SUZUKI OUTBOARD MOTOR

DF90/100/115 DF140 FOUR STROKE

SERVICE MANUAL

99500-90J07-03E

FOREWORD

This manual contains an introductory description on SUZUKI Outboard motor DF90/115/140 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 mechanics 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.

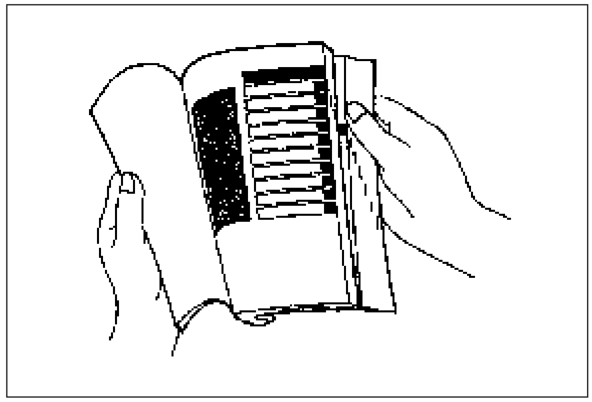
NOTE:
This manual is compiled based on 2001 (K1) model.

GROUP INDEX

HOW TO USE THIS MANUAL

TO LOCATE WHAT YOU ARE LOOKING FOR :

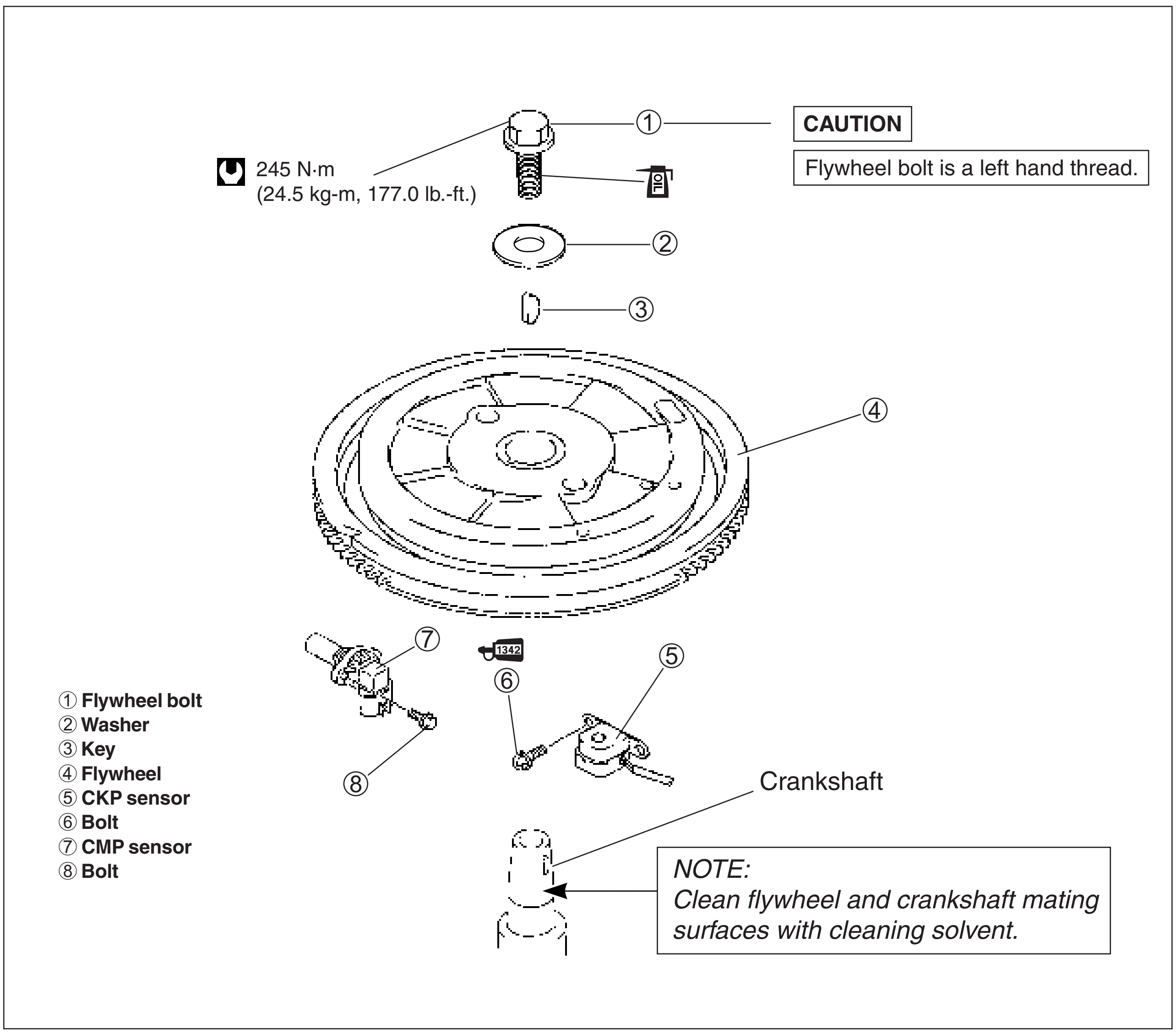
1. The text of this manual is divided into sections.
2. The section titles are listed on the previous page in a GROUP INDEX. Select the section needed for reference.
3. Holding the manual as shown at the right will allow you to find the first page of the section easily.
4. The first page of each section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



COMPONENT PARTS AND IMPORTANT ITEM ILLUSTRATIONS

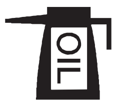
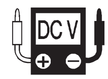
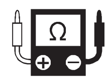
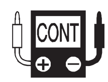
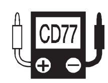
Under the name of each system or unit, an exploded view is provided with work instructions and other service information such as the tightening torque, lubrication and locking agent points.

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.		Apply SUZUKI MOLY PASTE.

GENERAL INFORMATION

1

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.**

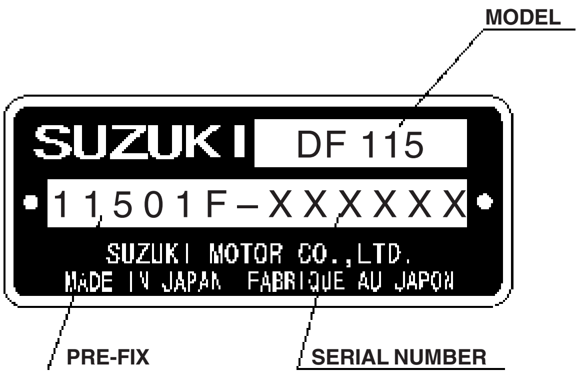
- **To protect the environment, do not unlawfully dispose of used motor oil, other fluids, and batteries.**
- **To protect the Earth's natural resources, properly dispose of used motor parts.**

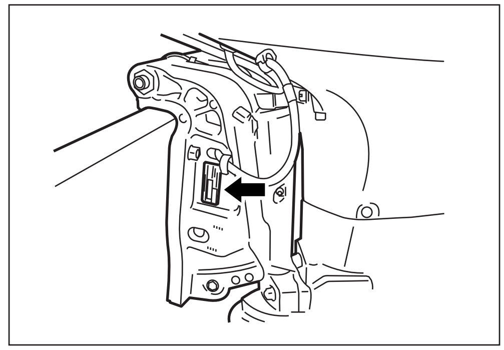
IDENTIFICATION NUMBER LOCATION

MODEL, PRE-FIX, SERIAL NUMBER

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

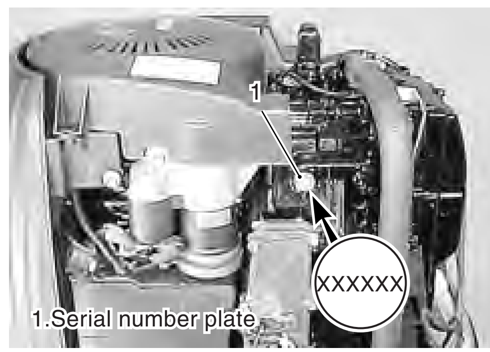
Example





ENGINE SERIAL NUMBER

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



1.Serial number plate

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

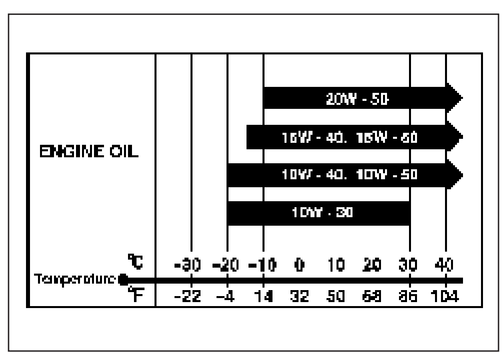
If leaded gasoline is used, engine damage may result. Use only unleaded gasoline.

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 planing.

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 DF90T/115T models are shown below.

Recommended full throttle speed range	**DF90T**	**4500 – 5500 r/min.**
	DF115T	**5000 – 6000 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	×	14	×	17	(X1700)
3	×	14	×	19	(X1900)
3	×	14	×	21	(X2100)
3	×	14	×	23	(X2300)

CAUTION

Installing a propeller with pitch either too high or too low will cause incorrect maximum engine speed, which may result in severe damage to the motor.

POWERHEAD DIRECTION OF ROTATION

This outboard motor is designed with a L.H. (left hand) rotation powerhead utilizing an offset crankshaft.
This design has the advantage of reducing the size of the motor and keeping the overall motor's weight closer to the boat transom and therefore closer to the boat C/G (center of gravity).

Rotation of the driveshaft is accomplished through a crankshaft drive gear and a driveshaft driven gear.
These gears are located beneath the powerhead in the same oil bath location as the camshaft chain.

As the rotational direction of the driven gear will be opposite of the drive gear, a left-hand rotation powerhead design was adopted to retain a conventional, standard rotation (right-hand) propeller shaft output.

*SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115T
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115T
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	UL	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	UL	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	UL	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115T
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6E
Ignition system		Full-transistorized ignition
Fuel supply system		Multi-point sequential electronic fuel injection
Exhaust system		Through prop exhaust
Cooling system		Water cooled
Lubrication system		Wet sump by trochoid pump
Starting system		Electric
Throttle control		Remote control

Item	Unit	Data	
		DF90T	DF115T

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)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)	
Gearcase oil amounts	ml (US/Imp. oz)	1050 (35.5 / 37.0)	

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.08)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	3 × 14 × 17 3 × 14 × 19 3 × 14 × 21 3 × 14 × 23

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.24)
2nd reduction gear ratio (Lower unit gear)	12 : 25 (2.08)
Total reduction gear ratio	$2.59\left(\frac{36}{29} \times \frac{25}{12}\right)$

*SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data	
		DF90T	DF115T

POWERHEAD

Item	Unit	DF90T	DF115T
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	
**Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
**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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF90T	DF115T

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)	37.320 – 37.480 (1.4693 – 1.4756)	39.220 – 39.380 (1.5441 – 1.5504)
		Limit	mm (in)	37.220 (1.4654)	39.120 (1.5402)
	EX	STD	mm (in)	37.030 – 37.190 (1.4579 – 1.4642)	39.040 – 39.200 (1.5370 – 1.5433)
		Limit	mm (in)	36.930 (1.4539)	38.940 (1.5330)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data DF90T	Data DF115T

VALVE / VALVE GUIDE

Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		——	15°, 45°, 60°
	EX		——	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN,EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit	mm (in)	0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit	mm (in)	41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF90T	DF115T

CYLINDER / PISTON / PISTON RING

Item			Unit	
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end.
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data DF90T	Data DF115T

CRANKSHAFT / CONROD

Item		Unit	DF90T / DF115T
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T

ELECTRICAL

Item		Unit	DF90T	DF115T
Ignition timing		Degrees	BTDC 1° – BTDC 44°	BTDC 3° – BTDC 44°
Over revolution limiter		r/min	6500	
CKP sensor resistance		Ω at 20°C	168 – 252	
CMP sensor resistance		Ω at 20°C	——	
Ignition coil resistance	Primary	Ω at 20°C	1.9 – 2.5	
	Secondary	kΩ at 20°C	No.2–No.3 : 18–34 (including H.T.cord and spark plug cap) No.1–No.4 : 19–36 (including H.T.cord and spark plug cap)	
High tension cord resistance		kΩ/m at 20°C	Approx.16	
Battery charge coil resistance		Ω at 20°C	0.16 – 0.24	
Battery charge coil output (12V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse : 60 Sub fuse : 30	
Recommended battery capacity (12V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25°C	1.8 – 2.3	
ECM main relay resistance		Ω at 20°C	80 – 120	
Starter relay coil resistance		Ω at 20°C	80 – 120	
PTT motor relay coil resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

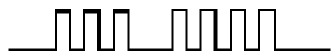
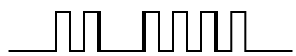
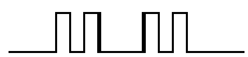
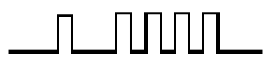
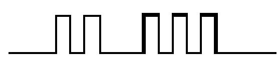
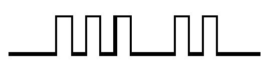
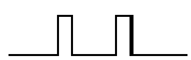
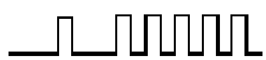
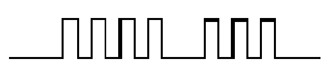
Item		Unit	Data
Max. continuous time of use		Sec	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

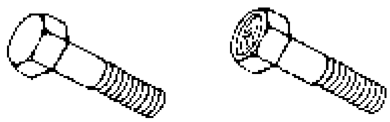
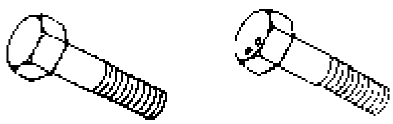
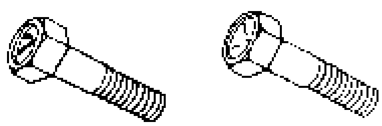
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

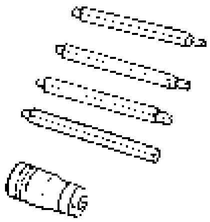
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	23	2.3	16.5
		10 mm	70	7.0	50.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	56	5.6	40.5
Conrod cap nut		8 mm	35	3.5	25.5
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	56.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Fuel delivery pipe bolt		8 mm	23	2.3	16.5
Fuel delivery pipe plug / union bolt	Upper	12 mm	35	3.5	25.5
	Lower	12 mm	35	3.5	25.5
Fuel return pipe bolt		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	85	8.5	61.5
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt / nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	20	2.0	14.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	20	2.0	14.5
Pinion nut		14 mm	100	10.0	72.5
Propeller nut		18 mm	55	5.5	40.0

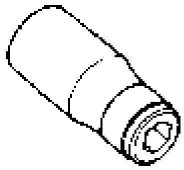
Tightening torque – general bolt

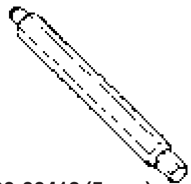
NOTE:
These values are only applicable when torque for a general bolt is not listed in the “Important Fasteners” table.

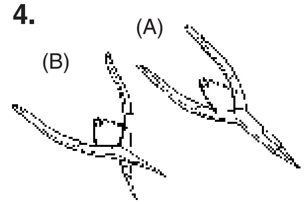
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb-ft
 **(Conventional or “4” marked bolt)**	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
	10 mm	22 – 35	2.3 – 3.5	16.0 – 25.5
 **(Stainless steel bolt)**	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0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

SPECIAL TOOLS

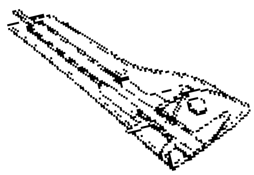
1.

09900-00410
Hexagon wrench set

2.

09900-00411
Hexagon socket
(included in 09900-00410)

3.

09900-00413 (5 mm)
09900-00414 (6 mm)
Hexagon bit
(included in 09900-00410)

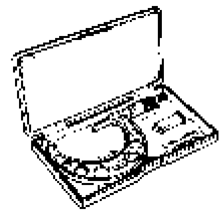
4.


(A) 09900-06107
(B) 09900-06108
Snap ring pliers

5.

09900-20101 (150 mm)
09900-20102 (200 mm)
Vernier calipers

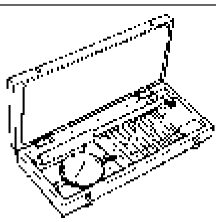
6.

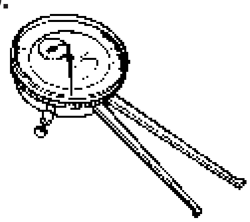
09900-20202
Micrometer (25 – 50 mm)

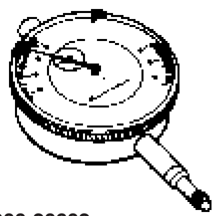
7.

09900-20203 (50 – 75 mm)
09900-20204 (75 – 100 mm)
Micrometer

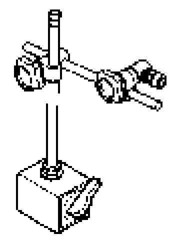
8.

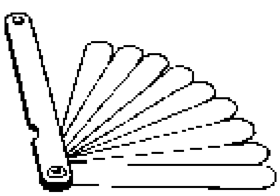
09900-20205
Micrometer (0 – 25 mm)

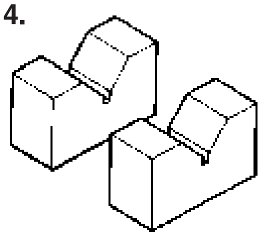
9.

09900-20530
Cylinder gauge set

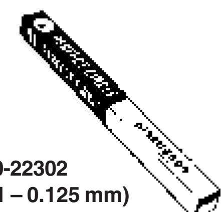
10.

09900-20605
Dial calipers (10 – 34 mm)

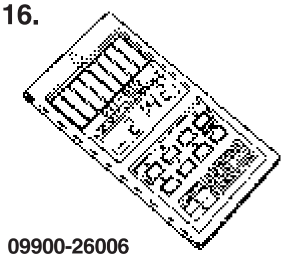
11.

09900-20602
Dial gauge

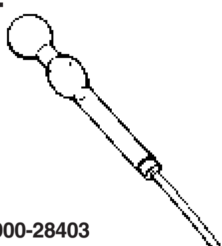
12.

09900-20701
Magnetic stand

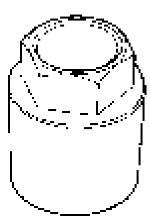
13.

09900-20803
Thickness gauge

14.

09900-21304
Steel "V" block set

15.

09900-22302
(0.051 – 0.125 mm)
09900-22301
(0.025 – 0.076 mm)
Plastigauge

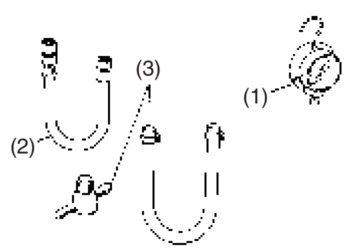
16.

09900-26006
Engine tachometer

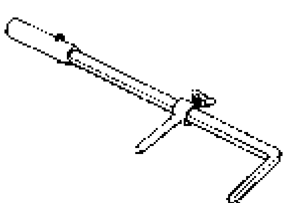
17.

09900-28403
Hydrometer

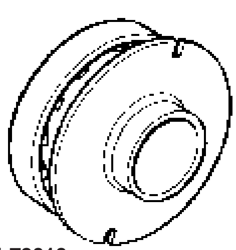
18.

09911-49910
Crankshaft holder

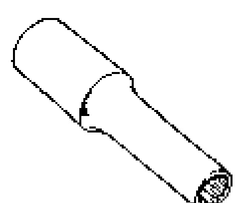
19.
09912-58413
Fuel pressure gauge set

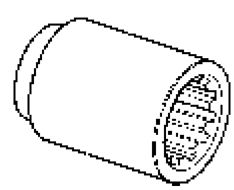
(1) 09912-58442
Fuel pressure gauge
(2) 09912-58432
Fuel pressure hose
(3) 09912-58490
3-way joint & hose

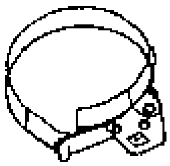
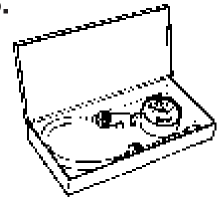
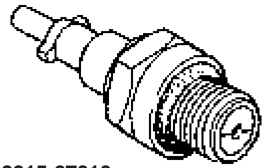
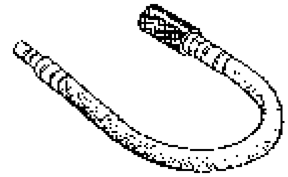
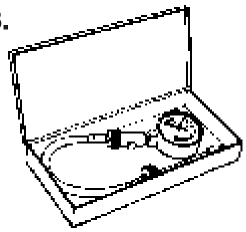
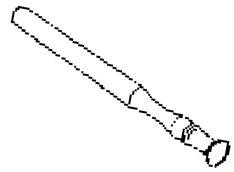
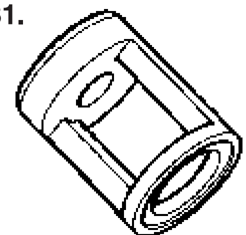
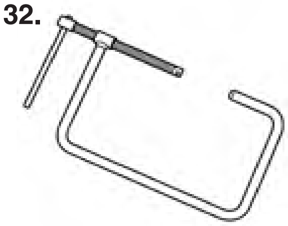
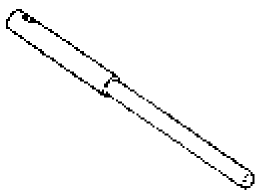
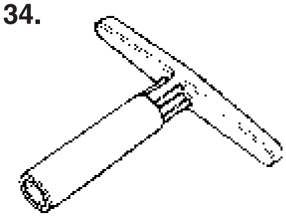
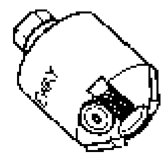
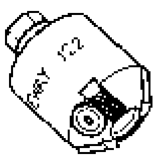
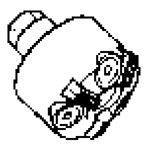
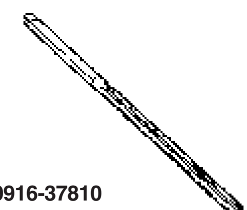
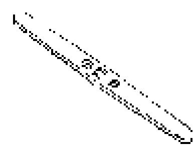
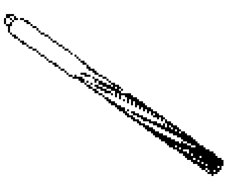
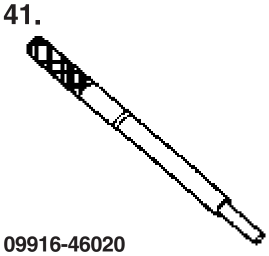
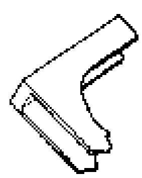
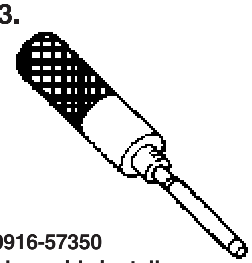
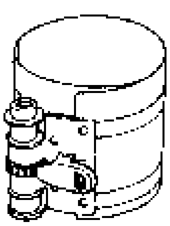
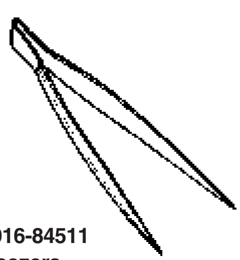
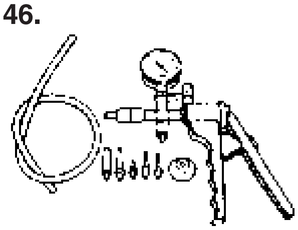
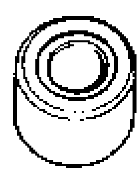


20.

09913-50121
Oil seal remover

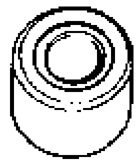
21.

09914-79010
Test wheel

22.

09919-16010
Deep socket wrench

23.

09921-29410
Driveshaft holder

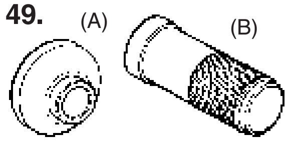
24.  09915-47332 Oil filter wrench	25.  09915-64512 Compression gauge	26.  09915-67010 Compression gauge hose attachment	27.  09915-64530 Compression gauge hose
28.  09915-77311 Oil pressure gauge	29.  09915-78211 Oil pressure gauge adapter	30.  09916-10911 Valve lapper	31.  09916-14910 Valve lifter attachment
32.  09916-19030 Valve lifter	33.  Solid pilot (Neway. N-120-6.0)	34.  09916-54910 Handle (N-505)	35.  09916-22420 Valve seat cutter (60°) (Neway 114)
36.  09916-20620 Valve seat cutter (45°) (Neway 122)	37.  09916-20610 Valve seat cutter (15°) (Neway 121)	38.  09916-37810 Valve guide reamer (ϕ 6 mm)	39.  09916-34542 Valve guide reamer handle
40.  09916-38210 Valve guide reamer (ϕ 11 mm)	41.  09916-46020 Valve guide remover	42.  09916-49040 Tappet holder	43.  09916-57350 Valve guide installer
44.  09916-77310 Piston ring compressor	45.  09916-84511 Tweezers	46.  09917-47011 Vacuum pump gauge	47.  09917-87810 Valve guide installer attachment

48.



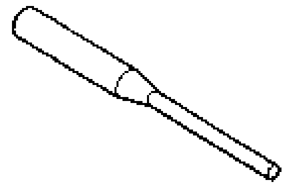
09917-98221
Valve guide stem seal installer attachment

49.



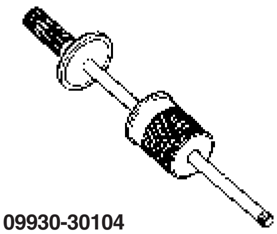
(A) 09922-59410
Propeller shaft housing installer
(B) 09922-59420
Housing installer handle

50.



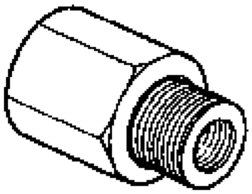
09922-89810
Shift lock pin remover

51.



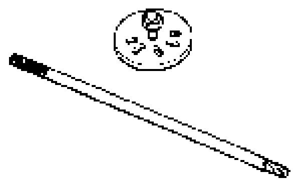
09930-30104
Sliding hammer

52.



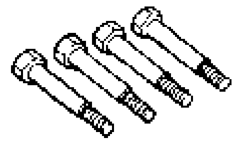
09930-30161
Propeller shaft remover

53.



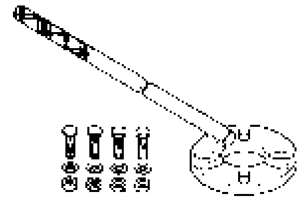
09930-39411
Flywheel rotor remover

54.



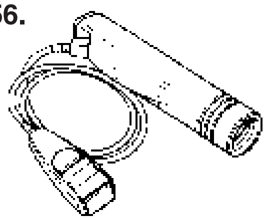
09930-39420
Rotor remover bolt

55.



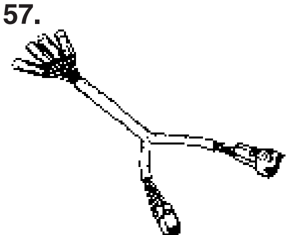
09930-48720
Flywheel holder

56.



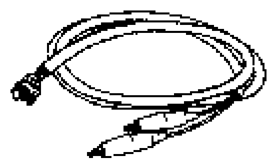
09930-76420
Timing light

57.



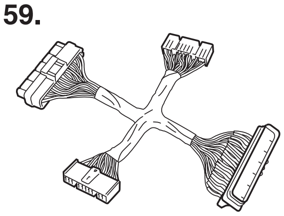
09930-89240
4-pin connector test cord

58.



09930-89260
Injector test cord A

59.

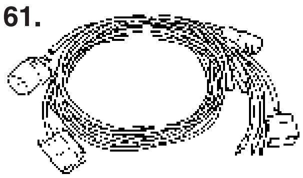


09930-89950
44-pin test cord

60.

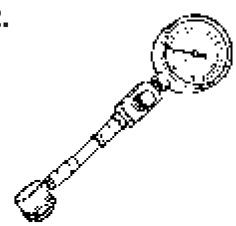
09930-99320
Digital tester

61.



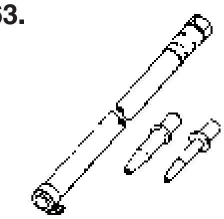
09932-79910
Diagnostic harness
09932-89910
SDS adapter

62.



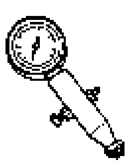
09940-44121
Air pressure gauge

63.



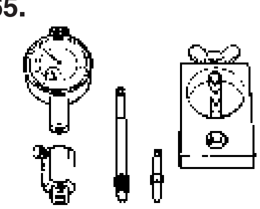
09940-44130
Attachment

64.



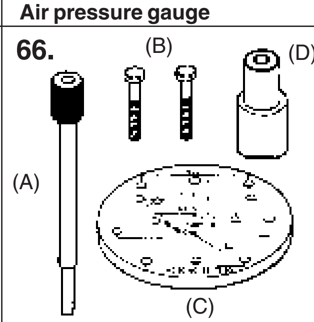
09950-69512
Gearcase oil leakage tester

65.



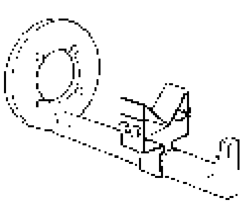
09951-09530
Gear adjusting gauge

66.



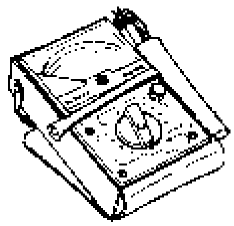
(A) 09951-59910
Pinion bearing installer & remover shaft
(B) 01500-08403
Bolt
(C) 09951-39914
Pinion bearing plate
(D) 09951-19421
Attachment

67.



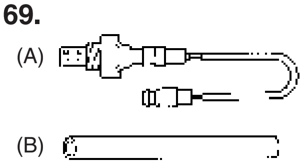
09951-09010
Shimming gauge

68.



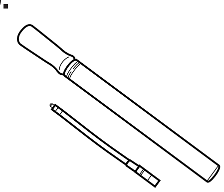
09900-25010
Pocket tester

69.

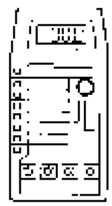
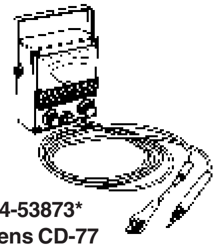
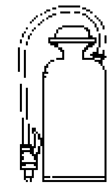


(A) 18213-74F00
O_2 sensor
(B) 18498-90J20
Protector

70.

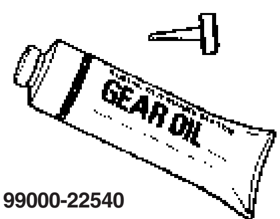
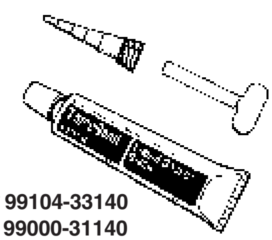
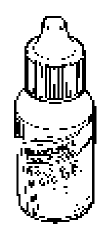


09952-99310
Air pump assy

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  99000-22540 (400 ml × 24 pcs.)	**SUZUKI SUPER GREASE "A"**  *99000-25030 99000-25011 (500 g)	**WATER RESISTANT GREASE**  99000-25161 (250 g)	**SUZUKI SILICONE SEAL**  99000-31120 (50 g)
	SUZUKI BOND "1207B"  * 99104-33140 99000-31140 (100 g)	**THREAD LOCK "1342"**  99000-32050 (50 g)	**THREAD LOCK SUPER "1333B"**  99000-32020 (50 g)
4-Stroke Motor Oil API : SE, SF, SG, SH, SJ SAE : 10W-40			

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

PERIODIC MAINTENANCE

2

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

Item to be serviced / Interval	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 [NOTE]	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

NOTE:
OIL CHANGE REMINDER SYSTEM
• Refer to page 3-32 for function and operation.
• See page 2-5 for reset information.

MAINTENANCE AND TUNE-UP PROCEDURES

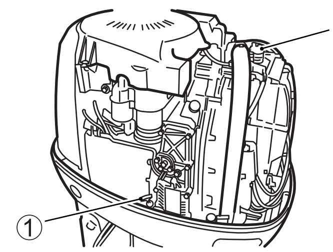
This section describes servicing procedures for each of periodic maintenance requirements.

ENGINE OIL / ENGINE OIL FILTER

ENGINE OIL LEVEL CHECK

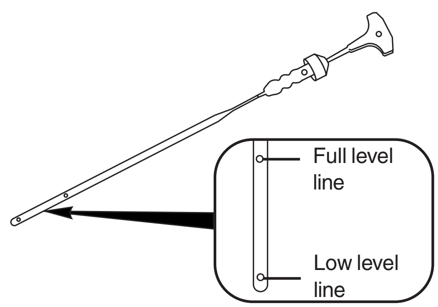
Inspect oil level before every use.

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



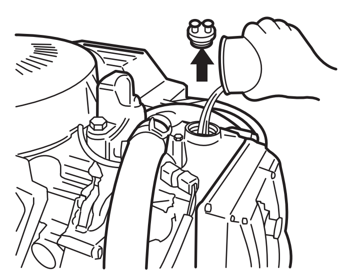
① Oil level dipstick
② Oil filler cap

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



If level is low, add recommended oil to full level hole (Max.).

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



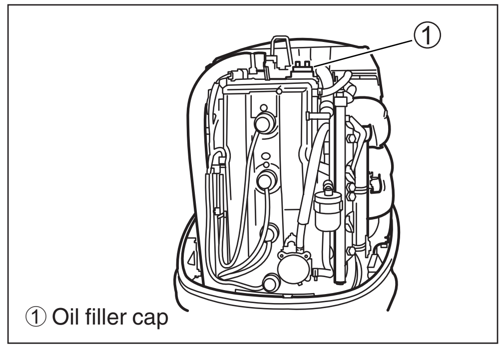
ENGINE OIL CHANGE / ENGINE OIL FILTER REPLACEMENT

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

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

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

1. Place outboard motor upright on a level surface.

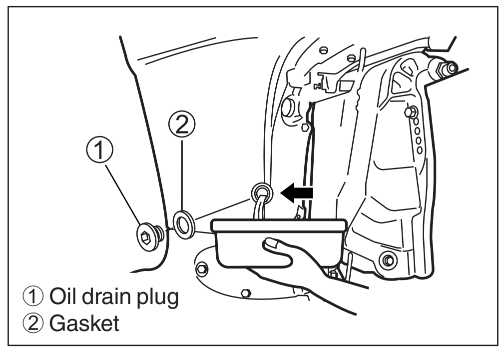


① Oil filler cap

2. Remove oil filler cap.

3. Place a container under engine oil drain plug.

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



① Oil drain plug
② Gasket

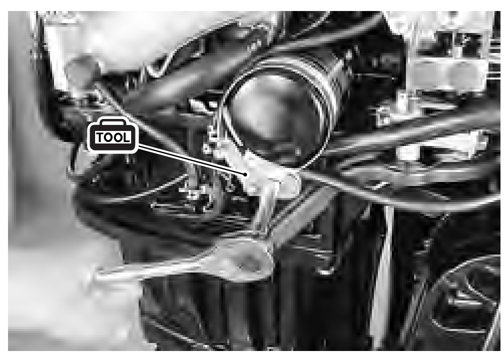
5. ENGINE OIL FILTER REPLACEMENT

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

To replace engine oil filter :

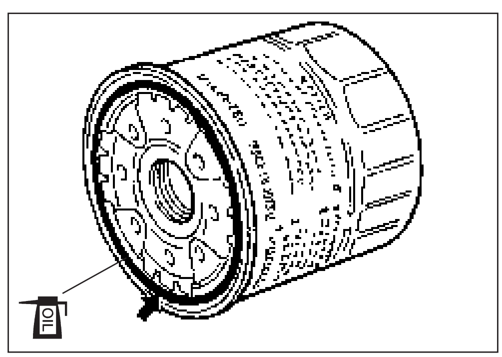
(1) Remove STBD side cover. (See page 7-2)

(2) Using oil filter wrench to loosen the oil filter, then remove filter and O-ring.



TOOL **09915-47332 : Oil filter wrench**

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



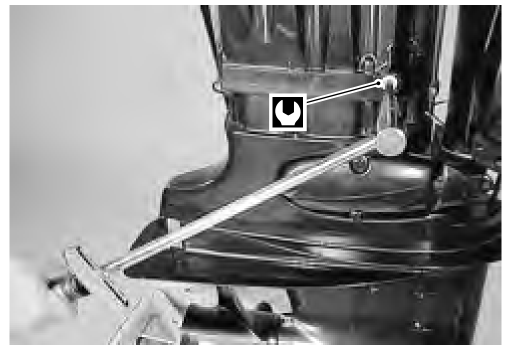
(3) Screw new filter on by hand until filter O-ring contacts the mounting surface.

(4) Tighten filter 3/4 turn from point of contact with 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 STBD side cover.

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

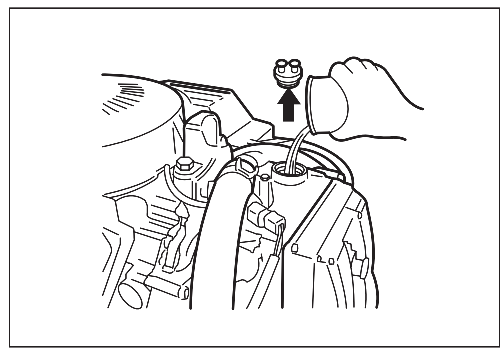


Engine oil drain plug : 13 N·m (1.3 kg-m, 9.5 lb.-ft.)

CAUTION

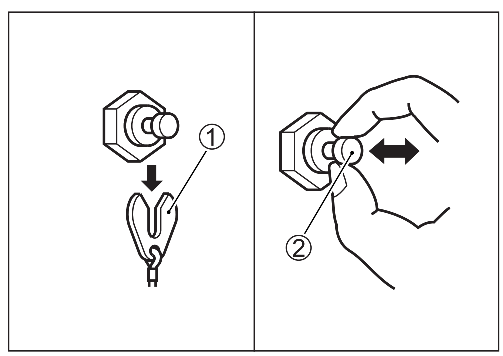
Do not re-use gasket once removed. Always use a new gasket.

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



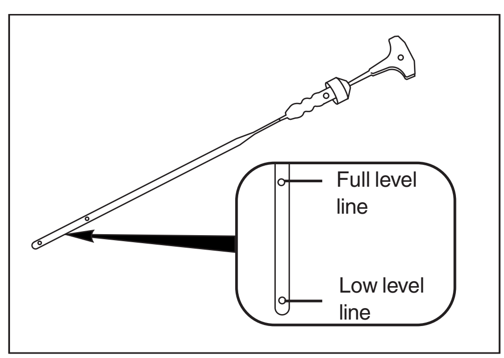
Engine oil amounts
Oil change only : 5.5 L (5.8 / 4.8 US / Imp. qt)
Oil filter change : 5.7 L (6.0 / 5.0 US / Imp. qt)

8. To reset oil change reminder system's operation time to zero (cancellation) ;
   (1) Turn ignition key to "ON" position.
   (2) Pull out emergency stop switch plate ①.
   (3) Pull up emergency stop switch knob ② three times in seven seconds. A short beep will be heard if cancellation is successfully finished.
   (4) Turn ignition key to "OFF" position, then set emergency stop switch plate ① in original position.



NOTE:
See "OIL CHANGE REMINDER SYSTEM" section on page 3-32.

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



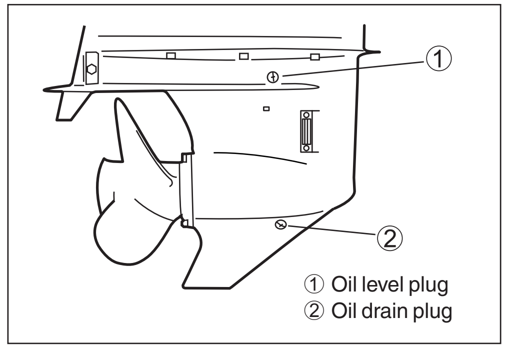
GEAR OIL

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

1. Place outboard motor upright on a level surface.

2. Place a container under lower unit.

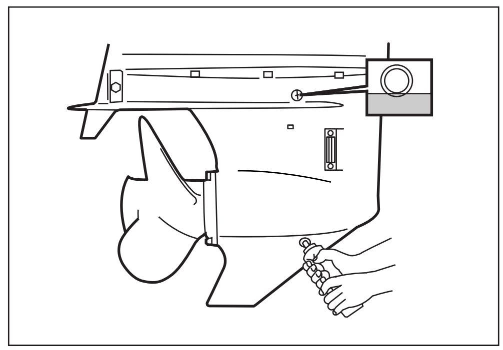
3. Remove lower gear oil drain plug before gear oil level plug and drain gear oil.



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

   Gear oil amounts : 1050 ml (35.5 / 37.0 US / Imp. oz)

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



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

6. Install oil drain plug.

CAUTION

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

NOTE:

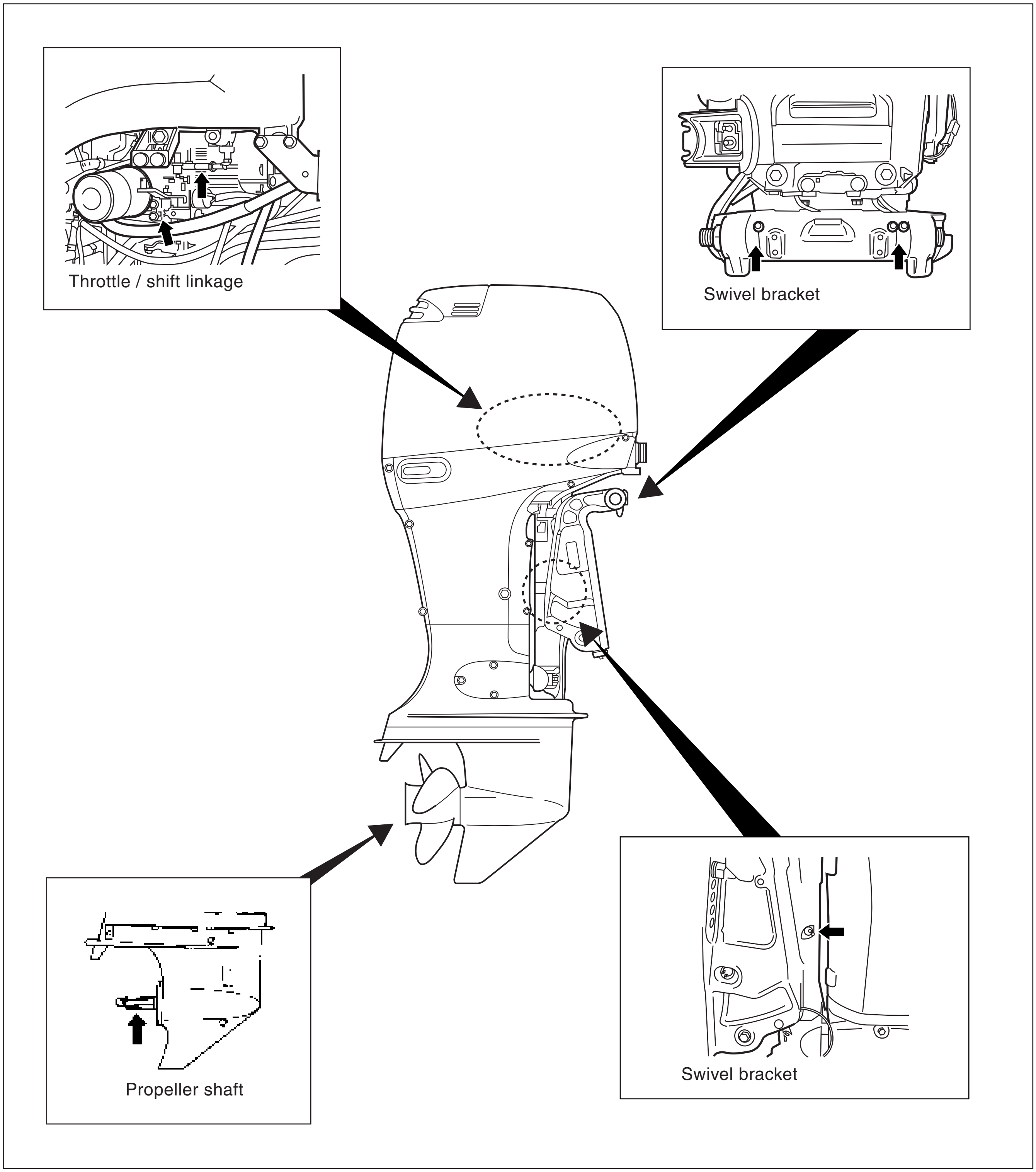
To avoid insufficient injection of gear oil, check gear oil level 10 minutes after doing procedure in step 6. If oil level is low, slowly inject gear oil up to the correct level.

LUBRICATION

Inspect every 50 hours (3 months).

Apply Suzuki Water Resistant Grease to the following points.

W/R G's **99000-25161 : Water Resistant Grease**



SPARK PLUG

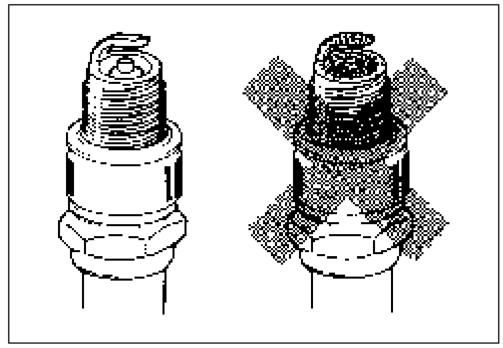
- **Inspect every 100 hours (6 months).**
- **Replace every 200 hours (12 months).**

Standard spark plug : NGK BKR6E

CAUTION

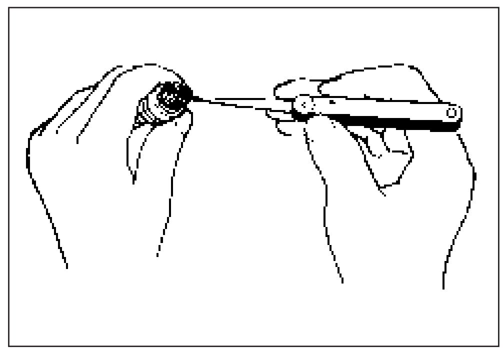
Only resistor (R) type spark plugs must be used with this engine. Using a non-resistor spark plug will cause ignition and fuel injection system malfunctions.

CARBON DEPOSIT



Inspect for a carbon deposit on 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

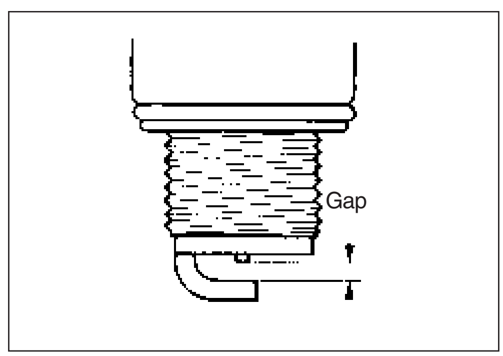


Using thickness gauge, measure for spark plug gap.
Adjust to within specified range if gap is out of specification.

Spark plug gap : 0.7 – 0.8 mm (0.028 – 0.031 in.)

TOOL **09900-20803 : Thickness gauge**

CONDITION OF ELECTRODE

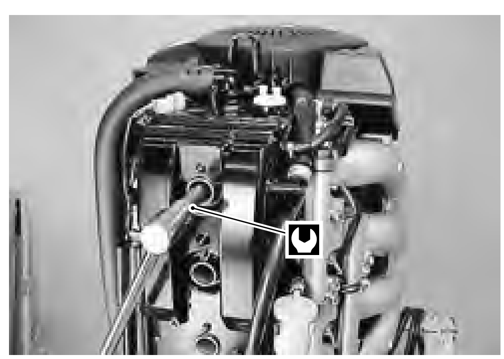


Inspect electrode for a worn or burnt condition.
If it is extremely worn or burnt, replace spark plug.
Also, be sure to replace spark plug if it has a broken insulator, damaged thread, etc.

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 : 28 N·m (2.8 kg-m, 20.0 lb.-ft.)

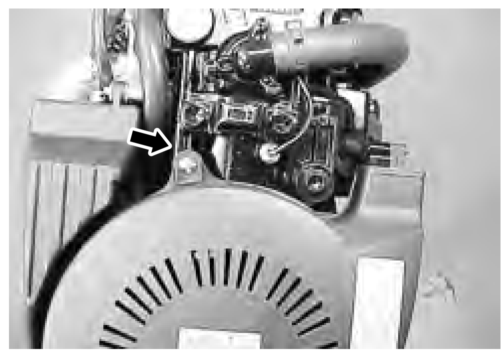


TAPPET CLEARANCE

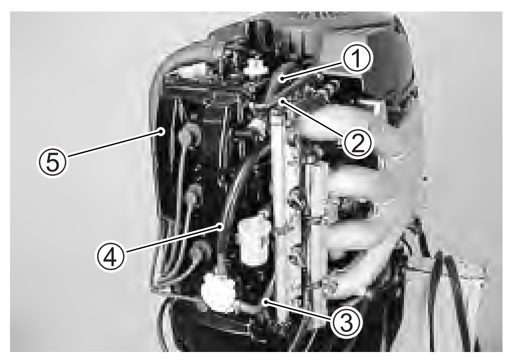
Inspect initially after 20 hours (1 month) and every 200 hours (12 months).

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 should be checked and adjusted :
- at time of periodic inspection
- when valve mechanism is serviced
- when camshafts are disturbed by removing them for inspection

CHECKING AND ADJUSTING TAPPET CLEARANCE

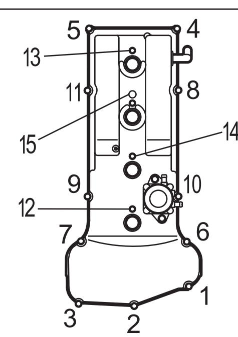


1. Remove following parts :
   - Engine side covers (see page 7-2)
   - Flywheel cover
   - Spark plugs



2. Remove breather hose ① and evaporation hose ② from cylinder head cover.

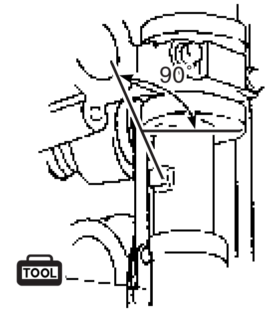
3. Remove fuel hose ③ and ④ from low pressure fuel pump.



Loosening order

4. Remove fifteen (15) bolts securing cylinder head cover ⑤ to cylinder head and remove cylinder head cover.

5. Rotate crankshaft counterclockwise 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. : 0.23 – 0.27 mm (0.009 – 0.011 in.)
EX. : 0.23 – 0.27 mm (0.009 – 0.011 in.)

TOOL **09900-20803 : Thickness gauge**

CAUTION

This is a left hand (LH) rotation powerhead. Rotate crankshaft counterclockwise to prevent water pump impeller damage.

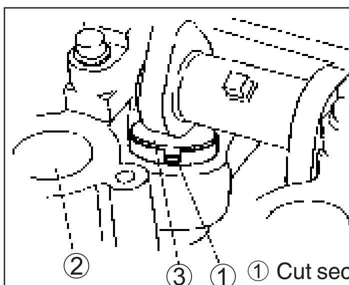
NOTE:
- *Rotate crankshaft and measure clearance for each tappet respectively by bringing cam nose vertical to shim surface.*
- *All tappet clearances can be measured during two turns of crankshaft.*

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

ADJUSTMENT

Tappet clearances are adjusted by replacing tappet shim.

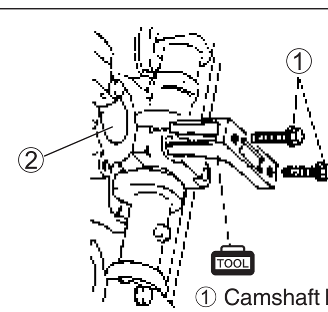
1. Close valve and turn tappet cut-away toward inside as shown in figure.



① Cut section of tappet
② Plug hole
③ Shim

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

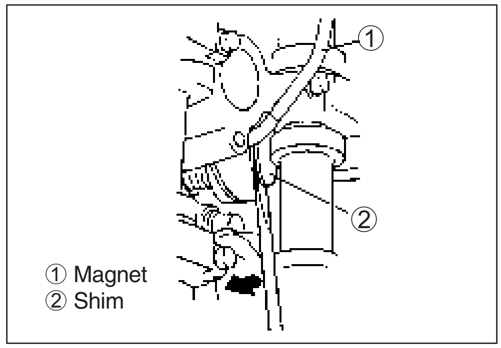
3. Install special tool with camshaft housing bolts as shown in figure.



① Camshaft housing bolt
② Plug hole

TOOL **09916-49040 : Tappet holder**

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)

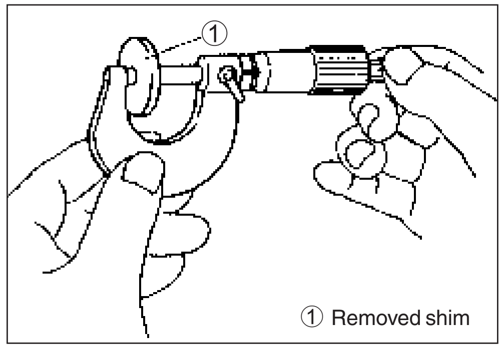


① Magnet
② Shim

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 should 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 following formula.



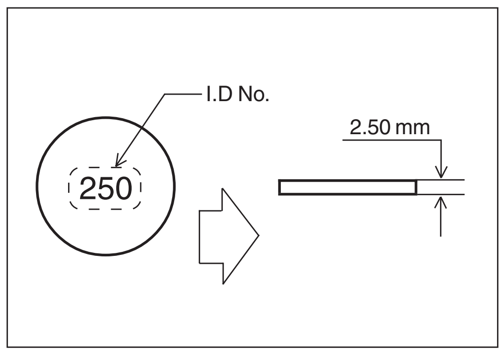
① Removed shim

TOOL **09900-20205 : Micrometer**

A = B + (C – 0.25 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	248	2.48	278	2.78
220	2.20	250	2.50	280	2.80
223	2.23	253	2.53	283	2.83
225	2.25	255	2.55	285	2.85
228	2.28	258	2.58	288	2.88
230	2.30	260	2.60	290	2.90
233	2.33	263	2.63	293	2.93
235	2.35	265	2.65	295	2.95
238	2.38	268	2.68	298	2.98
240	2.40	270	2.70	300	3.00
243	2.43	273	2.73		
245	2.45	275	2.75		



6. Install shim. Identification number should face towards tappet.

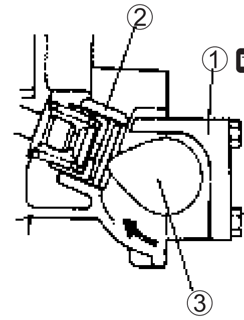
7. Rotate crankshaft to be open (lift up) valve.

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

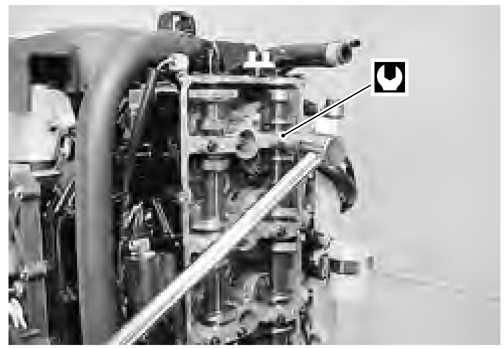
Camshaft housing bolt :
11 N·m (1.1 kg-m, 8.0 lb.-ft.)

9. Recheck tappet clearance.

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



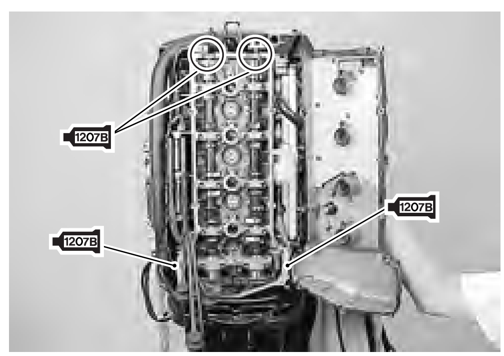
① Special tool
② Tappet
③ Camshaft

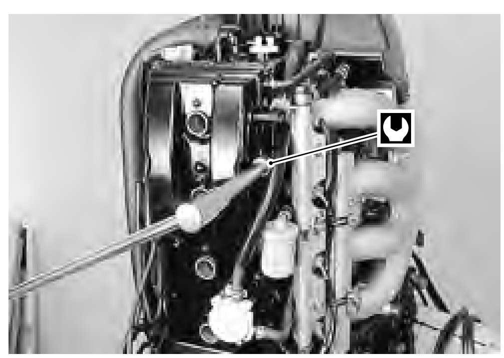


INSTALLATION

After checking and adjusting all tappet clearances, install cylinder head cover. Installation is reverse order of removal.
(See page 6-10)

Cylinder head cover bolts :
11 N·m (1.1 kg-m, 7.0 lb.-ft.)





TAPPET SHIM SELECTION CHART

Shim I.D. No.	218	220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300
Present shim size (mm) / Tappet clearance (mm)	2.18	2.20	2.23	2.25	2.28	2.30	2.33	2.35	2.38	2.40	2.43	2.45	2.48	2.50	2.53	2.55	2.58	2.60	2.63	2.65	2.68	2.70	2.73	2.75	2.78	2.80	2.83	2.85	2.88	2.90	2.93	2.95	2.98	3.00
0.00 – 0.04											220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278
0.05 – 0.09									220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283
0.10 – 0.14							220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288
0.15 – 0.19					220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293
0.20 – 0.22			220	223	225	225	228	230	233	235	240	240	245	245	250	250	255	255	260	260	263	265	270	270	273	278	280	280	283	285	290	290	293	295
0.23 – 0.27	SPECIFIED CLEARANCE / NO ADJUSTMENT REQUIRED																																	
0.28 – 0.32	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300		
0.33 – 0.37	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300				
0.38 – 0.42	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300						
0.43 – 0.47	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300								
0.48 – 0.52	243	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300										
0.53 – 0.57	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300												
0.58 – 0.62	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300														
0.63 – 0.67	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300																
0.68 – 0.72	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300																		
0.73 – 0.77	268	270	273	275	278	280	283	285	288	290	293	295	298	300																				
0.78 – 0.82	273	275	278	280	283	285	288	290	293	295	298	300																						
0.83 – 0.87	278	280	283	285	288	290	293	295	298	300																								
0.88 – 0.92	283	285	288	290	293	295	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 — 2.50 mm

IDLE SPEED

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

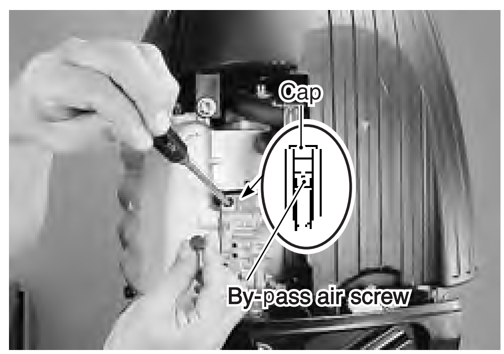
NOTE:
- *Before checking idle speed, engine should be allowed to warm up.*
- *Check and/or adjust idle speed after engine speed has stabilized.*
- *Before checking idle speed, check throttle link mechanism and throttle valve for smooth operation.*

1. Start engine and allow to warm up.
2. Attach engine tachometer to the ignition high-tension cord.

TOOL **09900-26006 : Engine tachometer**

3. Check engine speed.
   Idle speed (in neutral gear) : 600 – 650 r/min.

ADJUSTMENT :
If idle speed is out of specification, perform following adjustment procedure.



4. Check that CTP switch is in ON position.
5. To set the IAC valve duty to constant 15%, raise engine speed to 1000 r/min. or higher by turning the by-pass air screw and hold that speed for 10 seconds.

   At this time, caution buzzer will sound to notify that IAC duty is in fixed mode.

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

NOTE:
- *While IAC valve duty is at fixed 15%, caution buzzer will sound for repeated 0.5 second with an interval of 3 seconds.*
- *The 15% fixed mode of IAC valve duty will continue for 5 minutes and then it will be automatically cancelled.*

6. During fixed mode of IAC valve duty, adjust engine speed to 625 ± 25 r/min. by turning by-pass air screw.

7. Open warm-up lever to turn CTP switch off.

NOTE:
The fixed mode of IAC valve duty can be manually cancelled by turning CTP switch off.

8. Close warm-up lever and then recheck engine speed.
   It should now be stable at 600 – 650 r/min.

NOTE:
Idling / trolling speed of 600 – 650 r/min. is controlled by IAC (idle air control) system.
If engine speed does not return to specification, IAC passage (including the IAC hose) may be clogged or IAC system may not be operating correctly.
See "IDLE AIR CONTROL SYSTEM" section on page 3-21.

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

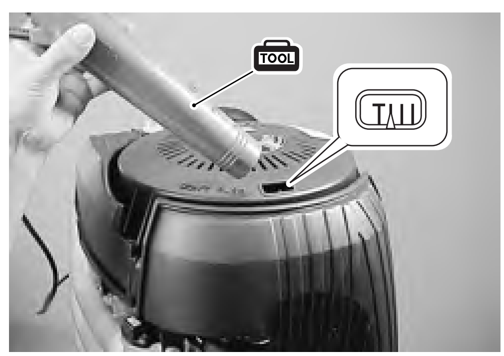
IGNITION TIMING

Inspect every 200 hours (12 months).

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

1. Start engine and allow to warm up.
2. Attach timing light cord to No.1 ignition high-tension cord.

TOOL **09930-76420 : Timing light**
09900-26006 : Engine tachometer



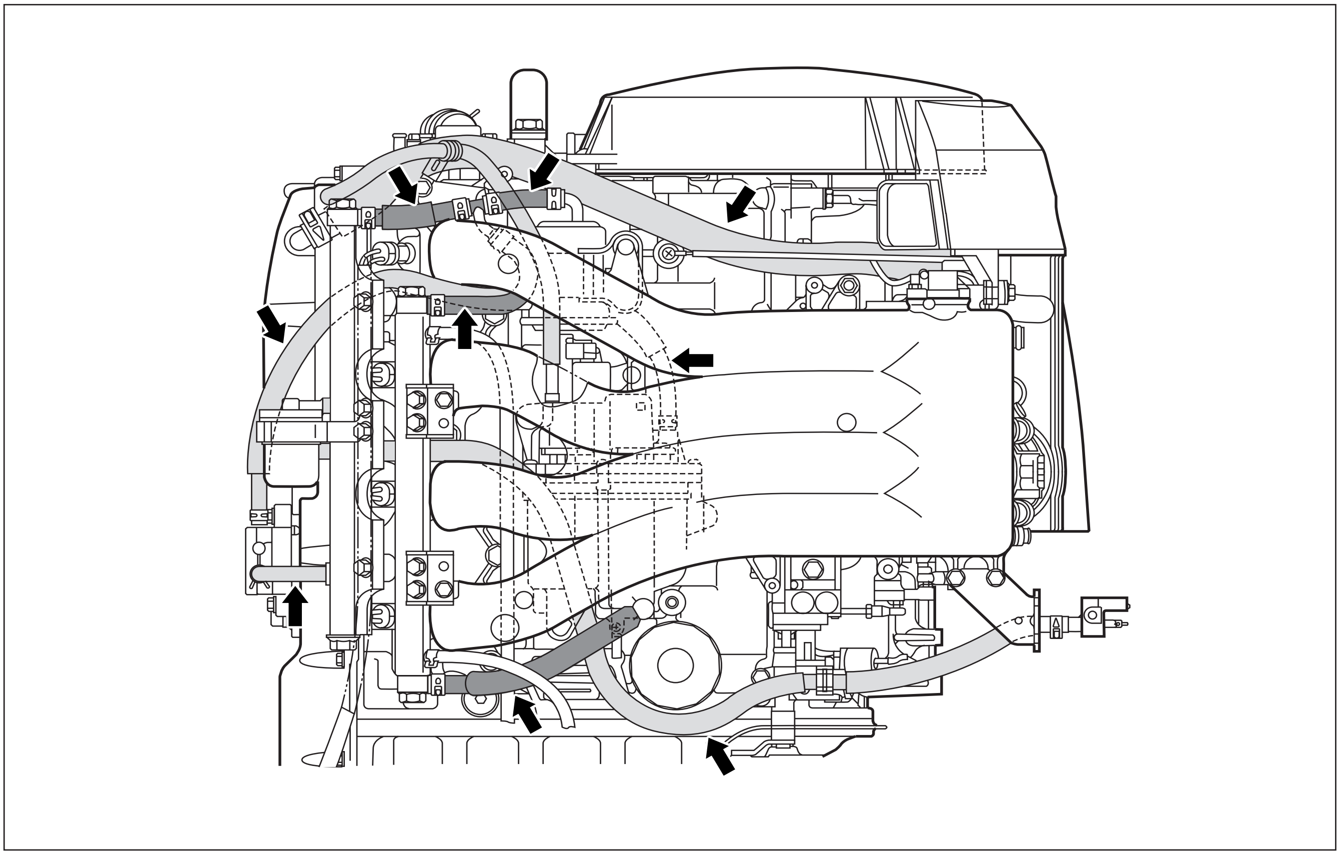
3. Check ignition timing while operating engine in neutral gear at 1000 r/min.

Ignition timing : Approx. BTDC 8° at 1000 r/min.

BREATHER AND FUEL LINE

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

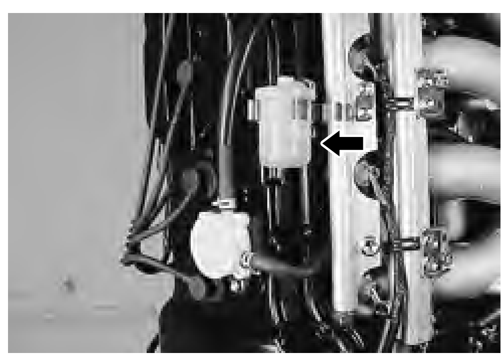
If leakage, cracks, swelling or other damage is found, replace breather line and/or fuel line.



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 fuel filter.



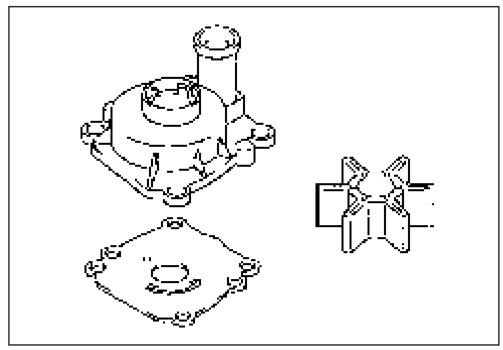
HIGH PRESSURE FUEL FILTER

Replace every 1000 hours.

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

WATER PUMP / WATER PUMP IMPELLER

WATER PUMP
Inspect every 200 hours (12 months).



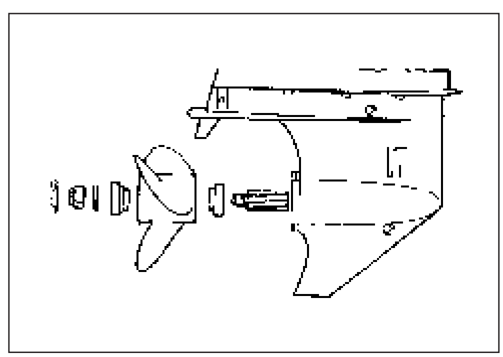
Inspect case and under panel.
Replace If wear, cracks, distortion or corrosion is found.

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

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

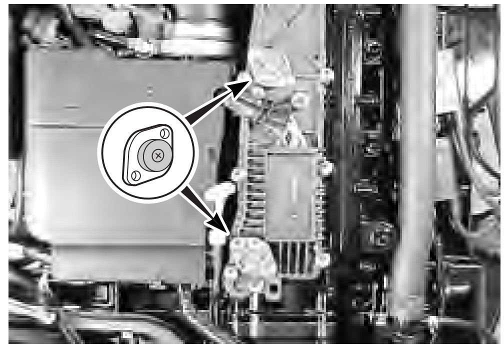
PROPELLER / NUT / COTTER PIN

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



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

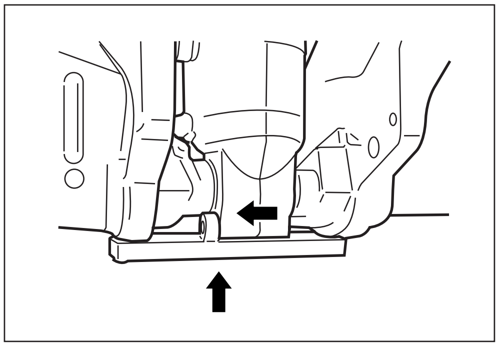
ANODES AND BONDING WIRES

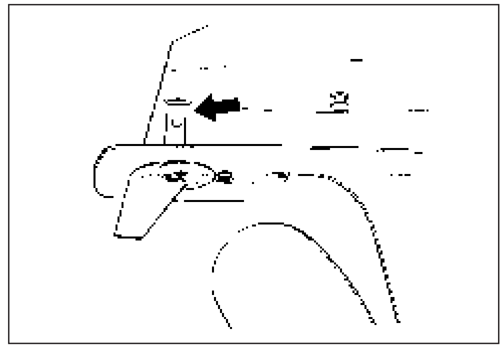


Inspect every 50 hours (3 months).

ANODES

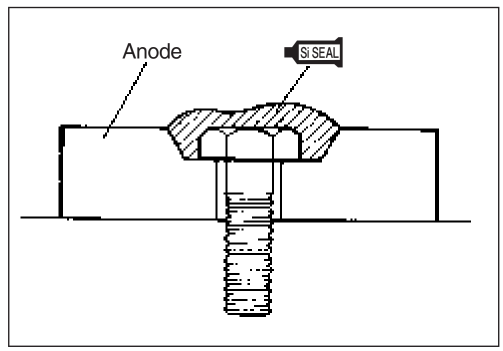
If 2/3 of zinc anode has corroded away, replace anode.
The anode should be periodically cleaned with a wire brush to ensure maximum effectiveness.





CAUTION

Never paint the anode.

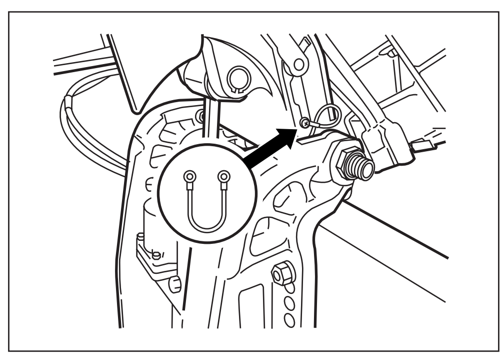


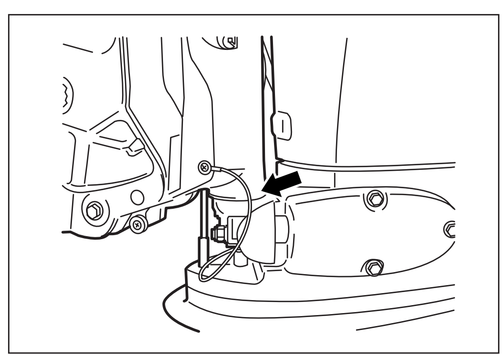
NOTE:
The anode securing bolt should be covered with Suzuki Silicone Seal.

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

BONDING WIRES

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





BATTERY

Inspect every 50 hours (3 months)

WARNING

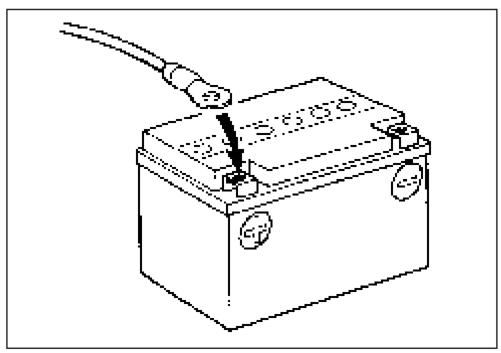
- **Never expose battery to open flame or electric spark as batteries generate gas, which is flammable and explosive.**
- **Battery acid is poisonous and corrosive. Avoid contact with eyes, skin, clothing, and painted surfaces. If battery acid comes in contact with any of these, flush immediately with 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 100 Ah (360 kC) or larger

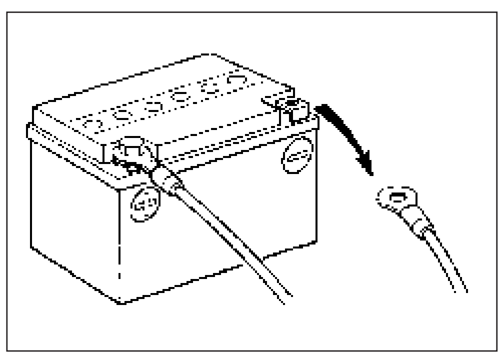
CONNECTING BATTERY

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

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



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

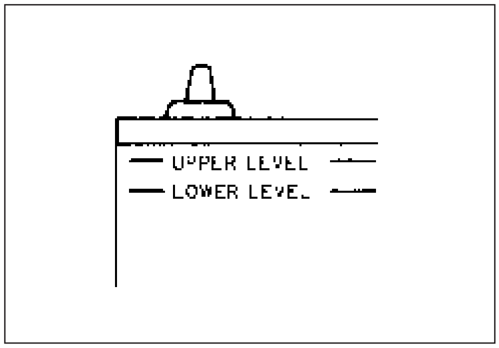


CAUTION

If the battery leads are incorrectly connected, the electrical system could be damage.

BATTERY SOLUTION LEVEL CHECK

Battery solution level should be between UPPER level and LOWER level.
If level is low, add distilled water only.

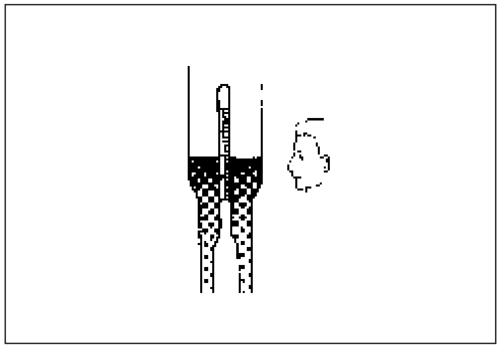


CAUTION

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 gravity of battery solution using 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).

Check that all bolts 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	11	1.1	8.0
Flywheel bolt	16 mm	245	24.5	177.0
Power unit mounting 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
Lower mount bolt / nut	12 mm	60	6.0	43.0
Gearcase bolt	10 mm	55	5.5	40.0
Propeller nut	18 mm	55	5.5	40.0

FUEL MIXTURE CHECK (O_2 FEEDBACK)

Perform every 2 years.

To perform fuel mixture check (O_2 feedback) operation, use personal computer and Suzuki Diagnostic System software.
For fuel mixture check (O_2 feedback) operation, refer to "Suzuki Diagnostic System Operation Manual".

NOTE:
See "O_2 FEEDBACK SYSTEM" section on page 3-34 before starting O_2 feedback operation.

OIL PRESSURE

Oil pressure (at normal operating temp.) :
550 – 600 kPa (5.5 – 6.0 kg/cm^2, 78 – 85 psi.) at 3000 r/min.

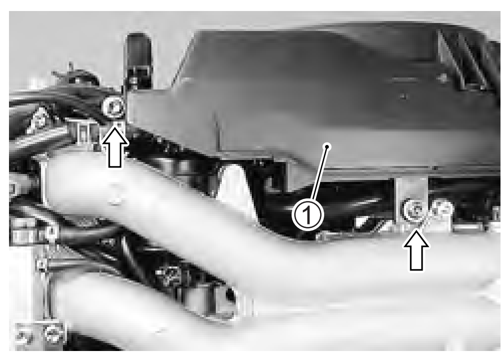
NOTE:
The figure shown above is a guideline only, not an absolute service limit.

If oil pressure is lower or higher than specification, following causes may be considered.
(See page 6-65 for oil passage locations)

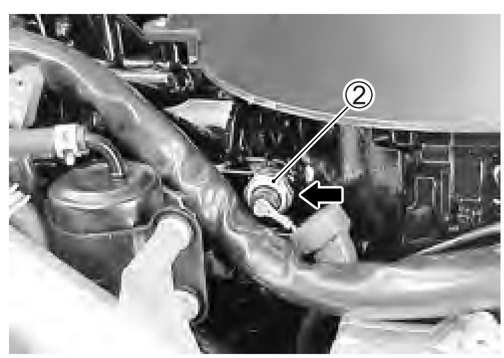
Low oil pressure
- Clogged oil filter
- Leakage from oil passages
- Defective oil pump
- Defective oil pressure regulator
- Damage O-ring
- Combination of above items

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 engine oil level.
2. Remove bolts and air duct ①.

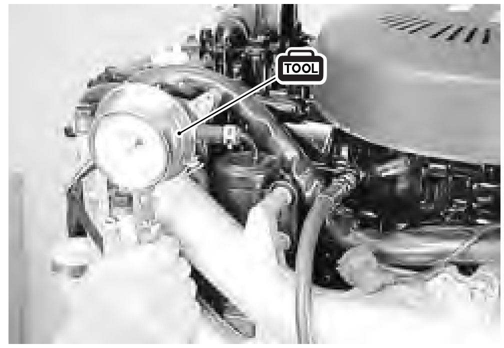


3. Loosen screw and disconnect blue lead wire from oil pressure switch ②.
   Remove oil pressure switch.



4. Install oil pressure gauge in place of pressure switch hole.

TOOL **09915-77311 : Oil pressure gauge**
09915-78211 : Oil pressure gauge adapter



5. Attach engine tachometer to ignition coil high tension cord.

TOOL **09900-26006 : Engine tachometer**

6. Start engine and allow to warm up as follows :

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

7. After warming up, shift into forward gear and increase engine speed to 3000 r/min. then compare pressure indicated on gauge to specifications.

8. After testing, reinstall oil pressure switch. (See page 3-54)

9. Reinstall air duct.

CYLINDER COMPRESSION

Cylinder compression :
Standard : 1300 – 1700 kPa
(13 – 17 kg/cm², 185 – 242 psi.)
Max. difference between any other cylinders :
100kPa (1.0 kg/cm², 14 psi.)

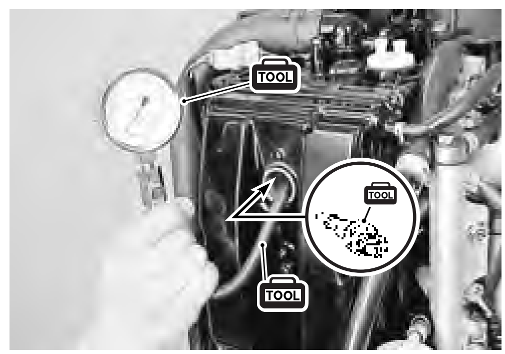
NOTE:
Figures shown are guidelines only, not absolute service limits.

Low compression pressure can indicate one or more of 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 STBD / PORT side covers.(See page 7-2)
3. Remove all spark plugs.
4. Install compression gauge hose attachment into plug hole, then connect compression gauge hose to gauge hose attachment and compression gauge.



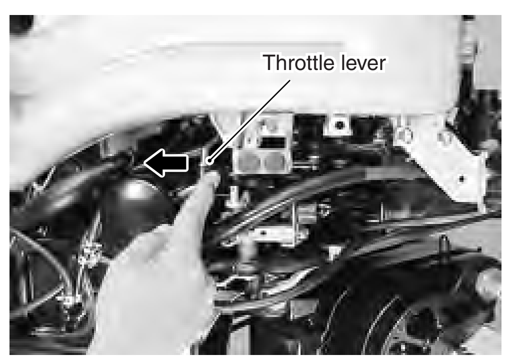
TOOL **09915-64512 : Compression gauge**
09915-64530 : Compression gauge hose
09915-67010 : Compression gauge hose attachment

5. Disconnect safety lanyard (switch plate) from 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 spark plug caps.

6. Disconnect remote control throttle cable from throttle lever.
7. Move and hold throttle lever in full-open position.
8. While cranking engine with starter motor, note maximum compression pressure reading on gauge for each cylinder.
9. Reinstall parts removed earlier. (spark plugs, side covers, etc.)



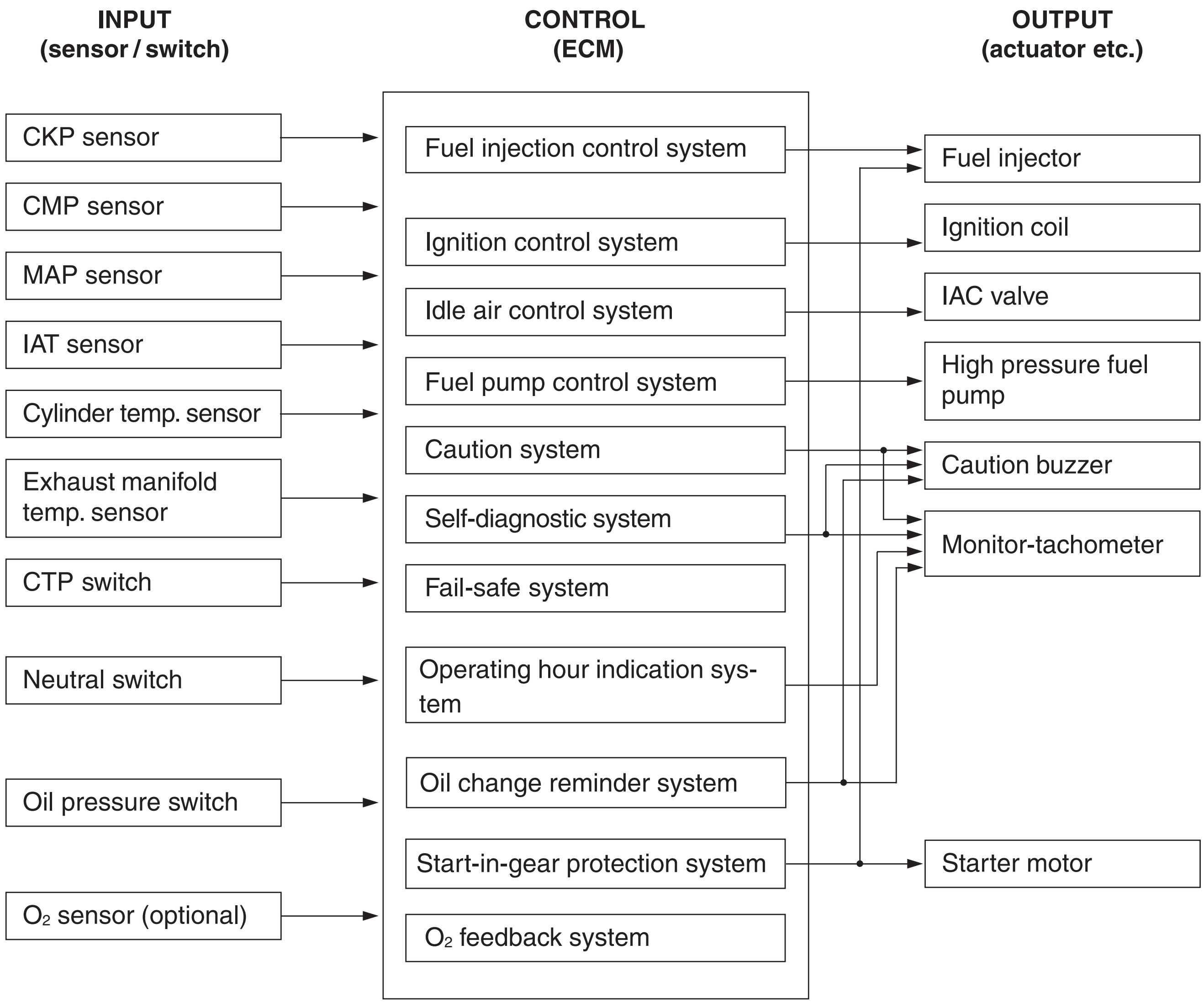
ENGINE CONTROL SYSTEM

CONTENTS

ENGINE CONTROL SYSTEM STRUCTURE

The DF90/DF115 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).

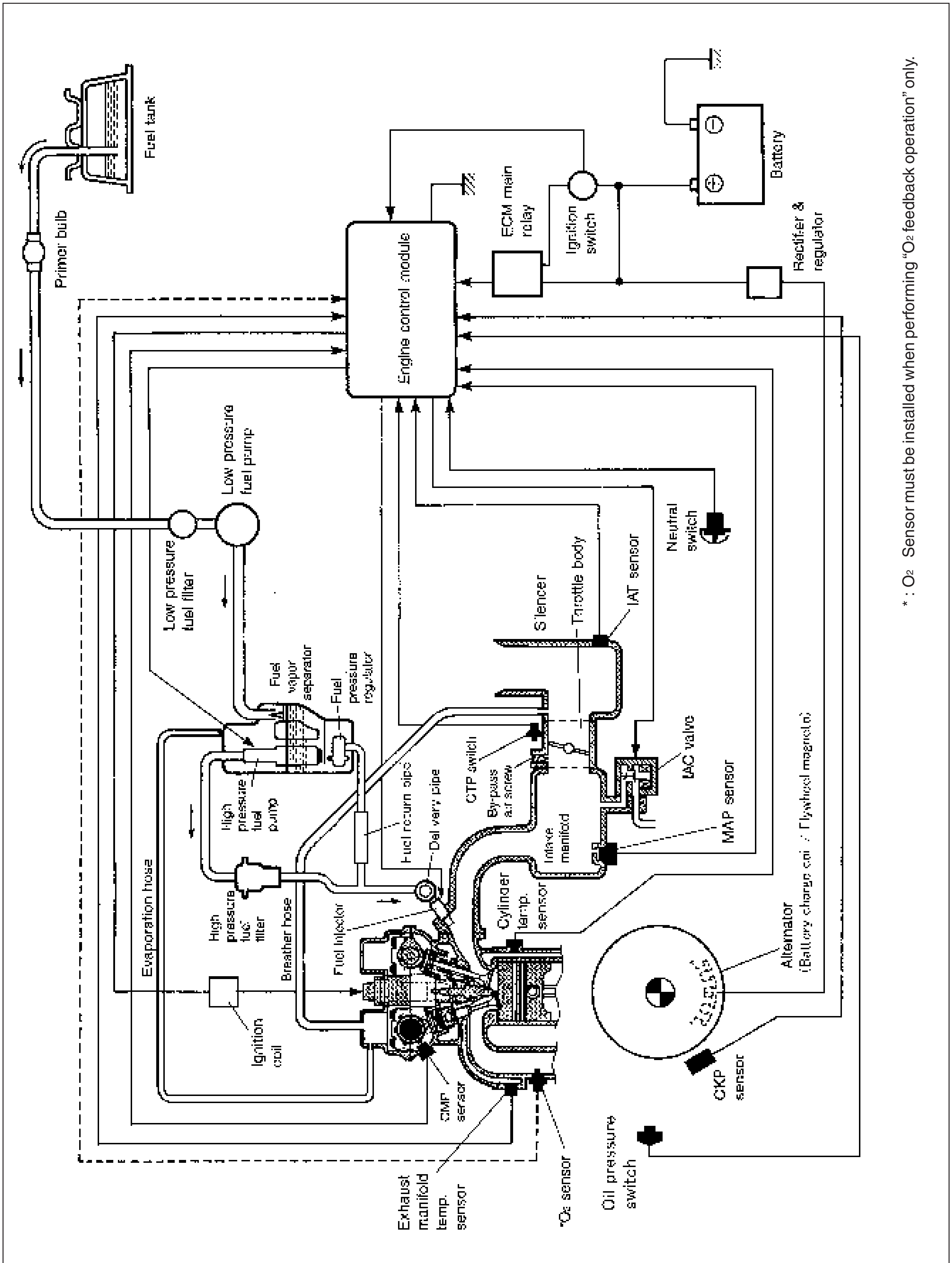
SYSTEM STRUCTURE 1



[Abbreviations used in this section]

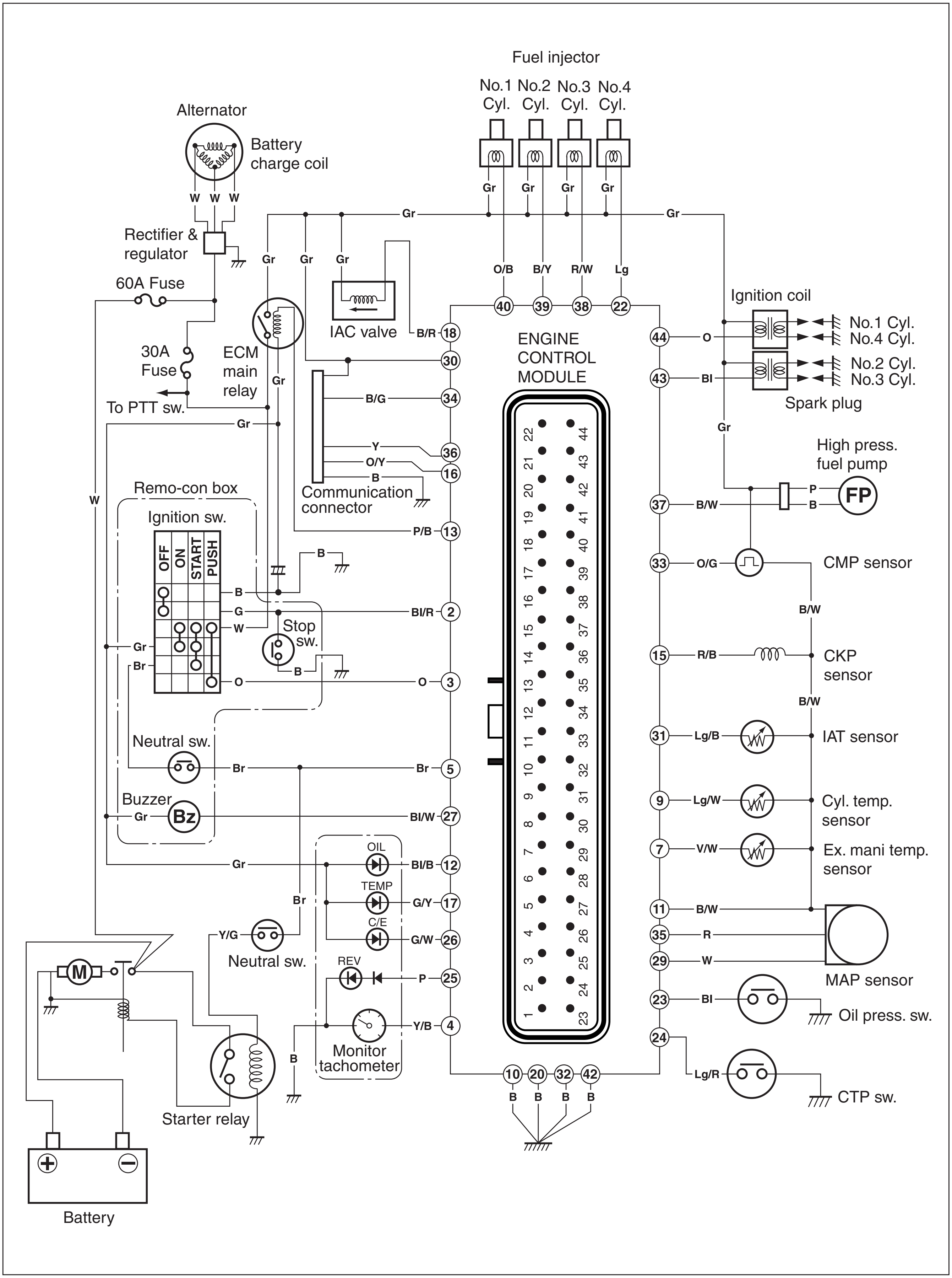
ECM (Engine control module)
CKP (Crankshaft position)
CMP (Camshaft position)
MAP (Manifold absolute pressure)
IAT (Intake air temperature)
CTP (Closed throttle position)
IAC (Idle air control)

SYSTEM STRUCTURE 2



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

WIRING DIAGRAM FOR ENGINE CONTROL



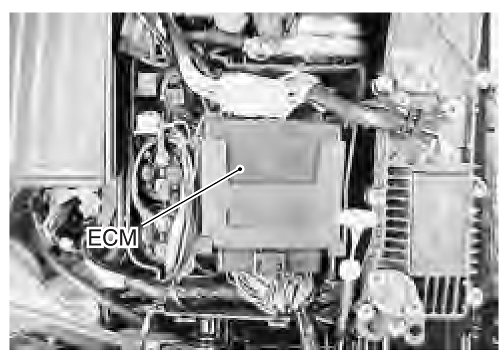
COMPONENTS FOR SYSTEM CONTROL

ENGINE CONTROL MODULE (ECM)

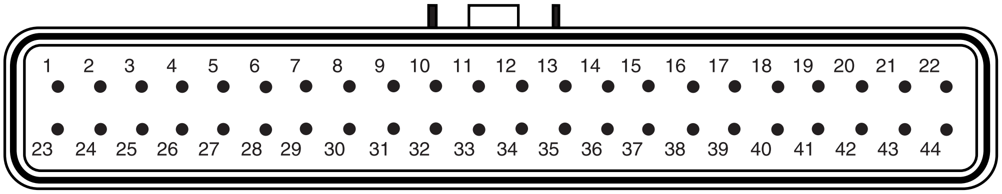
The ECM sends signals to control the actuators based on the information inputs from each sensor / switch. Major controls are as follows :

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.
Oil change reminder system control	• Informs operator of the required engine oil replacement intervals based on the maintenance schedule.
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:
Information related to the Caution system, Self-diagnostic system, Total operating hour indication system, Oil change reminder system and O_2 feedback system are retained in ECM memory.



ECM CONNECTOR / TERMINALS LAYOUT

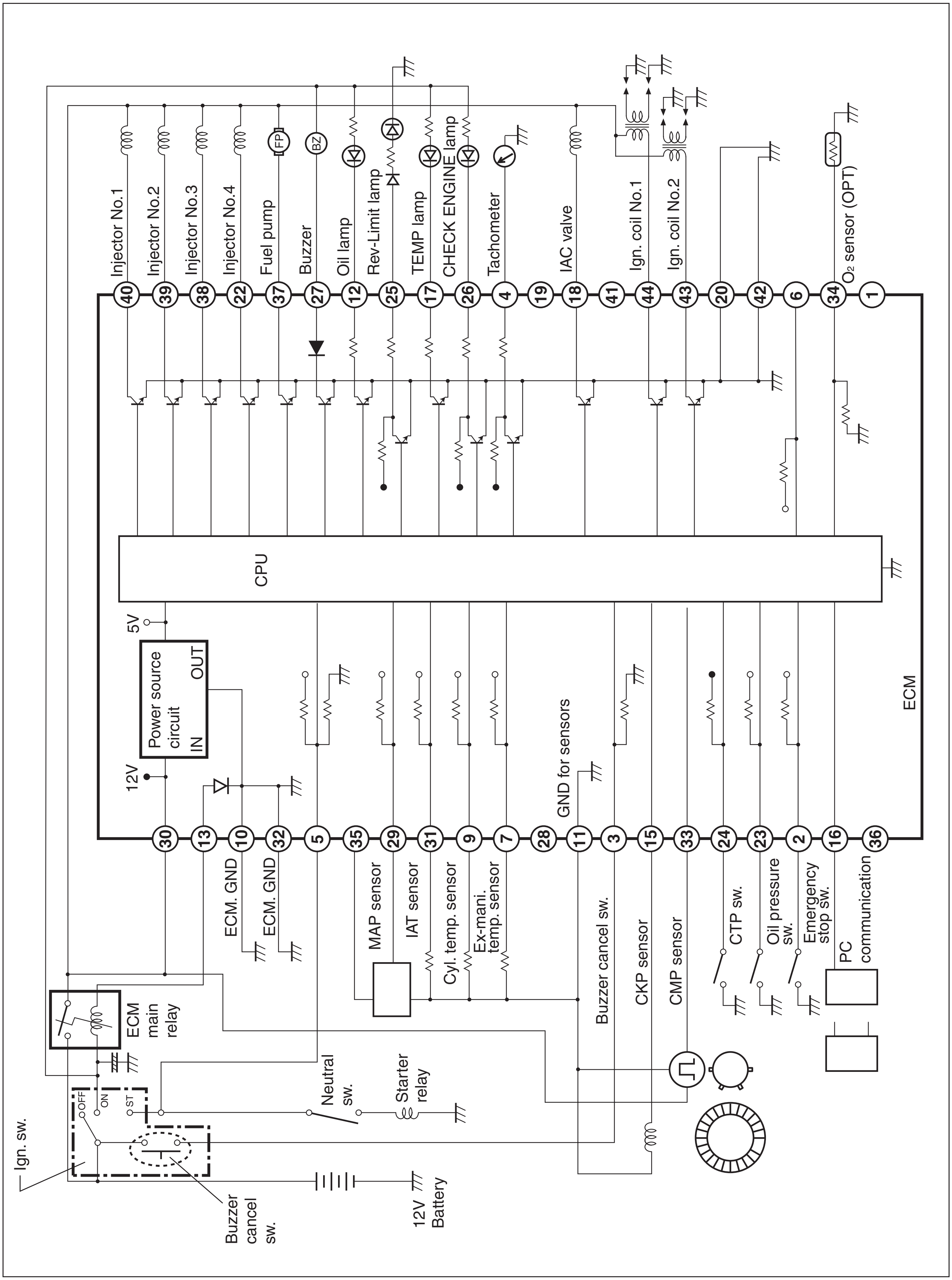


ECM CIRCUITS

TERMINAL	WIRE COLOR	CIRCUIT
1	—	—
2	Bl/R	Emergency stop switch
3	O	Buzzer cancel
4	Y/B	Tachometer
5	Br	Neutral switch
6	—	—
7	V/W	Ex-manifold temp. sensor
8	—	—
9	Lg/W	Cylinder temp. sensor
10	B	Ground for ECM
11	B/W	Ground for sensors
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 ignition coil
21	—	—
22	Lg	No.4 Fuel injector (–)

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	O_2 feedback / PC communication
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 ignition coil
43	Bl	No.2 Ignition coil (–)
44	O	No.1 Ignition coil (–)

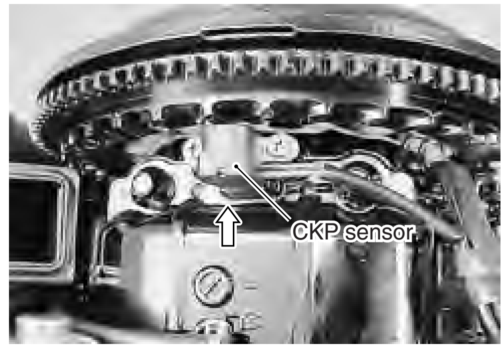
ECM INTERNAL STRUCTURE



SENSOR AND SWITCH

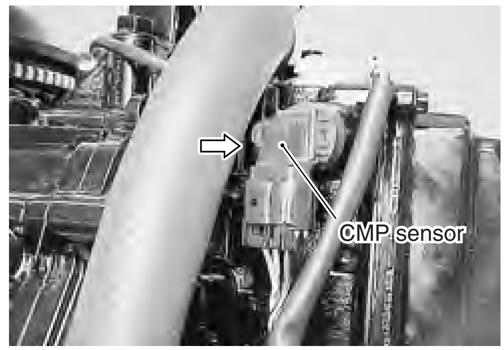
CKP (Crankshaft Position) SENSOR

There is one (1) CKP sensor installed below the flywheel rotor. When the reluctor bars on the flywheel pass the sensor, 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.
There are 34 reluctor bars, spaced 10 degrees apart, followed by a larger index space. During one crankshaft rotation, 34 signals are input to the ECM.

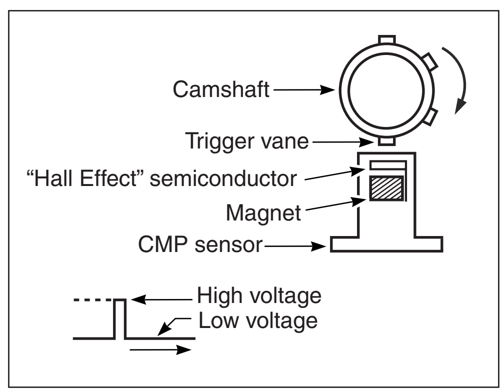


CMP (Camshaft Position) SENSOR

A CMP sensor mounted on the cylinder head cover and trigger vanes pressed onto the end of the exhaust 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.



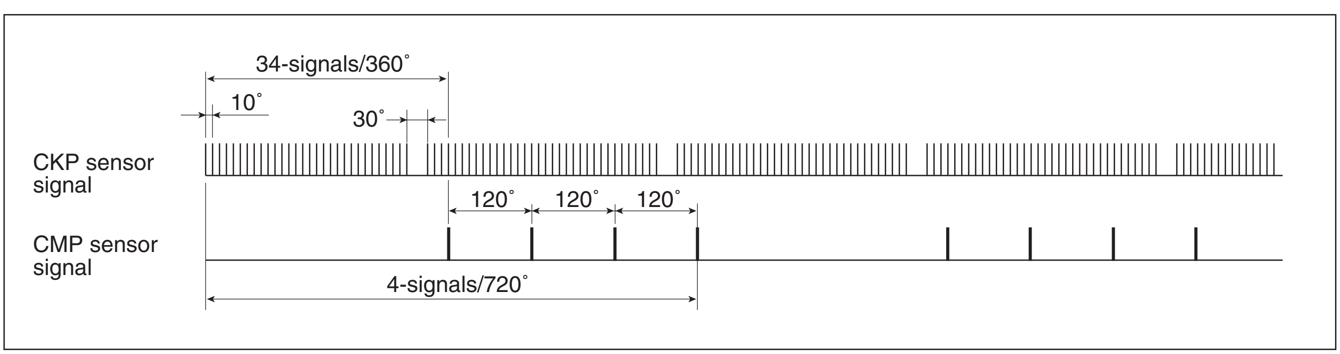
The CMP sensor contains a "Hall Effect" semiconductor and a magnet. The semiconductor generates a voltage in proportion to the line of magnetic force passed through it. When a trigger vane on the camshaft reluctor aligns with the sensor' internal magnet, a large amount of magnetic force is generated 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 to the ECM.



Four trigger vanes are provided on exhaust camshaft and during one rotation of camshaft (two rotations of crankshaft), four high voltage signals are supplied from CMP sensor to ECM.

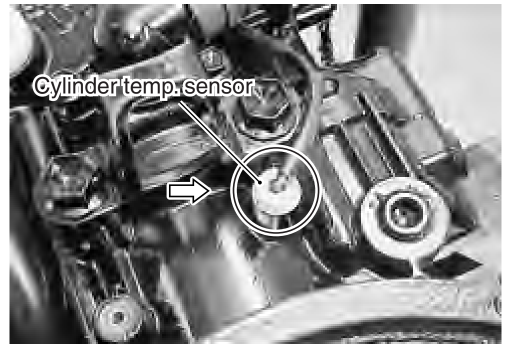
ECM cylinder identification :

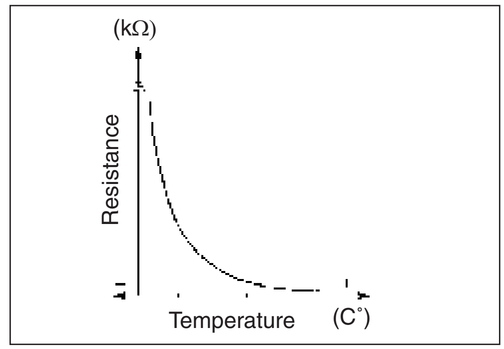
The cylinder is identified by a calculation combined from two signals ; one from the CKP sensor and one from the CMP sensor.



CYLINDER TEMPERATURE SENSOR

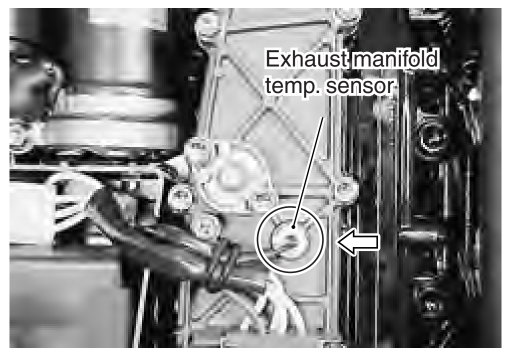
The cylinder temperature sensor is installed on the cylinder (top side) and used to detect the cylinder temperature.
This is a thermistor type sensor (resistance of which changes depending on the temperature) and inputs a signal to the ECM as a voltage value. This input signal is used to compensate the 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 also used to detect engine over-heat.

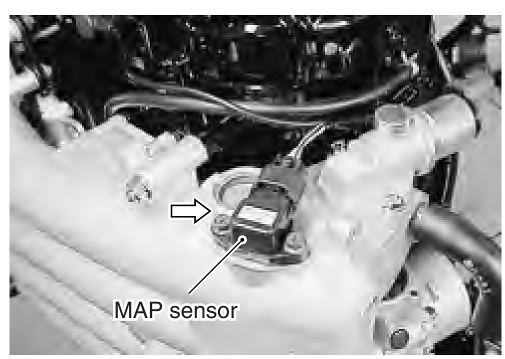


IAT (Intake Air Temperature) SENSOR

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.

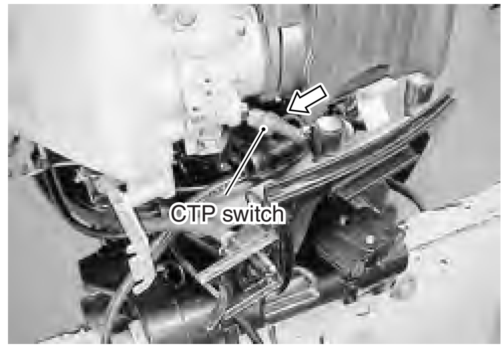
MAP (Manifold Absolute Pressure) SENSOR

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.



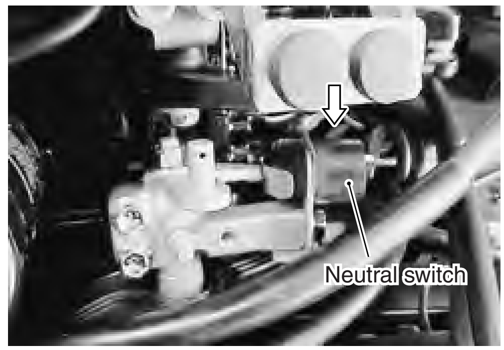
CTP (Closed Throttle Position) SWITCH

The CTP switch is installed on the bottom of throttle body and used to detect whether the throttle is fully closed or not.
This switch is “ON” at closed throttle and “OFF” at any open throttle position. Based on the switch’ throttle position signal input, the ECM 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 (STBD side) and used to detect the shift position.
This switch is “ON” in neutral and “OFF” in forward or reverse. Based on the switch’ shift position signal input, the ECM performs the following controls :



- When the shift is in forward or reverse at the time of engine start, the fuel injection function is cancelled.
  (Start-in-gear protection. See page 3-33.)
- 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 900 r/min., ignition timing is fixed at BTDC 8°.
- After shifting into forward or reverse from neutral, the IAC valve is controlled to increase intake air for two seconds to prevent unstable engine idle or stalling.

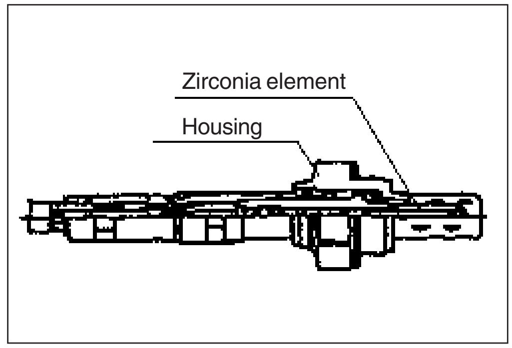
ECM MAIN RELAY

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) which changes output voltage depending on the oxygen concentration difference between its internal and external surfaces. 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.

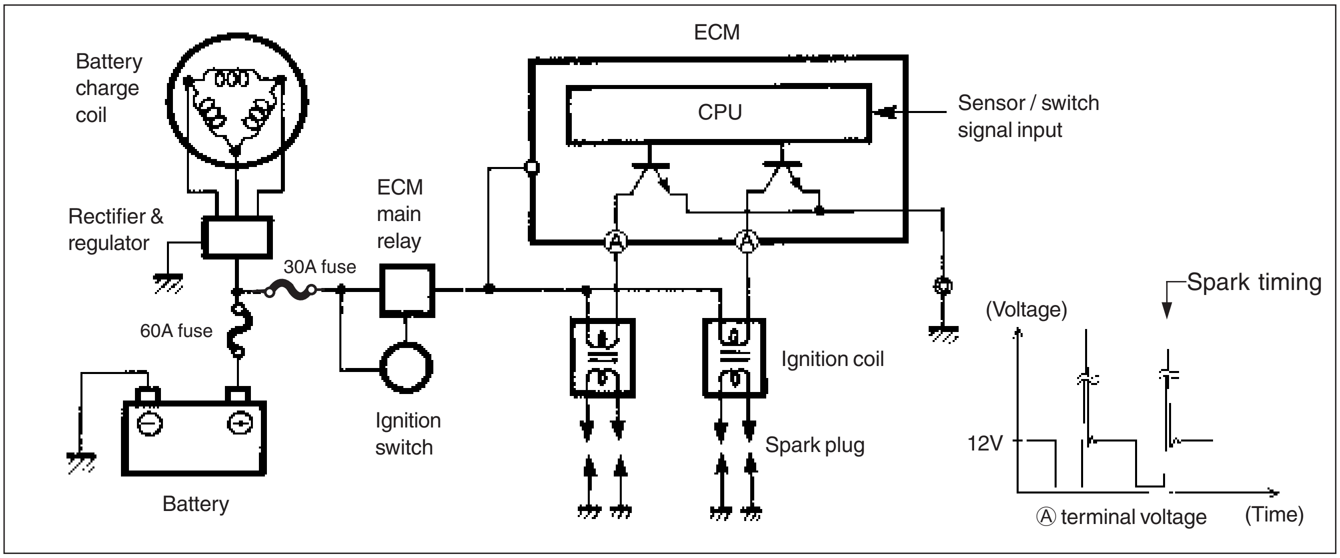
This detected voltage value therefore represents the oxygen concentration. The terminal voltage decreases when the oxygen concentration is high, and increases when it is low.

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 DF90/DF115 is a fully transistorized, electronic microcomputer timing advanced type.
This system is totally battery powered, 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.

Basic sensors

MAP sensor :
Informs ECM of intake manifold pressure.

CKP sensor :
Informs ECM of engine speed and crankshaft angle.

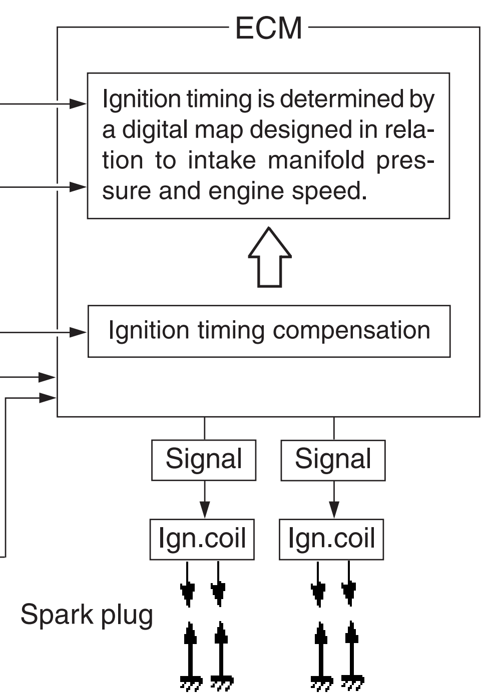
Compensating sensors

Cylinder temperature sensor :
Informs ECM of cylinder temperature.

Others

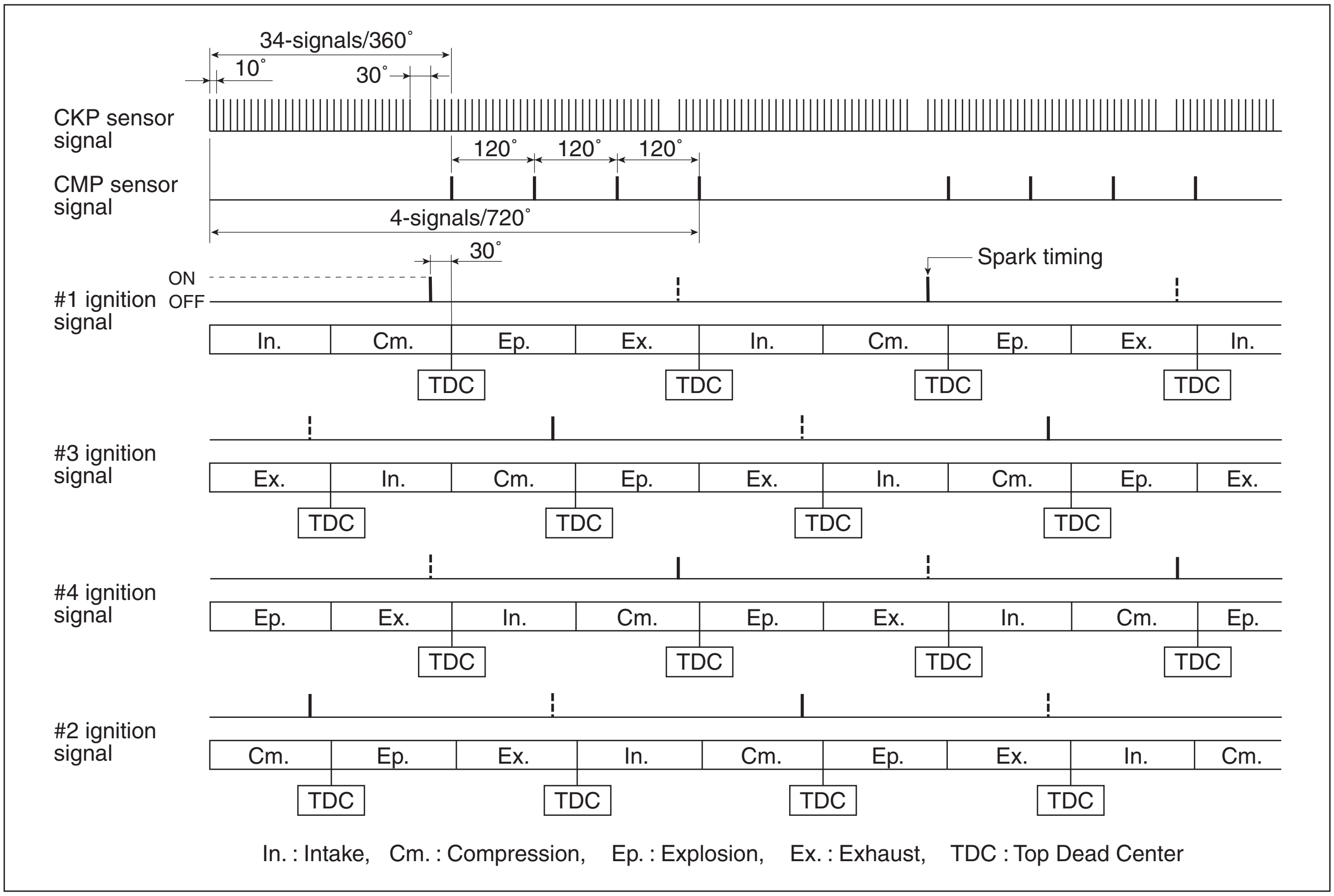
CTP switch :
Informs ECM of throttle position (open / closed).

Ignition switch :
Informs ECM of “START” signal.



IGNITION TIMING CHART

The following chart is an example for ignition at BTDC 30°.



CONTROL MODE

WHEN CRANKING :

The ignition timing is fixed at BTDC 5° until the engine starts.

WHEN IDLING / TROLLING :

The ignition timing is controlled within the range of BTDC 3° to 13° to provide stable engine operation at the specified idling / trolling speed.

When the shift lever is in neutral, if engine speed exceeds 900 r/min., ignition timing remains fixed at BTDC 8°.

WHEN RUNNING (NORMAL OPERATION) :

The ignition timing ranges between BTDC 1° – 44° (DF90) or BTDC 3° – 44° (DF115), depending on current engine operating conditions.

WHEN DECELERATING :

When the throttle valve is closed suddenly, turning the CTP switch “ON”, the return of ignition timing to the closed throttle specification (idle speed) 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 90 : BTDC 1° – 44°, DF 115 : BTDC 3° – 44°
Firing order	1 – 3 – 4 – 2

ELECTRONIC FUEL INJECTION SYSTEM

The fuel injection system used by the DF90/DF115 is a speed-density, multi-point, sequential, electronic fuel injection type.

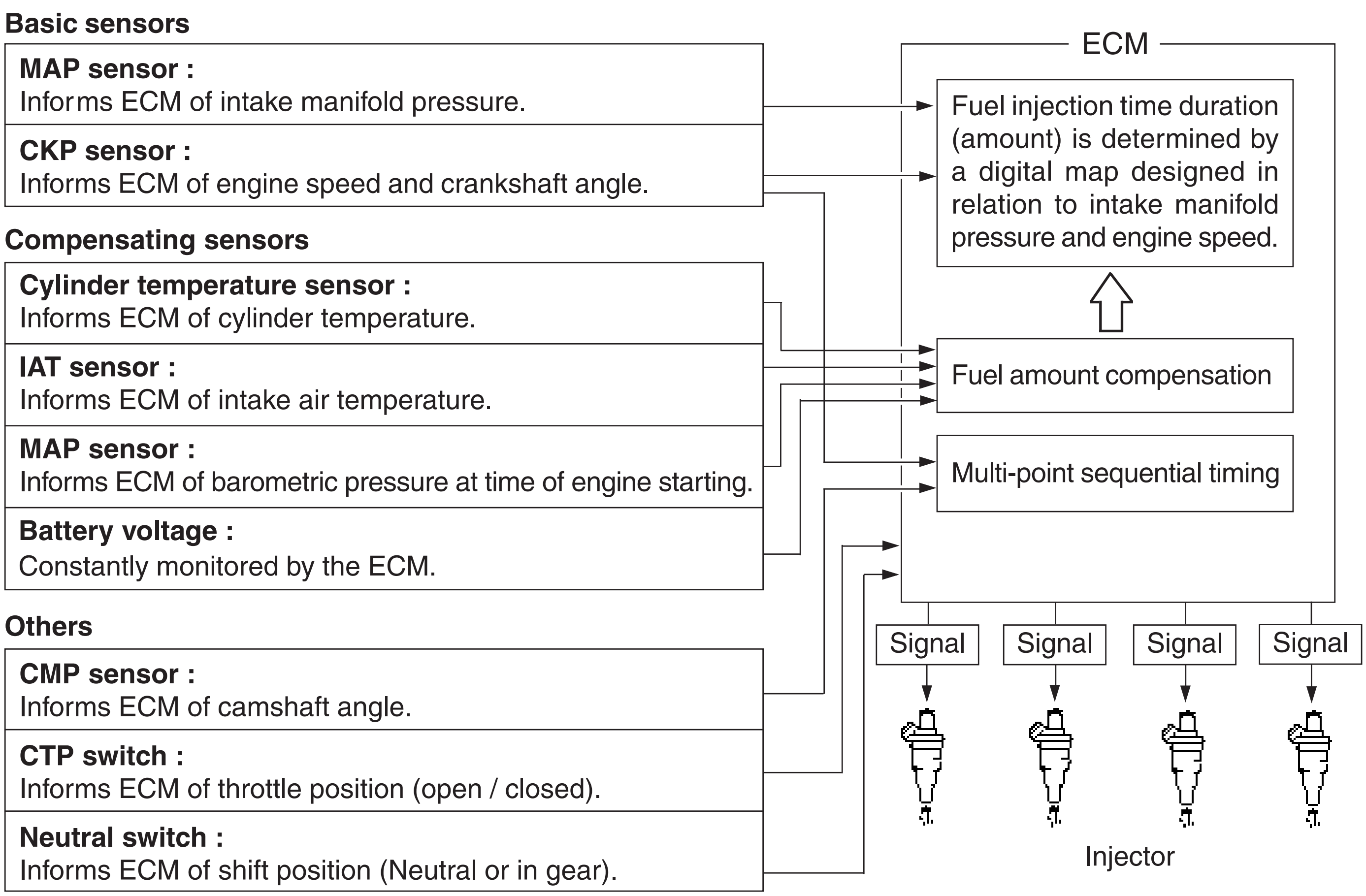
The fuel injection system is composed of the fuel line components, air intake components, and components for system control (ECM, sensors, switches, etc.).

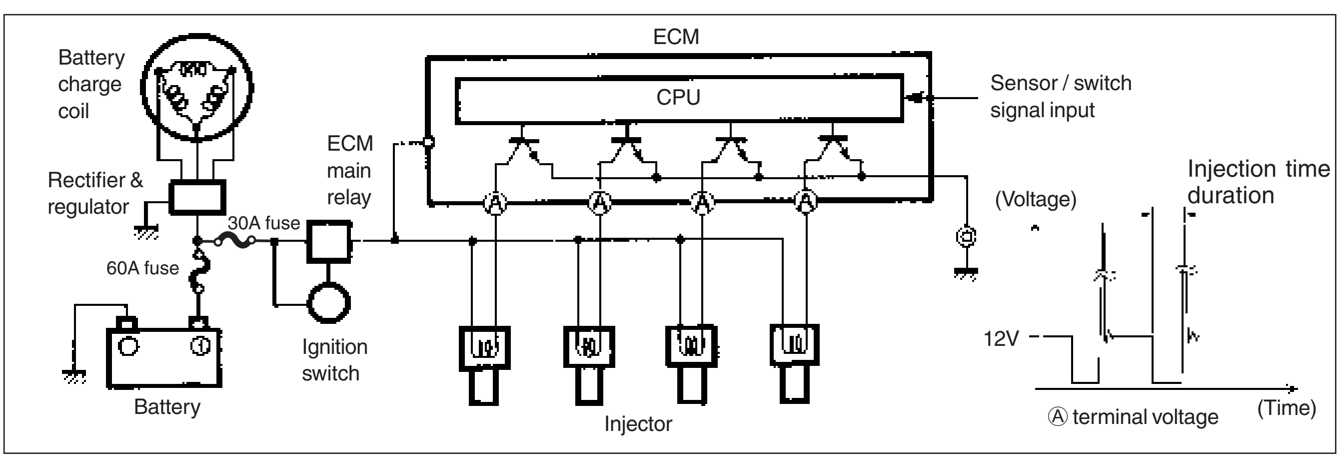
FUEL INJECTION CONTROL SYSTEM

OUTLINE

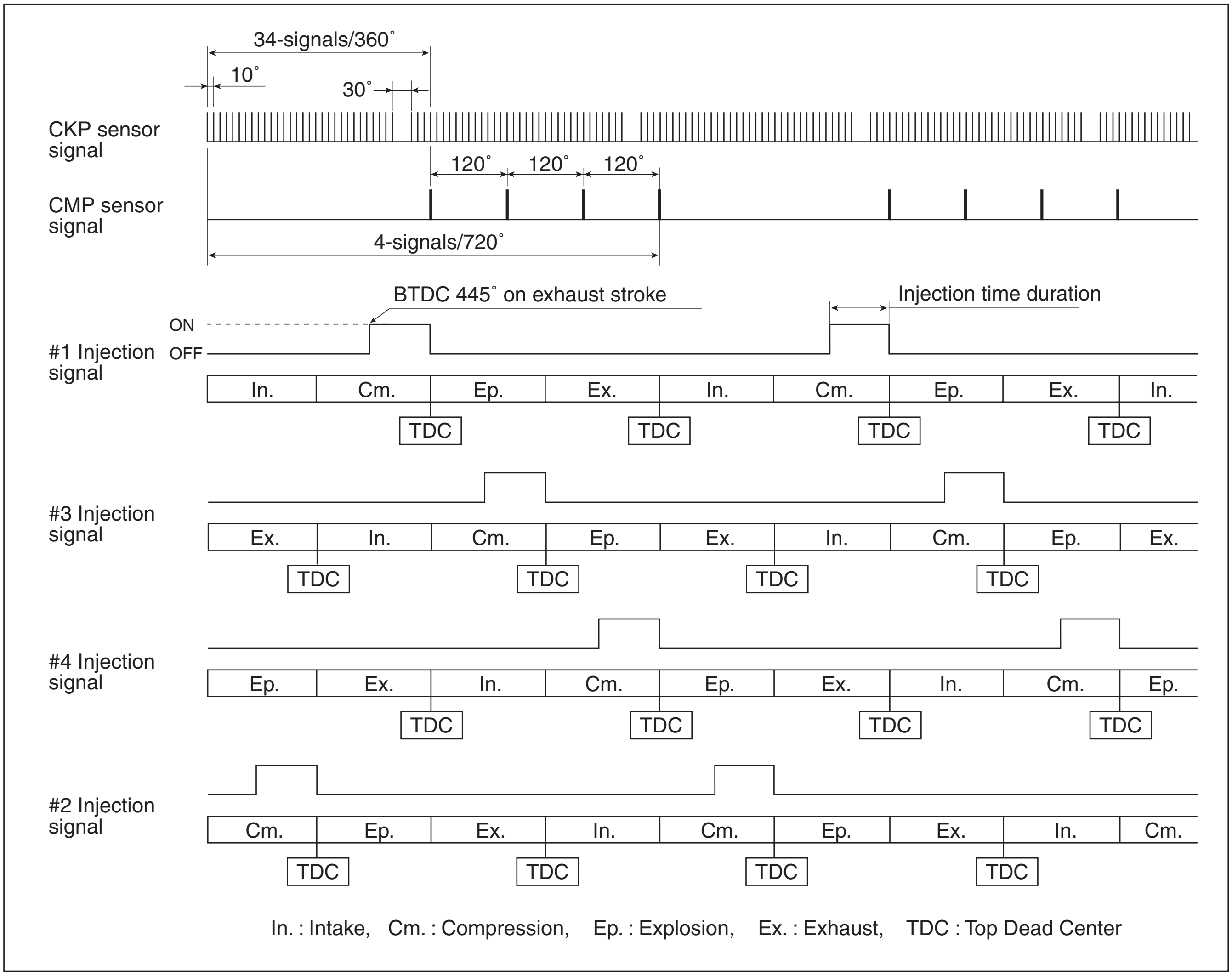
Sensors are mounted at precise locations on the motor to monitor the current conditions of engine operation and send signals to the ECM. Based on these signals, the ECM determines the optimum fuel injection time duration (fuel amount), fuel injection timing (multi-point sequential timing) and controls the injector operating signals accordingly.

Fuel injection start timing is set at BTDC445° 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. This signal 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 remain increased 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.

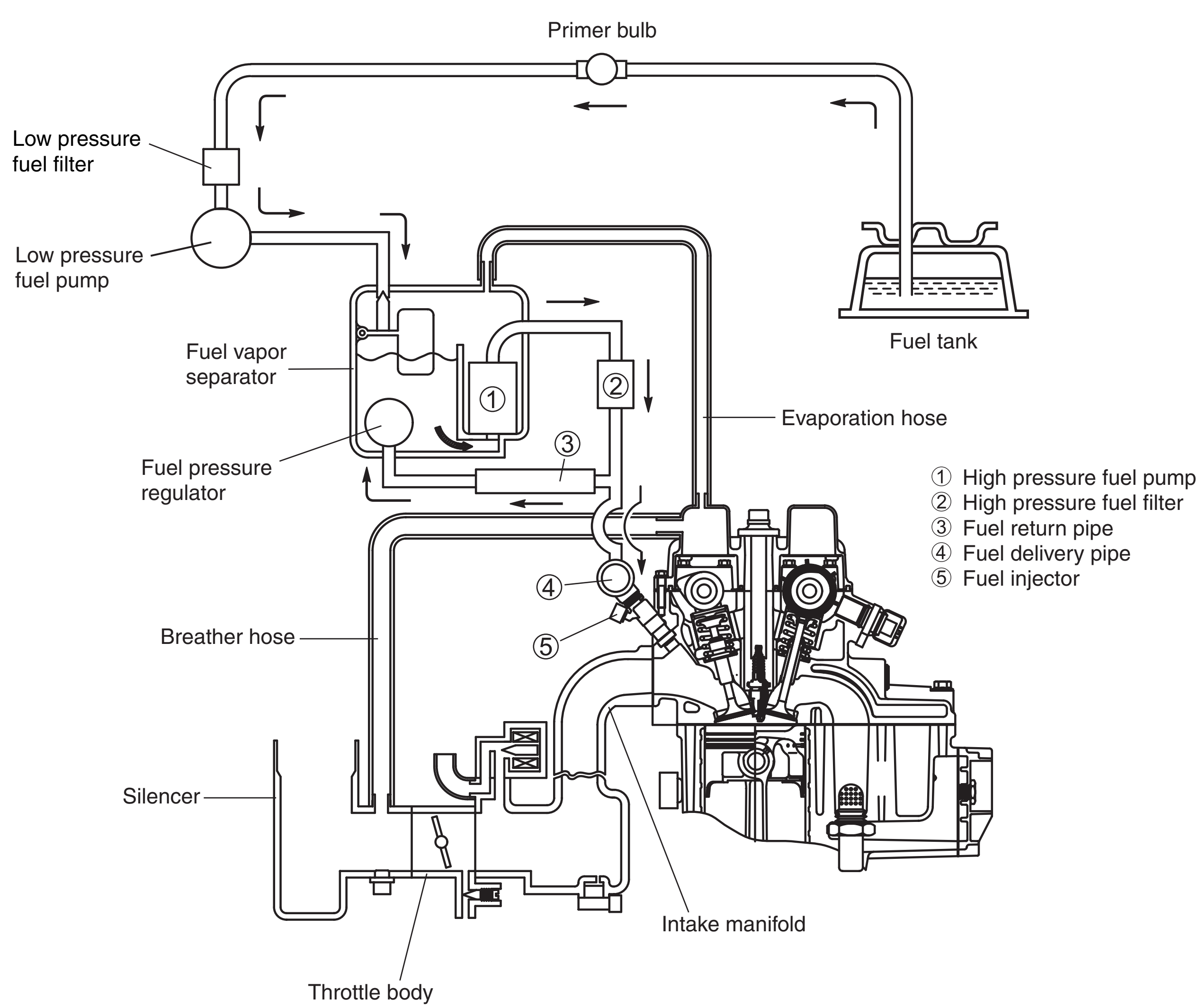
FUEL DELIVERY SYSTEM COMPONENTS

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), delivery pipe, 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 pipe 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.

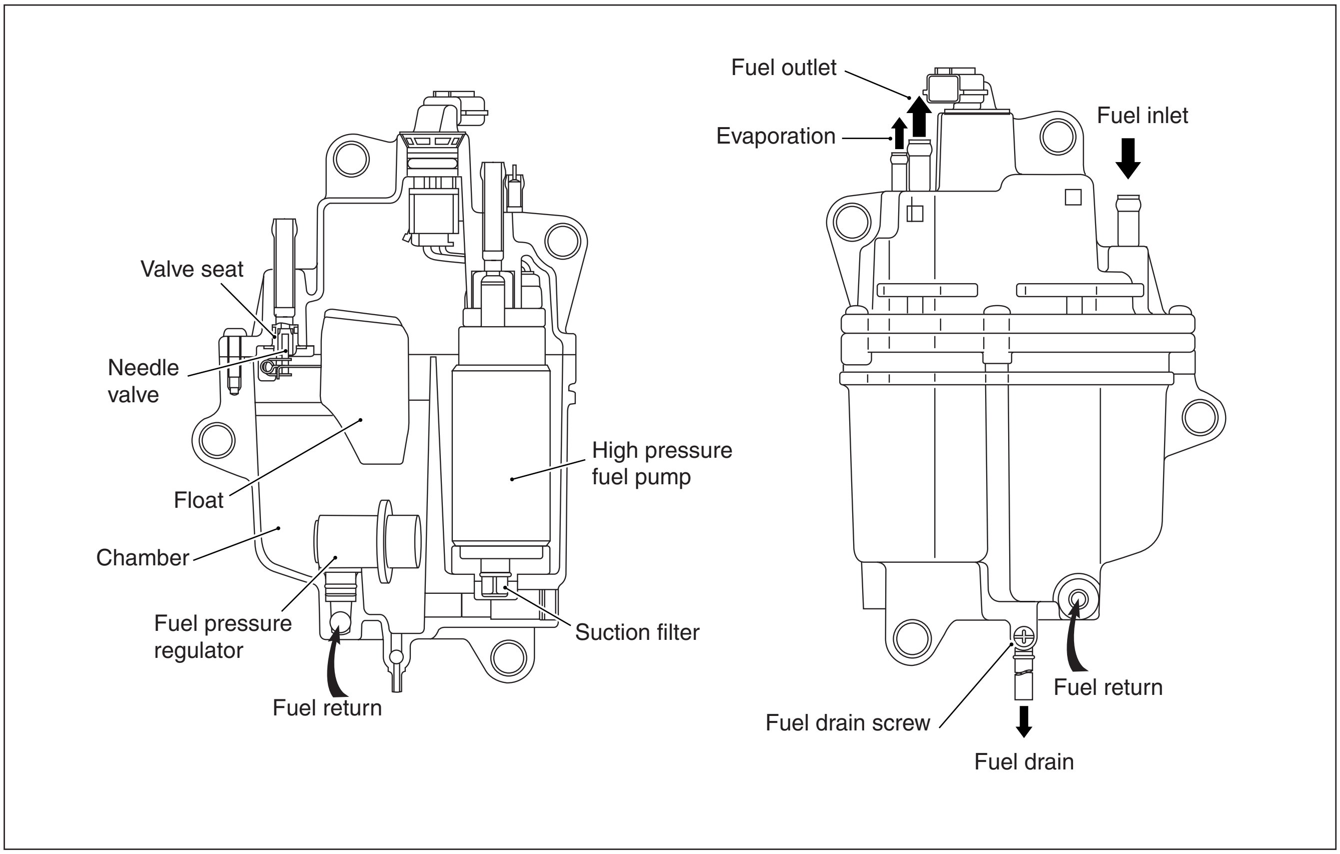
The function of this unit is to separate vapors from fuel delivered by the low pressure fuel pump or fuel returned from the fuel pressure regulator.

This vapor is routed through the evaporation hose connecting the vapor separator cover to the cylinder head cover.

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

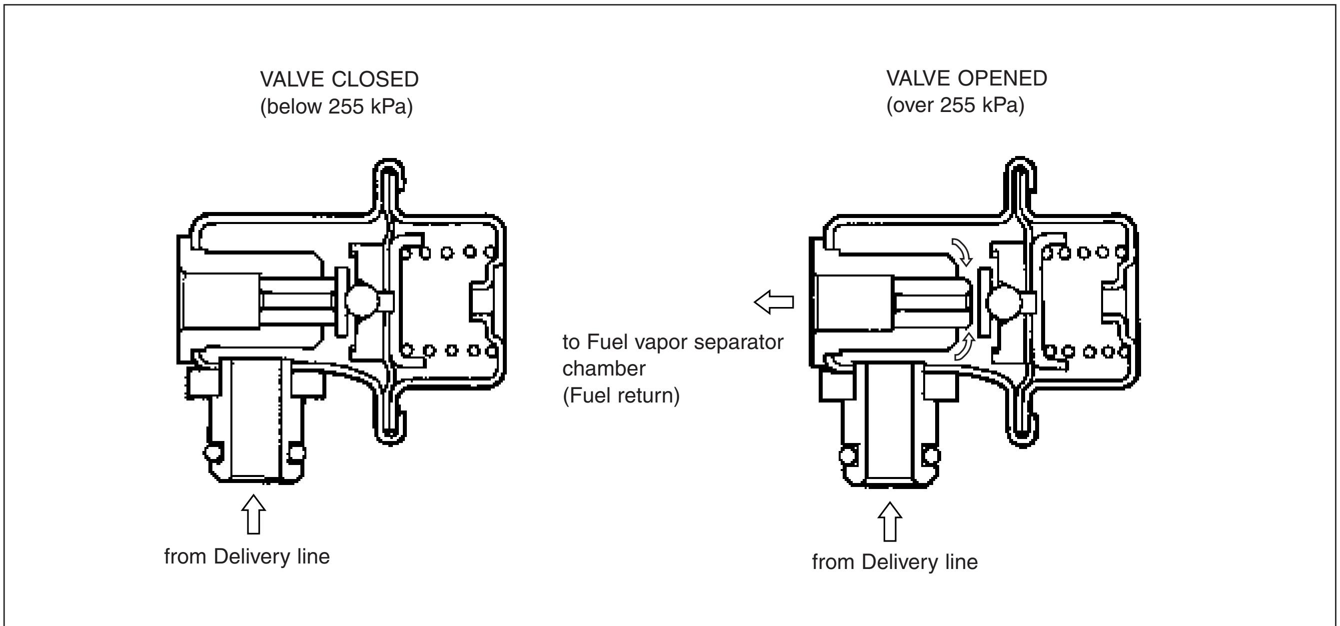
The fuel pressure regulator is located in the fuel vapor separator.

The regulator's 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 fuel vapor separator chamber to keep the pressure balanced.

Fuel pressure, adjusted by the regulator, is constantly maintained higher than the pressure in the fuel 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.



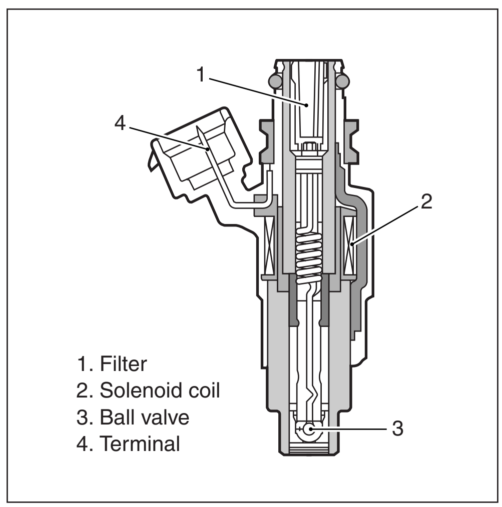
FUEL INJECTOR

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 valve and injects fuel.

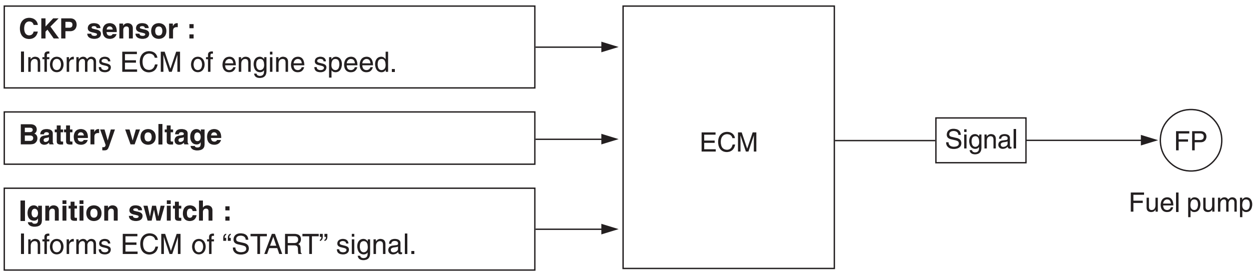
Because the fuel pressure is kept constant, the amount of fuel injected is determined by the amount of time (duration) the valve is open.

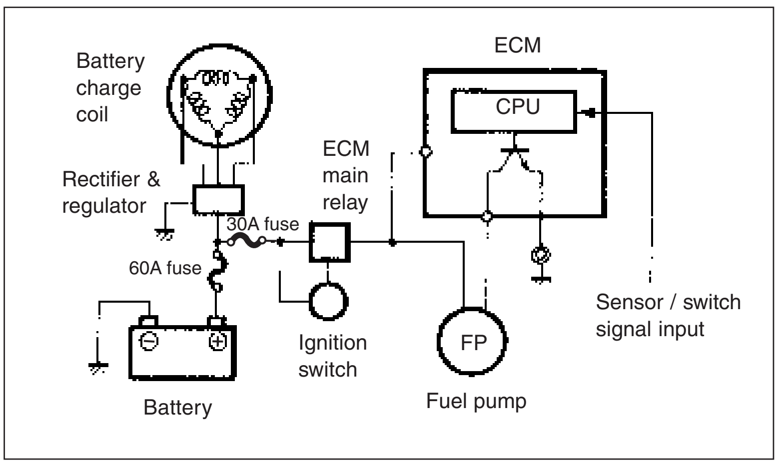


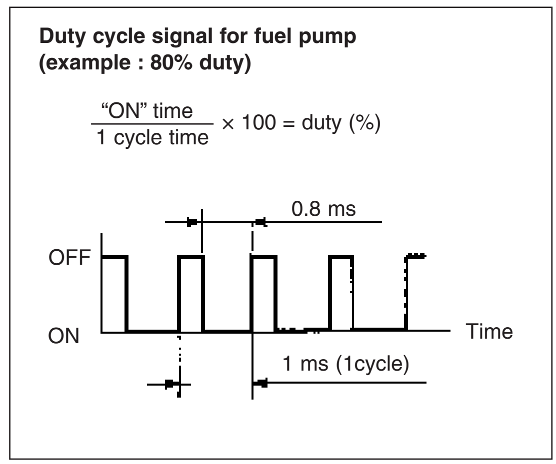
FUEL PUMP CONTROL SYSTEM

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

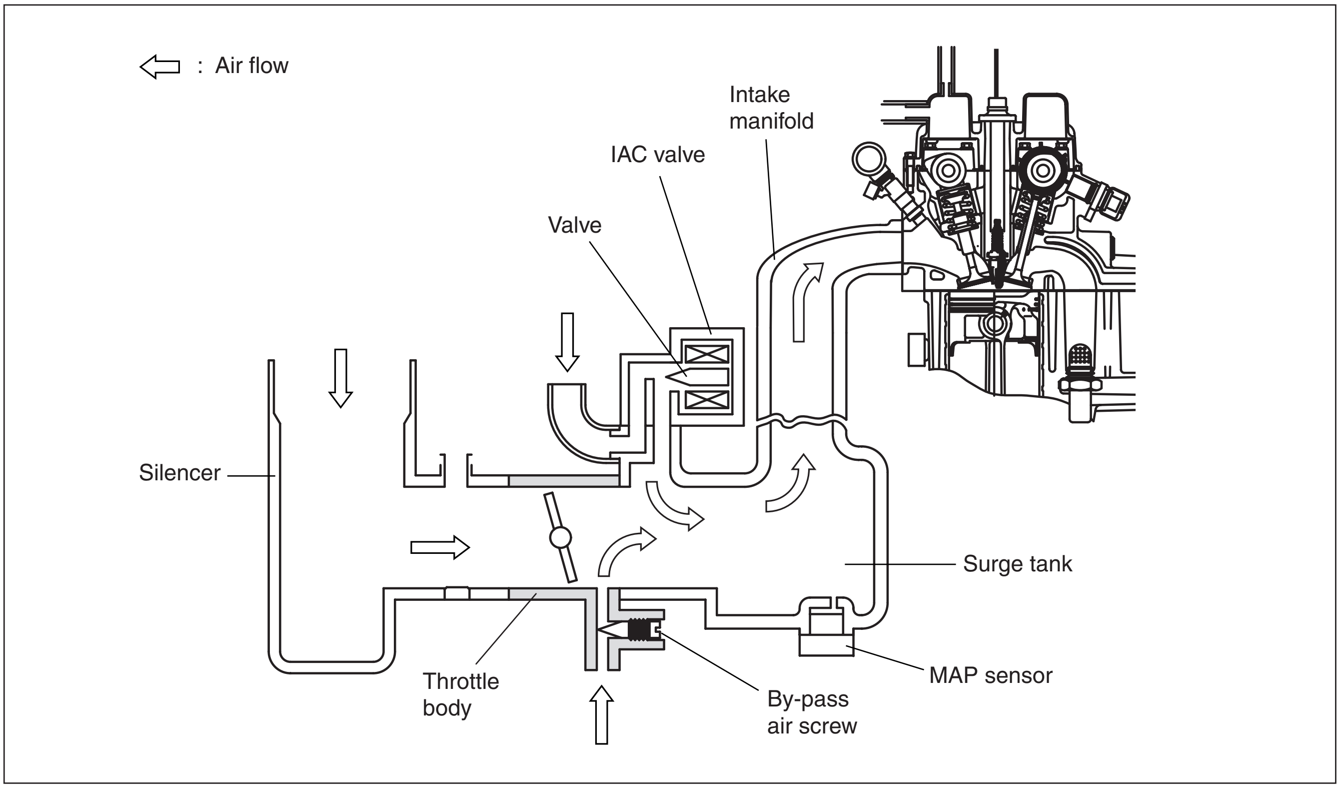
BEFORE START :
For 3 seconds after ignition switch is turned "ON", the pump is controlled to operate at 100% duty in order to initially pressurize the high pressure line.

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

WHEN RUNNING (NORMAL OPERATION) :
The pump is controlled to operate at 70 – 90% duty based on the current engine speed and battery voltage.

AIR INTAKE COMPONENTS

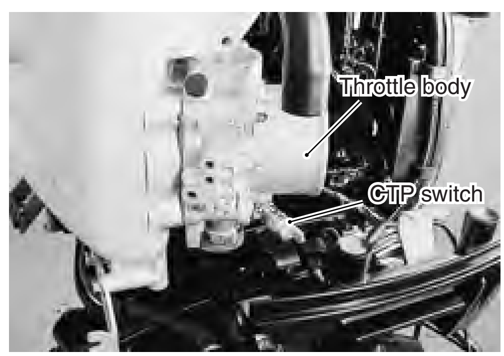
Air, after entering through the silencer, passes through the throttle body and flows into the surge tank where it is then distributed to the cylinder intake manifold.
Intake manifold pressure, monitored by the MAP sensor, is an indirect measure of the intake air amount.
When the throttle is fully closed, 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

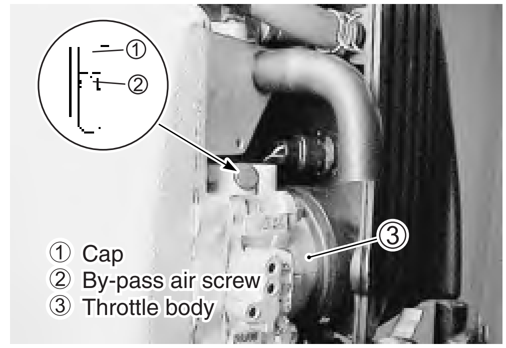
The throttle body assembly consists of the main bore, throttle valve, by-pass air passage, by-pass air screw and CTP switch.
The throttle body adjusts the intake air amount with the throttle valve which is connected to the throttle / linkage lever.
The CTP (closed throttle position) switch installed on the bottom 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

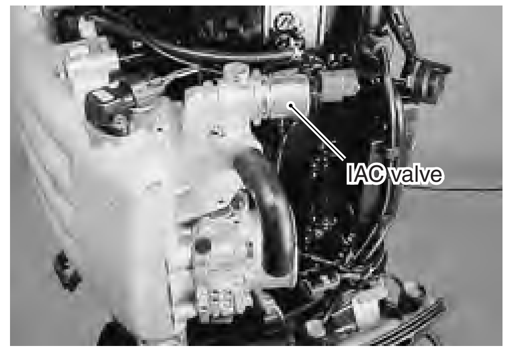
Since the throttle valve is almost fully closed when idling / trolling, the main flow of air necessary to maintain idling / trolling speed passes through the by-pass air passage.
The by-pass air screw controls the flow of air through the passage and provides a means of partially adjusting the total amount 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 linear solenoid plunger type mounted on the intake manifold.
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.



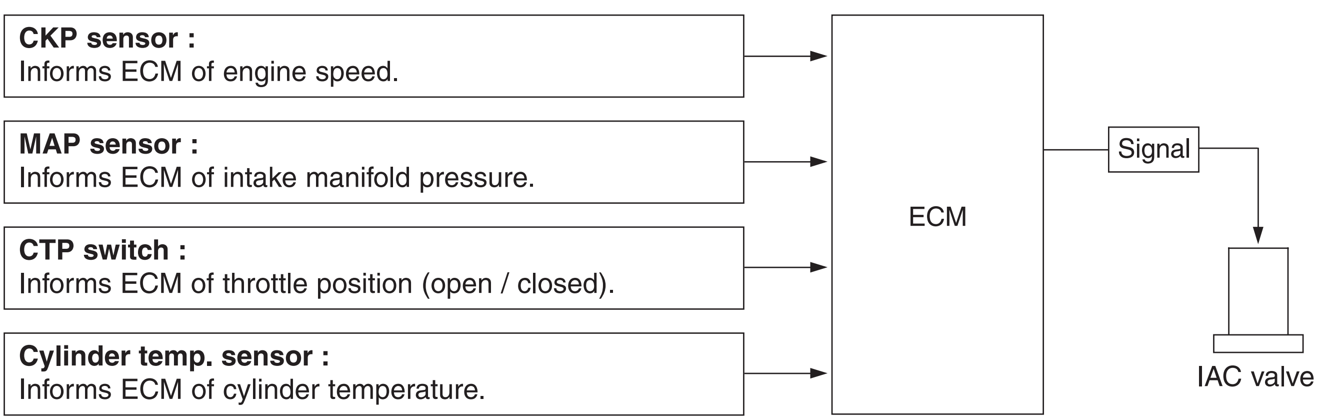
IDLE AIR CONTROL SYSTEM

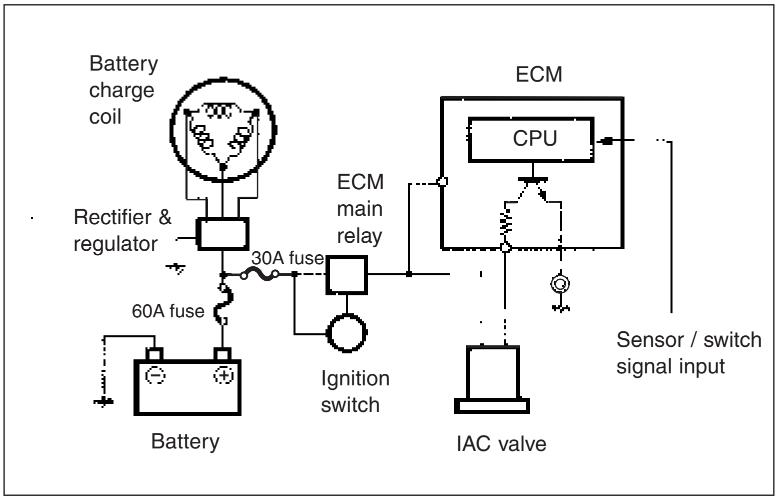
OUTLINE

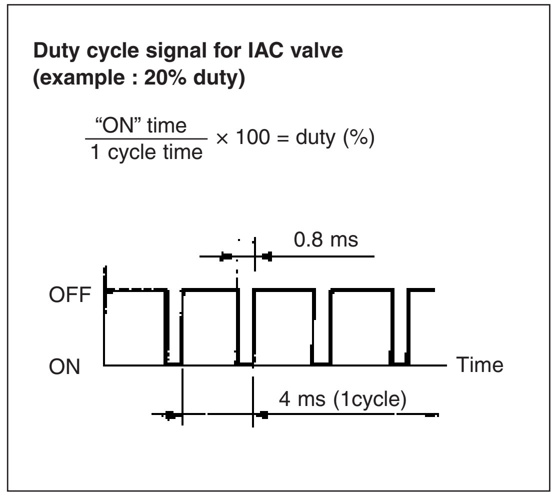
The ECM controls the duty cycle signal of the IAC valve to regulate a portion of the intake air flow to the intake manifold.
This system is used for the following purposes :

- To keep idling / trolling at 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 (250 times a second) is then sent to the IAC valve.







CONTROL MODE

BEFORE START :
The IAC valve is closed (0% duty) when engine is not running (but ignition switch is ON).

WHEN CRANKING :
The IAC valve is controlled to operate at approx. 80% duty.

AFTER START (FAST-IDLE FUNCTION) :
The IAC valve is controlled to operate at approx. 25 – 50% 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. 15% but will vary slightly as idling / trolling conditions change.

WHEN RUNNING (NORMAL OPERATION) :
The IAC valve is controlled to operate at 20 – 50% 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 approx. 15% duty at the engine idling / trolling specification.
See page 2-14 for the by-pass air screw adjustment procedure.

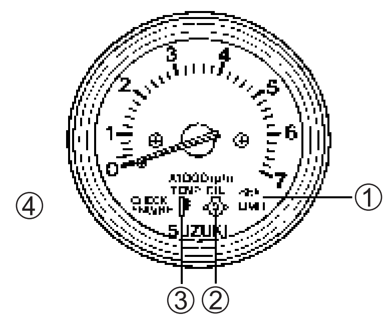
CAUTION SYSTEM

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., the ECM initiates intermittent fuel injection and ignition signals to provide a maximum engine speed of 6500 r/min. (Over-revolution limiter).

ACTION :

Engine speed	Automatically reduced to approx. 3000 r/min. by intermittent fuel injection and ignition signals.
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 and ignition signals 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 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 1.0 kg/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 114°C.

CONDITION 2 (Temp. rise vs Time)

Immediate activation of system when :

- The average temperature difference during three consecutive 10 seconds 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
86 °C ~ 99 °C	Approx. 2.2 °C
99 °C ~	Approx. 0.6 °C

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

Temperature range	Temperature difference
80 °C ~ 95 °C	Approx. 9.6 °C
95 °C ~	Approx. 1.4 °C

ACTION :

Engine speed	Automatically reduced to approx. 3000 r/min. by intermittent fuel injection and ignition signals 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 rev-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. 70 °C
Condition 2 (Temperature rise vs Time)	Approx. 65 °C

LOW BATTERY VOLTAGE CAUTION SYSTEM

CONDITION :

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

ACTION:

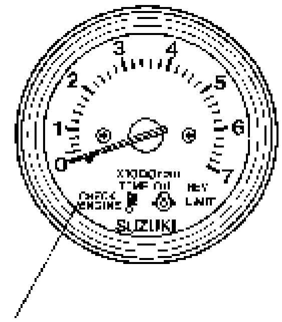
Engine speed	No engine speed limiter is activated.
Caution lamp	“CHECK ENGINE” lamp lights continuously.
Caution buzzer	Sounds in a series of long (1.5 sec.) beeps.

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

MONITOR-TACHOMETER



"CHECK ENGINE" lamp

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.

PRIORITY / CODE / PATTERN FOR SELF-DIAGNOSTIC SYSTEM OPERATION

PRIORITY	FAILED ITEM	CODE	LAMP FLASHING PATTERN	FAIL-SAFE SYSTEM ACTIVE
1	MAP sensor 1	3 – 4	on off	YES
2	CKP sensor	4 – 2	on off	YES
3	IAC valve / By-pass air screw adjustment	3 – 1	on off	NO
4	CMP sensor	2 – 4	on off	YES
5	CTP switch	2 – 2	on off	NO
6	Cylinder temp. sensor	1 – 4	on off	YES
7	IAT sensor	2 – 3	on off	YES
8	MAP sensor 2 (Pressure detect passage)	3 – 2	on off	NO
9	Rectifier & regulator (Over-charging) [NOTE1]	1 – 1	on off	NO
10	Exhaust manifold temp. sensor	1 – 5	on off	YES
11	Fuel injector	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 :

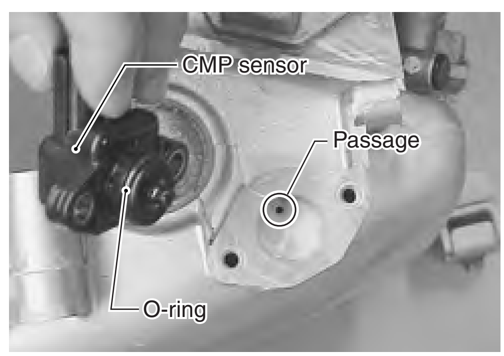
The self-diagnostic indication may be canceled by turning ignition switch “ON” because the ECM detects only battery voltage, not charging output. Under this condition the buzzer will not sound a 1-1 code.
However, if the rectifier & regulator have failed, the self-diagnostic indication will again appear 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	• During one crankshaft rotation, 34 signals are not input to the ECM
IAC valve / By-pass air screw adjustment	• IAC valve operates at 90% duty or higher when CTP switch is “ON” [NOTE 1]
CMP sensor	• During two crankshaft rotations, 4 signals are not input to the ECM
CTP switch	• Receiving “ON” signal when engine speed is 2500 r/min. or higher and intake manifold pressure is 319 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 +178 °C (0.04 – 4.46V)” signal
MAP sensor 2 (Pressure detect passage)	• 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 operation signal from the ECM

NOTE 1:
These conditions 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.

NOTE 2:
This condition will be caused by clogged pressure detect passage in intake manifold.



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]
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

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, using a combination of the tachometer needle and “REV-LIMIT” lamp flashing.

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

MONITOR-TACHOMETER

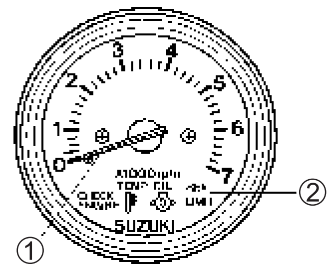


CHART OF TOTAL OPERATING HOURS INDICATION

Total operating hours	MONITOR-TACHOMETER	
	Needle ① indication	**REV-LIMIT lamp ② flashing ***
0 h – (49 h)	No	No
50 h	500 rpm	
60 h	600 rpm	
⋮	⋮	
540 h	5400 rpm	
550 h	500 rpm	1 time
560 h	600 rpm	
⋮	⋮	
1040 h	5400 rpm	
1050 h	500 rpm	2 times
⋮	⋮	
1540 h	5400 rpm	
1550 h	500 rpm	3 times
⋮	⋮	
2030 h	5300 rpm	
2040 h or over	5400 rpm	3 times

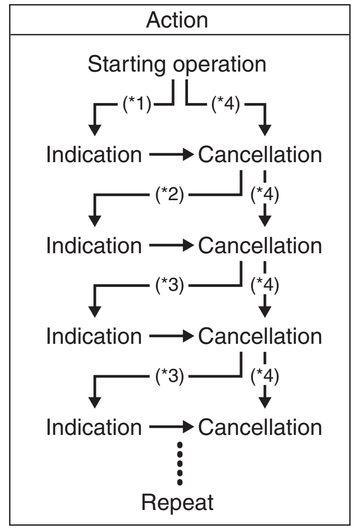
* : One flashing is corresponded to 500 hours.

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, 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 untill canceling system activation.

NOTE:

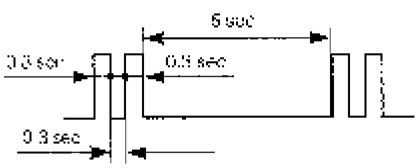
This system will activate up to 2100 hour’s operation.



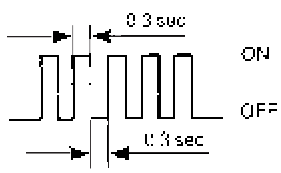
*1 : Lapse of initial 20 hour’s operation
*2 : Lapse of 80 hour’s operation
*3 : Lapse of 100 hour’s operation
*4 : When performing cancellation before system activation

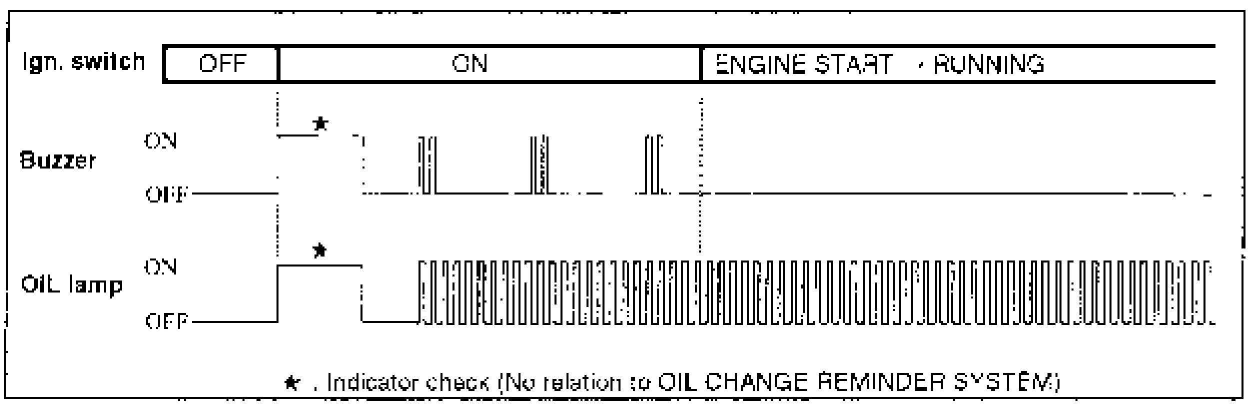
INDICATION OF SYSTEM ACTIVATION

Buzzer



OIL lamp

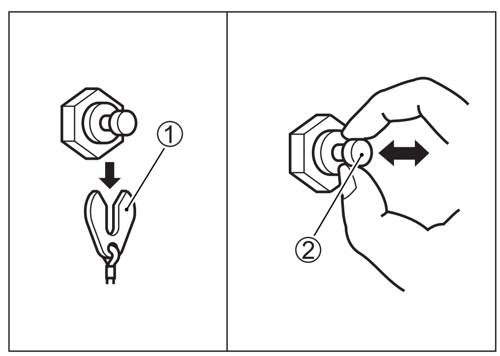




CANCELLATION

Procedure

1. Turn ignition key to “ON” position.
2. Pull out emergency stop switch plate ①.
3. Pull up emergency stop switch knob ② three times in seven seconds. A short beep will be heard if cancellation is successfully finished.
4. Turn ignition key to “OFF” position.
5. Set switch plate ① in 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.*

START-IN-GEAR PROTECTION SYSTEM

A switch to detect neutral gear position is located on the cylinder block (STBD side) and operated by the clutch control lever.

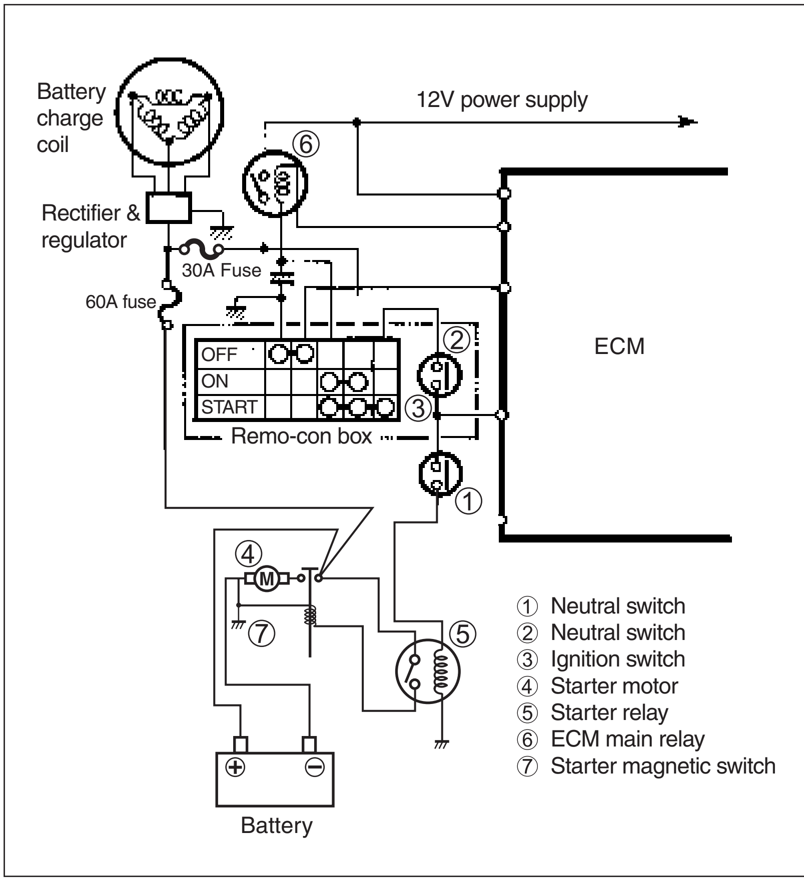
This ON / OFF type switch is “ON” in neutral and “OFF” in forward or reverse.

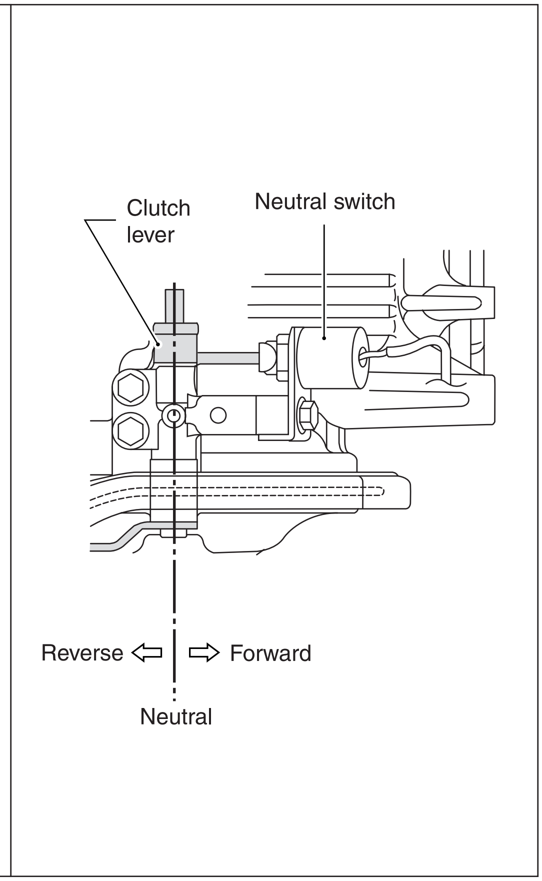
On starting the engine, the ECM detects the shift position using the neutral switch. When the neutral switch is “OFF”, the ECM does not provide injector operating signal.

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.

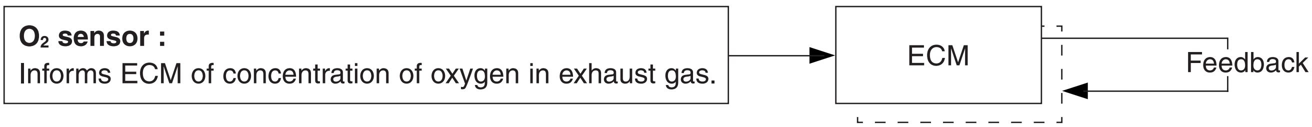
SHIFT POSITION	NEUTRAL SWITCH	OPERATION			
		Fuel injector	Ignition	Fuel pump	Starter motor
Neutral	ON	Yes	Yes	Yes	Yes
Forward / Reverse	OFF	No	Yes	Yes	No





O_2 FEEDBACK SYSTEM

After extended usage, 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 must be temporally installed in the exhaust manifold. This sensor is used to measure the concentration of oxygen in the exhaust gas at engine speeds of 2000, 3000 and 4000 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.



18213-74F00 : O_2 sensor

NOTE:
For fuel mixture check (O_2 feedback) operation procedure, refer to "Suzuki Diagnostic System Operation Manual".

INSPECTION

PRECAUTION ON SYSTEM INSPECTION

⚠ WARNING

To prevent any 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 5-3)**
  - **Disconnect high pressure fuel pump wire connector located on fuel vapor separator.**

CAUTION

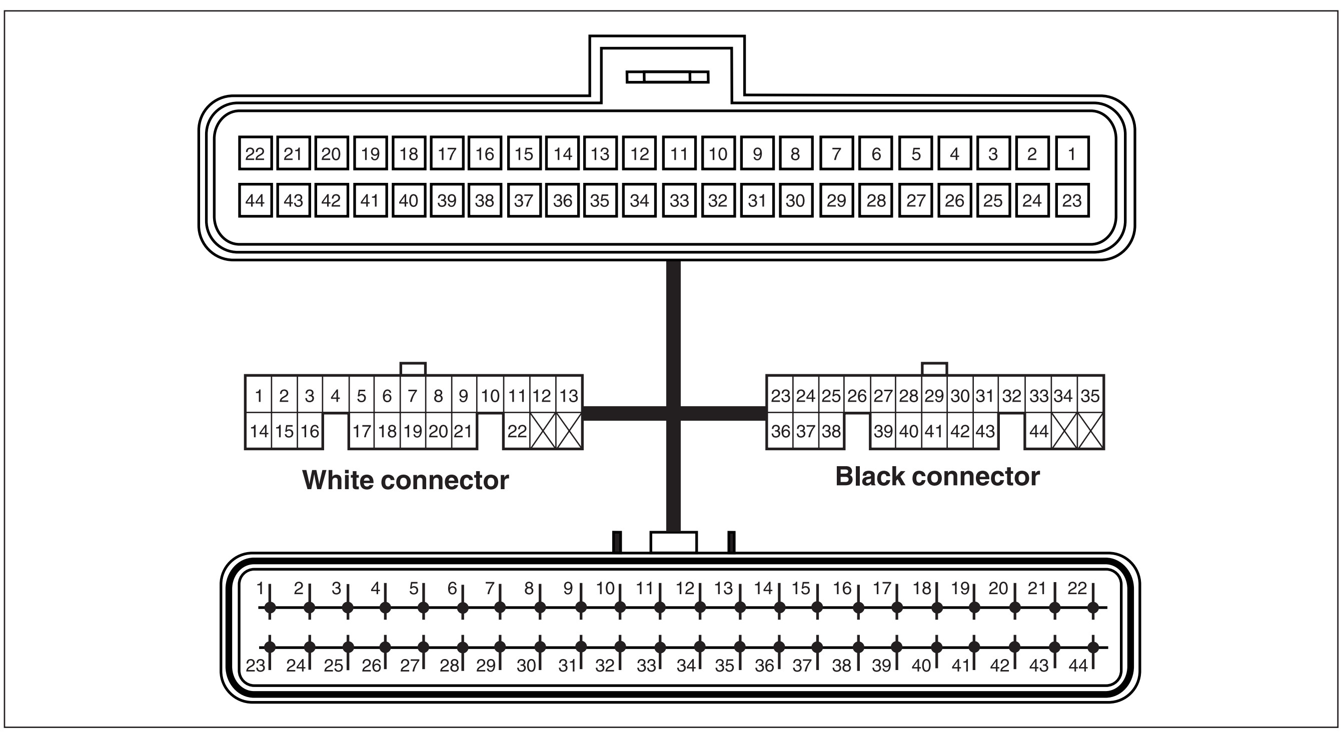
- **Always turn ignition switch "OFF" and disconnect battery cables when wires are being disconnected or connected.**
- **Hold and pull connector pieces when disconnecting. Do not pull wires.**

NOTE:
- *Self-diagnostic codes will remain in ECM memory 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.*

44-PIN TEST CORD

This test cord is used when checking the circuit for voltage, etc. and connected between ECM and the wiring harness.
To measure, connect the tester probe to the relevant terminal of the test cord.

TOOL **09930-89950 : 44-pin test cord**



INSPECTION FOR ECM CIRCUIT VOLTAGE

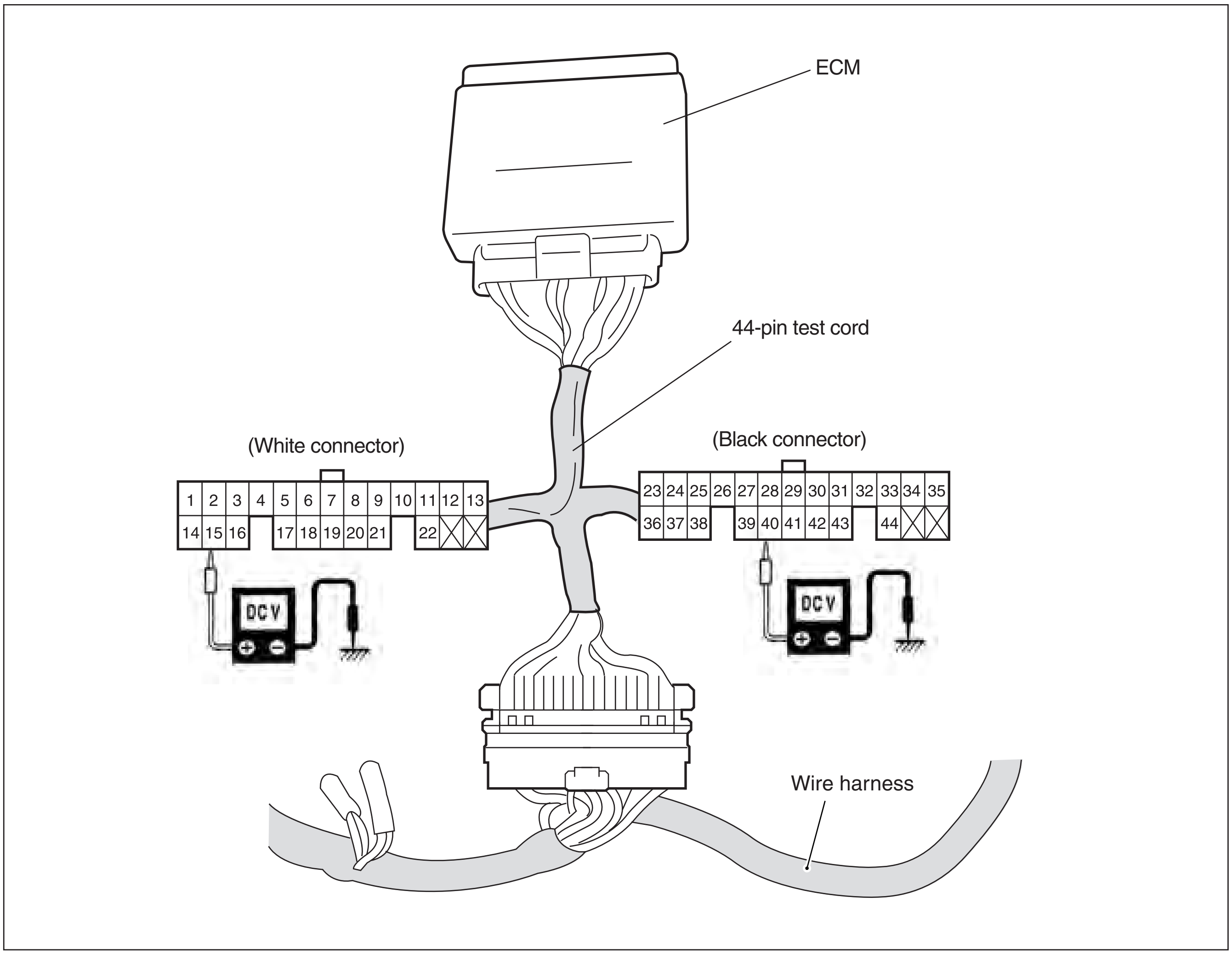
CAUTION

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 **09930-89950 : 44-pin test cord**
09930-99320 : Digital tester

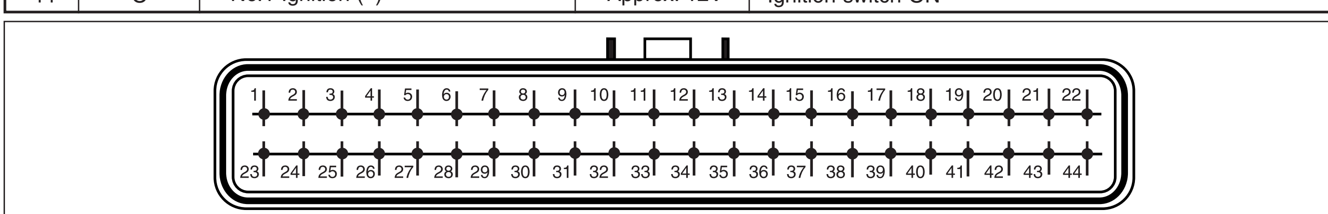
Tester range : ⎓ V (DC voltage)

1. Connect 44-pin test cord between ECM and wire harness as shown in figure.
2. Turn ignition switch ON.
3. Connect the tester probe ⊖ (Black) to body ground, and measure voltage according to "CIRCUIT VOLTAGE TABLE".



CIRCUIT VOLTAGE TABLE

TER-MINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION / REMARKS
1	—	—	—	—
2	Bl/R	Emergency stop switch	Approx. 5V	Ignition switch ON, stop switch plate IN
			Approx. 0V	Ignition switch ON, stop switch plate OUT
3	O	Buzzer cancel	Approx. 12V	Ignition switch ON, key pushed in
			Approx. 0V	Ignition switch ON, key not pushed in
4	Y/B	Tachometer	—	—
5	Br	Neutral switch	Approx. 0V	Ignition switch ON, shift in NEUTRAL
			Approx. 2.5V	Ignition switch ON, shift in FORWARD or REVERSE
			6 – 12V	While engine cranking.
6	—	—	—	—
7	V/W	Ex-manifold temp. sensor	0.10 – 4.63V	Ignition switch ON
8	—	—	—	—
9	Lg/W	Cylinder temp. sensor	0.10 – 4.63V	Ignition switch ON
10	B	Ground for ECM	—	—
11	B/W	Ground for sensors	—	—
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 (–)	Approx. 12V	Ignition switch ON
19	—	—	—	—
20	B	Ground for ignition coil	—	—
21	—	—	—	—
22	Lg	No.4 Fuel injector (–)	Approx. 12V	Ignition switch ON
23	Bl	Oil pressure switch	Approx. 5V	Engine running
			Approx. 0V	Engine stopped (Ignition switch ON)
24	Lg/R	CTP switch	Approx. 12V	Ignition switch ON, throttle open (any position)
			Approx. 0V	Ignition switch ON, throttle fully closed
25	P	REV-LIMIT lamp	—	—
26	G/W	CHECK ENGINE lamp	—	—
27	Bl/W	Buzzer	—	—
28	—	—	—	—
29	W	MAP sensor	0.20 – 4.53V	Ignition switch ON
30	Gr	ECM power source	Approx. 12V	Ignition switch ON
31	Lg/B	IAT sensor	0.04 – 4.46V	Ignition switch ON
32	B	Ground for ECM	—	—
33	O/G	CMP sensor	Approx. 0.3V or 5V	Ignition switch ON
34	B/G	O_2 feedback / PC communication	—	—
35	R	Power source for MAP sensor	Approx. 5V	Ignition switch ON
36	Y	PC communication	—	—
37	B/W	Fuel pump (–)	Approx. 0V	For 3 sec. after ignition switch ON
				Engine running
			Approx. 12V	Engine stopped (Ignition switch ON)
38	R/W	No.3 Fuel injector	Approx. 12V	Ignition switch ON
39	B/Y	No.2 Fuel injector injecortor	Approx. 12V	Ignition switch ON
40	O/B	No.1 Fuel injector	Approx. 12V	Ignition switch ON
41	—	—	—	—
42	B	Ground for ignition coil	—	—
43	Bl	No.2 Ignition (–)	Approx. 12V	Ignition switch ON
44	O	No.1 Ignition (–)	Approx. 12V	Ignition switch ON



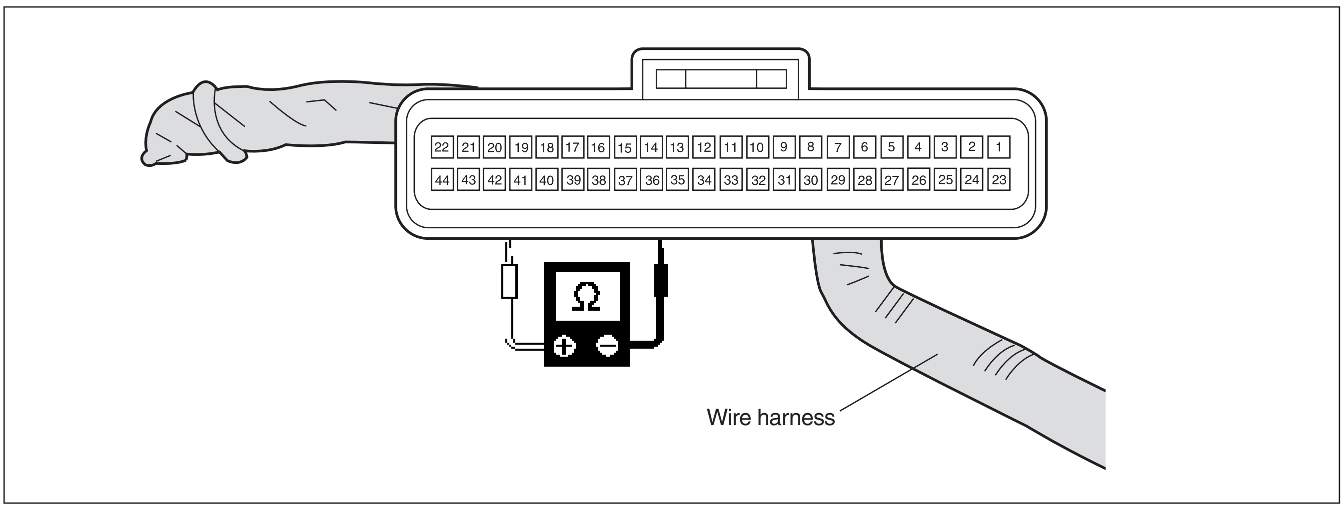
INSPECTION FOR RESISTANCE

TOOL 09930-99320 : Digital tester

Tester range : Ω (Resistance)

NOTE:
Make sure ignition switch is always OFF when measuring resistance.

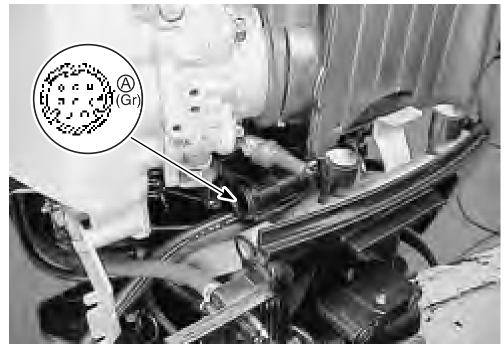
1. Disconnect battery cables from battery.
2. Disconnect wire harness connector from ECM.
3. Connect the tester probes to terminal (wire harness side), and measure resistance according to “RESISTANCE TABLE”.



RESISTANCE TABLE

ITEM	TERMINAL FOR TESTER PROBE CONNECTION	STANDARD RESISTANCE (at 20°C)
CKP sensor	15 (R/B) to 11(B/W)	168 – 252 Ω
Ignition coil No.1&4 (Primary)	30 (Gr) to 44 (O)	1.9 – 2.5 Ω
Ignition coil No.2&3 (Primary)	30 (Gr) to 43 (Bl)	
Fuel injector No.1	30 (Gr) to 40 (O/B)	11.0 – 16.5 Ω
Fuel injector No.2	30 (Gr) to 39 (B/Y)	
Fuel injector No.3	30 (Gr) to 38 (R/W)	
Fuel injector No.4	30 (Gr) to 22 (Lg)	
IAC valve	30 (Gr) to 18 (B/R)	8 – 12 Ω
IAT sensor	31 (Lg/B) to 11 (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	9 (Lg/W) to 11 (B/W)	
Ex-mani. temperature sensor	7 (V/W) to 11(B/W)	
ECM main relay	13 (P/B) to Terminal (A) [NOTE1]	80 – 120 Ω

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



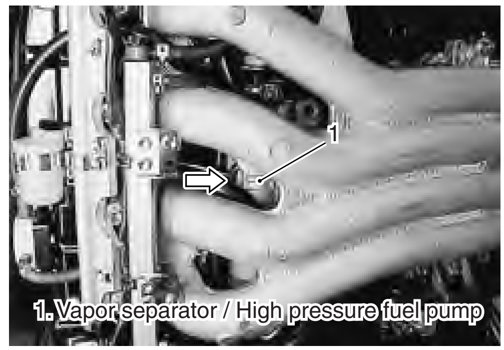
COMPONENT INSPECTIONS

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 pump sound clearly, use a sound scope or long blade screw driver.

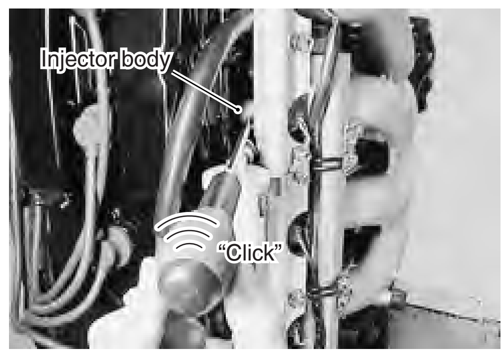


FUEL INJECTOR OPERATING SOUND (CRANKING)

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)

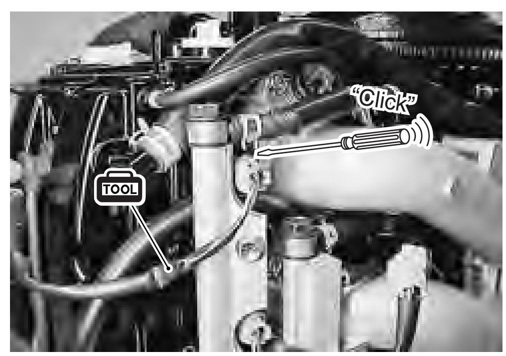
1. Disconnect fuel injector wire, and connect the test cord.

TOOL 09930-89260 : Injector test cord A

2. Connect Gray wire to body ground.

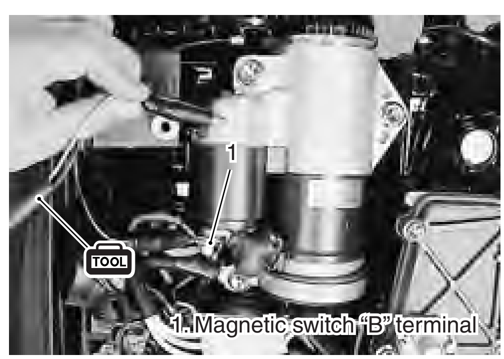
3. Momentarily touch Black/Yellow wire to starter motor magnetic switch "B" terminal (connected to battery positive ⊕ terminal), and check for injector operating sound.

   Injector operating sound : "Click"

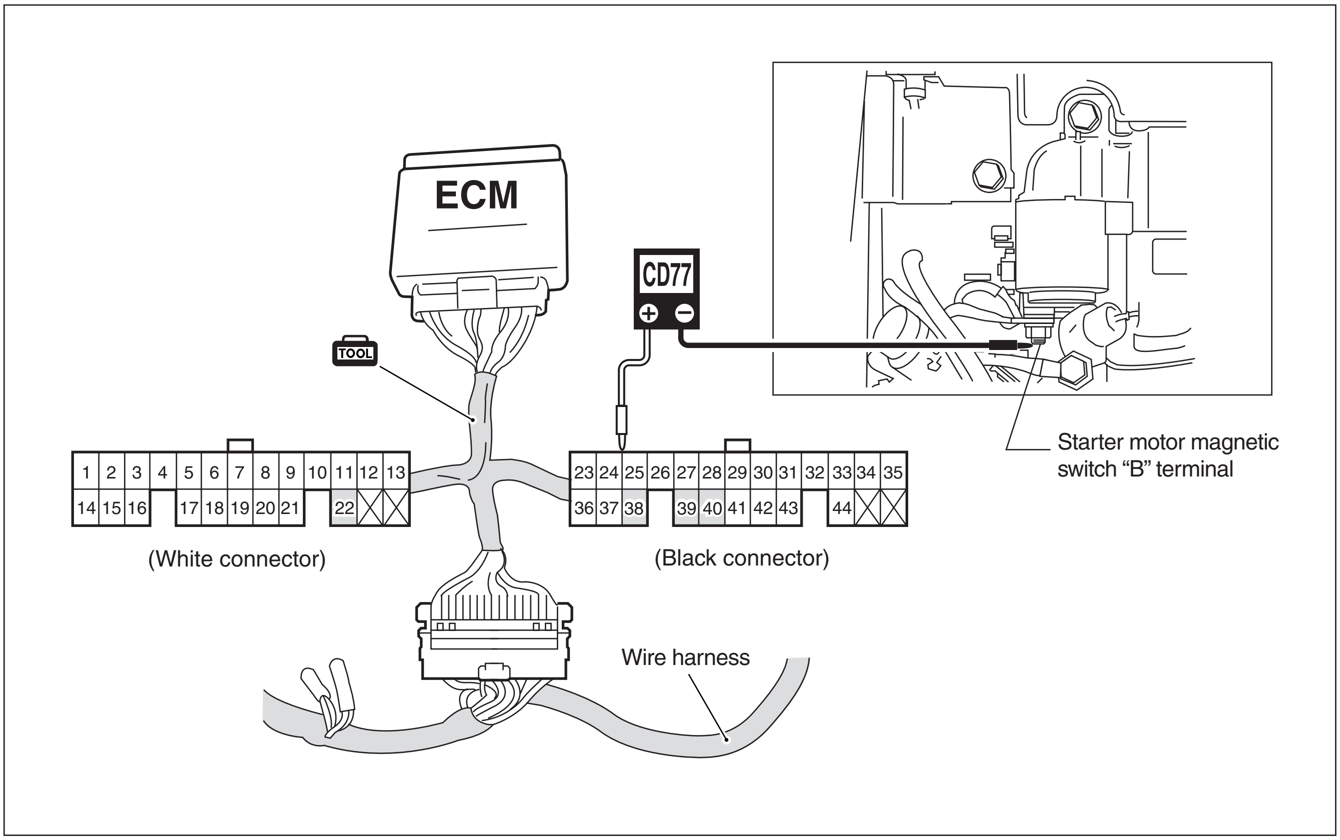


CAUTION

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



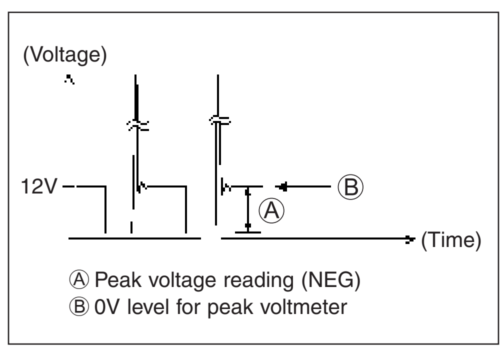
09930-89950 : 44-pin test cord

Peak voltmeter Stevens CD-77

Tester range : NEG50

1. Connect test cord between ECM and wire harness as shown in figure, then turn ignition switch ON.
2. Connect tester probe ⊖ (Black) to starter motor magnetic switch "B" terminal (connected to battery positive ⊕ terminal) as shown in figure.
3. Connect tester probe ⊕ (Red) to each terminal.

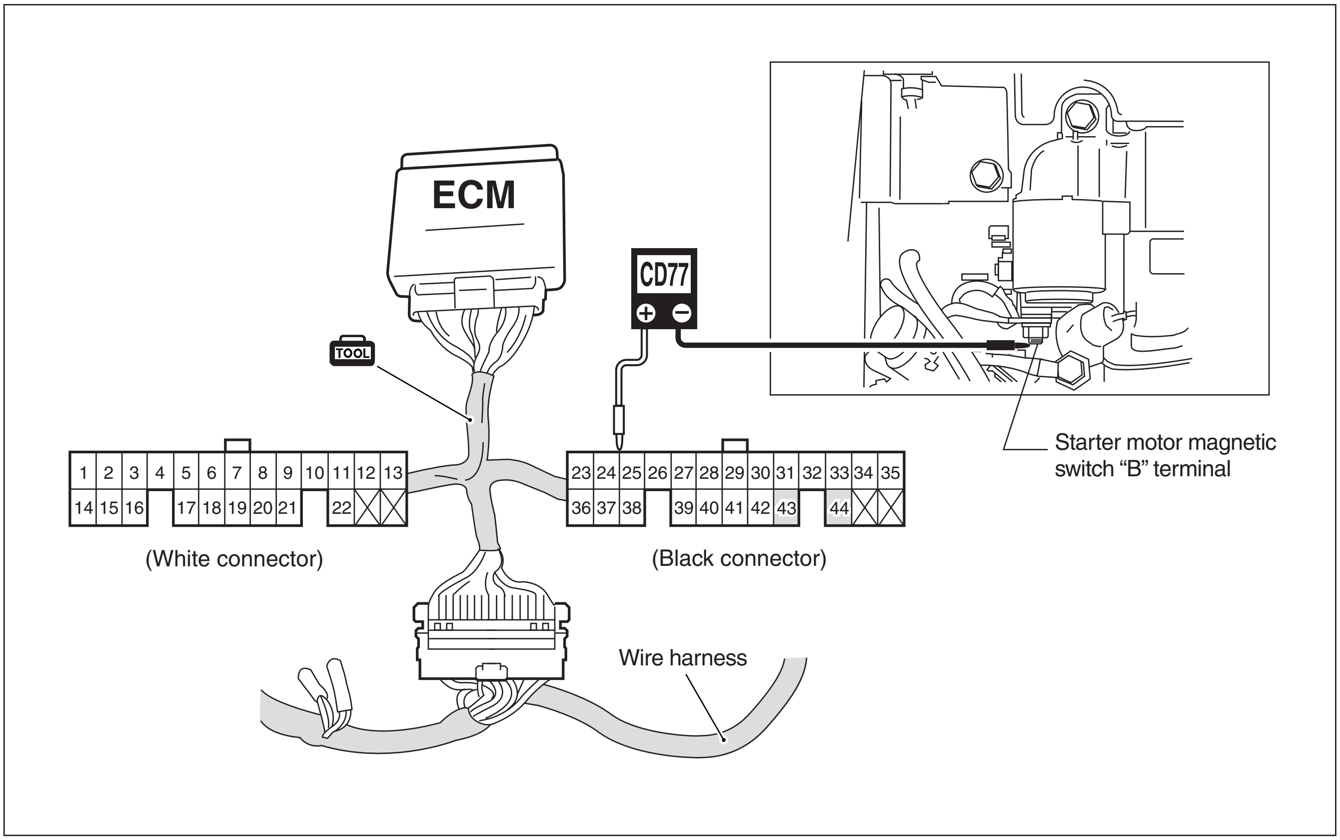
Injector	Terminal
No.1	40
No.2	39
No.3	38
No.4	22



4. Crank engine and measure voltage.

Fuel injector operating signal : 6 – 10 V

IGNITION COIL OPERATING SIGNAL

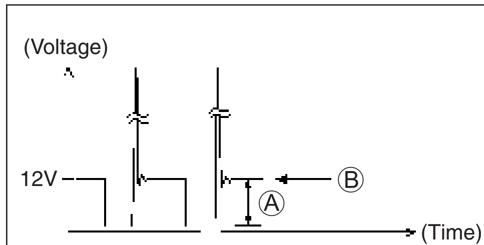


TOOL 09930-89950 : 44-pin test cord

Peak voltmeter Stevens CD-77
Tester range : NEG50

1. Connect test cord between ECM and wire harness as shown in figure, then turn ignition switch ON.
2. Connect tester probe ⊖ (Black) to starter motor magnetic switch "B" terminal (connected to battery positive ⊕ terminal) as shown in figure.
3. Connect tester probe ⊕ (Red) to each terminal.

Ignition coil	Terminal
No.1 & 4	44
No.2 & 3	43



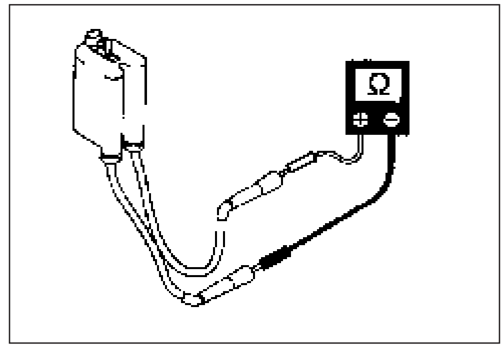
Ⓐ Peak voltage reading (NEG)
Ⓑ 0V level for peak voltmeter

4. Crank engine and measure voltage.
Ignition coil operating signal : 6 – 10 V

IGNITION SECONDARY COIL RESISTANCE

TOOL **09930-99320 : Digital tester**

Tester range : Ω (Resistance)



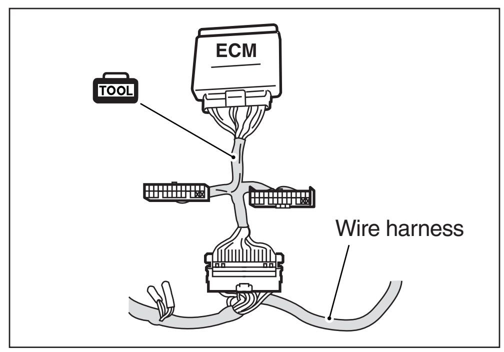
1. Disconnect spark plug caps from spark plugs.
2. Measure resistance between both spark plug caps as shown in figure.

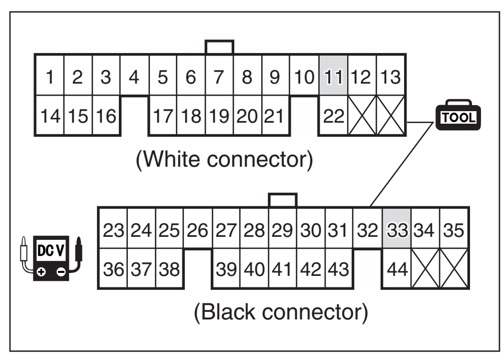
Ignition secondary coil resistance :
No. 2&3 18 – 34 kΩ
No. 1&4 19 – 36 kΩ

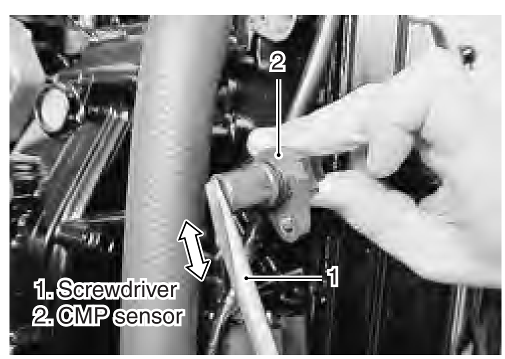
CMP SENSOR SIGNAL

TOOL **09930-89950 : 44-pin test cord**
09930-99320 : Digital tester

Tester range : ⎓ V (DC voltage)







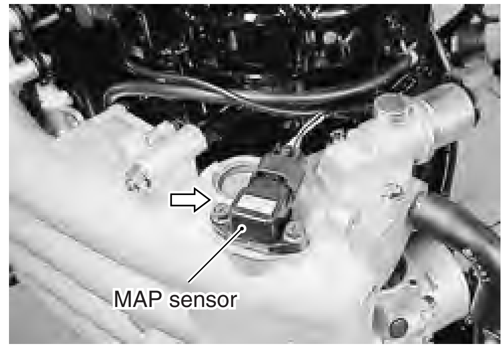
1. Remove CMP sensor. (See page 3-53.)
2. Connect 44-pin test cord between ECM and wire harness as shown in figure.
3. Connect tester probe ⊕ (Red) to No.33 terminal.
4. Connect tester probe ⊖ (Black) to No.11 terminal (or to body ground).
5. Turn ignition switch ON.
6. Measure voltage when steel tip of a screwdriver is brought near and then pulled away from sensor tip.

CMP sensor signal : Approx. 0.3V or 5V

NOTE:

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

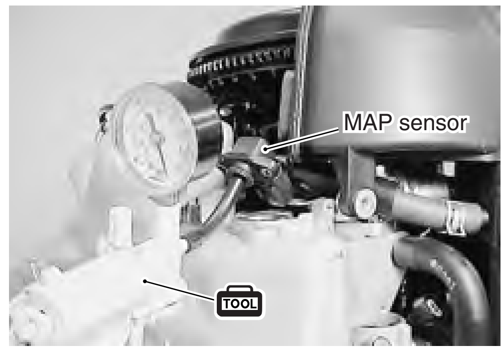
MAP SENSOR OUTPUT VOLTAGE CHANGE



TOOL **09917-47011 : Vacuum pump gauge**
09930-89950 : 44-pin test cord
09930-99320 : Digital tester

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

1. Remove bolts and MAP sensor from intake manifold.
2. Connect vacuum pump gauge (with hose) to MAP sensor as shown in figure.
3. Turn ignition switch ON.
4. While applying negative pressure (vacuum) to MAP sensor, measure "29" terminal voltage. (See page 3-36 and 3-37 for procedure)



MAP sensor output voltage change :

Negative pressure kPa (kg/cm², mm Hg)	0 (0, 0)	40 (0.4, 300)	80 (0.8, 600)
"29" terminal voltage (V)	4.00	2.42	0.84

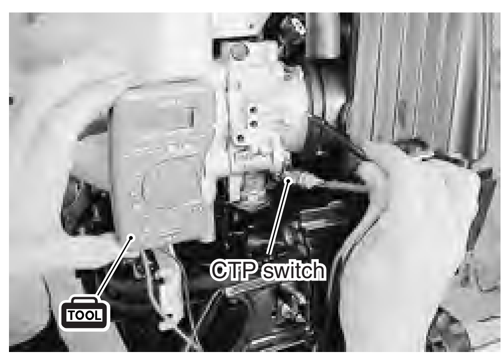
(at 1013 hPa barometric pressure)

CTP SWITCH

TOOL **09930-99320 : Digital tester**

CONT **Tester range : (Continuity)**

1. Disconnect CTP switch wire.
2. Inspect continuity between CTP switch terminal and body ground.



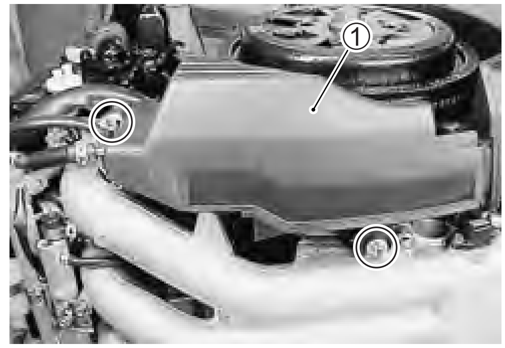
CTP switch function :

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

OIL PRESSURE SWITCH

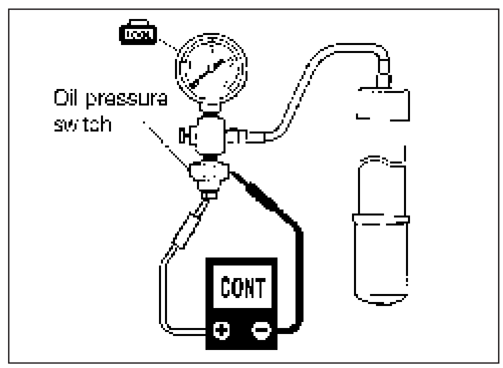
TOOL 09940-44121 : Air pressure gauge
09952-99310 : Air pump

Tester range : (Continuity)



1. Remove bolts and air duct ①.
2. Remove oil pressure switch. (See page 3-54)

3. Connect the gauge and pump as shown in figure.
4. While applying pressure to oil presure switch, inspect continuity between, switch body and switch terminal bolt as shown in figure.



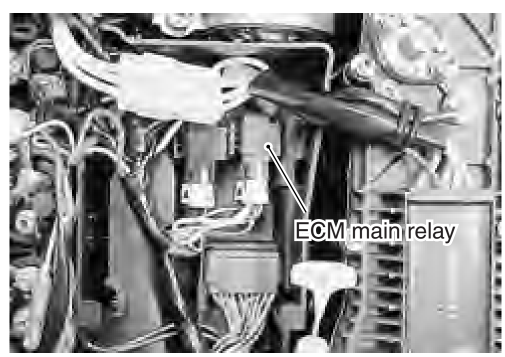
ECM main relay function :

Pressure kPa (kg/cm²)	Continuity
Less than 70 – 130 (0.7 – 1.3)	Yes
70 – 130 (0.7 – 1.3) or over	No

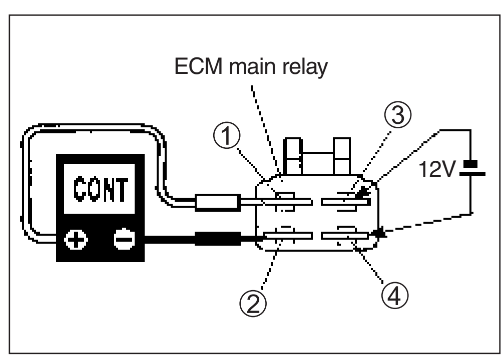
ECM MAIN RELAY

TOOL 09930-99320 : Digital tester

Tester range : (Continuity)



1. Disconnect ECM main relay from wire harness.
2. Inspect 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 3-35.

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 4-9.

CHART1 : SELF-DIAGNOSTIC CODE “3-4”

START

< Ignition switch “ON” >
Check “35” terminal voltage.
Is result OK? (See page 3-37)

NO → ECM failure

YES ↓

< Ignition switch “ON” >
Check “29” terminal voltage.
Is result OK? (See page 3-37)

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 3-38)

NO → CKP sensor failure

YES ↓

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

NOTE:
If there is an open circuit of any of the connector wires, sensor damage or any other malfunction, ignition timing will remain fixed at BTDC 5°.

CHART3 : SELF-DIAGNOSTIC CODE “3-1”

START

< Ignition switch “OFF” >
Check IAC valve resistance.
Is result OK? (See page 3-38)

NO → IAC valve failure

YES ↓

< Ignition switch “ON” >
Check “18” terminal voltage.
Is result OK? (See page 3-37)

NO → ECM failure

YES ↓

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

CHART4 : SELF-DIAGNOSTIC CODE “2-4”

START

< Ignition switch “ON”>
Check CMP sensor signal.
Is result OK? (See page 3-42)

NO → CMP sensor failure

YES ↓

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

NOTE:
If there is an open circuit of any of the connector wires, sensor damage or any other malfunction, ignition timing will remain fixed at BTDC 5°.

CHART5 : SELF-DIAGNOSTIC CODE “2-2”

START

< Ignition switch “ON” >
Check “24” terminal voltage.
Is result OK? (See page 3-37)

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 3-38)

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 3-38)

NO → IAT sensor failure

YES ↓

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

CHART8 : SELF-DIAGNOSTIC CODE “3-2”

START

< Ignition switch “ON” >
Check MAP sensor output voltage change.
Is result OK? (See page 3-43)

NO → MAP sensor failure

YES ↓

Possible cause :
- Clogged pressure detect passage
- 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 4-4)

NO → Rectifier & regulator failure

YES ↓

< Engine running >
Check “30” terminal voltage at idle speed. (See page 3-37)
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 3-38)

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 operating sound (individual).
Is result OK? (See page 3-39)

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.**

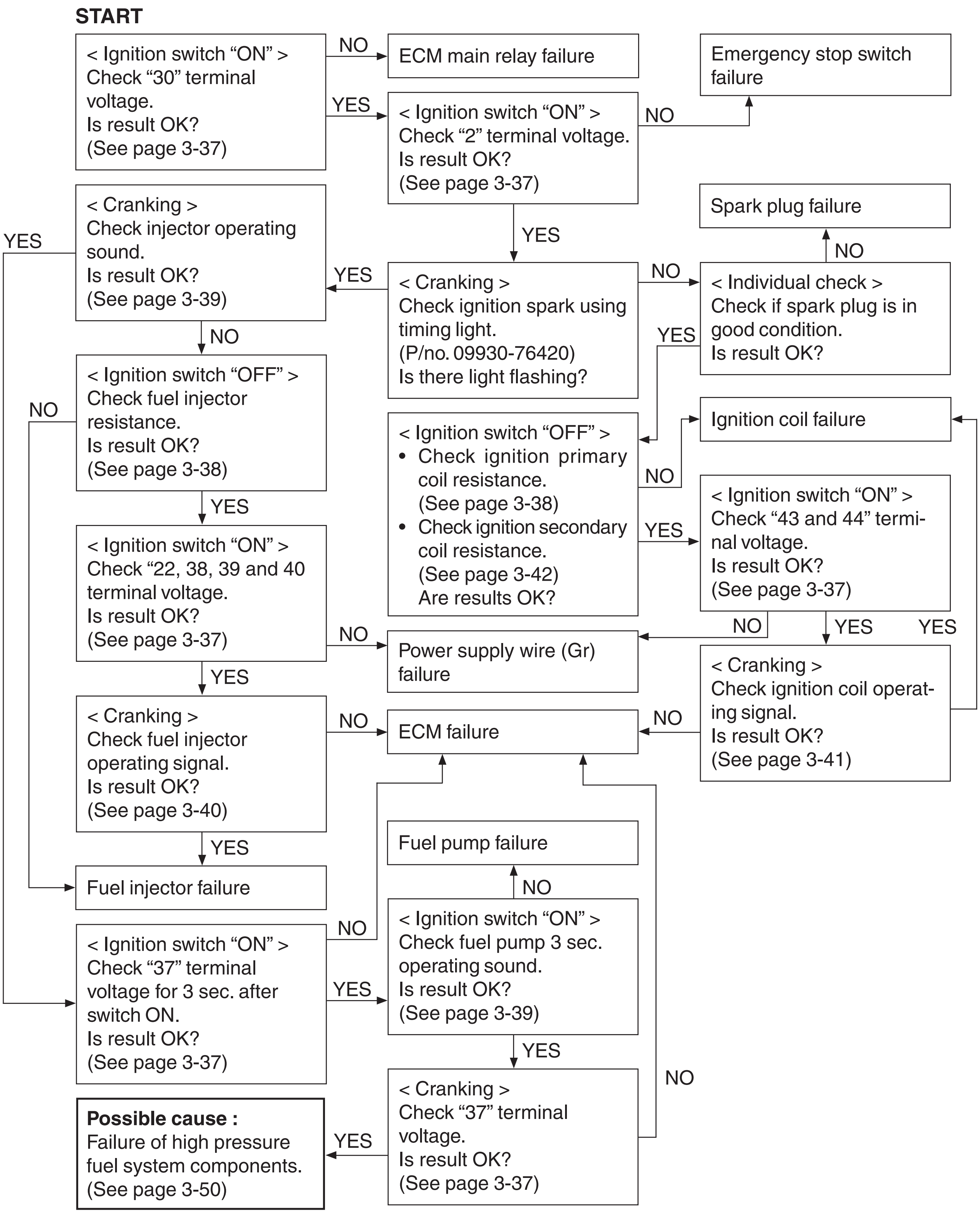
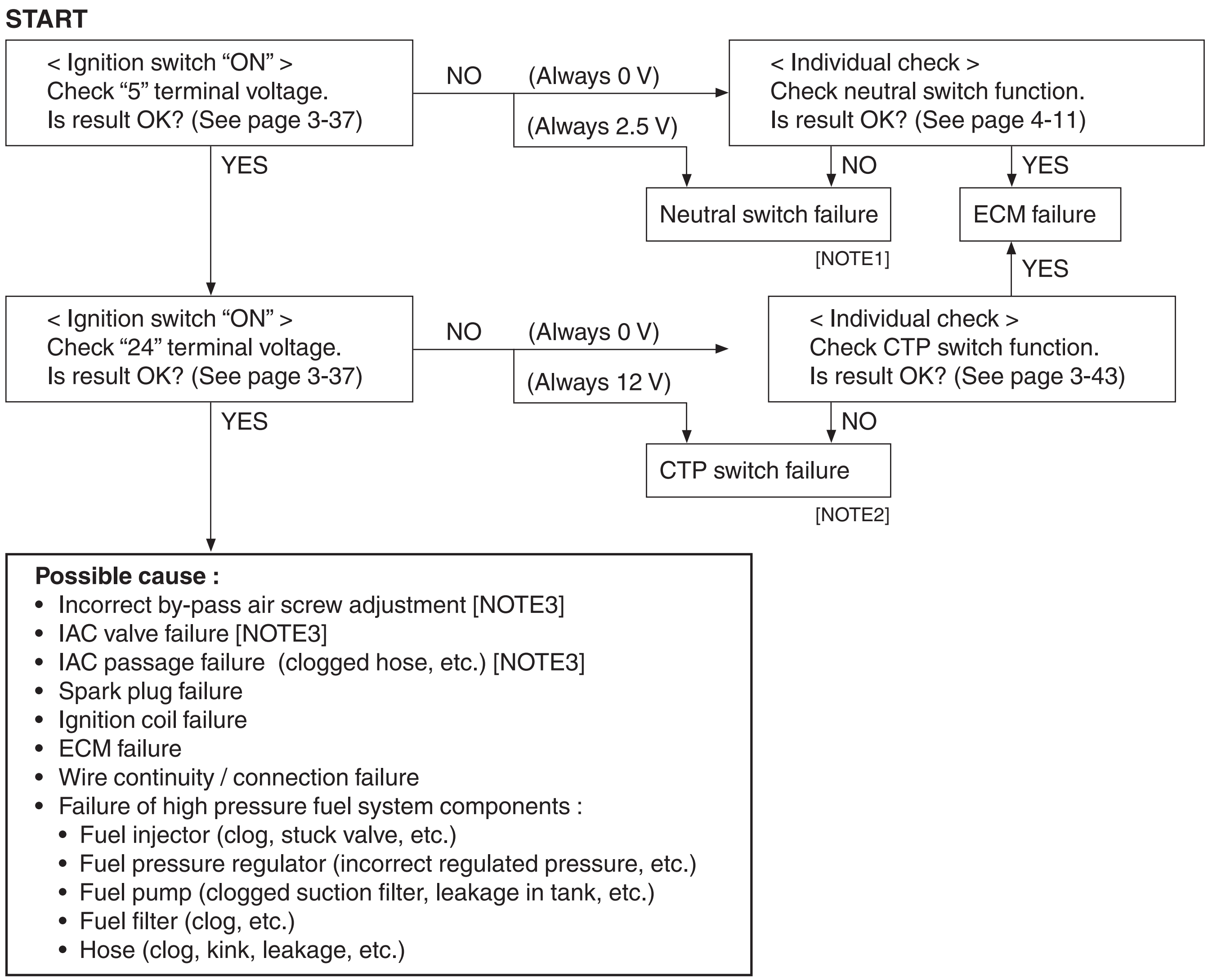


CHART13 : UNSTABLE IDLING / TROLLING (OR ENGINE TENDS TO STALL)

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

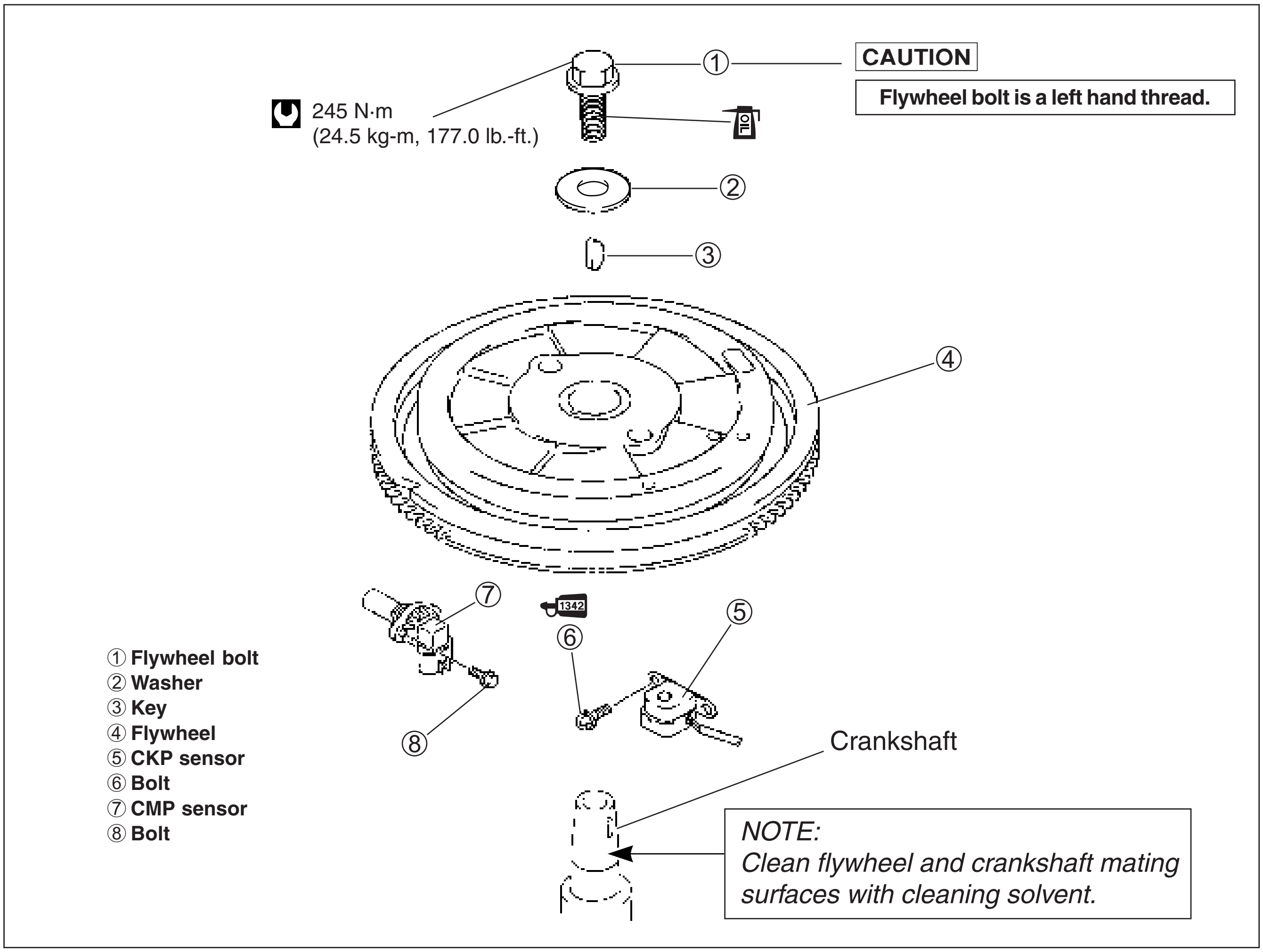


NOTE1:
If neutral switch has failed (while engine running), engine will tend to stall when shifting into gear.
If neutral switch has failed as “always ON”, engine speed is limited to 3000 r/min. by intermittent fuel injection and ignition timing is fixed at BTDC 8°.
If neutral switch has failed as “always OFF”, engine can not be cranked.

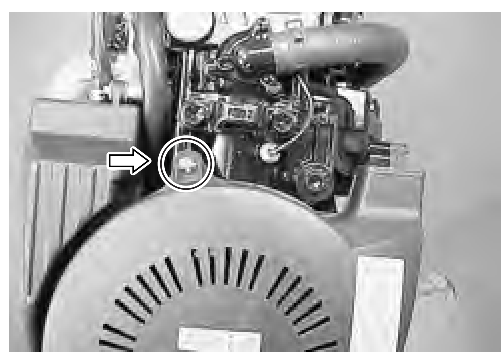
NOTE2:
If CTP switch has failed, engine will tend to stall when decelerating.

NOTE3:
- *The self-diagnostic code “3-1” may not be indicated because IAC valve condition depends on ECM control. (See page 3-29)*
- *If IAC valve has failed, “Fast-idle function (warm-up mode)” won’t operate.*

REMOVAL / INSTALLATION
FLYWHEEL



REMOVAL



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

1. Remove flywheel cover.
2. Loosen flywheel bolt 2 – 3 turns to right direction.

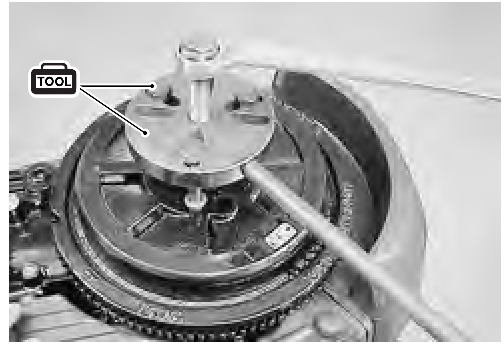
CAUTION

Flywheel bolt is a left hand (LH) thread.

TOOL **09930-48720 : Flywheel holder**

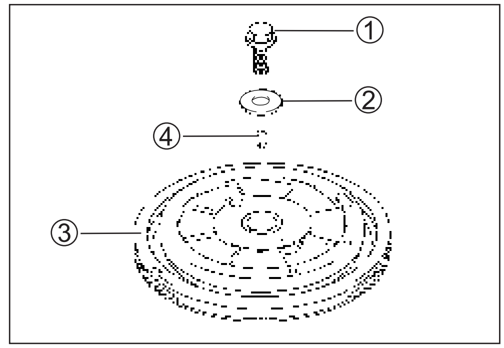
NOTE:
Do not remove flywheel bolt at this time.
This bolt prevents damage to crankshaft when using flywheel remover tools.

3. Using special tools, loosen flywheel from crankshaft.



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

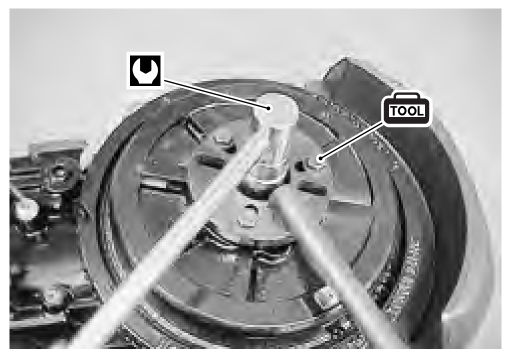
4. Remove flywheel bolt ①, washer ②, flywheel ③ and key ④.



INSTALLATION

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

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

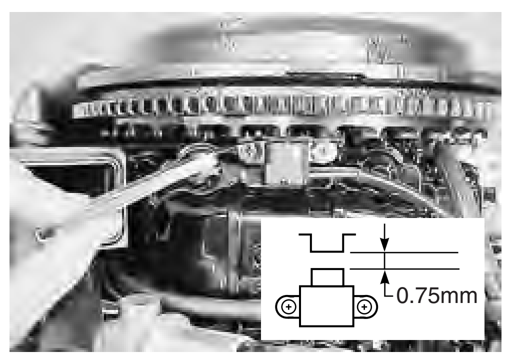


TOOL **09930-48720 : Flywheel holder**

Flywheel bolt : 245 N·m (24.5 kg-m, 177.0 lb.-ft.)

- Measure air gap between CKP sensor and reluctor bars on flywheel magneto. (See page 3-53)

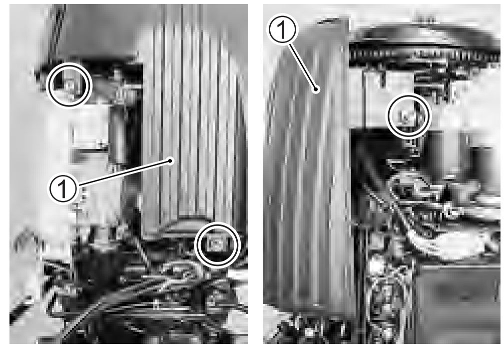
Air gap : 0.75 mm (0.030 in.)



CKP SENSOR

REMOVAL

Prior to removing CKP sensor :
• Disconnect battery cables from battery.



1. Remove flywheel cover.

2. Remove three (3) bolts and air silencer case ①.
   Disconnect IAT sensor lead wire connector at IAT sensor.

3. Disconnect CKP sensor lead wire connector in electric parts holder.

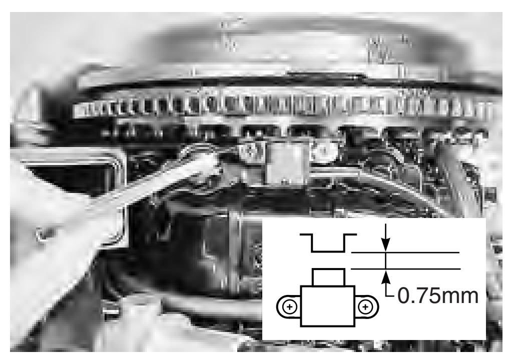
4. Remove two (2) bolts and CKP sensor ②.

INSTALLATION

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

- Apply Thread Lock 1342 to sensor mounting bolts.

99000-32050 : Thread Lock 1342



- Install CKP sensor with air gap of 0.75 mm between sensor and reluctor bar on flywheel, then tighten sensor mounting screw securely.

Air gap : 0.75 mm (0.030 in.)

CMP SENSOR

REMOVAL

1. Disconnect CMP sensor lead wire connector at CMP sen sor.

2. Remove bolt and CMP sensor.

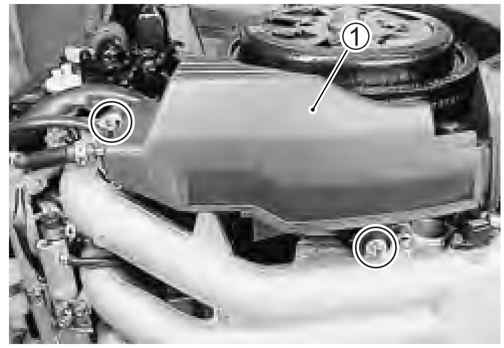
INSTALLATION

Installation is reverse order of removal.

OIL PRESSURE SWITCH

REMOVAL

1. Remove bolts and air duct ①.



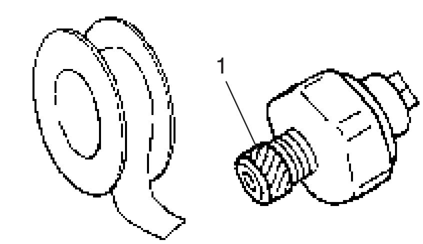
2. Loosen bolt and disconnect blue lead wire from switch.

3. 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 (1.3 kg-m, 9.5 lb.-ft.)

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

ELECTRICAL

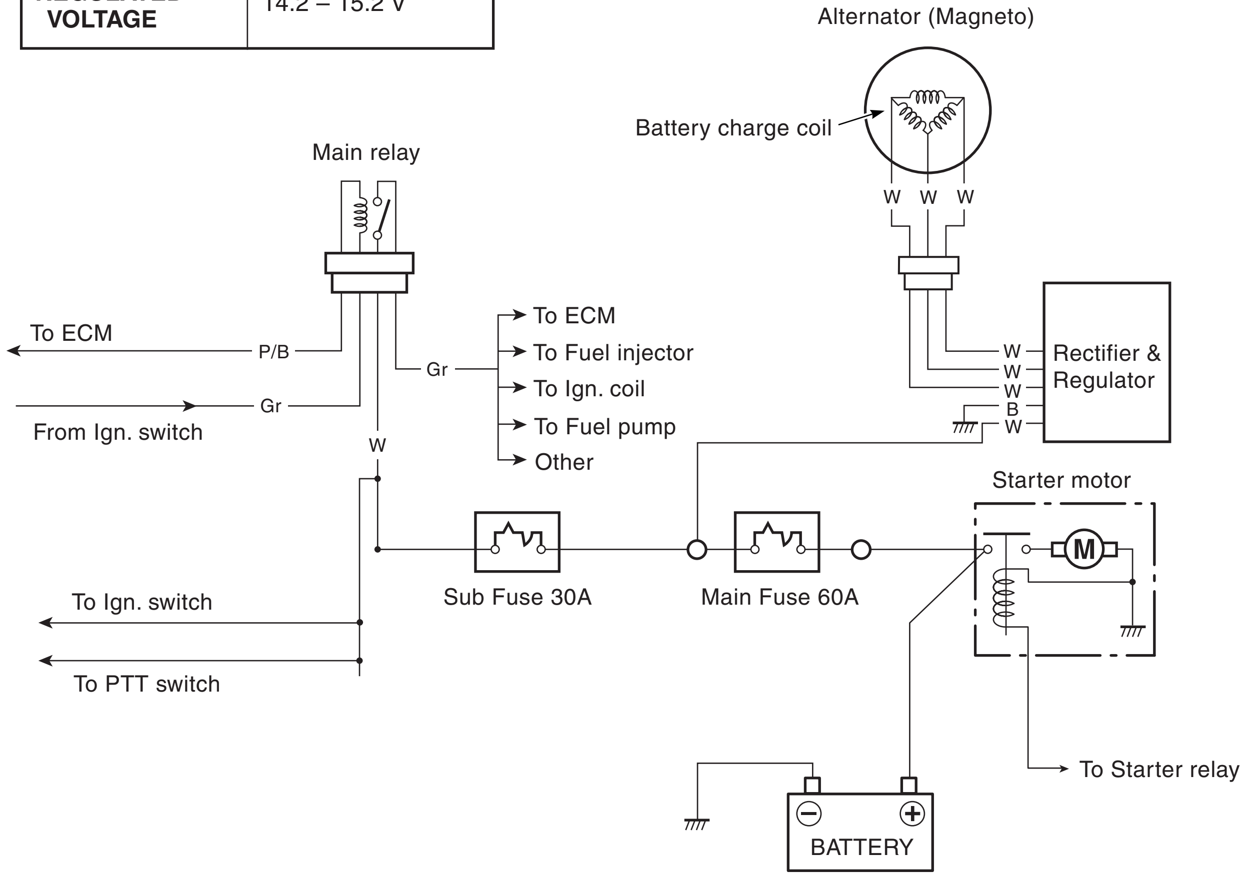
CONTENTS

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	480 W (12V 40A)
REGULATED VOLTAGE	14.2 – 15.2 V



INSPECTION

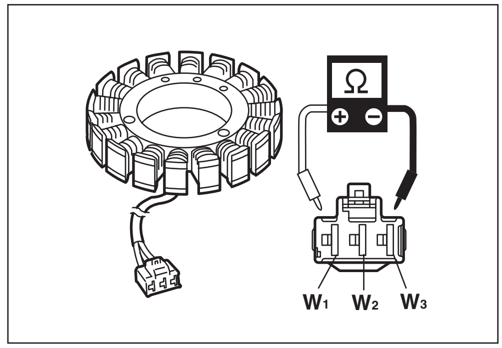
BATTERY CHARGE COIL

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 :

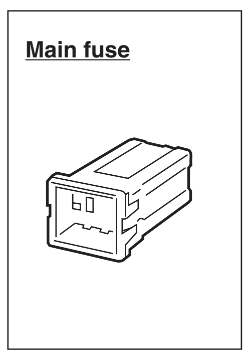
Terminal for tester probe connection	Resistance
White 1 to White 2	0.16 – 0.24 Ω
White 2 to White 3	
White 3 to White 1	

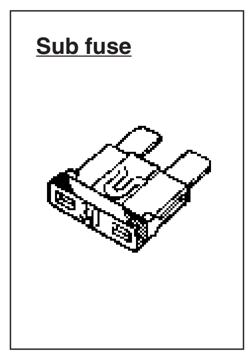
If out of specification, replace battery charge coil.

FUSE CASE / FUSE

09930-99320 : Digital tester

Tester range : (Continuity)





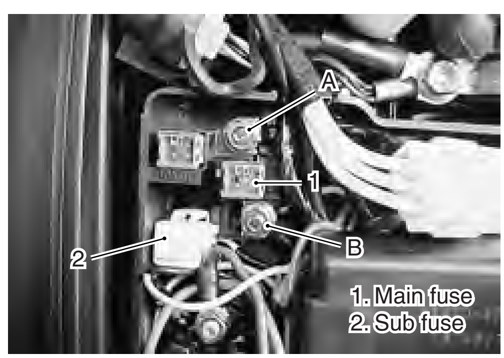
Fuse

1. Remove fuse from fuse case (or fuse terminal).
2. Inspect continuity between both terminals of fuse. If no continuity is exists, replace fuse.

Main fuse : 60A
Sub fuse : 30A

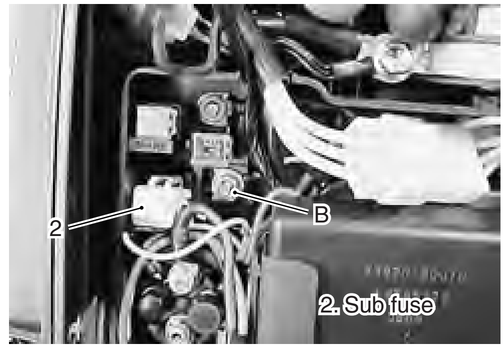
Main fuse terminal

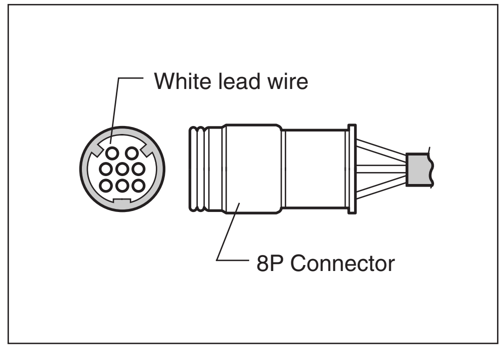
Inspect continuity between terminal (A) and (B).
If no continuity is exists, replace fuse terminal and/or fuse.



Sub fuse case

1. Disconnect white lead wire of fuse case from terminal (B).
2. Inspect continuity between White lead wire with plate terminal and White lead wire of main harness 8P connector. If no continuity is exists, replace main harness and/or fuse.





RECTIFIER & REGULATOR

09900-25010 : Pocket tester

Tester range : ×1 kΩ (Resistance)

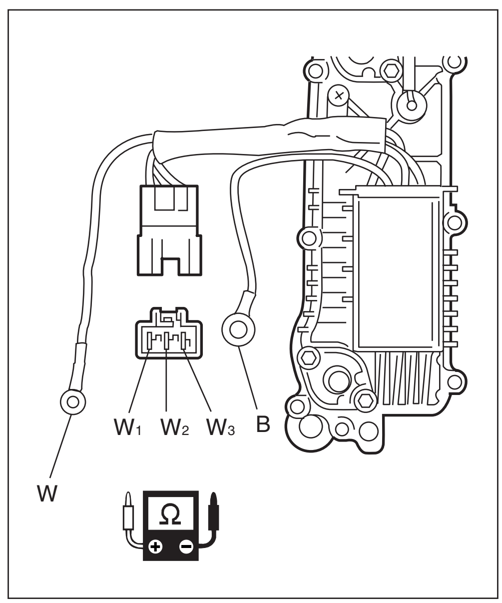
1. Disconnect all lead wires of rectifier & regulator.
2. Measure resistance between leads in combinations shown.

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

Rectifier & regulator resistance :

Unit : Approx. kΩ

		Tester probe ⊕ (Red)				
		Black	**White**	**White 1**	**White 2**	**White 3**
Tester probe ⊖ (Black)	**Black**		1~20	0.5~100	0.5~100	0.5~100
	White	3~60		4~80	4~80	4~80
	White 1	4~80	0.5~10		5~100	5~100
	White 2	4~80	0.5~10	5~100		5~100
	White 3	4~80	0.5~10	5~100	5~100	



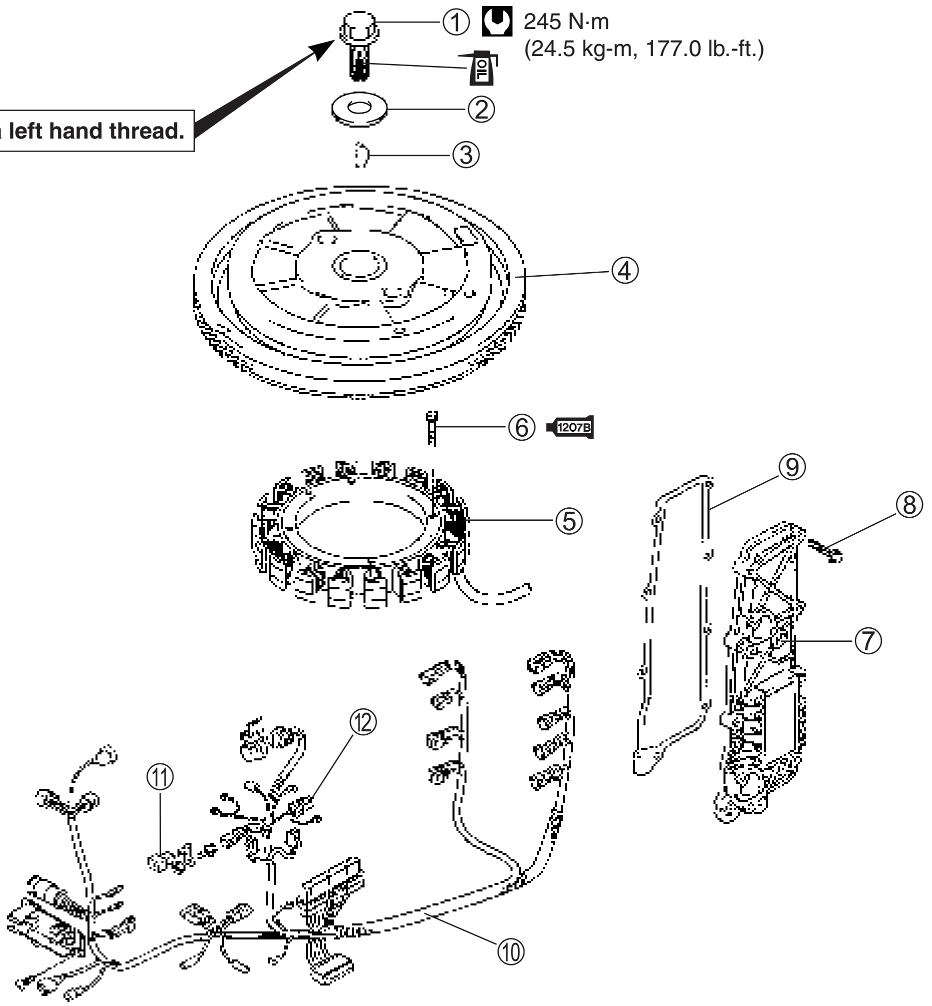
If measurement exceeds specification, replace rectifier & regulator.

REMOVAL / INSTALLATION

System construction

CAUTION

Flywheel bolt is a left hand thread.



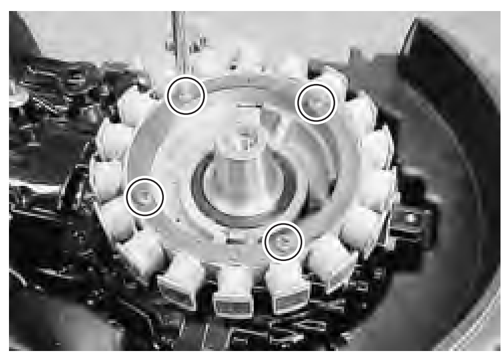
① **Bolt (1)**
② **Washer (1)**
③ **Key (1)**
④ **Flywheel (1)**
⑤ **Battery charge coil (1)**
⑥ **Screw (4)**
⑦ **Rectifier & regulator (1)**
⑧ **Bolt (9)**
⑨ **Gasket**
⑩ **Main harness**
⑪ **Main fuse 60A**
⑫ **Sub fuse 30A**

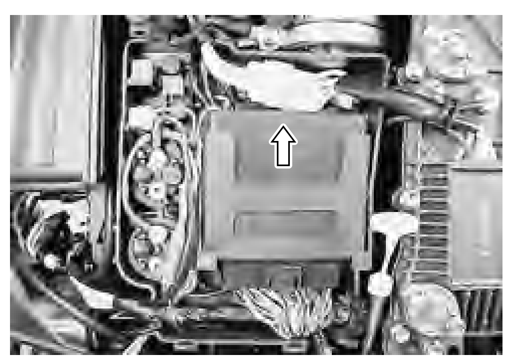
REMOVAL

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

Battery charge coil

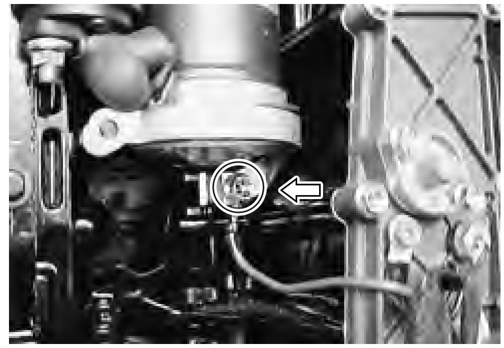
1. Remove flywheel. (See page 3-51)
2. Remove four screws securing battery charge coil.
3. Disconnect battery charge coil lead wire connector from rectifier & regulator.
4. Remove battery charge coil.



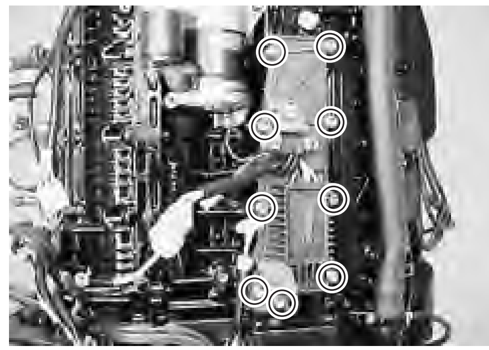


Rectifier & regulator

1. Remove electric parts holder. (See page 4-25)
2. Remove bolt securing ground lead wire of Rectifier & regulator.



3. Remove bolts securing exhaust cover (Rectifier & regu lator).
4. Remove exhaust cover with rectifier & regulator.



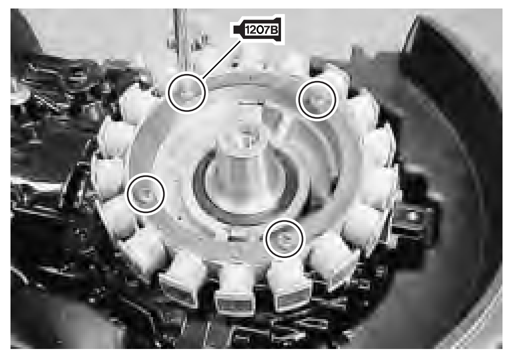
INSTALLATION

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

Battery charge coil

Apply Suzuki Bond to coil securing screws.

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



Wire routing

Check wire routing. (See page 10-2 to 10-7)

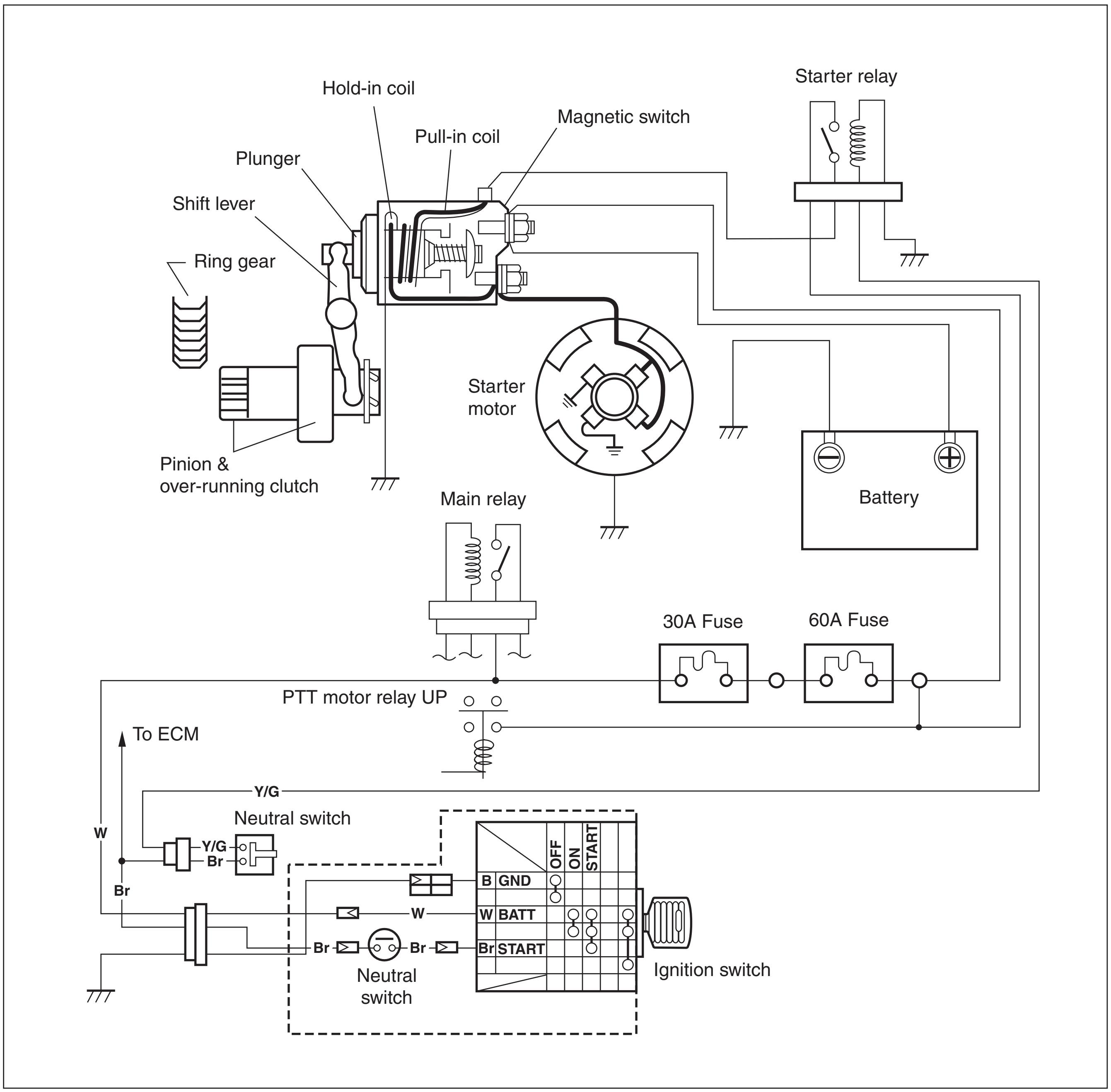
ELECTRIC STARTER SYSTEM

OUTLINE

The starting circuit consists of the battery, starting motor, ignition switch, neutral switch and related electrical wiring.
These components are connected electrically as shown in figure below.

STARTING SYSTEM CIRCUIT

In the circuit shown in figure below, the magnetic switch coils are magnetized when the ignition switch is closed (turn to "START").
The resulting plunger and pinion shift lever movement causes the pinion to engage the engine flywheel gear, the magnetic switch main contacts to close, and engine cranking to take place.
When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the switch is opened, at which time the torsion spring causes the pinion to disengage.



STARTER ENGAGEMENT MECHANISM

A solenoid (electromagnetic force) type starter switch, utilizing a torsion spring and shift lever, engages the pinion gear to the flywheel.

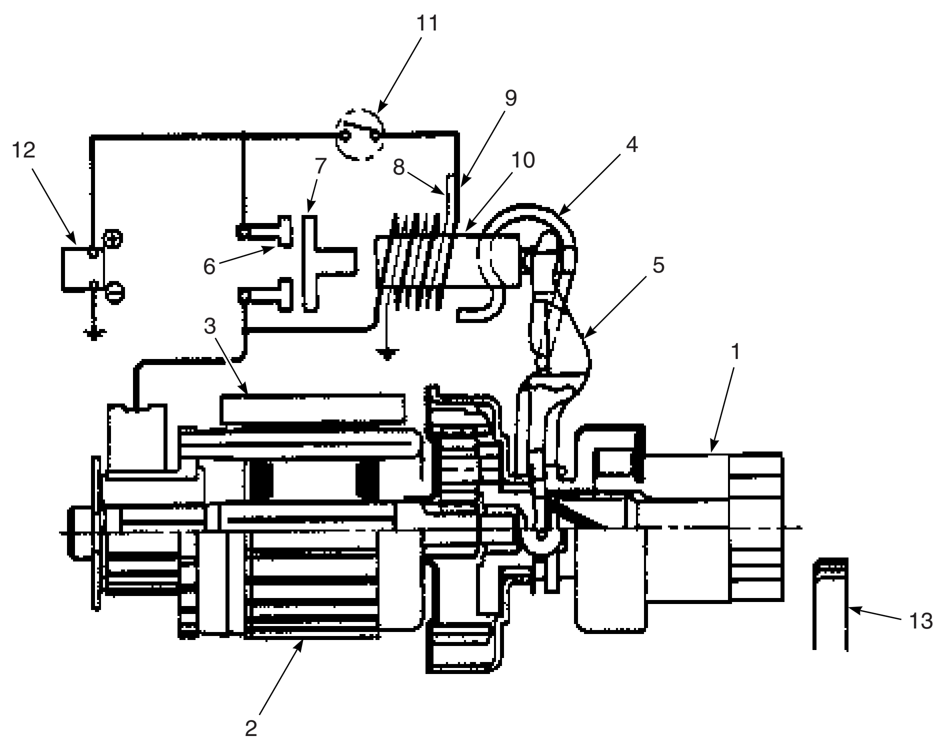
When the ignition key is turned to “START”, current flows through the switch winding creating an electromagnet pulling the plunger in.

The shift lever, attached to the plunger, then pushes the pinion up into engagement with the flywheel. Plunger and shift lever movement also compresses the torsion spring, which applies pressure against the shift lever and pinion gear to maintain positive engagement.

Final plunger movement closes the starter switch contacts, which allows current to flow through the starter motor windings, rotating the starter motor armature, pinion gear and flywheel.

When the ignition key is released from start, current flow to the switch is shut off and electromagnetic force ceases. The torsion spring then pulls the plunger out, disengaging the pinion gear from the flywheel through the shift lever.

Movement of the plunger also opens the switch contacts, stopping current flow to the starter motor windings, shutting off the starter motor.



1. Pinion
2. Armature
3. Magnet
4. Torsion spring
5. Shift lever
6. Stationary cantact
7. Movable contact
8. Hold-in coil
9. Pull-in coil
10. Plunger
11. Ignition switch
12. Battery
13. Ring gear

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.*

CAUTION

If any abnormality is found, immediately disconnect battery cables from battery.

Engine does not start.

Does engine turn over with continued cranking?

NO

Does starter motor rotate?

NO

- Check battery for charging condition.
- Check battery terminals for connections and corrosion.
- Check main (60A) and / or sub (30A) fuse / case. (See page 4-3)

YES

Check for starter relay "Click" sound when turning ignition switch to "START".
Is there "Click" sound?

NO

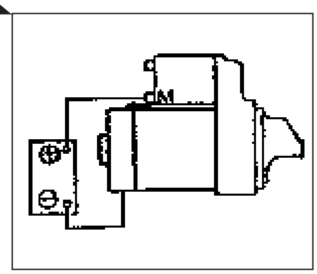
- Check function of neutral switch. (See page 4-11)
- Check ignition switch function. (See page 4-10)
- Check starter relay. (See page 4-10)
- Check wiring system and connections between starter relay and ignition switch.

YES

- Remove starter motor from engine.
- Does starter motor turn under no-load conditions by connecting battery ⊕ terminal to "M" terminal of starter motor and battery ⊖ terminal to the starter motor body.

NO

- Check the brush and brush holder. (See page 4-17)
- Check the armature coil. (See page 4-17)



YES

- The magnetic switch and / or connection is faulty.
Replace it.

YES

- Check pinion and overrunning clutch. (See page 4-18)
- Check starter magnetic switch. (See page 4-20)

YES

Does the flywheel rotate?

No (or turns slowly)

- Check battery for charging condition.
- Check battery terminals for connections and corrosion.

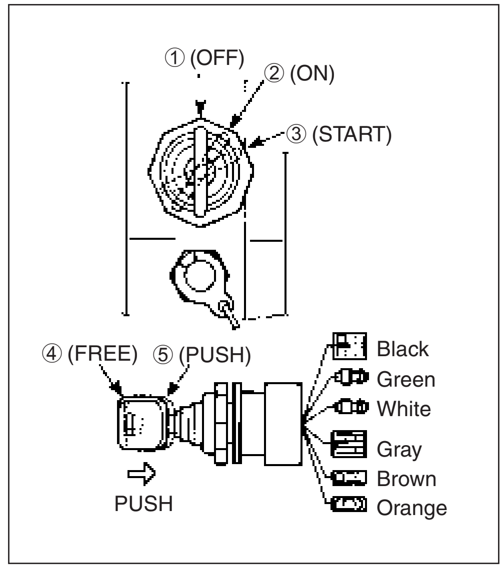
INSPECTION

IGNITION SWITCH

09930-99320 : Digital tester

Tester range : (Continuity)

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



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

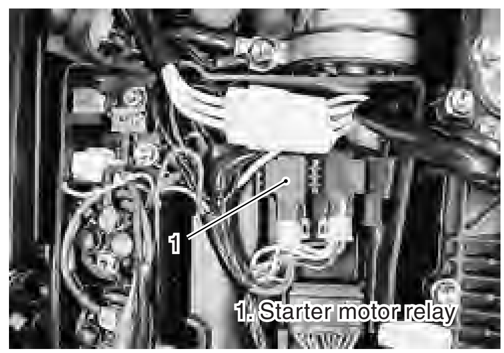
○—○ : Continuity

If out of specification, replace ignition switch.

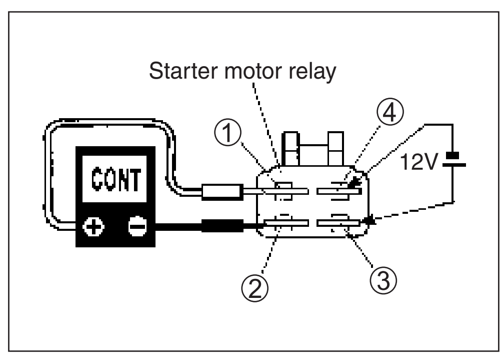
STARTER MOTOR RELAY

09930-99320 : Digital tester

Tester range : (Continuity)



1. Disconnect starter motor relay from wire.
2. Inspect continuity between terminal ① and ② each time 12V is applied. Connect positive ⊕ side to terminal ④, and negative ⊖ side to terminal ③.



Starter motor relay function :

12V power	Continuity
Applied	Yes
Not applied	No

CAUTION

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

3. Measure resistance between relay terminals ③ and ④.

Tester range : Ω (Resistance)
Starter motor relay solenoid coil resistance : 80–120 Ω

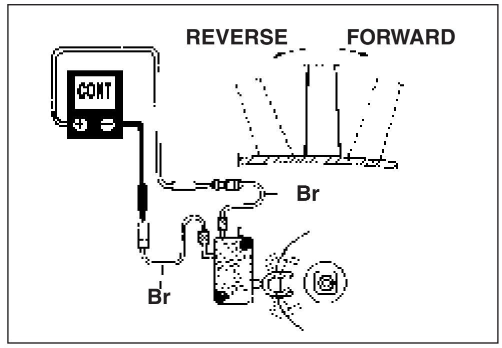
If out of specification, replace starter motor relay.

NEUTRAL SWITCH

Inspect continuity of neutral switch.

TOOL **09930-99320 : Digital tester**

Tester range : (Continuity)



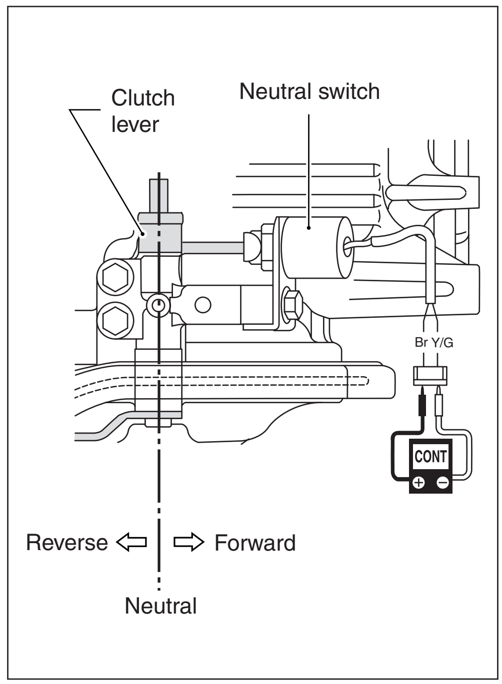
Neutral switch in remo-con box

1. Disconnect neutral switch lead wires in remo-con box.
2. Inspect continuity between switch Brown lead wires while operating remo-con handle.

Shift position	Continuity
Neutral	Yes
Forward	No
Reverse	No

If out of specification, replace neutral switch.

Neutral switch on cylinder block



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

Shift position	Continuity
Neutral	Yes
Forward	No
Reverse	No

If out of specification :

- 1st Check switch position adjustment, readjust if necessary.
- 2nd Replace neutral switch.

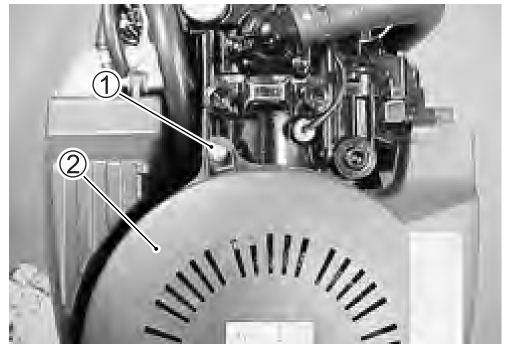
NOTE:
After installing neutral switch, check for proper correct function by operating remo-con handle.

STARTER MOTOR

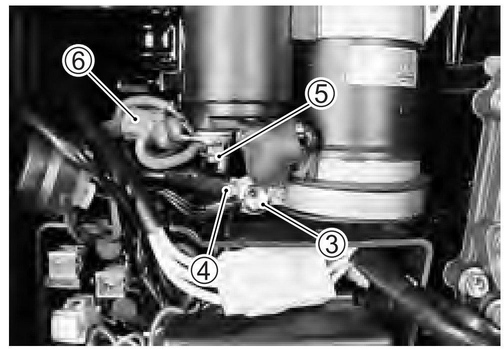
REMOVAL

Prior to removing starter motor :
- **Disconnect battery cables from battery.**

1. Remove bolt ① and flywheel cover ②.

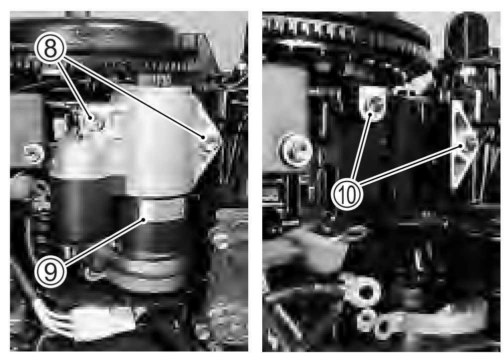


2. Remove bolt ③ and negative ⊖ battery cable ④.
3. Remove nut ⑤ and positive ⊕ battery cable ⑥ from magnetic switch of starter motor.



4. Disconnect Red lead wire ⑦ from terminal “S” of starter magnetic switch.

5. Remove two bolts ⑧ securing starter motor.
   Remove starter motor ⑨ and dowel pins ⑩.



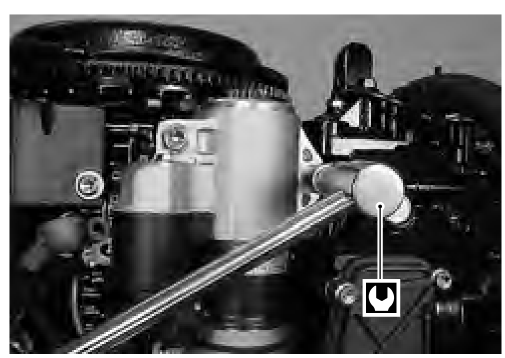
INSTALLATION

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

- Apply engine oil lightly to motor mounting bolts before installing.
- Install starter motor and tighten mounting bolts securely.

Starter motor mounting bolt :

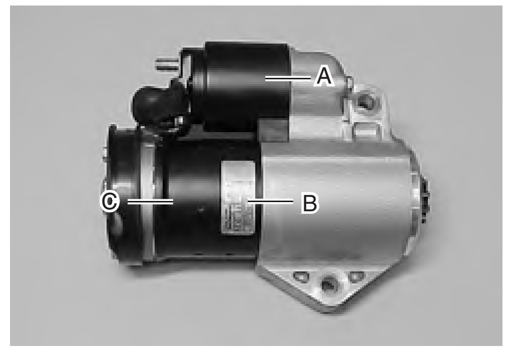
8 mm	**23 N·m (2.3 kg-m, 16.5 lb.-ft.)**
10 mm	**50 N·m (5.0 kg-m, 36.0 lb.-ft.)**



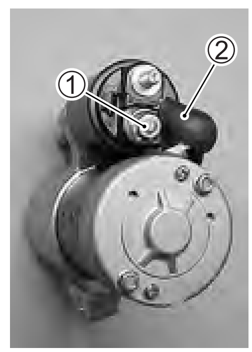
DISASSEMBLY

For overhauling of starting motor, it is recommended that component parts should be cleaned thoroughly.
However, yoke assembly, armature coil, over-running clutch assembly, magnetic switch assembly, rubber or plastic parts should not be washed in degreasing tank or with grease dissolving solvent. Those parts should be cleaned with compressed air and wiping with cloth.

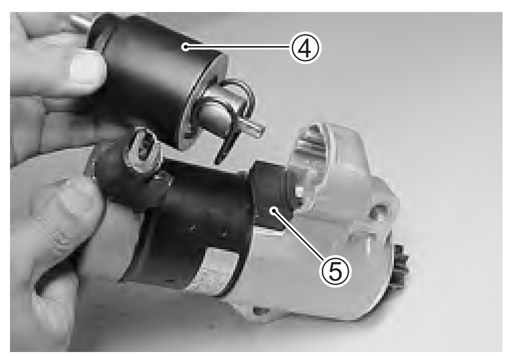
NOTE:
Before disassembling starting motor, be sure to put match marks at three locations (A, B and C) as shown in right figure so that any possible component alignment mistakes can be avoided.



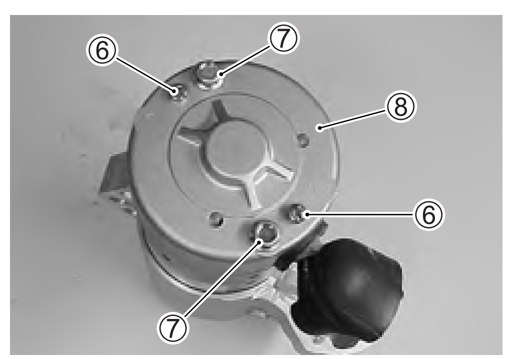
1. Remove nut ① from magnetic switch, then disconnect connecting wire ②.
2. Remove two bolts ③ securing magnetic switch.



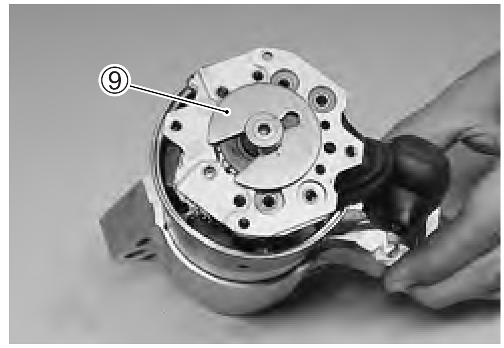
3. Remove magnetic switch ④ and rubber packing ⑤.



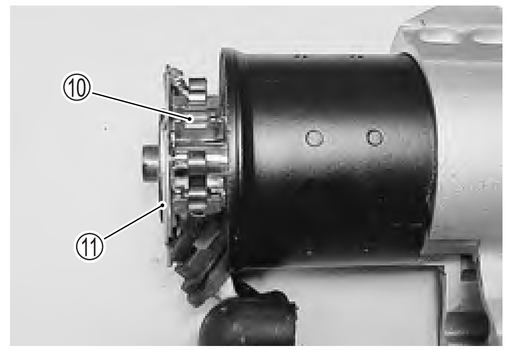
4. Remove screws ⑥, long through bolts ⑦ and rear cover ⑧.



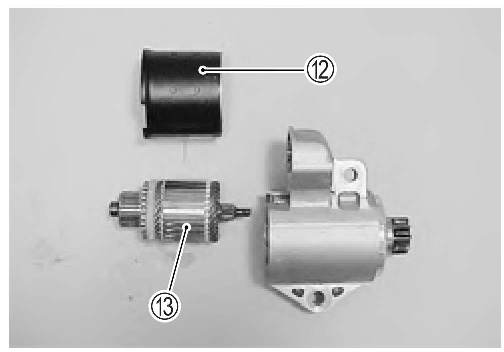
5. Remove thrust washer ⑨ with screwdriver.



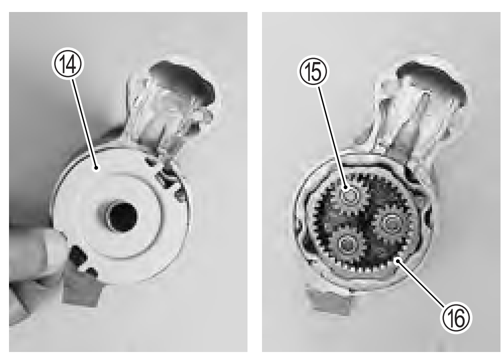
6. Pull brush spring ⑩ up so that brush is separated from surface of commutator, then remove brush holder ⑪.



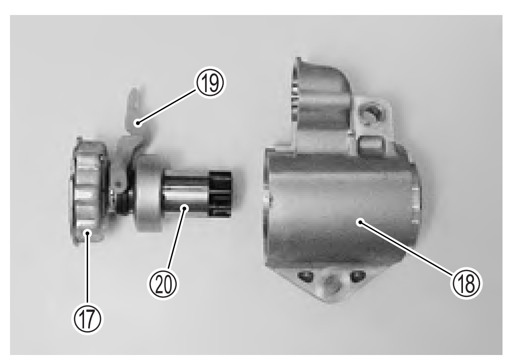
7. Remove yoke ⑫ and armature ⑬.



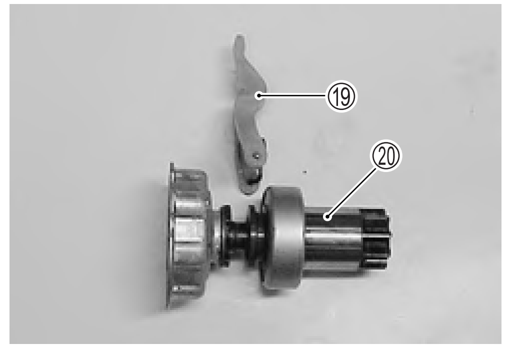
8. Remove center cover plate ⑭.
9. Remove planetary gears ⑮ and internal gear ⑯.



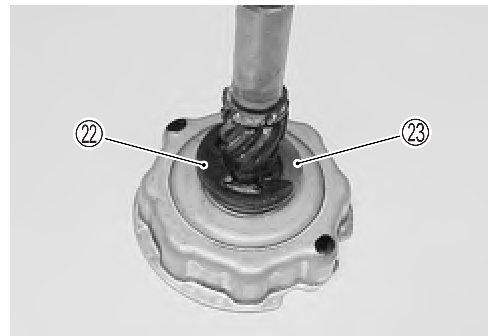
10. Remove center bracket ⑰ (with shift lever ⑲, pinion ⑳ and pinion shaft ㉑) from front housing ⑱.



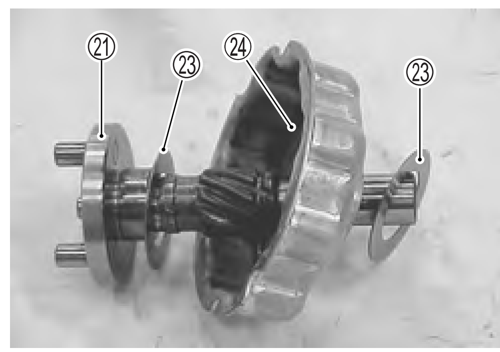
11. Remove shift lever ⑲ and pinion ⑳.



12. Remove E-ring ㉒ and washer ㉓.



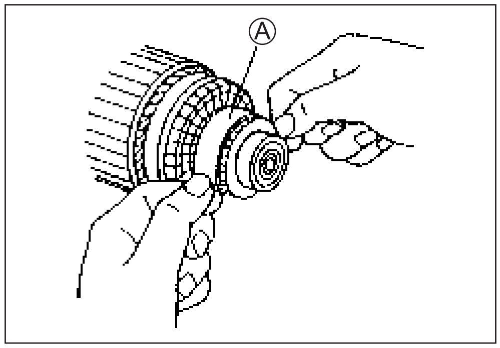
13. Remove pinion shaft ㉑, washer ㉓ and rubber ring ㉔ from center bracket.



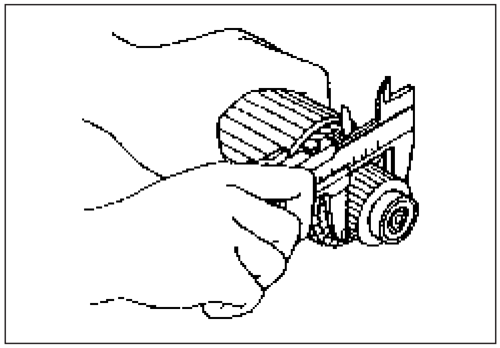
INSPECTION & SERVICING

Armature and Commutator

1. Inspect commutator surface for gum or dirt.
   Clean with #500 grit emery paper Ⓐ if necessary.



2. Measure commutator outside diameter.

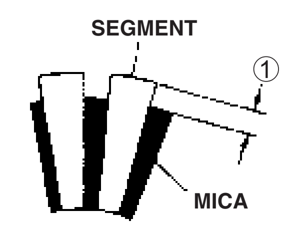


TOOL **09900-20101 : Vernier calipers**

Commutator outside diameter:
Standard : 29.0 mm (1.14 in.)
Service limit : 28.0 mm (1.10 in.)

If measurement exceeds service limit, replace armature.

3. Measure commutator undercut (depth) between mica (insulator) and segments.



① undercut

Commutator undercut ① (depth):
Standard : 0.5 – 0.8 mm (0.02 – 0.03 in.)
Service limit : 0.2 mm (0.01 in.)

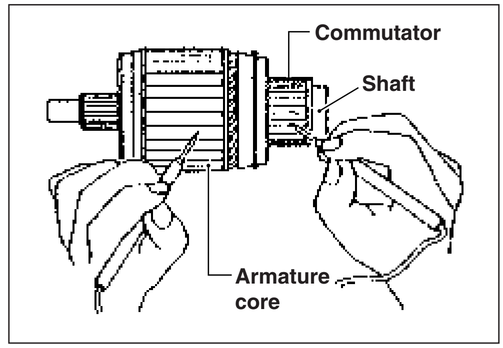
If measurement exceeds service limit, cut mica to specified depth.

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

⚠ WARNING

Wear safety grasses when using compressed air.

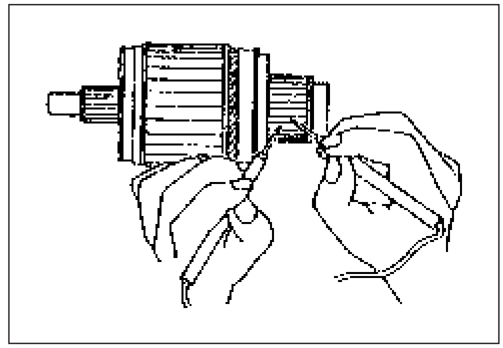
4. Inspect continuity between commutator and armature core / shaft.
   If continuity exists, replace armature.



09930-99320 : Digital tester

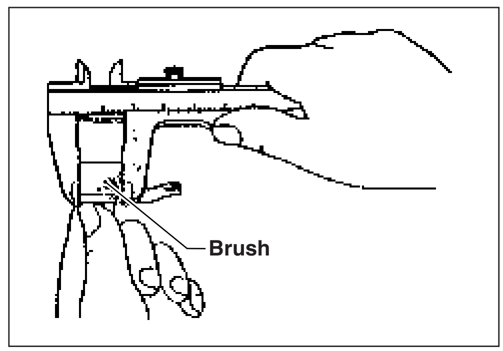
Tester range : (Continuity)

5. Inspect continuity between adjacent commutator segments.
   If no continuity exists, replace armature.



BRUSHES

Measure length of each brush.



09900-20101 : Vernier calipers

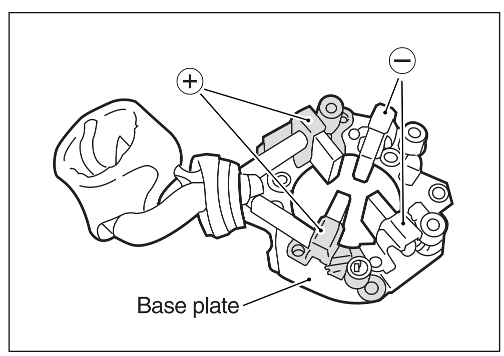
Brush length:

Standard : 16.0 mm (0.63 in.)
Service limit : 12.0 mm (0.47 in.)

If measurement exceeds service limit, replace brush.

BRUSH HOLDER

Inspect brush holder continuity.



09930-99320 : Digital tester

Tester range : (Continuity)

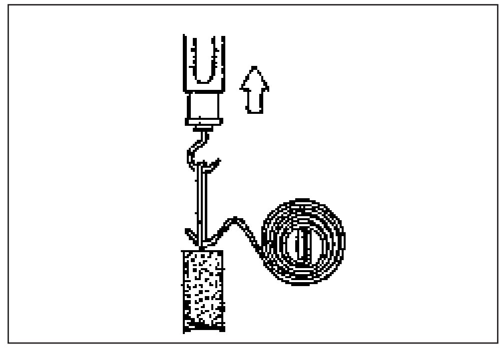
Brush holder continuity :

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

If out of specification, replace brush holder.

BRUSH SPRING

Inspect brush spring for wear or other damage.
Measure brush spring tension.
Replace if necessary.

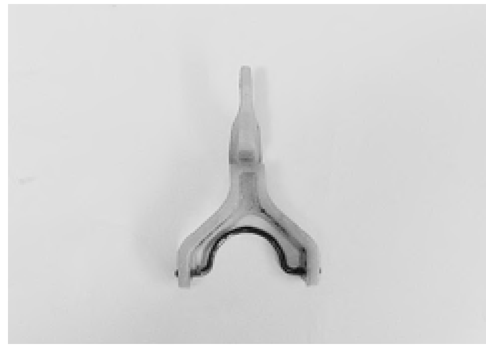


Brush spring tension

Standard : 15 – 18 N (1.5 – 1.8kg, 3.3 – 4.0 lb.)

SHIFT LEVER

Inspect shift lever for wear.
Replace if necessary.



PINION AND OVER-RUNNING CLUTCH

Inspect pinion for wear or other damage.
Inspect that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction.
Replace if necessary.

Inspect spline teeth for wear or other damage.
Inspect pinion for smooth movement.
Replace if necessary.

GEAR

Inspect planetary gears and internal gear for wear or other damage.
Replace if necessary.

PINION SHAFT / PINION SHAFT BUSH

Inspect pinion shaft for wear, damage or other abnormal conditions.
Inspect pinion shaft bush for wear or other damage.
Replace if necessary.

FRONT HOUSING BEARING

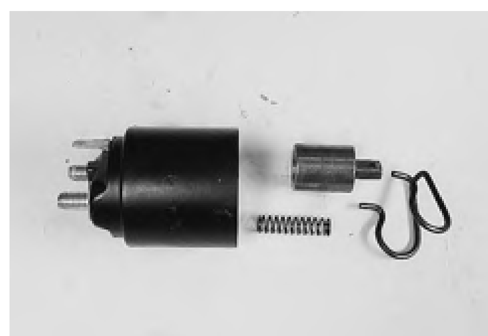
Inspect bearing for wear or other damage.
Replace if necessary.

ARMATURE SHAFT BUSH

Inspect bush for wear or other damage.
Replace if necessary.

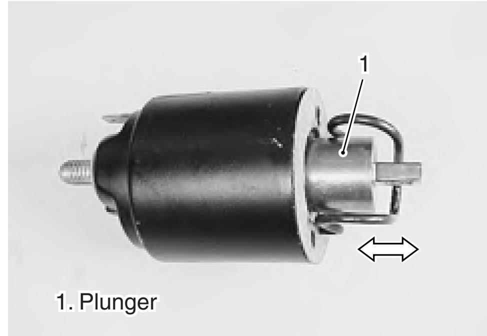
PLUNGER

Inspect plunger for wear or other damage.
Replace if necessary.



MAGNETIC SWITCH

Push in plunger and release. Plunger should return quickly to its original position.
Replace if necessary.

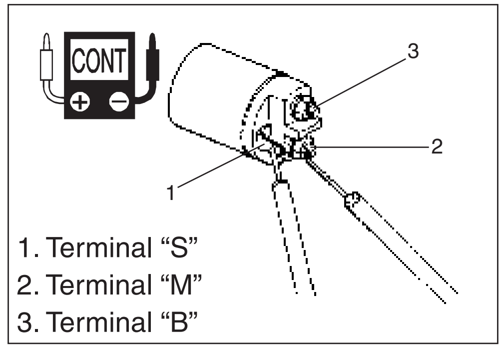


1. Plunger

Pull-in coil Open circuit Test

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

Inspect continuity between terminal“S” and terminal“M” .
If no continuity exists, replace magnetic switch.

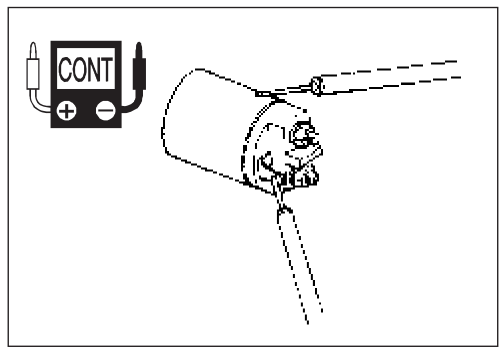


1. Terminal “S”
2. Terminal “M”
3. Terminal “B”

Hold-in coil Open circuit Test

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

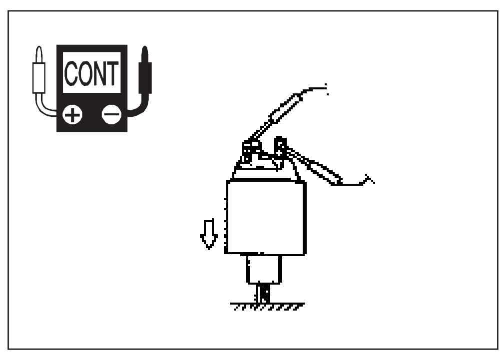
Inspect continuity between terminal“S” and coil case.
If no continuity exists, replace magnetic switch.



Contact points Test

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

Put the plunger on under side and then push magnetic switch down.
At this time, inspect continuity between terminal“B” and terminal“M”.
If no continuity exists, replace magnetic switch and/or plunger.



ASSEMBLY

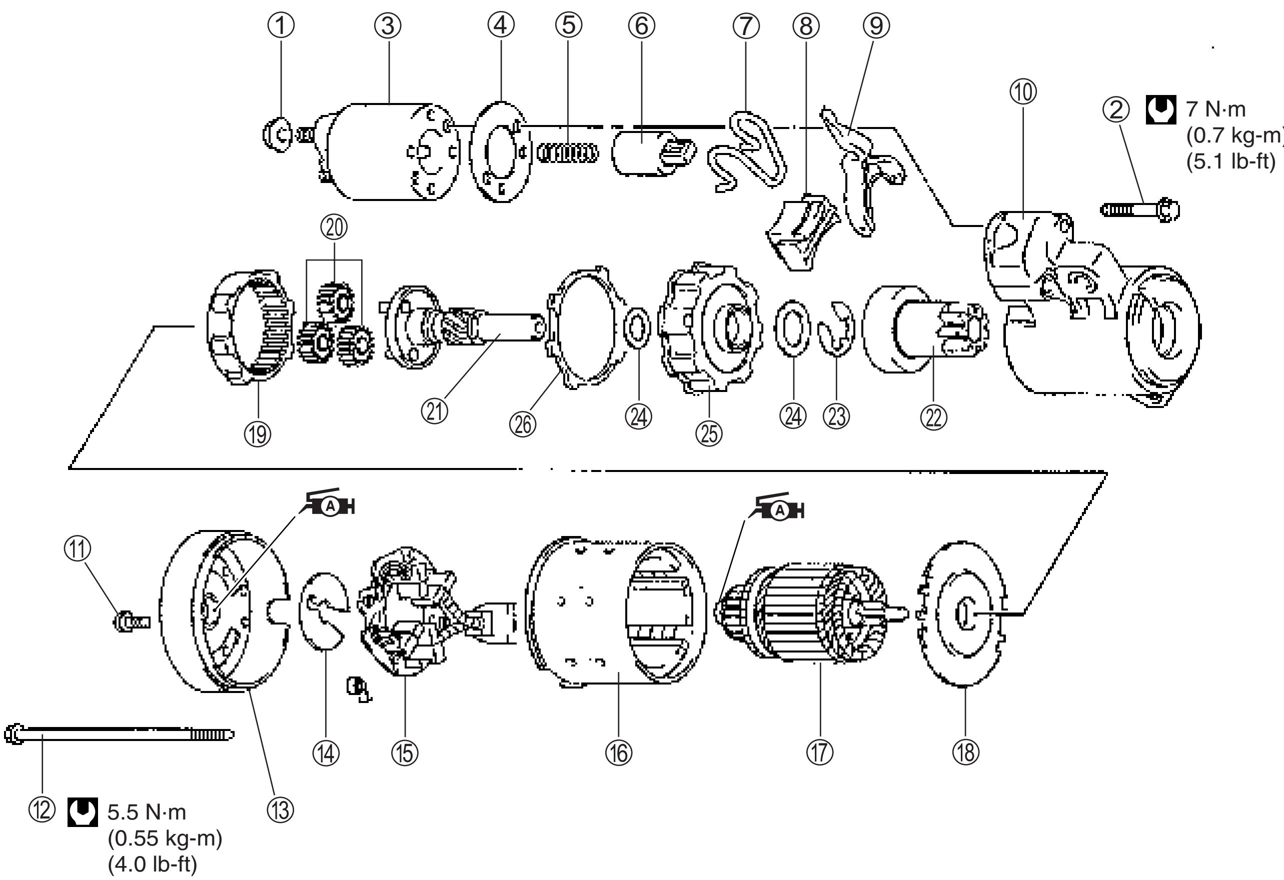
Assembly is reverse order of disassembly with special attention to the following steps.

CAUTION

When installing armature, exericise care to avoid breaking brushes.

When installing pinion shift lever, refer to figure in construction diagram for its installation direction.

Construction diagram



1. Nut
2. Bolt
3. Magnetic switch
4. Gasket
5. Spring
6. Plunger
7. Torsion spring
8. Rubber packing
9. Shift lever
10. Front housing
11. Screw
12. Through bolt
13. Rear cover
14. Thrust washer
15. Brush holder
16. Yoke
17. Armature
18. Center cover plate
19. Internal gear
20. Planetary gear
21. Pinion shaft
22. Pinion
23. E-ring
24. Washer
25. Center bracket
26. Rubber ring

PERFORMANCE TEST

CAUTION

Each test must be performed within 3 – 5 seconds to avoid coil from burning.

⚠ WARNING

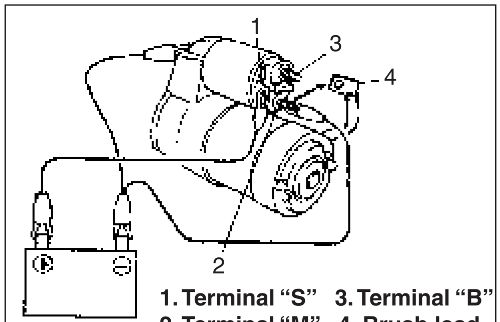
When performing the following test, be sure to connect the battery and the starting motor with a lead wire of the same size as the cable that was originally used there.

PULL-IN / HOLD-IN COIL TEST

Connect battery to magnetic switch as shown in figure.

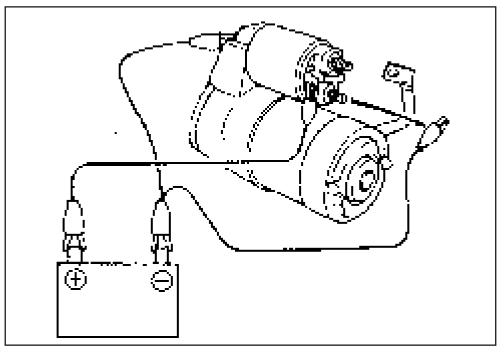
1. Check that plunger and pinion (over-running clutch) move outward.
   If plunger and pinion don't move, replace magnetic switch.

NOTE:
Before testing, disconnect brush lead from terminal "M".



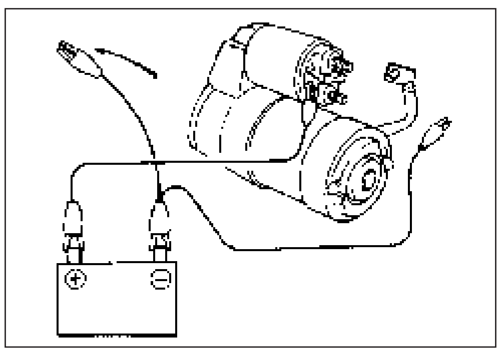
1. Terminal "S" 3. Terminal "B"
2. Terminal "M" 4. Brush lead

2. While connected as above with plunger out, disconnect nega tive lead from terminal "M".
   Check that plunger and pinion remain out.
   If plunger and pinion return inward, replace magnetic switch.



PLUNGER AND PINION RETURN TEST

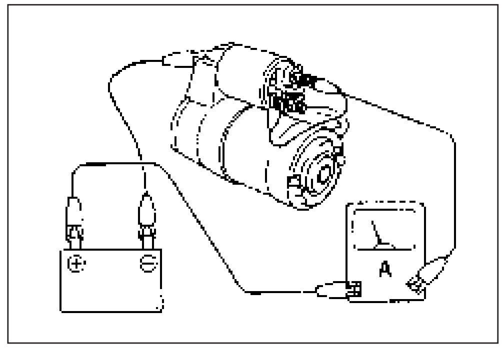
Disconnect negative lead from switch / motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return inward, replace magnetic switch.



NO-LOAD PERFORMANCE TEST

CAUTION

Before performing following test, set starter motor securely on test bench.



1. Connect battery and ammeter to starter motor as shown.

2. Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

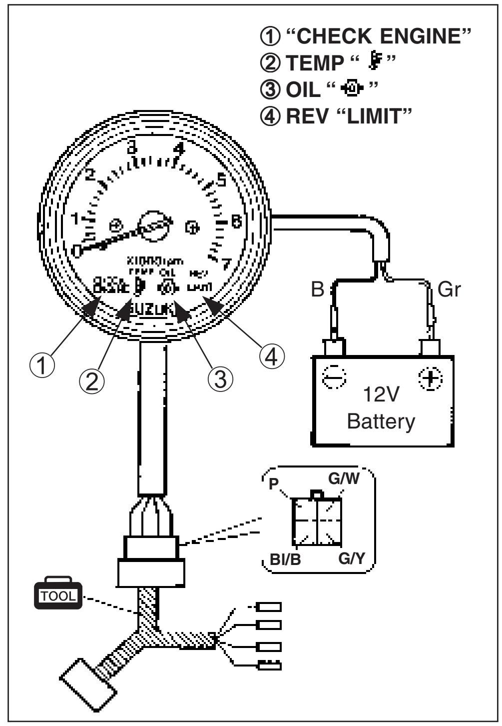
   No load current : Within 90 A at 11 V

MONITOR-TACHOMETER

INSPECTION

MONITOR LAMP CHECK

1. Connect test cord as shown in figure .

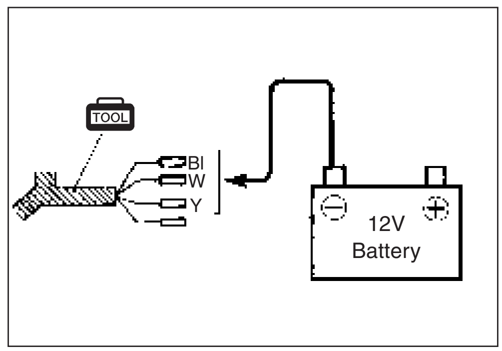


TOOL 09930-89240 : 4-pin test cord

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

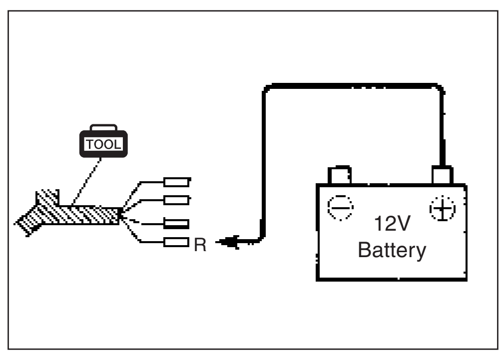
2. Apply 12V power to meter. Connect Gray wire to positive ⊕ terminal, and Black wire to negative ⊖ terminal of battery.

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



Monitor lamp check :

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



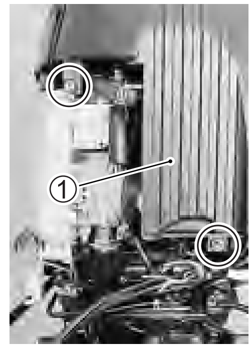
If out of specification, replace monitor-tachometer.

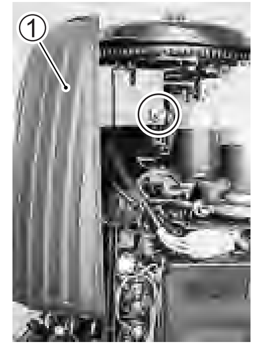
ELECTRIC PARTS HOLDER

REMOVAL

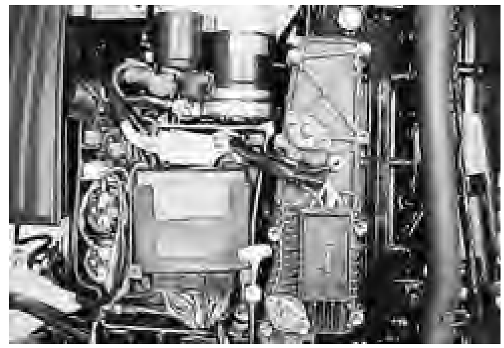
Before removing electric parts holder :
- **Disconnect battery cables from battery.**
- **Remove PORT side cover.**

1. Remove electric parts holder cover.
2. Remove three bolts and silencer case ①.





3. Disconnect lead wire connector from ECM, then remove ECM.

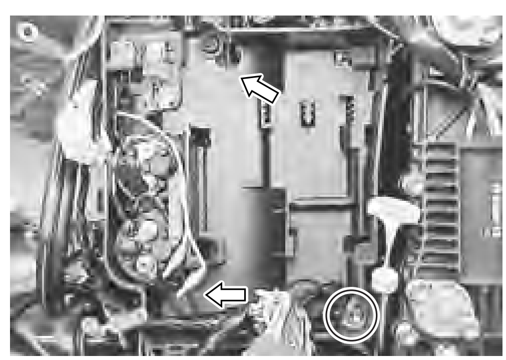


4. Disconnect following lead wire in electric parts holder.
   - Connector of Rectifier & regulator (W).
   - Connector of CKP sensor.
   - Connector of Ex-mani sensor.
   - Connector of ECM main relay.
   - Connector of starter relay.
   - Red lead wire on 60A main fuse upside terminal.
   - White 30A fuse lead and White Rectifier & Regulator lead wire on 60A main fuse lower side terminal.
   - Pink and Light blue lead wires of PTT motor relay.
   - Blue lead wire on PTT motor relay terminal.
   - Green lead wire on PTT motor relay terminal.
   - Red lead wire on Up PTT motor relay terminal.

5. Remove bolt securing starter motor band, then remove negative battery cable and main harness GND lead.
6. Disconnect Red lead wire from terminal“S” on starter motor.

7. Pull out 30A fuse case from electric parts holder.
8. Remove bolt, GND lead wire and electric parts holder.

NOTE:
To remove electric parts holder, first, slide bottom side of electric parts holder to the left, then slide parts holder toward direction of ten (10) o’clock.



INSTALLATION

Installation is reverse order of removal.
See page 10-2 to 10-7 for check of wire routing.

FUEL SYSTEM

CONTENTS

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.**

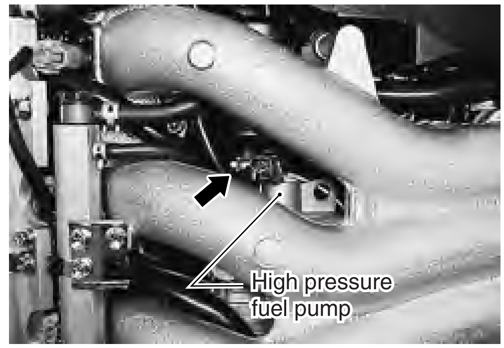
⚠ WARNING

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.

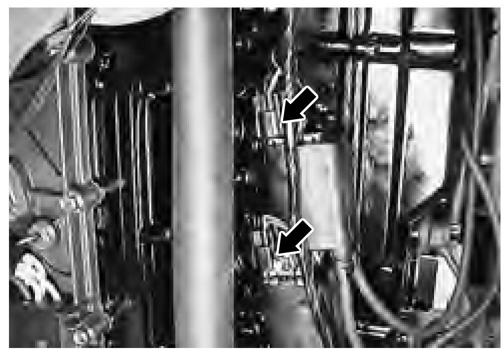
FUEL PRESSURE RELIEF PROCEDURE

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

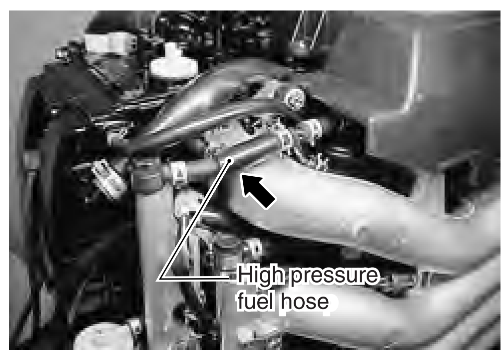
1. Turn OFF ignition switch.
2. Disconnect high pressure fuel pump lead wire connector at high pressure fuel pump.



3. Disconnect ignition coil primary lead wire connector from all ignition coils.
4. Crank 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 lead wire and high pressure fuel pump lead 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

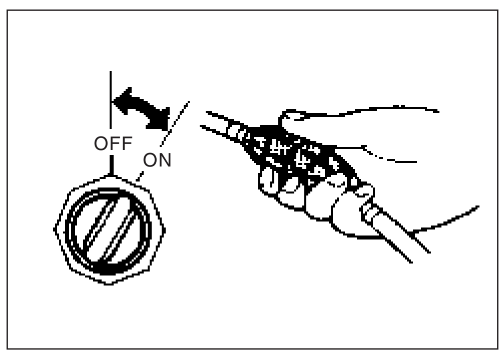
- **Do not over bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Be sure hoses do not contact rods, levers or other components with engine either operating or at rest.**
- **Extreme care should be taken not to cut, abrade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

NOTE:
- *Check fuel hose routing.* *(See page 10-8 and 10-11)*
- *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.

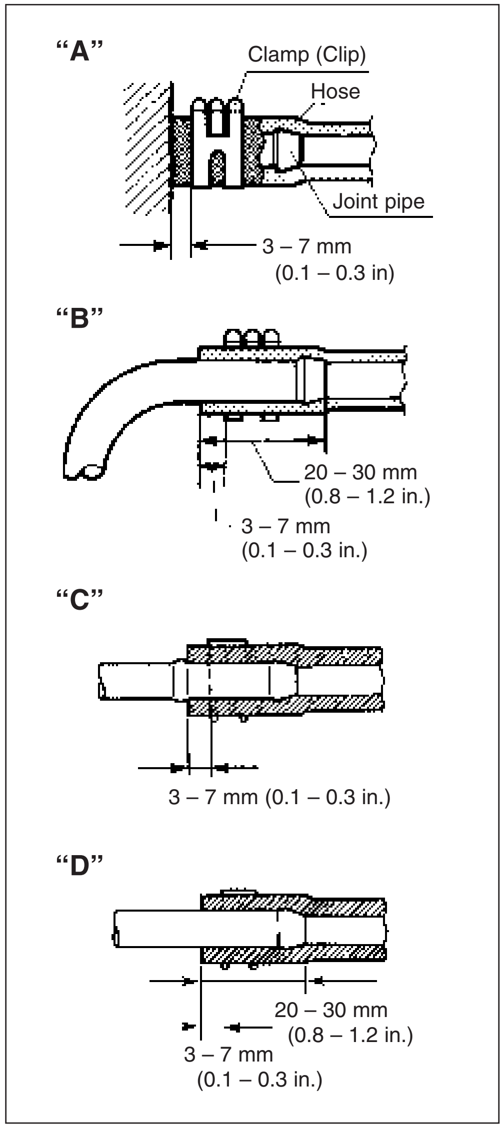
1. Squeeze fuel primer bulb until you feel resistance.
2. Turn ignition switch "ON" for 3 seconds (to operate fuel pump), then turn it "OFF".
   Repeat this (ON and OFF) procedure 3 or 4 times to pressurize fuel system.
3. Once pressurized, check all connections and components for any signs of leakage.



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 following figures.

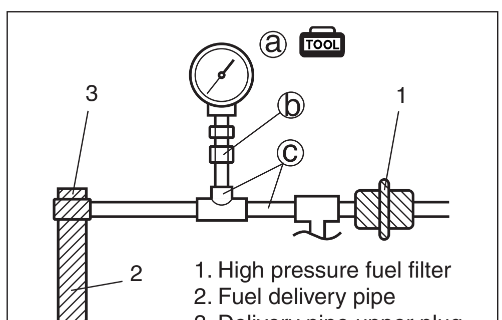
- For type "A" (short barbed end) pipe, hose should completely cover pipe.
- For type "B" (bent end) pipe, hose should cover straight part of pipe by 20 – 30mm (0.8 – 1.2 in.).
- For type "C" pipe, hose should fit up against flanged part of pipe.
- For type "D" pipe, hose should cover pipe by 20 – 30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



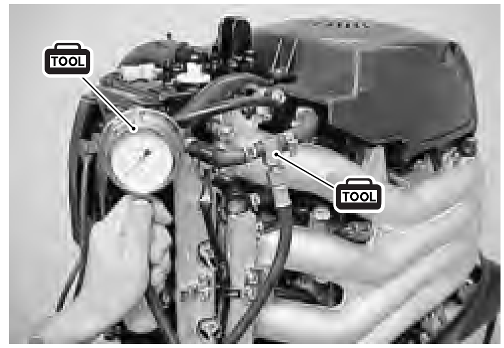
FUEL PRESSURE INSPECTION

1. Relieve fuel pressure in fuel feed line. (See page 5-3.)
2. Loosen delivery pipe upper plug.
3. Connect special tools (pressure gauge, pressure hose & pressure joint) between fuel feed hose and delivery pipe as shown in figure.
   Tighten delivery pipe upper plug to specified torque.
   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 – ⓒ



1. High pressure fuel filter
2. Fuel delivery pipe
3. Delivery pipe upper plug

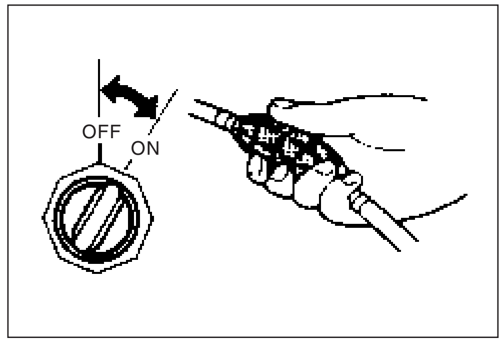


CAUTION

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

Delivery pipe upper plug :
35 N·m (3.5 kg-m, 25.5 lb.-ft.)

4. 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 fuel system and then check fuel pressure.

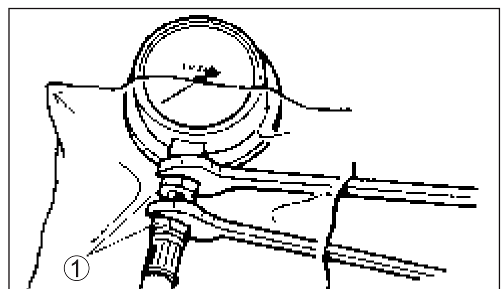


5. Measure fuel pressure in line at cranking or idle speed operation.

   Fuel pressure : Approx. 255 kPa
   (2.55 kg/cm^2, 36.3 psi)

6. Stop engine and wait 5 minutes.
7. Read residual fuel pressure in line.

   Residual fuel pressure : 200 kPa (2.0 kg/cm^2, 28.4 psi) or higher



① Joint nut

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.**

8. After measureing fuel pressure, remove fuel pressure gauge.
9. Reconnect fuel line.
10. With engine not running and ignition switch "ON", check fuel system for leaks.

FUEL VAPOR SEPARATOR / HIGH PRESSURE FUEL PUMP

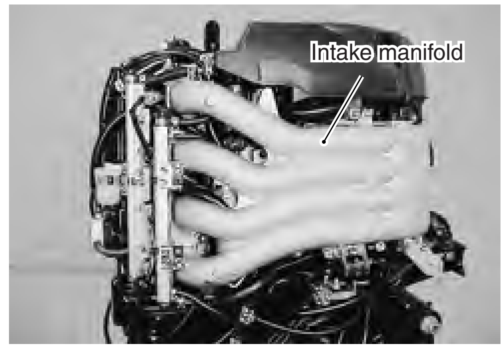
REMOVAL / INSTALLATION

REMOVAL

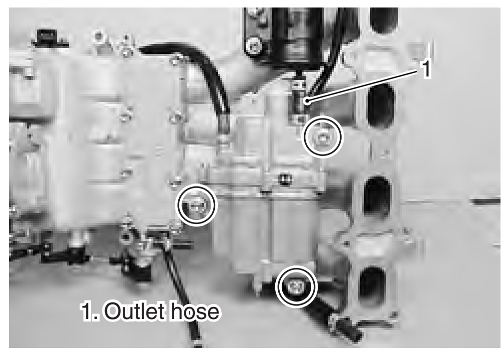
⚠ WARNING

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.

1. Remove intake manifold assembly.
   (See page 6-2)



2. Remove three bolts and fuel vapor separator assembly from intake manifold.
3. Disconnect fuel outlet hose from fuel vapor separator.

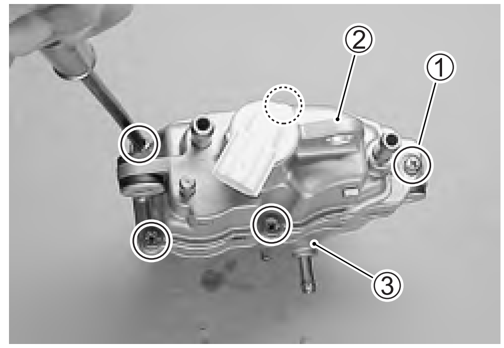


INSTALLATION

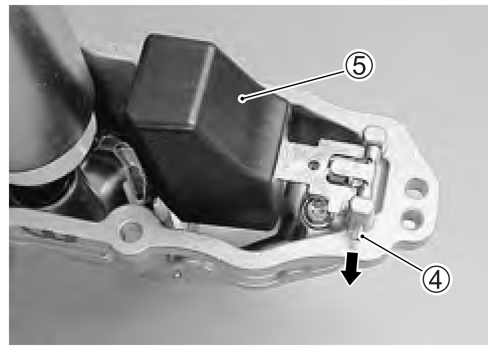
Installation is reverse order of removal.
See page 6-4 for installation of intake manifold assembly.

DISASSEMBLY

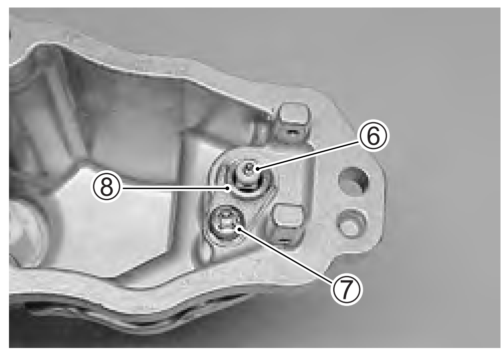
1. Remove five screws ①.
2. Remove separator cover ② with high pressure fuel pump from separator case ③.



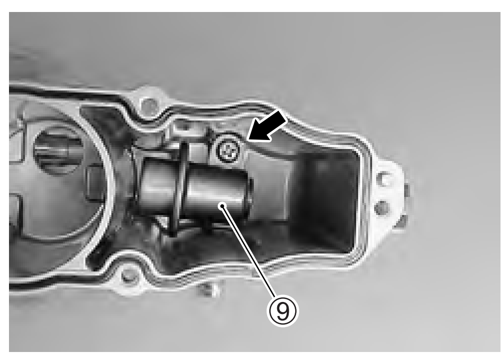
3. Remove float pin ④ and float ⑤.



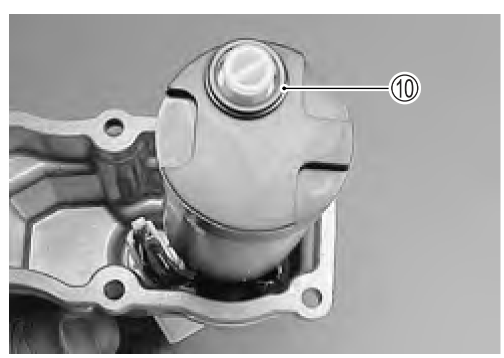
4. Remove needle valve ⑥, screw ⑦, plate and valve seat ⑧.



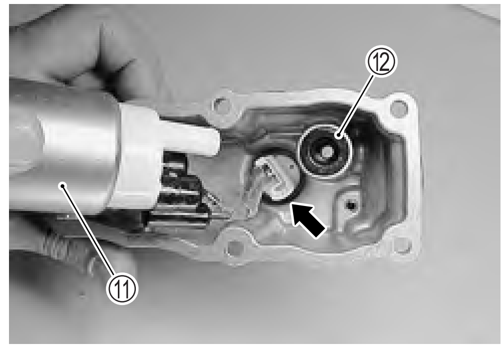
5. Remove screw and fuel pressure regulator ⑨ from separator case.



6. Remove suction filter ⑩.



7. Remove high pressure fuel pump ⑪ and grommet ⑫ from separator cover and then disconnect pump lead wire con nector.

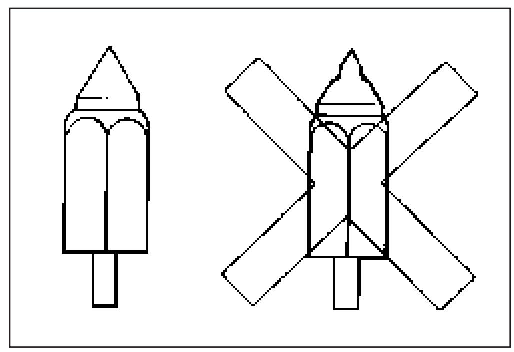


INSPECTION

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

Needle valve / Valve seat

Inspect needle valve and valve seat for groove, other damage or dirt.
Replace or clean if necessary.



Float

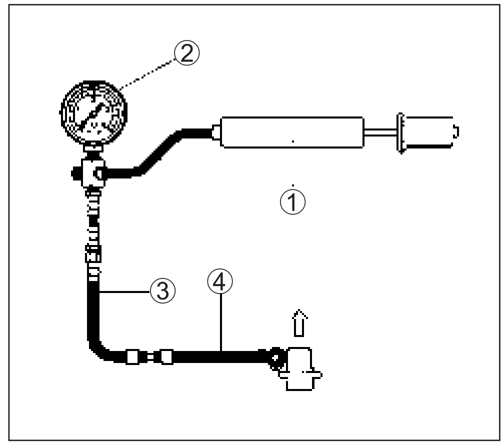
Inspect float for crack or other damage.
Replace if necessary.

Filter

Inspect pump suction filter for clog or other damage.
Replace or clean if necessary.

Fuel pressure regulator

Check fuel pressure regulator operation.



TOOL **09952-99310 : Hand air pump ①**
09940-44121 : Air pressure gauge ②
09940-44130 : Attachment ③
09912-58490 : Hose ④

1. Connect special tools to inlet side of regulator as shown in figure.

2. Pump air into regulator using pump ① until air is released through outlet side.

3. Read pressure on gauge when air is released.

Regulator operating pressure :
240 – 270 kPa (2.4 – 2.7 kg/cm², 34.1 – 38.4 psi)

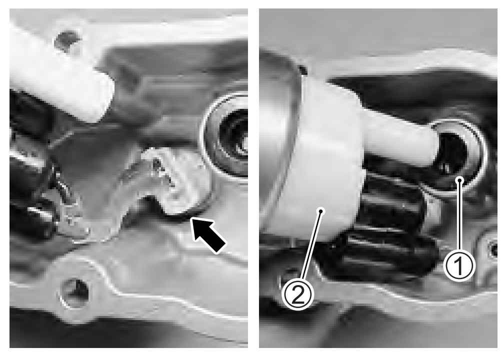
If out of specification, replace regulator.

ASSEMBLY

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

High pressure fuel pump

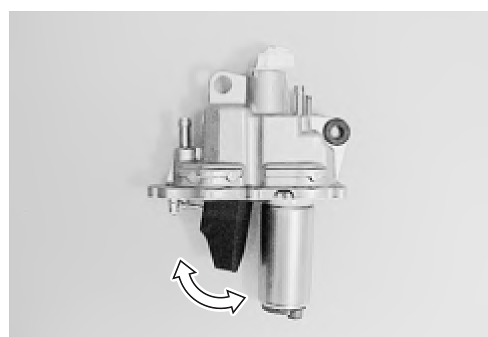
Connect pump lead wire connector, then install grommet ① and fuel pump ②.



NOTE:
Apply fuel to grommet before installing.

Float / Float pin

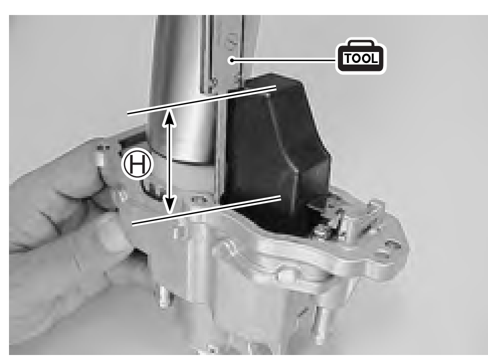
Install float and float pin.



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

Checking float height

Measure float height.



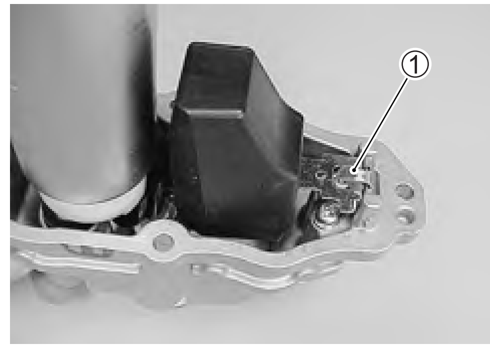
TOOL **09900-20101 : Vernier calipers**

Float height Ⓗ : 43 ± 1 mm

NOTE:
Make sure that float weight is not applied to needle valve.

Setting float height

To correct specification, bend only adjustment tab ①.



CAUTION

When adjusting tab, do not bend to the point that it applies pressure to the needle and seat.

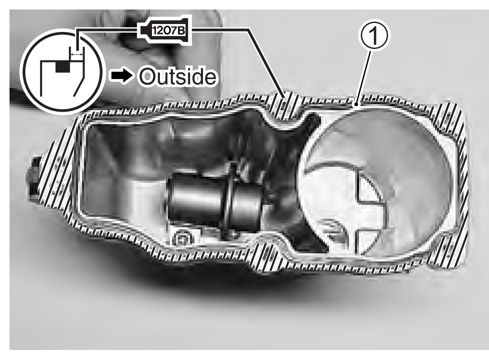
Fuel pressure regulator

Install fuel pressure regulator and tighten screw securely.

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

Separator cover / Separator case

1. Install seal ring ①, then apply Suzuki Bond evenly to only the outside mating surface of separator case as shown in figure.

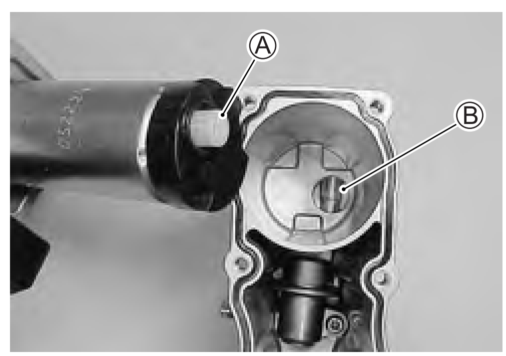


1207B **99000-31140 : Suzuki Bond 1207B**

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

2. Install separator case, then tighten screws securely.

NOTE:
When installing separator case, align suction hole Ⓐ with hole Ⓑ of separator case.

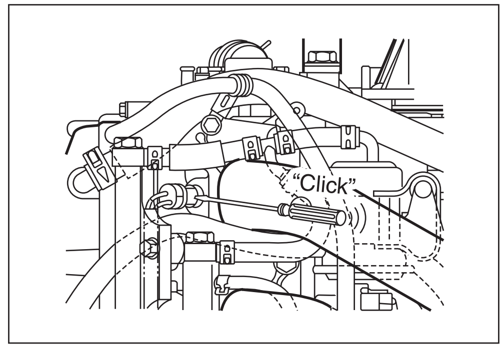


NOTE:
Separator cover and case are a set.
Make sure paint marks on both items are matched when assembling.

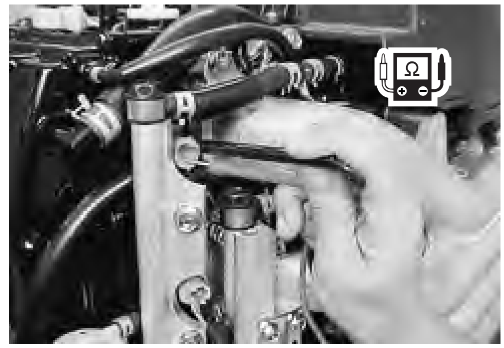
FUEL INJECTOR

INSPECTION

1. Using sound scope or equivelent, check operating sound of fuel injector when engine is running or cranking.
   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 measure resistance.



TOOL **09930-99320 : Digital tester**

Tester range : Ω (Resistance)

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

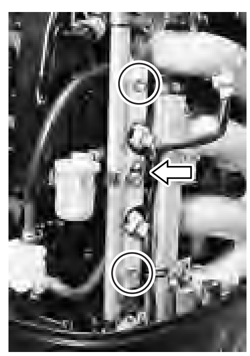
4. Connect lead wire connector to fuel injector securely.

REMOVAL

1. Relieve fuel pressure according to procedure described on page 5-3.
2. Loosen clamp and place a large cloth over end of fuel feed hose.
   Slowly pull fuel feed hose from fuel delivery pipe.
   Drain any excess fuel in hose into a small container.

1. Fuel feed hose

3. Disconnect four fuel injector connectors.
4. Remove bolts and low fuel filter bracket.
5. Remove two bolts and fuel delivery pipe (with fuel injectors).



CAUTION

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

6. Remove each injector from delivery pipe.

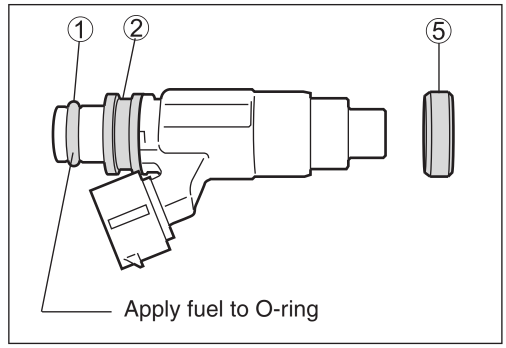
INSTALLATION

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

CAUTION

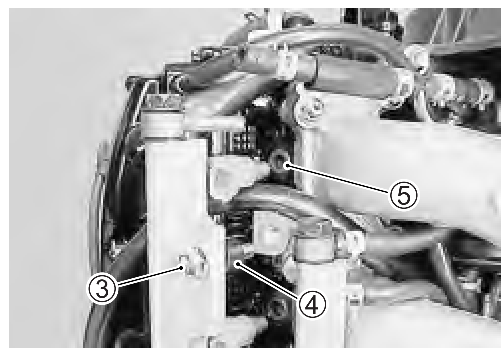
Do not re-use O-ring and cushion once removed.
Always use new parts.

1. Replace injector O-ring ① with new one using care not to damage it. Install grommet ② to injector.



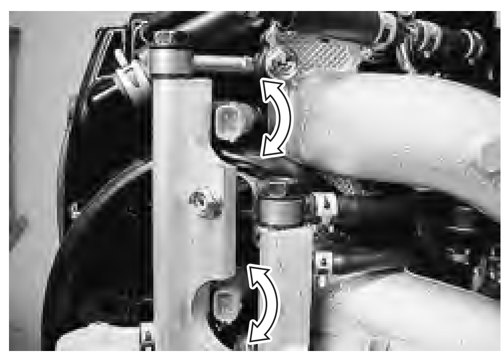
2. Place delivery pipe bolts ③ and two (2) insulators (collars) ④ in position.

3. Replace injector cushion ⑤ with new one and install it to cylinder head.



4. Apply thin coat of fuel to injector O-rings, then install injectors into delivery pipe ⑥ and cylinder head.
   Make sure that injectors rotate smoothly.

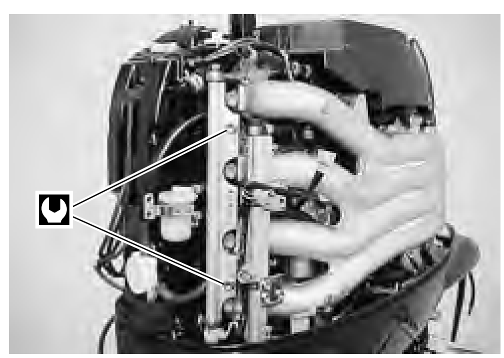
5. Tighten delivery pipe bolt and make sure that injectors rotate smoothly.



Fuel delivery pipe bolt : 23 N·m (2.3 kg-m, 16.5 lb.-ft.)

6. Reconnect fuel feed hose to fuel delirery pipe.

7. Connect lead wire connectors to each injector.



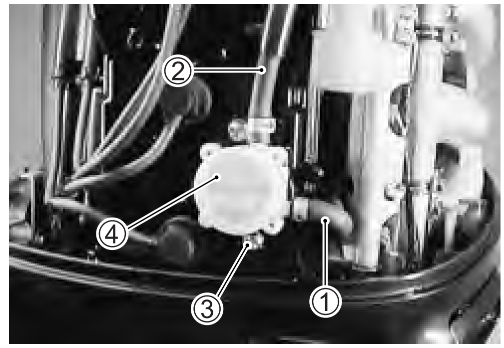
8. Turn ignition switch “ON” for 3 seconds (to operate fuel pump), then turn it “OFF”.
   Repeat this (ON and OFF) procedure 3 or 4 times to pressurize fuel system.
   Check for fuel leaks around fuel injector.

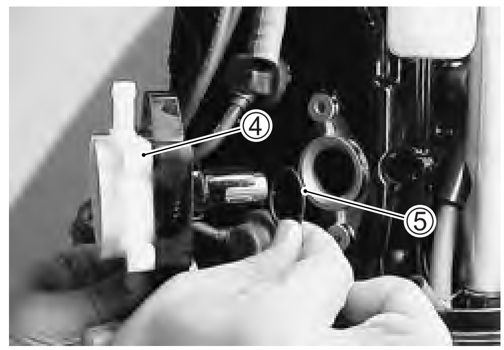
LOW PRESSURE FUEL PUMP

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.
   Note position before removing O-ring ⑤.



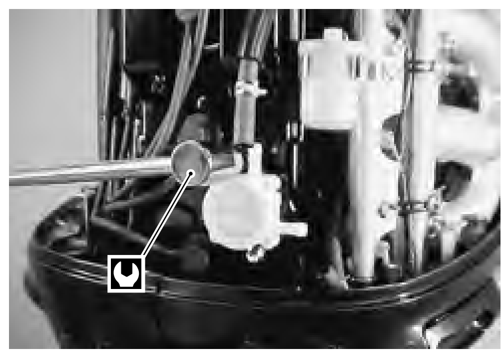


INSTALLATION

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.**
- **Do not re-use O-ring once removed. Always use a new O-ring.**

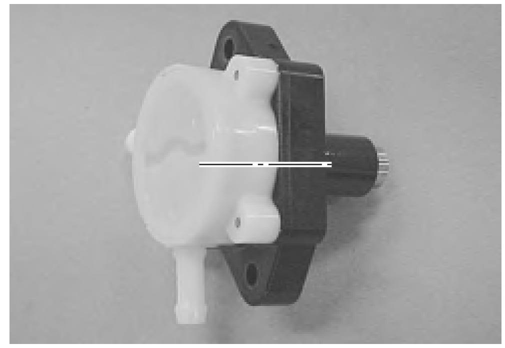


Low pressure fuel pump bolt :
10 N·m (1.0 kg-m, 7.0 lb.-ft.)

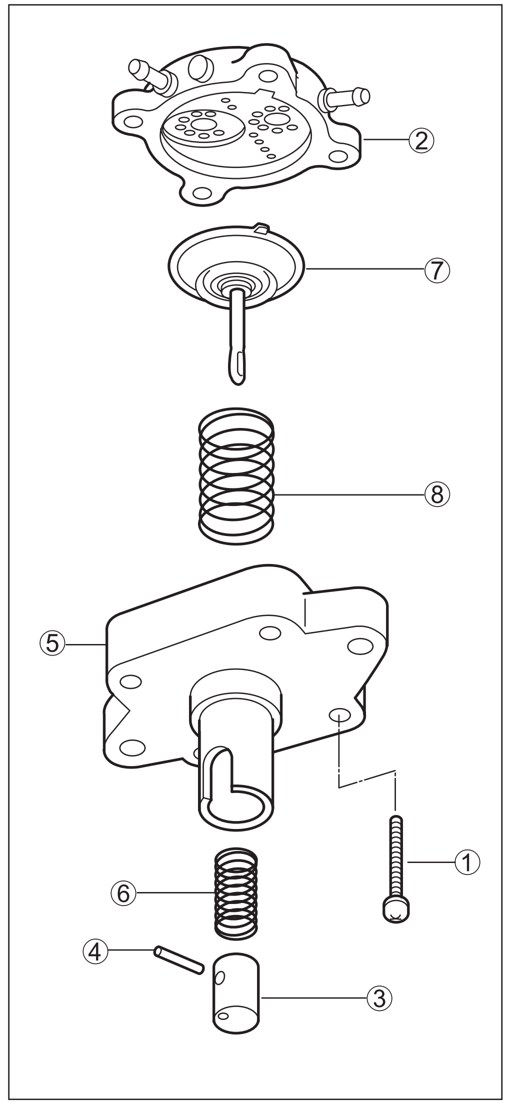
DISASSEMBLY / REASSEMBLY

DISASSEMBLY

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



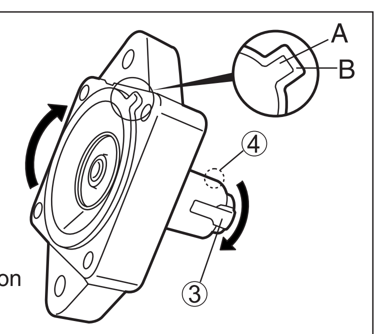
1. Remove four screws ① and valve body assembly ②.
2. Turn piston ③ until pin ④ comes out through cutaway of pump body ⑤.
3. Remove following parts :
   - Pin ④
   - Piston ③
   - Spring ⑥
   - Diaphragm ⑦
   - Spring ⑧



ASSEMBLY

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

NOTE:
After connecting diaphragm rod ⑦ to piston ③ with pin ④, align projection of diaphragm to groove of pump body by turning piston ③ and diaphragm ⑦ together. Turning them together prevents pin from coming out through pump body ⑤ cutaway.



A. Projection
B. Groove

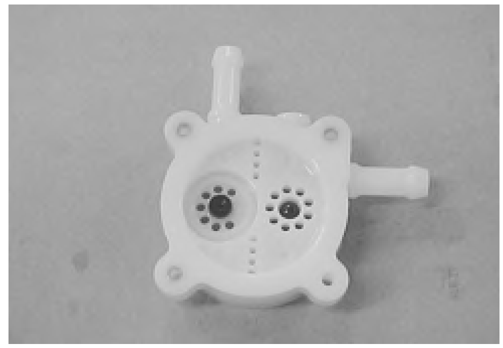
INSPECTION

Diaphragm

Inspect diaphragm for distortion, tears, or other damage.
Replace fuel pump assembly if necessary.

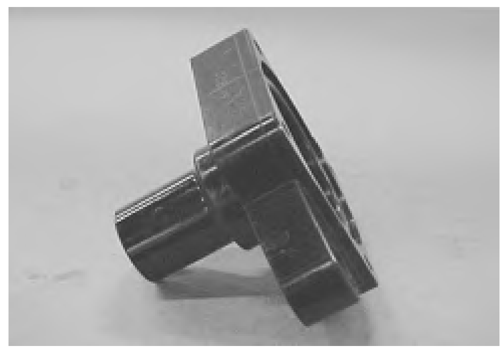
Check-valves

Inspect fuel pump check valves for tears, distortion or damage.
Replace fuel pump assembly if necessary.



Pump body

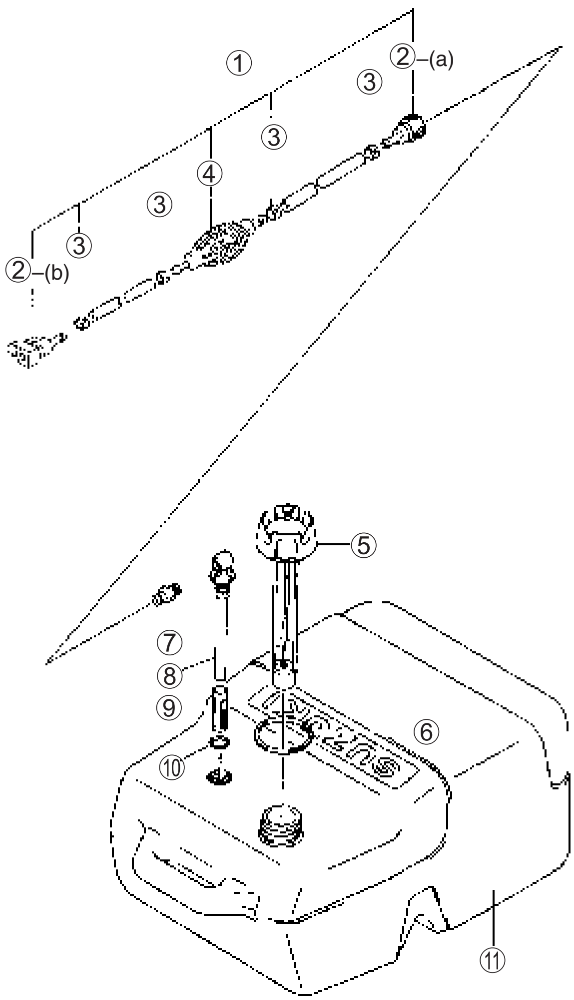
Inspect fuel pump body and valve body assembly for cracks, nicks, distortion or other damage.
Replace fuel pump assembly if necessary.



FUEL TANK (OPTIONAL PART)
DISASSEMBLY / REASSEMBLY

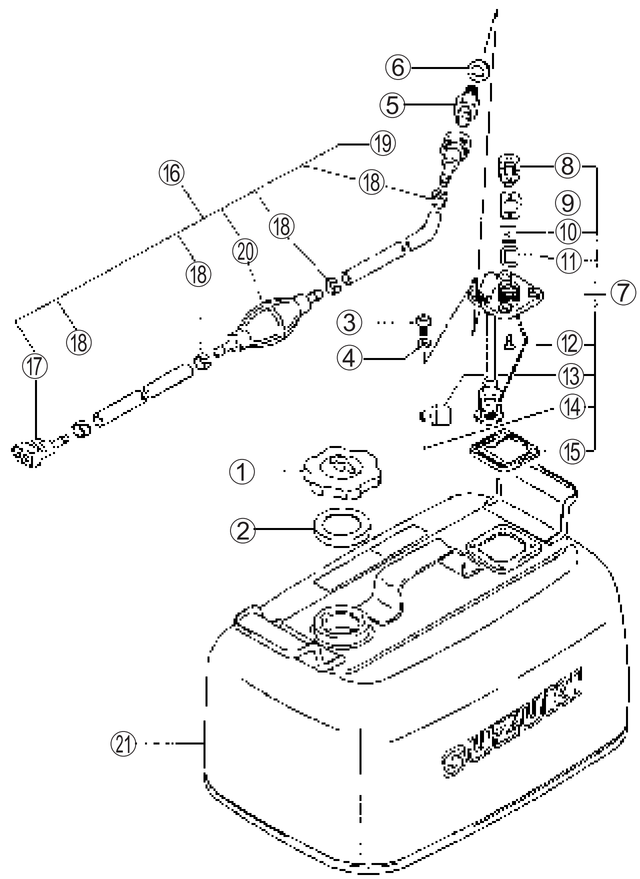
When disassembling or reassembling fuel tank, refer to the construction diagram below.

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

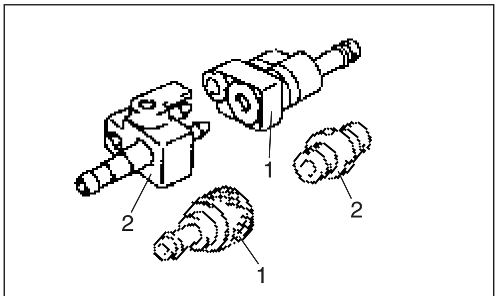


① Tank cap (1)
② Gasket (1)
③ Screw (4)
④ Gasket (4)
⑤ Connector plug (1)
⑥ Gasket (1)
⑦ Fuel gauge assy (1)
[⑧ Cover (1)]
[⑨ Gasket (1)]
[⑩ Lens (1)]
[⑪ Gasket (1)]
[⑫ Screw (2)]
[⑬ Float (1)]
[⑭ Push nut (1)]
[⑮ Gasket (1)]
⑯ Fuel hose assy (1)
[⑰ Connector (1)]
[⑱ Clip (4)]
[⑲ Connector (1)]
[⑳ Primer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

INSPECTION

Fuel connector

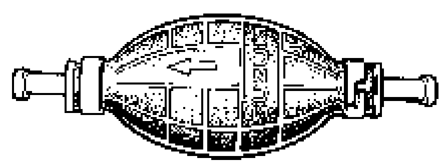
Inspect fuel connector for leakage,deterioration or other damage.
Replace if necessary.



1. Connector 2. Connector plug

Fuel primer bulb

Inspect fuel primer bulb for cracks, leakage, deterioration or check valve function.
Replace if necessary.

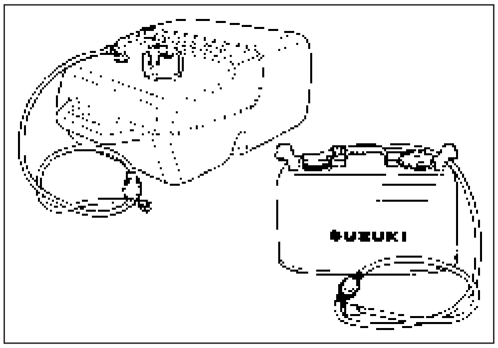


Fuel hose

Inspect fuel hose for cuts, cracks, leakage, tears or deterioration.
Replace if necessary.

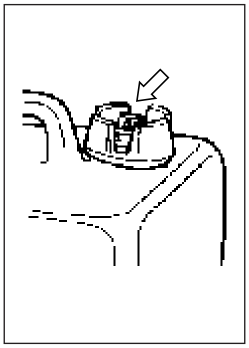
Fuel tank

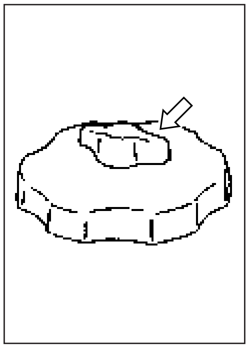
Inspect fuel tank for cracks, leakage or deterioration.
Replace if necessary.
If water or other contamination is found, drain and clean fuel tank.



Tank cap

Inspect tank cap for cracks, leakage, deterioration or vent function.
Replace if necessary.





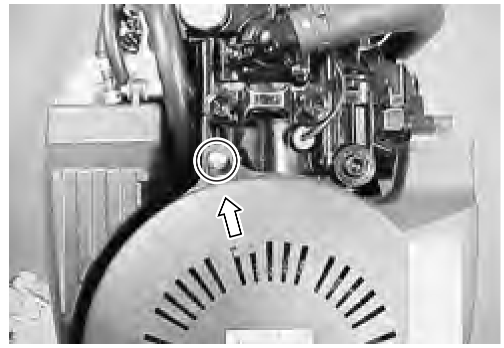
POWER UNIT

CONTENTS

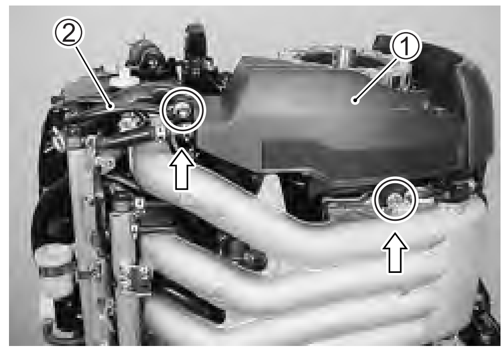
INTAKE MANIFOLD ASSEMBLY

REMOVAL

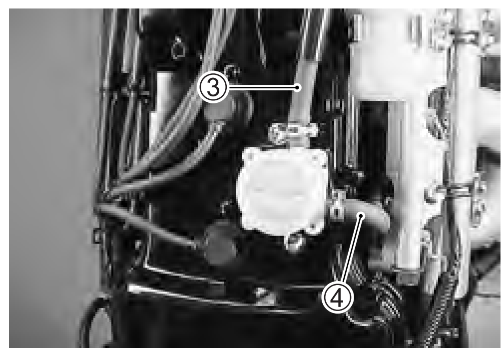
Before removing intake manifold :
- **Relieve fuel pressure. (See page 5-3)**
- **Disconnect battery cables from battery.**
- **Remove both side covers. (See page 7-2)**



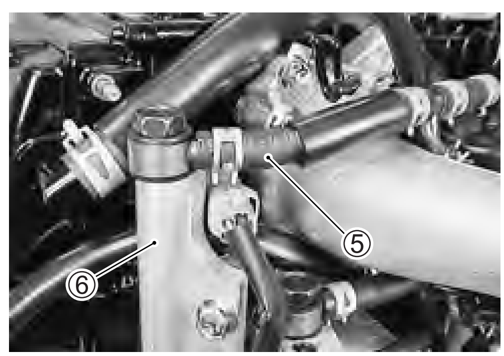
1. Remove flywheel cover.



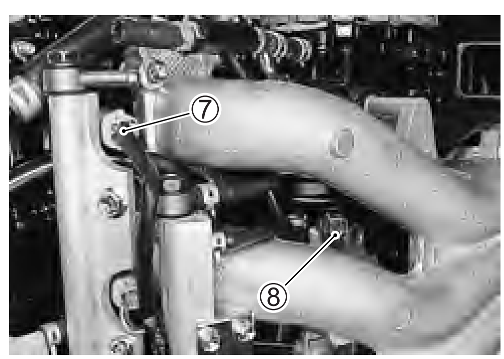
2. Remove two bolts and air duct ①.
3. Remove evaporation hose ② from cylinder head cover.



4. Disconnect fuel outlet hose ③ and fuel inlet hose ④ from low pressure fuel pump.

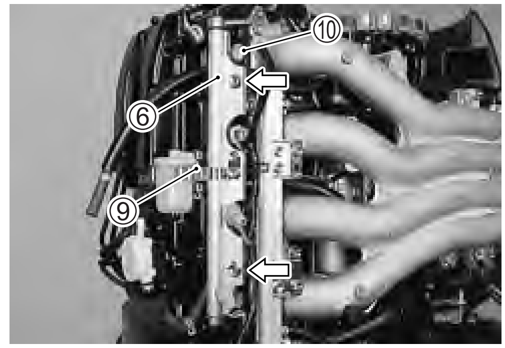


5. Loosen clamp and place a large cloth over end of fuel feed hose ⑤.
   Slowly pull fuel feed hose from fuel delivery pipe ⑥.
   Drain any excess fuel in hose into a small container.

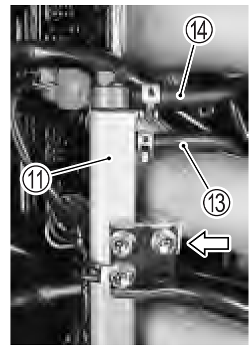


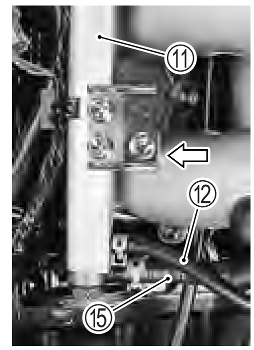
6. Disconnect four fuel injector connectors ⑦.
7. Disconnect high pressure fuel pump connector ⑧ from fuel vapor separator.

8. Remove bolts and low pressure fuel filter bracket ⑨.
9. Remove two (2) bolts securing fuel delivery pipe ⑥, then remove fuel delivery pipe and all fuel injectors ⑩.

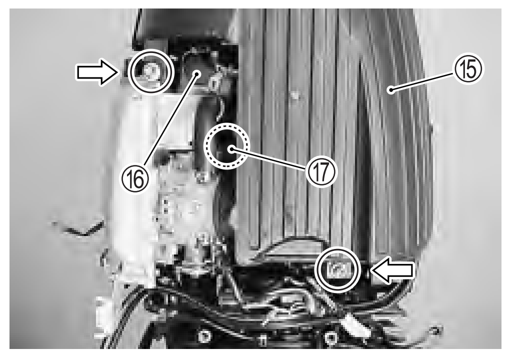


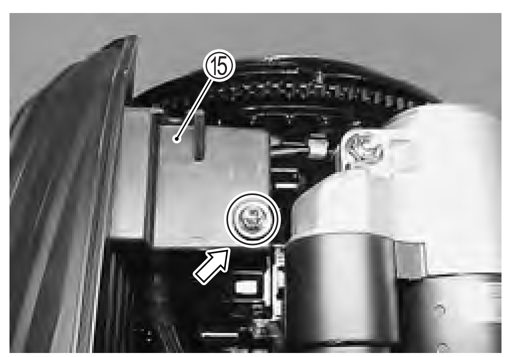
10. Remove two (2) bolts and fuel return pipe ⑪.
11. Disconnect water inlet hose ⑫ and water outlet hose ⑬ from fuel return pipe.
12. Place a suitable container under fuel return pipe, then disconnect fuel inlet hose ⑭ and fuel outlet hose ⑮ from fuel return pipe.



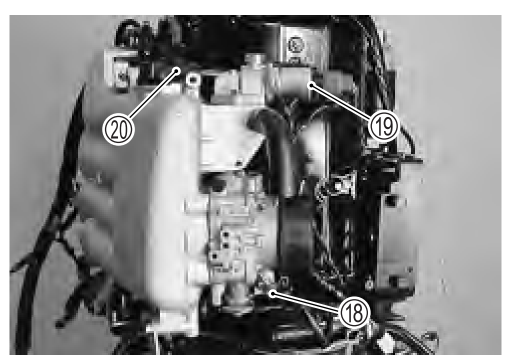


13. Remove three (3) bolts and silencer case ⑮.
14. Disconnect breather hose ⑯ from silencer case.
15. Disconnect IAT sensor connector ⑰.

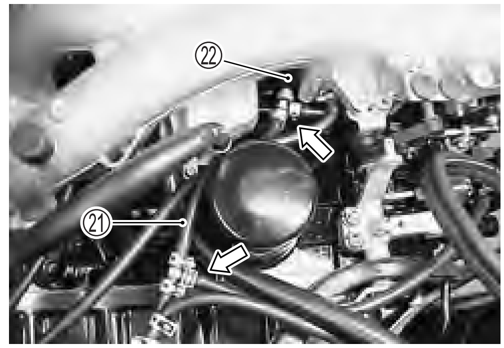




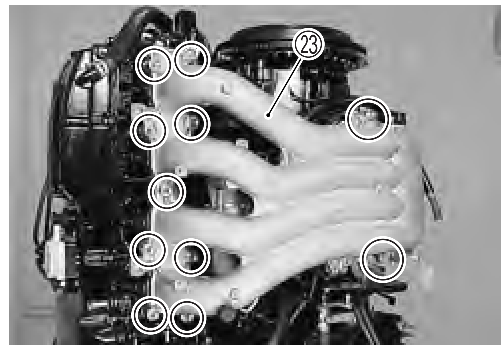
16. Disconnect CTP switch connector ⑱.
17. Disconnect IAC valve connector ⑲.
18. Disconnect MAP sensor connector ⑳.



19. Disconnect water inlet hose ㉑ and water outlet hose ㉒ from 3-way joint.

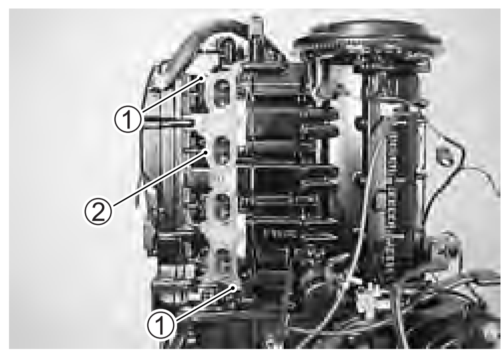


20. Remove nine (9) bolts and two (2) nuts and then remove intake manifold assembly ㉓.



INSTALLATION

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

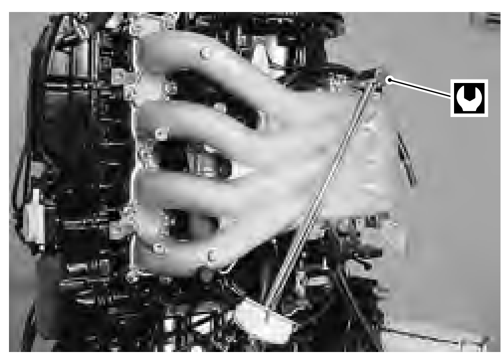


CAUTION

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

- Install two dowel pins ①, gasket ② and intake manifold assembly, then tighten bolts and nuts securely.

Intake manifold bolt & nut :
23 N·m (2.3 kg-m, 16.5 lb.-ft.)



- Install fuel injectors and fuel delivery pipe. (See page 5-13)
- Check to ensure that all removed parts are back in place.

Checking

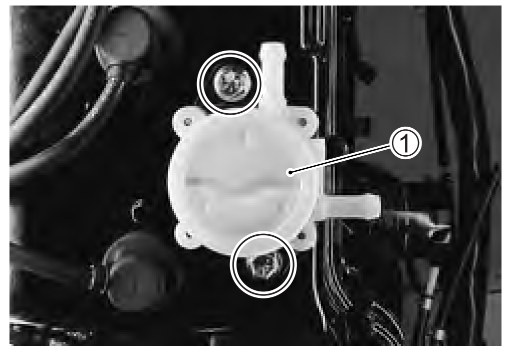
- Check fuel and water hose routing. (See page 10-8 to 10-11)
- Check wire routing. (See page 10-2 to 10-7)
- Check for fuel leakage. (See page 5-4)
- Check for water leakage.

POWER UNIT

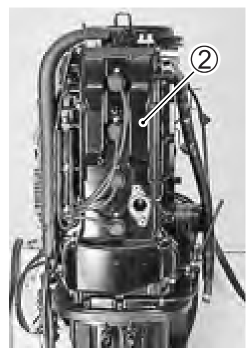
REMOVAL

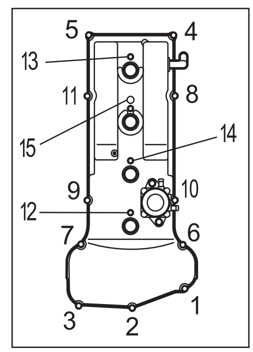
Before removing power unit :
- **Drain engine oil. (See page 2-4)**
- **Remove intake manifold assembly. (See page 6-2)**
- **Remove electric parts holder. (See page 4-25)**

1. Remove bolts and fuel pump ①.

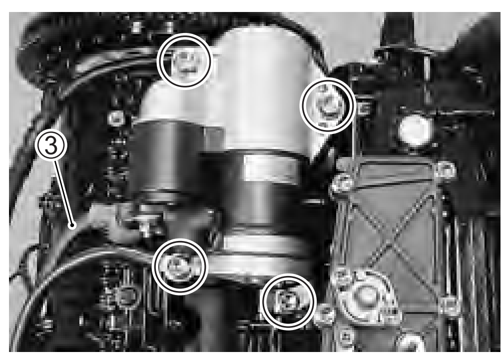


2. Remove all spark plugs.
3. Remove fifteen (15) cylinder head cover bolts, and then remove cylinder head cover ②.





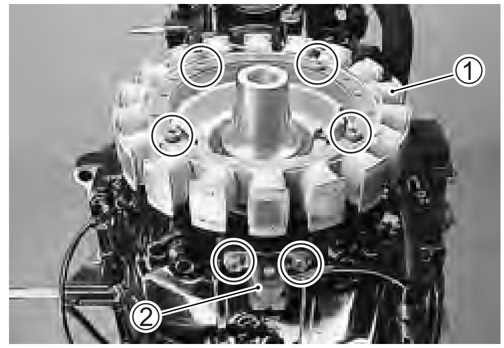
4. Remove nut and positive battery cable ③.
5. Remove starter motor. (See page 4-12)



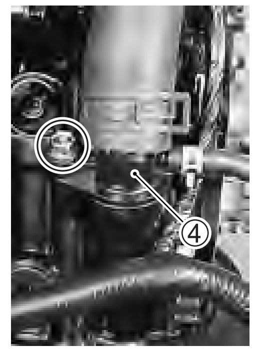
6. Remove flywheel. (See page 3-51)

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

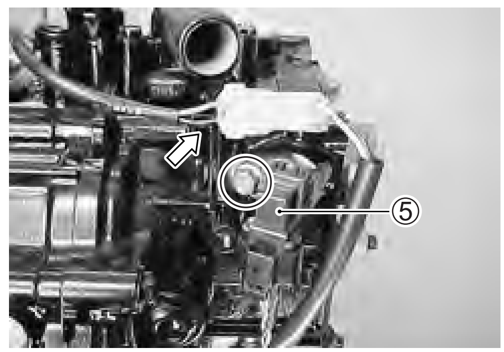
7. Remove battery charge coil ①. (See page 4-5)
8. Remove CKP sensor ②.(See page 3-53)



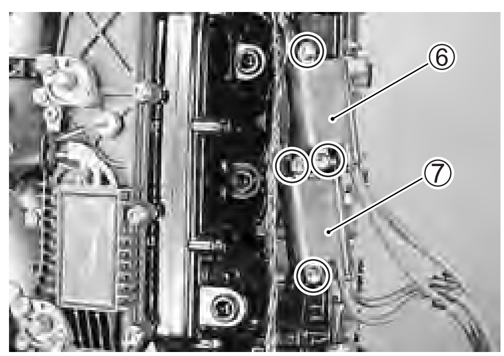
9. Disconnect water return hose ③ from thermostat cover.
10. Remove bolt and water return hose pipe ④.



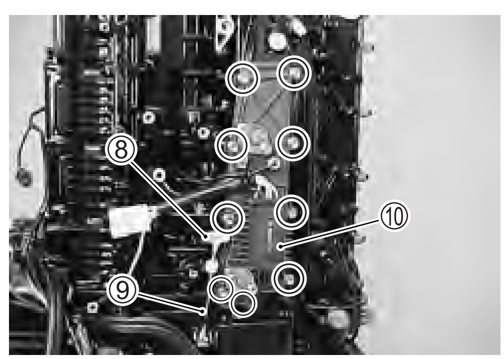
11. Disconnect cylinder temp sensor lead wire connector.
12. Disconnect CMP sensor connector, then remove bolt and CMP sensor ⑤ from cylinder head.



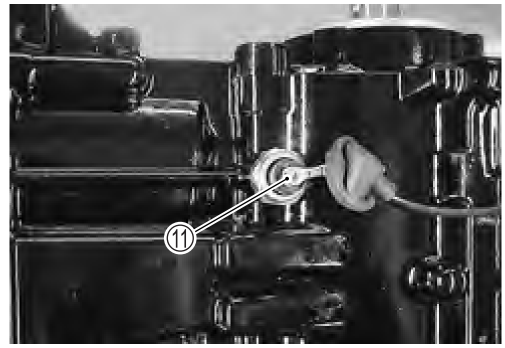
13. Disconnect two ignition coil connectors, then remove four bolts and ignition coil ⑥ and ⑦.



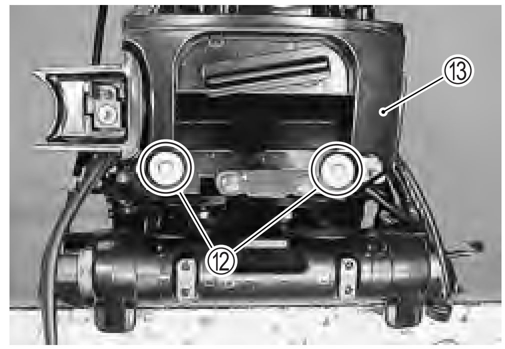
14. Remove oil level dipstick ⑧.
15. Remove bolt and oil level dipstick guide ⑨.
16. Remove nine (9) bolts and Rectifier & regulator ⑩.



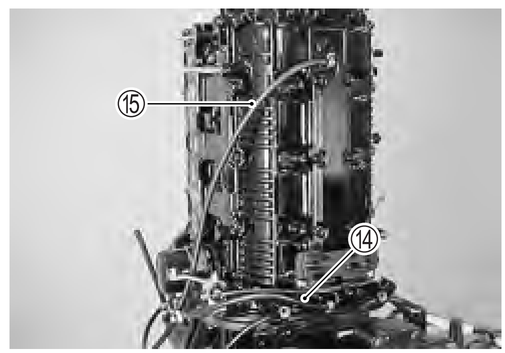
17. Loosen screw ⑪ and disconnect lead wire from oil pressure switch.



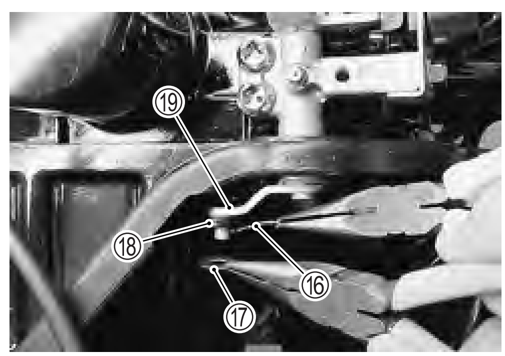
18. Remove two bolts ⑫ and front panel ⑬.



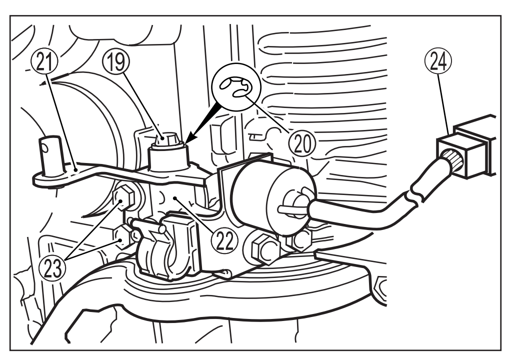
19. Disconnect water inlet hose ⑭ and water outlet hose ⑮ from crankcase.



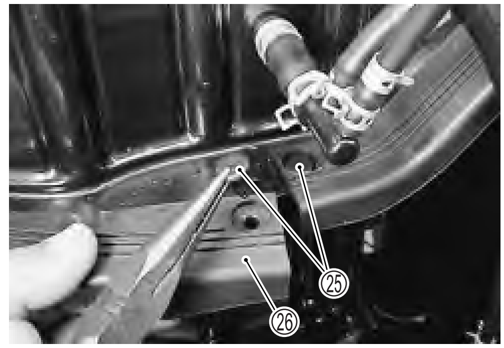
20. Remove cotter pin ⑯ and washer ⑰, then separate clutch lever link ⑱ from clutch shaft arm ⑲.



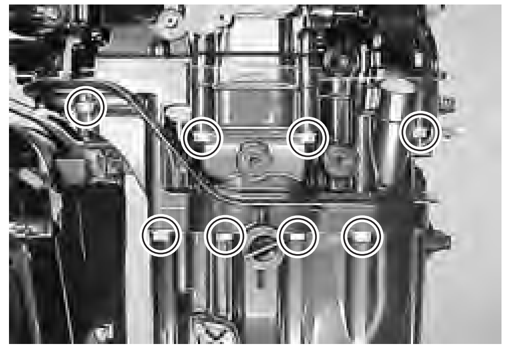
21. Remove E-ring ⑳, clutch control lever ㉑ and clutch shaft arm ⑲.
22. Remove two bolts ㉓ and clutch lever holder ㉒.
23. Disconnect neutral switch lead wire connector ㉔.

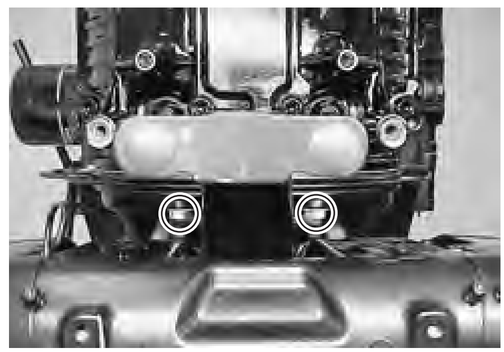


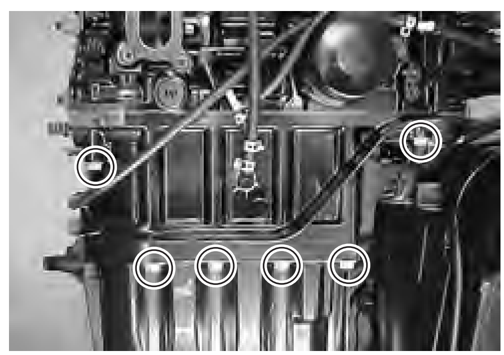
24. Remove pins ㉕ and side cover seal ㉖.



25. Remove sixteen (16) bolts.
26. Lift up and remove power unit from engine holder.

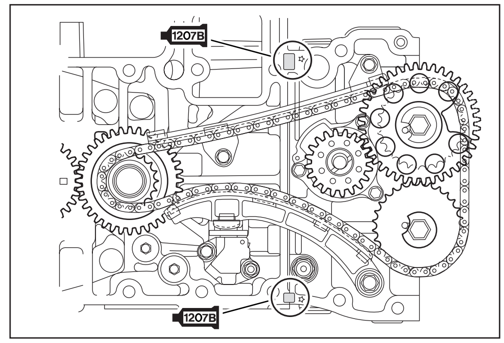






INSTALLATION

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

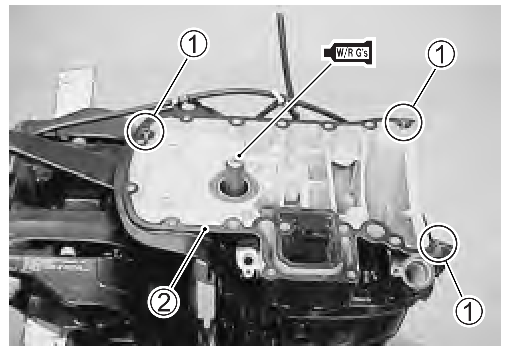


CAUTION

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

POWER UNIT

1. Install dowel pins ① and gasket ②.
2. Apply Suzuki Water Resistant Grease to driveshaft splines.

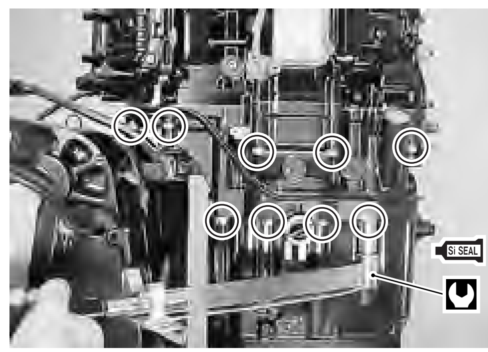


W/R G's **99000-25161 : Suzuki Water Resistant Grease**

NOTE:
Before installing power unit, apply Suzuki Bond to hatched part (2 parts) as shown in figure.

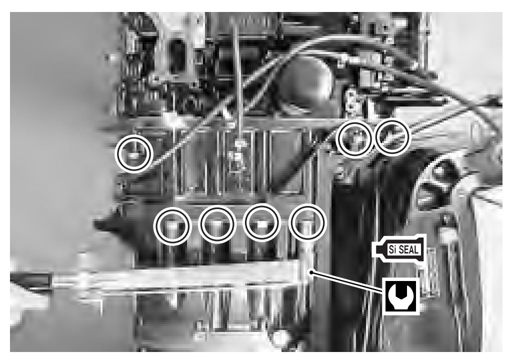
1207B **99000-31140 : Suzuki Bond 1207B**

3. Lower power unit onto engine holder.



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

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



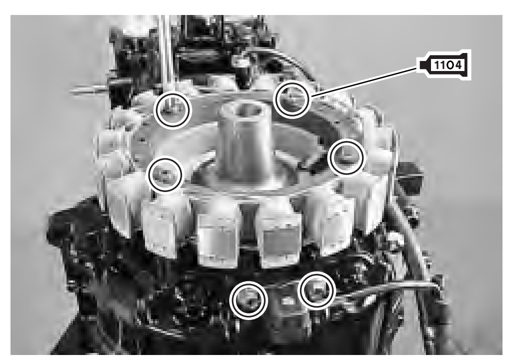
W/R G's **99000-31120 : Suzuki Silicone Seal**

Power unit mounting 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.)**

FLYWHEEL

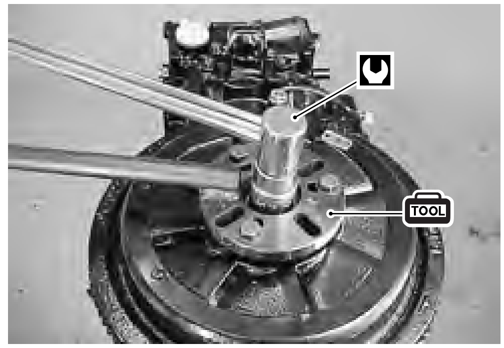
1. Install battery charge coil. (See page 4-6)
2. Install CKP sensor. (See page 3-53)



3. Install flywheel and tighten flywheel bolt to specified torque. (See page 3-52)

09930-48720 : Flywheel holder

Flywheel bolt : 245 N·m (24.5 kg-m, 177.0 lb.-ft.)

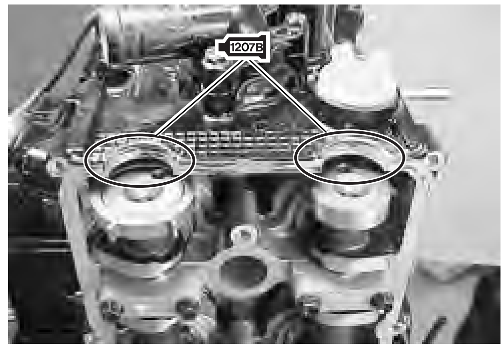


CYLINDER HEAD COVER

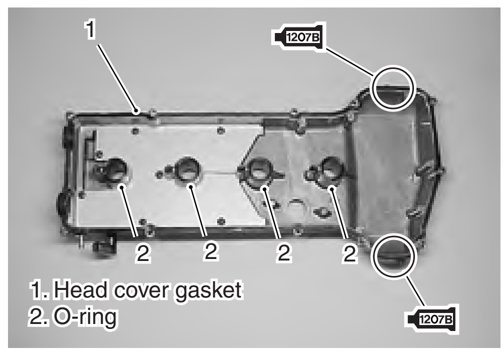
NOTE:
Before installing cylinder head cover, check tappet clearance. (See page 2-9)

1. Apply Suzuki Bond to area as shown in figure.

99000-31140 : Suzuki Bond No. 1207B



2. Assemble new O-rings and cylinder head cover gasket to cylinder head cover.



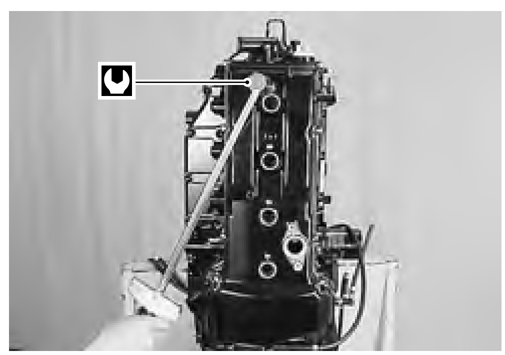
CAUTION

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

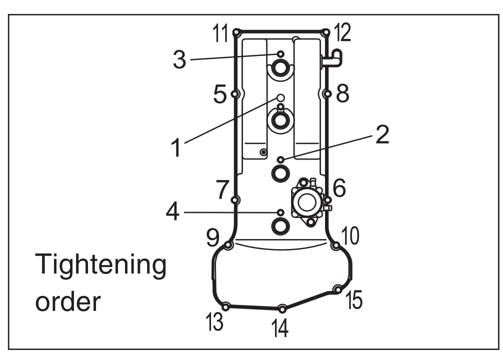
NOTE:
Be sure to check all parts for wear or any damage before installation and replace any found defective.

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

Cylinder head cover bolt :
11 N·m (1.1 kg-m, 8.0 lb.-ft.)

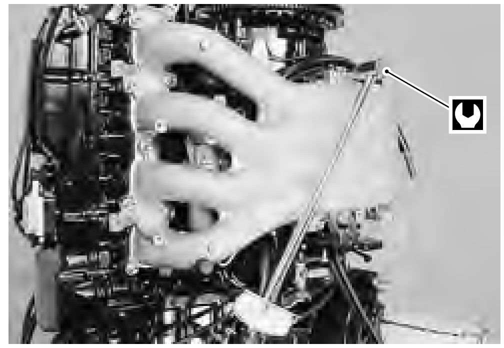


NOTE:
Use care when installing cylinder head cover.
Be certain cylinder head cover gasket and O-rings remain in their correct position.



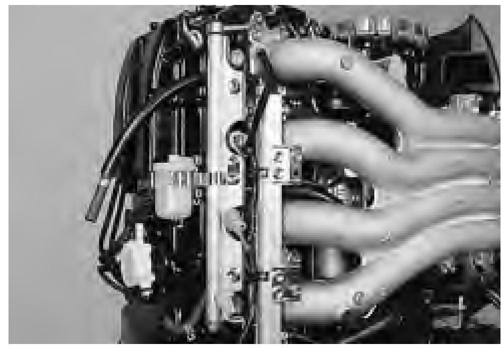
INTAKE MANIFOLD

Install intake manifold assembly. (See page 6-4)



FUEL INJECTOR

Install fuel injectors. (See page 5-13)



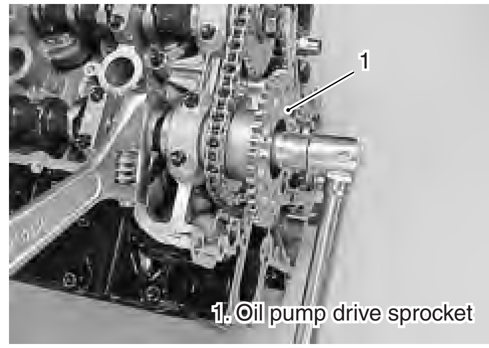
FINAL ASSEMBLY CHECK

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

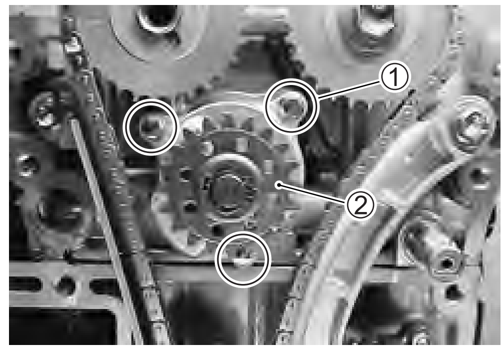
- All parts removed have been returned to their original positions.
- Lower unit gear engagement is properly adjusted.
- Fuel and water hose routing match's service manual illustration. (See page 10-8 to 10-11)
- Wire routing match's service manual illustration. (See page 10-2 to 10-7)
- No fuel leakage is evident when fuel system is pressurized. (See page 5-4)
- No water leakage is evident during final test running.

OIL PUMP
REMOVAL
1. Remove power unit. (See page 6-5 to 6-8)

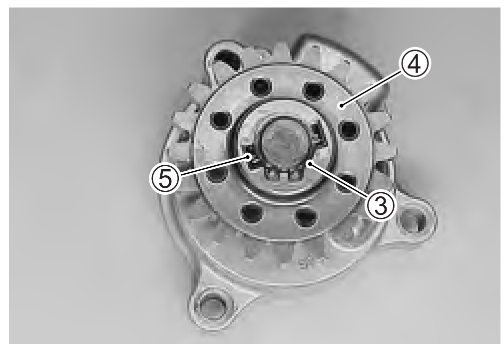
NOTE:
Hold camshaft by placing a wrench on hexagon area of camshaft.



2. Remove bolt securing oil pump drive sprocket to camshaft, then remove oil pump drive sprocket.
3. Remove three (3) bolts ① and oil pump assembly ②.



4. Remove circlip ③, driven sprocket ④, pin ⑤ and washer.



INSPECTION
Oil pump
Inspect outer/inner rotors and oil pump body for wear or other damage.
Replace if necessary.

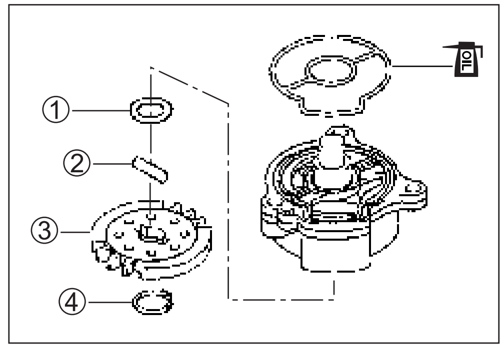
Seal ring
Inspect of seal ring for nick, cut or wear.

Drive / driven sprocket
Inspect teeth of sprocket for wear or other damage.
Replace if necessary.

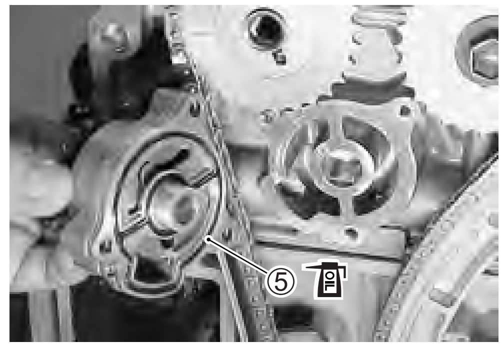
INSTALLATION

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

- Assemble washer ①, pin ②, driven sprocket ③ and circlip ④ to oil pump shaft.



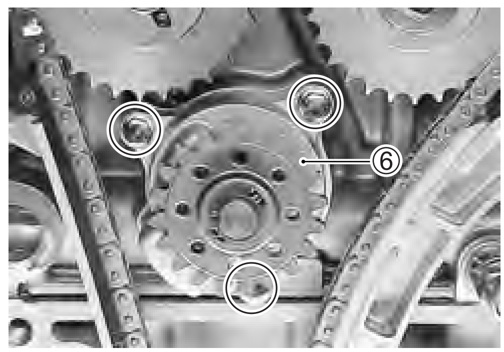
- Apply engine oil to seal ring ⑤, then install seal ring to oil pump body.



CAUTION

Do not re-use seal ring once removed. Always use a new seal ring.

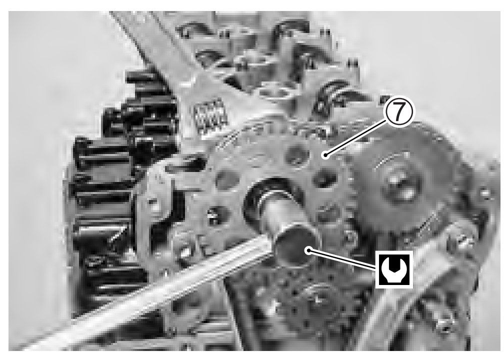
- Install oil pump ⑥ to cylinder head block, then tighten three (3) bolts securely.



- Install oil pump drive sprocket ⑦ and tighten bolt securely.

Oil pump drive sprocket bolt :

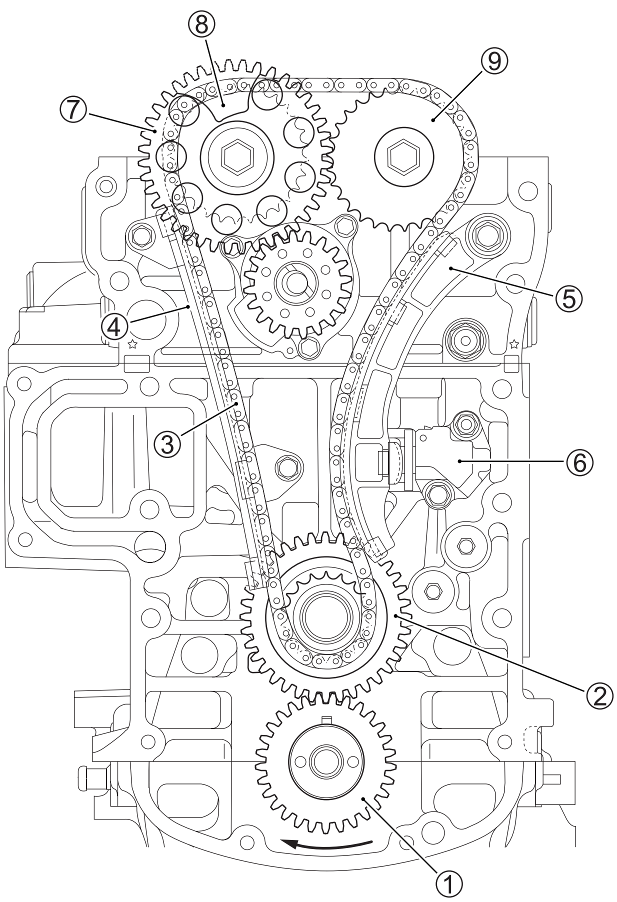
78 N·m (7.8 kg-m, 56.5 lb.-ft.)



TIMING CHAIN / TENSIONER

REMOVAL

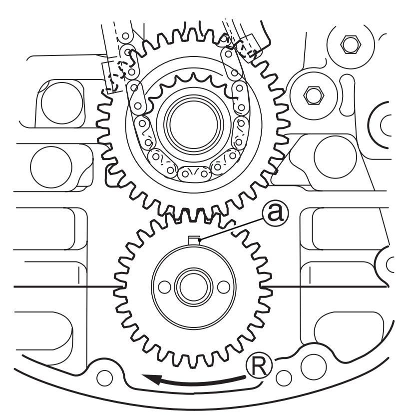
Prior to this service work :
• Remove power unit. (See page 6-5 to 6-8)



① Crankshaft / Drive gear
② Driven gear / Timing sprocket
③ Timing chain
④ Timing chain guide
⑤ Timing chain tensioner
⑥ Timing chain tensioner adjuster
⑦ Oil pump drive sprocket
⑧ Exhaust camshaft and timing sprocket
⑨ Intake camshaft and timing sprocket

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

NOTE :
To bring No.1 cylinder top dead center, turn crankshaft to locate match mark (key) ⓐ position at the top as shown in figure.



ⓐ: Match mark (key) on crank shaft
Ⓡ: Engine normal running direction

CAUTION

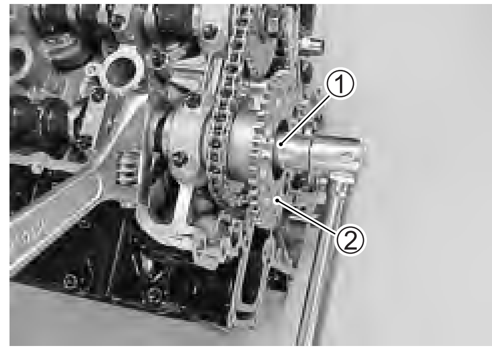
When timing chain has been removed, never turn crankshaft or camshaft.

TOOL **09911-49910 : Crankshaft holder**

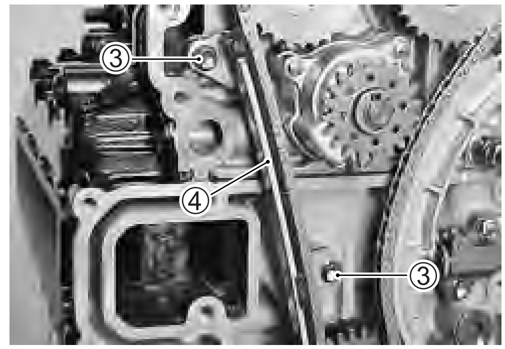
2. Remove bolt ① and oil pump drive sprocket ②.
   (See page 6-12)

NOTE:

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

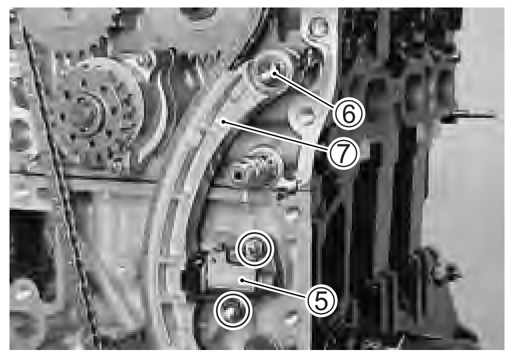


3. Remove bolts ③ and timing chain guide ④.



4. Remove bolt, nut and chain tensioner adjuster ⑤.

5. Remove bolt ⑥ and chain tensioner ⑦.

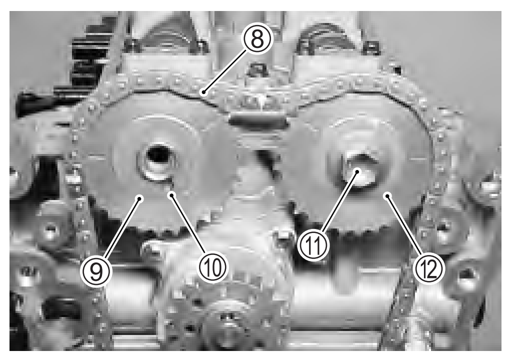


6. Remove timing chain ⑧, exhaust camshaft timing sprocket ⑨ and dowel pin ⑩.

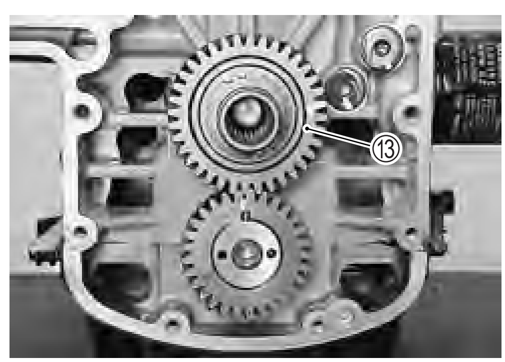
7. Remove bolt ⑪ and intake camshaft timing sprocket ⑫.

NOTE:

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

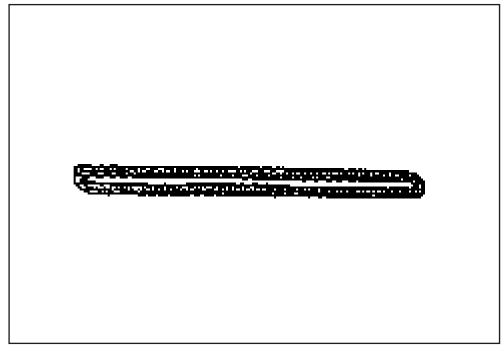


8. Remove driven gear ⑬.



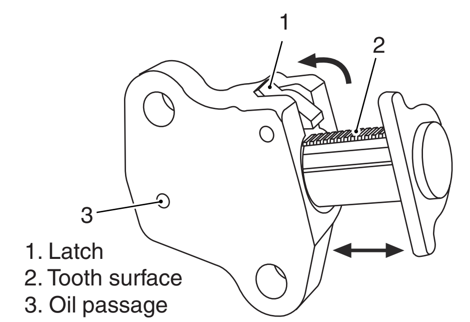
INSPECTION

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



Timing chain

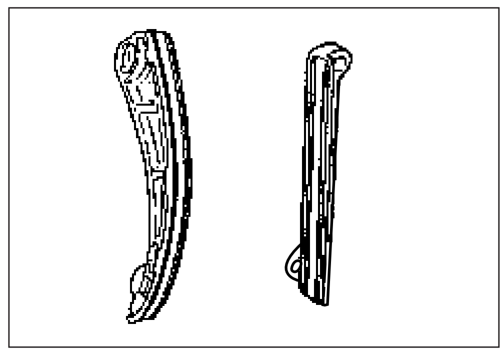
Inspect timing chain for wear or other damage.
Replace if necessary.



1. Latch
2. Tooth surface
3. Oil passage

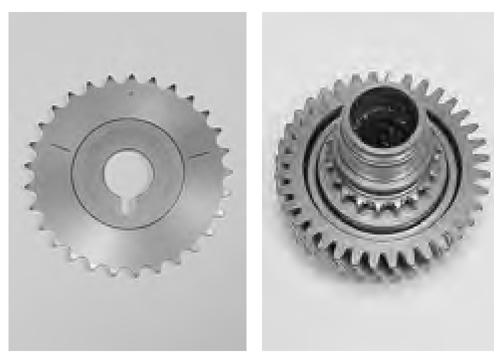
Tensioner adjuster

Inspect tensioner adjuster for smooth operation.
Inspect oil passage for clog.
Replace or clean if necessary.



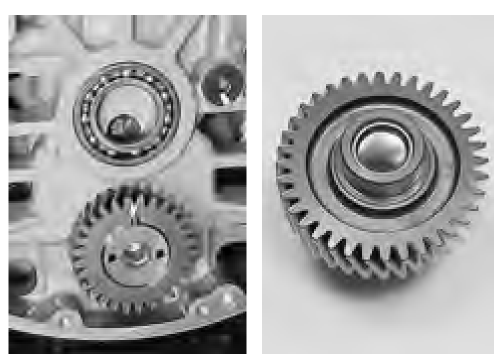
Timing chain tensioner / chain guide

Inspect oil shoe for wear or other damage.
Replace if necessary.



Timing chain sprocket

Inspect teeth of sprocket for wear or other damage.
Replace if necessary.



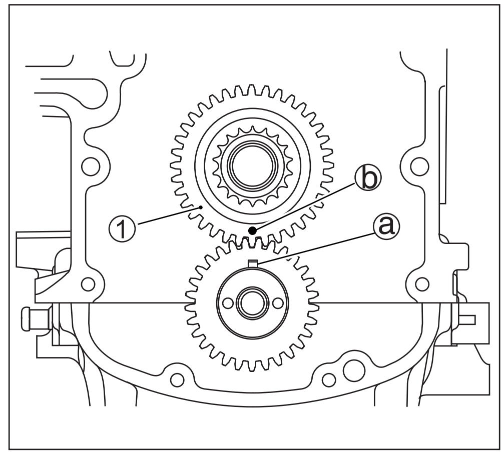
Drive / driven gear and bearing

Inspect drive gear and driven gear for wear or other damage.
Replace if necessary.

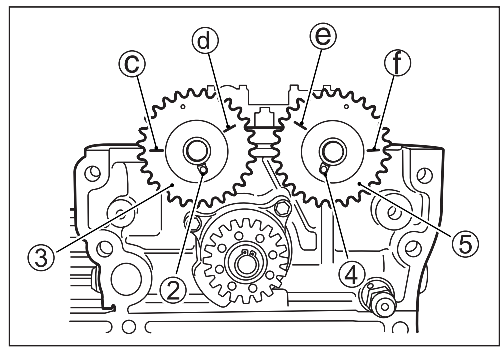
Inspect driven gear bearing for pitting, rough or other damage.
Replace if necessary.

INSTALLATION

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



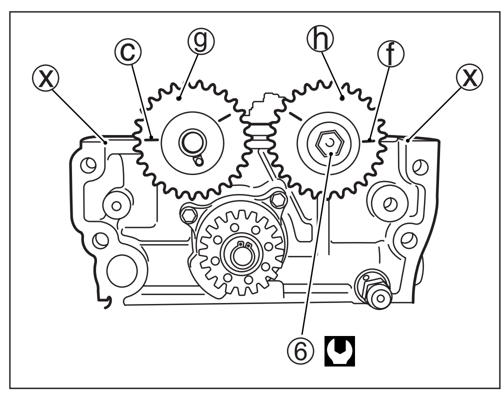
1. Check that match mark (key way) ⓐ on crankshaft drive gear points to 12 o'clock (towards cylinder head).
   (Check that #1 cylinder is at top dead center.)
2. Install driven gear ① on cylinder block so that match mark (key way) ⓐ aligns with match mark (•) ⓑ on driven gear as shown in figure.



3. Install dowel pin ② and sprocket ③ on exhaust camshaft.
   Install dowel pin ④ and sprocket ⑤ on intake camshaft, then tighten bolt ⑥ securely.

Timing sprocket bolt : 78 N·m (7.8 kg-m, 56.5 lb.-ft.)

NOTE:
When installing camshaft sprocket, position side of sprocket with two engraved lines ⓒ,ⓓ,ⓔ and ⓕ facing down toward engine holder as shown in figure.

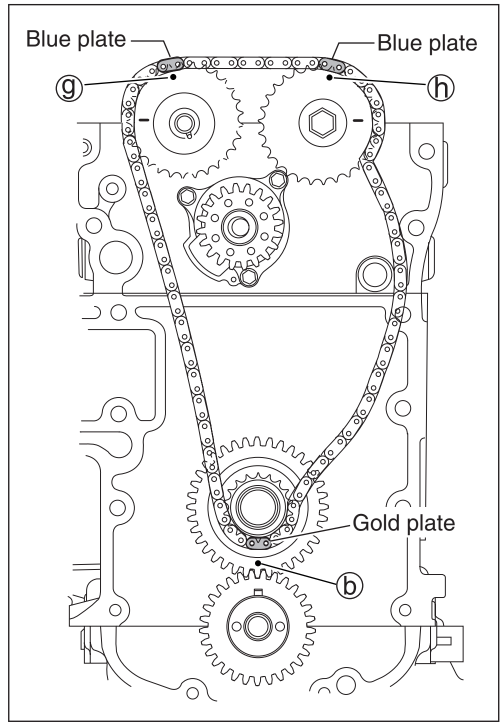


4. Check that engraved lines ⓒ and ⓕ on sprockets are opposite each other and aligned with mating face ⓧ of cylinder head cover when match marks (dot) ⓖ and ⓗ on sprockets are located as shown in figure.

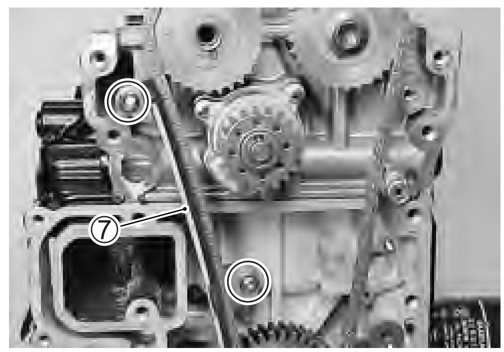
5. As shown in figure, position timing chain on driven gear sprocket with GOLD plate of chain aligned with match mark (•) ⓑ on driven gear.

6. As shown in figure, engage timing chain with exhaust sprocket with one BLUE plate of chain aligned with match mark (dot) ⓖ of exhaust sprocket.

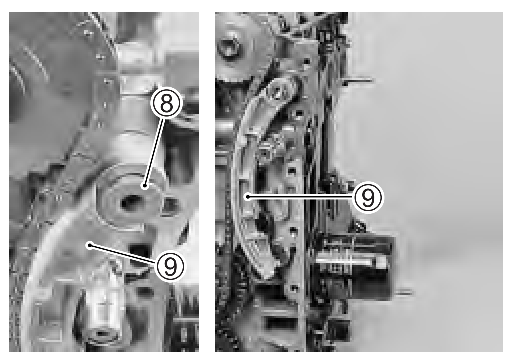
7. As shown in figure, engage timing chain with intake sprocket with another BLUE plate of chain aligned with match mark (dot) ⓗ of intake sprocket.



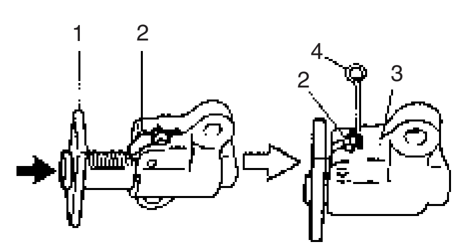
8. Install timing chain guide ⑦, then tighten bolts securely.



9. Insert spacer ⑧ into chain tensioner.
Install chain tensioner ⑨ as shown in figure.
Apply oil to chain tensioner.

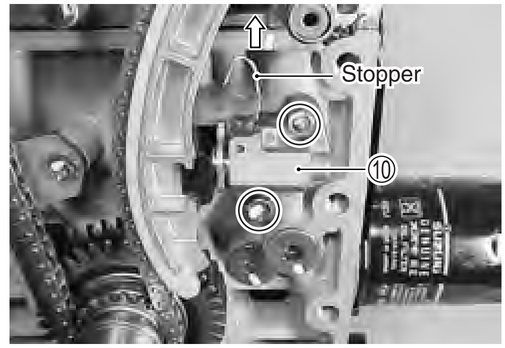


10. With latch of tensioner adjuster pushed in and plunger pushed back into body, insert stopper into latch and body.
After inserting stopper, check to make sure that plunger will not come out.



1. Plunger
2. Latch
3. Body
4. Stopper

11. Install timing chain tensioner adjuster ⑩.
    Tighten bolt and nut, pre-coated with thread lock, to specified torque.

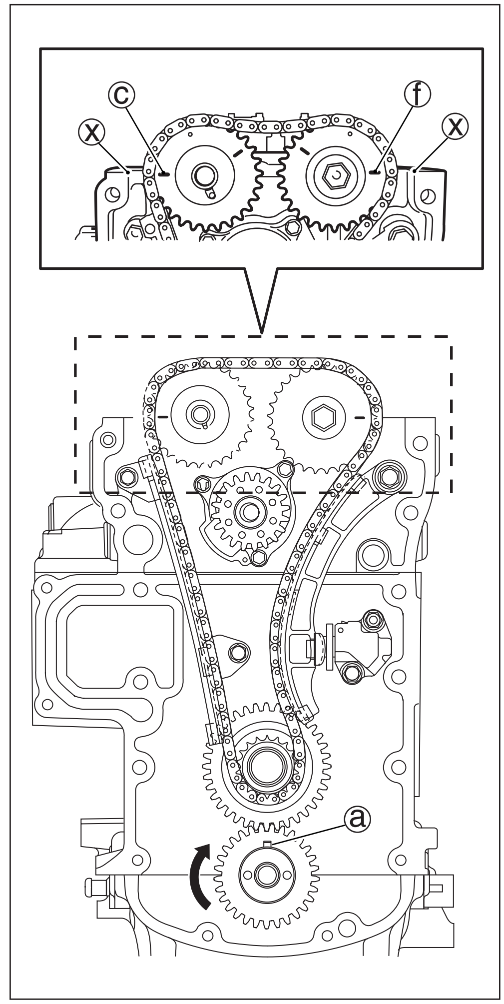


1342 **99000-32050 : Thread lock "1342"**

Tensioner adjuster bolt / nut :
11 N·m (1.1 kg-m, 8.0 lb.-ft.)

12. Apply engine oil to timing chain.

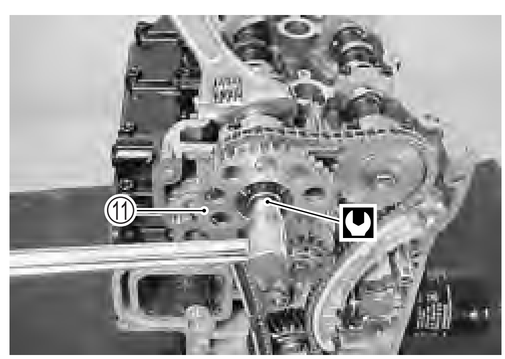
13. Remove stopper from tensioner adjuster to release plunger.



14. Turn crankshaft in normal running direction two complete turns and check that crankshaft match mark (key way) ⓐ points toward the top and at the same time, engraved lines ⓒ and ⓕ on sprockets aligns with cylinder head cover mating face ⓧ.

15. Install oil pump drive sprocket ⑪ and tighten bolt securely.

Oil pump drive sprocket bolt :
78 N·m (7.8 kg-m, 56.5 lb.-ft.)

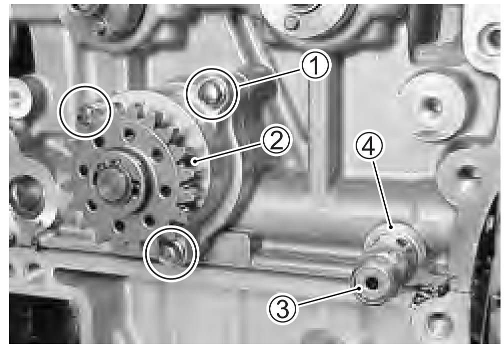


CYLINDER HEAD ASSEMBLY

(Cylinder head / valve / camshaft)

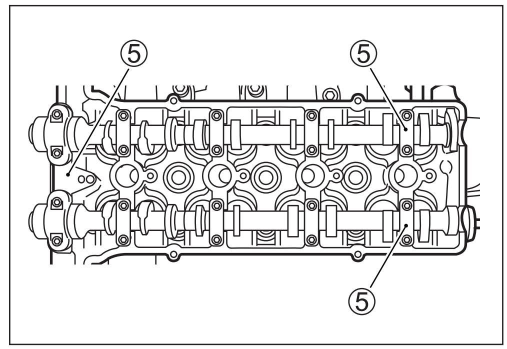
REMOVAL

Prior to removing cylinder head :
- **Remove power unit. (See page 6-5 to 6-8)**
- **Remove timing chain. (See page 6-14 to 6-15)**



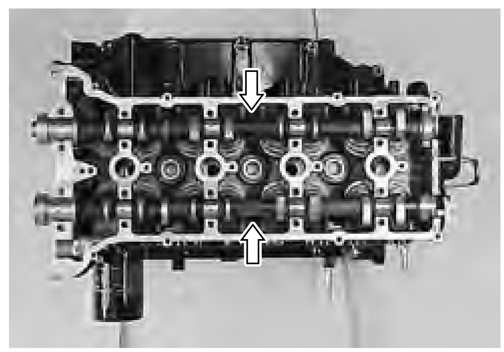
1. Remove bolts ① and oil pump ②.

2. Remove oil relief valve ③ and gasket ④.

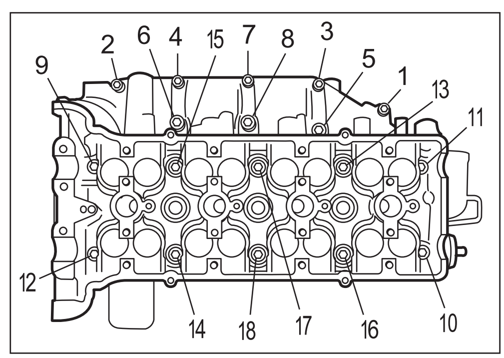


3. Remove bolts securing camshaft housing ⑤ to cylinder head, then remove each camshaft housing.

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



4. Remove intake and exhaust camshafts.



5. Loosen eighteen (18) cylinder head bolts according to numerical order in figure and remove them.

6. Remove cylinder head assembly and head gasket.

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

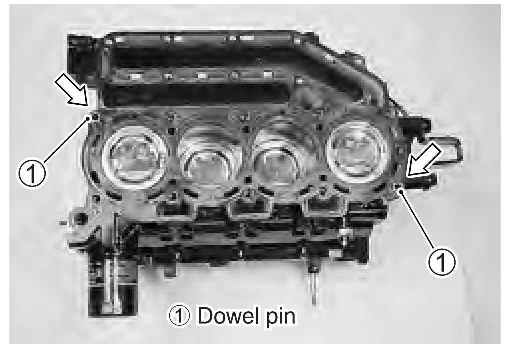
TOOL **09919-16010 : Deep socket wrench (10 mm)**

INSTALLATION

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

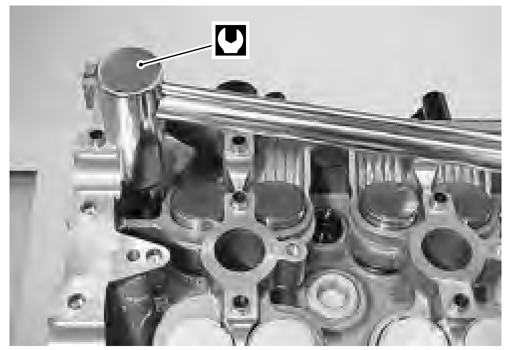
CAUTION

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



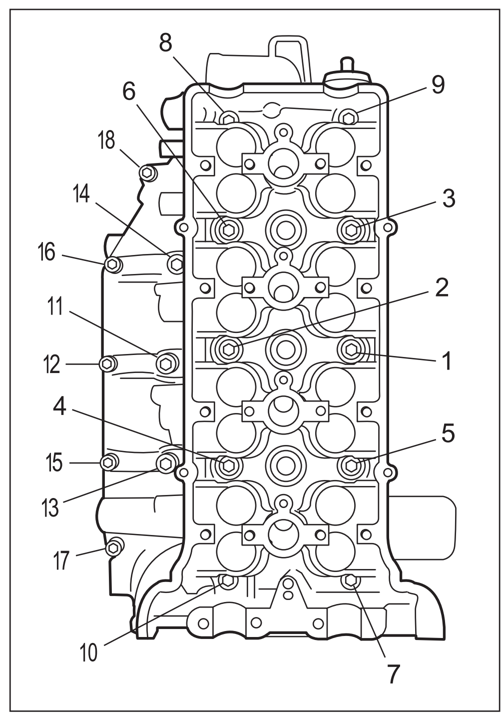
① Dowel pin

1. Insert dowel pins and place cylinder head gasket into position on cylinder.
2. Position cylinder head on cylinder.
3. Apply engine oil lightly to cylinder head bolts and tighten them gradually as follows.



(a) Tighten all bolts to 50 percent (%) of specified torque according to numerical order in figure.

Cylinder head bolt :
1 st step 10 mm 35 N·m (3.5 kg-m, 25.5 lb.-ft.)
8 mm 12 N·m (1.2 kg-m, 8.5 lb.-ft.)



(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 50 percent (%) of specified torque according to numerical order in figure.

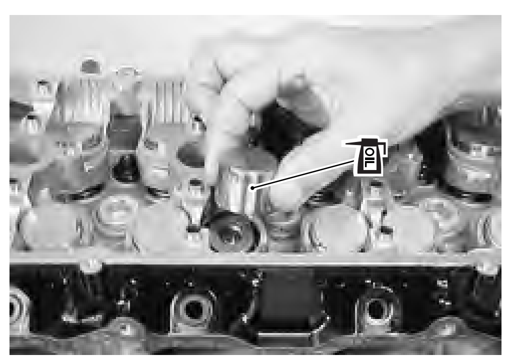
Cylinder head bolt :
3 rd step 10 mm 35 N·m (3.5 kg-m, 25.5 lb.-ft.)
8 mm 12 N·m (1.2 kg-m, 8.5 lb.-ft.)

(d) Finally tighten all bolts to specified torque according to numerical order in figure.

Cylinder head bolt :
Final step 10 mm 70 N·m (7.0 kg-m, 50.5 lb.-ft.)
8 mm 23 N·m (2.3 kg-m, 16.5 lb.-ft.)

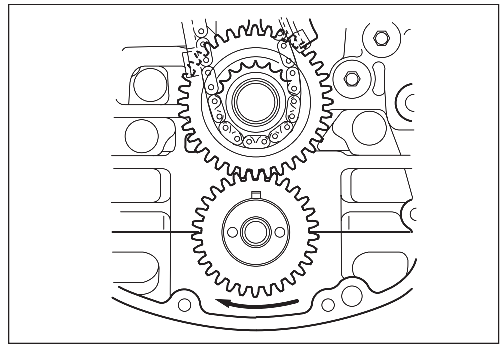
NOTE:
Use special tool (10 mm deep socket wrench) when tightening cylinder head bolts.

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

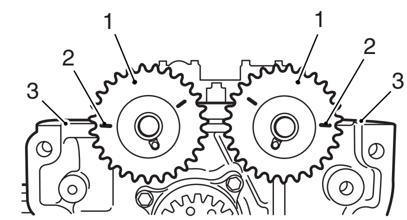


4. Apply engine oil around tappets and install them.
5. Install tappet shims.
6. Apply engine oil to surface of each camshaft lobe and journal, then install them.

NOTE:
Before installing camshafts, turn crankshaft until No.1 cylinder reaches top dead center. (See page 6-14)

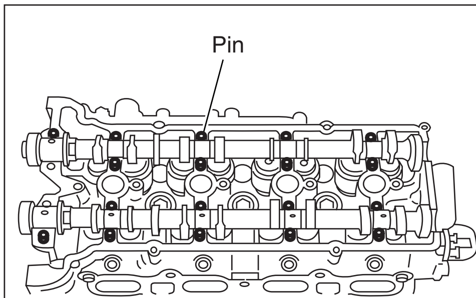


NOTE:
When install camshaft, adjust relative position between sprockets and chain so that match marks (dot) on timing sprockets are as shown in figure and engraved lines on sprockets align with cylinder head cover mating face.



1. Match mark (dot)
2. Match mark (engraved line)
3. Cylinder head cover mating face

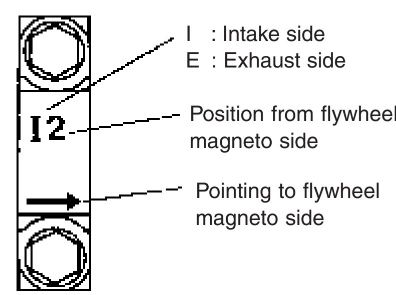
7. Install camshaft housing pins as shown in figure.



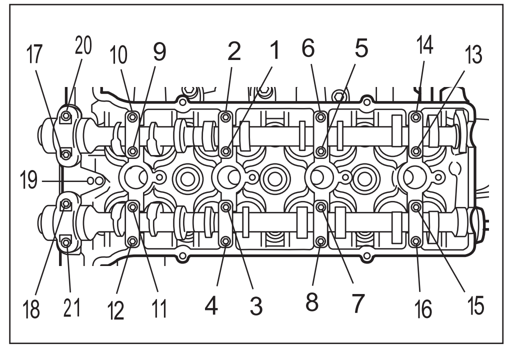
8. Check position of camshaft housing.

NOTE:
Embossed marks are provided on each camshaft housing indicating position and direction of installation.

9. Install housings as indicated by these marks.



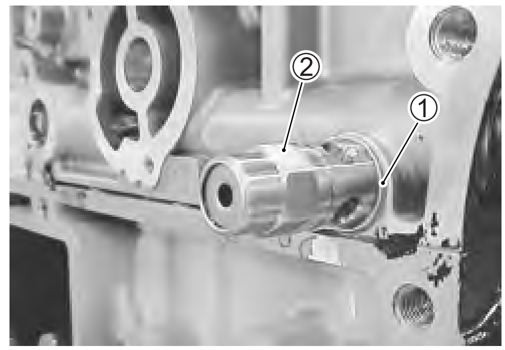
10. Apply engine oil lightly to housing bolts.



11. Lightly seat all housing bolts at first.
    According to 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 : 11 N·m (1.1 kg-m, 8.0 lb.-ft.)

12. Install gasket ① and oil relief valve ②, then tighten valve securely.



Oil relief valve : 27 N·m (2.7 kg-m, 19.5 lb.-ft.)

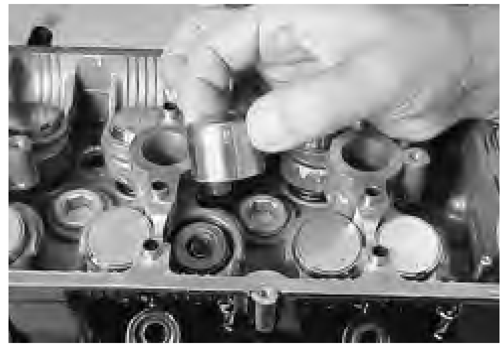
13. Install timing chain. (See page 6-17)

14. Install oil pump assembly. (See page 6-13)

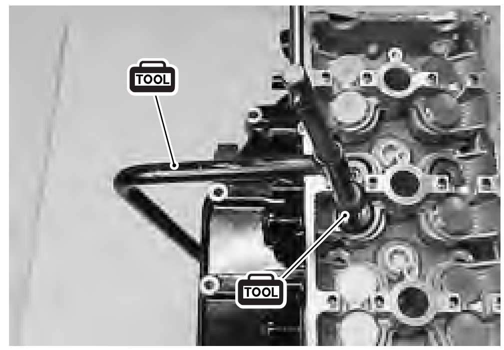
15. Adjust tappet clearance. (See page 2-9)

DISASSEMBLY

1. Remove tappets with shims.

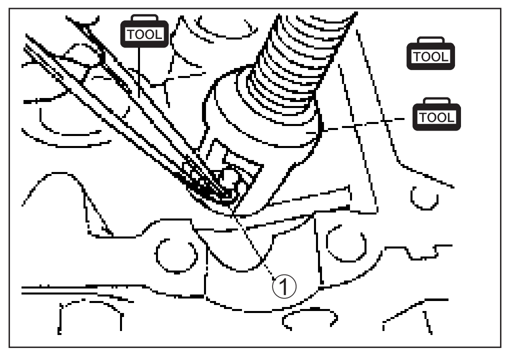


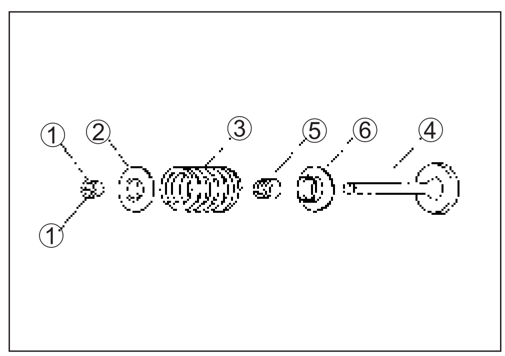
2. Using valve lifter and attachment, remove valve cotters ① while compressing valve spring.



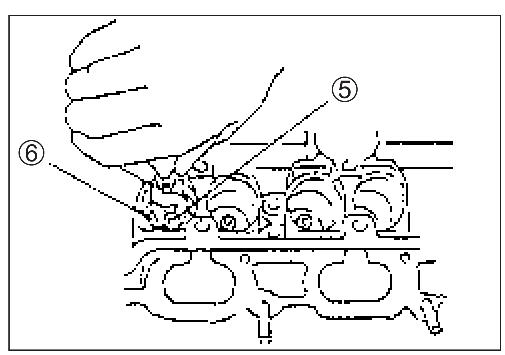
09916-19030 : Valve lifter
09916-14910 : Attachment
09916-84511 : Tweezers

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





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

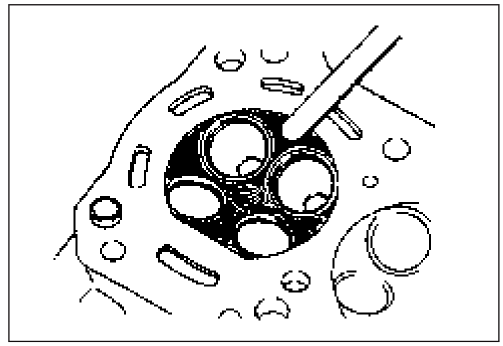


NOTE:
Reassemble each valve and valve spring in their original positions.

INSPECTION / SERVICING

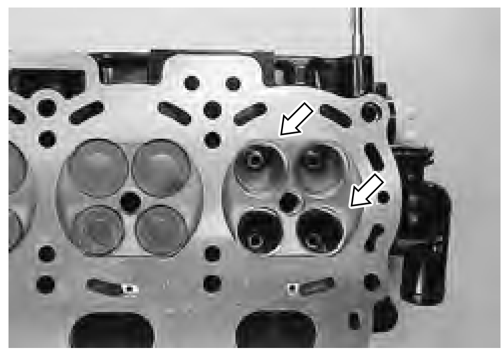
NOTE:
If cracks, excessive wear or other damage is found on any component, replace component.

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.*

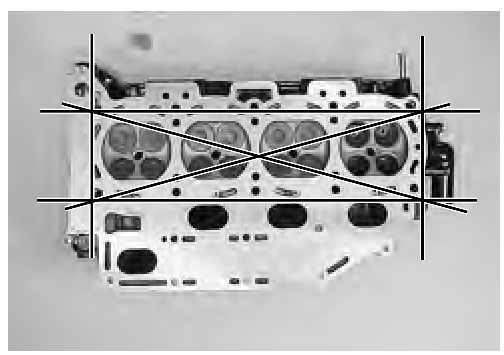


Inspect cylinder head for crack in intake and exhaust ports, combustion chambers and head surface.

Valve seat

Inspect valve seat for crack or other damage.
Replace if necessary.

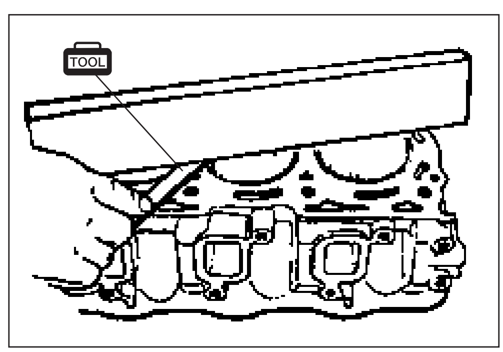
Cylinder head distortion



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

TOOL **09900-20803 : Thickness gauge**

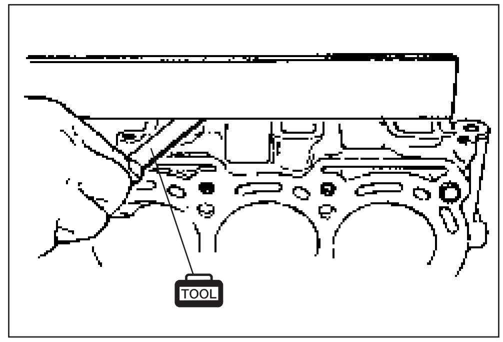
Cylinder head distortion :
Service limit : 0.05 mm (0.002 in.)



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 cylinder head in a figure eight pattern when sanding.

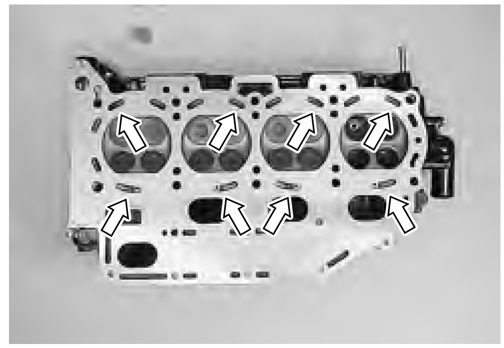
Manifold seating faces distortion
Using a straightedge and thickness gauge, measure cylinder head distortion to intake manifold seating faces.



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

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

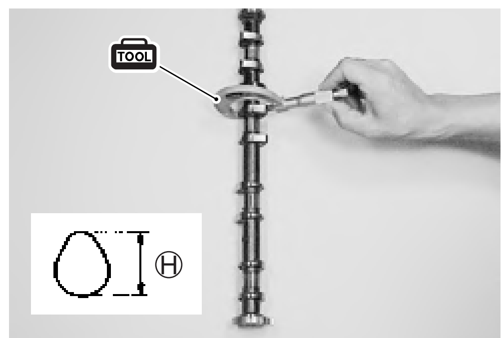
Water jackets
Inspect water jackets for clog or obstruction.
Clean water jackets if necessary.



CAMSHAFT

Cam face
Inspect cam face for scratches and wear.

Cam wear
Measure cam height Ⓗ.



TOOL **09900-20202 : Micrometer**

Cam height Ⓗ :

Standard :

DF90	**IN**	**37.320 – 37.480 mm (1.4693 – 1.4765 in.)**
	EX	**37.030 – 37.190 mm (1.4579 – 1.4642 in.)**
DF115	**IN**	**39.220 – 39.380 mm (1.5441 – 1.5504 in.)**
	EX	**39.040 – 39.200 mm (1.5370 – 1.5433 in.)**

Service limit :

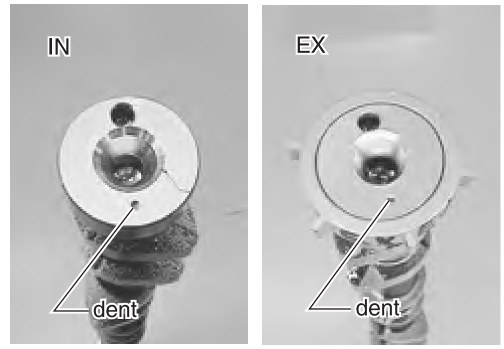
DF90	**IN**	**37.220 mm (1.4654 in.)**
	EX	**36.930 mm (1.4539 in.)**
DF115	**IN**	**39.120 mm (1.5402 in.)**
	EX	**38.940 mm (1.5330 in.)**

If measurement exceeds service limit, replace camshaft.

Camshaft identification

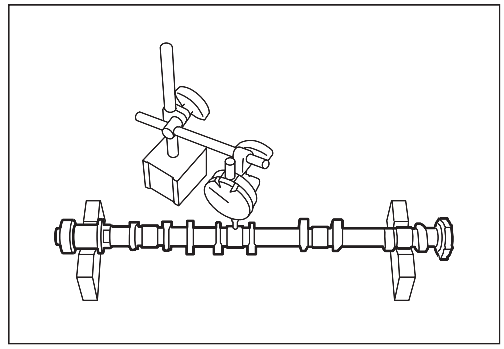
DF90 and DF115 camshafts differ as shown below.

Model	Identification mark
DF90	Dent
DF115	No dent



Camshaft runout

Using a set of V-blocks, support the camshaft on a surface plate. Measure runout using dial gauge.



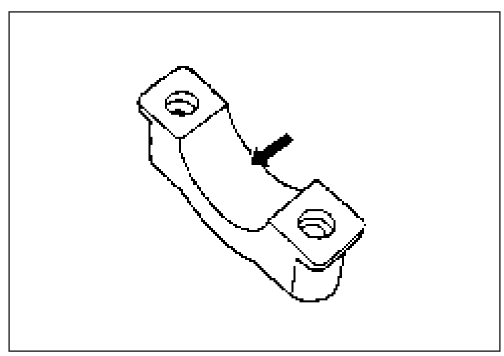
TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand

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

If measurement exceeds service limit, replace camshaft.

CAMSHAFT JOURNAL

Inspect camshaft journals and camshaft housing for pitting, scratches, wear or other damage.
Replace camshaft or cylinder head with housing if necessary.

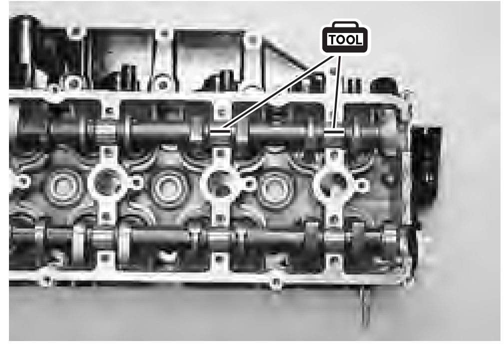


NOTE:
Camshaft housing and cylinder head should be replaced as a set.

Camshaft journal oil clearance

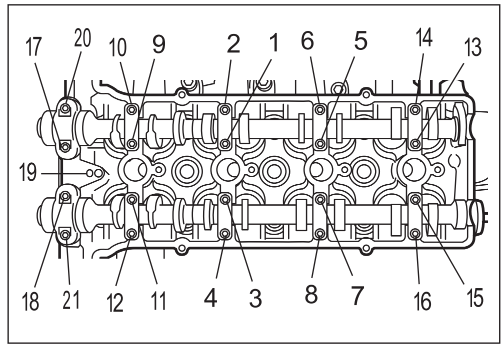
Measure journal oil clearance using Plastigauge as follows.

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



TOOL **09900-22302 : Plastigauge (0.051 — 0.125 mm)**
09900-22301 : Plastigauge (0.025 — 0.076 mm)

4. Install camshaft housing. According to numerical order in figure, tighten housing bolts in 3 steps. (1/3 of specification, 2/3 of specification, full torque specification)

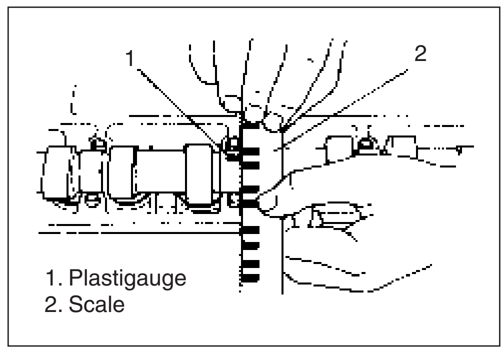


Camshaft housing bolt : 11 N·m (1.1 kg-m, 8.0 lb.-ft.)

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.

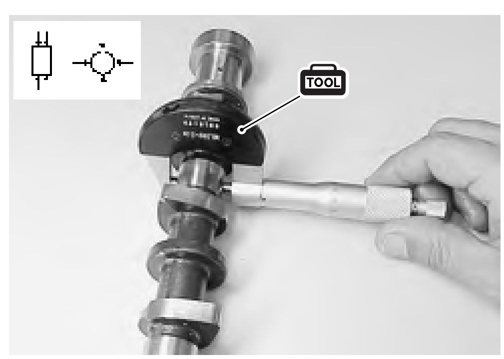


1. Plastigauge
2. Scale

Camshaft journal oil clearance :
Standard : Top, 2nd, 3rd, 4th journal
0.020 – 0.062 mm (0.0008 – 0.0024 in.)
5th journal
0.045 – 0.087 mm (0.0018 – 0.0034 in.)
Service limit : 0.12 mm (0.0047 in.)

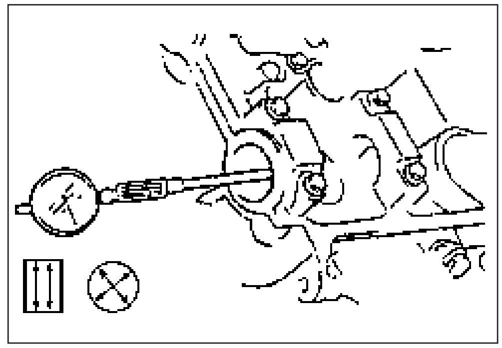
NOTE:
The location No.s of journal are in order from flywheel magneto to the bottom of cylinder.

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

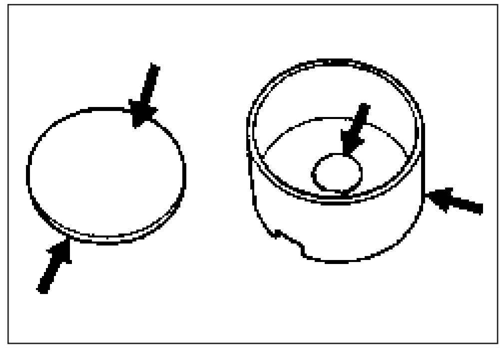


TOOL **09900-20205 : Micrometer**

Camshaft journal outside diameter :
Standard : Top, 2nd, 3rd, 4th journal
22.959 – 22.980 mm (0.9039 – 0.9047 in.)
5th journal
25.934 – 25.955 mm (1.0210 – 1.0219 in.)
Service limit : Top, 2nd, 3rd, 4th journal
22.869 mm (0.9004 in.)
5th journal
25.844 mm (1.0175 in.)



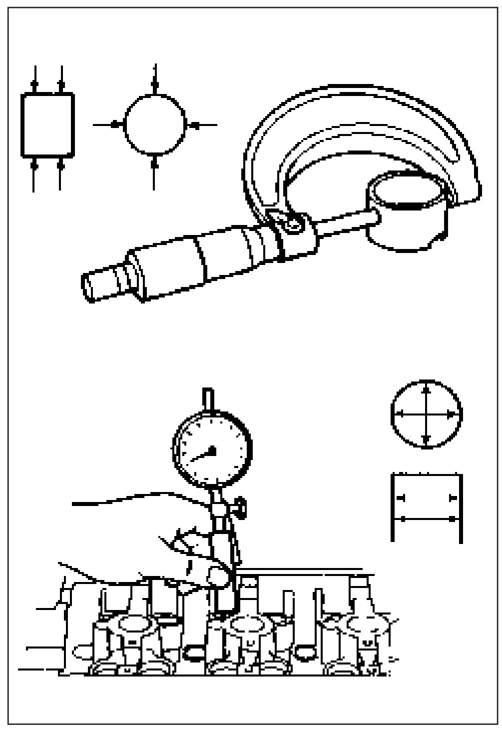
Camshaft journal (housing) inside diameter :
Standard : Top, 2nd, 3rd, 4th journal
23.000 – 23.021 mm (0.9055 – 0.9063 in.)
5th journal
26.000 – 26.021 mm (1.0236 – 1.0244 in.)
Service limit : Top, 2nd, 3rd, 4th journal
23.171 mm (0.9122 in.)
5th journal
26.171 mm (1.0304 in.)



TAPPET / TAPPET SHIM

Wear of tappet and shim

Inspect tappet and shim for pitting, scratches, or other damage. Replace if necessary.



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 – 0.066 mm (0.0010 – 0.0026 in.)
Service limit : 0.150 mm (0.0059 in.)

Tappet outer diameter :
Standard : 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

Cylinder head bore :
Standard : 31.000 – 31.025 mm (1.2203 – 1.2215 in.)

VALVE / VALVE GUIDE

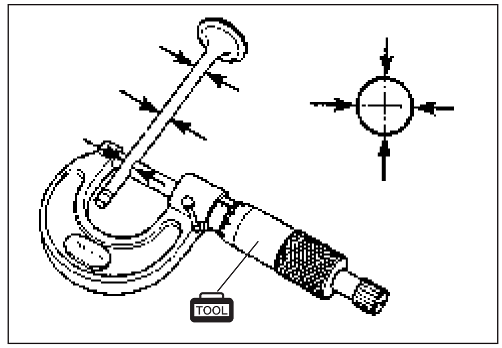
Valve guide to valve stem clearance

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 length of each stem and guide.

09900-20205 : Micrometer

Valve stem outside diameter

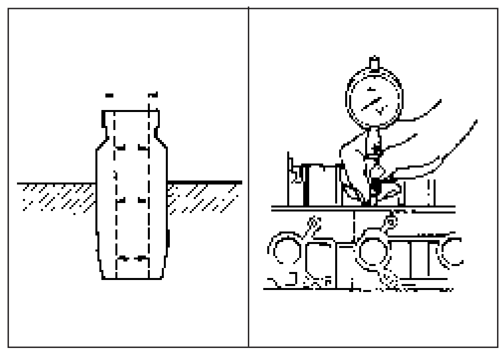
Using micrometer, measure valve stem outside diameter.



Valve stem outside diameter :
Standard:
IN 5.965 – 5.980 mm (0.2348 – 0.2354 in.)
EX 5.940 – 5.955 mm (0.2339 – 0.2344 in.)

Valve guide inside diameter

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



Valve guide inside diameter :
Standard :
IN 6.000 – 6.012 mm (0.2362 – 0.2367 in.)
EX 6.000 – 6.012 mm (0.2362 – 0.2367 in.)

Valve guide to valve stem clearance

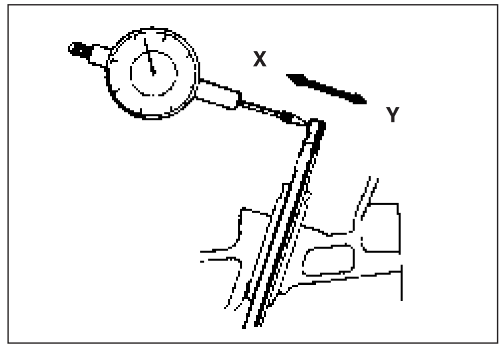
Valve guide to valve stem clearance :
Standard :
IN 0.020 – 0.047 mm (0.0008 – 0.0019 in.)
EX 0.045 – 0.072 mm (0.0018 – 0.0028 in.)

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, measure "Valve stem end deflection".



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

Measure valve stem end deflection as follows :

1. Install valve into valve guide.

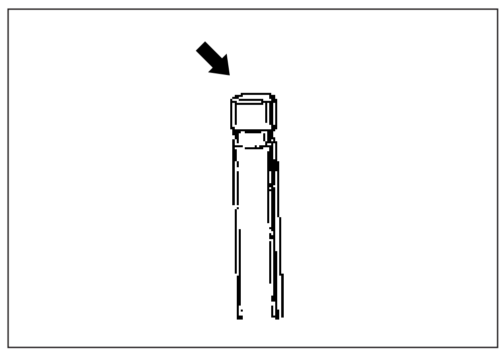
2. Position valve head at approx. 5mm away from valve seat.

3. Move stem end in the direction "X – Y", and measure deflection.

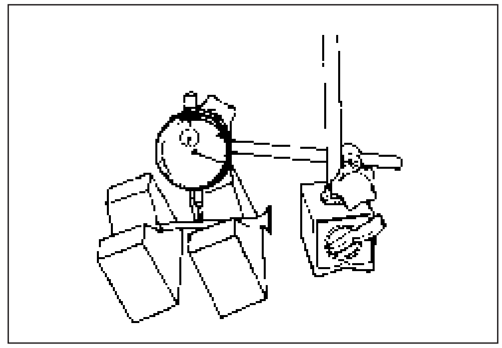
   Valve stem end deflection :
   Service limit :
   IN 0.14 mm (0.006 in.)
   EX 0.18 mm (0.007 in.)

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

Valve stem end
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.



Valve stem runout
Measure valve stem runout.

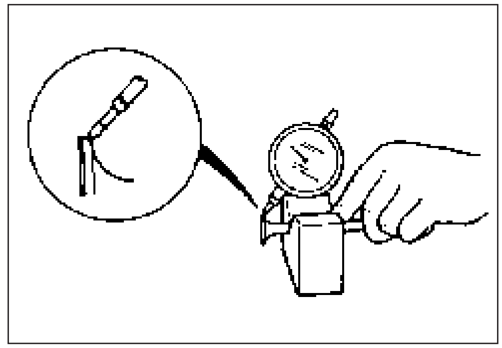


TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand
09900-21304 : "V" block set

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.

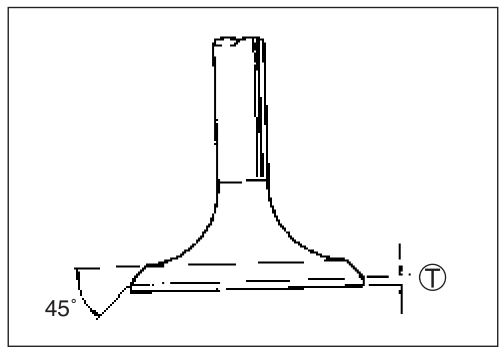


TOOL **09900-20602 : Dial gauge**
09900-20701 : Magnetic stand
09900-21304 : "V" block set

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 :

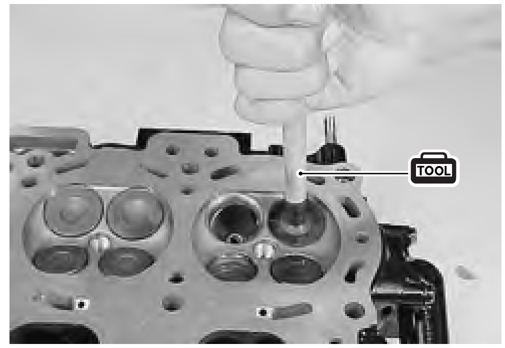
Standard :			
	IN	**1.0 mm**	**(0.04 in.)**
	EX	**1.2 mm**	**(0.05 in.)**
Service limit :			
	IN	**0.7 mm**	**(0.03 in.)**
	EX	**0.7 mm**	**(0.03 in.)**

If measurement exceeds service limit, replace valve.

Valve seat contact width

Measure valve seat contact width as follows :

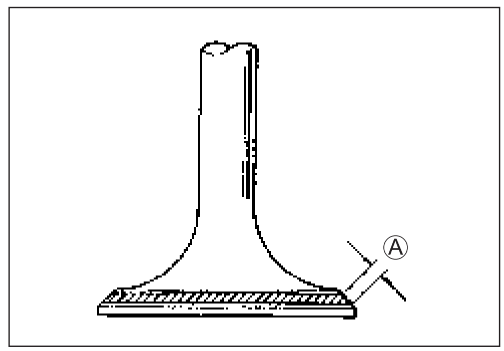
1. Remove all carbon from valve and seat.
2. Coat valve seat evenly with Prussian blue (or equivalent).
3. Install valve into valve guide.
4. Put valve lapper on valve.



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 :

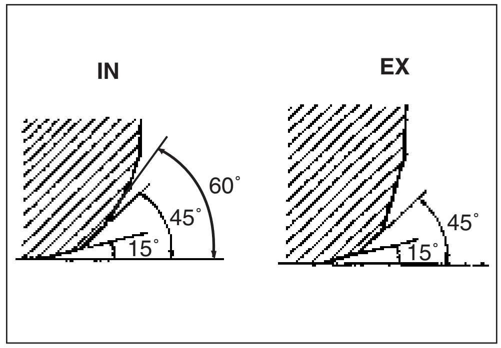
IN	**1.1 – 1.3 mm (0.04 – 0.05 in.)**
EX	**1.1 – 1.3 mm (0.04 – 0.05 in.)**

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 :

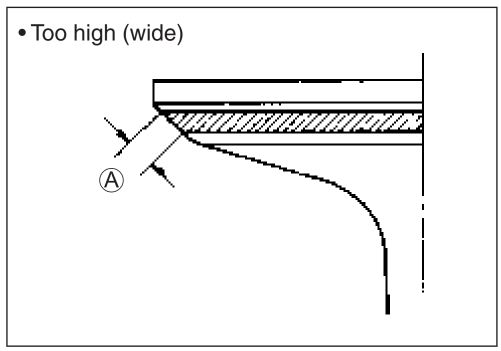


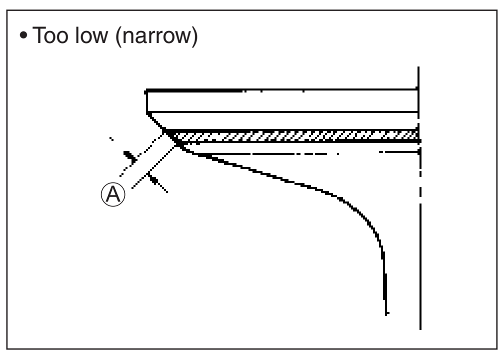
Valve seat angle :
Intake side : 15°, 45°, 60°
Exhaust side : 15°, 45°

TOOL **09916-20620 : Valve seat cutter (NEWAY122) 45°**
09916-20610 : Valve seat cutter (NEWAY121) 15°
09916-22420 : Valve seat cutter (NEWAY 114) 60°
Solid pilot (NEWAY. N-120-6.0)
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 page 6-33)
   - If width Ⓐ is too high (or wide), reface valve seat using 15° angle cutter. (Intake side, Exhaust side)
   - If width Ⓐ is too low (or narrow), reface valve seat using 45° angle cutter. (Exhaust side)
   - If width Ⓐ is too low (or narrow), reface valve seat using 60° angle cutter. (Intake side)



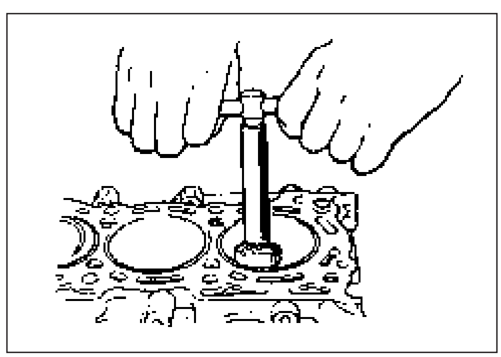


4. Clean up any burrs using 45° angle cutter very lightly.

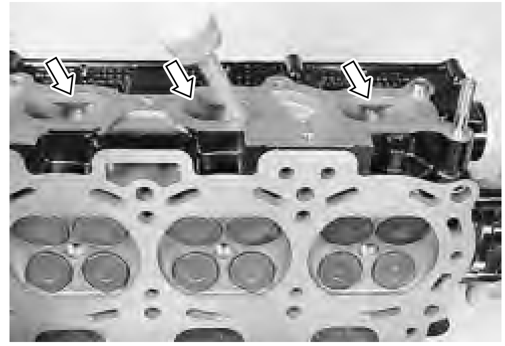
CAUTION

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

5. Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.
6. 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.

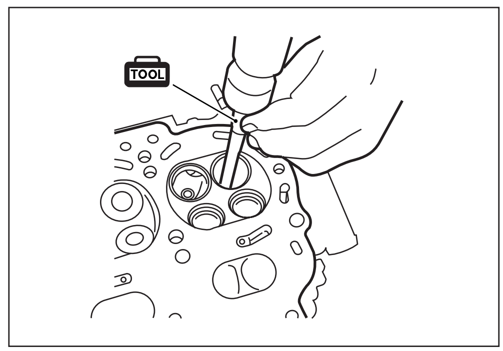


VALVE GUIDE REPLACEMENT

CAUTION

Be careful not to damage cylinder head when replacing valve guide.

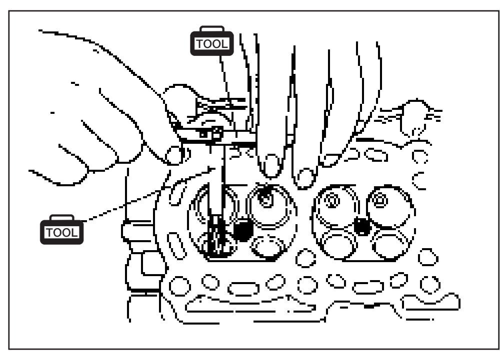
1. Using valve guide remover, drive valve guide out from combustion chamber side towards valve spring side.



TOOL **09916-46020 : 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 ϕ11 mm reamer to true hole and remove burrs.



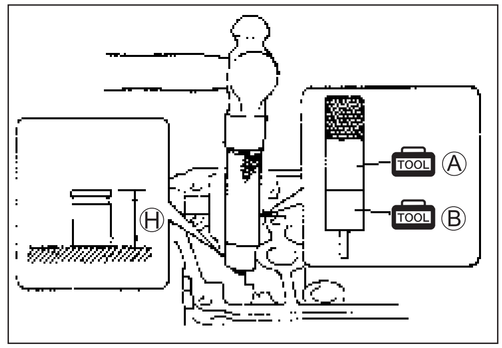
TOOL **09916-38210 : Valve guide reamer (ϕ11 mm)**
09916-34542 : Reamer handle

NOTE:
Turn reamer clockwise, never counterclockwise.

3. Install valve guide to cylinder head as follows.
   (1) Heat cylinder head to a temperature of 80 – 100°C (176 – 212°F).
   Apply heat uniformly so that head will not be dis torted.

   (2) 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.

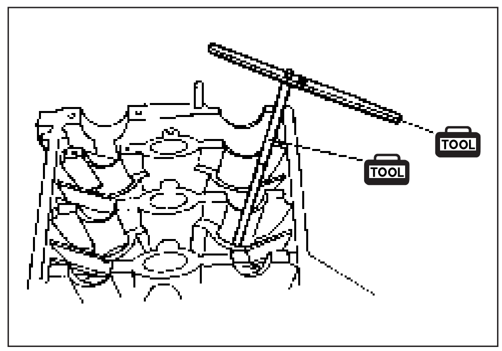
   (3) After installing, check valve guide protrusion Ⓗ.



TOOL **09916-57350 : Valve guide installer handle Ⓐ**
09917-87810 : Valve guide installer attachment Ⓑ

Valve guide protrusion Ⓗ :
Standard :
IN & EX 13.5 mm (0.53 in.)

4. Ream valve guide bore with ϕ6 mm reamer.



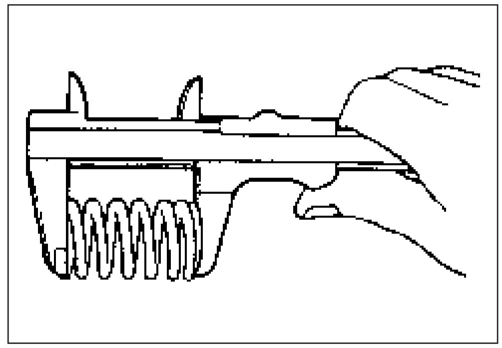
TOOL **09916-37810 : Valve guide reamer (ϕ6 mm)**
09916-34542 : Reamer handle

NOTE:
Clean and oil valve guide bore after reaming.

VALVE SPRING

Valve spring free length

Measure valve spring free length.



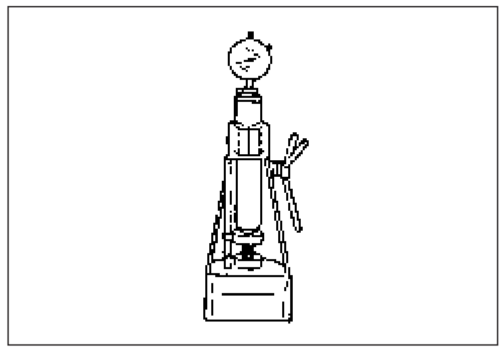
09900-20101 : Vernier calipers

Valve spring free length :
Standard :
IN & EX 42.7 mm (1.68 in.)
Service limit :
IN & EX 41.0 mm (1.61 in.)

If measurement exceeds service limit, replace valve spring.

Valve spring preload

Measure valve spring preload.



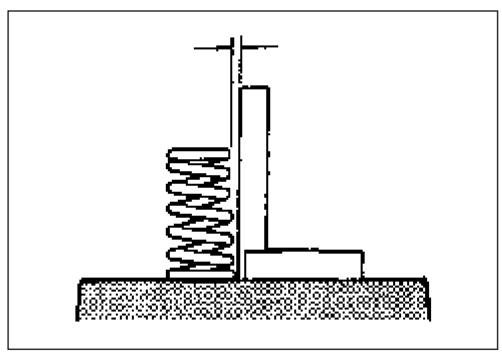
09900-20101 : Vernier calipers

Valve spring preload :
Standard :
IN & EX 167 –193 N (16.7 – 19.3 kg , 36.8 – 42.5 lbs.) for 32.6 mm (1.28 in.)
Service limit :
IN & EX 151 N (15.1 kg, 33.3 lbs.) for 32.6 mm (1.28 in.)

If measurement exceeds service limit, replace valve spring.

Valve spring squareness

Using a square and surface plate, measure 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.)

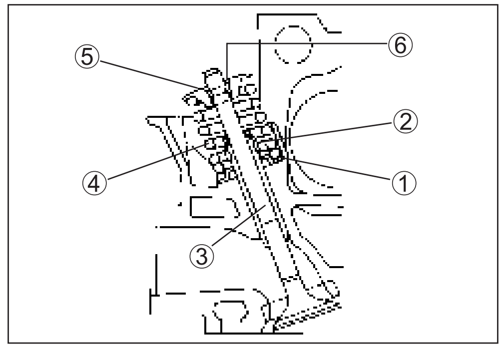
If measurement exceeds service limit, replace valve spring.

REASSEMBLY

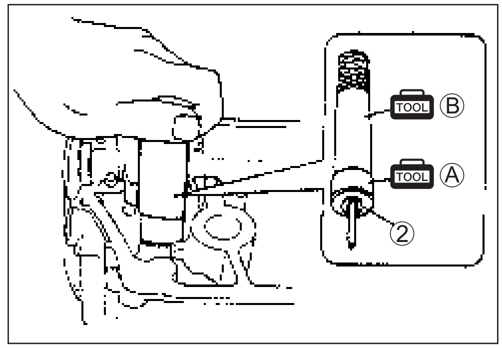
Reassemble is reverse order of disassembly with special attention to the following steps.

VALVE

1. Install valve spring seat ① to cylinder head.



2. 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.
3. Check to be sure that seal is properly fixed to valve guide.

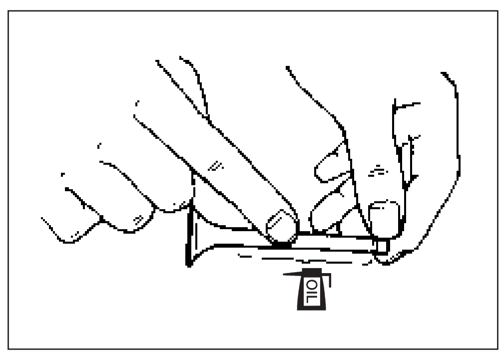


TOOL **09917-98221 : Installer attachment Ⓐ**
09916-57350 : Installer handle Ⓑ

CAUTION

Do not re-use stem seal once removed.
Always use a new stem seal.

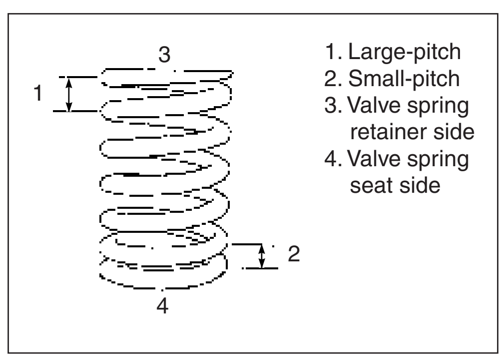
4. Apply engine oil to stem seal, valve guide bore and valve stem.



5. Install valve ③ to valve guide.

NOTE:
Reassemble each valve and valve spring to their original position.

6. Install valve spring ④, and valve retainer ⑤.

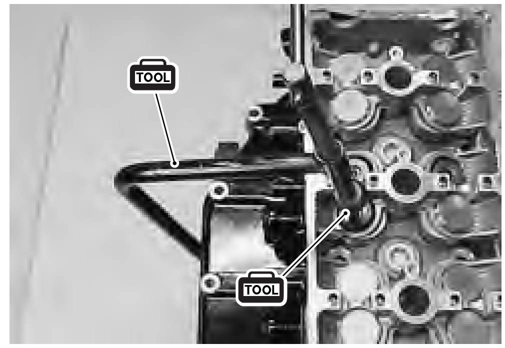


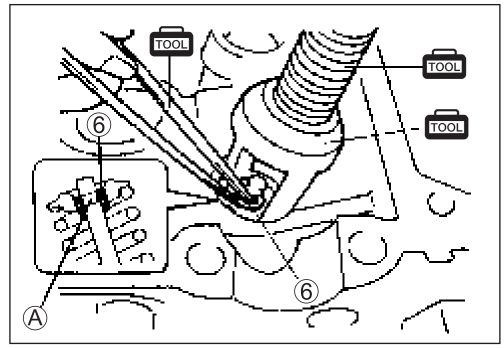
NOTE:
Set valve spring in place with narrow spiral area facing valve seat.

7. Hold valve spring compressed with special tool and install valve cotters ⑥.

8. Make sure valve cotters are properly seated in groove Ⓐ.

TOOL **09916-19030 : Valve lifter**
09916-14910 : Attachment
09916-84511 : Tweezers





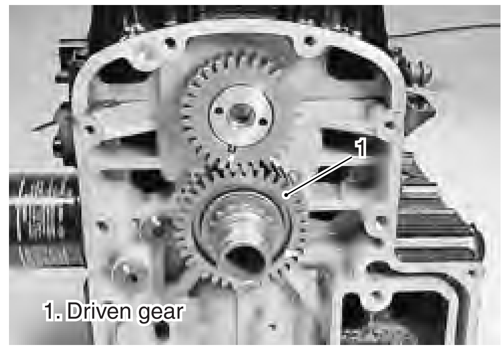
CYLINDER / CRANKSHAFT / PISTON

DISASSEMBLY

Before performing service work in this section :

- **Remove power unit (See page 6-5 to 6-8)**
- **Remove timing chain (See page 6-14 to 6-15)**
- **Remove cylinder head (See page 6-20)**

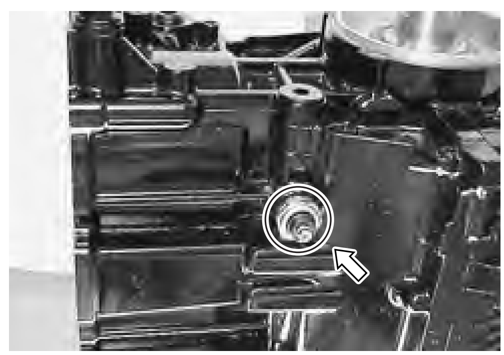
1. Remove driven gear.



2. Remove oil filter.

TOOL **09915-47332 : Oil filter wrench**

3. Remove oil pressure switch.

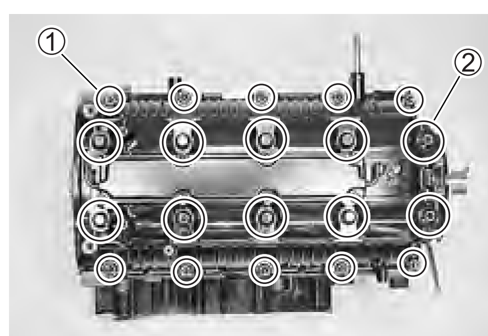


4. Remove ten (10) bolts ①.
   Remove ten (10) bolts ②.

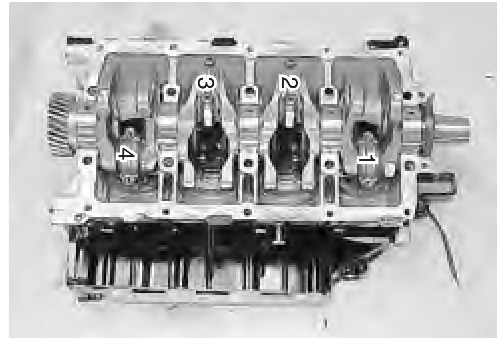
NOTE:

Removal (loosening order) is reverse of installation (tightening order). See page 6-62.

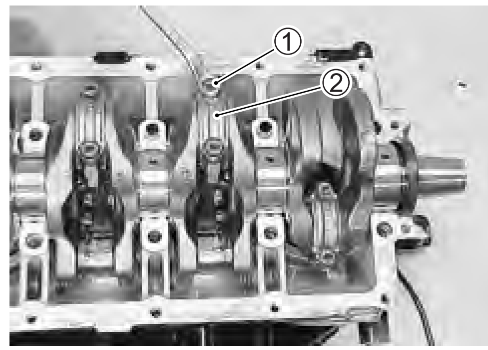
5. Remove crankcase from cylinder block.



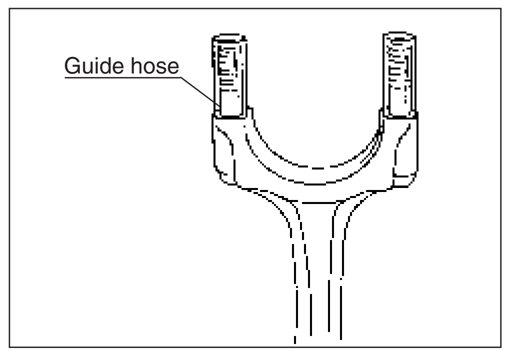
NOTE:
For proper assembly, mark cylinder number on all pistons, conrods, and conrod caps, using quick drying paint.



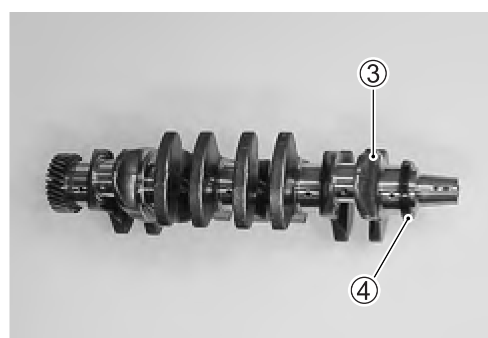
6. Remove all conrod cap nuts ① and conrod caps ②.



NOTE:
To prevent damage to crank pin and cylinder walls, install a piece of hose over threads of rod bolts.



7. Remove crankshaft ③.
8. Remove oil seal ④ from crankshaft.

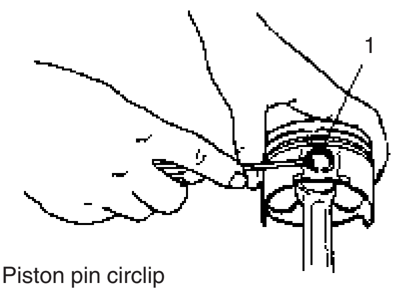


9. Mark cylinder number on pistons using quick dry paint.
10. Push piston (with conrod) out through the top of cylinder bore.

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.*

11. Remove two compression rings (top and 2nd) and oil ring from piston.

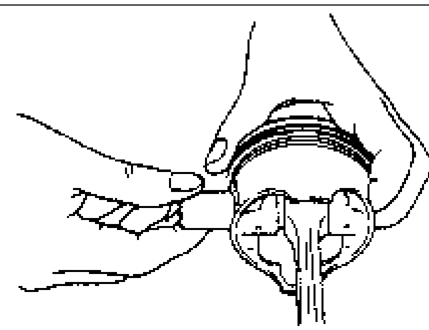
12. Mark cylinder number on conrod using quick dry paint.
13. Remove piston pin circlips as shown.



1. Piston pin circlip

14. Remove piston pin from conrod.

NOTE:
Reassemble each piston, piston pin and conrod in their original combination and position.



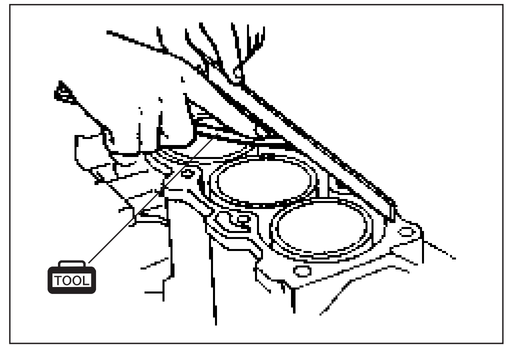
INSPECTION / SERVICING

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

CYLINDER

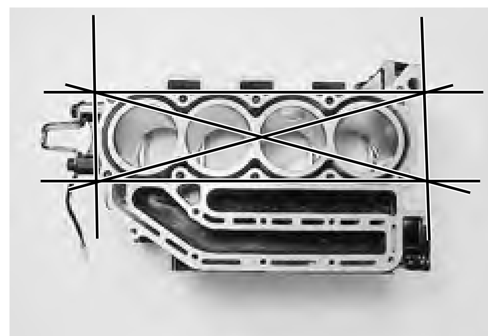
Cylinder distortion

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



TOOL **09900-20803 : Thickness gauge**

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

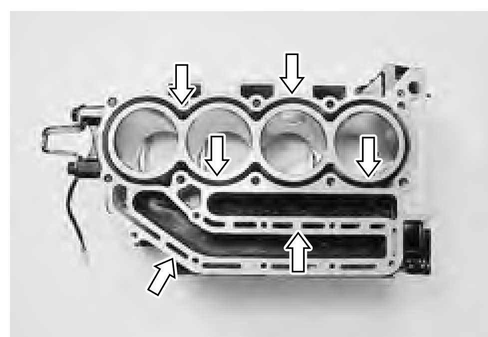


If measurement exceeds service limit, resurface or replace cylinder.

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

Water jackets

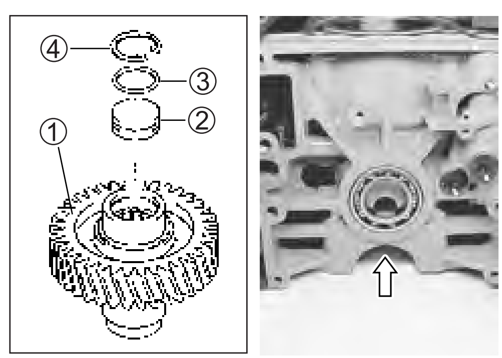
Inspect water jackets for clog or obstruction.
Clean water jacket if necessary.



Driven gear / bearing

Inspect driven gear for wear or other damage.
Replace if necessary.
Inspect driven gear bearing for pitting, rough or other damage.
Replace if necessary.

① Driven gear ② Plug ③ O-ring ④ Circlip



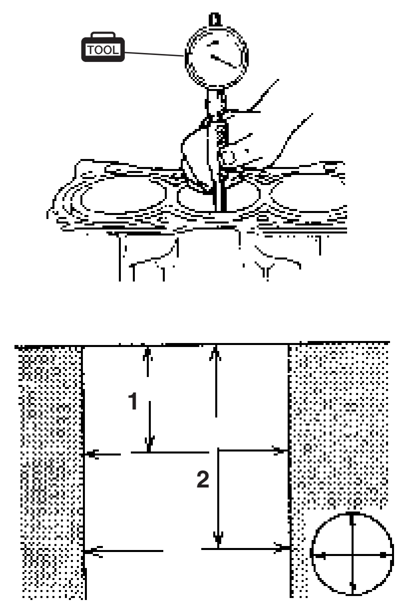
Cylinder bore

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.



1. 50 mm (1.96 in.)
2. 90 mm (3.54 in.)

TOOL **09900-20530 : Cylinder gauge set**

Check for following :

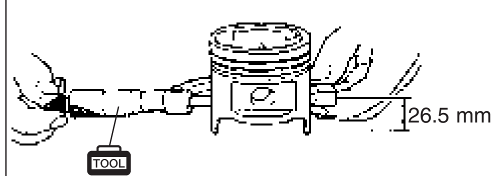
- Difference between measurements at the two positions (taper).
- Difference between axial and transverse measurement (out-of-round).

Cylinder bore wear (difference) :
Service limit : 0.100 mm (0.0039 in.)

If measurement exceeds service limit, rebore or replace cylinder.

PISTON TO CYLINDER CLEARANCE

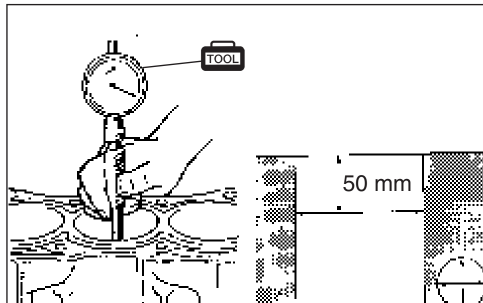
1. Measure piston diameter at a point 26.5 mm (1.04 in.) above piston skirt at a right angle to piston pin bore.



TOOL **09900-20204 : Micrometer**

Piston skirt diameter :
Standard : 83.970 – 83.990 mm (3.3059 – 3.3067 in.)

2. Measure cylinder bore at 50 mm (2.0 in.) below cylinder head gasket surface at a right angle to crankshaft pin.



TOOL **09900-20530 : Cylinder gauge set**

Cylinder bore :
Standard : 84.000 – 84.020 mm (3.3071 – 3.3079 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.)

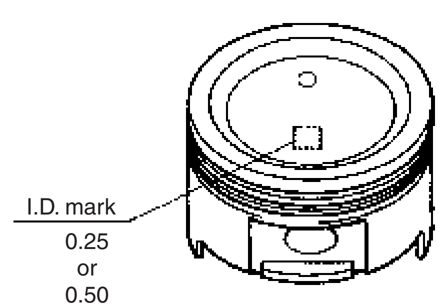
If clearance exceeds service limit, replace piston and/or cylinder or rebore cylinder.

Identification of oversize piston / piston ring

Two oversize piston / piston ring components, 0.25 mm and 0.50 mm, are available.
Oversize piston / piston ring are marked as shown below.

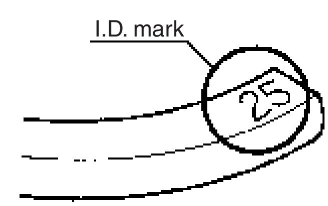
- **Piston**

Oversize	I.D. mark
0.25 mm	0.25
0.50 mm	0.50



- **1st & 2nd Piston ring**

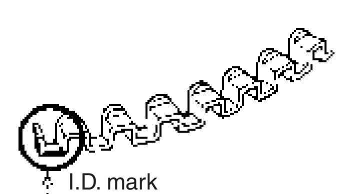
Oversize	I.D. mark
0.25 mm	25
0.50 mm	50



1st, 2nd ring

- **Oil ring**

Oversize	I.D. mark
0.25 mm	Two (2) blue paints
0.50 mm	Red paint



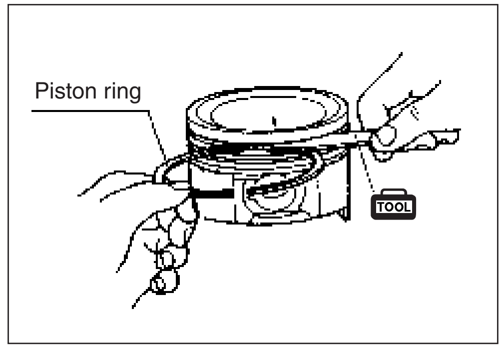
Oil ring spacer

PISTON

Inspect piston for faults, cracks or other damage.
Replace if necessary.

Piston ring to groove clearance

Before checking, piston grooves should 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 0.030 – 0.070 mm (0.0012 – 0.0028 in.)
2 nd 0.020 – 0.060 mm (0.0008 – 0.0024 in.)
Service limit :
1 st 0.120 mm (0.0047 in.)
2 nd 0.100 mm (0.0039 in.)

If measurement exceeds service limit, replace piston and/or piston ring.

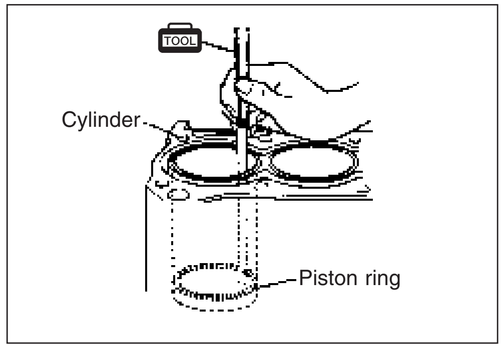
Piston ring groove width :
Standard :
1 st 1.22 – 1.24 mm (0.048 – 0.049 in.)
2 nd 1.51 – 1.53 mm (0.059 – 0.060 in.)
Oil 2.51 – 2.53 mm (0.099 – 0.100 in.)

Piston ring thickness :
Standard :
1 st 1.17 – 1.19 mm (0.046 – 0.047 in.)
2 nd 1.47 – 1.49 mm (0.058 – 0.059 in.)

PISTON RING

Piston ring end gap

Measure piston ring end gap with piston ring in the lowest position of cylinder bore.



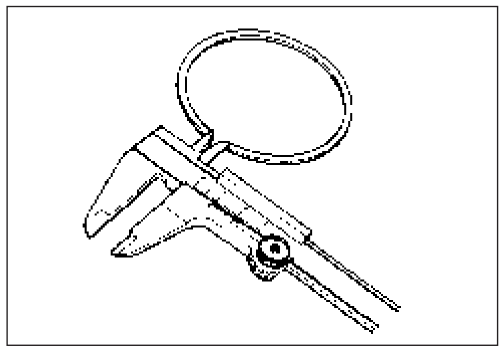
TOOL **09900-20803: Thickness gauge**

Piston ring end gap :
Standard :
1 st 0.20 – 0.35 mm (0.008 – 0.014 in.)
2 nd 0.35 – 0.50 mm (0.014 – 0.020 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. 11.3 mm (0.44 in.)
2 nd Approx. 11.0 mm (0.43 in.)
Service limit :
1 st 9.0 mm (0.354 in.)
2 nd 8.8 mm (0.347 in.)

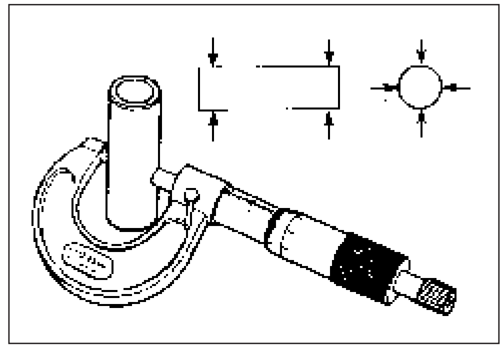
If measurement exceeds service limit, replace piston ring.

PISTON PIN

Inspect piston pin, conrod small end bore and piston pin hole for wear or other damage.
Replace if necessary.

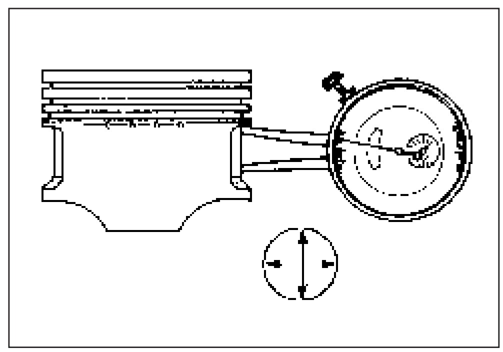
Piston pin clearance

Measure piston pin clearance in conrod small end.
Replace conrod if its small end is badly worn or damaged or if clearance exceeds service limit.



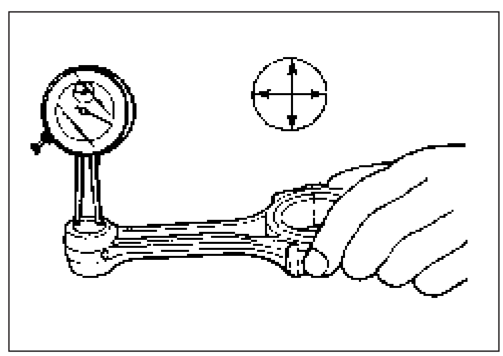
TOOL **09900-20205 : Micrometer**
09900-20605 : Dial calipers

Piston pin outside diameter :
Standard : 20.997 – 21.000 mm (0.8267 – 0.8268 in.)
Service limit : 20.980 mm (0.8260 in.)



Piston pin hole diameter :
Standard : 21.006 – 21.014 mm (0.8270 – 0.8273 in.)
Service limit : 21.040 mm (0.8283 in.)

Conrod small end bore :
Standard : 21.003 – 21.011 mm (0.8269 – 0.8272 in.)

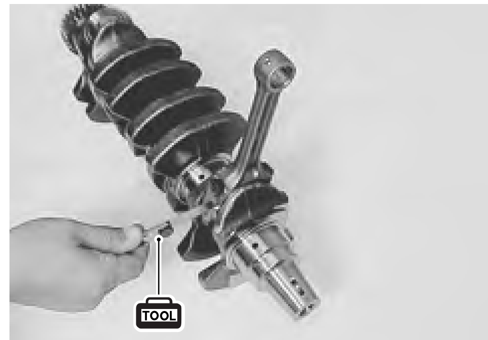


Pin clearance in piston pin hole :
Standard : 0.006 – 0.017 mm (0.0002 – 0.0007 in.)
Service limit : 0.040 mm (0.0016 in.)

Pin clearance in conrod small end :
Standard : 0.003 – 0.014 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 in figure.



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.)

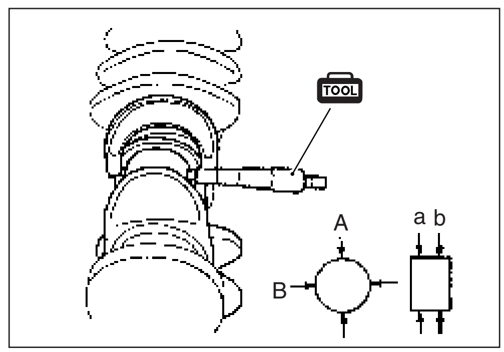
If measurement exceeds service limit, replace conrod and/or crankshaft.

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 other damage.
Measure crank pin for out-of-round or taper with micrometer.
If any crank pin is damaged or if measuremeants exceed service limit, replace crankshaft.



TOOL **09900-20202 : Micrometer**

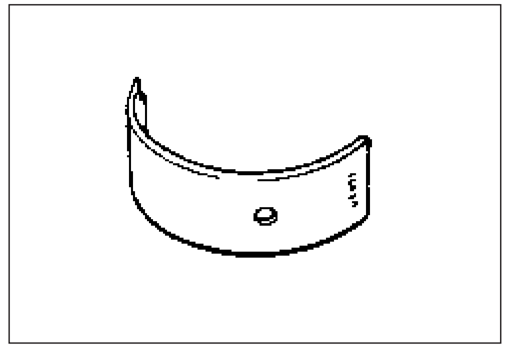
Out-of-round : A – B
Taper : a – b

Out-of-round and taper :
Service limit : 0.010 mm (0.0004 in.)

Crank pin diameter :
Standard : 43.982 – 44.000 mm (1.7316 – 1.7323 in.)

CONROD BEARING

Inspect bearings for proper contact pattern and signs of fusion, pitting, burning or flaking.
Replace if necessary.
Always replace both bearing halves, never replace only one half of a bearing set.



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.

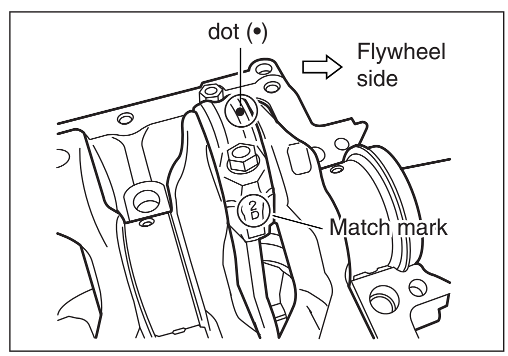
2. Install conrod bearing onto conrod and conrod cap.

NOTE:
- *Reassemble each bearing and conrod cap to their original position.*
- *Do not apply oil to bearing.*

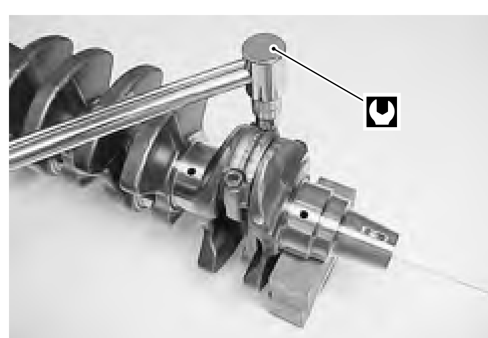
3. Place a piece of Plastigauge on crank pin parallel to crankshaft. Do not place Plastigauge over oil hole.

TOOL **09900-22301 : Plastigauge (0.025 — 0.076 mm)**

4. Install conrod cap (with bearing) to conrod with dot (•) mark on cap toward flywheel side.



5. Apply engine oil lightly 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.)**
Final step	**35 N·m (3.5 kg-m, 25.5 lb.-ft.)**

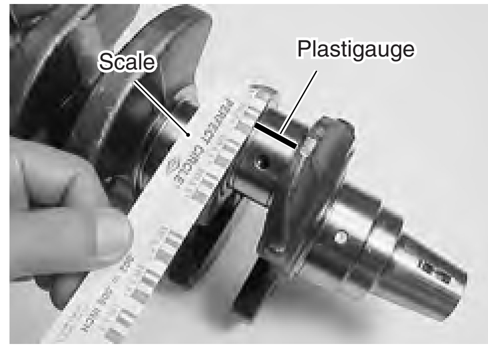
NOTE:
Do not rotate conrod while Plastigauge is installed.

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

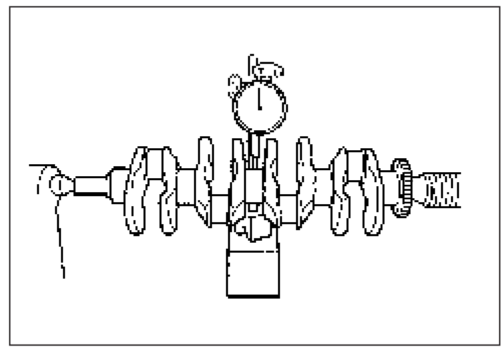
Crankshaft runout

Using a dial gauge, measure runout at center journal.

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

Crankshaft runout :
Service limit : 0.04 mm (0.002 in.)

If measurement exceeds service limit, replace crankshaft.



Crankshaft thrust play

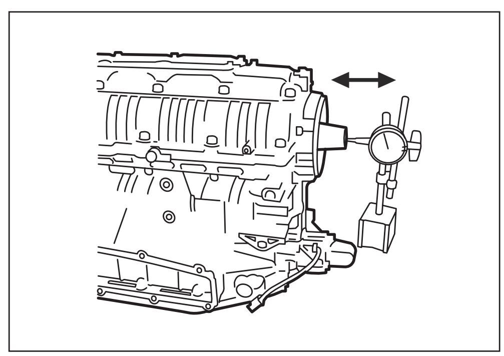
Measure thrust play with crankshaft, thrust bearing, journal bearing and crankcase/cylinder block assembled in a normal manner.
Tighten crankcase bolts to specified torque.

Crankcase bolt :

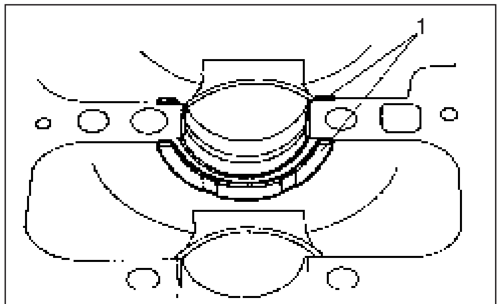
8 mm	**25 N·m (2.5 kg-m, 18.0 lb.-ft.)**
10 mm	**56 N·m (5.6 kg-m, 40.5 lb.-ft.)**

Using a dial gauge, measure 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.)



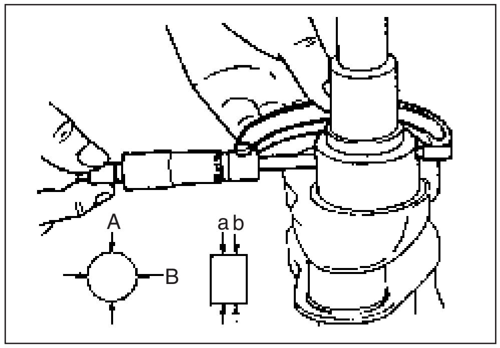
If measurement exceeds service limit, replace crankshaft thrust bearing.



1. Thrust bearing

Crankshaft thrust bearing thickness :
Standard : 2.425 – 2.475 mm (0.0955 – 0.0974 in.)

Out-of-round and taper (uneven wear) of journals
Inspect crankshaft journal for uneven wear or other damage.
Measure journal for out-of-round or taper with micrometer.
If any journal is damaged or if measurements exceed service limit, replace crankshaft.



TOOL **09900-20203 : Micrometer**

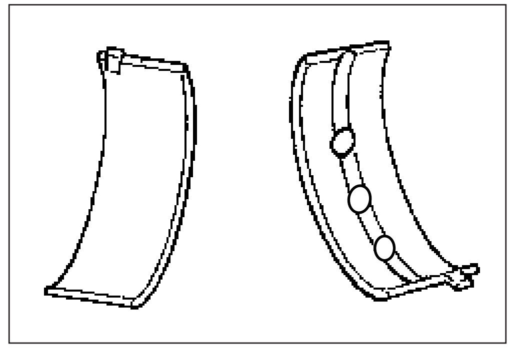
Out-of-round : A – B
Taper : a – b

Out-of-round and taper :
Service limit : 0.010 mm (0.0004 in.)

Crankshaft journal outside diameter :
Standard : 57.994 – 58.012 mm (2.2832 – 2.2839 in.)

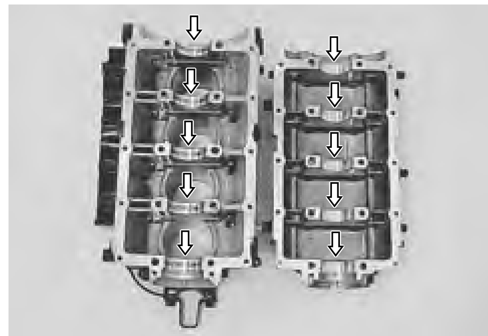
CRANKSHAFT MAIN BEARING

Inspect bearings for proper contact pattern and signs of fusion, pitting, burning or flaking.
Replace if necessary.
Always replace both bearing halves, never replace only one half of a bearing set.



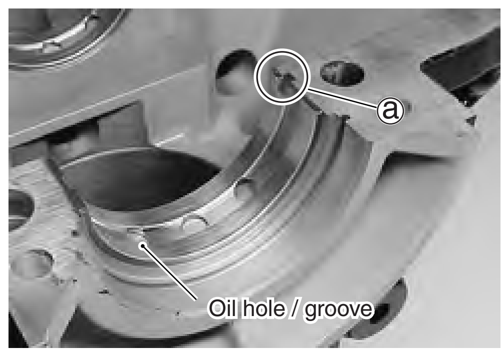
CRANKSHAFT JOURNAL OIL CLEARANCE

Check crankshaft journal oil clearance as follows:

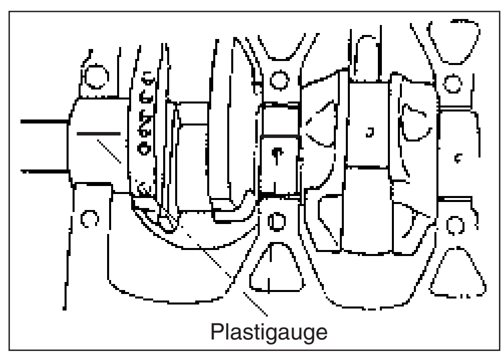


1. Clean surface of bearing holder (crankcase and cylinder), bearing and main bearing journal.
2. Install main bearing to cylinder and crankcase.

NOTE:
- *Assemble each bearing in its original position before checking clearance.*
- *Align the tab ⓐ of bearing with notch in cylinder and crankcase.*
- *Do not apply engine oil to bearing.*
- *Install bearing half with oil hole / groove to cylinder side.*



3. Install crankshaft to cylinder.
4. Place a piece of Plastigauge on journal parallel to crankshaft. Do not place Plastigauge over oil hole.



TOOL **09900-22301 : Plastigauge (0.025 — 0.076 mm)**

NOTE:
Do not rotate crankshaft while Plastigauge is installed.

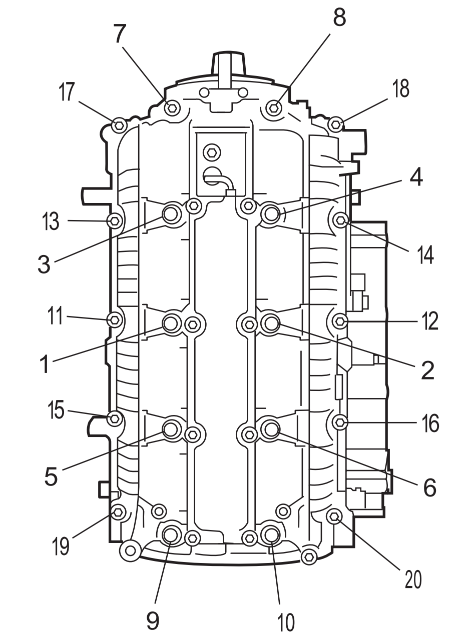
5. Install crankcase to cylinder.
6. Apply engine oil lightly to crankcase bolts.
   Tighten crankcase bolts in three (3) steps according to the order shown below and in figure.

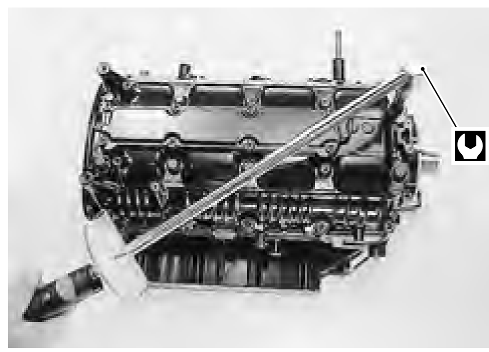
Crankcase bolt :

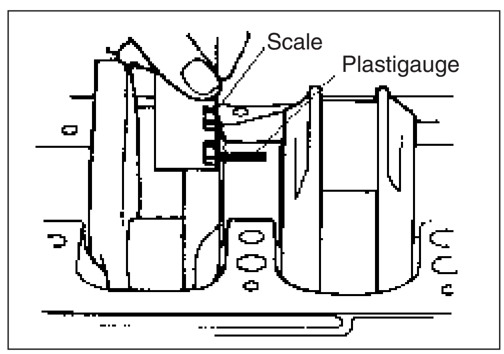
1st step	**8 mm**	**5 N·m (0.5 kg-m, 3.5 lb.-ft.)**
	10 mm	**11 N·m (1.1 kg-m, 8.0 lb.-ft.)**
2nd step	**8 mm**	**20 N·m (2.0 kg-m, 14.5 lb.-ft.)**
	10 mm	**43 N·m (4.3 kg-m, 31.0 lb.-ft.)**
Final step	**8 mm**	**25 N·m (2.5 kg-m, 18.0 lb.-ft.)**
	10 mm	**56 N·m (5.6 kg-m, 40.5 lb.-ft.)**

NOTE:
- *Crankcase should be torqued to specification in order to assure proper compression of Plastigauge and accurate reading of clearance.*
- *Do not rotate crankshaft while Plastigauge is installed.*

Tightening order







7. Remove crankcase from cylinder.
8. Using scale on Plastigauge envelope, measure Plastigauge width at its widest point.

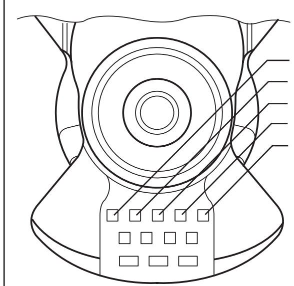
Crankshaft journal oil clearance :
Standard : 0.020 – 0.040 mm (0.0008 – 0.0016 in.)
Service limit : 0.065 mm (0.0026 in.)

If measurement exceeds service limit, replace crankshaft main bearing.

NOTE:
For bearing replacement, see “SELECTION OF MAIN BEARING” section on page 6-55.

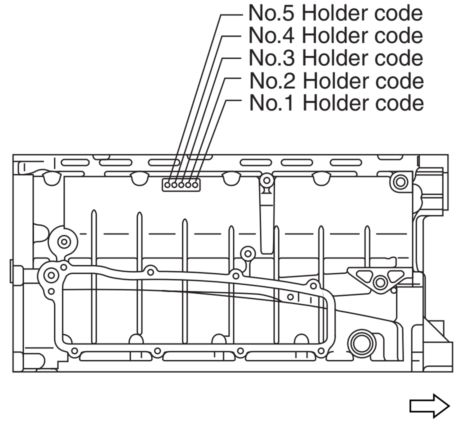
SELECTION OF MAIN BEARING

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 five (5) stamped code numerals.
   The numerals (1, 2 & 3) represent journal diameters shown below.

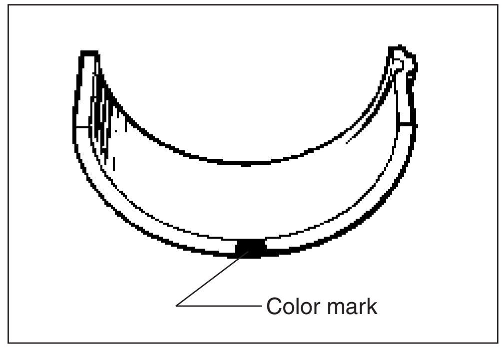
Numeral stamped	Journal diameter
1	58.006 – 58.012 mm (2.2837 – 2.2839 in.)
2	58.000 – 58.006 mm (2.2835 – 2.2837 in.)
3	57.994 – 58.000 mm (2.2832 – 2.2835 in.)



2. **Next, check bearing holder inside diameter without bearing.**
   As shown in figure, PORT side of cylinder block has five (5) stamped codes letters.
   The letters (A, B & C) represent bearing holder inside diameters shown below.

Code	Crank bearing holder inside diameter (w / o bearing)
A	62.000 – 62.006 mm (2.4409 – 2.4412 in.)
B	62.006 – 62.012 mm (2.4412 – 2.4414 in.)
C	62.012 – 62.018 mm (2.4414 – 2.4417 in.)

3. There are five (5) main bearings available, each of differing thickness.
To distinguish them, a color mark is painted at position indicated in figure.
Each color represents the following thickness measured at center of bearing.



Color mark	Bearing thickness
Green	1.990 – 1.994 mm (0.0783 – 0.0785 in.)
Black	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
No Color mark	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Yellow	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Blue	2.002 – 2.006 mm (0.0788 – 0.0790 in.)

4. Select crankshaft main bearing referring 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 oil seal for crack, cut or other damage.

REASSEMBLY

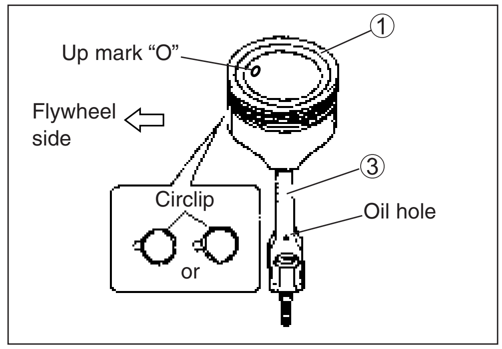
Assembly is reverse order of disassembly with special attention to the following steps.

CAUTION

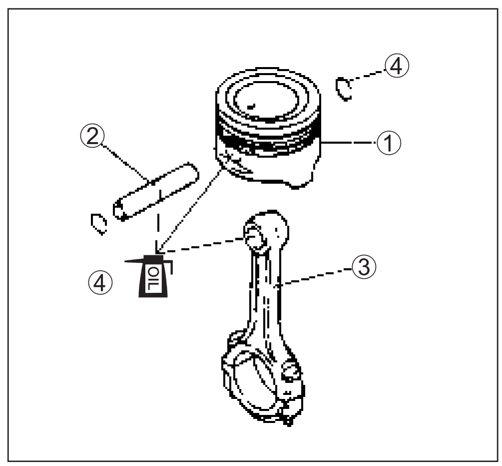
If original components are not replaced, each piston, piston pin and conrod is to be assembled and installed in its original order and position.

PISTON TO CONROD

1. Apply engine oil to piston pin ②, piston pin bore and conrod ③.
2. Fit conrod ③ to piston ① as shown in figure and insert piston pin ② through piston and conrod.
3. Install piston pin circlips ④.



NOTE:
- *Make sure conrod is installed in direction as shown in figure.*
- *Circlip should be installed with gap facing either up or down as shown in figure.*



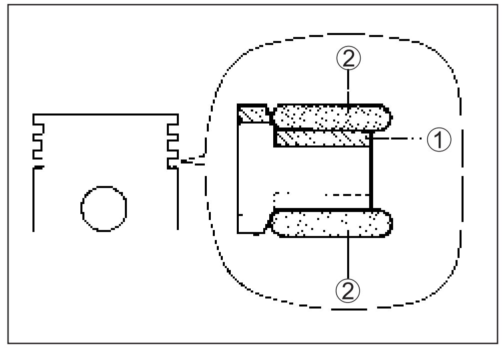
CAUTION

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

PISTON RING TO PISTON

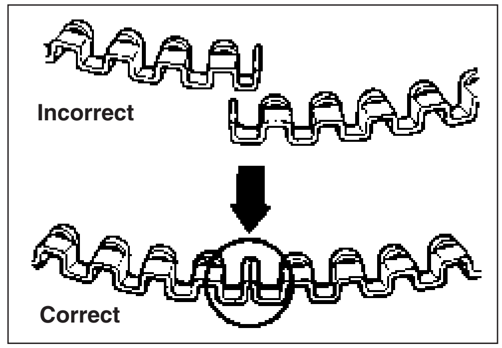
Oil ring

1. Apply engine oil to piston rings.
2. Install spacer ① first, then side rails ② to piston.



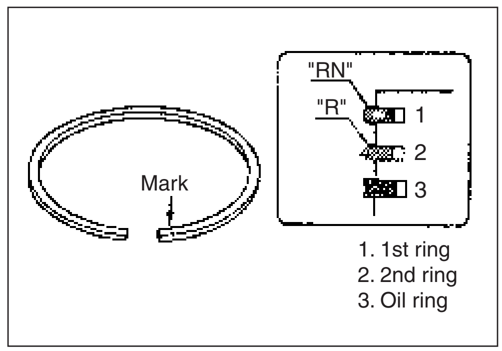
CAUTION

When installing spacer, do not allow ends to overlap in groove.



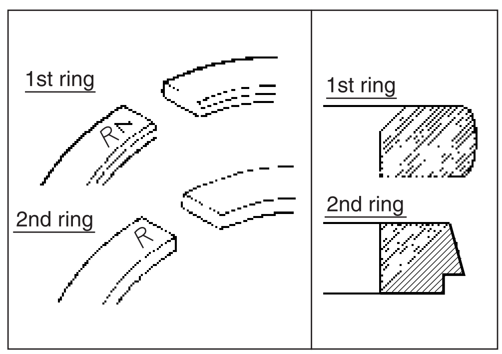
1st ring and 2nd ring

1. Apply engine oil to piston ring.
2. Install 2nd ring and 1st ring to piston.



NOTE:

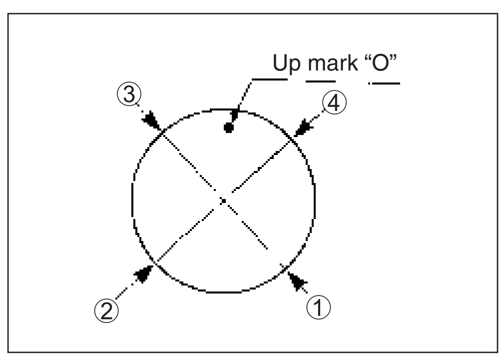
- *1st ring differs from 2nd ring in shape and color of surface contacting cylinder wall.*
  Distinguish 1st ring from 2nd ring by referring to figure.
- *As shown in figure, 1st and 2nd ring are marked, "RN" or "R". When installing these piston rings, the marked side of each ring should face towards top of piston.*



Ring gap direction

Position rings so that their gaps are staggered at approximately 90 degree angles as shown in figure.

① 1st ring　　③ 2nd ring
② Oil ring lower side rail　　④ Oil ring upper side rail

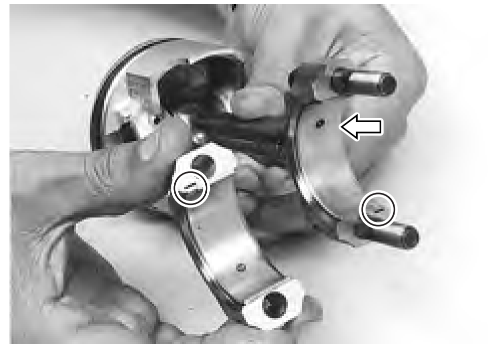


CAUTION

Failure to stagger piston ring gaps may result in crankcase oil dilution.

PISTON TO CYLINDER

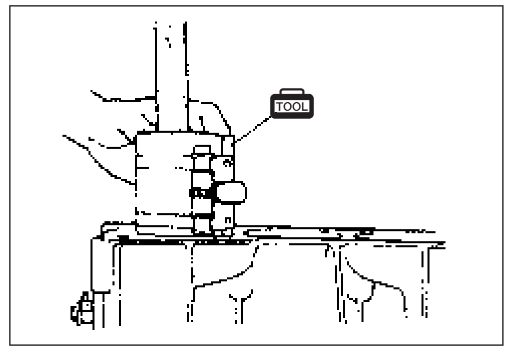
1. Install conrod bearing to conrod and conrod cap.



CAUTION

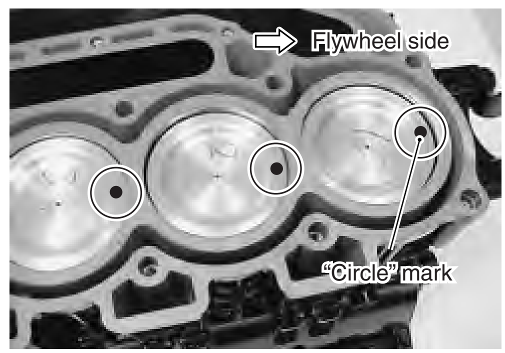
- **Assemble each conrod bearing to its original position.**
- **Do not apply oil between conrod and bearing or between conrod cap and bearing.**

2. Apply engine oil to piston and cylinder walls.



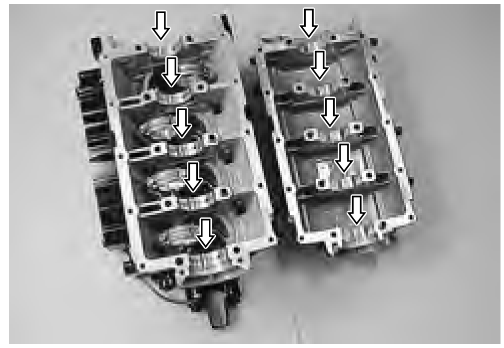
3. Insert piston and conrod assembly into cylinder bore from cylinder head side using special tool.

TOOL **09916-77310 : Piston ring compressor**



NOTE:
Position “circle” mark on piston head to flywheel side.

CRANKSHAFT TO CYLINDER



1. Install crankshaft main bearings in cylinder and crankcase.
2. Apply engine oil to bearings.

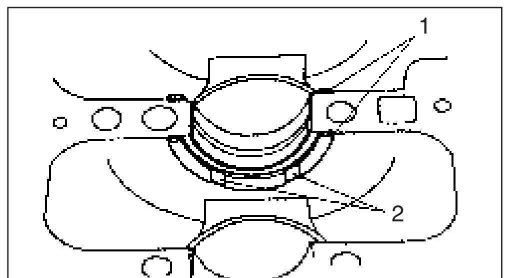
CAUTION

- **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

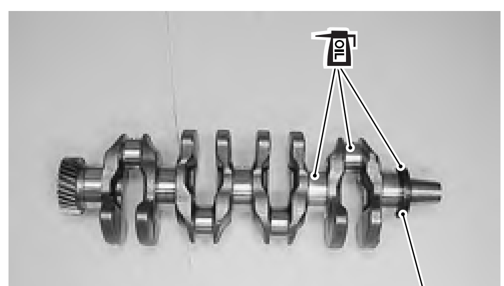
Apply engine oil to thrust bearing and install in cylinder block between the No.3 and No.4 cylinders.
Oil groove sides of thrust bearing should face towards crank webs.



1. Thrust bearing
2. Oil groove

Crankshaft

1. Apply engine oil to upper oil seal lip.
2. Install upper oil seal to crankshaft.



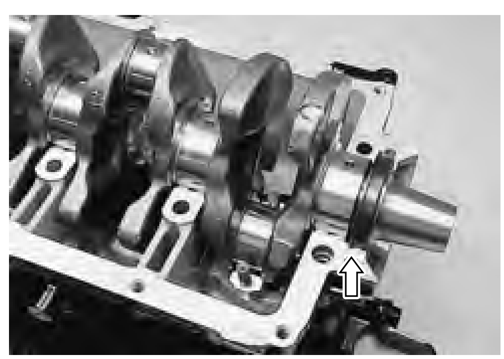
1. Oil seal

CAUTION

Do not re-use oil seal once removed. Always use a new oil seal.

NOTE:
Install upper oil seal with its spring / lipped side facing inward.

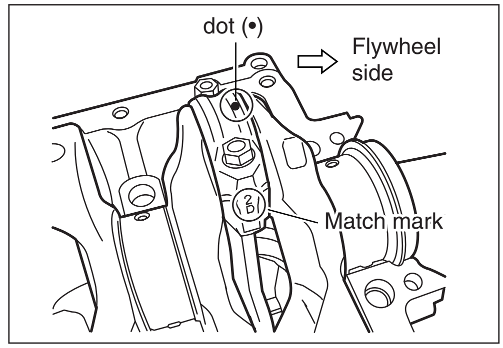
3. Apply engine oil to crank pin and crankshaft main journal and install crankshaft in cylinder.



NOTE:
When installing crankshaft to cylinder, be sure to fit tab of seal in groove of cylinder.

CONROD CAP

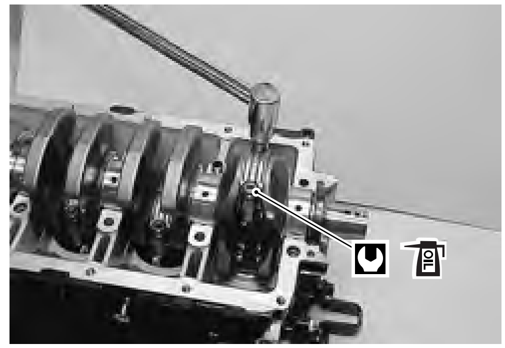
1. Apply engine oil to crank pin and conrod bearing.
2. Install conrod cap (with bearing) to conrod with dot (•) mark on cap toward flywheel side.



CAUTION

Reassemble each conrod cap to its original position.

3. Apply engine oil lightly to conrod bolts.
4. Tighten conrod cap nuts in two steps.

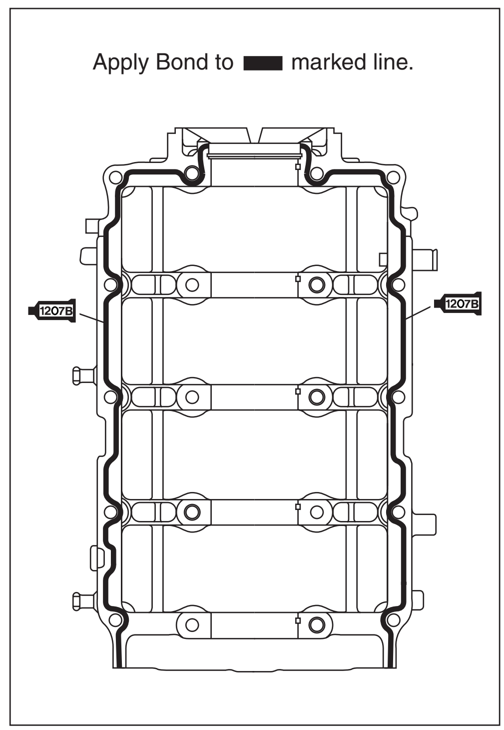


Conrod cap nut :

1st step 18 N·m (1.8 kg-m, 13.0 lb.-ft.)
Final step 35 N·m (3.5 kg-m, 25.5 lb.-ft.)

CRANKCASE TO CYLINDER

1. Clean mating surface of cylinder and crankcase.
2. Apply Suzuki Bond to mating surface of crankcase as shown in figure.

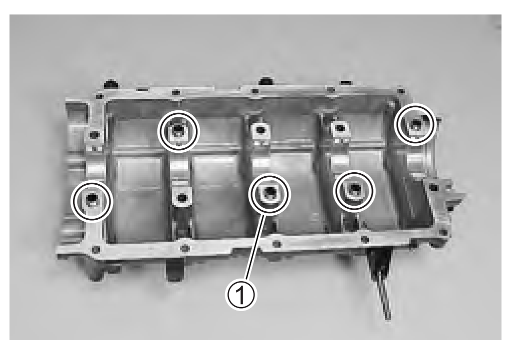


1207B **99000-31140 : Suzuki Bond 1207B**

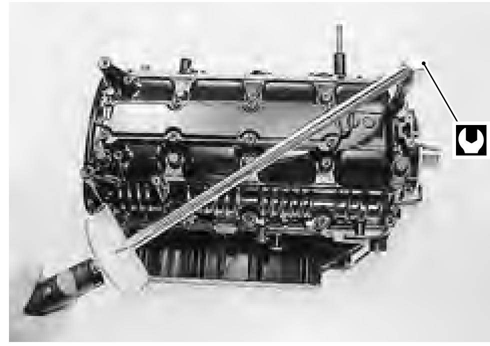
CAUTION

Apply bond to mating surface only.
Do not allow bond to contact surface of bearing.

3. Install five (5) dowel pins ①.



4. Install crankcase to cylinder.
5. Apply engine oil lightly to crankcase bolts.
6. Tighten crankcase bolts in three (3) steps according to the order shown below and in figure.

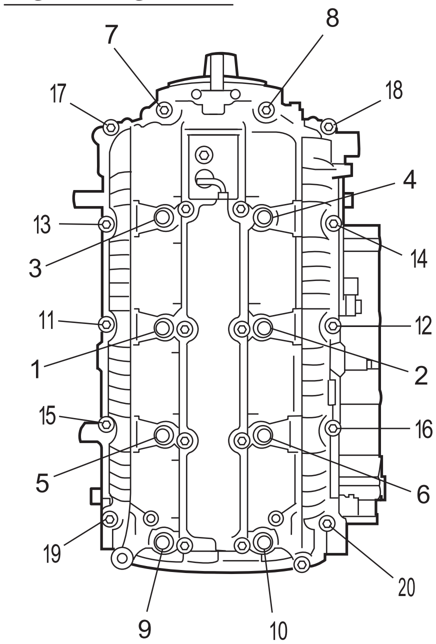


NOTE:
After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

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	**56 N·m (5.6 kg-m, 40.5 lb.-ft.)**

Tightening order



CYLINDER HEAD
Install cylinder head. (See page 6-21 to 6-23)

OIL PUMP
Install oil pump assembly. (See page 6-13)

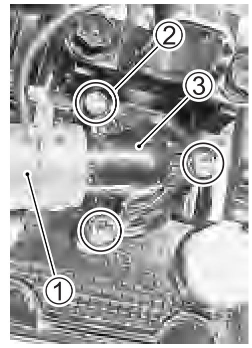
TIMING CHAIN
Install timing chain. (See page 6-17 to 6-19)

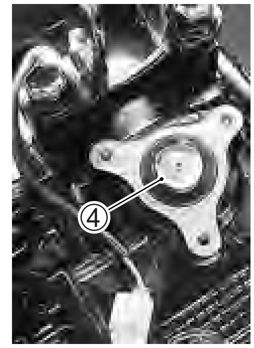
POWER UNIT
Install power unit. (See page 6-9 to 6-11)

THERMOSTAT

REMOVAL

1. Disconnect water hose ① from thermostat cover.
2. Remove the three (3) bolts ② securing the thermostat cover, then remove the cover ③ and thermostat ④.



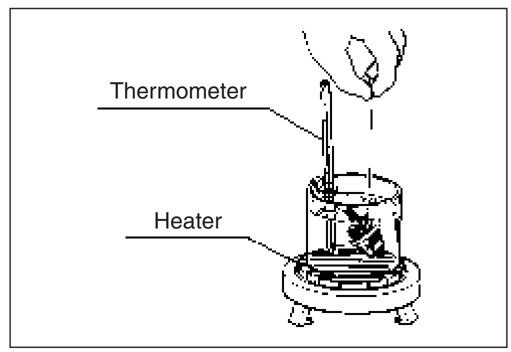


INSPECTION

Inspect thermostat for salt deposits, corrosion, wear or other damage.
Clean or replace if necessary.

Thermostat operation
Check thermostat opening temperature as follows :

1. Insert a length of thread between thermostat valve / body and suspend thermostat in a container filled with water.
2. Place thermometer in container and heat water.
   Observe water temperature when thermostat valve opens and releases thread.



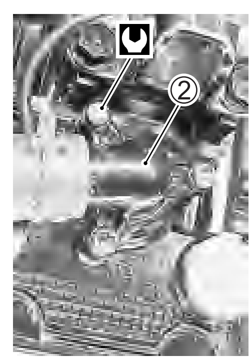
Thermostat operating temperature :
Standard : 58 – 62 °C (136 – 144 °F)

INSTALLATION

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

- Assemble thermostat ① and thermostat cover ② to cylinder head block and secure with bolts.

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

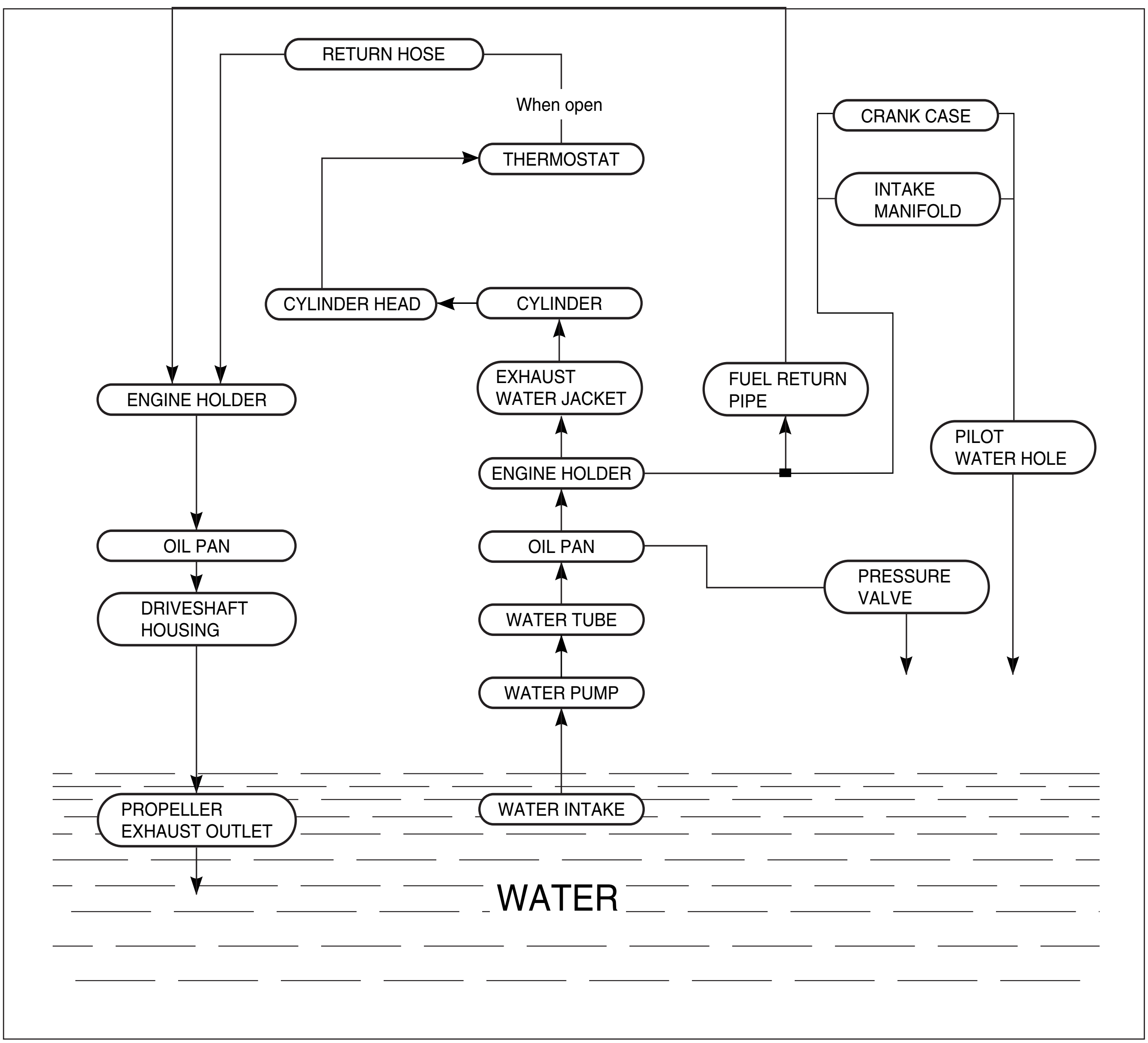


OPERATION

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	9-11
Water tube	7-6
Thermostat	6-63
Water pressure valve	7-20
Cylinder head	6-26
Cylinder block	6-43



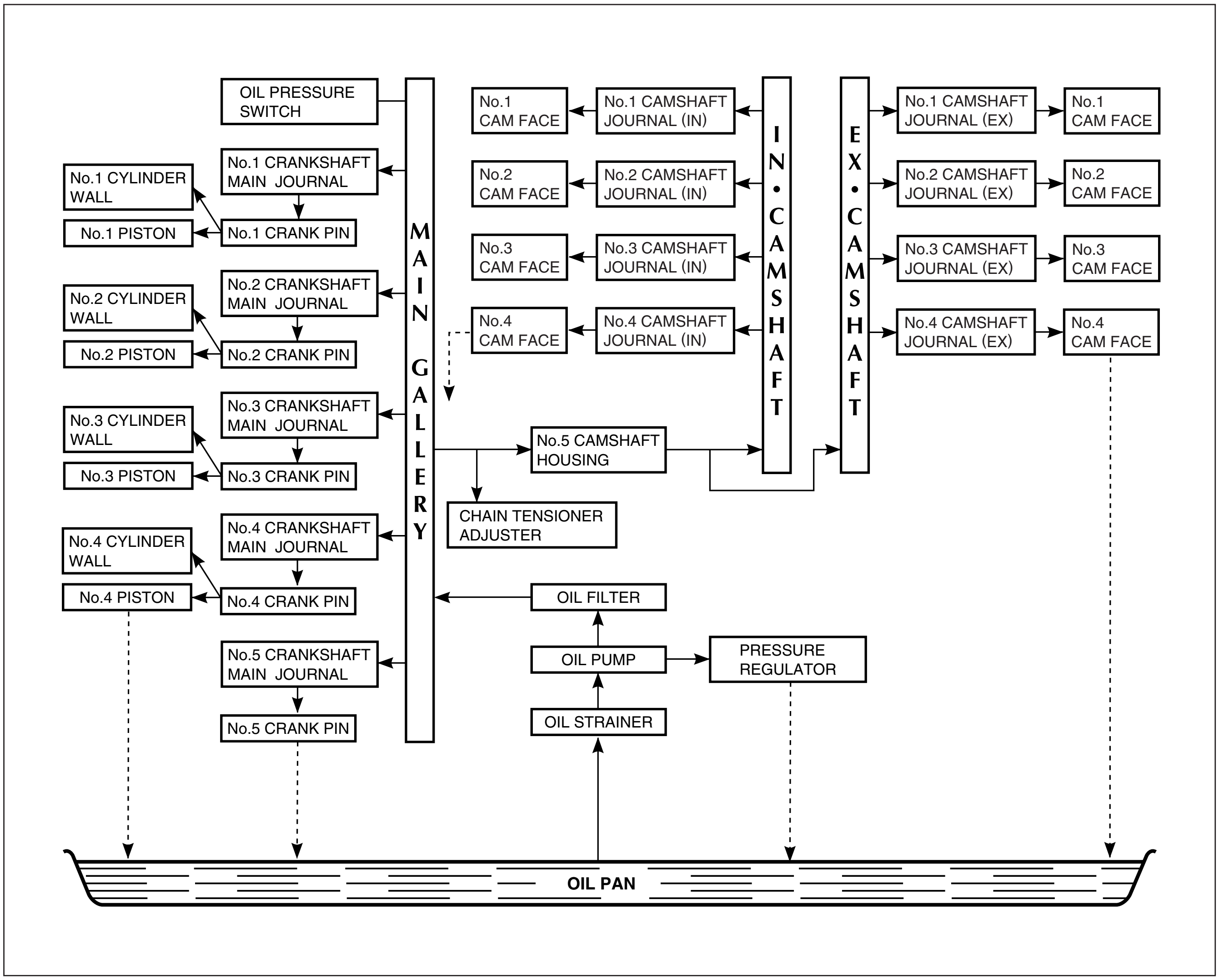
ENGINE LUBRICATION SYSTEM

A camshaft 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

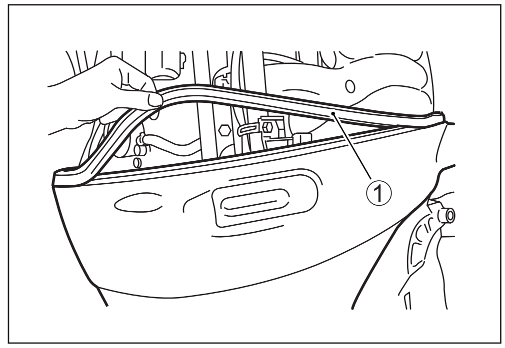


MID UNIT

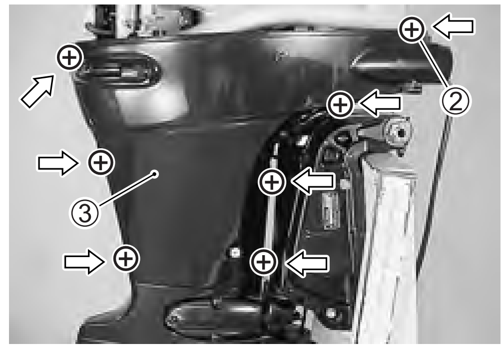
CONTENTS

ENGINE SIDE COVER
REMOVAL

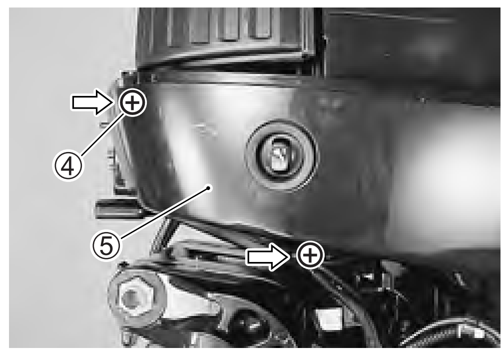
1. Remove side cover seal ①.



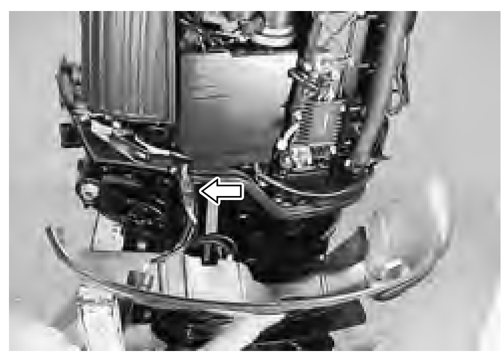
2. Remove seven screws ② and STBD side cover ③.



3. Remove two screws ④ and PORT side cover ⑤.



4. Disconnect PTT switch lead connector.

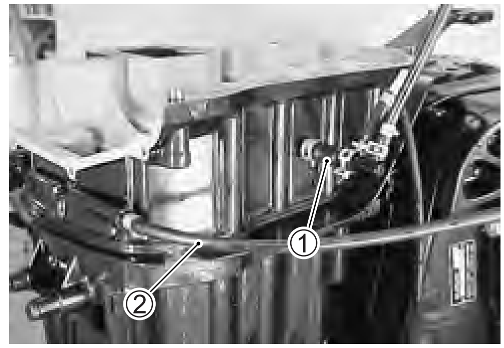


INSTALLATION
Installation is reverse order of removal.

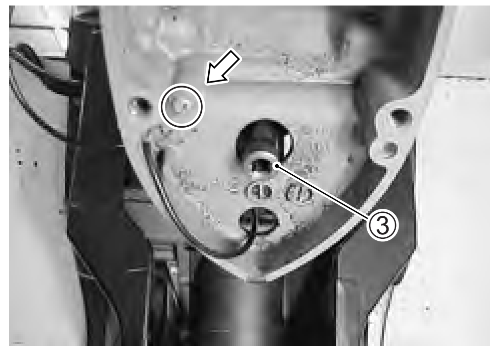
DRIVESHAFT HOUSING AND OIL PAN

REMOVAL

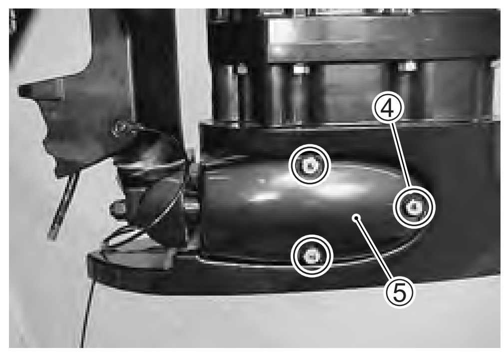
1. Remove power unit. (See pages 6-5 to 6-8)
2. Remove lower unit. (See page 9-2)
3. Disconnect water hose ① and ②.



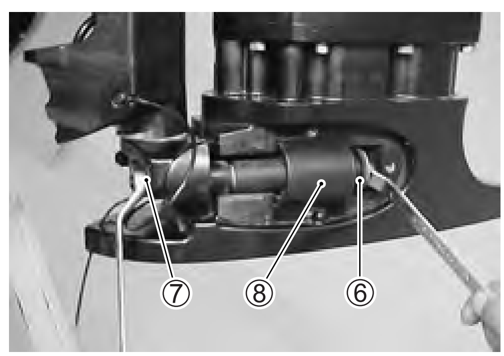
4. Remove screw and bonding wire from driveshaft housing.
5. Remove the clutch rod ③.

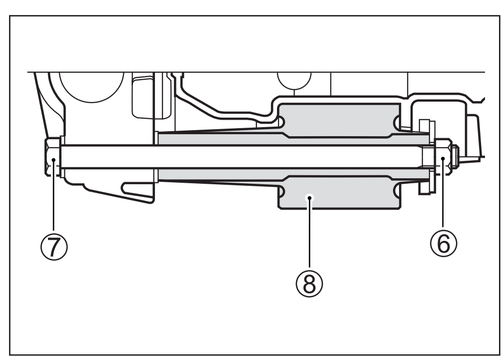


6. Remove lower mount cover bolts ④ and PORT/STBD lower mount covers ⑤.



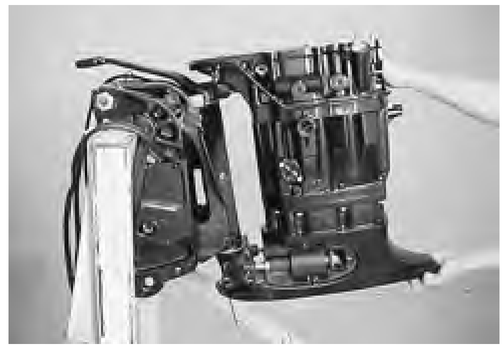
7. Remove STBD / PORT lower mount nuts ⑥ and lower mount bolts ⑦.
8. Remove lower mount assembly ⑧.





9. Remove two upper mount nuts ⑨ and washers.

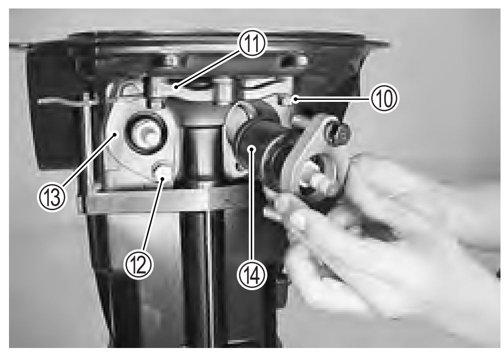
10. Remove driveshaft housing with oil pan.



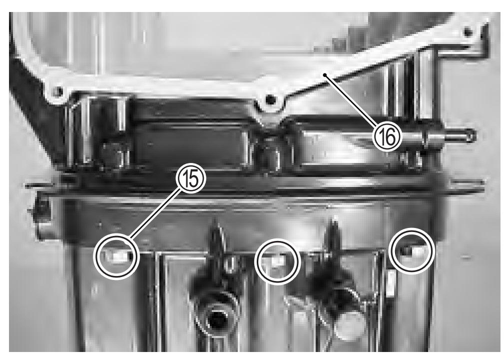
11. Remove two bolts ⑩ and clutch shaft holder ⑪.

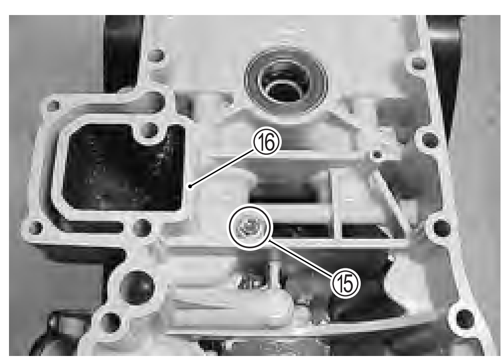
12. Remove four bolts ⑫ and upper mount cover ⑬.

13. Remove upper mount assemblys ⑭.

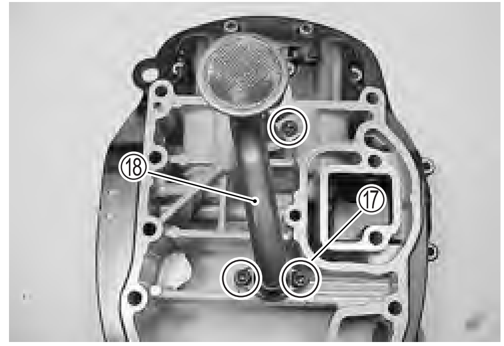


14. Remove four bolts ⑮ and engine holder ⑯.



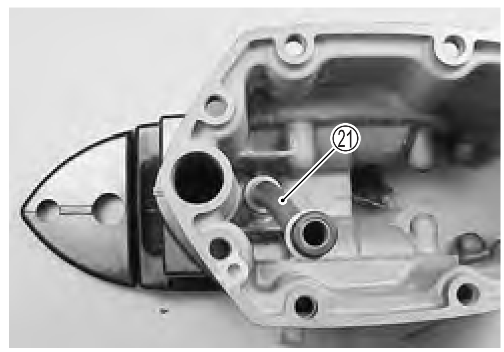


15. Remove three bolts ⑰ and oil strainer ⑱.



16. Remove eight bolts ⑲ and oil pan ⑳.

17. Remove water tube ㉑.



INSPECTION

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

Mid unit component
Inspect oil pan, driveshaft housing, engine holder and mount covers for cracks, defects or other damage.
Replace if necessary.

Mount

Inspect upper and lower mount for excessive wear, corrosion or other damage.
Replace if necessary.

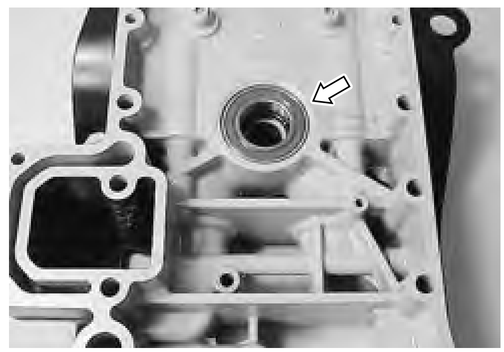
Water tube

Inspect water tube for clog, obstruction, crack, corrosion or other damage.
Clean or replace if necessary.

Inspect water tube grommet for excessive wear or other damage.
Replace if necessary.

Counter shaft bearing

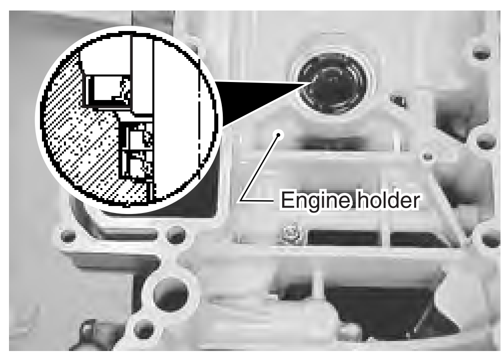
Inspect counter shaft bearing for pitting, routh or other damage.
Replace if necessary.



Oil seal

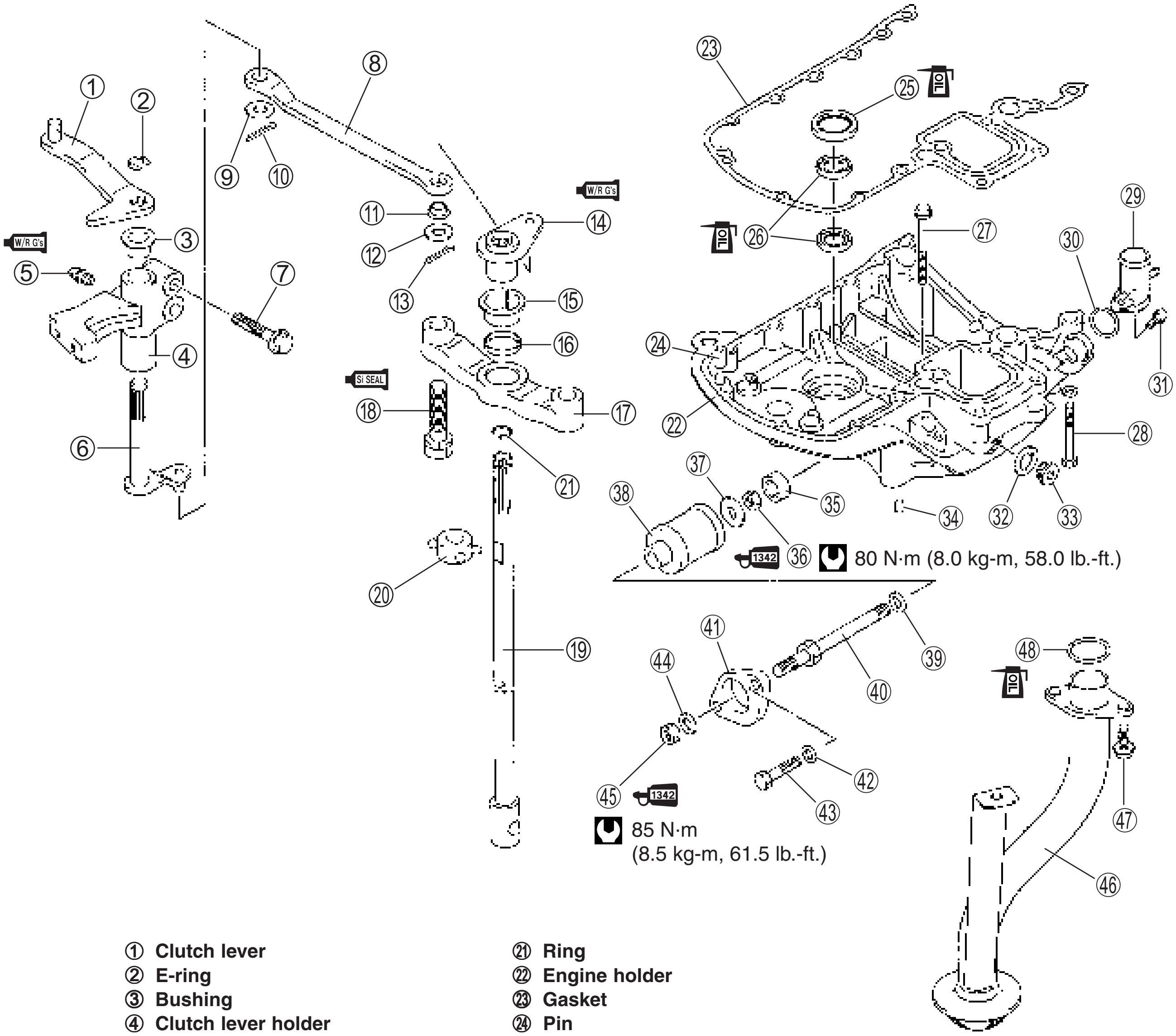
Inspect driveshaft upper and counter shaft oil seal for leakage, crank, cut or other damage.
Replace if necessary.

NOTE:
Install oil seal with lip (spring side) facing as shown in figure.

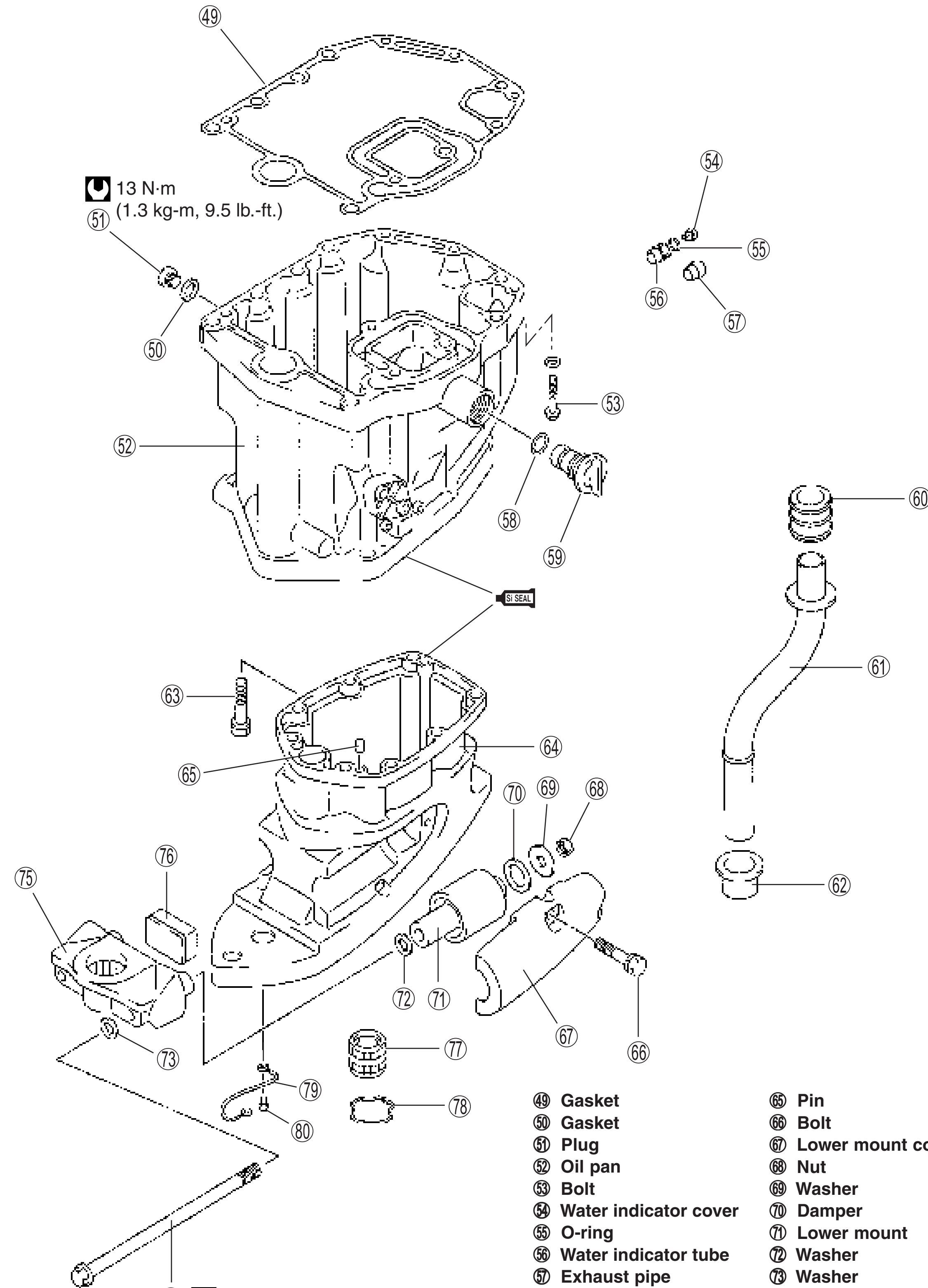


ASSEMBLY

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



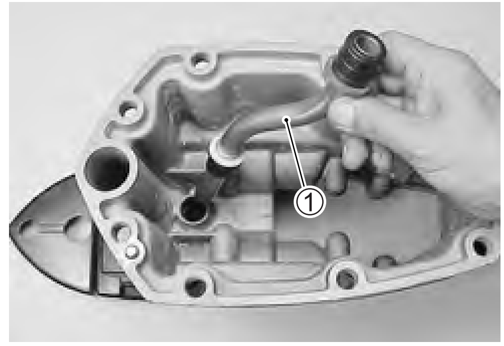
1. **Clutch lever**
2. **E-ring**
3. **Bushing**
4. **Clutch lever holder**
5. **Grease nipple**
6. **Clutch shaft arm**
7. **Bolt**
8. **Clutch lever link**
9. **Washer**
10. **Pin**
11. **Bushing**
12. **Washer**
13. **Pin**
14. **Clutch shaft**
15. **Bushing**
16. **Bushing**
17. **Clutch shaft holder**
18. **Bolt**
19. **Clutch rod**
20. **Guide**
21. **Ring**
22. **Engine holder**
23. **Gasket**
24. **Pin**
25. **Oil seal**
26. **Oil seal**
27. **Bolt**
28. **Bolt**
29. **Water return union**
30. **O-ring**
31. **Bolt**
32. **Gasket**
33. **Plug**
34. **Pin**
35. **Upper thrust mount**
36. **Nut**
37. **Washer**
38. **Upper mount**
39. **Washer**
40. **Upper mount bolt**
41. **Mount cover**
42. **Washer**
43. **Bolt**
44. **Washer**
45. **Nut**
46. **Oil strainer**
47. **Bolt**
48. **O-ring**



- 49 Gasket
- 50 Gasket
- 51 Plug
- 52 Oil pan
- 53 Bolt
- 54 Water indicator cover
- 55 O-ring
- 56 Water indicator tube
- 57 Exhaust pipe
- 58 O-ring
- 59 Water plug
- 60 Bushing
- 61 Water tube
- 62 Bushing
- 63 Bolt
- 64 Driveshaft housing
- 65 Pin
- 66 Bolt
- 67 Lower mount cover
- 68 Nut
- 69 Washer
- 70 Damper
- 71 Lower mount
- 72 Washer
- 73 Washer
- 74 Lower mount bolt
- 75 Lower mount bracket
- 76 Lower thrust mount
- 77 Bushing (type:UL)
- 78 Retaining ring
- 79 Bonding wire
- 80 Screw

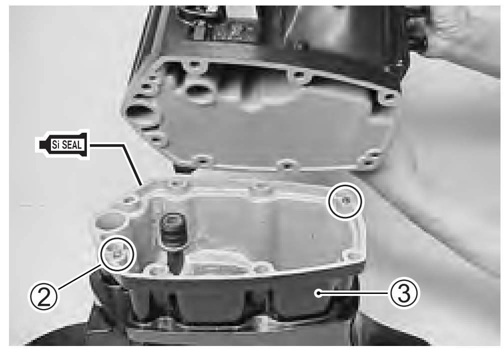
OIL PAN TO DRIVESHAFT HOUSING

1. Install water tube ①.

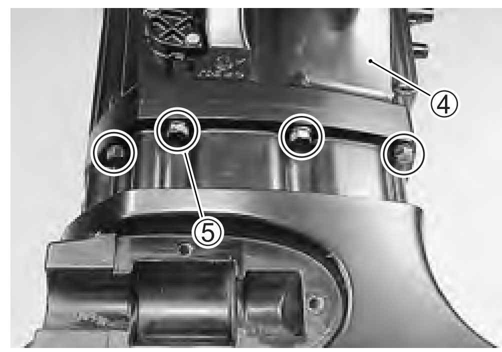


2. Install two dowel pins ② to driveshaft housing ③.
3. Apply sealant to mating surfaces of driveshaft housing and oil pan.

Si SEAL 99000-31120 : Suzuki Silicone Seal

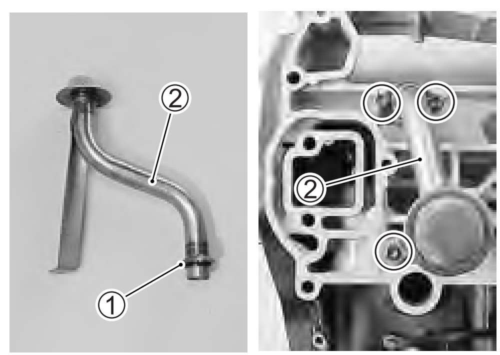


4. Install oil pan ④ to driveshaft housing, then tighten eight bolts ⑤ securely.



ENGINE HOLDER TO OIL PAN

1. Apply engine oil to O-ring ①, then install O-ring to oil strainer ②.
2. Install oil strainer to engine holder, then tighten bolts se curely.

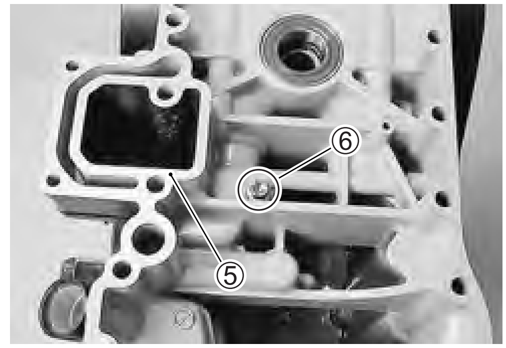


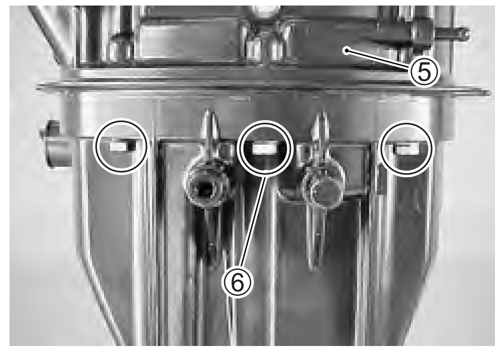
3. Install two (2) dowel pins ③ and gasket ④ to oil pan.

CAUTION

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

4. Install engine holder ⑤ to oil pan, then securely tighten it with four bolts ⑥.

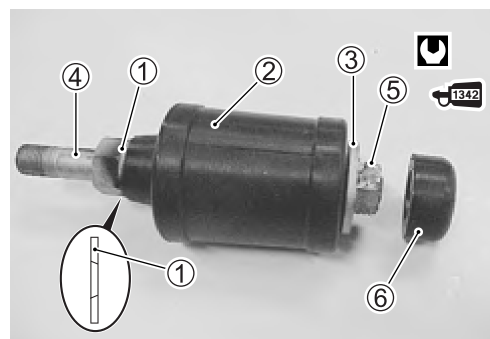




UPPER MOUNT

Upper mount and mount cover

1. Place washer ①, upper mount ② and washer ③ on upper mount bolt ④.
2. Tighten upper mount rear nut ⑤, pre-coated with thread lock, to specified torque.

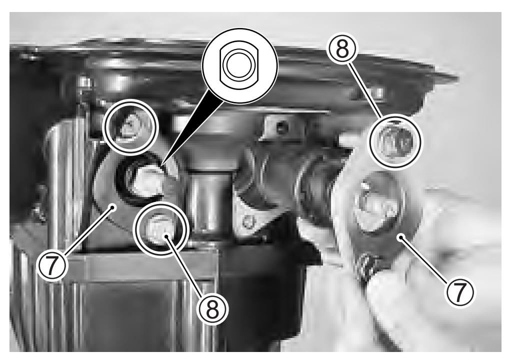


1342 99000-32050 : Thread Lock "1342"

Upper mount rear nut :

80 N·m (8.0 kg-m, 58.0 lb.-ft.)

3. Install thrust mount ⑥ to upper mount rear nut, then place upper mount into engine holder.
4. Install upper mount covers ⑦, then tighten bolts ⑧, pre-coated with thread lock, to specified torque.



NOTE:

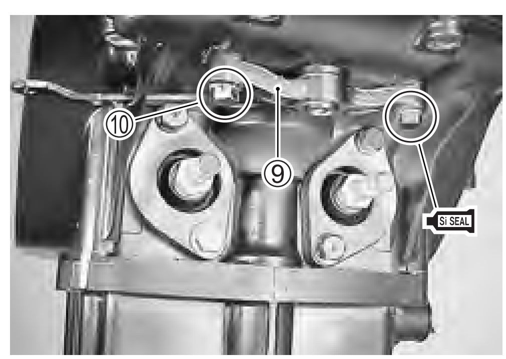
Before tightening mount cover bolts, be sure upper mount bolt head is positioned as shown in figure.

1342 99000-32050 : Thread Lock "1342"

Upper mount cover plate bolt :

50 N·m (5.0 kg-m, 36.0 lb.-ft.)

5. Install clutch shaft holder ⑨ to engine holder, then tighten bolts ⑩, pre-coated with silicone seal, to securely.

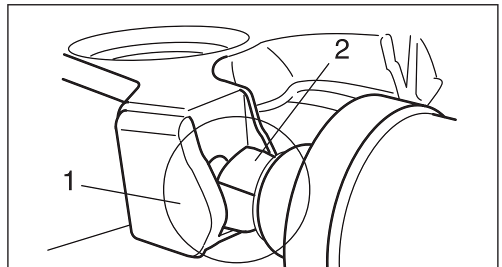


Si SEAL 99000-31120 : Suzuki silicone seal

DRIVESHAFT HOUSING / OIL PAN

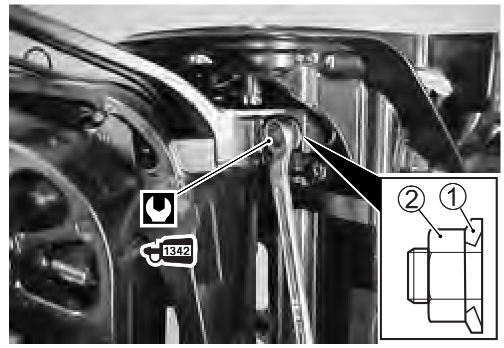
1. Install driveshaft housing / oil pan to steering bracket.

NOTE:
Be sure upper mount bolt head properly fits into the steering bracket groove when installing driveshaft housing / oil pan assembly.



1. Steering bracket
2. Upper mount bolt

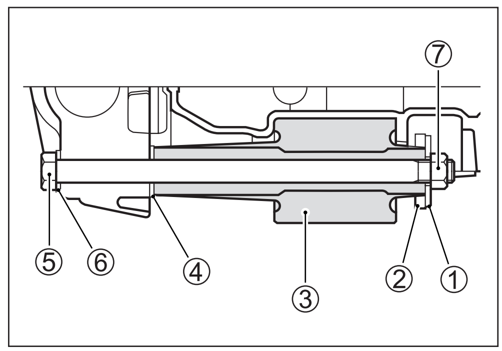
2. Install washer ① and upper mount front nut ②, then tighten two nuts, pre-coated with thread lock, to specified torque.



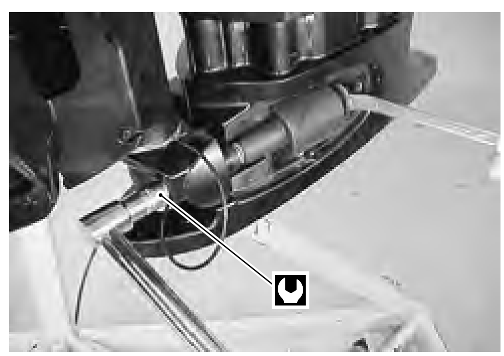
Upper mount front nut : 85 N·m (8.5 kg-m, 61.5 lb.-ft)

LOWER MOUNT / MOUNT BOLT

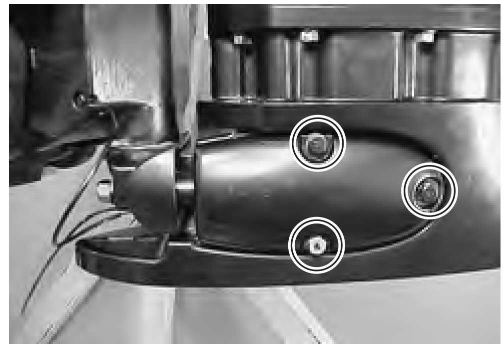
1. Place washer ①, damper ②, lower mount ③ and washer ④ into driveshaft housing.
2. Install lower mount bolt ⑤ and washer ⑥, then tighten mount bolt with lock nut ⑦ to specified torque.



Lower mount bolt / nut :
60 N·m (6.0 kg-m, 43.0 lb.-ft.)

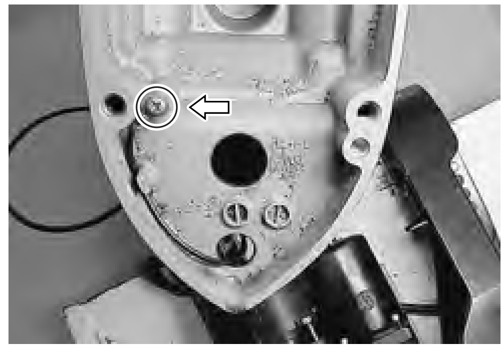


3. Install lower mount covers to driveshaft housing, then tighten lower mount cover bolts securely.



BONDING WIRE

Reattach bonding wire to driveshaft housing and tighten screw securely.



POWER UNIT

1. Install power unit. (See page 6-9 to 6-11)
2. Tighten power unit mounting bolts and engine holder bolts to specified torque.

Power unit mounting bolt & Engine holder bolt :

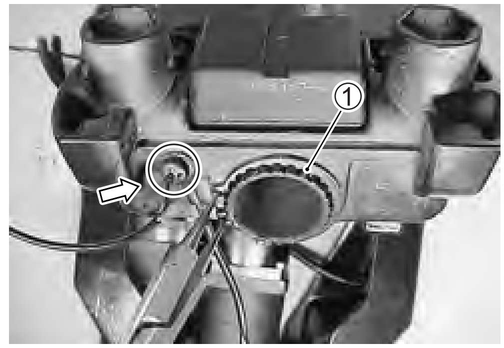
8 mm	**23 N·m**	**(2.3 kg-m, 16.5 lb.-ft.)**
10 mm	**50 N·m**	**(5.0 kg-m, 36.0 lb.-ft.)**

SWIVEL BRACKET, STEERING BRACKET AND CLAMP BRACKET

REMOVAL

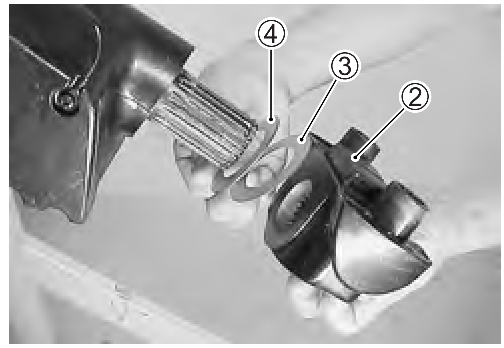
1. Remove driveshaft housing / oil pan.
   (See page 7-3)

2. Remove screw and bonding wire from lower mount bracket.



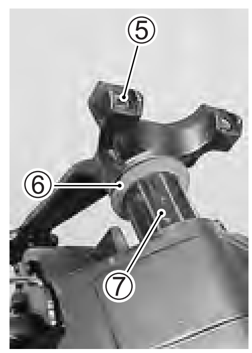
3. Remove circlip ①.

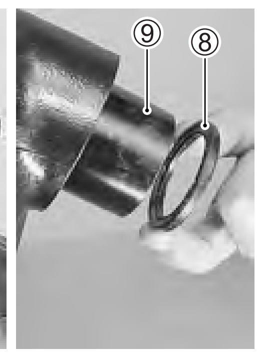
4. Remove lower mount bracket ②, shim ③, and washer ④ from the steering shaft.



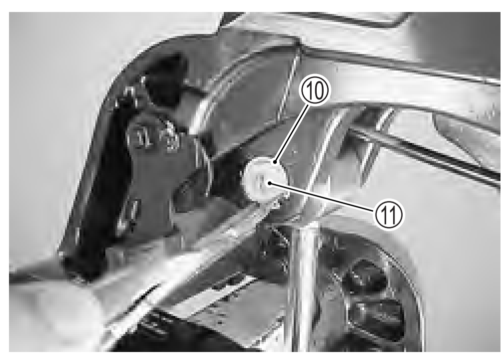
5. Lift steering bracket ⑤ upward to remove from swivel bracket.
6. Remove washer ⑥ and upper bushing ⑦.

7. Remove swivel bracket seal ⑧ and lower bushing ⑨.

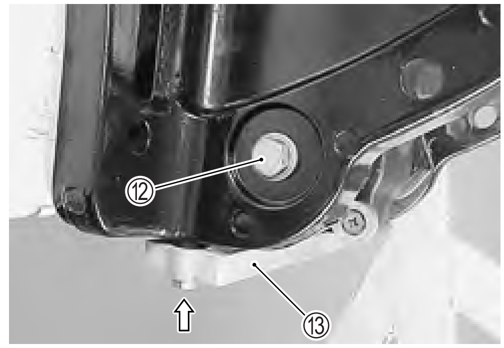


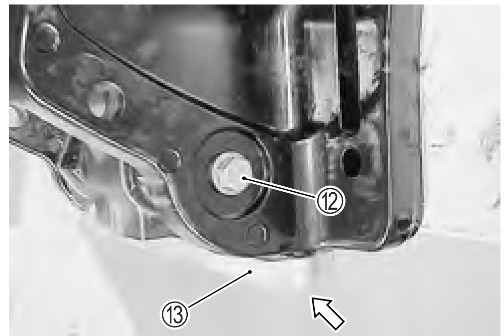


8. Remove circlip ⑩ and push out tilt cylinder upper rod ⑪.

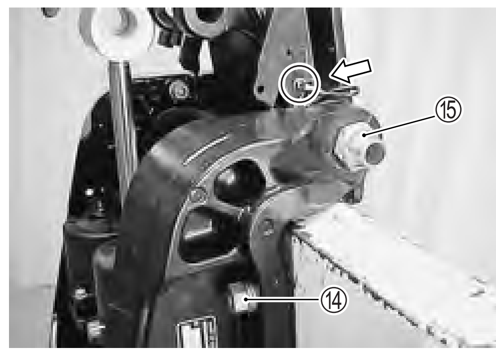


9. Remove tilt cylinder lower shaft bolts ⑫.
10. Remove bolts and anode ⑬.



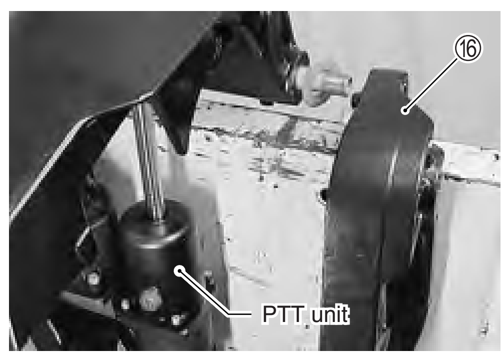


11. Remove STBD motor mounting bolts ⑭.
12. Remove clamp bracket shaft nut ⑮.

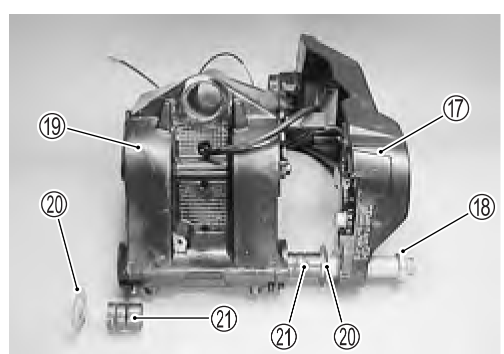


13. Slide STBD clamp bracket ⑯ off clamp bracket shaft, then remove screw and bonding wire from swivel bracket.

14. Remove PTT unit with lower rod.



15. Pull PORT clamp bracket ⑰ outward to remove clamp bracket and bracket shaft ⑱ from swivel bracket ⑲.
16. Remove washer ⑳ and bushing ㉑ from each side of swivel bracket.



INSPECTION

NOTE:

If excessive ware, cracks, defective or damage is found on any component, replace component.

BUSHINGS

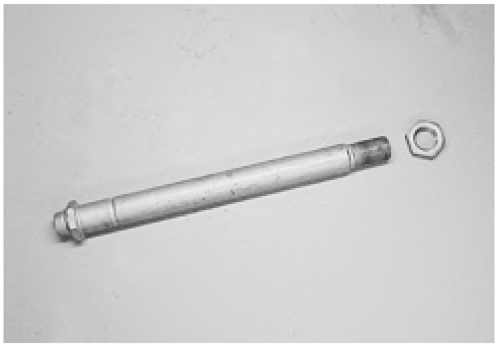
Inspect all bushings for excessive wear or other damage.
Replace if necessary.
If bushing fit is loose when installing, replace bushing.

OIL SEAL

Inspect swivel bracket seal for cuts, nicks, excessive wear or other damage.

CLAMP BRACKET SHAFT

Inspect clamp bracket shaft for bend, twist or other damage.
Replace if necessary.

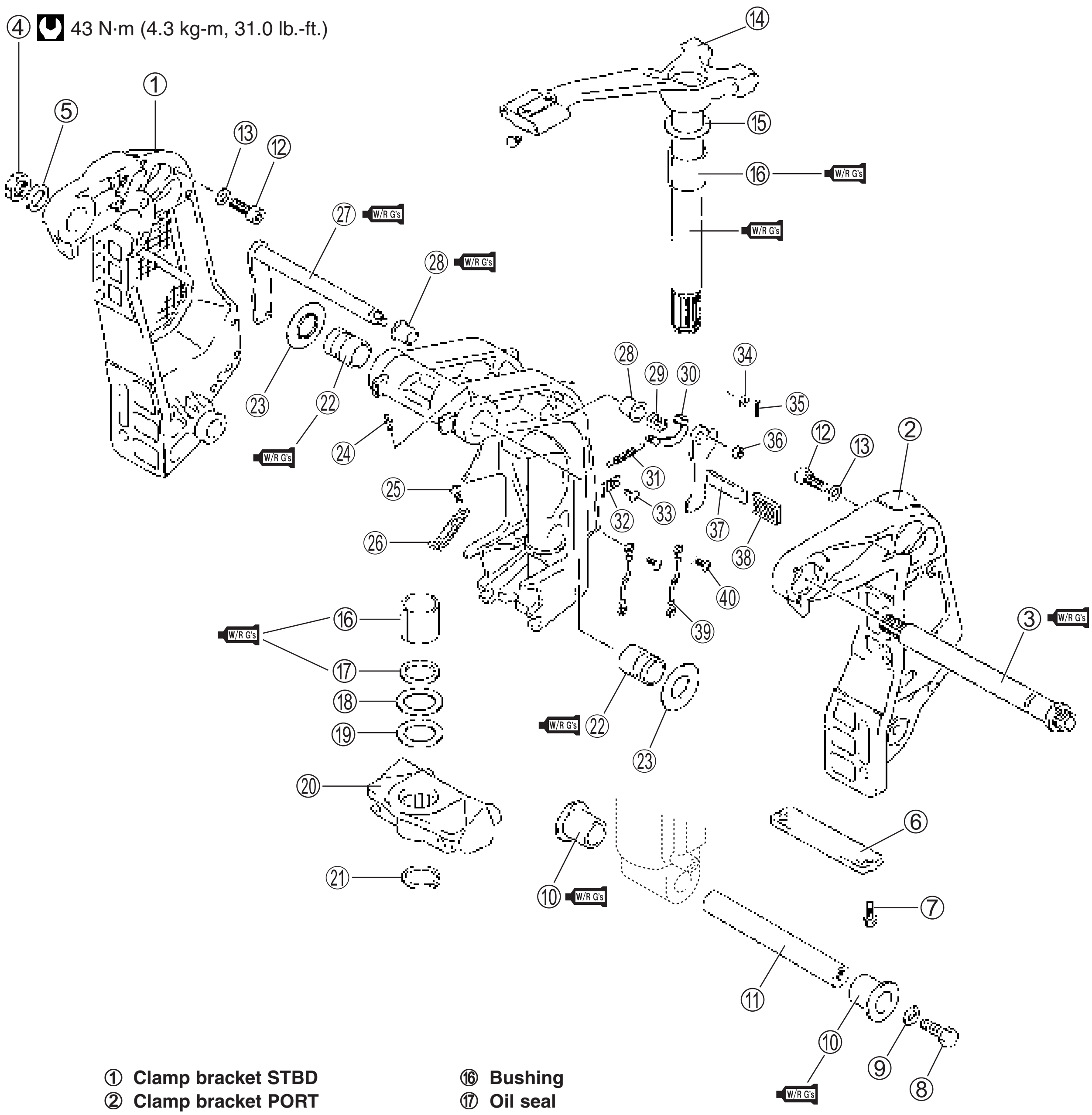


BRACKET

Inspect clamp brackets, steering bracket and swivel bracket for excessive wear, cracks or other damage.
Replace if necessary.

REASSEMBLY

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

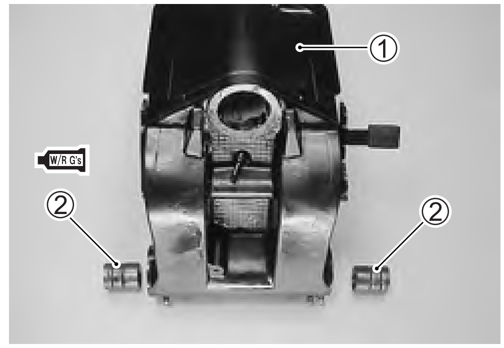


① Clamp bracket STBD
② Clamp bracket PORT
③ Clamp bracket shaft
④ Nut
⑤ Washer
⑥ Anode
⑦ Bolt
⑧ Bolt
⑨ Washer
⑩ Bushing
⑪ Lower shaft
⑫ Bolt
⑬ Washer
⑭ Steering bracket
⑮ Washer
⑯ Bushing
⑰ Oil seal
⑱ Washer
⑲ Shim
⑳ Lower mount bracket
㉑ Circlip
㉒ Bushing
㉓ Washer
㉔ Grease nipple
㉕ Screw
㉖ Clamp
㉗ Tilt lock lever
㉘ Bushing
㉙ Spring
㉚ Link
㉛ Spring
㉜ Bracket
㉝ Screw
㉞ Washer
㉟ Pin
㊱ Nut
㊲ Tilt lock lever PORT
㊳ Rubber
㊴ Bonding wire
㊵ Screw

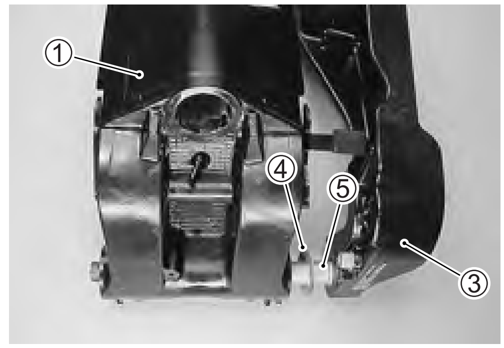
CLAMP BRACKET AND SWIVEL BRACKET

NOTE:
Before installing clamp bracket to swivel bracket, apply grease to clamp bracket shaft and bushings.

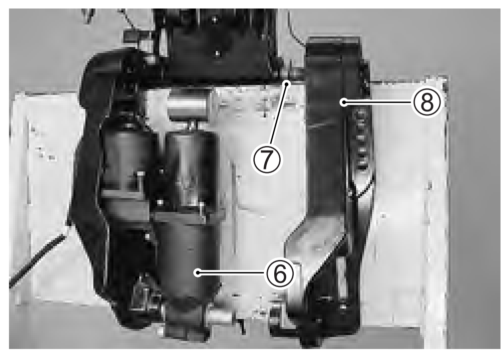
99000-25161 : Suzuki Water Resistant Grease



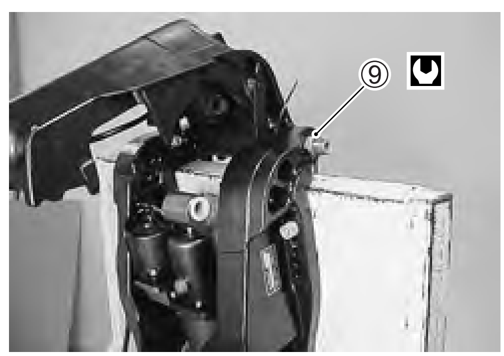
1. Insert PORT and STBD bushings ② into swivel bracket ①.



2. Assemble port clamp bracket ③, washer ④, clamp bracket shaft ⑤ and swivel bracket ①.

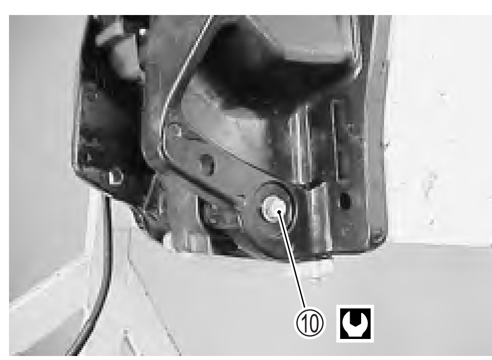


3. Install PTT unit assembly ⑥, lower shaft and bushings in position.
   (For PTT unit assembly installation, see page 8-15 to 8-16)



4. Install washer ⑦, STBD clamp bracket ⑧ and clamp bracket shaft nut ⑨, then tighten clamp bracket shaft nut to specified torque.

Clamp bracket shaft nut :
43 N·m (4.3 kg-m, 31.0 lb.-ft.)



5. Tighten lower shaft bolts ⑩, pre-coated with thread lock, to specified torque.

99000-32050 : Thread lock 1342

Cylinder lower shaft bolt :
50 N·m (5.0 kg-m, 36.0 lb.-ft.)

STEERING BRACKET

1. Apply Water Resistant Grease to steering bracket shaft.

W/R G's **99000-25161 : Suzuki Water Resistant Grease**

NOTE:
Apply grease to bushings, oil seal lip and pilot shaft portion of steering bracket.

2. Install upper bushing ①, and washer ② to swivel bracket.

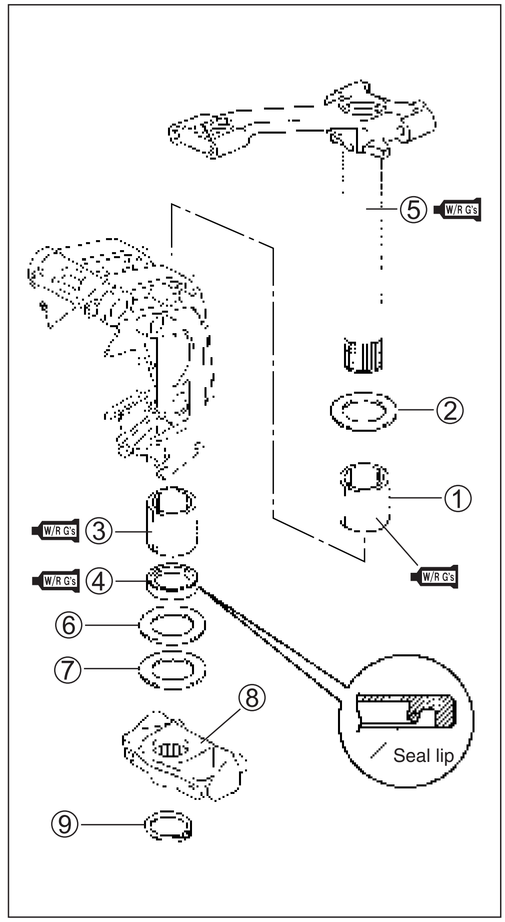
3. Install lower bushing ③ and swivel bracket seal ④ to swivel bracket.

NOTE:
Install seal ④ with lip (spring side) facing downward.

4. Install steering bracket ⑤ to swivel bracket.

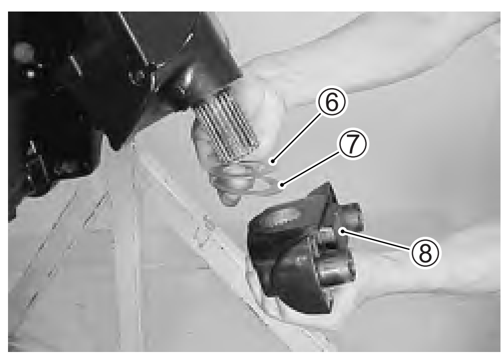
CAUTION

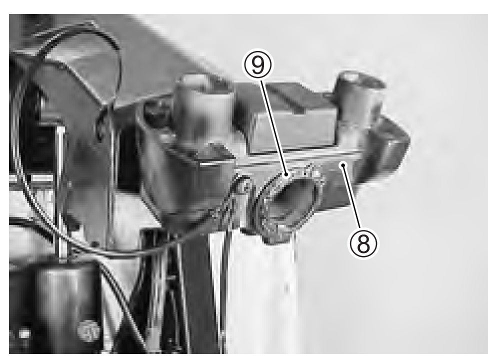
Do not re-use seal once removed. Always use a new seal.



LOWER MOUNT BRACKET

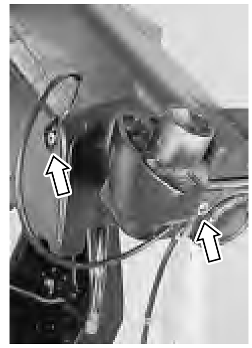
1. Install washer ⑥ and shim ⑦, and then slide lower mount bracket ⑧ upward on splines until it contacts shim.
2. Install circlip ⑨ to retain bracket.





BONDING WIRE

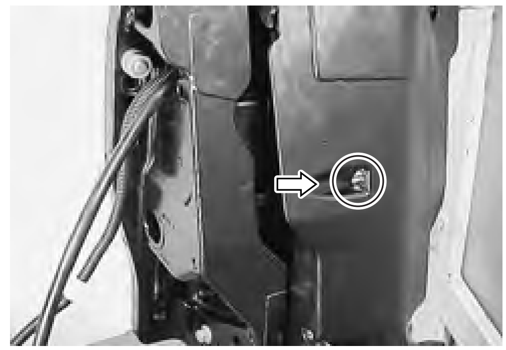
Reattach bonding wire, then tighten screw securely.

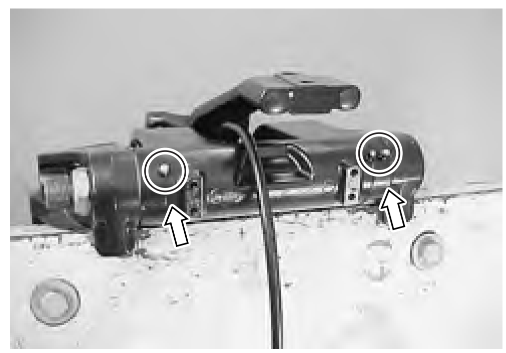


LUBRICATION

After completing reassembly of mid unit, apply grease through each grease nipple.

W/R G's **99000-25161 : Suzuki Water Resistant Grease**

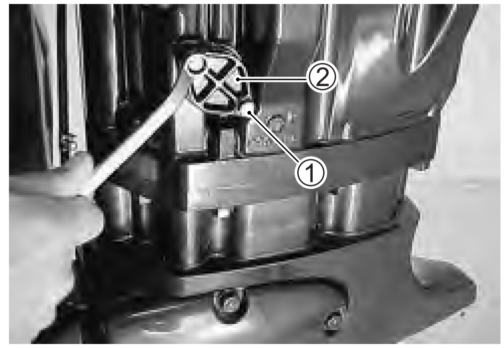


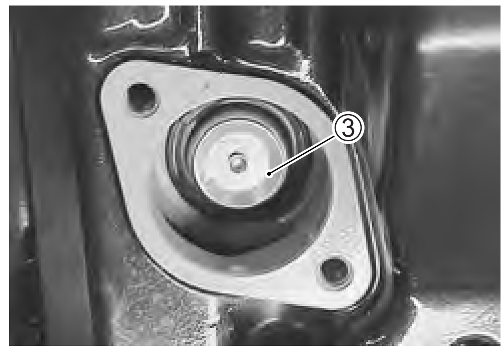


WATER PRESSURE VALVE

REMOVAL

1. Remove PORT side lower cover. (See page 7-2)
2. Remove two bolts ①, pressure valve cover ② and water pressure valve ③.



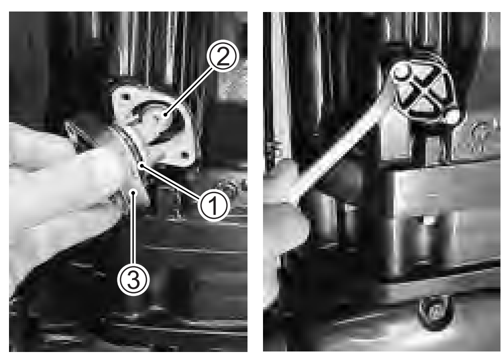


INSPECTION

Inspect water pressure valve and valve cover for salt deposits, corrosion, wear or other damage.
Clean or replace if necessary.

INSTALLATION

1. Install O-ring ① to pressure valve cover.
2. Install pressure valve ②, and pressure valve cover ③ to oil pan and secure with bolts.



NOTE:
Align projections on valve's seal rubber with cutaway parts on valve cover when installing.

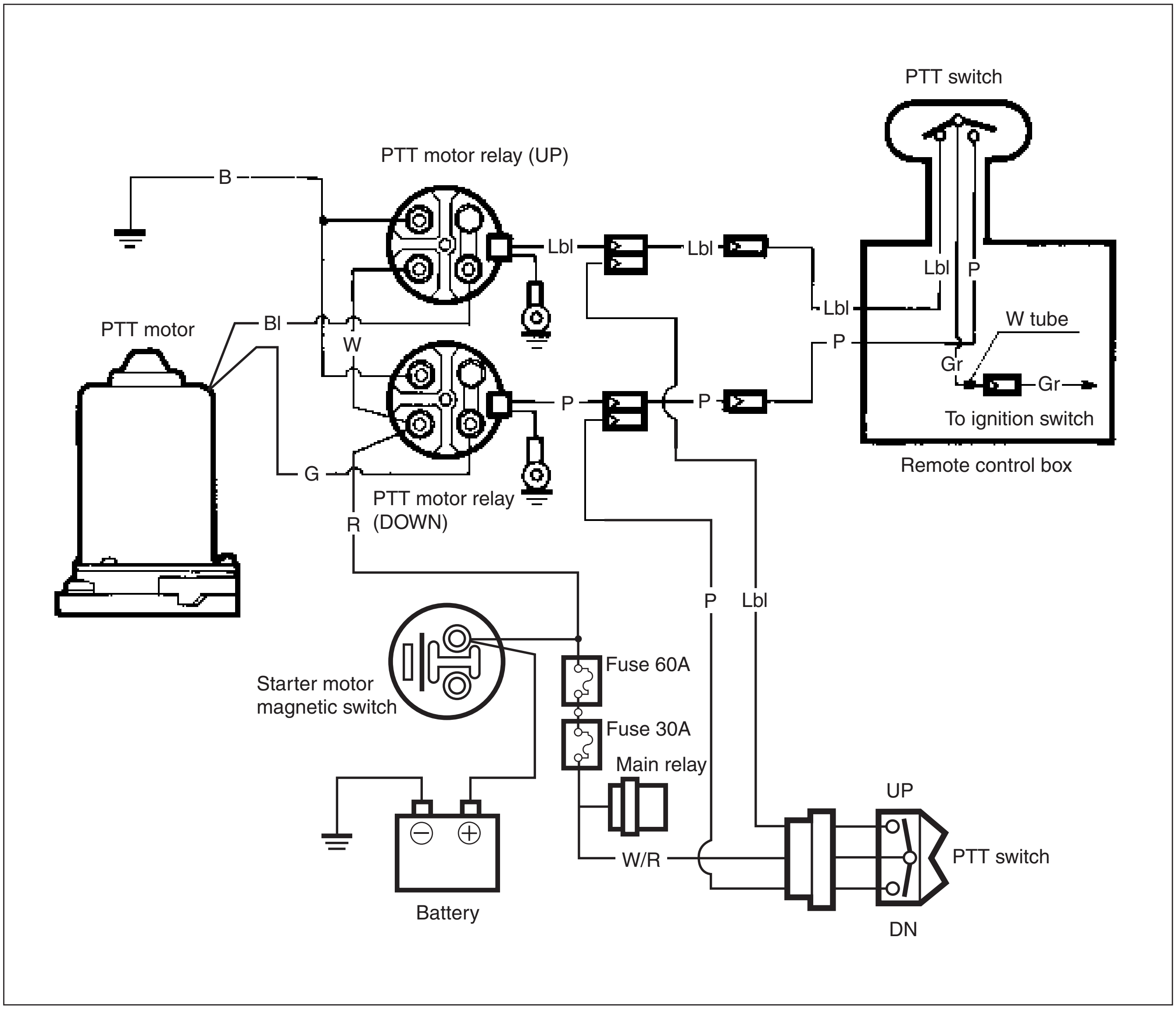
CAUTION

Do not re-use O-ring once removed. Always use a new O-ring.

POWER TRIM AND TILT

CONTENTS

SYSTEM WIRING DIAGRAM

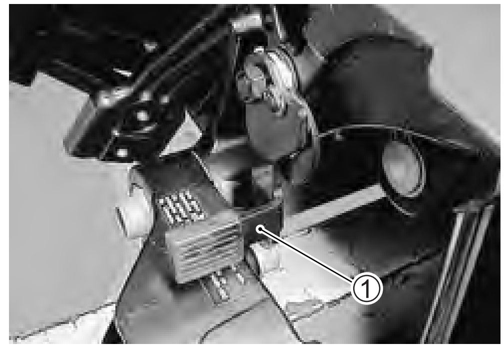


SERVICE PROCEDURE

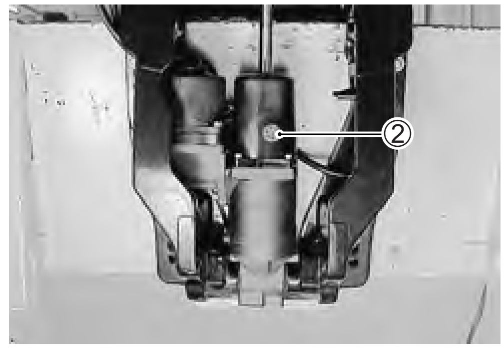
OIL LEVEL

To check PTT oil level :

1. Raised engine to a full-tilt position.



2. Lower manual tilt lock lever ①.
3. Remove oil filler plug ②.



4. If oil can be seen at filler plug level, unit is full.
5. If oil level is low, refill with recommended oil.

Recommended oil :

Dexron Ⅲ automatic transmission fluid or equivalent

CAUTION

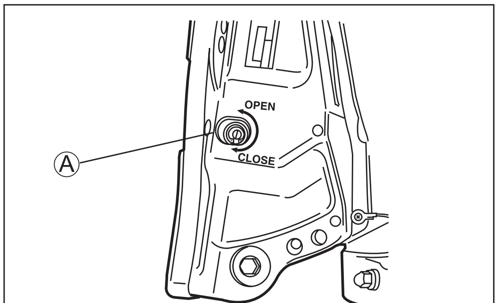
To ensure consistent pump operation, do not mix different types of oil.

6. Reinstall oil filler plug.

AIR BLEEDING

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

Manual release valve : 3.6 N·m (0.36 kg-m, 2.6 lb.-ft.)



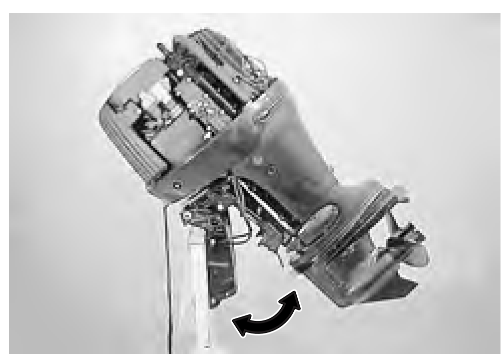
Ⓐ Manual release valve

CAUTION

Do not over-tighten manual release valve.

Counterclockwise = open
Clockwise = close

2. Operate PTT switch, raising and lowering motor up and down (full tilt position to full trim down position) 4 to 5 times.

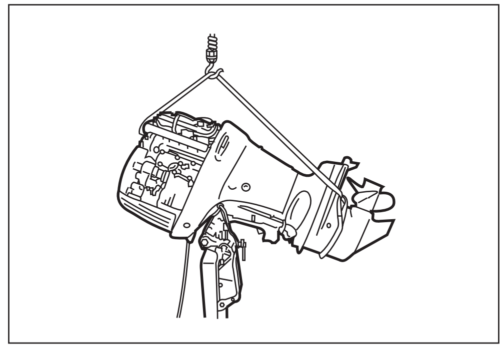


3. Check oil level, topping off if necessary.
4. Reinstall oil filler plug.

POWER TRIM AND TILT UNIT

REMOVAL

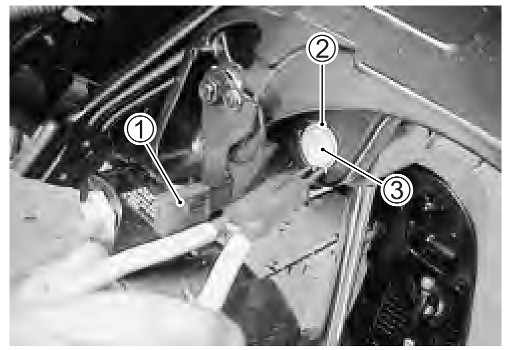
Raise engine to the full tilt position and lower manual tilt lock levers ①.



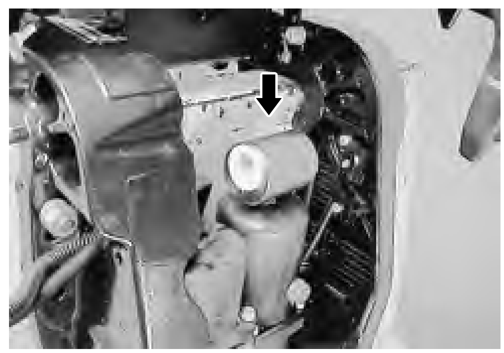
⚠ WARNING

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

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

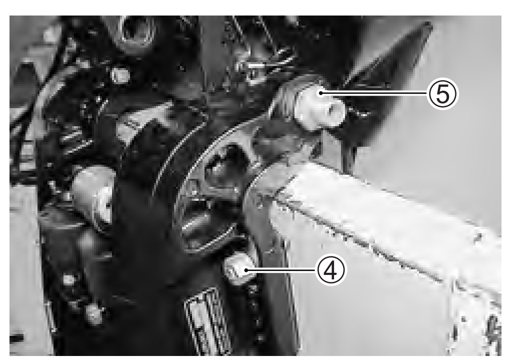


2. Lower tilt rod to full down position and disconnect battery cable.

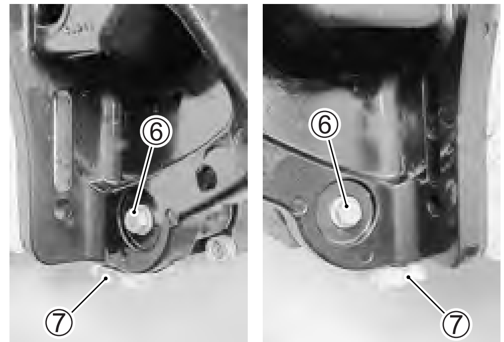


3. Disconnect PTT motor cable wire leads (Green, Blue) from PTT motor relays.
4. Remove PTT motor cable from engine lower cover.

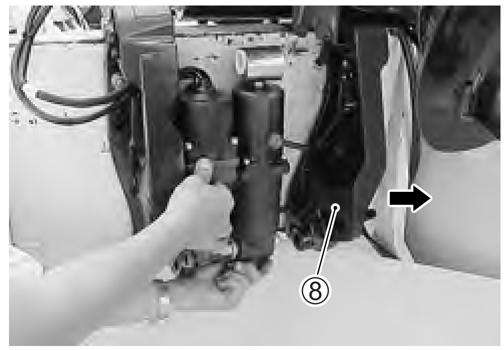
5. Remove STBD motor mounting bolts ④ and clamp bracket shaft nut ⑤.



6. Remove PTT cylinder lower shaft bolts ⑥.
7. Remove two bolts and anode ⑦.



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



DISASSEMBLY

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

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

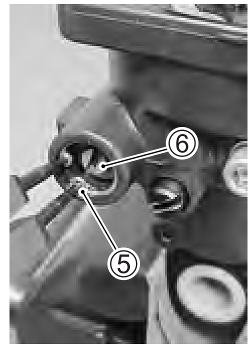
NOTE:
To prevent damage to PTT cylinder use wood blocks, vise jaw protectors, etc., between vise jaws and PTT components before tightening vise.

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

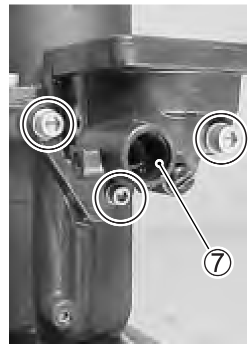
3. Remove PTT motor. (See page 8-10)
Note position of drive joint ③ and O-ring ④, before removing them.

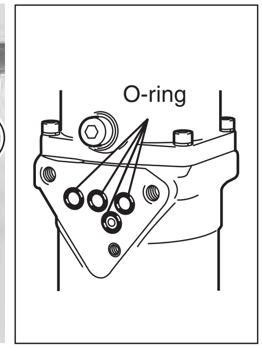
4. Remove fill plug and drain PTT oil into suitable container.

5. Remove manual release valve snap ring ⑤, then remove manual release valve ⑥.

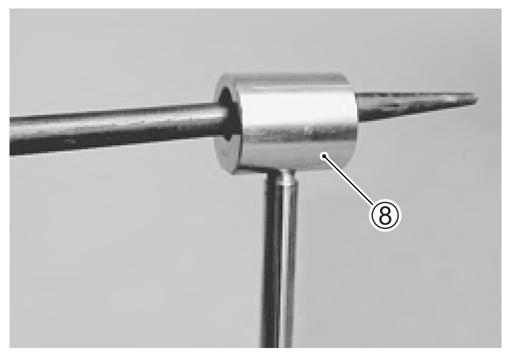


6. Remove three bolts securing PTT pump case ⑦, then detach PTT pump case from PTT body.
Note position of O-rings and remove them.

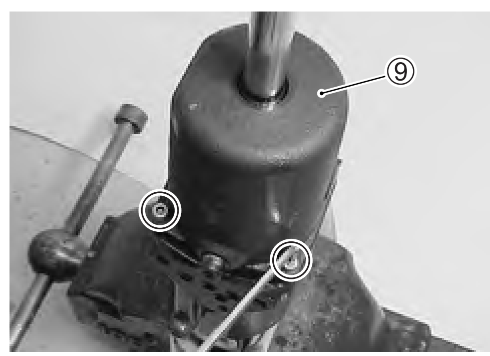


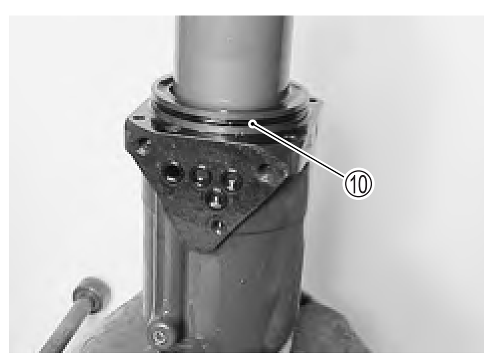


7. Remove upper eye ⑧.



8. Remove four bolts securing cylinder cover ⑨, then detach cover from PTT body.
9. Remove O-ring ⑩.





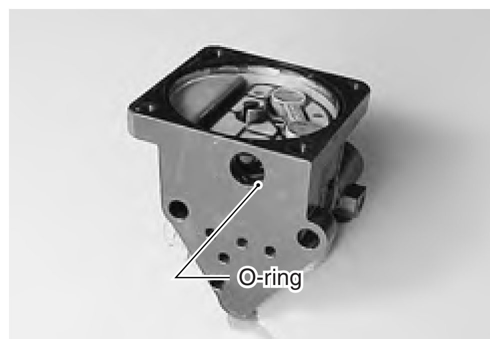
INSPECTION

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.

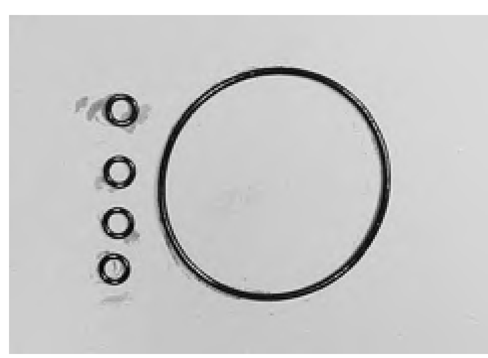
NOTE:
If excessive wear, cracks, defective or other damage is found on any component, replace component.

- Inspect PTT pump case for cracks, nicks, stripped threads and any other imperfections.
  Replace if necessary.



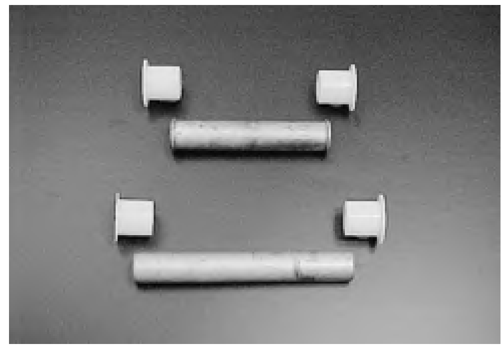
- Inspect cylinder cover for cracks, nicks or damage.
  Replace if necessary.
- Inspect cylinder cover seal for cuts, nicks or wear.

- Inspect all O-rings for cuts, nicks or tears.



- Inspect manual release valve for damage.
  Replace if necessary.
- Inspect O-rings for cuts, nicks or tears.

- Inspect lower shaft and upper shaft for bent, twist or other damage.
  Replace if necessary.
- Inspect all bushings for excessive wear or other damage.
  Replace if necessary.
  If bushing fit is loose when installing, replace bushing.



REASSEMBLY

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

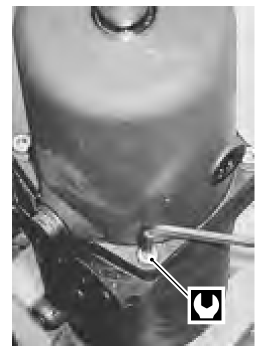
CAUTION

- **Do not re-use O-ring and seal once removed. Always use new parts.**
- **Lubricate all components and O-rings with PTT fluid before assembly.**
- **Do not re-use PTT fluid. Always refill with new fluid.**

TILT CYLINDER COVER

1. Apply PTT fluid to cylinder cover seal, then install cylinder cover.
2. Tighten four bolts securely.

Cylinder cover bolt : 4.7 N·m (0.47 kg-m, 3.4 lb.-ft.)

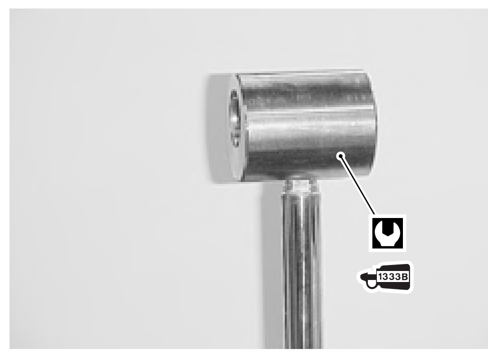


UPPER EYE

1. Apply Thread Lock super 1333B to threads of upper eye before threading it onto tilt rod.
2. Tighten upper eye to specified torque.

Upper eye : 108 N·m (10.8 kg-m, 78.0 lb.-ft.)

1333B **99000-32020 : Thread Lock super 1333B**



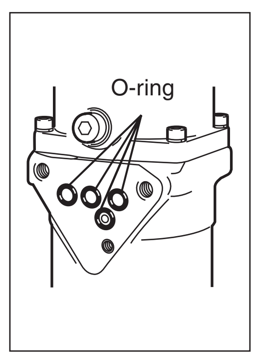
PTT PUMP CASE

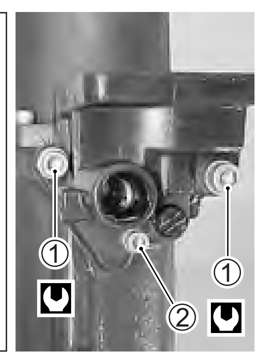
1. Install four O-rings to PTT body.

NOTE:
Lubricate O-ring with PTT fluid before installing PTT body.

2. Install PTT pump case, then tighten three bolts to specified torque.

PTT pump case bolt :
① 8 N·m (0.8 kg-m, 5.8 lb.-ft.)
② 5.5 N·m (0.55 kg-m, 4.0 lb.-ft.)



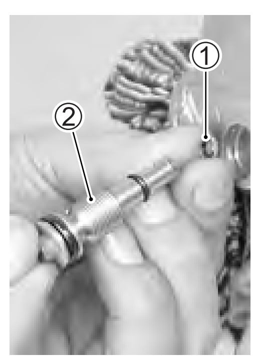


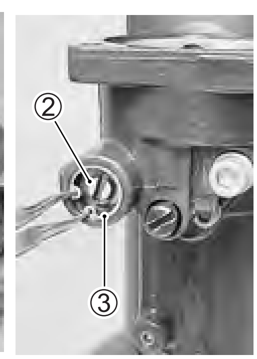
MANUAL RELEASE VALVE

1. Oil and install seal washer ① and manual release valve ②.
2. Tighten valve to specified torque.

Manual release valve : 3.6 N · m (0.36 kg-m, 2.6 lb.-ft.)

3. Install snap ring ③.





PTT MOTOR

See PTT MOTOR INSTALLATION section on page 8-14.

AIR BLEEDING

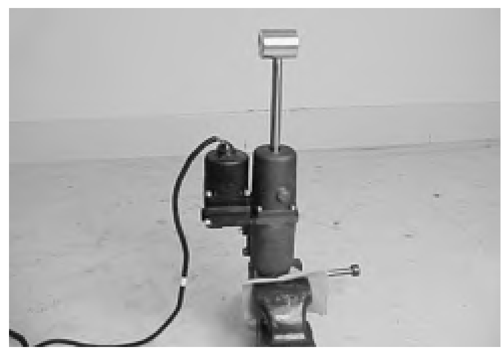
- Pour recommended PTT fluid in to reservoir until specified level.
- Perform air bleeding procedure.
  See AIR BLEEDING section on page 8-3.

PTT MOTOR

PTT MOTOR REMOVAL

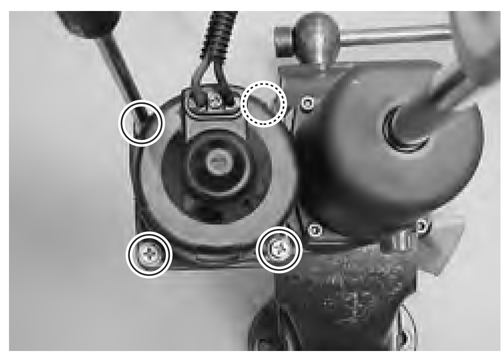
NOTE:
Before removing PTT motor, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry PTT body with compressed air.

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

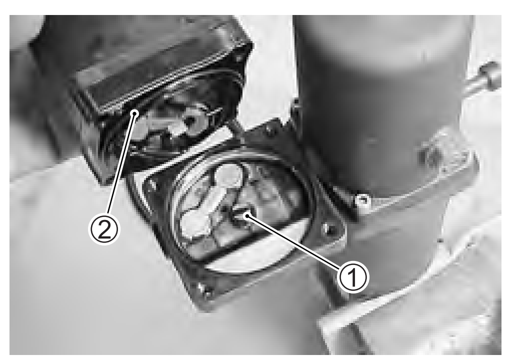


NOTE:
To prevent damage to PTT cylinder use wood blocks, vise jaw protectors, etc., between vise jaws and PTT components before tightening vise.

2. Remove four bolts securing PTT motor to PTT pump case.

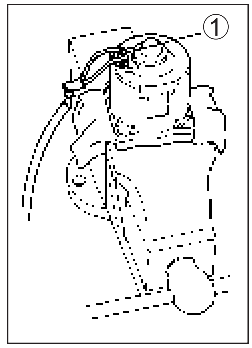


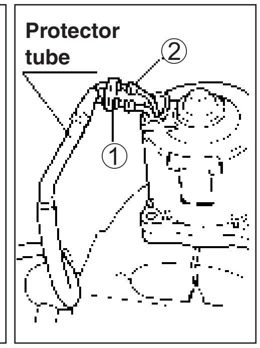
3. Detach PTT motor from PTT pump case.
   Note position of drive joint ① and O-ring ② and remove them.



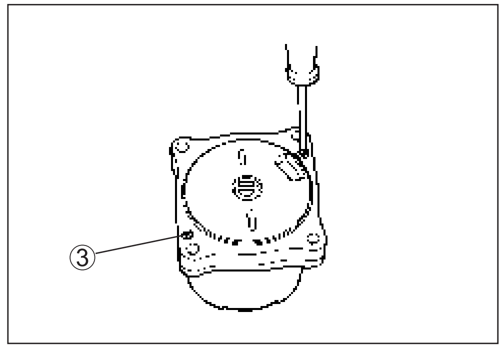
PTT MOTOR DISASSEMBLY

1. For correct assembly, scribe an alignment mark on field case and brush holder.
2. Remove tape from PTT motor cables and cable protector tube, then slide cable protector tube upward.
3. Remove screw securing motor cable holder ①, then slide motor cable holder and grommets ② out as shown in figure.



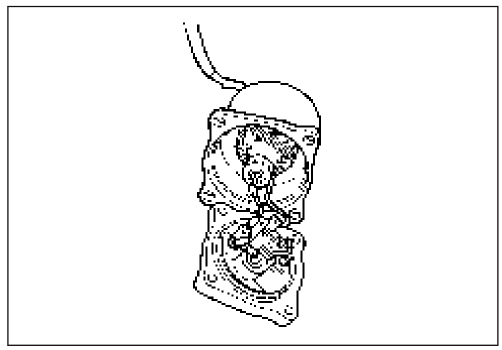


4. Remove two screws ③ securing field case to brush holder.

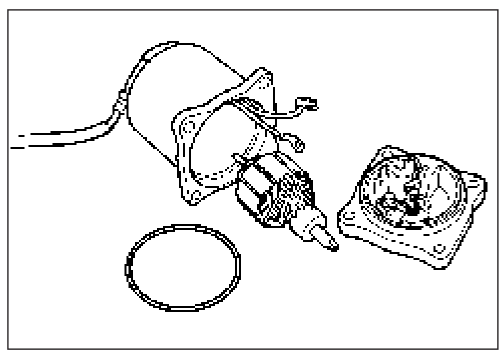


5. Slide field case upward and away from brush holder.

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



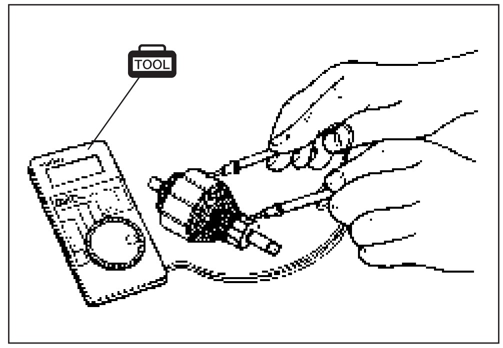
6. Disconnect PTT motor cables from brush holder.
7. Remove armature from field case.
   Note position of O-ring encircling brush holder.



PTT MOTOR INSPECTION

Armature and Commutator

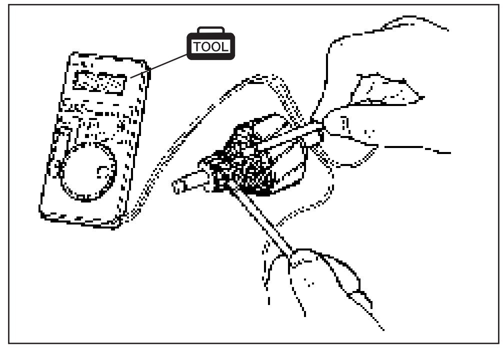
1. Inspect continuity between commutator and armature core / shaft.
   If continuity exists, replace armature.



09930-99320 : Digital tester

Tester range : (Continuity)

2. Inspect continuity between adjacent commutator segments.
   If no continuity exists, replace armature.



3. Inspect commutator surface for gum or dirt.
   Clean with #500 grit emery paper if necessary.

Measure commutator outside diameter.

09900-20101 : Vernier calipers

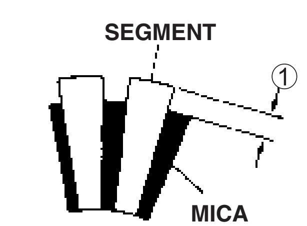
Commutator outside diameter :
Standard : 22.0 mm (0.87 in.)
Service limit : 21.0 mm (0.83 in.)

If measurement exceeds service limit, replace armature.

4. Measure commutator undercut (depth) between mica (insulator) and segments.

Commutator undercut ① (depth) :
Standard : 1.6 – 1.9 mm (0.06 – 0.07 in.)
Service limit : 1.3 mm (0.05 in.)

If measurement exceeds service limit, cut mica to specified depth.



① **Commutator undercut**

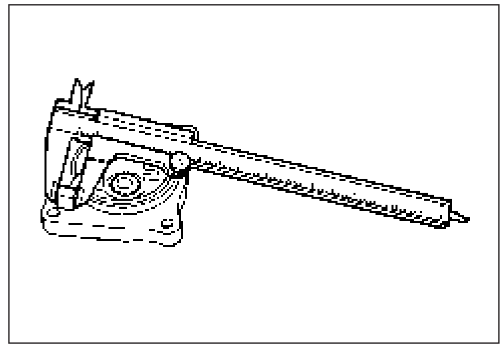
NOTE:
Remove all particles of mica and metal using compressed air.

⚠ WARNING

Wear safety grasses when using compressed air.

Brushes

Measure length of each brush.



TOOL **09900-20101 : Vernier calipers**

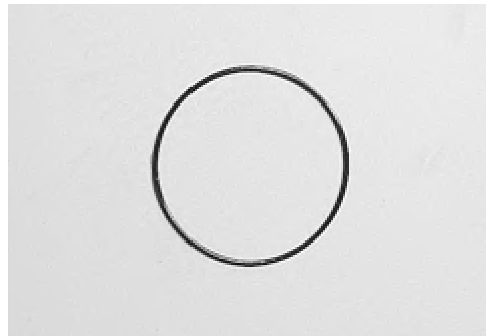
Brush length :

Standard	**: 9.8 mm (0.39 in.)**
Service limit	**: 5.5 mm (0.22 in.)**

If measurement exceeds service limit, replaced brush.

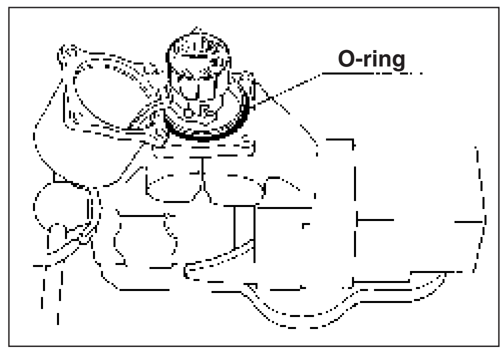
O-ring

Inspect O-ring between PTT motor and PTT pump case for cuts, nicks or tears.



PTT MOTOR ASSEMBLY

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

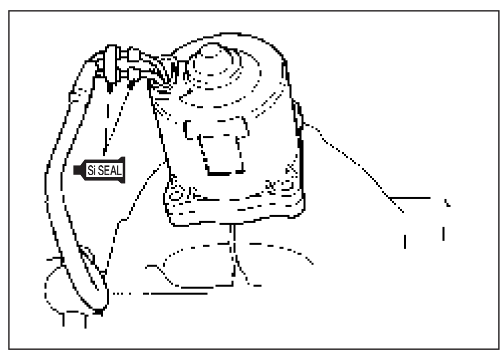


1. Install armature to brush holder first.

CAUTION

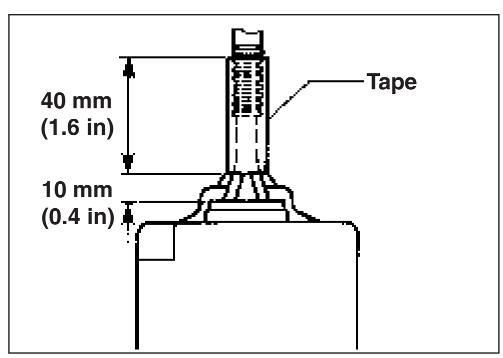
When installing armature, exercise care to avoid breaking brushes.

2. Match up previously scribed alignment marks.



3. When assembling field case to brush holder, proceed by pulling PTT motor cables out of field case.
4. Apply Silicone Seal to PTT motor cable holder and grommets, then install cable holder screw.

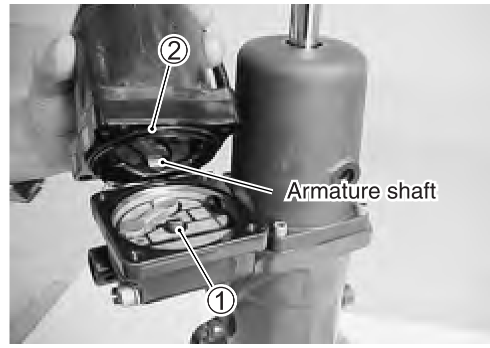
Si SEAL **99000-31120 : Suzuki Silicone Seal**



5. Fix cable protector tube to PTT motor cables with heat-resisting tape.

PTT MOTOR INSTALLATION

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



1. Ensure that drive joint ① is aligned and firmly inserted into gear pump assembly.

2. Fit O-ring ② to PTT motor.

3. Check level of PTT fluid contained in PTT pump case. If level is low, add recommended PTT fluid until level with mating surface of PTT motor.

4. Ensure that faces of PTT motor and pump unit are free of dirt or debris.
   When attaching PTT motor to PTT pump case, ensure that tip of armature shaft fits firmly into drive joint ①.

5. Tighten four bolts to specified torque.

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

6. Pour recommended PTT fluid into reservoir until specified level.

7. Perform air bleeding procedure.
   See AIR BLEEDING section on page 8-3.

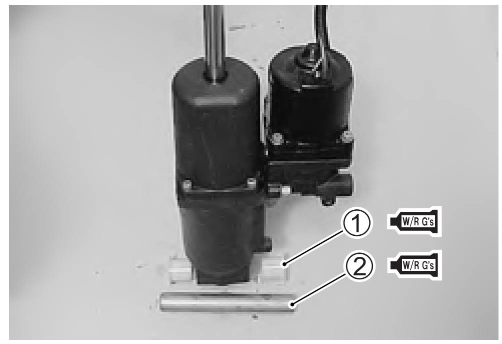
INSTALLATION

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

1. Lower tilt rod to full down position.

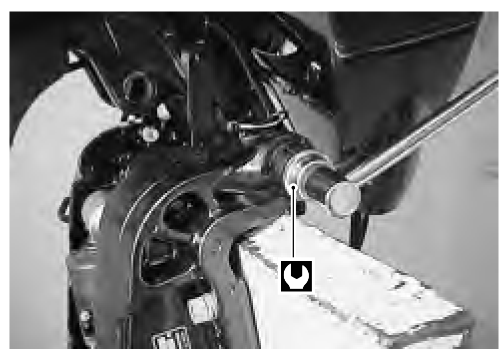
2. Apply Water Resistant Grease to tilt cylinder lower shaft and lower shaft bushes.
3. Install bushings ① and cylinder lower shaft ② to PTT unit.

W/R G's **99000-25161 : Water Resistant Grease**



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

Clamp bracket shaft nut :
43 N · m (4.3 kg-m, 31.0 lb.-ft.)

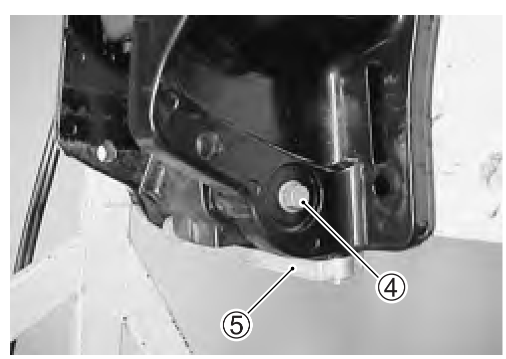


6. Tighten lower shaft bolts ④, pre-coated with thread lock, to specified torque.

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

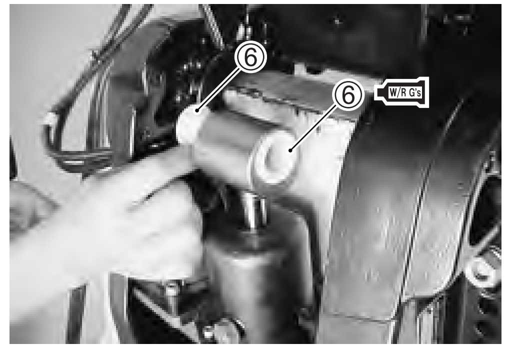
Cylinder lower shaft bolt : 50 N · m (5.0 kg-m, 36.0 lb.-ft)

7. Install anode ⑤, then tighten bolts securely.



8. Apply Water Resistant Grease to tilt rod upper bushings ⑥, then install bushings in tilt rod.
9. Operate PTT motor to extend PTT rod upward.
   Align tilt rod with hole in swivel bracket as tilt rod extends.

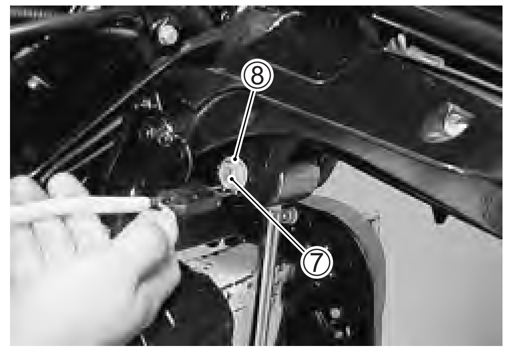
W/R G's **99000-25161 : Water Resistant Grease**



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

W/R G's **99000-25161 : Water Resistant Grease**

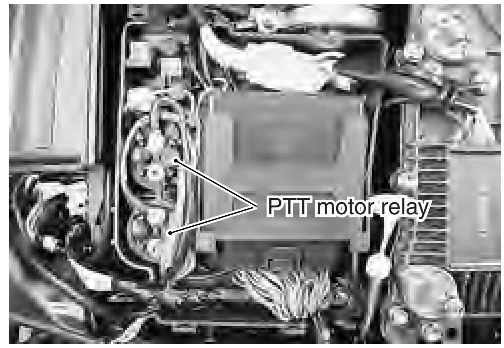
11. Secure upper shaft with snap ring ⑧.



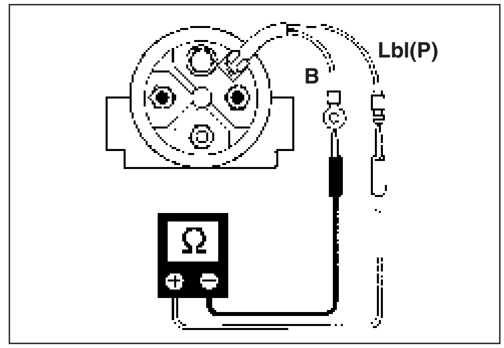
12. Route PTT motor cable in through lower cover and connect terminals to PTT motor relays.
    (Cable routing – See WIRE / HOSE ROUTING section on page 10-2 to 10-5)

PTT MOTOR RELAY

Two methods can be used to test PTT motor relays.



Method 1.
Measure resistance between two lead wires of relay.



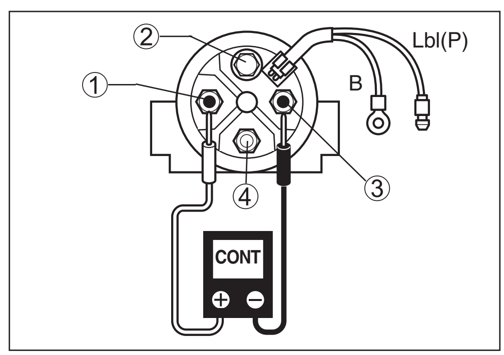
09930-99320 : Digital tester

Tester range : Ω (Resistance)

	Tester probe connection	
	Red ⊕	**Black ⊖**
UP relay	Light Blue	Black
DOWN relay	Pink	Black

PTT motor relay solenoid coil resistance : 3.0 – 4.5 Ω

Method 2.
1. Inspect relay operation using battery (12V) as follows:

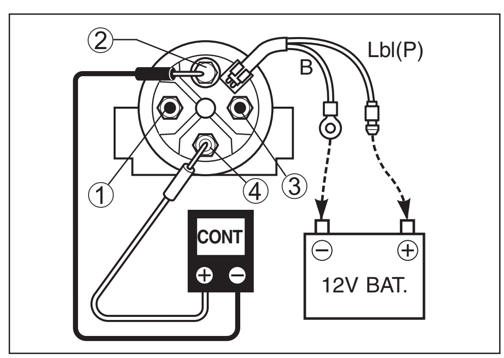


09930-99320 : Digital tester

Tester range : (Continuity)

(1) Without lead wires connected to battery, there should be continuity between terminals ①, ② and ③ but should be no continuity between terminals ③ and ④.

(2) With Black lead wire connected to battery negative ⊖ ter minal and Light blue (or Pink) lead wire connected to battery positive ⊕ terminal, there should be continuity between terminals ②, ③ and ④.



2. The relay is considered to be without defect if continuity test results are as stated above.

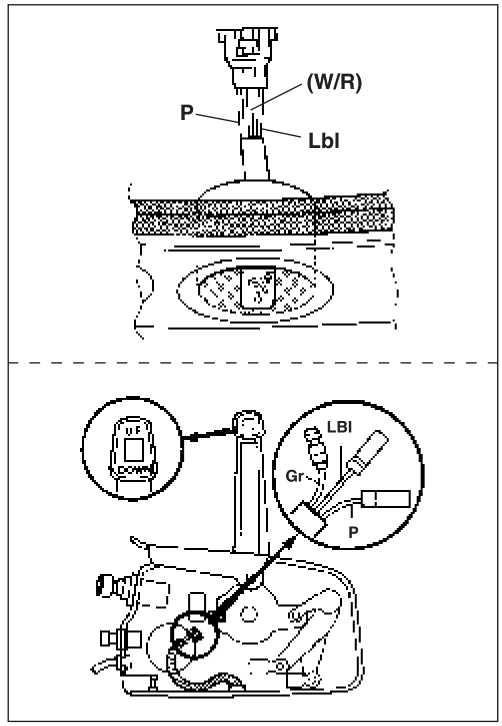
PTT SWITCH

Test continuity between switch lead wires at each of three switch positions.

09930-99320 : Digital tester

Tester range : (Continuity)

	Tester probe connection		Continuity
	Red ⊕	Black ⊖	
"DN" side depressed	Pink	Gray (White / Red)	**Yes**
"UP" side depressed	Light Blue	Gray (White / Red)	**Yes**
not depressed	Pink	Gray (White / Red)	**No**
	Light Blue		

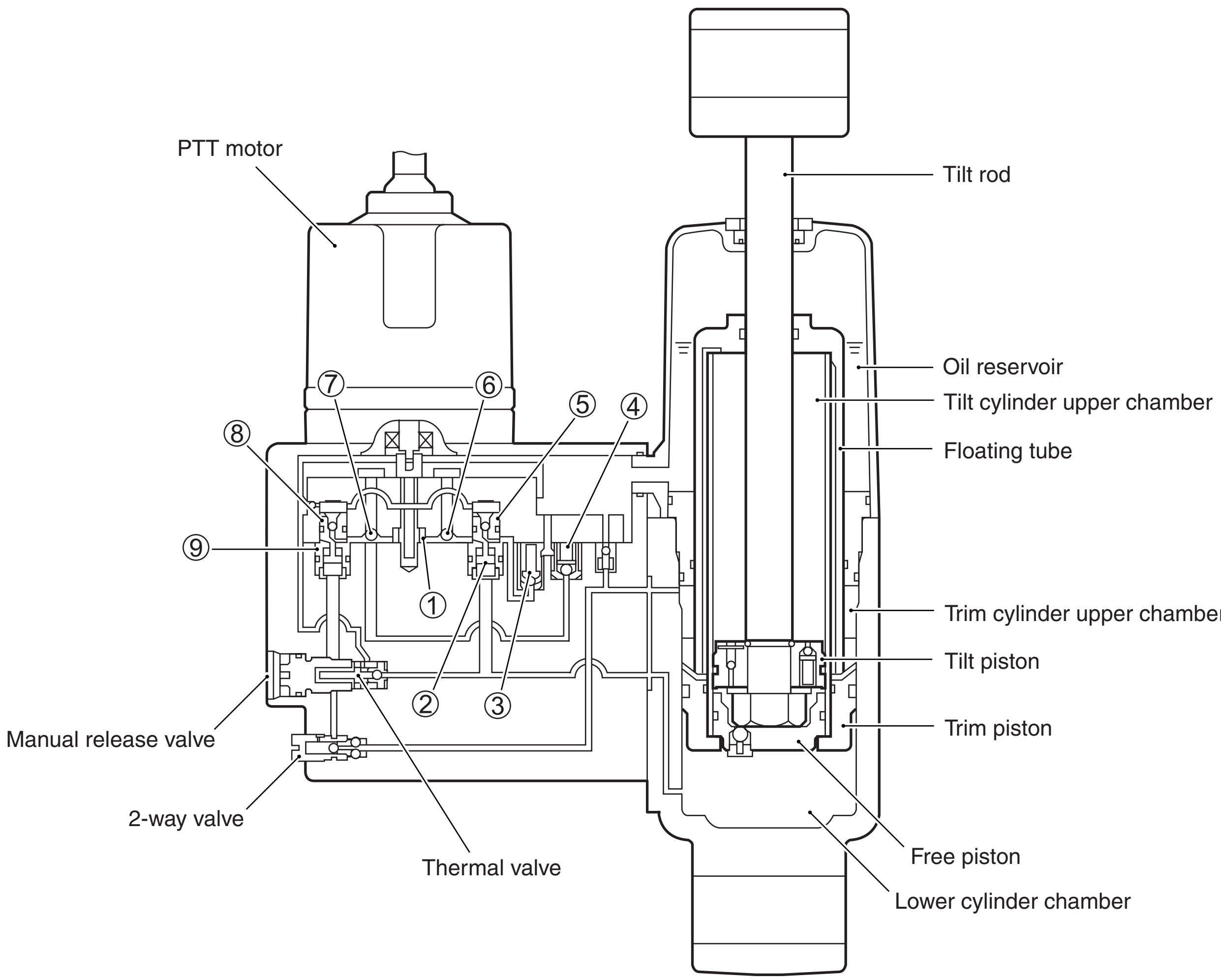


OPERATION

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



① Gear pump
② “UP” pressure main check valve
③ “UP” relief valve
④ “DOWN” relief valve
⑤ Spool valve Ⓑ
⑥ Check valve Ⓑ
⑦ Check valve Ⓐ
⑧ Spool valve Ⓐ
⑨ “DOWN” pressure main check valve

PRINCIPLES OF OPERATION

TRIM / TILT “UP”CIRCUIT

When the PTT switch is operated “UP” position, the electric motor and gear pump ④ will operation on clock-wise direction.

Pressurized oil will open check valve Ⓐ, oil will flow from reservoir to spool valve Ⓐ via pump and spool valve Ⓑ.

The spool valve Ⓐ will down, then “DOWN” pressure main check valve ① will open.

Oil in the upper chamber will return to pump via 2-way valve, and then oil pressure will rise and open “UP” pressure main check valve ②, then oil will flow to lower cylinder chamber of cylinder.

It makes the piston rod push up and the engine tilt up.

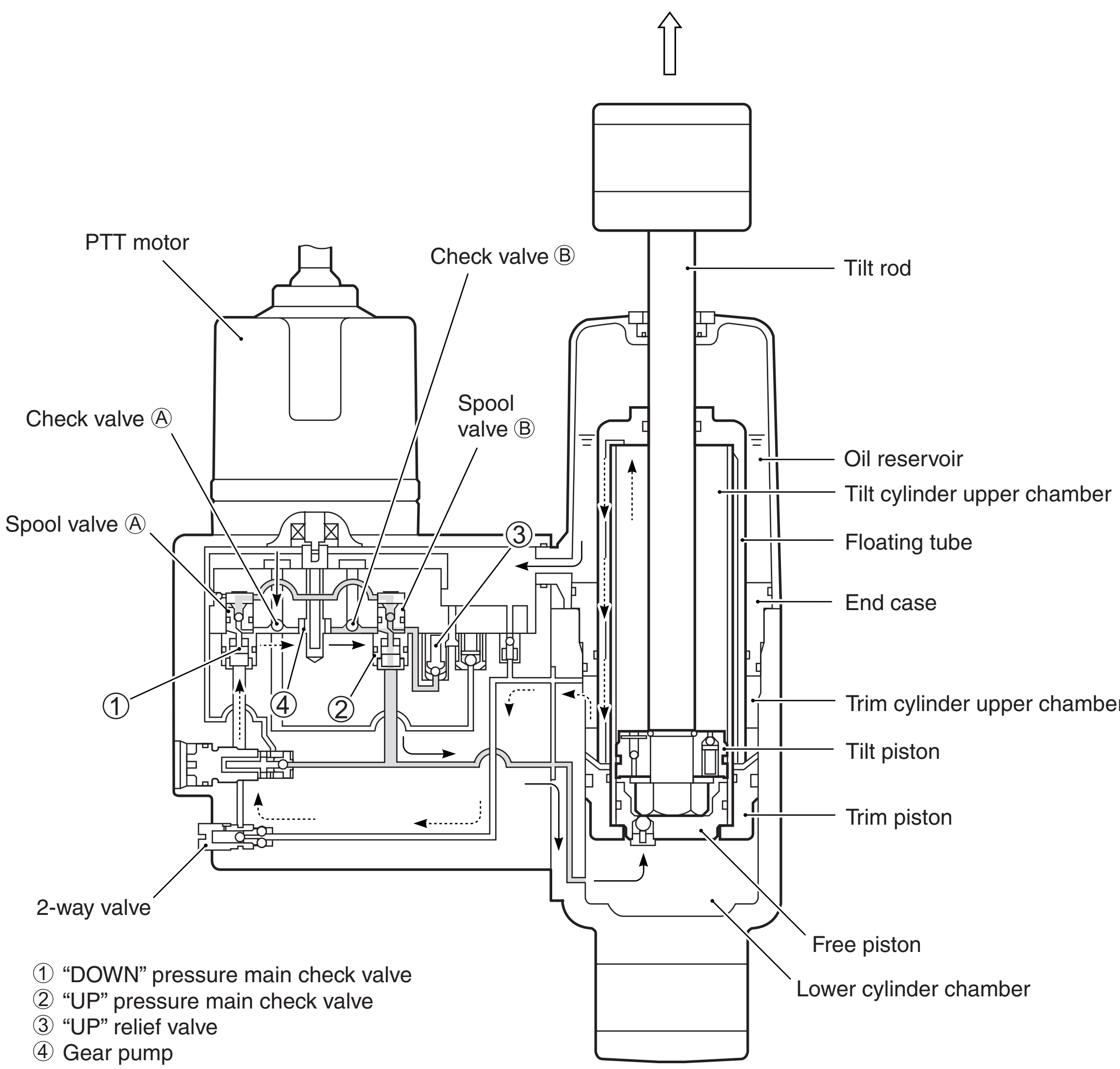
To keep oil level, oil flows from reservoir to pump through the check valve Ⓐ.

Oil through the “DOWN” pressure main check valve ① and returns to pump.

When trim motor stops, both the “DOWN” pressure main check valve ① and the “UP” pressure main check valve ② will close to retain tilt / trim position.

In the trim area, trim piston and floating tube are moving with piston rod.

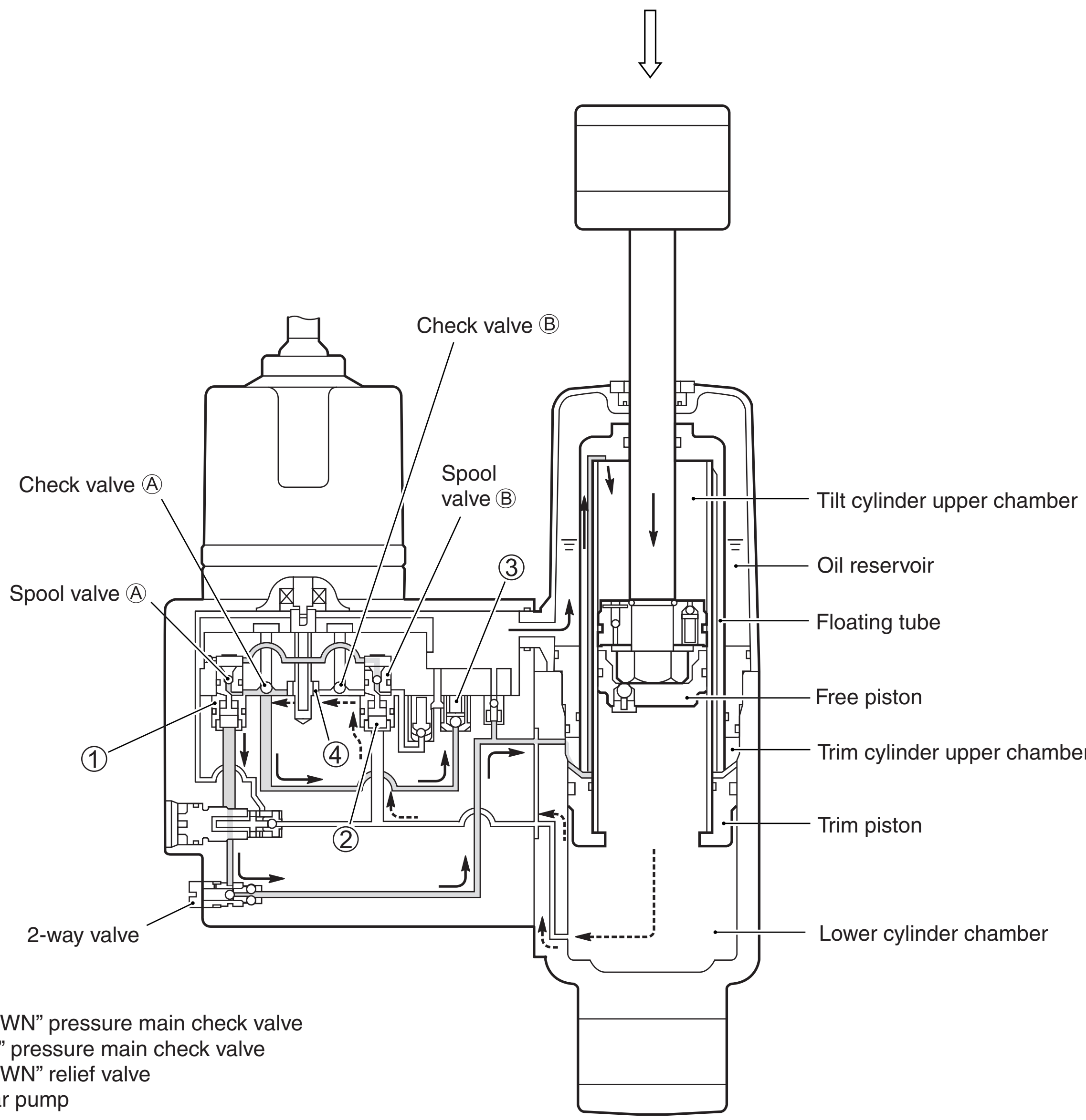
When full trim / tilt “UP” position is attained, sustained operation of the “UP” relay will have no effect, as pump oil flow will be returned to the reservoir through the “UP” relief valve ③.



① “DOWN” pressure main check valve
② “UP” pressure main check valve
③ “UP” relief valve
④ Gear pump

TRIM / TILT "DOWN" CIRCUIT

When the PTT switch is operated "DOWN" position, the electric motor and gear pump will operation on counterclockwise direction.
Check valve Ⓑ will open ; oil will flow from reservoir to spool valve Ⓐ.
It makes spool valve Ⓑ move to downward, then "UP" pressure main check valve ② open.
Oil in the lower chamber will return to pump, and then oil pressure will rise and open "DOWN" pressure main check valve ①, then oil will flow to upper cylinder chamber of cylinder.
It makes the piston rod push down and the engine will tilt down.
To keep oil level, oil flows from reservoir to pump through the check valve Ⓑ.
Surplus oil in the pump throughs the "DOWN" relief valve ③ and returns to reservoir.
When trim motor stops, both the "DOWN" pressure main check valve ① and the "UP" pressure main check valve ② will close to retain tilt / trim position.
In the trim area, trim piston and floating tube are moving with piston rod.
When full trim / tilt "DOWN" position is attained, sustained operation of the "DOWN" relay will have no effect, as pump oil flow will be returned to the reservoir through the "DOWN" relief valve ③.



① "DOWN" pressure main check valve
② "UP" pressure main check valve
③ "DOWN" relief valve
④ Gear pump

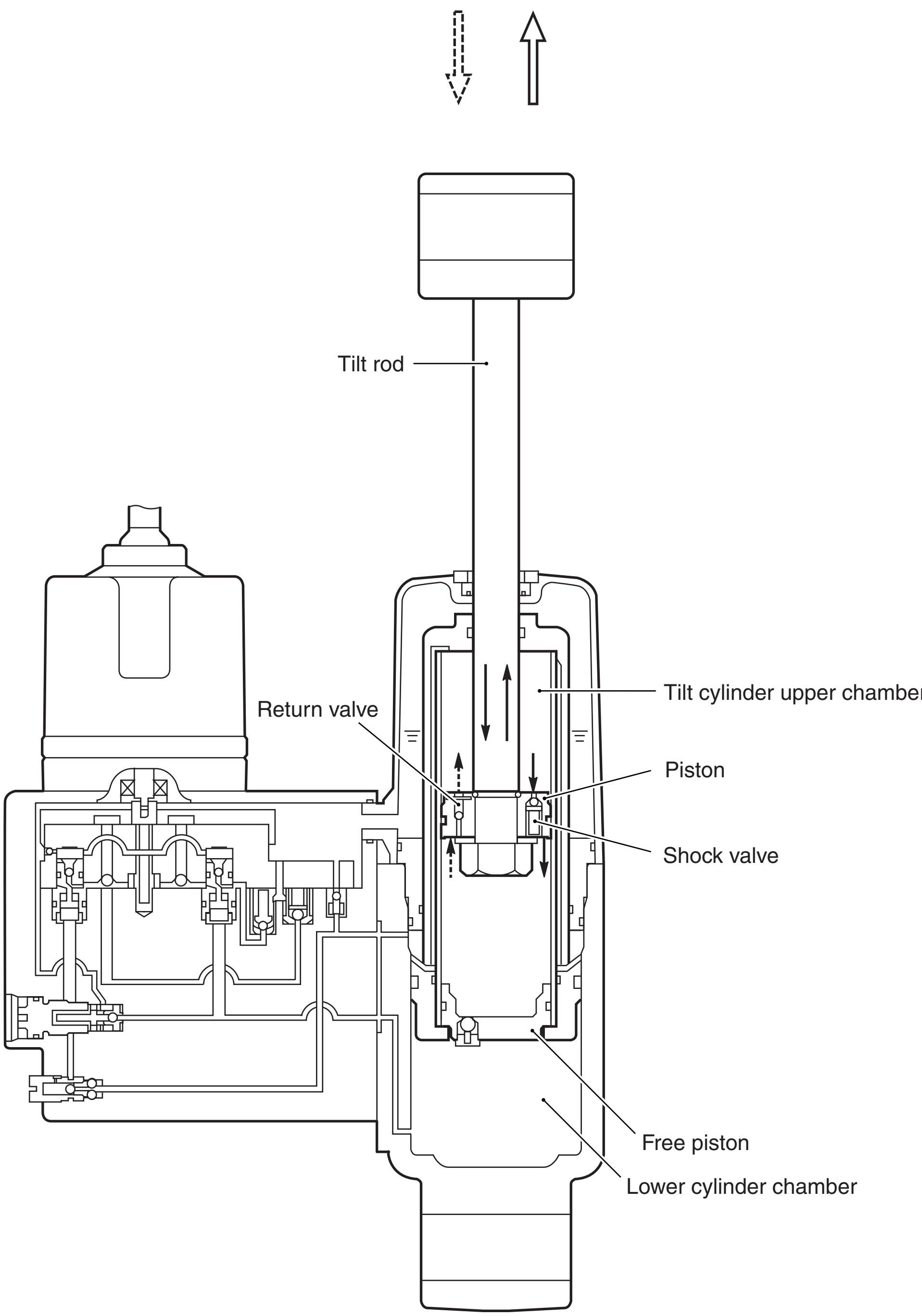
SHOCK ABSORBER CIRCUIT

(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

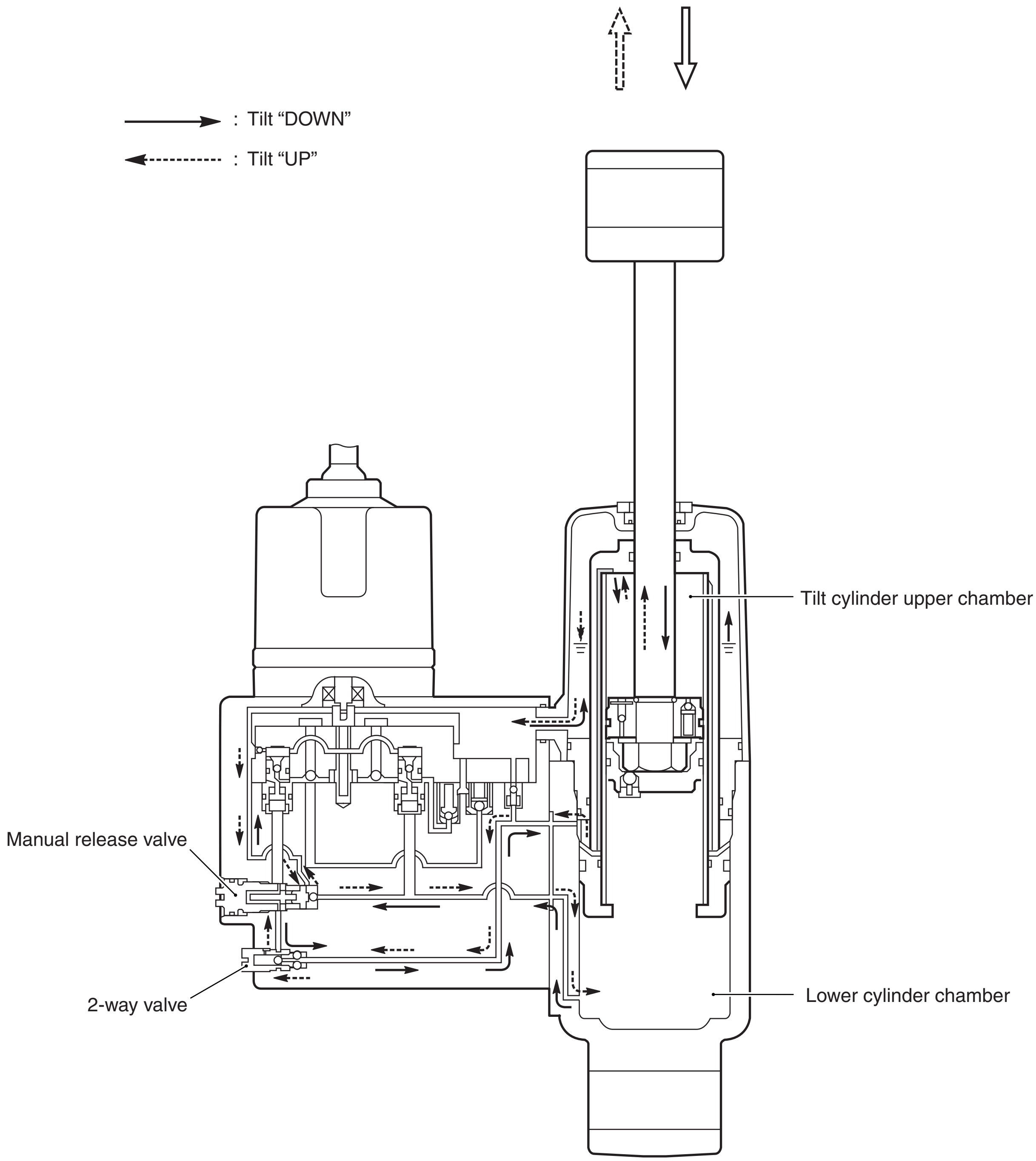
When the point of impact has passed, propeller thrust and motor weight will force the tilt ram piston back downwards. The oil from between the ram piston and the free piston is then expelled through the return valve before flowing into the upper cylinder chamber.



MANUAL RELEASE CIRCUIT (MANUAL VALVE)

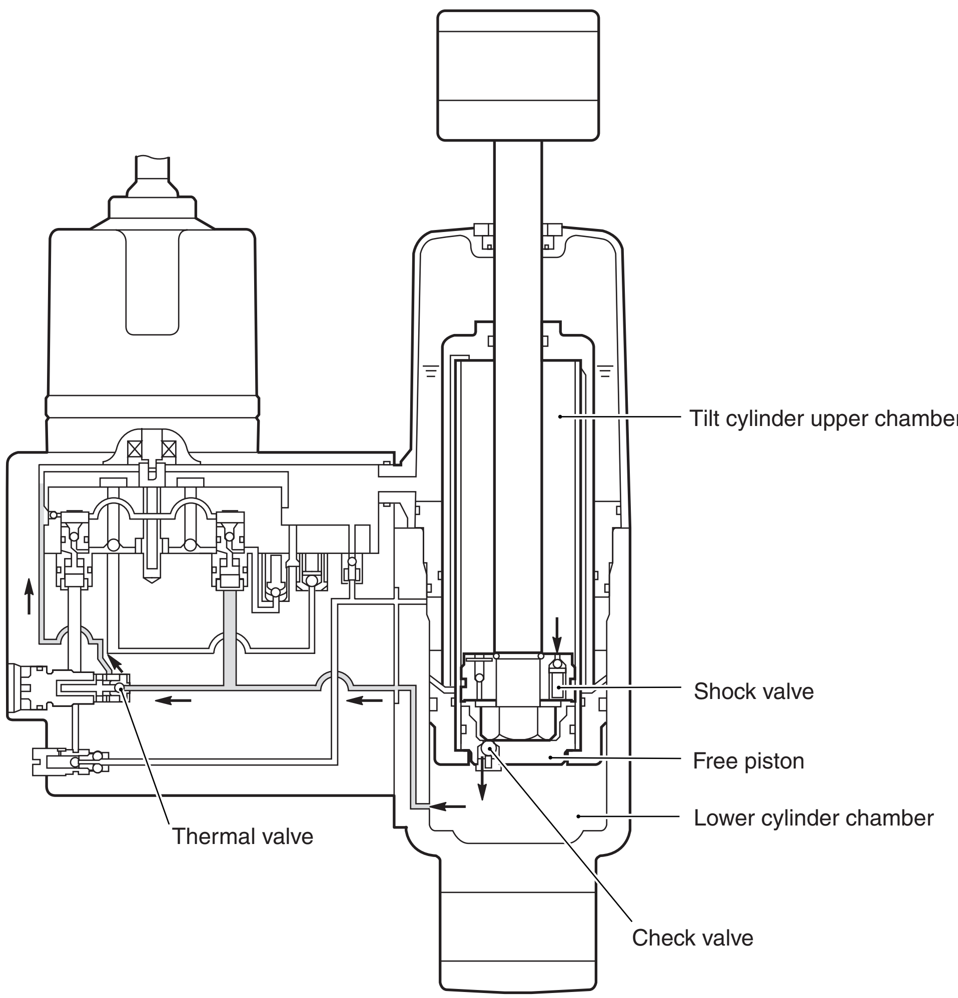
Operation : Turn manual valve maximum three (3) full turns counterclockwise.

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

As temperature goes up, oil pressure will increase and the oil in PTT unit will expand.
High oil pressure in the upper cylinder chamber caused by rising of outside temperature will release thermal valve and make the oil flow to reservoir to prevent from damaging of PTT unit.



LOWER UNIT

CONTENTS

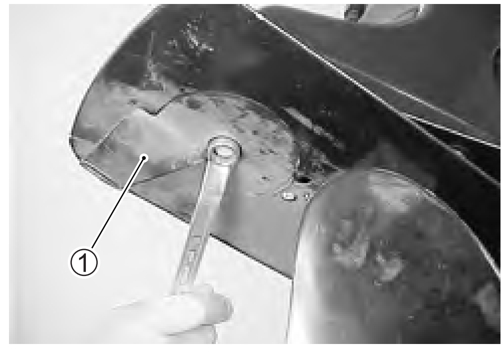
9

REMOVAL & DISASSEMBLY

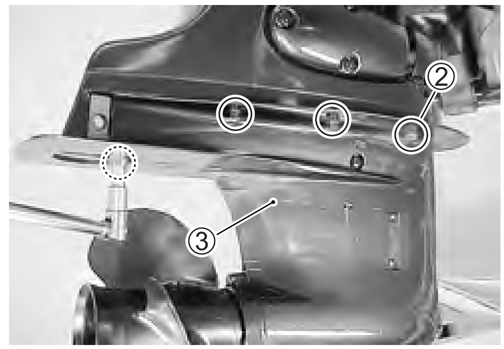
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

1. Shift to "NEUTRAL" position.
2. Remove bolt and trim tab ①.



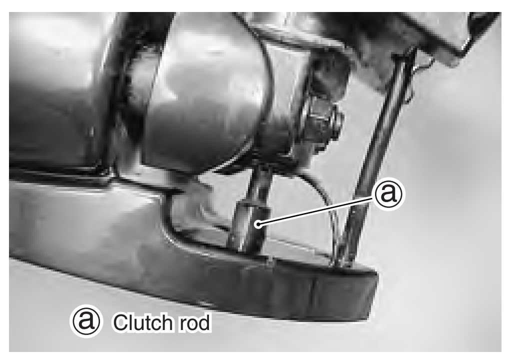
3. Remove seven (7) bolts ② and separate gearcase ③ from driveshaft housing.



NOTE:

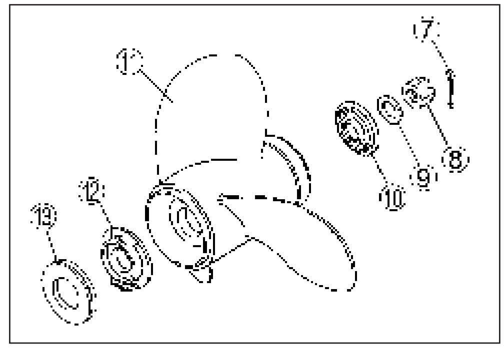
Before gearcase is removed completely, disconnect speedometer pick up tube ④ from gearcase.

4. Remove clutch rod from clutch shaft (if necessary).



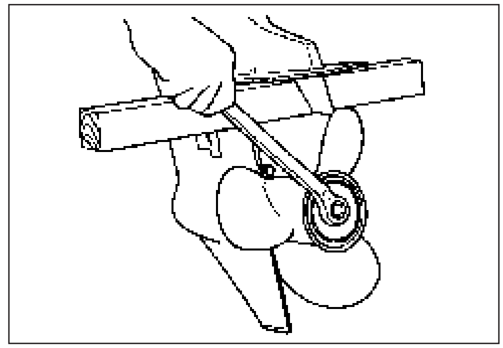
5. Place a drain pan under oil drain plug.
   Remove oil drain plug ⑥ first then oil level plug ⑤ and allow gear oil to drain.
   Inspect oil for water, contaminates or metal.

6. Remove cotter pin ⑦ from propeller nut and remove pro peller nut ⑧.
7. Remove washer ⑨, spacer ⑩, propeller ⑪, stopper ⑫ and spacer ⑬ from propeller shaft.

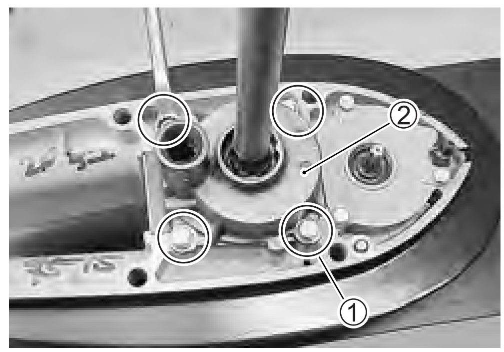


⚠ WARNING

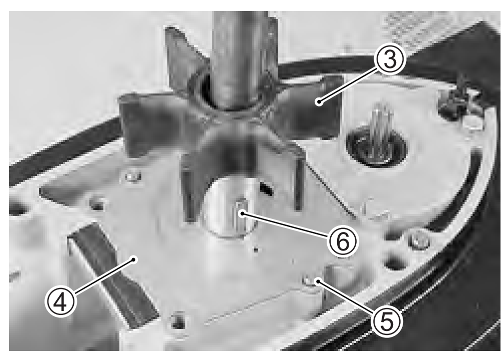
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place.



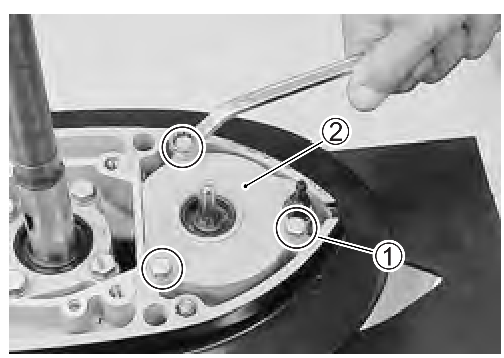
8. Loosen four bolts ①, then remove water pump case ②, impeller ③, impeller key ⑥, pump under plate ④ and dowel pins ⑤.



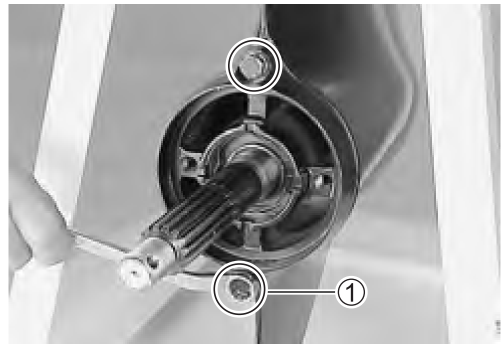
9. Keep impeller key ⑥ for reuse and discard plate gasket.



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

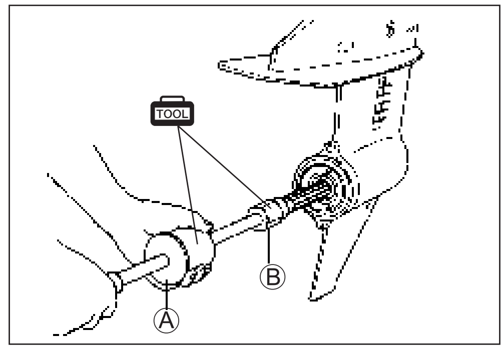


11. Remove two bolts ① securing propeller shaft bearing housing to gearcase.



12. Using special tools, draw out propeller shaft bearing housing.
    Remove propeller shaft and bearing housing assembly.

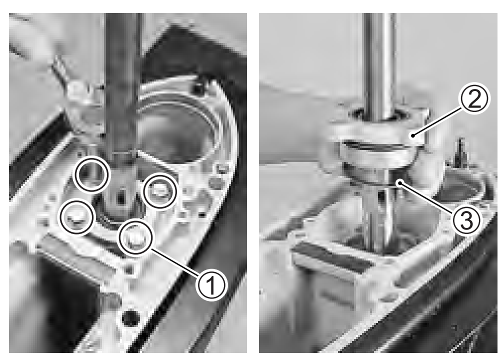
TOOL **09930-30104 : Sliding hammer Ⓐ**
09930-30161 : Propeller shaft remover Ⓑ



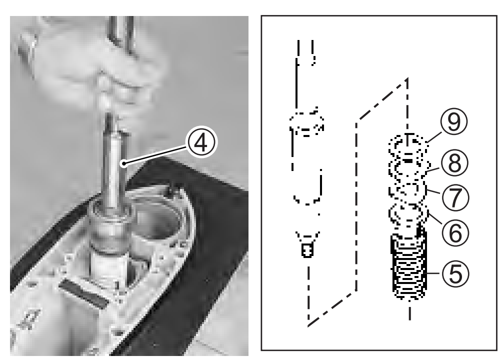
13. Hold pinion nut securely, then fit special tool to the driveshaft and loosen pinion nut.

TOOL **09921-29410 : Driveshaft holder**

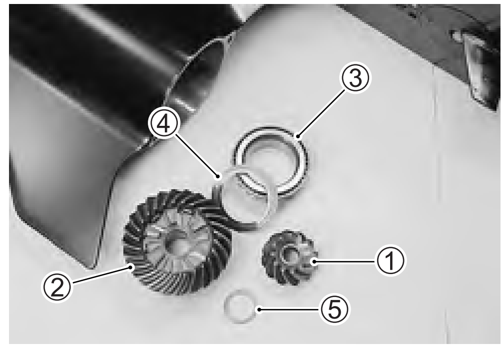
14. Remove four bolts ① securing driveshaft oil seal housing ②, then remove oil seal housing and pinion shim ③.



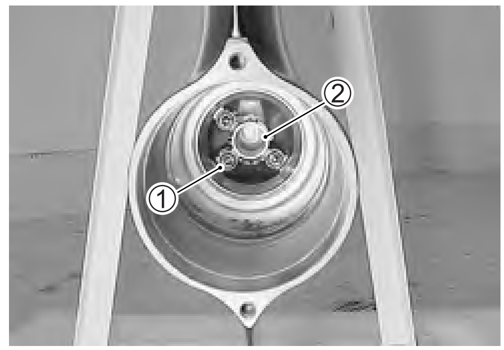
15. Lift out driveshaft assembly ④.
    Remove driveshaft collar ⑤, washer ⑥, wave washer ⑦, washer (with tab) ⑧ and washer ⑨ from driveshaft.



16. Remove pinion gear ①.
    Remove forward gear ② (with thrust washer ⑤, back-up shim ④ and bearing ③).

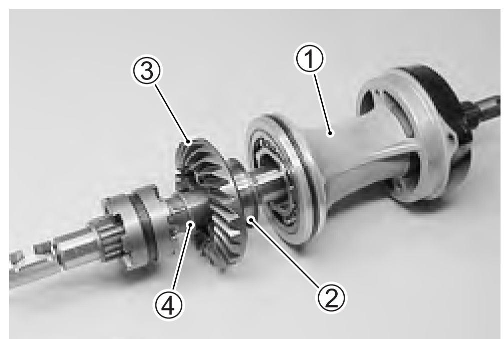


17. Remove three bolts ① securing shift cam housing, then remove shift cam housing ②.
    Account for dowel pins.

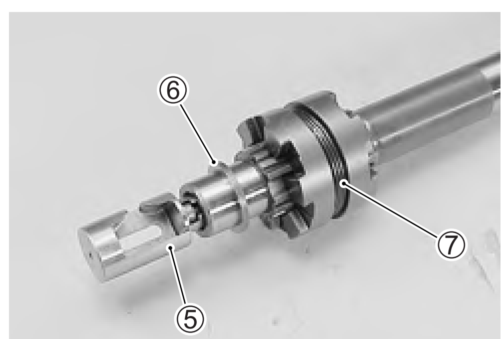


Disassembly of propeller shaft components

1. Slide propeller shaft away from reverse gear ③ and bearing housing assembly ①.
   Account for reverse gear back-up shim ② and reverse gear thrust washer ④.

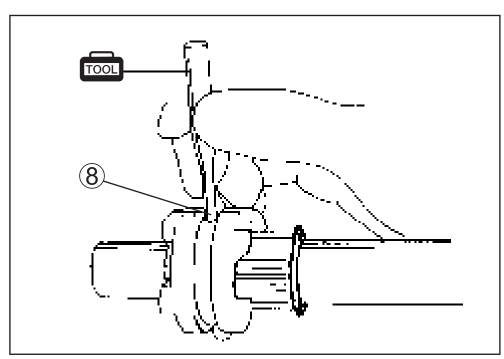


2. Remove horizontal slider ⑤ and forward gear thrust washer ⑥.
3. Remove spring ⑦ from clutch dog shifter.

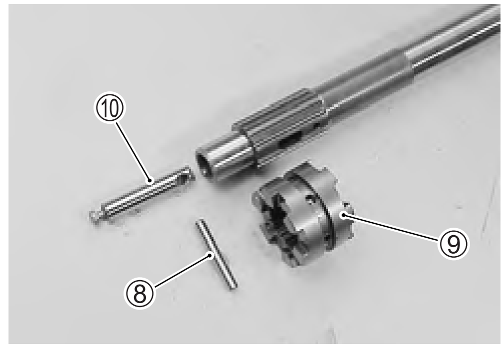


4. Using special tool, push dog pin ⑧ out of clutch dog shifter.

TOOL **09922-89810 : Shift pin remover**



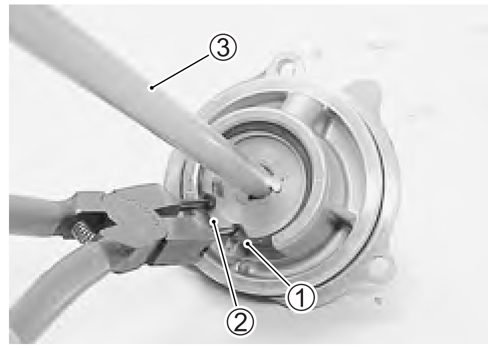
5. Remove clutch dog shifter ⑨ and connector pin ⑩ from propeller shaft.



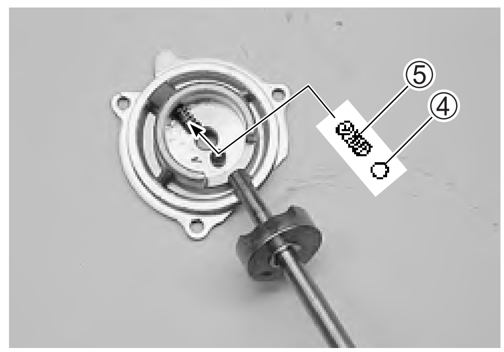
Disassembly of shift rod components

1. Remove circlip ① and washer ②.

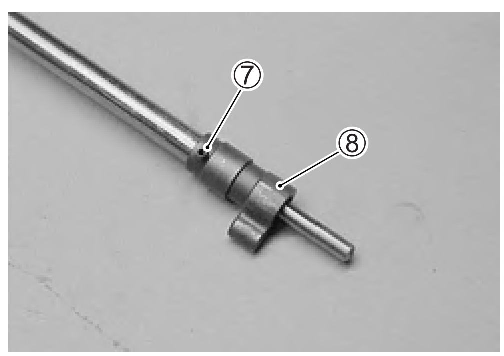
2. Slide shift rod ③ out of shift rod guide housing.



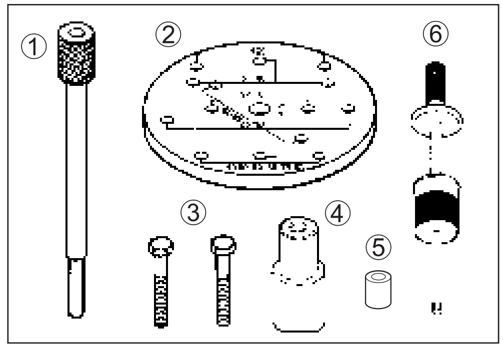
3. Remove detent ball ④ and spring ⑤.



4. Remove pin ⑦ and shifter yoke ⑧.



PINION BEARING



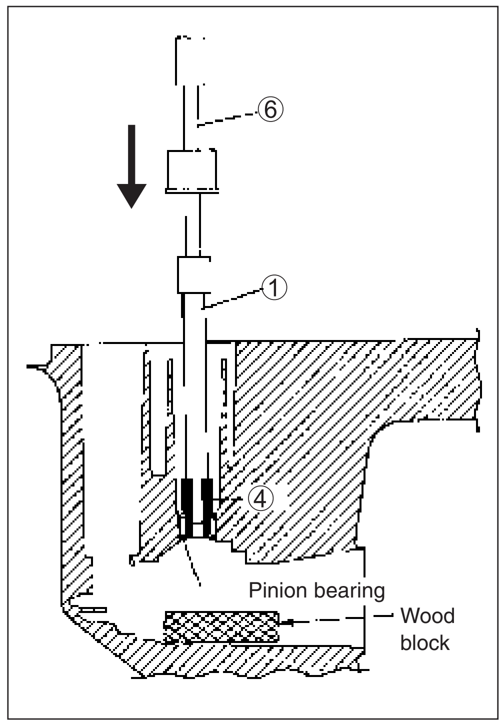
Removal / installation is in following procedure.

Removal & Installation Tools

TOOL **09951-59910 : Shaft (removal & installation) ①**
09551-39914 : plate ②
01500-08403 : Bolt ③
09951-19421 : Attachment ④
09917-98221 : Spacer ⑤
09930-30104 : Sliding hammer ⑥

REMOVAL

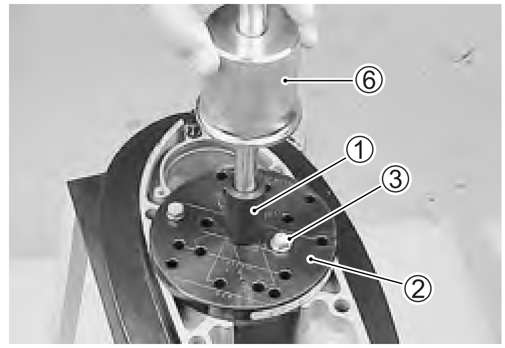
1. Place attachment ④ inside pinion bearing.
2. Insert shaft ① into attachment ④.
3. Thread sliding hammer ⑥ into top of shaft ①.
4. Put wood block under pinion bearing.
5. Drive pinion bearing out downwards by striking top of shaft ① with sliding hammer ⑥.



CAUTION

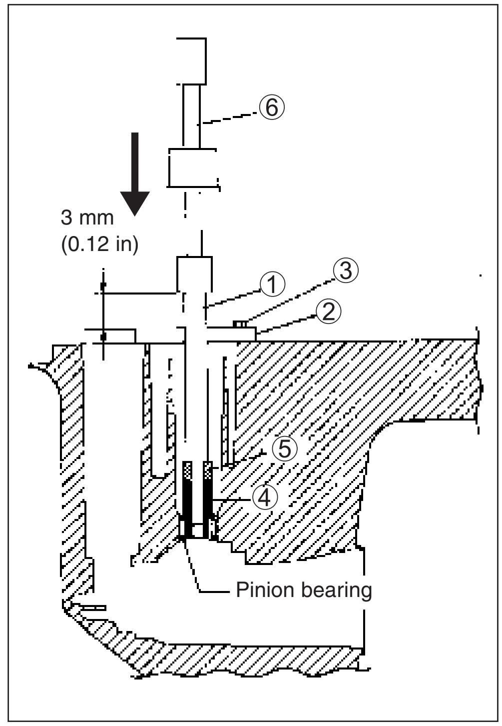
- **When removing pinion bearing, use care to avoid damaging gearcase.**
- **Do not re-use pinion bearing once removed. Always use a new pinion bearing.**

INSTALLATION



CAUTION

- **Before installing bearing, ensure that inside of gearcase is clean and free of debris.**
- **Ensure that the bearing stamped mark faces upward.**



1. Set shaft ①, plate ②, spacer ⑤, attachment ④ and pinion bearing as shown in figure.
2. Place shaft ① (with pinion bearing on end of shaft) into gearcase.
3. Secure plate ② by tightening bolts ③.
4. Thread sliding hammer ⑥ into top of shaft ①.
5. Drive pinion bearing down into position by gently striking shaft ① until dimension between undersurface of shaft ① shoulder and top surface of plate ② become 3 mm.

INSPECTION

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

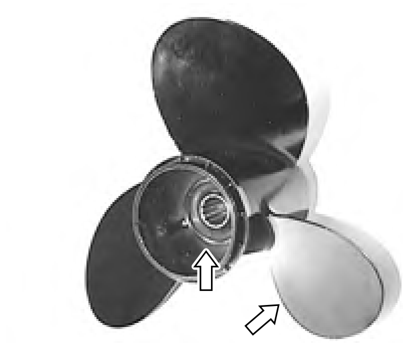
NOTE:
Thoroughly wash all metal components with cleaning solvent and dry with compressed air.

⚠ WARNING

Wear safety grasses when using compressed air.

PROPELLER

- Inspect propeller for bent, chipped or broken blades. Replace or repair if necessary.
- Inspect propeller bushing splines for wear or other damage. Replace if necessary.
- Inspect propeller bushing for deterioration or slipping. Replace if necessary.



GEARCASE

- Inspect gearcase for cracks or other damage. Replace if necessary.
- Inspect pinion bearing for pitting, rough or other damage. Replace if necessary.

NOTE:
If removal and replacement are required, see “PINION BEARING” section on page 9-7.

GEARS

- Inspect forward, reverse and pinion gear teeth and engaging dogs for excessive wear or other damage.
  Replace if necessary.

- Inspect forward gear bearing for pitting, rough or other damage. Replace if necessary.

PROPELLER SHAFT COMPONENTS

- Inspect horizontal slider and connector pin for excessive wear or other damage. Replace if necessary.

- Inspect clutch dog shifter for excessive wear, chip or other damage. Replace if necessary.

- Inspect dog pin for bent or other damage. Replace if necessary.

- Inspect propeller shaft / splines for wear, twist or other damage. Replace if necessary.

PROPELLER SHAFT BEARING HOUSING

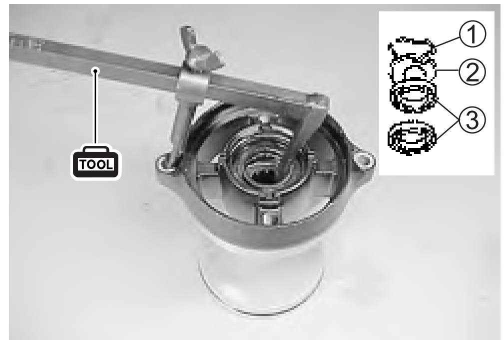
- Inspect housing for cracks or other damage. Replace if necessary.

- Inspect propeller shaft bearings and reverse gear bearing for pitting, rough or other damage. Replace if necessary.

- Inspect oil seals and O-ring for cuts, nicks or tears.

Replacing propeller shaft oil seal

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

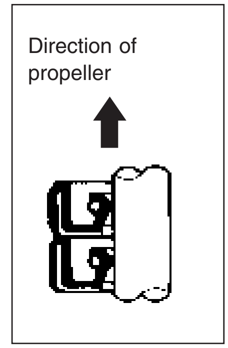


TOOL **09913-50121 : Oil seal remover**

CAUTION

Do not re-use oil seal once removed.
Always use a new oil seal.

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



W/R G's **99000-25161 : Water Resistant Grease**

5. Install washer and retaining ring.

SHIFT ROD GUIDE HOUSING COMPONENTS

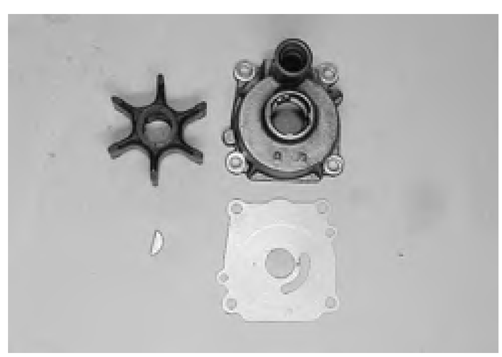
- Inspect shift rod guide housing for cracks or other damage. Replace if necessary.

- Inspect shifter yoke for excessive wear or other damage. Replace if necessary.
- Inspect oil seal and O-ring for wear, cuts, nicks or tears.
- Inspect shift rod / splines for excessive wear, twist or other damage. Replace if necessary.

- Inspect detent ball for wear, rough or other damage. Replace if necessary.

WATER PUMP AND RELATED ITEMS

- Inspect impeller vanes for cuts, cracks, tears or excessive wear. Replace if necessary.



- Inspect pump case and under panel for cracks, distortion or corrosion. Replace if necessary.

DRIVESHAFT OIL SEAL HOUSING

- Inspect housing for cracks or other damage. Replace if necessary.
- Inspect oil seals and O-ring for wear, cuts, nicks or tears.

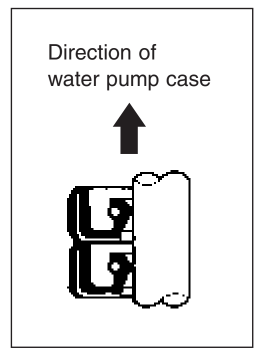
Replacing driveshaft oil seal

1. Extract oil seals using oil seal remover.

09913-50121 : Oil seal remover

2. Apply Water Resistant Grease to inner circumference of housing.

99000-25161 : Water Resistant Grease



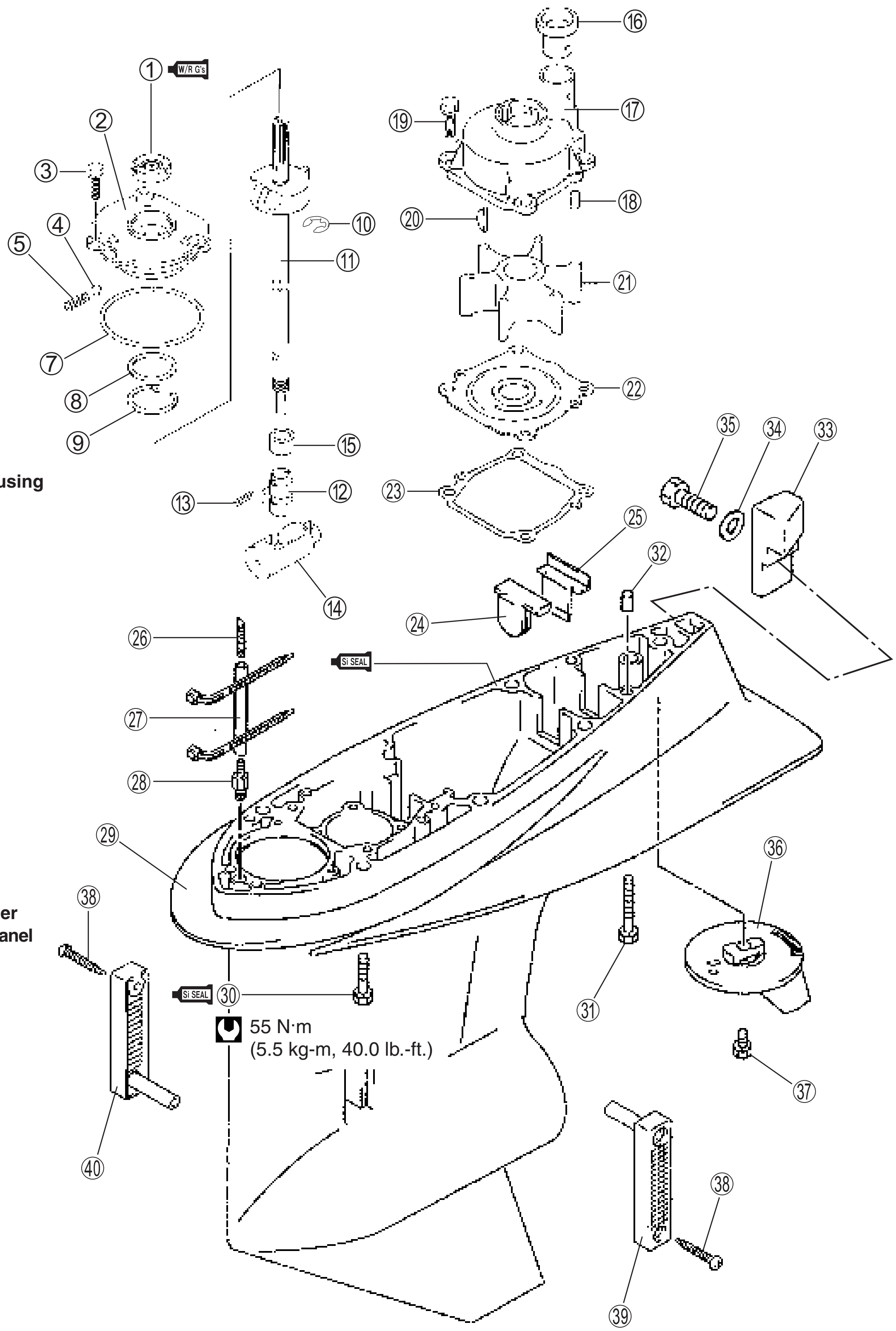
3. Using an oil seal installer, drive two oil seals (one at a time) into housing.
   The lipped portion of seal should face towards water pump case.
   Grease inner lips of seal.

DRIVESHAFT

- Inspect driveshaft / splines for wear, twist or other damage. Replace if necessary.
- Inspect driveshaft bearing for pitting, rough or other damage. Replace if necessary.

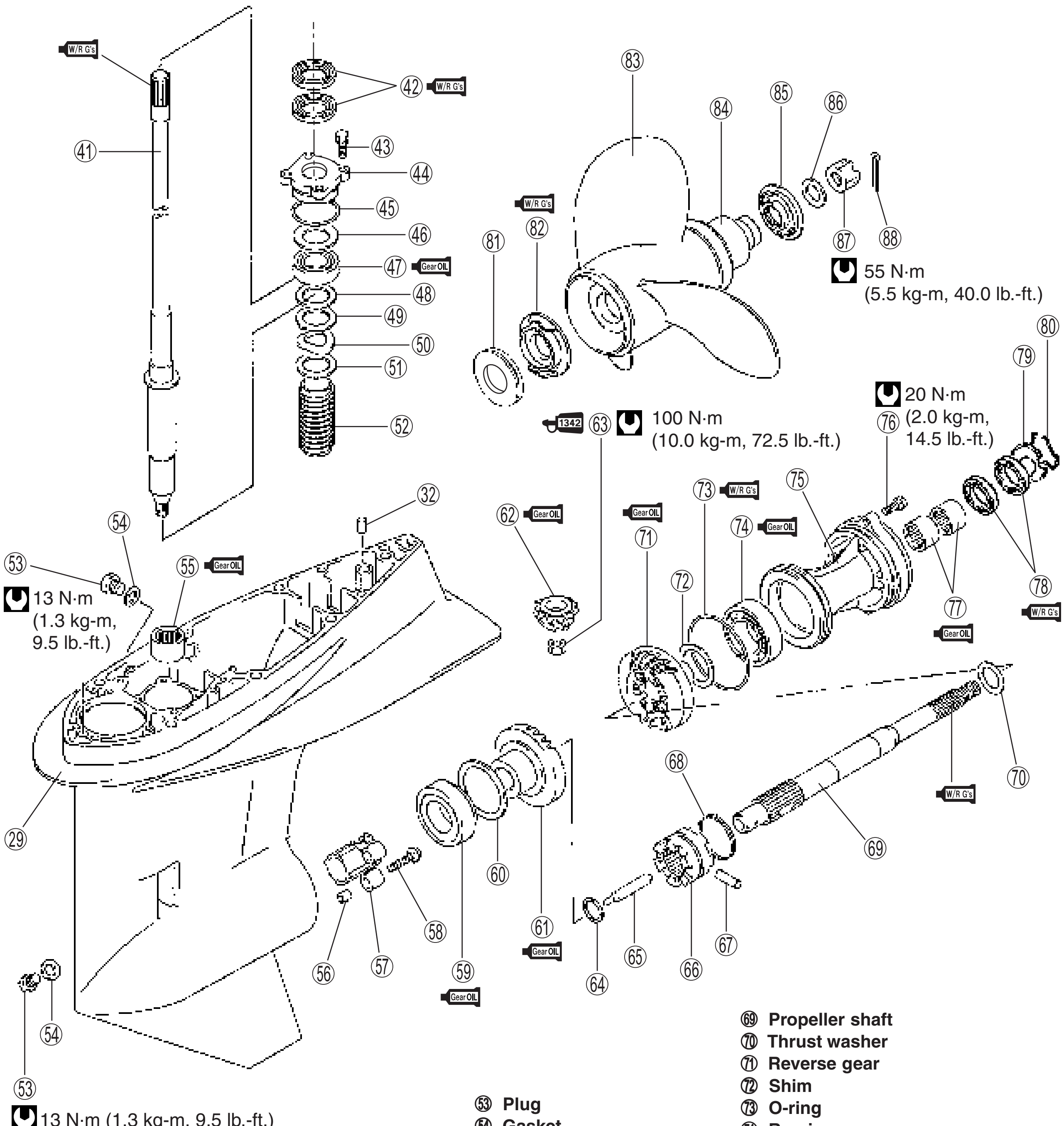
ASSEMBLY & INSTALLATION

Assembly & Installation are reverse order of disassembly with special attention to the following steps.



1 **Dust seal**
2 **Shift rod guide housing**
3 **Bolt**
4 **Ball**
5 **Spring**

7 **O-ring**
8 **Washer**
9 **Circlip**
10 **E-ring**
11 **Shift rod**
12 **Shifter yoke**
13 **Pin**
14 **Horizontal slider**
15 **Magneto**
16 **Grommet**
17 **Water pump case**
18 **Pin**
19 **Bolt**
20 **Key**
21 **Water pump impeller**
22 **Pump case under panel**
23 **Gasket**
24 **Exhaust seal**
25 **Exhaust seal plate**
26 **Union**
27 **Hose**
28 **Nipple**
29 **Gearcase**
30 **Bolt**
31 **Bolt**
32 **Pin**
33 **Anode**
34 **Washer**
35 **Bolt**
36 **Trim tab**
37 **Bolt**
38 **Screw**
39 **Water filter PORT**
40 **Water filter STBD**



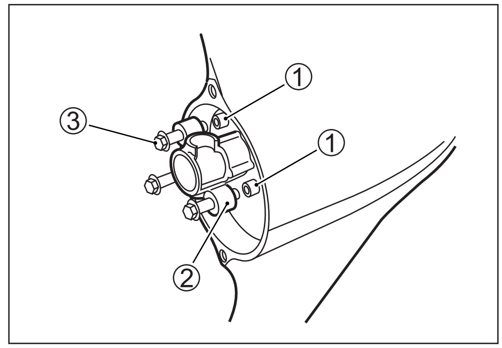
㊶ Driveshaft
㊷ Oil seal
㊸ Bolt
㊹ Oil seal housing
㊺ O-ring
㊻ Shim
㊼ Bearing
㊽ Washer
㊾ Washer
㊿ Wave washer
51 Washer
52 Driveshaft collar

53 Plug
54 Gasket
55 Bearing
56 Pin
57 Shift cam housing
58 Bolt
59 Bearing
60 Shim
61 Forward gear
62 Pinion gear
63 Pinion nut
64 Thrust washer
65 Connector pin
66 Clutch dog shifter
67 Dog pin
68 Dog spring

69 Propeller shaft
70 Thrust washer
71 Reverse gear
72 Shim
73 O-ring
74 Bearing
75 Propeller shaft bearing housing
76 Bolt
77 Bearing
78 Oil seal
79 Washer
80 Retaining ring
81 Spacer
82 Stopper
83 Propeller
84 Propeller bushing
85 Spacer
86 Washer
87 Nut
88 Pin

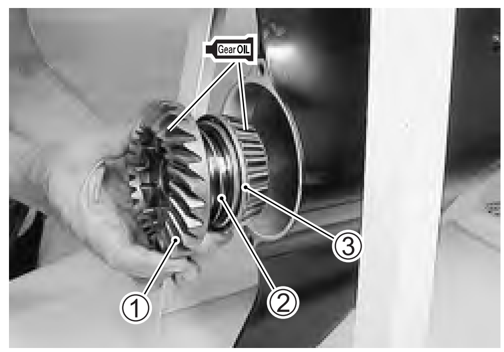
CAUTION

- **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 "GEARS SHIMMING AND ADJUSTMENT" section on page 9-24)



SHIFT CAM HOUSING

Install dowel pins ① and shift cam housing ②, then tighten three bolts ③ securely.



FORWARD GEAR

Place forward gear bearing ③ and back-up shim ② in position, then install forward gear ①.

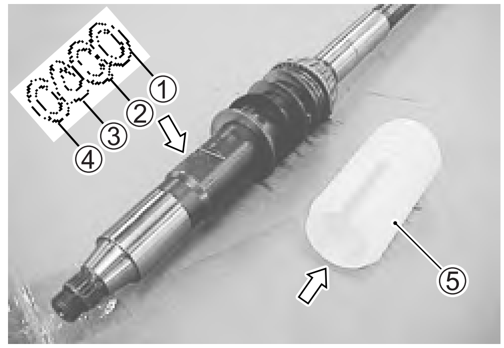
Gear OIL **99000-22540 : Suzuki Outboard Motor Gear Oil**

PINION GEAR

Place pinion gear in gearcase.

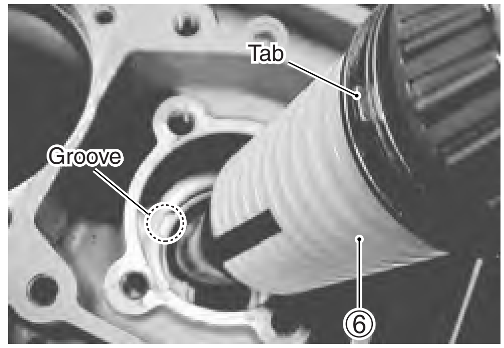
DRIVESHAFT

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

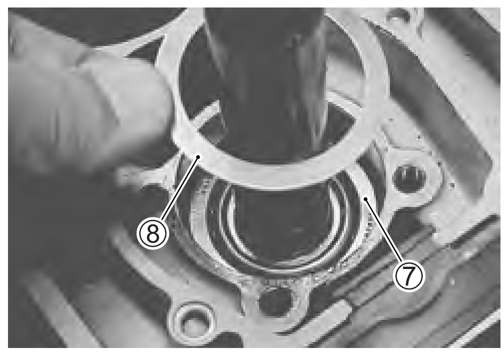


3. Lower driveshaft assembly ⑥ down into gearcase until bottom of shaft protrudes through center of pinion.

NOTE:
Washer tab should be located into groove on gearcase.



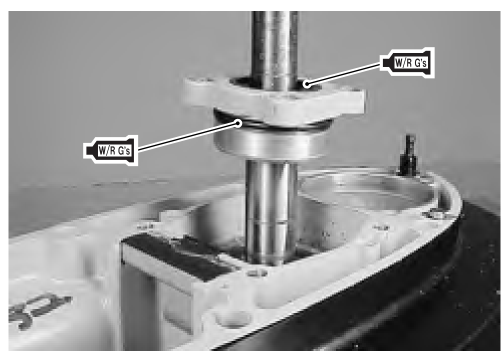
4. Install bearing outer race ⑦ and pinion shim ⑧ to driveshaft.



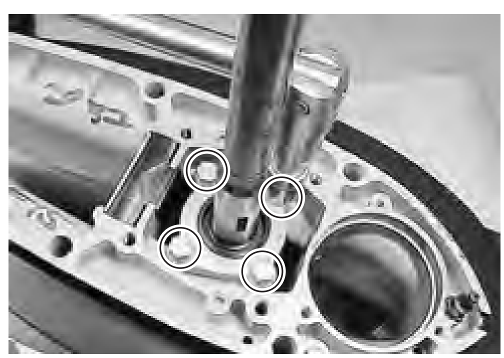
DRIVESHAFT OIL SEAL HOUSING

1. Apply Water Resistant Grease to driveshaft oil seal.

W/R G's **99000-25161 : Water Resistant Grease**

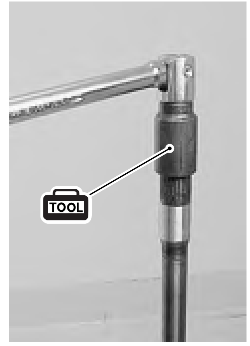


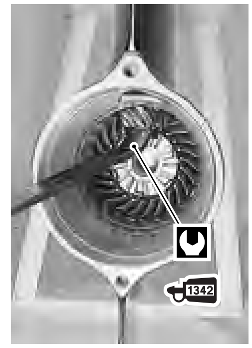
2. Apply Water Resistant Grease to O-ring, then install O-ring into groove on driveshaft oil seal housing.
3. Install driveshaft oil seal housing on gearcase, then tighten four bolts securely.



PINION NUT

Apply Thread Lock 1342 to threads of pinion nut, then tighten nut to specified torque.





Pinion nut : 100 N·m (10.0 kg-m, 72.5 lb.-ft.)

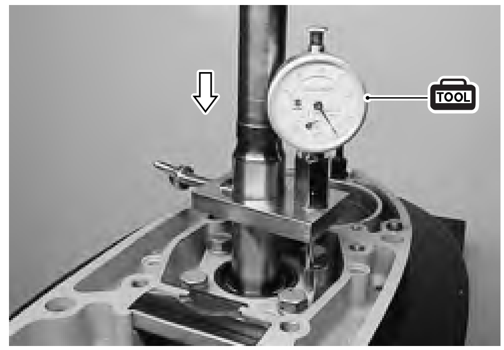
1342 **99000-32050 : Thread Lock 1342**

TOOL **09921-29410 : Drive shaft holder**

CHECKING DRIVESHAFT THRUST PLAY

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

(See CHECKING DRIVESHAFT THRUST PLAY section on page 9-27)

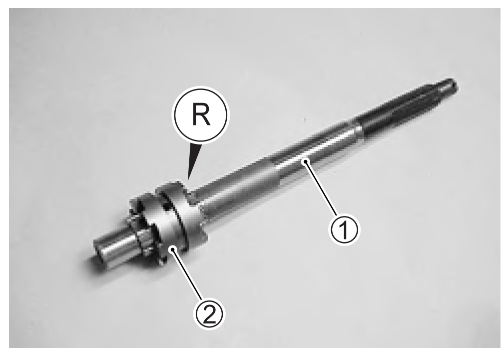


TOOL **09951-09530 : Gear adjusting gauge**

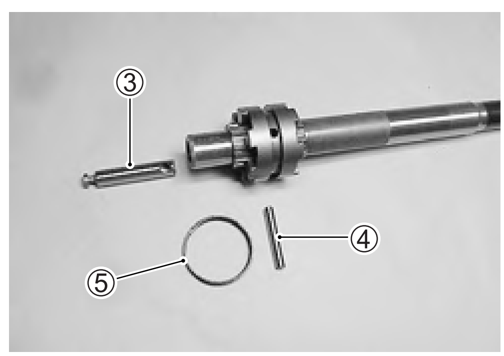
PROPELLER SHAFT

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

NOTE:
For correct installation, side of clutch dog shifter which should face towards reverse gear is marked with letter “R”.



2. Insert connector pin ③ into propeller shaft.
3. Align holes in clutch dog shifter ② and connector pin ③, then slide dog pin ④ through them.
4. Install dog spring ⑤, ensuring that it fits snugly into groove on clutch dog shifter.

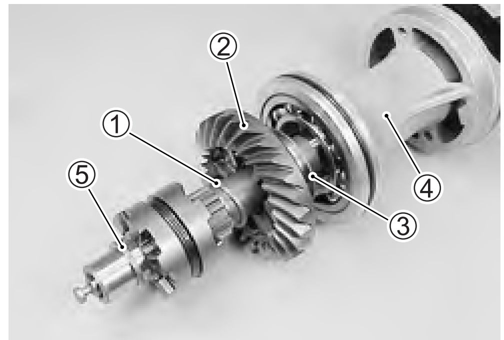


PROPELLER SHAFT / BEARING HOUSING

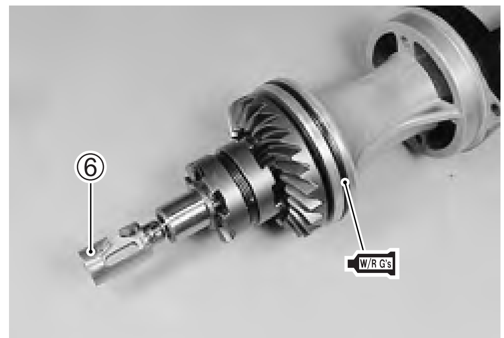
1. Assemble propeller shaft in following sequence : Forward thrust washer ⑤, Reverse thrust washer ①, Reverse gear ②, Reverse gear back-up shim ③, Propeller shaft housing ④.

W/R G's **99000-25161 : Water Resistant Grease**

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

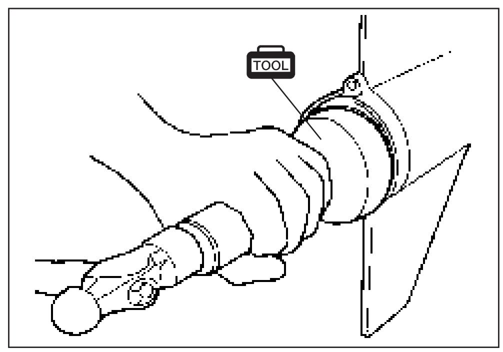


2. Assemble horizontal slider ⑥ to connector pin.



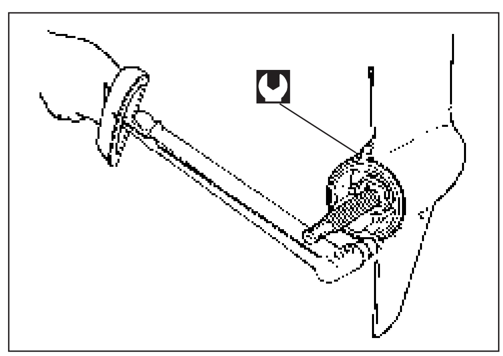
3. Using special tools, install propeller shaft and housing assembly in gear case.

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



4. When housing is fully seated, tighten two bolts to specified torque.

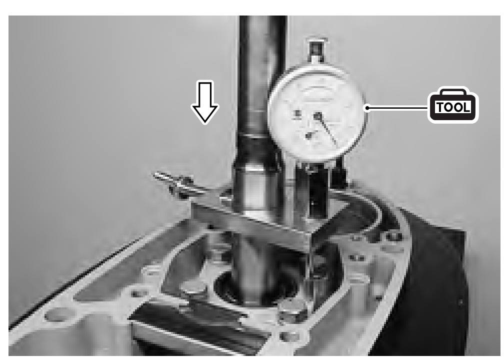
Bearing housing bolt : 20 N · m (2.0 kg-m, 14.5 lb.-ft.)



RECHECKING DRIVESHAFT THRUST PLAY

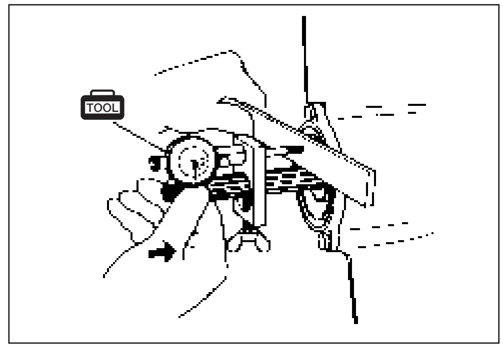
Recheck driveshaft thrust play.
This should not be less than previously checked on page 9-17. (See "RECHECKING DRIVESHAFT THRUST PLAY" section on page 9-27.)

TOOL **09951-09530 : Gear adjusting gauge**



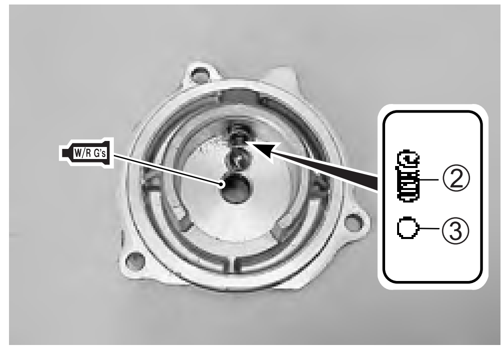
CHECKING PROPELLER SHAFT THRUST PLAY

See page 9-28.



SHIFT ROD GUIDE HOUSING

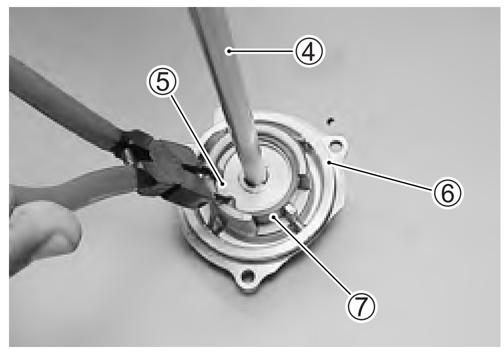
1. Install spring ② and detent ball ③ into shift rod guide housing.



2. Apply Water Resistant Grease to shift rod oil seal.

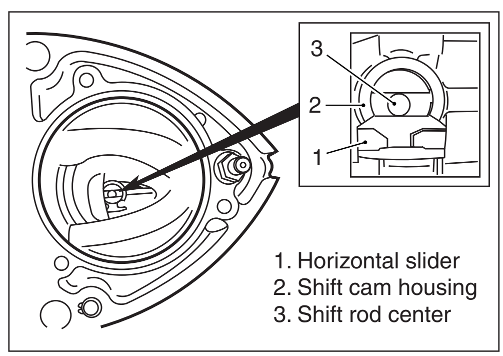
W/R G's **99000-25161 : Water Resistant Grease**

3. Install shift rod ④ and washer ⑤ into the shift rod guide housing ⑥, then secure it with snap ring ⑦.



NOTE:

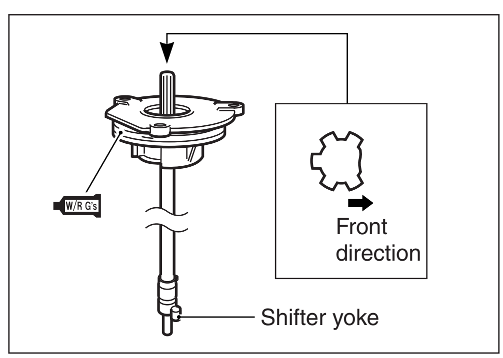
Before install shift rod guide housing assembly, be sure to put horizontal slider in neutral position.



4. Apply Water Resistant Grease to O-ring.

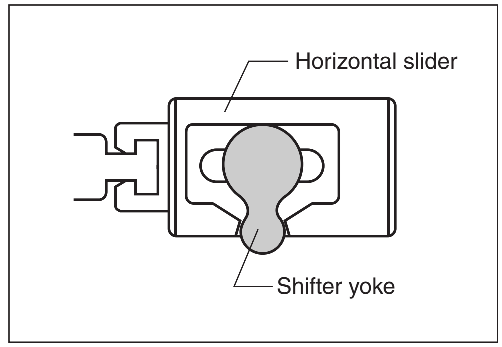
NOTE:

Before install shift rod guide housing assembly, bring shifter yoke to neutral position by turning shift rod.



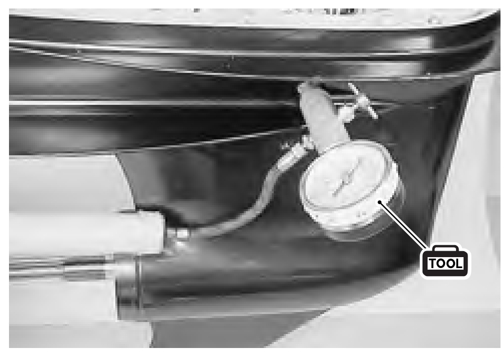
5. Install shift rod guide housing assembly by aligning shifter yoke with groove in horizontal slider, then tighten three housing bolts securely.

6. Turn shift rod from neutral position to forward and reverse position to check proper gear engagement.



LEAKAGE CHECK

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



TOOL **09950-69512 : Oil leakage tester**
09952-99310 : Hand air pump

Procedure

1. Install oil leakage tester into oil level hole.

2. Connect a hand air pump to oil leakage tester.

3. While rotate driveshaft and propeller shaft clockwise several times, apply specified pressure for leakage test.

NOTE:
Apply low initial pressure of 20 – 40 kpa, (0.2 – 0.4 kg/cm^2, 2.8 – 5.7 psi) first, then apply specified pressure.

Leakage test pressure : 100 kPa (1.0 kg/cm^2, 14.2 psi)

CAUTION

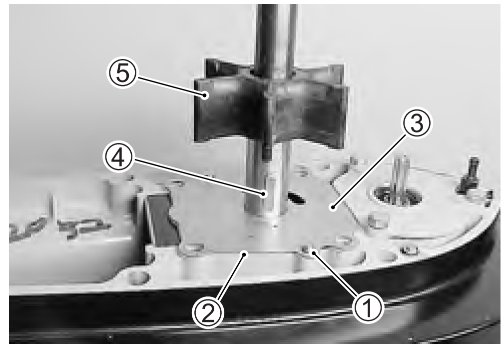
Do not exceed pressure of 110 kPa (1.1kg/cm^2, 15.6 psi) or damage to oil seals will result.

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

WATER PUMP

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

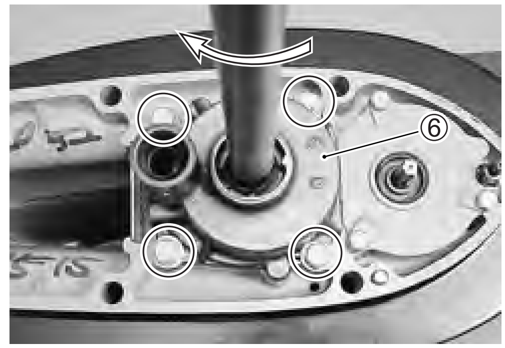
2. Insert key ④ in driveshaft and slide impeller ⑤ onto driveshaft, ensuring that key and keyway are aligned.



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

4. Tighten four pump case bolts to specified torque.

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



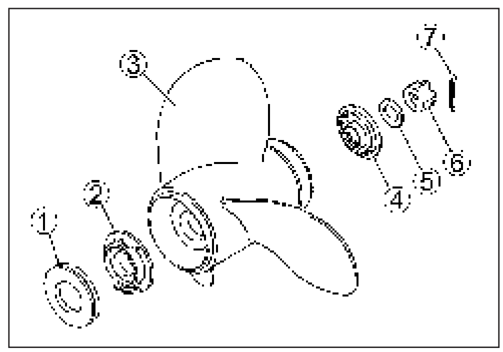
PROPELLER INSTALLATION

1. Install spacer ① and propeller stopper ② onto propeller shaft, then slide on propeller ③.

2. Fit spacer ④, washer ⑤ and nut ⑥, then tighten nut to specified torque.

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

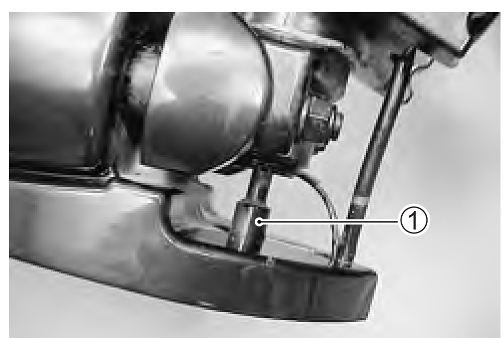
3. Push cotter pin ⑦ through nut and shaft, then bend to secure.



LOWER UNIT INSTALLATION

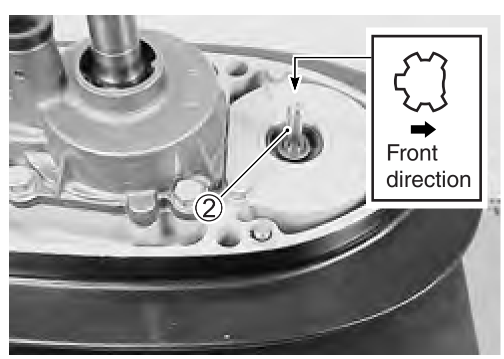
1. Apply clutch rod splines with Water Resistant Grease, then install clutch rod ① by aligning clutch rod splines with splines in clutch shaft.

W/R G's **99000-25161 : Water Resistant Grease**



2. Ensure that shift rod ② is at neutral position.

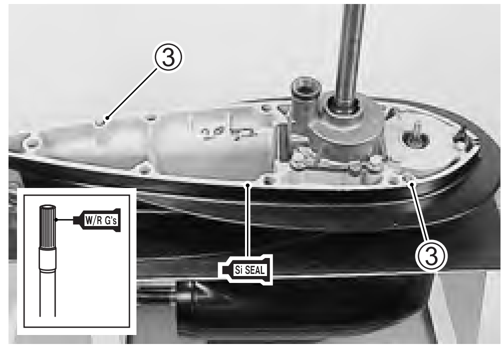
NOTE:
Before install lower unit assembly, bring shift to neutral position by turning shift rod.



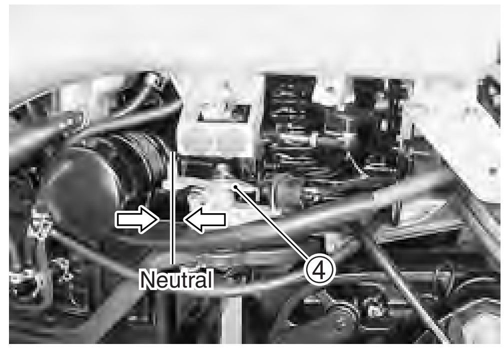
3. Insert two dowel pins ③.

4. Apply driveshaft splines and shift rod splines with Water Resistant Grease.

5. Apply Suzuki Silicone Seal lightly to mating surfaces of gearcase and driveshaft housing.



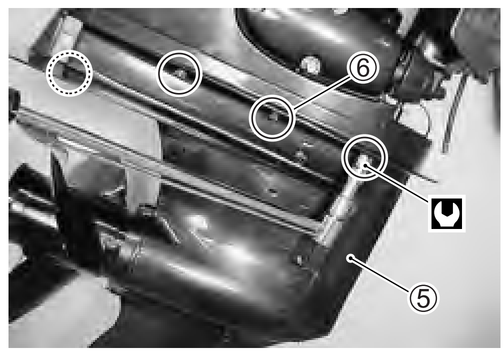
6. Set clutch control lever ④ at neutral position, then slide lower unit ⑤ into place, ensuring that top of driveshaft engages properly with countershaft and that water tube locates in water pump case outlet.



NOTE:

In order for shift rod splines and clutch rod splines to be aligned correctly, clutch rod may need to be turned slightly right or left.

7. Apply Silicone Seal to seven gearcase bolts ⑥ and tighten them to specified torque.

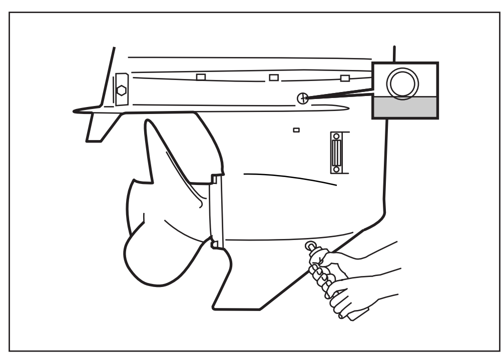


Gearcase bolt : 55 N · m (5.5 kg-m, 40.0 lb.-ft.)

W/R G's **99000-25161 : Water Resistant Grease**

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

8. Move clutch control lever ④ to forward and reverse positions from neutral position to check proper gear engagement.



GEAR OIL

Fill gearcase with specified gear oil.
(See "PERIODIC MAINTENANCE / GEAR OIL" section on page 2-6)

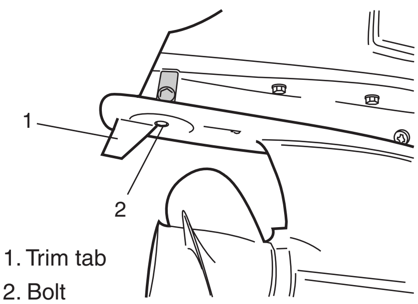
Gear OIL **99000-22540 : Suzuki Outboard Motor Gear Oil**

TRIM TAB

Trim tab counteracts or minimizes propeller torque "pull" felt through steering system.
If steering is pulled to starboard or port side, adjust trim tab with following procedure :

Adjusting

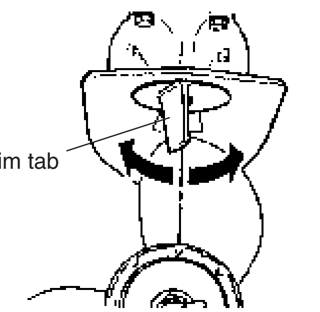
1. Loosen bolt of trim tab.



1. Trim tab
2. Bolt

2. Change direction of trim tab.
   - 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.

3. Tighten bolt of trim tab.



4. Test ride boat and repeat procedure 1–3 to set trim tab in the best position.

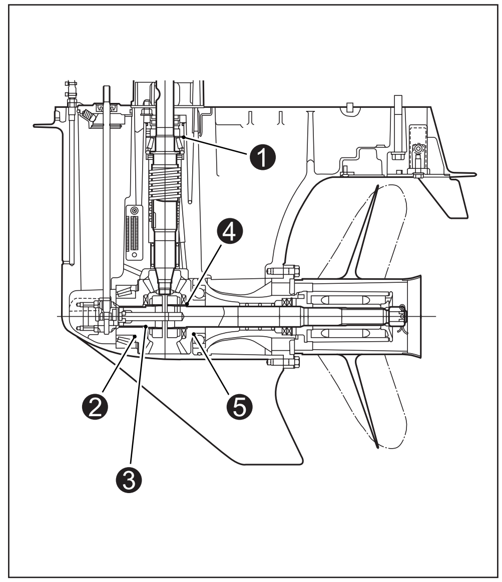
With a properly adjusted trim tab, steering should be neutral and there should be no tendency for steering to be pulled to either port or starboard.

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)
❶	Pinion gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15	1.0
❷	Forward gear back up shim	0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90	1.0
❸	Forward gear thrust washer	3.0	3.0
❹	Reverse gear thrust washer	0.9, 1.0, 1.2, 1.3, 1.4, 1.6	2.2
❺	Reverse gear back up shim	1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6	1.5



PINION GEAR BACK-UP SHIM ADJUSTMENT

1. Position shimming gauge Ⓐ horizontally in a vise and tighten vise securely.

TOOL **09951-09010 : Shimming gauge**

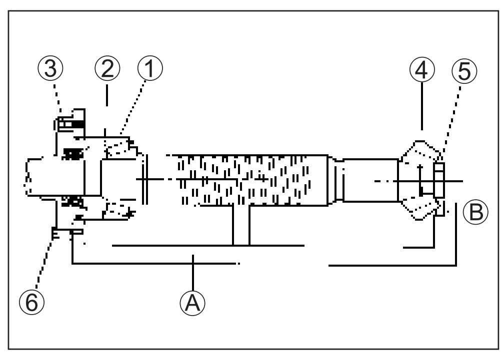
2. Assemble bearing outer race ①, back-up shim ② and driveshaft oil seal housing ③ to driveshaft.

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

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

Pinion nut : 100 N·m (10.0 kg-m, 72.5 lb.-ft.)

4. Install oil seal housing ③ to shimming gauge Ⓐ with bolts ⑥.



5. Depress and hold driveshaft so that driveshaft bearing is firmly seated in bearing outer race.

6. Hold driveshaft against oil seal housing ③ while measuring clearance Ⓑ between gauge and flat edge of pinion gear ④ with thickness gauge.
7. Select pinion gear back-up shim of thickness at clearance Ⓑ become 1.0 mm (0.04 in).

FORWARD GEAR BACK-UP SHIM ADJUSTMENT

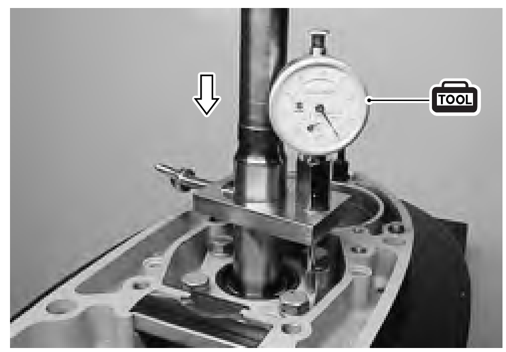
Follow the procedure below to adjust forward gear / pinion gear.

Step to prior to adjustment

1. Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. (See page 9-15 to 9-17)
   Do not install reverse gear at this time.

2. Tighten pinion nut to specified torque.

Pinion nut : 100 N·m (10.0 kg-m, 72.5 lb.-ft.)



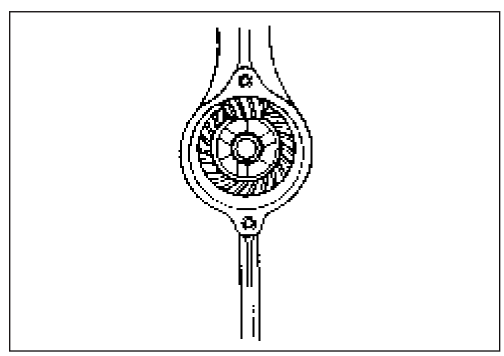
Checking driveshaft thrust play

1. Affix gear adjusting gauge to drive shaft.

TOOL **09951-09530 : Gear adjusting gauge**

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

Driveshaft thrust play:
Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)



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

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

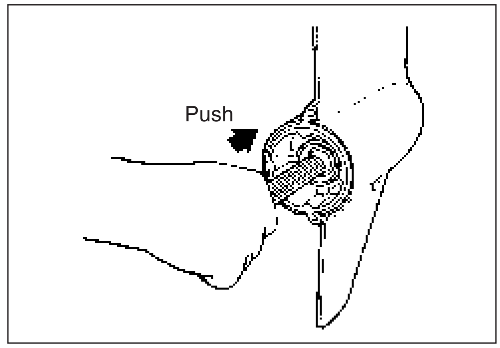
Check tooth contact pattern by using following procedure :

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

2. Install propeller shaft and housing assembly (minus reverse gear and internal components).

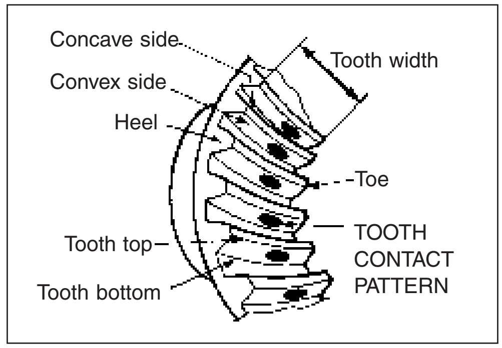
3. Push propeller shaft inward and hold in position.

4. Using driveshaft holder, rotate driveshaft 5 - 6 times.



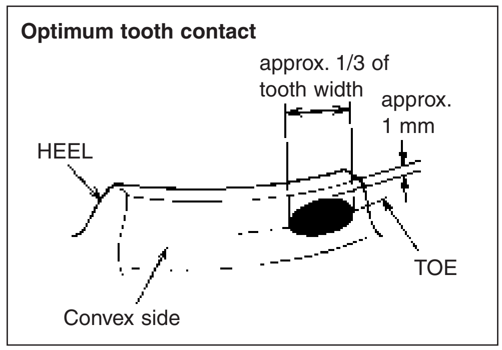
TOOL **09921-29410 : Driveshaft holder**

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



Optimum tooth contact

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

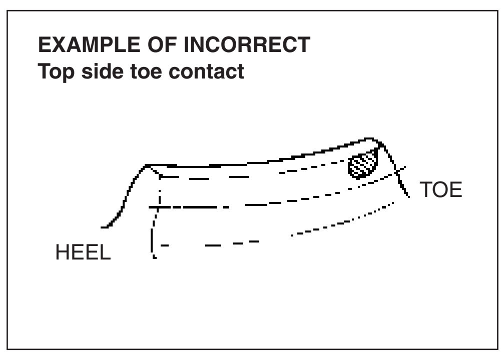


CAUTION

Backlash of gear should be checked when increasing or decreasing thickness of shim to adjust tooth contact.

Example (1)

Incorrect topside toe contact :
Correction measures :
- Decrease thickness of forward gear shim.
- Slightly increase pinion gear shim thickness.

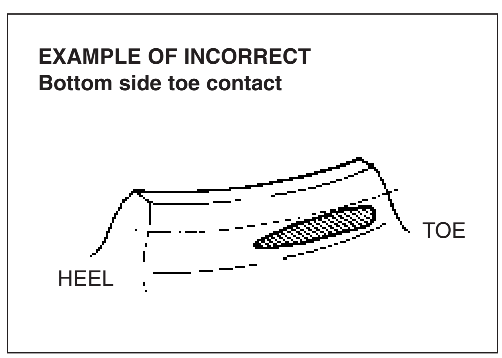


CAUTION

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

Example (2)

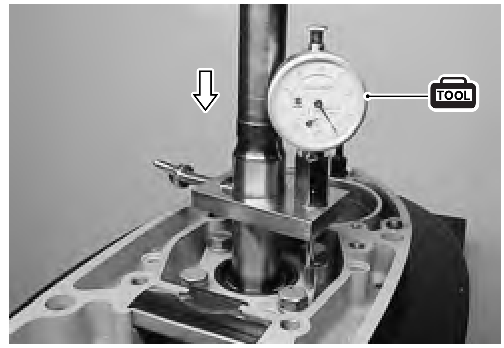
Incorrect bottom side toe contact :
Correction measures :
- Increase thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.



CAUTION

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

CHECKING DRIVESHAFT THRUST PLAY



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

1. Affix gear adjusting gauge to driveshaft.

TOOL **09951-09530 : Gear adjusting gauge**

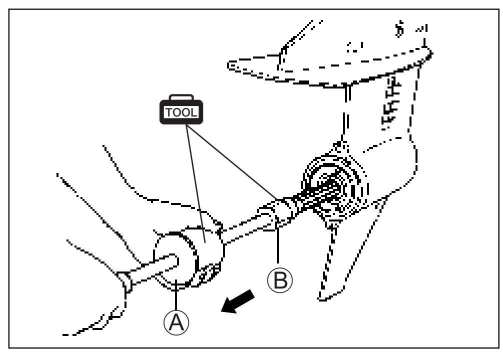
2. Slowly push driveshaft downward and read maximum play. Designate this amount of play as (A).

Driveshaft thrust play :
Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

NOTE:
Driveshaft thrust play (A) should 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. Install sliding hammer Ⓐ and remover Ⓑ onto propeller shaft and strike a few gentle outward taps.

TOOL **09930-30161 : Propeller shaft remover – Ⓑ**
09930-30104 : Sliding hammer – Ⓐ

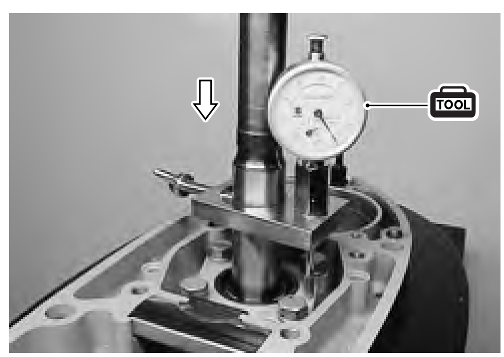
3. Affix gear adjusting gauge to driveshaft.

TOOL **09951-09530 : Gear adjusting gauge**

4. Slowly push driveshaft downward and read maximum play. Designate this measurement as play (B).

5. Compare play (B) to play (A) (page 9-27).

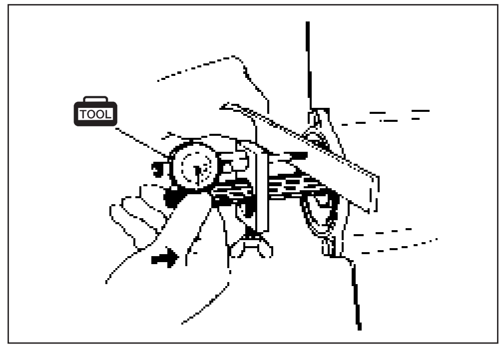
6. Reverse gear back-up shim adjustment is correct if (B) is equal to (A).



If (B) is less than (A), reduce reverse gear back-up shim thickness.

CHECKING PROPELLER SHAFT THRUST PLAY

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



Propeller shaft thrust play : 0.2 – 0.4 mm
(0.01 – 0.02 in.)

NOTE:
Maintain forward gear thrust washer at standard thickness (3.0 mm) and adjust only reverse gear thrust washer with shim.

Measurement step :

1. Affix gear adjusting gauge to propeller shaft.

TOOL **09951-09530 : Gear adjusting gauge**

2. Slowly push propeller shaft inward.
3. Hold shaft in and set dial gauge pointer to zero.
4. Slowly pull propeller shaft outward and read maximum thrust play.

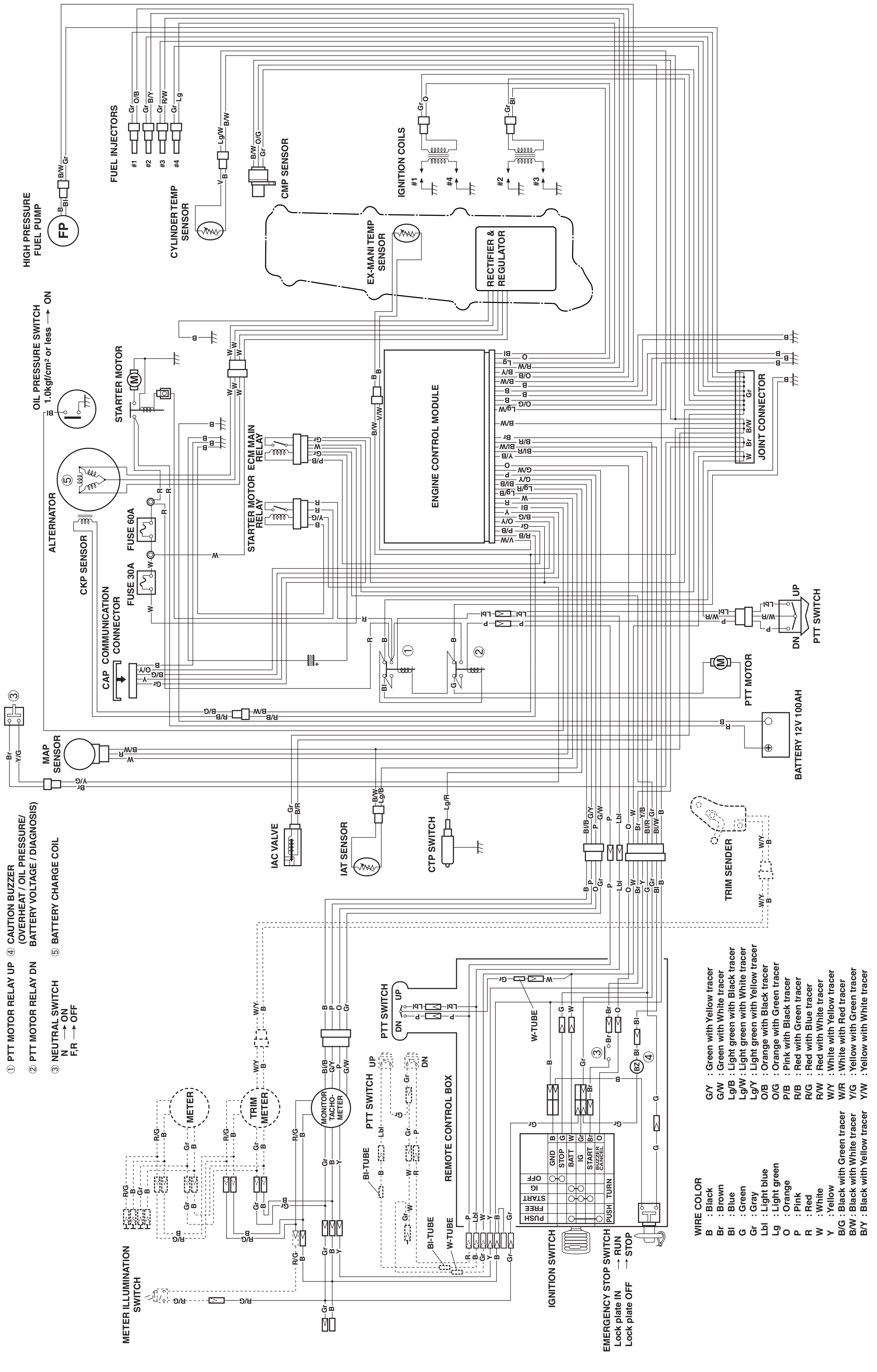
If measurement is more than specification, increase reverse gear thrust washer thickness.
If measurement is less than specification, reduce reverse gear thrust washer thickness.

WIRE / HOSE ROUTING

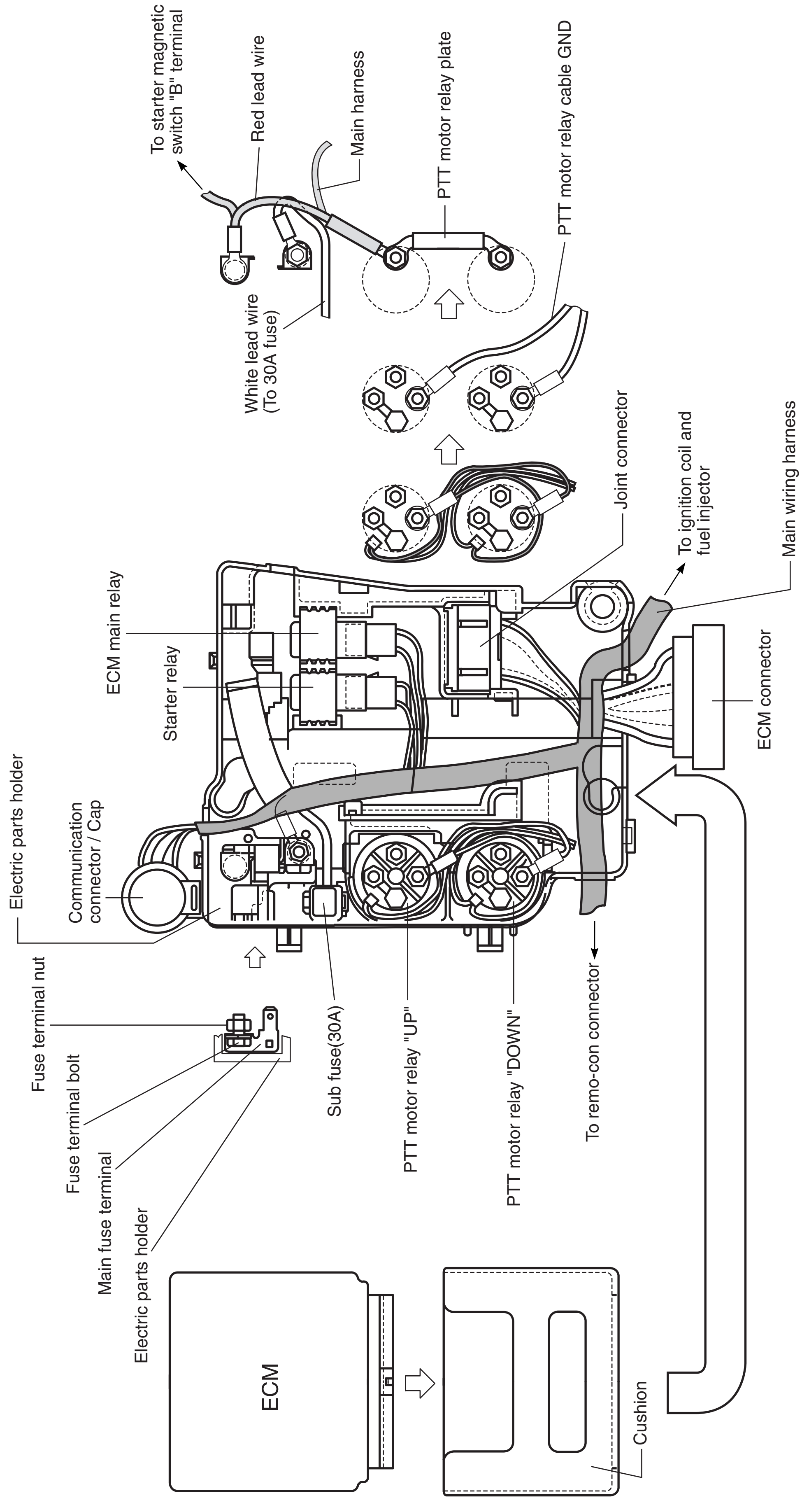
CONTENTS

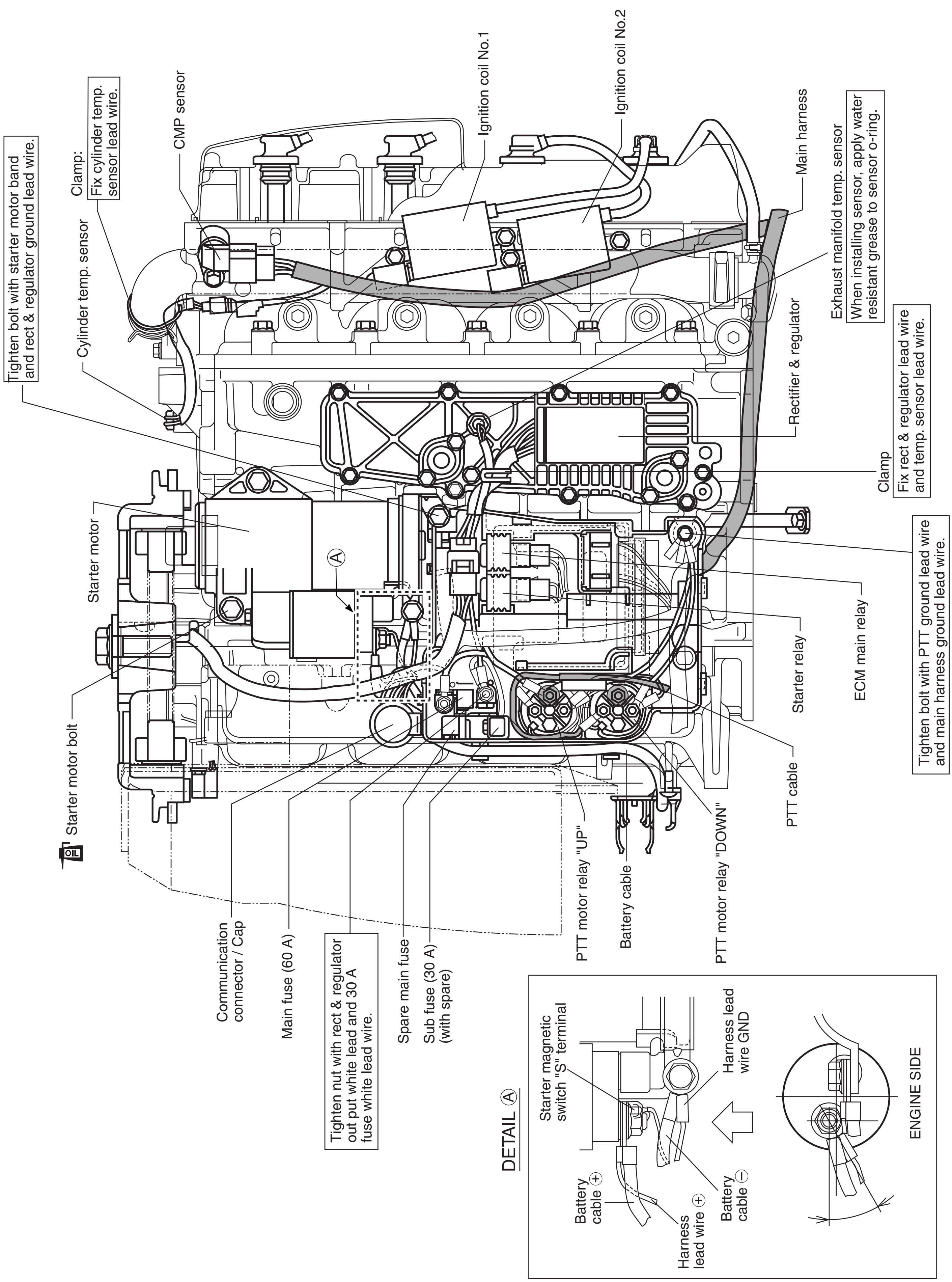
WIRING DIAGRAM

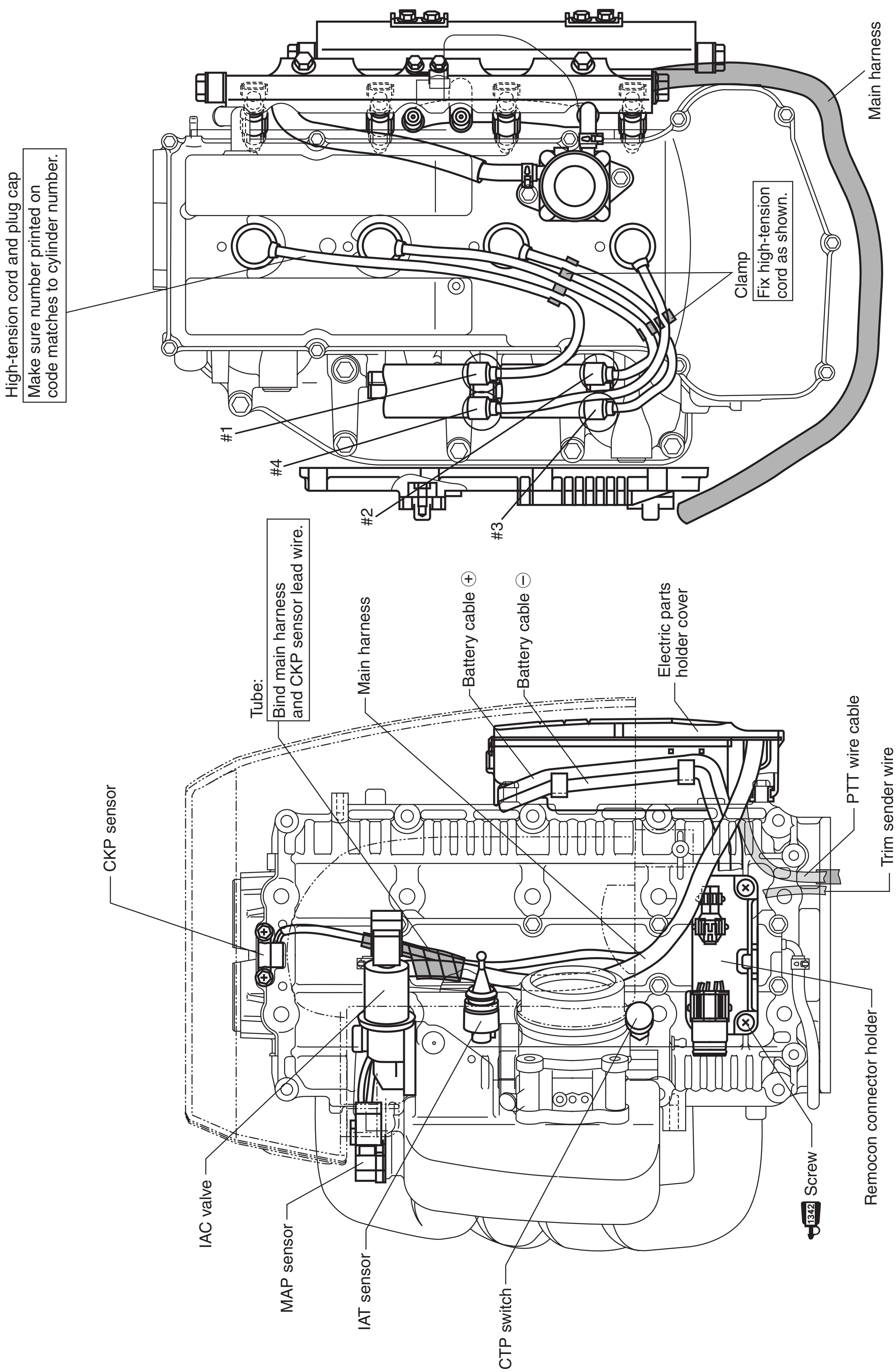
DF90T / DF115T



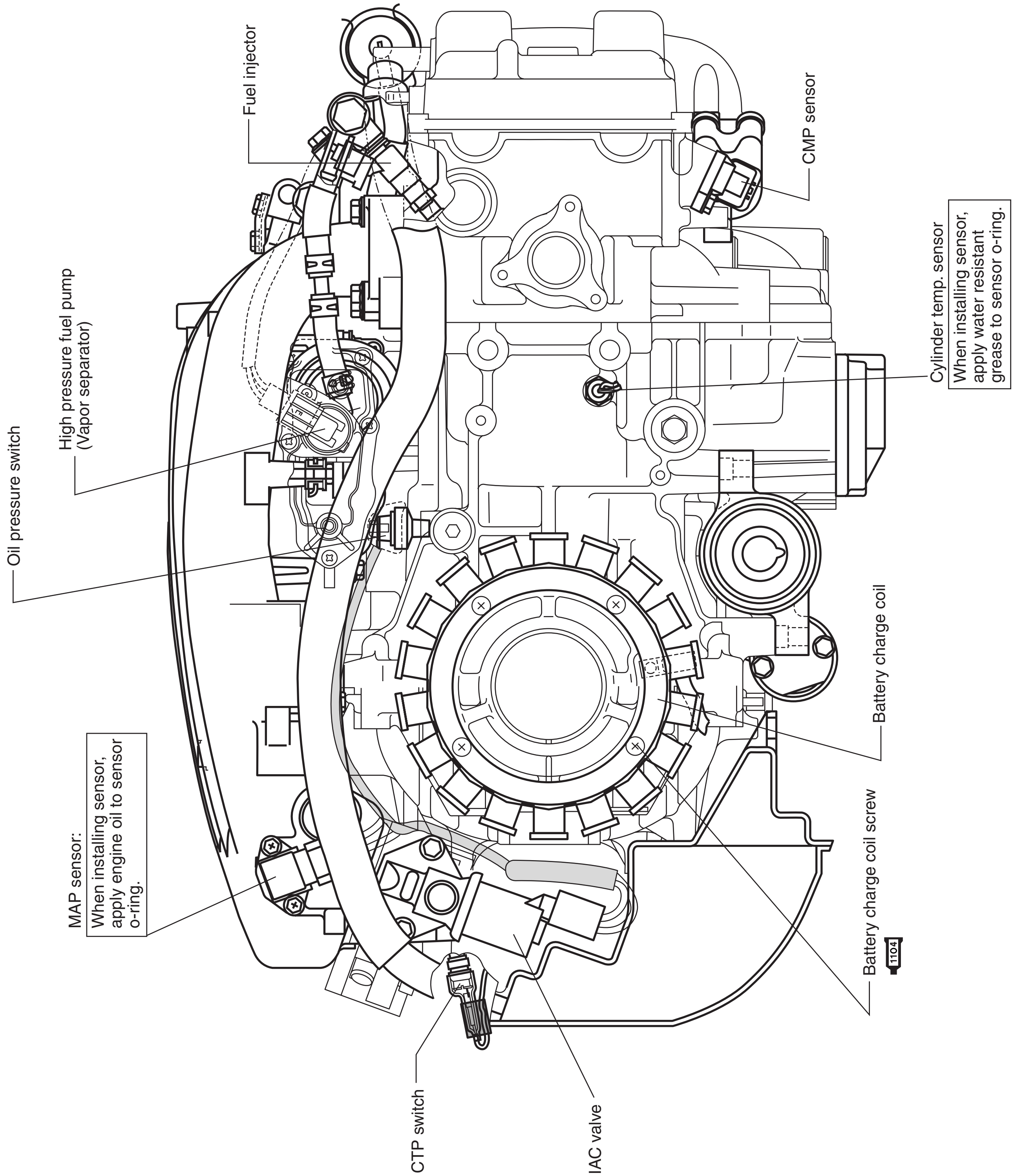
WIRE ROUTING

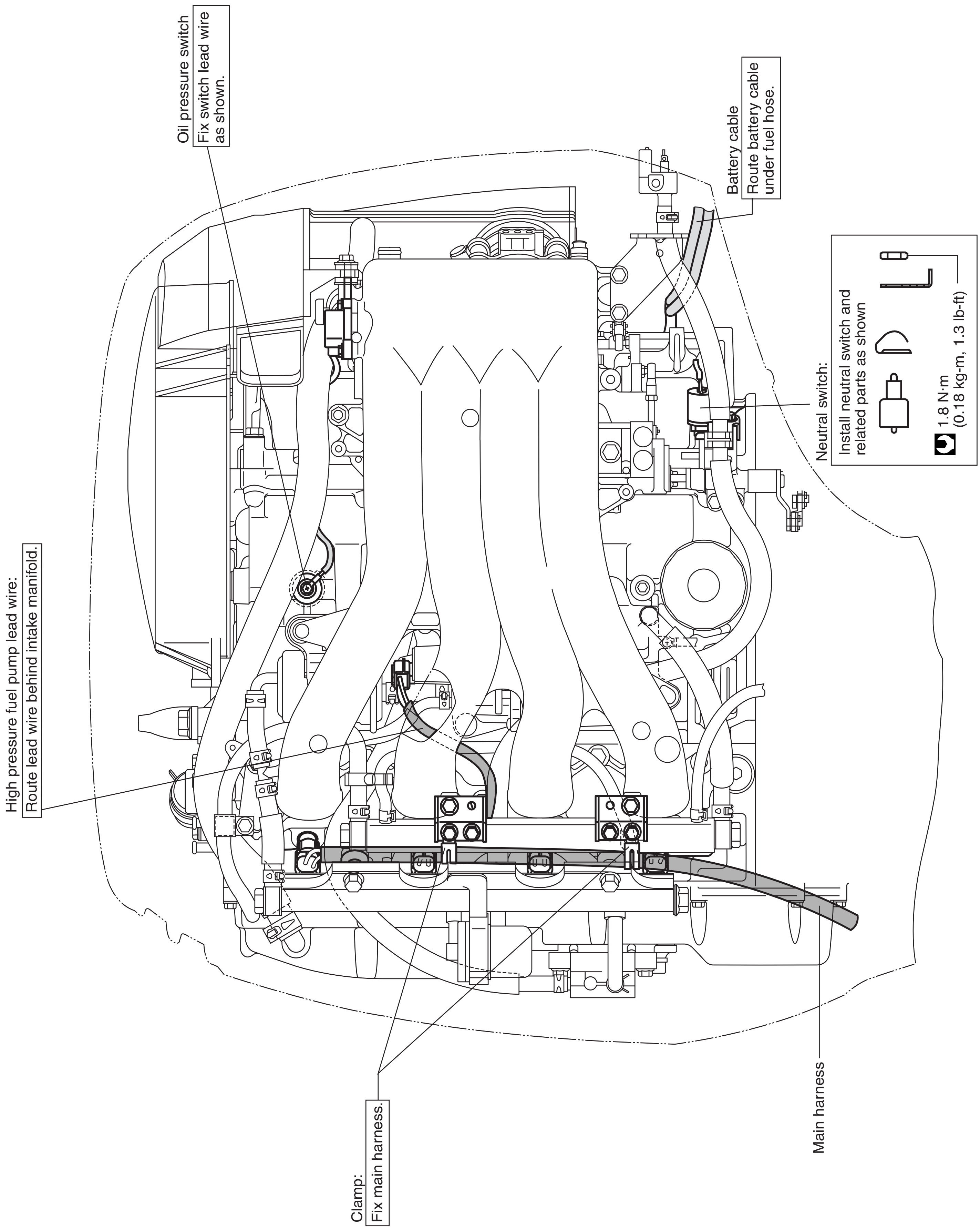



Tighten bolt with starter motor band and rect & regulator ground lead wire.
Clamp:
Fix cylinder temp. sensor lead wire.
CMP sensor
Cylinder temp. sensor
Ignition coil No.1
Ignition coil No.2
Main harness
Exhaust manifold temp. sensor
When installing sensor, apply water resistant grease to sensor o-ring.
Rectifier & regulator
Clamp
Fix rect & regulator lead wire and temp. sensor lead wire.
Tighten bolt with PTT ground lead wire and main harness ground lead wire.
ECM main relay
Starter relay
PTT cable
Starter motor
A
Starter motor bolt
OIL
Communication connector / Cap
Main fuse (60 A)
Tighten nut with rect & regulator out put white lead and 30 A fuse white lead wire.
Spare main fuse
Sub fuse (30 A) (with spare)
PTT motor relay "UP"
Battery cable
PTT motor relay "DOWN"
DETAIL A
Starter magnetic switch "S" terminal
Harness lead wire GND
Battery cable ⊕
Harness lead wire ⊕
Battery cable ⊖
ENGINE SIDE



High-tension cord and plug cap
Make sure number printed on code matches to cylinder number.
#1
#4
#2
#3
Clamp
Fix high-tension cord as shown.
Main harness
CKP sensor
Tube:
Bind main harness and CKP sensor lead wire.
Main harness
Battery cable ⊕
Battery cable ⊖
Electric parts holder cover
PTT wire cable
Trim sender wire
Remocon connector holder
Screw
1342
IAC valve
MAP sensor
IAT sensor
CTP switch

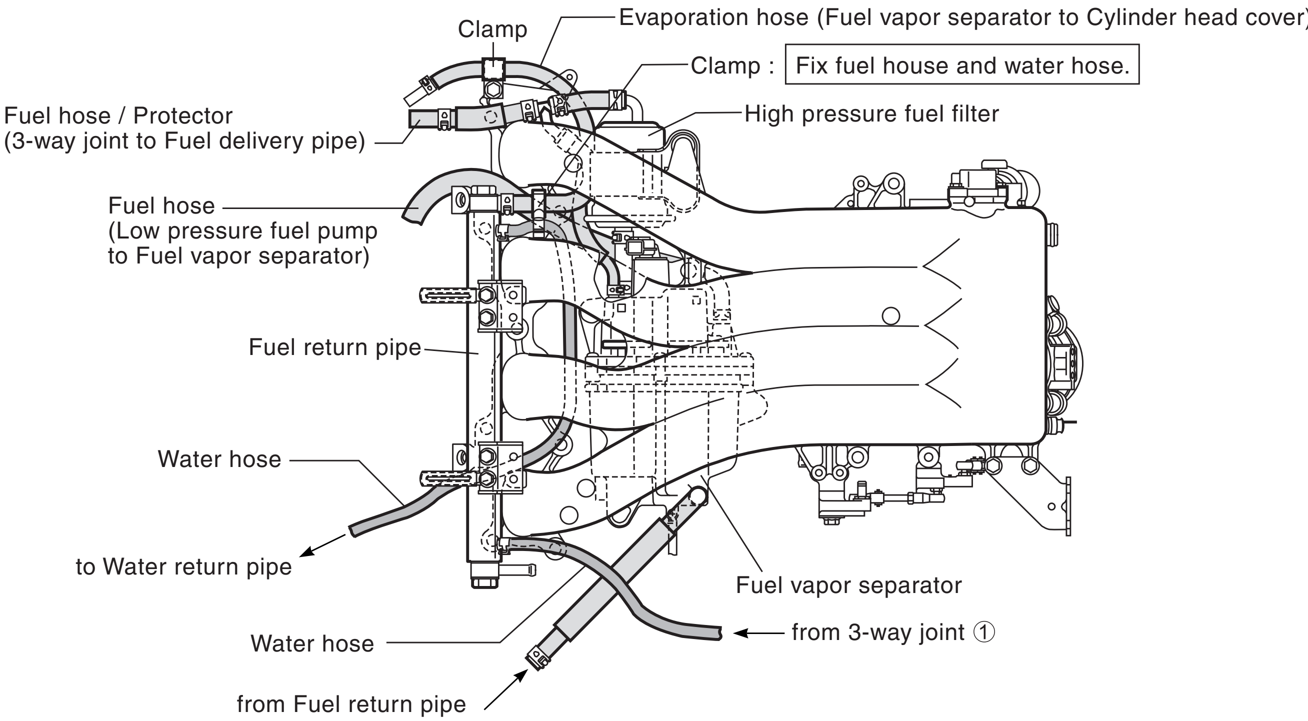

Fuel injector
CMP sensor
High pressure fuel pump
(Vapor separator)
Oil pressure switch
Cylinder temp. sensor
When installing sensor, apply water resistant grease to sensor o-ring.
Battery charge coil
MAP sensor:
When installing sensor, apply engine oil to sensor o-ring.
Battery charge coil screw
1104
CTP switch
IAC valve

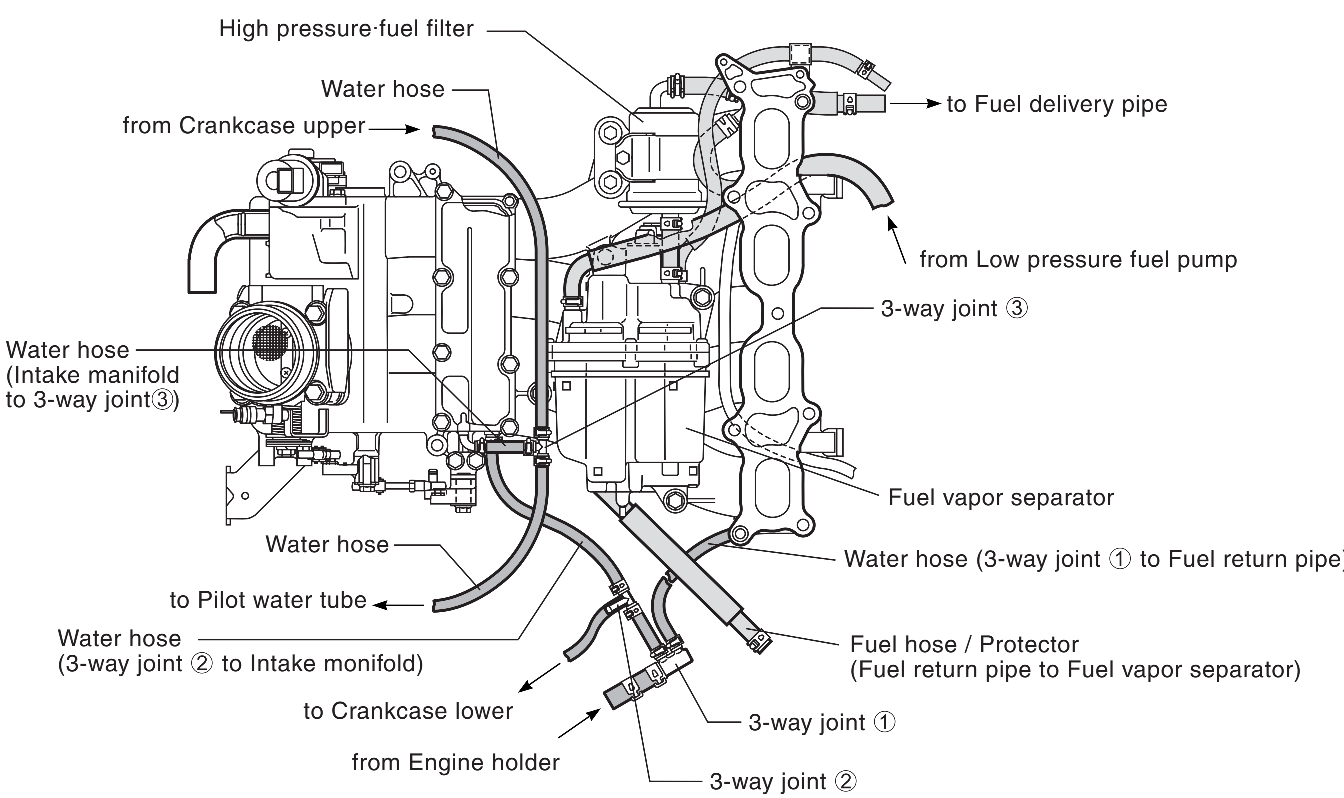

Oil pressure switch
Fix switch lead wire as shown.
Battery cable
Route battery cable under fuel hose.
Neutral switch:
Install neutral switch and related parts as shown
1.8 N·m (0.18 kg-m, 1.3 lb-ft)
High pressure fuel pump lead wire:
Route lead wire behind intake manifold.
Clamp:
Fix main harness.
Main harness

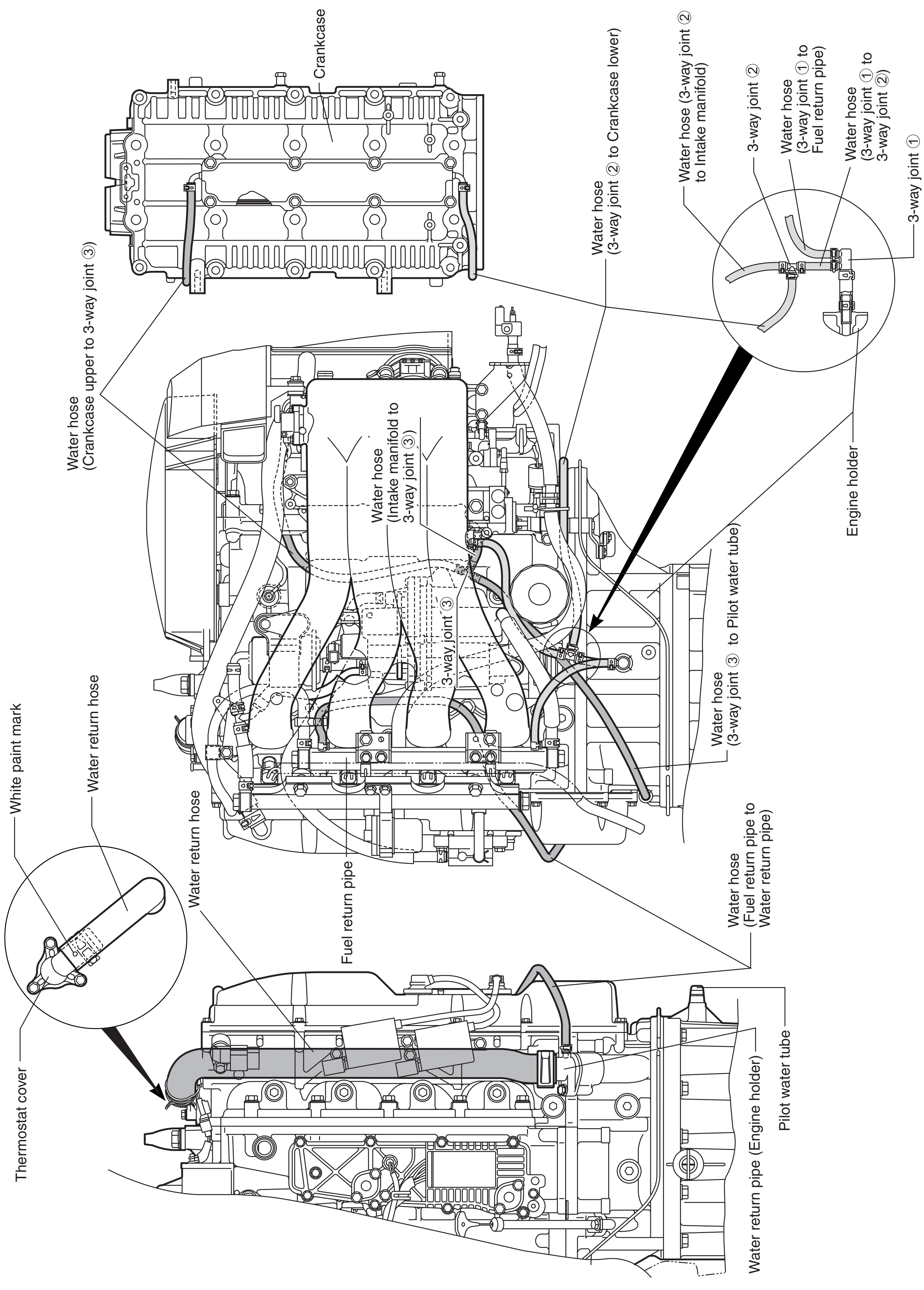
FUEL / WATER HOSE ROUTING

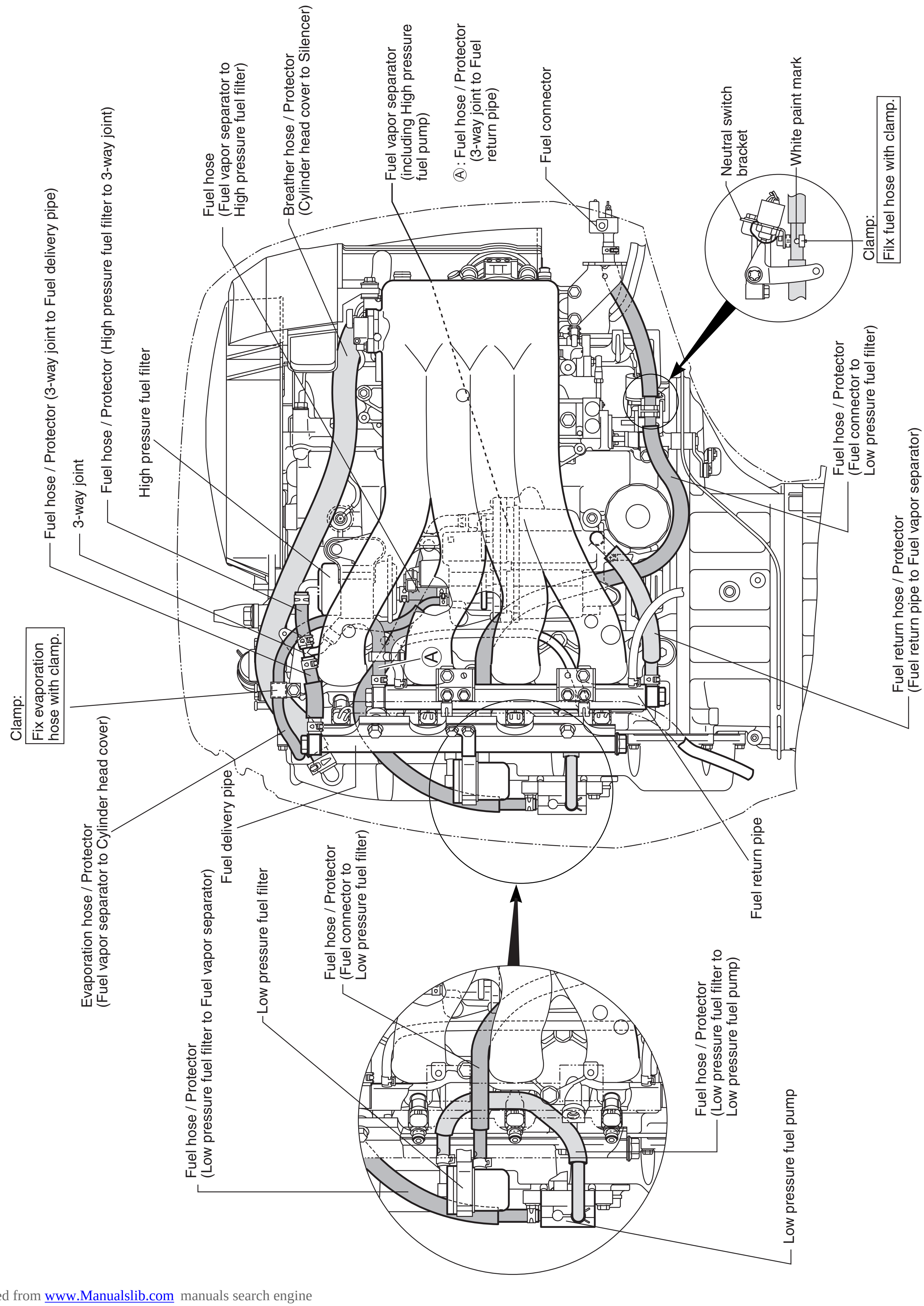
CAUTION

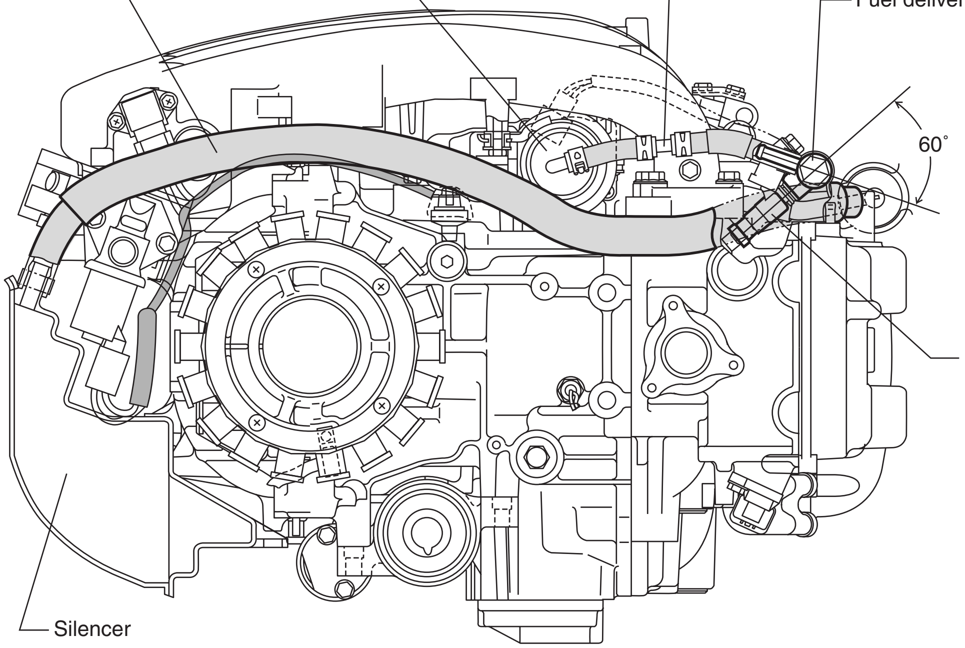
- **Do not over-bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Check that hoses do not contact rods and levers during either engine operation or standstill.**
- **Extreme care should be taken not to cut, abrade or cause any other damage on hoses.**
- **Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.**

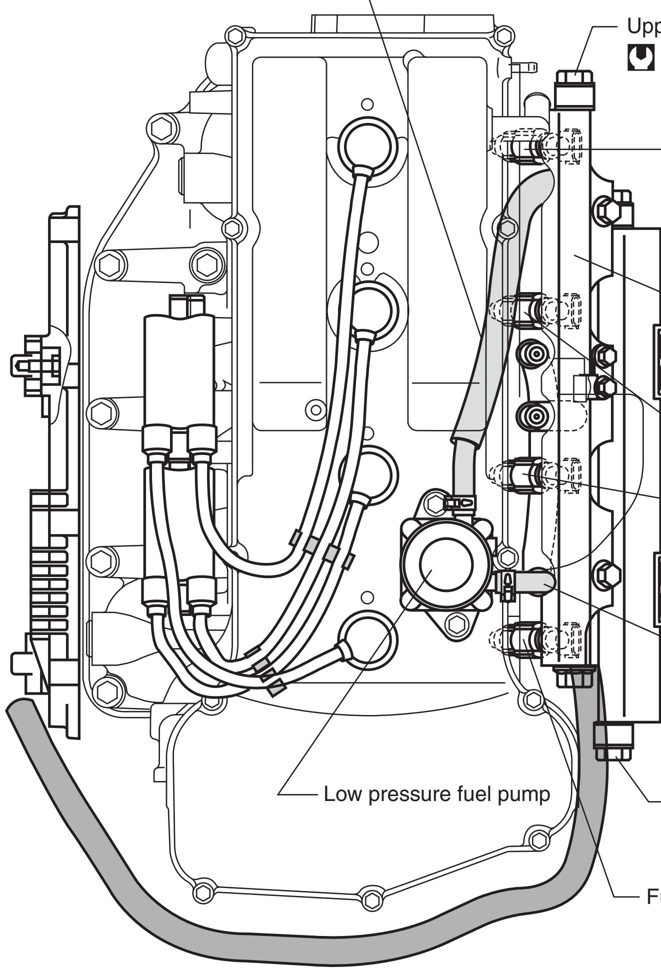





Crankcase
Water hose (3-way joint ② to Crankcase lower)
Water hose (3-way joint ② to Intake manifold)
3-way joint ②
Water hose (3-way joint ① to Fuel return pipe)
Water hose (3-way joint ① to 3-way joint ②)
3-way joint ①
Engine holder
Water hose (Crankcase upper to 3-way joint ③)
Water hose (Intake manifold to 3-way joint ③)
3-way joint ③
Water hose (3-way joint ③ to Pilot water tube)
White paint mark
Water return hose
Water return hose
Fuel return pipe
Water hose (Fuel return pipe to Water return pipe)
Thermostat cover
Water return pipe (Engine holder)
Pilot water tube


Fuel hose / Protector (3-way joint to Fuel delivery pipe)
3-way joint
Fuel hose / Protector (High pressure fuel filter to 3-way joint)
High pressure fuel filter
Fuel hose (Fuel vapor separator to High pressure fuel filter)
Breather hose / Protector (Cylinder head cover to Silencer)
Fuel vapor separator (including High pressure fuel pump)
Ⓐ : Fuel hose / Protector (3-way joint to Fuel return pipe)
Fuel connector
Neutral switch bracket
White paint mark
Clamp: Flix fuel hose with clamp.
Fuel hose / Protector (Fuel connector to Low pressure fuel filter)
Fuel return hose / Protector (Fuel return pipe to Fuel vapor separator)
A
Clamp: Fix evaporation hose with clamp.
Evaporation hose / Protector (Fuel vapor separator to Cylinder head cover)
Fuel delivery pipe
Fuel return pipe
Fuel hose / Protector (Low pressure fuel filter to Fuel vapor separator)
Low pressure fuel filter
Fuel hose / Protector (Fuel connector to Low pressure fuel filter)
Fuel hose / Protector (Low pressure fuel filter to Low pressure fuel pump)
Low pressure fuel pump


Breather hose / Protector
High pressure fuel filter
3-way joint
Fuel delivery pipe union
60°
Fuel injector
Silencer


Fuel hose / Protector
(Low pressure fuel pump to Fuel vapor separator)
Upper union bolt
35 N·m(3.5 kg-m, 25.5 lb-ft)
Fuel injector
Fuel delivery pipe
Fuel injector
Fuel injector
Fuel hose / Protector
(Low pressure fuel pump
to Low pressure fuel filter)
Lower plug
35 N·m(3.5 kg-m, 25.5 lb-ft)
Low pressure fuel pump
Fuel injector

DF140 “K2” (’02) MODEL

CONTENTS

11

GENERAL INFORMATION

*SPECIFICATIONS

* These specifications are subject to change without notice.

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

DIMENSIONS & WEIGHT

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

PERFORMANCE

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

POWERHEAD

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

Item	Unit	Data	
		DF140T	DF140Z

FUEL & OIL

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

BRACKET

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

LOWER UNIT

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

Item	Unit	Data	
		DF140T	DF140Z

REDUCTION SYSTEM

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

*SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data	
		DF140T	DF140Z

POWERHEAD

Recommended operating range	r/min.	5600 – 6200
Idle speed	r/min.	700 ± 50 (in-gear : approx. 700)
**Cylinder compression	kPa (kg/cm², psi)	1200 – 1600 (12 – 16, 171 – 228)
**Cylinder compression max. difference between any other cylinders	kPa (kg/cm², psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm², psi)	450 – 500 (4.5 – 5.0, 64 – 71) at 3000 r/min. (at normal operating temp.)
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8) : Oil change only 5.7 (6.0/5.0) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item		Unit		Data	
				DF140T	DF140Z

CYLINDER HEAD / CAMSHAFT

Item			Unit	DF140T / DF140Z
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)	39.520 – 39.680 (1.5560 – 1.5622)
		Limit	mm (in)	39.420 (1.5520)
	EX	STD	mm (in)	39.320 – 39.480 (1.5480 – 1.5543)
		Limit	mm (in)	39.220 (1.5441)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.120 (0.0047)
	5th	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)
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	mm (in)	22.869 (0.9004)
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	mm (in)	25.844 (1.0175)
Camshaft runout		Limit	mm (in)	0.10 (0.004)
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)
		Limit	mm (in)	0.150 (0.0059)
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)

Item			Unit	Data	
				DF140T	DF140Z

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		——	15°, 45°, 60°
	EX		——	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN,EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit	mm (in)	0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit	mm (in)	41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.7 – 42.5) for 32.6 mm (1.28 in.)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in.)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF140T	DF140Z

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.05 (0.002)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140T	DF140Z

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF140T	DF140Z

ELECTRICAL

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

STARTER MOTOR

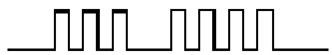
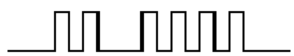
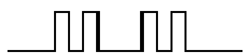
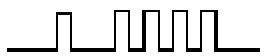
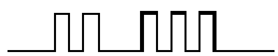
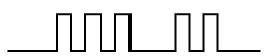
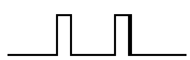
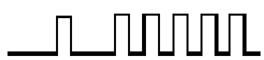
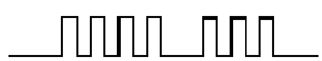
Max. continuous time of use		Sec	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.0 (0.20)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

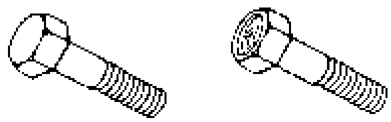
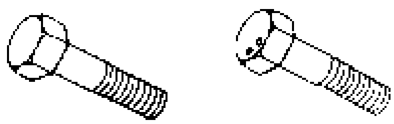
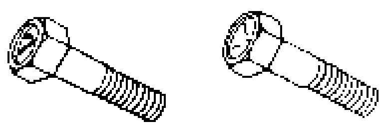
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

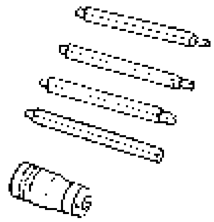
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	23	2.3	16.5
		10 mm	70	7.0	50.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	56	5.6	40.5
Conrod cap nut		8 mm	40	4.0	29.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	56.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt/nut		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Fuel delivery pipe nut		8 mm	23	2.3	16.5
Fuel delivery pipe plug/union bolt	Upper	12 mm	35	3.5	25.5
	Lower	12 mm	35	3.5	25.5
Fuel return pipe bolt		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Oil filter stand		——	40	4.0	29.0
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	85	8.5	61.5
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt/nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	20	2.0	14.5
Gearcase bolt		10 mm	54	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	20	2.0	14.5
Pinion nut		14 mm	120	12.0	87.0
Propeller nut		18 mm	55	5.5	40.0

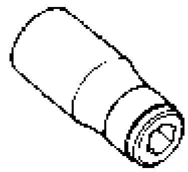
Tightening torque – general bolt

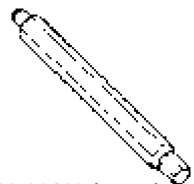
NOTE:
These values are only applicable when torque for a general bolt is not listed in the “Important Fasteners” table.

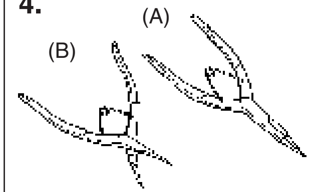
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N · m	kg-m	lb-ft
 (Conventional or “4” marked bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
	10 mm	22 – 35	2.3 – 3.5	16.0 – 25.5
 (Stainless steel bolt)	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 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

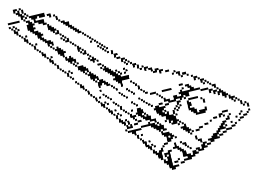
1.

09900-00410
Hexagon wrench set

2.

09900-00411
Hexagon socket
(included in 09900-00410)

3.

09900-00413 (5 mm)
09900-00414 (6 mm)
Hexagon bit
(included in 09900-00410)

4.


(A) 09900-06107
(B) 09900-06108
Snap ring pliers

5.

09900-20101 (150 mm)
09900-20102 (200 mm)
Vernier calipers

6.

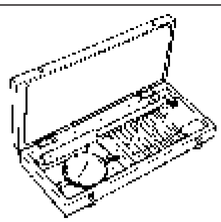
09900-20202
Micrometer (25 – 50 mm)

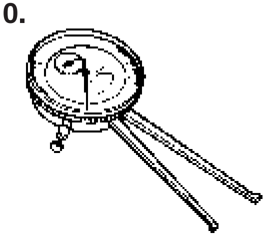
7.

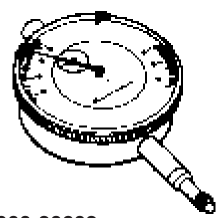
09900-20203 (50 – 75 mm)
09900-20204 (75 – 100 mm)
Micrometer

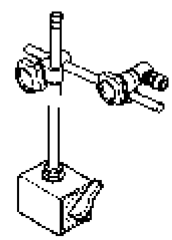
8.

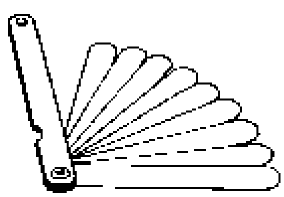
09900-20205
Micrometer (0 – 25 mm)

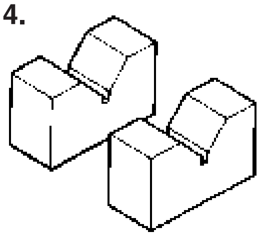
9.

09900-20530
Cylinder gauge set

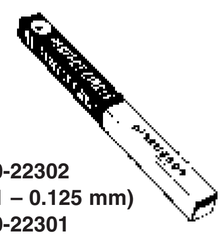
10.

09900-20605
Dial calipers (10 – 34 mm)

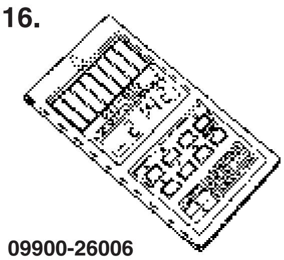
11.

09900-20602
Dial gauge

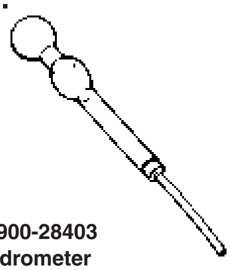
12.

09900-20701
Magnetic stand

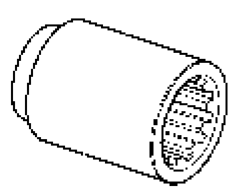
13.

09900-20803
Thickness gauge

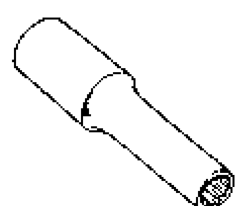
14.

09900-21304
Steel “V” block set

15.

09900-22302
(0.051 – 0.125 mm)
09900-22301
(0.025 – 0.076 mm)
Plastigauge

16.

09900-26006
Engine tachometer

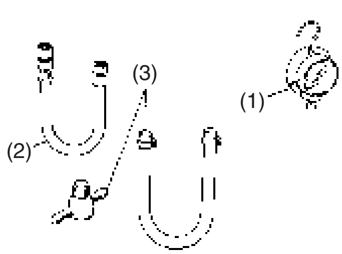
17.

09900-28403
Hydrometer

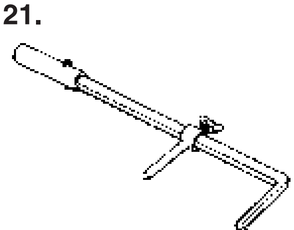
18.

09921-29410
Driveshaft holder

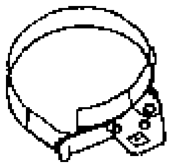
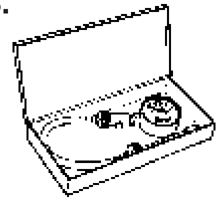
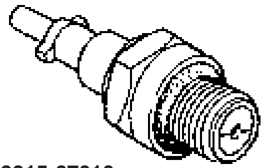
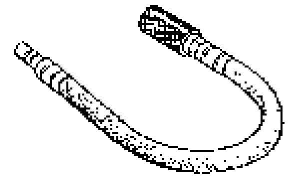
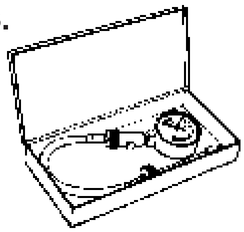
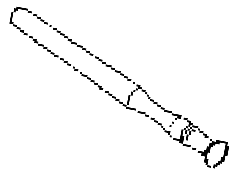
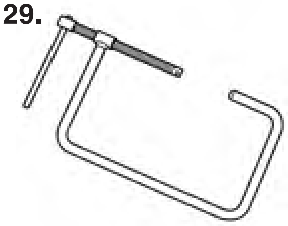
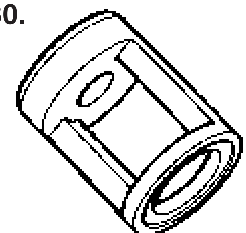
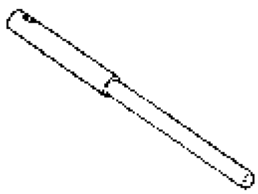
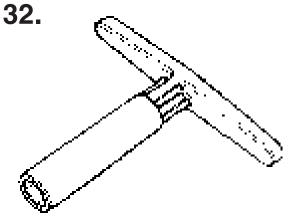
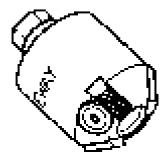
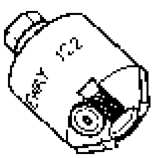
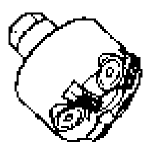
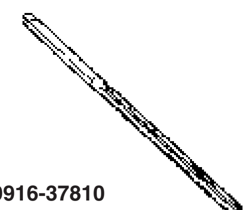
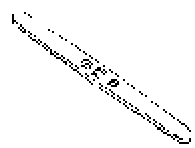
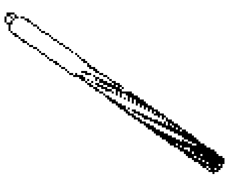
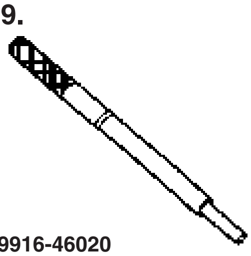
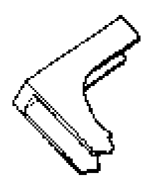
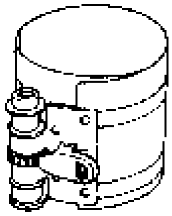
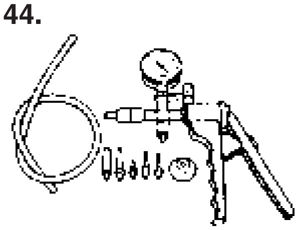
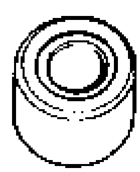
19.

09919-16010
Deep socket wrench

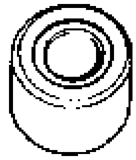
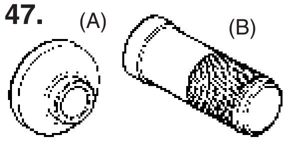
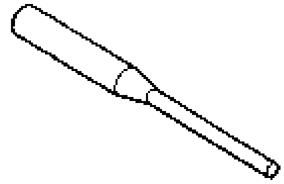
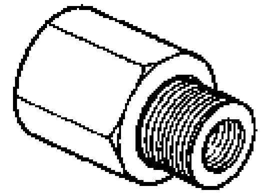
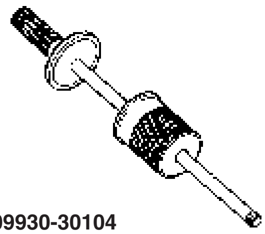
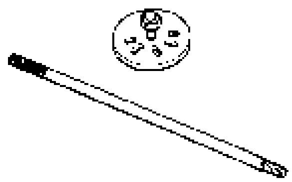
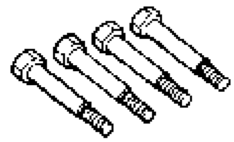
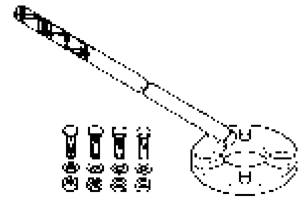
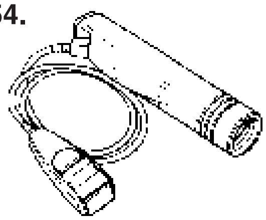
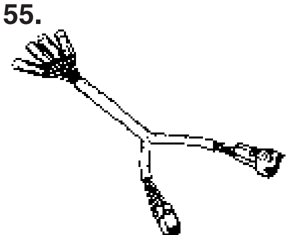
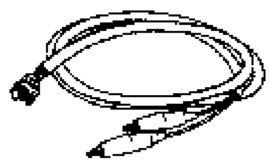
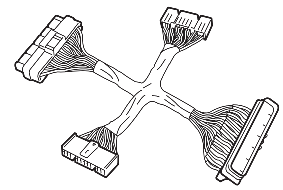
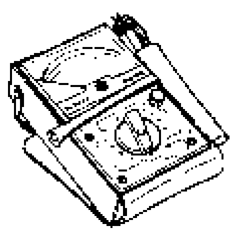
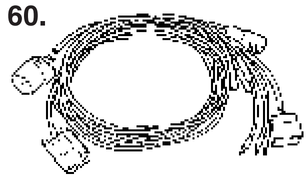
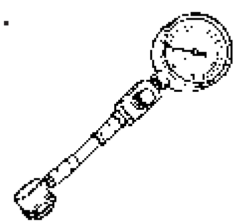
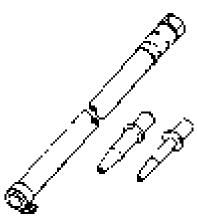
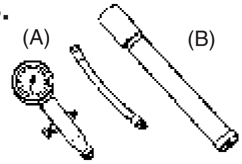
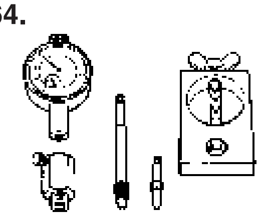
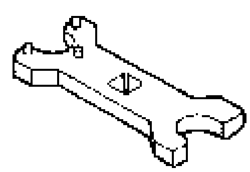
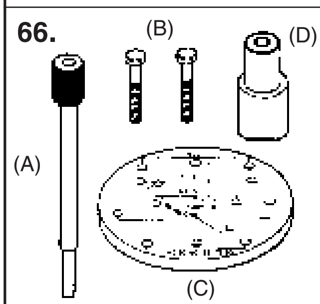
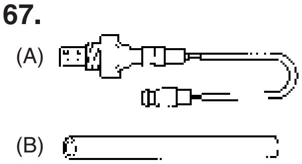
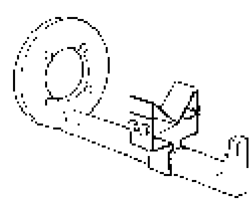
20.
09912-58413
Fuel pressure gauge set

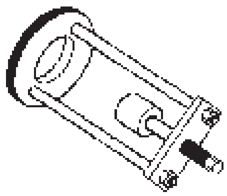
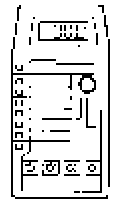
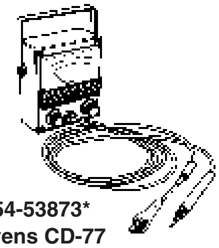
(1) 09912-58442
Fuel pressure gauge
(2) 09912-58432
Fuel pressure hose
(3) 09912-58490
3-way joint & hose



21.

09913-50121
Oil seal remover

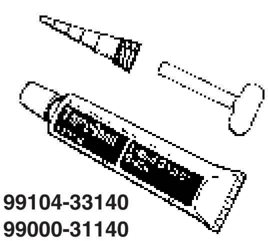
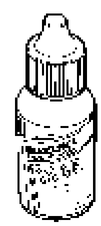
22.  09915-47332 Oil filter wrench	23.  09915-64512 Compression gauge	24.  09915-67010 Compression gauge hose attachment	25.  09915-64530 Compression gauge hose
26.  09915-77311 Oil pressure gauge	27.  09915-78211 Oil pressure gauge adapter	28.  09916-10911 Valve lapper	29.  09916-19030 Valve lifter
30.  09916-14910 Valve lifter attachment	31.  Solid pilot (Neway N-120-6.0)	32.  09916-54910 Handle (N-505)	33.  09916-22420 Valve seat cutter (60°) (Neway 114)
34.  09916-20620 Valve seat cutter (45°) (Neway 122)	35.  09916-20610 Valve seat cutter (15°) (Neway 121)	36.  09916-37810 Valve guide reamer (ϕ 6 mm)	37.  09916-34542 Valve guide reamer handle
38.  09916-38210 Valve guide reamer (ϕ 11 mm)	39.  09916-46020 Valve guide remover	40.  09916-57350 Valve guide installer	41.  09916-49040 Tappet holder
42.  09916-77310 Piston ring compressor	43.  09916-84511 Tweezers	44.  09917-47011 Vacuum pump gauge	45.  09917-87810 Valve guide installer attachment

46.  09917-98221 Valve guide stem seal installer attachment	47.  (A) 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 test cord
58.  09930-99320 Digital tester	59.  09900-25010 Pocket tester	60.  09932-79910 Diagnostic harness 09932-89910 SDS adapter	61.  09940-44120 Air pressure gauge
62.  09940-44130 Attachment	63.  (A) 09950-69512 Gearcase oil leakage tester (B) 09952-99310 Air pump	64.  09951-09530 Gear adjusting gauge	65.  09944-09420 PTT cylinder cap tool
66. 	Pinion bearing installer and remover (A) 09951-59910 Pinion bearing installer shaft (B) 01500-08403 Bolt (C) 09951-39914 Pinion bearing plate (D) 09951-19420 Attachment	67.  (A) 18213-74F00 O_2 sensor (B) 18498-90J20 Protector	68.  09951-09010 Shimming gauge

69.  09951-98721 Gear holder	70.  99954-53008-820* Digital voltmeter	71.  99954-53873* Stevens CD-77 Peak reading voltmeter	72.  99954-53883* Gear oil filler

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

MATERIALS REQUIRED

SUZUKI OUTBOARD MOTOR GEAR OIL  99000-22540 (400 ml × 24 pcs.)	SUZUKI SUPER GREASE “A”  *99000-25030 99000-25011 (500 g)	WATER RESISTANT GREASE  99000-25161 (250 g)	SUZUKI SILICONE SEAL  99000-31120 (50 g)
	SUZUKI BOND “1207B”  * 99104-33140 99000-31140 (100 g)	THREAD LOCK “1342”  99000-32050 (50 g)	THREAD LOCK SUPER “1333B”  99000-32020 (50 g)
4-Stroke Motor Oil API : SE, SF, SG, SH, SJ SAE : 10W-40			

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

ENGINE CONTROL SYSTEM

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

IDLING/TROLLING SPEED

Idling/Trolling engine speed as controlled by IAC system:
• Idling/Trolling engine speed: 700 ± 50 r/min
• IAC duty ratio (at idling/trolling): Approximately 30%

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

IGNITION TIMING

The ignition timing is controlled within the following range according to the engine operating condition.
• Ignition timing advance range: BTDC 5° – 45°
• Ignition timing (at idling/trolling): BTDC 10° ± 5°

OVER REVOLUTION LIMITER

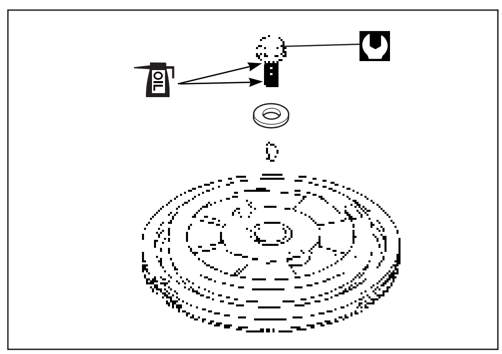
The over-rev detecting speed is as follows:
• DF140: 6500 rpm

SUZUKI DIAGNOSTIC SYSTEM

The database specially provided for DF140 needs to be added to the program ver. 4 currently used.

FLYWHEEL MAGNETO

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

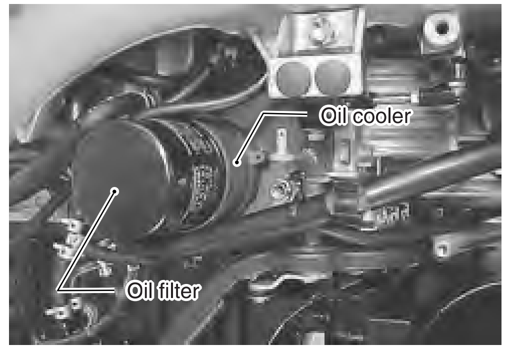


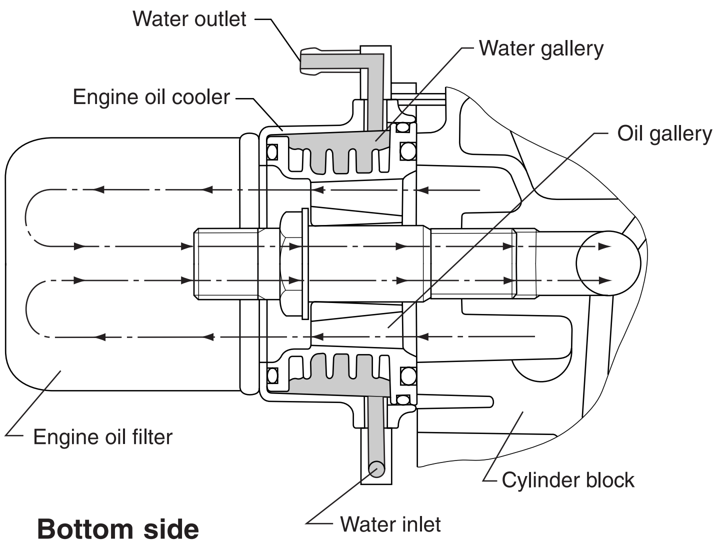
Flywheel bolt : 245 N·m (24.5 kg-m, 177 lb-ft)

POWER UNIT

ENGINE OIL COOLER

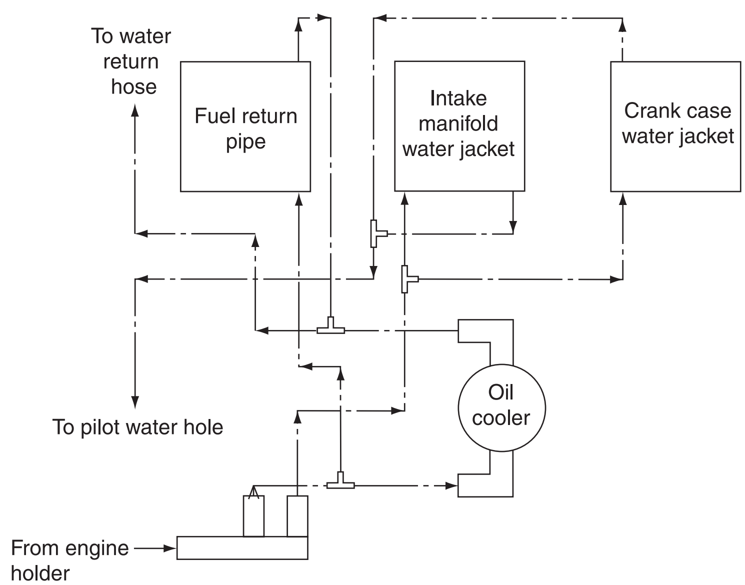
To keep a engine oil temp. properly and to show its optimum engine performance, a engine oil cooler was installed.
The water flow to cool the engine oil is shown in the figure.





Bottom side

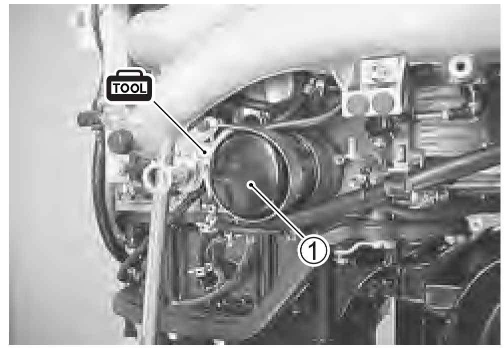
PIPING



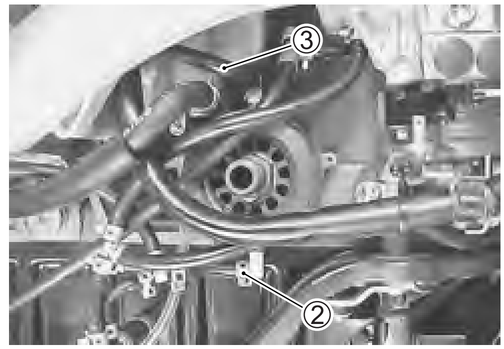
Removal

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

TOOL 09915-47332: Oil filter wrench

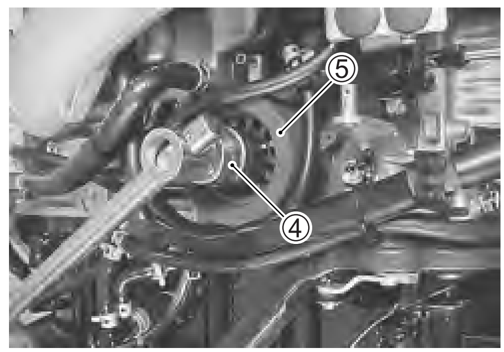


3. Disconnect both inlet ② and outlet ③ water hoses from engine oil cooler.



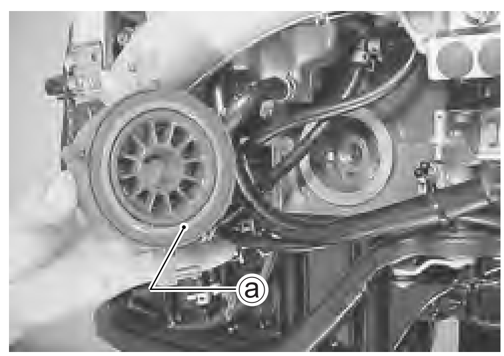
4. Loosen oil filter stand ④, then remove the oil filter stand and engine oil cooler assembly ⑤.

NOTE:
Use socket wrench to loose the oil filter stand.



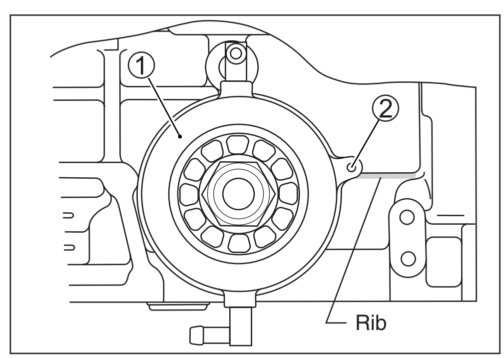
Installation

1. Install seal ring ⓐ to oil cooler assembly.



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

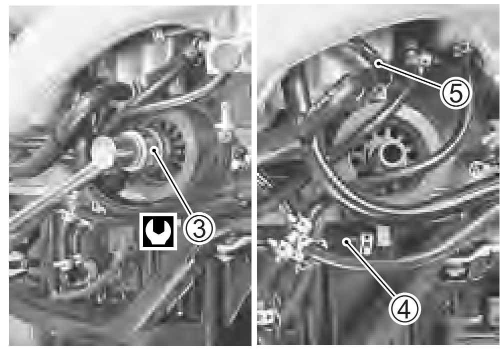
NOTE:
When installing the oil cooler, put a locating pin ② at the surface of rib in the cylinder block as shown in the figure.



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

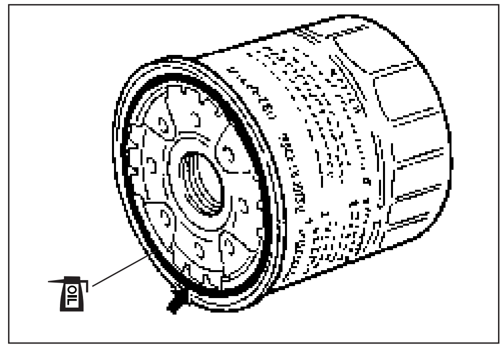
Oil filter stand: 40 N·m (4.0 kg-m, 29 lb-ft)

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



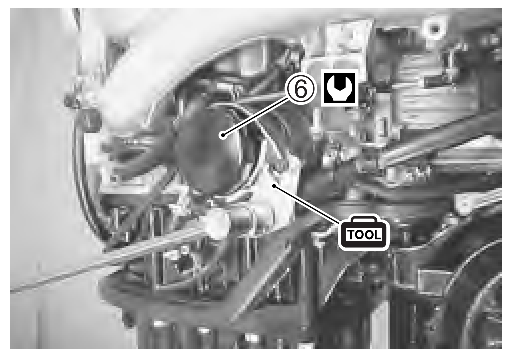
4. Screw engine oil filter ⑥ on by hand until the filter O-ring contacts the mounting surface.

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



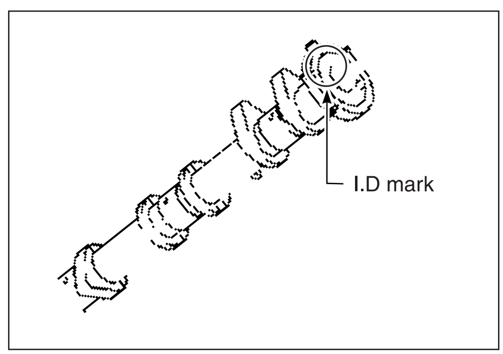
5. Tighten the engine oil filter 3/4 turn from the point of contact with the mounting surface using an oil filter wrench.

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



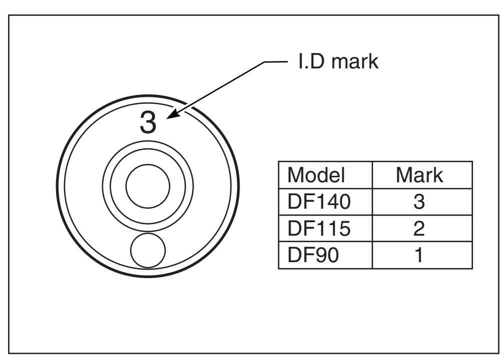
CAMSHAFT

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



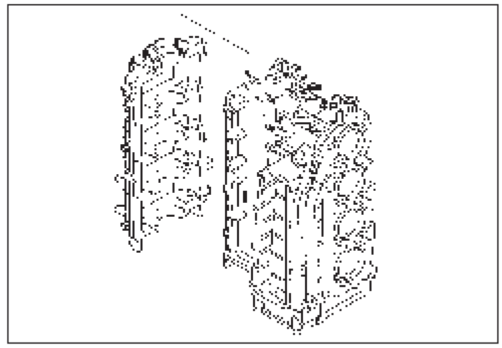
- **Cam height**
  Standard:
  IN. 39.520 – 39.680 mm (1.5560 – 1.5622 in.)
  EX. 39.320 – 39.480 mm (1.5480 – 1.5543 in.)
  Service limit:
  IN. 39.420 mm (1.5520 in.)
  EX. 39.220 mm (1.5441 in.)

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



Model	Mark
DF140	3
DF115	2
DF90	1

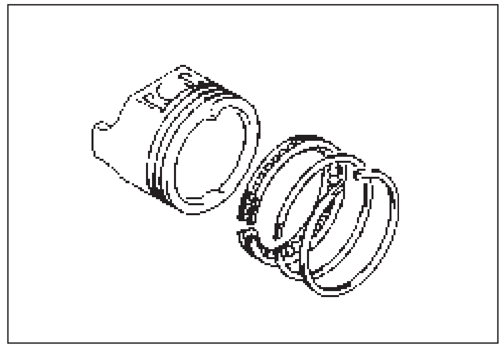
CYLINDER BLOCK



The cylinder bore is different from DF90/115.
The diameter for the cylinder of DF140 has become as the following.

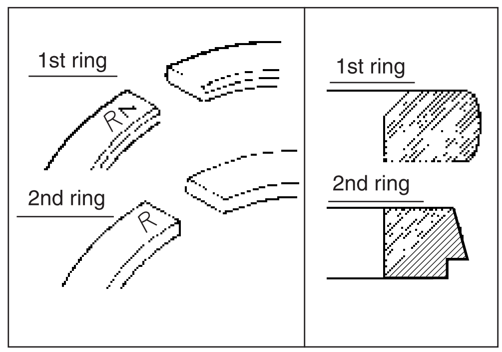
Cylinder bore
Standard: 86.000 – 86.020 mm (3.3858 – 3.3866 in.)

PISTON & PISTON RING



Piston and piston ring diameters are different from DF90/115.
The dimension of piston has become as the following.

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

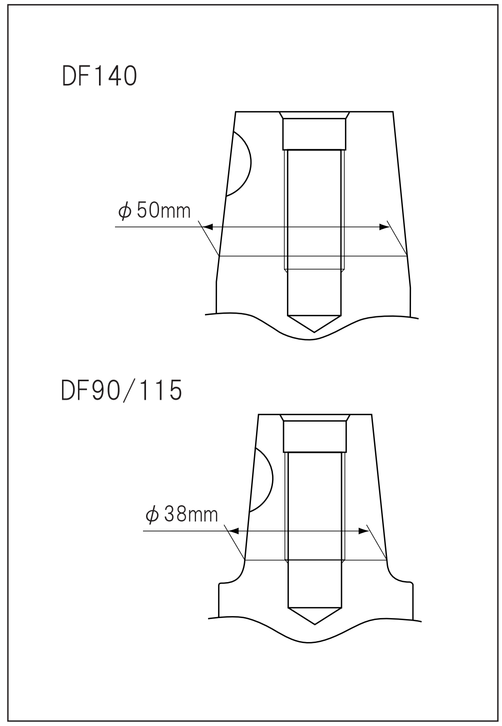


The shape of piston ring is the same as DF90/115.
- 1st ring: Barrel face and nitrogen treatment
- 2nd ring: Taper face with under cut and hard chrome plating

NOTE:
1st ring differs from 2nd ring in shape and color of surface contacting cylinder wall.
Distinguish 1st ring from 2nd ring by referring to figure.

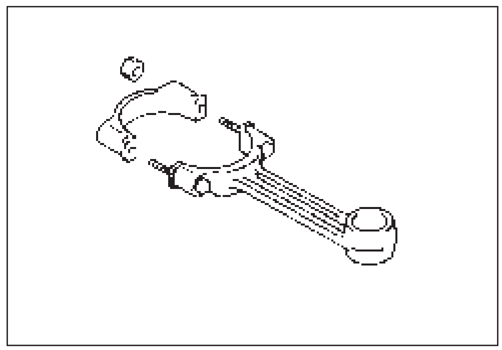
CRANKSHAFT

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



CONROD ASSEMBLY

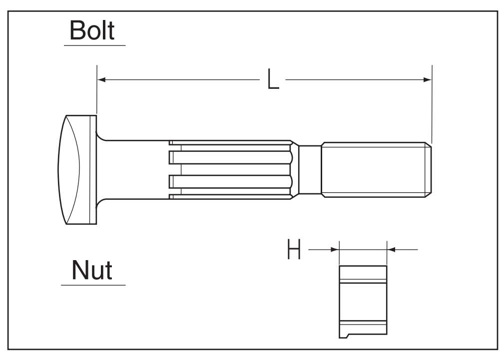
Conrod bolts and nuts are different between DF140 and DF90/115.
However, the conrod and cap of DF90/115 are used for DF140. Because the different conrod bolt is used for DF140, the torque for the conrod cap nuts of DF140 has become as the following.



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

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

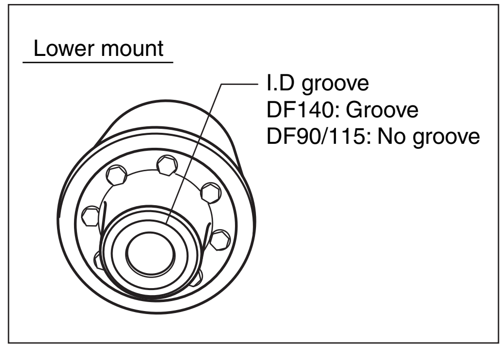
	DF140	DF90/115
Bolt length (L)	48 mm	46 mm
Nut height (H)	9.5 mm	7.5 mm



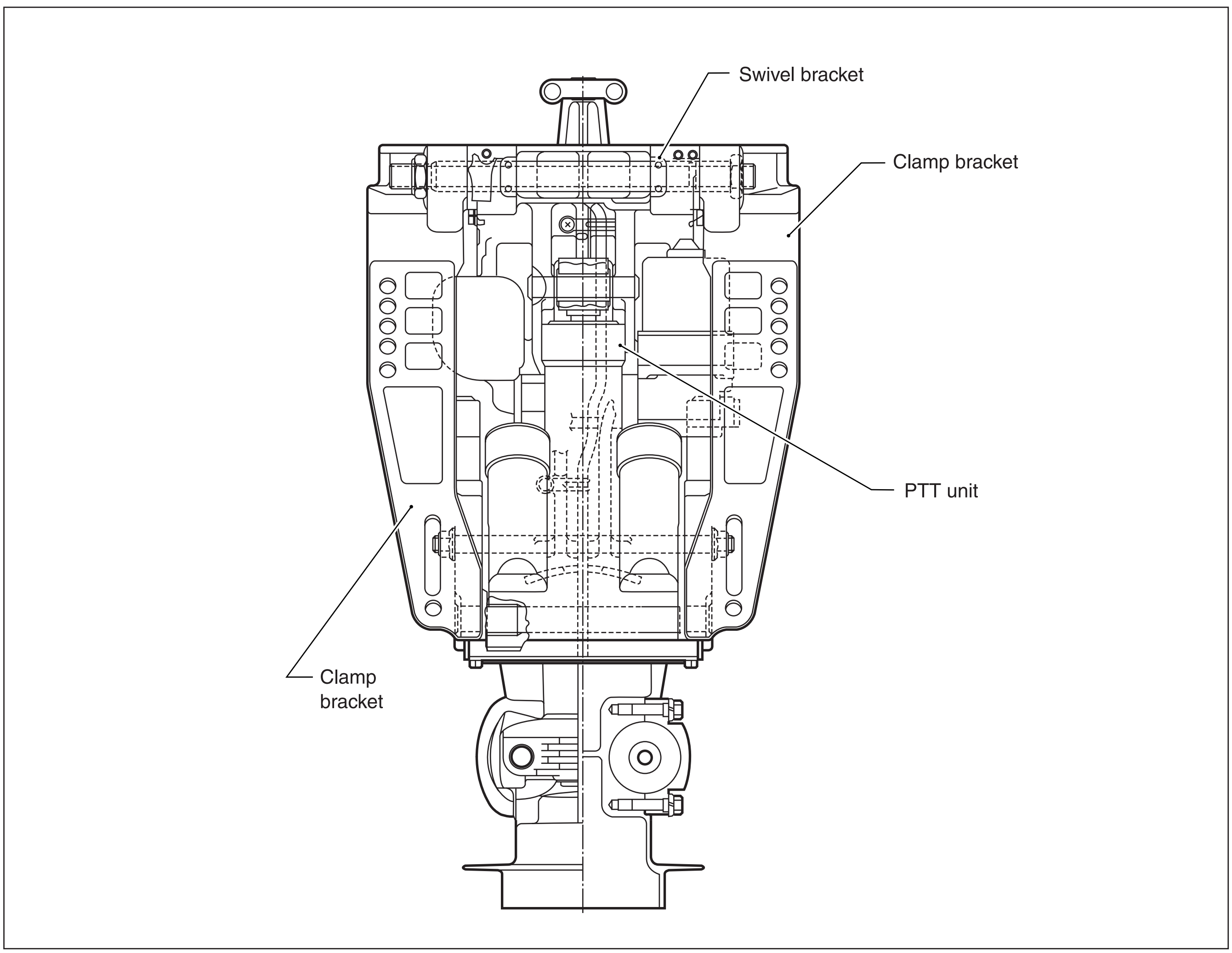
MID UNIT

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

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

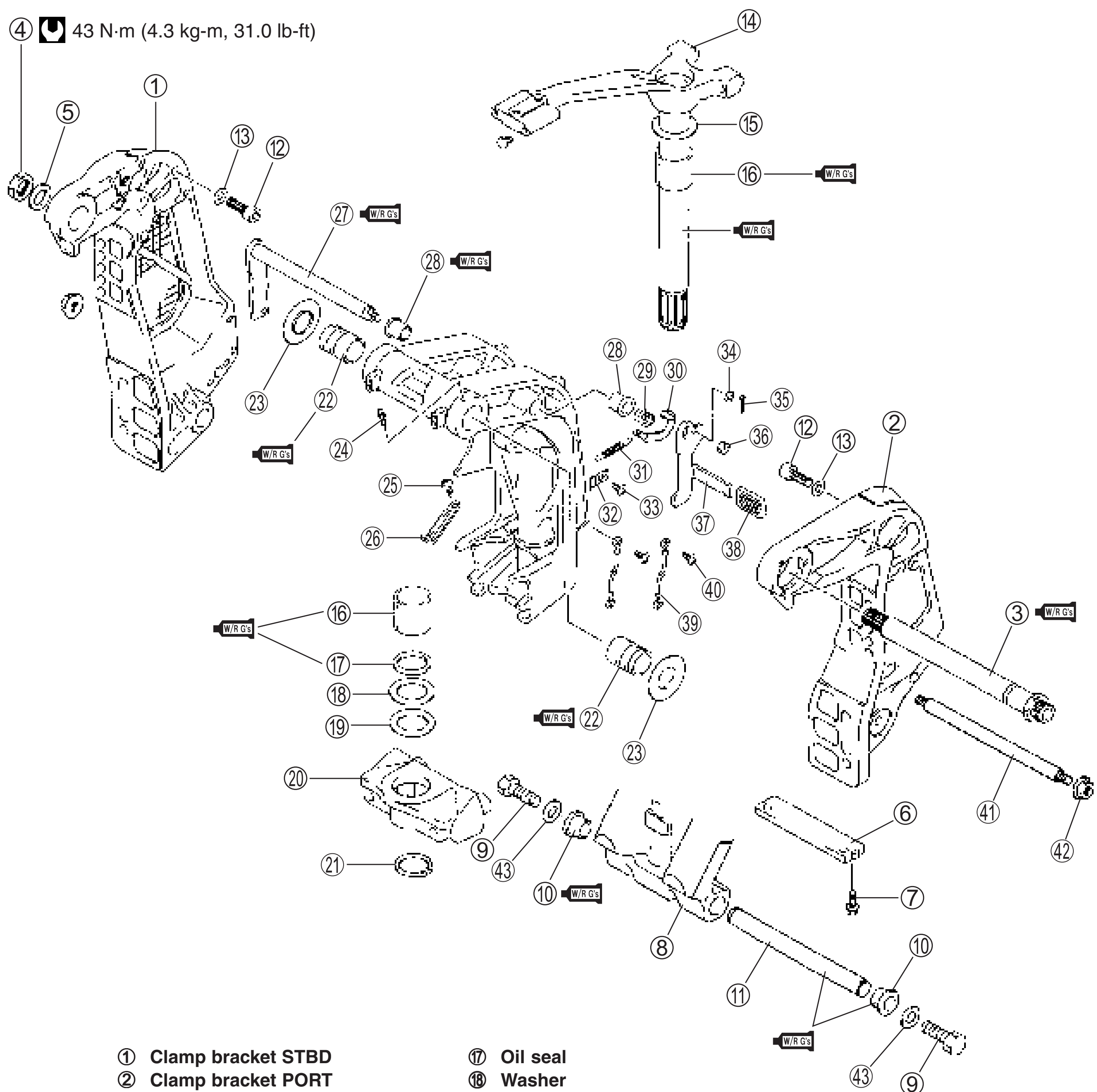


- To equip DF140 with new PTT unit, the swivel and clamp brackets have been modified.



CLAMP BRACKET / SWIVEL BRACKET / STEERING BRACKET

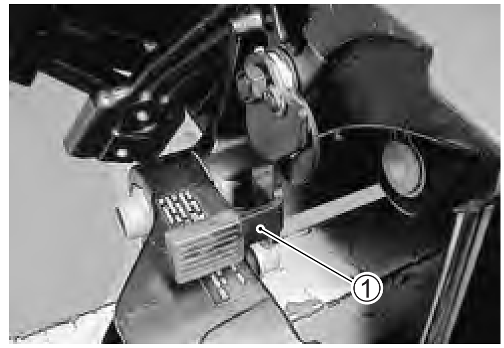
When disassembling or reassembling the components, refer to the construction diagram below.



① Clamp bracket STBD
② Clamp bracket PORT
③ Clamp bracket shaft
④ Nut
⑤ Washer
⑥ Anode
⑦ Bolt
⑧ (PTT unit)
⑨ Bolt
⑩ Bush
⑪ Lower shaft
⑫ Bolt
⑬ Washer
⑭ Steering bracket
⑮ Washer
⑯ Bush
⑰ Oil seal
⑱ Washer
⑲ Shim
⑳ Lower mount bracket
㉑ Circlip
㉒ Bush
㉓ Washer
㉔ Grease nipple
㉕ Screw
㉖ Clamp
㉗ Tilt lock lever
㉘ Bush
㉙ Spring
㉚ Link
㉛ Spring
㉜ Bracket
㉝ Screw
㉞ Washer
㉟ Pin
㊱ Nut
㊲ Tilt lock lever PORT
㊳ Rubber
㊴ Bonding wire
㊵ Screw
㊶ Tilt pin
㊷ Nut
㊸ Washer

POWER TRIM AND TILT

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



SERVICE PROCEDURE

OIL LEVEL

To check the oil level:

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

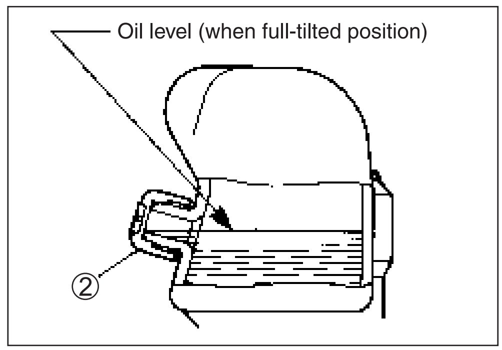
Recommended oil:

Dexron Ⅲ automatic transmission fluid or equivalent

CAUTION

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

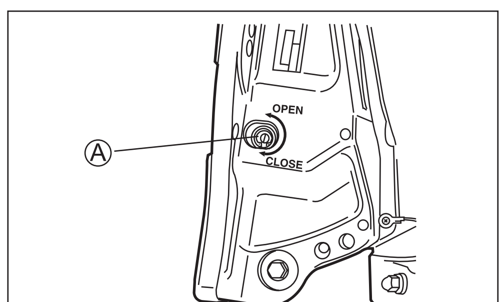
6. Reinstall oil filler plug.



AIR BLEEDING

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

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



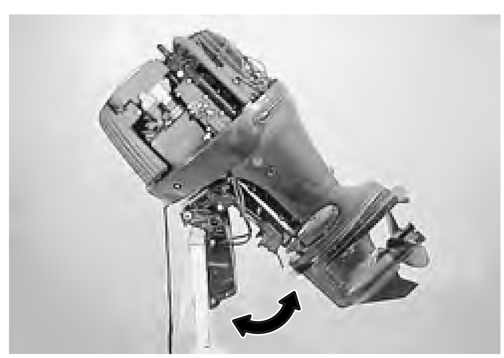
Ⓐ Manual release valve

CAUTION

Do not over-tighten manual release valve.

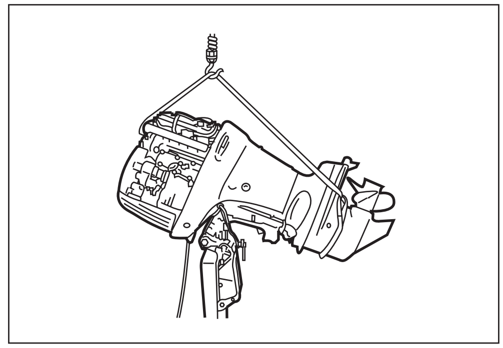
Counterclockwise	**= open**
Clockwise	**= close**

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



POWER TRIM AND TILT UNIT REMOVAL

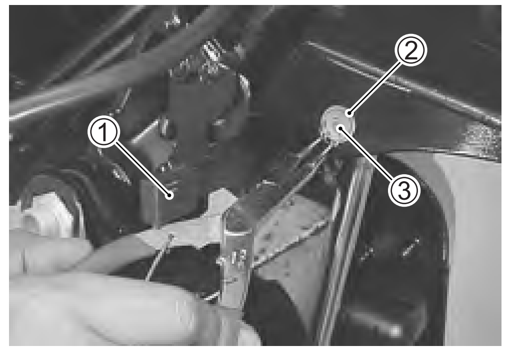
Raise the engine to the full tilt position and lower the manual tilt lock levers ①.



⚠ WARNING

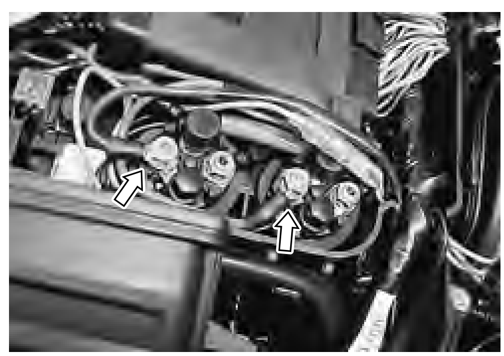
During the following procedures, the engine must be firmly secured and its weight fully supported. (See right)

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

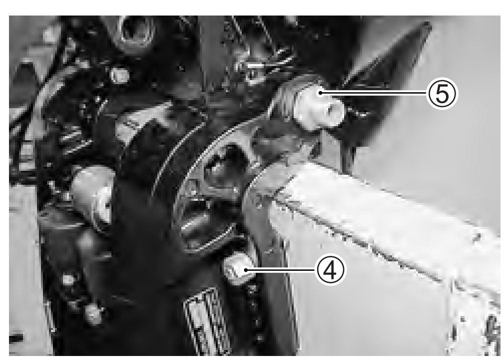


Lower tilt rod to full down position and disconnect the battery cable.

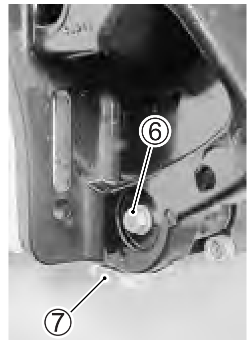
Disconnect the PTT motor cable wire leads (G, Bl) from the PTT relays.
Remove the PTT motor cable from engine lower cover.

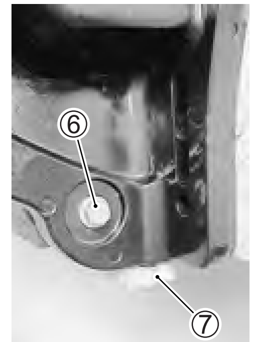


Remove the tilt pin.
Remove the two STBD motor mounting bolts ④ and the clamp bracket shaft nut ⑤.

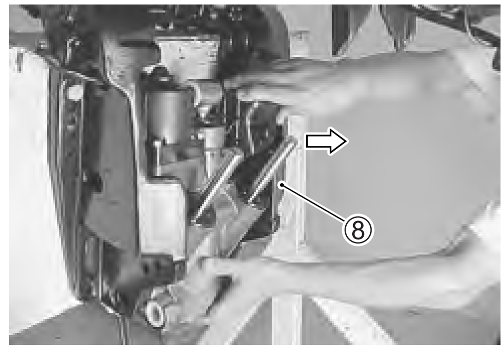


Remove the PTT cylinder lower shaft bolts ⑥.
Remove the two (2) bolts and anode ⑦.





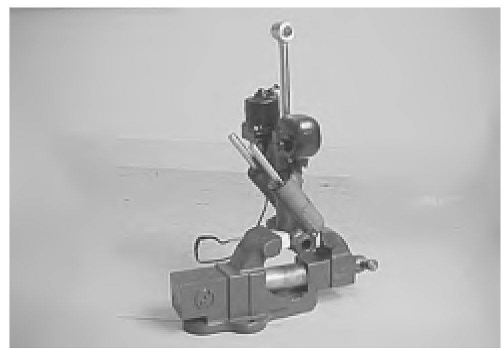
Slide the STBD clamp bracket ⑧ off the clamp bracket shaft, then remove the PTT unit.



DISASSEMBLY

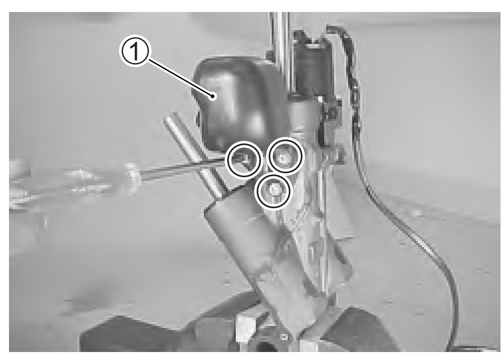
NOTE:
Before disassembly, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry the PTT body with compressed air.

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

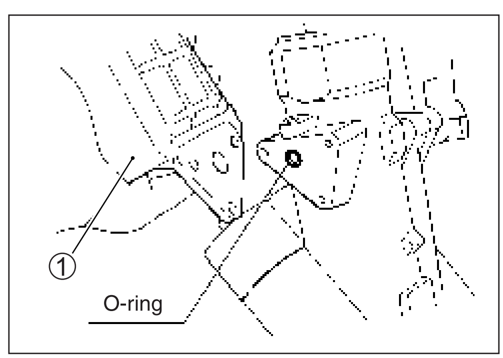


NOTE:
To prevent damage to the PTT cylinder use wood blocks, vise jaw protectors, etc., between the vise jaws and PTT components before tightening vise.

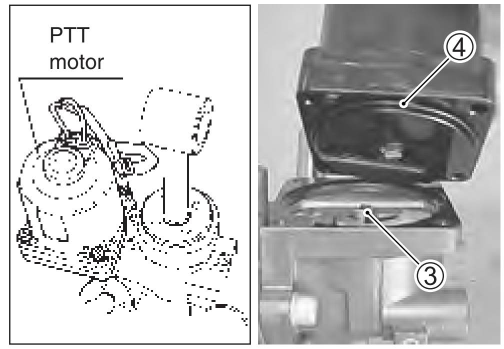
Connect the PTT motor cable leads (G, Bl) to battery and operate PTT motor until tilt piston rod is at maximum stroke.
(full-tilt up position)
Unscrew the fill plug and drain PTT oil into suitable container.



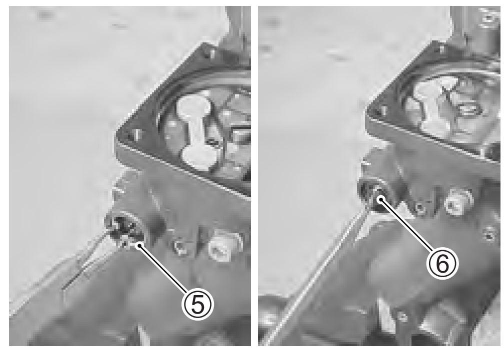
Remove the three (3) screws securing reservoir ①, then detach the reservoir from cylinder body.
Note the position of O-ring and remove it.



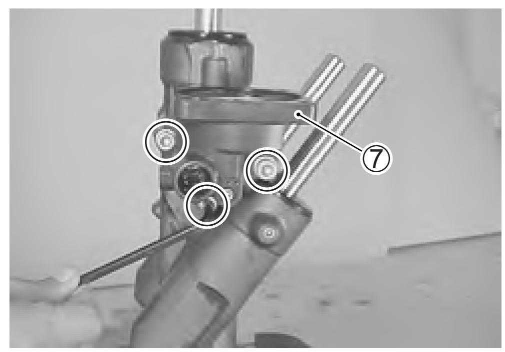
Remove the PTT motor assembly. (See page 11-33)
Note the position of drive joint ③ and O-ring ④, before removing them.



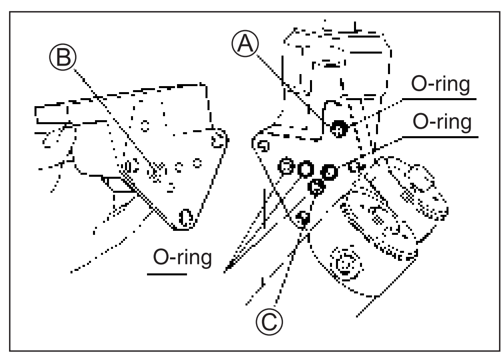
Remove the manual release valve snap ring ⑤, then unscrew the manual release valve ⑥.



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

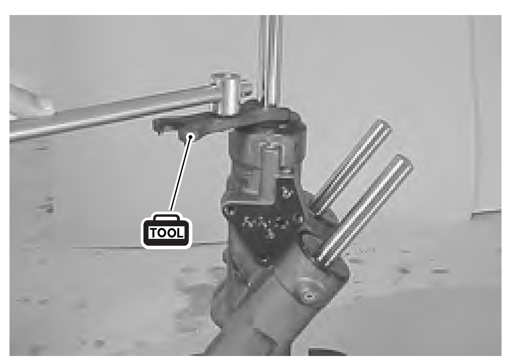


Ⓐ: Orifice collar (with ball valve)
Ⓑ: Orifice collar (with filter and ball valve)
Ⓒ: Orifice collar

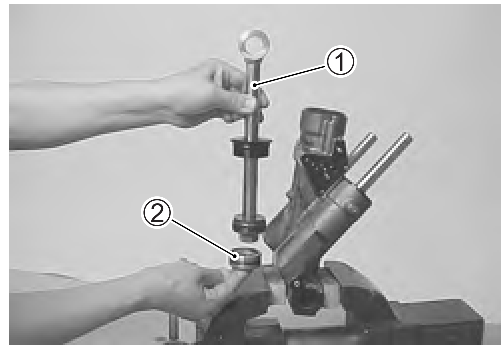


Using special tool, unscrew the PTT cylinder head.

TOOL 09944-09420: PTT cylinder cap tool

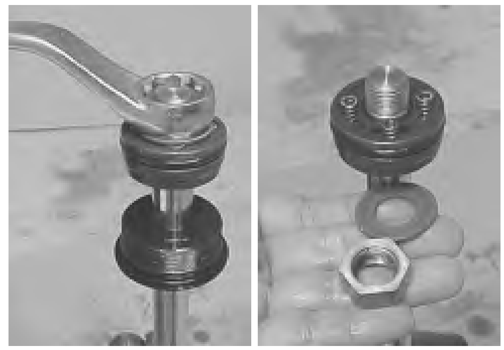


Pull the tilt rod/piston assembly ① out of the cylinder body.
Remove the free piston ② from the cylinder body.

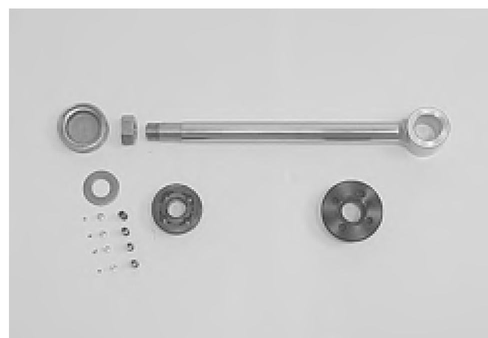


Disassembly of tilt rod/piston assembly

Unscrew the piston retaining nut from the bottom of the tilt rod and remove the washer.
Carefully retain and account for four shock valves, each composed of spring, rod and ball.



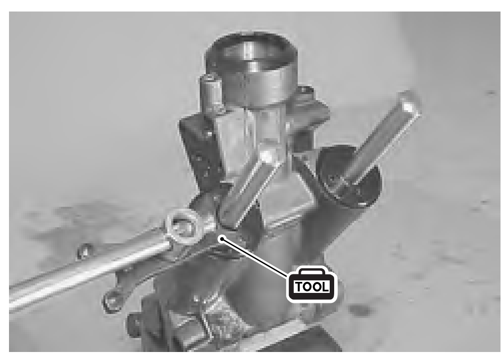
Remove the piston assembly and PTT cylinder head from the tilt rod by sliding them down and off the rod end.



Disassembly of trim rod / piston assembly

Using special tool, unscrew the trim cylinder head.

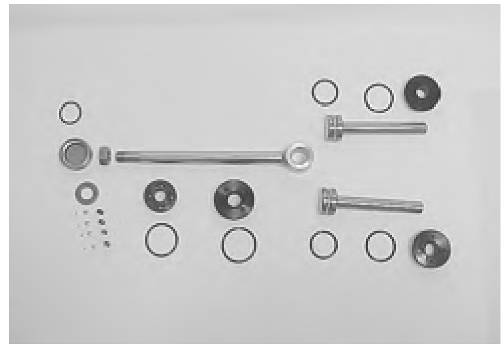
TOOL **09944-09420: PTT cylinder cap tool**



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

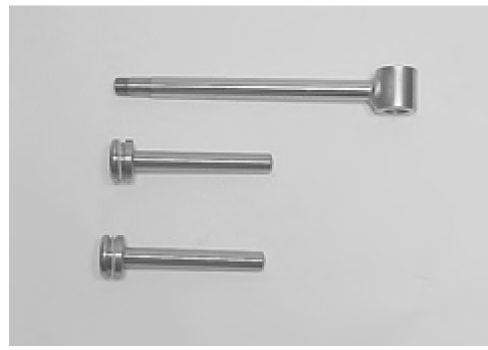
CLEANING AND INSPECTING

Thoroughly wash all metal components with cleaning solvent and dry them with compressed air.
Arrange all components on a clean sheet of paper.



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

Inspect tilt rod and trim rod, replace if damaged or bent.
Inspect the surface of tilt rod and trim rod for scores, grooves or roughness.
Slight roughness may be removed with fine emery paper.
A badly scored or grooved rod must be replaced.

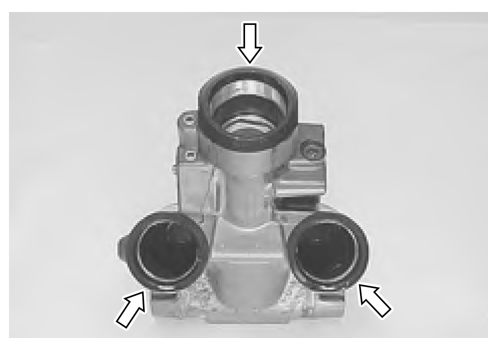


Inspect the PTT cap seal and O-ring.
Replace if cuts, nicks, or excessive wear is found.

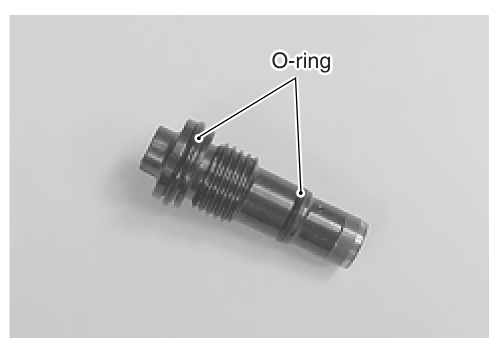
NOTE:
It is recommended that the O-ring always be replaced once the tilt/trim cylinder has been disassembled.

Inspect the shock valves (spring, rod and ball).
Replace if there are any signs of rust or pitting.

Inspect the cylinder bore for evidence of a rough or grooved surface.
Light honing may rectify slight surface roughness or scarring, but a deeply scarred surface will require replacement of the tilt cylinder.



Inspect manual release valve for damage.
Inspect manual release valve O-ring.
Replace if nicked or cut.



REASSEMBLY

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

CAUTION

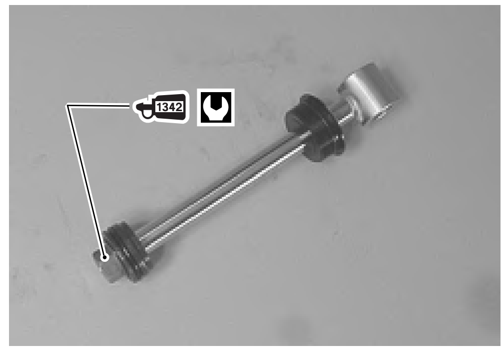
- **Do not reuse O-rings after removal, always use new O-rings.**
- **Lubricate all components and O-rings with PTT fluid before assembly.**
- **Do not reuse PTT fluid, always refill with new fluid.**

TILT ROD

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

99000-32050: Thread Lock 1342

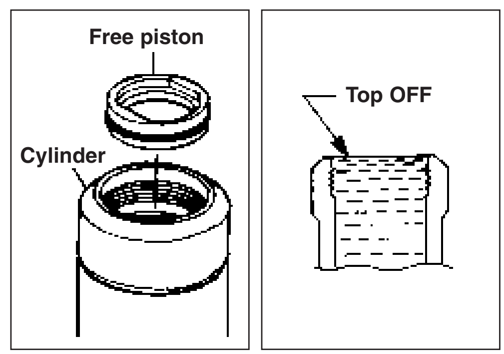
Piston retaining nut: 100 N·m (10.0 kg-m, 72.5 lb-ft)



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.

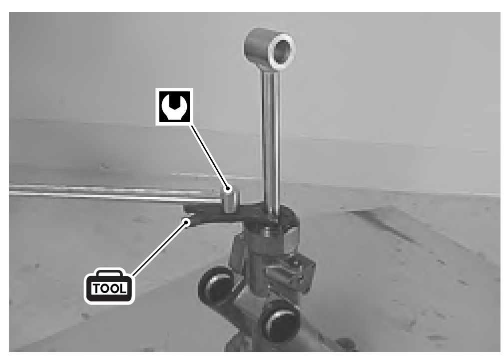
Pour PTT fluid into the cylinder until it is topped off.
Insert the tilt rod/piston into cylinder and thread the tilt cylinder head by hand until fully seated.



Tighten the cylinder head to specified torque using special tool.

Tilt cylinder head: 160 N·m (16.0 kg-m, 115.5 lb-ft)

09944-09420: PTT cylinder cap tool



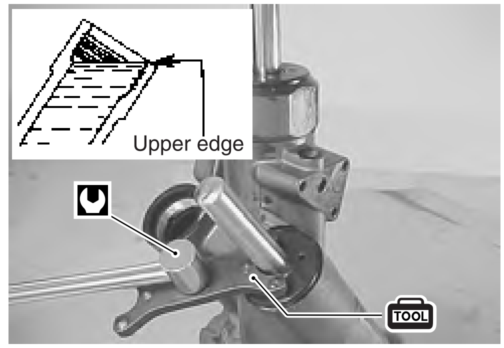
TRIM ROD

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

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

Trim cylinder head: 78 N·m (7.8 kg-m, 56.5 lb-ft)

TOOL **09944-09420: PTT cylinder cap tool**



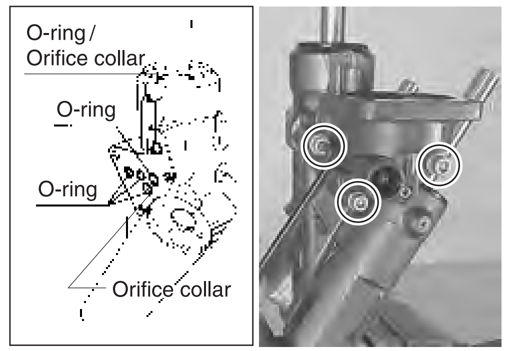
PTT PUMP CASE

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

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

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

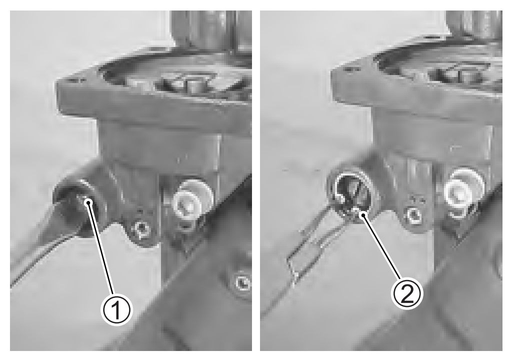
PTT pump case screw: 3.5 N·m (0.35 kg-m, 2.5 lb-ft)



MANUAL RELEASE VALVE

Oil and install the manual release valve ①.
Tighten the valve to specified torque.
Install snap ring ②.

Manual release valve: 3.5 N·m (0.35 kg-m, 2.5 lb-ft)



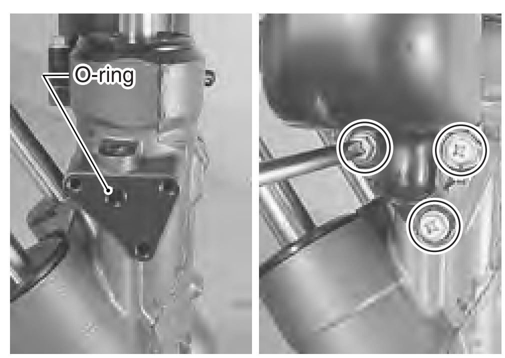
PTT MOTOR

See the PTT Motor Installation section on page 36.

RESERVOIR

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

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



AIR BLEEDING

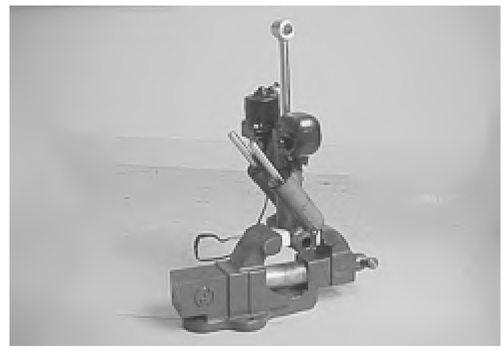
- Pour recommended PTT fluid in to reservoir until specified level.
- Perform the air bleeding procedure.
  For air bleeding, see page 11-25.

PTT MOTOR

Removal

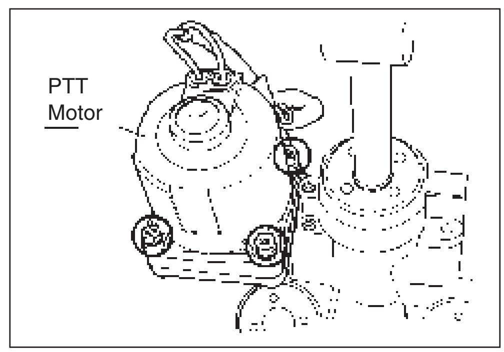
NOTE:
Before removing PTT motor, wash the PTT body with a stiff bristle brush and hot, soapy water to remove sand or dirt and dry the PTT body with compressed air.

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

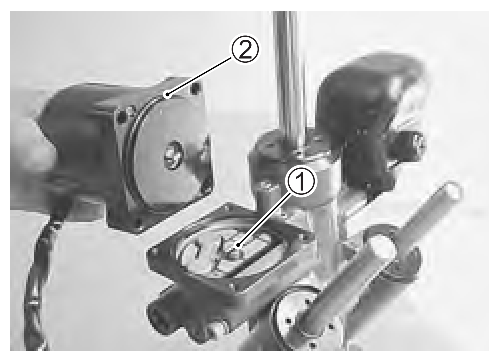


NOTE:
To prevent damage to the PTT cylinder use wood blocks, vise jaw protectors, etc., between the vise jaws and PTT components before tightening vise.

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

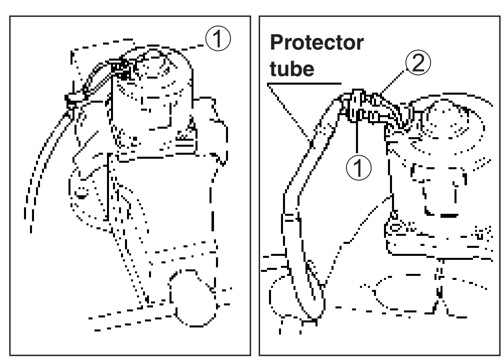


Detach the PTT motor from PTT pump case.
Note the position of drive joint ① and O-ring ② and remove them.

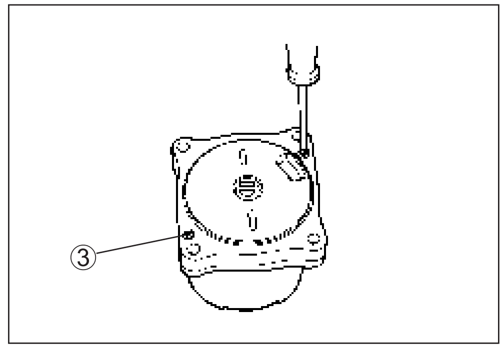


PTT motor Disassembly

For correct assembly, scribe an alignment mark on the field case and brush holder.
Slide cable protector tube upward.
Remove the screw securing the motor cable holder ①, then slide motor cable holder and grommets ② out as shown in figure.

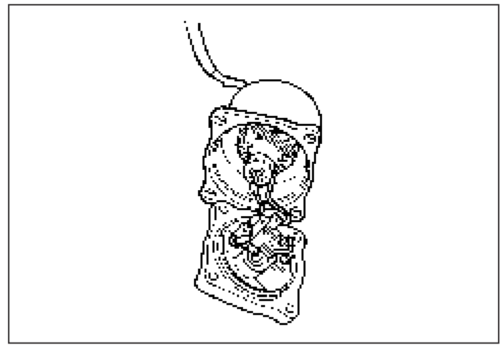


Remove the two (2) screws ③ securing the field case to the brush holder.

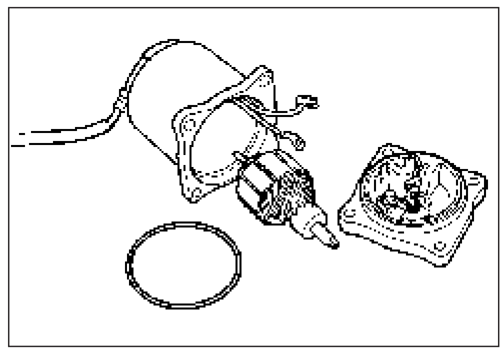


Slide the field case upward and away from the brush holder.

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



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



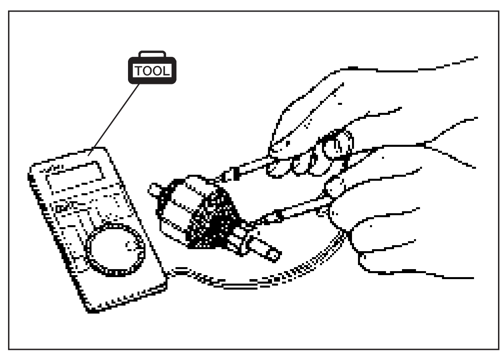
Inspection

Armature and Commutator

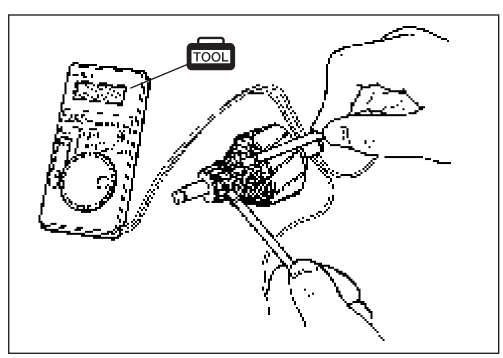
Check for continuity between the commutator and the armature core/shaft.
Replace armature if continuity is indicated.

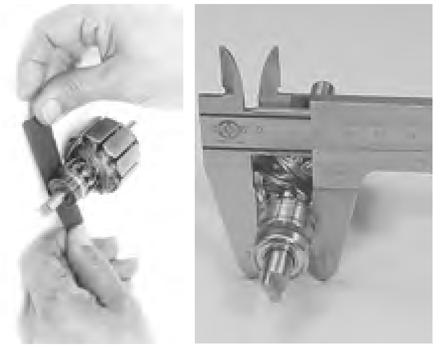
TOOL **09930-99320: Digital tester**

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 grit emery paper.

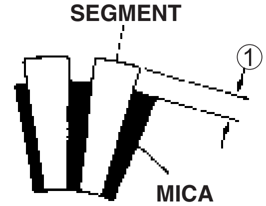
Measure commutator outside diameter.

TOOL **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.



① **Commutator undercut**

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

Commutator undercut:

Standard	**1.6 – 1.9 mm (0.06 – 0.07 in.)**
Service limit	**1.0 mm (0.04 in.)**

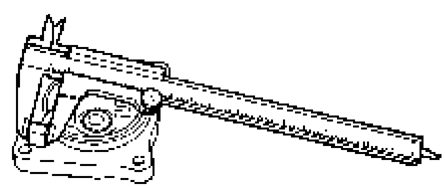
If undercut is less than service limit, cut to specified depth.

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

⚠ WARNING

Wear safety grasses when using compressed air.

Brushes



Check the length of each brush.

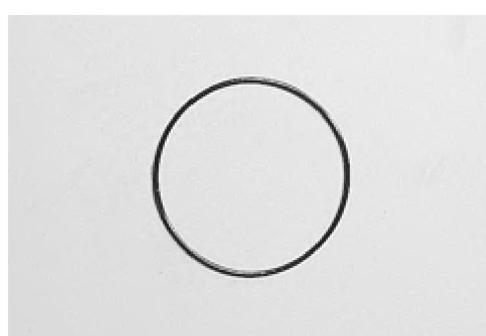
TOOL **09900-20101: Vernier calipers**

Brush length:

Standard	**9.8 mm (0.39 in.)**
Service limit	**5.0 mm (0.20 in.)**

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

O-ring

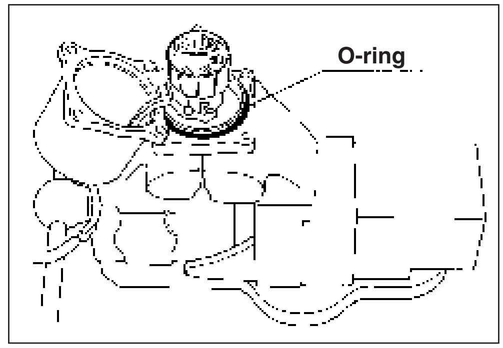


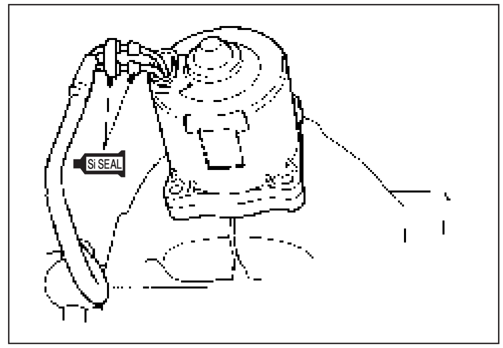
Inspect the O-ring between the PTT motor and PTT pump case.
Replace if cuts, nicks or tears are found.

Assembly

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

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

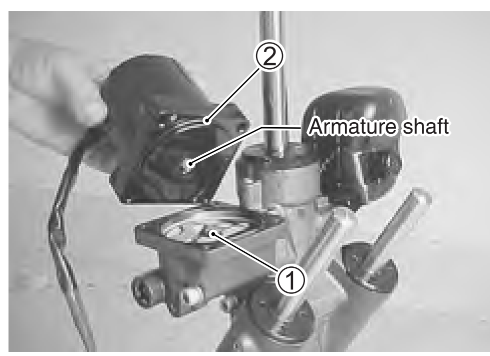




PTT motor installation

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

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



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

PTT motor screw: 5 N·m (0.5 kg-m, 3.5 lb-ft)

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

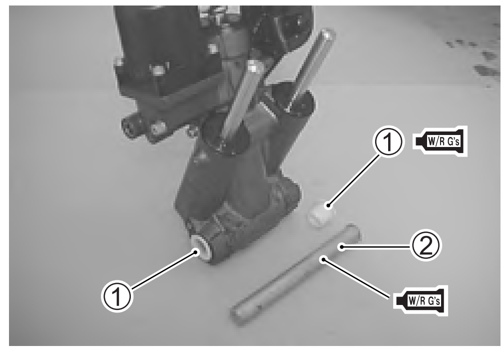
INSTALLATION

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

Lower tilt rod to full down position.

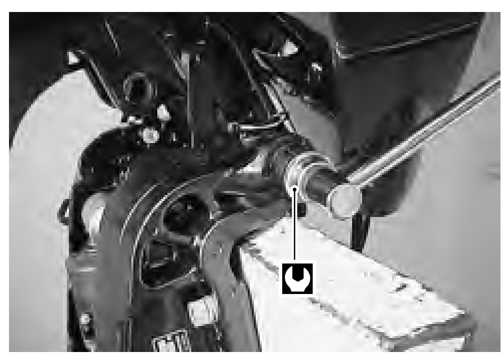
Apply Water Resistant Grease to the tilt cylinder lower shaft and lower shaft bushes.
Install bushes ① and cylinder lower shaft ② to PTT unit.

W/R G's **99000-25161: Water Resistant Grease**



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

Clamp bracket shaft nut:
43 N·m (4.3 kg-m, 31.0 lb-ft)

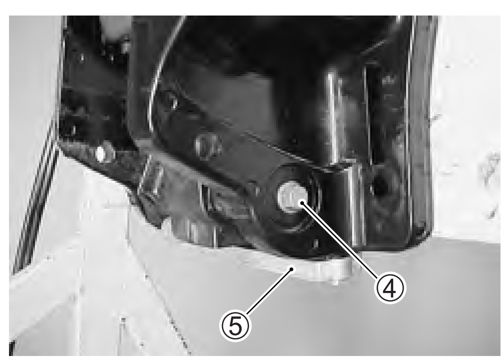


Tighten lower shaft bolts ④, pre-coated with thread lock, to specified torque.

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

Cylinder lower shaft bolt:
50 N·m (5.0 kg-m, 36.0 lb-ft)

Install anode ⑤, then tighten bolts securely.



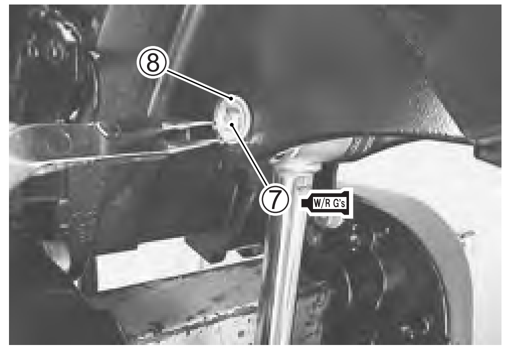
Apply Water Resistant Grease to tilt rod upper bushes ⑥, then install bushes in tilt rod.
Operate the PTT motor to extend the PTT rod upward.
Align the tilt rod with the hole in the swivel bracket as the tilt rod extends.

W/R G's **99000-25161: Water Resistant Grease**

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

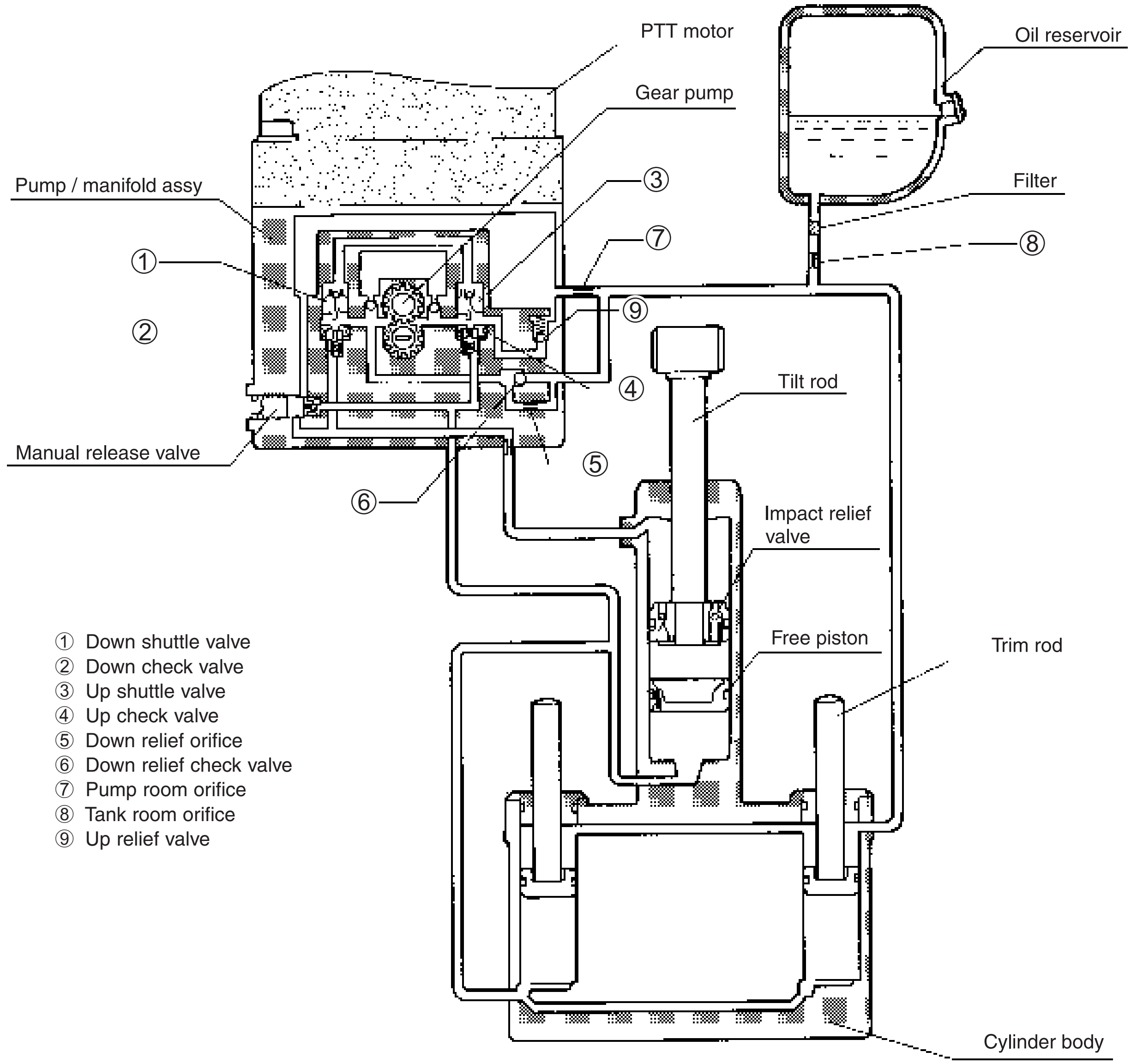
W/R G's **99000-25161: Water Resistant Grease**

Secure the upper shaft with the snap ring ⑧.



Route the PTT motor cable in through the lower cover and connect the terminals to the PTT relays.
(Cable routing – see the WIRE/HOSE ROUTING section.)

COMPONENT PARTS



① Down shuttle valve
② Down check valve
③ Up shuttle valve
④ Up check valve
⑤ Down relief orifice
⑥ Down relief check valve
⑦ Pump room orifice
⑧ Tank room orifice
⑨ Up relief valve

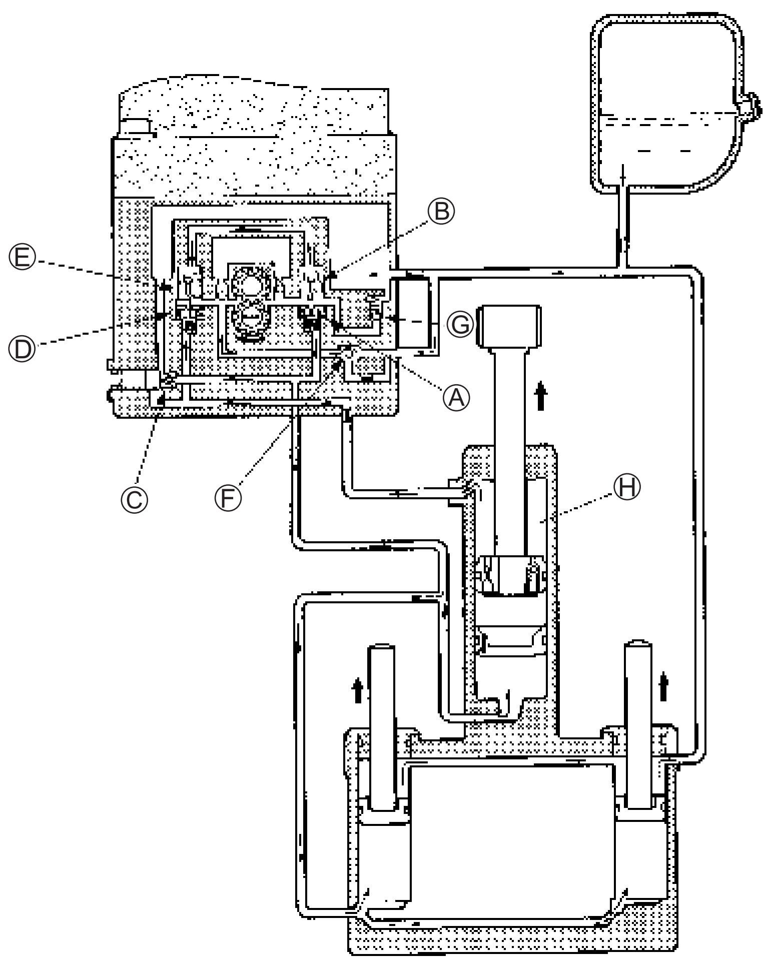
* When the manual valve is to be opened, turn the manual release valve to the left about two turns.
* When the oil level of the system should be checked, inspect the reservoir by placing the motor in the maximum tilt up position.

OPERATION

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

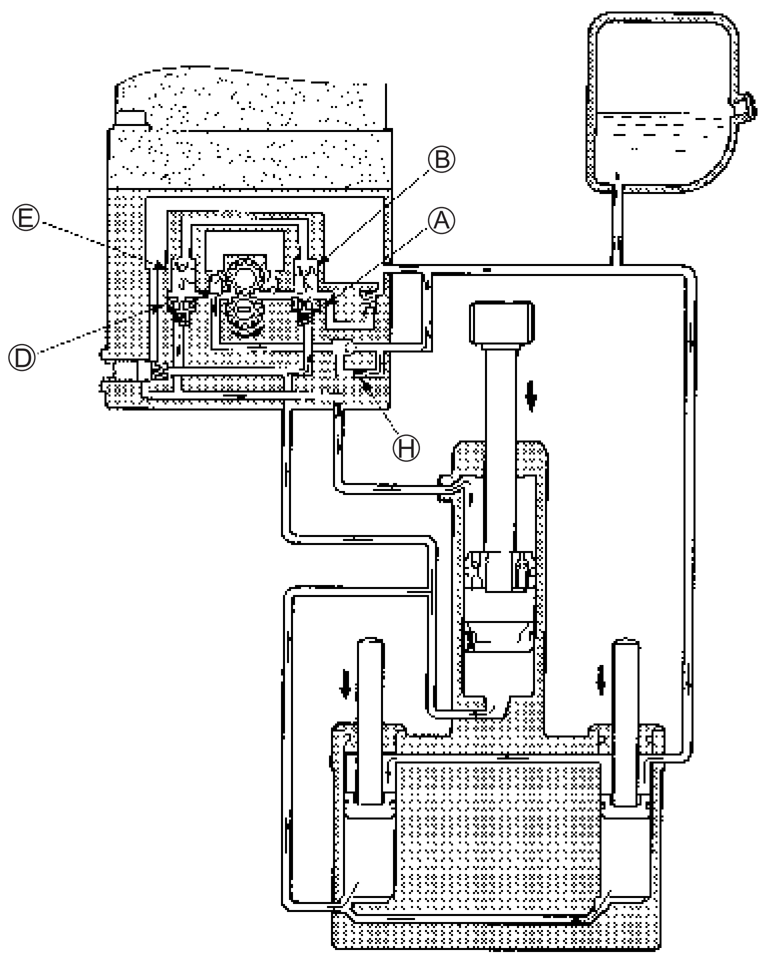
TRIM & TILT UP

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



TILT DOWN / TRIM IN

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

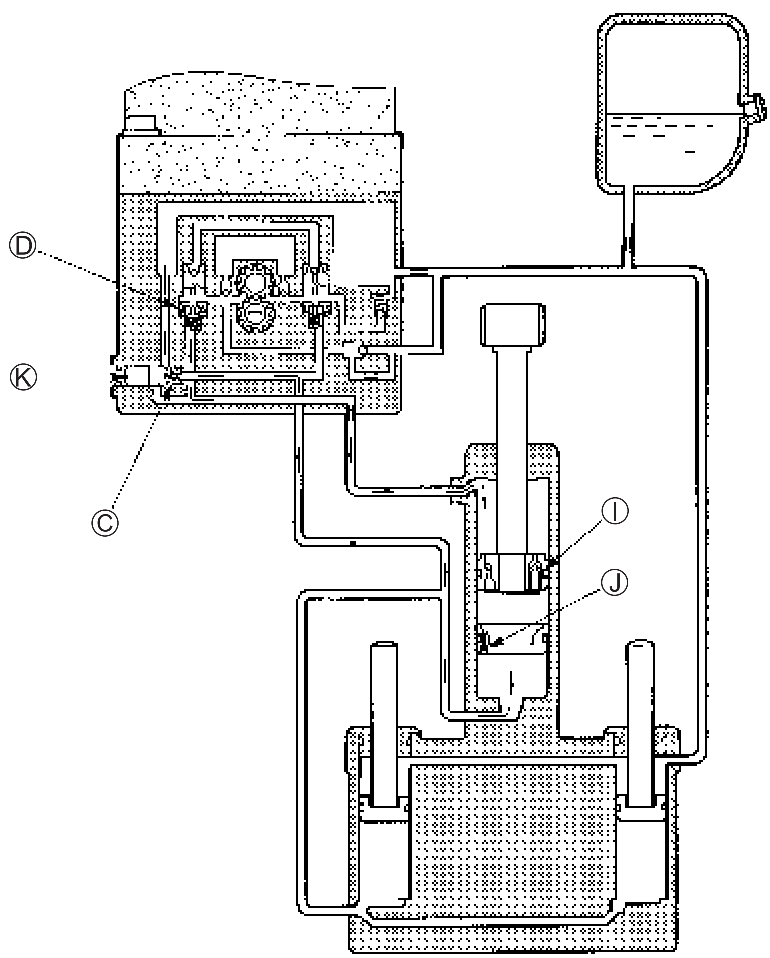


TILT SYSTEM PRESSURE RELIEF

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

THERMAL EXPANSION RELIEF

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

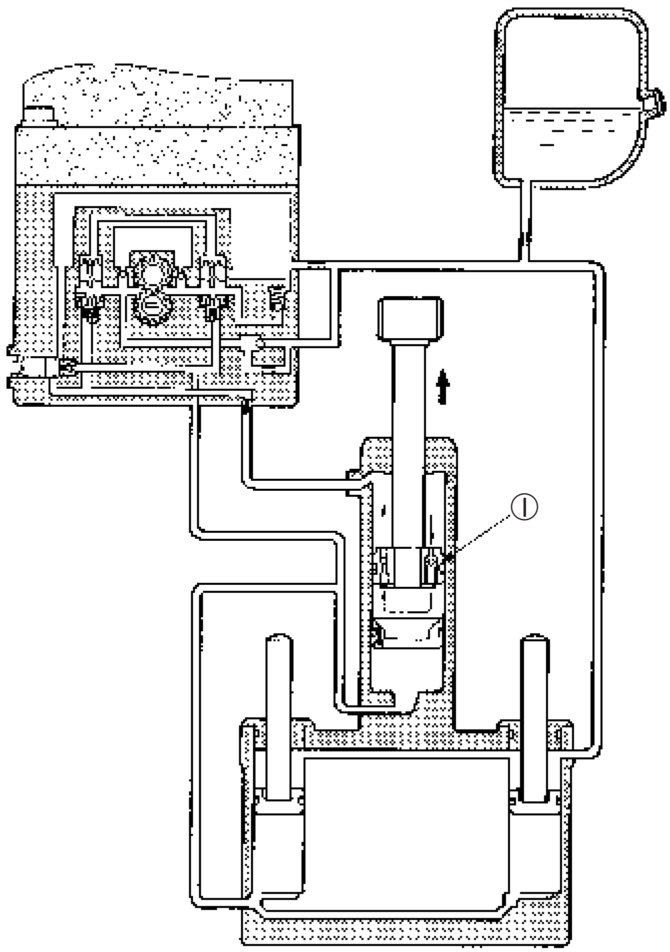


SHOCK ABSORBER CIRCUIT

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

(1) The pressure from a sudden impact will make impact relief valve ① open, allowing oil from the upper area of the tilt cylinder to flow into the area between the tilt rod piston and the free piston. The tilt rod will then extend.

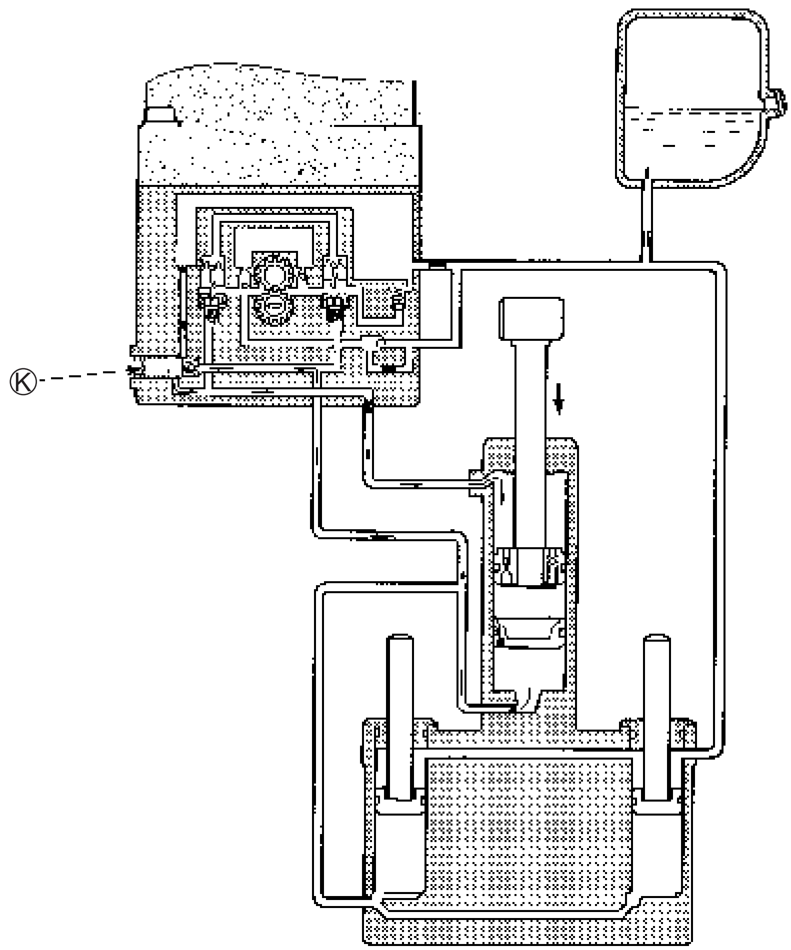
(2) When the moment of impact has passed, the PTT DOWN switch must be activated to return the engine to within the normal trim range. When the switch is pressed, the oil between the piston and free piston will be directed to the cylinder upper chamber via the return valve below the tilt piston.



MANUAL RELEASE CIRCUIT (DOWN MODE)

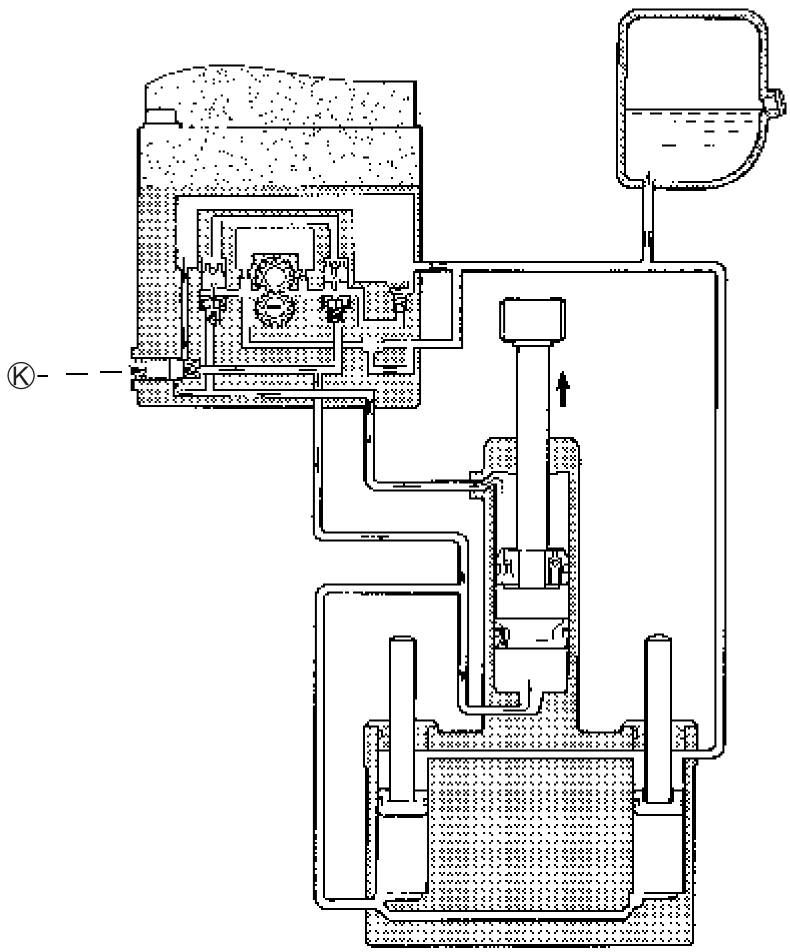
(1) By opening the manual release valve Ⓚ, the engine can be lowered manually to a running position. Oil underneath the trim and tilt pistons will be directed through this valve into the area above the tilt rod piston.

(2) The volume of oil flowing from under the trim rod pistons will be larger than the area above the tilt rod piston can accommodate. Excess oil therefore returns through the manual release valve Ⓚ to the reservoir.



MANUAL RELEASE CIRCUIT (UP MODE)

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



LOWER UNIT

(Normal rotation model)

REMOVAL AND INSTALLATION

Refer to the procedures in DF90/115 service manual.

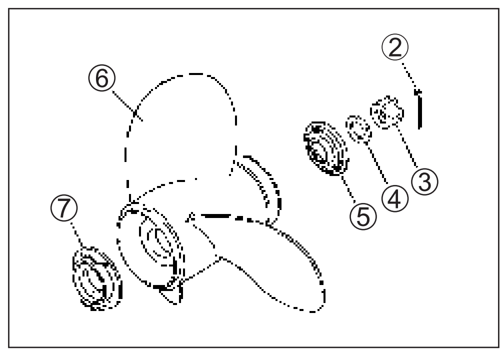
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

DISASSEMBLY

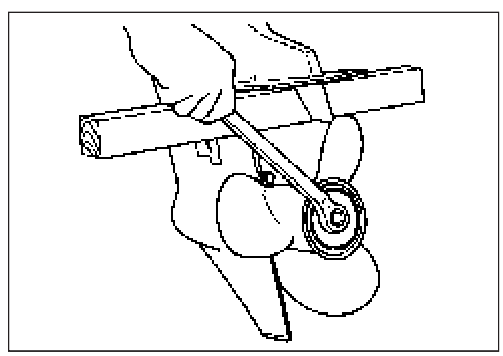
Place a drain pan under the oil drain plug.
Remove oil drain plug ① first then oil level plug ② and allow gear oil to drain.
Inspect oil for water, contaminates or metal.

Remove cotter pin ② from propeller nut and remove propeller nut ③.
Remove washer ④, spacer ⑤, propeller ⑥ and stopper ⑦ from the propeller shaft.

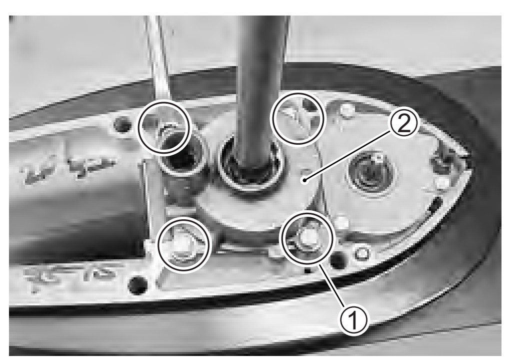


⚠ WARNING

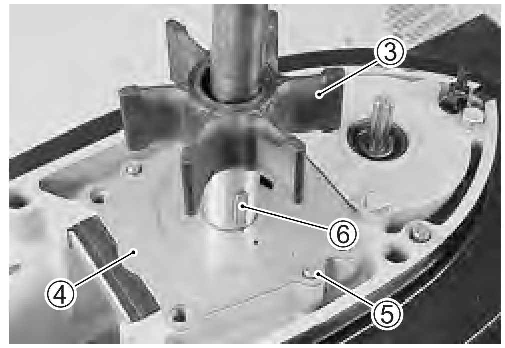
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place.



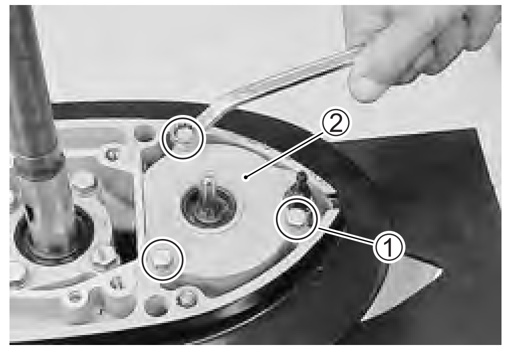
Loosen the four (4) bolts ①, then remove the water pump case ②.



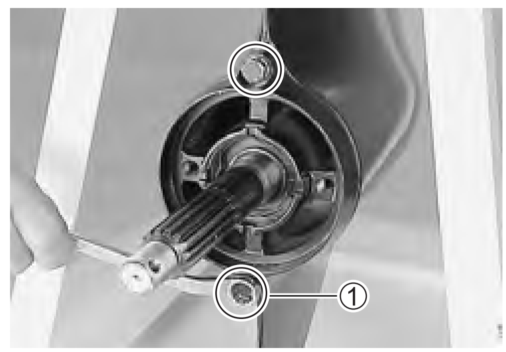
Remove the impeller ③, impeller key ⑥, pump under plate ④ and dowel pins ⑤.
Keep the impeller key ⑥ for reuse and discard the plate gasket.



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

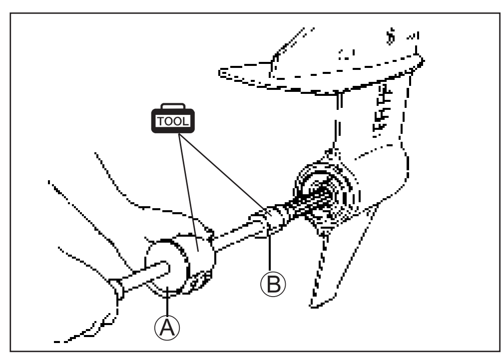


Remove the two (2) bolts ① securing the propeller shaft bearing housing to the gearcase.



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

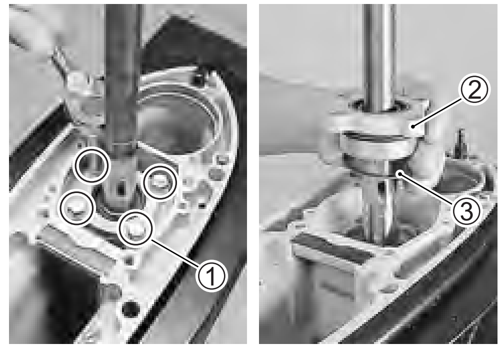
TOOL **09930-30104: Ⓐ Sliding hammer**
09930-30161: Ⓑ Propeller shaft remover



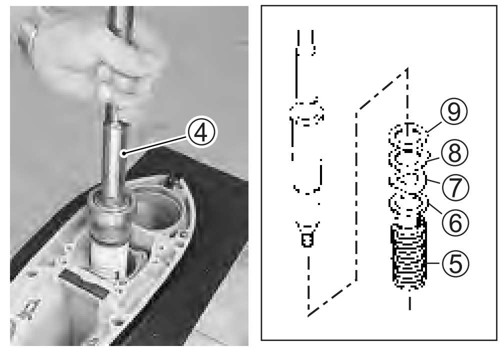
Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.

TOOL **09921-29410: Driveshaft holder**

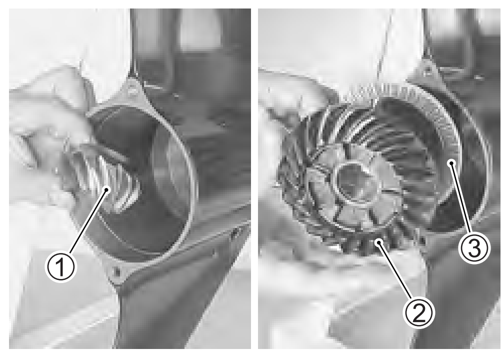
Unscrew the four (4) bolts ① securing driveshaft oil seal housing ②, then remove oil seal housing and pinion shim ③.



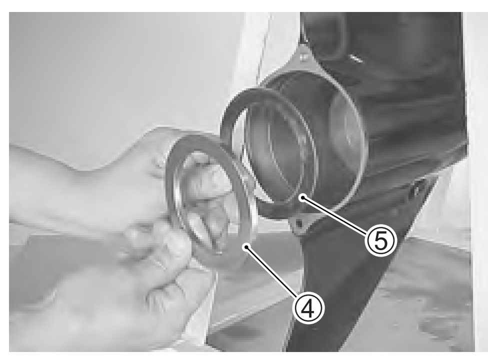
Lift out driveshaft assembly ④.
Remove the driveshaft collar ⑤, washer ⑥, wave washer ⑦, washer (with tab) ⑧ and washer ⑨ from driveshaft.



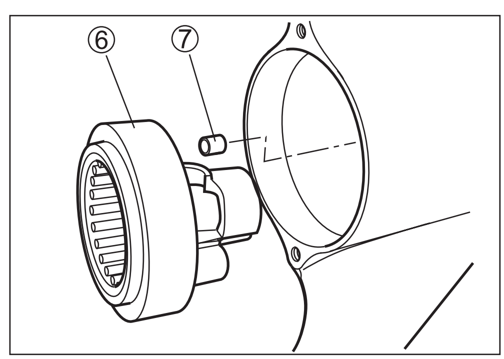
Remove the pinion gear ①.
Remove the forward gear ② and thrust bearing ③.



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



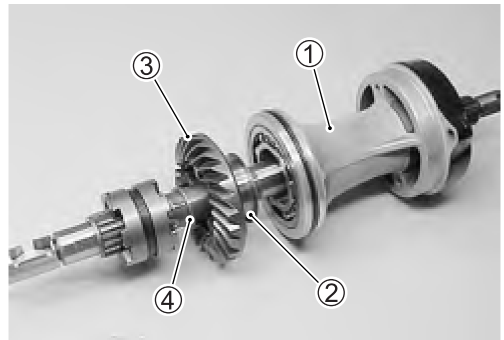
Remove the forward gear bearing housing ⑥.
Account for dowel pin ⑦.



Disassembly of propeller shaft components

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

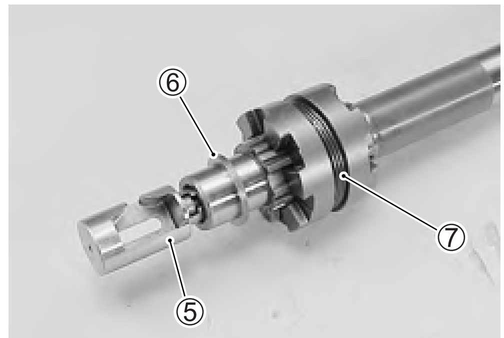
Account for the reverse gear back-up shim ② and reverse gear thrust washer ④.



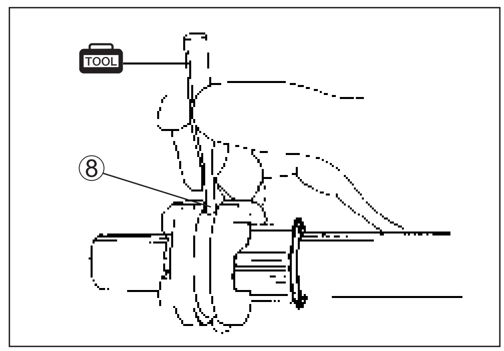
To disassemble propeller shaft components, refer to the following:

(a) Remove horizontal slider ⑤ and forward gear thrust washer ⑥.

(b) Remove the spring ⑦ from the clutch dog shifter.

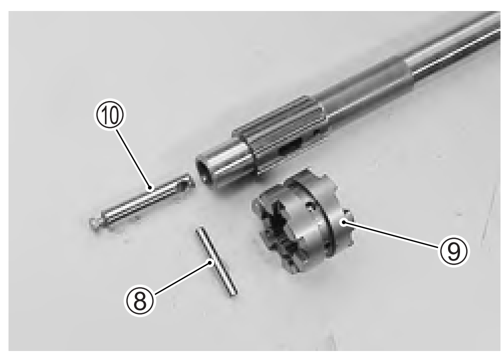


(c) Use special tool to push the dog pin ⑧ out of the clutch dog shifter.



TOOL **09922-89810: Shift pin remover**

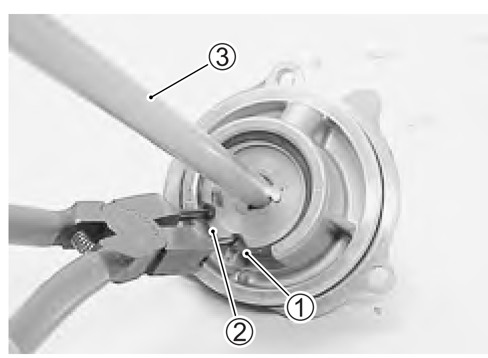
(d) Remove the clutch dog shifter ⑨ and connector pin ⑩ from propeller shaft.



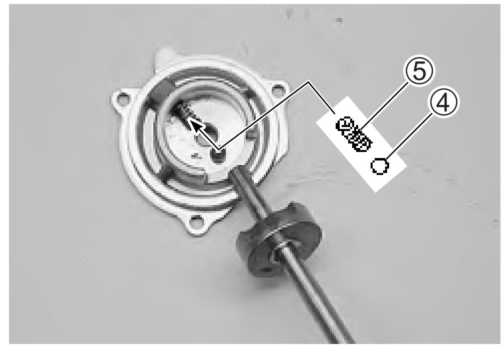
Disassembly of shift rod components

(a) Remove the circlip ① and washer ②.

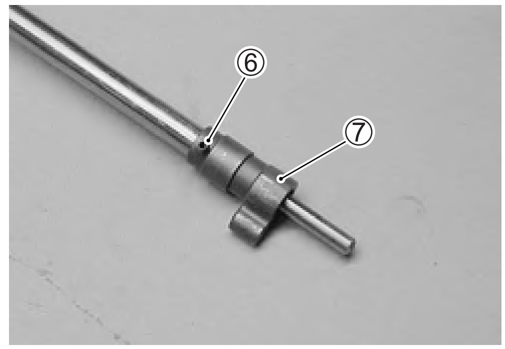
(b) Slide the shift rod ③ out of the shift rod guide housing.



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

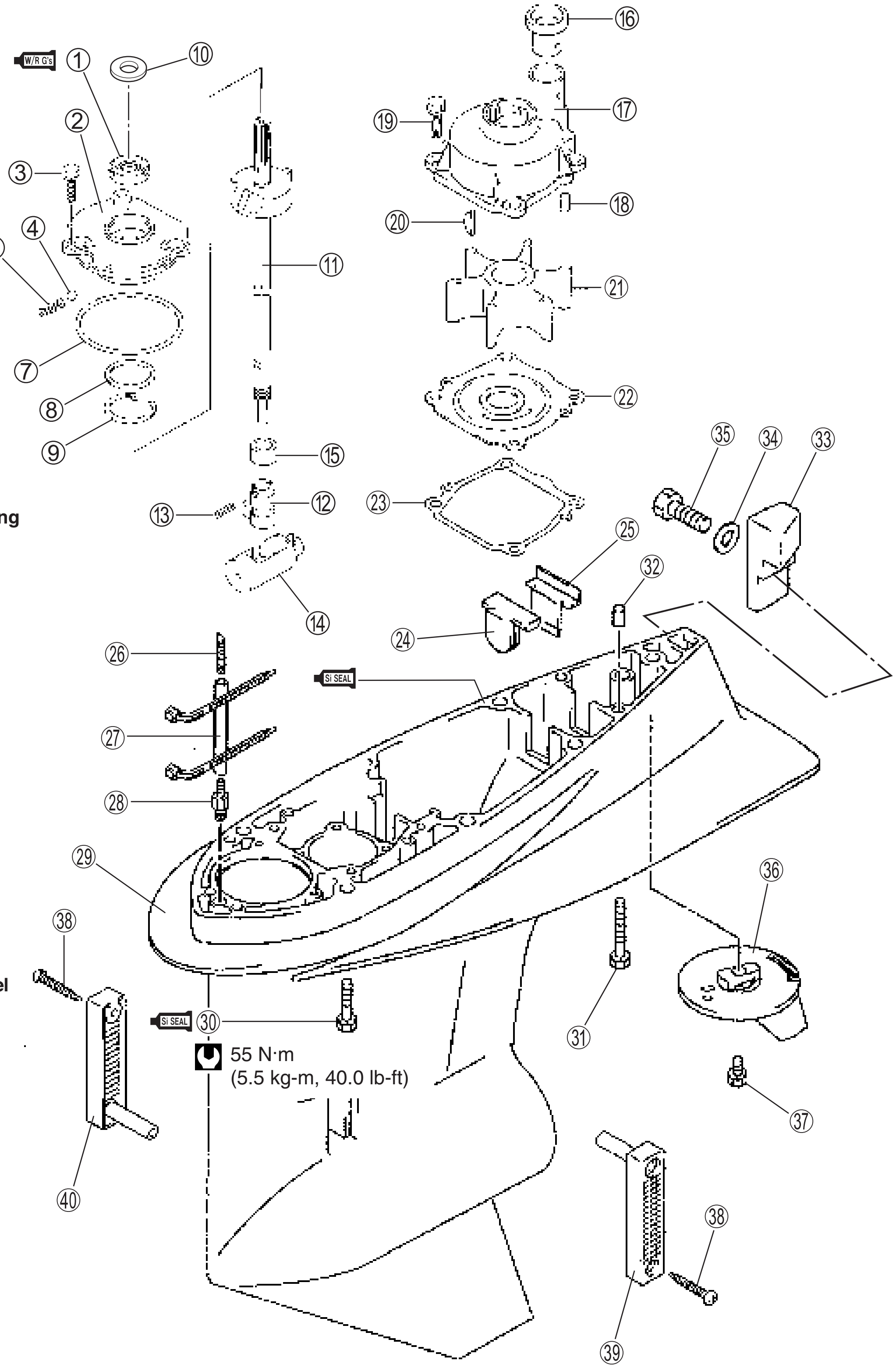


(d) Remove the pin ⑥ and shifter yoke ⑦.



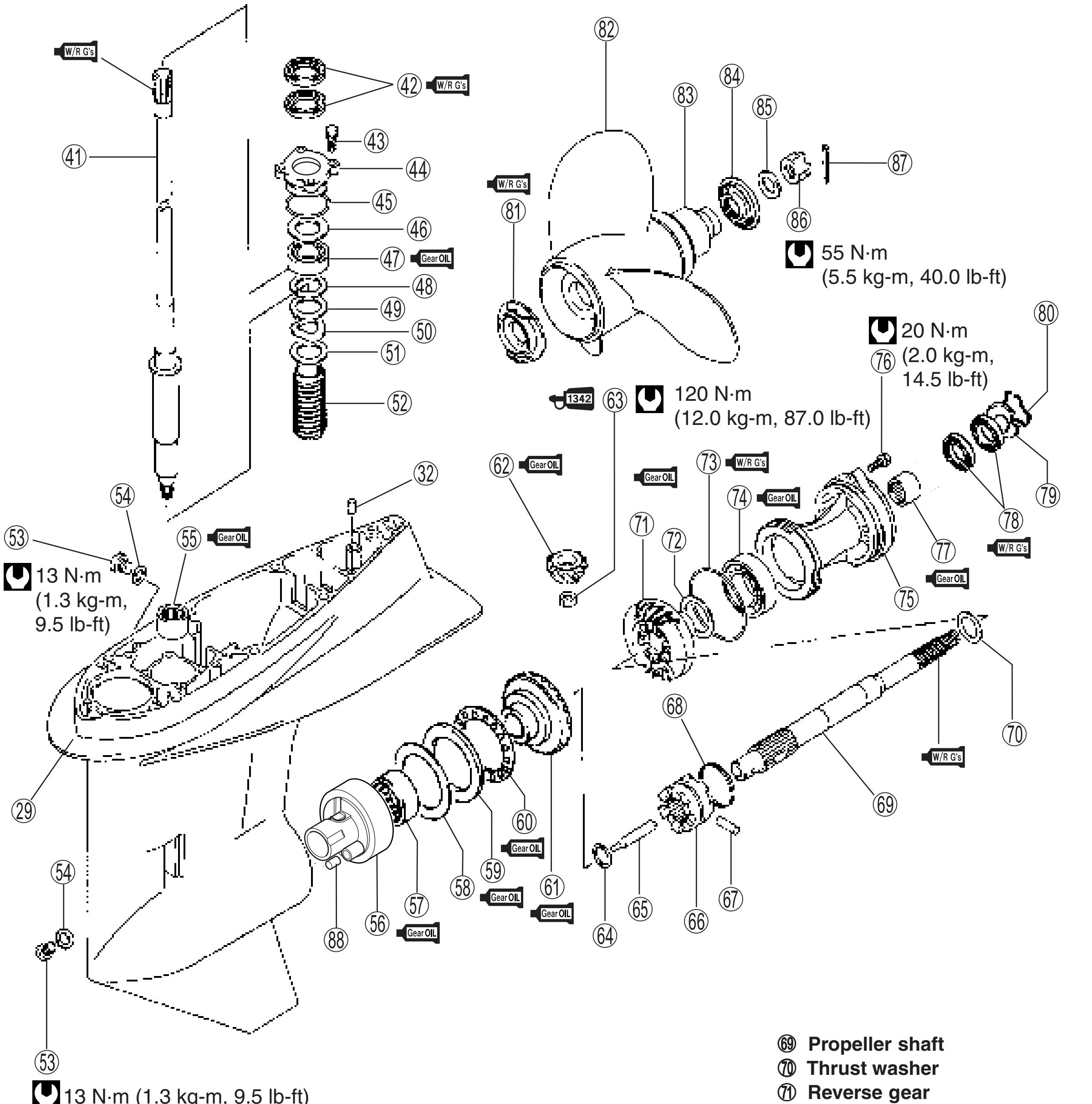
ASSEMBLY

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



① Oil seal
② Shift rod guide housing
③ Bolt
④ Ball
⑤ Spring

⑦ O-ring
⑧ Washer
⑨ Circlip
⑩ Seal cover
⑪ Shift rod
⑫ Yoke, shifter
⑬ Pin
⑭ Horizontal slider
⑮ Magneto
⑯ Grommet
⑰ Water pump case
⑱ Pin
⑲ Bolt
⑳ Key
㉑ Water pump impeller
㉒ Pump case under panel
㉓ Gasket
㉔ Exhaust seal
㉕ Exhaust seal plate
㉖ Union
㉗ Hose
㉘ Nipple
㉙ Gear case
㉚ Bolt
㉛ Bolt
㉜ Pin
㉝ Anode
㉞ Washer
㉟ Bolt
㊱ Trim tab
㊲ Bolt
㊳ Screw
㊴ Water filter PORT
㊵ Water filter STBD



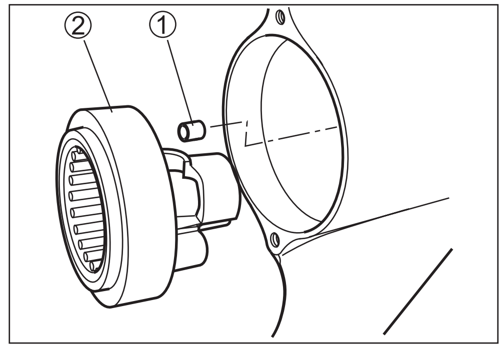
41 Driveshaft
42 Oil seal
43 Bolt
44 Oil seal housing
45 O-ring
46 Shim
47 Bearing
48 Washer
49 Washer
50 Wave washer
51 Washer
52 Driveshaft collar
53 Plug
54 Gasket
55 Bearing
56 F-gear bearing housing
57 F-gear bearing
58 Back-up shim
59 Thrust washer
60 F-gear thrust bearing
61 Forward gear
62 Pinion gear
63 Pinion nut
64 Thrust washer
65 Connector pin
66 Clutch dog shifter
67 Dog pin
68 Dog spring
69 Propeller shaft
70 Thrust washer
71 Reverse gear
72 Shim
73 O-ring
74 Bearing
75 Propeller shaft bearing housing
76 Bolt
77 Bearing
78 Oil seal
79 Washer
80 Retaining ring
81 Stopper
82 Propeller
83 Propeller bush
84 Spacer
85 Washer
86 Nut
87 Pin
88 Dowel 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 11-61.)

FORWARD GEAR BEARING HOUSING

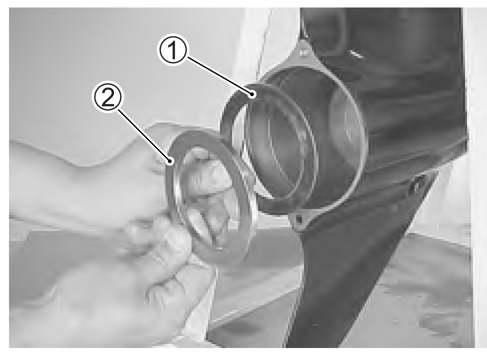
- Install dowel pin ① and forward gear bearing housing ②.

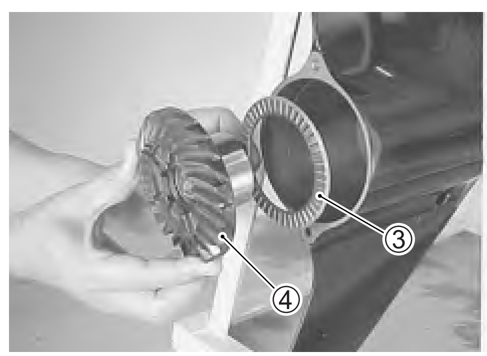


FORWARD GEAR

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

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



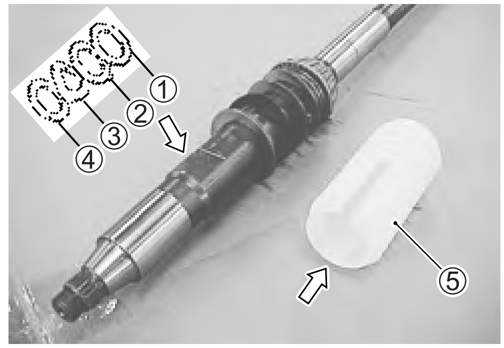


PINION GEAR

Place pinion gear in gearcase.

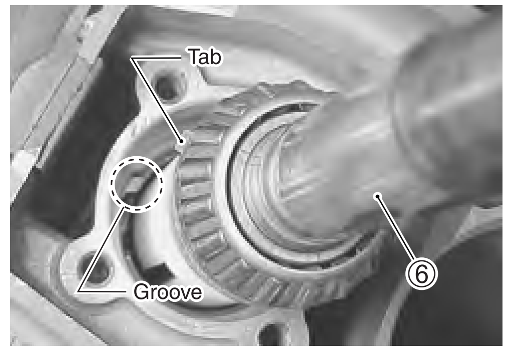
DRIVESHAFT

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

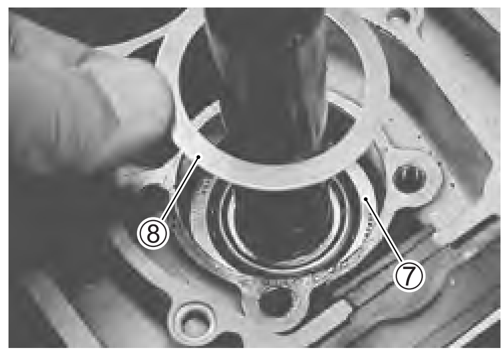


- Lower the driveshaft assembly ⑥ down into the gearcase until the bottom of shaft protrudes through center of pinion.

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



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

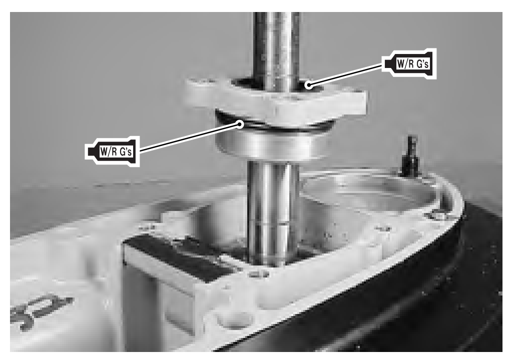


DRIVESHAFT OIL SEAL HOUSING

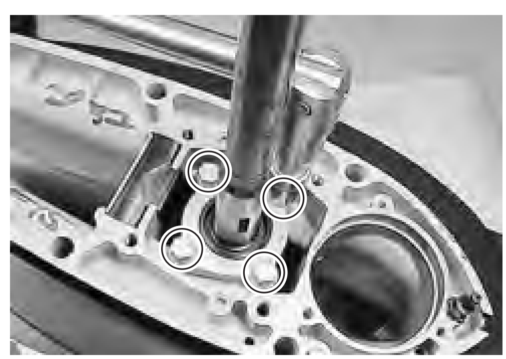
Apply Water Resistant Grease to the driveshaft oil seal.

W/R G's **99000-25161: Water Resistant Grease**

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



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



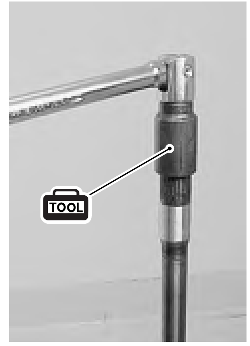
PINION NUT

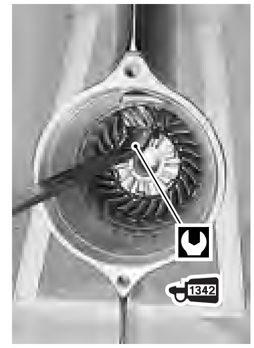
Apply Thread Lock 1342 to the threads of the pinion nut before threading it onto the driveshaft.
Tighten nut to the specified torque.

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

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

TOOL **09921-29410: Driveshaft holder**

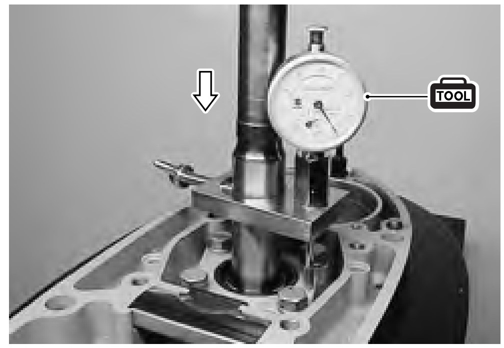




CHECKING DRIVESHAFT THRUST PLAY

Before installing reverse gear, driveshaft thrust play should checked.
(See the “GEARS-SHIMMING AND ADJUSTMENT/CHECKING DRIVESHAFT THRUST PLAY” section on page 11-62.)

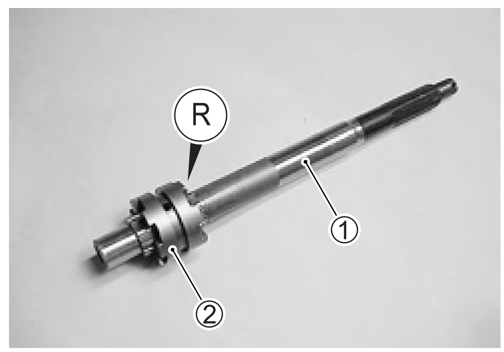
TOOL **09951-09530: Gear adjusting gauge**



PROPELLER SHAFT

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

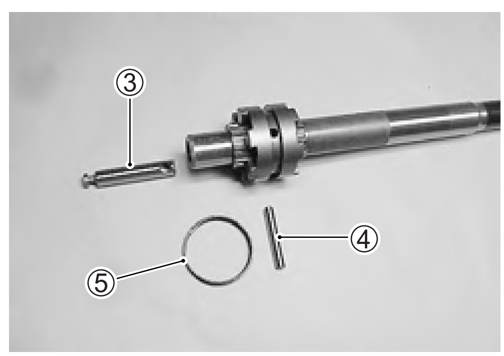
NOTE:
For correct installation the side of the clutch dog shifter which must face towards reverse gear is marked with the letter “R”.



Insert the connector pin ③ into propeller shaft.

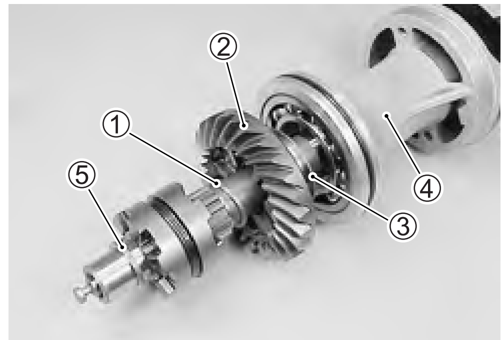
Align the holes in the shifter dog and connector pin and then slide the dog pin ④ through both dog and connector pin.

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



PROPELLER SHAFT / BEARING HOUSING

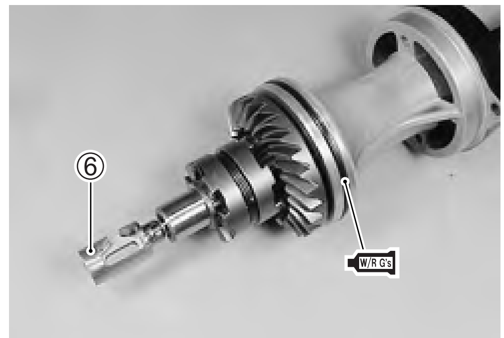
Assemble the propeller shaft in the following sequence: forward thrust washer ⑤, reverse thrust washer ①, reverse gear ②, reverse gear back-up shim ③ and propeller shaft housing ④.



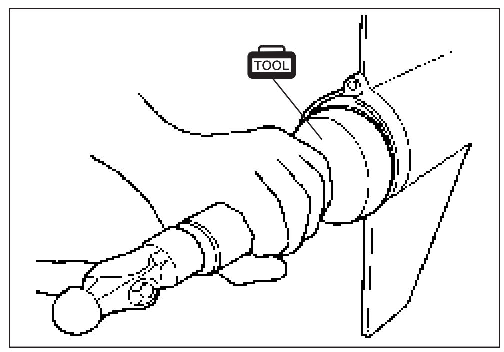
W/R G's **99000-25161: Water Resistant Grease**

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

Assemble horizontal slider ⑥ to connector pin.

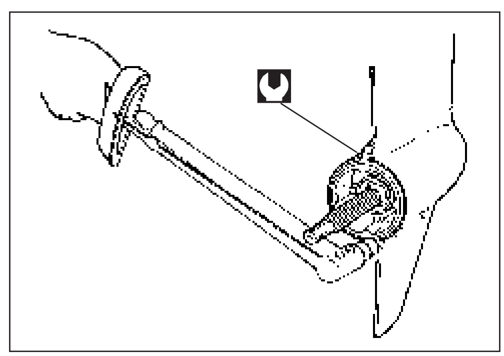


Using special tools, install the propeller shaft and housing assembly in the gear case.



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

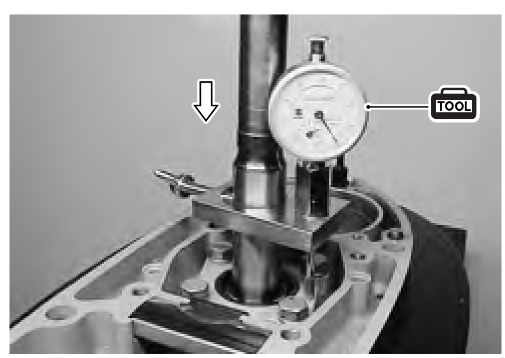
When the housing is fully seated, tighten both retaining bolts to the specified torque.



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

RECHECKING DRIVESHAFT THRUST PLAY

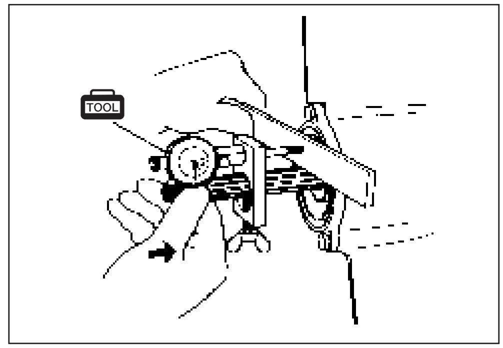
Recheck the driveshaft thrust play.
This should not be less than previously checked. If less, reduce the number/thickness of reverse gear back-up shims.



TOOL **09951-09530: Gear adjusting gauge**

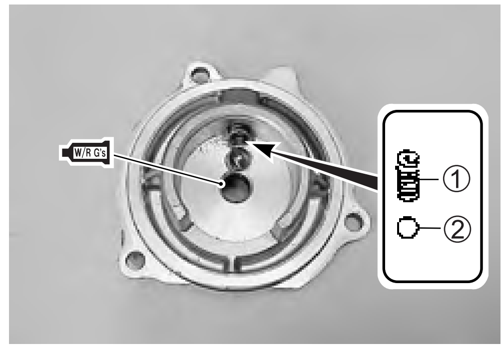
CHECKING PROPELLER SHAFT THRUST PLAY

See the “GEARS - SHIMMING AND ADJUSTMENT/CHECKING PROPELLER SHAFT THRUST PLAY” section on page 11-65.

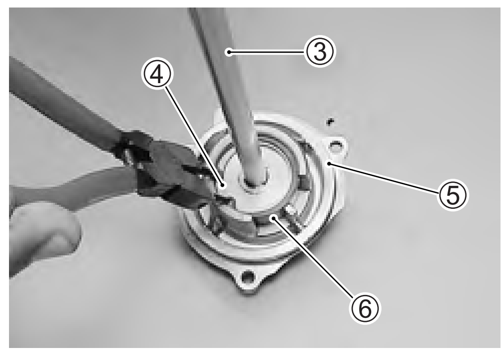


SHIFT ROD GUIDE HOUSING

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

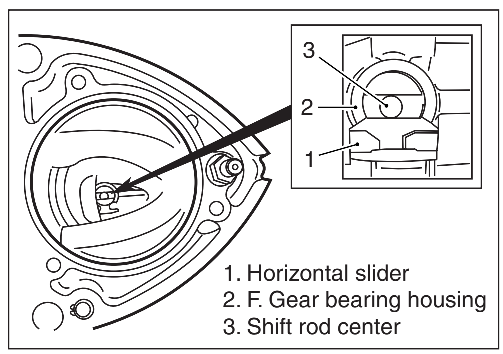


- Install shift rod ③ and washer ④ into the shift rod guide housing ⑤, then secure it with the snap ring ⑥.



NOTE:

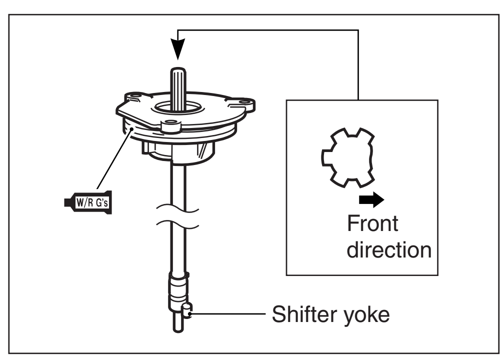
Before install the shift unit (Shift rod guide housing assembly), be sure to put the horizontal slider in the neutral position.



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

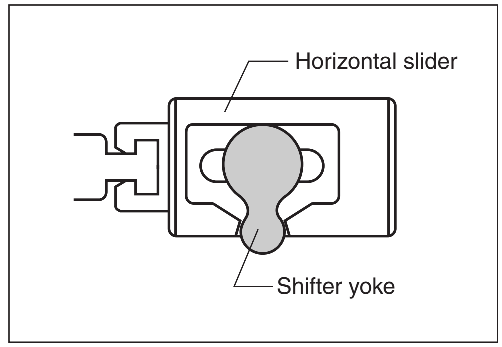
NOTE:

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

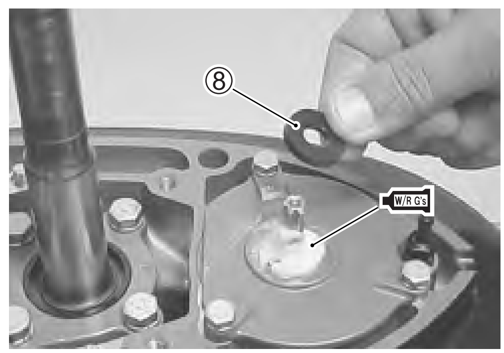


• Install the shift rod guide housing assembly ⑦ by aligning the shifter yoke with the groove in the horizontal slider, then tighten three (3) housing bolts securely.

• Shift the shift rod from Neutral through Forward and Reverse to check proper gear engagement.

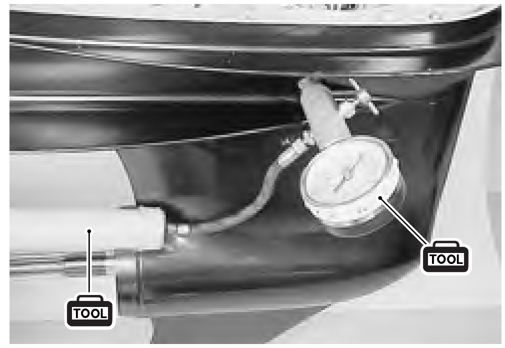


• Apply enough Water Resistant Grease on oil seal before putting seal cover ⑧ so that there is no space between them.



LEAKAGE CHECK

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



TOOL **09950-69511 : Oil leakage tester**
09952-99310 : Air pump

Procedure

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

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

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

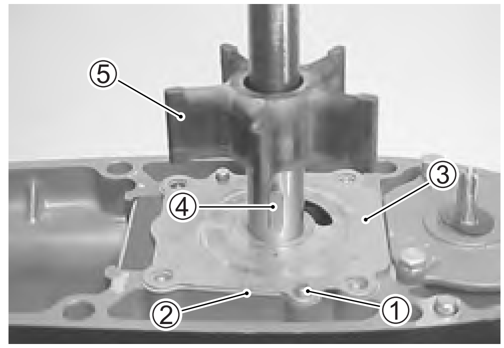
CAUTION

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

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

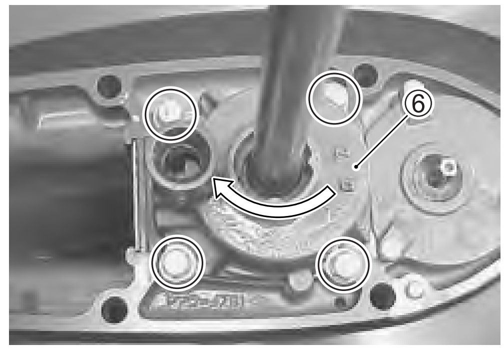
WATER PUMP (Impeller & Case)

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



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

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



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

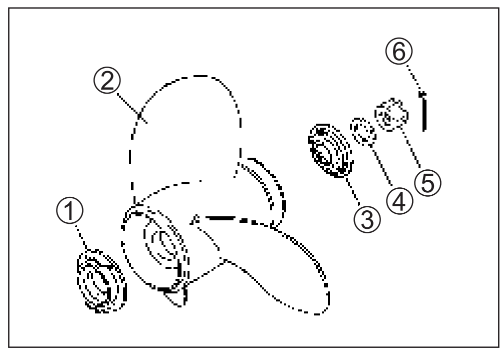
Pump case bolt: 20 N·m (2.0 kg-m, 14.5 lb-ft)

PROPELLER INSTALLATION

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

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

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



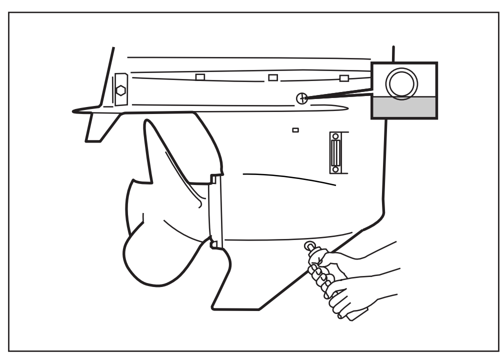
W/R G's **99000-25161: Water Resistant Grease**

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

GEAR OIL

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

Top up if necessary.



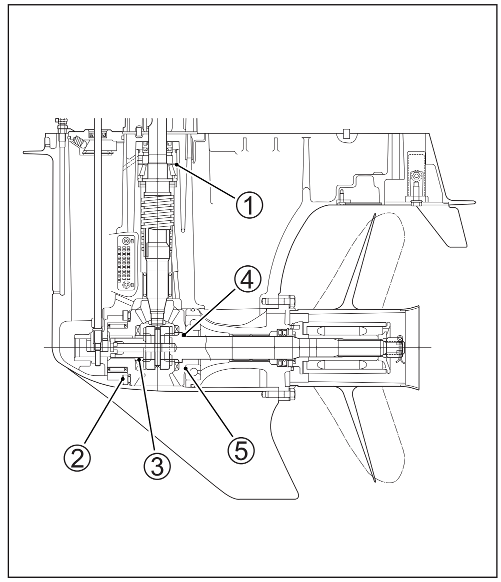
Gear OIL **99000-22540: Suzuki Outboard Motor Gear Oil**

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

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

Shim/Washer & Mounting position

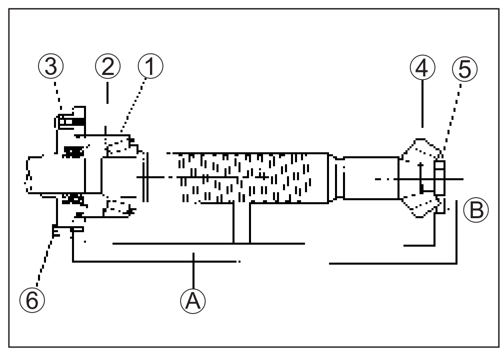
	Numerical index/item	Available thickness (mm)	Design specification Thickness (mm)
①	Pinion gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15	1.0
②	Forward gear back up shim	0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00	1.1
③	Forward gear thrust washer	9.0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



PINION GEAR BACK-UP SHIM ADJUSTMENT

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

TOOL **09951-09010: Shimming gauge**



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

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

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

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

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

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

FORWARD GEAR BACK-UP SHIM ADJUSTMENT

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

Step to prior to adjustment

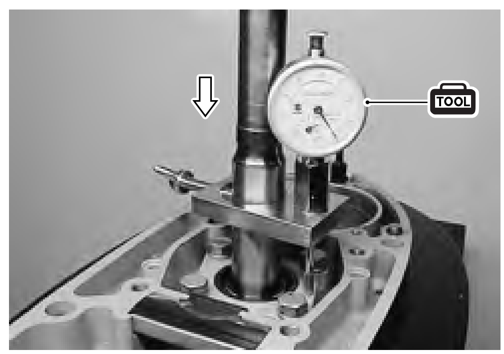
1. Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. (See page 11-53 to 11-55)
   Do not install reverse gear at this time.
2. Tighten pinion nut to specified torque.

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

Checking driveshaft thrust play

1. Affix gear adjusting gauge to drive shaft.

TOOL **09951-09530: Gear adjusting gauge**



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

Driveshaft thrust play:
Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

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

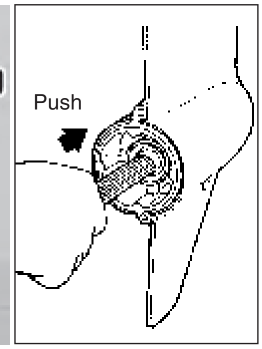
Checking and adjusting tooth contact pattern (Pinion and Forward gear)

Check tooth contact pattern by using the following procedure:

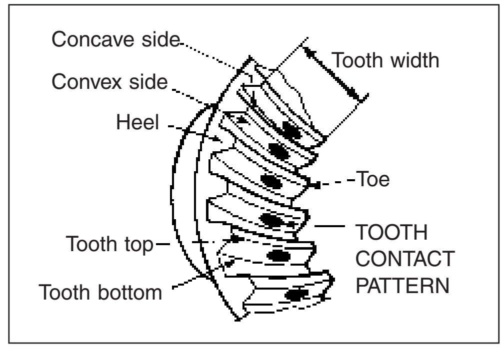
1. To assess tooth contact, apply a light coat of Prussian Blue on the convex surface of forward gear.

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

TOOL **09921-29410: Driveshaft holder**



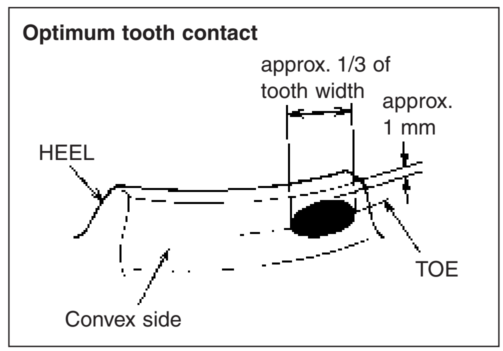
5. Carefully pull out propeller shaft and housing to check tooth contact pattern.



Optimum tooth contact

The optimum tooth contact is shown at right.

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



CAUTION

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

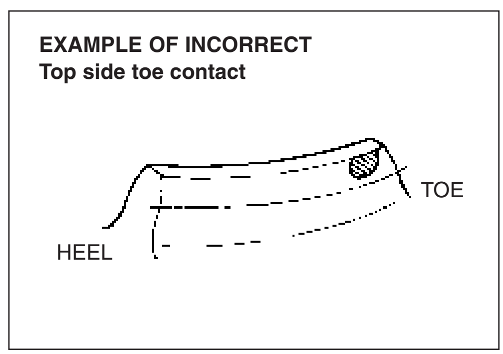
Example (1)

Incorrect topside toe contact:

Correction measures:

- Decrease thickness of forward gear shim.

(• Slightly increase pinion gear shim thickness.)



CAUTION

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

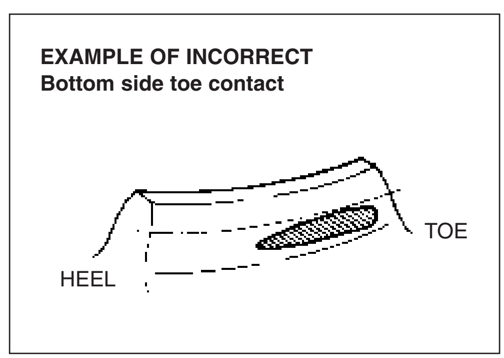
Example (2)

Incorrect bottom side toe contact:

Correction measures:

- Increase thickness of forward gear shim.

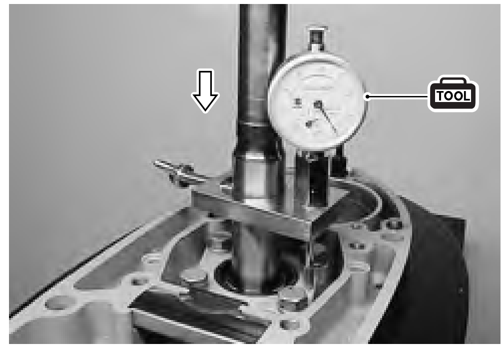
(• Slightly decrease pinion gear shim thickness.)



CAUTION

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

CHECKING DRIVESHAFT THRUST PLAY



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

1. Affix gear adjusting gauge to driveshaft.

TOOL **09951-09530: Gear adjusting gauge**

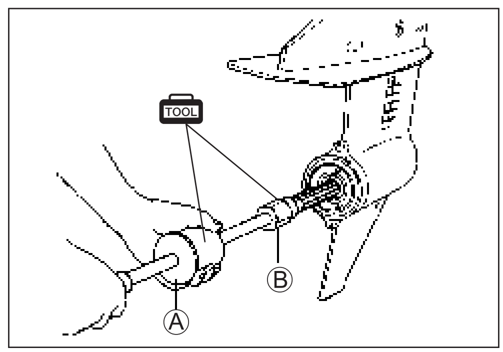
2. Slowly push driveshaft downward.
   Read the maximum play. Designate this amount of play as (A).

Driveshaft thrust play:
Approx. 0.4 – 0.6 mm (0.016 – 0.023 in.)

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

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

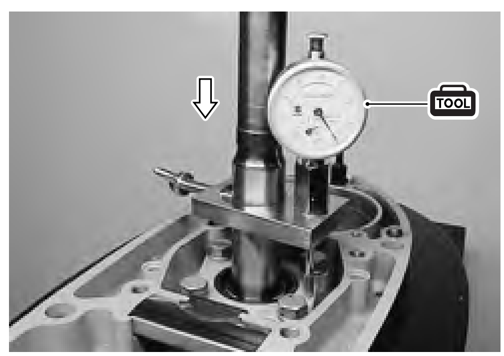
1. After adjusting forward gear tooth contact pattern, correctly assemble propeller shaft, housing assembly, reverse gear and related components (See page 11-55 to 11-56).
2. Screw sliding hammer assembly onto propeller shaft and strike a few gentle outward taps.



TOOL **09930-30161: Propeller shaft remover – Ⓑ**
09930-30104 : Sliding hammer – Ⓐ

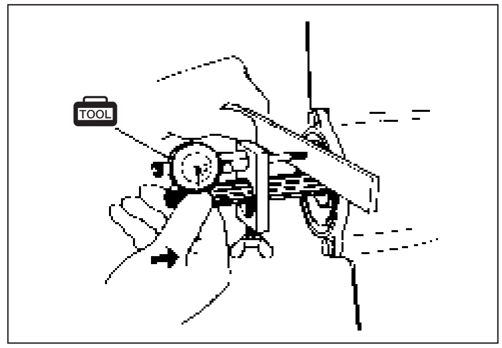
3. Affix gear adjusting gauge to driveshaft.

TOOL **09951-09530: 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 11-64).
6. Reverse gear back-up shim adjustment is correct if (B) is equal to (A).
   - If (B) is less than (A), reduce reverse gear back-up shim thickness.

CHECKING PROPELLER SHAFT THRUST PLAY



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

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

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

Measurement step:

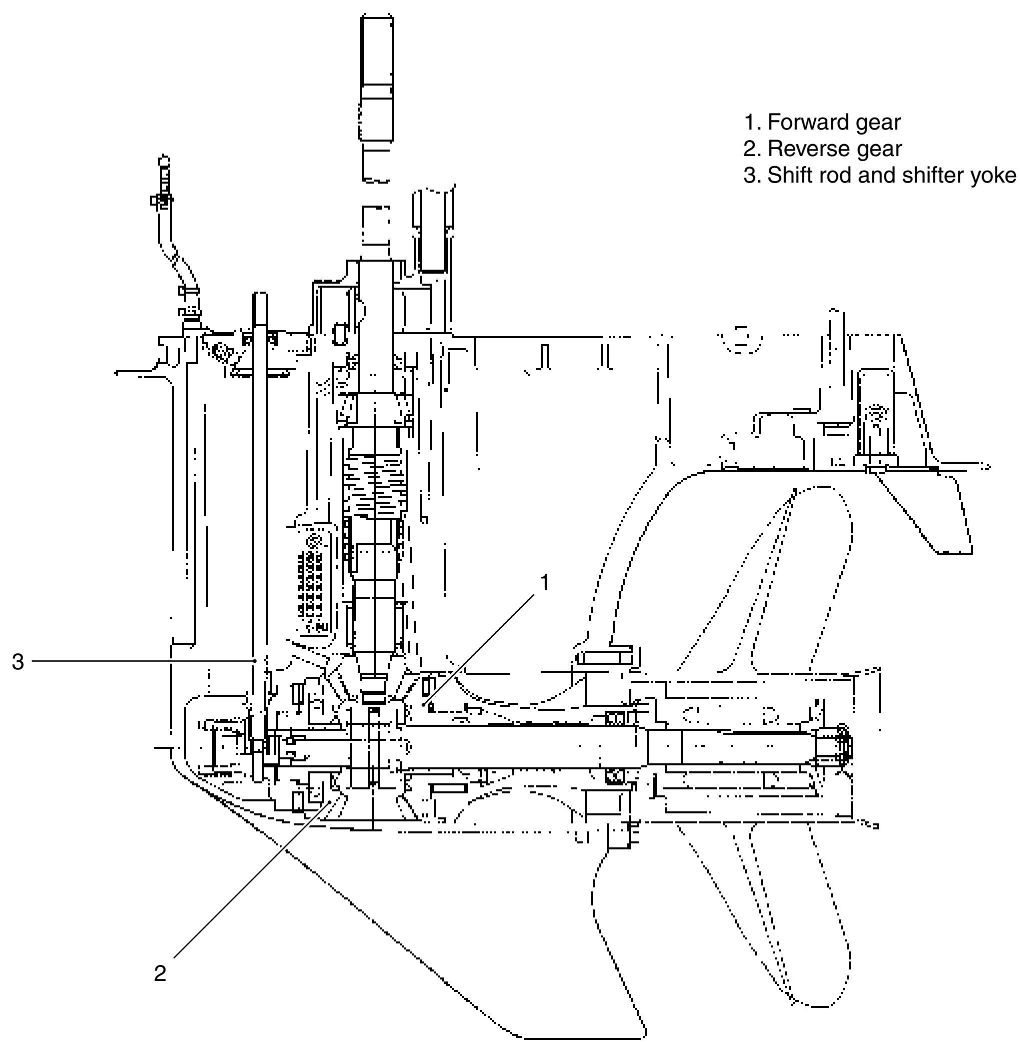
1. Assemble gear adjusting gauge to the propeller shaft.

TOOL **09951-09530: Gear adjusting gauge**

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

COUNTER ROTATION LOWER UNIT (DF140Z model)

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



PROPELLER SELECTION FOR COUNTER ROTATION

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

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

REMOVAL AND INSTALLATION

Refer to the procedures in DF90/115 service manual.

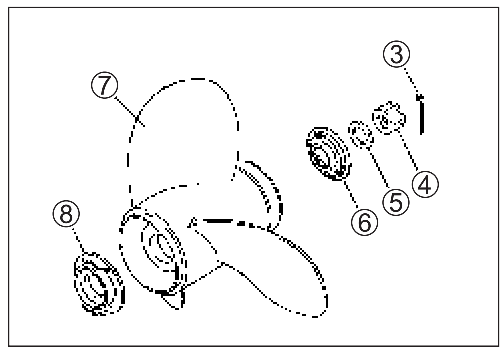
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

DISASSEMBLY

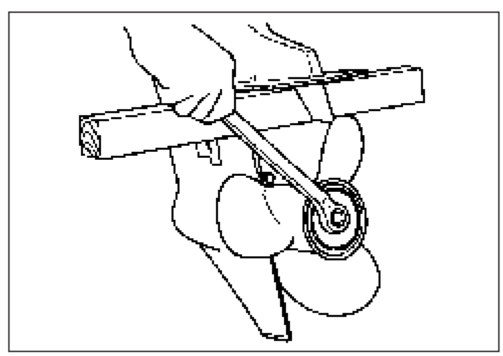
Place a drain pan under the oil drain plug.
Remove oil drain plug ① first then oil level plug ② and allow gear oil to drain.
Inspect oil for water, contaminates or metal.

Remove cotter pin ③ from propeller nut and remove propeller nut ④.
Remove washer ⑤, spacer ⑥, propeller ⑦ and stopper ⑧ from the propeller shaft.

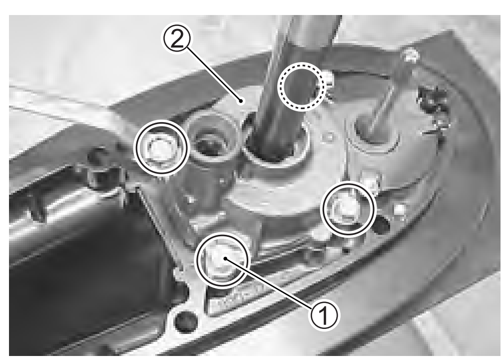


⚠ WARNING

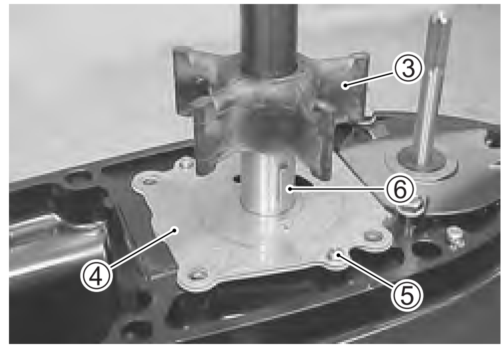
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place.



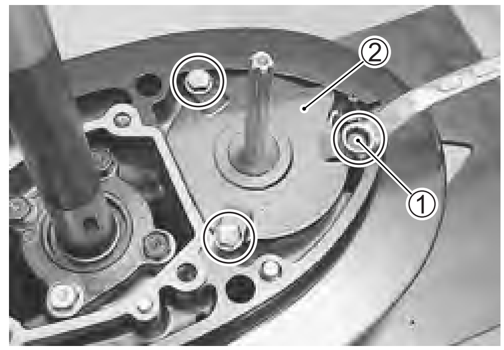
Loosen the four (4) bolts ①, then remove the water pump case ②.



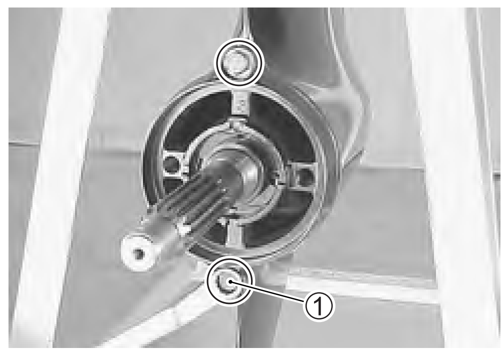
Remove the impeller ③, impeller key ⑥, pump under plate ④ and dowel pins ⑤.
Keep the impeller key ⑥ for reuse and discard the plate gasket.



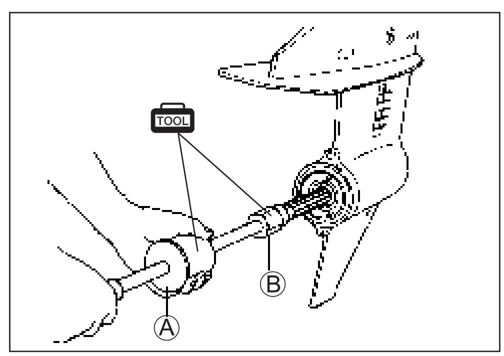
Remove three (3) bolts ① and shift rod guide housing assembly ②.



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



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

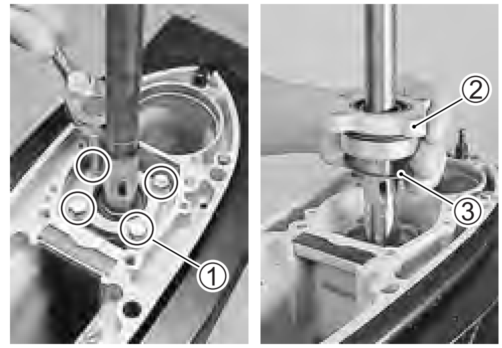


TOOL **09930-30104: Ⓐ Sliding hammer**
09930-30161: Ⓑ Propeller shaft remover

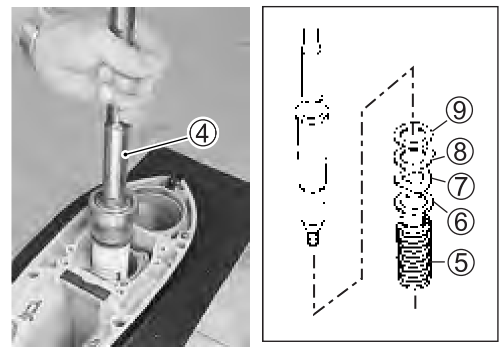
Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.

TOOL **09921-29410: Driveshaft holder**

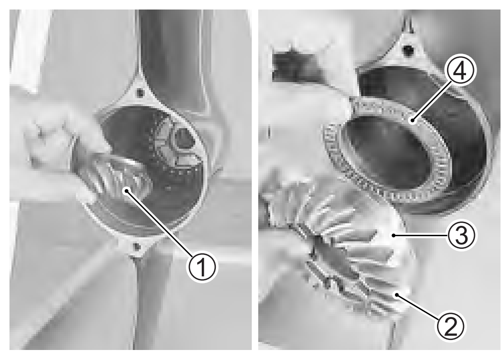
Unscrew the four (4) bolts ① securing driveshaft oil seal housing ②, then remove oil seal housing and pinion shim ③.



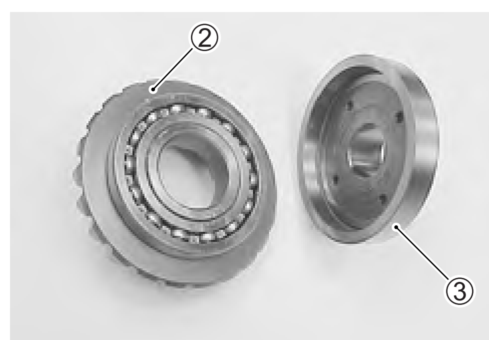
Lift out driveshaft assembly ④.
Remove the driveshaft collar ⑤, washer ⑥, wave washer ⑦, washer (with tab) ⑧ and washer ⑨ from driveshaft.



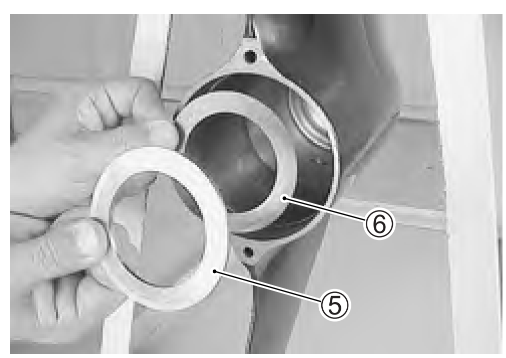
Remove the pinion gear ①.
Remove reverse gear ② (with reverse gear retainer ③) and thrust bearing ④.



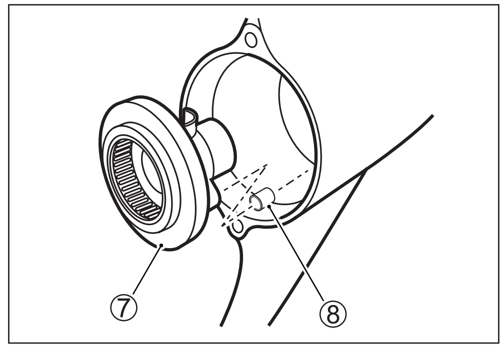
Remove the reverse gear ② from reverse gear retainer ③.



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

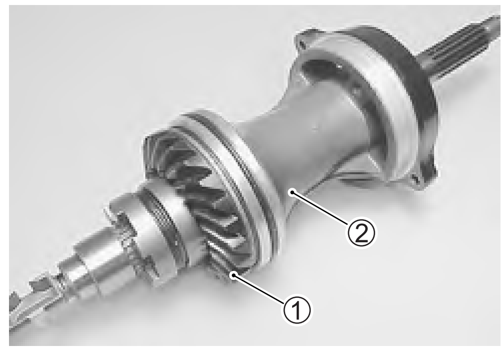


Remove the reverse gear bearing housing ⑦ and dowel pin ⑧.

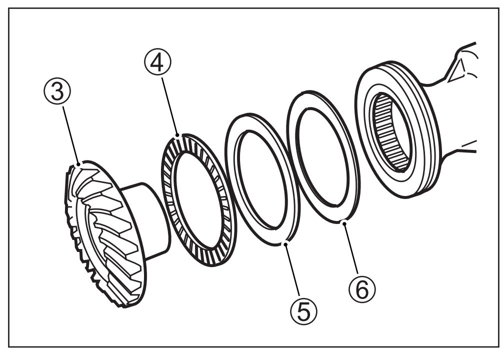


Disassembly of propeller shaft components

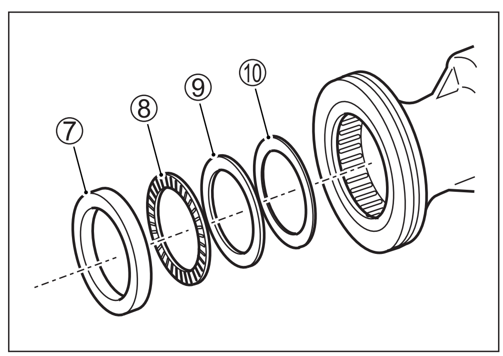
Slide propeller shaft away from forward gear ① and bearing housing assembly ②.



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



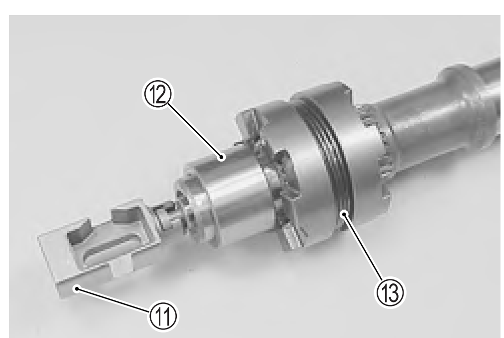
Remove the propeller shaft thrust washer ⑦, propeller shaft thrust bearing ⑧, bearing washer ⑨ and shim ⑩ from propeller shaft bearing housing.



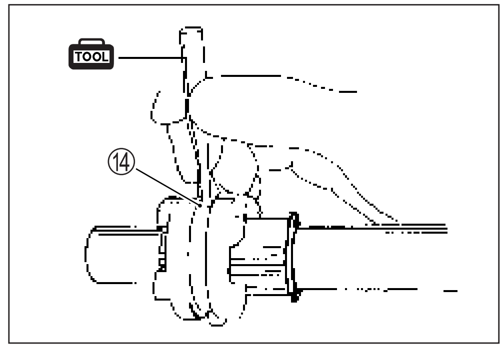
To disassemble propeller shaft components, refer to the following:

(a) Remove horizontal slider ⑪ and spacer ⑫.

(b) Remove the spring ⑬ from the clutch dog shifter.

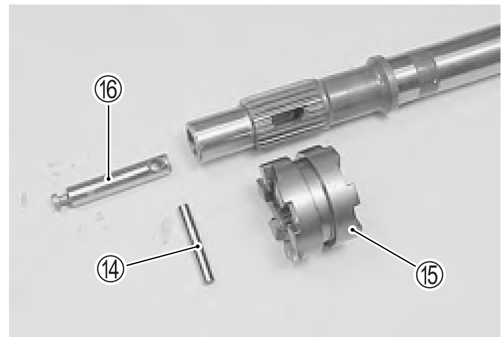


(c) Use special tool to push the dog pin ⑭ out of the clutch dog shifter.



TOOL 09922-89810: Shift pin remover

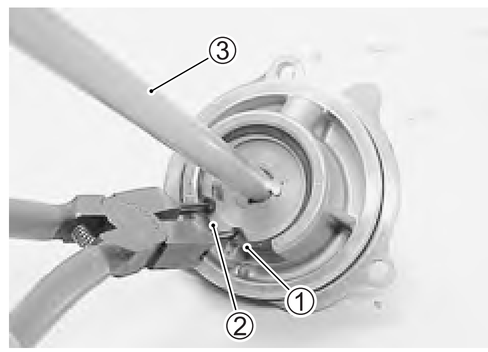
(d) Remove the clutch dog shifter ⑮ and connector pin ⑯ from propeller shaft.



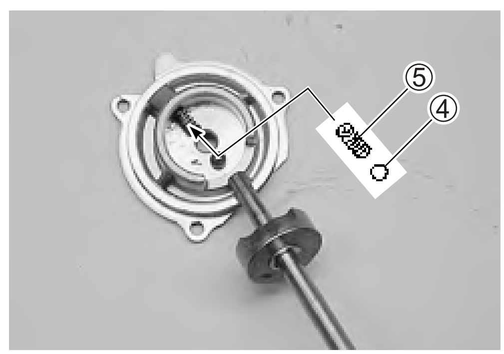
Disassembly of shift rod components

(a) Remove the circlip ① and washer ②.

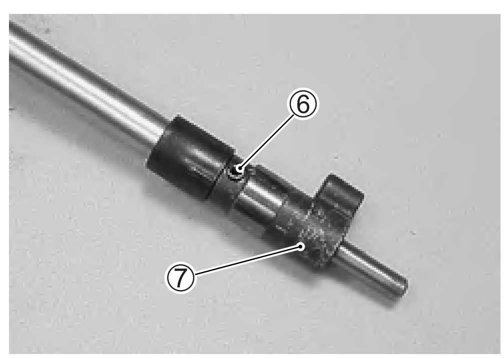
(b) Slide the shift rod ③ out of the shift rod guide housing.



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



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



INSPECTION

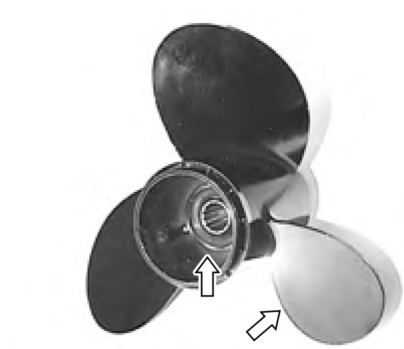
NOTE:
If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

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

⚠ WARNING

Wear safety 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

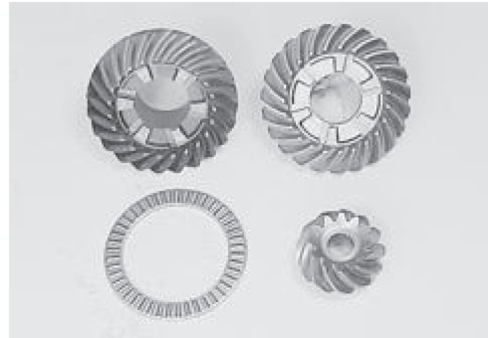
- Inspect the gearcase. Replace if cracked or damaged.
- Visually check the pinion bearing. Replace if pitted, noisy or rough.

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

REVERSE GEAR BEARING HOUSING / RETAINER

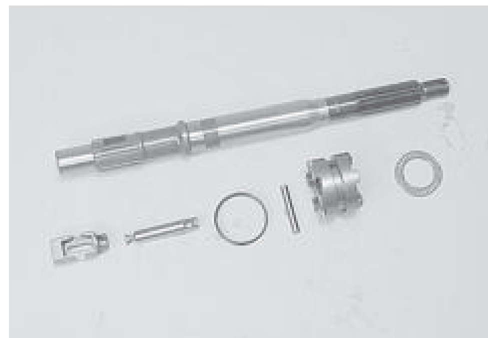
- Inspect the reverse gear retainer and reverse gear bearing housing.
  Replace if cracked or damaged.
- Visually check each bearings. Replace if pitted, noisy or rough.

GEAR



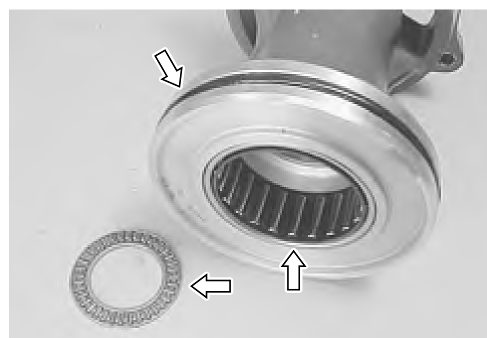
- Inspect forward, reverse and pinion gear teeth and engaging dogs.
  Replace gears if damaged or worn.
- Inspect forward gear thrust bearing. Replace bearing if pitted, noisy or rough.

PROPELLER SHAFT COMPONENTS



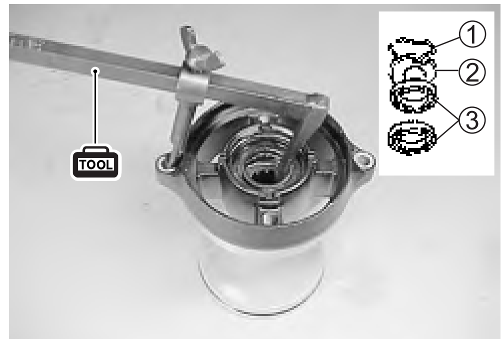
- Inspect horizontal slider and connector pin.
  Replace if wear, damage or other abnormal condition.
- Inspect clutch dog shifter. Replace if chipped, worn or damaged.
- Inspect dog pin. Replace if bent or worn.
- Inspect propeller shaft/splines. Replace if worn, twisted or damaged.
- Inspect thrust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

PROPELLER SHAFT BEARING HOUSING



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

Replacing propeller shaft oil seal

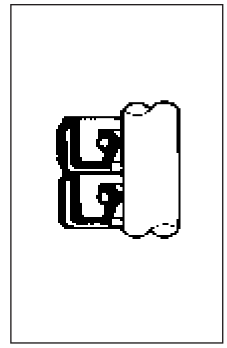


1. Remove the retaining ring ① and washer ②.
2. Extract the seals ③ with oil seal remover.

TOOL **09913-50121: Oil seal remover**

CAUTION

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



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

W/R G's **99000-25161: Water Resistant Grease**

5. Install washer and retaining ring.

SHIFT ROD GUIDE HOUSING COMPONENTS

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

WATER PUMP AND RELATED ITEMS

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

DRIVESHAFT OIL SEAL HOUSING

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

Replacing driveshaft oil seal

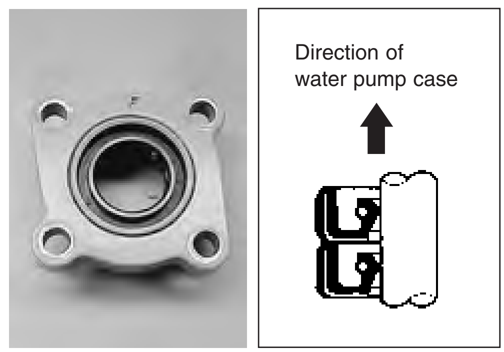
1. With the oil seal remover, draw the two oil seals out of the driveshaft oil seal housing.

TOOL **09913-50121: Oil seal remover**

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

W/R G's **99000-25161: Water Resistant Grease**

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

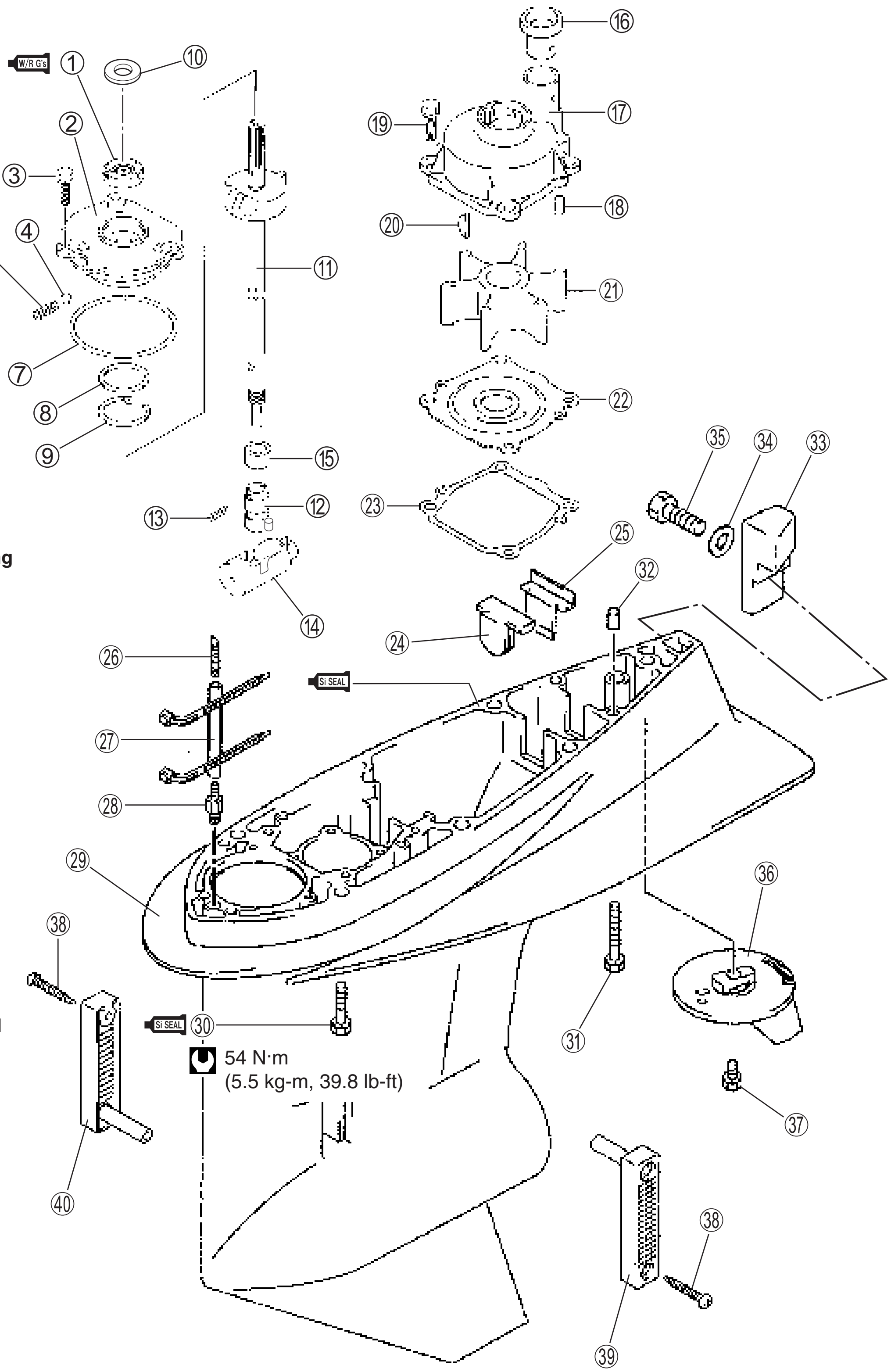


DRIVESHAFT

Inspect driveshaft/splines. Replace if worn, twisted or damaged.
Inspect driveshaft bearing, replace if pitted, noisy or rough.

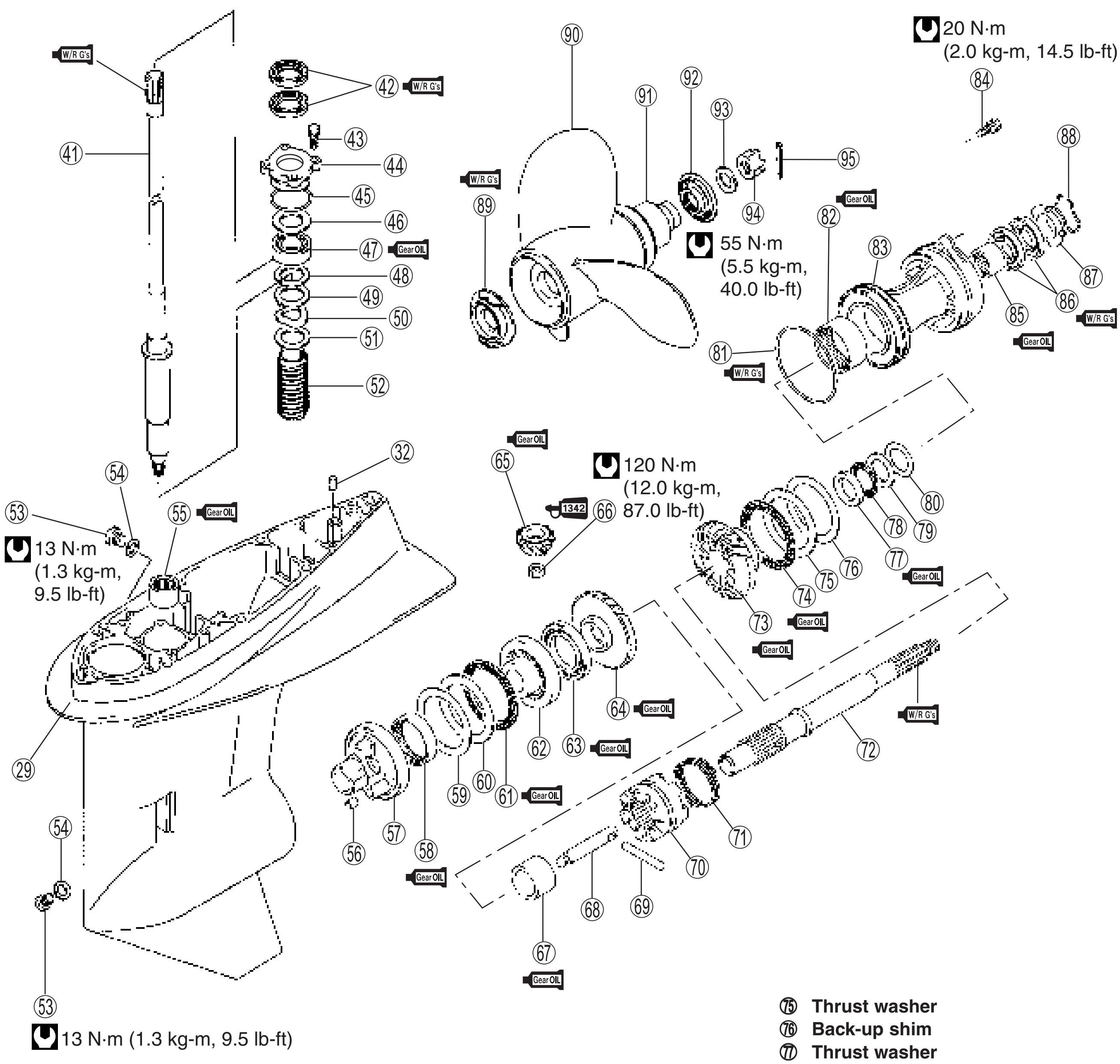
ASSEMBLY

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



① Oil seal
② Shift rod guide housing
③ Bolt
④ Ball
⑤ Spring

⑦ O-ring
⑧ Washer
⑨ Circlip
⑩ Seal cover
⑪ Shift rod
⑫ Yoke, shifter
⑬ Pin
⑭ Horizontal slider
⑮ Magneto
⑯ Grommet
⑰ Water pump case
⑱ Pin
⑲ Bolt
⑳ Key
㉑ Water pump impeller
㉒ Pump case under panel
㉓ Gasket
㉔ Exhaust seal
㉕ Exhaust seal plate
㉖ Union
㉗ Hose
㉘ Nipple
㉙ Gear case
㉚ Bolt
㉛ Bolt
㉜ Pin
㉝ Anode
㉞ Washer
㉟ Bolt
㊱ Trim tab
㊲ Bolt
㊳ Screw
㊴ Water filter PORT
㊵ Water filter STBD



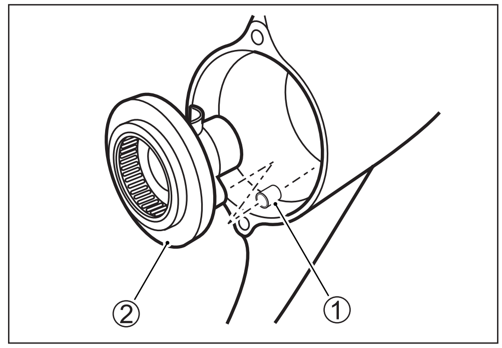
41 Driveshaft
42 Oil seal
43 Bolt
44 Oil seal housing
45 O-ring
46 Shim
47 Bearing
48 Washer
49 Washer
50 Wave washer
51 Washer
52 Driveshaft collar
53 Plug
54 Gasket
55 Bearing
56 Dowel pin
57 R-gear bearing housing
58 Bearing
59 Back-up shim
60 Thrust washer
61 Thrust bearing
62 R-gear retainer
63 Bearing
64 Reverse gear
65 Pinion gear
66 Pinion nut
67 Spacer
68 Connector pin
69 Dog pin
70 Clutch dog shifter
71 Dog spring
72 Propeller shaft
73 Forward gear
74 F-gear thrust bearing
75 Thrust washer
76 Back-up shim
77 Thrust washer
78 Bearing
79 Washer
80 Shim
81 O-ring
82 Bearing
83 Propeller shaft bearing housing
84 Bolt
85 Bearing
86 Oil seal
87 Washer
88 Retaining ring
89 Stopper
90 Propeller
91 Propeller bush
92 Spacer
93 Washer
94 Nut
95 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 11-86.)

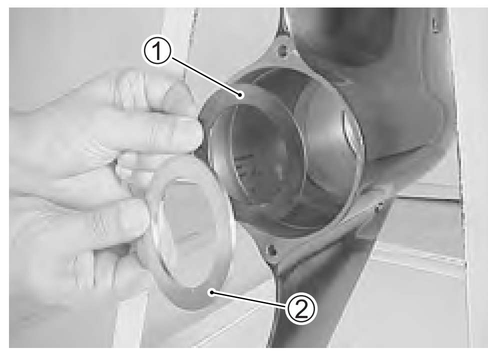
REVERSE GEAR BEARING HOUSING

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



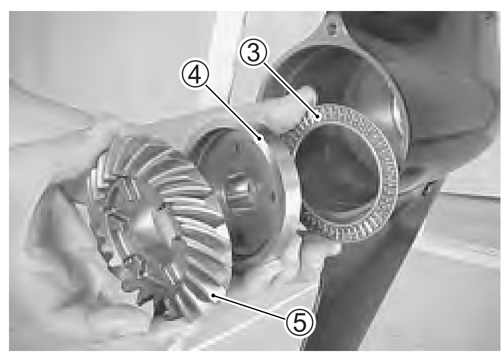
REVERSE GEAR

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



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

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

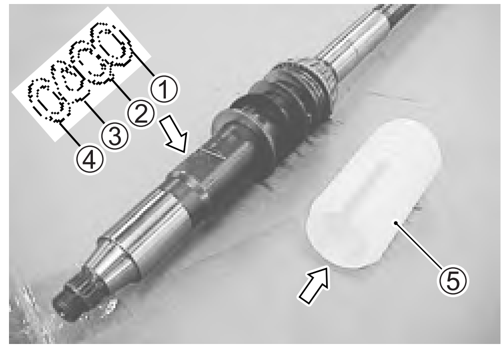


PINION GEAR

Place pinion gear in gearcase.

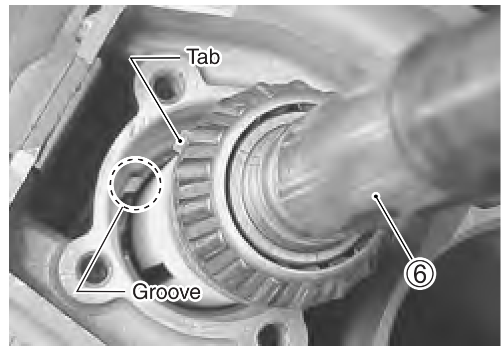
DRIVESHAFT

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

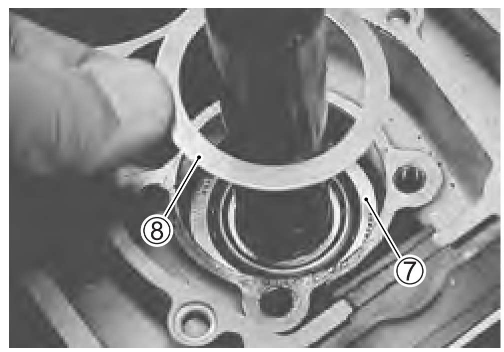


- Lower the driveshaft assembly ⑥ down into the gearcase until the bottom of shaft protrudes through center of pinion.

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



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

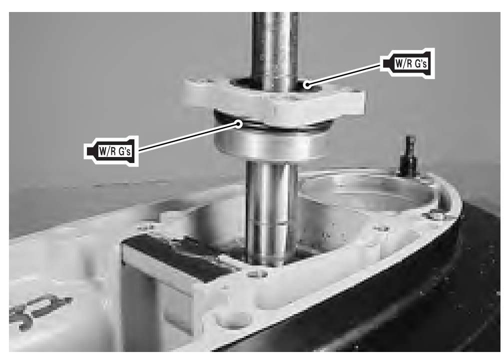


DRIVESHAFT OIL SEAL HOUSING

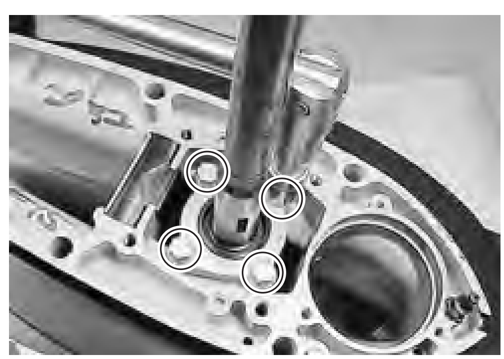
Apply Water Resistant Grease to the driveshaft oil seal.

W/R G's **99000-25161: Water Resistant Grease**

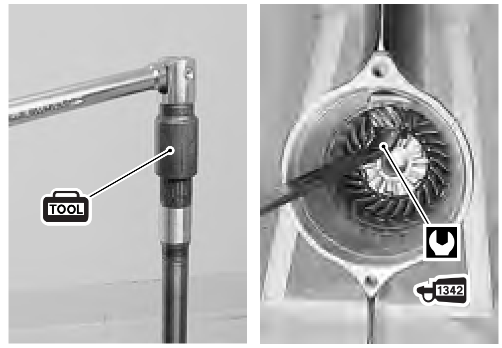
Apply Water Resistant Grease to O-ring, then install the O-ring into the groove on the driveshaft oil seal housing.



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



PINION NUT



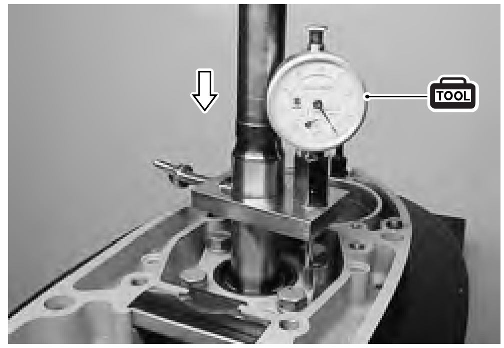
Apply Thread Lock 1342 to the threads of the pinion nut before threading it onto the driveshaft.
Tighten nut to the specified torque.

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

99000-32050: Thread Lock 1342

09921-29410: Driveshaft holder

CHECKING DRIVESHAFT THRUST PLAY

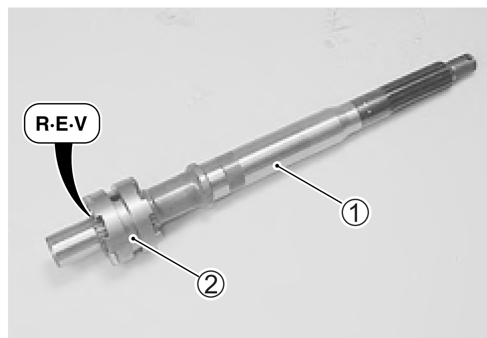


Before installing forward gear, driveshaft thrust play should checked.
(See the “GEARS-SHIMMING AND ADJUSTMENT/CHECKING DRIVESHAFT THRUST PLAY” section on page 11-88.)

Driveshaft thrust play:
Approx. 0.6 – 0.8 mm (0.024 – 0.031 in.)

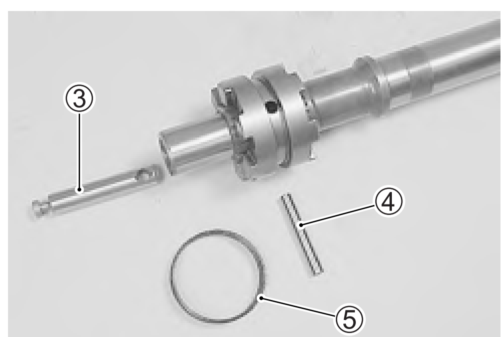
09951-09511: Gear adjusting gauge

PROPELLER SHAFT

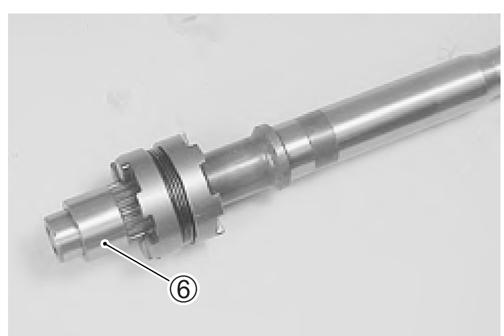


Slide the clutch dog shifter ② onto the propeller shaft ①.

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



Insert the connector pin ③ into propeller shaft.
Align the holes in the shifter dog and connector pin and then slide the dog pin ④ through both dog and connector pin.
Install the dog pin retaining spring ⑤, ensuring that it fits snugly into the groove on the dog shifter.



Install the spacer ⑥ to propeller shaft.

FORWARD GEAR/PROPELLER SHAFT / BEARING HOUSING

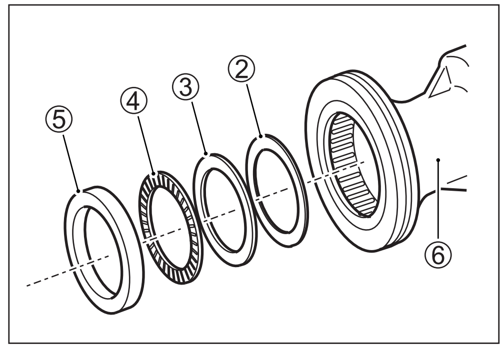
- Assemble the propeller shaft in the following sequence:

W/R G's **99000-25161 : Water Resistant Grease**

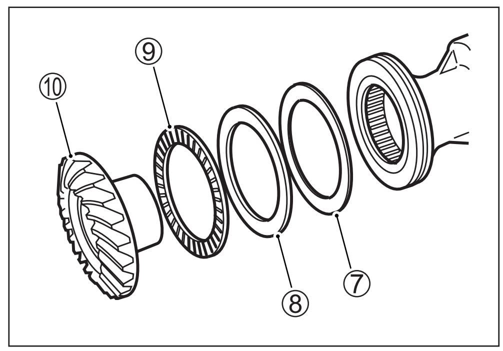
Gear OIL **99000-22540 : Suzuki Outboard Motor Gear Oil**

(a) Apply Water Resistant Grease to O-ring ①, then install the O-ring into the groove on the propeller shaft bearing housing.

(b) Install shim ②, bearing washer ③, propeller shaft thrust bearing ④, propeller shaft thrust washer ⑤ into propeller shaft bearing housing ⑥.

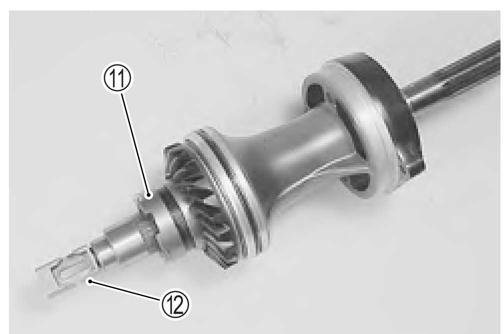


(c) Install F-gear back-up shim ⑦, F-gear thrust washer ⑧, F-gear thrust bearing ⑨ and forward gear ⑩ to propeller shaft bearing housing.



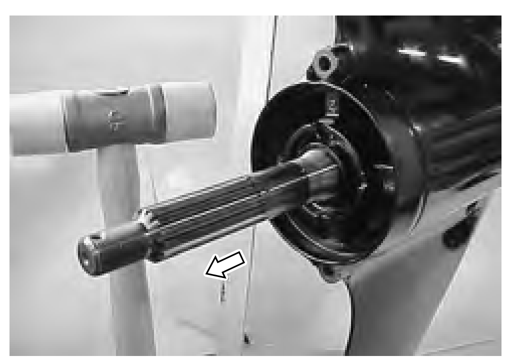
(d) Slide propeller shaft ⑪ into forward gear and propeller shaft bearing housing.

(e) Assemble horizontal slider ⑫ to connector pin.

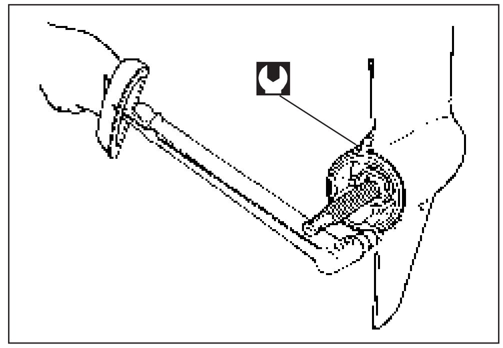


To hold the correct bearing position, pull propeller shaft backward and then install propeller shaft and housing assembly in the gearcase.

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



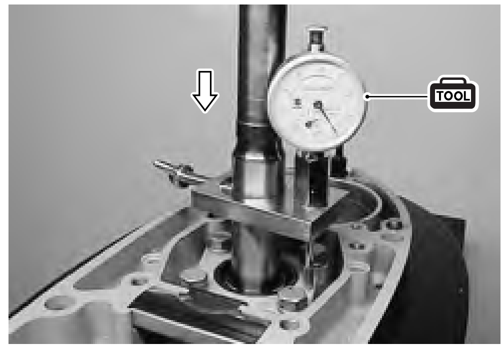
When the housing is fully seated, tighten both retaining bolts to the specified torque.



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

RECHECKING DRIVESHAFT THRUST PLAY

Recheck the driveshaft thrust play.

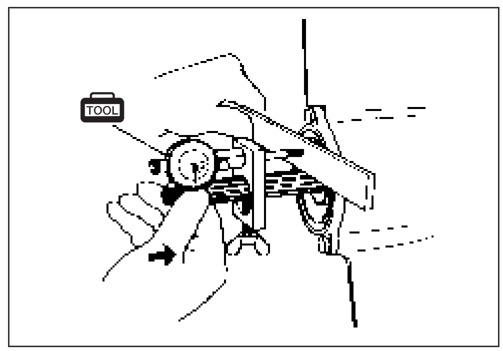


Driveshaft thrust play:
Approx. 0.3 – 0.5 mm (0.012 – 0.020 in.)

09951-09530: Gear adjusting gauge

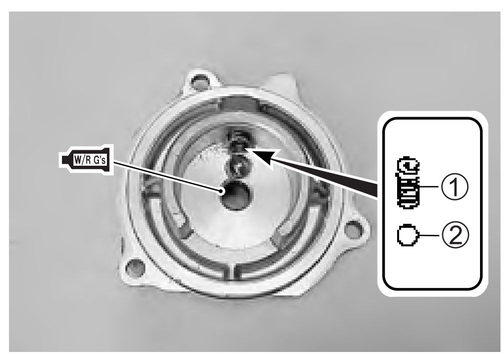
CHECKING PROPELLER SHAFT THRUST PLAY

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

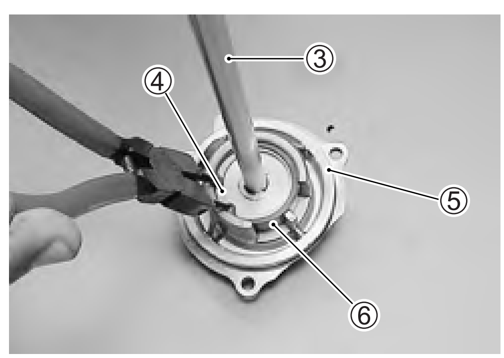


SHIFT ROD GUIDE HOUSING

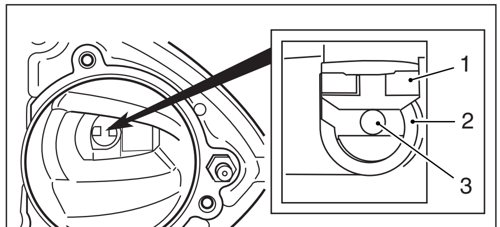
- Install the spring ① and detent ball ② into shift rod guide housing.
- Apply Water Resistant Grease to the shift rod oil seal.



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



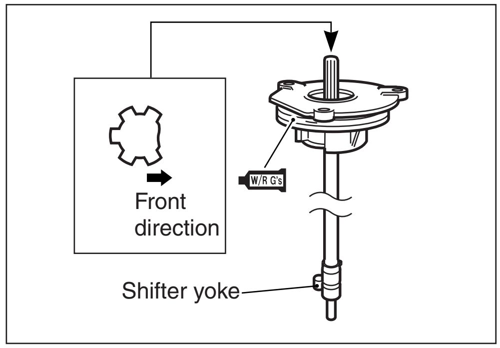
NOTE:
Before install the shift unit (Shift rod guide housing assembly), be sure to put the horizontal slider in the neutral position.



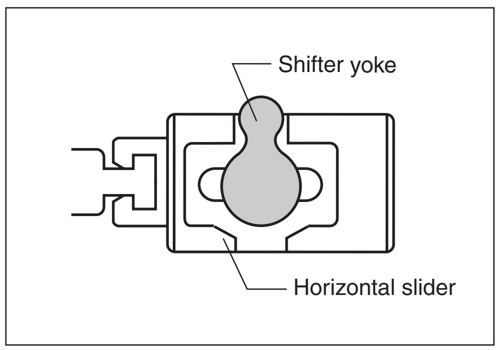
1. Horizontal slider
2. R-Gear bearing housing
3. Shift rod center

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

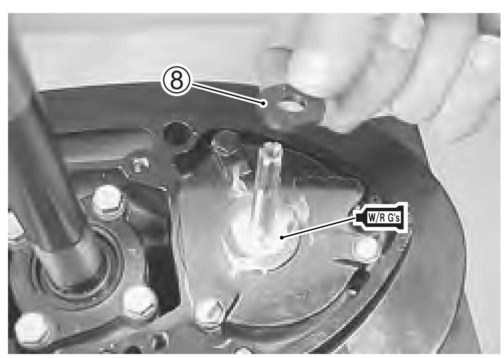
NOTE:
Before install the shift unit (Shift rod guide housing assembly), bring shifter yoke to the neutral position by turning shift rod right or left.



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

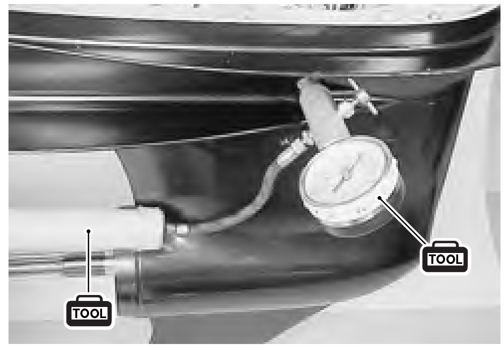


- Apply enough Water Resistant Grease on oil seal before putting seal cover ⑧ so that there is no space between them.



LEAKAGE CHECK

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



TOOL **09950-69511 : Oil leakage tester**
09952-99310 : Air pump

Procedure

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

NOTE:
Apply low initial pressure of 20 – 40 kpa, (0.2 – 0.4 kg/cm^2, 2.8 – 5.7 psi) first, then apply specified pressure.

Leakage test pressure: 100 kPa (1.0 kg/cm^2, 14.2 psi)

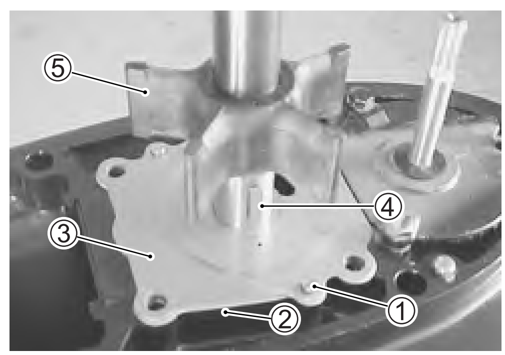
CAUTION

Do not exceed pressure of 110 kPa (1.1kg/cm^2, 15.6 psi) or damage to oil seals will result.

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

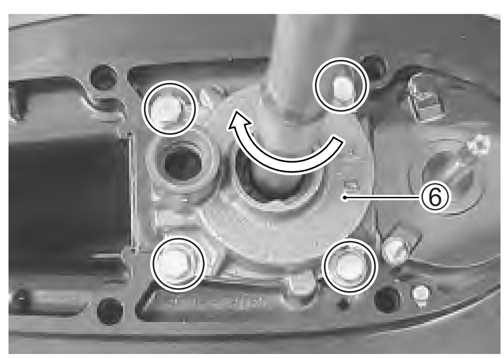
WATER PUMP (Impeller & Case)

Place the dowel pins ①, under panel gasket ② and under panel ③ into position.
Insert the key ④ in the driveshaft and slide the impeller ⑤ onto driveshaft, ensuring that key and keyway are aligned.



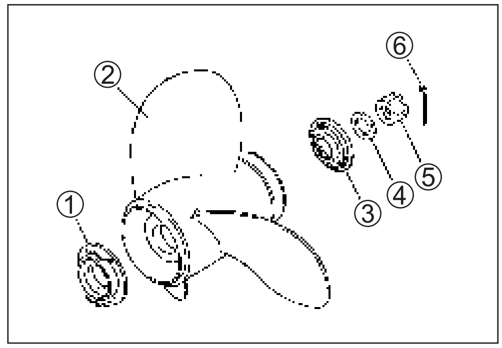
Install the pump case ⑥ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
Securely tighten the four (4) pump case bolts to the specified torque.

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



PROPELLER INSTALLATION

Install propeller stopper ① onto propeller shaft, then slide on the propeller ②.
Fit spacer ③, washer ④ and nut ⑤, then tighten nut to specified torque.
Push cotter pin ⑥ through nut and shaft, then bend to secure.

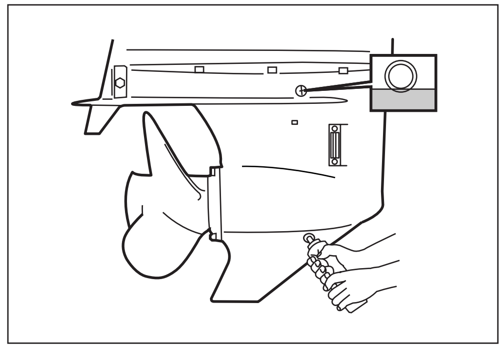


W/R G's **99000-25161: Water Resistant Grease**

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

GEAR OIL

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



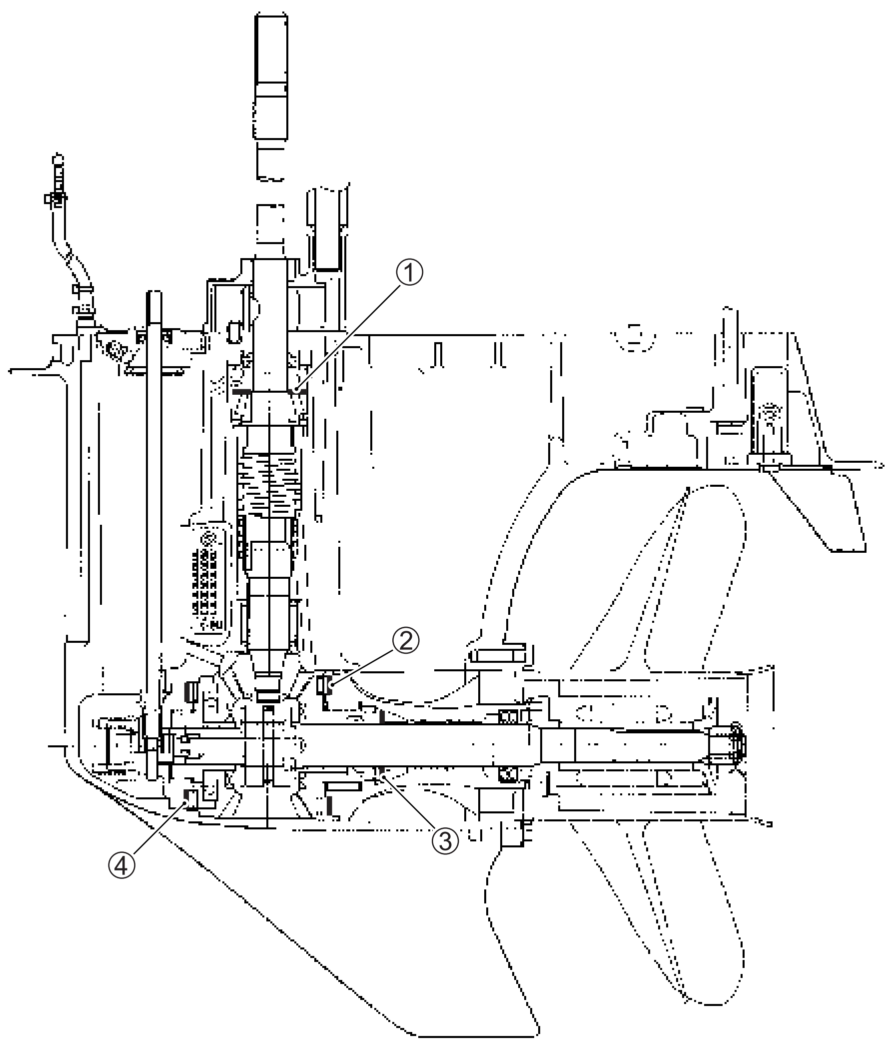
Gear OIL **99000-22540: Suzuki Outboard Motor Gear Oil**

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

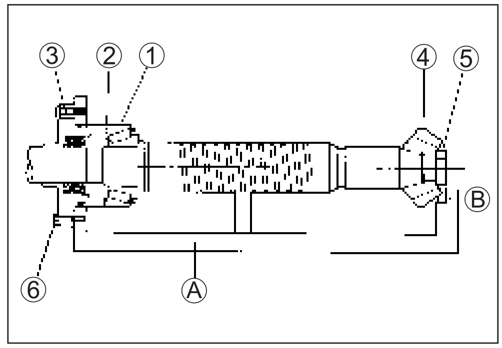
If lower unit has been rebuilt or has had components replaced, shimming for correct gear contact and backlash will have to be adjusted to ensure smooth, reliable operation of gears.

Shim/Washer & Mounting position

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



PINION GEAR BACK-UP SHIM ADJUSTMENT



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

TOOL **09951-09010: Shimming gauge**

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

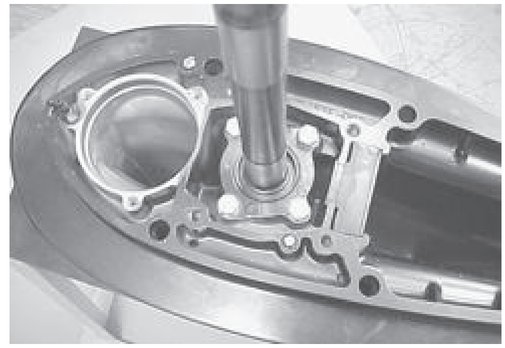
NOTE:
Use a thinner pinion back-up shim ② than the standard shim so that a clearance Ⓑ exists.

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

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

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

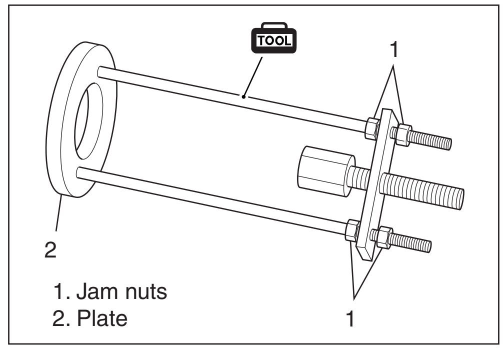
REVERSE GEAR BACK-UP SHIM ADJUSTMENT



1. Correctly assemble reverse gear bearing housing, reverse gear thrust bearing, reverse gear retainer, reverse gear, reverse gear spacer, pinion gear, driveshaft assembly/oil seal housing and related components.

2. Tighten pinion nut to specified torque.

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

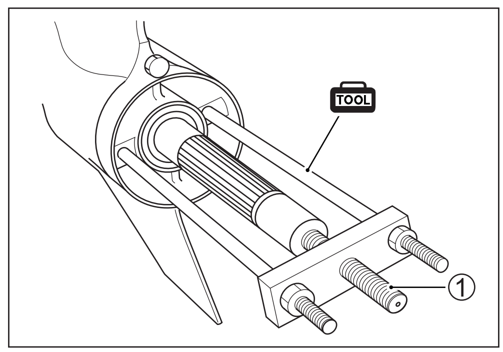


1. Jam nuts
2. Plate

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

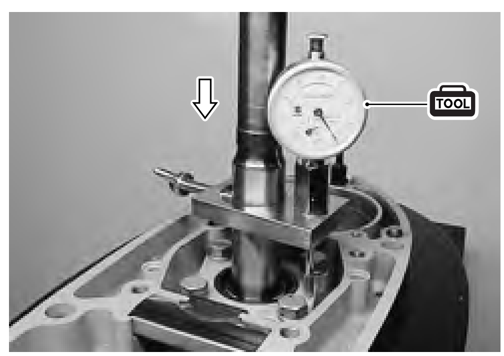
TOOL 09951-98721: Gear holder

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



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

TOOL 09951-09530: gear adjusting gauge



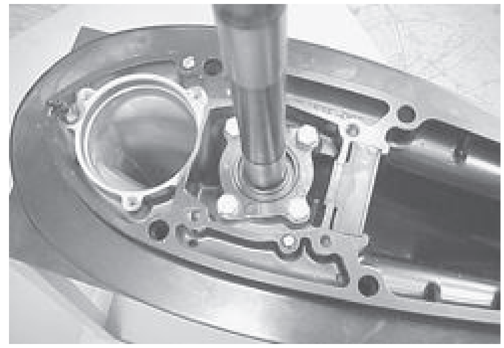
7. To check the driveshaft thrust play, slowly push driveshaft downward, then read the maximum play.

Driveshaft thrust play:
Approx. 0.6 – 0.8 mm (0.024 – 0.031 in.)

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

FORWARD GEAR BACK-UP SHIM ADJUSTMENT

Follow the procedure below to adjust forward gear.



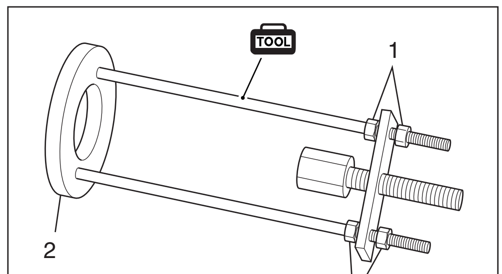
Step to prior to adjustment

1. Correctly assemble reverse gear, driveshaft oil seal housing, driveshaft, pinion gear and related components. (See page 11-78 – 11-80)
2. Tighten pinion nut to specified torque.

Pinion nut: 120 N·m (12.0 kg-m, 87.0 lb-ft)

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

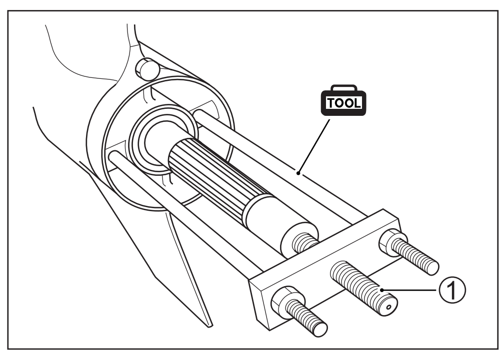
NOTE:
- *Before installing special tool, loosen the jam nuts securing the long bolts and then remove the plate from long bolts.*
- *Screw long bolts into the 10 mm thread on propeller shaft bearing housing.*



1. Jam nuts
2. Plate

5. Install the special toll to gearcase and then attach it to the propeller shaft as shown in the illustration.

TOOL **09951-98721: Gear holder**

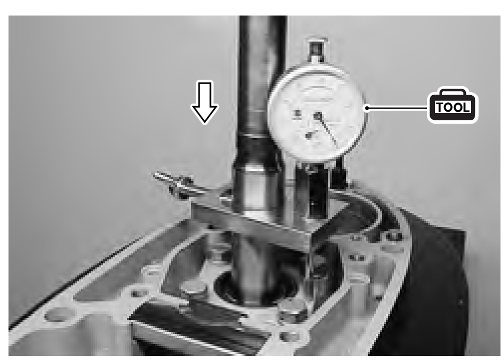


6. Turn the bolt ① counterclockwise and tighten until the propeller shaft can rotate smoothly without play.
   Do not over tighten.

Checking driveshaft thrust play

(a) Affix gear adjusting gauge to driveshaft.

TOOL **09951-09530: Gear adjusting gauge**



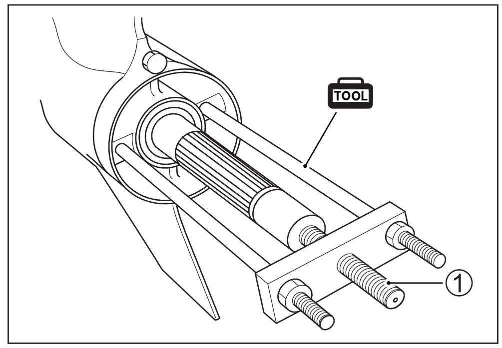
(b) To check the driveshaft thrust play, slowly push driveshaft downward, then read the maximum play

Driveshaft thrust play:
Approx. 0.3 – 0.5 mm (0.012 – 0.020 in.)

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

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

Check tooth contact pattern by using the following procedure:



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

(B) In accordance with step 1 – 6, assemble the lower unit, then install the special tool.
Turn the bolt ① counterclockwise and tighten until the propeller shaft can rotate smoothly without play.
Do not over tighten.

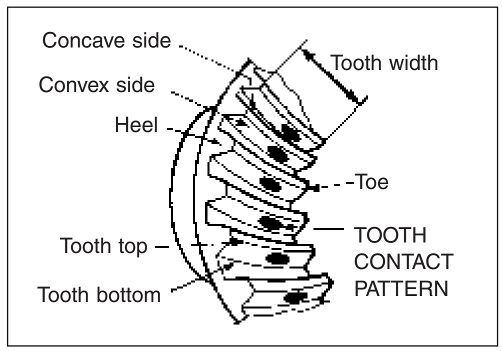
NOTE:
While assessing tooth contact, place the clutch dog shifter to Neutral position.

TOOL 09951-98721: Gear holder

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

TOOL 09921-29410: Driveshaft holder

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

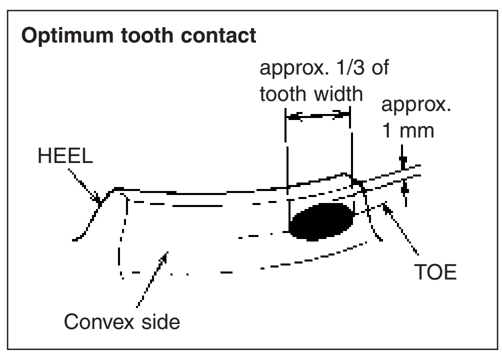


Optimum tooth contact

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

CAUTION

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



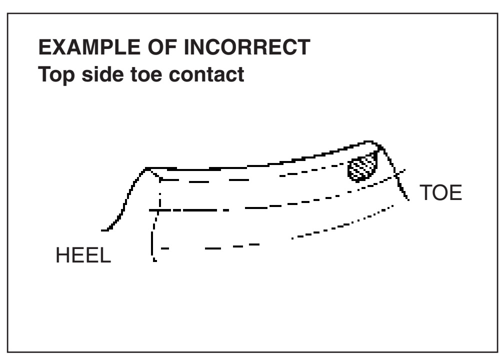
Example (1)

Incorrect topside toe contact:
Correction measures:
- Decrease thickness of forward gear shim.

(• Slightly increase pinion gear shim thickness.)

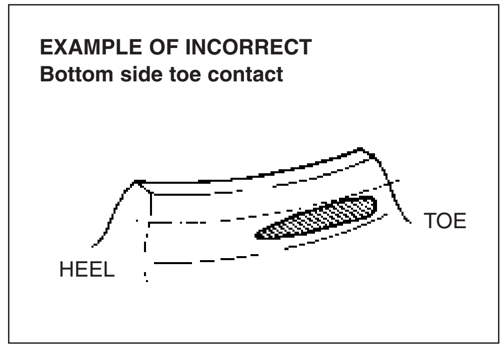
CAUTION

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



Example (2)
Incorrect bottom side toe contact:
Correction measures:
- Increase thickness of forward gear shim.

(• Slightly decrease pinion gear shim thickness.)

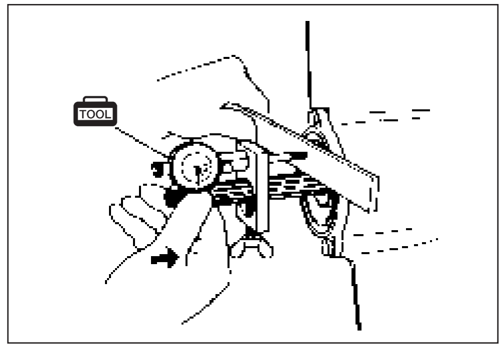


CAUTION

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

CHECKING PROPELLER SHAFT THRUST PLAY

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



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

Measurement step:

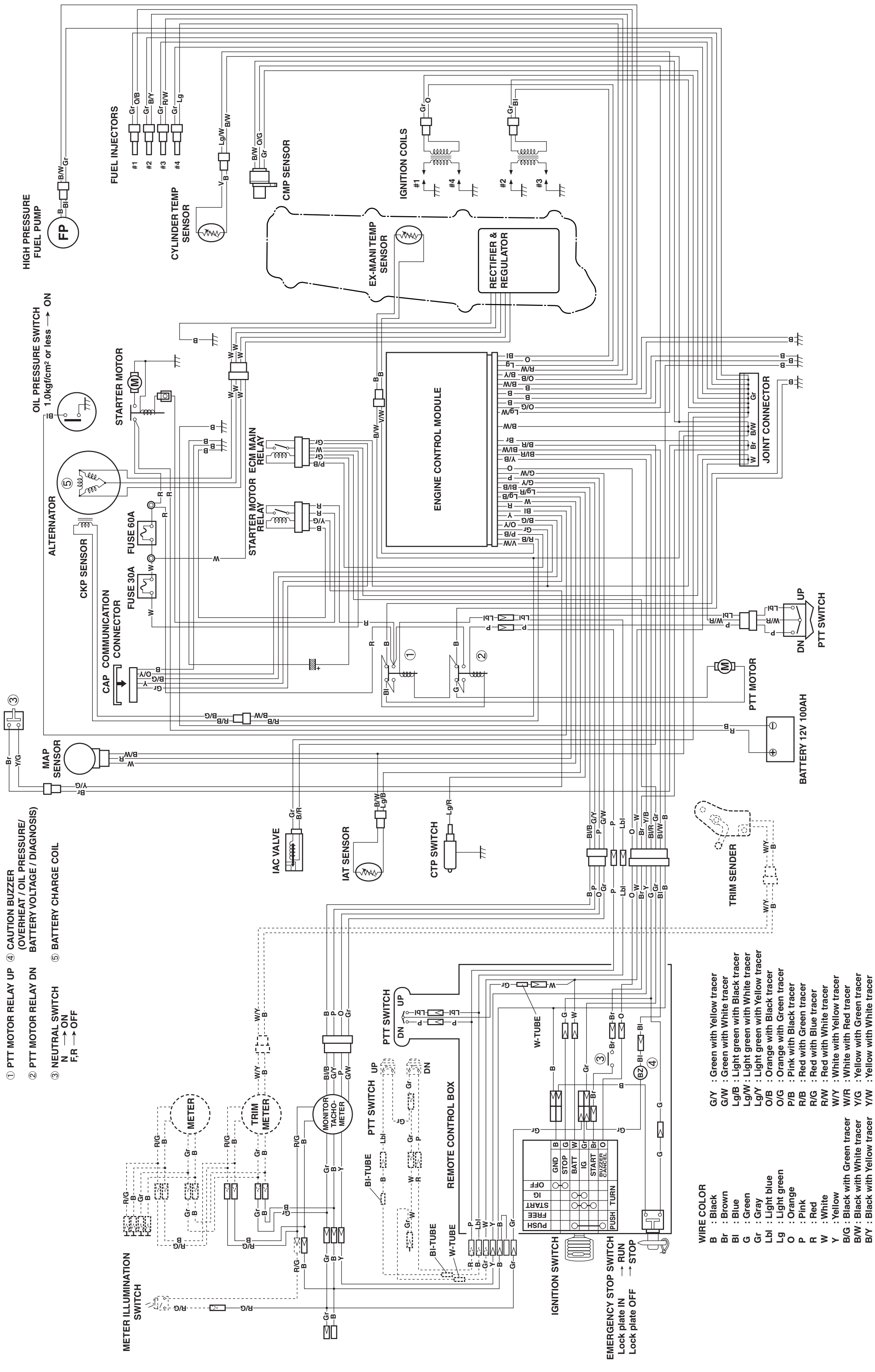
1. Assemble gear adjusting gauge to the propeller shaft.

TOOL **09951-09530: Gear adjusting gauge**

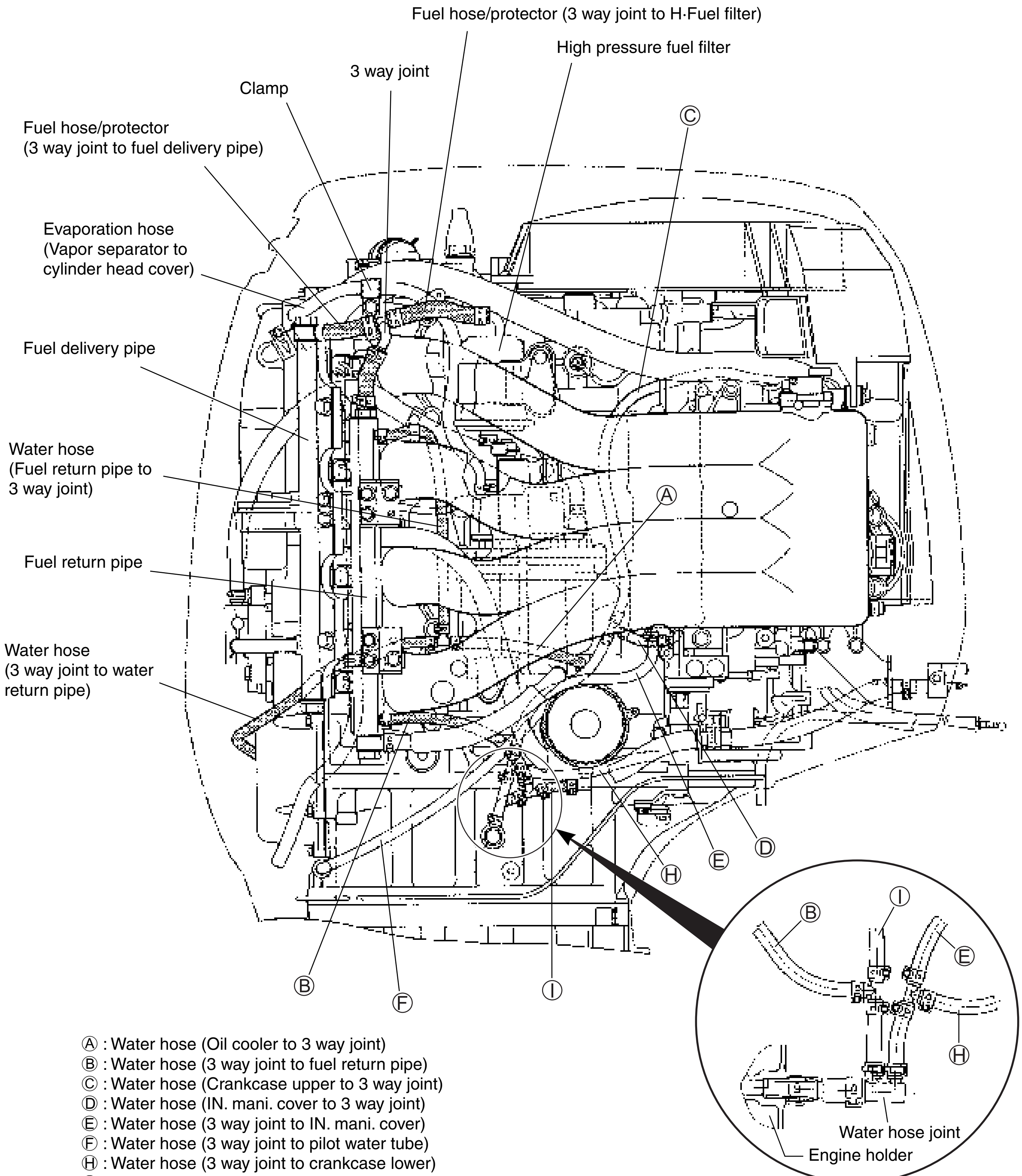
2. Push propeller shaft inward.
3. Hold shaft in and set dial gauge pointer to zero.
4. Slowly pull shaft outward and read the maximum thrust play on the dial.
   - If measurement is more than specification, increase propeller shaft thrust shim thickness.
   - If measurement is less than specification,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

WIRING DIAGRAM

DF140T/140Z



HOSE ROUTING



Ⓐ : Water hose (Oil cooler to 3 way joint)
Ⓑ : Water hose (3 way joint to fuel return pipe)
Ⓒ : Water hose (Crankcase upper to 3 way joint)
Ⓓ : Water hose (IN. mani. cover to 3 way joint)
Ⓔ : Water hose (3 way joint to IN. mani. cover)
Ⓕ : Water hose (3 way joint to pilot water tube)
Ⓗ : Water hose (3 way joint to crankcase lower)
Ⓘ : Water hose (3 way joint to oil cooler)

DF90/115 “K2” (’02) MODEL

CONTENTS

*SPECIFICATIONS

* These specifications are subject to change without notice.

Item	Unit	Data DF90T	Data DF115T
PRE-FIX		09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115T
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	UL	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	UL	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	UL	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115T
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6E
Ignition system		Full-transistorized ignition
Fuel supply system		Multi-point sequential electronic fuel injection
Exhaust system		Through prop exhaust
Cooling system		Water cooled
Lubrication system		Wet sump by trochoid pump
Starting system		Electric
Throttle control		Remote control

Item	Unit	Data	
		DF90T	DF115T

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)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	1050 (35.5 / 37.0)

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.08)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	3 × 14 × 17 3 × 14 × 19 3 × 14 × 21 3 × 14 × 23

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.24)
2nd reduction gear ratio (Lower unit gear)	12 : 25 (2.08)
Total reduction gear ratio	2.59 $\left(\frac{36}{29} \times \frac{25}{12}\right)$

*SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data	
		DF90T	DF115T

POWERHEAD

Item	Unit	DF90T	DF115T
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	
**Cylinder compression	kPa (kg/cm², psi)	1300 – 1700 (13 – 17, 185 – 242)	
**Cylinder compression max. difference between any other cylinders	kPa (kg/cm², psi)	100 (1.0, 14)	
**Engine oil pressure	kPa (kg/cm², psi)	550 – 600 (5.5 – 6.0, 78 – 85) at 3000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

<table>
<tr><th colspan="3" rowspan="2">Item</th><th rowspan="2">Unit</th><th colspan="2">Data</th></tr>
<tr><th>DF90T</th><th>DF115T</th></tr>
</table>

CYLINDER HEAD / CAMSHAFT

** New “K2” service data

<table>
<tr><td colspan="2">Cylinder head distortion</td><td>Limit</td><td>mm (in)</td><td colspan="2">0.05 (0.002)</td></tr>
<tr><td colspan="2">Manifold seating faces distortion</td><td>Limit</td><td>mm (in)</td><td colspan="2">0.10 (0.004)</td></tr>
<tr><td rowspan="4">Cam height</td><td rowspan="2">IN</td><td>STD</td><td>mm (in)</td><td>**36.920 – 37.080 (1.4535 – 1.4598)</td><td>**38.820 – 38.980 (1.583 – 1.5346)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>**36.820 (1.4496)</td><td>**38.720 (1.5244)</td></tr>
<tr><td rowspan="2">EX</td><td>STD</td><td>mm (in)</td><td>**36.630 – 36.790 (1.4421 – 1.4484)</td><td>**38.640 – 38.800 (1.5213 – 1.5276)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td>**36.530 (1.4382)</td><td>**38.540 (1.5173)</td></tr>
<tr><td rowspan="4">Camshaft journal oil clearance</td><td rowspan="2">Top, 2nd, 3rd, 4th</td><td>STD</td><td>mm (in)</td><td colspan="2">0.020 – 0.062 (0.0008 – 0.0024)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">0.120 (0.0047)</td></tr>
<tr><td rowspan="2">5th</td><td>STD</td><td>mm (in)</td><td colspan="2">0.045 – 0.087 (0.0018 – 0.0034)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">0.120 (0.0047)</td></tr>
<tr><td rowspan="4">Camshaft journal (housing) inside diameter</td><td rowspan="2">Top, 2nd, 3rd, 4th</td><td>STD</td><td>mm (in)</td><td colspan="2">23.000 – 23.021 (0.9055 – 0.9063)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">23.171 (0.9122)</td></tr>
<tr><td rowspan="2">5th</td><td>STD</td><td>mm (in)</td><td colspan="2">26.000 – 26.021 (1.0236 – 1.0244)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">26.171 (1.0304)</td></tr>
<tr><td rowspan="4">Camshaft journal outside diameter</td><td rowspan="2">Top, 2nd, 3rd, 4th</td><td>STD</td><td>mm (in)</td><td colspan="2">22.959 – 22.980 (0.9039 – 0.9047)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">22.869 (0.9004)</td></tr>
<tr><td rowspan="2">5th</td><td>STD</td><td>mm (in)</td><td colspan="2">25.934 – 25.955 (1.0210 – 1.0219)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">25.844 (1.0175)</td></tr>
<tr><td colspan="2">Camshaft runout</td><td>Limit</td><td>mm (in)</td><td colspan="2">0.10 (0.004)</td></tr>
<tr><td colspan="2" rowspan="2">Cylinder head bore to tappet clearance</td><td>STD</td><td>mm (in)</td><td colspan="2">0.025 – 0.066 (0.0010 – 0.0026)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">0.150 (0.0059)</td></tr>
<tr><td colspan="2">Tappet outer diameter</td><td>STD</td><td>mm (in)</td><td colspan="2">30.959 – 30.975 (1.2189 – 1.2195)</td></tr>
<tr><td colspan="2">Cylinder head bore</td><td>STD</td><td>mm (in)</td><td colspan="2">31.000 – 31.025 (1.2203 – 1.2215)</td></tr>
</table>

VALVE / VALVE GUIDE

Item			Unit	Data	
				DF90T	DF115T
Valve diameter		IN	mm (in)	33 (1.3)	
		EX	mm (in)	28 (1.1)	
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)	
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)	
Valve seat angle	IN		——	15°, 45°, 60°	
	EX		——	15°, 45°	
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)	
		Limit	mm (in)	0.070 (0.0028)	
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)	
		Limit	mm (in)	0.090 (0.0035)	
Valve guide inside diameter	IN,EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)	
Valve guide protrusion	IN,EX	STD	mm (in)	13.5 (0.53)	
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)	
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)	
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)	
	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)	1.2 (0.05)	
		Limit	mm (in)	0.7 (0.03)	
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)	
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)	
Valve spring free length		STD	mm (in)	42.7 (1.68)	
		Limit	mm (in)	41.0 (1.61)	
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)	
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)	
Valve spring squareness		Limit	mm (in)	2.0 (0.08)	

Item			Unit	Data DF90T	Data DF115T

CYLINDER / PISTON / PISTON RING

Item			Unit	DF90T	DF115T
Cylinder distortion		Limit	mm (in)	0.05 (0.002)	
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)	84.000 – 84.020 (3.3071 – 3.3079)	
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface	
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)	
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end.	
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)	
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)	
		Limit	mm (in)	0.70 (0.028)	
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)	
		Limit	mm (in)	1.00 (0.039)	
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)	
		Limit	mm (in)	9.0 (0.354)	
	2nd	STD	mm (in)	Approx. 11.0 (0.43)	
		Limit	mm (in)	8.8 (0.347)	
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)	
		Limit	mm (in)	0.120 (0.0047)	
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)	
		Limit	mm (in)	0.100 (0.0039)	
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)	
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)	
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)	
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)	
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)	
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)	
		Limit	mm (in)	0.040 (0.0016)	
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)	
		Limit	mm (in)	20.980 (0.8260)	
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)	
		Limit	mm (in)	21.040 (0.8283)	
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)	
		Limit	mm (in)	0.050 (0.0020)	
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)	

Item		Unit	Data	
			DF90T	DF115T

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T

ELECTRICAL

** New “K2” service data

Item		Unit	DF90T	DF115T
Ignition timing		Degrees	BTDC 1° – BTDC 44°	BTDC 3° – BTDC 44°
Over revolution limiter		r/min	**6200	
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	kΩ at 20°C	No.2–No.3 : 18–34 (including H.T.cord and spark plug cap) No.1–No.4 : 19–36 (including H.T.cord and spark plug cap)	
High tension cord resistance		kΩ/m at 20°C	Approx.16	
Battery charge coil resistance		Ω at 20°C	0.16 – 0.24	
Battery charge coil output (12V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse : 60 Sub fuse : 30	
Recommended battery capacity (12V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25°C	1.8 – 2.3	
ECM main relay resistance		Ω at 20°C	80 – 120	
Starter relay coil resistance		Ω at 20°C	80 – 120	
PTT motor relay coil resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

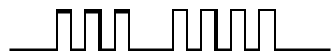
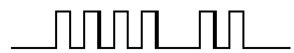
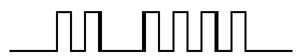
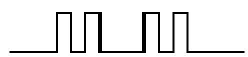
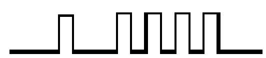
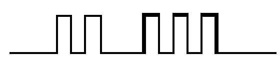
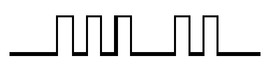
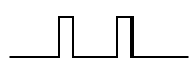
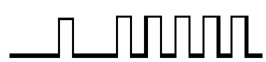
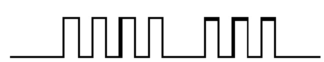
Item		Unit	Data
Max. continuous time of use		Sec	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

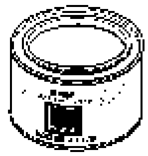
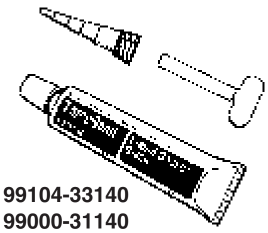
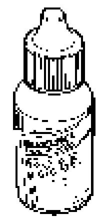
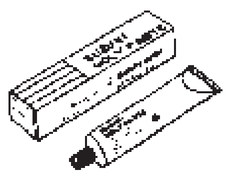
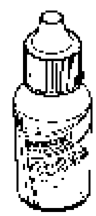
TIGHTENING TORQUE

Tightening Torque – Important Fasteners

* Tightening torques have been changed from the middle of 2002 year model.

ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	23	2.3	16.5
		10 mm	70	7.0	50.5
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	56	5.6	40.5
Conrod cap nut	DF90	8 mm	35	3.5	25.5
	DF115		*40	*4.0	*29.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	56.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		8 mm	23	2.3	16.5
Oil pressure switch		——	13	1.3	9.5
Fuel delivery pipe bolt		8 mm	23	2.3	16.5
Fuel delivery pipe plug / union bolt		12 mm	35	3.5	25.5
Fuel return pipe bolt		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Engine oil filter		——	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Engine holder bolt		8 mm	*25	*2.5	*18.0
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	85	8.5	61.5
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt / nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	20	2.0	14.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	20	2.0	14.5
Pinion nut		14 mm	100	10.0	72.5
Propeller nut		18 mm	55	5.5	40.0

MATERIALS REQUIRED

SUZUKI OUTBOARD MOTOR GEAR OIL  99000-22540 (400 ml × 24 pcs.)	SUZUKI SUPER GREASE “A”  *99000-25030 99000-25011 (500 g)	WATER RESISTANT GREASE  99000-25161 (250 g)	SUZUKI SILICONE SEAL  99000-31120 (50 g)
	SUZUKI BOND “1207B”  * 99104-33140 99000-31140 (100 g)	THREAD LOCK “1342”  99000-32050 (50 g)	THREAD LOCK SUPER “1333B”  99000-32020 (50 g)
4-Stroke Motor Oil API : SE, SF, SG, SH, SJ SAE : 10W-40	**SUZUKI MOLY PASTE  99000-25140 (50 g)	**THREAD LOCK SUPER “1303B”  99000-32030 (50 g)	

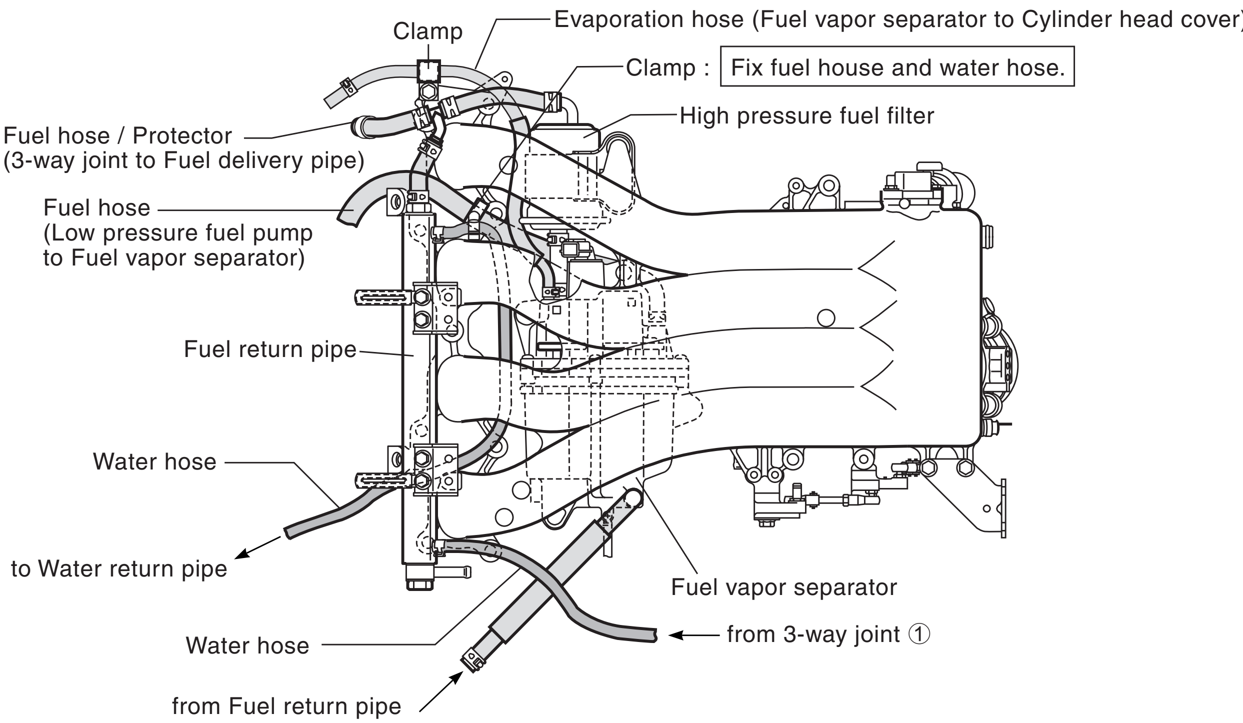
NOTE:
** Marked part No. is in U.S. market only.*
*** Marked materials have been added from 2002 year model.*

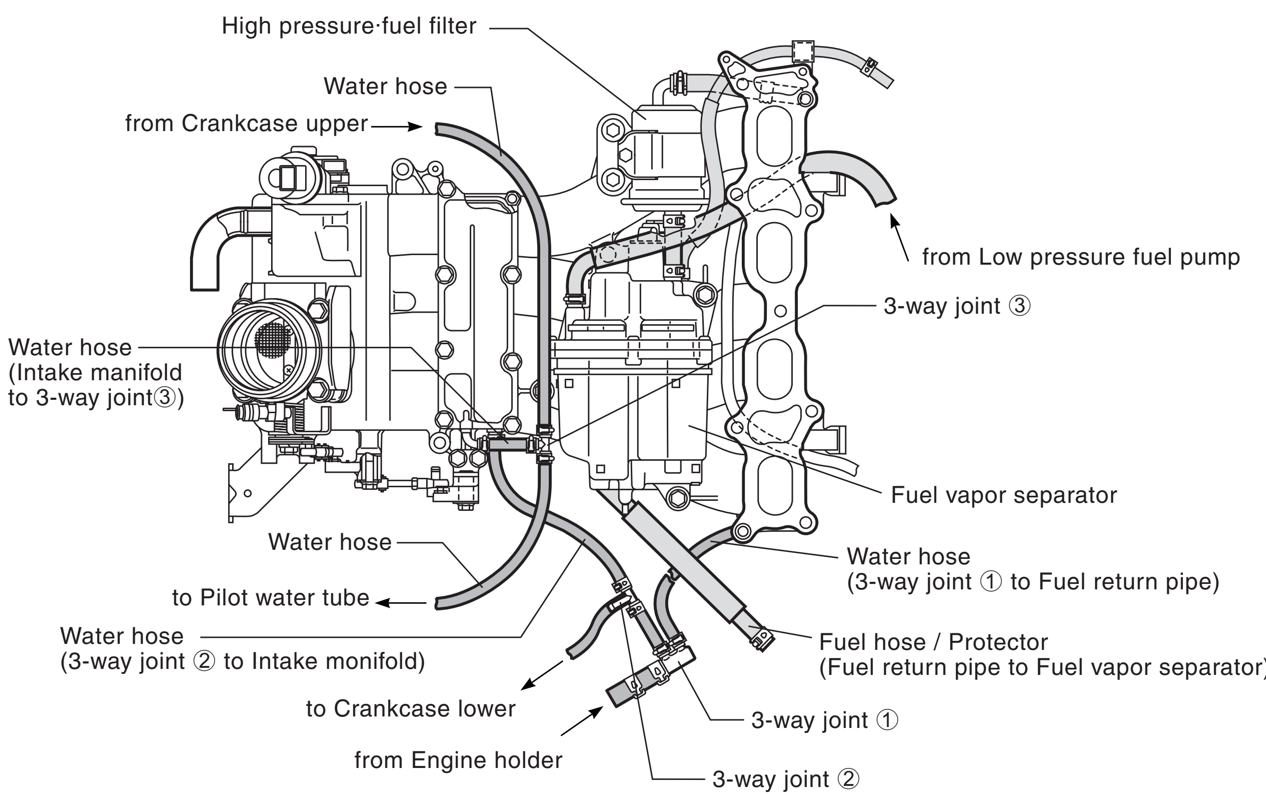
FUEL / WATER HOSE ROUTING

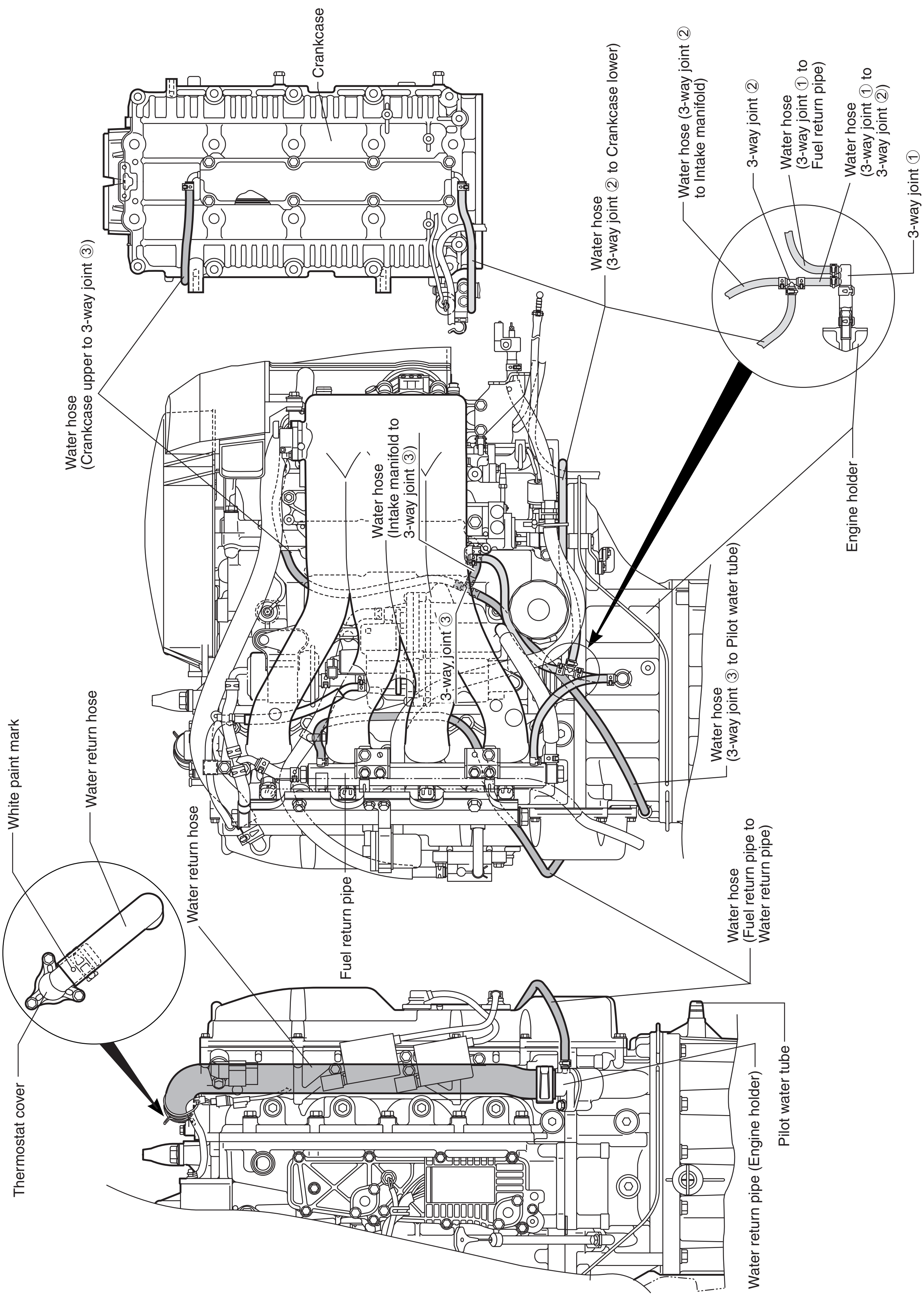
Fuel and water hose routing have been changed from the middle of 2002 year model.

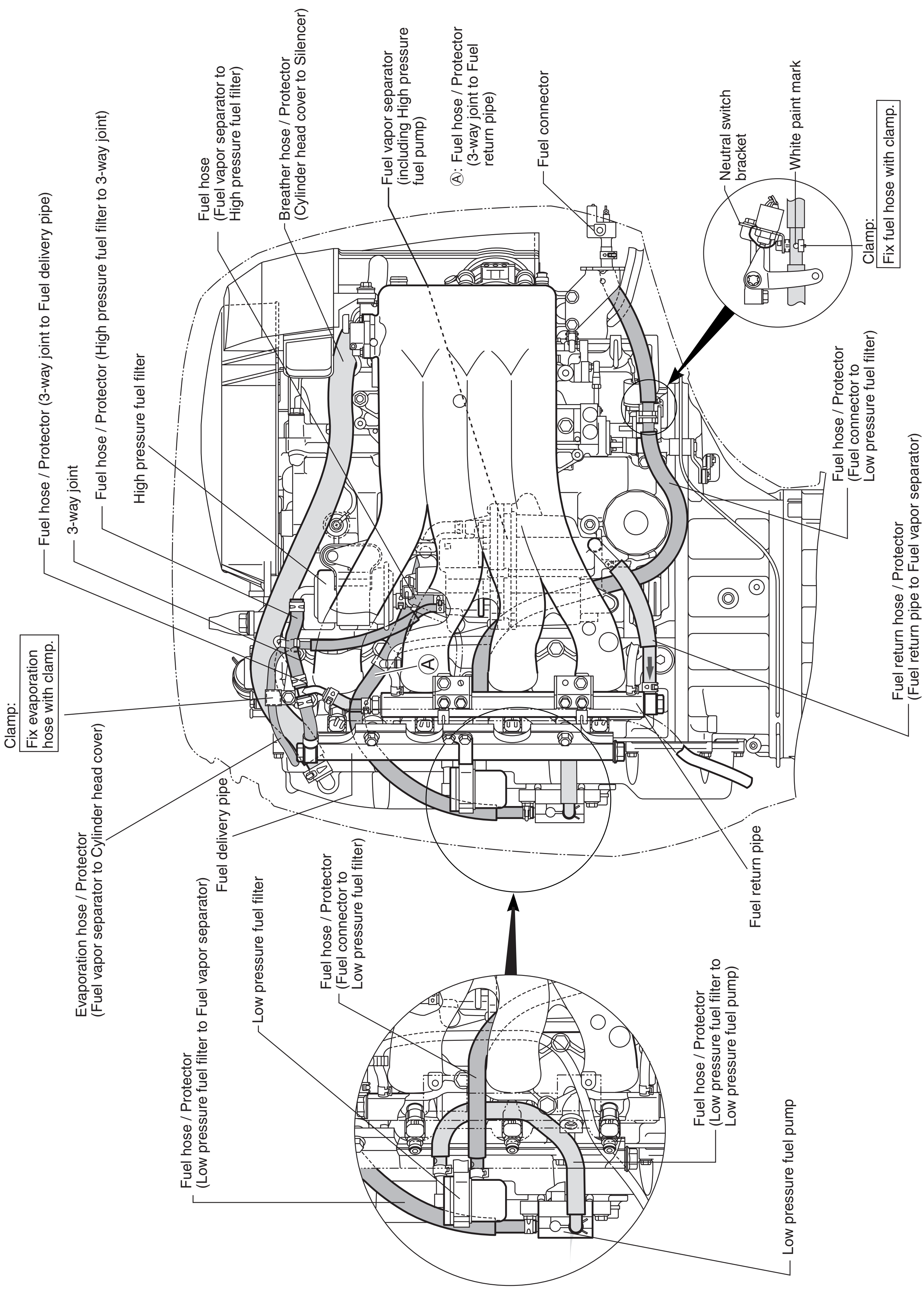
CAUTION

- **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.**






Crankcase
Water hose (Crankcase upper to 3-way joint ③)
Water hose (3-way joint ② to Crankcase lower)
Water hose (3-way joint ② to Intake manifold)
3-way joint ②
Water hose (3-way joint ① to Fuel return pipe)
Water hose (3-way joint ① to 3-way joint ②)
3-way joint ①
Water hose (Intake manifold to 3-way joint ③)
3-way joint ③
Engine holder
Water hose (3-way joint ③ to Pilot water tube)
White paint mark
Water return hose
Water return hose
Fuel return pipe
Water hose (Fuel return pipe to Water return pipe)
Thermostat cover
Water return pipe (Engine holder)
Pilot water tube



Fuel hose / Protector (3-way joint to Fuel delivery pipe)
3-way joint
Fuel hose / Protector (High pressure fuel filter to 3-way joint)
High pressure fuel filter
Fuel hose
(Fuel vapor separator to
High pressure fuel filter)
Breather hose / Protector
(Cylinder head cover to Silencer)
Fuel vapor separator
(including High pressure
fuel pump)
Ⓐ: Fuel hose / Protector
(3-way joint to Fuel
return pipe)
Fuel connector
Neutral switch
bracket
White paint mark
Fix fuel hose with clamp.
Clamp:
Fuel hose / Protector
(Fuel connector to
Low pressure fuel filter)
Fuel return hose / Protector
(Fuel return pipe to Fuel vapor separator)
Fuel return pipe
A
Clamp:
Fix evaporation
hose with clamp.
Evaporation hose / Protector
(Fuel vapor separator to Cylinder head cover)
Fuel delivery pipe
Fuel hose / Protector
(Low pressure fuel filter to Fuel vapor separator)
Low pressure fuel filter
Fuel hose / Protector
(Fuel connector to
Low pressure fuel filter)
Fuel hose / Protector
(Low pressure fuel filter to
Low pressure fuel pump)
Low pressure fuel pump

OVER-REVOLUTION CAUTION SYSTEM

The over revolution limiter have been changed.

Over revolution limiter

6500 r/min → 6200 r/min

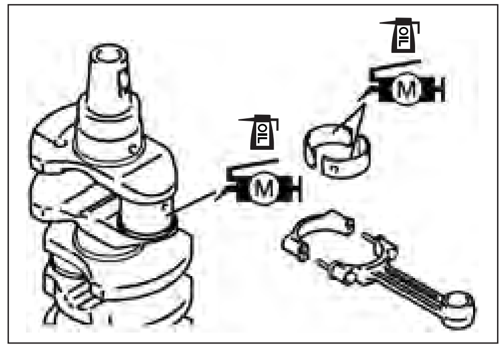
NOTE:

Although a function of the over revolution limiter is controlled by ECM, the part number of ECM has not been changed. If you install a 2002 year model ECM to the 2001 engine, the over revolution limiter will activate at about 6200 r/min.

CRANK PIN AND CONROD BEARING

Before installing conrod cap, apply Suzuki Moly Paste and engine oil to crank pin and connecting rod bearing.

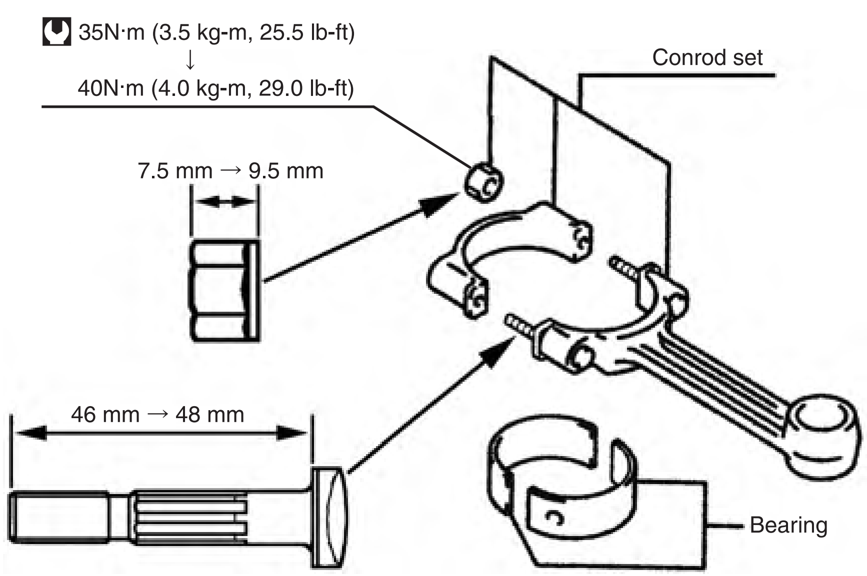
99000-25140: Suzuki Moly Paste



CONROD ASSY AND BEARING

The conrod assy and bearing have been changed from the middle of 2002 year model DF90/115.

In addition, the tightening torque of conrod nuts also have been changed.

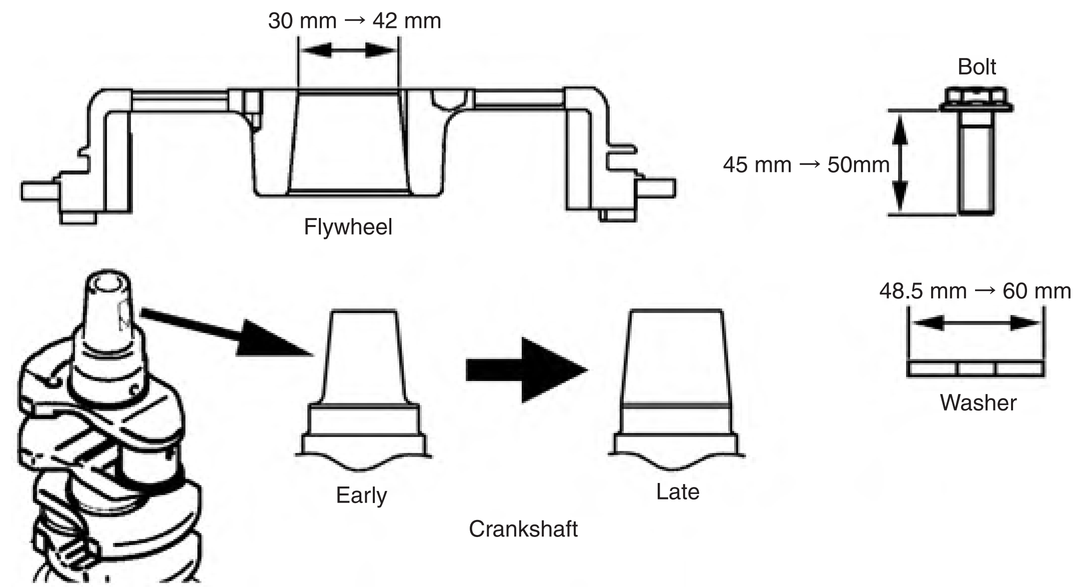


NOTE:

The bearing has been changed from plane type to micro-groove type.

CRANKSHAFT AND FLYWHEEL

The shape of crankshaft has changed from the middle of 2002 year model DF90/115.
As the result of this change, flywheel, flywheel bolt and washer also have been changed.

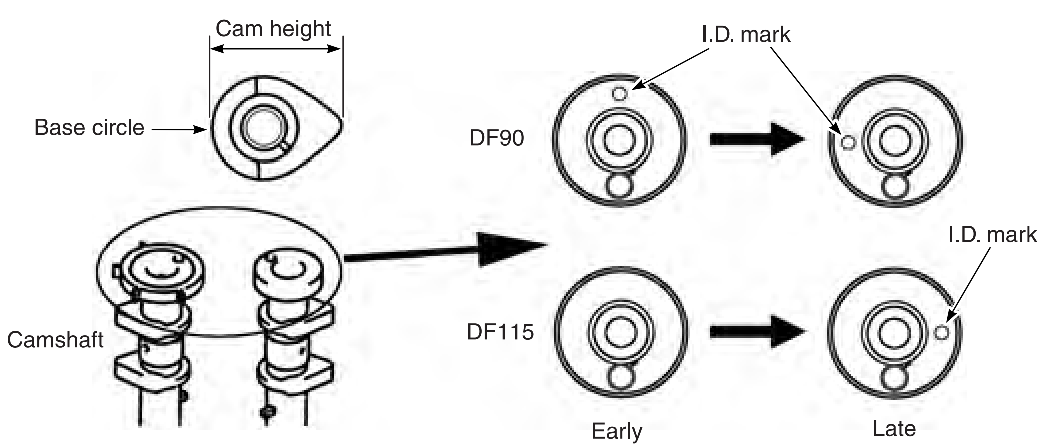


CAMSHAFT AND TAPPET SHIM

The shape of base circle (opposite side of cam face) of camshafts have been changed from 2002 year model DF90 and from the middle of 2001 year model DF115. As the result of this change, cam height has been changed.
And each camshaft has own identification mark.

Cam height

		DF90	DF115
Standard	IN	36.920 – 37.080 mm (1.4535 – 1.4598 in)	38.820 – 38.980 mm (1.5283 – 1.5346 in)
	EX	36.630 – 36.790 mm (1.4421 – 1.4484 in)	38.640 – 38.800 mm (1.5213 – 1.5276 in)
Limit	IN	36.820 mm (1.4496 in)	38.720 mm (1.5244 in)
	EX	36.530 mm (1.4382 in)	38.540 mm (1.5173 in)

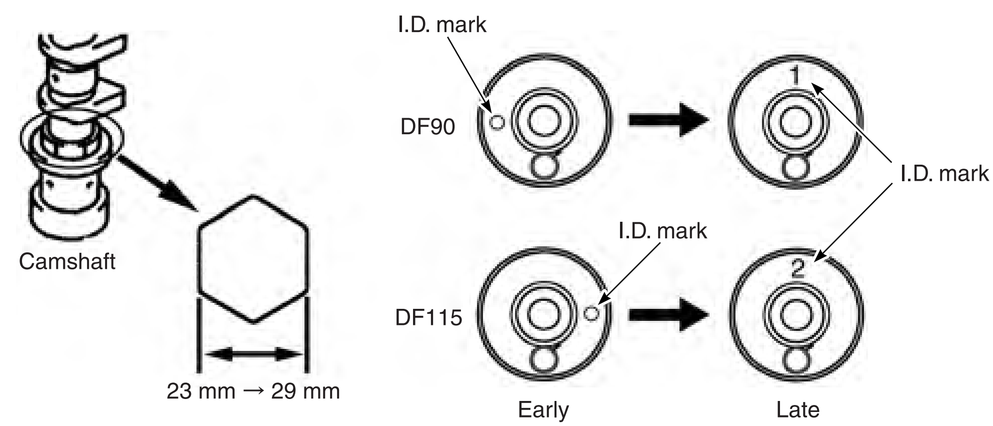


TAPPET SHIM

New size tappet shims have been added.

I.D. number	Thickness (mm)
303	3.025
305	3.050
308	3.075
310	3.100
313	3.125

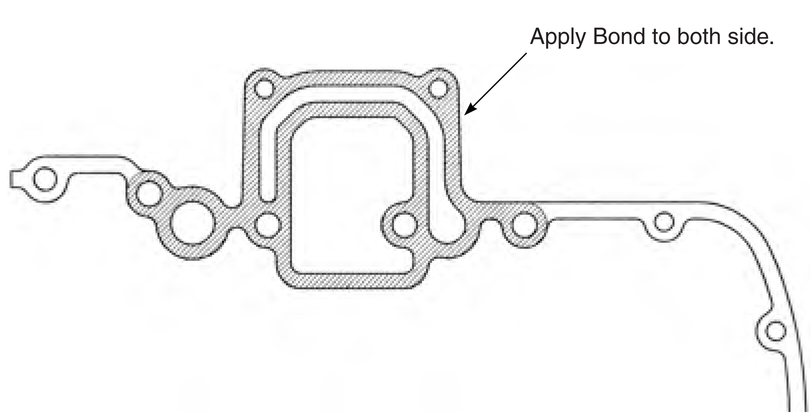
The shape of camshafts has been changed from the middle of 2002 year model.
And each camshaft has own identification mark.



ENGINE HOLDER GASKET

When installing the engine holder gasket, apply Suzuki Bond "1207B" as shown in figure.

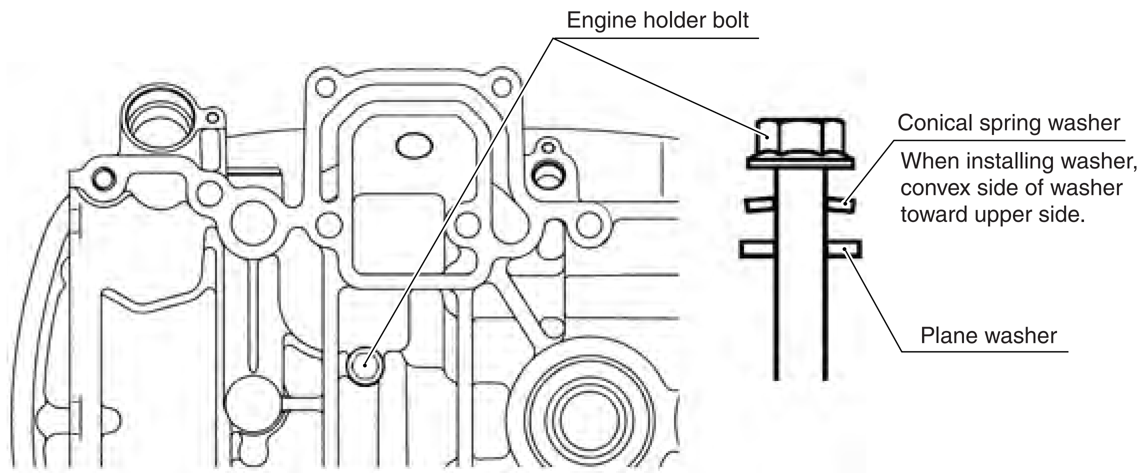
1207B **99000-31140 (Except for U.S. market) Suzuki Bond "1207B"**
99104-33140 (Only for U.S. market)



ENGINE HOLDER BOLT

The engine holder bolt has been changed from the middle of 2002 year model.
A conical spring washer and plane washer have been added.
In addition, the tightening torque of engine holder bolt also has been changed.

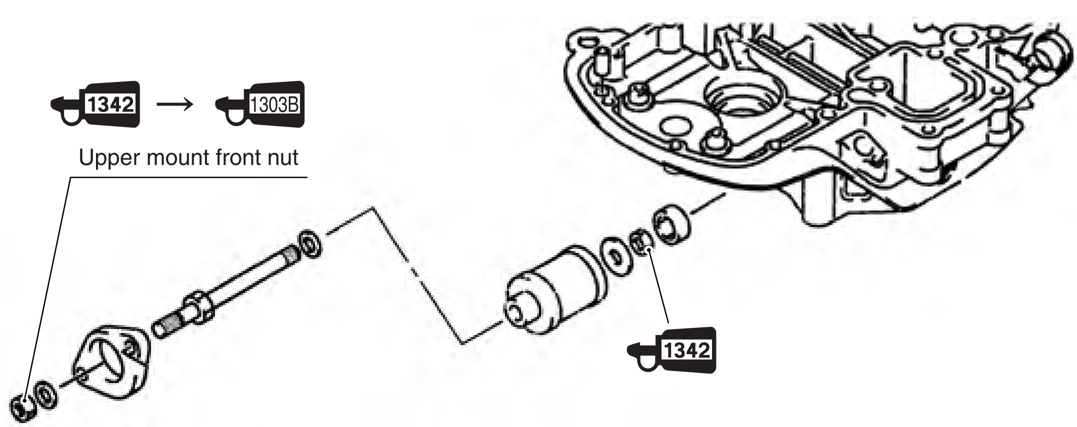
Engine holder bolt
1st step 23 N·m (2.3 kg-m, 16.5 lb-ft)
Final step–Before installing power unit, retighten a bolt.
25 N·m (2.5 kg-m, 18 lb-ft)



UPPER MOUNT FRONT NUT

The thread lock has been changed.

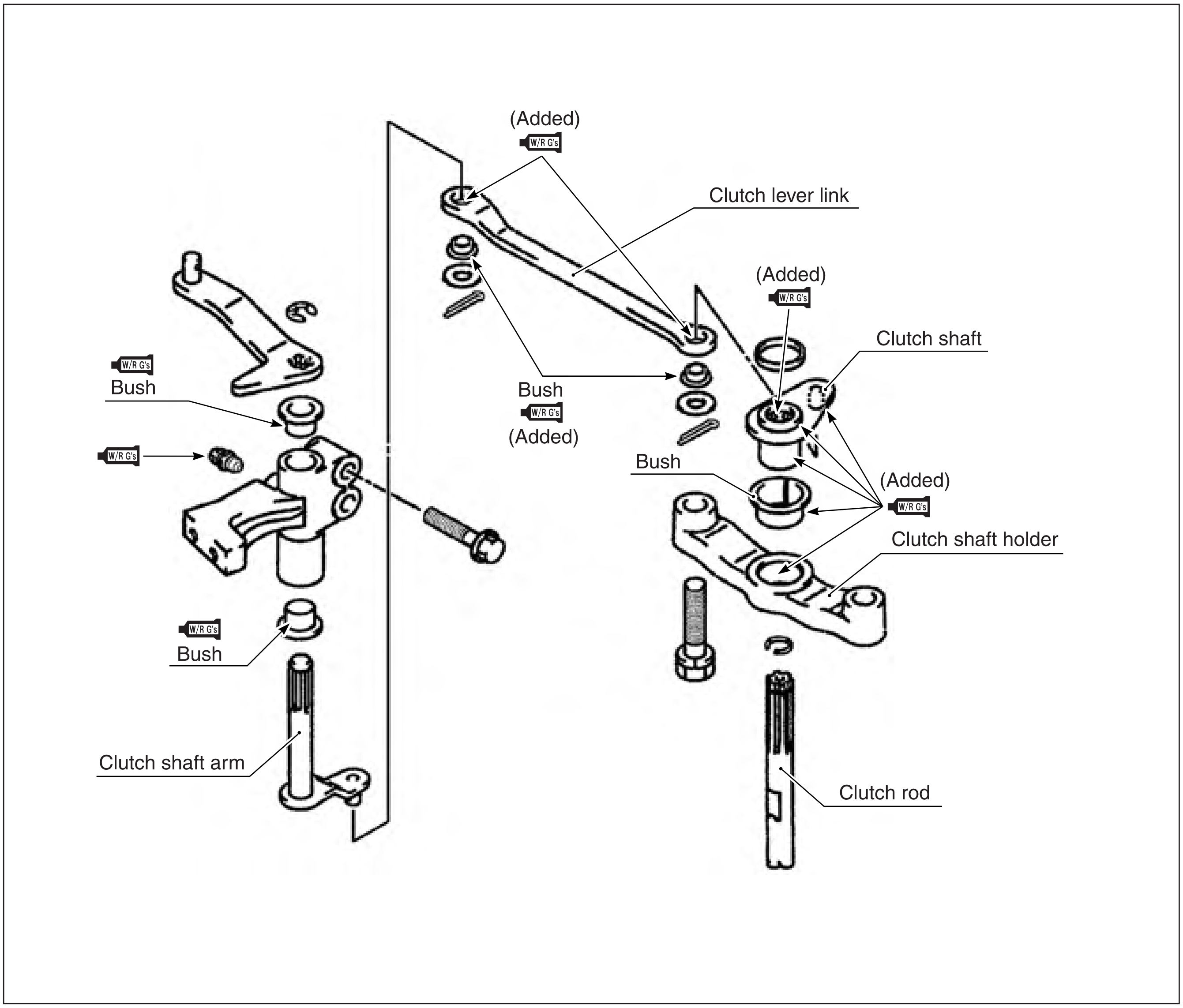
1303 **99000-32030: Thread Lock Super “1303B”**



CLUTCH LINKAGE

Apply Water Resistant Grease to the following points.

W/R G's 99000-25161: Water Resistant Grease



DF90/115/140 “K3” (2003) MODEL

CONTENTS

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*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115(W)T
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115(W)T
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	UL	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	UL	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	UL	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115(W)T
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6E
Ignition system		Full-transistorized ignition
Fuel supply system		Multi-point sequential electronic fuel injection
Exhaust system		Through prop exhaust
Cooling system		Water cooled
Lubrication system		Wet sump by trochoid pump
Starting system		Electric
Throttle control		Remote control

Item	Unit	Data	
		DF90T	DF115(W)T

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)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil capacity	ml (US/Imp. oz)	1050 (35.5 / 37.0)

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.08)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	3 × 14 × 17 3 × 14 × 19 3 × 14 × 21 3 × 14 × 23

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.24)
2nd reduction gear ratio (Lower unit gear)	12 : 25 (2.08)
Total reduction gear ratio	2.59 $\left(\frac{36}{29} \times \frac{25}{12}\right)$

*SPECIFICATIONS (DF140T/140W/140Z)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF140(W)T	DF140Z
PRE-FIX			14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Item	Unit	Data
Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5600 – 6200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140(W)T	DF140Z

FUEL & OIL

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

BRACKET

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

LOWER UNIT

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

REDUCTION SYSTEM

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

*SERVICE DATA (DF90T/115T/115WT)

* These service data are subject to change without notice.

Item	Unit	Data	
		DF90T	DF115(W)T

POWERHEAD

Item	Unit	DF90T	DF115(W)T
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear : approx. 625)	
**Cylinder compression	kPa (kg/cm², psi)	1300 – 1700 (13 – 17, 185 – 242)	
**Cylinder compression max. difference between any other cylinders	kPa (kg/cm², psi)	100 (1.0, 14)	
**Engine oil pressure	kPa (kg/cm², psi)	550 – 600 (5.5 – 6.0, 78 – 85) at 3000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8 / 4.8) : Oil change only 5.7 (6.0 / 5.0) : Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data DF90T	Data DF115(W)T

CYLINDER HEAD / CAMSHAFT

** New “K3” service data

Item			Unit	DF90T	DF115(W)T
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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	** 38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.530 (1.4382)	** 38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data DF90T	Data DF115(W)T

VALVE/VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		——	15°, 45°, 60°
	EX		——	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN,EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit	mm (in)	0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit	mm (in)	41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF90T	DF115(W)T

CYLINDER/PISTON/PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end.
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data (DF90T / DF115(W)T)

CRANKSHAFT / CONROD

Item		Unit	DF90T / DF115(W)T
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115(W)T

ELECTRICAL

Item		Unit	DF90T	DF115(W)T
Ignition timing		Degrees at r/min	BTDC 1° – BTDC 44°	BTDC 3° – BTDC 44°
Over revolution limiter		r/min	6200	
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	kΩ at 20°C	No.2–No.3 : 18–34 (including H.T.cord and spark plug cap) No.1–No.4 : 19–36 (including H.T.cord and spark plug cap)	
High tension cord resistance		kΩ/m at 20°C	Approx.16	
Battery charge coil resistance		Ω at 20°C	0.16 – 0.24	
Battery charge coil output (12V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse : 60 Sub fuse : 30	
Recommended battery capacity (12V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20°C	11.0 – 16.5	
IAC valve resistance		Ω at 20°C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25°C	1.8 – 2.3	
ECM main relay resistance		Ω at 20°C	145 – 190	
Starter relay coil resistance		Ω at 20°C	80 – 120	
PTT motor relay coil resistance		Ω at 20°C	3.0 – 4.5	

STARTER MOTOR

Item		Unit	DF90T	DF115(W)T
Max. continuous time of use		Sec	30	
Motor output		kW	1.4	
Brush length	STD	mm (in)	16.0 (0.63)	
	Limit	mm (in)	12.0 (0.47)	
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)	
	Limit	mm (in)	0.2 (0.01)	
Commutator outside diameter	STD	mm (in)	29.0 (1.14)	
	Limit	mm (in)	28.0 (1.10)	
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)	
	Limit	mm (in)	0.40 (0.016)	

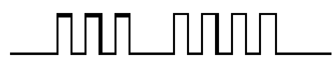
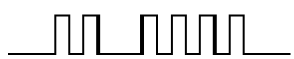
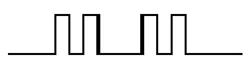
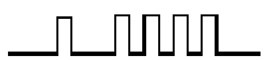
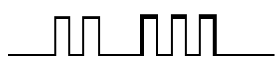
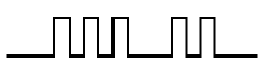
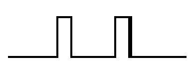
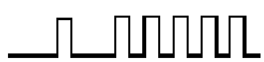
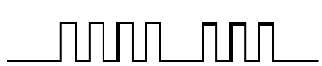
Item	Unit	Data	
		DF90T	DF115(W)T

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

*SERVICE DATA (DF140T/140WT/140Z)

* These service data are subject to change without notice.

Item	Unit	Data	
		DF140(W)T	DF140Z

POWERHEAD

Item	Unit	Data
Recommended operating range	r/min.	5600 – 6200
Idle speed	r/min.	700 ± 50 (in-gear : approx. 700)
**Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3000 r/min. (at normal operating temp.)
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE 10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8) : Oil change only 5.7 (6.0/5.0) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data	
				DF140(W)T	DF140Z

CYLINDER HEAD/CAMSHAFT

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

Item			Unit	Data DF140(W)T	Data DF140Z

VALVE/VALVE GUIDE

Item			Unit	DF140(W)T / DF140Z
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		——	15°, 45°, 60°
	EX		——	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN,EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN,EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit	mm (in)	0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit	mm (in)	41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in.)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in.)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF140(W)T	DF140Z

CYLINDER/PISTON/PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.05 (0.002)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data DF140(W)T	Data DF140Z

CRANKSHAFT/CONROD

Item		Unit	DF140(W)T / DF140Z
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item	Unit	Data	
		DF140(W)T	DF140Z

ELECTRICAL

Item		Unit	Data
Ignition timing		Degrees	BTDC 5° – BTDC 45°
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	——
Ignition coil resistance	Primary	Ω at 20°C	1.9 – 2.5
	Secondary	kΩ at 20°C	No.2 – No.3 : 18 – 34 (including H.T.cord and spark plug cap) No.1 – No.4 : 19 – 36 (including H.T.cord and spark plug cap)
High tension cord resistance		kΩ/m at 20°C	Approx.16
Battery charge coil resistance		Ω at 20°C	0.16 – 0.24
Battery charge coil output (12V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse : 60 Sub fuse : 30
Recommended battery capacity (12V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20°C	11.0 – 16.5
IAC valve resistance		Ω at 20°C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25°C	1.8 – 2.3
ECM main relay resistance		Ω at 20°C	145 – 190
Starter relay coil resistance		Ω at 20°C	145 – 190
PTT motor relay coil resistance		Ω at 20°C	3.0 – 4.5

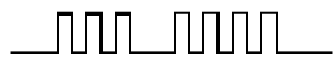
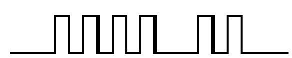
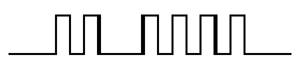
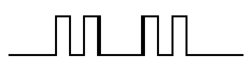
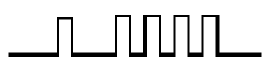
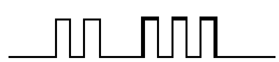
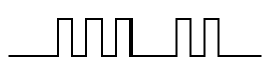
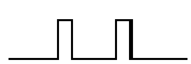
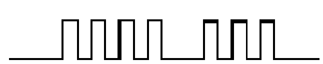
STARTER MOTOR

Item		Unit	Data
Max. continuous time of use		Sec	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

Item		Unit	Data: DF140(W)T	Data: DF140Z
PTT MOTOR				
Brush length	STD	mm (in)	9.8 (0.39)	
	Limit	mm (in)	5.0 (0.20)	
Commutator outside diameter	STD	mm (in)	22.0 (0.87)	
	Limit	mm (in)	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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

TIGHTENING TORQUE

* Tightening torques have been changed from the 2003 year model.

Tightening Torque – Important Fasteners

ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N · m	kg-m	lb.-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	*25	*2.5	*18.0
		10 mm	70	7.0	50.0
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	55	5.5	40.5
Conrod cap nut		8 mm	40	4.0	29.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	55.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt / nut		8 mm	23	2.3	16.5
Oil pressure switch		———	13	1.3	9.5
Fuel delivery pipe bolt		8 mm	23	2.3	16.5
Fuel delivery pipe plug / union bolt		12 mm	35	3.5	25.5
Fuel return pipe bolt (nut)		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Engine oil filter		———	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Oil relief valve		———	27	2.7	19.5
Engine holder upper bolt		8 mm	25	2.5	18.0
Engine holder bolt		8 mm	23	2.3	16.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	85	8.5	61.5
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt / nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	*23	*2.3	*16.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	*23	*2.3	*16.5
Pinion nut	DF90/115	14 mm	100	10.0	72.5
	DF140		120	12.0	87.0
Propeller nut		18 mm	55	5.5	40.0

ECM

DF90/115

- For EU model and general market model, the map of fuel injection has been changed.
- For U. S. model, the motion under operation of the emergency stop switch has been changed.
- The IAC valve operating duty at idle speed (625 r/min) has been changed from 15 % to 30 %.
  This duty can be monitored by using the Suzuki Diagnostic System (SDS).

DF140

- For U. S. model, the motion under operation of the emergency stop switch has been changed.

NOTE:
- *EU model and general model have not been changed.*

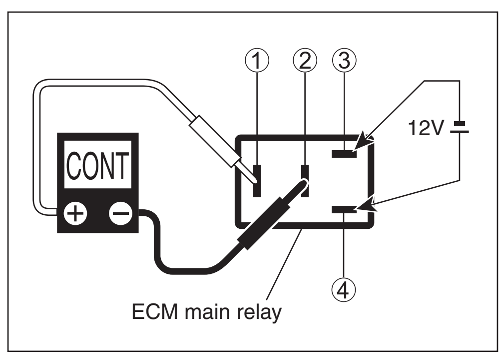
NOTE:
From 2003 year model, ECM identification code recorded in its memory has been changed.
Use the Suzuki Diagnostic System (SDS) updated by the database version 4.10 (program version 4.00) in order to communicate with the ECM on 2003 year model DF90/115/140.

ECM MAIN RELAY AND STARTER MOTOR RELAY

TOOL **09930-99320 : Digital tester**

CONT **Tester range : (Continuity)**

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



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.

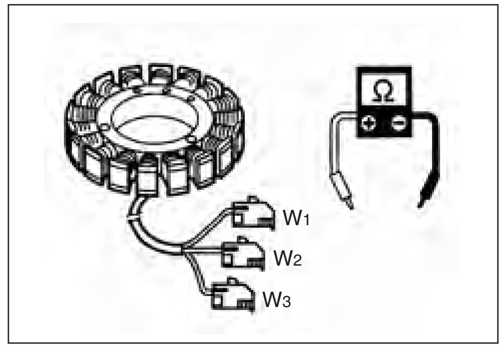
BATTERY CHARGE COIL

Battery charge coil has been changed in shape of connector.
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	0.16 – 0.24 Ω
White 2 to White 3	
White 3 to White 1	

If out of specification, replace battery charge coil.

RECTIFIER & REGULATOR

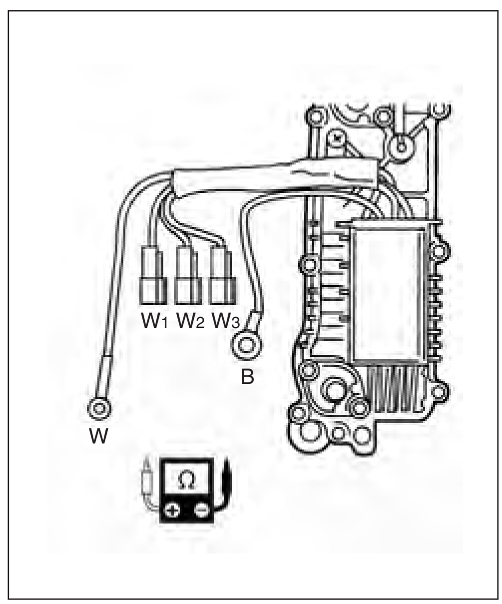
Rectifire & Regulator has been changed in shape of connector.

09900-25010 : Pocket tester

Tester range : ×1 kΩ (Resistance)

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

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



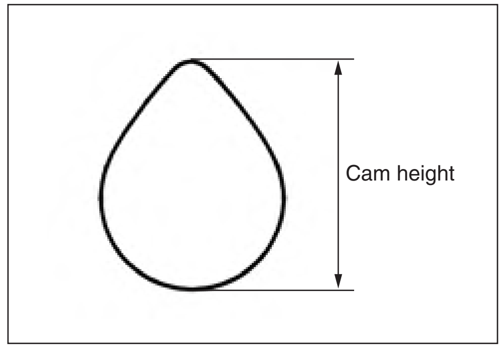
Rectifier & regulator resistance : **Unit : kΩ**

	Tester probe ⊕ (Red)				
Tester probe ⊖ (Black)	**Black**	**White**	**White 1**	**White 2**	**White 3**
Black		1~20	0.5~100	0.5~100	0.5~100
White	3~60		4~80	4~80	4~80
White 1	4~80	0.5~10		5~100	5~100
White 2	4~80	0.5~10	5~100		5~100
White 3	4~80	0.5~10	5~100	5~100	

If measurement exceeds specification, replace rectifier & regulator.

EXHAUST CAMSHAFT (FOR DF115 ONLY)

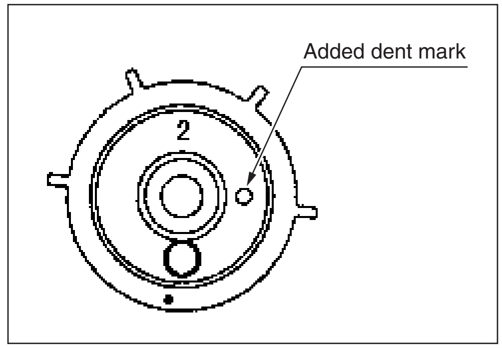
The profile of exhaust cam has been changed.
As the result of this change, cam height has been changed.



Cam height (DF115 exhaust cam)

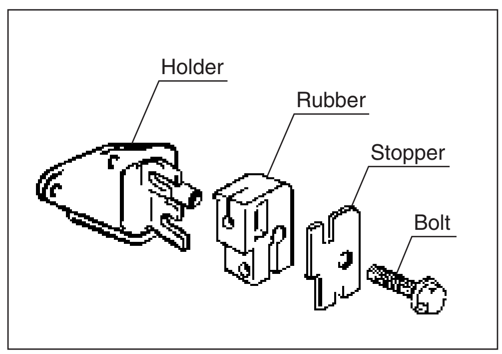
Standard : 38.820 – 38.980 mm (1.5283 – 1.5346 in)
Limit : 38.720 mm (1.5244 in)

The indentification (dent) mark has been added on the top end of the late camshaft.



REMOTE CONTROL CABLE HOLDER

The remote control cable holder, stopper and bolt have been changed.
The remote control cable rubber has been added between the holder and stopper.



CYLINDER HEAD INSTALLATION

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

CAUTION

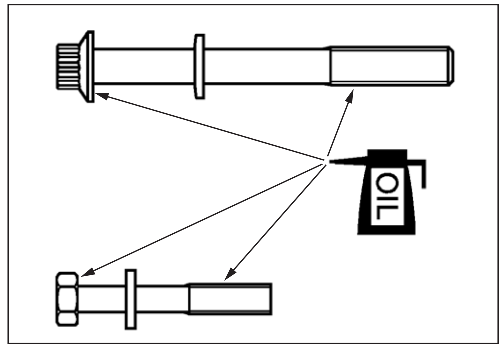
Do not re-use gasket once removed. Always use a new gasket.


① Dowel pin

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

2. Position cylinder head on cylinder.

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

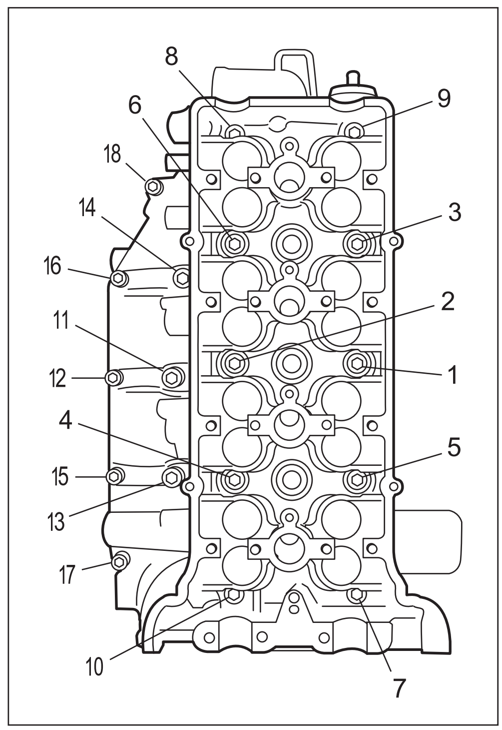


(a) Tighten all bolts to 50 percent (%) of specified torque according to numerical order in figure.

Cylinder head bolt :
1 st step 10 mm 35 N·m (3.5 kg-m, 25.5 lb.-ft.)
8 mm 12 N·m (1.2 kg-m, 8.5 lb.-ft.)

(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 50 percent (%) of specified torque according to numerical order in figure.



Cylinder head bolt :
3 rd step 10 mm 35 N·m (3.5 kg-m, 25.5 lb.-ft.)
8 mm 12 N·m (1.2 kg-m, 8.5 lb.-ft.)

(d) Finally tighten all bolts to specified torque according to numerical order in figure.

Cylinder head bolt :
Final step 10 mm 70 N·m (7.0 kg-m, 50.5 lb.-ft.)
8 mm 25 N·m (2.5 kg-m, 18.0 lb.-ft.)

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

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

CRANKCASE TO CYLINDER INSTALLATION

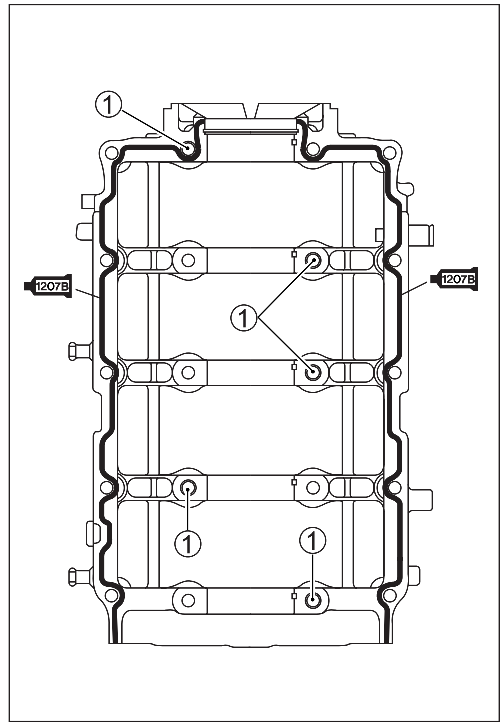
1. Clean mating surface of cylinder and crankcase.
2. Apply Suzuki Bond to mating surface of crankcase as shown in figure.

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

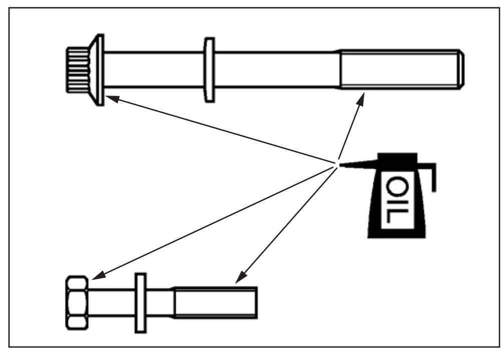
CAUTION

> **Apply bond to mating surface only.**
> **Do not allow bond to contact surface of bearing.**

3. Install five (5) dowel pins ①.



4. Install crankcase to cylinder.
5. Apply engine oil lightly to crankcase bolts.
6. Tighten crankcase bolts in three (3) steps according to the order shown below and in figure.

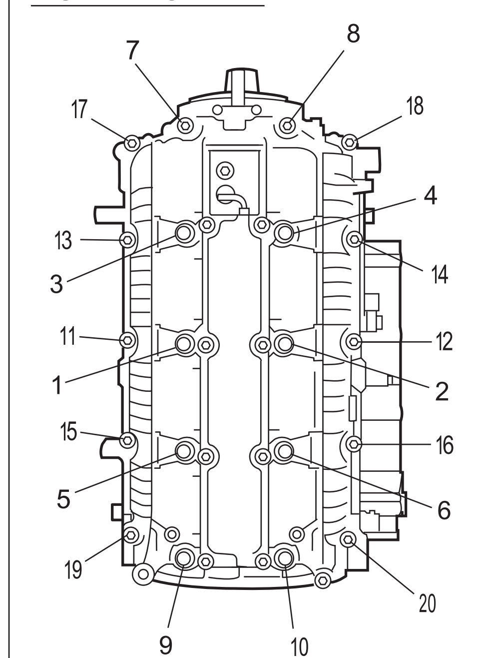


NOTE:
After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

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	**45 N·m (4.5 kg-m, 31.0 lb.-ft.)**
Final step	**8 mm**	**25 N·m (2.5 kg-m, 18.0 lb.-ft.)**
	10 mm	**56 N·m (5.6 kg-m, 40.5 lb.-ft.)**

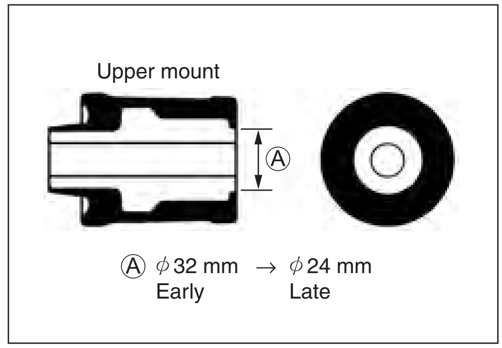
Tightening order

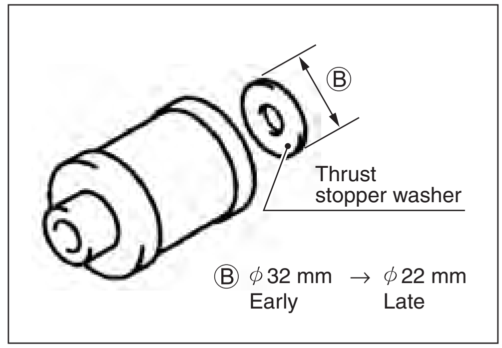


UPPER MOUNT

FOR DF90/115

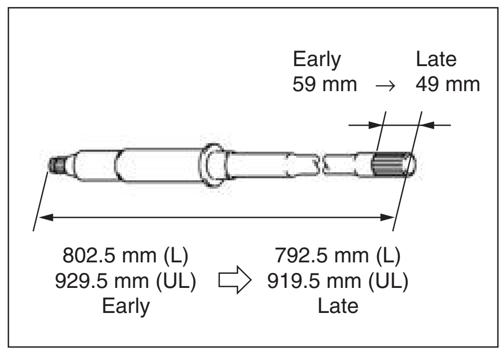
The upper mount has been changed in shape of core metal.
In accordance with this change, the thrust stopper washer has been changed in diameter.





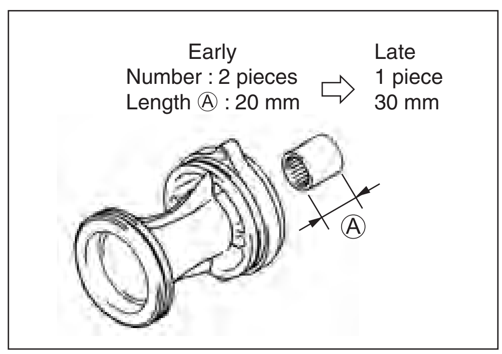
DRIVESHAFT

The drive shaft has been changed in length.

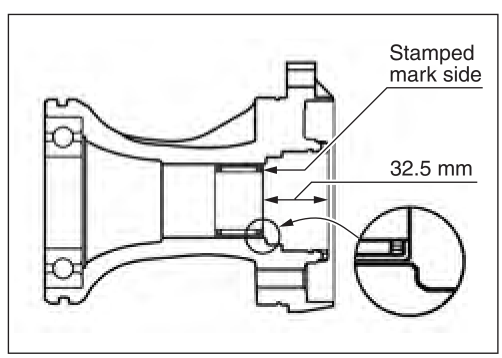


PROPELLER SHAFT BEARING HOUSING

The propeller shaft bearing has been changed in number and size.

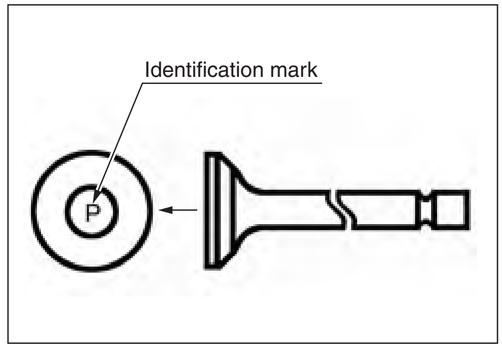


When installing the bearing, stamped mark of bearing must face outside.
Place bearing in the position shown figure.



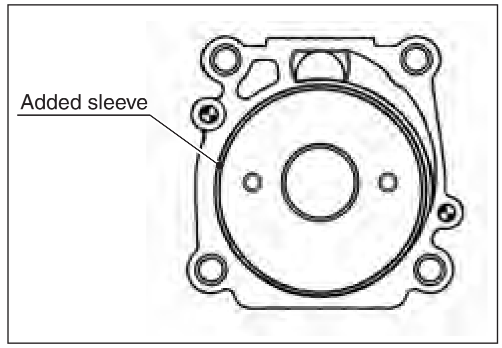
DF115WT AND DF140WT

This section describes servicing procedures which differ from those of the DF115/140 “K2” models.



EXHAUST VALVE

The exhaust valve has been changed in surface treatment.
The identification mark “P” has been added on the valve head.



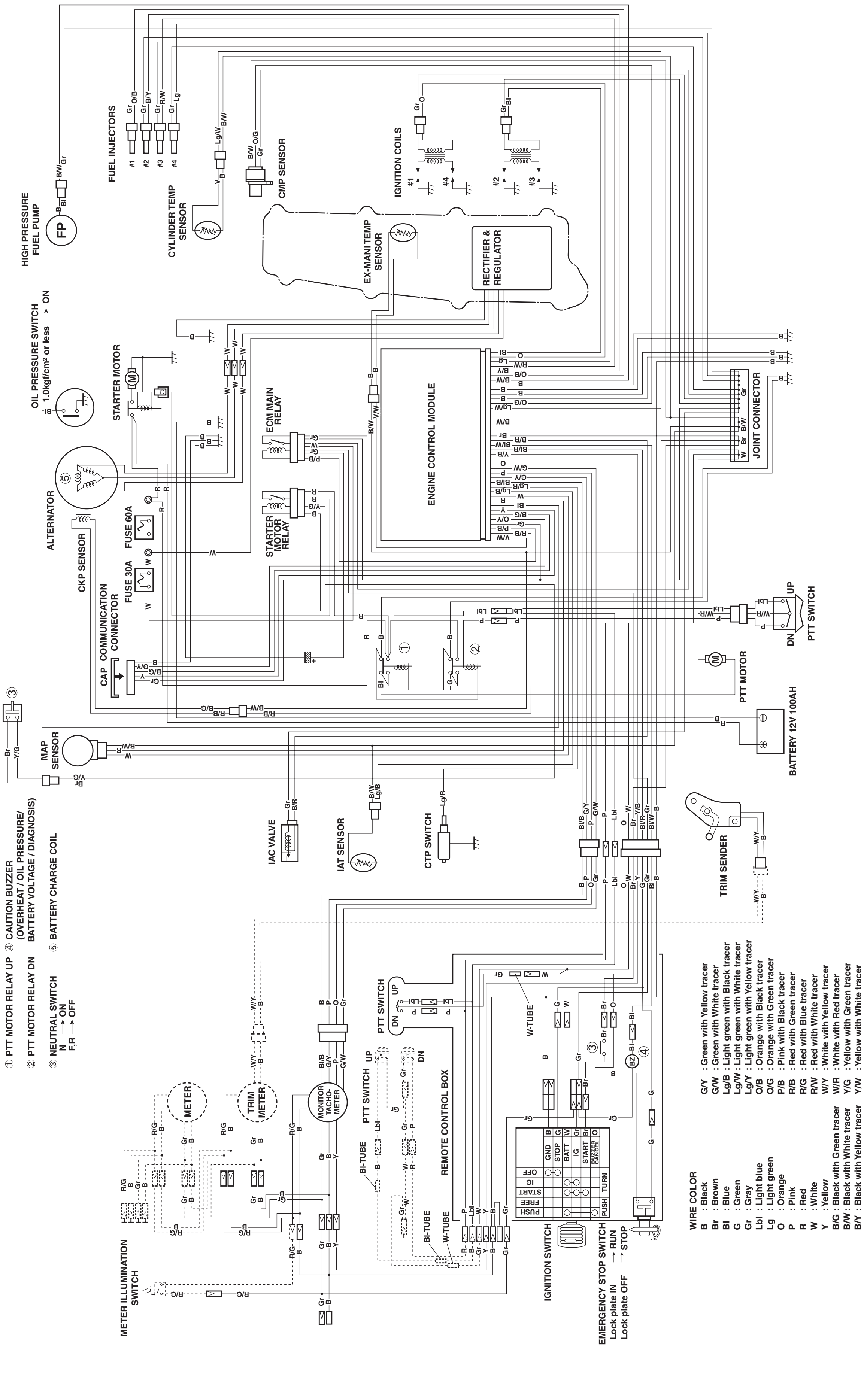
WATER PUMP CASE

The sleeve has been added inside of water pump case.

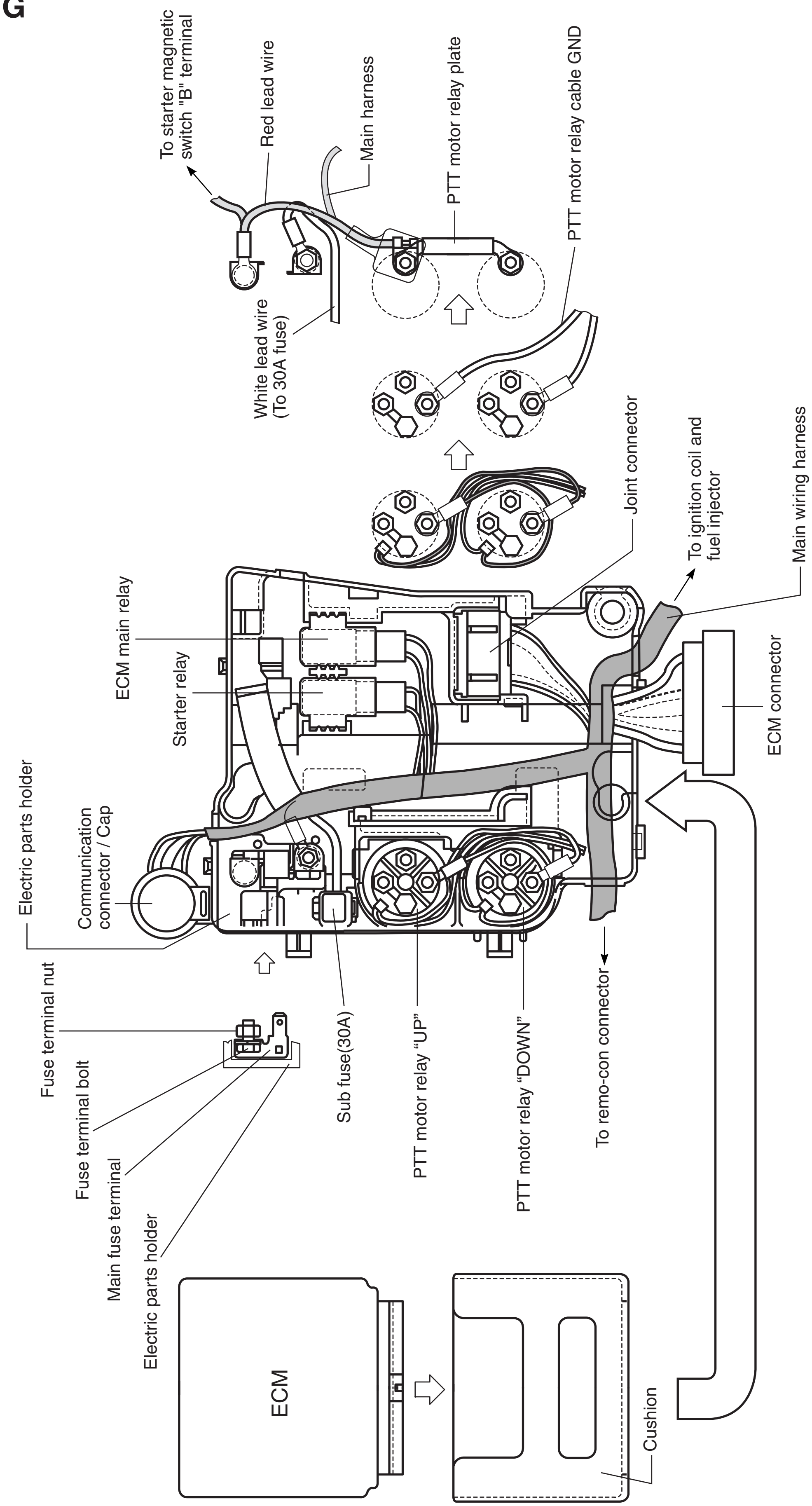
ECM

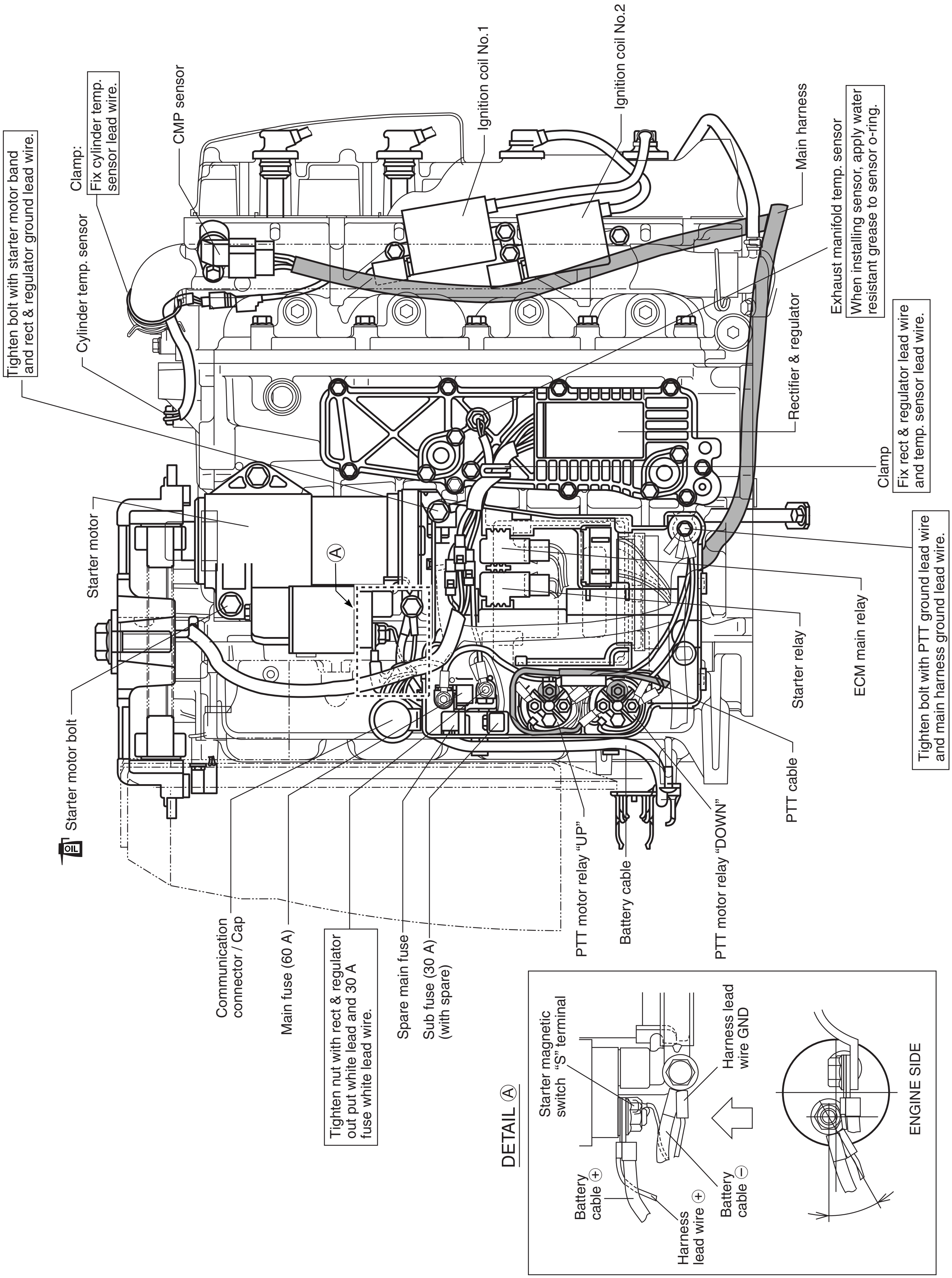
The motion under operation of the emergency stop switch has been changed.

WIRING DIAGRAM



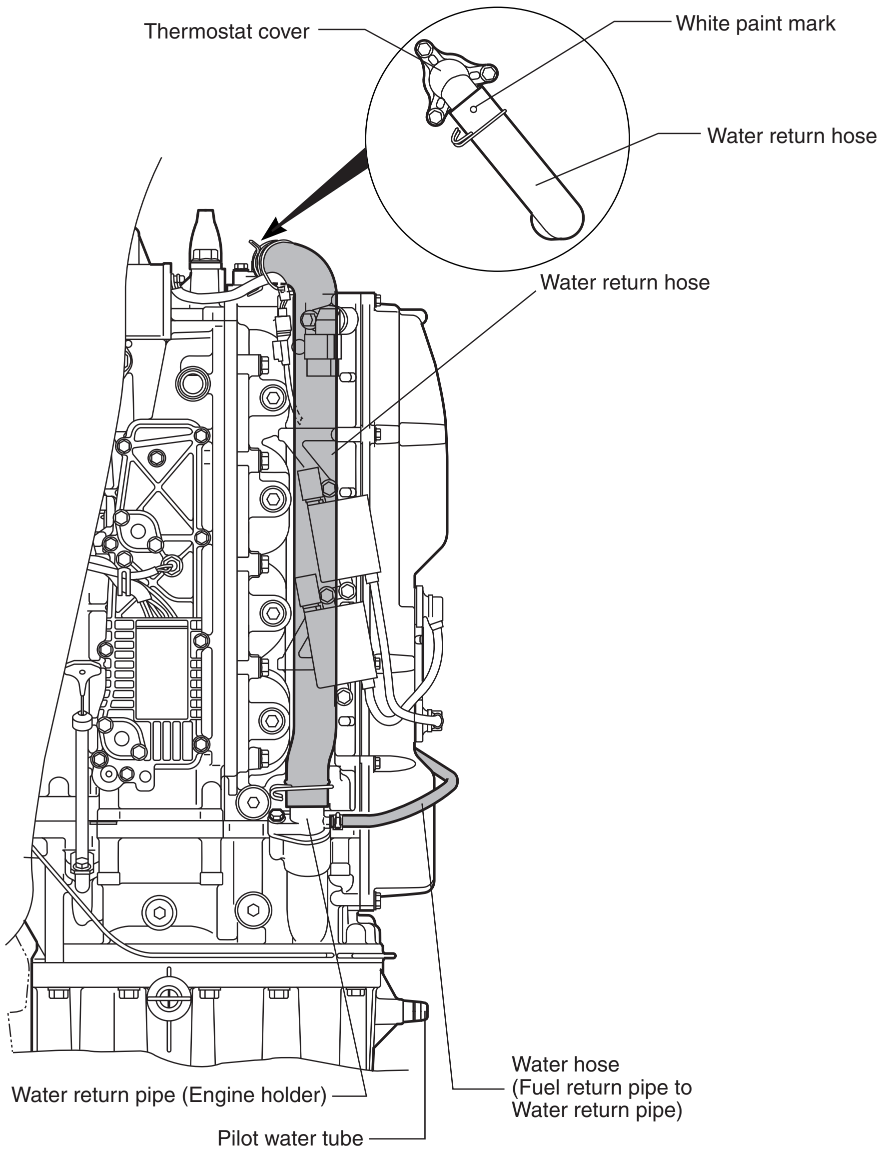
WIRE ROUTING





Tighten bolt with starter motor band and rect & regulator ground lead wire.
Clamp:
Fix cylinder temp. sensor lead wire.
Cylinder temp. sensor
CMP sensor
Ignition coil No.1
Ignition coil No.2
Main harness
Exhaust manifold temp. sensor
When installing sensor, apply water resistant grease to sensor o-ring.
Rectifier & regulator
Fix rect & regulator lead wire and temp. sensor lead wire.
Clamp
Tighten bolt with PTT ground lead wire and main harness ground lead wire.
ECM main relay
Starter relay
PTT cable
PTT motor relay "DOWN"
Battery cable
PTT motor relay "UP"
Starter motor
Starter motor bolt
OIL
A
Communication connector / Cap
Main fuse (60 A)
Tighten nut with rect & regulator out put white lead and 30 A fuse white lead wire.
Spare main fuse
Sub fuse (30 A) (with spare)
DETAIL A
Starter magnetic switch "S" terminal
Harness lead wire GND
Battery cable +
Harness lead wire +
Battery cable −
ENGINE SIDE

WATER HOSE ROUTING



DF90/115/140 “K4” (’04) MODEL

CONTENTS

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*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115(W)T
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115(W)T
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	UL	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	UL	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	UL	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115(W)T
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6ES
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	
		DF90T	DF115(W)T

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Item	Data
Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.08)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	3 × 14 × 17 3 × 14 × 19 3 × 14 × 21 3 × 14 × 23

REDUCTION SYSTEM

Item	Data
1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.24)
2nd reduction gear ratio (Crankshaft drive gear: Driven gear)	12 : 25 (2.08)
Total reduction gear ratio	2.59 (36/29 × 25/12)

*SPECIFICATIONS (DF140T/140WT/140Z)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF140(W)T	DF140Z
PRE-FIX			14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5 600 – 6 200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140(W)T	DF140Z

FUEL & OIL

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

BRACKET

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

LOWER UNIT

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

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.24)	
2nd reduction gear ratio (Crankshaft drive gear: Driven gear)		12 : 23 (1.92)	
Total reduction gear ratio		2.38 (36/29 × 23/12)	

SERVICE DATA (DF90/115)

Item	Unit	Data	
		DF90T	DF115(W)T

POWERHEAD

Item	Unit	DF90T	DF115(W)T
Recommended operation range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF90T	DF115(W)T
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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
	IN	Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	38.820 – 38.980 (1.5283 – 1.5346)
	EX	Limit	mm (in)	36.530 (1.4382)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
	Top, 2nd, 3rd, 4th	Limit	mm (in)	0.120 (0.0047)	
	5th	STD	mm (in)	0.045 – 0.087 (0.0018 – 0.0034)	
	5th	Limit	mm (in)	0.120 (0.0047)	
Camshaft holder (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	23.000 – 23.021 (0.9055 – 0.9063)	
	Top, 2nd, 3rd, 4th	Limit	mm (in)	23.171 (0.9122)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
	5th	Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
	Top, 2nd, 3rd, 4th	Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
	5th	Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data	
				DF90T	DF115(W)T

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF90T	DF115(W)T

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod amall end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF90T	DF115(W)T

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)	
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)	
	Limit	mm (in)	0.065 (0.0026)	
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)	
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)	
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)	
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)	
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)	
	Limit	mm (in)	0.350 (0.0138)	
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)	
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)	
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)	
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)	62.000 – 62.018 (2.4409 – 2.4417)	
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)	
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)	
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)	
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)	
	Limit	mm (in)	0.35 (0.014)	
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)	

Item		Unit	Data	
			DF90T	DF115(W)T

ELECTRICAL

Ignition timing		Degrees	BTDC 1° – BTDC 44°	BTDC 3° – BTDC 44°
Over revolution limiter		r/min	6200	
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)	
High tension code resistance		kΩ/m at 20 °C	Approx. 16	
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24	
Battery charge coil output (12 V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30	
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5	
IAC valve resistance		Ω at 20 °C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3	
ECM main relay resistance		Ω at 20 °C	145 – 190	
Starter motor relay resistance		Ω at 20 °C	145 – 190	
PTT motor relay resistance		Ω at 20 °C	25 – 37	

STARTER MOTOR

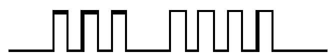
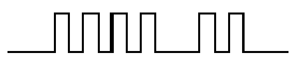
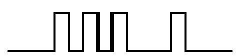
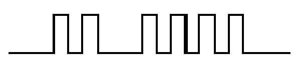
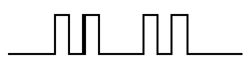
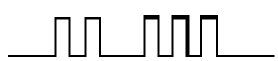
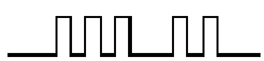
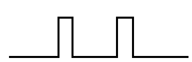
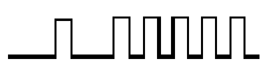
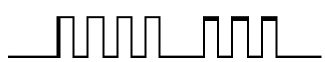
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

SERVICE DATA (DF140)

Item	Unit	Data	
		DF140(W)T	DF140Z

POWERHEAD

Recommended operation range	r/min	5600 – 6200	
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)	
* Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF140(W)T	DF140Z

CYLINDER HEAD / CAMSHAFT

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

Item			Unit	Data DF140(W)T	Data DF140Z

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF140(W)T	DF140Z

CYLINDER / PISTON / PISTON RING

Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod amall end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140(W)T	DF140Z

CRANKSHAFT / CONROD

Item		Unit	Data (DF140(W)T / DF140Z)
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF140(W)T	DF140Z

ELECTRICAL

Item		Unit	Data
Ignition timing		Degrees	BTDC 5 – BTDC 45
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20 °C	168 – 252
CMP sensor resistance		Ω at 20 °C	—
Ignition coil resistance	Primary	Ω at 20 °C	1.9 – 2.5
	Secondary	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ /m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

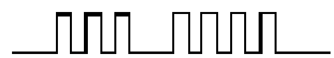
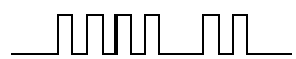
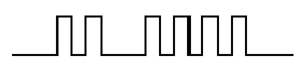
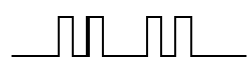
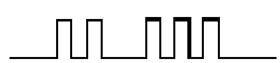
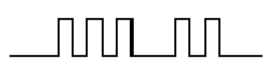
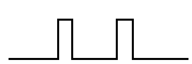
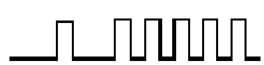
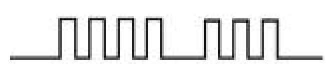
Item		Unit	Data
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

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

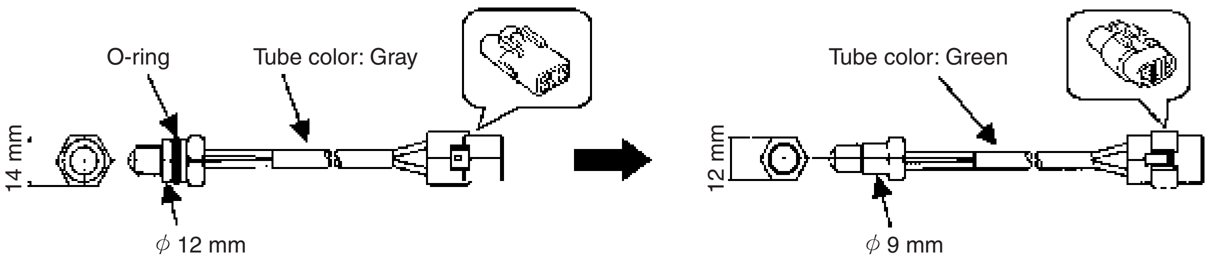
PRIORITY *	FAILED ITEM	CODE	LAMP FLASHING PATTERN	FAIL-SAFE SYSTEM ACTIVATING
1	MAP sensor 1	3 – 4	on off 	YES
2	CKP sensor	4 – 2	on off 	YES
3	IAC valve/By-pass air screw adjustment	3 – 1	on off 	NO
4	CMP sensor	2 – 4	on off 	YES
5	CTP switch	2 – 2	on off 	NO
6	Cylinder temp. sensor	1 – 4	on off 	YES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

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

TEMPERATURE SENSOR

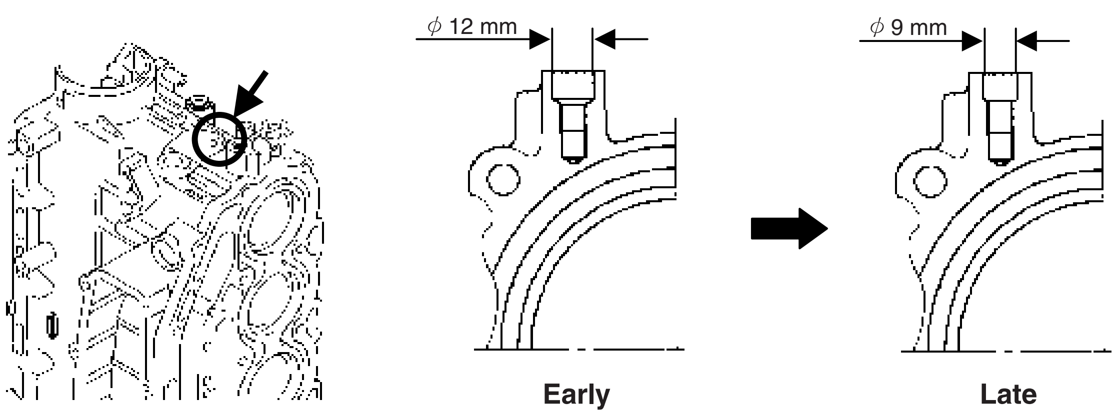
The cylinder temperature sensor has been changed.

① Change of sensor shape ② Change of connector ③ Elimination of O-ring
④ Change of tube color



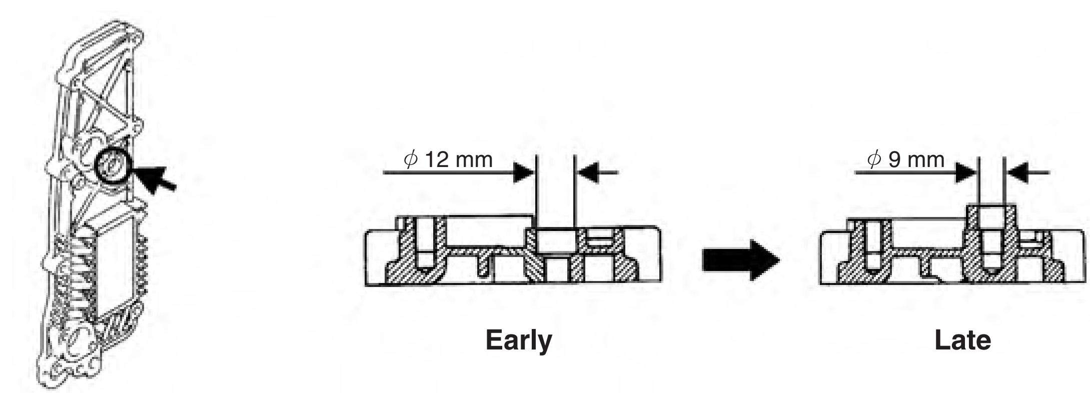
CYLINDER BLOCK

The cylinder block has been changed because of the change of temperature sensor.



RECTIFIER & REGULATOR

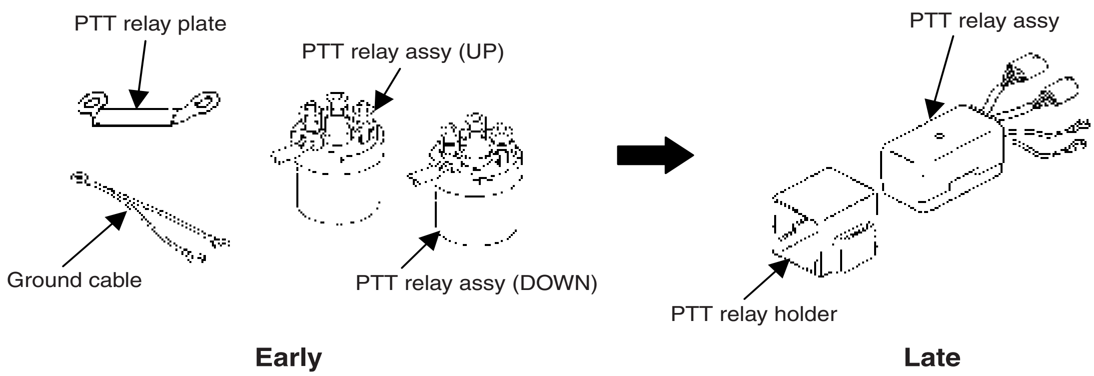
The rectifier & regulator has been changed because of the change of temperature sensor.



NOTE:
On the late type rectifier & regulator, the temperature sensor does not contact with cooling water.

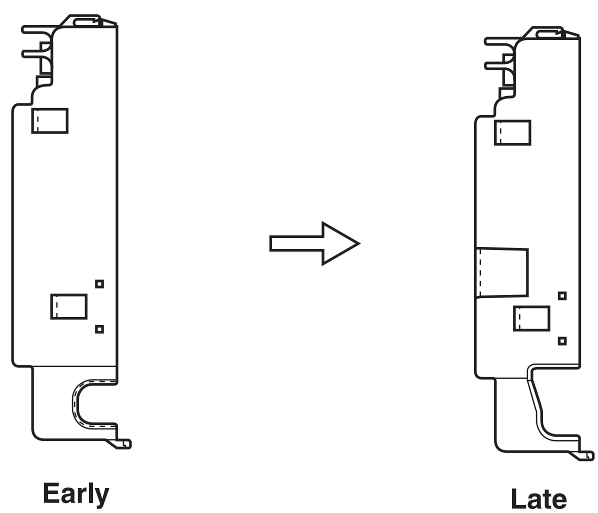
POWER TRIM & TILT (P.T.T.) RELAY

The P.T.T. relays (for UP and for DOWN) have been incorporated and changed in shape.
In accordance with this change, the P.T.T. relay plate and the ground cable have been eliminated and the holder has been added.



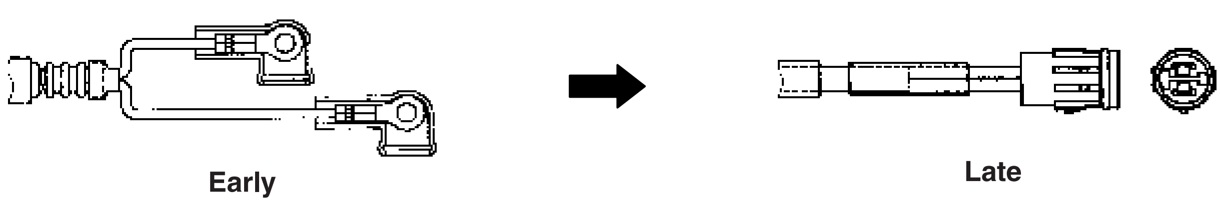
ELECTRIC PARTS HOLDER

In accordance with the change of P.T.T. relay, the electric parts holder has been changed in shape.



P.T.T. MOTOR

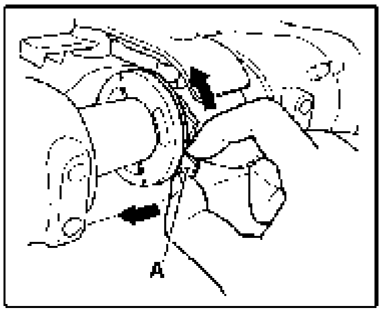
In accordance with the change of P.T.T. relay, the lead connector of P.T.T. motor has been changed.

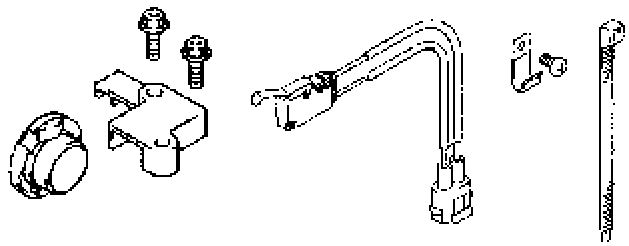


TILT LIMIT SWITCH SYSTEM

To adjust the maximum tilt position, the tilt limit switch system has been added on the clamp bracket shaft.
Adjusting procedure:

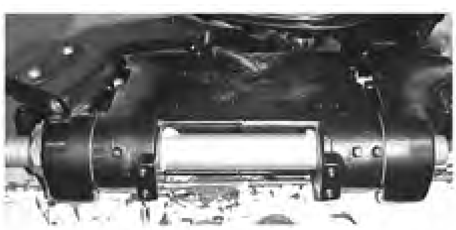
To reduce the amount of tilt, move the tab "A" of cam upward.
To increase the amount of tilt, move the tab "A" of cam downward.





SWIVEL BRACKET

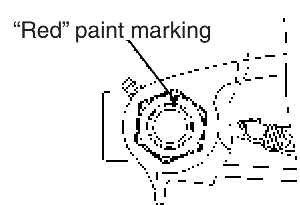
In accordance with the additional of the tilt limit switch system, the swivel bracket has been changed in shape and machining.


Early


Late

CLAMP BRACKET SHAFT

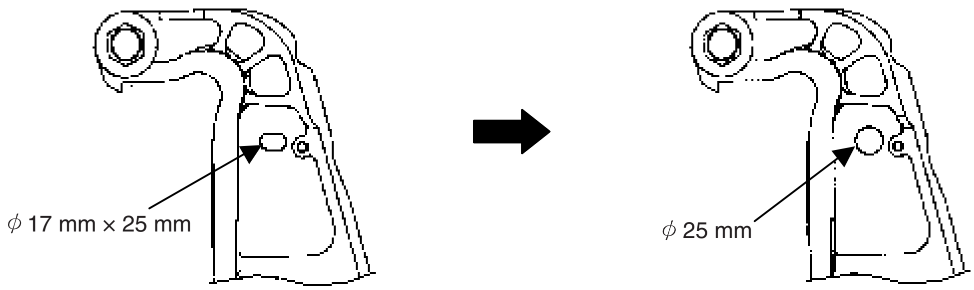
In accordance with additional of the tilt limit switch, the hole and paint marking have been added on the clamp bracket shaft.



NOTE:
Install the clamp bracket shaft with "Red" paint marking toward up side.

PORT CLAMP BRACKET

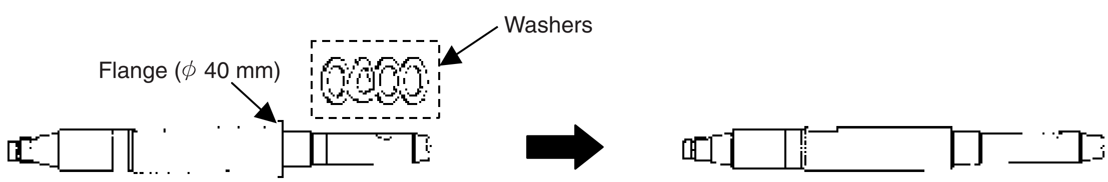
The hole in the port clamp bracket has been enlarged.



Early Late

DRIVESHAFT

The driveshaft has been changed in shape.
In accordance with this change, the washers pre-loading to driveshaft have been eliminated.



Early Late

NOTE:
In accordance with this change, the servicing procedure for “Back-up Shim Adjustment” has been changed.

PINION GEAR BACK UP SHIM

The pinion gear back-up shim has been added.
Available thickness: 0.50 mm, 0.55 mm

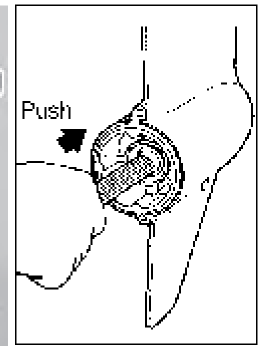
LOWER UNIT GEARS-SHIMMING AND ADJUSTMENT

In accordance with the eliminate of the washers preloading to driveshaft, the servicing procedure for "Tooth Contact Pattern Check" has been changed.

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

Check the tooth contact pattern by using the following procedure:

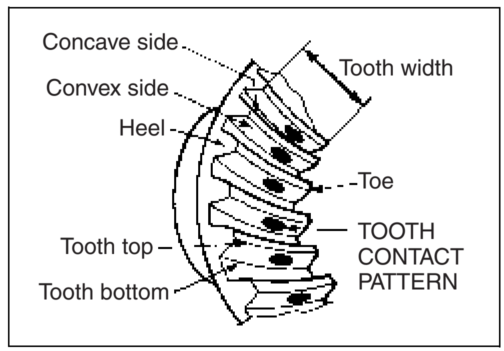
1. To assess the tooth contact, apply a light coat of Prussian Blue on the convex surface of the forward gear.



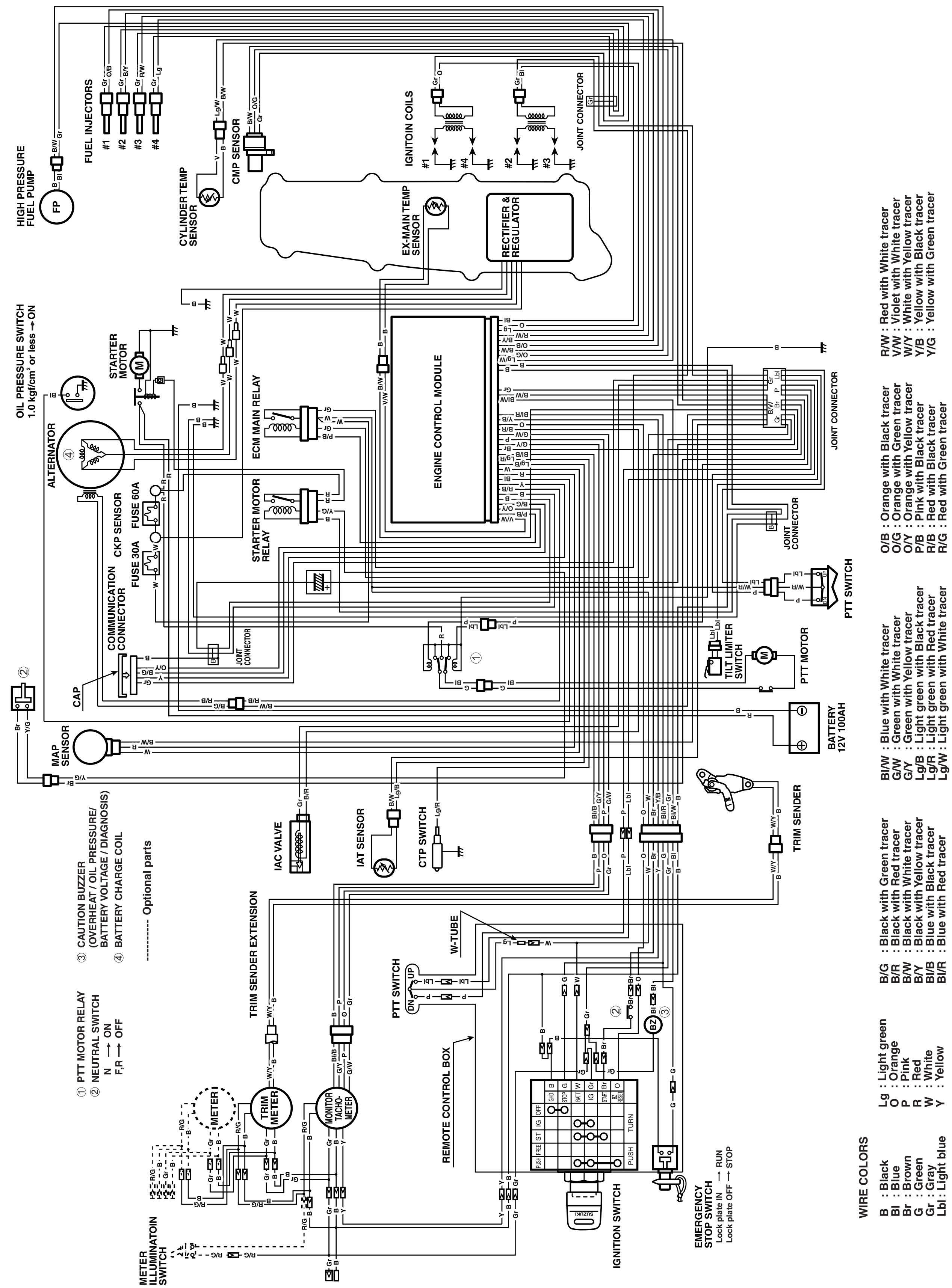
2. Install the propeller shaft and the housing assembly (minus the reverse gear and the internal components).
3. Push the propeller shaft inward and hold in position.
4. Pull the driveshaft upward and hold in position.
5. Using driveshaft holder tool, rotate the driveshaft 5 – 6 times.

TOOL 09921-29410: Driveshaft holder

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



WIRING DIAGRAM
DF90/115/140



DF90/115/140 “K5” (2005) MODEL

CONTENTS

*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115T/115WT
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115T/115WT
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	UL	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	UL	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	UL	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115T/115WT
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6ES
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	
		DF90T	DF115T/115WT

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system		Gear
Transmission		Forward-Neutral-Reverse
Reduction system		Bevel gear
Gear ratio		12 : 25 (2.083)
Drive line impact protection		Spline drive rubber hub
Propeller ☆: Aluminum propeller ★: Stainless steel propeller		Blade × Diam. (in) × Pitch (in) ☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.241)
2nd reduction gear ratio (Lower unit)	12 : 25 (2.083)
Total reduction gear ratio	2.586 (36/29 × 25/12)

*SPECIFICATIONS (DF140T/140WT/140Z/140WZ)

* These specifications are subject to change without notice.

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ
PRE-FIX		14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Item	Unit	Data
Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5 600 – 6 200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system		Gear	
Transmission		Forward-Neutral-Reverse	
Reduction system		Bevel gear	
Gear ratio		12 : 23 (1.917)	
Drive line impact protection		Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)		clockwise	counterclockwise
Propeller		Blade × Diam. (in) × Pitch (in)	
☆: Aluminum propeller ★: Stainless steel propeller		☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24	★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.241)	
2nd reduction gear ratio (Lower unit gear)		12 : 23 (1.917)	
Total reduction gear ratio		2.379 (36/29 × 23/12)	

SERVICE DATA (DF90T/115T/115WT)

Item	Unit	Data	
		DF90T	DF115T/115WT

POWERHEAD

Recommended operation range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF90T	DF115T/115WT

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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.530 (1.4382)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data	
				DF90T	DF115T/115WT

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF90T	DF115T/115WT

CYLINDER / PISTON / PISTON RING

Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF90T	DF115T/115WT

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T/115WT

ELECTRICAL

Ignition timing		Degrees	BTDC 1 – BTDC 44	BTDC 3 – BTDC 44
Over revolution limiter		r/min	6200	
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)	
High tension code resistance		kΩ/m at 20 °C	Approx. 16	
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24	
Battery charge coil output (12 V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30	
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5	
IAC valve resistance		Ω at 20 °C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3	
ECM main relay resistance		Ω at 20 °C	145 – 190	
Starter motor relay resistance		Ω at 20 °C	145 – 190	
PTT motor relay resistance		Ω at 20 °C	25 – 37	

STARTER MOTOR

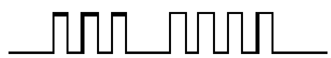
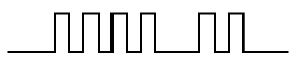
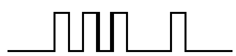
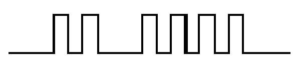
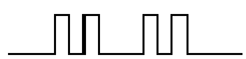
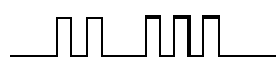
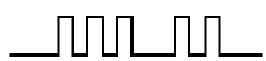
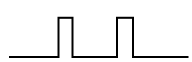
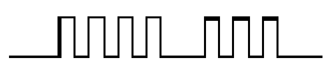
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

SERVICE DATA (DF140T/140WT/140Z/140WZ)

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

POWERHEAD

Recommended operation range	r/min	5600 – 6200	
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)	
* Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data DF140T/140WT	Data DF140Z/140WZ

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)	39.520 – 39.680 (1.5560 – 1.5622)
		Limit	mm (in)	39.420 (1.5520)
	EX	STD	mm (in)	39.320 – 39.480 (1.5480 – 1.5543)
		Limit	mm (in)	39.220 (1.5441)
Camshaft journal oil clearance	Top 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.120 (0.0047)
	5th	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)
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	mm (in)	22.869 (0.9004)
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	mm (in)	25.844 (1.0175)
Camshaft runout		Limit	mm (in)	0.10 (0.004)
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)
		Limit	mm (in)	0.150 (0.0059)
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

CYLINDER / PISTON / PISTON RING

Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

CRANKSHAFT / CONROD

Item		Unit	Data	
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)	
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)	
	Limit	mm (in)	0.065 (0.0026)	
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)	
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)	
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)	
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)	
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)	
	Limit	mm (in)	0.350 (0.0138)	
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)	
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)	
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)	
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)	62.000 – 62.018 (2.4409 – 2.4417)	
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)	
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)	
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)	
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)	
	Limit	mm (in)	0.35 (0.014)	
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)	

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

ELECTRICAL

Ignition timing		Degrees	BTDC 5 – BTDC 45
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20 °C	168 – 252
CMP sensor resistance		Ω at 20 °C	—
Ignition coil resistance	Primary	Ω at 20 °C	1.9 – 2.5
	Secondary	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ /m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

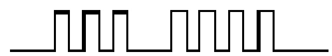
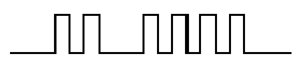
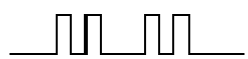
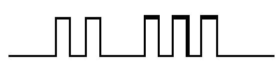
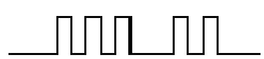
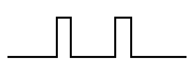
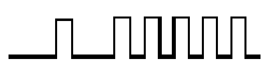
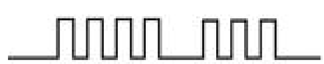
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.0 (0.20)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	21.0 (0.83)

SELF-DIAGNOSTIC SYSTEM INDICATION

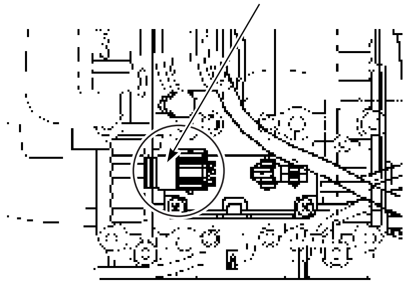
When the abnormality occurs in a signal from sensor, switch, etc., the "CHECK ENGINE" lamp on the monitor-tachometer flashes (lights intermittently) according to the each code pattern with buzzer sounding.

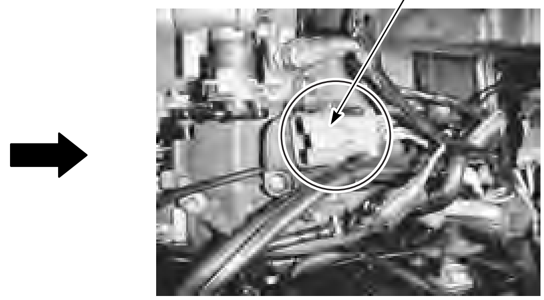
PRIORITY	FAILED ITEM	CODE	LAMP FLASHING PATTERN	FAIL-SAFE SYSTEM ACTIVATING
1	MAP sensor 1	3 – 4	on off 	YES
2	CKP sensor	4 – 2	on off 	YES
3	IAC valve/By-pass air screw adjustment	3 – 1	on off 	NO
4	CMP sensor	2 – 4	on off 	YES
5	CTP switch	2 – 2	on off 	NO
6	Cylinder temp. sensor	1 – 4	on off 	YES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

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

ENGINE WIRING HARNESS

The connectors of engine wiring harness have been changed from 8-pin to 16-pin type connector.
In accordance with this change, the connector holder has been changed and Monitor-Tachometer wire has been eliminated.

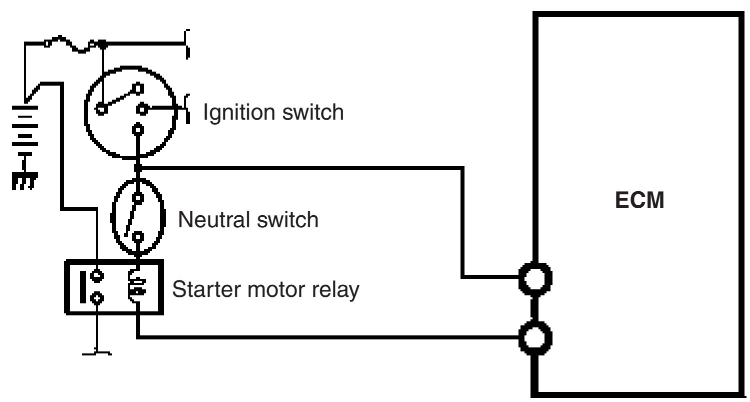




SAFETY RELAY SYSTEM

This system is to avoid operating the starter motor when the engine is already operating.
The starter motor relay will only engage when the ignition switch is turned to the "START" position if the all of the following conditions are satisfied:

- Lock plate is attached to emergency stop switch.
- Neutral switch is in "ON" position.
- Engine is not already operating.

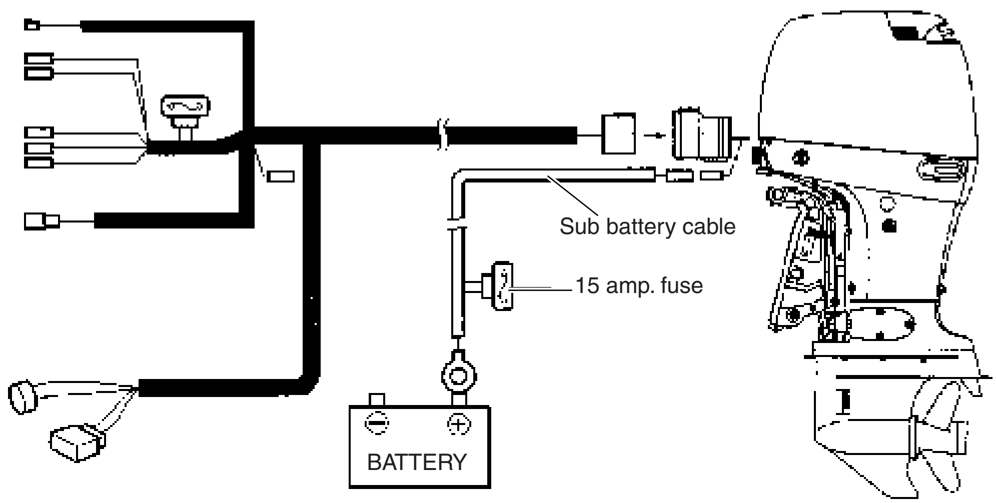


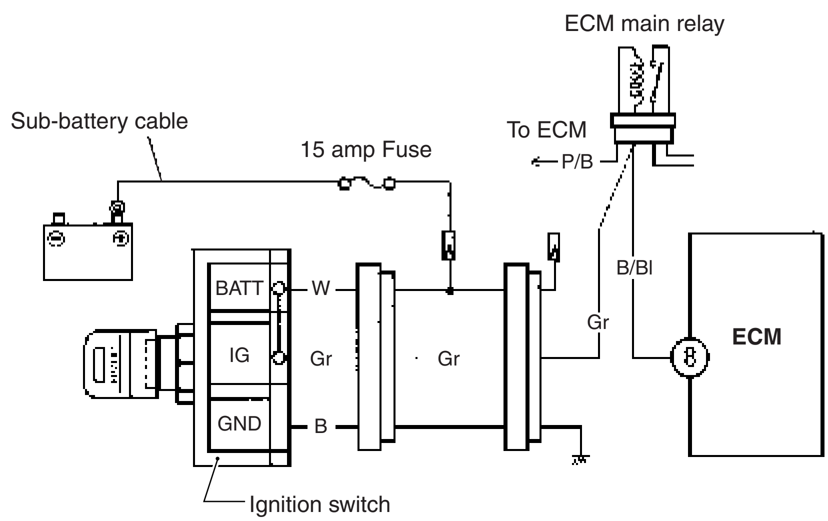
ECM

In accordance with addition of the safety relay system, ECM has been changed.

SUB-BATTERY CABLE

The sub-battery cable (ECM power source cable) is newly provided for accurate ECM operation.
The ECM power source flows through the white lead wire in the remote control extension harness which carries battery power to the ignition switch. When the ignition switch is turned ON, battery power passes from the white lead wire, through the ignition switch contacts to the gray output lead wire to the ECM.

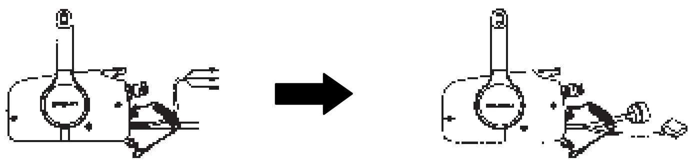




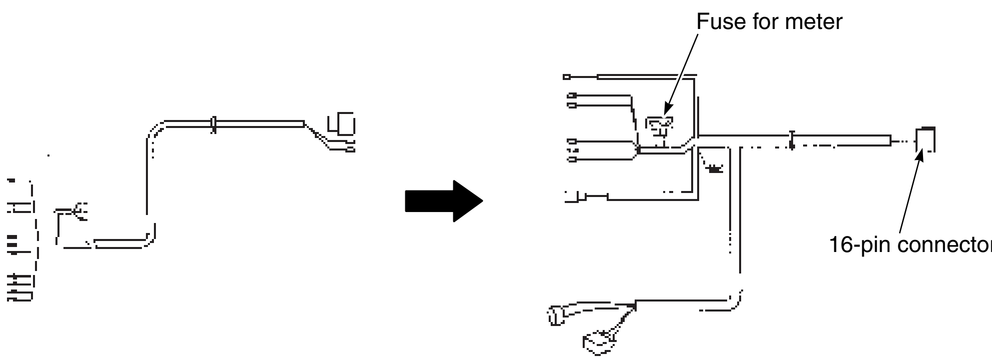
REMOTE CONTROL BOX AND REMOTE CONTROL WIRE

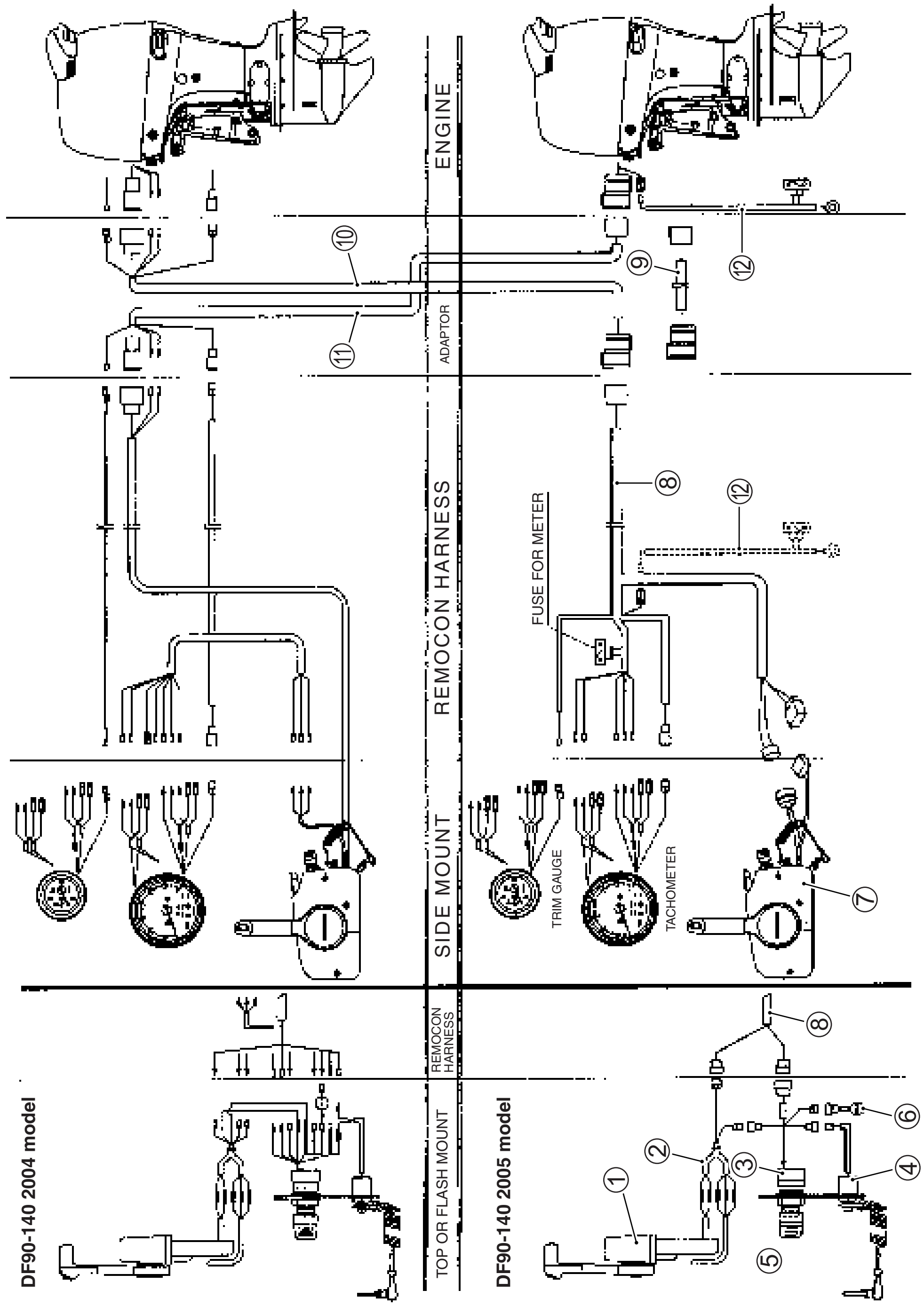
The remote control box and remote control wire have been changed.

Remote control box



Remote control wire

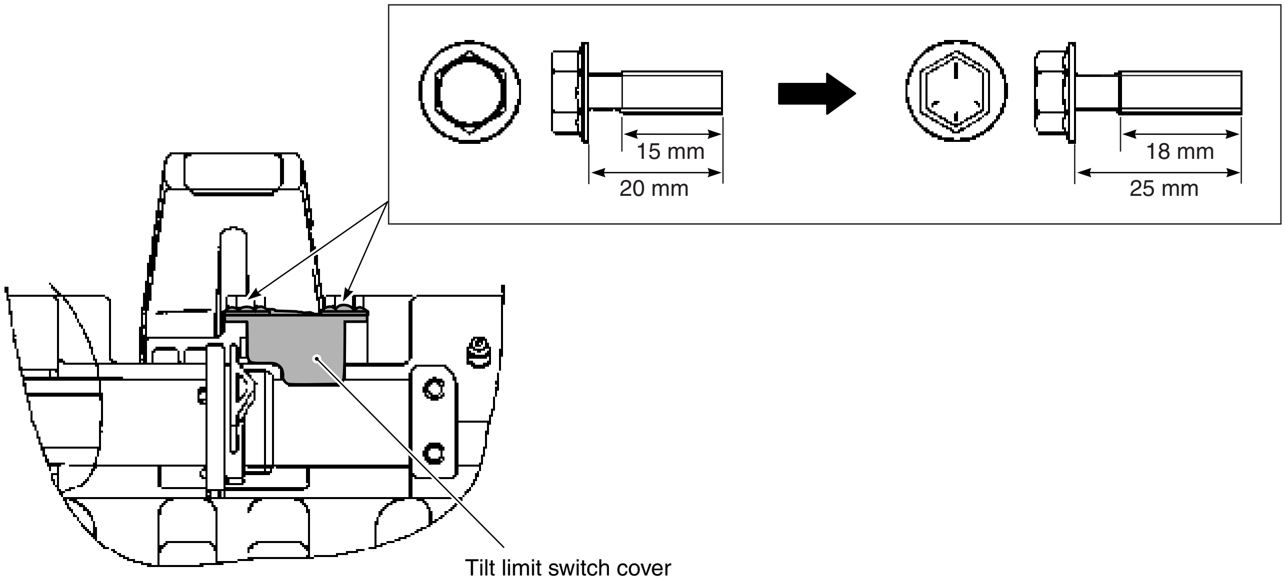




① Top-mount remote control box
② PTT switch extension wire
③ Ignition switch
④ Emergency stop switch
⑤ Ignition & stop switch panel
⑥ Caution buzzer
⑦ Side-mount remote control box
⑧ Remote control wire
⑨ Extension wire
⑩ Remote control wire adaptor
⑪ Remote control wire adaptor
⑫ Sub-battery cable (3.7 m)

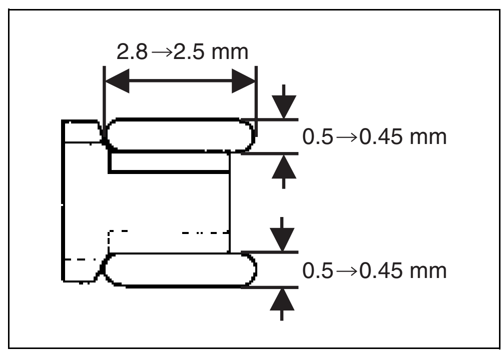
TILT LIMIT SWITCH COVER

The cover has been added on the tilt limit switch.
In accordance with this change, the tilt limit switch holder bolts have been changed in length and shape as indicated below.



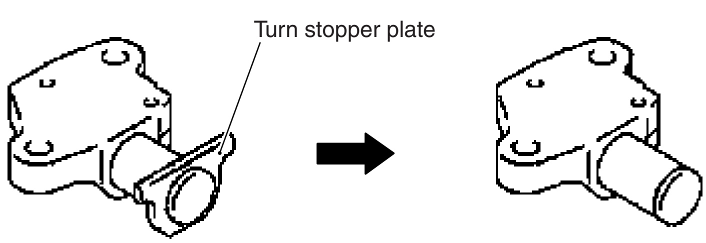
PISTON OIL RING (For DF140)

The side rails of the piston oil ring have been changed in shape and material.



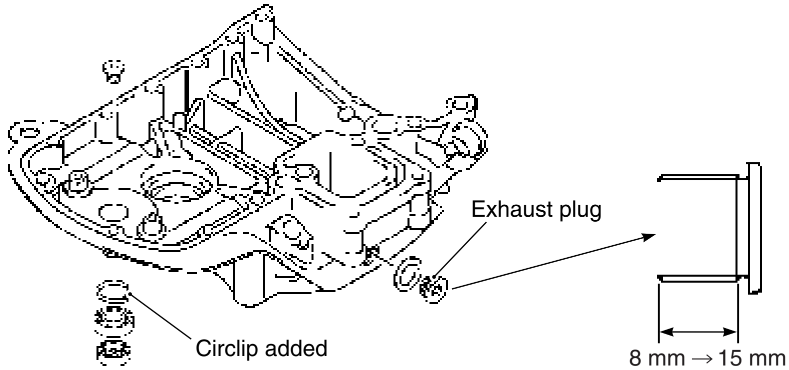
TENSIONER ADJUSTER

The turn stopper plate of the tensioner adjuster has been eliminated.



ENGIN HOLDER

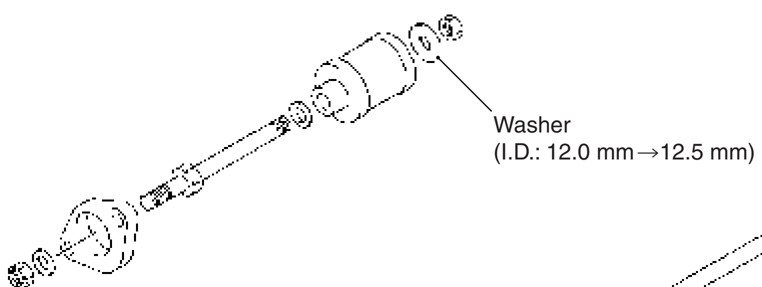
The exhaust plug has been changed in length.
The circlip retaining the clutch shaft bearing has been added.



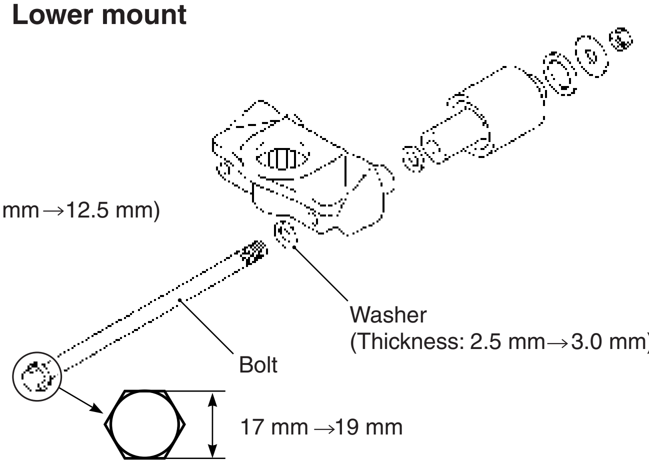
UPPER AND LOWER MOUNT

The upper mount washer has been changed in inside diameter from 12.0 mm to 12.5 mm.
The lower mount washer has been changed in thickness from 2.5 mm to 3.0 mm.
The lower mount bolt has been changed in shape.

Upper mount

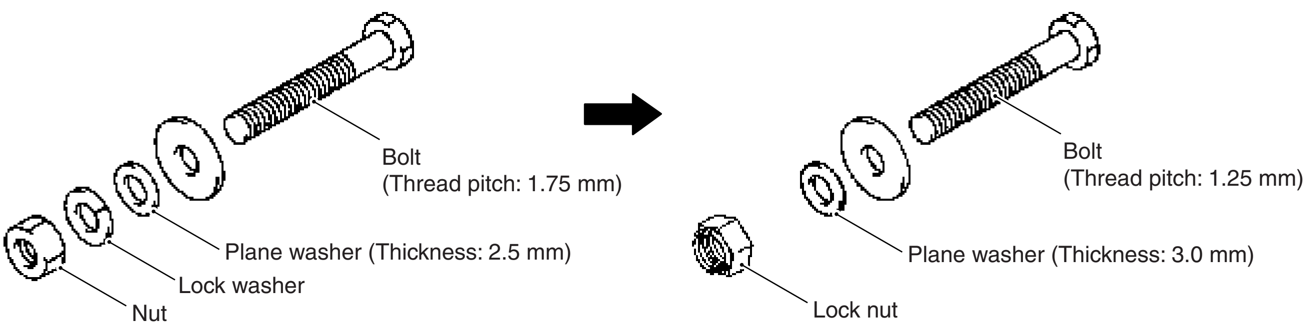


Lower mount

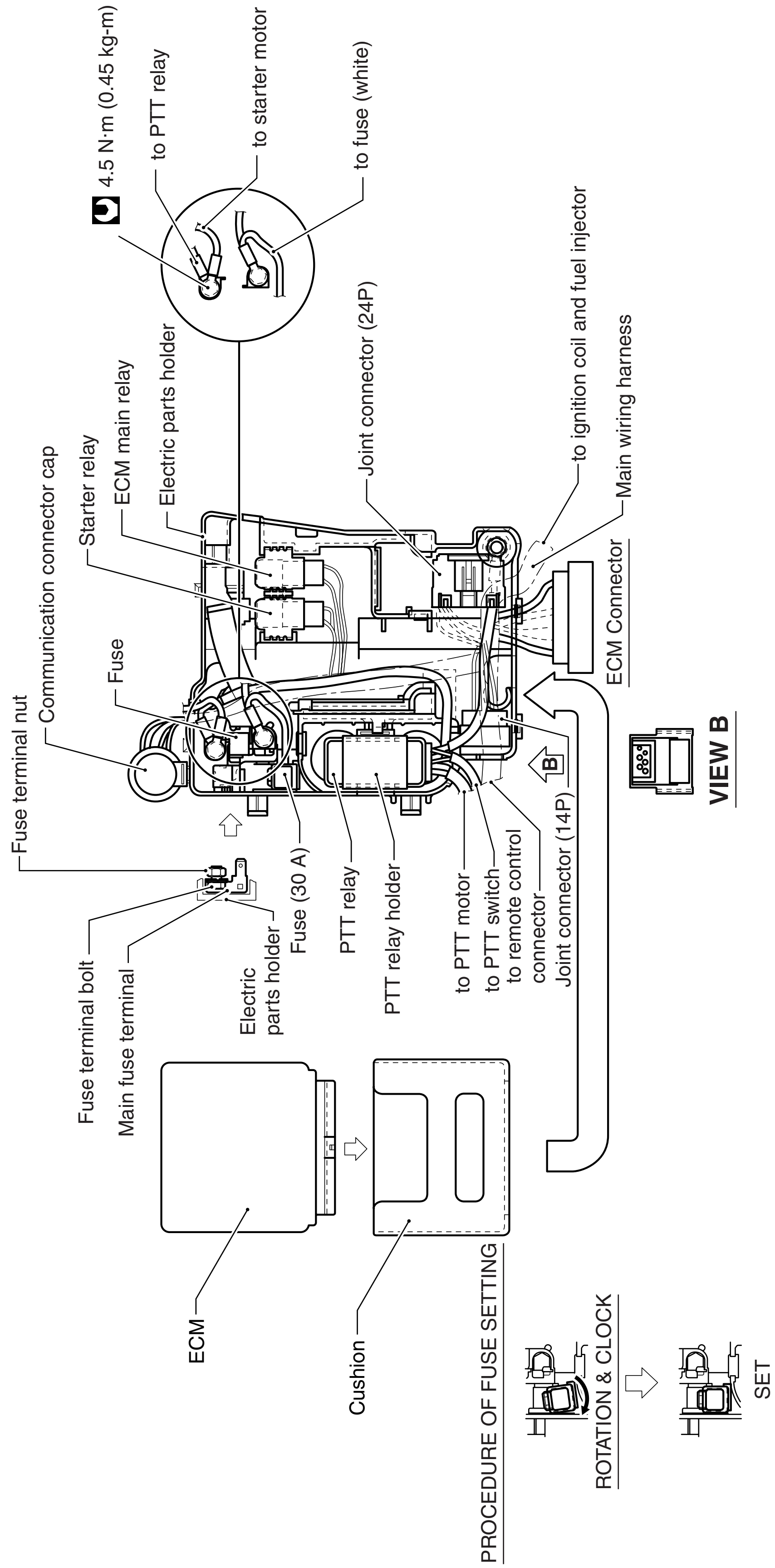


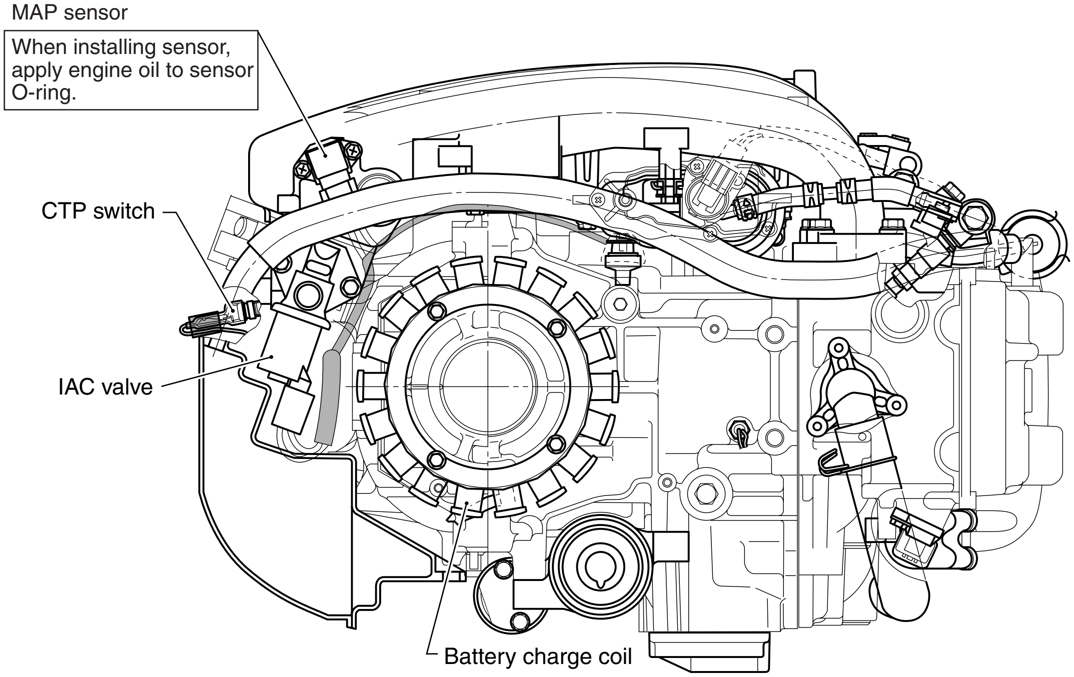
TRANSOM BOLT

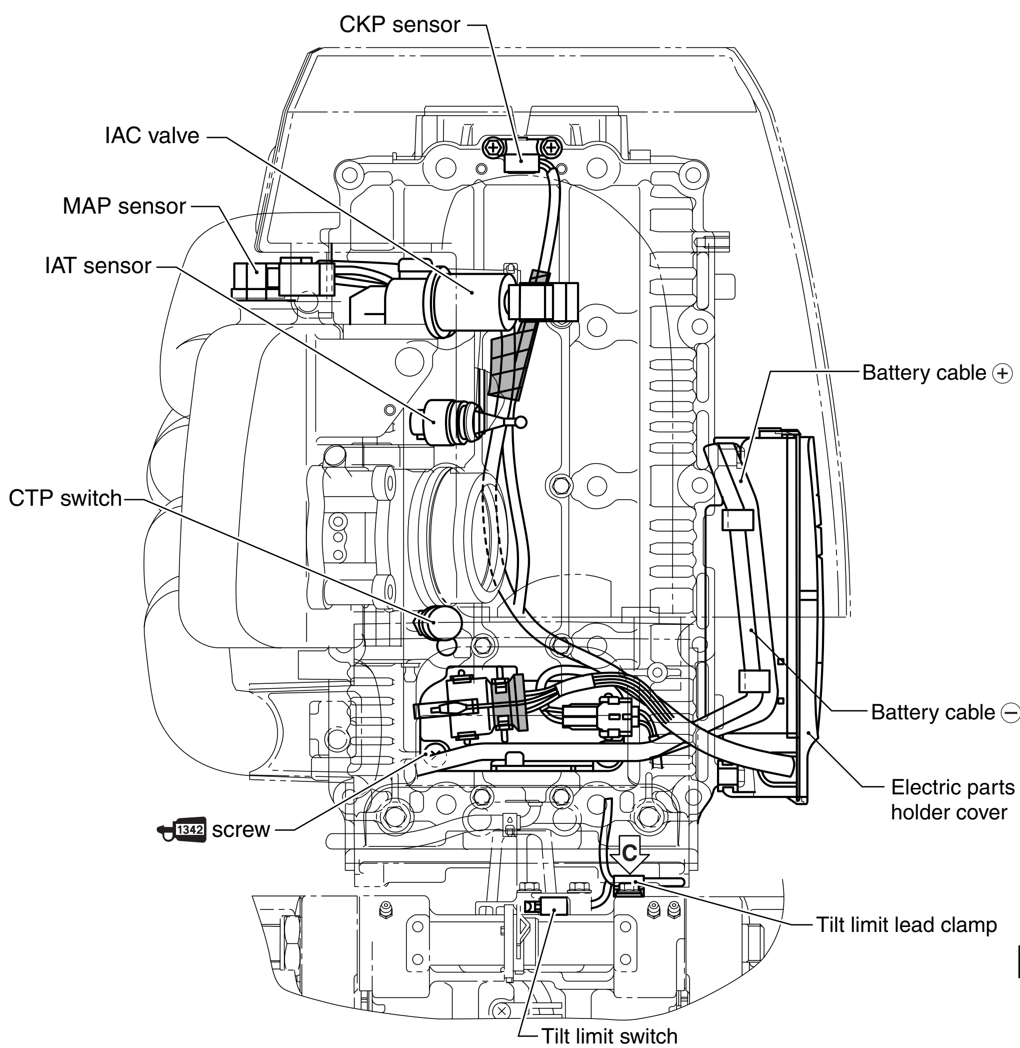
The transom bolt and related parts have been changed as shown below:
The transom bolt has been changed in thread pitch from 1.75 mm to 1.25 mm.
The lock washer has been eliminated.
The plane washer (O.D. 22 mm) has been changed in thickness from 2.5 mm to 3.0 mm.
The nut has been changed to lock nut.

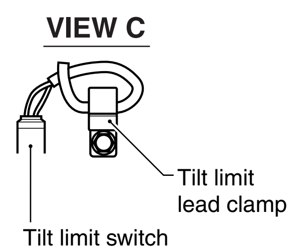


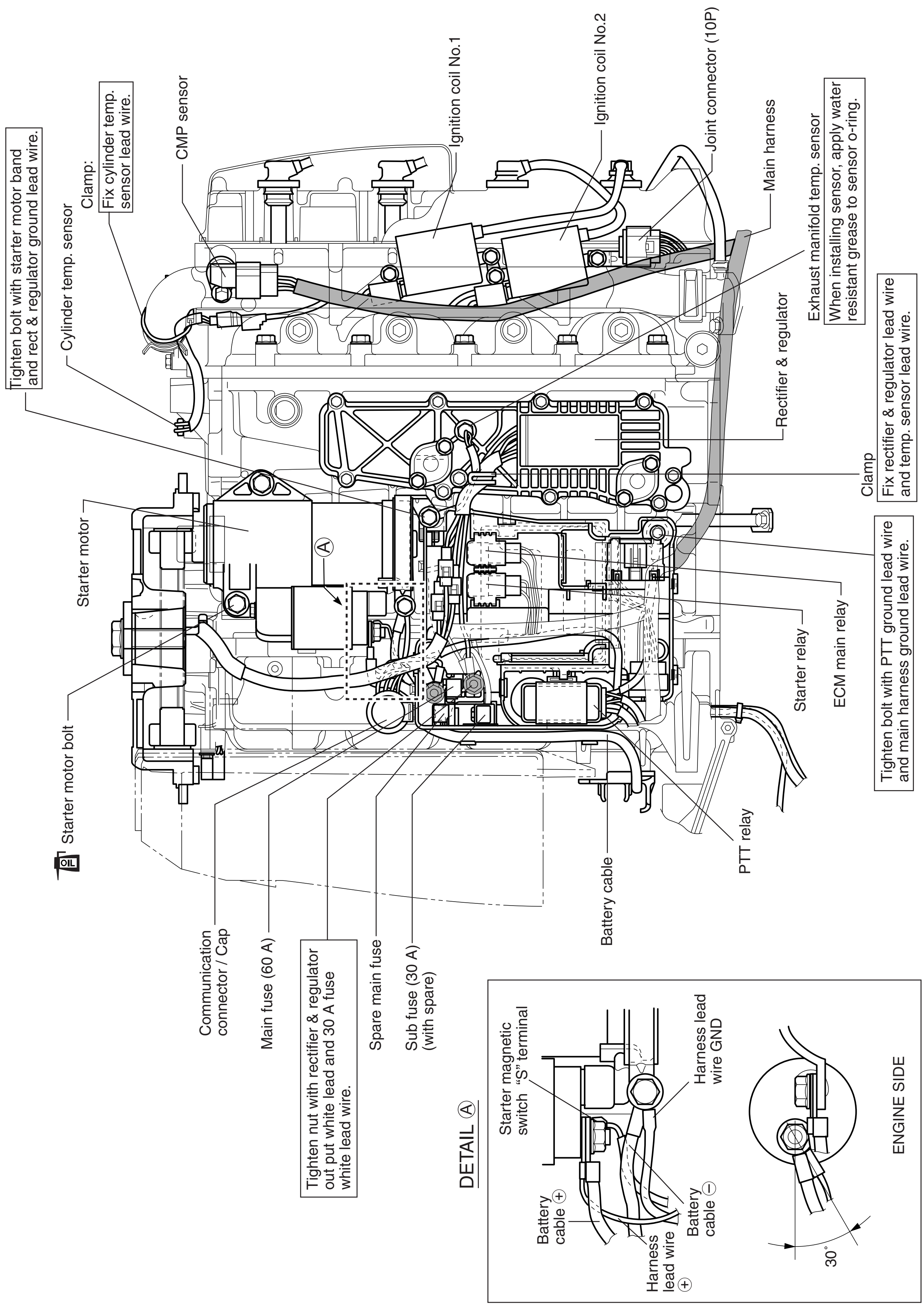
WIRE/HOSE ROUTING



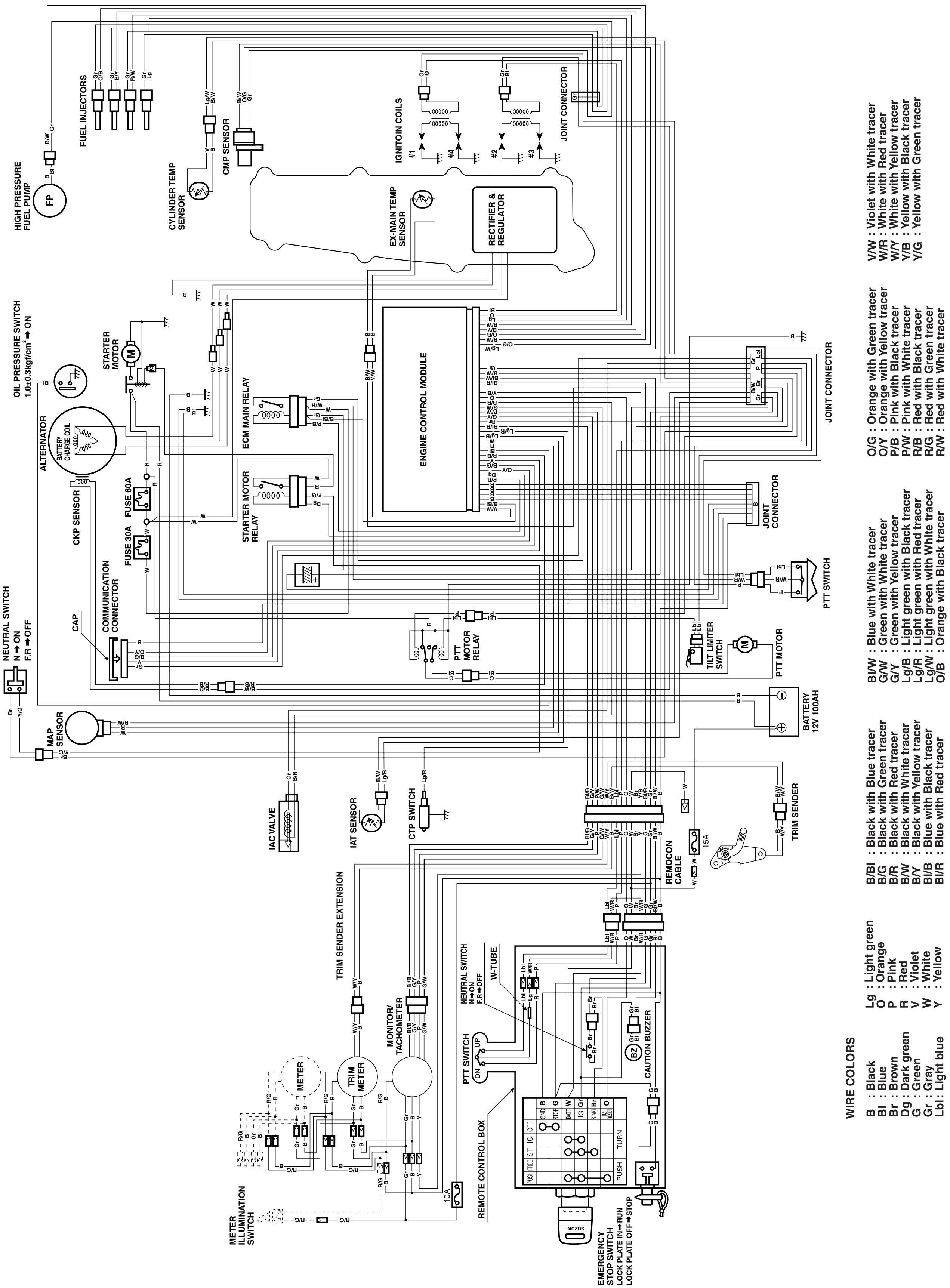

MAP sensor
When installing sensor, apply engine oil to sensor O-ring.
CTP switch
IAC valve
Battery charge coil


CKP sensor
IAC valve
MAP sensor
IAT sensor
CTP switch
Battery cable ⊕
Battery cable ⊖
Electric parts holder cover
1342 screw
C
Tilt limit lead clamp
Tilt limit switch


VIEW C
Tilt limit lead clamp
Tilt limit switch


Tighten bolt with starter motor band and rect & regulator ground lead wire.
Cylinder temp. sensor
Clamp:
Fix cylinder temp. sensor lead wire.
CMP sensor
Ignition coil No.1
Ignition coil No.2
Joint connector (10P)
Main harness
Exhaust manifold temp. sensor
When installing sensor, apply water resistant grease to sensor o-ring.
Rectifier & regulator
Clamp
Fix rectifier & regulator lead wire and temp. sensor lead wire.
Tighten bolt with PTT ground lead wire and main harness ground lead wire.
ECM main relay
Starter relay
PTT relay
Battery cable
Starter motor
A
Starter motor bolt
OIL
Communication connector / Cap
Main fuse (60 A)
Tighten nut with rectifier & regulator out put white lead and 30 A fuse white lead wire.
Spare main fuse
Sub fuse (30 A) (with spare)
DETAIL A
Starter magnetic switch “S” terminal
Harness lead wire GND
Battery cable ⊕
Battery cable ⊖
Harness lead wire ⊕
30°
ENGINE SIDE

WIRING DIAGRAM



DF90/115/140 “K6” (2006) MODEL

CONTENTS

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*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115T/115WT
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Item		Unit	DF90T	DF115T/115WT
Overall length (front to back)		mm (in)	779 (30.7)	
Overall width (side to side)		mm (in)	481 (18.9)	
Overall height	L	mm (in)	1556 (61.3)	
	X	mm (in)	1683 (66.3)	
Weight (without engine oil)	L	kg (lbs)	189.0 (416)	
	X	kg (lbs)	194.0 (427)	
Transom height	L	mm (inch type)	539 (20)	
	X	mm (inch type)	666 (25)	

PERFORMANCE

Item	Unit	DF90T	DF115T/115WT
Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6ES
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	
		DF90T	DF115T/115WT

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.083)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
☆: Aluminum propeller ★: Stainless steel propeller	☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.241)
2nd reduction gear ratio (Lower unit)	12 : 25 (2.083)
Total reduction gear ratio	2.586 (36/29 × 25/12)

*SPECIFICATIONS (DF140T/140WT/140Z/140WZ)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ
PRE-FIX			14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5 600 – 6 200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system		Gear	
Transmission		Forward-Neutral-Reverse	
Reduction system		Bevel gear	
Gear ratio		12 : 23 (1.917)	
Drive line impact protection		Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)		clockwise	counterclockwise
Propeller		Blade × Diam. (in) × Pitch (in)	
		☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24	★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24
☆: Aluminum propeller ★: Stainless steel propeller			

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.241)	
2nd reduction gear ratio (Lower unit gear)		12 : 23 (1.917)	
Total reduction gear ratio		2.379 (36/29 × 23/12)	

SERVICE DATA (DF90T/115T/115WT)

Item	Unit	Data	
		DF90T	DF115T/115WT

POWERHEAD

Item	Unit	DF90T	DF115T/115WT
Recommended operation range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data DF90T	Data DF115T/115WT

CYLINDER HEAD / CAMSHAFT

Item			Unit	DF90T	DF115T/115WT
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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.530 (1.4382)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data	
				DF90T	DF115T/115WT

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter	IN		mm (in)	33 (1.3)
	EX		mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data DF90T	Data DF115T/115WT

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF90T	DF115T/115WT

CRANKSHAFT / CONROD

Item		Unit	Data
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T/115WT

ELECTRICAL

Ignition timing		Degrees	BTDC 1 – BTDC 44	BTDC 3 – BTDC 44
Over revolution limiter		r/min	6200	
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)	
High tension code resistance		kΩ/m at 20 °C	Approx. 16	
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24	
Battery charge coil output (12 V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30	
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5	
IAC valve resistance		Ω at 20 °C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3	
ECM main relay resistance		Ω at 20 °C	145 – 190	
Starter motor relay resistance		Ω at 20 °C	145 – 190	
PTT motor relay resistance		Ω at 20 °C	25 – 37	

STARTER MOTOR

Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off	NO
10	Exhaust manifold temp. sensor	1 – 5	on off	YES
11	Fuel injector	4 – 3	on off	NO

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

SERVICE DATA (DF140T/140WT/140Z/140WZ)

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

POWERHEAD

Item	Unit	Data
Recommended operation range	r/min	5600 – 6200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)
* Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3 000 r/min. (at normal operating temp.)
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

<table>
<tr><th colspan="3" rowspan="2">Item</th><th rowspan="2">Unit</th><th colspan="2">Data</th></tr>
<tr><th>DF140T/140WT</th><th>DF140Z/140WZ</th></tr>
</table>

CYLINDER HEAD / CAMSHAFT

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

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

VALVE / VALVE GUIDE

Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item	Unit	Data DF140T/140WT	Data DF140Z/140WZ

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

CRANKSHAFT / CONROD

Item		Unit	
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

ELECTRICAL

Ignition timing		Degrees	BTDC 5 – BTDC 45
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20 °C	168 – 252
CMP sensor resistance		Ω at 20 °C	—
Ignition coil resistance	Primary	Ω at 20 °C	1.9 – 2.5
	Secondary	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ /m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

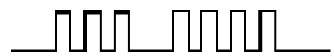
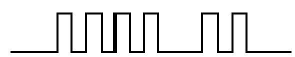
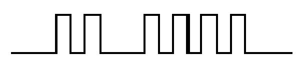
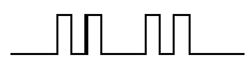
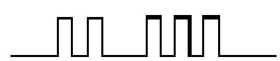
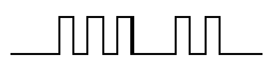
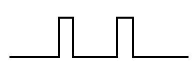
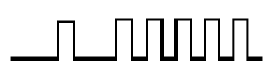
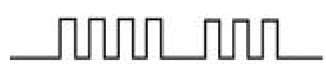
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.0 (0.20)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector (Open circuit)	4 – 3	on off 	NO

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

TIGHTENING TORQUE

Tightening torque – Important fasteners

* Tightening torque has been changed from the 2006 year model.

ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N·m	kg-m	lb-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	25	2.5	18.0
		10 mm	70	7.0	50.0
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	52	5.2	37.5
Conrod cap nut		8 mm	40	4.0	29.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	55.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt/nut		8 mm	23	2.3	16.5
Oil pressure switch		—	13	1.3	9.5
Fuel delivery pipe bolt		8 mm	23	2.3	16.5
Fuel delivery pipe plug/union bolt		12 mm	35	3.5	25.5
Fuel return pipe bolt (nut)		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Oil filter Stand		—	40	4.0	29.0
Engine oil filter		—	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Oil relief valve		—	27	2.7	19.5
Engine holder upper bolt		8 mm	25	2.5	18.0
Engine holder bolt		8 mm	23	2.3	16.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	*80	*8.0	*58.0
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt/nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	17	1.7	12.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	23	2.3	16.5
Pinion nut	DF90/115	14 mm	100	10.0	72.5
	DF140		120	12.0	87.0
Propeller nut		18 mm	55	5.5	40.0

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
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

* The maintenance interval of tappet clearance has been changed.

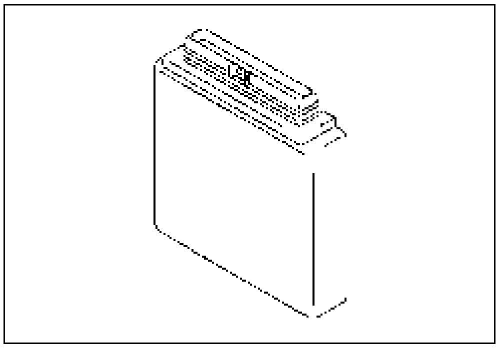
Inspect initially after 20 hours (1 month) and every 200 hours (12 months).

⬇

Inspect every 200 hours (12 months).

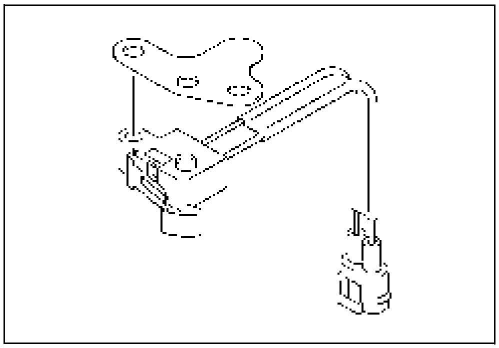
ECM

The ECM has been changed in program.



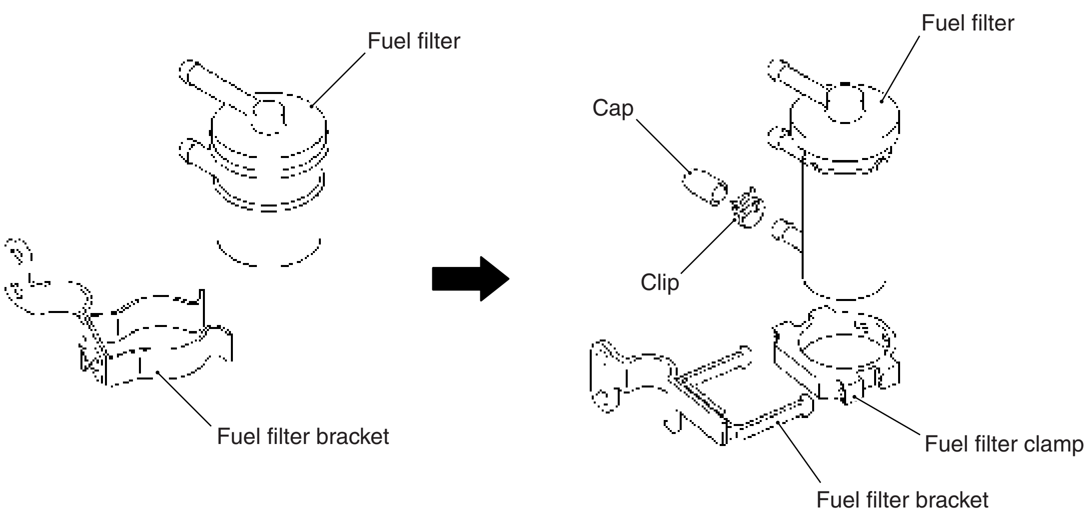
NEUTRAL SWITCH

The neutral switch feature has been redesigned with a micro type switch.



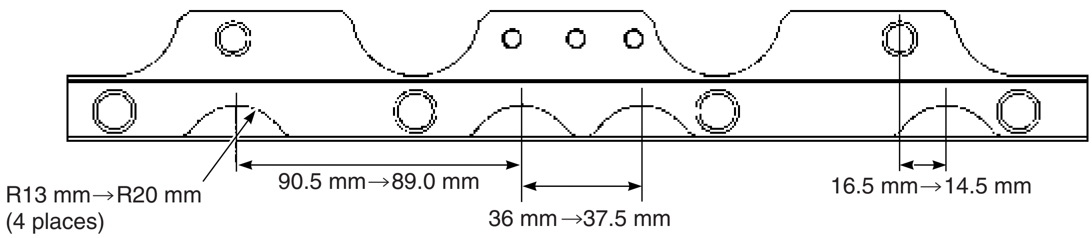
FUEL FILTER

A new style fuel filter will be used that provides a drain feature.
This new filter requires several new components shown below and a new mounting bracket to retain the filter onto the outboard.



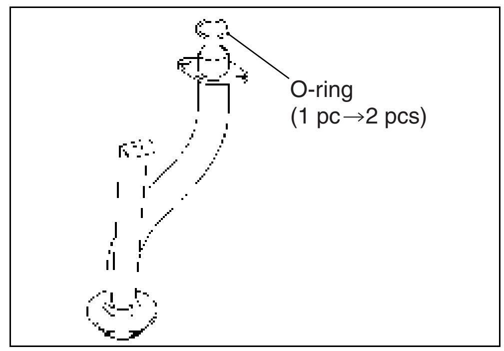
DELIVERY PIPE

The delivery pipe has been changed in shape.



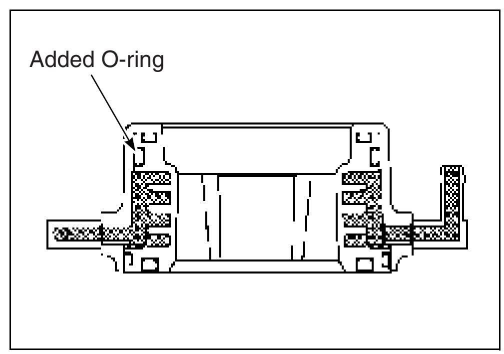
OIL STRAINER

The O-ring of oil strainer has been changed in number from one to two.



OIL COOLER (For DF140)

The oil cooler has been changed to add one O-ring.

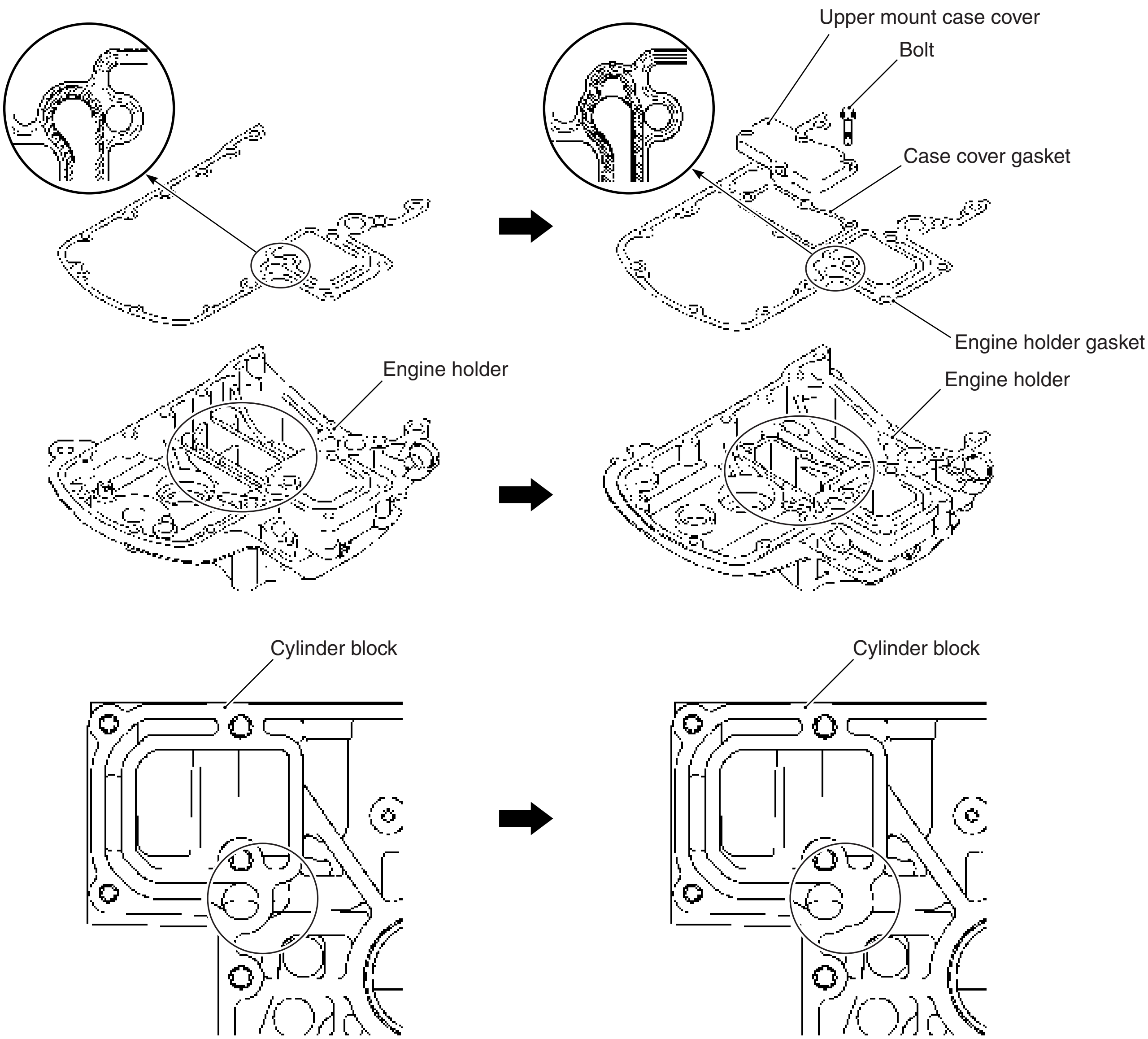


ENGINE HOLDER AND CYLINDER BLOCK

The cooling water passage in the engine holder has been changed.

In accordance with this change, the engine holder, engine holder gasket and cylinder block have been changed at the part of water passage.

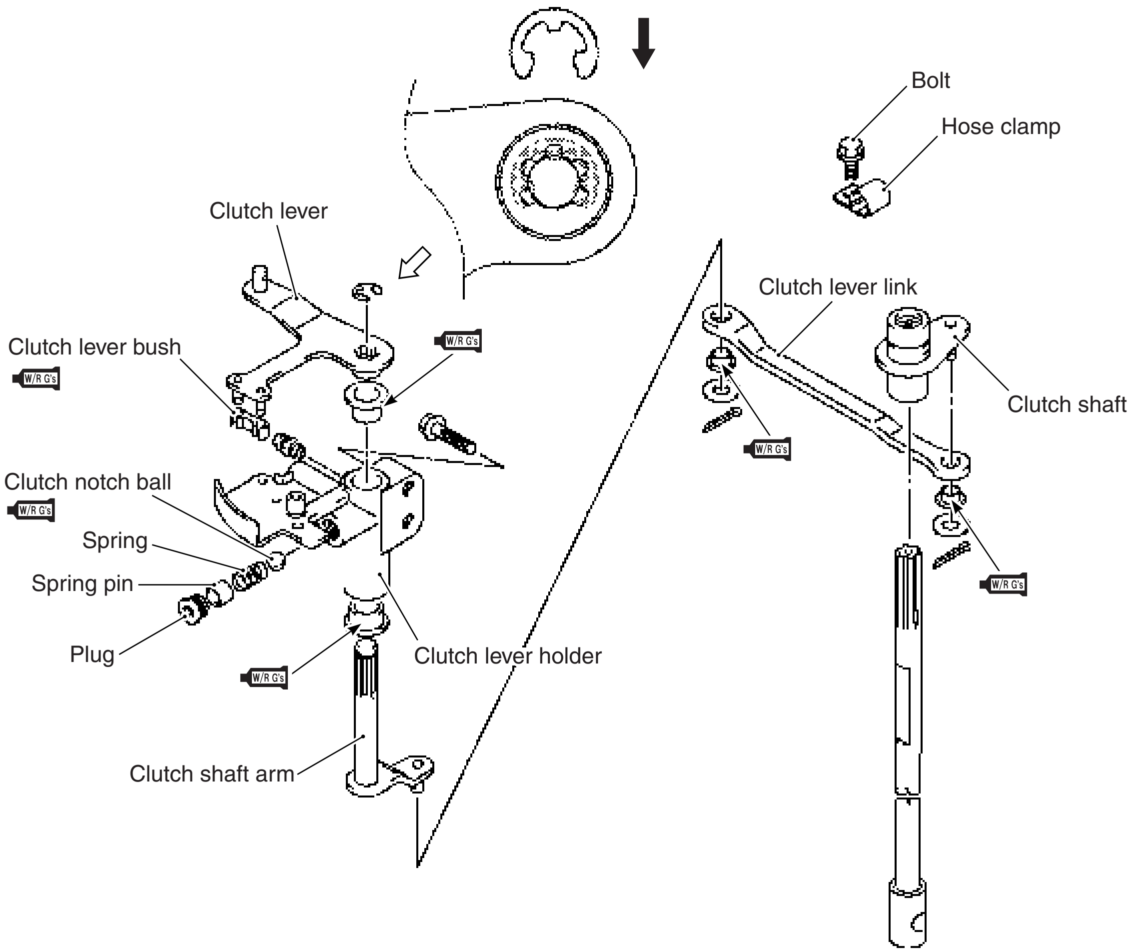
The upper mount case cover, mount case cover gasket and bolts have newly been added.



CLTUCH LINK

The clutch link and related parts have been changed.
Apply Water Resistant Grease to the following points.

W/R G's 99000-25161: Water Resistant Grease

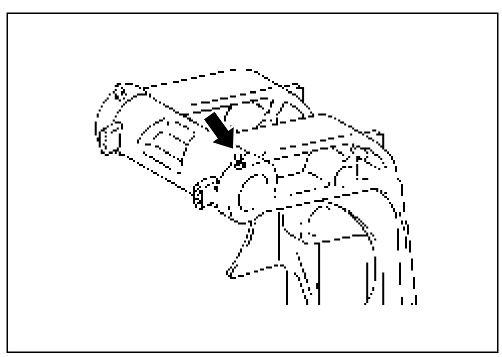


SWIVEL BRACKET BUSHING GREASE PATH

The lubrication path for the swivel bracket bushing have been redesigned affecting the swivel bracket, bushing and shaft. Basically, the grease routing slot located on the clamp bracket shaft has been moved to the clamp bracket bushing.

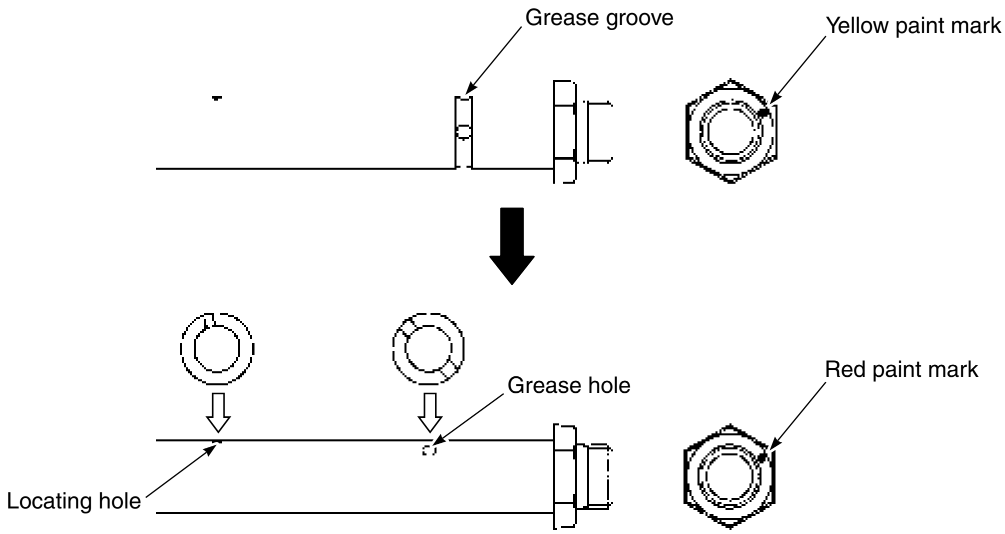
SWIVEL BRACKET

The swivel brackets have been redesigned from two to only one grease nipple on the port side.

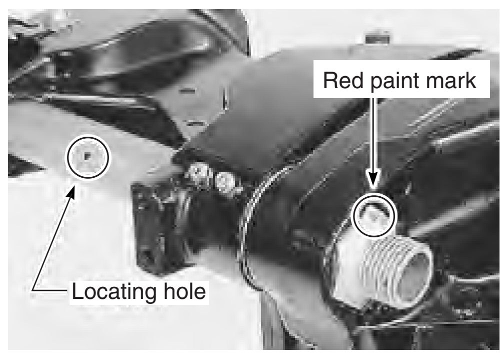


CLAMP BRACKET SHAFT AND BUSHING

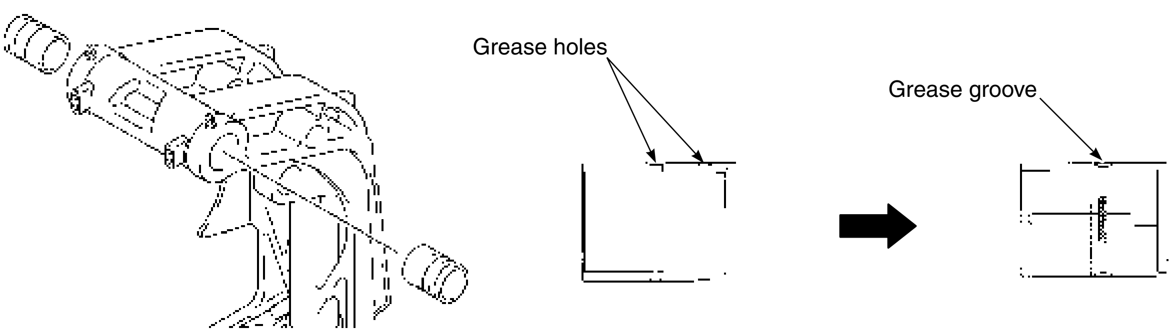
The clamp bracket shaft has been redesigned with a clearance hole in place of a slot for routing the grease lubrication.



NOTE:
Install the clamp bracket shaft with "Red" paint marking toward up side.

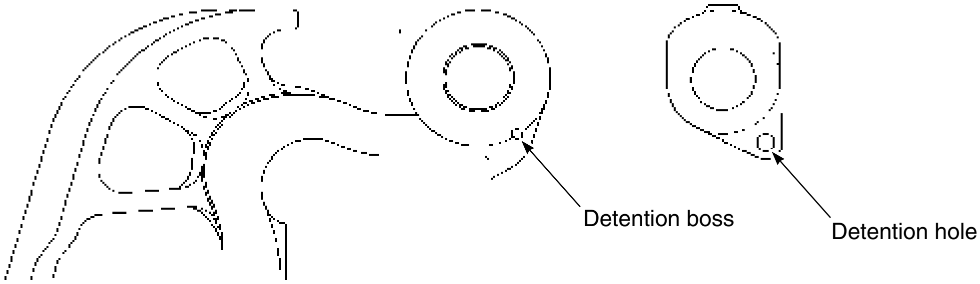


The clamp bracket shaft bushing has been redesigned with slot in place of two holes to provide routing for the grease lubrication.

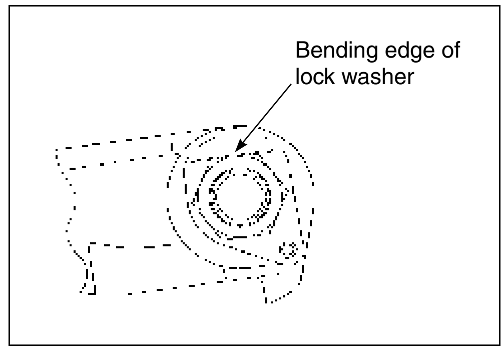


CLAMP BRACKET (For DF90 and DF115)

The clamp bracket shaft has been redesigned to use lock nut with a lock washer which is bent during assembly.

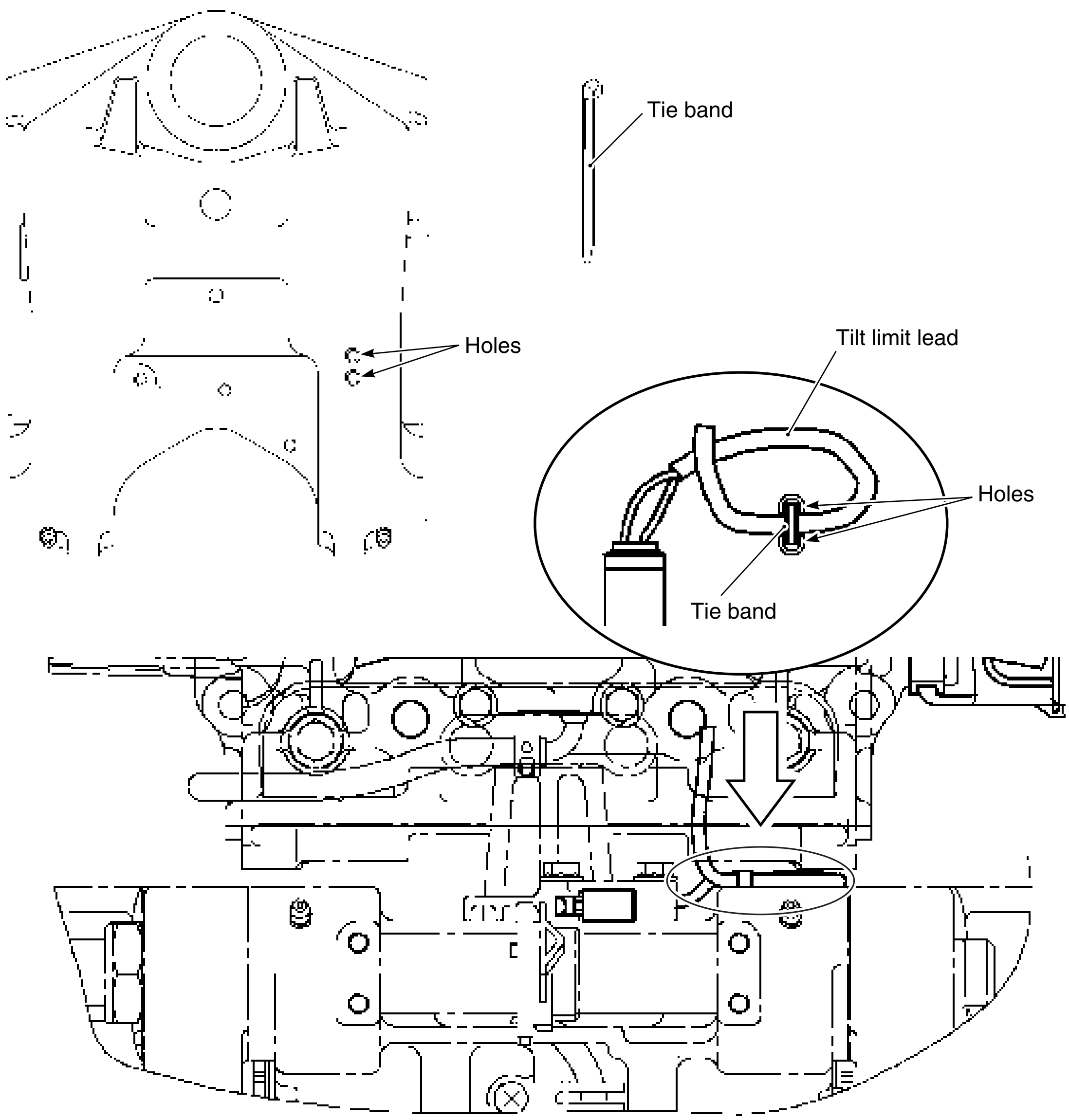


To prevent the lock washer from rotation, a boss has been added to the clamp bracket.



SWIVEL BRACKET

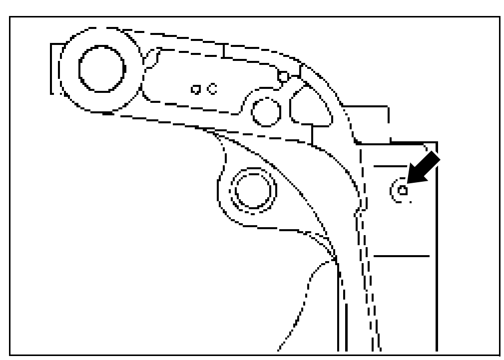
The swivel bracket has been redesigned to hold the tilt limit lead from a bolt and clamp design to a plastic tie strap looped through two holes in the swivel bracket.



DF90/115 (Transom “L” model only)

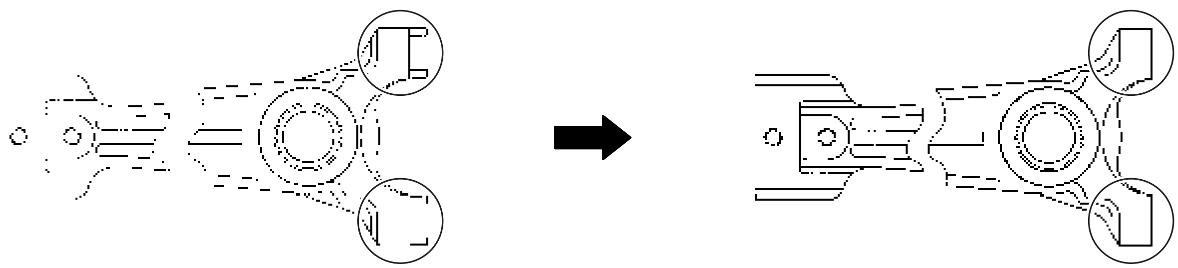
A tapped hole and a grease nipple have been added on the swivel bracket (transom “L”).

Use of grease nipple has been changed from 4 places to 5 places.



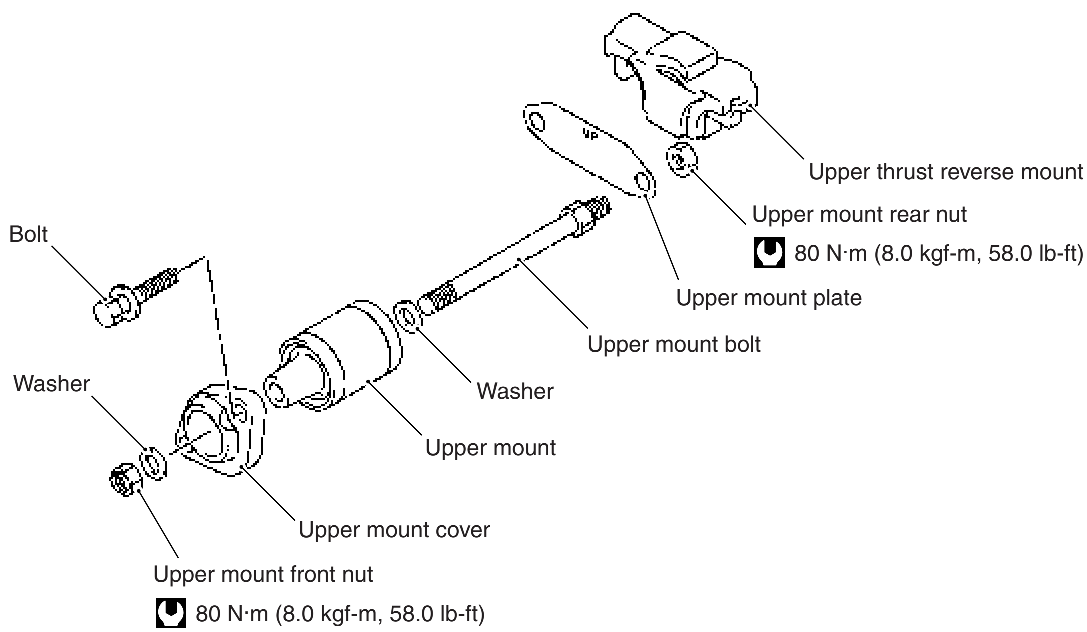
STEERING BRACKET

The upper mount system has been redesigned. The steering bracket required modification in the upper mount boss surface.



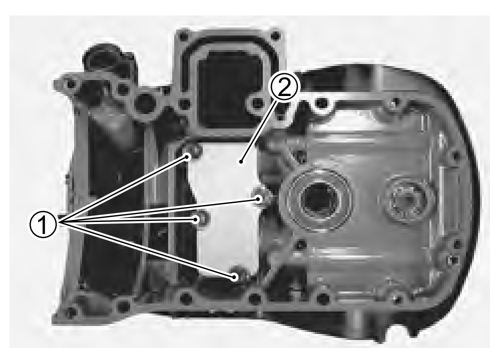
UPPER MOUNT

The upper mount and related parts have been changed.
Tightening torque of the upper mount front nut has been changed from 85 N·m to 80 N·m



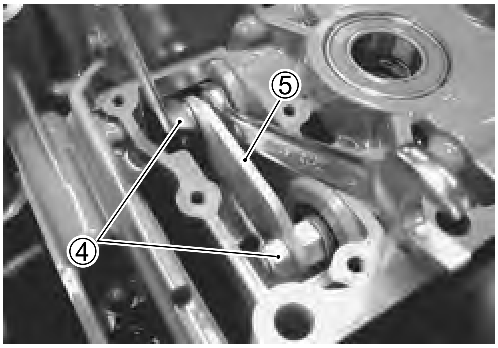
Removal the upper mount

1. Remove the four bolts ①, upper cover ② and gasket.

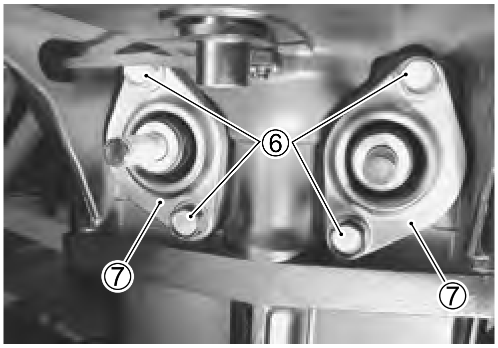


2. Remove the upper thrust reverse mount ③.

3. Remove the two nuts ④ and upper mount plate ⑤.

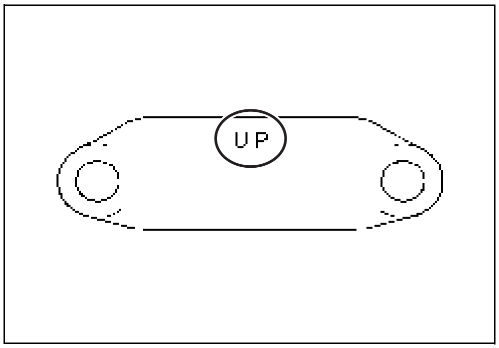


4. Remove the four bolts ⑥ and upper mount covers ⑦. Remove the upper mount assembly.

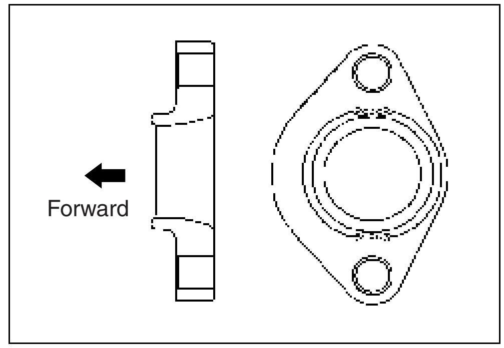


Reassemble the upper mount
When reassembling the upper mount parts, follow the removal instruction in reverse. Also, paying close attention the parts orientation shown below.

Install the upper mount plate with the UP mark pointing upside.

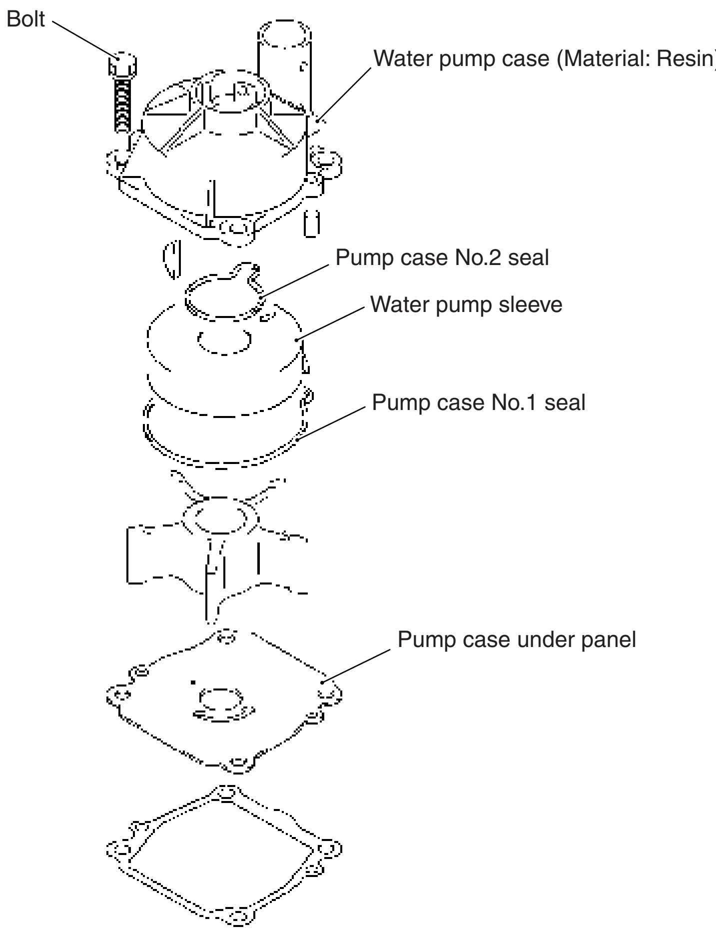


Install the upper mount cover with rib side to be facing to forward.



WATER PUMP

The water pump and related parts have been changed.



Water Pump Installation

1. Install the pump case No.2 seal into the water pump case.

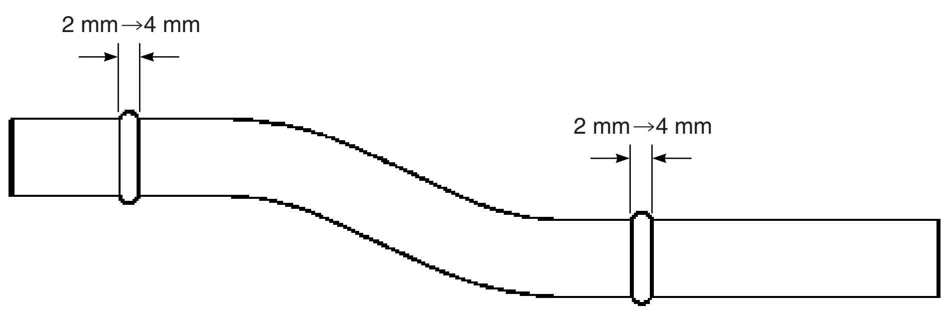
2. Apply Suzuki Bond No.1207B onto the outer-surface of water pump sleeve.
   Install the water pump sleeve into the water pump case by confirming the boss on the sleeve should be meeting with the groove on the pump case.

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

3. Install the pump case No.1 seal into the water pump case.
   Install the water pump case assembly on the gearcase.

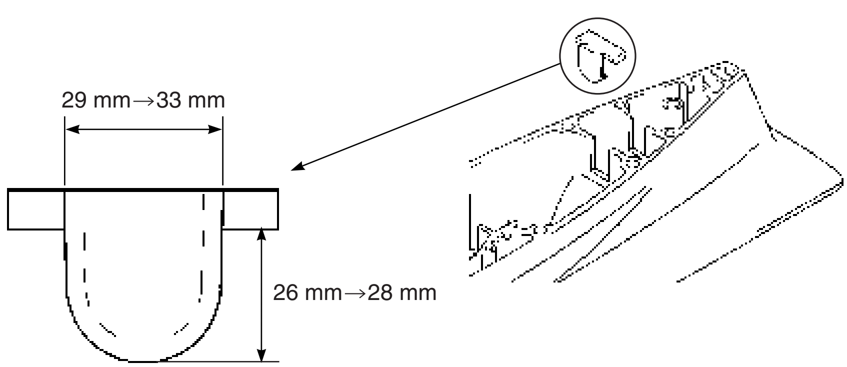
WATER PUMP TUBE

The water pump tube has been changed in shape.



EXHAUST SEAL RUBBER

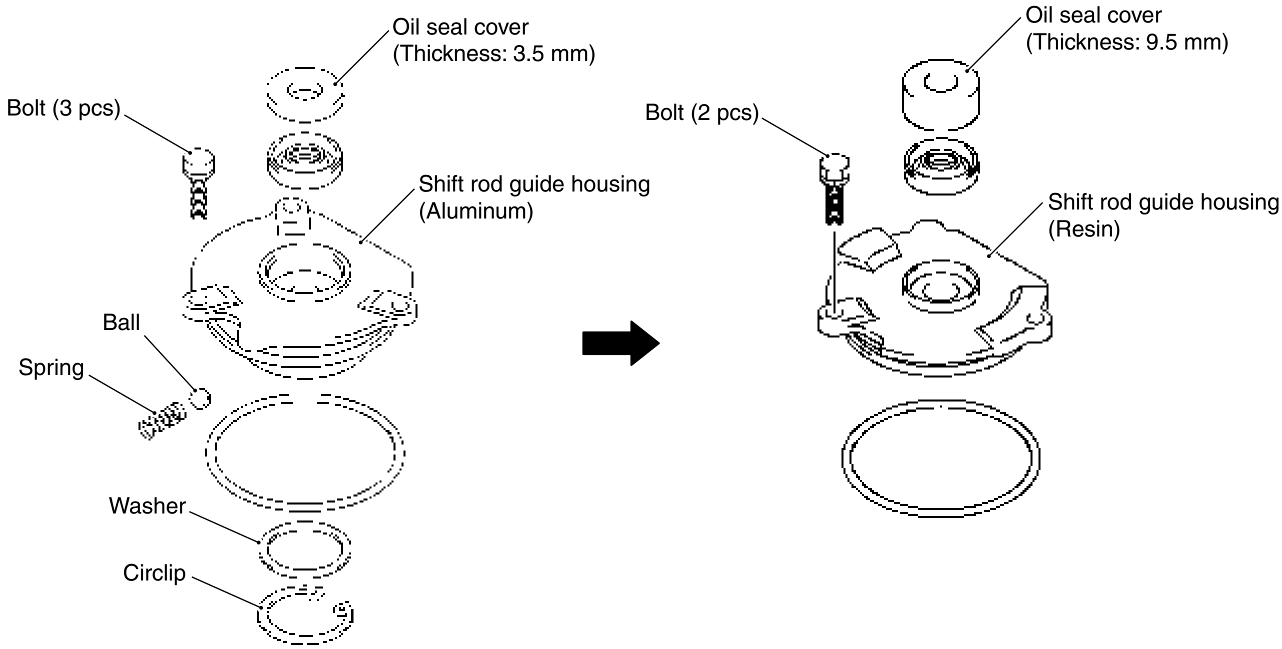
The exhaust seal rubber has been changed in shape.



SHIFT ROD GUIDE HOUSING

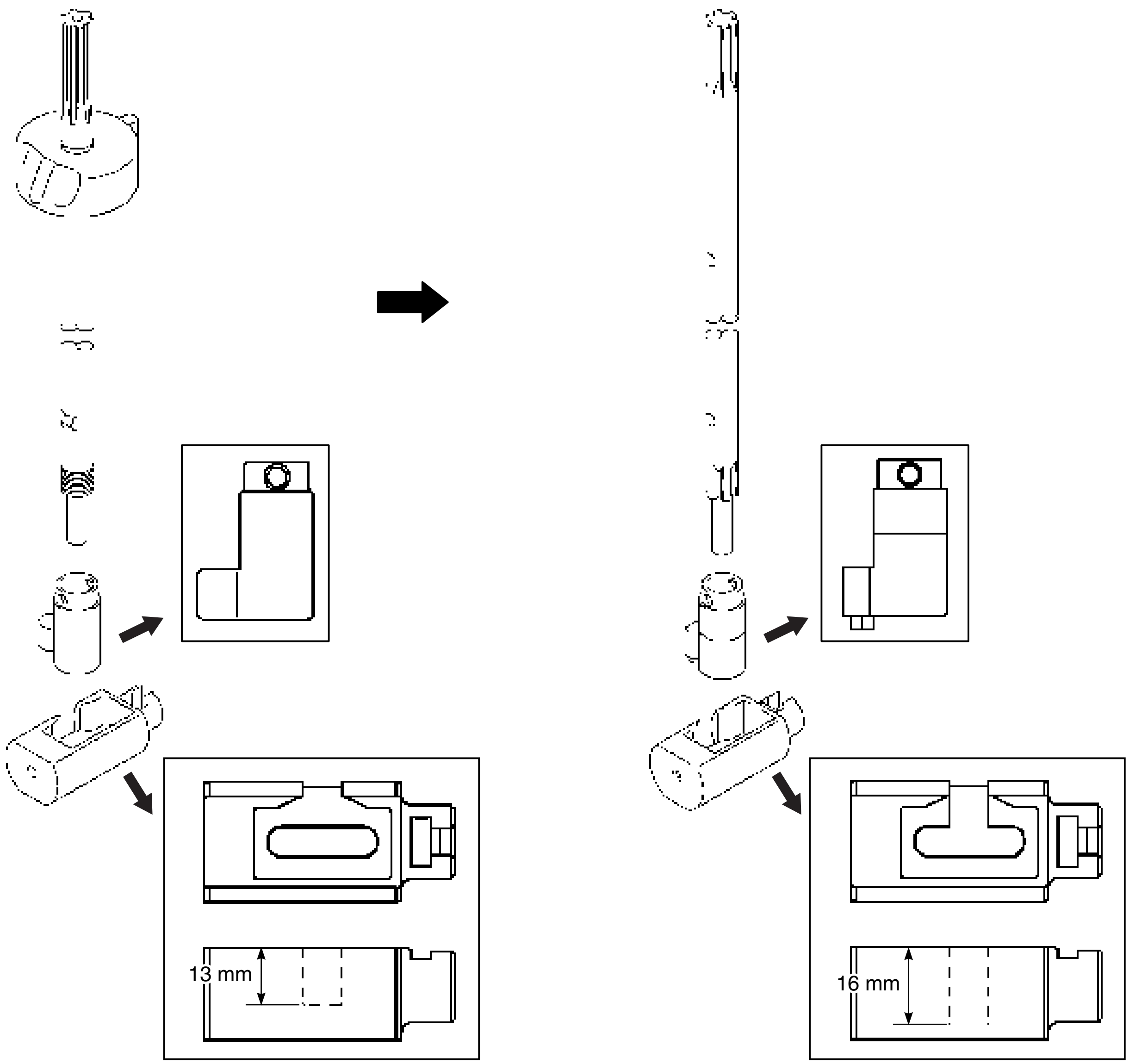
The shift rod guide housing and related parts have been changed as follows:

* The shift rod guide housing has been changed in shape.
* The shift rod guide housing has been changed in materials from aluminum to resin.
* Number of securing bolts have been changed from 3 to 2.
* Thickness of oil seal cover has been changed from 3.5 mm to 9.5 mm.
* The detent ball, spring, washer and circlip have been eliminated.



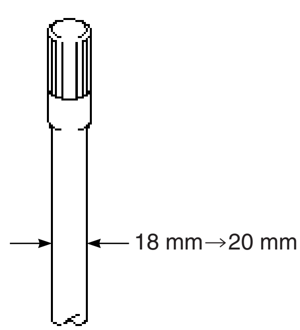
SHIFT ROD, SHIFTER YOKE AND HORIZONTAL SLIDER

The shift rod, shifter yoke and horizontal slider have been changed in shape.



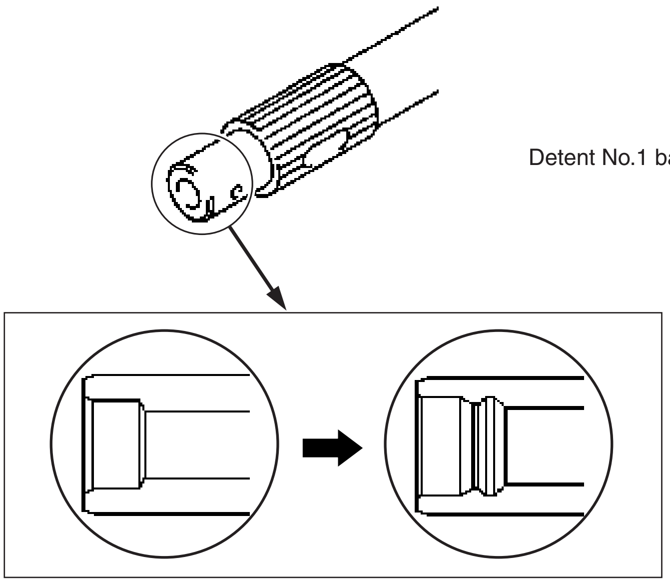
DRIVE SHAFT

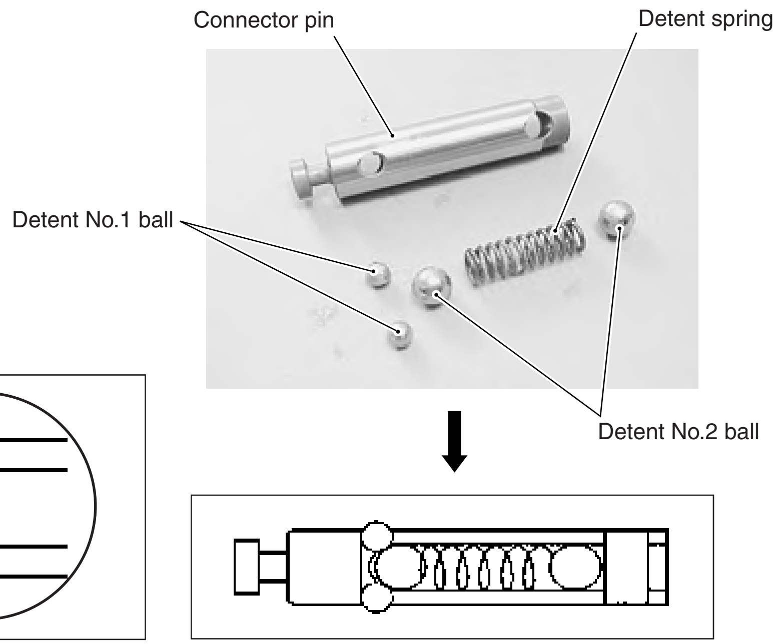
The outside diameter of drive shaft has partially been changed from 18 mm to 20 mm.



PROPELLER SHAFT AND CONNECTOR PIN

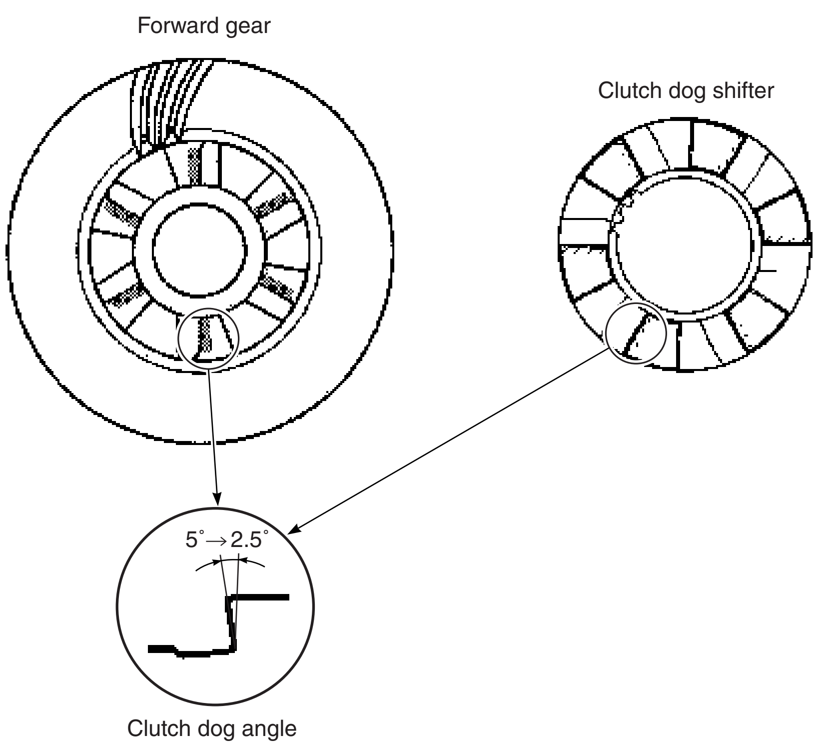
The propeller shaft having an additional detent function.



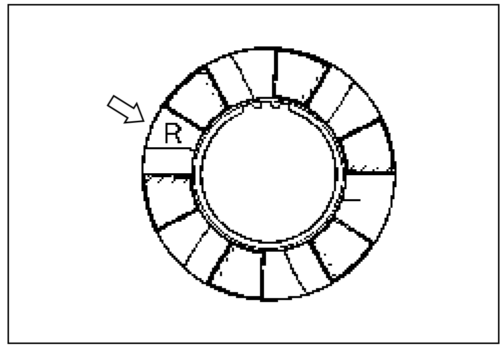


FORWARD GEAR AND CLUTCH DOG

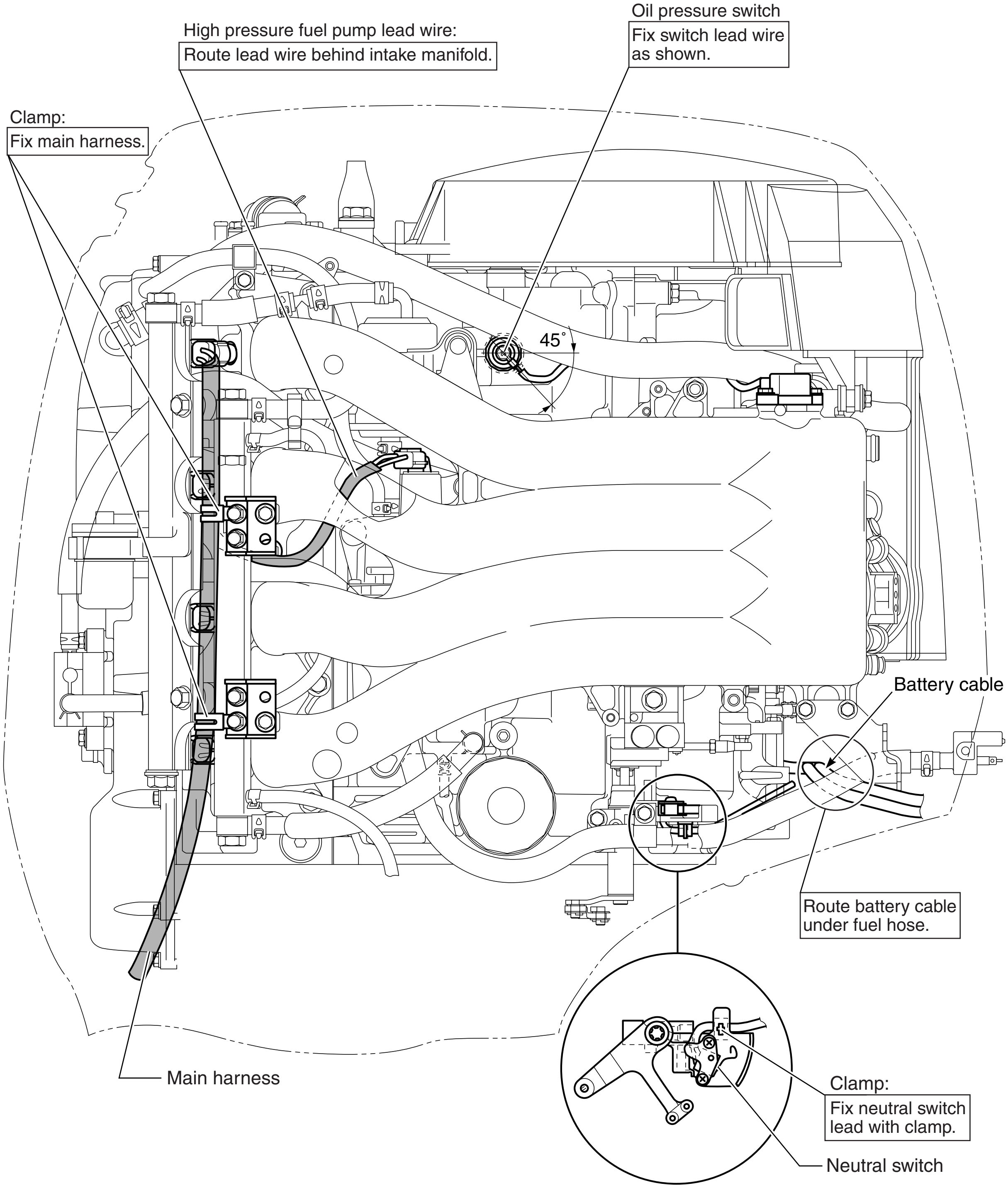
The forward gear and clutch dog shifter have been changed in engage angle from 5° to 2.5°.

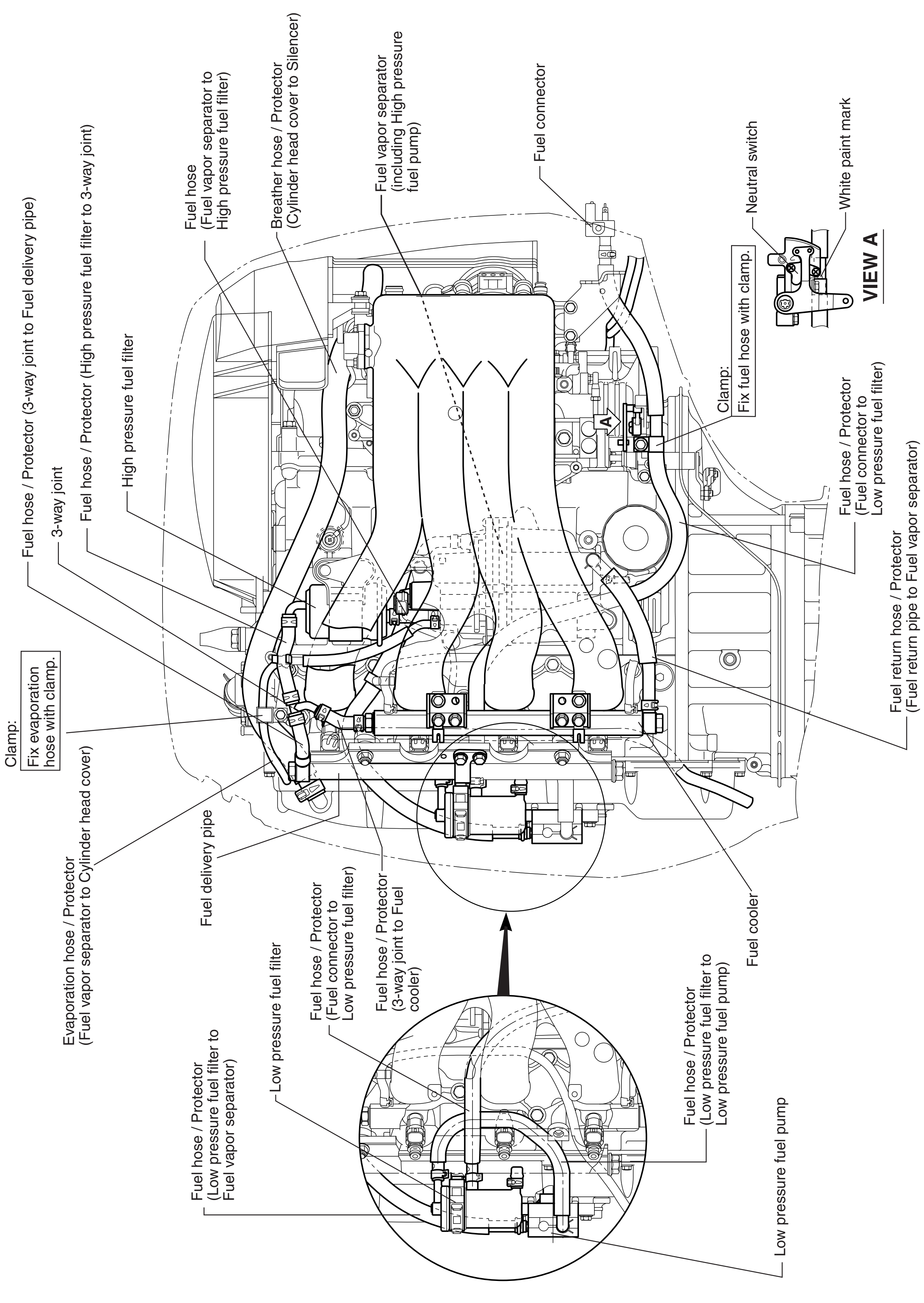


The punch letter on the reverse gear side of clutch dog shifter has been changed from “R, E, V,” to “R”.



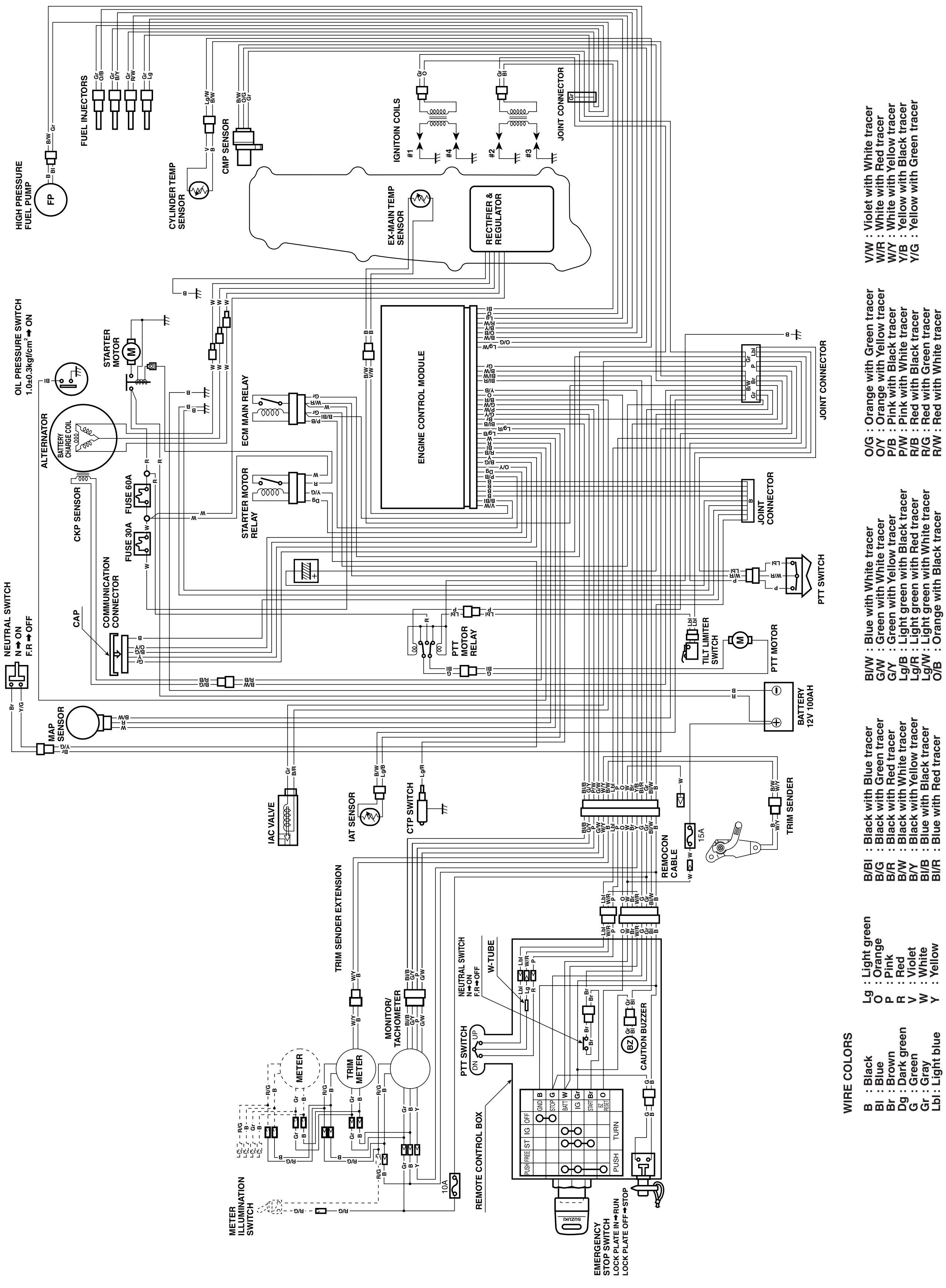
WIRING/HOSE ROUTING





Fuel hose / Protector (3-way joint to Fuel delivery pipe)
3-way joint
Fuel hose / Protector (High pressure fuel filter to 3-way joint)
High pressure fuel filter
Fuel hose (Fuel vapor separator to High pressure fuel filter)
Breather hose / Protector (Cylinder head cover to Silencer)
Fuel vapor separator (including High pressure fuel pump)
Fuel connector
Neutral switch
White paint mark
VIEW A
Fix fuel hose with clamp.
Clamp: Fix fuel hose with clamp.
A
Fuel hose / Protector (Fuel connector to Low pressure fuel filter)
Fuel hose / Protector (Fuel connector to Low pressure fuel separator)
Fuel return hose / Protector (Fuel return pipe to Fuel vapor separator)
Clamp: Fix evaporation hose with clamp.
Evaporation hose / Protector (Fuel vapor separator to Cylinder head cover)
Fuel delivery pipe
Fuel hose / Protector (3-way joint to Fuel cooler)
Fuel cooler
Fuel hose / Protector (Low pressure fuel filter to Fuel vapor separator)
Low pressure fuel filter
Fuel hose / Protector (Low pressure fuel filter to Low pressure fuel pump)
Low pressure fuel pump

WIRING DIAGRAM



DF90/115/140 “K7” (2007) MODEL

CONTENTS

*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115T/115WT
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	779 (30.7)
Overall width (side to side)		mm (in)	481 (18.9)
Overall height	L	mm (in)	1556 (61.3)
	X	mm (in)	1683 (66.3)
Weight (without engine oil)	L	kg (lbs)	189.0 (416)
	X	kg (lbs)	194.0 (427)
Transom height	L	mm (inch type)	539 (20)
	X	mm (inch type)	666 (25)

PERFORMANCE

Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	

POWERHEAD

Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6ES
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	
		DF90T	DF115T/115WT

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.083)
Drive line impact protection	Spline drive rubber hub
Propeller ☆: Aluminum propeller ★: Stainless steel propeller	Blade × Diam. (in) × Pitch (in) ☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14 × 18 ★ 3 × 14 × 20 ★ 3 × 14 × 22 ★ 3 × 14 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.241)
2nd reduction gear ratio (Lower unit)	12 : 25 (2.083)
Total reduction gear ratio	2.586 (36/29 × 25/12)

*SPECIFICATIONS (DF140T/140WT/140Z/140WZ)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ
PRE-FIX			14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5 600 – 6 200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system		Gear	
Transmission		Forward-Neutral-Reverse	
Reduction system		Bevel gear	
Gear ratio		12 : 25 (2.083)	
Drive line impact protection		Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)		clockwise	counterclockwise
Propeller		Blade × Diam. (in) × Pitch (in)	
		☆ 3 × 13-1/2 × 15	
		☆ 3 × 14 × 17	
		☆ 3 × 14 × 19	
		☆ 3 × 14 × 21	
		☆ 3 × 14 × 23	
		★ 3 × 14 × 18	★ 3 × 14 × 18
		★ 3 × 14 × 20	★ 3 × 14 × 20
☆: Aluminum propeller		★ 3 × 14 × 22	★ 3 × 14 × 22
★: Stainless steel propeller		★ 3 × 14 × 24	★ 3 × 14 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.241)	
2nd reduction gear ratio (Lower unit gear)		12 : 23 (1.917)	
Total reduction gear ratio		2.379 (36/29 × 23/12)	

SERVICE DATA (DF90T/115T/115WT)

Item	Unit	Data	
		DF90T	DF115T/115WT

POWERHEAD

Item	Unit	DF90T	DF115T/115WT
Recommended operation range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data DF90T	Data DF115T/115WT

CYLINDER HEAD / CAMSHAFT

Item			Unit	DF90T	DF115T/115WT
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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.530 (1.4382)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data DF90T	Data DF115T/115WT

VALVE / VALVE GUIDE

Item			Unit	DF90T	DF115T/115WT
Valve diameter		IN	mm (in)	33 (1.3)	
		EX	mm (in)	28 (1.1)	
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)	
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)	
Valve seat angle	IN		—	15°, 45°, 60°	
	EX		—	15°, 45°	
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)	
		Limit	mm (in)	0.070 (0.0028)	
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)	
		Limit	mm (in)	0.090 (0.0035)	
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)	
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)	
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)	
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)	
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)	
	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)	1.2 (0.05)	
		Limit		0.7 (0.03)	
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)	
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)	
Valve spring free length		STD	mm (in)	42.7 (1.68)	
		Limit		41.0 (1.61)	
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)	
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)	
Valve spring squareness		Limit	mm (in)	2.0 (0.08)	

Item			Unit	Data	
				DF90T	DF115T/115WT

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF90T	DF115T/115WT

CRANKSHAFT / CONROD

Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T/115WT

ELECTRICAL

Ignition timing		Degrees	BTDC 1 – BTDC 44	BTDC 3 – BTDC 44
Over revolution limiter		r/min	6200	
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)	
High tension code resistance		kΩ/m at 20 °C	Approx. 16	
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24	
Battery charge coil output (12 V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30	
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5	
IAC valve resistance		Ω at 20 °C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3	
ECM main relay resistance		Ω at 20 °C	145 – 190	
Starter motor relay resistance		Ω at 20 °C	145 – 190	
PTT motor relay resistance		Ω at 20 °C	25 – 37	

STARTER MOTOR

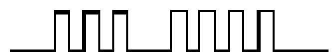
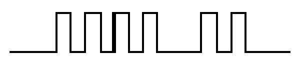
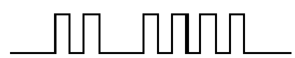
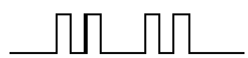
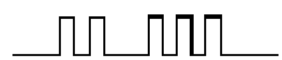
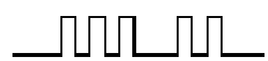
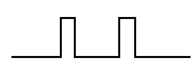
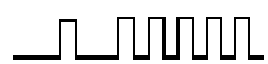
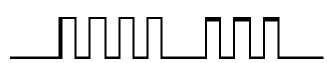
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

SERVICE DATA (DF140T/140WT/140Z/140WZ)

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

POWERHEAD

Recommended operation range	r/min	5600 – 6200	
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)	
* Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data DF140T/140WT	Data DF140Z/140WZ

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)	39.520 – 39.680 (1.5560 – 1.5622)
		Limit	mm (in)	39.420 (1.5520)
	EX	STD	mm (in)	39.320 – 39.480 (1.5480 – 1.5543)
		Limit	mm (in)	39.220 (1.5441)
Camshaft journal oil clearance	Top 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.120 (0.0047)
	5th	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)
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	mm (in)	22.869 (0.9004)
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	mm (in)	25.844 (1.0175)
Camshaft runout		Limit	mm (in)	0.10 (0.004)
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)
		Limit	mm (in)	0.150 (0.0059)
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)

Item			Unit	Data DF140T/140WT	Data DF140Z/140WZ

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

CYLINDER / PISTON / PISTON RING

Item			Unit	Data
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

CRANKSHAFT / CONROD

Item		Unit	DF140T/140WT, DF140Z/140WZ
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

ELECTRICAL

Ignition timing		Degrees	BTDC 5 – BTDC 45
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20 °C	168 – 252
CMP sensor resistance		Ω at 20 °C	—
Ignition coil resistance	Primary	Ω at 20 °C	1.9 – 2.5
	Secondary	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ /m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

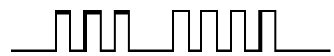
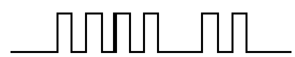
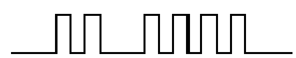
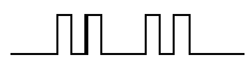
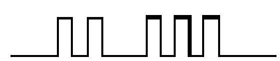
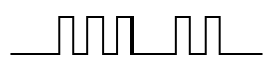
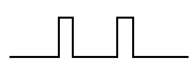
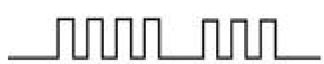
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.0 (0.20)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector (Open circuit)	4 – 3	on off 	NO

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

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

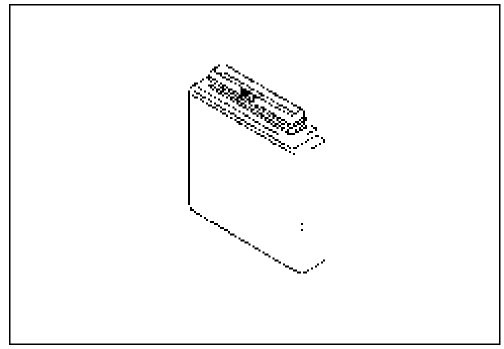
Interval / Item to be serviced	Initial 20 hrs. or 1 month	Every 50 hrs. or 3 months	Every 100 hrs. or 6 months	Every 200 hrs. or 12 months
Spark plug	—	—	I	R
Breather hose & Fuel line	I	I	I	I
	Replace every 2 years.			
Engine oil	R	—	R	R
Gear oil	R	—	R	R
Lubrication	—	I	I	I
Anodes & Bonding wires	—	I	I	I
Battery	—	I	I	I
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
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

* The fuel mixture check (O_2 feedback) has been abolished.
In accordance with this change, the item of “Fuel mixture check (O_2 feedback)” was deleted.

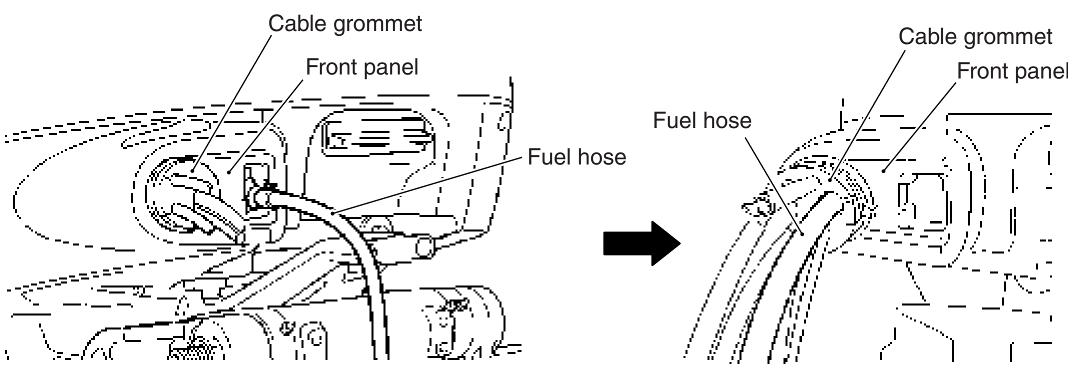
ECM

The warning memory condition program on ECM has been changed.



FUEL HOSE, CABLE GROMMET AND FRONT PANEL

The fuel hose, cable grommet and front panel have been changed.



FUEL HOSE

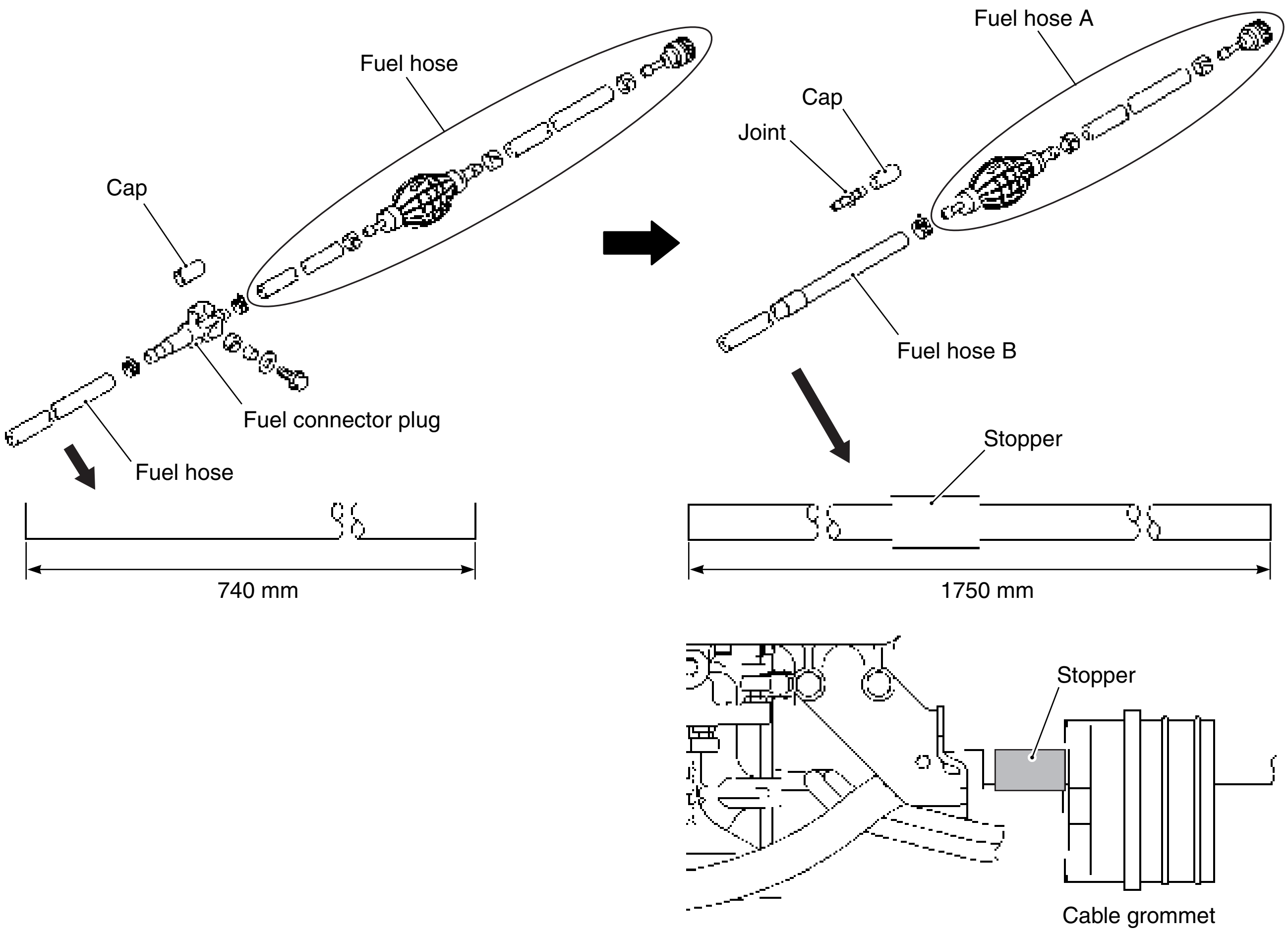
The fuel hose has been changed in length.

The hose joint has been added.

The fuel connector plug and related parts have been eliminated.

NOTE:

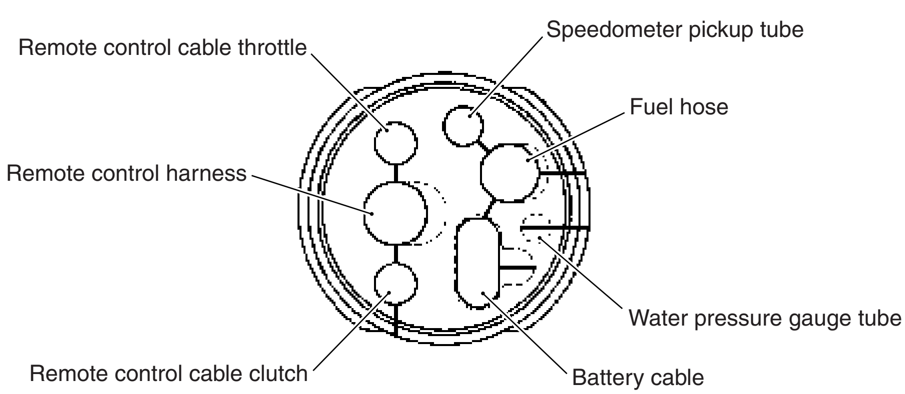
When connecting the fuel hose A and B, disconnect the joint from fuel hose B.



CABLE GROMMET

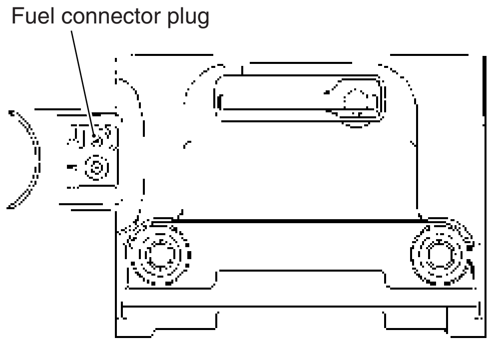
The fuel hose through hole has been added.

In accordance with this change, the position of remote control harness through hole has been changed.

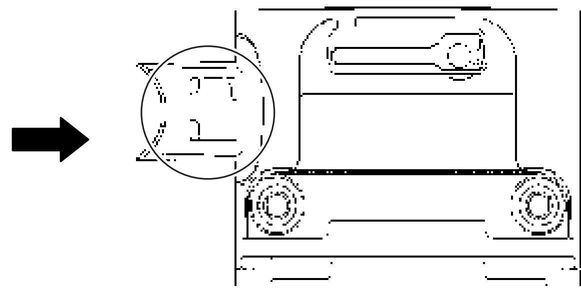


FRONT PANEL

The fuel connector plug and related parts have been eliminated.
The hole on front panel for fuel connector plug has been eliminated.



Early



Late

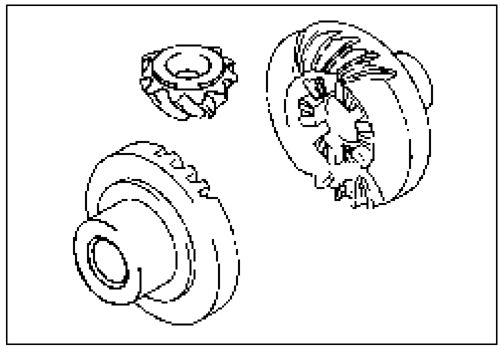
PINION/GEAR SET

DF140

The tooth numbers of forward and reverse gears for DF140 have been changed from 23 to 25.
In accordance with this change, the gear ratio for DF140 has been changed.

DF140	2006 (K6) Model	2007 (K7) Model
Gear ratio	12 : 23 (1.917)	12 : 25 (2.083)

NOTE:
The 2007 model DF140 pinion is the same one as 2007 model DF90/DF115.



DF90/115/140

As the pinion, forward gear and reverse gear have been changed in machining from 2007 models, these are not inter-changeable among 2007 and 2006 models.

DF90/115/140 “K8” (2008) MODEL

CONTENTS

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*SPECIFICATIONS (DF90T/115T/115WT)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF90T	DF115T/115WT
PRE-FIX			09001F	11501F

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	779 (30.7)
Overall width (side to side)		mm (in)	481 (18.9)
Overall height	L	mm (in)	1556 (61.3)
	X	mm (in)	1683 (66.3)
Weight (without engine oil)	L	kg (lbs)	189.0 (416)
	X	kg (lbs)	194.0 (427)
Transom height	L	mm (inch type)	539 (20)
	X	mm (inch type)	666 (25)

PERFORMANCE

Maximum output	kW (PS)	66.2 (90)	84.6 (115)
Recommended operating range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	

POWERHEAD

Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6ES
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	
		DF90T	DF115T/115WT

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Item	Data
Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.083)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	☆ 3 × 13-1/2 × 15
	☆ 3 × 14 × 17
	☆ 3 × 14 × 19
	☆ 3 × 14 × 21
	☆ 3 × 14 × 23
	★ 3 × 14-1/4 × 18
	★ 3 × 14-1/4 × 20
☆: Aluminum propeller	★ 3 × 14-1/4 × 22
★: Stainless steel propeller	★ 3 × 14-1/4 × 24

REDUCTION SYSTEM

Item	Data
1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.241)
2nd reduction gear ratio (Lower unit)	12 : 25 (2.083)
Total reduction gear ratio	2.586 (36/29 × 25/12)

*SPECIFICATIONS (DF140T/140WT/140Z/140WZ)

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ
PRE-FIX			14001F	14001Z

DIMENSIONS & WEIGHT

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

PERFORMANCE

Maximum output	kW (PS)	103 (140)
Recommended operating range	r/min	5 600 – 6 200
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)

POWERHEAD

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

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

FUEL & OIL

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

BRACKET

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

LOWER UNIT

Reversing system		Gear	
Transmission		Forward-Neutral-Reverse	
Reduction system		Bevel gear	
Gear ratio		12 : 25 (2.083)	
Drive line impact protection		Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)		clockwise	counterclockwise
Propeller		Blade × Diam. (in) × Pitch (in)	
☆: Aluminum propeller ★: Stainless steel propeller		☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14-1/4 × 18 ★ 3 × 14-1/4 × 20 ★ 3 × 14-1/4 × 22 ★ 3 × 14-1/4 × 24	★ 3 × 14-1/4 × 18 ★ 3 × 14-1/4 × 20 ★ 3 × 14-1/4 × 22 ★ 3 × 14-1/4 × 24

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.241)	
2nd reduction gear ratio (Lower unit gear)		12 : 25 (2.083)	
Total reduction gear ratio		2.586 (36/29 × 25/12)	

SERVICE DATA (DF90T/115T/115WT)

Item	Unit	Data	
		DF90T	DF115T/115WT

POWERHEAD

Item	Unit	DF90T	DF115T/115WT
Recommended operation range	r/min	4500 – 5500	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)	
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)	
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF90T	DF115T/115WT

CYLINDER HEAD / CAMSHAFT

Item			Unit	DF90T	DF115T/115WT
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)	36.920 – 37.080 (1.4535 – 1.4598)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.820 (1.4496)	38.720 (1.5244)
	EX	STD	mm (in)	36.630 – 36.790 (1.4421 – 1.4484)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	36.530 (1.4382)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)	
		Limit	mm (in)	0.120 (0.0047)	
	5th	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)	
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)	
		Limit	mm (in)	26.171 (1.0304)	
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)	
		Limit	mm (in)	22.869 (0.9004)	
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)	
		Limit	mm (in)	25.844 (1.0175)	
Camshaft runout		Limit	mm (in)	0.10 (0.004)	
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)	
		Limit	mm (in)	0.150 (0.0059)	
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)	
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)	

Item			Unit	Data	
				DF90T	DF115T/115WT

VALVE / VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit		0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit		41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data DF90T	Data DF115T/115WT

CYLINDER / PISTON / PISTON RING

Item			Unit	DF90T / DF115T/115WT
Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF90T	DF115T/115WT

CRANKSHAFT / CONROD

Item		Unit	Data
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF90T	DF115T/115WT

ELECTRICAL

Ignition timing		Degrees	BTDC 1 – BTDC 44	BTDC 3 – BTDC 44
Over revolution limiter		r/min	6200	
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)	
High tension code resistance		kΩ/m at 20 °C	Approx. 16	
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24	
Battery charge coil output (12 V)		Watt	480	
Standard spark plug	Type	NGK	BKR6E	
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)	
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30	
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger	
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5	
IAC valve resistance		Ω at 20 °C	8 – 12	
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3	
ECM main relay resistance		Ω at 20 °C	145 – 190	
Starter motor relay resistance		Ω at 20 °C	145 – 190	
PTT motor relay resistance		Ω at 20 °C	25 – 37	

STARTER MOTOR

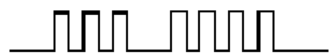
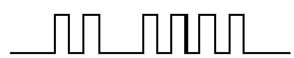
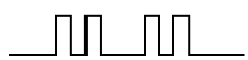
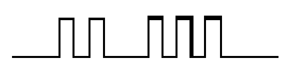
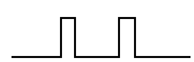
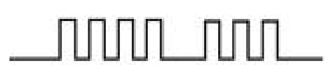
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

SERVICE DATA (DF140T/140WT/140Z/140WZ)

Item	Unit	Data	
		DF140T/140WT	DF140Z/140WZ

POWERHEAD

Recommended operation range	r/min	5600 – 6200	
Idle speed	r/min	700 ± 50 (in-gear: approx. 700)	
* Cylinder compression	kPa (kg/cm^2, psi)	1200 – 1600 (12 – 16, 171 – 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)	450 – 500 (4.5 – 5.0, 64 – 71) at 3 000 r/min. (at normal operating temp.)	
Engine oil		API classification SE, SF, SG, SH, SJ Viscosity rating SAE10W-40	
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change	
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)	

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

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

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)	39.520 – 39.680 (1.5560 – 1.5622)
		Limit	mm (in)	39.420 (1.5520)
	EX	STD	mm (in)	39.320 – 39.480 (1.5480 – 1.5543)
		Limit	mm (in)	39.220 (1.5441)
Camshaft journal oil clearance	Top 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.120 (0.0047)
	5th	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)
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	mm (in)	22.869 (0.9004)
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	mm (in)	25.844 (1.0175)
Camshaft runout		Limit	mm (in)	0.10 (0.004)
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)
		Limit	mm (in)	0.150 (0.0059)
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)

<table>
<tr><th colspan="3" rowspan="2">Item</th><th rowspan="2">Unit</th><th colspan="2">Data</th></tr>
<tr><th>DF140T/140WT</th><th>DF140Z/140WZ</th></tr>
<tr><td colspan="6">VALVE / VALVE GUIDE</td></tr>
<tr><td colspan="2" rowspan="2">Valve diameter</td><td>IN</td><td>mm (in)</td><td colspan="2">33 (1.3)</td></tr>
<tr><td>EX</td><td>mm (in)</td><td colspan="2">28 (1.1)</td></tr>
<tr><td rowspan="2">Tappet clearance (Cold engine condition)</td><td>IN</td><td>STD</td><td>mm (in)</td><td colspan="2">0.23 – 0.27 (0.009 – 0.011)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td colspan="2">0.23 – 0.27 (0.009 – 0.011)</td></tr>
<tr><td rowspan="2">Valve seat angle</td><td>IN</td><td></td><td>—</td><td colspan="2">15°, 45°, 60°</td></tr>
<tr><td>EX</td><td></td><td>—</td><td colspan="2">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 colspan="2">0.020 – 0.047 (0.008 – 0.019)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">0.070 (0.0028)</td></tr>
<tr><td rowspan="2">EX</td><td>STD</td><td>mm (in)</td><td colspan="2">0.045 – 0.072 (0.0018 – 0.0028)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">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 colspan="2">6.000 – 6.012 (0.2362 – 0.2367)</td></tr>
<tr><td>Valve guide protrusion</td><td>IN, EX</td><td>STD</td><td>mm (in)</td><td colspan="2">13.5 (0.53)</td></tr>
<tr><td rowspan="2">Valve stem outside diameter</td><td>IN</td><td>STD</td><td>mm (in)</td><td colspan="2">5.965 – 5.980 (0.2348 – 0.2354)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td colspan="2">5.940 – 5.955 (0.2339 – 0.2344)</td></tr>
<tr><td rowspan="2">Valve stem end deflection</td><td>IN</td><td>Limit</td><td>mm (in)</td><td colspan="2">0.14 (0.006)</td></tr>
<tr><td>EX</td><td>Limit</td><td>mm (in)</td><td colspan="2">0.18 (0.007)</td></tr>
<tr><td>Valve stem runout</td><td>IN, EX</td><td>Limit</td><td>mm (in)</td><td colspan="2">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 colspan="2">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 colspan="2">1.0 (0.04)</td></tr>
<tr><td>Limit</td><td>mm (in)</td><td colspan="2">0.7 (0.03)</td></tr>
<tr><td rowspan="2">EX</td><td>STD</td><td>mm (in)</td><td colspan="2">1.2 (0.05)</td></tr>
<tr><td>Limit</td><td></td><td colspan="2">0.7 (0.03)</td></tr>
<tr><td rowspan="2">Valve seat contact width</td><td>IN</td><td>STD</td><td>mm (in)</td><td colspan="2">1.1 – 1.3 (0.04 – 0.05)</td></tr>
<tr><td>EX</td><td>STD</td><td>mm (in)</td><td colspan="2">1.1 – 1.3 (0.04 – 0.05)</td></tr>
<tr><td colspan="2" rowspan="2">Valve spring free length</td><td>STD</td><td>mm (in)</td><td colspan="2">42.7 (1.68)</td></tr>
<tr><td>Limit</td><td></td><td colspan="2">41.0 (1.61)</td></tr>
<tr><td colspan="2" rowspan="2">Valve spring tension</td><td>STD</td><td>N (kg, lbs)</td><td colspan="2">167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)</td></tr>
<tr><td>Limit</td><td>N (kg, lbs)</td><td colspan="2">151 (15.1, 33.3) for 32.6 mm (1.28 in)</td></tr>
<tr><td colspan="2">Valve spring squareness</td><td>Limit</td><td>mm (in)</td><td colspan="2">2.0 (0.08)</td></tr>
</table>

Item			Unit	Data	
				DF140T/140WT	DF140Z/140WZ

CYLINDER / PISTON / PISTON RING

Cylinder distortion		Limit	mm (in)	0.05 (0.002)
Piston to cylinder clearance		STD	mm (in)	0.020 – 0.040 (0.0008 – 0.0016)
		Limit	mm (in)	0.100 (0.0039)
Cylinder bore		STD	mm (in)	86.000 – 86.020 (3.3858 – 3.3866)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	85.970 – 85.990 (3.3846 – 3.3854)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.6 (0.46)
		Limit	mm (in)	9.3 (0.37)
	2nd	STD	mm (in)	Approx. 11.5 (0.45)
		Limit	mm (in)	9.2 (0.36)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

CRANKSHAFT / CONROD

Item		Unit	Data
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data	
			DF140T/140WT	DF140Z/140WZ

ELECTRICAL

Ignition timing		Degrees	BTDC 5 – BTDC 45
Over revolution limiter		r/min	6500
CKP sensor resistance		Ω at 20 °C	168 – 252
CMP sensor resistance		Ω at 20 °C	—
Ignition coil resistance	Primary	Ω at 20 °C	1.9 – 2.5
	Secondary	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ /m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

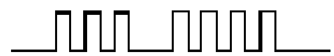
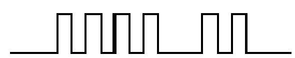
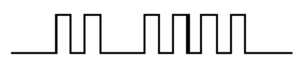
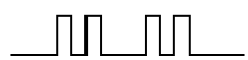
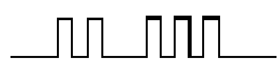
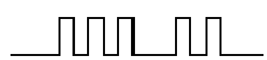
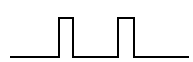
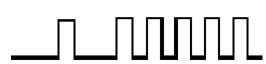
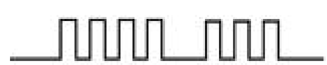
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.0 (0.20)
Commutator outside diameter	STD	mm (in)	22.0 (0.87)
	Limit	mm (in)	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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector (Open circuit)	4 – 3	on off 	NO

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

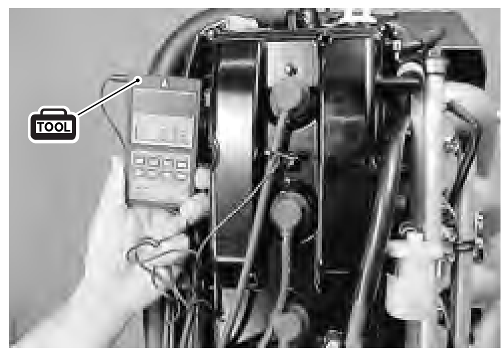
PERIODIC MAINTENANCE

IDLE SPEED

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

Change the idle speed adjustment procedure as following:
The idle adjustment of 2008 model can be performed by fixing duty of IAC valve as well as DF150 – DF250 model.

NOTE:
- *Before checking idle speed, engine should be allowed to warm up.*
- *Check and/or adjust idle speed after engine speed has stabilized.*
- *Before checking idle speed, check throttle link mechanism and throttle valve for smooth operation.*



1. Start engine and allow to warm up.

2. Attach engine tachometer to the ignition high-tension cord.

09900-26006 : Engine tachometer

3. Check engine speed.
   Idle speed (in neutral gear):
   DF90/115: 600 – 650 r/min
   DF140: 650 – 750 r/min

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

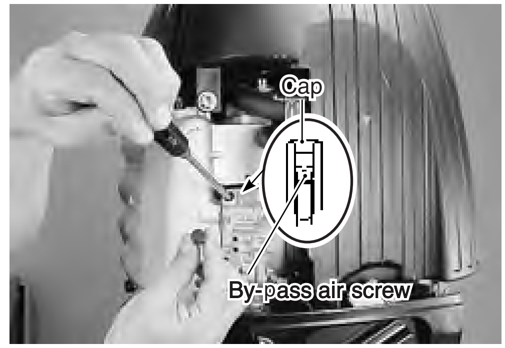
4. Shift into neutral and close the throttle fully.

5. To set the IAC valve duty to constant 30 %, turn the ignition key from ON to START five times within ten seconds.
   At this time, the caution buzzer will sound to notify that IAC duty is in fixed mode.

NOTE:
- *The ignition key operation should be performed with the engine running at idle.*
- *While IAC valve duty is at a fixed 30 % duty, the caution buzzer will sound in a repeating pattern of 0.5 second on with an interval of 3 seconds off.*
- *The fixed mode will continue for 5 minutes.*

6. During this fixed mode, adjust engine speed to 625 ± 25 r/min (DF140: 700 ± 50 r/min) by turning by-pass air screw.

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



7. When finished adjusting the idle speed, opening the throttle will cancel the (IAC) fixed mode.

8. Return the throttle to fully close and check engine speed.
   It should now be stable at 600 – 650 r/min (DF140: 650 – 750 r/min).

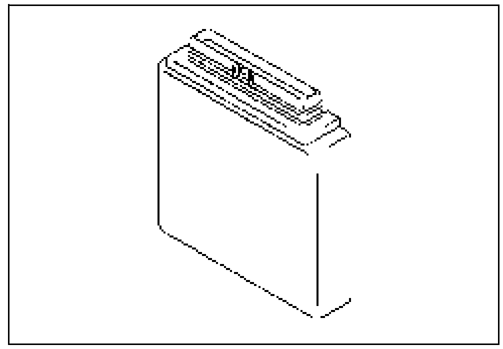
NOTE:
Trolling speed (in- gear) is same as idle speed.

ENGINE CONTROL SYSTEM

ECM

The program (internal circuit) of ECM has been changed.
This change is performed by following reasons:

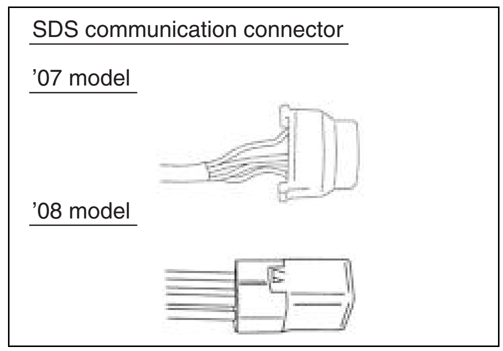
1. Addition of the IAC valve fixing mode.
2. Accommodation of the optional digital gauges (Teleflex gauges).

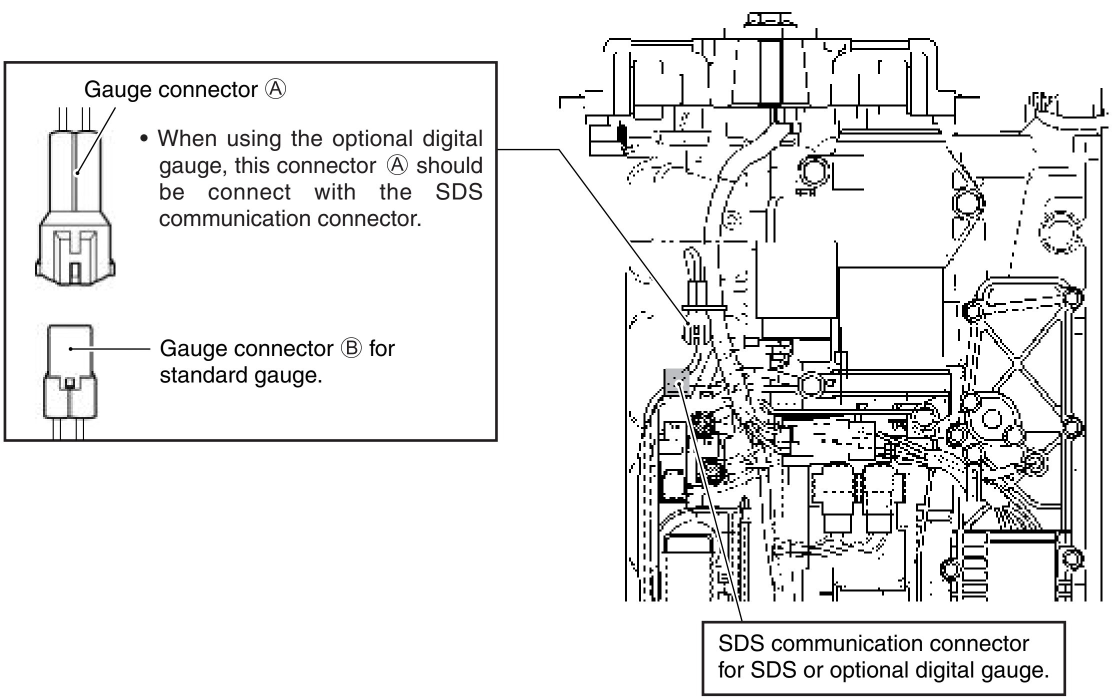


Part Name	Early (’07 model) Part Number	Interchange-ability	Late (’08 model) Part Number
ECM (DF90 E01)	33920-90J82	Yes ← → No	33920-90J83
ECM (DF90 E03)	33920-90J92	Yes ← → No	33920-90J93
ECM (DF115 E01)	33920-90JA2	Yes ← → No	33920-90JA3
ECM (DF115 E03, E40)	33920-90JB2	Yes ← → No	33920-90JB3
ECM (DF140 E01)	33920-92J42	Yes ← → No	33920-92J43
ECM (DF140 E03, E40)	33920-92J52	Yes ← → No	33920-92J53

WIRING HARNESS

- The shape of the SDS communication connector has been changed, as shown in the figure, to connect SDS-Ver.5 without conversion harness.
- The optional digital gauge operating signal is output from the three lead wires in this connector. For this reason, when the optional gauge (Teleflex gauge) is used, the connector Ⓐ for the standard gauge in the wiring harness in the figure should be connect with the SDS communication connector.





DIGITAL GAUGE SYSTEM

DIGITAL GAUGE

The digital gauge and the components required for installing the digital gauge are available as optional components.
The new gauge system components are as follows.

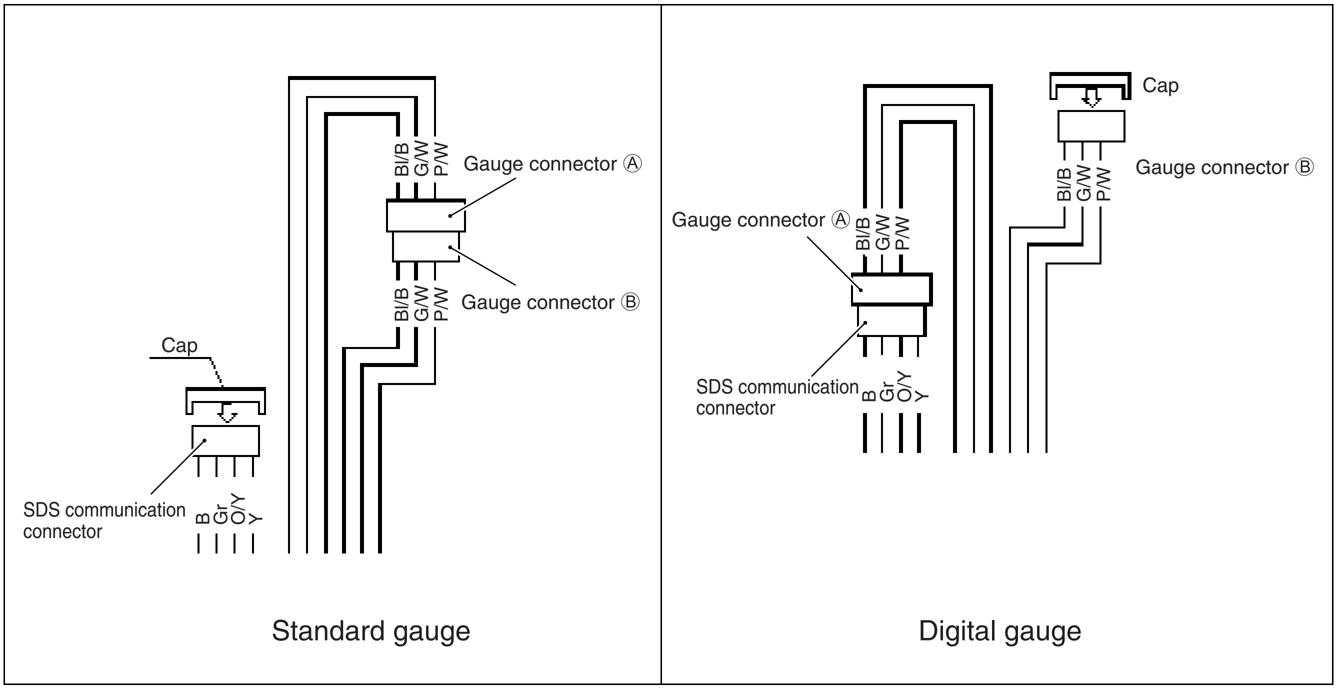
Refer No.	Part name	Part No.	Remarks
—	Speedometer assy. [NOTE 2]	34100-98J00	Max. 130 KM/H (Black)
	Speedometer assy. [NOTE 2]	34100-98J10	Max. 130 KM/H (White)
	Speedometer assy. [NOTE 2]	34100-98J20	Max. 80 KM/H (Black)
	Speedometer assy. [NOTE 2]	34100-98J30	Max. 80 KM/H (White)
—	Tachometer assy. [NOTE 1]	34200-98J01	Black
	Tachometer assy. [NOTE 1]	34200-98J11	White
—	Fuel gauge assy.	34300-98J00	Black
	Fuel gauge assy.	34300-98J10	White
—	Voltage meter assy.	34600-98J00	Black
	Voltage meter assy.	34600-98J10	White
—	Trim meter assy.	34800-98J00	Black
	Trim meter assy.	34800-98J10	White
—	Active hub	34921-98J00	
—	Passive hub	34921-98J10	Multiple engine
—	Interface module [NOTE 1]	34922-98J01	
①	Adaptor, Interface module harness	36661-93J00	
②	Interface harness assy.	36661-98J00	
—	Hub harness (1 M)	36662-98J00	Dual stations
	Hub harness (6.5 M)	36662-98J10	
③	Active hub power harness (2.5 M)	36663-98J00	
	Active hub power harness (6 M)	36663-98J10	
④	3” gauge harness assy.	36664-98J00	
⑤	2” gauge harness assy.	36664-98J10	
⑥	Jumper wire	36665-98J00	
—	8 pin connector cap	36666-98J00	In case of one piece of 3 inch gauge.
⑦	6 pin connector cap	36666-98J10	
—	2 pin connector cap	36667-98J00	Dual stations

NOTE 1:
- *Tachometer (P/no. 34200-98J00, 34200-98J10) and interface module (P/no. 34922-98J00) for DF300 can not be used.*
- *Conversely, New tachometer (P/no. 34200-98J01, 34200-98J11) and interface module (P/no. 34922-98J01) can be used for DF300.*

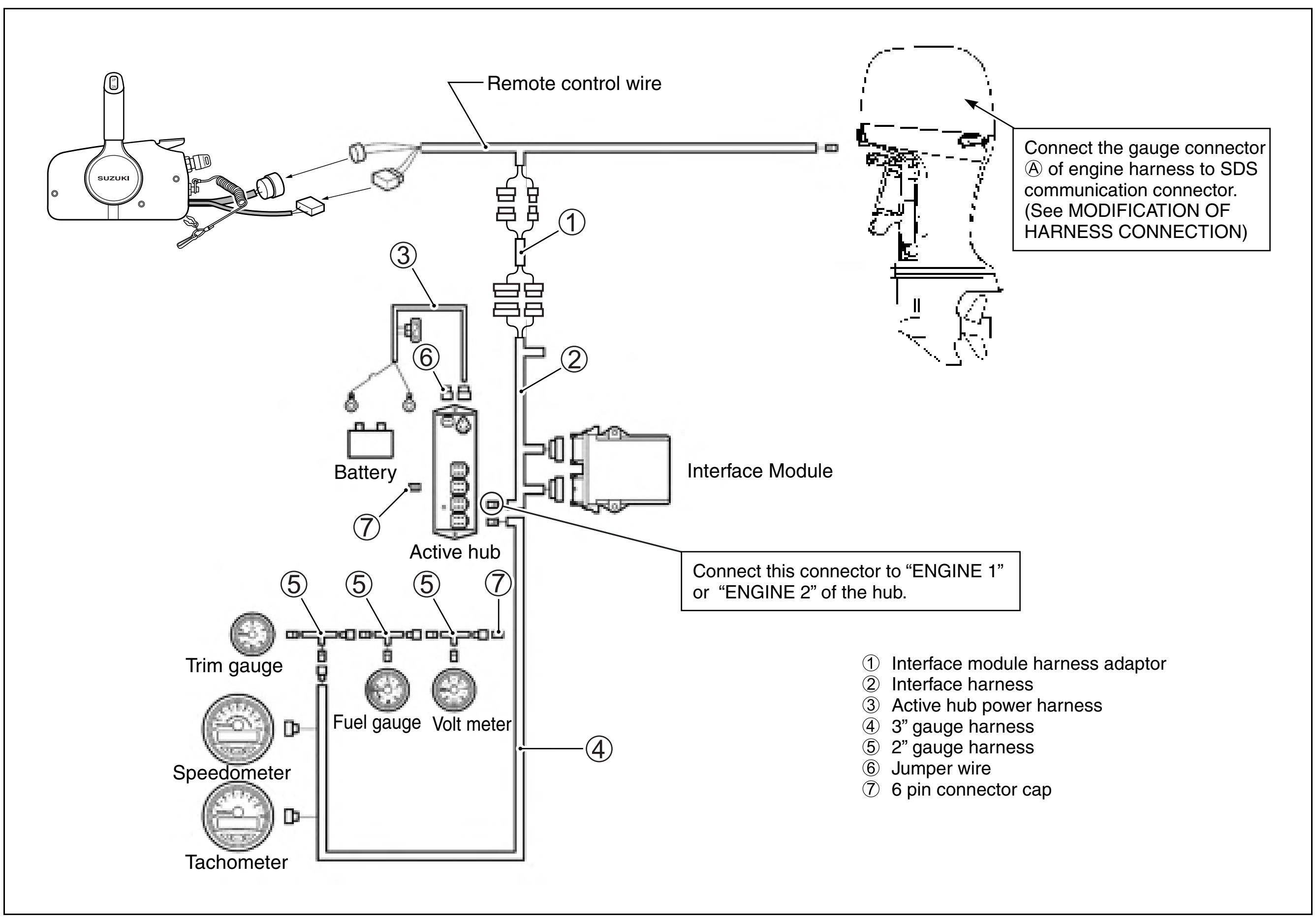
NOTE 2:
- *Requires commercially available NMEA 2000 transducer with speed input.*

MODIFICATION OF HARNESS CONNECTION

For operating the digital gauge, disconnect the gauge connector Ⓐ from gauge connector Ⓑ, and connect the gauge connector Ⓐ to the SDS communication connector as shown in the illustration.

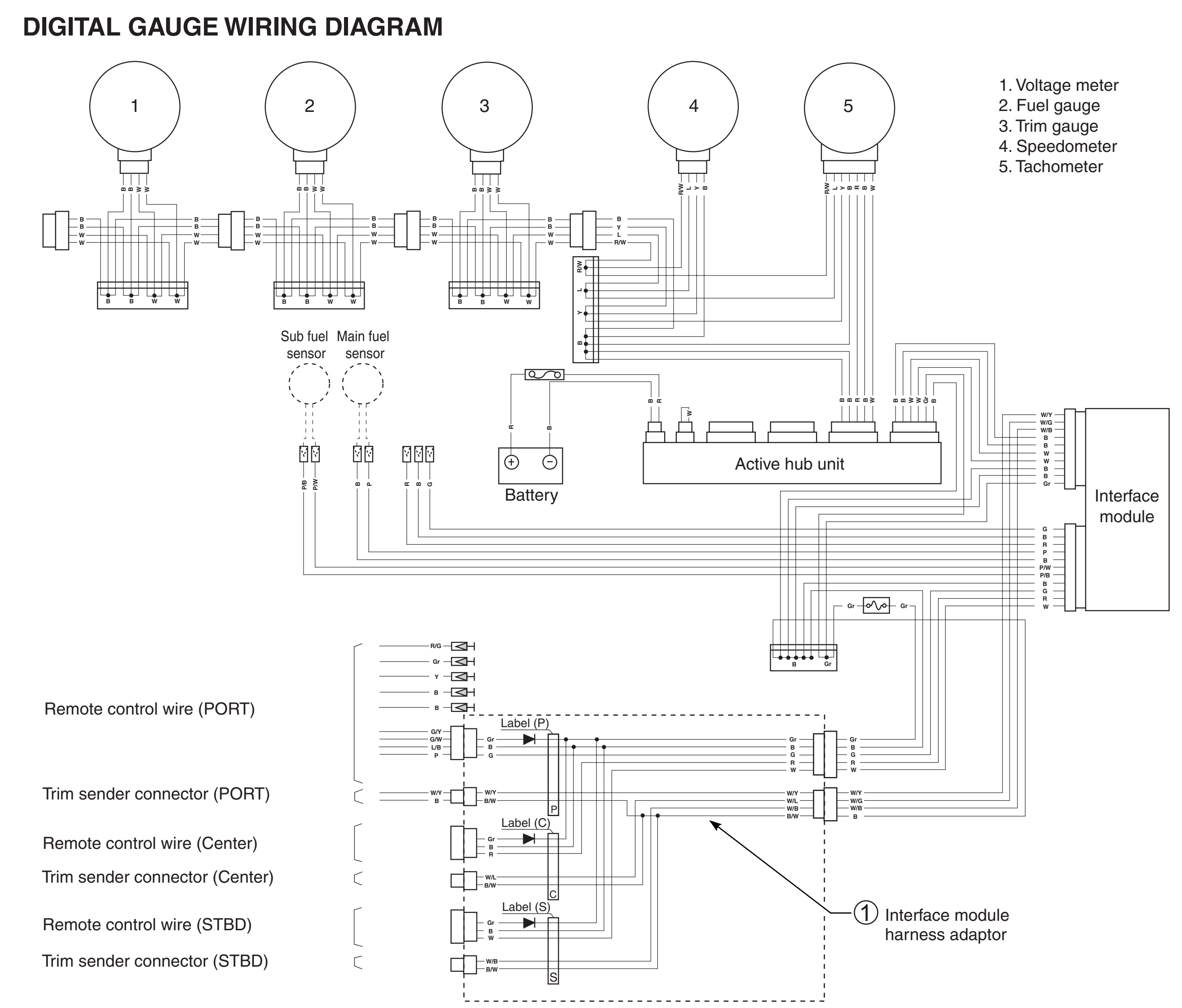


DIGITAL GAUGE AND RELATED PARTS CONNECTION



NOTE:
- *In the case that the wiring harness gauge connector is connected to the SDS communication connector, SDS (SUZUKI Diagnosis System) cannot be used.*
- *When SDS has to be used, disconnect the SDS communication connector from the gauge connector.*
- *When SDS is being used, the digital gauge system cannot be operated.*

DIGITAL GAUGE WIRING DIAGRAM



NOTE:
- *The remote control wire should be connected to the interface module harness adaptor with the specified connector as shown below. If the remote control wire is not connected to the specified connector of the interface module harness, the meter will not function properly.*
  - *Single engine: Connect to label (P) connector.*
  - *Twin engine:*
    PORT engine: Connect to label (P) connector.
    STBD engine: Connect to label (S) connector.

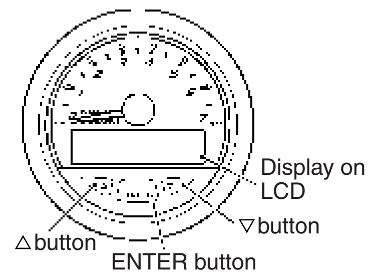
SET-UP OF TACHOMETER

NOTE:
Each tachometer should be set up according to the applicable engine.
If the setting is incorrect, the tachometer does not function as required. Default value of the tachometer is “SETUP Eng Position 0”.

Set up the tachometer in the following procedure.

(1) Turn ON the ignition switch.

(2) Press the “△” and “▽” buttons to display “System Setup” on the LCD.



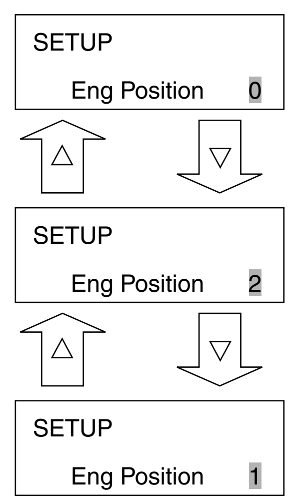
(3) Press the “ENTER” button.

(4) “SETUP Contrast” is displayed on the LCD.

(5) Press the “▽” button once to display “SETUP Eng Position” on the LCD.

(6) By pressing the “ENTER” button, “SETUP Eng Position 0” is displayed on the LCD.

At this condition, press the “△” and “▽” buttons. Display on the LCD is changed as shown in the right figure.
Display the required engine on the LCD and press the “ENTER” button to define.



Single engine
Set to “Eng Position 0”.

Dual engine
PORT outboard motor: Set to “Eng Position 0”.
STBD outboard motor: Set to “Eng Position 1”.

Triple engine
PORT outboard motor: Set to “Eng Position 0”.
CENTER outboard motor: Set to “Eng Position 1”.
STBD outboard motor: Set to “Eng Position 2”.

NOTE:
By pressing the “ENTER” button for more than 3 seconds, “System Setup” menu returns.

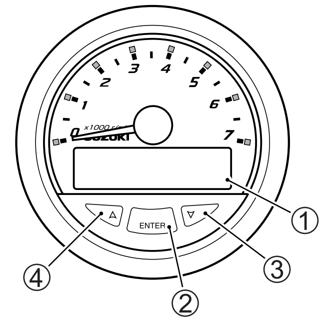
(7) Start the engines in succession from the one on the PORT side and check that the tachometers work according to the engines.

TACHOMETER-MONITOR

DIGITAL DISPLAY SCREEN

The digital display screen can indicate the following engine information.

1. Engine RPM
2. Engine Temperature
3. Engine operation hours
4. Atmospheric pressure
5. Fuel rate : Lit. or Gallons per hour
6. Intake manifold pressure
7. Trim Angle
8. Battery Voltage
9. Shift position
10. CAUTION name (When problem is detected)
11. Oil change reminder (When the total motor operating hours have reached pre programmed hours)
12. Self-Diagnostic code (When problem is detected)



① Digital display screen
② ENTER button
③ ▽ button
④ △ button

NOTE:

- *The items of No. 1 – 8 can be selected by pressing “ENTER” or △/▽ button. (For details, see Meter operation manual.) Pressing “ENTER” or △/▽ button once changes the displayed data.*
- *When the ignition key is turned from OFF to ON:*
  - *A caution buzzer will sound for two seconds.*
  - *Two caution lamps also turns on for two seconds.*
  - *The tachometer needle swings up then returns to zero (0) rpm.*

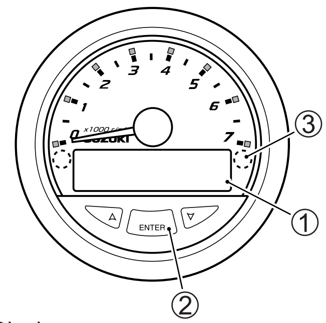
NOTE:

- *The total operating hours displayed are those of actual engine operation, not ignition switch “ON” time.*
- *The Caution information and Self-Diagnostic information shown in the display screen can be deleted by pressing “ENTER” button.*
  When more than one information occur at the same time, press “ENTER” button to read the next information.
  Even though deleting the information from the display screen, both the caution lamp and buzzer remain on until the problems have been solved.

TACHOMETER DISPLAY INDICATION

CAUTION SYSTEM

When a problem is detected, the caution name appears on the display screen of tachometer-monitor, caution buzzer sounds and caution lamps lights continuously.



① Display screen
② ENTER button
③ Caution lamp

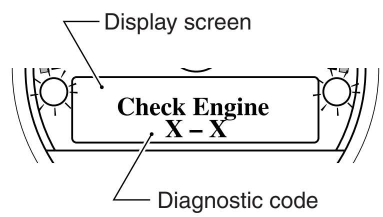
CAUTION TYPE	TACHOMETER DISPLAY INDICATION
Over-revolution	Rev Limit [NOTE 1]
	Over Revolution [NOTE 2]
Low oil pressure	Low Oil Pressure
Over heat	Over Heat
Low battery voltage	Low Batt Voltage

NOTE 1:
When the engine speed detected by ECM exceeds the preset maximum engine speed.

NOTE 2:
Engine is continuously operated with the over-revolution limiter that exceeds the preset maximum engine speed for more than 10 seconds.

SELF-DIAGNOSTIC SYSTEM

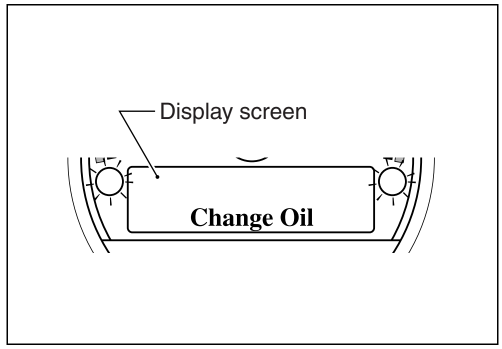
When an abnormality occurs in a signal from sensor, switch, etc., the diagnostic code appears on the display screen of tachometer-monitor, caution buzzer sounds and caution lamps lights continuously.
When engine is not running, the buzzer sounds according to self-diagnostic code pattern.



NOTE:
- *When two or more failures have occurred at the same time, the caution buzzer beeps three times repeatedly in the order of descending priorities according to the diagnostic code pattern (while the engine is standstill with the ignition switch in ON).*
- *In the display screen, the following diagnostic code information appears when “ENTER” button is pressed. This information is shown in the order of occurrence.*

OIL CHANGE REMINDER SYSTEM

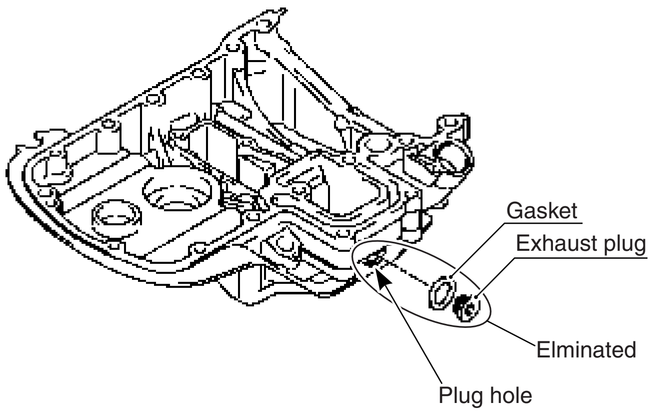
When the total motor operating hours have reached the preprogrammed hours, the “Change Oil” appears on the display screen of tachometer-monitor, caution buzzer sounds if engine is not running (but ignition switch ON) and caution lamps lights continuously.



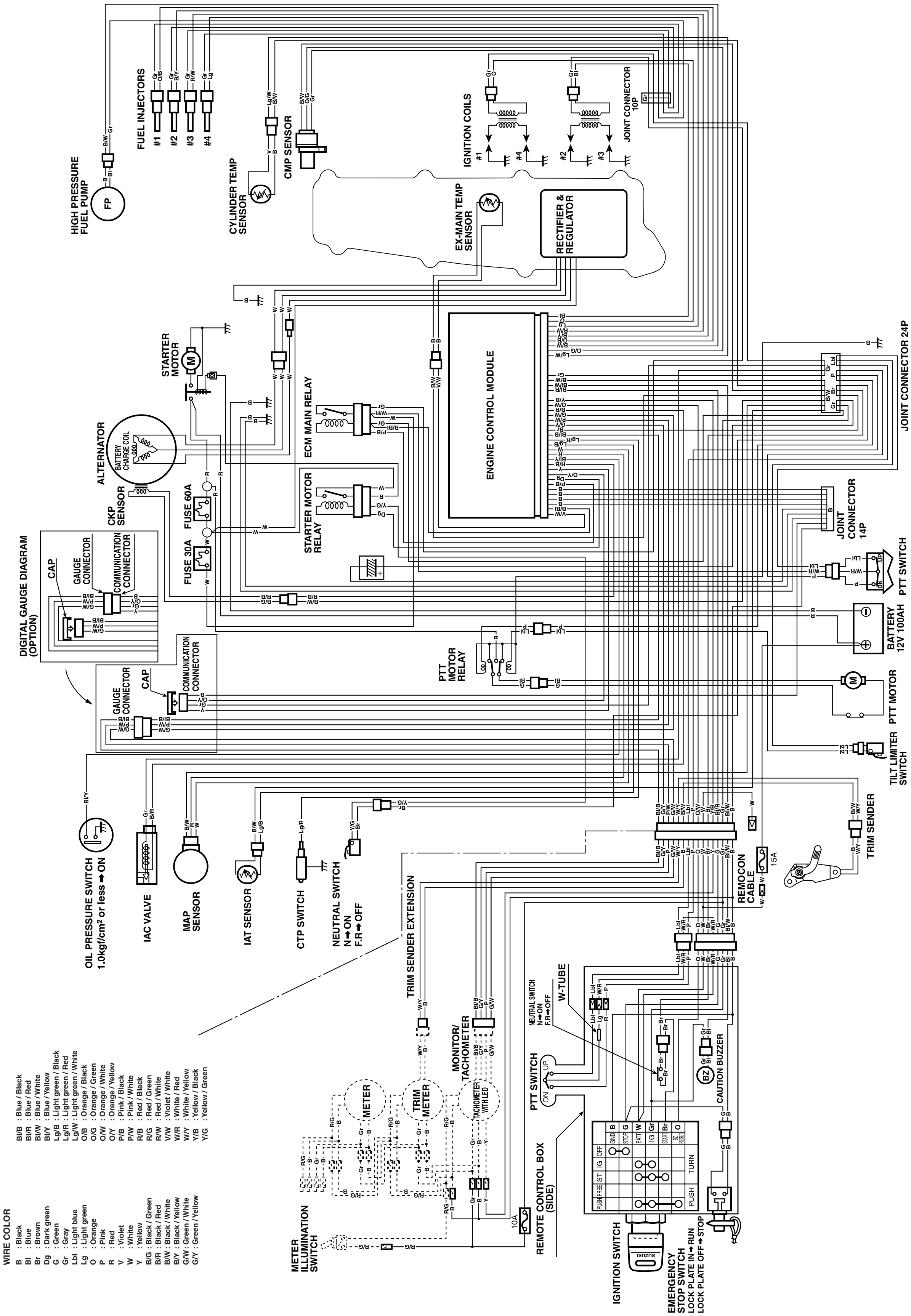
ENGINE HOLDER

The exhaust plug and gasket have been eliminated.

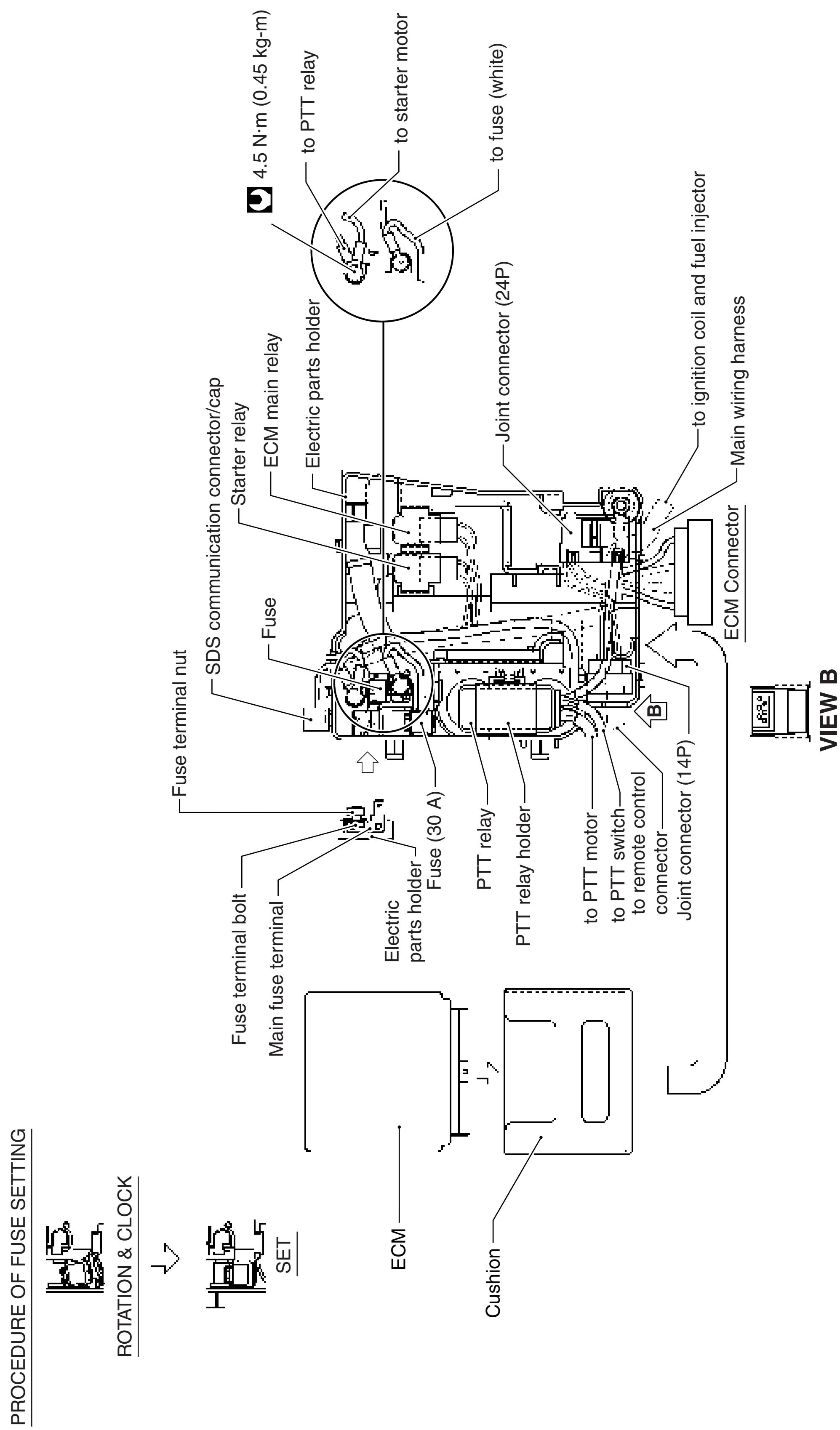
In accordance with this change, the plug hole in engine holder has been eliminated.

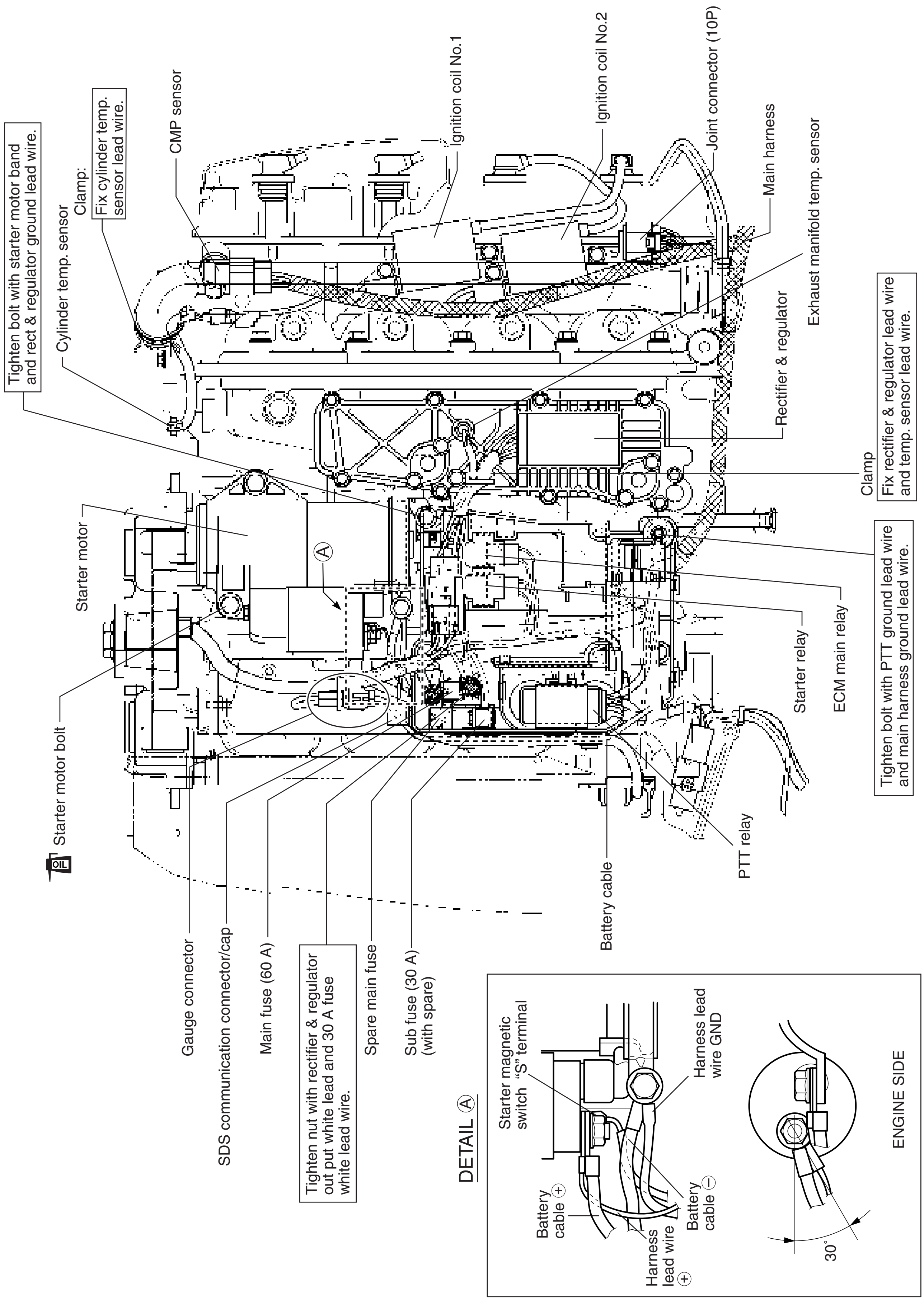


WIRING DIAGRAM
DF90/115/140



WIRE ROUTING





Tighten bolt with starter motor band and rect & regulator ground lead wire.
Cylinder temp. sensor
Clamp:
Fix cylinder temp. sensor lead wire.
CMP sensor
Ignition coil No.1
Ignition coil No.2
Joint connector (10P)
Main harness
Exhaust manifold temp. sensor
Rectifier & regulator
Clamp
Fix rectifier & regulator lead wire and temp. sensor lead wire.
Tighten bolt with PTT ground lead wire and main harness ground lead wire.
ECM main relay
Starter relay
PTT relay
Battery cable
Starter motor
Starter motor bolt
OIL
A
Gauge connector
SDS communication connector/cap
Main fuse (60 A)
Tighten nut with rectifier & regulator out put white lead and 30 A fuse white lead wire.
Spare main fuse
Sub fuse (30 A) (with spare)
DETAIL A
Starter magnetic switch “S” terminal
Harness lead wire GND
Battery cable +
Harness lead wire +
Battery cable −
30°
ENGINE SIDE

DF100 “K9” (2009) MODEL

FOREWORD

This supplementary service manual describes service data and servicing procedures which differ from those of the DF115 “K9” model.
The entire manual should be thoroughly reviewed before any servicing is performed.

NOTE:
* *Refer to the DF90/115/140 service manual (P/no. 99500-90J0 • -01E) for details which are not given in this supplementary service manual.*
* *Use this supplement with the following service manual: DF90/115/140 Service manual (P/no. 99500-90J0 • -01E)*
* *No major changes for DF115/DF140 on the 2009 year model.*

CONTENTS

GENERAL INFORMATION
*SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data
			DF100T/100WT
PRE-FIX			10001F

DIMENSIONS & WEIGHT

Item		Unit	Data
Overall length (front to back)		mm (in)	779 (30.7)
Overall width (side to side)		mm (in)	481 (18.9)
Overall height	L	mm (in)	1556 (61.3)
	X	mm (in)	1683 (66.3)
Weight (without engine oil)	L	kg (lbs)	189.0 (416)
	X	kg (lbs)	194.0 (427)
Transom height	L	mm (inch type)	539 (20)
	X	mm (inch type)	666 (25)

PERFORMANCE

Item	Unit	Data
Maximum output	kW (PS)	73.6 (100)
Recommended operating range	r/min	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)

POWERHEAD

Item	Unit	Data
Engine type		4-stroke DOHC
Number of cylinders		4
Bore	mm (in)	84.0 (3.31)
Stroke	mm (in)	88.0 (3.46)
Total displacement	cm^3 (cu in)	1950 (119.0)
Compression ratio	: 1	9.8
Spark plug	NGK	BKR6E
Ignition system		Full-transistorized ignition
Fuel supply system		Multi-point sequential electronic fuel injection
Exhaust system		Through prop exhaust
Cooling system		Water cooled
Lubrication system		Wet sump by trochoid pump
Starting system		Electric
Throttle control		Remote control

Item	Unit	Data
		DF100T/100WT

FUEL & OIL

Fuel		Suzuki highly recommends the use of alcohol-free unleaded gasoline with a minimum pump octane rating of 87 (R/2 + 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: SG, SH, SJ, SL, SM or NMMA FC-W classification: SG, SH, SJ, SL, SM • Viscosity rating: SAE10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (Hypoid gear oil SAE90, API classification GL-5)
Gearcase oil capacity	ml (US/Imp. oz)	1050 (35.5/37.0)

BRACKET

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

LOWER UNIT

Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 25 (2.083)
Drive line impact protection	Spline drive rubber hub
Propeller	Blade × Diam. (in) × Pitch (in)
	☆ 3 × 13-1/2 × 15 ☆ 3 × 14 × 17 ☆ 3 × 14 × 19 ☆ 3 × 14 × 21 ☆ 3 × 14 × 23 ★ 3 × 14-1/4 × 18 ★ 3 × 14-1/4 × 20 ★ 3 × 14-1/4 × 22 ★ 3 × 14-1/4 × 24
☆: Aluminum propeller ★: Stainless steel propeller (Optional parts)	

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	29 : 36 (1.241)
2nd reduction gear ratio (Lower unit)	12 : 25 (2.083)
Total reduction gear ratio	2.586 (36/29 × 25/12)

*SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data DF100T/100WT

POWERHEAD

Recommended operation range	r/min	5000 – 6000
Idle speed	r/min	625 ± 25 (in-gear: approx. 625)
* Cylinder compression	kPa (kg/cm^2, psi)	1300 – 1700 (13 – 17, 185 – 242)
* 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)	550 – 600 (5.5 – 6.0, 78 – 85) at 3 000 r/min. (at normal operating temp.)
Engine oil		• API classification: SG, SH, SJ, SL, SM or NMMA FC-W classification: SG, SH, SJ, SL, SM • Viscosity rating: SAE10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/Imp. qt)	5.5 (5.8/4.8): Oil change only 5.7 (6.0/5.0): Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data DF100T/100WT

CYLINDER HEAD / CAMSHAFT

Item			Unit	DF100T/100WT
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)	38.120 – 38.280 (1.5008 – 1.5071)
		Limit	mm (in)	38.020 (1.4969)
	EX	STD	mm (in)	38.820 – 38.980 (1.5283 – 1.5346)
		Limit	mm (in)	38.720 (1.5244)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.020 – 0.062 (0.0008 – 0.0024)
		Limit	mm (in)	0.120 (0.0047)
	5th	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)
	5th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	26.171 (1.0304)
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	22.959 – 22.980 (0.9039 – 0.9047)
		Limit	mm (in)	22.869 (0.9004)
	5th	STD	mm (in)	25.934 – 25.955 (1.0210 – 1.0219)
		Limit	mm (in)	25.844 (1.0175)
Camshaft runout		Limit	mm (in)	0.10 (0.004)
Cylinder head bore to tappet clearance		STD	mm (in)	0.025 – 0.066 (0.0010 – 0.0026)
		Limit	mm (in)	0.150 (0.0059)
Tappet outer diameter		STD	mm (in)	30.959 – 30.975 (1.2189 – 1.2195)
Cylinder head bore		STD	mm (in)	31.000 – 31.025 (1.2203 – 1.2215)

Item			Unit	Data DF100T/100WT

VALVE / VALVE GUIDE

Item			Unit	DF100T/100WT
Valve diameter		IN	mm (in)	33 (1.3)
		EX	mm (in)	28 (1.1)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.008 – 0.019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	6.000 – 6.012 (0.2362 – 0.2367)
Valve guide protrusion	IN, EX	STD	mm (in)	13.5 (0.53)
Valve stem outside diameter	IN	STD	mm (in)	5.965 – 5.980 (0.2348 – 0.2354)
	EX	STD	mm (in)	5.940 – 5.955 (0.2339 – 0.2344)
Valve stem end deflection	IN	Limit	mm (in)	0.14 (0.006)
	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)	1.2 (0.05)
		Limit	mm (in)	0.7 (0.03)
Valve seat contact width	IN	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
	EX	STD	mm (in)	1.1 – 1.3 (0.04 – 0.05)
Valve spring free length		STD	mm (in)	42.7 (1.68)
		Limit	mm (in)	41.0 (1.61)
Valve spring tension		STD	N (kg, lbs)	167 – 193 (16.7 – 19.3, 36.8 – 42.5) for 32.6 mm (1.28 in)
		Limit	N (kg, lbs)	151 (15.1, 33.3) for 32.6 mm (1.28 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data DF100T/100WT

CYLINDER / PISTON / PISTON RING

Cylinder distortion		Limit	mm (in)	0.05 (0.002)
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)	84.000 – 84.020 (3.3071 – 3.3079)
Cylinder measuring position			mm (in)	50 (2.0) from cylinder top surface
Piston skirt diameter		STD	mm (in)	83.970 – 83.990 (3.3059 – 3.3067)
Piston measuring position			mm (in)	26.5 (1.04) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.35 (0.008 – 0.014)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.35 – 0.50 (0.014 – 0.020)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 11.3 (0.44)
		Limit	mm (in)	9.0 (0.354)
	2nd	STD	mm (in)	Approx. 11.0 (0.43)
		Limit	mm (in)	8.8 (0.347)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.070 (0.0012 – 0.0028)
		Limit	mm (in)	0.120 (0.0047)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.100 (0.0039)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.24 (0.048 – 0.049)
	2nd	STD	mm (in)	1.51 – 1.53 (0.059 – 0.060)
	Oil	STD	mm (in)	2.51 – 2.53 (0.099 – 0.100)
Piston ring thickness	1st	STD	mm (in)	1.17 – 1.19 (0.046 – 0.047)
	2nd	STD	mm (in)	1.47 – 1.49 (0.058 – 0.059)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.017 (0.0002 – 0.0007)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	20.997 – 21.000 (0.8267 – 0.8268)
		Limit	mm (in)	20.980 (0.8260)
Piston pin hole diameter		STD	mm (in)	21.006 – 21.014 (0.8270 – 0.8273)
		Limit	mm (in)	21.040 (0.8283)
Pin clearance in conrod small end		STD	mm (in)	0.003 – 0.014 (0.0001 – 0.0006)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)

Item		Unit	Data DF100T/100WT

CRANKSHAFT / CONROD

Item		Unit	DF100T/100WT
Conrod small end inside diameter	STD	mm (in)	21.003 – 21.011 (0.8269 – 0.8272)
Conrod big end oil clearance	STD	mm (in)	0.030 – 0.050 (0.0012 – 0.0020)
	Limit	mm (in)	0.065 (0.0026)
Conrod big end inside diameter	STD	mm (in)	47.000 – 47.018 (1.8504 – 1.8511)
Crank pin outside diameter	STD	mm (in)	43.982 – 44.000 (1.7316 – 1.7323)
Crank pin outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.484 – 1.502 (0.0584 – 0.0591)
Conrod big end side clearance	STD	mm (in)	0.100 – 0.250 (0.0039 – 0.0098)
	Limit	mm (in)	0.350 (0.0138)
Conrod big end width	STD	mm (in)	21.950 – 22.000 (0.8642 – 0.8661)
Crank pin width	STD	mm (in)	22.100 – 22.200 (0.8700 – 0.8740)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
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)	62.000 – 62.018 (2.4409 – 2.4417)
Crankshaft journal outside diameter	STD	mm (in)	57.994 – 58.012 (2.2832 – 2.2839)
Crankshaft journal outside diameter difference (out of round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	1.990 – 2.006 (0.0783 – 0.0790)
Crankshaft thrust play	STD	mm (in)	0.11 – 0.31 (0.004 – 0.012)
	Limit	mm (in)	0.35 (0.014)
Crankshaft thrust bearing thickness	STD	mm (in)	2.425 – 2.475 (0.0955 – 0.0974)

Item		Unit	Data
			DF100T/100WT

ELECTRICAL

Ignition timing		Degrees	BTDC 2 – BTDC 26
Over revolution limiter		r/min	6200
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	kΩ at 20° C	No. 2 – No. 3: 18 – 34 (including H.T. cord and spark plug cap) No. 1 – No. 4: 19 – 36 (including H.T. cord and spark plug cap)
High tension code resistance		kΩ/m at 20 °C	Approx. 16
Battery charge coil resistance		Ω at 20 °C	0.16 – 0.24
Battery charge coil output (12 V)		Watt	480
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60 Sub fuse: 30
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger
Fuel injector resistance		Ω at 20 °C	11.0 – 16.5
IAC valve resistance		Ω at 20 °C	8 – 12
IAT sensor / Cylinder temp. sensor / Ex- mani. temp. sensor (Thermistor characteristic)		kΩ at 25° C	1.8 – 2.3
ECM main relay resistance		Ω at 20 °C	145 – 190
Starter motor relay resistance		Ω at 20 °C	145 – 190
PTT motor relay resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

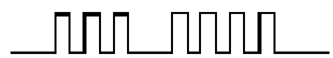
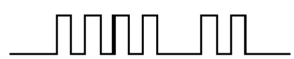
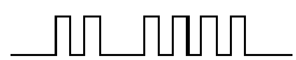
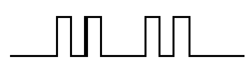
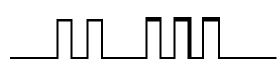
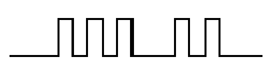
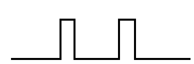
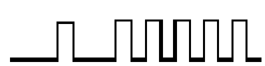
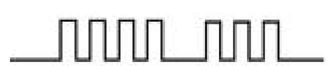
Max. continuous time of use		Sec.	30
Motor output		kW	1.4
Brush length	STD	mm (in)	16.0 (0.63)
	Limit	mm (in)	12.0 (0.47)
Commutator undercut	STD	mm (in)	0.5 – 0.8 (0.02 – 0.03)
	Limit	mm (in)	0.2 (0.01)
Commutator outside diameter	STD	mm (in)	29.0 (1.14)
	Limit	mm (in)	28.0 (1.10)
Commutator outside diameter difference	STD	mm (in)	0.05 (0.002)
	Limit	mm (in)	0.40 (0.016)

PTT MOTOR

Brush length	STD	mm (in)	9.8 (0.39)
	Limit	mm (in)	5.5 (0.22)
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 (Pressure detect passage)	3 – 2	on off 	NO
9	Rectifier & regulator (Over-charging)	1 – 1	on off 	NO
10	Exhaust manifold temp. sensor	1 – 5	on off 	YES
11	Fuel injector	4 – 3	on off 	NO

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

TIGHTENING TORQUE

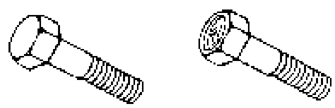
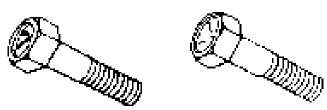
Tightening torque – Important fasteners

ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N·m	kg-m	lb-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	25	2.5	18.0
		10 mm	70	7.0	50.0
Crankcase bolt		8 mm	25	2.5	18.0
		10 mm	52	5.2	37.5
Conrod cap nut		8 mm	40	4.0	29.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Camshaft timing sprocket bolt		10 mm	78	7.8	55.5
Timing chain guide bolt		6 mm	10	1.0	7.0
Intake manifold bolt/nut		8 mm	23	2.3	16.5
Oil pressure switch		—	13	1.3	9.5
Fuel delivery pipe bolt		8 mm	23	2.3	16.5
Fuel delivery pipe plug/union bolt		12 mm	35	3.5	25.5
Fuel return pipe bolt (nut)		8 mm	23	2.3	16.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		16 mm	245	24.5	177.0
Starter motor mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Engine oil filter		—	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Oil relief valve		—	27	2.7	19.5
Engine holder upper bolt		8 mm	25	2.5	18.0
Engine holder bolt		8 mm	23	2.3	16.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut	Front	12 mm	80	8.0	58.0
	Rear	12 mm	80	8.0	58.0
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt/nut		12 mm	60	6.0	43.0
Clamp bracket shaft nut		22 mm	43	4.3	31.0
Water pump case bolt		8 mm	17	1.7	12.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	23	2.3	16.5
Pinion nut		14 mm	120	12.0	87.0
Propeller nut		18 mm	55	5.5	40.0

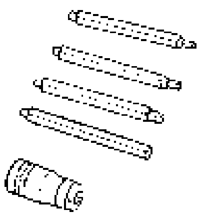
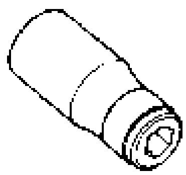
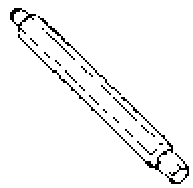
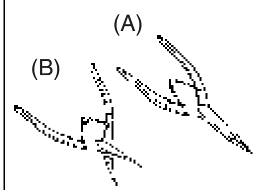
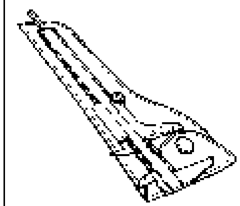
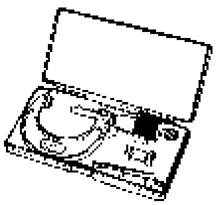
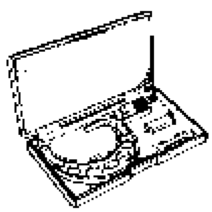
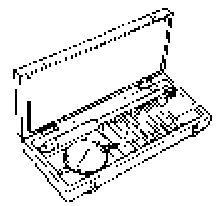
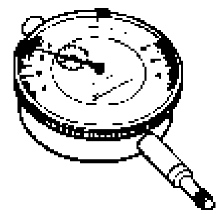
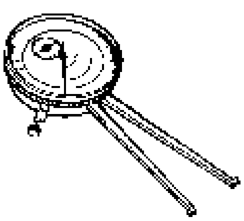
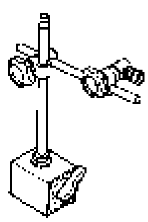
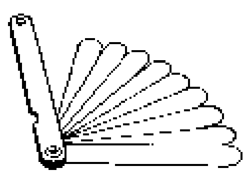
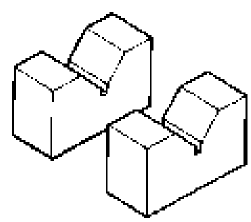
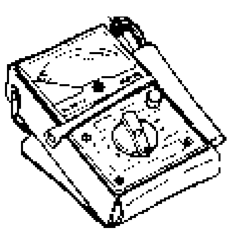
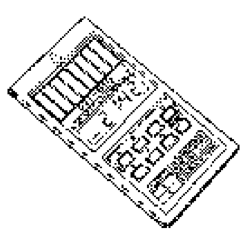
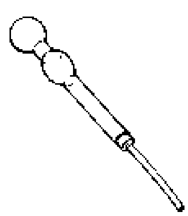
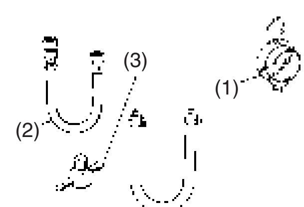
Tightening torque – General bolt

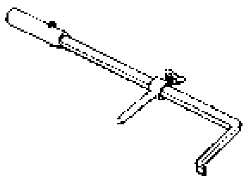
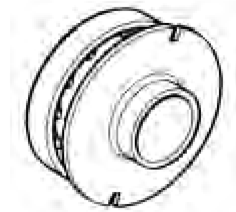
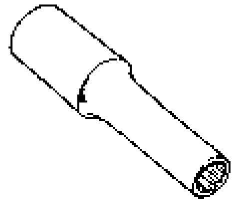
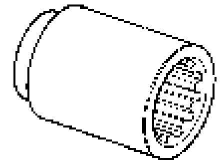
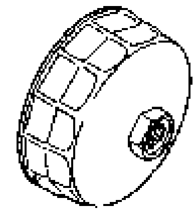
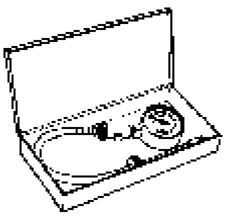
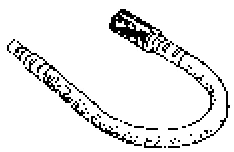
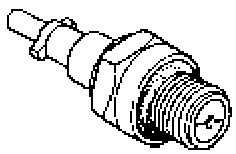
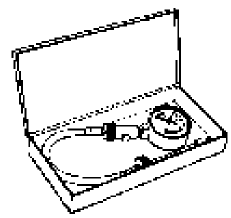
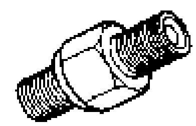
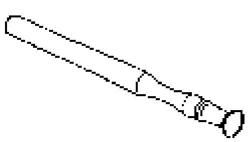
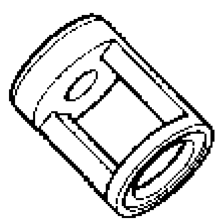
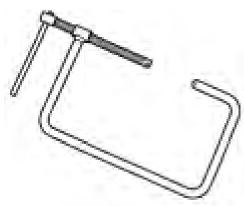
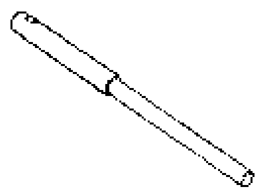
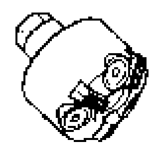
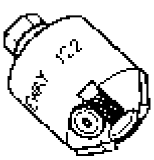
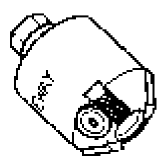
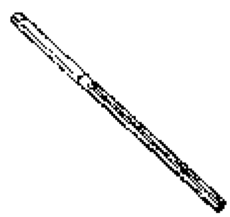
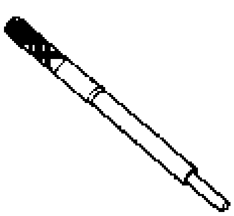
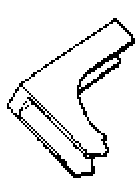
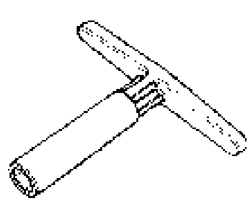
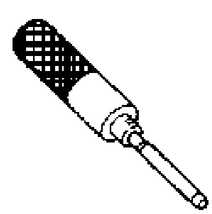
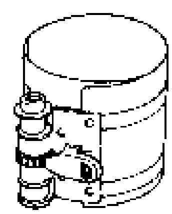
NOTE:

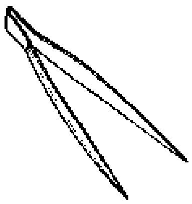
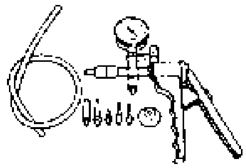
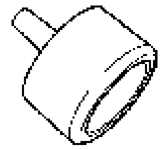
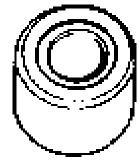
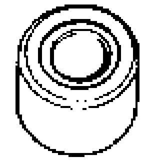
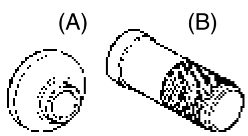
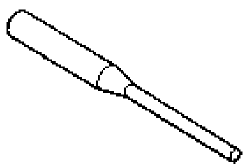
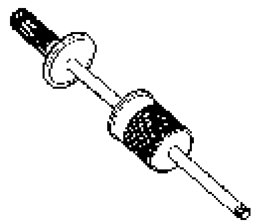
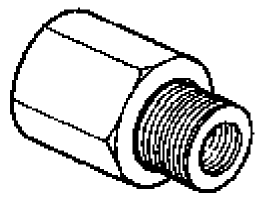
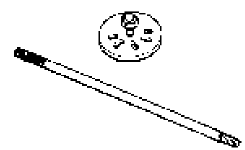
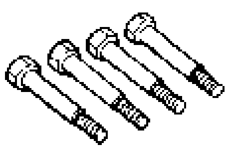
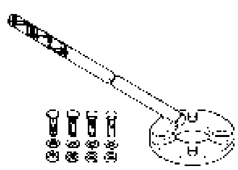
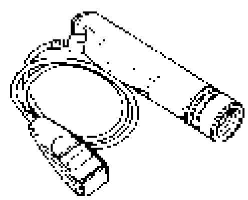
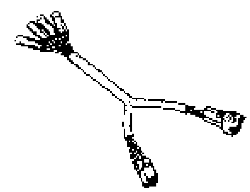
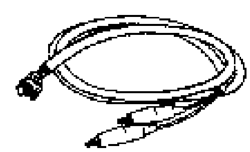
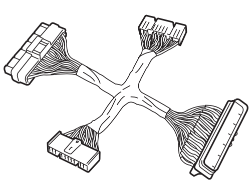
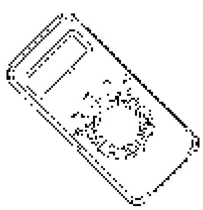
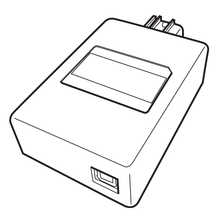
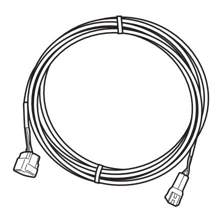
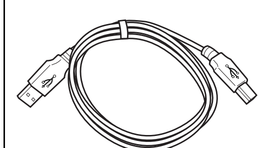
These value are only applicable when torque for a general bolt is not listed in the “Important Fasteners” table.

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	2.2 – 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

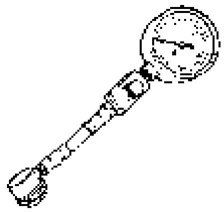
SPECIAL TOOLS

1.  09900-00410 Hexagon wrench set	2.  09900-00411 Hexagon socket (included in 09900-00410)	3.  09900-00413 (5 mm) 09900-00414 (6 mm) Hexagon bit (included in 09900-00410)	4.  (A) 09900-06107 (B) 09900-06108 Snap ring pliers	5.  09900-20101 (150 mm) 09900-20102 (200 mm) Vernier calipers
6.  09900-20202 Micrometer (25 – 50 mm)	7.  09900-20203 (50 – 75 mm) 09900-20204 (75 – 100 mm) Micrometer	8.  09900-20205 Micrometer (0 – 25 mm)	9.  09900-20530 Cylinder gauge set	10.  09900-20602 Dial gauge
11.  09900-20605 Dial calipers (10 – 34 mm)	12.  09900-20701 Magnetic stand	13.  09900-20803 Thickness gauge	14.  09900-21304 Steel “V” block set	15.  09900-22302 (0.051 – 0.125 mm) 09900-22301 (0.025 – 0.076 mm) Plastigauge
16.  09900-25010 Pocket tester	17.  09900-26006 Engine tachometer	18.  09900-28403 Hydrometer	19.  09912-58413: Fuel pressure gauge set (1) 09912-58442: Fuel pressure gauge (2) 09912-58432: Fuel pressure hose (3) 09912-58490: 3-way joint & hose	

20.  09913-50121 Oil seal remover	21.  09914-79010 Test wheel	22.  09919-16010 Deep socket wrench	23.  09921-29410 Driveshaft holder	24.  09915-47341 Oil filter wrench
25.  09915-64512 Compression gauge	26.  09915-64530 Compression gauge hose	27.  09915-67010 Compression gauge hose attachment	28.  09915-77311 Oil pressure gauge	29.  09915-78211 Oil pressure gauge adapter
30.  09916-10911 Valve lapper	31.  09916-14910 Valve lifter attachment	32.  09916-19030 Valve lifter	33.  Solid pilot (Neway N-120-6.0)	34.  09916-20610 Valve seat cutter (15°) (Neway 121)
35.  09916-20620 Valve seat cutter (45°) (Neway 122)	36.  09916-22420 Valve seat cutter (60°) (Neway 114)	37.  09916-34542 Valve guide reamer handle	38.  09916-37810 Valve guide reamer (ϕ 6 mm)	39.  09916-38210 Valve guide reamer (ϕ 11 mm)
40.  09916-46020 Valve guide remover	41.  09916-49040 Tappet holder	42.  09916-54910 Handle (N-505)	43.  09916-57350 Valve guide installer	44.  09916-77310 Piston ring compressor

45.  09916-84511 Tweezers	46.  09917-47011 Vacuum pump gauge	47.  09917-49610 Vacuum pump adapor	48.  09917-87810 Valve guide installer attachment	49.  09917-98221 Valve guide stem seal installer attach-ment
50.  (A) 09922-59410 Propeller shaft housing installer (B) 09922-59420 Housing installer handle	51.  09922-89810 Shift lock pin remover	52.  09930-30104 Sliding hammer	53.  09930-30161 Propeller shaft remover	54.  09930-39411 Flywheel rotor remover
55.  09930-39420 Rotor remover bolt	56.  09930-48720 Flywheel holder	57.  09930-76420 Timing light	58.  09930-89240 4-pin connector test cord	59.  09930-89260 Injector test cord A
60.  09930-89950 44-pin test cord	61.  09930-99320 Digital tester	62.  09933-19830 USB adaptor	63.  09933-19840 USB adaptor	64.  09933-19850 USB cable

<table>
<tr>
<td>65.


09933-19861
SDS software
(Ver. 5.00)</td>
<td>66.

09940-44121
Air pressure gauge</td>
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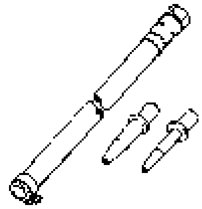
09940-44130
Attachment</td>
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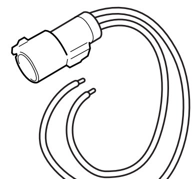
09945-79310
PTT cable extension</td>
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09950-69512
Gearcase oil leakage tester</td>
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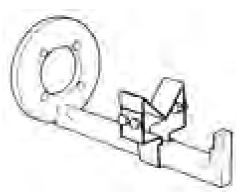
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Shimming gauge</td>
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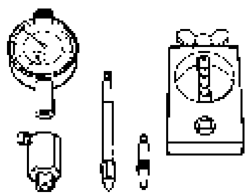
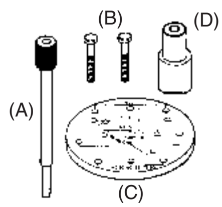
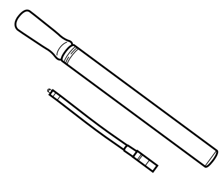

09951-09530
Gear adjusting gauge</td>
<td colspan="2">72.


(A) 09951-59910: Pinion bearing installer & remover shaft
(B) 01500-0840A: Bolt
(C) 09951-39914: Pinion bearing plate
(D) 09951-19421: Attachment</td>
<td>73.

09952-99310
Air pump assy</td>
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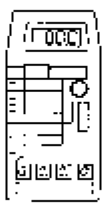
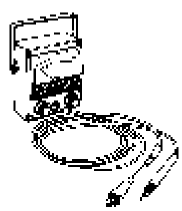
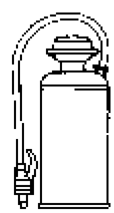
<td>74.

99954-53008-820*
Digital voltmeter</td>
<td>75.

99954-53873*
Stevens CD-77
Peak reading volt-meter</td>
<td>76.

99954-53883*
Gear oil filler</td>
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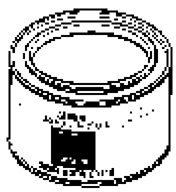
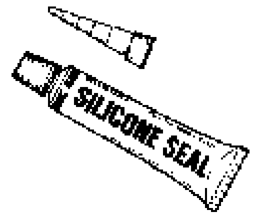
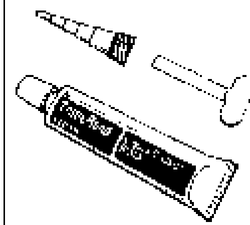
NOTE:

** 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	SUZUKI BOND “1207B”
				
99000-22540 (400 ml × 24 pcs)	99000-25030* 99000-25011 (500 g)	99000-25161 (250 g)	99000-31120 (50 g)	99104-33140* 99000-31140 (100 g)
THREAD LOCK “1342”	THREAD LOCK SUPER “1333B”	4-Stroke Motor Oil		
				
99000-32050 (50 g)	99000-32020 (50 g)	API: SG, SH, SJ, SL, SM SAE: 10W-40		

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

ENGINE CONTROL

ECM

The model DF100 uses the ECM that is designed exclusively for this model.

The specifications of engine control system such as ignition and fuel injection systems on model DF100 are basically the same as those on DF115.
However, the control specifications on DF100 differ from DF115 as shown below.

Ignition timing

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

- Ignition timing advance range: BTDC 2° – 26°
- Ignition timing (at idling/trolling): BTDC 8° ± 5°

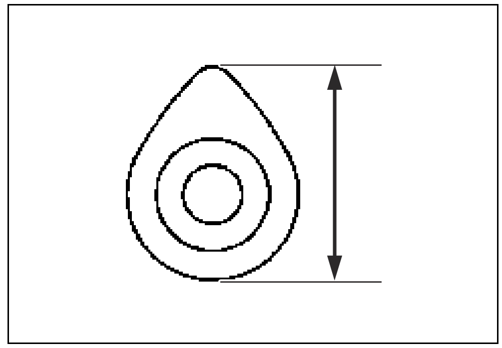
SUZUKI DIAGNOSTIC SYSTEM (SDS)

The SDS software version 4.00 or 5.00 can communicate with the DF100’s ECM.

POWER UNIT

INTAKE CAMSHAFT

The intake camshaft for DF100 was specially designed.
The cam height of the intake comshaft is different from DF115.



Cam height

Standard:

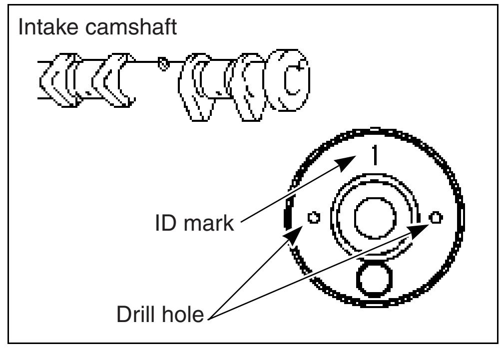
IN 38.120 – 38.280 mm (1.5008 – 1.5071 in)

Service limit:

IN 38.020 mm (1.4969 in)

Camshaft identification

The camshaft is distinguished by the mark at the top end of shaft.
On the intake camshaft for DF100, the mark “1” and two drill holes are provided in the position as illustrated, while DF90 camshaft bears the mark “1” only.



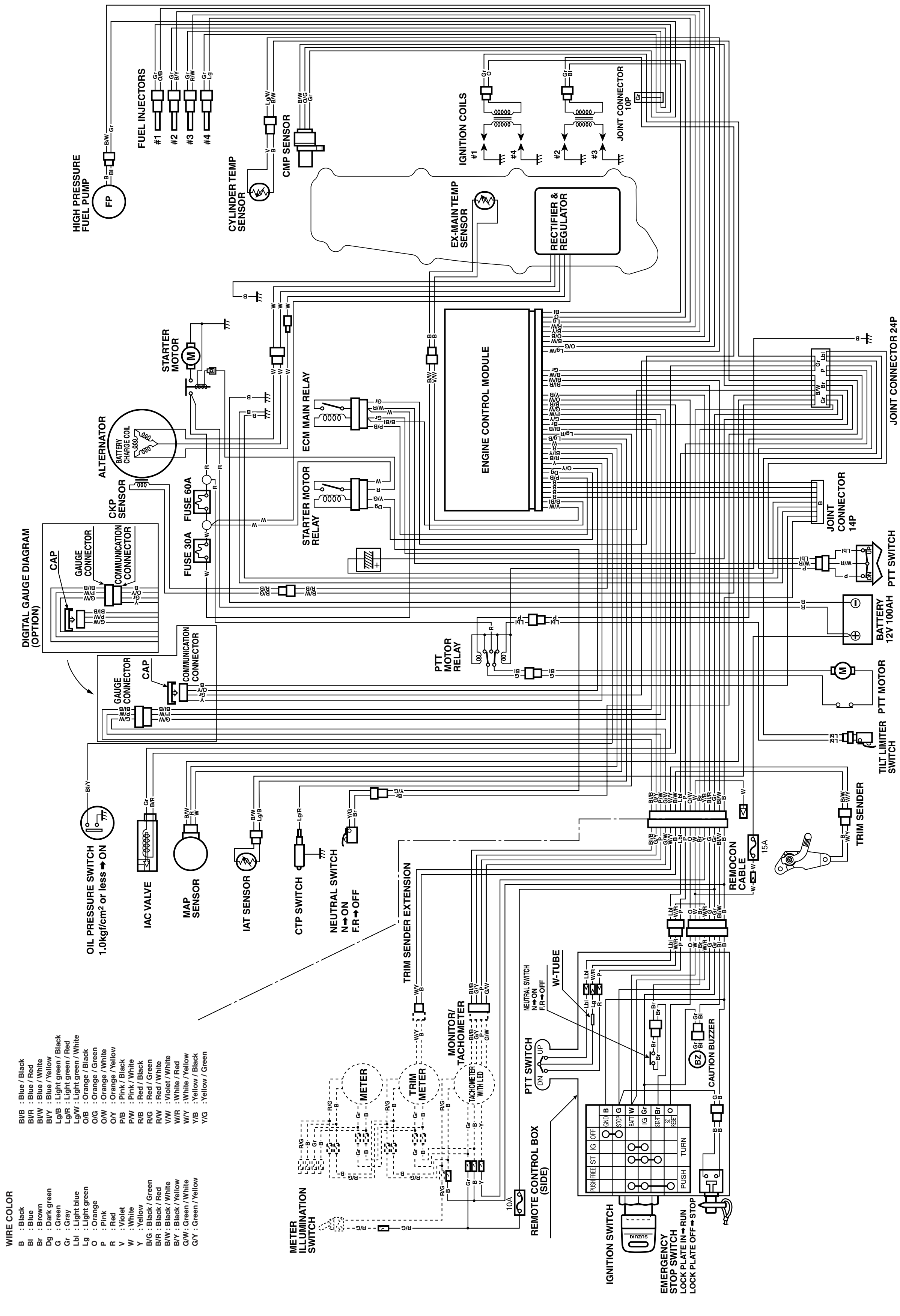
DF100, DF115, DF140 and DF90 camshafts differ as shown below.

ID mark

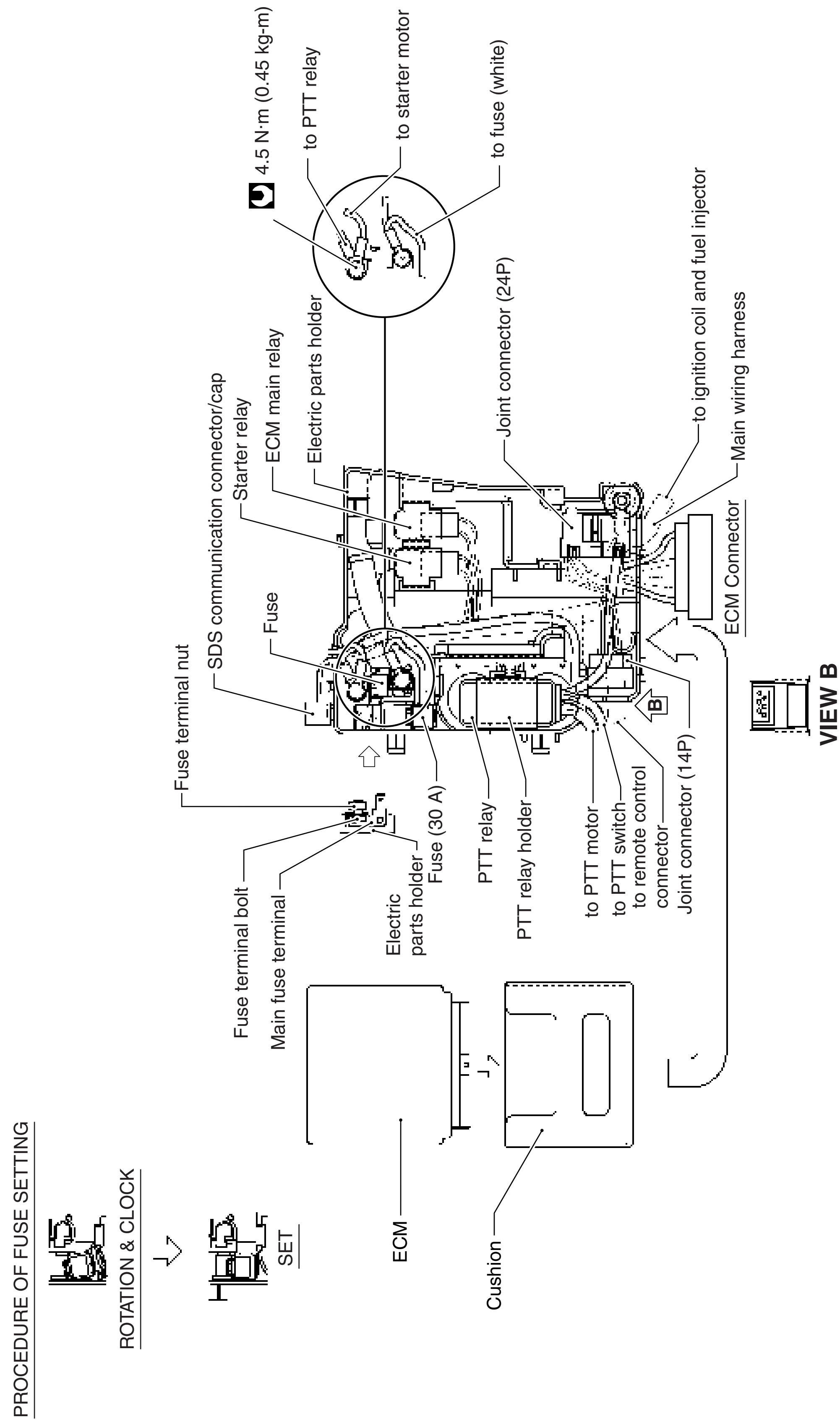
Model	Intake	Exhaust
DF100	1 mark and two drill holes	2
DF115	2	2
DF140	3	3
DF90	1	1

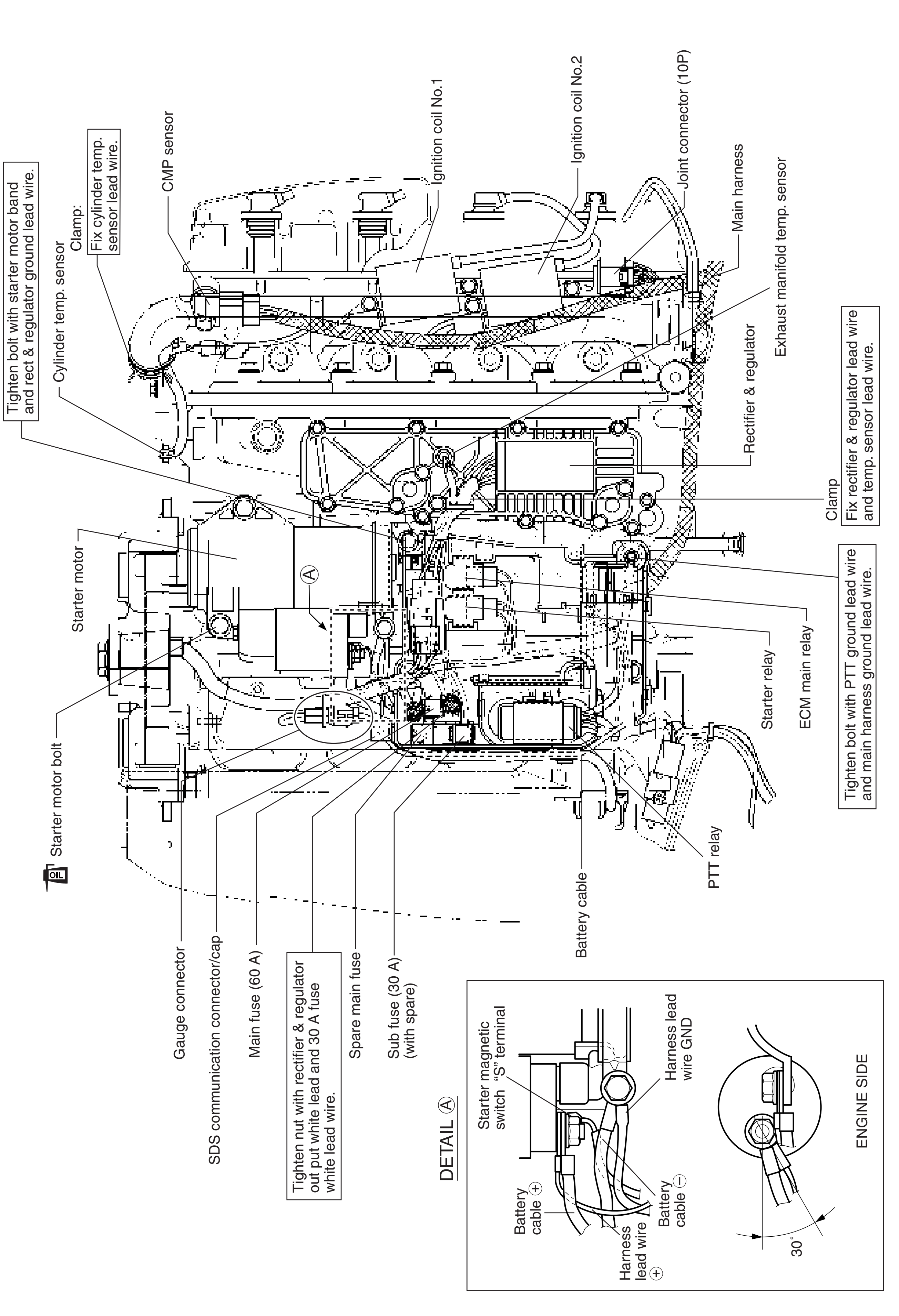
WIRE/HOSE ROUTING

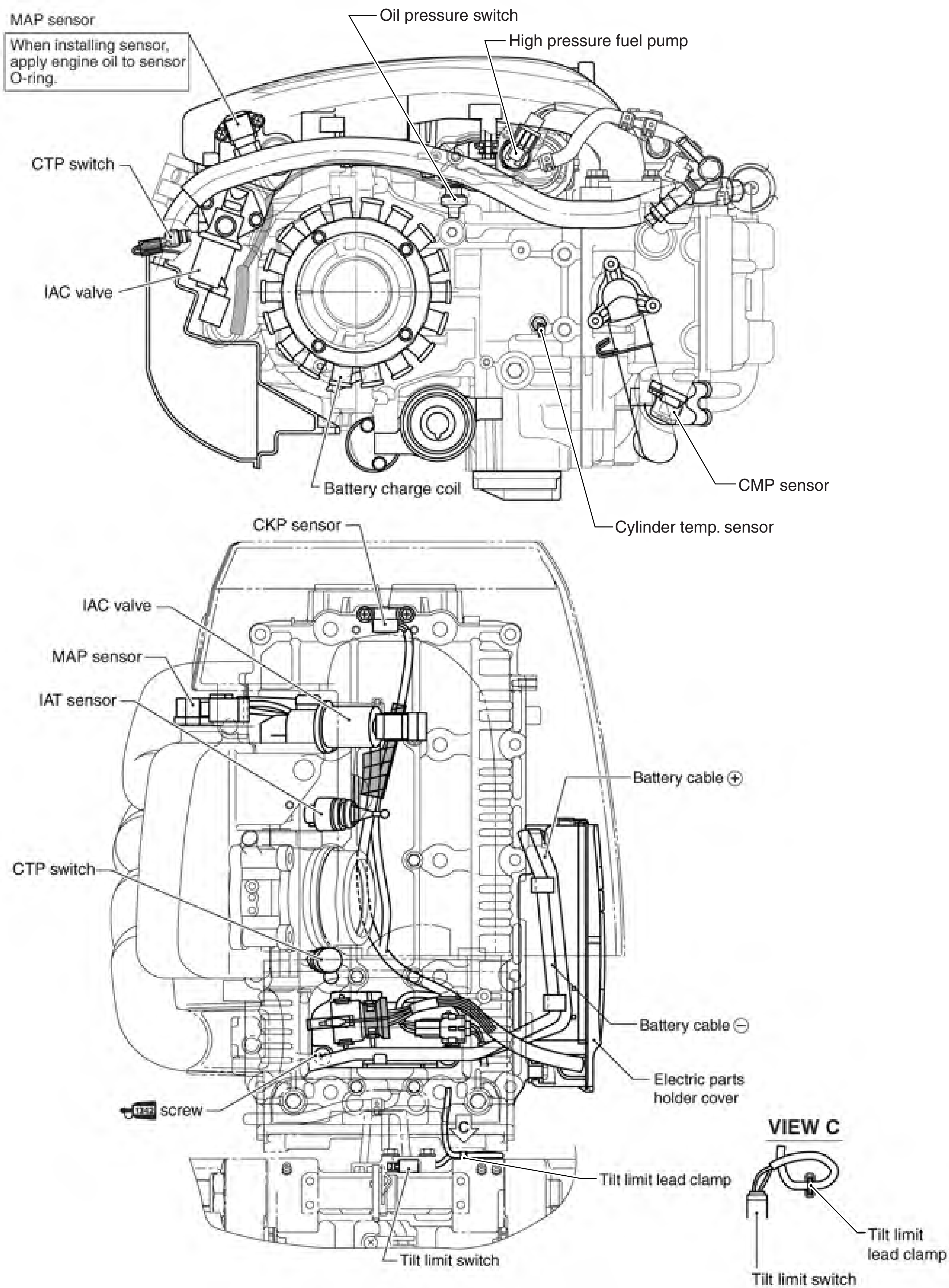
WIRING DIAGRAM

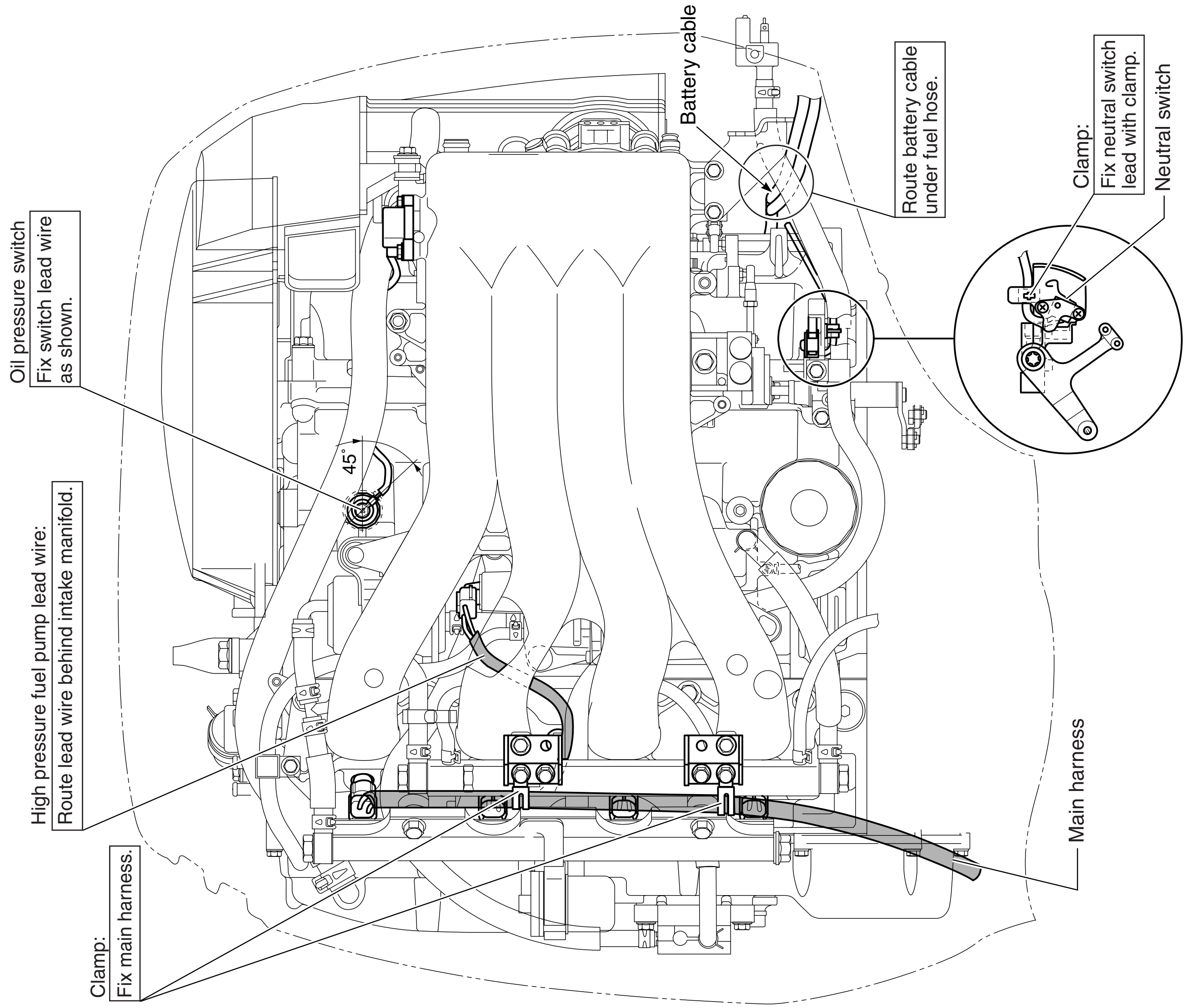


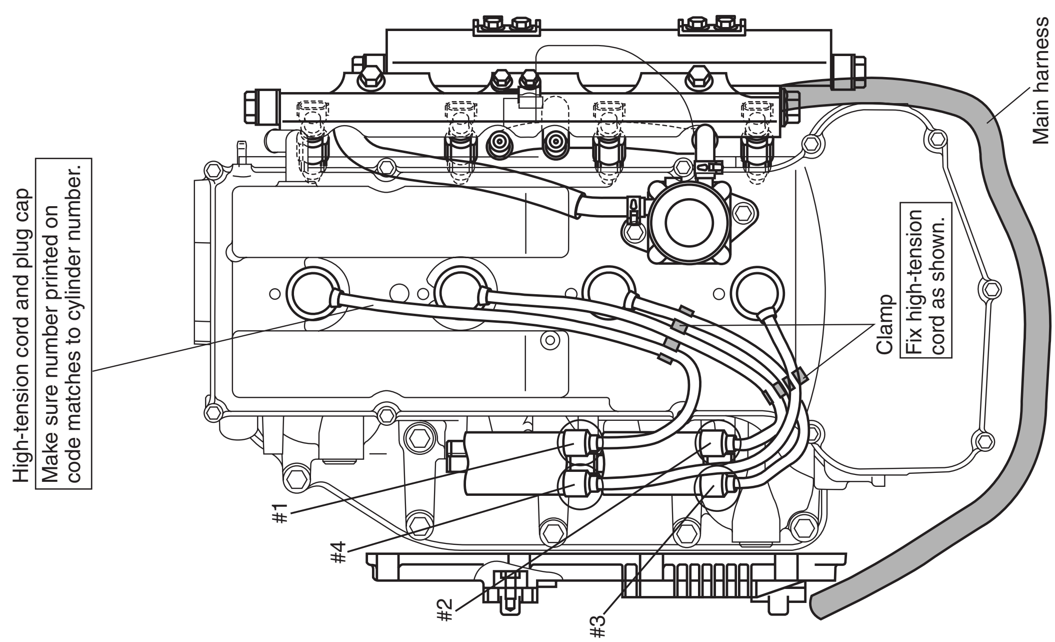
WIRE ROUTING




Tighten bolt with starter motor band and rect & regulator ground lead wire.
Cylinder temp. sensor
Clamp:
Fix cylinder temp. sensor lead wire.
CMP sensor
Ignition coil No.1
Ignition coil No.2
Joint connector (10P)
Main harness
Exhaust manifold temp. sensor
Rectifier & regulator
Fix rectifier & regulator lead wire and temp. sensor lead wire.
Clamp
Tighten bolt with PTT ground lead wire and main harness ground lead wire.
ECM main relay
Starter relay
PTT relay
Battery cable
Starter motor
Starter motor bolt
OIL
A
Gauge connector
SDS communication connector/cap
Main fuse (60 A)
Tighten nut with rectifier & regulator out put white lead and 30 A fuse white lead wire.
Spare main fuse
Sub fuse (30 A) (with spare)
DETAIL A
Starter magnetic switch "S" terminal
Harness lead wire GND
Battery cable +
Harness lead wire +
Battery cable −
30°
ENGINE SIDE


MAP sensor
When installing sensor, apply engine oil to sensor O-ring.
Oil pressure switch
High pressure fuel pump
CTP switch
IAC valve
Battery charge coil
CMP sensor
Cylinder temp. sensor
CKP sensor
IAC valve
MAP sensor
IAT sensor
Battery cable ⊕
CTP switch
Battery cable ⊖
Electric parts holder cover
1342 screw
C
Tilt limit lead clamp
Tilt limit switch
VIEW C
Tilt limit lead clamp
Tilt limit switch

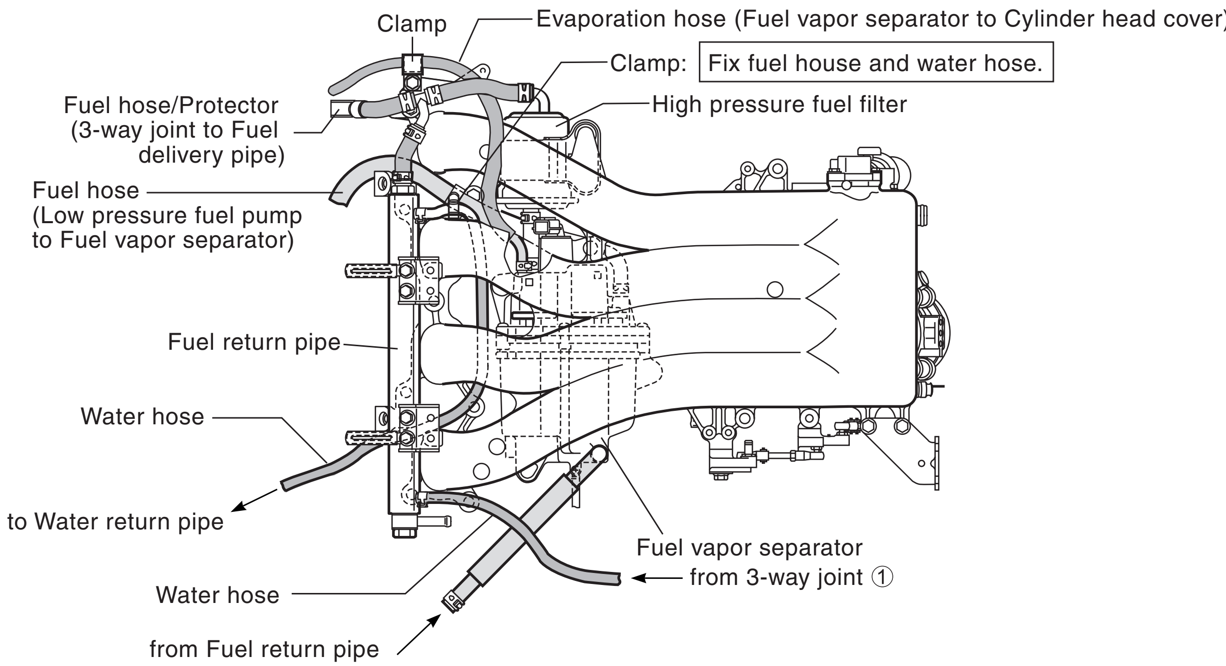

Battery cable
Route battery cable under fuel hose.
Clamp:
Fix neutral switch lead with clamp.
Neutral switch
Oil pressure switch
Fix switch lead wire as shown.
45°
High pressure fuel pump lead wire:
Route lead wire behind intake manifold.
Clamp:
Fix main harness.
Main harness

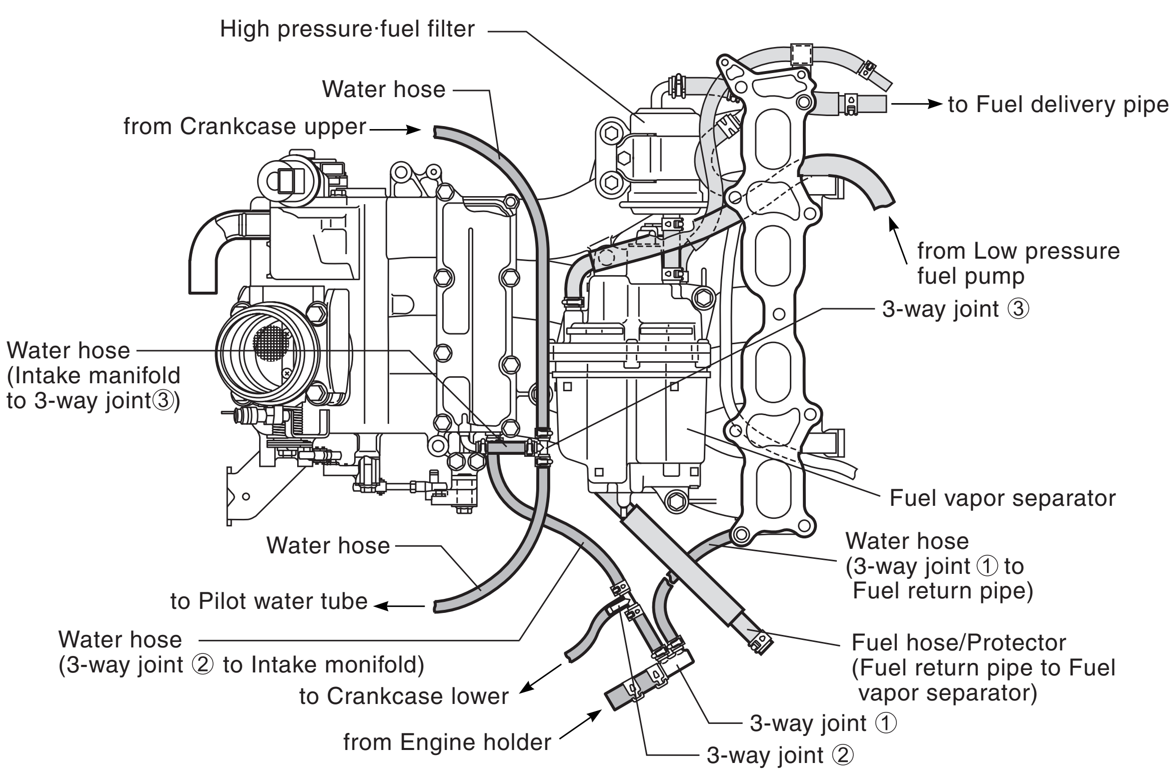

High-tension cord and plug cap
Make sure number printed on code matches to cylinder number.
Main harness
Clamp
Fix high-tension cord as shown.
#1
#4
#2
#3

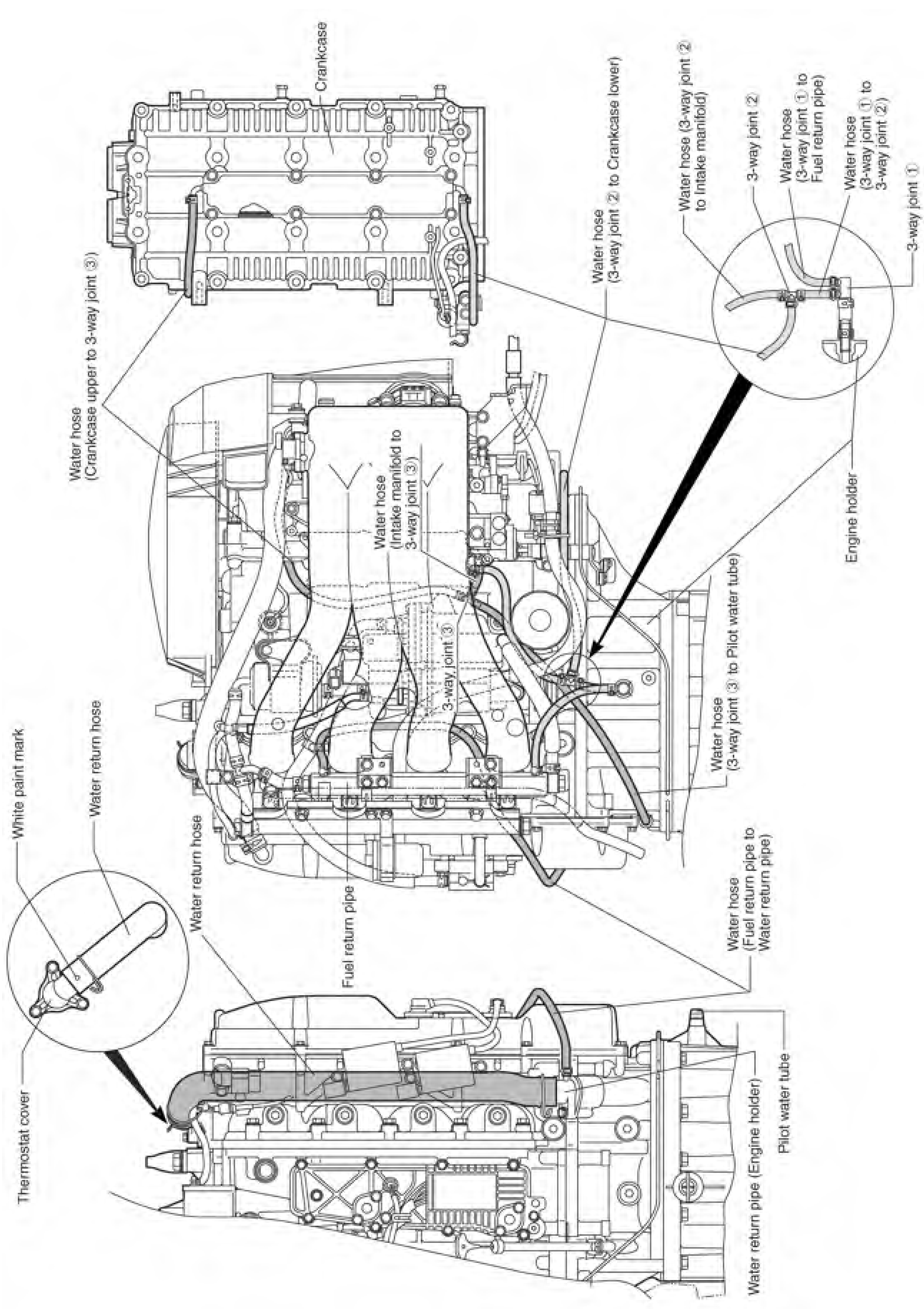
FUEL/WATER HOSE ROUTING

CAUTION

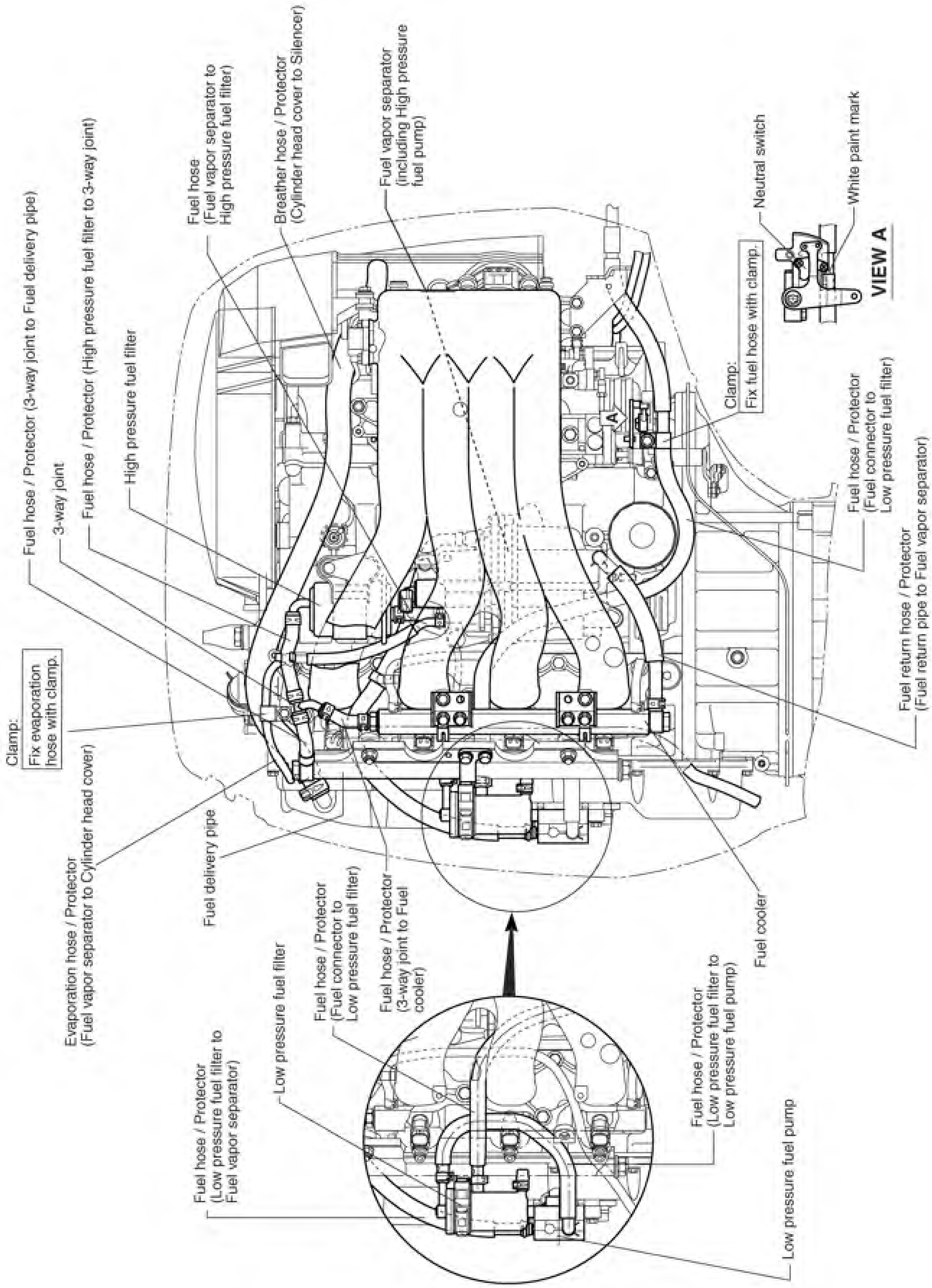
- **Do not over-bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Check that hoses do not contact rods and levers during either engine operation or standstill.**
- **Extreme care should be taken not to cut, abrade or cause any other damage on hoses.**
- **Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.**



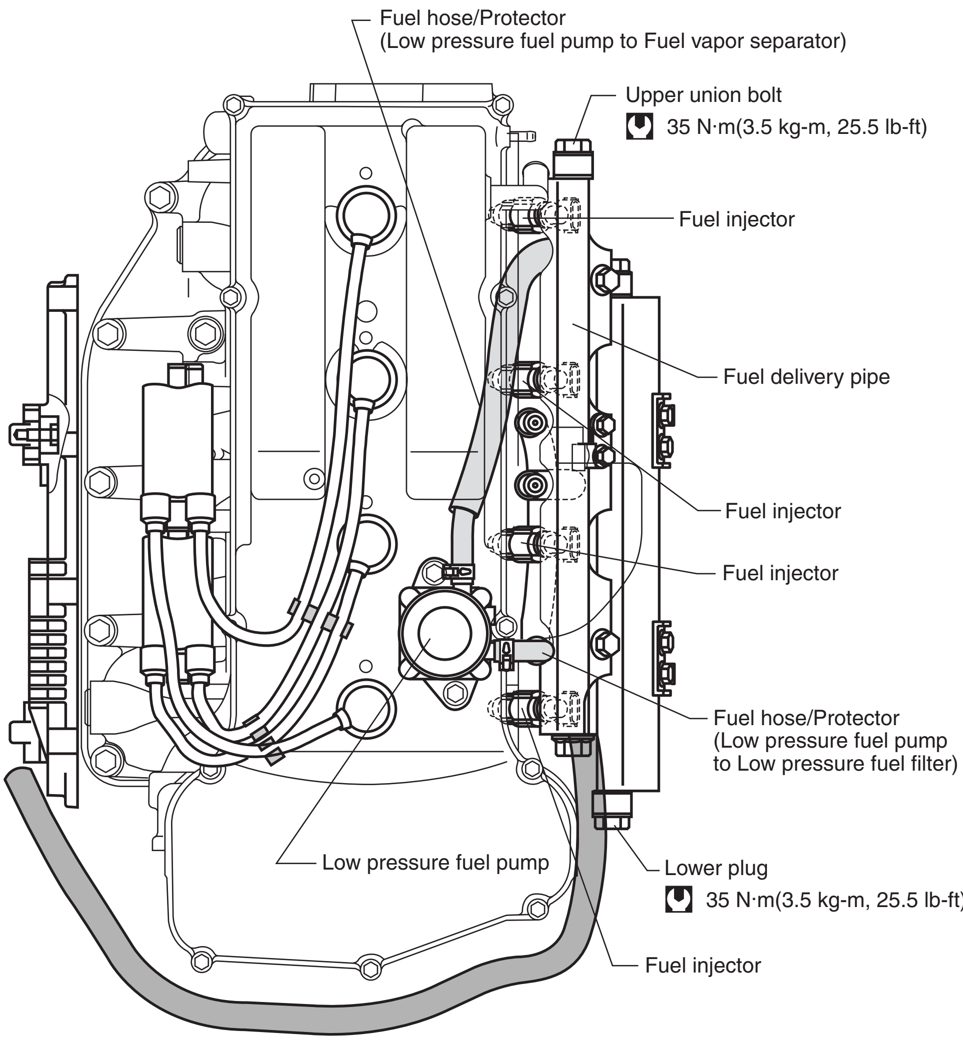




Crankcase
Water hose (Crankcase upper to 3-way joint ③)
Water hose (3-way joint ② to Crankcase lower)
Water hose (3-way joint ② to Intake manifold)
3-way joint ②
Water hose (3-way joint ① to Fuel return pipe)
Water hose (3-way joint ① to 3-way joint ②)
3-way joint ①
Engine holder
Water hose (Intake manifold to 3-way joint ③)
3-way joint ③
Water hose (3-way joint ③ to Pilot water tube)
White paint mark
Water return hose
Water return hose
Fuel return pipe
Water hose (Fuel return pipe to Water return pipe)
Thermostat cover
Water return pipe (Engine holder)
Pilot water tube



Clamp:
Fix evaporation hose with clamp.
Fuel hose / Protector (3-way joint to Fuel delivery pipe)
3-way joint
Fuel hose / Protector (High pressure fuel filter to 3-way joint)
High pressure fuel filter
Fuel hose
(Fuel vapor separator to
High pressure fuel filter)
Breather hose / Protector
(Cylinder head cover to Silencer)
Fuel vapor separator
(including High pressure
fuel pump)
Neutral switch
White paint mark
Clamp:
Fix fuel hose with clamp.
VIEW A
A
Fuel hose / Protector
(Fuel connector to
Low pressure fuel filter)
Fuel return hose / Protector
(Fuel return pipe to Fuel vapor separator)
Fuel cooler
Evaporation hose / Protector
(Fuel vapor separator to Cylinder head cover)
Fuel delivery pipe
Fuel hose / Protector
(Low pressure fuel filter to
Fuel vapor separator)
Low pressure fuel filter
Fuel hose / Protector
(Fuel connector to
Low pressure fuel filter)
Fuel hose / Protector
(3-way joint to Fuel
cooler)
Fuel hose / Protector
(Low pressure fuel filter to
Low pressure fuel pump)
Low pressure fuel pump


Fuel hose/Protector
(Low pressure fuel pump to Fuel vapor separator)
Upper union bolt
35 N·m(3.5 kg-m, 25.5 lb-ft)
Fuel injector
Fuel delivery pipe
Fuel injector
Fuel injector
Fuel hose/Protector
(Low pressure fuel pump
to Low pressure fuel filter)
Low pressure fuel pump
Lower plug
35 N·m(3.5 kg-m, 25.5 lb-ft)
Fuel injector

Prepared by

SUZUKI MOTOR CORPORATION

Service Department

1st Ed. October, 2000
Manual No.99500-90J07-03E

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SUZUKI MOTOR CORPORATION

Printed in Japan TK
K1 K2 K3 K4 K5 K6 K7 K8 K9