levers ①.

⚠ WARNING

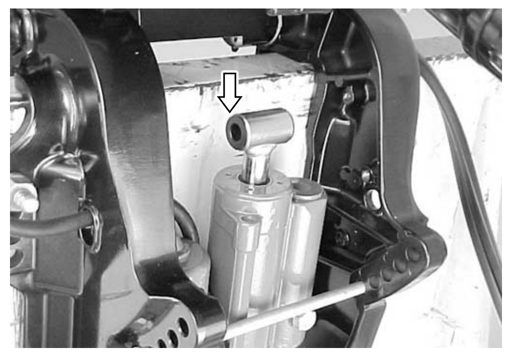
During the following procedures, firmly secure the engine and support its weight. (see right)



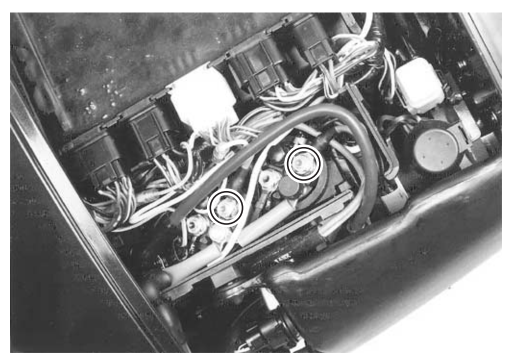
Remove the tilt rod snap ring ② and push tilt cylinder upper shaft pin ③ out.



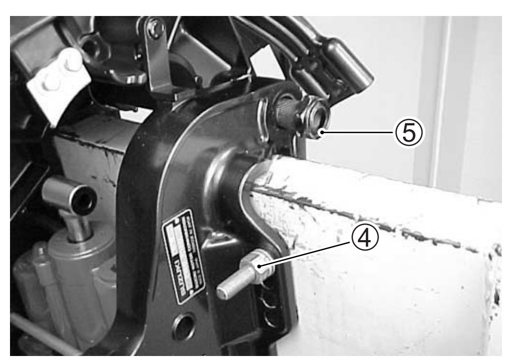
Lower tilt rod to full down position and disconnect the battery cable.



Disconnect the PTT motor cable wire leads (G, Bl) from the PTT relays.
Remove the PTT motor cable from engine lower cover.

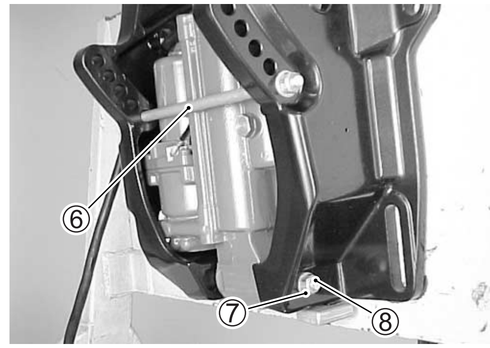


Remove the two STBD motor mounting bolts ④.
Loosen the clamp bracket shaft nut ⑤.

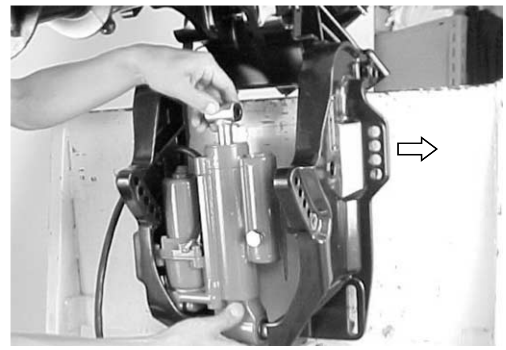


NOTE:
Complete removal of the clamp bracket shaft nut is not required. Nut should be loosened as far as the end of the shaft threads only to facilitate removal of the PTT unit.

Remove the tilt pin ⑥.
Loosen the PTT cylinder lower shaft nut ⑦ and remove the lower shaft bolt ⑧.



Slide the STBD clamp bracket fully outward to the right hand side.
Remove the PTT unit from between the clamp brackets.



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.

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

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 component before tightening vise.

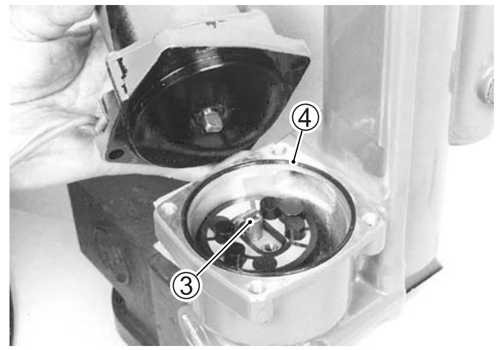
Using special tool, unscrew the PTT cylinder head.

TOOL **09944-08711 : PTT cylinder cap tool**

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

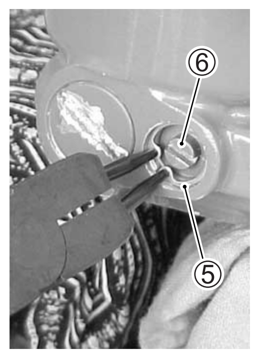
Remove the PTT motor.
Note the position of drive joint ③ and O-ring ④, before removing them.
(see page 8-10)

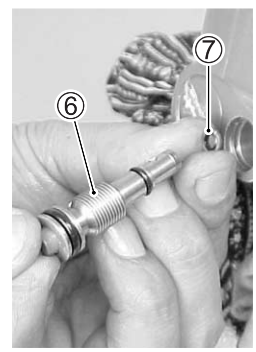
Unscrew the fill plug and drain PTT oil into suitable container.



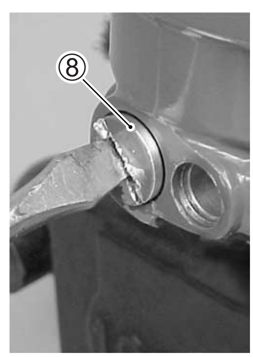
Remove the manual release valve snap ring ⑤, then unscrew the manual release valve ⑥.

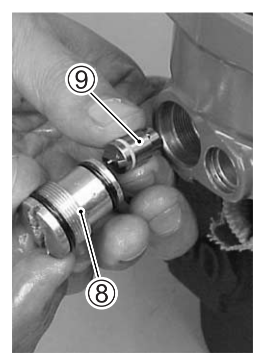
Remove the seal washer ⑦.





Remove the main check valve ⑧ and spool valve ⑨.



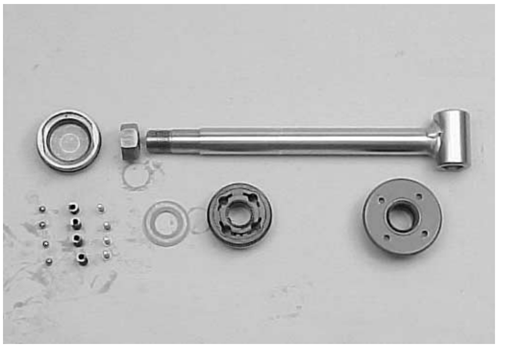


Disassembly of tilt rod / piston assembly

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 a 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.



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, replace if damaged or bent.

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

Slight roughness may be removed with fine emery paper.

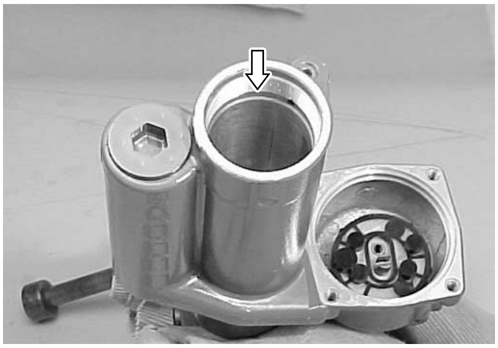
A badly scored or grooved rod must be replaced.

Inspect the PTT cap seal and O-ring.
Replace if cuts, nicks, or excessive wear is found.

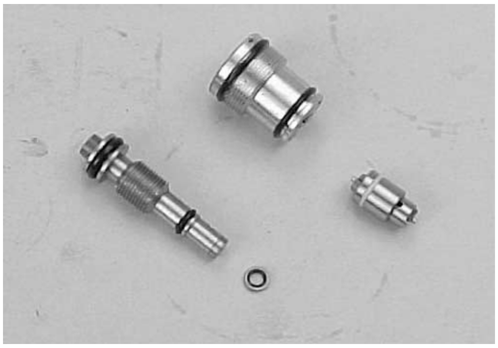
NOTE:
It is recommended that the O-ring always be replaced once the tilt cylinder has been disassembled.

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 all O-ring (manual release valve and main check valve).
Replace if nicked or cut.



REASSEMBLY

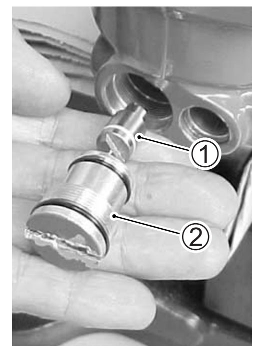
Assembly is reverse of disassembly with special attention to following steps.

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.**

MAIN CHECK VALVE

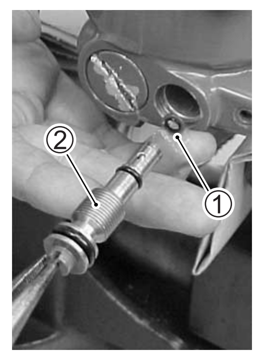
Oil and install spool valve ① and main check valve ②.
Tighten the main check valve ② to specified torque.

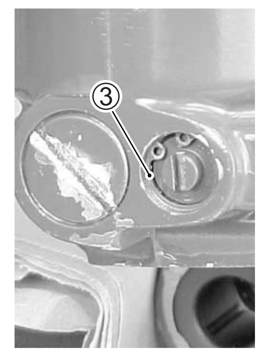


Main check valve plug : 20 N · m (2.0 kg-m, 14.5 lb.-ft.)

MANUAL RELEASE VALVE

Oil and install the seal washer ① and manual release valve ②.
Tighten the valve to specified torque.
Install snap ring ③.





Manual release valve : 1.7 N · m (0.17 kg-m, 1.2 lb.-ft.)

TILT ROD

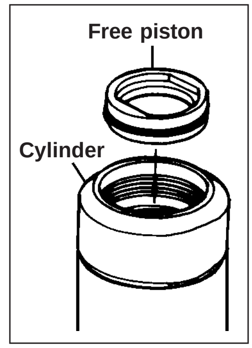
When tightening the piston retaining nut on the tilt rod piston, apply Thread lock 1342 to the threads.
Tighten the nut to specified torque.

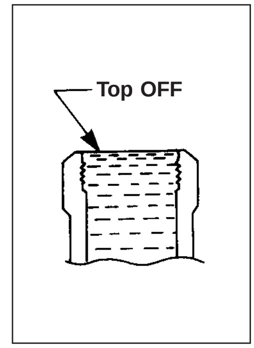
1342 99000-32050 : Thread Lock 1342

Piston retaining nut : 100 N · m (10.0 kg-m, 72.5 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 : 45 N · m (4.5 kg-m, 32.5 lb.-ft.)

TOOL **09944-08711 : PTT cylinder cap tool**

PTT MOTOR

See the PTT Motor Installation section on page 8-13.

AIR BLEEDING

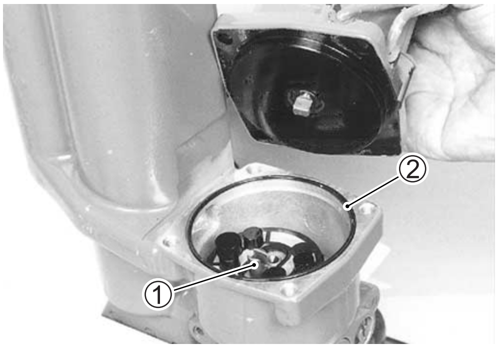
See the AIR BLEEDING section on page 8-2.

PTT MOTOR

Removal

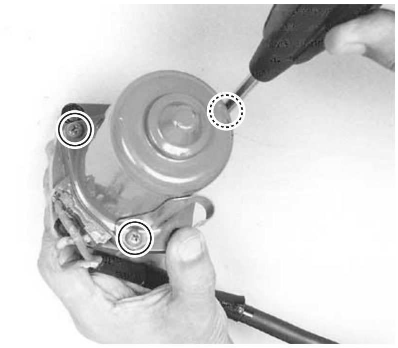
Remove the four (4) screws securing the PTT motor to the pump & reservoir.

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



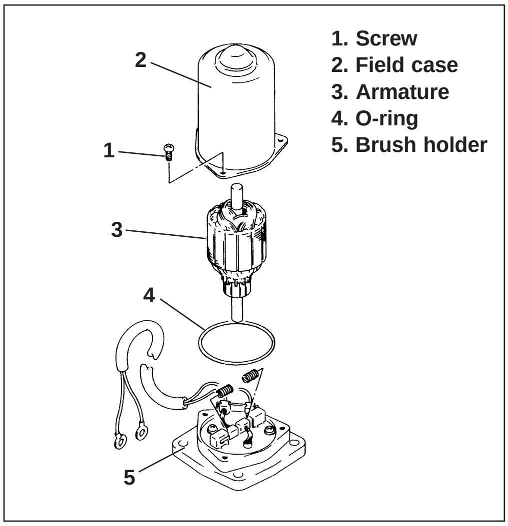
PTT motor Disassembly

For correct assembly, scribe an alignment mark on the field case and brush holder.
Remove the three (3) screws securing the field case to the brush holder.



Using a soft face hammer, gently tap the field case from side to side to unseat it from the brush holder.
Slide the field case upward and away from the brush holder.
Note the position of the O-ring encircling the brush holder.

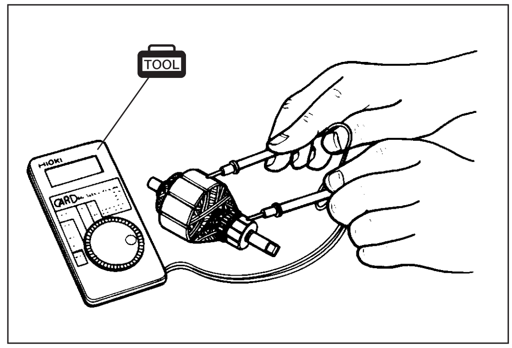
Slide the armature free of the brushes.



Inspection

Armature and Commutator

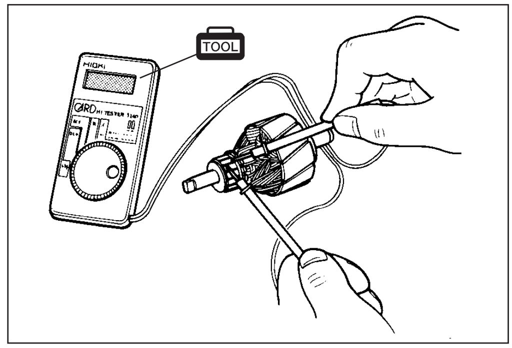
Check for continuity between the commutator and the armature core / shaft.
Replace armature if continuity is indicated.



TOOL **09930-99320 : Digital tester**

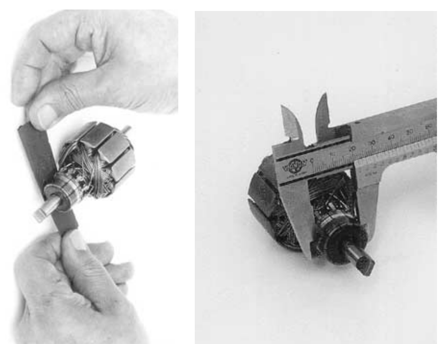
CONT **Tester range : (Continuity)**

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 grade emery paper.

Measure commutator outside diameter.



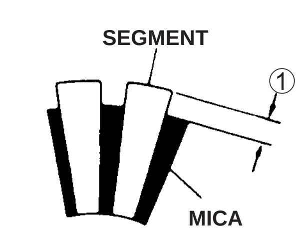
TOOL **09900-20101 : Vernier calipers**

Commutator outside diameter :

Standard	**22 mm (0.87 in.)**
Service limit	**21 mm (0.83 in.)**

If measurement exceeds service limit, replace armature.

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



① Commutator undercut

Commutator undercut :

Standard	**0.5 – 0.8 mm (0.02 – 0.03 in.)**
Service limit	**0.2 mm (0.008 in.)**

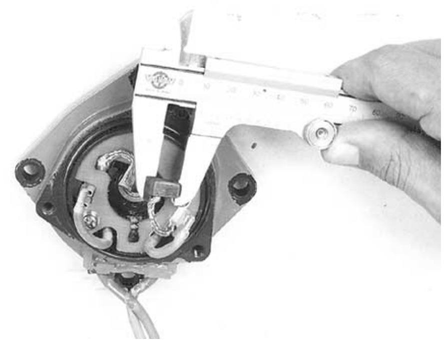
If undercut is less than service limit, cut to specified depth.

NOTE:
Remove all particles of mica and metal using compressed air.

⚠ WARNING

Wear safety grasses when using compressed air.

Brushes
Check the length of each brush.



TOOL **09900-20101 : Vernier calipers**

Brush length :

Standard	**9.8 mm (0.39 in.)**
Service limit	**4.8 mm (0.19 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 pump & reservoir. Replace if cuts, nicks or tears are found.

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

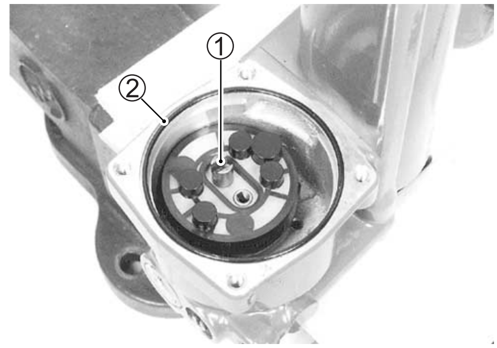
When installing the armature, exercise care not to break the brushes.

CAUTION

When installing armature, exercise care to avoid breaking brushes.

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 pump & reservoir.
- Check the level of PTT fluid contained in the pump & reservoir. 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 pump & reservoir, ensure that the tip of armature shaft fits firmly into the drive joint.

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

PTT motor screw : 6 N · m (0.6 kg-m, 4.5 lb.-ft.)

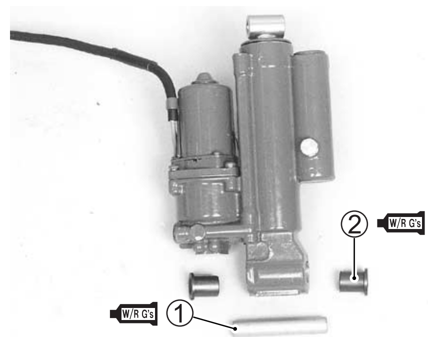
INSTALLATION

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

Lower tilt rod full down position.

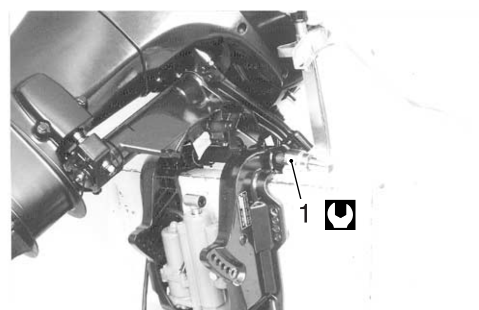
Apply Water Resistant Grease to the tilt cylinder lower shaft ① and lower shaft bushes ②.
Install lower shaft and bushes into position in the lower eyelet.

W/R G's 99000-25160 : Water Resistant Grease



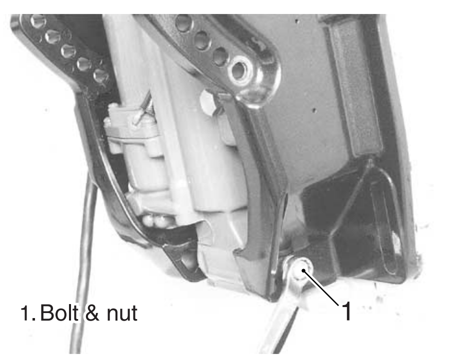
Place the PTT unit in position between the clamp brackets.
Tighten the clamp bracket shaft nut to specified torque.

Clamp bracket shaft nut :
43 N · m (4.3 kg-m, 31.0 lb.-ft.)



1. Clamp bracket shaft nut

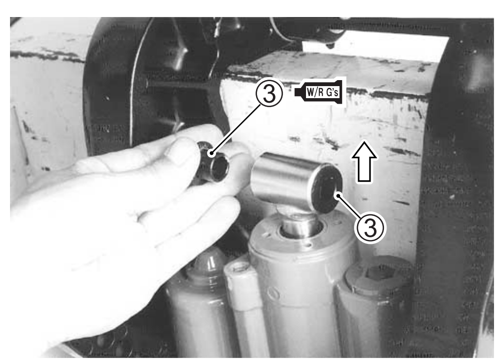
Slide the PTT cylinder lower shaft bolt through the clamp bracket and lower shaft, then secure with the nut.



1. Bolt & nut

Apply Water Resistant Grease to tilt rod upper bushes ③, then install bushs 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.

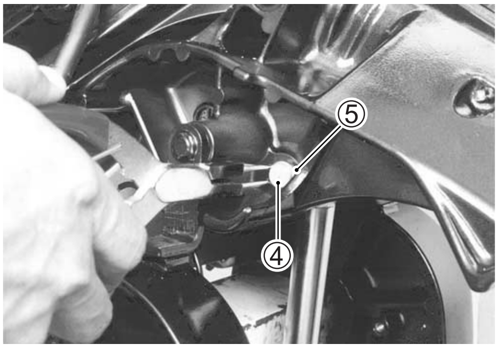
W/R G's 99000-25160 : Water Resistant Grease



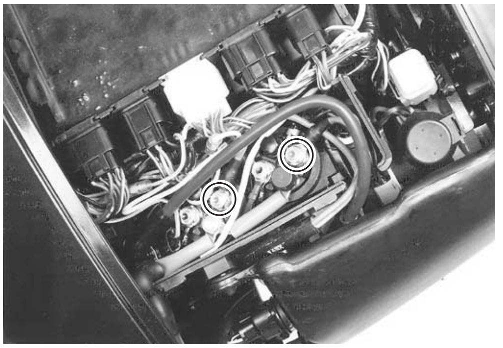
Apply Water Resistant Grease to the PTT rod upper shaft ④, then insert the shaft through the swivel bracket and tilt rod.

W/R G's **99000-25160 : Water Resistant Grease**

Secure the upper shaft with the snap ring ⑤.

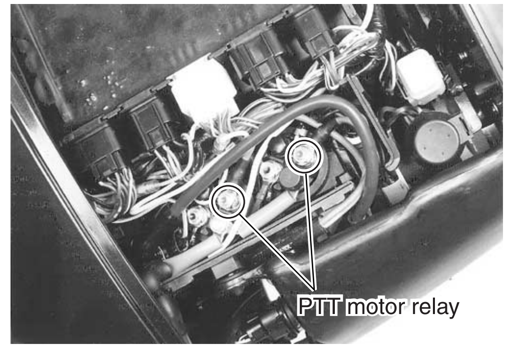


Route the PTT motor cable in through the lower cover and connect the terminals to the PTT relays.
(Cable routing–see the WIRE / HOSE ROUTING section on page 10-2 to 10-6.)

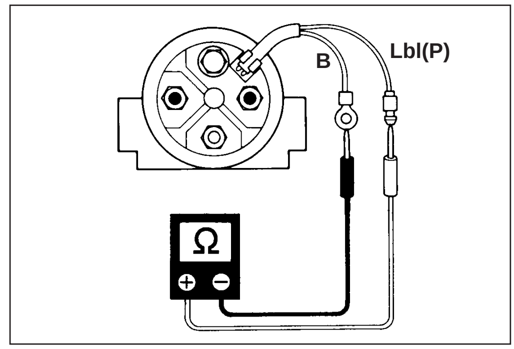


PTT MOTOR RELAY

Two methods can be used to test PTT relays.



Method 1.
Measure resistance between wiring leads of the relay.



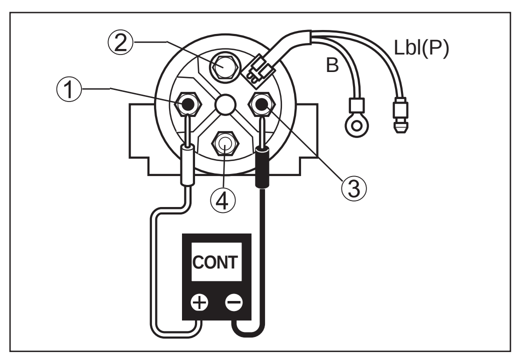
09930-99320 : Digital tester

Tester range : Ω (Resistance)

	Tester probe connection	
	Red (+)	**Black (–)**
UP	Light Blue	Black
DOWN	Pink	Black

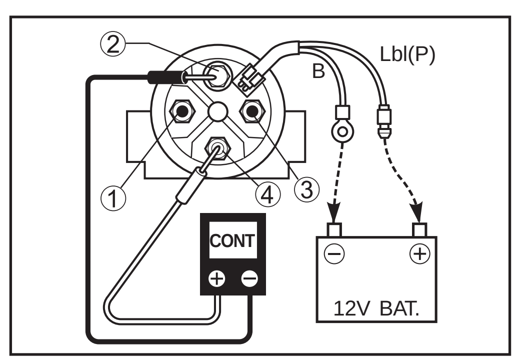
PTT relay solenoid coil resistance :
Standard 3.0 – 4.5 Ω

Method 2.
Connect the wiring leads of the relay to battery (12V) and check relay operation.



09930-99320 : Digital tester

Tester range : (Continuity)
When there is continuity between terminals ①↔②↔③, the unit is considered to be without defect.



With Black lead wire connected to the battery negative (–) terminal and Light blue or Pink lead wires are connected to battery positive (+) terminal there should be continuity between ②↔③↔④.
With the lead wires disconnected from the battery there should be no continuity between ③↔④.
The relay is considered to be without defect if continuity test results are as stated above.

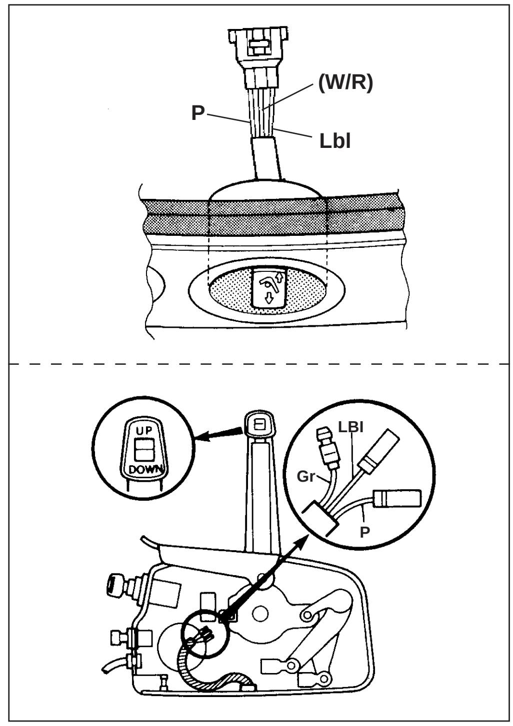
PTT SWITCH

Test continuity between the wires at each of the three switch positions.

09930-99320 : Digital tester

Tester range : (Continuity)

	Tester probe connection		Tester indicates
	Red (+)	**Black (–)**	
“DN” side depressed	Pink	Gray (White/Red)	**Continuity**
“UP” side depressed	Light Blue	Gray (White/Red)	**Continuity**
not depressed	Pink	Gray (White/Red)	**Infinity**
	Light Blue		

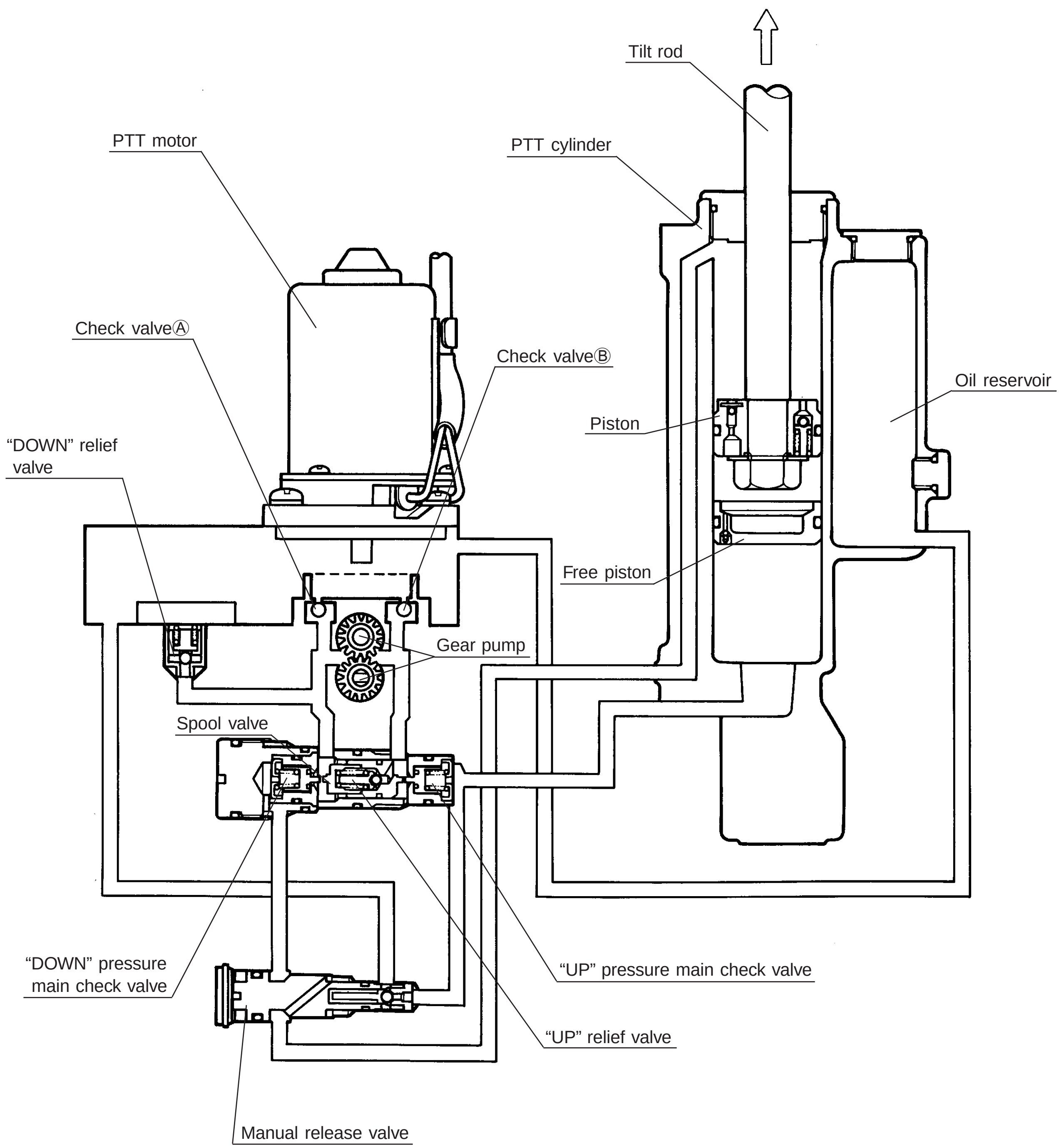


OPERATION

The power trim and tilt system is operated by a “rocker” type switch (protected by a rubber thumb pad) on top of the remote control box handle.

When the switch is depressed, power is delivered to the electric motor via the relevant relay. The relay with the Blue wire connected to the PTT pump is for trim/ tilt “up”, while the relay with the Green wire is for trim/tilt “down”.

COMPONENTS



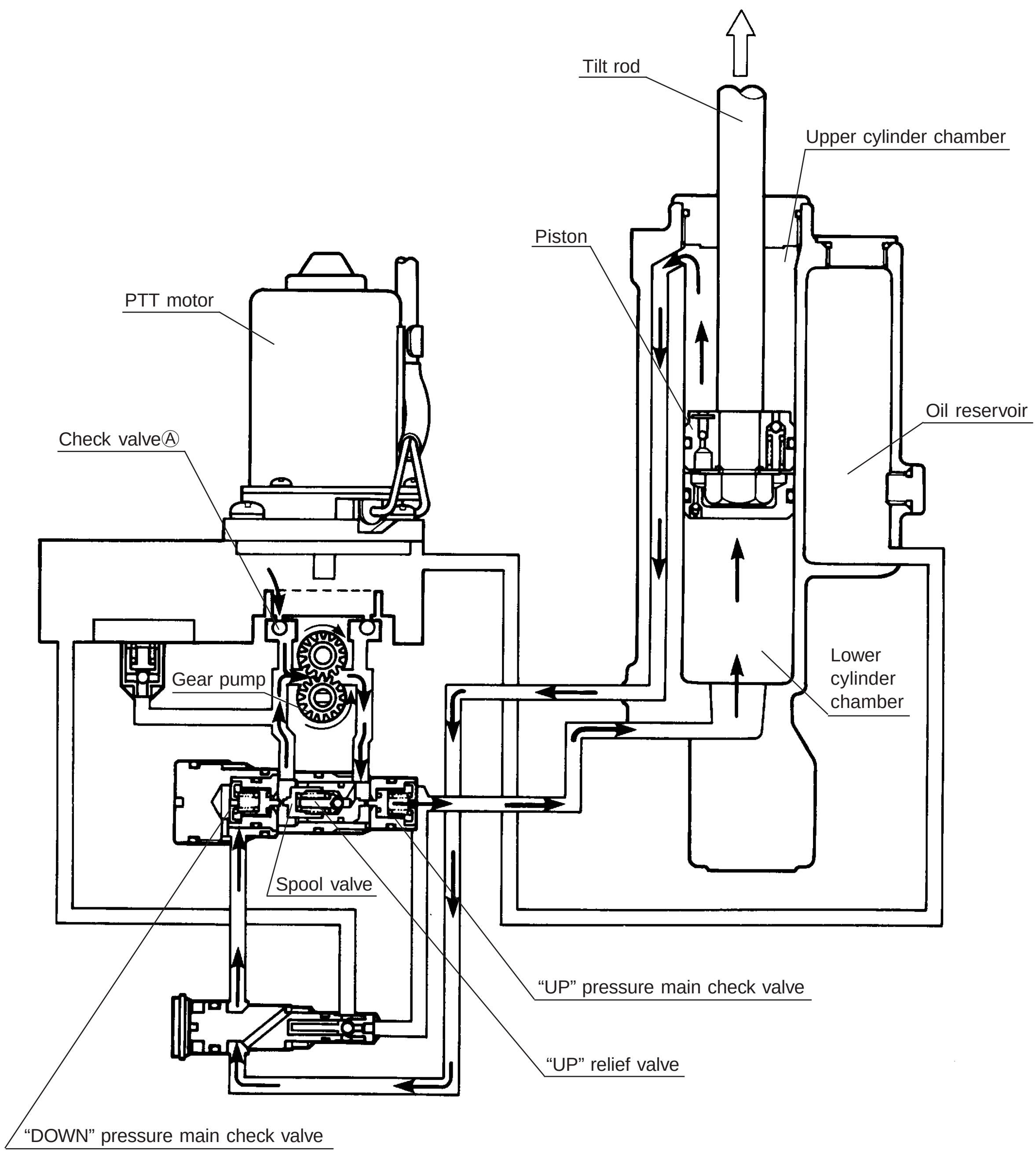
PRINCIPLES OF OPERATION

TRIM/TILT "UP" CIRCUIT

The electric motor is operating in a clockwise direction. Check valve Ⓐ will open, allowing oil to flow from the reservoir to the pump. Oil flow from the pump enters the spool valve, moving it to the left, opening the "down" pressure main check valve and returning oil from the upper cylinder chamber (plus oil from the reservoir) to the pump. Pressure built up by the pump will then open the "up" pressure main check valve and oil will enter the lower cylinder chamber.

When trim motor stops, both the "DOWN" pressure main check valve and the "up" pressure main check valve will close to retain tilt/trim position.

When full trim/tilt "up" position is attained, sustained operation of the "up" relay will have no effect, as pump oil flow will be returned to the reservoir through the "up" relief valve.

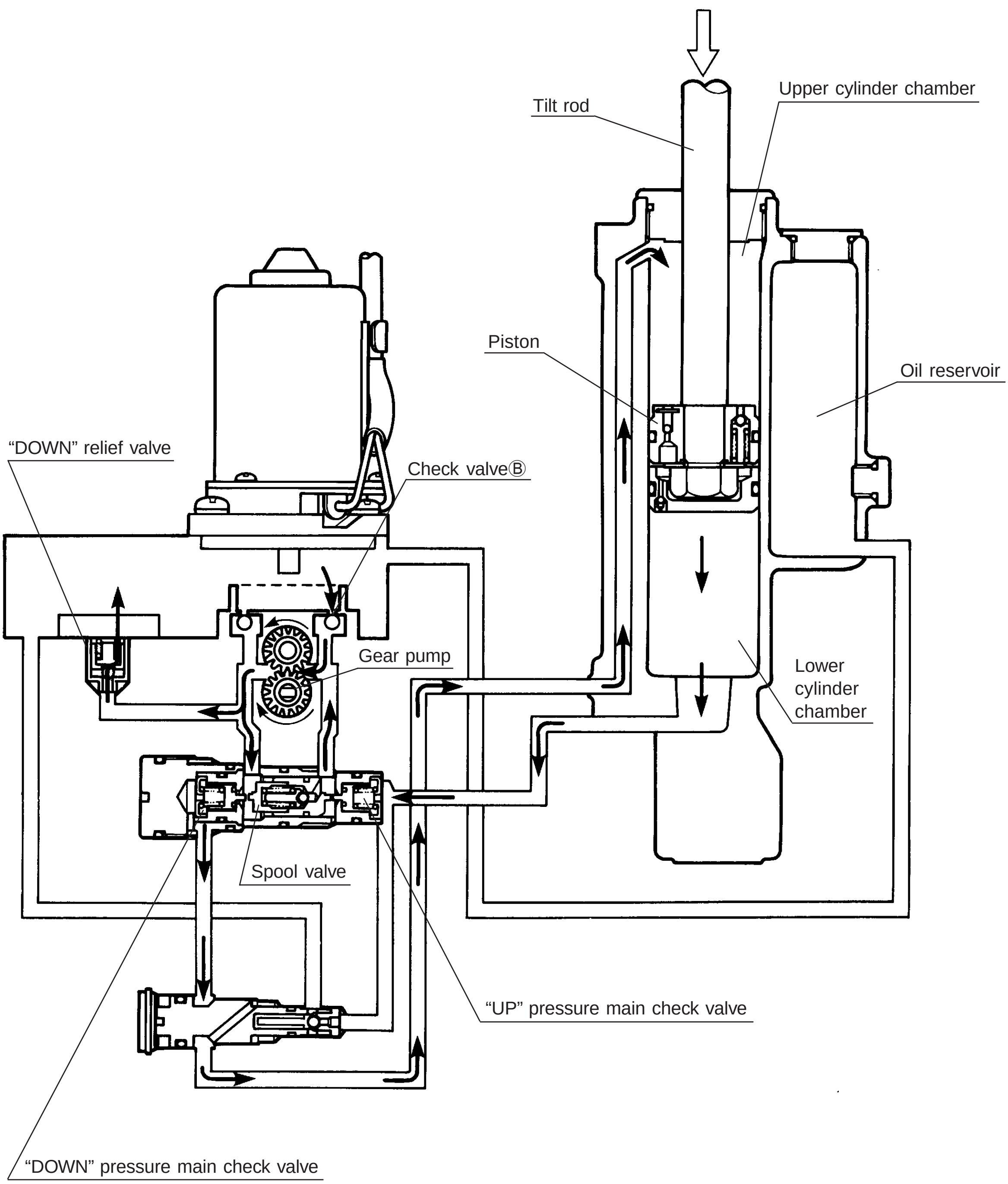


TRIM/TILT “DOWN” CIRCUIT

The electric motor is operating in a counterclockwise direction. Check valve Ⓑ will open, allowing oil to flow from the reservoir to the pump. Oil flow from the pump enters the spool valve, moving it to the right, thereby opening the “up” pressure main check valve. Oil from the lower cylinder chamber will go through the “up” pressure main check valve to the pump.

Pressure built up by the pump will open the “down” pressure main check valve and oil will enter the upper cylinder chamber. The piston will retract (move inward), which will tilt the outboard down. Oil in the lower cylinder chamber is returned to the pump through the “up” pressure main check valve.

When full “down” position is reached, continued operation of the “down” relay will have no effect, as pump oil flow will be returned to the reservoir through the “down” relief valve.



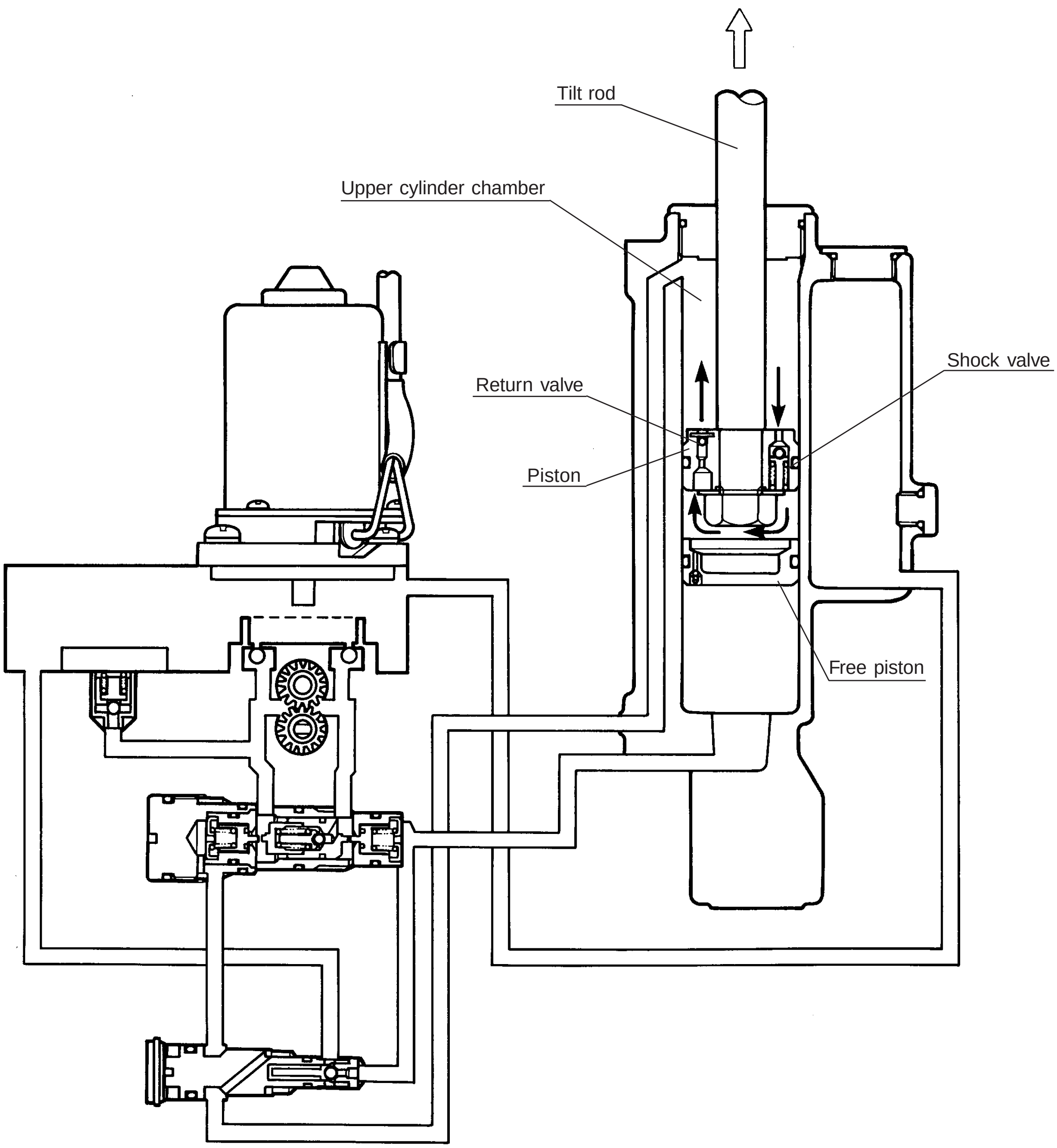
SHOCK ABSORBER CIRCUIT

(i) Shock valve

Should the lower unit strike an underwater object whilst in motion, the piston will rise abruptly, creating a sudden high impact pressure in the upper cylinder chamber. The shock valve will then open, allowing oil to flow into the area between the tilt ram piston and the free piston, thereby dampening (absorbing) the impact.

(ii) Return valve

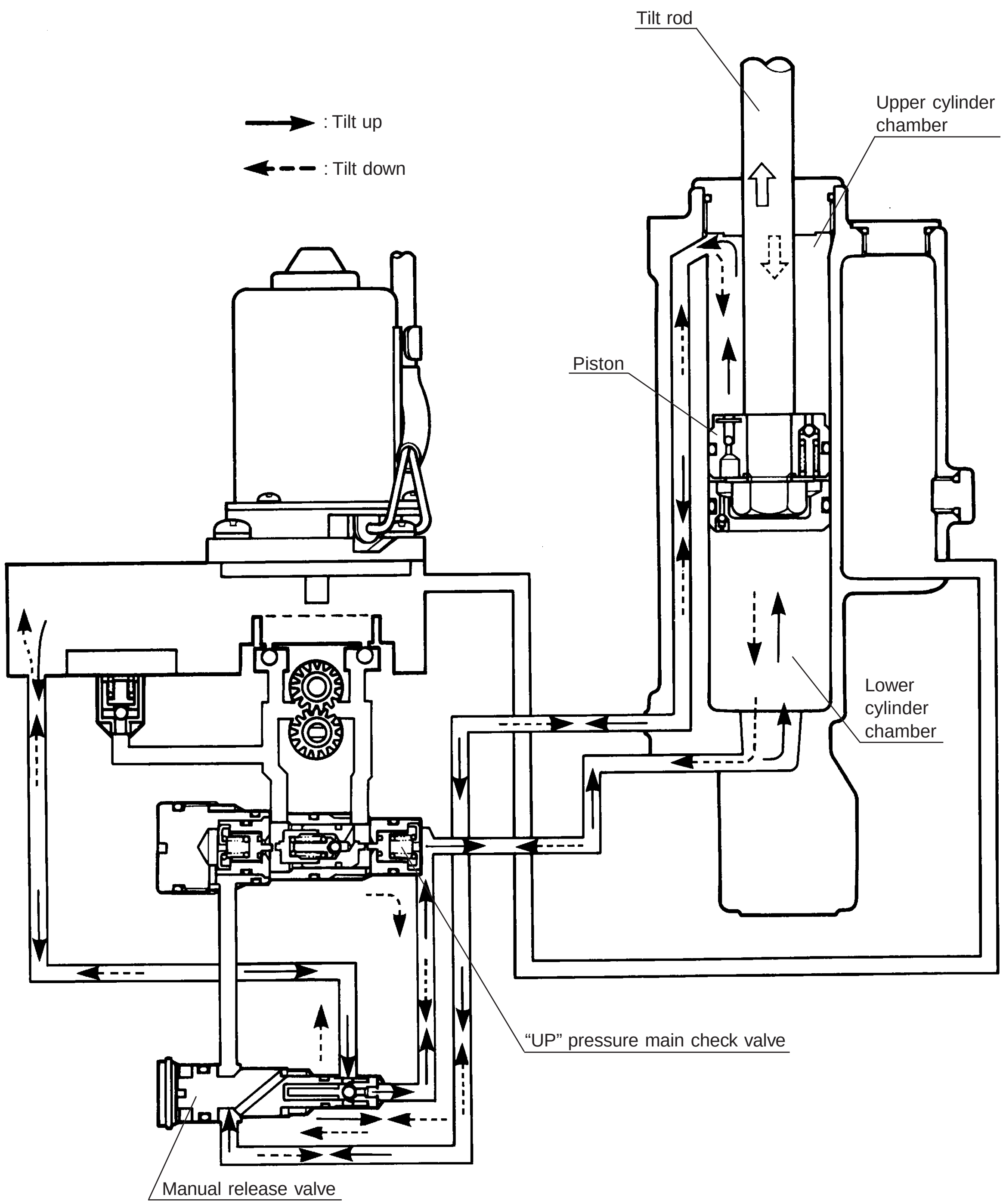
When the point of impact has passed, propeller thrust and motor weight will force the tilt ram piston back downwards. The oil from between the ram piston and the free piston is then expelled through the return valve before flowing into the upper cylinder chamber.



MANUAL RELEASE CIRCUIT (MANUAL VALVE)

Operation:Turn manual valve maximum two (2) full turns counterclockwise.

When the manual valve is loosened, oil will flow unimpeded (without resistance) through the internal pump tubes, thereby facilitating manual tilting or lowering of the outboard. To hold the engine in a selected position, the manual valve must be closed again.

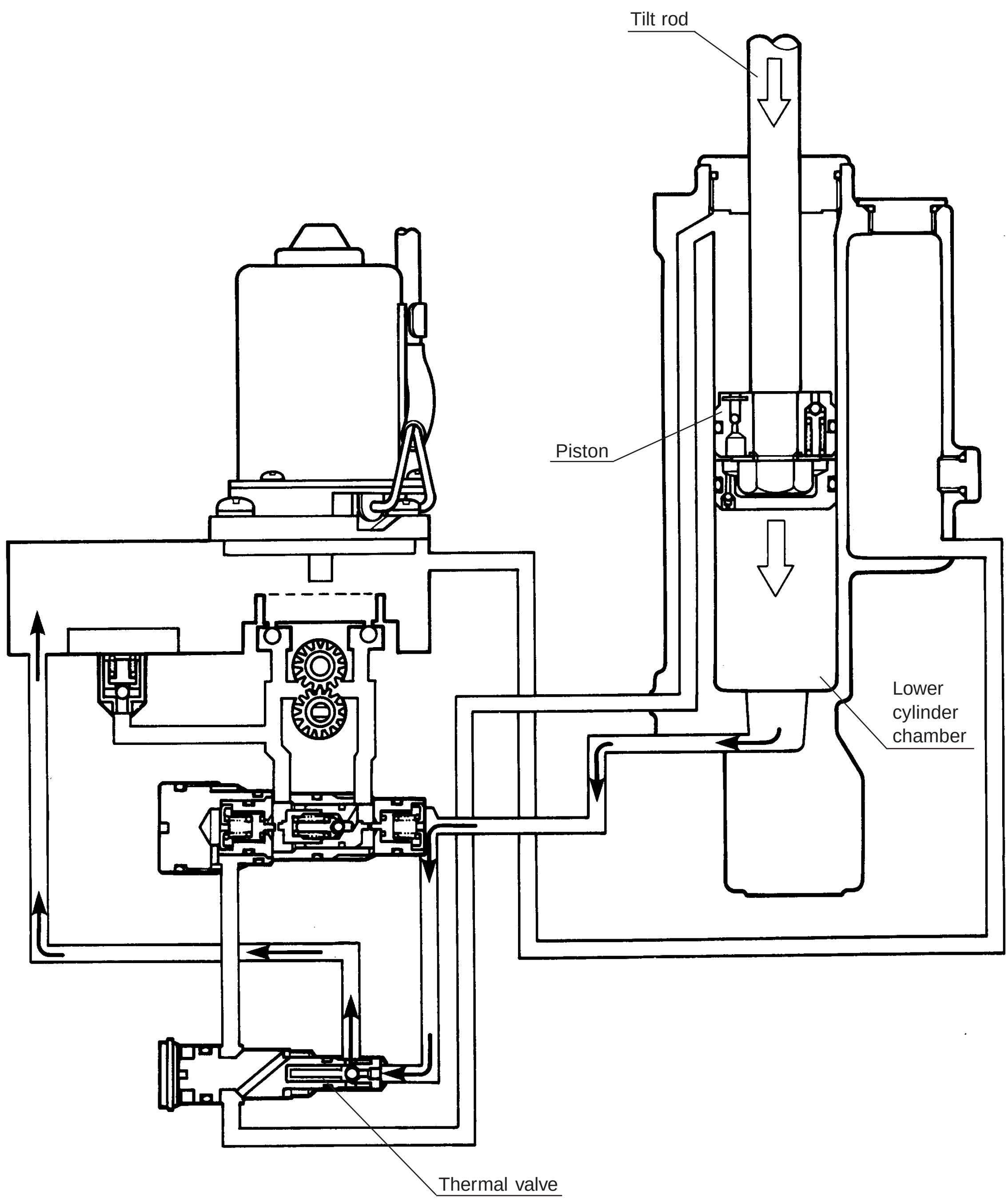


THERMAL VALVE

The PTT system incorporates a thermal valve for protection of the internal components, should excessive downward force be exerted on the lower unit with the motor in a tilted position, or (in the case of an impact in reverse gear), the outboard clamp/swivel brackets and the boat transom.

Should the propeller strike an underwater object whilst in reverse gear, a build up of pressure will be induced in the lower cylinder chamber, whereby the outboard mounting bracket and/or the boat transom may sustain damage. To prevent this, the thermal valve will open to relieve the oil pressure, thereby softening the impact.

Internal PTT circuits are protected, as the thermal valve will open to reduce oil pressure (caused by either hot climate or abnormally heavy usage).



LOWER UNIT

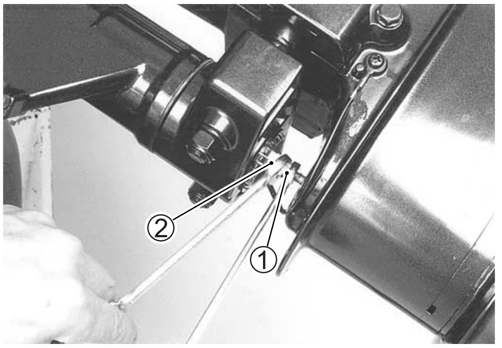
CONTENTS

REMOVAL & DISASSEMBLY

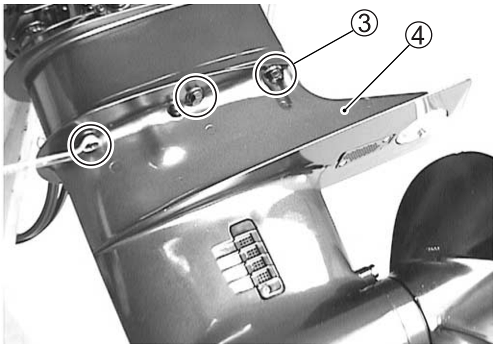
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

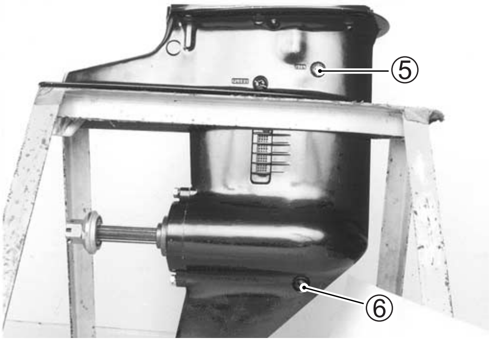
To separate the clutch rod from the shift rod, loosen the clutch rod lock nut ①, then unscrew the turnbuckle ②.



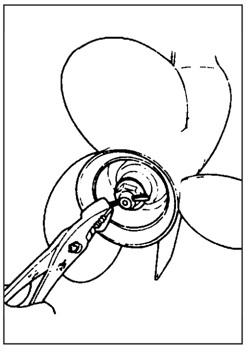
Remove six(6) bolts ③ and separate gearcase ④ from driveshaft housing.

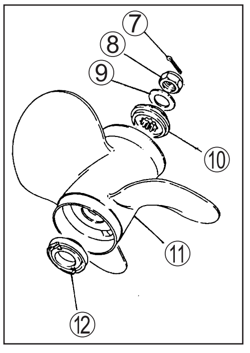


Place a drain pan under the oil drain plug.
Remove oil drain plug first ⑥ then oil level plug ⑤ and allow gear oil to drain.



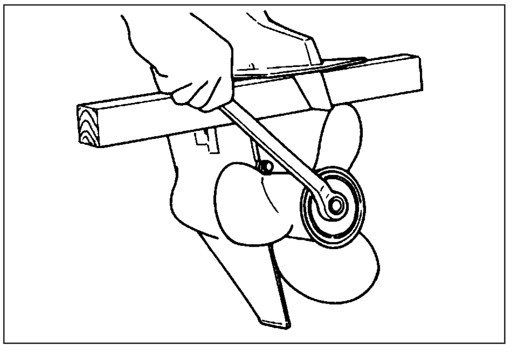
Remove cotter pin ⑦ from propeller nut and remove propeller nut ⑧.
Remove washer ⑨, spacer ⑩, propeller ⑪ and stopper ⑫ from the propeller shaft.



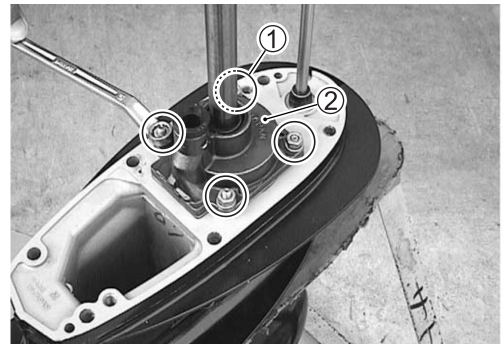


⚠ WARNING

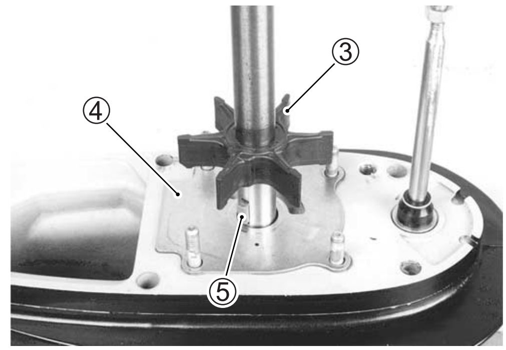
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti - cavitation plate and the propeller blade tips to lock the propeller in place.



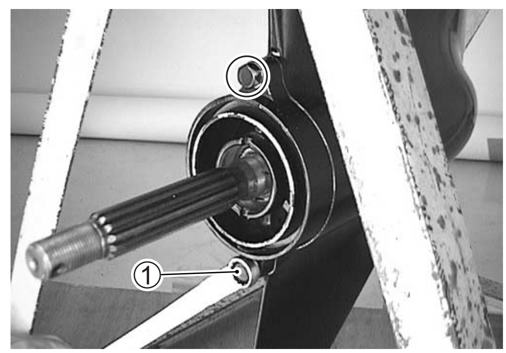
Loosen the four(4) nuts ①, then remove the water pump case ②, impeller ③, and pump under plate ④.



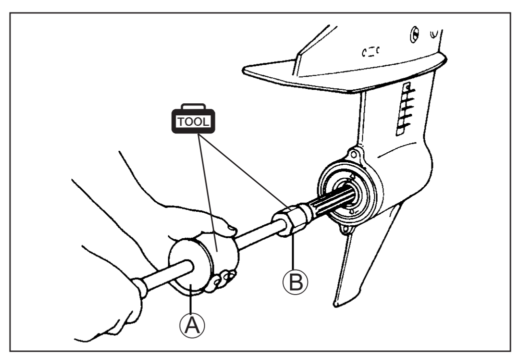
Keep the impeller key ⑤ for reuse and discard the plate gasket.



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

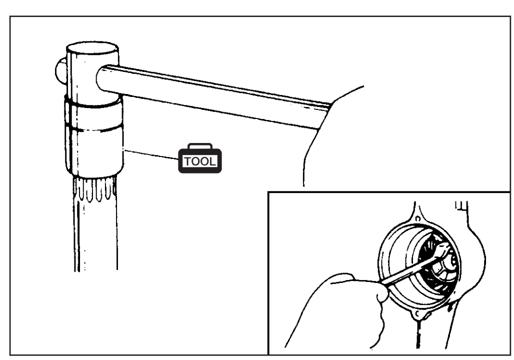


Using special tools, draw out the propeller shaft bearing housing.
Remove the propeller shaft and bearing housing assembly.



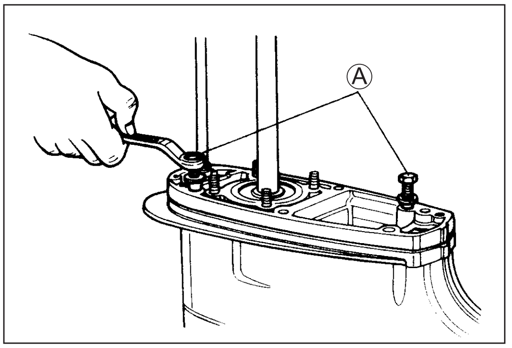
TOOL **09930-30104 : Ⓐ Sliding hammer**
09930-30161 : Ⓑ Propeller shaft remover

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

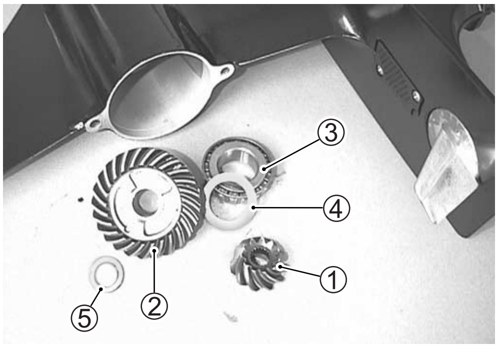


TOOL **09921-29510 : Driveshaft holder**

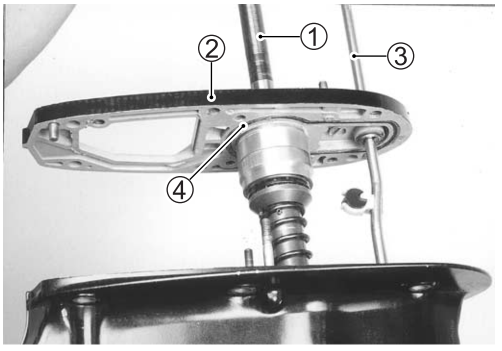
To separate the bearing housing from the gearcase, use two (2) 8mm bolts Ⓐ as screw jacks, by alternately turning each one equally.
This will keep the housing level as it pushed off the gearcase.



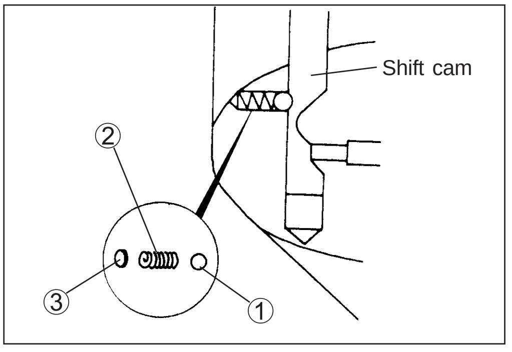
Remove the pinion gear ①.
Remove the forward gear ② (with thrust washer ⑤, back-up shim ④ and bearing ③)



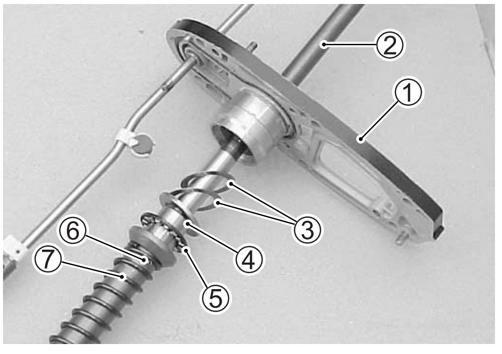
Lift out driveshaft ①, driveshaft bearing housing ② and shift rod assembly ③.
Account for the seal ④ on the driveshaft bearing housing.



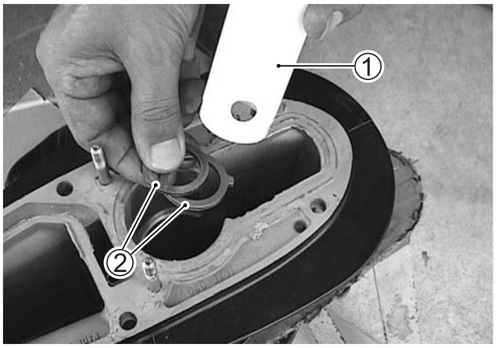
Remove the detent ball ①, spring ② and plate ③.



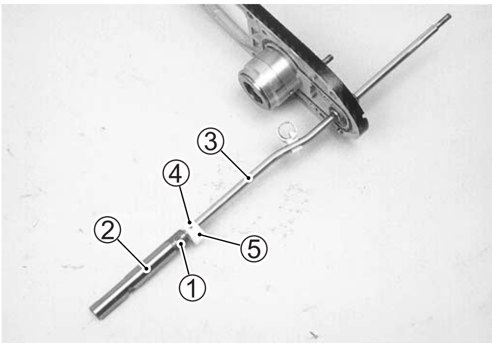
Remove driveshaft ② from driveshaft bearing housing ① and take off shim ③, thrust washer ④ and thrust bearing ⑤.
Pull out the spring pin ⑥, then remove the preload spring ⑦.



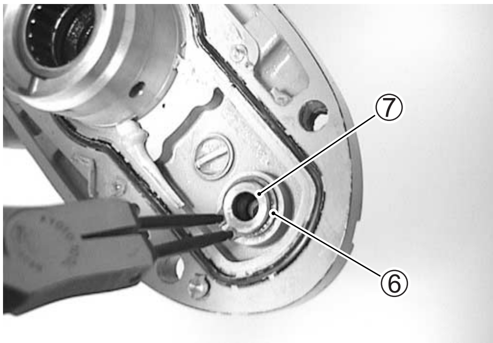
Remove the spring collar ① and two driveshaft thrust washers ② from the gear case.



Slide the shift rod out of the shift rod guide.
Separate the shift cam ② from the shift rod ③ by driving out the spring pin ①.
Remove the lower shift rod guide ⑤ by driving out the spring pin ④.

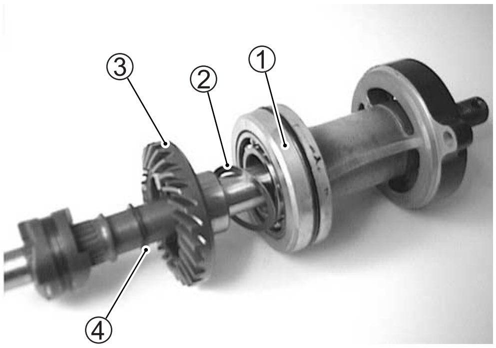


Remove the snap ring ⑥ and push shift rod guide ⑦ out of bearing housing.



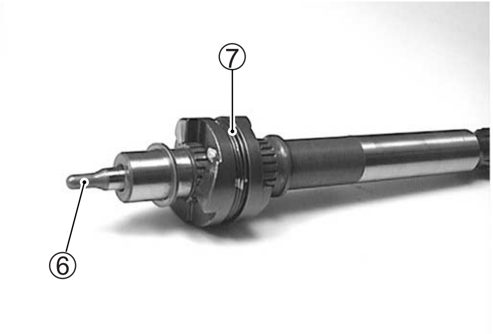
Disassembly of propeller shaft components

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.

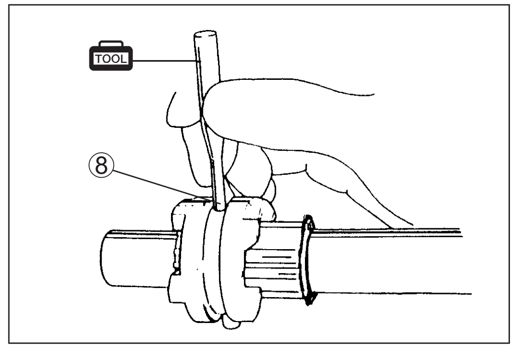


To disassemble propeller shaft components, refer to the following :

(a) Pull the push rod ⑥ out of the propeller shaft.
(b) Remove the spring ⑦ from the clutch dog shifter.

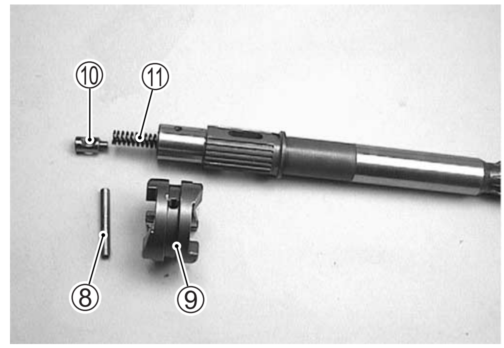


(c) Use special tool to push the dog pin ⑧ out of the clutch dog shifter.



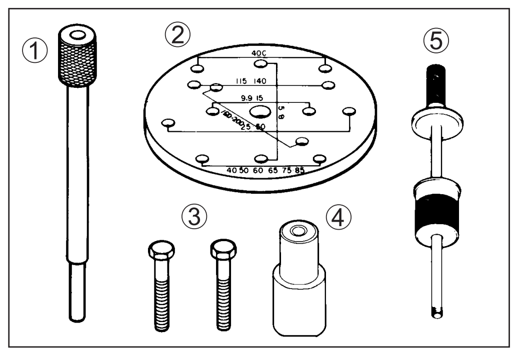
TOOL **09922-89810 : Shift pin remover**

(d) Remove the clutch dog shifter ⑨, push pin ⑩, and return spring ⑪ from propeller shaft.



PINION BEARING

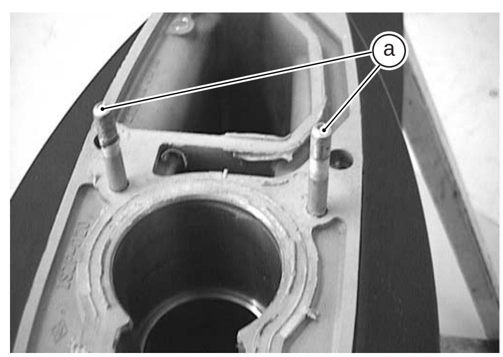
Removal & Installation Tools



TOOL **09951-59910 : Shaft (removal & installation) ①**
09951-39914 : plate ②
01500-08403 : Bolt ③
09951-19431 : Attachment ④
09930-30104 : Sliding hammer ⑤

REMOVAL

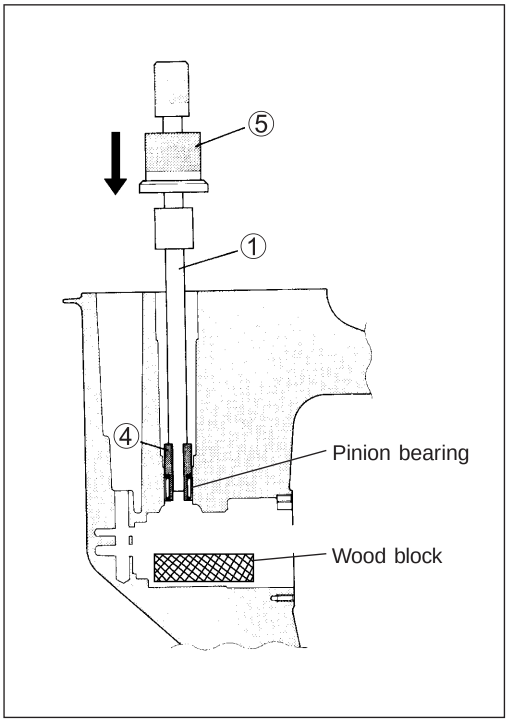
1. Remove the water pump stud bolts ⓐ.



2. Place the attachment ④ inside the pinion bearing.
3. Insert the removal shaft ① into attachment.
4. Thread sliding hammer ⑤ into top of removal shaft.
5. Put wood block under pinion bearing.
6. Drive the pinion bearing out by striking top of shaft with sliding hammer.

CAUTION

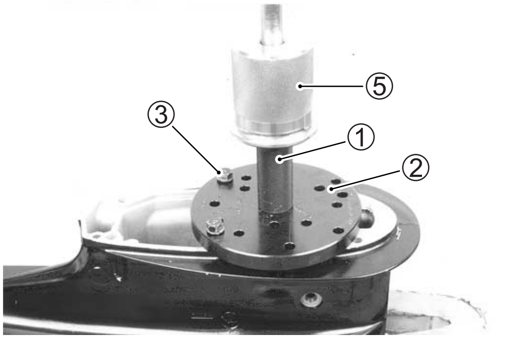
When removing the pinion bearing, use care to avoid damaging the gearcase.



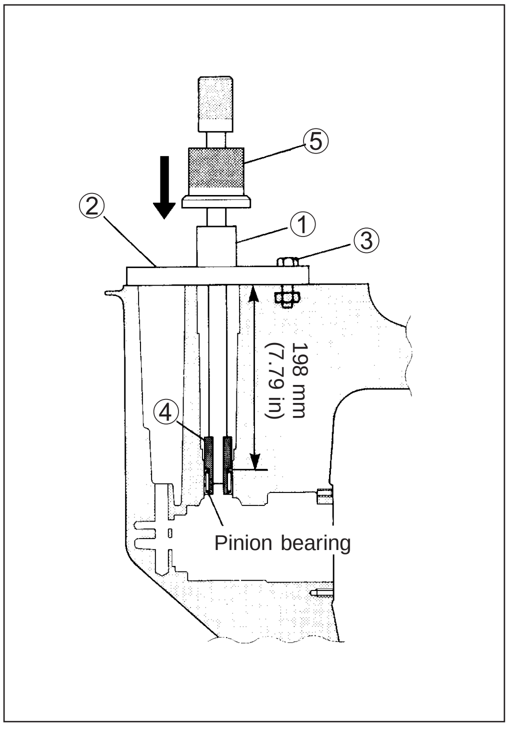
INSTALLATION

CAUTION

Before installing bearing, ensure that inside of gear case is clean and free of debris.



7. Set the installer shaft ①, plate ②, attachment ④ and pinion bearing as shown.
8. Place the installer shaft (with pinion bearing on end of installer) into the gearcase.
9. Secure the plate ② by tightening the bolts ③.
10. Thread the sliding hammer ⑤ into the top of the installer shaft.
11. Drive the bearing down into position by gently striking the installer shaft until the coupler touches the plate.



INSPECTION

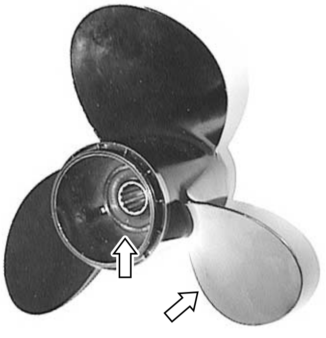
NOTE:
If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

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

⚠ WARNING

Wear safety grasses 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.

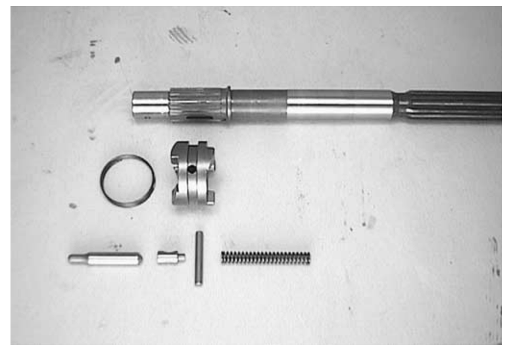
NOTE:
If removal and replacement are required, see the “PINION BEARING” section on page 9-5.

GEAR

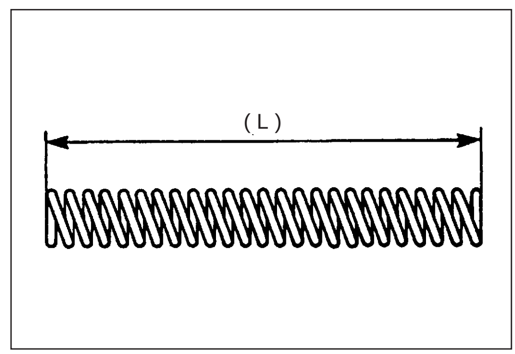
- Inspect forward, reverse and pinion gear teeth and engaging dogs.
  Replace gears if damaged or worn.

- Inspect forward gear bearing. Replace bearing if pitted, noisy or rough.

PROPELLER SHAFT COMPONENTS



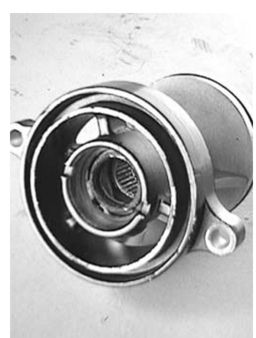
- Inspect push rod, replace if worn, broken, or tip is flattened.
- Inspect clutch dog shifter. Replace if chipped, worn or damaged.
- Inspect dog pin. Replace if bent or worn.
- Inspect propeller shaft / splines. Replace if worn, twisted or damaged.



- Check clutch return spring by measuring its free length.
  If free length is not within specifications, replace the return spring.

Clutch return spring free length (L)
Standard : 62 mm (2.44 in.)
Service limit : 60 mm (2.36 in.)

PROPELLER SHAFT BEARING HOUSING




- Inspect housing. Replace if cracked or damaged.
- Inspect reverse 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.

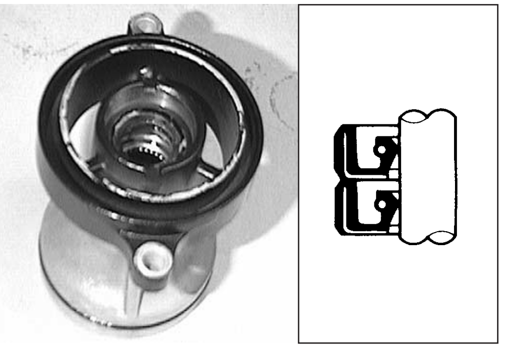
Replacing propeller shaft oil seal

1. Extract the seals with oil seal remover.

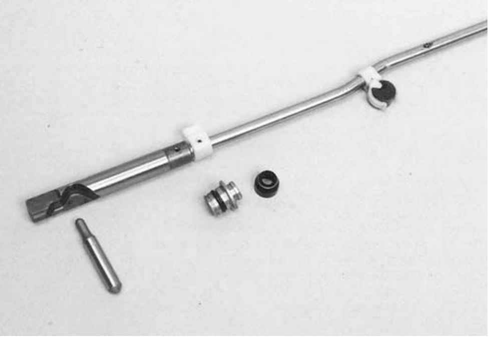
TOOL **09913-50121 : Oil seal remover**

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

3. 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.



SHIFT ROD AND SHIFT CAM



- Inspect the “stepped” surfaces of the shift cam.
  Replace if chipped, damaged or excessively worn.
- Inspect shift rod guide. Replace if pitted, stiff or corroded.
- Inspect O-ring. Replace if nicked, cut or torn.
- Inspect shift rod boot. Replace if cracked or damaged.

WATER PUMP AND RELATED ITEMS

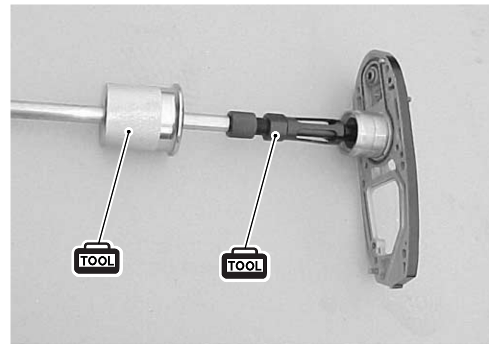
- Inspect impeller. Replace if vanes are cut, torn or worn.
- Inspect pump case. Replace if cracked, distorted or corroded.
- Inspect under panel. Replace if cracked, distorted or corroded.

DRIVESHAFT BEARING HOUSING

- Inspect housing. Replace if cracked or damaged.
- Inspect bearing. Replace if pitted, noisy or rough.

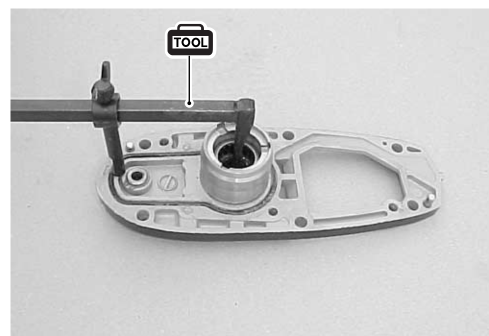
- Check condition of oil seals. Replace if nicked, cut or worn.

Replacing driveshaft oil seal



1. Using bearing remover, draw the driveshaft bearing out of the driveshaft housing.

09923-74510 : Bearing remover

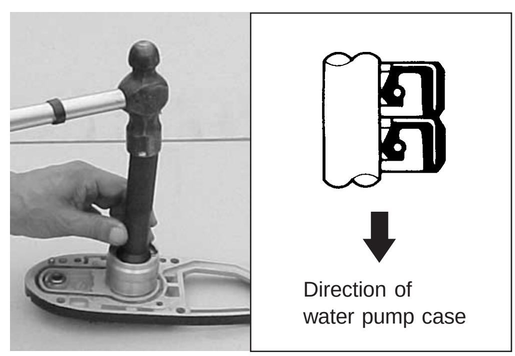


2. With the oil seal remover, draw the two oil seals out of the driveshaft bearing housing.

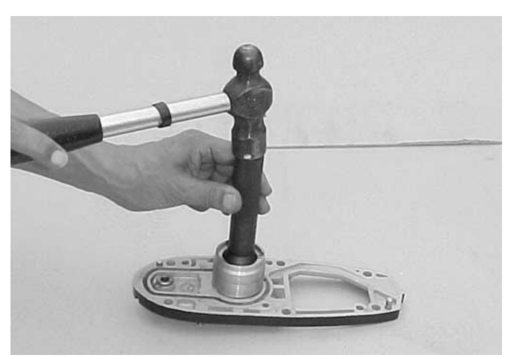
09913-50121 : Oil seal remover

3. Apply Water Resistant Grease to the inner circumference of the driveshaft bearing housing.

99000-25160 : Water Resistant Grease



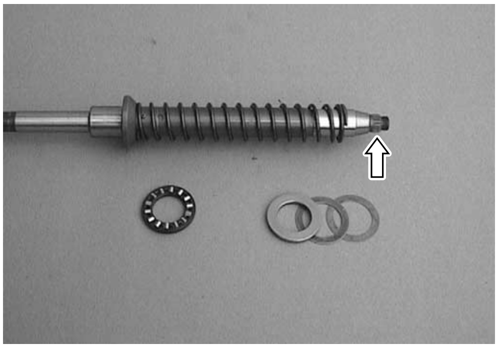
4. Grease the inner lips of the seal.
   With the lips facing away from driveshaft bearing, place seal in position and drive it into the bearing housing.



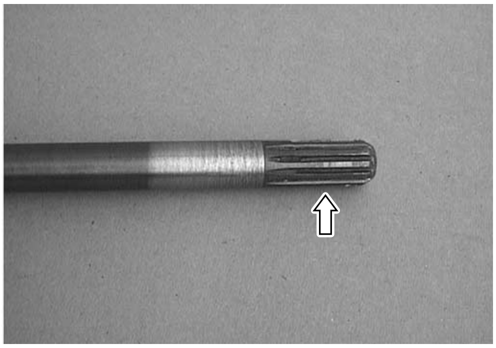
5. Place the driveshaft bearing in position and drive it into the bearing housing.

DRIVESHAFT

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

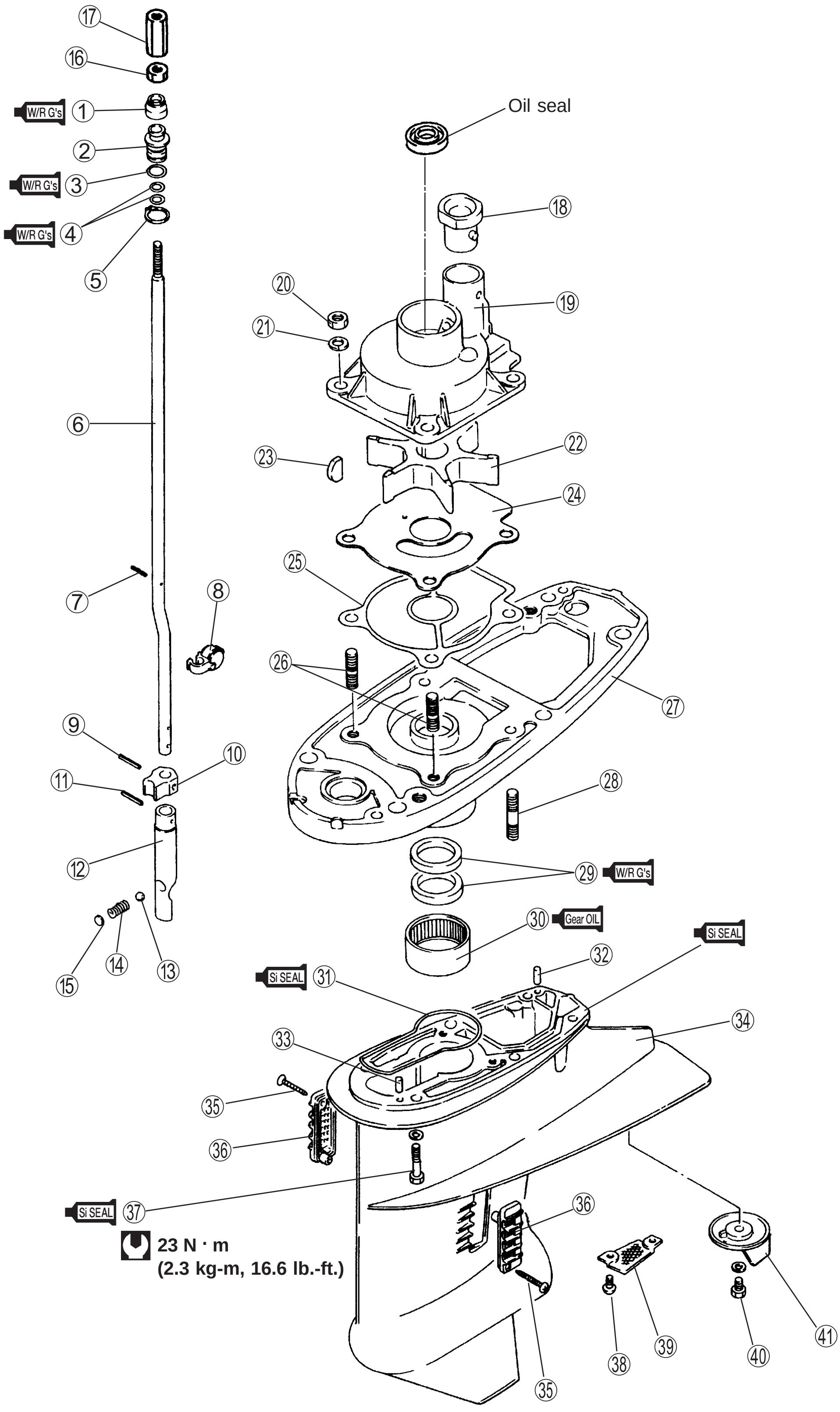


Inspect driveshaft bearing, replace if pitted, noisy or rough.

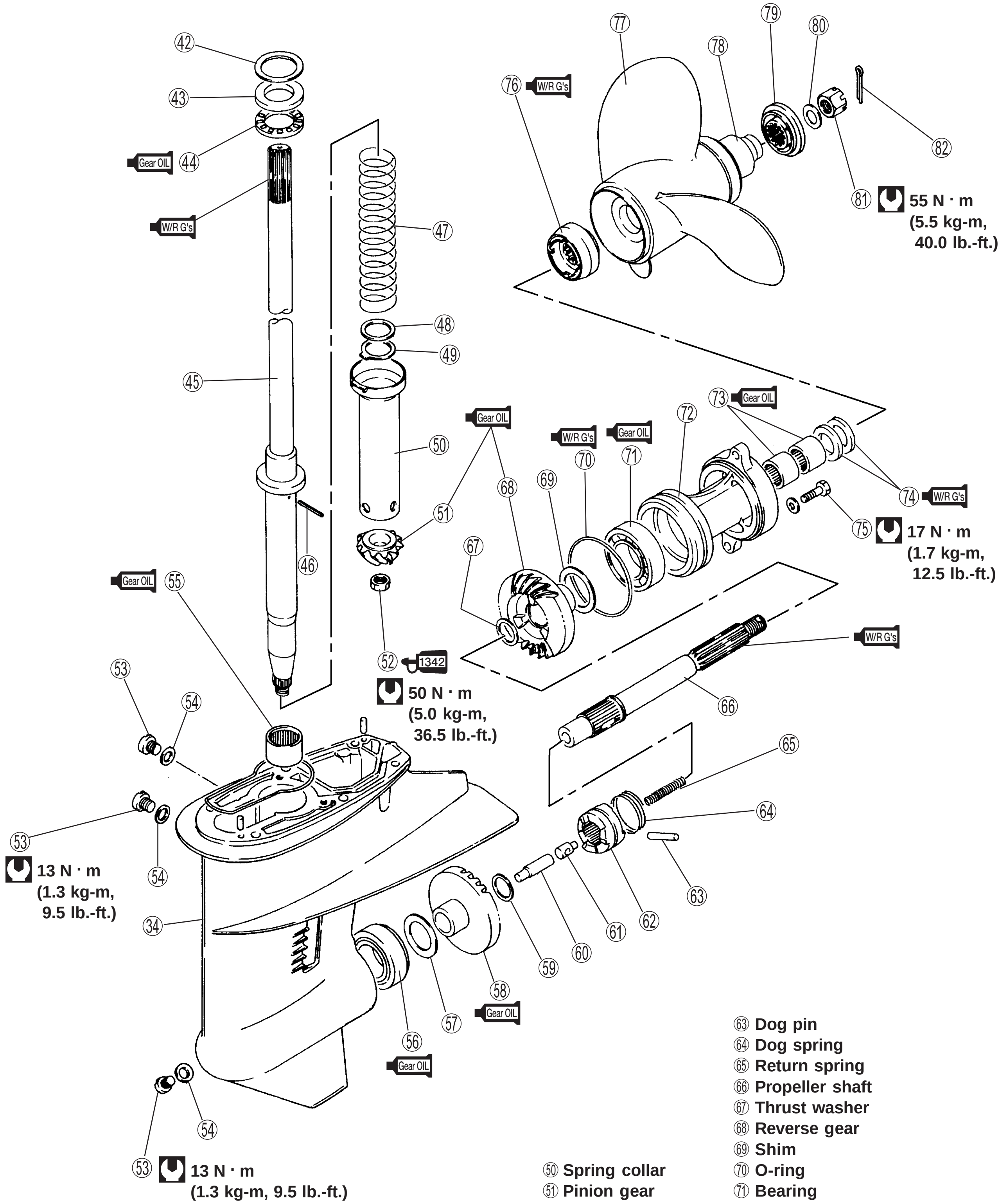


ASSEMBLY & INSTALLATION

Assembly & Installation are reverse of disassembly with special attention to following steps.



① Dust boot
② Shift rod guide
③ O-ring
④ O-ring
⑤ Circlip
⑥ Shift rod
⑦ Pin
⑧ Magnet set
⑨ Pin
⑩ Shift rod lower guide
⑪ Pin
⑫ Shift cam
⑬ Ball
⑭ Spring
⑮ Notch plate
⑯ Nut
⑰ Turnbuckle
⑱ Grommet
⑲ Water pump case
⑳ Nut
㉑ Lock washer
㉒ Water pump impeller
㉓ Key
㉔ Pump case under panel
㉕ Gasket
㉖ Stud bolt
㉗ Driveshaft bearing housing
㉘ Stud bolt
㉙ Oil seal
㉚ Bearing
㉛ Seal ring
㉜ Pin
㉝ Pin
㉞ Gear case
㉟ Screw
㊱ Water filter
㊲ Bolt w/washer
㊳ Screw
㊴ Sub water filter
㊵ Bolt
㊶ Trim tab



- ㊷ Shim
- ㊸ Washer
- ㊹ Bearing
- ㊺ Driveshaft
- ㊻ Spring pin
- ㊼ Pre-load spring
- ㊽ Washer
- ㊾ Washer
- ㊿ Spring collar
- 51 Pinion gear
- 52 Pinion nut
- 53 Plug
- 54 Gasket
- 55 Pinion bearing
- 56 F, gear bearing
- 57 Shim
- 58 Forward gear
- 59 Thrust washer
- 60 Push rod
- 61 Push pin
- 62 Clutch dog shifter
- 63 Dog pin
- 64 Dog spring
- 65 Return spring
- 66 Propeller shaft
- 67 Thrust washer
- 68 Reverse gear
- 69 Shim
- 70 O-ring
- 71 Bearing
- 72 Propeller shaft bearing housing
- 73 Bearing
- 74 Oil seal
- 75 Bolt
- 76 Stopper
- 77 Propeller
- 78 Propeller Bush
- 79 Spacer
- 80 Washer
- 81 Nut
- 82 Pin

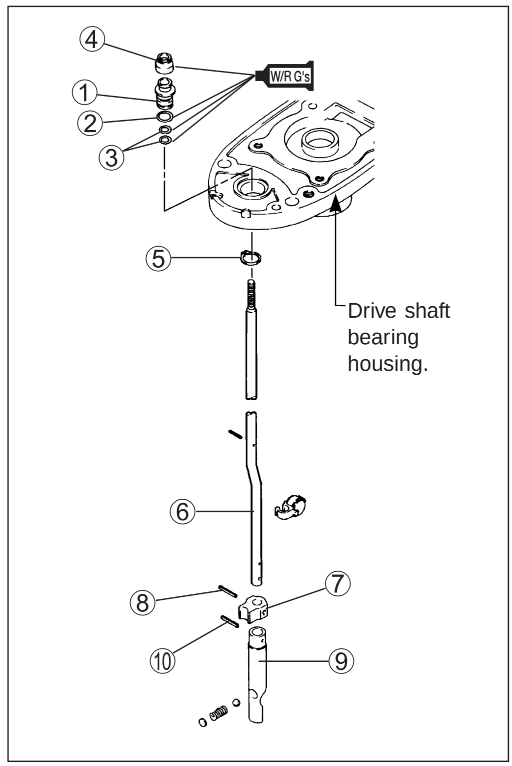
CAUTION

- **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 9-23)

SHIFT CAM AND SHIFT ROD

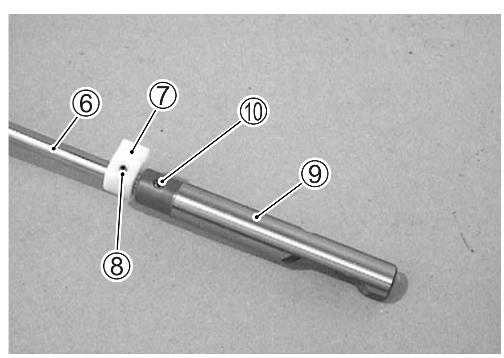
Apply Water Resistant Grease to the shift rod guide O-ring ②, ③ and the inside of the dust boot ④.

Slide complete dust boot ④ and shift rod guide ① into the drive shaft bearing housing, then secure it with the snap ring ⑤.



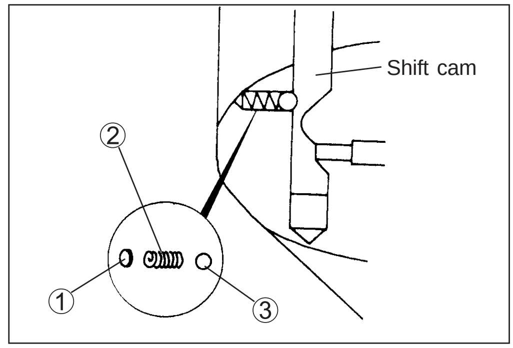
Attach lower shift rod guide ⑦ to shift rod ⑥, then secure it with the pin ⑧.
Attach shift cam ⑨ to shift rod, then insert pin ⑩.

Slide the shift rod through shift rod guide.



DETENT BALL

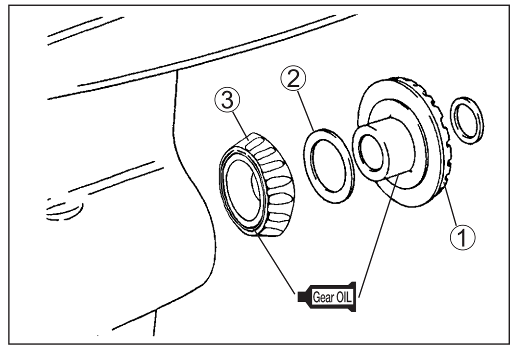
Insert the plate ①, spring ② and detent ball ③ into gearcase.



FORWARD GEAR

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

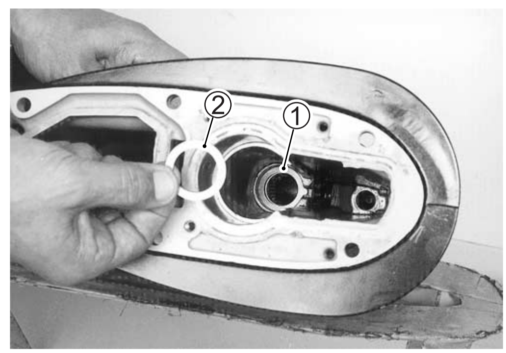
Gear OIL **99000-22540 : Suzuki Outboard Motor Gear Oil**



DRIVESHAFT THRUST WASHERS

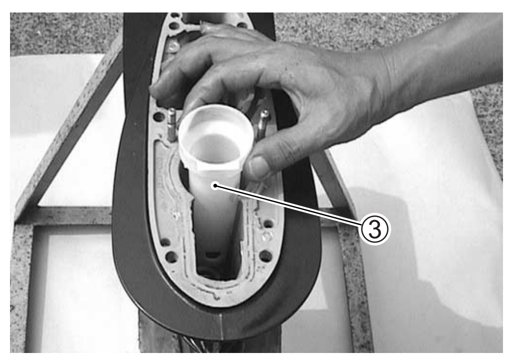
Install the two driveshaft thrust washers ①, ②.

The lower washer(with the tab) is located as shown.



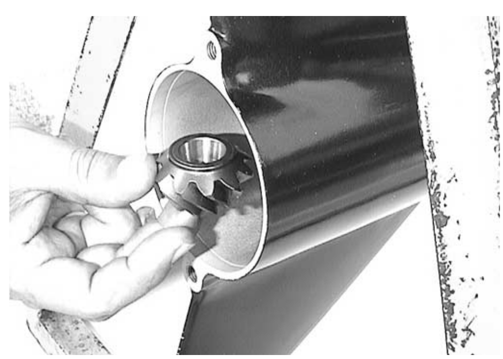
DRIVESHAFT SPRING COLLAR

Install the collar ③ on top of the two thrust washers.



PINION GEAR

Place pinion gear in gearcase.

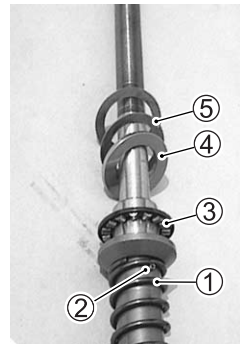


DRIVESHAFT

Slide on the pre-load spring ① and secure it with the pin ②.

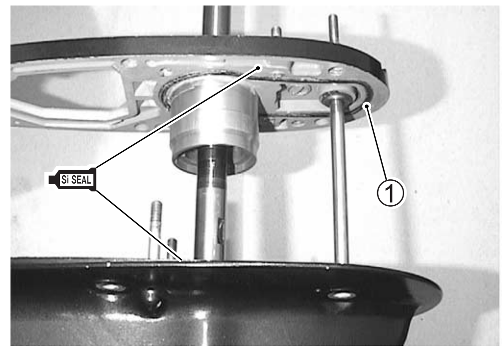
Assemble the thrust bearing ③, washer ④ and pinion shim ⑤ to the driveshaft.

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



DRIVESHAFT BEARING HOUSING

Apply Water Resistant Grease to the driveshaft oil seal.



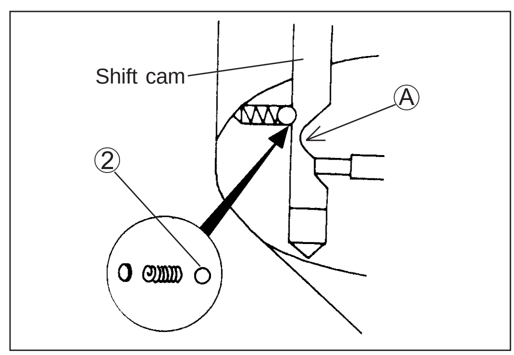
W/R G's **99000-25160 : Water Resistant Grease**

Install the gearcase seal ring ① into the groove on the driveshaft bearing housing.
Apply Suzuki Silicone Seal to gearcase and driveshaft bearing housing surfaces.

Si SEAL **99000-31120 : Suzuki Silicone Seal**

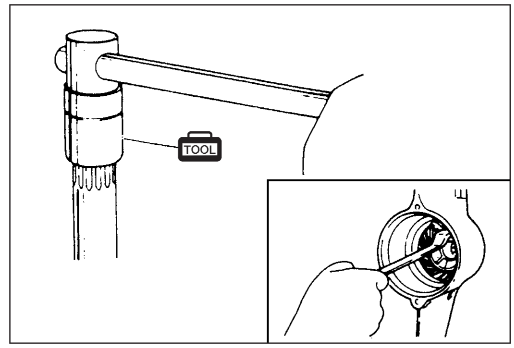
Install complete housing and shift rod assembly on gearcase.

NOTE:
Be sure the stepped section Ⓐ of shift cam faces towards propeller shaft.
Also be sure the rear side of the shift cam (with detent notch) is positioned over the detent ball ② in the gearcase.



PINION NUT

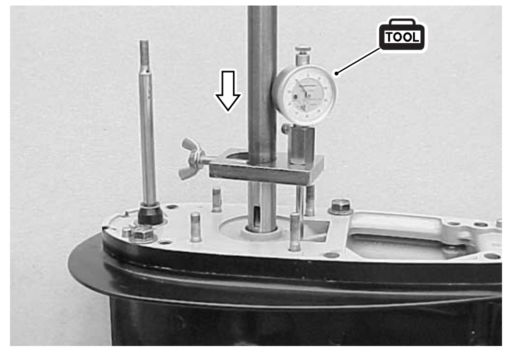
Apply Thread Lock 1342 to the threads of the pinion nut before threading it onto the driveshaft.
Tighten nut to the specified torque.



Pinion nut : 50 N · m (5.0 kg-m, 36.2 lb.-ft.)
1342 **99000-32050 : Thread Lock 1342**
TOOL **09921-29510 : Drive shaft holder**

CHECKING DRIVESHAFT THRUST PLAY

Before installing reverse gear, driveshaft thrust play should checked.
(See the "GEARS-SHIMMING AND ADJUSTMENT / CHECKING DRIVESHAFT THRUST PLAY" section on page 9-26)

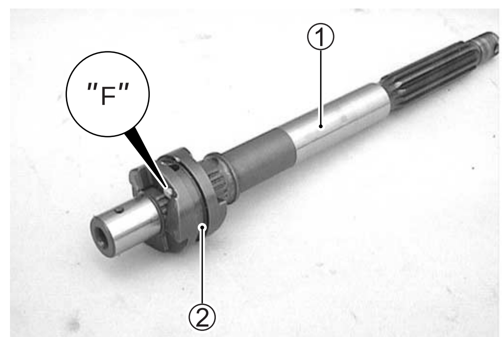


TOOL **09951-09511 : Gear adjusting gauge**

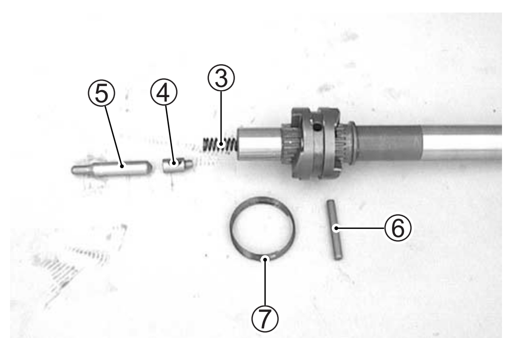
PROPELLER SHAFT

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 forward gear is marked with the letter "F".



Insert the return spring ③ , push pin ④ and push rod ⑤ into propeller shaft.

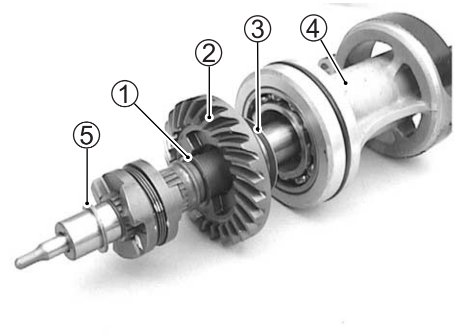


Align the holes in the shifter dog and push pin. Depress the push rod and slide the dog pin ⑥ through both dog and push pin.

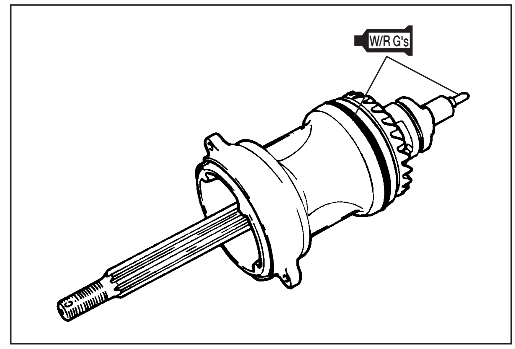
Install the dog pin retaining spring ⑦, ensuring that it fits snuggly into the groove on the dog shifter.

PROPELLER SHAFT / BEARING HOUSING

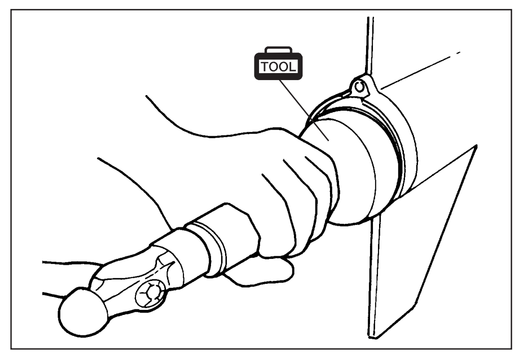
Assemble the propeller shaft in the following sequence : forward thrust washer ⑤, reverse thrust washer ①, reverse gear ②, reverse gear back-up shim ③ and propeller shaft housing ④.



W/R G's **99000-25160 : Water Resistant Grease**
Gear OIL **99000-22540 : Suzuki Outboard Motor Gear Oil**

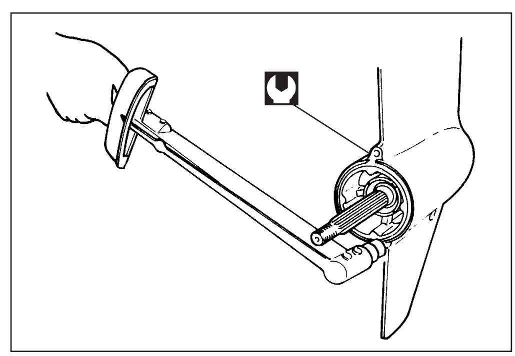


Using special tools, install the propeller shaft and housing assembly in the gear case.



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

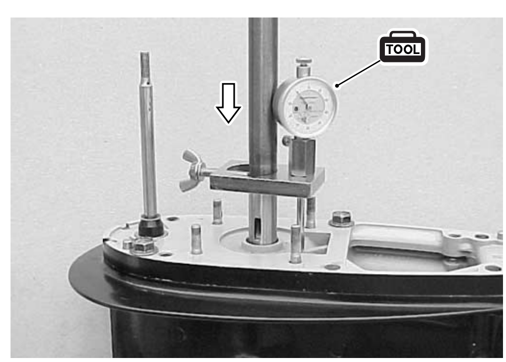
When the housing is fully seated, tighten both retaining bolts to the specified torque.



Bearing housing bolt : 17 N · m (1.7 kg-m, 12.5 lb.-ft.)

RECHECKING DRIVESHAFT THRUST PLAY

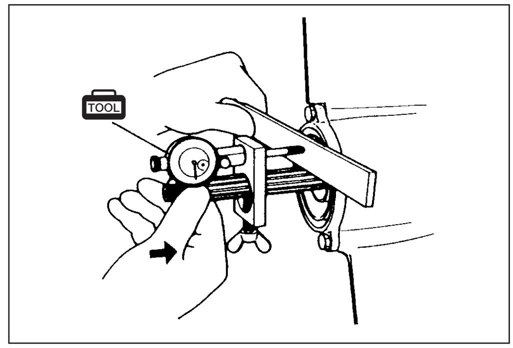
Recheck the driveshaft thrust play.
This should not be less than previously checked. If less, reduce the number / thickness of reverse gear back-up shims.



TOOL **09951-09511 : Gear adjusting gauge**

CHECKING PROPELLER SHAFT THRUST PLAY

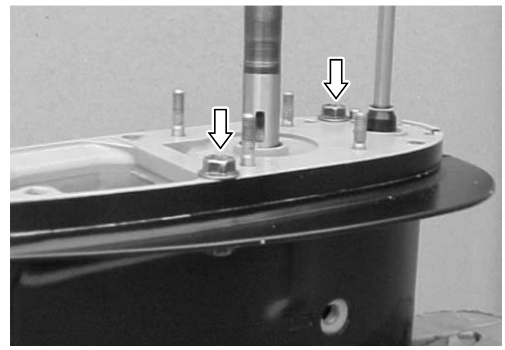
See the "GEARS - SHIMMING AND ADJUSTMENT / CHECKING PROPELLER SHAFT THRUST PLAY" section on page 9-27.



LEAKAGE CHECK

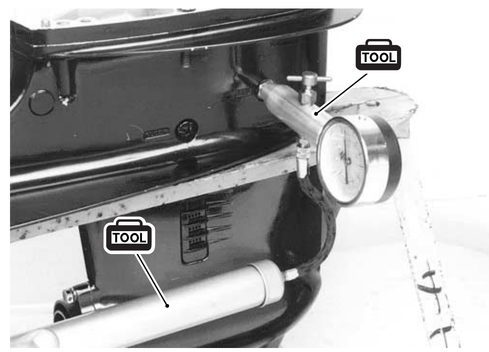
To check for oil seal or o-ring leakage, use oil leakage tester.

Before leakage check, temporarily fasten the driveshaft bearing housing to gearcase using two bolts and nuts (placed through the two diagonally opposite gearcase mounting holes).



Apply the specified pressure through the oil level hole and rotate the drive and propeller shafts.

If pressure does not fall, sealing performance is correct.



TOOL **09950-69512 : Oil leakage tester**
: Air pump

Leakage test pressure : 100 kPa (1.0 kg/cm^2, 14.2 psi)

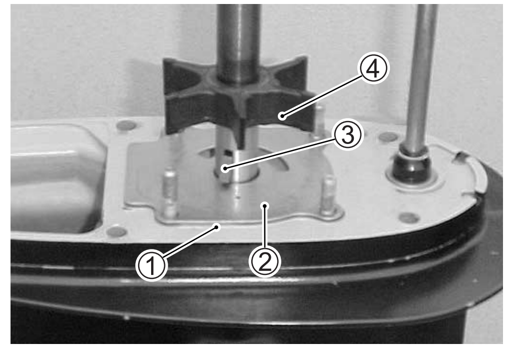
NOTE:
Apply low initial pressure of 0.2 – 0.4 kg / cm^2, (2.8 – 5.7 psi) first, then apply specified pressure.

CAUTION

Do not exceed pressure of 110 kPa (1.1kg/cm^2, 15.6 psi) or damage to oil seals will result.

WATER PUMP (Impeller & Case)
Place the under panel gasket ① and under panel ② into position.

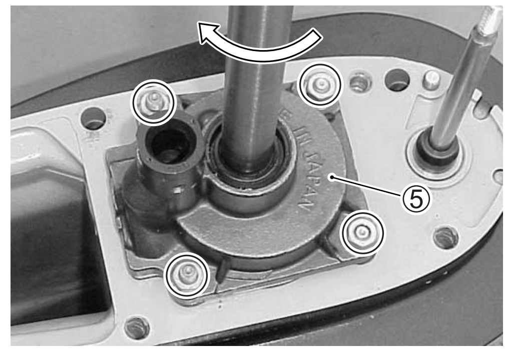
Insert the key ③ in the driveshaft and slide the impeller ④ onto driveshaft, ensuring that key and keyway are aligned.



Install the pump case ⑤ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.

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

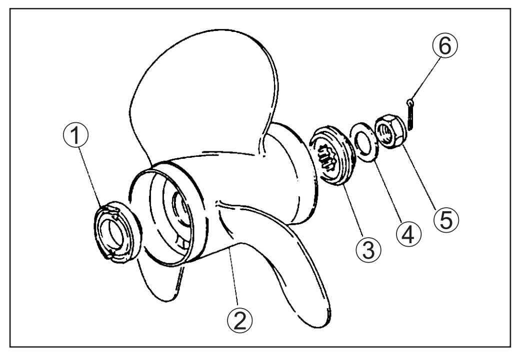
Pump case nut : 8 N · m (0.8 kg-m, 6.0 lb.-ft.)



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.

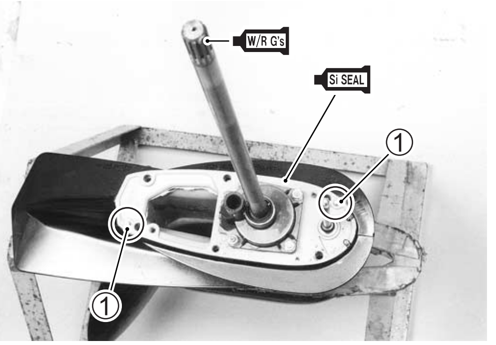
Push cotter pin ⑥ through nut and shaft, then bend to secure.



W/R G's **99000-25160 : Water Resistant Grease**
Propeller nut : 55 N · m (5.5 kg-m, 40.0 lb.-ft.)

LOWER UNIT INSTALLATION

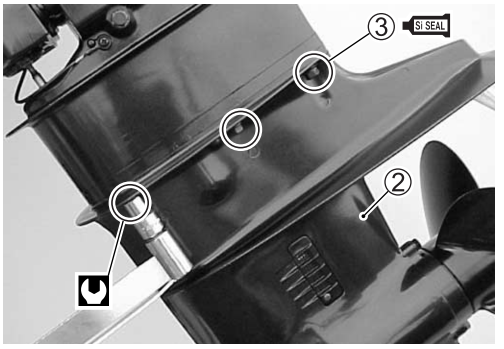
Insert dowel pins ①.



Coat the driveshaft splines with Water Resistant Grease.

Apply a light coat of Suzuki Silicone Seal to mating surfaces of gearcase and driveshaft housing.

Slide the lower unit ② into place, making sure that the top of the driveshaft engages properly with the crankshaft and that water tube locates in the water pump case outlet.



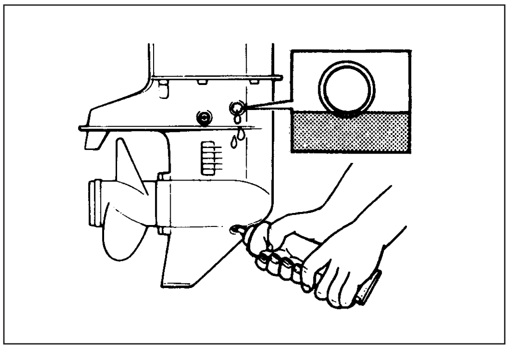
Apply Suzuki Silicone Seal to the retaining bolts ③ and tighten them to specified torque.

W/R G's **99000-25160 : Water Resistant Grease**
Si SEAL **99000-31120 : Suzuki Silicone Seal**
Gearcase bolt : 23 N · m (2.3 kg-m, 16.5 lb.-ft.)

NOTE:
Apply Suzuki Silicone Seal to the six (6) gearcase bolts.

GEAR OIL

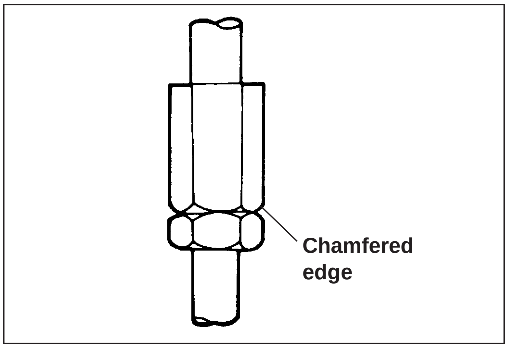
Fill the gearcase with specified gear oil.
(See the “PERIODIC MAINTENANCE / GEAR OIL” section on page 2-5.)



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

CLUTCH ADJUSTMENT

Connect clutch rod to shift rod as shown.

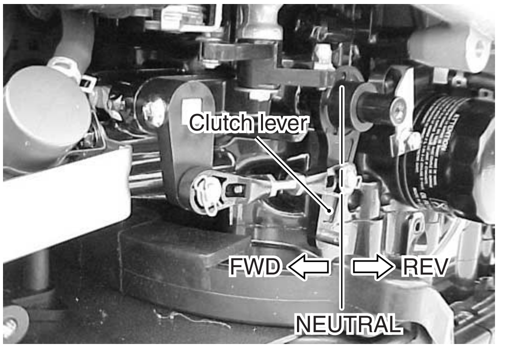


CAUTION

Make sure that chamfered edge of the turnbuckle faces downward to seat against the lower nut when tightened.

Adjustment step :

1. Shift the clutch lever from Neutral through Forward and Reverse to check that proper engagement of both gears is at an equal angle from Neutral.
   - If Forward gear engages earlier (at a smaller angle) than Reverse, the turnbuckle should be rotated clockwise until both gears engage with the same amount of clutch lever travel.
   - If Reverse gear engages earlier than Forward, the turnbuckle should be rotated counterclockwise.



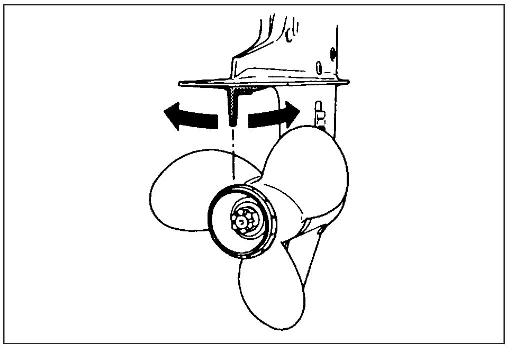
2. Lock the lower nut securely against the turnbuckle when clutch lever adjustment is correct.

TRIM TAB

Adjusting

The trim tab counteracts or minimizes propeller torque "pull" felt through the steering system.

- To compensate for a veer to starboard, set trailing edge of tab to the right (as viewed from behind).
- To compensate for a veer to port, set trailing edge of tab to the left.



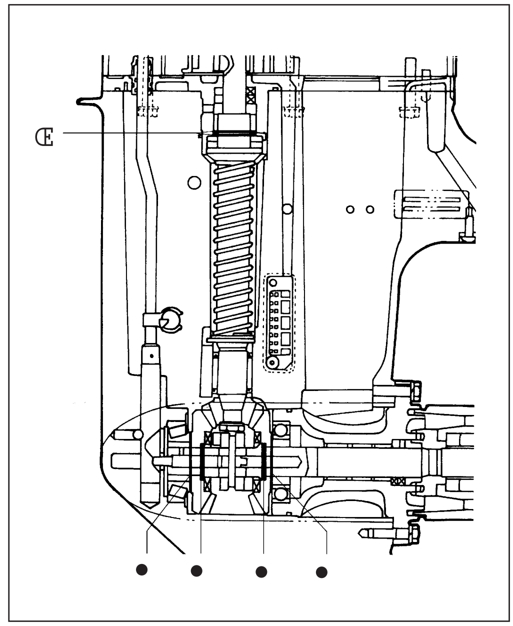
With a properly adjusted trim tab, steering will be neutral meaning there should be no tendency for the steering to "pull" to either port or starboard.

LOWER UNIT GEARS- SHIMMING AND ADJUSTMENT

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)**
Œ	Pinion gear back up shim	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	1.0
●	Forward gear back up shim	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	1.0
●	Forward gear thrust washer	2.0, 2.2	2.0
●	Reverse gear thrust washer	1.8, 1.9, 2.0, 2.1, 2.2, 2.3	2.0
●	Reverse gear back up shim	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	1.0



FORWARD GEAR / PINION GEAR

Step to prior to adjustment

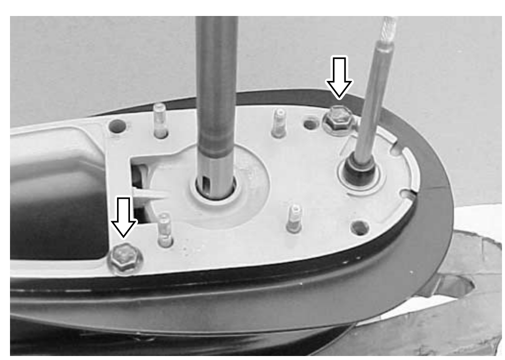
1. Correctly assemble driveshaft bearing housing, driveshaft, forward gear, pinion gear and related components (see page 9-14 to 9-17).

NOTE:
When installing forward gear back-up shim, choose shim thinner than design specification for calculating adjustment.

2. Tighten pinion nut to specified torque.

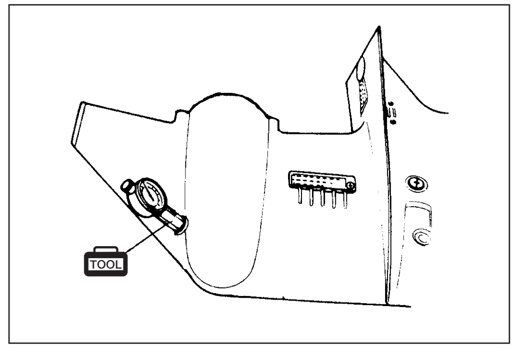
Pinion nut : 50 N · m (5.0 kg-m, 36.0 lb.-ft.)

3. Temporarily fasten the driveshaft bearing housing to the gearcase with two bolts and nuts.



Adjusting gear backlash

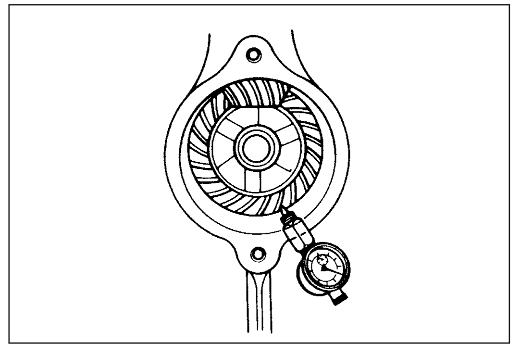
1. Screw gear adjusting gauge into the oil drain hole.



TOOL **09951-09511 : Gear adjusting gauge**

CAUTION

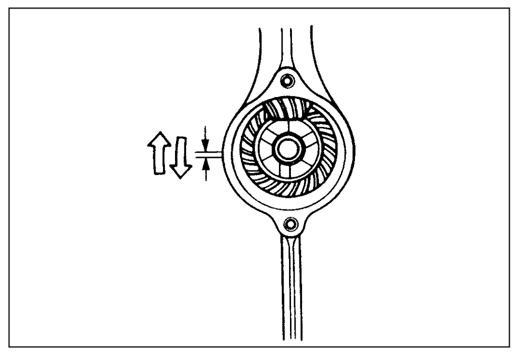
When adjusting gauge, align the gauge rod end to contact the gear tooth at the convex side (heel end). Make sure the rod does not contact the adjacent tooth. Rod end alignment is as illustrated in the figure.



2. Hold the driveshaft by hand, then gently rock forward gear back and forth by hand.
   Read the backlash on the dial gauge.

   Gear backlash : 0.1 – 0.2 mm (0.004 – 0.008 in.)

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



CAUTION

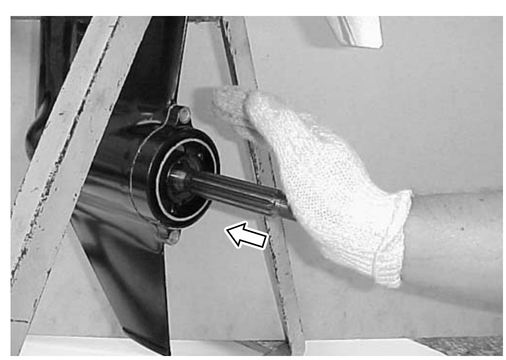
When measuring backlash, rotate forward gear back and forth very gently. Do not force the gear beyond the point where the forward and pinion gears make contact. Excessive movement may also result in breakage of the gauge rod.

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).

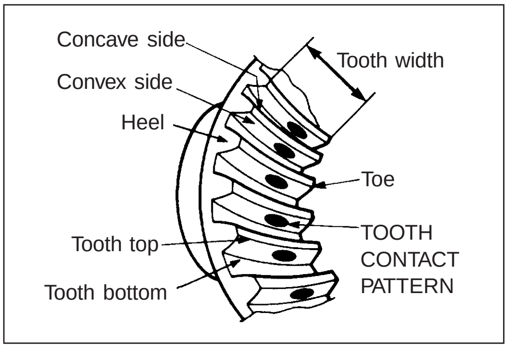


3. Push propeller shaft inward and hold in position.

4. Using driveshaft holder tool, rotate the driveshaft 5 - 6 times.

TOOL **09921-29510 : Driveshaft holder**

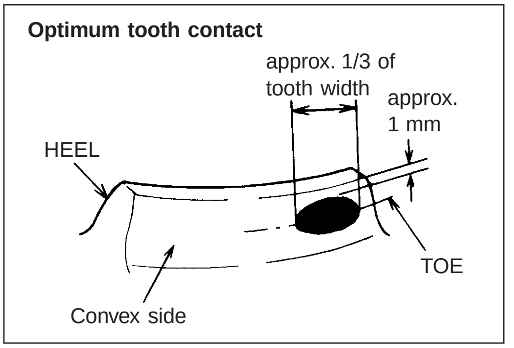
5. Carefully pull out propeller shaft and housing to check tooth contact pattern.



Optimum tooth contact

The optimum tooth contact is shown at right.

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

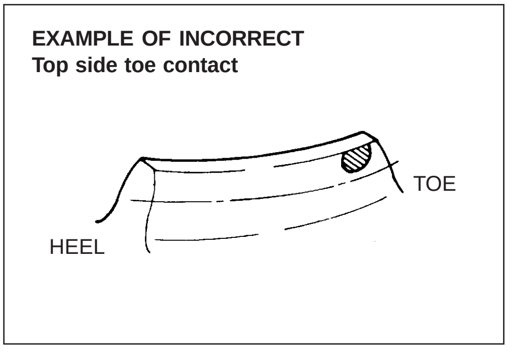


Example(1)

Incorrect topside toe contact :

Correction measures :

- Decrease thickness of forward gear shim.
- Slightly increase pinion gear shim thickness.



CAUTION

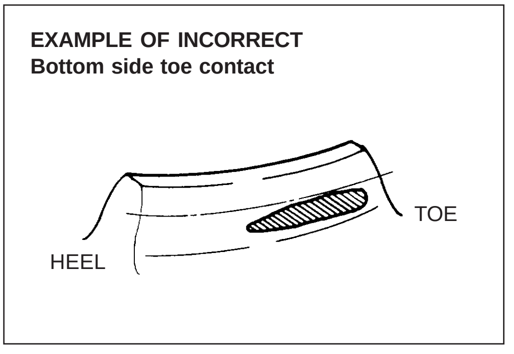
Do not set tooth contact in this position (top side toe contact). Damage and chipping of forward and pinion gear may result.

Example(2)

Incorrect bottom side toe contact :

Correction measures :

- Increase thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.

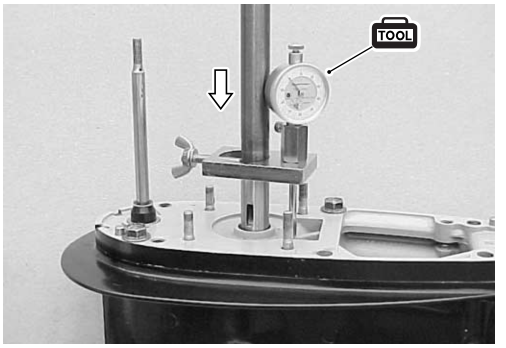


CAUTION

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.

TOOL **09951-09511 : Gear adjusting gauge**

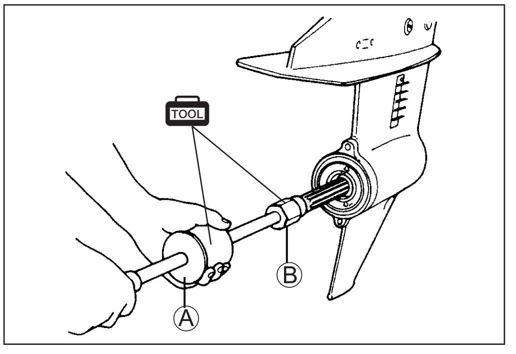
2. Slowly push driveshaft downward.
   Read the maximum play. Designate this amount of play as (A).

NOTE:

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

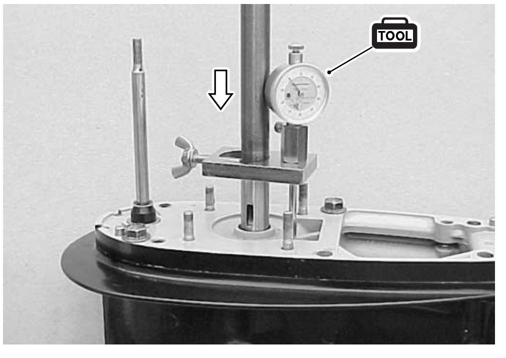
RECHECKING DRIVESHAFT THRUST PLAY
(Reverse gear back-up shim adjustment)

1. After adjusting forward gear tooth contact pattern, correctly assemble propeller shaft, housing assembly, reverse gear and related components (see page 9-17 to 9-18).



2. Screw sliding hammer assembly onto propeller shaft and strike a few gentle outward taps.

TOOL **09930-30161 : Propeller shaft remover – Ⓑ**
09930-30104 : Sliding hammer – Ⓐ



3. Affix gear adjusting gauge to driveshaft.

TOOL **09951-09511 : Gear adjusting gauge**

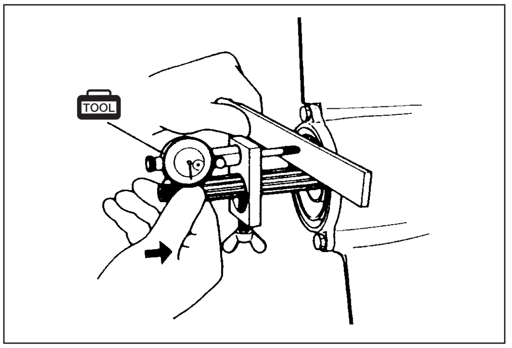
4. Push shaft downward and read maximum play. Designate this measurement as play (B).

5. Compare play (B) to play (A)(page 9-26).

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 : 0.20 – 0.40 mm (0.008 – 0.016 in.)

NOTE:
Maintain the forward gear thrust washer at standard thickness (2.0 mm) and adjust only the reverse gear thrust washer with shim.

Measurement step :

1. Assemble gear adjusting gauge to the propeller shaft.

TOOL **09951-09511 : Gear adjusting gauge**

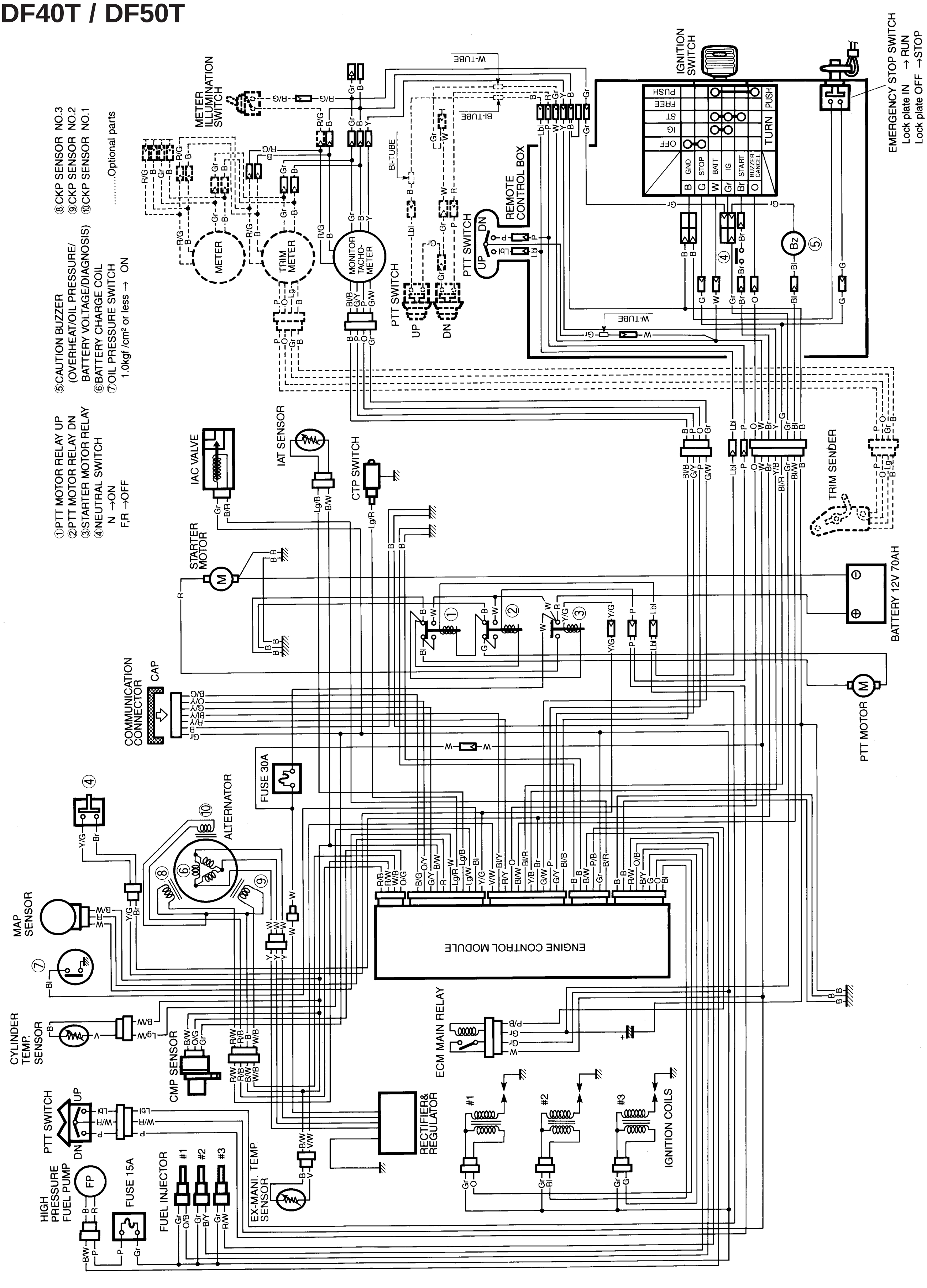
2. Push propeller shaft inward.
3. Hold shaft in and set dial gauge pointer to zero.
4. Slowly pull shaft outward and read the maximum thrust play on the dial.
   - If measurement is more than specification, increase reverse gear thrust washer thickness.
   - If measurement is less than specification,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

WIRE / HOSE ROUTING

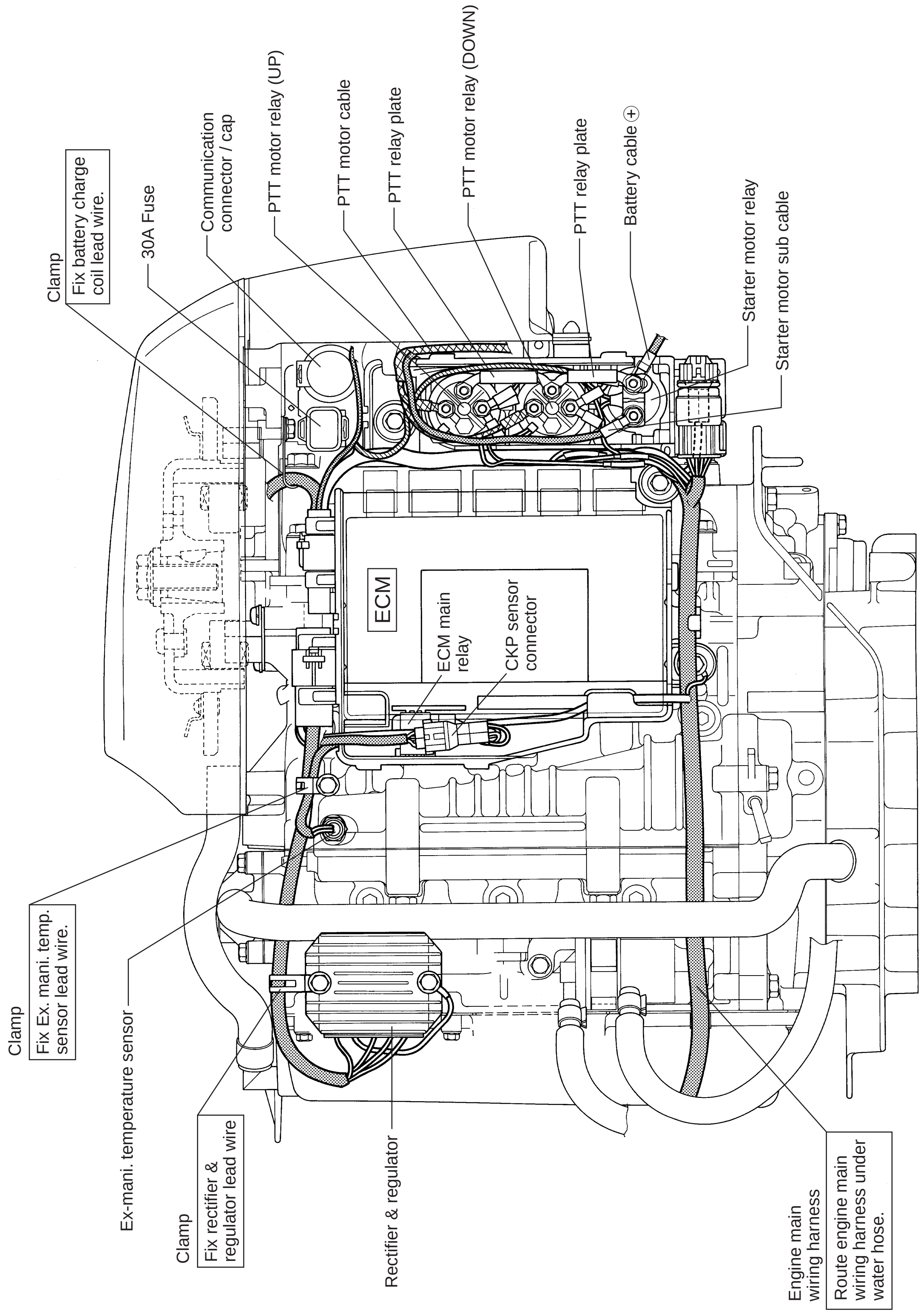
CONTENTS

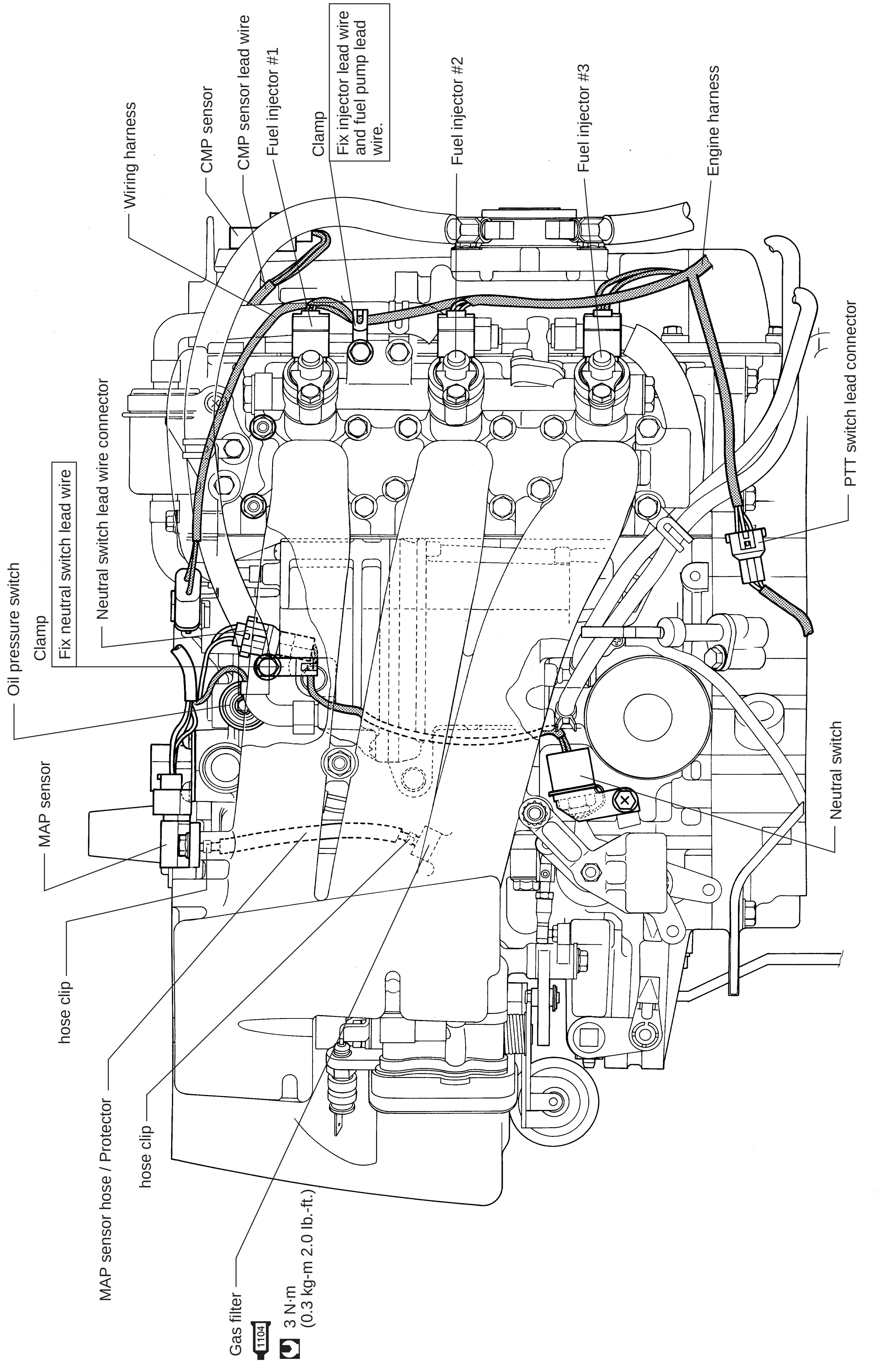
WIRING DIAGRAM

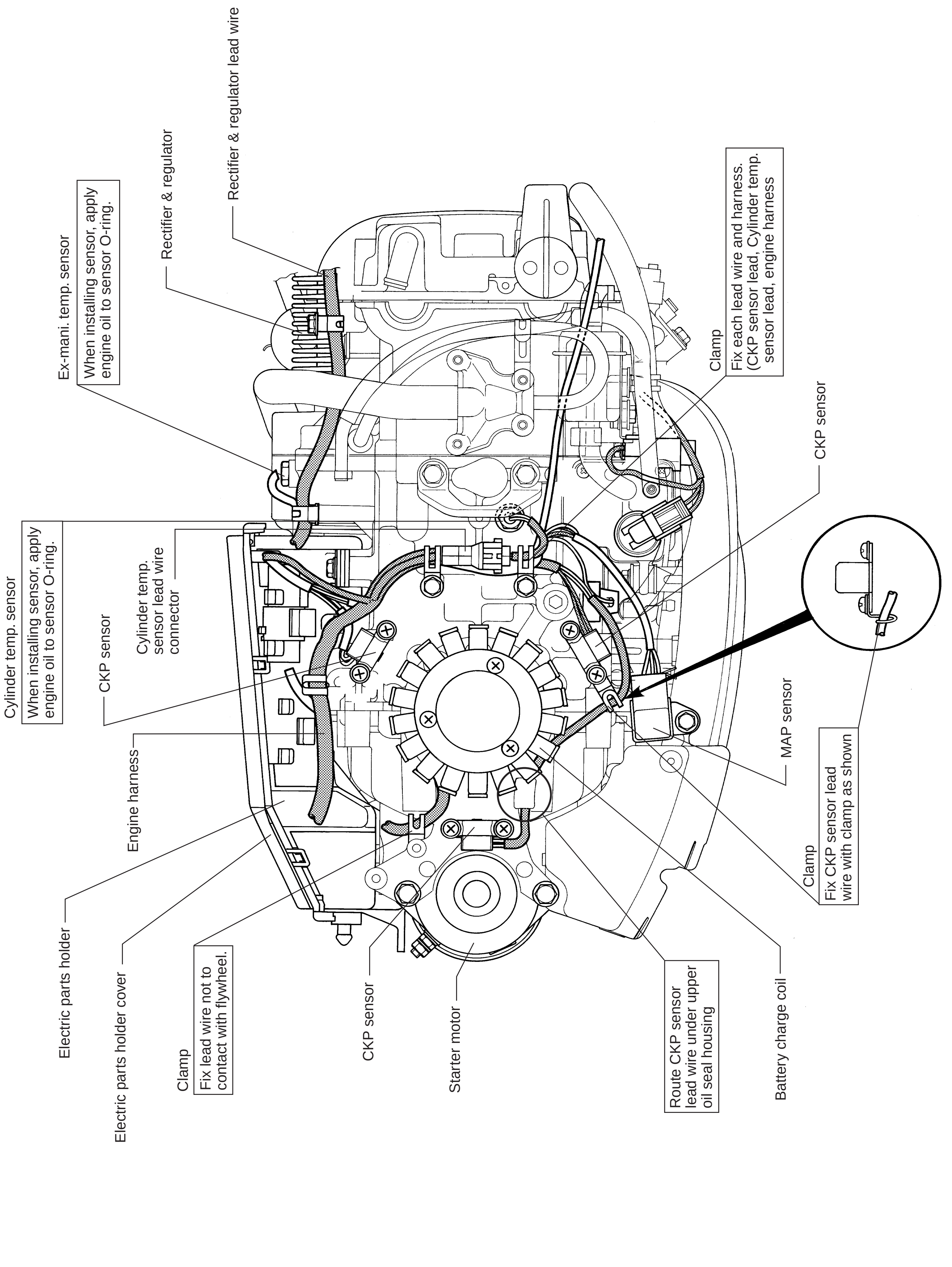
DF40T / DF50T



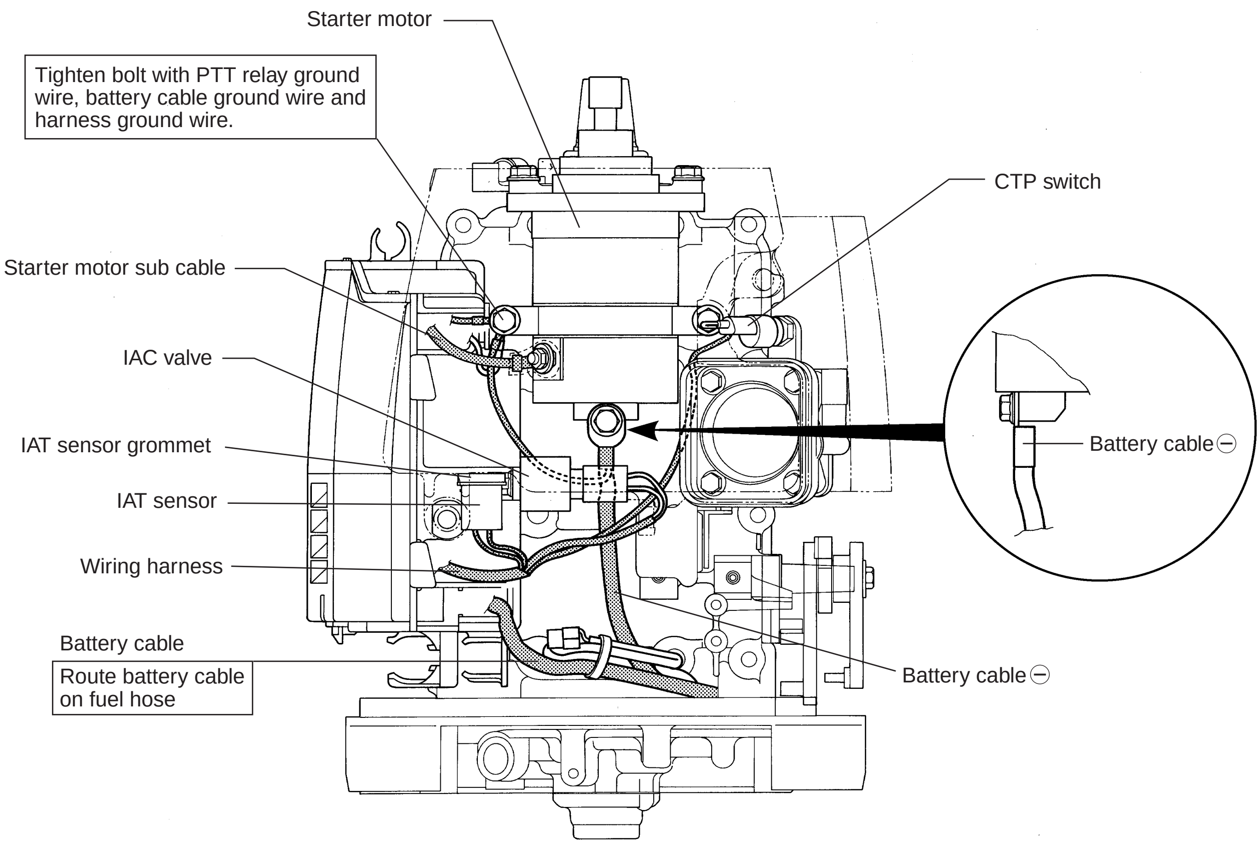
WIRE ROUTING

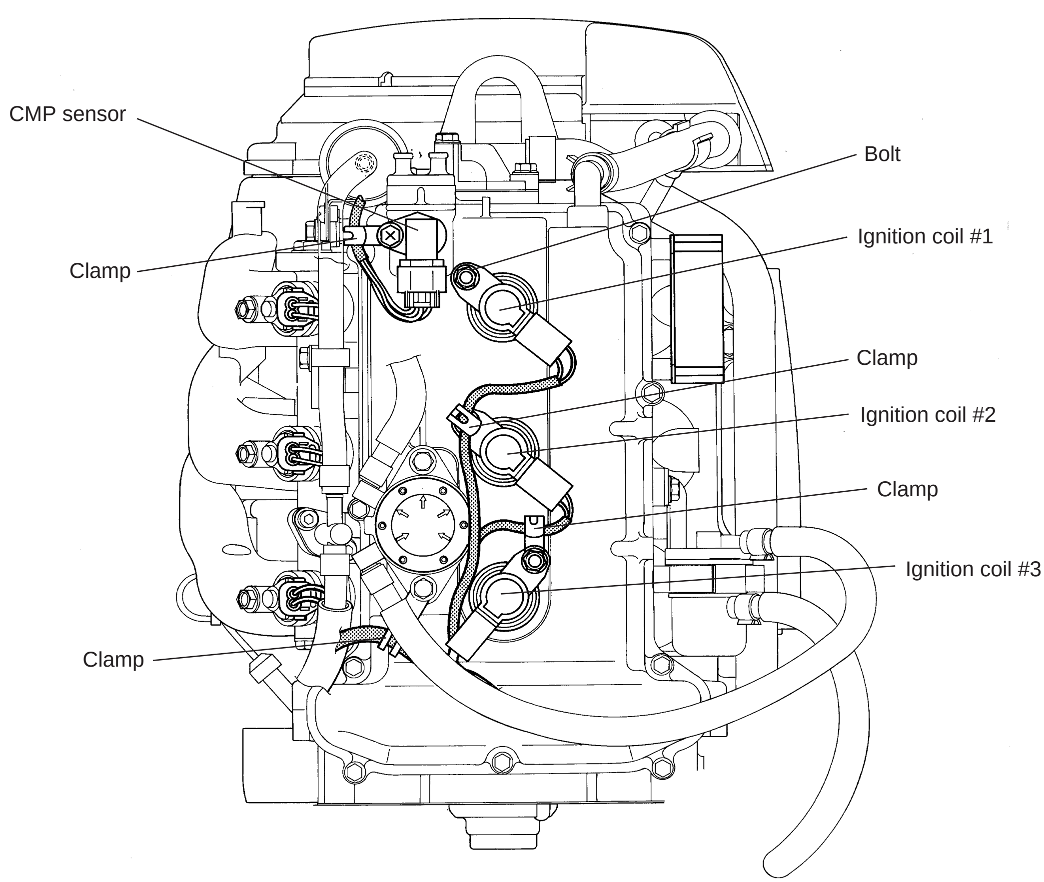


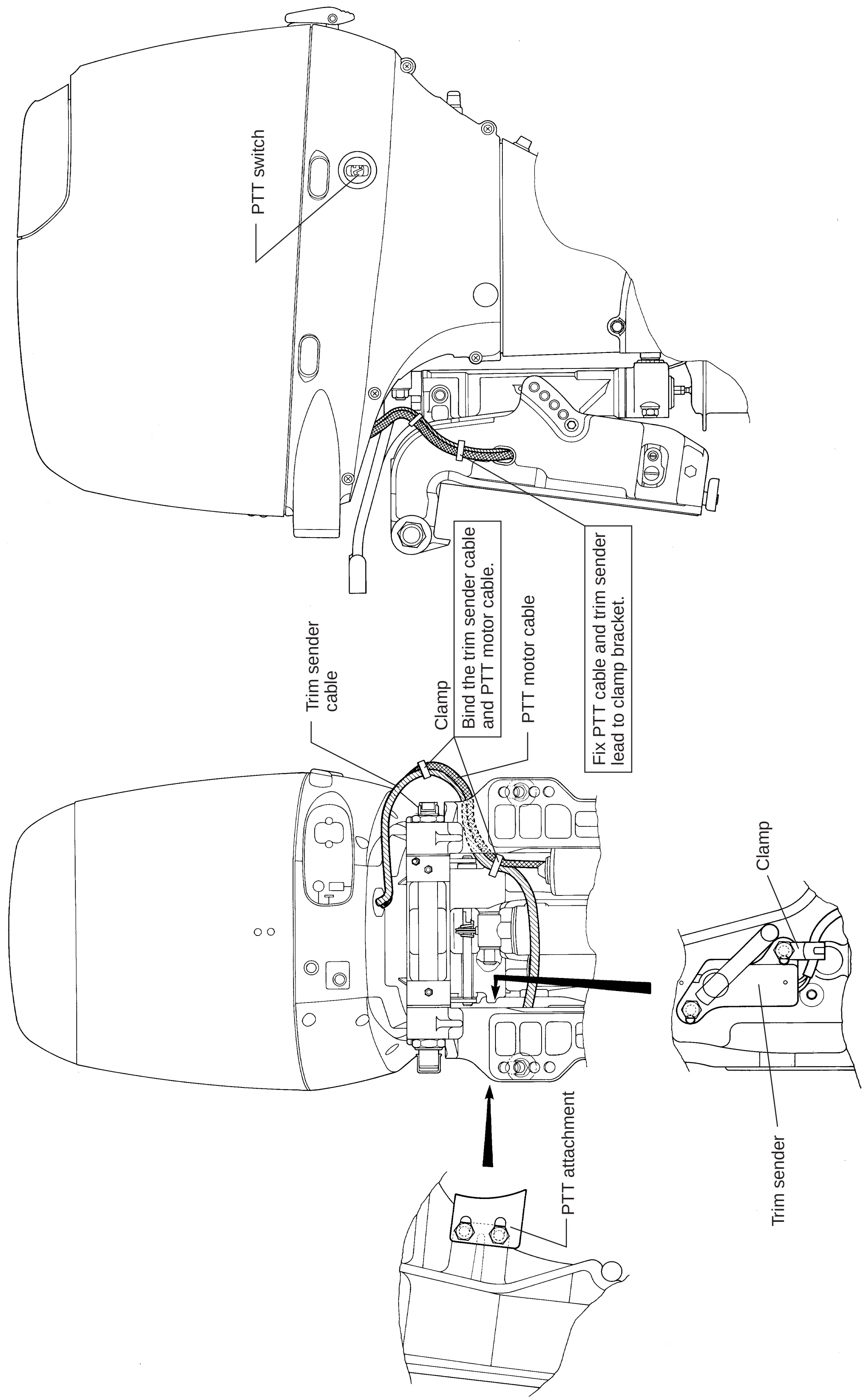

Wiring harness
CMP sensor
CMP sensor lead wire
Fuel injector #1
Clamp
Fix injector lead wire and fuel pump lead wire.
Fuel injector #2
Fuel injector #3
Engine harness
PTT switch lead connector
Neutral switch
Neutral switch lead wire connector
Clamp
Fix neutral switch lead wire
Oil pressure switch
MAP sensor
hose clip
MAP sensor hose / Protector
hose clip
Gas filter
1104
3 N·m
(0.3 kg-m 2.0 lb.-ft.)



Cylinder temp. sensor
When installing sensor, apply engine oil to sensor O-ring.
Electric parts holder
Electric parts holder cover
CKP sensor
Engine harness
Ex-mani. temp. sensor
When installing sensor, apply engine oil to sensor O-ring.
Cylinder temp. sensor lead wire connector
Clamp
Fix lead wire not to contact with flywheel.
Rectifier & regulator
Rectifier & regulator lead wire
CKP sensor
Starter motor
Route CKP sensor lead wire under upper oil seal housing
Clamp
Fix each lead wire and harness. (CKP sensor lead, Cylinder temp. sensor lead, engine harness
Battery charge coil
MAP sensor
CKP sensor
Clamp
Fix CKP sensor lead wire with clamp as shown


Starter motor
Tighten bolt with PTT relay ground wire, battery cable ground wire and harness ground wire.
CTP switch
Starter motor sub cable
IAC valve
IAT sensor grommet
IAT sensor
Wiring harness
Battery cable
Route battery cable on fuel hose
Battery cable ⊖
Battery cable ⊖

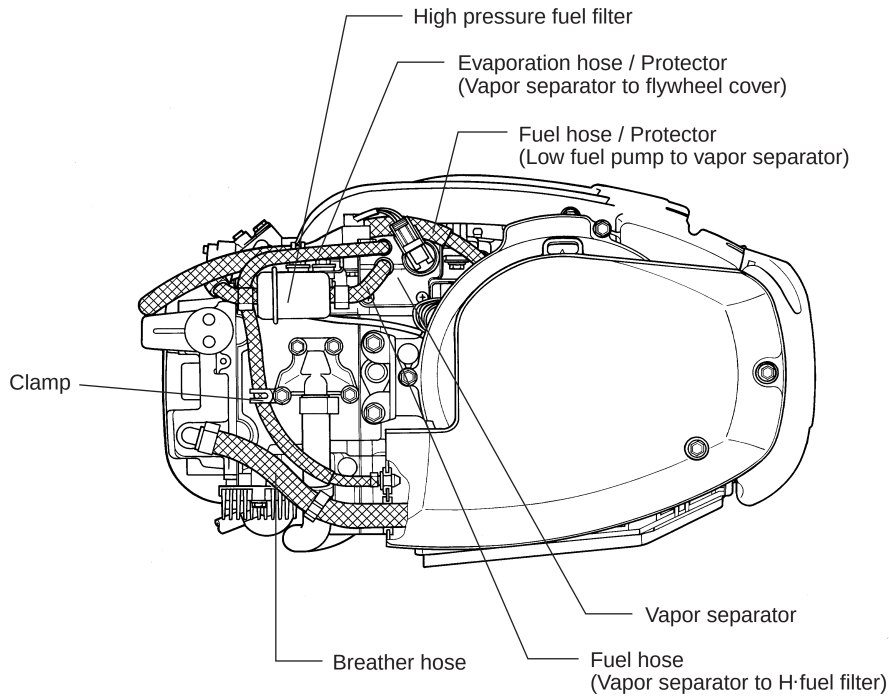

CMP sensor
Bolt
Ignition coil #1
Clamp
Clamp
Ignition coil #2
Clamp
Ignition coil #3
Clamp

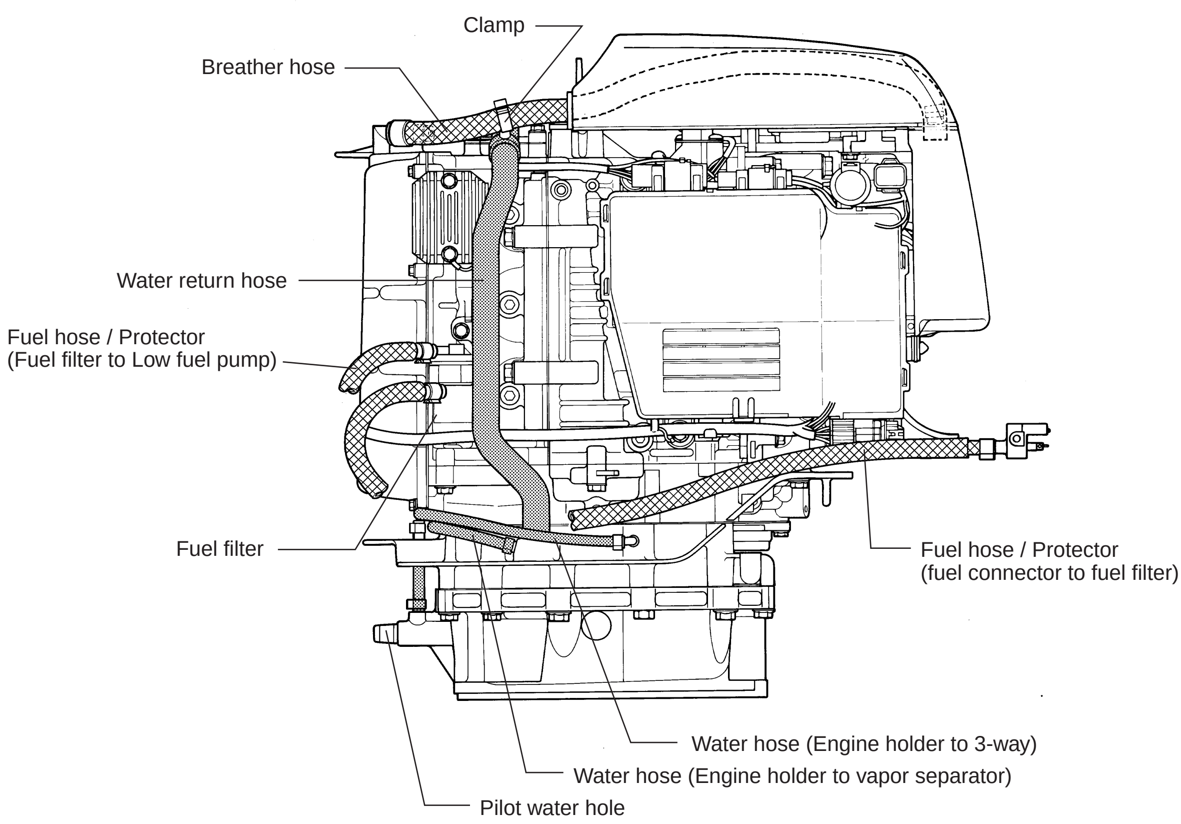

PTT switch
Trim sender cable
Clamp
Bind the trim sender cable and PTT motor cable.
PTT motor cable
Fix PTT cable and trim sender lead to clamp bracket.
Clamp
PTT attachment
Trim sender

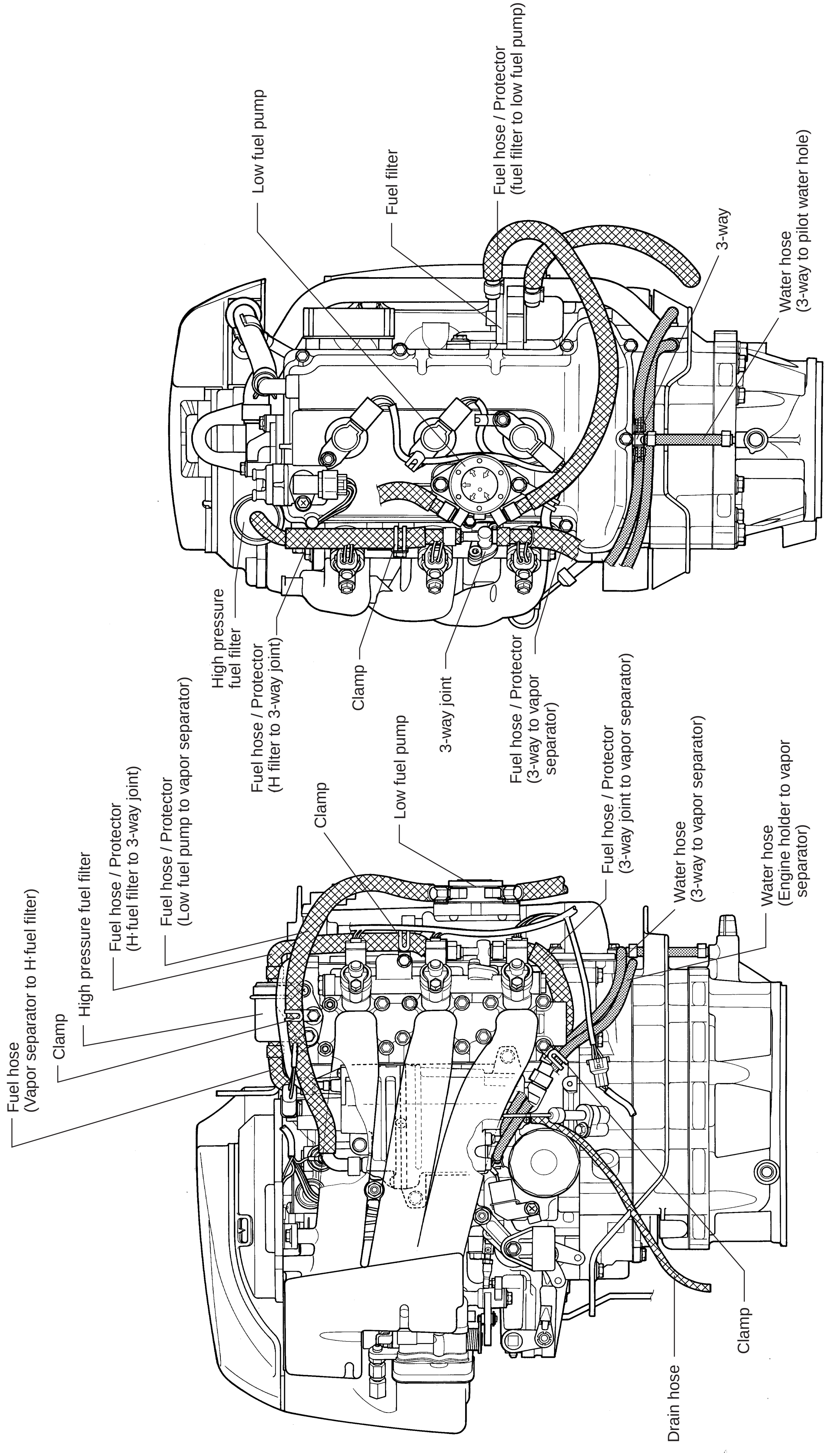
FUEL / WATER HOSE ROUTING

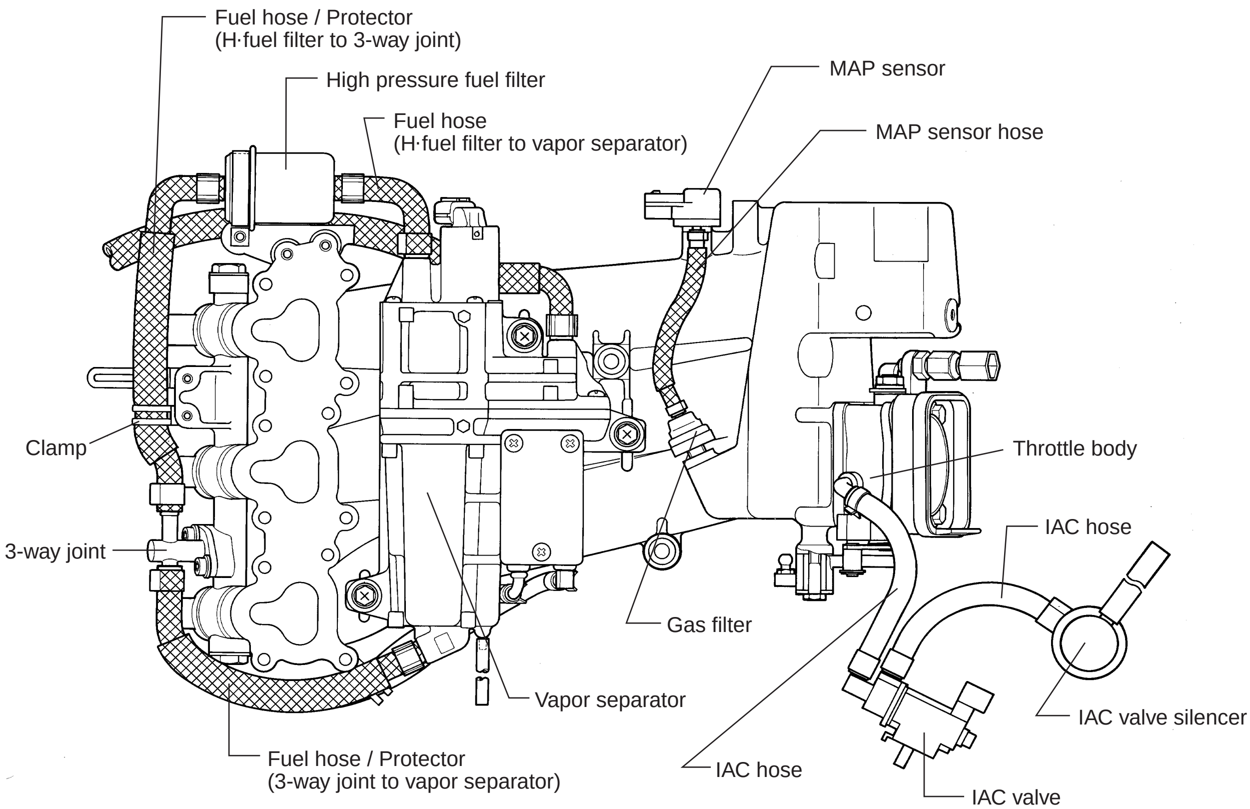
CAUTION

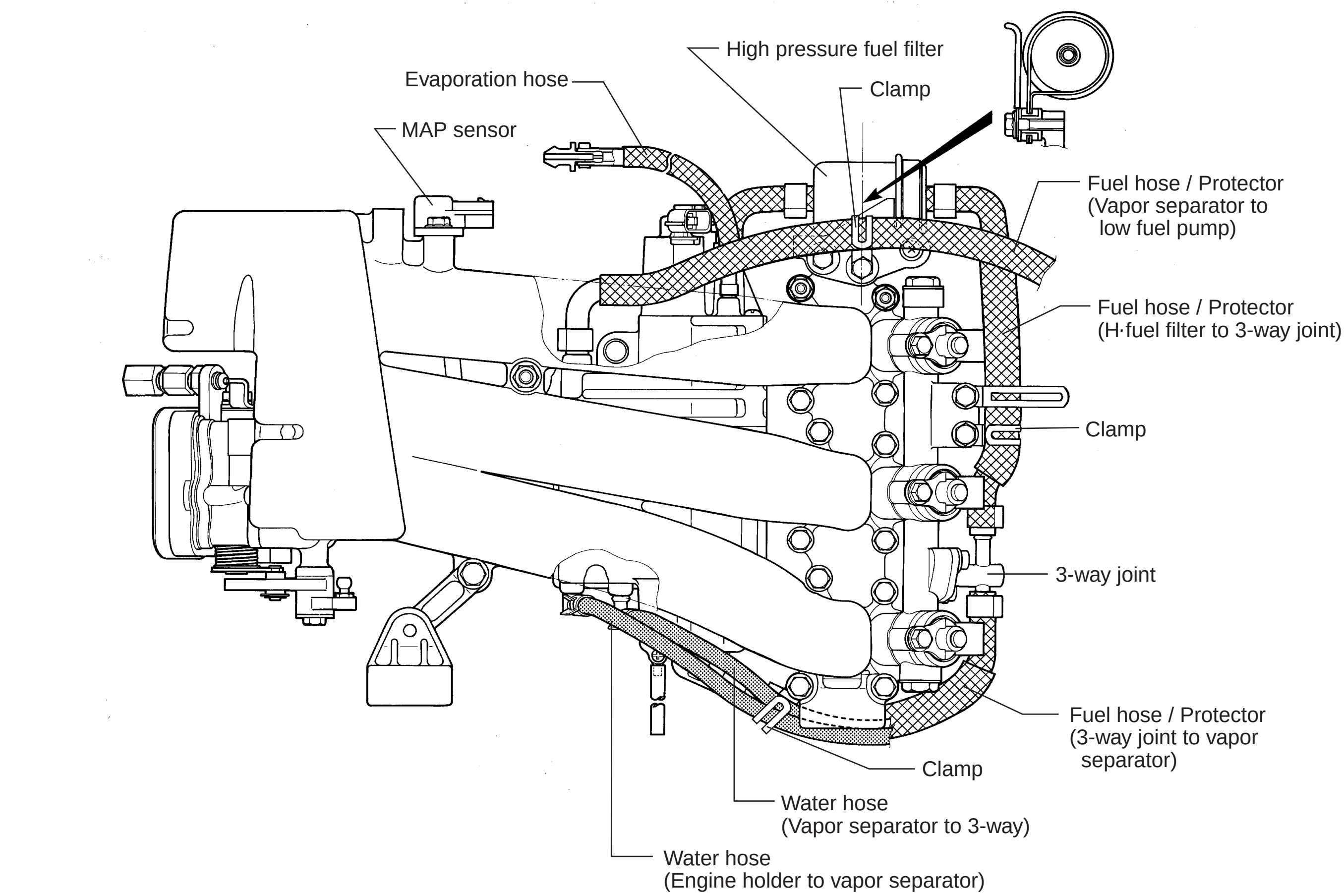
- **Do not over-bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Check that hoses do not contact rods and levers during either engine operation or standstill.**
- **Extreme care should be taken not to cut, abrade or cause any other damage on hoses.**
- **Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.**






Low fuel pump
Fuel filter
Fuel hose / Protector
(fuel filter to low fuel pump)
3-way
Water hose
(3-way to pilot water hole)
High pressure
fuel filter
Fuel hose / Protector
(H filter to 3-way joint)
Clamp
3-way joint
Fuel hose / Protector
(3-way to vapor
separator)
Fuel hose
(Vapor separator to H·fuel filter)
Clamp
High pressure fuel filter
Fuel hose / Protector
(H·fuel filter to 3-way joint)
Fuel hose / Protector
(Low fuel pump to vapor separator)
Clamp
Low fuel pump
Fuel hose / Protector
(3-way joint to vapor separator)
Water hose
(3-way to vapor separator)
Water hose
(Engine holder to vapor
separator)
Drain hose
Clamp


Fuel hose / Protector
(H·fuel filter to 3-way joint)
High pressure fuel filter
Fuel hose
(H·fuel filter to vapor separator)
MAP sensor
MAP sensor hose
Clamp
Throttle body
3-way joint
IAC hose
Gas filter
Vapor separator
IAC valve silencer
Fuel hose / Protector
(3-way joint to vapor separator)
IAC hose
IAC valve


High pressure fuel filter
Evaporation hose
Clamp
MAP sensor
Fuel hose / Protector
(Vapor separator to
low fuel pump)
Fuel hose / Protector
(H·fuel filter to 3-way joint)
Clamp
3-way joint
Fuel hose / Protector
(3-way joint to vapor
separator)
Clamp
Water hose
(Vapor separator to 3-way)
Water hose
(Engine holder to vapor separator)

CONTENTS

SPECIFICATIONS

Item		Unit	Data	
			DF40QH	DF50QH
PRE-FIX			04001F	05001F

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	852 (33.5)	
Overall width (side to side)		mm (in)	382 (15.0)	
Overall height	S	mm (in)	1263 (49.7)	
	L	mm (in)	1390 (54.7)	
Weight (without engine oil)	S	kg (Ibs)	107 (236)	
	L	kg (Ibs)	110 (243)	
Transom height	S	mm (in. type)	401 (15)	
	L	mm (in. type)	528 (20)	

PERFORMANCE

Maximum output	kW (PS)	29.4 (40)	36.8 (50)
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx. 850)	

POWERHEAD

Engine type		4-stroke DOHC
Number of cylinders		3
Bore	mm (in)	71.0 (2.80)
Stroke	mm (in)	68.6 (2.70)
Total displacement	cm^3 (cu in)	815 (49.7)
Compression ratio	: 1	10
Spark plug	NGK	DCPR6E
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		Twist grip

Item	Unit	Data	
		DF40QH	DF50QH

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 10W-40
Engine oil amounts	L (US/Imp. qt)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	610 (20.6/21.5)

BRACKET

Trim angle		Manual Trim and Gas Assisted Tilt System
Number of trim position	Adjustable	5
Maximum tilt angle	degree	73°

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	11 : 25 (2.27)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in.) × Pitch (in.)
	3 × 11-1/2 × 9 (S900) 3 × 11-1/2 × 10 (S1000) 3 × 11-1/2 × 11 (S1100) 3 × 11-5/8 × 12 (S1200) 3 × 11-1/2 × 13 (S1301, SS1300) 3 × 11-3/8 × 14 (S1400, SS1400) 3 × 11-1/4 × 15 (S1500) 3 × 11-1/8 × 16 (S1600, SS1600) 3 × 11 × 17 (S1700)
S : Aluminum propeller SS : Stainless steel propeller	

These specifications are subject to change without notice.

SERVICE DATA

Item	Unit	Data	
		DF40QH	DF50QH

POWERHEAD

Item	Unit	DF40QH	DF50QH
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx.850)	
**Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1600 (13 – 16, 185 – 228)	
**Cylinder compression max. difference between any two cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)	
**Engine oil pressure	kPa (kg/cm^2, psi)	300 – 380 (3.0 – 3.8, 43 – 54) at 4000 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)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change	
Thermostat operating temperature	°C (°F)	48 – 52 (118 – 126)	

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

Item			Unit	Data	
				DF40QH	DF50QH

ENGINE OIL PUMP

Radial clearance	Limit	mm (in)	0.31 (0.012)	
Side clearance	Limit	mm (in)	0.15 (0.006)	

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	mm (in)	37.530–37.690 (1.4776–1.4839)	38.230–38.390 (1.5051–1.5114)
		Limit	mm (in)	37.430 (1.4736)	38.130 (1.5012)
	EX	STD	mm (in)	37.740–37.900 (1.4858–1.4921)	37.740–37.900 (1.4858–1.4921)
		Limit	mm (in)	37.640 (1.4819)	37.640 (1.4819)
Camshaft journal oil clearance		STD	mm (in)	0.045 – 0.087 (0.0018 – 0.0034)	
		Limit	mm (in)	0.120 (0.0047)	
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)	
		Limit	mm (in)	23.171 (0.9122)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.934 – 22.955 (0.9029 – 0.9037)	
		Limit	mm (in)	22.784 (0.8970)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.062 (0.0010 – 0.0024)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	26.959 – 26.975 (1.0614 – 1.0620)	
Cylinder head bore		STD	mm (in)	27.000 – 27.021 (1.0630 – 1.0638)	

<table>
<tr><th colspan="3" rowspan="2">Item</th><th rowspan="2">Unit</th><th colspan="2">Data</th></tr>
<tr><th>DF40QH</th><th>DF50QH</th></tr>
</table>

VALVE / VALVE GUIDE

<table>
<tr><td colspan="2" rowspan="2">Valve diameter</td><td>IN</td><td>mm (in)</td><td>24.6 (0.97)</td></tr>
<tr><td>EX</td><td>mm (in)</td><td>21.5 (0.85)</td></tr>
<tr><td rowspan="2">Tappet clearance (Cold engine condition)</td><td>IN</td><td>STD</td><td>mm (in)</td><td>0.18 – 0.24 (0.007 – 0.009)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td>0.18 – 0.24 (0.007 – 0.009)</td></tr>
<tr><td colspan="2" rowspan="2">Valve seat angle</td><td>IN</td><td>degree</td><td>30°, 45°</td></tr>
<tr><td>EX</td><td>degree</td><td>15°, 45°</td></tr>
<tr><td rowspan="4">Valve guide to valve stem clearance</td><td rowspan="2">IN</td><td>STD</td><td>mm (in)</td><td>0.020 – 0.047 (0.0008 – 0.0019)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>0.070 (0.0028)</td></tr>
<tr><td rowspan="2">EX</td><td>STD</td><td>mm (in)</td><td>0.045 – 0.072 (0.0018 – 0.0028)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>0.090 (0.0035)</td></tr>
<tr><td>Valve guide inside diameter</td><td>IN,EX</td><td>STD</td><td>mm (in)</td><td>5.500 – 5.512 (0.2165 – 0.2170)</td></tr>
<tr><td>Valve guide protrusion</td><td>IN,EX</td><td>STD</td><td>mm (in)</td><td>11.0 (0.43)</td></tr>
<tr><td rowspan="2">Valve stem outside diameter</td><td>IN</td><td>STD</td><td>mm (in)</td><td>5.465 – 5.480 (0.2152 – 0.2157)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td>5.440 – 5.455 (0.2142 – 0.2148)</td></tr>
<tr><td>Valve stem end length</td><td>IN,EX</td><td>Limit</td><td>mm (in)</td><td>3.20 (0.126)</td></tr>
<tr><td rowspan="2">Valve stem end deflection</td><td>IN</td><td>Limit</td><td>mm (in)</td><td>0.14 (0.006)</td></tr>
<tr><td>EX</td><td>Limit</td><td>mm (in)</td><td>0.18 (0.007)</td></tr>
<tr><td>Valve stem runout</td><td>IN,EX</td><td>Limit</td><td>mm (in)</td><td>0.05 (0.002)</td></tr>
<tr><td>Valve head radial runout</td><td>IN,EX</td><td>Limit</td><td>mm (in)</td><td>0.08 (0.003)</td></tr>
<tr><td rowspan="4">Valve head thickness</td><td rowspan="2">IN</td><td>STD</td><td>mm (in)</td><td>1.0 (0.04)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>0.7 (0.03)</td></tr>
<tr><td rowspan="2">EX</td><td>STD</td><td>mm (in)</td><td>1.15 (0.045)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>0.5 (0.02)</td></tr>
<tr><td rowspan="2">Valve seat contact width</td><td>IN</td><td>STD</td><td>mm (in)</td><td>1.80 – 2.20 (0.071 – 0.087)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td>1.65 – 2.05 (0.065 – 0.081)</td></tr>
<tr><td colspan="2" rowspan="2">Valve spring free length</td><td>STD</td><td>mm (in)</td><td>33.1 (1.30)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>31.8 (1.25)</td></tr>
<tr><td colspan="2" rowspan="2">Valve spring tension</td><td>STD</td><td>N (kg, lbs)</td><td>97 – 113 (9.7–11.3, 21.4–24.9) for 28.5 mm (1.12 in)</td></tr>
<tr><td>Limit</td><td>N (kg, lbs)</td><td>89 (8.9, 19.6) for 28.5 mm (1.12 in)</td></tr>
<tr><td colspan="2">Valve spring squareness</td><td>Limit</td><td>mm (in)</td><td>2.0 (0.08)</td></tr>
</table>

Item			Unit	Data DF40QH	Data DF50QH
CYLINDER / PISTON / PISTON RING					
Cylinder distortion		Limit	mm (in)	0.060 (0.0024)	
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)	71.000 – 71.020 (2.7953 – 2.7961)	
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface	
Piston skirt diameter		STD	mm (in)	70.970 – 70.990 (2.7941 – 2.7949)	
Piston measuring position			mm (in)	19 (0.7) from piston skirt end	
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)	
Piston ring end gap	1st	STD	mm (in)	0.10 – 0.25 (0.004 – 0.010)	
		Limit	mm (in)	0.70 (0.028)	
	2nd	STD	mm (in)	0.25 – 0.40 (0.010 – 0.016)	
		Limit	mm (in)	1.00 (0.039)	
Piston ring free end gap	1st	STD	mm (in)	Approx. 7.5 (0.30)	
		Limit	mm (in)	6.0 (0.24)	
	2nd	STD	mm (in)	Approx. 11.0 (0.43)	
		Limit	mm (in)	8.8 (0.35)	
Piston ring to groove clearance	1st	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)	
		Limit	mm (in)	0.10 (0.004)	
	2nd	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)	
		Limit	mm (in)	0.10 (0.004)	
Piston ring groove width	1st	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)	
	2nd	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)	
	Oil	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)	
Piston ring thickness	1st	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)	
	2nd	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)	
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.018 (0.0002 – 0.0007)	
		Limit	mm (in)	0.040 (0.0016)	
Piston pin outside diameter		STD	mm (in)	17.996 – 18.000 (0.7085 – 0.7087)	
		Limit	mm (in)	17.980 (0.7079)	
Piston pin hole diameter		STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)	
		Limit	mm (in)	18.040 (0.7102)	
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.015 (0.0001 – 0.0006)	
		Limit	mm (in)	0.05 (0.002)	
Conrod small end bore		STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)	

Item	Unit	Data	
		DF40QH	DF50QH

CRANKSHAFT / CONROD

Item		Unit	Data (DF40QH / DF50QH)
Conrod small end inside diameter	STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)
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)	41.000 – 41.018 (1.6142 – 1.6149)
Crank pin outside diameter	STD	mm (in)	37.982 – 38.000 (1.4954 – 1.4961)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.486 – 1.502 (0.0585 – 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 (0.002)
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)	49.000 – 49.018 (1.9291 – 1.9298)
Crankshaft journal outside diameter	STD	mm (in)	44.982 – 45.000 (1.7709 – 1.7717)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.999 – 2.015 (0.0787 – 0.0793)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.470 – 2.520 (0.0972 – 0.0992)

LOWER UNIT

Design specification thickness for shim & washer

Pinion gear back-up shim	mm (in)	1.0 (0.04)
Forward gear back-up shim	mm (in)	1.0 (0.04)
Forward gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear back-up shim	mm (in)	1.0 (0.04)

Item		Unit	Data	
			DF40QH	DF50QH

ELECTRICAL

Item		Unit	DF40QH	DF50QH
Ignition timing		Degrees at r/min	BTDC 0° – BTDC 32°	BTDC 0° – BTDC 25°
Over revolution limiter		r/min	6500	7000
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	8.1 – 11.1	
Battery charge coil resistance		Ω at 20°C	0.56 – 0.84	
Battery charge coil output (12V)		Watt	216	
Standard spark plug	Type	NGK	DCPR6E	
	Gap	mm (in)	0.8 – 0.9 (0.031 – 0.035)	
Fuse amp. rating		A	Main fuse : 30 Fuel pump fuse : 15	
Recommended battery capacity (12V)		Ah (kC)	70 (252) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	21.5 – 32.3	
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 motor relay resistance		Ω at 20°C	3.5 – 5.1	

STARTER MOTOR

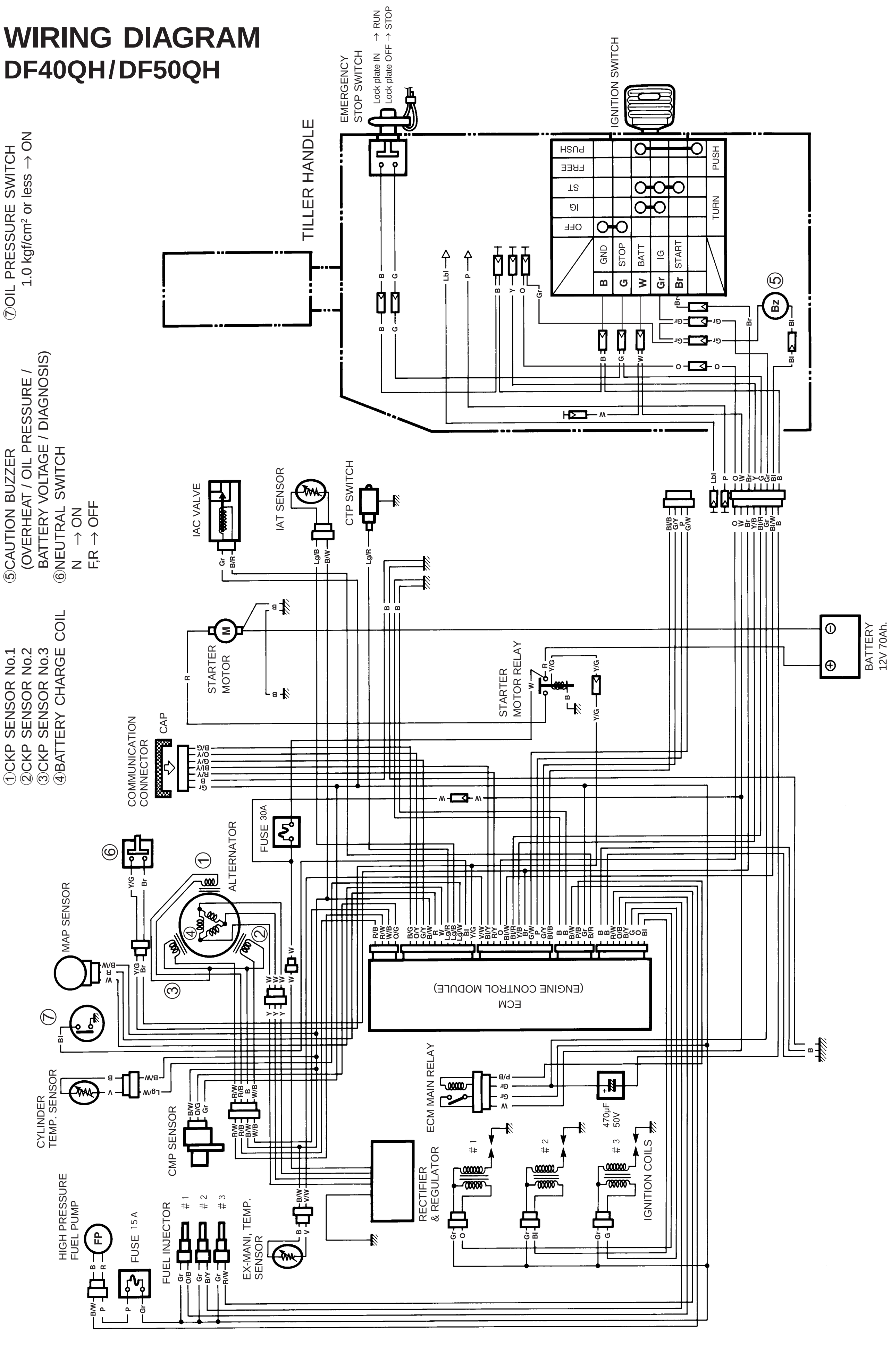
Item		Unit	Data
Max. continuous time of use		Sec.	30
Motor output		kW	0.9
Brush length	STD	mm (in)	17.0 (0.67)
	Limit	mm (in)	10.0 (0.39)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	33.0 (1.30)
	Limit	mm (in)	32.0 (1.26)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)
Pinion to ring gear gap	STD	mm (in)	3.0 – 5.0 (0.12 – 0.20)

TIGHTENING TORQUE

Tightening Torque – Important Fasteners

ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft.
Cylinder head cover bolt		6 mm	10	1.0	7.0
Cylinder head bolt		10 mm	60	6.0	43.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	53	5.3	38.5
Conrod cap nut		8 mm	35	3.5	25.5
Camshaft housing bolt		6 mm	10	1.0	7.0
Camshaft timing sprocket bolt		6 mm	10	1.0	7.0
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		6 mm	11	1.1	8.0
		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Intake manifold fuel main gallery	3-way joint bolt	6 mm	10	1.0	7.0
	Upper/lower plug	——	35	3.5	25.5
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	200	20.0	144.5
Starter motor mounting bolt		8 mm	23	2.3	16.5
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt/nut		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		10 mm	40	4.0	29.5
Upper mount cover bolt		8 mm	23	2.3	16.5
Lower mount nut	Front	12 mm	60	6.0	43.5
	Rear	12 mm	40	4.0	29.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Tiller handle mounting bolt		10 mm	50	5.0	36.0
Tiller handle pivot bolt/nut		10 mm	45	4.5	32.5
Water pump case nut		6 mm	8	0.8	6.0
Gearcase bolt		8 mm	23	2.3	16.5
Propeller shaft bearing housing bolt		8 mm	17	1.7	12.5
Pinion nut		12 mm	50	5.0	36.0
Propeller nut		18 mm	55	5.5	40.0

WIRING DIAGRAM
DF40QH / DF50QH

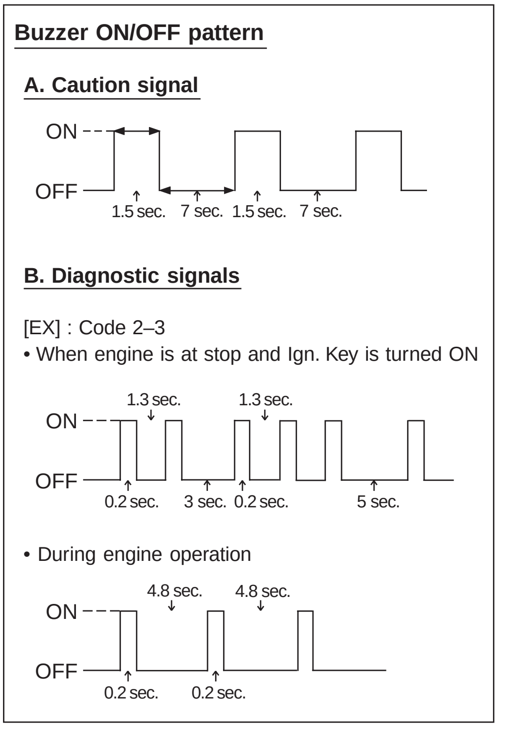


ENGINE CONTROL SYSTEM

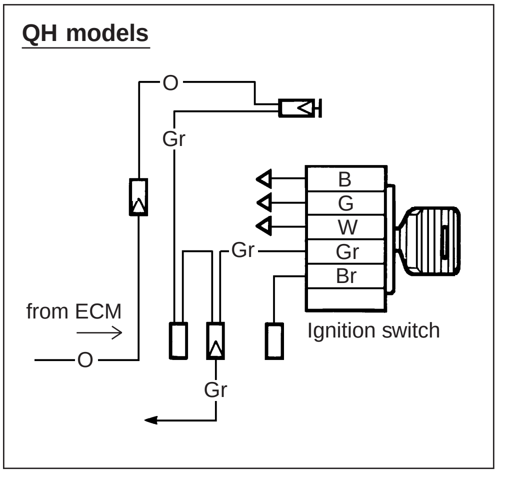
The engine control systems such as ignition and fuel injection are basically the same as DF40/50T model specification except for the following:

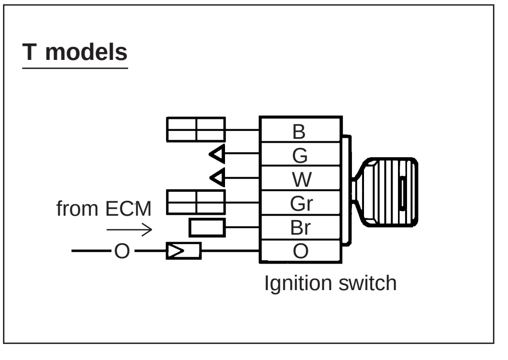
Caution / Diagnostic System

Caution and Diagnostic system operator alert signals are audio only on QH models. Alerts will be signaled by a sound sequence from the caution buzzer contained in the tiller handle. When any caution system is activated, the diagnostic code buzzer sound sequence for that caution will be the same as that of a T- specification model.
Refer to the illustration for the QH model buzzer sound sequence (ON/OFF pattern) of caution and diagnostic signals.



NOTE:
The buzzer cancellation feature found on T-specification Models is not available on QH models. Due to this features removal, the ignition switch and the function of the orange lead extending from ECM to the ignition switch is different between T and QH specifications.





Engine speed control during shifting

On QH-specification models, a special safety feature to control engine speed during shifting has been added. This feature fixes the upper limit of engine speed during shifting to a preset value of 1500 r/min.

[Operation]

If the CTP switch is “OFF” and engine speed at the moment of shifting (neutral switch turns “OFF”) is above the rpm limit of 1500 r/min, engine speed will automatically be lowered to approximately 1500 r/min.
Once this feature is engaged, engine speed will be regulated to remain at the fixed 1500 r/min limit until the feature is cancelled.

[Cancellation]

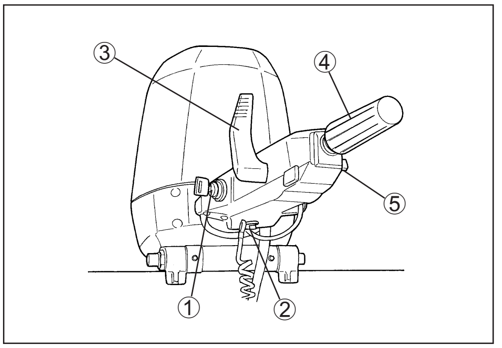
The engine speed control feature will be canceled if any one of the following conditions is satisfied:

- Throttle is returned to and remains at full close (CTP switch “ON”) for at least one second.
- Engine speed is lowered below the control speed (1500 r/min) and remains there for at least for two seconds.

Checking engine total operating hours

As a monitor-tachometer gauge is not supplied with QH models, engine total operating hours must be checked using SDS and a personal computer or by temporarily connecting a DF model monitor-tachometer.

MID UNIT
TILLER HANDLE
Functions

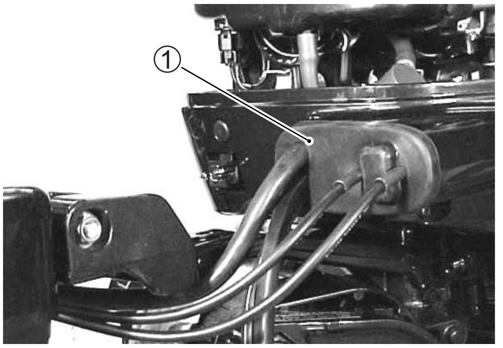


The tiller handle is equipped with the following centralized component parts necessary for proper operation and handling.

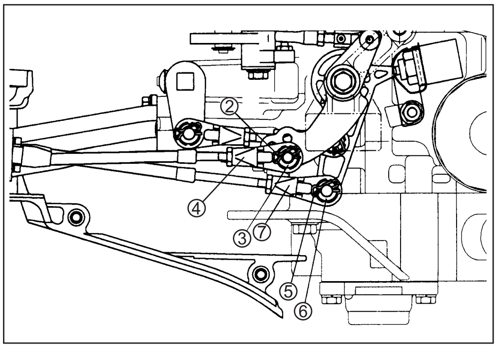
①Ignition switch ②Emergency stop switch
③Shift lever ④Throttle control grip
⑤Throttle friction adjust knob

REMOVAL

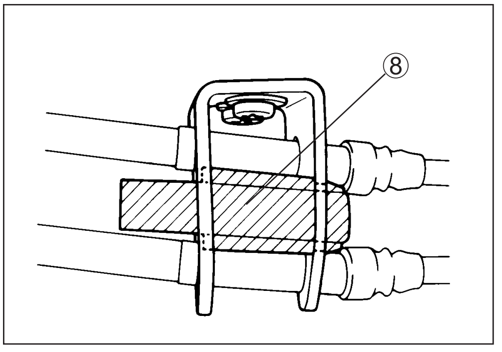
1. Remove the rigging port grommet ① from front panel. Remove both lower side covers.



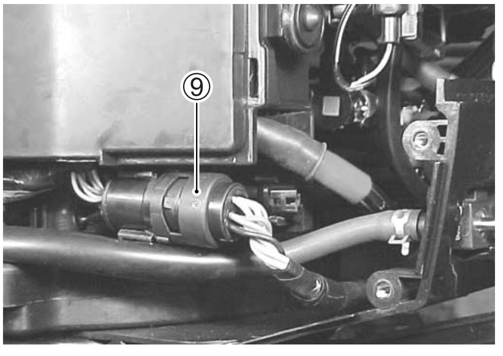
2. Remove snap pin ②, washer ③ and throttle cable connector ④ from throttle control arm. Unthread connector from throttle cable.
3. Remove snap pin ⑤, washer ⑥ and shift cable connector ⑦ from clutch control lever. Unthread connector from shift cable.



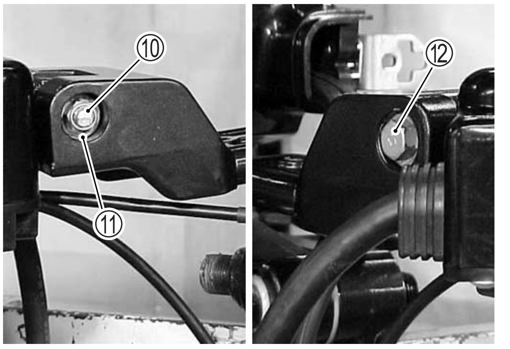
4. Remove cable stopper ⑧ from between cables.



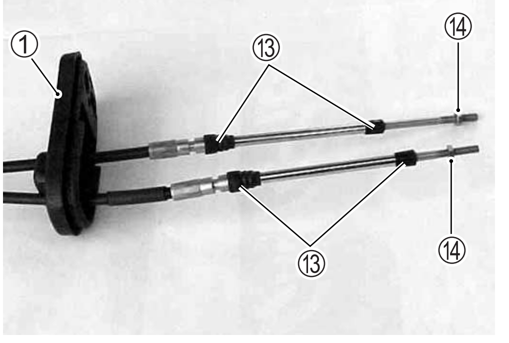
5. Disconnect handle wire harness connector ⑨ from engine wiring harness.



6. Remove nut ⑩ and washer ⑪.
   Loosen and remove the handle pivot bolt ⑫.
   Remove tiller handle assembly.
   Account for three washers and spring.

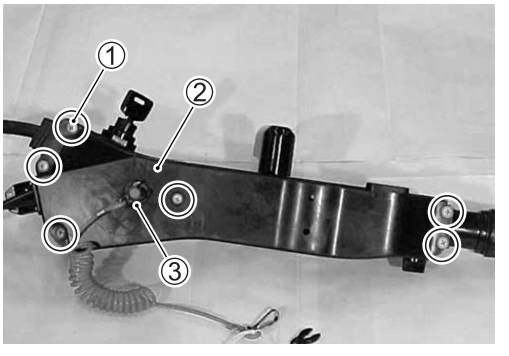


7. Remove the seals ⑬ and connector lock nuts ⑭ from throttle / shift cables.
   Slide rigging port grommet ① off.

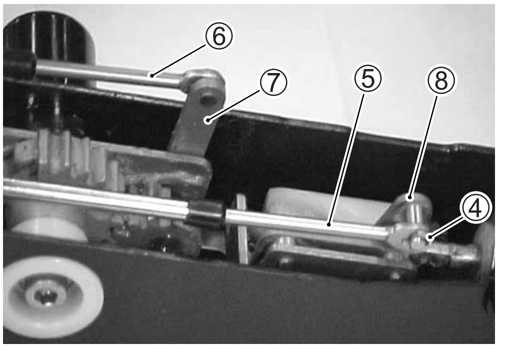


DISASSEMBLY

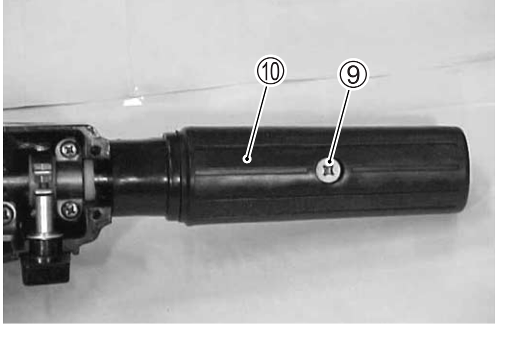
Remove six (6) screws ① and take off tiller handle lower cover ②.
Disconnect emergency stop switch lead connector ③.



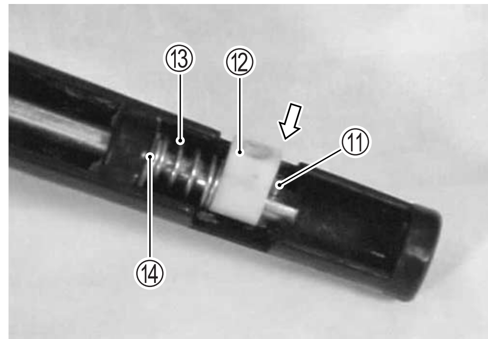
Remove E-ring ④ and throttle cable ⑤ from throttle link ⑧.
Remove shift cable ⑥ from clutch link ⑦ in the same manner.



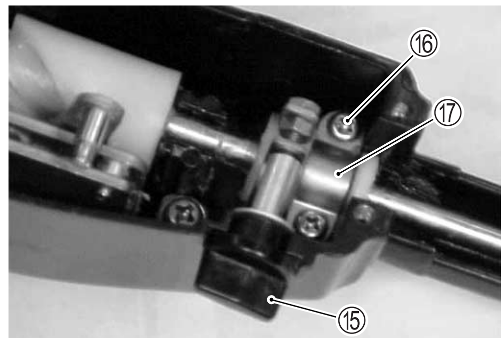
Remove screw ⑨, handle grip ⑩.



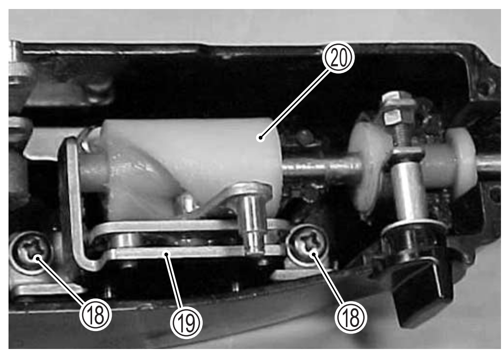
Drive out handle rod stopper pin ⑪, then pull out rod stopper ⑫, spring ⑬ and handle rod bush ⑭.



Loosen handle grip adjuster ⑮.
Remove screws ⑯ and handle rod plate ⑰.

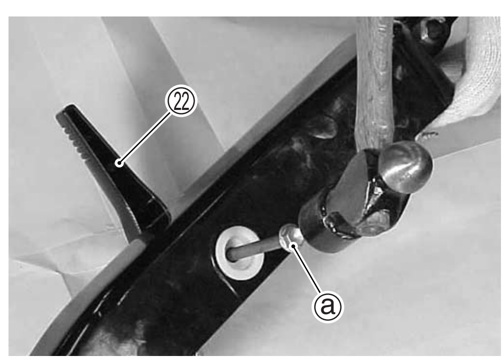


Remove the two screws ⑱ securing the throttle link ⑲ to tiller handle housing, then remove throttle link ⑲ and handle rod assembly ⑳.

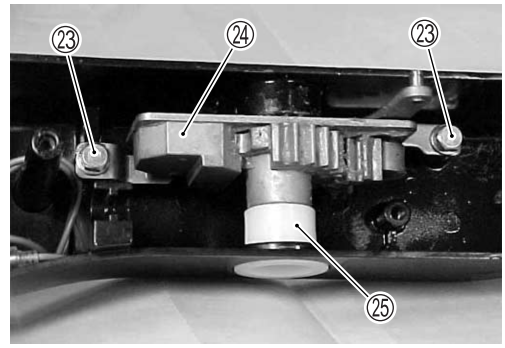


Remove the bolt ㉑ securing the shift lever.

Separate the shift lever ㉒ by installing 8mm bolt ⓐ in shift lever as shown in figure.
Using a hammer, tap on bolt head until the shift lever separates, then remove 8mm bolt.

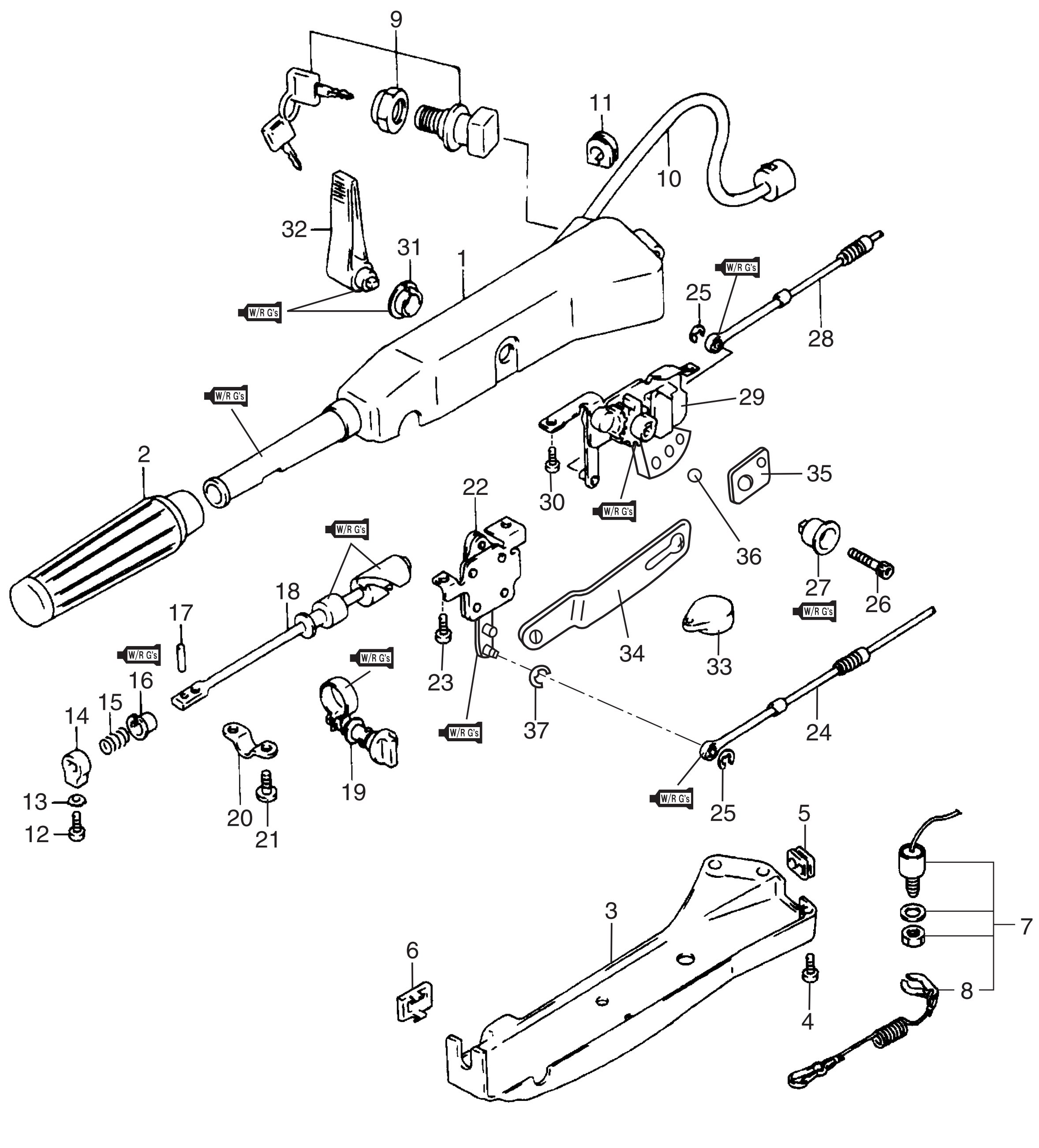


Remove the two bolts ㉓ securing the clutch link ㉔ to tiller handle housing, then remove clutch link and spacer ㉕.



ASSEMBLY

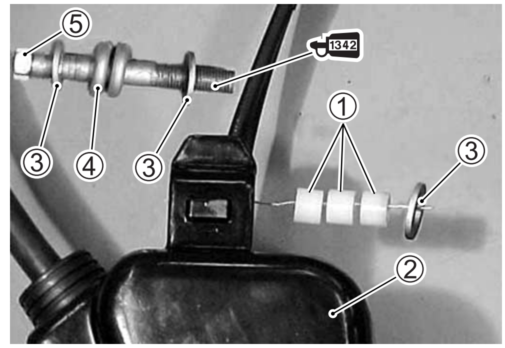
Assembly is reverse order of disassembly.
When reassembling tiller handle, refer to the construction diagram below .



1.Tiller handle housing (1)	12.Screw (1)	23.Screw (2)	34.Lock plate (1)
2.Handle grip (1)	13.Washer (1)	24.Throttle cable (1)	35.Guide plate (1)
3.Lower cover (1)	14.Handle rod stopper (1)	25. E-ring (2)	36.Ball (1)
4.Screw (6)	15.Spring (1)	26.Bolt (1)	37.E-ring (1)
5.Cable grommet (1)	16.Bush (1)	27.Bush (1)	
6.Switch cover (1)	17.Pin (1)	28.Shift cable (1)	
7.Emergency switch (1)	18.Handle rod (1)	29.Shift link (1)	
8.Lock plate (1)	19.Handle grip adjuster (1)	30.Screw (2)	
9.Ignition switch (1)	20.Plate (1)	31.Bush (1)	
10.Handle wire harness (1)	21.Screw (2)	32.Shift lever (1)	
11.Handle wire grommet (1)	22.Throttle link (1)	33.Buzzer (1)	

INSTALLATION

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

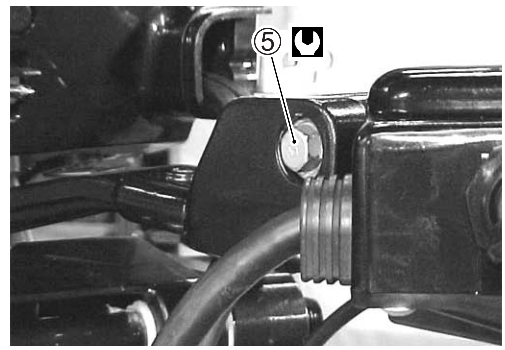


Tiller handle assembly

- Install three (3) nylon bushes ① into tiller handle mounting hole and set tiller handle ② on handle bracket.
- Place three (3) washers ③ and spring ④ into position.
  Insert handle pivot bolt ⑤.
  Coat pivot bolt threads with thread lock and tighten pivot bolt to specified torque.

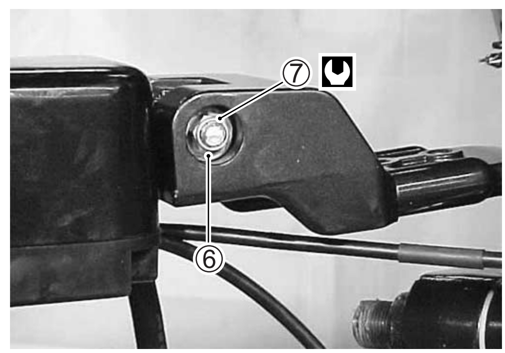
Handle pivot bolt: 45 N·m (4.5 kg-m, 32.5 lb.-ft.)

1342 **99000-32050: Thread Lock 1342**



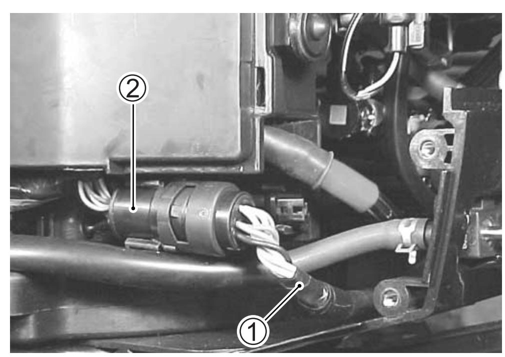
- Install washer ⑥, nut ⑦ and tighten nut to specified torque.

Handle pivot nut: 45 N·m (4.5 kg-m, 32.5 lb.-ft.)



Handle wire harness

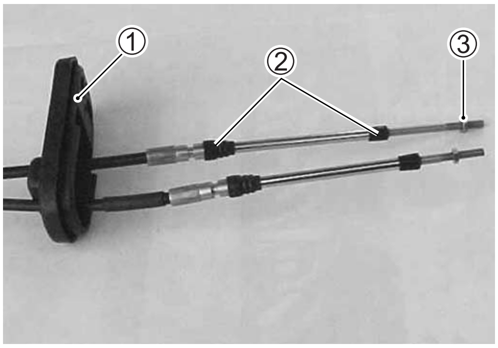
Route the handle wire harness ① as shown in figure.
Connect handle wire harness connector to engine wiring harness ②.



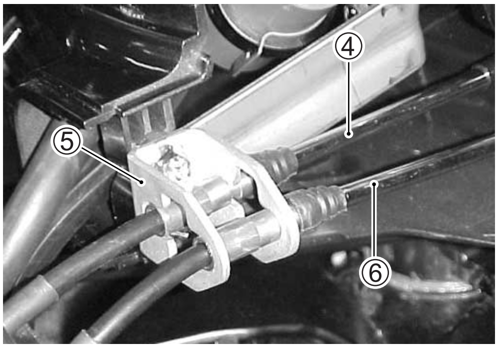
Throttle / Shift cable installation

• Installation

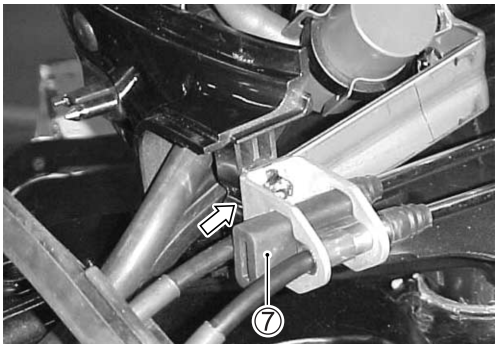
(1) Insert shift cable and throttle cable through the rigging port grommet ① as shown in figure.
Install the seals ② and connector lock nut ③ on both cables.



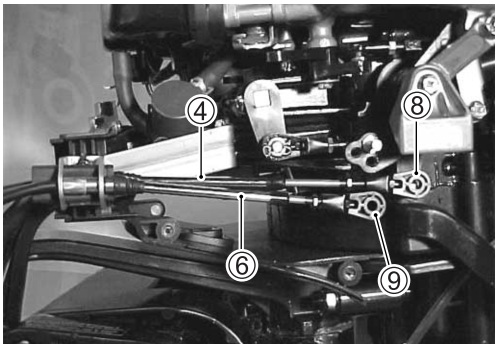
(2) Secure the shift cable ④ and throttle cable ⑥ in the cable holder ⑤ by fitting groove on the cable into slots of holder.



(3) Push the cable stopper ⑦ into the clearance between both cables until the stopper is fixed on the cable holder.



(4) Screw cable connector ⑧, ⑨ onto both cables.



- **Adjustment**

Shift cable to clutch control lever

(a) Place shift lever and clutch control lever ⓐ in the neutral position.

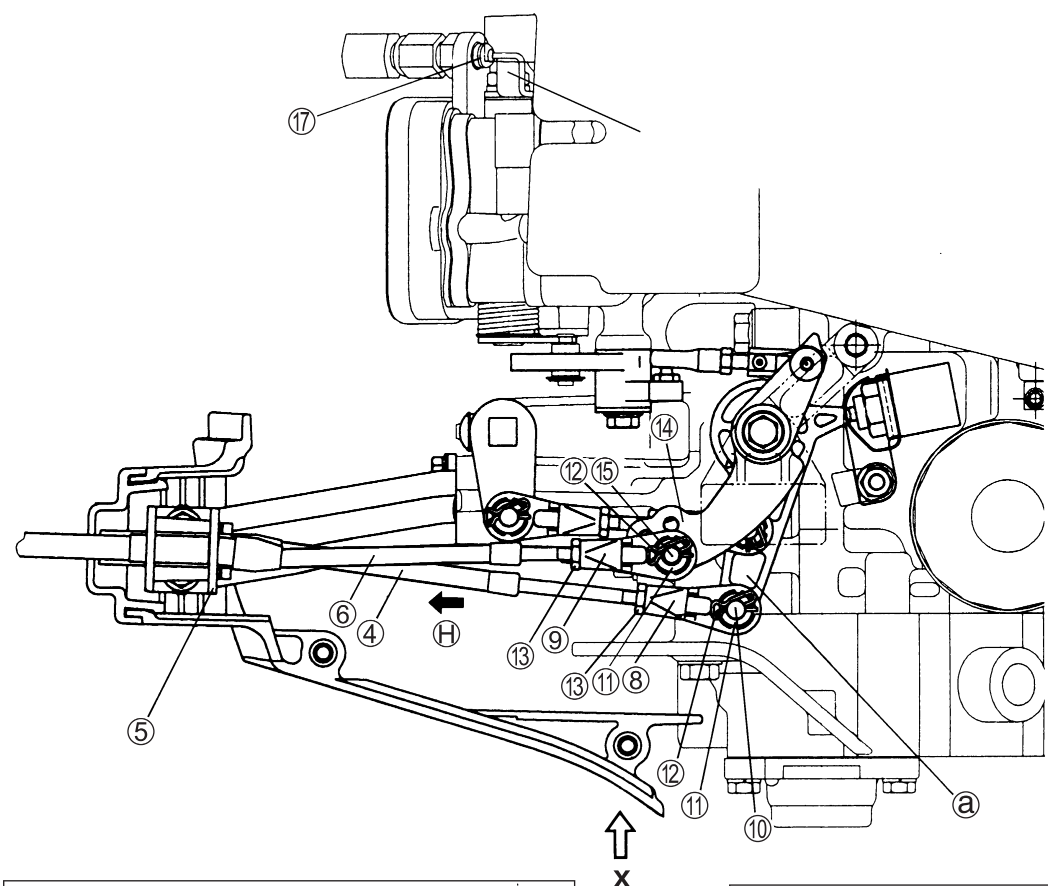
(b) Push the cable connector ⑧ and shift cable ④ in the direction shown by the arrow Ⓗ to remove all play in the cable.

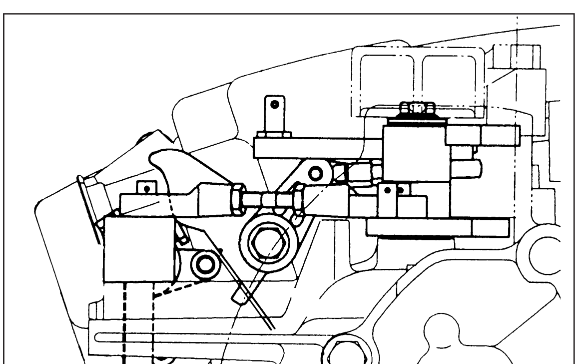
(c) While pressing against the cable and connector, adjust the connector ⑧ to align with pivot pin ⑩ on the clutch control lever.

(d) When aligned, press the connector ⑧ (flat side of connector towards the clutch control lever) over the pivot pin ⑩.

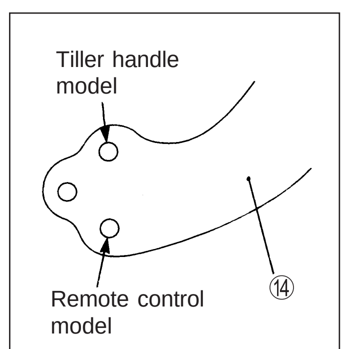
(e) Install the washer ⑪ and snap pin ⑫, then tighten the cable lock nut ⑬ against the connector to maintain adjustment.

(f) Make sure that both forward and reverse gears can be engaged with the same angle of shift lever travel from “NEUTRAL” position.





View X



PIVOT PIN POSITION

Throttle cable to throttle control arm

(A) Set the throttle grip to the fully closed position.

(B) Make sure that the throttle lever is fully closed (CTP switch ⑰ must be in “ON”, pushed-in, position).

(C) Push the cable connector ⑨ and throttle cable in the direction shown by the arrow Ⓗ to remove all play in the cable.

(D) While pressing against the cable and connector, adjust the connector ⑨ to align with the pivot pin ⑮ on the throttle control arm ⑭.

(E) When aligned , press the connector ⑨ (flat side of connector towards the throttle control arm) over the pivot pin ⑮.

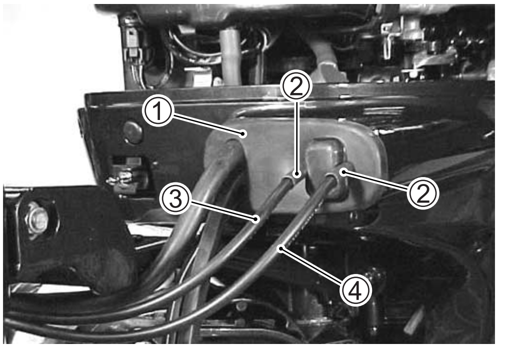
(F) Install the washer ⑪ and snap pin ⑫, then tighten the cable lock nut ⑬ against the connector to maintain adjustment.

CAUTION

Cable connectors must be threaded at least 13 mm (0.5 in.) onto cable.

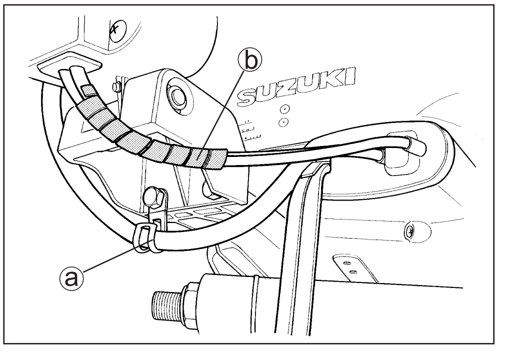
Rigging port grommet

- Install both side lower covers and rigging port grommet ①.
- Push the cable seal tube ② into the clearance between shift / throttle cable ③/④ and rigging port grommet.



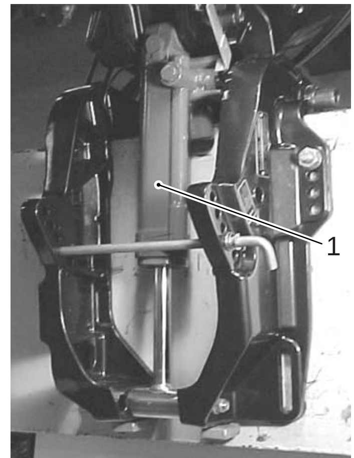
Harness/Cable routing

- Fix handle wire harness with clamp ⓐ as shown at right.
- Bind shift and throttle cable with spiral tube ⓑ as shown at right.



TILT AID SYSTEM

The DF40QH/50QH models are equipped with a tilt aid cylinder assembly located between the PORT and STBD clamp brackets.
This mechanism helps decrease the manual effort required to tilt the motor. The nitrogen gas sealed in the cylinder expands as the cylinder rod extends, thereby assisting the manual tilting process.



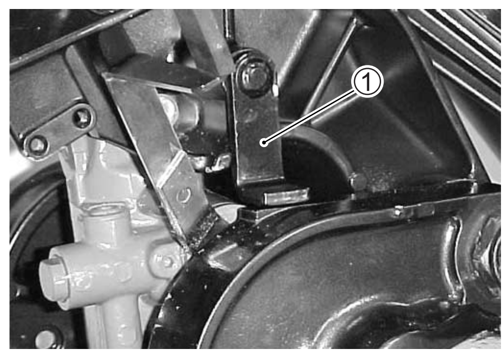
1. Tilt aid cylinder assembly

⚠ WARNING

This unit contains high pressure gas and it must not be disassembled, punctured, incinerated or exposed to heat.

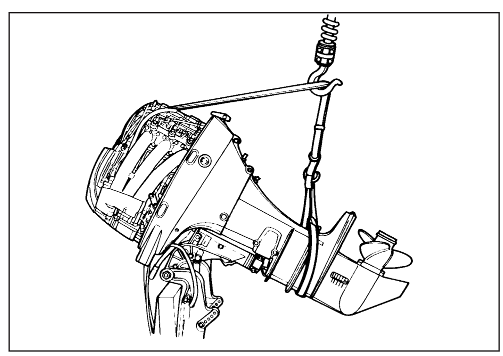
REMOVAL

Tilt engine fully up and lower the manual tilt lock levers ①.

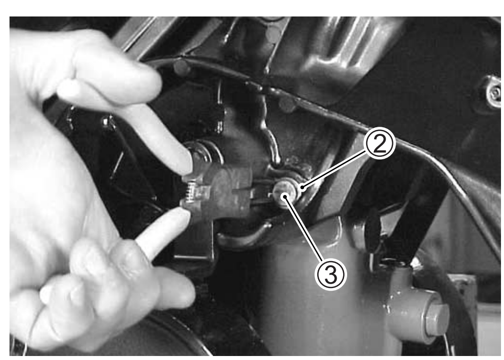


⚠ WARNING

During the following procedure, firmly secure the engine and support its weight. (see right)

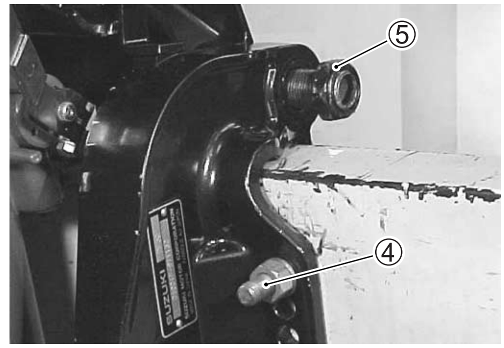


Remove the snap ring ② and push tilt cylinder upper shaft pin ③ out.

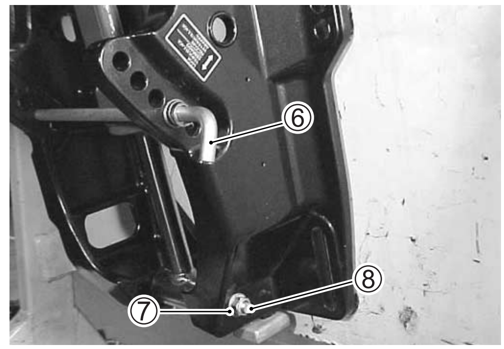


Remove the two STBD motor mounting bolts ④.
Loosen the clamp bracket shaft nut ⑤.

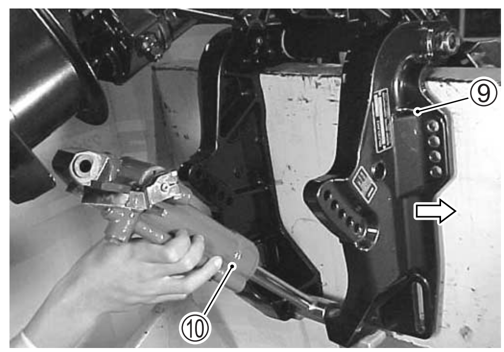
NOTE:
Complete removal of the clamp bracket shaft nut is not required.
Nut should only be loosened as far as the end of the shaft threads to facilitate removal of the tilt aid gas cylinder.



Remove the tilt pin ⑥.
Loosen the tilt aid gas cylinder lower shaft nut ⑦ and remove the lower shaft bolt ⑧.



Slide the STBD clamp bracket ⑨ fully outward to the right hand side.
Remove the tilt aid gas cylinder ⑩ from between the clamp brackets.

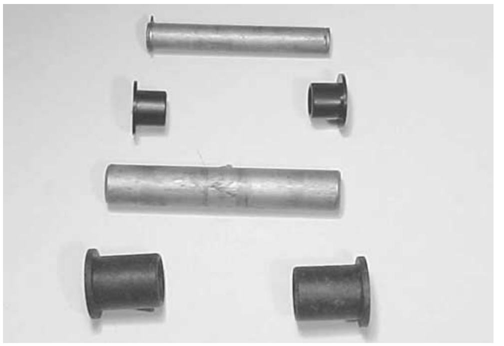


INSPECTION
NOTE:
If any component is found to be excessively worn, cracked, defective or damaged in any way, it must be replaced.

Tilt aid gas cylinder
Check tilt aid gas cylinder.
If cracks, defects or other damage is found, replace the cylinder assembly complete.

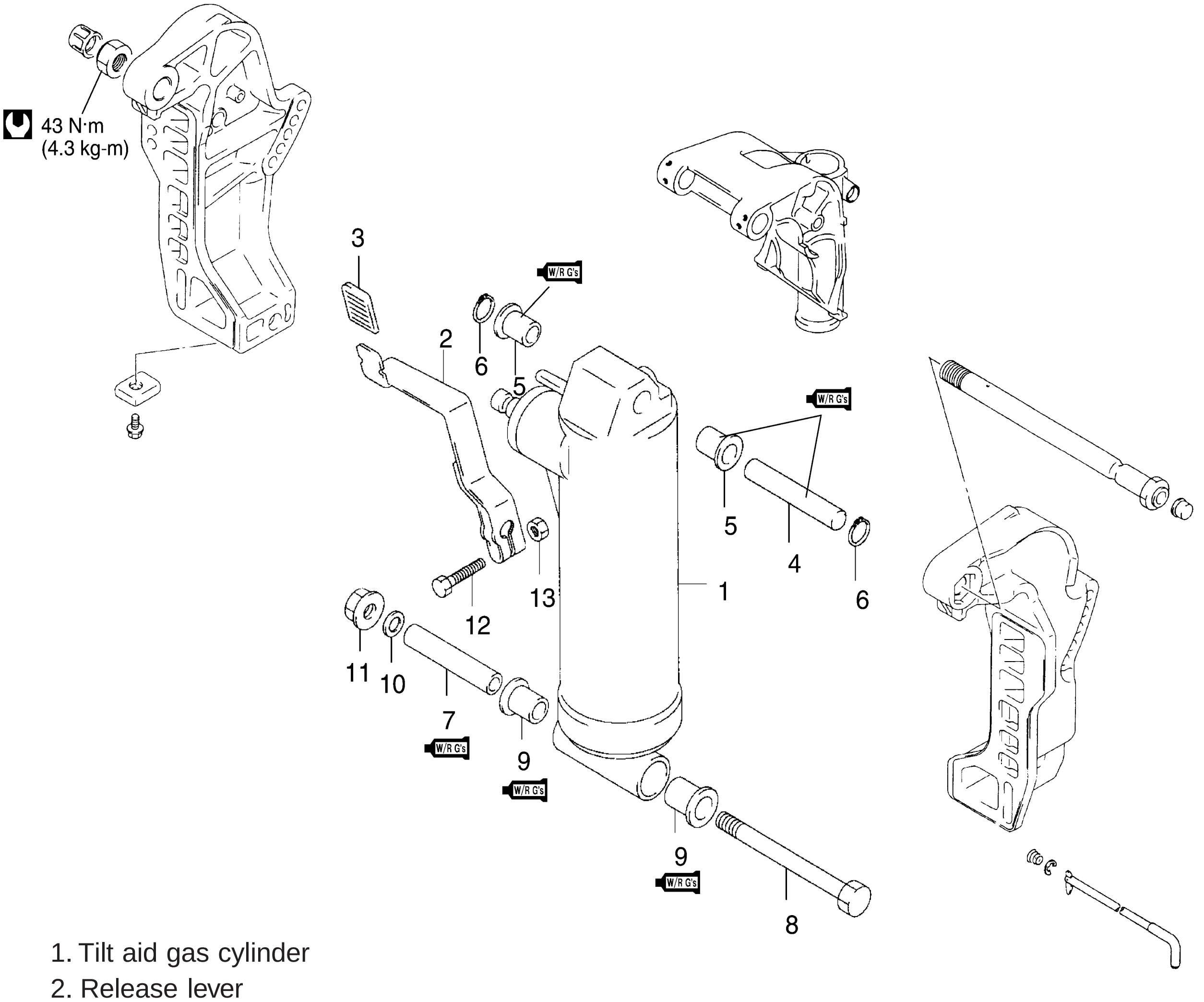
Bushings

Check all bushings.
If excessive wear or other damage is found, replace bushing.
If bushing fit is loose when installing, replace bushing.



INSTALLATION

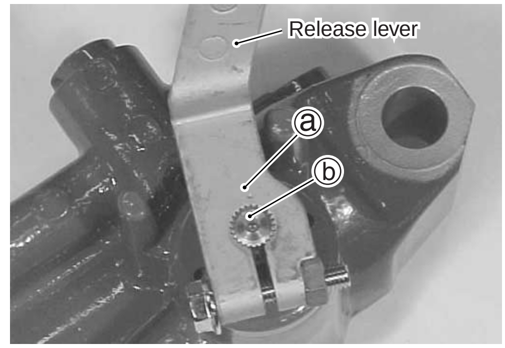
Installation is reverse order of removal with special attention to following steps.



1. Tilt aid gas cylinder
2. Release lever
3. Rubber, release lever
4. Cylinder upper shaft
5. Bush
6. Snap ring
7. Gas cylinder lower shaft
8. Bolt
9. Bush
10. Washer
11. Nut
12. Bolt
13. Nut

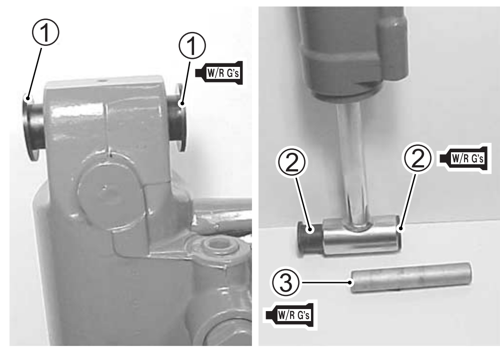
Release lever

Install release lever by aligning with punch mark ⓐ of release lever and punch mark ⓑ of shaft as shown in figure.
Tighten lever bolt securely.



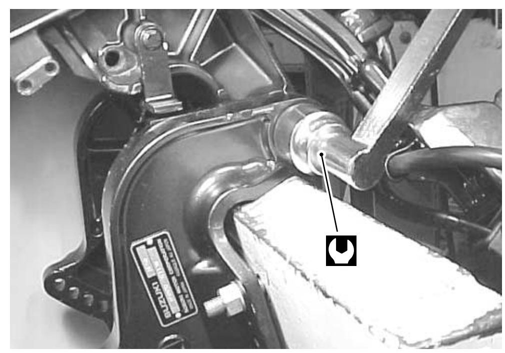
Tilt aid gas cylinder

Apply grease to each bush, cylinder lower shaft and cylinder upper shaft.
Install bushes ①, ② and cylinder lower shaft ③.



W/R G's 99000-25160 : Suzuki Water Resistant Grease

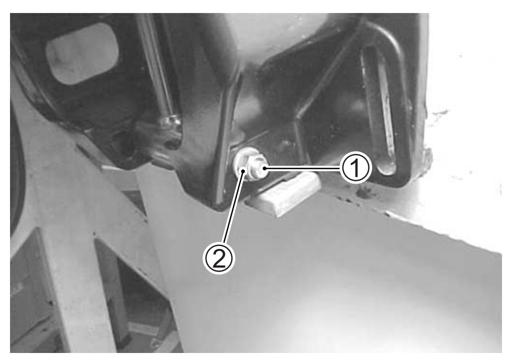
Place the tilt aid gas cylinder in position between the clamp brackets.
Tighten clamp bracket shaft nut to specified torque.



Clamp bracket shaft nut:

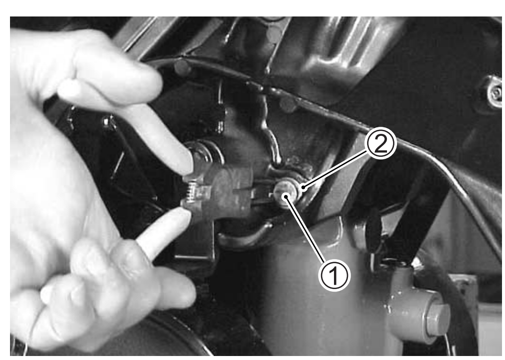
43 N·m (4.3 kg-m, 31.0 lb.-ft.)

Slide the cylinder lower shaft bolt through the clamp bracket and lower shaft, then secure with the nut.



① Lower shaft bolt
② Nut

Align the cylinder upper eyelet with the hole in the swivel bracket, then insert the upper shaft through the swivel bracket and gas cylinder.
Secure the upper shaft with the snap ring.



① Upper shaft
② Snap ring

DF40 / DF50 "Y" ('00) MODEL

CONTENTS

SPECIFICATIONS

Item		Unit	Data			
			DF40T	DF40QH	DF50T	DF50QH
PRE-FIX			04001F		05001F	

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	756 (29.8)	852 (33.5)	756 (29.8)	852 (33.5)
Overall width (side to side)		mm (in)	382 (15.0)	382 (15.0)	382 (15.0)	382 (15.0)
Overall height	S	mm (in)	1263 (49.7)	1263 (49.7)	1263 (49.7)	1263 (49.7)
	L	mm (in)	1390 (54.7)	1390 (54.7)	1390 (54.7)	1390 (54.7)
Weight (without engine oil)	S	kg (lbs)	106 (234)	107 (236)	106 (234)	107 (236)
	L	kg (lbs)	109 (240)	110 (243)	109 (240)	110 (243)
Transom height	S	mm (in. type)	401 (15)	401 (15)	401 (15)	401 (15)
	L	mm (in. type)	528 (20)	528 (20)	528 (20)	528 (20)

PERFORMANCE

Maximum output	kW (PS)	29.4 (40)	36.8 (50)
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx. 850)	

POWERHEAD

Engine type		4-stroke DOHC			
Number of cylinders		3			
Bore	mm (in)	71.0 (2.80)			
Stroke	mm (in)	68.6 (2.70)			
Total displacement	cm^3 (cu in)	815 (49.7)			
Compression ratio	: 1	10			
Spark plug	NGK	DCPR6E			
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	Twist grip	Remote control	Twist grip

Item	Unit	Data			
		DF40T	DF40QH	DF50T	DF50QH

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 10W-40
Engine oil amounts	L (US/Imp. qt)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	610 (20.6/21.5)

BRACKET

Trim angle		PTT system	Manual trim and gas assisted tilt system	PTT system	Manual trim and gas assisted tilt system
Number of trim position	Adjustable	PTT system	5	PTT system	5
Maximum tilt angle	degree	73°			

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	11 : 25 (2.27)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in.) × Pitch (in.)
	3 × 11-1/2 × 9 (S900)
	3 × 11-1/2 × 10 (S1000)
	3 × 11-1/2 × 11 (S1100)
	3 × 11-5/8 × 12 (S1200)
	3 × 11-1/2 × 13 (S1301, SS1300)
	3 × 11-3/8 × 14 (S1400, SS1400)
	3 × 11-1/4 × 15 (S1500)
S : Aluminum propeller	3 × 11-1/8 × 16 (S1600, SS1600)
SS : Stainless steel propeller	3 × 11 × 17 (S1700)

These specifications are subject to change without notice.

SERVICE DATA

Item	Unit	Data	
		DF40T/40QH	DF50T/50QH

POWERHEAD

Item	Unit	DF40T/40QH	DF50T/50QH
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx.850)	
**Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1600 (13 – 16, 185 – 228)	
**Cylinder compression max. difference between any other cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)	
**Engine oil pressure	kPa (kg/cm^2, psi)	300 – 380 (3.0 – 3.8, 43 – 54) at 4000 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)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change	
Thermostat operating temperature	°C (°F)	48 – 52 (118 – 126), *58 – 62 (136 – 144)	

* For serial no. DF40-031586 and later models, DF50-031526 and later models.

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

ENGINE OIL PUMP

Radial clearance	Limit	mm (in)	0.31 (0.012)
Side clearance	Limit	mm (in)	0.15 (0.006)

CYLINDER HEAD/CAMSHAFT

				DF40T/40QH	DF50T/50QH
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	mm (in)	37.530–37.690 (1.4776–1.4839)	38.230–38.390 (1.5051–1.5114)
		Limit	mm (in)	37.430 (1.4736)	38.130 (1.5012)
	EX	STD	mm (in)	37.740–37.900 (1.4858–1.4921)	37.740–37.900 (1.4858–1.4921)
		Limit	mm (in)	37.640 (1.4819)	37.640 (1.4819)
Camshaft journal oil clearance		STD	mm (in)	0.045 – 0.087 (0.0018 – 0.0034)	
		Limit	mm (in)	0.120 (0.0047)	
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)	
		Limit	mm (in)	23.171 (0.9122)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.934 – 22.955 (0.9029 – 0.9037)	
		Limit	mm (in)	22.784 (0.8970)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.062 (0.0010 – 0.0024)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	26.959 – 26.975 (1.0614 – 1.0620)	
Cylinder head bore		STD	mm (in)	27.000 – 27.021 (1.0630 – 1.0638)	

Item			Unit	Data: DF40T/40QH	Data: DF50T/50QH

VALVE / VALVE GUIDE

Item			Unit	DF40T/40QH	DF50T/50QH
Valve diameter		IN	mm (in)	24.6 (0.97)	
		EX	mm (in)	21.5 (0.85)	
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)	
	EX	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)	
Valve seat angle		IN	degree	30°, 45°	
		EX	degree	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)	5.500 – 5.512 (0.2165 – 0.2170)	
Valve guide protrusion	IN,EX	STD	mm (in)	11.0 (0.43)	
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)	
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)	
Valve stem end length	IN,EX	Limit	mm (in)	3.20 (0.126)	
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)	
	EX	Limit	mm (in)	0.18 (0.007)	
Valve stem runout	IN,EX	Limit	mm (in)	0.05 (0.002)	
Valve head radial runout	IN,EX	Limit	mm (in)	0.08 (0.003)	
Valve head thickness	IN	STD	mm (in)	1.0 (0.04)	
		Limit	mm (in)	0.7 (0.03)	
	EX	STD	mm (in)	1.15 (0.045)	
		Limit	mm (in)	0.5 (0.02)	
Valve seat contact width	IN	STD	mm (in)	1.80 – 2.20 (0.071 – 0.087)	
	EX	STD	mm (in)	1.65 – 2.05 (0.065 – 0.081)	
Valve spring free length		STD	mm (in)	33.1 (1.30)	
		Limit	mm (in)	31.8 (1.25)	
Valve spring tension		STD	N (kg, lbs)	97 – 113 (9.7–11.3, 21.4–24.9) for 28.5 mm (1.12 in)	
		Limit	N (kg, lbs)	89 (8.9, 19.6) for 28.5 mm (1.12 in)	
Valve spring squareness		Limit	mm (in)	2.0 (0.08)	

Item			Unit	Data DF40T/40QH	Data DF50T/50QH

CYLINDER/PISTON/PISTON RING

Item			Unit	
Cylinder distortion		Limit	mm (in)	0.060 (0.0024)
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)	71.000 – 71.020 (2.7953 – 2.7961)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	70.970 – 70.990 (2.7941 – 2.7949)
Piston measuring position			mm (in)	19 (0.7) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.10 – 0.25 (0.004 – 0.010)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.25 – 0.40 (0.010 – 0.016)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 7.5 (0.30)
		Limit	mm (in)	6.0 (0.24)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.35)
Piston ring to groove clearance	1st	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)
		Limit	mm (in)	0.10 (0.004)
	2nd	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)
	2nd	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)
	Oil	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060) *2.01 – 2.03 (0.079 – 0.080)
Piston ring thickness	1st	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)
	2nd	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.018 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	17.996 – 18.000 (0.7085 – 0.7087)
		Limit	mm (in)	17.980 (0.7079)
Piston pin hole diameter		STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)
		Limit	mm (in)	18.040 (0.7102)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.015 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)

* For serial no. DF40-031716 and later models, DF50-031700 and later models.

Item	Unit	Data	
		DF40T/40QH	DF50T/50QH

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)
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)	41.000 – 41.018 (1.6142 – 1.6149)
Crank pin outside diameter	STD	mm (in)	37.982 – 38.000 (1.4954 – 1.4961)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.486 – 1.502 (0.0585 – 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 (0.002)
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)	49.000 – 49.018 (1.9291 – 1.9298)
Crankshaft journal outside diameter	STD	mm (in)	44.982 – 45.000 (1.7709 – 1.7717)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.999 – 2.015 (0.0787 – 0.0793)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.470 – 2.520 (0.0972 – 0.0992)

LOWER UNIT

Design specification thickness for shim & washer

Pinion gear back-up shim	mm (in)	1.0 (0.04)
Forward gear back-up shim	mm (in)	1.0 (0.04)
Forward gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear back-up shim	mm (in)	1.0 (0.04)

Item		Unit	Data	
			DF40T/40QH	DF50T/50QH

ELECTRICAL

Ignition timing		Degrees at r/min	BTDC 0° – BTDC 32°	BTDC 0° – BTDC 25°
Over revolution limiter		r/min	6500	7000
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	8.1 – 11.1	
Battery charge coil resistance		Ω at 20°C	0.56 – 0.84	
Battery charge coil output (12V)		Watt	216	
Standard spark plug	Type	NGK	DCPR6E	
	Gap	mm (in)	0.8 – 0.9 (0.031 – 0.035)	
Fuse amp. rating		A	Main fuse : 30 Fuel pump fuse : 15	
Recommended battery capacity (12V)		Ah (kC)	70 (252) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	21.5 – 32.3	
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 motor relay resistance		Ω at 20°C	3.5 – 5.1	
PTT motor relay resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

Max. continuous time of use		Sec.	30
Motor output		kW	0.9
Brush length	STD	mm (in)	17.0 (0.67)
	Limit	mm (in)	10.0 (0.39)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	33.0 (1.30)
	Limit	mm (in)	32.0 (1.26)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)
Pinion to ring gear gap	STD	mm (in)	3.0 – 5.0 (0.12 – 0.20)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	4.8 (0.19)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	21.0 (0.83)

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	34	on off 	YES
2	CKP sensor	42	on off 	NO
3	IAC valve/By-pass air screw adjustment	31	on off 	NO
4	CMP sensor	24	on off 	YES
5	CTP switch	22	on off 	NO
6	Cylinder temp. sensor	14	on off 	YES
7	IAT sensor	23	on off 	YES
8	MAP sensor 2 (Sensor hose)	32	on off 	NO
9	Rectifier & regulator (Over-charging)	11	on off 	NO
10	Exhaust manifold temp. sensor	15	on off 	YES

NOTE:

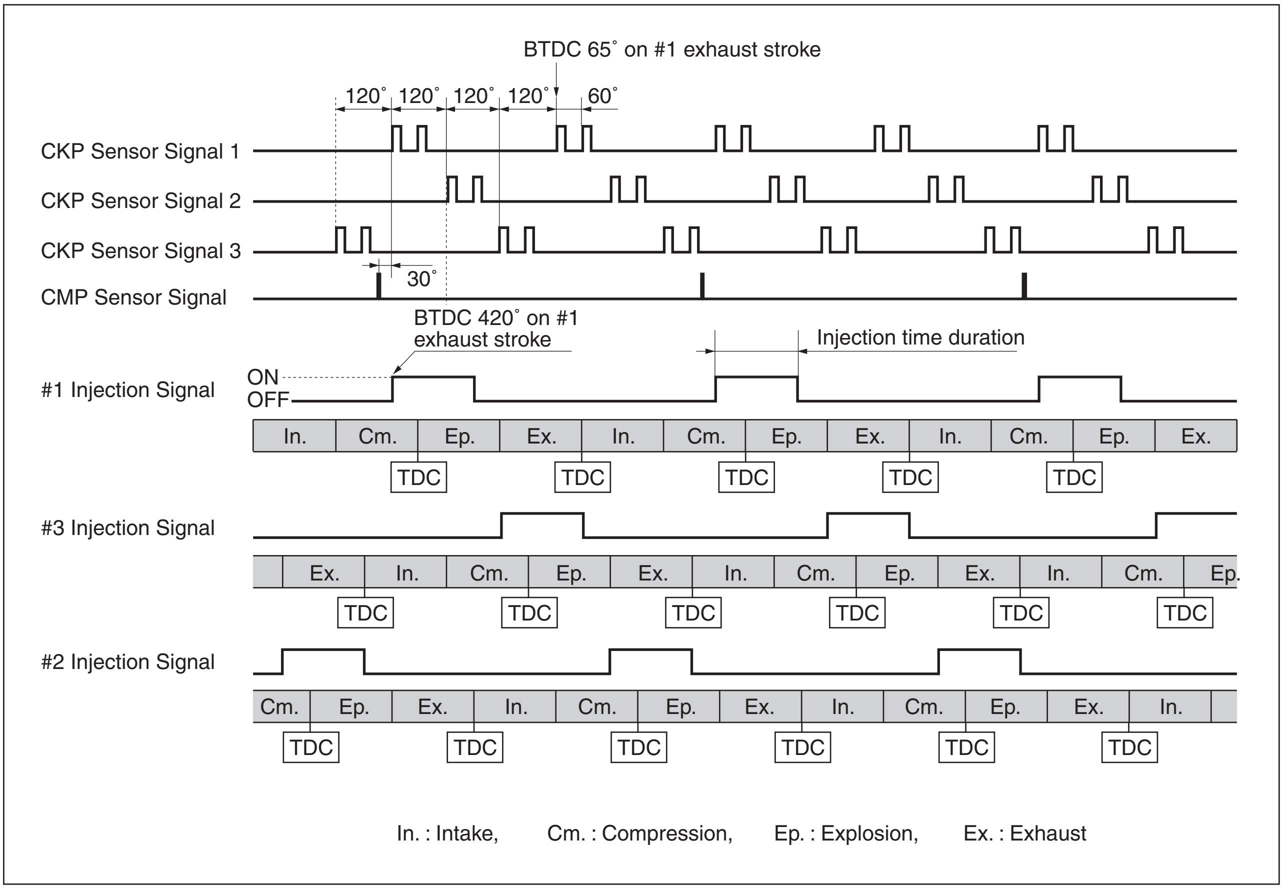
- *If more than two items fail at once, the self-diagnostic indication appears according to priority order. The indication repeats three times.*
- *On the tiller handle (QH) model, alerts is signaled by a sound from the caution buzzer contained in the tiller handle.*

ENGINE CONTROL SYSTEM

ENGINE CONTROL MODULE

The fuel injection timing has been modified from the "Y" ('00) model.
The fuel injection will be started at BTDC 420° on exhaust stroke as shown in the chart below.

FUEL INJECTION TIMING CHART



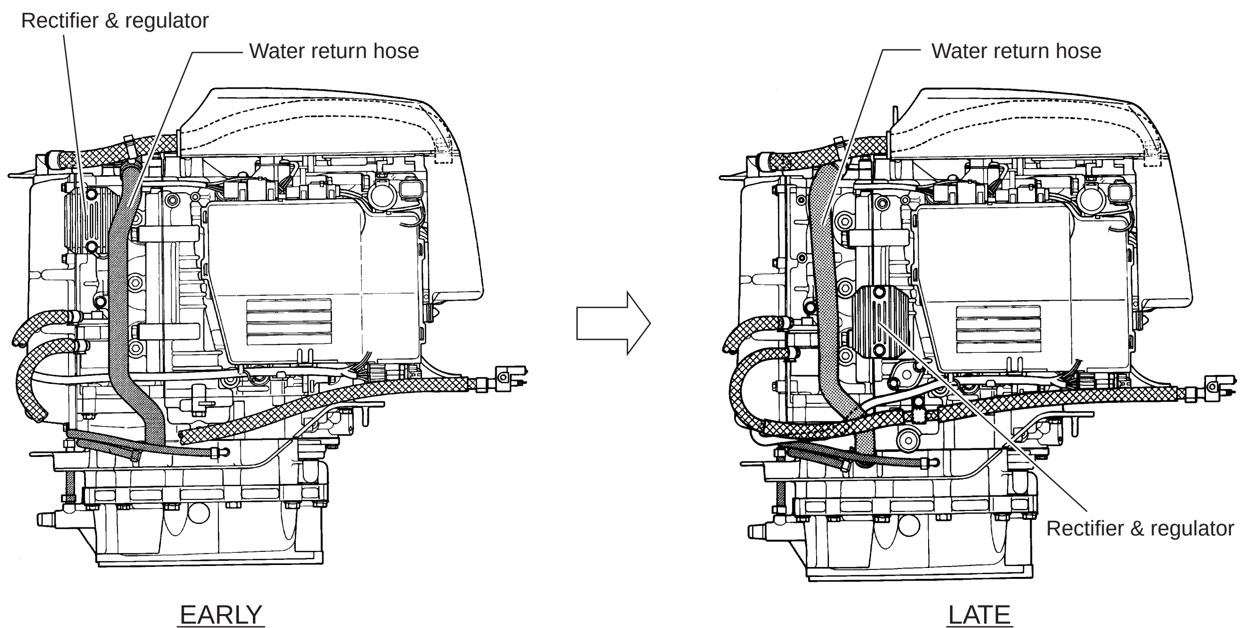
ELECTRICAL

RECTIFIER & REGULATOR

The location of the rectifier & regulator has been modified from the cylinder head to the cylinder block. In relation to this modification;

- Bosses have been added to facilitate mounting of the rectifier & regulator to the cylinder block.
- Water return hose has been modified in shape.

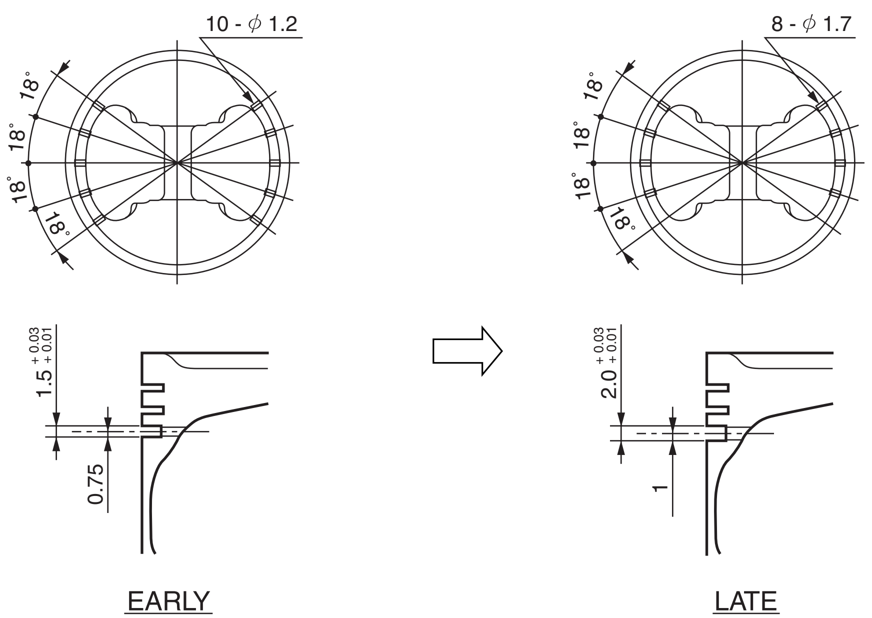
This modification has been carried out from the “Y” (‘00) model.



POWER UNIT

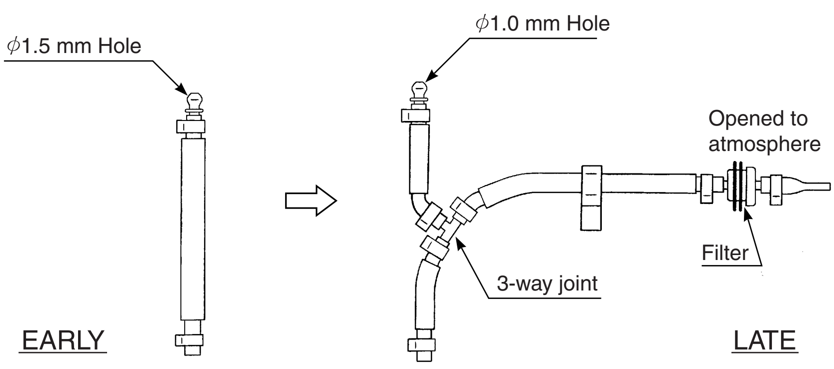
PISTON / PISTON RNG

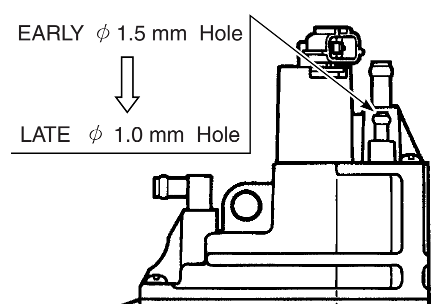
Number of diameter of the piston oil holes and thickness of oil ring have been modified.
This modification has been carried out from the middle of “Y” (‘00) model. Refer to the page 12-5.



EVAPORATION HOSE / FUEL VAPOR SEPARATOR

The evaporation hose and related items have been modified. In reration to this modification, the hose nipple on the fuel vapor separator has been modified also.
This modification has been carred out from the middle of “Y” (‘00) model.





THERMOSTAT

The thermostat has been modified in specification of operating temperature from 50 ±2°C to 60 ±2°C.
This modification has been carried out from the middle of “Y” (‘00) model. Refer to the page 12-3.

LOWER UNIT

GEARCASE

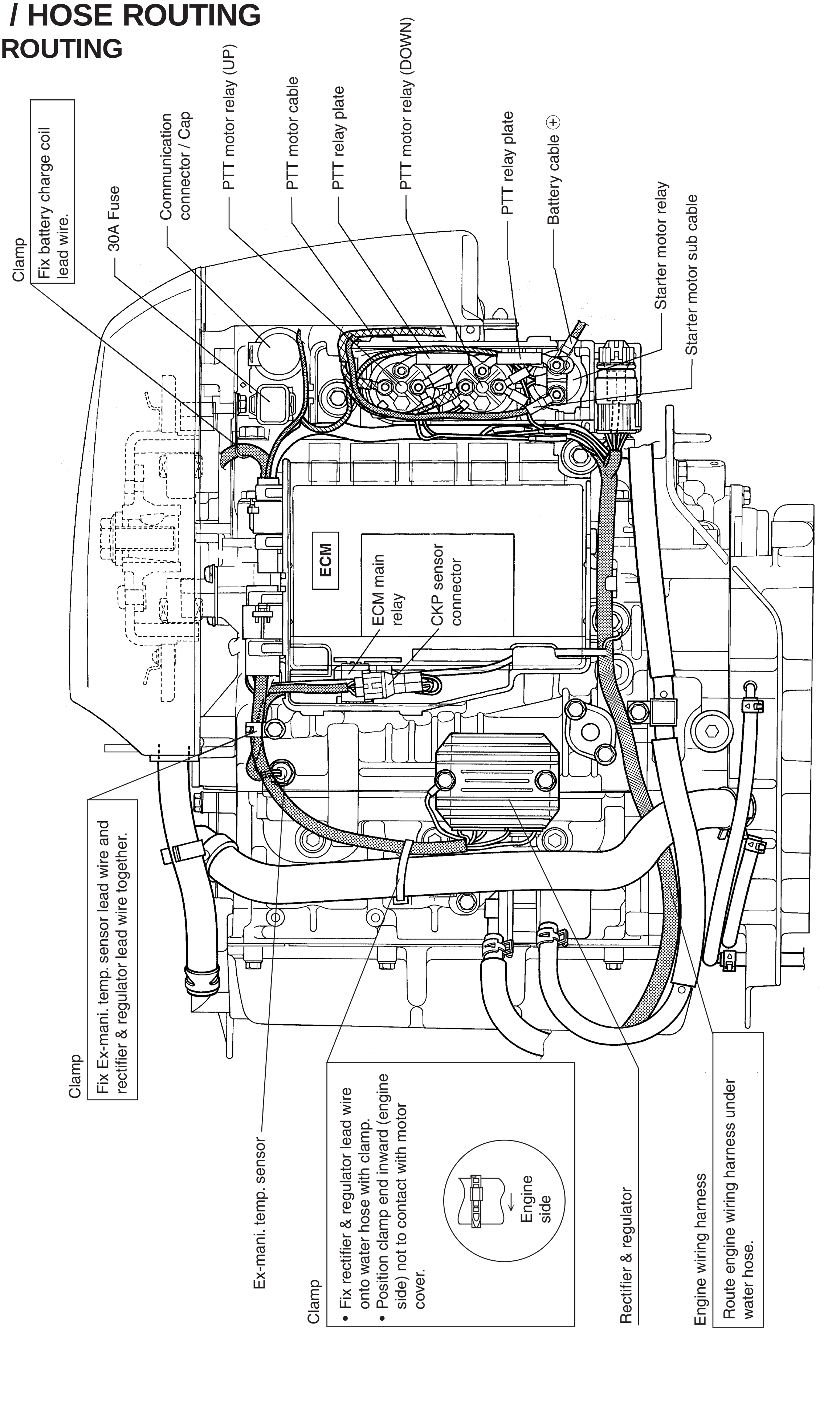
The gearcase has been modified in shape as follows:

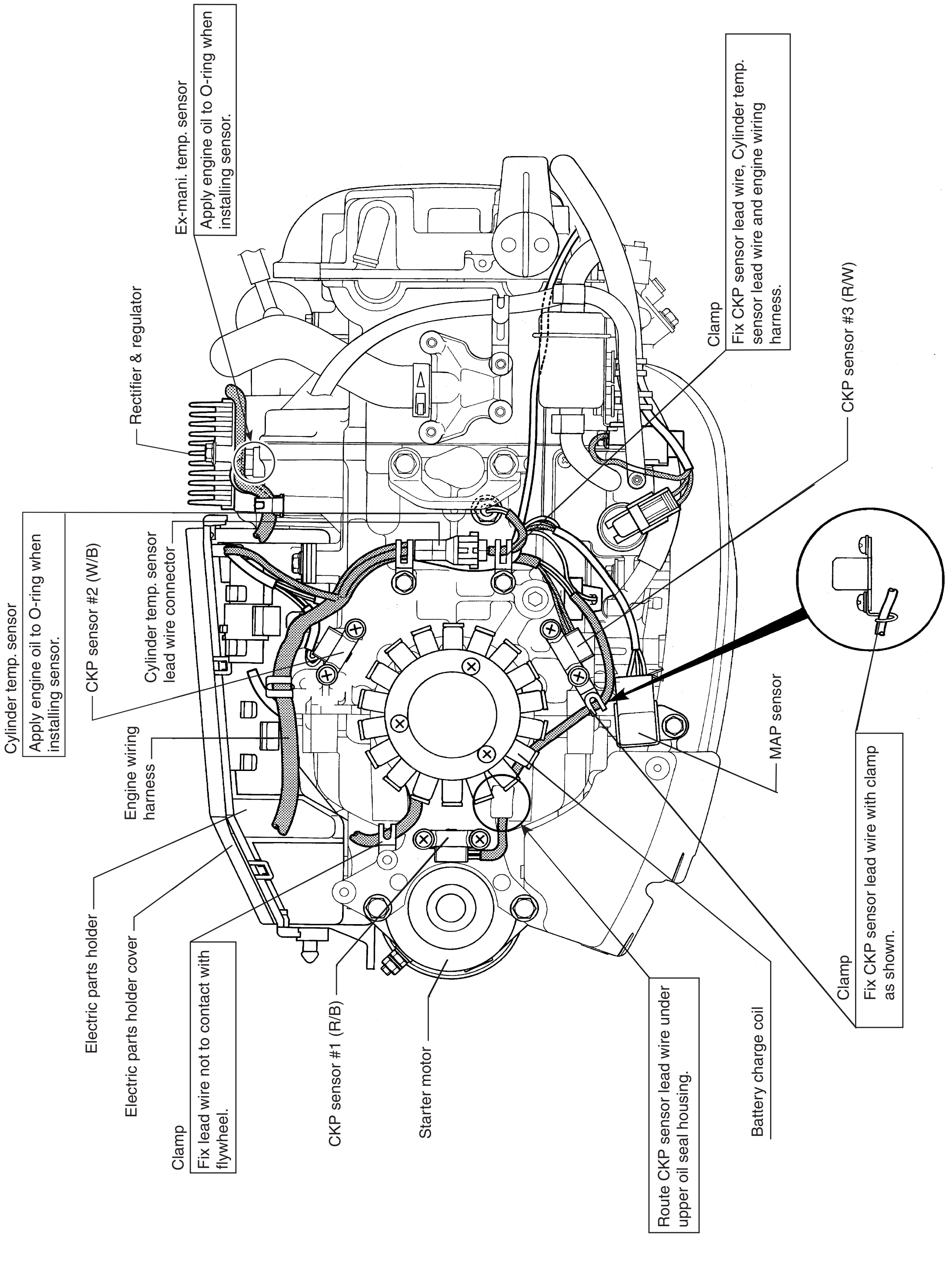
- Modified the shape of the part above the cavitation plate.
- Modified the shape of the splash plate to make common use with “S” transom size.
- Aligned the height of the oil level plug and flashing plug.
- Modified the shape of the skeg end.
- Chamfied the edge.
- Added rib behind the shift cam.

This modification has been carried out from the “Y” (‘00) model.

WIRE / HOSE ROUTING

WIRE ROUTING

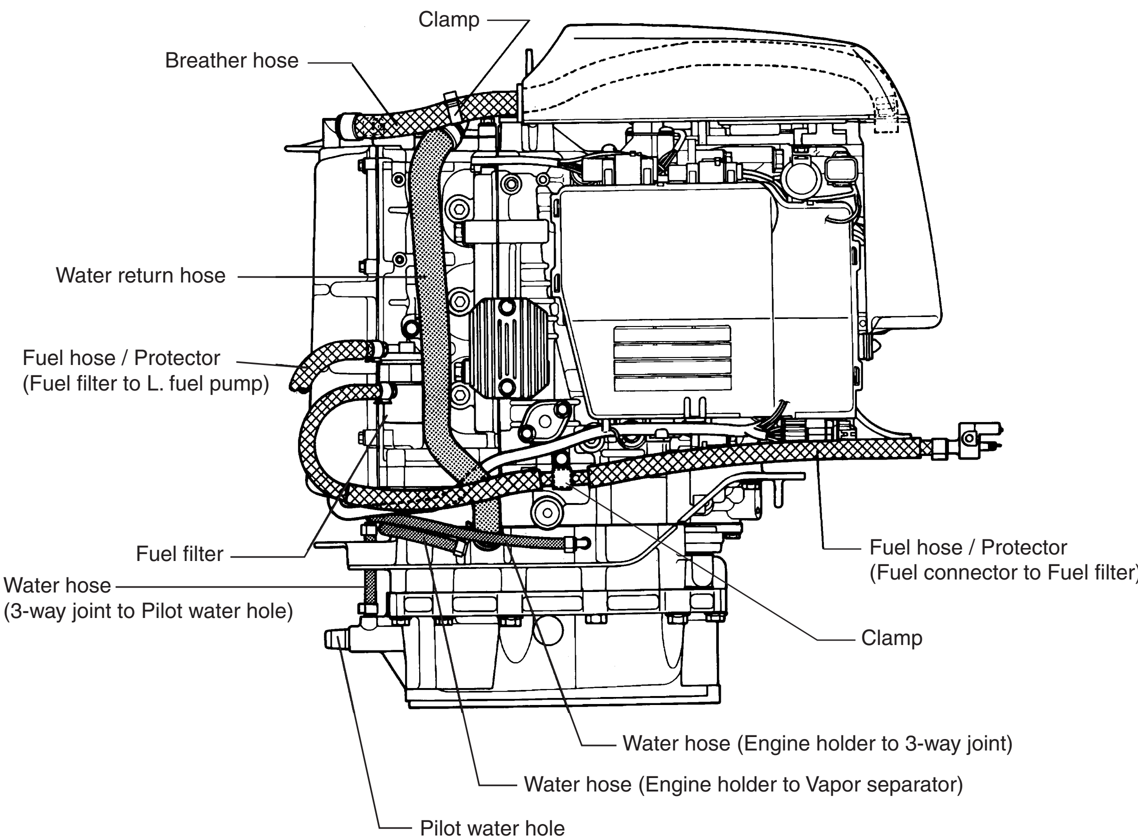


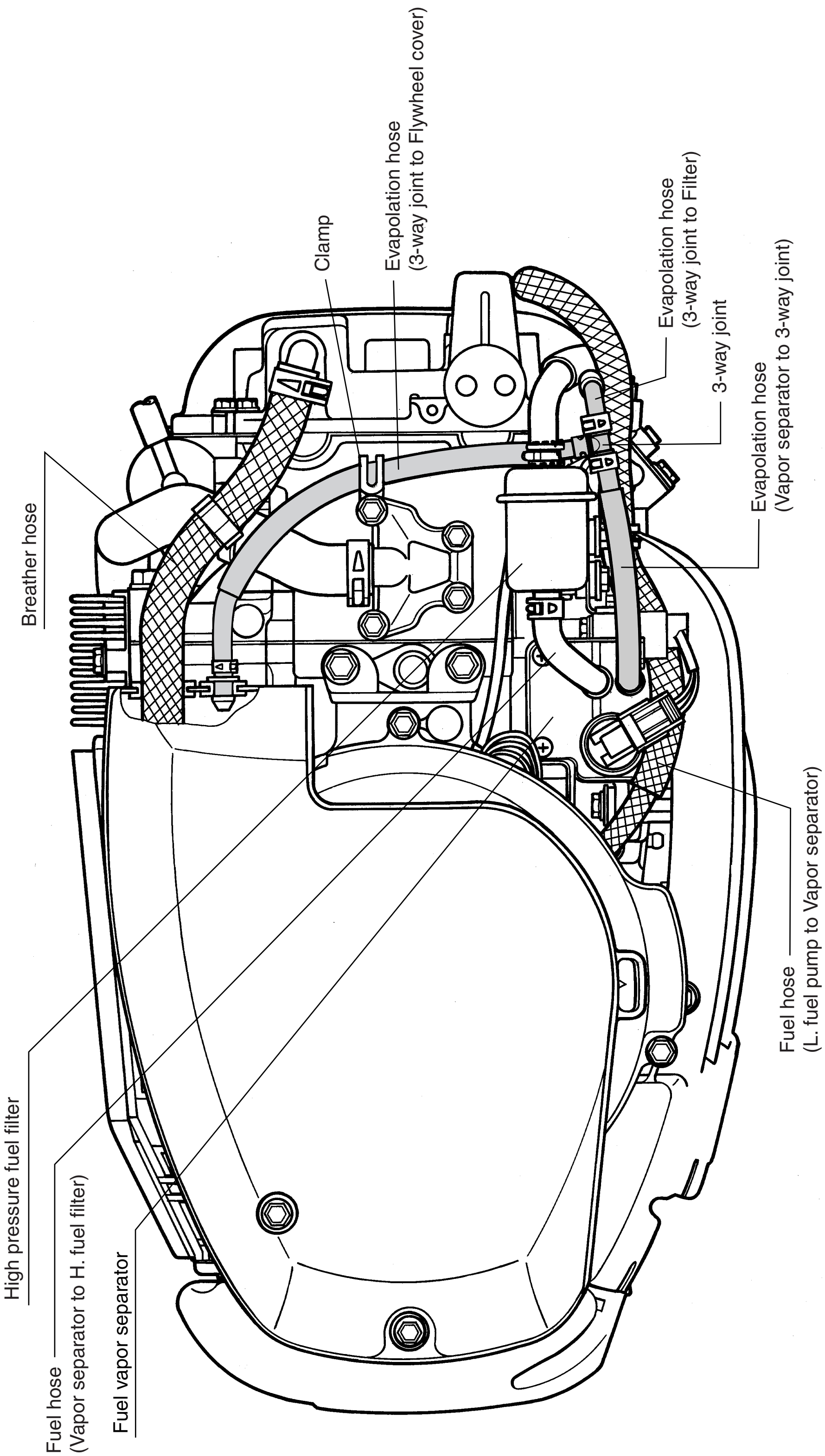

Ex-mani. temp. sensor
Apply engine oil to O-ring when installing sensor.
Rectifier & regulator
Clamp
Fix CKP sensor lead wire, Cylinder temp. sensor lead wire and engine wiring harness.
CKP sensor #3 (R/W)
Cylinder temp. sensor
Apply engine oil to O-ring when installing sensor.
CKP sensor #2 (W/B)
Cylinder temp. sensor lead wire connector
Engine wiring harness
MAP sensor
Electric parts holder
Electric parts holder cover
Clamp
Fix lead wire not to contact with flywheel.
CKP sensor #1 (R/B)
Starter motor
Route CKP sensor lead wire under upper oil seal housing.
Battery charge coil
Clamp
Fix CKP sensor lead wire with clamp as shown.

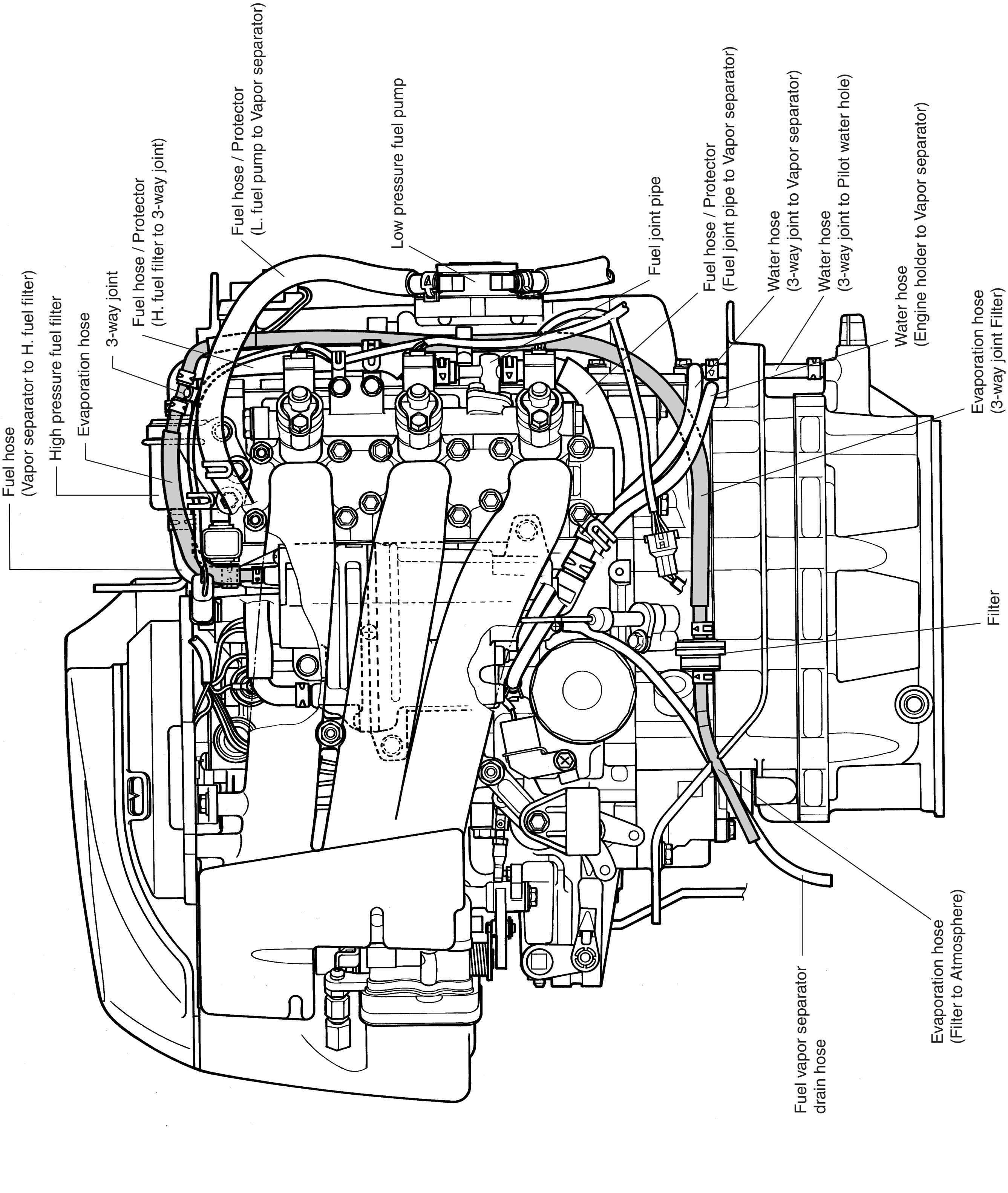
FUEL / WATER HOSE ROUTING

CAUTION

- **Do not over-bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Check that hoses do not contact rods and levers during either engine operation or stand-still.**
- **Extreme care should be taken not to cut, abrade or cause any other damage on hoses.**
- **Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.**




Evapolation hose
(3-way joint to Flywheel cover)
Clamp
Evapolation hose
(3-way joint to Filter)
3-way joint
Evapolation hose
(Vapor separator to 3-way joint)
Breather hose
Fuel hose
(L. fuel pump to Vapor separator)
High pressure fuel filter
Fuel hose
(Vapor separator to H. fuel filter)
Fuel vapor separator


Fuel hose
(Vapor separator to H. fuel filter)
High pressure fuel filter
Evaporation hose
3-way joint
Fuel hose / Protector
(H. fuel filter to 3-way joint)
Fuel hose / Protector
(L. fuel pump to Vapor separator)
Low pressure fuel pump
Fuel joint pipe
Fuel hose / Protector
(Fuel joint pipe to Vapor separator)
Water hose
(3-way joint to Vapor separator)
Water hose
(3-way joint to Pilot water hole)
Water hose
(Engine holder to Vapor separator)
Evaporation hose
(3-way joint Filter)
Evaporation hose
(3-way joint Filter)
Filter
Evaporation hose
(Filter to Atmosphere)
Fuel vapor separator
drain hose

DF40 / DF50(W) “K1” (’01) MODEL

CONTENTS

GENERAL INFORMATION

SPECIFICATIONS

Item	Unit	Data			
		DF40T	DF40QH	DF50(W)T	DF50(W)QH

PRE-FIX	04001F	05001F

DIMENSIONS & WEIGHT

Item		Unit	DF40T	DF40QH	DF50(W)T	DF50(W)QH
Overall length (front to back)		mm (in)	756 (29.8)	852 (33.5)	756 (29.8)	852 (33.5)
Overall width (side to side)		mm (in)	382 (15.0)	382 (15.0)	382 (15.0)	382 (15.0)
Overall height	S	mm (in)	1263 (49.7)	—	1263 (49.7)	—
	L	mm (in)	1390 (54.7)	1390 (54.7)	1390 (54.7)	1390 (54.7)
	UL	mm (in)	—	—	1517 (59.7)	1517 (59.7)
Weight (without engine oil)	S	kg (lbs)	106 (234)	—	106 (234)	—
	L	kg (lbs)	109 (240)	110 (243)	109 (240)	110 (243)
	UL	kg (lbs)	—	—	112 (247)	113 (249)
Transom height	S	mm (in. type)	401 (15)	—	401 (15)	—
	L	mm (in. type)	528 (20)	528 (20)	528 (20)	528 (20)
	UL	mm (in. type)	—	—	655 (25)	655 (25)

PERFORMANCE

Item	Unit	DF40T / DF40QH	DF50(W)T / DF50(W)QH
Maximum output	kW (PS)	29.4 (40)	36.8 (50)
Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx. 850)	

POWERHEAD

Item	Unit	DF40T	DF40QH	DF50(W)T	DF50(W)QH
Engine type		4-stroke DOHC			
Number of cylinders		3			
Bore	mm (in)	71.0 (2.80)			
Stroke	mm (in)	68.6 (2.70)			
Total displacement	cm^3 (cu in)	815 (49.7)			
Compression ratio	: 1	10			
Spark plug	NGK	DCPR6E			
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	Twist grip	´	Twist grip

Item	Unit	Data			
		DF40T	DF40QH	DF50(W)T	DF50(W)QH

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 10W-40
Engine oil amounts	L (US/Imp. qt)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	610 (20.6/21.5)

BRACKET

Trim angle		PTT system	Manual trim and gas assisted tilt system	PTT system	Manual trim and gas assisted tilt system
Number of trim position	Adjustable	PTT system	5	PTT system	5
Maximum tilt angle	degree	73°			

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	11 : 25 (2.27)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
S : Aluminum propeller SS : Stainless steel propeller	3 × 11-1/2 × 9 (S900) 3 × 11-1/2 × 10 (S1000) 3 × 11-1/2 × 11 (S1100) 3 × 11-5/8 × 12 (S1200) 3 × 11-1/2 × 13 (S1301, SS1300) 3 × 11-3/8 × 14 (S1400, SS1400) 3 × 11-1/4 × 15 (S1500) 3 × 11-1/8 × 16 (S1600, SS1600) 3 × 11 × 17 (S1700)

These specifications are subject to change without notice.

SERVICE DATA

Item	Unit	Data	
		DF40T/40QH	DF50(W)T/50(W)QH

POWERHEAD

Recommended operating range	r/min	5200 – 5800	5900 – 6500
Idle speed	r/min	850 ± 50 (in-gear: approx.850)	
*Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1600 (13 – 16, 185 – 228)	
*Cylinder compression max. difference between any other cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)	
*Engine oil pressure	kPa (kg/cm^2, psi)	300 – 380 (3.0 – 3.8, 43 – 54) at 4000 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)	2.2 (2.3/1.9) : Oil change only 2.4 (2.5/2.1) : Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

ENGINE OIL PUMP

Radial clearance	Limit	mm (in)	0.31 (0.012)
Side clearance	Limit	mm (in)	0.15 (0.006)

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	mm (in)	37.530–37.690 (1.4776–1.4839)	38.230–38.390 (1.5051–1.5114)
		Limit	mm (in)	37.430 (1.4736)	38.130 (1.5012)
	EX	STD	mm (in)	37.740–37.900 (1.4858–1.4921)	37.740–37.900 (1.4858–1.4921)
		Limit	mm (in)	37.640 (1.4819)	37.640 (1.4819)
Camshaft journal oil clearance		STD	mm (in)	0.045 – 0.087 (0.0018 – 0.0034)	
		Limit	mm (in)	0.120 (0.0047)	
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)	
		Limit	mm (in)	23.171 (0.9122)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.934 – 22.955 (0.9029 – 0.9037)	
		Limit	mm (in)	22.784 (0.8970)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.062 (0.0010 – 0.0024)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	26.959 – 26.975 (1.0614 – 1.0620)	
Cylinder head bore		STD	mm (in)	27.000 – 27.021 (1.0630 – 1.0638)	

Item			Unit	Data: DF40T/40QH	Data: DF50(W)T/50(W)QH

VALVE / VALVE GUIDE

Item			Unit	DF40T/40QH	DF50(W)T/50(W)QH
Valve diameter		IN	mm (in)	24.6 (0.97)	
		EX	mm (in)	21.5 (0.85)	
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)	
	EX	STD	mm (in)	0.18 – 0.24 (0.007 – 0.009)	
Valve seat angle		IN	degree	30°, 45°	
		EX	degree	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)	5.500 – 5.512 (0.2165 – 0.2170)	
Valve guide protrusion	IN,EX	STD	mm (in)	11.0 (0.43)	
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)	
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)	
Valve stem end length	IN,EX	Limit	mm (in)	3.20 (0.126)	
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)	
	EX	Limit	mm (in)	0.18 (0.007)	
Valve stem runout	IN,EX	Limit	mm (in)	0.05 (0.002)	
Valve head radial runout	IN,EX	Limit	mm (in)	0.08 (0.003)	
Valve head thickness	IN	STD	mm (in)	1.0 (0.04)	
		Limit	mm (in)	0.7 (0.03)	
	EX	STD	mm (in)	1.15 (0.045)	
		Limit	mm (in)	0.5 (0.02)	
Valve seat contact width	IN	STD	mm (in)	1.80 – 2.20 (0.071 – 0.087)	
	EX	STD	mm (in)	1.65 – 2.05 (0.065 – 0.081)	
Valve spring free length		STD	mm (in)	33.1 (1.30)	
		Limit	mm (in)	31.8 (1.25)	
Valve spring tension		STD	N (kg, lbs)	97 – 113 (9.7–11.3, 21.4–24.9) for 28.5 mm (1.12 in)	
		Limit	N (kg, lbs)	89 (8.9, 19.6) for 28.5 mm (1.12 in)	
Valve spring squareness		Limit	mm (in)	2.0 (0.08)	

Item			Unit	Data DF40T/40QH	Data DF50(W)T/50(W)QH

CYLINDER/PISTON/PISTON RING

Item			Unit	
Cylinder distortion		Limit	mm (in)	0.060 (0.0024)
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)	71.000 – 71.020 (2.7953 – 2.7961)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	70.970 – 70.990 (2.7941 – 2.7949)
Piston measuring position			mm (in)	19 (0.7) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.10 – 0.25 (0.004 – 0.010)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.25 – 0.40 (0.010 – 0.016)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 7.5 (0.30)
		Limit	mm (in)	6.0 (0.24)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.35)
Piston ring to groove clearance	1st	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)
		Limit	mm (in)	0.10 (0.004)
	2nd	STD	mm (in)	0.02 – 0.06 (0.001 – 0.002)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)
	2nd	STD	mm (in)	1.01 – 1.03 (0.040 – 0.041)
	Oil	STD	mm (in)	2.01 – 2.03 (0.079 – 0.080)
Piston ring thickness	1st	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)
	2nd	STD	mm (in)	0.97 – 0.99 (0.038 – 0.039)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.018 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	17.996 – 18.000 (0.7085 – 0.7087)
		Limit	mm (in)	17.980 (0.7079)
Piston pin hole diameter		STD	mm (in)	18.006 – 18.014 (0.7089 – 0.7092)
		Limit	mm (in)	18.040 (0.7102)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.015 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)

Item		Unit	Data	
			DF40T/40QH	DF50(W)T/50(W)QH

CRANKSHAFT / CONROD

Item		Unit	Data
Conrod small end inside diameter	STD	mm (in)	18.003 – 18.011 (0.7088 – 0.7091)
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)	41.000 – 41.018 (1.6142 – 1.6149)
Crank pin outside diameter	STD	mm (in)	37.982 – 38.000 (1.4954 – 1.4961)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.486 – 1.502 (0.0585 – 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 (0.002)
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)	49.000 – 49.018 (1.9291 – 1.9298)
Crankshaft journal outside diameter	STD	mm (in)	44.982 – 45.000 (1.7709 – 1.7717)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.999 – 2.015 (0.0787 – 0.0793)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.470 – 2.520 (0.0972 – 0.0992)

LOWER UNIT

Design specification thickness for shim & washer

Pinion gear back-up shim	mm (in)	1.0 (0.04)
Forward gear back-up shim	mm (in)	1.0 (0.04)
Forward gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear thrust washer	mm (in)	2.0 (0.08)
Reverse gear back-up shim	mm (in)	1.0 (0.04)

Item		Unit	Data	
			DF40T/40QH	DF50(W)T/50(W)QH

ELECTRICAL

Item		Unit	DF40T/40QH	DF50(W)T/50(W)QH
Ignition timing		Degrees at r/min	ATDC 1° – BTDC 27°	ATDC 1° – BTDC 24°
Over revolution limiter		r/min	6500	7000
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	8.1 – 11.1	
Battery charge coil resistance		Ω at 20°C	0.56 – 0.84	
Battery charge coil output (12V)		Watt	216	
Standard spark plug	Type	NGK	DCPR6E	
	Gap	mm (in)	0.8 – 0.9 (0.031 – 0.035)	
Fuse amp. rating		A	Main fuse : 30	
Recommended battery capacity (12V)		Ah (kC)	70 (252) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	21.5 – 32.3	
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 motor relay resistance		Ω at 20°C	3.5 – 5.1	
PTT motor relay resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

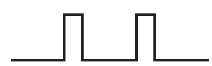
Max. continuous time of use		Sec.	30
Motor output		kW	0.9
Brush length	STD	mm (in)	17.0 (0.67)
	Limit	mm (in)	10.0 (0.39)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	33.0 (1.30)
	Limit	mm (in)	32.0 (1.26)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)
Pinion to ring gear gap	STD	mm (in)	3.0 – 5.0 (0.12 – 0.20)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	4.8 (0.19)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	21.0 (0.83)

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 (Sensor hose)	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 (Open circuit)	4-3	on off 	NO

NOTE:
- *If more than two items fail at once, the self-diagnostic indication appears according to priority order. The indication repeats three times.*
- *On the tiller handle (QH) model, alerts is signaled by a sound from the caution buzzer contained in the tiller handle.*

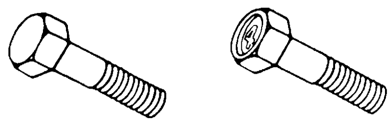
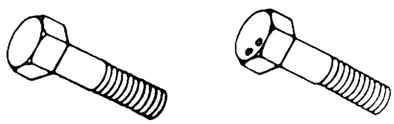
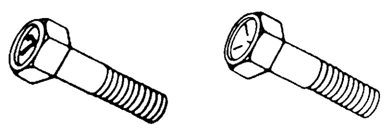
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

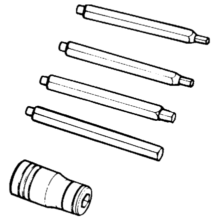
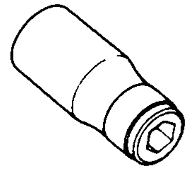
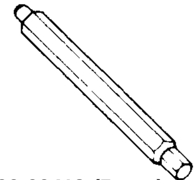
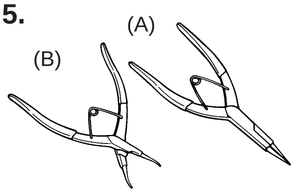
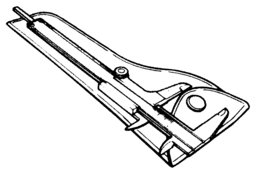
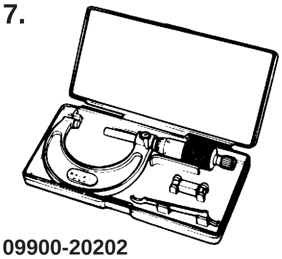
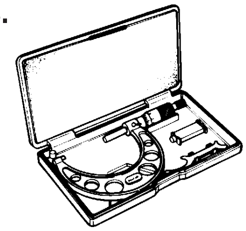
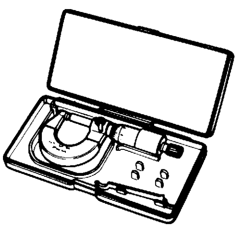
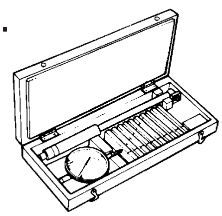
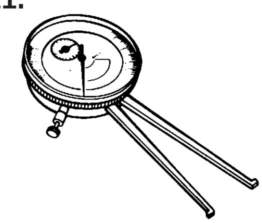
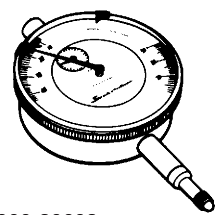
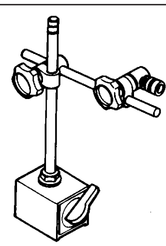
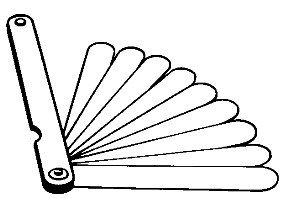
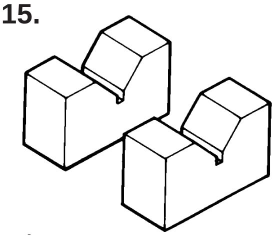
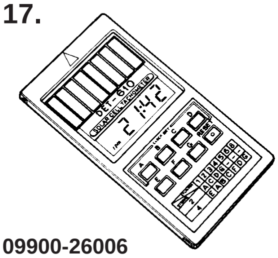
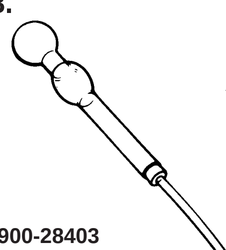
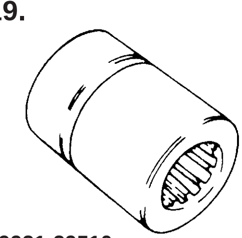
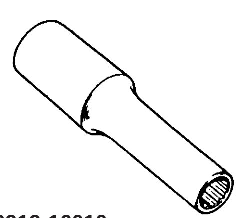
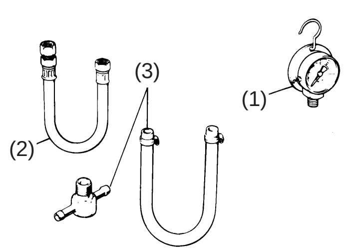
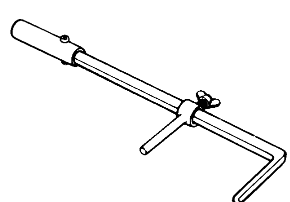
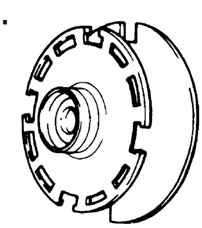
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft.
Cylinder head cover bolt		6 mm	10	1.0	7.0
Cylinder head bolt		10 mm	60	6.0	43.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	53	5.3	38.5
Conrod cap nut		8 mm	35	3.5	25.5
Camshaft housing bolt		6 mm	10	1.0	7.0
Camshaft timing sprocket bolt		6 mm	10	1.0	7.0
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		6 mm	11	1.1	8.0
		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Intake manifold fuel main gallery	3-way joint bolt	6 mm	10	1.0	7.0
	Upper/lower plug	——	35	3.5	25.5
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	190	19.0	137.5
Starter motor mounting bolt		8 mm	23	2.3	16.5
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt/nut		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		10 mm	40	4.0	29.0
Upper mount cover bolt		8 mm	23	2.3	16.5
Lower mount nut	Front	12 mm	60	6.0	43.5
	Rear	12 mm	40	4.0	29.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case nut		6 mm	8	0.8	6.0
Gearcase bolt		8 mm	23	2.3	16.5
Propeller shaft bearing housing bolt		8 mm	17	1.7	12.5
Pinion nut		12 mm	50	5.0	36.0
Propeller nut		18 mm	55	5.5	40.0

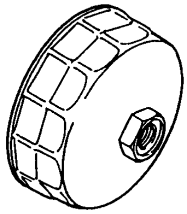
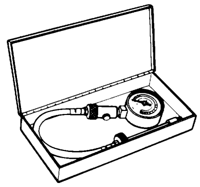
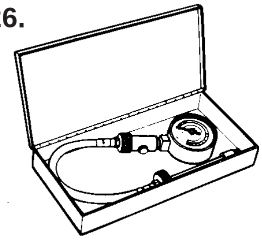
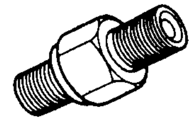
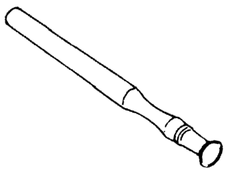
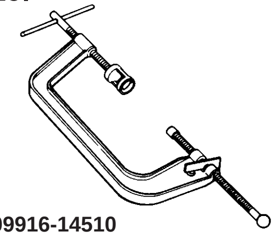
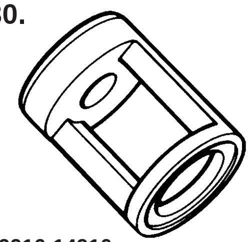
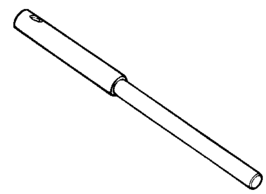
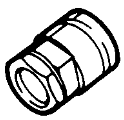
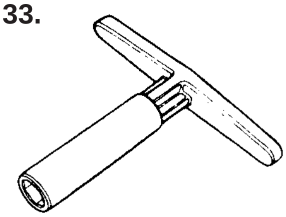
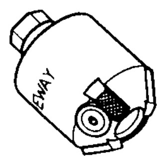
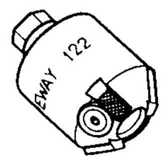
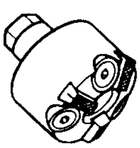
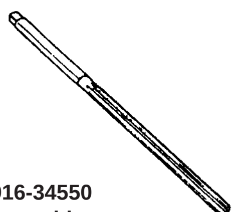
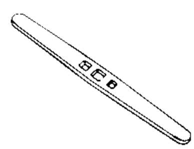
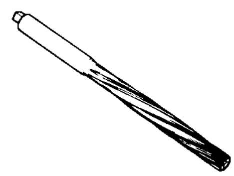
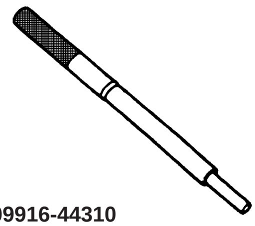
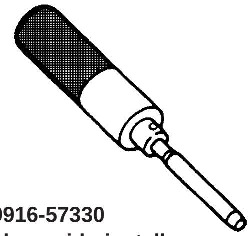
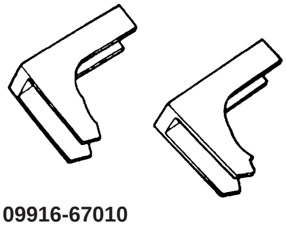
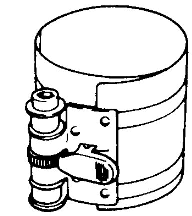
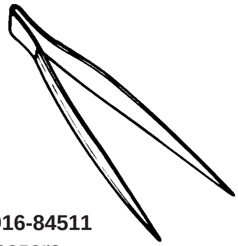
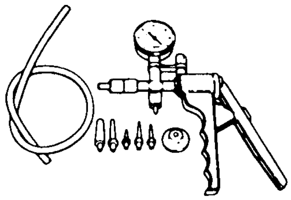
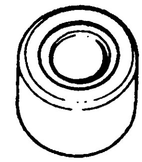
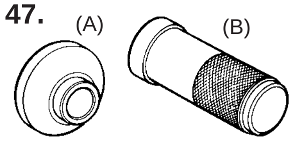
Tightening torque – general bolt

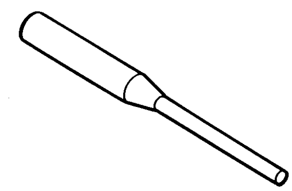
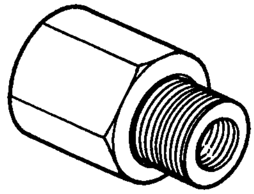
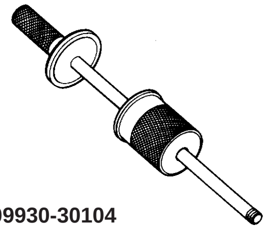
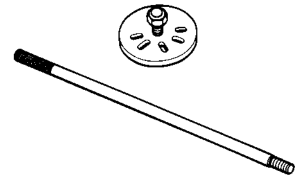
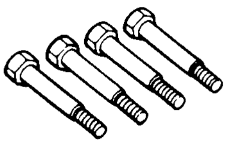
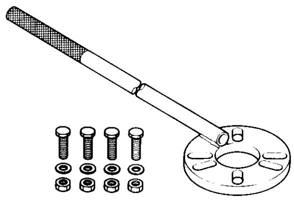
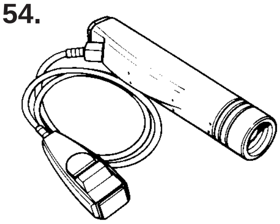
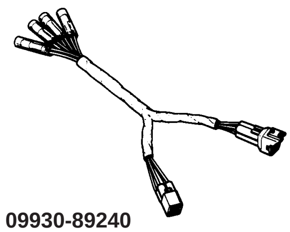
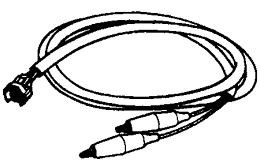
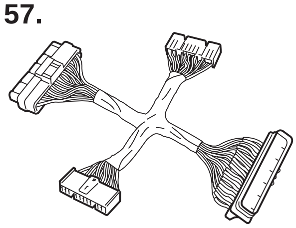
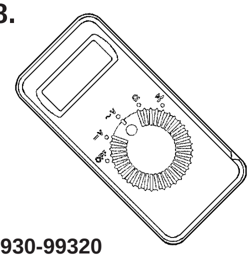
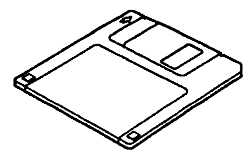
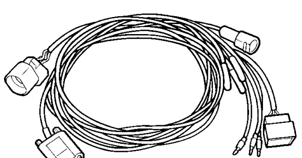
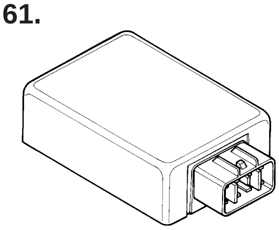
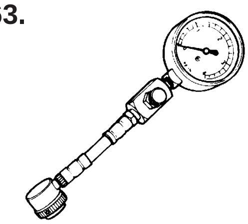
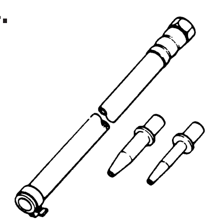
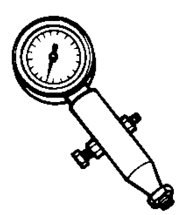
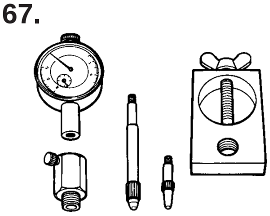
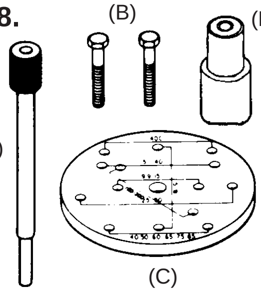
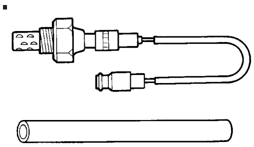
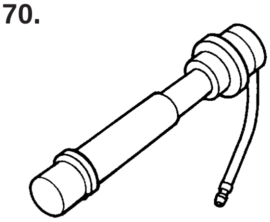
NOTE:
These values are only applicable when torque for a general bolt is not listed in the “Important Fasteners” table.

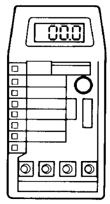
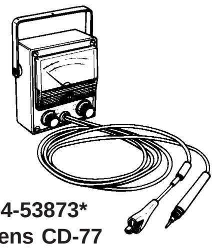
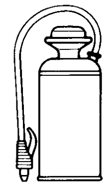
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb.-ft.
 (Conventional or “4” marked bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
	10 mm	22 – 35	2.3 – 3.5	16.0 – 25.5
 (Stainless steel bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	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.	**2.**  09900-00410 Hexagon wrench set	**3.**  09900-00411 Hexagon socket (included in 09900-00410)	**4.**  09900-00413 (5 mm) 09900-00414 (6 mm) Hexagon bit (included in 09900-00410)
5.  (A) 09900-06107 (B) 09900-06108 Snap ring pliers	**6.**  09900-20101 (150 mm) 09900-20102 (200 mm) Vernier calipers	**7.**  09900-20202 Micrometer (25 – 50 mm)	**8.**  09900-20203 Micrometer (50 – 75 mm)
9.  09900-20205 Micrometer (0 – 25 mm)	**10.**  09900-20508 Cylinder gauge set (40 – 80 mm)	**11.**  09900-20605 Dial calipers (10 – 34 mm)	**12.**  09900-20602 Dial gauge
13.  09900-20701 Magnetic stand	**14.**  09900-20803 Thickness gauge	**15.**  09900-21304 Steel “V” block set	**16.**  09900-22302 (0.051 – 0.125 mm) 09900-22301 (0.025 – 0.076 mm) Plastigauge
17.  09900-26006 Engine tachometer	**18.**  09900-28403 Hydrometer	**19.**  09921-29510 Driveshaft holder	**20.**  09919-16010 Deep socket wrench
21. (1) 09912-58442 Fuel pressure gauge (2) 09912-58432 Fuel pressure hose (3) 09912-58490 3-way joint & hose 		**22.**  09913-50121 Oil seal remover	**23.**  09914-79410 Test wheel

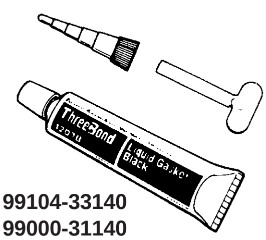
24.  **09915-47340** **Oil filter wrench**	**25.**  **09915-64512** **Compression gauge** **09915-63210** **Adaptor**	**26.**  **09915-77310** **Oil pressure gauge**	**27.**  **09915-78211** **Oil pressure gauge adapter**
28.  **09916-10911** **Valve lapper**	**29.**  **09916-14510** **Valve lifter**	**30.**  **09916-14910** **Valve lifter attachment**	**31.**  **09916-24450** **Solid pilot (N-100-5.52)**
32.  **09916-24440** **Handle adaptor** **(N-503-1)**	**33.**  **09916-54910** **Handle (N-505)**	**34.**  **09916-20630** **Valve seat cutter** **(Neway 126)**	**35.**  **09916-20620** **Valve seat cutter** **(Neway 122)**
36.  **09916-20610** **Valve seat cutter** **(Neway 121)**	**37.**  **09916-34550** **Valve guide reamer** **(ϕ 5.5 mm)**	**38.**  **09916-34542** **Valve guide reamer handle**	**39.**  **09916-37320** **Valve guide reamer** **(ϕ 10.5 mm)**
40.  **09916-44310** **Valve guide remover**	**41.**  **09916-57330** **Valve guide installer**	**42.**  **09916-67010** **Tappet holder**	**43.**  **09916-77310** **Piston ring compressor**
44.  **09916-84511** **Tweezers**	**45.**  **09917-47011** **Vacuum pump gauge**	**46.**  **09917-87010** **Valve guide installer attachment**	**47.**  **(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.**  **09930-30104** **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 connector test cord**	**58.**  **09930-99320** **Digital tester**	**59.**  **09932-69930-01E** **SDS software ver. 3.00**
60.  **09932-79910** **Diagnostic harness**	**61.**  **09932-89910** **Adapter**	**62.**	**63.**  **09940-44121** **Air pressure gauge**
64.  **09940-44130** **Attachment**	**65.**	**66.**  **09950-69512** **Gearcase oil leakage tester**	**67.**  **09951-09511** **Gear adjusting gauge**
68.  (A) (B) (C) (D)	**Pinion bearing installer and remover** **(A) 09951-59910** **Pinion bearing installer shaft** **(B) 01500-08403** **Bolt** **(C) 09951-39914** **Pinion bearing plate** **(D) 09951-19431** **Attachment**	**69.**  (A) (B) **(A) 18213-74F00** **O_2 sensor** **(B) 18498-99E70** **Protector**	**70.**  **09930-88720** **H·T cord adapter**

71.	72.	73 .
		
99954-53008-820* Digital voltmeter	99954-53873* Stevens CD-77 Peak reading voltmeter	99954-53883* Gear oil filler

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

MATERIALS REQUIRED

SUZUKI OUTBOARD MOTOR GEAR OIL	SUZUKI SUPER GREASE “A”	WATER RESISTANT GREASE	SUZUKI SILICONE SEAL
 99000-22540 (400 ml × 24 pcs.)	 *99000-25030 99000-25010 (500 g)	 99000-25160 (250 g)	 99000-31120 (50 g)
	SUZUKI BOND “1207B”  * 99104-33140 99000-31140 (100 g)	THREAD LOCK “1342” THREAD LOCK “1333B”  99000-32050 (TB1342, 50 g) 09900-32020 (TB1333B, 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.*

PERIODIC MAINTENANCE

MAINTENANCE AND TUNE-UP PROCEDURES

The following items have been modified from “K1” (‘01) model.

- Checking for tightening torque of the lower mount nut (front) has been added in the “BOLT AND NUT” section.
- Servicing procedure for the “FUEL MIXTURE CHECK (O_2 FEEDBACK)” has been modified to the method by using the Suzuki Diagnostic System (SDS) software with a personal computer. It is no longer possible to perform the O_2 feedback operation by using the diagnostic cable (P/N. 09932-79910) only.

BOLT AND NUTS

Inspect initially after 20 hours (1 month) and every 100 hours (6 months) thereafter.

Check that all bolt and nuts listed below are tightened to their specified torque.

ITEM	THREAD DIAMETER	TIGHTENING TORQUE		
		N·m	kg-m	lb-ft
Cylinder head cover bolt	6 mm	10	1.0	7.0
Intake manifold bolt / nut	6 mm	11	1.1	8.0
	8 mm	23	2.3	16.5
Flywheel bolt	16 mm	190	19.0	137.5
ECM ground bolt	6 mm	10	1.0	7.0
Power unit mount bolt	8 mm	23	2.3	16.5
	10 mm	50	5.0	36.0
Clamp bracket shaft nut	22 mm	43	4.3	31.0
Gearcase bolt	8 mm	23	2.3	16.5
Propeller nut	18 mm	55	5.5	40.0
Lower mount nut (Front)	12 mm	60	6.0	43.5

FUEL MIXTURE CHECK (O_2 FEEDBACK)

Perform every 2 years.

CAUTION

Before performing a fuel mixture check (O_2 feedback), the outboard motor must be checked to be sure that it is free of any trouble codes or operational problems.

NOTE:
See “O_2 FEEDBACK SYSTEM” section on page 3-32 before starting O_2 feedback operation.

To perform the O_2 feedback, use the SDS software with a personal computer.

Procedure

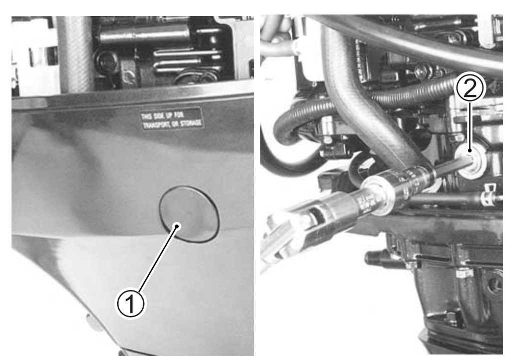
⚠ WARNING

To prevent any sudden boat movement, the boat must be securely moored to the dock while the test wheel equipped engine is running in gear during the feedback test procedure.

1. Remove propeller and install a test wheel.

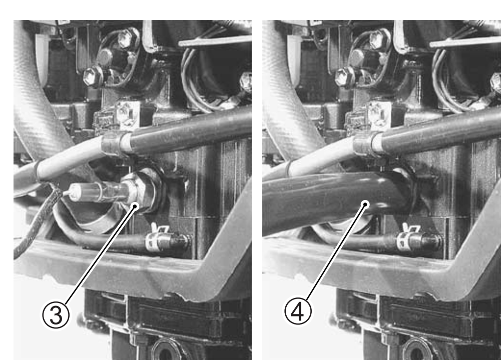
TOOL **09914-79410 : Test wheel**

2. Remove grommet ① and stbd. lower side cover.



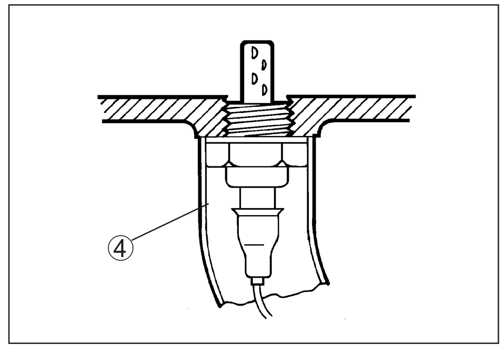
3. Remove plug ② from oil pump case and install the O_2 sensor ③ and protector sleeve ④.

TOOL **18213-74F00 : O_2 sensor**
18498-99E70 : Protector sleeve



CAUTION

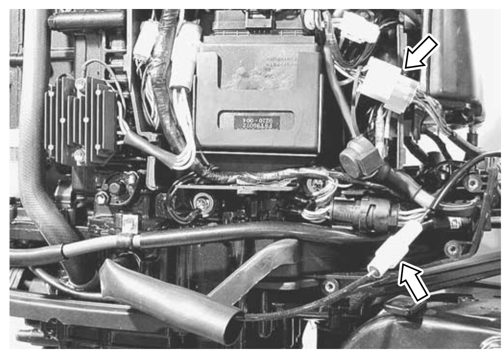
The O_2 sensor used for the feedback test procedure must be in proper working order and installed securely. If either sensor or installation is improper, the O_2 feedback operation will be performed incorrectly and could possibly result in engine operating problems.



NOTE:
- *The O_2 sensor is NOT WATERPROOF. Cover O_2 sensor with the protector sleeve to protect from water spray.*
- *Cut off the protector (P/N 18498-99E40) to a length of 20 – 30 cm (7.8 – 11.8 in.). The O2 sensor must be completely covered as shown.*

4. Connect the diagnostic harness to both O_2 sensor and engine harness connectors.

TOOL **09932-79910 : Diagnostic harness**

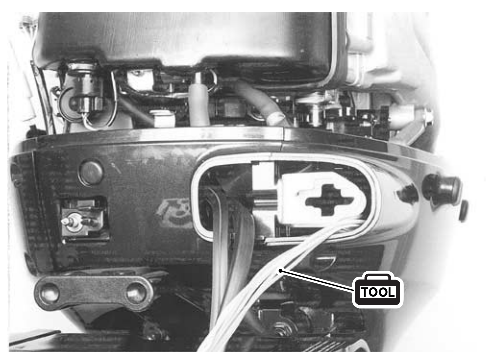


5. Connect the adapter to the diagnostic harness.

TOOL **09932-89910 : Adapter**

6. Install stbd. side lower cover.

NOTE:
Route the diagnostic harness through clearance between remote control cable holder plate and side cover.



7. Install motor cover.

8. Connect the diagnostic harness (with the adapter) to the personal computer.

9. Start and warm-up the engine for at least 5 minutes at around 2,000 r/min.

NOTE:
Before starting the SDS program, read and follow the “SDS Operation Manual” which comes supplied with each unit of the SDS software.

10. After starting the SDS program, select “O_2 Feedback” on the “Main Menu” screen and Fig. A appears. (STAND-BY mode)

TOOL **09932-69930-01E : SDS software (required installation on to personal computer)**

: Battery-powered personal computer

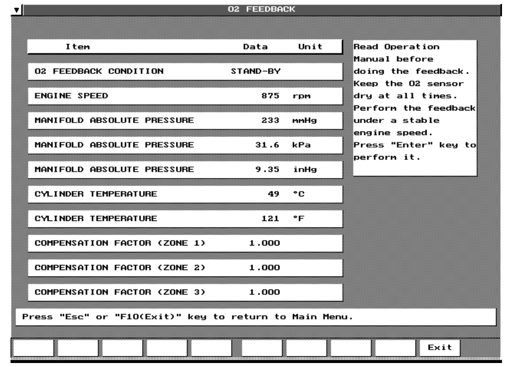


Fig. A

11. Shift into forward gear.

NOTE:
The O_2 feedback operation must be performed under engine load. Do not perform the O_2 feedback operation using warm-up lever (or throttle control grip) without first shifting into forward gear.

12. Adjust engine speed at the ZONE1 rpm and press the [Enter] key, then Fig. B appears. (ACTION mode) Hold the engine speed specified for a minimum of 20 seconds.
    - If buzzer sounds for approx. 3 seconds, the feedback operation at this zone was successfully finished. Also the “Compensation Factor” data will be changed. Go to next step.
    - If no buzzer sounds within approx. 2 minutes, the feedback operation at this zone failed. Ignore this zone and proceed to next step.

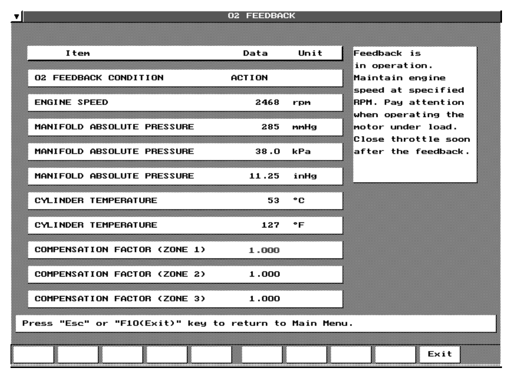


Fig. B

NOTE:
- *Do not close throttle fully for more than 10 seconds while feedback operation is being performed. This will cause the O_2 feedback operation to finish with incomplete data.*
- *Do not allow the engine to be stable at an unnecessary speed range (other than the zone rpm) for more than 10 seconds. This will cause the O_2 feedback operation to be done with an incorrect data for that speed range.*

13. Repeat the procedure in step “5” at the ZONE2 rpm.
14. Repeat the procedure in step “5” at the ZONE3 rpm.
15. If the feedback operation at any zone failed, repeat the feedback operation at that zone.

Zone RPM for DF40/50

ZONE1	2,500±100 rpm
ZONE2	3,500±100 rpm
ZONE3	4,500±100 rpm

16. Return throttle to a full closed position only after the O_2 feedback operation at all zones has been successfully finished.
17. Approximately 10 seconds after closing the throttle, the buzzer will sound as follows:
    - If the total feedback operation was successfully finished, a series of short (0.5 sec.) buzzer sounds will be heard. Also “FIN. OK” is displayed. (Fig. C)
    - If the total feedback operation failed, a series of long (3 sec.) buzzer sounds will be heard. Also “FIN. NG” is displayed. (Fig. D)
18. If retrying feedback operation, repeat procedure used in step “12” through “16”.

NOTE:
Following causes may be considered if the total feedback operation failed:
- *There was no feedback operation at any zone before returning throttle to a full closed position.*
- *There was the feedback operation with an abnormal compensation factor (coefficient).*

NOTE:
Repeat the O_2 feedback operation with a new O_2 sensor if:
- *The total feedback operation finished without returning throttle to a full closed position.*
- *The total feedback operation failed repeatedly.*

CAUTION

The O_2 sensor is only used when performing the O_2 feedback operation.
After O_2 feedback operation is completed the original plug must be installed in the original position.

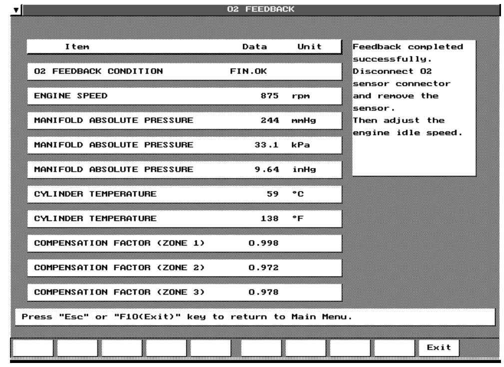


Fig. C

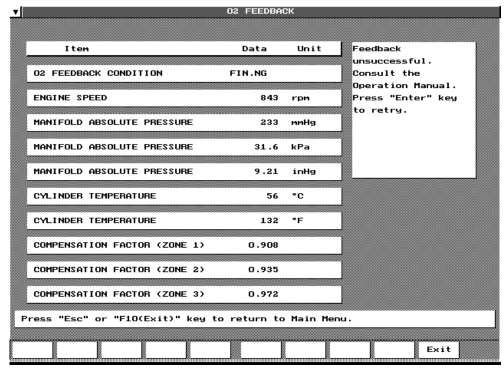


Fig. D

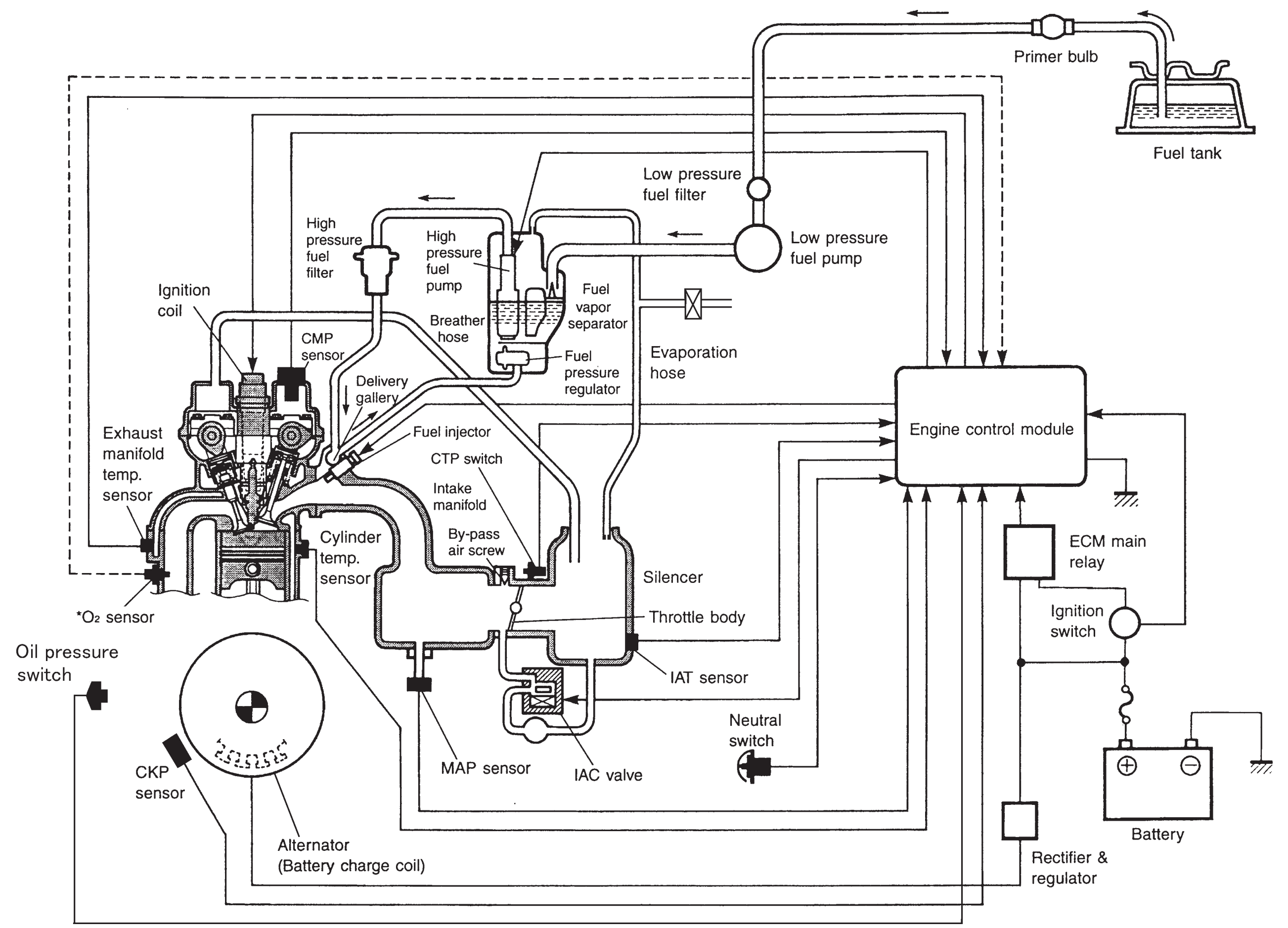
ENGINE CONTROL SYSTEM

Main modifications from “K1” (‘01) model are as follows:

- For more accurate control, ECM, CKP sensor, flywheel magneto etc. have been modified.
- Ignition timing and fuel injection timing controls have been modified.
- The total operating hours indication system has been modified.
- An oil change reminder system has been added.
- Self-diagnostic system for fuel injector circuit has been added.

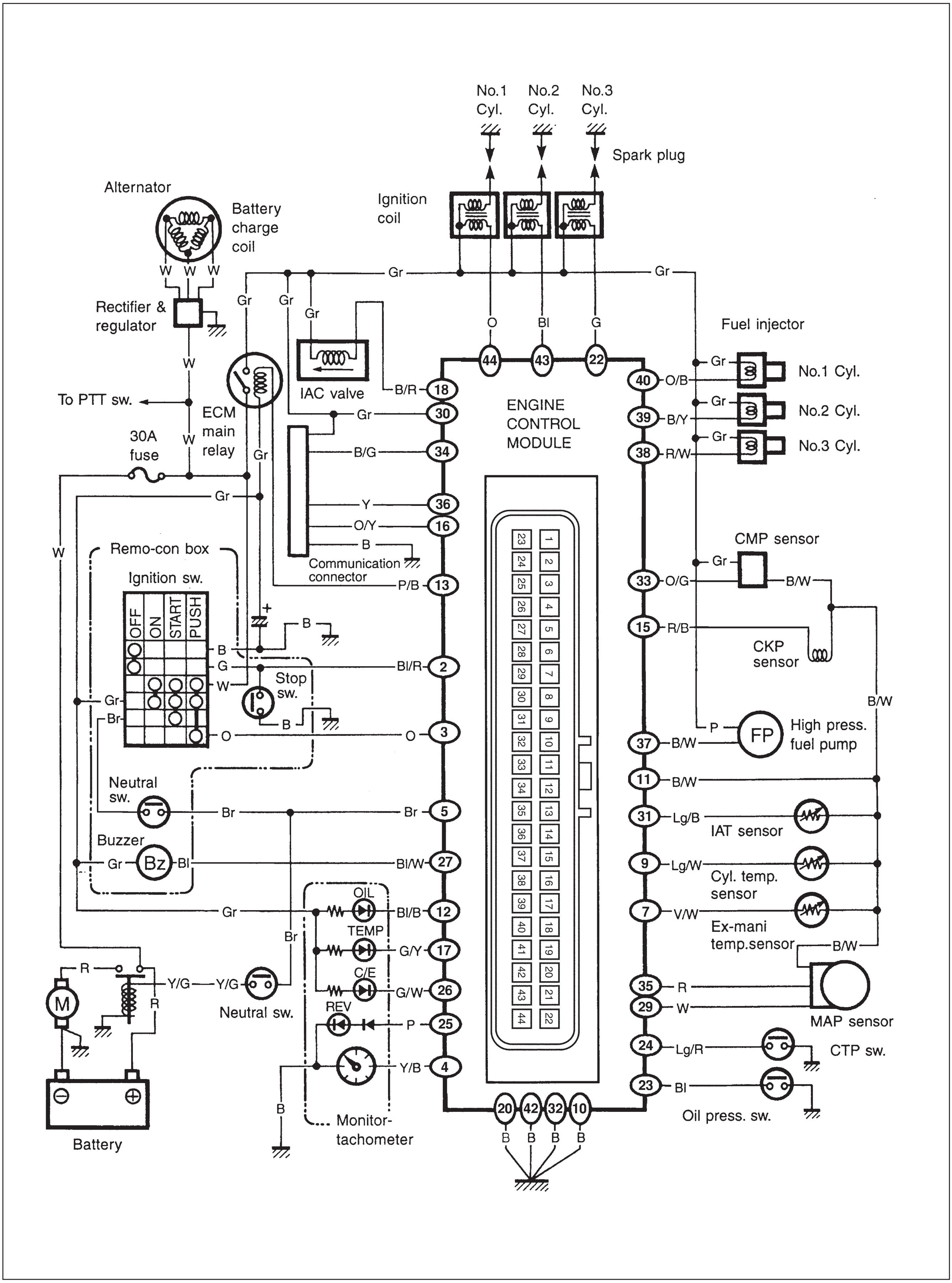
ENGINE CONTROL SYSTEM STRUCTURE

SYSTEM STRUCTURE



* : O_2 Sensor must be installed when performing “O_2 feedback operation” only.

WIRING DIAGRAM FOR ENGINE CONTROL



ECM CIRCUIT

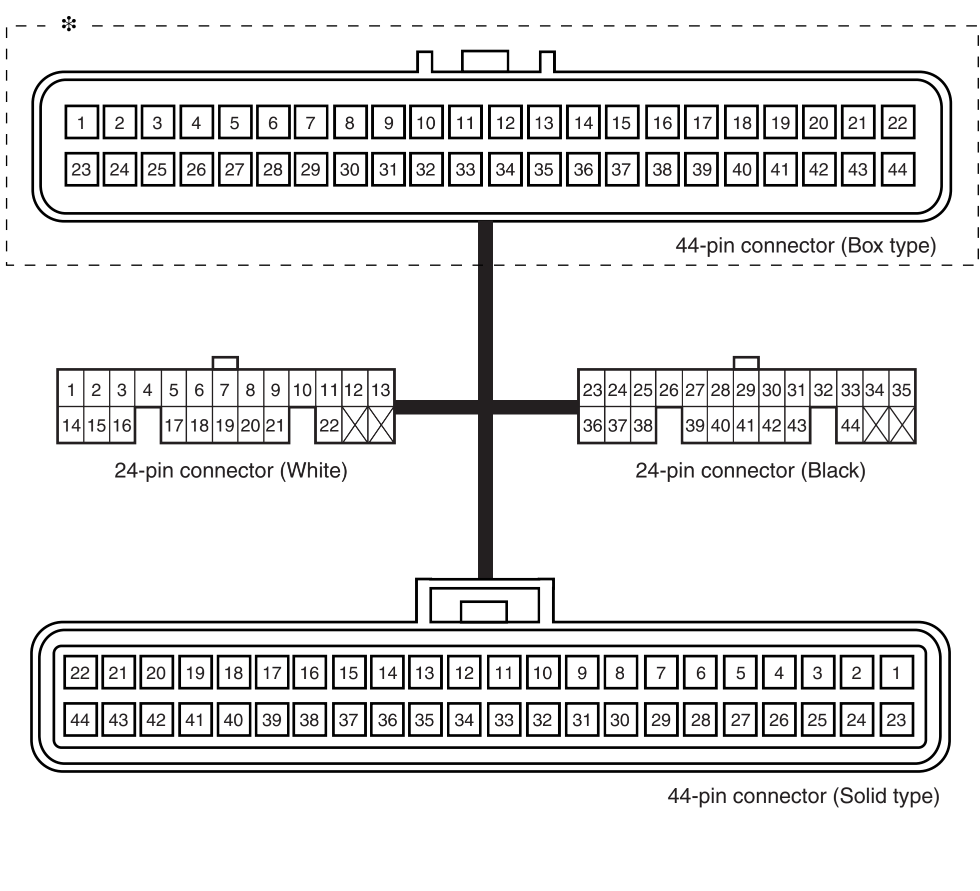
TERMINAL	WIRE COLOR	CIRCUIT
1	–	–
2	Bl/R	Emergency stop switch
3	O	Buzzer cancel
4	Y/B	Tachometer
5	Br	Neutral switch, Engine start signal
6	–	–
7	V/W	Ex-manifold temperature sensor
8	–	–
9	Lg/W	Cylinder temperature sensor
10	B	Ground for ECM
11	B/W	Ground for sensor
12	Bl/B	OIL lamp
13	P/B	Ground for ECM main relay
14	–	–
15	R/B	CKP sensor
16	O/Y	PC communication
17	G/Y	TEMP lamp
18	B/R	IAC valve solenoid (–)
19	–	–
20	B	Ground for power souce
21	–	–
22	G	No.3 Ignition (–)

TERMINAL	WIRE COLOR	CIRCUIT
23	Bl	Oil pressure switch
24	Lg/R	CTP switch
25	P	REV-LIMIT lamp
26	G/W	CHECK ENGINE lamp
27	Bl/W	Buzzer
28	–	–
29	W	MAP sensor
30	Gr	ECM power source
31	Lg/B	IAT sensor
32	B	Ground for ECM
33	O/G	CMP sensor
34	B/G	O2 feedback
35	R	Power source for MAP sensor
36	Y	PC communication
37	B/W	Fuel pump (–)
38	R/W	No.3 Fuel injector (–)
39	B/Y	No.2 Fuel injector (–)
40	O/B	No.1 Fuel injector (–)
41	–	–
42	B	Ground for power source
43	Bl	No.2 Ignition (–)
44	O	No.1 Ignition (–)

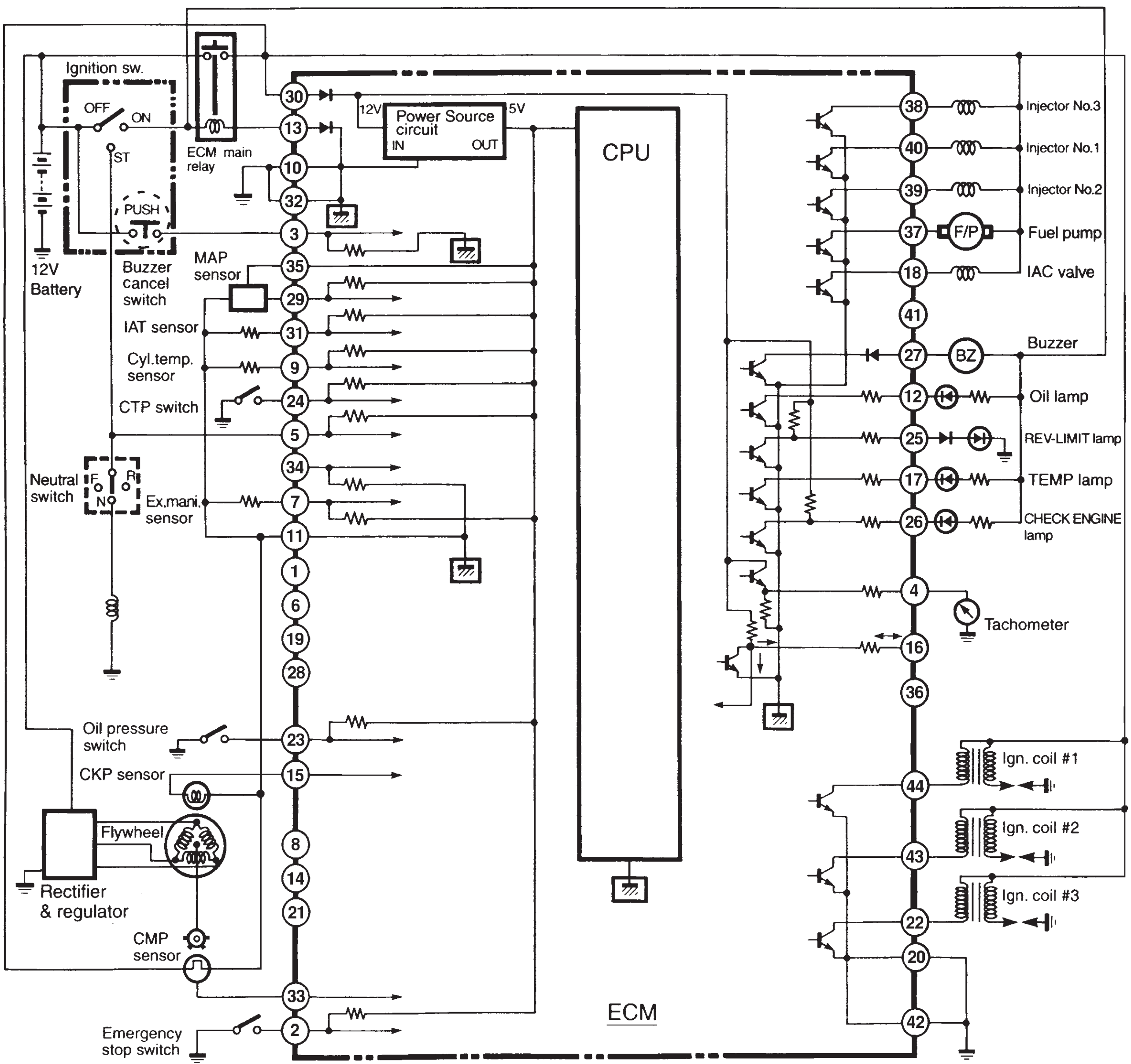
NOTE: “WIRE COLOR” shows the wire color of engine wire harness side.

ECM TERMINAL LAYOUT / TEST CORD

Terminal layout on the ECM is the same as the “❇” marked terminal in the illustration of the 44-pin test cord (special tool P/N. 09930-89950) below.

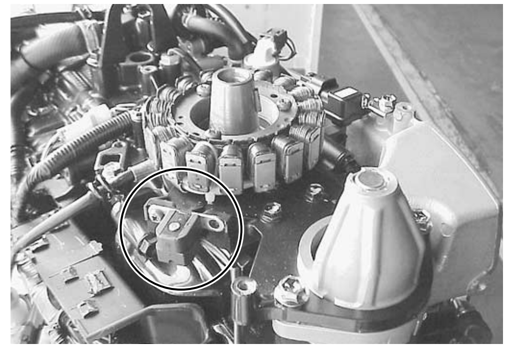


ECM INTERNAL STRUCTURE



SENSOR AND RELATED COMPONENTS

For more accurate control and simplification of structure, CKP sensor and related components have been modified.

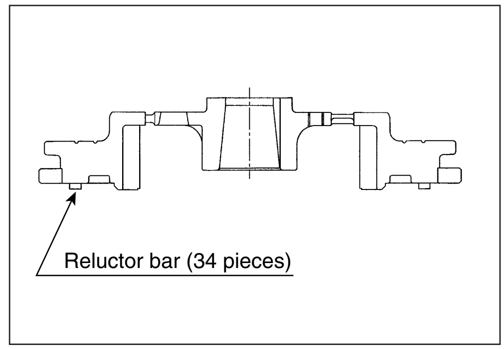


CKP SENSOR

Number of pickup coil of CKP sensor assy has been modified from 3 pieces to 1 piece.

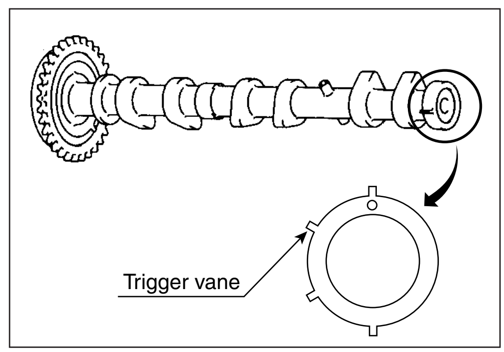
FLYWHEEL MAGNETO

Number of reluctor bar (trigger vane) on the flywheel magneto has been modified from 1 piece to 34 pieces.



CMP SENSOR / INTAKE CAMSHAFT

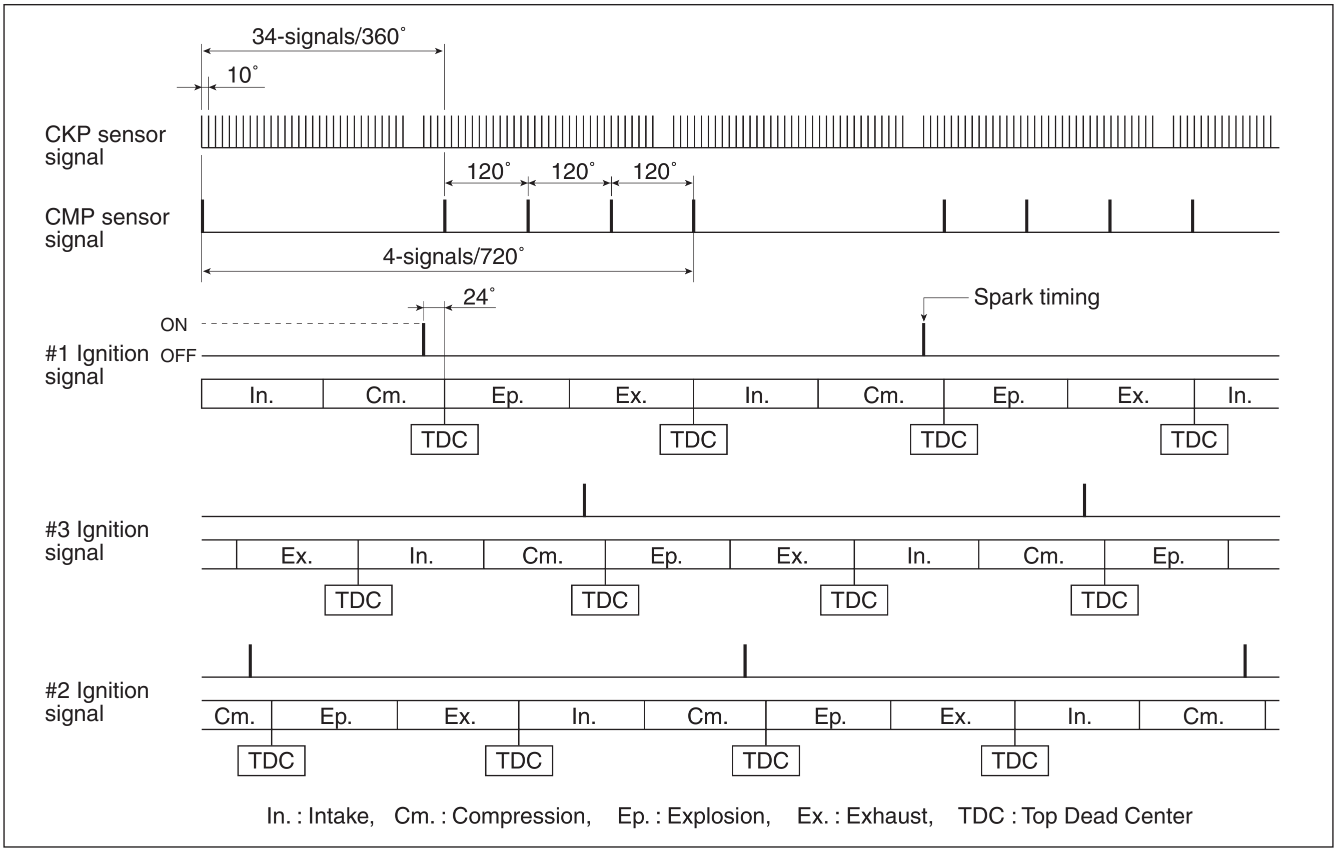
The CMP sensor on the "K1" ('01) model is the same as the one on the previous year models, number of trigger vane on the sensing rotor installed to the intake camshaft, however, has been modified from 1 piece to 4 pieces.



IGNITION SYSTEM

IGNITION TIMING CHART

- The following chart shows example for ignition at BTDC24°.
- The ignition timing is varied by the condition of engine running.
- Angles indicated in the following chart show CRANKSHAFT angle.



CONTROL MODE

WHEN CRANKING :

The ignition timing is fixed at BTDC 7° until the engine starts.

WHEN IDLING / TROLLING :

The ignition timing is controlled to within the range of ATDC 1° to BTDC 17° to provide stable engine operation at the specified idling / trolling speed.

When the shift lever is in neutral, if engine speed exceeds 1200 r / min , ignition timing remains fixed at BTDC 9°.

WHEN RUNNING (NORMAL OPERATION) :

The ignition timing ranges between BTDC 0° – 27° (DF40) or 24° (DF50), depending on current engine operating conditions.

WHEN DECELERATING :

When the throttle valve is closed suddenly, turning the CTP switch “ON”, ignition timing is delayed for a programmed duration to prevent engine stalling or unstable running.

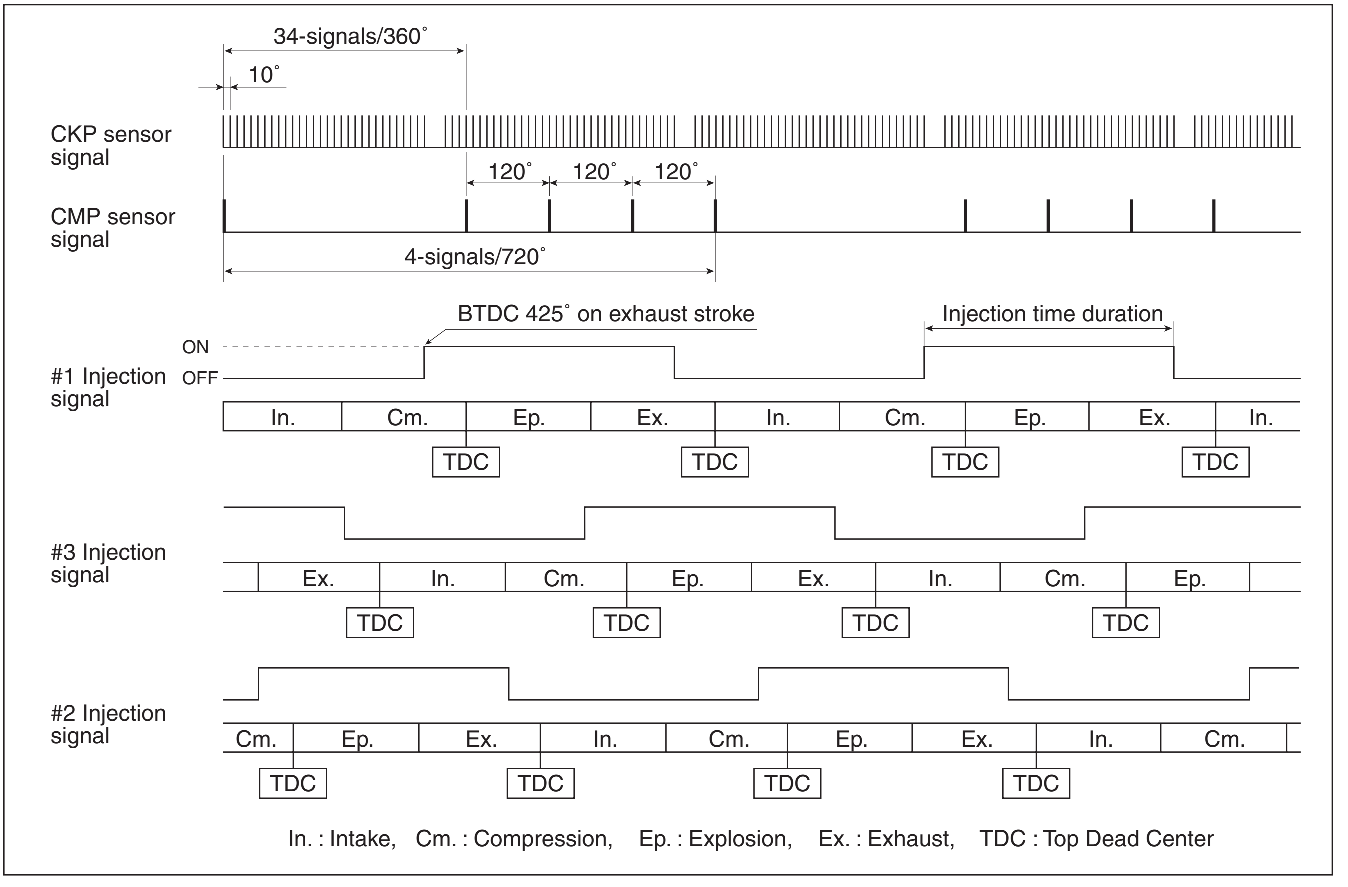
SPECIFICATION

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	DF 40 : ATDC 1° – BTDC 27°, DF 50 : ATDC 1° – BTDC 24°
Firing order	1 – 3 – 2

ELECTRONIC FUEL INJECTION SYSTEM

FUEL INJECTION TIMING CHART

- Fuel injection start timing is set at BTDC 425° on exhaust stroke.
- The fuel injection time duration (amount) is varied by the condition of engine running.
- Angles indicated in the following chart show CRANKSHAFT angle.



CONTROL MODE

BEFORE START :

When the ignition switch is turned “ON”, the ECM receives a MAP sensor signal, indicating the static barometric pressure of the intake manifold, which is used to compensate the fuel injection map for altitude.

WHEN CRANKING :

Fuel is simultaneously injected to all cylinders every time any piston is positioned at compression stroke.

AFTER START (FAST-IDLE FUNCTION):

The fuel injection amount is controlled to increase until the timer, set according to cylinder temperature at the time of engine start, expires.

WHEN IDLING / TROLLING :

The fuel injection amount is controlled to maintain a stable engine speed at the specified idle / trolling rpm.

WHEN ACCELERATING :

The fuel injection amount is controlled to increase.

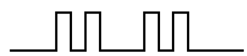
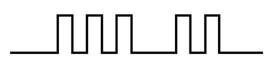
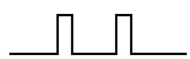
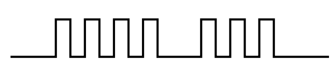
WHEN DECELERATING :

The fuel injection amount is controlled to decrease.

The fuel injection is also cut off on very rapid engine deceleration.

SELF-DIAGNOSTIC SYSTEM

PRIORITY / CODE / PATTERN FOR SELF-DIAGNOSTIC SYSTEM OPERATION

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 (Sensor hose)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging) **[**NOTE 1**]**	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector (Open circuit)	4 – 3	on off 	NO

NOTE:
- *If more than two items fail at once, the self- diagnostic indication appears according to priority order. The indication repeats three times.*
- *If the failed item remains, the self-diagnostic indication appears again after turning the ignition switch “ON”.*
- *After correcting failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running.*
- *For cylinder temp. sensor, exhaust manifold temp. sensor or IAT sensor the self-diagnostic indication will be canceled after corrective action by turning the ignition switch “ON”.*
  (The ECM will require 10 – 20 seconds after turning the ignition switch “ON” to cancel the self-diagnostic indication.)

NOTE 1 :
The self-diagnostic indication may be canceled by turning ignition switch “ON” because the ECM detects only battery voltage, not charging output. Under this condition the buzzer will not sound a 1-1 code.
However, if the rectifier & regulator have failed, the self-diagnostic indication will again appear after starting the engine.

CONDITION FOR SELF-DIAGNOSTIC SYSTEM OPERATION

FAILED ITEM	CONDITION
MAP sensor 1	• No signal (With engine running) • Receiving an out of range “37 – 860 mmHg (0.20 – 4.53V)” signal (With engine running)
CKP sensor	• No signal from CKP sensor while receiving 3 signals from CMP sensor.
IAC valve / By-pass air screw adjustment	• IAC valve operates at 90% duty or higher when CTP switch is “ON” [NOTE 1]
CMP sensor	• No signal from CMP sensor while receiving 544 signals from CKP sensor. (Corresponded to 16 turns of crankshaft)
CTP switch	• Receiving “ON” signal when engine speed is 2500 r/ min or higher and intake manifold pressure is 300 mmHg or higher.
Cylinder temp. sensor	• No signal • Receiving an out of range “– 46 to +170 °C (0.10 – 4.63 V)” signal
IAT sensor	• No signal • Receiving an out of range “– 46 to +169 °C (0.04 – 4.46V)” signal
MAP sensor 2 (Sensor hose)	• Receiving unchanging signal regardless engine speed change [NOTE 2]
Rectifier & regulator (Over-charging)	• Receiving 16 volts or higher signal
Exhaust manifold temp, sensor	• No signal • Receiving an out of range “– 46 to +170 °C (0.10 – 4.63V)” signal
Fuel injector	• No signal

NOTE 1:
This condition will be caused by IAC valve failure or incorrect by-pass air screw adjustment. If IAC valve is always closed or by-pass air is too low, the ECM controls the IAC valve duty to increase to maintain the idling/ trolling speed specified.
Conversely, if IAC valve is always opened or by -pass air is too high, the ECM controls the IAC valve duty to decrease to maintain the idling / trolling speed specified.

NOTE 2:
This condition will be caused by disconnected, kinked or clogged MAP sensor hose or clogged inlet manifold gas filter.

FAIL-SAFE SYSTEM

PRE-PROGRAMMED VALUE FOR FAIL-SAFE SYSTEM

FAILED ITEM	PRE-PROGRAMMED VALUE
MAP sensor 1	• 319 – 475 mmHg (Correspond to approx. 750 – 4000 r/min) **[**NOTE1**]**
CKP sensor	Based on signals from CMP sensor: • Ignition timing fixed at BTDC 5° • Normal sequential fuel injection
CMP sensor	Based on signals from CKP sensor: (a) Failed while engine running • Ignition timing fixed at BTDC 5° • Normal sequential fuel injection (b) Failed prior to engine start • Ignition timing fixed at BTDC 5° • 1 simultaneous injection for all cylinders per 2 crankshaft rotations
Cylinder temp. sensor	60 °C (140 °F)
IAT sensor	45 °C (113 °F)
Exhaust manifold temp. sensor	60 °C (140 °F)

NOTE:
There is no back-up system for the ECM itself. The engine will stop if it has failed.

NOTE 1:
This value will change according to the current engine speed.

OPERATING HOUR INDICATION SYSTEM
(For remote control model)

After 2-seconds indicator check, monitor-tachometer will indicate the total motor operating hours by means of the “REV-LIMIT” lamp flashing and needle indicating as shown on the chart below.

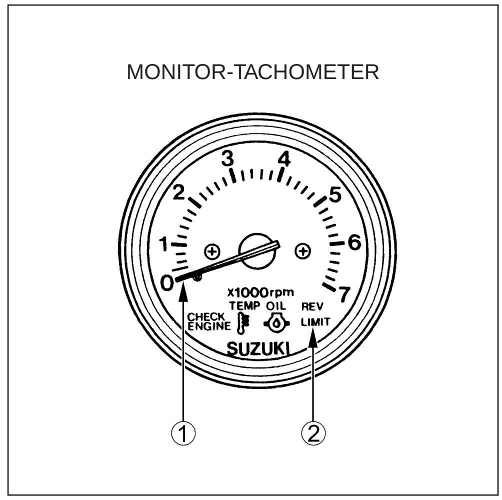
NOTE:

The total operating hours displayed are those of actual engine operation, not ignition switch “ON” time.

CHART OF TOTAL OPERATING HOURS INDICATION

Total operating hours	MONITOR-TACHOMETER	
	Needle ① indication	REV-LIMIT lamp ② flashing *
0h-(49h)	No	No
50h-	500rpm	No
60h-	600rpm	No
: :	: :	: :
540h-	5400rpm	No
550h-	500rpm	1 time
560h-	600rpm	1 time
: :	: :	: :
1040h-	5400rpm	1 time
1050h-	500rpm	2 times
: :	: :	: :
1540h-	5400rpm	2 times
1550h-	500rpm	3 times
: :	: :	: :
2030h-	5300rpm	3 times
2040h or over	5400rpm	3 times

*: One flashing is corresponded to 500 hours.



OIL CHANGE REMINDER SYSTEM

This system informs the operator of the time for replacing ENGINE OIL on the basis of the recommended maintenance schedule.

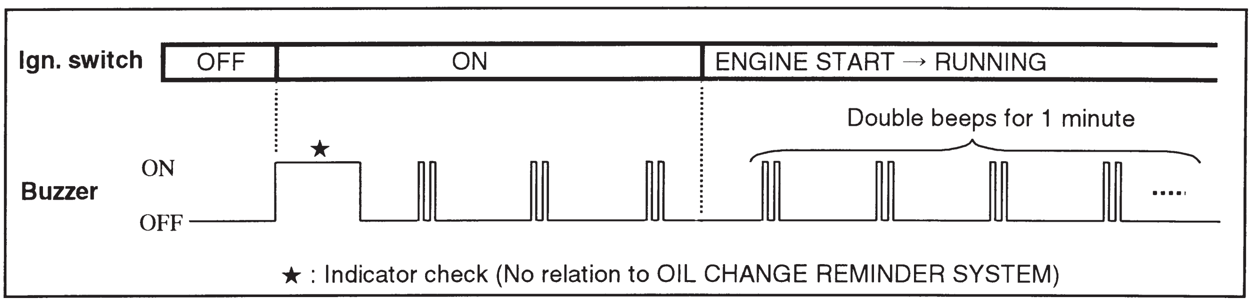
When the total motor operating hours have reached the preprogrammed hours;

- On the tiller handle model, the buzzer will begin a series of double beeps for approx. 1 minute.
- On the remote control model, the “OIL” lamp will flash, and the buzzer will begin a series of double beeps if engine is not running (but ignition switch is ON).

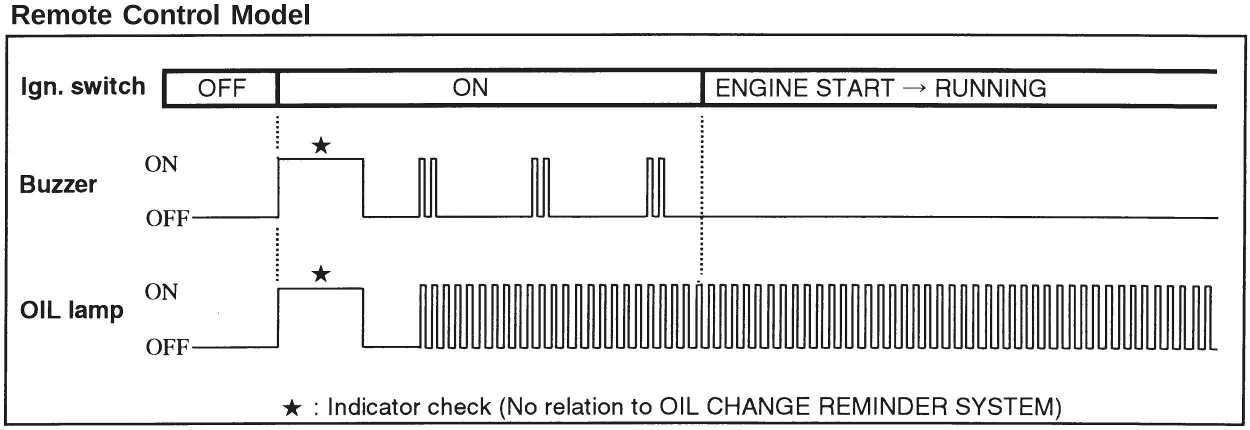
The above mentioned indication will repeat until canceling system activation.

INDICATION OF SYSTEM ACTIVATION

Tiller Handle Model



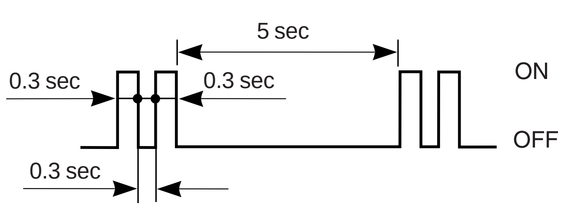
Remote Control Model



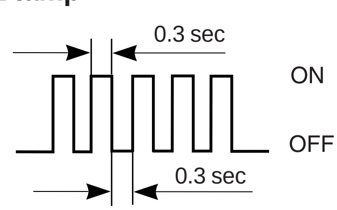
NOTE:

On the tiller handle model, the buzzer for system activation will first begin to sound when the engine is stopped (but ignition switch is ON) after reaching the preprogrammed hours.

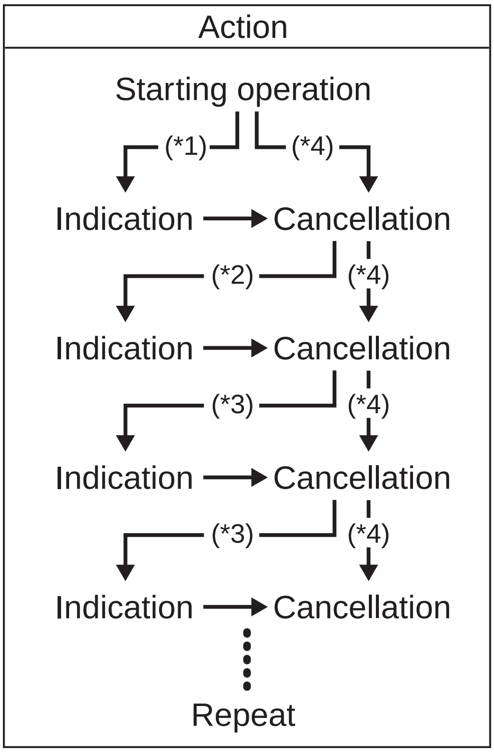
Buzzer



OIL lamp



FLOWCHART OF SYSTEM ACTIVATION AND CANCELLATION

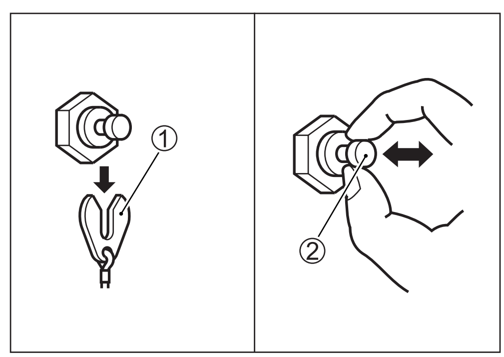


*1 : Lapse of initial 20 hour’s operation
*2 : Lapse of 80 hour’s operation
*3 : Lapse of 100 hour’s operation
*4 : When performing cancellation before system activation

NOTE:
This system will activate up to 2100 hour’s operation.

CANCELLATION

Procedure



1. Turn the ignition key to the “ON” position.
2. Pull out the emergency stop switch plate ①.
3. Pull up the emergency stop switch knob ② three times in seven seconds. A short beep will be heard if the cancellation is successfully finished.
4. Turn the ignition key to the “OFF” position.
5. Set the plate ① in the original position.

NOTE:
- *Canceling of the system activation is possible regardless of whether or not the engine oil has been replaced. Once the system has operated, however, Suzuki strongly recommends that the engine oil be replaced before canceling the system activation.*
- *Even if the engine oil has been replaced with the system not operating, it is still necessary to perform the cancellation.*

INSPECTION

PRECAUTION ON SYSTEM INSPECTION

⚠ WARNING

To prevent an unexpected engine start, perform the following before proceeding with any CRANKING tests.
- **When performing tests not related to fuel injector operation :**
  - **Disconnect all fuel injector wire connectors.**
- **When performing tests related to fuel injector operation :**
  - **Relieve fuel pressure in line.**
  - **Disconnect high pressure fuel pump wire connector located on fuel vapor separator.**

CAUTION

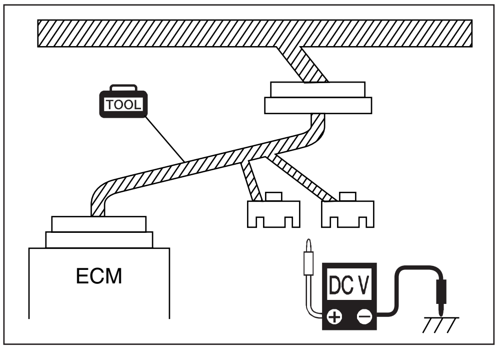
- **Always turn ignition switch “OFF” and disconnect battery cables when wires are being disconnected or connected.**
- **Hold and pull connector pieces when disconnecting. Do not pull wires.**

NOTE:
- *The self-diagnostic code memory in ECM will remain even if battery is disconnected.*
- *As each terminal voltage is affected by battery voltage, use a full-charged battery.*
- *Make sure all ground points have good electrical contact.*
- *Make sure all wires/cables are securely connected.*
- *For the test cord terminal numbers and layout, refer to the “ECM TERMINAL LAYOUT/TEST CORD” section on page 13-22.*

INSPECTION FOR ECM CIRCUIT VOLTAGE

CAUTION

ECM cannot be bench checked. It is strictly prohibited to connect any tester (voltmeter or ohmmeter) to an ECM separated from the engine wiring harness.




09930-89950 : 44-pin test cord

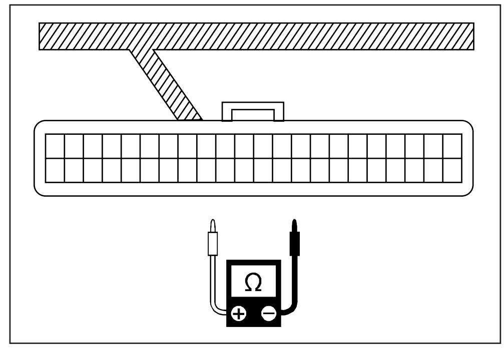

Tester range : ⎓ V (DC voltage)

(1) Connect the test cord between ECM and wire harness as shown.
(2) Turn ignition switch ON.
(3) Connect the tester probe ⊖ (Black) to body ground, and measure voltage according to the “CIRCUIT VOLTAGE TABLE”.

CIRCUIT VOLTAGE TABLE

TERMINAL NUMBER	CIRCUIT	STANDARD VOLTAGE	CONDITION / REMARKS
1	–	–	–
2	Emergency stop switch	Approx. 5V	Ignition switch ON, plate IN
		Approx. 0V	Ignition switch ON, plate OUT
3	Buzzer cancel	Approx. 12V	Ignition switch ON, key pushed
		Approx. 0V	Ignition switch ON, key not pushed
4	Tachometer	–	–
5	Neutral switch / Engine start signal	Approx. 0V	Ignition switch ON, shift into NEUTRAL
		Approx. 2.5V	Ignition swich ON, shift into FORWARD or REVERSE
		6 – 12V	While engine cranking
6	–	–	–
7	EX-manifold temperature sensor	0.10 – 4.63V	Ignition switch ON
8	–	–	–
9	Cylinder temperature sensor	0.10 – 4.63V	Ignition switch ON
10	Ground for ECM	–	–
11	Ground for sensors	–	–
12	OIL lamp	–	–
13	Ground for ECM main relay	–	–
14	–	–	–
15	CKP sensor	–	–
16	PC communication	–	–
17	TEMP lamp	–	–
18	IAC valve solenoid (–)	Approx. 12V	Ignition switch ON
19	–	–	–
20	Ground for power source	–	–
21	–	–	–
22	No. 3 Ignition (–)	Approx. 12V	Ignition switch ON
23	Oil pressure switch	Approx. 5V	While engine running
		Approx. 0V	Other than above (Ignition switch ON)
24	CTP switch	Approx. 5V	Ignition switch ON, throttle not fully closed
		Approx. 0V	Ignition switch ON, throttle fully closed
25	REV-LIMIT lamp	–	–
26	CHECK ENGINE lamp	–	–
27	Buzzer	–	–
28	–	–	–
29	MAP sensor	0.20 – 4.53V	Ignition switch ON
30	ECM power source	Approx. 12V	Ignition switch ON
31	IAT sensor	0.04 – 4.46V	Ignition switch ON
32	Ground for ECM	–	–
33	CMP sensor	Approx. 0.3V or 5V	Ignition switch ON
34	O2 feedback / PC communication	–	–
35	Power source for MAP sensor	Approx. 5V	Ignition switch ON
36	PC communication	–	–
37	Fuel pump (–)	Approx. 0V	For 3 sec. after ignition switch ON
			While engine running
		Approx. 12V	Other than above (Ignition switch ON)
38	No. 3 Fuel injector (–)	Approx. 12V	Ignition switch ON
39	No. 2 Fuel injector (–)	Approx. 12V	Ignition switch ON
40	No. 1 Fuel injector (–)	Approx. 12V	Ignition switch ON
41	–	–	–
42	Ground for power source	–	–
43	No. 2 Ignition (–)	Approx. 12V	Ignition switch ON
44	No. 1 Ignition (–)	Approx. 12V	Ignition switch ON

INSPECTION FOR RESISTANCE



09930-99320 : Digital tester

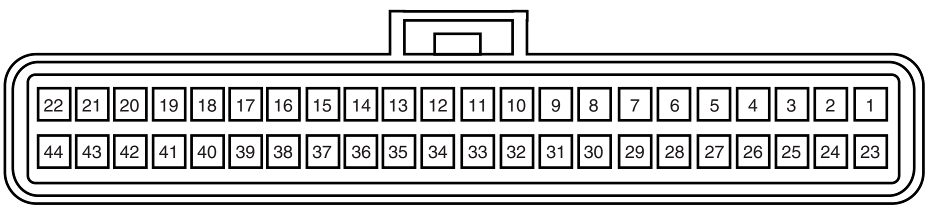
Tester range : Ω (Resistance)

NOTE:

Make sure ignition switch is always OFF when measuring resistance.

(1) Disconnect battery cables from battery.
(2) Disconnect wire harness from ECM.
(3) Connect the tester probes to terminal of wire harness side, and measure resistance according to the “RESISTANCE TABLE”.

TERMINAL LAYOUT OF WIRE HARNESS CONNECTOR

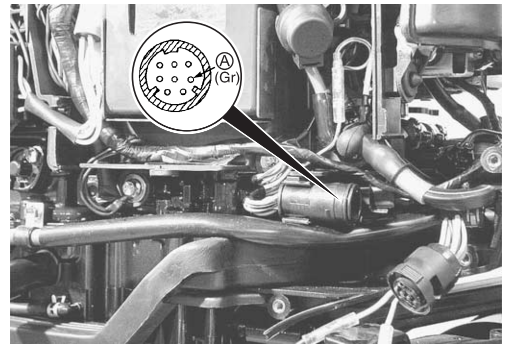


RESISTANCE TABLE

ITEM	TERMINAL NO. FOR TESTER PROBE CONNECTION	STANDARD RESISTANCE (at 20°C)
CKP sensor	15 to 11	168 – 252 Ω
Ignition coil No.1 (Primary)	44 to 30	1.9 – 2.5 Ω
Ignition coil No.2 (Primary)	43 to 30	
Ignition coil No.3 (Primary)	22 to 30	
Ignition coil No.1 (Secondary)	30 to No.1 spark plug cap	8.1 – 11.1 kΩ
Ignition coil No.2 (Secondary)	30 to No.2 spark plug cap	
Ignition coil No.3 (Secondary)	30 to No.3 spark plug cap	
Fuel injector No.1	40 to 30	11.0 – 16.5 Ω
Fuel injector No.2	39 to 30	
Fuel injector No.3	38 to 30	
IAC valve	18 to 30	21.5 – 32.3 Ω
IAT sensor	31 to 11	0°C (32°F) : 5.3 – 6.6 kΩ 25°C (77°F) : 1.8 – 2.3 kΩ 50°C (122°F) : 0.73 – 0.96 kΩ 75°C (135°F) : 0.33 – 0.45 kΩ (Thermistor characteristic)
Cylinder temperature sensor	9 to 11	
Ex-mani. temperature sensor	7 to 11	
ECM main relay	13 to Terminal Ⓐ [NOTE 1]	80 – 120 Ω
Starter motor relay	5 to GND [NOTE 2]	3.5 – 5.1 Ω

NOTE 1:
Disconnect remote control wire harness, and connect tester probe to terminal Ⓐ (Gray wire).

NOTE 2:
Measure resistance with shift in NEUTRAL position.

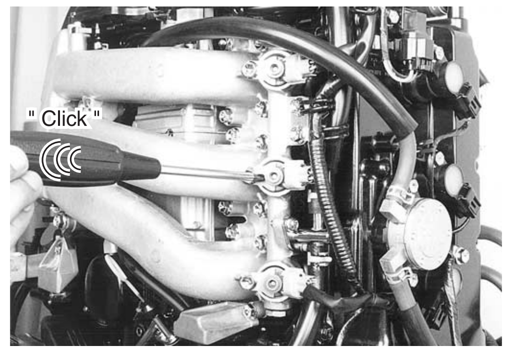


OTHER INSPECTION

FUEL INJECTOR OPERATING SOUND (CRANKING)

(1) Touch a sound scope or long blade screw driver to fuel injector body as shown.
(2) Crank engine and check for injector operating sound.

Injector operating sound : "Click"



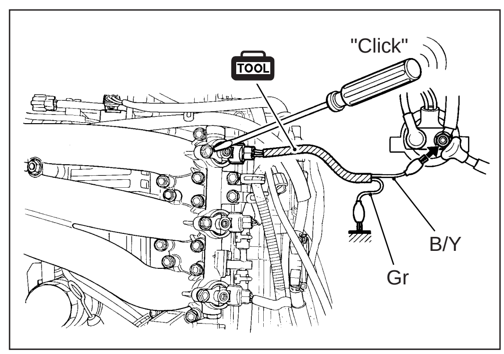
FUEL INJECTOR OPERATING SOUND (INDIVIDUAL)

(1) Disconnect fuel injector wire, and connect the test cord.

TOOL **09930-89260 : Injector test cord A**

(2) Connect Gray wire to body ground.
(3) Momentarily touch Black/Yellow wire to starter motor relay right terminal (connected to battery positive (+) terminal), and check for injector operating sound.

Injector operating sound : "Click"



CAUTION

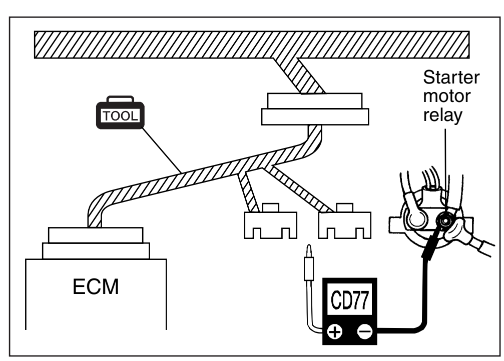
Connecting fuel injector to battery positive for more than a few seconds may cause injector overheating and possible injector solenoid failure.

FUEL INJECTOR OPERATING SIGNAL

TOOL **09930-89950 : 44-pin test cord**

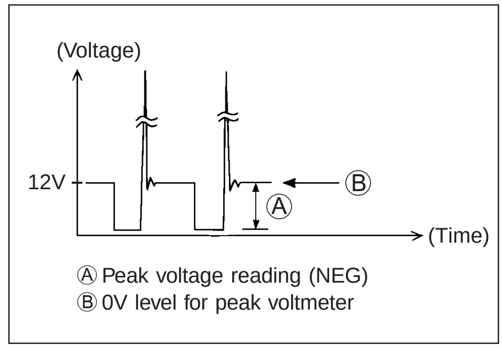
CD77 **Peak voltmeter Stevens CD-77**
Tester range : NEG50

(1) Connect the test cord as shown, then turn ignition switch ON.
(2) Connect the tester probe⊖ (Black) to starter motor relay right terminal (connected to battery positive (+) terminal) as shown.



(3) Connect the tester probe ⊕ (Red) to each terminal.

Injector	Terminal No.
No.1	40
No.2	39
No.3	38

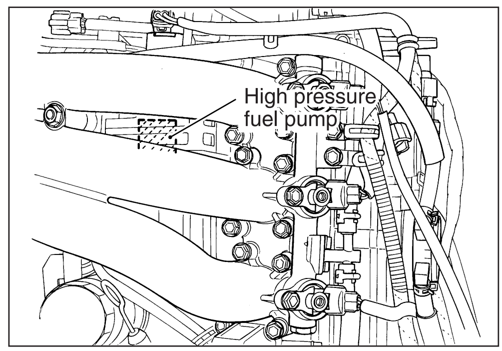


(4) Crank engine and measure voltage.

Fuel injector operating signal : 6 – 10 V

FUEL PUMP 3 SEC. OPERATING SOUND

Turn ignition switch ON and check for fuel pump operating sound.



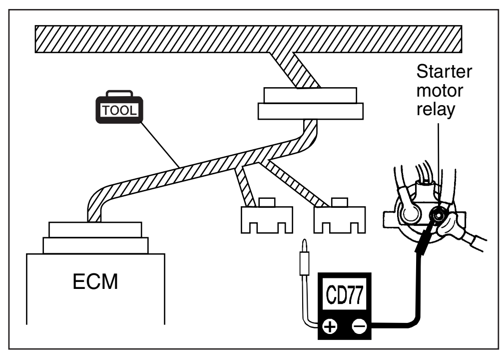
Fuel pump operating sound :

Sounds for approx. 3 seconds only

NOTE:

Fuel pump operating sound is low because pump is in fuel vapor separator. If you cannot hear clearly, use a sound scope or long blade screw driver.

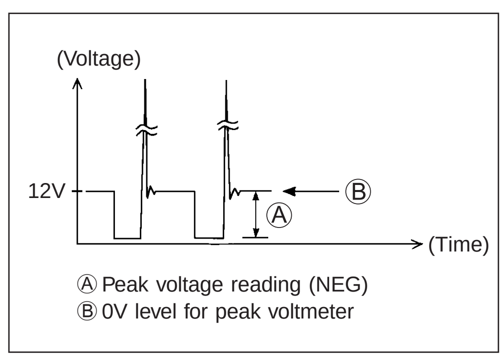
IGNITION COIL OPERATING SIGNAL



TOOL **09930-89950 : 44-pin test cord**

Peak voltmeter Stevens CD-77
Tester range : NEG50

(1) Connect the test cords as shown, then turn ignition switch ON.
(2) Connect the tester probe ⊖ (Black) to starter motor relay right terminal (connected to battery positive (+) terminal) as shown.
(3) Connect the tester probe ⊕ (Red) to each terminal.



Ignition coil	Terminal No.
No.1	44
No.2	43
No.3	22

(4) Crank engine and measure voltage.

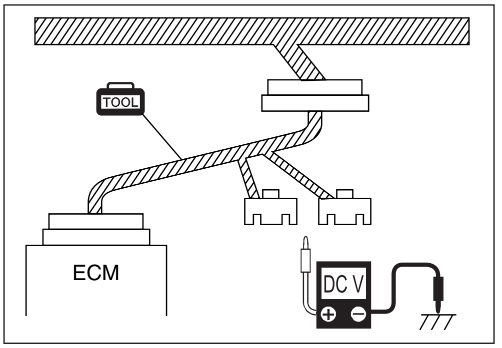
Ignition coil operating signal : 6 – 10 V

CMP SENSOR SIGNAL

09930-89950 : 44-pin test cord
09930-99320 : Digital tester
Tester range : ⎓ V (DC voltage)

(1) Rremote CMP sensor from engine. (See page 3-48)

(2) Connect the test cord as shown, then turn ignition switch ON.



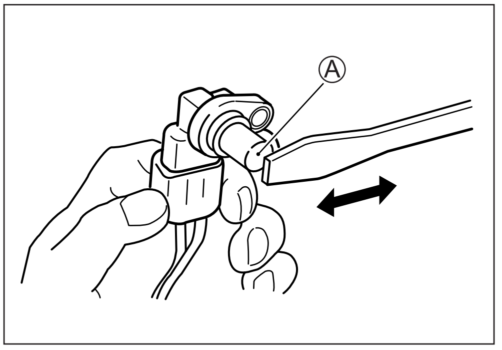
(3) Connect the tester probe (+) (Red) to terminal “33”.

(4) Connect the tester probe (–) (Black) to body ground.

(5) Measure voltage when steel tip of a screwdriver is brought near and then pulled away from sensor tip Ⓐ.

CMP sensor signal : Approx. 0.3 V or 5 V

NOTE:
Two signal voltages mentioned above (0.3 V or 5 V) will change by repeating movement of screwdriver.

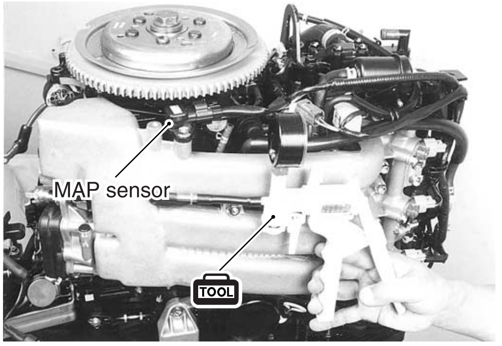


MAP SENSOR OUTPUT VOLTAGE CHANGE

09917-47011 : Vaccum pump gauge
09930-89950 : 44-pin test cord
09930-99320 : Digital tester

Tester range : ⎓ V (DC voltage)

(1) Disconnect MAP sensor hose from gas filter (surge tank) side.
(2) Connect the gauge to MAP sensor hose end as shown.
(3) While applying negative pressure to MAP sensor, measure “29” terminal voltage. (See page 13-33 and 13-34 for procedure.)



MAP sensor output voltage change :

Negative pressure kPa (kg/cm², mmHg)	0 (0, 0)	40 (0.4, 300)	80 (0.8, 600)
“29” terminal voltage (V)	4.00	2.42	0.84

(at 1013 hPa barometric pressure)

CTP SWITCH

09930-99320 : Digital tester

Tester range : (Continuity)

(1) Disconnect CTP switch wire.
(2) Check continuity between CTP switch terminal and body ground.

CTP switch function :

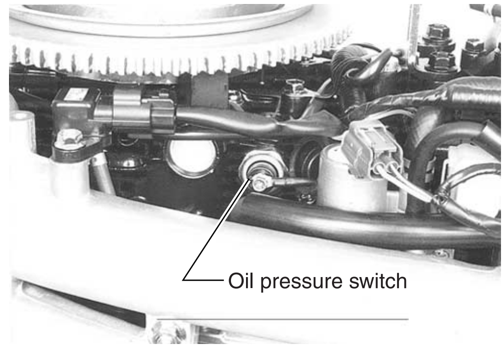
Throttle position	Continuity
Fully closed (switch contact in)	Yes
Not fully closed (switch contact out)	No

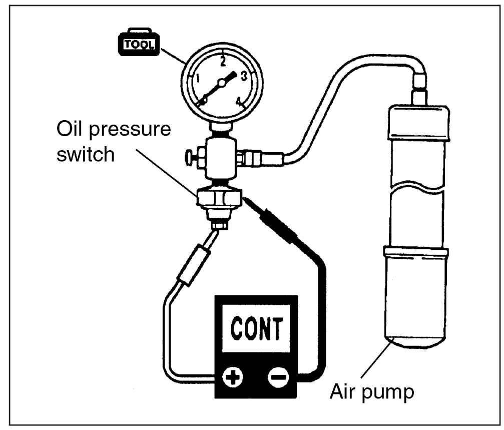
OIL PRESSURE SWITCH

09940-44121 : Air pressure gauge
09930-99320 : Digital tester
: Air pump

Tester range : (Continuity)

(1) Remove oil pressure switch.
(2) Connect the gauge and pump as shown.
(3) While applying pressure to oil pressure switch, check continuity.





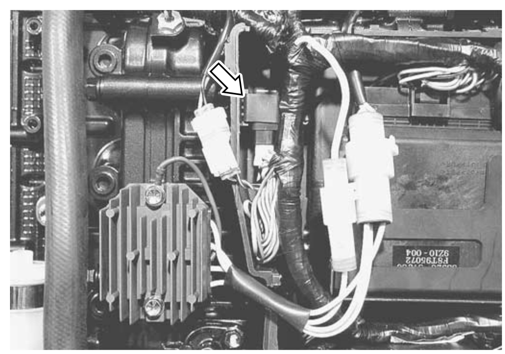
Oil pressure switch function :

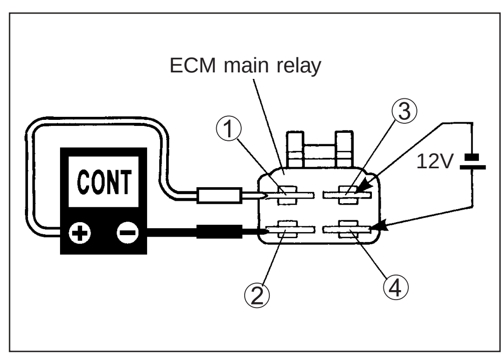
Pressure kPa (kg/cm^2)	Continuity
Less than 70 – 130 (0.7 – 1.3)	Yes
70 – 130 (0.7 – 1.3) or over	No

ECM MAIN RELAY

09930-99320 : Digital tester
Tester range : (Continuity)

(1) Disconnect ECM main relay from wire.
(2) Check continuity between terminal ① and ② each time 12V is applied. Connect positive (+) side to terminal ④, and negative (–) side to terminal ③.





ECM main relay function :

12 V power	Continuity
Applied	Yes
Not applied	No

CAUTION

Be careful not to touch 12 V power supply wires to each other or with other terminals.

TROUBLESHOOTING

⚠ WARNING

Before starting troubleshooting, read and follow the “PRECAUTION ON SYSTEM INSPECTION” section on page 13-33.

In this section, troubleshooting procedures are based on the assumption that “low pressure fuel system” and “mechanical components (power unit, lower unit, etc.)” are normal.

NOTE:
For troubleshooting of “Starter motor will not run”, see page 4-7 in Service Manual P/N. 99500-87J0•-01E.

CHART1 : SELF-DIAGNOSTIC CODE “3-4”

START

< Ignition switch “ON” >
Check “35” terminal voltage.
Is result OK? (See page 13-34.)

NO → ECM failure

YES ↓

< Ignition switch “ON” >
Check “29” terminal voltage.
Is result OK? (See page 13-34.)

NO → MAP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART2 : SELF-DIAGNOSTIC CODE “4-2”

START

< Ignition switch “OFF” >
Check CKP sensor resistance.
Is result OK? (See page 13-35.)

NO → CKP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
- *It will be possible to start engine if CKP sensor has failed.*

CHART3 : SELF-DIAGNOSTIC CODE “3-1”

START

< Ignition switch “OFF” >
Check IAC valve resistance.
Is result OK? (See page 13-35.)

NO → IAC valve failure

YES ↓

< Ignition switch “ON” >
Check “18” terminal voltage.
Is result OK? (See page 13-34.)

NO → ECM failure

YES ↓

Possible cause :
- Incorrect by-pass air screw adjustment
- IAC valve failure (mechanical)
- IAC passage failure (clogged hose/silencer, etc.)
- ECM failure
- Wire continuity/connection failure

CHART4 : SELF-DIAGNOSTIC CODE “2-4”

START

< Ignition switch “ON” / Cranking >
Check CMP sensor signal.
Is result OK? (See page 13-38.)

NO → CMP sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
It will be possible to start engine if CMP sensor has failed.

CHART5 : SELF-DIAGNOSTIC CODE “2-2”

START

< Ignition switch “ON” >
Check “24” terminal voltage.
Is result OK? (See page 13-34.)

NO → CTP switch failure [NOTE1]

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE1:
In this case, CTP switch will be in “always ON” condition. (“24” terminal voltage will be 0V always regardless throttle position.)

CHART6 : SELF-DIAGNOSTIC CODE “1-4”

START

< Ignition switch “OFF” >
Check cylinder temp. sensor resistance.
Is result OK? (See page 13-35.)

NO → Cylinder temp. sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART 7 : SELF-DIAGNOSTIC CODE “2-3”

START

< Ignition switch “OFF” >
Check IAT sensor resistance.
Is result OK? (See page 13-35.)

NO → IAT sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART8 : SELF-DIAGNOSTIC CODE “3-2”

START

< Individual check >
Check MAP sensor hose is in good condition/connection.
Is result OK?

NO → MAP sensor hose failure

YES ↓

< Ignition switch “ON” >
Check MAP sensor output voltage change.
Is result OK? (See page 13-39.)

NO → MAP sensor failure

YES ↓

Possible cause :
- Gas filter failure (clogged, etc.)
- ECM failure
- Wire continuity/connection failure

CHART9 : SELF-DIAGNOSTIC CODE “1-1”

START

< Individual check >
Check rectifier & regulator resistance.
[NOTE1]
Is result OK?

NO → Rectifier & regulator failure

YES ↓

< Engine running >
Check “30” terminal voltage at idle speed. (See page 13-34.)
Is result 16 V or over?

YES → Rectifier & regulator failure

NO ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

NOTE:
This self-diagnostic code indication may be canceled by turning ignition switch ON because ECM detects battery voltage.

NOTE1:
It is difficult to check rectifier & regulator completely. Before replacing with new one, check if its ground point has good electrical contact.

CHART10 : SELF-DIAGNOSTIC CODE “1-5”

START

< Ignition switch “OFF” >
Check exhaust manifold temp. sensor resistance.
Is result OK? (See page 13-35.)

NO → Exhaust manifold temp. sensor failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART11 : SELF-DIAGNOSTIC CODE “4-3”

START

< Ignition switch “OFF” >
Check fuel injector resistance.
Is result OK? (See page 13-35.)

NO → Fuel injector failure

YES ↓

Possible cause :
- ECM failure
- Wire continuity/connection failure

CHART12 : ENGINE CRANKED, BUT NOT START (OR STOPS SHORTLY AFTER STARTING)

Before starting this troubleshooting, make sure that :
- **There is no self-diagnostic code indication.**
- **Emergency stop switch plate is set in place.**

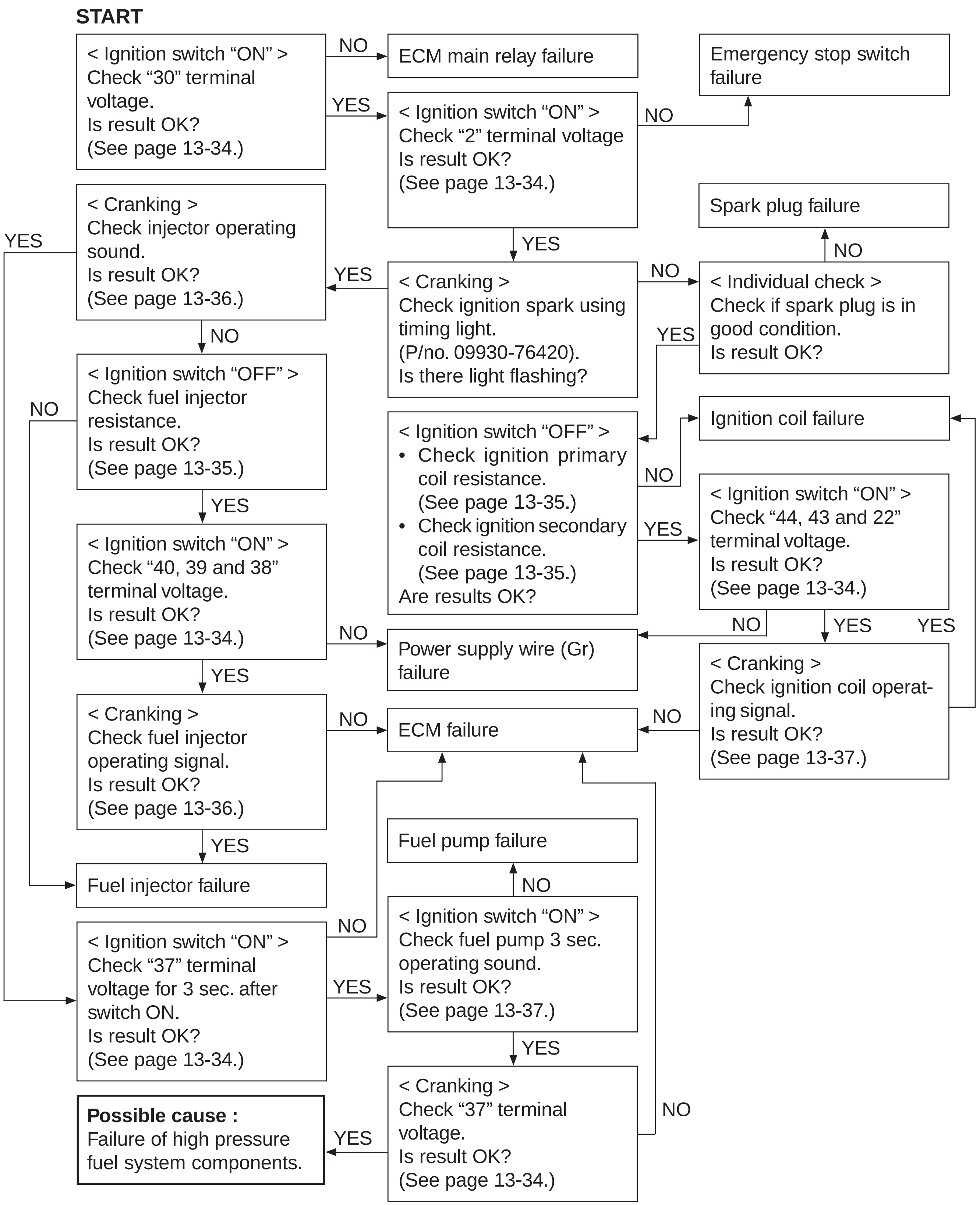
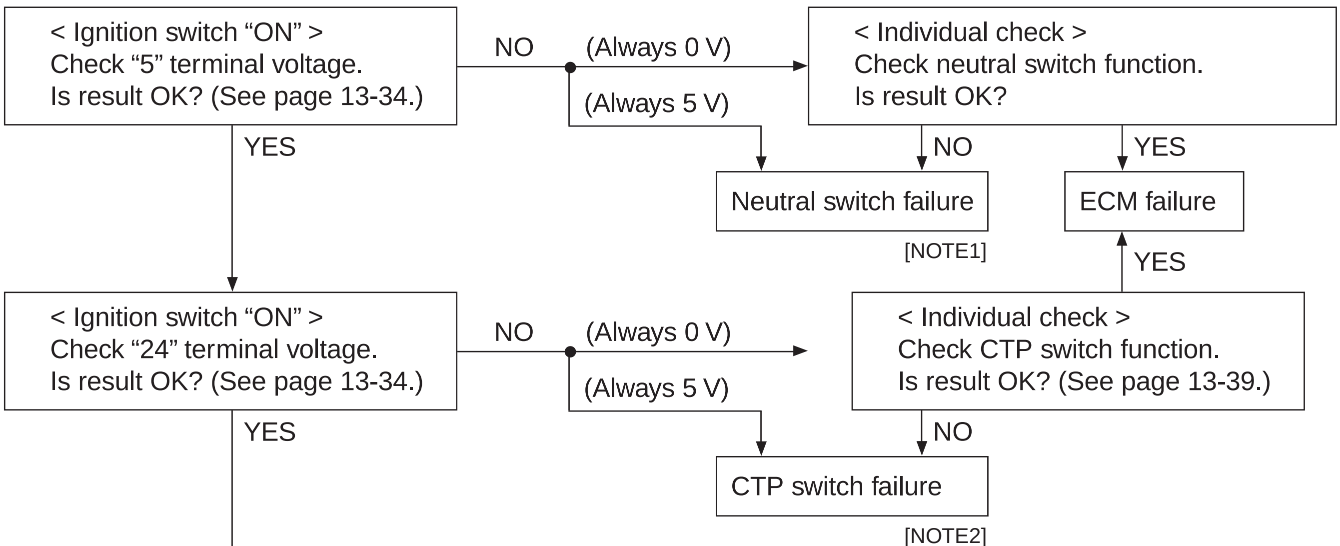


CHART13 : UNSTABLE IDLING / TROLLING (OR ENGINE TENDS TO STALL)

Before starting this troubleshooting, make sure that :
- **There is no self-diagnostic code indication.**

START



Possible cause :
- Incorrect by-pass air screw adjustment [NOTE3]
- IAC valve failure [NOTE3]
- IAC passage failure (clogged hose / silencer, etc.) [NOTE3]
- Spark plug failure
- Ignition coil failure
- ECM failure
- Wire continuity / connection failure
- Failure of high pressure fuel system components :
  - Fuel injector (clog, stuck valve, etc.)
  - Fuel pressure regulator (incorrect regulated pressure, etc.)
  - Fuel pump (clogged suction filter, leakage in tank, etc.)
  - Fuel filter (clog, etc.)
  - Hose (clog, kink, leakage, etc.)

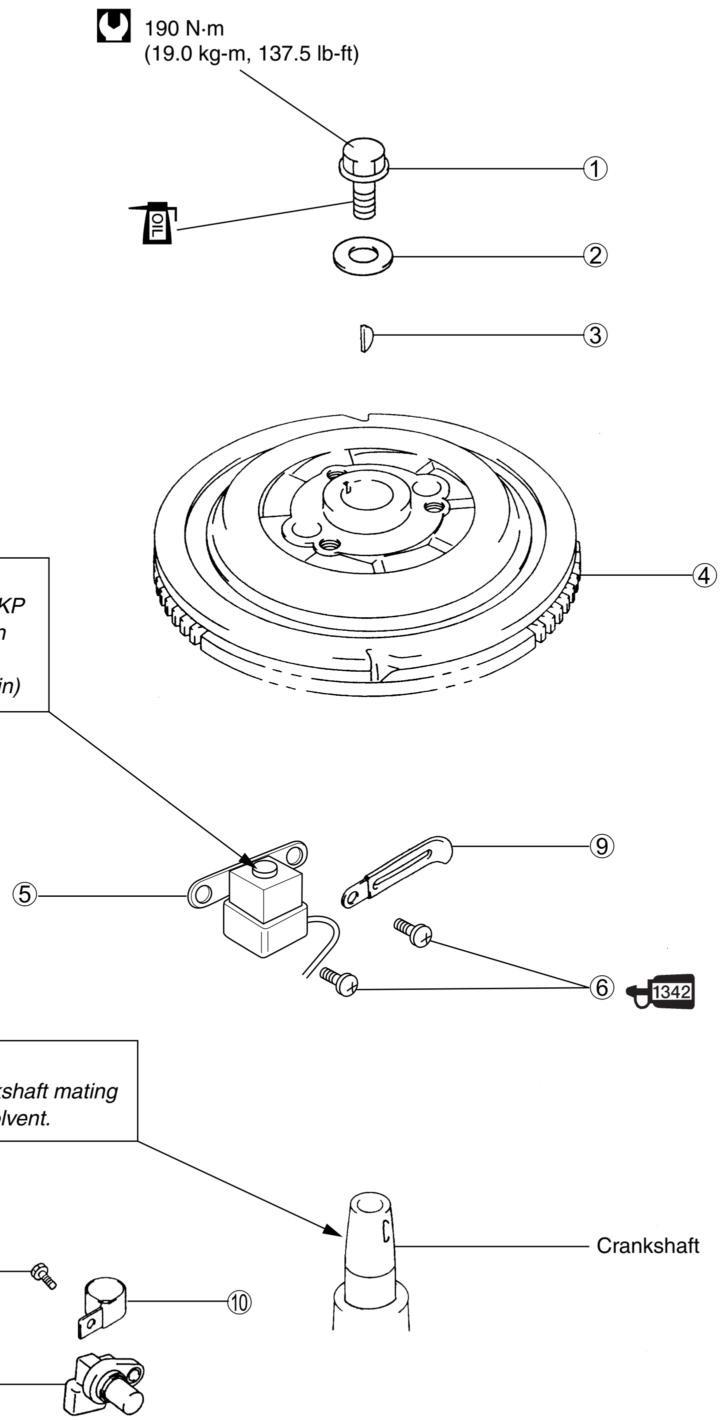
NOTE1:
If neutral switch has failed (while engine running), engine will tend to stall when shifting into gear.
If neutral switch has failed as “always ON”, engine speed is limited to 3000 r/min by intermittent fuel injection and ignition timing is fixed at BTDC9 °.
If neutral switch has failed as “always OFF”, engine cannot be cranked.

NOTE2:
If CTP switch has failed, engine will tend to stall when decelerating.

NOTE3:
- *The self-diagnostic code “3-1” may not be indicated because IAC valve condition depends on ECM control. (See page 13-28.)*
- *If IAC valve has failed, “Fast-idle function (warm-up mode)” won’t operate.*

REMOVAL / INSTALLATION
FLYWHEEL / CKP SENSOR / CMP SENSOR

① Flywheel bolt (1)
② Washer (1)
③ Key (1)
④ Flywheel magneto (1)
⑤ CKP sensor (1)
⑥ Screw (2)
⑦ CMP sensor (1)
⑧ Bolt (1)
⑨ Clamp (1)
⑩ Clamp (1)



NOTE:
Check air gap between CKP sensor and reluctor bar on flywheel magneto.
Air gap : 0.75 mm (0.030 in)

NOTE:
Clean flywheel and crankshaft mating surfaces with cleaning solvent.

09930-48720 : Flywheel holder
09930-39411 : Flywheel remover
09930-39420 : Flywheel remover bolt

ELECTRICAL

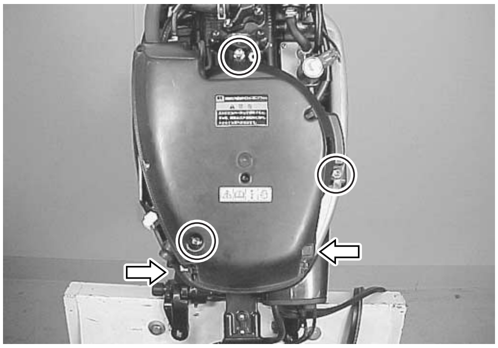
ELECTRIC STARTER SYSTEM

STARTER MOTOR

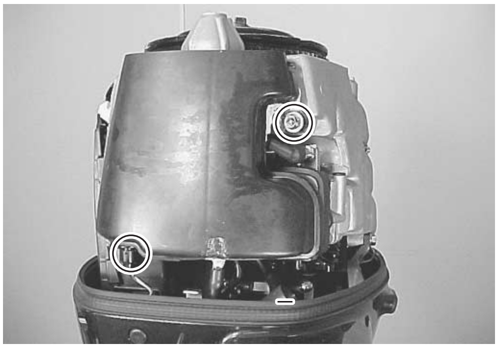
REMOVAL

Prior to removing starter motor: **• Disconnect battery cables from battery.**

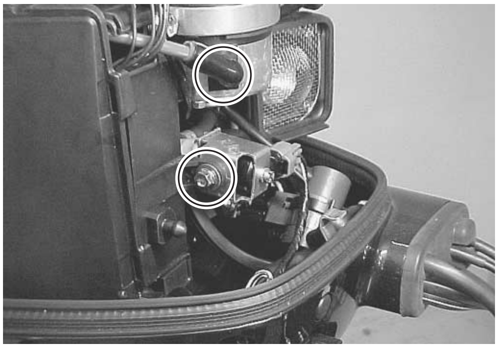
Remove three bolts, two fastening bands and flywheel cover.



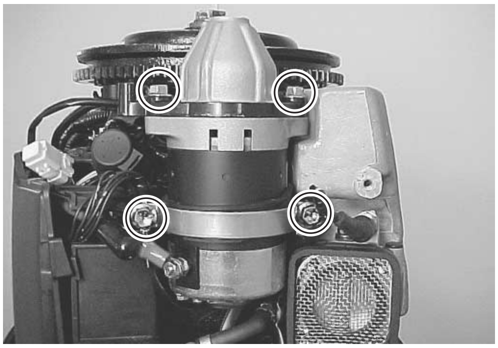
Remove bolt and silencer cover.
Disconnect lead wire connector from IAT sensor.



Remove nut and IAC valve from electric parts holder.
Remove starter motor sub cable.



Remove four bolts, motor band and starter motor assy.



INSTALLATION

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

- Install starter motor and tighten starter motor mounting bolts securely.

Starter motor mounting bolt :

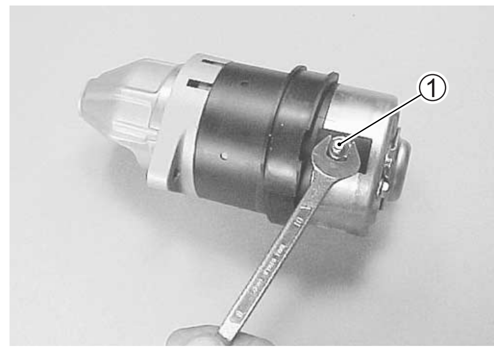
23 N·m (2.3 kg-m, 16.5 lb-ft)

DISASSEMBLY

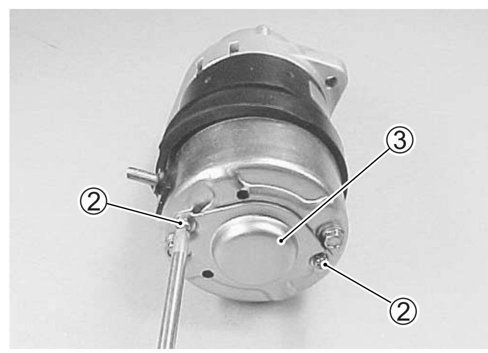
NOTE:

For correct assembly, scribe an alignment mark on the front cover, stator and rear cover.

Remove nut ① on ⊕ terminal.



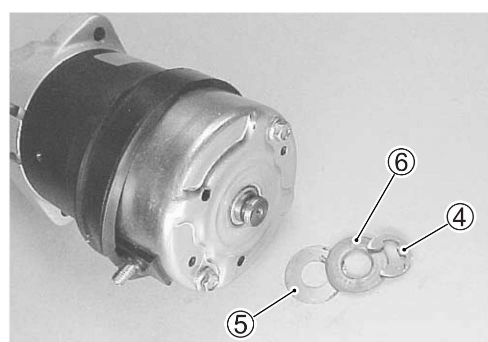
Remove two screws ② and sub rear cover ③.



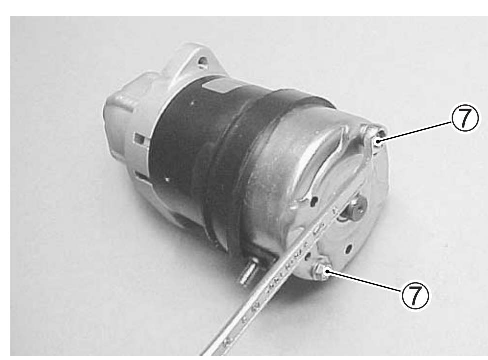
Remove circrip ④, washer ⑤ and ⑥.

NOTE:

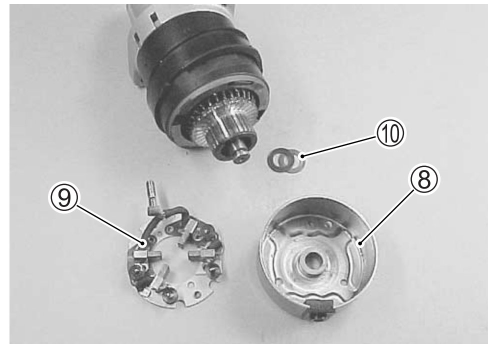
When installing, set thicker washer ⑥ to circrip side.



Remove two bolts ⑦.

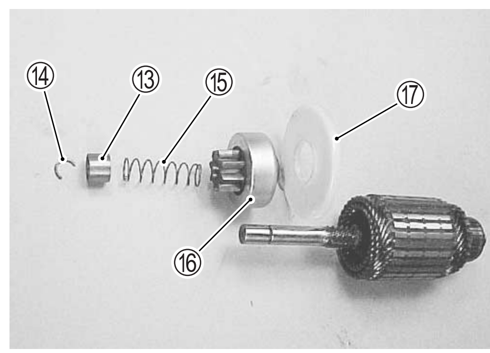


Remove rear cover ⑧ and brush holder ⑨.
Remove washers ⑩ from armature shaft.



Remove front cover ⑪ and stator ⑫.

Push down pinion stopper ⑬, remove stopper ring ⑭.
Remove pinion stopper ⑬, spring ⑮, pinion ⑯ and cover ⑰.



⚠ WARNING

Wear safety grasses when disassembling and assembling stopper ring.

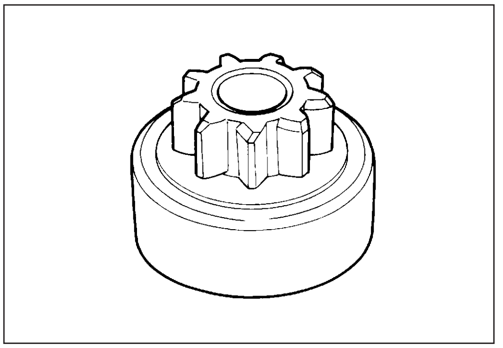
NOTE:

Using a screw-driver, pry off the stopper ring.

INSPECTION & SERVICING

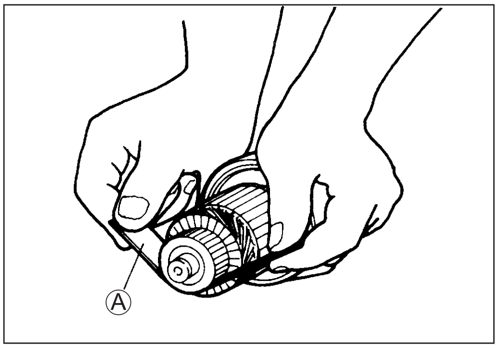
Pinion

Inspect pinion.
Replace pinion if damaged or worn.

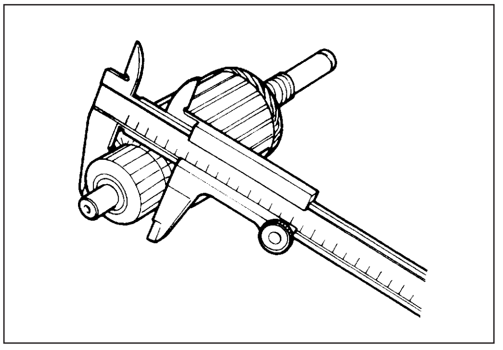


Armature and Commutator

Inspect the commutator surface.
If surface is gummy or dirty, clean with 400 grade emery paper Ⓐ.



Measure commutator outside diameter.



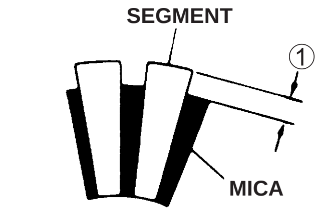
TOOL **09900-20101 : Vernier calipers**

Commutator outside diameter:

Standard : 33.0mm (1.30 in)
Service limit : 32.0mm (1.26 in)

If measurement exceeds service limit, replace armature.

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



①. undercut

Commutator undercut:

Standard : 0.5 – 0.8mm (0.02 – 0.03 in)
Service limit : 0.2 mm (0.01in)

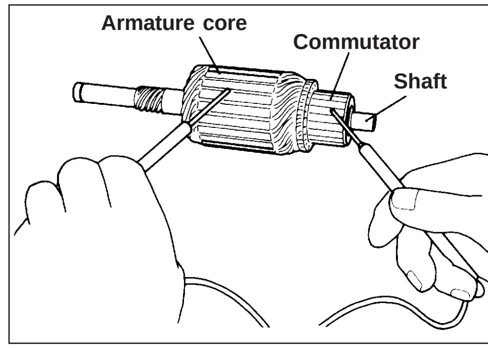
If measurement exceeds service limit, cut to specified depth.

NOTE:
Remove all particles of mica and metal using compressed air.

⚠ WARNING

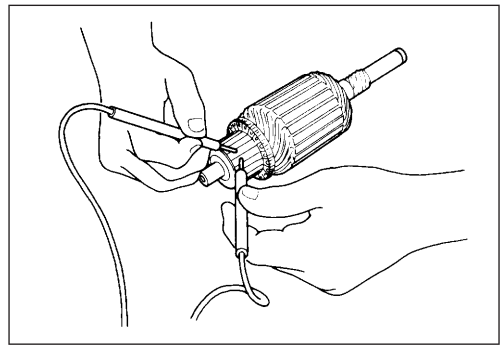
Wear safety grasses when using compressed air.

Check for continuity between the commutator and the armature core / shaft.
Replace armature if continuity is indicated.



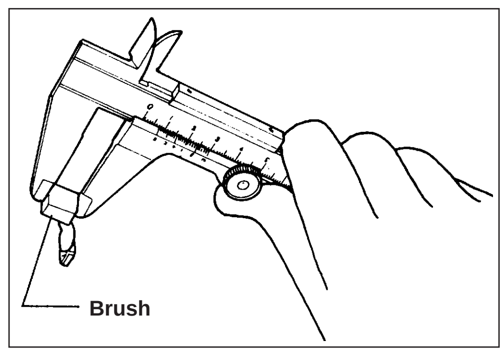
Check for continuity between the adjacent commutator segments.
Replace armature if no continuity is indicated.

TOOL **09930-99320 : Digital tester**
Tester range : (Continuity)



BRUSHES
Check the length of each brush.

TOOL **09900-20101 : Vernier calipers**

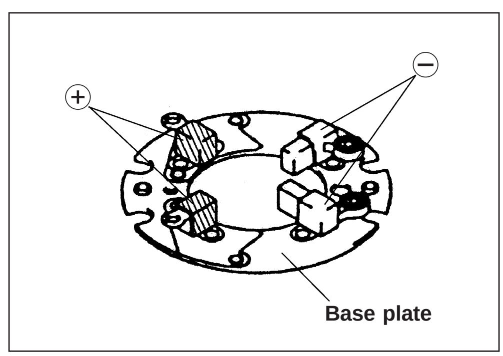


Brush length:
Standard : 17.0 mm (0.67 in)
Service limit : 10.0 mm (0.39 in)

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

BRUSH HOLDER
Check brush holder continuity.

TOOL **09930-99320 : Digital tester**
Tester range : (Continuity)



Brush holder continuity :

Tester probe connection	Continuity
Brush holder positive ⊕ to Brush holder negative ⊖	No
Brush holder positive ⊕ to Base plate (ground)	No

ASSEMBLY

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

CAUTION

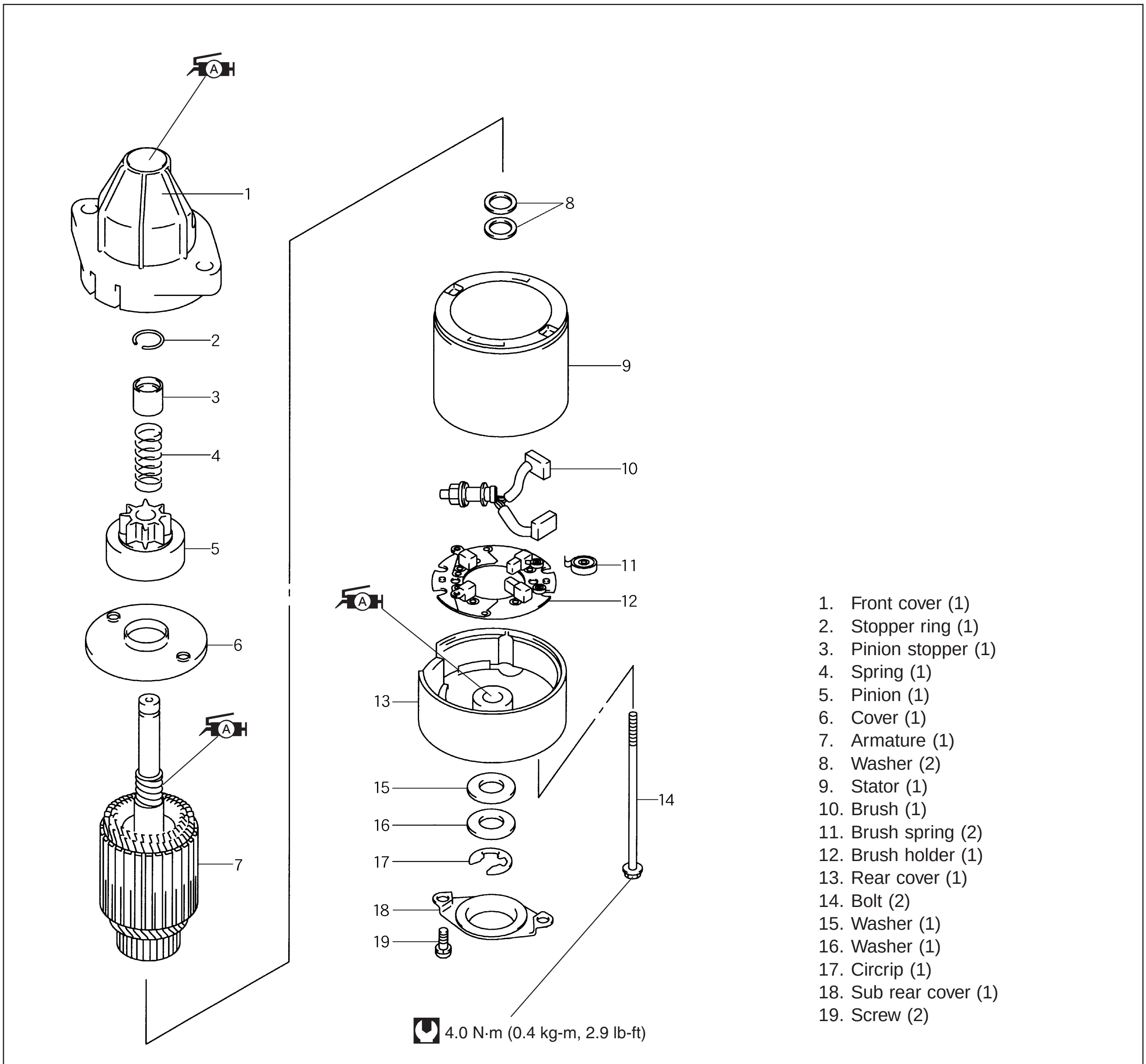
When installing armature, exercise care to avoid breaking brushes.

Apply grease to armature shaft and shaft holes.

99000-25010 : Suzuki Super Grease “A”

Align front cover, stator and rear cover with alignment lines scribed earlier and assemble starter.

Bolt ⑭: 4.0 N·m (0.4 kg-m, 2.9 lb-ft)



MID UNIT

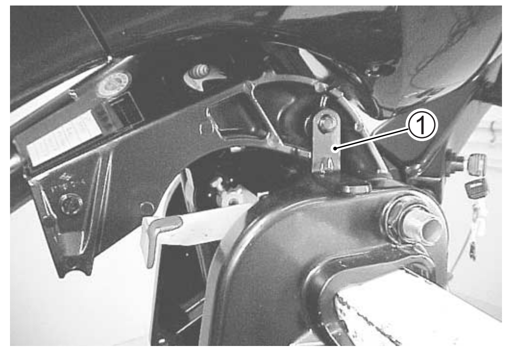
TILT AID SYSTEM

⚠ WARNING

This unit contains high pressure gas and it must not be disassembled, punctured, incinerated or exposed to heat.

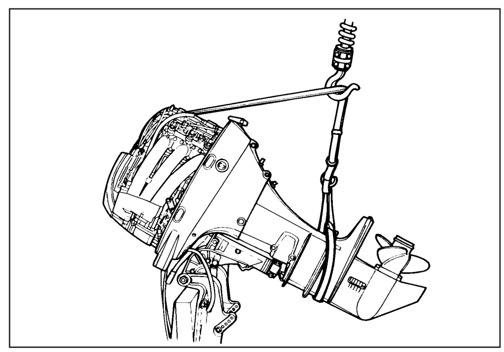
REMOVAL

Tilt engine fully up and lower the manual tilt lock levers ①.

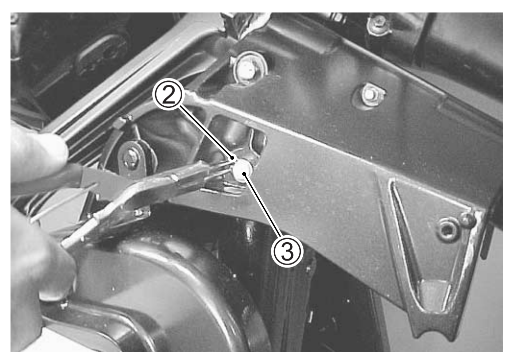


⚠ WARNING

During the following procedure, firmly secure the engine and support its weight. (see right)



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

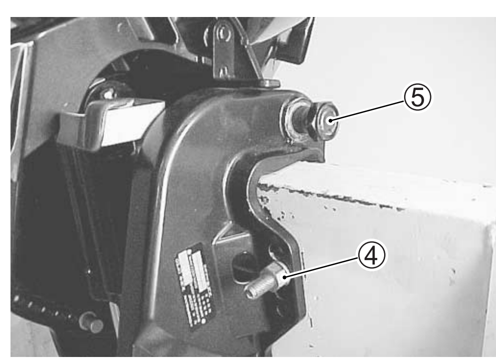


Remove the two STBD motor mounting bolts ④.
Loosen the clamp bracket shaft nut ⑤.

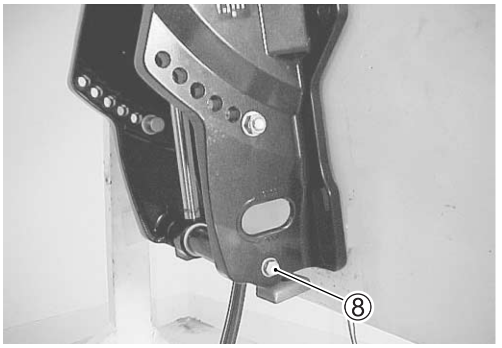
NOTE:

Complete removal of the clamp bracket shaft nut is not required.

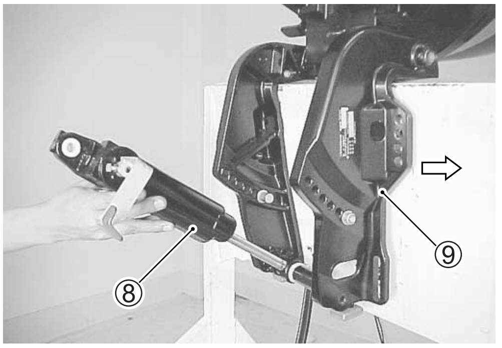
Nut should only be loosened as far as the end of the shaft threads to facilitate removal of the tilt aid gas cylinder.



Remove the both lower shaft bolts ⑧.



Slide the STBD clamp bracket ⑨ fully outward to the right hand side.
Remove the tilt aid gas cylinder ⑩ from between the clamp brackets.

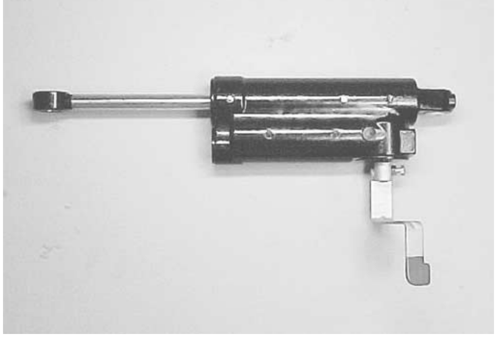


INSPECTION

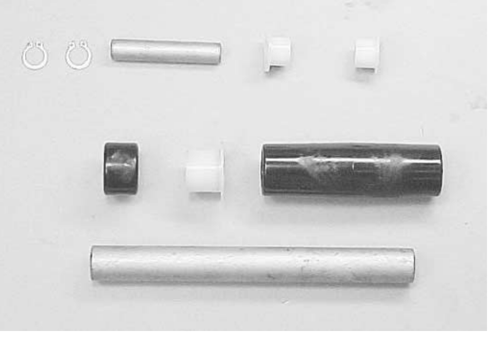
NOTE:

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

Tilt aid gas cylinder
Check tilt aid gas cylinder.
If cracks, defects or other damage is found, replace the cylinder assembly complete.



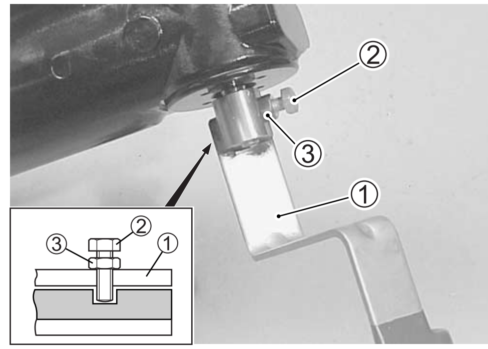
Bush
Check all bush.
If excessive wear or other damage is found, replace bush.
If bush fit is loose when installing, replace bush.



INSTALLATION

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

- Install release lever ①, bolt ② and lock nut ③ as shown. Tighten the bolt ② first, then the lock nut ③.



- Apply grease to the cylinder lower shaft, cylinder upper shaft and bushes.

W/R G's **99000-25160 : Suzuki Washer Resistant Grease**

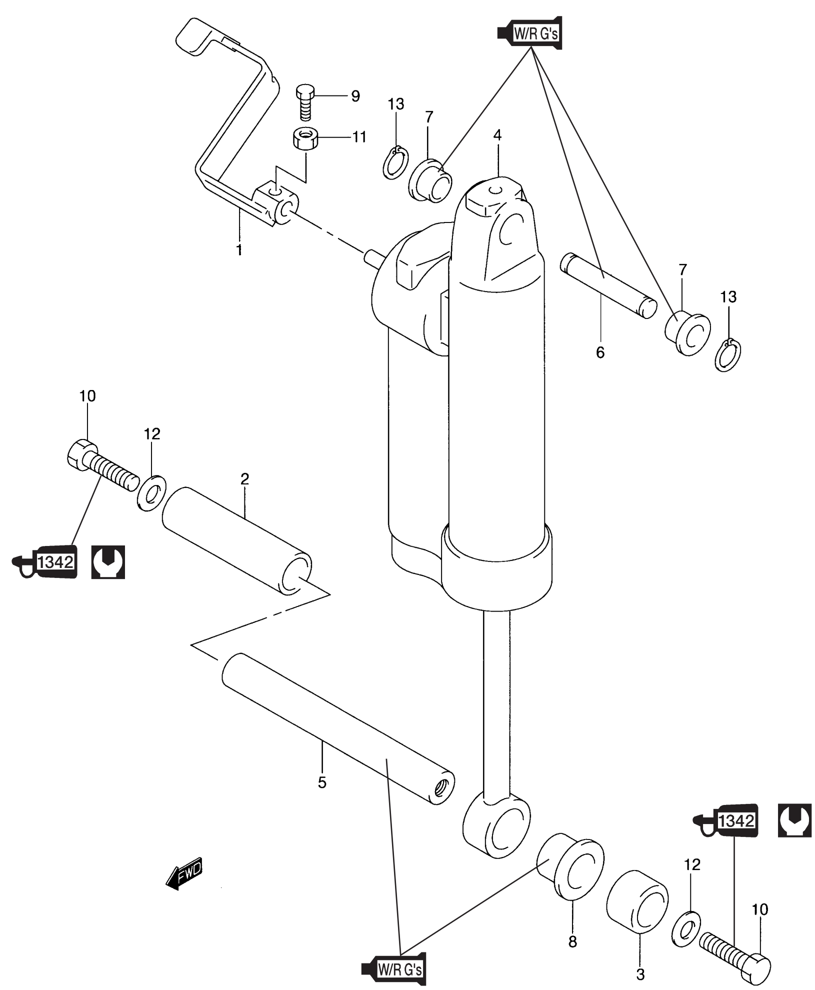
- Tighten the clamp bracket shaft nut to specified torque.

Clamp bracket shaft nut : 43 N·m (4.3 kg-m, 31.0 lb-ft)

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

1342 **99000-32050 : Thread Lock “1342”**

Lower shaft bolt : 23 N·m (2.3 kg-m, 16.5 lb-ft)



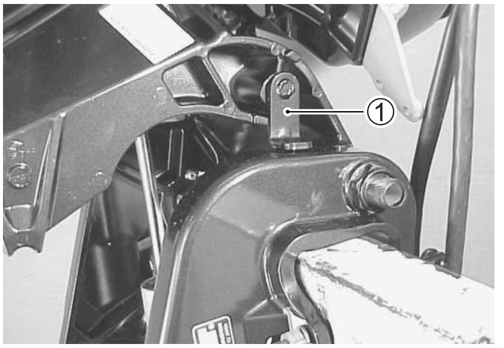
1. Release lever (1)
2. Spacer (1)
3. Spacer (1)
4. Tilt aid gas cylinder (1)
5. Lower shaft (1)
6. Upper shaft (1)
7. Bush (2)
8. Bush (1)
9. Bolt (1)
10. Bolt (2)
11. Nut (1)
12. Washer (2)
13. Snap ring (2)

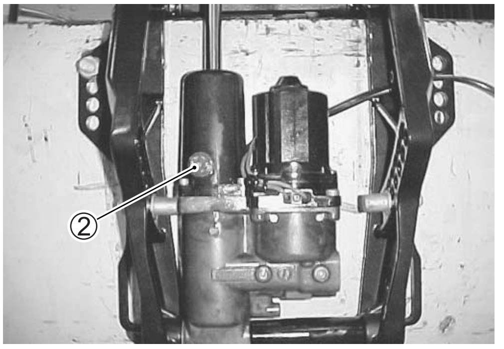
POWER TRIM AND TILT

OIL LEVEL

To check the oil level :

1. The motor should be raised 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

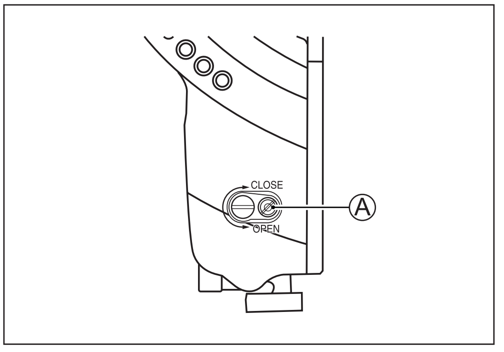
CAUTION

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

6. Reinstall oil filler plug.

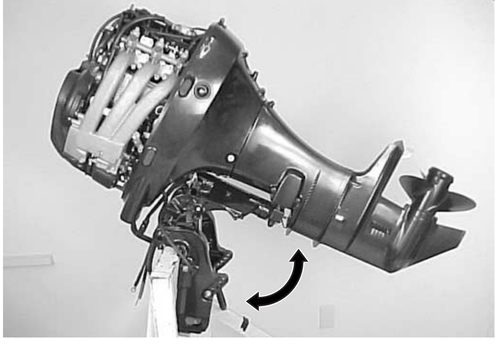
AIR BLEEDING

1. Make sure the manual release valve Ⓐ is closed securely before performing air bleeding.



Manual release valve : 1.7 N·m (0.17 kg-m, 1.2 lb-ft)

2. Using PTT switch, raise and lower engine (full up to full down) 5-6 times.
3. Check oil level, topping off if necessary.
4. Reinstall oil filler plug.



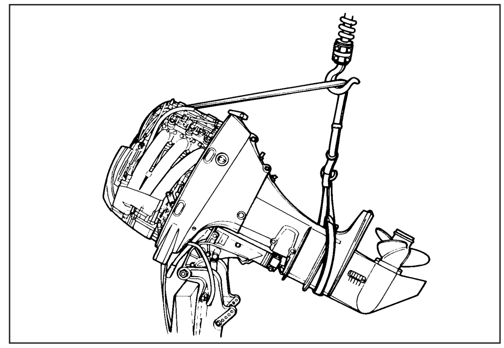
POWER TRIM AND TILT UNIT

REMOVAL

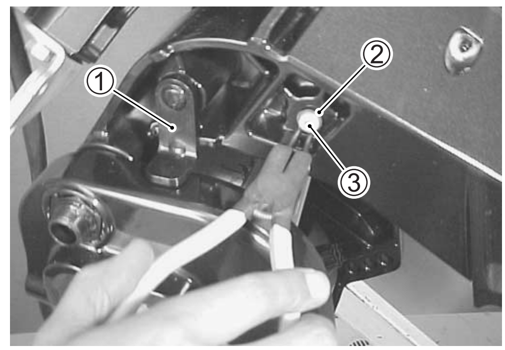
Tilt engine fully up and lower the manual tilt lock levers ①.

⚠ WARNING

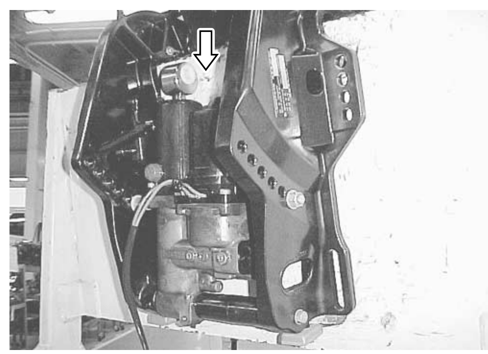
During the following procedures, firmly secure the engine and support its weight. (see right)



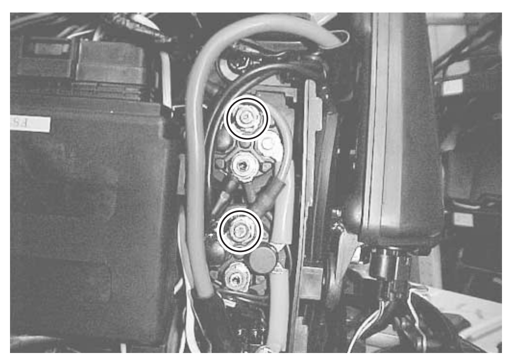
Remove the tilt rod snap ring ② and push tilt cylinder upper shaft pin ③ out.



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

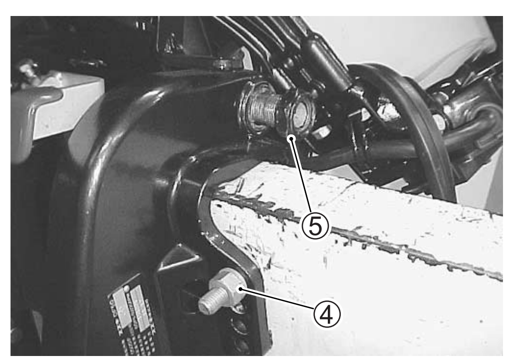


Disconnect the PTT motor cable wire leads (G, Bl) from the PTT relays.
Remove the PTT motor cable from engine lower cover.

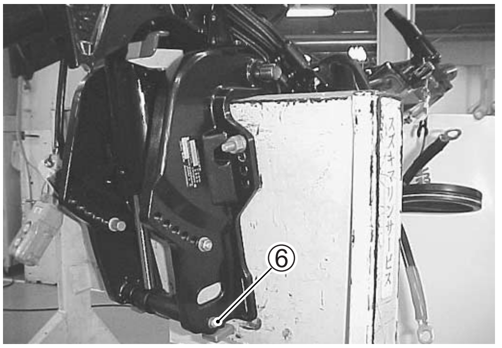


Remove the two STBD motor mounting bolts ④.
Loosen the clamp bracket shaft nut ⑤.

NOTE:
Complete removal of the clamp bracket shaft nut is not required. Nut should be loosened as far as the end of the shaft threads only to facilitate removal of the PTT unit.

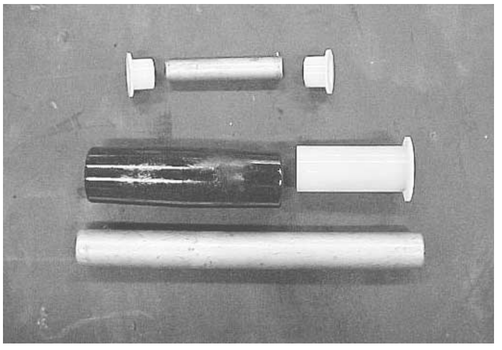


Remove the both lower shaft bolts ⑥.



Slide the STBD clamp bracket fully outward to the right hand side.
Remove the PTT unit from between the clamp brackets.

Check all bush.
If excessive wear or other damage is found, replace bush.
If bush fit is loose when installing, replace bush.



DISASSEMBLY

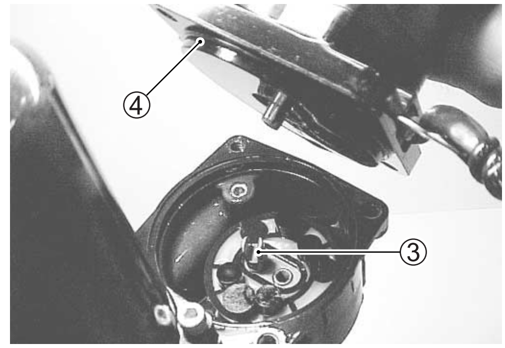
NOTE:
Before disassembly, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry the PTT body with compressed air.

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

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 component before tightening vise.

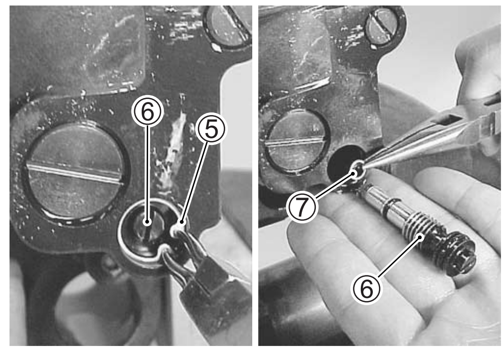
Remove the PTT motor.
Note the position of drive joint ③ and O-ring ④, before removing them.
(See page 13-63)



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

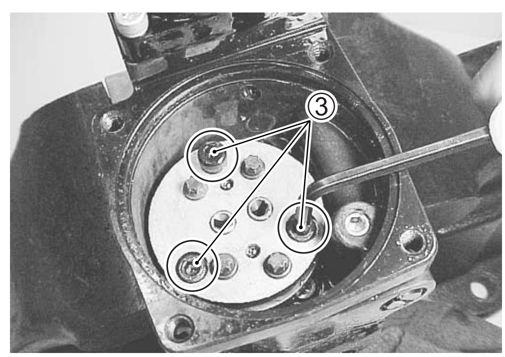
Remove the manual release valve snap ring ⑤, then unscrew the manual release valve ⑥.

Remove the seal washer ⑦.

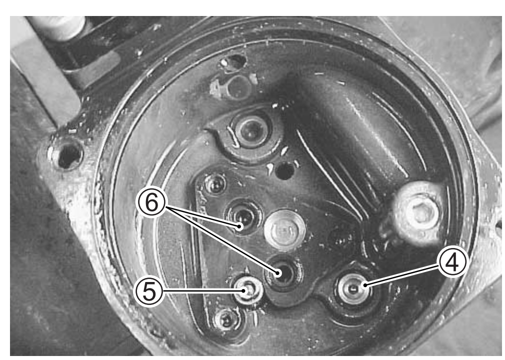


PUMP ASSY
Remove the drive joint ① and filter ②.

Remove three bolts ③ and pump assy.



Remove the check valve ④, down-blow valve ⑤ and O-ring ⑥.

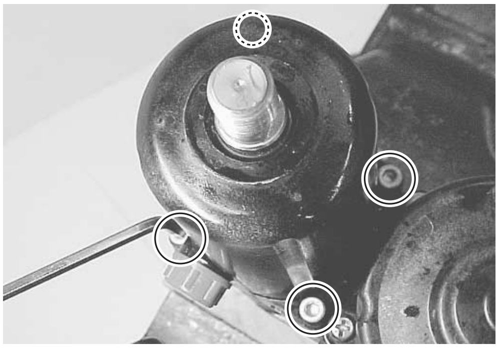


Remove the tilt rod joint.

Remove four bolts and cylinder housing.

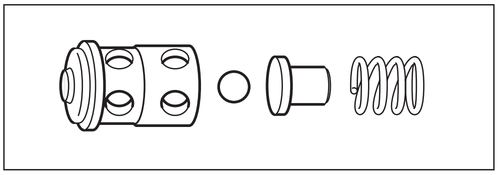
CAUTION

When removing the cylinder housing, exercise care to avoid damaging the rip of oil seal.



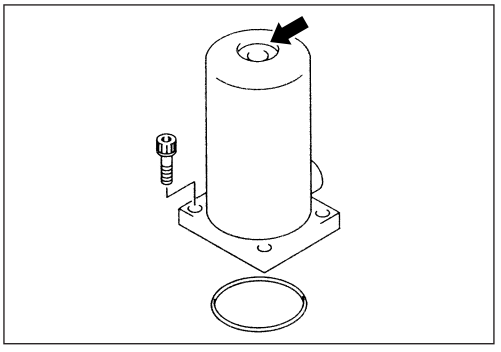
CLEANING AND INSPECTING

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 manual release valve, down-blow valve, seal and O-ring. Replace if cuts, nicks, excessive wear or other damages are found.



REASSEMBLY

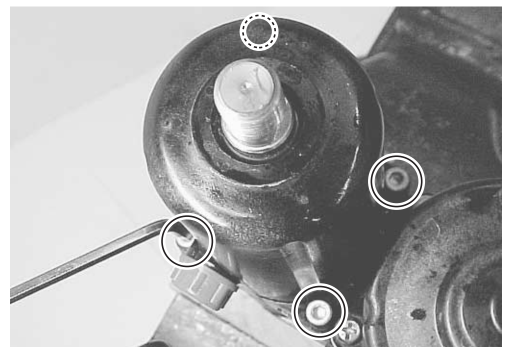
Assembly is reverse of disassembly with special attention to following steps.

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.**

CYLINDER HOUSING

Install the the cylinder housing .
Tighten four bolts.



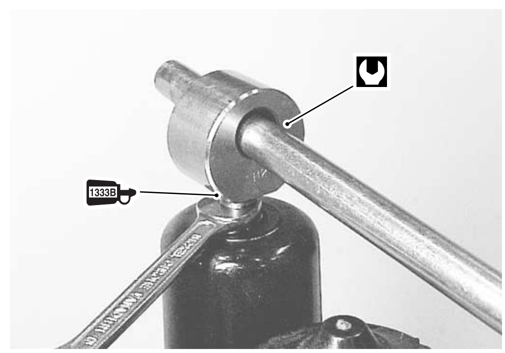
CAUTION

When installing the the cylinder housing, exercise care to avoid damaging the rip of oil seal.

TILT ROD JOINT

Apply Thread Lock 1333B to the thread part of tilt rod joint.

1333 **99000-32020 Thread Lock 1333B**

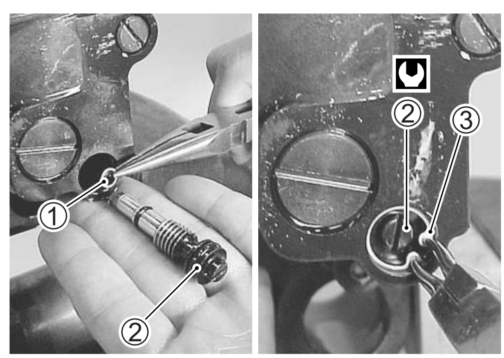


Tighten the tilt rod joint to specified torque.

Piston rod joint : 40 N·m (4.0 kg-m, 30.0 lb-ft)

MANUAL RELEASE VALVE

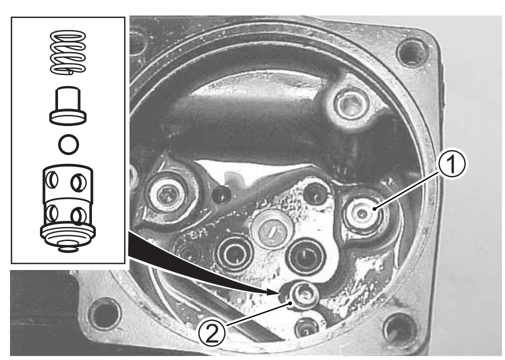
Oil and install the seal washer and manual release valve.
Tighten the valve to specified torque.
Install snap ring.



Manual release valve : 1.7 N·m (0.17 kg-m, 1.2 lb-ft)

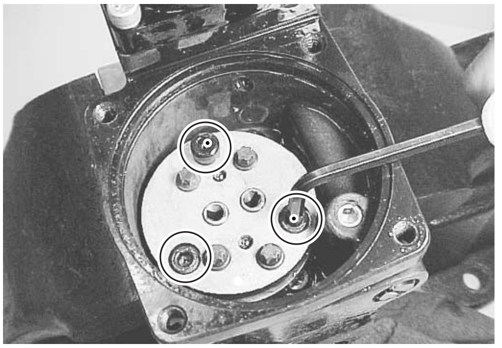
PUMP ASSY

Install the check valve and down-blow valve.



Install the pump assy.
Tighten three bolts to specified torque.

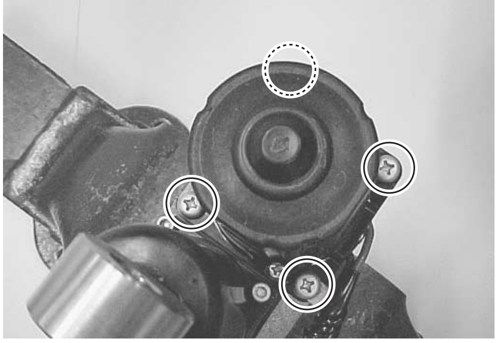
Pump securing bolt : 5 N·m (0.5 kg-m, 3.6 lb-ft)



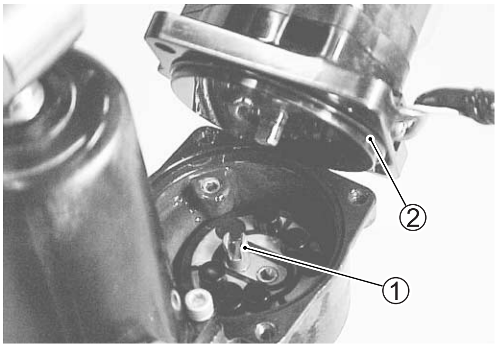
PTT MOTOR
See the PTT MOTOR-installation section on page 13-66.

AIR BLEEDING
See the AIR BLEEDING section on page 13-57.

PTT MOTOR
Removal
Remove the four screws securing the PTT motor to the pump & reservoir.



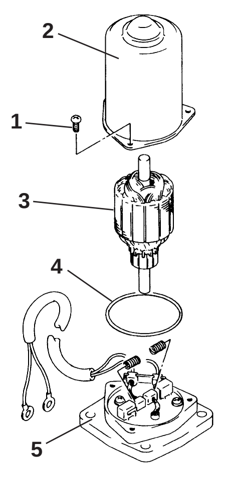
Detach the PTT motor from pump & reservoir.
Note the position of drive joint ① and O-ring ② and remove them.



Disassembly
For correct assembly, scribe an alignment mark on the field case and brush holder.
Remove the three screws securing the field case to the brush holder.

Using a soft face hammer, gently tap the field case from side to side to unseat it from the brush holder.
Slide the field case upward and away from the brush holder.
Note the position of the O-ring encircling the brush holder.

Slide the armature free of the brushes.

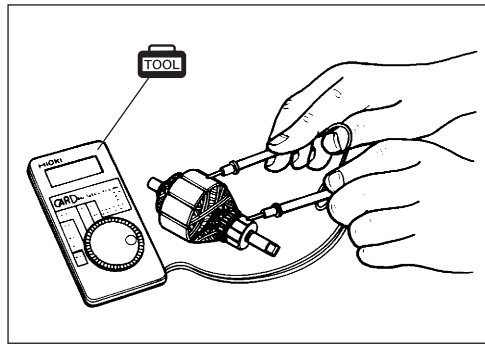


1. Screw
2. Field case
3. Armature
4. O-ring
5. Brush holder

Inspection

• **Armature and commutator**

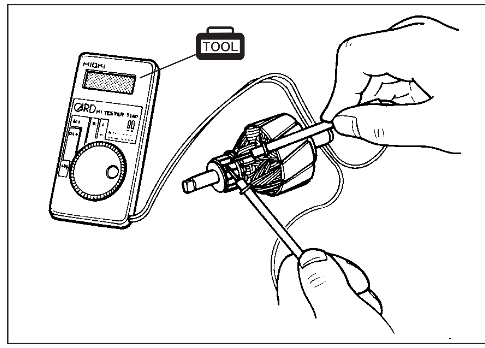
Check for continuity between the commutator and the armature core / shaft.
Replace armature if continuity is indicated.



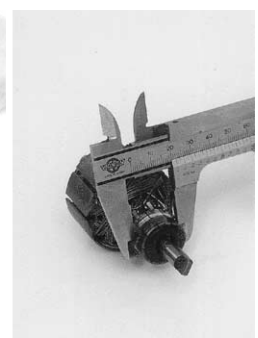
09930-99320 : Digital tester

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 grade emery paper.



Measure commutator outside diameter.

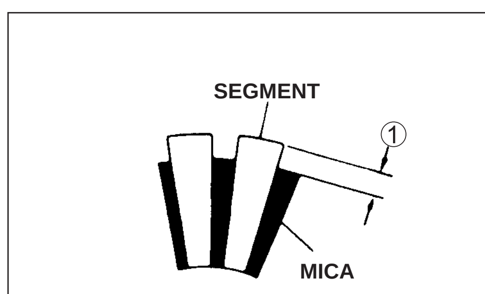
09900-20101 : Vernier calipers

Commutator outside diameter :

Standard	**22.0 mm (0.87 in)**
Service limit	**21.0 mm (0.83 in)**

If measurement exceeds service limit, replace armature.

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



① **Commutator undercut**

Commutator undercut :

Standard	**0.5 – 0.8 mm (0.02 – 0.03 in)**
Service limit	**0.2 mm (0.01 in)**

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

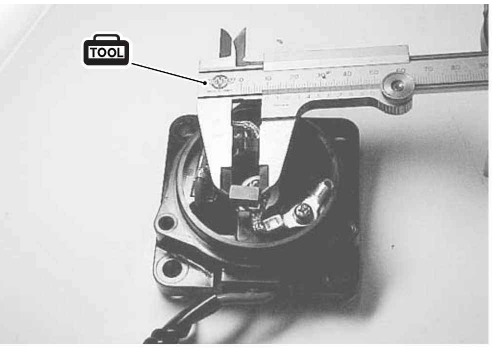
NOTE:
Remove all particles of mica and metal using compressed air.

⚠ WARNING

Wear safety grasses when using compressed air.

- **Brushes**

Check the length of each brush.



TOOL 09900-20101 : Vernier calipers

Brush length :

Standard	**9.8 mm (0.39 in)**
Service limit	**4.8 mm (0.19 in)**

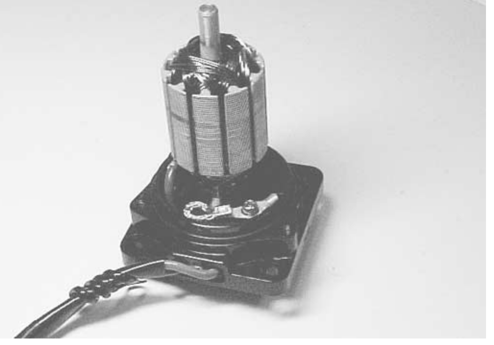
If brushes are worn down to the service limit, they must be re-placed .

- **O-ring**

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

Assembly

Assembly is reverse of disassembly with special attention to fol-lowing steps.

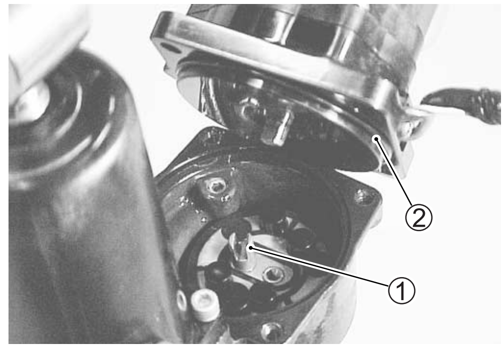


CAUTION

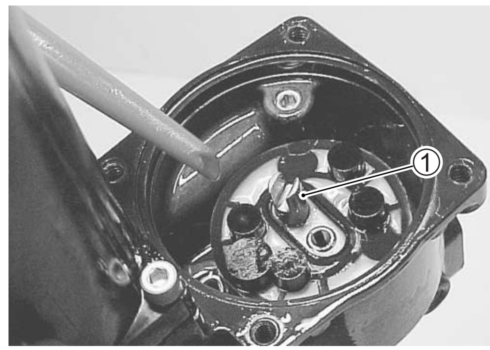
When installing the armature, exercise care to avoid breaking brushes.

Installation

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



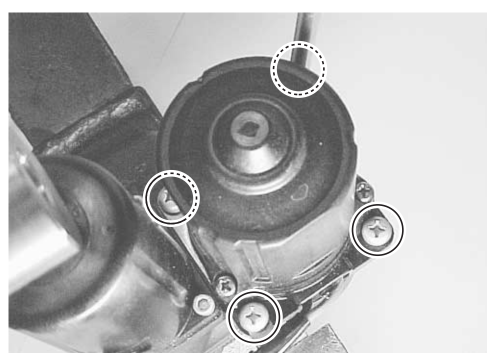
- Ensure that the drive joint ① is aligned and firmly inserted into the gear pump assembly.
- Fit O-ring ② to pump & reservoir.
- Check the level of PTT fluid contained in the pump & reservoir. If level is low, add recommended PTT fluid until level with mating surface of PTT motor.



- Ensure that the faces of the PTT motor and pump unit are free of dirt or debris.
  When attaching the PTT motor to the pump & reservoir, ensure that the tip of armature shaft fits firmly into the drive joint.

- Tighten the four screws to specified torque.

PTT motor screw : 4.5 N·m (0.45 kg-m, 3.3 lb-ft)



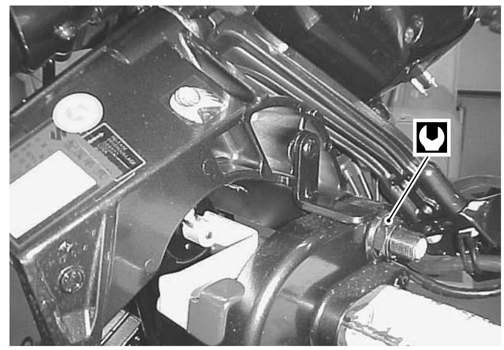
INSTALLATION

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

- Apply grease to the cylinder lower shaft, cylinder upper shaft and bushes.

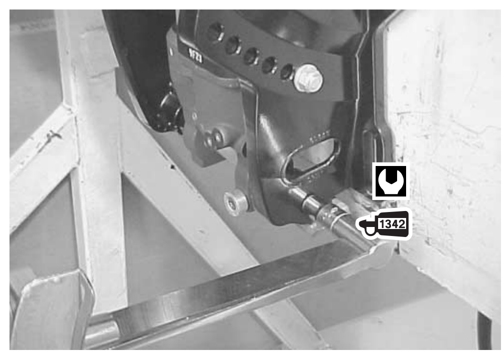
W/R G's **99000-25160 : Water Resistant Grease**

- Lower tilt rod full down position.
  Place the PTT unit in position between the clamp brackets.
  Tighten the clamp bracket shaft nut to specified torque.



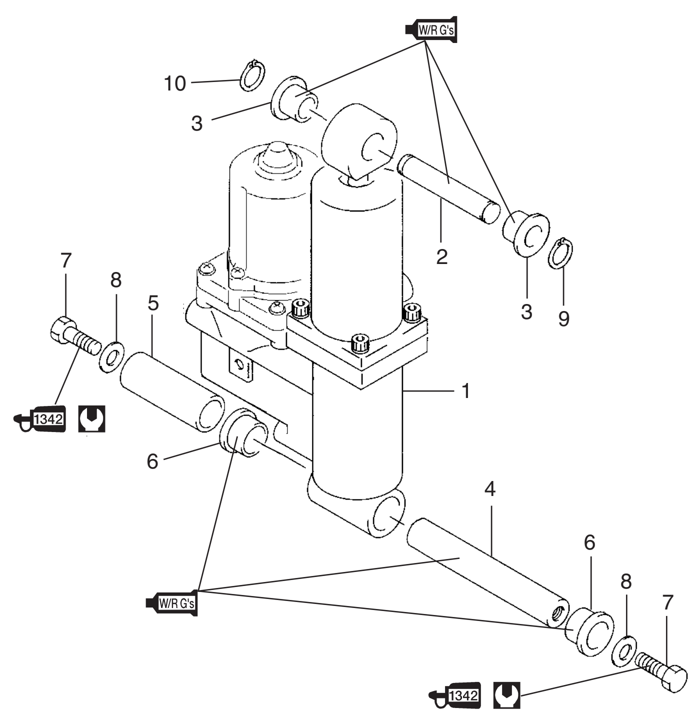
Clamp bracket shaft nut :
43 N·m (4.3 kg-m, 31.0 lb-ft)

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



1342 **99000-32050 : Thread Lock “1342”**

Lower shaft bolt : 23 N·m (2.3 kg-m, 16.5 lb-ft)

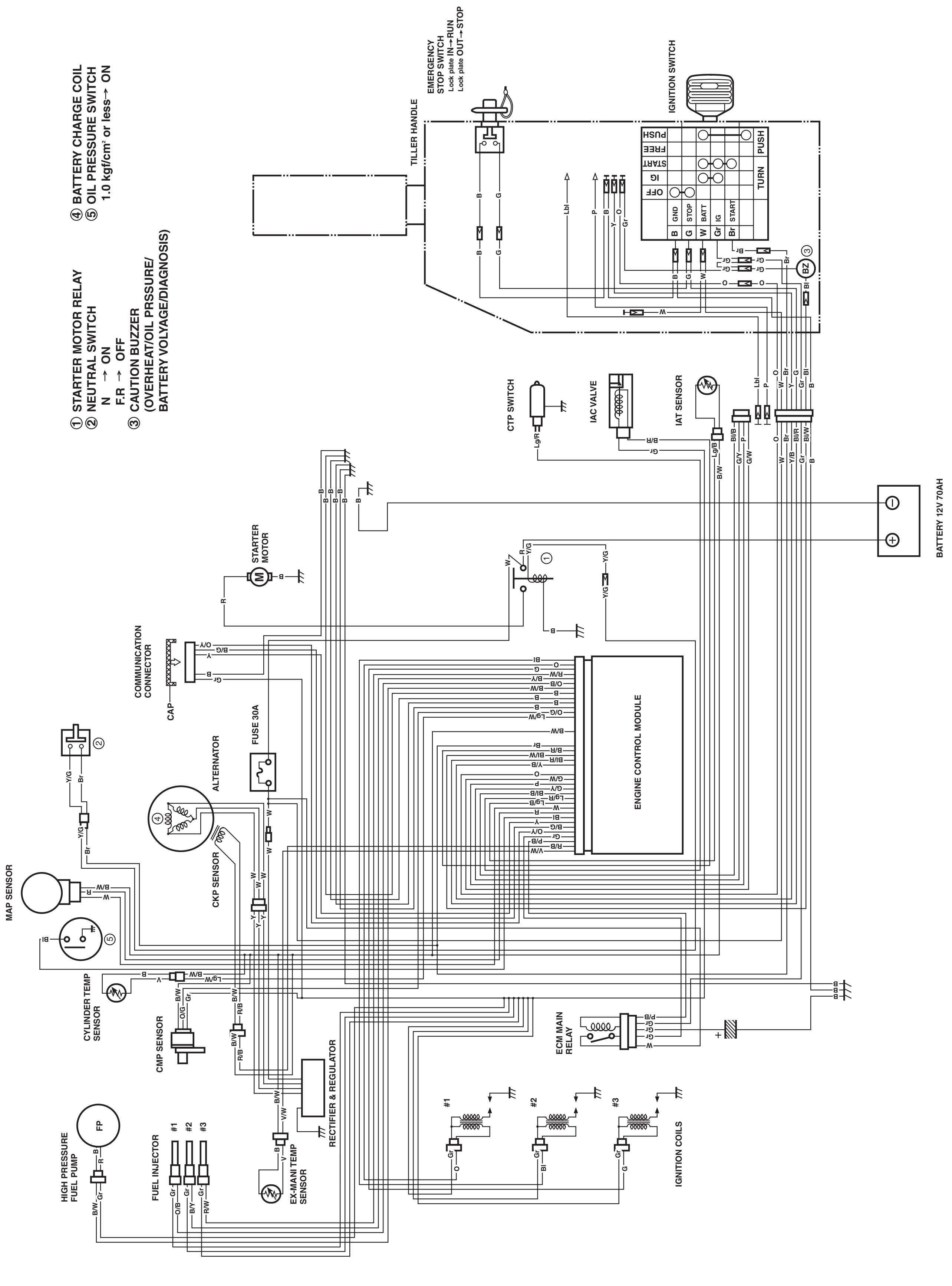


1. PTT unit (1)
2. Upper shaft (1)
3. Bush (2)
4. Lower shaft (1)
5. Spacer (1)
6. Bush (2)
7. Bolt (2)
8. Washer (2)
9. Snap ring (2)

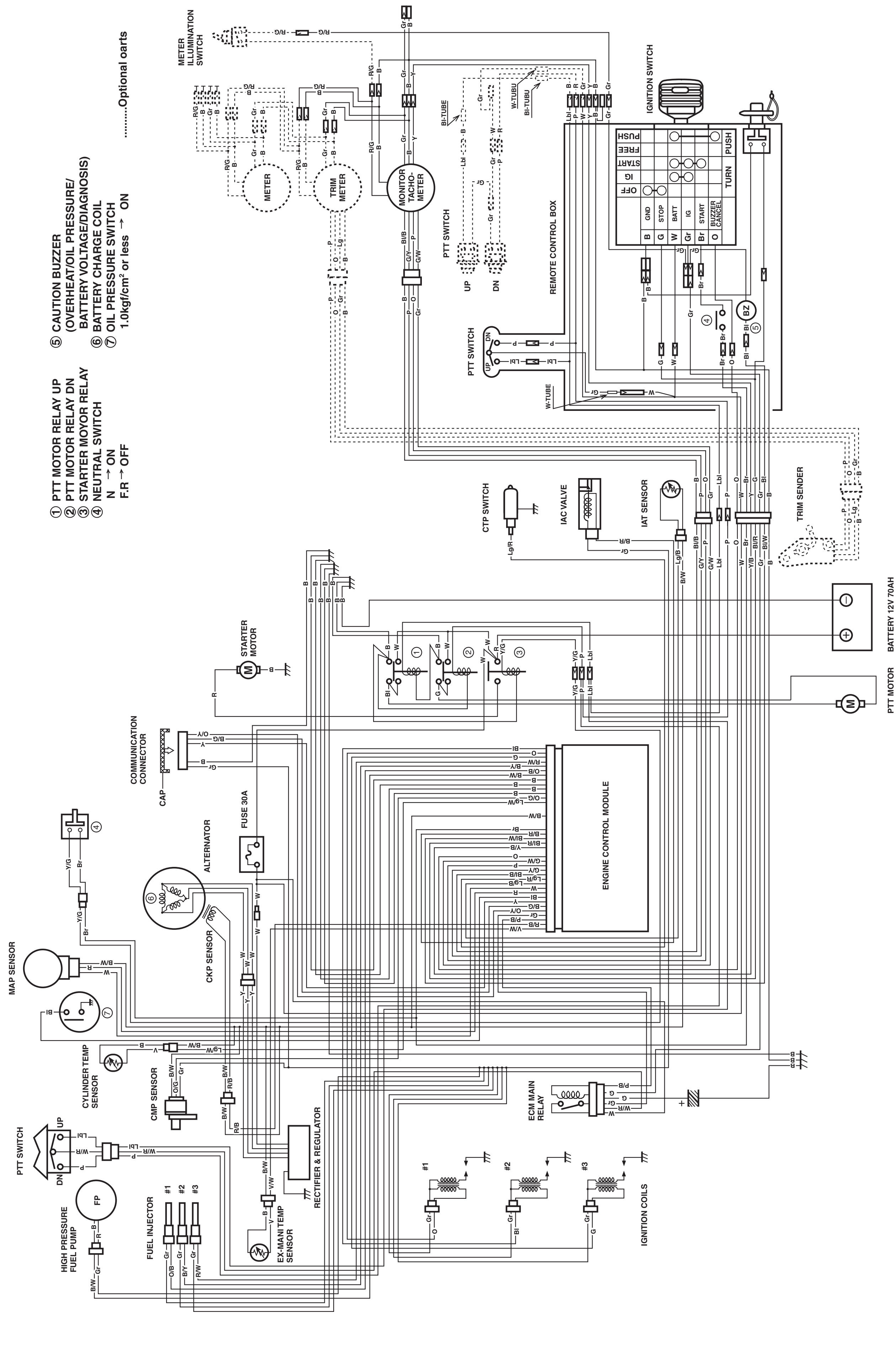
WIRE / HOSE ROUTING

WIRING DIAGRAM

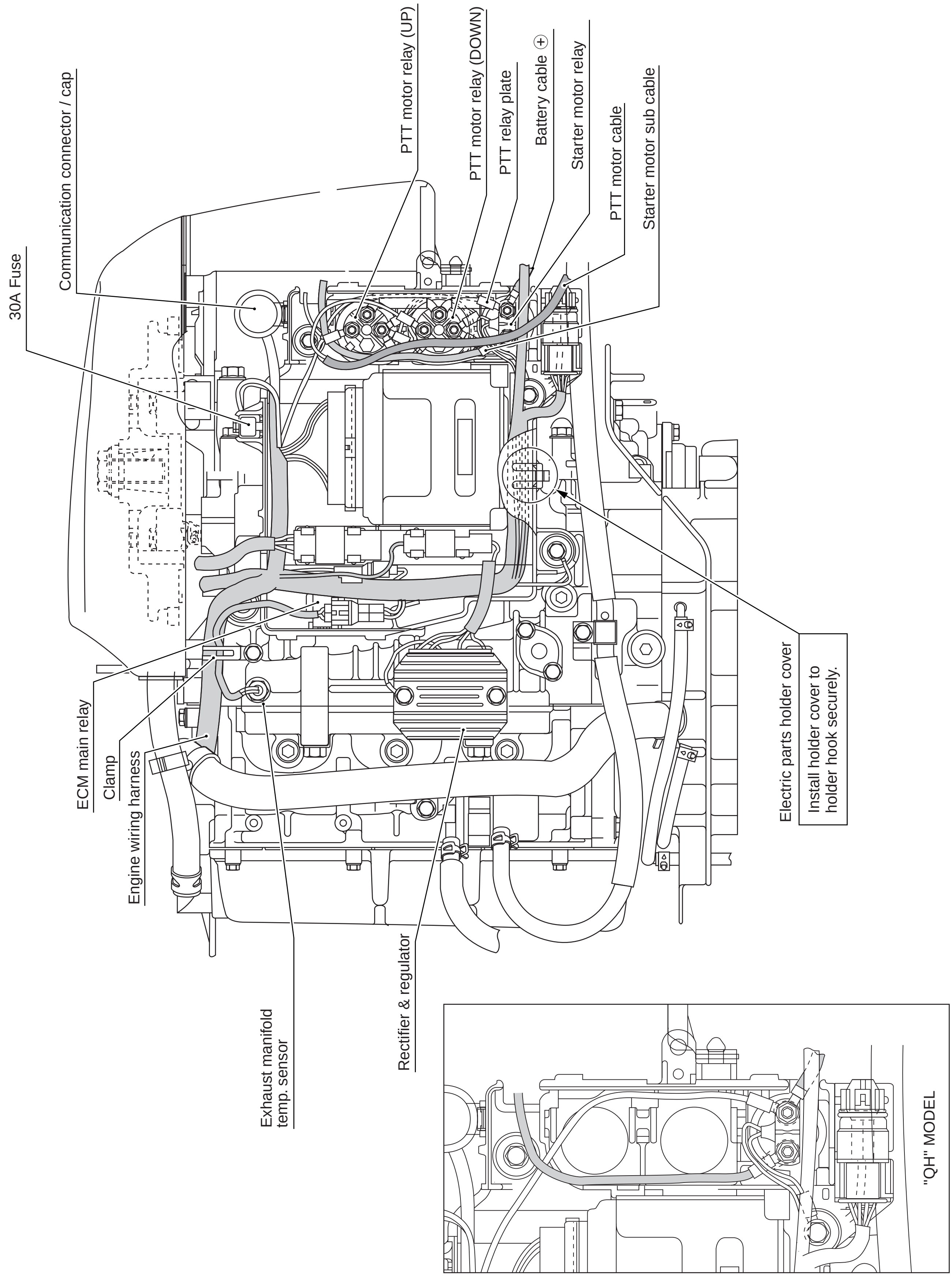
DF40QH / DF50QH / DF50WQH

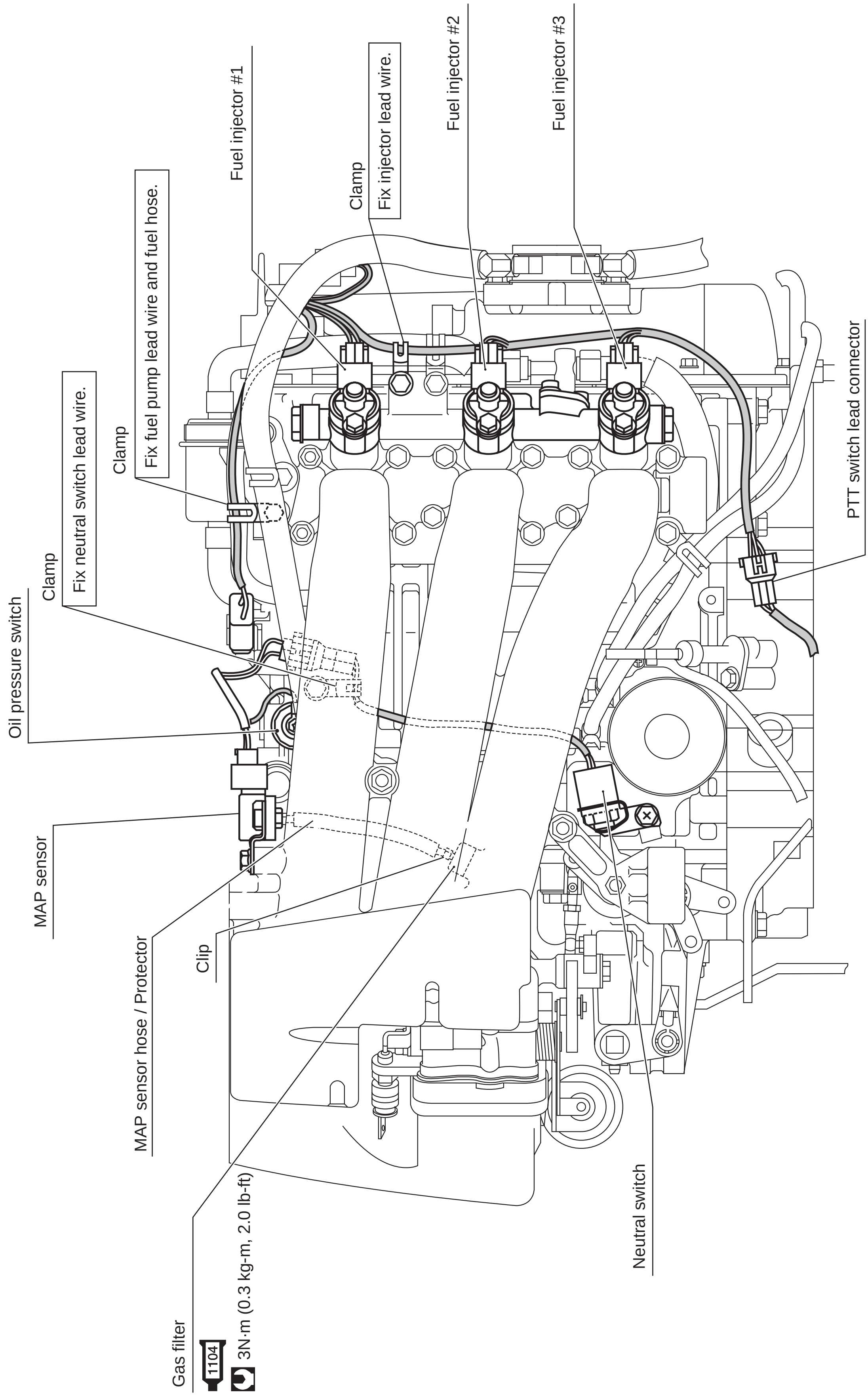


DF40T / DF50T / DF50WT

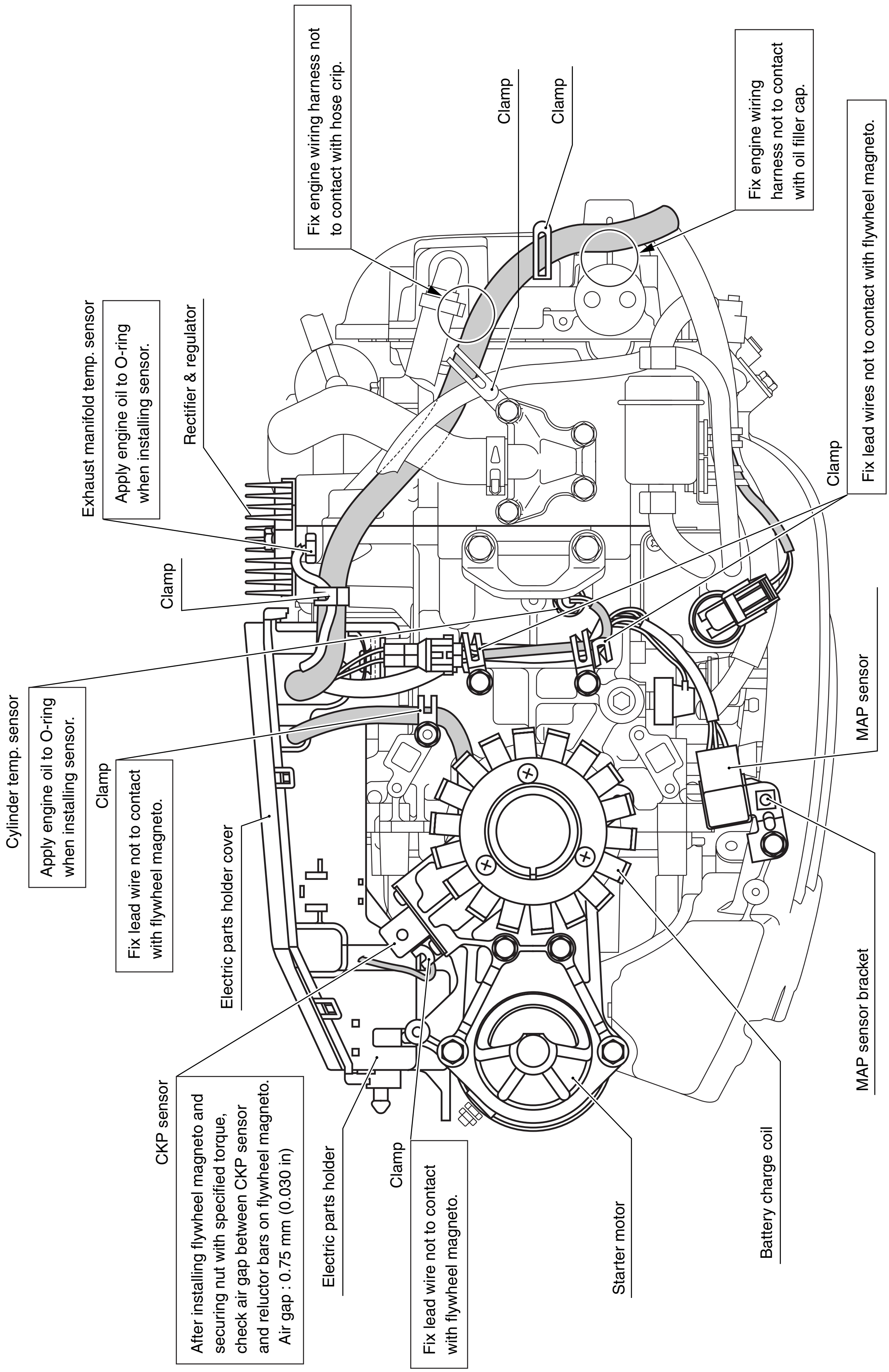


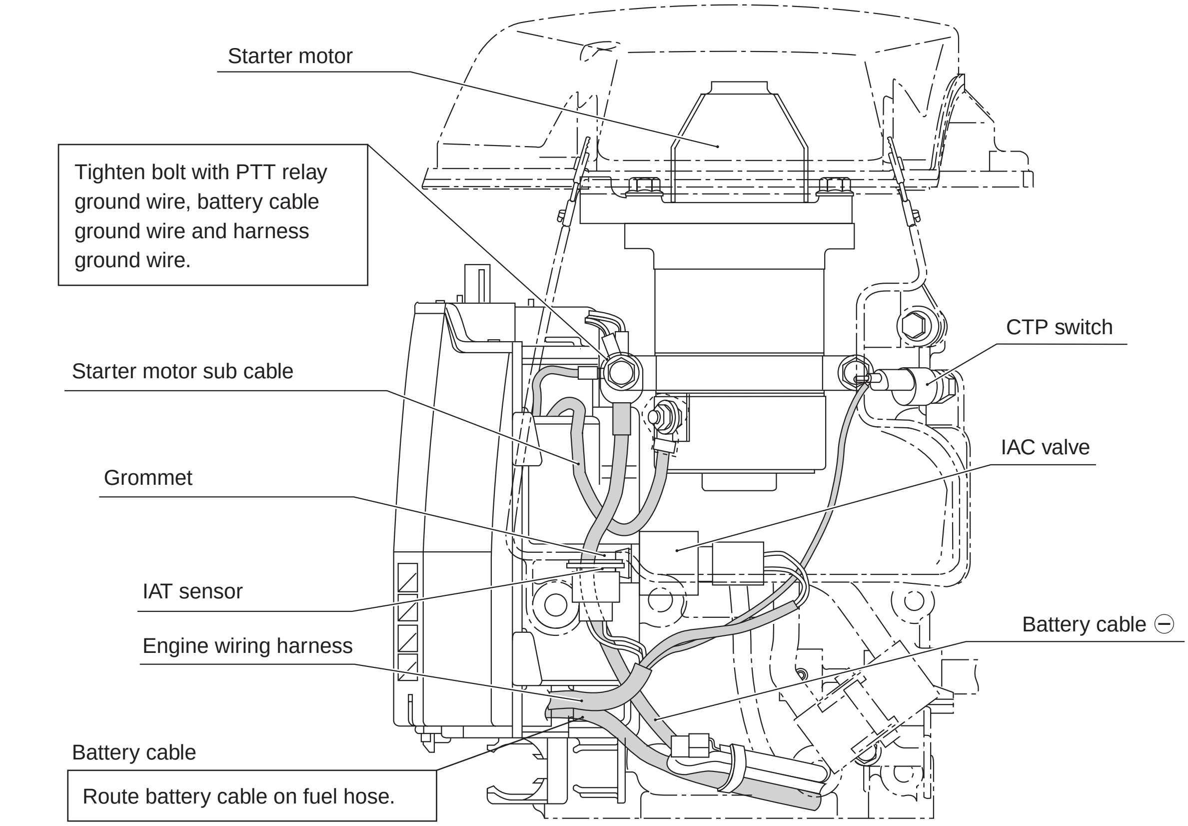
WIRE ROUTING

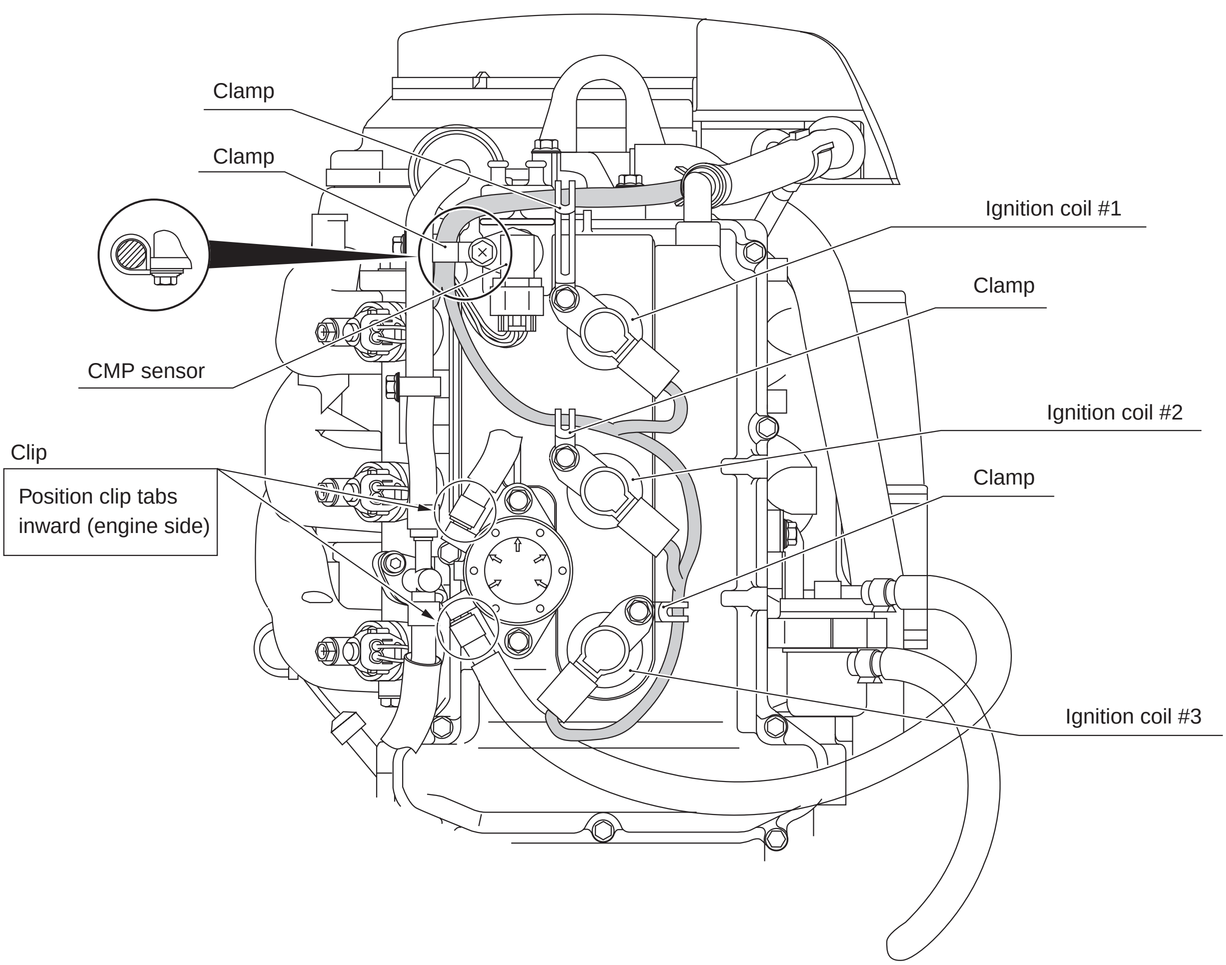


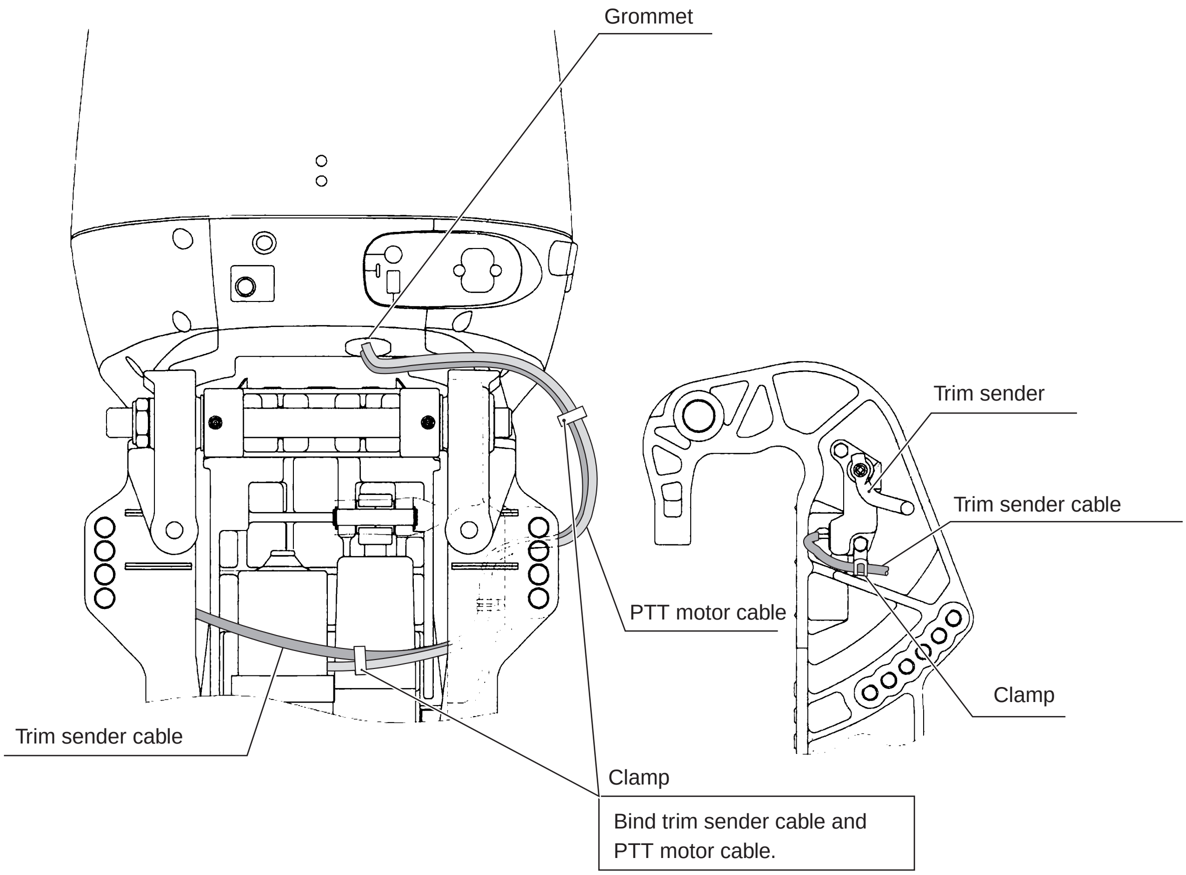


Fuel injector #1
Clamp
Fix injector lead wire.
Fuel injector #2
Fuel injector #3
Fix fuel pump lead wire and fuel hose.
Clamp
Fix neutral switch lead wire.
Clamp
Oil pressure switch
MAP sensor
MAP sensor hose / Protector
Clip
PTT switch lead connector
Neutral switch
Gas filter
1104
3N·m (0.3 kg-m, 2.0 lb-ft)


Fix engine wiring harness not to contact with hose crip.
Clamp
Clamp
Fix engine wiring harness not to contact with oil filler cap.
Fix lead wires not to contact with flywheel magneto.
Clamp
Exhaust manifold temp. sensor
Apply engine oil to O-ring when installing sensor.
Rectifier & regulator
Clamp
Cylinder temp. sensor
Apply engine oil to O-ring when installing sensor.
Clamp
Fix lead wire not to contact with flywheel magneto.
Electric parts holder cover
MAP sensor
MAP sensor bracket
CKP sensor
After installing flywheel magneto and securing nut with specified torque, check air gap between CKP sensor and reluctor bars on flywheel magneto.
Air gap : 0.75 mm (0.030 in)
Electric parts holder
Clamp
Fix lead wire not to contact with flywheel magneto.
Starter motor
Battery charge coil


Starter motor
Tighten bolt with PTT relay ground wire, battery cable ground wire and harness ground wire.
Starter motor sub cable
Grommet
IAT sensor
Engine wiring harness
Battery cable
Route battery cable on fuel hose.
CTP switch
IAC valve
Battery cable ⊖


Clamp
Clamp
CMP sensor
Clip
Position clip tabs inward (engine side)
Ignition coil #1
Clamp
Ignition coil #2
Clamp
Ignition coil #3


Grommet
Trim sender
Trim sender cable
PTT motor cable
Clamp
Trim sender cable
Clamp
Bind trim sender cable and
PTT motor cable.

Prepared by

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