SUZUKI OUTBOARD MOTOR

DF 300

FOUR STROKE

SERVICE MANUAL

99500-98J01-03E

FOREWORD

This manual contains an introductory description of the SUZUKI DF300 Outboard motor and procedures for inspection, service and overhaul of their 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, assisting you in providing your customers with optimum and quick service.

- *This manual has been prepared using the latest information available at the time of publication.*
  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 SUZUKI outboard engines by relying on this manual only and should contact an 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 2007 (K7) model.

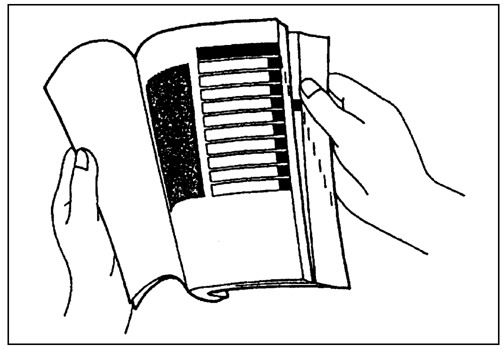
GROUP INDEX

SUZUKI MOTOR CORPORATION
Service Department

HOW TO USE THIS MANUAL

TO LOCATE WHAT YOU ARE LOOKING FOR:

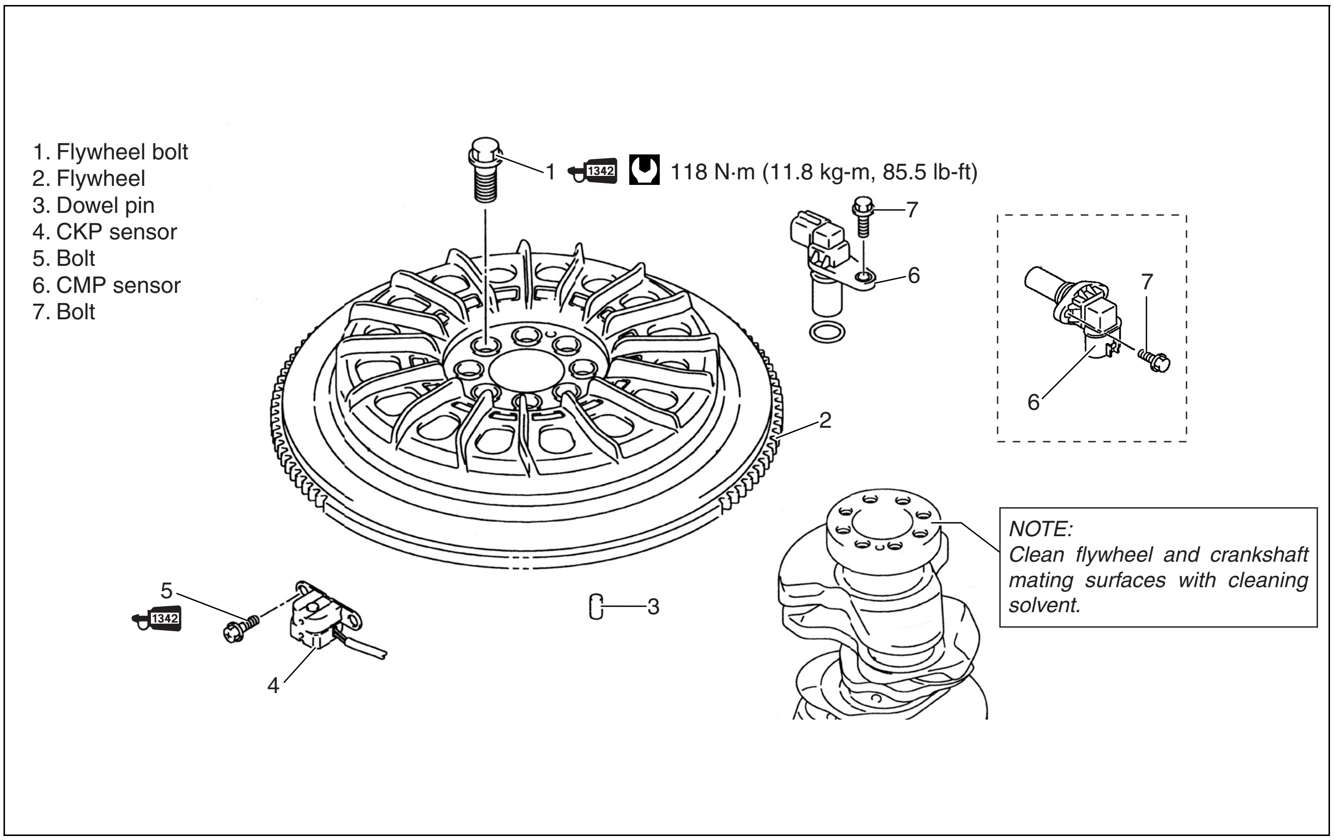
1. The text of this manual is divided into sections.
2. The section titles are listed on the previous page in a GROUP INDEX. Select the section needed for reference.
3. Holding the manual as shown at the right will allow you to find the first page of the section easily.
4. The first page of each section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



COMPONENT PARTS AND IMPORTANT ITEM ILLUSTRATIONS

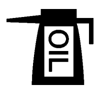
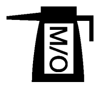
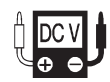
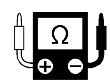
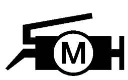
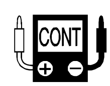
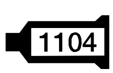
Under the name of each system or unit, an exploded view is provided with work instructions and other service information such as the tightening torque, lubrication and locking agent points.

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 SUZUKI SILICONE SEAL.
	Apply oil. Use the engine oil unless otherwise specified.		Apply THREAD LOCK “1342”.
	Apply molybdenum oil solution. (Mixture of engine oil and SUZUKI MOLY PASTE in a ratio of 1 : 1)		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 MOLY PASTE. 99000-25140		Measure in continuity test range.
	Apply SUZUKI WATER RESISTANT GREASE.		Use peak voltmeter “Stevens CD-77”.
	Apply SUZUKI BOND “1104”.		Use special tool.
	Apply SUZUKI BOND “1207B”.		

ABBREVIATIONS

Abbreviations used in this service manual are as follows:

BCM	: Boat Control Module
BTDC	: Before Top Dead Center
CKP	: Crankshaft position
CMP	: Camshaft position
CTP	: Close Throttle position
DBW	: Drive By Wire
DC	: Direct Current
DOHC	: Double Over Head Camshaft
ECM	: Engine Control Module
ETV	: Electronic Throttle Valve
ESA	: Electronic Shift Actuator
EX (Ex.)	: Exhaust
IAT	: Intake Air Temperature
IN (In.)	: Intake
LPS	: Lever Position sensor
MAP	: Manifold absolute pressure
OCV	: Oil control valve
PCV	: Positive Crankcase Ventilation
PORT	: Port
PTT	: Power Trim & Tilt
SPC system	: SUZUKI Precision Control system
SPS	: Shift Position Sensor
STBD	: Starboard
TPS	: Throttle Position Sensor
VSV	: Vacuum switching valve
VVT	: Variable Valve Timing

GENERAL INFORMATION

CONTENTS

WARNING/CAUTION/NOTE

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

⚠ WARNING

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

CAUTION

Indicates a potential hazard that could result in motor damage.

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

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

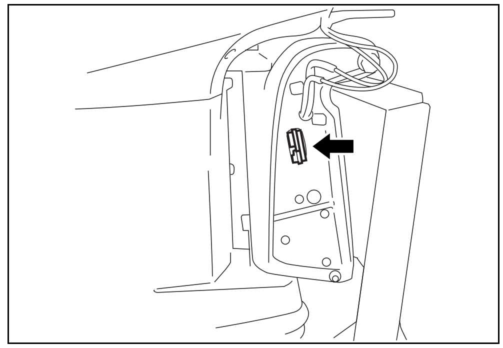
- **If parts replacement is necessary, replace the parts with Suzuki Genuine Parts or their equivalent.**
- **When removing parts that are to be reused, keep them arranged in an orderly manner so that they may be reinstalled in the proper order and orientation.**
- **Be sure to use special tools where 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.**

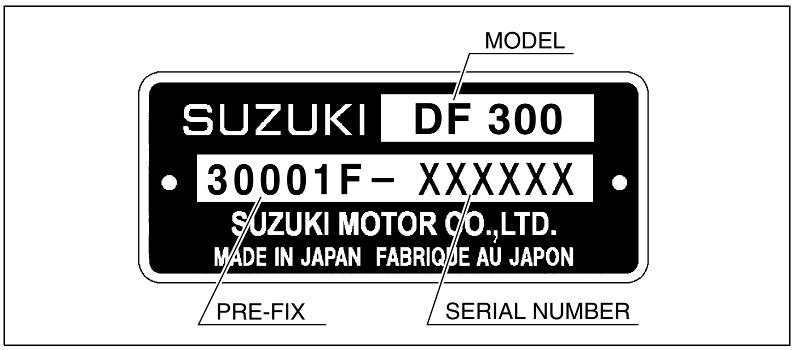
IDENTIFICATION NUMBER LOCATION

MODEL, PRE-FIX, SERIAL NUMBER

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

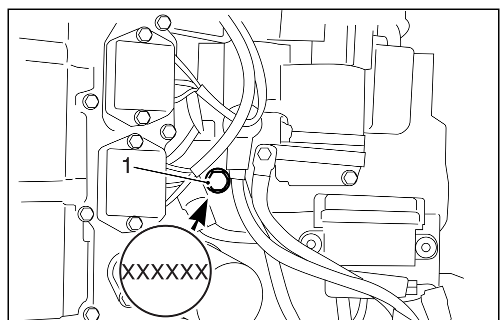


Example



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/2+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):

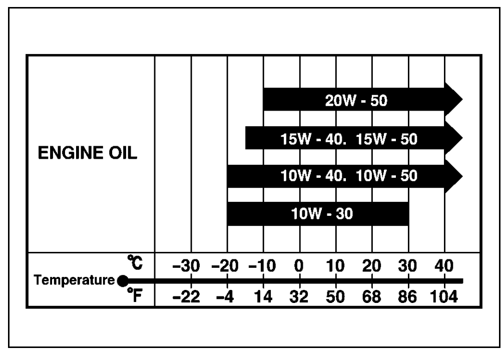
5% Methanol, 10% Ethanol, 15% MTBE

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 or NMMA FC-W classification system.
The viscosity rating should be SAE (or NMMA FC-W) 10W-40.
If SAE (or NMMA FC-W) 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 (3 000 r/min).

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

2. NEXT 1 HOUR
   Operate the engine in-gear at less than 3/4 (three-quarter) throttle (4 000 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 DF300 model is shown below.

Recommended full throttle speed range	**DF300**	**5 700 – 6 300 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

Right-hand rotation models
Blade × Dia. (in.) × Pitch (in.)
3 × 16 × 17
3 × 16 × 18 and 1/2
3 × 16 × 20
3 × 16 × 21 and 1/2
3 × 16 × 23
3 × 16 × 24 and 1/2
3 × 16 × 26
3 × 16 × 27 and 1/2

Counter rotation models
Blade × Dia. (in.) × Pitch (in.)
3 × 16 × 17
3 × 16 × 18 and 1/2
3 × 16 × 20
3 × 16 × 21 and 1/2
3 × 16 × 23
3 × 16 × 24 and 1/2
3 × 16 × 26

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.

NOTE:
In the case of twin installation, always use, the same size right-hand rotation and counter-rotation propellers on both engine.

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.

SUZUKI PRECISION CONTROL SYSTEM

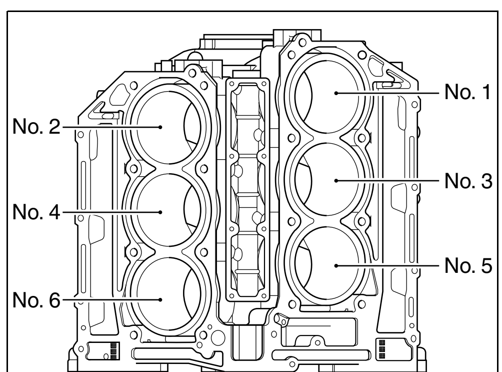
New for Suzuki is the Precision Control System, which electronically controls the throttle and shift systems.
This system uses wires in places of the mechanical cables to control the throttle and shift function. In this system the remote control sends an electronic signal to actuators on the outboard engine. These actuators activate the shift and throttle movement. With this system, smooth, accurate control is achieved and boat rigging is simplified.

⚠ WARNING

Electronic calibration is required before use. After installation of this product, the Suzuki Precision Control System requires electronic calibration, only by a person who has been specifically trained in the Suzuki Precision Control System. Improper electronic calibration of the system will make this product and/or the system inoperable or unsafe for use.

CYLINDER NUMBER

Cylinder number is as mentioned in the right figure.



* SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF300T	DF300Z
PRE-FIX			30001F	30001Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	953 (37.5)
Overall width (side to side)		mm (in)	564 (22.2)
Overall height	X	mm (in)	1 889 (74.4)
	XX	mm (in)	2 016 (79.4)
Weight (without engine oil)	X	kg (lbs)	274 (604)
	XX	kg (lbs)	279 (615)
Transom height	X	mm (in. type)	635 (25)
	XX	mm (in. type)	762 (30)

PERFORMANCE

Maximum output	kW (PS)	220.7 (300)
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)

POWER HEAD

Engine type		4-stroke DOHC
Number of cylinders		V-6
Bore	mm (in)	98 (3.86)
Stroke	mm (in)	89 (3.50)
Total displacement	cm^3 (cu. in)	4 028 (245.6)
Compression ratio	: 1	9.5
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		Electronic remote control

Item	Unit	Data	
		DF300T	DF300Z

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 or NMMA FC-W classification : SE, SF, SG, SH, SJ • Viscosity rating : SAE 10W-40 or NMMA FC-W 10W-40	
Engine oil amounts	L (US/Imp. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)	
Gearcase oil amounts	ml (US/Imp. oz)	1 100 (37.2/38.7)	

BRACKET

Trim angle	degree	0 – 19 (PTT system)	
Number of trim position		PTT system	
Maximum tilt angle	degree	70	

LOWER UNIT

Shift control		Electronic remote control	
Reversing system		Gear	
Transmission		Forward-Neutral-Reverse	
Reduction system		Bevel gear	
Gear ratio		12 : 20 (1.67)	
Drive line impact protection		Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)		DF300T : Clockwise DF300Z : Counterclockwise	
Propeller		Right-hand rotation models	
		Blade × Dia. (in.) × Pitch (in.)	
		3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26 3 × 16 × 27 and 1/2	

Item	Unit	Data	
		DF300T	DF300Z

LOWER UNIT

Propeller	Counter rotation models
	Blade × Dia. (in.) × Pitch (in.)
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	32 : 40 (1.25)
2nd reduction gear ratio (Lower unit gear)	12 : 20 (1.67)
Total reduction gear ratio	2.08 (40/32 × 20/12)

* SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data
		DF300T/Z

POWERHEAD

Item	Unit	DF300T/Z
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)
**Cylinder compression	kPa (kg/cm^2, psi)	1 100 – 1 500 (11 – 15, 156 – 213)
**Cylinder compression max. difference between cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm^2, psi)	400 – 600 (4.0 – 6.0, 57 – 85) at 3 000 r/min (at normal operating temp.)
Engine oil		• API classification : SE, SF, SG, SH, SJ or NMMA FC-W classification : SE, SF, SG, SH, SJ • Viscosity rating : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/lpm. qt))	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data DF300T/Z

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.03 (0.001)
Manifold seating faces distortion		Limit	mm (in)	0.10 (0.004)
Cam height	IN	STD	mm (in)	45.330 – 45.490 (1.7846 – 1.7909)
		Limit	mm (in)	45.230 (1.7807)
	EX	STD	mm (in)	44.420 – 44.580 (1.7488 – 1.7551)
		Limit	mm (in)	44.320 (1.7449)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.043 – 0.085 (0.0017 – 0.0033)
		Limit	mm (in)	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	—
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	25.936 – 25.957 (1.0211 – 1.0219)
		Limit	mm (in)	—
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)	33.959 – 33.975 (1.3370 – 1.3376)
Cylinder head bore		STD	mm (in)	34.000 – 34.025 (1.3386 – 1.3396)

Item	Unit	Data DF300T/Z

VALVE/VALVE GUIDE

Item			Unit	Data
Valve diameter		IN	mm (in)	37.9 (1.49)
		EX	mm (in)	31.4 (1.24)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.33 – 0.37 (0.013 – 0.015)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°, 60°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN, EX	STD	mm (in)	11.4 – 11.8 (0.45 – 0.46)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem 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)	1.1 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.05 (0.04)
		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)	39.75 (1.56)
		Limit	mm (in	38.2 (1.50)
Valve spring tension		STD	N (kg, lbs)	147 – 173 (14.7 – 17.3, 32.3 – 38.1) for 31.1 mm (1.22 in)
		Limit	N (kg, lbs)	136 (13.6, 29.2) for 31.1 mm (1.22 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data DF300T/Z

CYLINDER/PISTON/PISTON RING

Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.085 – 0.105 (0.0033 – 0.0041)
		Limit	mm (in)	0.15 (0.0059)
Cylinder bore		STD	mm (in)	98.000 – 98.020 (3.8583 – 3.8591)
Cylinder measuring position			mm (in)	50 (1.969) from cylinder top surface
Piston skirt diameter		STD	mm (in)	97.905 – 97.925 (3.8545 – 3.8553)
Piston measuring position			mm (in)	11 (0.43) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.33 (0.008 – 0.013)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.33 – 0.48 (0.013 – 0.019)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 13.6 (0.54)
		Limit	mm (in)	10.9 (0.43)
	2nd	STD	mm (in)	Approx. 13.7 (0.54)
		Limit	mm (in)	10.9 (0.43)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.080 (0.0012 – 0.0031)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.25 (0.048 – 0.049)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	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)	1.17 – 1.19 (0.046 – 0.047)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.021 (0.0002 – 0.0008)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	21.993 – 22.000 (0.8659 – 0.8661)
		Limit	mm (in)	21.980 (0.8654)
Piston pin hole diameter		STD	mm (in)	22.006 – 22.014 (0.8664 – 0.8667)
		Limit	mm (in)	22.030 (0.8673)
Pin clearance in conrod small end		STD	mm (in)	0.010 – 0.025 (0.0004 – 0.0010)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)

Item		Unit	Data
			DF300T/Z

CRANKSHAFT/CONROD

Item		Unit	DF300T/Z
Conrod small end inside diameter	STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)
Conrod big end oil clearance	STD	mm (in)	0.045 – 0.063 (0.0018 – 0.0025)
	Limit	mm (in)	0.080 (0.0031)
Conrod big end inside diameter	STD	mm (in)	57.000 – 57.018 (2.2441 – 2.2448)
Crank pin outside diameter	STD	mm (in)	53.982 – 54.000 (2.1253 – 2.1260)
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.482 – 1.497 (0.0583 – 0.0589)
Conrod big end side clearance	STD	mm (in)	0.300 – 0.450 (0.0118 – 0.0177)
	Limit	mm (in)	0.550 (0.0217)
Conrod big end width	STD	mm (in)	20.750 – 20.800 (0.8169 – 0.8189)
Crank pin width	STD	mm (in)	21.100 – 21.200 (0.8307 – 0.8346)
Crankshaft center journal runout	Limit	mm (in.)	0.04 (0.002)
Crankshaft journal oil clearance	STD	mm (in)	0.030 – 0.048 (0.0012 – 0.0019)
	Limit	mm (in)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in)	75.000 – 75.018 (2.9528 – 2.9535)
Crankshaft journal outside diameter	STD	mm (in)	69.982 – 70.000 (2.7552 – 2.7559)
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	2.499 – 2.514 (0.0984 – 0.0990)
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 DF300T/Z

ELECTRICAL

Ignition timing		Degrees at r/min	ATDC 5° – BTDC 24°
Over revolution limiter		r/min	6 400
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	—
	Secondary	kΩ at 20°C	—
Battery charge coil resistance		Ω at 20°C	0.21 – 0.32
Battery charge coil output (12 V)		Watt	648
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60, Throttle valve: 15 Starter motor: 30, Shift actuator: 15 Ignition coil, Injector, ECM: 30 PTT switch: 10 Isolator: 40
Recommended battery capacity (12 V)		Ah (kC)	130 (468) or larger
Fuel injector resistance		Ω at 20 °C	10 – 14
IAT sensor/Cylinder temp. sensor/ Ex. mani. temp. sensor (Thermistor characteristic)		kΩ at 25 °C	1.8 – 2.3
ECM main relay coil resistance		Ω at 20 °C	145 – 190
Starter motor relay coil resistance		Ω at 20 °C	145 – 190
PTT motor relay coil 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 SPC system or in the signal from sensors, switches, etc., the code representing the failure is displayed in the digital display screen on the tachometer · monitor.

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVATING
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO
Rectifier & regulator (Over-charging)	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO
ESA ECM	8 – 1	NO
ESA motor	8 – 2	NO
ESA	8 – 3	NO

NOTE:
If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when “ENTER” key of tachometer · monitor is pressed.

TIGHTENING TORQUE

Tightening torque – Important fasteners

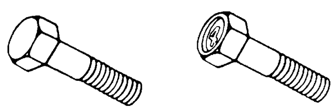
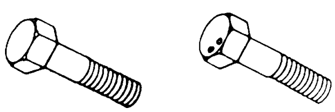
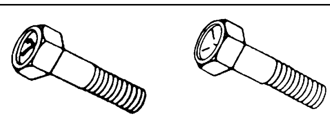
ITEM		THREAD DIAMETER	TIGHTENING TORQUE		
			N·m	kg-m	lb-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	23	2.3	16.5
		11 mm	86	8.6	62.0
Crankcase bolt		8 mm	25	2.5	18.1
		10 mm	52	5.2	37.5
Crankshaft drive gear bolt		10 mm	48	4.8	34.5
Conrod cap bolt		9 mm	68	6.8	49.2
Camshaft housing bolt		6 mm	12	1.2	8.5
Piston cooling jet		—	5	0.5	3.6
Oil pump bolt		8 mm	23	2.3	16.5
IN. camshaft timing sprocket	VVT model	—	60	6.0	43.5
EX. camshaft timing sprocket		—	78	7.8	56.0
OCV		6 mm	12	1.2	8.5
Chain tensioner adjuster bolt		6 mm	11	1.1	8.0
Timing chain guide bolt		8 mm	23	2.3	16.5
Collector cover		8 mm	23	2.3	16.5
Engine holder cover bolt		8 mm	23	2.3	16.5
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	14 mm	35	3.5	25.5
	Lower	14 mm	35	3.5	25.5
Low pressure fuel pump bolt		6 mm	10	1.0	7.0
Thermostat cover bolt		6 mm	10	1.0	7.0
Flywheel bolt		12 mm	118	11.8	85.5
Starter motor mounting bolt		8 mm	23	2.3	16.5
Engine oil filter		—	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt		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 bolt/nut		14 mm	100	10.0	72.5
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt/nut		14 mm	100	10.0	72.5
Clamp bracket shaft nut		7/8-14 UNF	43	4.3	31.0
Water pump case bolt		8 mm	17	1.7	12.5
Driveshaft oil seal housing		—	100	10.0	72.5

ITEM	THREAD DIAMETER	TIGHTENING TORQUE		
		N·m	kg-m	lb-ft
Gearcase bolt	10 mm	55	5.5	40.0
	12 mm	83	8.3	60.0
Propeller shaft bearing housing bolt	10 mm	50	5.0	36.1
Pinion gear nut	16 mm	145	14.5	105.0
Propeller nut	18 mm	55	5.5	40.0

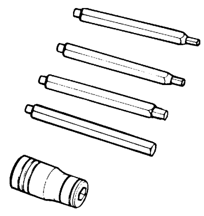
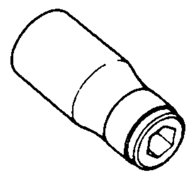
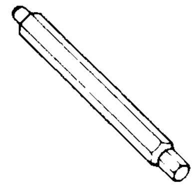
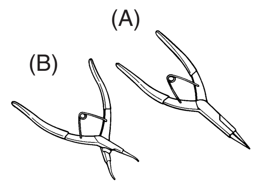
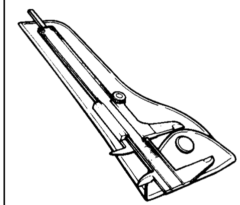
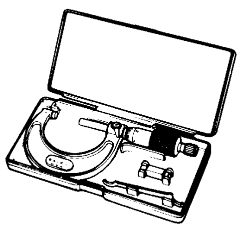
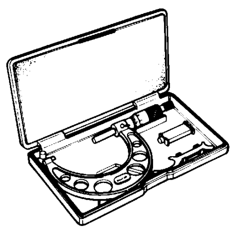
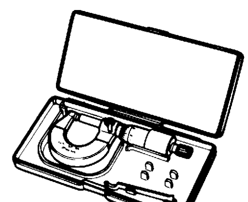
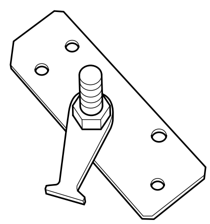
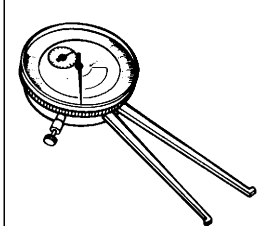
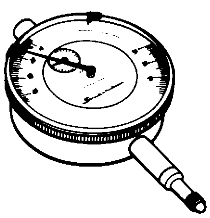
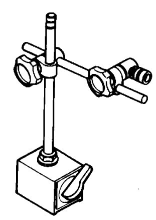
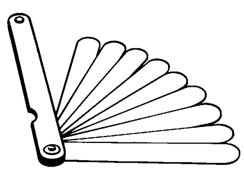
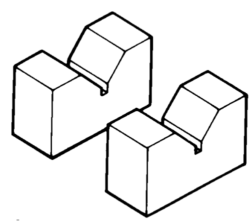
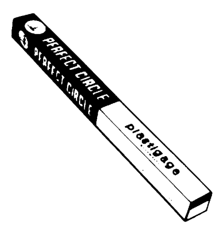
Tightening torque – General bolt

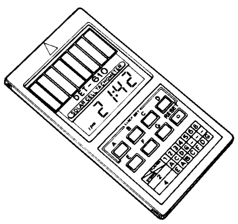
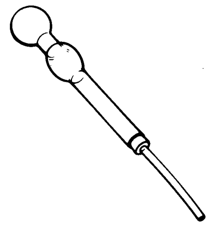
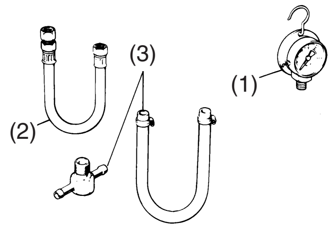
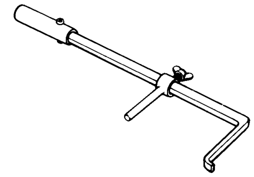
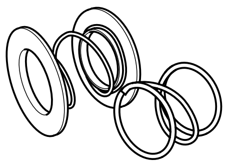
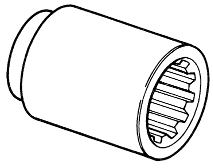
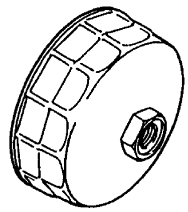
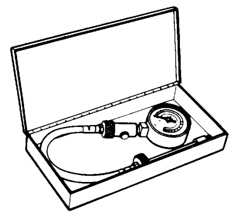
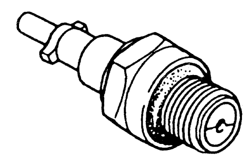
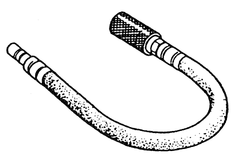
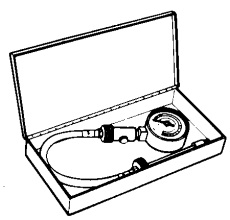
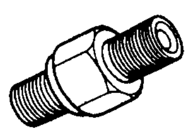
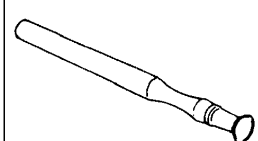
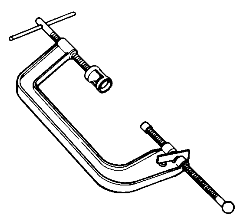
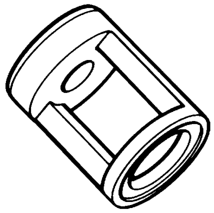
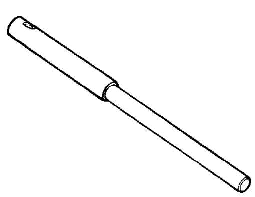
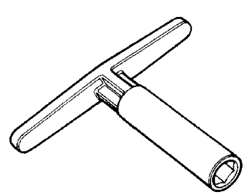
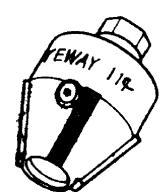
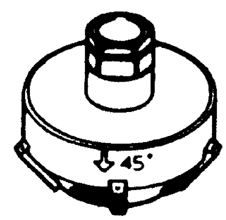
NOTE:

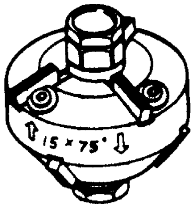
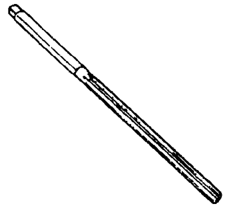
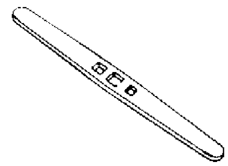
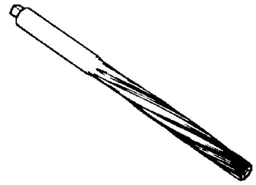
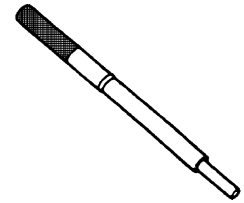
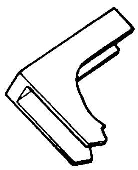
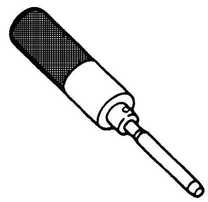
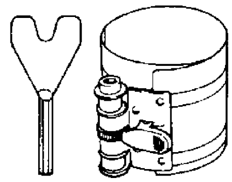
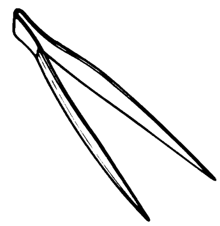
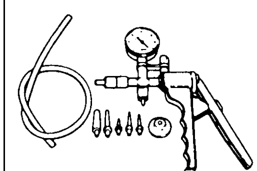
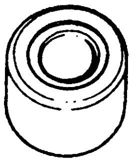
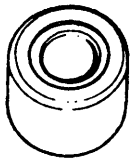
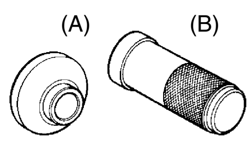
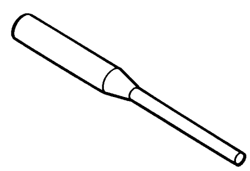
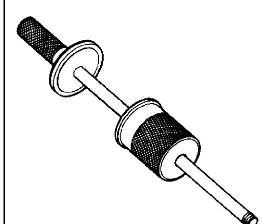
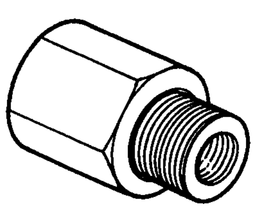
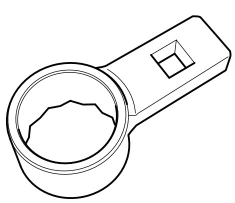
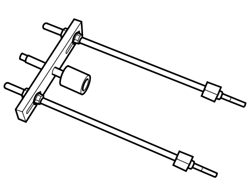
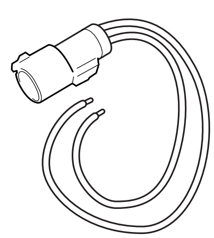
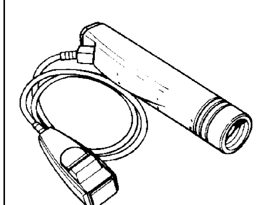
These value are only applicable when torque for a general bolt is not listed in the "Important Fasteners" table.

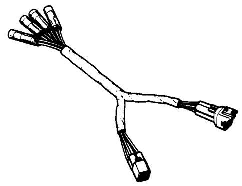
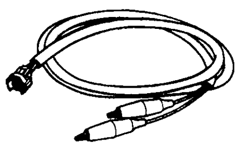
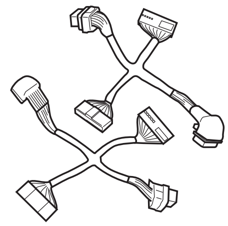
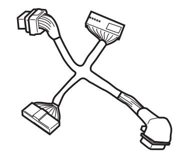
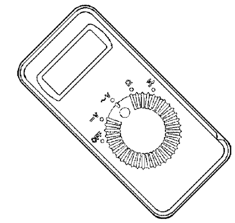
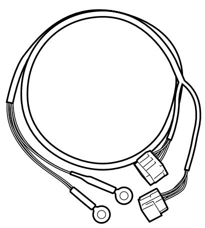
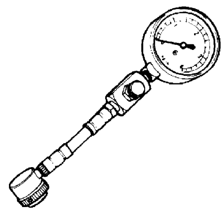
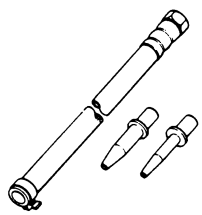
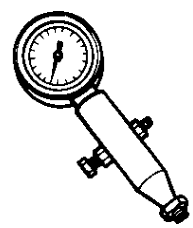
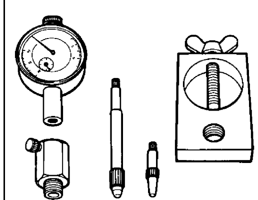
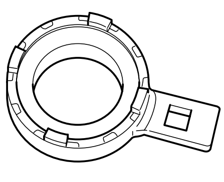
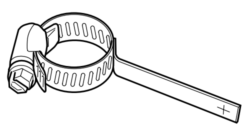
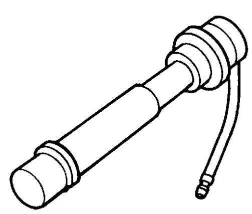
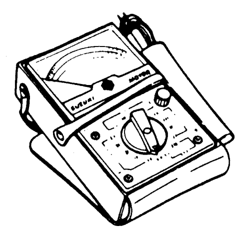
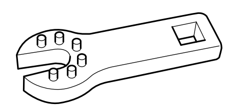
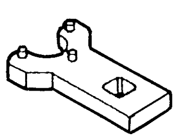
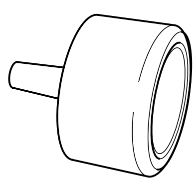
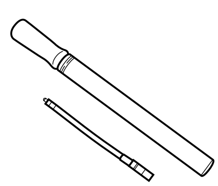
TYPE OF BOLT	THREAD DIAMETER	TIGHTENING TORQUE		
		N·m	kg-m	lb-ft
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.0 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
(Conventional or "4" marked bolt)	10 mm	22 – 35	2.2 – 3.5	16.0 – 25.5
	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 10	0.6 – 1.0	4.5 – 7.0
	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

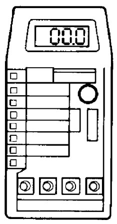
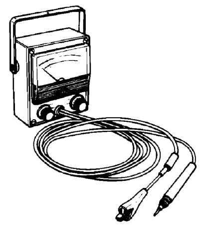
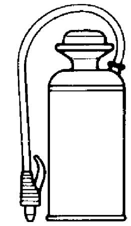
SPECIAL TOOLS

1.  **09900-00410** **Hexagon wrench set**	**2.**  **09900-00411** **Hexagon socket** **(included in** **09900-00410)**	**3.**  **09900-00413 (5 mm)** **09900-00414 (6 mm)** **09900-00415 (8 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.**  **09916-99311** **Flywheel holder**	**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.**  **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**		**19.**  **09913-50121** **Oil seal remover**
20.  **09951-09310** **Gear adjust spring set**	**21.**  **09921-29410** **Driveshaft holder**	**22.**  **09915-47341** **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.**  **09916-14510** **Valve lifter**
30.  **09916-14521** **Valve lifter attach-ment**	**31.**  **09916-24450** **Solid pilot** **(N-100-5.52)** **Solid pilot** **Neway N-150-5.5**	**32.**  **09916-54910** **Handle (N-505)**	**33.**  **09916-22420** **Valve seat cutter (60°)** **(N-114)**	**34.**  **Valve seat cutter (45°)** **(Neway 128)**

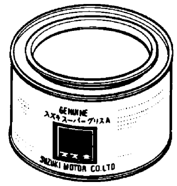
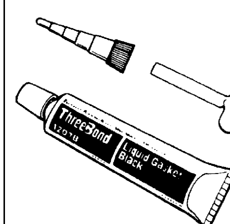
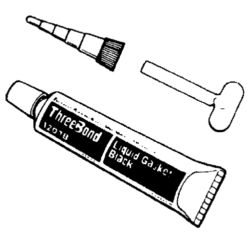
35.  **Valve seat cutter (15°)** **(Neway 212)**	**36.**  **09916-34550** **Valve guide reamer** **(ϕ 5.5 mm)**	**37.**  **09916-34542** **Valve guide reamer** **handle**	**38.**  **09916-37320** **Valve guide reamer** **(ϕ 10.5 mm)**	**39.**  **09916-44310** **Valve guide remover**
40.  **09916-69310** **Tappet holder**	**41.**  **09916-57330** **Valve guide installer**	**42.**  **09916-77310** **Piston ring com-** **pressor**	**43.**  **09916-84511** **Tweezers**	**44.**  **09917-47011** **Vacuum pump** **gauge**
45.  **09916-56011** **Valve guide installer** **attachment**	**46.**  **09917-98221** **Valve guide stem** **seal installer attach-** **ment**	**47.**  **(A) 09922-59410** **Propeller shaft** **housing installer** **(B) 09922-59420** **Housing installer** **handle**	**48.**  **09922-89810** **Shift lock pin** **remover**	**49.**  **09930-30104** **Sliding hammer**
50.  **09930-30161** **Propeller shaft** **remover**	**51.**  **09926-29310** **Driveshaft housing** **remover**	**52.**  **09951-99310** **Gear holder**	**53.**  **09945-79310** **PTT cable extension**	**54.**  **09930-76420** **Timing light**

55.  09930-89240 4-pin connector test cord	56.  09930-89260 Injector test cord A	57.  09930-89340 26-pin (A) & 34-pin test cord	58.  09930-89850 26-pin (B) test cord	59.  09930-99320 Digital tester
60.  09930-89860 BCM simulator harness	61.  09940-44121 Air pressure gauge	62.  09940-44130 Attachment	63.  09950-69512 Gearcase oil leakage tester	64.  09951-09511 Gear adjusting gauge
65.  09951-19820 Bearing stopper Remover & installer	66.  09952-09310 Back lash indicator tool	67.  09930-89350 H·T cord adapter	68.  09900-25002 Pocket tester	69.  09944-09820 Tilt cylinder cap tool
70.  09944-09810 PTT trim cap tool	71.  09917-49610 Vacuum pump adapter	72.  09952-99310 hand air pump	73. SDS Set 09933-19811 • Suzuki Diagnostic System Software Ver. 5.00 • Diagnostic harness • USB cable • USB adapter • Conversion adapter	

74.	75.	76.
		
99954-53008-820* **Digital voltmeter**	**99954-53873*** **Stevens CD-77** **Peak reading volt-meter**	**99954-53883*** **Gear oil filler**

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

MATERIALS REQUIRED

SUZUKI OUTBOARD MOTOR GEAR OIL	SUZUKI SUPER GREASE "A"	WATER RESISTANT GREASE	SUZUKI SILICONE SEAL	SUZUKI BOND "1104"
				
99000-22540 (400 ml × 24 pcs)	99000-25030* 99000-25010 (500 g)	99000-25160 (250 g)	99000-31120 (50 g)	99000-31030 (100 g)
SUZUKI BOND "1207B"	**THREAD LOCK "1342"**	**THREAD LOCK SUPER "1333B"**	**4-Stroke Motor Oil**	**SUZUKI MOLY PASTE**
				
99104-33140* 99000-31140 (100 g)	99000-32050 (50 g)	99000-32020 (50 g)	API: SE, SF, SG, SH, SJ SAE: 10W-40	99000-25140 (50 g)

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

PERIODIC MAINTENANCE

CONTENTS

PERIODIC MAINTENANCE SCHEDULE

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

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

PERIODIC MAINTENANCE CHART

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
Fuel line	I	I	I	I
	Replace every 2 years.			
PCV system	I	I	I	I
	Replace PCV/breather hose 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
Engine oil filter	R	—	—	R
Low pressure fuel filter	—	I	I	I
	Replace every 400 hours or 2 years.			
Low pressure fuel pump filter	Replace every 1 000 hours.			
High pressure fuel filter	Replace every 1 000 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

NOTE:
OIL CHANGE REMINDER SYSTEM
- *Refer to page 3-55 for function and operation.*
- *See page 2-5 for reset information.*

MAINTENANCE AND TUNE-UP PROCEDURES

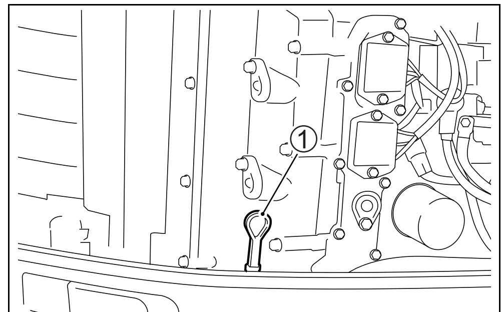
This section describes servicing procedures for each periodic maintenance requirement.

ENGINE OIL/ENGINE OIL FILTER

ENGINE OIL LEVEL CHECK

Inspect oil level before every use.

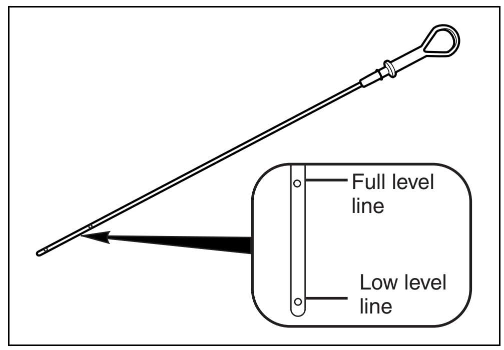
1. Place outboard motor upright on a level surface.
2. Remove motor cover.
3. Remove oil level dipstick and wipe it clean.
4. Reinsert dipstick fully into dipstick tube, then remove to check oil level.



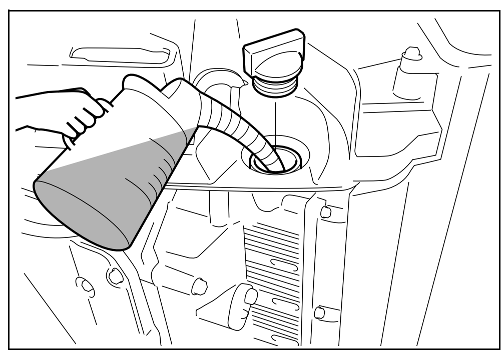
① Oil level dipstick

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

   If level is low, add recommended oil to full level Max. mark.



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



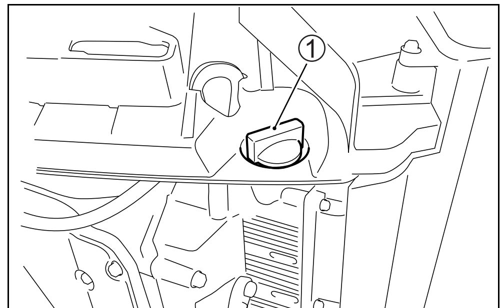
ENGINE OIL CHANGE/ENGINE OIL FILTER REPLACEMENT

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

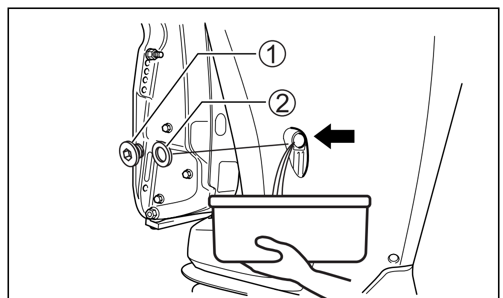
ENGINE OIL FILTER
Replace initially after 20 hours (1 month) and every 200 hours (12 months).

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.
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 filler cap

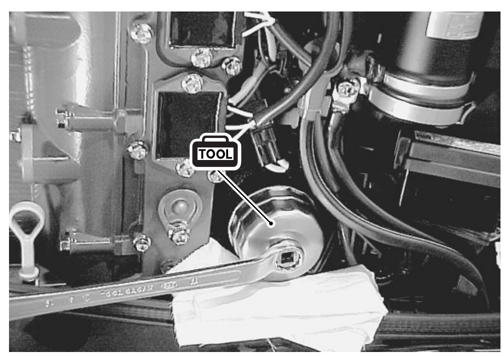


① Oil drain plug ② Gasket

5. ENGINE OIL FILTER REPLACEMENT

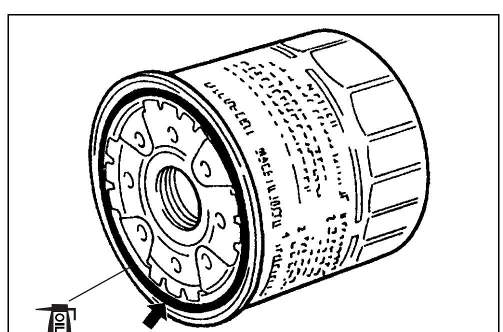
NOTE:
For engine oil change only, go to step 6.

To replace engine oil filter:
(1) Place a shop cloth under oil filter before removal to absorb any oil released.
(2) Using oil filter wrench to loosen the oil filter, then remove filter and O-ring.



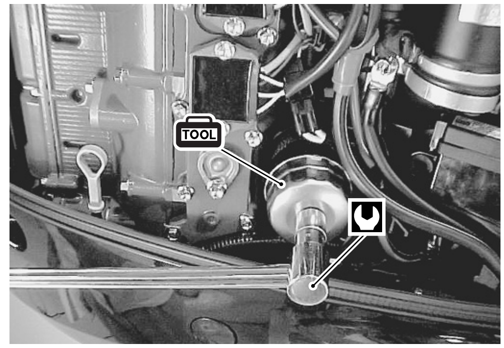
TOOL 09915-47341: Oil filter wrench

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



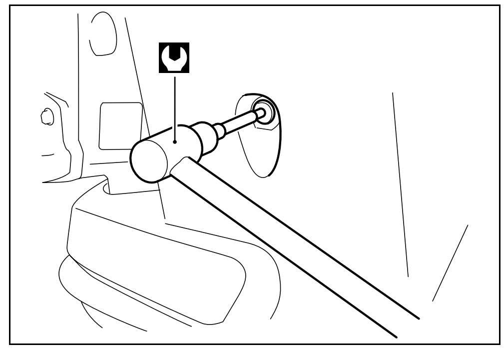
(3) Screw new filter on by hand until filter O-ring contacts the mounting surface.
(4) Tighten filter 3/4 turn from point of contact with mounting surface using an oil filter wrench.

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



6. Install new 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)

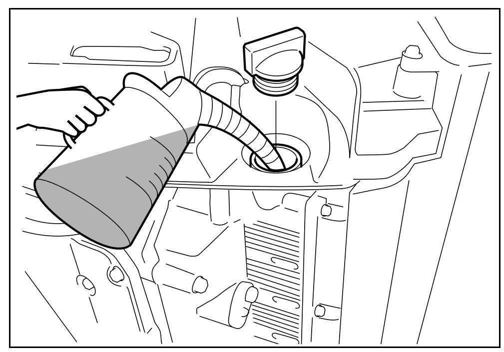


CAUTION

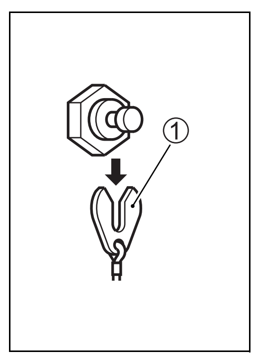
To avoid water entry into oil pan or oil leakage into the environment do not reuse gasket once removed. Always use a new gasket.

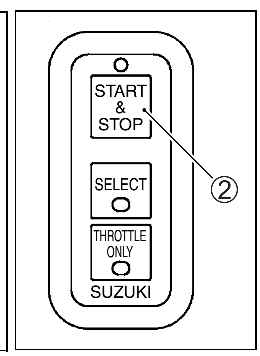
7. Pour recommended engine oil into oil filler opening, then install oil filler cap.

   Engine oil amounts
   Oil change only: 8.0 L (8.5/7.0 US/Imp. qt)
   Oil filter change: 8.2 L (8.7/7.2 US/Imp. qt)



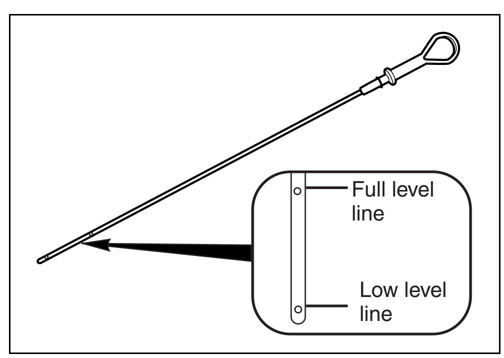
8. To reset oil change reminder system's operation time to zero (cancellation);
   (1) Turn main switch key to "ON" position.
   (2) Pull out emergency stop switch plate ①.
   (3) Depress "START & STOP" button ② three times in ten seconds. A short beep will be heard if cancellation is successfully finished.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





NOTE:
See "OIL CHANGE REMINDER SYSTEM" section on page 3-55.

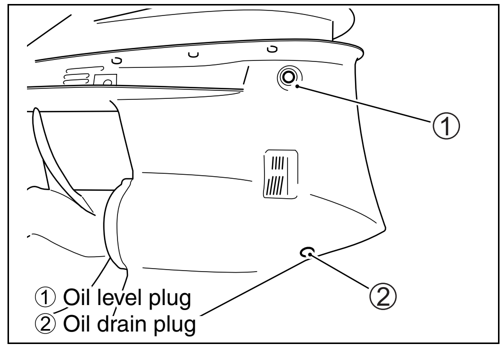
9. Start engine and allow it to run for several minutes at idle speed.
   Check oil filter for oil leakage.
   Turn off engine and wait for approx. two minutes, then recheck engine oil level.



GEAR OIL

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

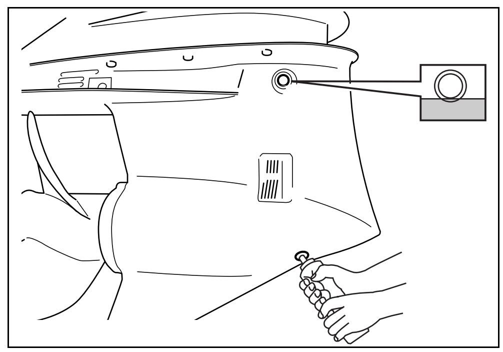
1. Place outboard motor upright on a level surface.
2. Place a container under the lower unit.
3. Remove lower gear oil drain plug first, then remove gear oil level plug and drain gear oil.



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

   Gear oil amount: 1 100 ml (37.2/38.7 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 reuse gaskets once removed. Always use a new gasket.

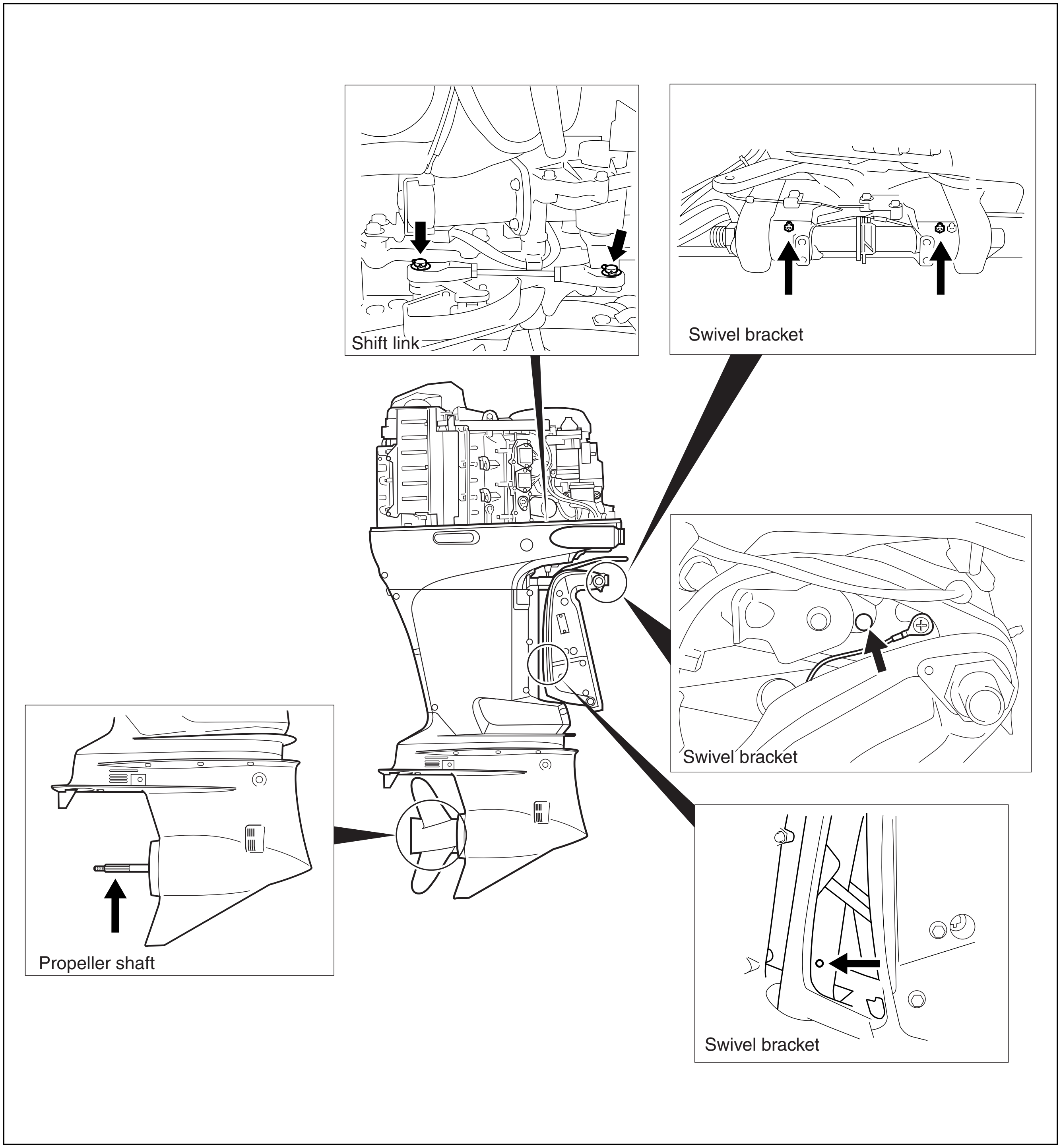
NOTE:
To avoid a possible low gear oil level, recheck gear oil level 10 minutes after doing procedure in step 6. If oil level is low, add additional gear oil until level is correct.

LUBRICATION

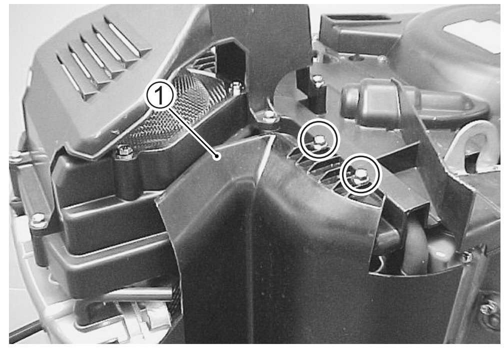
Inspect every 50 hours (3 months).

Apply SUZUKI Water Resistant Grease to the following points.

99000-25160: SUZUKI WATER RESISTANT GREASE

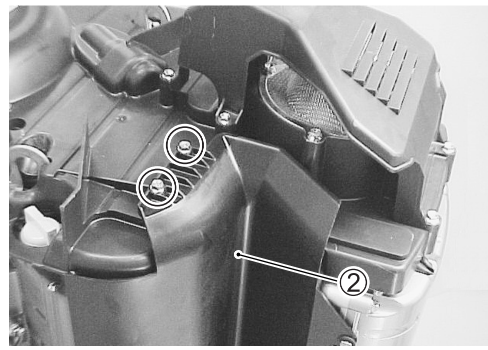


SPARK PLUG



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

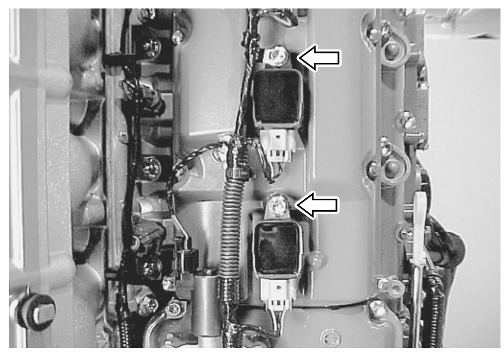
Standard spark plug: NGK BKR6E



CAUTION

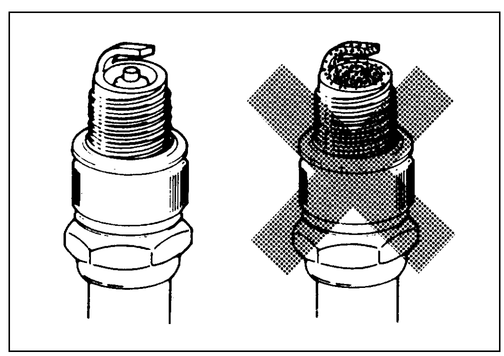
Only resistor (R) type spark plugs must be used with this engine. Using a non-resistor spark plug will cause ignition and fuel injection system malfunctions.

REMOVAL



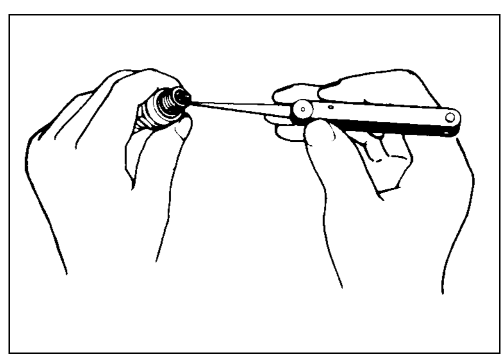
- Remove the bolts and STBD air duct guard ①.
- Remove the bolts and PORT air duct guard ②.
- Disconnect ignition coil connector, then remove the bolt securing the ignition coil.
- Remove the ignition coil and spark plug.

CARBON DEPOSIT



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

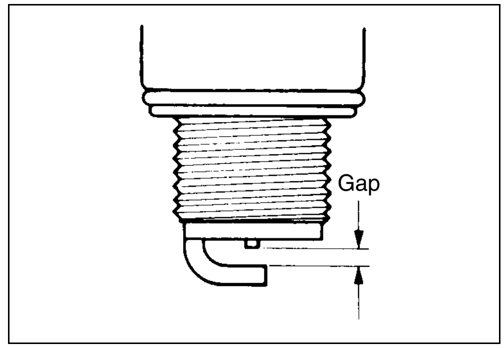
SPARK PLUG GAP



Measure spark plug gap with a thickness gauge.
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.

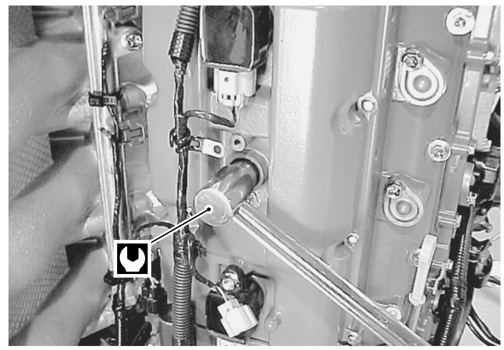
CAUTION

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.

INSTALLATION

Installation is reverse order of removal.

Spark plug: 28 N·m (2.8 kg-m, 20.0 lb-ft)



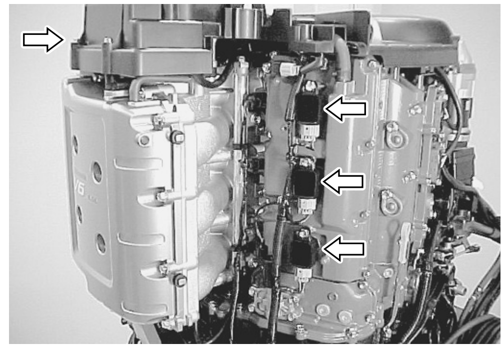
TAPPET CLEARANCE

Inspect every 200 hours (12 months).

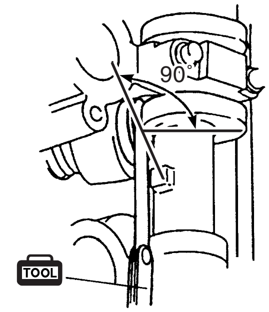
The tappet clearance specification is different for intake and exhaust valves.
Too small a tappet clearance may reduce engine power, too large a tappet clearance increases valve noise and hastens valve and seat wear.
When the tappets are set to the specified clearance, the engine will run without excessive 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.
Using the proper tools provides for easy removal and installation of the shim disc.
Tappet clearance adjustment should be checked and adjusted:

- during scheduled 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 lower cover (See page 7-2.)
   - Ring gear cover and air intake silencer case (See page 6-2.)
   - Ignition coils
   - Spark plugs
2. Remove PORT and STBD cylinder head covers. (See page 6-3.)



3. Rotate crankshaft counterclockwise to bring cam nose vertical to shim surface.
4. 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.: 0.33 – 0.37 mm (0.013 – 0.015 in)

TOOL **09900-20803: Thickness gauge**

CAUTION

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

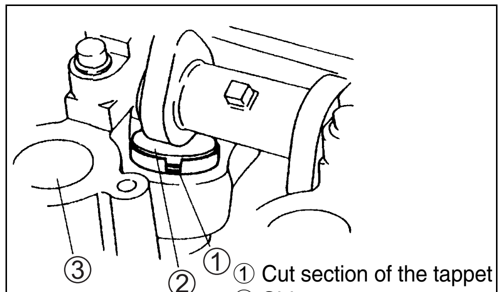
NOTE:
- *Rotate crankshaft and measure clearance for each tappet respectively by bringing cam nose vertical to shim surface.*
- *All tappet clearances can be measured during two crankshaft rotations.*

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

ADJUSTMENT

Tappet clearances are adjusted by replacing tappet shim.

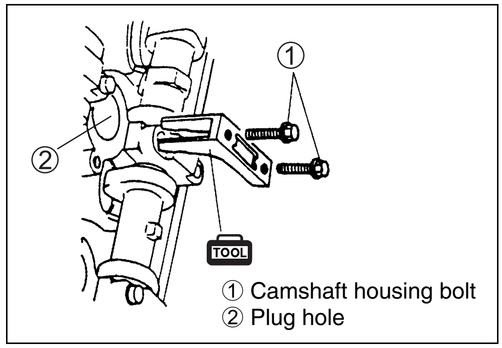
1. With cam nose vertical to valve, turn tappet cut-away towards center of cylinder head as shown in figure.



① Cut section of the tappet
② Shim
③ Plug hole

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.

TOOL **09916-69310: Tappet holder**

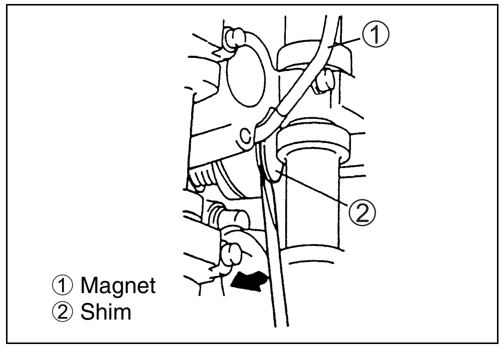


① Camshaft housing bolt
② Plug hole

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

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 down (towards tappet).**



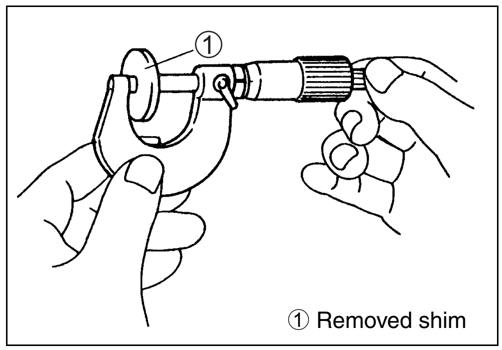
① Magnet
② Shim

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

TOOL **09900-20205: Micrometer**

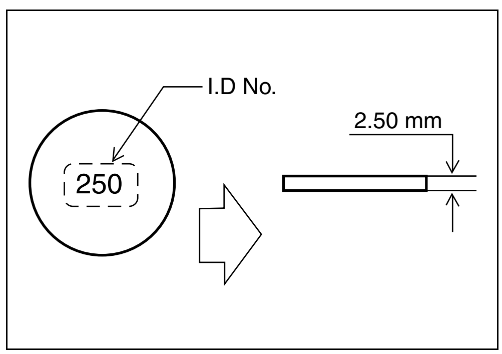
IN. side:
A = B + (C – 0.25 mm)
EX. side:
A = B + (C – 0.35 mm)

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



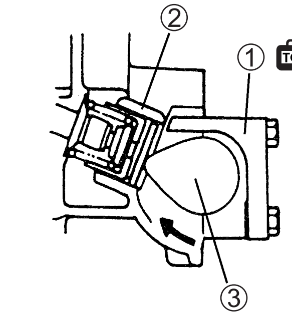
① Removed shim

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 down (towards tappet).
7. Rotate crankshaft to be open (lift up) valve.
8. Remove tappet holder ① and tighten camshaft housing bolts to specified torque.

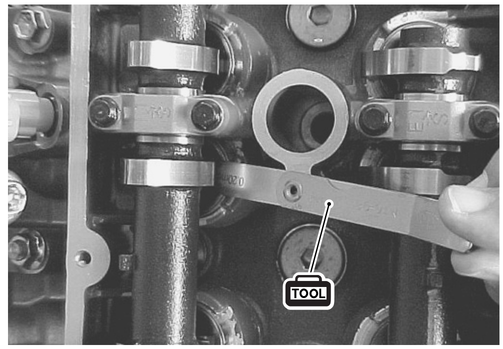
Camshaft housing bolt: 12 N·m (1.2 kg-m, 8.7 lb-ft)



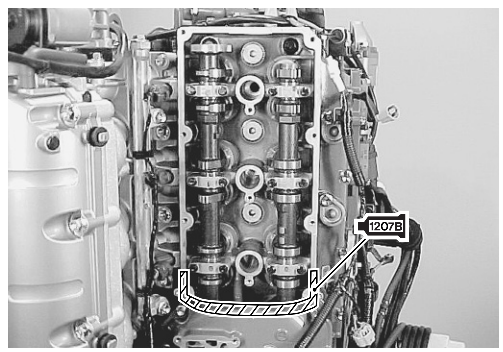
① Special tool
② Tappet
③ Camshaft

9. Recheck tappet clearance.

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



REASSEMBLY
After checking and adjusting all valves, reinstall parts removed earlier.
Installation is reverse order of removal.

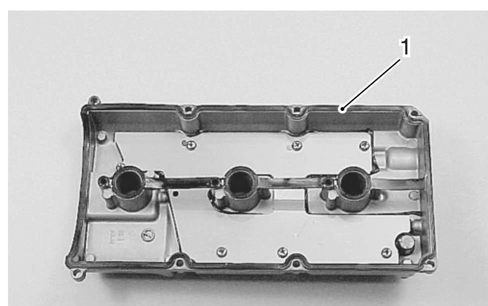


Cylinder head cover
Install the cylinder head cover. (See page 6-5.)

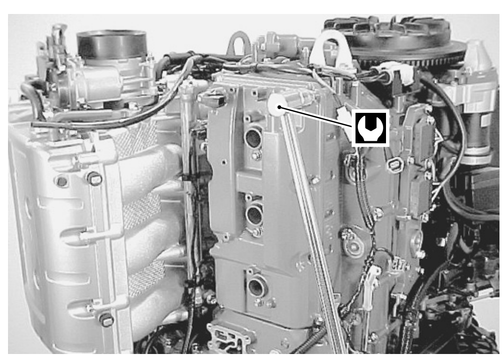
NOTE:
Examine cylinder head cover gasket for damage.
Always replace gasket if sealing performance is suspect.

- Tighten cylinder head cover bolts to specification.

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



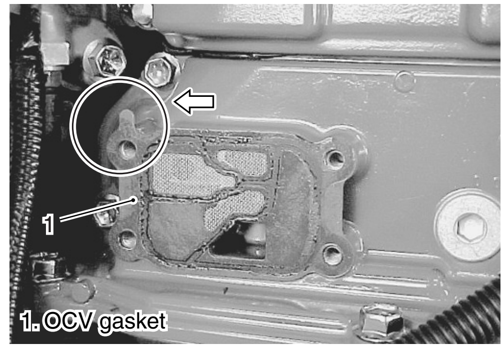
1. Head cover gasket



OCV (Oil control valve)

- Install gasket and OCV, and then tighten bolts securely.

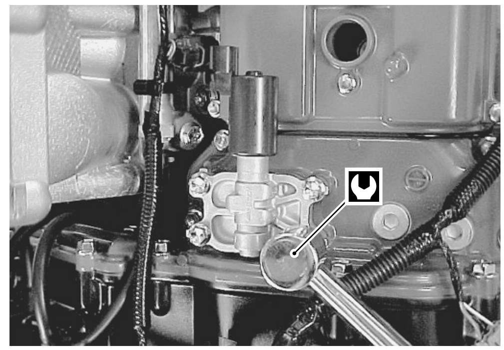
NOTE:
Position the OCV gasket tab as shown the right.



CAUTION

Do not reuse OCV gasket. Always replace with new one.

OCV bolt: 12 N·m (1.2 kg-m, 8.5 lb-ft)



FINAL ASSEMBLY CHECK

- All parts removed have been returned to their original positions.
- Check hose and wire routing. (See page 11-14 to 11-26.)
- Check oil leakage.

TAPPET SHIM SELECTION CHART [IN. side]

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

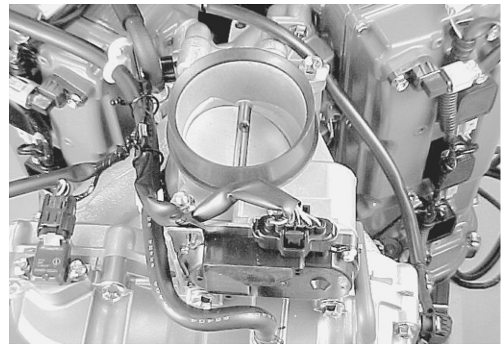
TAPPET SHIM SELECTION CHART [EX. side]

Shim ID 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
0.05 – 0.09												218	220	223	225	228	230	233	235	238	240	243	245	248	250	253	255	258	260	263	265	268	270	273
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
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
0.20 – 0.24						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
0.25 – 0.29				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
0.30 – 0.32			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
0.33 – 0.37	SPECIFIED CLEARANCE / NO ADJUSTMENT REQUIRED																																	
0.38 – 0.39	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		
0.40 – 0.44	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			
0.45 – 0.49	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					
0.50 – 0.54	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							
0.55 – 0.59	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									
0.60 – 0.64	245	248	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300											
0.65 – 0.69	250	253	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300													
0.70 – 0.74	255	258	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300															
0.75 – 0.79	260	263	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300																	
0.80 – 0.84	265	268	270	273	275	278	280	283	285	288	290	293	295	298	300																			
0.85 – 0.89	270	273	275	278	280	283	285	288	290	293	295	298	300																					
0.90 – 0.94	275	278	280	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 — 0.40 mm
Present shim size — 2.40 mm
Shim size to be used — 2.48 mm

IDLE SPEED



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

NOTE:
- *Before checking idle speed, engine must be warmed up.*
- *Check idle speed after engine speed has stabilized.*
- *Before checking idle speed, check throttle control mechanism and throttle valve for smooth operation.*

NOTE:
To check the engine speed, a battery powered personal computer and the Suzuki Diagnostic System must be used.

1. Start engine and allow to be warmed up.
2. Check engine speed.
   Idle speed (in neutral gear): 600 – 700 r/min

NOTE:
- *Idling/trolling speed of 600 – 700 r/min is controlled by Electronic Throttle System.*
- *This throttle system is not equipped with IAC valve for idle speed control.*
- *Idle speed control is done by the throttle actuator which controls the throttle valve opening.*
  See "Electronic Throttle System" section on page 3-36.
- *If engine idle speed is out of specification, electronic throttle system may not be operating correctly.*
  For system check, see page 3-81.

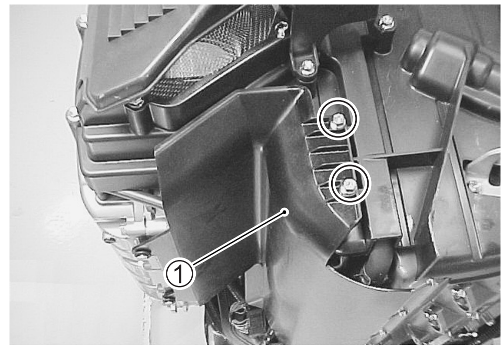
NOTE:
Trolling speed (in-gear idle speed) is same as idle speed.

IGNITION TIMING

Inspect every 200 hours (12 months).

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

1. Remove the bolts and STBD air duct guard ①.

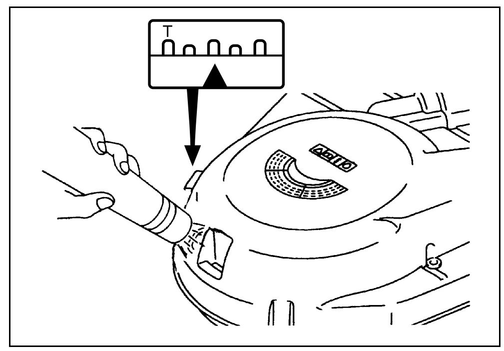


2. Start the engine and allow to warm up.
3. Attach the timing light cord to the No. 1 ignition coil primary wire.

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

4. Check the ignition timing while operating the engine in neutral gear at 1 000 r/min.

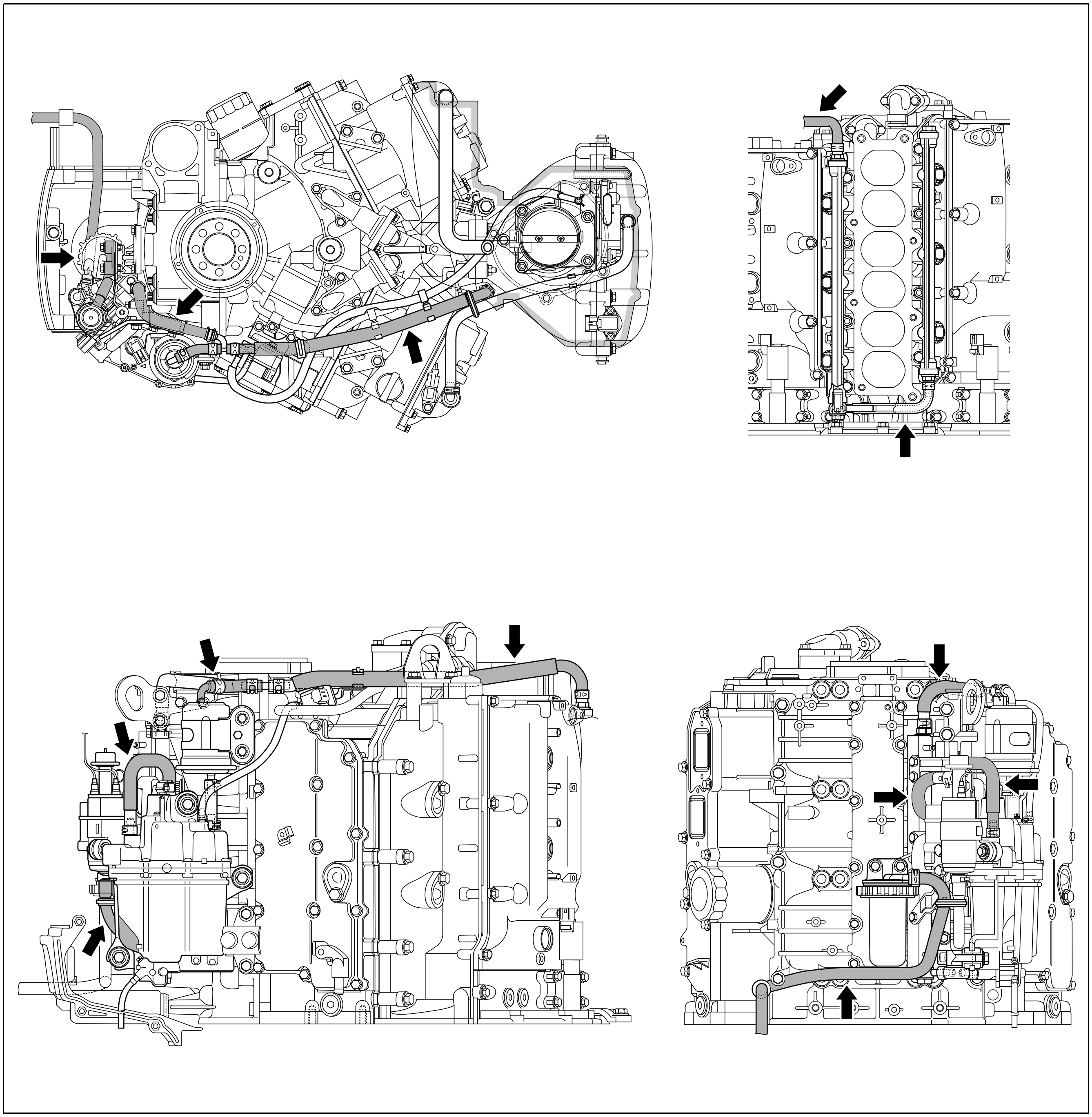
   Ignition timing: Approx. BTDC 5° ± 5° at 1 000 r/min.



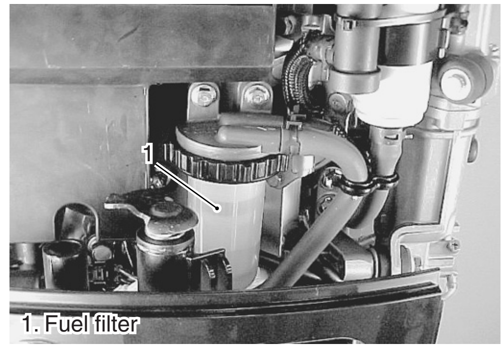
FUEL LINE

- **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 the fuel line.



LOW PRESSURE FUEL FILTER

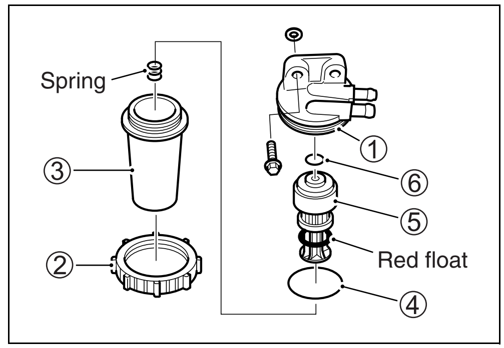


1. Fuel filter

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

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

NOTE:
When water is present in the fuel supply, the red indicator float surrounding the filter element rises.
Whenever the red float is up, remove filter cap and drain the water.



Inspect and Cleaning

⚠ WARNING

- **Stop the motor before cleaning the fuel filter.**
- **Do not smoke and keep open flames and sparks away while working near any part of the fuel system.**

1. Turn the engine “off”.
2. Remove the two (2) bolts securing low pressure fuel filter to filter bracket and remove fuel filter.
3. Remove the ring nut ②.
4. Separate the filter cap ③ from filter body ①, then remove large O-ring ④, filter element ⑤ and small O-ring ⑥.
5. Inspect filter element and O-rings for damage.
   Replace if damaged.
6. Wash the filter element with cleaning solvent.
7. Assemble the small O-ring ⑥ and filter element ⑤ to filter body ①.
8. Install large O-ring ④ and filter cap ③, then thread the ring nut ② into position.
9. Install low pressure fuel filter and tighten bolts securely.
10. Restart the engine and check that there are no leaks around the fuel filter.

HIGH PRESSURE FUEL FILTER

1. High pressure fuel filter

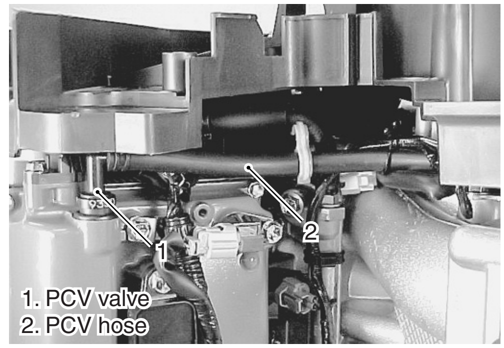
Replace every 1 000 hours.

SUZUKI recommends that replacing the high pressure fuel filter every 1 000 operating hours.

PCV SYSTEM

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

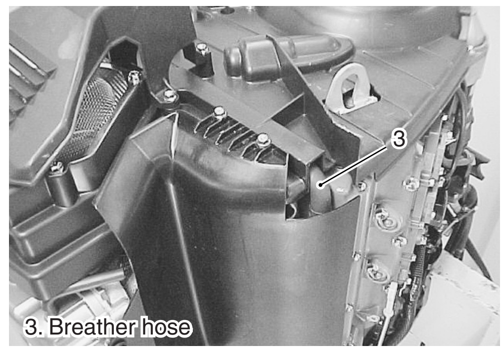
NOTE:
Be sure to check for any obstruction in the PCV valve or its hose before checking engine idle speed.
An obstructed PCV valve or hose prevents proper operation of idle speed control.



1. PCV valve
2. PCV hose

PCV HOSE

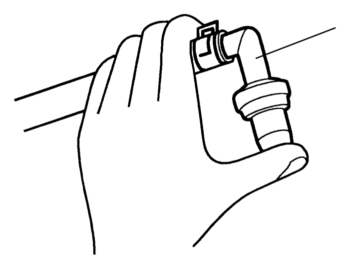
Check crank case ventilation hoses (breather hose) and PCV hoses for connection, leakage, cracks, clog or deterioration.
Check for sticking or clogged PCV valve. Replace as necessary.



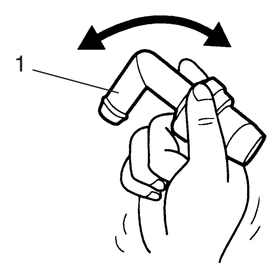
3. Breather hose

PCV valve inspection

1. Remove ring gear cover and air intake silencer case. (See page 6-2.)
2. Disconnect PCV valve from cylinder head cover.
3. Reinstall ring gear cover and air intake silencer case.
4. Run engine at idle.
5. Place your finger over end of PCV valve to check for vacuum.
   If there is no vacuum, check for clogged valve. Replace as necessary.
6. After checking vacuum, stop engine and remove PCV valve from hose.
   Shake valve and listen for the rattle of check needle inside the valve.
   If valve does not rattle, replace valve.
7. After checking, connect PCV valve, PCV hose and tighten clamps securely.



1. PCV valve

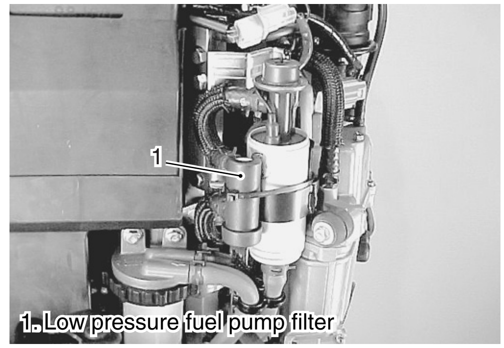


1. PCV valve

LOW PRESSURE FUEL PUMP FILTER

Replace every 1 000 hours.

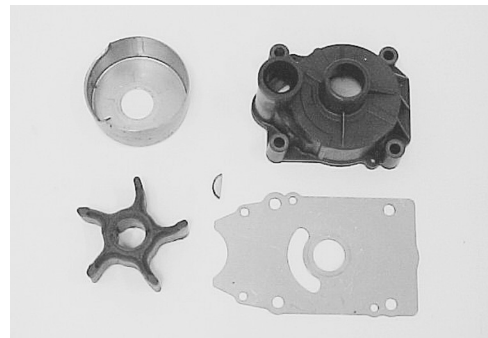
SUZUKI recommends that replacing the low pressure fuel pump filter every 1 000 operating hours.



1. Low pressure fuel pump filter

WATER PUMP/WATER PUMP IMPELLER

WATER PUMP
Inspect every 200 hours (12 months).



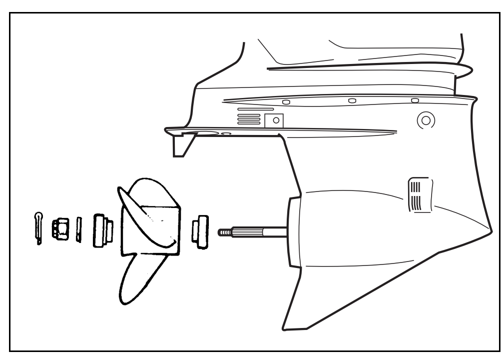
Inspect water pump case, inner sleeve and under panel.
Replace if wear, cracks, distortion or corrosion is found.

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

SUZUKI recommends that replacing the water pump impeller every 200 hours (12 months).
Inspect water pump impeller.
Replace if vanes are cut, torn or worn.

PROPELLER/NUT/COTTER PIN

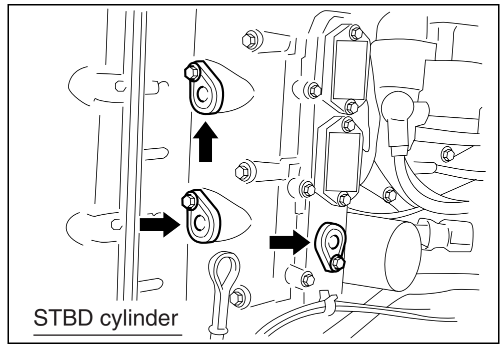
Inspect initially after 20 hours (1 month) and every 100 hours (6 months).



- 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

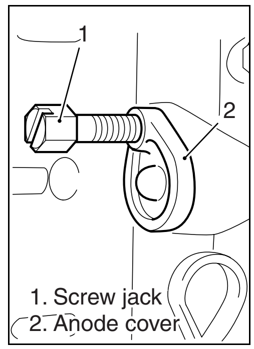
Inspect every 50 hours (3 months).

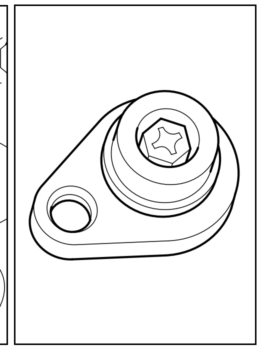


ANODES

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.

NOTE:
The anode cover may be separated from the power unit body by inserting and turning a 10 mm bolt to function as a screw jack.



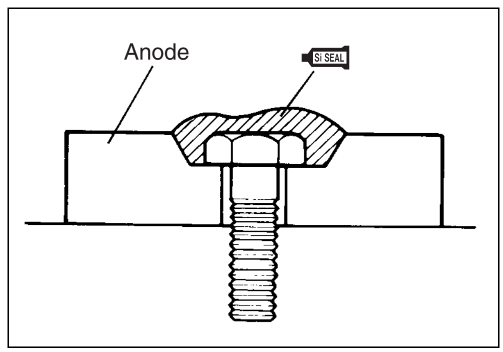


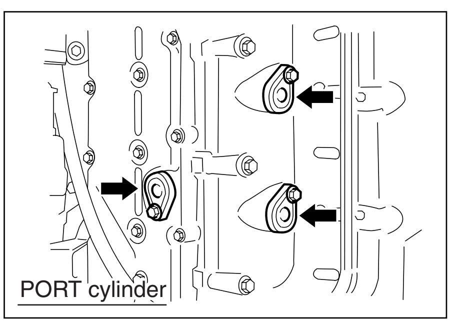
CAUTION

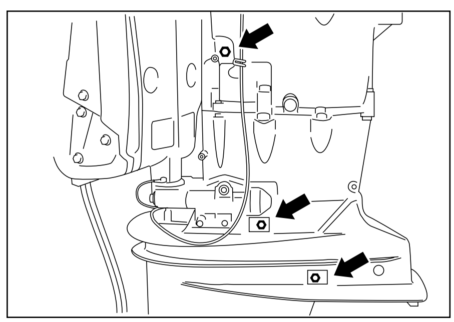
Never paint the anode.

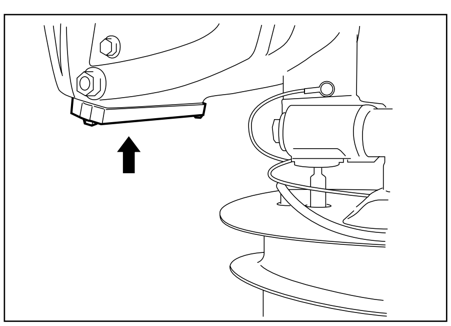
NOTE:
The anode securing bolt should be covered with SUZUKI SILICONE SEAL.

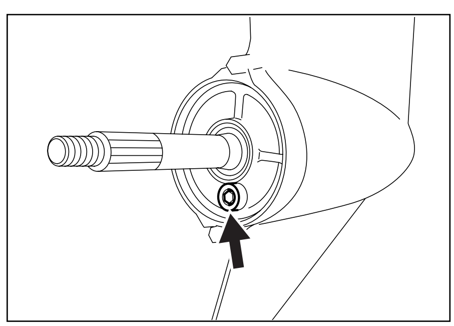
99000-31120: SUZUKI SILICONE SEAL







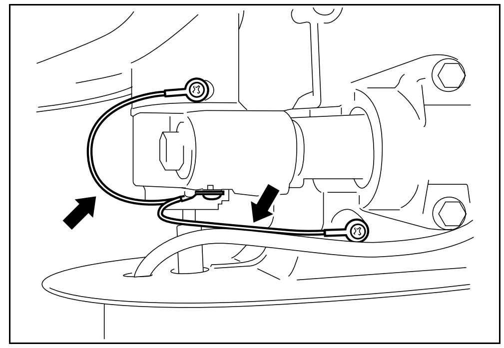


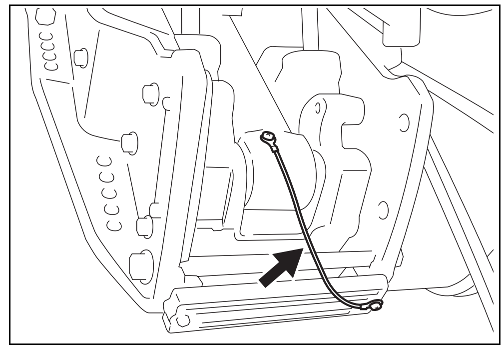


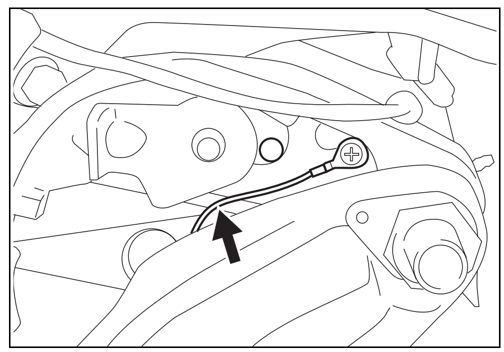
BONDING WIRES

Inspect every 50 hours (3 months).

- If breakage or other damage is found on bonding wire, replace the 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).

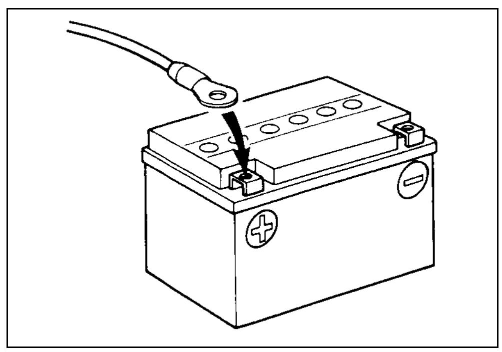
⚠ WARNING

- **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 130 AH (468 kC) or larger

CONNECTING BATTERY

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

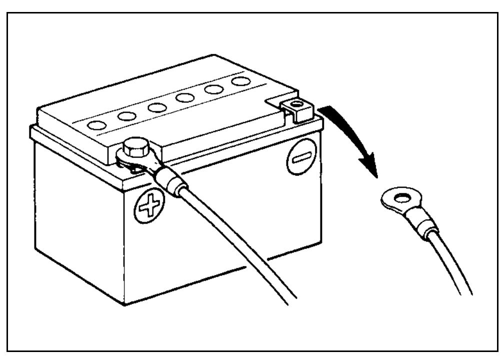


How to connect:

1. Connect positive (+) terminal first.
2. Connect negative (–) terminal second.

How to disconnect:

1. Disconnect negative (–) terminal first.
2. Disconnect positive (+) terminal second.

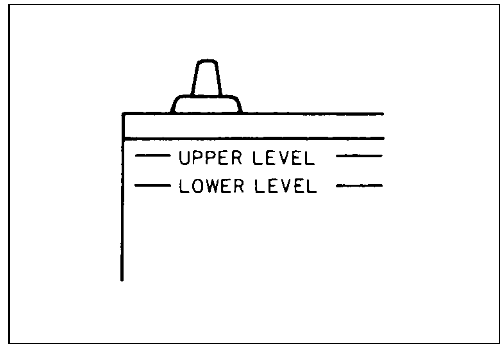


CAUTION

- **If the battery leads are loose, incorrectly connected or reversed, the electrical system could be damaged.**
- **Wing nuts must not be used and hexagon nuts must be used to secure sub battery cable to the battery terminals to avoid loss of electrical power.**

BATTERY SOLUTION LEVEL CHECK

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

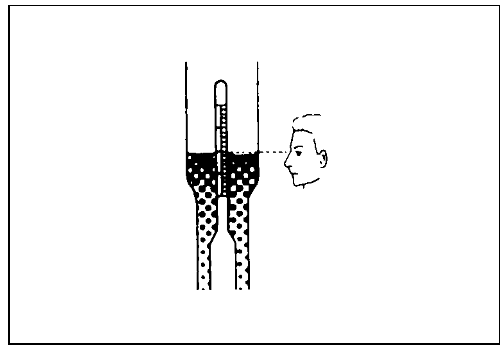


CAUTION

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

BATTERY SOLUTION GRAVITY CHECK

Measure the gravity of battery solution using a hydrometer.



Battery solution gravity: 1.28 at 20 °C

TOOL **09900-28403: Hydrometer**

BOLTS 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
Intake collector	8 mm	23	2.3	16.5
Flywheel bolt	12 mm	118	11.8	85.5
Power unit mounting bolt	8 mm	23	2.3	16.5
	10 mm	50	5.0	36.0
Clamp bracket shaft nut	7/8-14 UNF	43	4.3	31.0
Gearcase bolt	10 mm	55	5.5	40.0
	12 mm	83	8.3	60.0
Propeller nut	18 mm	55	5.5	40.0

OIL PRESSURE

Oil pressure (at normal operating temp.):
400 – 600 kPa (4.0 – 6.0 kg/cm², 57 – 85 psi)
at 3000 r/min.

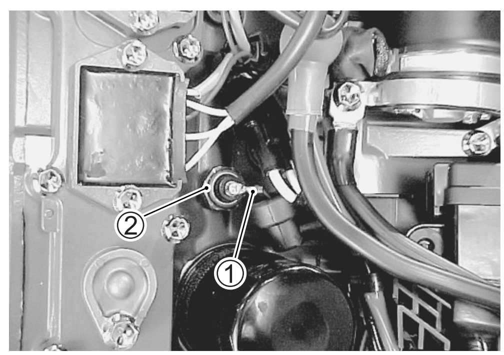
NOTE:
The figure shown above is a guideline only, not an absolute service limit.

If oil pressure is lower or higher than specification, the following causes may be considered.
(See page 6-84 for oil passage locations.)

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

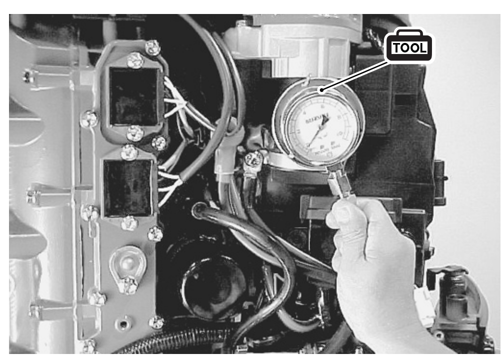
High oil pressure
- Using an engine oil of too high viscosity
- Clogged oil passage
- Clogged oil pressure regulator
- Combination of above items

TEST PROCEDURE
1. Check the engine oil level.
2. Loosen screw and disconnect blue lead wire ① from oil pressure switch ②.
   Remove the oil pressure switch.



3. Install oil pressure gauge adaptor into oil pressure switch hole in place of oil pressure switch.

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



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

   Summer : 5 min. at 2 000 r/min.
   Winter : 10 min. at 2 000 r/min.

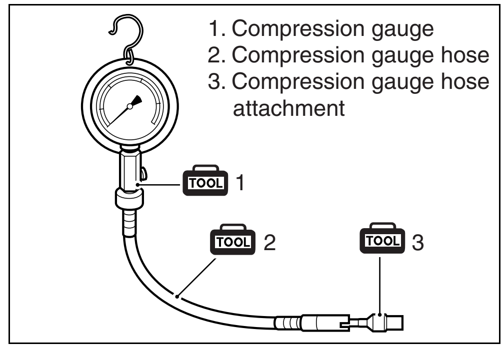
5. After warming up, shift into forward gear and increase engine speed to 3 000 r/min., then compare pressure indicated on gauge to specifications.
6. After testing, reinstall oil pressure switch.
   (See page 3-95.)

Monitor-tachometer

CYLINDER COMPRESSION

Cylinder compression:
Standard: 1 100 – 1 500 kPa
(11 – 15 kg/cm², 156 – 213 psi)
Max. difference between cylinders:
100 kPa (1.0 kg/cm², 14 psi)

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

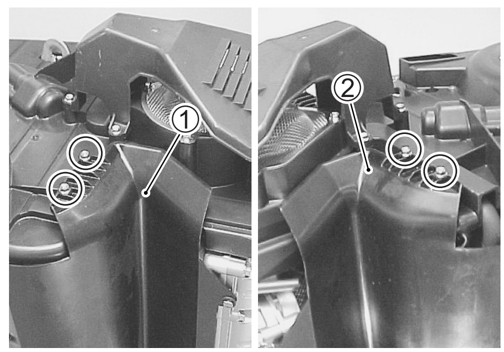


Low compression pressure can indicate one or more of the following:

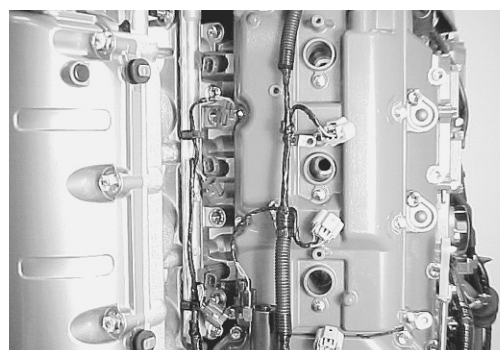
- Excessively worn cylinder wall
- Worn piston or piston rings
- Stuck piston rings
- Poor seating of valves
- Ruptured or otherwise damaged cylinder head gasket

TEST PROCEDURE

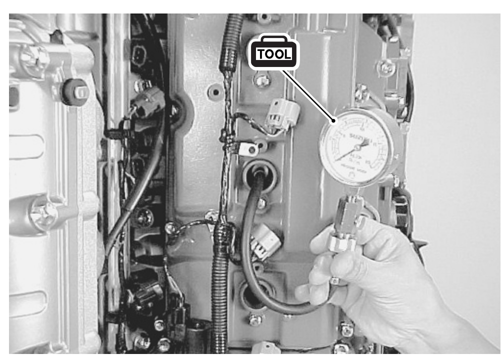
1. Start engine and allow to warm up, then shut engine off.
2. Remove bolts and PORT and STBD air duct guard ①·②.



3. Disconnect all fuel injector connectors at fuel injector.
4. Disconnect all ignition coil connectors.
5. Remove the bolts securing the ignition coil, then remove all ignition coils and spark plugs.

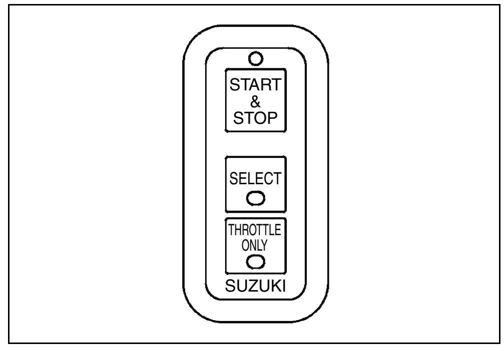


6. Install compression gauge hose attachment into spark plug hole, then connect compression gauge hose to gauge hose attachment and compression gauge.



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

7. Turn the main switch “ON”.
8. Confirm the select switch LED lights.
   If not, depress the “SELECT” button on switch panel.
9. Depress the “THROTTLE ONLY” button.
10. Move and hold remote control lever on throttle full open position.
11. While cranking engine with starter motor by pushing “START & STOP” button, note maximum compression pressure reading on gauge for each cylinder.
12. Reinstall parts removed earlier (spark plugs, ignition coils etc.).



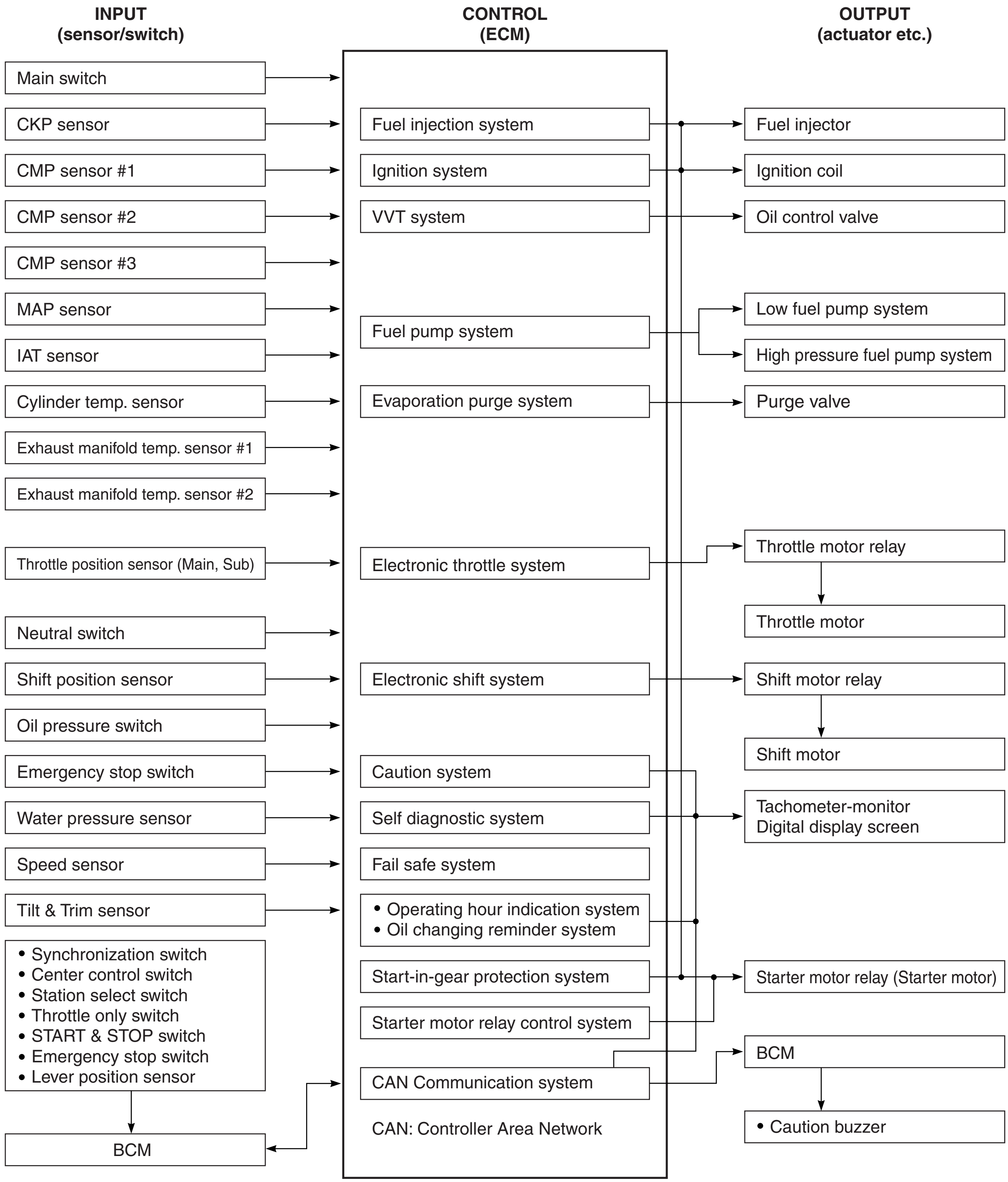
ENGINE CONTROL SYSTEM

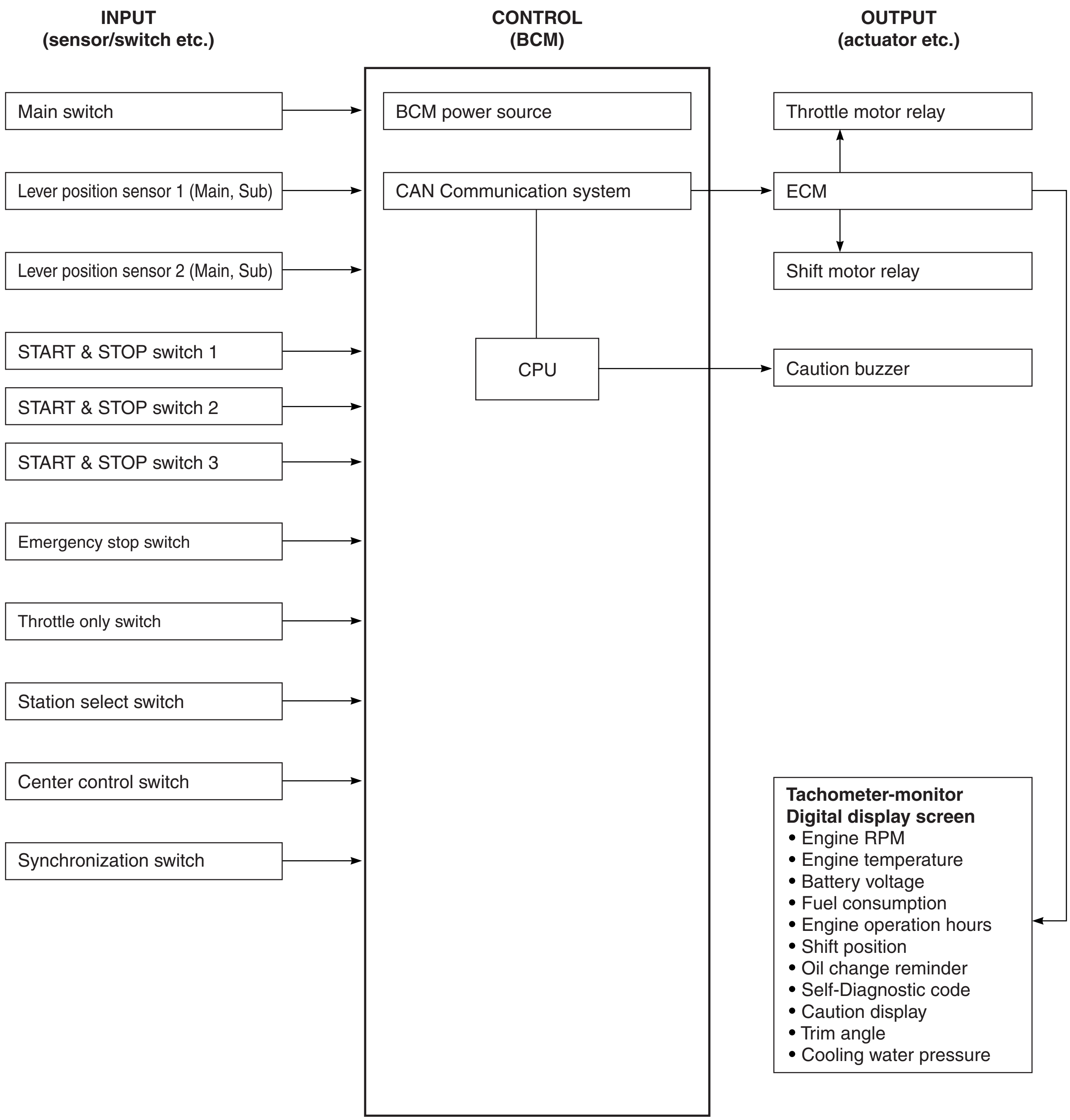
CONTENTS

ENGINE CONTROL SYSTEM STRUCTURE

The DF300 model will employ an integrated control system which performs the control functions for electronic gear shift system, electronic throttle system, fuel injection, ignition, etc. through the BCM (Boat Control Module) and ECM (Engine Control Module).

SYSTEM STRUCTURE 1




INPUT
(sensor/switch etc.)
CONTROL
(BCM)
OUTPUT
(actuator etc.)
Main switch
Lever position sensor 1 (Main, Sub)
Lever position sensor 2 (Main, Sub)
START & STOP switch 1
START & STOP switch 2
START & STOP switch 3
Emergency stop switch
Throttle only switch
Station select switch
Center control switch
Synchronization switch
BCM power source
CAN Communication system
CPU
Throttle motor relay
ECM
Shift motor relay
Caution buzzer
Tachometer-monitor
Digital display screen
• Engine RPM
• Engine temperature
• Battery voltage
• Fuel consumption
• Engine operation hours
• Shift position
• Oil change reminder
• Self-Diagnostic code
• Caution display
• Trim angle
• Cooling water pressure

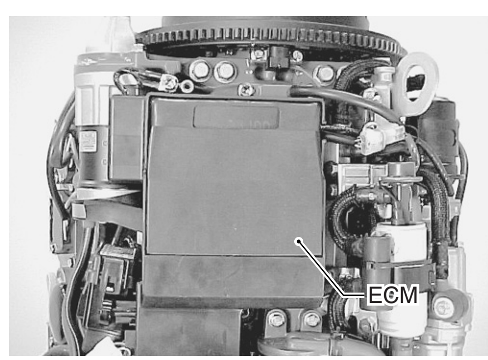
COMPONENTS FOR SYSTEM CONTROL

ENGINE CONTROL MODULE (ECM)

The ECM sends signals to control the actuators based on the information inputs from each sensor/switch and BCM (Boat Control Module). Major controls are as follows:

NAME OF CONTROL	DESCRIPTION
Fuel injection control	• Controls fuel injection amount and timing.
Ignition control	• Controls ignition timing.
Electronic throttle system	• Controls engine speed by adjusting intake air amount through electronic throttle system.
VVT system	• Controls intake cam valve timing through OCV (Oil control valve).
Fuel pump control	• Controls high pressure fuel pump drive. • Controls Low pressure fuel pump drive.
Evaporation purge system	• Discharges vapor generated within fuel vapor separator to air intake silencer case by controlling purge valve.
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 with back-up system during sensor/switch malfunction.
Total operating hour indication system control	• Informs operator of total operating time.
Oil changing reminder system control	• Informs operator of time for replacing engine oil on the basis of the maintenance schedule.
Start-in-gear protection system control	• Prevents engine start when shift is positioned in forward or reverse.
Starter motor relay control system	• Prevents starter motor operation when engine is already operating.
Electronic gear shift system	• Controls gear shifting by controlling shift actuator.
CAN communication system	• ECM and BCM communicate control data between each module. Communication is established by CAN (Controller Area Network) communication system.

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



BOAT CONTROL MODULE (BCM)

BCM sends a signal value (control signal) to ECM on the basis of input signals from switches and sensors. Based on the received signal value from BCM, ECM controls the engine and the actuators.
BCM controls the caution buzzer with the current engine condition detected through ECM. The major controls are as follows:

NAME OF CONTROL	DESCRIPTION
Throttle control	• In accordance with the control lever position (input signal from LPS) of the respective engines, the throttle operation is controlled for each engine independently. • By operating the throttle only switch, the throttle open or close operation is controlled with the shift position held in neutral.
Shift control	• In accordance with the control lever position of the respective engines, the shift operation is controlled for each engine independently.
Center control [NOTE 1]	• In the case of triple engines, the interlink between the CENTER and PORT engines is released with the center control switch operated. At this time, the CENTER engine is set to idle throttle opening (Neutral position).
Start & stop control [NOTE 2]	• During the engine at stop, pressing START & STOP switch once controls the auto-start of the engine. • During engine in operation, pressing START & STOP switch continuously for a given duration stops the engine.
Synchronization [NOTE 3]	• In the case of multi engines, pressing the Synchronization switch automatically adjusts the speed of each engine to that of PORT engine approximately. • By operating the Synchronization switch, either turning on or off the synchronization function can be selected.
Caution buzzer control	• The caution buzzer at each operator seat are controlled according to engine operating conditions.
LED control	• The lighting of LED in the switch panel at each operator seat is controlled according to the boat and engine operating conditions.
Engine stop control	• The engine stopping is controlled by the signal sent from the emergency stop switch.

NOTE:
- *After completion of rigging, the following calibration must be made to the BCM using SDS Ver.5 and PC prior to boating.*
  - *Number of stations*
  - *Number of engines*
  - *Position of outboard motor*
  - *Characteristic of remote control lever*
  - *Full trim down position*
- *Maximum of three engines can be controlled with one BCM.*
- *One BCM should be installed for each station.*
- *In the case of two stations, BCM of the 1st station is the master BCM and that of the 2nd station is the sub-BCM.*
- *The sub-BCM functions as an Input/Output device for the master BCM.*

NOTE 1:

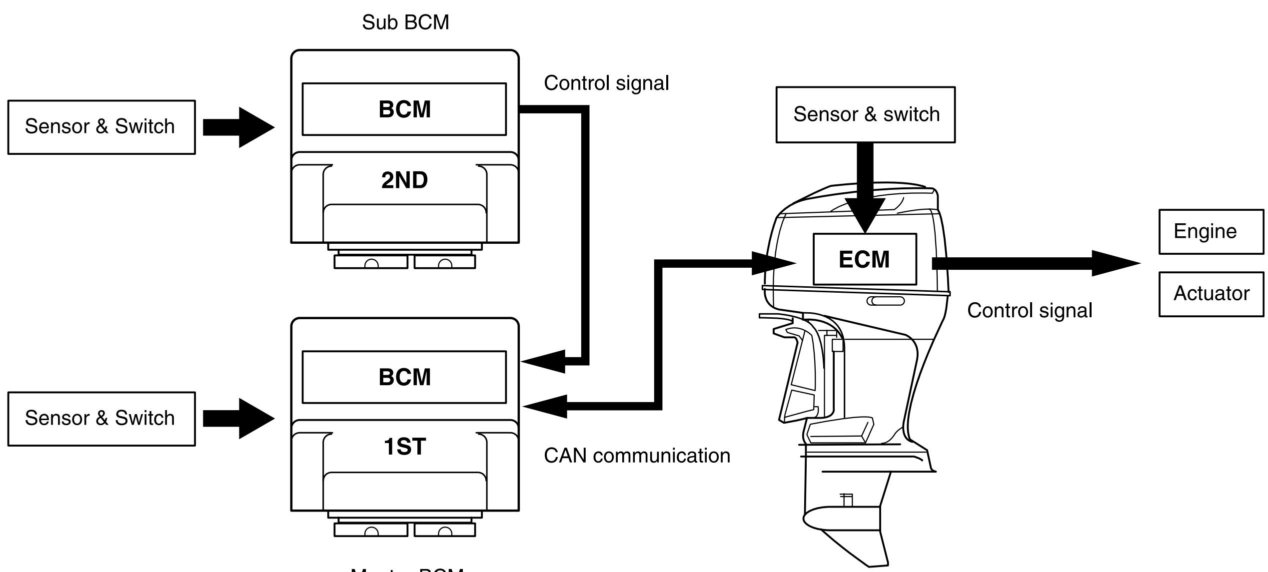
- *In the case of triple engines, normally the CENTER engine interlinks with the PORT engine.*
  The CENTER engine is controlled with the PORT remote control lever.

NOTE 2:

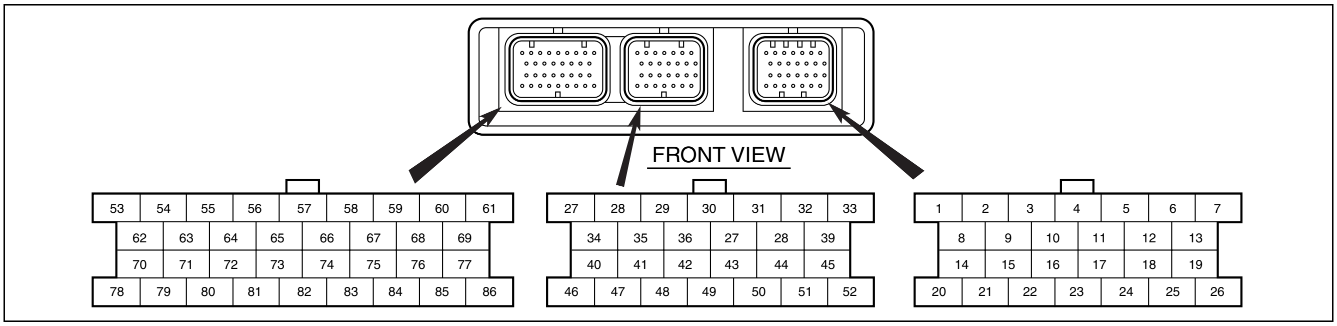
- *Pressing START & STOP switch once closes (ON) the starter circuit for three seconds but when the engine has been started, the circuit opens (OFF).*

NOTE 3:

- *Synchronization control will not function when PORT and STBD remote control lever positions are different from each other.*



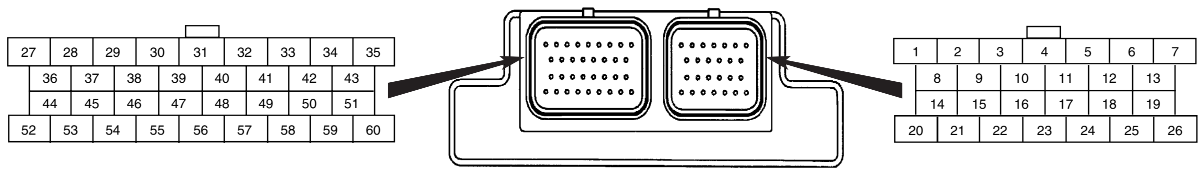
ECM CONNECTOR/TERMINALS LAYOUT



TERMI-NAL	WIRE COLOR	CIRCUIT
1	—	—
2	—	—
3	Y/Bl	CMP sensor #1
4	R/B	CKP sensor
5	V/W	Ex-manifold temp. sensor #1
6	B/W	Sensor GND
7	W	CAN (H)
8	Bl	Oil pressure switch
9	O/G	CMP sensor #2 (VVT_ PORT)
10	B/O	CMP sensor #3 (VVT_ STBD)
11	Bl/B	Water pressure sensor
12	G/R	Ex-manifold temp. sensor #2
13	B	CAN (L)
14	P/W	Throttle position sensor (Sub)
15	Bl/R	Emergency stop switch
16	Lbl	PTT switch UP
17	W/Y	Trim and tilt sensor
18	—	—
19	Lg/W	Cylinder temp. sensor
20	P/Bl	Shift position sensor
21	Br	Neutral/Cranking switch
22	P	PTT switch DOWN
23	G/B	Starter relay control
24	W	MAP sensor
25	Bl/W	Speed sensor
26	Lg/B	IAT sensor
27	—	—
28	—	—
29	Br/Y	Throttle position sensor (Main)
30	R/Bl	Power source for TPS
31	R/W	Power source for SPS
32	Br/B	Shift position sensor GND
33	B	Ground for ECM
34	G/Bl	Shift motor relay
35	—	—
36	—	—
37	—	—
38	B/W	Ground for TPS
39	B	Ground for ECM
40	Bl/Y	No.6 Ignition coil (–)
41	—	—
42	—	—
43	—	—

TERMI-NAL	WIRE COLOR	CIRCUIT
44	R	Power source for sensor
45	Gr	ECM power source
46	Lg/R	No.4 Ignition coil (–)
47	W/G	No.5 Ignition coil (–)
48	O	ECM main relay
49	Y	Communication line No.1
50	O/Y	Communication line No.2
51	Y/G	Ignition switch
52	Gr	ECM power source
53	Br/R	No.2 OCV (–)
54	Lg	No.4 Fuel injector (–)
55	O/B	No.1 Fuel injector (–)
56	B/Br	No.2 Fuel injector (–)
57	W/Bl	Throttle motor (–)
58	Y	Throttle motor power source
59	Y	Throttle motor power source
60	R/Y	Throttle motor (+)
61	G	Shift motor (–)
62	Br/W	No.1 OCV (–)
63	B	Ground for ECM power
64	—	—
65	B	Ground for throttle motor
66	B	Ground for throttle motor
67	B	Ground for shift motor
68	B	Ground for shift motor
69	Gr/R	Shift motor power source
70	B/R	High pressure fuel pump (–)
71	B	Ground for ECM power
72	—	—
73	Gr/Y	No.3 Ignition coil (–)
74	Bl	No.2 Ignition coil (–)
75	O	No.1 Ignition coil (–)
76	W/B	Throttle motor relay
77	Gr/R	Power source for shift motor
78	B/Y	Low pressure fuel pump (–)
79	R/W	No.3 Fuel injector (–)
80	Y/R	No.6 Fuel injector (–)
81	O/Bl	No.5 Fuel injector (–)
82	—	—
83	—	—
84	O/W	Purge valve
85	—	—
86	R	Shift motor (+)

BCM CONNECTOR/TERMINALS LAYOUT

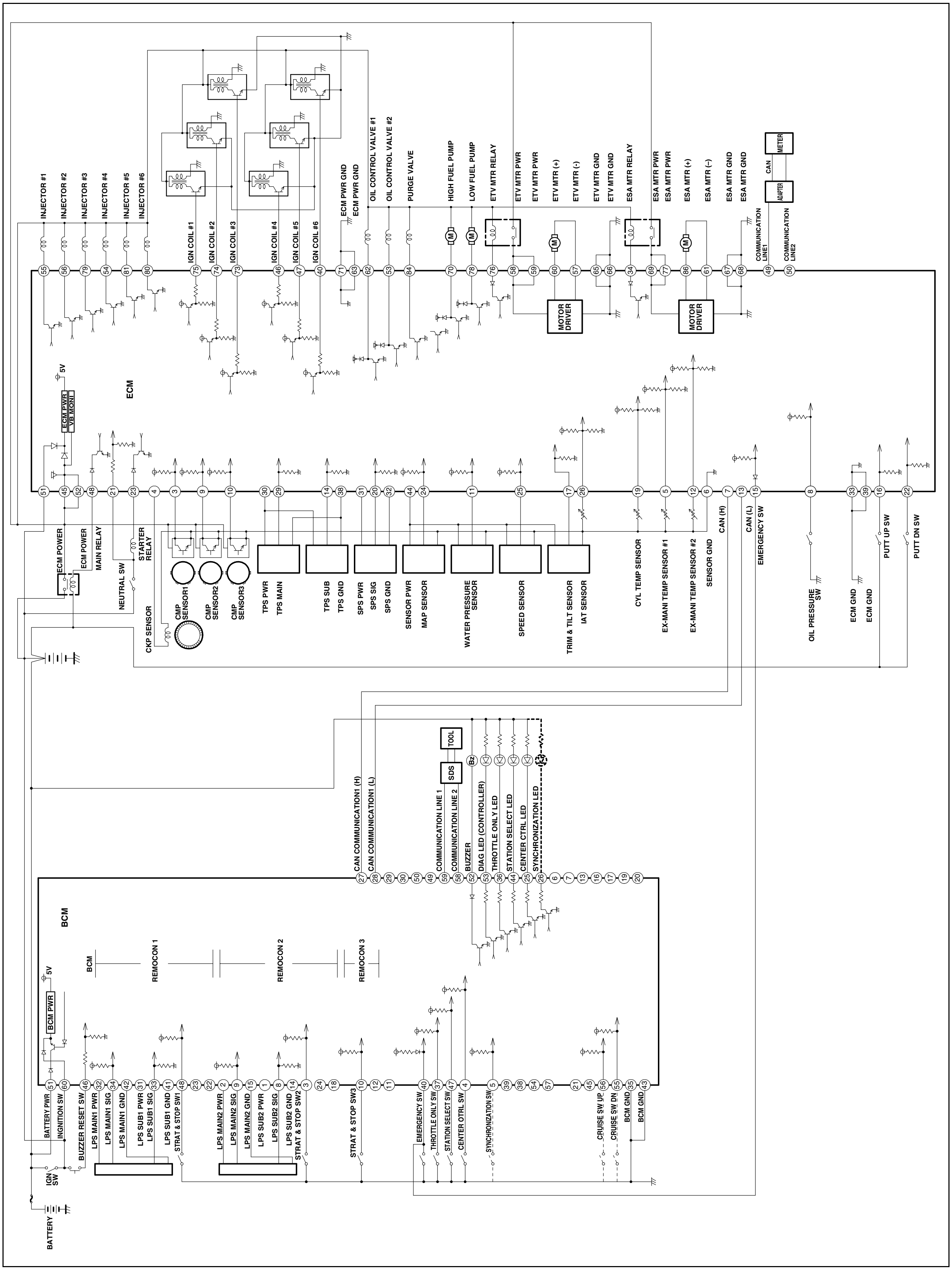


(FRONT VIEW)

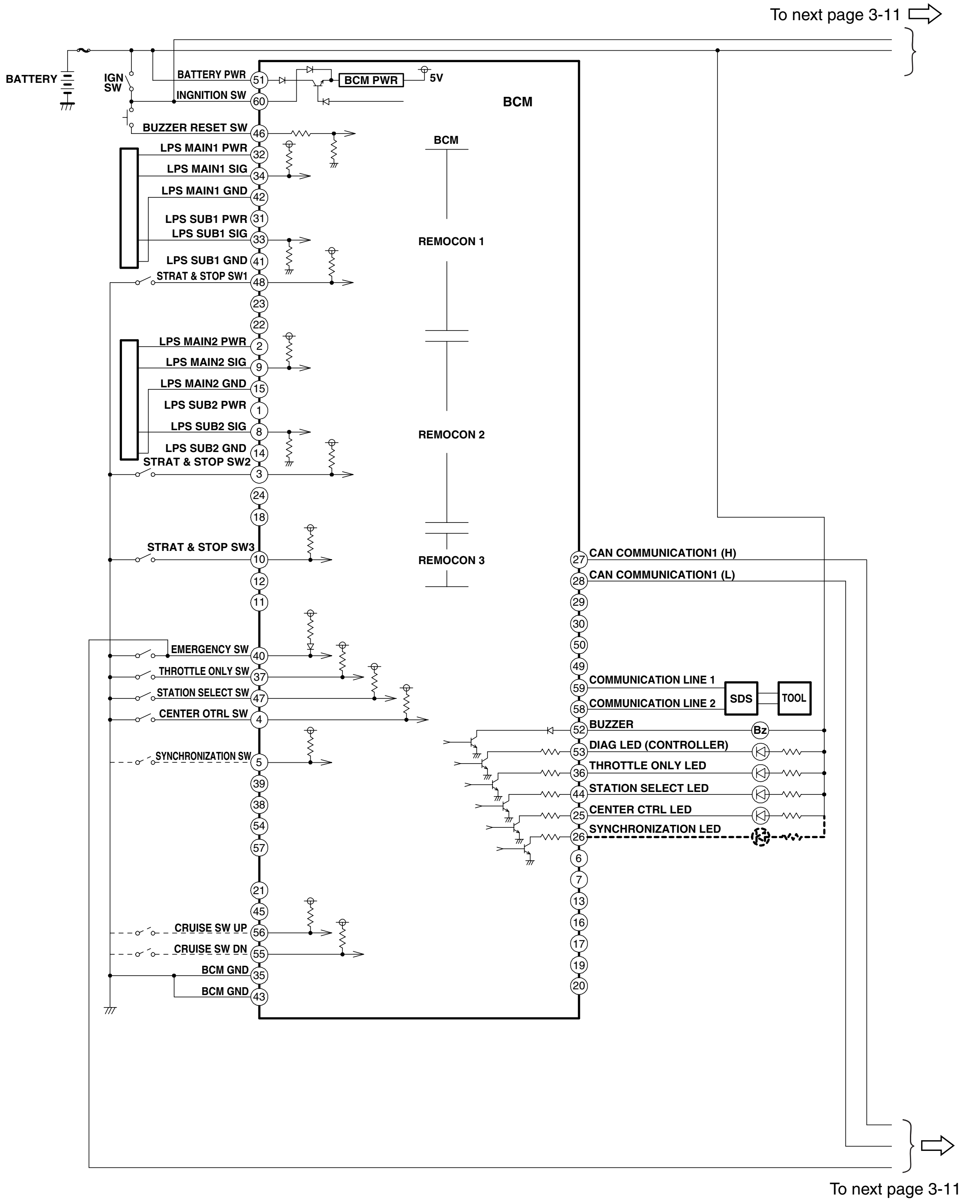
TERMINAL	WIRE COLOR	CIRCUIT
1	—	—
2	R/Y	Power source for LPS main 2
3	Y/B	Start & Stop switch 2
4	Lg/B	Center control switch
5	O/B	Synchronization switch
6	—	—
7	—	—
8	Bl/Y	Lever position sensor sub 2
9	W/Y	Lever position sensor main 2
10	Y/R	Start & Stop switch 3
11	—	—
12	—	—
13	—	—
14	—	—
15	B/Y	Lever position sensor main 2 GND
16	—	—
17	—	—
18	—	—
19	—	—
20	—	—
21	—	—
22	—	—
23	—	—
24	—	—
25	Lg	Center engine control LED
26	O	Synchronization LED
27	W	CAN 1 (H)
28	B	CAN 1 (L)
29	—	—
30	—	—

TERMINAL	WIRE COLOR	CIRCUIT
31	—	—
32	R/W	Power source for LPS main 1
33	W/B	Lever position sensor sub 1
34	Bl/W	Lever position sensor main 1
35	B	Ground for BCM
36	G	Throttle only LED
37	G/B	Throttle only switch
38	—	—
39	—	—
40	G	Emergency stop switch
41	—	—
42	B/W	Lever position sensor main 1 GND
43	B	Ground for BCM
44	Br	Station select LED
45	—	—
46	O	Buzzer reset switch
47	Br/W	Station select switch
48	Y/G	Start & Stop switch 1
49	—	—
50	—	—
51	W	BCM power source
52	Bl	Buzzer
53	G/W	Diag LED
54	—	—
55	Lg/G	Cruise down switch
56	Lg/Bl	Cruise up switch
57	—	—
58	Y	Communication line No.2
59	O/Y	Communication line No.1
60	Gr	Main switch

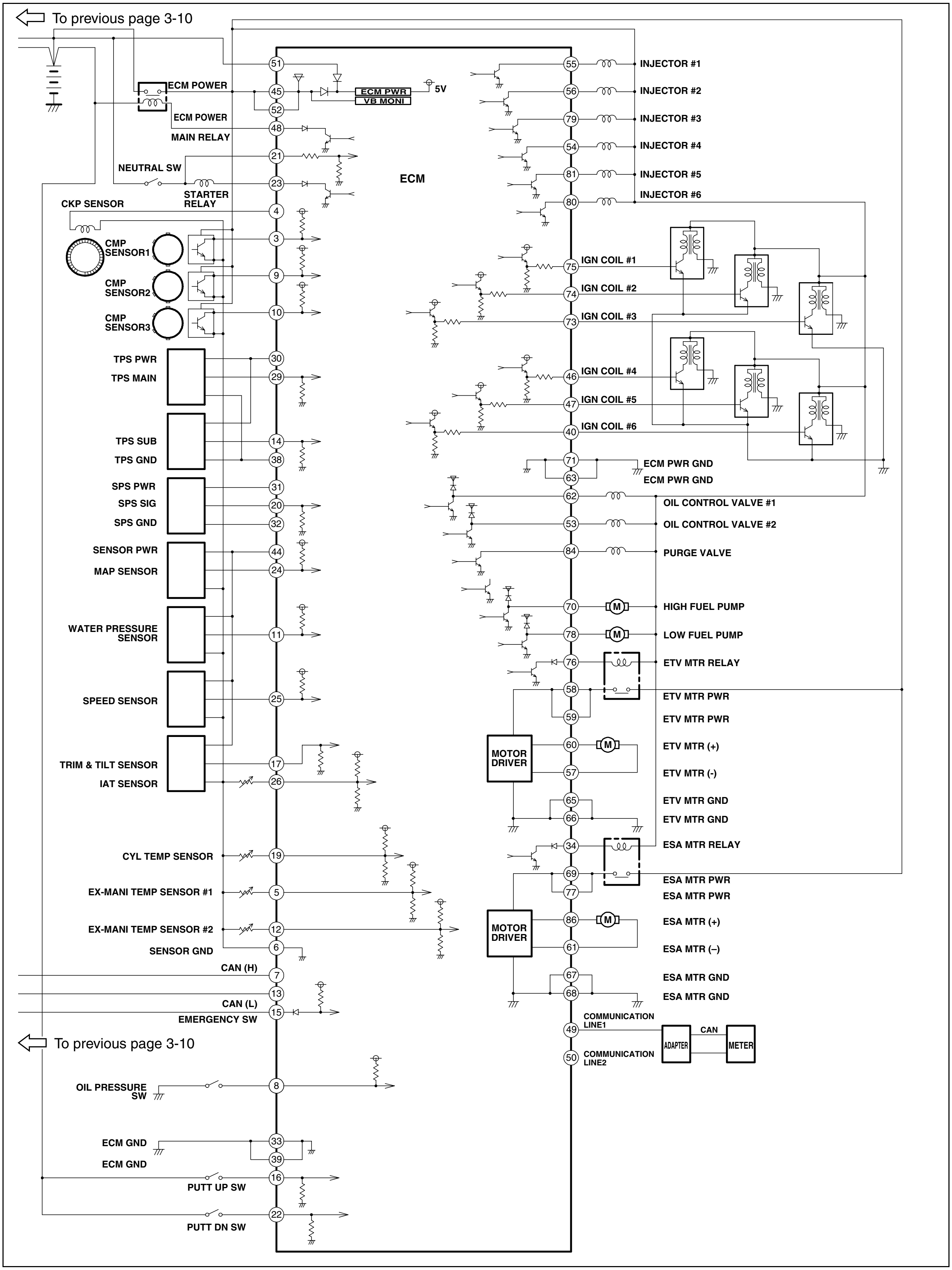
ECM AND BCM INTERNAL STRUCTURE [WHOLE STRUCTURE]



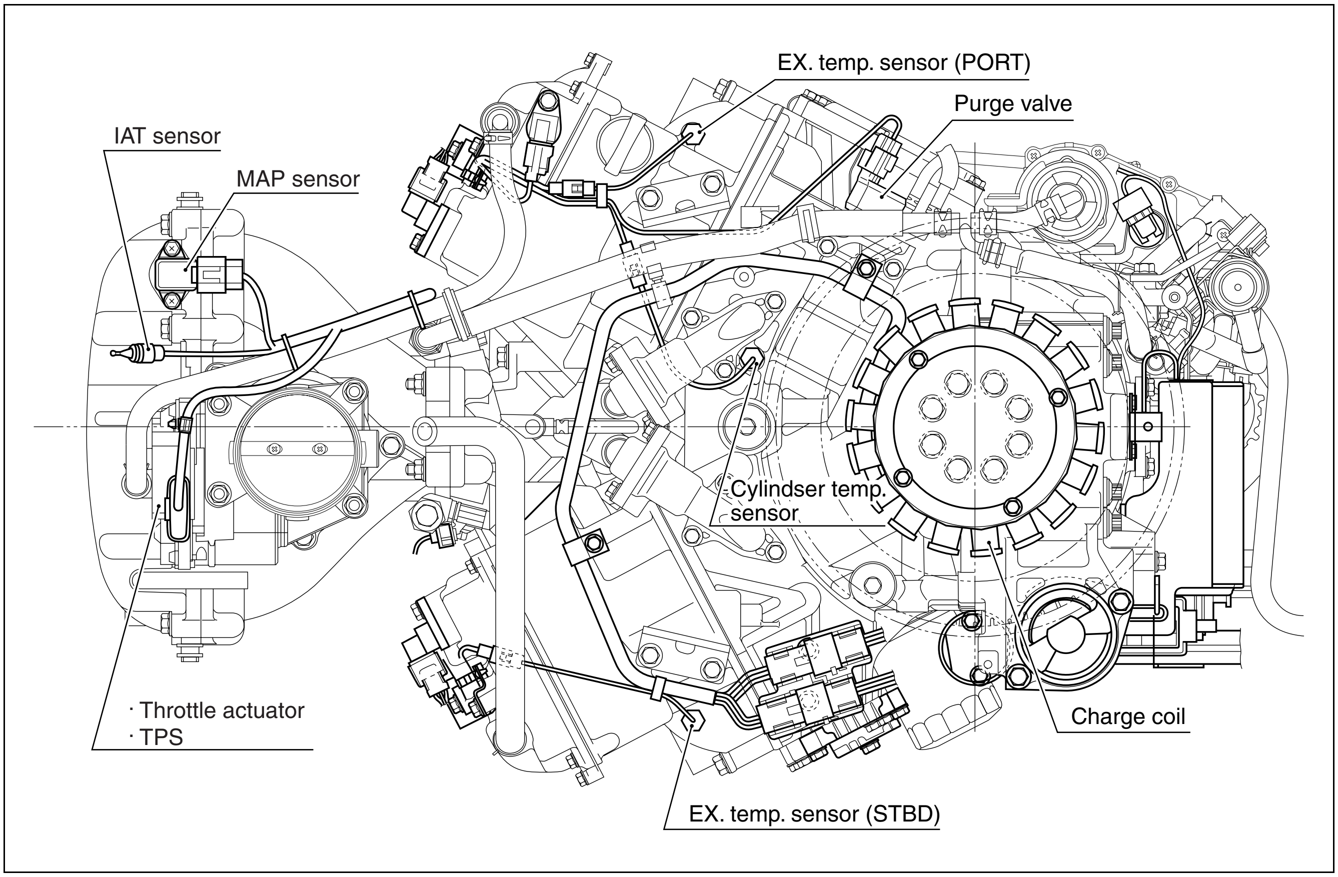
BCM INTERNAL STRUCTURE [PART STRUCTURE-1]

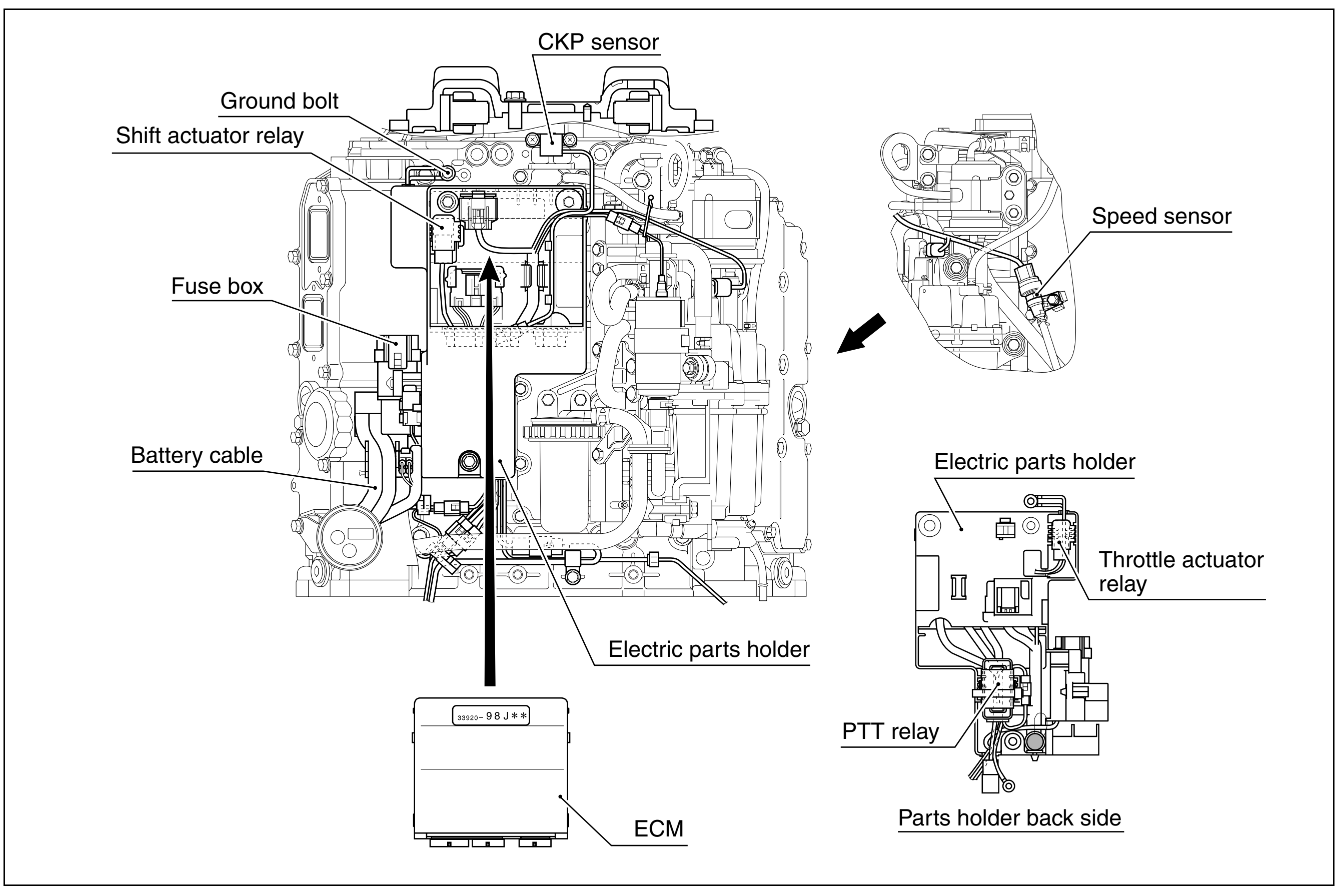


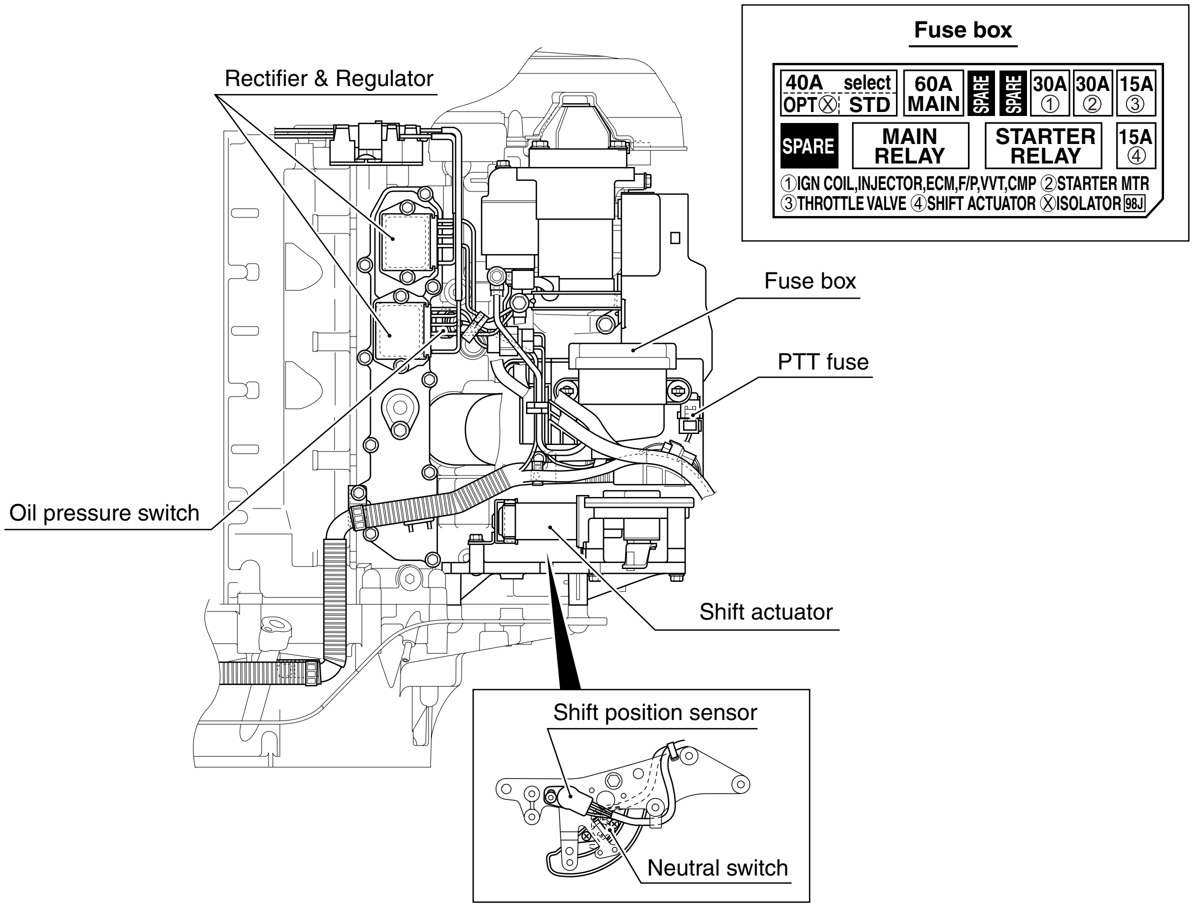
ECM INTERNAL STRUCTURE [PART STRUCTURE-2]

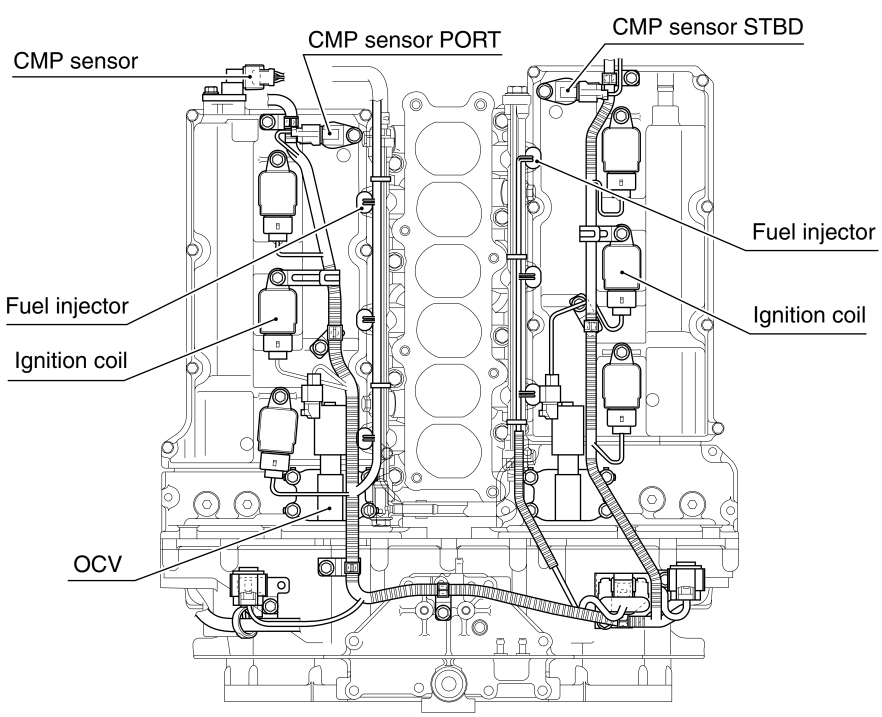


LOCATION OF SENSOR AND SWITCH






Fuse box
40A select
OPT ⓧ STD
60A
MAIN
SPARE
SPARE
30A ①
30A ②
15A ③
SPARE
MAIN RELAY
STARTER RELAY
15A ④
①IGN COIL,INJECTOR,ECM,F/P,VVT,CMP ②STARTER MTR
③THROTTLE VALVE ④SHIFT ACTUATOR ⓧISOLATOR 98J
Rectifier & Regulator
Fuse box
PTT fuse
Oil pressure switch
Shift actuator
Shift position sensor
Neutral switch


CMP sensor
CMP sensor PORT
CMP sensor STBD
Fuel injector
Fuel injector
Ignition coil
Ignition coil
OCV

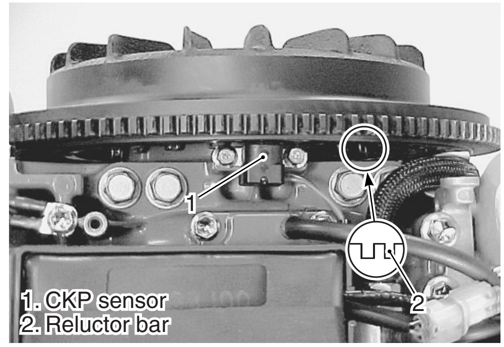
SENSOR AND SWITCH

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.

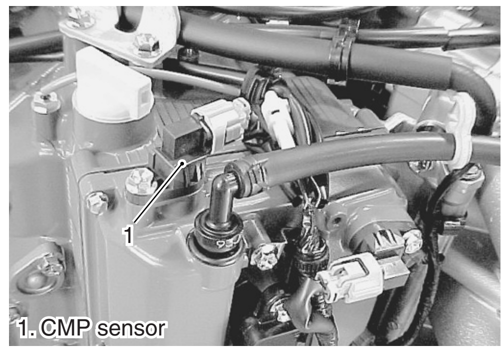
This is the fundamental signal used to judge engine speed and crankshaft angle.

There are 34 reluctor bars, spaced 10 degrees apart, followed by a 20 degree index space. During one crankshaft rotation, 34 signals are input to the ECM.



CMP (Camshaft Position) SENSOR #1

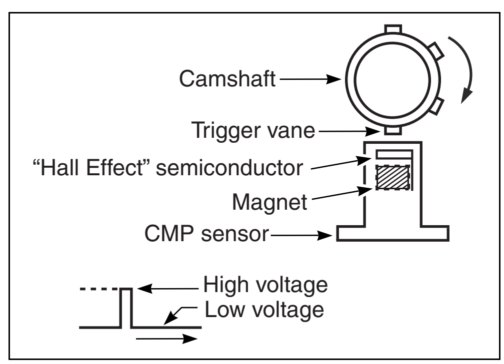
- CMP sensor #1 is mounted on the PORT cylinder head cover with trigger vanes pressed onto the end of the PORT exhaust camshaft. This sensor detects piston position.
- Signals received from this sensor are also used by the ECM to determine sequential fuel injection and ignition control.



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.

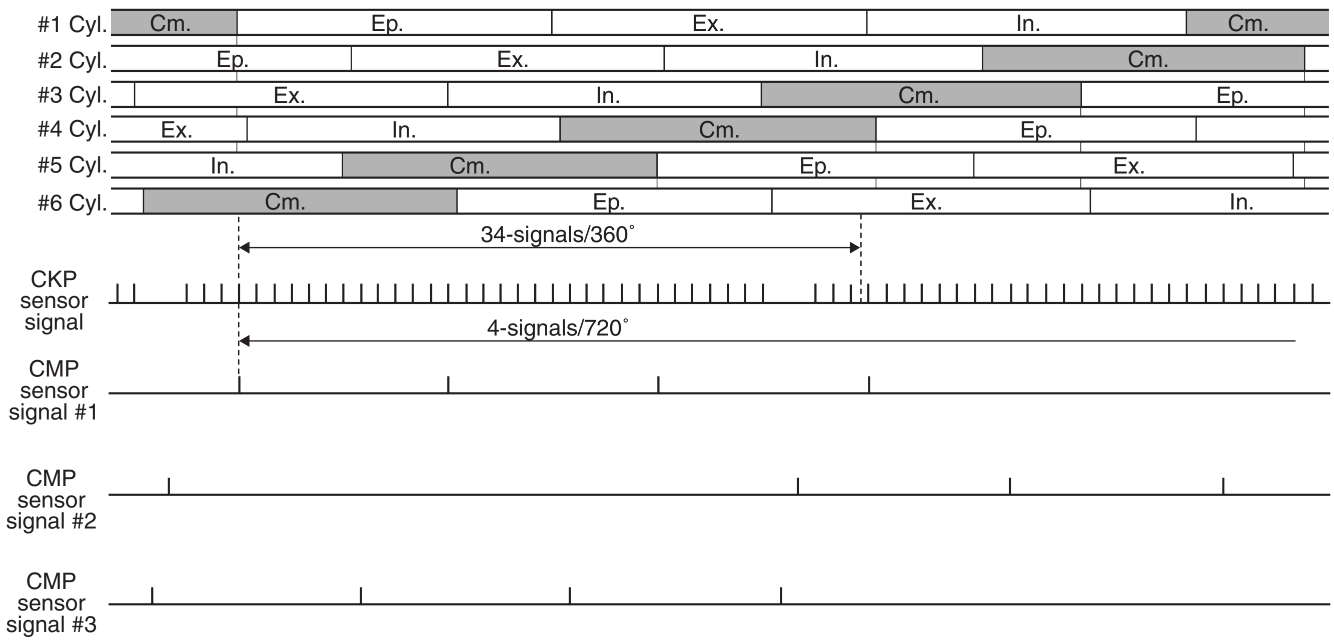
These generated voltages are rectified to create “ON” (high voltage) & “OFF” (low voltage) signals to the ECM.

The four camshaft trigger vanes provide four high voltage signals from CMP sensor to ECM during one rotation of camshaft (two rotations of crankshaft).



ECM cylinder identification:

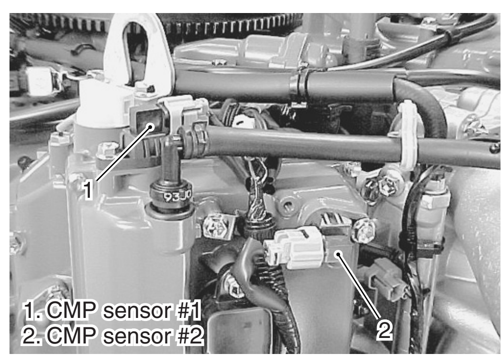
Cylinders are identified by a calculation combined from two signals; one from the CKP sensor and one from the CMP sensor.



In.: Intake, Cm.: Compression, Ep.: Explosion, Ex.: Exhaust

CMP (Camshaft position) SENSOR #2

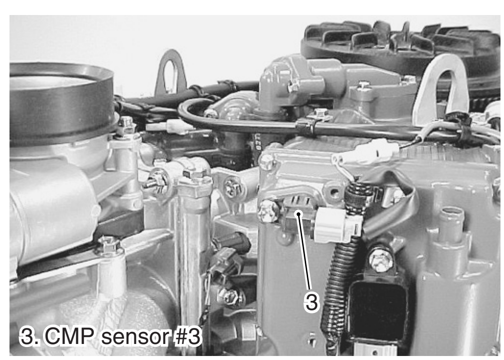
- CMP sensor #2 is mounted on the PORT cylinder head cover with trigger vanes pressed onto the end of the PORT intake camshaft. This sensor detects camshaft position.
- This sensor is the same type as the CMP sensor #1, and inputs signals to ECM. This signal is used to control PORT intake camshaft valve timing through OCV (Oil control valve).



1. CMP sensor #1
2. CMP sensor #2

CMP (Camshaft position) SENSOR #3

- CMP sensor #3 is mounted on the STBD cylinder head cover with trigger vanes pressed onto the end of the STBD intake camshaft. This sensor detects camshaft position.
- This sensor is the same type as the CMP sensor #1, and inputs signals to ECM. This signal is used to control STBD intake camshaft valve timing through OCV (Oil control valve).



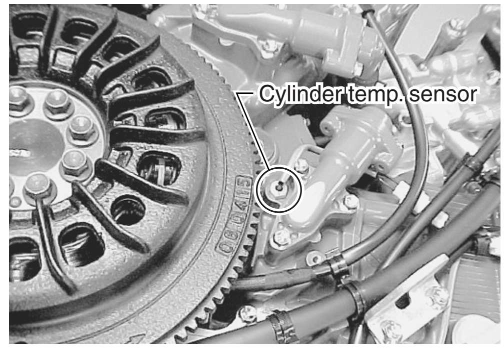
3. CMP sensor #3

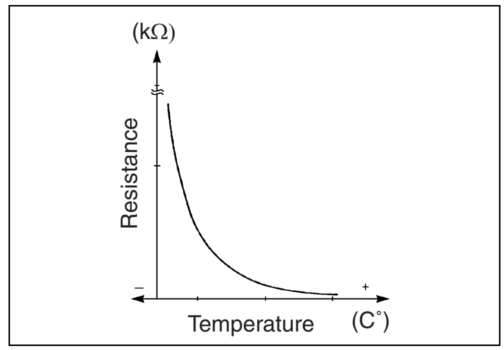
CYLINDER TEMPERATURE SENSOR

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 temperature) and inputs a signal to the ECM as a voltage value. This signal is used to compensate the fuel injection time duration, ignition timing, evaporation purge system, etc.

This sensor is also used to detect engine over-heat as the ECM detects both the temperature and temperature change gradient (temperature increase vs time).



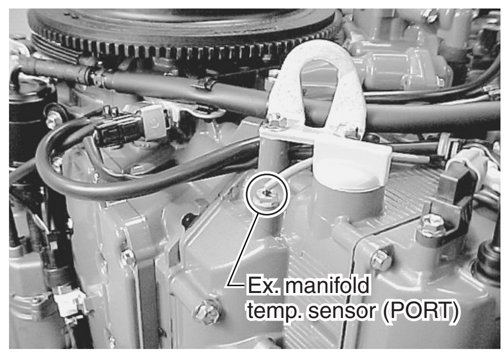


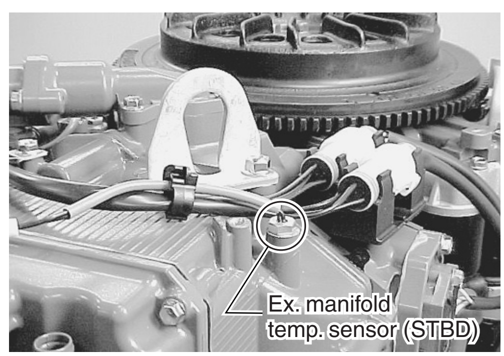
EXHAUST MANIFOLD TEMPERATURE SENSOR

Two exhaust manifold temperature sensor are used, one installed on each exhaust manifold (PORT and STBD) and used to detect 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 signal is also used to detect engine over-heat and control evaporation purge system.



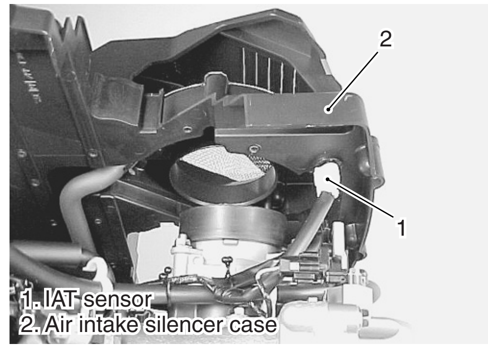


IAT (Intake Air Temperature) SENSOR

The IAT sensor is installed on the bottom of the ring gear cover and air intake silencer case 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 signal is used to compensate the fuel injection time duration.



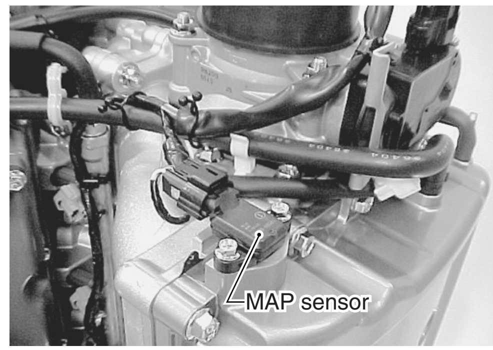
1. IAT sensor
2. Air intake silencer case

MAP (Manifold Absolute Pressure) SENSOR

The MAP sensor is installed on the intake collector assembly (top side) and used to detect the intake manifold (surge tank) pressure.

It also detects the barometric pressure before starting the engine. This sensor inputs the intake manifold (surge tank) pressure to the ECM as a voltage value.

This input signal is used as the fundamental signal to determine fuel injection time duration, ignition timing, VVT system control etc.



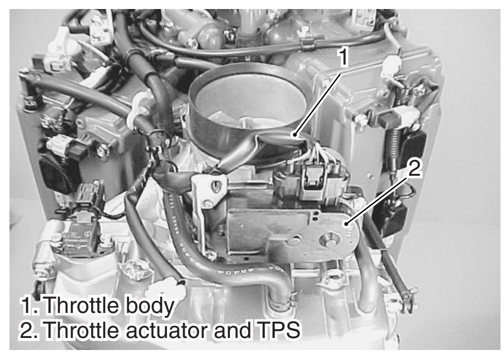
TPS (Throttle Position Sensor)

TPS is integrated in the throttle body and detects the throttle opening.

TPS is of non contact type using a hall IC (element) implementing the detection in two systems, main- and sub-systems.

The sensor converts the throttle valve opening into a voltage signal which is then inputted to ECM.

Based on the TPS voltage and remote control LPS signal, the ECM calculates the idle position and throttle opening and determines the control modes of various controls systems (Fuel injection control system, Electronic throttle system, etc.).



1. Throttle body
2. Throttle actuator and TPS

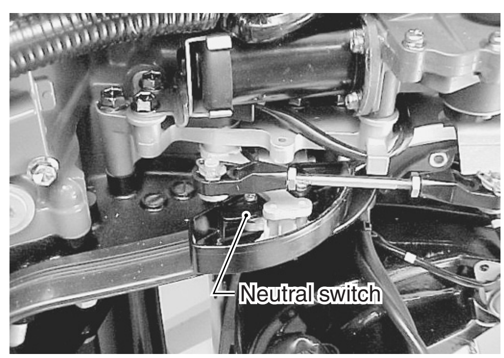
NEUTRAL SWITCH

The neutral switch is installed on the shift actuator holder 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:

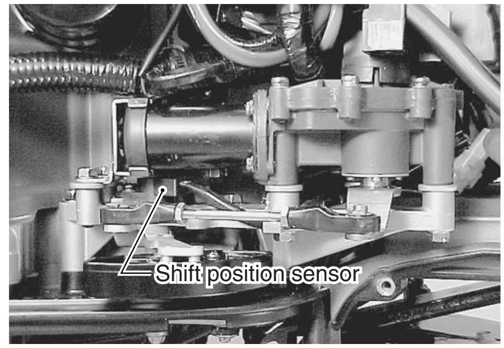
- When the shift is in forward or reverse at the time of engine start, no power is supplied to starter motor relay preventing starter motor engagement.
  (Start-in-gear protection. See page 3-56.)



SPS (Shift Position Sensor)

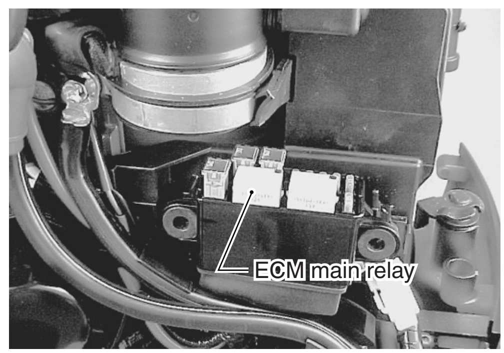
The SPS is installed on the shift actuator holder and detects the shift position with the clutch lever operation interlocked.
This sensor is a variable resistor that changes resistance (ohms) in accordance with the shift position.
The varying resistance value is converted to voltage and input to the ECM.
Based on the SPS voltage and remote control lever position sensor signal, the ECM calculates and determines the change of shift position and executes the following controls.

- When the shift is in neutral, fuel injection is controlled to prevent engine speed from exceeding 3 000 r/min.



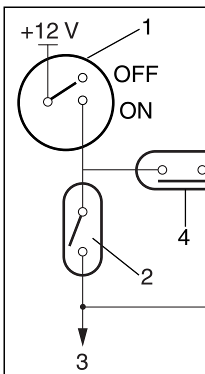
ECM MAIN RELAY

The ECM main relay is installed in the fuse box. When energized by turning the main switch ON, a circuit is formed which supplies battery voltage to the ECM, fuel injector, ignition coil, throttle actuator, shift actuator, CMP sensor, high/low pressure fuel pump, purge valve and OCV (Oil control valve).



CRANKING SWITCH SIGNAL

The ECM detects the engine being started by the main switch ON. When the main key is turned to ON position, a voltage (12 V) signal is input to the ECM.
Pushing the start button, the ECM in turn controls the actuators for ignition, fuel injection, etc. to the starting mode.



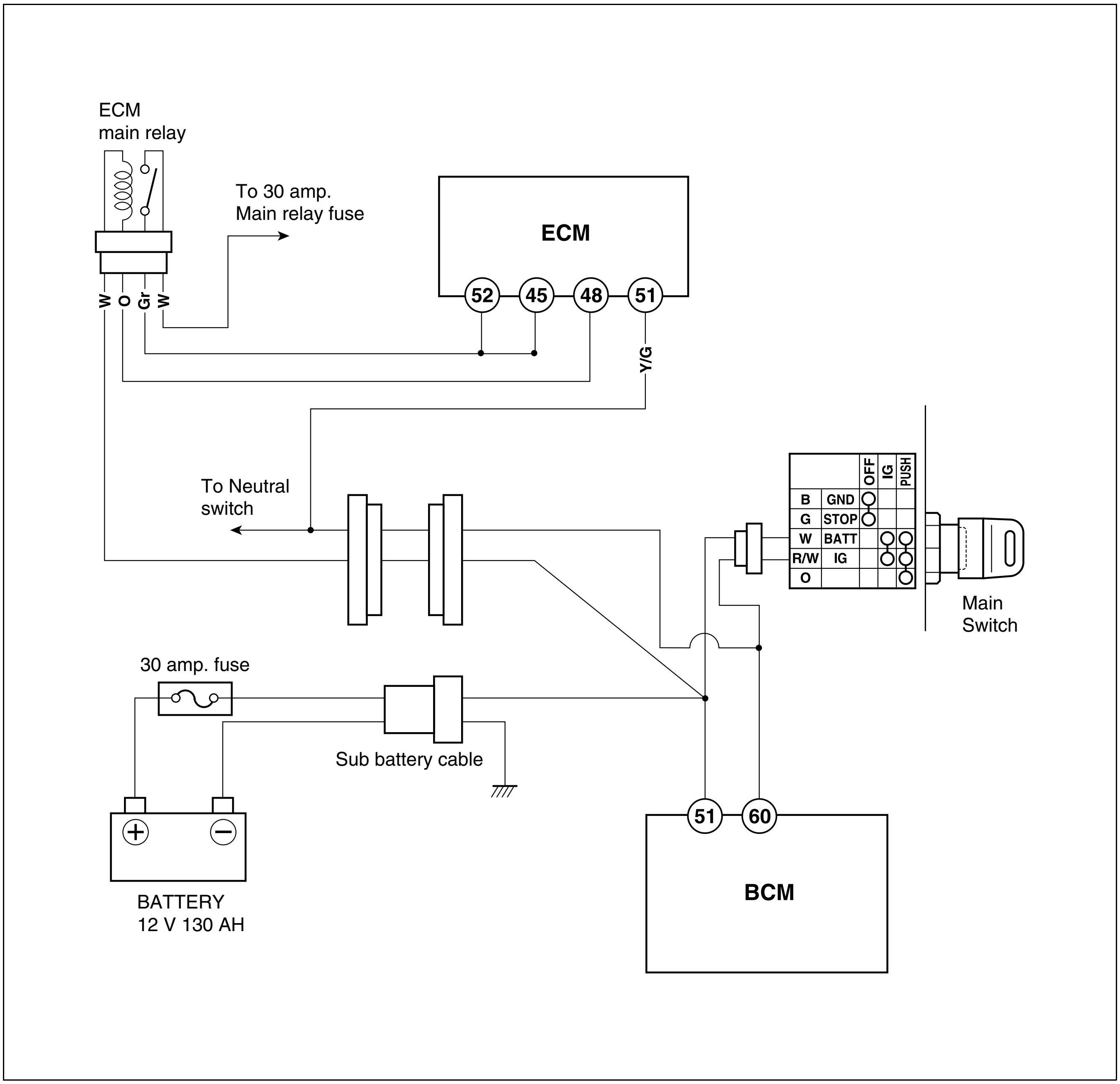
1. Main switch
2. Neutral switch
3. To starter motor relay
4. Start button

SUB BATTERY CABLE (ECM & BCM power source line)

The source voltage is supplied to BCM and ECM each through the two system lines.

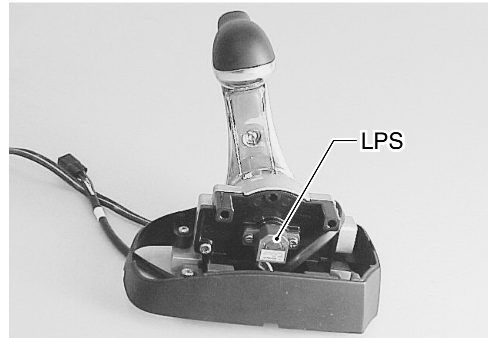
1. From the battery, the source is inputted to BCM No.51 terminal through the sub-battery cable.
2. When the main switch is turned on:
   - The source is supplied to BCM No.60 terminal through R/W line of the main switch.
   - ECM main relay turns on and battery voltage is supplied to ECM No.45, 52 terminals through the main relay.

NOTE:
Ensure battery cable connection are clean and secure.
Failure at the battery connection will cause incorrect operation of BCM and ECM.



LEVER POSITION SENSOR (LPS)

The lever position sensor is installed in the remote control box and detects the remote control lever position.
LPS is of noncontact type using a hall IC (element) supplying voltage signal of two systems, main- and sub-systems, to BCM. This voltage signal as a signal value is sent from BCM to ECM. Then ECM controls both the electronic throttle system and the electronic shift system.

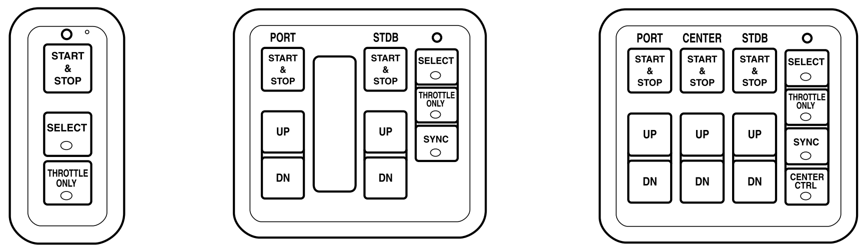


COMMUNICATION SYSTEM

ECM outputs various information as an ON/OFF digital signal to the tachometer LCD display through one communication line and SIM (Sensor Interface Module).
BCM receives input signals from switches on the switch panel and the lever position sensor in the remote control box.
As above, sending/receiving multiple information through a single system communication line is called serial communication.
As a type of serial communication, there is CAN communication. Both BCM and ECM use CAN communication to transmit information.
They are connected with two twist pair communication lines (CAN-HI and CAN-LO).
The transmission speed of CAN communication is faster than the normal serial communication and therefore it is suitable for high-speed processing requirement such as ECM control data, etc.

SWITCH PANEL

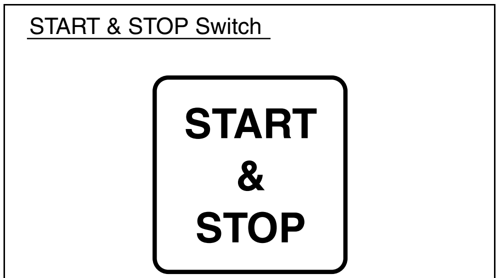
BCM performs the engine control according to the signal from various switches as explained below:



For single engine	For dual engine	For triple engine

START & STOP SWITCH

BCM performs control of engine starting and stopping by a signal from START & STOP switch on the basis of engine speed.



START control

- BCM generates the start signal for each engine based on START & STOP switch signal in accordance with the current engine condition.
- Pressing START & STOP switch once cranks the engine for three seconds continuously for starting.
  Holding START & STOP switch pressed cranks the engine continuously until the engine starts.
  When the engine speed exceeds the predetermined level, the start signal will be reset.
- Unless the actual shift position is in neutral, the start signal will not be generated.
  When the shift position sensor fails, Neutral is indicated in the tachometer LCD display regardless of whether the position is F, N or R.

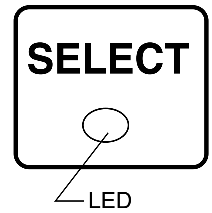
STOP control

- BCM generates the stop signal on the basis of START & STOP switch signal.
- Pressing START & STOP switch once during operation will set the stop signal and perform the engine stop control.
  When the engine stop has been confirmed, the stop signal will be reset.
- When the engine stops, the caution buzzer sounds twice briefly.

SELECT SWITCH

- This switch selects the 1st or 2nd station in the case of a 2-station system.
  By operating the remote control lever and switch in the selected station, BCM control is performed.
- When the main switch is turned from OFF to ON, the 1st station will be selected.
- Only when all stations remote control levers are in the neutral position, the station selection can be made.
  If the switch operation is made in other than neutral position, the select switch LED starts to flash and the caution buzzer will sound briefly.
- In the selected station, the select switch LED will turn on and in the unselected station, the LED will go off.
- The remote control lever and switch in the unselected station will be inoperative due to BCM control except the main switch and emergency stop switch that remain constantly operational.
- The output operation of LED and buzzer in the unselected station are the same as those in the selected station except the select switch LED.

SELECT switch

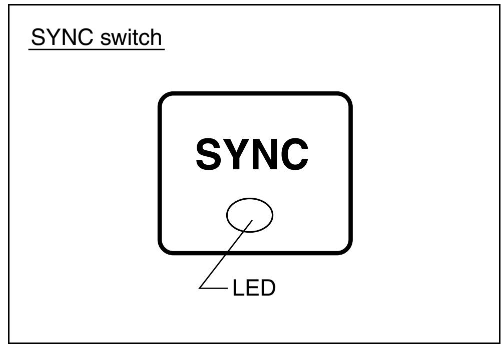


THROTTLE ONLY SWITCH

- Regardless of remote control lever operation, THROTTLE ONLY switch fixes the shift position into neutral. (Free throttle mode)
- In the free throttle mode, THROTTLE ONLY switch LED turns on.
- Only when the remote control lever is in neutral, ON signal of THROTTLE ONLY switch is receivable to activate free throttle mode.
  If the switch is operated other than in neutral, THROTTLE ONLY switch LED flashes and the caution buzzer starts to sound briefly.
- To cancel the free throttle mode, shift the remote control lever to neutral and press THROTTLE ONLY switch once again.

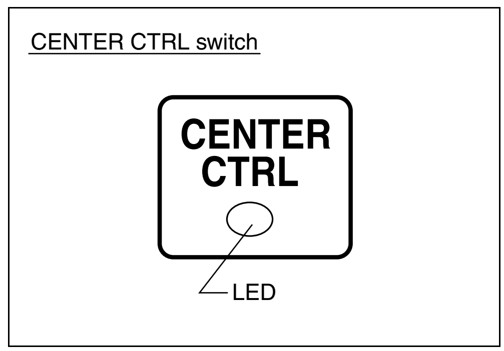
THROTTLE ONLY switch

SYNCHRONIZATION SWITCH



- In the case of multi engines, BCM monitors the actual speed of each engine and controls the target throttle opening of other than PORT engines to synchronize with PORT engine speed.
- To implement the synchronization control, select the synchronization mode by pressing SYNC switch.
- This control should be made during forward running.
  The control will become inactive during acceleration, deceleration, no load condition, idle/trolling speed and WOT running.
  When the synchronization mode is active, SYNC switch LED turns on.
- During synchronization control in process, if the engine operating condition is changed by operating the remote control lever, the synchronization control will be canceled.
- When PORT and STBD remote control levers are in different position from each other, the synchronization control will be inoperative.

CENTER CONTROL SWITCH

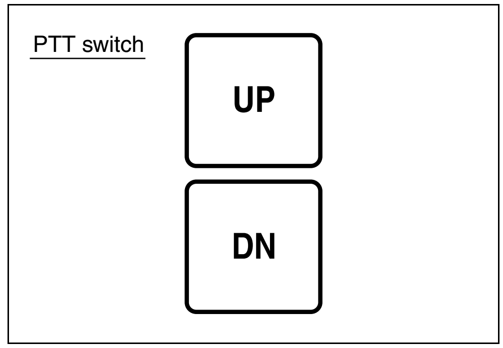


- In the case of triple engines, CENTER CTRL switch selects either interlinking or unlinking of the center engine with PORT engine.
- The switch operating signal is active only when all the remote control levers are in neutral.
  During interlinking state, pressing the switch once will change it to unlinking state. Pressing the switch once again during unlinking state will change it to interlinking state.
  If the switch is pressed in other than neutral position, CENTER CTRL switch LED flashes and the caution buzzer starts to sound.
- During center engine control mode in process, the center engine interlinks with PORT engine. During other than center control modes, the engines are unlinked and the idle opening (Neutral) takes place.
- When the main switch is turned from OFF to ON, the center control mode takes place.
- During center control mode, CENTER CTRL switch LED turns on.

PTT SWITCH

The “Power Trim and Tilt” is operated by pressing the switch.
To tilt up, press the UP switch. To tilt down, press the DN switch.

NOTE:
The tilt up and tilt down switches can not be activated when the main switch is off.



IGNITION SYSTEM

The ignition system used by the DF300 is a fully transistorized, electronic microcomputer timing advanced type.

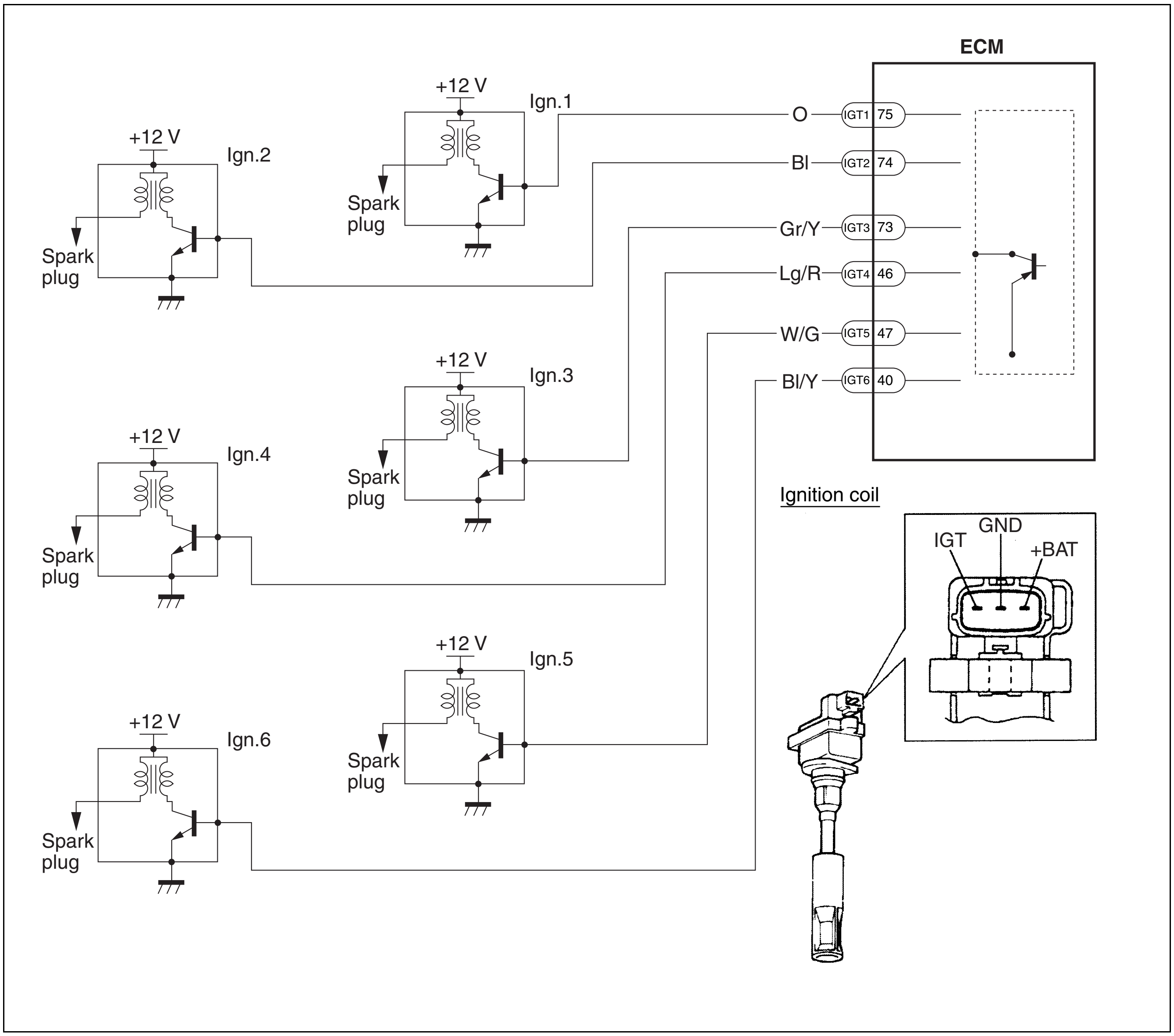
This system is totally battery powered, with the ECM controlling all ignition timing functions.

The ignition system is composed of the ignition coil, spark plug and components for system control (ECM, sensor, switch etc.)

When the main switch is "ON", battery voltage (12 V) is applied to the circuit as shown in the illustration.

The ECM determines the optimum ignition timing and duration of current flowing through the ignition coil primary winding based on the signals received from various sensors. The ECM interrupts the base current of the power transistor inside the ignition coil thereby controlling current flow (ignition) to the primary winding of ignition coil.

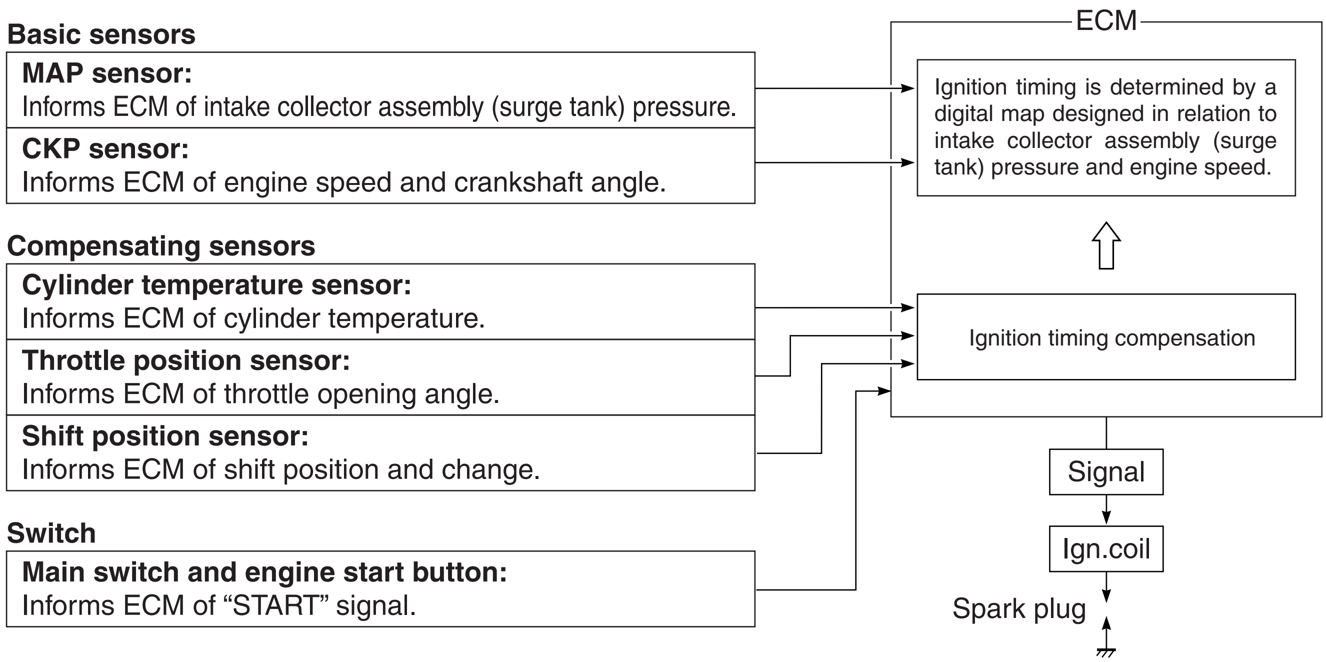
In this way, a mutual induction high voltage occurs in the ignition coil secondary side and spark is generated.



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.

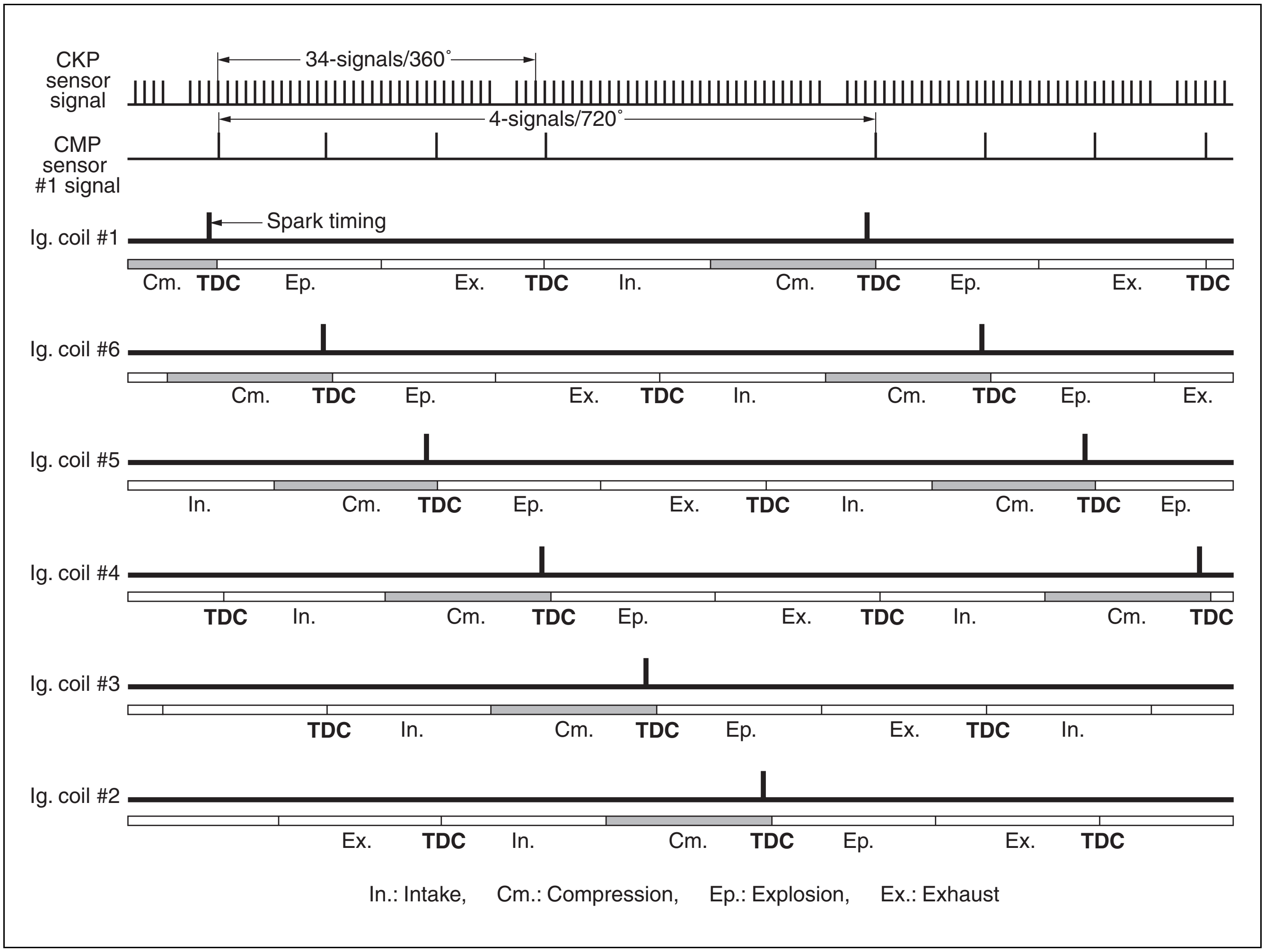


SPECIFICATION

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	ATDC 5° – BTDC 24°
Firing order	1 – 6 – 5 – 4 – 3 – 2

IGNITION TIMING CHART

The following chart is an example for ignition at BTDC 10°.



CONTROL MODE

WHEN CRANKING:

The ignition timing is fixed at BTDC 5° (STBD bank) or BTDC 0° (PORT bank) until the engine starts.

WHEN IDLING/TROLLING:

The ignition timing is controlled within the range of ATDC 5° ± 12° to provide stable engine operation at the specified idling/trolling speed.

WHEN RUNNING (NORMAL OPERATION):

The ignition timing ranges between ATDC 5° – BTDC 24°, depending on current engine operating conditions.

ELECTRONIC FUEL INJECTION SYSTEM

The fuel injection system used by the DF300 is a speed-density, multi-point, sequential, electronic fuel injection type.

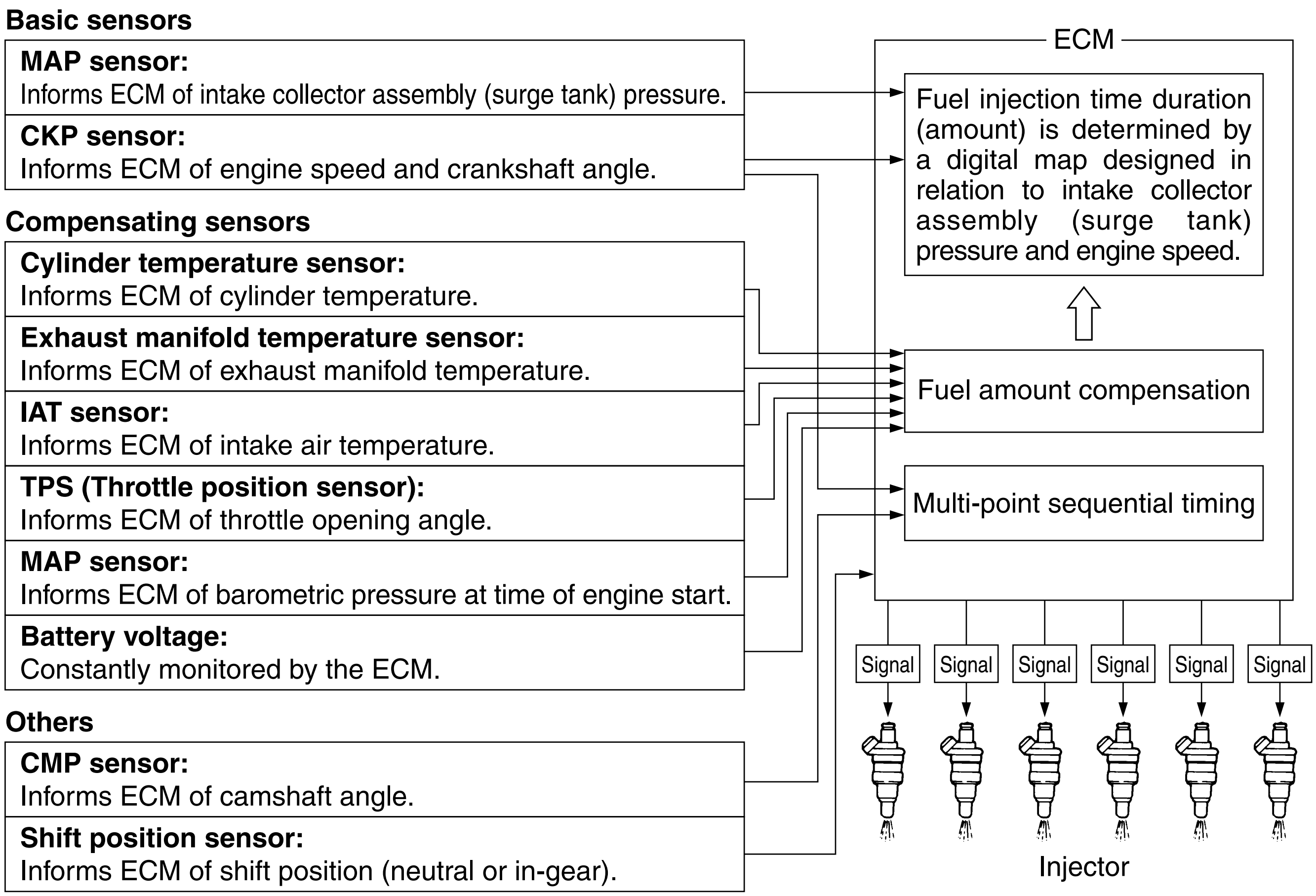
The fuel injection system is composed of the fuel line components, air intake components, and components for system control (ECM, sensors, switches, etc.).

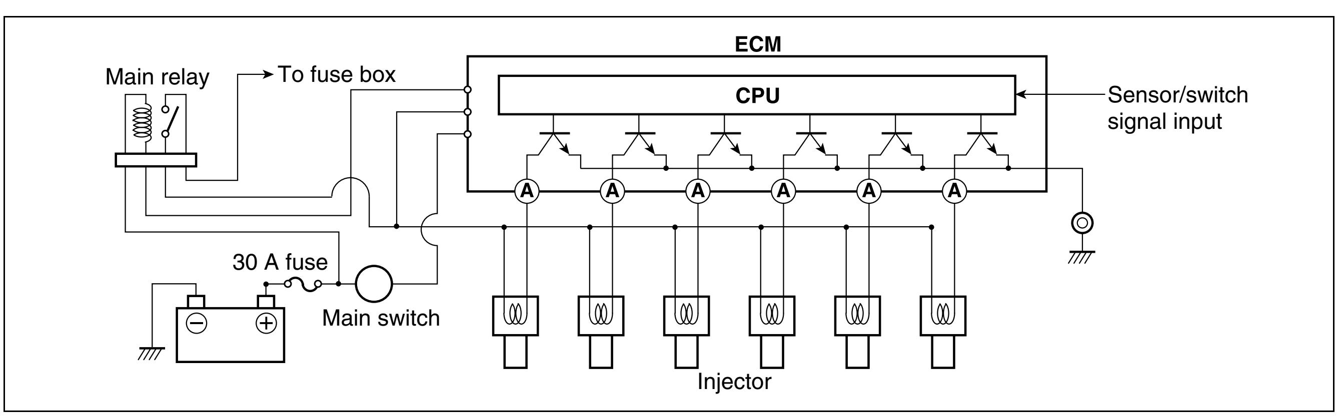
FUEL INJECTION CONTROL SYSTEM

OUTLINE

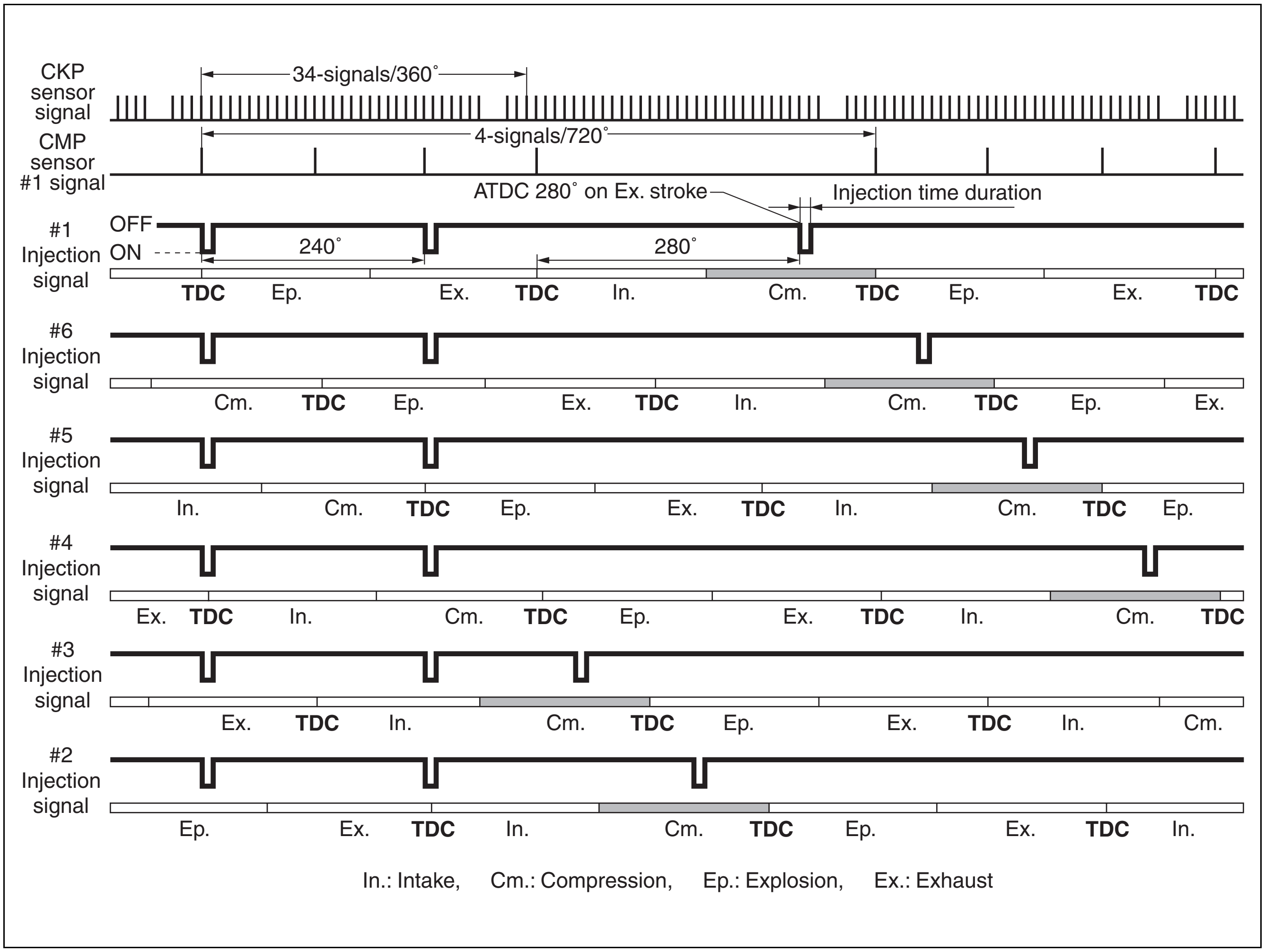
Sensors are mounted at precise locations on the motor to monitor the current conditions of engine operation and send signals to the ECM. Based on these signals, the ECM determines the optimum fuel injection time duration (fuel amount), fuel injection timing (multi-point sequential timing) and controls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

Fuel injection start timing is set at a constant of ATDC 280° (640° of crankshaft rotation) on the exhaust stroke.





FUEL INJECTION TIMING CHART



CONTROL MODE

BEFORE START:

When the main switch is turned “ON”, the ECM receives a MAP sensor signal, indicating the static barometric pressure of the intake collector assembly (surge tank). This signal is used to compensate the fuel injection map for altitude.

WHEN CRANKING:

Fuel is simultaneously injected to all cylinders according to the “Start up mode” map in relation to crankshaft angle.

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 fuel 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 fuel pump to the fuel vapor separator.

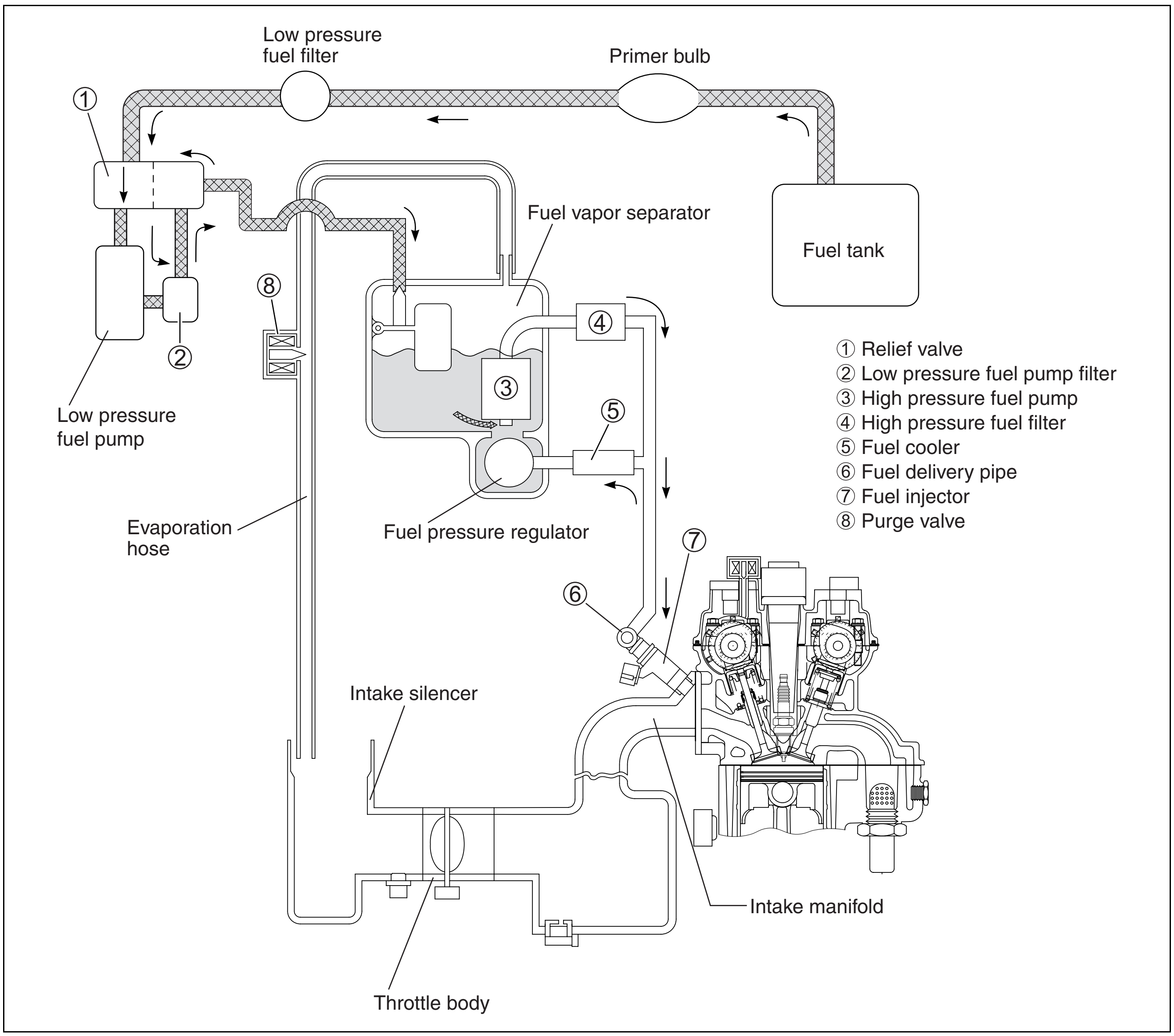
Fuel flow from the fuel vapor separator is pressurized by the high pressure fuel pump and supplied through the high pressure fuel filter and fuel delivery pipe to the fuel injectors.

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.

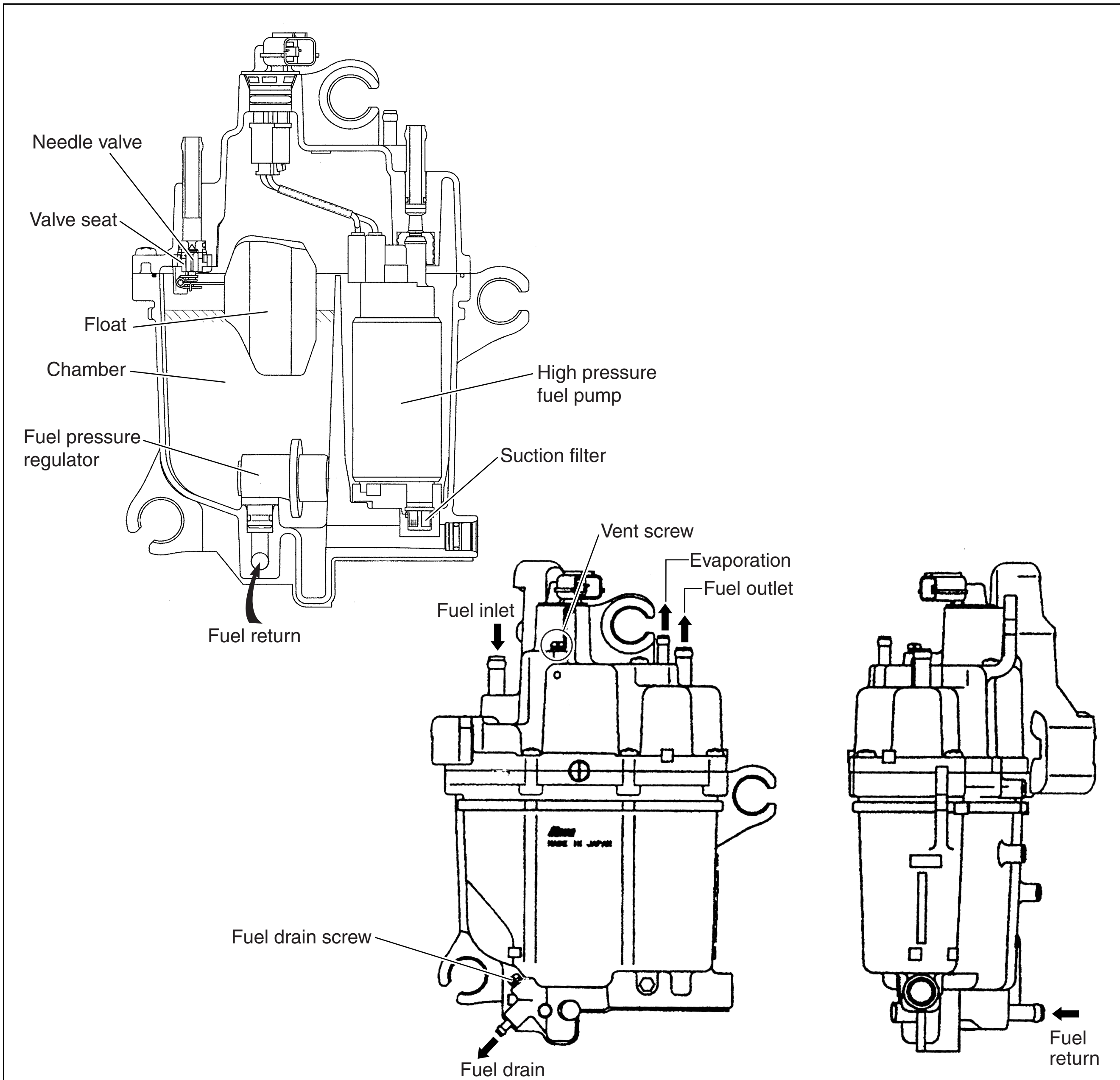


FUEL VAPOR SEPARATOR

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 purge system to the air intake silencer case. (See page 3-34 for the Evaporation purge system.)

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

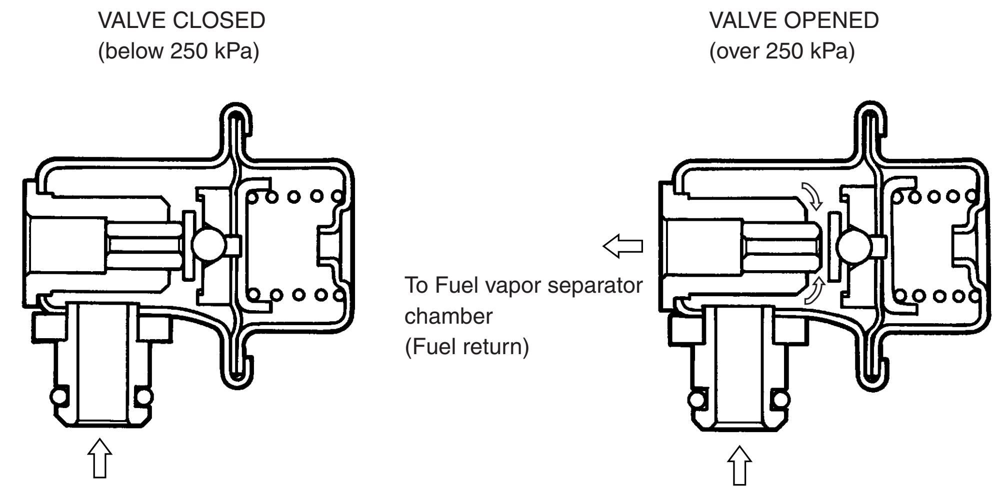
The fuel pressure regulator is located in the fuel vapor separator.

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. 250 kPa (2.55 kg/cm^2, 36.3 psi).

Bypass fuel is returned to the fuel vapor separator chamber.



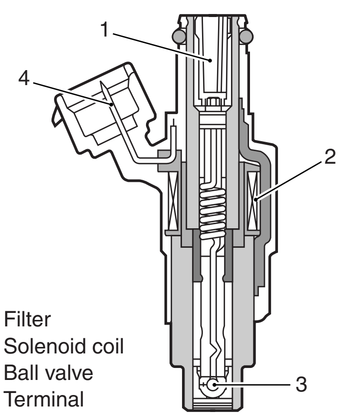
FUEL INJECTOR

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.

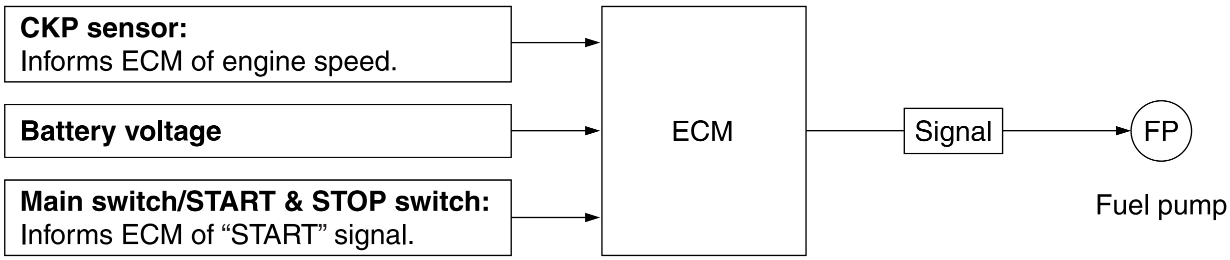


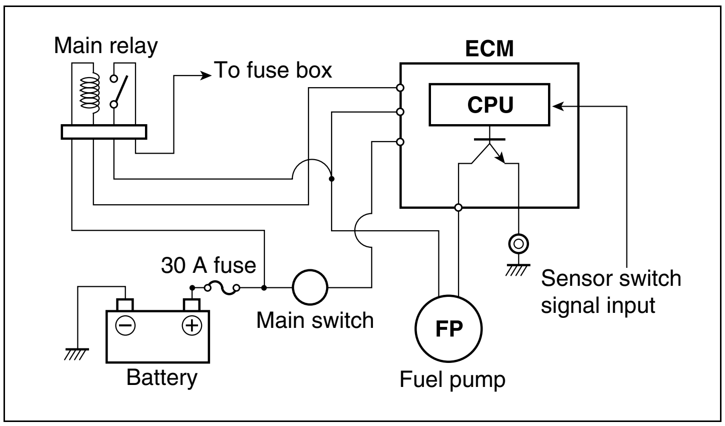
1. Filter
2. Solenoid coil
3. Ball valve
4. Terminal

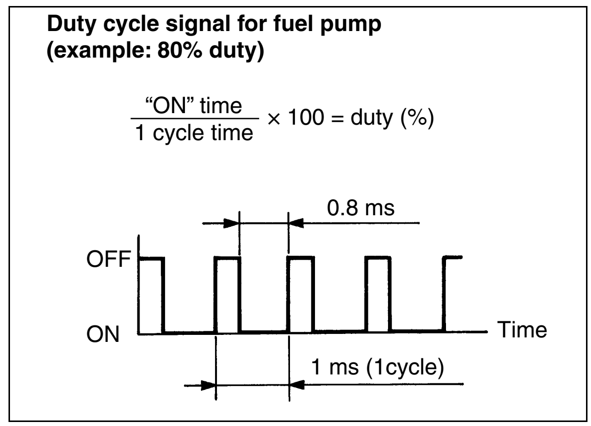
HIGH PRESSURE FUEL PUMP CONTROL SYSTEM

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 (1 000 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.







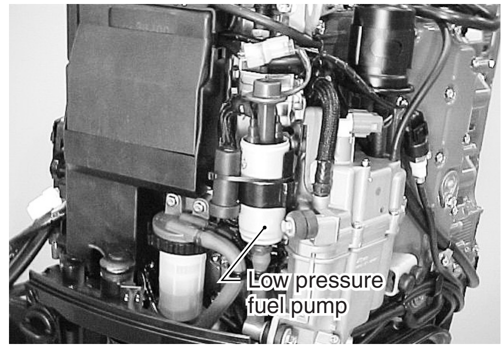
CONTROL MODES

BEFORE START:
For 6 seconds after the main 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 50 – 100% duty based on the current engine speed and battery voltage.

LOW PRESSURE FUEL PUMP CONTROL SYSTEM

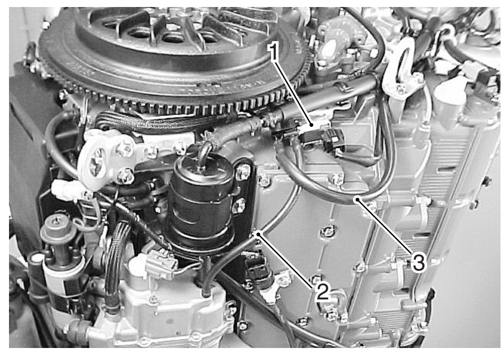


CAUTION

Fuel flowing through the pump is the pump coolant. The fuel pump should never be run dry for long periods or it will become damaged.

The low pressure fuel pump is an electrically operated type that supplies fuel from the fuel tank to the vapor separator.
The pump is controlled by the ECM and operates with at approx. 100% duty under any of the conditions below.
- Six (6) seconds after the main switch has been turned ON.
- Whenever the ECM receives a signal input from the CKP sensor.

EVAPORATION PURGE SYSTEM



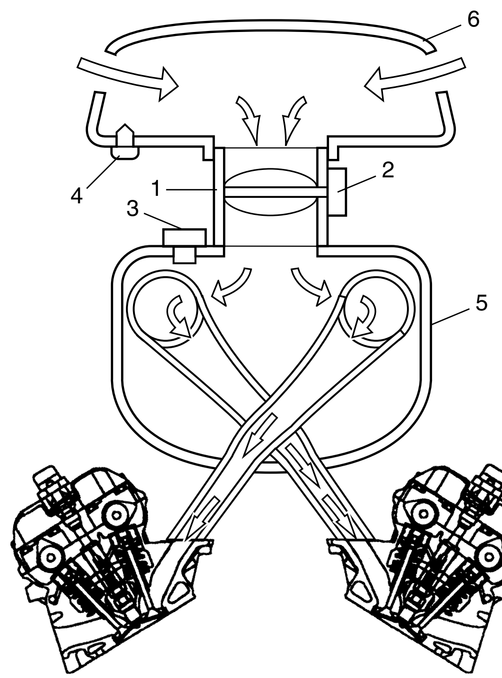
1. Purge valve
2. Hose (Vapor separator to purge valve)
3. Hose (Purge valve to air intake case)

The evaporation purge system connects the vapor separator and the air intake silencer case with a hose in which the purge valve is installed. This system's function is to prevent hard starting of the engine during hot soak periods by controlling the discharge of vapors from the vapor separator into the air intake case.
The ECM outputs a signal to the purge valve for opening/closing on the basis of signals from IAT sensor, cylinder temp. sensor, exhaust manifold temp. sensor and CKP sensor. (Normally, the purge valve closes when the engine is shut off and opens after the engine has been started.)

NOTE:
- *The purge valve is driven by a duty cycle control signal from the ECM.*
  During the engines "hot soak period", the valve will be closed, the valve opens when engine run at approx. 2000 r/min. and a 40 – 50% duty control takes place.
  Otherwise, the valve opens after the engine has started and a 30 – 50% duty control takes place.
- *Evaporative emissions can occur when fuel heats up and evaporates from the vapor separator. They are also released from a hot engine when it is running and/or idling.*
  After the engine is turned off, engine heat rises slightly as the cooling system water flow ceases, causing a small portion of the fuel in the vapor separator to vaporize. This is generally termed the "hot soak period". Vapors are also released during engine operation as new fuel enters the vapor separator pushing air and fuel vapors out.
- *See page 5-17 for the evaporation purge system check.*

AIR INTAKE COMPONENTS

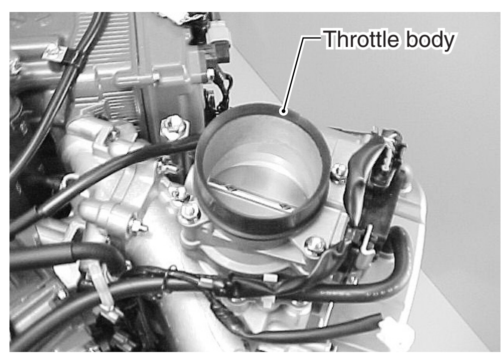
The main components of air intake system are silencer case, electronic throttle body assembly, intake collector assembly and intake manifold.
Air, after entering through the silencer case, passes through the throttle body and flows into the intake collector assembly where it is then distributed to the cylinder intake manifold.
Intake collector assembly (surge tank) pressure, monitored by the MAP sensor, is an indirect measure of the intake air amount.
Electronic throttle system is not equipped with IAC valve for idle speed control.
Idle speed is controlled by the throttle actuator which open/close the throttle valve.



Air flow

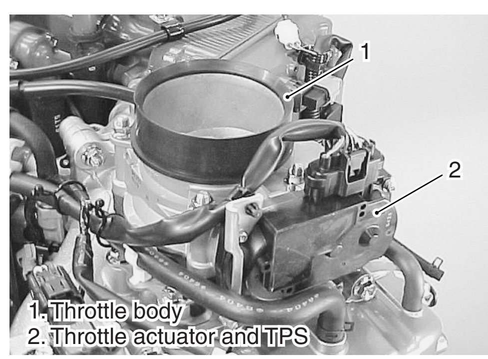
1. Throttle body
2. Throttle actuator/Throttle position sensor
3. MAP sensor
4. IAT sensor
5. Intake collector assembly
6. Air intake silencer

ELECTRONIC THROTTLE BODY



- The electronic throttle body is located on top of the intake collector assembly.
- The throttle body assembly consists of the main bore, throttle valve, TPS (Throttle position sensor) and throttle motor.
- The throttle body adjusts the intake air amount by the throttle actuator which open /close the throttle valve.

NOTE:
Do not try to adjust or remove any of the throttle body component parts (Throttle position sensor, throttle valve, throttle actuator, etc.).
These components have been factory adjusted to precise specifications.



1. Throttle body
2. Throttle actuator and TPS

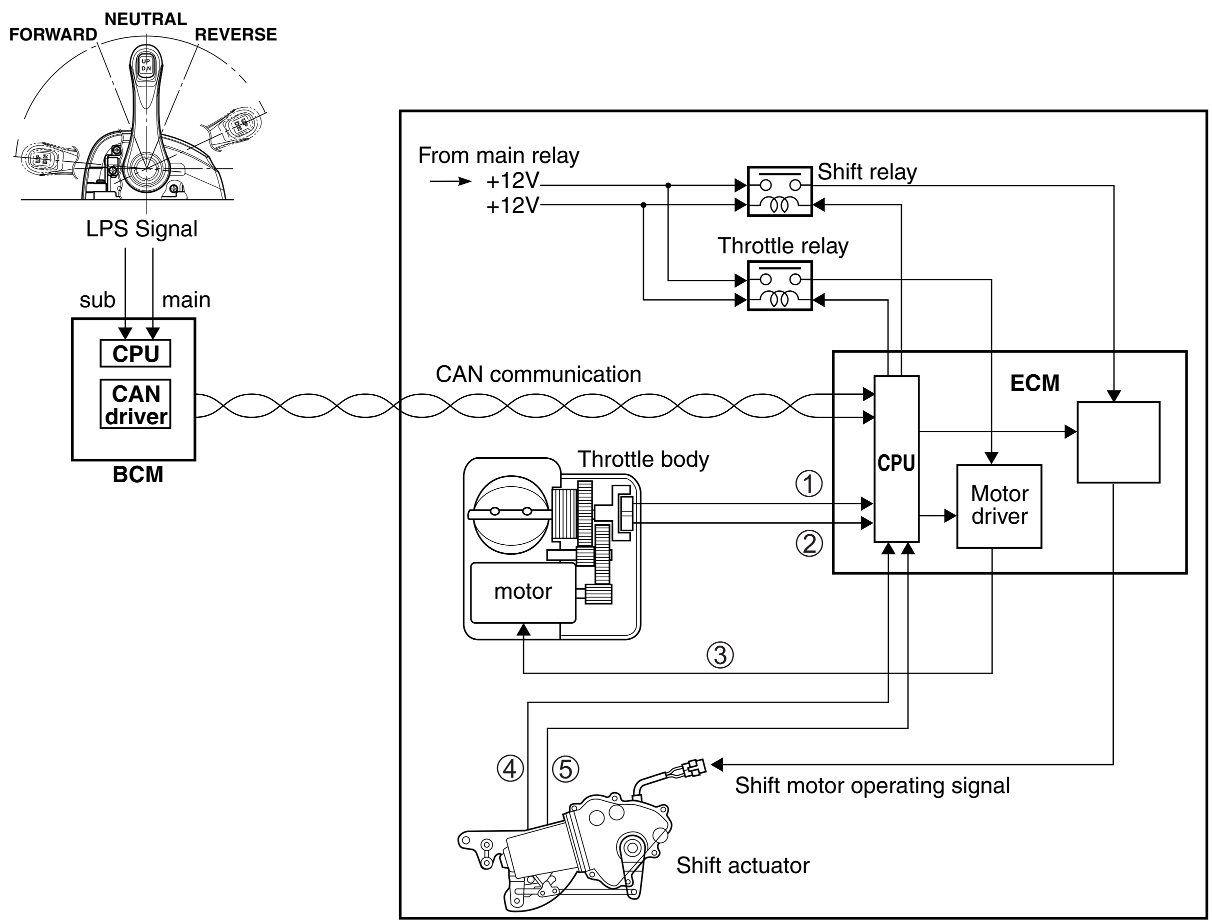
ELECTRONIC THROTTLE SYSTEM

OUTLINE

Description of Electronic Throttle System

The electronic throttle system consists of electronic throttle body assembly, lever position sensor assembly, ECM, BCM and throttle actuator control relay. Among them, assembly components are as follows.

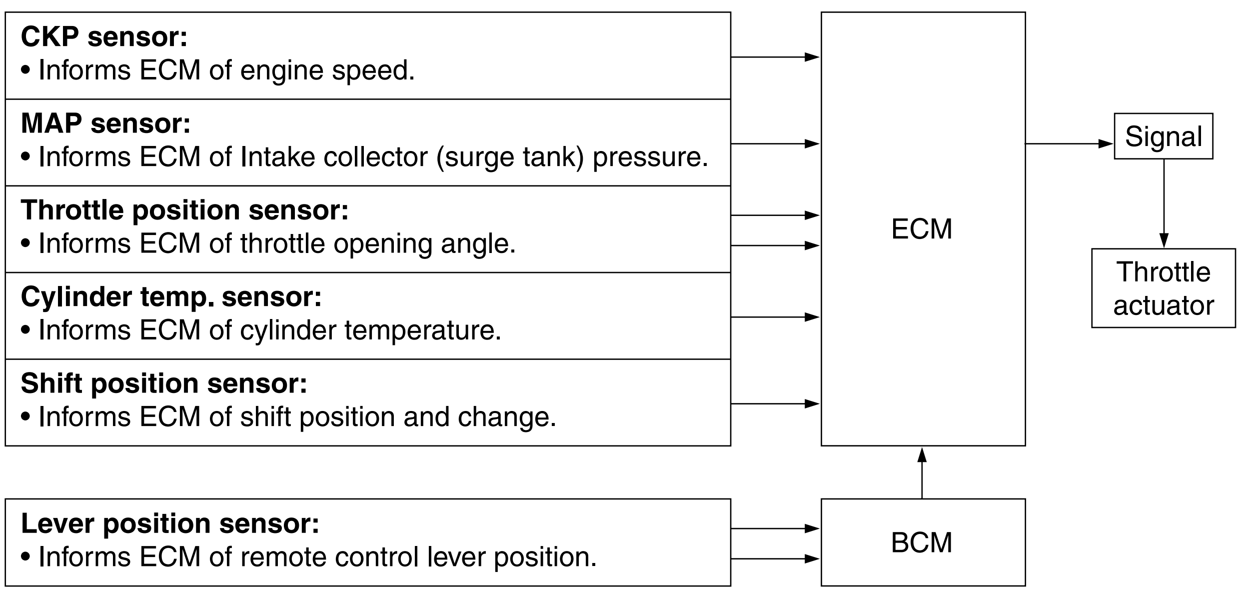
- Electronic throttle body assembly: throttle valve, throttle actuator, two (2) throttle position sensors.
- Lever position sensor assembly: remote control lever, two (2) lever position sensor.



① Throttle sensor signal (main)
② Throttle sensor signal (sub)
③ Throttle motor operating signal
④ Shift sensor signal
⑤ Neutral switch signal
LPS: Lever position sensor

Operation

- ECM detects the remote control lever position by the voltage signal supplied from the lever position sensor that is built in the remote control box. The lever position sensor signal is inputted to ECM through BCM.
  ECM calculates and determines the optimum throttle valve opening on the basis of detected target throttle valve opening (lever position voltage signal), current throttle valve opening (actual throttle valve opening) and the current engine condition. It then drives the motor built in the throttle body to open the throttle valve.
  The throttle valve opening is sensed by the throttle position sensor and is supplied to ECM as feedback.
- The idling/trolling speed control is performed by the electronic throttle system and the throttle valve is opened/closed by means of the throttle actuator. There is no IAC valve for this purpose.
- To enhance reliability, a dual system (main and sub) is used for monitoring failures of throttle and lever position sensor systems.
- When a failure is detected in the throttle position sensor, this system turns off the throttle motor relay, then the throttle valve is locked by the return spring into the default opening (approximately 16° of mechanical opening from complete close position).
- When the lever position sensor failure is detected, the throttle valve is locked into the complete position.
- When the remote control box is replaced, the setting change should be performed using SDS Ver.5.
- When ECM is replaced, BCM initialization and the system calibration should be performed using SDS Ver.5.



CONTROL MODE

On the basis of lever position sensor voltage signal, throttle position sensor signal and the engine condition, a calculation is operated for driving throttle motor, then the throttle opening is controlled.
According to the engine condition, the following controls are performed.

- **Start-up control**
  The throttle valve opening at start-up is predetermined in relation to the cylinder wall temperature. Therefore, according to the engine temperature at start-up, the throttle valve is opened slightly to supply optimum intake air for improving start ability.
  For improved starting, the lower the cylinder wall temperature, the wider the throttle valve opening.

- **Normal control**
  The throttle valve opening is determined according to the conditions such as cylinder wall temperature, shift position, lever position, etc.

  (Compensations)
  - Feedback compensation
    If the actual engine speed deviates from the target engine speed for more than a predetermined time, this compensation is designed to adjust the speed close to the target.
  - Shift compensation
    According to the condition of shift transition (F⇔N⇔R), the engine speed is compensated.

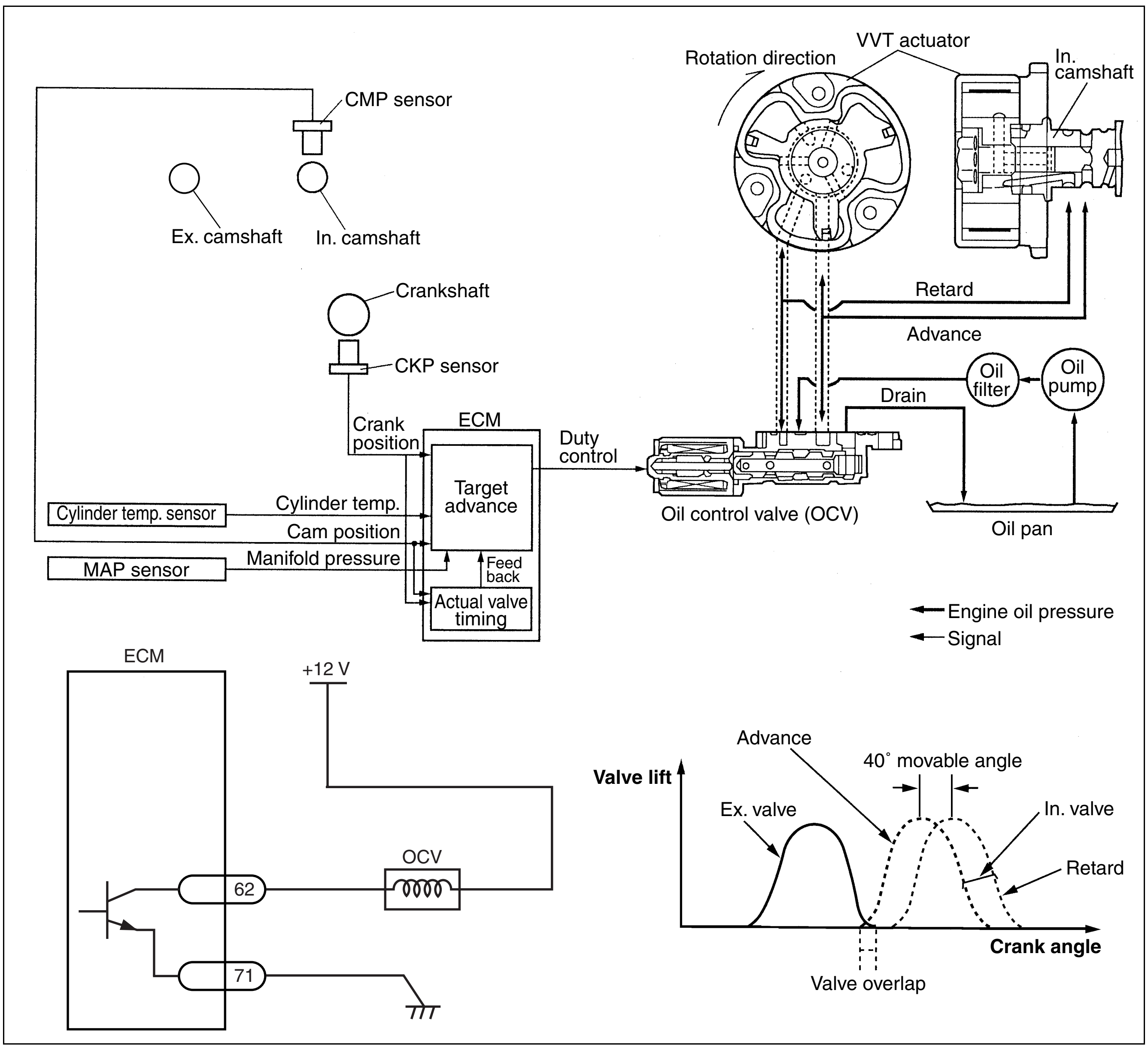
  - **Deceleration control**
    During deceleration, the throttle valve is opened by a certain amount for increased air intake to prevent the engine speed from falling to quickly resulting in engine stalling.

- **Fail safe control**
  - When a failure is detected in the throttle position sensor, this system turns off the throttle motor relay, then the throttle valve is locked by the return spring into the default opening (approximately 16° of mechanical opening from complete close position).
  - When the lever position sensor failure is detected, the throttle valve is locked into the complete close position.
    The operation of fail safe control depends on the detected diagnosis code.

- **Fully closed position learning**
  When the main switch is turned OFF, the throttle valve once returns to the fully closed position, then opens to the fully open position and thereafter closes to the default position.

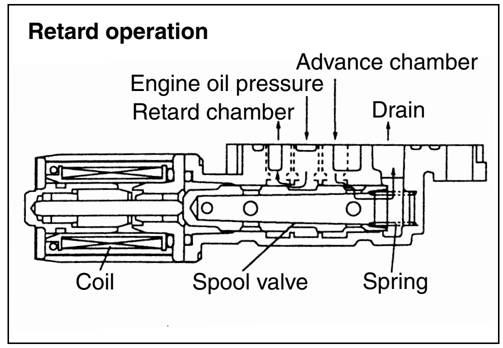
VVT (Variable Valve Timing) SYSTEM

- The VVT system is designed to continuously vary intake valve timing to best fit the engines current operating condition.
- The intake cam timing sprocket assembly (VVT actuator) is located at the front end of the intake camshaft. The timing sprocket' internal rotor is operated by engine oil pressure. Since the rotor and intake camshaft are bolted together, the rotor and camshaft move together. Varying the intake valve timing is accomplished by changing the intake camshaft phase angle relative to the intake cam timing sprocket using pressurized engine oil applied to the rotor through an ECM controlled oil control valve.
- The oil control valve (OCV) directs engine oil pressure to the advance chamber or retard chamber inside the intake cam timing sprocket assembly (VVT actuator). The oil control valve operates on a duty cycle controlled by the ECM.
- The ECM determines the optimum valve timing (advance angle) under various operating conditions based on engine speed, manifold pressure (throttle opening) and cylinder wall temperature. These input values are then used to control the position of the oil control valve (OCV). The ECM also detects the actual advance angle from the CMP sensor inputs to perform feedback control and accurately maintain the target advance angle.



OCV (Oil Control Valve)
Two OCV are used, one installed on each (PORT/STBD) lower camshaft housing.

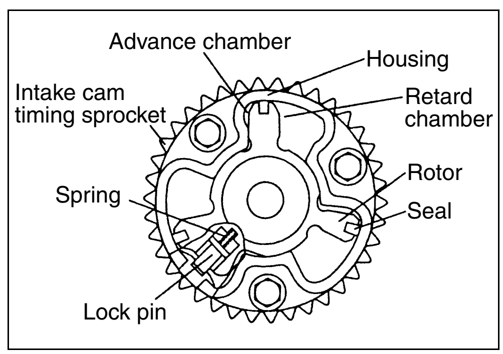
RETARD OPERATION
When the duty ratio of the ECM is small, the OCV spool valve is pushed away from the coil by spring force and engine oil pressure is applied to the retard chamber.
Engine oil remaining in the advance chamber is drained out through the spool valve.



ADVANCE OPERATION
When the duty ratio of the ECM is large, the spool valve is towards the coil by magnetic force, compressing the spring and applying engine oil pressure to the advance chamber side.
Engine oil remaining in the retard chamber side is drained out through the spool valve.

RETAINING OPERATION
When the duty ratio of the ECM is medium, the OCV coil magnetic and return spring forces are equal. This positions the spool valve between the advance and retard chamber, closing both oil passages.

INTAKE CAM TIMING SPROCKET ASSY
Inside the intake cam timing sprocket assembly (VVT actuator), there are separate advance chamber and retard chamber formed by partition of the rotor.
The rotor moves inside the housing as engine oil pressure is applied to the advance or retard chamber.
The intake cam timing sprocket is part of the sprocket housing assembly. Since the rotor and intake camshaft are bolted together, when the rotor moves inside the housing, a change of phase angle takes place in the relative position between the intake camshaft and intake cam timing sprocket. The rotor has a spring pressured lock pin which engages with the housing when spring force is greater than oil pressure, locking the rotor in the most retarded position. This prevents a change of phase angle between the intake camshaft and intake cam timing sprocket when the engine oil pressure is low at engine start.
When the engine is started and the engine oil pressure is applied to the advance chamber, the lock pin is forced up, compressing the return spring, releasing the rotor and allowing the VVT actuator to function.



ELECTRONIC SHIFT SYSTEM

OUTLINE

Description of electronic shift system

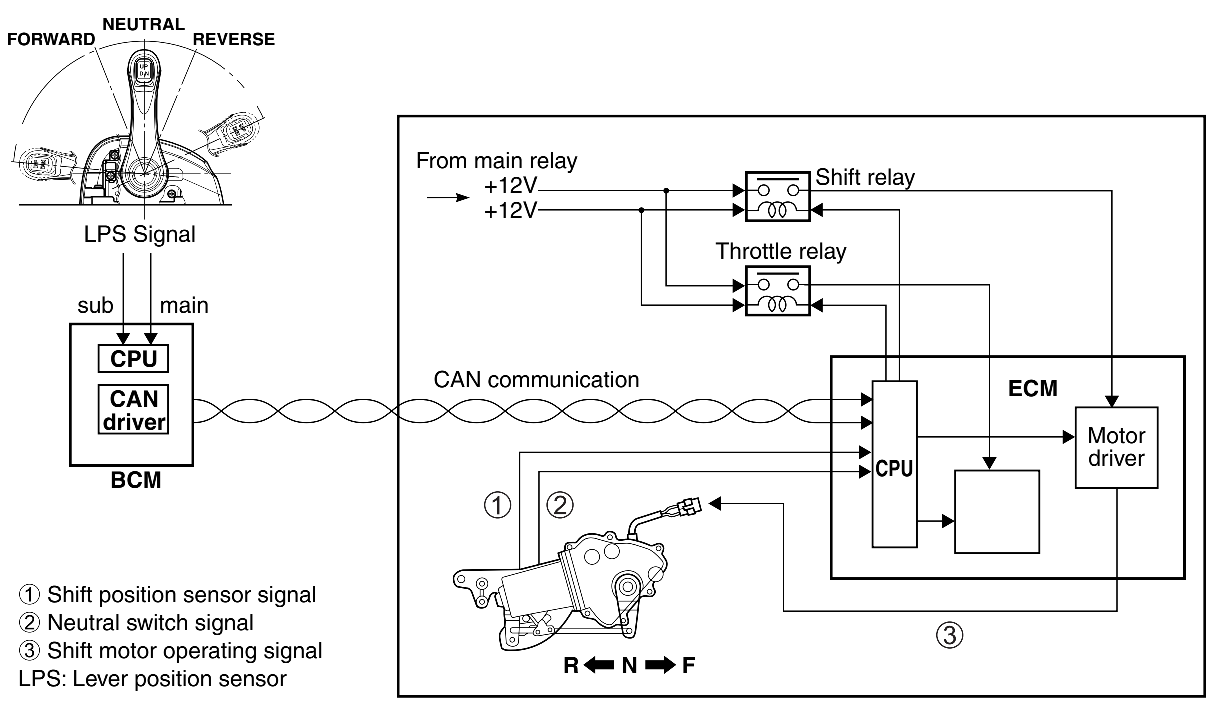
The electronic shift system consists of lever position sensor assembly, ECM, BCM, shift control actuator relay and shift actuator.

OPERATION

- ECM detects the remote control lever position by the voltage signal sent from the lever position sensor which is built in the remote control box.
  ECM receives the lever position sensor signal through BCM and drives the actuator motor so that the actual clutch lever (gear) position agrees with the detected target shift position (lever position voltage signal). Thus, gear shifting to forward, neutral or reverse is performed.
  The actual shift position is checked by the shift position sensor detecting it and is feed back to ECM.
- When a failure is detected in the system components, the shift motor relay is turned off causing the shift actuator drive to be interrupted.
- When the remote control box is replaced, the setting change should be performed using SDS Ver.5.
- When ECM is replaced, BCM initialization and the system calibration should be performed using SDS Ver.5.

NOTE:

- *The shift change can be done by remote control lever only when ECM receives signal of engine turning. The shift change can not be done by remote control lever during engine stopping even main switch is ON position.*
- *When engine is stopped, ECM controls the shift actuator to shift in neutral regardless the position of remote control lever.*



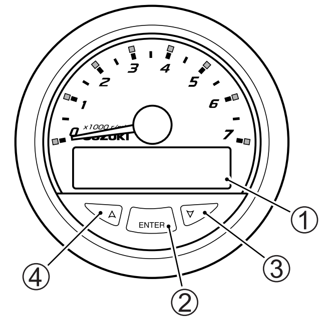
① Shift position sensor signal
② Neutral switch signal
③ Shift motor operating signal
LPS: Lever position sensor

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. Cooling Water Pressure
7. Intake manifold pressure
8. Trim Angle
9. Battery Voltage
10. Shift position
11. CAUTION name (When problem is detected)
12. Oil change reminder (When the total motor operating hours have reached pre programmed hours)
13. Self-Diagnostic code (When problem is detected)



① Digital display screen
② ENTER button
③ ▽ button
④ △ button

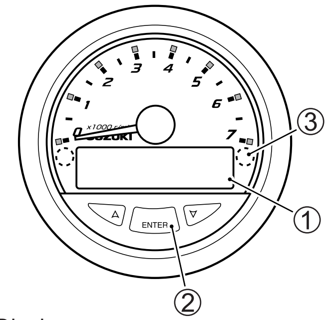
NOTE:
- *The items of No. 1 – 9 can be selected by pressing “ENTER” or △/▽ button. (For details, see Meter operation manual.) Pressing “ENTER” or △/▽ button once changes the displayed data.*
- *When the main key is turned from OFF to ON:*
  - *A caution buzzer will sound for three seconds.*
  - *Two caution lamps also turns on for three 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 main 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.

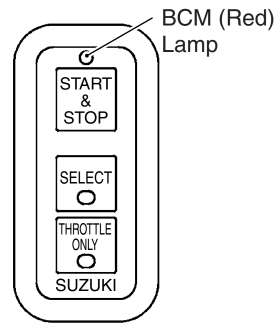
CAUTION SYSTEM

The following caution systems alert the operator when an abnormality occurs on the engine.
When a problem is detected, the caution name appears on the display screen of tachometer-monitor, caution buzzer sounds and caution lamps lights continuously.

- **OVER-REVOLUTION CAUTION**
- **LOW OIL PRESSURE CAUTION**
- **OVERHEAT CAUTION**
- **LOW BATTERY VOLTAGE CAUTION**
- **CHECK CONTROL UNIT COMMUNICATION CAUTION**
- **CHECK SECOND STATION CAUTION**
- **CHECK THROTTLE SYSTEM CAUTION**
- **CHECK SHIFT CONTROL CAUTION**



① Display screen
② ENTER button
③ Caution lamp



CAUTION TYPE	TACHOMETER DISPLAY INDICATION	CAUTION BUZZER	OVER-REV LIMITER	BCM (Red) Lamp
Over-revolution	Over revolution	Yes	Yes (3 000 r/min)	—
Low oil pressure	Low Oil Pressure	Yes	Yes (1 500 r/min)	—
Overheat	Over Heat	Yes	Yes (2 500 r/min)	—
Low battery voltage	Low Batt Voltage	Yes	No	—
Check control unit communication	Check control unit communication	Yes	No	ON
Check second station	Check 2nd Station	Yes	No	ON
Check throttle system	Check Throttle System	Yes	No	—
Check shift control	Check Shift Control	Yes	No	—

OVER-REVOLUTION CAUTION SYSTEM

CONDITION:

The ECM controlled over revolution limiter will engage at the engine speeds shown below. Once engaged it will initiate an intermittent fuel injection signal to reduce engine speed.

Over revolution limiter
DF300: 6 400 r/min

ACTION:

- When the system detects an engine speed higher than 6 400 r/min, the tachometer display screen will indicate “Rev Limit” and two caution lamps turn on.
  If this condition continues for ten seconds, the engine speed will be limited to approximately 3 000 r/min by making the fuel injection signal intermittent.
  At the same time, the tachometer display screen indicates “Over Revolution” and the caution buzzer turns on.
- If the engine speed is reduced to 6 400 r/min or lower within ten seconds, the over revolution caution will be automatically canceled.

RESET:

Close throttle to reduce engine speed below approx. 3 000 r/min for one second.

LOW OIL PRESSURE CAUTION SYSTEM

CONDITION:

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

ACTION:

- When this system operates, the tachometer display screen will indicate “Low Oil Pressure” and at the same time, the caution buzzer sounds and two caution lamps turn on.
- If this caution system operates at higher than 1 500 r/min, the engine speed will be reduced to approximately 1 500 r/min by making the fuel injection signal intermittent.

RESET:

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

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

NOTE:
The low oil pressure caution system is reset when the oil pressure is restored to over 1.0 kg/cm^2 with approx. 1 500 r/min or less engine speed operation.
However, the engine must be stopped and checked immediately once the system is activated.

OVERHEAT CAUTION

CONDITION 1 (Maximum temperature)

Immediate activation of system when:

- Cylinder temperature reaches 120 °C (248 °F)
- Exhaust manifold temperature reaches 114 °C (237 °F)

CONDITION 2 (Temp. rise vs Time)

Immediate activation of system when:

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

Temperature range	Temperature difference
88 – 99 °C (190 – 210 °F)	Approx. 8 °C (46 °F)
99 °C – (210 °F –)	Approx. 1.5 °C (35 °F)

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

Temperature range	Temperature difference
80 – 95 °C (176 – 203 °F)	Approx. 14 °C (57 °F)
95 °C – (203 °F –)	Approx. 1.7 °C (35 °F)

ACTION:

When this system operates, the tachometer display screen will indicate “Over Heat” and at the same time, the caution buzzer sounds and two caution lamps turn on.

If this caution system operates at higher than 2 500 r/min, the engine speed will be reduced to approximately 2500 r/min by making both the fuel injection and ignition signals intermittent.

RESET:

Close throttle completely and then shift into neutral.

System reset will occur when cylinder temperature drops below the limits shown below. 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. 78 °C (172 °F)
Condition 2 (Temperature rise vs Time)	Approx. 76 °C (169 °F)

LOW BATTERY VOLTAGE CAUTION SYSTEM

CONDITION 1:
System activated when battery voltage decreases to less than 9 volts for 30 seconds.

CONDITION 2:
System activated if battery voltage is less than 2 V for more than 2 seconds with the main switch turned "ON" and engine not running.

ACTION:
When this system operates, the tachometer display screen will indicate "Low Batt Voltage" and at the same time, the caution buzzer sounds and two caution lamps turn on.

RESET:
CONDITION 1:
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.

CONDITION 2:
For the caution system to engage under this condition possibilities such as deteriorated battery, poor battery cable connection, battery switch in OFF condition, etc. must be inspected.
To cancel the caution system activation for these conditions, check all power source related items and eliminate the problem.

CHECK CONTROL UNIT COMMUNICATION CAUTION

CONDITION:
This system operates when a failure has occurred in the control of electrical shift system or electrical throttle system including electrical remote control box.

ACTION:
When the system operates, the tachometer display screen will indicate "Check Control Unit Communication" and at the same time the caution buzzer sounds and two caution lamps turn on.
In addition, a red light on the switch panel turns on.

NOTE:
When the tachometer "ENTER" button is pressed, the diagnosis code "Check Engine 7-5" appears on the display screen.

NOTE:
When the system operates, the engine will keep running at idle (in neutral) or stop in some conditions.

RESET:
Inspect the control system of electronic shift and throttle systems and repair or replace the component that has caused the failure.

CHECK SECOND STATION CAUTION

CONDITION:
This system operates when a failure has occurred in the 2nd station control system.

ACTION:
When the system operates, the tachometer display screen will indicate “Check 2nd Station” and at the same time the caution buzzer sounds and two caution lamps turn on.
In addition, a red light on the switch panel turns on.

NOTE:
When the tachometer “ENTER” button is pressed, the diagnosis code “Check Engine 7-4” appears on the display screen.

NOTE:
When this system operates, the engine control is operational only in the 1st station and not in the 2nd station.

RESET:
Inspect the control systems of Sub BCM and the 2nd station and repair or replace the component that has caused the failure.

CHECK THROTTLE SYSTEM CAUTION

CONDITION:
This system operates when a failure has occurred in the electronic throttle control system.

ACTION:
When the system operates, the tachometer display screen will indicate “Check Throttle System” and at the same time the caution buzzer sounds and two caution lamps turn on.
The engine speed will fluctuate limiting the speed to the maximum of 2 000 r/min.

NOTE:
When the tachometer “ENTER” button is pressed, the diagnosis code of any one of “Check Engine 7-1, 7-2, 7-3 or 2-1” appears on the display screen.

RESET:
Inspect the control system of electronic throttle system and repair or replace the component that has caused the failure.

CHECK SHIFT CONTROL CAUTION

CONDITION:
This system operates when a failure has occurred in the electronic shift control system.

ACTION:
When the system operates, the tachometer display screen will indicate “Check Shift Control” and at the same time the caution buzzer sounds and two caution lamps turn on.

NOTE:
When the tachometer “ENTER” button is pressed, the diagnosis code of any one of “Check Engine 8-1, 8-2, 8-3 or 1-2” appears on the display screen.

NOTE:
When this system is in operation:
- *ECM turns off the shift motor relay and fixed the shift position to that when the failure occurred.*
- *It is not possible to adjust the engine speed or shift by operating the remote control lever.*
- *The engine can be operated at idle (minimum speed).*
- *If “THROTTLE ONLY” switch is pressed with the remote control lever in neutral position, the engine speed can be adjusted to the maximum of 2 000 r/min by operating the remote control lever.*

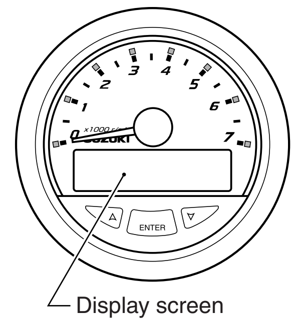
⚠ WARNING

When “Check Shift Control” is shown in the display screen, no shift operation of forward, neutral or reverse is possible.
If the engine speed adjustment is attempted with the shift in forward or reverse, the boat may abruptly start off possibly leading to an accident.
Except in an emergency, never operate the engine when “Check Shift Control” is shown in the display screen.

RESET:
Inspect the control system of electronic shift system and repair or replace the component that has caused the failure.

SELF-DIAGNOSTIC SYSTEM

The self-diagnostic system alerts the operator when an abnormality occurs in a signal from sensor, switch, etc. When the system is activated, the “Diagnostic code” appears on the display screen of tachometer- monitor, caution buzzer sound and caution lamps lights.
The buzzer sounds a series of short (0.2 sec.) beeps.
The buzzer sound, activated by the self – diagnostic system, can be temporally canceled by pushing the main key in.



CODE FOR SELF-DIAGNOSTIC SYSTEM OPERATION

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVE
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO [NOTE 3]
Rectifier & regulator (Over-charging) [NOTE 1]	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor [NOTE 2]	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO [NOTE 3]
ESA ECM	8 – 1	NO [NOTE 3]
ESA motor	8 – 2	NO [NOTE 3]
ESA	8 – 3	NO [NOTE 3]

NOTE:

- *If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when "ENTER" key is pressed.*
- *If the failed item remains, the self-diagnostic indication appears again after turning the main switch "ON".*
- *After correcting failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running or turn on the main switch from OFF.*
- *For cylinder temp. sensor, exhaust manifold temp. sensor or IAT sensor the self-diagnostic indication will be canceled after corrective action by turning the main switch "ON".*
  (The ECM will require 10 – 20 seconds after turning the main switch "ON" to cancel the self-diagnostic indication.)

NOTE 1:

This self-diagnostic indication may not display (be canceled) by turning the main switch "ON" because the ECM detects only battery voltage, not charging output.

Under this condition the buzzer will not sound and diagnostic code not appear.

However, if the rectifier & regulator have failed, the self diagnostic indication will again appear after starting the engine.

NOTE 2:

During the engine operation, even if the sensor fails, the fuel injection and ignition timing are controlled properly.

If there is a failure in the sensor, the engine cannot be started.

NOTE 3:

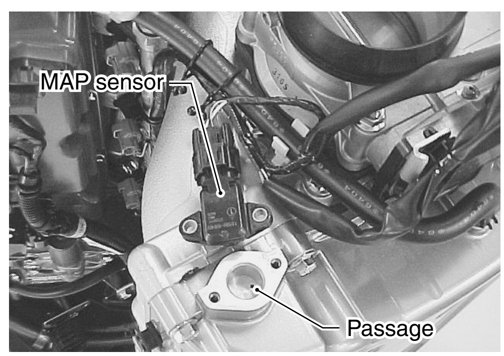
For fail-safe condition, see page 3-53 and 3-54.

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 (1.46 – 33.86 inHg) (0.50 – 4.84 V)” signal (With engine running)
Cylinder temp. sensor	• No signal • Receiving an out of range “–46 to +170 °C (–114.8 – +338.0 °F) (0.10 – 4.6 V)” signal
IAT sensor	• No signal • Receiving an out of range “–46 to +169 °C (–114.8 – +336.2 °F) (0.10 – 4.6 V)” signal
CKP sensor	• During one crankshaft rotation, 34 signals are not input to ECM.
CMP sensor	• During two crankshaft rotation, 4 signals are not input to the ECM.
Air intake system	• During the ECM’s receiving input of the complete close signal from the throttle position sensor, the engine operates at an abnormally high speed. (Criterion: 2 500 r/min MIN)
MAP sensor 2 (Pressure detect passage)	• Receiving unchanging signal regardless engine speed change. [NOTE 1]
Rectifier & Regulator. (Over-charging)	• Receiving 16 volts or higher signal
Exhaust manifold temp. sensor (PORT or STBD)	• No signal • Receiving an out of range “–46 to +170 °C (–114.8 – +338.0 °F) (0.10 – 4.6 V)” signal
Fuel injector	• No operation signal from the ECM
Throttle position sensor	• Receiving an out of range “0.35 – 4.8 V” TPS main sensor signal. • The difference of output voltage between the main sensor and sub sensor is outside the specified range.
Shift position sensor	• Receiving an out of range “0.35 – 4.8 V” signal.
CMP sensor (VVT PORT or STBD)	• During two crankshaft rotation, 4 signals are not input to ECM.
VVT advance (PORT or STBD)	• There is a large difference between the target advance angle and the actual advance angle.
Neutral switch	• While the shift sensor outputs the forward or reverse signal, the ECM receives input of the neutral signal from the neutral switch.
Oil control valve (PORT or STBD)	• OCV not operating.

FAILED ITEM	CONDITION
Speed sensor	• Receiving an out of range “0.2 – 4.8 V” signal.
Trim sensor	• Receiving an out of range “0.2 – 4.8 V” signal.
ETV ECM	• ECM electronic throttle control circuit failure
ETV motor	• Throttle valve actuator motor operation failure or its power supply system (throttle relay, etc.) failure. • Motor connector open • Motor power supply line open
ETV valve	• Throttle valve operation failure
Sub BCM	• Sub BCM communication error • Low sub BCM source voltage. • Sub BCM failure
DBW system	• CAN communication error between BCM and ECM. • LPS error (ECM received an input signal from each sensor which was outside the range of 4.5 – 5.5 V as total of main sensor and sub sensor output voltage.). • Low BCM source voltage (less than 6 V). • BCM failure. • ECM failure.
ESA ECM	• ECM electronic shift control circuit failure.
ESA motor	• Electronic shift motor failure. • Motor connector open • Motor power supply line open
ESA position	• Response failure ECM has detected the target LPS output voltage signal, but no change occurs in the input signal voltage from shift position sensor.

NOTE 1:
This condition will be caused by clogged pressure detect passage in intake collector assembly.



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	• 280 – 560 mmHg / (11.02 – 22.05 inHg.) (The control takes place in accordance with the engine speed.) [NOTE1] • VVT advance is fixed at the most retarded angle.
CMP sensor	Based on signals from CKP sensor: (a) Failed with engine running • Normal Ignition timing. • Normal sequential fuel injection. • VVT advance is fixed at the most retarded angle. Failed prior to engine start: • Engine will not start.
Air intake system	• The control is executed with the maximum engine speed as 2 000 r/min.
Cylinder temp. sensor	• 60 °C (140 °F)
IAT sensor	• 45 °C (113 °F)
Exhaust manifold temp. sensor	• 60 °C (140 °F)
Throttle position sensor	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
Shift position sensor	• ECM detects the shift position as neutral even under in-gear condition and controls the engine speed to idling. • If the “Throttle only” button is pressed with the remote control lever in neutral, the engine speed can be controlled at the maximum of 2 000 r/min by operating the lever.
CMP sensor (VVT)	• VVT advance is fixed at the most retarded angle.
VVT advance	• VVT advance is fixed at the most retarded angle. • The ECM cyclically outputs the drive and stop signals for the OCV and when the difference between the VVT’s target advance angle and the actual advance angle has come to the normal range, the diagnostic code display is canceled.

FAILED ITEM	PRE-PROGRAMMED VALUE
ETV ECM	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever. (The engine rpm is controlled both by altering the ignition timing and skipping ignition for intermittent misfiring.)
ETV motor	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
ETV	• The throttle opening is fixed to default with the throttle motor relay turned off. • ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
Sub BCM	• The main BCM controls the engine appropriately.
DBW system	• ECM causes the shift to return and fix to the neutral position and controls the engine speed to idling.
ESA ECM	• ECM turns off the shift motor relay and fixes the shift position to that when the failure occurred. The engine rpm is controlled with ECM at the maximum of 2 000 r/min by operating the remote control lever.
ESA motor	
ESA position	

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

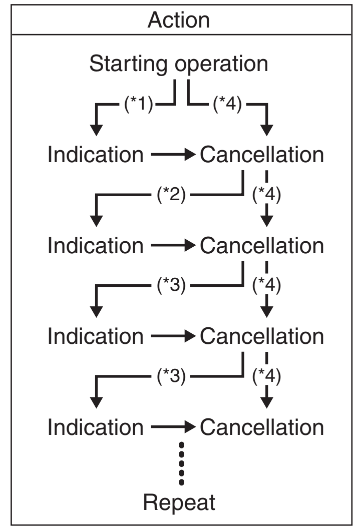
NOTE 1:
This value will change according to the current engine speed.

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 “Change Oil ” appears on the display screen of tachometer-monitor, the buzzer will begin a series of double beeps if engine is not running (but main switch is ON) and caution lamps lights.

The above mentioned indication will repeat until the activated system is manually cancelled.

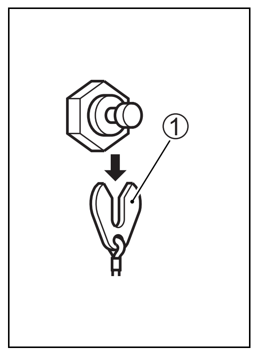


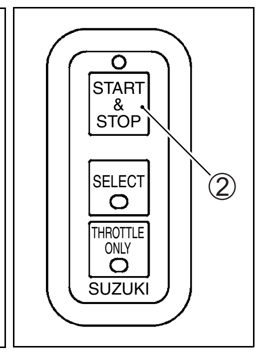
*1 : Lapse of initial 20 hour’s operation
*2 : Lapse of 80 hour’s operation
*3 : Lapse of 100 hour’s operation
*4 : When performing cancellation before system activation

CANCELLATION

Procedure

1. Turn the main switch key to “ON” position.
2. Pull out the emergency stop switch plate ①.
3. Depress the START & STOP button ② three times in ten seconds.
   A short beep will be heard if cancellation is successfully finished.
4. Turn the main switch key to “OFF” position.
5. Set the switch plate ① in original position.





NOTE:

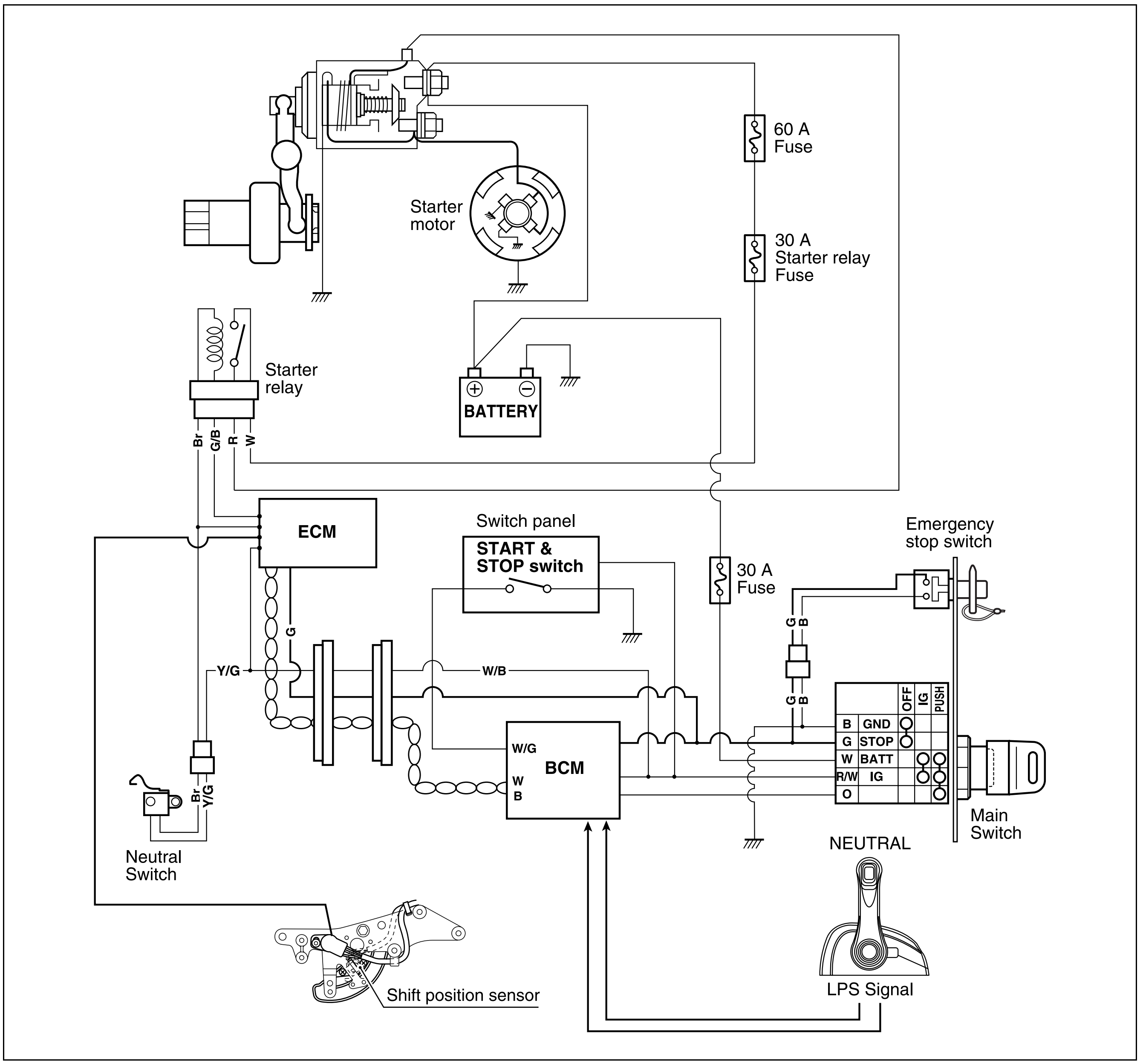
- *Canceling of the system activation is possible regardless of whether or not the engine oil has been replaced.*
  Once the system has operated, however, SUZUKI strongly recommends that the engine oil be replaced before canceling the system activation.
- *Even if the engine oil has been replaced with the system not operating, it is still necessary to perform the cancellation.*

START-IN-GEAR PROTECTION SYSTEM

To avoid an accidental movement of the boat at the time of engine starting, the system prohibits the starter motor operation when the shift is "IN."
At the time of starting, BCM detects the status of each input signal.
When the conditions below are met, pressing "START & STOP" switch causes the start instruction signal to be sent to ECM. Then the starter relay circuit is closed and the starter motor starts to operate.

- When BCM detects that the target shift position is neutral according to the LPS input signal and
- When BCM detects that the actual shift position is neutral according to the SPS (ECM) input signal.
- When ECM and BCM detects emergency stop switch OFF signal.

If "START & STOP" switch is pressed and the start instruction signal from BCM is not inputted to ECM, the starter motor does not operate and ECM does not output the injection drive signal, ignition signal, high/low pressure fuel pump drive signal to the respective actuators.



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

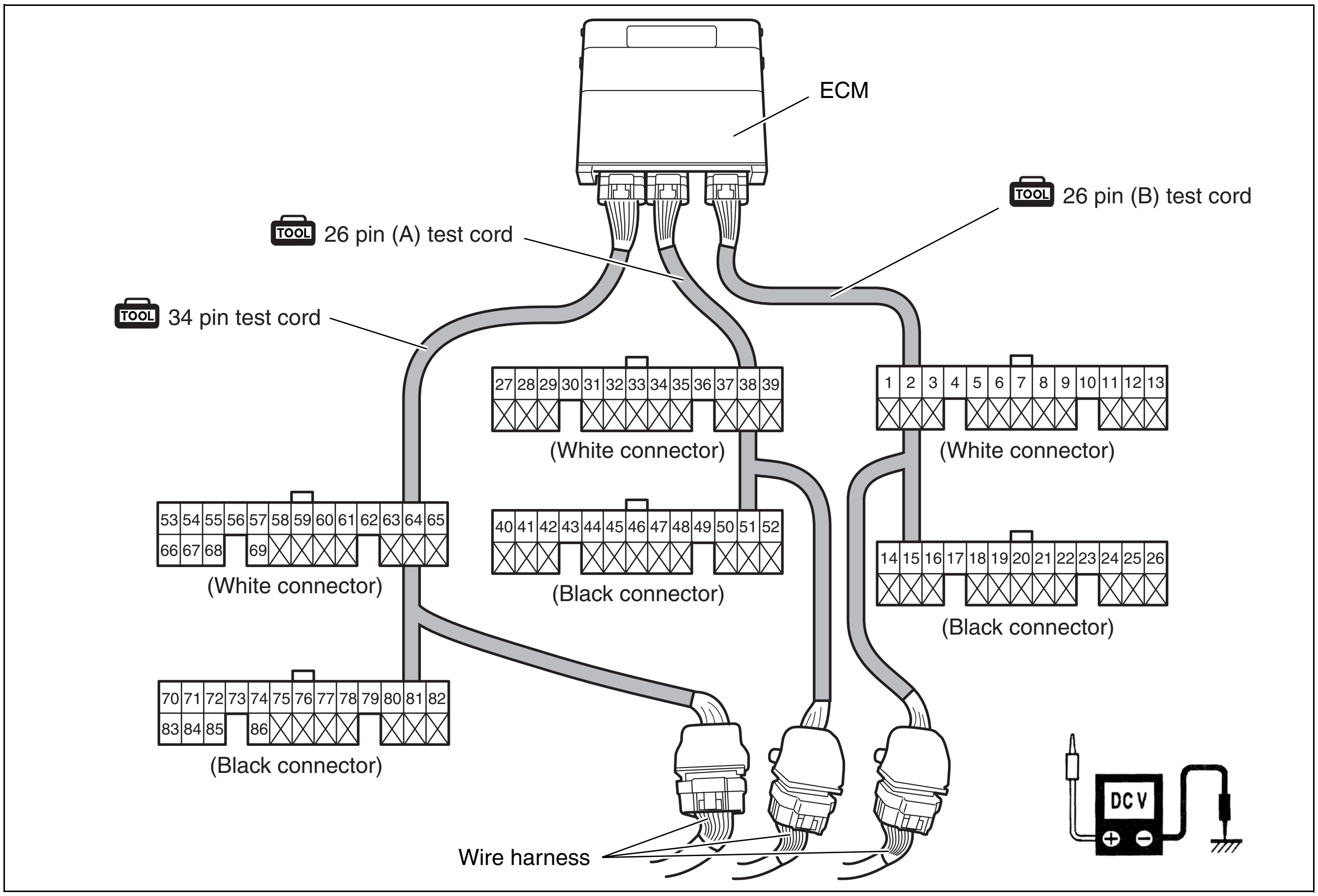
NOTE:
- *To troubleshoot ECM, BCM and the engine control system consisting of sensors and actuators, use the Suzuki Diagnostic System.*
- *When ECM or BCM has been replaced, it is necessary to perform the initialization and re-calibration of SPC system.*
- *The self-diagnostic codes memory in ECM will remain even if battery is disconnected.*
- *As each terminal voltage is affected by battery voltage, always use a full-charged battery.*
- *Make sure all ground points have good electrical contact.*
- *Make sure all wires/cables are securely connected.*

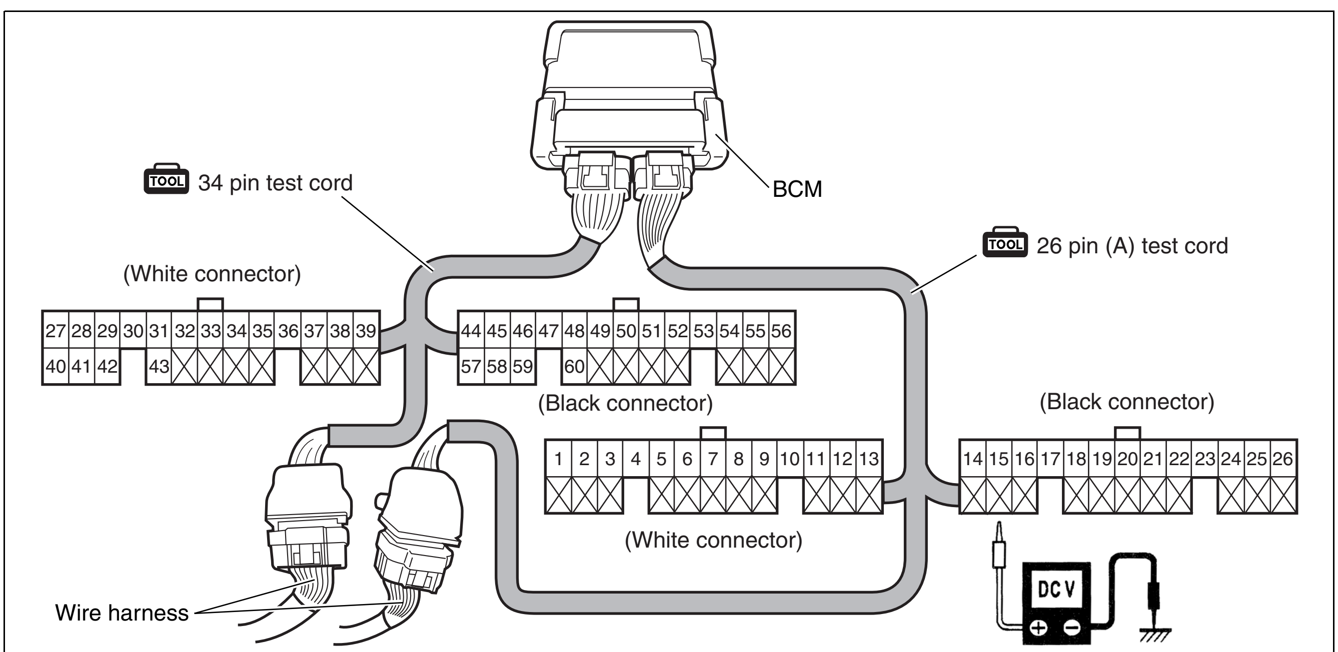
26-PIN & 34-PIN TEST CORD

This test cord is used when checking the circuit for voltage, etc. and connected between ECM or BCM and the wiring harness.

To measure, connect the tester probe to the relevant terminal of the test cord.

TOOL 09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord





INSPECTION FOR ECM CIRCUIT VOLTAGE

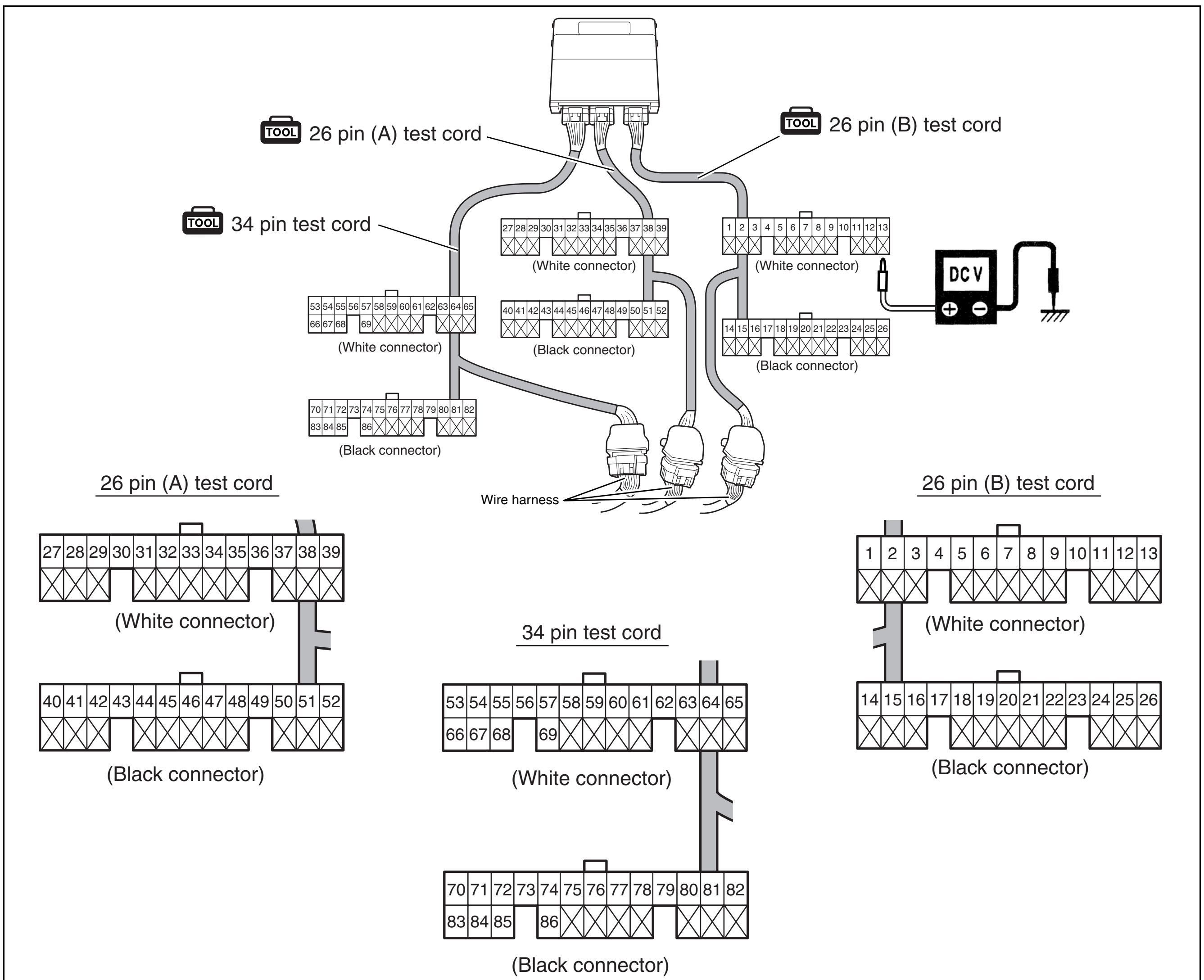
CAUTION

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

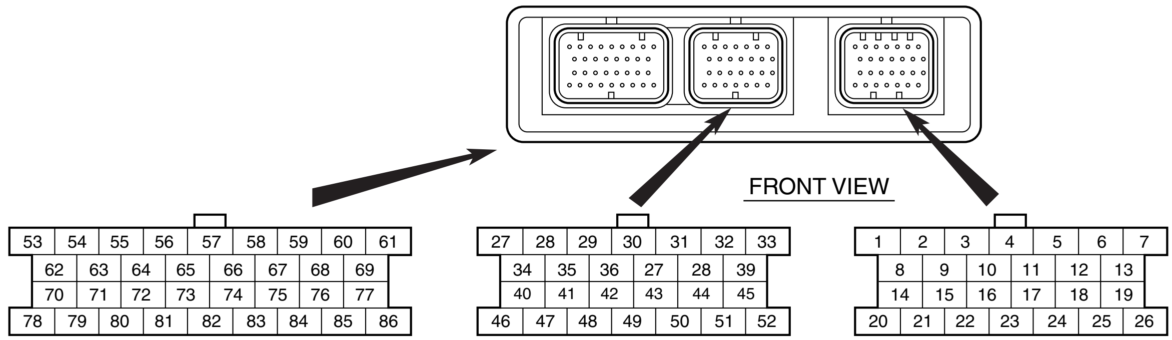
09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

Tester range: ⎓ DCV (See chart for range.)

1. Turn main switch OFF.
2. Connect the 26-pin (A), (B) and 34-pin test cord between ECM and wire harness as shown in figure.
3. Turn main switch ON.
4. Connect the tester probe ("⊖", Black) to body ground, and measure voltage according to the "CIRCUIT VOLTAGE TABLE".



ECM CIRCUIT VOLTAGE TABLE



TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
1	—	—	—	—
2	—	—	—	—
3	Y/Bl	CMP sensor #1	Approx. 0.3 V or 5 V	Main switch ON
4	R/B	CKP sensor	—	—
5	V/W	Ex. manifold temp. sensor #1	0.14 – 4.75 V	Main switch ON
6	B/W	Sensor GND	—	—
7	W	CAN (H)	Approx. 2.5 V or 3.6 V	Main switch ON
8	Bl	Oil pressure switch	Approx. 5 V	While engine running
			Approx. 0 V	Engine stopped (Main switch ON)
9	O/G	CMP sensor #2 (VVT_ PORT)	Approx. 0.3 V or 5 V	Main switch ON
10	B/O	CMP sensor #3 (VVT_ STBD)	Approx. 0.3 V or 5 V	Main switch ON
11	Bl/B	Water pressure sensor	0.5 – 4.5 V	Main switch ON
12	G/R	Ex. manifold temp. sensor #2	0.14 – 4.75 V	Main switch ON
13	B	CAN (L)	Approx. 2.5 V or 1.4 V	Main switch ON
14	P/W	Throttle position sensor (SUB)	2.5 – 4.5 V	Main switch ON
15	Bl/R	Emergency stop switch	Approx. 5 V	Main switch ON. Stop switch plate IN
			Approx. 0 V	Main switch ON. Stop switch plate OUT
16	LBl	PTT switch UP	Approx. 12 V	Main switch ON. PTT UP switch depressed.
			Approx. 0 V	Main switch ON. PTT UP switch not depressed.
17	W/Y	Trim and Tilt sensor	0.3 – 4.5 V	Main switch ON
18	—	—	—	—
19	Lg/W	Cylinder temp. sensor	0.14 – 4.75 V	Main switch ON
20	P/Bl	Shift position sensor	Approx. 2.5 V	Main switch ON. Shift in Neutral
			Approx. 3.7 V	While engine running. Shift in Forward
			Approx. 1.3 V	While engine running. Shift in Reverse
21	Br	Neutral switch	Approx. 12 V	Main switch ON. Shift into NEUTRAL.
			Approx. 0 V	While engine running. Shift into FOR-WARD or REVERSE.
22	P	PTT switch DOWN	Approx. 12 V	Main switch ON. PTT DN switch depressed.
			Approx. 0 V	Main switch ON. PTT DN switch not depressed.
23	G/B	Starter relay control	Approx. 0.5 V	Main switch ON. While engine Cranking.
			Approx. 12 V	Main switch ON. Normal
24	W	MAP sensor	0.5 – 4.5 V	Main switch ON
25	Bl/W	Speed sensor	0.5 – 4.5 V	Main switch ON

TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
26	Lg/B	IAT sensor	0.04 – 4.46 V	Main switch ON
27	—	—	—	—
28	—	—	—	—
29	Br/Y	Throttle position sensor (main)	0.5 – 4.5 V	Main switch ON
30	R/Bl	Power source for TPS	Approx. 5 V	Main switch ON
31	R/W	Power source for SPS	Approx. 5 V	Main switch ON
32	Br/B	Shift position sensor GND	—	—
33	B	Ground for ECM	—	—
34	G/Bl	Shift motor relay	Approx. 12 V	Main switch ON. ESA system Fail.
			Approx. 0.5 V	Main switch ON. ESA system Normal.
35	—	—	—	—
36	—	—	—	—
37	—	—	—	—
38	B/W	Ground for TPS	—	—
39	B	Ground for ECM	—	—
40	Bl/Y	No.6 Ignition coil (–)	Approx. 0 V	Main switch ON
41	—	—	—	—
42	—	—	—	—
43	—	—	—	—
44	R	Power source for sensor	Approx. 5 V	Main switch ON
45	Gr	ECM power source	Approx. 12 V	Main switch ON
46	Lg/R	No.4 Ignition coil (–)	Approx. 0 V	Main switch ON
47	W/G	No.5 Ignition coil (–)	Approx. 0 V	Main switch ON
48	O	ECM main relay	Approx. 0.8 V	Main switch ON
49	Y	Communication line No.1	—	—
50	O/Y	Communication line No.2	—	—
51	Y/G	Ignition switch	Approx. 12 V	Main switch ON
52	Gr	ECM power source	Approx. 12 V	Main switch ON
53	Br/R	No.2 OCV (–)	Approx. 12 V	Main switch ON
54	Lg	No.4 Fuel injector (–)	Approx. 12 V	Main switch ON
55	O/B	No.1 Fuel injector (–)	Approx. 12 V	Main switch ON
56	B/Br	No.2 Fuel injector (–)	Approx. 12 V	Main switch ON
57	W/Bl	Throttle motor (–)	Approx. 0 V or 12 V	Main switch ON
58	Y	Throttle motor power source	Approx. 12 V	Main switch ON
59	Y	Throttle motor power source	Approx. 12 V	Main switch ON
60	R/Y	Throttle motor (+)	Approx. 0 V or 12 V	Main switch ON
61	G	Shift motor (–)	Approx. 0 V or 12 V	Main switch ON
62	Br/W	No.1 OCV (–)	Approx. 12 V	Main switch ON
63	B	Ground for ECM power	—	—
64	—	—	—	—
65	B	Ground for throttle motor	—	—
66	B	Ground for throttle motor	—	—
67	B	Ground for shift motor	—	—
68	B	Ground for shift motor	—	—
69	Gr/R	Shift motor power source	Approx. 12 V	Main switch ON

TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
70	B/R	High pressure fuel pump (–)	Approx. 0 V	• Stop switch plate IN. • Shift into NEUTRAL • For 6 sec. after main switch ON. • While engine running
			Approx. 12 V	• Engine stopped. • Main switch ON. • Stop switch plate IN. • Shift into NEUTRAL
71	B	Ground for ECM power	—	—
72	—	—	—	—
73	Gr/Y	No.3 Ignition coil (–)	Approx. 0 V	Main switch ON
74	Bl	No.2 Ignition coil (–)	Approx. 0 V	Main switch ON
75	O	No.1 Ignition coil (–)	Approx. 0 V	Main switch ON
76	W/B	Throttle motor relay	Approx. 12 V	Main switch ON. ETV system Fail.
			Approx. 0.5 V	Main switch ON. ETV system Normal.
77	Gr/R	Power source for shift motor	Approx. 12 V	Main switch ON
78	B/Y	Low pressure fuel pump (–)	Approx. 0 V	• Stop switch plate IN. • Shift into NEUTRAL • For 6 sec. after main switch ON. • While engine running
			Approx. 12 V	• Engine stopped. • Main switch ON. • Stop switch plate IN. • Shift into NEUTRAL
79	R/W	No.3 Fuel injector (–)	Approx. 12 V	Main switch ON
80	Y/R	No.6 Fuel injector (–)	Approx. 12 V	Main switch ON
81	O/Bl	No.5 Fuel injector (–)	Approx. 12 V	Main switch ON
82	—	—	—	—
83	—	—	—	—
84	O/W	Purge valve	Approx. 12 V	Main switch ON
85	—	—	—	—
86	R	Shift motor (+)	Approx. 0 V or 12 V	Main switch ON

INSPECTION FOR BCM CIRCUIT VOLTAGE

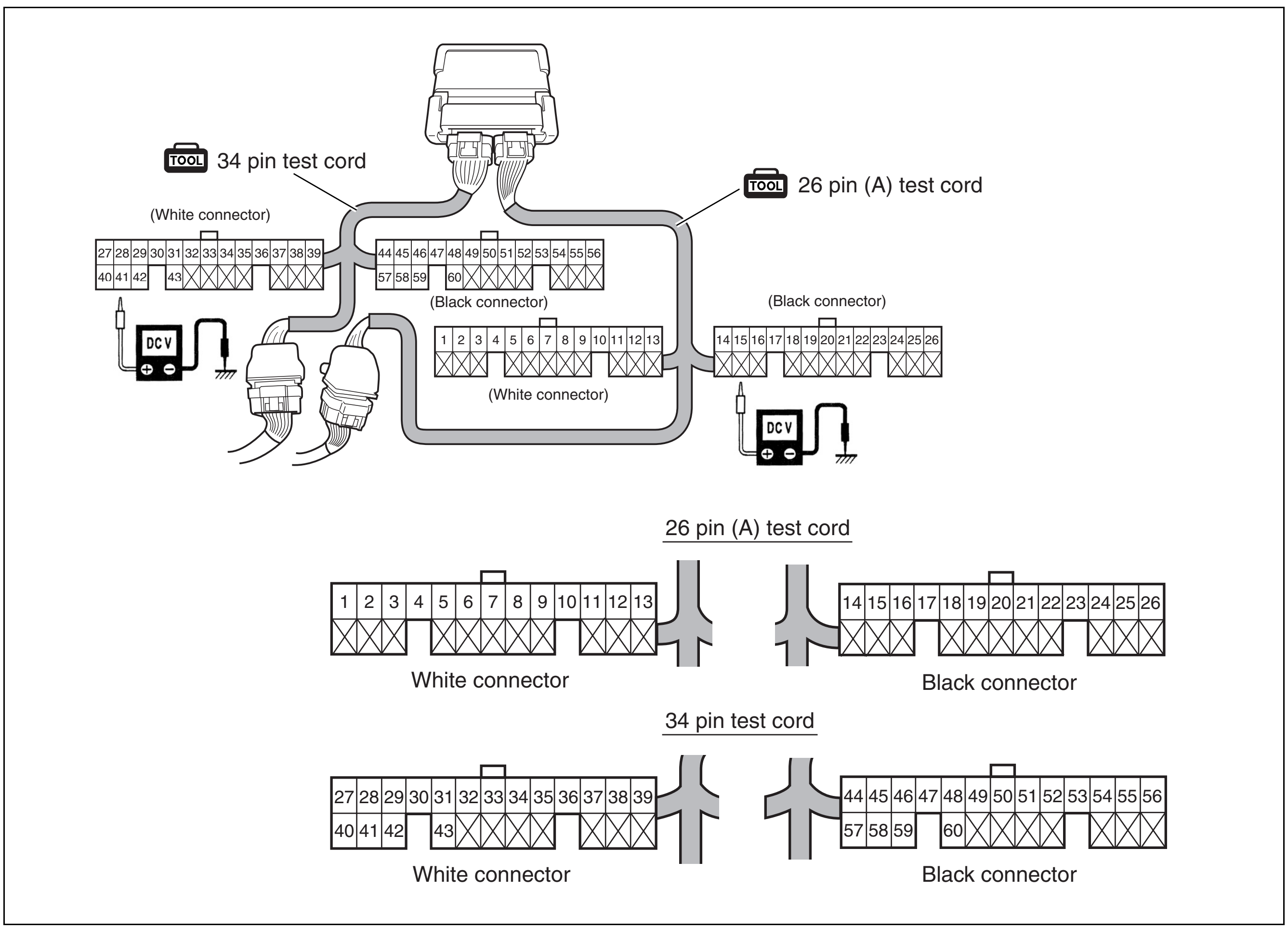
CAUTION

BCM cannot be bench checked. It is strictly prohibited to connect any tester (voltmeter or ohmmeter) to an BCM which has been disconnected from the BCM wiring harness assembly.

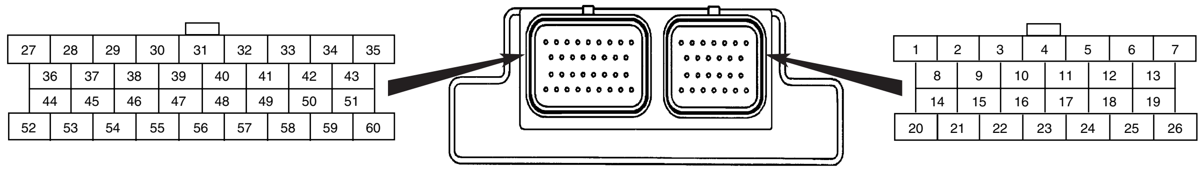
TOOL 09930-89340: 26-pin (A) & 34-pin test cord
09930-99320: Digital tester

Tester range: ⎓ DCV (See chart for range.)

1. Turn main switch OFF.
2. Connect the 26-pin (A) and 34-pin test cord between BCM and BCM wire harness assembly as shown in figure.
3. Turn main switch ON.
4. Connect the tester probe ("⊖", Black) to No.43 terminal (or body ground), and measure voltage according to the "CIRCUIT VOLTAGE TABLE".



BCM CIRCUIT VOLTAGE TABLE



(FRONT VIEW)

TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
1	—	—	—	—
2	R/Y	Power source for LPS main 2	Approx. 5 V	Main switch ON
3	Y/B	Start & Stop switch 2	Approx. 5 V	Main switch ON, Not depressed Start & Stop switch 2.
			Approx. 0 V	Main switch ON, Depressed Start & Stop switch 2.
4	Lg/B	Center control switch	Approx. 5 V	Main switch ON, Not depressed Center control switch.
			Approx. 0 V	Main switch ON, Depressed Center control switch.
5	O/B	Synchronization switch	Approx. 5 V	Main switch ON, Not depressed Sync switch.
			Approx. 0 V	Main switch ON, Depressed Sync switch.
6	—	—	—	—
7	—	—	—	—
8	Bl/Y	Lever position sensor sub 2	Approx. 2.2 V	Main switch ON, Shift in Neutral
			0.5 – 1.7 V	Main switch ON, Shift in Forward
			2.7 – 4.5 V	Main switch ON, Shift in Reverse
9	W/Y	Lever position sensor main 2	Approx. 2.2 V	Main switch ON, Shift in Neutral
			2.7 – 4.5 V	Main switch ON, Shift in Forward
			0.5 – 1.7 V	Main switch ON, Shift in Reverse
10	Y/R	Start & Stop switch 3	Approx. 5 V	Main switch ON, Start & Stop switch 3 not depressed.
			Approx. 0 V	Main switch ON, Start & Stop switch 3 depressed.
11	—	—	—	—
12	—	—	—	—
13	—	—	—	—
14	—	—	—	—
15	B/Y	Lever position sensor main 2 GND	—	—
16	—	—	—	—
17	—	—	—	—
18	—	—	—	—
19	—	—	—	—
20	—	—	—	—
21	—	—	—	—
22	—	—	—	—
23	—	—	—	—
24	—	—	—	—
25	Lg	Center engine control LED	—	—
26	O	Synchronization LED	—	—

TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
27	W	CAN 1 (H)	Approx. 2.5 or 3.6 V	Main switch ON
28	B	CAN 1 (L)	Approx. 2.5 or 1.4 V	Main switch ON
29	—	—	—	—
30	—	—	—	—
31	—	—	—	—
32	R/W	Power source for LPS main 1	Approx. 5 V	Main switch ON
33	W/B	Lever position sensor sub 1	Approx. 2.2 V	Main switch ON, Shift in Neutral
			0.5 – 1.7 V	Main switch ON, Shift in Forward
			2.7 – 4.5 V	Main switch ON, Shift in Reverse
34	Bl/W	Lever position sensor main 1	Approx. 2.2 V	Main switch ON, Shift in Neutral
			2.7 – 4.5 V	Main switch ON, Shift in Forward
			0.5 – 1.7 V	Main switch ON, Shift in Reverse
35	B	Ground for BCM	—	—
36	G	Throttle only LED	—	—
37	G/B	Throttle only switch	Approx. 5 V	Main switch ON, Not depressed Throttle only switch
			Approx. 0 V	Main switch ON, Depressed Throttle only switch
38	—	—	—	—
39	—	—	—	—
40	G	Emergency stop switch	Approx. 5 V	Main switch ON, Emergency stop switch plate IN
			Approx. 0 V	Main switch ON, Emergency stop switch plate OUT.
41	—	—	—	—
42	B/W	Lever position sensor main 1 GND	—	—
43	B	Ground for BCM	—	—
44	Br	Station select switch	—	—
45	—	—	—	—
46	O	Buzzer reset switch	Approx. 0 V	Main switch ON, Main switch key not pushed in.
			Approx. 12 V	Main switch ON, Main switch key pushed in.
47	Br/W	Station select switch	Approx. 5 V	Main switch ON, Not depressed Select switch
			Approx. 0 V	Main switch ON, Depressed Select switch
48	Y/G	Start & Stop switch 1	Approx. 5 V	Main switch ON, Not depressed Start & Stop switch
			Approx. 0 V	Main switch ON, Depressed Start & Stop switch
49	—	—	—	—
50	—	—	—	—
51	W	BCM power source	Approx. 12 V	Main switch ON
52	Bl	Buzzer	—	—
53	G/W	Diag LED	—	—
54	—	—	—	—
55	Lg/G	Cruise down switch	—	—
56	Lg/Bl	Cruise up switch	—	—
57	—	—	—	—
58	Y	Communication line No.2	—	—
59	O/Y	Communication line No.1	—	—
60	Gr	Main switch	Approx. 12 V	Main switch ON

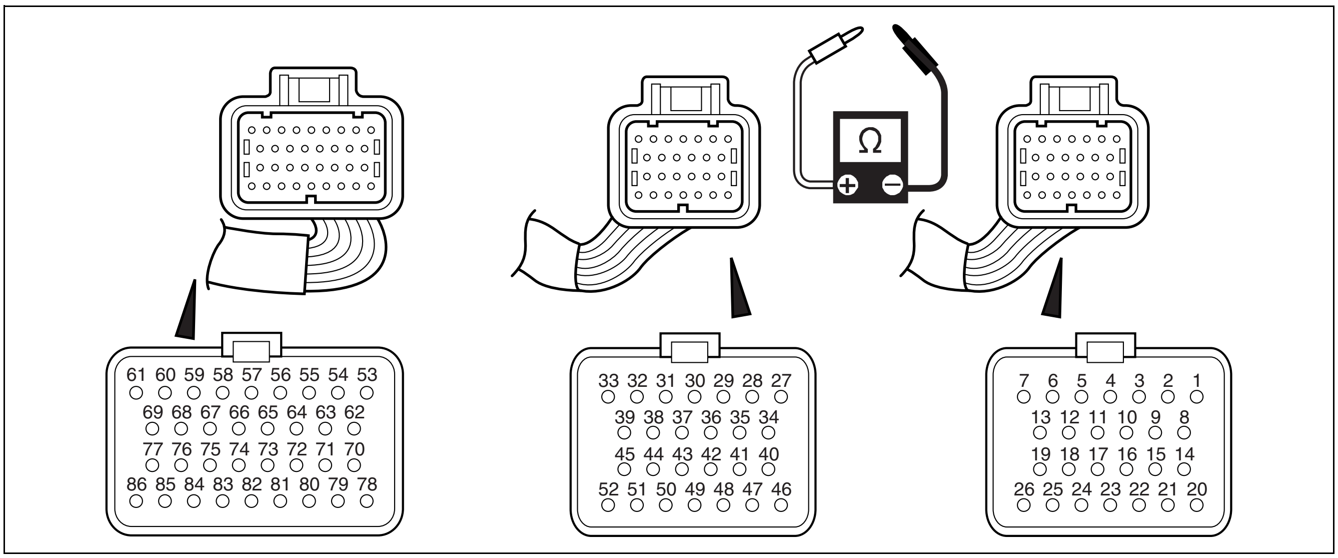
INSPECTION FOR RESISTANCE

TOOL 09930-99320: Digital tester

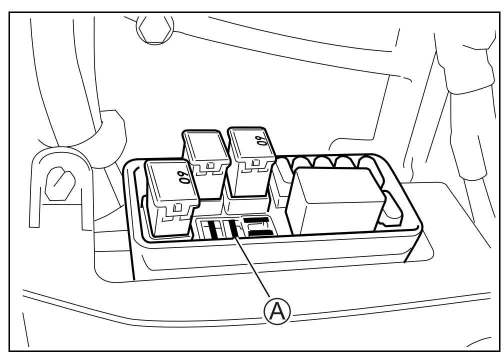
Tester range: Ω (Resistance, See chart for range.)

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

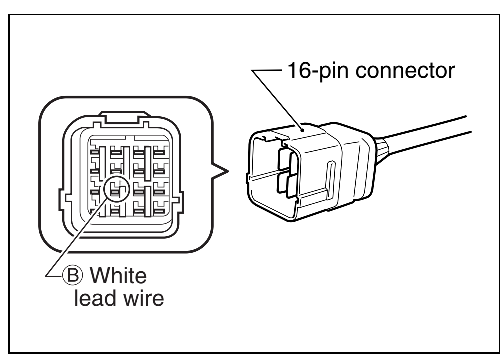
1. Turn main switch OFF.
2. Disconnect battery cables from battery.
3. Disconnect wire harness connector from ECM.
4. Connect the tester probes to terminal (wire harness side) and measure resistance according to the "RESISTANCE TABLE".



NOTE 1:
Disconnect ECM main relay from fuse box, and connect tester probe to relay terminal "Ⓐ" of fuse box side.



NOTE 2:
Disconnect remote control wire harness and connect tester probe to terminal ("Ⓑ", White wire) in engine main wiring harness connector.



RESISTANCE TABLE

ITEM	TERMINAL FOR TESTER PROBE CONNECTION	STANDARD RESISTANCE (at 20 °C)
CKP sensor	4 (R/B) to 6 (B/W)	168 – 252 Ω
Fuel injector No. 1	55 (O/B) to Terminal Ⓐ [NOTE 1]	10 – 14 Ω
Fuel injector No. 2	56 (B/Br) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 3	79 (R/W) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 4	54 (Lg) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 5	81 (O/Bl) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 6	80 (Y/R) to Terminal Ⓐ [NOTE 1]	
OCV (Oil control valve) #1	62 (Br/W) to Terminal Ⓐ [NOTE 1]	6.0 – 8.3 Ω
OCV (Oil control valve) #2	53 (Br/R) to Terminal Ⓐ [NOTE 1]	
Purge valve	84 (O/W) to Terminal Ⓐ [NOTE 1]	28 – 35 Ω
IAT sensor	26 (Lg/B) to 6 (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	19 (Lg/W) to 6 (B/W)	
Ex-manifold temperature sensor #1	5 (V/W) to 6 (B/W)	
Ex-manifold temperature sensor #2	12 (G/R) to 6 (B/W)	
ECM main relay	48 (O) to Terminal Ⓑ [NOTE 2]	145 – 190 Ω
Throttle motor relay	76 (W/B) to 45 (Gr)	145 – 190 Ω
Shift motor relay	34 (G/Bl) to 45 (Gr)	145 – 190 Ω

COMPONENT INSPECTIONS

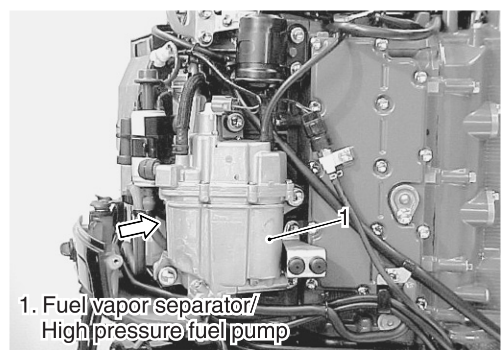
FUEL PUMP 6 SEC OPERATING SOUND

[High pressure side]

1. Install the emergency stop switch lock plate in position.
2. Shift into Neutral.
3. Turn main switch ON and check for fuel pump operating sound.

Fuel pump operating sound:
Sounds for approx. 6 seconds only

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

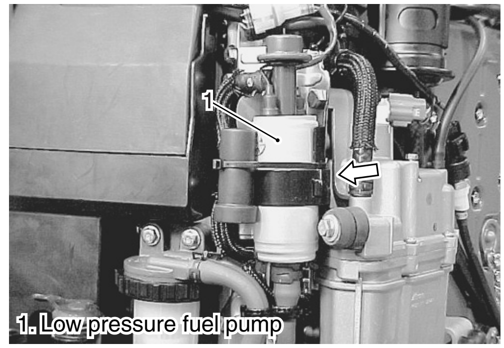


1. Fuel vapor separator/ High pressure fuel pump

[Low pressure side]

1. Install the emergency stop switch lock plate in position.
2. Shift into Neutral.
3. Turn main switch ON and check for fuel pump operating sound.

Fuel pump operating sound:
Sounds for approx. 6 seconds only



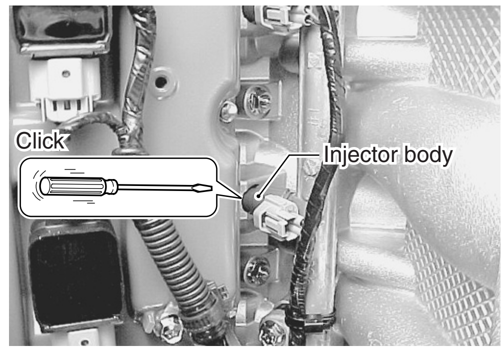
1. Low pressure fuel pump

FUEL INJECTOR OPERATING SOUND (CRANKING)

1. Remove the bolts and STBD/PORT air duct guard. (See page 6-2.)
2. Disconnect all ignition coil connectors.
3. Touch a sound scope or long blade screw driver to fuel injector body as shown.
4. Crank engine and check for injector operating sound.

Injector operating sound: "Click"

5. Reinstall the air duct guards.



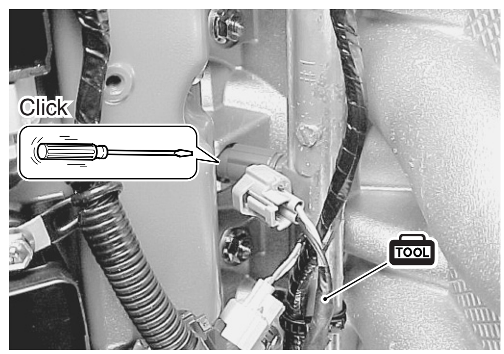
FUEL INJECTOR OPERATING SOUND (INDIVIDUAL)

1. Remove the bolts and STBD/PORT air duct guard. (See page 6-2.)
2. Disconnect fuel injector wire and connect test cord.

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

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

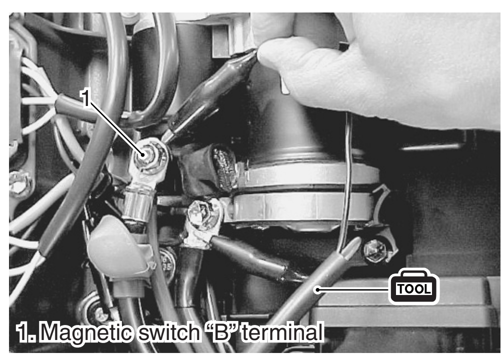
Injector operating sound: "Click"



CAUTION

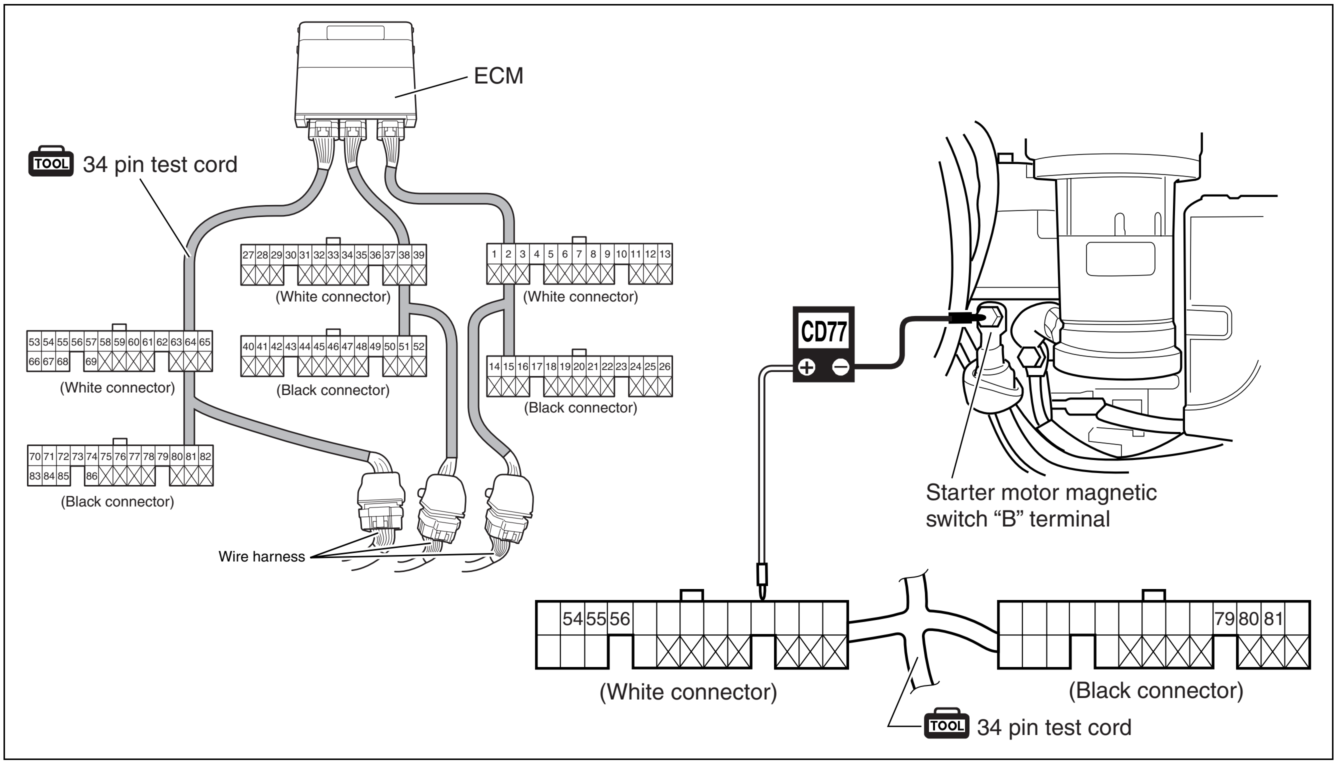
Connecting fuel injector to battery positive for more than a few seconds may cause injector overheating and possible injector solenoid failure.

5. Reinstall the air duct guards.



1. Magnetic switch "B" terminal

FUEL INJECTOR OPERATING SIGNAL

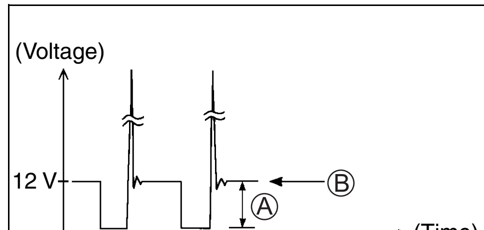


TOOL 09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord

Peak voltmeter Stevens CD-77
Tester range: NEG 50

1. Remove the bolts and STBD/PORT air duct guard. (See page 6-2.)
2. Disconnect all ignition coil connectors.
3. Connect test cord between ECM and wire harness as shown in figure then turn main switch ON.
4. Connect the tester probe ("⊖", Black) to starter motor magnetic switch "B" terminal (connected to battery positive ⊕ terminal) as shown in figure.
5. Connect the tester probe ("⊕", Red) to each terminal.

Injector	Terminal	Wire color (engine harness)
No. 1	55	O/B
No. 2	56	B/Br
No. 3	79	R/W
No. 4	54	Lg
No. 5	81	O/Bl
No. 6	80	Y/R

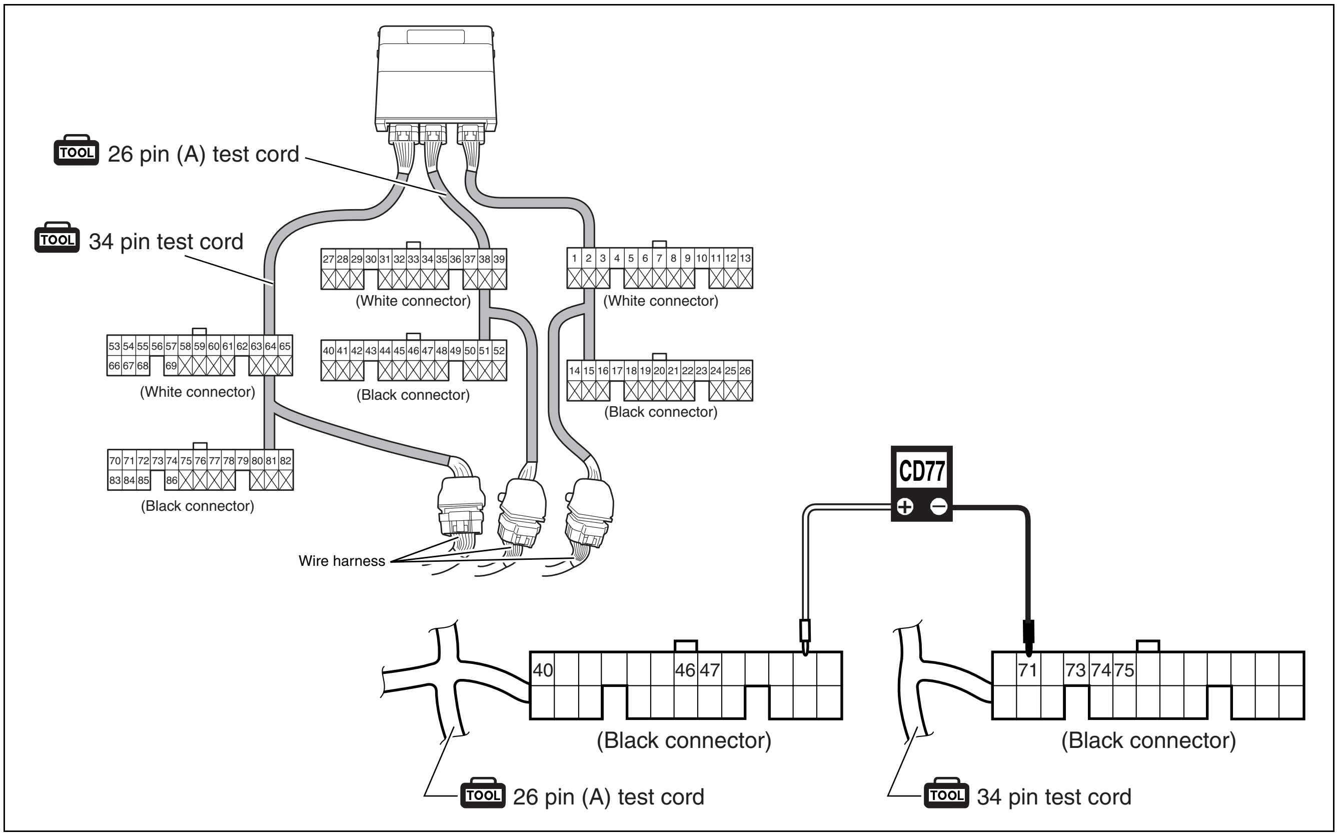


Ⓐ Peak voltage reading (NEG)
Ⓑ 0 V level for peak voltmeter

6. Crank engine and measure voltage.

Fuel injector operating signal: 6 – 10 V

IGNITION COIL OPERATING SIGNAL



09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord

Peak voltmeter Stevens CD-77
Tester range: SEN 50

1. Connect test cord between ECM and wire harness as shown in figure then turn main switch ON.
2. Connect the tester probe ("⊕", Red) to each terminal.

Ignition coil	Terminal	Wire color (engine harness)
No. 1	75	O
No. 2	74	Bl
No. 3	73	Gr/Y
No. 4	46	Lg/R
No. 5	47	W/G
No. 6	40	Bl/Y

3. Connect the tester probe ("⊖" Black) to No. 71 terminal (or to body ground).
4. Crank engine and measure voltage.

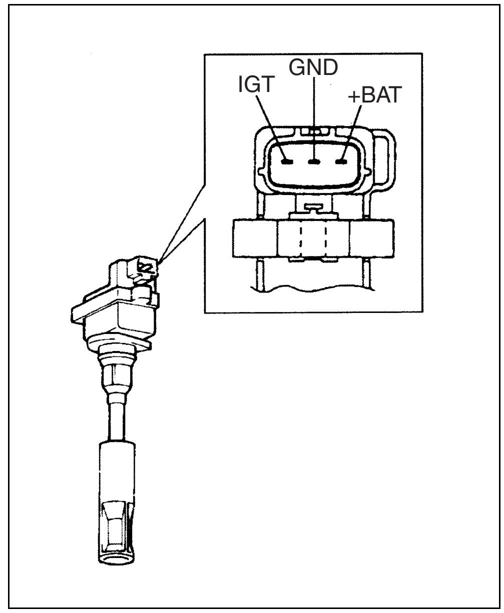
Ignition coil operating signal: Approx. 5 V

IGNITION COIL ASSEMBLY

TOOL 09930-99320: Digital tester

Tester range: ⎓ DCV (See chart for range.)

NOTE:
The ignition coil power transistor and high-tension lead are an integral part of the coil internal circuit. Using resistance measurements to check for a defect on either the primary or secondary coil is not possible.

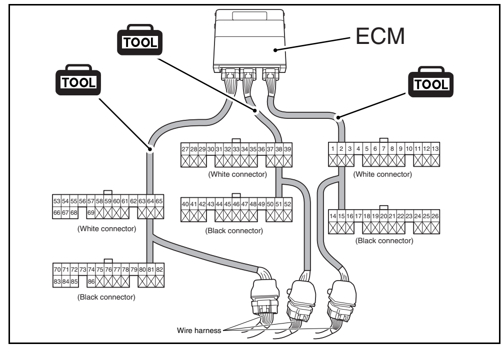


1. Turn main key OFF.
2. Remove the bolts and STBD/PORT air duct guard. (See page 6-2.)
3. Disconnect ignition coil connector.
4. Check for continuity between GND ⊖ terminal on the wiring harness side connector and the engine body ground.
5. Turn the main key to ON position. Check for battery voltage by measuring between the BAT ⊕ terminal and GND terminal on the wiring harness side connector.
6. Connect the wiring harness connector to the ignition coil and measure the ignition operating signal. (See page 3-70.)
7. If any failure exists, check for open circuit, short-circuited battery, short-circuited lead and connector's contact condition for each circuit.
8. If there is no spark even with the wiring harness and spark plug in sound condition, perform inspection again using an ignition coil that is known to be in good condition (new or used from another cylinder that is operating properly).
9. If there is still no spark even with the wiring harness, spark plug and ignition coil in sound condition, replace the ECM and perform inspection again.

CMP SENSOR SIGNAL

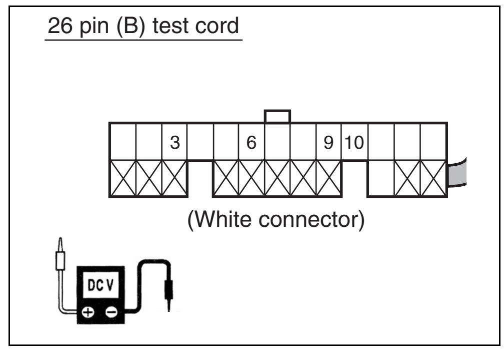
09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

Tester range: ⎓ DCV (See chart for range.)



1. Turn main switch OFF.
2. Remove CMP sensor. (See page 3-95.)
3. Connect the 26-pin (A)/(B) and 34-pin test cord between ECM and wire harness as shown in figure.
4. Connect the tester probe ("⊕", Red) to each terminal.

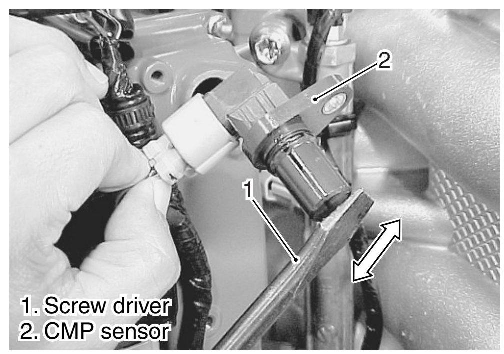
CMP sensor	Terminal	Wire color (engine harness)
No. 1	3	Y/Bl
No. 2 (VVT_PORT)	9	O/G
No. 3 (VVT_STBD)	10	B/O



5. Connect the tester probe ("⊖", Black) to No. 6 terminal (or to body ground).
6. Turn main switch ON.
7. Measure the voltage when the tip of a steel screwdriver is brought near and then pulled away from the sensor tip.

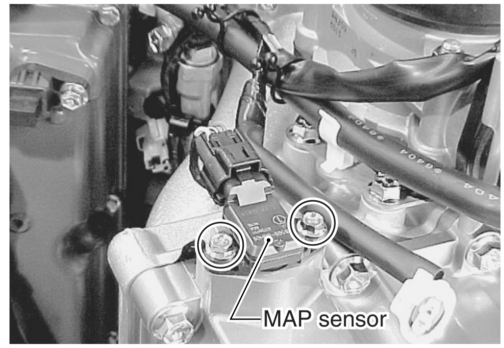
   When screwdriver is brought near: Approx. 5 V
   When screwdriver is pulled away: Approx. 0.3 V

   If the voltage does not change in the above test, check wire harnesses for open and short.
   If wire harnesses are in good condition, replace CMP sensor and recheck.



1. Screw driver
2. CMP sensor

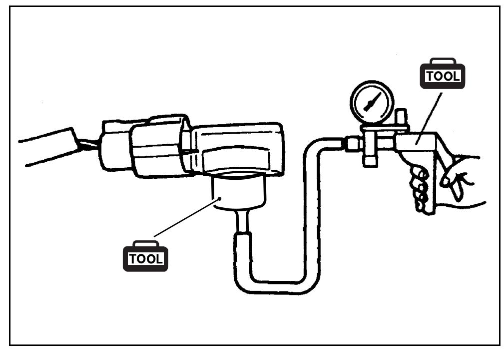
MAP SENSOR OUTPUT VOLTAGE CHANGE



TOOL 09917-47011: Vacuum pump gauge
09930-89340: 26-pin (A) & 34-pin test cord
09930-89850: 26-pin (B) test cord
09917-49610: Vacuum pump adaptor
09930-99320: Digital tester

DCV Tester range: ⎓ DCV (See chart for range.)

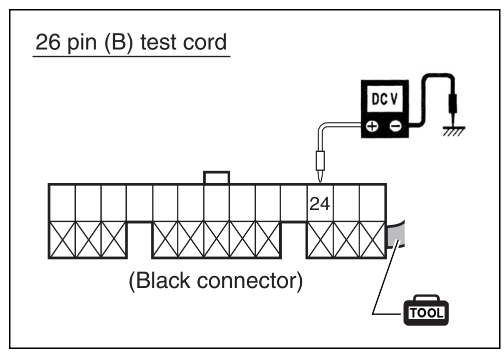
1. Remove ring gear cover and silencer case. (See page 6-2.)
2. Remove bolts and MAP sensor from intake collector assembly.



3. Install MAP sensor into special tool.

TOOL 09917-49610: Vacuum pump adaptor

4. Connect vacuum pump gauge (with hose) to MAP sensor (special tool) as shown in figure.
5. Turn main switch ON.
6. While applying negative pressure (vacuum) to MAP sensor, measure “24” terminal voltage. (See page 3-59 and 3-60 for procedure.)



MAP sensor output voltage change:

Negative pressure kPa (kg/cm^2, mmHg)	0 (0, 0)	40 (0.4, 300)	80 (0.8, 600)
“24” terminal voltage (V)	4.00	2.42	0.84

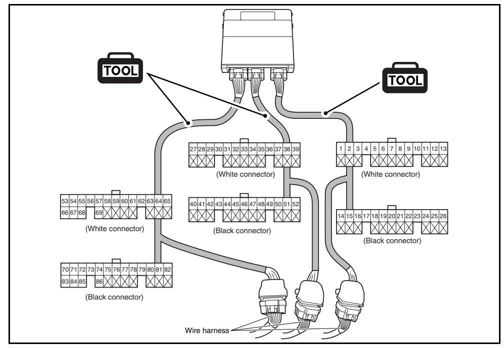
(at 759.8 mmHg, 29.91 inHg, 1013 hPa barometric pressure)

7. If out of specification, check wire harness for open and short. If wire harnesses are in good condition, replace MAP sensor and recheck.

SHIFT POSITION SENSOR POWER SOURCE AND OUTPUT VOLTAGE

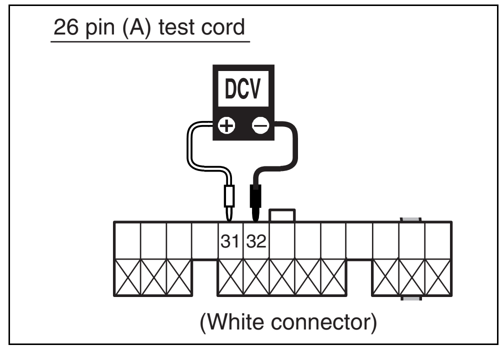
TOOL **09930-89340: 26-pin (A) & 34 pin test cord**
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

DCV **Tester range: ⎓ DCV (See chart for range)**



1. Turn main switch OFF.
2. Connect the 26 pin (A)/(B) and 36 pin test cord between ECM and wire harness as shown in figure.
3. Connect tester probe ("⊕", Red) to No.31 terminal.
4. Connect tester probe ("⊖", Black) to No.32 terminal (or to body ground).
5. Turn main switch ON.
   Check for sensor power source voltage.

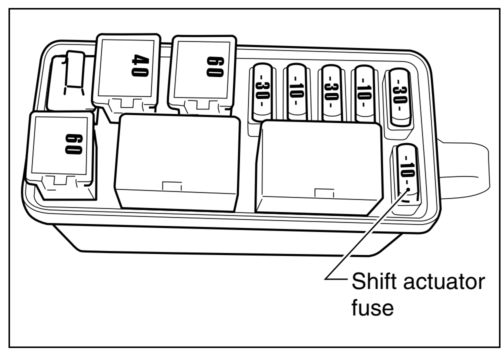
   Sensor power source voltage: Approx. 5 V



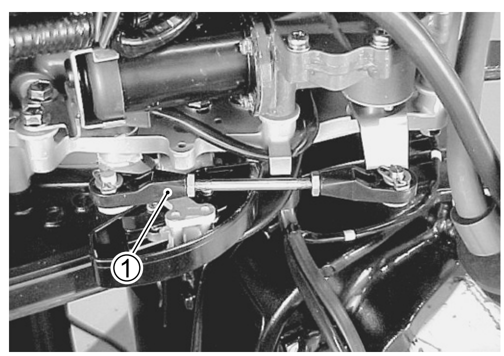
CAUTION

> **Remove the shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.**

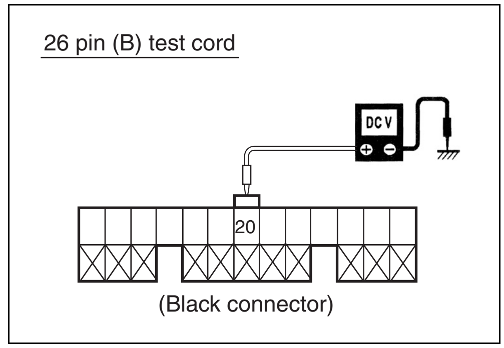
6. Remove the shift actuator fuse from fuse box.



7. Remove the clutch link rod from ① clutch lever.

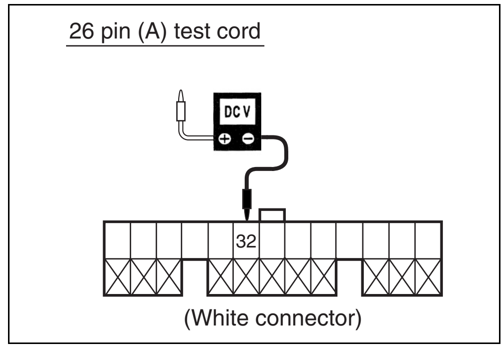


8. Connect tester probe ("⊕", Red) to No.20 terminal.
   Connect tester probe ("⊖", Black) to No.32 terminal (or to body ground).
9. Check for sensor output voltage while operating clutch lever.

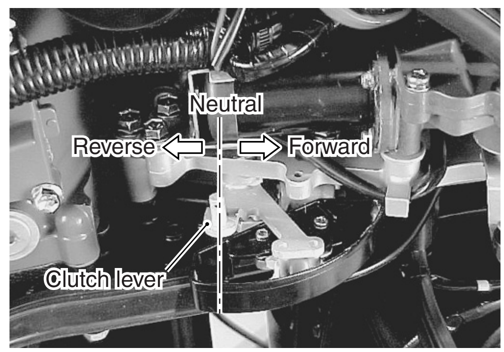


Sensor output voltage

Shift position	Output voltage
Forward	Approx. 3.7 V
Neutral	Approx. 2.5 V
Reverse	Approx. 1.3 V



If out of specification:
- 1st check sensor mount position, readjust if necessary.
- 2nd check wire harnesses for open and short.
  If wire harnesses are in good condition, replace shift position sensor and recheck.



SHIFT POSITION SENSOR OUTPUT VOLTAGE OF GEAR ENGAGEMENT START

CAUTION

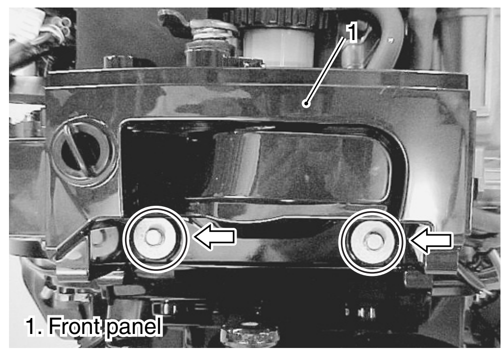
To maintain accurate operation of the electronic shift system, the output voltage from the shift position sensor should be adjusted to the specification for each shift position.
When the lower unit and its components or the shift link system components have been replaced, make sure to check the output voltage of shift position sensor in neutral and forward position.
If the output voltage is not within the specification, adjust the position of sensor installation.

TOOL **09930-89340: 26-pin (A) & 34 pin test cord**
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

DCV **Tester range: ⎓ DCV (See chart for range)**

Inspection

1. Turn main switch OFF.
2. Remove the STBD side cover (See page 7-2.)
   Remove the two bolts securing front panel.

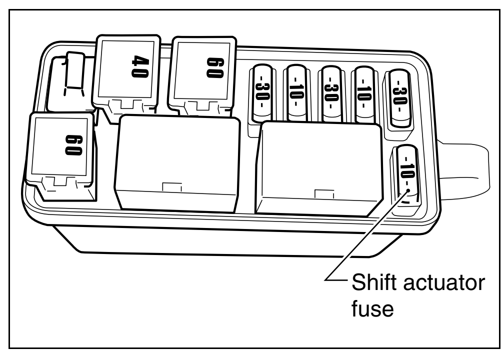


1. Front panel

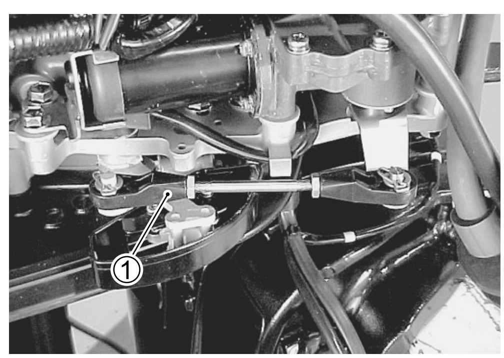
CAUTION

Remove the shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.

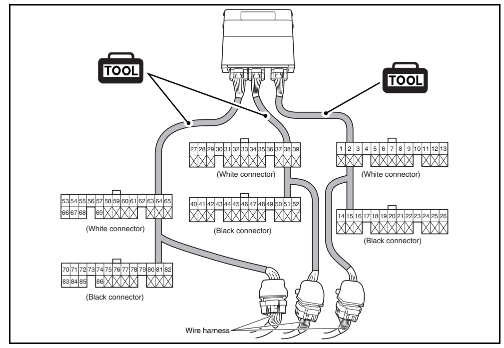
3. Remove the shift actuator fuse from fuse box.



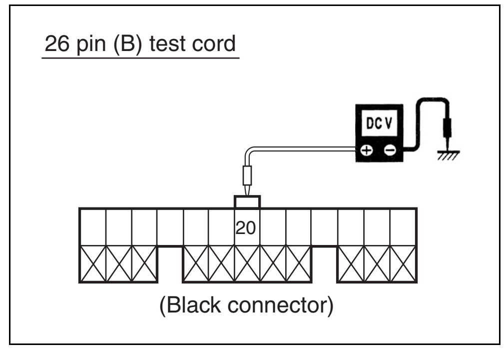
4. Remove the clutch link rod ① from clutch lever.



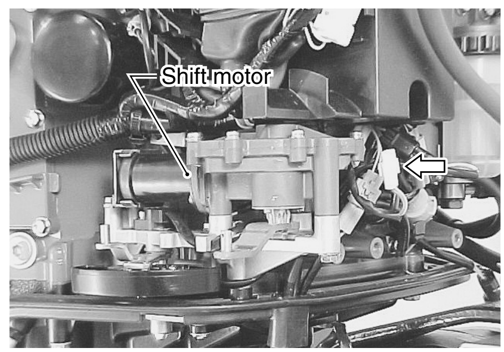
5. Connect the 26 pin (A)/(B) and 36 pin test cord between ECM and wire harness as shown in figure.



6. Connect tester probe ("⊕", Red) to No.20 terminal.
   Connect tester probe ("⊖", Black) to No.32 terminal (or to body ground).

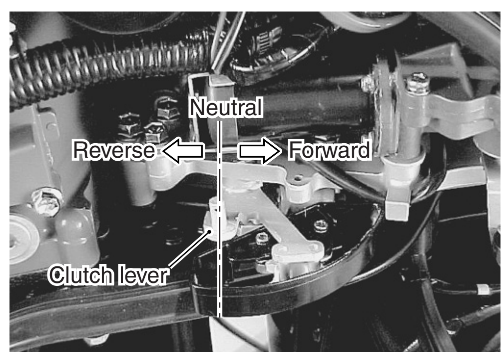


7. Disconnect shift motor lead wire connector from engine wiring harness
8. Turn main switch ON.



9. Check that the clutch lever is in neutral position.
   Move the clutch lever slightly in forward and reverse directions within the neutral range to check for the lever play and locate the lever in the middle of the play. With the lever held in this position, check for the shift position sensor output voltage.

   Sensor output voltage in Neutral position: 2.46 – 2.54 V



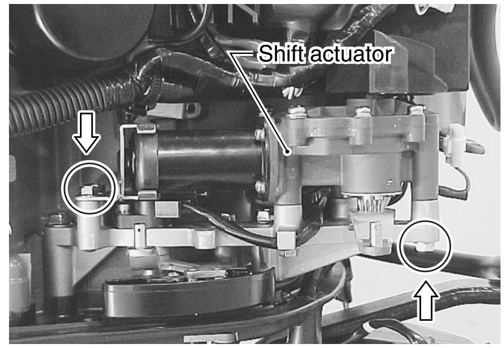
10. Move the clutch lever slowly in the forward direction while turning the propeller and check for the sensor output voltage just when the clutch dog begins to contact the forward gear.

    Sensor output voltage in gear engagement start:
    2.9 – 3.1 V

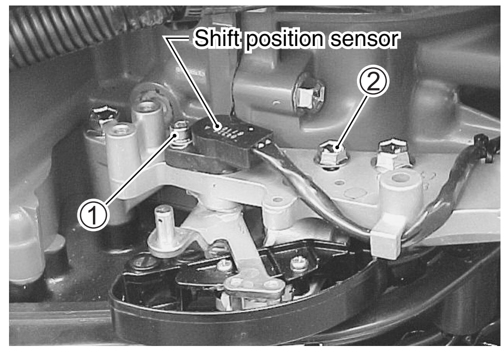
11. In the procedures 9 and 10, if the sensor output voltage measurement is out of the specified range, adjust the position of shift position sensor installation.

Adjustment

If sensor output voltage is out of specification, the following adjustment procedure must be performed.



12. Remove the five bolts securing shift actuator, then remove shift actuator. (See page 7-4.)



13. Loosen the screw ① securing shift position sensor.
    Loosen the screw ② securing clutch lever holder.
14. Adjust the location of shift position sensor and perform the procedures 9 and 10 so that each of the output voltage comes to the specification.
15. When the specified sensor output voltage has been obtained, tighten the screw ① first then screw ②.
16. Perform the procedures 9 and 10 to recheck the sensor output voltage and readjust the voltage as necessary.

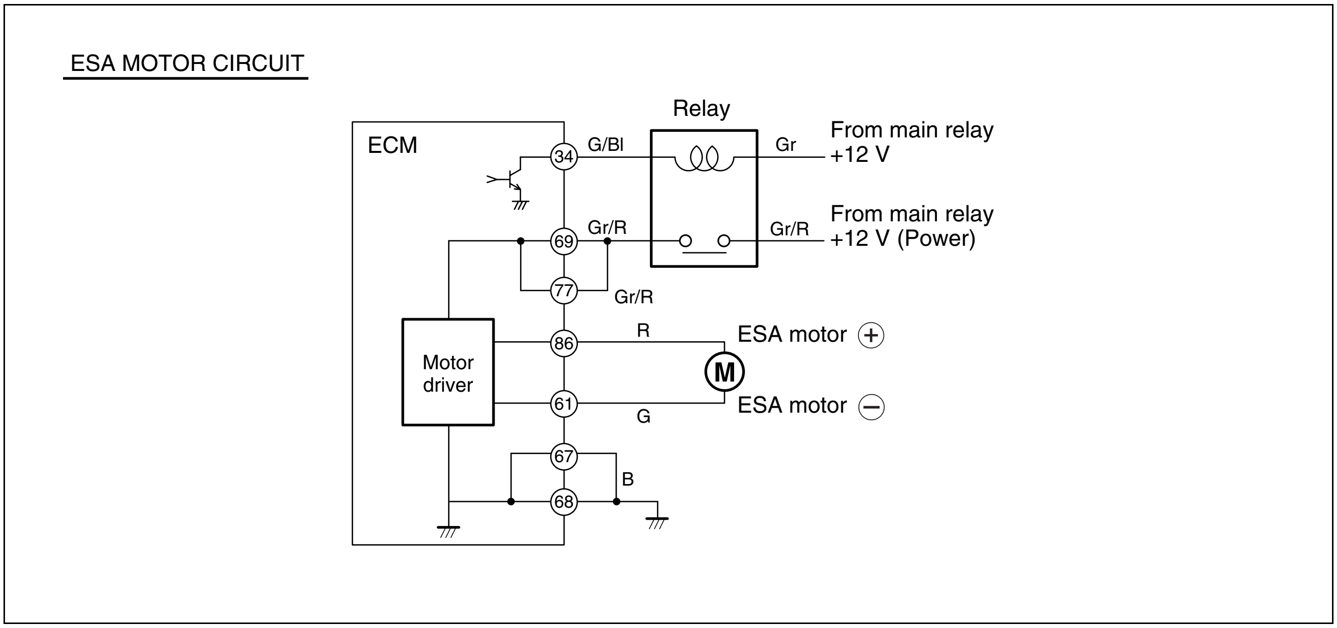
NOTE:

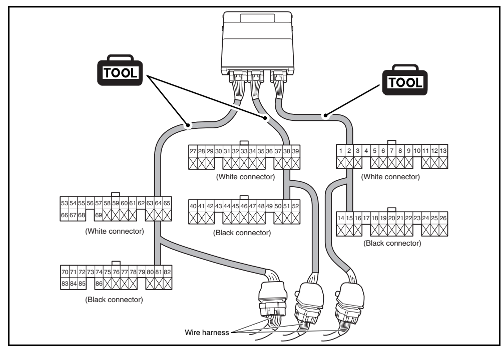
If the specified sensor output voltage cannot be obtained even though attempting the adjustment of shift position sensor location several times, check for wear and damage of the component parts of shift link mechanism.

17. Reinstall parts removed earlier.
    Check to ensure that all removed parts are back in place.

ESA MOTOR/MOTOR RELAY CIRCUIT

Check ESA motor/motor relay circuit voltage as following steps.



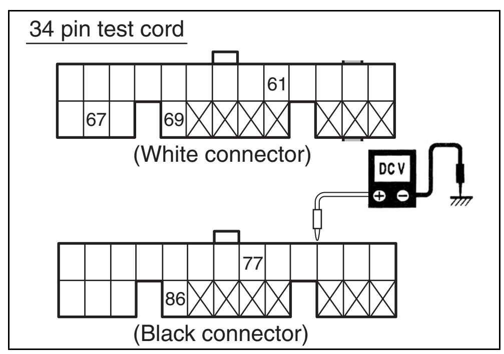


TOOL 09930-89340: 26-pin (A) & 34 pin test cord
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

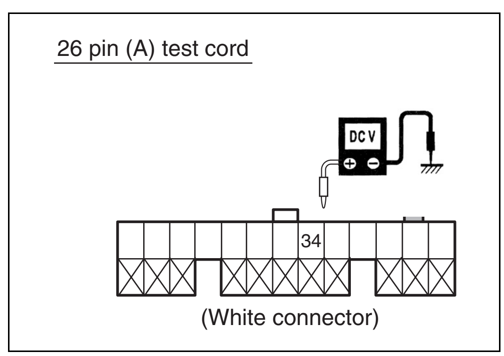
Tester range: ⎓ DCV (See chart for range)

1. Turn main switch OFF.
2. Connect the 26 pin (A)/(B) and 34 pin test cord between ECM and wire harness.
3. Connect the tester probe ("⊕", Red) to each terminal.

Circuit	Terminal	Wire color (engine harness)
Shift motor relay	34	G/Bl
Motor power source	69 or 77	Gr/R
Shift motor ⊕	86	R
Shift motor ⊖	61	G



4. Connect the tester probe ("⊖", Black) to No.67 terminal (or to body ground).



5. Turn main switch ON and measure terminal voltage.

Circuit	Terminal	Output voltage
Shift motor relay	34	Approx. 0.5 V
Motor power source	69 or 77	Approx. 12 V
Shift motor ⊕	86	Approx. 0 or 12 V
Shift motor ⊖	61	Approx. 0 or 12 V

If out of specification,

- 1st check wire harnesses for open and short.
- 2nd check ESA motor relay.
- 3rd check shift motor

If wire harnesses, motor relay and shift motor test "good", replace ECM and recheck.

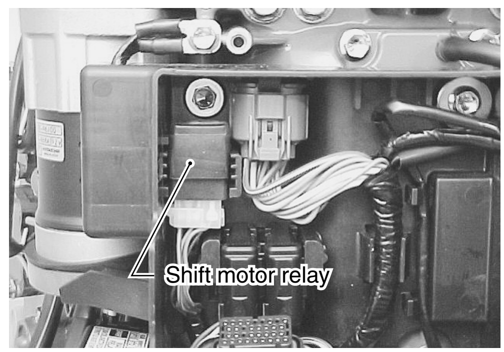
NOTE:
The terminal voltage of No. 86 and 61 is alternating between 0 V and 12 V at the frequency of 500 Hz.
The tester indication will be shown as 12 V.

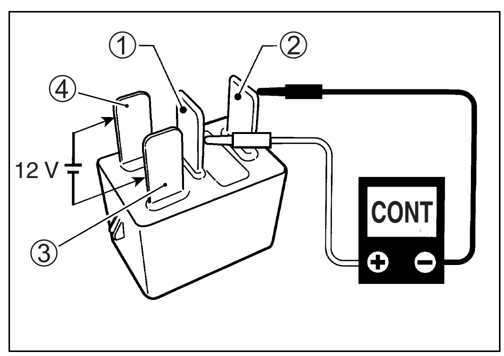
SHIFT MOTOR RELAY

TOOL 09930-99320: Digital tester

Tester range: (Continuity)

1. Remove the ECM.
2. Disconnect shift motor relay from wire harness.
3. Check continuity between terminal ① and ② each time 12 V is applied. Connect positive ⊕ probe to terminal ④, and negative ⊖ probe to terminal ③.





Shift motor relay function:

12 V power	Continuity
Applied	Yes
Not applied	No

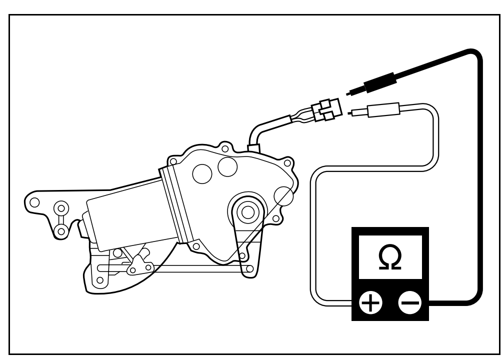
CAUTION

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

SHIFT MOTOR CHECK

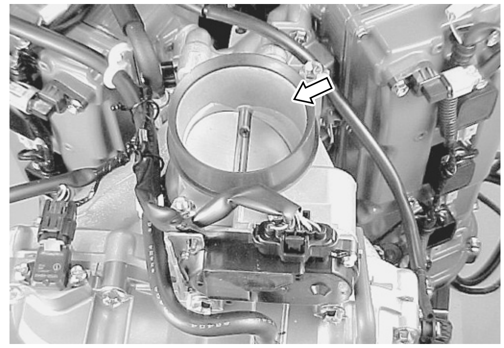
1. Turn main switch OFF.
2. Disconnect shift motor lead wire connector from engine wiring harness.
3. Measure resistance between two terminals.

Shift motor resistance: 0.3 – 10 Ω



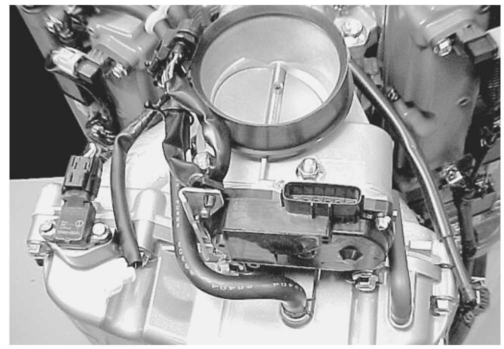
ELECTRONIC THROTTLE BODY

Throttle valve visual check



1. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
2. Check that there is not any foreign matter caught between throttle valve and throttle body housing.
   If there is, take it out after removing throttle body referring to "Electronic Throttle Body Assembly Removal and Installation: in section 3-97" and clean inside of throttle body thoroughly.

Throttle Valve Operation Check

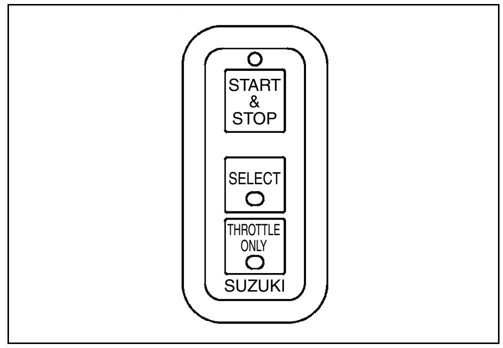


1. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
2. Turn OFF main switch and then disconnect connector at electronic throttle body assembly.
3. Move throttle valve with your finger to its full open position and check that it moves smoothly.
4. Move throttle valve to its completely closed position and check that it moves smoothly.
5. Move throttle valve to the full open position and release it. Insure that it moves smoothly (By the return spring force) to the complete closed position.

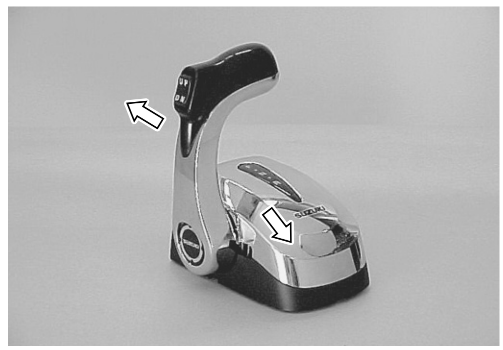
If check result is not satisfactory, replace electronic throttle body assembly.

Electronic Throttle body Assembly operation check

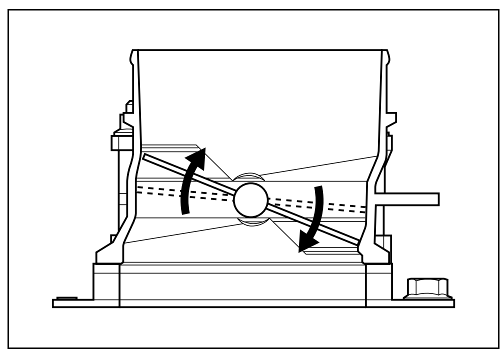
1. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
2. Turn ON main switch.
3. Confirm the select switch LED lights.
   If not, depress the "SELECT" button on switch panel.
4. Depress the "THROTTLE ONLY" button.



5. Move remote control lever gradually and check that throttle valve moves smoothly until it opens fully.
6. Return remote control lever in step 5 and check that throttle valve moves back to completely closed position.



If check result is satisfactory, electronic throttle body system is in good condition.
If check result is not satisfactory, proceed to next step.

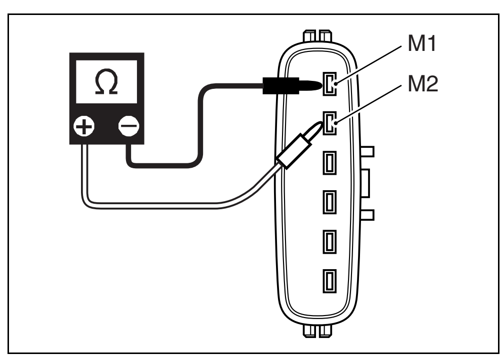


7. Perform "Lever Position sensor assembly Inspection", "Throttle Actuator (Motor) Check" and "Throttle Position Sensor Performance Check".
   If check results are not satisfactory, replace electronic throttle body assembly.
   If check results are satisfactory, wire circuit and/or ECM, BCM are faulty.

Throttle Actuator (Motor) Check

1. Turn main switch OFF.
2. Disconnect connector at electronic throttle body assembly.
3. Measure resistance between "M1" terminal and "M2" terminal of electronic throttle body assembly.
   If measured resistance is out of specified value, replace electronic throttle body assembly.

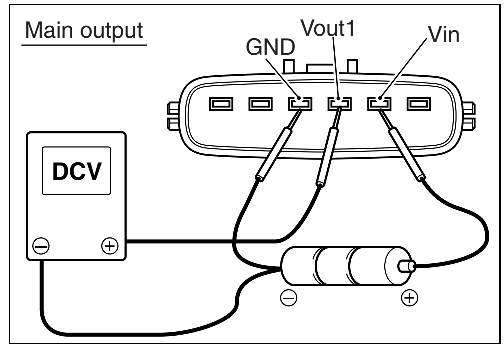
   Throttle actuator (motor) resistance: 0.3 – 10 Ω at 20 °C



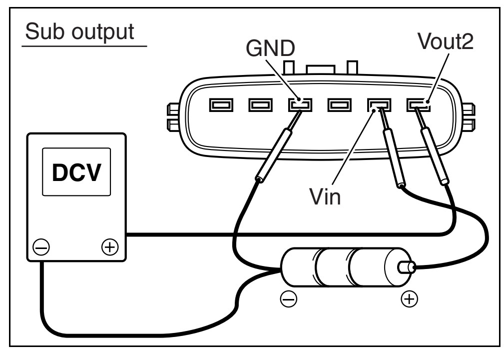
Throttle Position Sensor performance Check

1. Remove the ring gear cover and air intake silencer case.
2. Turn main switch off.
3. Disconnect connector at electronic throttle body assembly.
4. Check throttle position sensor (main and sub) output voltage as following steps.

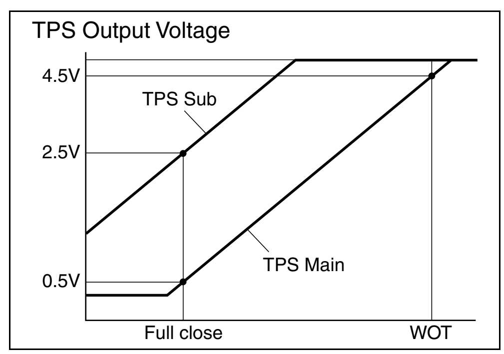
   a) For throttle position sensor (main), arrange 3 new 1.5 V batteries in series (check that total voltage is 4.7 – 5.0 V) and connect its positive terminal to “Vin” terminal and negative terminal to “Ground” terminal of sensor.
   Then using voltmeter, connect positive terminal to “Vout 1” terminal of sensor and negative terminal to battery.



   b) For throttle position sensor (sub), arrange 3 new 1.5 V batteries in series (check that total voltage is 4.7 – 5.0 V) and connect its positive terminal to “Vin” terminal and negative terminal to “Ground” terminal of sensor.
   Then using voltmeter, connect positive terminal to “Vout 2” terminal of sensor and negative terminal to battery.



   c) Measure output voltage variation while throttle valve is opened and closed as following specification (graph).

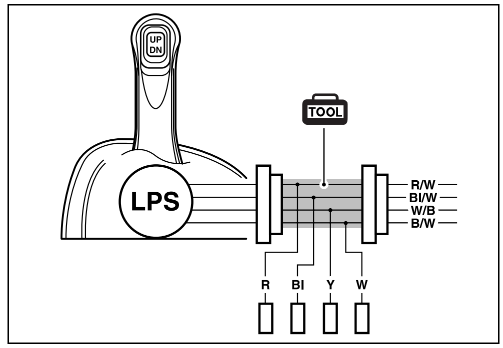


If sensor voltage is out of specified value and linear variation as the following graph, replace electronic throttle body assembly.

Lever position sensor inspection

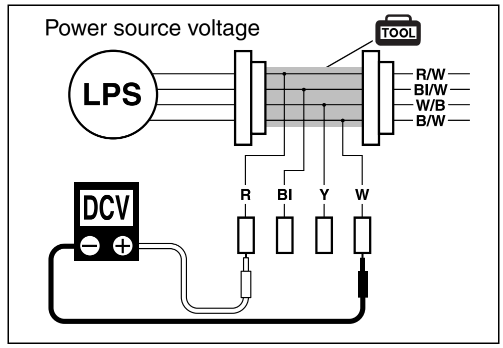
Check lever position sensor (main and sub) output voltage as following steps.

TOOL **09930-99320: Digital tester**
09930-89240: 4-pin test cord

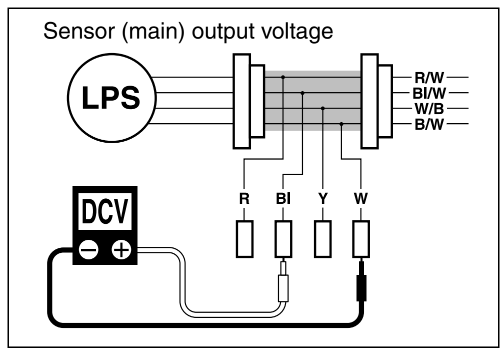


1. Turn main switch OFF.
2. Connect 4-pin test cord between lever position sensor and wire harness as shown figure.
3. Turn the main switch ON.
4. Connect tester probe as shown in the illustration and check for sensor power source voltage.

   Sensor power source voltage: Approx. 5 V



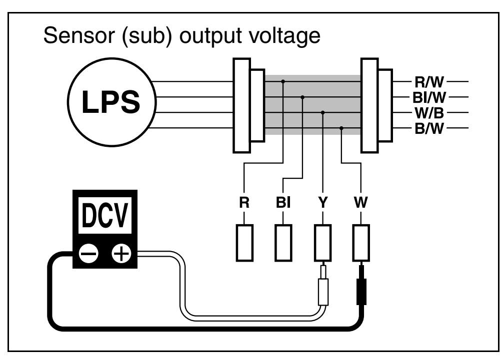
5. Connect tester probe as shown in the illustration and check for sensor (main) output voltage.
   Slowly move the remote control lever, and check if voltage changes linearly within specification, according to remote control lever position.



Sensor (main) output voltage

Lever position	Output voltage
Reverse side. WOT	Approx. 0.5 V
Reverse	Approx. 1.7 V
Neutral	Approx. 2.2 V
Forward	Approx. 2.7 V
Forward side. WOT	Approx. 4.5 V

6. Connect tester probe as shown in the illustration and check for sensor (sub) output voltage.
   Slowly move the remote control lever, and check if voltage changes linearly within specification, according to remote control lever position.

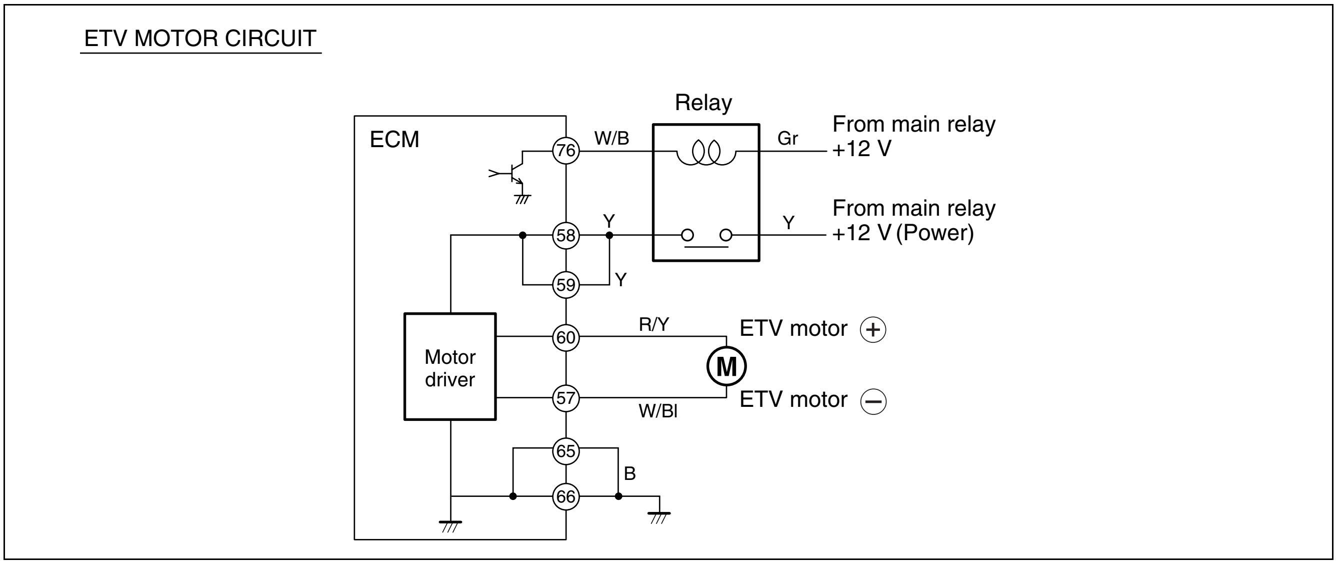


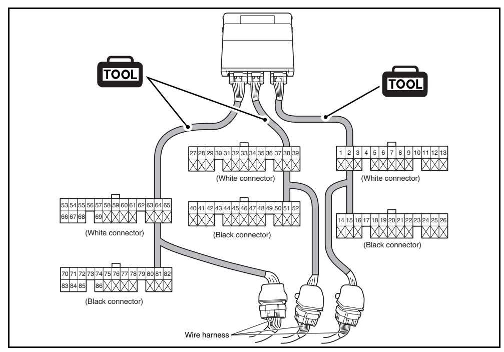
Sensor (Sub) output voltage

Lever position	Output voltage
Reverse side. WOT	Approx. 4.5 V
Reverse	Approx. 3.3 V
Neutral	Approx. 2.8 V
Forward	Approx. 2.3 V
Forward side. WOT	Approx. 0.5 V

ETV MOTOR / MOTOR RELAY CIRCUIT

Check ETV motor/motor relay circuit voltage as following steps.



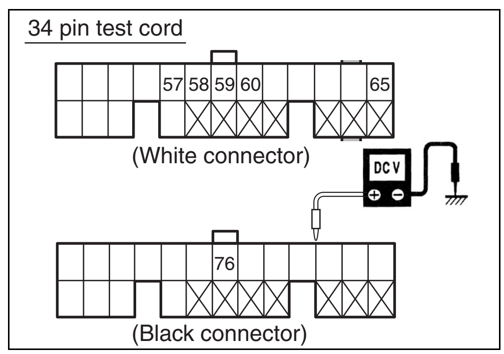


TOOL 09930-89340: 26-pin (A) & 34 pin test cord
09930-89850: 26-pin (B) test cord
09930-99320: Digital tester

Tester range: ⎓ DCV (See chart for range)

1. Turn main switch OFF.
2. Connect the 26 pin (A)/(B) and 34 pin test cord between ECM and wire harness.
3. Connect the tester probe ("⊕", Red) to each terminal.

Circuit	Terminal	Wire color (engine harness)
Throttle motor relay	76	W/B
Motor power source	58 or 59	Y
Throttle motor ⊕	60	R/Y
Throttle motor ⊖	57	W/Bl



4. Connect the tester probe ("⊖", Black) to No.65 terminal (or to body ground).

5. Turn main switch ON and measure terminal voltage.

Circuit	Terminal	Output voltage
Throttle motor relay	76	Approx. 0.5 V
Motor power source	58 or 59	Approx. 12 V
Throttle motor ⊕	60	Approx. 0 or 12 V
Throttle motor ⊖	57	Approx. 0 or 12 V

If out of specification,

- 1st check wire harnesses for open and short.
- 2nd check ETV motor relay.
- 3rd check throttle motor.

If wire harnesses, motor relay and throttle motor good condition, replace ECM and recheck.

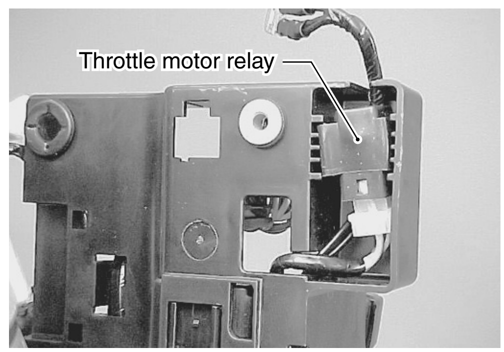
NOTE:
The terminal voltage of No. 60 and 57 is alternating between 0 V and 12 V at the frequency of 500 Hz.
The tester indication will be shown as 12 V.

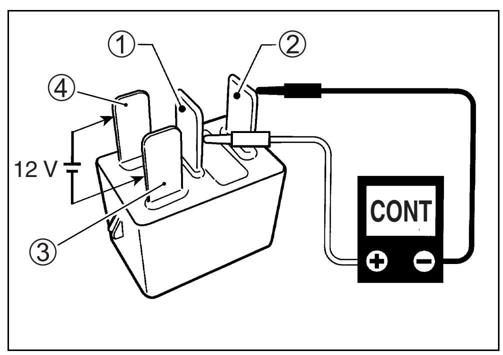
THROTTLE MOTOR RELAY

TOOL 09930-99320: Digital tester

Tester range: (Continuity)

1. Remove the electric parts holder. (See page 4-30.)
2. Disconnect throttle motor relay from wire harness.
3. Check continuity between terminal ① and ② each time 12 V is applied. Connect positive ⊕ probe to terminal ④, and negative ⊖ probe to terminal ③.





Throttle motor relay function:

12 V power	Continuity
Applied	Yes
Not applied	No

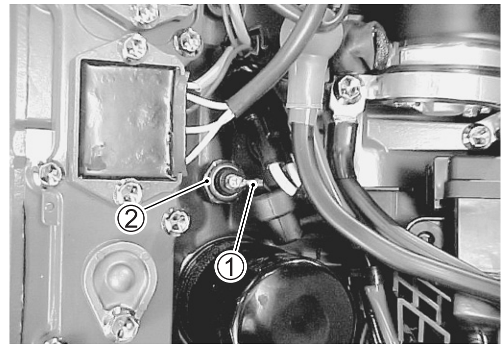
CAUTION

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

OIL PRESSURE SWITCH

NOTE:
Before checking the oil pressure switch, make sure the engine oil pressure is within specification.

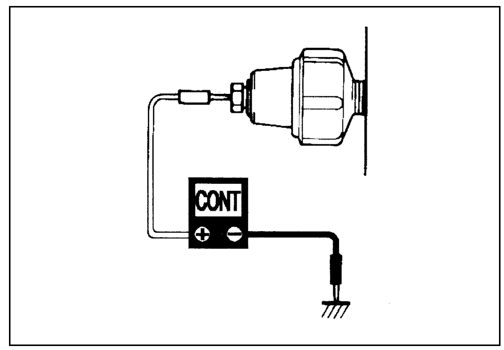
1. Remove the blue lead wire ① from oil pressure switch ②.
2. Check the continuity between the switch terminal and engine body ground.



TOOL **09930-99320: Digital tester**

Tester range: (Continuity)

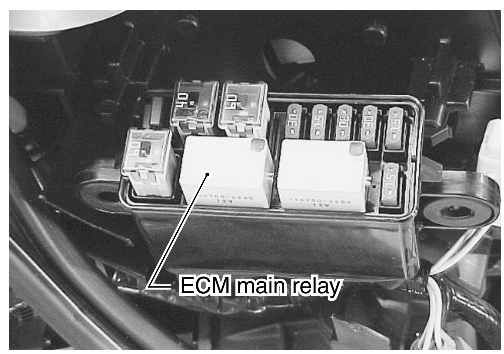
Engine running	Infinity
Engine stopped	Continuity



If measurement exceeds specification, replace oil pressure switch.

3. Reinstall parts removed earlier.

ECM MAIN RELAY



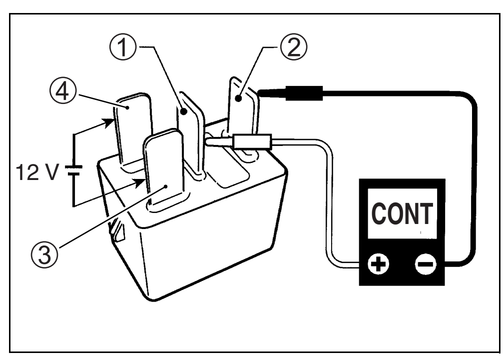
TOOL **09930-99320: Digital tester**

Tester range: (Continuity)

1. Disconnect ECM main relay from fuse box.
2. Check continuity between terminal ① and ② each time 12 V is applied. Connect positive ⊕ probe to terminal ④, and negative ⊖ probe to terminal ③.

ECM main relay function:

12 V power	Continuity
Applied	Yes
Not applied	No



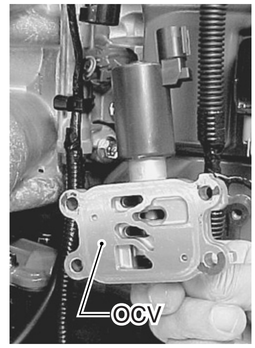
CAUTION

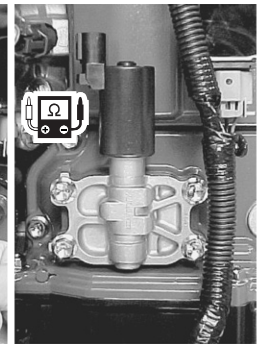
Do not touch 12 V power supply wires to each other or with other terminals.

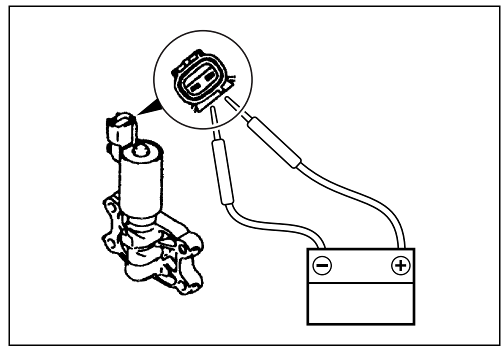
OCV (Oil control valve)

1. Remove OCV. (See page 3-96.)
2. Check for operating sound (ticking sound) when battery voltage applied to and removed from the terminals of oil control valve.
3. Check resistance between the two OCV terminals.

   OCV resistance: 6.0 – 8.0 Ω

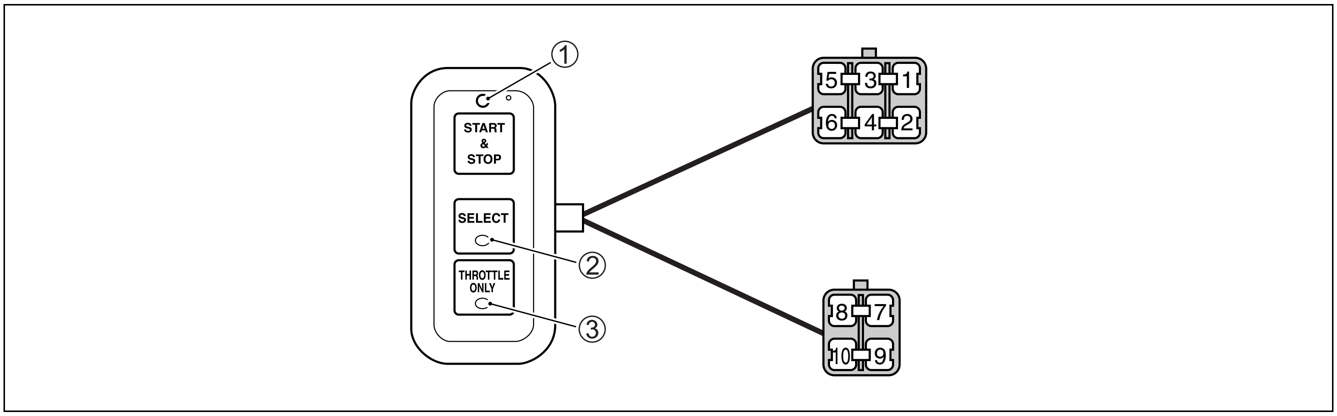






SWITCH PANEL

SINGLE SWITCH PANEL



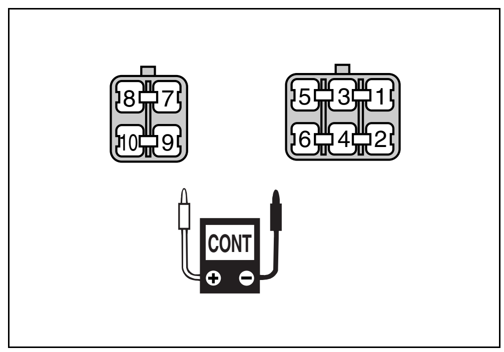
TOOL 09930-99320: Digital tester

Tester range: (Continuity)

1. SWITCH OPERATION

(a) Check continuity/infinity between each terminal of the switch by operating them.

SWITCH NAME	OPERA-TION	TERMINAL FOR TESTER PROBE CONNECTION		Tester indication
		⊕ Tester probe	⊖ Tester probe	
START & STOP	PUSH	No.7 terminal	No.6 terminal	Continuity
	FREE			Infinity
SELECT	PUSH	No.8 terminal	No.6 terminal	Continuity
	FREE			Infinity
THROTTLE ONLY	PUSH	No.10 terminal	No.6 terminal	Continuity
	FREE			Infinity

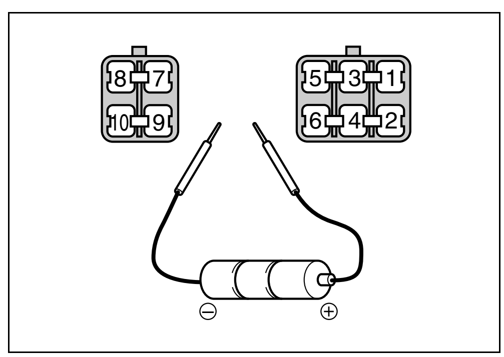


(b) Replace the switch panel if the above test shows out of specification.

2. LAMP OPERATION

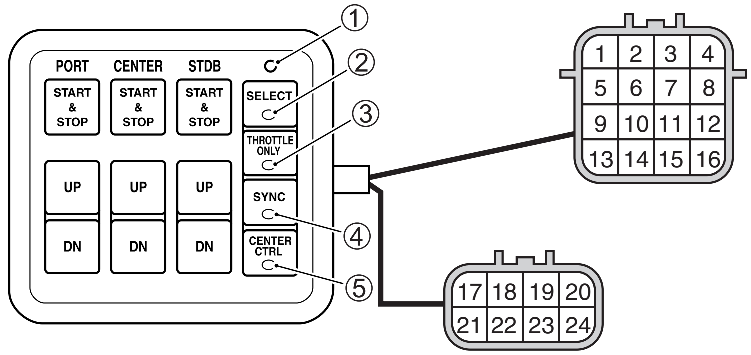
(a) Check if each lamp lights when connecting battery to the terminal.
Use 4.5 V power source (3 new 1.5 V batteries in series) for test.

LAMP NAME	TERMINAL FOR BATTERY CONNECTION		Lamp condition
	⊕ Positive	⊖ Negative	
Red LED ①	No.2 terminal	No.3 terminal	ON
SELECT LED ②	No.2 terminal	No.4 terminal	ON
THROTTLE ONLY LED ③	No.2 terminal	No.5 terminal	ON



(b) Replace the switch panel if the above test shows out of specification.

TRIPLE SWITCH PANEL/DUAL SWITCH PANEL

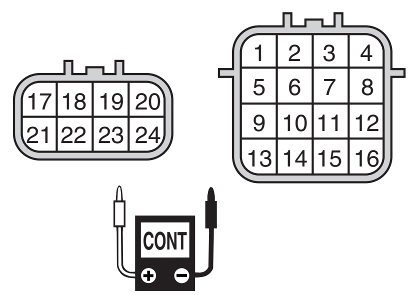


09930-99320: Digital tester

Tester range: (Continuity)

1. OPERATION

(a) Check continuity/infinity between each terminal of the switch by operating them.



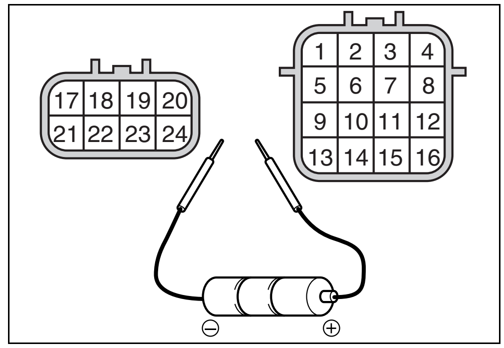
SWITCH NAME	OPERA-TION	TERMINAL FOR TESTER PROBE CONNECTION		Tester indication
		⊕ Tester probe	⊖ Tester probe	
START & STOP (PORT)	PUSH	No.3 (Y/G) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
START & STOP (CENTER)	PUSH	No.13 (Y/R) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
START & STOP (STBD)	PUSH	No.7 (Y/B) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
SELECT	PUSH	No.4 (Br/W) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
THROTTLE ONLY	PUSH	No.6 (G/B) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
SYNC	PUSH	No.8 (O/B) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
CENTER CTRL	PUSH	No.14 (Y) terminal	No.16 (B) terminal	Continuity
	FREE			Infinity
PTT UP (PORT)	PUSH	No.2 (Gr) terminal	No.17 (Bl/R) terminal	Continuity
	FREE			Infinity
PTT DN (PORT)	PUSH	No.2 (Gr) terminal	No.21 (R) terminal	Continuity
	FREE			Infinity
PTT UP (CENTER)	PUSH	No.2 (Gr) terminal	No.19 (Bl/B) terminal	Continuity
	FREE			Infinity
PTT DN (CENTER)	PUSH	No.2 (Gr) terminal	No.23 (R/B) terminal	Continuity
	FREE			Infinity
PTT UP (STBD)	PUSH	No.2 (Gr) terminal	No.18 (Sb/W) terminal	Continuity
	FREE			Infinity
PTT DN (STBD)	PUSH	No.2 (Gr) terminal	No.22 (P/W) terminal	Continuity
	FREE			Infinity

(b) Replace the switch panel if the above test shows out of specification.

2. LAMP OPERATION

(a) Check if each lamp lights when connecting battery to the terminal.
Use 4.5 V power source (3 new 1.5 V batteries in series) for test.

LAMP NAME	TERMINAL FOR BATTERY CONNECTION		Lamp condition
	⊕ Positive	⊖ Negative	
Red LED ①	No.2 (Gr) terminal	No.9 (G/W) terminal	Lamp ON
SELECT LED ②	No.2 (Gr) terminal	No.10 (Br) terminal	Lamp ON
THROTTLE ONLY LED ③	No.2 (Gr) terminal	No.11 (G) terminal	Lamp ON
SYNC LED ④	No.2 (Gr) terminal	No.12 (O) terminal	Lamp ON
CENTER CTRL LED ⑤	No.2 (Gr) terminal	No.15 (Lg) terminal	Lamp ON



(b) Replace the switch panel if the above test shows out of specification.

3. PTT CIRCUIT

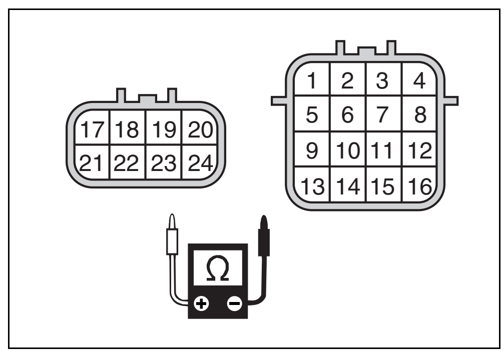
TOOL 09900-25002: Pocket tester

Tester range: × 1 kΩ

(a) Inspect PTT circuit diodes with tester.

TERMINAL FOR TESTER PROBE CONNECTION		Tester indication
⊕ Tester probe	⊖ Tester probe	
No.17 (Bl/R), No.18 (Sb/W), No.19 (Bl/B) terminal	No.20 (Sb) terminal	Continuity
No.21 (R), No.22 (P/W), No.23 (R/B) terminal	No.24 (P) terminal	Continuity

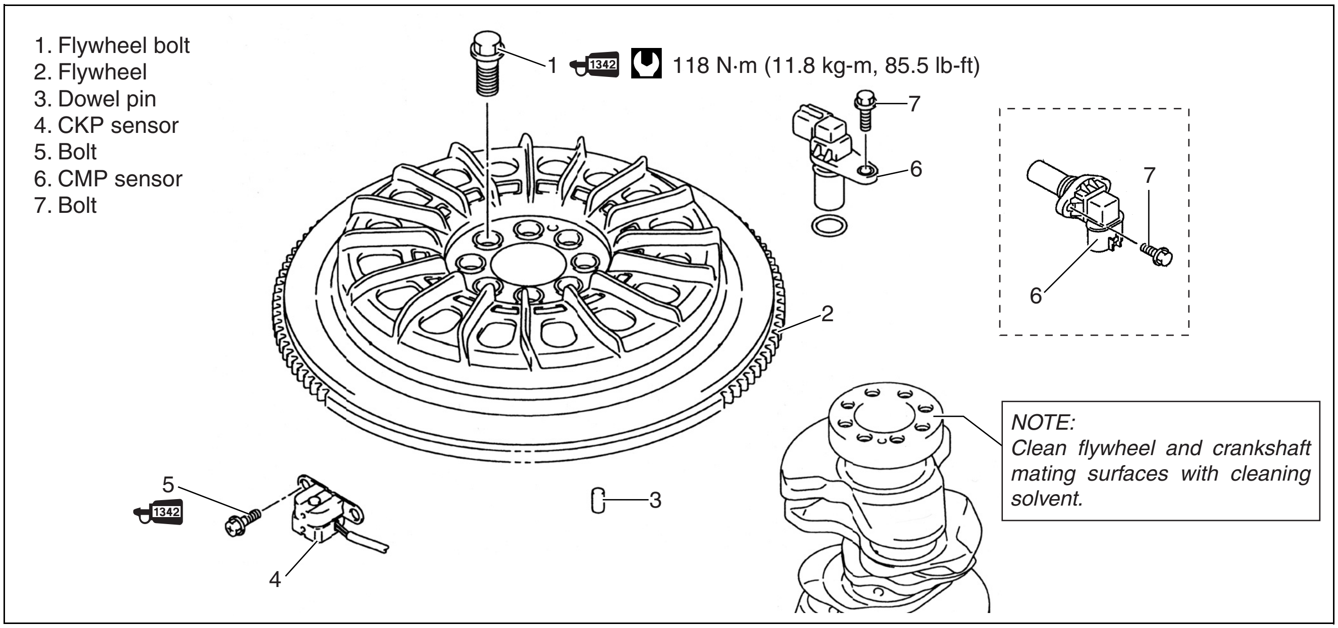
TERMINAL FOR TESTER PROBE CONNECTION		Tester indication
⊕ Tester probe	⊖ Tester probe	
No.20 (Sb) terminal	No.17 (Bl/R), No.18 (Sb/W), No.19 (Bl/B) terminal	Infinity
No.24 (P) terminal	No.21 (R), No.22 (P/W), No.23 (R/B) terminal	Infinity



(b) If out of specification, replace the switch panel.

REMOVAL/INSTALLATION

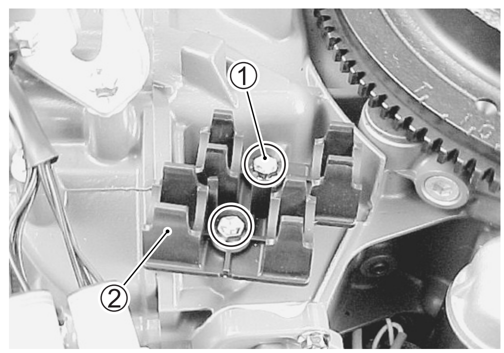
FLYWHEEL



REMOVAL

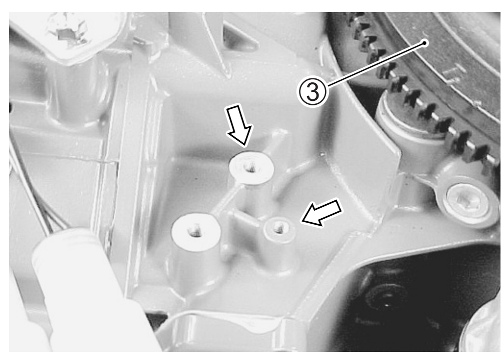
Prior to removing flywheel: **• Disconnect battery cables from battery.**

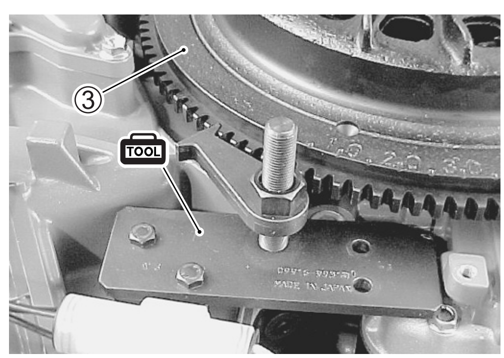
1. Remove ring gear cover and air intake silencer case. (See page 6-2.)
2. Remove screws ① and battery charge coil connector holder ② from cylinder.



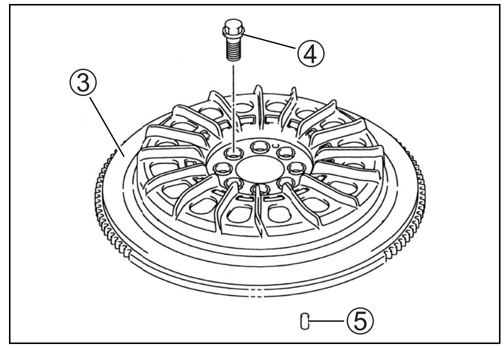
3. To lock the flywheel ③, use special tool shown in figure. Use screws and threaded holes on top of cylinder to attach special tool.

TOOL **09916-99311: Flywheel holder**



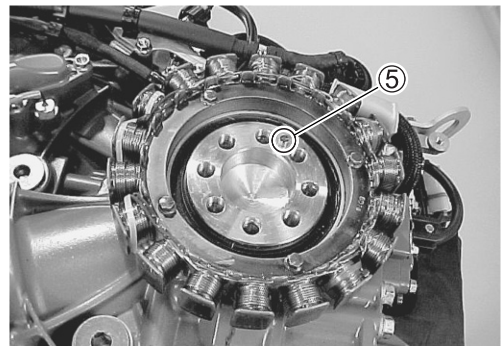


4. Remove eight (8) flywheel bolts ④.
5. Remove flywheel ③ and dowel pin ⑤.



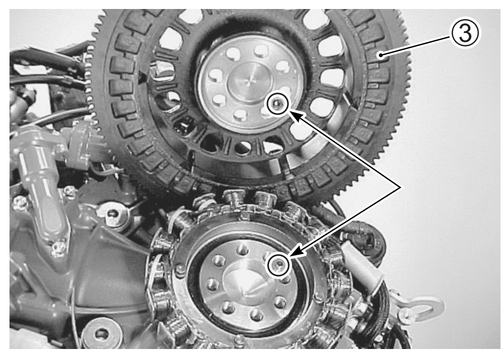
INSTALLATION

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



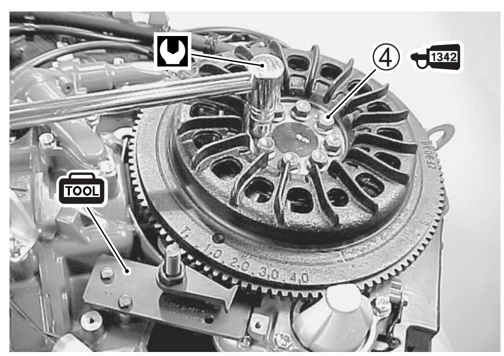
- Install dowel pin ⑤.
- Install flywheel ③ onto crankshaft making sure to align dowel pin hole.

NOTE:
Before installing the flywheel magneto, wipe the crankshaft and flywheel clean.



CAUTION

Before tightening flywheel bolts, make sure the flywheel dowel pin hole and crankshaft dowel pin align or severe damage may result.

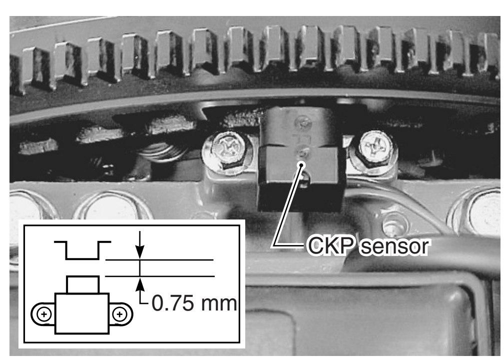


- Apply THREAD LOCK "1342" to flywheel bolts ④ before installing.
- Tighten flywheel bolts ④ to specified torque. To lock flywheel, use special tool as shown in figure.

Flywheel bolt: 118 N·m (11.8 kg-m, 85.5 lb-ft)

TOOL **09916-99311: Flywheel holder**

1342 **99000-32050: THREAD LOCK "1342"**



- After installing flywheel and torquing bolts to specification, check air gap between CKP sensor and reluctor bars on flywheel.

  Air gap: 0.75 mm (0.030 in)

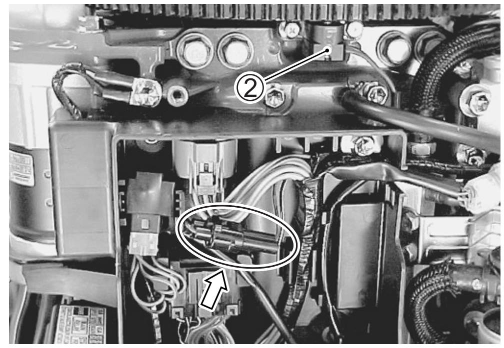
- Check to ensure that all removed parts are back in original position.

CKP SENSOR

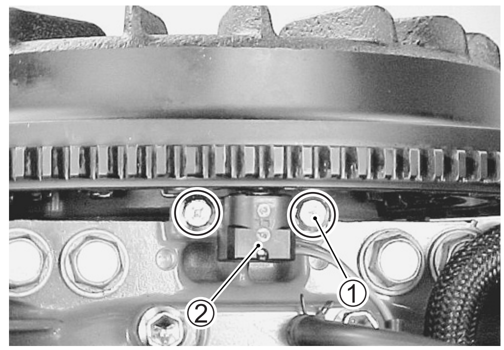
REMOVAL

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

1. Remove ring gear cover and air intake silencer case.
   (See page 6-2.)



2. Disconnect CKP sensor lead wire connector in electric parts holder.
3. Remove two (2) screws ① and CKP sensor ②.

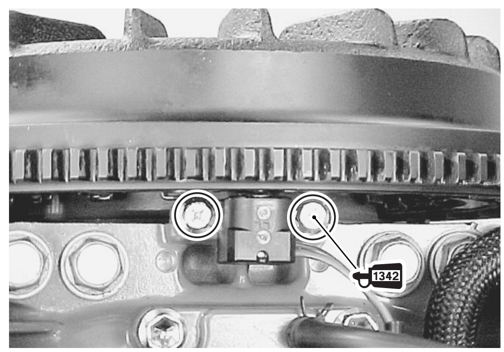


INSTALLATION

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

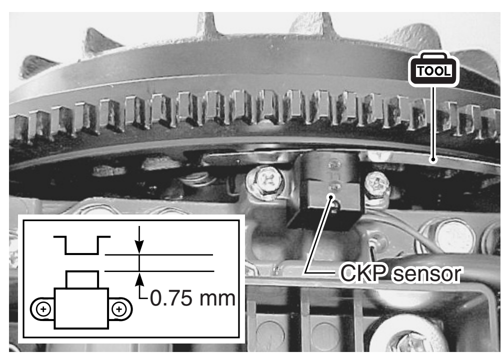
• Apply THREAD LOCK “1342” to the sensor mounting screws.

1342 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 screws securely.

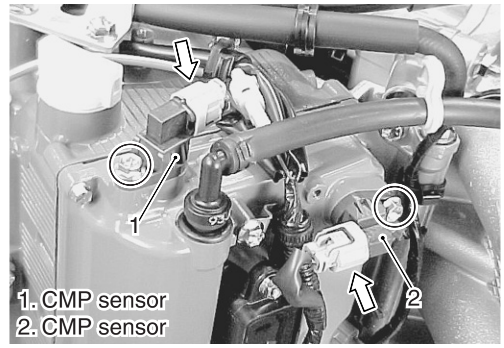
Air gap: 0.75 mm (0.030 in)



CMP SENSOR

REMOVAL

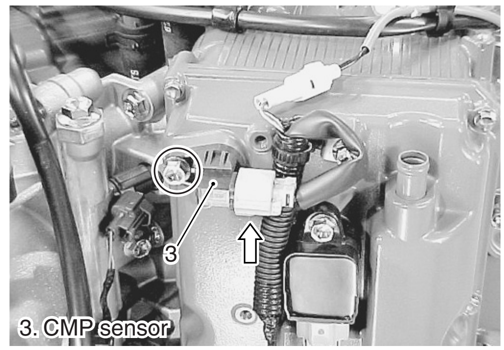
1. Remove the ring gear cover. (See page 6-2.)
2. Disconnect CMP sensor lead wire connector at sensor.
3. Remove bolt and CMP sensor.



INSTALLATION

Installation is reverse order of removal.

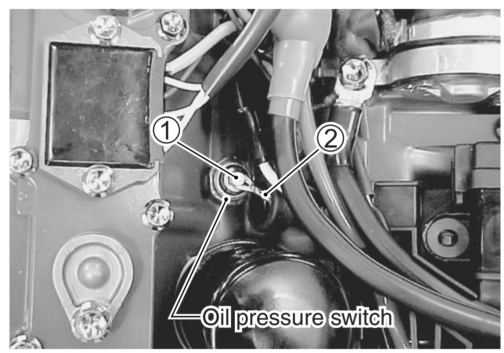
- Install CMP sensor, then tighten sensor mounting screw securely.
- Connect sensor lead wire connector to CMP sensor.
- Check to ensure that all removed parts are back in original position.



OIL PRESSURE SWITCH

REMOVAL

1. Loosen screw ① and disconnect blue lead wire ② from switch.
2. Remove oil pressure switch from cylinder block.



INSTALLATION

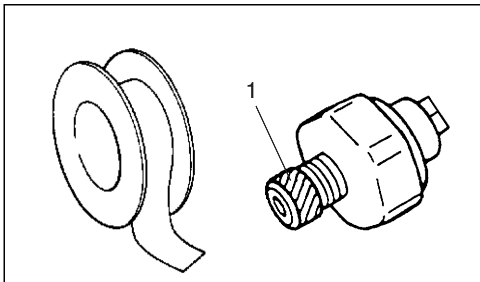
Installation is reverse order of removal with special attention to the following steps.

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

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.

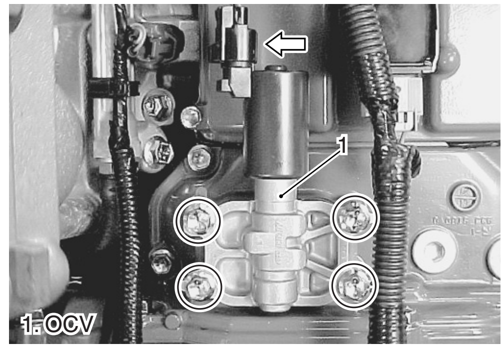


1. Sealing tape

OCV (Oil control valve)

REMOVAL

1. Remove air duct guard. (See page 6-2.)
2. Disconnect OCV lead wire connector at OCV.
3. Remove the four (4) bolts securing OCV, then remove OCV and discard OCV gasket.

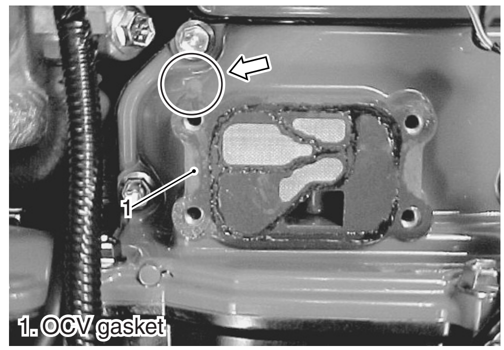


INSTALLATION

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

- Install gasket and OCV, then tighten bolts securely.

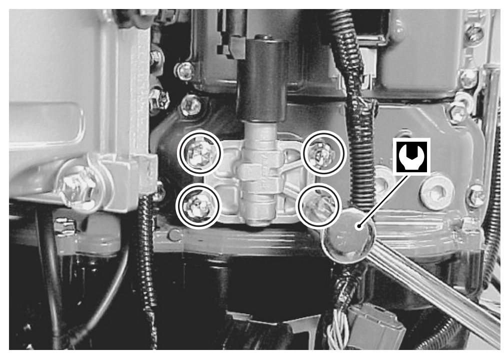
NOTE:
Position the OCV gasket tab as shown the right.



CAUTION

Do not reuse the OCV gasket, always replace with new one.

OCV bolt: 12 N·m (1.2 kg-m, 8.5 lb-ft)



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

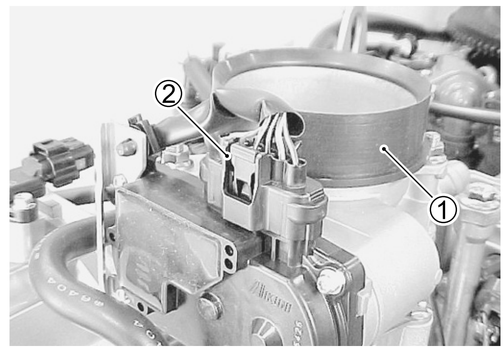
ELECTRONIC THROTTLE BODY ASSEMBLY

CAUTION

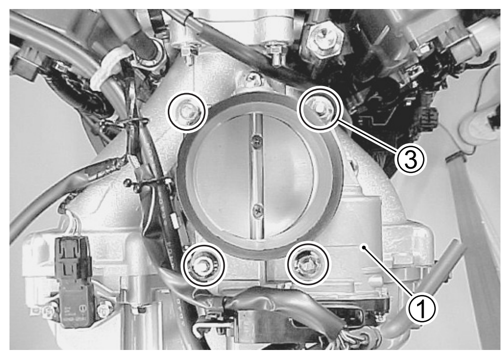
- **Do not disassemble electronic throttle body assembly.**
- **Be careful not to accumulate foreign materials (such as dust and/or metallic particles) on the throttle body housing and/or throttle valve.**
  Otherwise, damage may occur to the throttle body assembly.

REMOVAL

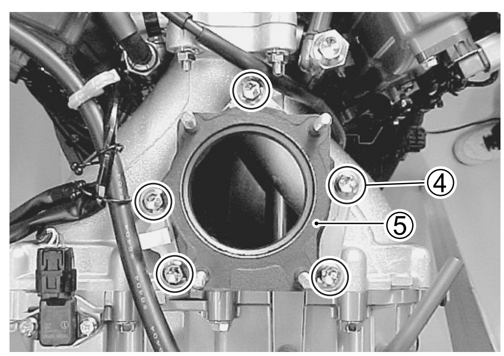
1. Disconnect battery cables from battery.
2. Remove ring gear cover and air intake silencer case. (See page 6-2.)
3. Disconnect lead wire connector ② at electronic throttle body assembly ①.



4. Remove the four (4) nuts ③ securing electronic throttle body assembly, then detach electronic throttle body assembly ① from intake collector.



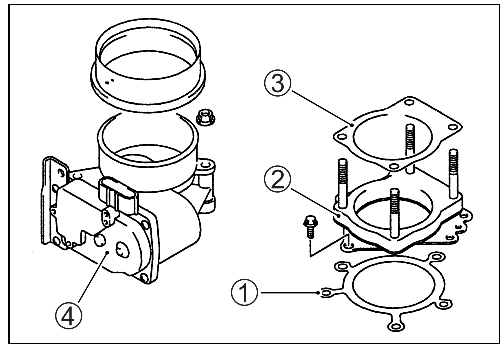
5. Remove the five (5) bolts ④ securing throttle body dumper ⑤, then detach dumper and gasket.

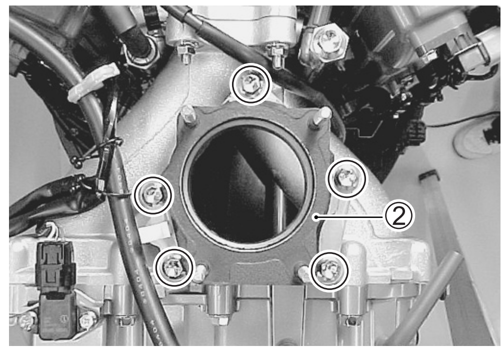


INSTALLATION

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

- Clean mating surfaces and install new throttle body dumper gasket ①.
- Install throttle body dumper ②, then tighten dumper mounting bolts securely.

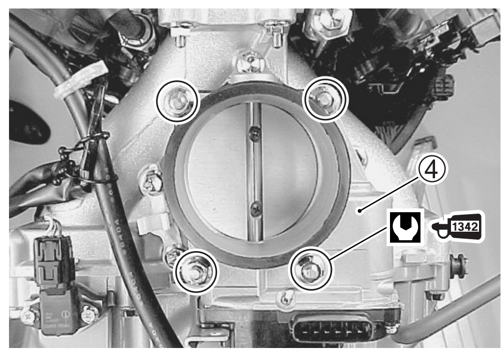




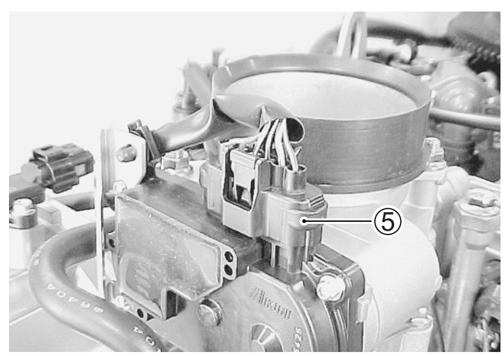
- Install gasket ③ and electronic throttle body assembly ④.
- Tighten four (4) throttle body nuts, pre-coated with thread lock, to specified torque.

Throttle body nut: 27 N·m (2.7 kg-m, 19.5 lb-ft)

1342 **99000-32050: THREAD LOCK "1342"**



- Connect lead wire connector ⑤ to electronic throttle body assembly.
- Check to ensure that all removed parts are back in original position.

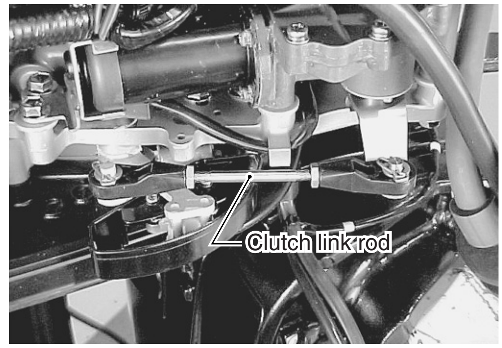


CLUTCH LINK ROD

When replacing a link rod and/or connector, see the illustration below to adjust the link rod length to specification.

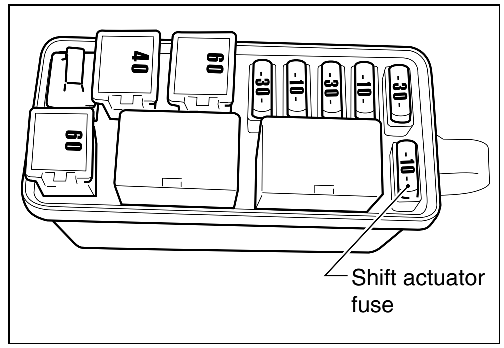
NOTE:

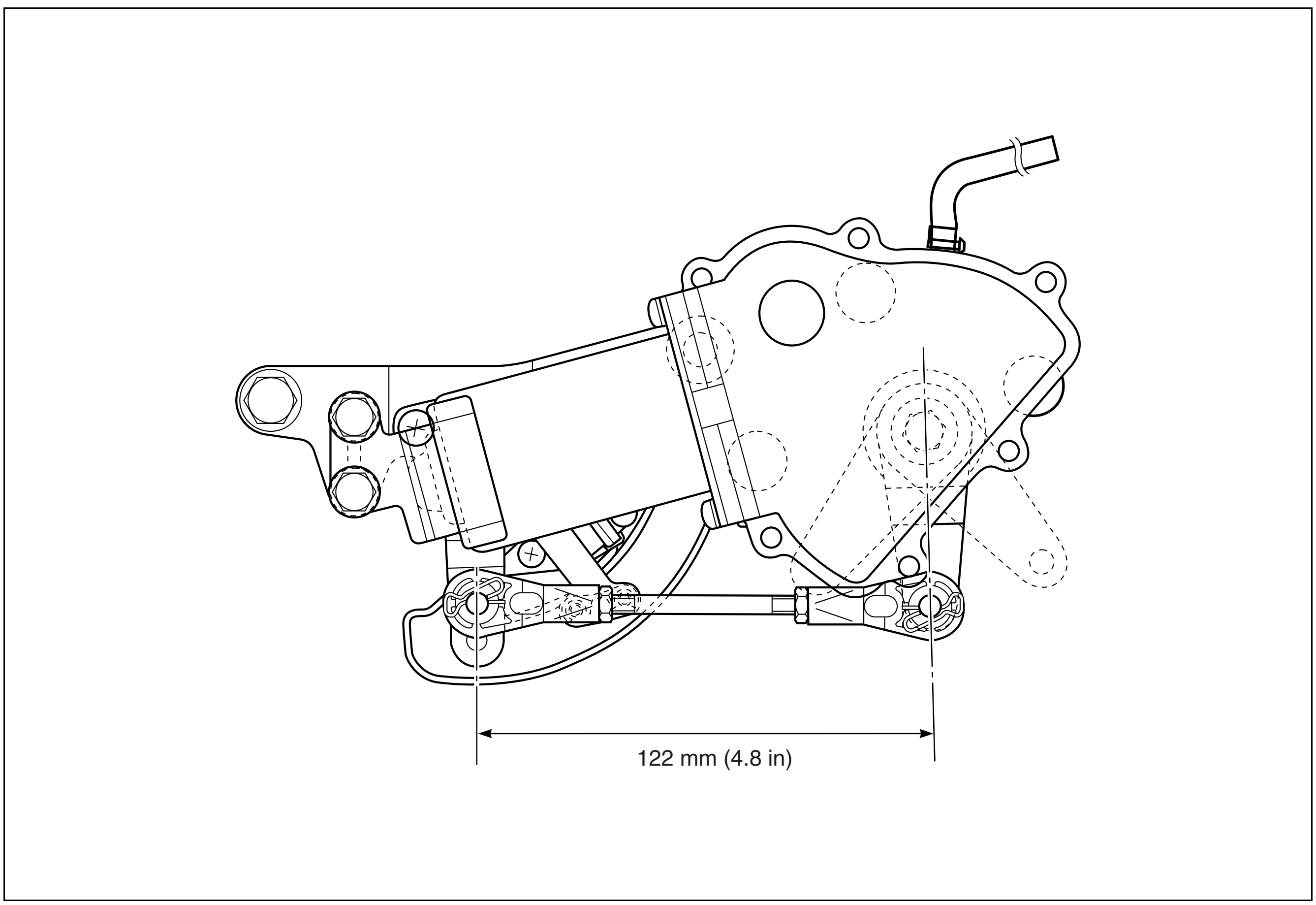
- *Be sure an equal length of link rod is threaded into each connector.*
- *Tighten lock nut against the connector after adjusting the link rod length.*



CAUTION

Remove the shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.





TROUBLESHOOTING

⚠ WARNING

Before starting troubleshooting, read and follow the “PRECAUTION ON SYSTEM INSPECTION” section on page 3-57.

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 (4-14).

CHART 1: SELF-DIAGNOSTIC CODE “3-4” MAP sensor

START

< Main switch “ON” >
Check ECM “44” terminal voltage.
Is result OK? (See page 3-59.)

NO →
- ECM failure
- Wire continuity/connection failure

↓ YES

< Main switch “ON”>
Check ECM “24” terminal voltage.
Is result OK? (See page 3-73.)

NO →
MAP sensor failure

↓ YES

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

CHART 2: SELF-DIAGNOSTIC CODE “1-4” Cylinder temp. sensor

START

<Main switch “OFF”>
Check cylinder temp. sensor resistance.
Is result OK? (See page 3-66.)

NO →
- Cylinder temp. sensor failure
- Wire continuity/connection failure

↓ YES

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

CHART 3: SELF-DIAGNOSTIC CODE “2-3” IAT sensor

START

<Main switch “OFF”>
Check IAT sensor resistance.
Is result OK? (See page 3-66.)

NO →
- IAT sensor failure
- Wire continuity/connection failure

↓ YES

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

CHART 4: SELF-DIAGNOSTIC CODE “1-5” Ex. mani. sensor STBD

START

<Main switch “OFF”>
Check Ex. manifold temp. sensor STBD resistance.
Is result OK? (See page 3-66.)

NO →
- Ex. manifold temp. sensor STBD failure
- Wire continuity/connection failure

YES ↓

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

CHART 5: SELF-DIAGNOSTIC CODE “1-6” Ex. mani. sensor PORT

START

<Main switch “OFF”>
Check Ex. manifold temp. sensor PORT resistance.
Is result OK? (See page 3-66.)

NO →
- Ex. manifold temp. sensor PORT failure
- Wire continuity/connection failure

YES ↓

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

CHART 6: SELF-DIAGNOSTIC CODE “3-5” Speed sensor

START

<Main switch “ON”>
Check ECM “44” terminal voltage.
Is result OK? (See page 3-59.)

NO →
- ECM failure
- Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Check ECM “25” terminal voltage.
Is result OK? (See page 3-59.)

NO → Speed sensor failure

YES ↓

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

CHART 7: SELF-DIAGNOSTIC CODE “3-7” Trim sensor

START

<Main switch “ON”>
Check ECM “44” terminal voltage.
Is result OK? (See page 3-59.)

NO →
- ECM failure
- Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Check ECM “17” terminal voltage.
Is result OK? (See page 3-59.)

NO → Trim sensor failure

YES ↓

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

CHART 8: SELF-DIAGNOSTIC CODE “2-1” Throttle position sensor

START

<Main switch “OFF”>
Check throttle position sensor output voltage change.
Is result OK? (See page 3-83.)

NO → Throttle position sensor failure

YES ↓

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

CHART 9: SELF-DIAGNOSTIC CODE “1-2” Shift position sensor

START

<Main switch “ON”>
Check shift position sensor output voltage change.
Is result OK? (See page 3-74.)

NO →
- Shift position sensor failure
- Wire continuity/connection failure

YES ↓

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

CHART 10: SELF-DIAGNOSTIC CODE “1-1” Over charging

START

<Individual check>
Check rectifier & regulator resistance.
[NOTE 1]
Is result OK? (See page 4-9.)

NO → Rectifier & regulator failure

YES ↓

<Engine running>
Check ECM “52” terminal voltage at idle speed.
Is result 16 V or over? (See page 3-59.)

YES → Rectifier & regulator failure

NO ↓

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

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

NOTE 1:
It is difficult to check rectifier & regulator completely. Before replacing with new one, check if its ground point has good electrical contact.

CHART 11: SELF-DIAGNOSTIC CODE “4-3” Fuel injector

START

<Main switch “ON”>
Check ECM “55” “56” “79” “54” “81” “80” terminal voltage.
Is result OK? (See page 3-59.)

NO →
- ECM failure
- Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Check fuel injector operating signal.
Is result OK? (See page 3-69.)

NO →
- ECM failure
- Wire continuity/connection failure

YES ↓

<Main switch “OFF”>
Check fuel injector operating sound (individual).
Is result OK? (See page 3-68.)

NO → Fuel injector failure

YES ↓

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

CHART 12: SELF-DIAGNOSTIC CODE “4-2” CKP sensor

START

<Main switch “OFF”>
Check CKP sensor resistance.
Is result OK? (See page 3-66.)

NO → CKP sensor failure

YES ↓

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

CHART 13: SELF-DIAGNOSTIC CODE “2-4” CMP sensor

START

<Main switch “ON”>
Check CMP sensor signal.
Is result OK? (See page 3-72.)

NO →
- CMP sensor failure
- Wire continuity/connection failure

YES ↓

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

CHART 14: SELF-DIAGNOSTIC CODE “2-6” CMP sensor (VVT_PORT)

START

<Main switch “ON”>
Check CMP sensor (VVT_PORT) signal.
Is result OK? (See page 3-72.)

NO →
- CMP sensor failure
- Wire continuity/connection failure

YES ↓

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

CHART 15: SELF-DIAGNOSTIC CODE “2-5” CMP sensor (VVT_STBD)

START

<Main switch “ON”>
Check CMP sensor (VVT_STBD) signal.
Is result OK? (See page 3-72.)

NO →
- CMP sensor failure
- Wire continuity/connection failure

YES ↓

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

CHART 16: SELF-DIAGNOSTIC CODE “2-2” Air intake system

START

<Main switch “ON”>
Check throttle position sensor output voltage change.
Is result OK? (See page 3-83.)

- NO → Throttle position sensor failure
- YES ↓

<Main switch “OFF”>
- Check MAP sensor, throttle body for air leakage.
- Check intake collector and cover for air leakage.

Is result OK?

- YES → Air intake system failure
- NO ↓

Possible cause:
- ECM failure

CHART 17: SELF-DIAGNOSTIC CODE “3-2” MAP sensor 2

START

<Main switch “ON”>
Check MAP sensor output voltage change.
Is result OK? (See page 3-73.)

- NO → MAP sensor failure
- YES ↓

Possible cause:
- Clogged pressure detect passage
- ECM failure
- Wire continuity/connection failure

CHART 18: SELF-DIAGNOSTIC CODE “3-3” Neutral switch

START

<Main switch “OFF”>
Check neutral switch function.
Is result OK? (See page 4-16.)

- NO → Neutral switch failure
- YES ↓

Possible cause:
- ECM failure
- Wire short circuit
- Shift position sensor lever damage

CHART 19: SELF-DIAGNOSTIC CODE “5-1” VVT advance (STBD)

START

<Main switch “ON”>
Check ECM “45” “52” terminal voltage (ECM power source voltage).
Is result OK? (See page 3-59.)

NO → ECM power source (battery, battery switch, sub-battery cable, etc.) failure

YES ↓

<Main switch “OFF”>
Check OCV operation and OCV gasket filter condition.
Is result OK? (See page 3-88.)

NO → OCV and/or OCV gasket failure

YES ↓

Possible cause:
- ECM failure
- Wire continuity/connection failure
- OCV oil passage failure
- OCV actuator failure

CHART 20: SELF-DIAGNOSTIC CODE “5-2” VVT advance (PORT)

START

<Main switch “ON”>
Check ECM “45” “52” terminal voltage (ECM power source voltage).
Is result OK? (See page 3-59.)

NO → ECM power source (battery, battery switch, sub-battery cable, etc.) failure

YES ↓

<Main switch “OFF”>
Check OCV operation and OCV gasket filter condition.
Is result OK? (See page 3-88.)

NO → OCV and/or OCV gasket failure

YES ↓

Possible cause:
- ECM failure
- Wire continuity/connection failure
- OCV oil passage failure
- OCV actuator failure

CHART 21: SELF-DIAGNOSTIC CODE “6-1” OCV (STBD)

START

<Main switch “OFF”>
Check OCV operation.
Is result OK? (See page 3-88.)

NO → OCV failure

YES ↓

<Main switch “OFF”>
Check OCV resistance.
Is result OK? (See page 3-88.)

NO → OCV failure

YES ↓

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

CHART 22: SELF-DIAGNOSTIC CODE “6-2” OCV (PORT)

START

<Main switch “OFF”>
Check OCV operation.
Is result OK? (See page 3-88.)

NO → OCV failure

YES ↓

<Main switch “OFF”>
Check OCV resistance.
Is result OK? (See page 3-88.)

NO → OCV failure

YES ↓

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

CHART 23: SELF-DIAGNOSTIC CODE “7-1” ETV ECM

START

Replace the ECM.
Check electronic throttle valve operation.
(See page 3-82.)
Is result OK?

NO → **Possible cause:**
- Wire continuity/connection failure

YES ↓

ECM failure

CHART 24: SELF-DIAGNOSTIC CODE “7-2” ETV motor

START

<Main switch “OFF”>
Check throttle motor resistance.
(See page 3-82.)
Is result OK?

NO → Throttle motor failure

YES ↓

<Individual check>
Check ETV motor relay. (See page 3-86.)
Is result OK?

NO → ETV motor relay failure

YES ↓

<Main switch “ON”>
Check ETV motor/motor relay circuit.
(See page 3-85.)
Is result OK?

NO → **Possible cause:**
- ECM failure
- Wire continuity/connection failure

CHART 25: SELF-DIAGNOSTIC CODE “7-3” ETV

START

<Main switch “OFF”>
Check throttle valve operation.
(See page 3-81.)
Is result OK?

NO → Electronic throttle body assembly failure

YES ↓

<Main switch “ON”>
Check electronic throttle valve operation.
(See page 3-82.)
Is result OK?

NO → Electronic throttle body assembly failure

CHART 26: SELF-DIAGNOSTIC CODE “7-4” Sub BCM

START

<Main switch “ON”>
Check sub BCM “51” terminal voltage.
(See page 3-63.)
Is result OK?

NO → Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Check sub BCM “27” “28” terminal voltage.
(See page 3-63.)
Is result OK?

NO → Wire continuity/connection failure

YES ↓

Possible cause:
- Sub BCM failure

CHART 27: SELF-DIAGNOSTIC CODE “7-5” DBW system

START

<Main switch “ON”>
Check BCM “51” terminal voltage.
(See page 3-63.)
Is result OK?

NO →
- Wire continuity/connection failure
- BCM failure

YES ↓

<Main switch “ON”>
Select the 1st station.
Check 1st lever position sensor output voltage change. (See page 3-84.)
Is result OK?

NO →
- Lever position sensor failure
- Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Select the 2nd station.
Check 2nd lever position sensor output voltage change. (See page 3-84.)
Is result OK?

NO →
- Lever position sensor failure
- Wire continuity/connection failure

YES ↓

<Main switch “ON”>
Check ECM “7” “13” terminal voltage.
(See page 3-59.)
Is result OK?

NO →
- Wire continuity/connection failure
- ECM failure

YES ↓

<Main switch “ON”>
Check BCM “27” “28” terminal voltage.
(See page 3-63.)
Is result OK?

NO →
- Wire continuity/connection failure
- BCM failure

CHART 28: SELF-DIAGNOSTIC CODE “8-1” ESA ECM

START

Replace the ECM.
<Engine running>
Check electronic shift system operation.
Is result OK?

NO →
Possible cause:
- Wire continuity/connection failure

YES ↓

ECM failure

CHART 29: SELF-DIAGNOSTIC CODE “8-2” ESA motor

START

<Main switch “OFF”>
Check shift motor resistance.
(See page 3-80.)
Is result OK?

NO → Shift motor failure

YES ↓

<Individual check>
Check ESA motor relay. (See page 3-80.)
Is result OK?

NO → ESA motor relay failure

YES ↓

<Main switch “ON”>
Check ESA motor/motor relay circuit.
(See page 3-79.)

NO → **Possible cause:**
- ECM failure
- Wire continuity/connection failure

CHART 30: SELF-DIAGNOSTIC CODE “8-3” ESA position

START

<Main switch “ON”>
Check shift position sensor output voltage.
(See page 3-74.)
Is result OK?

NO →
- Shift position sensor failure
- Wire continuity/connection failure

YES ↓

<Main switch “OFF”>
- Remove the Main relay from fuse box, then remove the clutch link rod from clutch lever. (See page 9-2.)
- To check smooth gear engagement, shift the clutch control lever to Forward and Reverse position from Neutral position. Is result OK?

NO → Shift link mechanism failure

YES ↓

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

CHART 31: ENGINE CRANKED, BUT NOT START (OR STOPS SHORTLY AFTER STARTING)

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

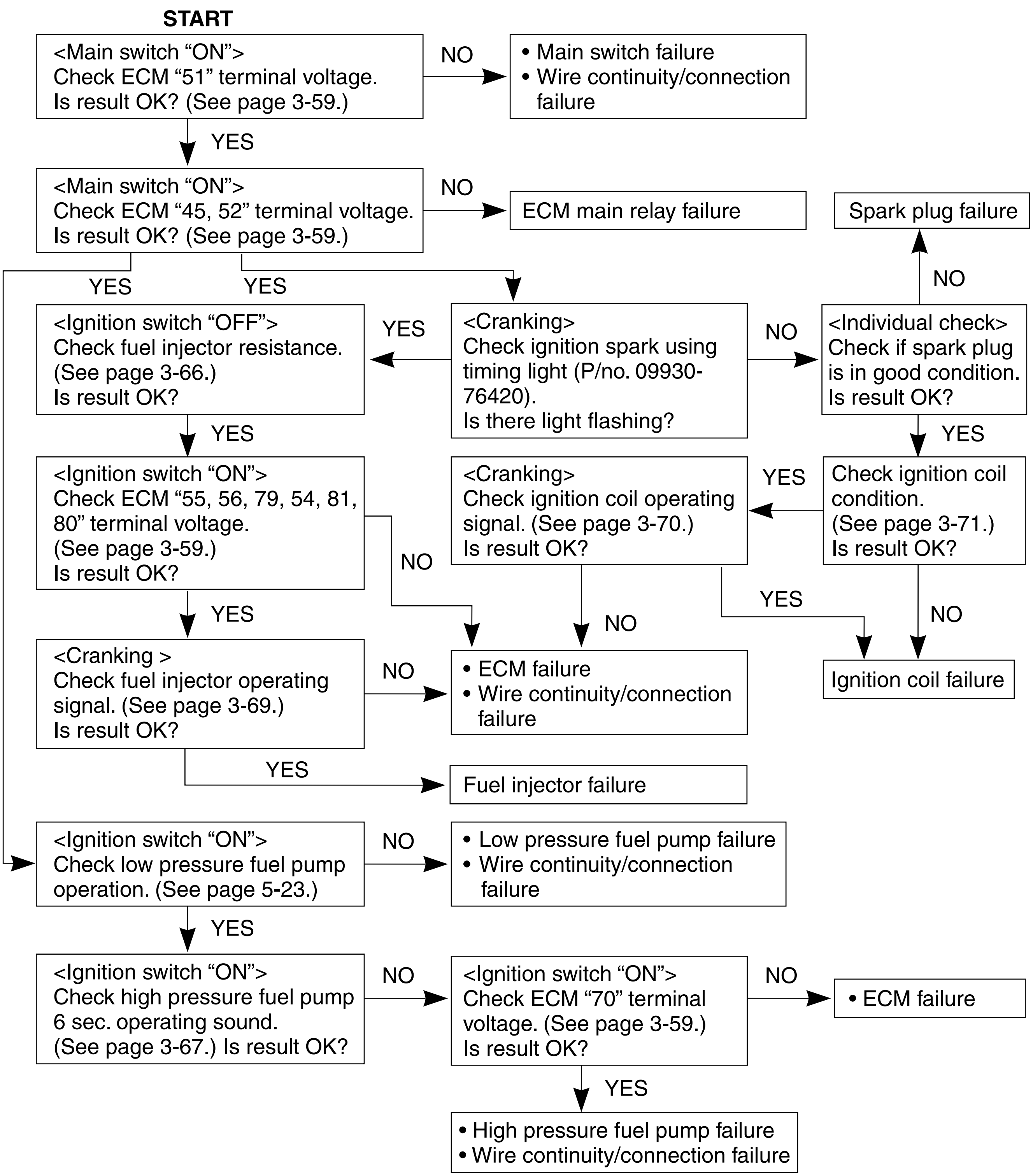


CHART 32 : UNSTABLE IDLING/TROLLING (OR ENGINE TENDS TO STALL)

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

START

<Main switch “OFF”>
Check throttle valve operation.
(See page 3-81.)
Is result OK?

- NO → Electronic throttle body assembly failure
- YES ↓

<Main switch “OFF”>
Check throttle position sensor output voltage change. (See page 3-83.)
Is result OK?

- NO → Throttle position sensor failure
- YES ↓

<Main switch “OFF”>
Check air intake system (Throttle body, MAP sensor, Intake collector, etc.) for air leakage.
Is result OK?

- NO → Air intake system failure
- YES ↓

Possible cause:
- Spark plug failure
- Ignition coil failure
- ECM failure
- Wire continuity/connection failure
- Failure of high pressure fuel system components:
  - Fuel injector (clog, stuck valve, etc.)
  - Fuel pressure regulator (incorrect regulated pressure, etc.)
  - Fuel pump (clogged suction filter, leakage in tank, etc.)
  - Fuel filter (clog, etc.)
  - Hose (clog, kink, leakage, etc.)

ENGINE ELECTRICAL

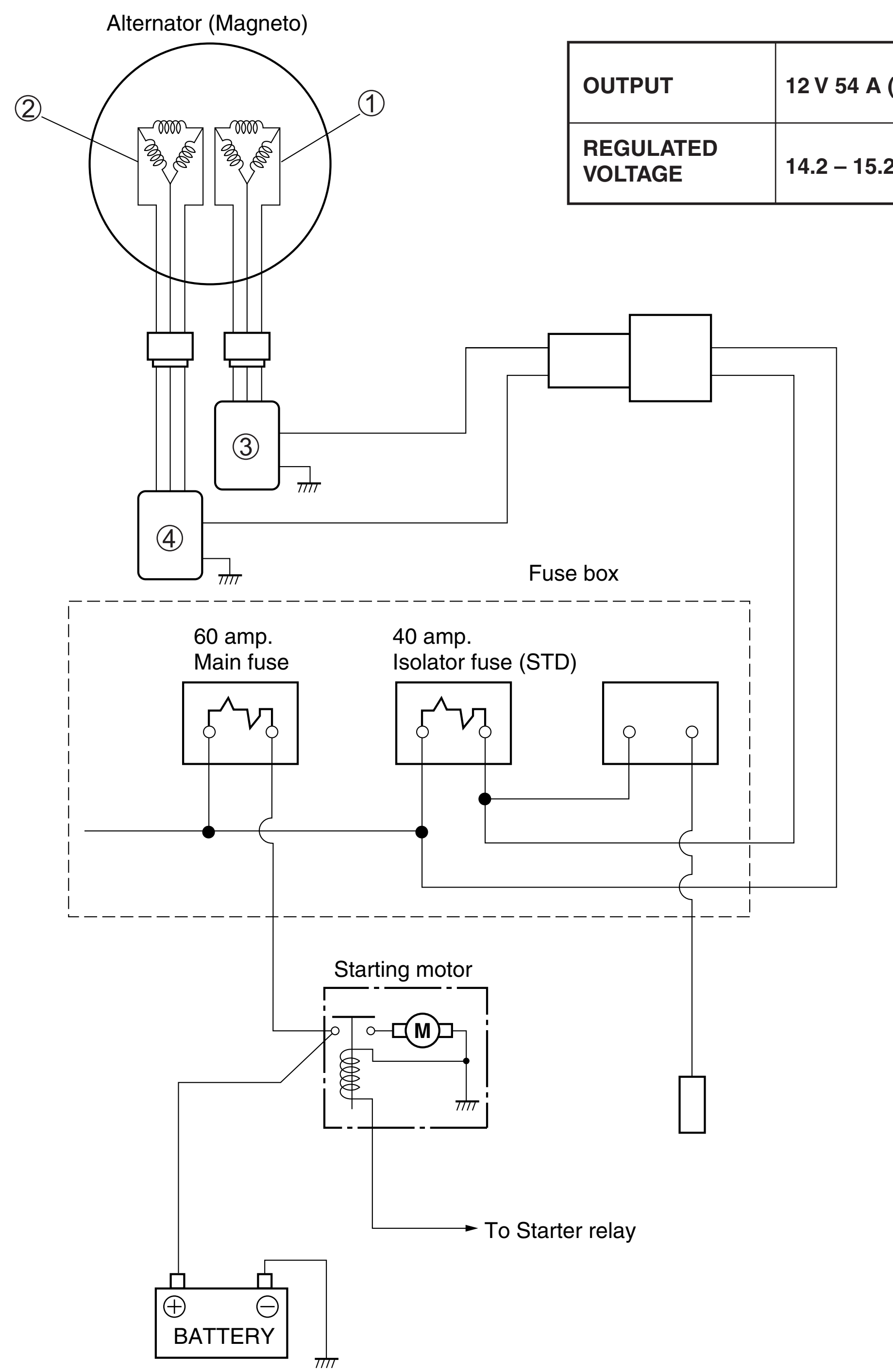
CONTENTS

BATTERY CHARGING SYSTEM

OUTLINE

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

OUTPUT	12 V 54 A (648 W)/3 000 r/min.
REGULATED VOLTAGE	14.2 – 15.2 V



① Battery charge coil
② Battery charge coil
③ Rectifier & Regulator
④ Rectifier & Regulator

ISOLATOR FUNCTION

The battery charging system is equipped with an isolator function.

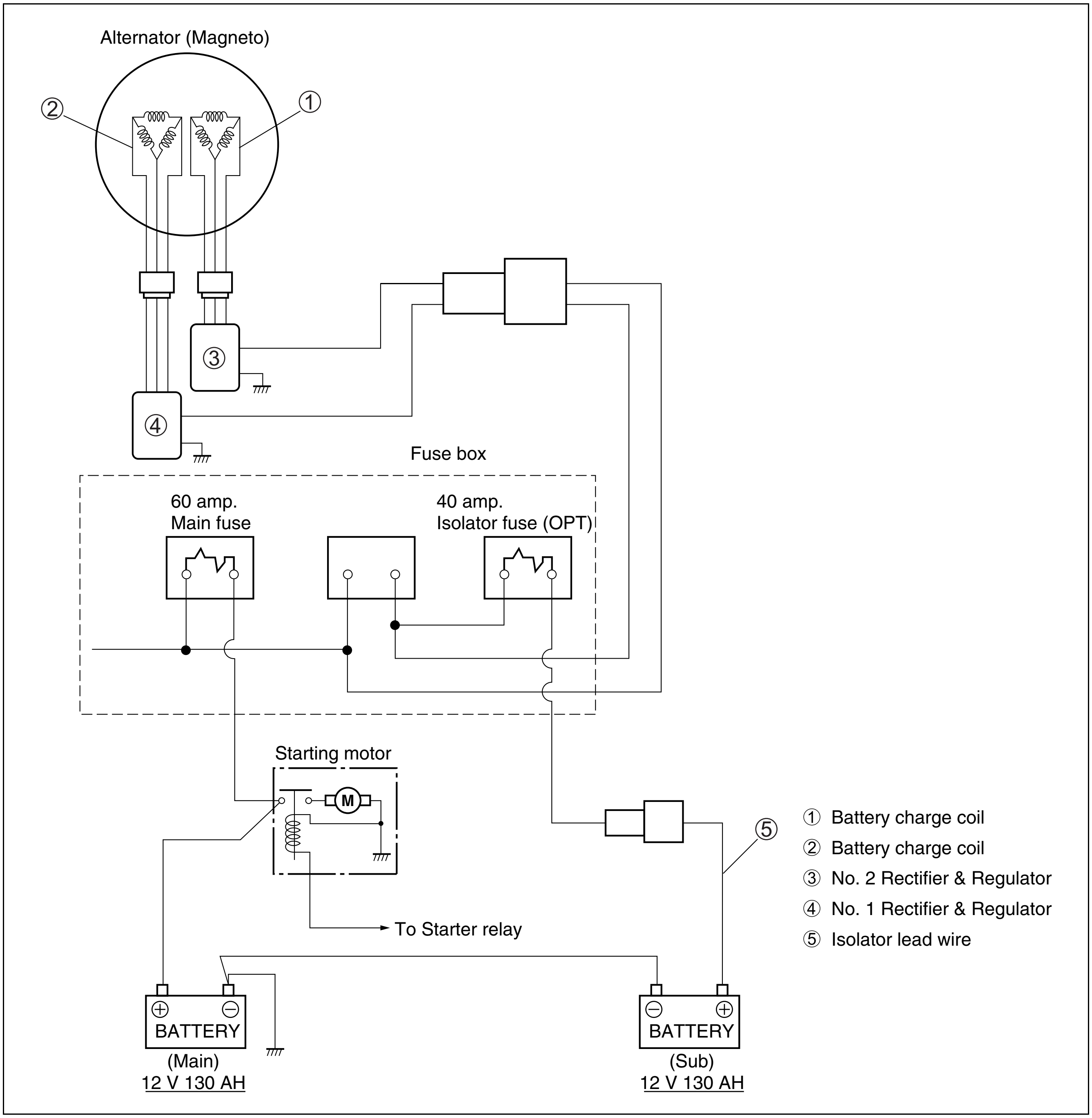
When a sub battery is used in addition to the main battery for engine operation, this function allows both the batteries to be charged at the same time.

To modify the charging circuit and distribute the power to the individual batteries, relocate the 40 amp fuse in [STD] position to [OPT ⓧ] position in the fuse box.

Relocation of the 40 amp fuse to [OPT ⓧ] position modifies the charging circuit so the output lead of the No.2 Rectifier & Regulator can charge the main battery for engine operation and the output lead of No.1 Rectifier & Regulator can charge the sub battery.

NOTE:

For proper charging circuit operation, the negative terminals of both batteries, main and sub batteries, must be connected with a cable of the same size as the existing battery cable.



INSPECTION

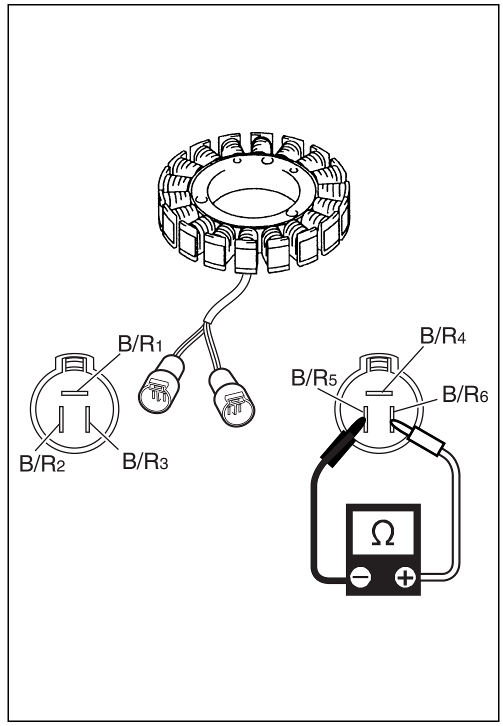
BATTERY CHARGE COIL

Measure battery charge coil resistance.

09930-99320: Digital tester

Tester range: Ω (Resistance)

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



Battery charge coil resistance:

Terminal for tester probe connection	Resistance
Black/Red 1 to Black/Red 2	0.21 – 0.32 Ω
Black/Red 2 to Black/Red 3	
Black/Red 3 to Black/Red 1	
Black/Red 4 to Black/Red 5	0.21 – 0.32 Ω
Black/Red 5 to Black/Red 6	
Black/Red 6 to Black/Red 4	

If measurement exceeds specification, replace battery charge coil.

FUSE BOX/FUSE

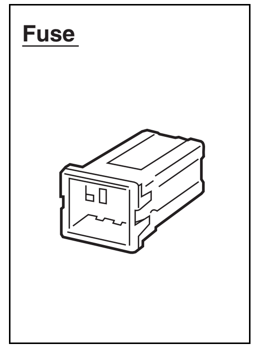
09930-99320: Digital tester

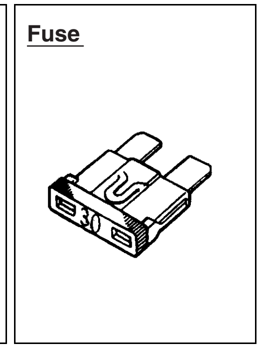
Tester range: (Continuity)

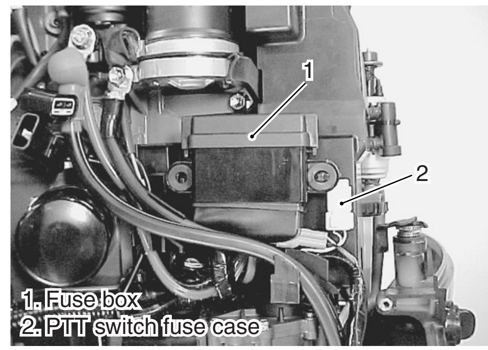
Fuse

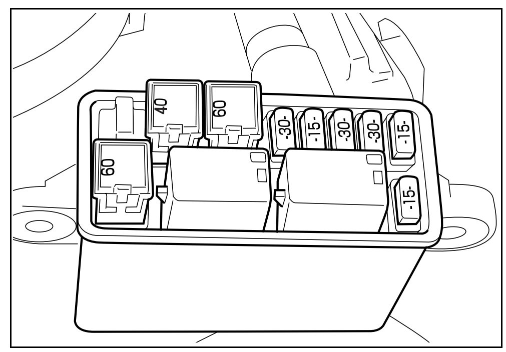
1. Remove the fuse from fuse box.
2. Inspect continuity between both terminals of fuse.
   If no continuity is indicated, replace fuse.

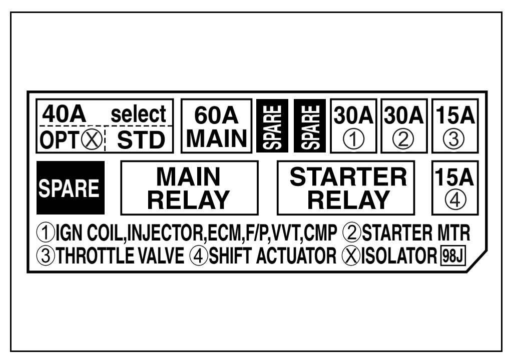
   Main fuse: 60 A
   Isolator select fuse: 40 A
   Ign. coil/Injector/ECM/Fuel pump/VVT/CMP fuse: 30 A
   Starter motor relay fuse: 30A
   Throttle valve fuse: 15 A
   Shift actuator fuse: 15 A
   PTT switch fuse: 10 A





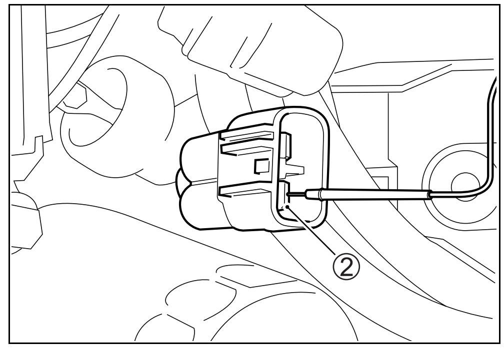




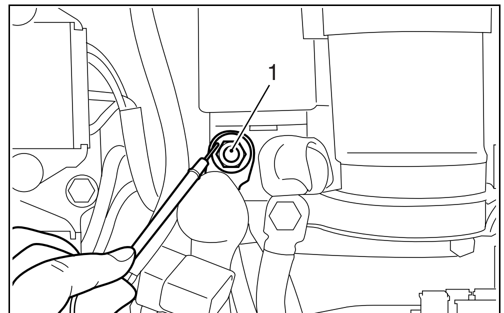


60 amp. main fuse line

1. Disconnect battery cables from battery.
2. Disconnect output lead wire connector from rectifier & regulator.



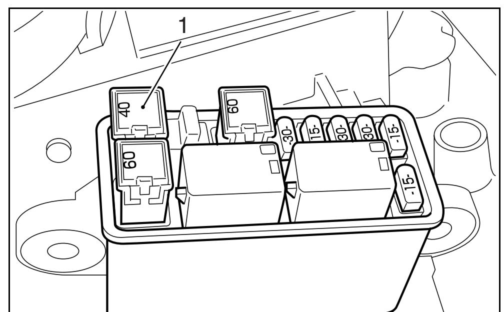
3. Inspect continuity between the white charge lead wire terminal ② and “B” terminal of starter motor magnetic switch.
4. If no continuity is indicated, replace fuse and/or main harness.



1. Starter motor magnetic switch “B” terminal

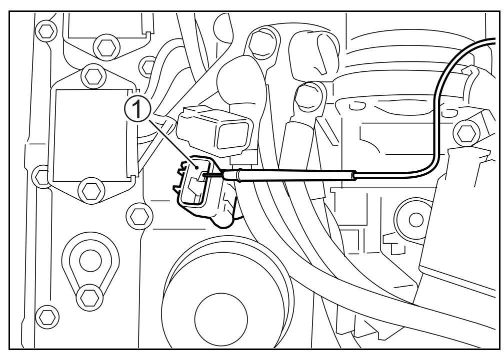
40 amp. Isolator select fuse line

1. Disconnect battery cables from battery.
2. Install 40 amp. isolator select fuse to “OPT ⓧ” position.

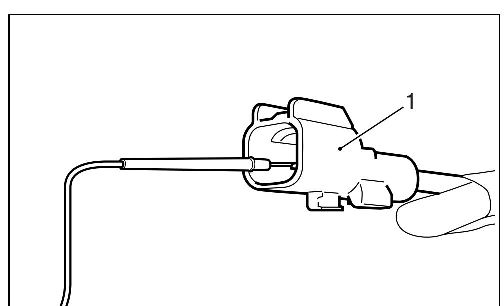


1. 40 amp. isolator fuse

3. Disconnect output lead wire connector from rectifier & regulator.



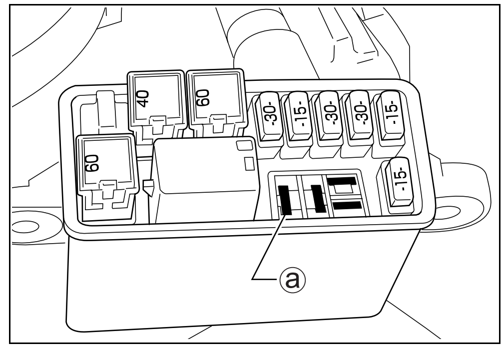
4. Inspect continuity between the white charge lead wire terminal ① and isolator charge lead wire connector terminal as shown.
5. If no continuity is indicated, replace fuse and/or main harness.



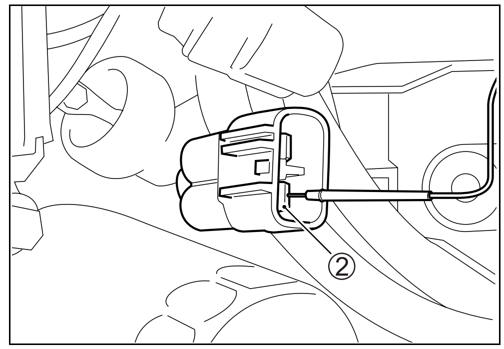
1. Isolator charge lead wire connector

30 amp. starter motor relay fuse line

1. Disconnect battery cables from battery.
2. Disconnect starter motor relay from fuse box.
3. Disconnect output lead wire connector from rectifier & regulator.

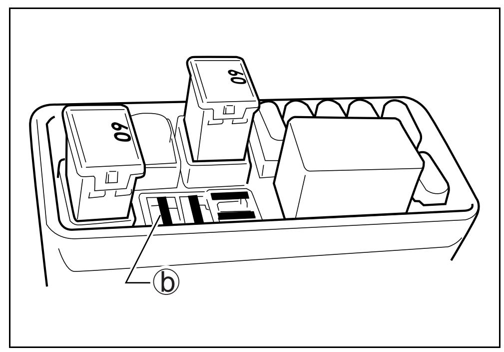


4. Inspect continuity between the lead wire terminal ⓐ of starter motor relay and the white charge lead wire terminal ②.
5. If no continuity is indicated, replace fuse and/or main harness.

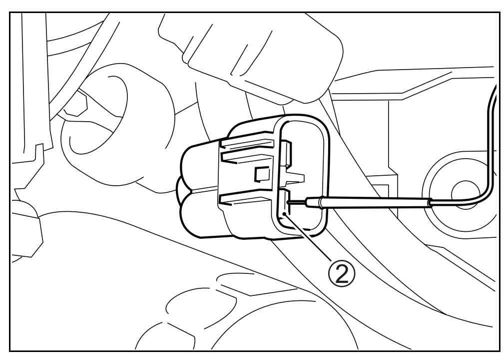


30 amp. ECM/Ign. coil etc. fuse line

1. Disconnect battery cables from battery.
2. Disconnect main relay from fuse box.
3. Disconnect output lead wire connector from rectifier & regulator.

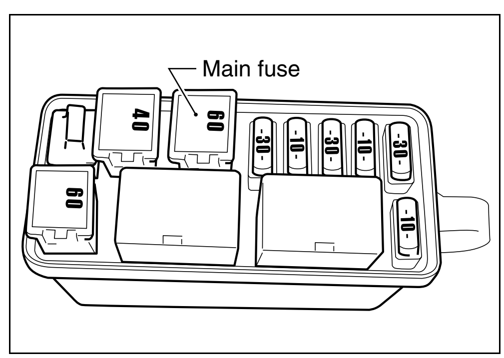


4. Inspect continuity between the lead wire terminal ⓑ of main relay and the white charge lead wire terminal ②.
5. If no continuity is indicated, replace fuse and/or main harness.

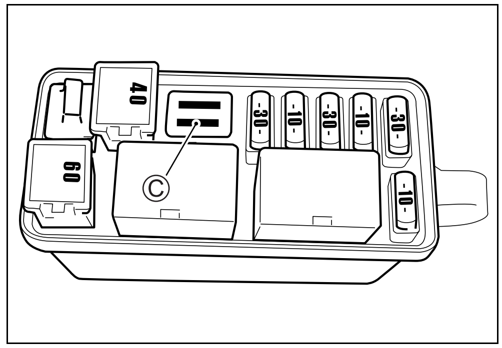


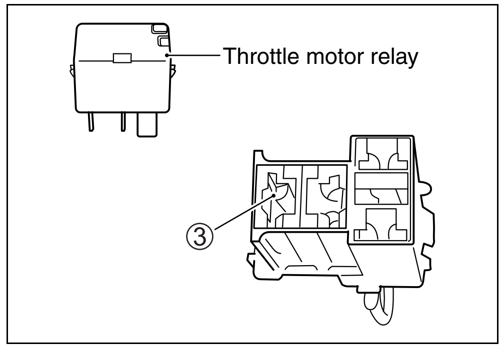
15 amp. Throttle valve (motor) fuse line

1. Disconnect battery cables from battery.
2. Remove 60 amp. main fuse from fuse box.
3. Remove the electric parts holder. (See page 4-30.)
4. Remove throttle motor relay from engine main harness.

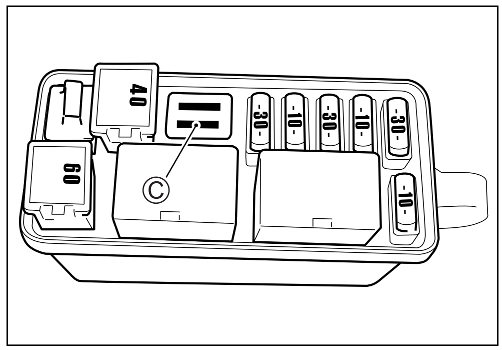


5. Inspect continuity between the lead wire terminal ⓒ of main fuse and the Yellow lead wire terminal ③ of engine main harness (motor relay harness).
6. If no continuity is indicated, replace fuse and/or main harness.

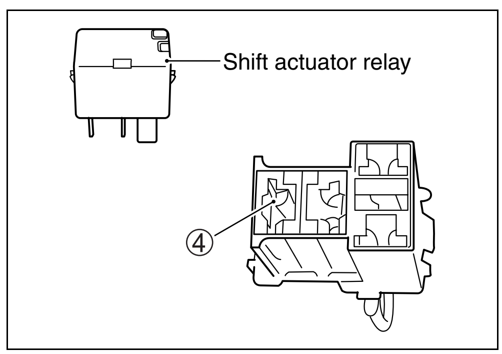




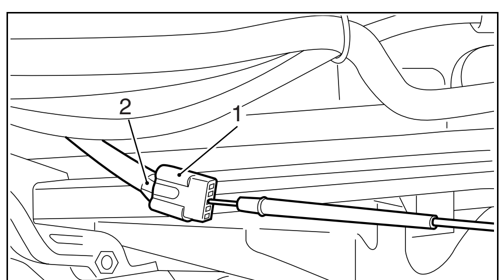
15 amp. Shift actuator fuse line
1. Disconnect battery cables from battery.
2. Remove 60 amp. main fuse from fuse box.
3. Remove the ECM.
4. Disconnect shift actuator relay from engine main harness.



5. Inspect continuity between the lead wire terminal ⓒ of main fuse and the Gray/Red lead wire terminal ④ of engine main harness (motor relay harness).
6. If no continuity is indicated, replace fuse and/or main harness.

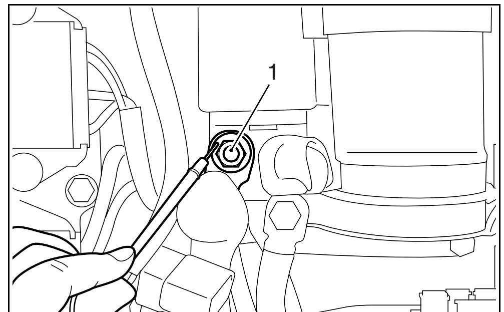


10 amp. PTT switch fuse line
1. Disconnect battery cables from battery.
2. Disconnect PTT switch lead wire connector from switch.



1. PTT switch lead wire connector
2. White/Red lead wire

3. Inspect continuity between the White/Red lead wire of main harness and "B" terminal of starter motor magnetic switch.
4. If no continuity is indicated, replace fuse and/or main harness.



1. Starter motor magnetic switch "B" terminal

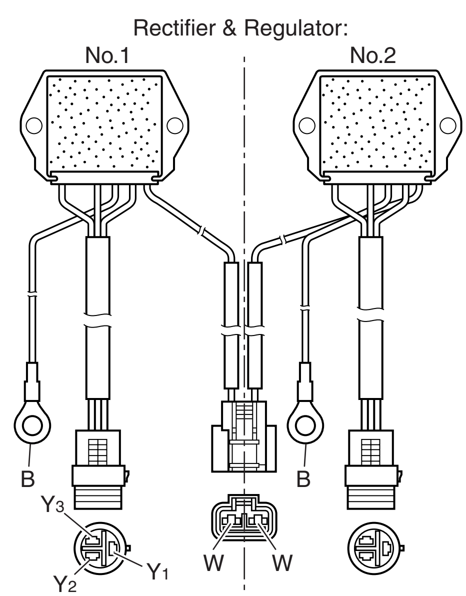
RECTIFIER & REGULATOR

TOOL 09900-25010: Pocket tester

Tester range: ×1 kΩ (Resistance)

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

NOTE:
The values given below are for a SUZUKI 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 ⊖ (Black) \ Tester probe ⊕ (Red)	Black	White	Yellow 1	Yellow 2	Yellow 3
Black		3.0 – 4.6	1.8 – 2.8	1.8 – 2.8	1.8 – 2.8
White	∞		∞	∞	∞
Yellow 1	2 – 3.2	2 – 3.4		4 – 7	4 – 7
Yellow 2	2 – 3.2	2 – 3.4	4 – 7		4 – 7
Yellow 3	2 – 3.2	2 – 3.4	4 – 7	4 – 7	

If measurement exceeds specification, replace rectifier & regulator.

REMOVAL/INSTALLATION

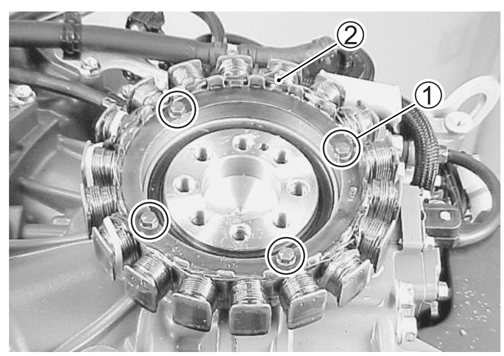
System construction

① **Bolt**
② **Flywheel**
③ **Dowel pin**
④ **Screw**
⑤ **Battery charge coil**
⑥ **Rectifier & regulator**
⑦ **Bolt**
⑧ **Seal ring**
⑨ **Clamp**
⑩ **Bolt**
⑪ **Main harness**
⑫ **Main fuse 60 A**
⑬ **Fuse**
⑭ **Main relay**
⑮ **Starter relay**

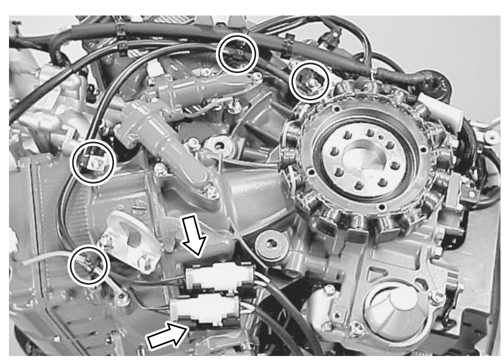
REMOVAL

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

Battery charge coil

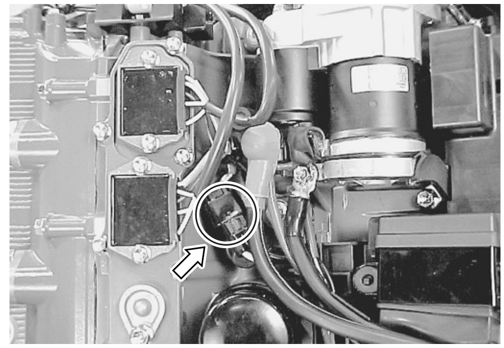


- Remove flywheel magneto. (See page 3-92.)
- Remove four (4) screws ① securing the battery charge coil ②.
- Disconnect battery charge coil lead wire connectors from Rectifier & regulator.
- Remove the lead wire clamps and battery charge coil.

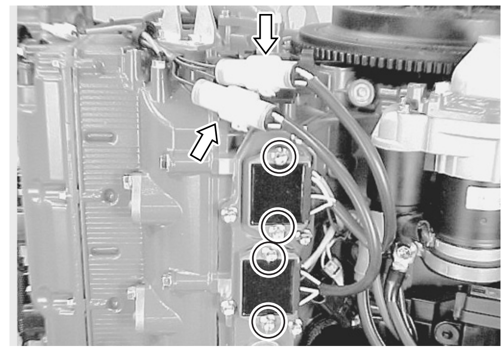


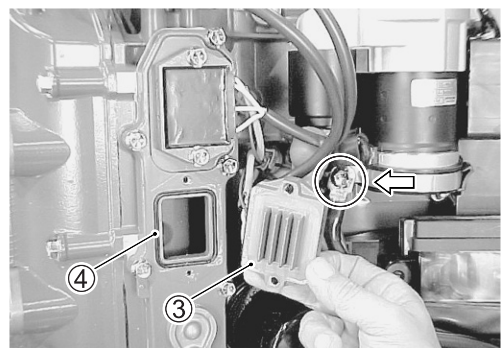
Rectifier & regulator

- Disconnect charge output lead wire connector.



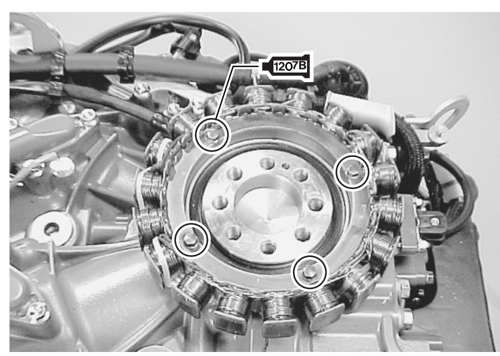
- Disconnect battery charge coil lead wire connector from Rectifier & regulator.
- Remove the bolt securing ground lead wire of Rectifier & regulator.
- Remove the bolts securing the Rectifier & regulator.
- Remove the rectifier & regulator ③ and seal ring ④.





INSTALLATION

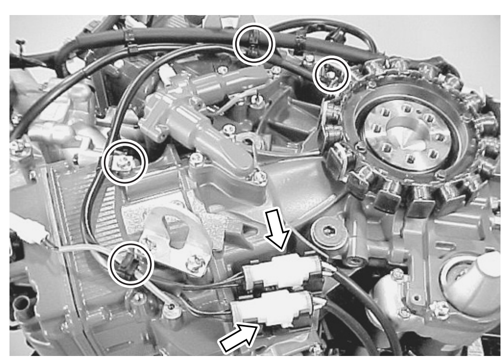
Installation is reverse order of removal with special attention to the following steps.



Battery charge coil

Apply Suzuki Bond to the coil securing screws.

1207B 99000-31140: SUZUKI BOND "1207B"



Wire routing

Secure coil lead wire with lead wire clamps, then check that coil lead wire is routed properly and away from hot or rotating parts. (For wire routing – See page 11-14 to 11-19.)

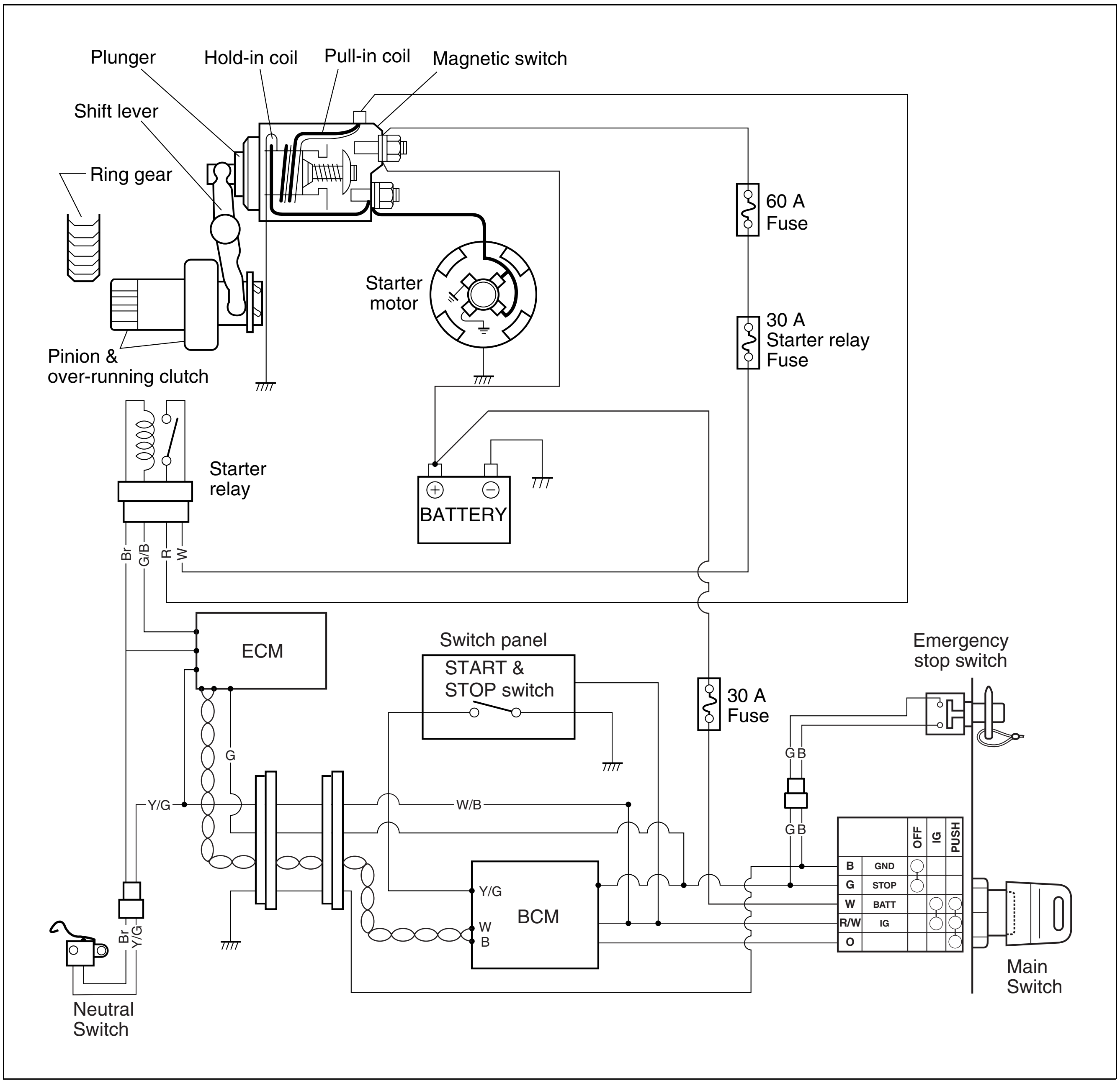
ELECTRIC STARTER SYSTEM

OUTLINE

The starting circuit consists of the battery, starting motor, main switch, "START & STOP" switch, neutral switch, BCM, ECM 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 main switch is closed (turn to "ON") and depress the "START & STOP" button.
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 MOTOR OPERATION CONDITION

The starter motor relay will only engage when the main switch is turned to “ON” position and depress the “START & STOP” button 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.
- When BCM detects that the target shift position is neutral according to the LPS input signal.
- When BCM detects that the actual shift position is neutral according to the SPS (ECM) input signal.

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.*
- *Emergency stop switch lock plate is set in place.*

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?

YES → Does the flywheel rotate?

No (or turns slowly) →
- Check battery for charging condition.
- Check battery terminals for connections and corrosion.

Does starter motor rotate?

YES →
- Check pinion and overrunning clutch. (See page 4-24.)
- Check starter magnetic switch. (See page 4-25.)

NO →
- Check battery for charging condition.
- Check battery terminals for connections and corrosion.
- Check main (60 A) and/or starter relay (30 A) fuse. (See page 4-5.)

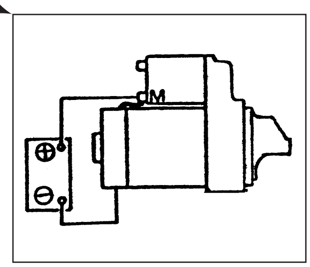
YES → Check for starter relay "Click" sound when turning main switch to "ON" and depress the "START" button.
Is there "Click" sound?

NO →
- Check sub-battery cable circuit.
- Check function of neutral switch. (See page 4-16.)
- Check emergency stop switch function. (See page 4-17.)
- Check main switch function. (See page 4-15.)
- Check switch panel. (See page 3-89.)
- Check starter relay. (See page 4-15.)
- Check wiring system and connections between starter relay and main switch.

YES →
- Check BCM-No. 27, 28, 48 terminal voltage. (See page 3-63.)

YES →
- Check ECM-No. 21, 23, 13, 7 terminal voltage. (See page 3-59.)

Is there "Click" sound? 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 4-23.)
- Check the armature coil. (See page 4-22.)

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

INSPECTION

MAIN SWITCH

09930-99320: Digital tester

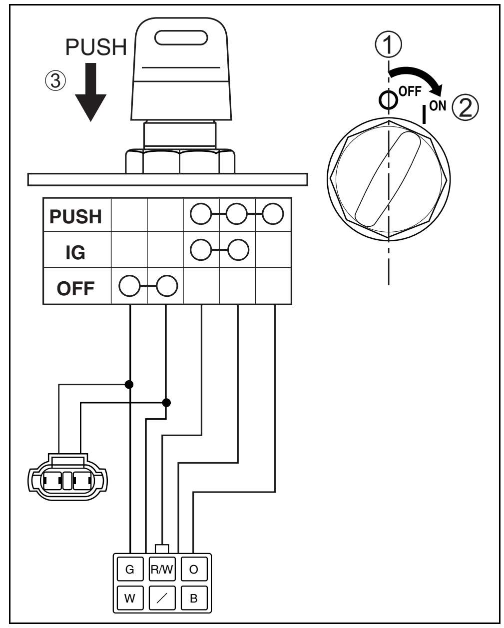
Tester range: (Continuity)

1. Disconnect the main switch from switch panel wiring harness.
2. Check continuity between wiring leads at the key positions shown in the chart.

Key Position	Switch Lead Wires				
	Black	Green	White	Red/White	Orange
① OFF	○—	—○			
② ON			○—	—○	
③ PUSH			○—	—○—	—○

○——○: Continuity

If out of specification, replace main switch.

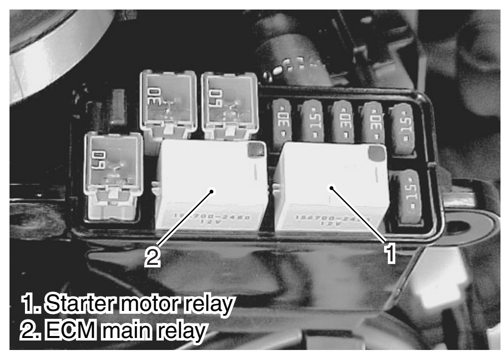


STARTER MOTOR RELAY

09930-99320: Digital tester

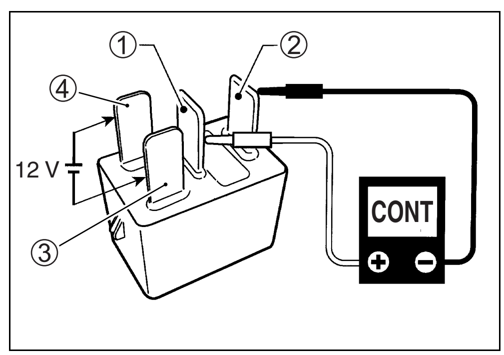
Tester range: (Continuity)

1. Disconnect starter motor relay from fuse box.



1. Starter motor relay
2. ECM main relay

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.



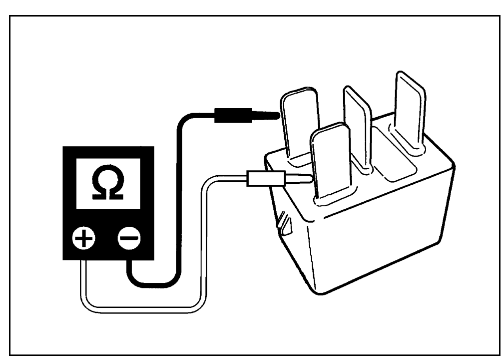
Starter motor relay function:

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.

3. Measure resistance between relay terminals ③ and ④.



Tester range: Ω (Resistance)
Starter motor relay solenoid coil resistance:
145 – 190 Ω

If out of specification, replace starter motor relay.

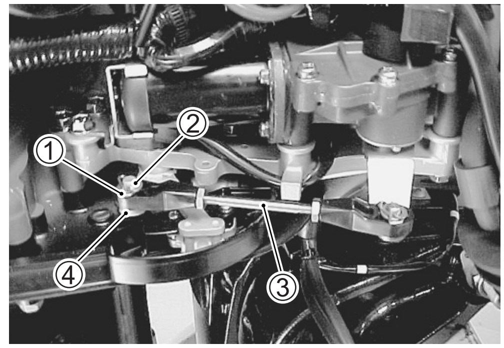
NEUTRAL SWITCH

Check for continuity/infinity of the neutral switch.

09930-99320: Digital tester

Tester range: (Continuity)

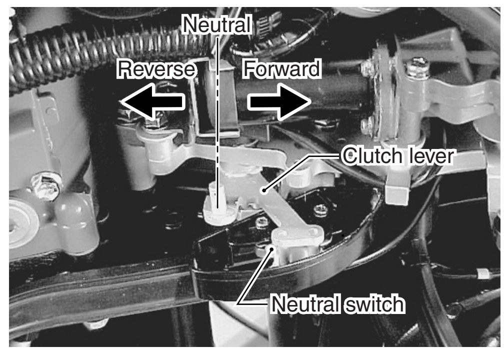
1. Shift to “NEUTRAL” position.
2. Remove the clip ①, washer ② and clutch link rod ③ from clutch lever ④.



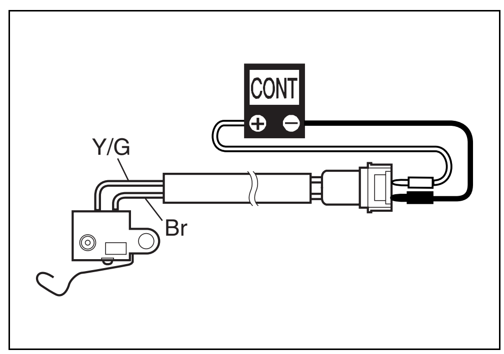
CAUTION

Remove the main relay or shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.

3. Disconnect neutral switch lead wire connector.
4. Check continuity/infinity between Yellow/Green and Brown lead wires while operating clutch lever.



Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity



If out of specification:
- 1st Check switch position adjustment, readjust if necessary.
- 2nd Replace neutral switch.

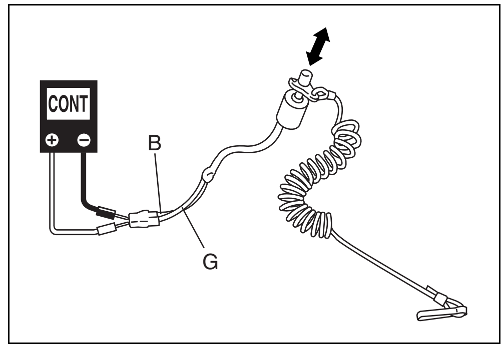
NOTE:
After installing neutral switch, check for correct function by operating clutch lever.

EMERGENCY STOP SWITCH

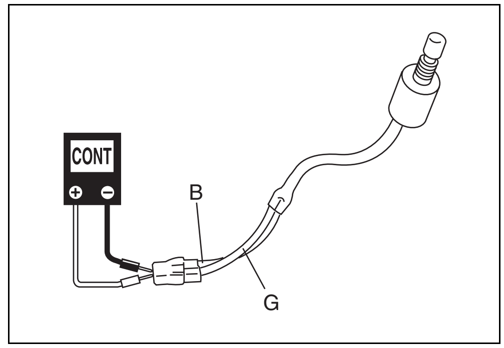
09930-99320: Digital tester

Tester range: (Continuity)

1. Disconnect the emergency stop switch lead wire.



2. Check continuity/infinity between the wiring leads under the condition shown below.



	Tester probe connection		Tester indicates
	Red (+)	Black (–)	
Lock plate installed	Green	Black	Infinity
Lock plate removed			Continuity

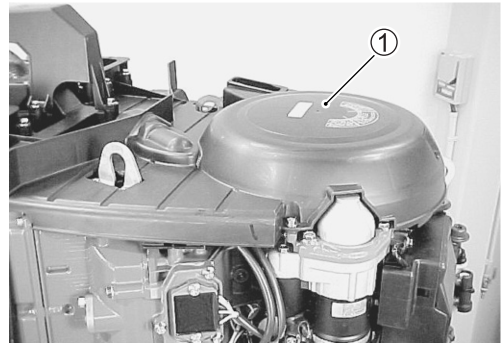
3. If out of specification, replace switch.

STARTER MOTOR

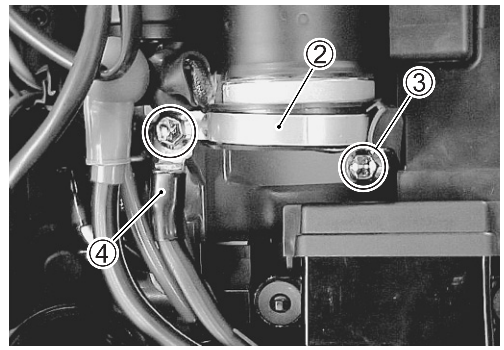
REMOVAL

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

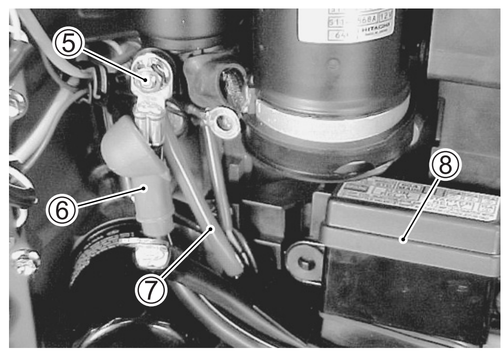
1. Remove bolts and ring gear cover and air intake silencer case ①. (See page 6-2.)



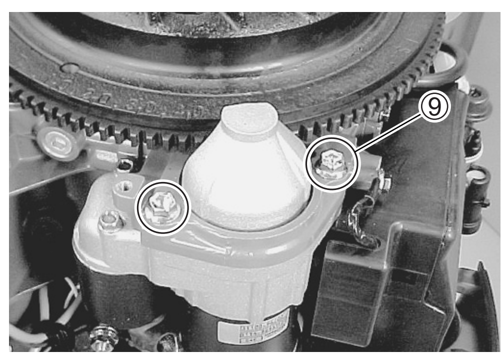
2. Remove the two (2) bolts ③, negative ⊖ battery cable ④ and starter motor band ②.



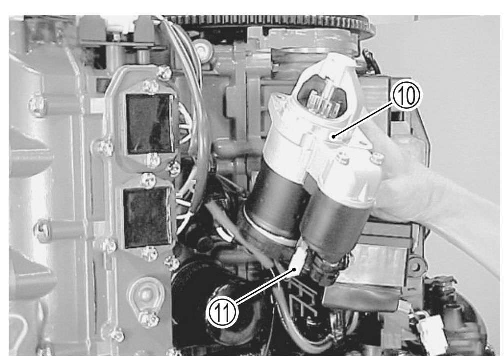
3. Remove nut ⑤ and positive ⊕ battery cable ⑥, positive ⊕ cable ⑦ from the magnetic switch of starter motor.
4. Pull and remove fuse box assembly ⑧ from electric parts holder.



5. Remove the two bolts ⑨ securing starter motor.



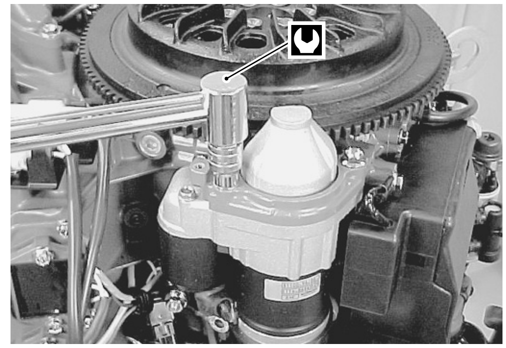
6. Remove the starter motor ⑩, then disconnect the red lead wire ⑪ from "S" terminal of starter magnetic switch.



INSTALLATION

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

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



Starter motor mounting bolt:

23 N·m (2.3 kg-m, 16.5 lb-ft)

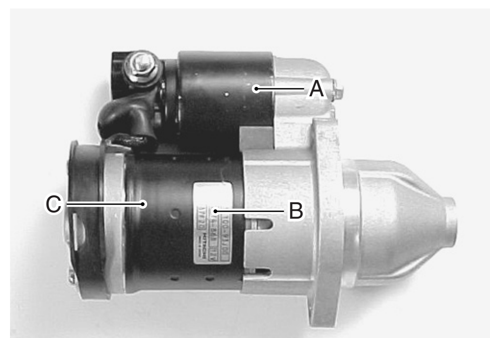
DISASSEMBLY

When overhauling starting motor, it is recommended that component parts be cleaned thoroughly.

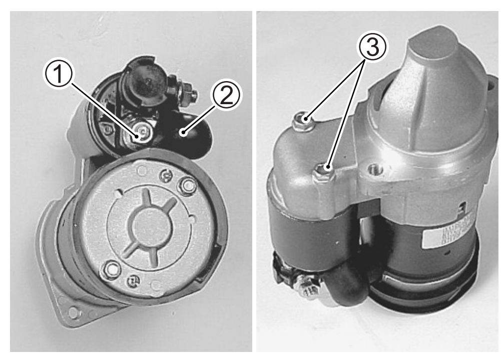
However, the yoke assembly, armature coil, over-running clutch assembly, magnetic switch assembly, and rubber or plastic parts should not be washed in a degreasing tank or with a grease dissolving solvent. These parts should be cleaned with compressed air or wiped with clean cloth.

NOTE:

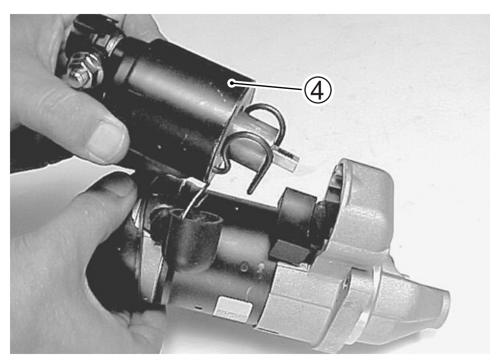
Before disassembling starting motor, be sure to put match marks at three locations (A, B and C) as shown in figure at right to avoid any possible component alignment mistakes.



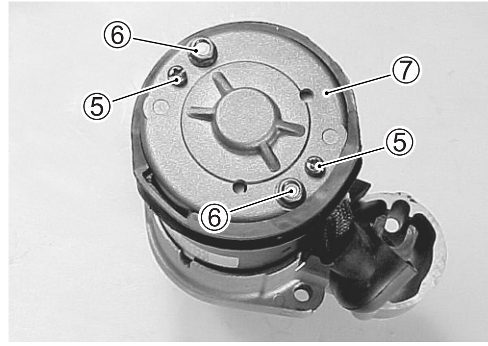
1. Remove nut ① from magnetic switch, then disconnect the connecting wire ②.
2. Remove two bolts ③ securing magnetic switch.



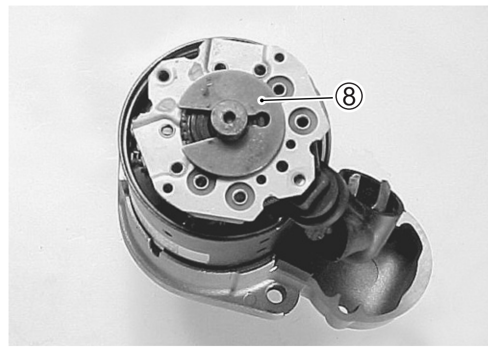
3. Remove the magnetic switch ④.



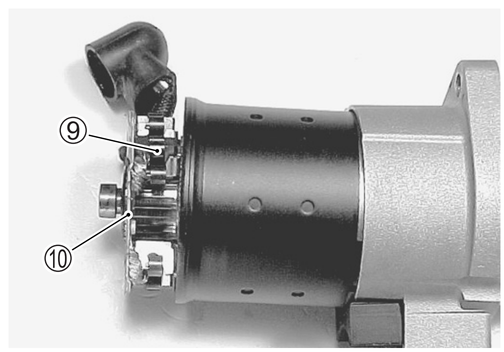
4. Remove screws ⑤, long through bolts ⑥ and rear cover ⑦.



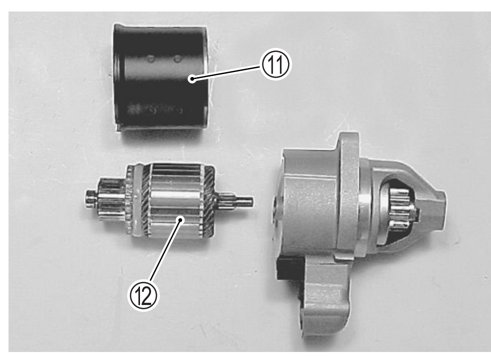
5. Remove thrust washer ⑧ with screwdriver.



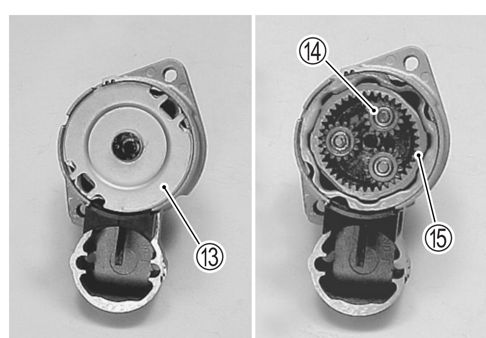
6. Pull the brush spring ⑨ up to separate the brush from the surface of the commutator, then remove the brush holder ⑩.



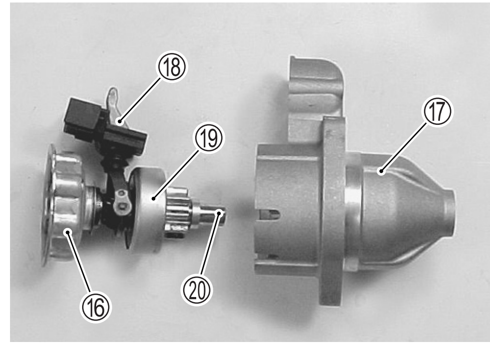
7. Remove the yoke ⑪ and armature ⑫.



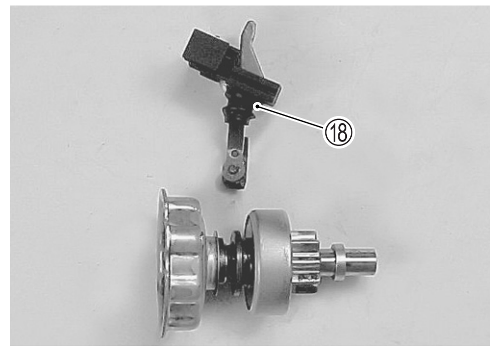
8. Remove the center cover plate ⑬.
9. Remove the planetary gears ⑭ and internal gear ⑮.



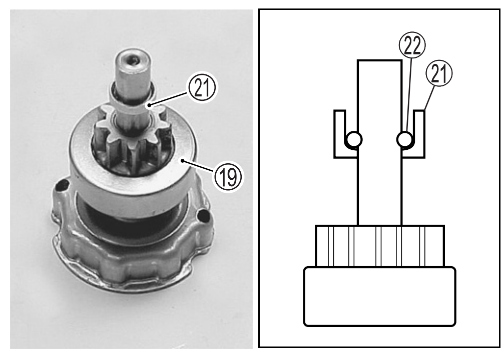
10. Remove the center bracket ⑯ (with shift lever ⑱, pinion ⑲ and pinion shaft ⑳) from front housing ⑰.



11. Remove the shift lever ⑱.



12. Push the pinion stopper ㉑ down, then remove stopper ring ㉒.
    Remove the pinion stopper and pinion ⑲.

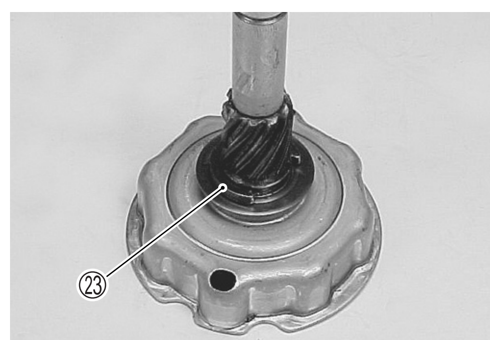


⚠ WARNING

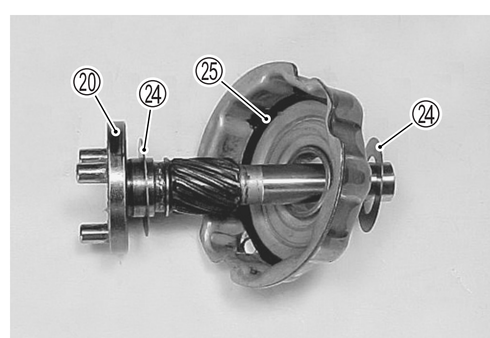
Wear safety glasses when disassembling and assembling stopper ring.

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

13. Remove the E-ring ㉓.



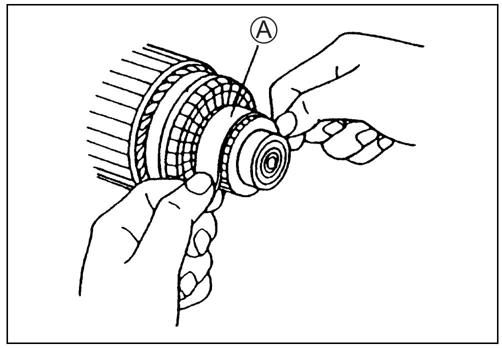
14. Remove the pinion shaft ⑳, washers ㉔ and rubber ring ㉕ from center bracket.



INSPECTION AND SERVICING

Armature and Commutator

- Inspect the commutator surface.
  If surface is gummy or dirty, clean with #500 grit emery paper Ⓐ.

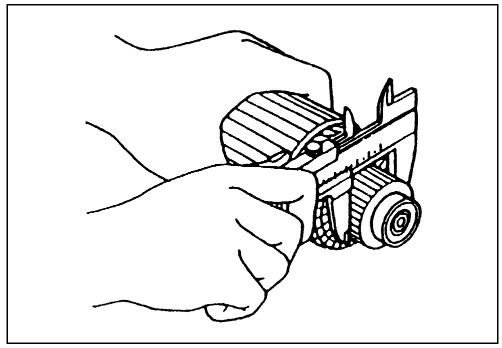


- Measure commutator outside diameter.

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.

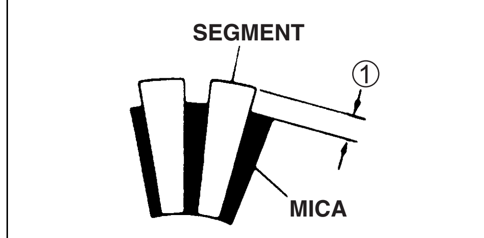


- Check that mica (insulator) between the segments is undercut to specified depth.

Commutator undercut ①:
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 to specified depth.

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



① undercut

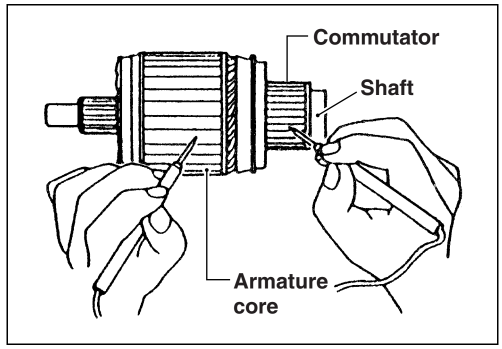
⚠ WARNING

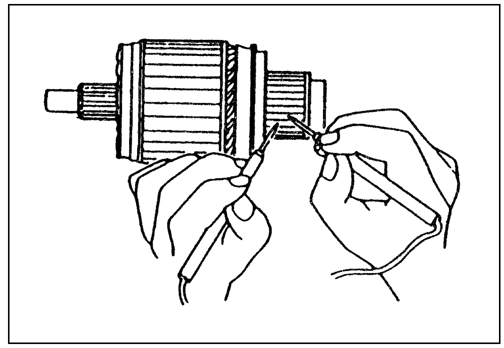
Wear safety glasses when using compressed air.

- 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)**

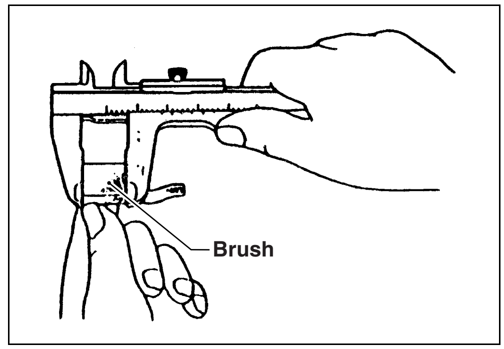




- Check for continuity between adjacent commutator segments. Replace armature if no continuity is indicated.

09930-99320: Digital tester

Tester range: (Continuity)

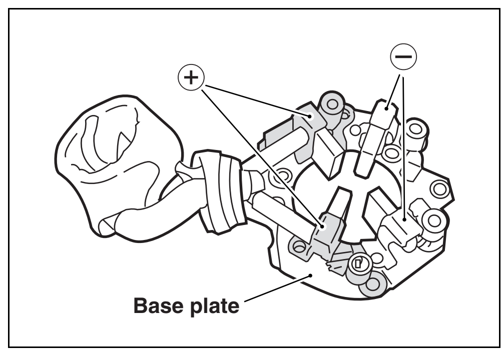


BRUSHES
Check the length of each brush.

09900-20101: Vernier calipers

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

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



BRUSH HOLDER
- Check brush holder continuity.

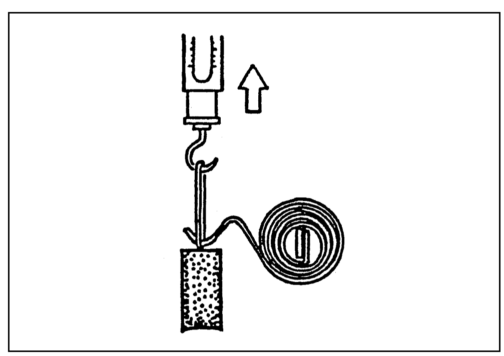
09930-99320: Digital tester

Tester range: (Continuity)

Brush holder continuity:

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

Replace brush holder if the tester doesn't show the above.

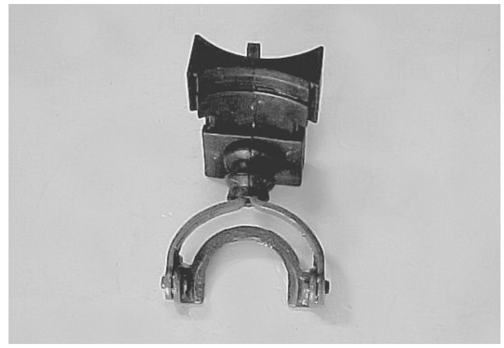


BRUSH SPRING
Inspect brush spring for wear, damage or other abnormal conditions.
Check the brush spring tension.
Replace if necessary.

Brush spring tension
Standard: 15 – 18 N (1.5 – 1.8 kg, 3.3 – 4.0 lbs)

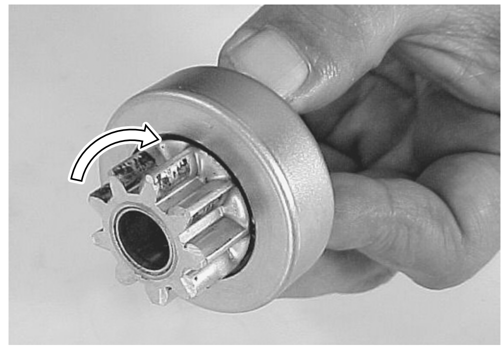
SHIFT LEVER

Inspect shift lever for wear.
Replace if necessary.

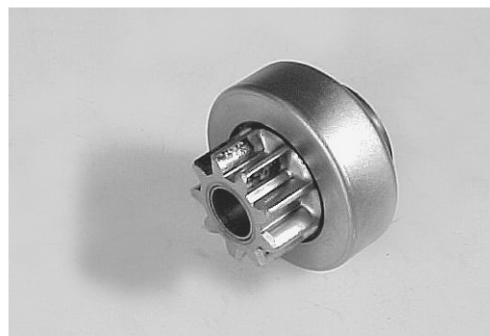


PINION AND OVER-RUNNING CLUTCH

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

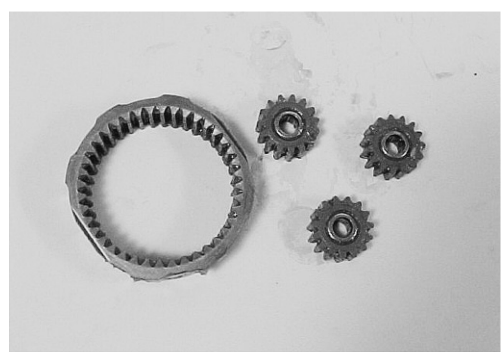


- Inspect spline teeth for wear or other damage.
  Inspect pinion for smooth movement.
  Replace if necessary.



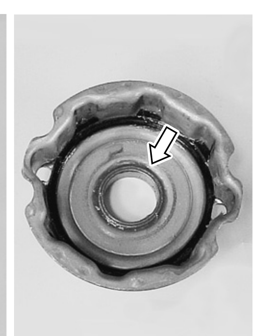
GEAR

- Inspect planetary gears and internal gear for wear, damage or other abnormal conditions.
  Replace if necessary.



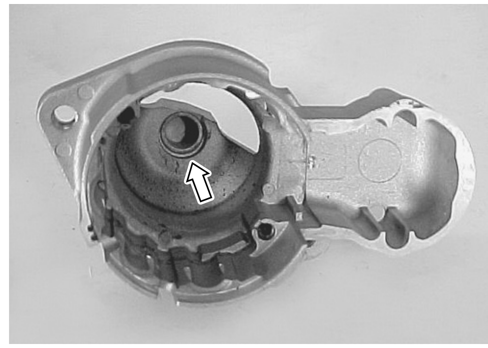
PINION SHAFT/PINION SHAFT BUSH

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



FRONT HOUSING

- Inspect front housing for wear, damage or other abnormal conditions. Replace if necessary.
- Inspect bush for wear or other damage.
  Replace if necessary.

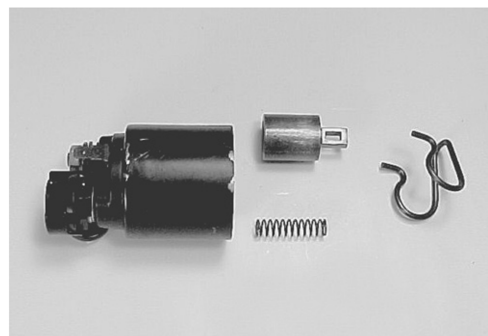


ARMATURE SHAFT BUSH

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

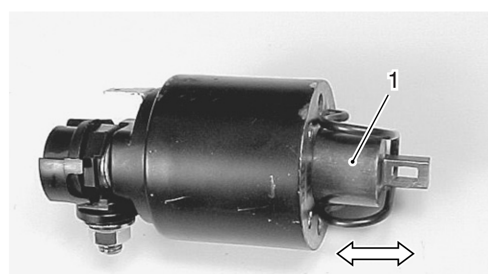
PLUNGER

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



MAGNETIC SWITCH

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



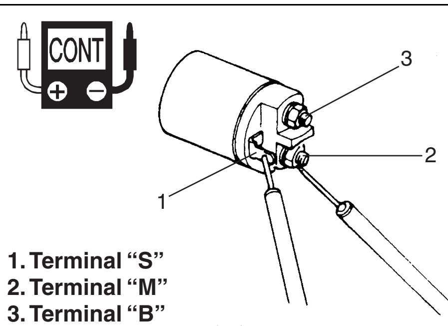
1. Plunger

Pull-in coil Open circuit Test

TOOL 09930-99320: Digital tester

CONT Tester range: (Continuity)

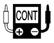
Check for continuity across magnetic switch “S” terminal and “M” terminal.
If no continuity exists, the coil is open and should be replaced.



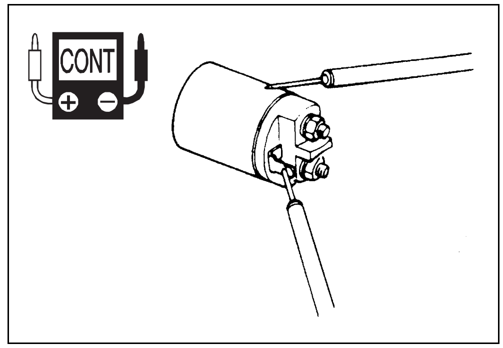
1. Terminal “S”
2. Terminal “M”
3. Terminal “B”

Hold-in coil Open circuit Test

 **09930-99320: Digital tester**

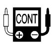
 **Tester range: (Continuity)**

Check for continuity across magnetic switch "S" terminal and coil case.
If no continuity exists, the coil is open and should be replaced.

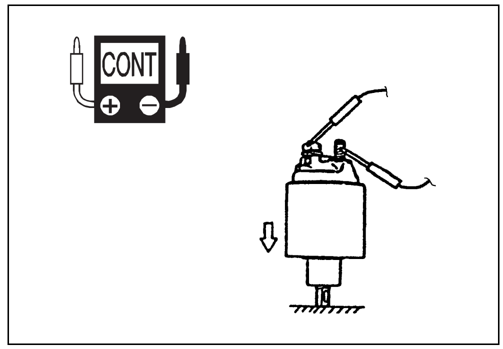


Contact points Test

 **09930-99320: Digital tester**

 **Tester range: (Continuity)**

Put the plunger on the under side and then push the magnetic switch down. At this time, check for continuity between terminal "B" and terminal "M".
Continuity indicates proper condition. If no continuity exists, replace the magnetic switch and/or plunger.

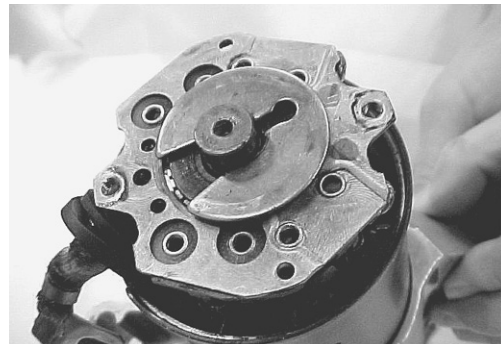


ASSEMBLY

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

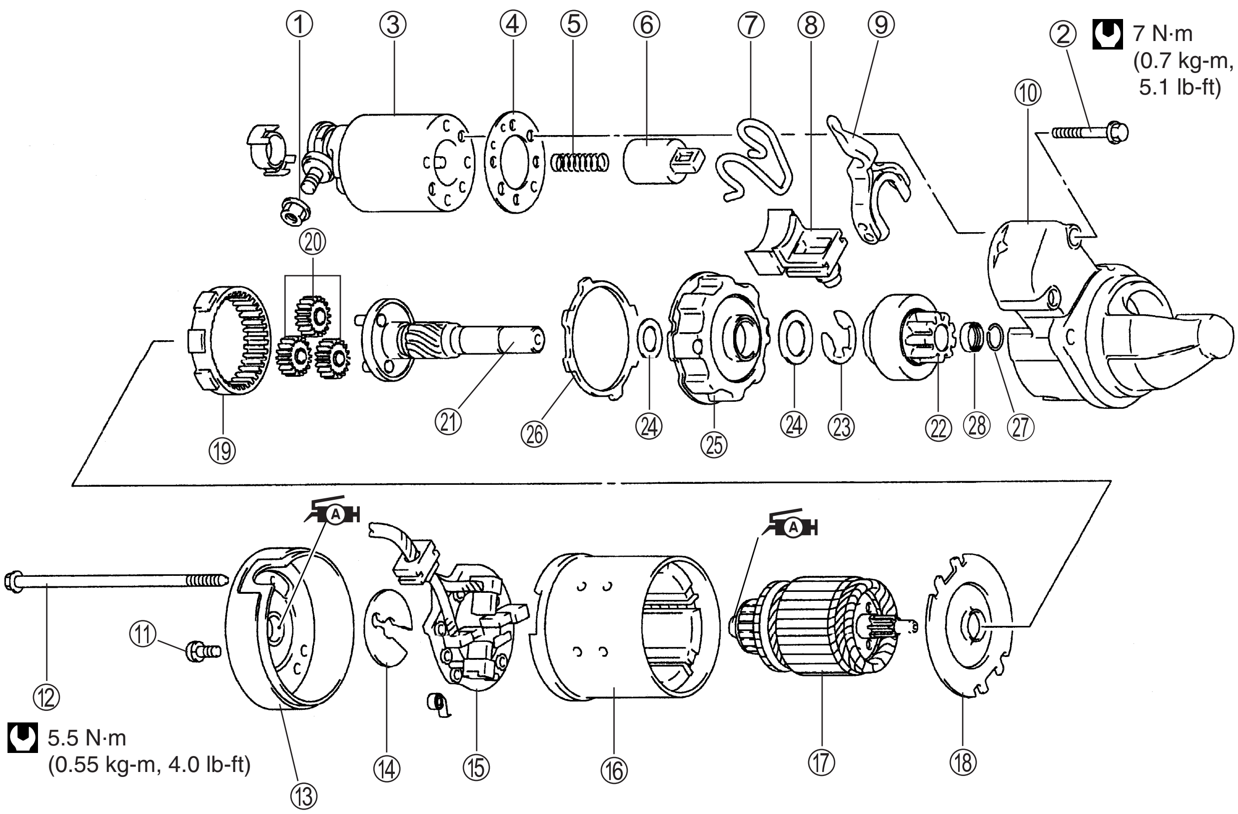
CAUTION

When installing armature, use care to avoid breaking brushes.



When installing pinion shift lever, refer to figure in construction diagram for 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**
㉗ **Stopper ring**
㉘ **Pinion stopper**

PERFORMANCE TEST

CAUTION

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

⚠ WARNING

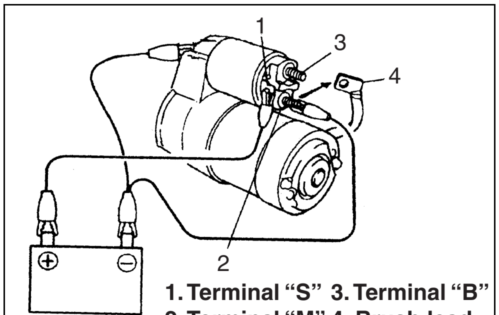
When performing the following test, be sure to connect the battery and the starting motor with a lead wire of the same size as original equipment used there.

PULL-IN/HOLD-IN TEST

Connect battery to magnetic switch as shown in figure.

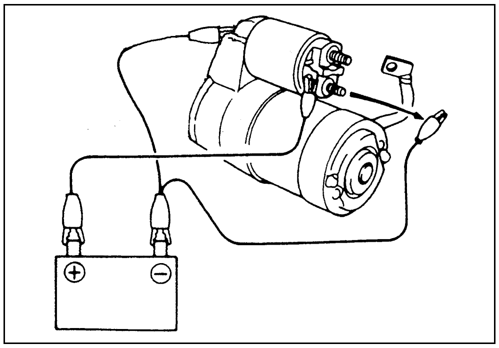
- Check that plunger and pinion (over-running clutch) move outward.
  If plunger and pinion don't move, replace magnetic switch.

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



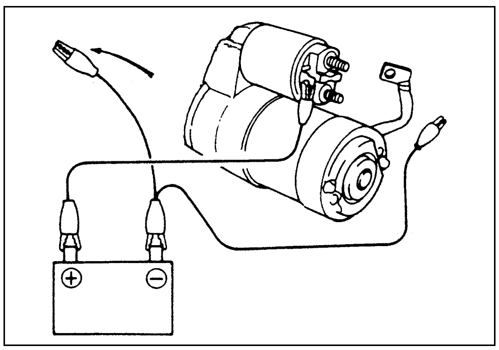
1. Terminal "S" 3. Terminal "B"
2. Terminal "M" 4. Brush lead

- While connected as above with plunger out, disconnect negative 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.



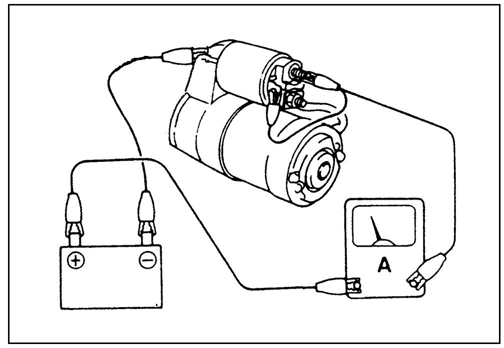
NO-LOAD PERFORMANCE TEST

CAUTION

Before performing following test, secure the starter motor to the 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

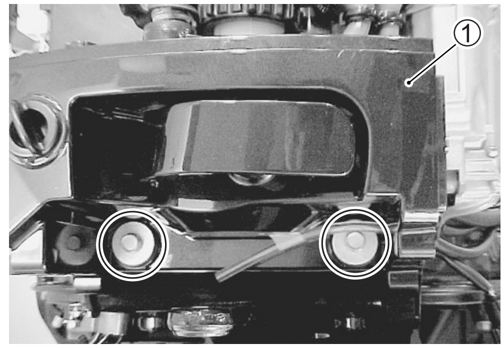


ELECTRIC PARTS HOLDER

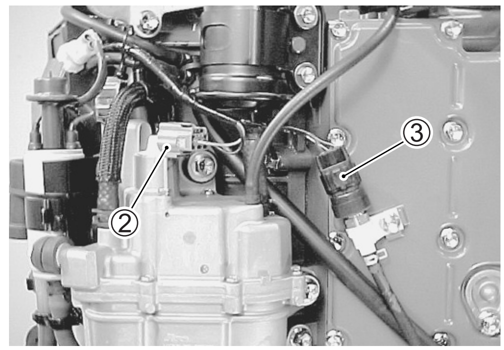
REMOVAL

Before removing electric parts holder:
- **Disconnect battery cables from battery.**

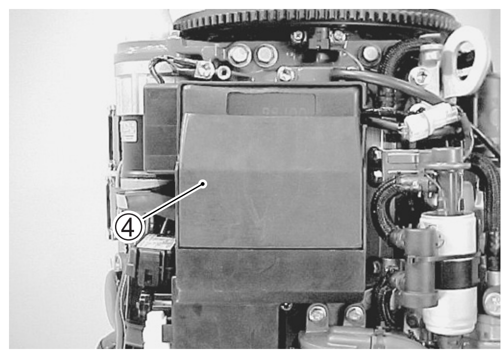
1. Remove engine side cover. (See page 7-2.)
2. Remove bolts and front panel ①.



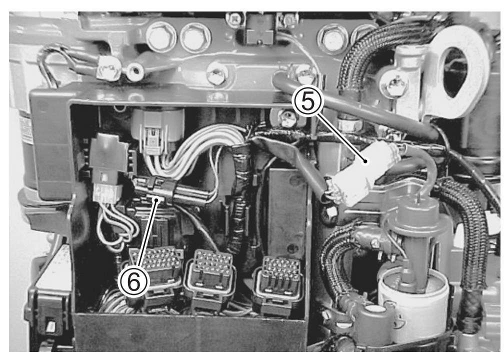
3. Disconnect high pressure fuel pump lead wire connector ② at fuel pump.
   Disconnect speed sensor lead wire connector ③ at sensor.



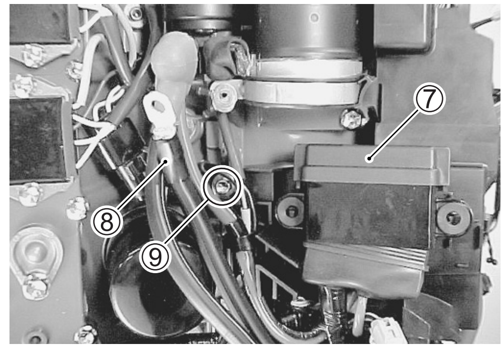
4. Disconnect lead wire connectors from ECM ④, then remove ECM.



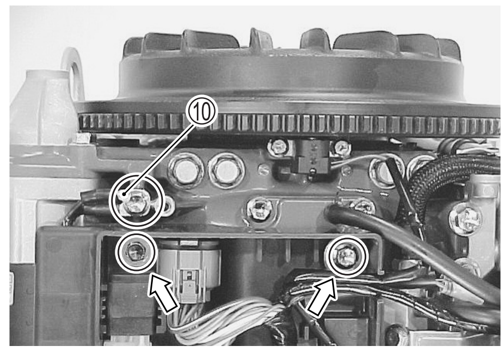
5. Disconnect low pressure fuel pump lead wire connector ⑤.
   Disconnect CKP sensor lead wire connector ⑥.

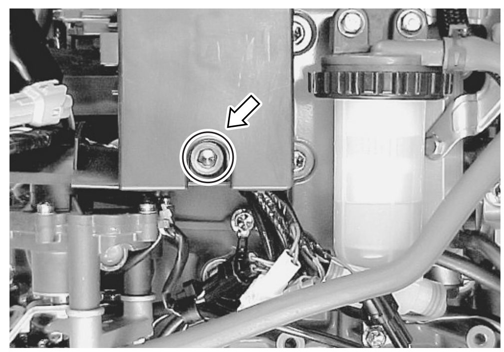


6. Pull and remove fuse box ⑦ from electric parts holder.
   Remove the bolt and negative ⊖ battery cable ⑧.
   Remove the bolt ⑨ securing electric parts holder.

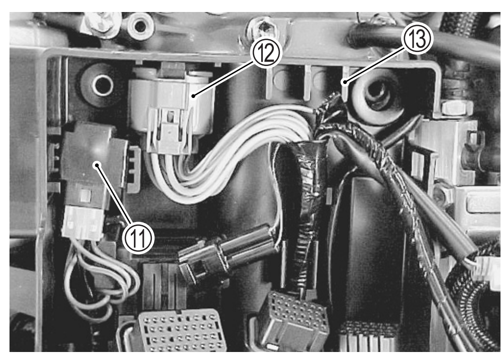


7. Remove the three (3) bolts securing electric parts holder.
   Remove the bolt securing GND lead wire ⑩.

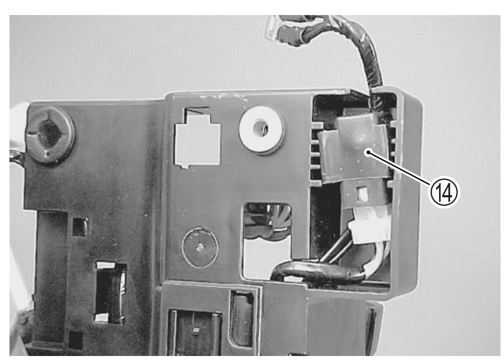




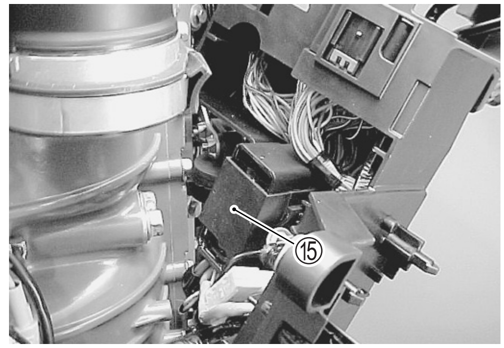
8. Remove shift actuator relay ⑪ and joint connectors ⑫ from electric parts holder.
   Remove electric parts holder ⑬ from crankcase.



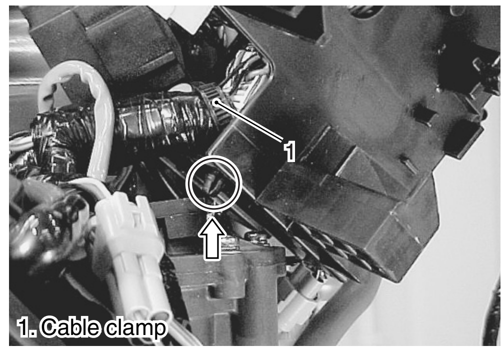
9. Remove throttle actuator relay ⑭ from electric parts holder.
   Disconnect throttle actuator relay from lead wire.



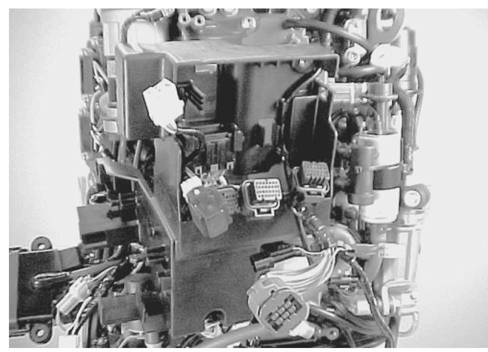
10. Remove PTT relay ⑮ from electric parts holder.



11. Remove cable clamp from electric parts holder by releasing clamp's lock.



12. To remove the electric parts holder, pull each lead wire out of electric parts holder.



INSTALLATION

Installation is reverse order of removal.

Final check:

- All parts removed have been returned to their original position.
- Check wire routing. (See page 11-14 to 11-19.)

FUEL SYSTEM

CONTENTS

PRECAUTIONS WHEN SERVICING FUEL SYSTEM

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.**

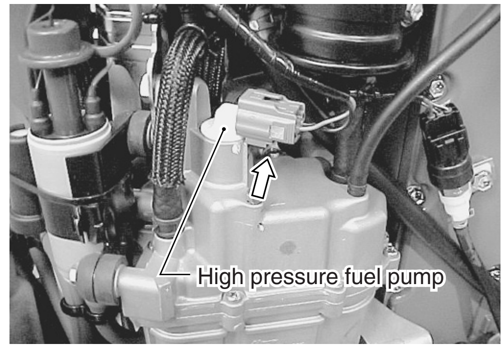
⚠ WARNING

Fuel components and fuel hoses 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.

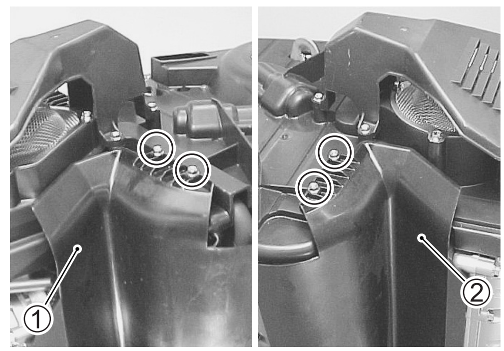
FUEL PRESSURE RELIEF PROCEDURE

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

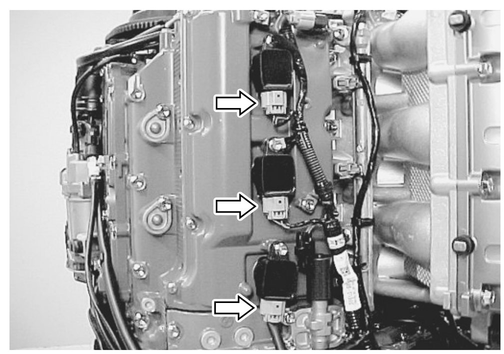
1. Turn OFF main switch.
2. Disconnect high pressure fuel pump lead wire connector at high pressure fuel pump.



3. Remove bolts and STBD/PORT air duct guard ①·②.



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



6. Make sure fuel pressure has been removed by pinching high pressure fuel hose between finger tips (line should feel soft without pressure).
7. Upon completion of servicing, connect ignition coil primary lead wire and high pressure fuel pump lead wire.
8. Install STBD/PORT air duct guard, then securely tighten it with bolts.

FUEL LINE

REMOVAL/INSTALLATION

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

⚠ WARNING

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

CAUTION

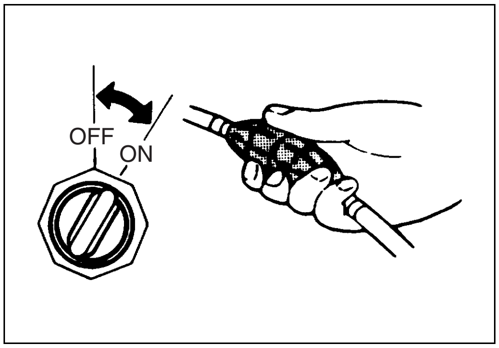
- **Do not over bend (kink) or twist hoses when installing.**
- **When installing hose clamps, position tabs to avoid contact with other parts.**
- **Be sure hoses do not contact rods, levers or other components with engine either operating or at rest.**
- **Extreme care should be taken not to cut, abrade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

NOTE:
- *Check fuel hose routing. (See page 11-20 and 11-23.)*
- *Check for fuel leakage.*

FUEL LEAKAGE CHECK PROCEDURE

After performing any fuel system service, always be sure there is no fuel leakage by checking as follows.

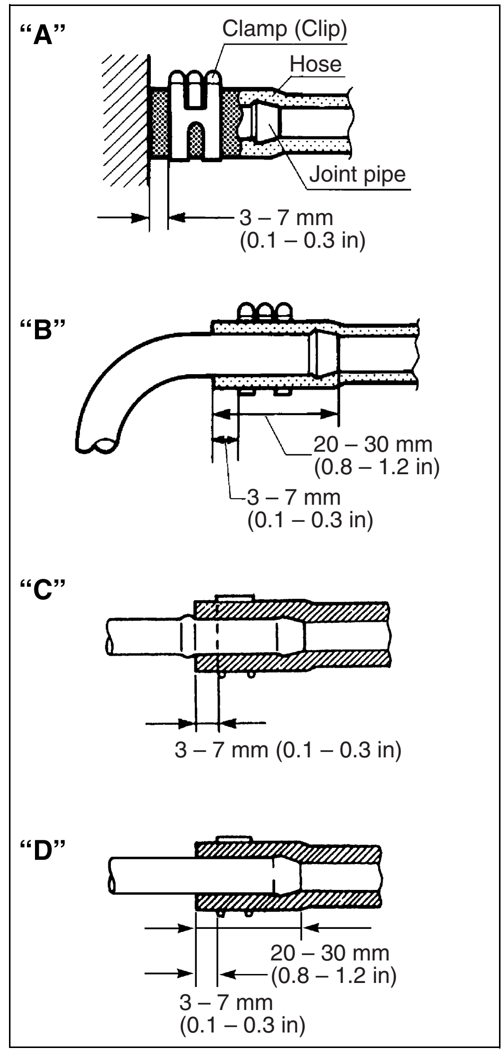
1. Squeeze fuel primer bulb until you feel resistance.
   Shift into "NEUTRAL" position.
2. Ensure emergency stop switch lock plate is in place.
3. Turn main switch "ON" for 6 seconds (to operate fuel pump), then turn it "OFF".
   Repeat this (ON and OFF) procedure 3 or 4 times to pressurize the fuel system.
4. Once pressurized, check all connections and components for any signs of leakage.



FUEL HOSE CONNECTION

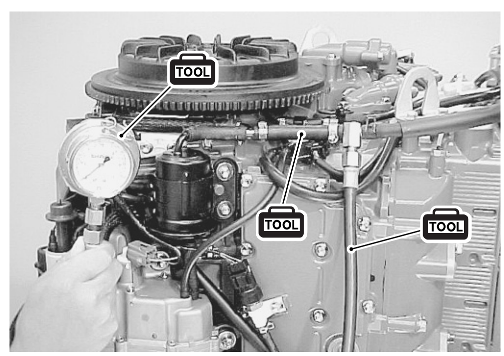
Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly by referring to the figure.

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



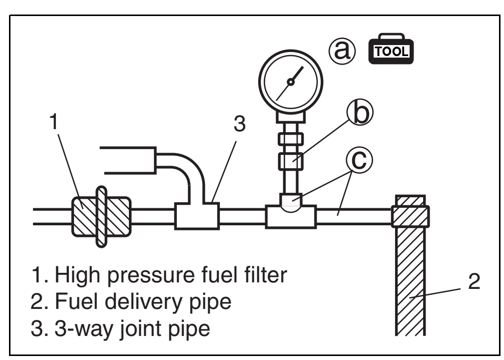
FUEL PRESSURE INSPECTION

1. Relieve fuel pressure in fuel feed line. (See page 5-3.)
2. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
3. Disconnect high pressure fuel feed hose from 3-way joint pipe.



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

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

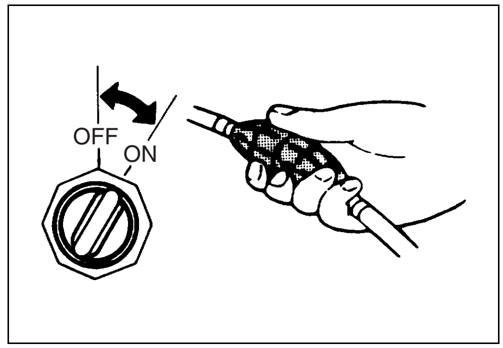


1. High pressure fuel filter
2. Fuel delivery pipe
3. 3-way joint pipe

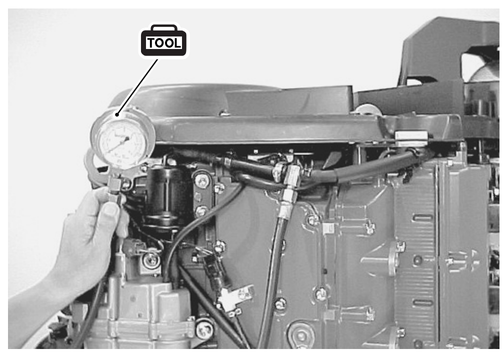
CAUTION

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

5. Ensure emergency stop switch lock plate is in place.
   Shift into “NEUTRAL” position.



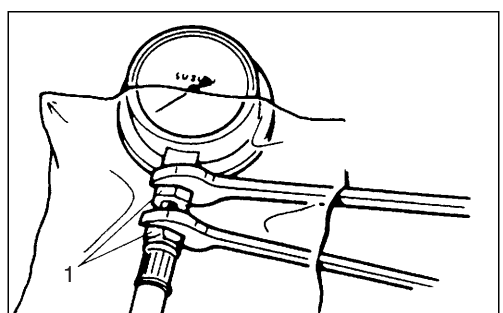
6. Squeeze fuel primer bulb until you feel resistance.
7. Turn main switch “ON” for 6 seconds (to operate fuel pump), then turn it “OFF”.
8. Repeat this (“ON” and “OFF”) procedure 3 or 4 times to pressurize the fuel system and then check fuel pressure.
9. Check for any signs of fuel leakage, then reinstall the ring gear cover and air intake silencer case.
10. Measure fuel pressure in line at cranking or idle speed operation.



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

11. Stop engine and wait 5 minutes.
    Check residual fuel pressure in line.

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



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.**

12. After checking fuel pressure, remove fuel pressure gauge.
13. Reconnect fuel line.
14. With engine not running and main switch “ON”, check fuel system for leaks .
15. Reinstall the ring gear cover and air intake silencer case.

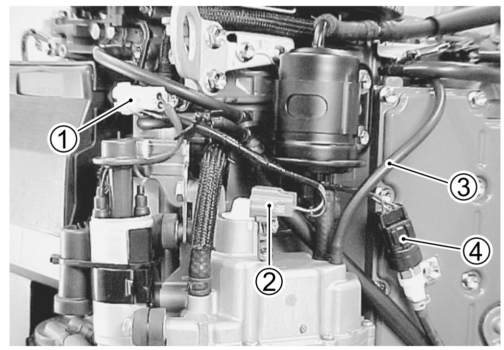
LOW PRESSURE FUEL PUMP/FUEL VAPOR SEPARATOR SET

REMOVAL

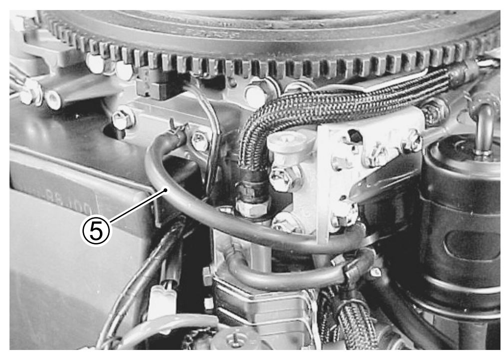
⚠ WARNING

> **Fuel components and fuel hoses 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. Relieve fuel pressure in fuel feed line. (See page 5-3.)
2. Remove engine side cover. (See page 7-2.)
3. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
4. Disconnect low pressure fuel pump lead wire connector ①.
   Disconnect high pressure fuel pump lead wire connector ② at fuel pump.
5. Disconnect purge valve hose ③ from fuel vapor separator.
   Disconnect speed sensor lead wire connector at sensor ④.



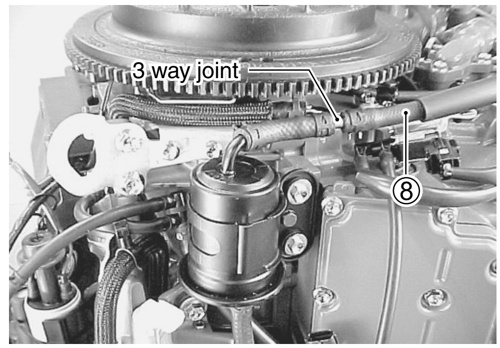
6. Disconnect water outlet hose ⑤ from crankcase water jacket cover.



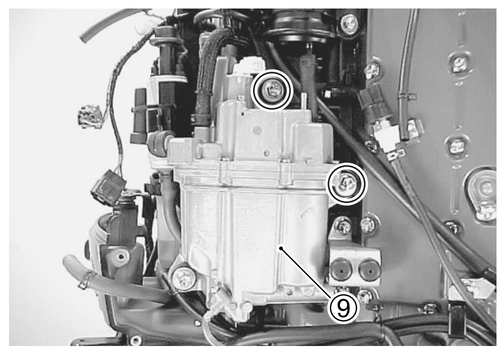
7. Disconnect fuel inlet hose ⑥ from low pressure fuel filter.

8. Disconnect water inlet hose ⑦ from fuel cooler.

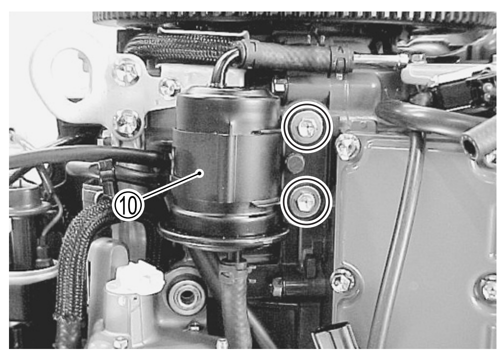
9. Disconnect high pressure fuel feed hose ⑧ from 3-way joint pipe.



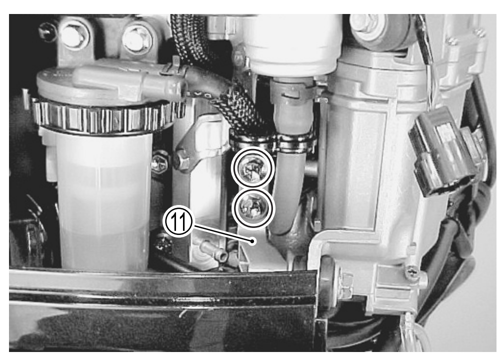
10. Remove the two (2) bolts securing fuel vapor separator ⑨ to crankcase.



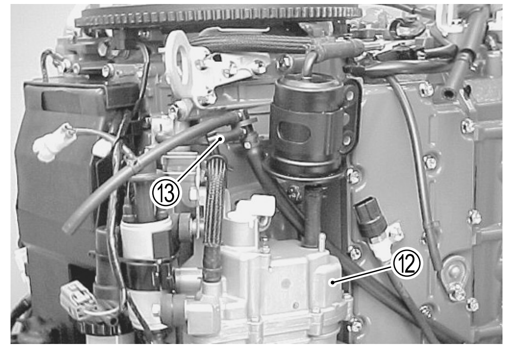
11. Remove the two (2) bolts securing high pressure fuel filter ⑩ to crankcase.



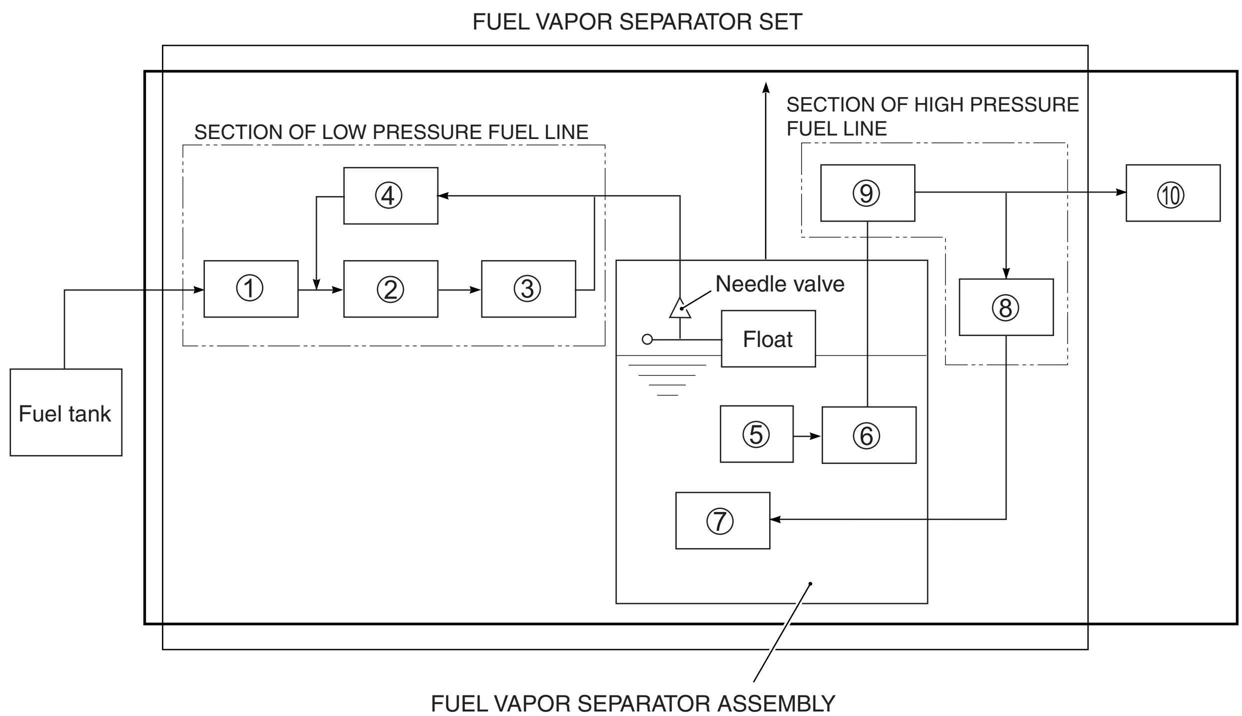
12. Remove the two (2) bolts securing fuel vapor separator bracket ⑪.



13. Remove the low pressure fuel pump/fuel vapor separator set ⑫, then disconnect cooling water outlet hose ⑬ from fuel cooler.



FUEL SYSTEM DIAGRAM

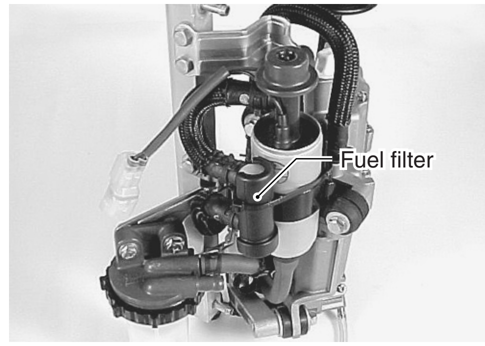


① Low pressure fuel filter
② Low pressure fuel pump
③ Fuel filter
④ Relief valve
⑤ Fuel filter
⑥ High pressure fuel pump
⑦ Pressure regulator
⑧ Fuel cooler
⑨ High pressure fuel filter
⑩ Fuel delivery pipe

INSPECTION

FUEL FILTER

- Remove the fuel filter.
- Inspect filter for clog or other damage.
  Replace or clean if necessary.
- Reinstall fuel filter, then secure the hose with hose clamp (clip).

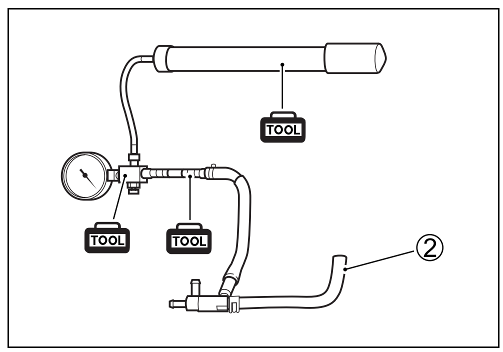


RELIEF VALVE

Check the relief valve operation.

TOOL **09952-99310 : Hand air pump**
09940-44121 : Air pressure gauge
09940-44130 : Attachment

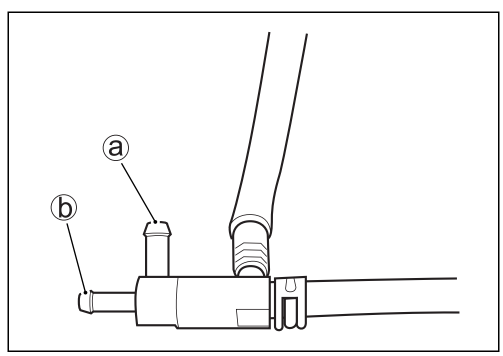
1. Remove the relief valve ①.
2. Connect special tool to inlet side of relief valve as shown in figure.
3. Plug the outlet hose ②.



4. Pump air into the relief valve using hand air pump until air is released through fitting ⓐ·ⓑ.
5. Read pressure on gauge when air is released.

   Relief valve operating pressure:
   70 – 80 kPa (0.7 – 0.8 kg/cm^2, 10.0 – 11.4 psi)

   If out of specification, replace relief valve.
6. Reinstall relief valve, then secure the hose with hose clamp (clip).



INSTALLATION

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

Final Check

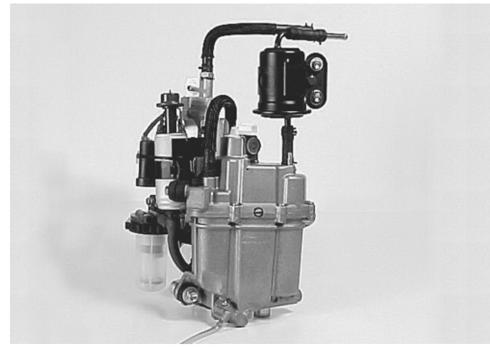
- Check to ensure that all removed parts are back in place.
- Check fuel and water hose routing.
  (See page 11-20 to 11-26.)
- Check wire routing. (See page 11-14 to 11-19.)
- Check for fuel leakage. (See page 5-4.)
- Check for water leakage.

FUEL VAPOR SEPARATOR/HIGH PRESSURE FUEL PUMP

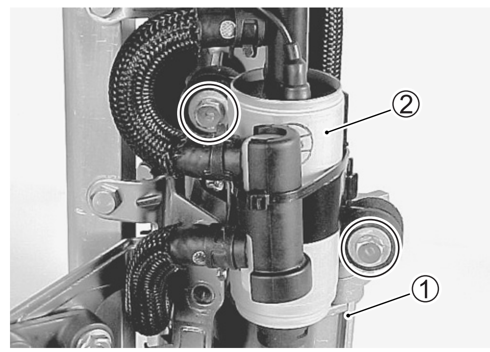
REMOVAL AND DISASSEMBLY

⚠ WARNING

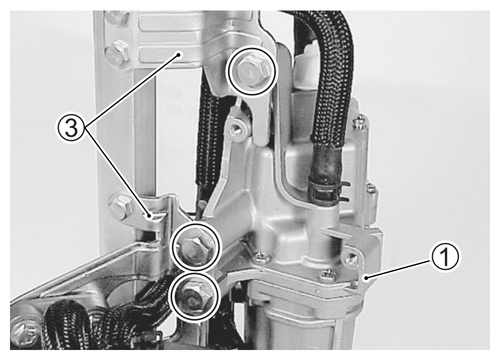
Fuel components and fuel hoses after the high pressure fuel pump remain pressurized at all times.
To protect against fuel spray, relieve fuel line pressure before disconnecting or removing components.



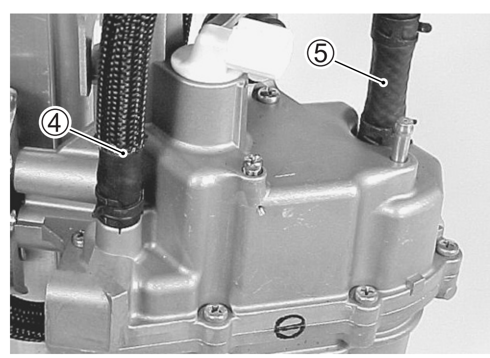
1. Remove the low pressure fuel pump/fuel vapor separator set. (See page 5-7.)



2. Remove the two (2) bolts securing low pressure fuel pump ② to fuel vapor separator ①.

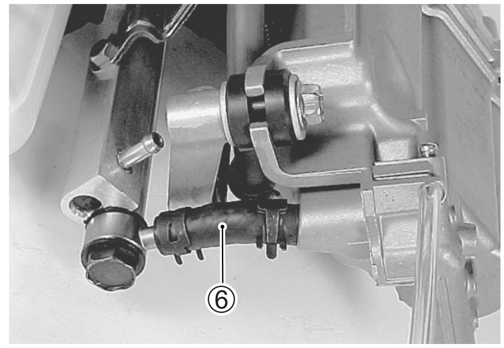


3. Remove the three (3) bolts securing fuel cooler bracket ③ to fuel vapor separator ①.

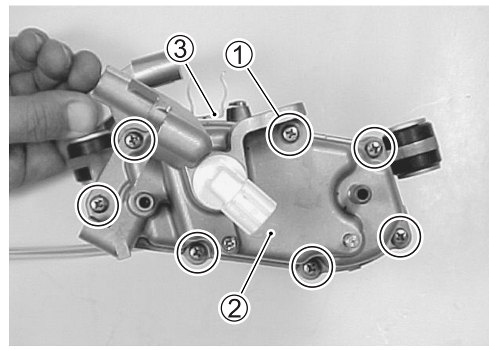


4. Disconnect fuel inlet hose ④ and fuel outlet hose ⑤ from fuel vapor separator.

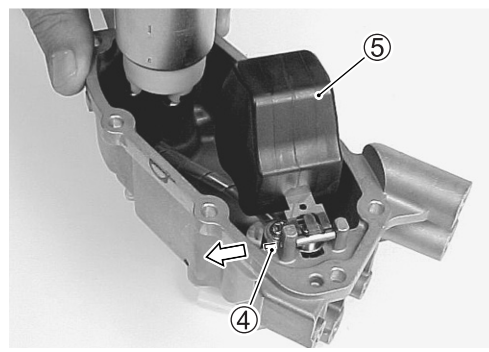
5. Disconnect fuel return hose ⑥ from fuel vapor separator.



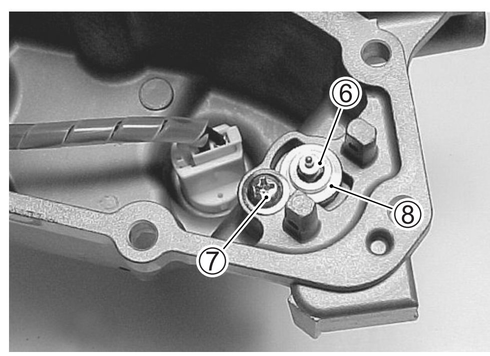
6. Remove seven (7) screws ①.
   Remove separator cover ② with high pressure fuel pump from separator case ③.



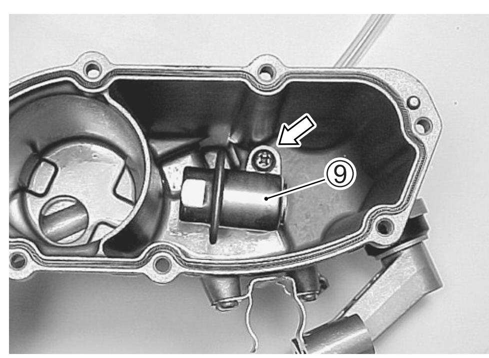
7. Remove float pin ④ and float ⑤.



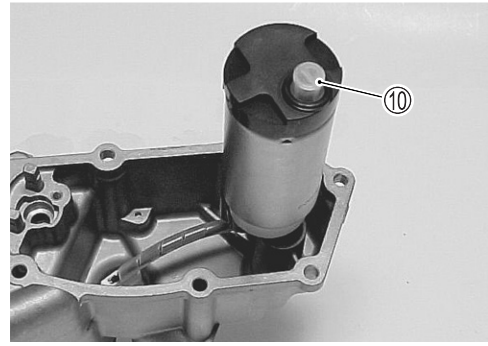
8. Remove needle valve ⑥, screw ⑦ and valve seat ⑧.



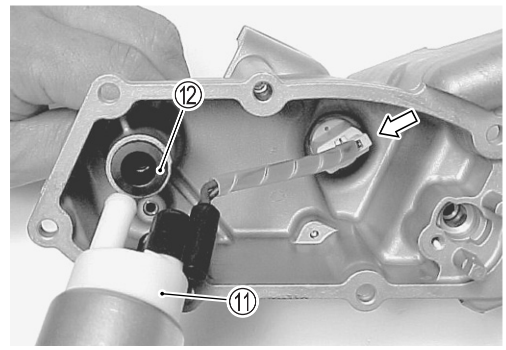
9. Remove screw and fuel pressure regulator ⑨ from separator case.



10. Remove suction filter ⑩.



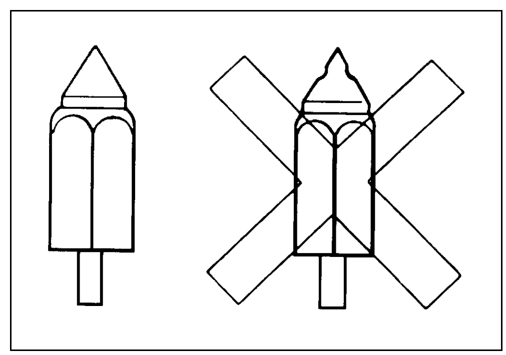
11. Remove high pressure fuel pump ⑪ and grommet ⑫ from separator cover and then disconnect pump lead wire connector.



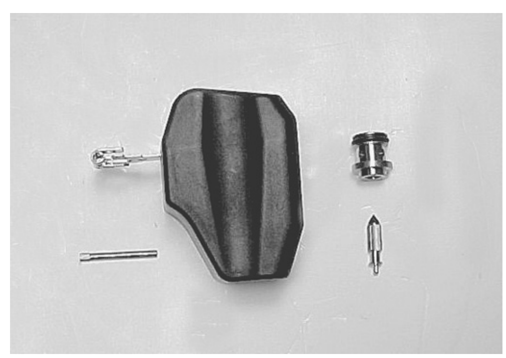
INSPECTION

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

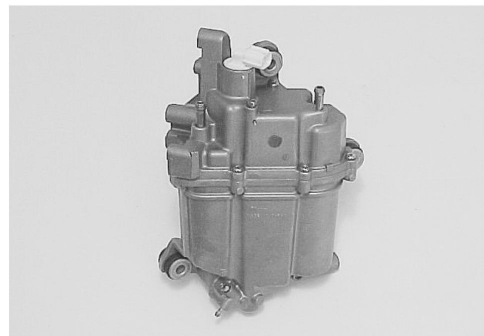
Needle valve/Valve seat
Inspect needle valve and valve seat for groove, other damage or dirt.
Replace or clean if necessary.



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

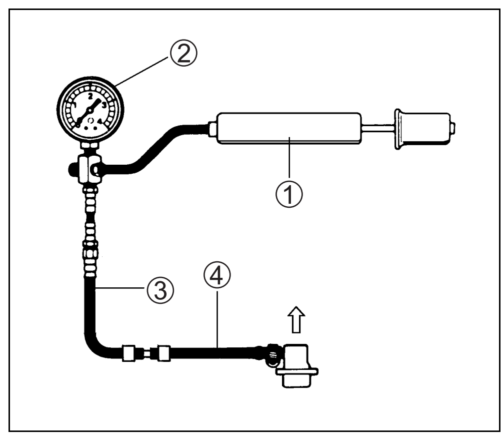


Filter
Inspect pump suction filter for clog or other damage.
Replace or clean if necessary.



Separator cover and case
Inspect separator cover and case.
Replace if cracked, damaged or other abnormal condition.

NOTE:
Separator cover and case are a set.
If any repair is required on cover and case, replace them as a fuel vapor separator assembly.



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

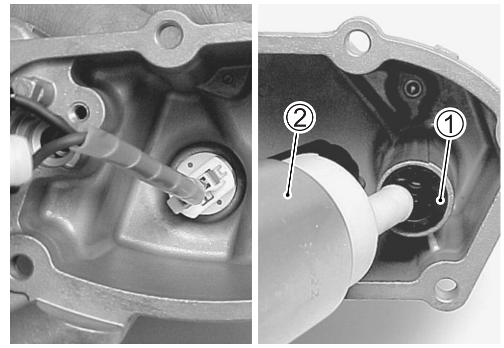
1. Connect special tools to inlet side of regulator as shown in figure.
2. Pump air into regulator using pump ① until air is released through outlet side.
3. Read pressure on gauge when air is released.

   Regulator operating pressure:
   240 – 270 kPa (2.4 – 2.7 kg/cm^2, 34.1 – 38.4 psi)

   If out of specification, replace regulator.

ASSEMBLY

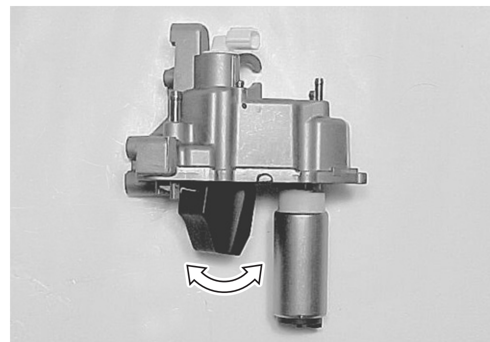
Assembly is reverse order of disassembly with special attention to the following steps.



High pressure fuel pump

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

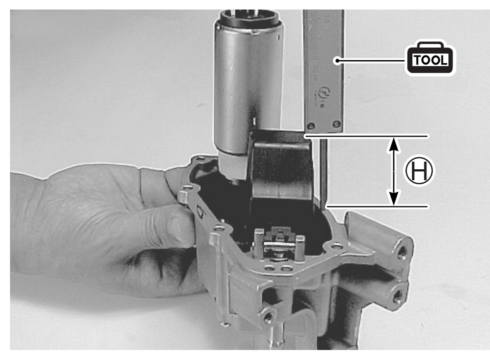
NOTE:
Apply fuel to grommet before installing.



Float/Float pin

Install float and float pin.

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



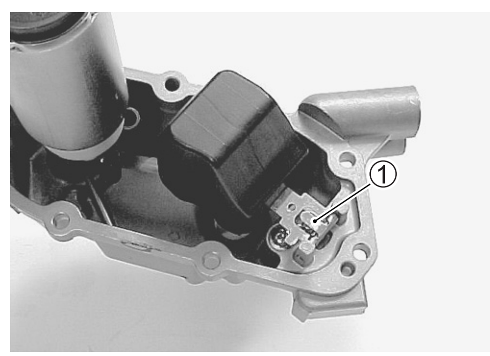
Checking float height

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.

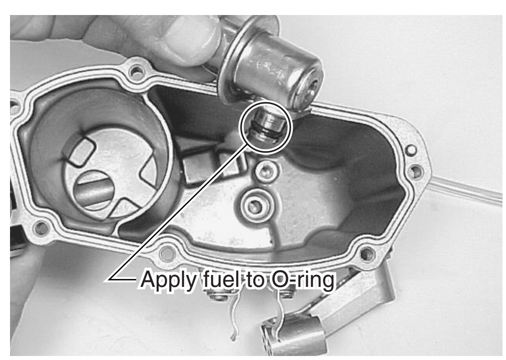


Setting float height

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.



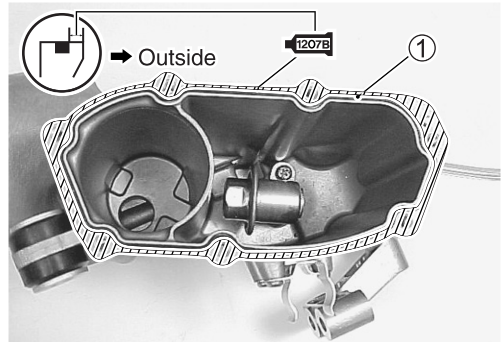
Fuel pressure regulator

Install fuel pressure regulator and tighten screw securely.

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

Separator cover/Separator case

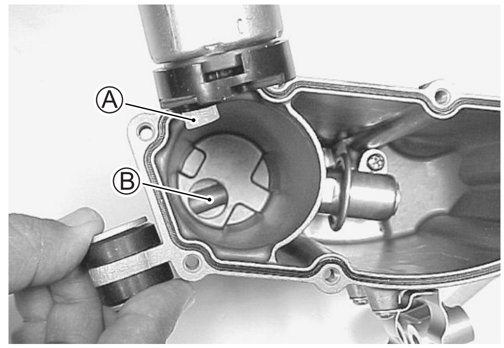
1. Install seal ring ①, then apply SUZUKI BOND evenly to only the outside mating surface of separator case as shown in figure.



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.

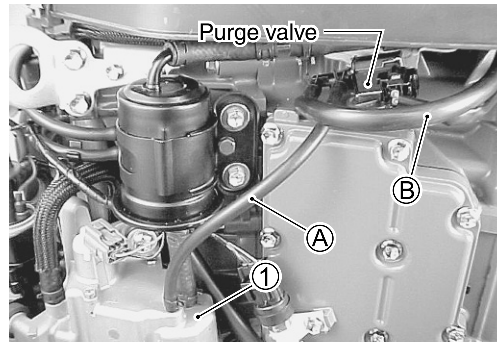
Final check

- Check to ensure that all removed part are back in place.
- Check fuel and water hose routing.
  (See page 11-20 to 11-26.)
- Check for fuel leakage. (See page 5-4.)

EVAPORATION PURGE SYSTEM

SYSTEM INSPECTION

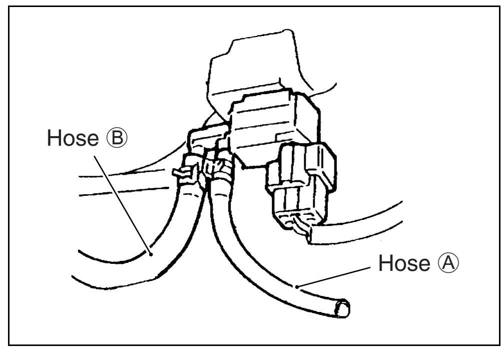
1. Warm up engine to normal operating temperature.
2. Disconnect purge hose Ⓐ from fuel vapor separator ①.



⚠ WARNING

Do not suck air through valve.
Fuel vapor inside valve is harmful.

3. Blow into hose Ⓐ, air should come out of hose Ⓑ.
4. Stop engine, blow into hose Ⓐ.
   Air should not come out of hose Ⓑ.
5. If check results are not satisfactory, check vacuum passage, hose, purge valve, wire harness and ECM. (See page 3-59.)



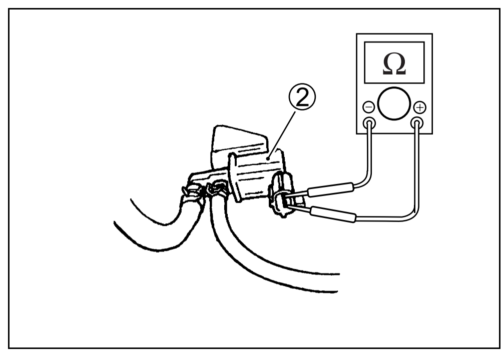
PURGE VALVE

INSPECTION

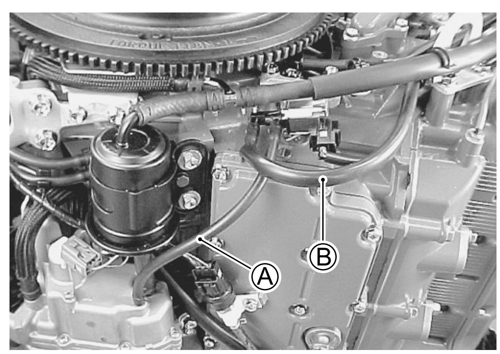
1. With main switch OFF, disconnect connector from purge valve ②.
2. Check resistance between two terminals of purge valve.

   Resistance of purge valve: 28 – 35 Ω at 20 °C

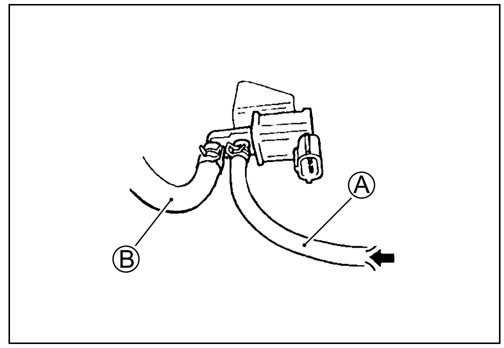
   If resistance is as specified, proceed to next operation check.



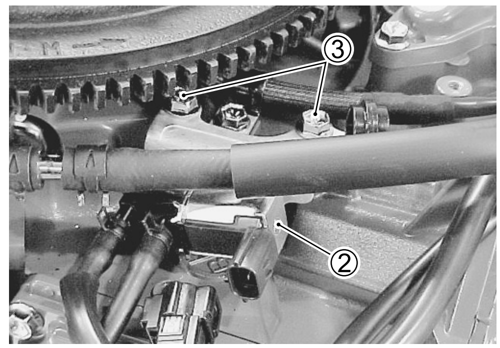
3. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
   Disconnect purge hose Ⓐ from fuel vapor separator.



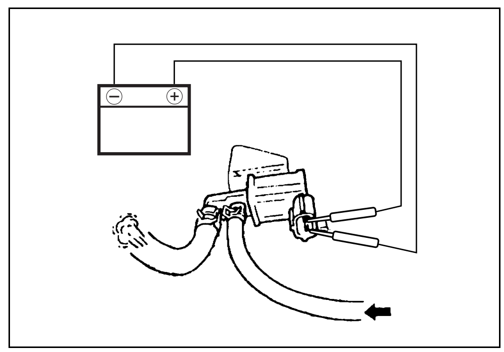
4. With connector disconnected, blow into hose Ⓐ. Air should not come out of hose Ⓑ.



5. Remove two (2) bolts ③, purge valve ② and purge valve bracket.



6. Connect 12-V battery to purge valve terminals. With voltage applied, blow into hose Ⓐ.
   Air should come out of hose Ⓑ.
   If check result is not as described, replace purge valve.

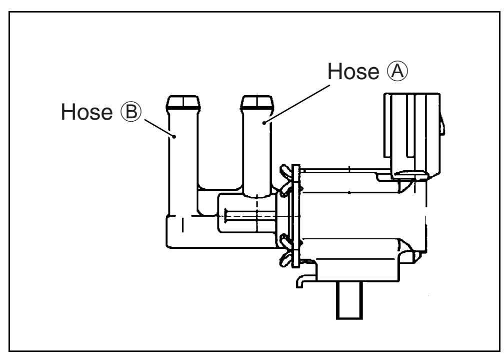


⚠ WARNING

Do not suck air through valve.
Fuel vapor inside valve is harmful.

7. Install purge valve and purge valve bracket, then connect purge hose.
   Install the ring gear cover and air intake silencer case.

   Hose Ⓐ: Vapor separator to purge valve.
   Hose Ⓑ: Purge valve to air intake silencer case.

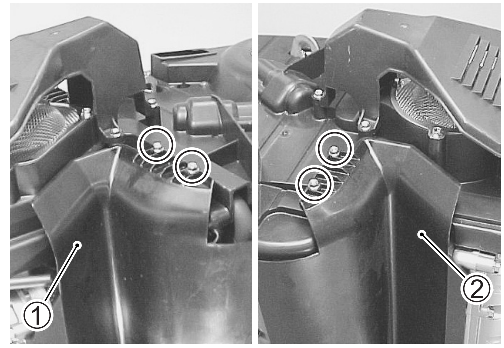


8. Connect purge valve connector securely.

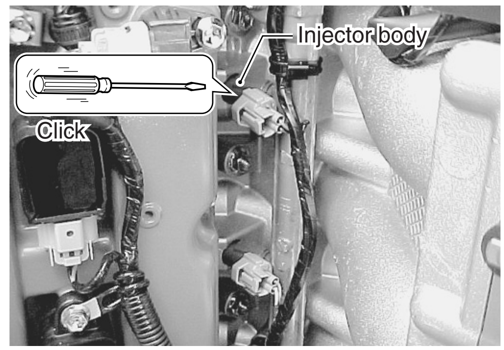
FUEL INJECTOR

INSPECTION

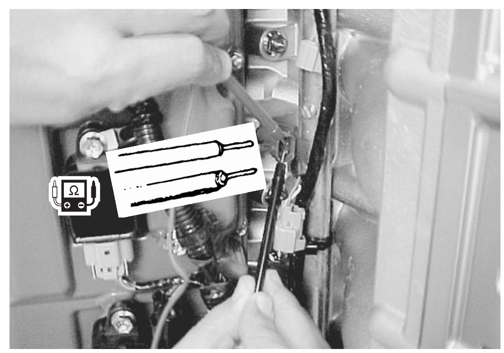
1. Remove the bolts and STBD/PORT air duct guard ①·②.



2. Using sound scope or equivalent, 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.



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



TOOL **09930-99320: Digital tester**

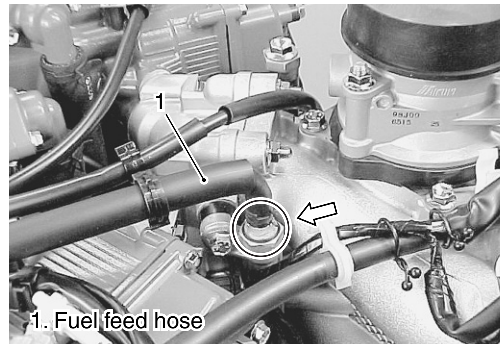
Tester range: Ω (Resistance)
Fuel injector resistance: 10.0 – 14.0 Ω

If out of specification, replace fuel injector.

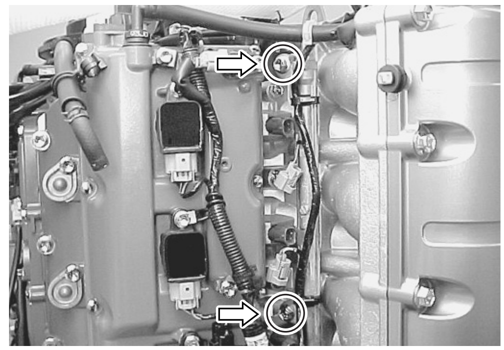
5. Connect lead wire connector to fuel injector securely.

REMOVAL

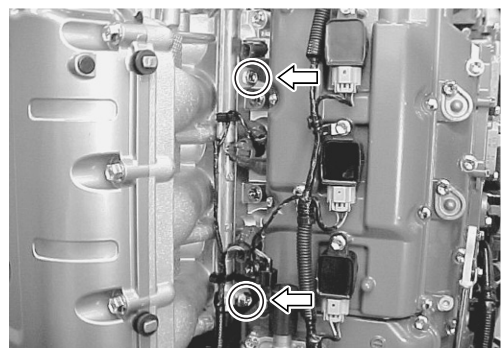
1. Relieve fuel pressure according to procedure described on page 5-3.
2. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
3. Loosen clamp and place a large cloth over end of fuel feed hose.
   Slowly pull fuel feed hose from PORT side fuel delivery pipe.
   Drain any excess fuel in hose into a small container.



4. Disconnect six (6) fuel injector connectors.
5. For PORT side bank:
   Remove the two cable ties binding lead wire to fuel delivery pipe.
   Loosen the two (2) bolts securing fuel delivery pipe.

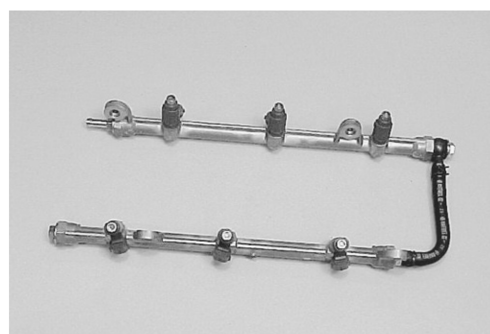


6. For STBD side bank:
   Remove the two cable ties binding lead wire to fuel delivery pipe.
   Loosen the two (2) bolts securing fuel delivery pipe.
7. Remove PORT/STBD fuel delivery pipes (with fuel injectors), delivery pipe bolts and collars.



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.



8. Remove each injector from delivery pipe.

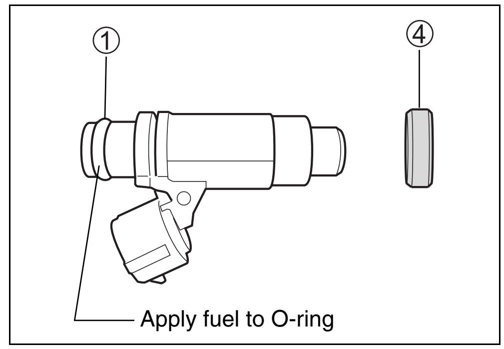
INSTALLATION

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

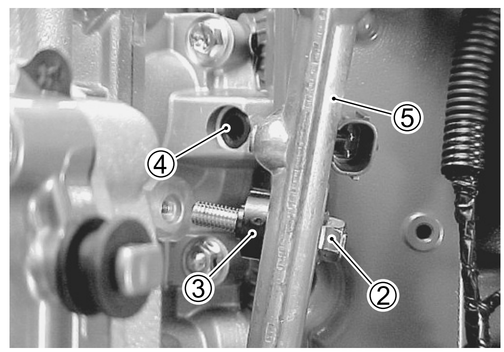
CAUTION

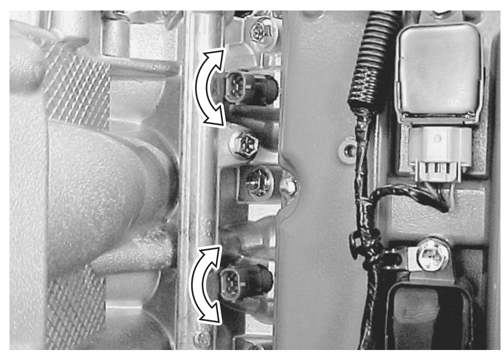
Do not reuse O-ring and cushion once removed. Always use new parts.

1. Replace injector O-ring ① with new one using care not to damage it.
2. Place delivery pipe bolts ② and four (4) insulators (collars) ③ in position.



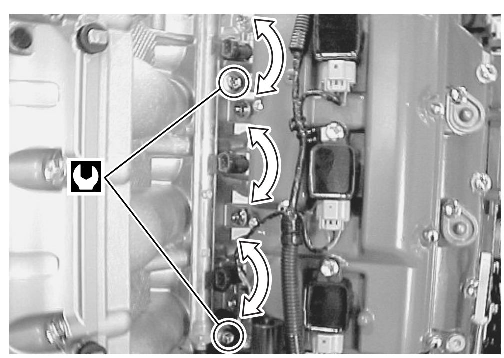
3. Replace injector cushion ④ with new one and install it to intake manifold.
4. Apply thin coat of fuel to injector O-rings, then install injectors into delivery pipes ⑤ and intake manifold.
   Make sure that injectors rotate smoothly.



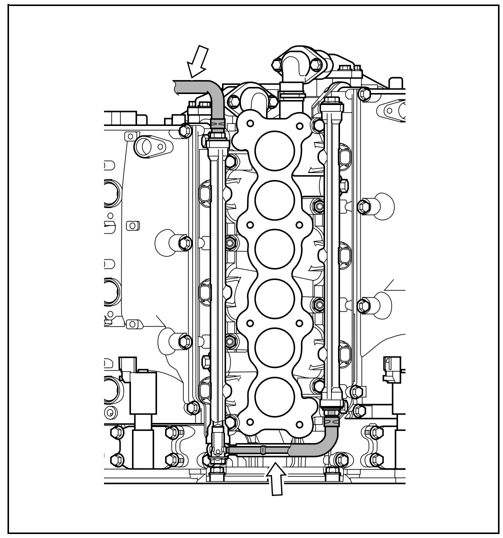


5. Tighten delivery pipe bolts and make sure that injectors rotate smoothly.

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



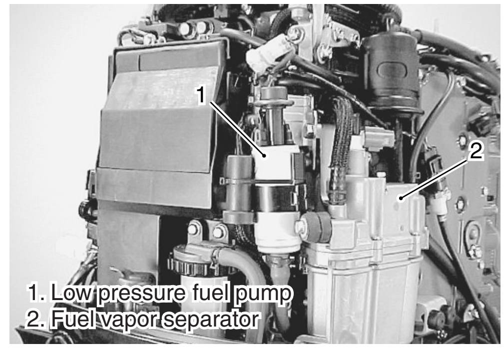
6. Reconnect fuel feed hose securely.
7. Connect lead wire connector to injectors securely.
8. Check to ensure that all removed parts are back in original position.



9. Make sure the emergency stop switch lock plate is in place. Shift into “NEUTRAL” position.
10. Squeeze fuel primer bulb until you feel resistance.
    Turn main switch “ON” for 6 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.
11. Install ring gear cover. (See page 6-2.)

LOW PRESSURE FUEL PUMP

The low pressure fuel pump is a non-serviceable component.
If it is defective, it must be replaced as a complete unit.
The following procedure will determine whether or not the pump is defective.



INSPECTION

NOTE:
To prevent damage to the low pressure fuel pump, fill the fuel feed lines with fuel prior to operating the pump.

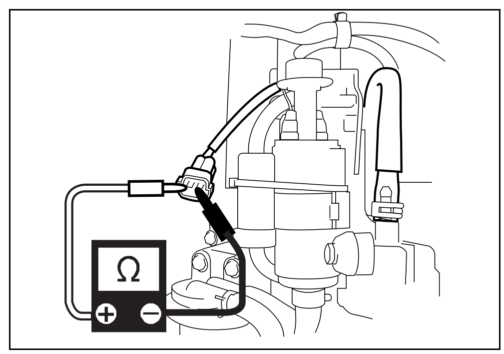
1. Install the emergency stop switch lock plate in position.
   Shift into “NEUTRAL” position.
2. When the main switch key is turned to ON from OFF, check that a pump operating sound is heard for six (6) seconds.
3. If no pump operating sound is heard:
   (a) Turn the main switch key to OFF and disconnect the pump lead connector.
   (b) Check for contact failure in the lead connector.
   (c) Measure resistance between the two terminals of pump lead connector.

09930-99320: Digital tester

Tester range: Ω (Resistance)

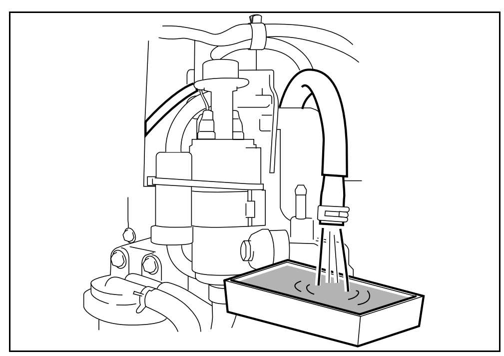
Pump resistance: Standard 0.8 – 5 Ω

If the measurement is out of specification, replace the pump.



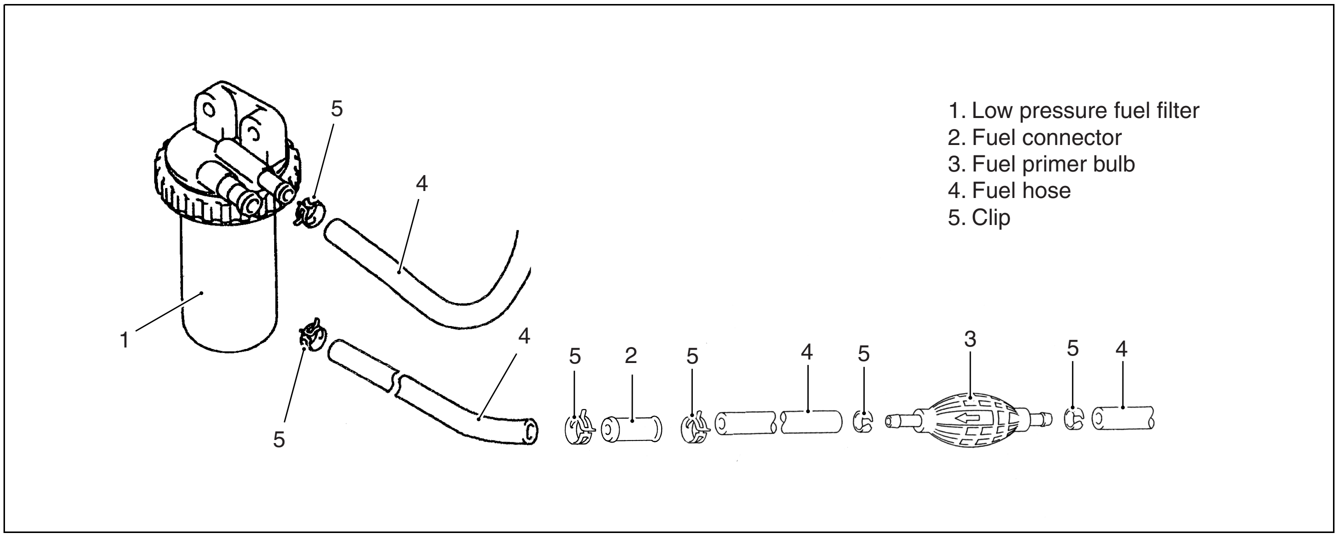
   (d) Check that pump drive voltage is output from ECM and no abnormal condition exists in the engine main wiring harness. (See page 3-59.)

4. If the pump operating sound is heard:
   (1) Remove the fuel feed hose from the vapor separator.
   (2) Operate the pump by turning the main switch key from OFF to ON and discharge fuel into a suitable container.
   (3) If no fuel is discharged, check for clogging or other failure in the fuel feed line. If no failure is found, replace the pump.



LOW PRESSURE FUEL FILTER/FUEL HOSE

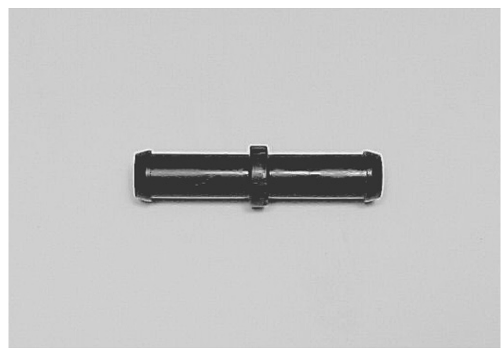
When disassembling or reassembling fuel line, refer to the construction diagram below.



INSPECTION

FUEL CONNECTOR

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

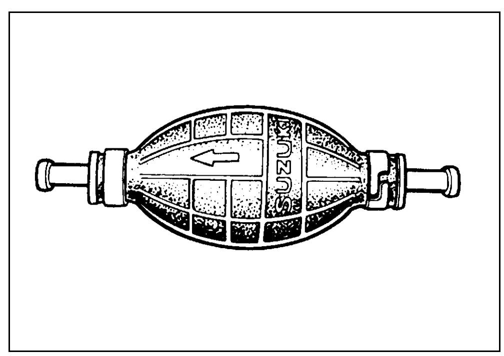


FUEL HOSE

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

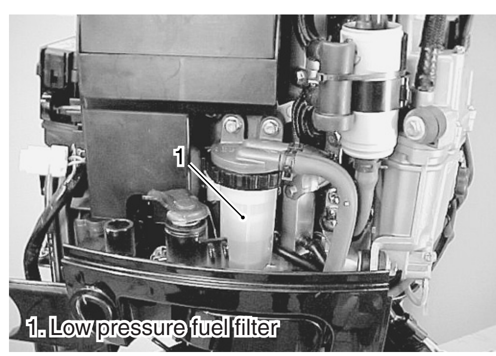
FUEL PRIMER BULB

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



LOW PRESSURE FUEL FILTER

To perform fuel filter inspection, refer to "PERIODIC MAINTENANCE/LOW PRESSURE FUEL FILTER" section on page 2-19.



POWER UNIT

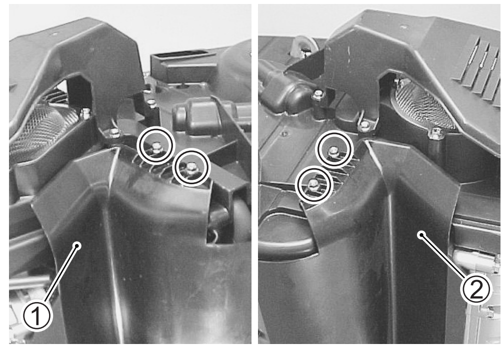
CONTENTS

RING GEAR COVER AND AIR INTAKE SILENCER CASE

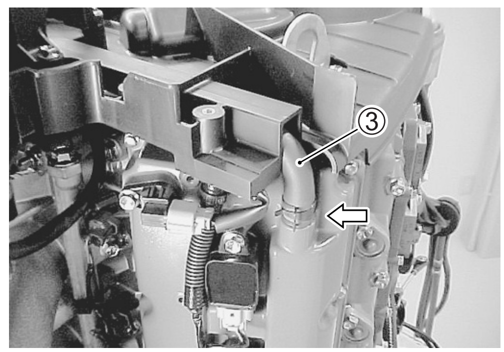
REMOVAL

Prior to removing Ring gear cover:
- **Disconnect battery cables from battery.**

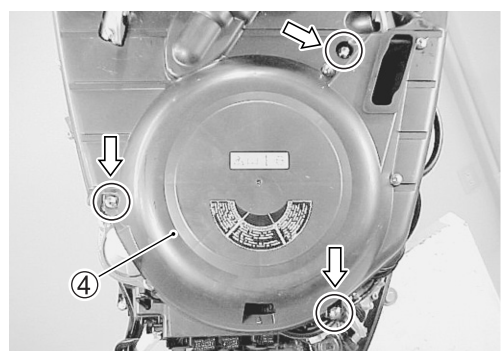
1. Remove the two bolts and STBD air duct guard ①.
2. Remove the two bolts and PORT air duct guard ②.



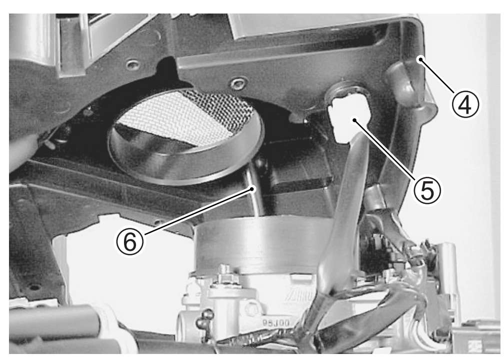
3. Loosen the clamp securing breather hose ③, then remove the breather hose from STBD cylinder head cover.



4. Remove the three (3) bolts securing ring gear cover ④.



5. Raise the ring gear cover and air intake silencer case ④ slightly and remove the intake air temp. sensor ⑤ and purge valve hose ⑥ from air intake silencer case.
   Continue raising and remove the cover and case.



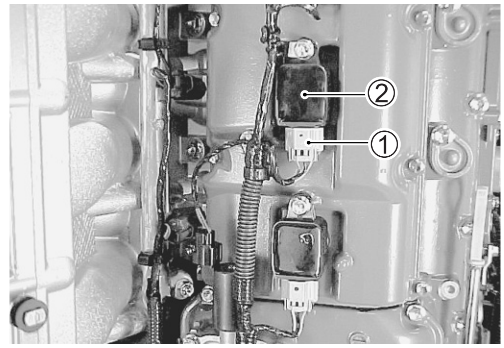
INSTALLATION

Installation is reverse order of removal.

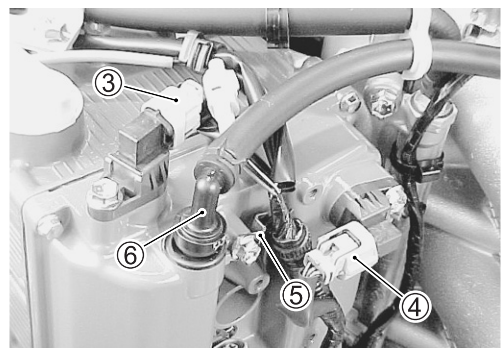
CYLINDER HEAD COVER
REMOVAL

Before removing cylinder head cover:
- **Disconnect battery cables from battery.**
- **Remove both side covers. (See page 7-2.)**

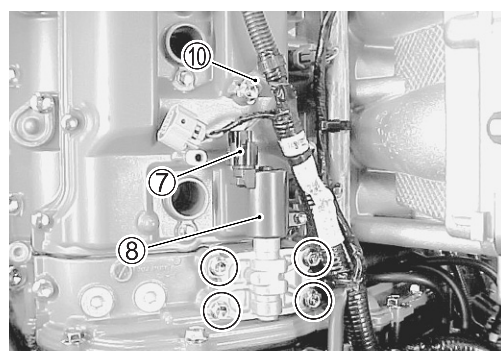
1. Remove the ring gear cover and air intake silencer case. (See page 6-2.)
2. Disconnect ignition coil connectors ①.
   Remove the bolts securing the ignition coils.
   Remove all ignition coils ② and spark plugs.

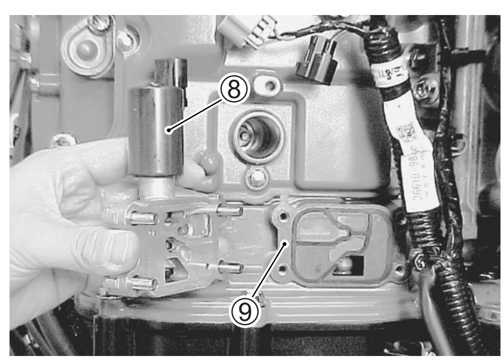


3. On the PORT side bank:
   - Disconnect EX. CMP sensor lead wire connector ③ at sensor.
   - Disconnect IN. CMP sensor lead wire connector ④ at sensor.
   - Remove the bolt securing lead wire clamp plate ⑤.
   - Remove PCV valve ⑥ from cylinder head cover.

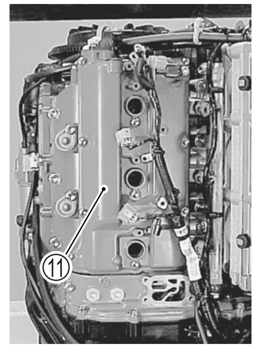


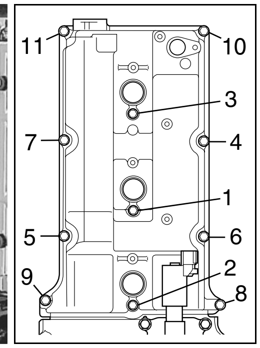
   - Disconnect OCV lead wire connector ⑦ at OCV.
     Remove the four (4) bolts securing OCV ⑧, then remove OCV and discard OCV gasket ⑨.
   - Remove the bolt securing lead wire clamp plate ⑩.



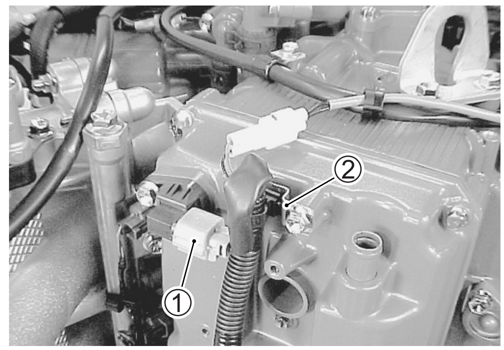


- Remove the eleven (11) bolts securing cylinder head cover ⑪ to the cylinder head, then remove the cylinder head cover.

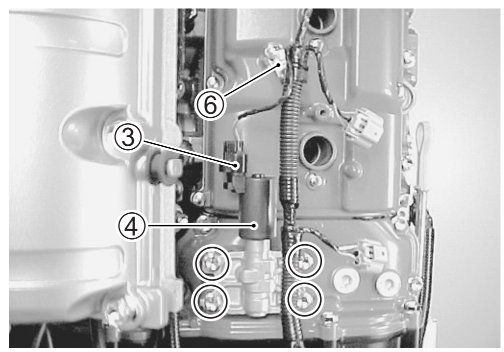


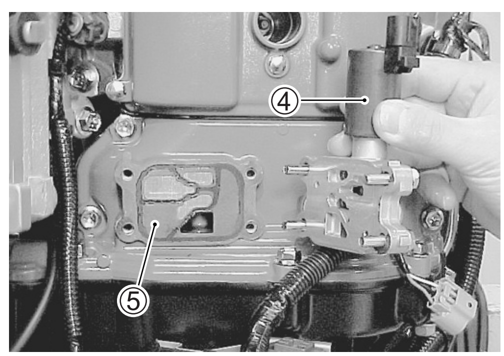


4. On the STBD side bank:
   - Disconnect IN. CMP sensor lead wire connector ① at sensor.
   - Remove the bolt securing lead wire clamp plate ②.

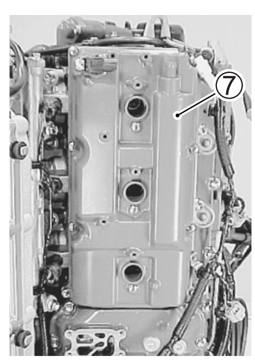


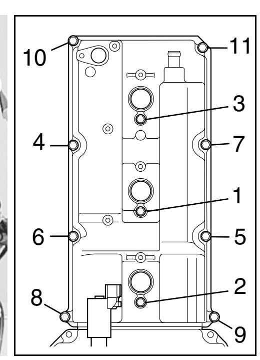
- Disconnect OCV lead wire connector ③ at OCV.
  Remove the four (4) bolts securing OCV ④, then remove OCV and discard OCV gasket ⑤.
- Remove the bolt securing lead wire clamp plate ⑥.





- Remove the eleven (11) bolts securing cylinder head cover ⑦ to the cylinder head, then remove the cylinder head cover.

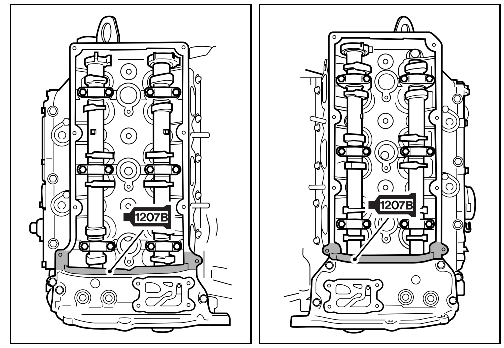




INSTALLATION

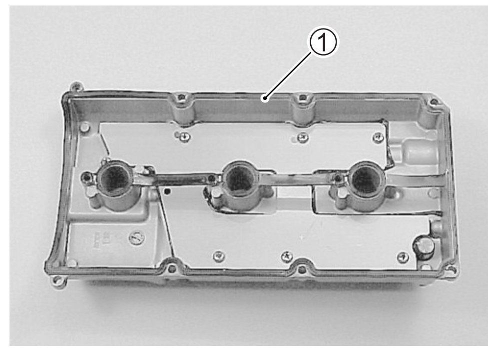
Installation is reverse order of removal with special attention to the following steps.

- Clean sealing surfaces on cylinder heads and covers.
- Remove oil, old sealant, and dust from sealing surfaces.
- After cleaning, apply sealant to cylinder heads sealing surface area as shown in figure.



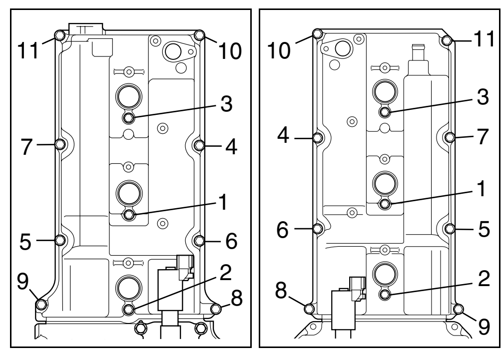
1207B 99000-31140: SUZUKI BOND “1207B”

- Install new cylinder head cover gasket ① to head cover.



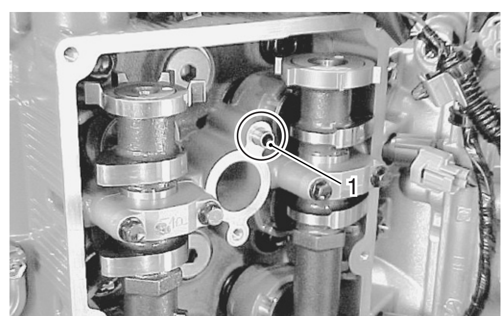
NOTE:
Examine cylinder head cover gasket for damage.
Always replace gasket with new one.

- Install cylinder head covers ② to cylinder heads, then tighten cylinder head cover bolts to specified torque.

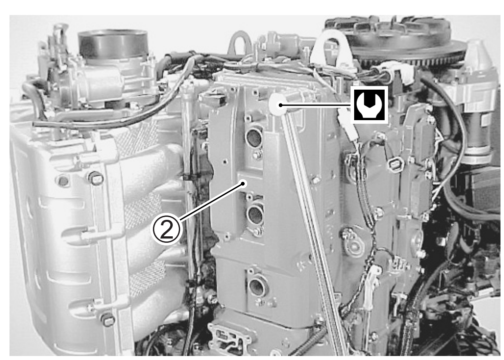


Cylinder head cover bolt: 11 N·m (1.1 kg-m, 8.0 lb-ft)

NOTE:
On the PORT side bank, do not forget to install dowel pin shown figure.

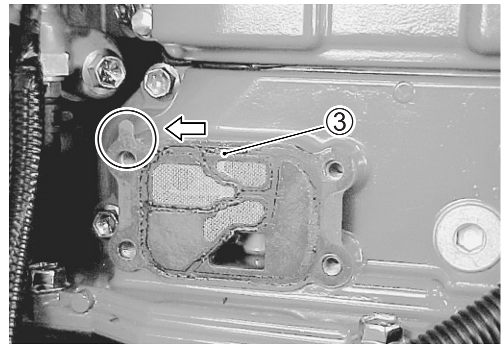


1. Dowel pin



• Install gasket ③ and OCV ④ and then tighten bolts securely.

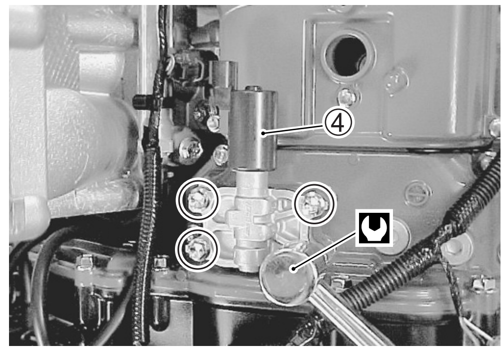
NOTE:
Position the OCV gasket tab as shown right.



CAUTION

Do not reuse the OCV gasket, always replace with new one.

OCV bolt: 12 N·m (1.2 kg-m, 8.6 lb-ft)



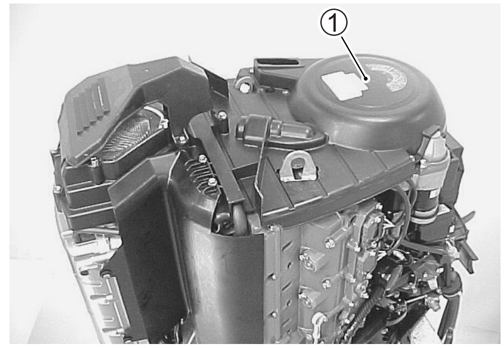
FINAL ASSEMBLY CHECK

• All parts removed have been returned to their original positions.
• Wire and hose routing match's service manual illustration.
• No oil leakage is evident during final test running.

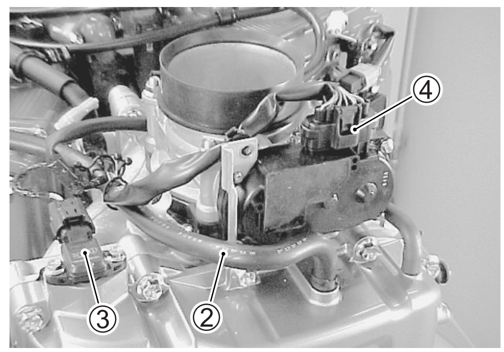
INTAKE COLLECTOR ASSEMBLY
REMOVAL

Before removing intake collector assembly:
- **Disconnect battery cables from battery.**
- **Remove both side covers. (See page 7-2.)**

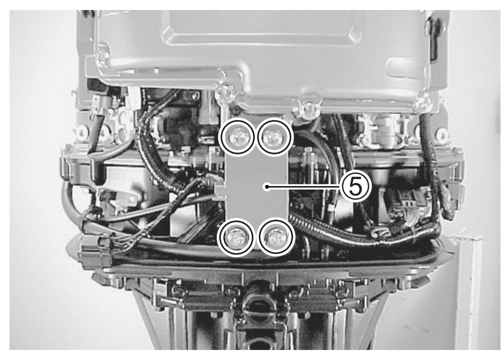
1. Remove the ring gear cover and air intake silencer case ①. (See page 6-2.)



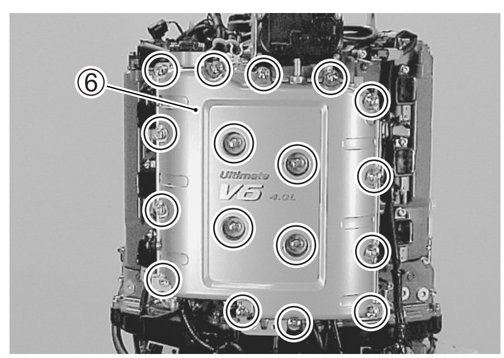
2. Loosen the clamp securing PCV hose ②, then remove the PCV hose from intake collector cover.
3. Disconnect MAP sensor lead wire connector at MAP sensor ③.
4. Disconnect lead wire connector ④ at electric throttle body assembly.



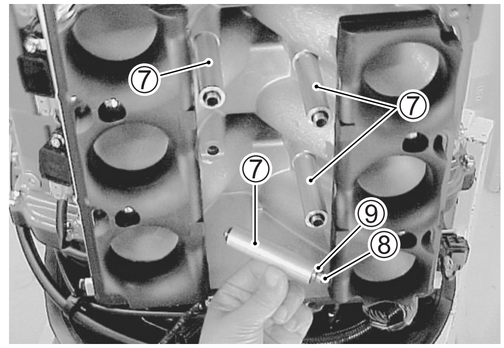
5. Remove four (4) bolts and bracket ⑤.



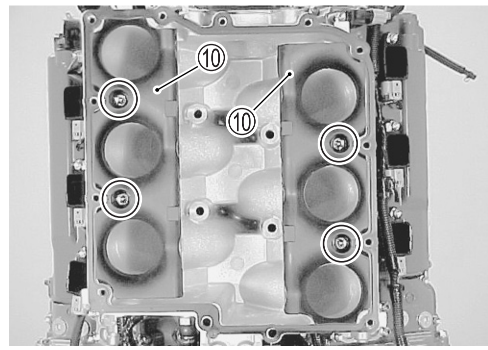
6. Remove the seventeen (17) bolts securing intake collector cover ⑥, then remove the collector cover.



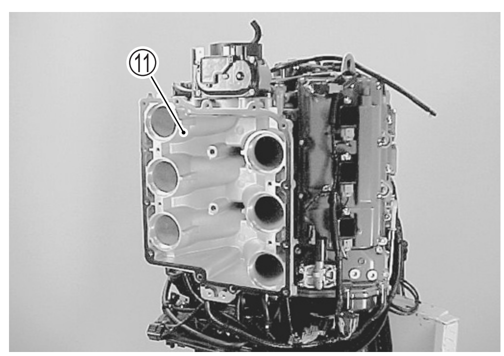
7. Remove four (4) spacers ⑦.
   Remove dowel pin ⑧ and O-ring ⑨ from each side of spacer.



8. Remove the four (4) bolts securing funnels ⑩, then remove two funnels.



9. Remove two nuts and intake collector body ⑪.



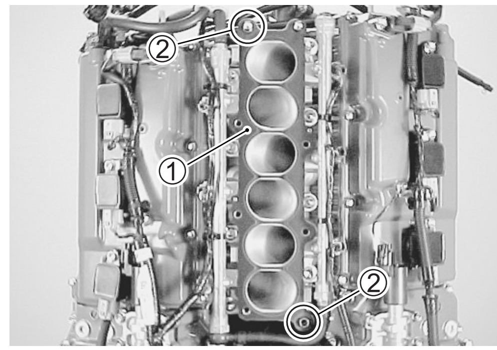
INSTALLATION

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

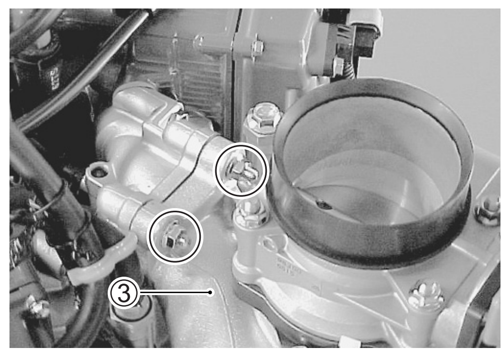
CAUTION

Do not reuse gasket. Always use a new gasket.

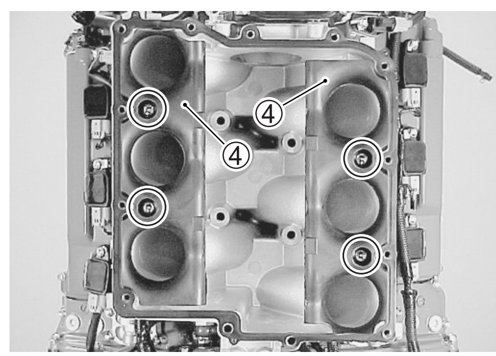
- Install gasket ① and dowel pins ②.



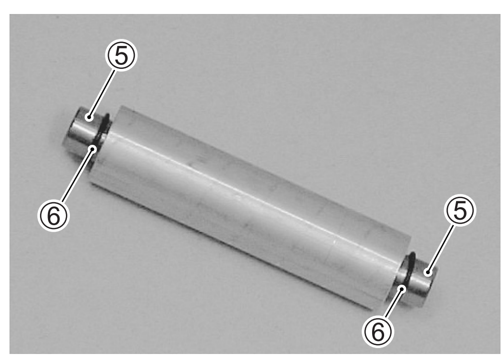
- Install intake collector body ③, then temporarily tighten two nuts.



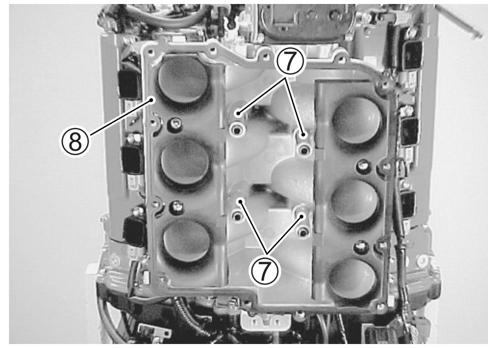
- Install funnels ④, then tighten bolts securely.



- Place dowel pins ⑤ and O-rings ⑥ to each spacer.

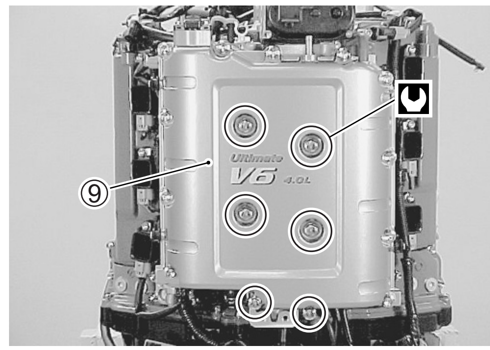


• Install four (4) spacers ⑦ and gasket ⑧.

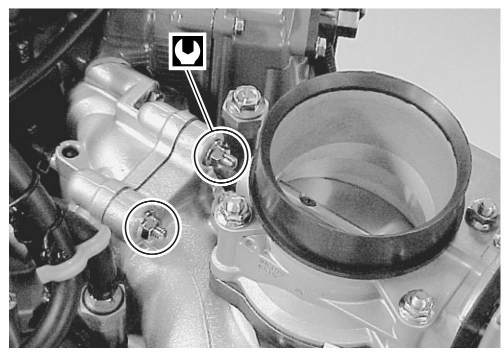


• Install intake collector cover ⑨.
Tighten intake collector mounting bolts and nuts to specified torque.

Intake collector bolt and nut: 23 N·m (2.3 kg-m, 16.5 lb-ft)

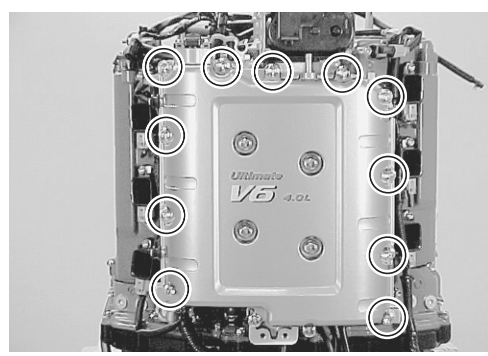


NOTE:
Tighten collector mounting bolts and nuts first (following the order shown in figure), then tighten collector cover bolts.



• Tighten intake collector cover bolts securely.

Intake collector cover bolt: 23 N·m (2.3 kg-m, 16.5 lb-ft)

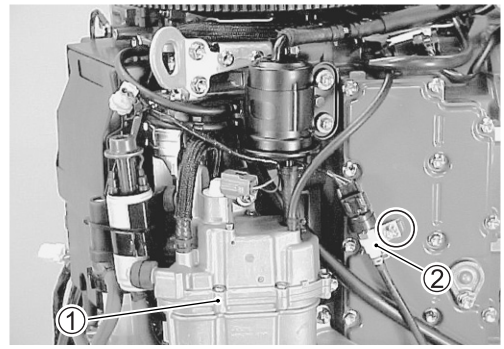


• Install bracket, then tighten bolts securely.
• Check to ensure that all removed parts are back in place.

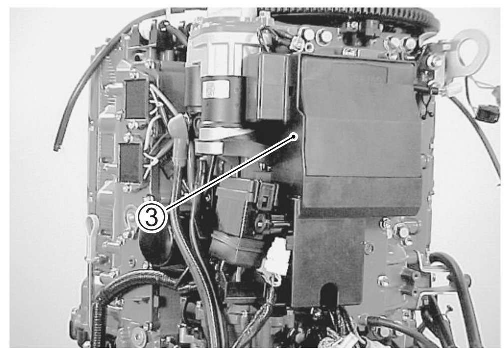
POWER UNIT
REMOVAL

Before removing power unit:
- **Relieve fuel pressure. (See page 5-3.)**
- **Drain engine oil.**
- **Disconnect battery cables from battery.**

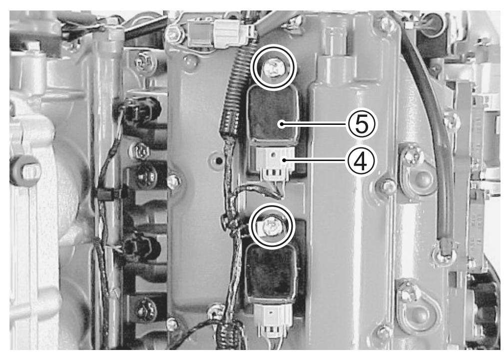
Remove the low pressure fuel pump/fuel vapor separator ① as a set. (See page 5-7.)
Remove the bolt and speed sensor ②.



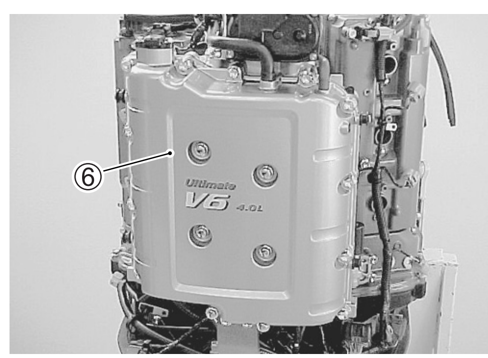
Remove the electric parts holder ③. (See page 4-30.)



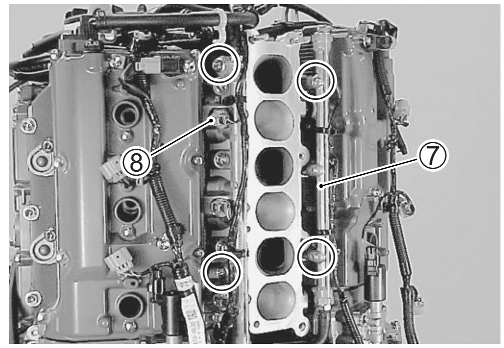
Disconnect ignition coil connectors ④.
Remove bolts securing the ignition coils ⑤.
Remove all ignition coils ⑤ and spark plugs.



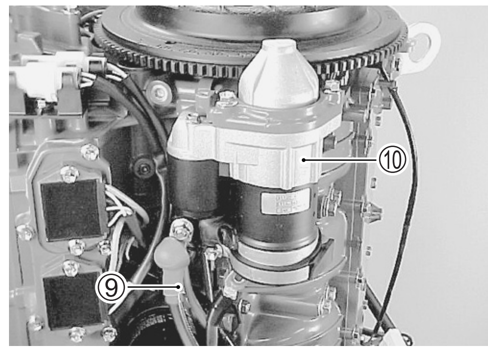
Remove the intake collector assembly ⑥. (See page 6-7.)



Remove bolts securing fuel delivery pipe ⑦, then remove fuel delivery pipes and all fuel injectors ⑧. (See page 5-20.)

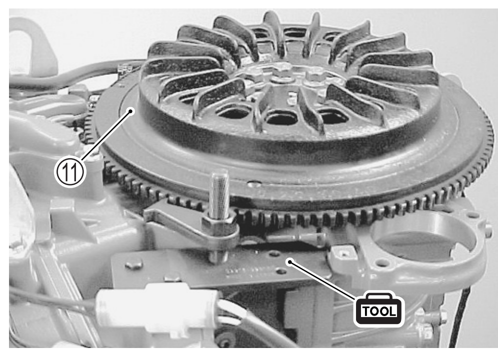


Remove nut and positive battery cable ⑨.
Remove starter motor ⑩. (See page 4-18.)

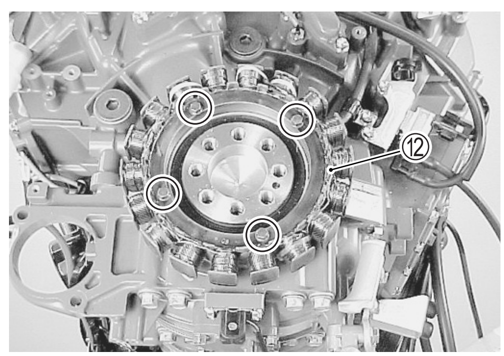


Remove flywheel ⑪. (See page 3-92.)

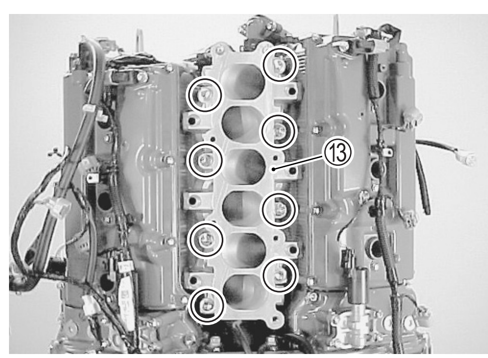
TOOL **09916-99311: Flywheel holder**



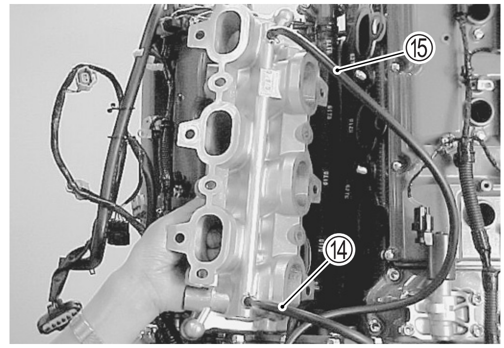
Remove battery charge coil ⑫. (See page 4-10.)



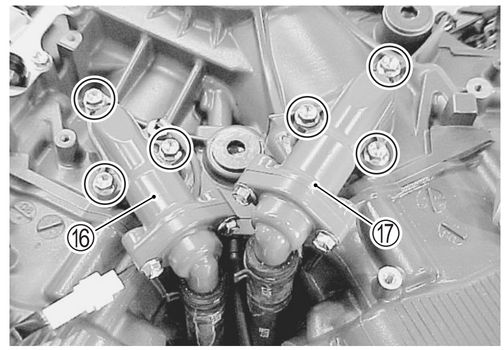
Remove four (4) bolts and four (4) nuts, then remove intake manifold ⑬.



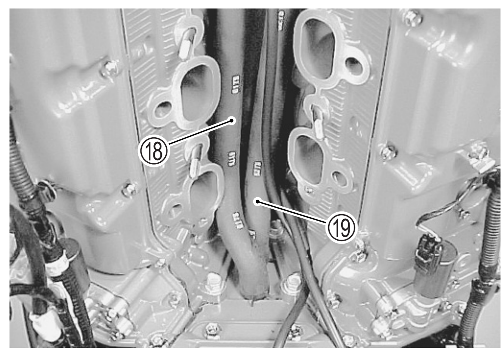
Disconnect water inlet hose ⑭ and outlet hose ⑮ from intake manifold.



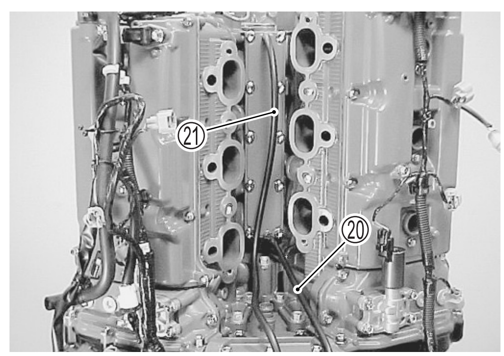
Remove three (3) bolts and PORT thermostat housing ⑯.
Remove three (3) bolts and STBD thermostat housing ⑰.



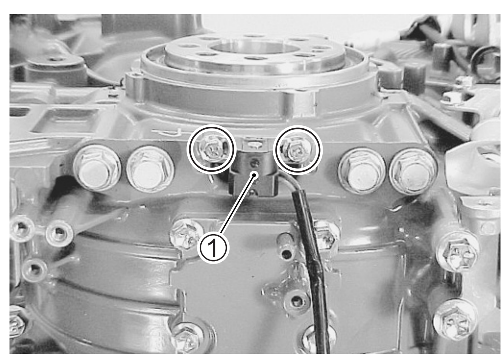
Disconnect PORT and STBD water return hose ⑱·⑲ from engine holder.



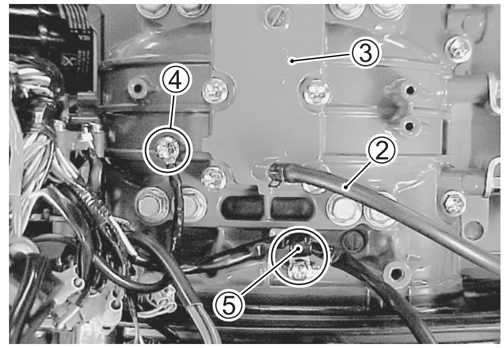
Disconnect water inlet hose ⑳ and outlet hose ㉑ from rear crankcase water jacket cover.



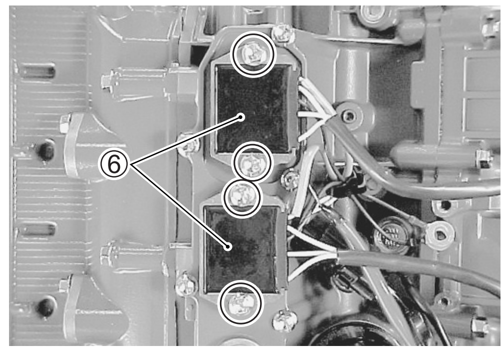
Remove screws and CKP sensor ①.



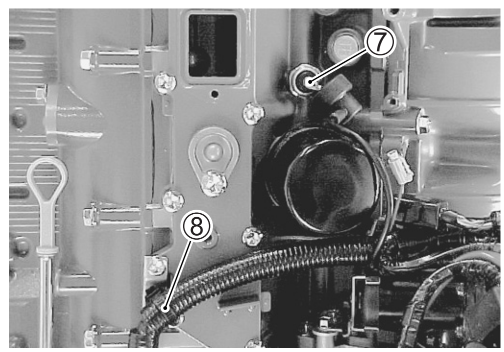
Disconnect water inlet hose ② from the front crankcase water jacket cover ③.
Remove the bolt ④ securing the ground lead wire of PTT relay.
Remove bolt and PTT switch lead wire clamp ⑤.



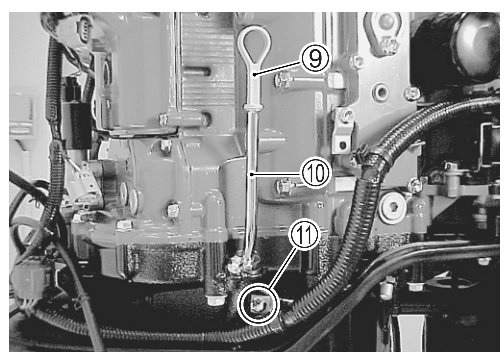
Remove bolts and two (2) Rectifier & regulators ⑥.
(See page 4-11.)



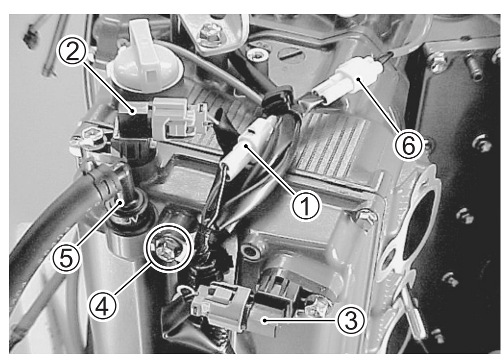
Loosen screw ⑦ and disconnect lead wire from oil pressure switch.
Remove cable clamp ⑧ from clamp plate by releasing clamps' lock.



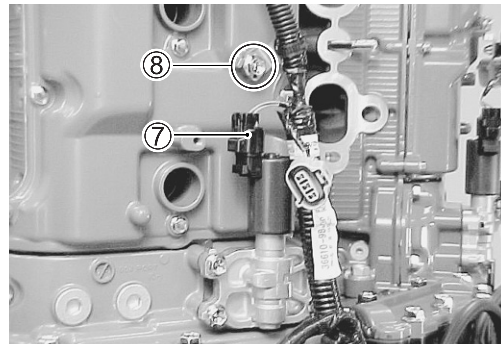
Remove oil level dipstick ⑨.
Remove bolt and oil level dipstick guide ⑩.
Remove the bolt ⑪ securing the engine main harness clamp plate.



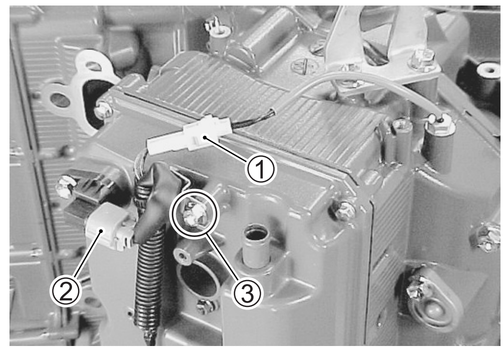
On the PORT side bank
- Disconnect EX. manifold temperature sensor lead wire connector ①.
- Disconnect EX. CMP sensor lead wire connector at sensor ②.
- Disconnect IN. CMP sensor lead wire connector at sensor ③.
- Remove the bolt ④ securing lead wire clamp plate.
- Remove PCV valve ⑤ from cylinder head cover.



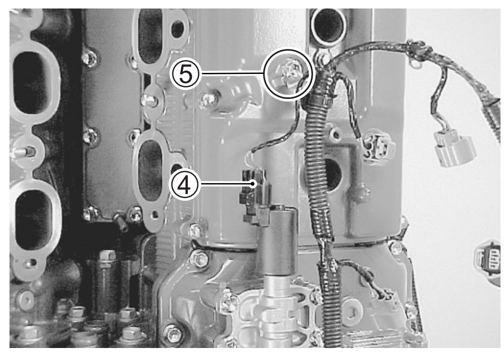
- Disconnect cylinder temperature sensor lead wire connector ⑥.
- Disconnect OCV lead wire connector ⑦ at OCV.
- Remove the bolt ⑧ securing lead wire clamp plate.



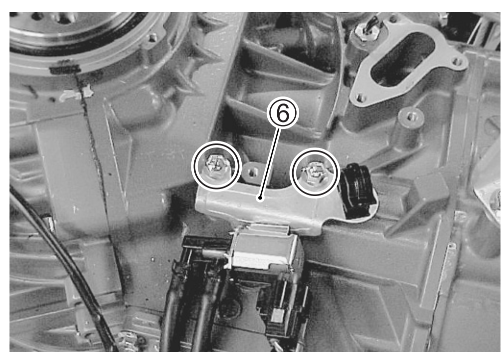
On the STBD side bank
- Disconnect EX. manifold temperature sensor lead wire connector ①.
- Disconnect IN. CMP sensor lead wire connector ② at sensor.
- Remove the bolt ③ securing lead wire clamp plate.



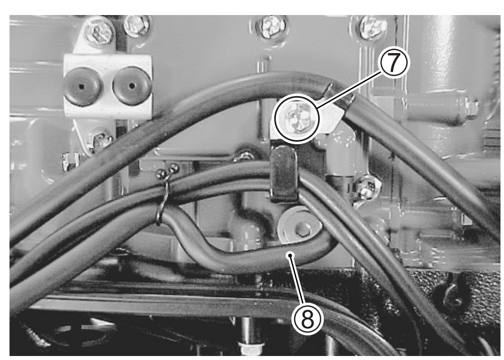
- Disconnect OCV lead wire connector ④ at OCV.
- Remove the bolt ⑤ securing lead wire clamp plate.



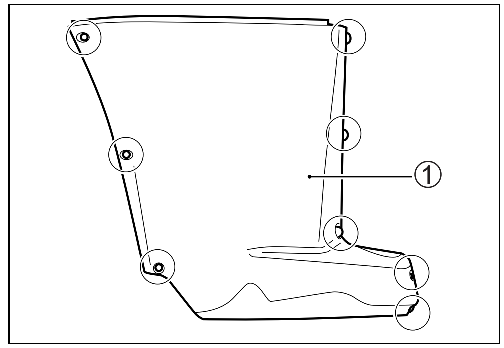
Remove bolts and purge valve bracket ⑥ (with purge valve).



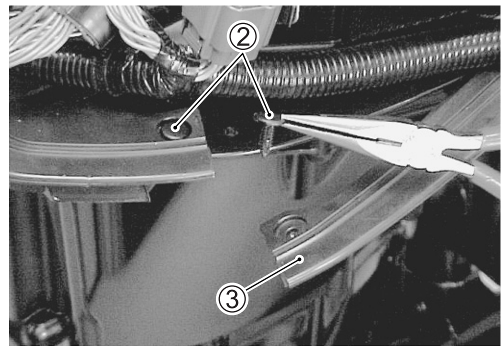
Remove the bolt ⑦ securing hose clamp plate.
Remove water flush hose ⑧ from cylinder block.



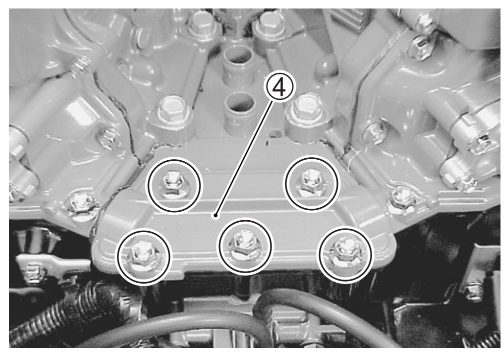
Remove oil pan cover ①. (See page 7-2.)



Remove pins ② and side cover seal ③.

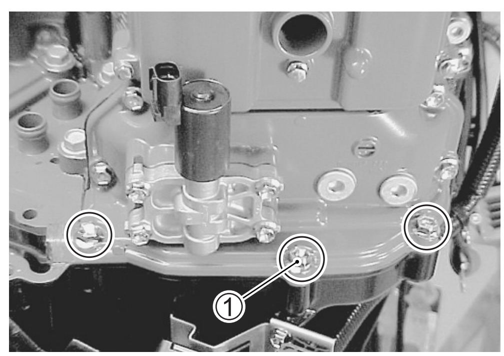


Remove five (5) bolts and upper engine holder cover ④.

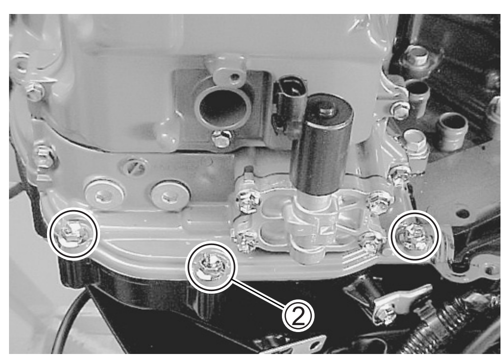


[From engine upper side]

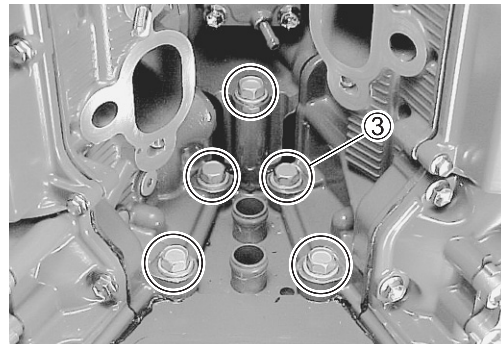
- On the STBD bank, remove three (3) bolts ①.



- On the PORT bank, remove three (3) bolts ②.

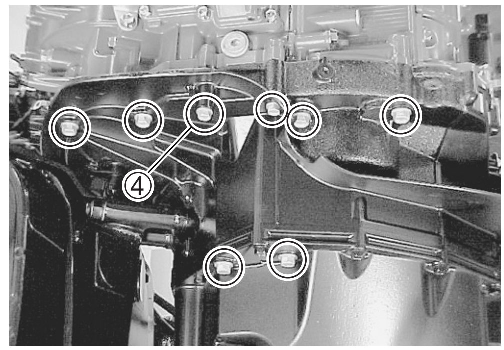


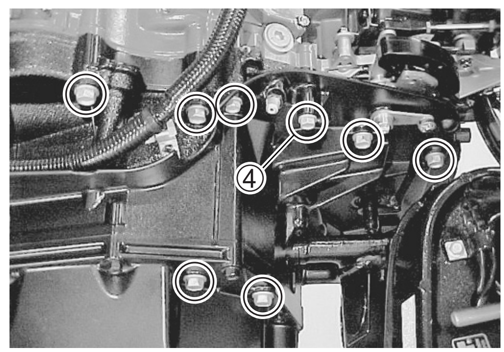
- Remove five (5) bolts ③.



[From engine under side]

- Remove sixteen (16) bolts ④.
  Lift up and remove power unit from engine holder.





INSTALLATION

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

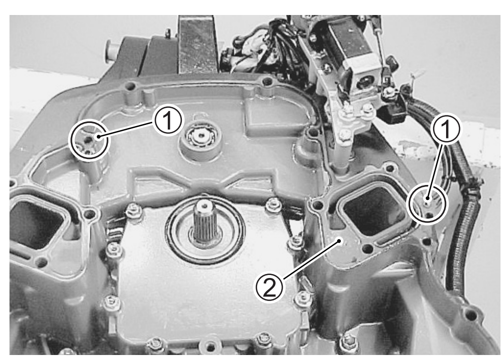
CAUTION

Do not reuse gaskets, O-rings and seals.
Always replace with new parts.

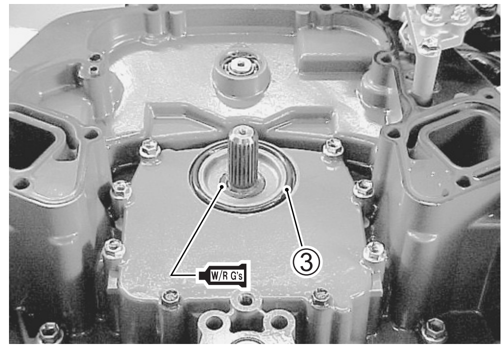
POWER UNIT

- Install dowel pins ①, gasket ②.
  Apply Water Resistant Grease to driveshaft splines.

W/R G's **99000-31140: SUZUKI WATER RESISTANT GREASE**

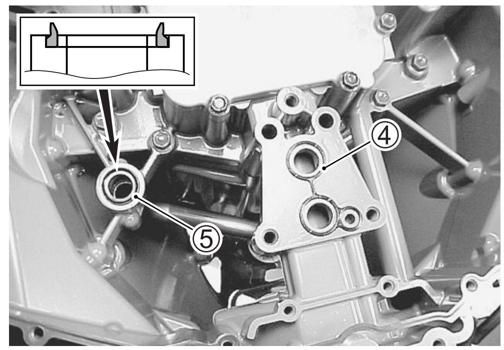


- Install O-ring ③ to mount oil seal cover, then apply enough Water Resistant Grease on O-ring.



- Install the water return seal ④ and engine holder seal ⑤.

NOTE:
Install seal ⑤ with lip facing upward.

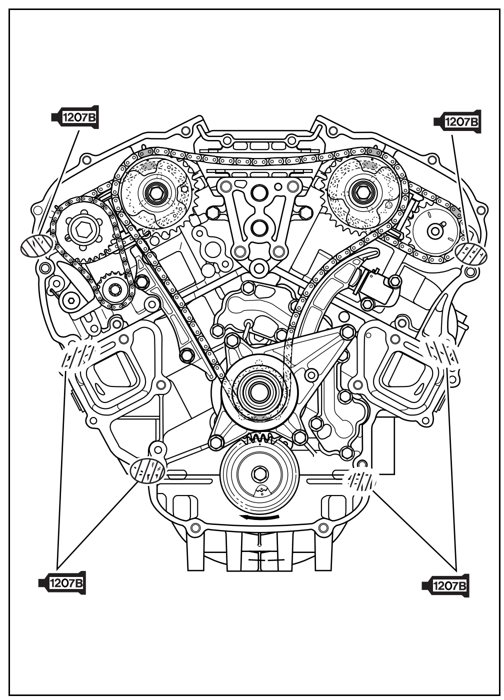


NOTE:
Before installing power unit, apply sealant to the six hatched areas shown in the illustration at right.

1207B 99000-31140: SUZUKI BOND "1207B"

- Lower the power unit onto engine holder.

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

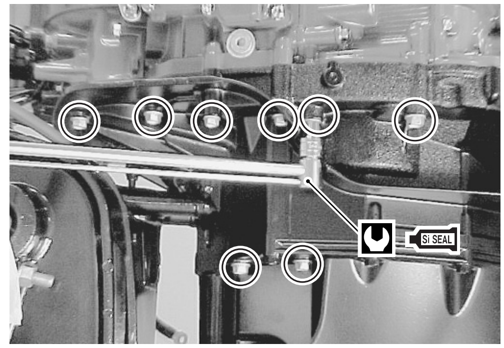


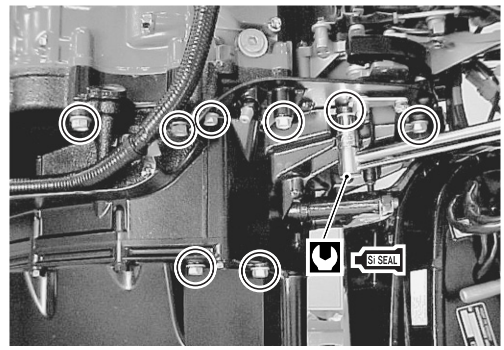
- Apply Suzuki Silicone Seal to power unit mounting bolts and tighten bolts to specified torque.

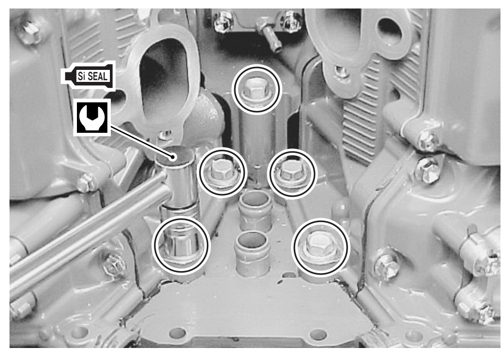
Si SEAL **99000-31120: SUZUKI SILICONE SEAL**

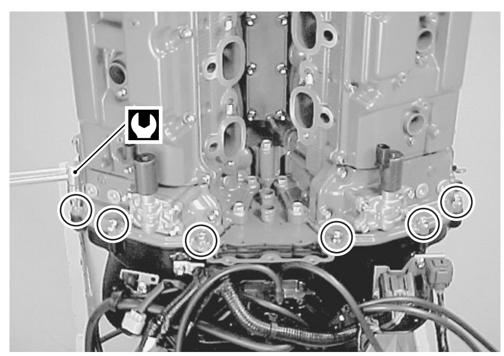
Power unit mounting bolt:

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)**



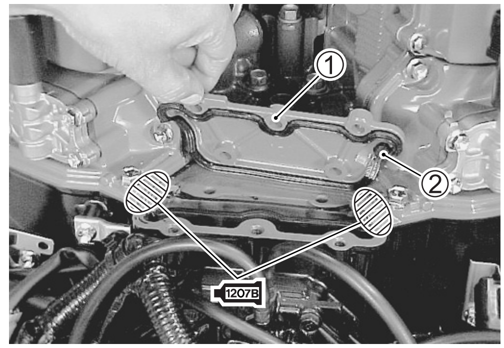






- Assemble new seal ② to upper engine holder cover ①, then install engine holder cover and tighten cover bolts to specified torque.

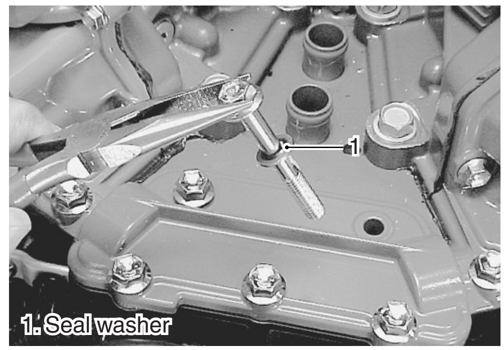
Engine holder cover bolt:
8 mm 23 N·m (2.3 kg-m, 16.5 lb-ft)

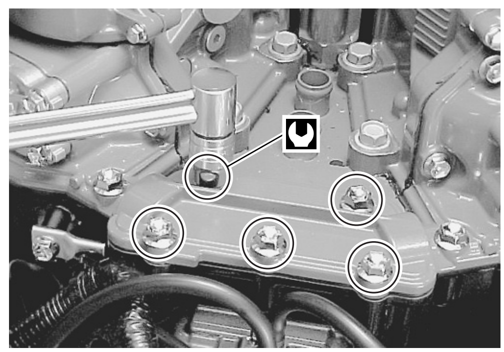


NOTE:
Before installing upper engine holder cover, apply sealant to the two hatched areas shown in the illustration at right.

1207B **99000-31140: SUZUKI BOND "1207B"**

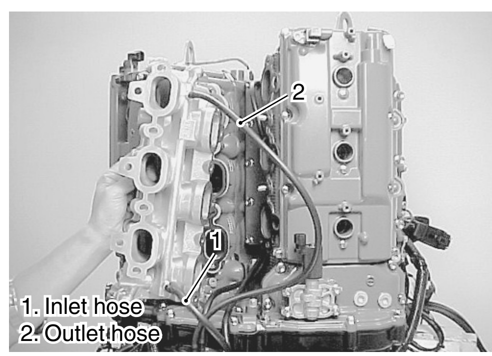
NOTE:
Before installing two long bolts, check that the seal washer is attached.





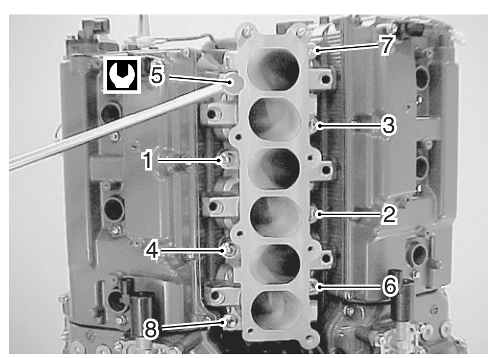
INTAKE MANIFOLD
- Connect inlet and outlet water hoses to the correct intake manifold fittings.
- Install gasket and intake manifold.
- Apply THREAD LOCK 1342 to the threads of manifold bolts and nuts.

1342 **99000-32050: THREAD LOCK "1342"**



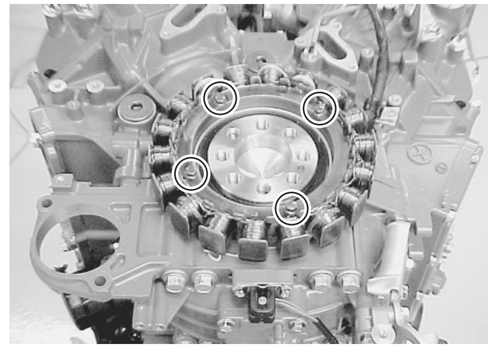
- Lightly seat all intake manifold bolts and nuts at first. Following sequence in figure, tighten bolts and nuts in 3 step. Tighten bolts and nuts to 1/3 of specified torque, then 2/3 of specified torque and finally to full specified torque.

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



FLYWHEEL

- Install battery charge coil. (See page 4-11.)

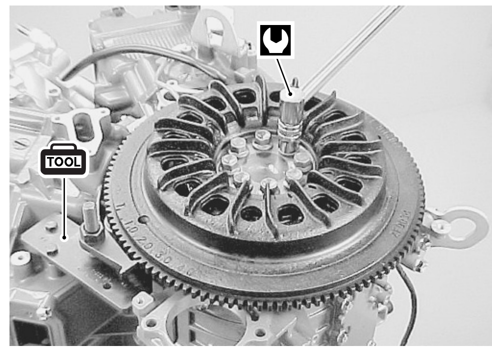


- Install flywheel and tighten flywheel bolts to specified torque. (See page 3-93.)

TOOL **09916-99311: Flywheel holder**

Flywheel bolt: 118 N·m (11.8 kg-m, 85.5 lb-ft)

- Install CKP sensor. (See page 3-94.)

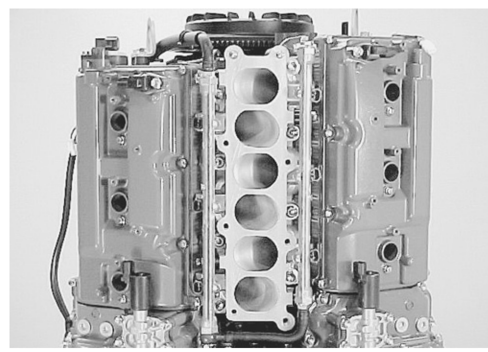


FUEL INJECTORS

- Install fuel injectors and fuel delivery pipes. (See page 5-21.)

INTAKE COLLECTOR ASSEMBLY

- Install intake collector assembly.
  For intake collector assembly installation, see page 6-9.



FINAL ASSEMBLY CHECK

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

- All parts removed have been returned to their original positions.
- Fuel and water hose routing match's service manual illustration. (See page 11-20 to 11-26.)
- Wire routing match's service manual illustration.
  (See page 11-14 to 11-19.)
- No fuel leakage is evident when fuel system is pressurized. (See page 5-4.)
- No water leakage is evident during final test running.

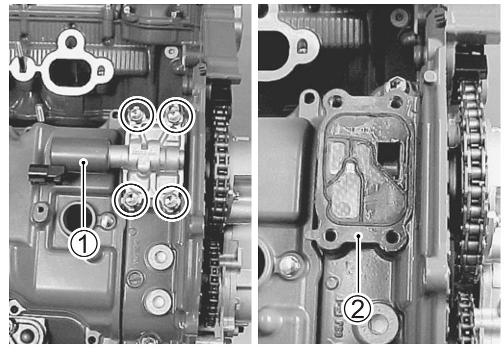
OIL PUMP

REMOVAL

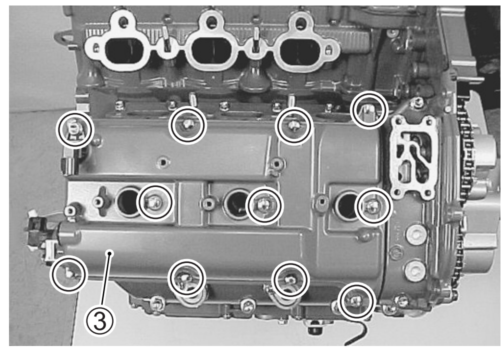
1. Remove the power unit. (See page 6-11 to 6-17.)

[On the PORT side bank]

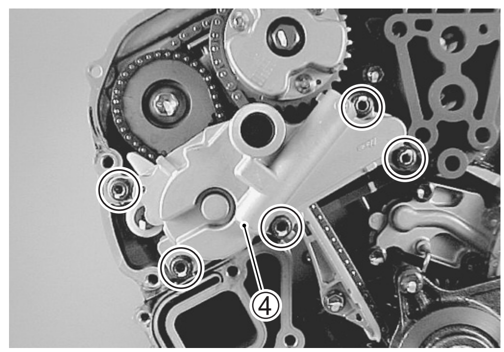
2. Remove the four (4) bolts securing OCV ①, then remove OCV and gasket ②.



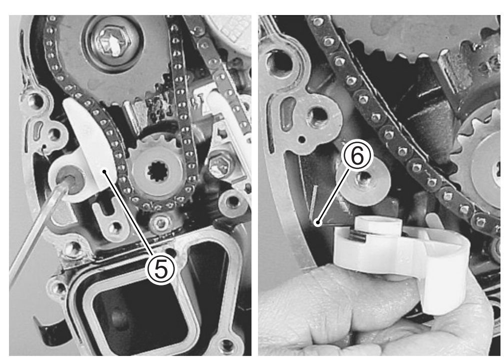
3. Remove the eleven (11) bolts securing cylinder head cover ③ to cylinder head, then remove the cylinder head cover.



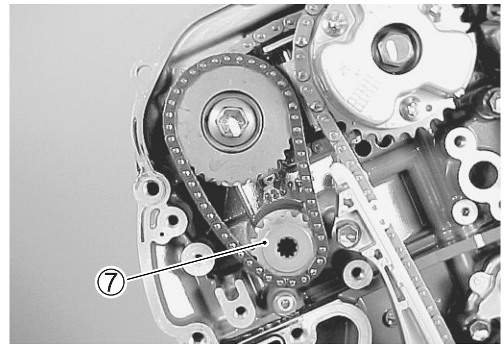
4. Remove the five (5) bolts securing oil pump ④, then remove the oil pump.
   Account for shim washer.



5. Remove the bolt, oil pump chain tensioner ⑤ and tensioner spring ⑥.

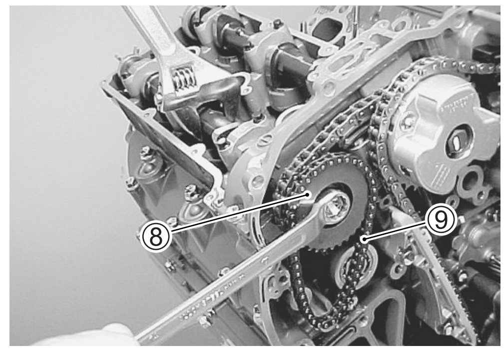


6. Remove the oil pump driven gear ⑦.



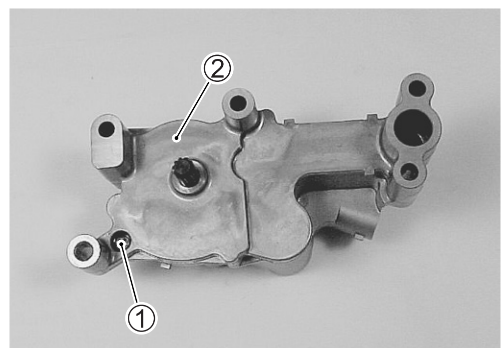
NOTE:
- *Sprocket bolt is LH thread.*
- *Hold camshaft by placing a wrench on the hexagon area of the camshaft.*

7. Remove the bolt securing oil pump drive sprocket ⑧ to camshaft, then remove the oil pump drive sprocket and chain ⑨.

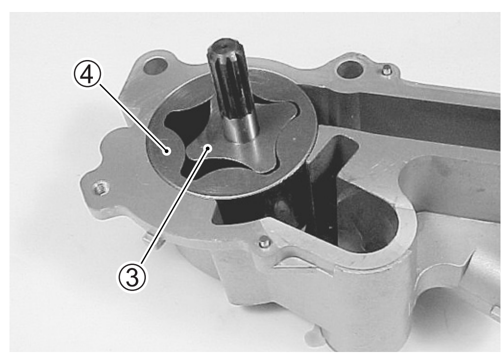


DISASSEMBLY

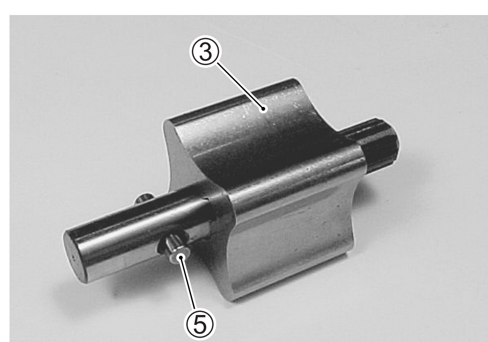
1. Remove the screw ① securing oil pump rotor plate ② to the oil pump case, then remove the oil pump rotor plate.



2. Take out inner rotor ③ and outer rotor ④.



3. Remove the pin ⑤ and inner rotor ③.

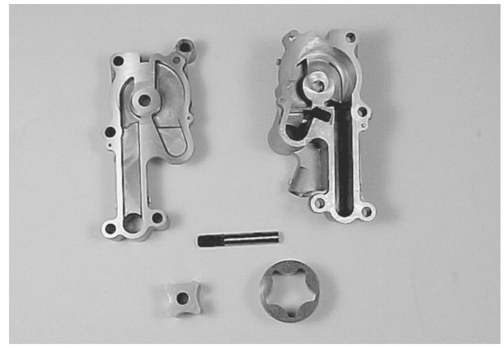


INSPECTION

OIL PUMP ASSEMBLY

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

NOTE:
If any repair is required on outer rotor, inner rotor and oil pump case/plate, replace them as an oil pump assembly.



DRIVE/DRIVEN SPROCKET

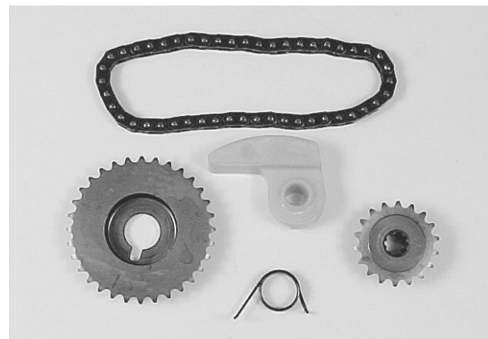
Check teeth of sprocket for wear or damage.
Replace as necessary.

OIL PUMP DRIVE CHAIN

Check oil pump drive chain. Replace if worn or damage.

CHAIN TENSIONER

Check chain tensioner. Replace if worn or damage.



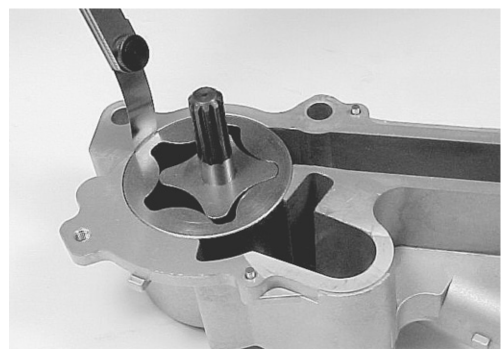
MEASURING PUMP COMPONENTS

RADIAL CLEARANCE

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

Radial clearance:
Service limit: 0.31 mm (0.0122 in)

If measurement is not within specifications, replace the oil pump assembly.

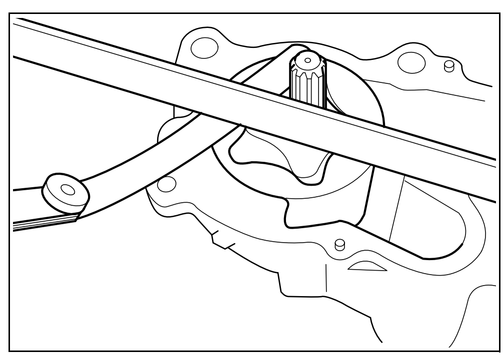


SIDE CLEARANCE

Using straightedge and feeler gauge, measure side clearance.

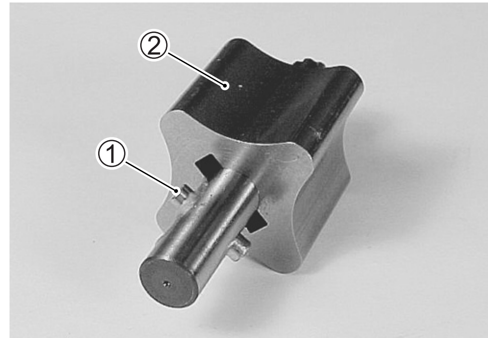
Side clearance:
Service limit: 0.15 mm (0.0059 in)

If measurement is not within specifications, replace the oil pump assembly.



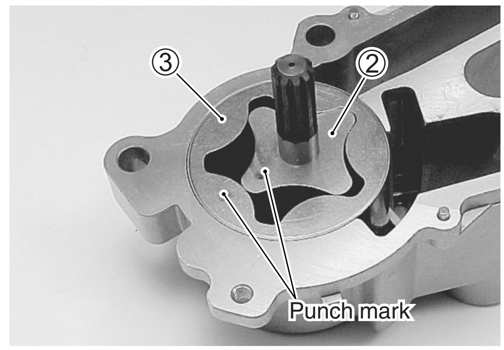
ASSEMBLY

1. Wash, clean and then dry all disassembled parts.
2. Apply thin coat of engine oil to inner and outer rotors, inside surfaces of oil pump case and plate.
3. Assemble pin ① and inner rotor ② to oil pump shaft.

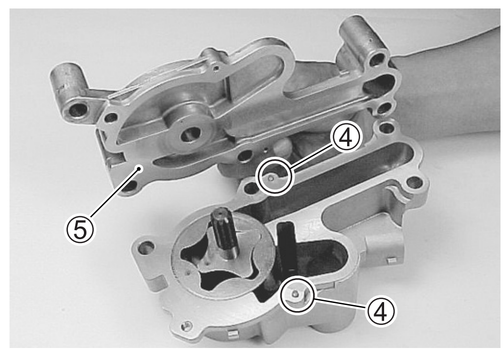


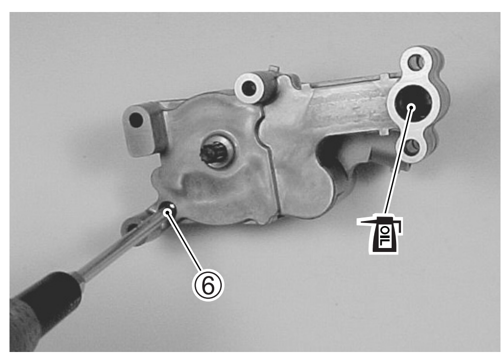
4. Install outer ③ and inner rotor ② to pump case.

NOTE:
When installing outer and inner rotors, the punch mark on each rotor must face rotor plate.



5. Install dowel pins ④ and rotor plate ⑤, and then tighten screw ⑥ securely.
   After mounting the rotor plate, make sure that each rotor turns smoothly by hand.
6. Pour approx. 50 ml (1.7 oz.) of engine oil into pump case for initial lubrication.

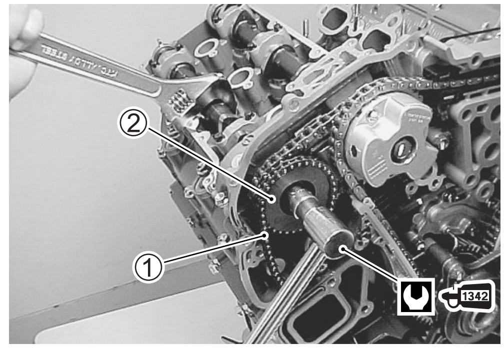




INSTALLATION

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

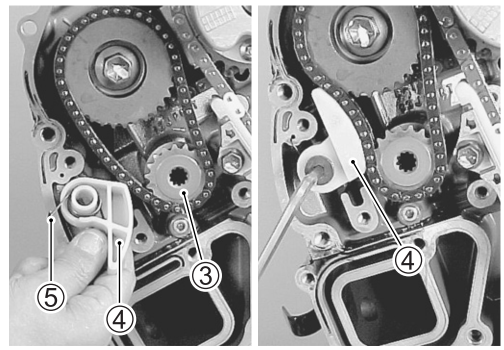
- Install oil pump drive chain ① and pump drive sprocket ②.
- Tighten sprocket bolt, pre-coated with thread lock, to specified torque.



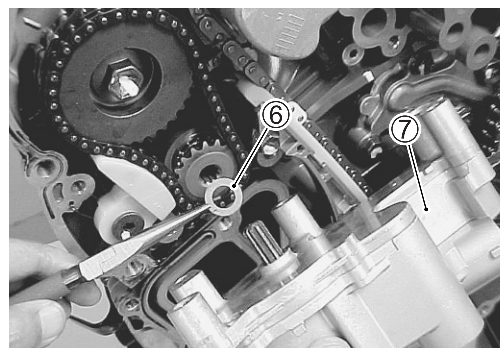
1342 99000-32050: THREAD LOCK 1342

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

- Install oil pump driven gear ③, chain tensioner ④ and tensioner spring ⑤ as shown in figure, then tighten bolt securely.

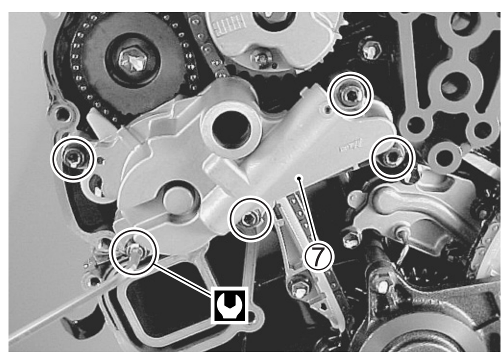


- Install washer ⑥ and oil pump assembly ⑦, then tighten five (5) bolts securely.



Oil pump bolt: 23 N·m (2.3 kg-m, 16.5 lb-ft)

- Pour approx. 50 ml (1.7 oz.) of engine oil into pump case for initial lubrication.

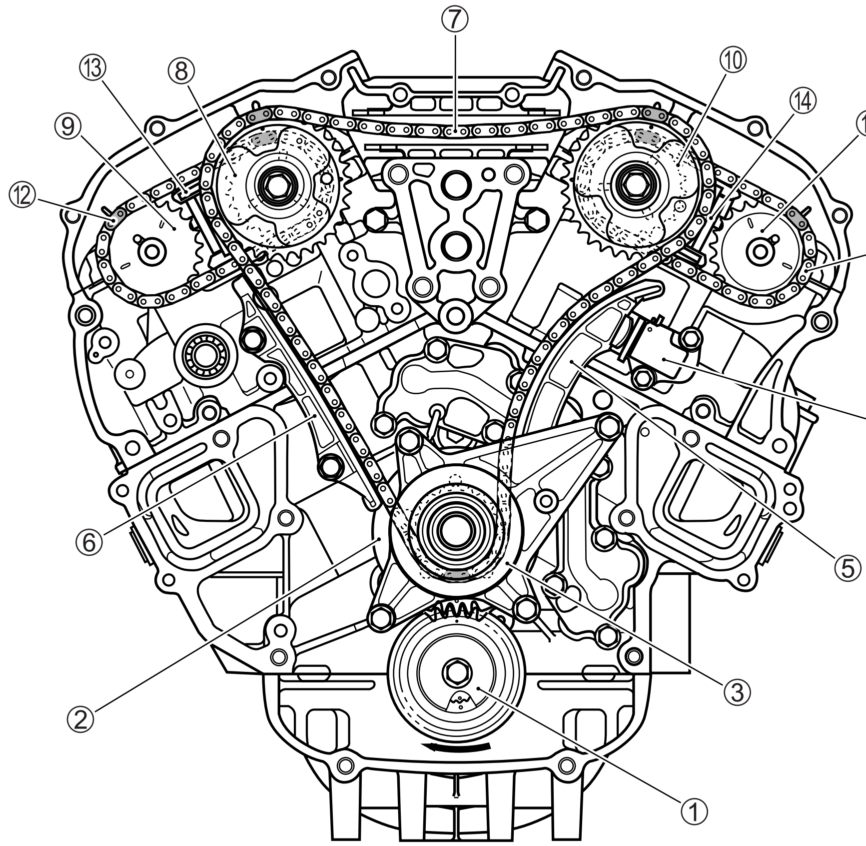


- Install cylinder head cover. (See page 6-5.)

TIMING CHAIN

REMOVAL

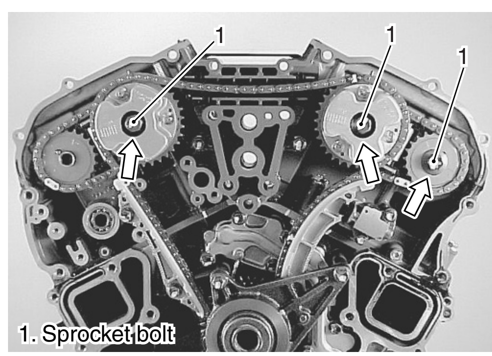
Prior to this service work:
- **Remove the power unit. (See page 6-11 to 6-17.)**



① Crankshaft/Drive gear
② Driven gear/Timing sprocket
③ Driven gear holder
④ Chain tensioner adjuster No. 1
⑤ Timing chain tensioner
⑥ Timing chain guide No. 2
⑦ 1st timing chain
⑧ IN. Camshaft timing sprocket (PORT)
⑨ EX. Camshaft timing sprocket (PORT)
⑩ IN. Camshaft timing sprocket (STBD)
⑪ EX. Camshaft timing sprocket (STBD)
⑫ 2nd timing chain
⑬ PORT chain tensioner
⑭ STBD chain tensioner

1. Remove the cylinder head cover. (See page 6-3 to 6-4.)
2. Remove the oil pump. (See page 6-22 to 6-23.)
3. Loosen the bolts securing IN./EX. camshaft timing sprockets to each cam shaft.

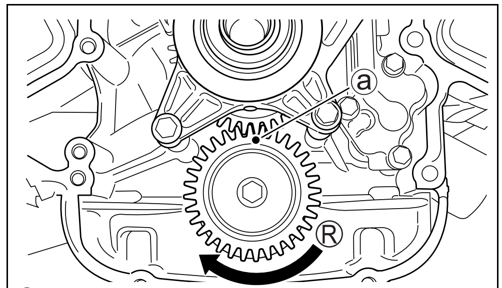
NOTE:
- *Sprocket bolt is LH thread.*
- *Hold camshaft by placing a wrench on the hexagon area of the camshaft.*



4. Turn the crankshaft in its normal running direction (Ⓡ_LH direction) until the match mark (•) on the crankshaft drive gear points to 12 o'clock (toward cylinder head).

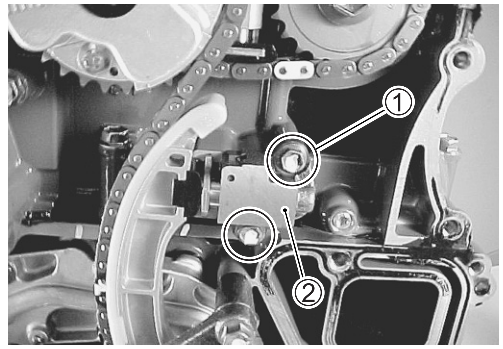
CAUTION

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

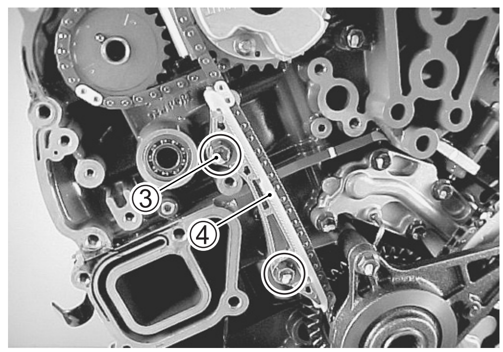


ⓐ Match mark (•) on crankshaft drive gear
Ⓡ Engine normal running direction

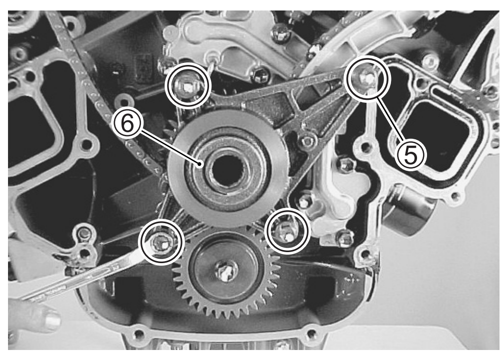
5. Remove the bolts ① and chain tensioner adjuster No. 1 ②.



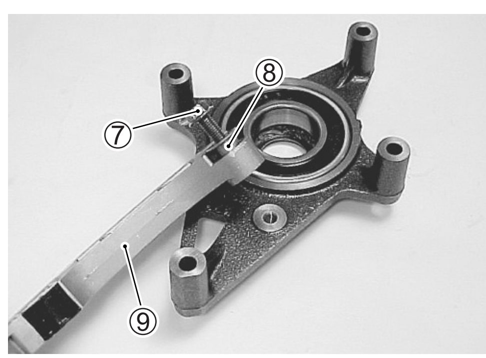
6. Remove the bolts ③ and timing chain guide No. 2 ④.



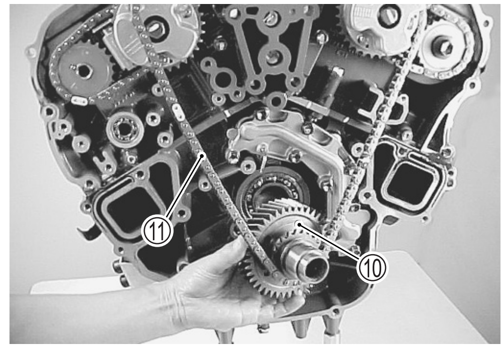
7. Remove the four (4) bolts ⑤ securing driven gear holder ⑥, then remove the driven gear holder (with timing chain tensioner).



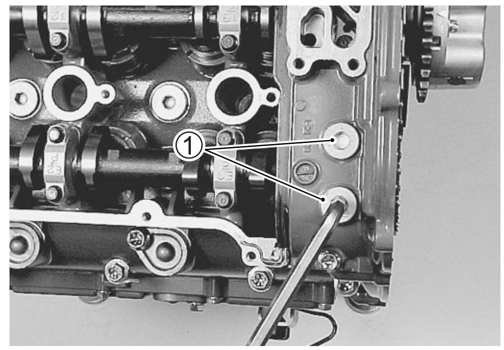
8. Remove the bolt ⑦, spacer ⑧ and timing chain tensioner ⑨.



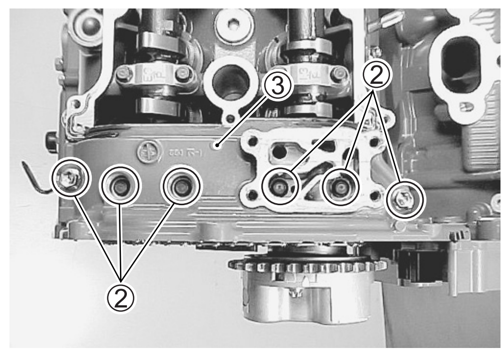
9. Remove the driven gear ⑩ and 1st timing chain ⑪.



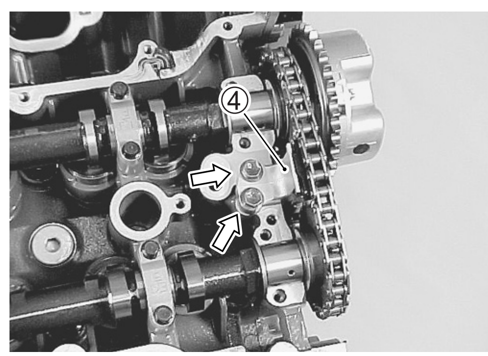
10. [On the PORT side bank]
    • Remove two (2) plugs ①.



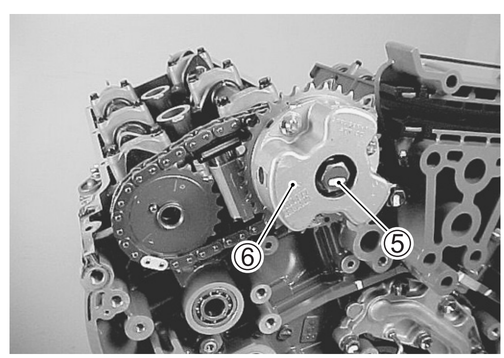
    • Remove the bolts ② securing lower camshaft housing ③, then remove the lower camshaft housing and dowel pins.



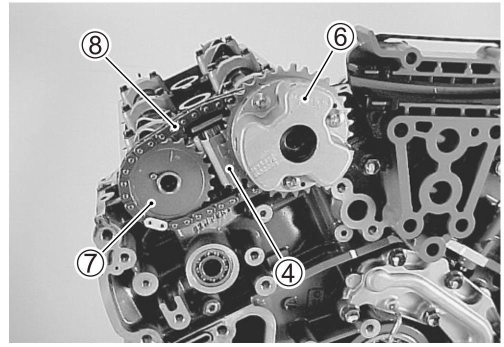
    • Remove two (2) bolts securing PORT chain tensioner ④.



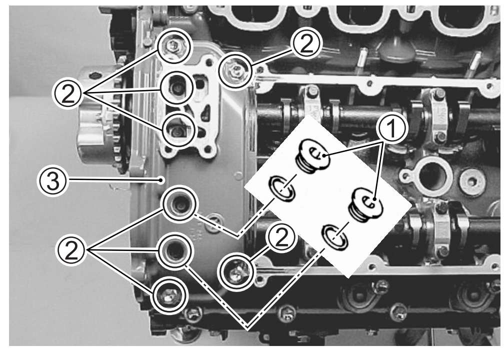
    • Remove the bolt ⑤ securing IN. camshaft timing sprocket ⑥.



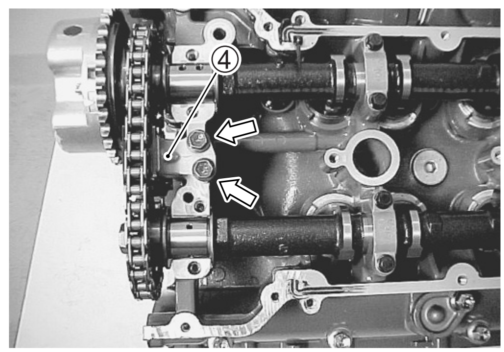
- Remove the IN. camshaft timing sprocket ⑥, EX. camshaft timing sprocket ⑦, 2nd timing chain ⑧ and PORT chain tensioner ④.
- Remove dowel pins from IN./EX. camshaft.



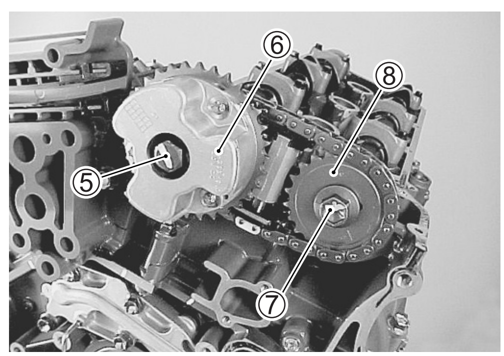
11. [On the STBD side bank]
    - Remove two (2) plugs ①.
    - Remove the bolts ② securing lower camshaft housing ③, then remove the lower camshaft housing and dowel pins.



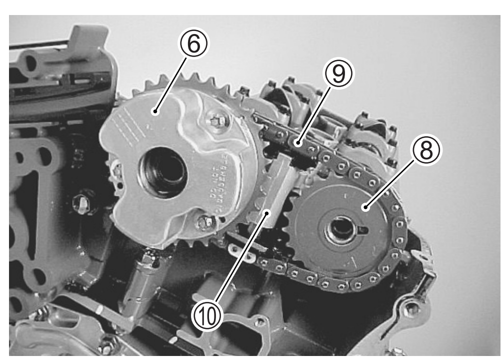
- Remove two (2) bolts securing STBD chain tensioner ④.



- Remove the bolt ⑤ securing IN. camshaft timing sprocket ⑥.
- Remove the bolt ⑦ securing EX. camshaft timing sprocket ⑧.



- Remove the IN. camshaft timing sprocket ⑥, EX. camshaft timing sprocket ⑧, 2nd timing chain ⑨ and STBD chain tensioner ⑩.
- Remove dowel pins from IN./EX. camshaft.



INSPECTION

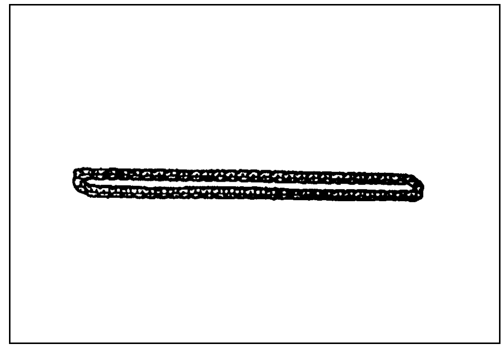
NOTE:
If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

1ST TIMING CHAIN

- Inspect 1st timing chain.
  Replace if worn excessively or damaged.

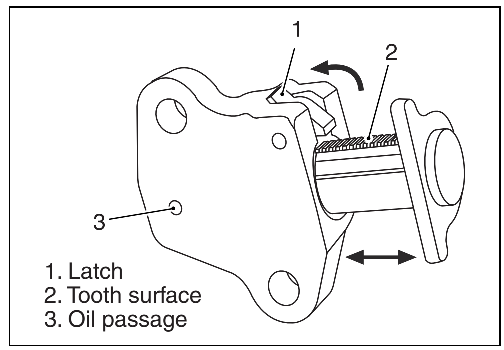
2ND TIMING CHAIN

- Inspect 2nd timing chain.
  Replace if worn excessively or damaged.



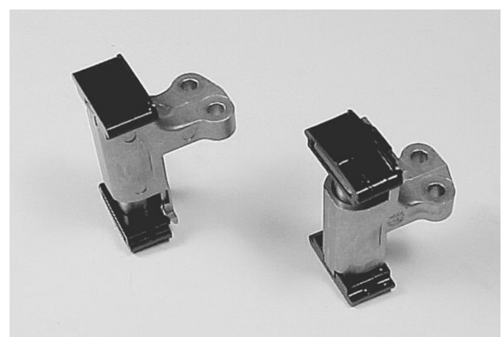
TENSIONER ADJUSTER NO. 1

- Inspect tensioner adjuster for smooth operation.
  Replace if faulty.
  Check oil delivery passage to tensioner.



PORT/STBD CHAIN TENSIONER

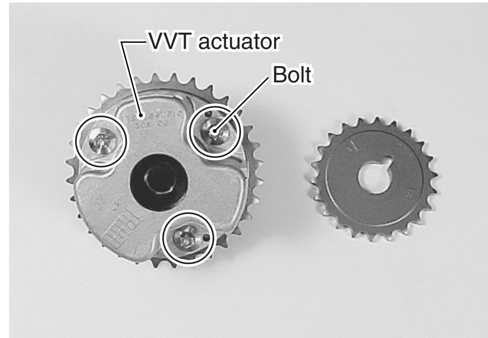
- Inspect chain tensioner for smooth operation.
  Replace if faulty.



TIMING CHAIN TENSIONER/CHAIN GUIDE NO. 2

- Check chain guide shoe for wear or damage.
  If excessive wear or other damage is found, replace it.

CAMSHAFT TIMING SPROCKET

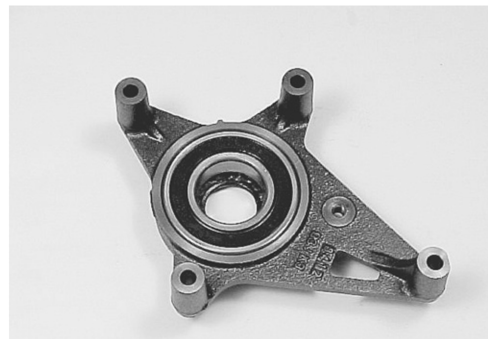


- Check teeth of sprocket for wear or damage.
  If excessive wear or other damage is found, replace it.

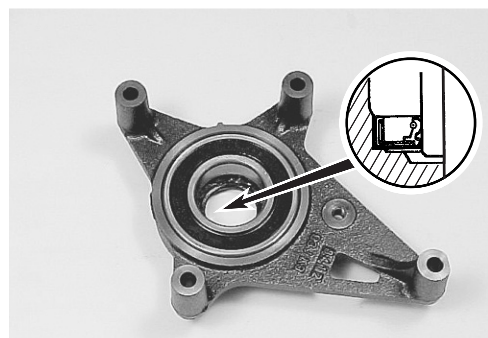
CAUTION

Do not attempt to remove bolts or disassemble the VVT actuator.

DRIVEN GEAR HOLDER

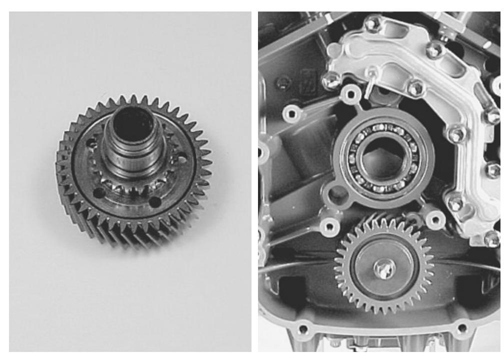


- Check driven gear holder.
  If cracks or other damage is found, replace holder.
- Check driven gear bearing.
  Replace bearing if pitted, noisy, or rough condition.
- Check oil seal.
  If excessive wear or other damage is found, replace oil seal.



NOTE:
Install oil seal lip (spring side) facing as shown in figure.

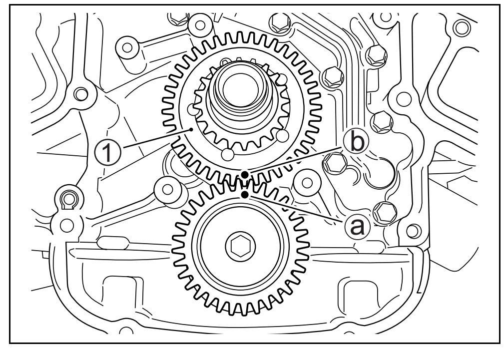
DRIVE GEAR/DRIVEN GEAR/BEARING



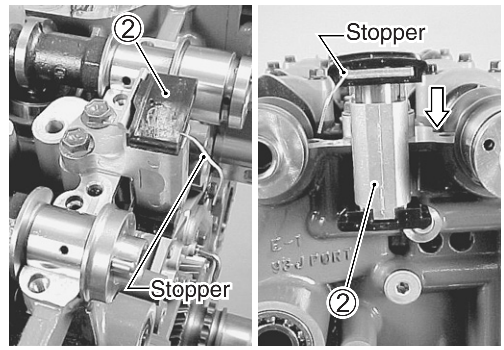
- Inspect drive and driven gears.
  Replace gear if damaged or worn excessively.
- Check driven gear bearing.
  Replace bearing if pitted, noisy, or rough condition.

INSTALLATION

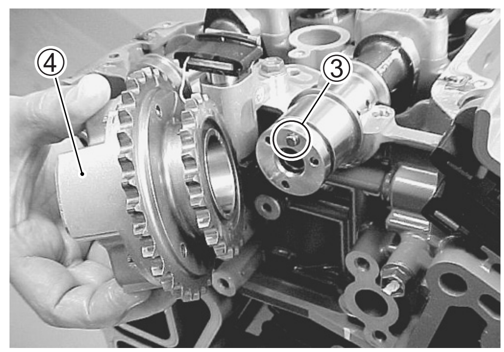
Installation is reverse of removal with special attention to following steps.



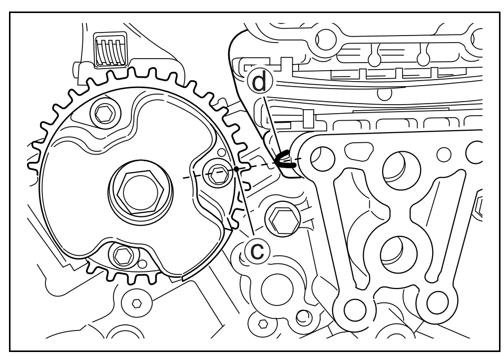
1. Check that the match mark (•) ⓐ on the crankshaft drive gear points to 12 o'clock (towards cylinder head).
2. Install the driven gear ① on the cylinder block so that the match mark (•) ⓐ aligns with match mark (•) ⓑ on the driven gear as shown in the illustration.



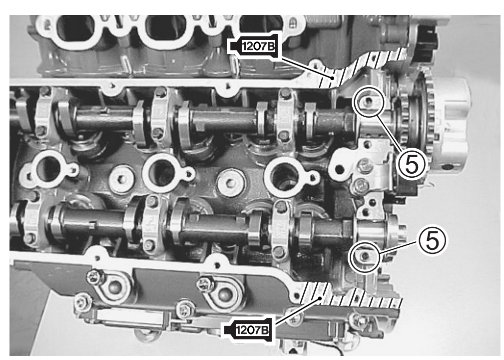
3. On the PORT side bank:
   (1) Install PORT tensioner ② and secure with bolts.
   (2) With plunger pushed back into body, insert stopper into body as shown in the illustration.
   After inserting stopper, check to make sure that plunger will not come out.



   (3) On the IN. camshaft, fit the dowel pin ③ and IN. camshaft timing sprocket ④ and tighten the sprocket temporarily with the bolt.
   Check that the match marks ⓒ · ⓓ are correctly aligned as shown in the illustration.



   Match mark ⓒ: ••
   Match mark ⓓ: <



   (4) Remove oil, old sealant, and dust from sealing surface.
   (5) Apply sealant to lower camshaft housing sealing surface area as shown in figure.
   Install camshaft housing pins ⑤.

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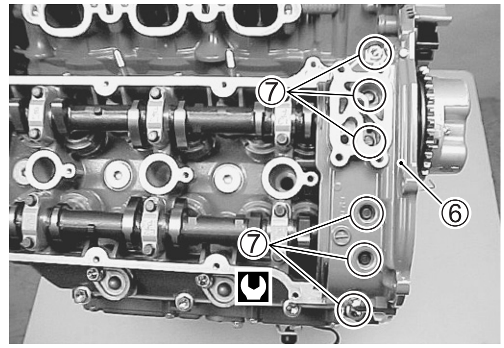
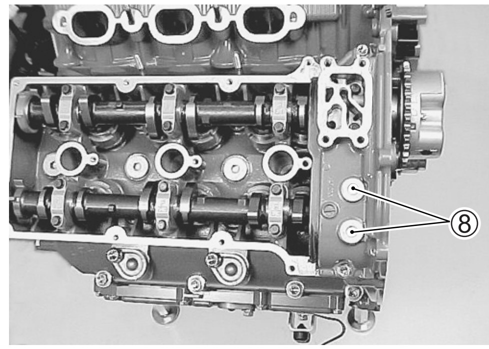
(6) Install lower camshaft housing ⑥.
Tighten lower camshaft housing bolts ⑦, pre-coated with engine oil, to specified torque.

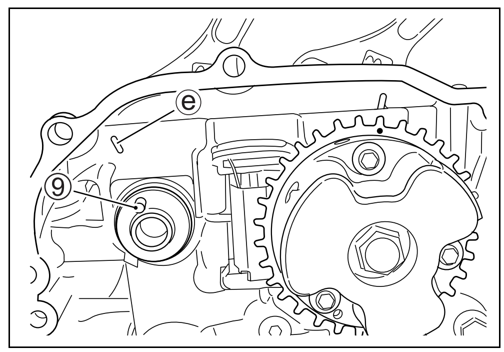
Camshaft housing bolt: 12 N·m (1.2 kg-m, 8.6 lb-ft)



(7) Install gasket and plugs ⑧ in lower camshaft housing.

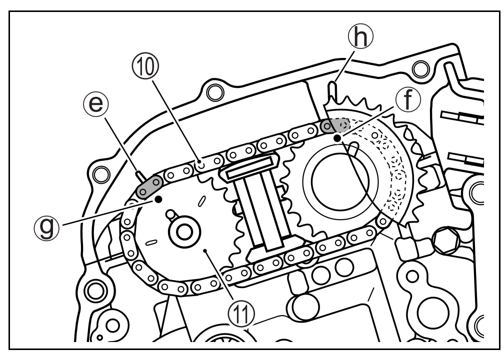


(8) Fit the dowel pin ⑨ on the EX. camshaft.
Check that the dowel pin is correctly aligned with the match mark ⓔ on the lower camshaft housing as shown in the illustration.

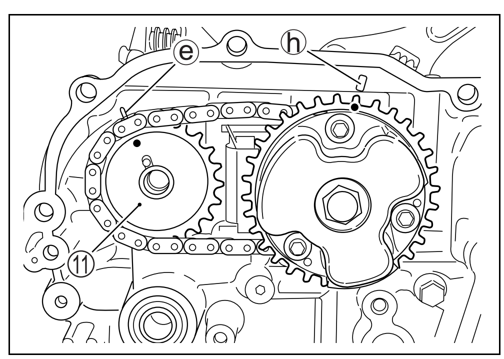


(9) Align the yellow plate of 2nd timing chain ⑩ with the match mark (•) ⓕ on the IN. camshaft timing sprocket and fit the chain on the sprocket.
(10)Align the yellow plate of 2nd timing chain with the match mark (•) ⓖ on the EX. camshaft timing sprocket ⑪ and fit the chain on the sprocket.

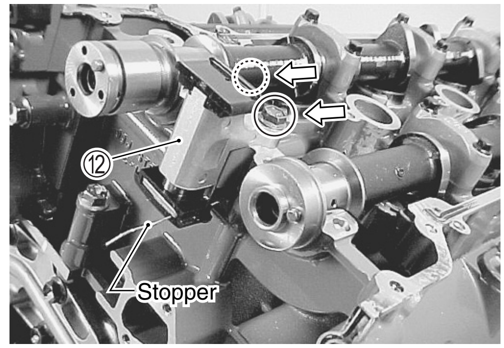
NOTE:
Install the sprocket so that the match mark and slit mark are both visible.



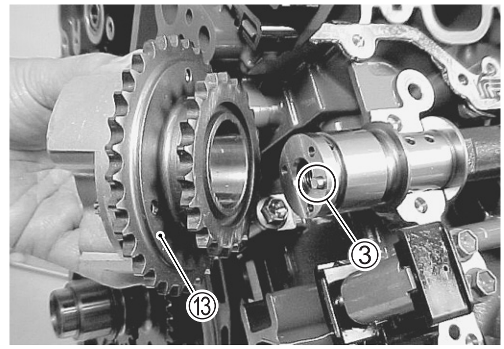
(11) Install the EX. camshaft timing sprocket ⑪ on the EX. camshaft.
Check that two yellow plates of the chain are correctly aligned with the match marks ⓔ/ⓗ on the camshaft housing as shown in the illustration.
(12) Remove the stopper from PORT tensioner.
(13) Apply engine oil to 2nd chain.



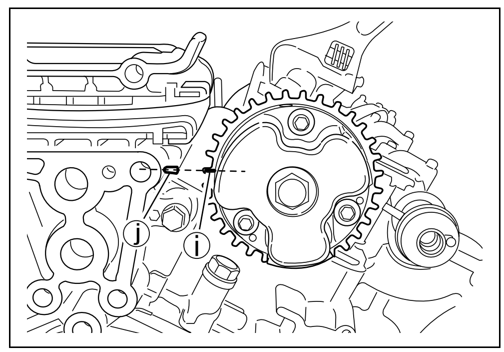
4. On the STBD side bank:
   (Install the STBD side 2nd timing chain in the same manner as the PORT side bank.)
   (1) Install STBD tensioner ⑫ and secure with bolts.
   (2) With plunger pushed back into body, insert stopper into body as shown in the illustration.
   After inserting stopper, check to make sure that plunger will not come out.



   (3) On the IN. camshaft, fit the dowel pin ③ and IN. camshaft timing sprocket ⑬ and tighten the sprocket temporarily with the bolt.
   Check that the match marks ⓘ/ⓙ are correctly aligned as shown in the illustration.



Match mark ⓘ:
Match mark ⓙ:



   (4) Remove oil, old sealant, and dust from sealing surface.
   (5) Apply sealant to lower camshaft housing sealing surface area as shown in figure.
   Install camshaft housing pins ⑭.

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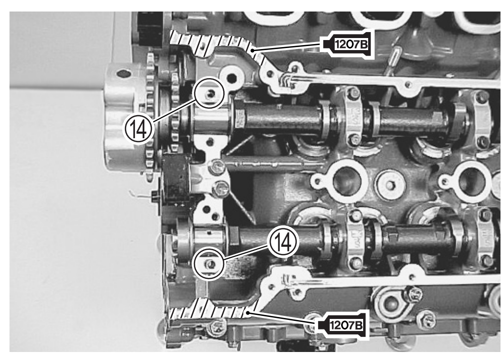
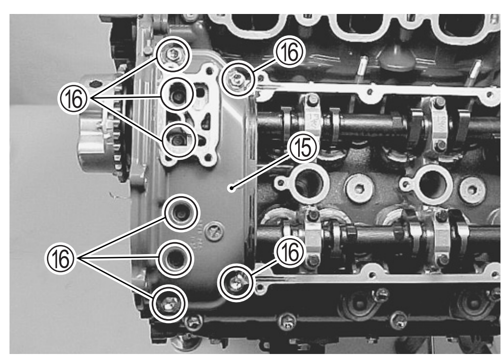
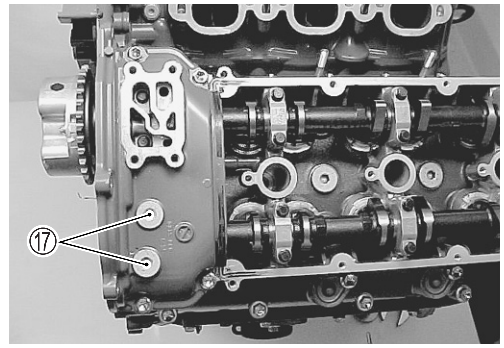


   (6) Install lower camshaft housing ⑮.
   Tighten lower camshaft housing bolts ⑯, pre-coated with engine oil, to specified torque.

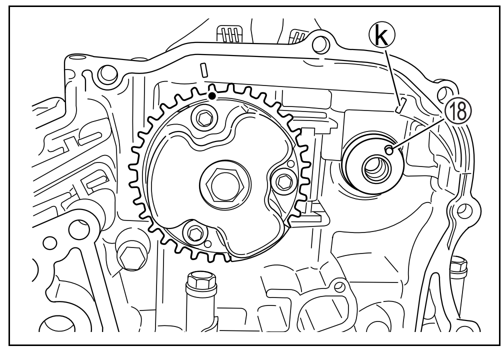
Camshaft housing bolt: 12 N·m (1.2 kg-m, 8.6 lb-ft)



(7) Install gasket and plugs ⑰ in lower camshaft housing.



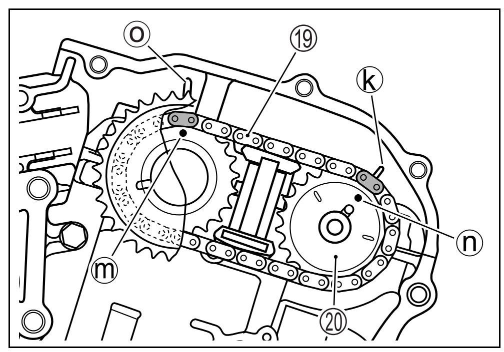
(8) Fit the dowel pin ⑱ on the EX. camshaft.
Check that the dowel pin is correctly aligned with the match mark ⓚ on the lower camshaft housing as shown in the illustration.



(9) Align the yellow plate of 2nd timing chain ⑲ with the match mark (•) ⓜ on the IN. camshaft timing sprocket and fit the chain on the sprocket.

(10) Align the yellow plate of 2nd timing chain with the match mark (•) ⓝ on the EX. camshaft timing sprocket ⑳ and fit the chain on the sprocket.

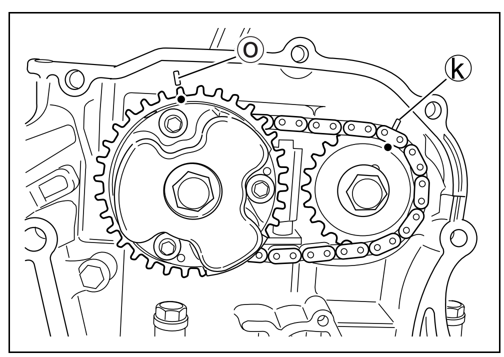
NOTE:
Install the sprocket so that the match mark and slit mark are both visible.



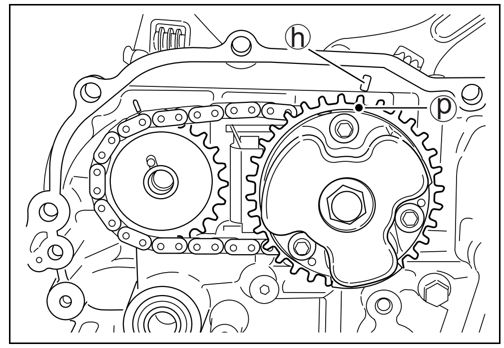
(11) Install the EX. camshaft timing sprocket ⑳ on the EX. camshaft, then tighten sprocket temporarily with the bolt.
Check that two yellow plates of the chain are correctly aligned with the match marks ⓞ/ⓚ on the camshaft housing as shown in the illustration.

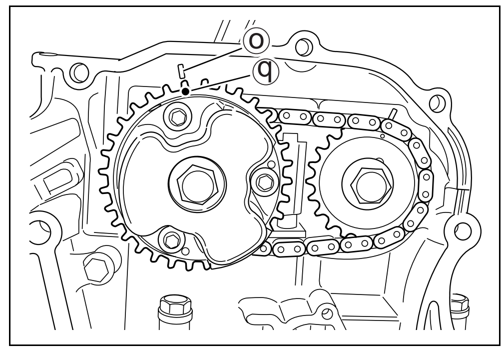
(12) Remove the stopper from STBD tensioner.

(13) Apply engine oil to 2nd chain.

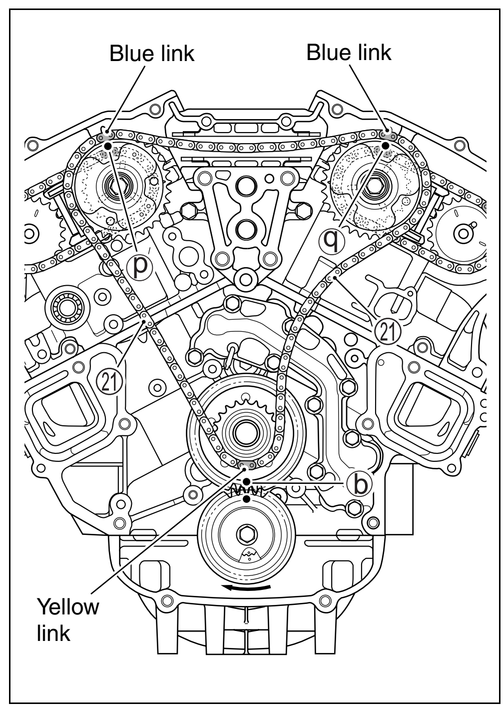


5. Check that the match marks (•) ⓟ/ⓠ on both the PORT & STBD side IN. camshaft timing sprockets are correctly aligned with the match marks ⓗ·ⓞ on the camshaft housing as shown in the illustration.

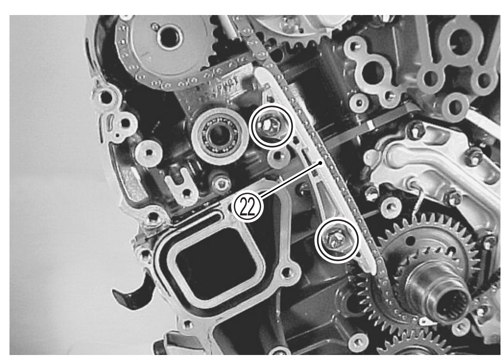




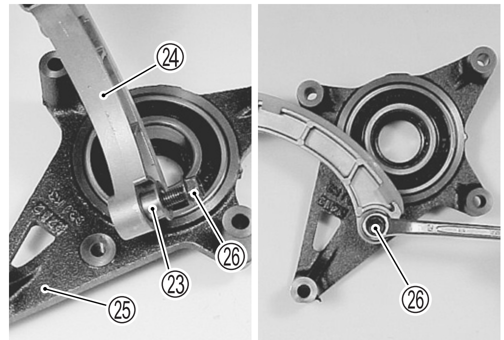
6. As shown in the illustration, fit the 1st timing chain ㉑ with one blue link aligned with the match mark (•) ⓟ on the PORT side IN. camshaft timing sprocket and one blue link aligned with the match mark (•) ⓠ on the STBD side IN. camshaft timing sprocket.
7. As shown in the illustration, fit the 1st timing chain with its yellow link aligned with the match mark (•) ⓑ on the driven gear.



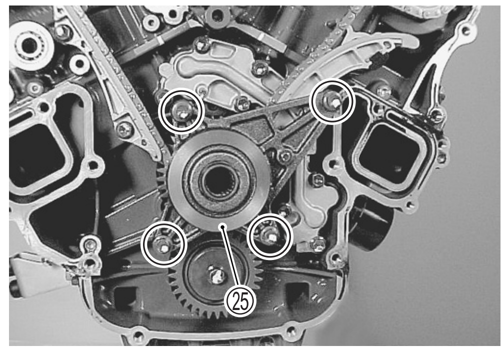
8. Install No. 2 timing chain guide ㉒, then tighten bolts securely. Apply engine oil to chain guide.



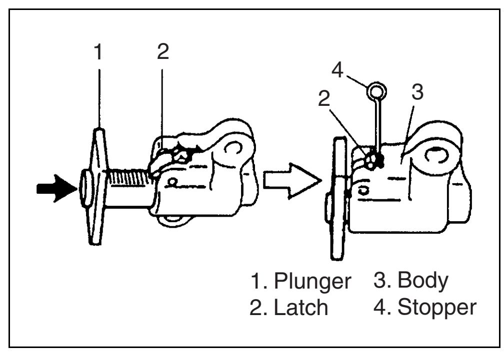
9. Insert the spacer ㉓ into chain tensioner ㉔.
   Install chain tensioner to driven gear holder ㉕, then tighten bolt ㉖ securely.
   Apply engine oil to chain tensioner.



10. Install driven gear holder ㉕, then tighten four (4) bolts securely.



11. With latch of tensioner adjuster ㉗ 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.

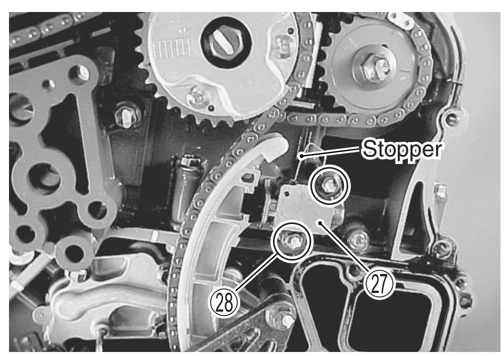


12. Install timing chain tensioner adjuster ㉗, then tighten bolts ㉘ to specified torque.

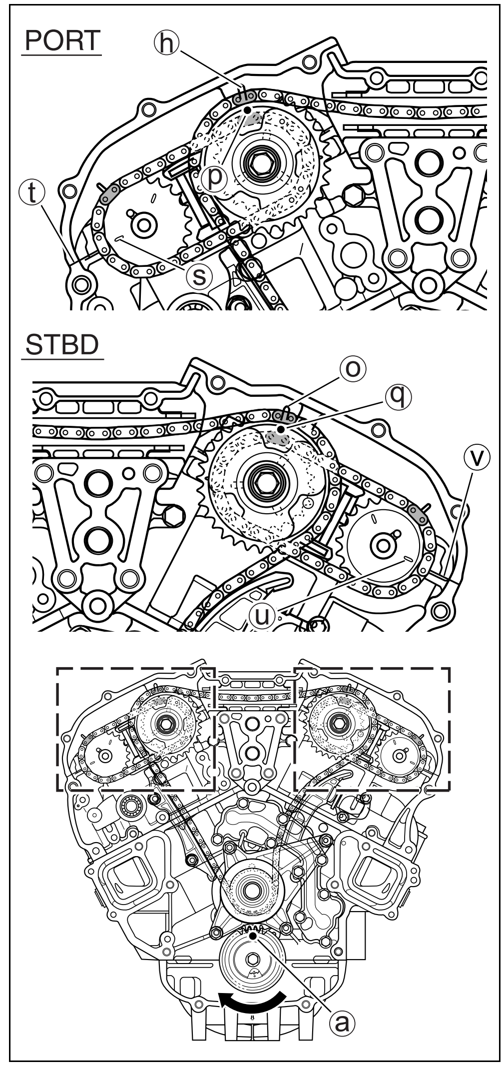
Tensioner adjuster bolt: 11 N·m (1.1 kg-m, 8.0 lb-ft)

Apply engine oil to timing chain.

13. Remove the stopper from tensioner adjuster.



14. Turn the crankshaft two (2) complete rotations in direction shown in figure.
    As shown in the illustration, check that all match marks are in alignment as written below when the match mark (•) ⓐ on the drive gear is pointing to 12 o'clock.
    - The match mark (•) ⓟ on the PORT side IN. sprocket aligns with the match mark ⓗ on the camshaft housing.
    - The match mark (•) ⓠ on the STBD side IN. sprocket aligns with the match mark ⓞ on the camshaft housing.
    - The match mark (slit) ⓢ on the PORT side EX. sprocket aligns with the mating face ⓣ of lower camshaft housing.
    - The match mark (slit) ⓤ on the STBD side EX. sprocket aligns with the mating face ⓥ of lower camshaft housing.

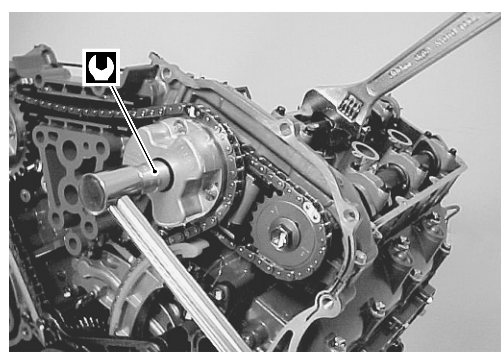


15. Tighten PORT/STBD IN. camshaft timing sprocket bolts to specified torque.

IN. camshaft timing sprocket bolt:
60 N·m (6.0 kg-m, 43.4 lb-ft)

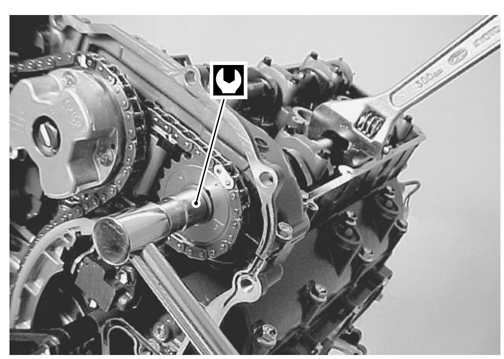
CAUTION

Do not over tighten to avoid damaging VVT actuator.



16. Tighten PORT/STBD EX. camshaft timing sprocket bolts to specified torque.

EX. camshaft timing sprocket bolt:
78 N·m (7.8 kg-m, 56.4 lb-ft)



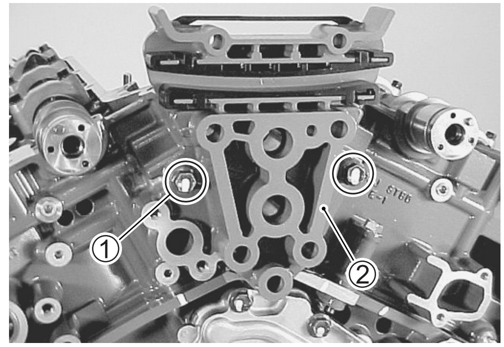
CYLINDER HEAD ASSEMBLY

(Cylinder head/valve/camshaft)

REMOVAL

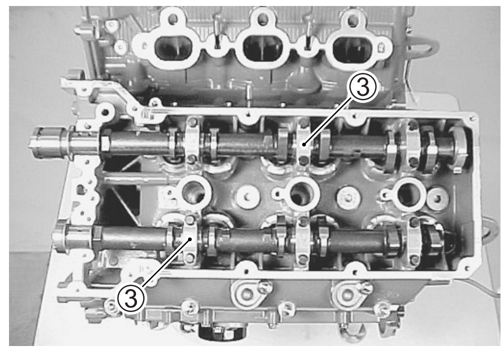
Prior to removing cylinder head:
- **Remove the power unit. (See page 6-11 to 6-17.)**
- **Remove the timing chain. (See page 6-27 to 6-30.)**

1. Remove the bolts ① and timing chain guide base ②.



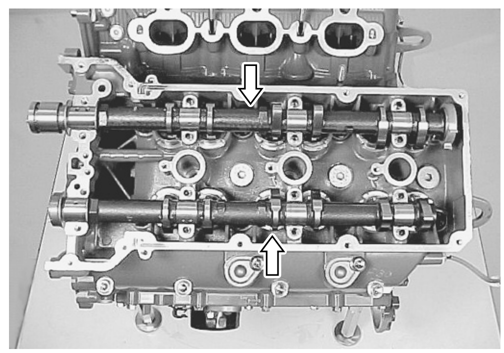
2. Remove the bolts securing the camshaft housing ③ to cylinder head, then remove each camshaft housing.

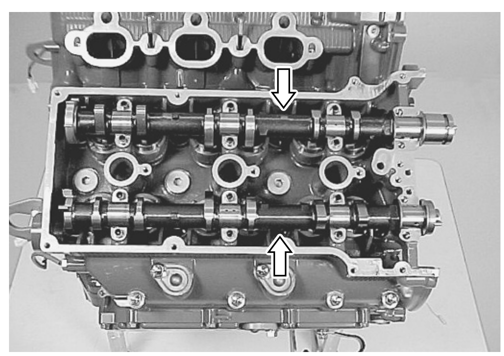
NOTE:
For ease of assembly, note position of each individual camshaft housing.



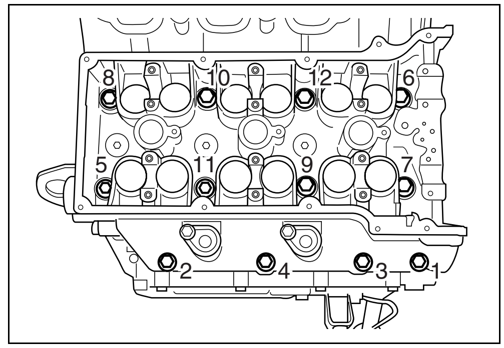
3. Remove intake/exhaust camshafts, tappets and tappet shims.

NOTE:
For ease of assembly, lay out tappets and record shim thickness for each individual cylinder/valve position.

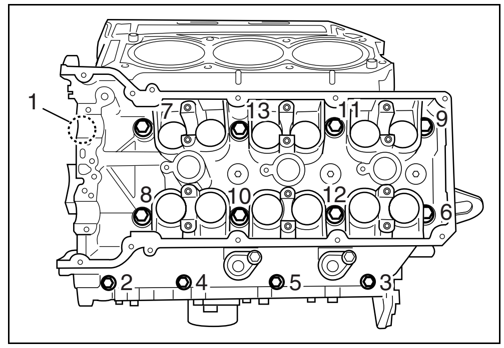




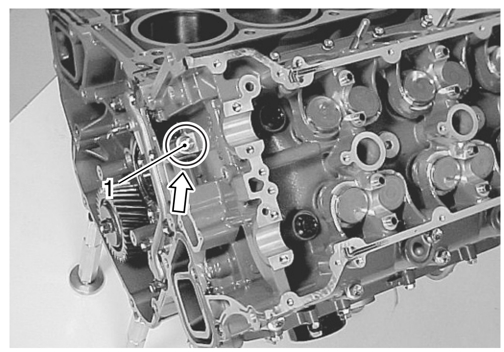
4. On the PORT side bank, loosen and remove twelve (12) cylinder head bolts in the order indicated in figure.
   Remove cylinder head assembly and head gasket.



5. On the STBD side bank, loosen first, then remove thirteen (13) cylinder head bolts according to sequence in figure. Remove cylinder head assembly and head gasket.



NOTE:
Do not forget to remove bolt in shown figure.



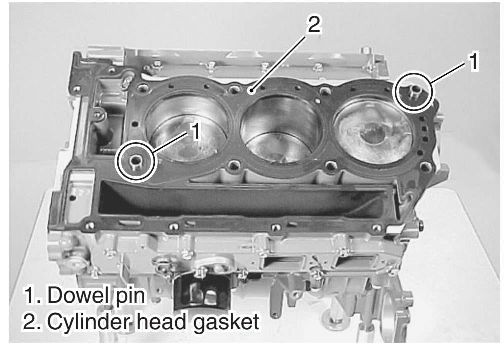
ASSEMBLY

Assemble in reverse order of removal paying special attention to the following steps.

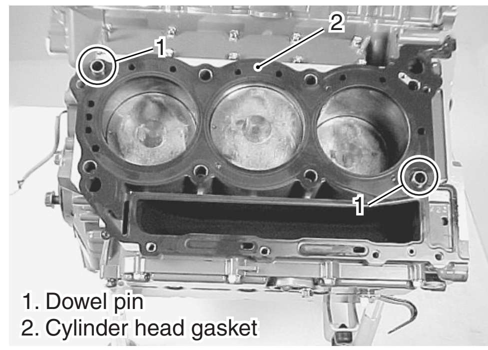
CAUTION

Do not reuse gasket. Always use a new gasket.

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



1. Dowel pin
2. Cylinder head gasket



1. Dowel pin
2. Cylinder head gasket

NOTE:
Before installing cylinder head gasket, apply sealant to both surfaces of the hatched areas shown in illustration.

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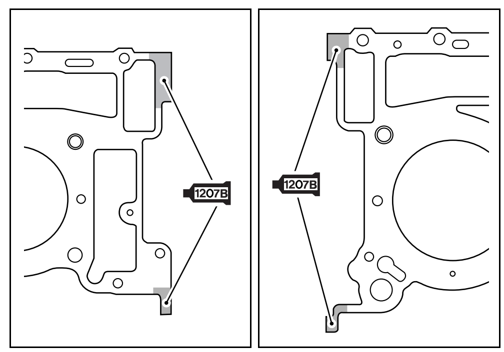
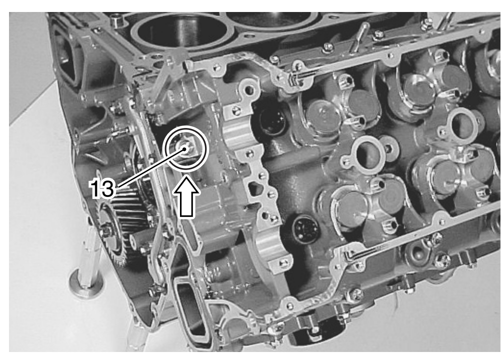


2. Position cylinder head on cylinder.
3. Apply engine oil to cylinder head bolts and tighten them gradually as follows.

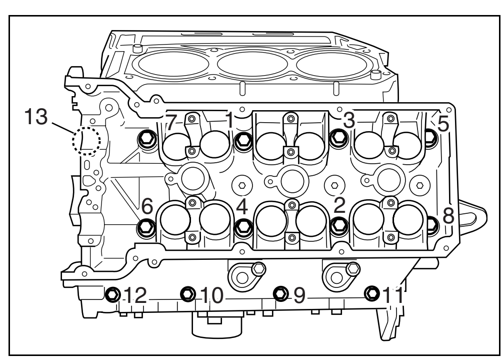
NOTE:
Do not forget to install bolt shown in figure.



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

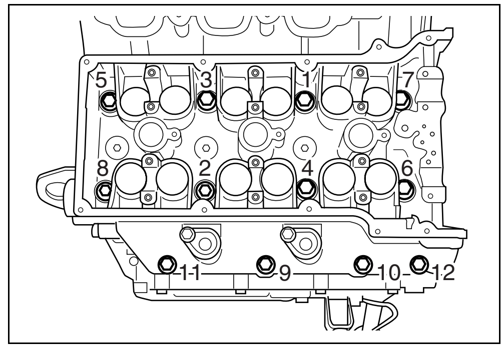
Cylinder head bolt:

1st step 11 mm 43 N·m (4.3 kg-m, 31.1 lb-ft)
8 mm 12 N·m (1.2 kg-m, 8.7 lb-ft)



(b) Loosen all bolts to 0 N·m (0 kg-m, 0 lb-ft) according to reverse sequence in figure.

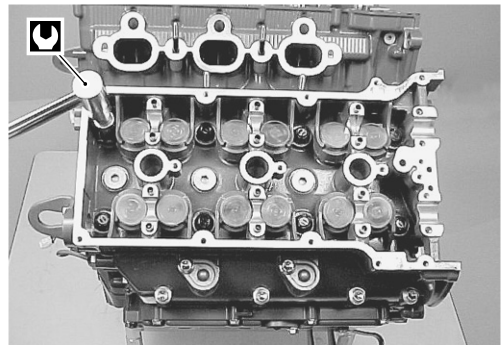
(c) Again tighten all bolts to 50 percent (%) of specified torque according to sequence in figure.



Cylinder head bolt:

3rd step	**11 mm**	**43 N·m (4.3 kg-m, 31.1 lb-ft)**
	8 mm	**12 N·m (1.2 kg-m, 8.7 lb-ft)**

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

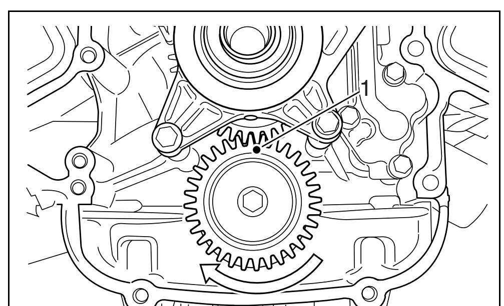


Cylinder head bolt:

Final step	**11 mm**	**86 N·m (8.6 kg-m, 62.2 lb-ft)**
	8 mm	**23 N·m (2.3 kg-m, 16.6 lb-ft)**

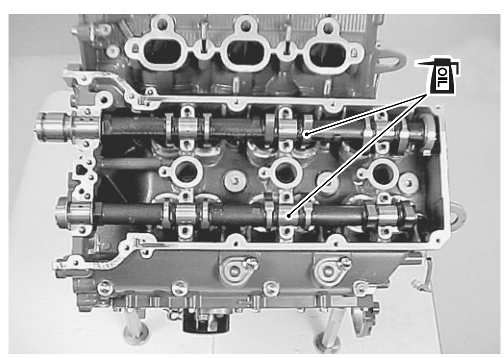
4. Apply engine oil around tappets and install in their original position.
   Install tappet shims in their original position.

NOTE:
Before installing camshafts, turn crankshaft until the match mark (•) on the crankshaft drive gear points to 12 o'clock (toward cylinder head).

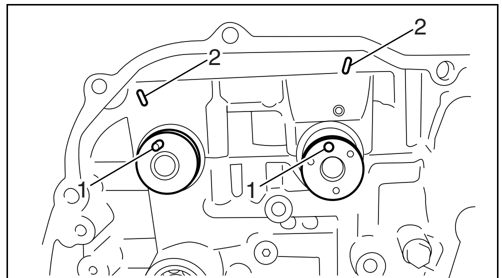


1. Match mark (•) on drive gear

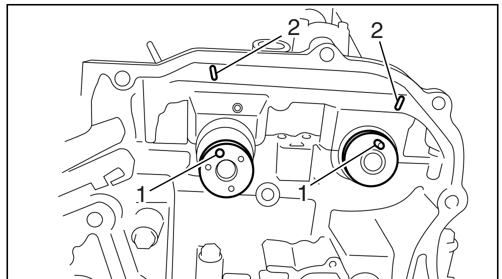
5. Apply engine oil to the surface of each camshaft lobe and journal, then install them as shown in figure.



NOTE:
When installing the camshaft, aligns dowel pin on the camshafts with the match mark on lower camshaft housing.

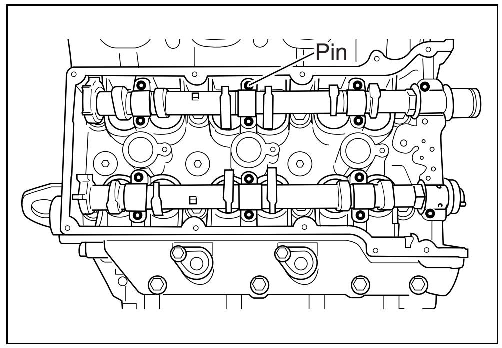


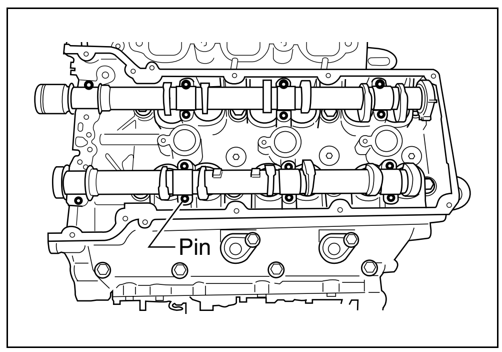
1. Dowel pin on camshaft
2. Match mark on lower camshaft housing



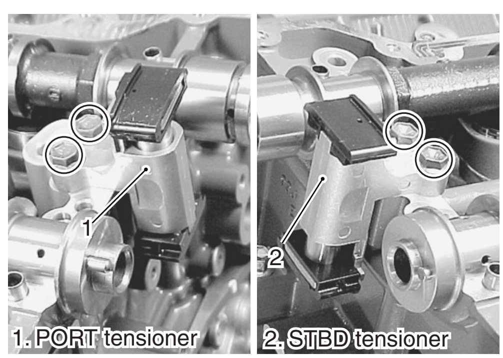
1. Dowel pin on camshaft
2. Match mark on lower camshaft housing

6. Install camshaft housing pins as shown in figure.





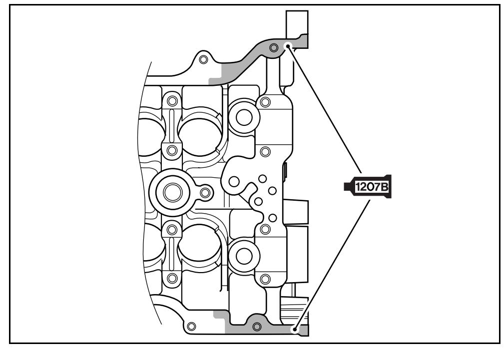
7. Install PORT tensioner and bolts, then tighten bolts securely. Install STBD tensioner and bolts, then tighten bolts securely.

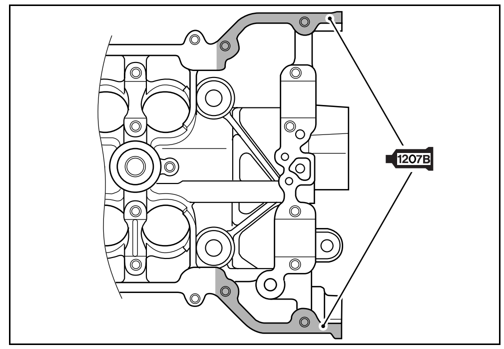


1. PORT tensioner
2. STBD tensioner

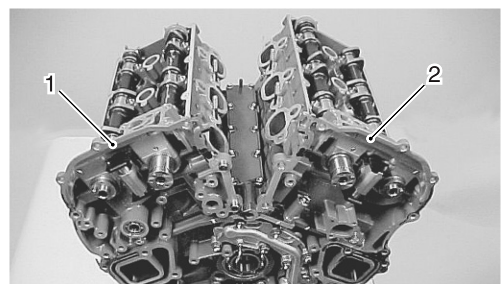
8. Apply sealant to lower camshaft housing sealing surface area as shown in figure.

1207B **99000-31140: SUZUKI BOND "1207B"**





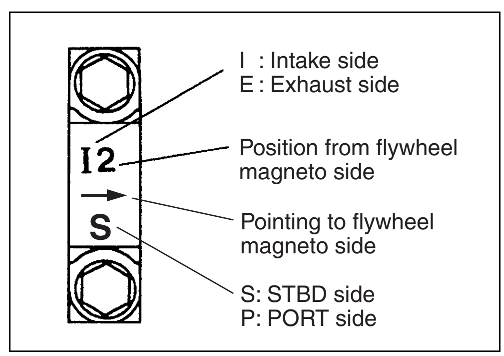
9. Install the lower camshaft housing.



1. Lower camshaft housing PORT
2. Lower camshaft housing STBD

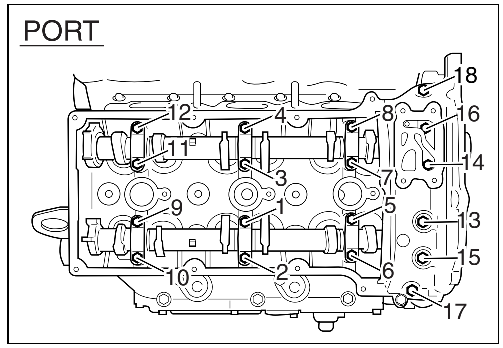
10. Check position of camshaft housing.
    - Embossed marks are provided on each camshaft housing indicating position and direction of installation.

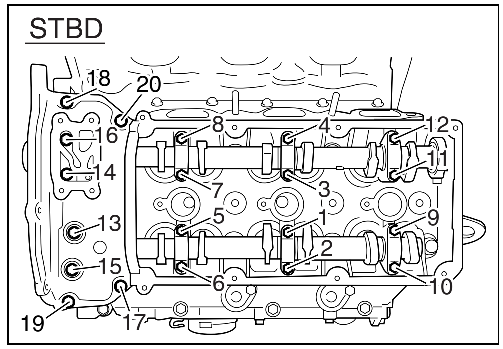
    Install housings as indicated by these marks.



11. Apply engine oil to housing bolts.
12. Lightly seat all housing bolts at first.
    Following sequence 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: 12 N·m (1.2 kg-m, 8.7 lb-ft)

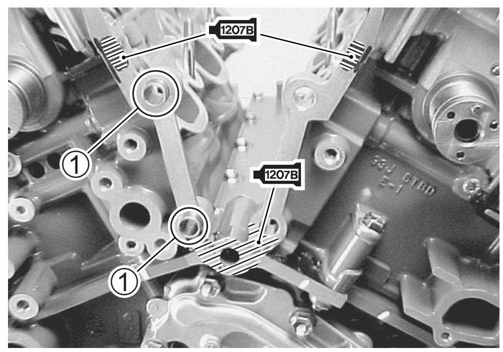


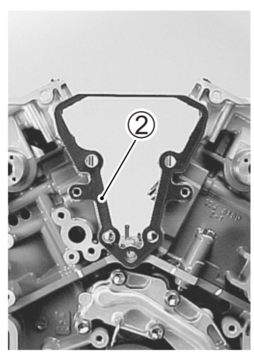


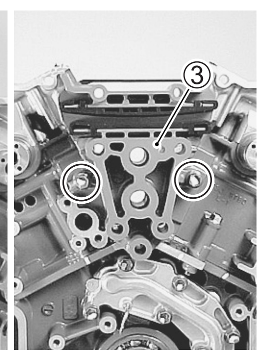
13. Install dowel pins ①, gasket ② and timing chain guide base ③, then tighten bolts securely.

NOTE:
Before installing timing chain guide base, apply sealant to hatched areas shown in illustration.

1207B 99000-31140: SUZUKI BOND "1207B"







14. Install timing chain. (See page 6-33.)

15. Install oil pump assembly. (See page 6-26.)

16. Check tappet clearance and adjust as necessary.
    (See page 2-9.)

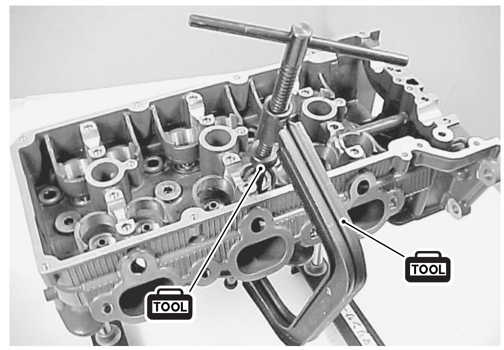
DISASSEMBLY

1. Remove tappets with shims.

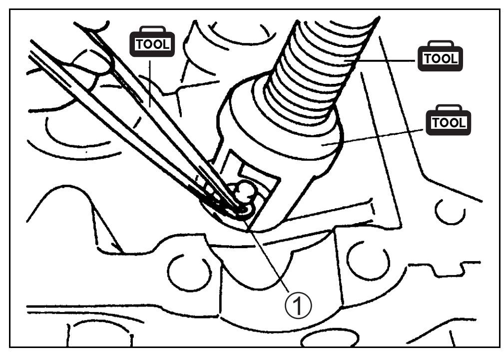
NOTE:
For ease of assembly, lay out tappets and record shim thickness for each individual cylinder/valve position.

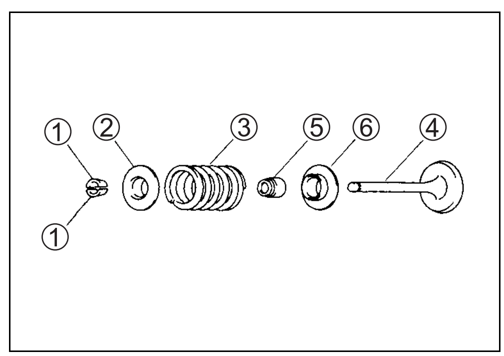
2. Using valve lifter and attachment, remove valve cotters ① while compressing valve spring.

TOOL **09916-14510: Valve lifter**
09916-14521: Attachment
09916-84511: Tweezers



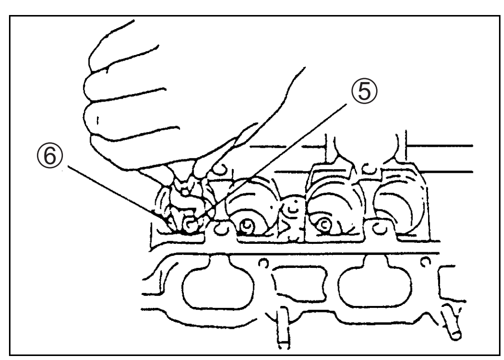
3. Remove valve spring retainer ②, valve spring ③ and valve ④.





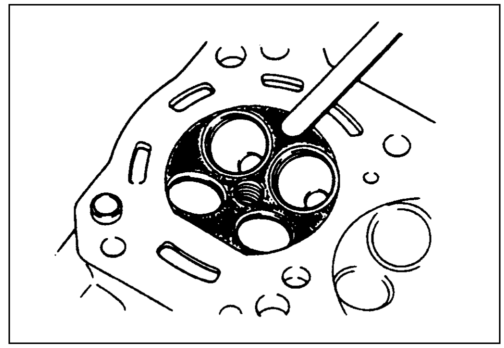
4. Remove valve stem seal ⑤ and valve spring seat ⑥.

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



INSPECTION/SERVICING

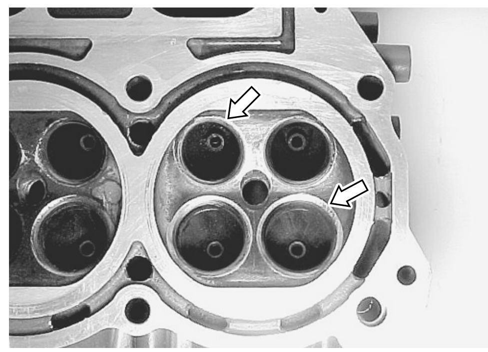
NOTE:
If cracks, excessive wear or other damage is found on any component, replace component.



CYLINDER HEAD

Remove all carbon from combustion chambers.

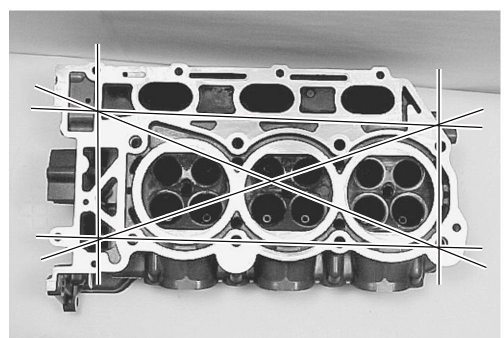
NOTE:
- *Do not use any sharp edged tool to scrape carbon off cylinder head or its components.*
- *Be careful not to scuff or nick metal surfaces when decarboning.*



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

Valve seat

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

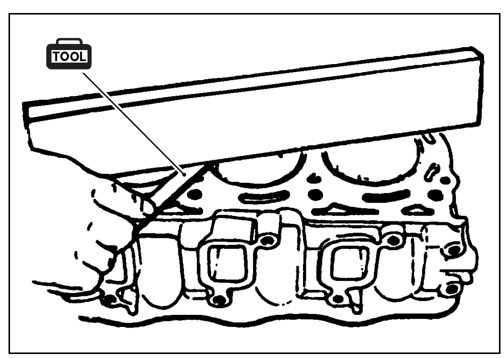


Cylinder head distortion

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

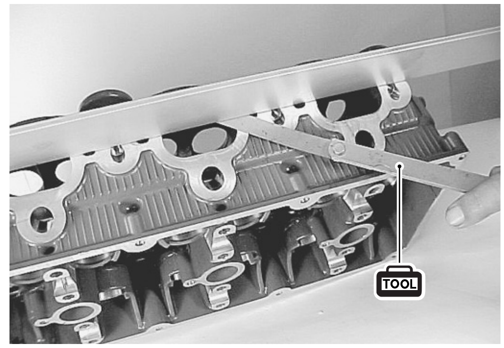
TOOL **09900-20803: Thickness gauge**

Cylinder head distortion
Service limit: 0.03 mm (0.001 in)



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

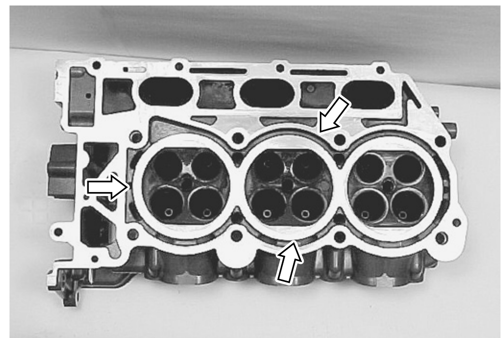
Manifold seating faces distortion
Using a straightedge and thickness gauge, check cylinder head to manifold seating faces.



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

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

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



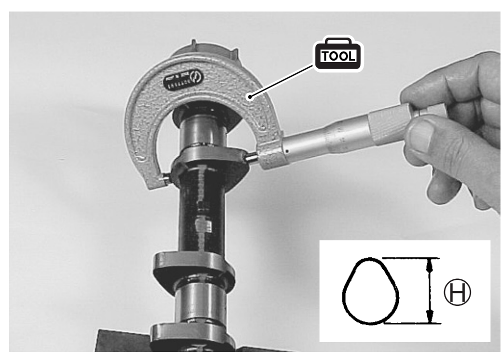
CAMSHAFT
Cam face
Inspect cam face for scratches and wear.

Cam wear
Using micrometer, measure cam height Ⓗ.

TOOL **09900-20202: Micrometer**

Cam height
Standard:
DF300 IN. 45.330 – 45.490 mm (1.7846 – 1.7909 in)
EX. 44.420 – 44.580 mm (1.7488 – 1.7551 in)

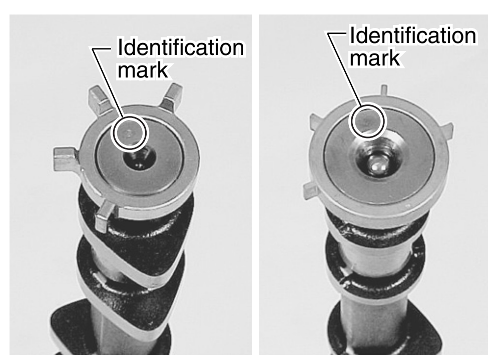
Service limit
DF300 IN. 45.230 mm (1.7807 in)
EX. 44.320 mm (1.7449 in)



If measurement exceeds service limit, replace camshaft.

Camshaft identification
DF200/225/250 and DF300 camshafts differ as indicated below.

Model	Identification mark	
	IN.	EX.
DF200	0	0
DF225	1	0
DF250	2	2
DF300	8	8



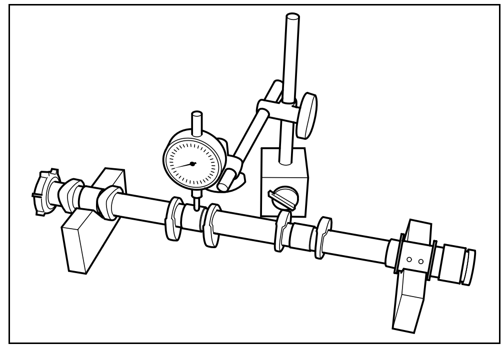
Camshaft runout

Support camshaft on a surface plate using a set of V-blocks.
Measure runout using a dial gauge.

09900-20606: Dial gauge
: "V" block set
09900-20701: Magnetic stand

Camshaft runout
Service limit: 0.10 mm (0.004 in)

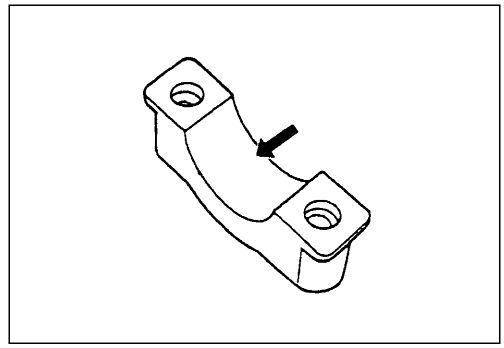
If measurement exceeds service limit, replace camshaft.



CAMSHAFT JOURNAL

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

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

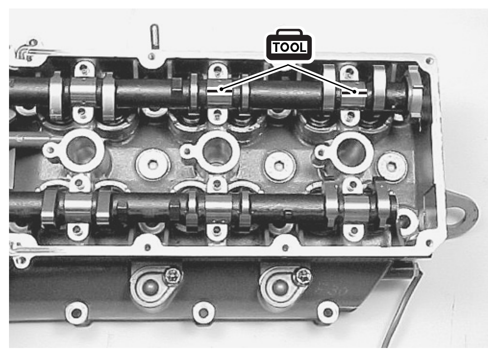


Camshaft journal oil clearance

Check journal oil clearance using Plastigauge as follows.

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

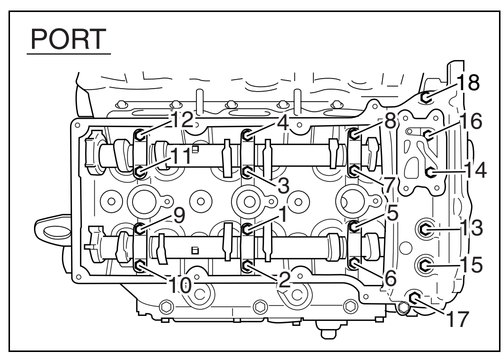
09900-22302: Plastigauge

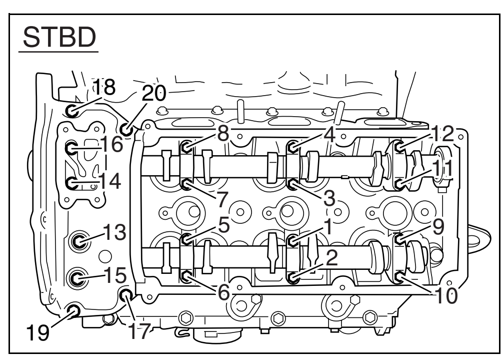


4. Install camshaft housing. Tighten housing bolts in 3 steps (1/3 of specification, 2/3 of specification, full torque specification) in the indicated order.

Camshaft housing bolt: 12 N·m (1.2 kg-m, 8.6 lb-ft)

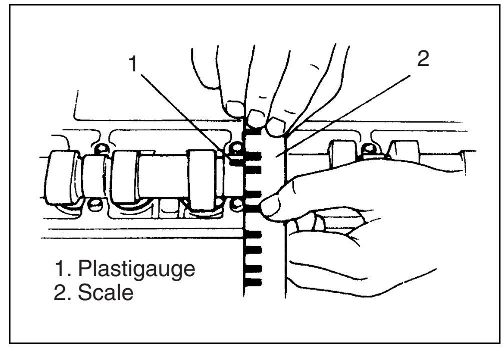
NOTE:
Do not rotate camshaft while Plastigauge is installed.





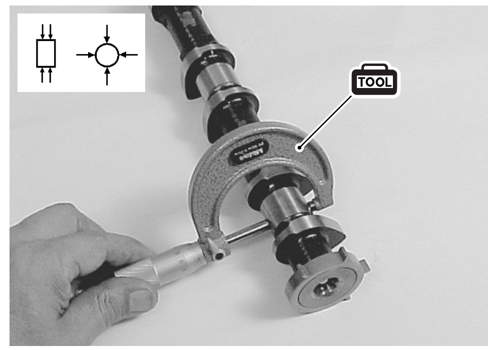
5. Remove camshaft housing.
6. Using scale on Plastigauge envelope, measure Plastigauge at its widest point.

Camshaft journal oil clearance
Standard: 0.043 – 0.085 mm (0.0017 – 0.0033 in)
Service limit: 0.120 mm (0.0047 in)



1. Plastigauge
2. Scale

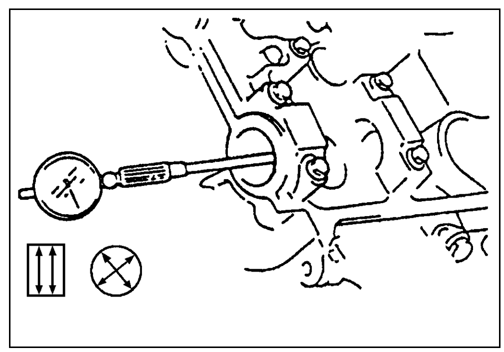
If journal oil clearance exceeds the service limit, measure camshaft journal (outside dia.) and camshaft housing (inner dia.). Based on measurements, replace camshaft and/or cylinder head with camshaft housing.



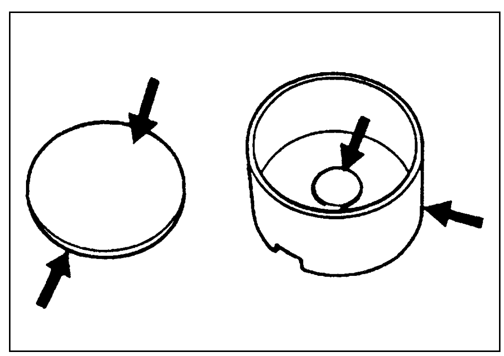
09900-20202: Micrometer (25 – 50 mm)

Camshaft journal outside diameter
Standard: 25.936 – 25.957 mm (1.0211 – 1.0219 in)

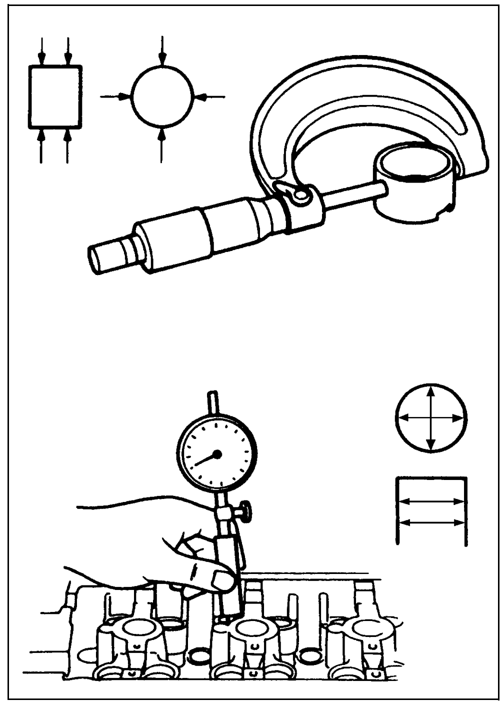
Camshaft journal (housing) inside diameter
Standard: 26.000 – 26.021 mm (1.0236 – 1.0244 in)



TAPPET/TAPPET SHIM
Wear of tappet and shim
Check tappet and shim for pitting, scratches, or damage.
If any above conditions are found, replace component.



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



TOOL **09900-20202: Micrometer**

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

Cylinder head bore to tappet clearance
Standard: 0.025 – 0.066 mm (0.0010 – 0.0026 in)
Service limit: 0.150 mm (0.0059 in)

Tappet outer diameter
Standard: 33.959 – 33.975 mm (1.3370 – 1.3376 in)

Cylinder head bore
Standard: 34.000 – 34.025 mm (1.3386 – 1.3396 in)

VALVE/VALVE GUIDE

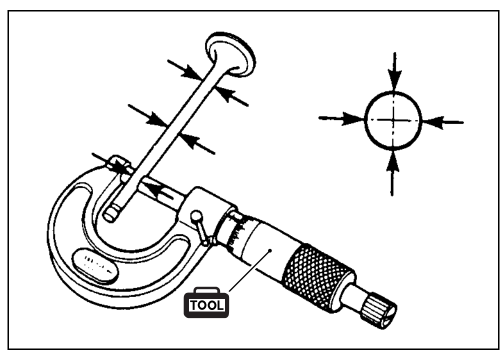
Valve guide to valve stem clearance

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

TOOL **09900-20205: Micrometer**

Valve stem outside diameter

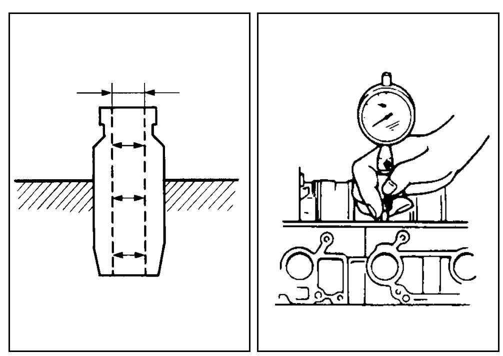
Using micrometer, measure valve stem outside diameter.



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

Valve guide inside diameter

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



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

Valve guide to valve stem clearance

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

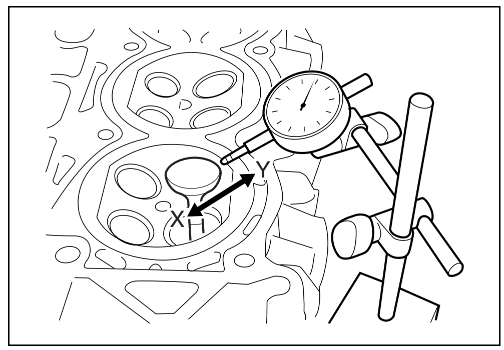
Service limit:
IN. 0.070 mm (0.0028 in)
EX. 0.090 mm (0.0035 in)

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

NOTE:
For valve guide replacement, see “VALVE GUIDE REPLACEMENT” section on page 6-56.

Valve stem deflection

If unable to measure valve guide inside diameter, check “Valve stem deflection”.



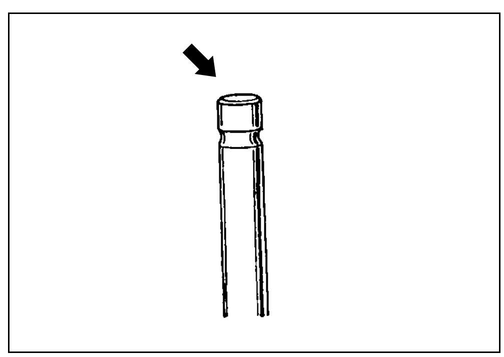
TOOL **09900-20606: Dial gauge**
09900-20701: Magnetic stand

Measure valve stem deflection as follows:
(1) Install valve into valve guide.
(2) Position valve head at approx. 5 mm away from valve seat.
(3) Move valve head in the direction “X – Y”, and measure deflection.

Valve stem deflection
Service limit:
IN. 0.14 mm (0.0055 in)
EX. 0.18 mm (0.0071 in)

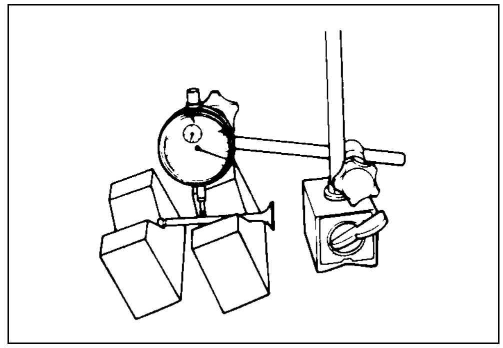
If measurement exceeds service limit, replace valve.
If measurement still exceeds service limit with new valve, replace valve guide.

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.

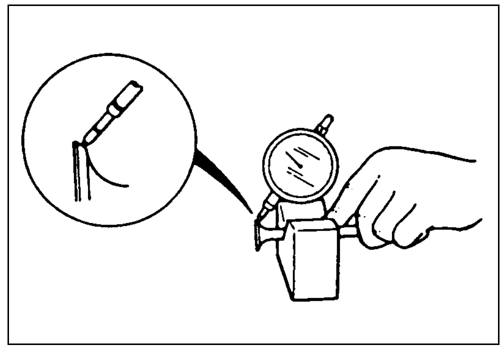


TOOL **09900-20606: Dial gauge**
09900-20701: Magnetic stand
09900-21304: "V" block set

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.

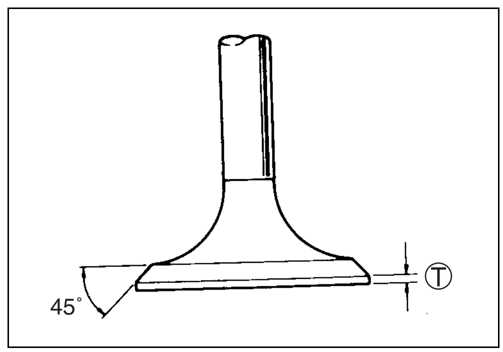


TOOL **09900-20606: Dial gauge**
09900-20701: Magnetic stand
09900-21304: "V" block set

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.

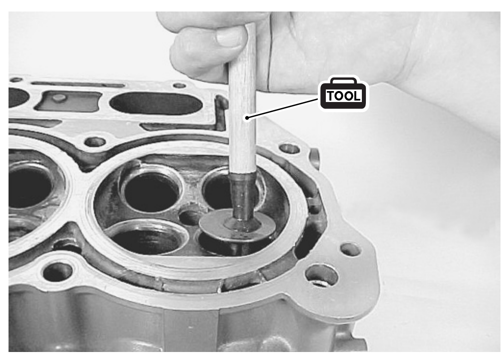


TOOL **09900-20101: Vernier calipers**

Valve head thickness
Standard:
IN. 1.1 mm (0.0433 in)
EX. 1.05 mm (0.0394 in)
Service limit:
IN. 0.7 mm (0.0276 in)
EX. 0.7 mm (0.0276 in)

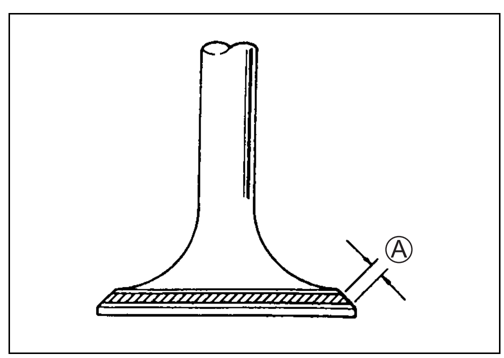
If measurement exceeds service limit, replace valve.

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

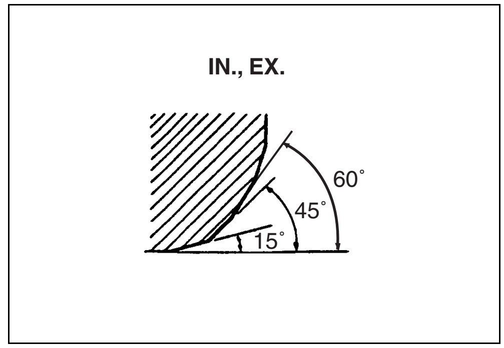
Valve seat contact width Ⓐ
Standard:
IN. & EX. 1.1 – 1.3 mm (0.0433 – 0.0512 in)

If measurement exceeds specification, repair valve seat.

NOTE:
For valve seat repair, see “Valve seat servicing” section on page 6-55.

VALVE SEAT SERVICING

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

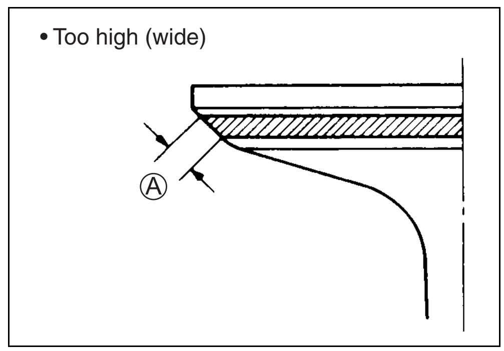


Valve seat angle
Intake side : 15°, 45°, 60°
Exhaust side : 15°, 45°, 60°

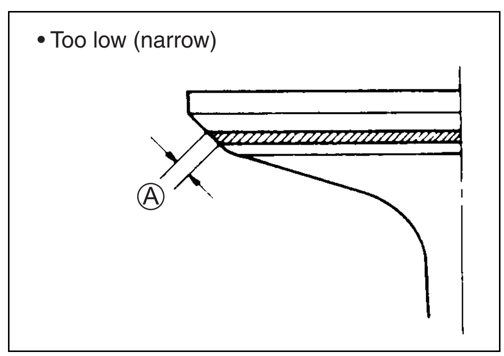
TOOL : Valve seat cutter (NEWAY128) 45°
: Valve seat cutter (NEWAY212) 15°
09916-22420: Valve seat cutter (NEWAY114) 60°
Solid pilot (NEWAY, N-150-5.5)
09916-24450: Solid pilot (NEWAY. N-100-5.52)
09916-54910: Handle (N-505)

NOTE:
Turn cutter clockwise, never counterclockwise.

(1) Remove all carbon from valve and valve seat.
(2) Using 45° angle cutter, reface valve seat.
(3) Check valve seat contact width Ⓐ.
See the “Valve seat contact width” section on page 6-54.



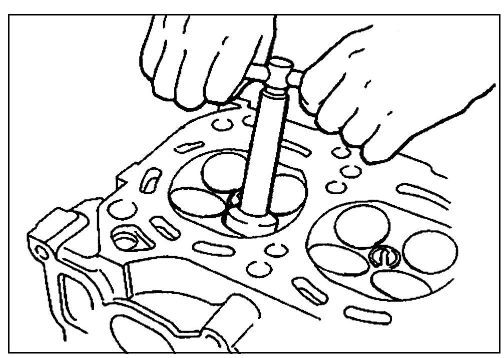
(4) • If width Ⓐ is too high (or wide), reface valve seat using 15° angle cutter.
• If width Ⓐ is too low (or narrow), reface valve seat using 60° angle cutter.



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

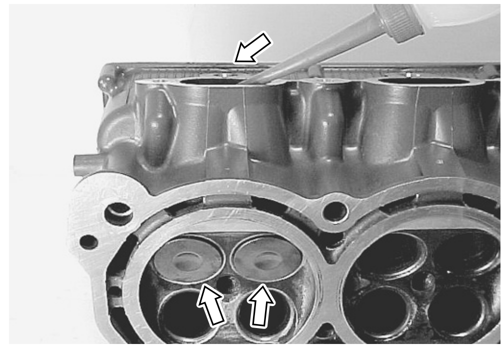
CAUTION

Cut seat areas minimally only.
Do not cut more than necessary.



(6) Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.
(7) Recheck valve seat contact width Ⓐ.

NOTE:
Clean and assemble cylinder head and valve components.
Fill intake and exhaust ports with solvent to check for leaks between valve seat and valve.
If any leaks occur, inspect valve seat and face for burrs or other things that could prevent valve from sealing.



VALVE GUIDE REPLACEMENT

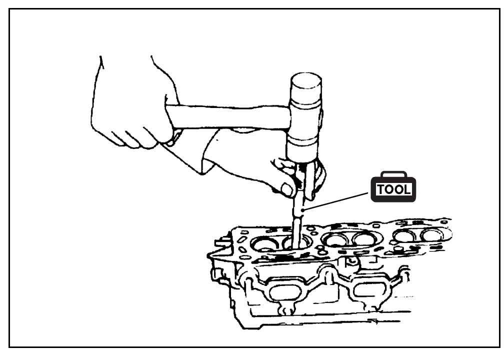
CAUTION

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

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

TOOL **09916-44310: Valve guide remover**

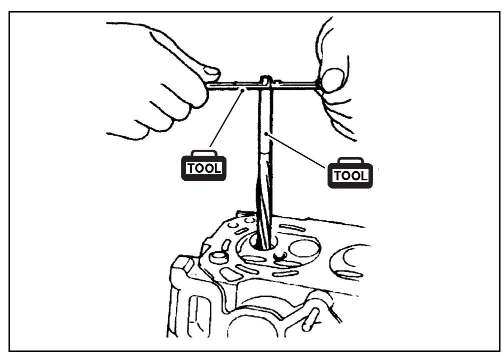
NOTE:
Do not reuse valve guide once it has been removed.
Always use a new valve guide (oversize) when assembling.



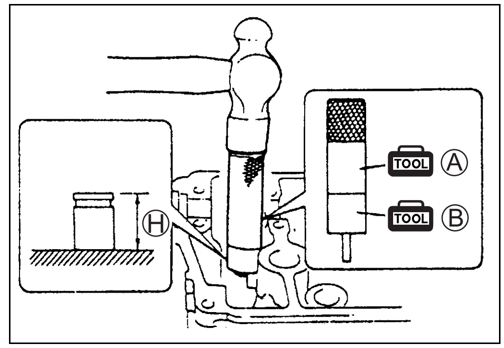
(2) Ream valve guide hole with ϕ10.5 mm reamer to true hole and remove burrs.

TOOL **09916-37320: Valve guide reamer (ϕ10.5 mm)**
09916-34542: Reamer handle

NOTE:
Turn reamer clockwise, never counterclockwise.



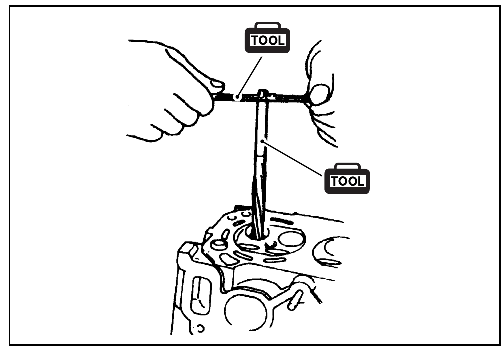
(3) Install valve guide to cylinder head.
- Heat cylinder head to a temperature of 80 – 100 °C (176 – 212 °F).
  Apply heat uniformly so that head will not be distorted.
- Use special tools to drive new valve guide into hole.
  Drive in new valve guide until special tool (valve guide installer attachment) contacts cylinder head.
- After installing, check valve guide protrusion Ⓗ.



TOOL **09916-57330: Valve guide installer handle Ⓐ**
09916-56011: Valve guide installer attachment Ⓑ

Valve guide protrusion Ⓗ
Standard:
IN. & EX. 11.5 mm (0.4528 in)

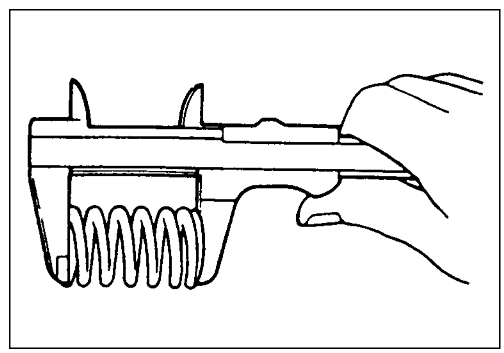
(4) Ream valve guide bore with ϕ5.5 mm reamer.



TOOL **09916-34550: Valve guide reamer (ϕ5.5 mm)**
09916-34542: Reamer handle

NOTE:
Clean and oil valve guide bore after reaming.

VALVE SPRING
Valve spring free length
Check spring strength by measuring free length.

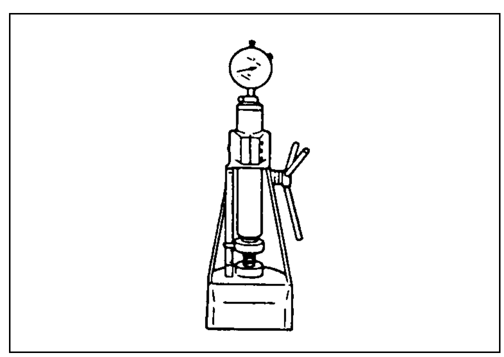


TOOL **09900-20101: Vernier calipers**

Valve spring free length
Standard:
IN. & EX. 39.75 mm (1.56 in)
Service limit:
IN. & EX. 38.20 mm (1.50 in)

If lower than service limit, replace valve spring.

Valve spring preload
Measure valve spring preload.



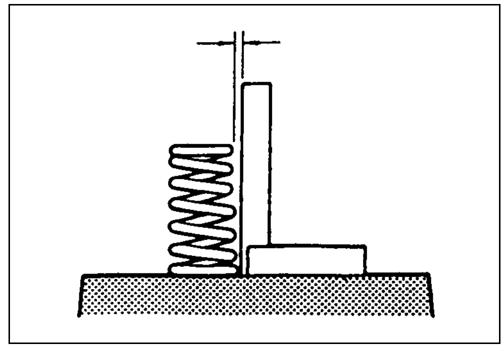
TOOL **09900-20101: Vernier calipers**

Valve spring preload
Standard:
IN. & EX. 147 – 173 N (14.7 – 17.3 kg, 32.3 – 38.1 lbs) for 31.1 mm (1.22 in)
Service limit:
IN. & EX. 136 N (13.6 kg, 29.2 lbs) for 31.1 mm (1.22 in)

If lower than service limit, replace valve spring.

Valve spring squareness

Use a square and surface plate to check each spring for squareness (clearance between end of valve spring and square).



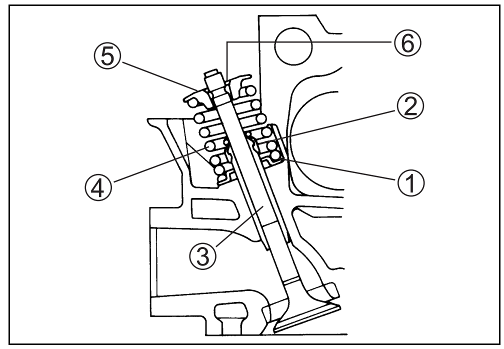
TOOL **09900-20101: Vernier calipers**

Valve spring squareness
Service limit:
IN. & EX. 2.0 mm (0.08 in)

If measurement exceeds service limit, replace valve spring.

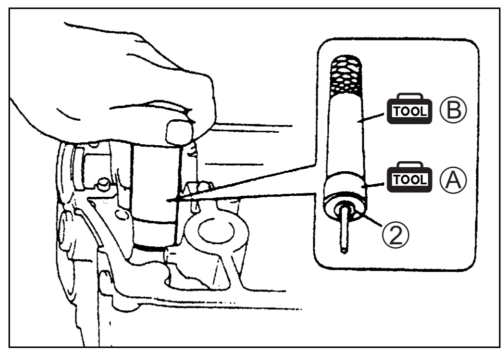
REASSEMBLY

Reassemble in reverse order of disassembly paying special attention to the following steps.



VALVE

Install valve spring seat ① to cylinder head.

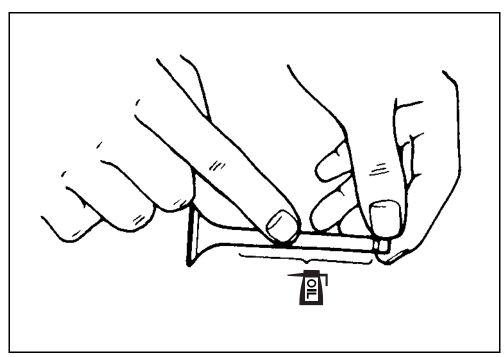


After applying engine oil to stem seal ② and spindle of special tool (Installer attachment), fit stem seal to spindle.
Then, pushing special tool by hand, install stem seal to valve guide.
Check to be sure that seal is properly fixed to valve guide.

TOOL **09917-98221: Installer attachment Ⓐ**
09916-57330: Installer handle Ⓑ

CAUTION

> **Do not reuse stem seal once removed.**
> **Always install new seal.**

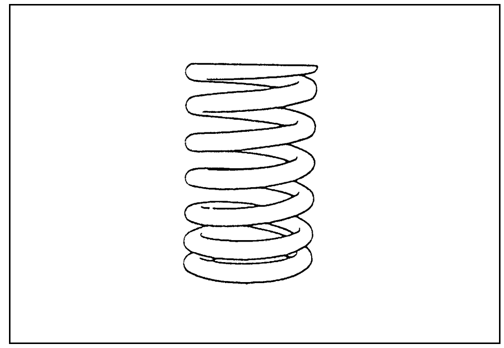


Apply engine oil to stem seal, valve guide bore and valve stem.

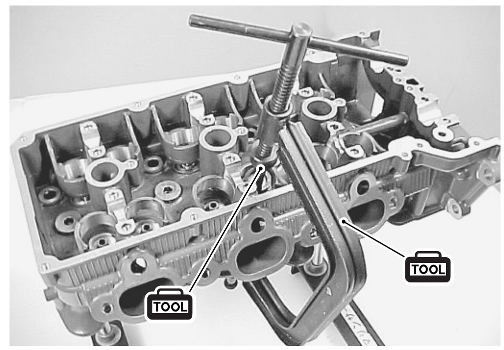
Install valve ③ to valve guide.

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

Install valve spring ④, and valve retainer ⑤.

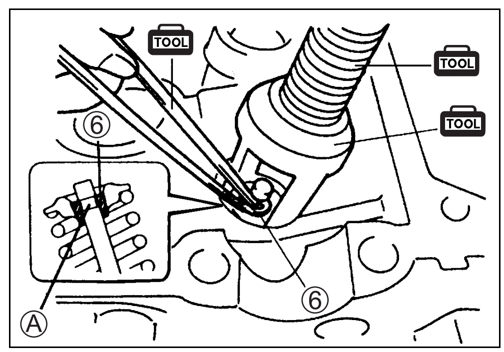


Hold valve spring compressed with special tool and install valve cotters ⑥.



Make sure valve cotters are properly seated in groove Ⓐ.

TOOL **09916-14510: Valve lifter**
09916-14521: Attachment
09916-84511: Tweezers

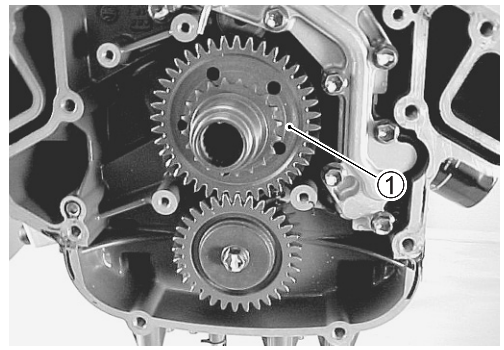


CYLINDER/CRANKSHAFT/PISTON

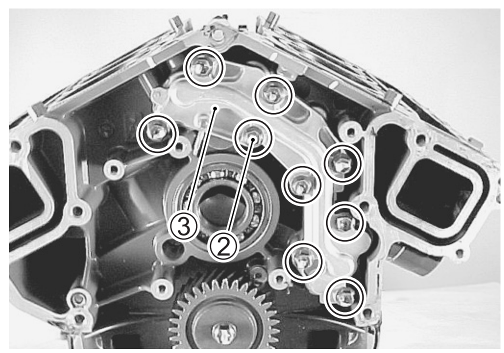
DISASSEMBLY

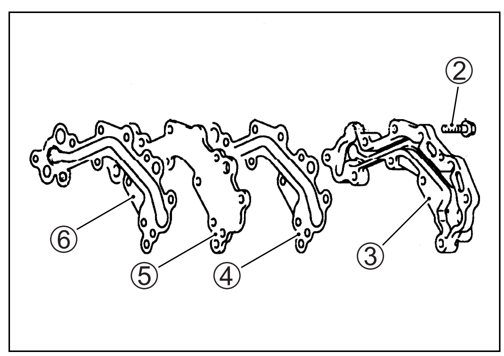
Before performing service work in this section:
- **Remove power unit. (See page 6-11 to 6-17.)**
- **Remove timing chain. (See page 6-27 to 6-30.)**
- **Remove cylinder head. (See page 6-40.)**

Remove the driven gear ①.

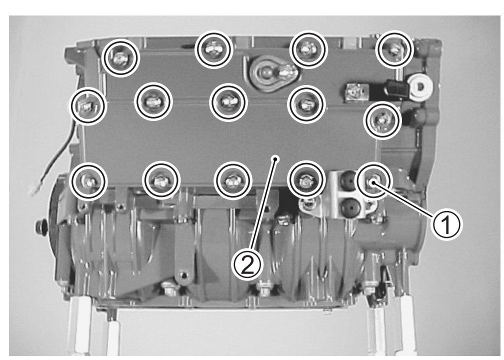


Remove the nine (9) bolts ② securing the oil gallery cover ③, then remove oil gallery cover ③, gasket ④, oil gallery plate ⑤ and gasket ⑥.





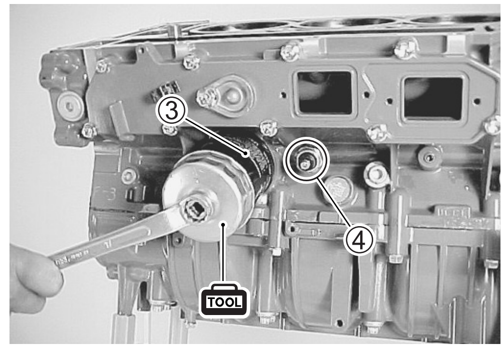
Remove the bolts ① and PORT exhaust cover ②.



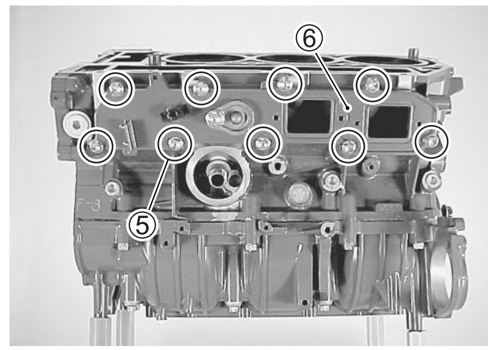
Remove oil filter ③.

TOOL 09915-47341: Oil filter wrench

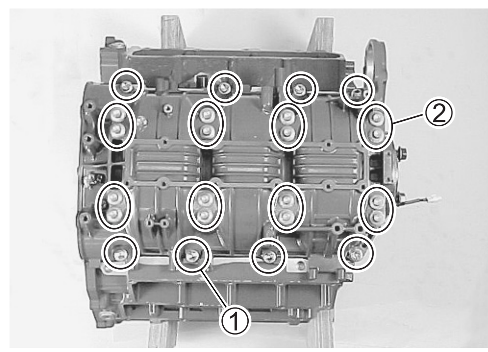
Remove oil pressure switch ④.



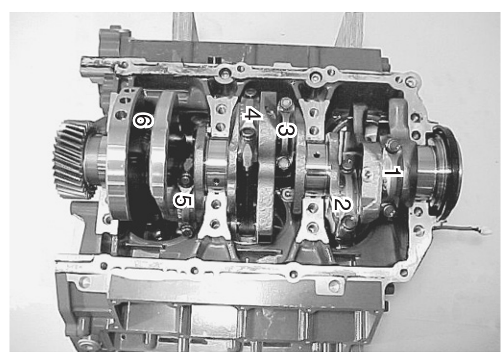
Remove the bolts ⑤ and STBD exhaust cover ⑥.



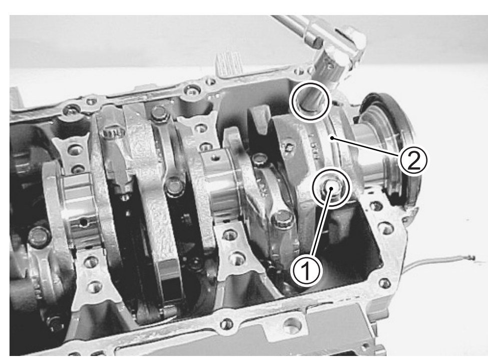
Remove eight (8) bolts ①.
Remove sixteen (16) bolts ②.
Remove crankcase from cylinder block.



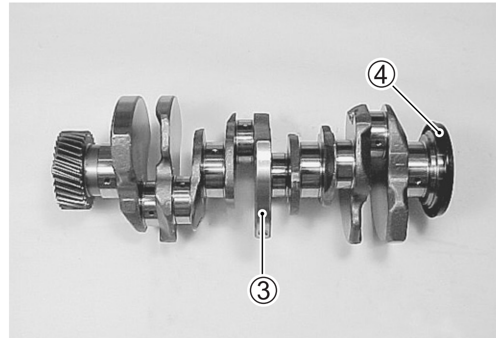
NOTE:
For proper assembly, mark cylinder number on all pistons, conrods, and conrod caps, using quick drying paint.



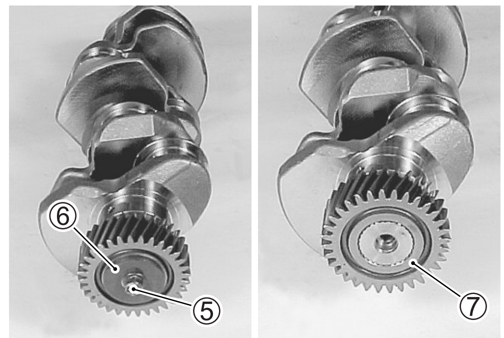
Remove all conrod cap bolts ① and conrod caps ②.



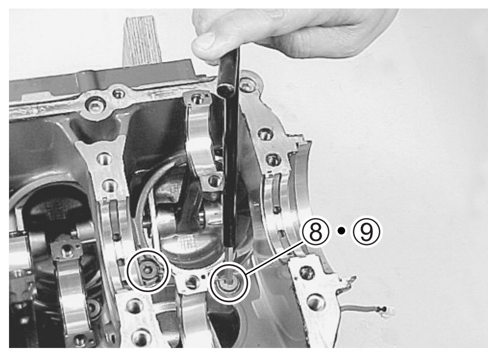
Remove crankshaft ③.
Remove oil seal ④ from crankshaft.



Remove the bolt ⑤, washer ⑥ and drive gear ⑦.



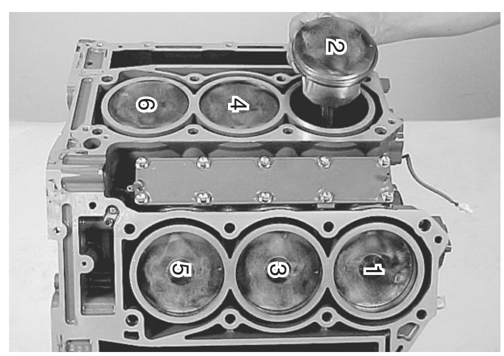
Remove bolts ⑧ and piston cooling jets ⑨ from each cylinder.



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

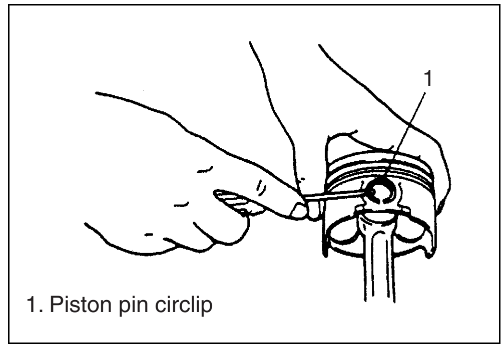
NOTE:

- *To prevent damage to piston rings, decarbon top of cylinder bore wall before removing piston.*
- *Reassemble each conrod cap to its original position after removing piston from bore.*



Remove two compression rings (top and 2nd) and oil ring from piston.
Mark cylinder number on conrod using quick dry paint.

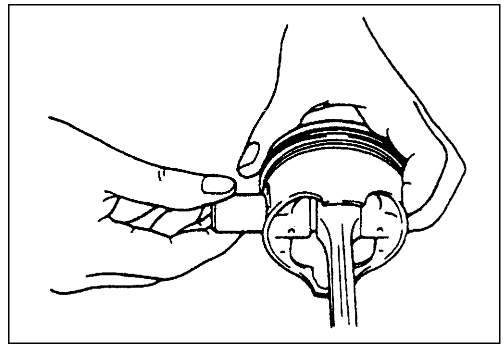
Remove piston pin circlips as shown.



1. Piston pin circlip

Remove piston pin from conrod.

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



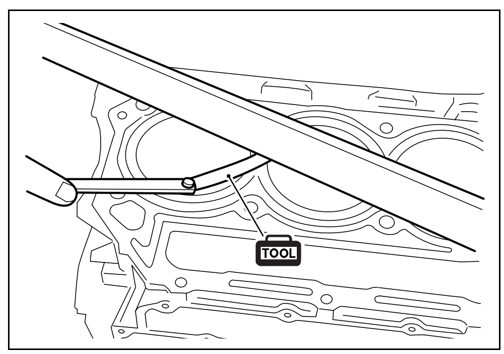
INSPECTION/SERVICING

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

CYLINDER

Cylinder distortion

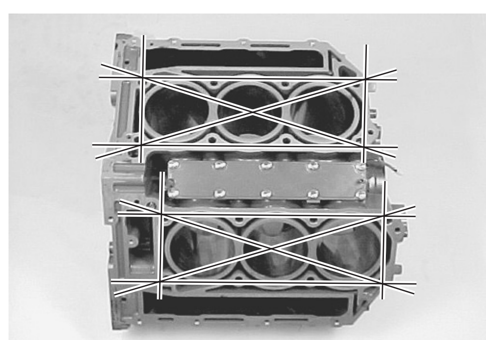
Using a straightedge and thickness gauge, measure cylinder distortion (gasket surface) at a total of six (6) locations as shown.



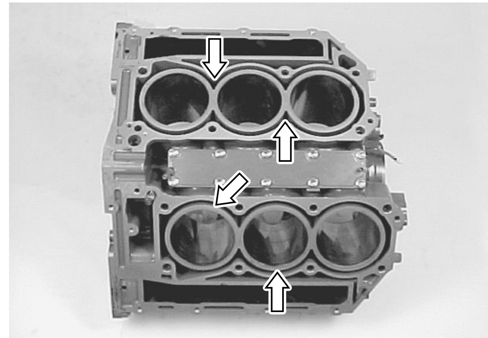
TOOL 09900-20803: Thickness gauge

Cylinder distortion
Service limit: 0.03 mm (0.001 in)

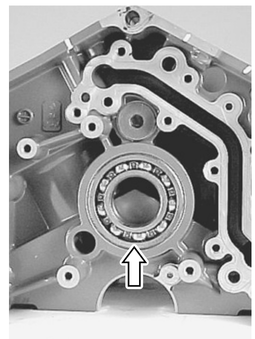
If measurement exceeds service limit, resurface or replace cylinder.

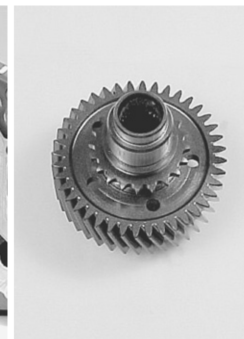


Water jackets
Check water jackets.
If clog or obstruction is found, clean water jacket.



Driven gear/bearing
Inspect driven gear. Replace gear if damaged or worn.
Inspect driven gear bearing. Replace bearing if pitted, noisy or rough.

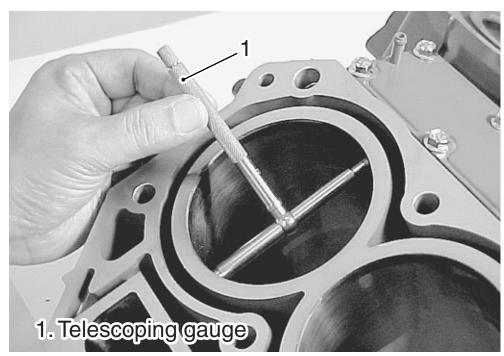




Cylinder bore
Inspect cylinder walls for scratches, roughness, or ridges which indicate excessive wear.
If cylinder bore is very rough, deeply scratched or ridged, bore cylinder and use oversize piston.

Cylinder bore wear (difference)
Using telescoping 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.

NOTE:
Purchase a commercially available telescoping gage for this measurement.

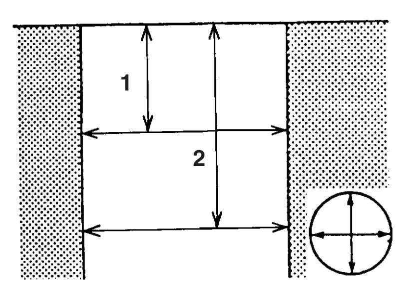


1. Telescoping gauge

Check for followings:
- 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)

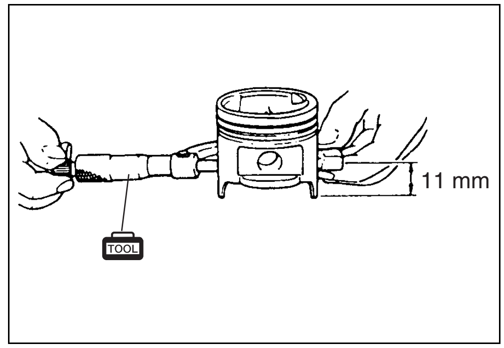
If measurement exceeds service limit, bore or replace cylinder.



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

PISTON TO CYLINDER CLEARANCE

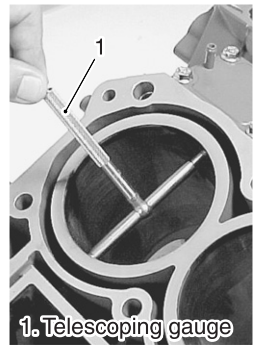
(1) Measure the piston diameter at a point 11 mm (0.433 in) above the piston skirt at a right angle to the piston pin bore.

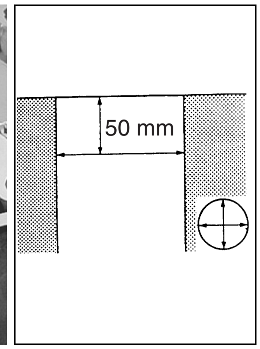


TOOL **09900-20204: Micrometer**

Piston skirt diameter
Standard: 97.905 – 97.925 mm (3.8545 – 3.8553 in)

(2) Measure the cylinder bore at 50 mm (1.969 in) below the cylinder head gasket surface at a right angle to the crankshaft pin.





NOTE:
Purchase a commercially available telescoping gage for this measurement.

Cylinder bore diameter
Standard: 98.000 – 98.020 mm (3.8583 – 3.8591 in)

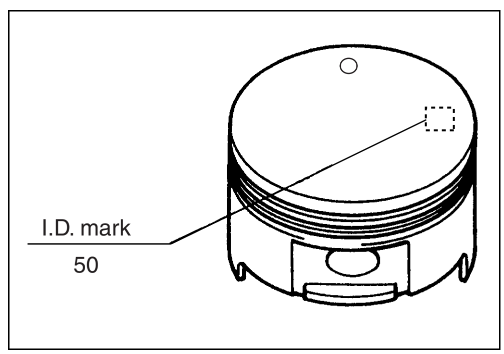
(3) Calculate the piston/cylinder clearance (Clearance equals difference between piston diameter and cylinder bore measurements).

Piston to cylinder clearance
Standard: 0.085 – 0.105 mm (0.0033 – 0.0041 in)
Service limit: 0.150 mm (0.0059 in)

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

Identification of oversize piston/piston ring

One oversize piston/piston ring components, 0.50 mm, is available.
Oversize piston/piston ring are marked as shown, below.

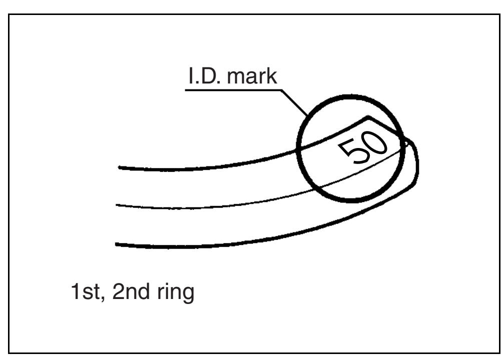


Piston

Oversize	I.D. mark
0.50 mm	50

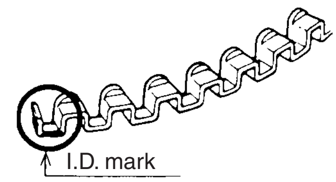
1st & 2nd Piston ring

Oversize	I.D. mark
0.50 mm	50



Oil ring

Oversize	I.D. mark
0.50 mm	One (1) Red paint



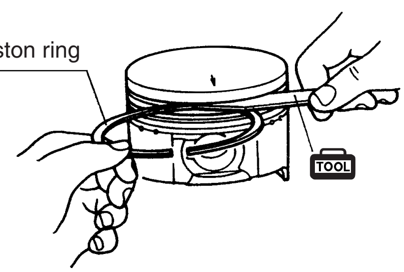
PISTON

Inspect piston for faults, cracks or other damage. Damaged or faulty piston(s) should be replaced.

Piston ring to groove clearance

Before checking, piston grooves must be clean, dry and free of carbon.

Fit piston ring into piston groove, and measure clearance between ring and ring groove using thickness gauge.



TOOL **09900-20803: Thickness gauge**

Piston ring to groove clearance
Standard:
1st 0.030 – 0.080 mm (0.0012 – 0.0031 in)
2nd 0.020 – 0.060 mm (0.0008 – 0.0024 in)
Service limit:
1st 0.12 mm (0.0047 in)
2nd 0.10 mm (0.0039 in)

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

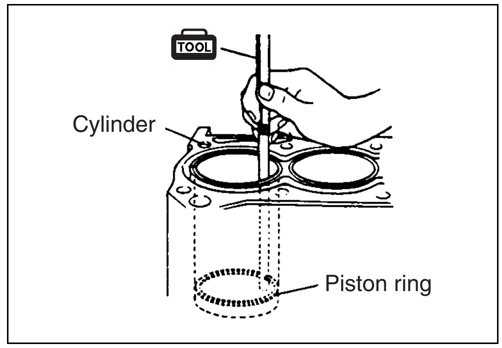
Piston ring groove width
Standard:
1st 1.22 – 1.25 mm (0.048 – 0.0492 in)
2nd 1.21 – 1.23 mm (0.0476 – 0.0484 in)
Oil 2.51 – 2.53 mm (0.099 – 0.0996 in)

Piston ring thickness
Standard:
1st 1.17 – 1.19 mm (0.0461 – 0.0469 in)
2nd 1.17 – 1.19 mm (0.0461 – 0.0469 in)

PISTON RING

Piston ring end gap

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



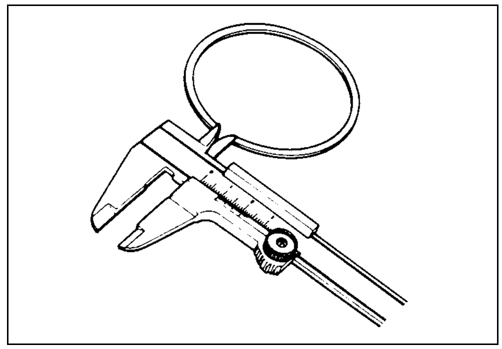
TOOL **09900-20803: Thickness gauge**

Piston ring end gap
Standard:
1st 0.20 – 0.33 mm (0.0079 – 0.0130 in)
2nd 0.33 – 0.48 mm (0.0130 – 0.0189 in)
Service limit:
1st 0.70 mm (0.0276 in)
2nd 1.00 mm (0.0394 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:
1st Approx. 13.6 mm (0.54 in)
2nd Approx. 13.7 mm (0.54 in)
Service limit:
1st 10.9 mm (0.43 in)
2nd 10.9 mm (0.43 in)

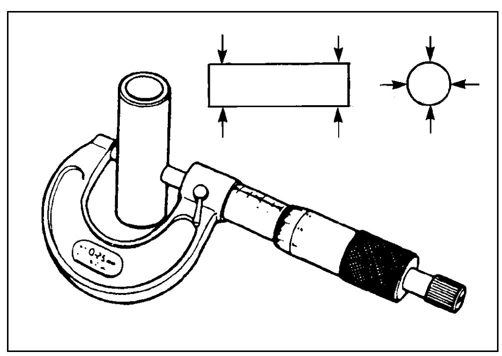
If measurement exceeds service limit, replace piston ring.

PISTON PIN

Check piston pin, conrod small end bore and piston pin hole for wear or damage.
If badly worn or damaged, replace component.

Piston pin clearance

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



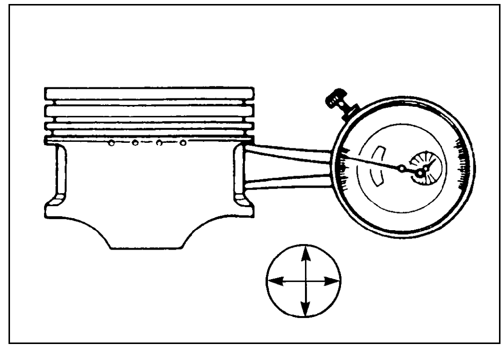
TOOL **09900-20205: Micrometer**
09900-20605: Dial calipers

Piston pin outside diameter
Standard: 21.993 – 22.000 mm (0.8659 – 0.8661 in)
Service limit: 21.980 mm (0.8654 in)

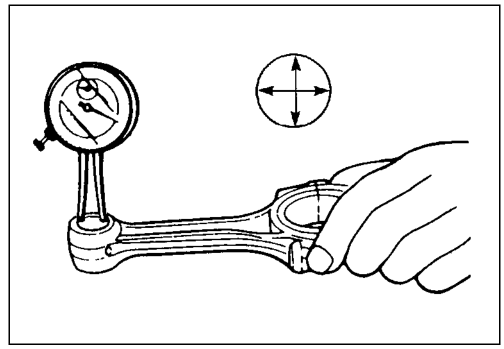
Piston pin hole diameter
Standard: 22.006 – 22.014 mm (0.8664 – 0.8667 in)
Service limit: 22.030 mm (0.8673 in)

Conrod small end bore
Standard: 22.010 – 22.018 (0.8665 – 0.8669 in)

Pin clearance in piston pin hole
Standard: 0.006 – 0.021 mm (0.0002 – 0.0008 in)
Service limit: 0.040 mm (0.0016 in)



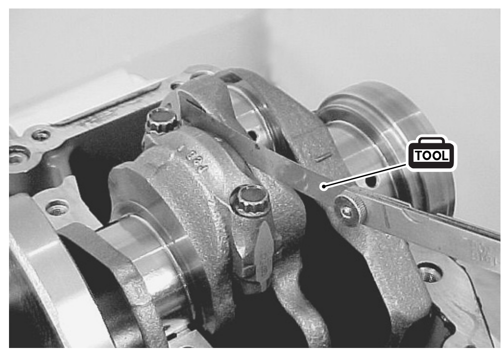
Pin clearance in conrod small end
Standard: 0.010 – 0.025 mm (0.0004 – 0.0010 in)
Service limit: 0.050 mm (0.0020 in)



CONROD BIG END SIDE CLEARANCE

Measure conrod big end side clearance with conrod installed on crank pin as shown.

TOOL **09900-20803: Thickness gauge**



Conrod big end side clearance
Standard: 0.300 – 0.450 mm (0.0118 – 0.0177 in)
Service limit: 0.550 mm (0.0217 in)

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

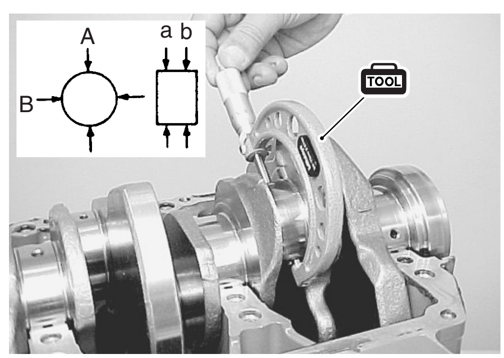
Conrod big end width
Standard: 20.750 – 20.800 mm (0.8169 – 0.8189 in)

Crank pin width
Standard: 21.100 – 21.200 mm (0.8307 – 0.8346 in)

CRANK PIN

Inspect crank pin for uneven wear or damage.
Measure crank pin for out-of-round or taper with micrometer.
If crank pin is damaged, out-of-round or taper is out of service limit, replace crankshaft.

TOOL **09900-20203: Micrometer**



Out-of-round : A – B
Taper : a – b

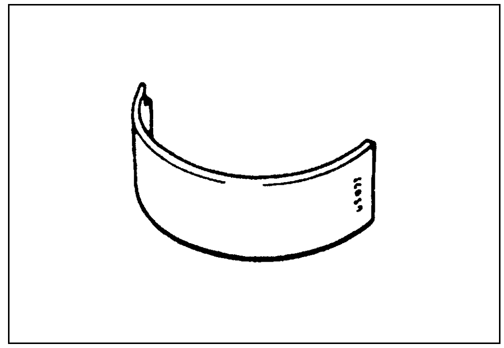
Out-of-round and taper
Service limit: 0.010 mm (0.0004 in)

Crank pin diameter
Standard: 53.982 – 54.000 mm (2.1253 – 2.1260 in)

CONROD BEARING

Inspect bearing shell for proper contact pattern and signs of fusion, pitting, burning or flaking.

Bearing shells found in defective condition must be replaced.



Conrod big end oil clearance

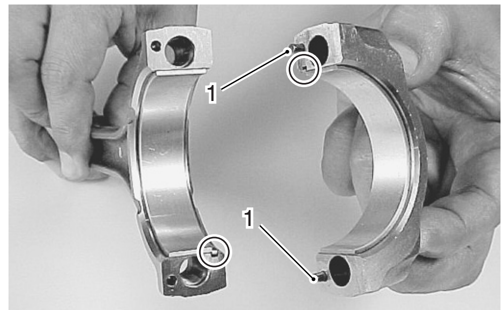
Check conrod big end oil clearance as follows;

(1) Clean surface of conrod, conrod cap, conrod bearing, and crank pin.

(2) Install conrod bearing onto conrod and conrod cap.

NOTE:

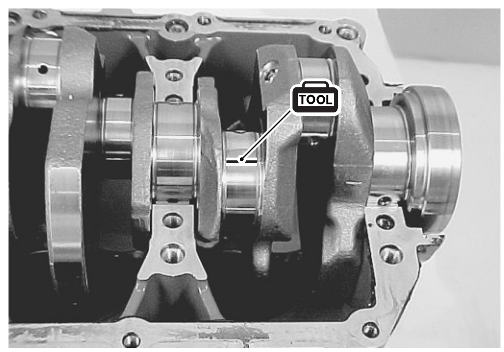
- *Reassemble each bearing and conrod cap to their original position.*
- *Do not apply oil to bearing.*



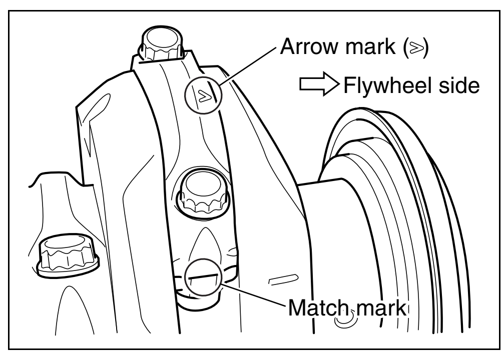
1. Dowel pin

(3) Place a piece of Plastigauge on crank pin parallel to crankshaft. Avoid placing Plastigauge over oil hole.

TOOL **09900-22301: Plastigauge**



(4) Install conrod cap (with bearing) to conrod with the arrow mark on cap toward flywheel side.



(5) Apply engine oil to conrod bolts and tighten bolt in two steps.

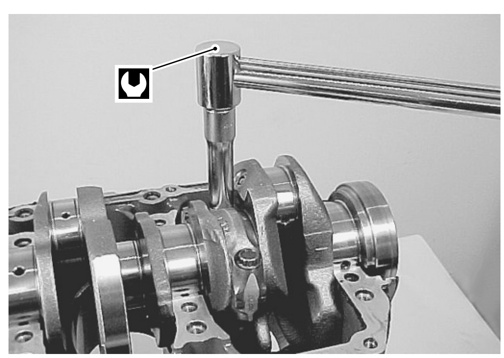
Conrod cap bolt:

1st step 34 N·m (3.4 kg-m, 24.6 lb-ft)

Final step 68 N·m (6.8 kg-m, 49.2 lb-ft)

NOTE:

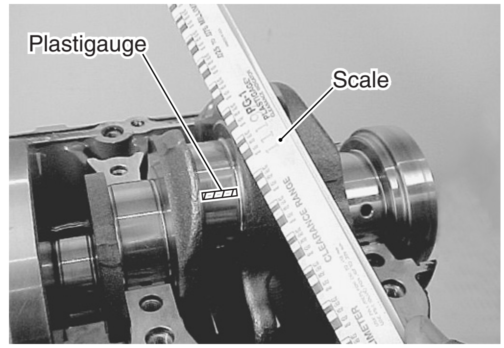
Do not rotate conrod with Plastigauge in place.



(6) Remove conrod and conrod cap from crank pin.
(7) Using scale on Plastigauge envelope, measure Plastigauge width at its widest point.

Conrod big end oil clearance
Standard: 0.045 – 0.063 mm (0.0018 – 0.0025 in)
Service limit: 0.080 mm (0.0031 in)

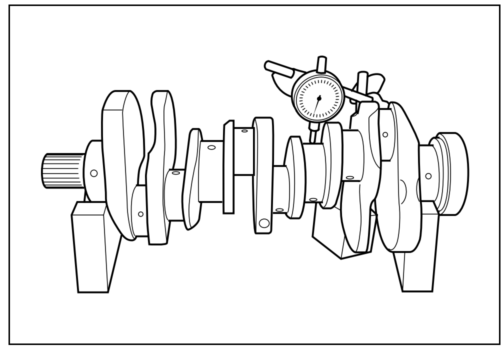
If measurement exceeds service limit, replace conrod bearing.



CRANKSHAFT

Crankshaft runout

Using a dial gauge, measure runout at center journal.



TOOL **09900-20606: Dial gauge**
09900-20701: Magnetic stand

Crankshaft runout
Service limit: 0.04 mm (0.0016 in)

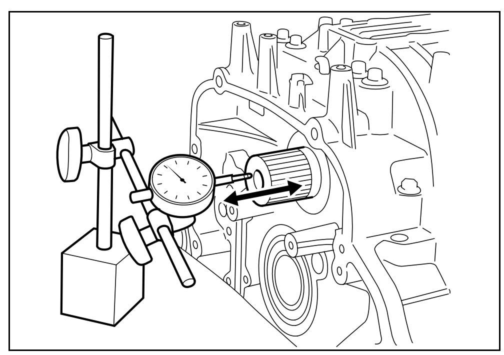
If measurement exceeds service limit, replace crankshaft.

Crankshaft thrust play

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

Crankcase bolt:
8 mm 25 N·m (2.5 kg-m, 18.1 lb-ft)
10 mm 52 N·m (5.2 kg-m, 37.5 lb-ft)

Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.



Crankshaft thrust play
Standard: 0.11 – 0.31 mm (0.0043 – 0.0122 in)
Service limit: 0.35 mm (0.0138 in)

If measurement exceeds service limit, replace crankshaft thrust bearing.

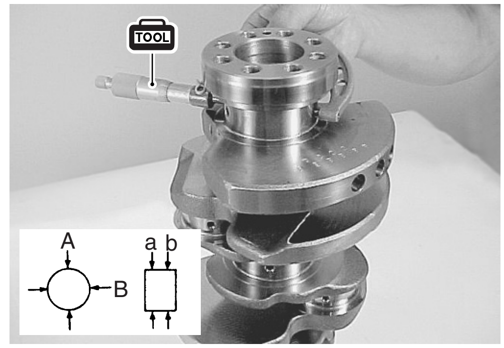
Crankshaft thrust bearing thickness
Standard: 2.425 – 2.475 mm (0.0955 – 0.0974 in)

Out-of-round and taper (uneven wear) of journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both).

This difference, if any, is determined by taking micrometer readings.

If any journal is badly damaged or if measurements exceed service limit, replace crankshaft.



TOOL **09900-20203: Micrometer**

Out-of-round: A – B
Taper : a – b

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

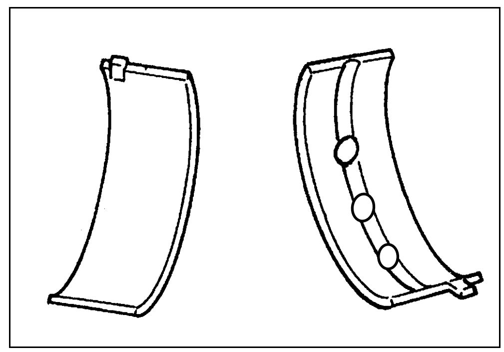
Crankshaft journal outside diameter
Standard: 69.982 – 70.000 mm (2.7552 – 2.7559 in)

CRANKSHAFT MAIN BEARING

Check bearings for pitting, scratches, wear or damage.

If any improper condition is found, replace both upper and lower halves.

Always replace both bearing halves, never replace only one half of a bearing set.

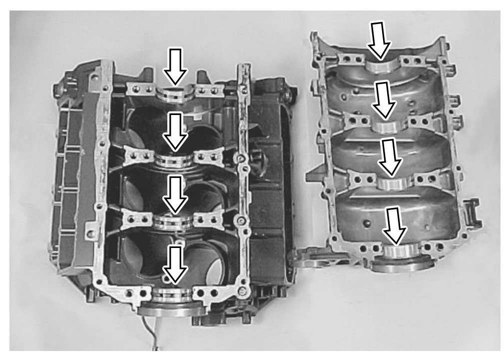


CRANKSHAFT JOURNAL OIL CLEARANCE

Check clearance using Plastigauge according to the following procedure.

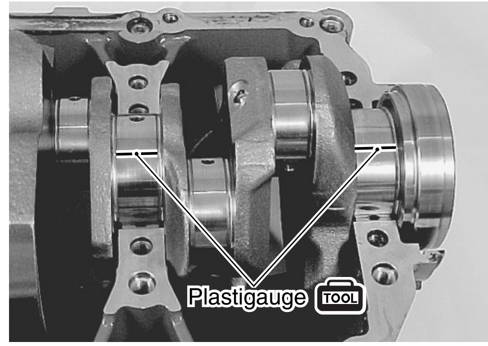
NOTE:
Assemble each bearing in its original position before checking clearance.

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



(2) Install main bearing to cylinder and crankcase.

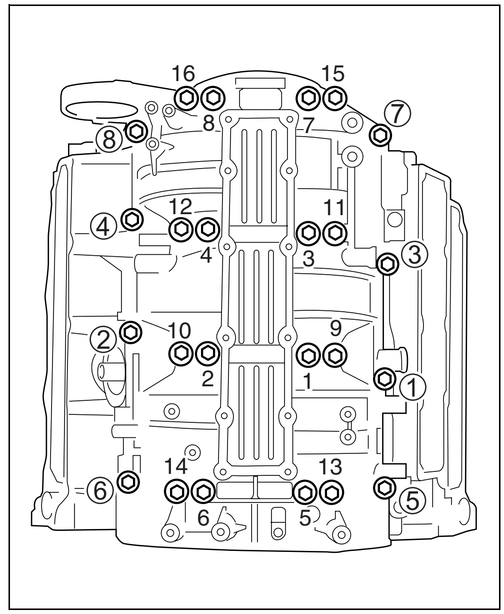
NOTE:
- *Align tab ⓐ of bearing with notch in cylinder and crankcase.*
- *Do not apply engine oil to bearing.*
- *Install lower bearing half with oil hole/groove towards cylinder side.*



(3) Install crankshaft to cylinder.
(4) Place a piece of Plastigauge across full width of bearing (parallel to crankshaft) on journal.
Do not place Plastigauge over oil hole.

09900-22301: Plastigauge

NOTE:
Do not rotate crankshaft while Plastigauge is installed.



(5) Assemble crankcase to cylinder.
(6) Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three (3) steps following the order indicated below.

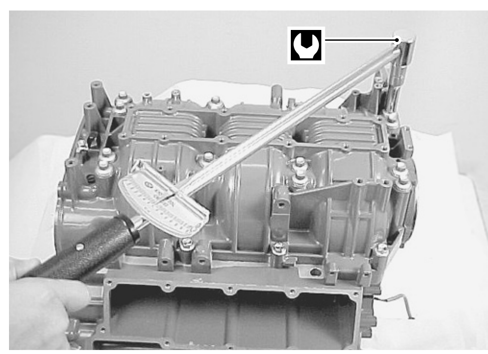
NOTE:
Tighten 10 mm (0.394 in) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in) thread diameter bolts.

Crankcase bolt (10 mm thread diameter):

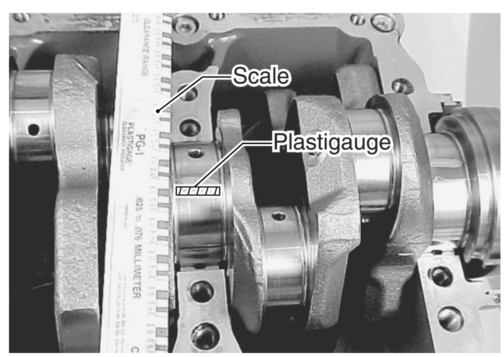
1st step	**11 N·m (1.1 kg-m, 8.0 lb-ft)**
2nd step	**42 N·m (4.2 kg-m, 30.0 lb-ft)**
Final step	**52 N·m (5.2 kg-m, 37.6 lb-ft)**

Crankcase bolt (8 mm thread diameter):

1st step	**6 N·m (0.6 kg-m, 4.3 lb-ft)**
2nd step	**20 N·m (2.0 kg-m, 14.5 lb-ft)**
Final step	**25 N·m (2.5 kg-m, 18.1 lb-ft)**



NOTE:
Crankcase must be torqued to specification in order to assure proper compression of Plastigauge and accurate reading of clearance.



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

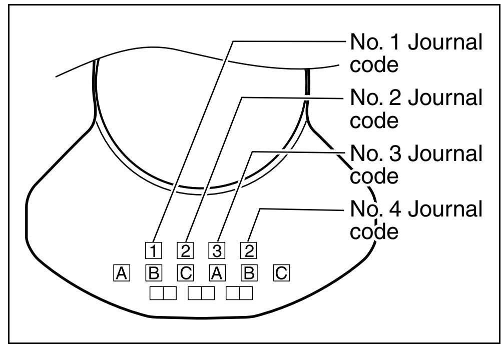
Crankshaft journal oil clearance
Standard: 0.030 – 0.048 mm (0.0012 – 0.0019 in)
Service limit: 0.065 mm (0.0026 in)

If measurement exceeds service limit, replace crankshaft main bearing.

NOTE:
For bearing replacement, see the “SELECTION OF MAIN BEARING” section on page 6-73.

SELECTION OF MAIN BEARING

Whenever a bearing requires replacement, select a new bearing according to following procedure.

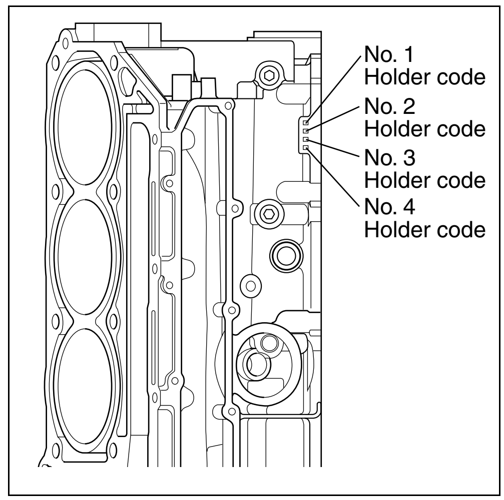


(1) First, check journal diameter.

As shown in figure, upper (flywheel side) crank web of No.1 cylinder has four (4) stamped code numerals.

The numerals (1, 2 & 3) represent the journal diameters shown below.

Numeral stamped	Journal diameter
1	69.994 – 70.000 mm (2.7557 – 2.7559 in)
2	69.988 – 69.994 mm (2.7554 – 2.7557 in)
3	69.982 – 69.988 mm (2.7552 – 2.7554 in)

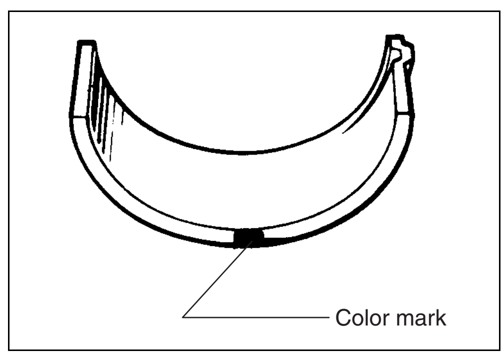


(2) Next, check bearing holder inside diameter without bearing.

As shown in figure, the cylinder block STBD side has four (4) stamped code letters.

The letters (A, B & C) represent the bearing holder inside diameters shown below.

Code	Crank bearing holder inside diameter (w/o bearing)
A	75.000 – 75.006 mm (2.9528 – 2.9530 in)
B	75.006 – 75.012 mm (2.9530 – 2.9532 in)
C	75.012 – 75.018 mm (2.9532 – 2.9535 in)



(3) There are five (5) main bearings available, each of differing thickness.

To distinguish them, a color mark is painted at the position indicated in figure.

Each color represents the following thickness measured at the center of the bearing.

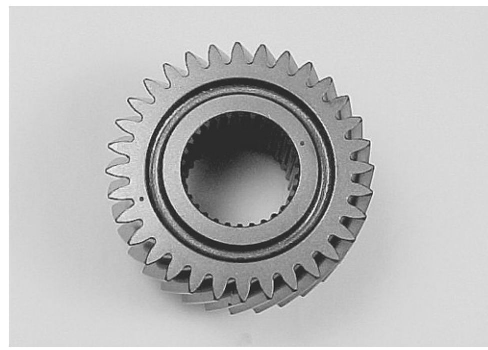
Color mark	Bearing thickness
Black	2.499 – 2.502 mm (0.0984 – 0.0985 in)
No color mark	2.502 – 2.505 mm (0.0985 – 0.0986 in)
Yellow	2.505 – 2.508 mm (0.0986 – 0.0987 in)
Blue	2.508 – 2.511 mm (0.0987 – 0.0989 in)
Pink	2.511 – 2.514 mm (0.0989 – 0.0990 in)

(4) Select crankshaft main bearing referring the below table.

		Numeral stamped on crank web (journal outside diameter)		
		1	**2**	**3**
Code stamped on cylinder block (Bearing holder inside diameter)	**A**	Black	No color	Yellow
	B	No color	Yellow	Blue
	C	Yellow	Blue	Pink

NOTE:
Measure crankshaft journal oil clearance again after installing new bearing selected. (See page 6-71.)

CRANKSHAFT DRIVE GEAR
Inspect drive gear. Replace gear if damaged or worn.



PISTON COOLING JET
Check the piston cooling jet.
If crack or other damage is found, replace the jet.
Clean the jet thoroughly to ensure there is no obstruction.

OIL GALLERY COVER/PLATE
Check the oil gallery cover and plate.
If crack or other damage is found, replace it.
Clean the oil jet thoroughly to ensure there is no obstruction.

OIL SEAL

Inspect condition. If cracked, cut or damaged, replace.

REASSEMBLY

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

CAUTION

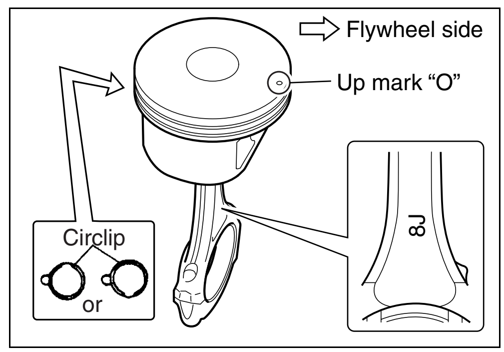
If original components are not replaced, each piston, piston pin and conrod is to be assembled and installed in its original order and position.

PISTON TO CONROD

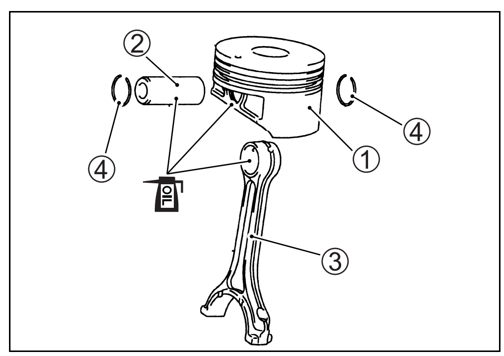
Apply engine oil to piston pin ②, piston pin bore and conrod ③.
Assemble conrod ③ to piston ① as shown in figure and insert piston pin ② through piston and conrod.
Install piston pin circlips ④.

NOTE:

- *"8J" mark on conrod and up mark (○) on piston dome must face toward flywheel side.*



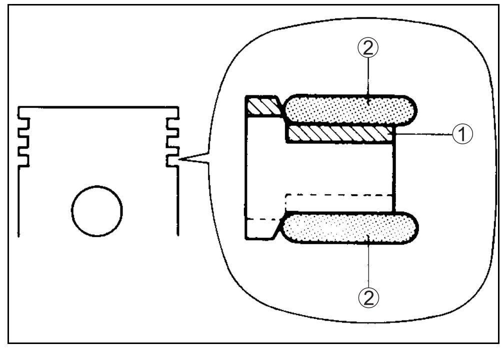
- *End gap of the circlip should not be aligned with the cutaway in the piston pin bore.*
- *Always use new piston pin circlip.*



PISTON RING TO PISTON

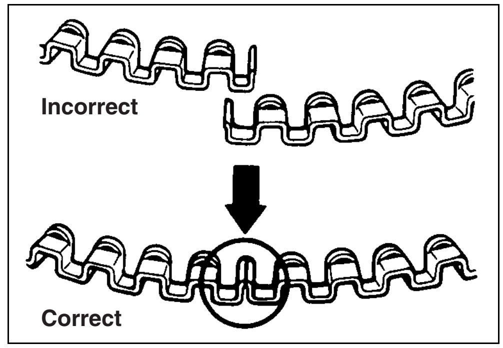
Oil ring

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



CAUTION

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

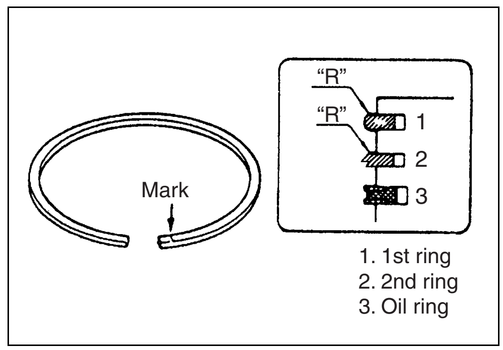


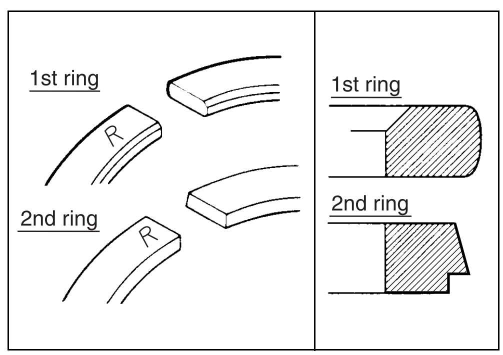
1st and 2nd piston ring

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

NOTE:

- *1st and 2nd ring differ in shape and color as shown in figure.*
- *Also indicated in figure, the 1st and 2nd ring are marked with the letter "R" which must face towards top of piston.*

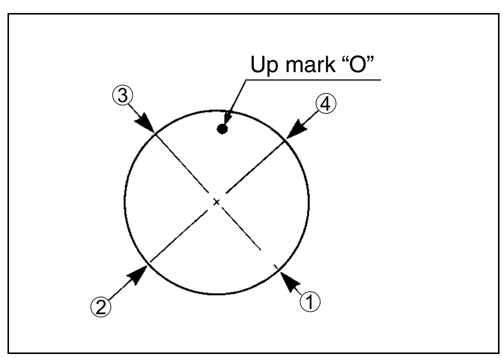




Ring gap direction

Position piston rings so gaps are staggered at approximately 90 degree angles as shown.

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

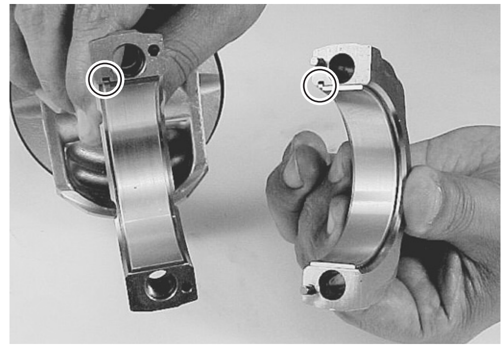


CAUTION

Failure to stagger piston ring gaps may result in crankcase oil dilution.

PISTON TO CYLINDER

Install conrod bearing to conrod and conrod cap.

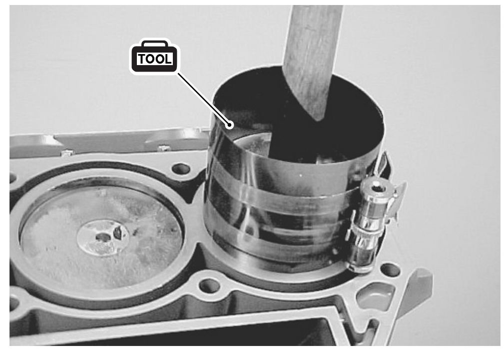


CAUTION

- **Assemble each conrod bearing to its original position.**
- **Do not apply oil between conrod and bearing or between bearing cap and bearing.**

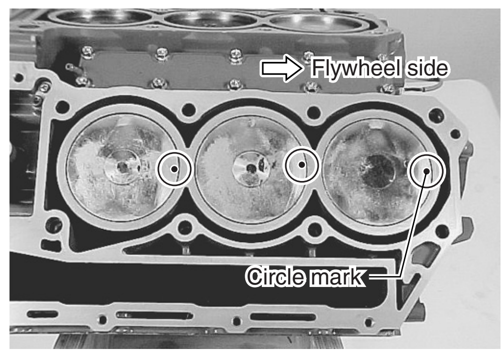
Apply engine oil to piston and cylinder walls.

Insert piston and conrod assembly into cylinder bore from cylinder head side using special tool.



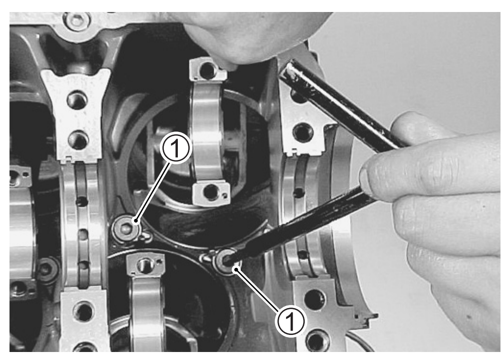
TOOL **09916-77310: Piston ring compressor**

NOTE:
Position the “circle” mark (○) on piston head to flywheel side.



PISTON COOLING JET

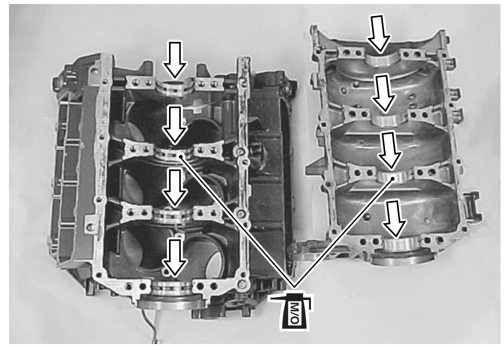
Install the piston cooling jet ① in position, then tighten bolt securely.



Piston cooling jet: 5 N·m (5.0 kg-m, 3.6 lb-ft)

CRANKSHAFT TO CYLINDER

Install crankshaft main bearings in cylinder and crankcase.
Apply Molybdenum Oil Solution to bearings.

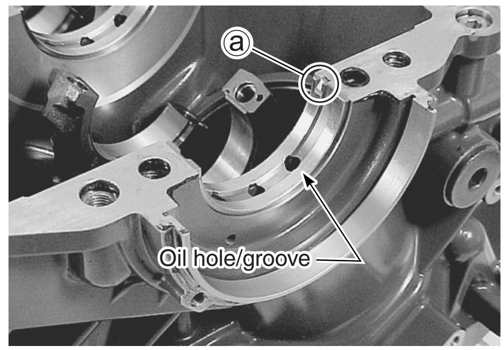


MOLYBDENUM OIL SOLUTION

Mix equal amounts of engine oil and SUZUKI MOLY PASTE (P/no. 99000-25140) in a ratio of 1 : 1.

CAUTION

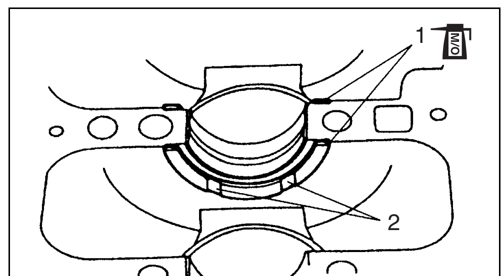
- **Assemble each bearing to its original position.**
- **Assemble main bearing half containing oil groove/hole to cylinder block.**
  Assemble the half without oil groove to crankcase.
- **Do not apply MOLYBDENUM OIL SOLUTION between crank bearing holder and crank main bearing.**



NOTE:
Align bearing tab ⓐ with notch in cylinder and crankcase.

Thrust bearing

Apply Molybdenum Oil Solution to the thrust bearing and install in cylinder block overlaping both sides of the No. 3 main journal. Oil groove on the thrust bearing must face towards crank webs.



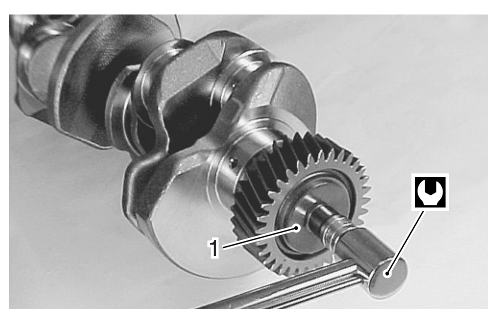
1. Thrust bearing
2. Oil groove

MOLYBDENUM OIL SOLUTION

Crankshaft drive gear

To assemble the drive gear on crankshaft, align the dot (•) mark on drive gear with the dot (•) mark on crankshaft, then install washer and secure with bolt.

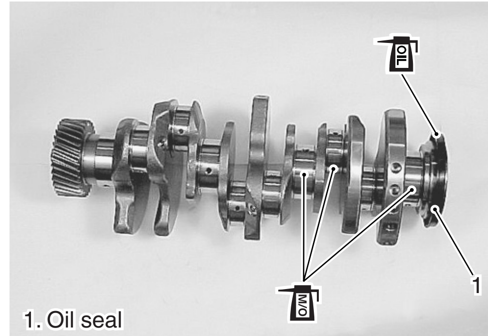
Drive gear bolt: 48 N·m (4.8 kg-m, 34.7 lb-ft)



1. Washer

Crankshaft

Apply engine oil to upper oil seal lip.
Install upper oil seal to crankshaft.



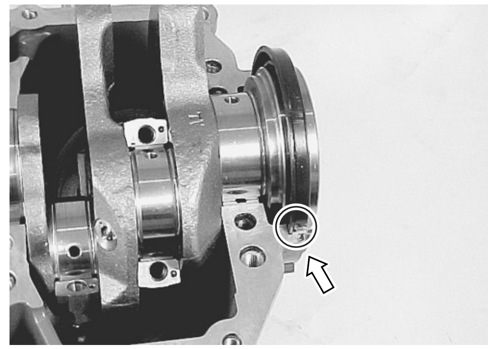
1. Oil seal

CAUTION

Do not reuse seal removed. Be sure to use new seal.

NOTE:
Install upper oil seal with its spring/lipped side facing inward.

Apply Molybdenum Oil Solution to crank pin and crankshaft main journal and install crankshaft in cylinder.

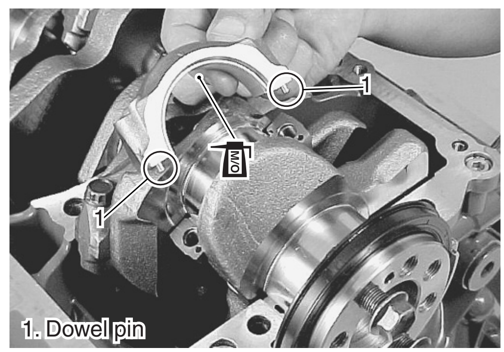


NOTE:
When installing crankshaft to cylinder, be sure to fit tab of seal in groove of cylinder.

MOLYBDENUM OIL SOLUTION

CONROD CAP

Apply Molybdenum Oil Solution to crank pin and conrod bearing.
Install dowel pins and conrod cap (with bearing) to conrod with arrow mark on cap toward flywheel side.

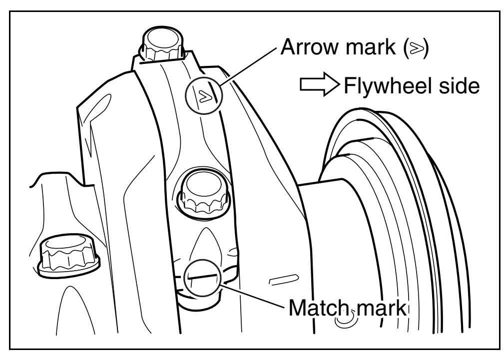


1. Dowel pin

CAUTION

Reassemble each conrod cap to its original position.

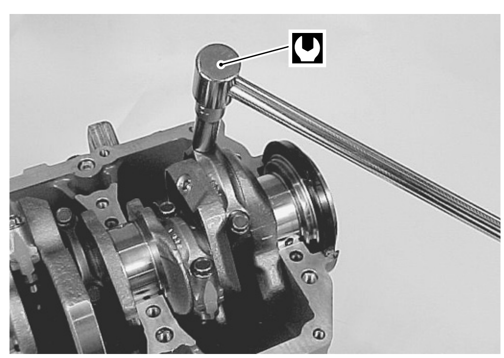
MOLYBDENUM OIL SOLUTION



Apply engine oil to conrod bolts.
Tighten conrod cap bolts in two steps.

Conrod cap bolt:

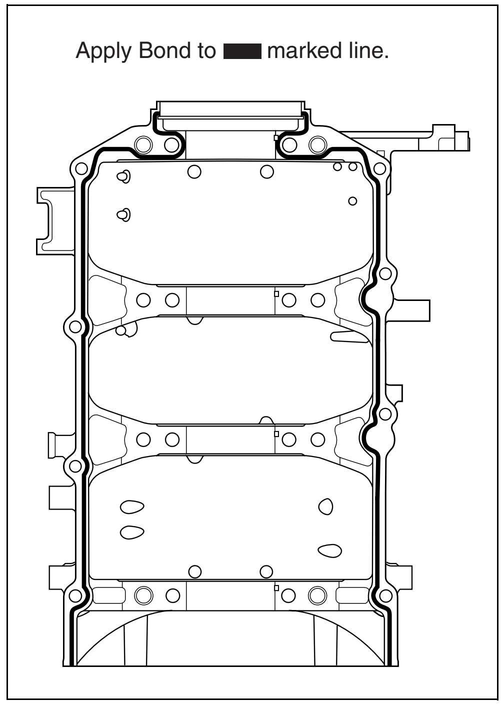
1st step	**34 N·m (3.4 kg-m, 24.6 lb-ft)**
Final step	**68 N·m (6.8 kg-m, 49.2 lb-ft)**



CRANKCASE TO CYLINDER

Clean mating surface of cylinder and crankcase.

Apply SUZUKI BOND to mating surface of crankcase as shown.

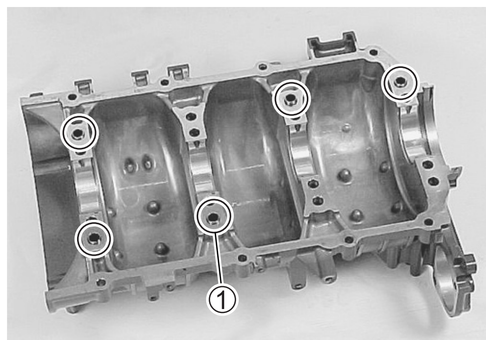


CAUTION

> **Apply bond to mating surface only.**
> **Do not allow bond to contact surface of bearing.**

1207B **99000-31140: SUZUKI BOND "1207B"**

Install five (5) dowel pins ①.



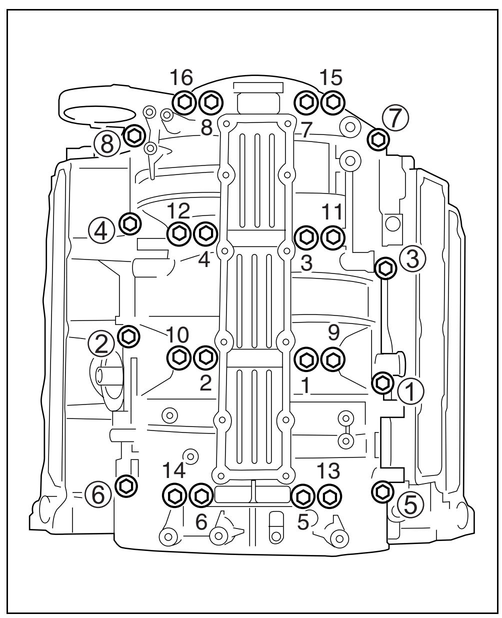
Install crankcase to cylinder.

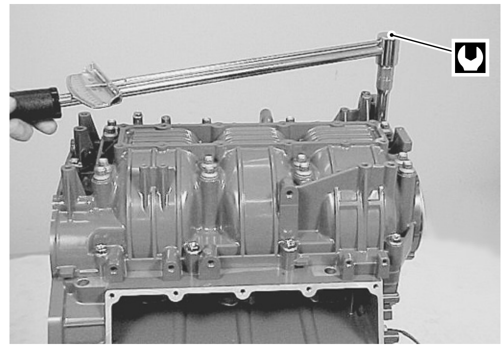
Apply engine oil to crankcase bolts.

Tighten crankcase bolts in three (3) steps following the order indicated below.

NOTE:

Tighten 10 mm (0.394 in) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in) thread diameter bolts.





Crankcase bolt (10 mm thread diameter):
1st step 11 N·m (1.1 kg-m, 8.0 lb-ft)
2nd step 42 N·m (4.2 kg-m, 30.0 lb-ft)
Final step 52 N·m (5.2 kg-m, 37.6 lb-ft)

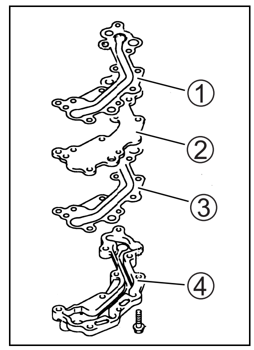
Crankcase bolt (8 mm thread diameter):
1st step 6 N·m (0.6 kg-m, 4.3 lb-ft)
2nd step 20 N·m (2.0 kg-m, 14.5 lb-ft)
Final step 25 N·m (2.5 kg-m, 18.1 lb-ft)

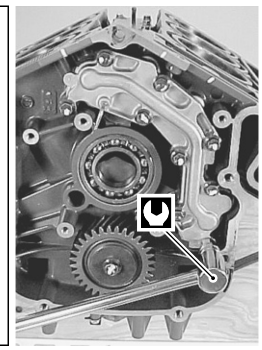
NOTE:
After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

OIL GALLERY COVER/PLATE

Install the gasket ①, oil gallery plate ②, gasket ③ and oil gallery cover ④, then secure with bolts.

Oil gallery cover: 23 N·m (2.3 kg-m, 16.6 lb-ft)





CYLINDER HEAD

Install cylinder head. (See page 6-42 to 6-46.)

TIMING CHAIN

Install timing chain. (See page 6-33 to 6-39.)

OIL PUMP

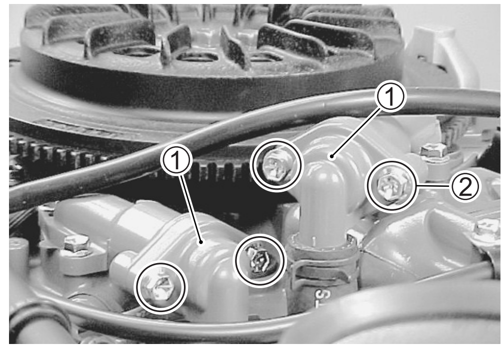
Install oil pump assembly. (See page 6-26.)

POWER UNIT

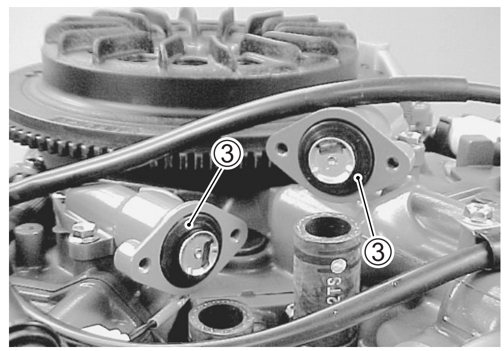
Install power unit. (See page 6-17 to 6-21.)

THERMOSTAT

REMOVAL



- Remove the ring gear cover and air intake silencer case. (See page 6-2.)
- Remove the two (2) bolts ② securing the thermostat cover ①, then remove the cover ① and thermostat ③.

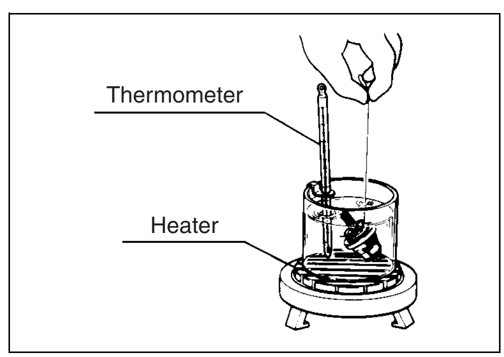


INSPECTION

- If salt deposits, corrosion, wear or other damage is found, clean or replace.

- **Thermostat operation**
  Check thermostat opening temperature as follows:
  - Insert a length of thread between thermostat valve/body and suspend thermostat in a container filled with water.
  - Place thermometer in container and heat water.
    Observe water temperature when thermostat valve opens and releases thread.

Thermostat operating temperature
Standard: 58 – 62 °C (136 – 144 °F)



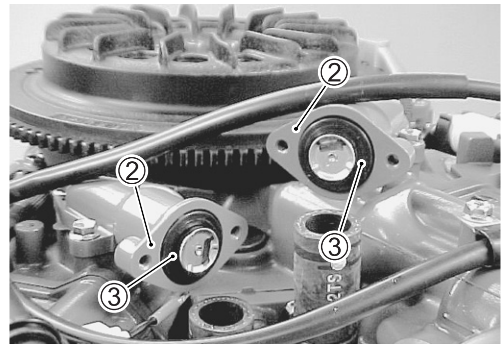
INSTALLATION

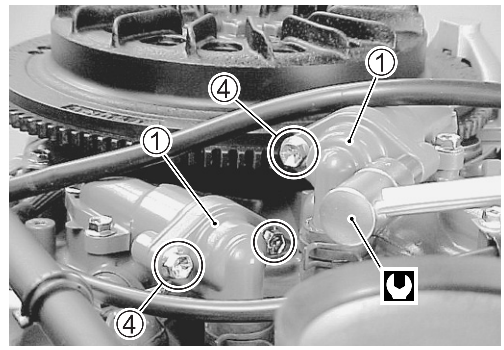
Installation is reverse order of removal with special attention to the following steps.

- Assemble thermostat ③ and thermostat cover ① to thermostat housing ② and secure with bolts ④.

Thermostat cover bolt: 10 N·m (1.0 kg-m, 7.2 lb-ft)

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





OPERATION

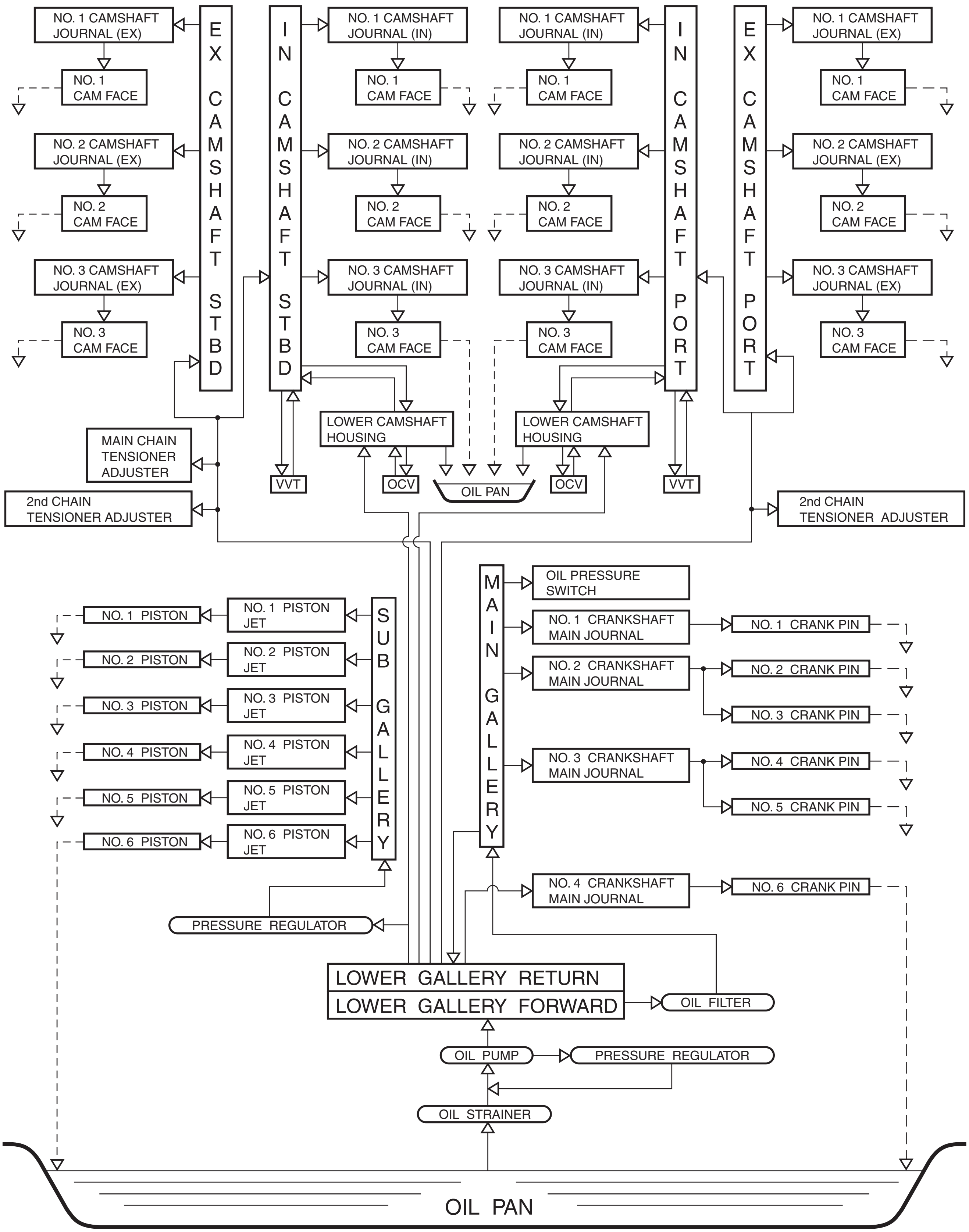
ENGINE LUBRICATION SYSTEM

The engine lubrication system uses a camshaft-driven oil pump that pressure feeds engine oil to the engine' moving parts. The chart below shows the lubrication system oil flow.

Engine oil is drawn up by the oil pump through the oil strainer. After passing through the oil filter, engine oil flows to the main gallery and lower gallery from which various passages distribute oil for lubrication and other engine functions requiring engine oil pressure to operate.

- Oil from the main gallery:
  Lubricates crankshaft journal bearings #1 through #3.
  Lubricates crank pins #1 through #5.
- Oil from the lower gallery:
  - Lubricates crank journal bearing #4 and crank pin #6.
  - Passes through the sub-gallery and sprays through six cylinder lubrication jets to lubricate the cylinder, piston, piston pin and cylinder wall.
  - Passes through the cylinder head oil passage to lubricate the IN. and EX. camshaft journals and cam faces.
  - Flows to OCV, supplying pressurized engine oil to operate the VVT system. From the ECM controlled OCV, oil flows to the VVT actuator to advance, retard or maintain intake valve timing.

ENGINE OIL LUBRICATION CHART

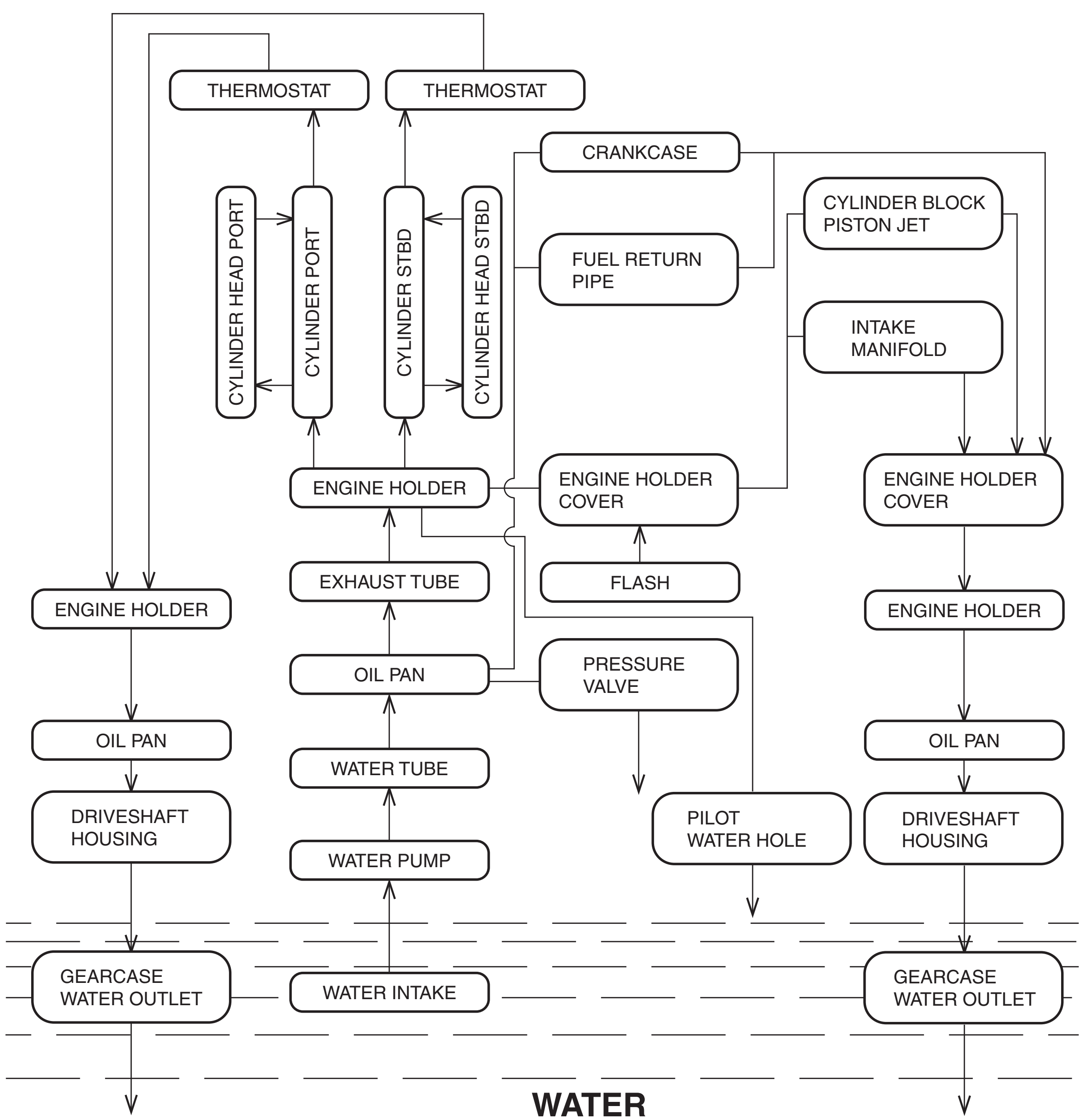


WATER COOLING SYSTEM

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 thermostats.
This system cools both the power unit and exhaust and is shown in schematic form 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**

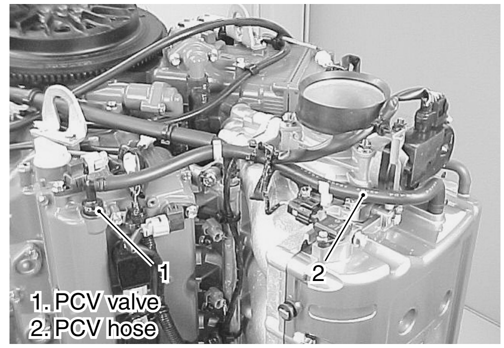
Water pump/Impeller........................ 9-12, 10-13
Water tube 7-11
Thermostat....................................... 6-82
Water pressure valve 7-28
Cylinder head................................... 6-49
Cylinder block 6-64



PCV SYSTEM

(PCV: POSITIVE CRANKCASE VENTILATION)

Due to the necessary piston to cylinder clearance, unburned combustion gasses (blow-by) will naturally pass through and enter the crankcase.
The PCV system is provided to recirculate these gasses back to the combustion chamber to be reburned.
The system consists of cylinder head cover, PCV valve, breather hose, throttle body and intake collector assembly.

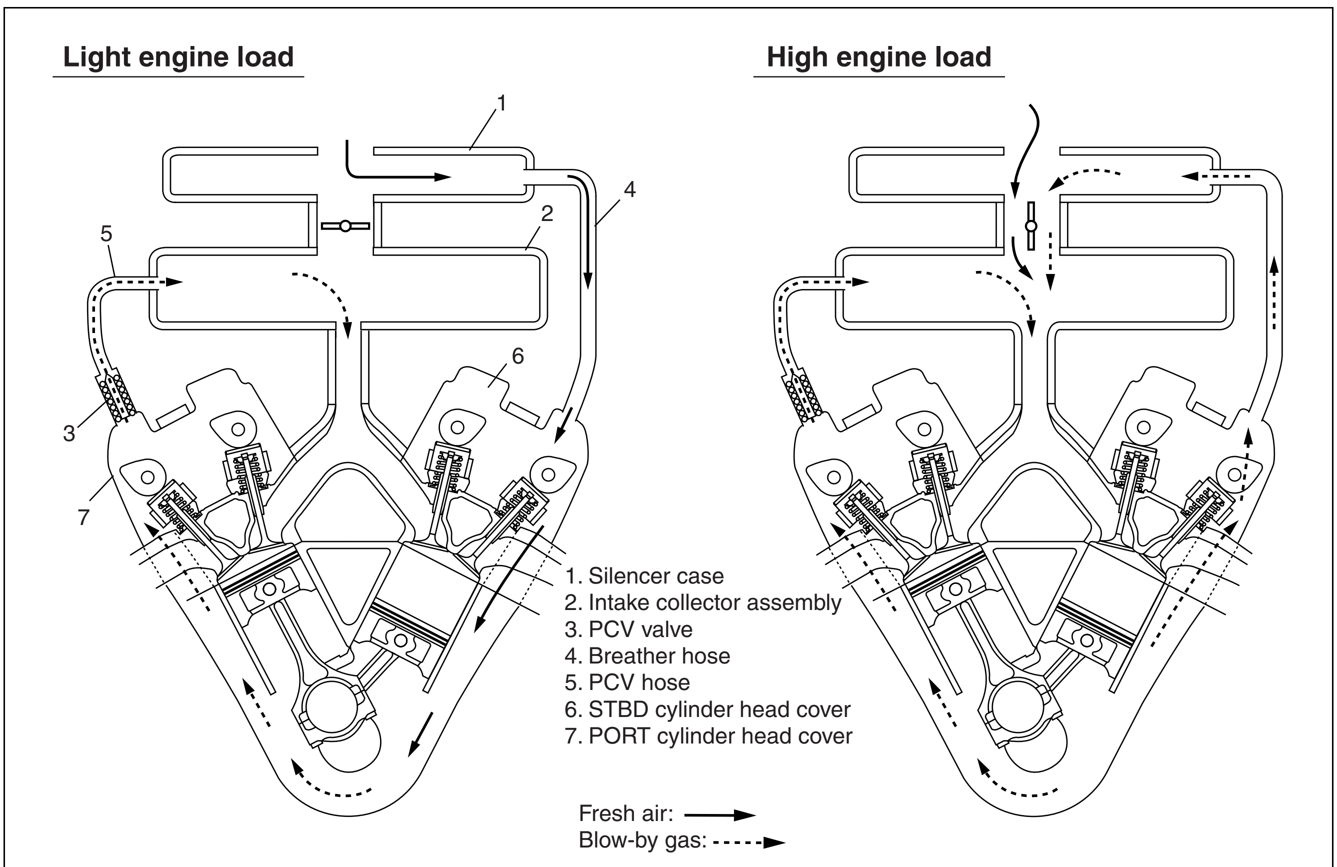


UNDER LIGHT ENGINE LOAD CONDITIONS

When the throttle valve opening is small, air entering from the air intake silencer case is directed through the breather hose to the cam chamber. At this time, a high vacuum occurs inside the intake collector resulting in a minimal PCV valve opening.
Due to this high vacuum condition, blow-by gasses inside the cam chamber are taken into the intake collector (scavenged) along with the air flowing from the breather hose.
The volume of gasses is small at this time.

UNDER HIGH ENGINE LOAD CONDITIONS

When the throttle valve opening is large, the vacuum inside the intake collector decreases causing the PCV valve, assisted by an internal spring, to open fully.
With the PCV fully open, blow-by gasses inside the cam chamber are now directed (scavenged) through the valve into the intake collector.
At the same time, gasses passing through the breather hose are still being directed into the silencer case.



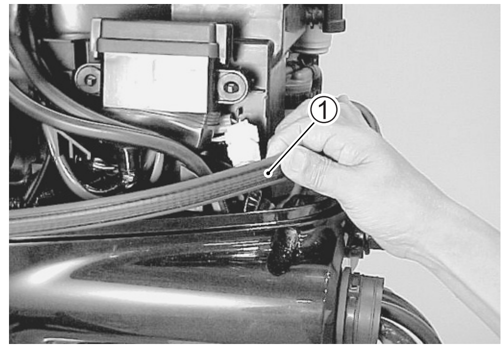
MID UNIT

CONTENTS

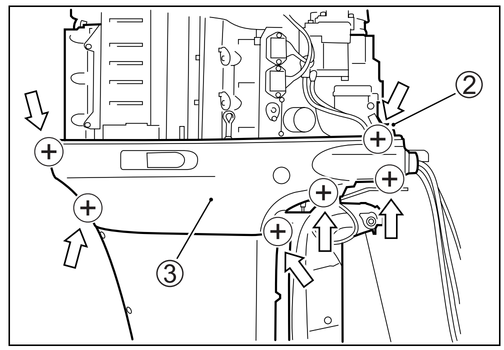
ENGINE SIDE COVER

REMOVAL

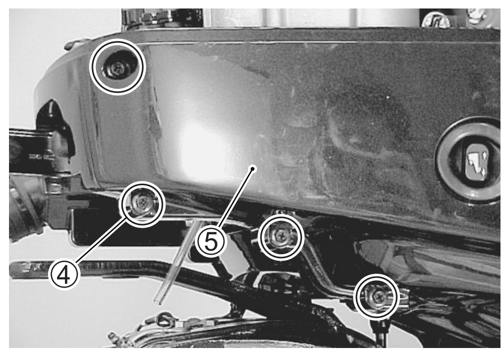
Remove the side cover rubber ①.



Remove six (6) screws ② and STBD side cover ③.

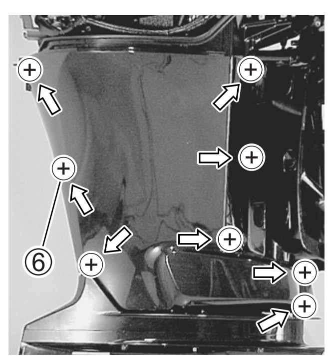


Remove four (4) screws ④ and PORT side cover ⑤.



Disconnect PTT switch lead connector.

Remove eight (8) screws ⑥ and STBD/PORT oil pan covers ⑦・⑧.



INSTALLATION

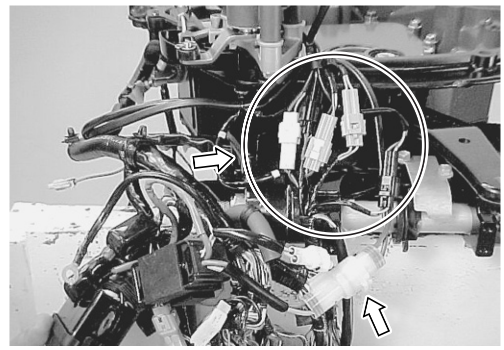
Installation is reverse order of removal.

DRIVESHAFT HOUSING AND OIL PAN

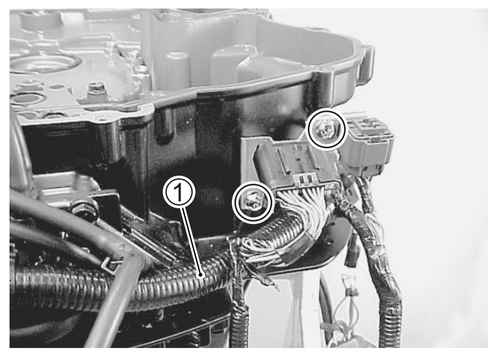
REMOVAL

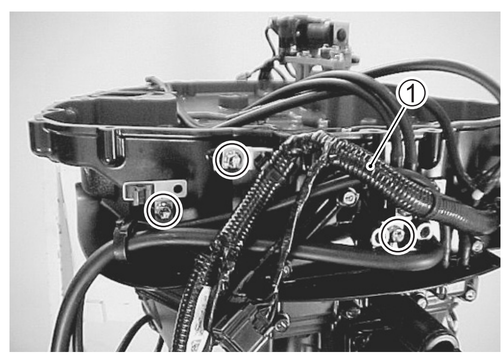
Remove power unit. (See page 6-11 to 6-17.)
Remove lower unit. (See page 9-2.)

Disconnect following lead wire connectors.
- PTT motor cable wire
- Neutral switch lead wire
- Shift position sensor lead wire
- Tilt limit switch lead wire
- Shift actuator lead wire
- Trim sender lead wire

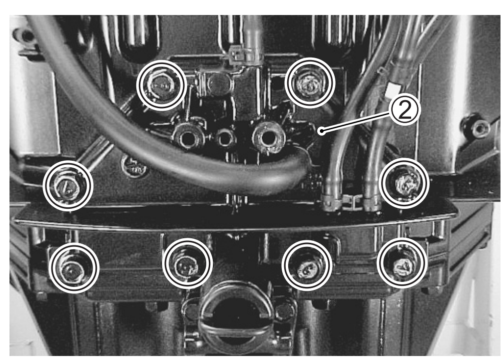


Remove the bolts securing harness clamp plates to engine holder, then remove the engine wiring harness ①.

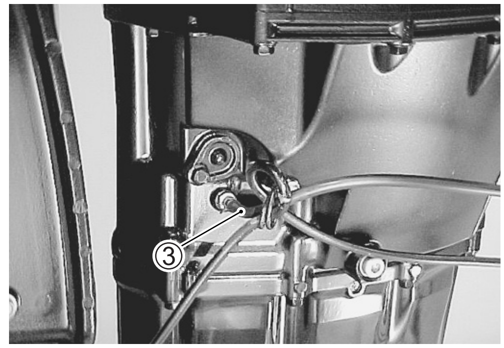




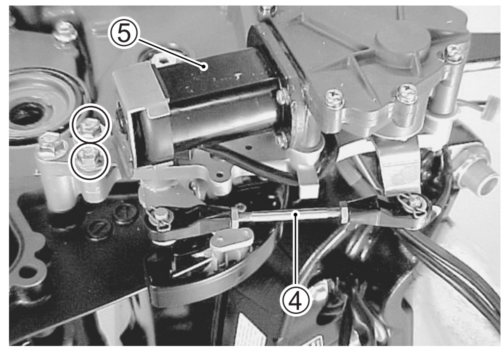
Remove eight (8) bolts and engine holder cover ②.

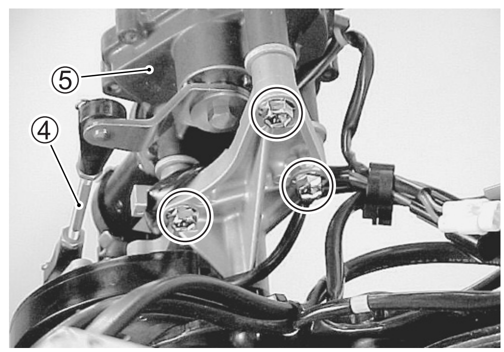


Disconnect cooling water hose ③ from oil pan.

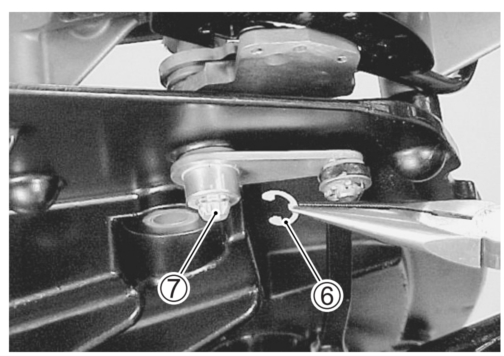


Remove clutch link rod ④.
Remove the five (5) bolts securing shift actuator ⑤, then remove shift actuator.

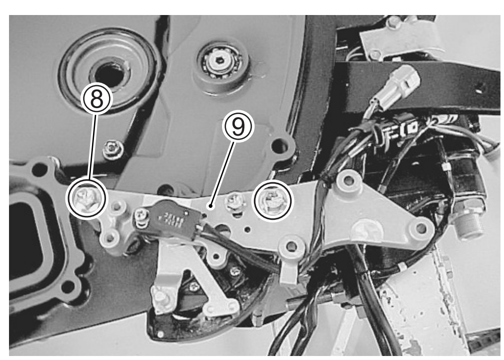




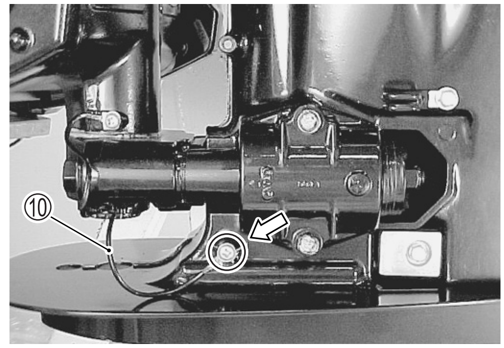
Remove E-ring ⑥ from clutch lever shaft ⑦.



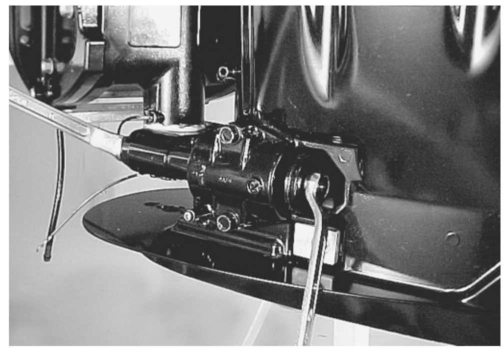
Remove two (2) bolts ⑧ and shift actuator holder ⑨.

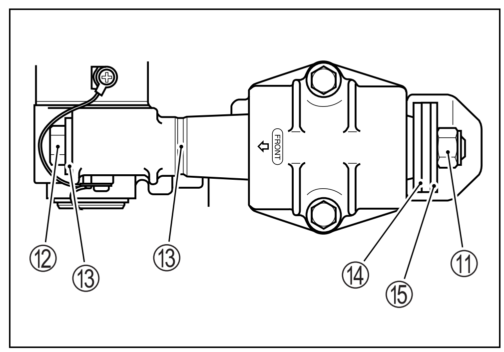


Remove screw and bonding wire ⑩ from driveshaft housing.

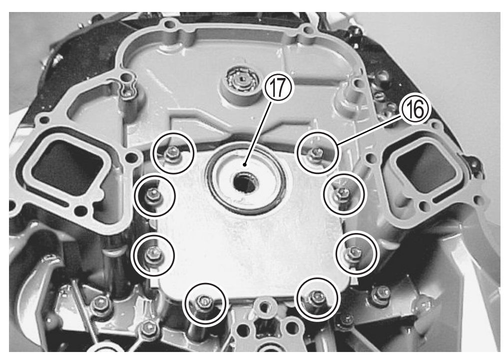


Remove STBD/PORT lower mount nuts ⑪ and lower mount bolts ⑫.
Account for washers ⑬, dampers ⑭ and washer ⑮.

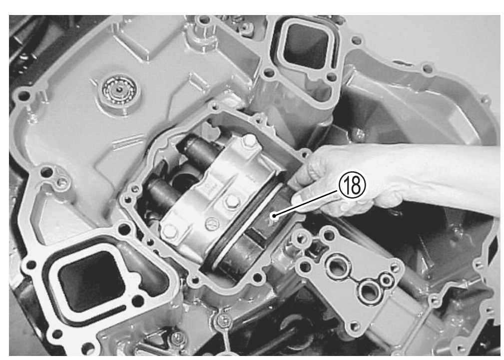




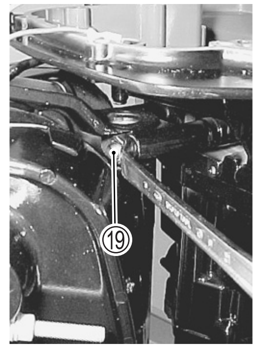
Remove eight (8) bolts ⑯ and the mount·oil seal cover ⑰.
Account for two (2) dowel pins.

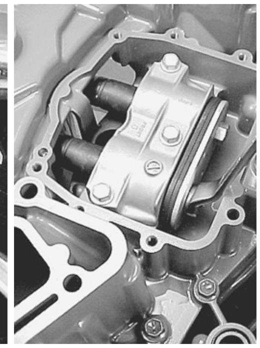


Remove thrust mount ⑱.

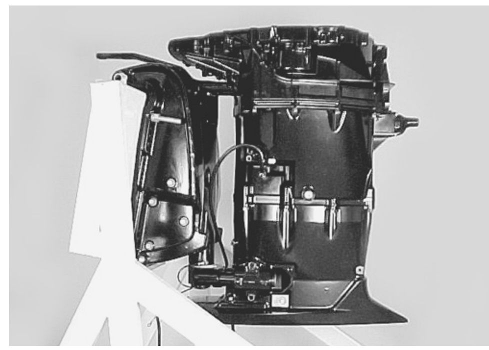


Remove STBD/PORT upper mount nuts ⑲ and washers.

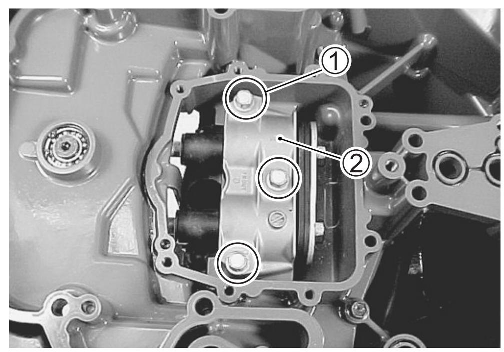




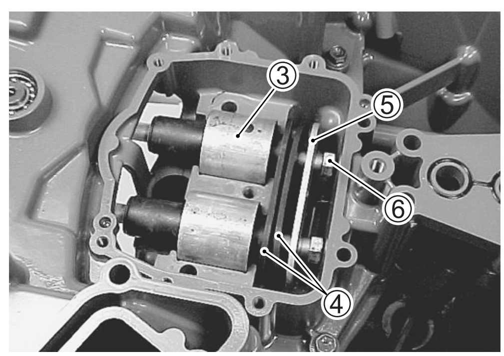
Remove driveshaft housing with oil pan.



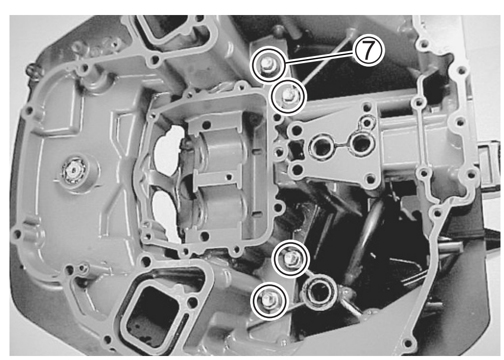
Remove three (3) bolts ① and upper mount cover ②.



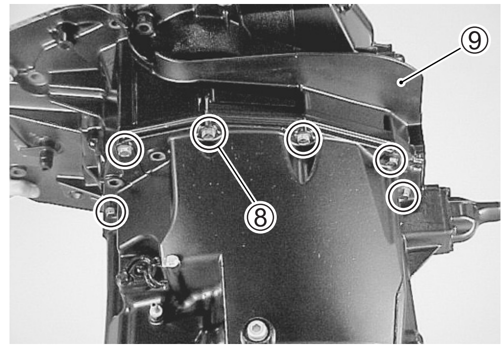
Remove upper mounts ③, thrust stoppers ④, mount plate ⑤ and mount bolts ⑥.

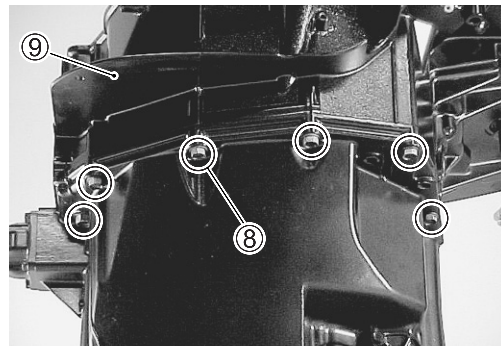


Remove four (4) exhaust tube bolts ⑦.

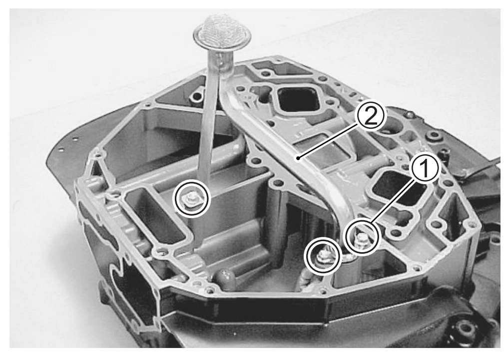


Remove twelve (12) bolts ⑧ and engine holder ⑨.

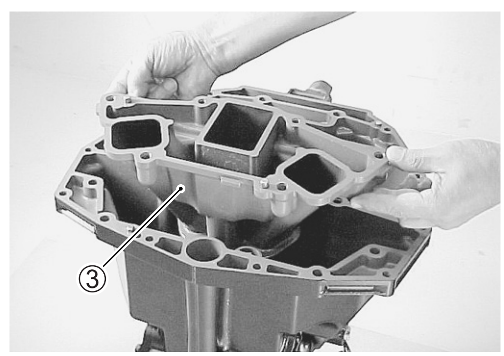




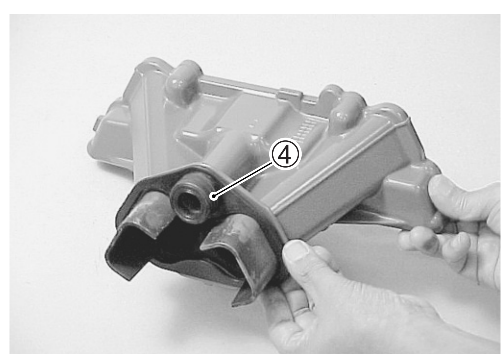
Remove three (3) bolts ① and oil strainer ②.



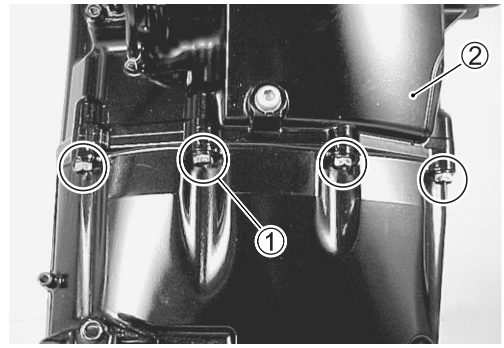
Remove the exhaust tube ③.



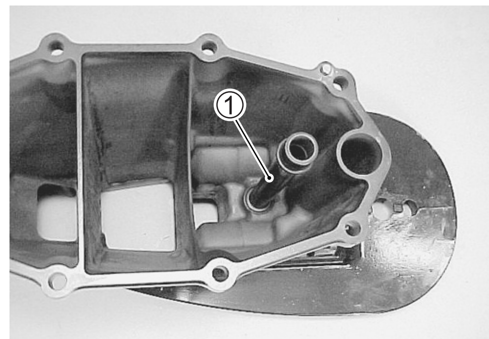
Remove the exhaust tube seal ④ from exhaust tube.



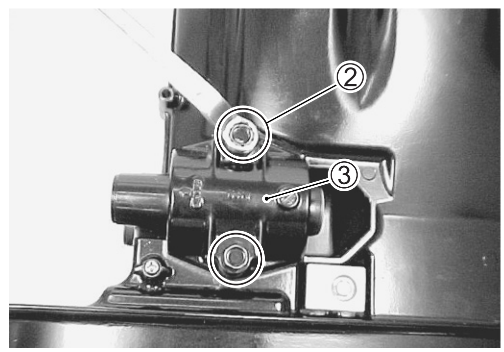
Remove eight (8) bolts ① and oil pan ②.

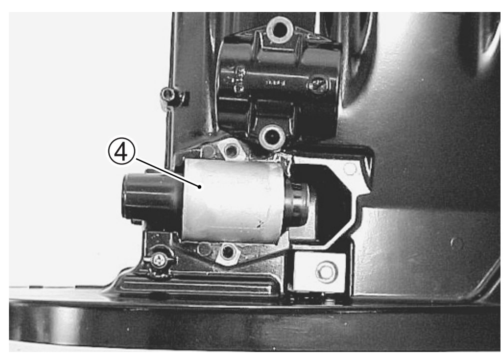


Remove water tube ①.



Remove bolts ②, lower mount cover ③ and lower mounts ④.



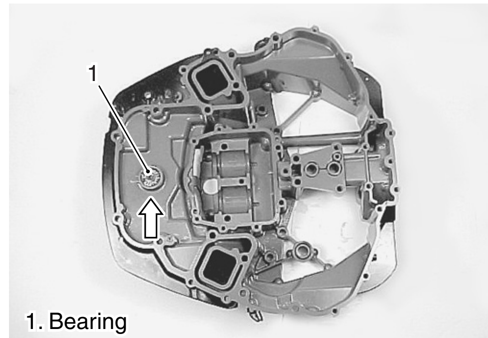


INSPECTION

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

ENGINE HOLDER

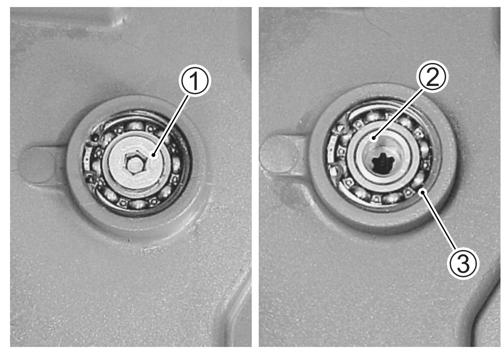
- Inspect engine holder. Replace if cracked, damaged, or other abnormal conditions are noted.
- Check water passage. If clogged or obstructed, clean water passage.
- Visually check the clutch shaft bearing. Replace if pitted, noisy, rough or other abnormal condition.
- Check clutch shaft oil seal. Replace oil seal if nicked, cut, worn or other abnormal conditions are noted.



1. Bearing

Replacing bearing and oil seal

1. Loosen and remove clutch shaft plug ①.
   Remove clutch shaft ②.
2. Remove circlip ③.

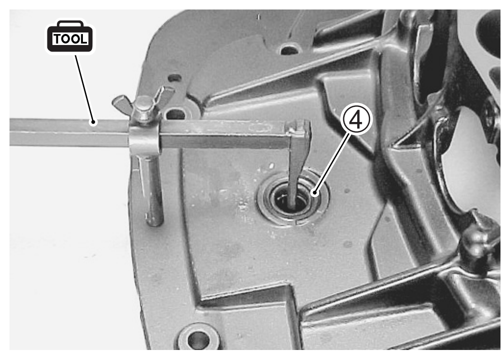


3. Extract oil seal ④ with oil seal remover.

09913-50121: Oil seal remover

CAUTION

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

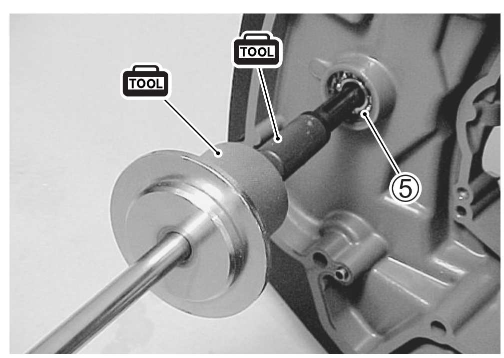


4. Remove bearing ⑤ with special tool and sliding hammer.

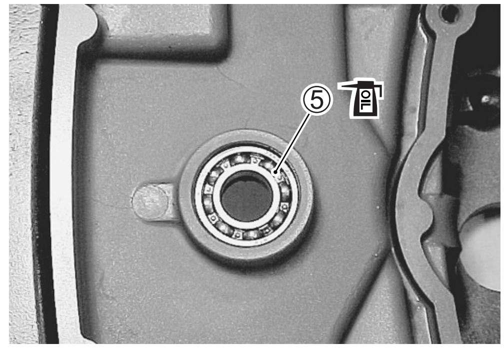
09923-73210: Bearing remover
09930-30104: Sliding hammer

CAUTION

Do not reuse the bearing once removed.
Always use a new bearing.



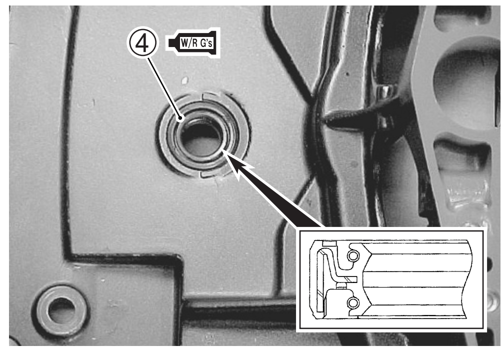
5. Apply engine oil to outer circumference of bearing ⑤.
   Install bearing into engine holder.



6. Apply Water Resistant Grease to outer circumference of oil seal ④.
   Drive oil seal into engine holder.
   Apply Water Resistant Grease to the seal lip.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

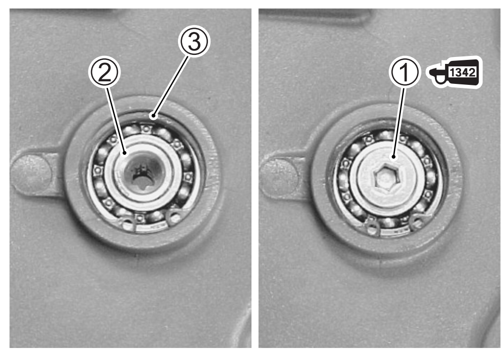
NOTE:
Install oil seal as shown in figure.



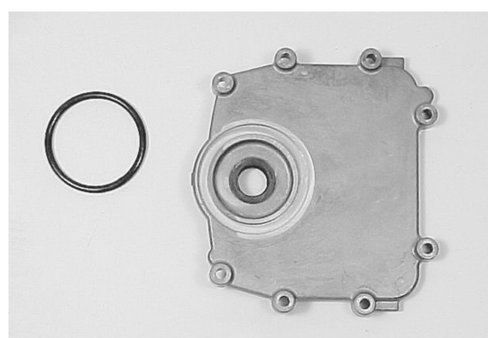
7. Install circlip ③.
8. Install clutch shaft ②.
   Tighten clutch shaft plug ①, pre-coated with thread lock, to specified torque.

1342 **99000-32050: THREAD LOCK "1342"**

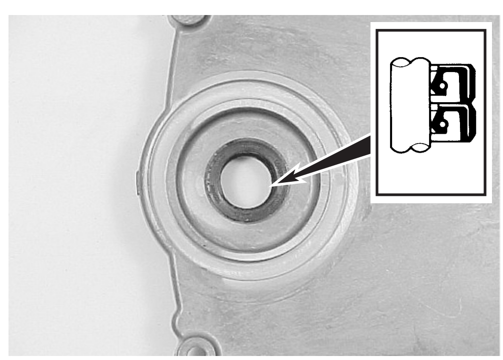
Clutch shaft plug: 85 N·m (8.5 kg-m, 61.5 lb-ft)



MOUNT·OIL SEAL COVER
- Inspect mount·oil seal cover. Replace if cracked, damaged or other abnormal conditions are noted.
- Check condition of O-ring. Replace O-ring if nicked, cut, worn or other abnormal conditions are noted.
- Check condition of oil seal. Replace oil seal if nicked, cut, worn or other abnormal conditions are noted.



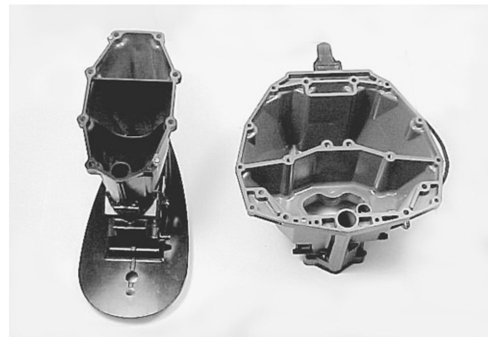
NOTE:
Install oil seal with lip (spring side) facing downward (oil pan side).



OIL STRAINER

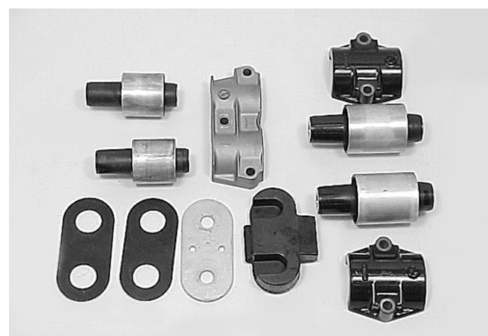
- Inspect oil strainer. Replace if cracked, damaged or other abnormal conditions are noted.
  If clog or obstruction, clean oil strainer.
- Check condition of O-ring. Replace O-ring if nicked, cut, worn or other abnormal conditions are noted.

OIL PAN/DRIVESHAFT HOUSING



Check oil pan, driveshaft housing.
If cracks, defects or other damage is found, replace it.

MOUNT



- Check upper, lower and thrust mounts.
  If excessive wear, corrosion or other damage is found, replace mount.
- Inspect mount cover. Replace if cracked, damaged or other abnormal conditions are noted.

EXHAUST TUBE/SEAL

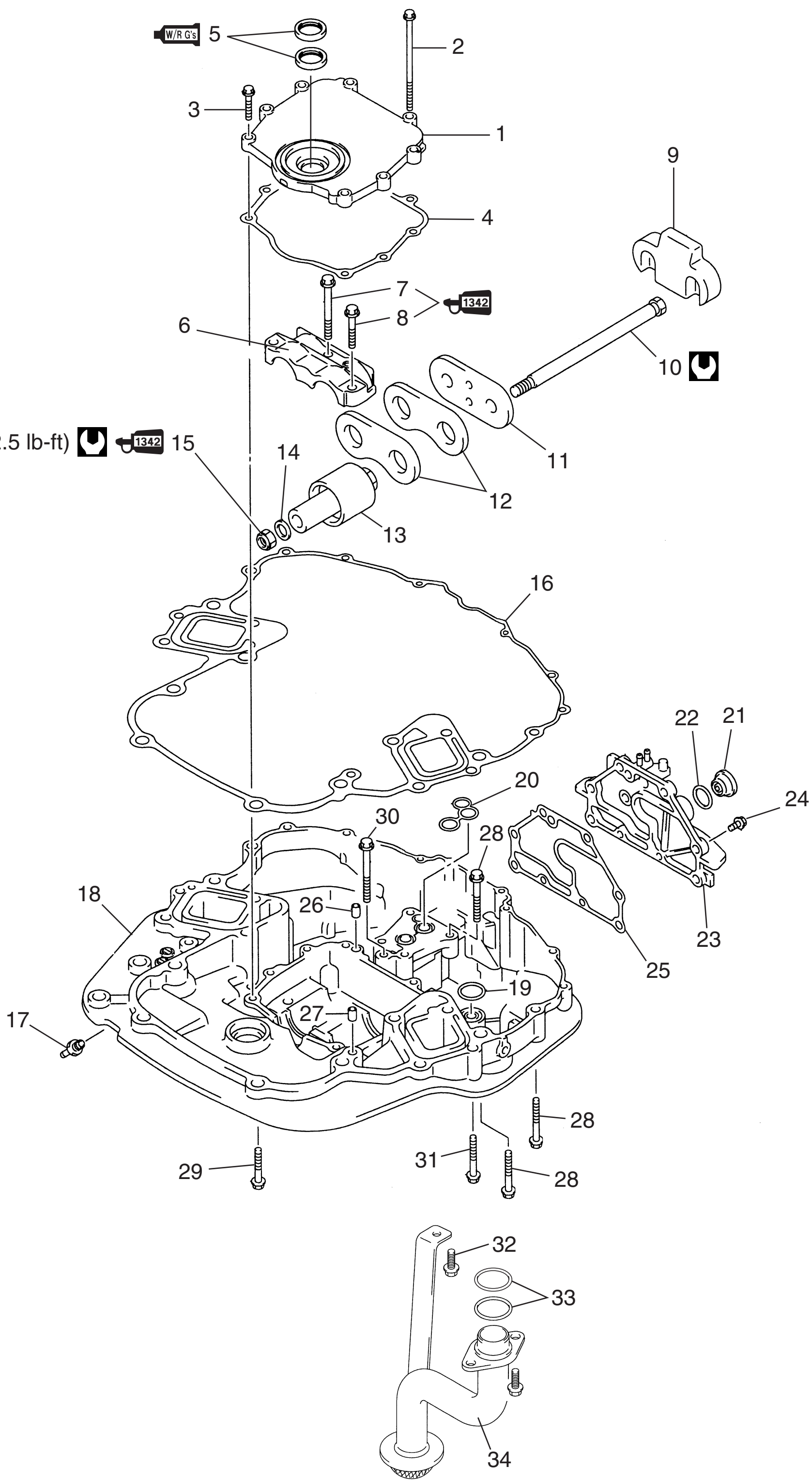
- Inspect exhaust tube. Replace if cracked, damaged or other abnormal conditions are noted.
- Check water passage. If clogged or obstructed, clean water passage.
- Check exhaust passage. If clogged or obstructed, clean exhaust passage.
- Check exhaust tube seal. If excessive wear or other damage is found, replace seal.

WATER TUBE

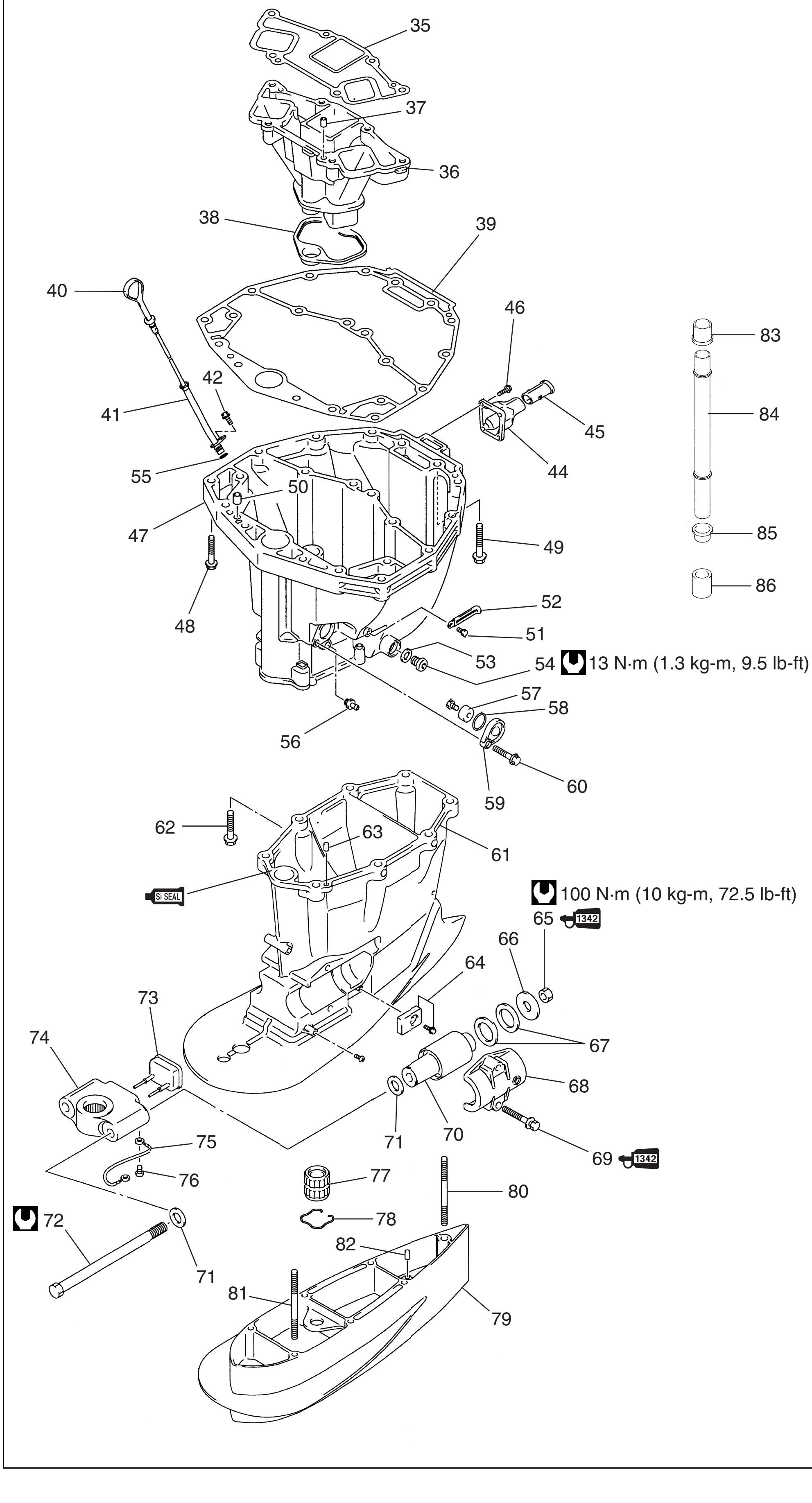
- Check water tube.
  If a clog or obstruction is found, clean water tube.
  If cracks, corrosion or other damage is found, replace water tube.
- Check water tube grommet.
  If excessive wear or other damage is found, replace grommet.

ASSEMBLY

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

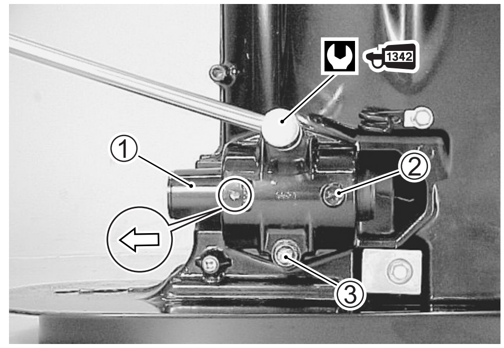


1. Mount oil seal cover
2. Bolt
3. Bolt
4. Gasket
5. Oil seal
6. Upper mount cover
7. Bolt
8. Bolt
9. Upper thrust mount
10. Bolt
11. Mount plate
12. Thrust stopper
13. Upper mount
14. Washer
15. Nut
16. Gasket
17. Water indicator union
18. Engine holder
19. Oil seal
20. Water return seal
21. Water plug
22. Gasket
23. Engine holder cover
24. Bolt
25. Gasket
26. Pin
27. Pin
28. Bolt
29. Bolt
30. Bolt
31. Bolt
32. Bolt
33. O-ring
34. Oil strainer



35. Exhaust tube gasket
36. Exhaust tube
37. Pin
38. Exhaust tube seal
39. Gasket
40. Oil level gauge
41. Oil level gauge guide
42. Bolt
44. Exhaust pipe
45. Exhaust release pipe
46. Bolt
47. Oil pan
48. Bolt
49. Bolt
50. Pin
51. Bolt
52. Clamp
53. Gasket
54. Drain plug
55. O-ring
56. Union
57. Anode
58. O-ring
59. Anode cover
60. Bolt
61. Driveshaft housing
62. Bolt
63. Pin
64. Anode
65. Nut
66. Washer
67. Damper
68. Mount cover
69. Bolt
70. Lower mount
71. Washer
72. Lower mount bolt
73. Thrust mount
74. Lower mount bracket
75. Bonding wire
76. Screw
77. Bush
78. Snap ring
79. Extension case (Type_XX)
80. Bolt
81. Bolt
82. Pin
83. Bush
84. Water tube
85. Bush
86. Water tube spacer

LOWER MOUNT/MOUNT COVER



Install lower mount ① and lower mount cover ②.

Tighten mount cover bolts ③, pre-coated with thread lock, to specified torque.

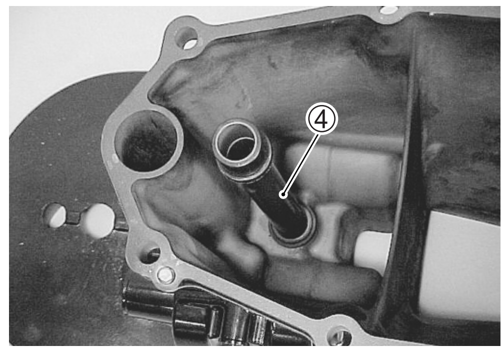
NOTE:

Install the lower mount cover to driveshaft housing with arrow (→) mark facing forward.

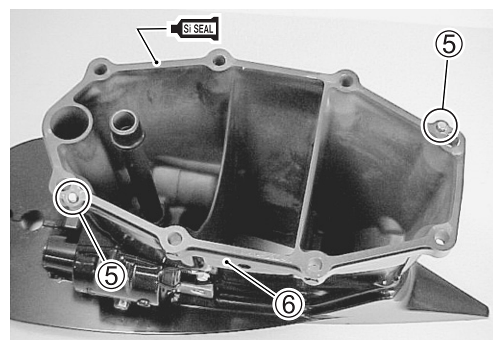
1342 99000-32050: THREAD LOCK "1342"

Lower mount cover bolt: 50 N·m (5.0 kg-m, 36.0 lb-ft)

OIL PAN TO DRIVESHAFT HOUSING



- Install water tube ④.



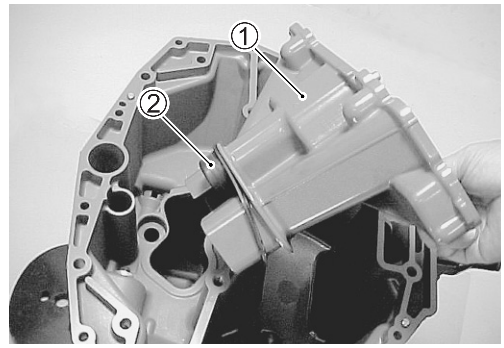
- Install two dowel pins ⑤ to driveshaft housing ⑥.
  Apply sealant to mating surfaces of driveshaft housing and oil pan.

Si SEAL 99000-31120: SUZUKI SILICONE SEAL

- Install oil pan ⑦ to driveshaft housing ⑥, then tighten eight (8) bolts ⑧ securely.

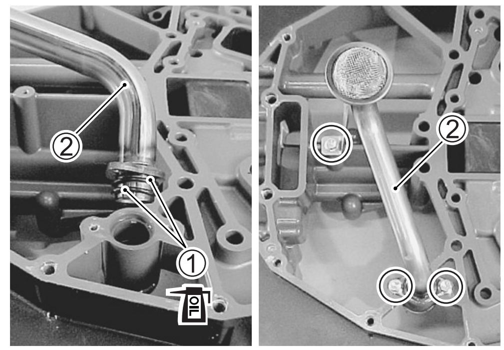
EXHAUST TUBE

Place exhaust tube seal ② to exhaust tube, then install exhaust tube ①.



ENGINE HOLDER TO OIL PAN

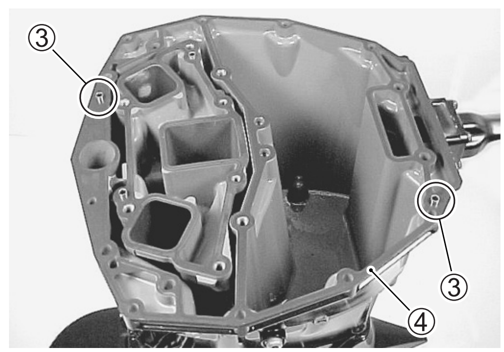
- Apply engine oil to O-rings ①, then install O-rings to oil strainer ②.
- Install oil strainer to engine holder, then tighten bolts securely.



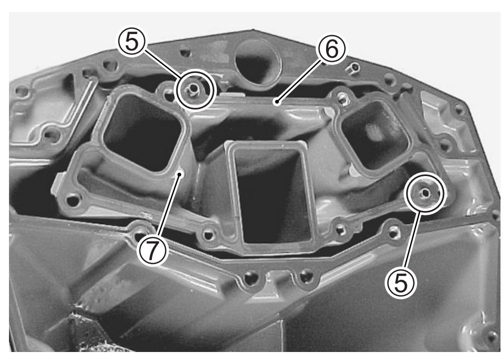
- Install two (2) dowel pins ③ and gasket ④ to oil pan.

CAUTION

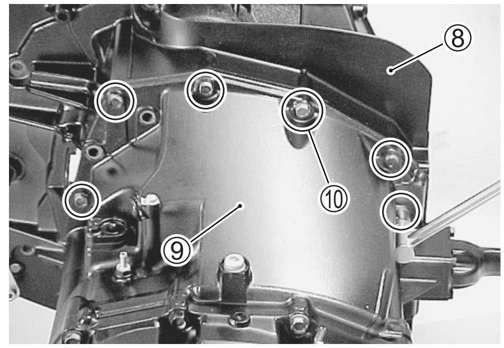
> **Do not reuse gasket. Always assemble with a new gasket.**

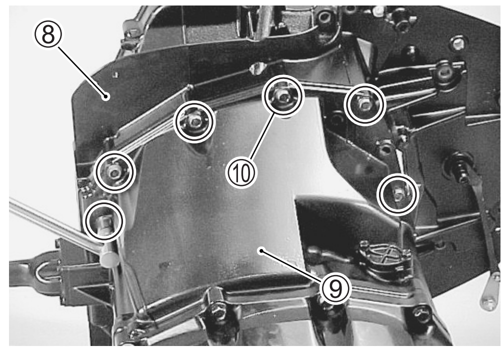


- Install two (2) dowel pins ⑤ and gasket ⑥ to exhaust tube ⑦.

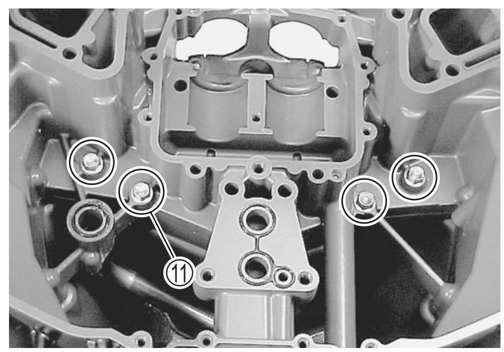


• Install engine holder ⑧ to oil pan ⑨, then securely tighten it with engine holder bolts ⑩.



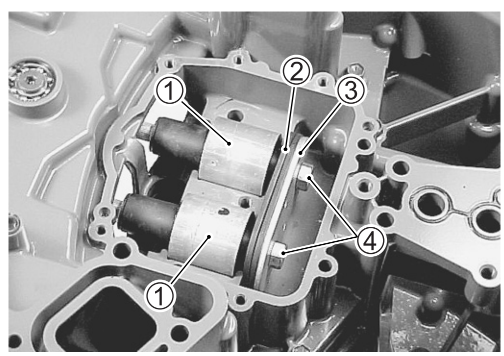


• Install exhaust tube bolts ⑪, then tighten four (4) exhaust tube bolts securely.



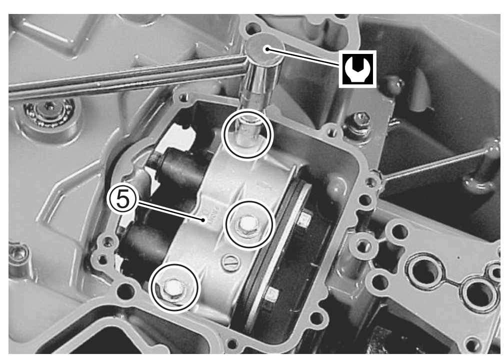
UPPER MOUNT AND MOUNT COVER

• Assemble these items in the following sequence:
  Place upper mount plate ③, thrust stopper plates ② and upper mounts ① on upper mount bolts ④.
• Place upper mount assembly and upper mount cover ⑤ into position.
• Tighten upper mount cover bolts, pre-coated with thread lock, to specified torque.



1342 99000-32050: THREAD LOCK "1342"

Upper mount cover bolt: 50 N·m (5.0 kg-m, 36.0 lb-ft)

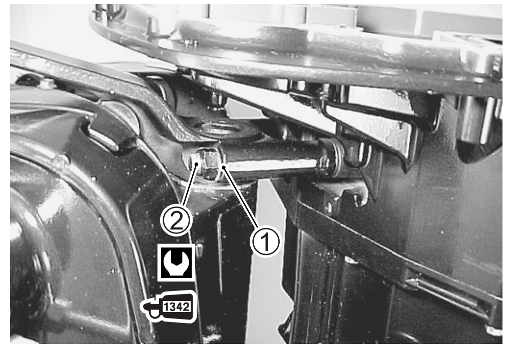


DRIVESHAFT HOUSING/OIL PAN

- Install driveshaft housing/oil pan to steering bracket.
- Install washer ① and upper mount nut ②, then tighten two (2) nuts, pre-coated with thread lock, to specified torque.

1342 99000-32050: THREAD LOCK “1342”

Upper mount nut: 100 N·m (10.0 kg-m, 72.5 lb-ft)

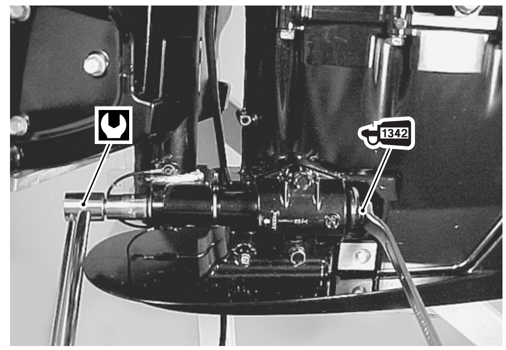


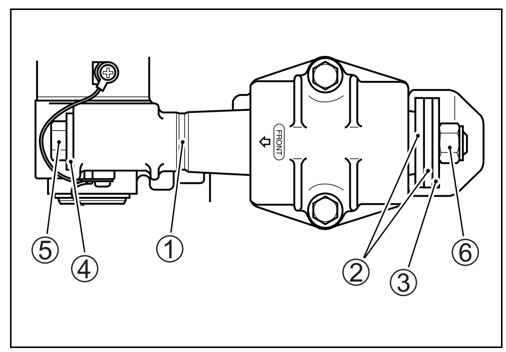
LOWER MOUNT BOLT/NUT

- Place washer ①, dampers ② and washer ③ into driveshaft housing.
- Install lower mount bolt ⑤, washer ④ and nut ⑥, then tighten nut, pre-coated with thread lock, to specified torque.

1342 99000-32050: THREAD LOCK “1342”

Lower mount bolt/nut: 100 N·m (10.0 kg-m, 72.5 lb-ft)



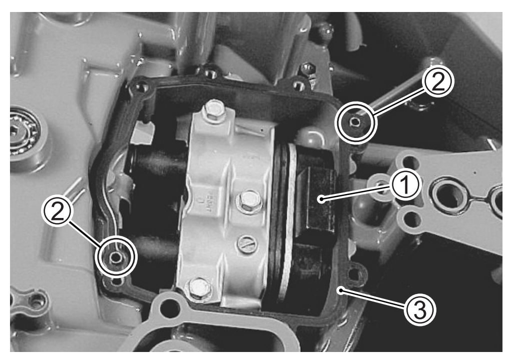


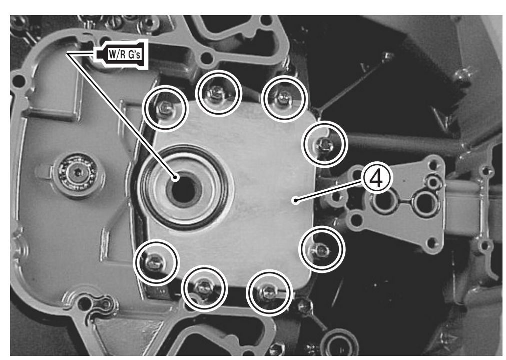
MOUNT·OIL SEAL COVER

- Install thrust mount ①.
- Apply Water Resistant Grease to oil seal.

W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

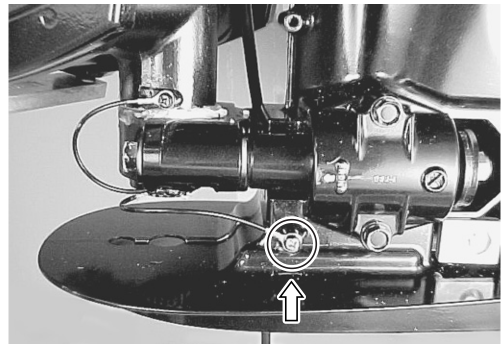
- Install dowel pins ②, gasket ③ and mount·oil seal cover ④, then tighten eight (8) cover bolts securely.





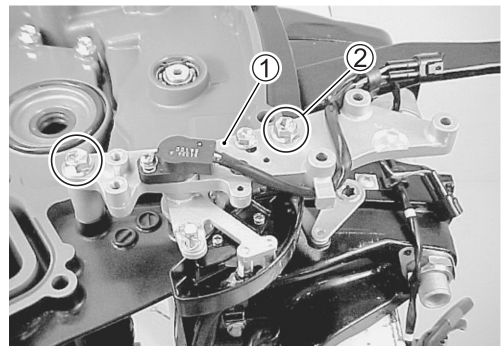
BONDING WIRE

Reattach bonding wire to driveshaft housing and tighten screw securely.

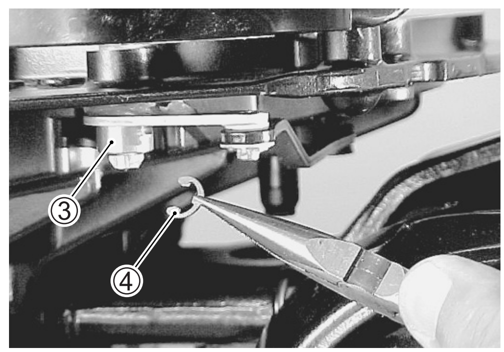


SHIFT ACTUATOR

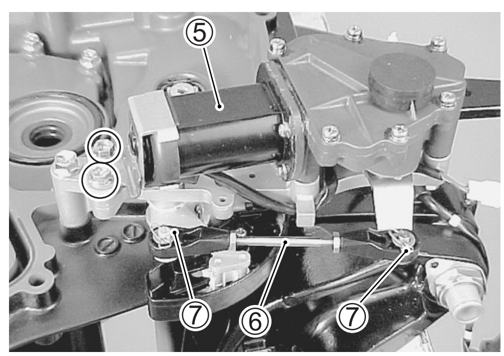
- Install shift actuator holder ① to engine holder, then tighten two (2) bolts ② securely.



- Install clutch lever shaft ③ and E-ring ④.



- Install shift actuator ⑤ to actuator holder, then tighten five (5) bolts securely.
- Install clutch link rod ⑥, then fit the washer and lock pin ⑦ to each pivot pin.



POWER UNIT

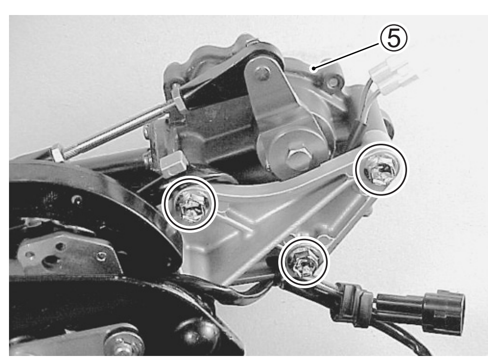
Install power unit. (See page 6-17 to 6-21.)

Tighten power unit mounting bolts and engine holder bolts to specified torque.

Power unit mounting bolt & Engine holder bolt:

8 mm 23 N·m (2.3 kg-m, 16.5 lb-ft)

10 mm 50 N·m (5.0 kg-m, 36.0 lb-ft)

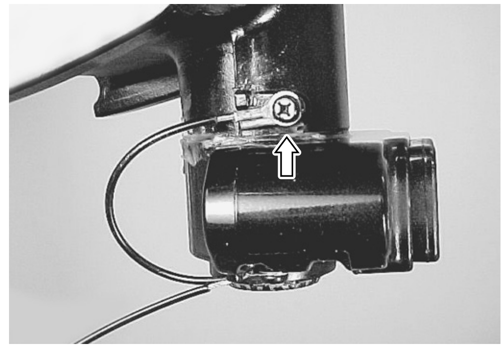


SWIVEL BRACKET, STEERING BRACKET AND CLAMP BRACKET

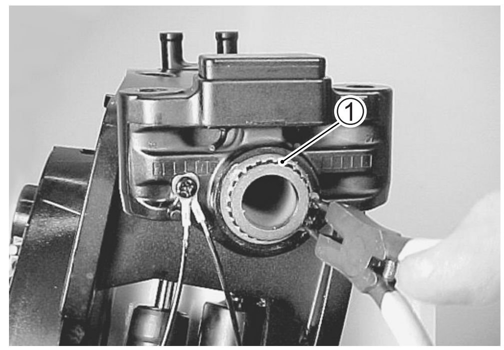
REMOVAL

Remove driveshaft housing/oil pan.
(See page 7-3.)

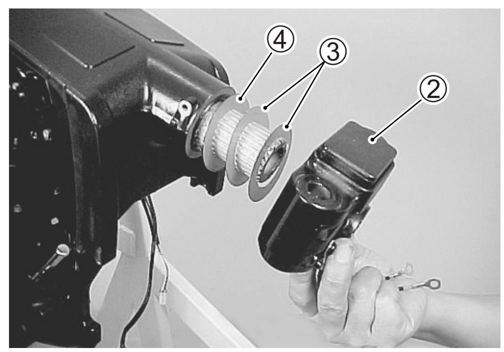
Remove screw and bonding wire from lower mount bracket.



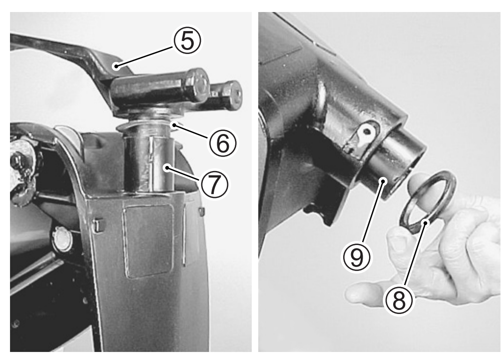
Remove circlip ①.



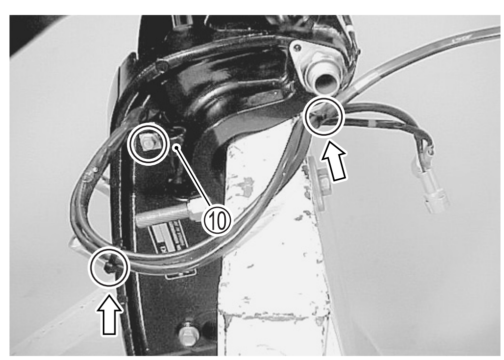
Remove lower mount bracket ②, shims ③ and washer ④ from the steering shaft.



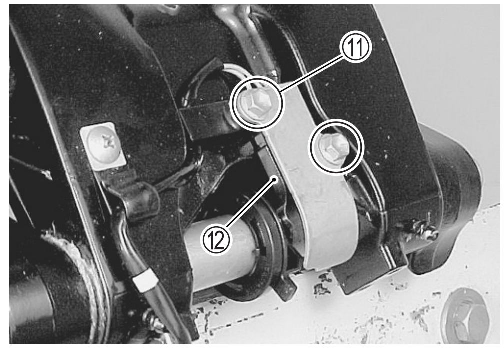
Lift steering bracket ⑤ upward to remove from swivel bracket.
Remove washer ⑥ and upper bushing ⑦.
Remove swivel bracket seal ⑧ and lower bushing ⑨.



Cut the cable ties binding PTT motor cable, trim sender lead wire and tilt limit switch lead wire.
Remove bolt and cable clamp ⑩.

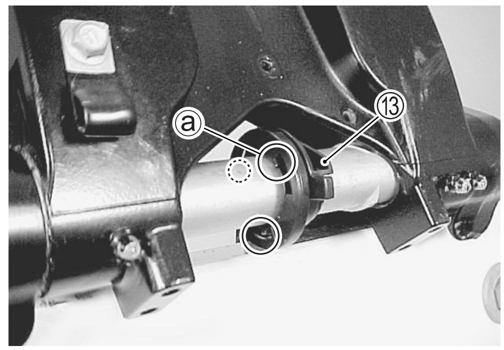


Remove two (2) bolts ⑪, tilt limit switch ⑫ and switch cover.



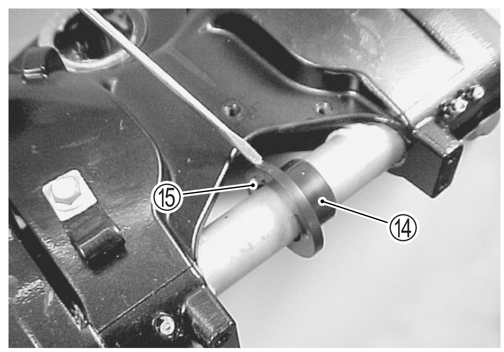
Remove tilt limit switch cam ⑬.

NOTE:
Unfasten three (3) stoppers ⓐ from the tilt limit switch cam to remove it from cam holder.

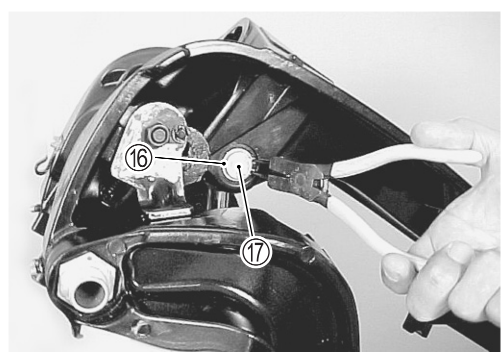


Remove upper cam holder ⑭ and lower cam holder ⑮ from clamp bracket shaft.

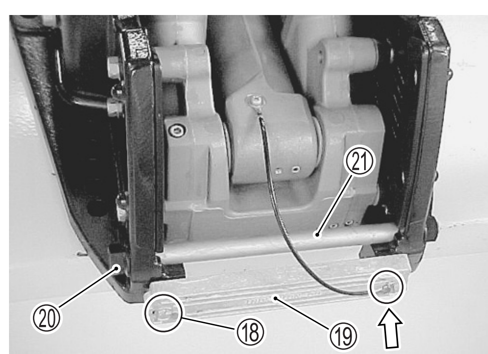
NOTE:
Use thin flat screw-driver to release the two hooks to separate the cam holder upper and lower halves.



Remove circlip ⑯ and push out tilt cylinder upper rod ⑰.

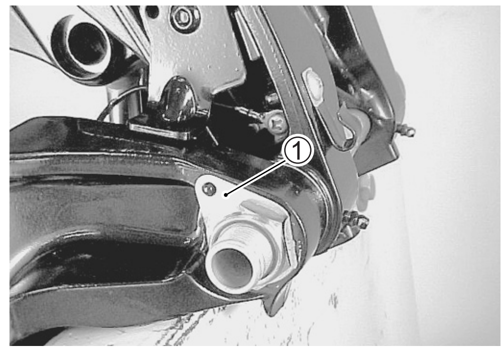


Remove bolts ⑱ and anode ⑲.
Remove nut ⑳ and tilt pin ㉑.

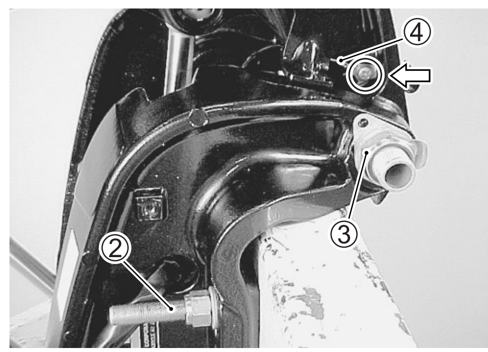


Remove bolts ㉒ securing PTT unit to the STBD and PORT clamp brackets.

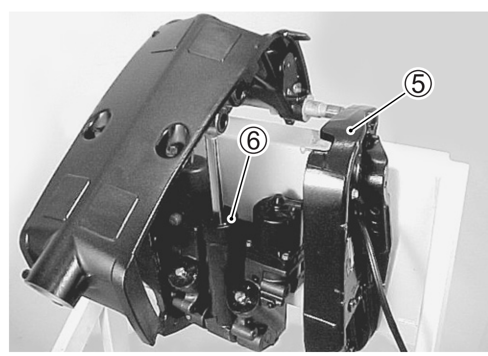
Using flat screw-driver, drive locking edge of lock washer ① to clamp bracket side.



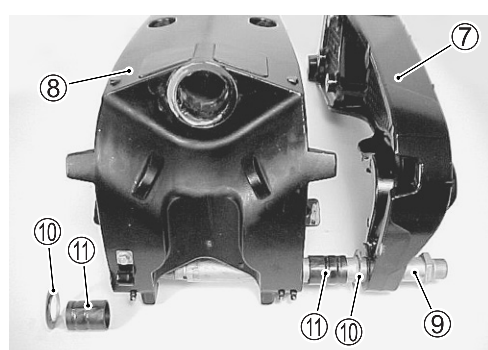
Remove the two STBD motor mounting bolts ②.
Remove the clamp bracket shaft nut ③ and washer.
Remove screw and bonding wire ④ from swivel bracket.



Slide STBD clamp bracket ⑤ off clamp bracket shaft, then remove PTT unit ⑥.



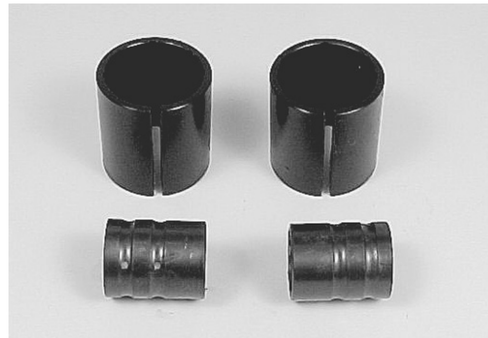
Pull PORT clamp bracket ⑦ outward to remove clamp bracket and bracket shaft ⑨ from swivel bracket ⑧.
Remove washer ⑩ and bushing ⑪ from each side of swivel bracket.



INSPECTION

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

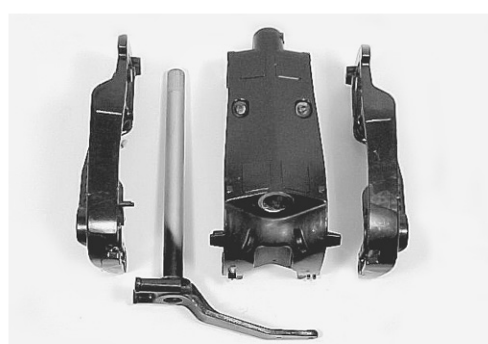
BUSHINGS
Check all bushings.
If excessive wear or other damage is found, replace bushing.
If bushing fit is loose when installing, replace bushing.



OIL SEAL
Check swivel bracket seal.
If excessive wear or other damage is found, replace seal.

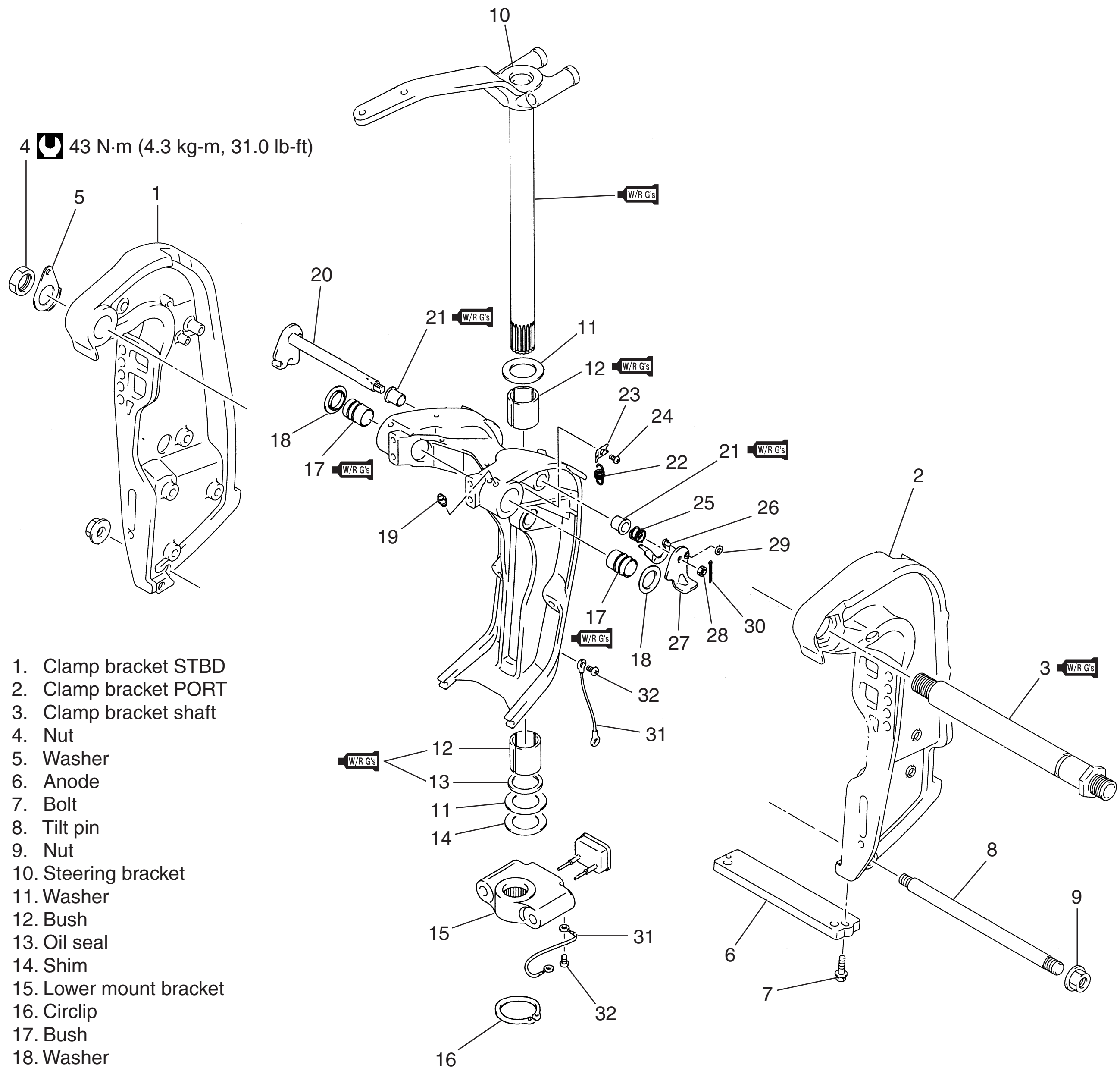
CLAMP BRACKET SHAFT
Check clamp bracket shaft.
If clamp bracket shaft is bent or twisted, replace shaft.

BRACKET
Check clamp brackets, steering bracket and swivel bracket.
If cracks or other damage is found, replace bracket (s).



REASSEMBLY

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



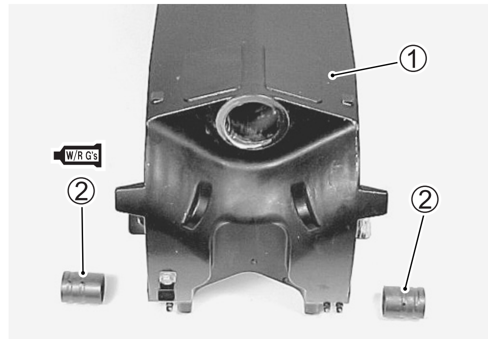
1. Clamp bracket STBD
2. Clamp bracket PORT
3. Clamp bracket shaft
4. Nut
5. Washer
6. Anode
7. Bolt
8. Tilt pin
9. Nut
10. Steering bracket
11. Washer
12. Bush
13. Oil seal
14. Shim
15. Lower mount bracket
16. Circlip
17. Bush
18. Washer
19. Grease nipple
20. Tilt lock lever
21. Bush
22. Spring
23. Bracket
24. Screw
25. Spring
26. Link
27. Tilt lock lever PORT
28. Nut
29. Washer
30. Pin
31. Bonding wire
32. Screw

CLAMP BRACKET AND SWIVEL BRACKET

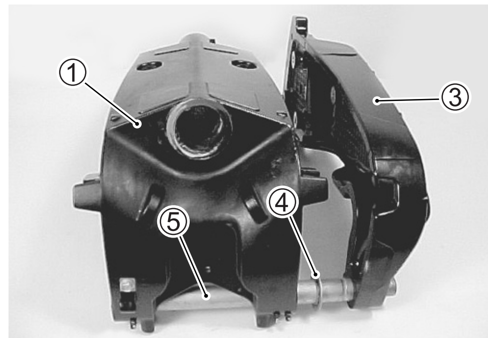
NOTE:
Before installing clamp bracket to swivel bracket, apply grease to clamp bracket shaft and bushings.

W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

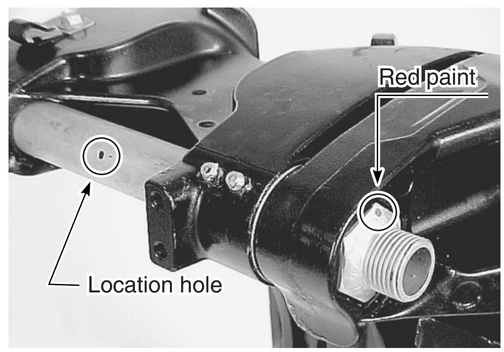
- Insert PORT and STBD bushings ② into the swivel bracket ①.



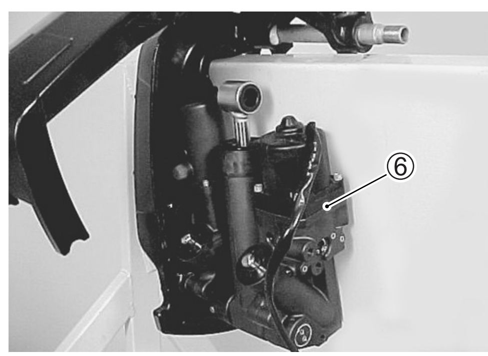
- Assemble port clamp bracket ③, washer ④, clamp bracket shaft ⑤ and swivel bracket ①.



NOTE:
For proper operation of the tilt limit device, install the clamp bracket shaft to the port clamp bracket so the red paint mark on the hex section and the cam holder location hole on the clamp bracket shaft are positioned as shown in the illustration.



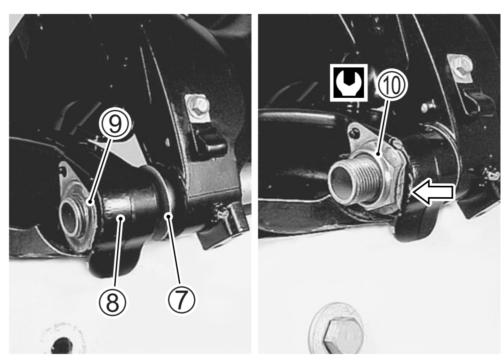
- Install PTT unit assembly ⑥.
  (For PTT unit assembly installation, see page 8-19 to 8-20.)



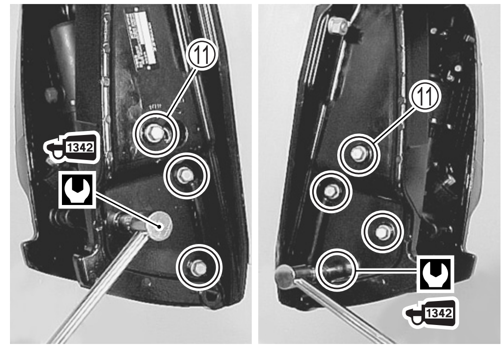
- Install washer ⑦, STBD clamp bracket ⑧, lock washer ⑨ and clamp bracket shaft nut ⑩, then tighten clamp bracket shaft nut to specified torque.

Clamp bracket shaft nut: 43 N·m (4.3 kg-m, 31.0 lb-ft)

- After tightening clamp bracket shaft nut with specific torque, bend lock washer edge toward nut for locking.



- Tighten eight (8) PTT unit retaining bolts ⑪, pre-coated with thread lock, to specified torque.

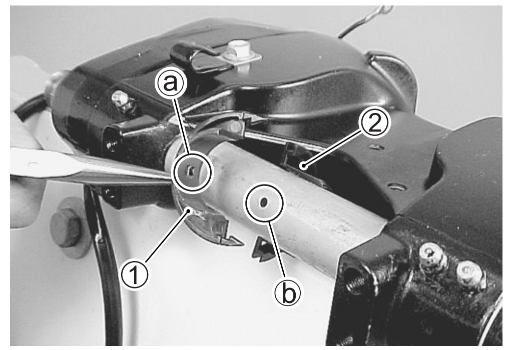


1342 99000-32050: THREAD LOCK “1342”

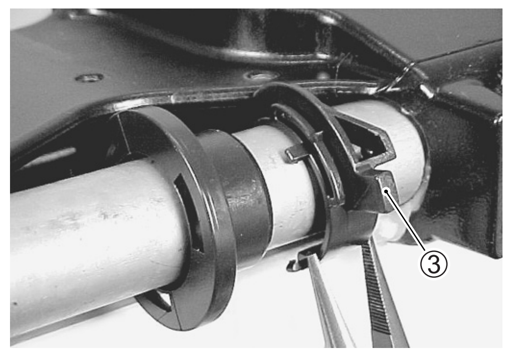
PTT retaining bolt: 50 N·m (5.0 kg-m, 36.0 lb-ft)

TILT LIMIT DEVICE

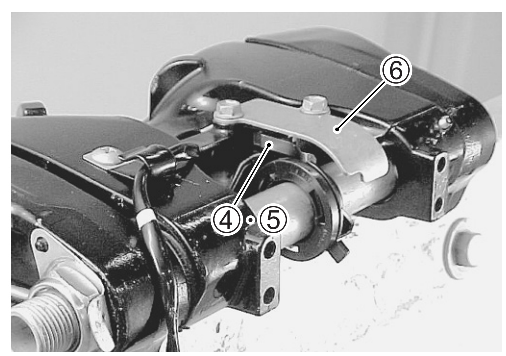
- Install the lower cam holder ① engaging its locating pin ⓐ with the clamp bracket shaft hole ⓑ, then install the upper cam holder ②.



- Install tilt limit switch cam ③.



- Install tilt limit switch ④, switch holder ⑤ and switch cover ⑥, then secure with bolts.



STEERING BRACKET

- Apply Water Resistant Grease to steering bracket shaft.

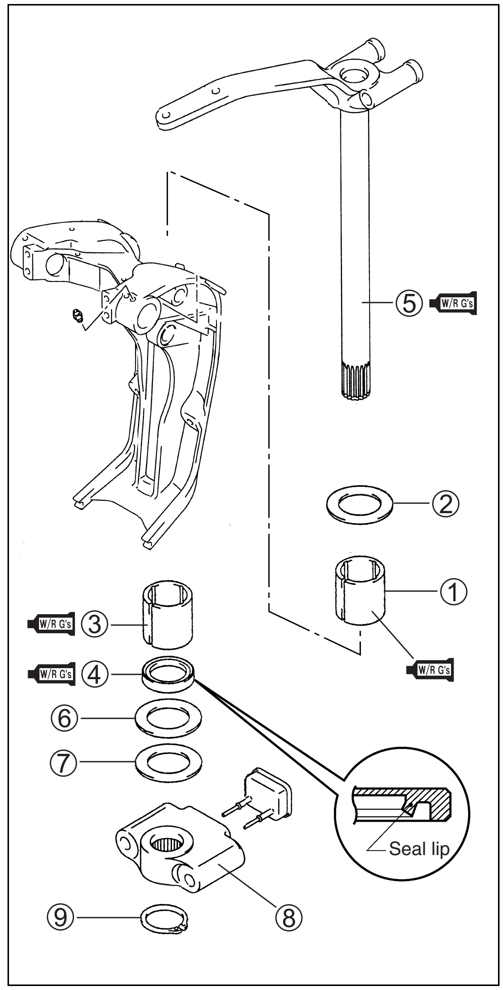
W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

NOTE:
Apply grease to bushings, oil seal lip and pilot shaft portion of steering bracket.

- Install upper bushing ① and washer ② to swivel bracket.
- Install lower bushing ③ and swivel bracket seal ④ to swivel bracket.

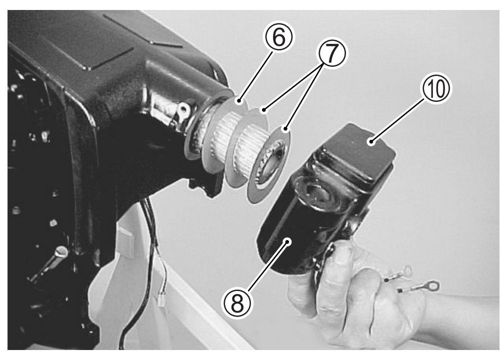
NOTE:
Install seal ④ with lip (spring side) facing downward.

- Install steering bracket ⑤ to swivel bracket.

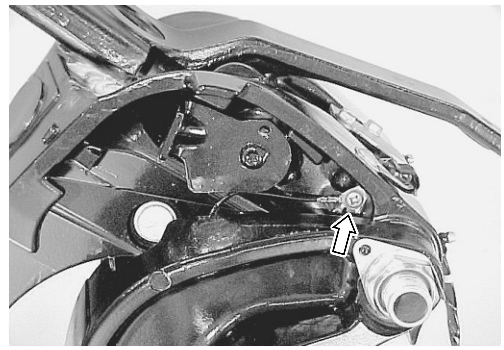


LOWER MOUNT BRACKET

- Install lower thrust mount ⑩ to lower mount bracket ⑧.
- Install washer ⑥ and shim ⑦, and then slide the lower mount bracket ⑧ upward on the splines until it contacts the shim.
- Install circlip ⑨ to retain bracket.

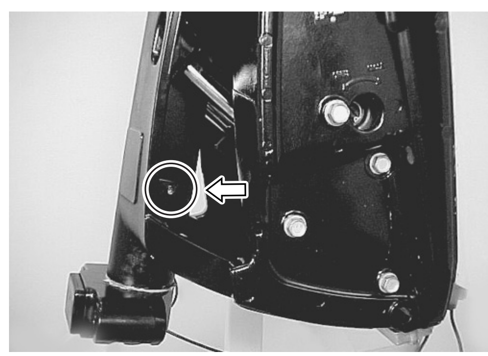


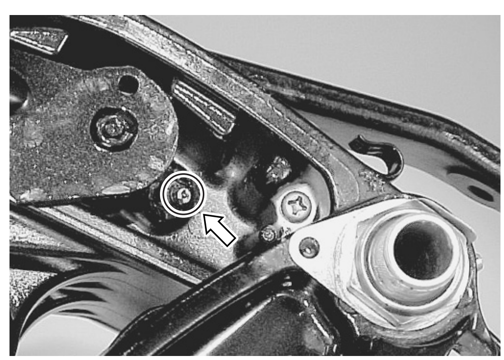
BONDING WIRE
Reattach bonding wire, tightening screw securely.



LUBRICATION
After completing reassembly of the mid unit, apply grease through each grease nipple.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

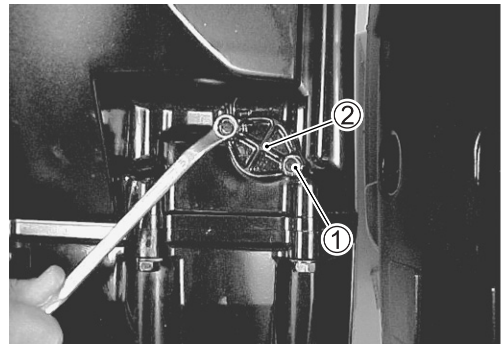


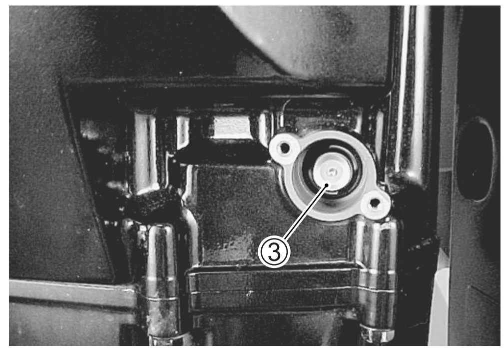


WATER PRESSURE VALVE

REMOVAL

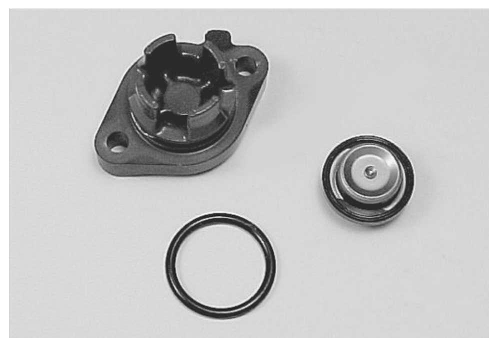
- Remove oil pan cover. (See page 7-2.)
- Remove two bolts ①, pressure valve cover ② and water pressure valve ③.





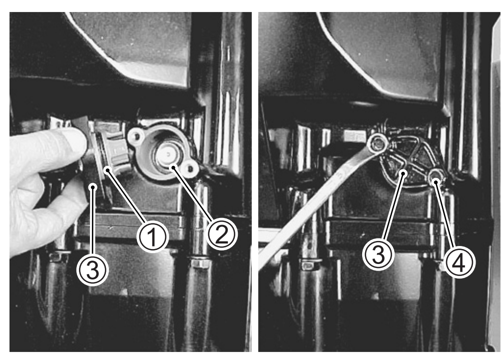
INSPECTION

- If salt deposits, corrosion, wear or other damage is found, clean or replace.
- Inspect O-ring. Replace if nicked, cut or torn.



INSTALLATION

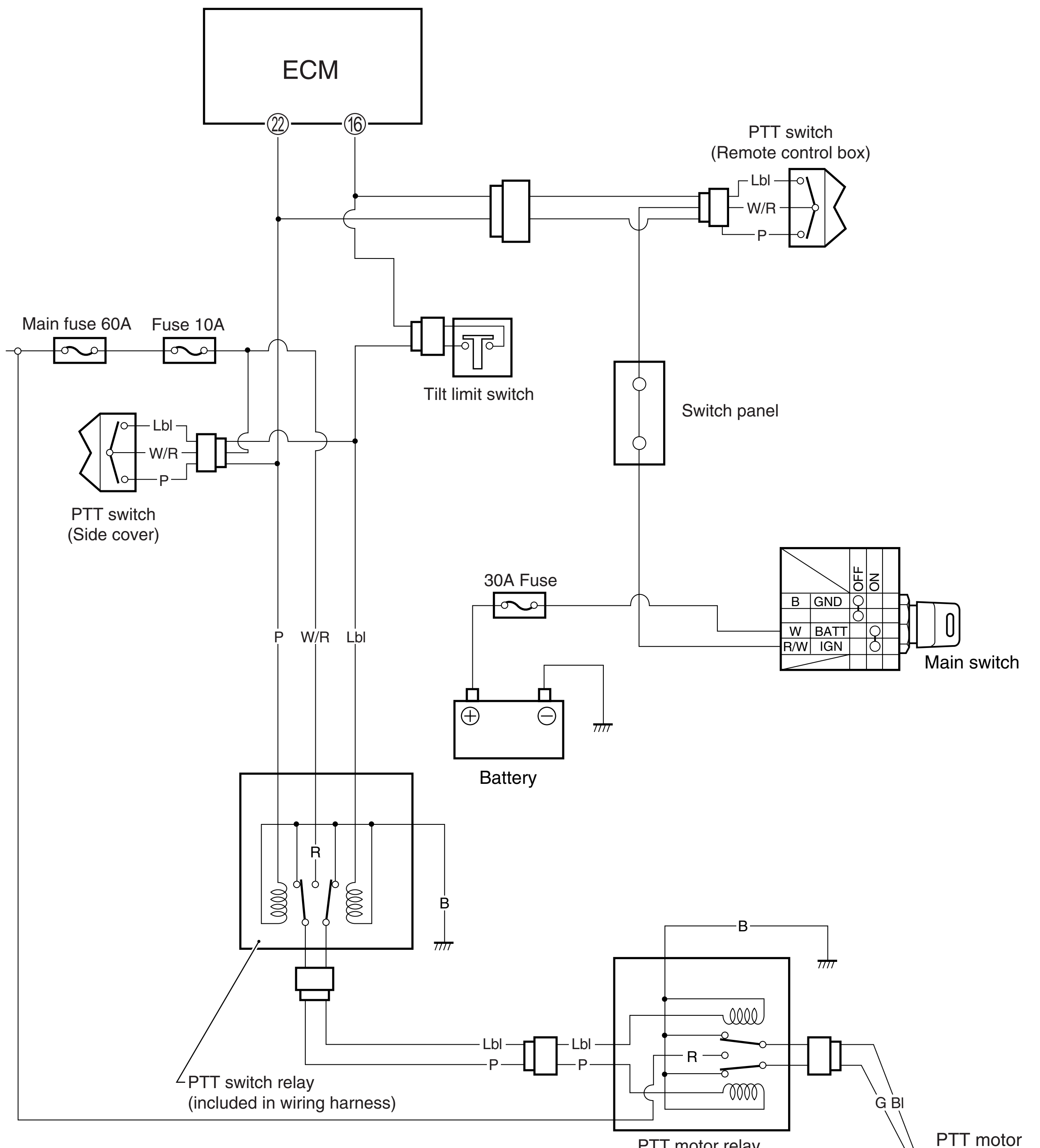
- Install O-ring ① to pressure valve cover.
- Install pressure valve ② and pressure valve cover ③ to oil pan and secure with bolts ④.



POWER TRIM AND TILT

CONTENTS

SYSTEM WIRING DIAGRAM



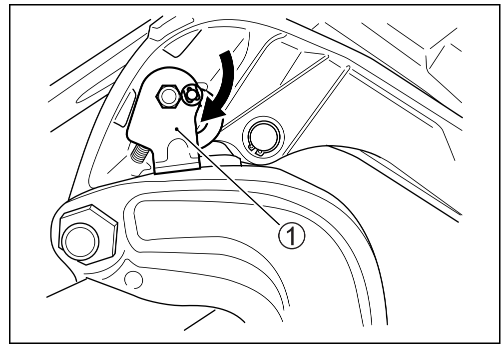
NOTE:
The input voltage supplied from PTT switch to ECM No.16 (Lbl) and No.22 (P) terminals is the voltage necessary to record the engine position (PORT, CENTER and STBD) into BCM when performing SPC system calibration. The input voltage supplied to each ECM terminal is not a voltage used for controlling up/down operation of the outboard motor trim/tilt.

SERVICE PROCEDURE

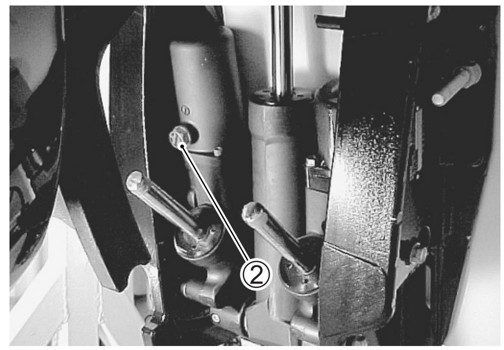
OIL LEVEL

To check the PTT 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:

Suzuki Power Trim and Tilt Fluid

or

Dexron Ⅲ automatic transmission fluid or equivalent

CAUTION

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

6. Reinstall oil filler plug.

AIR BLEEDING

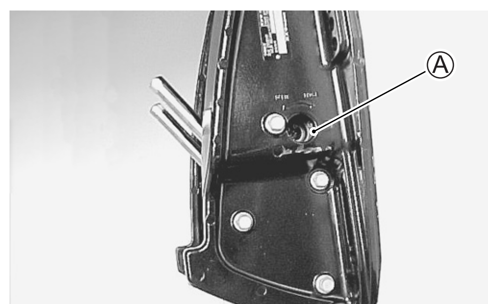
1. Check that the manual release valve is tightened to the specified torque.

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

CAUTION

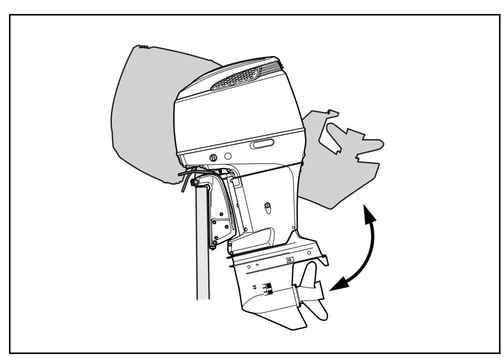
> **Do not over-tighten manual release valve.**

Counterclockwise = Open
Clockwise = Close



Ⓐ Manual release valve

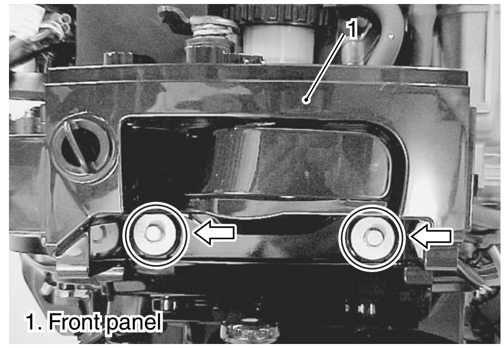
2. Operate the PTT switch, raising and lowering the motor up and down (full tilt position to full trim down position) 4 to 5 times.
3. Check oil level, topping off if necessary.
4. Reinstall oil filler plug.



POWER TRIM AND TILT UNIT

REMOVAL

Remove both side covers. (See page 7-2.)
Remove two (2) bolts and front panel.

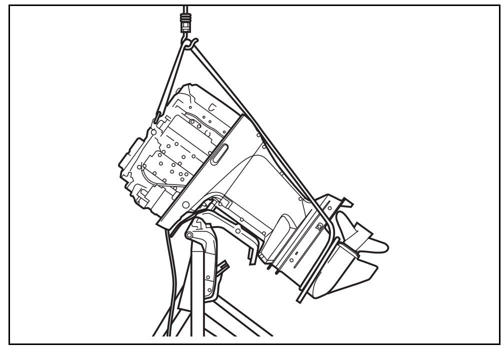


1. Front panel

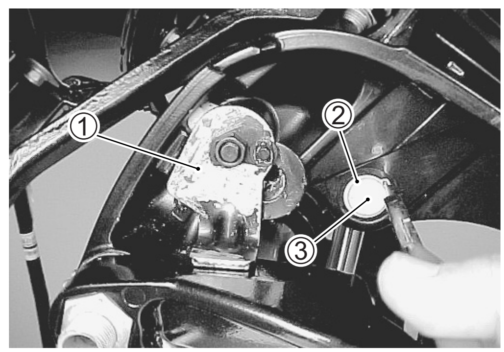
Raise the engine to the full tilt position and lower the manual tilt lock levers ①.

⚠ WARNING

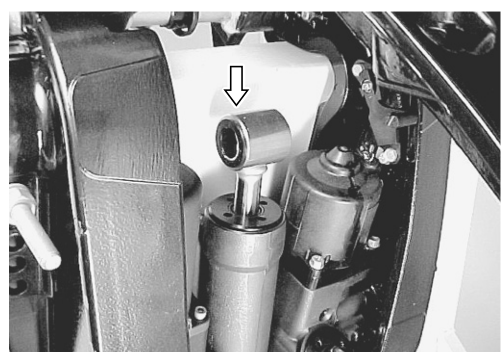
During the following procedures, the engine must be firmly secured and its weight fully supported. (See right.)



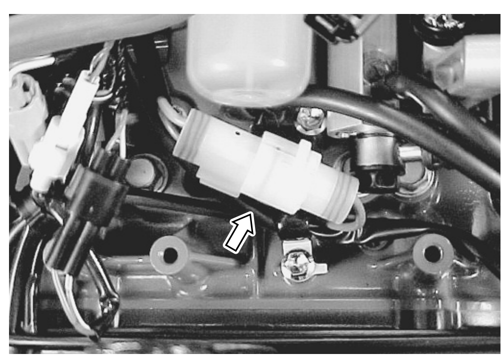
Remove the tilt rod snap ring ② and push tilt cylinder upper shaft pin ③ out.



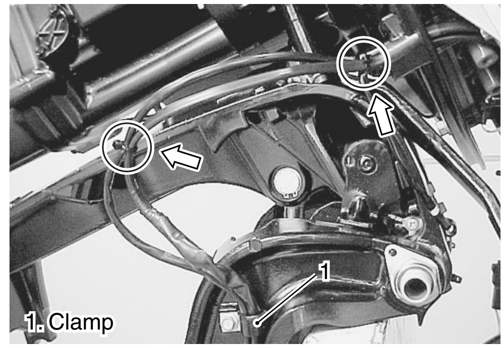
Lower tilt rod to full down position and disconnect the battery cable.



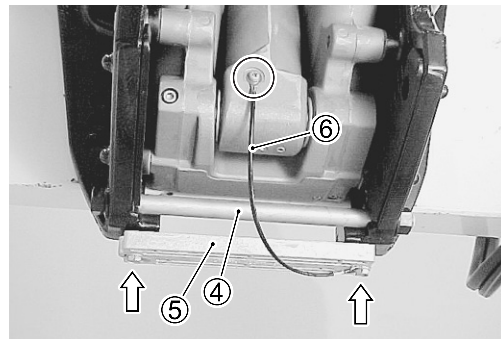
Disconnect the PTT motor cable wire connector from the PTT relay.



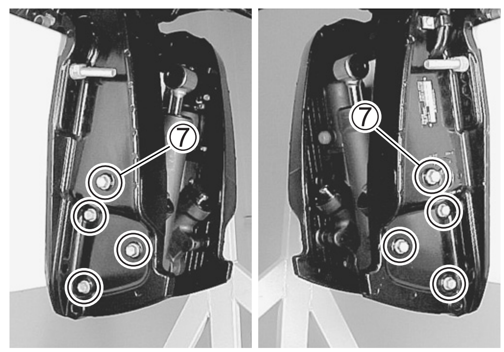
Cut the cable ties binding PTT motor cable and trim sender lead wire.
Remove the bolt and clamp.
Remove the PTT motor cable from engine lower cover.



Remove the tilt pin ④.
Remove two (2) bolts and anode ⑤.
Remove the screw securing bonding wire ⑥.

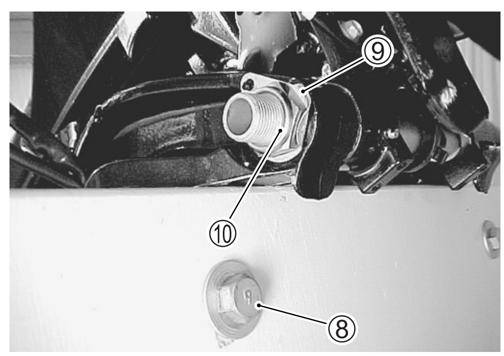


Remove the eight (8) bolts ⑦ securing PTT unit to STBD/PORT clamp bracket.

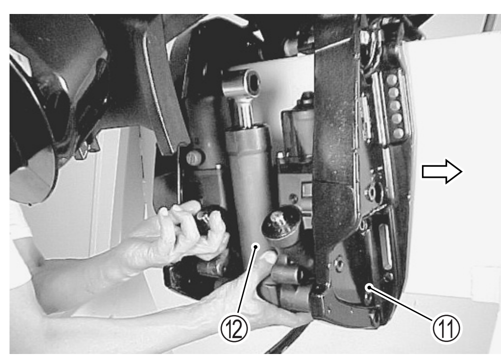


Remove two STBD motor mounting bolts ⑧.
Using flat screw driver, drive locking edge of lock washer ⑨ to clamp bracket side.
Loosen the clamp bracket shaft nut ⑩.

NOTE:
Complete removal of the clamp bracket shaft nut is not required. Nut should be loosened as far as the end of the shaft threads only to facilitate removal of the PTT unit.



Slide the STBD clamp bracket ⑪ fully outward to the right hand side.
Remove the PTT unit ⑫ from between the clamp brackets.

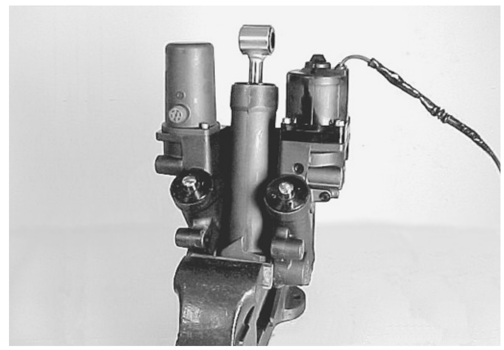


DISASSEMBLY

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

Place the lower of the PTT unit in a vise. Tighten the vise only enough to secure the PTT unit, DO NOT OVER TIGHTEN.

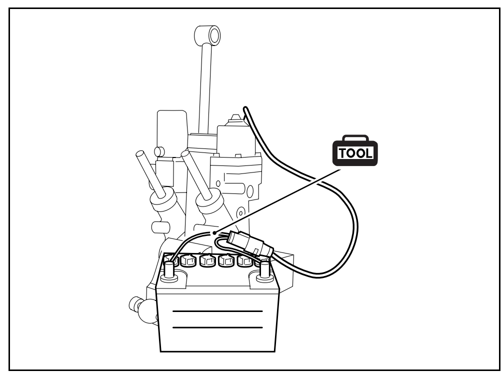
NOTE:
To prevent damage to the PTT cylinder use wood blocks, vise jaw protectors, etc., between the vise jaws and PTT components before tightening vise.



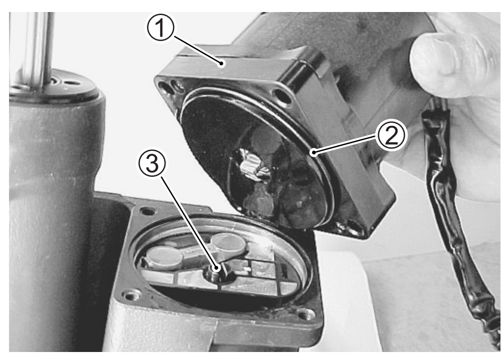
Connect the PTT cable extension to PTT motor cable connector.

TOOL **09945-79310: PTT cable extension**

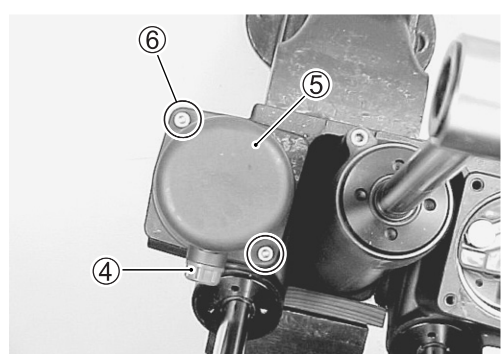
Connect the PTT cable extension leads (G, Bl) to battery and operate PTT motor until tilt piston rod is at maximum stroke. (full-tilt up position)



Remove the PTT motor assembly ①. (See page 8-15.)
Note the position of drive joint ③ and O-ring ②, before removing them.

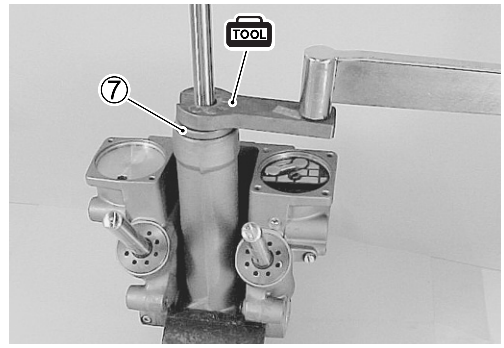


Unscrew the filler plug ④ and drain PTT oil into suitable container.
Remove the two (2) screws ⑥ securing reservoir ⑤, then detach the reservoir from PTT manifold.
Note the position of O-ring and remove it.

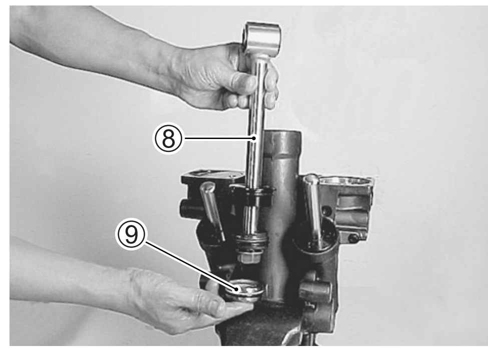


Using special tool, unscrew the PTT cylinder head ⑦.

09944-09820: PTT cylinder cap tool

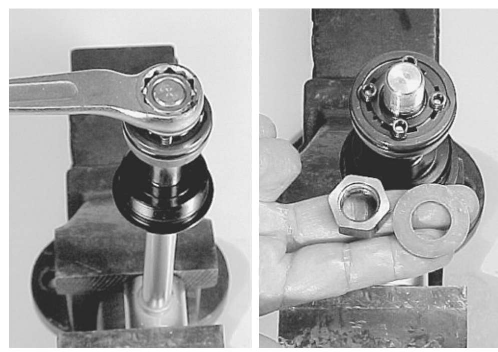


Pull the tilt rod/piston assembly ⑧ out of the cylinder body.
Remove the free piston ⑨ from the cylinder body.

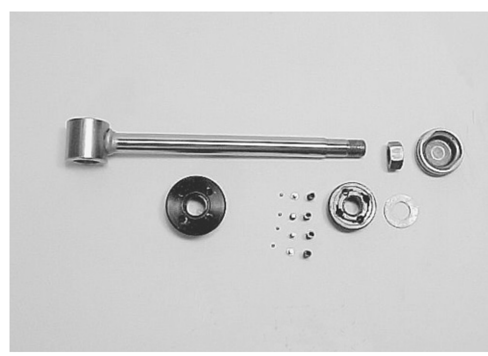


Disassembly of tilt rod/piston assembly

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.



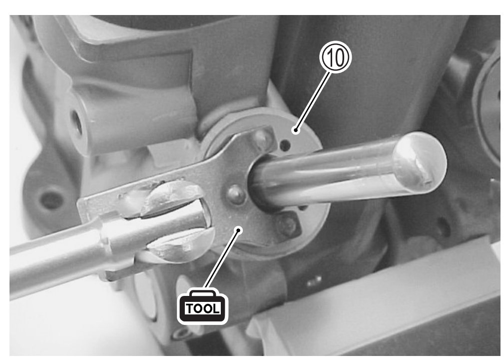
Remove the piston assembly and PTT cylinder head from the tilt rod by sliding them down and off the rod end.



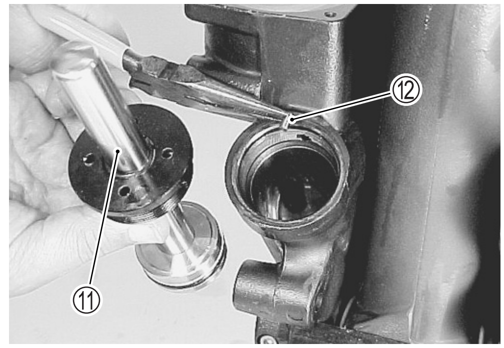
Disassembly of trim rod/piston assembly

Using special tool, unscrew the trim cylinder head ⑩.

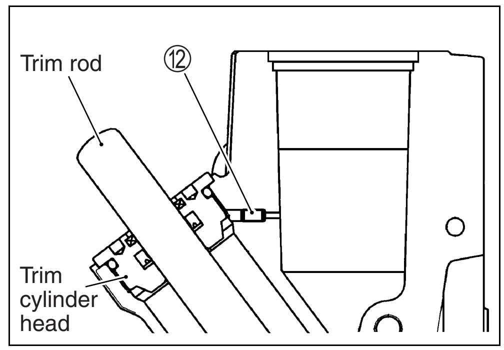
09944-09810: PTT trim cap tool



Pull the trim rod/piston assembly ⑪ out of the trim cylinder.



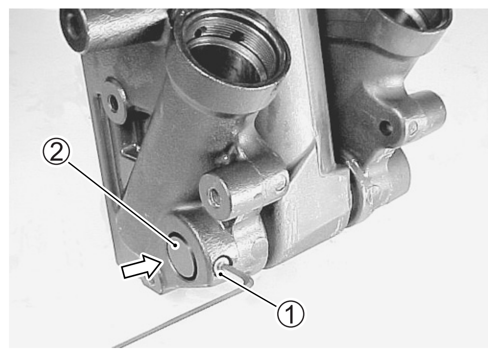
NOTE:
For PORT side trim cylinder:
Be careful not to lose the trim chamber valve ⑫ on disassembly.



Disassembly of tilt cylinder assembly

Remove screw ①.

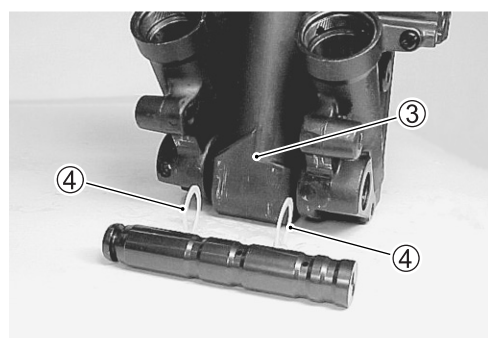
Push the lower rod ② out by tapping gently with a soft faced mallet.

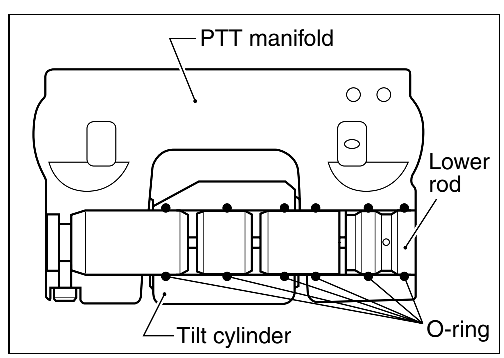


Detach the tilt cylinder ③ from PTT manifold.

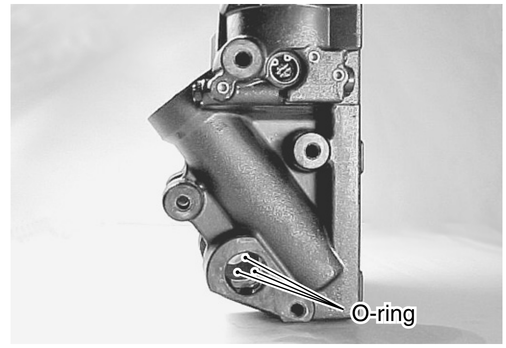
Note the position of three (3) O-rings and remove them from cylinder lower eyelet.

Remove washer ④ from each side of tilt cylinder lower eyelet.

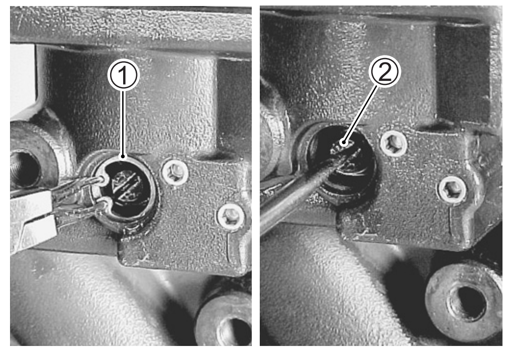




Remove three (3) O-rings from lower eyelet of PTT manifold.



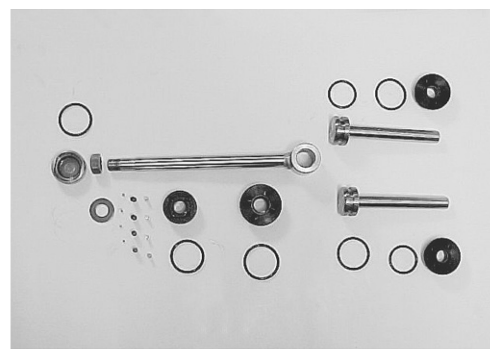
Remove the manual release valve snap ring ①, then unscrew the manual release valve ②.



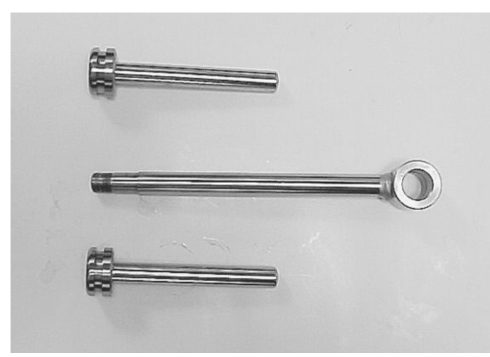
CLEANING AND INSPECTING

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.



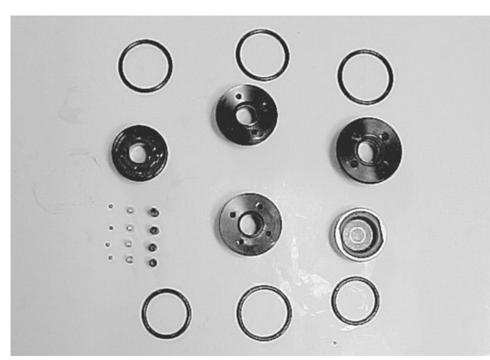
Inspect tilt rod and trim rod, replace if damaged or bent.
Inspect the surface of tilt rod and trim rod for scores, grooves or roughness.
Slight roughness may be removed with fine emery paper.
A badly scored or grooved rod must be replaced.



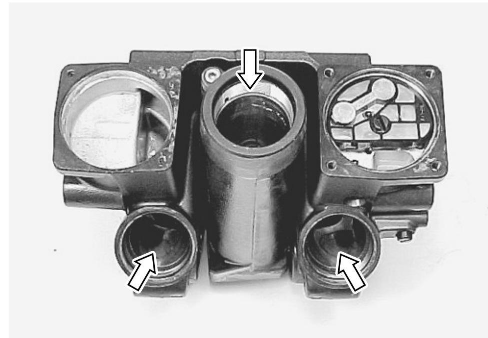
Inspect the PTT cap seal and O-ring.
Replace if cuts, nicks or excessive wear is found.

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.

Inspect lower rod.
If a clog or obstruction is found, clean lower rod.
If bending, cracks, corrosion or other damage is found, replace lower rod.

Inspect 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

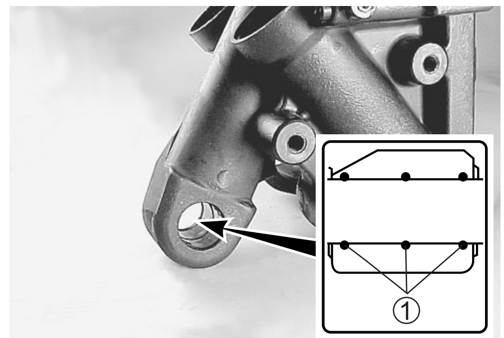
Assembly is reverse order of disassembly with special attention to following steps.

CAUTION

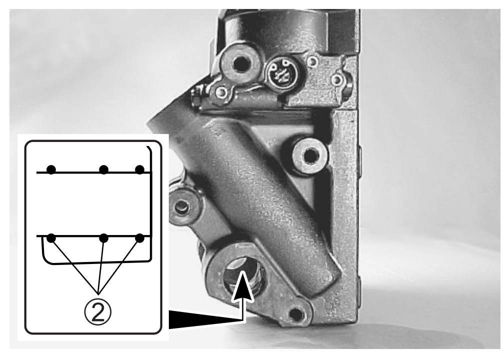
- **Do not reuse O-rings after removal, always use new O-rings.**
- **Lubricate all components and O-rings with PTT fluid before assembly.**
- **Do not reuse PTT fluid, always refill with new fluid.**

TILT CYLINDER

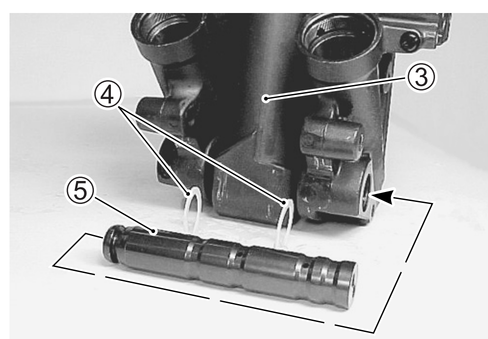
- Install three (3) O-rings ① into the grooves in the tilt cylinder lower eyelet.



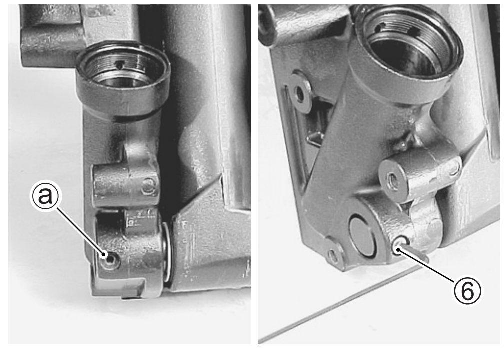
- Install three (3) O-rings ② into the grooves in the PTT manifold lower eyelet.



- Place the tilt cylinder ③ and washer ④ in position, then slide the lower rod ⑤ through both PTT manifold lower eyelets and tilt cylinder lower eyelet.



- Align threaded hole ⓐ on the PTT manifold with groove of lower rod, then tighten stopper screw ⑥ securely.



TILT ROD

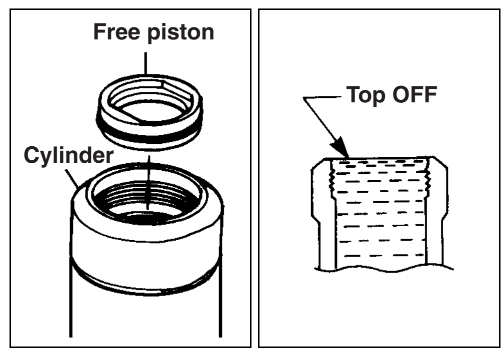
When tightening the piston retaining nut on the tilt rod piston, apply Thread Lock 1342 to the threads.
Tighten the nut to specified torque.

99000-32050: THREAD LOCK “1342”

Piston retaining nut: 100 N·m (10.0 kg-m, 72.0 lb-ft)

Installing tilt rod/piston

Pour 100 ml (3.4 oz.) of PTT fluid into cylinder.
Insert the free piston into cylinder and push it down to the bottom of the cylinder.

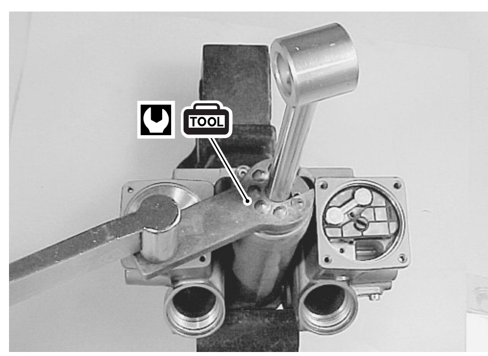


Pour PTT fluid into the cylinder until it is topped off.
Insert the tilt rod/piston into cylinder and thread the tilt cylinder head by hand until fully seated.

Tighten the cylinder head to specified torque using special tool.

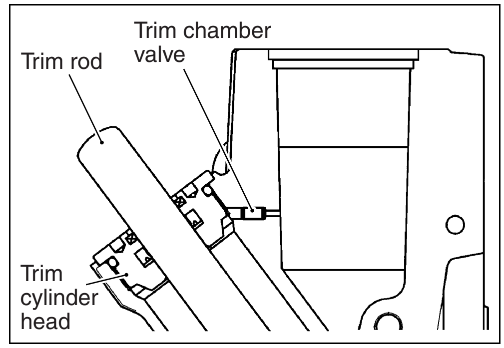
Tilt cylinder head: 310 N·m (31.0 kg-m, 224 lb-ft)

09944-09820: PTT cylinder cap tool



TRIM ROD

NOTE:
For PORT side trim cylinder:
Before installing trim rod/piston, make sure the trim chamber valve is positioned correctly.

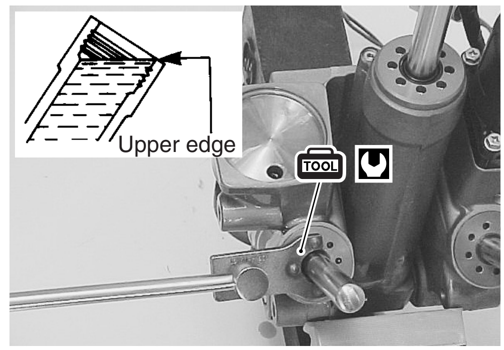


Pour PTT fluid into the trim cylinder until it is topped off.
Insert the trim rod/piston assembly into cylinder and thread the trim cylinder head by hand until fully seated.

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

Trim cylinder head: 160 N·m (16.0 kg-m, 116 lb-ft)

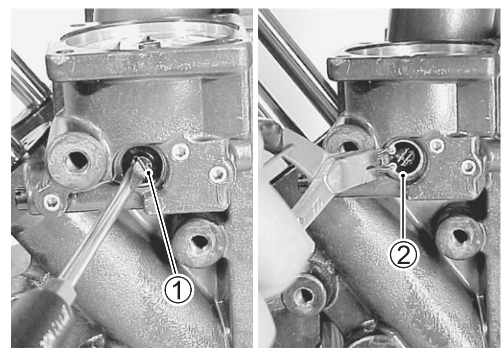
TOOL **09944-09810: PTT trim cap tool**



MANUAL RELEASE VALVE

Oil and install the manual release valve ①.
Tighten the valve to specified torque.
Install snap ring ②.

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



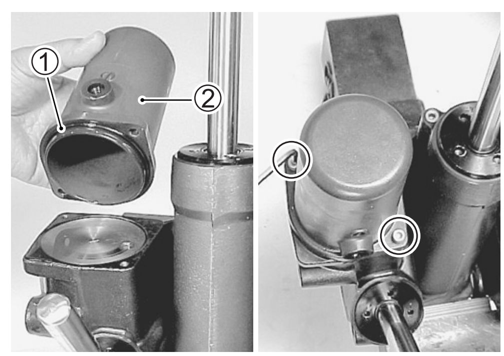
PTT MOTOR

See the PTT motor installation section on page 8-18.

RESERVOIR

Install O-ring ① and reservoir ②, then tighten screws to specified torque.
Pour recommended PTT fluid into reservoir until specified level.

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



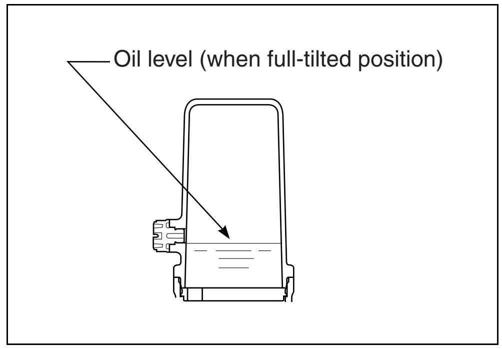
AIR BLEEDING

(Air bleeding on unit as alone)

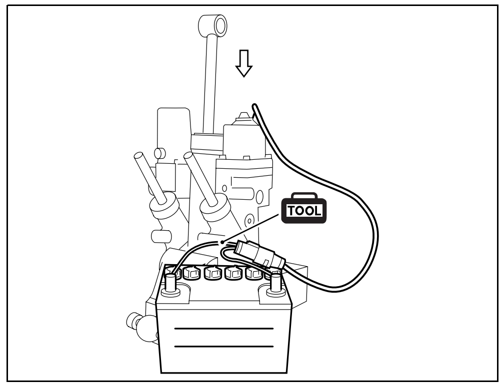
Before installing the PTT unit on the outboard motor, use the following procedure to bleed air from the system.

1. Support the PTT unit in an upright position in a vise.
2. Fill the reservoir with PTT oil to the specified level, then install oil filler plug.
3. Tighten the manual release valve to the specified torque.
4. Connect the PTT cable extension to the PTT motor cable connector.

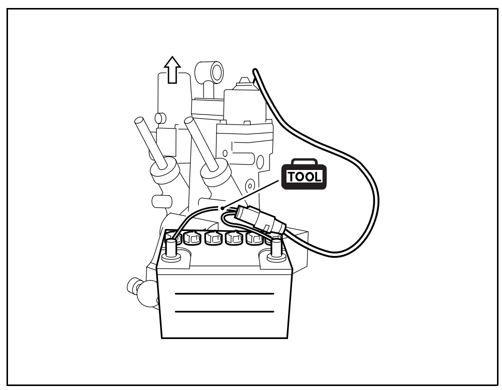
TOOL 09945-79310: PTT cable extension



5. Connect the two extension cable lead wires (G to pos./Bl to neg.) to the battery as shown in the illustration. Operate the PTT motor until the PTT rod is in the fully trimmed down position (completely contracted).
   If the rod does not come down smoothly, push it in by hand while operating the motor.



6. Reverse the two extension cable lead wires (Bl to pos./G to neg.).
   Operate the PTT motor until the PTT rod is in the full tilt up position (fully extended)
   If the rod does not come up smoothly, pull it up by hand while operating the motor.
7. Remove the reservoir oil filler plug and fill with PTT fluid to the specified level.
8. Repeat procedures 5 – 7 until the fluid level in the PTT unit stabilizes at the specified position.



NOTE:

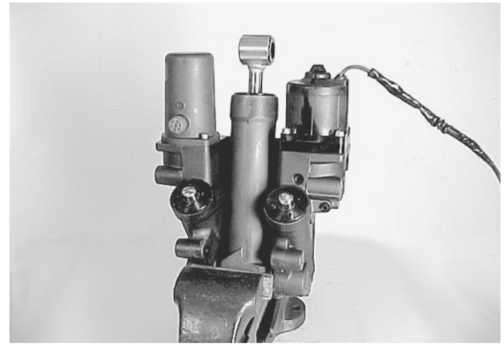
Repeat the air bleeding procedure after the PTT unit has been installed on the outboard motor.

(For air bleeding, see page 8-3.)

PTT MOTOR

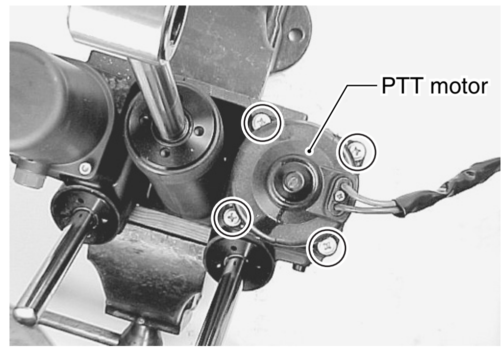
REMOVAL

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.



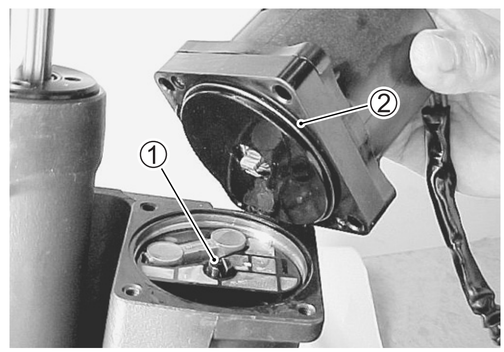
Place the lower of the PTT unit in a vise.
Tighten the vise only enough to secure the PTT unit, DO NOT OVER TIGHTEN.

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.



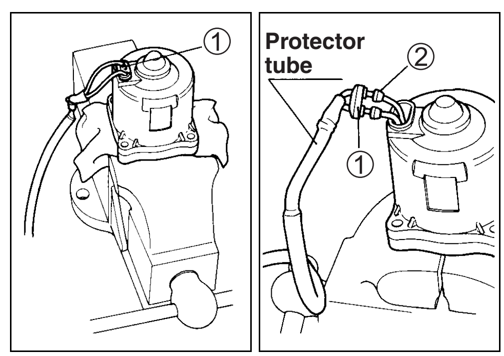
Remove the four (4) screws securing the PTT motor to the PTT manifold.

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

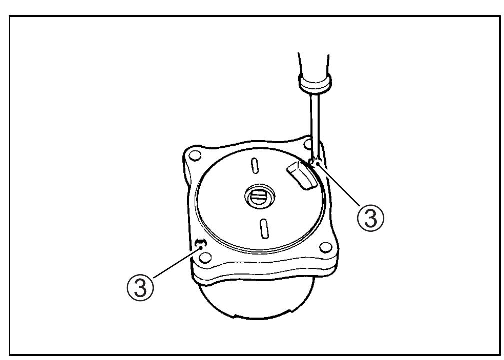


PTT MOTOR DISASSEMBLY

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.

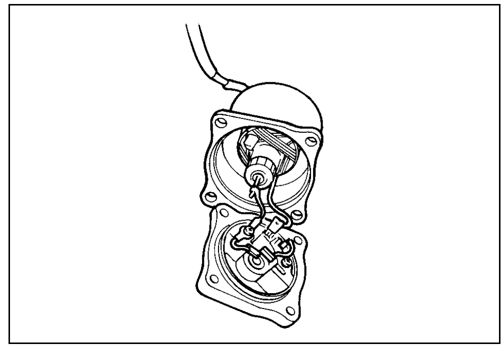


Remove the two (2) screws ③ securing the field case to the brush holder.

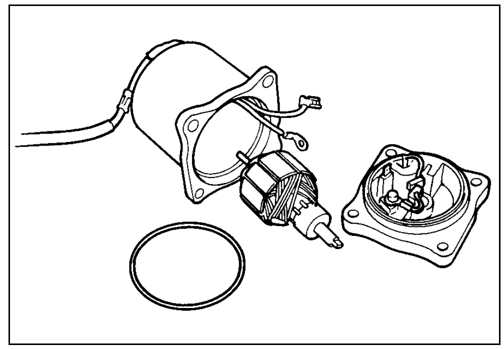


Slide the field case upward and away from the brush holder.

NOTE:
When separating field case from brush holder, push the PTT motor cables into brush holder as the field case is removed.



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



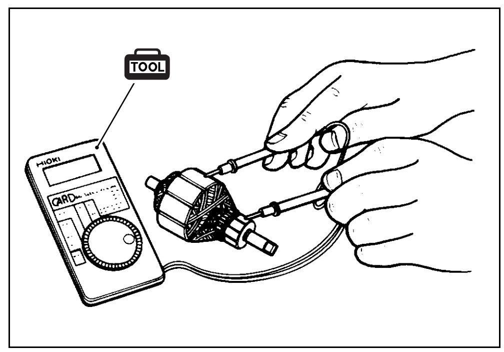
INSPECTION

Armature and commutator

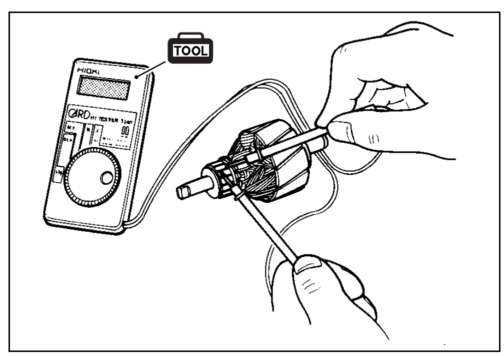
Check for continuity between the commutator and the armature core/shaft.
Replace armature if continuity is indicated.

09930-99320: Digital tester

Tester range: (Continuity)



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



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

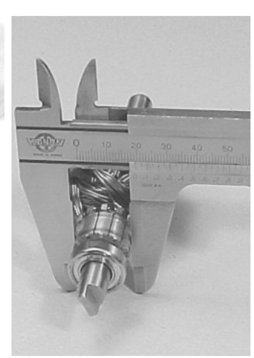
Measure commutator outside diameter.

09900-20101: Vernier calipers

Commutator outside diameter:

Standard	**22.0 mm (0.87 in)**
Service limit	**21.0 mm (0.83 in)**

If measurement exceeds service limit, replace armature.



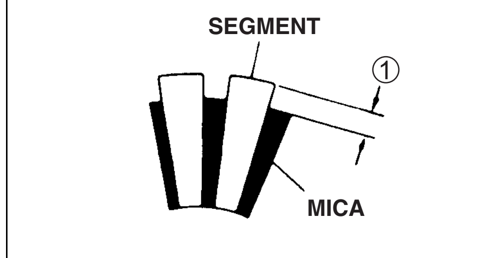
Ensure that the mica (insulator) between commutator segments is undercut to specified depth.

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.



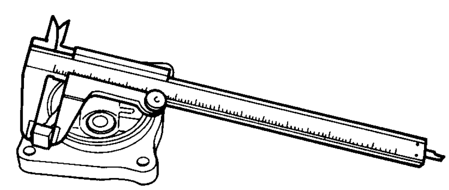
① Commutator undercut

⚠ WARNING

Wear safety glasses when using compressed air.

Brushes

Check the length of each brush.



TOOL **09900-20101: Vernier calipers**

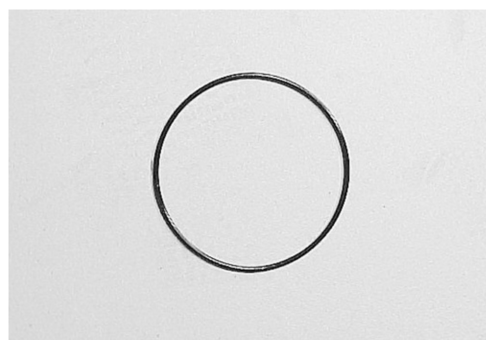
Brush length:

Standard	**9.8 mm (0.39 in)**
Service limit	**5.5 mm (0.22 in)**

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

O-Ring

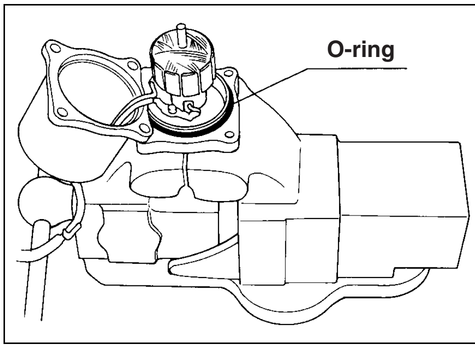
Inspect the O-ring between the PTT motor and PTT manifold. Replace if cuts, nicks or tears are found.



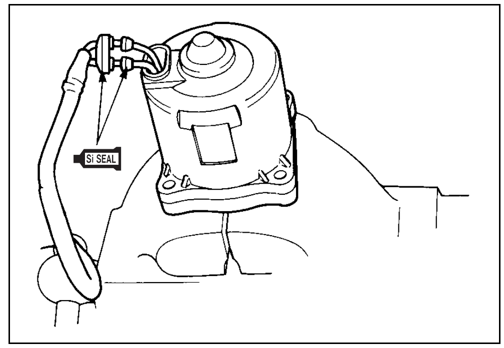
ASSEMBLY

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

- Install armature to brush holder first.
  When installing the armature, use care to avoid breaking the brushes.
- Match up previously scribed alignment marks.
- When assembling field case to brush holder, pull out on the PTT motor cables as the field case is assembled into position.



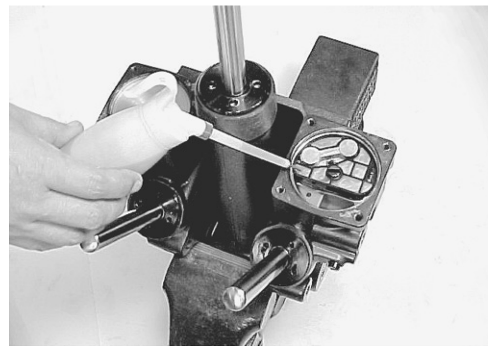
• Apply silicone seal to PTT motor cable holder and grommets and install cable holder screw.



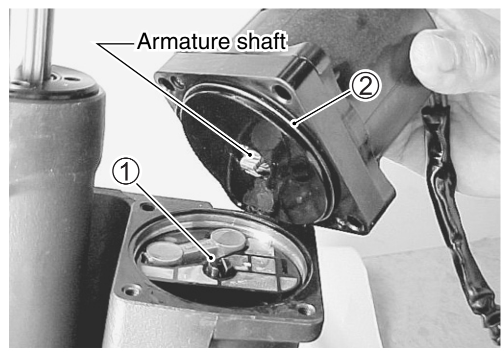
PTT MOTOR INSTALLATION

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 manifold. If level is low, add recommended PTT fluid until level with mating surface of PTT motor.



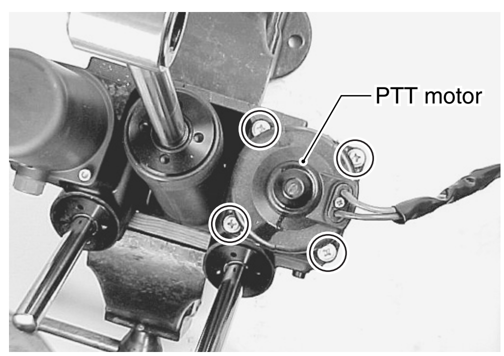
• Ensure that the faces of the PTT motor and pump unit are free of dirt or debris.
When attaching the PTT motor to the PTT manifold, ensure that the tip of armature shaft fits firmly into the drive joint ①.



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

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

• Pour recommended PTT fluid into reservoir until specified level.
• Perform the air bleeding procedure.
For air bleeding, see page 8-14.



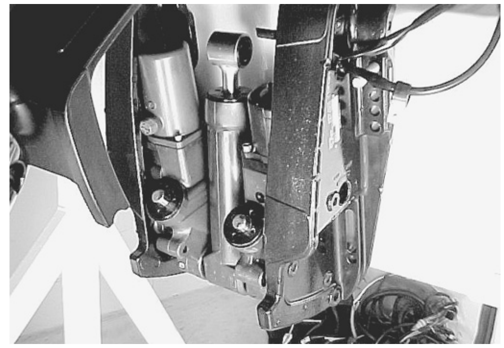
INSTALLATION

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

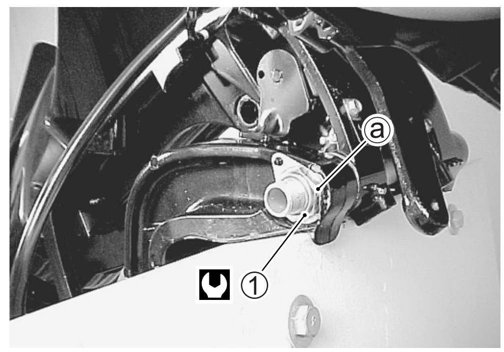
Lower tilt rod to full down position.

Place the PTT unit in position between the clamp brackets.
Tighten the clamp bracket shaft nut ① to specified torque.

Clamp bracket shaft nut: 43 N·m (4.3 kg-m , 31.0 lb-ft)



NOTE:
After tightening clamp bracket shaft nut with specific torque, bend lock washer edge ⓐ toward nut for locking.

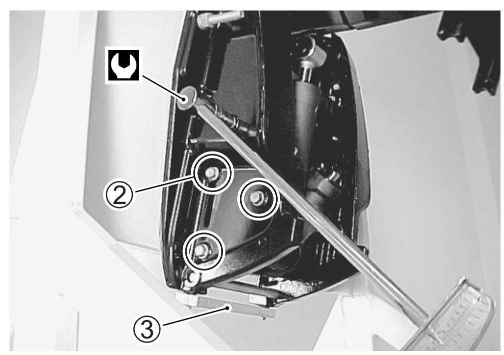


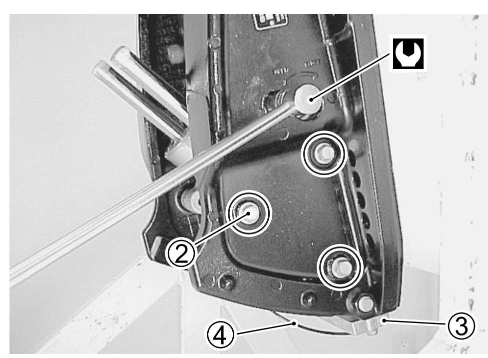
Tighten eight (8) PTT unit retaining bolts ②, pre-coated with thread lock, to specified torque.

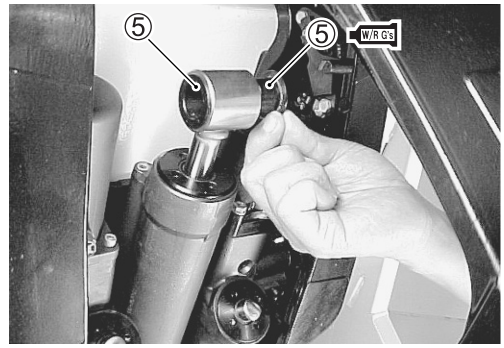
1342 **99000-32050: THREAD LOCK "1342"**

PTT unit retaining bolt: 50 N·m (5.0 kg-m, 36.0 lb-ft)

Install anode ③, then tighten bolts securely.
Install bonding wire ④, then tighten screw securely.

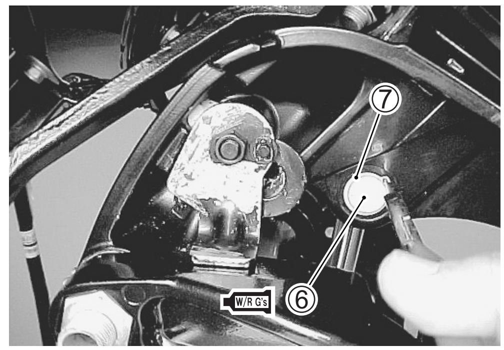






Apply Water Resistant Grease to tilt rod upper bushes ⑤, then install bushes in tilt rod.
Operate the PTT motor to extend the PTT rod upward.
Align the tilt rod with the hole in the swivel bracket as the tilt rod extends.

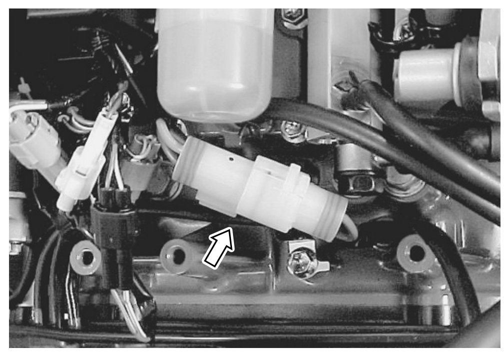
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**



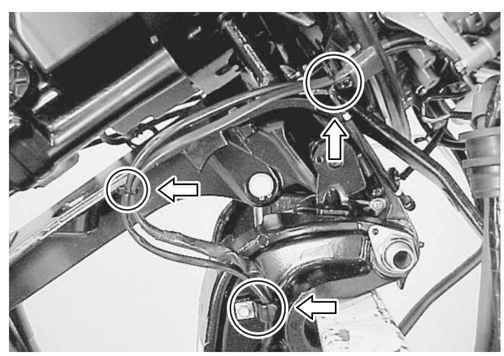
Apply Water Resistant Grease to the PTT rod upper shaft ⑥, then insert the shaft through the swivel bracket and tilt rod.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

Secure the upper shaft with the snap ring ⑦.



Route the PTT motor cable in through the lower cover and connect the PTT cable connector to the PTT relay.
(Cable routing – See the WIRE/HOSE ROUTING section on page 11-14 to 11-19.)
Check to ensure that all removed parts are back in original position.



PTT MOTOR RELAY

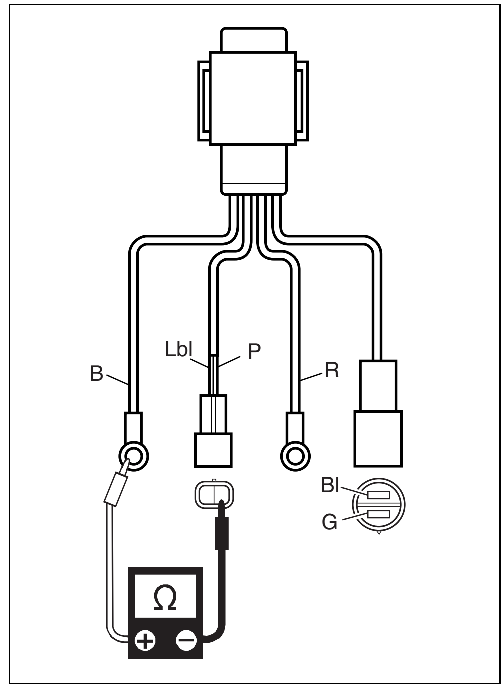
INSPECTION

1. Disconnect battery cable from battery.
2. Remove the electric parts holder and PTT relay. (See page 4-30.)
3. Disconnect all cables/lead wires from PTT relay.
4. Check resistance between each two (2) lead wires.

09930-99320: Digital tester

Tester range: Ω (Resistance)

Between "P" wire and "B" wire: 25 – 37 Ω
Between "Lbl" wire and "B" wire: 25 – 37 Ω



5. Connect "R" wire to positive ⊕ terminal, and black wire to negative ⊖ terminal of 12 V battery.

CAUTION

Each operation test must be performed within 3 – 5 seconds to avoid overheat damage to the relay coil.

6. Temporarily connect a jumper wire from the "P" lead wire to the battery positive ⊕ terminal, then check voltage between "G" wire and "B" wire.

09930-99320: Digital tester

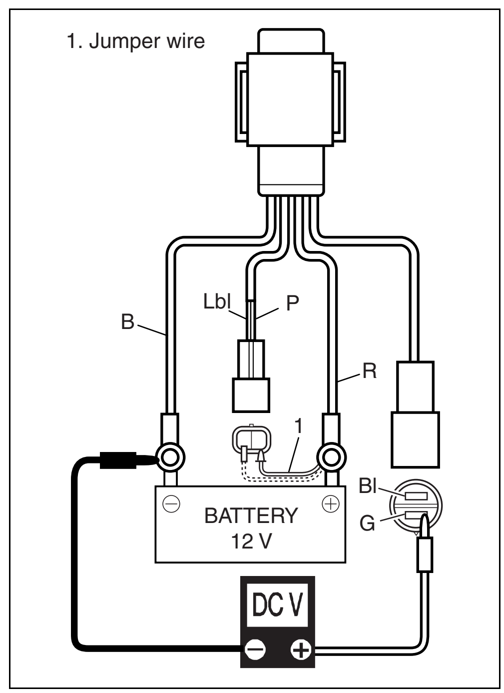
Tester range: DCV

Between "G" wire and "B" wire: 12 V (Battery voltage)

7. Temporarily connect a jumper wire from the "Lbl" lead wire to the battery positive ⊕ terminal, then check voltage between "Bl" wire and "B" wire.

Between "Bl" wire and "B" wire: 12 V (Battery voltage)

8. If inspection in step 4 and/or step 6, 7 fails, replace PTT relay.

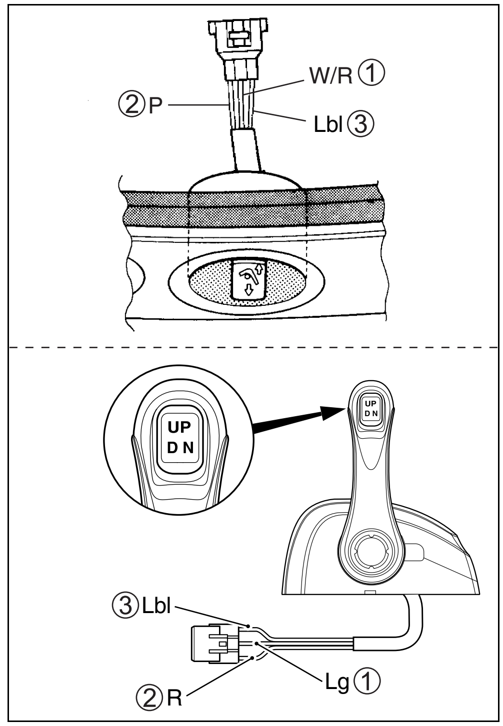


PTT SWITCH

Test continuity between the switch lead wires at each of the three switch positions.

09930-99320: Digital tester

Tester range: (Continuity)



	Tester probe connection		Tester indicates
	Red ⊕	**Black ⊖**	
DN side depressed	terminal ②	terminal ①	Continuity
UP side depressed	terminal ③	terminal ①	Continuity
Not depressed	terminal ②	terminal ①	Infinity
	terminal ③		

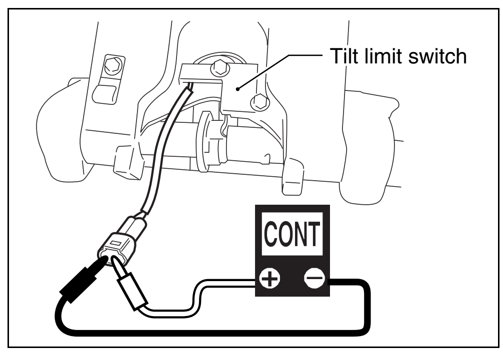
TILT LIMIT SWITCH

INSPECTION

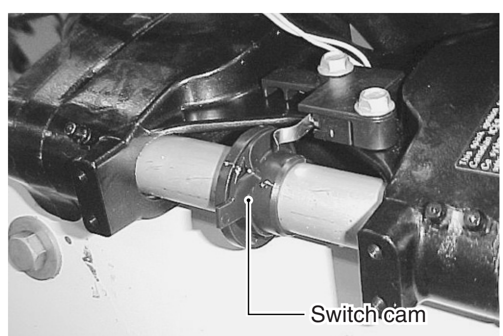
Test continuity between wires.
If found defective, replace switch.

09930-99320: Digital tester

Tester range: (Continuity)

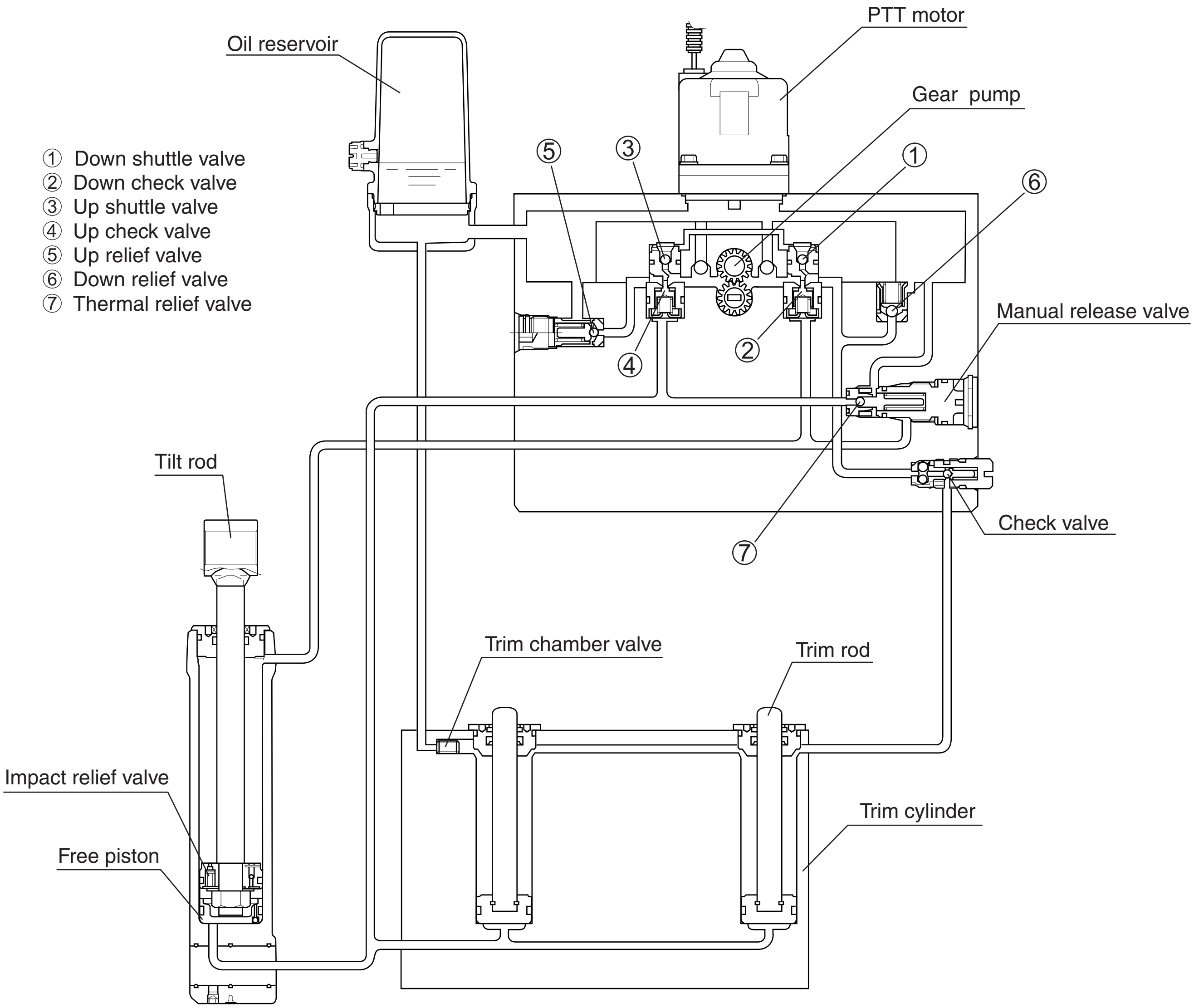


Push the switch actuator plate. (Full tilt up position)	No continuity
Release the switch actuator plate. (Except for full tilt up position)	Continuity



OPERATION

COMPONENT PARTS



* When the manual valve is to be opened, turn the manual release valve to the left about three (3) turns.
* When the oil level of the system should be checked, inspect the reservoir by placing the motor in the full tilt up position.

PRINCIPLES OF 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.

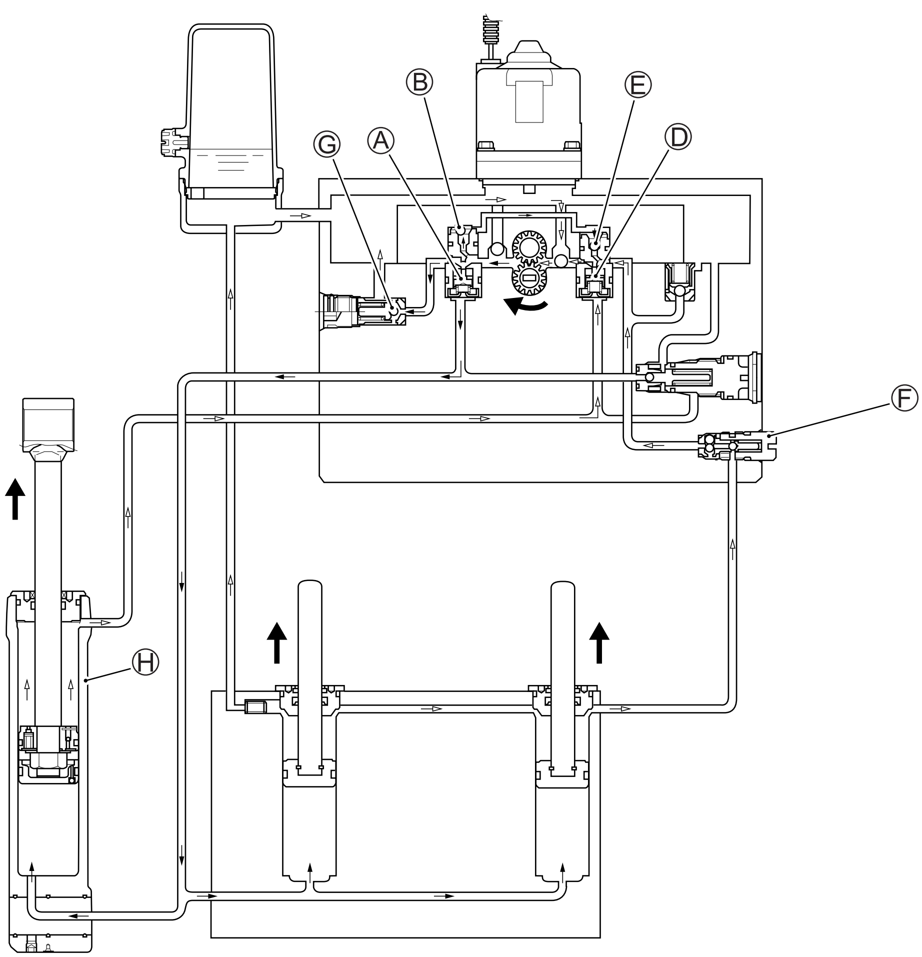
(3) Pressurized oil flows through the “Up” check valve Ⓐ to the bottom of the trim and tilt cylinders, thereby pushing the trim and tilt pistons upward.

(4) Residual oil in the upper area of the tilt cylinder Ⓗ is returned to the geared pump through “Down” check valve Ⓓ.

(5) Any oil in the area above both trim cylinder pistons will be returned to the reservoir and to the geared pump through the check valve Ⓕ.

(6) Oil will then flow from the reservoir to the geared 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.

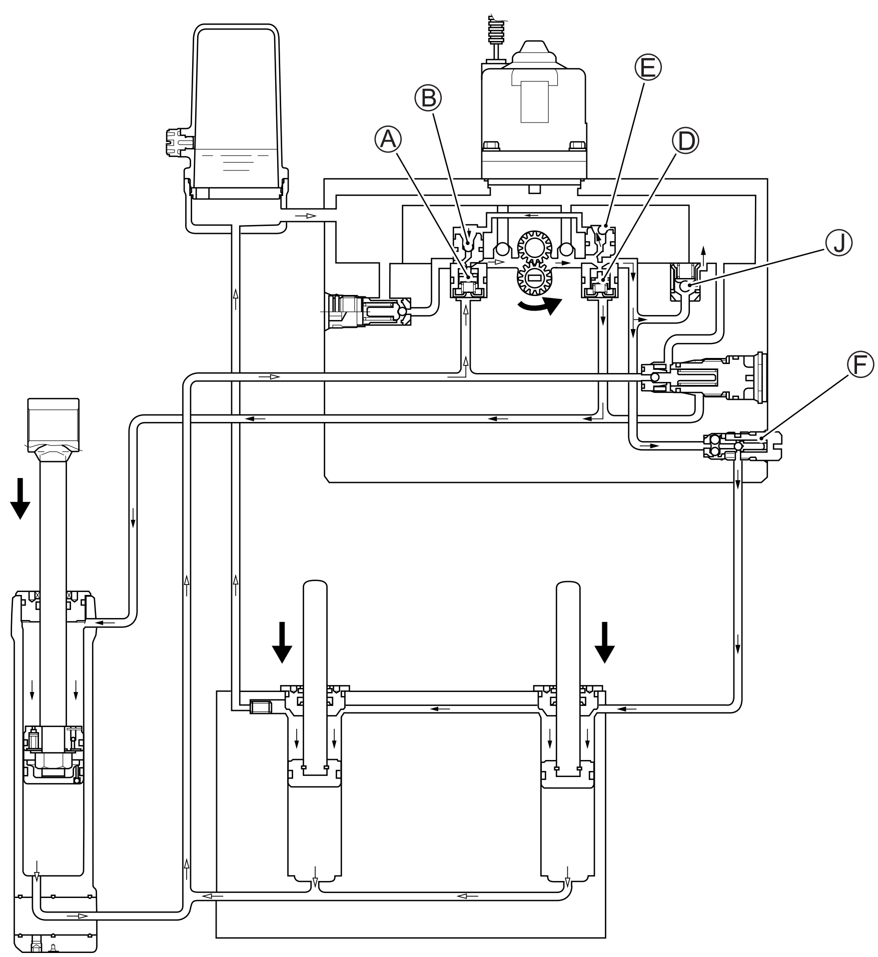
(4) When the swivel bracket contacts the trim rams, the check valve Ⓕ will begin to open, oil flows into the upper area in the trim cylinder.
This pressure forces the trim pistons downward.

(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 valve Ⓙ.

(7) Throughout trim operation range, oil will be discharged from the bottom of all three cylinders and the pump will supply oil to the upper chamber of the tilt and trim cylinders. Excess oil is then vented to the reservoir through the “Down” relief valve Ⓙ.

(8) To prevent damage from excessive oil pressure when all three rods are fully retraced, this pressure is relieved through the “Down” relief valve Ⓙ.



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 Ⓒ.

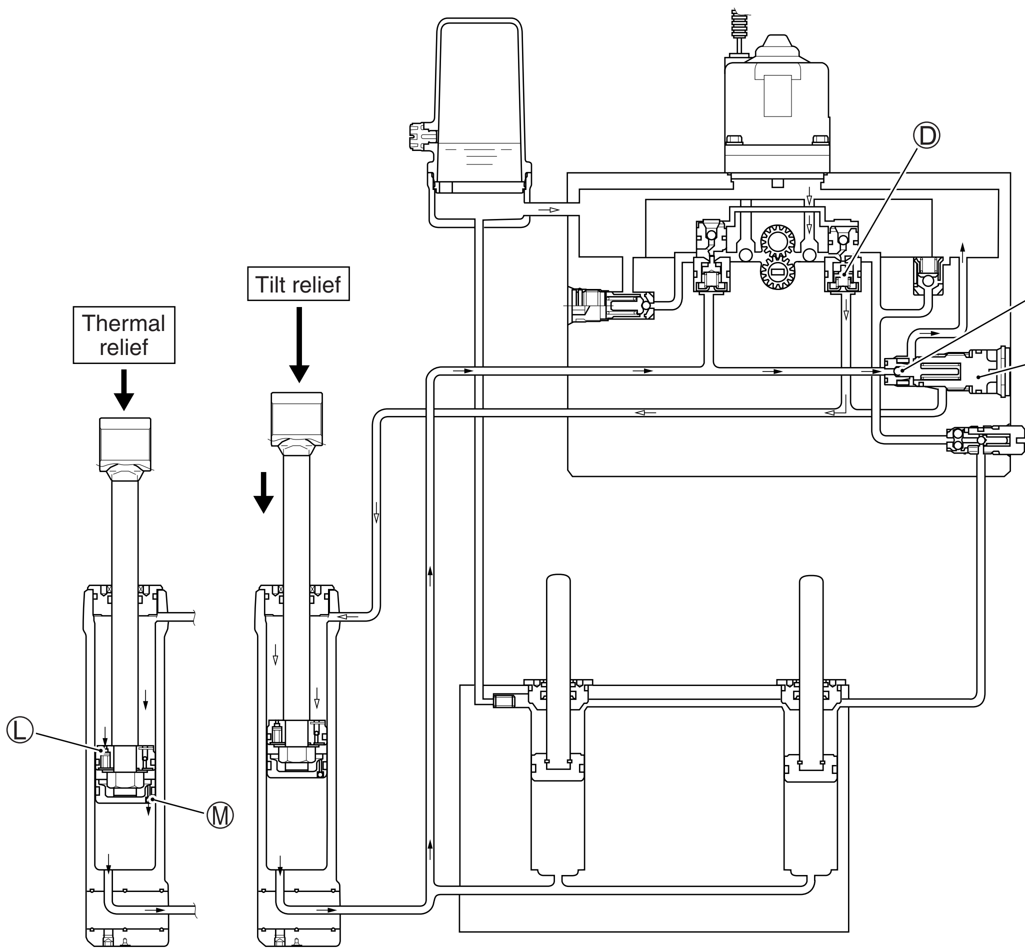
(3) As the power of the engine continues to exert downward force on the tilt piston, this will open "Down" check valve Ⓓ, thereby allowing oil from the reservoir to flow into the chamber above the tilt piston.

(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 Ⓒ.

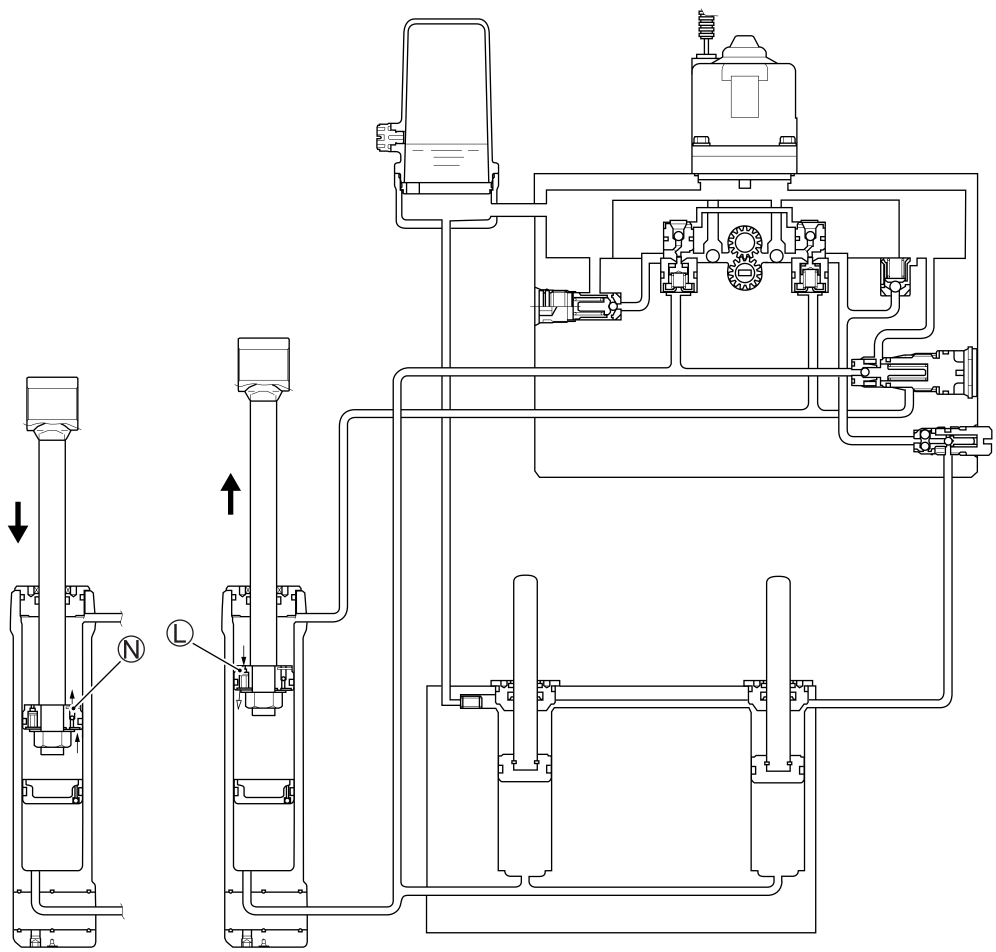


SHOCK ABSORBER CIRCUIT

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 Ⓛ 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.

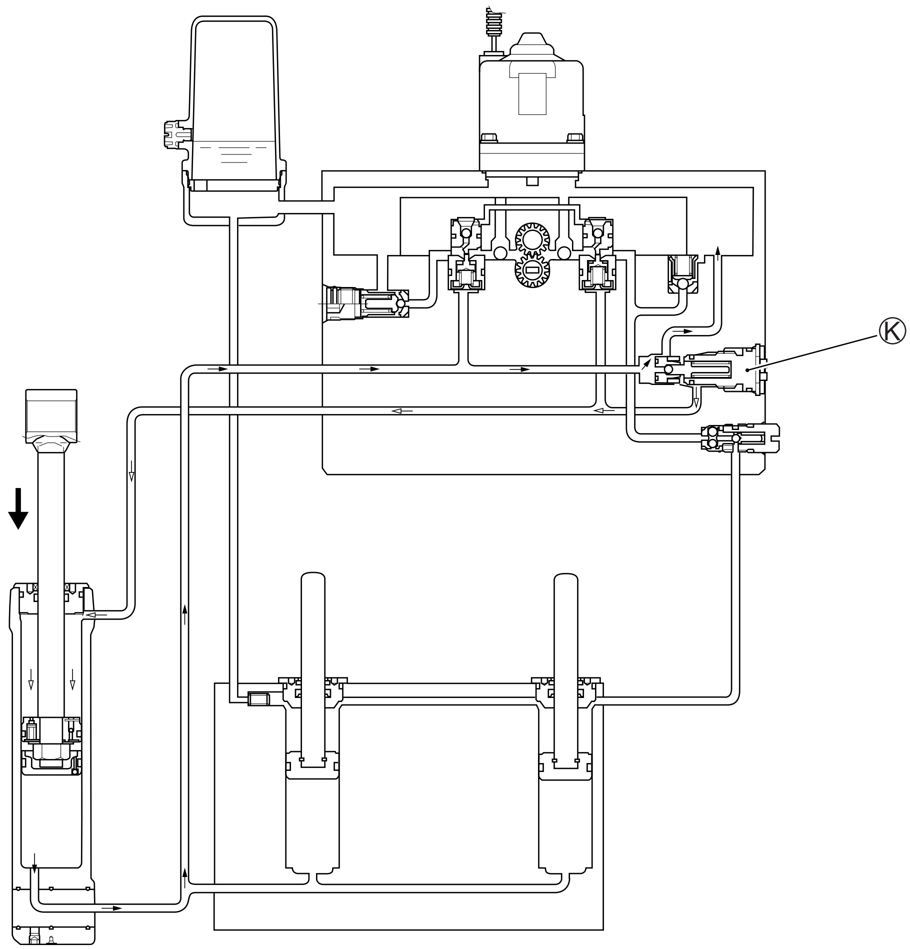
(2) When the moment of impact has passed, the PTT DOWN switch must be activated to return the engine to within the normal trim range. When the switch is pressed, the oil between the piston and free piston will be directed to the cylinder upper chamber via the return valve Ⓝ below the tilt piston.



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 tilt piston will be directed through this valve into the area above the tilt rod piston.

(2) The volume of oil flowing from under the tilt rod piston 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.

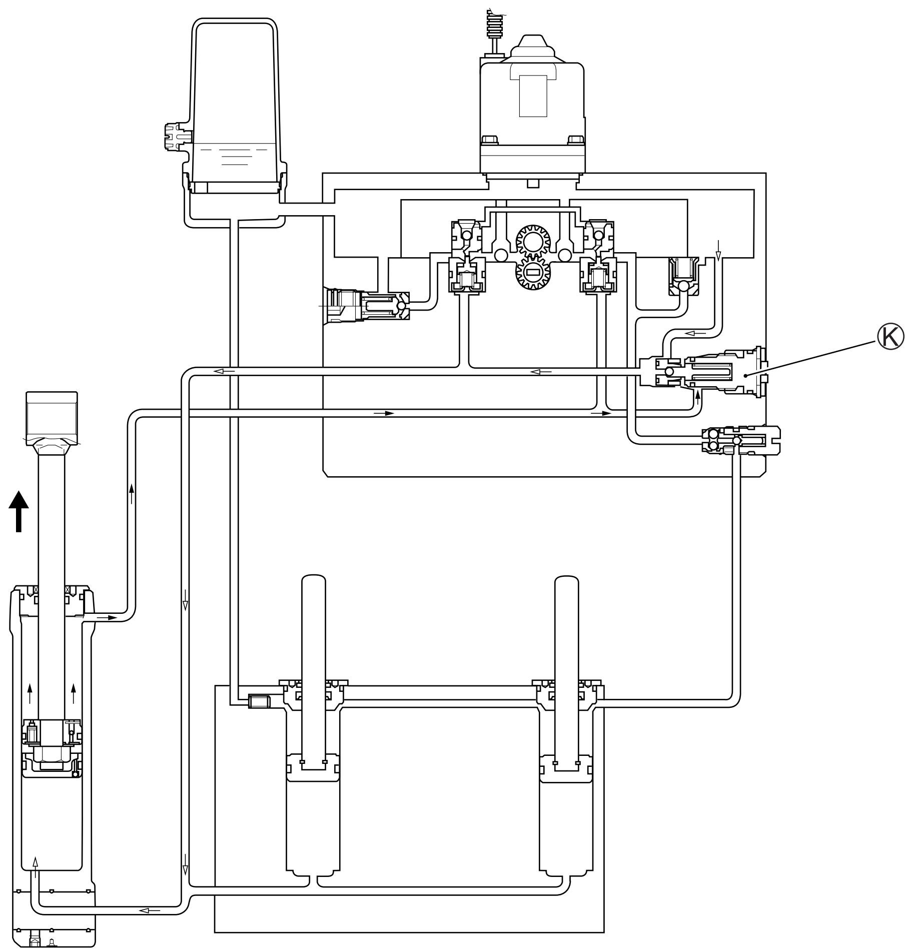


MANUAL RELEASE CIRCUIT (UP MODE)

(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 [Standard rotation (Right-hand) model]

CONTENTS

9

REMOVAL & DISASSEMBLY

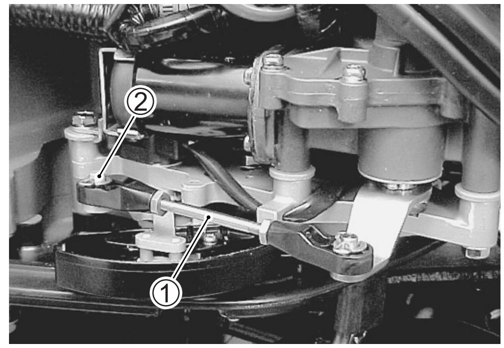
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

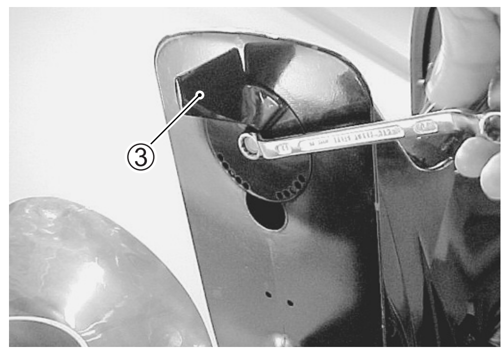
CAUTION

Remove the main relay or shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.

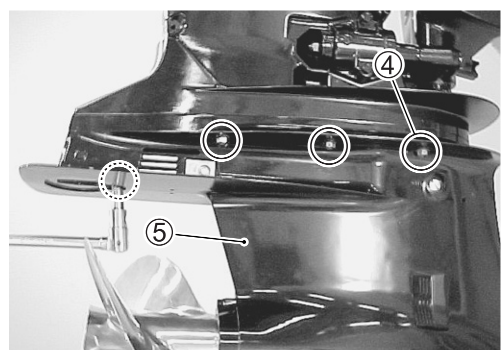
Shift to "NEUTRAL" position.
Remove the clip, washer and clutch link rod ① from clutch lever ②.



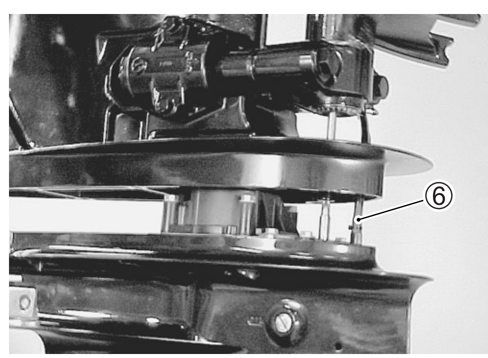
Remove bolt and trim tab ③.



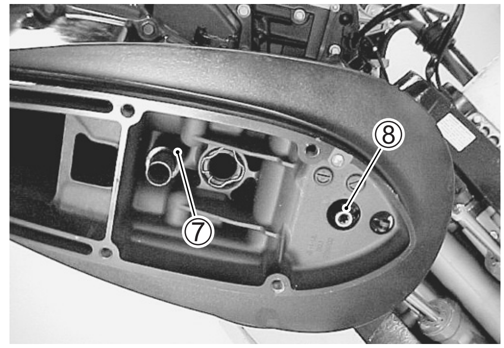
Remove seven (7) bolts ④ and separate gearcase ⑤ from driveshaft housing.



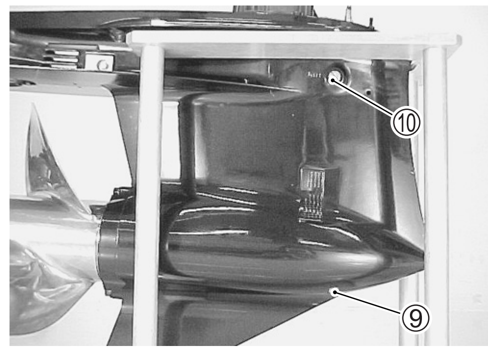
NOTE:
Before gearcase is removed completely, disconnect speedometer pick up tube ⑥ from gearcase.



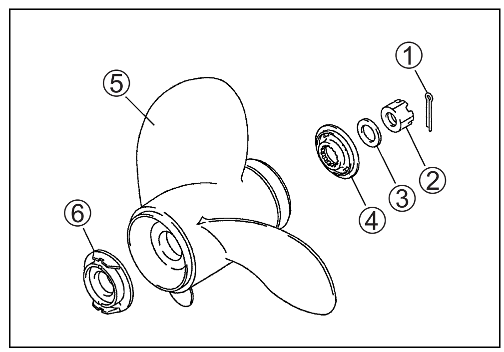
Remove water tube spacer ⑦.
Remove clutch rod ⑧ from clutch shaft (if necessary).



Place a drain pan under oil drain plug.
Remove oil drain plug ⑨ first then oil level plug ⑩ and allow gear oil to drain.
Inspect oil for water, contaminates or metal.

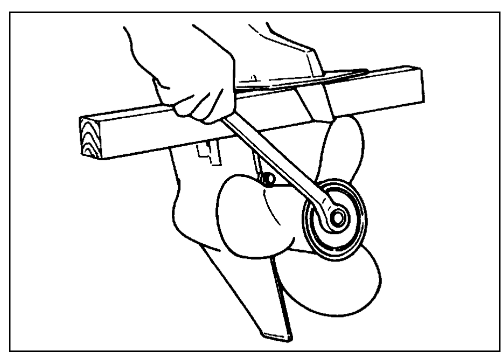


Remove cotter pin ① from propeller nut and remove propeller nut ②.
Remove washer ③, spacer ④, propeller ⑤ and stopper ⑥ from the propeller shaft.

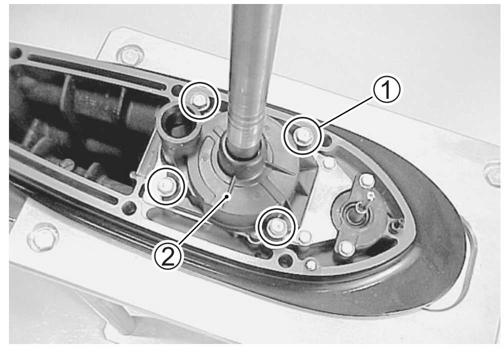


⚠ WARNING

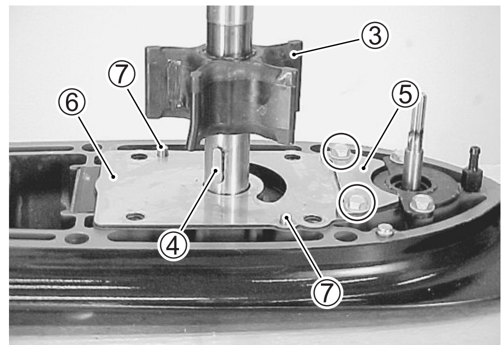
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place before attempting to remove propeller nut.



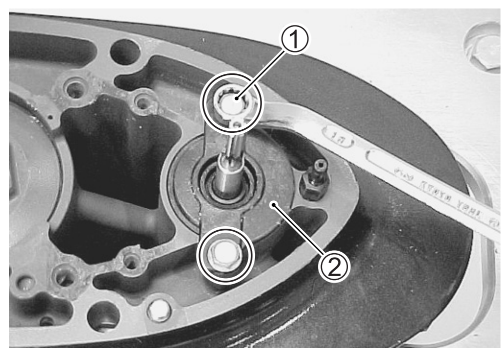
Loosen four (4) bolts ①, then remove water pump case ②.



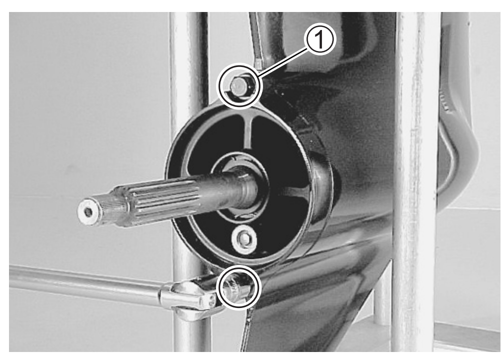
Remove impeller ③ and impeller key ④.
Remove two bolts and shift rod guide housing stopper ⑤.
Remove pump under plate ⑥ and dowel pins ⑦.
Keep impeller key ④ for reuse and discard the plate gasket.



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

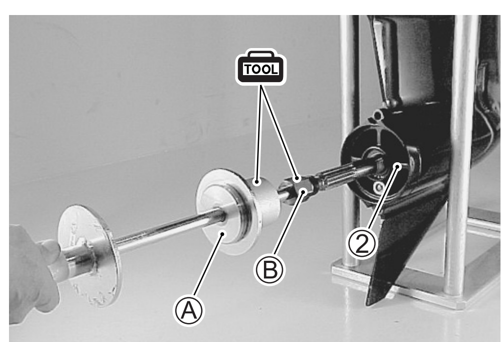


Remove two (2) bolts ① securing the propeller shaft bearing housing to the gearcase.

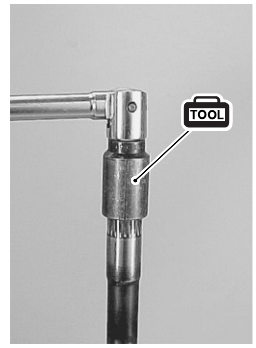


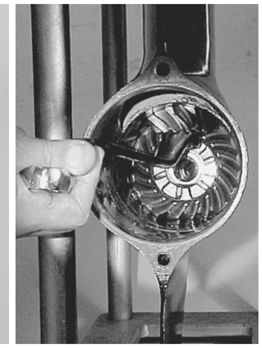
Using special tools, pull out the propeller shaft bearing housing.
Remove the propeller shaft and bearing housing assembly ②.

TOOL **09930-30104: Ⓐ Sliding hammer**
09930-30161: Ⓑ Propeller shaft remover

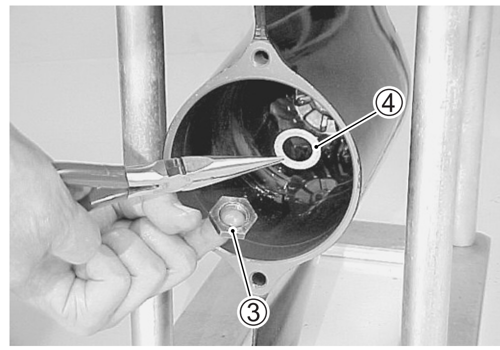


Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.
Remove pinion nut ③ and washer ④.



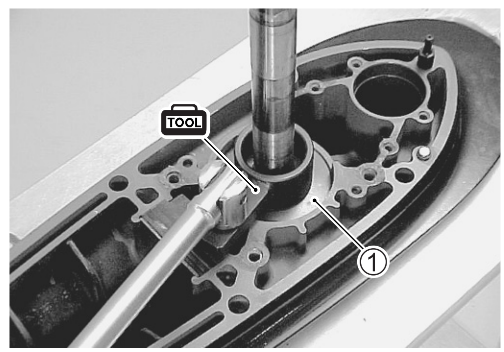


TOOL **09921-29410: Driveshaft holder**

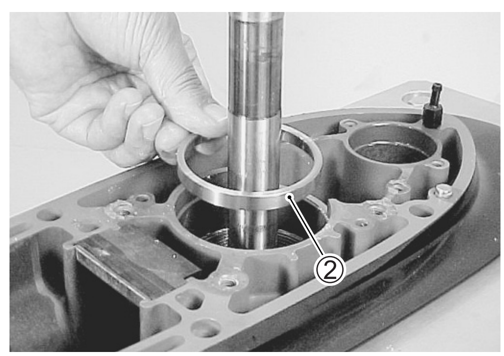


Use special tool to unscrew driveshaft oil seal housing ①, then remove oil seal housing from drive shaft.

TOOL **09926-29310: Driveshaft housing remover**

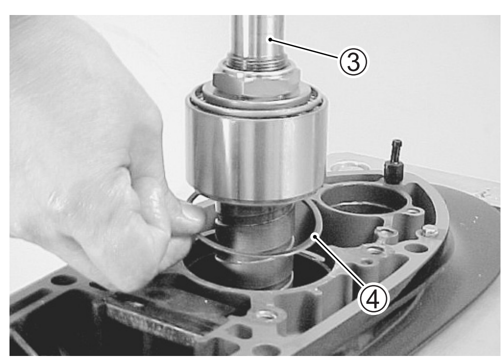


Remove driveshaft bearing spacer ②.

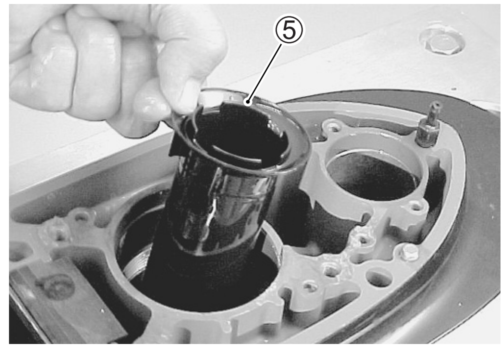


Slowly lift out driveshaft assembly ③.
Remove the pinion shim ④.

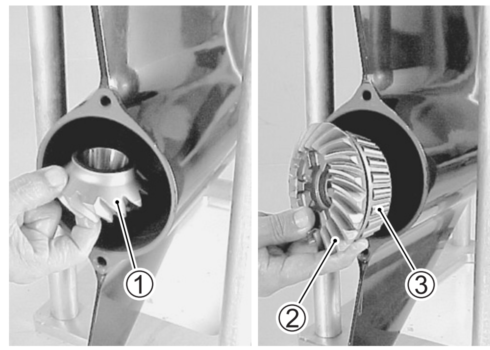
NOTE:
The driveshaft pinion gear bearing contains 26 loose roller bearings. Account for all roller bearings on disassembly.



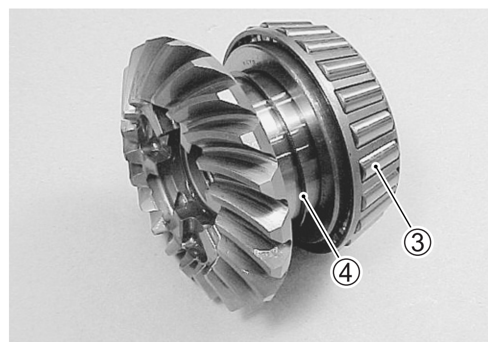
Remove the driveshaft collar ⑤.



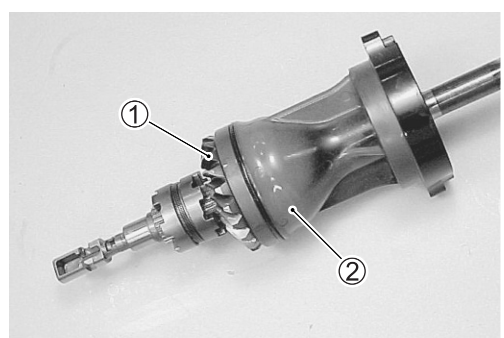
Remove the pinion gear ①.
Remove the forward gear ② and forward gear bearing ③.



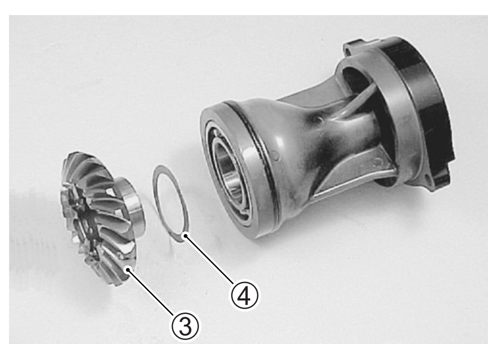
Remove the bearing ③ and back-up shim ④ from forward gear.



Disassembly of propeller shaft components
Slide propeller shaft away from reverse gear ① and bearing housing assembly ②.



Remove the reverse gear ③, reverse gear back-up shim ④.

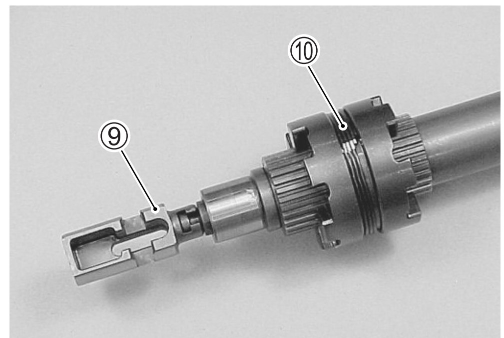


Remove the propeller shaft thrust washer ⑤, propeller shaft thrust bearing ⑥, bearing washer ⑦ and shim ⑧ from propeller shaft bearing housing.

To disassemble propeller shaft components, refer to following:

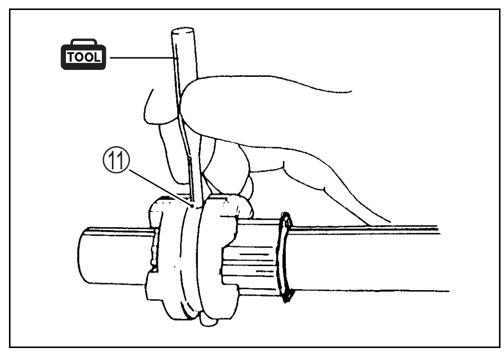
(a) Remove horizontal slider ⑨.

(b) Remove spring ⑩ from clutch dog shifter.



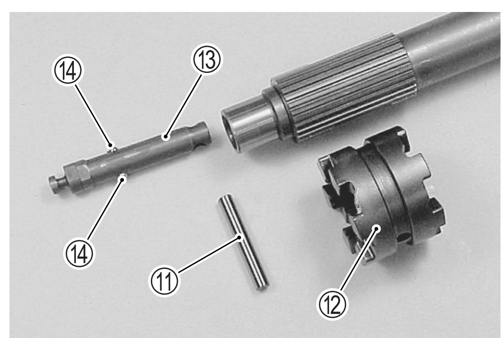
(c) Use special tool to push the dog pin ⑪ out of the clutch dog shifter.

TOOL 09922-89810: Shift pin remover



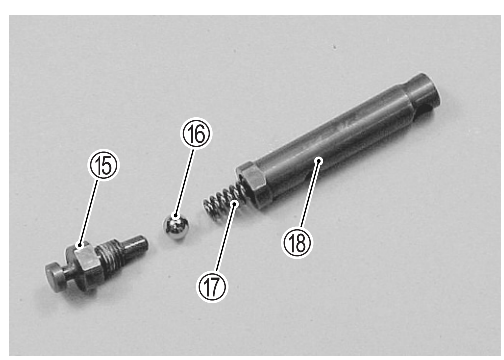
(d) Remove clutch dog shifter ⑫ and connector pin assembly ⑬ from propeller shaft.
Note the position of two (2) small detent balls ⑭.

NOTE:
Be careful not to lose the two small detent balls on disassembly.



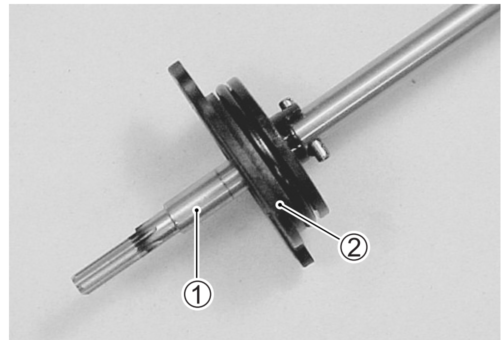
(e) Loosen and remove the connector pin ⑮, then take out detent ball ⑯ and detent spring ⑰ from connector body ⑱.

NOTE:
To facilitate the removal of connector pin, lightly heat up the it thread area using a heat gun.

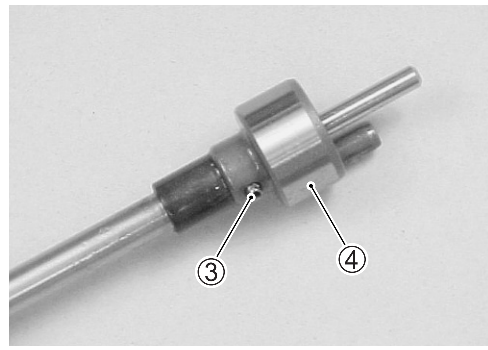


Disassembly of shift rod components

(a) Slide shift rod ① out of shift rod guide housing ②.



(b) Remove pin ③ and shifter yoke ④.

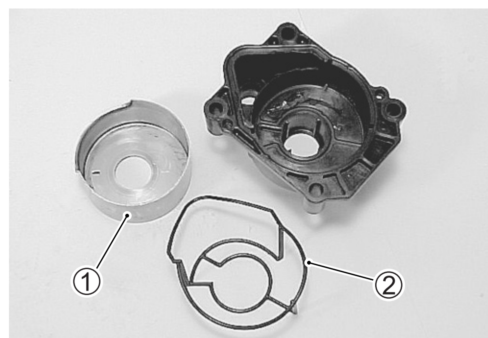


Disassembly of water pump case

Remove inner sleeve ① and rubber seal ring ②.

NOTE:

To facilitate the removal of inner sleeve from the pump case, warm up the entire case using a heater like hair dryer.



INSPECTION

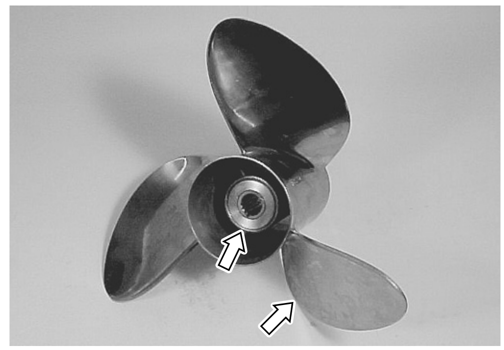
NOTE:
If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

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

⚠ WARNING

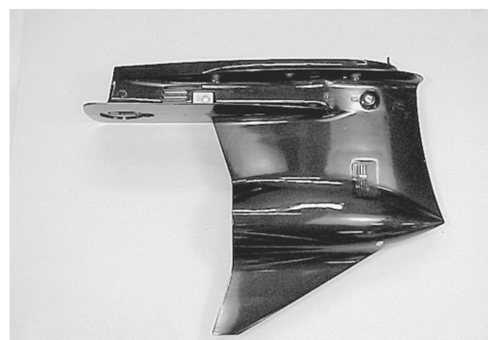
Wear safety glasses when using compressed air.

PROPELLER



- Inspect propeller for bent, chipped or broken blades.
  Replace or repair propeller if damaged or other conditions are noted.
- 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

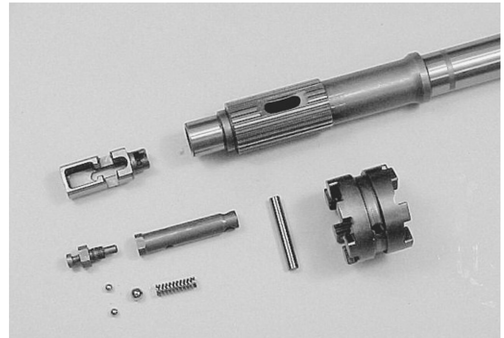


- Inspect the gearcase. Replace if cracked, damaged or other abnormal conditions are noted.
- Visually check the pinion bearing. Replace gearcase if pitted, rough or other abnormal conditions are noted.

GEARS/BEARING

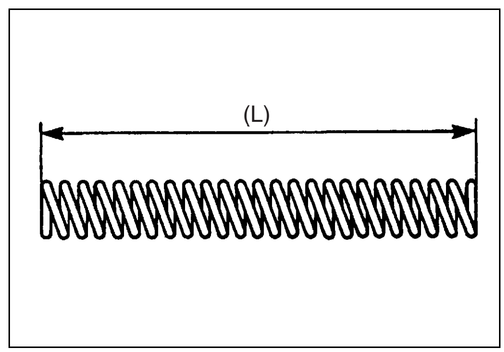
- Inspect forward, reverse and pinion gear teeth and engaging dogs.
  Replace gears if damaged, worn or other abnormal conditions are noted.
- Inspect propeller shaft forward bearing, forward gear bearing.
  Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.

PROPELLER SHAFT COMPONENTS



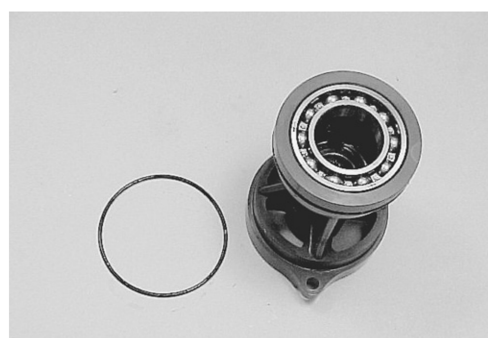
- Inspect horizontal slider and connector pin.
  Replace if worn, damaged or other abnormal conditions are noted.
- Inspect detent balls. Replace if wear, damage or other abnormal conditions are noted.
- Inspect clutch dog shifter. Replace if chipped, worn, damaged or other abnormal conditions are noted.
- Inspect dog pin. Replace if bent, worn or other abnormal conditions are noted.
- Inspect propeller shaft/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.

- Check detent spring by measuring its free length. If free length is not within specifications, replace detent spring.



Detent spring free length (L)
Standard: 27.8 mm (1.09 in)
Service limit: 25.0 mm (0.98 in)

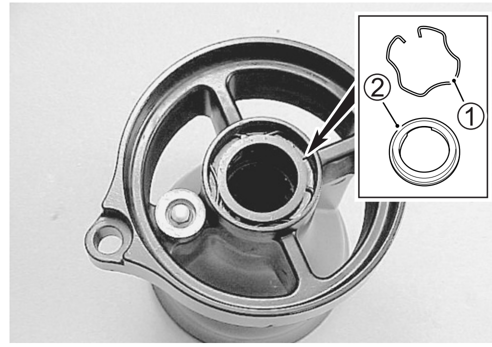
PROPELLER SHAFT BEARING HOUSING



- Inspect housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect reverse gear bearing and propeller shaft thrust bearing. Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.
- Check condition of oil seal and O-ring.
  Replace oil seal and O-ring if nicked, cut, worn or other abnormal conditions are noted.

Replacing propeller shaft oil seal

1. Remove retaining ring ① and oil seal protector ②.

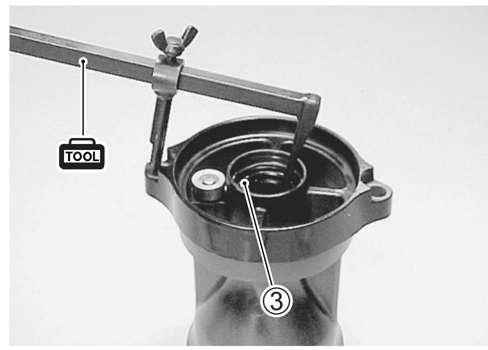


2. Extract seals ③ with oil seal remover.

TOOL **09913-50121: Oil seal remover**

CAUTION

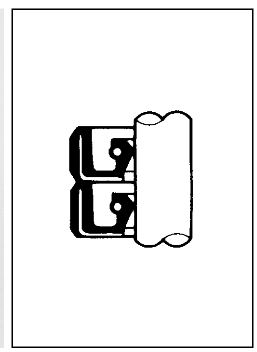
> **Do not reuse oil seal once removed.**
> **Always use new oil seal.**



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.

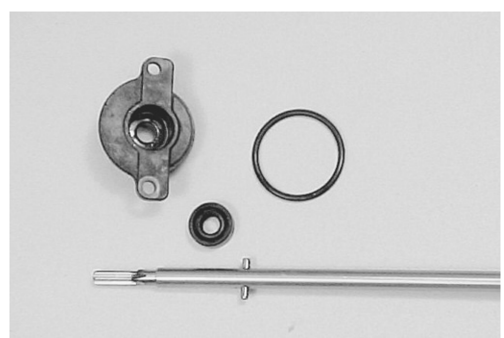
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

5. Install the oil seal protector and retaining ring.

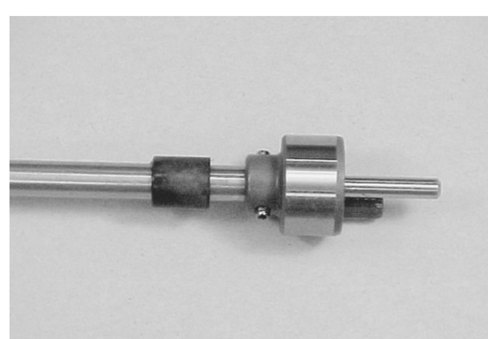


SHIFT ROD GUIDE HOUSING COMPONENTS

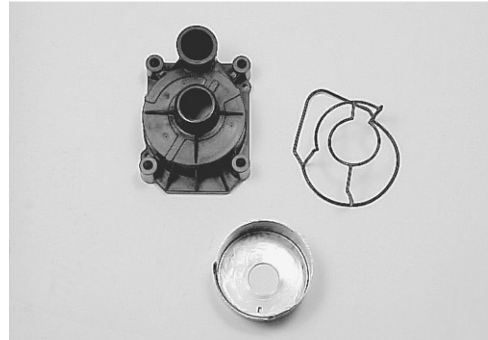
- Inspect shift rod guide housing. Replace if cracked, damaged or other abnormal condition.
- Inspect shifter yoke. Replace if wear, damaged or other abnormal conditions are noted.
- Inspect shift rod/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.
- Inspect O-ring. Replace if nicked, cut, torn, swollen or other abnormal conditions are noted.



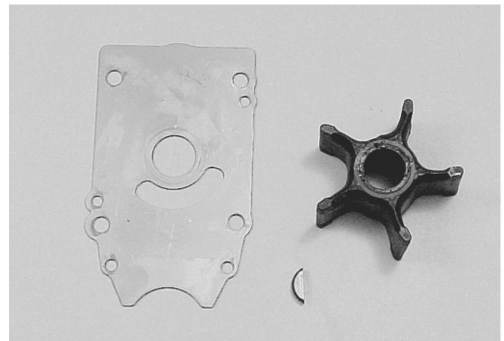
- Inspect oil seal. Replace if nicked, cut, worn or other abnormal conditions are noted.



WATER PUMP AND RELATED ITEMS



- Inspect impeller. Replace if vanes are cut, torn, worn or other abnormal conditions are noted.
- Inspect pump case. Replace if cracked, distorted or other abnormal conditionds are noted.
- Inspect pump inner sleeve. Replace if worn, cracked, distorted, corroded or other abnormal conditions are noted.

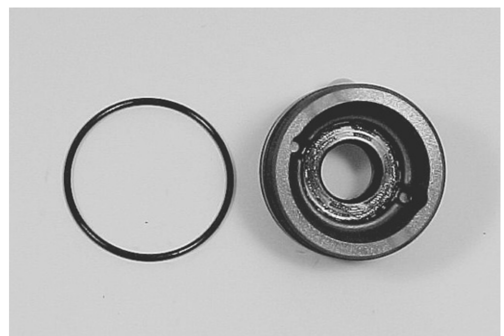


- Inspect under panel. Replace if cracked, distorted, corroded or other abnormal conditions are noted.

CAUTION

Do not reuse seal ring once removed.
Always use new seal ring.

DRIVESHAFT OIL SEAL HOUSING



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

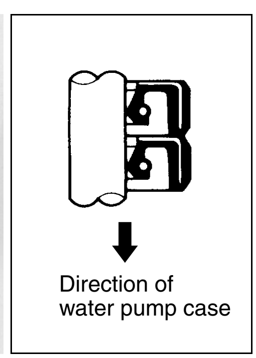
Replacing driveshaft oil seal

1. Using special tool, remove two (2) oil seals out of the driveshaft oil seal housing.

TOOL **09913-50121: Oil seal remover**

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

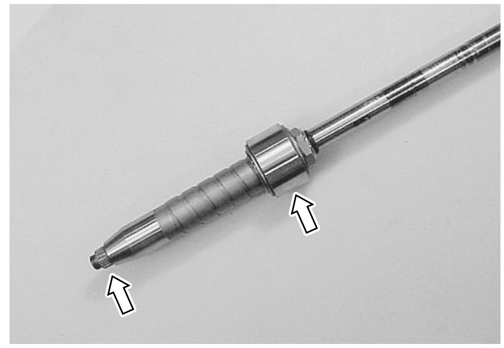
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

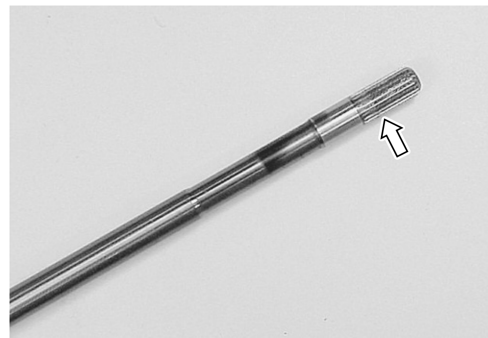


3. Grease the inner lips of oil seal. With the lips facing away from driveshaft bearing, place seal in position and drive it into the oil seal housing.

DRIVESHAFT

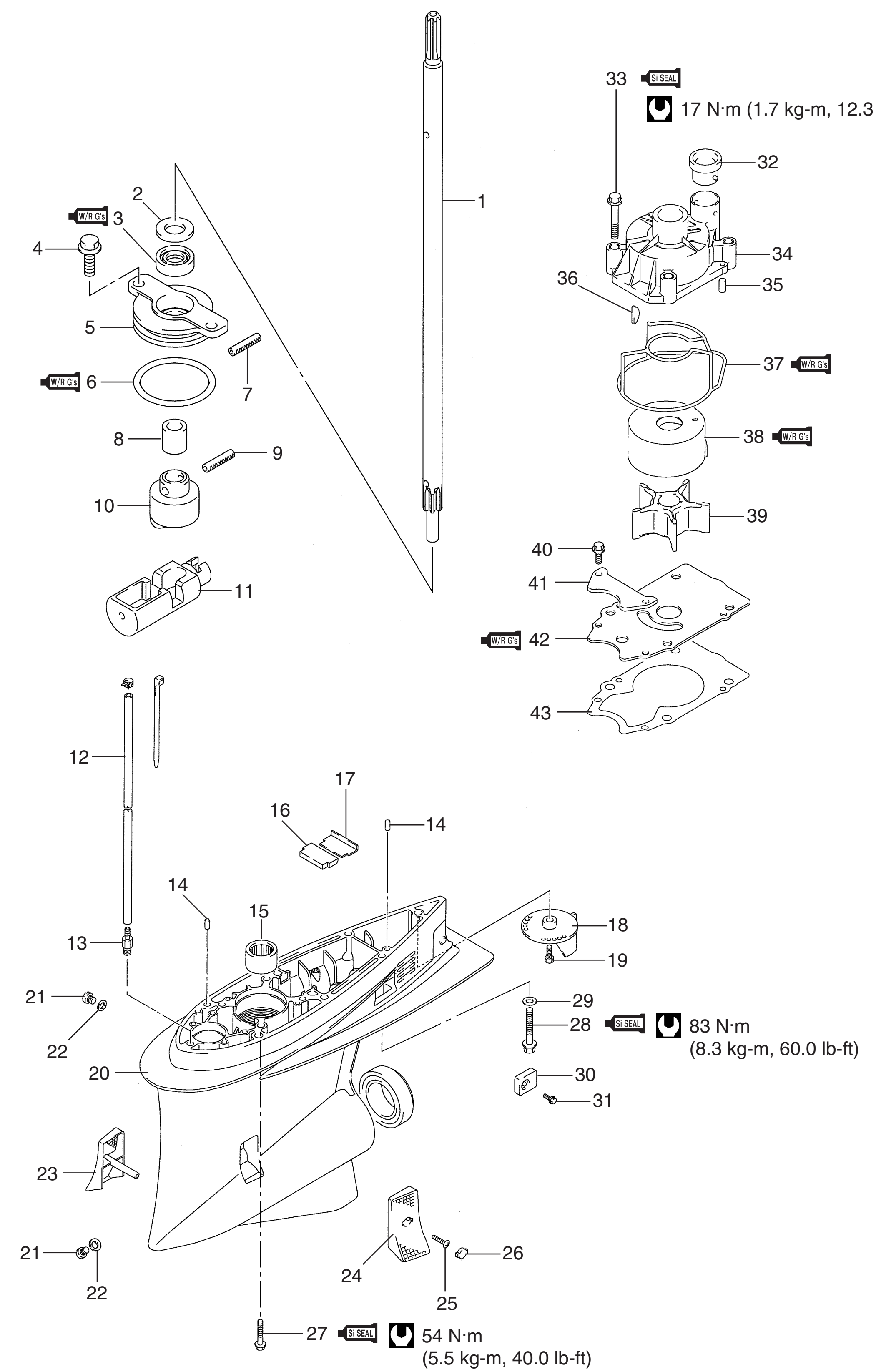
- Inspect driveshaft/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.
- Inspect driveshaft bearing, replace if pitted, noisy, rough or other abnormal conditions are noted.



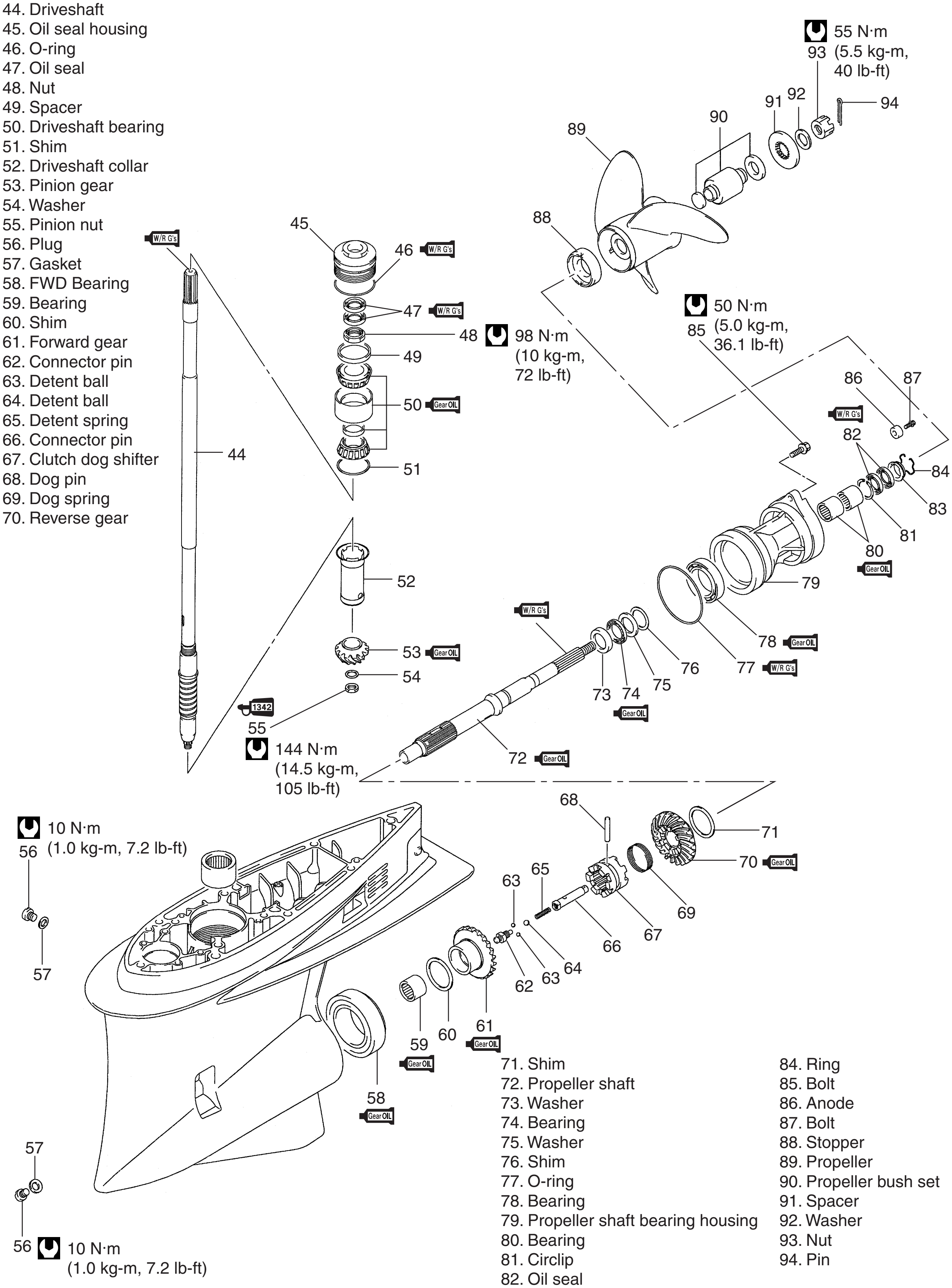


ASSEMBLY & INSTALLATION

Assembly & installation are in reverse order of disassembly with special attention to the following steps.



1. Shift rod
2. Cover
3. Dust seal
4. Bolt
5. Shift rod housing
6. O-ring
7. Pin
8. Magnet
9. Pin
10. Shifter yoke
11. Horizontal slider
12. Hose
13. Nipple
14. Dowel pin
15. Pinion bearing
16. Exhaust seal rubber
17. Plate
18. Trim tab
19. Bolt
20. Gearcase
21. Plug
22. Gasket
23. STBD water filter
24. PORT water filter
25. Screw
26. Cover
27. Bolt
28. Bolt
29. Washer
30. Anode
31. Bolt
32. Bush
33. Bolt
34. Water pump case
35. Dowel pin
36. Key
37. Case sealing
38. Sleeve
39. Water pump impeller
40. Bolt
41. Panel
42. Under panel
43. Gasket



44. Driveshaft
45. Oil seal housing
46. O-ring
47. Oil seal
48. Nut
49. Spacer
50. Driveshaft bearing
51. Shim
52. Driveshaft collar
53. Pinion gear
54. Washer
55. Pinion nut
56. Plug
57. Gasket
58. FWD Bearing
59. Bearing
60. Shim
61. Forward gear
62. Connector pin
63. Detent ball
64. Detent ball
65. Detent spring
66. Connector pin
67. Clutch dog shifter
68. Dog pin
69. Dog spring
70. Reverse gear
71. Shim
72. Propeller shaft
73. Washer
74. Bearing
75. Washer
76. Shim
77. O-ring
78. Bearing
79. Propeller shaft bearing housing
80. Bearing
81. Circlip
82. Oil seal
83. Seal protector
84. Ring
85. Bolt
86. Anode
87. Bolt
88. Stopper
89. Propeller
90. Propeller bush set
91. Spacer
92. Washer
93. Nut
94. Pin

CAUTION

- **Make sure that all parts used in assembly are clean and lubricated.**
- **It is recommended that all seals, gaskets and O-rings be replaced with new on assembly.**
- **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 9-27.)

CAUTION

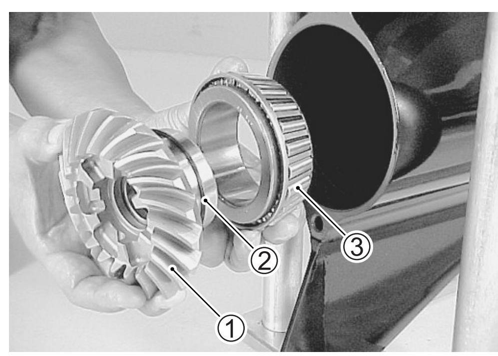
- **To insure accurate operation of the electronic shift system, the output voltage from the shift position sensor must be adjusted to the specification for each shift position.**

- **When the lower unit and its components or the shift link system components have been replaced, make sure to check the output voltage of shift position sensor in neutral and forward position. If the output voltage is not within the specification, adjustment of the shift position sensor is required. For shift position sensor adjustment, see page 3-76.**

FORWARD GEAR

Assemble the forward gear ①, back-up shim ② and forward gear bearing ③, then install forward gear assembly.

Gear OIL **99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL**

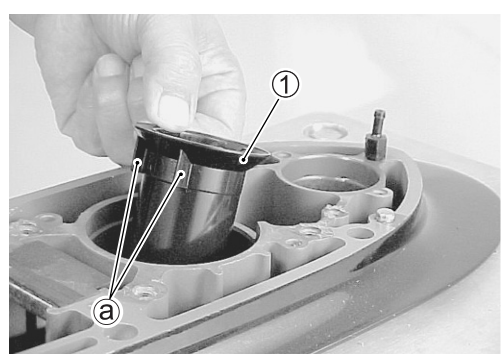


DRIVESHAFT COLLAR

Install driveshaft collar ①.

NOTE:

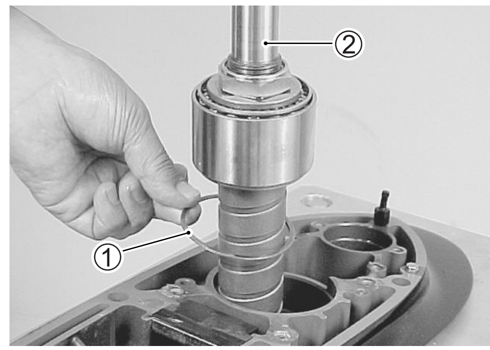
The tongue ⓐ of collar must be located into groove on the gearcase.



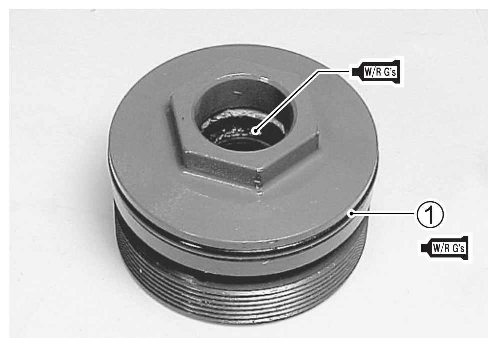
PINION GEAR
Place pinion gear in gearcase.

NOTE:
Before installing pinion gear, check for the correct number and position of pinion bearing rollers.
Use oil soluble grease to retain bearing rollers.

DRIVESHAFT
Install pinion shim ①, then lower the driveshaft assembly ② down into the gearcase until the bottom of shaft protrudes through center of pinion.

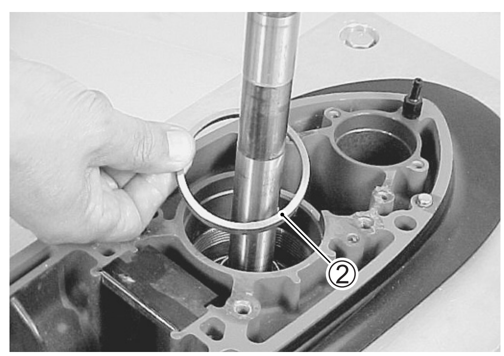


DRIVESHAFT OIL SEAL HOUSING
- Apply Water Resistant Grease to the driveshaft oil seal.
- Apply Water Resistant Grease to O-ring ①, then install O-ring into groove on the driveshaft oil seal housing.

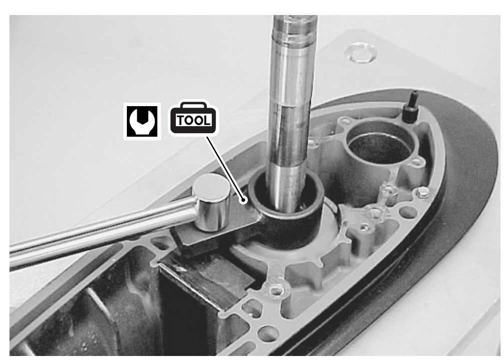


W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

- Install driveshaft bearing spacer ②.



- Install driveshaft oil seal housing on gearcase, then tighten oil seal housing to specified torque.



Driveshaft oil seal housing: 100 N·m (10.0 kg-m, 72.5 lb-ft)

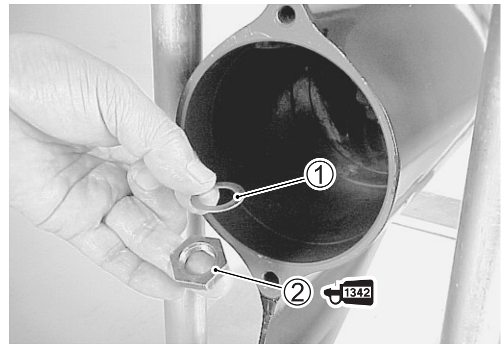
TOOL **09926-29310: Driveshaft housing remover**

PINION NUT

- Apply THREAD LOCK 1342 to the threads of pinion nut ② before threading it onto driveshaft.

1342 99000-32050: THREAD LOCK "1342"

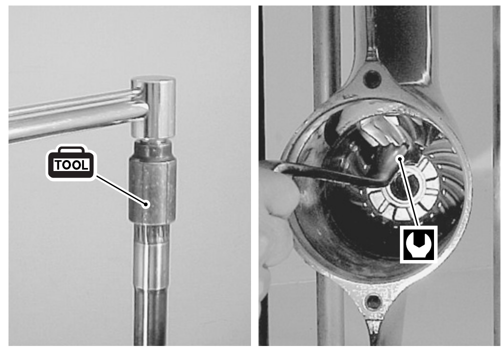
NOTE:
It is recommended the original pinion nut be used for the purposes of shimming during repair. A new pinion nut should be used on final assembly.



- Install washer ①, pinion nut ②, then tighten nut to specified torque.

Pinion nut: 145 N·m (14.5 kg-m, 105.0 lb-ft)

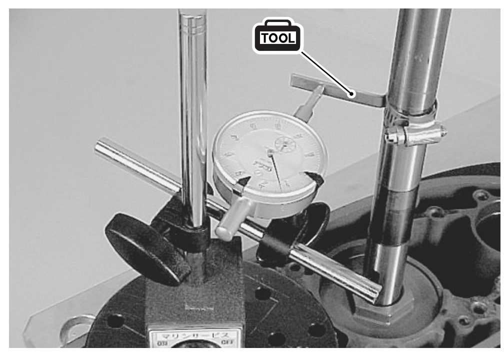
TOOL 09921-29410: Driveshaft holder



CHECKING GEAR BACKLASH

Before installing reverse gear, gear backlash should checked. (See the "GEARS-SHIMMING AND ADJUSTMENT/Adjusting gear backlash" section on page 9-28.)

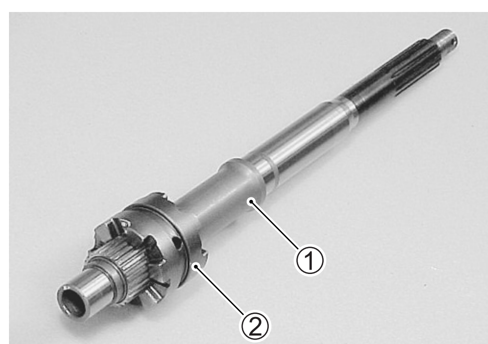
TOOL 09952-09310: Backlash indicator tool

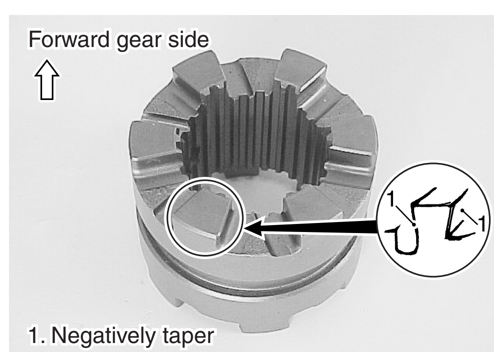


PROPELLER SHAFT

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

NOTE:
The side of clutch dog shifter negatively taper machined at both sides of the dog must face towards forward gear. (Opposite side of the dog has been machined only one side.)

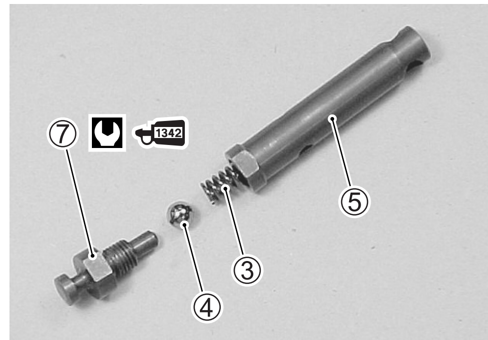




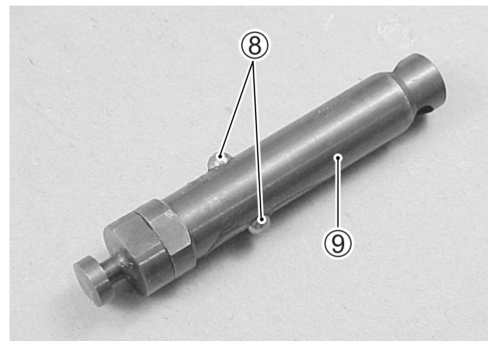
- Insert detent spring ③ and large detent ball ④ into connector body ⑤.
  Install connector pin ⑦, then tighten connector pin, pre-coated with thread lock, to specified torque.

1342 99000-32050: THREAD LOCK "1342"

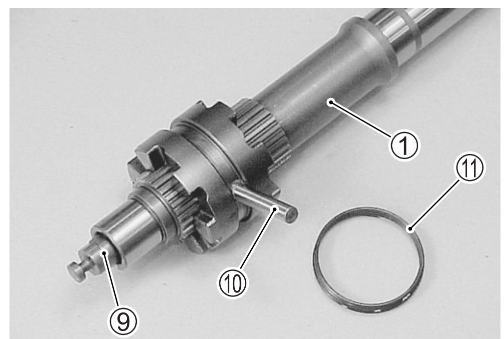
Connector pin: 23 N·m (2.3 kg-m, 16.6 lb-ft)



- Install two small detent balls ⑧ to connector pin assembly ⑨.



- Insert the connector pin assembly ⑨ (with small detent balls) into propeller shaft ①.
- Align the holes in the shifter dog and connector pin and then slide the dog pin ⑩ through both dog and connector pin.
- Install the dog pin retaining spring ⑪, ensuring that it fits snugly into the groove on the dog shifter.



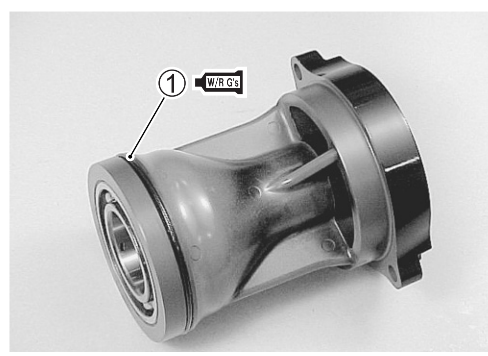
PROPELLER SHAFT/BEARING HOUSING

- Assemble the propeller shaft in the following sequence:

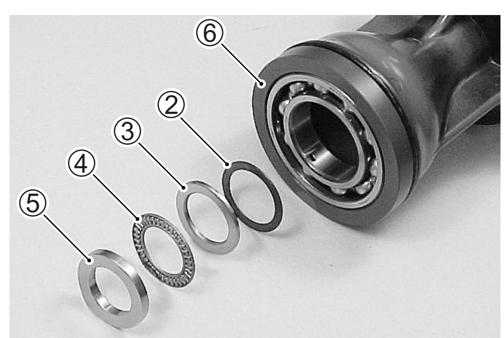
W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

Gear OIL 99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL

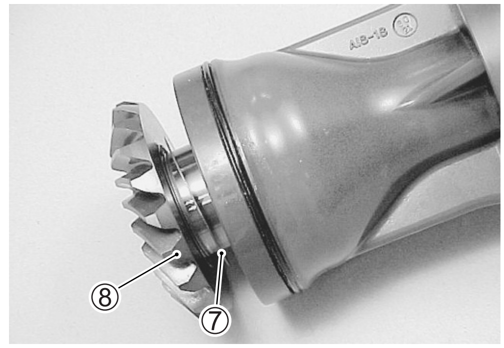
(a) Apply Water Resistant grease to O-ring ①, then install O-ring into groove on the propeller shaft bearing housing.



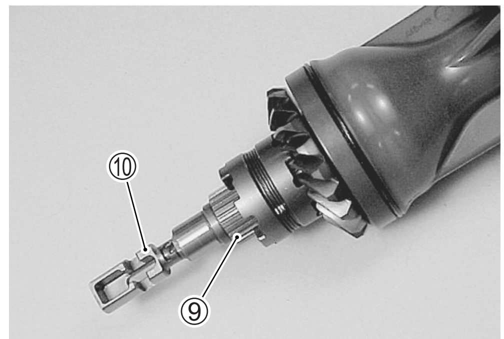
(b) Install shim ②, bearing washer ③, propeller shaft thrust bearing ④ and propeller shaft thrust washer ⑤ into propeller shaft bearing housing ⑥.



(c) Install reverse gear back-up shim ⑦ and reverse gear ⑧ to propeller shaft bearing housing.



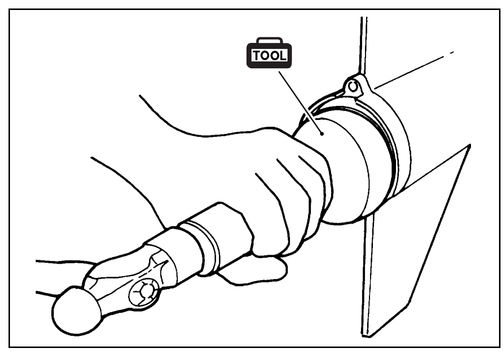
(d) Slide propeller shaft ⑨ into reverse gear and propeller shaft bearing housing.
(e) Assemble horizontal slider ⑩ to connector pin.



NOTE:
Before installing propeller shaft/bearing housing assembly, move shifter dog to bring horizontal slider to the neutral position.

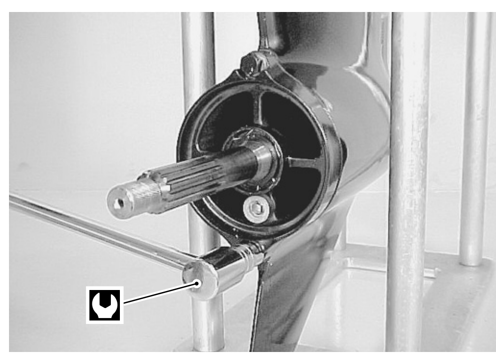
- Using special tools, install the propeller shaft and housing assembly in the gearcase.

TOOL **09922-59410: Propeller shaft housing installer**
09922-59420: Housing installer handle



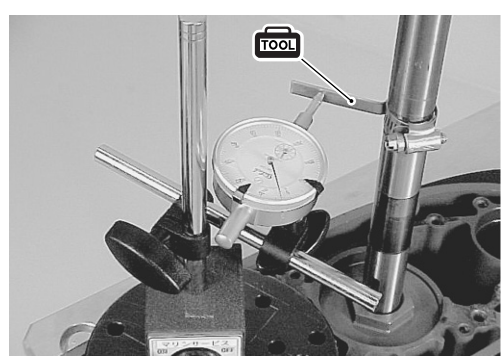
- When the housing is fully seated, tighten both retaining bolts to the specified torque.

Bearing housing bolt: 50 N·m (5.0 kg-m, 36.1 lb-ft)



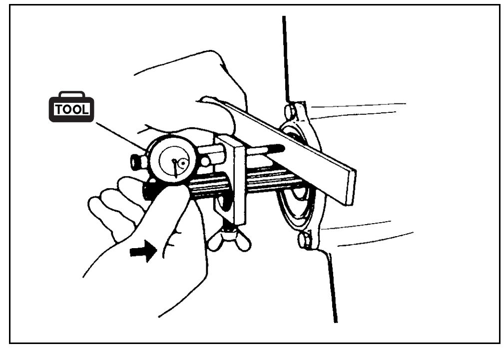
RECHECKING GEAR BACKLASH
Recheck the gear backlash.
This should not be less than previously checked.
If less, reduce the number/thickness of reverse gear back-up shims.
(See the "GEARS-SHIMMING AND ADJUSTMENT/RECHECKING GEAR BACKLASH" section on page 9-31.)

TOOL **09952-09310: Backlash indicator tool**



CHECKING PROPELLER SHAFT THRUST PLAY

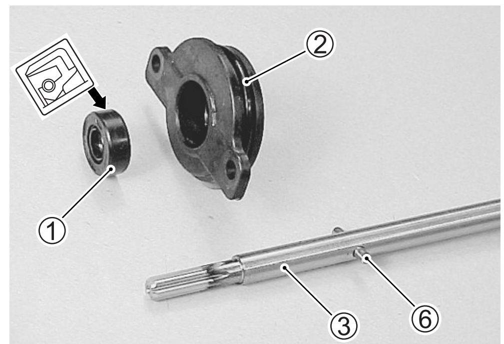
See the “GEARS-SHIMMING AND ADJUSTMENT/CHECKING PROPELLER SHAFT THRUST PLAY” section on page 9-33.



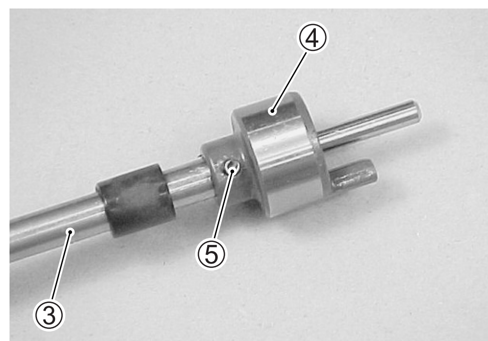
SHIFT ROD GUIDE HOUSING

- Using an oil seal installer, drive the oil seal ① into the shift rod guide housing ②.
  The lipped portion of oil seal must face towards the driveshaft housing.

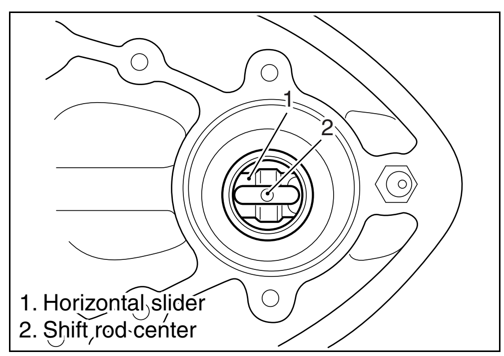
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**



- Attach shifter yoke ④ to shift rod ③, then insert pin ⑤.
- Install pin ⑥ to shift rod, then slide shift rod guide housing onto shift rod.



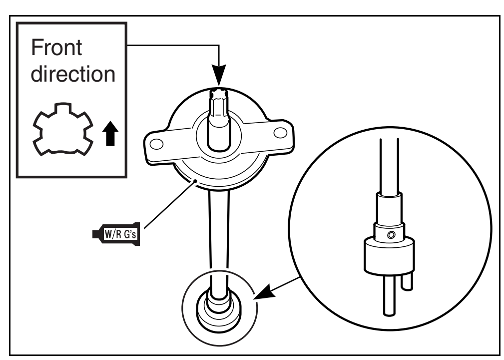
NOTE:
Be sure the horizontal slider is in the neutral position before installing the shift unit (shift rod guide housing assembly.).



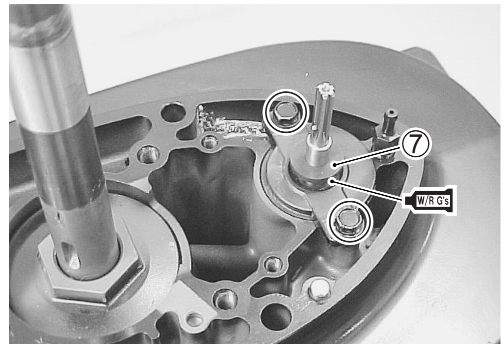
- Apply Water Resistant Grease to the shift rod guide housing O-ring.

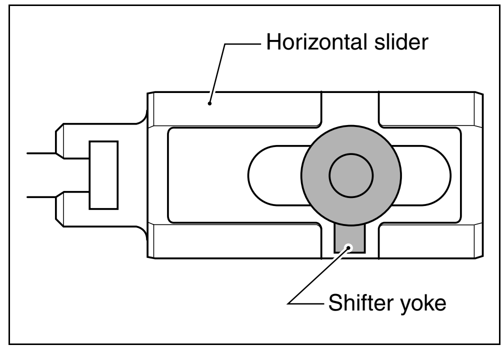
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

NOTE:
Before installing shift rod guide housing assembly, bring shifter yoke to neutral position by turning shift rod right or left.



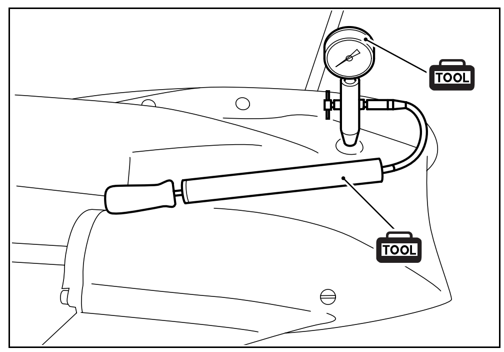
- Install shift rod guide housing assembly by aligning shifter yoke with groove in horizontal slider, then tighten two (2) housing bolts securely.
- Turn shift rod from Neutral position to Forward and Reverse position to check proper gear engagement.
- Apply enough Water Resistant Grease on oil seal before putting seal cover ⑦, then install seal cover.





LEAKAGE CHECK

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



TOOL **09950-69512: 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)

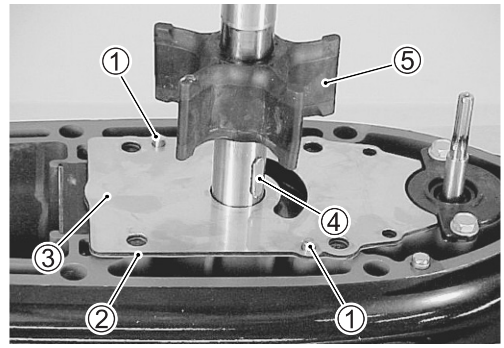
CAUTION

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

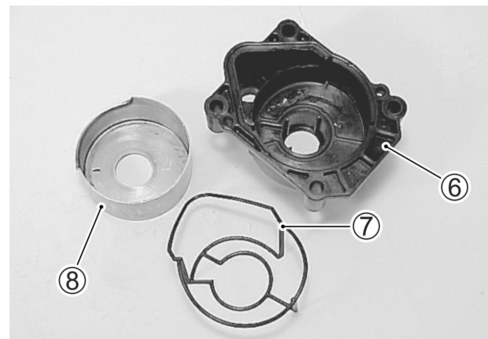
4. Once stabilized, pressure should remain steady for at least 5 min.
   If pressure does not fall, sealing performance is correct.

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.



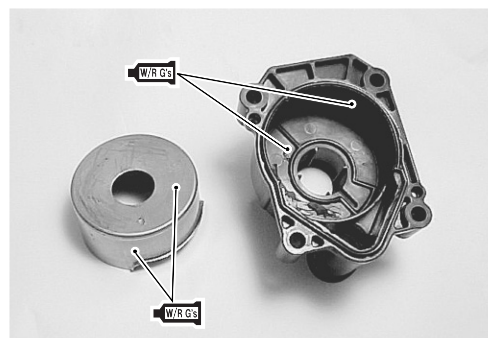
- Place the seal ring ⑦ into groove of the pump case ⑥, then install inner sleeve ⑧ to pump case.



CAUTION

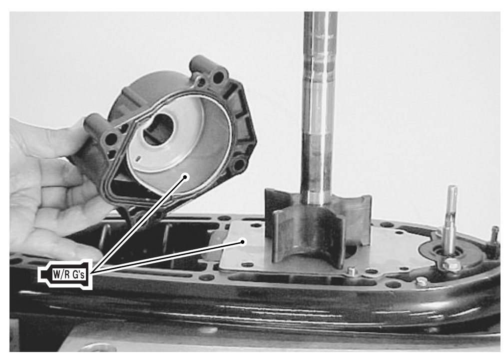
Do not reuse seal ring once removed.
Always use new ring.

NOTE:
Before installing pump inner sleeve, apply water resistant grease lightly between inner sleeve and pump case mating surfaces.



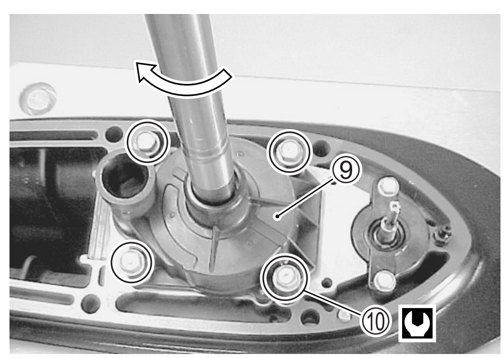
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

NOTE:
Before installing water pump case assembly, apply Water Resistant Grease lightly on pump case inner sleeve and under panel for initial lubrication.



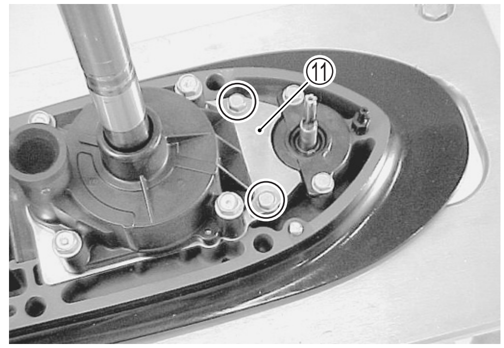
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

- Install the pump case assembly ⑨ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
- Securely tighten the four (4) pump case bolts ⑩ to the specified torque.



Pump case bolt: 17 N·m (1.7 kg-m, 12.5 lb-ft)

- Install shift rod guide housing stopper ⑪, then tighten stopper bolts securely.

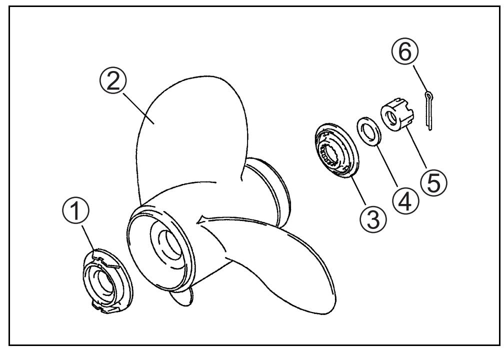


PROPELLER INSTALLATION

Install propeller stopper ① onto propeller shaft, then slide on the propeller ②.
Fit spacer ③, washer ④ and nut ⑤, then tighten nut to specified torque.
Push cotter pin ⑥ through nut and shaft, then bend to secure.

W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

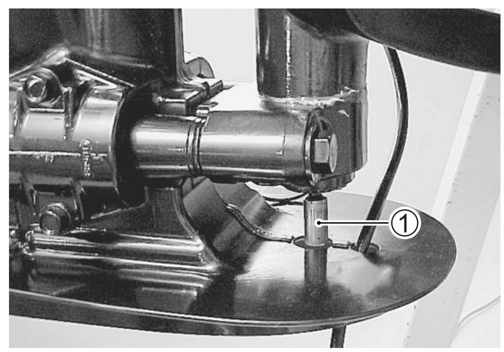
Propeller nut: 55 N·m (5.5 kg-m, 40.0 lb-ft)



LOWER UNIT INSTALLATION

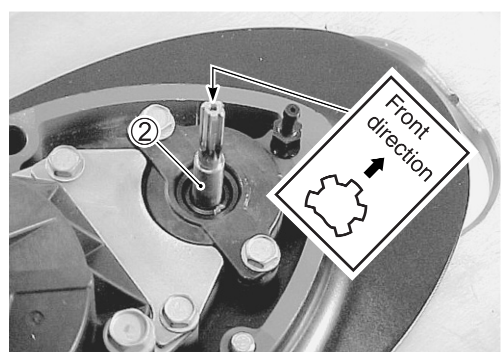
- Apply Water Resistant Grease to clutch rod splines, then install clutch rod ① by aligning clutch rod splines with splines in clutch shaft.

W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

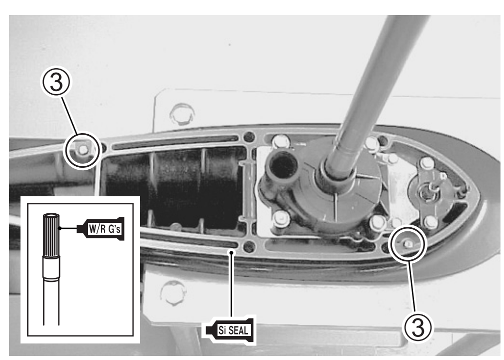


- Ensure that shift rod ② is at neutral position.

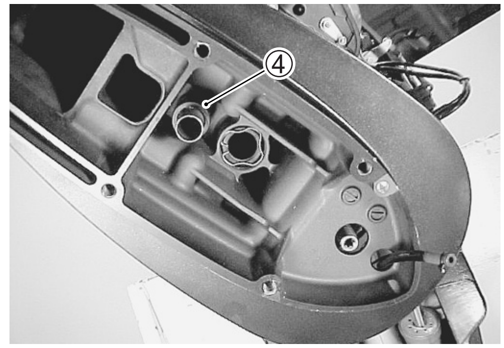
NOTE:
Before installing lower unit assembly, bring shift to neutral position by turning shift rod right or left.



- Insert two (2) dowel pins ③.
- Apply Water Resistant Grease to driveshaft and shift rod splines.
- Apply a light coating of SUZUKI SILICONE SEAL to mating surfaces of gearcase and driveshaft housing.

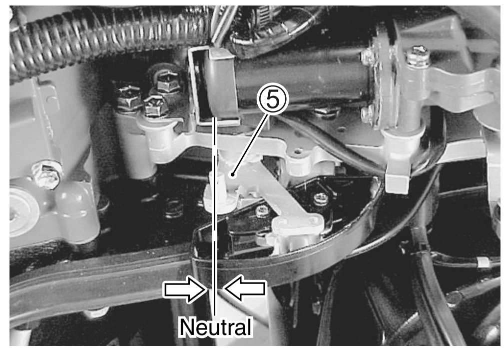


- Install spacer ④ to water tube.



- Set the clutch control lever ⑤ at Neutral position, then slide the lower unit ⑥ into place, ensuring that the top of driveshaft engages properly with driven gear shaft and that water tube locates in water pump case outlet.

NOTE:
In order for shift rod and clutch rod splines to be aligned correctly, clutch rod may need to be turned slightly right or left.

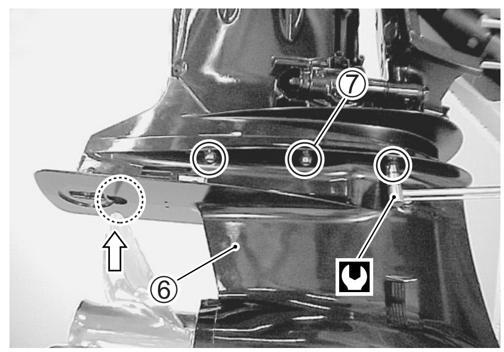


- Apply SUZUKI SILICONE SEAL to seven (7) gearcase bolts ⑦ and tighten them to specified torque.

Gearcase bolt: 10 mm 55 N·m (5.5 kg-m, 40.0 lb-ft)
12 mm 83 N·m (8.3 kg-m, 60.0 lb-ft)

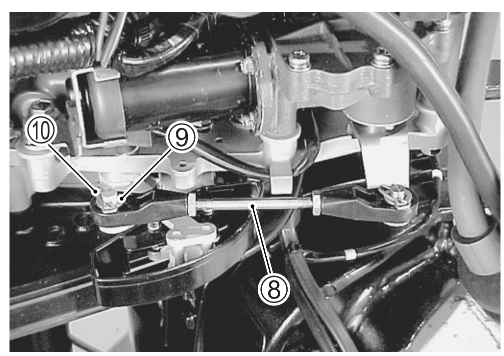
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

Si SEAL **99000-31120: SUZUKI SILICONE SEAL**



- Shift the clutch control lever to Forward and Reverse position from Neutral position to check proper gear engagement.

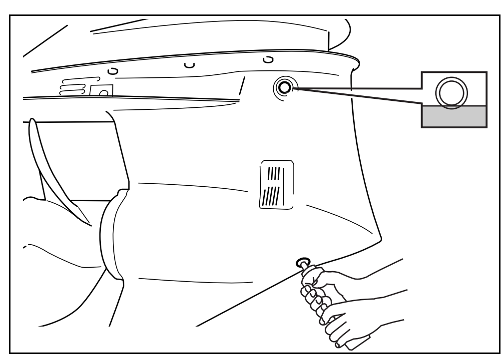
- Connect the clutch link rod ⑧, then install washer ⑨ and lock pin ⑩.



GEAR OIL

Fill the gearcase with specified gear oil for initial testing and recheck the level after 10 minutes. Top up if necessary.
(See "PERIODIC MAINTENANCE/GEAR OIL" section on page 2-6.)

Gear OIL **99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL**



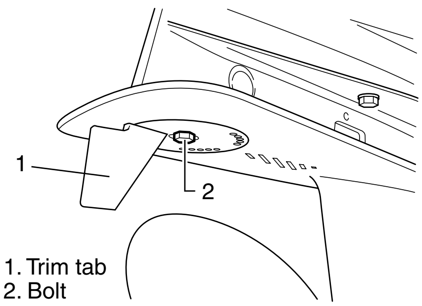
TRIM TAB

The trim tab counteracts or minimizes propeller torque “pull” felt through the steering system.

If the steering is pulled to starboard or port side, adjust trim tab with following procedure:

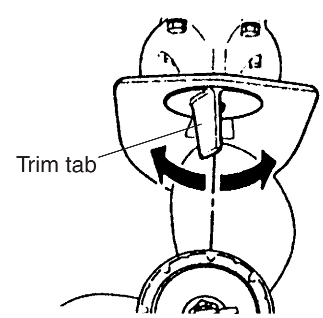
Adjusting

1. Loosen the bolt of trim tab.
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.



1. Trim tab
2. Bolt

3. Tighten the bolt of trim tab.
4. Test ride the boat and repeat the procedure 1 – 3 to set the trim tab in the best position.



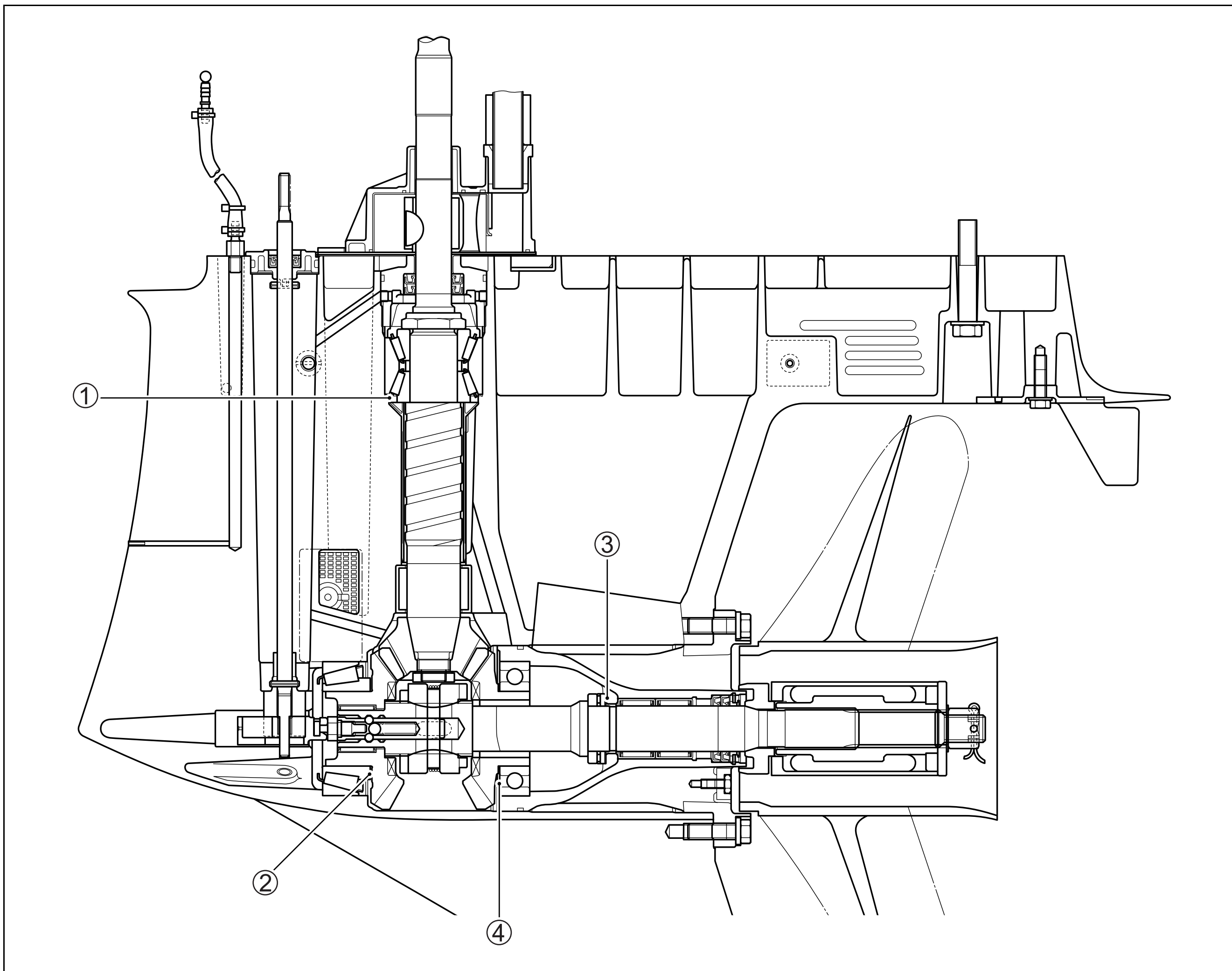
With a properly adjusted trim tab, steering should be neutral and there should be no tendency for the steering to be pulled to either port or starboard.

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 checked and/or adjusted to ensure smooth, reliable operation of gears.

Shim/Washer & Mounting position

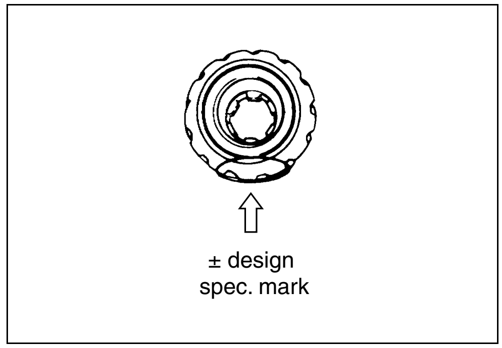
	Numerical index/item	Available thickness (mm)	Design specification Thickness (mm)
①	Pinion gear back-up shim	0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90	1.0
②	Forward gear back-up shim	0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90	1.0
③	Propeller shaft reverse thrust washer	0.6, 0.7, 0.8, 0.9, 0.95, 1.0, 1.1, 1.15	1.0
④	Reverse 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



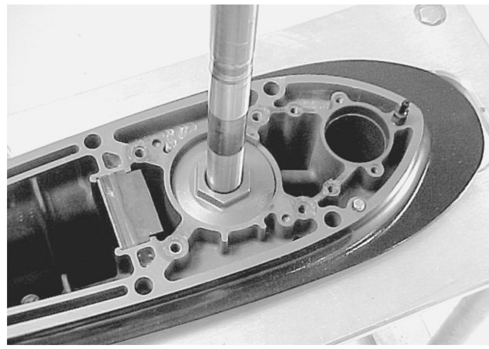
FORWARD GEAR/PINION GEAR
Follow the procedure below to adjust forward gear/pinion gear.

Step to prior to adjustment

1. Install standard pinion gear back-up shim thickness modified according to ± design specification mark on gear.



2. Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. (See page 9-16 to 9-18.)
   Do not install reverse gear at this time.
3. Tighten pinion nut to specified torque.

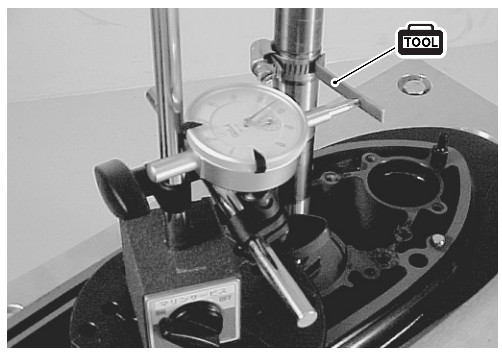


Pinion nut: 145 N·m (14.5 kg-m, 105.0 lb-ft)

Adjusting gear backlash

(a) Assemble special tool to driveshaft as shown in figure.

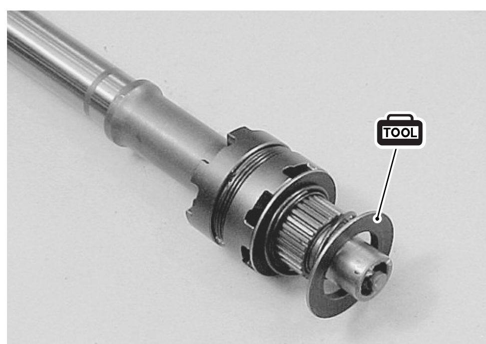
TOOL **09900-20602: Dial gauge**
09900-20701: Magnetic stand
09952-09310: Backlash indicator tool

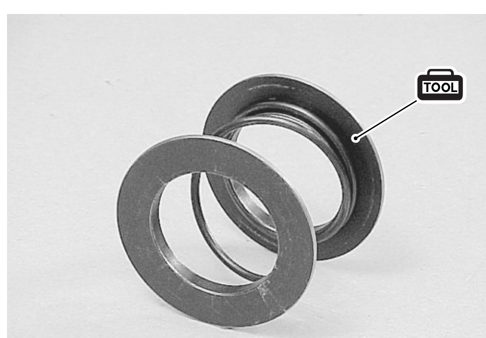


(b) Move shifter dog to reverse position, then set the special tool to propeller shaft as shown in figure.

TOOL **09951-09310: Gear adjust spring set**

NOTE:
Use longer spring (free length: 42.3 mm, 1.67 in) in the gear adjust spring set to adjust the forward gear backlash.

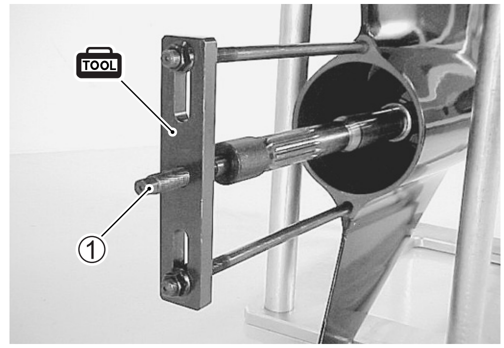




(c) Install propeller shaft (with special tool) into gearcase.
(d) Install the special tool and then attach it to the propeller shaft as shown.

TOOL 09951-99310: Gear holder

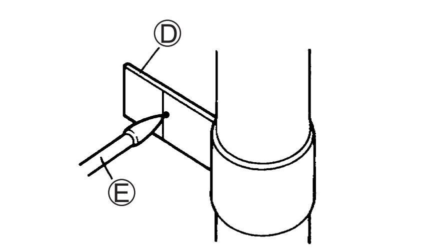
(e) Turn the bolt ① clockwise to push forward gear inward.



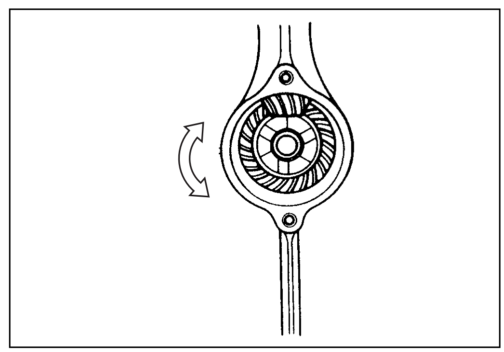
(f) Align dial gauge pointer at 90 ° to the mark on the backlash indicator tool and read backlash on dial gauge by lightly moving driveshaft clockwise and counterclockwise by hand.

Gear backlash: Approx. 0.4 – 0.7 mm (0.016 – 0.028 in)

- If the backlash measured is larger than the specification, add the amount over the specification to the temporary use forward gear back-up shim and install this shim.
- If the backlash measured is smaller than the specification, subtract the amount less than the specification from the temporary use forward gear back-up shim and install this shim.



Ⓓ Backlash indicator tool
Ⓔ Dial gauge



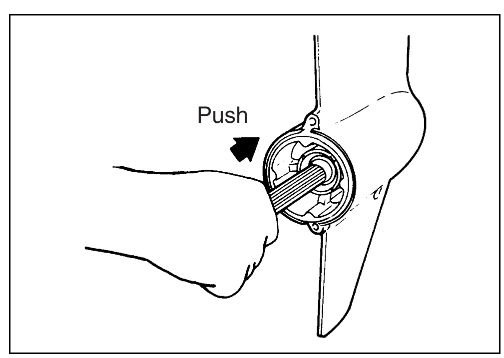
Checking and adjusting tooth contact pattern (Pinion and Forward gear)

Check tooth contact pattern using the following procedure:

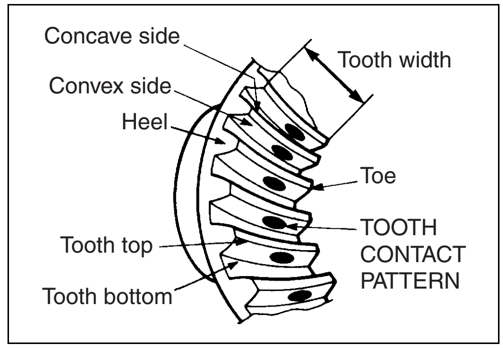
1. To assess tooth contact, apply a light coat of Prussian Blue on the convex surface of forward gear.

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.

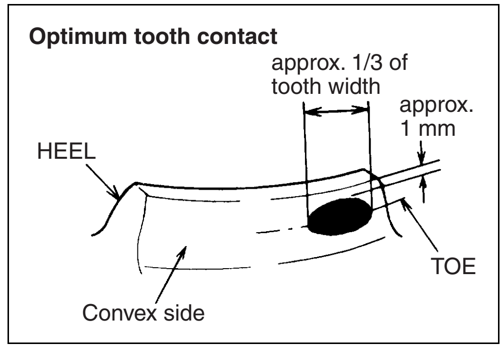
TOOL 09921-29410: Driveshaft holder



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



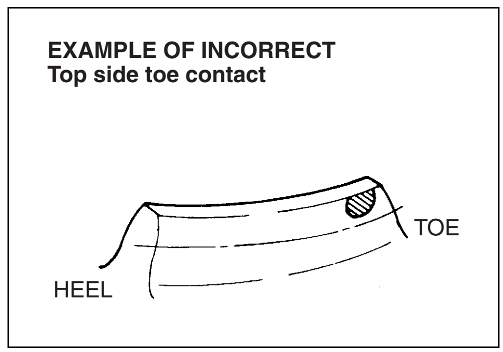
Optimum tooth contact
The optimum tooth contact is shown at right.
A shim adjustment may be necessary to obtain this contact pattern.



CAUTION

Gear backlash should be checked when increasing or decreasing shim thickness to adjust tooth contact.

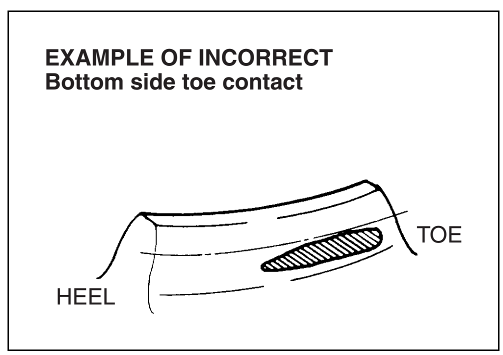
Example (1)
Incorrect topside toe contact:
Correction measures:
- Decrease thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.



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 increase pinion gear shim thickness.

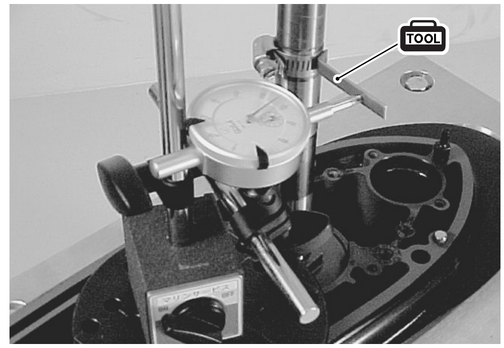


CAUTION

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

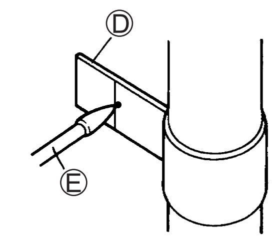
CHECKING GEAR BACKLASH

After obtaining optimum tooth contact, gear backlash should be measured.
(For measure the gear backlash, see “Adjusting gear backlash” section on page 9-28.)



09900-20602: Dial gauge
09900-20701: Magnetic stand
09952-09310: Backlash indicator tool

Designate this amount of gear backlash as (A).



Ⓓ Backlash indicator tool
Ⓔ Dial gauge

Gear backlash: Approx. 0.4 – 0.7 mm (0.016 – 0.028 in)

NOTE:
Gear backlash (A) must be known to adjust reverse gear shim.

RECHECKING GEAR BACKLASH
(Reverse gear back-up shim adjustment)

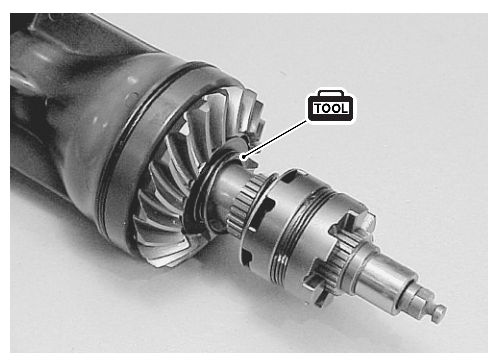
After adjusting forward gear tooth contact pattern, follow the procedure below to adjust reverse gear.

1. Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. (See page 9-16 to 9-18.)

2. Tighten pinion nut to specified torque.

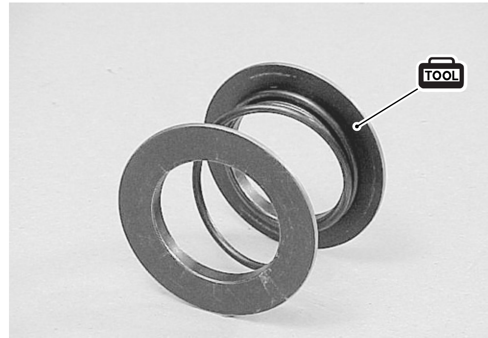
Pinion nut: 144 N·m (14.4 kg-m, 105.0 lb-ft)

3. Correctly assemble reverse gear, propeller shaft, propeller shaft thrust bearing, propeller shaft bearing housing and related components.
   When assembling the reverse gear and propeller shaft housing assembly, place the special tool between clutch dog shifter and reverse gear as shown in the illustration.



NOTE:
- *Before installing special tool, move shifter dog to forward position.*
- *Use longer spring (free length: 42.3 mm, 1.67 in) in the gear adjust spring set to adjust the reverse gear backlash.*

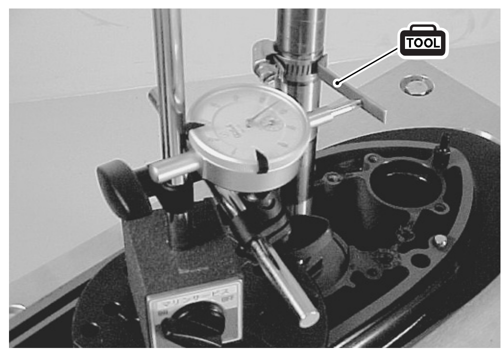
TOOL **09951-09310: Gear adjust spring set**



4. Install reverse gear and propeller shaft housing assembly into gearcase, then tighten both bearing housing retaining bolts to specified torque.

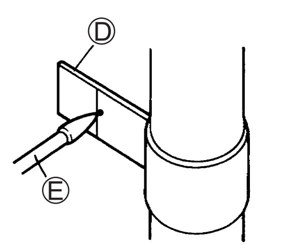
5. Assemble special tool to driveshaft as shown in figure.

TOOL **09900-20602: Dial gauge**
09900-20701: Magnetic stand
09952-09310: Backlash indicator tool



6. Read backlash on dial gauge by lightly moving driveshaft clockwise and counterclockwise by hand.
   Designate this measurement as backlash (B).

   Reverse gear backlash:
   Approx. 0.5 – 0.8 mm (0.020 – 0.031 in)
7. Compare backlash (B) to backlash (A). (See page 9-31.)
8. Reverse gear back-up shim adjustment is correct if (B) is equal or more to (A).
   If (B) is less than (A), reduce reverse gear back-up shim thickness.



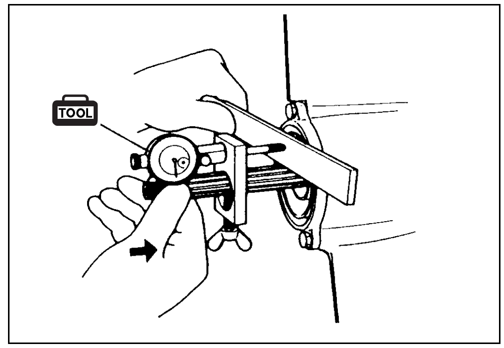
D Backlash indicator tool
E Dial gauge

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:
Approx. 0.1 – 0.2 mm (0.004 – 0.008 in.)

NOTE:
Use only the propeller shaft reverse thrust washer to adjust thrust play.



Measurement step:

1. Assemble gear adjusting gauge to the propeller shaft.

TOOL **09951-09511: Gear adjusting gauge**

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

LOWER UNIT [Counter rotation (Left-hand) model]

CONTENTS

REMOVAL & DISASSEMBLY

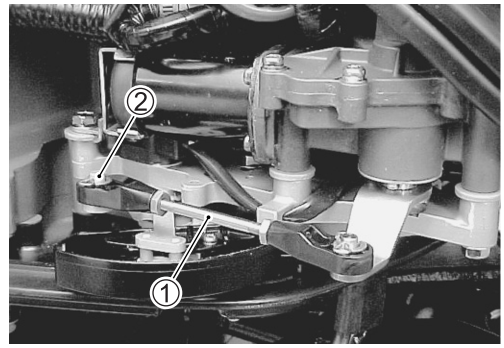
⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

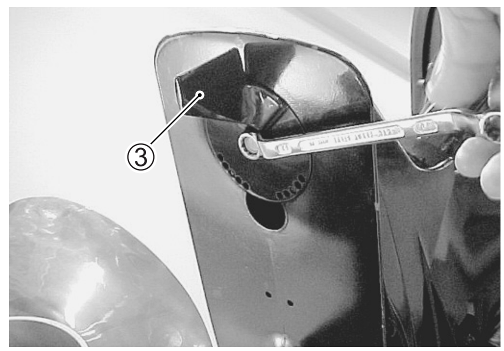
CAUTION

Remove the main relay or shift actuator fuse from fuse box to avoid damaging shift actuator while clutch link rod has been removed.

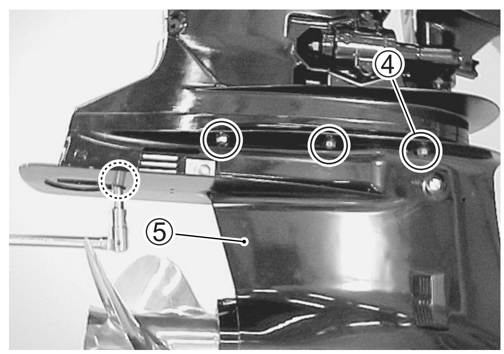
Shift to “NEUTRAL” position.
Remove the clip, washer and clutch link rod ① from clutch lever ②.



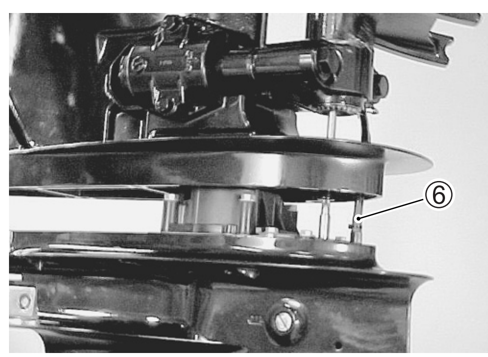
Remove bolt and trim tab ③.



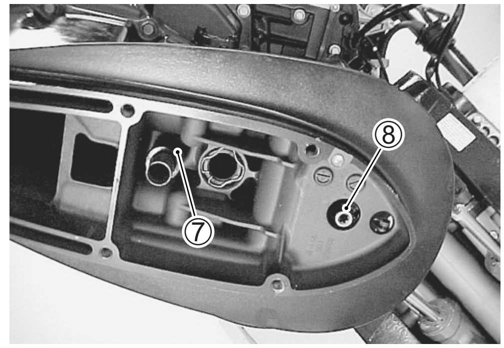
Remove seven (7) bolts ④ and separate gearcase ⑤ from driveshaft housing.



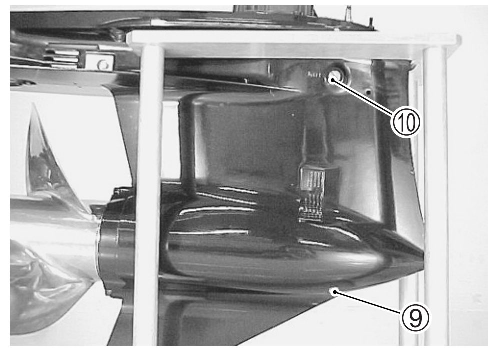
NOTE:
Before gearcase is removed completely, disconnect speedometer pick up tube ⑥ from gearcase.



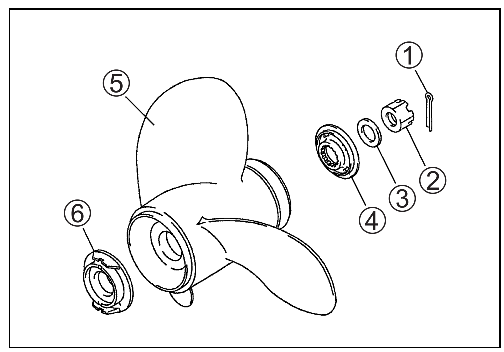
Remove water tube spacer ⑦.
Remove clutch rod ⑧ from clutch shaft (if necessary).



Place a drain pan under oil drain plug.
Remove oil drain plug ⑨ first then oil level plug ⑩ and allow gear oil to drain.
Inspect oil for water, contaminates or metal.

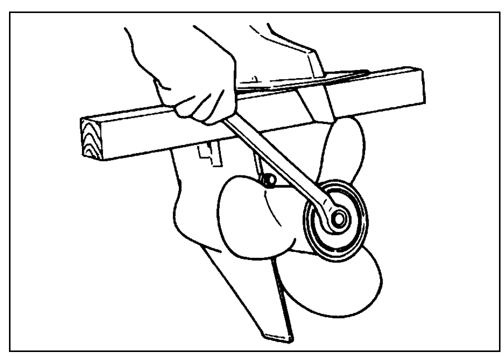


Remove cotter pin ① from propeller nut and remove propeller nut ②.
Remove washer ③, spacer ④, propeller ⑤ and stopper ⑥ from the propeller shaft.

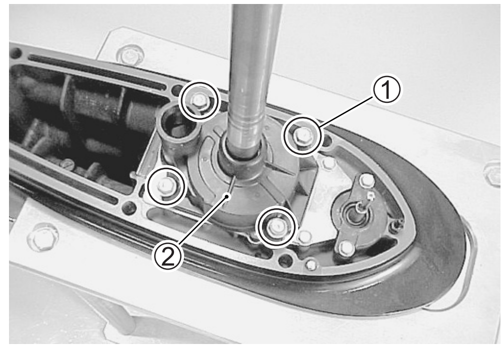


⚠ WARNING

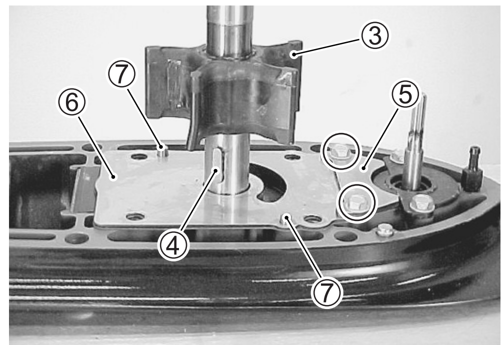
To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place before attempting to remove propeller nut.



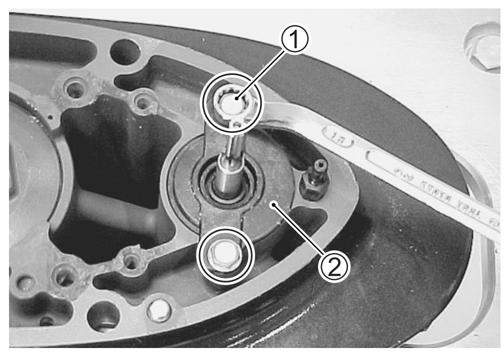
Loosen four (4) bolts ①, then remove water pump case ②.



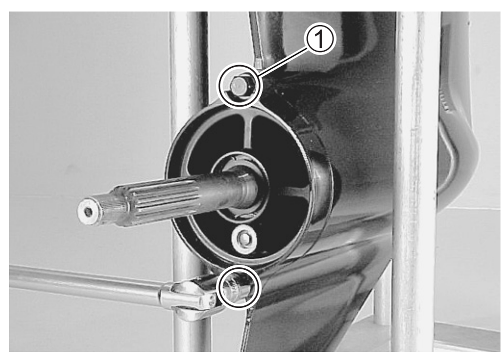
Remove impeller ③ and impeller key ④.
Remove two bolts and shift rod guide housing stopper ⑤.
Remove pump under plate ⑥ and dowel pins ⑦.
Keep impeller key ④ for reuse and discard the plate gasket.



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

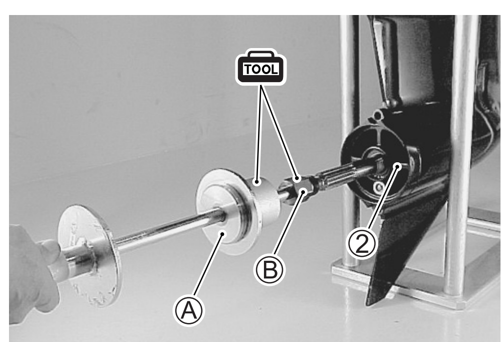


Remove two (2) bolts ① securing the propeller shaft bearing housing to the gearcase.



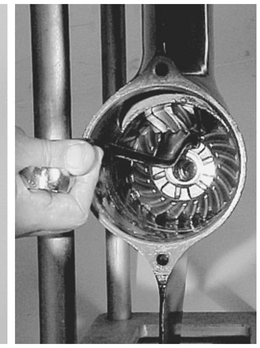
Using special tools, pull out the propeller shaft bearing housing.
Remove the propeller shaft and bearing housing assembly ②.

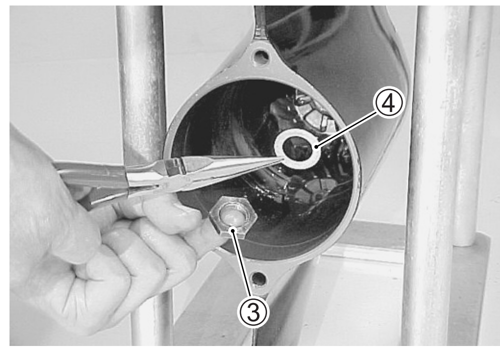
TOOL **09930-30104: Ⓐ Sliding hammer**
09930-30161: Ⓑ Propeller shaft remover



Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut.
Remove pinion nut ③ and washer ④.

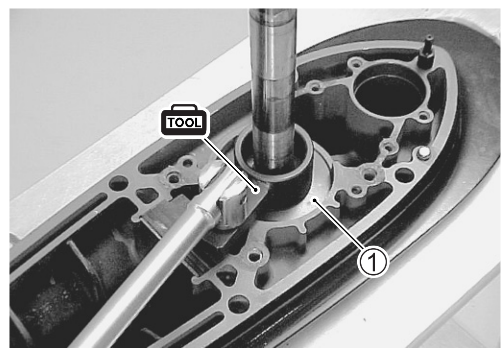
TOOL **09921-29410: Driveshaft holder**



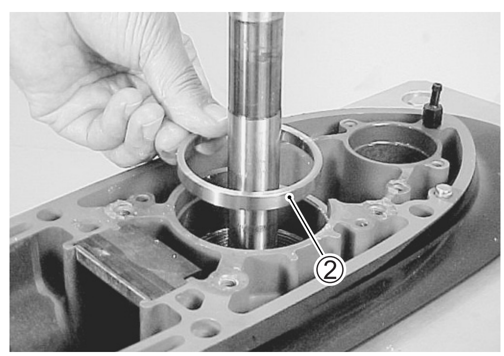


Use special tool to unscrew driveshaft oil seal housing ①, then remove oil seal housing from drive shaft.

TOOL **09926-29310: Driveshaft housing remover**

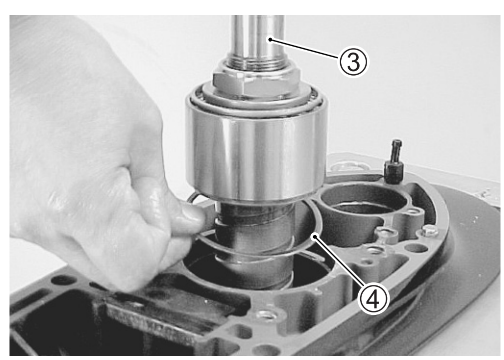


Remove driveshaft bearing spacer ②.

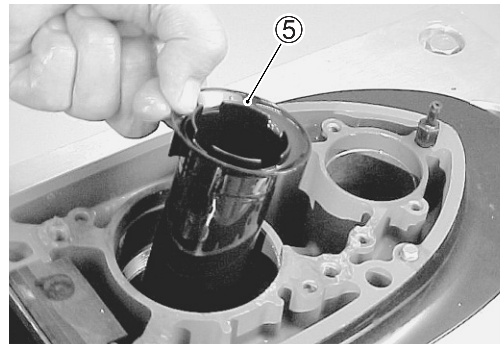


Slowly lift out driveshaft assembly ③.
Remove the pinion shim ④.

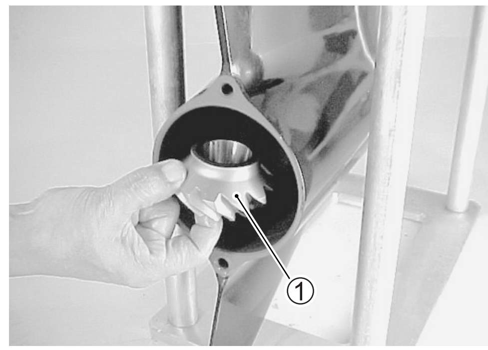
NOTE:
The driveshaft pinion gear bearing contains 26 loose roller bearings. Account for all roller bearings on disassembly.



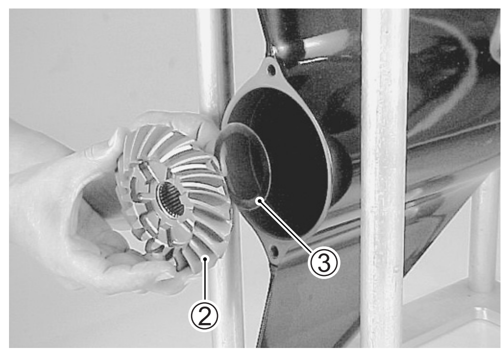
Remove the driveshaft collar ⑤.



Remove the pinion gear ①.



Remove the reverse gear ② and back-up shim ③.

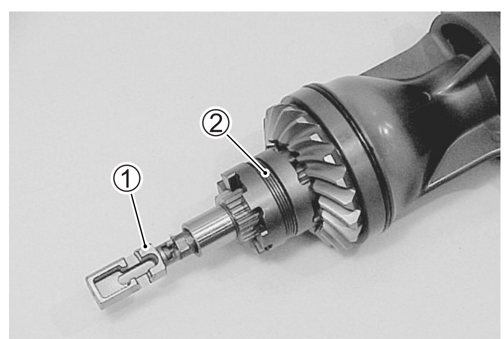


Disassembly of forward gear and propeller shaft components

To disassemble forward gear and propeller shaft components, refer to following:

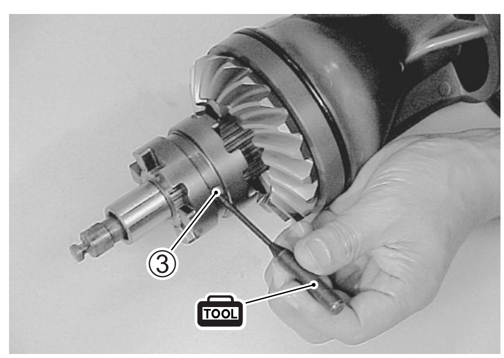
(a) Remove horizontal slider ①.

(b) Remove spring ② from clutch dog shifter.



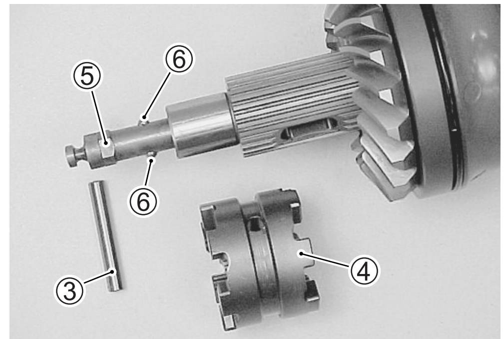
(c) Use special tool to push the dog pin ③ out of the clutch dog shifter.

TOOL **09922-89810: Shift pin remover**



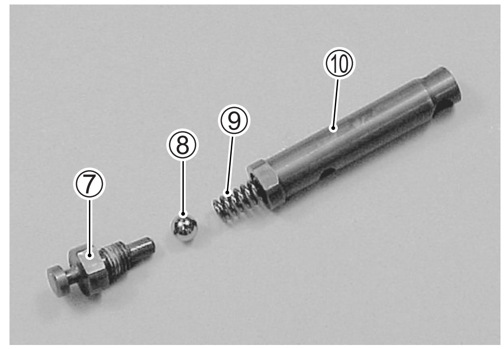
(d) Remove clutch dog shifter ④ and connector pin assembly ⑤ from propeller shaft.
Note the position of two (2) small detent balls ⑥.

NOTE:
Be careful not to lose the two small detent balls on disassembly.

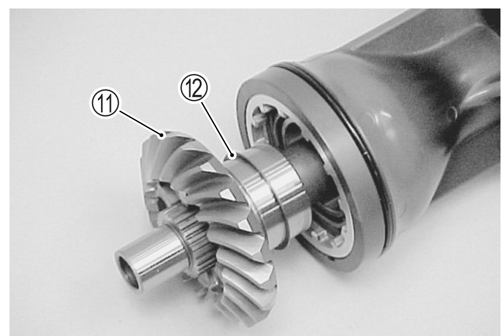


(e) Loosen and remove the connector pin ⑦, then take out detent ball ⑧ and detent spring ⑨ from connector body ⑩.

NOTE:
To facilitate the removal of connector pin, lightly heat up the it thread area using a heat gun.

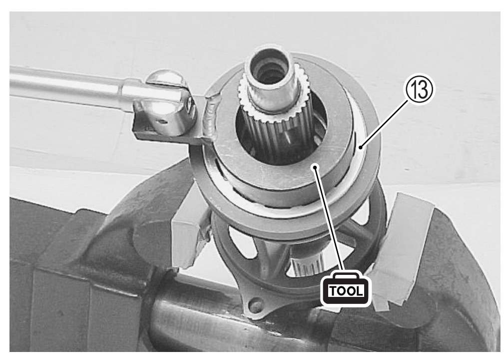


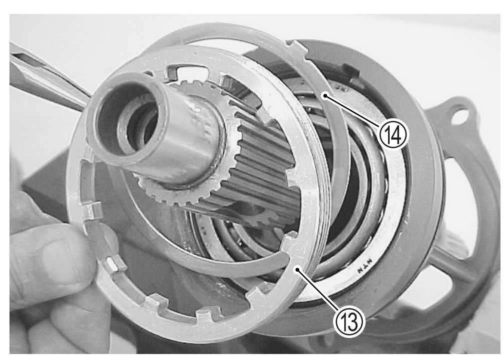
(f) Remove the forward gear ⑪ and back-up shim ⑫.



(g) Loosen and remove forward gear bearing stopper ⑬ from bearing housing, then take out the forward gear bearing washer ⑭ from bearing housing.

TOOL **09951-19820: Bearing stopper remover**

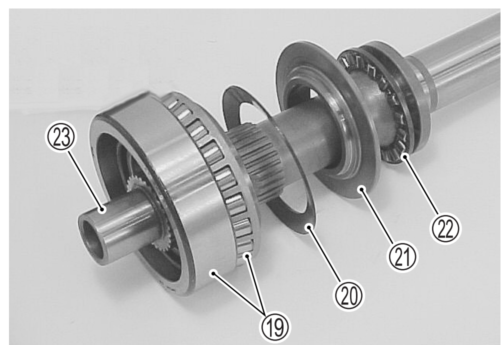




(h) Slide propeller shaft assembly ⑮ away from propeller shaft bearing housing.

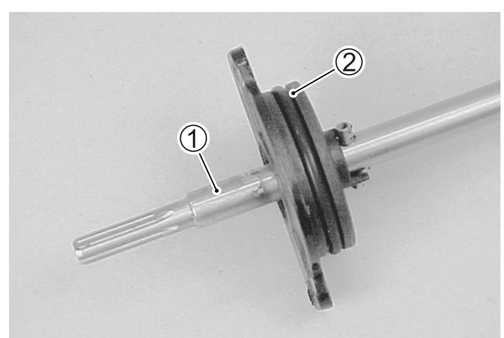
(i) Remove the propeller shaft thrust bearing ⑯, bearing washer ⑰ and thrust shim ⑱ from propeller shaft bearing housing.

(j) Remove the forward gear bearing ⑲, concave washer ⑳, thrust spacer ㉑ and thrust bearing ㉒ from propeller shaft ㉓.

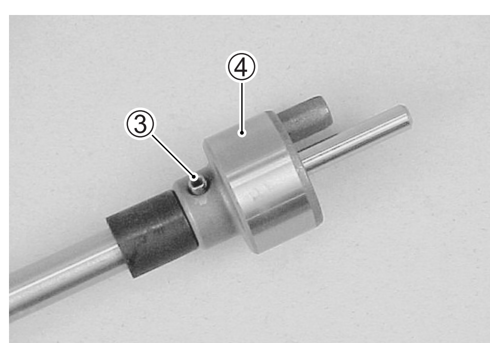


Disassembly of shift rod components

(a) Slide shift rod ① out of shift rod guide housing ②.



(b) Remove pin ③ and shifter yoke ④.

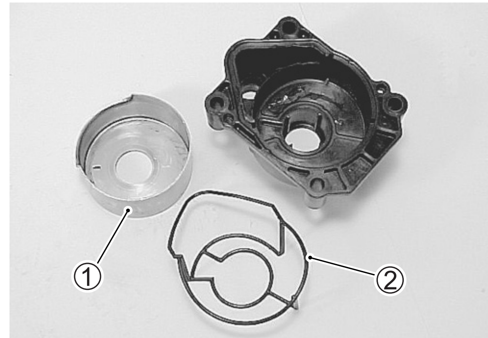


Disassembly of water pump case

Remove inner sleeve ① and rubber seal ring ②.

NOTE:

To facilitate the removal of inner sleeve from the pump case, warm up the entire case using a heater like hair dryer.



INSPECTION

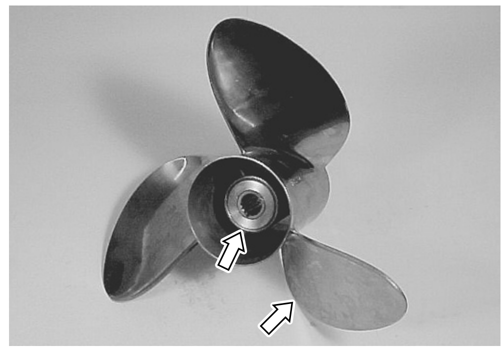
NOTE:
If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.

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

⚠ WARNING

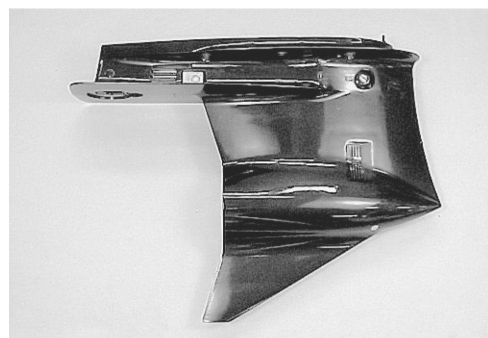
Wear safety glasses when using compressed air.

PROPELLER

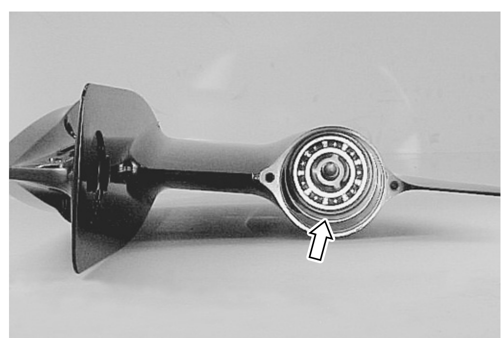


- Inspect propeller for bent, chipped or broken blades.
  Replace or repair propeller if damaged or other conditions are noted.
- Inspect propeller bush splines. Replace or repair propeller if splines are worn or damaged.
- Inspect propeller bush for deterioration or slipping.
  Replace if necessary.

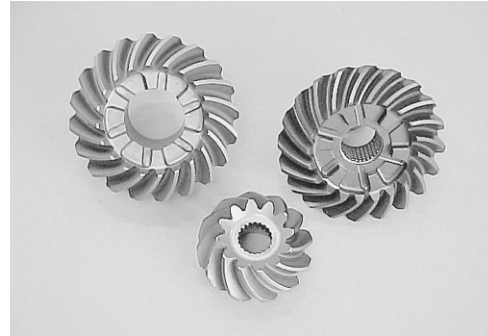
GEARCASE



- Inspect the gearcase. Replace if cracked, damaged or other abnormal conditions are noted.
- Visually check the pinion bearing. Replace gearcase if pitted, rough or other abnormal conditions are noted.
- Visually check the reverse gear bearing. Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.



GEARS/BEARING

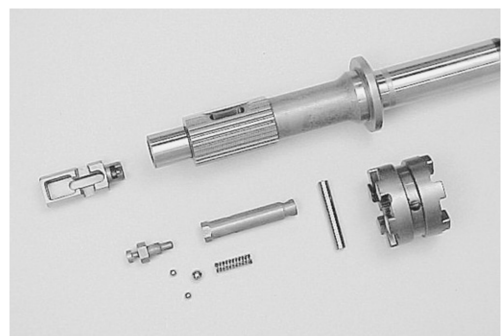


- Inspect forward, reverse and pinion gear teeth and engaging dogs.
  Replace gears if damaged, worn or other abnormal conditions are noted.
- Inspect propeller shaft forward bearing.
  Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.

FORWARD GEAR BEARING/THRUST BEARING

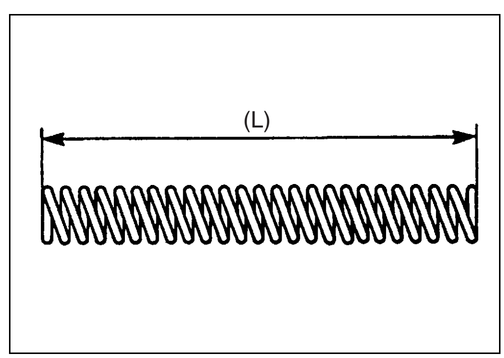
- Visually check forward gear bearing and thrust bearing. Replace if pitted, noisy, rough or other abnormal conditions are noted.

PROPELLER SHAFT COMPONENTS



- Inspect horizontal slider and connector pin.
  Replace if worn, damaged or other abnormal conditions are noted.
- Inspect detent balls. Replace if wear, damage or other abnormal conditions are noted.
- Inspect clutch dog shifter. Replace if chipped, worn, damaged or other abnormal conditions are noted.
- Inspect dog pin. Replace if bent, worn or other abnormal conditions are noted.
- Inspect propeller shaft/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.

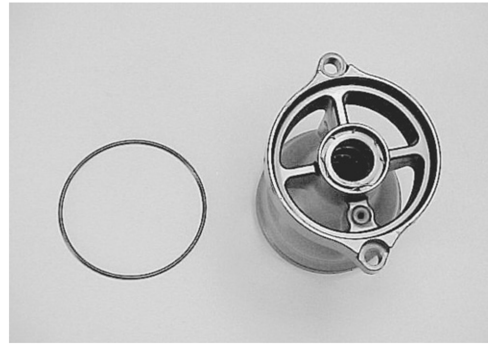
- Check detent spring by measuring its free length. If free length is not within specifications, replace detent spring.

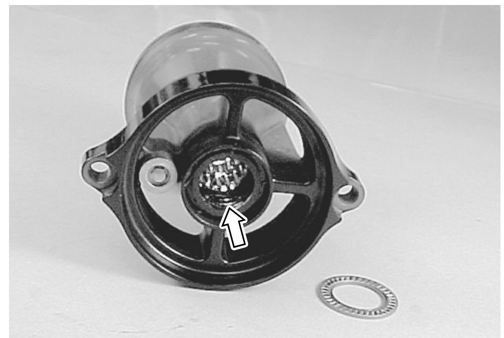


Detent spring free length (L)
Standard: 27.8 mm (1.09 in)
Service limit: 25.0 mm (0.98 in)

PROPELLER SHAFT BEARING HOUSING

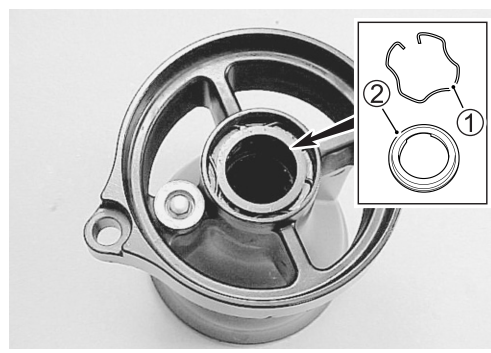
- Inspect housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect propeller shaft thrust bearing and propeller shaft bearing. Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.
- Check condition of oil seal and O-ring.
  Replace oil seal and O-ring if nicked, cut, worn or other abnormal conditions are noted.





Replacing propeller shaft oil seal

1. Remove retaining ring ① and oil seal protector ②.

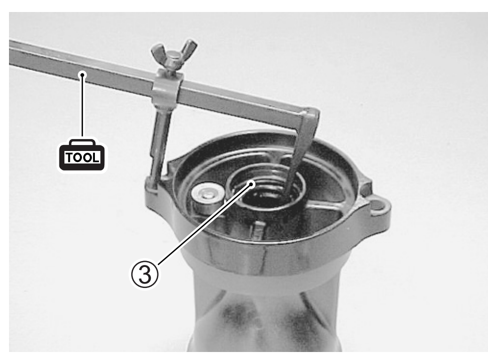


2. Extract seals ③ with oil seal remover.

TOOL **09913-50121: Oil seal remover**

CAUTION

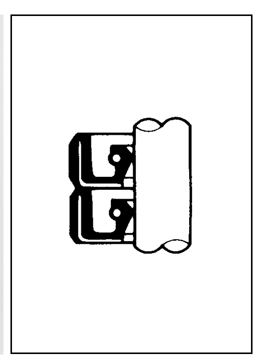
> **Do not reuse oil seal once removed.**
> **Always use new oil seal.**



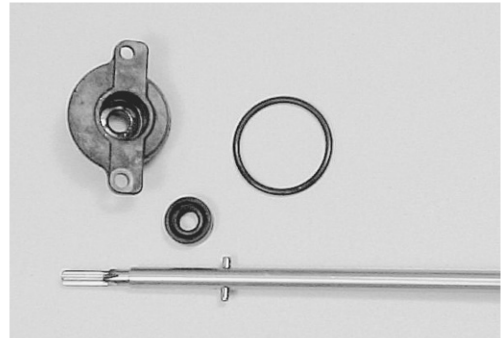
3. Apply Water Resistant Grease to the inner circumference of the housing.
4. Using an oil seal installer, drive the two oil seals (one at a time) into the propeller shaft bearing housing.
   The lipped portion of the seal must face towards the propeller.
   Apply Water Resistant Grease to the seal lips.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

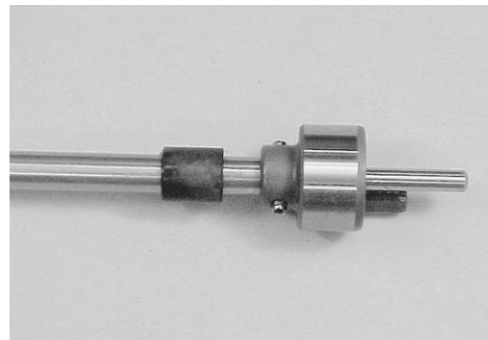
5. Install the oil seal protector and retaining ring.



SHIFT ROD GUIDE HOUSING COMPONENTS

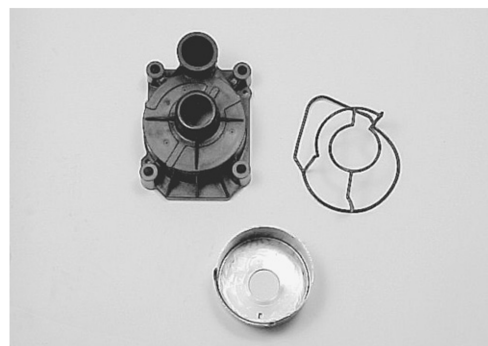


- Inspect shift rod guide housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect shifter yoke. Replace if wear, damaged or other abnormal conditions are noted.
- Inspect shift rod/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.
- Inspect O-ring. Replace if nicked, cut, torn, swollen or other abnormal conditions are noted.

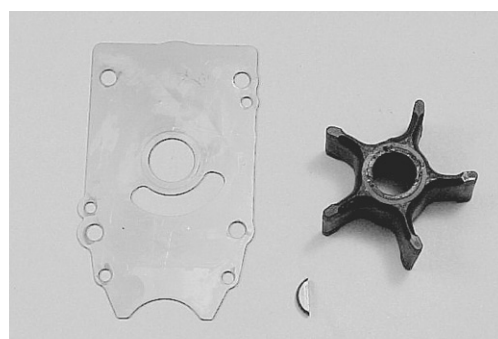


- Inspect oil seal. Replace if nicked, cut, worn or other abnormal conditions are noted.

WATER PUMP AND RELATED ITEMS



- Inspect impeller. Replace if vanes are cut, torn, worn or other abnormal conditions are noted.
- Inspect pump case. Replace if cracked, distorted or other abnormal conditions are noted.
- Inspect pump inner sleeve. Replace if worn, cracked, distorted, corroded or other abnormal conditions are noted.

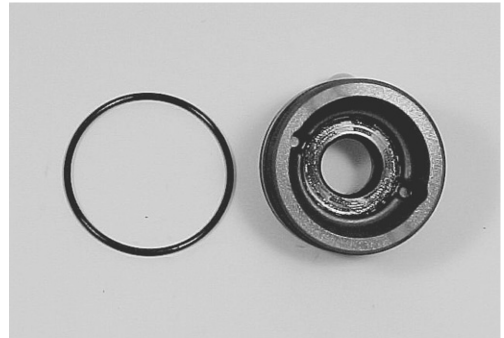


- Inspect under panel. Replace if cracked, distorted, corroded or other abnormal conditions are noted.

CAUTION

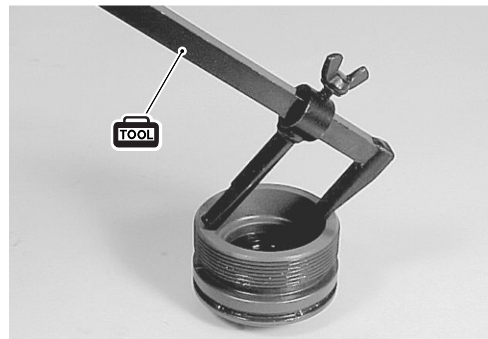
Do not reuse seal ring once removed.
Always use new seal ring.

DRIVESHAFT OIL SEAL HOUSING



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

Replacing driveshaft oil seal



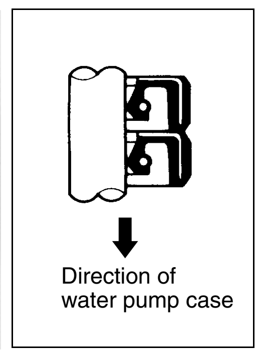
1. Using special tool, remove two (2) oil seals out of the driveshaft oil seal housing.

TOOL **09913-50121: Oil seal remover**

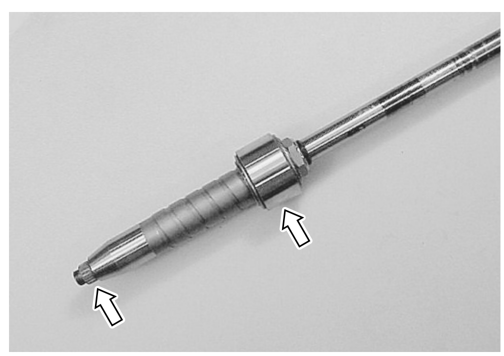
2. Apply Water Resistant Grease to inner circumference of driveshaft oil seal housing.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

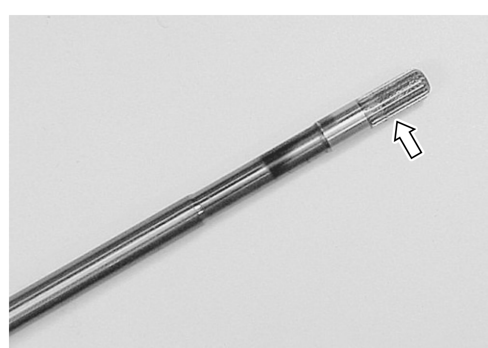
3. Grease the inner lips of oil seal. With the lips facing away from driveshaft bearing, place seal in position and drive it into the oil seal housing.



DRIVESHAFT

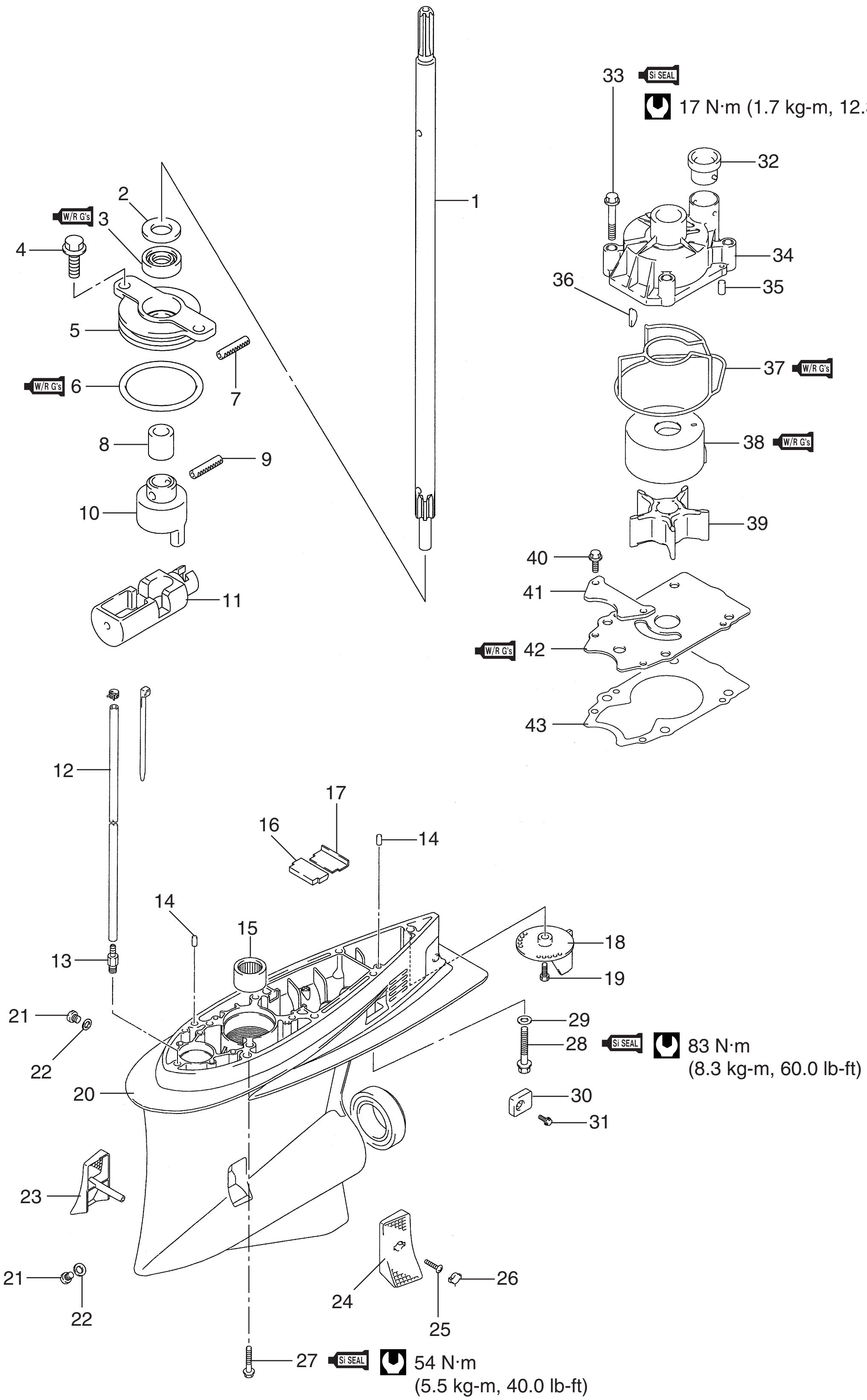


- Inspect driveshaft/splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.
- Inspect driveshaft bearing, replace if pitted, noisy, rough or other abnormal conditions are noted.



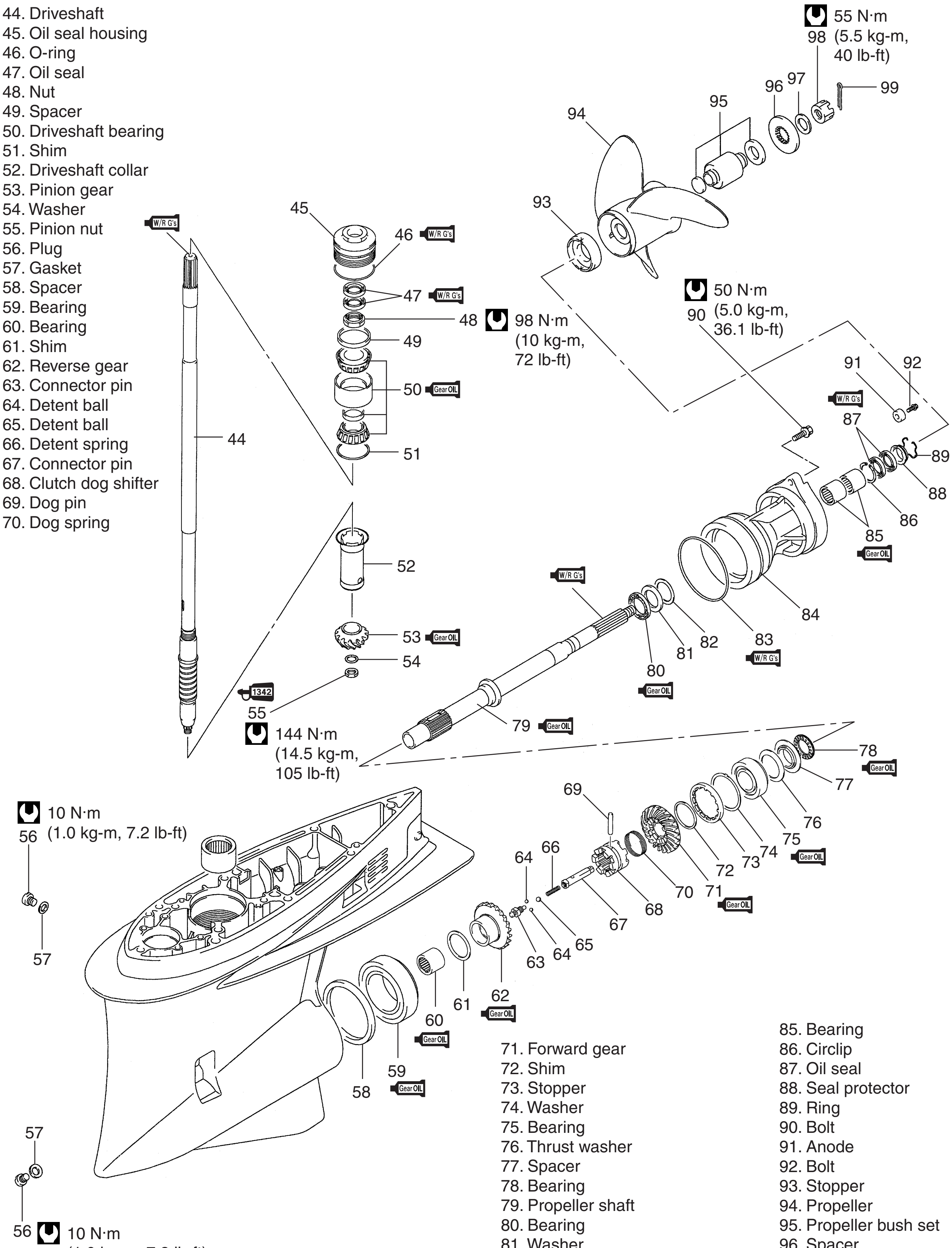
ASSEMBLY & INSTALLATION

Assembly & installation are in reverse order of disassembly with special attention to the following steps.



1. Shift rod
2. Cover
3. Dust seal
4. Bolt
5. Shift rod housing
6. O-ring
7. Pin
8. Magnet
9. Pin
10. Shifter yoke
11. Horizontal slider
12. Hose
13. Nipple
14. Dowel pin
15. Pinion bearing
16. Exhaust seal rubber
17. Plate
18. Trim tab
19. Bolt
20. Gearcase
21. Plug
22. Gasket
23. STBD water filter
24. PORT water filter
25. Screw
26. Cover
27. Bolt
28. Bolt
29. Washer
30. Anode
31. Bolt
32. Bush
33. Bolt
34. Water pump case
35. Dowel pin
36. Key
37. Case sealing
38. Sleeve
39. Water pump impeller
40. Bolt
41. Panel
42. Under panel
43. Gasket

44. Driveshaft
45. Oil seal housing
46. O-ring
47. Oil seal
48. Nut
49. Spacer
50. Driveshaft bearing
51. Shim
52. Driveshaft collar
53. Pinion gear
54. Washer
55. Pinion nut
56. Plug
57. Gasket
58. Spacer
59. Bearing
60. Bearing
61. Shim
62. Reverse gear
63. Connector pin
64. Detent ball
65. Detent ball
66. Detent spring
67. Connector pin
68. Clutch dog shifter
69. Dog pin
70. Dog spring



71. Forward gear
72. Shim
73. Stopper
74. Washer
75. Bearing
76. Thrust washer
77. Spacer
78. Bearing
79. Propeller shaft
80. Bearing
81. Washer
82. Washer
83. O-ring
84. Propeller shaft bearing housing
85. Bearing
86. Circlip
87. Oil seal
88. Seal protector
89. Ring
90. Bolt
91. Anode
92. Bolt
93. Stopper
94. Propeller
95. Propeller bush set
96. Spacer
97. Washer
98. Nut
99. Pin

CAUTION

- **Make sure that all parts used in assembly are clean and lubricated.**
- **It is recommended that all seals, gaskets and O-rings be replaced with new on assembly.**
- **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 10-30.)

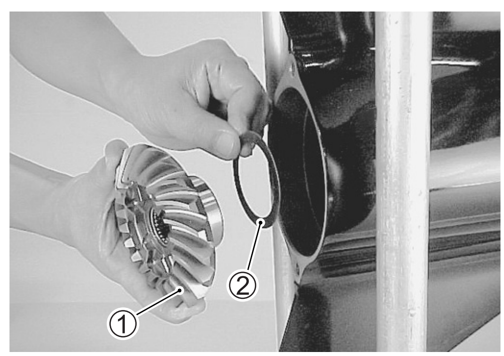
CAUTION

- **To insure accurate operation of the electronic shift system, the output voltage from the shift position sensor must be adjusted to the specification for each shift position.**
- **When the lower unit and its components or the shift link system components have been replaced, make sure to check the output voltage of shift position sensor in neutral and forward position. If the output voltage is not within the specification, adjustment of the shift position sensor is required. For shift position sensor adjustment, see page 3-76.**

REVERSE GEAR

Place the back-up shim ② into position, then install reverse gear ①.

Gear OIL **99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL**

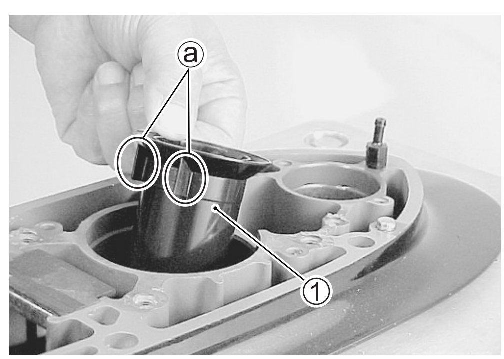


DRIVESHAFT COLLAR

Install driveshaft collar ①.

NOTE:

The tongue ⓐ of collar must be located into groove on the gearcase.



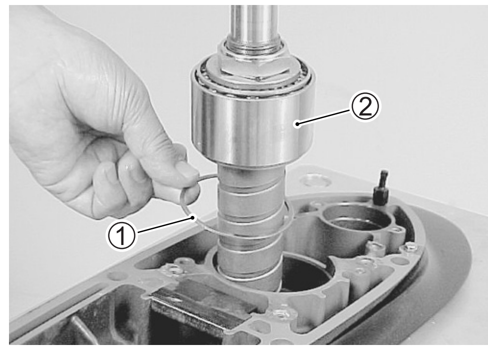
PINION GEAR

Place pinion gear in gearcase.

NOTE:
Before installing pinion gear, check for the correct number and position of pinion bearing rollers.
Use oil soluble grease to retain bearing rollers.

DRIVESHAFT

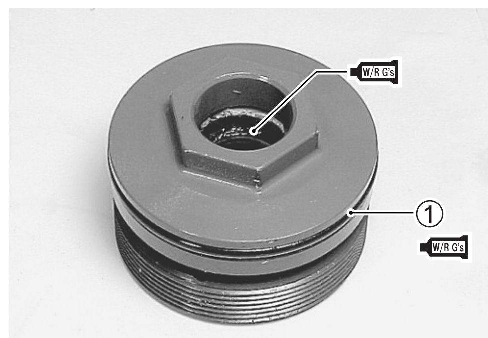
Install pinion shim ①, then lower the driveshaft assembly ② down into the gearcase until the bottom of shaft protrudes through center of pinion.



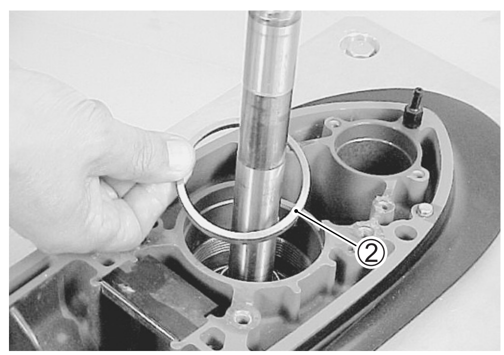
DRIVESHAFT OIL SEAL HOUSING

- Apply Water Resistant Grease to the driveshaft oil seal.
- Apply Water Resistant Grease to O-ring ①, then install O-ring into groove on the driveshaft oil seal housing.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**



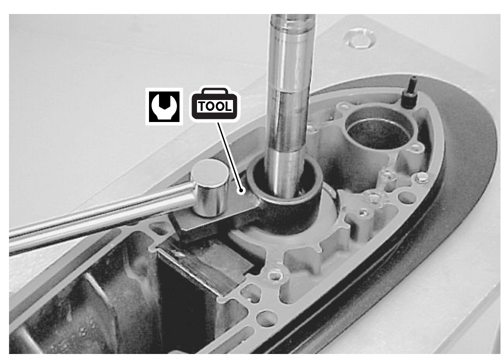
- Install driveshaft bearing spacer ②.



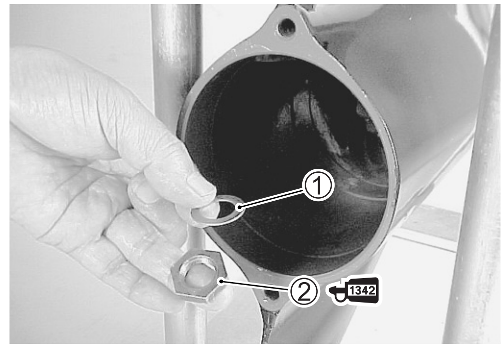
- Install driveshaft oil seal housing on gearcase, then tighten oil seal housing to specified torque.

Driveshaft oil seal housing: 100 N·m (10.0 kg-m, 72.5 lb-ft)

TOOL **09926-29310: Driveshaft housing remover**



PINION NUT

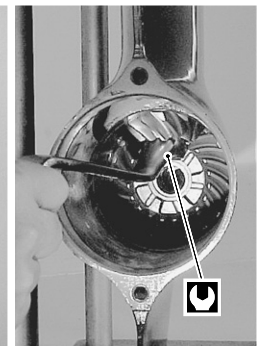


- Apply THREAD LOCK “1342” to the threads of pinion nut ② before threading it onto driveshaft.

99000-32050: THREAD LOCK “1342”

NOTE:

It is recommended the original pinion nut be used for the purposes of shimming during repair. A new pinion nut should be used on final assembly.

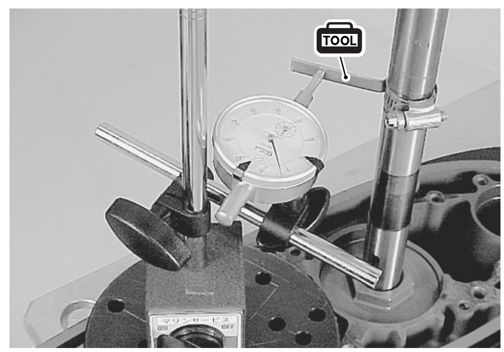


- Install washer ①, pinion nut ②, then tighten nut to specified torque.

Pinion nut: 145 N·m (14.5 kg-m, 105.0 lb-ft)

09921-29410: Driveshaft holder

CHECKING GEAR BACKLASH



Before installing forward gear, gear backlash should checked.

Gear backlash: Approx. 0.5 – 0.7 mm (0.020 – 0.028 in)

(See the “GEARS-SHIMMING AND ADJUSTMENT/ADJUSTING GEAR BACKLASH” section on page 10-31.)

09952-09310: Backlash indicator tool

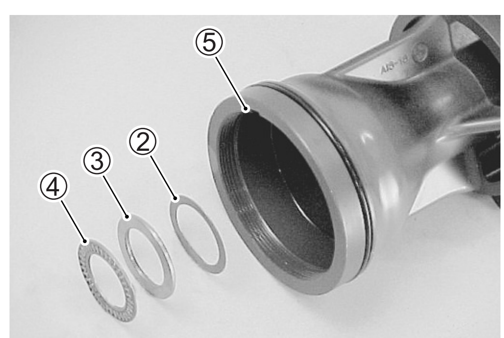
FORWARD GEAR/PROPELLER SHAFT/ BEARING HOUSING

- Assemble the propeller shaft in the following sequence:

99000-25160: SUZUKI WATER RESISTANT GREASE

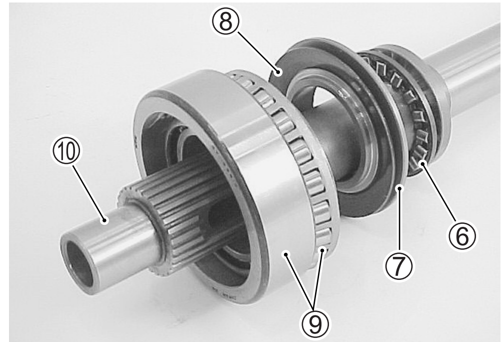
99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL

(a) Apply Water Resistant grease to O-ring ①, then install the O-ring into groove on the propeller shaft bearing housing.



(b) Install thrust shim ②, bearing washer ③ and propeller shaft thrust bearing ④ into propeller shaft bearing housing ⑤.

(c) Install the thrust bearing ⑥, thrust spacer ⑦, concave washer ⑧ and forward gear bearing ⑨ to propeller shaft ⑩.



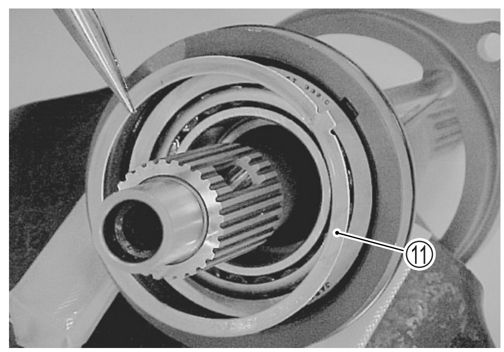
(d) Slide propeller shaft assembly into propeller shaft bearing housing.

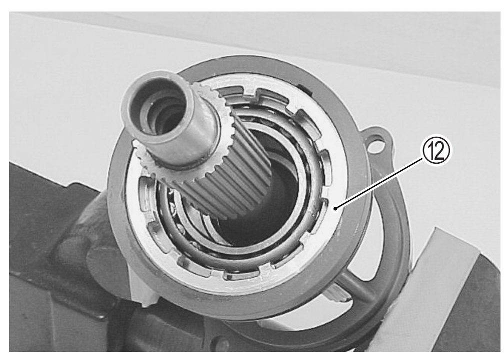
(e) Install the forward gear bearing washer ⑪ and bearing stopper ⑫, then tighten bearing stopper to the specified torque.

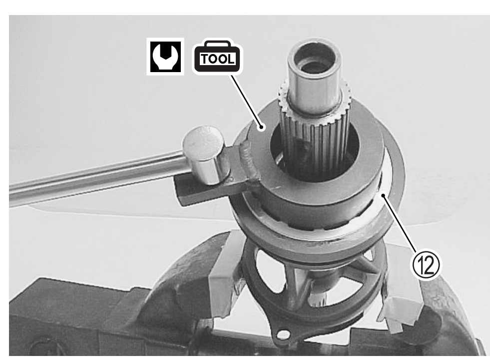
Bearing stopper: 100 N·m (10 kg-m, 72.3 lb-ft)

TOOL **09951-19820: Bearing stopper installer**

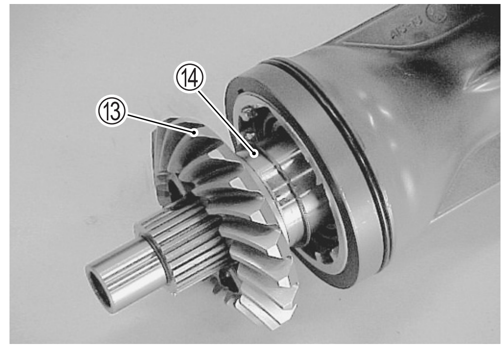
NOTE:
The tab of bearing washer must be located into groove on the bearing housing.





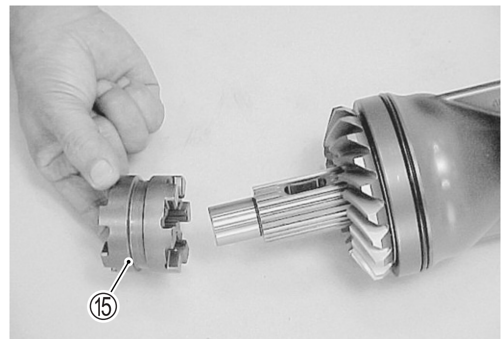


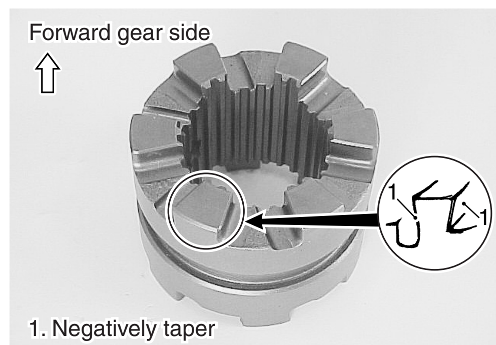
(f) Install the forward gear ⑬ and back-up shim ⑭.



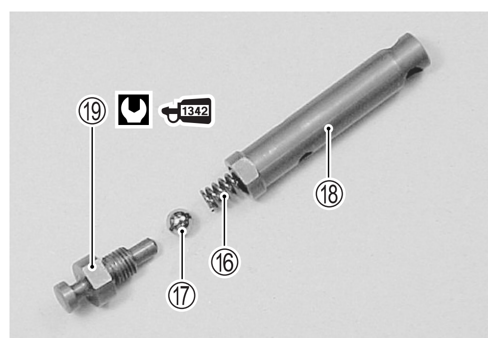
(g) Slide the clutch dog shifter ⑮ onto the propeller shaft.

NOTE:
The side of the clutch dog shifter negatively taper machined at both sides of the dog must face towards forward gear. (Opposite side of the dog has been machined only one side.)





(h) Insert detent spring ⑯ and large detent ball ⑰ into connector body ⑱.
Install connector pin ⑲, then tighten connector pin, pre-coated with thread lock, to specified torque.

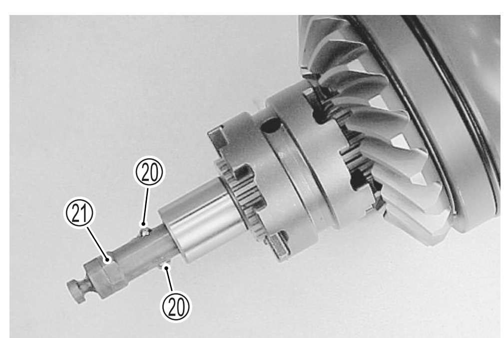


1342 99000-32050: THREAD LOCK "1342"

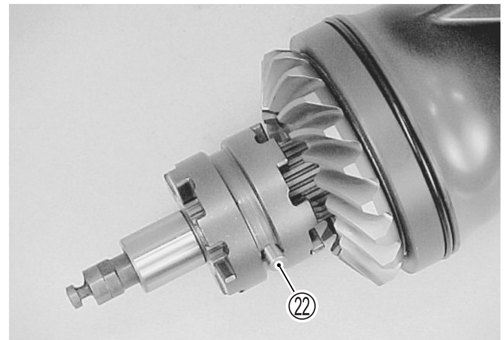
Connector pin: 23 N·m (2.3 kg-m, 16.6 lb-ft)

(i) Install two small detent balls ⑳ to connector pin assembly ㉑.

(j) Insert the connector pin assembly ㉑ (with small detent balls) into propeller shaft.

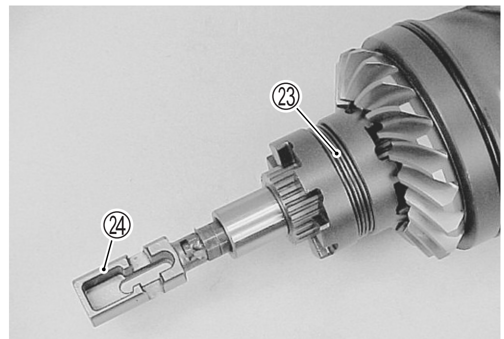


(k) Align the holes in the shifter dog and connector pin and then slide the dog pin ㉒ through both dog and connector pin.



(l) Install the dog pin retaining spring ㉓, ensuring that it fits snugly into the groove on the dog shifter.

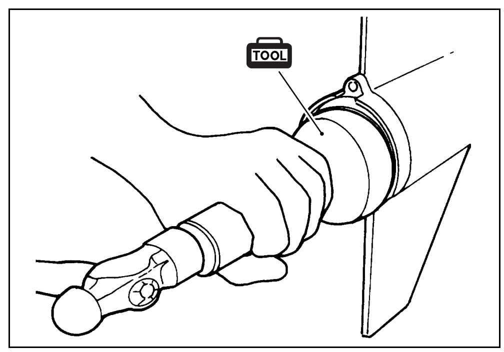
(m) Assemble horizontal slider ㉔ to connector pin.



NOTE:
Before installing propeller shaft/bearing housing assembly, move shifter dog to bring horizontal slider to the neutral position.

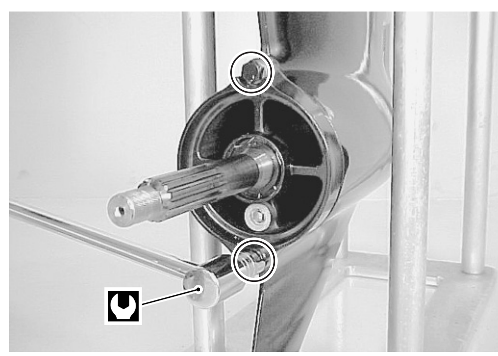
(n) Using special tools, install the propeller shaft and housing assembly in the gearcase.

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



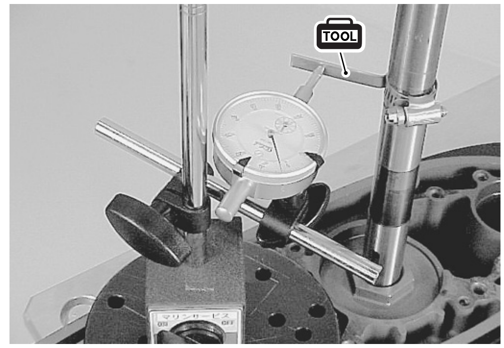
(o) When the housing is fully seated, tighten both retaining bolts to the specified torque.

Bearing housing bolt: 50 N·m (5.0 kg-m , 36.1 lb-ft)



RECHECKING GEAR BACKLASH

Recheck the forward gear backlash.



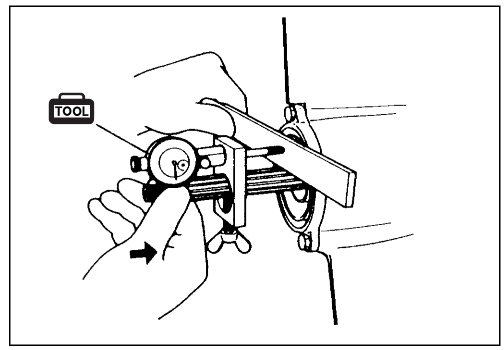
Gear backlash: Approx. 0.8 – 1.1 mm (0.030 – 0.043 in)

(See the "GEARS-SHIMMING AND ADJUSTMENT/ADJUSTING GEAR BACKLASH" section on page 10-33.)

TOOL **09951-09310: Gear adjust spring set**
09952-09310: Backlash indicator tool

CHECKING PROPELLER SHAFT THRUST PLAY

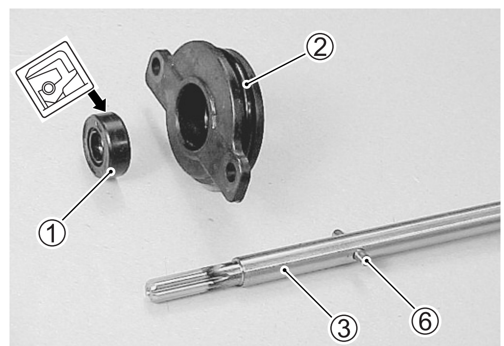
See the "GEARS-SHIMMING AND ADJUSTMENT/CHECKING PROPELLER SHAFT THRUST PLAY" section on page 10-36.



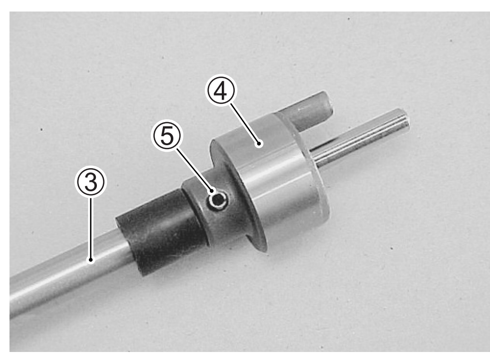
SHIFT ROD GUIDE HOUSING

- Using an oil seal installer, drive the oil seal ① into the shift rod guide housing ②.
  The lipped portion of oil seal must face towards the driveshaft housing.

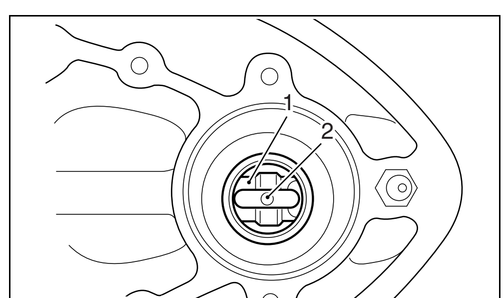
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**



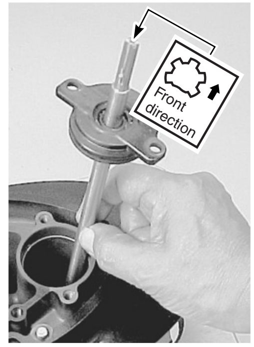
- Attach shifter yoke ④ to shift rod ③, then insert pin ⑤.
- Install pin ⑥ to shift rod, then slide shift rod guide housing onto shift rod.

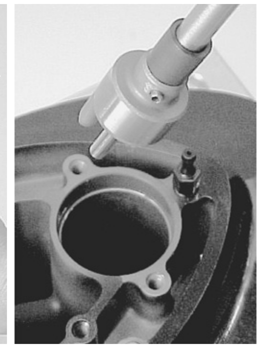


NOTE:
Be sure the horizontal slider is in the neutral position before installing the shift unit (shift rod guide housing assembly.).



1. Horizontal slider
2. Shift rod center

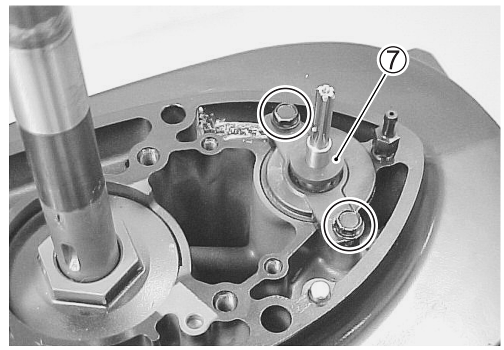




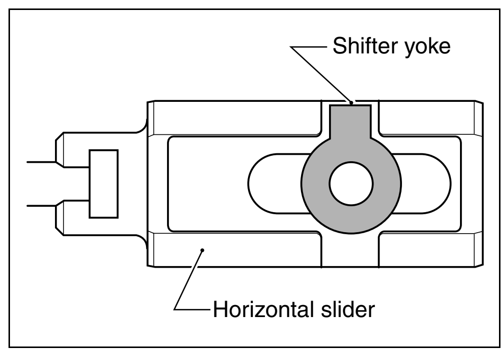
- Apply Water Resistant Grease to the shift rod guide housing O-ring.

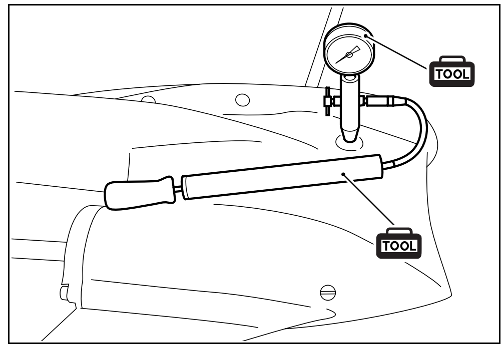
W/R G's 99000-25160: SUZUKI WATER RESISTANT GREASE

NOTE:
Before installing shift rod guide housing assembly, bring shifter yoke to neutral position by turning shift rod right or left.



- Install shift rod guide housing assembly by aligning shifter yoke with groove in horizontal slider, then tighten two (2) housing bolts securely.
- Turn shift rod from Neutral position to Forward and Reverse position to check proper gear engagement.
- Apply enough Water Resistant Grease on oil seal before putting seal cover ⑦, then install seal cover.





LEAKAGE CHECK

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

TOOL **09950-69512: 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)

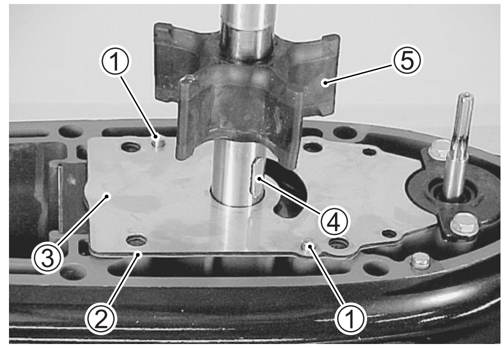
CAUTION

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)

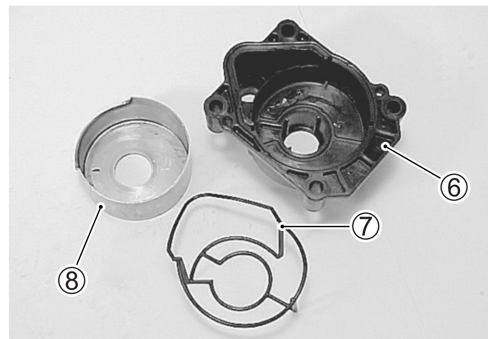
- Place the dowel pins ①, under panel gasket ② and under panel ③ into position.
- Insert the key ④ in the driveshaft and slide the impeller ⑤ onto driveshaft, ensuring that key and keyway are aligned.



- Place the seal ring ⑦ into groove of the pump case ⑥, then install inner sleeve ⑧ to pump case.

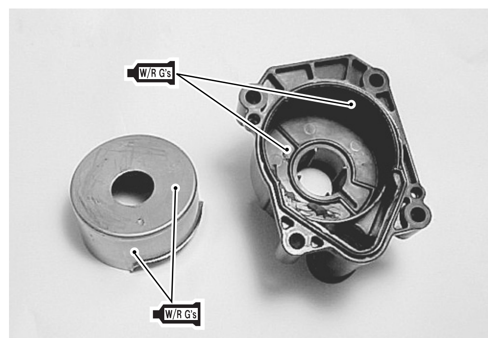
CAUTION

Do not reuse seal ring once removed.
Always use new ring.



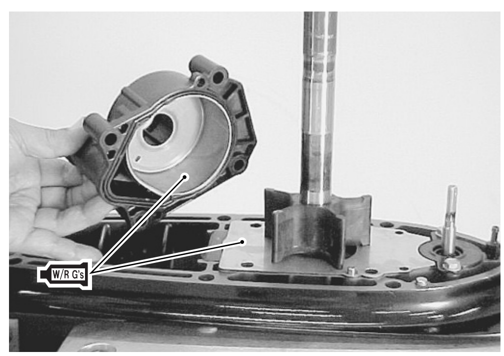
NOTE:
Before installing pump inner sleeve, apply Water Resistant Grease lightly between inner sleeve and pump case mating surfaces.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**



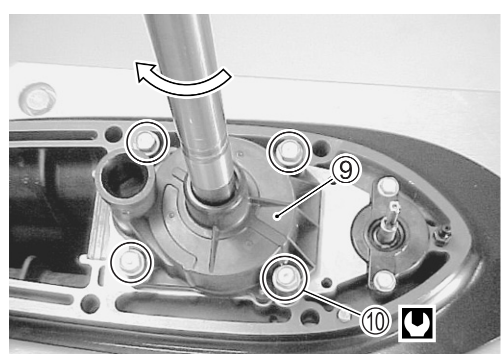
NOTE:
Before installing water pump case assembly, apply Water Resistant Grease lightly on pump case inner sleeve and under panel for initial lubrication.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

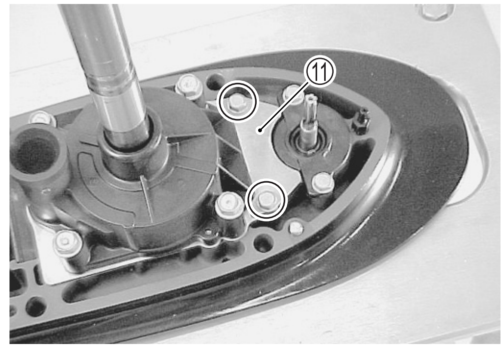


- Install the pump case assembly ⑨ while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
- Securely tighten the four (4) pump case bolts ⑩ to the specified torque.

Pump case bolt: 17 N·m (1.7 kg-m, 12.5 lb-ft)



• Install shift rod guide housing stopper ⑪, then tighten stopper bolts securely.

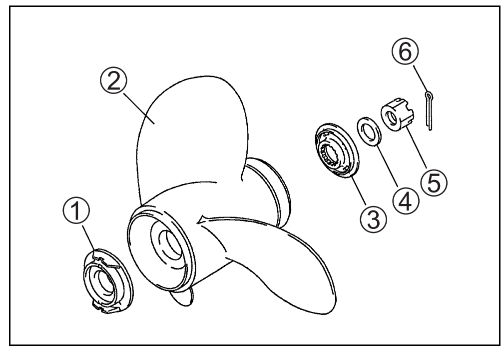


PROPELLER INSTALLATION

Install propeller stopper ① onto propeller shaft, then slide on the propeller ②.
Fit spacer ③, washer ④ and nut ⑤, then tighten nut to specified torque.
Push cotter pin ⑥ through nut and shaft, then bend to secure.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

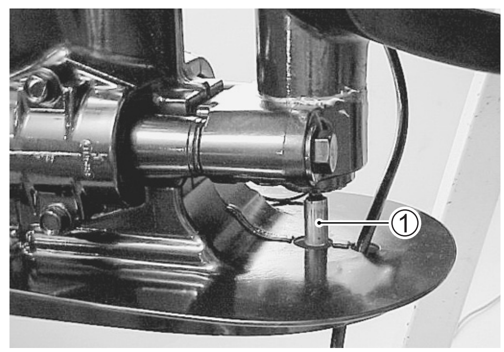
Propeller nut: 55 N·m (5.5 kg-m, 40.0 lb-ft)



LOWER UNIT INSTALLATION

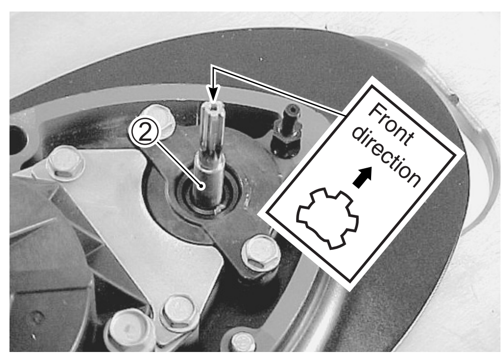
• Apply Water Resistant Grease to clutch rod splines, then install clutch rod ① by aligning clutch rod splines with splines in clutch shaft.

W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

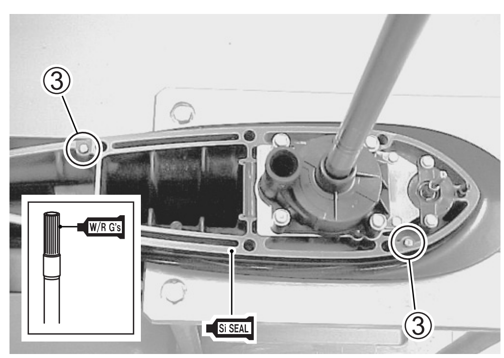


• Ensure that shift rod ② is at neutral position.

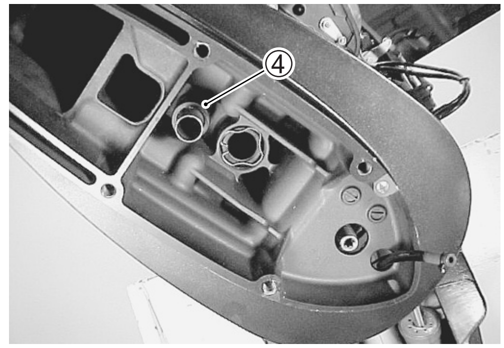
NOTE:
Before installing lower unit assembly, bring shift to neutral position by turning shift rod right or left.



• Insert two (2) dowel pins ③.
• Apply Water Resistant Grease to driveshaft and shift rod splines.
• Apply a light coating of SUZUKI SILICONE SEAL to mating surfaces of gearcase and driveshaft housing.

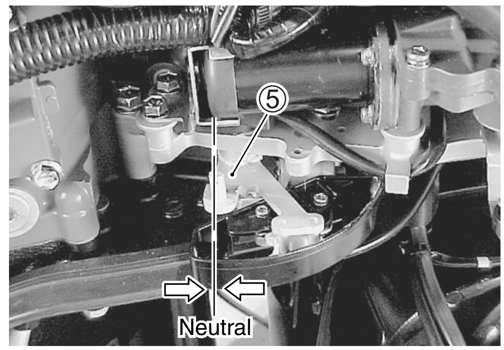


- Install spacer ④ to water tube.



- Set the clutch control lever ⑤ at Neutral position, then slide the lower unit ⑥ into place, ensuring that the top of driveshaft engages properly with driven gear shaft and that water tube locates in water pump case outlet.

NOTE:
In order for shift rod and clutch rod splines to be aligned correctly, clutch rod may need to be turned slightly right or left.

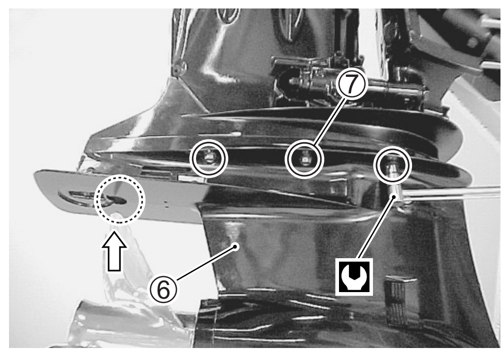


- Apply SUZUKI SILICONE SEAL to seven (7) gearcase bolts ⑦ and tighten them to specified torque.

Gearcase bolt: 10 mm 55 N·m (5.5 kg-m, 40.0 lb-ft)
12 mm 83 N·m (8.3 kg-m, 60.0 lb-ft)

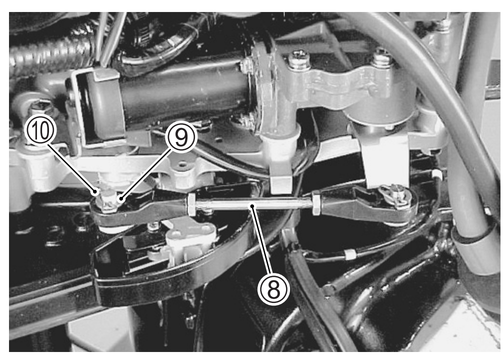
W/R G's **99000-25160: SUZUKI WATER RESISTANT GREASE**

Si SEAL **99000-31120: SUZUKI SILICONE SEAL**



- Shift the clutch control lever to Forward and Reverse position from Neutral position to check proper gear engagement.

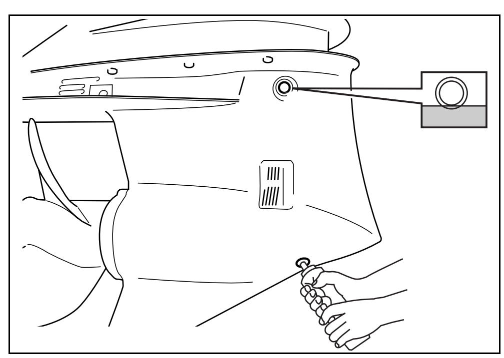
- Connect the clutch link rod ⑧, then install washer ⑨ and lock pin ⑩.



GEAR OIL

Fill the gearcase with specified gear oil for initial testing and recheck the level after 10 minutes. Top up if necessary.
(See "PERIODIC MAINTENANCE/GEAR OIL" section on page 2-6.)

Gear OIL **99000-22540: SUZUKI OUTBOARD MOTOR GEAR OIL**



TRIM TAB

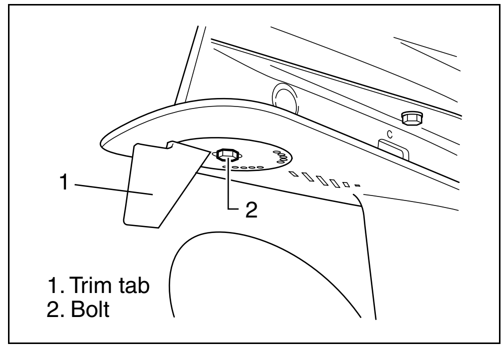
The trim tab counteracts or minimizes propeller torque “pull” felt through the steering system.

If the steering is pulled to starboard or port side, adjust trim tab with following procedure:

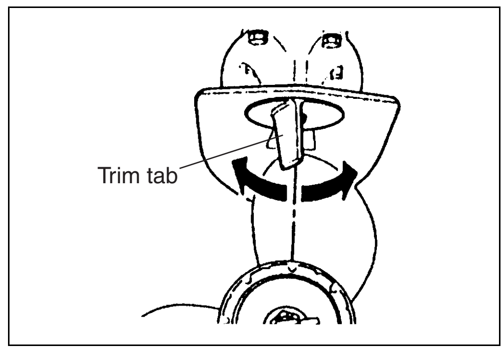
Adjusting

1. Loosen the bolt of trim tab.
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 the bolt of trim tab.
4. Test ride the boat and repeat the procedure 1 – 3 to set the trim tab in the best position.



With a properly adjusted trim tab, steering should be neutral and there should be no tendency for the steering to be pulled to either port or starboard.

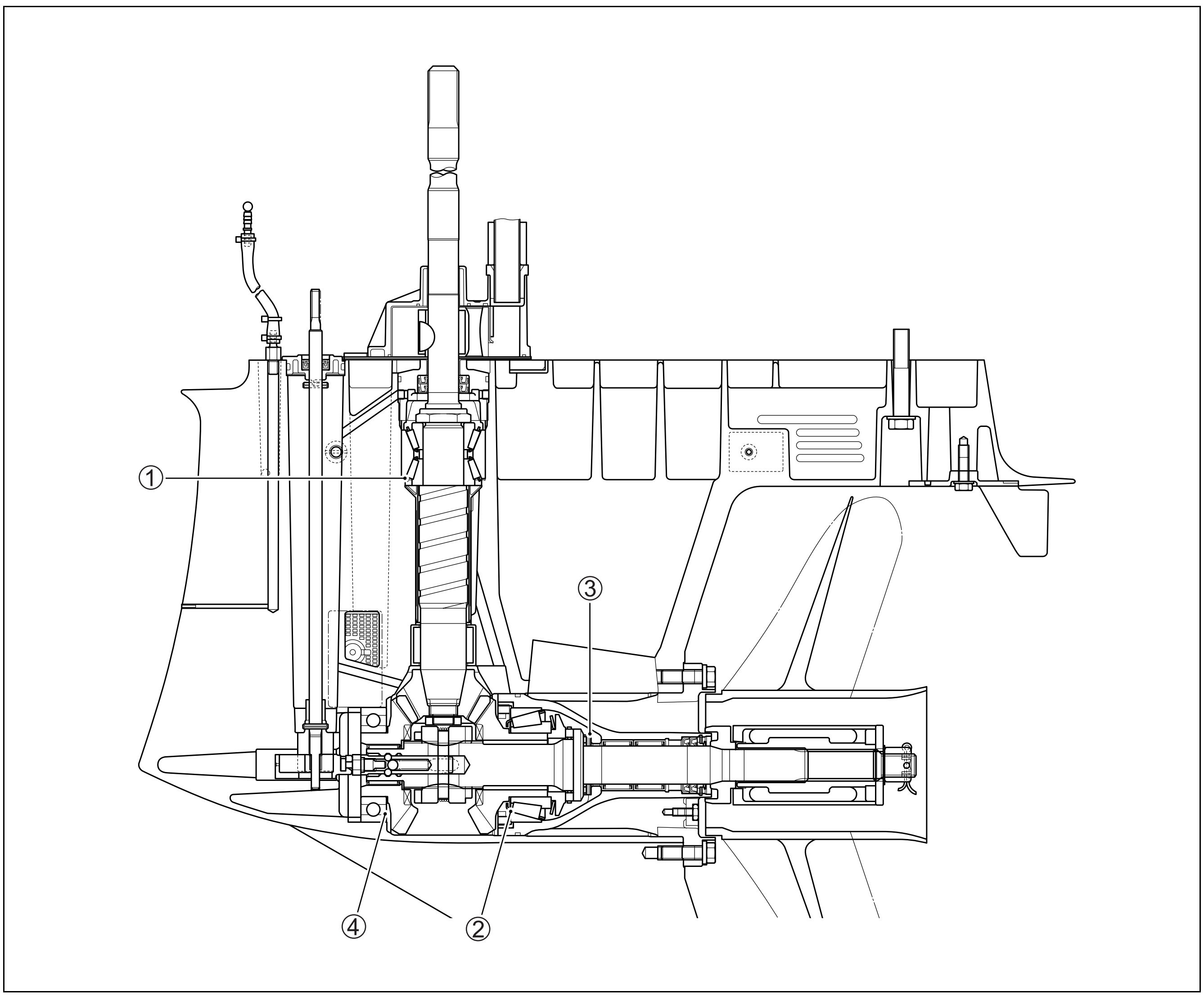
LOWER UNIT GEARS- SHIMMING AND ADJUSTMENT

(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 checked and/or 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	0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90	1.0
②	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
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	0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90	1.0

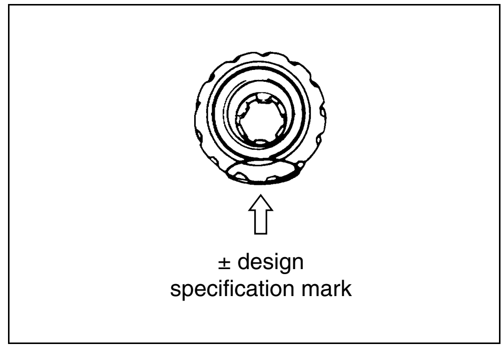


REVERSE GEAR/PINION GEAR

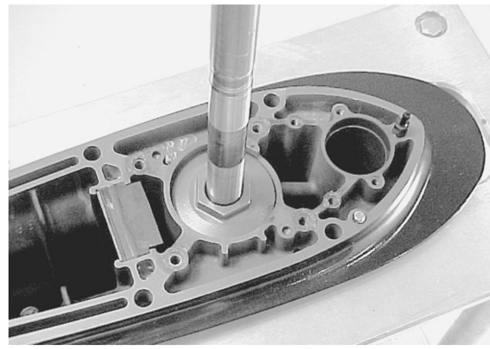
Follow the procedure below to adjust reverse gear/pinion gear.

STEP TO PRIOR TO ADJUSTMENT

1. Install standard pinion gear back-up shim thickness modified according to ± design specification mark on gear.



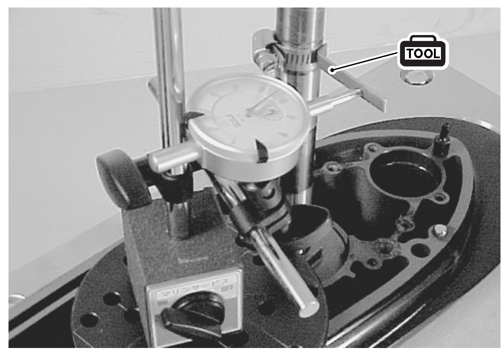
2. Correctly assemble driveshaft oil seal housing, driveshaft, reverse gear, pinion gear and related components.
   (See page 10-17 to 10-19.)
   Do not install forward gear at this time.
3. Tighten pinion nut to specified torque.



Pinion nut: 145 N·m (14.5 kg-m, 105.0 lb-ft)

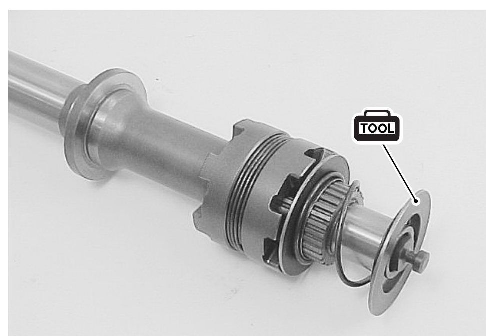
ADJUSTING GEAR BACKLASH

(a) Assemble special tool to driveshaft as shown in figure.



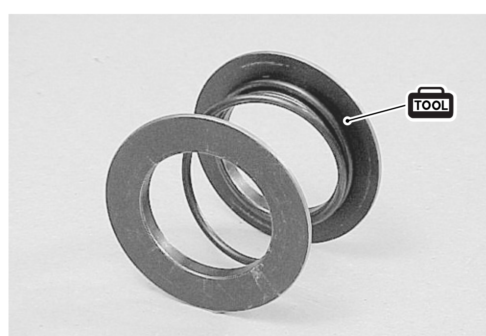
TOOL **09900-20602: Dial gauge**
09900-20701: Magnetic stand
09952-09310: Backlash indicator tool

(b) Move shifter dog to forward position, then set the special tool to propeller shaft as shown in figure.



TOOL **09951-09310: Gear adjust spring set**

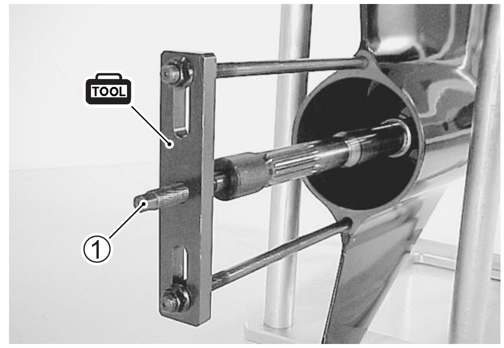
NOTE:
Use longer spring (free length: 42.3 mm, 1.67 in) in the gear adjust spring set to adjust the reverse gear backlash.



(c) Install propeller shaft (with special tool) into gearcase.
(d) Install the special tool and then attach it to the propeller shaft as shown.

TOOL **09951-99310: Gear holder**

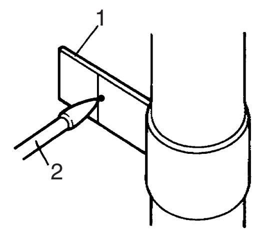
(e) Turn the bolt ① clockwise to push reverse gear inward.



(f) Align dial gauge pointer at 90° to the mark on the backlash indicator tool and read backlash on dial gauge by lightly moving driveshaft clockwise and counterclockwise by hand.

Gear backlash: Approx. 0.5 – 0.7 mm (0.020 – 0.028 in)

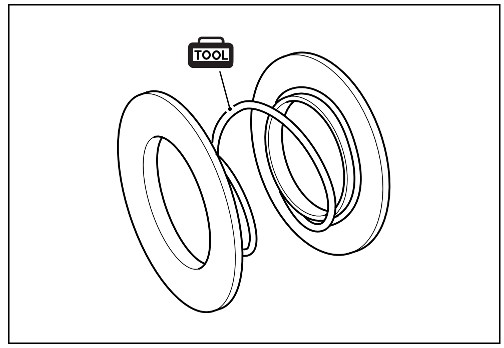
- If the backlash measured is larger than the specification, add the amount over the specification to the temporary use reverse gear back-up shim and install this shim as the final shim.
- If the backlash measured is smaller than the specification, subtract the amount less than the specification from the temporary use reverse gear back-up shim and install this shim as the final shim.



1. Backlash indicator tool
2. Dial gauge

FORWARD GEAR SHIM

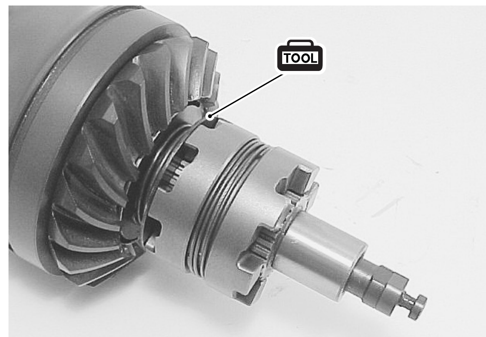
After adjusting reverse gear backlash, follow the procedure below to adjust forward gear.



Adjusting gear backlash

1. Correctly assemble driveshaft oil seal housing, driveshaft, reverse gear, pinion gear and related components.
   (See page 10-17 to 10-19.)
2. Tighten pinion nut to specified torque.

Pinion nut: 145 N·m (14.5 kg-m, 105.0 lb-ft)



3. Correctly assemble forward gear, forward gear bearing, propeller shaft, propeller shaft thrust bearing, propeller shaft bearing housing and related components.
   When assembling the forward gear and propeller shaft housing assembly, place the special tool between clutch dog shifter and forward gear as shown in the illustration.

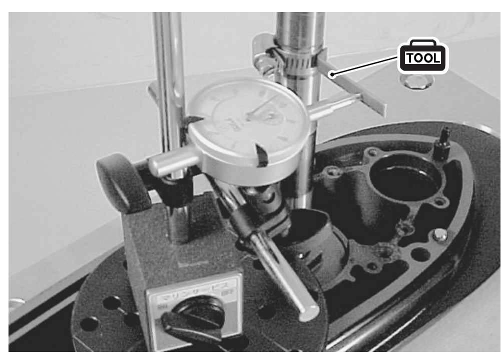
NOTE:
- *Before installing special tool, move shifter dog to reverse position.*
- *Use shorter spring (free length: 23.8 mm, 0.94 in) in the gear adjust spring set to adjust the forward gear backlash.*

TOOL **09951-09310: Gear adjust spring set**

4. Install forward gear and propeller shaft housing assembly into gearcase, then tighten both bearing housing retaining bolts to specified torque.

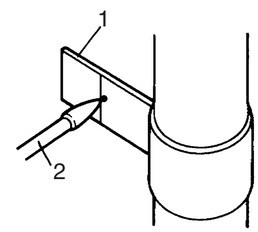
5. Assemble special tool to driveshaft as shown in figure.

TOOL **09900-20602: Dial gauge**
09900-20701: Magnetic stand
09952-09310: Backlash indicator tool



6. Align dial gauge pointer at 90 ° to the mark on the backlash indicator tool and read backlash on dial gauge by lightly moving driveshaft clockwise and counterclockwise by hand.

   Gear backlash: Approx. 0.8 – 1.1 mm (0.030 – 0.043 in)



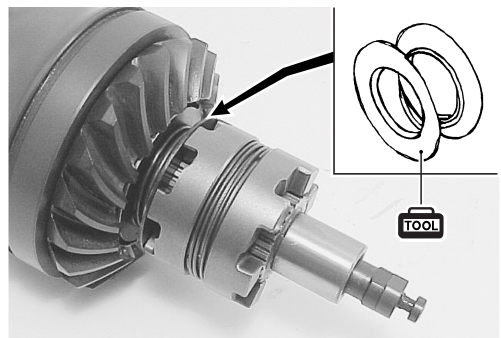
1. Backlash indicator tool
2. Dial gauge

- If the backlash measured is larger than the specification, add the amount over the specification to the temporary use forward gear back-up shim and install this shim.
- If the backlash measured is smaller than the specification, subtract the amount less than the specification from the temporary use forward gear back-up shim and install this shim.

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

Check tooth contact pattern using the following procedure:

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



NOTE:
- *Use shorter spring (free length: 23.8 mm, 0.94 in) in the gear adjust spring set and install it between forward gear and clutch dog to check the tooth contact pattern.*
- *Before installing special tool, move shifter dog to reverse position.*

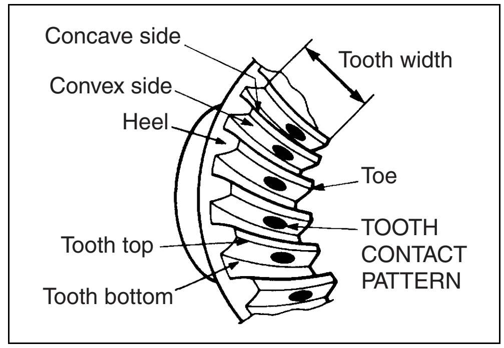
TOOL **09951-09310: Gear adjust spring set**

2. Install forward gear and propeller shaft housing assembly into gearcase, then tighten both bearing housing retaining bolts to specified torque.

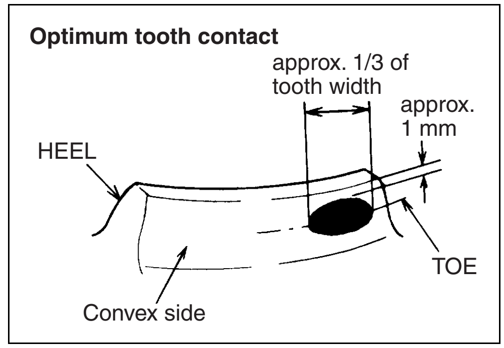
3. Using driveshaft holder tool, rotate the driveshaft 5 – 6 times.

TOOL **09921-29410: Driveshaft holder**

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



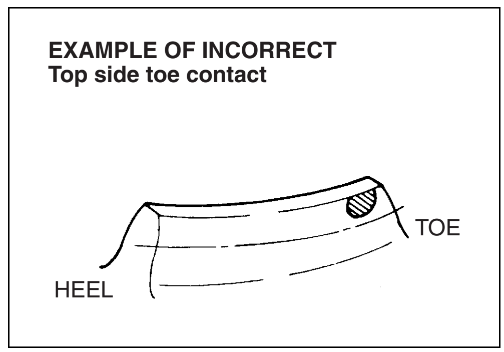
Optimum tooth contact
The optimum tooth contact is shown at right.
A shim adjustment may be necessary to obtain this contact pattern.



CAUTION

Gear backlash should be checked when increasing or decreasing shim thickness to adjust tooth contact.

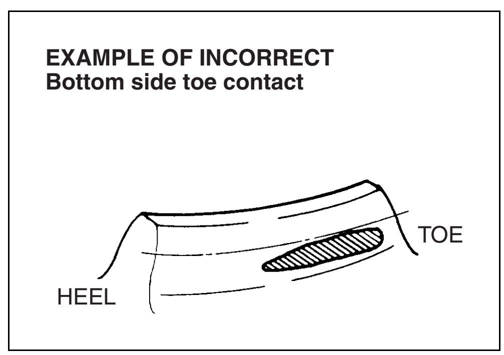
Example (1)
Incorrect topside toe contact:
Correction measures:
- Decrease thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.



CAUTION

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

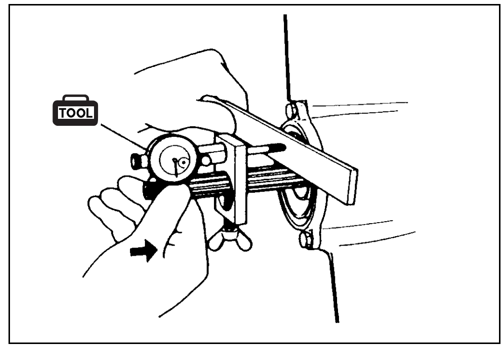
Example (2)
Incorrect bottom side toe contact:
Correction measures:
- Increase thickness of forward gear shim.
- Slightly increase pinion gear shim thickness.



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: 0.1 – 0.2 mm (0.004 – 0.008 in)

NOTE:
Use only the propeller shaft thrust shim to adjust thrust play.

Measurement step:

1. Assemble gear adjusting gauge to the propeller shaft.

09951-09511: Gear adjusting gauge

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

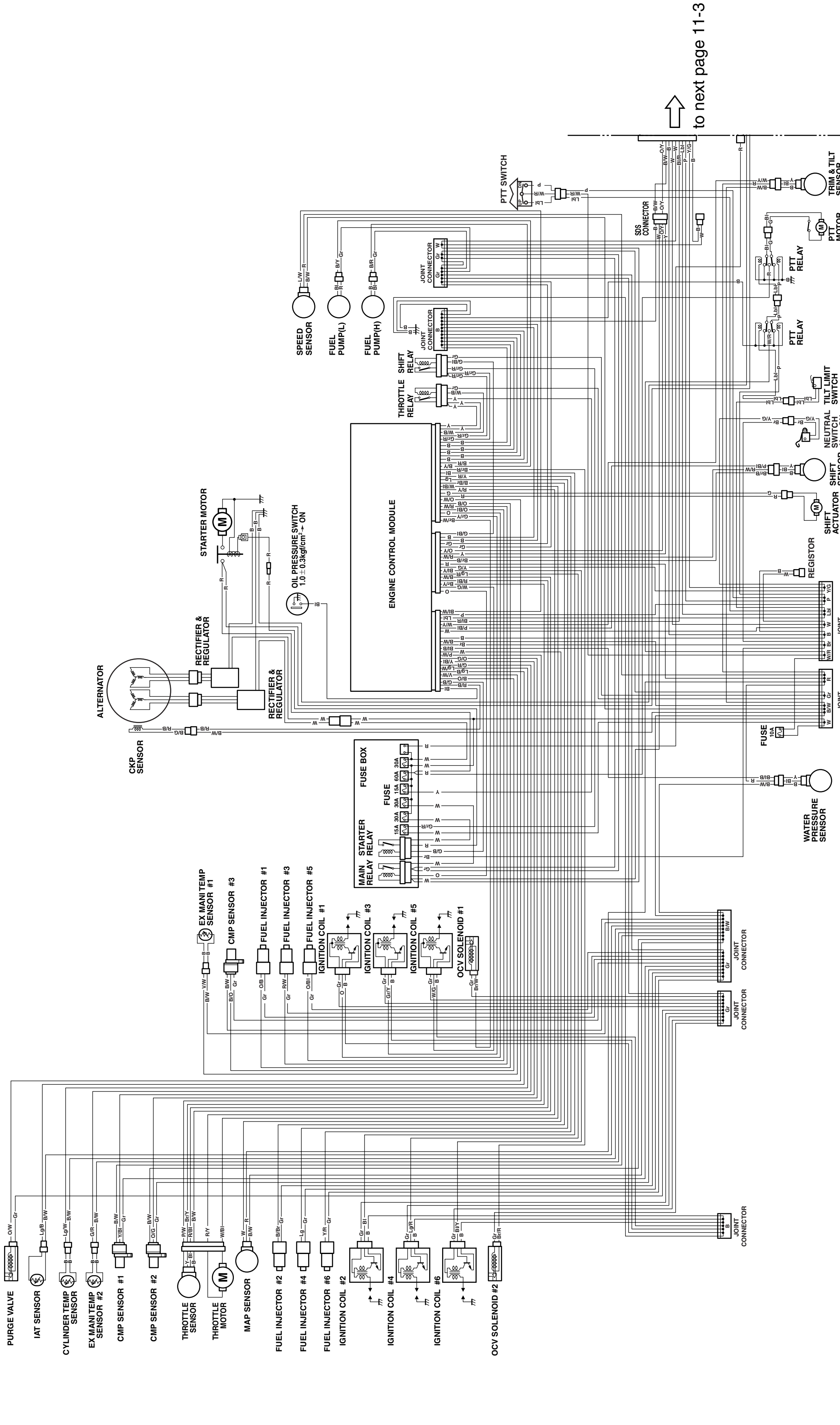
WIRE/HOSE ROUTING

CONTENTS

WIRING DIAGRAM

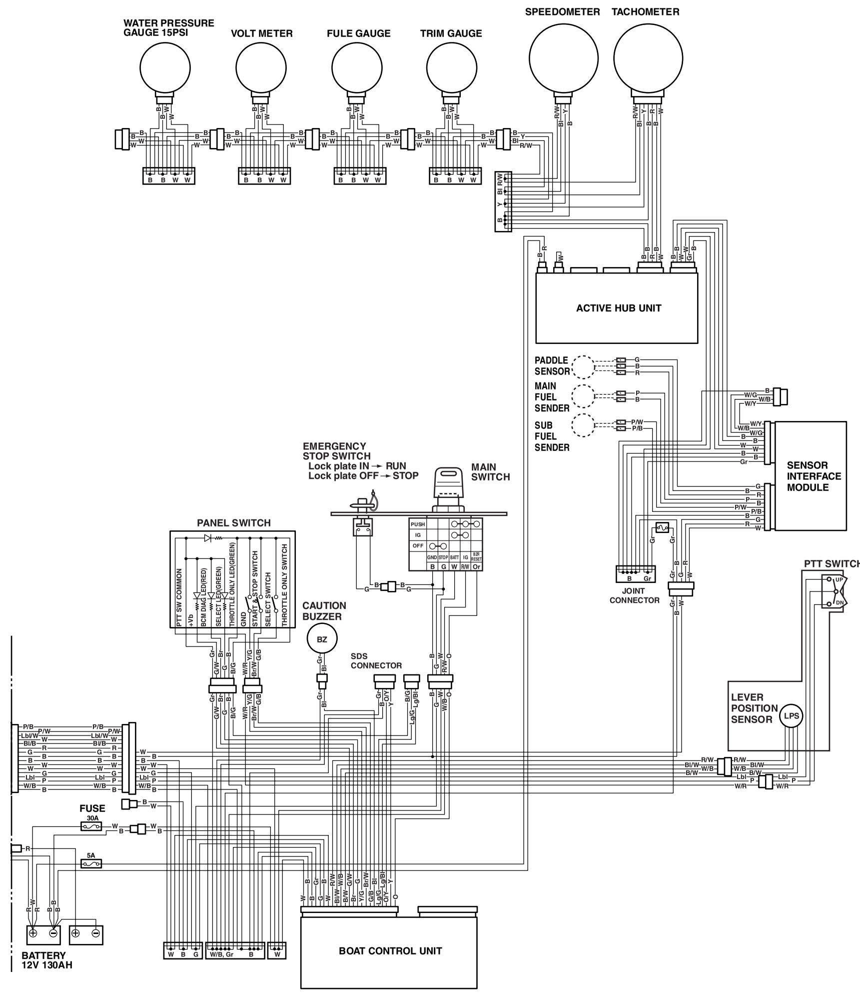
DF300

For single engine



WIRE COLOR

B	: Black
Bl	: Blue
Br	: Brown
G	: Green
Gr	: Gray
Lbl	: Light blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
W	: White
Y	: Yellow
B/Br	: Black with Brown tracer
B/G	: Black with Green tracer
B/O	: Black with Orange tracer
B/R	: Black with Red tracer
B/W	: Black with White tracer
B/Y	: Black with Yellow tracer
Bl/B	: Blue with Black tracer
Bl/R	: Blue with Red tracer
Bl/W	: Blue with White tracer
Bl/Y	: Blue with Yellow tracer
Br/R	: Brown with Red trancer
Br/W	: Brown with White tracer
Br/Y	: Brown with Yellow tracer
G/B	: Green with Black tracer
G/Bl	: Green with Blue tracer
G/R	: Green with Red tracer
G/W	: Green with White tracer
Gr/R	: Gray with Red tracer
Gr/Y	: Gray with Yellow tracer
Lbl/W	: Light blue with White tracer
Lg/B	: Light green with Black tracer
Lg/Bl	: Light green with Blue tracer
Lg/G	: Light green with Green tracer
Lg/R	: Light green with Red tracer
Lg/W	: Light green with White tracer
O/B	: Orange with Black tracer
O/Bl	: Orange with Blue tracer
O/G	: Orange with Green tracer
O/R	: Orange with Red tracer
O/W	: Orange with White tracer
O/Y	: Orange with Yellow tracer
P/B	: Pink with Black tracer
P/Bl	: Pink with Blue tracer
P/W	: Pink with White tracer
R/B	: Red with Black tracer
R/Bl	: Red with Blue tracer
R/W	: Red with White tracer
R/Y	: Red with Yellow tracer
V/W	: Violet with White tracer
W/B	: White with Black tracer
W/Bl	: White with Blue tracer
W/G	: White with Green tracer
W/R	: White with Red tracer
W/Y	: White with Yellow tracer
Y/Bl	: Yellow with Blue tracer
Y/G	: Yellow with Green tracer
Y/R	: Yellow with Red tracer



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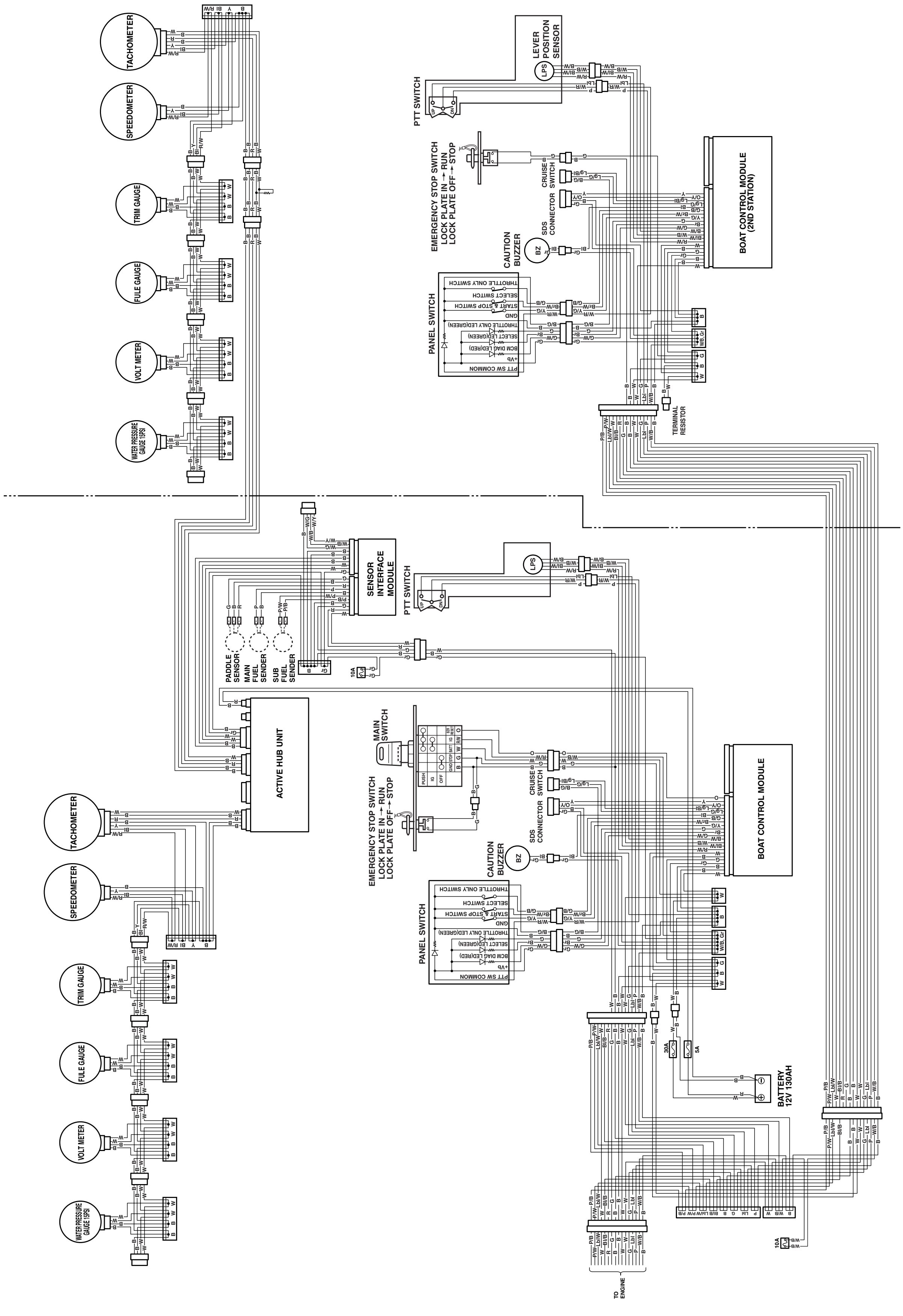
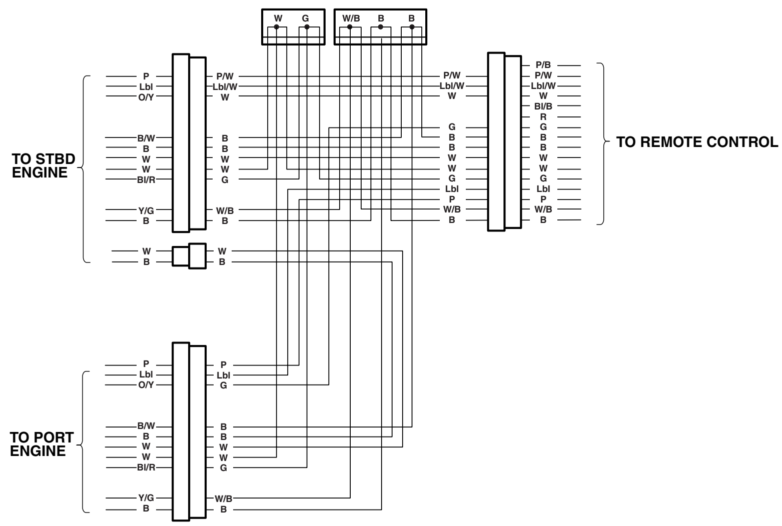
For single engine and dual station

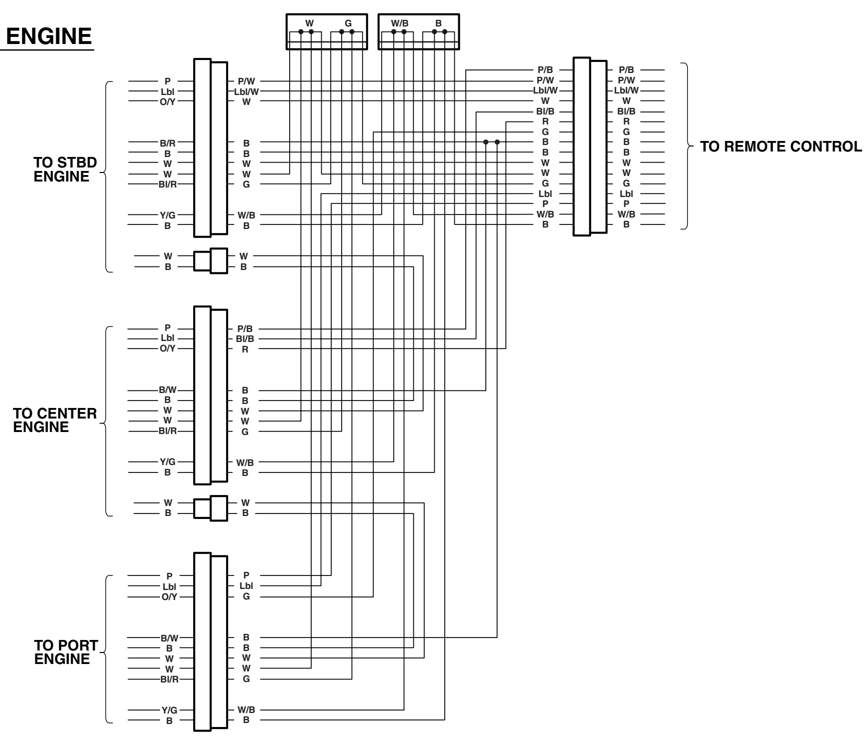


For multiple engine

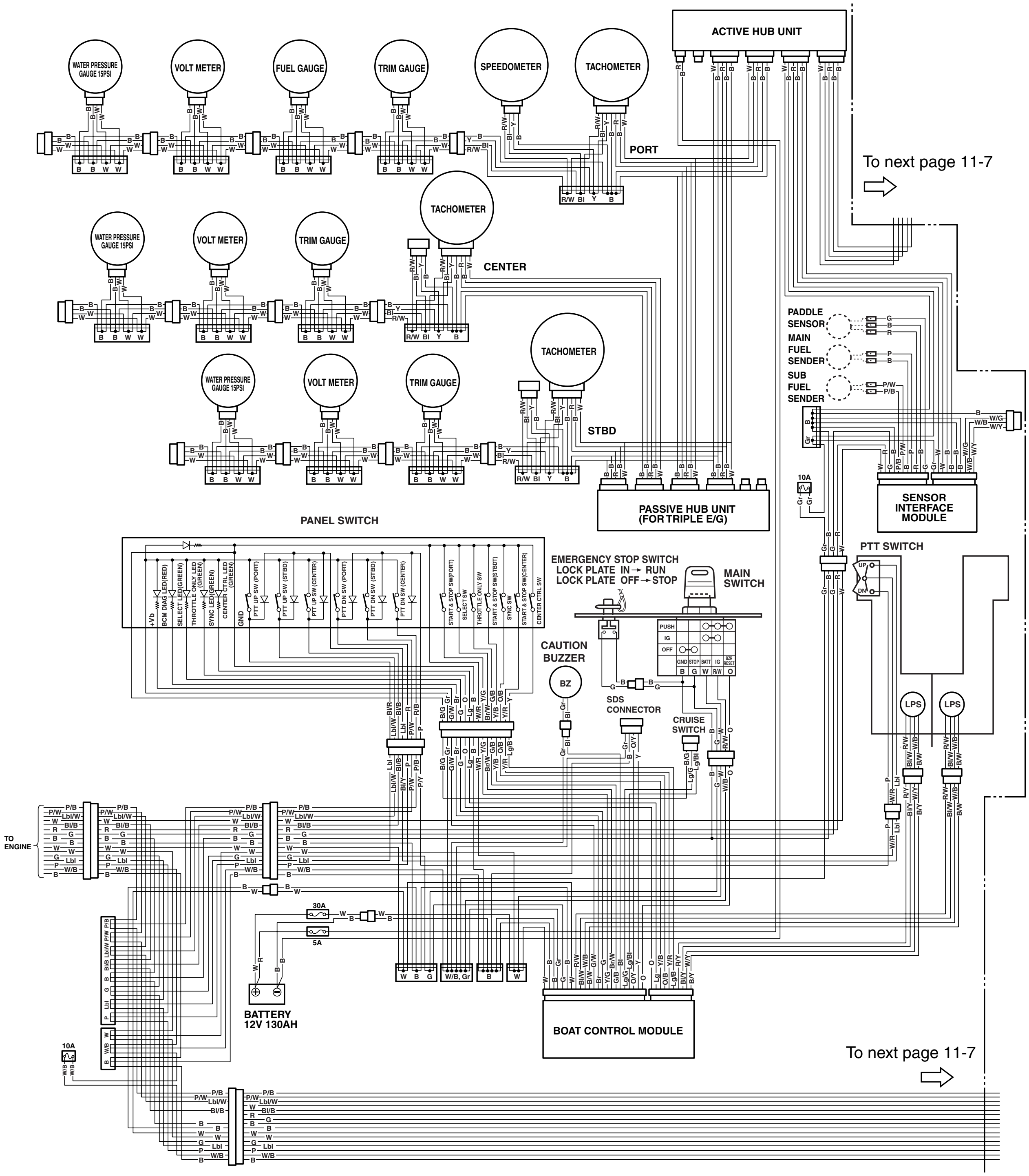
FOR DUAL ENGINE

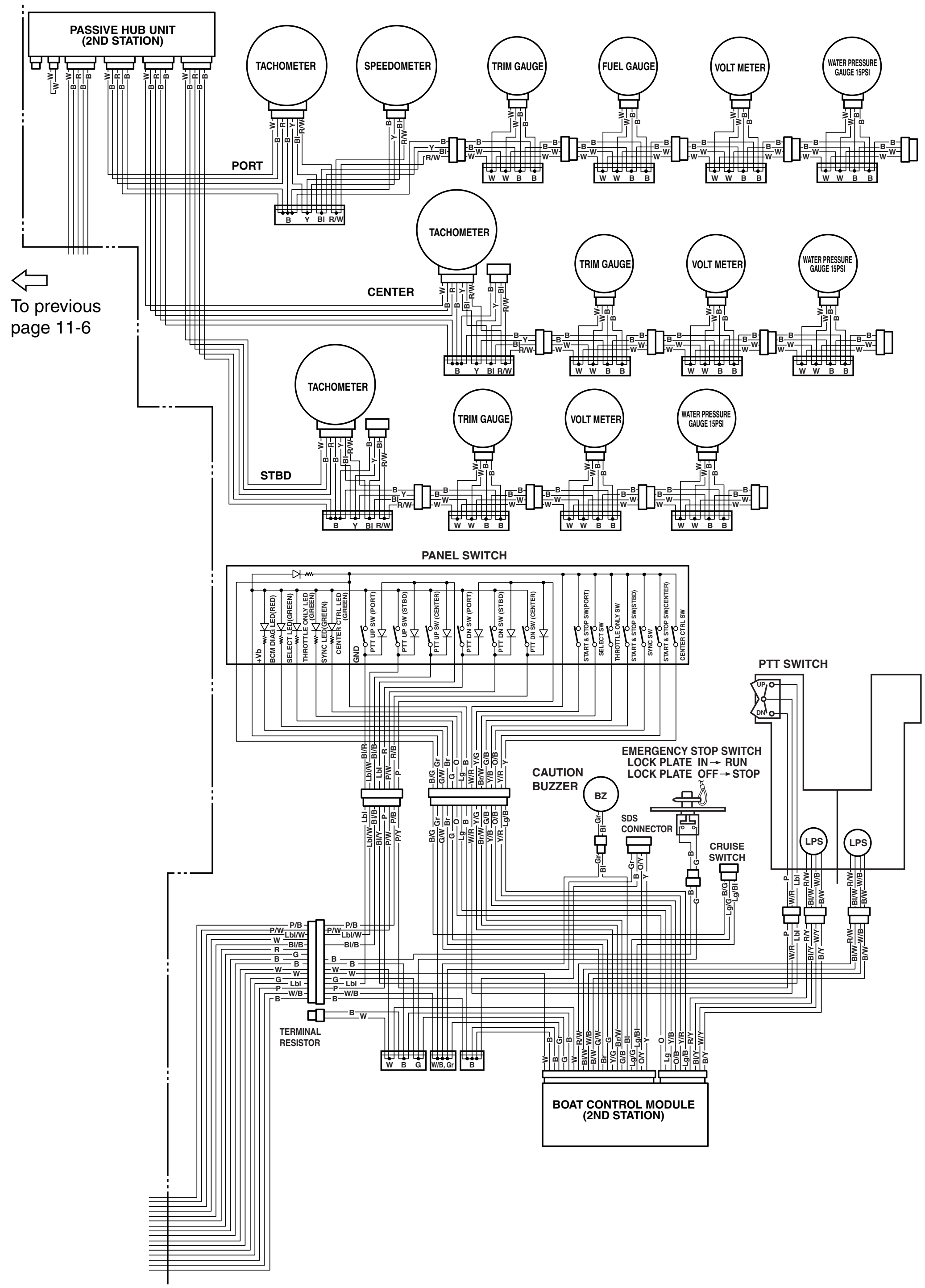


FOR TRIPLE ENGINE



For multiple engine and dual station





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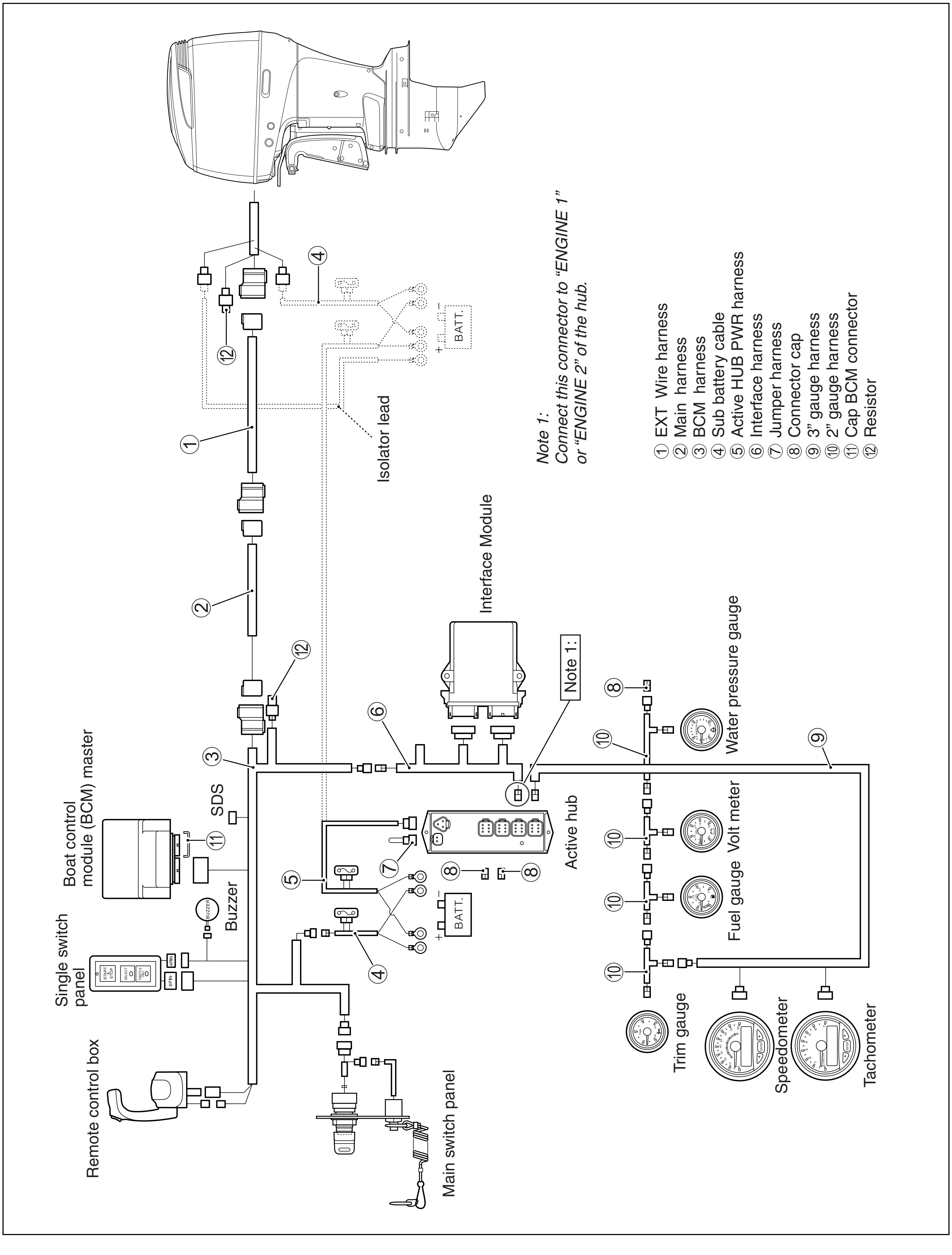
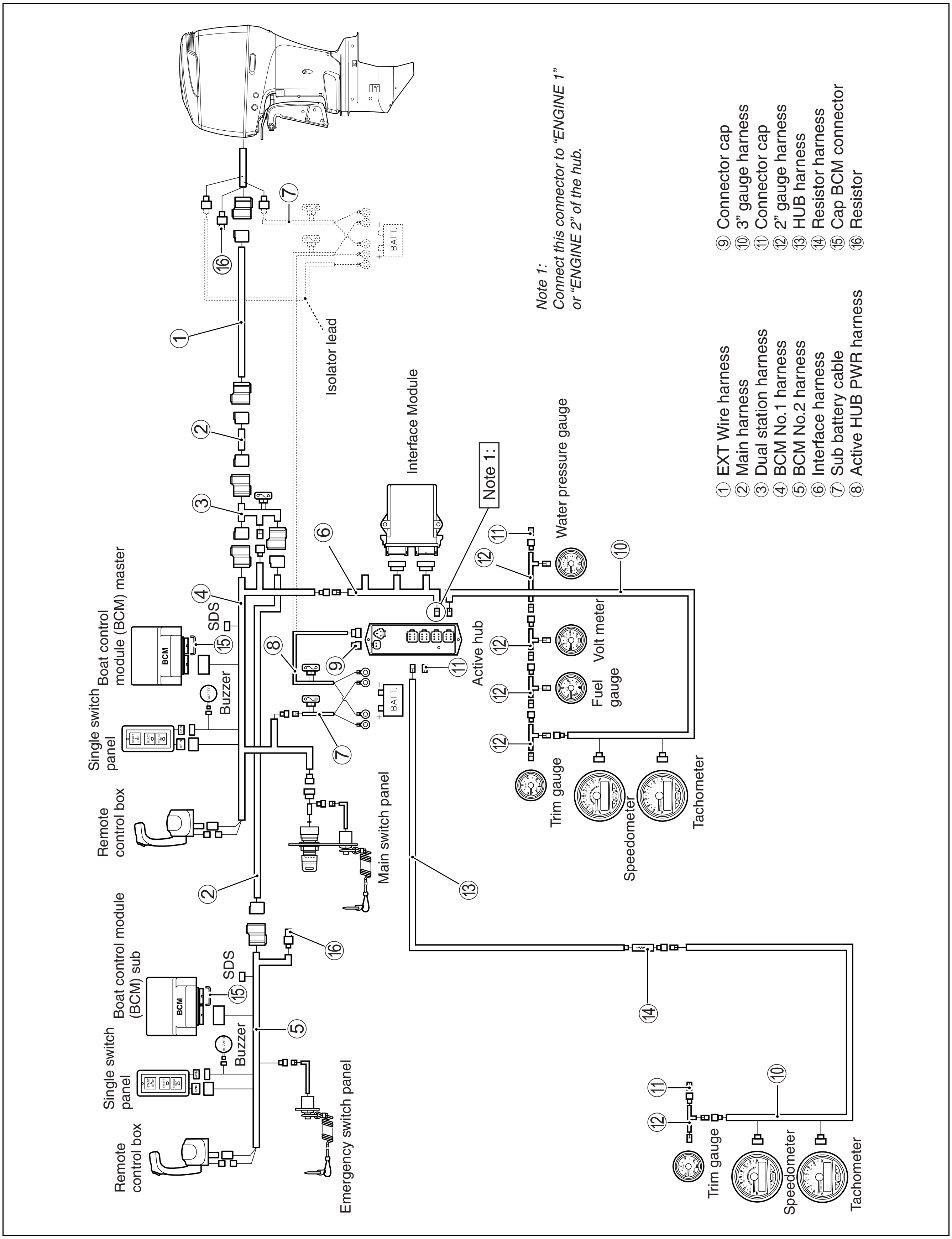
To previous page 11-6

WIRING

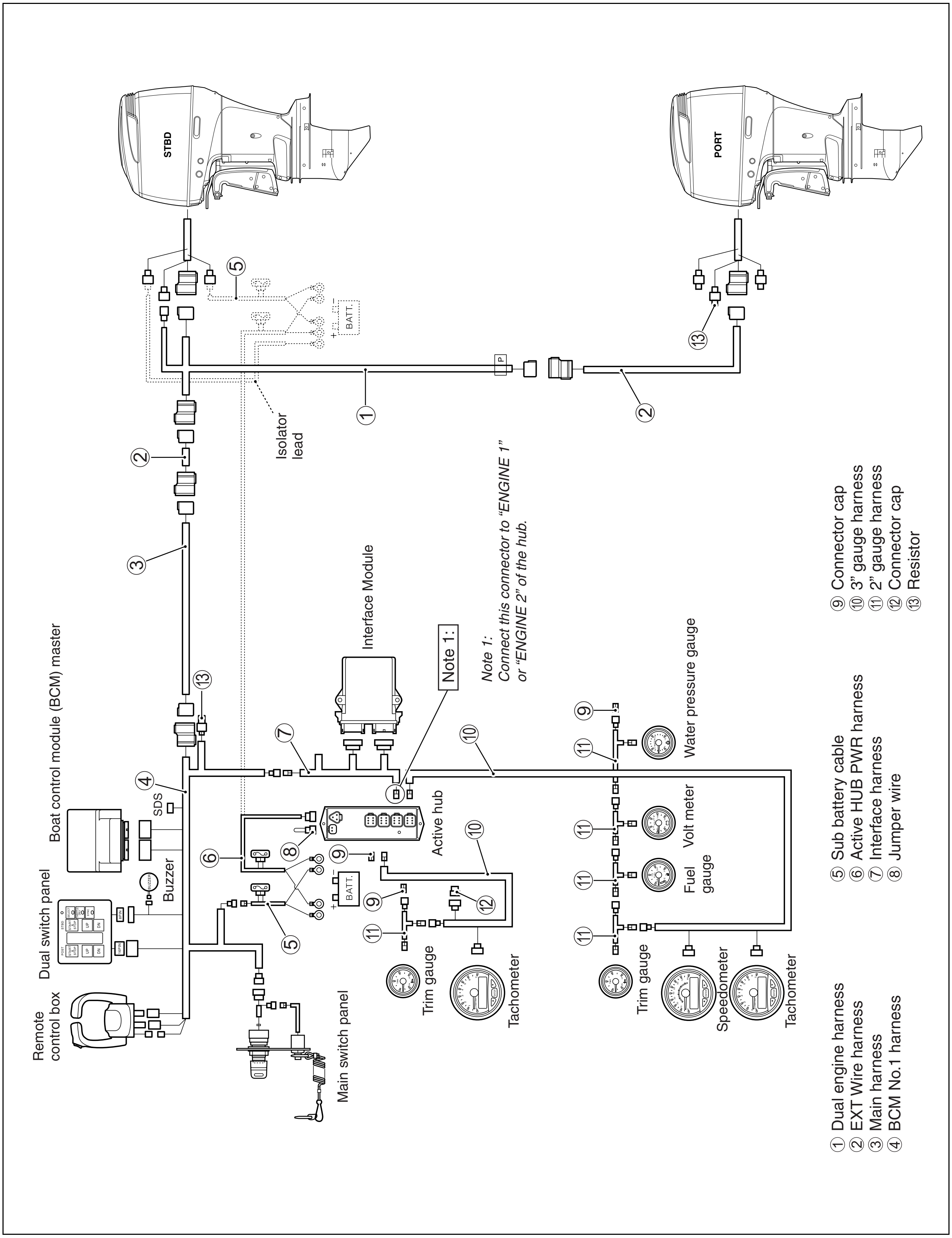
SINGLE ENGINE, SINGLE STATION



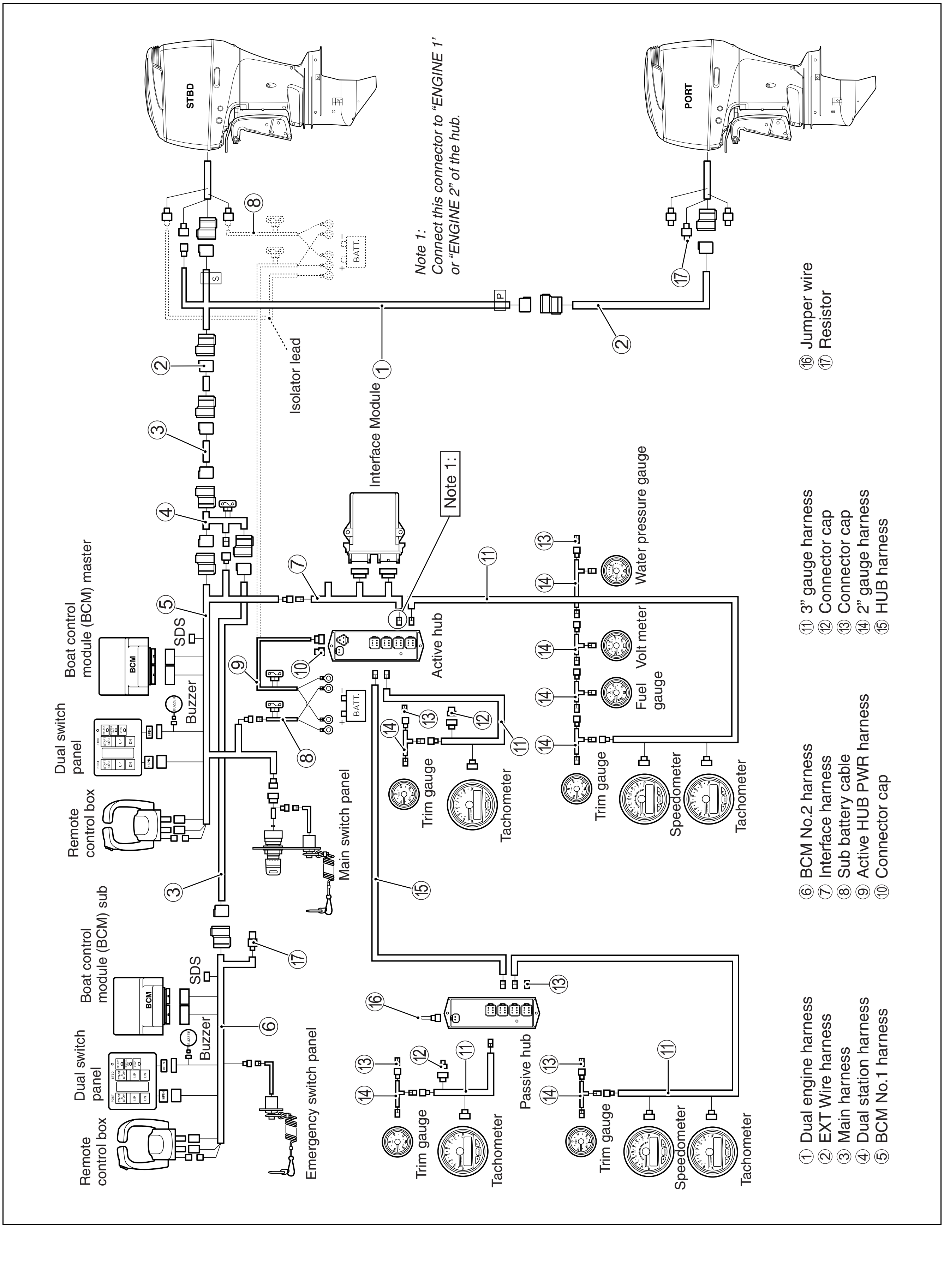
SINGLE ENGINE, DUAL STATIONS



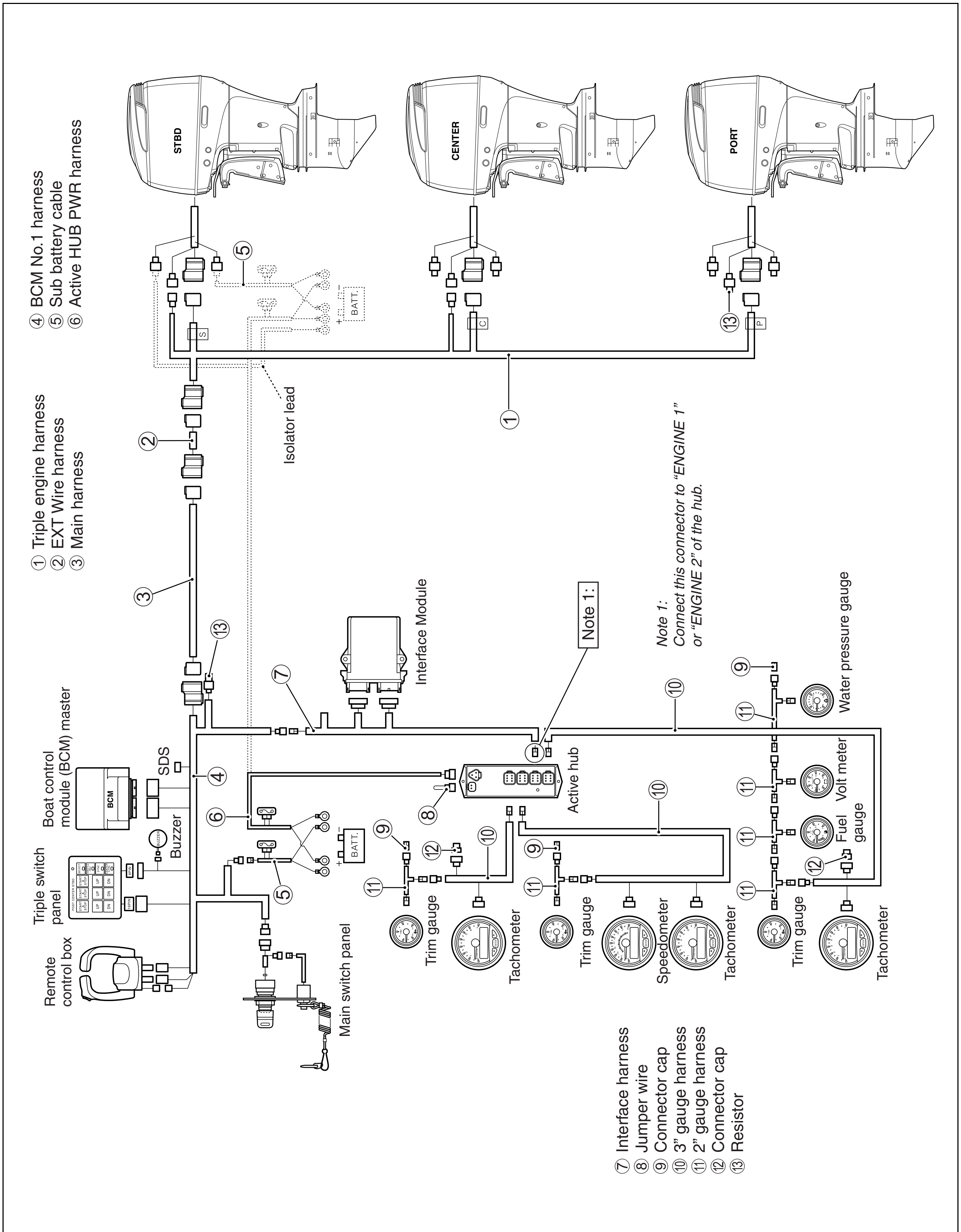
TWIN ENGINES, SINGLE STATION



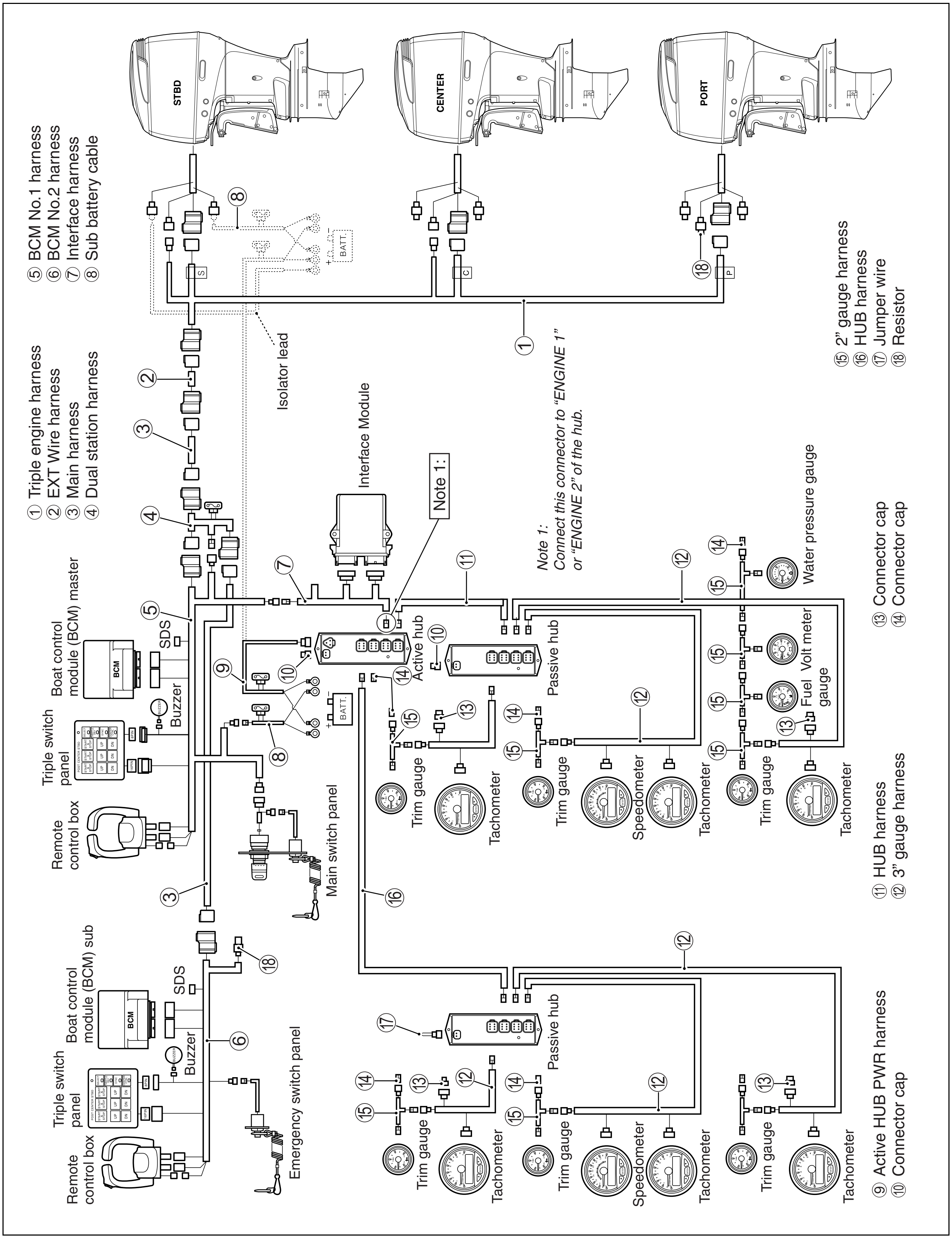
TWIN ENGINES, DUAL STATIONS



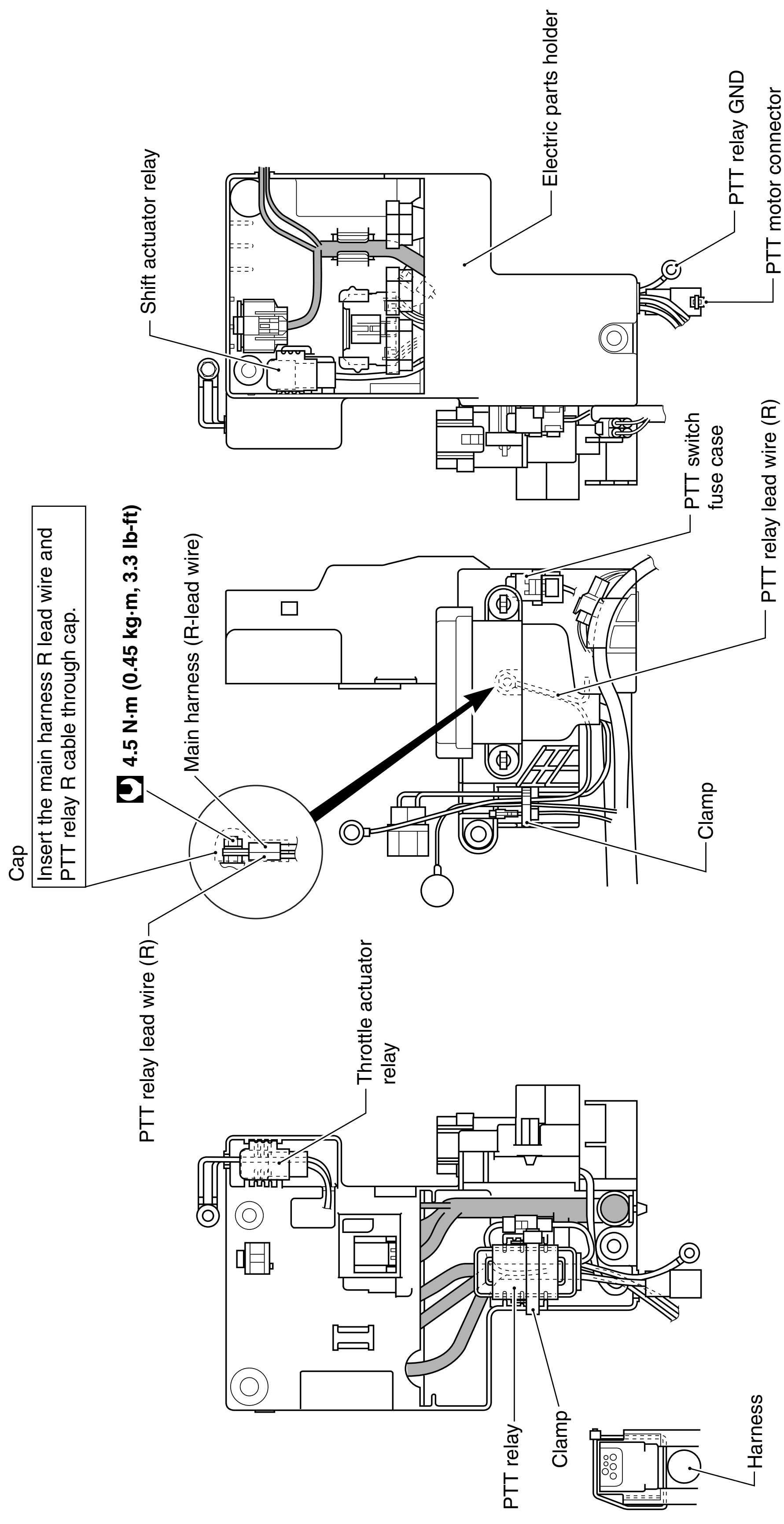
TRIPLE ENGINES, SINGLE STATION

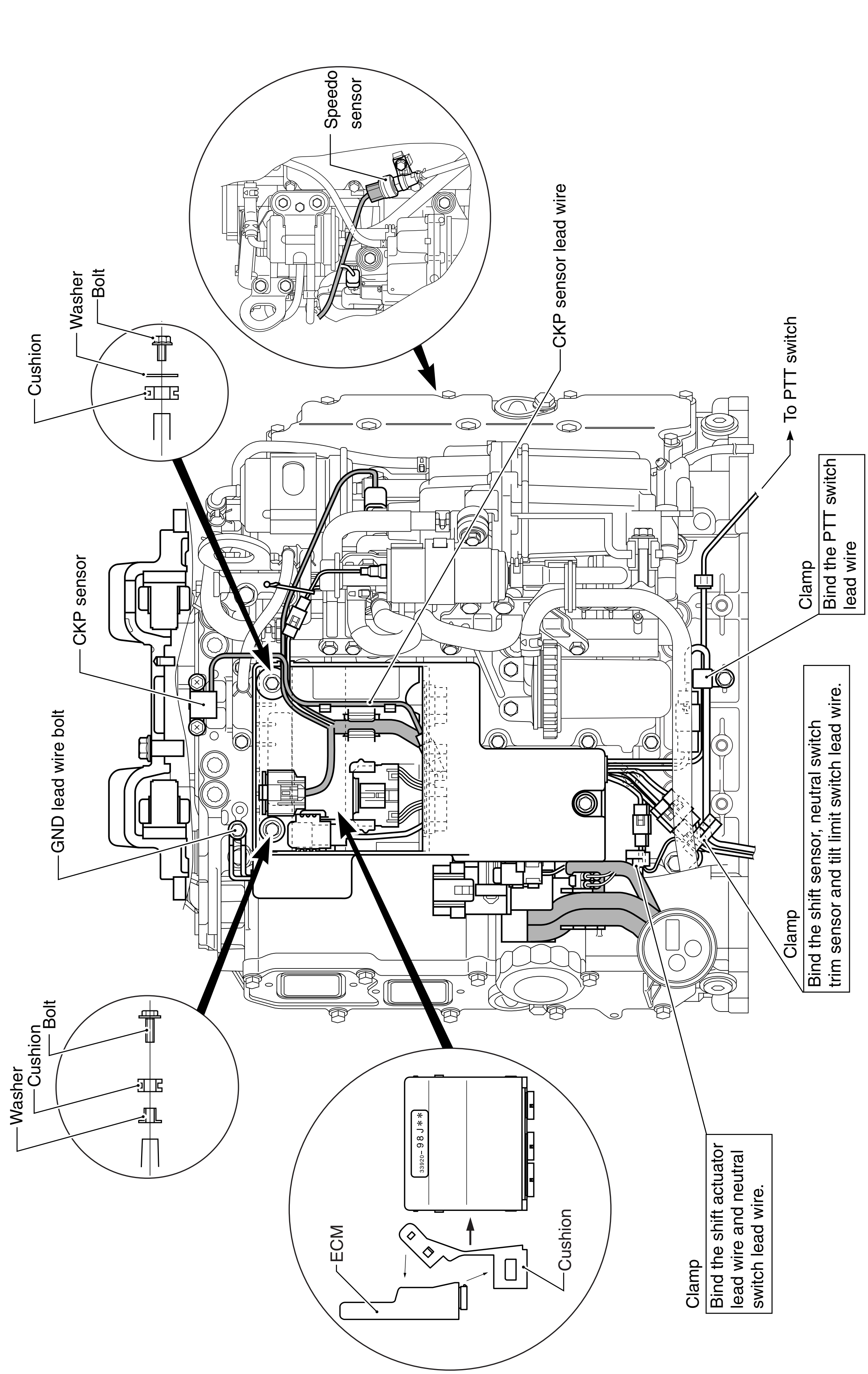


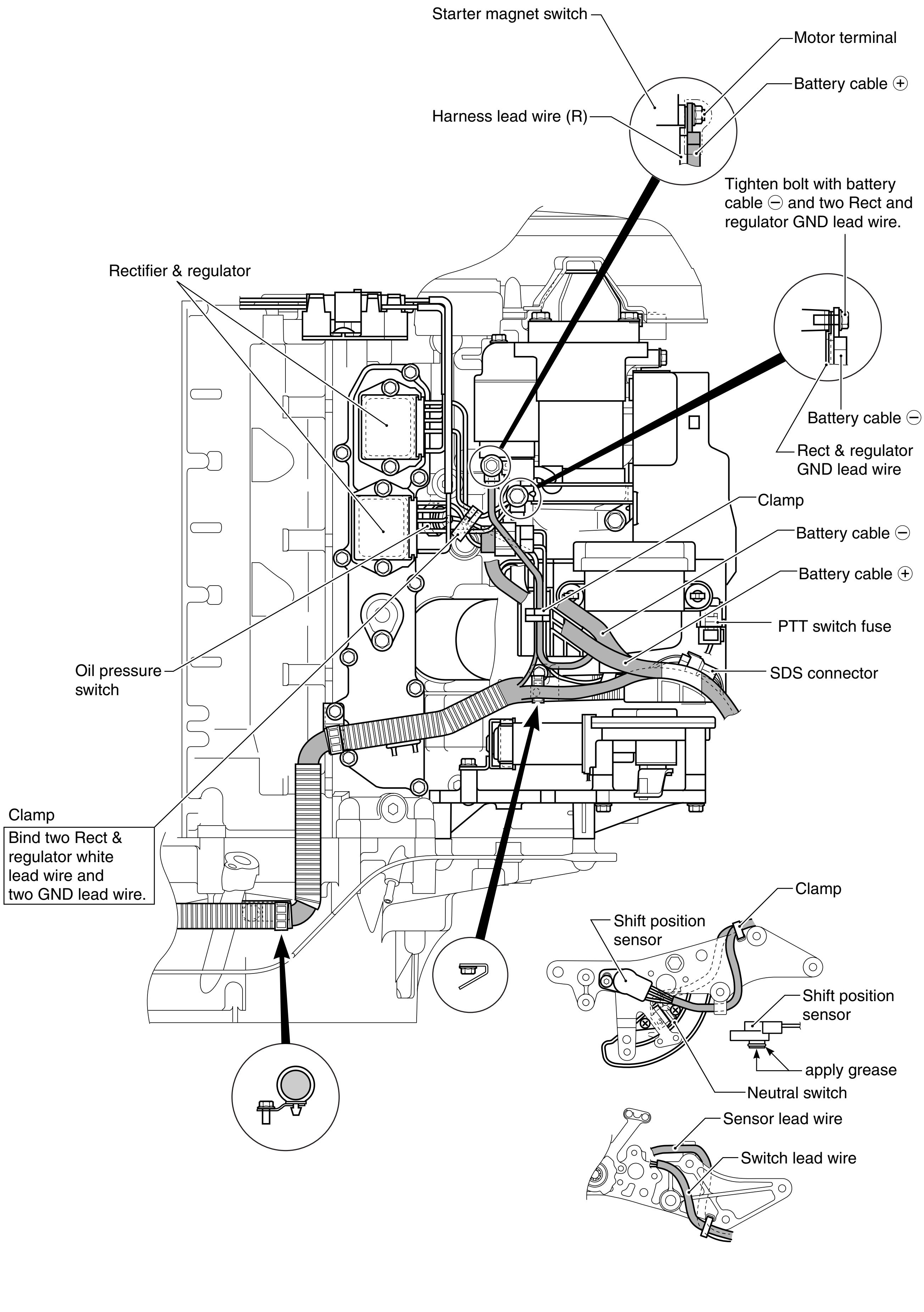
TRIPLE ENGINES, DUAL STATIONS

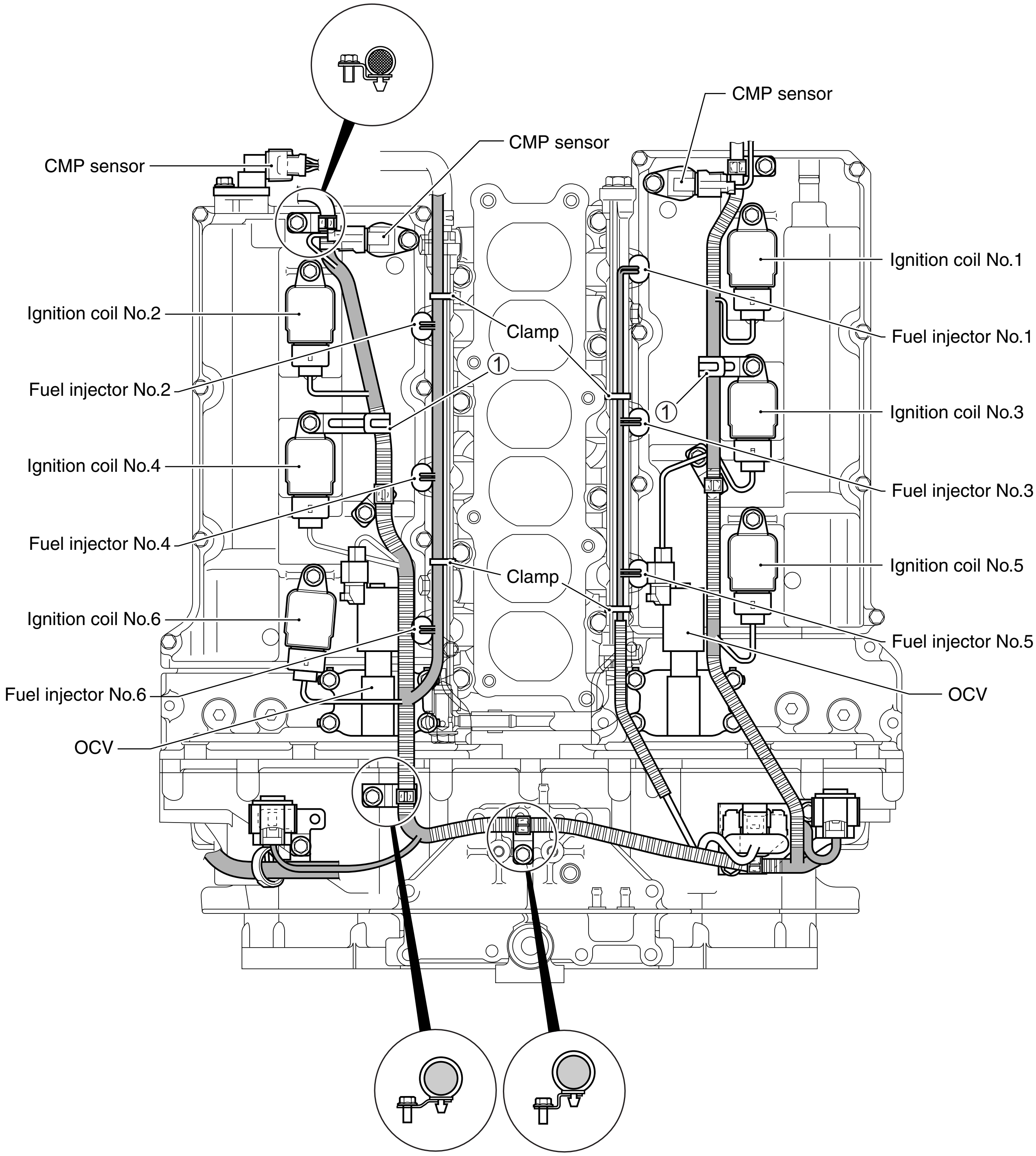


WIRE ROUTING



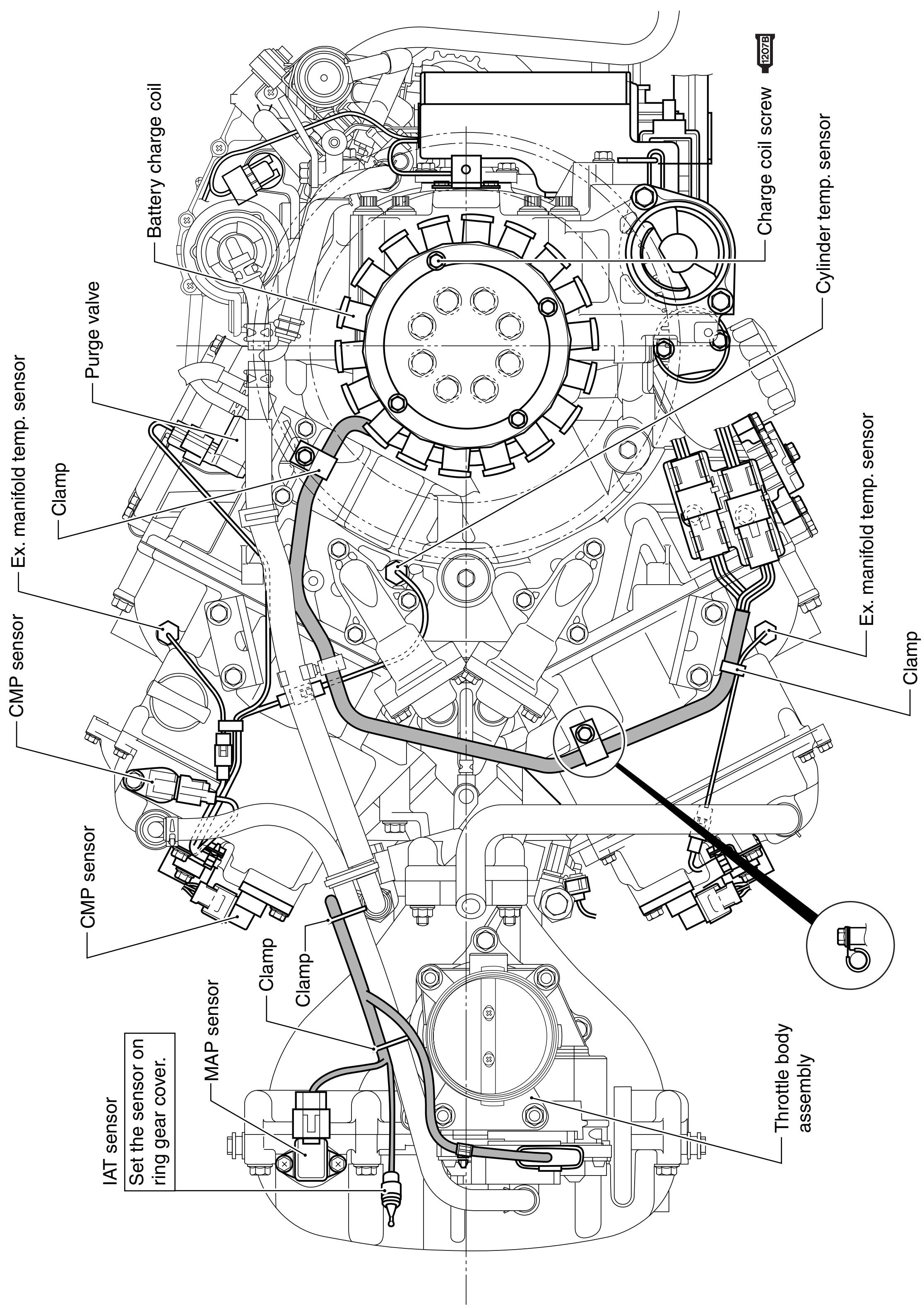

Speedo sensor
CKP sensor lead wire
To PTT switch
Clamp
Bind the PTT switch lead wire
Washer
Bolt
Cushion
CKP sensor
GND lead wire bolt
Clamp
Bind the shift sensor, neutral switch trim sensor and tilt limit switch lead wire.
Washer
Cushion
Bolt
33920-98J**
ECM
Cushion
Clamp
Bind the shift actuator lead wire and neutral switch lead wire.

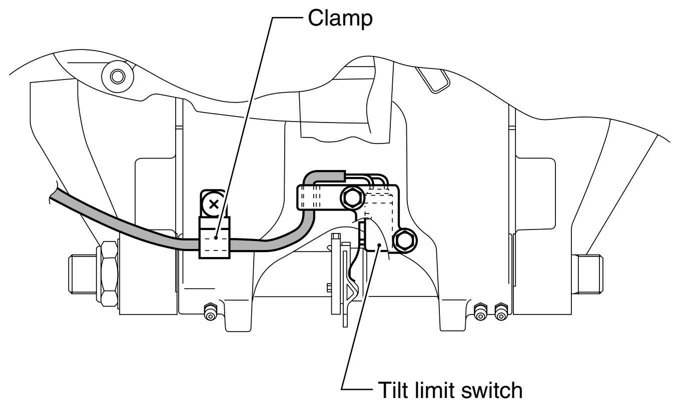

Starter magnet switch
Motor terminal
Battery cable ⊕
Harness lead wire (R)
Tighten bolt with battery cable ⊖ and two Rect and regulator GND lead wire.
Rectifier & regulator
Battery cable ⊖
Rect & regulator GND lead wire
Clamp
Battery cable ⊖
Battery cable ⊕
PTT switch fuse
SDS connector
Oil pressure switch
Clamp
Bind two Rect & regulator white lead wire and two GND lead wire.
Clamp
Shift position sensor
Shift position sensor
apply grease
Neutral switch
Sensor lead wire
Switch lead wire

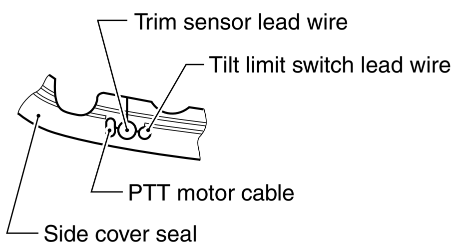


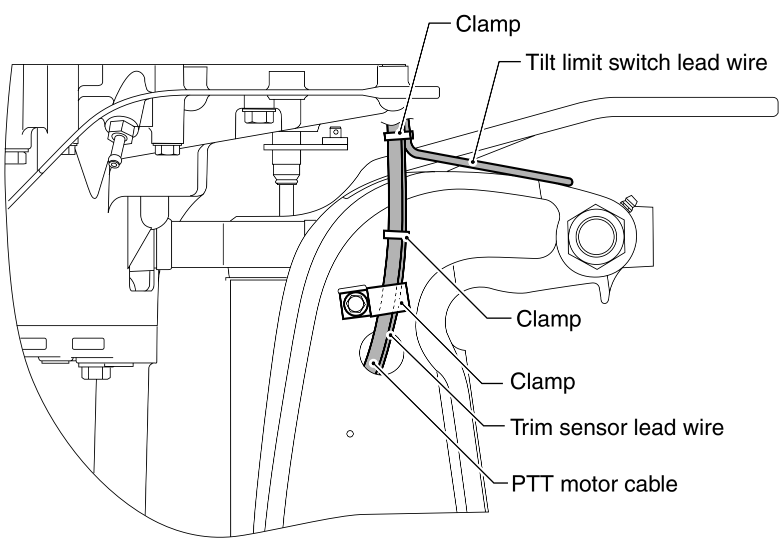
NOTICE ON IGNITION COIL ASSEMBLING

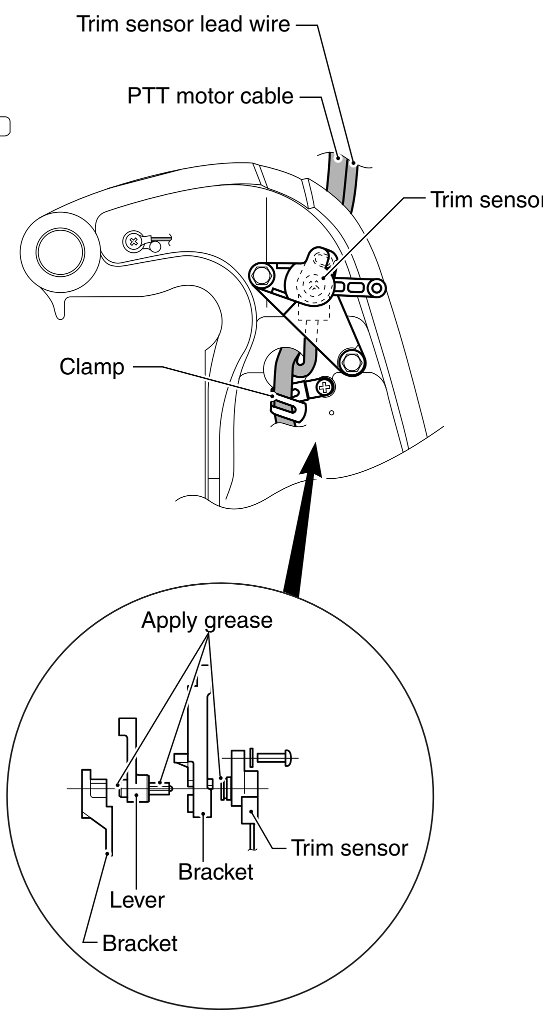
1. Locate two clamps ① at horizontal position while installing the ignition coil No.3 and No4. Then tighten the bolts securely.
2. Fix the wiring harness with two clamps ①.
3. Make sure that connector lead wires are not stretched when connecting the connectors to ignition coil No.1 and No.2.
4. Connect connectors to the remaining ignition coils securely.
5. Disassembly is reverse of the assembly.


Battery charge coil
Purge valve
Ex. manifold temp. sensor
Clamp
CMP sensor
CMP sensor
IAT sensor
Set the sensor on ring gear cover.
MAP sensor
Clamp
Clamp
Throttle body assembly
1207B
Charge coil screw
Cylinder temp. sensor
Ex. manifold temp. sensor
Clamp


Clamp
Tilt limit switch


Trim sensor lead wire
Tilt limit switch lead wire
PTT motor cable
Side cover seal


Clamp
Tilt limit switch lead wire
Clamp
Clamp
Trim sensor lead wire
PTT motor cable

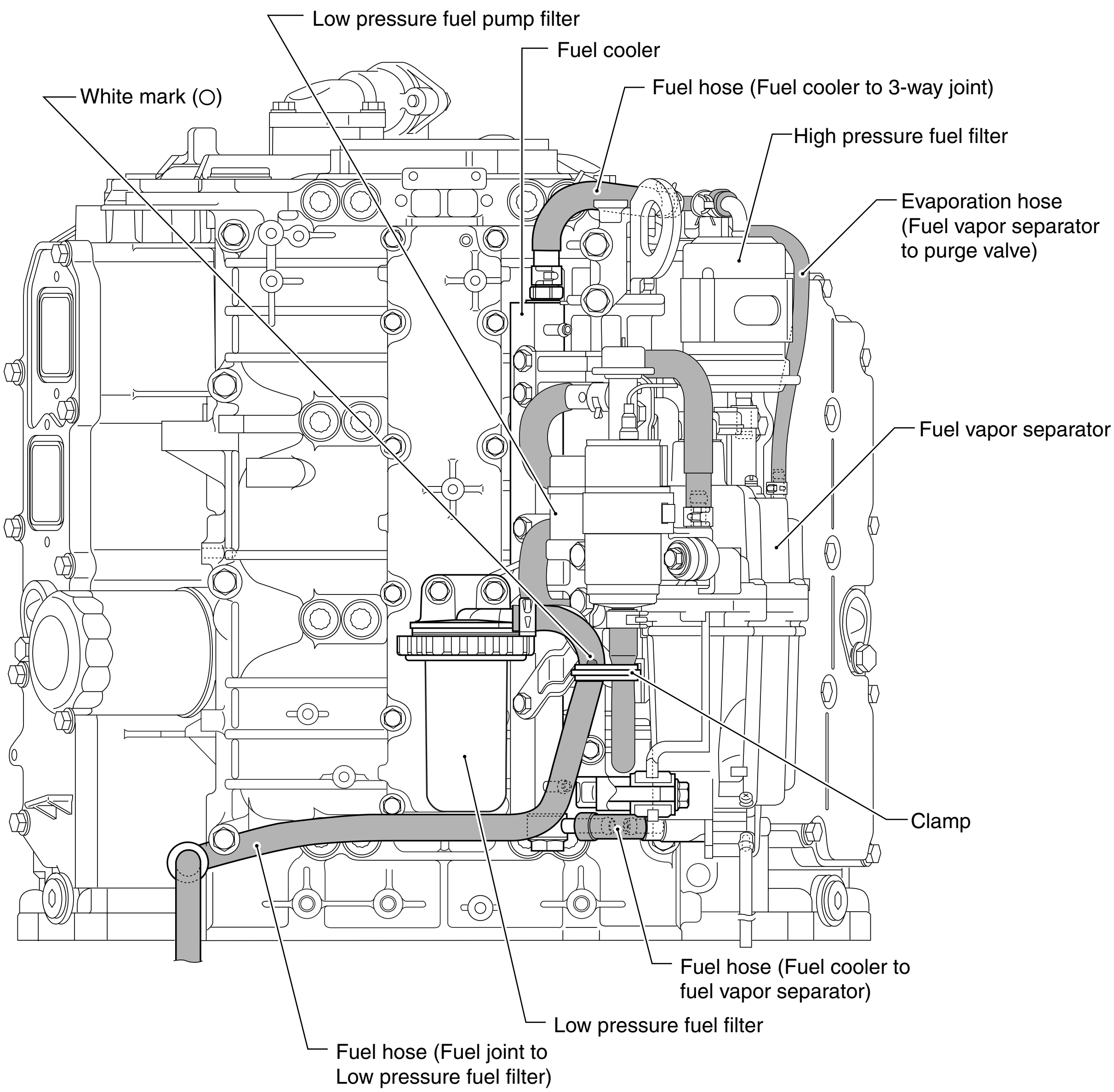

Trim sensor lead wire
PTT motor cable
Trim sensor
Clamp
Apply grease
Trim sensor
Bracket
Lever
Bracket

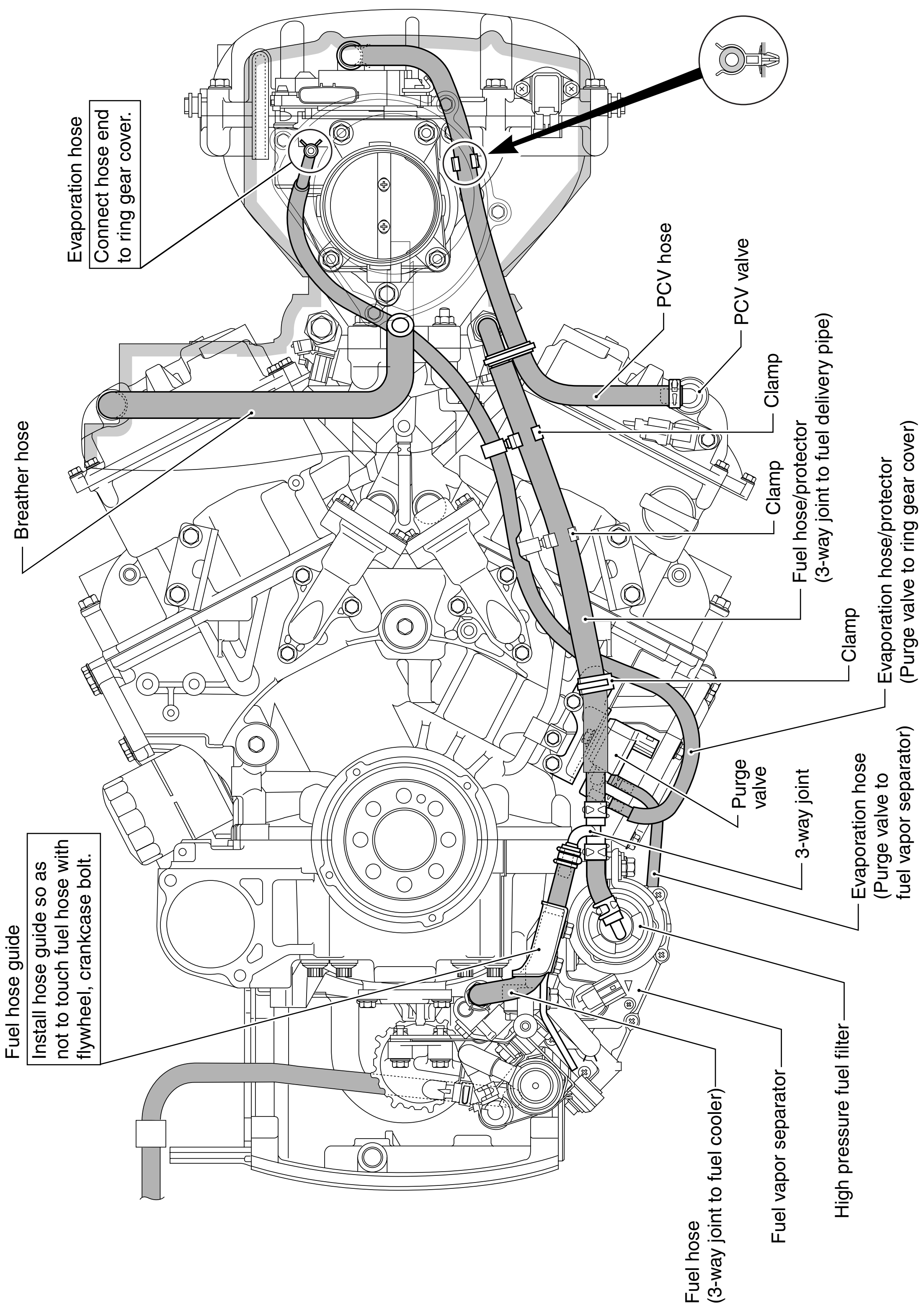
FUEL/WATER HOSE ROUTING

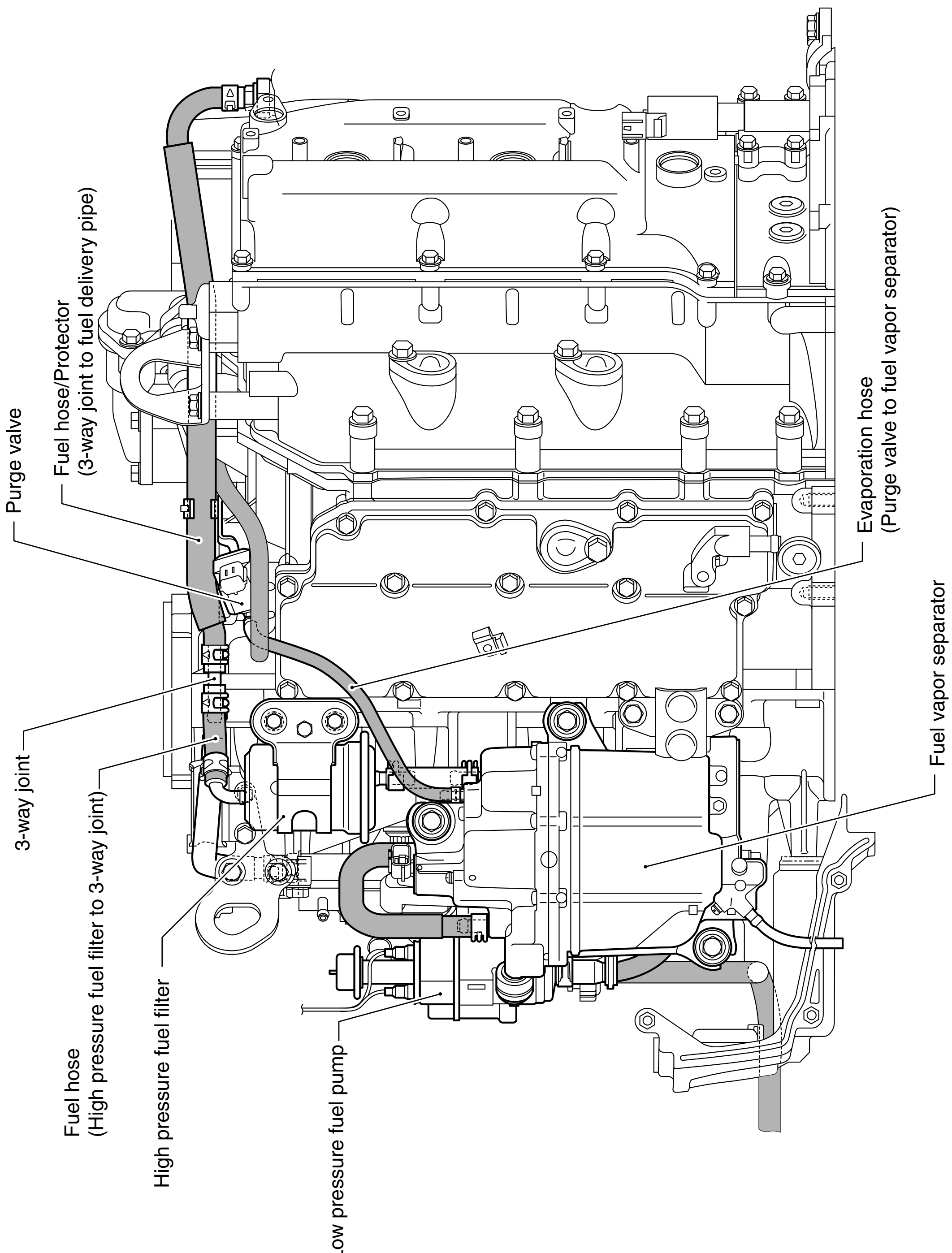
CAUTION

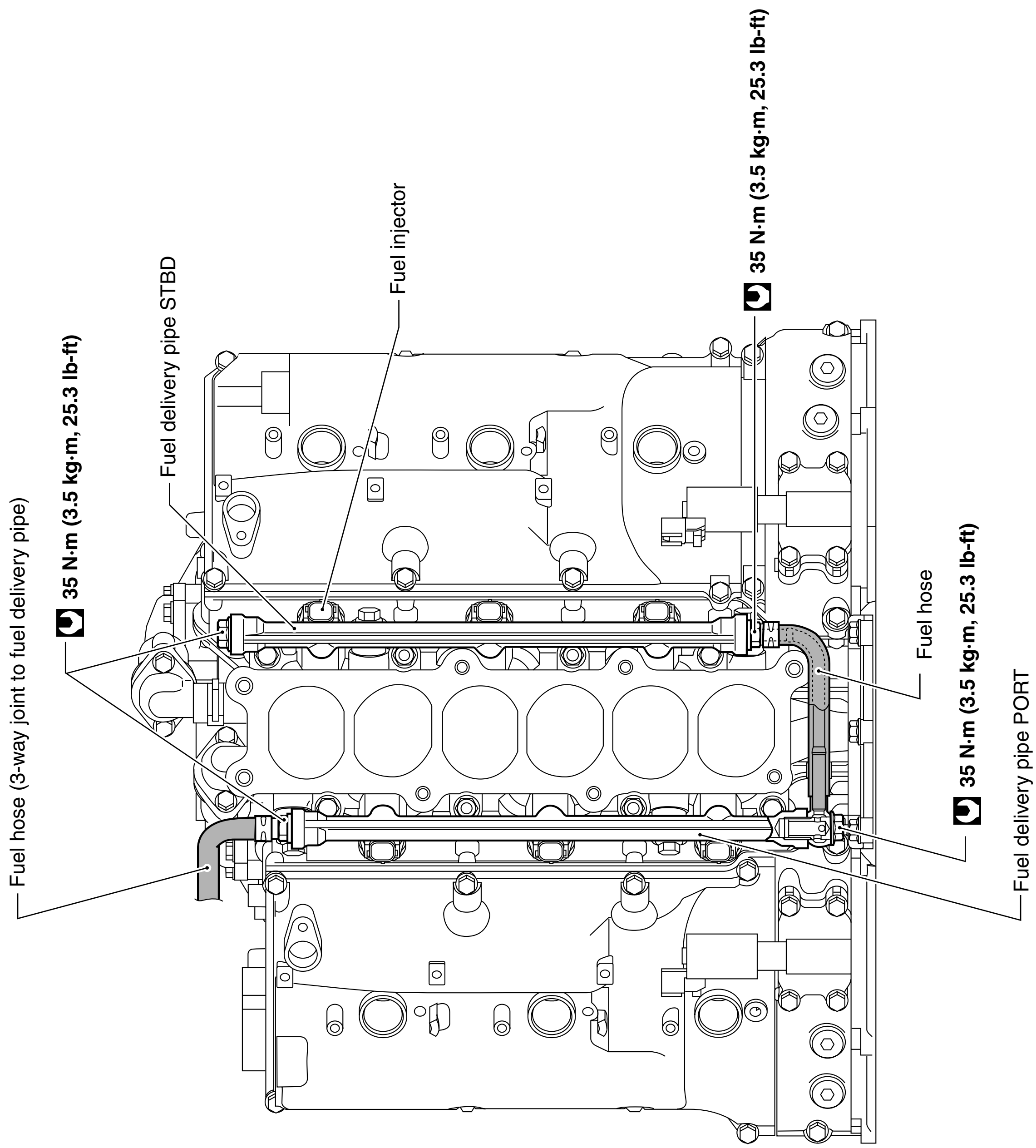
- **Do not over-bend (kink) or twist hoses when installing.**
- **When installing hose clips, position tabs to avoid contact with other parts.**
- **Check that hoses do not contact rods and levers during either engine operation or standstill.**
- **Extreme care should be taken not to cut, abrade or cause any other damage on hoses.**
- **Care should be taken not to cause hoses to be compressed excessively by any clamp when fitted.**

FUEL HOSE ROUTING

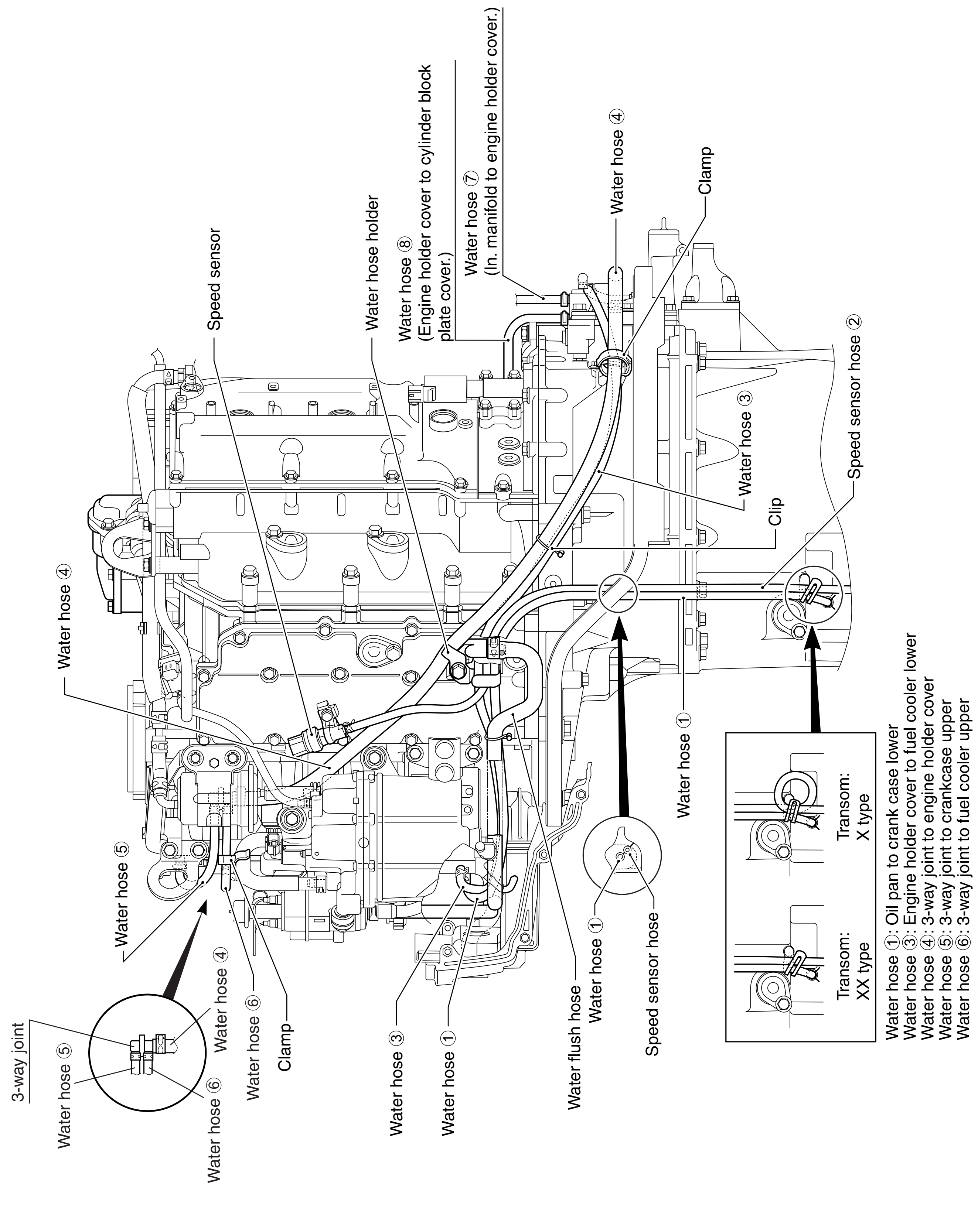


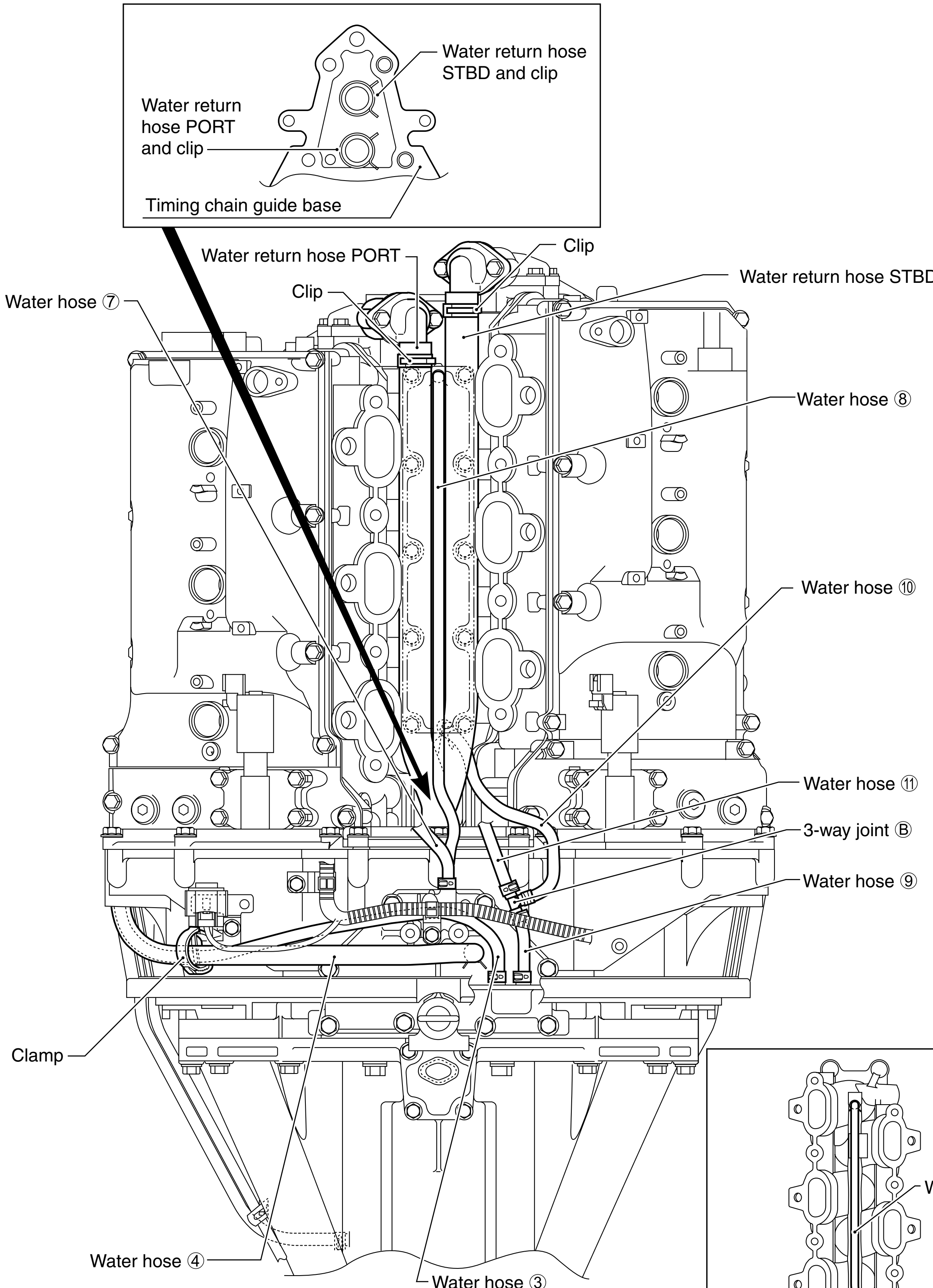

Evaporation hose
Connect hose end to ring gear cover.
Breather hose
Fuel hose guide
Install hose guide so as not to touch fuel hose with flywheel, crankcase bolt.
PCV hose
PCV valve
Clamp
Clamp
Fuel hose/protector (3-way joint to fuel delivery pipe)
Evaporation hose/protector (Purge valve to ring gear cover)
Clamp
Purge valve
3-way joint
Evaporation hose (Purge valve to fuel vapor separator)
High pressure fuel filter
Fuel vapor separator
Fuel hose (3-way joint to fuel cooler)

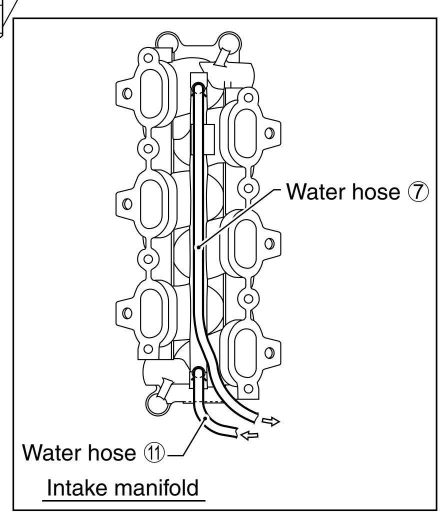

Purge valve
Fuel hose/Protector
(3-way joint to fuel delivery pipe)
Evaporation hose
(Purge valve to fuel vapor separator)
Fuel vapor separator
3-way joint
Fuel hose
(High pressure fuel filter to 3-way joint)
High pressure fuel filter
Low pressure fuel pump


Fuel hose (3-way joint to fuel delivery pipe)
35 N·m (3.5 kg·m, 25.3 lb-ft)
Fuel delivery pipe STBD
Fuel injector
35 N·m (3.5 kg·m, 25.3 lb-ft)
Fuel hose
35 N·m (3.5 kg·m, 25.3 lb-ft)
Fuel delivery pipe PORT

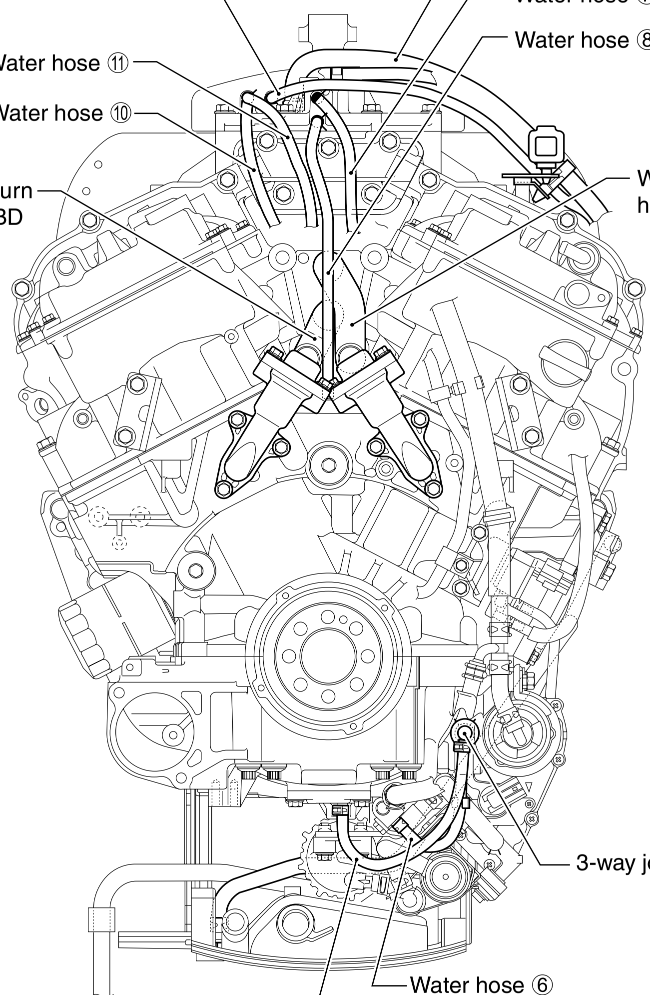
WATER HOSE ROUTING

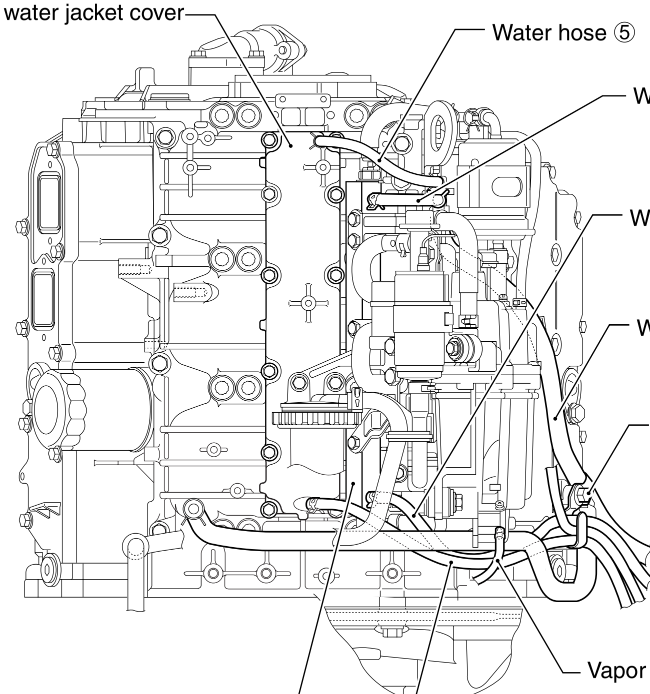






Water hose ③: Engine holder cover to fuel cooler lower
Water hose ④: 3-way joint to engine holder cover
Water hose ⑦: In. manifold upper to engine holder cover
Water hose ⑧: Engine holder cover to cylinder block plate upper
Water hose ⑨: Engine holder cover to 3-way joint Ⓑ
Water hose ⑩: Engine holder cover to cylinder block plate lower
Water hose ⑪: 3-way joint Ⓑ to In. manifold lower





Water hose ①: Oil pan to crankcase lower
Water hose ③: Engine holder cover to fuel cooler lower
Water hose ④: 3-way joint to engine holder cover
Water hose ⑤: 3-way joint to crankcase upper
Water hose ⑥: 3-way joint to fuel cooler upper
Water hose ⑦: In. manifold upper to engine holder cover
Water hose ⑧: Engine holder cover to cylinder block plate upper
Water hose ⑩: Engine holder cover to cylinder block plate lower
Water hose ⑪: 3-way joint Ⓑ to In. manifold lower

DF300 “K8” (2008) MODEL

FOREWORD

This supplementary service manual describes the outline, technical data and servicing procedures for the “K8” (2008) model outboard motors.
Please read and thoroughly familiarize yourself with this information before using it for your service activities.

CONTENTS

* SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF300T	DF300Z
PRE-FIX			30001F	30001Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	953 (37.5)	
Overall width (side to side)		mm (in)	564 (22.2)	
Overall height	X	mm (in)	1 889 (74.4)	
	XX	mm (in)	2 016 (79.4)	
Weight (without engine oil)	X	kg (lbs)	274 (604)	
	XX	kg (lbs)	279 (615)	
Transom height	X	mm (in. type)	635 (25)	
	XX	mm (in. type)	762 (30)	

PERFORMANCE

Maximum output	kW (PS)	220.7 (300)
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)

POWER HEAD

Engine type		4-stroke DOHC
Number of cylinders		V-6
Bore	mm (in)	98 (3.86)
Stroke	mm (in)	89 (3.50)
Total displacement	cm^3 (cu. in)	4 028 (245.6)
Compression ratio	: 1	9.5
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		Electronic remote control

Item	Unit	Data	
		DF300T	DF300Z

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 or NMMA FC-W classification : SE, SF, SG, SH, SJ • Viscosity rating : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/Imp. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Gear oil		SUZUKI Outboard Motor Gear Oil (SAE #90 hypoid gear oil)
Gearcase oil amounts	ml (US/Imp. oz)	1 100 (37.2/38.7)

BRACKET

Trim angle	degree	0 – 19 (PTT system)
Number of trim position		PTT system
Maximum tilt angle	degree	70

LOWER UNIT

Shift control	Electronic remote control
Reversing system	Gear
Transmission	Forward-Neutral-Reverse
Reduction system	Bevel gear
Gear ratio	12 : 20 (1.67)
Drive line impact protection	Spline drive rubber hub
Propeller shaft rotation (when shift into forward)	DF300T : Clockwise DF300Z : Counterclockwise
Propeller	Right-hand rotation models
	Blade × Dia. (in.) × Pitch (in.)
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26 3 × 16 × 27 and 1/2

Item	Unit	Data	
		DF300T	DF300Z

LOWER UNIT

Propeller	Counter rotation models
	Blade × Dia. (in.) × Pitch (in.)
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	32 : 40 (1.25)
2nd reduction gear ratio (Lower unit gear)	12 : 20 (1.67)
Total reduction gear ratio	2.08 (40/32 × 20/12)

* SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data
		DF300T/Z

POWERHEAD

Item	Unit	DF300T/Z
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)
**Cylinder compression	kPa (kg/cm^2, psi)	1 100 – 1 500 (11 – 15, 156 – 213)
**Cylinder compression max. difference between cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm^2, psi)	400 – 600 (4.0 – 6.0, 57 – 85) at 3 000 r/min (at normal operating temp.)
Engine oil		• API classification : SE, SF, SG, SH, SJ or NMMA FC-W classification : SE, SF, SG, SH, SJ • Viscosity rating : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/lpm. qt))	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data DF300T/Z

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.03 (0.001)
Manifold seating faces distortion		Limit	mm (in)	0.10 (0.004)
Cam height	IN	STD	mm (in)	45.330 – 45.490 (1.7846 – 1.7909)
		Limit	mm (in)	45.230 (1.7807)
	EX	STD	mm (in)	44.420 – 44.580 (1.7488 – 1.7551)
		Limit	mm (in)	44.320 (1.7449)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.043 – 0.085 (0.0017 – 0.0033)
		Limit	mm (in)	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	—
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	25.936 – 25.957 (1.0211 – 1.0219)
		Limit	mm (in)	—
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)	33.959 – 33.975 (1.3370 – 1.3376)
Cylinder head bore		STD	mm (in)	34.000 – 34.025 (1.3386 – 1.3396)

Item			Unit	Data DF300T/Z

VALVE/VALVE GUIDE

Valve diameter		IN	mm (in)	37.9 (1.49)
		EX	mm (in)	31.4 (1.24)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.33 – 0.37 (0.013 – 0.015)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°, 60°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN, EX	STD	mm (in)	11.4 – 11.8 (0.45 – 0.46)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem 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)	1.1 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.05 (0.04)
		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)	39.75 (1.56)
		Limit	mm (in	38.2 (1.50)
Valve spring tension		STD	N (kg, lbs)	147 – 173 (14.7 – 17.3, 32.3 – 38.1) for 31.1 mm (1.22 in)
		Limit	N (kg, lbs)	136 (13.6, 29.2) for 31.1 mm (1.22 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data
				DF300T/Z

CYLINDER/PISTON/PISTON RING

Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.085 – 0.105 (0.0033 – 0.0041)
		Limit	mm (in)	0.15 (0.0059)
Cylinder bore		STD	mm (in)	98.000 – 98.020 (3.8583 – 3.8591)
Cylinder measuring position			mm (in)	50 (1.969) from cylinder top surface
Piston skirt diameter		STD	mm (in)	97.905 – 97.925 (3.8545 – 3.8553)
Piston measuring position			mm (in)	11 (0.43) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.33 (0.008 – 0.013)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.33 – 0.48 (0.013 – 0.019)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 13.6 (0.54)
		Limit	mm (in)	10.9 (0.43)
	2nd	STD	mm (in)	Approx. 13.7 (0.54)
		Limit	mm (in)	10.9 (0.43)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.080 (0.0012 – 0.0031)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.25 (0.048 – 0.049)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	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)	1.17 – 1.19 (0.046 – 0.047)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.021 (0.0002 – 0.0008)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	21.993 – 22.000 (0.8659 – 0.8661)
		Limit	mm (in)	21.980 (0.8654)
Piston pin hole diameter		STD	mm (in)	22.006 – 22.014 (0.8664 – 0.8667)
		Limit	mm (in)	22.030 (0.8673)
Pin clearance in conrod small end		STD	mm (in)	0.010 – 0.025 (0.0004 – 0.0010)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)

Item		Unit	Data
			DF300T/Z

CRANKSHAFT/CONROD

Item		Unit	DF300T/Z
Conrod small end inside diameter	STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)
Conrod big end oil clearance	STD	mm (in)	0.045 – 0.063 (0.0018 – 0.0025)
	Limit	mm (in)	0.080 (0.0031)
Conrod big end inside diameter	STD	mm (in)	57.000 – 57.018 (2.2441 – 2.2448)
Crank pin outside diameter	STD	mm (in)	53.982 – 54.000 (2.1253 – 2.1260)
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.482 – 1.497 (0.0583 – 0.0589)
Conrod big end side clearance	STD	mm (in)	0.300 – 0.450 (0.0118 – 0.0177)
	Limit	mm (in)	0.550 (0.0217)
Conrod big end width	STD	mm (in)	20.750 – 20.800 (0.8169 – 0.8189)
Crank pin width	STD	mm (in)	21.100 – 21.200 (0.8307 – 0.8346)
Crankshaft center journal runout	Limit	mm (in.)	0.04 (0.002)
Crankshaft journal oil clearance	STD	mm (in)	0.030 – 0.048 (0.0012 – 0.0019)
	Limit	mm (in)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in)	75.000 – 75.018 (2.9528 – 2.9535)
Crankshaft journal outside diameter	STD	mm (in)	69.982 – 70.000 (2.7552 – 2.7559)
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	2.499 – 2.514 (0.0984 – 0.0990)
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 DF300T/Z

ELECTRICAL

Item		Unit	DF300T/Z
Ignition timing		Degrees at r/min	ATDC 5° – BTDC 24°
Over revolution limiter		r/min	6 400
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	—
	Secondary	kΩ at 20°C	—
Battery charge coil resistance		Ω at 20°C	0.21 – 0.32
Battery charge coil output (12 V)		Watt	648
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60, Throttle valve: 15 Starter motor: 30, Shift actuator: 15 Ignition coil, Injector, ECM: 30 PTT switch: 10 Isolator: 40
Recommended battery capacity (12 V)		Ah (kC)	130 (468) or larger
Fuel injector resistance		Ω at 20 °C	10 – 14
IAT sensor/Cylinder temp. sensor/ Ex. mani. temp. sensor (Thermistor characteristic)		kΩ at 25 °C	1.8 – 2.3
ECM main relay coil resistance		Ω at 20 °C	145 – 190
Starter motor relay coil resistance		Ω at 20 °C	145 – 190
PTT motor relay coil resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

Item		Unit	DF300T/Z
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 SPC system or in the signal from sensors, switches, etc., the code representing the failure is displayed in the digital display screen on the tachometer · monitor.

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVATING
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO
Rectifier & regulator (Over-charging)	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO
ESA ECM	8 – 1	NO
ESA motor	8 – 2	NO
ESA	8 – 3	NO

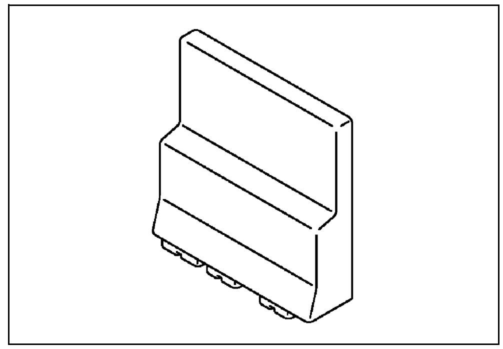
NOTE:

If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when "ENTER" key of tachometer · monitor is pressed.

ENGINE CONTROL

ECM

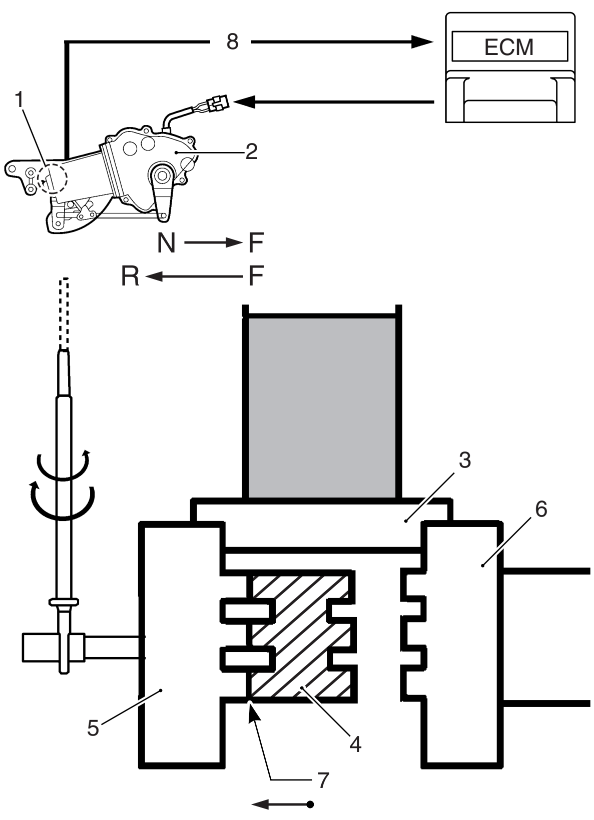
The program (internal circuit) of ECM has been changed.
This change is to add the shift learning function in the electronic shift system.



Early (’07 model) Part Number	Interchange-ability	Late (’08 model) Part Number
ECM (E01) 33920-98J00	No ← → No	33920-98J20
ECM (E03) 33920-98J10	No ← → No	33920-98J30

SHIFT LEARNING

A shift learning function is provided in the electronic shift system.
In this function, ECM calculates and controls the travel of clutch dog shifter so that the depth of gear engagement can be held optimum.



1. Shift position sensor
2. Shift actuator
3. Pinion gear
4. Clutch dog shifter
5. Forward gear
6. Reverse gear
7. Gear engagement start point
8. Gear engagement start voltage

Outline

The shift learning function is performed in such a process that it memorizes the gear engagement start voltage of the shift position sensor and on the basis of the memorized value, it determines the travel of clutch dog shifter for forward/reverse gear engagement.

The shift learning is performed when all the following conditions are met:

- The main switch is turned from ON to OFF and the engine has stopped;
- The cylinder temperature is 45°C or higher; and
- The battery voltage is 11.5 V or higher.

Operation of shift learning

- This control is performed in this manner:
  The system learns the position (the gear engagement start voltage of shift position sensor) at which the clutch dog tip has just contacted the other gear dog tip being engaged when the clutch lever is driven by the shift motor in the direction of Neutral → Forward → Reverse, thus determining the control voltage for forward and reverse shifting.
- The learned value is renewed when the voltage at which the dog has contacted is within the allowable range. (When the dog has encountered to engage with the gear completely, the learned value will not be renewed.)
- The learning is operated each time the power is turned from ON to OFF.

NOTE:

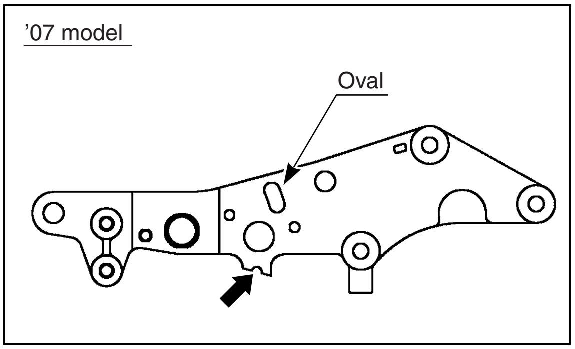
For ’08 model, the addition of shift learning function and the change of shift actuator holder shape have excluded the requirement of checking and adjusting “gear engagement start voltage of shift position sensor.” Instead of such a requirement, the sensor position should always be in a proper adjustment, that is the output voltage in neutral should come within the specification.

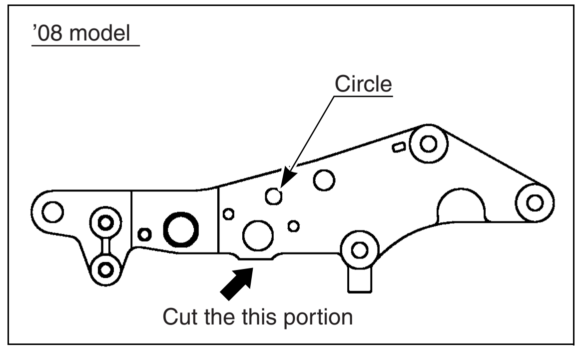
When the lower unit (including components) is replaced or when the shift linkage parts are replaced, perform the shift learning procedure several times during test run.

MID UNIT

SHIFT ACTUATOR HOLDER (CLUTCH LEVER HOLDER)

The shift actuator holder (Clutch lever holder) shape has been changed as shown in the illustration.





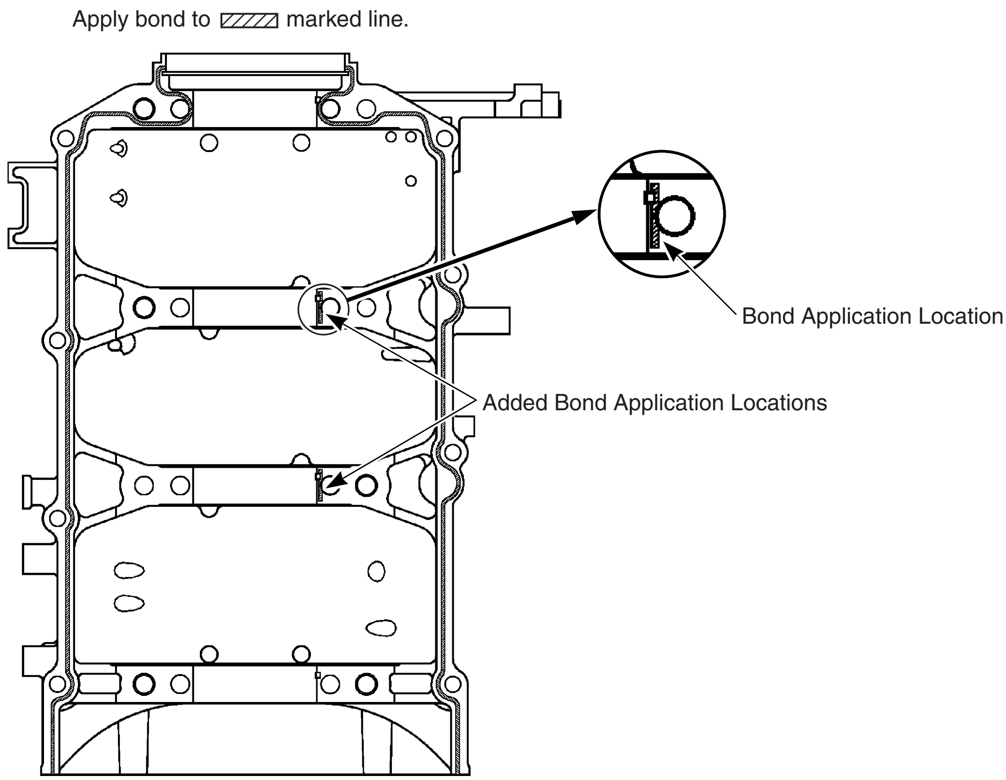
Early (’07 model) Part Number	Interchange-ability	Late (’08 model) Part Number
Holder, Clutch lever 19115-98J00	No ← → No	19115-98J10

NOTE:
The change of shift actuator holder is closely linked to the addition of shift learning function in ECM.
The shift actuator holder and ECM used must be in a proper matching appropriate for the model year.

POWER UNIT

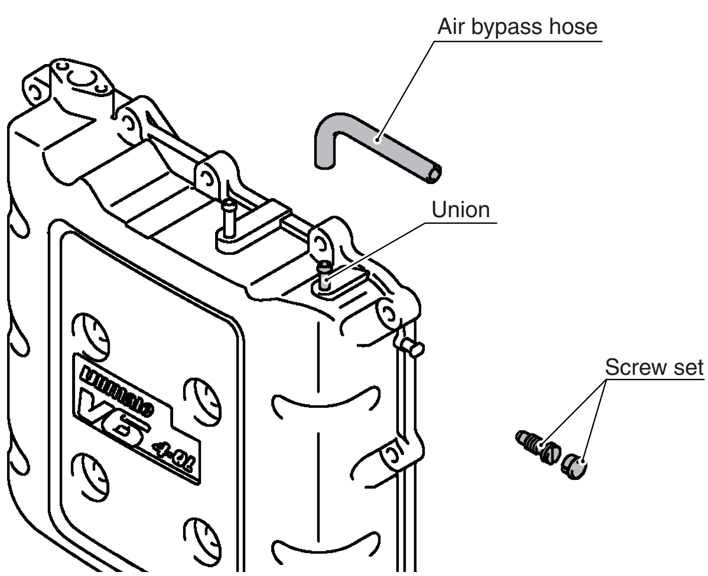
CRANKCASE

Some bond application locations are added on the crankcase.



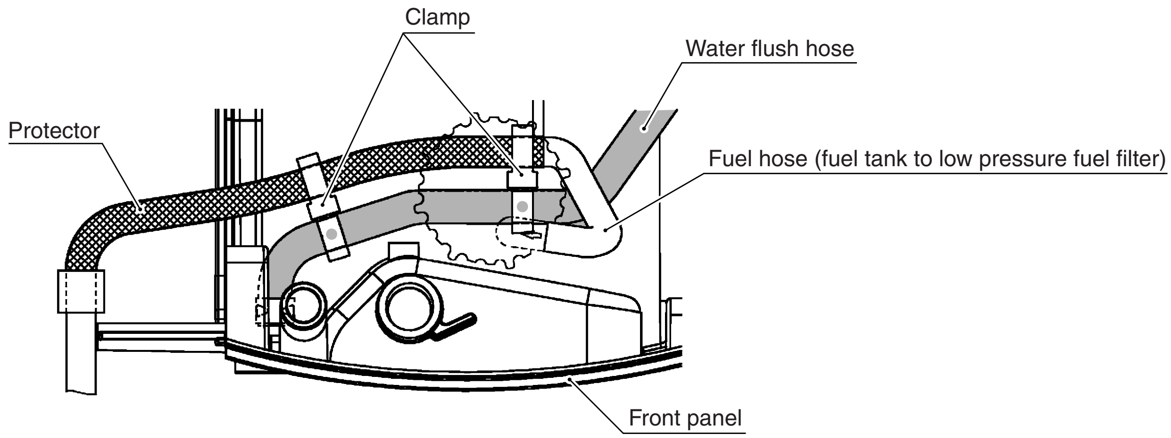
COLLECTOR COVER

The union, screw set and air bypass hose were eliminated from the collector cover.
In accordance with this eliminate, the collector cover has been changed in shape.



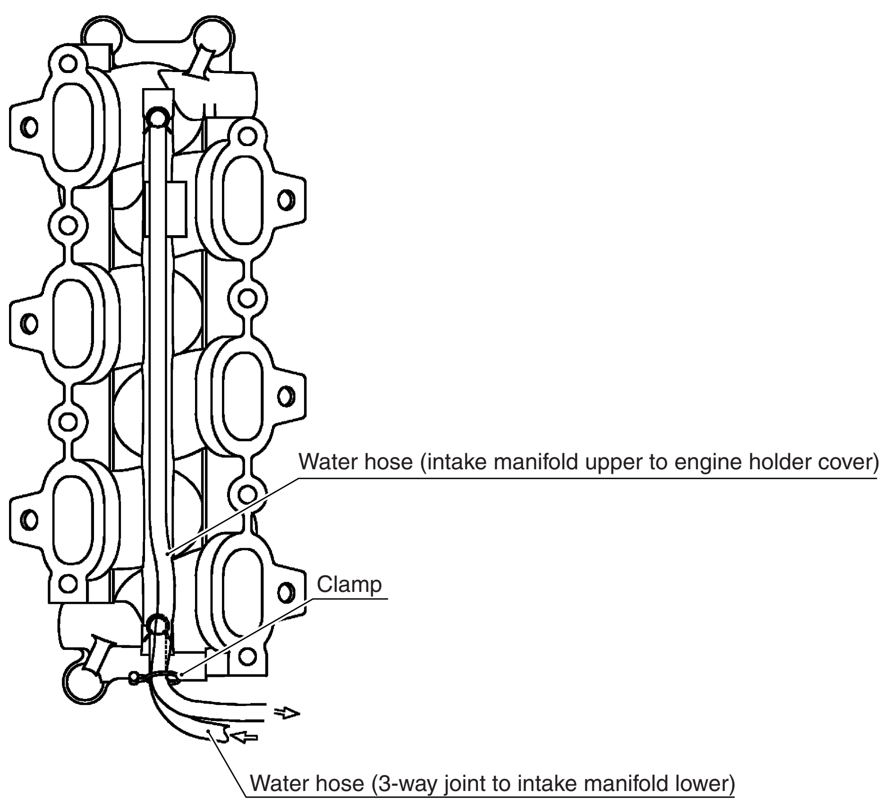
FUEL HOSE (Fuel tank to low pressure fuel filter)

A protector was added to the fuel hose (fuel tank to low pressure fuel filter).
Two clamps were added, the water hose and water flash hose were fixed by the clamps.



WATER HOSE

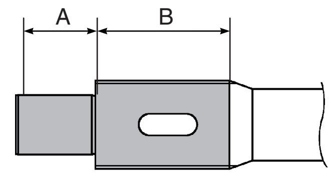
A clamp was added, the water hoses of intake manifold were fixed by the clamp.



LOWER UNIT

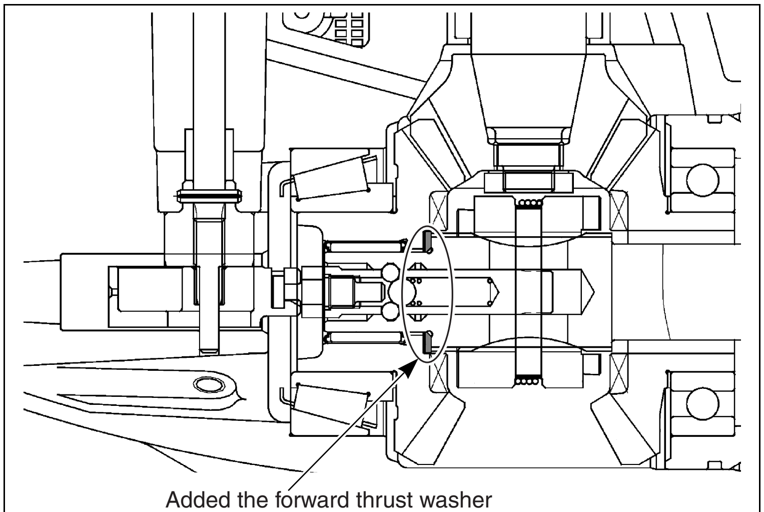
PROPELLER SHAFT/FORWARD THRUST WASHER

(Applicable to right hand rotation model)
The length of propeller shaft spline section where the shifter dog is installed has been changed as shown in the illustration.
With this change, the forward thrust washer has been added between the propeller shaft and forward gear as shown in the illustration.

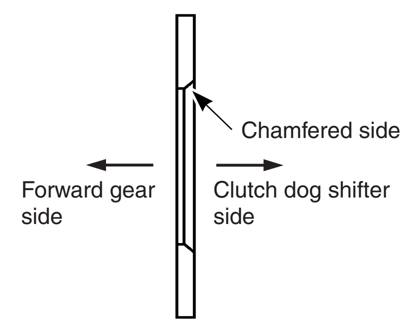


Unit: mm

	A	B
’07 model	31	59
’08 model	33.5	56.5



NOTE:
The chamfered side of forward thrust washer must face toward the clutch dog shifter.

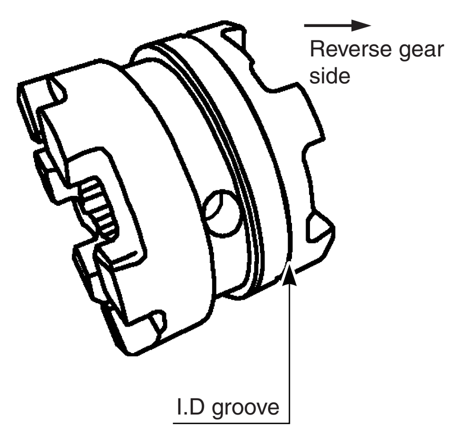


Early (’07 model) Part Number	Interchange-ability	Late (’08 model) Part Number
Propeller shaft 57610-98J00	Yes ← → No (as a set)	57610-98J20
Forward thrust washer —		09160-25019

CLUTCH DOG SHIFTER

To facilitate proper installation of the clutch dog shifter on the propeller shaft, an identifying groove is provided on the circumference of clutch dog shifter on the reverse side.

NOTE:
When installing the clutch dog shifter on the propeller shaft, the identification groove on clutch dog shifter must face toward the reverse gear as shown in the illustration.



DF300 “K9” (2009) MODEL

FOREWORD

This supplementary service manual describes the outline, technical data and servicing procedures for the “K9” (2009) model outboard motors.
Please read and thoroughly familiarize yourself with this information before using it for your service activities.

CONTENTS

* SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF300T	DF300Z
PRE-FIX			30001F	30001Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	953 (37.5)
Overall width (side to side)		mm (in)	564 (22.2)
Overall height	X	mm (in)	1 889 (74.4)
	XX	mm (in)	2 016 (79.4)
Weight (without engine oil)	X	kg (lbs)	274 (604.1)
	XX	kg (lbs)	279 (615.1)
Transom height	X	mm (in. type)	635 (25)
	XX	mm (in. type)	762 (30)

PERFORMANCE

Maximum output	kW (PS)	220.7 (300)
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)

POWER HEAD

Engine type		4-stroke DOHC
Number of cylinders		V-6
Bore	mm (in)	98 (3.86)
Stroke	mm (in)	89 (3.50)
Total displacement	cm^3 (cu. in)	4 028 (245.6)
Compression ratio	: 1	9.5
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		Electronic remote control

Item	Unit	Data	
		DF300T	DF300Z

FUEL & OIL

Item	Unit	DF300T	DF300Z
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 : SAE 10W-40 or NMMA FC-W 10W-40	
Engine oil amounts	L (US/Imp. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (Hypoid gear oil SAE90, API classification GL-5)	
Gearcase oil amounts	ml (US/Imp. oz)	1 100 (37.2/38.7)	

BRACKET

Item	Unit	DF300T	DF300Z
Trim angle	Degrees	0 – 19 (PTT system)	
Number of trim position		PTT system	
Maximum tilt angle	Degrees	70	

LOWER UNIT

Item	DF300T	DF300Z
Shift control	Electronic remote control	
Reversing system	Gear	
Transmission	Forward-Neutral-Reverse	
Reduction system	Bevel gear	
Gear ratio	12 : 20 (1.667)	
Drive line impact protection	Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)	Clockwise	Counterclockwise
Propeller	Blade × Dia. (in.) × Pitch (in.)	
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26 3 × 16 × 27 and 1/2	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26

Item	Unit	Data	
		DF300T	DF300Z

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	32 : 40 (1.250)
2nd reduction gear ratio (Lower unit gear)	12 : 20 (1.667)
Total reduction gear ratio	2.084 (40/32 × 20/12)

* SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data
		DF300T/Z

POWERHEAD

Item	Unit	DF300T/Z
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)
**Cylinder compression	kPa (kg/cm^2, psi)	1 100 – 1 500 (11 – 15, 156 – 213)
**Cylinder compression max. difference between cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm^2, psi)	400 – 600 (4.0 – 6.0, 57 – 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 : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/lpm. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data
				DF300T/Z

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.03 (0.001)
Manifold seating faces distortion		Limit	mm (in)	0.10 (0.004)
Cam height	IN	STD	mm (in)	45.330 – 45.490 (1.7846 – 1.7909)
		Limit	mm (in)	45.230 (1.7807)
	EX	STD	mm (in)	44.420 – 44.580 (1.7488 – 1.7551)
		Limit	mm (in)	44.320 (1.7449)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.043 – 0.085 (0.0017 – 0.0033)
		Limit	mm (in)	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	—
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	25.936 – 25.957 (1.0211 – 1.0219)
		Limit	mm (in)	—
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)	33.959 – 33.975 (1.3370 – 1.3376)
Cylinder head bore		STD	mm (in)	34.000 – 34.025 (1.3386 – 1.3396)

Item			Unit	Data DF300T/Z

VALVE/VALVE GUIDE

Valve diameter		IN	mm (in)	37.9 (1.49)
		EX	mm (in)	31.4 (1.24)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.33 – 0.37 (0.013 – 0.015)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°, 60°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN, EX	STD	mm (in)	11.4 – 11.8 (0.45 – 0.46)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem 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)	1.1 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.05 (0.04)
		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)	39.75 (1.56)
		Limit	mm (in)	38.2 (1.50)
Valve spring tension		STD	N (kg, lbs)	147 – 173 (14.7 – 17.3, 32.4 – 38.1) for 31.1 mm (1.22 in)
		Limit	N (kg, lbs)	136 (13.6, 30.0) for 31.1 mm (1.22 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data DF300T/Z

CYLINDER/PISTON/PISTON RING

Item			Unit	DF300T/Z
Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.085 – 0.105 (0.0033 – 0.0041)
		Limit	mm (in)	0.15 (0.0059)
Cylinder bore		STD	mm (in)	98.000 – 98.020 (3.8583 – 3.8591)
Cylinder measuring position			mm (in)	50 (1.969) from cylinder top surface
Piston skirt diameter		STD	mm (in)	97.905 – 97.925 (3.8545 – 3.8553)
Piston measuring position			mm (in)	11 (0.43) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.33 (0.008 – 0.013)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.33 – 0.48 (0.013 – 0.019)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 13.6 (0.54)
		Limit	mm (in)	10.9 (0.43)
	2nd	STD	mm (in)	Approx. 13.7 (0.54)
		Limit	mm (in)	10.9 (0.43)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.080 (0.0012 – 0.0031)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.25 (0.048 – 0.049)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	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)	1.17 – 1.19 (0.046 – 0.047)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.021 (0.0002 – 0.0008)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	21.993 – 22.000 (0.8659 – 0.8661)
		Limit	mm (in)	21.980 (0.8654)
Piston pin hole diameter		STD	mm (in)	22.006 – 22.014 (0.8664 – 0.8667)
		Limit	mm (in)	22.030 (0.8673)
Pin clearance in conrod small end		STD	mm (in)	0.010 – 0.025 (0.0004 – 0.0010)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)

Item		Unit	Data
			DF300T/Z

CRANKSHAFT/CONROD

Item		Unit	DF300T/Z
Conrod small end inside diameter	STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)
Conrod big end oil clearance	STD	mm (in)	0.045 – 0.063 (0.0018 – 0.0025)
	Limit	mm (in)	0.080 (0.0031)
Conrod big end inside diameter	STD	mm (in)	57.000 – 57.018 (2.2441 – 2.2448)
Crank pin outside diameter	STD	mm (in)	53.982 – 54.000 (2.1253 – 2.1260)
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.482 – 1.497 (0.0583 – 0.0589)
Conrod big end side clearance	STD	mm (in)	0.300 – 0.450 (0.0118 – 0.0177)
	Limit	mm (in)	0.550 (0.0217)
Conrod big end width	STD	mm (in)	20.750 – 20.800 (0.8169 – 0.8189)
Crank pin width	STD	mm (in)	21.100 – 21.200 (0.8307 – 0.8346)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
Crankshaft journal oil clearance	STD	mm (in)	0.030 – 0.048 (0.0012 – 0.0019)
	Limit	mm (in)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in)	75.000 – 75.018 (2.9528 – 2.9535)
Crankshaft journal outside diameter	STD	mm (in)	69.982 – 70.000 (2.7552 – 2.7559)
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	2.499 – 2.514 (0.0984 – 0.0990)
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 DF300T/Z

ELECTRICAL

Item		Unit	DF300T/Z
Ignition timing		Degrees	ATDC 5 – BTDC 24
Over revolution limiter		r/min	6 400
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	—
	Secondary	kΩ at 20°C	—
Battery charge coil resistance		Ω at 20°C	0.21 – 0.32
Battery charge coil output (12 V)		Watt	648
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60, Throttle valve: 15 Starter motor: 30, Shift actuator: 15 Ignition coil, Injector, ECM: 30 PTT switch: 10 Isolator: 40
Recommended battery capacity (12 V)		Ah (kC)	130 (468) or larger
Fuel injector resistance		Ω at 20 °C	10 – 14
IAT sensor/Cylinder temp. sensor/ Ex. mani. temp. sensor (Thermistor characteristic)		kΩ at 25 °C	1.8 – 2.3
ECM main relay coil resistance		Ω at 20 °C	145 – 190
Starter motor relay coil resistance		Ω at 20 °C	145 – 190
PTT motor relay coil resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

Item		Unit	DF300T/Z
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 SPC system or in the signal from sensors, switches, etc., the code representing the failure is displayed in the digital display screen on the tachometer-monitor.

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVATING
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO
Rectifier & regulator (Over-charging)	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO
ESA ECM	8 – 1	NO
ESA motor	8 – 2	NO
ESA	8 – 3	NO

NOTE:
If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when “ENTER” key of tachometer · monitor is pressed.

ENGINE CONTROL

ECM

As an ECM parameter for the actuator control, PTT relay has been added.
The ON/OFF signal for PTT UP or DOWN is inputted to ECM PTT relay drive circuit from ECM terminal No.16 or No.22. And the output signal from terminal No.82 or No.83 controls ON/OFF for PTT relay’s UP or DOWN circuit.

NOTE:

- *Due to addition of PTT relay control circuit in ECM, for the motor trim/tilt UP or DOWN, the battery voltage must be supplied to ECM with the sub battery cable connected to the main wiring harness.*
  Even through the PTT switch is depressed with only the main battery cable connected as in the current models, the PTT motor will not operate.
- *When the PTT switch located on the side cover is operated, the following operation takes place:*
  Even with the ignition switch in OFF, if only the PTT switch is operated, the tilt/trim can be moved UP or DOWN.
  With the ignition switch in OFF, operating the PTT switch wil cause it to supply a 12 V ON signal to ECM.
  With this signal received, ECM causes the main relay to be driven (ON), allowing the ECM drive signal to feedback to ECM and then the PTT relay circuit to be controlled.
  Thus the PTT system functions if only the PTT switch is operated.
  When the PTT switch signal turns from ON to OFF and a predetermined time has elapsed, the ECM drive voltage will be interrupted automatically.
- *To cause the trim/tilt to move UP/DOWN by operating the PTT switch that is located in the switch panel and the remote control box, it is necessary to turn the ignition switch ON. The reason for this is that 12 V will not be supplied to the PTT switch without turning the ignition switch ON.*

Part Name	Early Part Number	Interchangeability	Late Part Number
ECM (For E01)	33920-98J20	*-1	33920-98J40
ECM (E03 and E40)	33920-98J30	*-1	33920-98J50

*-1:
The combination of new wiring harness (P/no. 36610-98J10) and ECM as a set can be used in the early models.

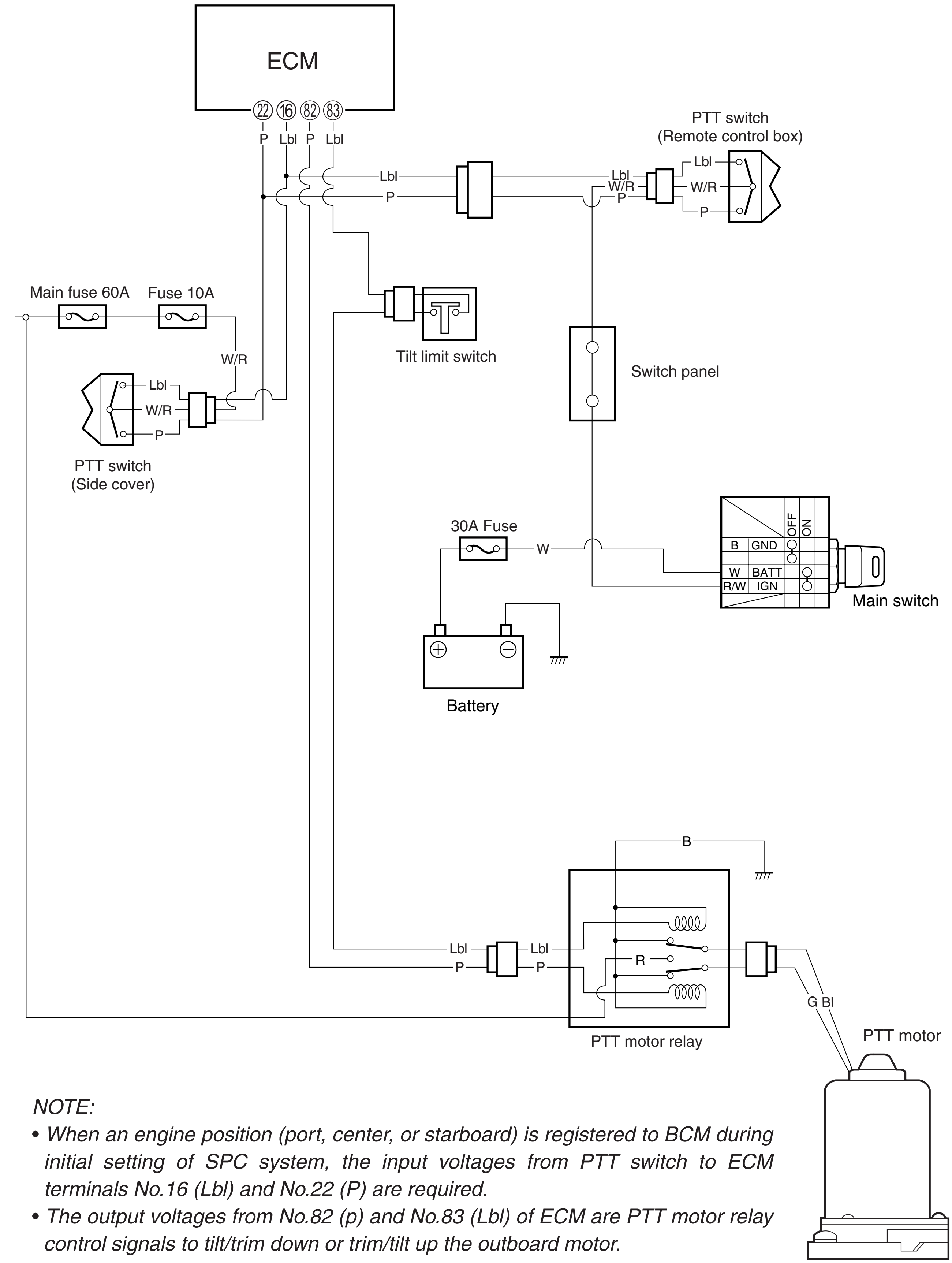
WIRING HARNESS

With the PTT relay control circuit incorporated in ECM, the PTT switch relay that was previously built in the wiring harness has been eliminated.

Part Name	Early Part Number	Interchangeability	Late Part Number
Wiring harness	36610-98J21	*-1	36610-98J10

*-1:
The combination of new wiring harness and ’09 model ECM as a set can be used in the early models.

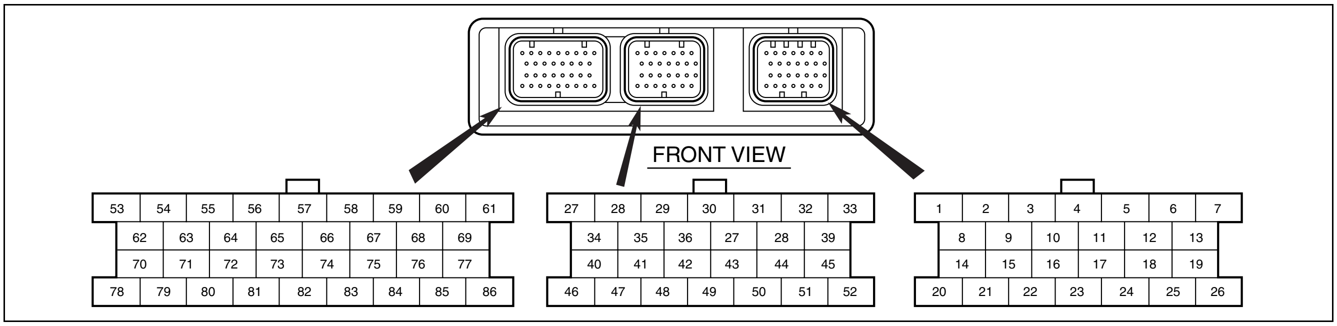
PTT SYSTEM WIRING DIAGRAM



NOTE:

- *When an engine position (port, center, or starboard) is registered to BCM during initial setting of SPC system, the input voltages from PTT switch to ECM terminals No.16 (Lbl) and No.22 (P) are required.*
- *The output voltages from No.82 (p) and No.83 (Lbl) of ECM are PTT motor relay control signals to tilt/trim down or trim/tilt up the outboard motor.*

ECM CONNECTOR/TERMINALS LAYOUT

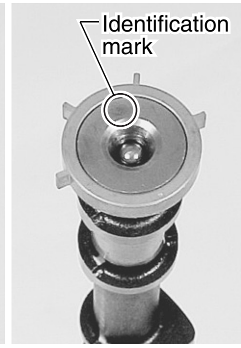


TERMINAL	WIRE COLOR	CIRCUIT
1	—	—
2	—	—
3	Y/Bl	CMP sensor #1
4	R/B	CKP sensor
5	V/W	Ex-manifold temp. sensor #1
6	B/W	Sensor GND
7	W	CAN (H)
8	Bl	Oil pressure switch
9	O/G	CMP sensor #2 (VVT_ PORT)
10	B/O	CMP sensor #3 (VVT_ STBD)
11	Bl/B	Water pressure sensor
12	G/R	Ex-manifold temp. sensor #2
13	B	CAN (L)
14	P/W	Throttle position sensor (Sub)
15	Bl/R	Emergency stop switch
16	Lbl	PTT switch UP
17	W/Y	Trim and tilt sensor
18	—	—
19	Lg/W	Cylinder temp. sensor
20	P/Bl	Shift position sensor
21	Br	Neutral/Cranking switch
22	P	PTT switch DOWN
23	G/B	Starter relay control
24	W	MAP sensor
25	Bl/W	Speed sensor
26	Lg/B	IAT sensor
27	—	—
28	—	—
29	Br/Y	Throttle position sensor (Main)
30	R/Bl	Power source for TPS
31	R/W	Power source for SPS
32	Br/B	Shift position sensor GND
33	B	Ground for ECM
34	G/Bl	Shift motor relay
35	—	—
36	—	—
37	—	—
38	B/W	Ground for TPS
39	B	Ground for ECM
40	Bl/Y	No.6 Ignition coil (–)
41	—	—
42	—	—
43	—	—
44	R	Power source for sensor
45	Gr	ECM power source
46	Lg/R	No.4 Ignition coil (–)
47	W/G	No.5 Ignition coil (–)
48	O	ECM main relay
49	Y	Communication line No.1
50	O/Y	Communication line No.2
51	Y/G	Ignition switch
52	Gr	ECM power source
53	Br/R	No.2 OCV (–)
54	Lg	No.4 Fuel injector (–)
55	O/B	No.1 Fuel injector (–)
56	B/Br	No.2 Fuel injector (–)
57	W/Bl	Throttle motor (–)
58	Y	Throttle motor power source
59	Y	Throttle motor power source
60	R/Y	Throttle motor (+)
61	G	Shift motor (–)
62	Br/W	No.1 OCV (–)
63	B	Ground for ECM power
64	—	—
65	B	Ground for throttle motor
66	B	Ground for throttle motor
67	B	Ground for shift motor
68	B	Ground for shift motor
69	Gr/R	Shift motor power source
70	B/R	High pressure fuel pump (–)
71	B	Ground for ECM power
72	—	—
73	Gr/Y	No.3 Ignition coil (–)
74	Bl	No.2 Ignition coil (–)
75	O	No.1 Ignition coil (–)
76	W/B	Throttle motor relay
77	Gr/R	Power source for shift motor
78	B/Y	Low pressure fuel pump (–)
79	R/W	No.3 Fuel injector (–)
80	Y/R	No.6 Fuel injector (–)
81	O/Bl	No.5 Fuel injector (–)
82	P	PTT relay switch (down)
83	Lbl	PTT relay switch (up)
84	O/W	Purge valve
85	—	— *Added*
86	R	Shift motor (+)

POWER UNIT

CAMSHAFT

For the reason of parts control, camshaft part number has been changed.
In accordance with this change, identification mark has also been changed from “8” to “9”.



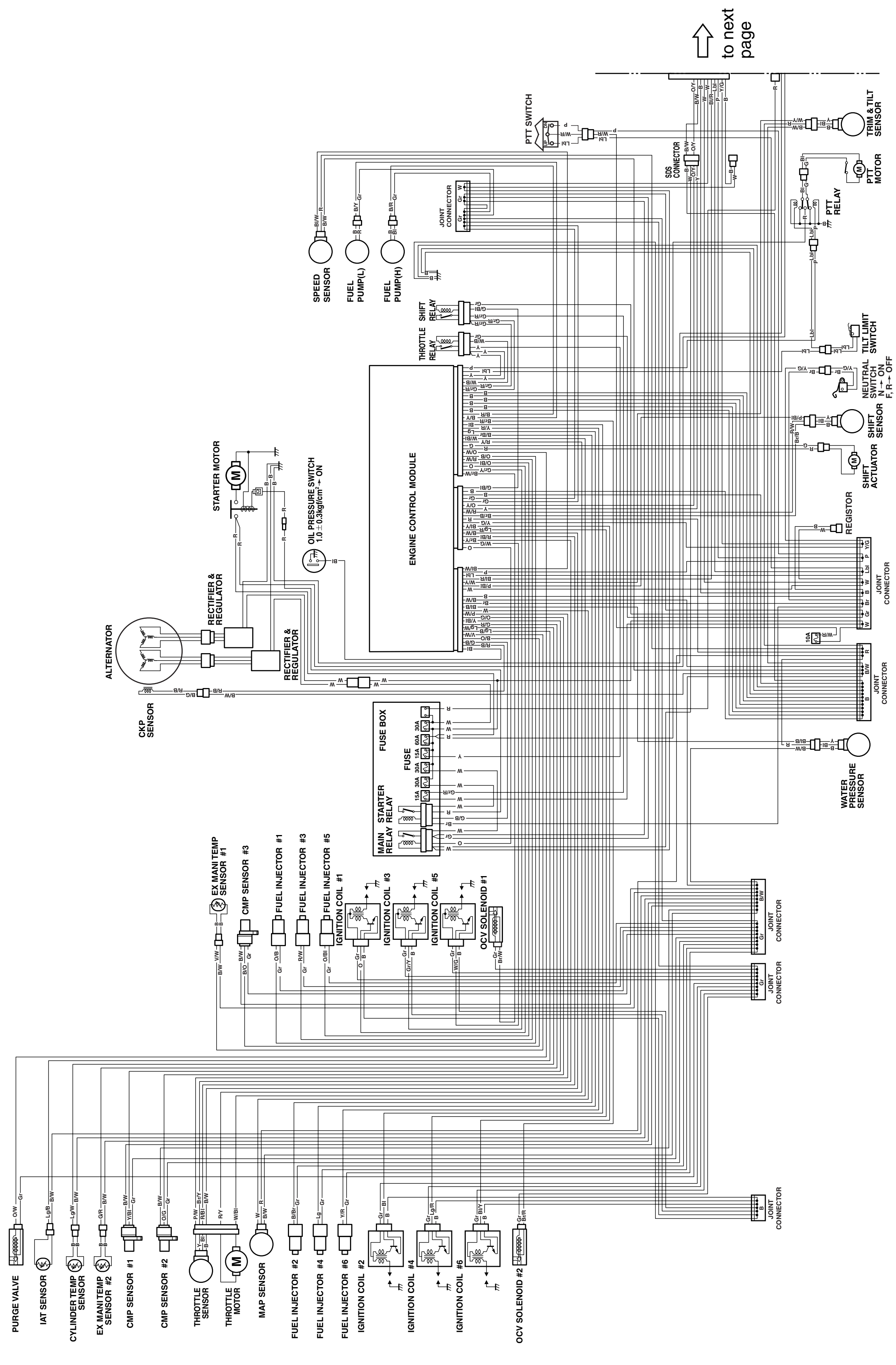
DF200, DF225, DF250 and DF300 camshafts differ as shown below.

Model	Intake	Exhaust
DF200	3	3
DF225	4	3
DF250	5	5
DF250S	9	9
DF300	9	9

Part Name	Early Part Number	Interchangeability	Late Part Number
Camshaft, Intake STBD	12701-98J00	Yes ← → No	12701-98J10
Camshaft, Intake PORT	12705-98J00	Yes ← → No	12705-98J10
Camshaft, Exhaust STBD	12721-98J00	Yes ← → No	12721-98J10
Camshaft, Exhaust PORT	12729-98J00	Yes ← → No	12729-98J10

WIRING DIAGRAM

DF300



WIRE COLOR

B : Black
Bl : Blue
Br : Brown
G : Green
Gr : Gray
Lbl : Light blue
Lg : Light green
O : Orange
P : Pink
R : Red
W : White
Y : Yellow
B/Br : Black with Brown tracer
B/G : Black with Green tracer
B/O : Black with Orange tracer
B/R : Black with Red tracer
B/W : Black with White tracer
B/Y : Black with Yellow tracer
Bl/B : Blue with Black tracer
Bl/R : Blue with Red tracer
Bl/W : Blue with White tracer
Bl/Y : Blue with Yellow tracer
Br/R : Brown with Red trancer
Br/W : Brown with White tracer
Br/Y : Brown with Yellow tracer
G/B : Green with Black tracer
G/Bl : Green with Blue tracer
G/R : Green with Red tracer
G/W : Green with White tracer
Gr/R : Gray with Red tracer
Gr/Y : Gray with Yellow tracer
Lbl/W : Light blue with White tracer
Lg/B : Light green with Black tracer
Lg/Bl : Light green with Blue tracer
Lg/G : Light green with Green tracer
Lg/R : Light green with Red tracer
Lg/W : Light green with White tracer
O/B : Orange with Black tracer
O/Bl : Orange with Blue tracer
O/G : Orange with Green tracer
O/R : Orange with Red tracer
O/W : Orange with White tracer
O/Y : Orange with Yellow tracer
P/B : Pink with Black tracer
P/Bl : Pink with Blue tracer
P/W : Pink with White tracer
R/B : Red with Black tracer
R/Bl : Red with Blue tracer
R/W : Red with White tracer
R/Y : Red with Yellow tracer
V/W : Violet with White tracer
W/B : White with Black tracer
W/Bl : White with Blue tracer
W/G : White with Green tracer
W/R : White with Red tracer
W/Y : White with Yellow tracer
Y/Bl : Yellow with Blue tracer
Y/G : Yellow with Green tracer
Y/R : Yellow with Red tracer

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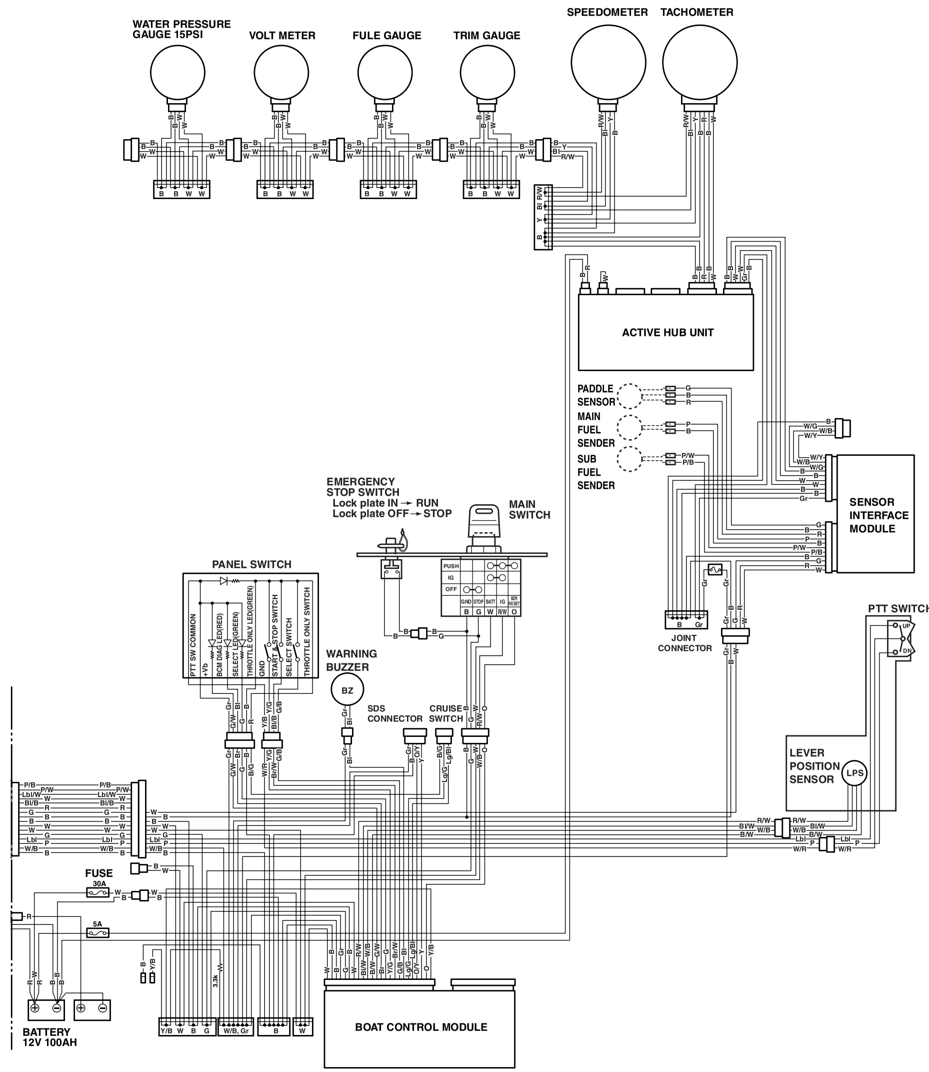

Prepared by

SUZUKI MOTOR CORPORATION

Service Department

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SUZUKI MOTOR CORPORATION

K7, K8, K9

DF300 "K10" (2010) MODEL

FOREWORD

This supplementary service manual describes the outline, technical data and servicing procedures for the "K10" (2010) model outboard motors.
Please read and thoroughly familiarize yourself with this information before using it for your service activities.

NOTE:
- *Use this supplement with the following service manual:*
  DF300 Service Manual (P/no, 99500-98J0 • -01E)
  DF300 Supplementary Service Manual for 2009 model (P/no, 99501-98J10-01E)
- *This Supplementary Service Manual describes the modification for 2009 model.*

CONTENTS

* SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF300T	DF300Z
PRE-FIX			30002F	30002Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	953 (37.5)	
Overall width (side to side)		mm (in)	564 (22.2)	
Overall height	X	mm (in)	1 889 (74.4)	
	XX	mm (in)	2 016 (79.4)	
Weight (without engine oil)	X	kg (lbs)	274 (604.1)	
	XX	kg (lbs)	279 (615.1)	
Transom height	X	mm (in. type)	635 (25)	
	XX	mm (in. type)	762 (30)	

PERFORMANCE

Maximum output	kW (PS)	220.7 (300)
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)

POWER HEAD

Engine type		4-stroke DOHC
Number of cylinders		V-6
Bore	mm (in)	98 (3.86)
Stroke	mm (in)	89 (3.50)
Total displacement	cm^3 (cu. in)	4 028 (245.6)
Compression ratio	: 1	9.5
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		Electronic remote control

Item	Unit	Data	
		DF300T	DF300Z

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 : SAE 10W-40 or NMMA FC-W 10W-40	
Engine oil amounts	L (US/Imp. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (Hypoid gear oil SAE90, API classification GL-5)	
Gearcase oil amounts	ml (US/Imp. oz)	1 100 (37.2/38.7)	

BRACKET

Trim angle	Degrees	0 – 19 (PTT system)	
Number of trim position		PTT system	
Maximum tilt angle	Degrees	70	

LOWER UNIT

Shift control	Electronic remote control	
Reversing system	Gear	
Transmission	Forward-Neutral-Reverse	
Reduction system	Bevel gear	
Gear ratio	12 : 20 (1.667)	
Drive line impact protection	Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)	Clockwise	Counterclockwise
Propeller	Blade × Dia. (in.) × Pitch (in.)	
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26 3 × 16 × 27 and 1/2	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26

Item	Unit	Data	
		DF300T	DF300Z

REDUCTION SYSTEM

Item	Unit	DF300T	DF300Z
1st reduction gear ratio (Crankshaft drive gear: Driven gear)		32 : 40 (1.250)	
2nd reduction gear ratio (Lower unit gear)		12 : 20 (1.667)	
Total reduction gear ratio		2.084 (40/32 × 20/12)	

* SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data
		DF300T/Z

POWERHEAD

Item	Unit	DF300T/Z
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)
**Cylinder compression	kPa (kg/cm², psi)	1 100 – 1 500 (11 – 15, 156 – 213)
**Cylinder compression max. difference between cylinders	kPa (kg/cm², psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm², psi)	400 – 600 (4.0 – 6.0, 57 – 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 : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/lpm. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data
				DF300T/Z

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.03 (0.001)
Manifold seating faces distortion		Limit	mm (in)	0.10 (0.004)
Cam height	IN	STD	mm (in)	45.330 – 45.490 (1.7846 – 1.7909)
		Limit	mm (in)	45.230 (1.7807)
	EX	STD	mm (in)	44.420 – 44.580 (1.7488 – 1.7551)
		Limit	mm (in)	44.320 (1.7449)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.043 – 0.085 (0.0017 – 0.0033)
		Limit	mm (in)	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	—
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	25.936 – 25.957 (1.0211 – 1.0219)
		Limit	mm (in)	—
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)	33.959 – 33.975 (1.3370 – 1.3376)
Cylinder head bore		STD	mm (in)	34.000 – 34.025 (1.3386 – 1.3396)

Item	Unit	Data
		DF300T/Z

VALVE/VALVE GUIDE

Item			Unit	DF300T/Z
Valve diameter	IN		mm (in)	37.9 (1.49)
	EX		mm (in)	31.4 (1.24)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.33 – 0.37 (0.013 – 0.015)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°, 60°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN, EX	STD	mm (in)	11.4 – 11.8 (0.45 – 0.46)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem 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)	1.1 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.05 (0.04)
		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)	39.75 (1.56)
		Limit	mm (in)	38.2 (1.50)
Valve spring tension		STD	N (kg, lbs)	147 – 173 (14.7 – 17.3, 32.4 – 38.1) for 31.1 mm (1.22 in)
		Limit	N (kg, lbs)	136 (13.6, 30.0) for 31.1 mm (1.22 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data
				DF300T/Z

CYLINDER/PISTON/PISTON RING

Item			Unit	DF300T/Z
Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.085 – 0.105 (0.0033 – 0.0041)
		Limit	mm (in)	0.15 (0.0059)
Cylinder bore		STD	mm (in)	98.000 – 98.020 (3.8583 – 3.8591)
Cylinder measuring position			mm (in)	50 (1.969) from cylinder top surface
Piston skirt diameter		STD	mm (in)	97.905 – 97.925 (3.8545 – 3.8553)
Piston measuring position			mm (in)	11 (0.43) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.40 (0.008 – 0.016)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.33 – 0.48 (0.013 – 0.019)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 13.6 (0.54)
		Limit	mm (in)	10.9 (0.43)
	2nd	STD	mm (in)	Approx. 13.7 (0.54)
		Limit	mm (in)	10.9 (0.43)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.080 (0.0012 – 0.0031)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.25 (0.048 – 0.049)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	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)	1.17 – 1.19 (0.046 – 0.047)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.021 (0.0002 – 0.0008)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	21.993 – 22.000 (0.8659 – 0.8661)
		Limit	mm (in)	21.980 (0.8654)
Piston pin hole diameter		STD	mm (in)	22.006 – 22.014 (0.8664 – 0.8667)
		Limit	mm (in)	22.030 (0.8673)
Pin clearance in conrod small end		STD	mm (in)	0.010 – 0.025 (0.0004 – 0.0010)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)

Item		Unit	Data
			DF300T/Z

CRANKSHAFT/CONROD

Conrod small end inside diameter	STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)
Conrod big end oil clearance	STD	mm (in)	0.045 – 0.063 (0.0018 – 0.0025)
	Limit	mm (in)	0.080 (0.0031)
Conrod big end inside diameter	STD	mm (in)	57.000 – 57.018 (2.2441 – 2.2448)
Crank pin outside diameter	STD	mm (in)	53.982 – 54.000 (2.1253 – 2.1260)
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.482 – 1.497 (0.0583 – 0.0589)
Conrod big end side clearance	STD	mm (in)	0.300 – 0.450 (0.0118 – 0.0177)
	Limit	mm (in)	0.550 (0.0217)
Conrod big end width	STD	mm (in)	20.750 – 20.800 (0.8169 – 0.8189)
Crank pin width	STD	mm (in)	21.100 – 21.200 (0.8307 – 0.8346)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
Crankshaft journal oil clearance	STD	mm (in)	0.030 – 0.048 (0.0012 – 0.0019)
	Limit	mm (in)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in)	75.000 – 75.018 (2.9528 – 2.9535)
Crankshaft journal outside diameter	STD	mm (in)	69.982 – 70.000 (2.7552 – 2.7559)
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	2.499 – 2.514 (0.0984 – 0.0990)
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
			DF300T/Z

ELECTRICAL

Item		Unit	DF300T/Z
Ignition timing		Degrees	ATDC 5 – BTDC 24
Over revolution limiter		r/min	6 400
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	—
	Secondary	kΩ at 20°C	—
Battery charge coil resistance		Ω at 20°C	0.21 – 0.32
Battery charge coil output (12 V)		Watt	648
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60, Throttle valve: 15 Starter motor: 30, Shift actuator: 15 Ignition coil, Injector, ECM: 30 PTT switch: 10 Isolator: 40
Recommended battery capacity (12 V)		Ah (kC)	130 (468) or larger
Fuel injector resistance		Ω at 20 °C	10 – 14
IAT sensor/Cylinder temp. sensor/ Ex. mani. temp. sensor (Thermistor characteristic)		kΩ at 25 °C	1.8 – 2.3
ECM main relay coil resistance		Ω at 20 °C	145 – 190
Starter motor relay coil resistance		Ω at 20 °C	145 – 190
PTT motor relay coil resistance		Ω at 20 °C	25 – 37

STARTER MOTOR

Item		Unit	DF300T/Z
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 SPC system or in the signal from sensors, switches, etc., the code representing the failure is displayed in the digital display screen on the tachometer-monitor.

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVATING
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO
Rectifier & regulator (Over-charging)	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil control valve (STBD)	6 – 1	NO
Oil pressure switch	5 – 3	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO
ESA ECM	8 – 1	NO
ESA motor	8 – 2	NO
ESA	8 – 3	NO

NOTE:

If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when “ENTER” key of tachometer · monitor is pressed.

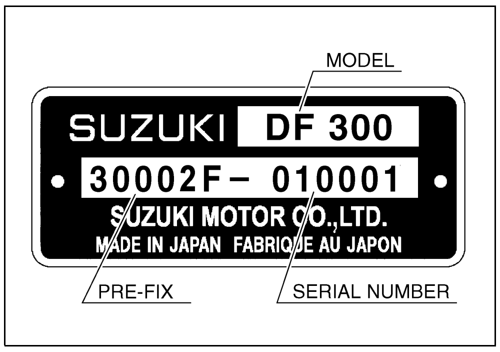
GENERAL INFORMATION

IDENTIFICATION NUMBER LOCATION

MODEL, PRE-FIX, SERIAL NUMBER

The model pre-fix has been changed as follows:

This change is effected in relation to manufacturing control and does not affect the basic performance of the outboard motor. The engine serial number starts from the following six-figure number located after the model pre-fix.



Model	Pre-fix	
	Early	Late
DF300	30001F	30002F
DF300Z	30001Z	30002Z

ENGINE CONTROL

ECM

The following have been added to the engine control functions.

1. The low oil pressure caution system and the overheat caution system have been modified.
   In addition to the previous controls, ECM automatically shuts off the engine if the engine continuously runs for three minutes after the caution control has been activated. This function has been already used on DF70A/80A/90A.
2. The oil pressure switch has been added to the failed item of self-diagnostic system. The diagnostic code is 5-3.
   This diagnostic code appears when the following malfunction occurs within the signal supplied from the oil pressure switch.

Condition:
When the ECM receives an “off” signal from the oil pressure switch while the engine is stopped and the ignition key is on.

NOTE:
- *This code is not displayed on the SDS screen.*
- *Diagnostic code 5-3 will be signaled by the caution buzzer only, not display on the LCD screen.*

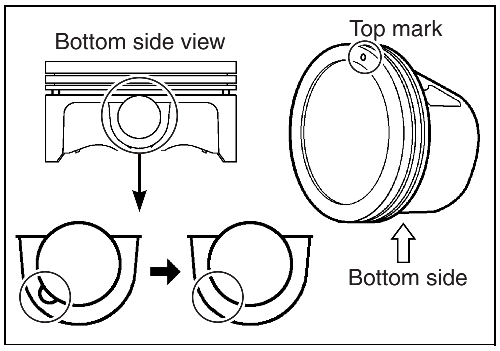
CKP SENSOR

This part has been modified for reasons of parts commonalization with other models.

POWER UNIT

PISTON

The groove on the piston for removing/installing the piston pin circlip at the bottom side has been eliminated.
Due to this modification, the removal/installation of piston pin circlip can be performed only from the top side of piston.



NOTE:
There is no change of part number due to this modification.

POWER TRIM AND TILT

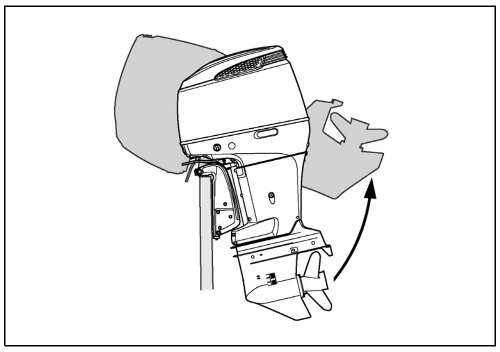
MOORING

At the time of mooring, retract the trim rod fully into the trim cylinder.
This will help prevent the trim rod from deteriorating (pitting corrosion).

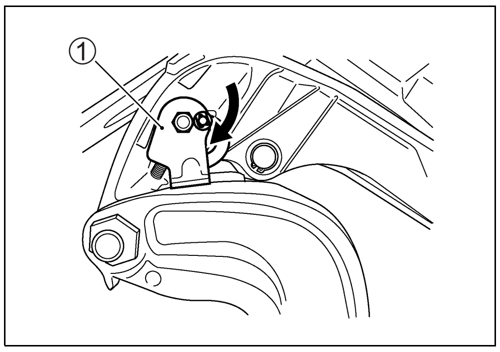
NOTE:
To prevent the tilt bracket from being damaged, avoid performing the same practice on 2009 year models or earlier.

To retract trim rods:

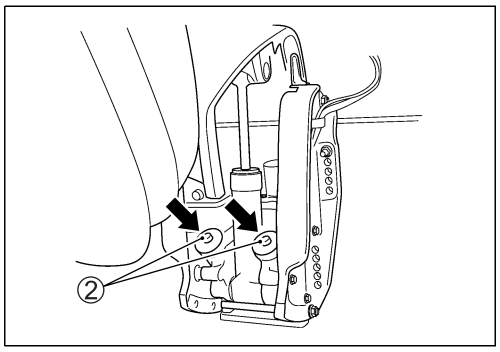
1. Tilt the motor fully by pressing the PTT "UP" switch.



2. Pull down the Tilt Lock Lever ① as shown in the illustration.
3. Lower the motor by pressing the PTT "DOWN" switch, until the motor is supported by the Tilt Lock Lever.



4. Continue, to operate the PTT "DOWN" switch until the trim rods ② are completely retracted



CAUTION

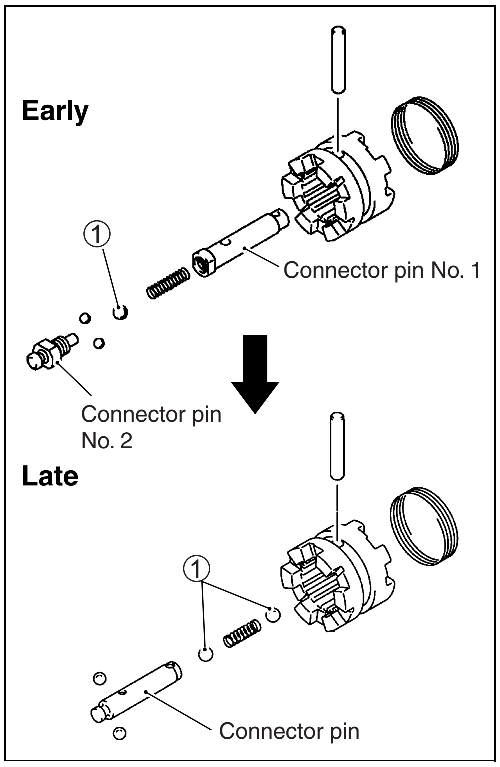
Be sure to retract the trim rods completely when mooring. This helps protect the trim rods from pitting corrosion.

NOTE:
For the detail, refer to previous service bulletin OF-305 dated Jan. 29, 2009.

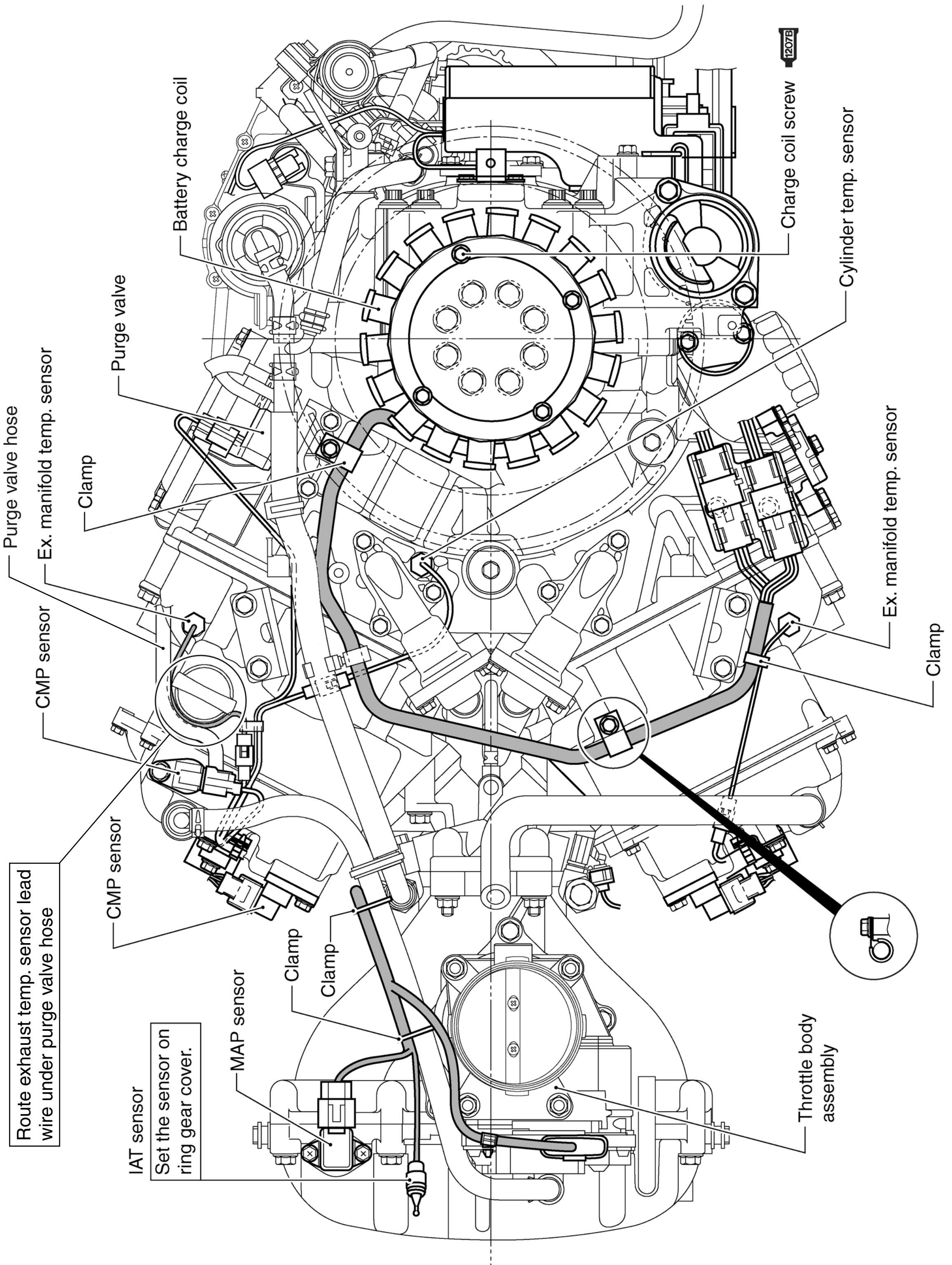
LOWER UNIT

CONNECTOR PIN

The connector pin has been modified from an assembly type to an integrated type.
Due to this modification, the number of detent balls ① used has been changed from one to two.



WIRE ROUTING



SUZUKI OUTBOARD MOTOR

DF 300

FOUR STROKE

SUPPLEMENTARY SERVICE MANUAL

Applicable model and effective serial number:
30002F-110001 and later
30002Z-110001 and later
Use this manual with:
99500-98J0●-01E

99501-98J30-01E

DF300 (30002F-110001 –, 30002Z-110001 –)

FOREWORD

This supplementary service manual describes the outline, technical data and servicing procedures for the following models.

- 30002F-110001 and later
- 30002Z-110001 and later

Please read and thoroughly familiarize yourself with this information before using it for your service activities.

NOTE:
- *Use this supplement with the following service manual:*
  DF300 Service Manual (P/no, 99500-98J0 • -01E)

CONTENTS

* SPECIFICATIONS

* These specifications are subject to change without notice.

Item		Unit	Data	
			DF300T	DF300Z
PRE-FIX			30002F	30002Z

DIMENSIONS & WEIGHT

Overall length (front to back)		mm (in)	953 (37.5)
Overall width (side to side)		mm (in)	564 (22.2)
Overall height	X	mm (in)	1 889 (74.4)
	XX	mm (in)	2 016 (79.4)
Weight (without engine oil)	X	kg (lbs)	274 (604.1)
	XX	kg (lbs)	279 (615.1)
Transom height	X	mm (in. type)	635 (25)
	XX	mm (in. type)	762 (30)

PERFORMANCE

Maximum output	kW (PS)	220.7 (300)
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)

POWER HEAD

Engine type		4-stroke DOHC
Number of cylinders		V-6
Bore	mm (in)	98 (3.86)
Stroke	mm (in)	89 (3.50)
Total displacement	cm^3 (cu. in)	4 028 (245.6)
Compression ratio	: 1	9.5
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		Electronic remote control

Item	Unit	Data	
		DF300T	DF300Z

FUEL & OIL

Item	Unit	DF300T	DF300Z
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 : SAE 10W-40 or NMMA FC-W 10W-40	
Engine oil amounts	L (US/Imp. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change	
Gear oil		SUZUKI Outboard Motor Gear Oil (Hypoid gear oil SAE90, API classification GL-5)	
Gearcase oil amounts	ml (US/Imp. oz)	1 100 (37.2/38.7)	

BRACKET

Item	Unit	DF300T	DF300Z
Trim angle	Degree	0 – 19 (PTT system)	
Number of trim position		PTT system	
Maximum tilt angle	Degree	70	

LOWER UNIT

Item	DF300T	DF300Z
Shift control	Electronic remote control	
Reversing system	Gear	
Transmission	Forward-Neutral-Reverse	
Reduction system	Bevel gear	
Gear ratio	12 : 20 (1.667)	
Drive line impact protection	Spline drive rubber hub	
Propeller shaft rotation (when shift into forward)	Clockwise	Counterclockwise
Propeller	Blade × Dia. (in.) × Pitch (in.)	
	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26 3 × 16 × 27 and 1/2	3 × 16 × 17 3 × 16 × 18 and 1/2 3 × 16 × 20 3 × 16 × 21 and 1/2 3 × 16 × 23 3 × 16 × 24 and 1/2 3 × 16 × 26

Item	Unit	Data	
		DF300T	DF300Z

REDUCTION SYSTEM

1st reduction gear ratio (Crankshaft drive gear: Driven gear)	32 : 40 (1.250)
2nd reduction gear ratio (Lower unit gear)	12 : 20 (1.667)
Total reduction gear ratio	2.084 (40/32 × 20/12)

* SERVICE DATA

* These service data are subject to change without notice.

Item	Unit	Data
		DF300T/Z

POWERHEAD

Item	Unit	DF300T/Z
Recommended operating range	r/min	5 700 – 6 300
Idle speed	r/min	650 ± 50 (in-gear: Approx. 650)
**Cylinder compression	kPa (kg/cm^2, psi)	1 100 – 1 500 (11 – 15, 156 – 213)
**Cylinder compression max. difference between cylinders	kPa (kg/cm^2, psi)	100 (1.0, 14)
**Engine oil pressure	kPa (kg/cm^2, psi)	400 – 600 (4.0 – 6.0, 57 – 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 : SAE 10W-40 or NMMA FC-W 10W-40
Engine oil amounts	L (US/lpm. qt)	8.0 (8.5/7.0) : Oil change only 8.2 (8.7/7.2) : Oil filter change
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)

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

Item			Unit	Data
				DF300T/Z

CYLINDER HEAD/CAMSHAFT

Cylinder head distortion		Limit	mm (in)	0.03 (0.001)
Manifold seating faces distortion		Limit	mm (in)	0.10 (0.004)
Cam height	IN	STD	mm (in)	45.330 – 45.490 (1.7846 – 1.7909)
		Limit	mm (in)	45.230 (1.7807)
	EX	STD	mm (in)	44.420 – 44.580 (1.7488 – 1.7551)
		Limit	mm (in)	44.320 (1.7449)
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th	STD	mm (in)	0.043 – 0.085 (0.0017 – 0.0033)
		Limit	mm (in)	0.120 (0.0047)
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	26.000 – 26.021 (1.0236 – 1.0244)
		Limit	mm (in)	—
Camshaft journal outside diameter	Top, 2nd, 3rd, 4th	STD	mm (in)	25.936 – 25.957 (1.0211 – 1.0219)
		Limit	mm (in)	—
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)	33.959 – 33.975 (1.3370 – 1.3376)
Cylinder head bore		STD	mm (in)	34.000 – 34.025 (1.3386 – 1.3396)

Item			Unit	Data DF300T/Z

VALVE/VALVE GUIDE

Item			Unit	DF300T/Z
Valve diameter		IN	mm (in)	37.9 (1.49)
		EX	mm (in)	31.4 (1.24)
Tappet clearance (Cold engine condition)	IN	STD	mm (in)	0.23 – 0.27 (0.009 – 0.011)
	EX	STD	mm (in)	0.33 – 0.37 (0.013 – 0.015)
Valve seat angle	IN		—	15°, 45°, 60°
	EX		—	15°, 45°, 60°
Valve guide to valve stem clearance	IN	STD	mm (in)	0.020 – 0.047 (0.0008 – 0.0019)
		Limit	mm (in)	0.070 (0.0028)
	EX	STD	mm (in)	0.045 – 0.072 (0.0018 – 0.0028)
		Limit	mm (in)	0.090 (0.0035)
Valve guide inside diameter	IN, EX	STD	mm (in)	5.500 – 5.512 (0.2165 – 0.2170)
Valve guide protrusion	IN, EX	STD	mm (in)	11.4 – 11.8 (0.45 – 0.46)
Valve stem outside diameter	IN	STD	mm (in)	5.465 – 5.480 (0.2152 – 0.2157)
	EX	STD	mm (in)	5.440 – 5.455 (0.2142 – 0.2148)
Valve stem 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)	1.1 (0.04)
		Limit	mm (in)	0.7 (0.03)
	EX	STD	mm (in)	1.05 (0.04)
		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)	39.75 (1.56)
		Limit	mm (in)	38.2 (1.50)
Valve spring tension		STD	N (kg, lbs)	147 – 173 (14.7 – 17.3, 32.4 – 38.1) for 31.1 mm (1.22 in)
		Limit	N (kg, lbs)	136 (13.6, 30.0) for 31.1 mm (1.22 in)
Valve spring squareness		Limit	mm (in)	2.0 (0.08)

Item			Unit	Data
				DF300T/Z

CYLINDER/PISTON/PISTON RING

Cylinder distortion		Limit	mm (in)	0.03 (0.001)
Piston to cylinder clearance		STD	mm (in)	0.085 – 0.105 (0.0033 – 0.0041)
		Limit	mm (in)	0.15 (0.0059)
Cylinder bore		STD	mm (in)	98.000 – 98.020 (3.8583 – 3.8591)
Cylinder measuring position			mm (in)	50 (1.969) from cylinder top surface
Piston skirt diameter		STD	mm (in)	97.905 – 97.925 (3.8545 – 3.8553)
Piston measuring position			mm (in)	11 (0.43) from piston skirt end
Cylinder bore wear		Limit	mm (in)	0.100 (0.0039)
Piston ring end gap	1st	STD	mm (in)	0.20 – 0.40 (0.008 – 0.016)
		Limit	mm (in)	0.70 (0.028)
	2nd	STD	mm (in)	0.33 – 0.48 (0.013 – 0.019)
		Limit	mm (in)	1.00 (0.039)
Piston ring free end gap	1st	STD	mm (in)	Approx. 13.6 (0.54)
		Limit	mm (in)	10.9 (0.43)
	2nd	STD	mm (in)	Approx. 13.7 (0.54)
		Limit	mm (in)	10.9 (0.43)
Piston ring to groove clearance	1st	STD	mm (in)	0.030 – 0.080 (0.0012 – 0.0031)
		Limit	mm (in)	0.12 (0.005)
	2nd	STD	mm (in)	0.020 – 0.060 (0.0008 – 0.0024)
		Limit	mm (in)	0.10 (0.004)
Piston ring groove width	1st	STD	mm (in)	1.22 – 1.25 (0.048 – 0.049)
	2nd	STD	mm (in)	1.21 – 1.23 (0.0476 – 0.0484)
	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)	1.17 – 1.19 (0.046 – 0.047)
Pin clearance in piston pin hole		STD	mm (in)	0.006 – 0.021 (0.0002 – 0.0008)
		Limit	mm (in)	0.040 (0.0016)
Piston pin outside diameter		STD	mm (in)	21.993 – 22.000 (0.8659 – 0.8661)
		Limit	mm (in)	21.980 (0.8654)
Piston pin hole diameter		STD	mm (in)	22.006 – 22.014 (0.8664 – 0.8667)
		Limit	mm (in)	22.030 (0.8673)
Pin clearance in conrod small end		STD	mm (in)	0.010 – 0.025 (0.0004 – 0.0010)
		Limit	mm (in)	0.050 (0.0020)
Conrod small end bore		STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)

Item		Unit	Data
			DF300T/Z

CRANKSHAFT/CONROD

Conrod small end inside diameter	STD	mm (in)	22.010 – 22.018 (0.8665 – 0.8668)
Conrod big end oil clearance	STD	mm (in)	0.045 – 0.063 (0.0018 – 0.0025)
	Limit	mm (in)	0.080 (0.0031)
Conrod big end inside diameter	STD	mm (in)	57.000 – 57.018 (2.2441 – 2.2448)
Crank pin outside diameter	STD	mm (in)	53.982 – 54.000 (2.1253 – 2.1260)
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Conrod bearing thickness	STD	mm (in)	1.482 – 1.497 (0.0583 – 0.0589)
Conrod big end side clearance	STD	mm (in)	0.300 – 0.450 (0.0118 – 0.0177)
	Limit	mm (in)	0.550 (0.0217)
Conrod big end width	STD	mm (in)	20.750 – 20.800 (0.8169 – 0.8189)
Crank pin width	STD	mm (in)	21.100 – 21.200 (0.8307 – 0.8346)
Crankshaft center journal runout	Limit	mm (in)	0.04 (0.002)
Crankshaft journal oil clearance	STD	mm (in)	0.030 – 0.048 (0.0012 – 0.0019)
	Limit	mm (in)	0.065 (0.0026)
Crankcase bearing holder inside diameter	STD	mm (in)	75.000 – 75.018 (2.9528 – 2.9535)
Crankshaft journal outside diameter	STD	mm (in)	69.982 – 70.000 (2.7552 – 2.7559)
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in)	0.010 (0.0004)
Crankshaft bearing thickness	STD	mm (in)	2.499 – 2.514 (0.0984 – 0.0990)
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
			DF300T/Z

ELECTRICAL

Ignition timing		Degree	BTDC 0 – BTDC 25
Over revolution limiter		r/min	6 400
CKP sensor resistance		Ω at 20°C	168 – 252
CMP sensor resistance		Ω at 20°C	—
Ignition coil resistance	Primary	Ω at 20°C	—
	Secondary	kΩ at 20°C	—
O_2 sensor heater resistance		Ω at 20°C	5.5 – 8.5
Battery charge coil resistance		Ω at 20°C	0.21 – 0.32
Battery charge coil output (12 V)		Watt	648
Standard spark plug	Type	NGK	BKR6E
	Gap	mm (in)	0.7 – 0.8 (0.028 – 0.031)
Fuse amp. rating		A	Main fuse: 60, Throttle valve: 15 Starter motor: 30, Shift actuator: 15 Ignition coil, Injector, ECM: 30 PTT switch: 10 Low pressure fuel pump: 15 Isolator: 40
Recommended battery capacity (12 V)		Ah (kC)	130 (468) or larger
Fuel injector resistance		Ω at 20 °C	10 – 14
IAT sensor/Cylinder temp. sensor/ Ex. mani. temp. sensor (Thermistor characteristic)		kΩ at 25 °C	1.8 – 2.3
ECM main relay coil resistance		Ω at 20 °C	145 – 190
Starter motor relay coil resistance		Ω at 20 °C	145 – 190
PTT motor relay coil resistance		Ω at 20 °C	25 – 37
O_2 sensor heater relay resistance		Ω at 20 °C	145 – 190

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

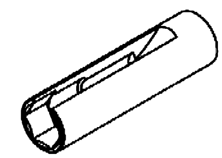
When the abnormality occurs in SPC system or in the signal from sensors, switches, etc., the code representing the failure is displayed in the screen on the SMIS 4" gauge.

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVATING
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO
Rectifier & regulator (Over-charging)	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
O_2 sensor	3 – 6	YES
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil pressure switch	5 – 3	NO
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO
ESA ECM	8 – 1	NO
ESA motor	8 – 2	NO
ESA	8 – 3	NO

NOTE:
If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when “PAGES/ENTER” key of the 4 inch gauge is pressed.

SPECIAL TOOLS

The special tool has been provided for removal and installation of the O_2 sensor.

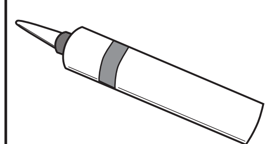


09933-39810
O_2 sensor socket

MATERIALS REQUIRED

The liquid gasket applied on mating surface of the crankcase and the cylinder has been changed from Suzuki Bond 1207B to 1217G.

SYMBOL	DEFINITION
1217G	Apply SUZUKI BOND "1217G" 99000-31260



99000-31260
Suzuki Bond 1217G
(500 g)

PERIODIC MAINTENANCE

MAINTENANCE AND TUNE-UP PROCEDURES

LOW PRESSURE FUEL FILTER

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

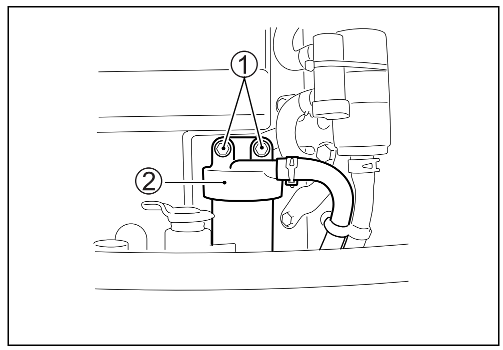
If leakage, cracks or other damage is found, replace the fuel filter.

Inspect and Cleaning

⚠ WARNING

- **Stop the motor before cleaning the fuel filter.**
- **Do not smoke and keep open flames and sparks away while working near any part of the fuel system.**

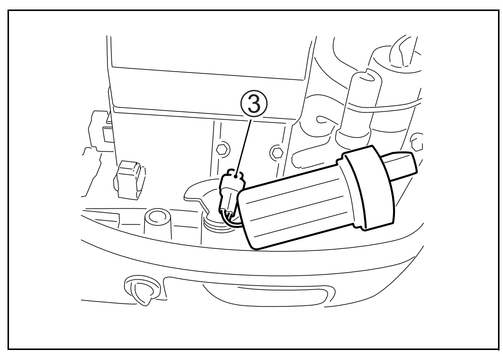
1. Turn the engine off.
2. Remove the two bolts ① securing the fuel filter cap ② and remove the fuel filter.



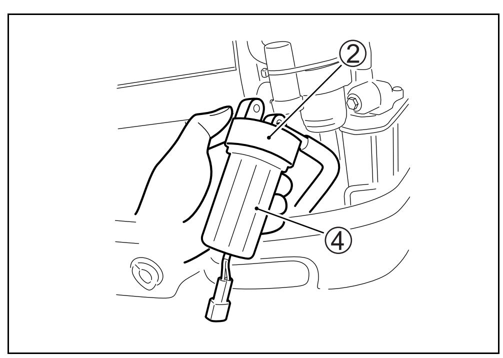
CAUTION

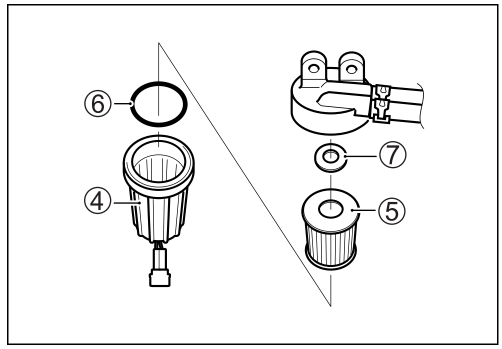
Improperly loosening the filter cup can cause sensor lead wire damage.
- **Be careful not to twist the sensor lead wire when removing the filter cup.**
- **Disconnect the lead wire connector before removing the filter cup.**

3. Disconnect the water in fuel sensor lead wire connector ③.

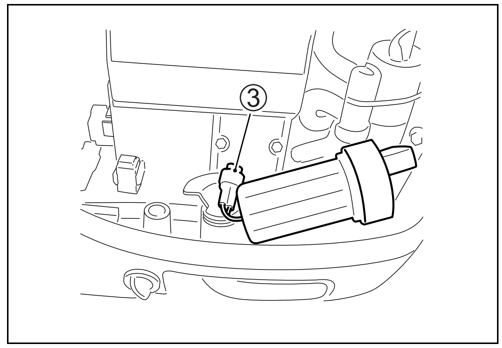


4. Separate the fuel filter cup ④ from the fuel filter cap ② by turning the fuel filter cup counterclockwise.

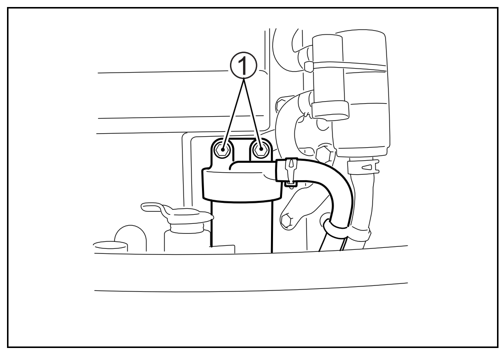




5. Drain the fuel and water in the fuel filter cup ④ into a suitable container.
6. Pull out the filter element ⑤.
7. Inspect the filter element ⑤, O-ring ⑥ and seal ring ⑦ for damage. If they are damaged, replace them.
8. Wash the filter element ⑤ with clean solvent and dry it.
9. Reinstall the seal ring ⑦ and filter element ⑤ in their original positions.
10. Verify that the O-ring ⑥ is in place in the top of the filter cup ④ and screw the filter cup back into place.
11. Connect the water in fuel sensor lead wire connector ③.



12. Reinstall the fuel filter with the attaching bolts ①.

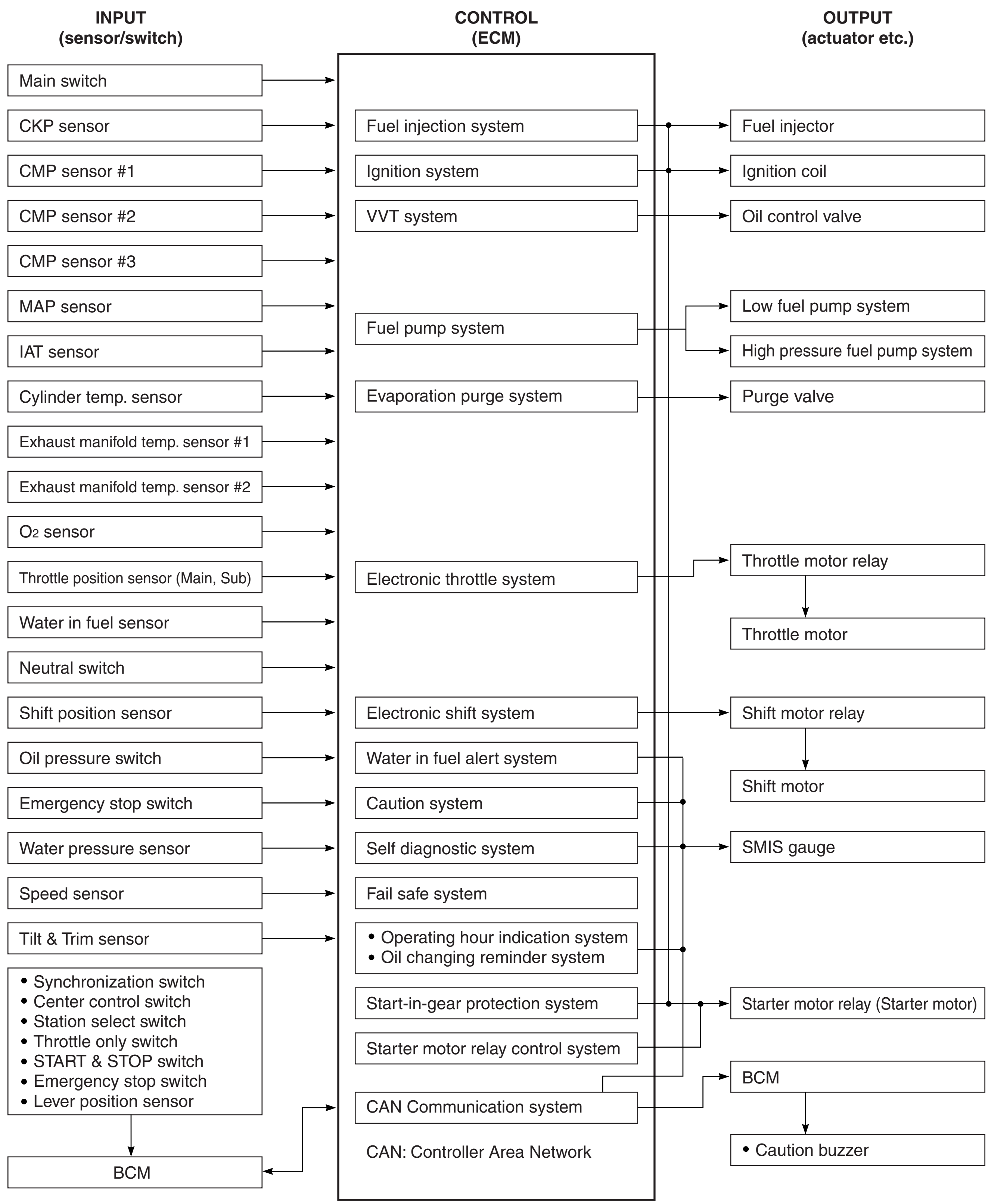


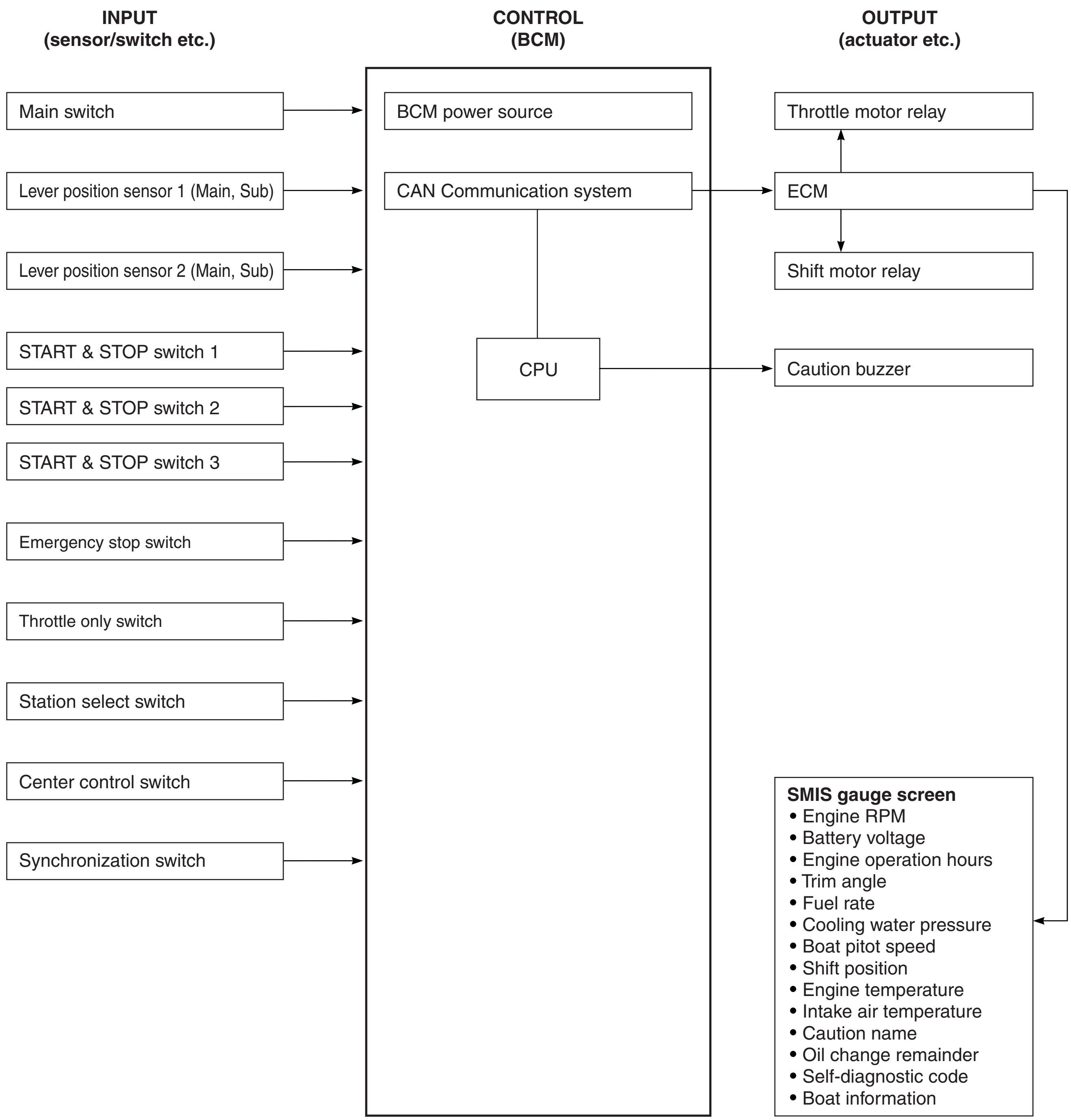
13. Restart the engine and check that there are no leaks around the fuel filter.

ENGINE CONTROL SYSTEM

ENGINE CONTROL SYSTEM STRUCTURE

In addition to the existing sensor in the engine control system, the O_2 sensor and the water in fuel sensor have been installed.




INPUT
(sensor/switch etc.)
CONTROL
(BCM)
OUTPUT
(actuator etc.)
Main switch
Lever position sensor 1 (Main, Sub)
Lever position sensor 2 (Main, Sub)
START & STOP switch 1
START & STOP switch 2
START & STOP switch 3
Emergency stop switch
Throttle only switch
Station select switch
Center control switch
Synchronization switch
BCM power source
CAN Communication system
CPU
Throttle motor relay
ECM
Shift motor relay
Caution buzzer
SMIS gauge screen
• Engine RPM
• Battery voltage
• Engine operation hours
• Trim angle
• Fuel rate
• Cooling water pressure
• Boat pitot speed
• Shift position
• Engine temperature
• Intake air temperature
• Caution name
• Oil change remainder
• Self-diagnostic code
• Boat information

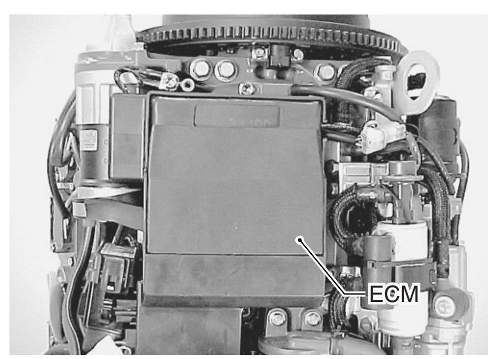
COMPONENTS FOR SYSTEM CONTROL

ENGINE CONTROL MODULE (ECM)

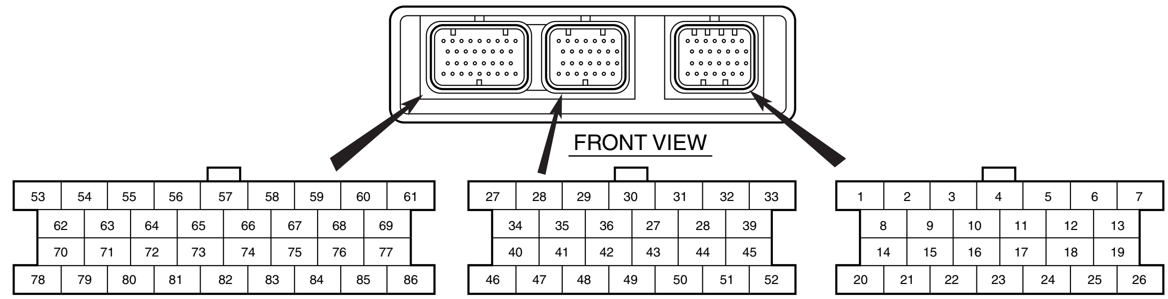
Due to addition of the "Water in fuel alert system" in the engine control system, the major controls of ECM are as follows:

NAME OF CONTROL	DESCRIPTION
Fuel injection control	• Controls fuel injection amount and timing.
Ignition control	• Controls ignition timing.
Electronic throttle system	• Controls engine speed by adjusting intake air amount through electronic throttle system.
VVT system	• Controls intake cam valve timing through OCV (Oil control valve).
Fuel pump control	• Controls high pressure fuel pump drive. • Controls Low pressure fuel pump drive.
Evaporation purge system	• Discharges vapor generated within fuel vapor separator to air intake silencer case by controlling purge valve.
Water in fuel alert system	• Informs operator of water accumulates in the fuel filter.
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 with back-up system during sensor/switch malfunction.
Total operating hour indication system control	• Informs operator of total operating time.
Oil changing reminder system control	• Informs operator of time for replacing engine oil on the basis of the maintenance schedule.
Start-in-gear protection system control	• Prevents engine start when shift is positioned in forward or reverse.
Starter motor relay control system	• Prevents starter motor operation when engine is already operating.
Electronic gear shift system	• Controls gear shifting by controlling shift actuator.
CAN communication system	• ECM and BCM communicate control data between each module. Communication is established by CAN (Controller Area Network) communication system.

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



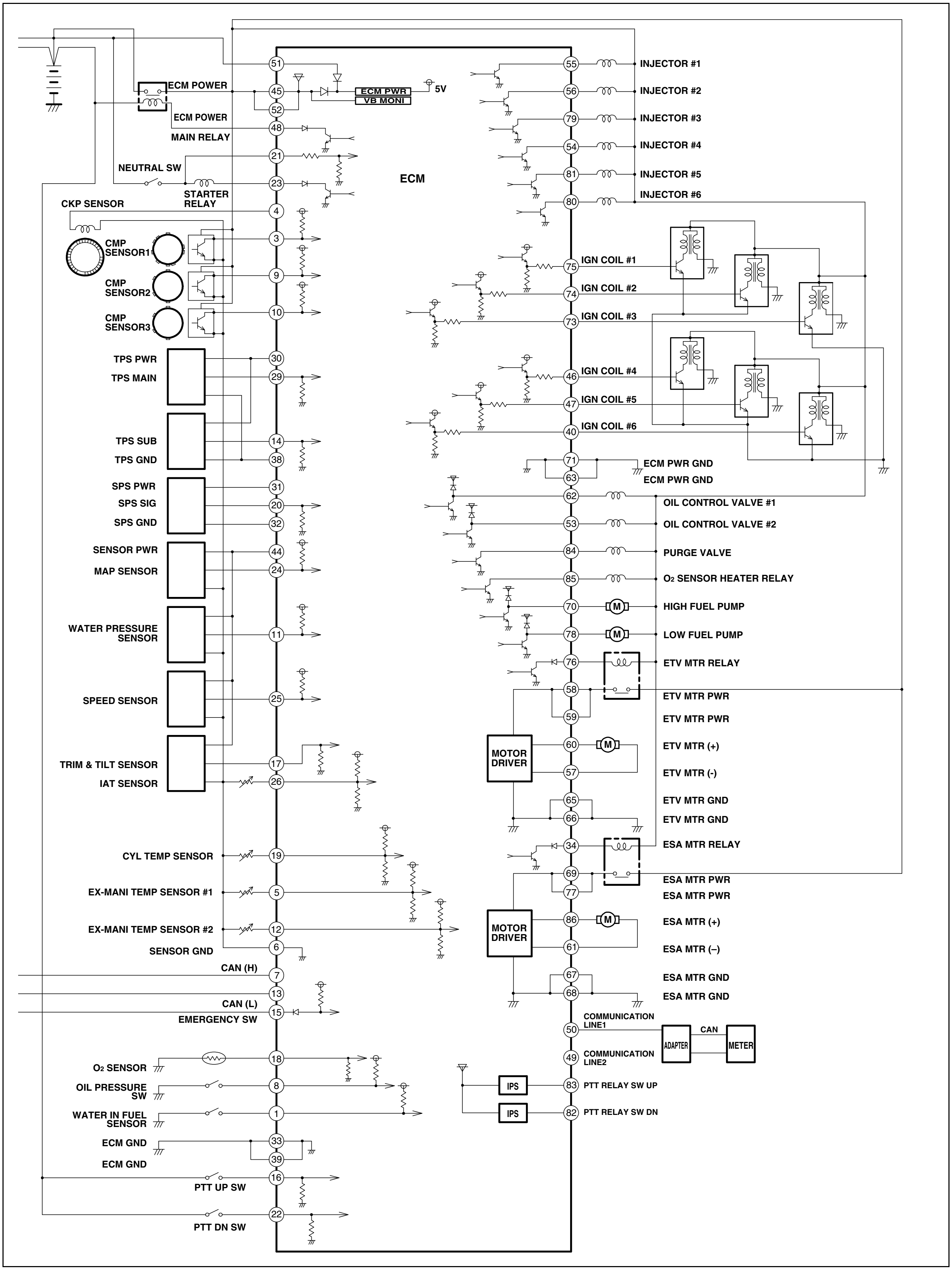
ECM CONNECTOR/TERMINALS LAYOUT



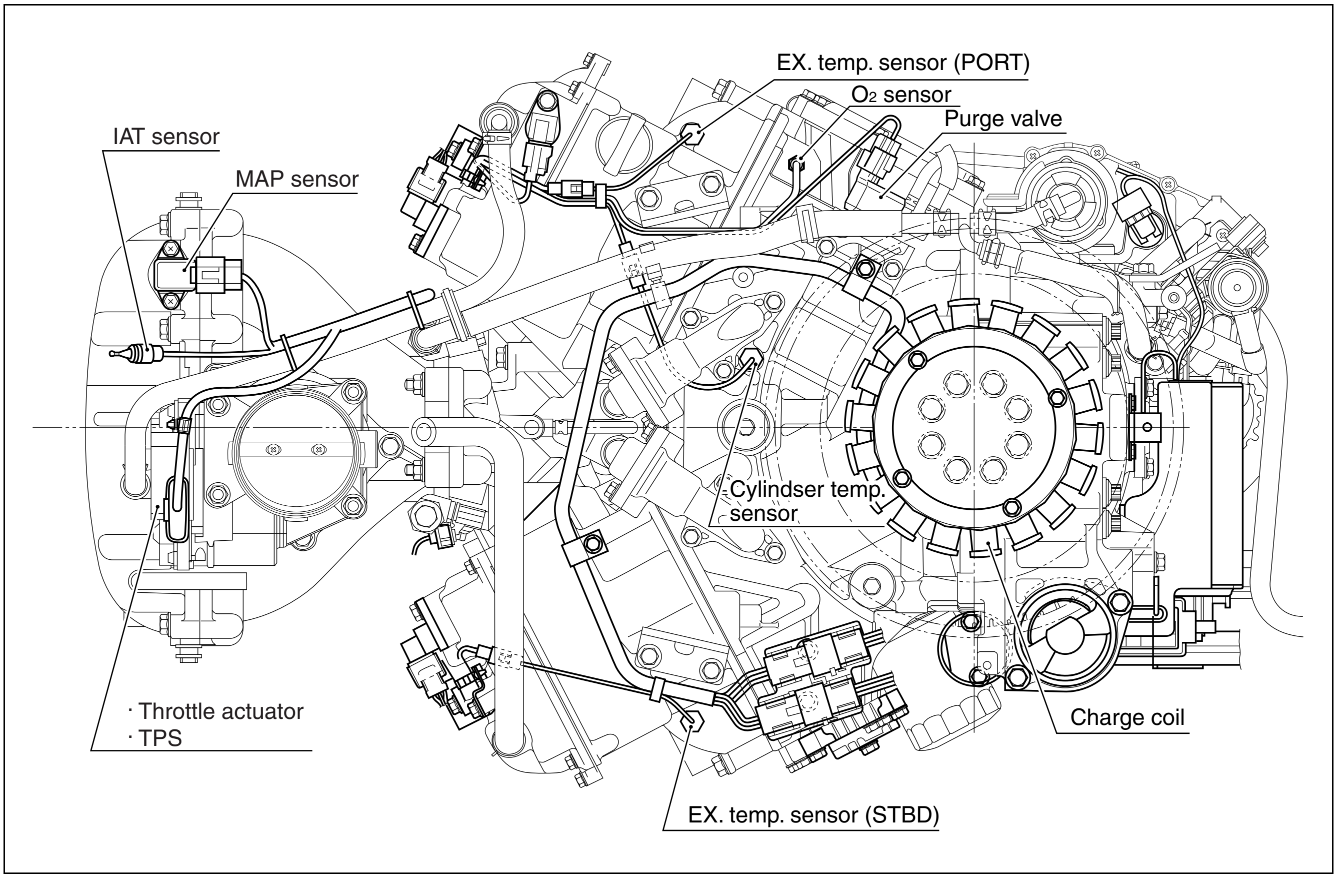
TERMINAL	WIRE COLOR	CIRCUIT
1	R/Bl	Water in fuel sensor
2	—	—
3	Y/Bl	CMP sensor #1
4	R/B	CKP sensor
5	V/W	Ex-manifold temp. sensor #1
6	B/W	Sensor GND
7	W	CAN (H)
8	Bl	Oil pressure switch
9	O/G	CMP sensor #2 (VVT_ PORT)
10	B/O	CMP sensor #3 (VVT_ STBD)
11	Bl/B	Water pressure sensor
12	G/R	Ex-manifold temp. sensor #2
13	B	CAN (L)
14	P/W	Throttle position sensor (Sub)
15	Bl/R	Emergency stop switch
16	Lbl	PTT switch UP
17	W/Y	Trim and tilt sensor
18	Gr/R	O_2 sensor
19	Lg/W	Cylinder temp. sensor
20	P/Bl	Shift position sensor
21	Br	Neutral/Cranking switch
22	P	PTT switch DOWN
23	G/B	Starter relay control
24	W	MAP sensor
25	Bl/W	Speed sensor
26	Lg/B	IAT sensor
27	—	—
28	—	—
29	Br/Y	Throttle position sensor (Main)
30	R/Bl	Power source for TPS
31	R/W	Power source for SPS
32	Br/B	Shift position sensor GND
33	B	Ground for ECM
34	G/Bl	Shift motor relay
35	—	—
36	—	—
37	—	—
38	B/W	Ground for TPS
39	B	Ground for ECM
40	Bl/Y	No.6 Ignition coil (–)
41	—	—
42	—	—
43	—	—

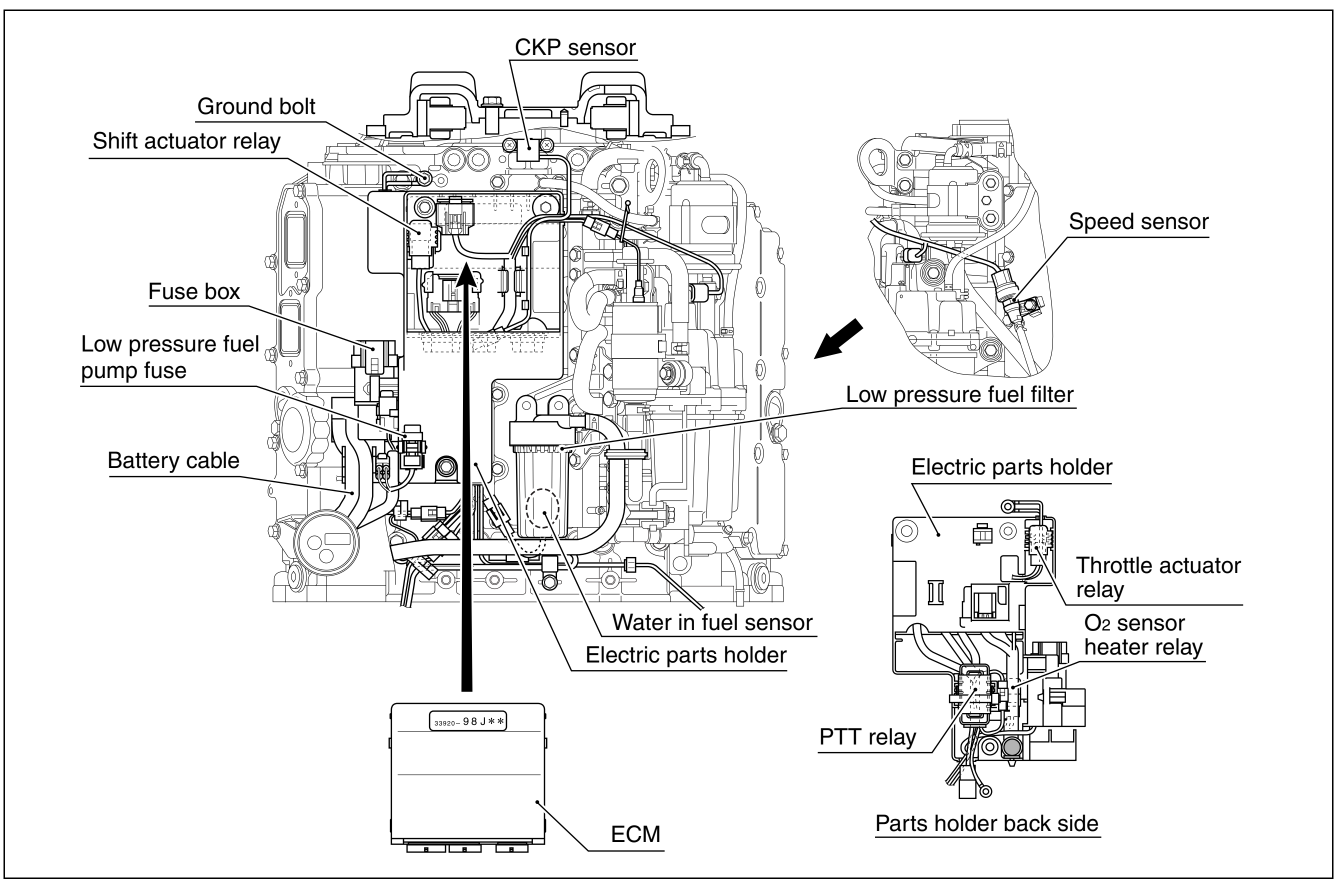
TERMINAL	WIRE COLOR	CIRCUIT
44	R	Power source for sensor
45	Gr	ECM power source
46	Lg/R	No.4 Ignition coil (–)
47	W/G	No.5 Ignition coil (–)
48	O	ECM main relay
49	Y	Communication line No.2
50	O/Y	Communication line No.1
51	Y/G	Ignition switch
52	Gr	ECM power source
53	Br/R	No.2 OCV (–)
54	Lg	No.4 Fuel injector (–)
55	O/B	No.1 Fuel injector (–)
56	B/Br	No.2 Fuel injector (–)
57	W/Bl	Throttle motor (–)
58	Y	Throttle motor power source
59	Y	Throttle motor power source
60	R/Y	Throttle motor (+)
61	G	Shift motor (–)
62	Br/W	No.1 OCV (–)
63	B	Ground for ECM power
64	—	—
65	B	Ground for throttle motor
66	B	Ground for throttle motor
67	B	Ground for shift motor
68	B	Ground for shift motor
69	Gr/R	Shift motor power source
70	B/R	High pressure fuel pump (–)
71	B	Ground for ECM power
72	—	—
73	Gr/Y	No.3 Ignition coil (–)
74	Bl	No.2 Ignition coil (–)
75	O	No.1 Ignition coil (–)
76	W/B	Throttle motor relay
77	Gr/R	Power source for shift motor
78	B/Y	Low pressure fuel pump (–)
79	R/W	No.3 Fuel injector (–)
80	Y/R	No.6 Fuel injector (–)
81	O/Bl	No.5 Fuel injector (–)
82	P	PTT relay switch (down)
83	Lbl	PTT relay switch (up)
84	O/W	Purge valve
85	Lg/R	O_2 sensor heater relay
86	R	Shift motor (+)

ECM INTERNAL STRUCTURE



LOCATION OF SENSOR AND SWITCH





SENSOR AND SWITCH

CKP (Crankshaft Position) SENSOR/Flywheel

The flywheel magneto has been changed and the number of the reluctor bars has been changed from 34 to 30.

There are 30 reluctor bars. They are located 10 degrees apart, except at three positions where they are 30 degrees apart. During one crankshaft rotation, 30 signals are input to the ECM.

- **Failure symptom:**
  Without the CKP sensor signal input, the ECM does not output the ignition and fuel injection signals.

CMP (Camshaft Position) SENSOR #1/PORT Ex. Camshaft

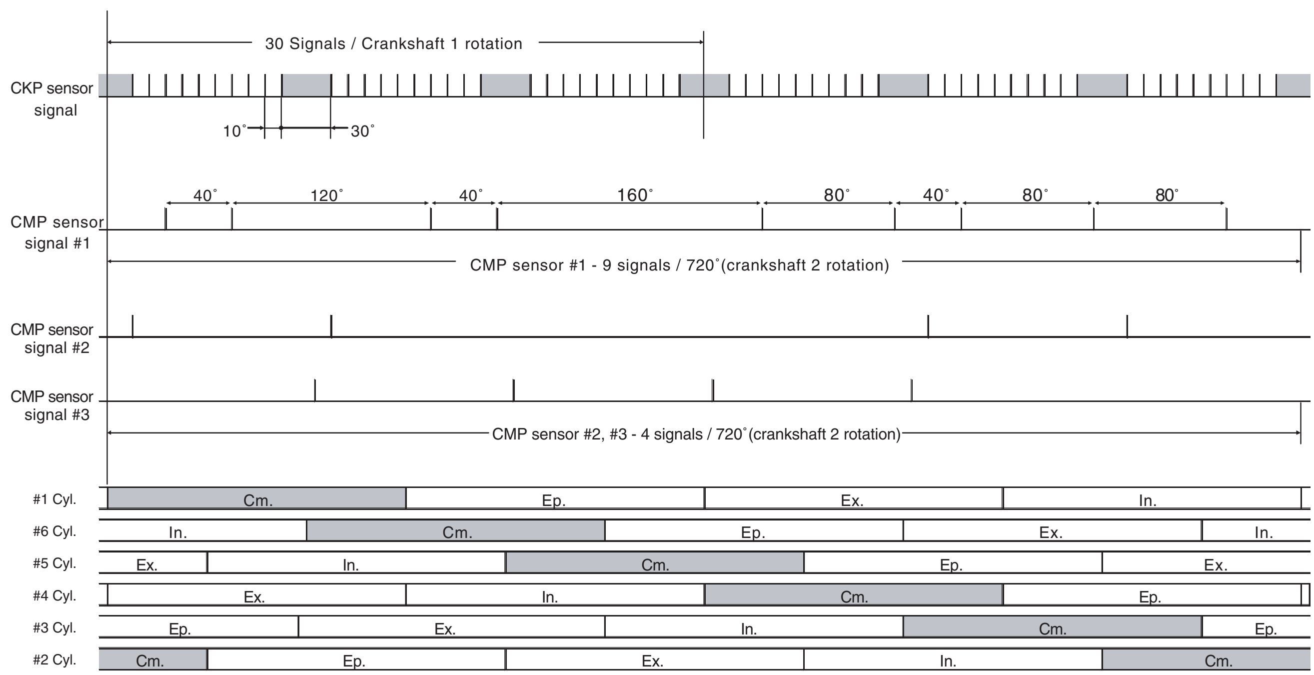
The number of the PORT exhaust camshaft trigger vanes has been changed from four to nine.

The nine camshaft trigger vanes provide nine signals from CMP sensor to ECM during one rotation of camshaft (two rotations of crankshaft).

- **Failure symptom:**
  Without the CMP sensor signal input, the ECM does not output the ignition and fuel injection signals.

ECM cylinder identification:

Cylinders are identified by a calculation combined from two signals; one from the CKP sensor and one from the CMP sensor.

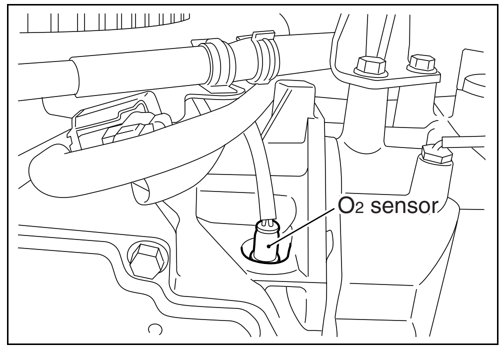


Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake

O_2 SENSOR

The O_2 sensor is installed on the top of the cylinder.

To bring the actual air/fuel mixture ratio closer to the theoretical ratio, the O_2 sensor detects the oxygen concentration in the exhaust gas and feeds it back to the ECM, compensating (increasing/decreasing) the fuel injection duration.

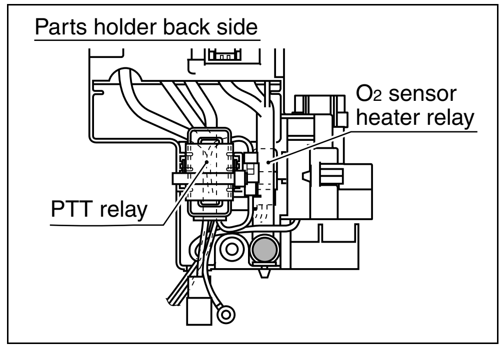


O_2 SENSOR HEATER RELAY

The O_2 sensor does not function properly as designed when its temperature is low. To make the O_2 sensor function properly, a built-in heater is equipped in the O_2 sensor.

The built-in heater is turned on or off by a relay controlled by the ECM.

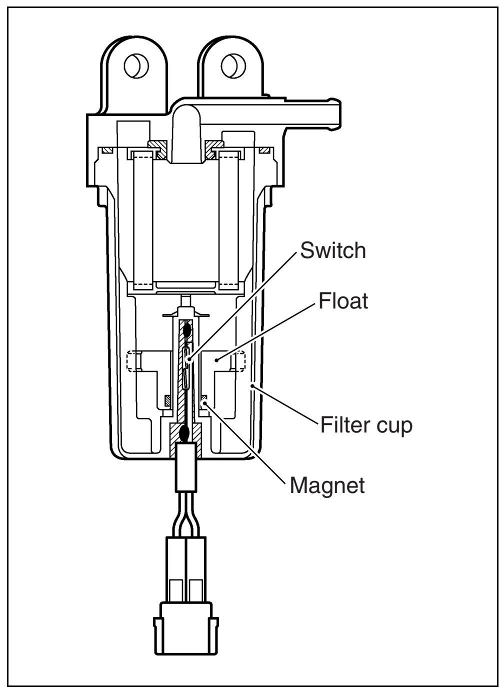
When starting the engine, the relay turns on the switching circuit and energizes the sensor heater for warming up.



WATER IN FUEL SENSOR

A water in fuel sensor has been added to the low pressure fuel filter. The water in fuel sensor is designed to turn on its switch when water in the filter cup accumulates to the predetermined level.

Then, the Water in Fuel Alert System is activated to alert the user that the filter must be cleaned.



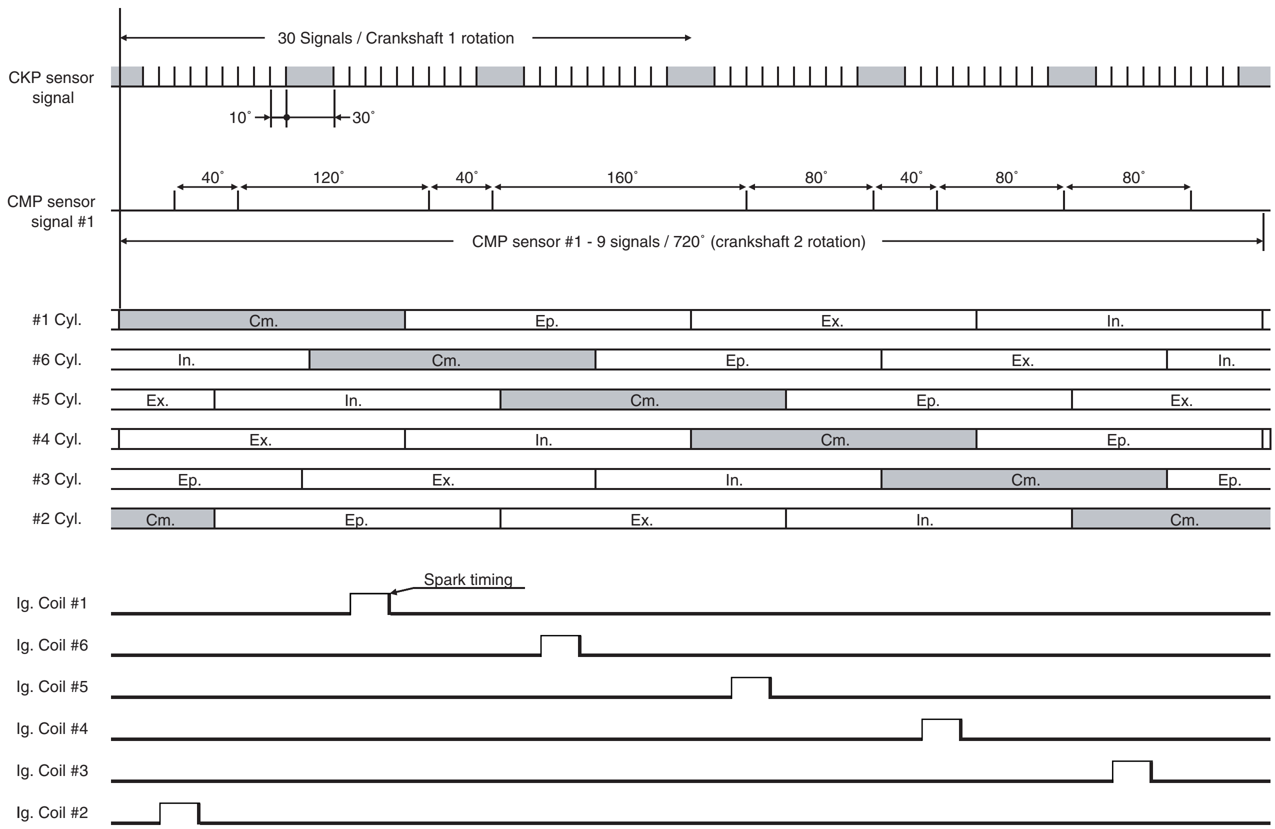
IGNITION SYSTEM

SPECIFICATION

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	BTDC 0° – BTDC 25°
Firing order	1 – 6 – 5 – 4 – 3 – 2

IGNITION TIMING CHART

The following chart is an example for ignition at BTDC 10°.



Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake

CONTROL MODE

WHEN CRANKING:

The ignition timing is fixed at BTDC 5° (STBD bank) or BTDC 0° (PORT bank) until the engine starts.

WHEN IDLING/TROLLING:

The ignition timing is controlled within the range of BTDC 0° ± 5° to provide stable engine operation at the specified idling/trolling speed.

WHEN RUNNING (NORMAL OPERATION):

The ignition timing ranges between BTDC 0° – BTDC 25°, depending on current engine operating conditions.

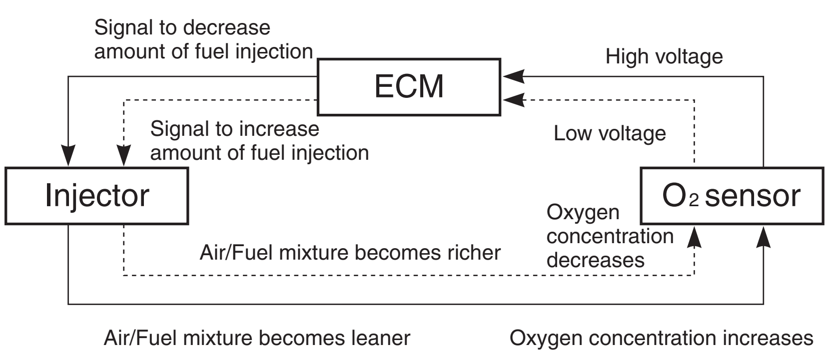
ELECTRONIC FUEL INJECTION SYSTEM

Fuel injection timing and injection duration are compensated by the oxygen concentration value in the exhaust gas detected with the O_2 sensor in addition to the current sensors.
Fuel injection end timing is set at 0° – 60° BTDC on the exhaust stroke by engine speed.

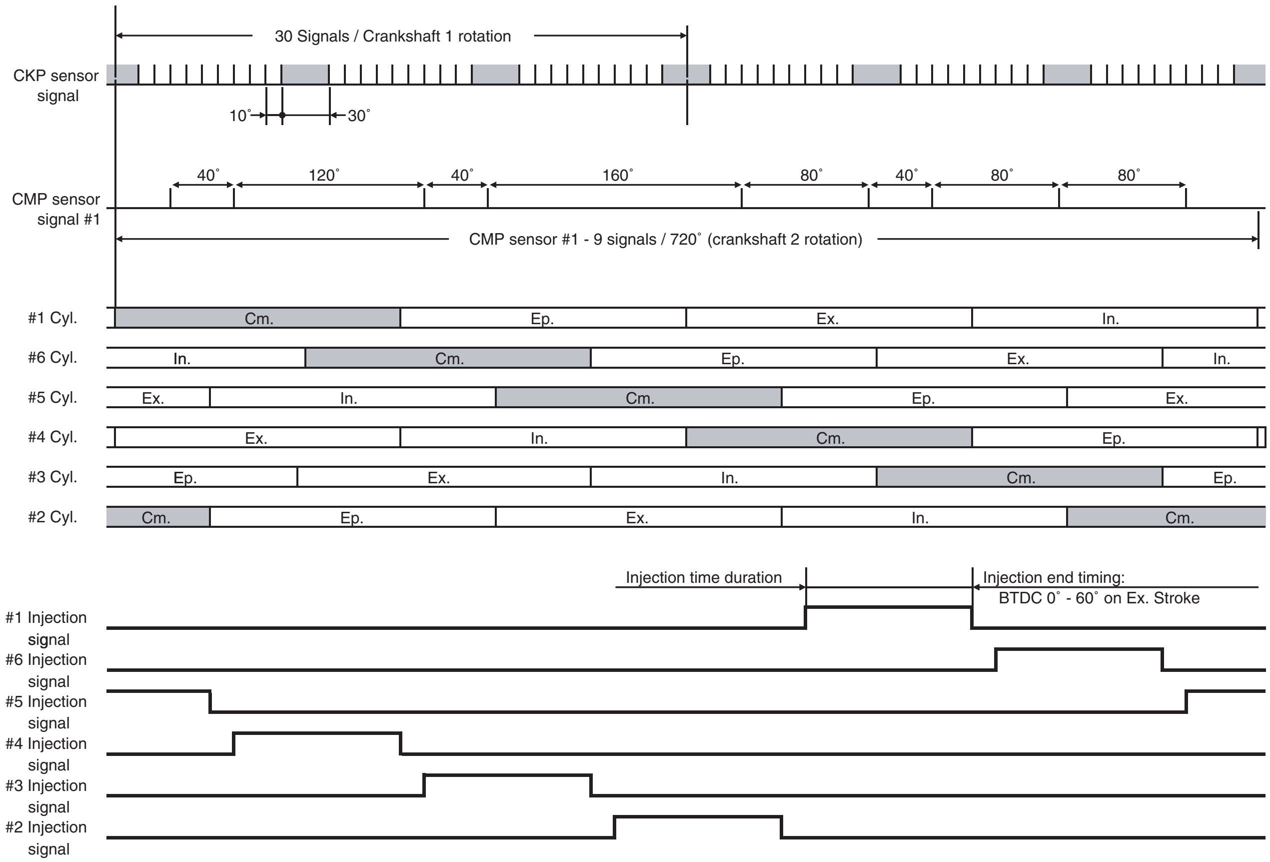
Air/Fuel Feed Back Compensation

By bringing the actual air/fuel mixture ratio closer to the theoretical air/fuel ratio, the best possible combustion efficiency is attained. This improves fuel economy and decreases harmful components in the exhaust gasses.
For that purpose, the ECM operates as follows. It first compares the signal from the O_2 sensor with a specified reference voltage. If the signal is higher, the ECM detects that the air/fuel ratio is richer than the theoretical air/fuel ratio and reduces the amount of fuel. If the signal is lower, the ECM detects that the air/fuel ratio is leaner and increases the amount of fuel.
By repeating these operations the ECM constantly adjusts the air/fuel ratio closer to the theoretical air/fuel ratio.

1. When the oxygen concentration in the exhaust gas is low, the air/fuel ratio is less than theoretical, the electromotive force of the O_2 sensor increases and a rich signal is sent to ECM.
2. Upon receipt of the rich signal the ECM decreases the amount of fuel injection. This causes the oxygen concentration in the exhaust gas to increase and the electromotive force of the O_2 sensor to decrease. When this occurs a lean signal is sent to the ECM.
3. As the ECM increases the amount of fuel injection according to the lean signal the oxygen concentration in the exhaust gas decreases and the situation reverts back to 1) above.



FUEL INJECTION TIMING CHART



Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake

CONTROL MODE

BEFORE START:

When the main switch is turned “ON”, the ECM receives a MAP sensor signal, indicating the static barometric pressure of the intake collector assembly (surge tank). This signal is used to compensate the fuel injection map for altitude.

WHEN CRANKING:

Fuel is injected in each cylinders according to the “Start up mode” map which is based on the cylinder temperature and intake air temperature (sequential injection).

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.

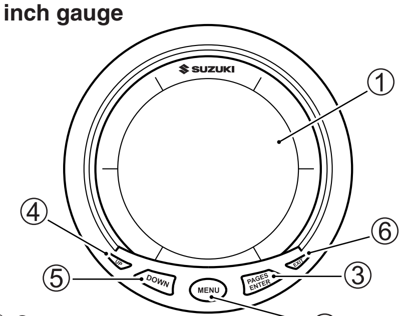
4 INCH/2 INCH GAUGE

The 4 inch gauge and 2 inch gauge can indicate the following engine informatiom.

1. Engine RPM
2. Battery voltage
3. Engine operation hours
4. Trim angle
5. Fuel rate: Lit. or Gallons per hour
6. Cooling water pressure
7. Boat pitot speed (Speed over water): Kiro meter or Mile per hour or Knotes
8. Shift position: 4 inch gauge only
9. Engine temperature
10. Intake air temperture
11. Caution name (When problem is detected)
12. Oil change reminder (When the total motor operation hours have reached pre programmed hours)
13. Self-diagnostic code (When problem is detected): 4 inch gauge only
14. Boat information (Fuel remaining, GPS coordinate, etc.)

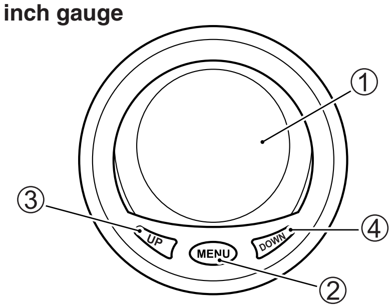
NOTE:
- *The item to display can be set beforehand.*
  The set item is changed the display by pushing of "PAGES/ ENTER"or "EXIT" (4 inch), "UP" or "DOWN" button (2 inch).
- *When the main key is turned from OFF to ON, a caution buzzer will sound for three seconds.*
- *The total operating hours displayed are those of actual engine operation, not main switch "ON" time.*
- *The caution information and self-diagnostic information shown in the gauge screen can be deleted by pressing "MENU" button.*
  When more than one information occur at the same time, press "PAGES/ENTER" (4 inch), "EXIT" (4 inch) or "MENU" button (2 inch) to read the next information.
  The self-diagnostic information is indicated on the 4 inch gauge only, not on the 2 inch gauge.
  Even though deleting the information from the gauge screen, the caution buzzer remains on until the problems have been solved.

4 inch gauge



① Gauge screen
② Menu button
③ Pages/Enter button
④ Up button
⑤ Down button
⑥ Exit button

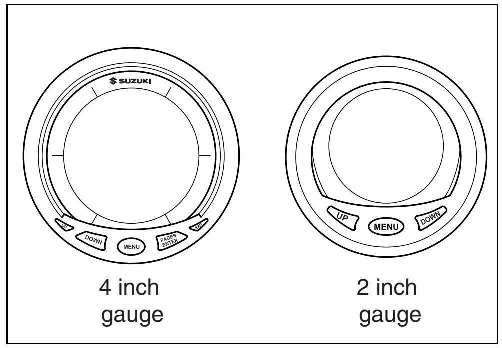
2 inch gauge

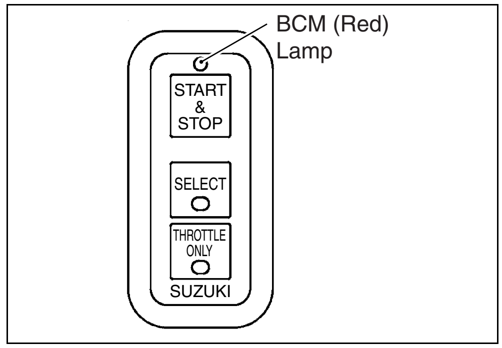


① Gauge screen
② Menu button
③ Up button
④ Down button

CAUTION SYSTEM

The following caution systems alert the operator when an abnormality occurs on the engine.
When a problem is detected, the caution name appears on the display screen of 4 inch/2 inch gauge, caution buzzer sounds continuously.





- **OVER-REVOLUTION CAUTION**
- **LOW OIL PRESSURE CAUTION**
- **OVERHEAT CAUTION**
- **LOW BATTERY VOLTAGE CAUTION**
- **CHECK CONTROL UNIT COMMUNICATION CAUTION**
- **CHECK SECOND STATION CAUTION**
- **CHECK THROTTLE SYSTEM CAUTION**
- **CHECK SHIFT CONTROL CAUTION**

CAUTION TYPE	GAUGE DISPLAY INDICATION	CAUTION BUZZER	OVER-REV LIMITER	BCM (Red) Lamp
Over-revolution	Over Revolution	Yes	Yes (3 000 r/min)	—
Low oil pressure	Low Oil Pressure	Yes	Yes (1 500 r/min)	—
Overheat	Over Heat	Yes	Yes (2 500 r/min)	—
Low battery voltage	Low Battery Voltage	Yes	No	—
Check control unit communication	Check Control Unit Comm	Yes	No	ON
Check second station	Check 2nd Station	Yes	No	ON
Check throttle system	Check Throttle System	Yes	No	—
Check shift control	Check Shift Control	Yes	No	—

OVER-REVOLUTION CAUTION SYSTEM

CONDITION:

The ECM controlled over revolution limiter will engage at the engine speeds shown below. Once engaged it will initiate an intermittent fuel injection signal to reduce engine speed.

Over revolution limiter
DF300: 6 400 r/min

ACTION:

- When the system detects an engine speed higher than 6 400 r/min, the gauge screen will indicate "Rev Limit".
  If this condition continues for ten seconds, the engine speed will be limited to approximately 3 000 r/min by making the fuel injection signal intermittent, and the caution buzzer sounds.
  When the "PAGES/ENTER" (4 inch), "EXIT" (4 inch) or "MENU" (2 inch) button is pressed, the "Over Revolution" indication appears on the gauge screen.
- If the engine speed is reduced to 6 400 r/min or lower within ten seconds, the over revolution caution will be automatically canceled.
- By pressing the "PAGES/ENTER" (4 inch), "EXIT" (4 inch) or "MENU" (2 inch) button, the caution alarm icon appears on the gauge screen and then the "Over Revolution" indication will be cleared.

RESET:

Close throttle to reduce engine speed below approx. 3 000 r/min for one second.

LOW OIL PRESSURE CAUTION SYSTEM

CONDITION:

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

ACTION:

- When this system operates, the gauge screen will indicate “Low Oil Pressure” and the same time, the caution buzzer sounds.
- If this caution system operates at higher than 1 500 r/min, the engine speed will be reduced to approximately 1 500 r/min by making the fuel injection signal intermittent.
- The engine automatically stops 3 minutes after the caution system is activated.
- By pressing the “PAGES/ENTER” (4 inch), “EXIT” (4 inch) or “MENU” (2 inch) button, the caution alarm icon appears on the gauge screen and then the “Low Oil Pressure” indication will be cleared.

NOTE:

If the engine is automatically stopped due to the caution system, the engine can be started again. However, the caution system will repeatedly activate until the cause is eliminated.

RESET:

Stop engine and check engine oil level. Refill engine oil to the correct level if below the low oil mark.

If the engine oil level is correct, the following causes may be considered:

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

NOTE:

The low oil pressure caution system is reset when the oil pressure is restored to over 1.0 kg/cm^2 with approx. 1 500 r/min or less engine speed operation.

However, the engine must be stopped and checked immediately once the system is activated.

OVERHEAT CAUTION

CONDITION 1 (Maximum temperature)

Immediate activation of system when:

- Cylinder temperature reaches 110 °C (230 °F)
- Exhaust manifold temperature reaches 104 °C (219 °F)

CONDITION 2 (Temp. rise vs Time)

Immediate activation of system when:

- The average temperature difference during three consecutive 8 second measurement periods of the cylinder temperature sensor at engine speeds of 500 r/min or higher exceeds the limits as shown below.

Temperature range	Temperature difference
80 – 85 °C (176 – 185 °F)	Approx. 6 °C (10.8 °F)
85 °C – (185 °F –)	Approx. 1.2 °C (2.2 °F)

- The average temperature difference during three consecutive 8 second 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
72 – 85 °C (161 – 185 °F)	Approx. 11 °C (19.8 °F)
85 °C – (185 °F –)	Approx. 1.4 °C (2.5 °F)

ACTION:

When this system operates, the gauge screen will indicate “Over Heat” and at the same time, the caution buzzer sounds.

If this caution system operates at higher than 2 500 r/min, the engine speed will be reduced to approximately 2 500 r/min by making both the fuel injection and ignition signals intermittent.

The engine automatically stops 3 minutes after the caution system is activated.

By pressing the “PAGES/ENTER” (4 inch), “EXIT” (4 inch) or “MENU” (2 inch) button, the caution alarm icon appears on the gauge screen and then the “Over Heat” indication will be cleared.

NOTE:

If the engine is automatically stopped due to the caution system, the engine can be started again. However, the caution system will repeatedly activate until the cause is eliminated.

RESET:

Close throttle completely and then shift into neutral.

System reset will occur when cylinder temperature drops below the limits shown below. 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. 78 °C (172 °F)
Condition 2 (Temperature rise vs Time)	Approx. 76 °C (169 °F)

LOW BATTERY VOLTAGE CAUTION SYSTEM

CONDITION 1:

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

CONDITION 2:

System activated if battery voltage is less than 2 V for more than 2 seconds with the main switch turned "ON" and engine not running.

ACTION:

When this system operates, the gauge screen will indicate "Low Battery Voltage" and at the same time, the caution buzzer sounds.
By pressing the "PAGES/ENTER" (4 inch), "EXIT" (4 inch) or "MENU" (2 inch) button, the caution alarm icon appears on the gauge screen and then the "Low Battery Voltage" indication will be cleared.

RESET:

CONDITION 1:

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.

CONDITION 2:

For the caution system to engage under this condition possibilities such as deteriorated battery, poor battery cable connection, battery switch in OFF condition, etc. must be inspected.
To cancel the caution system activation for these conditions, check all power source related items and eliminate the problem.

CHECK CONTROL UNIT COMMUNICATION CAUTION

CONDITION:

This system operates when a failure has occurred in the control of electrical shift system or electrical throttle system including electrical remote control box.

ACTION:

When the system operates, the 4 inch gauge screen will indicate "Check Control Unit Comm" and at the same time the caution buzzer sounds.
In addition, a red light on the switch panel turns on.

NOTE:

When the "PAGES/ENTER" or "EXIT" button is pressed, the diagnosis code "Check Engine 7-5" appears on the gauge screen and then the "Check Control Unit Comm" indication will be cleared.
When the "PAGES/ENTER" or "EXIT" button is pressed again, the caution alarm icon appears on the gauge screen and then the "Check Engine 7-5" indication will be cleared.

NOTE:

When the system operates, the engine will keep running at idle (in neutral) or stop in some conditions.

RESET:

Inspect the control system of electronic shift and throttle systems and repair or replace the component that has caused the failure.

CHECK SECOND STATION CAUTION

CONDITION:
This system operates when a failure has occurred in the 2nd station control system.

ACTION:
When the system operates, the 4 inch gauge screen will indicate "Check 2nd Station" and at the same time the caution buzzer sounds.
In addition, a red light on the switch panel turns on.

NOTE:
When the "PAGES/ENTER" or "EXIT" button is pressed, the diagnosis code "Check Engine 7-4" appears on the gauge screen and then the "Check 2nd Station" indication will be cleared.
When the "PAGES/ENTER" or "EXIT" button is pressed again, the caution alarm icon appears on the gauge screen and then the"Check Engine 7-4" indication will be cleared.

NOTE:
When this system operates, the engine control is operational only in the 1st station and not in the 2nd station.

RESET:
Inspect the control systems of Sub BCM and the 2nd station and repair or replace the component that has caused the failure.

CHECK THROTTLE SYSTEM CAUTION

CONDITION:
This system operates when a failure has occurred in the electronic throttle control system.

ACTION:
When the system operates, the 4 inch gauge screen will indicate "Check Throttle System" and at the same time the caution buzzer sounds.
The engine speed will fluctuate limiting the speed to the maximum of 2 000 r/min.

NOTE:
When the "PAGES/ENTER" or "EXIT" button is pressed, the diagnosis code of any one of "Check Engine 7-1, 7-2, 7-3 or 2-1" appears on the gauge screen and then "Check Throttle System" indication will be cleared.
When the "PAGES/ENTER" or "EXIT" button is pressed again, the caution alarm icon appears on the gauge screen and then the "Check Engine 7-1, 7-2, 7-3 or 2-1" indication will be cleared.

RESET:
Inspect the control system of electronic throttle system and repair or replace the component that has caused the failure.

CHECK SHIFT CONTROL CAUTION

CONDITION:

This system operates when a failure has occurred in the electronic shift control system.

ACTION:

When the system operates, the 4 inch gauge screen will indicate “Check Shift Control” and at the same time the caution buzzer sounds.

NOTE:

When the “PAGES/ENTER” or “EXIT” button is pressed, the diagnosis code of any one of “Check Engine 8-1, 8-2, 8-3 or 1-2” appears on the gauge screen and then the “Check Shift Control” indication will be cleared.
When the “PAGES/ENTER” or “EXIT” button is pressed again, the caution alarm icon appears on the gauge screen and then the “Check Engine 8-1, 8-2, 8-3 or 1-2” indication will be cleared.

NOTE:

When this system is in operation:

- *ECM turns off the shift motor relay and fixed the shift position to that when the failure occurred.*
- *It is not possible to adjust the engine speed or shift by operating the remote control lever.*
- *The engine can be operated at idle (minimum speed).*
- *If “THROTTLE ONLY” switch is pressed with the remote control lever in neutral position, the engine speed can be adjusted to the maximum of 2 000 r/min by operating the remote control lever.*

⚠ WARNING

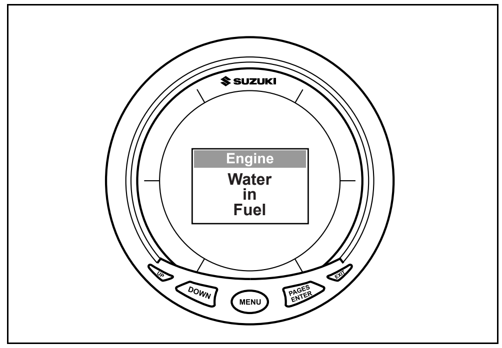
When “Check Shift Control” is shown in the gauge screen, no shift operation of forward, neutral or reverse is possible.
If the engine speed adjustment is attempted with the shift in forward or reverse, the boat may abruptly start off possibly leading to an accident.
Except in an emergency, never operate the engine when “Check Shift Control” is shown in the gauge screen.

RESET:

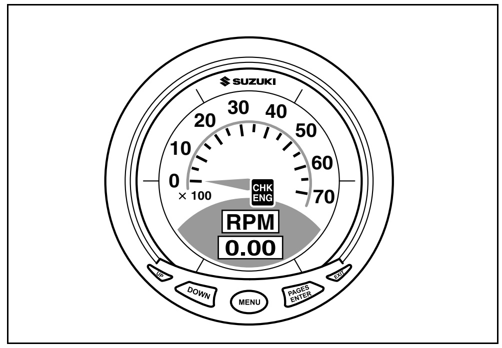
Inspect the control system of electronic shift system and repair or replace the component that has caused the failure.

WATER IN FUEL ALART SYSTEM

CONDITION:
This system operates when the water has separated from the fuel exceeds a specific volume.



ACTION:
If the system activates, the “Water in Fuel” will indicate on the gauge screen at all time and the caution buzzer will sound when the engine is in neutral only.
By pressing the “PAGES/ENTER” (4 inch), “EXIT” (4 inch) or “MENU” (2 inch) button, the caution alarm icon “CHK ENG” appears on the gauge screen and then the “Water in Fuel” indication will be cleared.

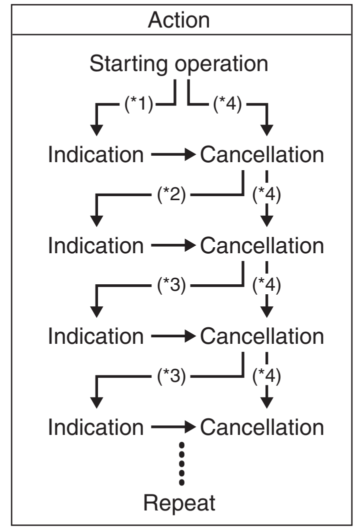


NOTE:
Checking the operation of the water in Fuel Alert System with SDS is not possible.

RESET:
Stop the engine and check the fuel filtter/water seperator for water, and clean the fuel filter.

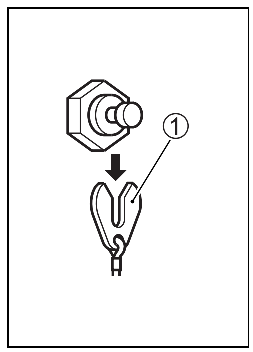
OIL CHANGE REMINDER SYSTEM

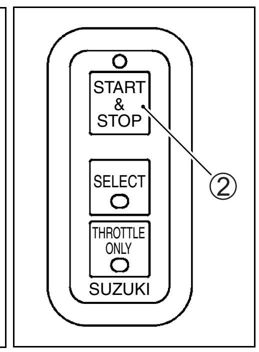
This system informs the operator of the time for replacing ENGINE OIL on the basis of the recommended maintenance schedule.
When the total motor operating hours have reached the preprogrammed hours, the “Change Oil” appears on the 4 inch gauge screen, the buzzer will begin a series of double beeps if engine is not running (but main switch is ON).
The above mentioned indication will repeat until the activated system is manually cancelled.
By pressing the “PAGES/ENTER” or “EXIT” button after confirming the display of “Change Oil”, the caution alarm icon appears on the display screen and then the “Change Oil” indication will be cleared.



*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

CANCELLATION
Procedure
1. Turn the main switch key to “ON” position.
2. Pull out the emergency stop switch plate ①.
3. Depress the START & STOP button ② three times in ten seconds.
   A short beep will be heard if cancellation is successfully finished.
4. Turn the main switch key to “OFF” position.
5. Set the switch plate ① in original position.

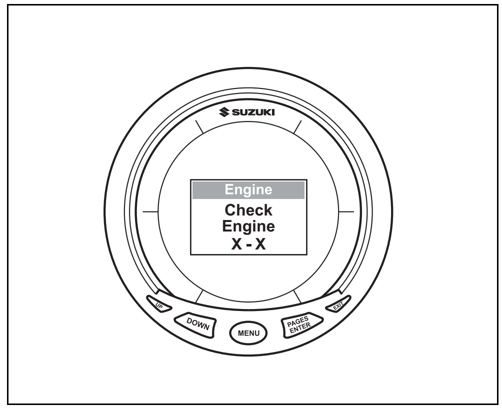




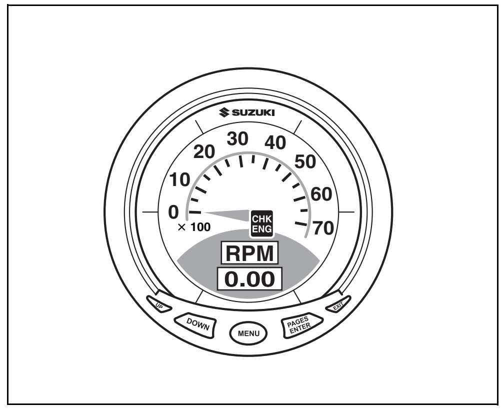
NOTE:
- *Canceling of the system activation is possible regardless of whether or not the engine oil has been replaced.*
  Once the system has operated, however, SUZUKI strongly recommends that the engine oil be replaced before canceling the system activation.
- *Even if the engine oil has been replaced with the system not operating, it is still necessary to perform the cancellation.*

SELF-DIAGNOSTIC SYSTEM

The self-diagnostic system alerts the operator when an abnormality occurs in a signal from sensor, switch, etc. When the system is activated, the “Diagnostic code” appears on the 4 inch gauge screen and caution buzzer sound.
The buzzer sounds a series of short (0.2 sec.) beeps.
The buzzer sound, activated by the self – diagnostic system, can be temporally canceled by pushing the main key in.



By pressing the “PAGES/ENTER” or “EXIT” button after confirming the display of “Check Engine X – X”, the caution alarm icon appears on the display screen and then the “Check Engine X – X” indication will be cleared.



CODE FOR SELF-DIAGNOSTIC SYSTEM OPERATION

FAILED ITEM	CODE	FAIL-SAFE SYSTEM ACTIVE
MAP sensor 1	3 – 4	YES
Cylinder temp. sensor	1 – 4	YES
IAT sensor	2 – 3	YES
Exhaust manifold temp. sensor (STBD)	1 – 5	YES
Exhaust manifold temp. sensor (PORT)	1 – 6	YES
Speed sensor	3 – 5	NO
Trim sensor	3 – 7	NO
Throttle position sensor	2 – 1	YES
Shift position sensor	1 – 2	NO [NOTE 2]
Rectifier & regulator (Over-charging) [NOTE 1]	1 – 1	NO
Fuel injector	4 – 3	NO
CKP sensor	4 – 2	NO
CMP sensor	2 – 4	NO
CMP sensor (VVT·PORT)	2 – 6	YES
CMP sensor (VVT·STBD)	2 – 5	YES
Air intake system	2 – 2	YES
MAP sensor 2 (Pressure detect passage)	3 – 2	NO
Neutral switch	3 – 3	NO
O_2 sensor	3 – 6	YES
VVT advance (STBD)	5 – 1	YES
VVT advance (PORT)	5 – 2	YES
Oil pressure switch	5 – 3	NO
Oil control valve (STBD)	6 – 1	NO
Oil control valve (PORT)	6 – 2	NO
ETV ECM	7 – 1	YES
ETV Motor	7 – 2	YES
ETV	7 – 3	YES
Sub BCM	7 – 4	YES
DBW system	7 – 5	NO [NOTE 2]
ESA ECM	8 – 1	NO [NOTE 2]
ESA motor	8 – 2	NO [NOTE 2]
ESA	8 – 3	NO [NOTE 2]

NOTE:
- *If more than one failed items exist, the self-diagnostic system shows the failures in the order of their occurrence, one at a time, when "ENTER" key is pressed.*
- *If the failed item remains, the self-diagnostic indication appears again after turning the main switch "ON".*
- *After correcting failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running or turn on the main switch from OFF.*
- *It is the basic theory that the cancellation of self-diagnostic indication is automatically performed when the failure is corrected and then supplying power to the ECM or operating the motor to receive a normal signal from sensor, switch, etc. by the ECM.*
  However, in addition to the above, it has to meet the following conditions.
  – *The period of 20 – 30 seconds which is necessary for the ECM to decide the signal is normal.*
  – *In the case of the codes 5-1 or 5-2 "VVT advance" or 6-1 or 6-2" oil control valve", it is necessary to operate the VVT system actually.*
    So it is required to operate the motor at around 3 500 r/min for a certain period.
    However, the self-diagnostic code remains until the ECM decides the input signal during cruising.

NOTE:
O_2 sensor diagnostic:
- *When the O_2 sensor is failed, this code is indicated by 4 inch gauge and the caution buzzer, but not displayed on the SDS screen.*
- *With the main switch key turned off, the self-diagnostic display can be temporarily cleared in the gauge screen.*
  If the engine is operated without repairing the failure, the diagnostic code will be displayed again in the gauge screen.

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

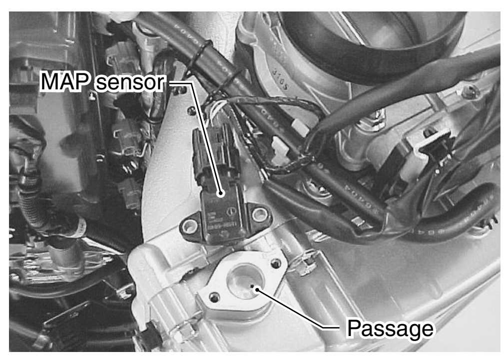
NOTE 2:
For fail-safe condition, see page 41 and 42.

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 (1.46 – 33.86 inHg) (0.50 – 4.84 V)” signal (With engine running)
Cylinder temp. sensor	• No signal • Receiving an out of range “–46 to +170 °C (–114.8 – +338.0 °F) (0.10 – 4.6 V)” signal
IAT sensor	• No signal • Receiving an out of range “–46 to +169 °C (–114.8 – +336.2 °F) (0.10 – 4.6 V)” signal
CKP sensor	• During one crankshaft rotation, 30 signals are not received by the ECM. • During cranking, CMP sensor signal is received by the ECM, but not CKP sensor signal.
CMP sensor	• During six crankshaft rotations, the normal CMP sensor signal pattern is not received by the ECM.
Air intake system	• During the ECM’s receiving input of the complete close signal from the throttle position sensor, the engine operates at an abnormally high speed. (Criterion: 2 500 r/min MIN)
MAP sensor 2 (Pressure detect passage)	• Receiving unchanging signal regardless engine speed change. [NOTE 1]
Rectifier & Regulator. (Over-charging)	• Receiving 16 volts or higher signal
Exhaust manifold temp. sensor (PORT or STBD)	• No signal • Receiving an out of range “–46 to +170 °C (–114.8 – +338.0 °F) (0.10 – 4.6 V)” signal
Fuel injector	• No operation signal from the ECM
Throttle position sensor	• Receiving an out of range “0.35 – 4.8 V” TPS main sensor signal. • The difference of output voltage between the main sensor and sub sensor is outside the specified range.
Shift position sensor	• Receiving an out of range “0.35 – 4.8 V” signal.
CMP sensor (VVT PORT or STBD)	• During two crankshaft rotation, 4 signals are not input to ECM.
VVT advance (PORT or STBD)	• There is a large difference between the target advance angle and the actual advance angle.
Neutral switch	• While the shift sensor outputs the forward or reverse signal, the ECM receives input of the neutral signal from the neutral switch.
O_2 sensor	• Air/Fuel mixture output from ECM is lean state, but O_2 sensor signal circuit is higher than 0.7 V (rich state). • Air/Fuel mixtue output from ECM is rich state, but O_2 sensor signal circuit is lower than 0.2 V (lean state).
Oil control valve (PORT or STBD)	• OCV not operating.
Oil pressure switch	• While the engine is stopped and the main switch is on, the ECM receives an “OFF” signal from the oil pressure switch.

FAILED ITEM	CONDITION
Speed sensor	• Receiving an out of range "0.2 – 4.8 V" signal.
Trim sensor	• Receiving an out of range "0.2 – 4.8 V" signal.
ETV ECM	• ECM electronic throttle control circuit failure
ETV motor	• Throttle valve actuator motor operation failure or its power supply system (throttle relay, etc.) failure. • Motor connector open • Motor power supply line open
ETV valve	• Throttle valve operation failure
Sub BCM	• Sub BCM communication error • Low sub BCM source voltage. • Sub BCM failure
DBW system	• CAN communication error between BCM and ECM. • LPS error (ECM received an input signal from each sensor which was outside the range of 4.5 – 5.5 V as total of main sensor and sub sensor output voltage.). • Low BCM source voltage (less than 6 V). • BCM failure. • ECM failure.
ESA ECM	• ECM electronic shift control circuit failure.
ESA motor	• Electronic shift motor failure. • Motor connector open • Motor power supply line open
ESA position	• Response failure ECM has detected the target LPS output voltage signal, but no change occurs in the input signal voltage from shift position sensor.

NOTE 1:
This condition will be caused by clogged pressure detect passage in intake collector assembly.



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	• 280 – 560 mmHg / (11.02 – 22.05 inHg.) (The control takes place in accordance with the engine speed.) [NOTE1] • VVT advance is fixed at the most retarded angle.
Air intake system	• The control is executed with the maximum engine speed as 2 000 r/min.
Cylinder temp. sensor	• 60 °C (140 °F)
IAT sensor	• 45 °C (113 °F)
Exhaust manifold temp. sensor	• 60 °C (140 °F)
Throttle position sensor	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
Shift position sensor	• ECM detects the shift position as neutral even under in-gear condition and controls the engine speed to idling. • If the “Throttle only” button is pressed with the remote control lever in neutral, the engine speed can be controlled at the maximum of 2 000 r/min by operating the lever.
CMP sensor (VVT)	• VVT advance is fixed at the most retarded angle.
VVT advance	• VVT advance is fixed at the most retarded angle. • The ECM cyclically outputs the drive and stop signals for the OCV and when the difference between the VVT’s target advance angle and the actual advance angle has come to the normal range, the diagnostic code display is canceled.
O_2 sensor	• In the event of O_2 sensor failure, the ECM memorizes the normal controlling values as detected before the failure and performs the air/fuel ratio compensation control with these values.

FAILED ITEM	PRE-PROGRAMMED VALUE
ETV ECM	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever. (The engine rpm is controlled both by altering the ignition timing and skipping ignition for intermittent misfiring.)
ETV motor	• The throttle opening is fixed to default with the throttle motor relay turned off. ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
ETV	• The throttle opening is fixed to default with the throttle motor relay turned off. • ECM controls the engine speed at the maximum of 2 000 r/min by operating the remote control lever.
Sub BCM	• The main BCM controls the engine appropriately.
DBW system	• ECM causes the shift to return and fix to the neutral position and controls the engine speed to idling.
ESA ECM	• ECM turns off the shift motor relay and fixes the shift position to that when the failure occurred. The engine rpm is controlled with ECM at the maximum of 2 000 r/min by operating the remote control lever.
ESA motor	
ESA position	

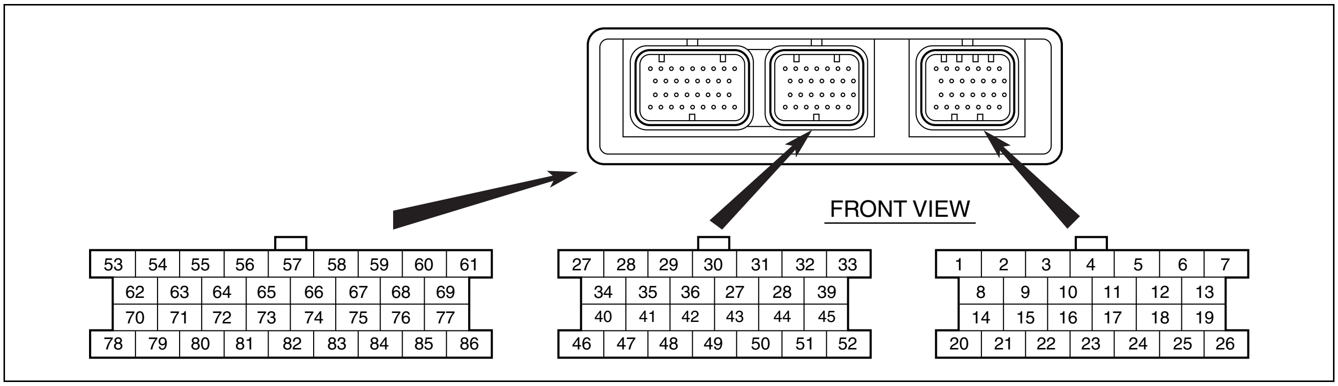
NOTE:
There is no back-up system for the ECM itself. The engine will stop if it has failed.

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

INSPECTION

INSPECTION FOR ECM CIRCUIT VOLTAGE

ECM CIRCUIT VOLTAGE TABLE

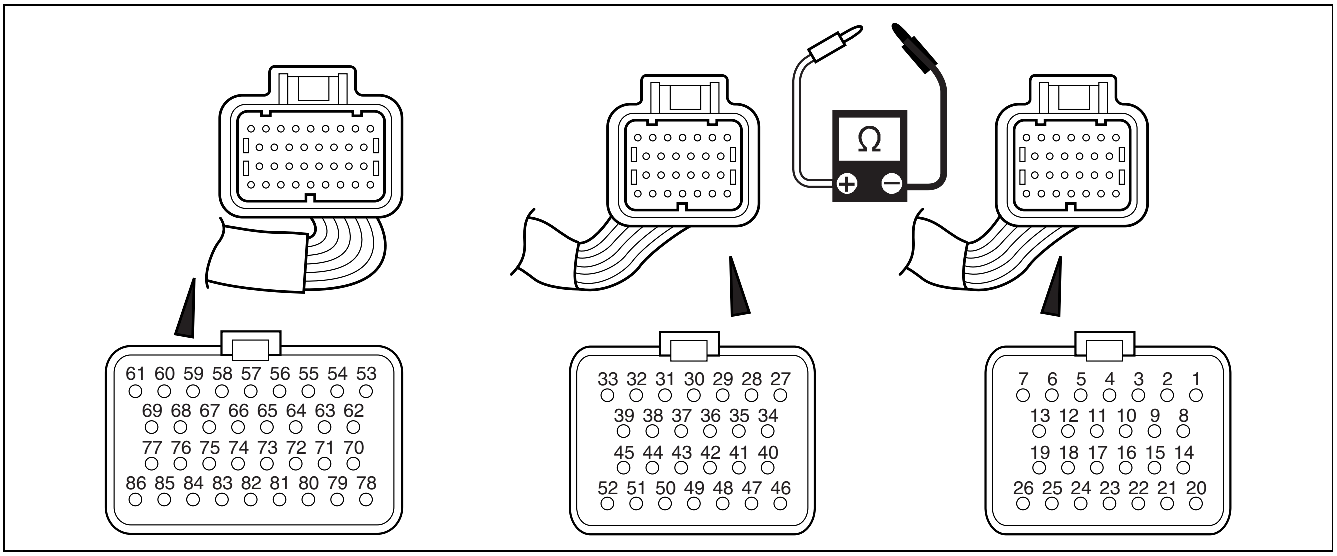


TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
1	R/Bl	Water in fuel sensor	Approx. 12 V	Main switch ON. Water in fuel sensor OFF.
			Approx. 0 V	Main switch ON. Water in fuel sensor ON.
2	—	—	—	—
3	Y/Bl	CMP sensor #1	Approx. 0.3 V or 5 V	Main switch ON
4	R/B	CKP sensor	—	—
5	V/W	Ex. manifold temp. sensor #1	0.14 – 4.75 V	Main switch ON
6	B/W	Sensor GND	—	—
7	W	CAN (H)	Approx. 2.5 V or 3.6 V	Main switch ON
8	Bl	Oil pressure switch	Approx. 5 V	While engine running
			Approx. 0 V	Engine stopped (Main switch ON)
9	O/G	CMP sensor #2 (VVT_ PORT)	Approx. 0.3 V or 5 V	Main switch ON
10	B/O	CMP sensor #3 (VVT_ STBD)	Approx. 0.3 V or 5 V	Main switch ON
11	Bl/B	Water pressure sensor	0.5 – 4.5 V	Main switch ON
12	G/R	Ex. manifold temp. sensor #2	0.14 – 4.75 V	Main switch ON
13	B	CAN (L)	Approx. 2.5 V or 1.4 V	Main switch ON
14	P/W	Throttle position sensor (SUB)	2.5 – 4.5 V	Main switch ON
15	Bl/R	Emergency stop switch	Approx. 5 V	Main switch ON. Stop switch plate IN
			Approx. 0 V	Main switch ON. Stop switch plate OUT
16	LBl	PTT switch UP	Approx. 12 V	Main switch ON. PTT UP switch depressed.
			Approx. 0 V	Main switch ON. PTT UP switch not depressed.
17	W/Y	Trim and Tilt sensor	0.3 – 4.5 V	Main switch ON
18	Gr/R	O_2 sensor	0.7 V and more	While engine idling after warming up
			0.2 V and less	Engine stopped (Main switch ON)
19	Lg/W	Cylinder temp. sensor	0.14 – 4.75 V	Main switch ON
20	P/Bl	Shift position sensor	Approx. 2.5 V	Main switch ON. Shift in Neutral
			Approx. 3.7 V	While engine running. Shift in Forward
			Approx. 1.3 V	While engine running. Shift in Reverse
21	Br	Neutral switch	Approx. 12 V	Main switch ON. Shift into NEUTRAL.
			Approx. 0 V	While engine running. Shift into FOR-WARD or REVERSE.
22	P	PTT switch DOWN	Approx. 12 V	Main switch ON. PTT DN switch depressed.
			Approx. 0 V	Main switch ON. PTT DN switch not depressed.

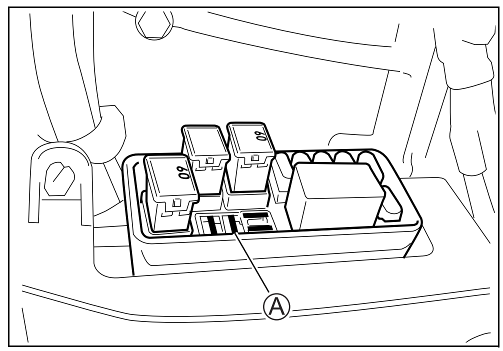
TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
23	G/B	Starter relay control	Approx. 0.5 V	Main switch ON. While engine Cranking.
			Approx. 12 V	Main switch ON. Normal
24	W	MAP sensor	0.5 – 4.5 V	Main switch ON
25	Bl/W	Speed sensor	0.5 – 4.5 V	Main switch ON
26	Lg/B	IAT sensor	0.04 – 4.46 V	Main switch ON
27	—	—	—	—
28	—	—	—	—
29	Br/Y	Throttle position sensor (main)	0.5 – 4.5 V	Main switch ON
30	R/Bl	Power source for TPS	Approx. 5 V	Main switch ON
31	R/W	Power source for SPS	Approx. 5 V	Main switch ON
32	Br/B	Shift position sensor GND	—	—
33	B	Ground for ECM	—	—
34	G/Bl	Shift motor relay	Approx. 12 V	Main switch ON. ESA system Fail.
			Approx. 0.5 V	Main switch ON. ESA system Normal.
35	—	—	—	—
36	—	—	—	—
37	—	—	—	—
38	B/W	Ground for TPS	—	—
39	B	Ground for ECM	—	—
40	Bl/Y	No.6 Ignition coil (–)	Approx. 0 V	Main switch ON
41	—	—	—	—
42	—	—	—	—
43	—	—	—	—
44	R	Power source for sensor	Approx. 5 V	Main switch ON
45	Gr	ECM power source	Approx. 12 V	Main switch ON
46	Lg/R	No.4 Ignition coil (–)	Approx. 0 V	Main switch ON
47	W/G	No.5 Ignition coil (–)	Approx. 0 V	Main switch ON
48	O	ECM main relay	Approx. 0.8 V	Main switch ON
49	Y	Communication line No.2	—	—
50	O/Y	Communication line No.1	—	—
51	Y/G	Ignition switch	Approx. 12 V	Main switch ON
52	Gr	ECM power source	Approx. 12 V	Main switch ON
53	Br/R	No.2 OCV (–)	Approx. 12 V	Main switch ON
54	Lg	No.4 Fuel injector (–)	Approx. 12 V	Main switch ON
55	O/B	No.1 Fuel injector (–)	Approx. 12 V	Main switch ON
56	B/Br	No.2 Fuel injector (–)	Approx. 12 V	Main switch ON
57	W/Bl	Throttle motor (–)	Approx. 0 V or 12 V	Main switch ON
58	Y	Throttle motor power source	Approx. 12 V	Main switch ON
59	Y	Throttle motor power source	Approx. 12 V	Main switch ON
60	R/Y	Throttle motor (+)	Approx. 0 V or 12 V	Main switch ON
61	G	Shift motor (–)	Approx. 0 V or 12 V	Main switch ON
62	Br/W	No.1 OCV (–)	Approx. 12 V	Main switch ON
63	B	Ground for ECM power	—	—
64	—	—	—	—
65	B	Ground for throttle motor	—	—
66	B	Ground for throttle motor	—	—
67	B	Ground for shift motor	—	—
68	B	Ground for shift motor	—	—
69	Gr/R	Shift motor power source	Approx. 12 V	Main switch ON

TERMINAL	WIRE COLOR	CIRCUIT	STANDARD VOLTAGE	CONDITION/REMARKS
70	B/R	High pressure fuel pump (–)	Approx. 0 V	• Stop switch plate IN. • Shift into NEUTRAL • For 6 sec. after main switch ON. • While engine running
			Approx. 12 V	• Engine stopped. • Main switch ON. • Stop switch plate IN. • Shift into NEUTRAL
71	B	Ground for ECM power	—	—
72	—	—	—	—
73	Gr/Y	No.3 Ignition coil (–)	Approx. 0 V	Main switch ON
74	Bl	No.2 Ignition coil (–)	Approx. 0 V	Main switch ON
75	O	No.1 Ignition coil (–)	Approx. 0 V	Main switch ON
76	W/B	Throttle motor relay	Approx. 12 V	Main switch ON. ETV system Fail.
			Approx. 0.5 V	Main switch ON. ETV system Normal.
77	Gr/R	Power source for shift motor	Approx. 12 V	Main switch ON
78	B/Y	Low pressure fuel pump (–)	Approx. 0 V	• Stop switch plate IN. • Shift into NEUTRAL • For 6 sec. after main switch ON. • While engine running
			Approx. 12 V	• Engine stopped. • Main switch ON. • Stop switch plate IN. • Shift into NEUTRAL
79	R/W	No.3 Fuel injector (–)	Approx. 12 V	Main switch ON
80	Y/R	No.6 Fuel injector (–)	Approx. 12 V	Main switch ON
81	O/Bl	No.5 Fuel injector (–)	Approx. 12 V	Main switch ON
82	P	PTT relay switch (down)	Approx. 0 V	PTT switch DN free
			Approx. 12 V	PTT switch DN push
83	Lbl	PTT relay switch (up)	Approx. 0 V	PTT switch UP free
			Approx. 12 V	PTT switch UP push
84	O/W	Purge valve	Approx. 12 V	Main switch ON
85	Lg/R	O_2 sensor heater relay	Approx. 12 V	Engine stopped (Main switch ON)
			Approx. 0 V	While engine running
86	R	Shift motor (+)	Approx. 0 V or 12 V	Main switch ON

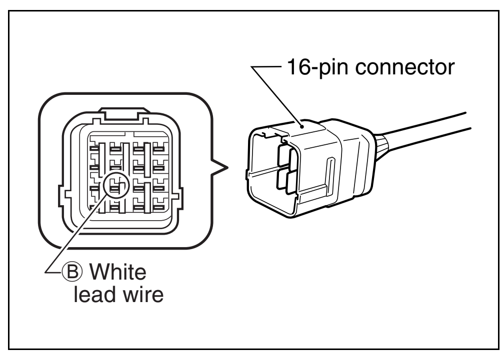
INSPECTION FOR RESISTANCE



NOTE 1:
Disconnect ECM main relay from fuse box, and connect tester probe to relay terminal "Ⓐ" of fuse box side.



NOTE 2:
Disconnect remote control wire harness and connect tester probe to terminal ("Ⓑ", White wire) in engine main wiring harness connector.



RESISTANCE TABLE

ITEM	TERMINAL FOR TESTER PROBE CONNECTION	STANDARD RESISTANCE (at 20 °C)
CKP sensor	4 (R/B) to 6 (B/W)	168 – 252 Ω
Fuel injector No. 1	55 (O/B) to Terminal Ⓐ [NOTE 1]	10 – 14 Ω
Fuel injector No. 2	56 (B/Br) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 3	79 (R/W) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 4	54 (Lg) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 5	81 (O/Bl) to Terminal Ⓐ [NOTE 1]	
Fuel injector No. 6	80 (Y/R) to Terminal Ⓐ [NOTE 1]	
OCV (Oil control valve) #1	62 (Br/W) to Terminal Ⓐ [NOTE 1]	6.0 – 8.3 Ω
OCV (Oil control valve) #2	53 (Br/R) to Terminal Ⓐ [NOTE 1]	
Purge valve	84 (O/W) to Terminal Ⓐ [NOTE 1]	28 – 35 Ω
IAT sensor	26 (Lg/B) to 6 (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	19 (Lg/W) to 6 (B/W)	
Ex-manifold temperature sensor #1	5 (V/W) to 6 (B/W)	
Ex-manifold temperature sensor #2	12 (G/R) to 6 (B/W)	
ECM main relay	48 (O) to Terminal Ⓑ [NOTE 2]	145 – 190 Ω
Throttle motor relay	76 (W/B) to 45 (Gr)	145 – 190 Ω
Shift motor relay	34 (G/Bl) to 45 (Gr)	145 – 190 Ω
O_2 sensor heater relay	85 (Lg/R) to 45 (Gr)	145 – 190 Ω

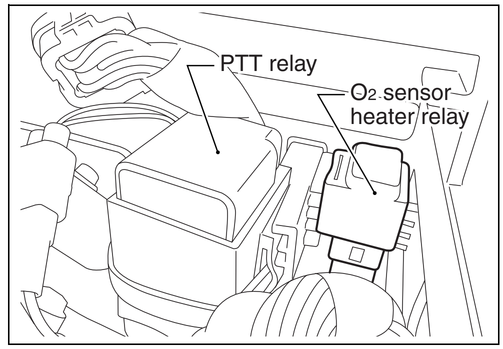
COMPONENT INSPECTIONS

O_2 SENSOR HEATER RELAY

TOOL 09930-99320: Digital tester

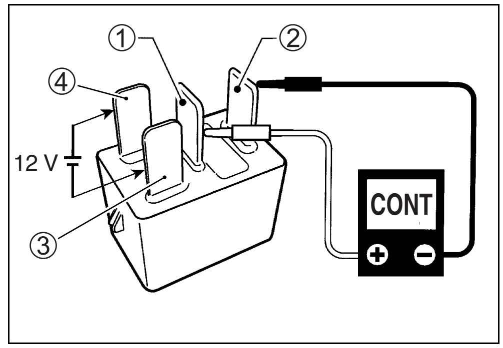
Tester range: (Continuity)

1. Remove the electric parts holder.
2. Disconnect O_2 sensor heater relay from wire harness.
3. Check continuity between terminal ① and ② each time 12 V is applied. Connect positive ⊕ lead to terminal ④, and negative ⊖ lead to terminal ③.



O_2 sensor heater relay function:

12 V power	Continuity
Applied	Yes
Not applied	No



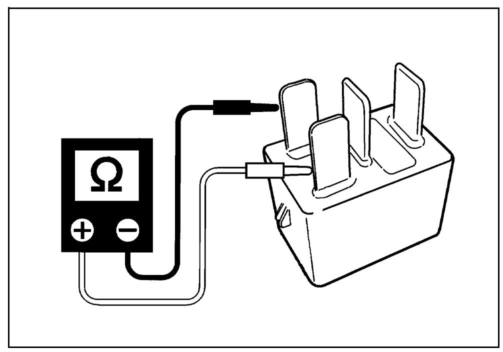
CAUTION

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

4. Measure resistance between relay terminals ③ and ④.

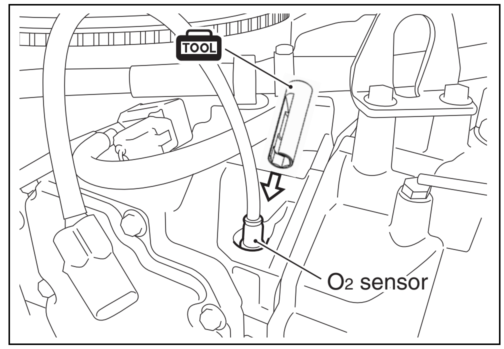
Tester range: Ω (Resistance)
O_2 sensor heater relay coil resistance: 145 – 190 Ω

If out of specification, replace O_2 sensor heater relay.



O_2 SENSOR

REMOVAL



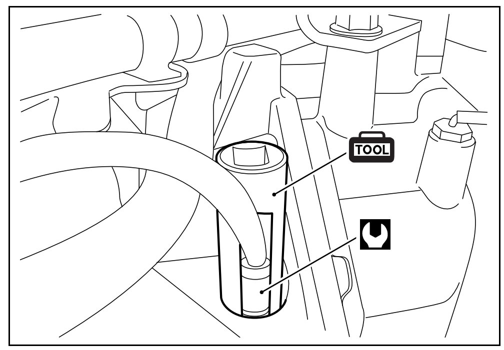
⚠ WARNING

The hot engine can burn you.
The O_2 sensor removal should be performed when the exhaust system is cool.

1. Remove the ring gear cover.
2. Disconnect O_2 sensor lead wire connector.
3. Using special tool, remove the O_2 sensor.

TOOL 09933-39810: O_2 sensor socket

INSTALLATION



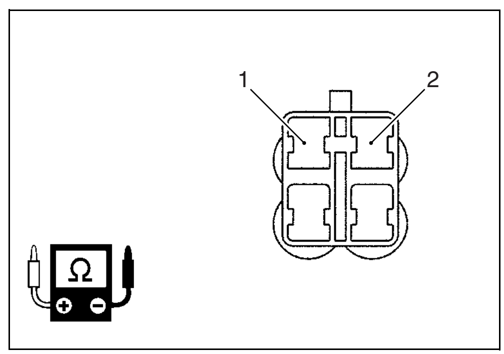
Installation is reverse order of removal.

NOTE:
- *Always keep the O_2 sensor away from any greese and oil.*
- *Examine O_2 sensor gasket for damage.*
  Always replace O_2 sensor assembly if sealing performance is suspect.

Tighten O_2 sensor to specified torque.

O_2 sensor: 10 N·m (1.0 kg-m, 7.0 lb-ft)

INSPECTION



TOOL 09930-99320: Digital tester

Tester range: Ω (Resistance)

1. Disconnect O_2 sensor lead wire connector.
2. Connect the tester probe to following terminal.

ITEM	Tester probe connection	Resistance (at 20 °C)
O_2 sensor heater	Terminal 1 – Terminal 2	5.5 – 8.5 Ω

NOTE:
Using resistance measurements to check for a defect on O_2 sensor is not possible.
For checking the O_2 sensor, measure voltage between the ECM No.18 terminal and GND.
Refer to troubleshooting section.

If measurement exceeds specification, replace the O_2 sensor.

TROUBLESHOOTING

SELF-DIAGNOSTIC CODE “5-3” Oil Pressure switch

START

With the main switch “OFF”, remove the oil pressure switch wire.
With the main switch “ON”, check the voltage between the oil pressure switch wire terminal and engine body ground.
Is the voltage approx. 5 V?

NO → **Possible cause:**
- ECM failure
- Wire continuity/connection failure

YES ↓

Check the continuity between the oil pressure terminal and body ground.
Engine running: Infinity
Engine stopped: Continuity
Is result OK?

YES → **Possible cause:** (ECM failure / Wire continuity/connection failure)

NO ↓

Oil pressure switch failure

SELF-DIAGNOSTIC CODE “3-6” O_2 sensor

START

With the main switch “ON”, check ECM “18” terminal voltage.
Engine running at idle speed: 0.7 V and more (After warming up)
Engine stopped: 0.2 V and less
Is result OK?

NO →
- O_2 sensor failure
- Wire continuitly/connection failre

YES ↓

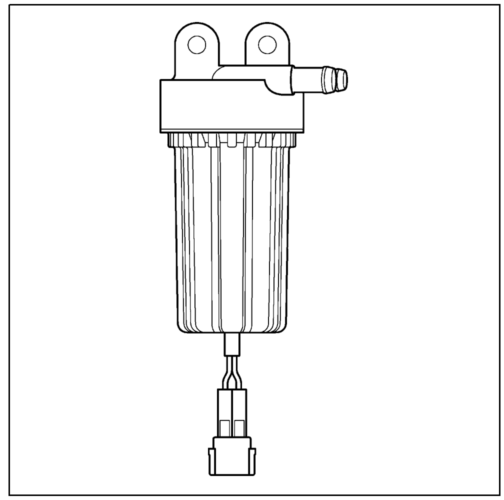
Possible cause:
- ECM failure
- Wire continuity/connection failure

FUEL SYSTEM

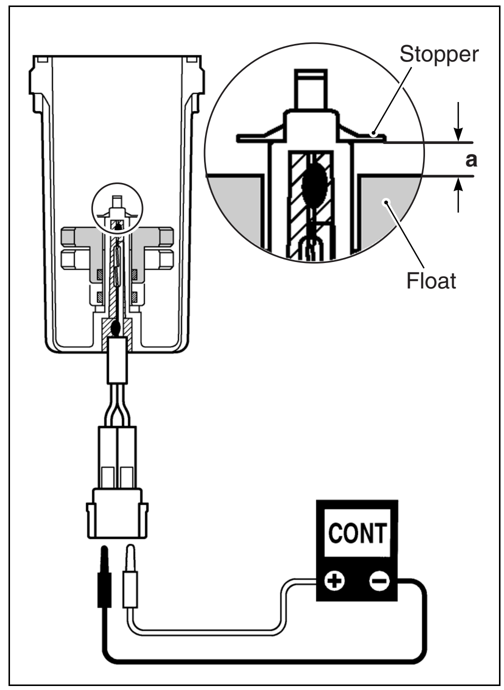
LOW PRESSURE FUEL FILTER

REMOVAL AND INSTALLATION

Refer to "LOW PRESSURE FUEL FILTER/Inspection and cleaning".



INSPECTION FOR WATER IN FUEL SENSOR



TOOL **09930-99320: Digital tester**

Tester range: (Continuity)

Check continuity between two leads while moving the float up and down.

If out of specification, replace the fuel filter.

Float position (clearance "a")	Tester indicates
Less than approx. 4 mm	Continuity
Approx. 4 mm or over	Infinity

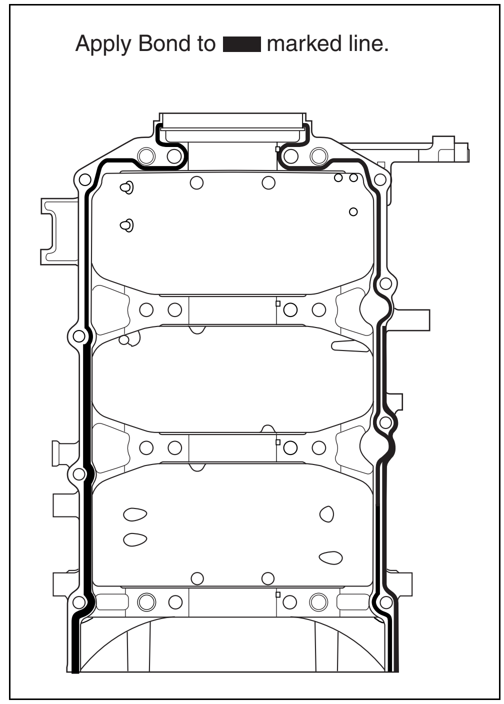
NOTE:
Clearance "a" : Between upper float surface and stopper.

POWER UNIT

CYLINDER

CRANKCASE TO CYLINDER

Clean mating surface of cylinder and crankcase.
Apply SUZUKI BOND to mating surface of crankcase as shown.

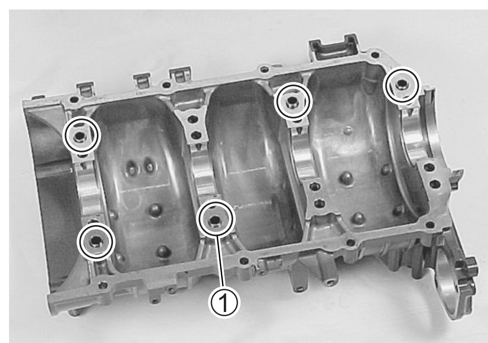


CAUTION

Apply bond to mating surface only.
Do not allow bond to contact surface of bearing.

1217G **99000-31260: SUZUKI BOND “1217G”**

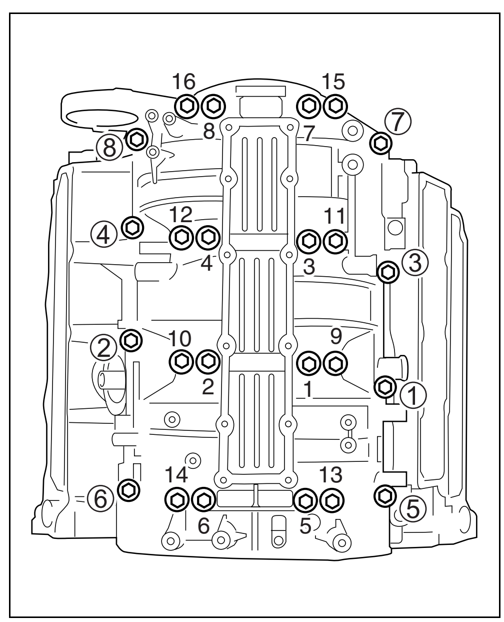
Install five (5) dowel pins ①.



Install crankcase to cylinder.
Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three (3) steps following the order indicated below.

NOTE:

Tighten 10 mm (0.394 in) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in) thread diameter bolts.



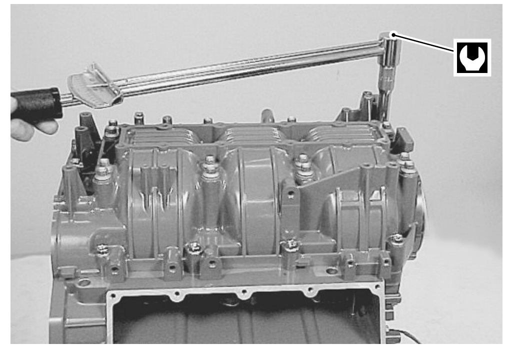
Crankcase bolt (10 mm thread diameter):

1st step	**11 N·m (1.1 kg-m, 8.0 lb-ft)**
2nd step	**21 N·m (2.1 kg-m, 15.0 lb-ft)**
Final step	**52 N·m (5.2 kg-m, 37.5 lb-ft)**

Crankcase bolt (8 mm thread diameter):

1st step	**5 N·m (0.5 kg-m, 3.5 lb-ft)**
2nd step	**20 N·m (2.0 kg-m, 14.5 lb-ft)**
Final step	**25 N·m (2.5 kg-m, 18.0 lb-ft)**

NOTE:
After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.



POWER TRIM AND TILT

The trim and tilt sensor controls the down limit for trim.

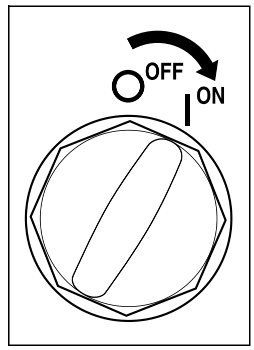
SETTING OF TRIM DOWN POSITION LIMIT

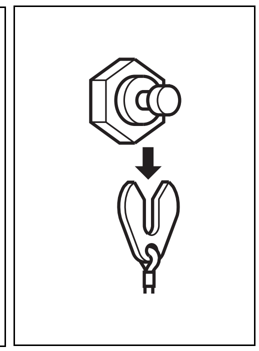
Once the ECM has been replaced or the trim sensor removed and reinstalled, the resetting of the trim down position limit should be performed.
Perform this set-up after the current position setting has been cancelled, as explained in the following procedure.

NOTE:
The tilt upper limit should be adjusted by the tilt limit cam (switch).

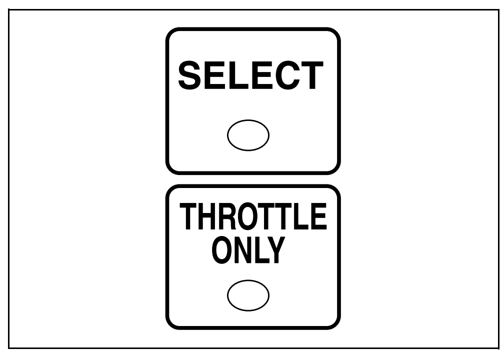
CANCELING THE TRIM DOWN POSITION LIMIT SETTING

1. Turn the main key to the “ON” position.
2. Pull out the emergency stop switch lock plate.
3. Make sure that remote control handle is in “NEUTRAL”.

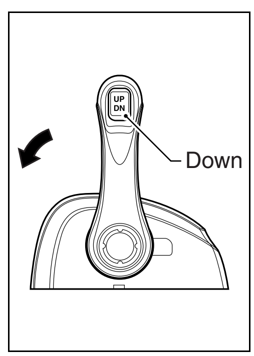


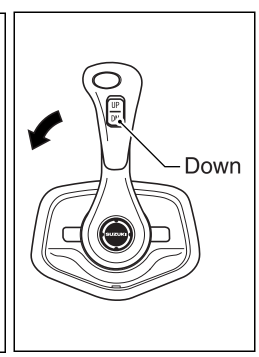


4. Confirm the select switch LED lights, if not, depress the select button on the switch panel.
   Depress the “THROTTLE ONLY” button.

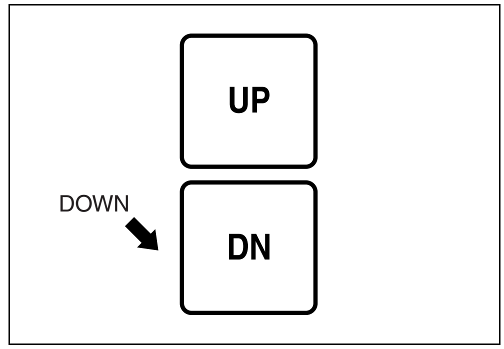


5. Move the control handle forward until the caution buzzer sound one time.





6. Press the “DOWN” side of PTT switch for three seconds and the buzzer will sound twice briefly indicating the setting has been canceled.
7. Return the throttle to the fully closed position.



SETTING THE TRIM DOWN POSITION LIMIT

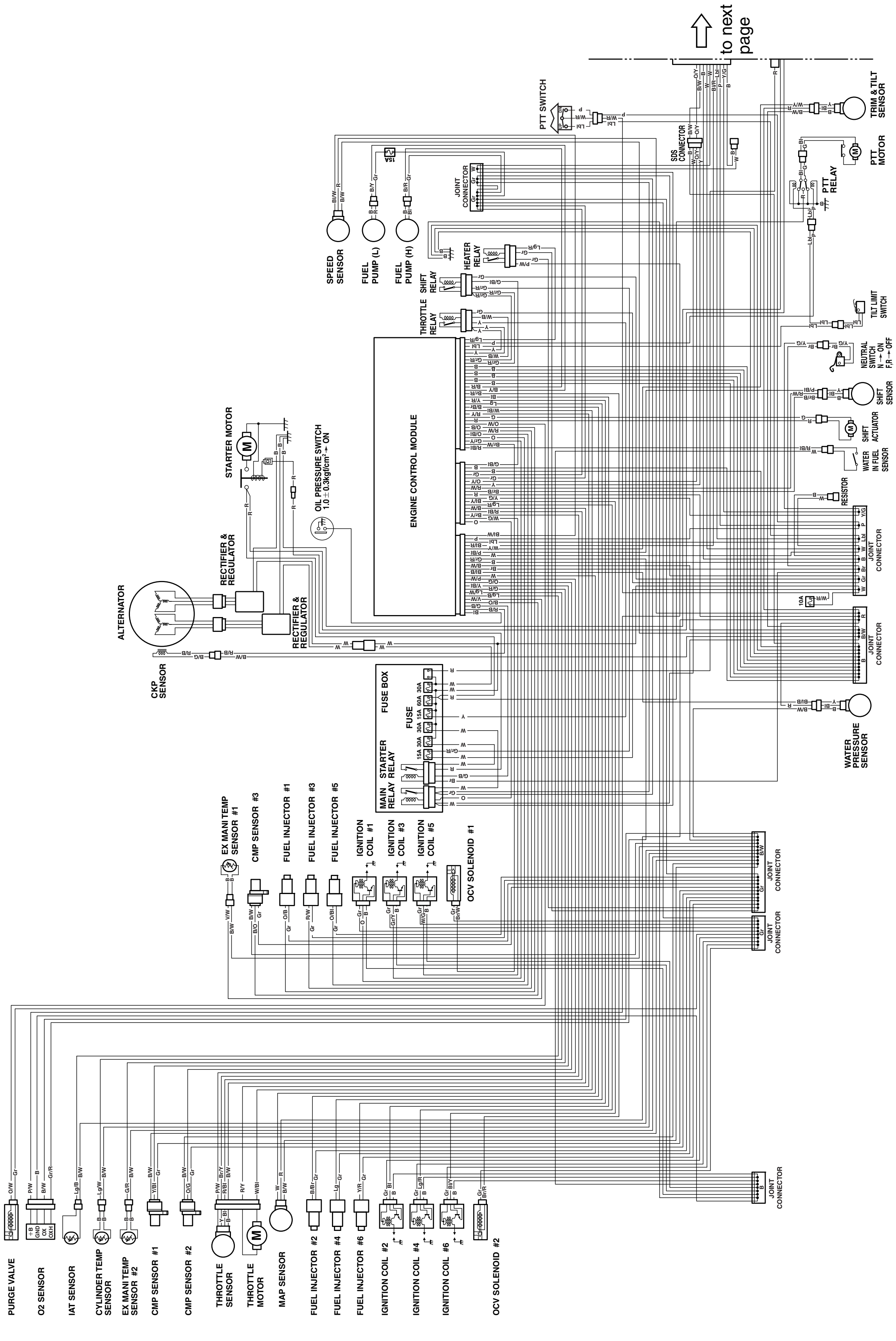
8. Press the “DOWN” or “UP” side of the PTT switch so that the optimum full trim down position for the boat can be obtained.
9. Move the control handle forward until the caution buzzer sound one time.
10. Press the “DOWN” side of the PTT switch three times within three seconds. The buzzer will sound one time briefly indicating the setting has been accepted.
11. Return the throttle to the fully closed position and install the lock plate on the emergency switch. Operate the full tilt up and full trim down operations several times by pressing the PTT switch and check that the setting of the down limit is properly set.

WIRE/HOSE ROUTING

WIRING DIAGRAM

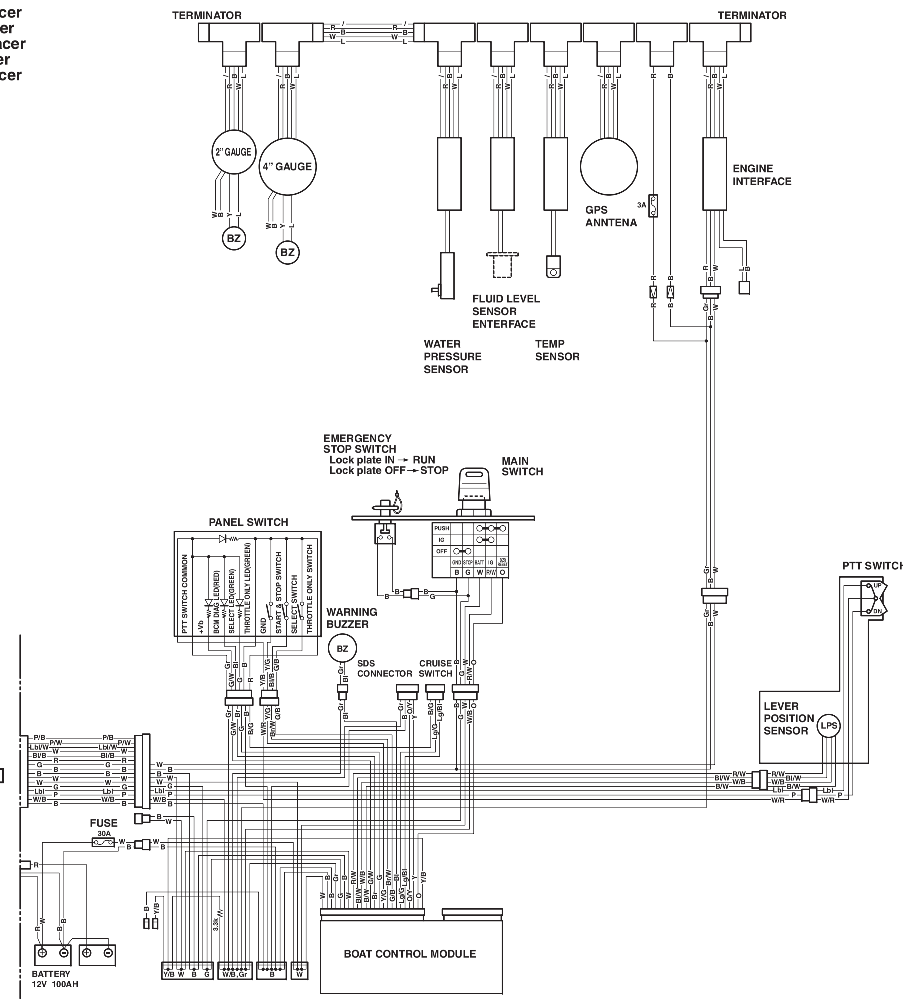
DF300

For single engine



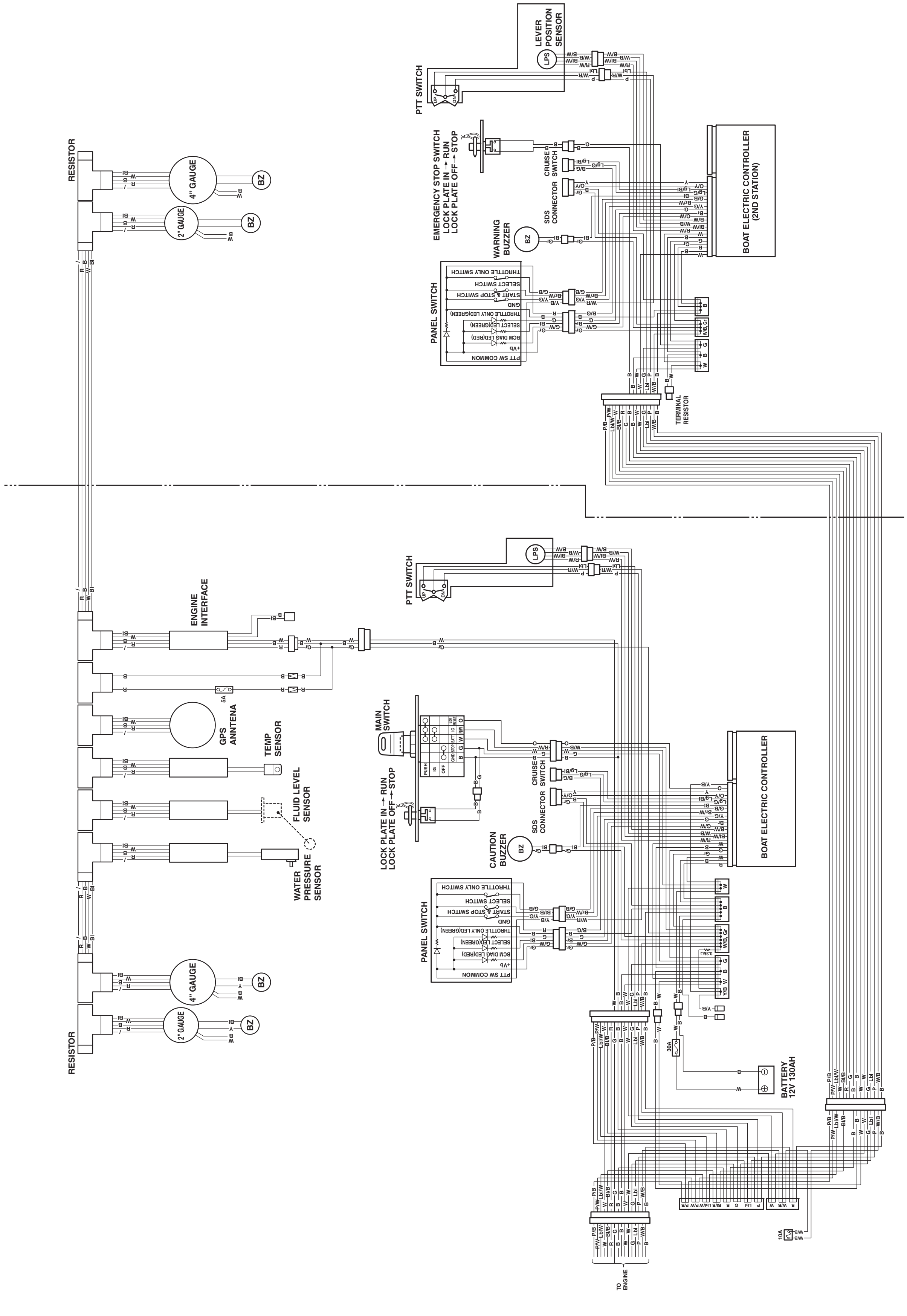
WIRE COLOR

B : Black
Bl : Blue
Br : Brown
G : Green
Gr : Gray
Lbl : Light blue
Lg : Light green
O : Orange
P : Pink
R : Red
W : White
Y : Yellow
B/Br : Black with Brown tracer
B/G : Black with Green tracer
B/O : Black with Orange tracer
B/R : Black with Red tracer
B/W : Black with White tracer
B/Y : Black with Yellow tracer
Bl/B : Blue with Black tracer
Bl/R : Blue with Red tracer
Bl/W : Blue with White tracer
Bl/Y : Blue with Yellow tracer
Br/R : Brown with Red trancer
Br/W : Brown with White tracer
Br/Y : Brown with Yellow tracer
G/B : Green with Black tracer
G/Bl : Green with Blue tracer
G/R : Green with Red tracer
G/W : Green with White tracer
Gr/R : Gray with Red tracer
Gr/Y : Gray with Yellow tracer
Lbl/W : Light blue with White tracer
Lg/B : Light green with Black tracer
Lg/Bl : Light green with Blue tracer
Lg/G : Light green with Green tracer
Lg/R : Light green with Red tracer
Lg/W : Light green with White tracer
O/B : Orange with Black tracer
O/Bl : Orange with Blue tracer
O/G : Orange with Green tracer
O/R : Orange with Red tracer
O/W : Orange with White tracer
O/Y : Orange with Yellow tracer
P/B : Pink with Black tracer
P/Bl : Pink with Blue tracer
P/W : Pink with White tracer
R/B : Red with Black tracer
R/Bl : Red with Blue tracer
R/W : Red with White tracer
R/Y : Red with Yellow tracer
V/W : Violet with White tracer
W/B : White with Black tracer
W/Bl : White with Blue tracer
W/G : White with Green tracer
W/R : White with Red tracer
W/Y : White with Yellow tracer
Y/Bl : Yellow with Blue tracer
Y/G : Yellow with Green tracer
Y/R : Yellow with Red tracer



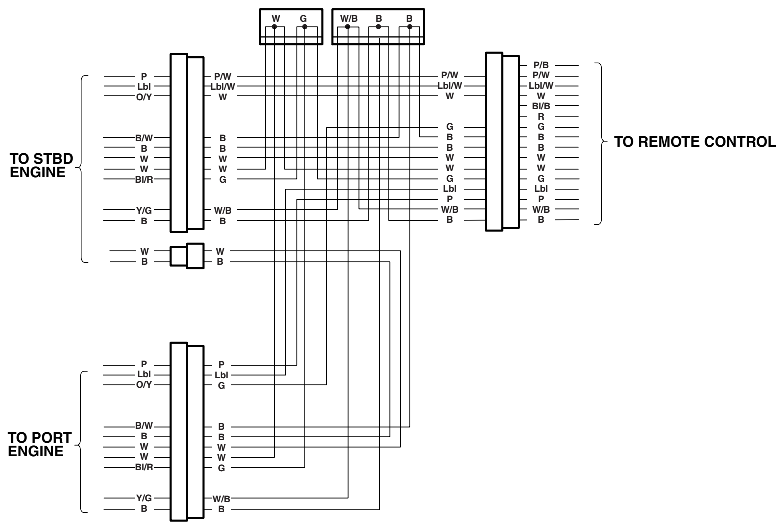
to previous page

For single engine and dual station

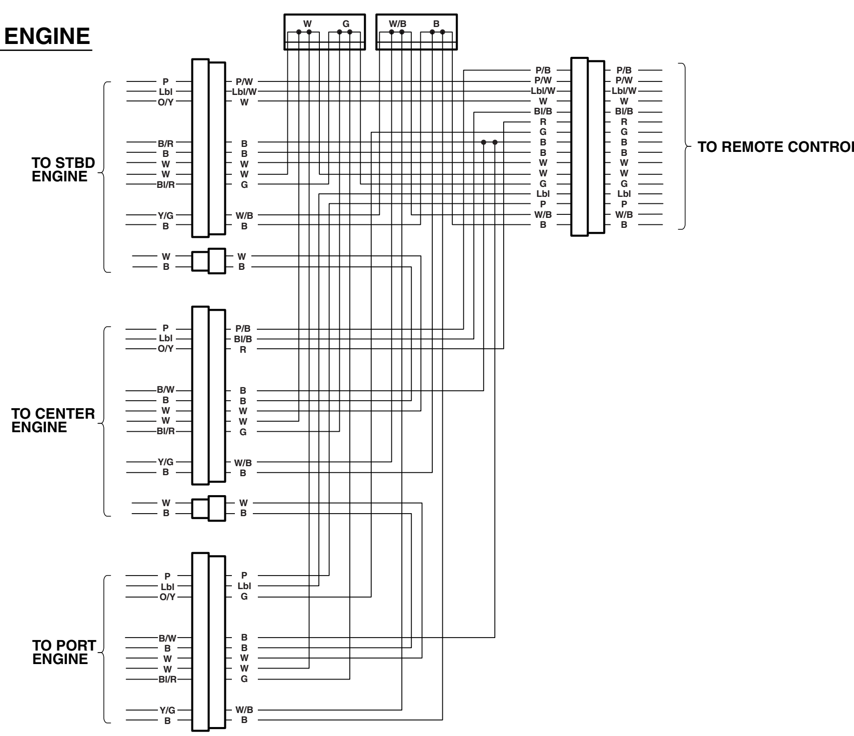


For multiple engine

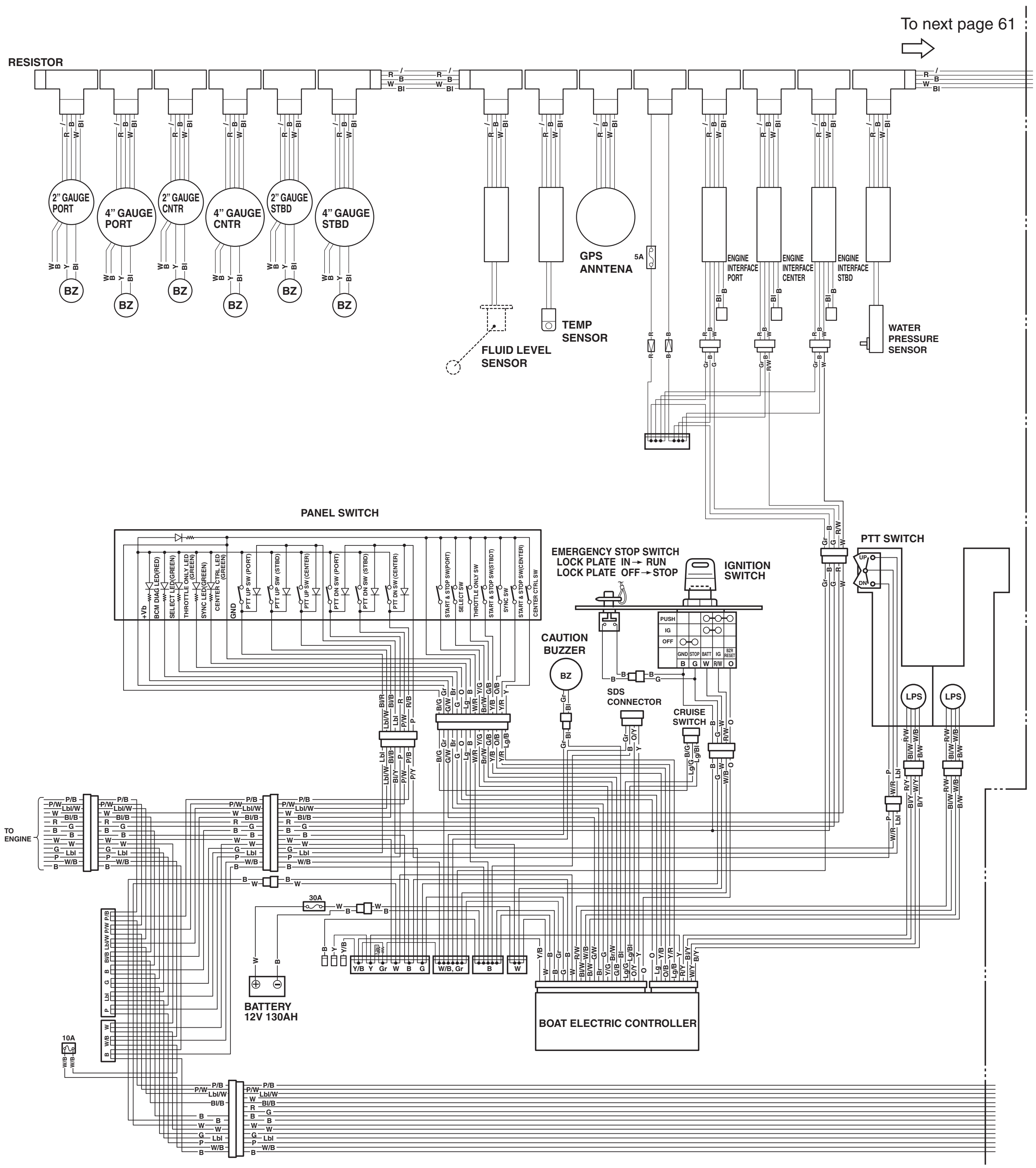
FOR DUAL ENGINE

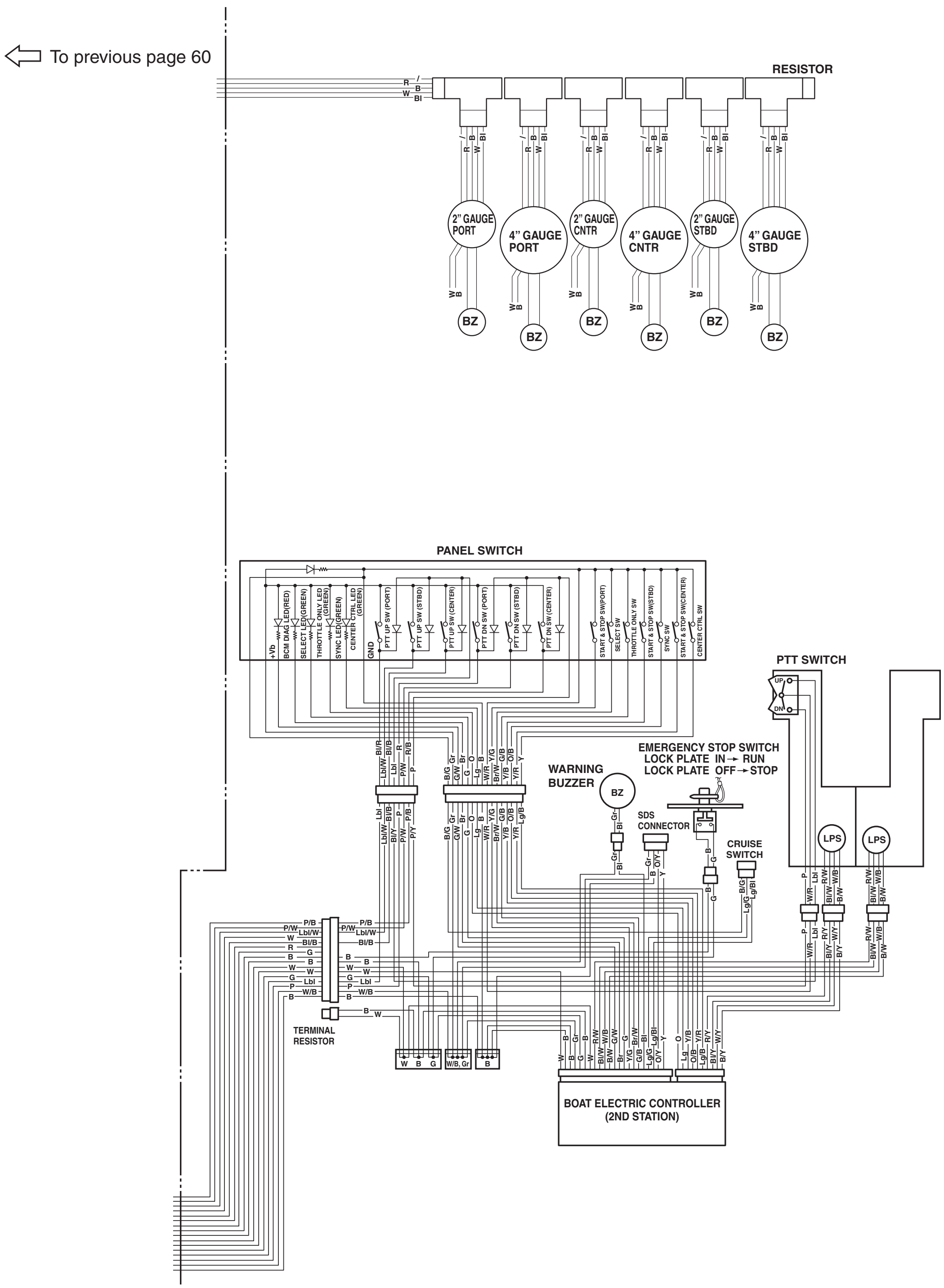


FOR TRIPLE ENGINE



For multiple engine and dual station

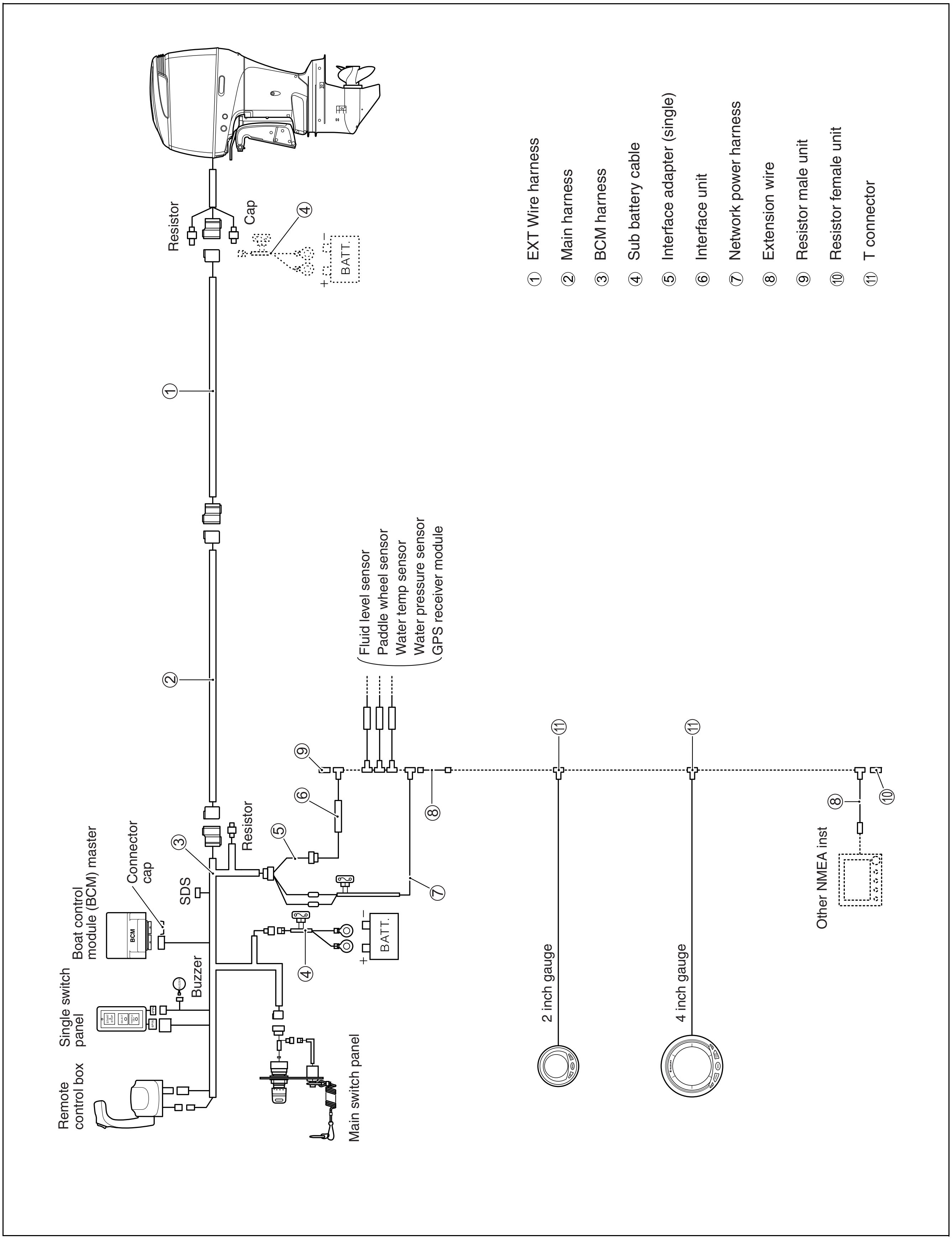




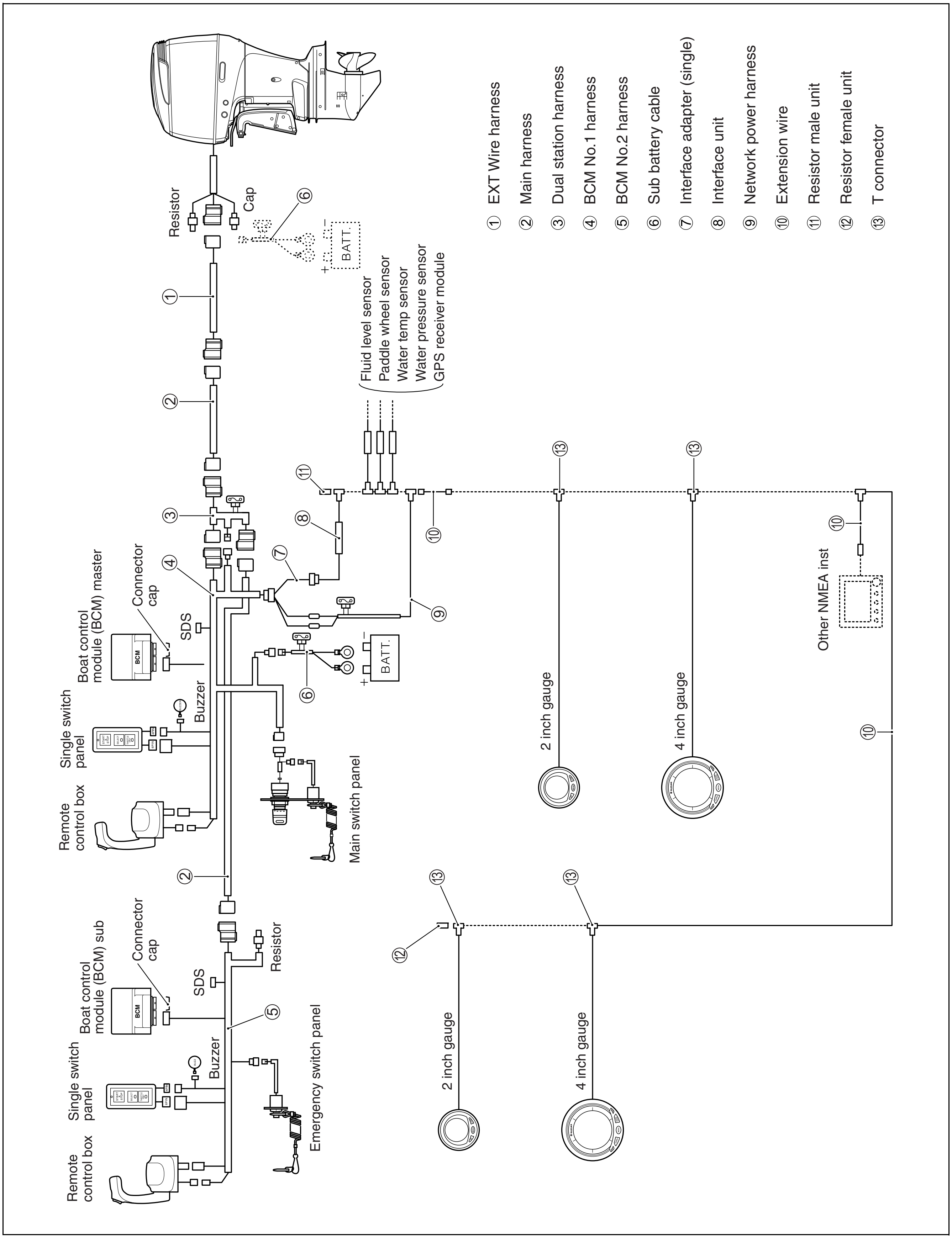
To previous page 60
RESISTOR
2" GAUGE PORT
4" GAUGE PORT
2" GAUGE CNTR
4" GAUGE CNTR
2" GAUGE STBD
4" GAUGE STBD
BZ
PANEL SWITCH
PTT SWITCH
EMERGENCY STOP SWITCH
LOCK PLATE IN → RUN
LOCK PLATE OFF → STOP
WARNING BUZZER
SDS CONNECTOR
CRUISE SWITCH
LPS
TERMINAL RESISTOR
BOAT ELECTRIC CONTROLLER (2ND STATION)

WIRING

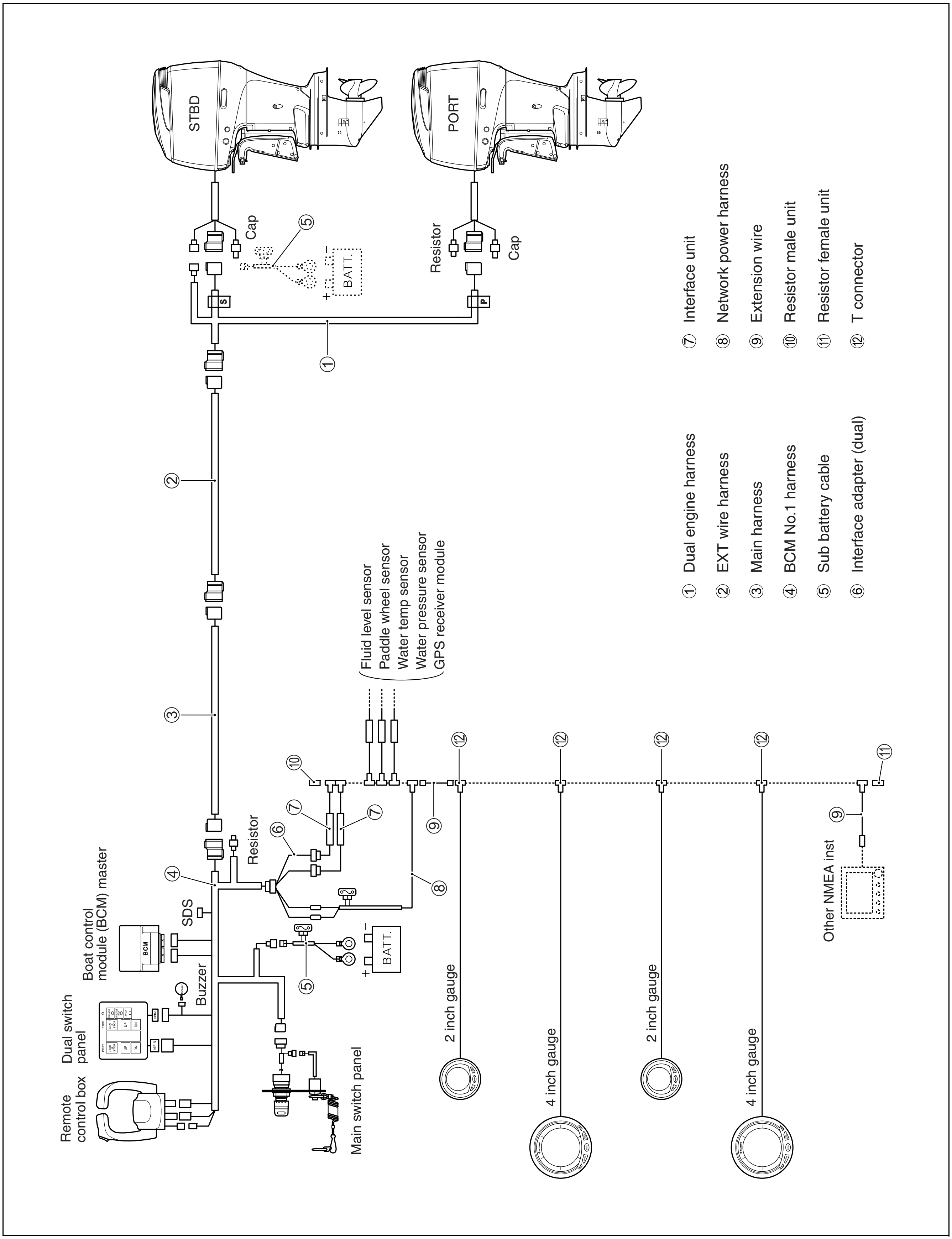
SINGLE ENGINE, SINGLE STATION



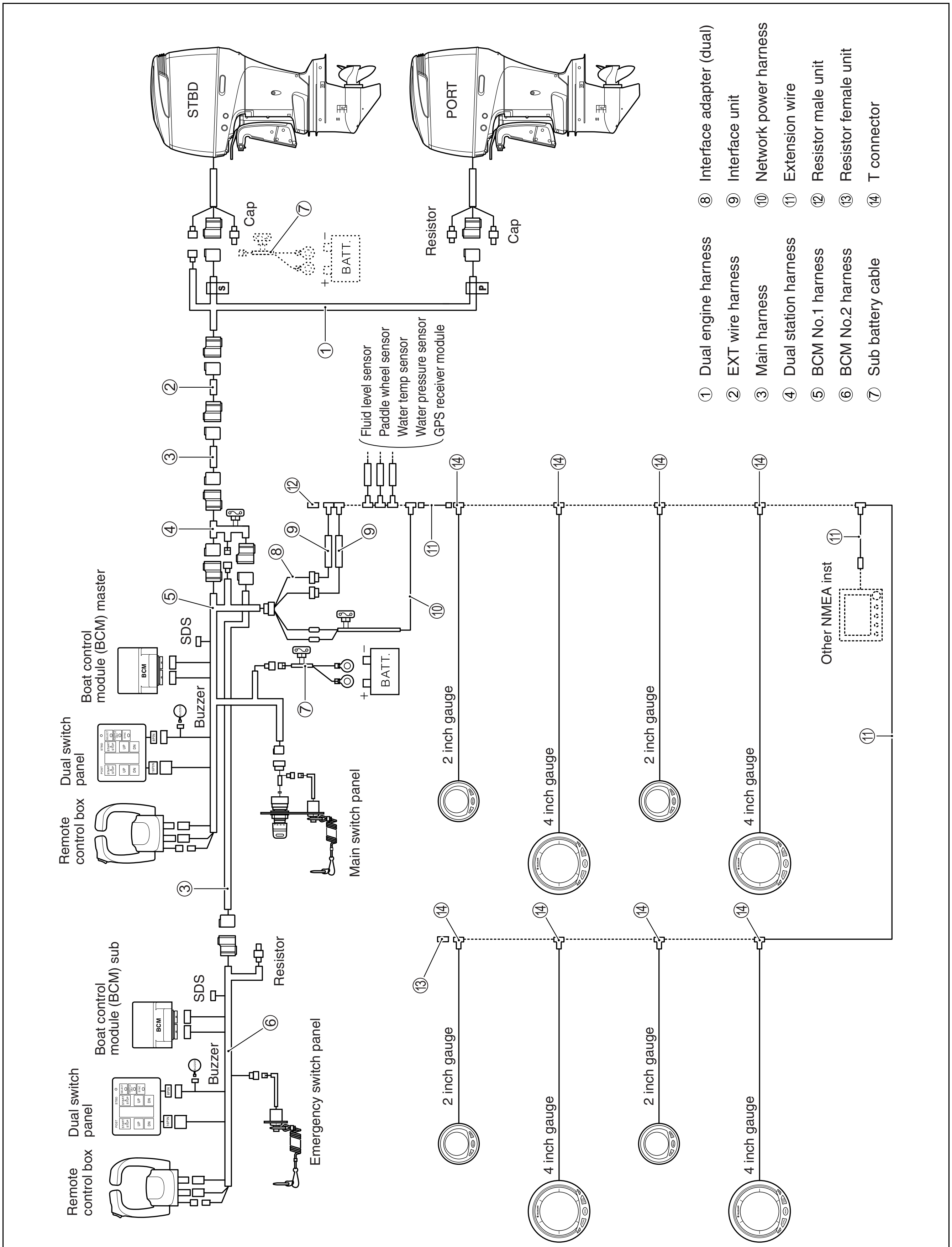
SINGLE ENGINE, DUAL STATIONS



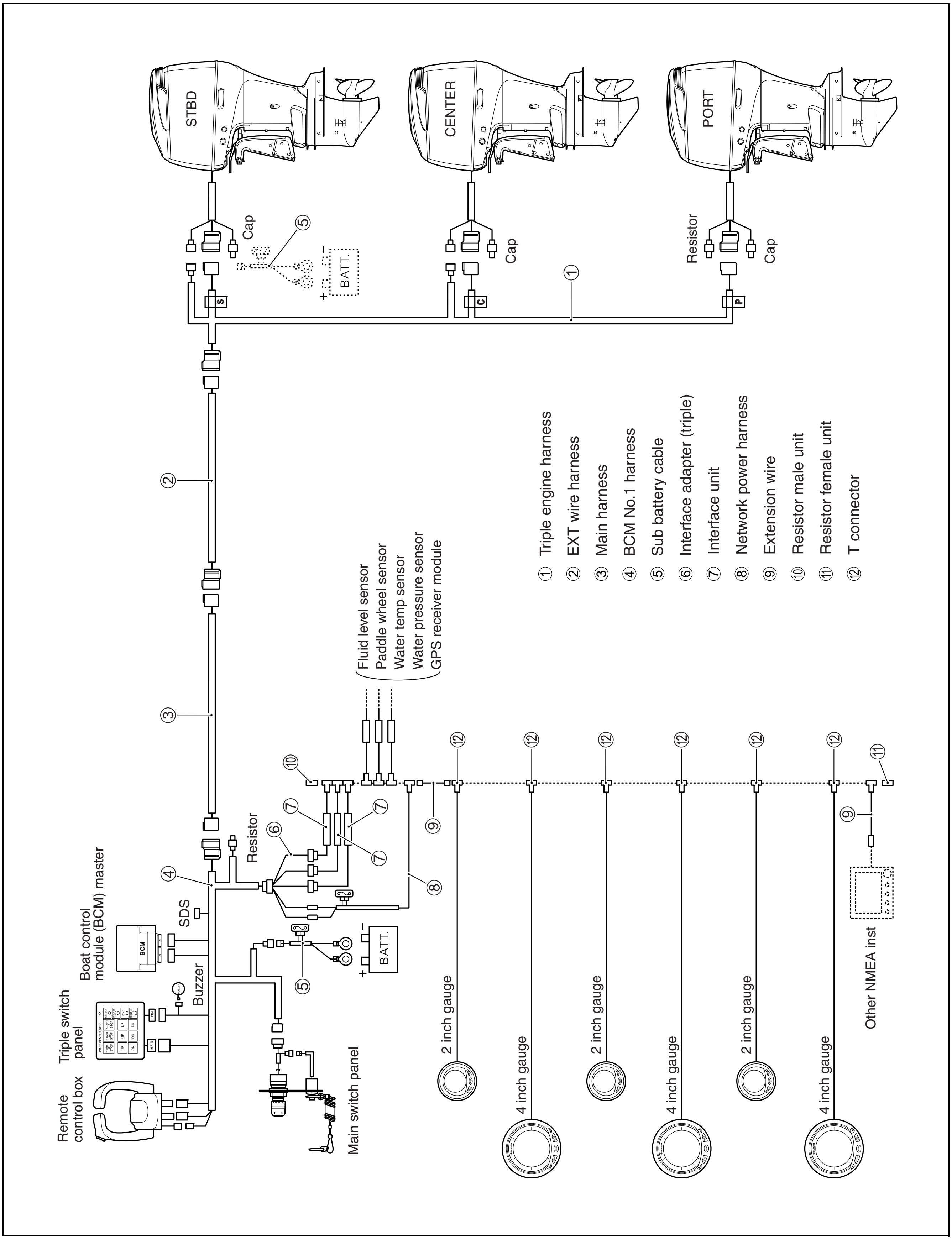
TWIN ENGINES, SINGLE STATION



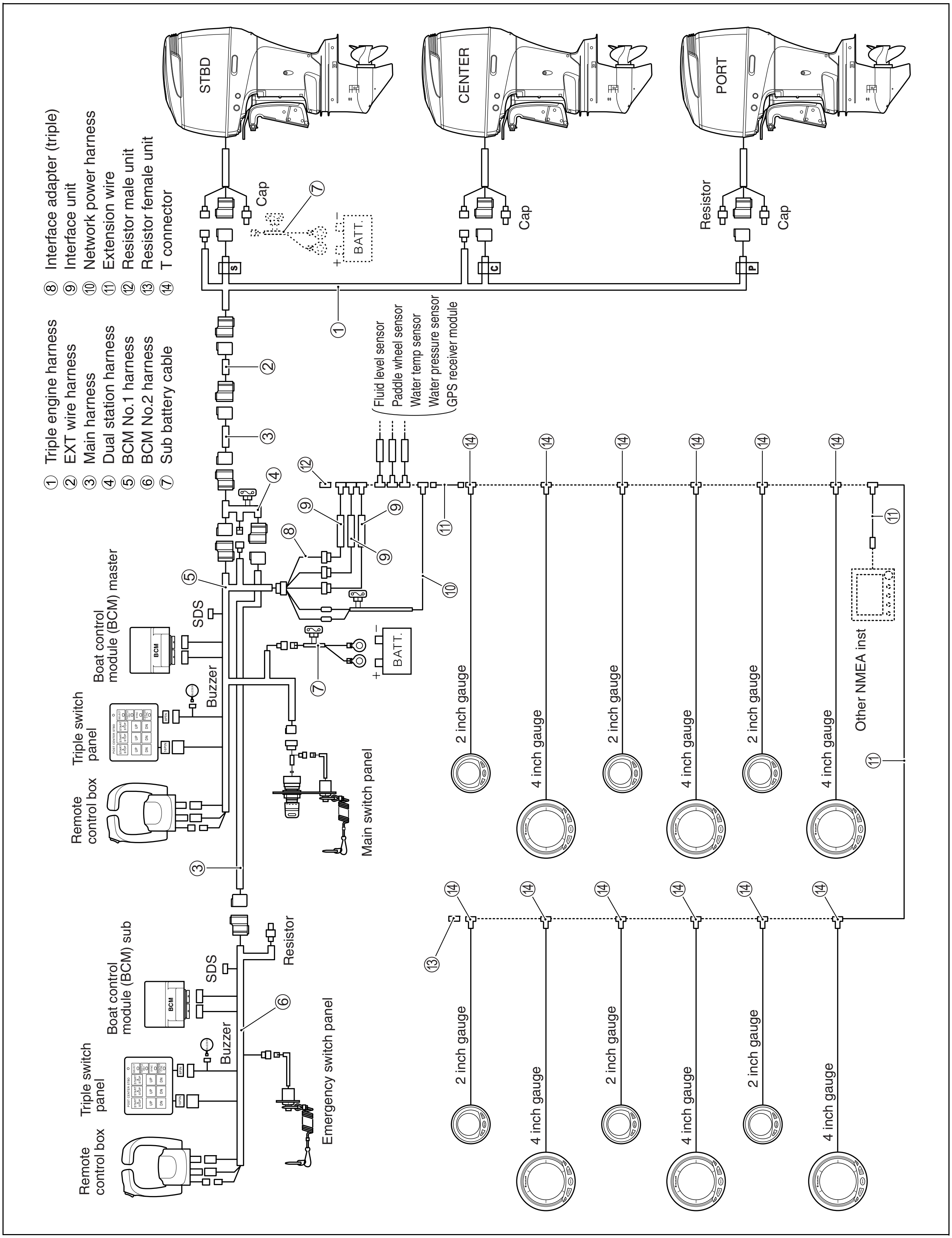
TWIN ENGINES, DUAL STATIONS



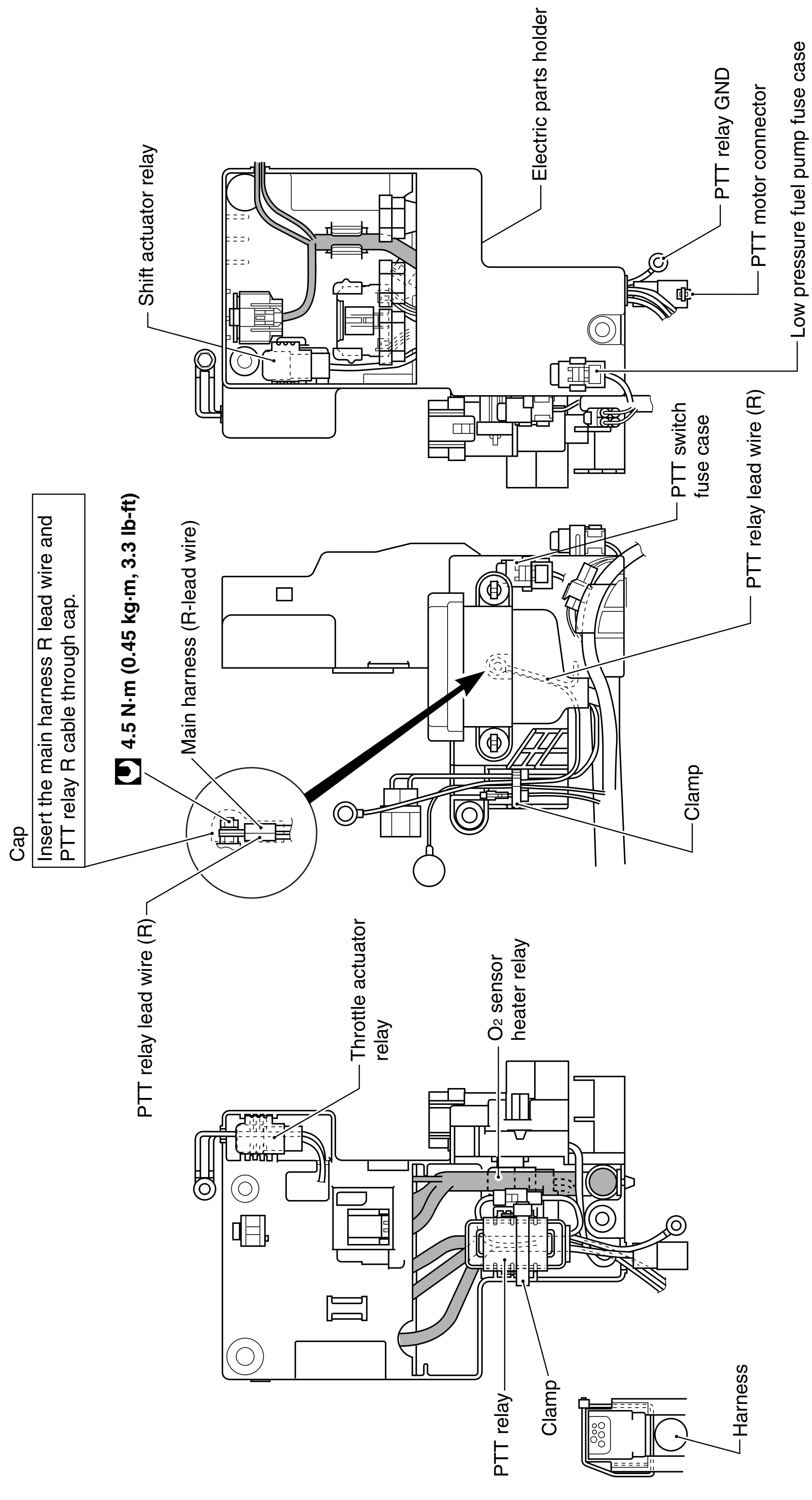
TRIPLE ENGINES, SINGLE STATION

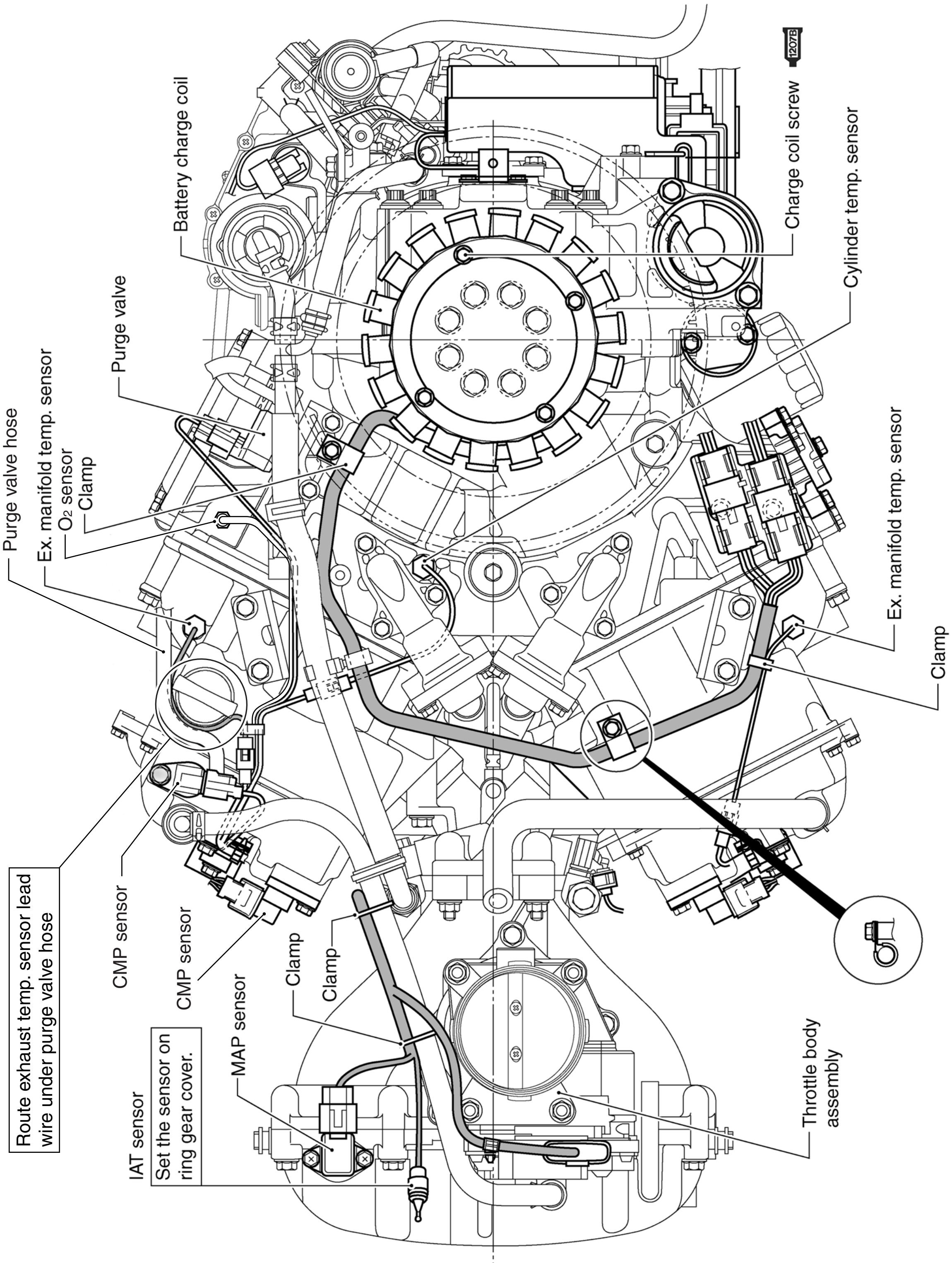


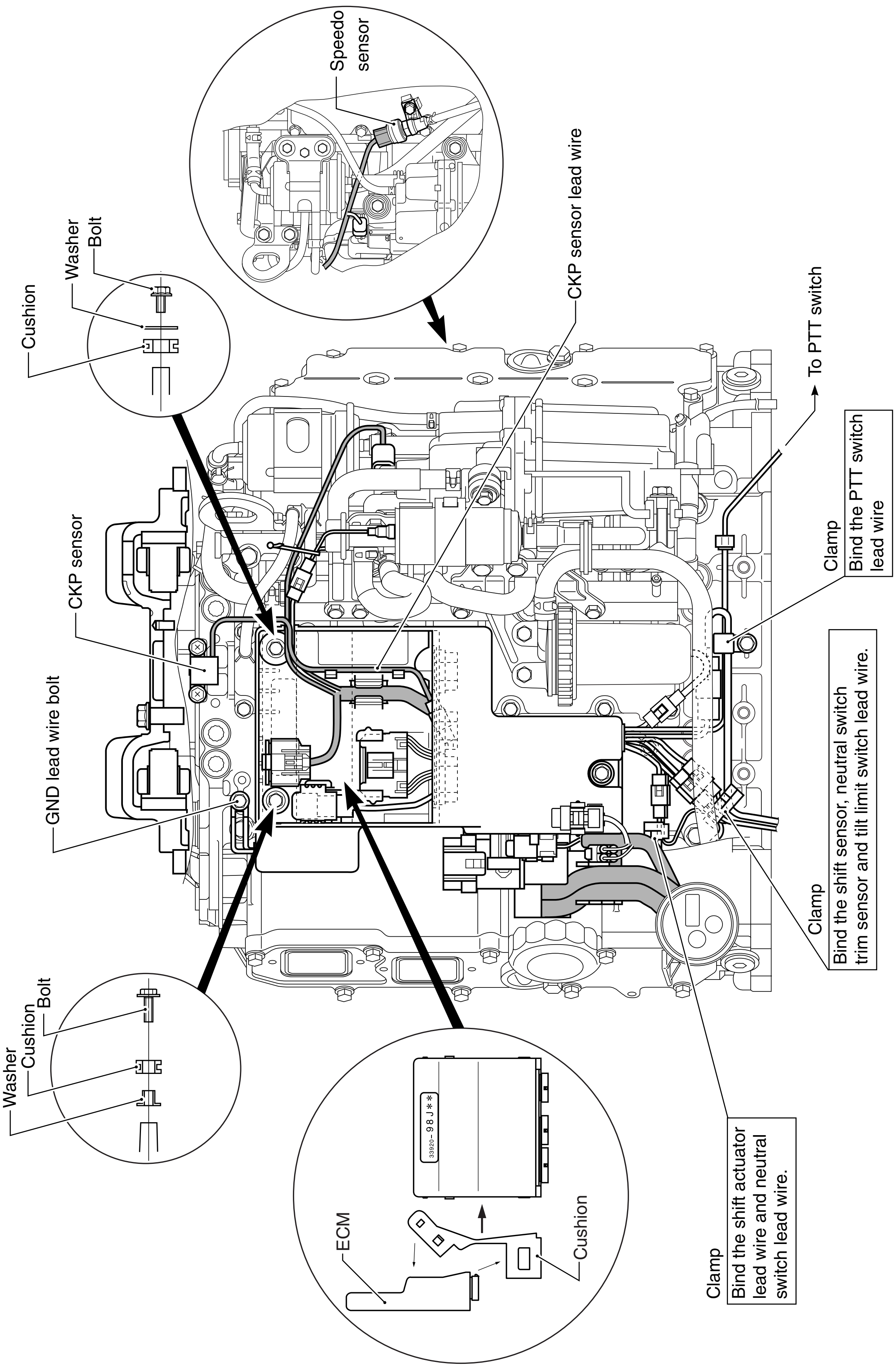
TRIPLE ENGINES, DUAL STATIONS



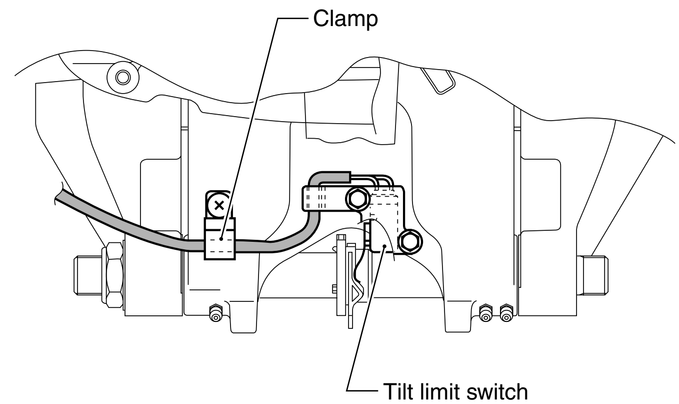
WIRE ROUTING

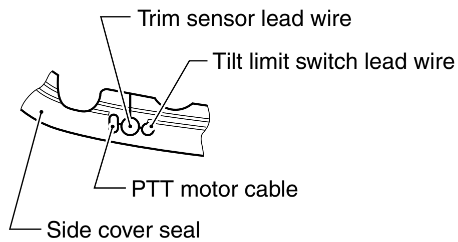


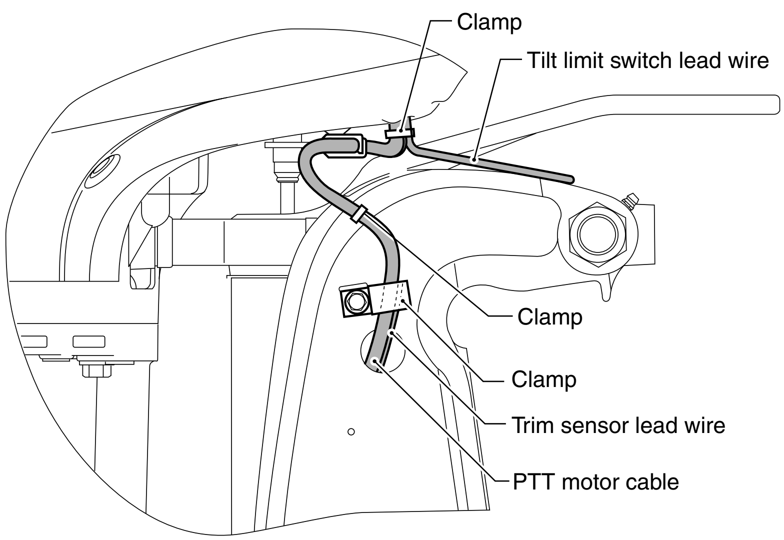

Route exhaust temp. sensor lead wire under purge valve hose
Purge valve hose
Ex. manifold temp. sensor
O2 sensor
Clamp
Purge valve
Battery charge coil
Charge coil screw
1207B
Cylinder temp. sensor
Ex. manifold temp. sensor
Clamp
IAT sensor
Set the sensor on ring gear cover.
CMP sensor
CMP sensor
MAP sensor
Clamp
Clamp
Throttle body assembly

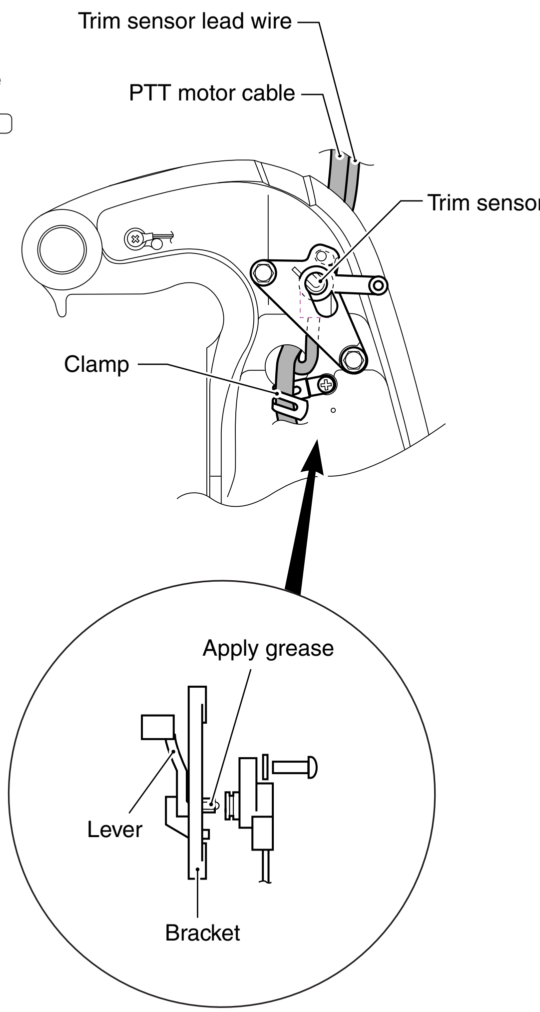


Speedo sensor
CKP sensor lead wire
Washer
Bolt
Cushion
To PTT switch
Clamp
Bind the PTT switch lead wire
CKP sensor
GND lead wire bolt
Clamp
Bind the shift sensor, neutral switch trim sensor and tilt limit switch lead wire.
Washer
Cushion
Bolt
33920-98J**
ECM
Cushion
Clamp
Bind the shift actuator lead wire and neutral switch lead wire.


Clamp
Tilt limit switch


Trim sensor lead wire
Tilt limit switch lead wire
PTT motor cable
Side cover seal


Clamp
Tilt limit switch lead wire
Clamp
Clamp
Trim sensor lead wire
PTT motor cable


Trim sensor lead wire
PTT motor cable
Trim sensor
Clamp
Apply grease
Lever
Bracket

Prepared by

SUZUKI MOTOR CORPORATION

Outboard Motor Engineering Department

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Printed in Japan

SUZUKI

Way of Life!

SUZUKI MOTOR CORPORATION

Printed in Japan TK