SUZUKI OUTBOARD MOTOR

DF70A
DF80A
DF90A

FOUR STROKE

SERVICE MANUAL

99500-87L00-01E

IMPORTANT NOTICE

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.

⚠ WARNING

This service manual is intended for authorized Suzuki outboard motor dealers and qualified service technicians only.
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.

FOREWORD

This manual contains an introductory description of the SUZUKI DF70/80/90 Outboard motors 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 these outboard motors, 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.*

NOTE:
This manual is compiled based on 2009 (K9) model.

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Section 00

Precautions

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Precautions

Precautions

General Precautions

Z9J0110000002

⚠ 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 glasses when filing metals, working on a grinder, or doing other work, which could cause debris.**
- **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, 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 latex 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 the fuel, lubrication, cooling and/or the 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 or batteries.**
- **To protect the Earth's natural resources, properly dispose of used motor parts.**

Section 0

General Information

0

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General Information

General Description

Symbols

Z9J0110101001

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
	Torque control required. Data beside it indicates specified torque.
	Apply oil. Use engine oil unless otherwise specified.
	Apply molybdenum oil solution. (Mixture of engine oil and SUZUKI MOLY PASTE in a ratio of 1 : 1)
GearOIL	Apply SUZUKI Outboard Motor Gear Oil.
A	Apply SUZUKI Super Grease A.
M	Apply SUZUKI Moly Paste. 99000-25140
W	Apply SUZUKI Water Resistant Grease.
1207B	Apply SUZUKI Bond 1207B.
Si	Apply SUZUKI Silicone Seal.
1342	Apply SUZUKI Thread Lock 1342.
1333	Apply SUZUKI Thread Lock Super 1333B.
TOOL	Use special tool.
	Do not reuse.
	Note on reassembly.
CD-77	Use peak voltmeter Stevens CD-77.

Abbreviations

Z9J0110101002

Abbreviations used in this service manual are as follows:

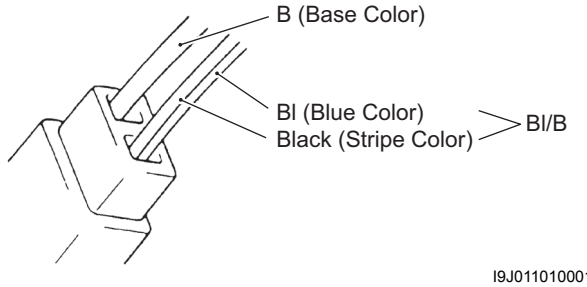
A:
ATDC: After Top Dead Center
AC: Alternating Current
B:
BTDC: Before Top Dead Center
C:
CKP Sensor: Crankshaft Position sensor
CMP Sensor: Camshaft Position sensor
CTP: Close Throttle Position
D:
DC: Direct Current
DOHC: Double Over Head Camshaft
E:
ECM: Engine Control Module
EX (Ex.): Exhaust
F:
FP: Fuel Pump
G:
GND: Ground
I:
IAC: Idle Air Control
IAT: Intake Air Temperature
IG: Ignition
Ign.: Ignition
IN (In.): Intake
L:
LPS: Lever Position Sensor
M:
MAP: Manifold Absolute Pressure
P:
PCV: Positive Crankcase Ventilation
PORT: Port
PTT: Power Trim and Tilt
S:
SPS: Shift Position Sensor
STBD: Starboard
SIGP: Start-In-Gear Protection
T:
TPS: Throttle Position Sensor

Wire Color Symbols

Z9J0110101010

There are two kinds of colored wire used in this product.
One is single colored wire and the other is dual colored (striped) wire.
The single colored wire uses only one color symbol. example: B (Black).
The dual colored wire uses two color symbols. example: Bl/B.
The first symbol represents the base color of the wire and the second symbol represents the color of the stripe.
Example: Bl/B (Blue with Black stripe).

Symbol	Wire color	Symbol	Wire color
B	Black	Lg	Light green
Bl	Blue	O	Orange
Br	Brown	P	Pink
Dg	Dark green	R	Red
G	Green	V	Violet
Gr	Gray	W	White
Lbl	Light blue	Y	Yellow

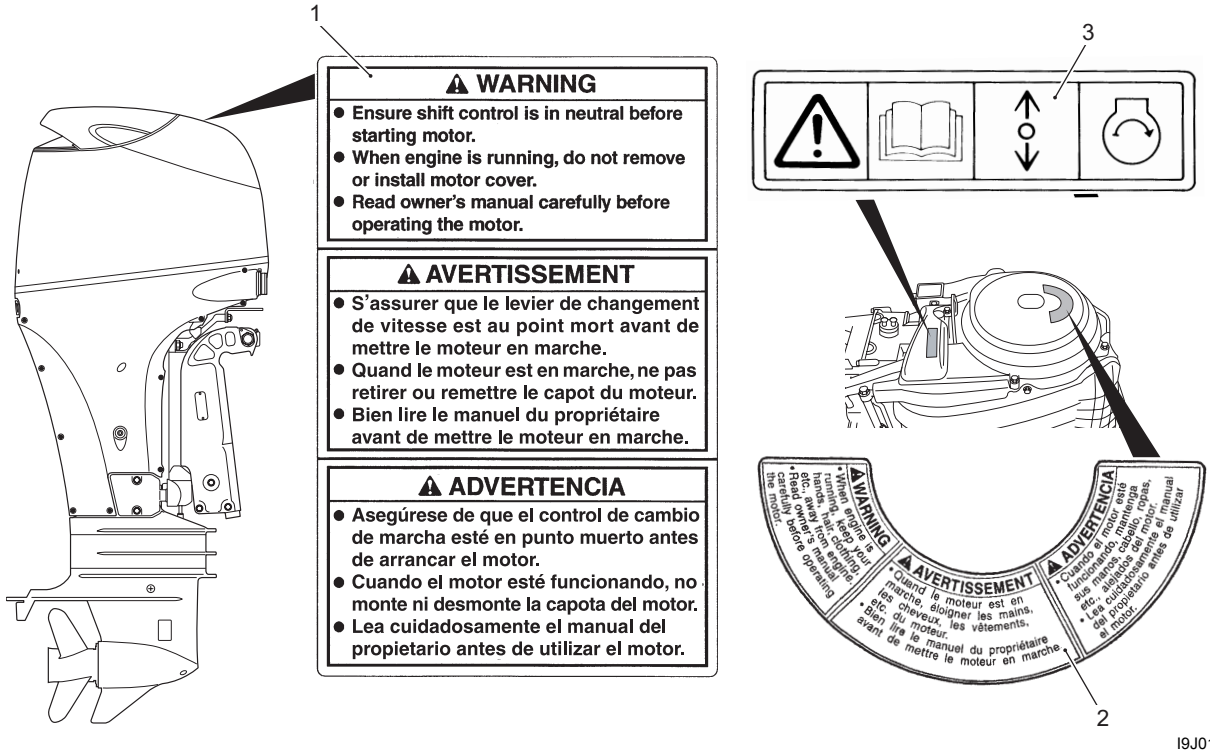


I9J011010001-02

Warning, Caution and Information Label Locations

Z9J0110101011

The figure shows main labels among others that are attached to outboard motor.
When servicing outboard motor, refer to WARNING / CAUTION instructions printed on labels.
If any WARNING / CAUTION label is found stained or damage, clean or replace it as necessary.
Do not reuse a label after it has been removed. Always use new label.



I9J011010004-02

1. Label, engine cover	2. Label, mag cover	3. Label S.I.G.P.

Genuine Parts Description

Z9J0110101012

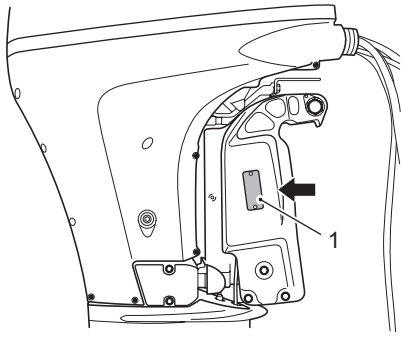
If parts replacement is necessary, Suzuki strongly recommends that you use genuine Suzuki parts or their equivalent.
They are precision-made to ensure high quality and correct fit.

Outboard Motor Identification Number Location

Z9J0110101013

Model, Pre-fix, Serial number

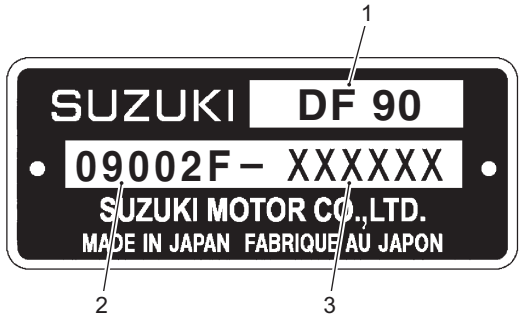
The Model, Pre-fix and Serial number of motor are stamped on a plate attached to the clamp bracket.



I9J011010005-01

1. Identification number plate	

Example

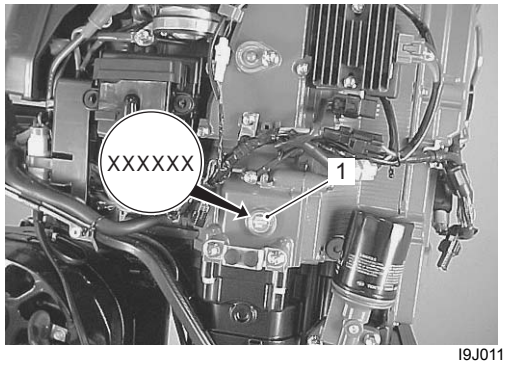


I9J011010002-03

1. Model	3. Serial number
2. Pre-fix	

Engine Serial Number Location

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



I9J011010012-02

1. Serial number plate	

Fuel and Oil Recommendations

Z9J0110101015

Gasoline

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

Allowable maximum blend of a single additive (not combination)

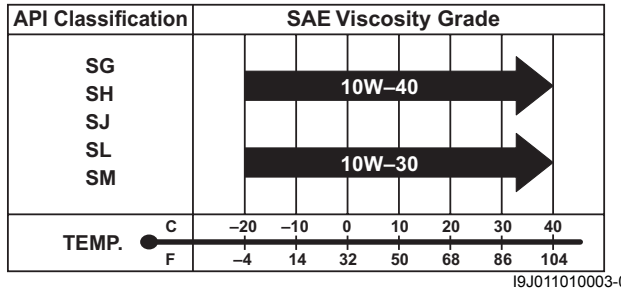
5% Methanol, 10% Ethanol, 15% MTBE

CAUTION

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

Engine oil

Oil quality is a major contributor to your engine's performance and life. Always select good quality engine oil.
Suzuki recommends the use of a SAE 10 W – 40 NMMA certified oil.
If NMMA certified FC-W oil is not available, select a good quality 4-cycle motor oil from the following chart according to the average temperatures in your area.



I9J011010003-02

Gear oil

Suzuki recommends the use of SUZUKI Outboard Motor Gear Oil. If it is not available, use SAE 90 hypoid gear oil which is rated GL-5 under the API classification system.

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Break-In Procedures

Z9J0110101016

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 period by varying the throttle position occasionally.

First 2 hours
For the 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.

Next 1 hour
Operate the engine in-gear at less than 3/4 (three - quarter) throttle (4 000 r/min).

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

Propeller Selection Guide

Z9J0110101017

An outboard motor is designed to develop its rated power within a specified engine speed range. The maximum rated power delivered by the DF70 / 80 / 90 models are shown below.

Recommended full throttle speed range

DF70	5 000 – 6 000 r/min
DF80	5 000 – 6 000 r/min
DF90	5 500 – 6 300 r/min

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.

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 size chart

Blade x Dia. (in.) x Pitch (in.)
3 x 14 x 13
3 x 13 and 7/8 x 15
3 x 13 and 3/4 x 17
3 x 13 and 3/4 x 19
3 x 13 and 3/4 x 21
3 x 13 and 3/4 x 23
3 x 13 and 1/2 x 15
3 x 14 x 17
3 x 14 x 19
3 x 14 x 21
3 x 14 x 23

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Battery Requirement

Z9J0110101018

Suzuki recommends a 12 volt cranking type lead acid battery for the DF70A / 80A / 90A.
Minimum battery requirement for starting the engine is provided below.
The battery must satisfy one of the specifications described below.

NOTE

- **The specifications listed below are the minimum battery rating requirements for starting the engine.**
- **Additional electrical loads from the boat will require larger capacity batteries.**
- **Dual-purpose (Cranking / Deep Cycle) batteries can be used if they meet the minimum specifications listed below (MCA, CCA, or RC).**
- **Do not use a Deep Cycle battery for the main cranking battery.**
- **The use of Maintenance-Free, sealed, or Gel-Cell batteries is not recommended because they may not be compatible with Suzuki's charging system.**
- **When connecting batteries in parallel, they must be of the same type, capacity, manufacturer, and of similar age. When replacement is necessary, they should be replaced as a set.**
- **It is recommended that the battery be installed in an enclosed case.**
- **When connecting batteries, hexagon nuts must be used to secure battery leads to battery terminals.**

Battery Specification

650 Marine Cranking Amps (MCA)/ABYC, or 512 Cold Cranking Amps (CCA)/SAE or 160 Reserve Capacity (RC) Minutes/SAE or 12 V 100 AH

Powerhead Direction of Rotation Description

Z9J0110101019

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.

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Specifications

Specifications

Z9J0110107001

NOTE

These specifications are subject to change without notice.

Model Pre-fix

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
PRE-FIX		07002F	08001F	09002F

Dimensions and Weight

Item		Unit	Data		
			DF70AT	DF80AT	DF90AT
Overall length (front to back)		mm (in.)	724 (28.5)		
Overall width (side to side)		mm (in.)	459 (18.1)		
Overall height	L	mm (in.)	1 480 (58.2)		
	X	mm (in.)	1 607 (63.3)		
Weight (without engine oil)	L	kg (lbs)	155 (341)		
	X	kg (lbs)	158 (348)		
Transom height	L	mm (in. type)	510 (20)		
	X	mm (in. type)	637 (25)		

Performance

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
Maximum output	kW (PS)	51.5 (70)	58.8 (80)	66.2 (90)
Recommended operating range	r/min	5 000 – 6 000	5 000 – 6 000	5 500 – 6 300
Idle speed	r/min	600 ± 50 (in-gear: Approx. 600)		

Powerhead

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
Engine type		4-stroke DOHC		
Number of cylinders		4		
Bore	mm (in.)	75 (2.95)		
Stroke	mm (in.)	85 (3.35)		
Total displacement	cm^3 (cu. in)	1 502 (91.6)		
Compression ratio	: 1	9.5		
Spark plug	NGK	DCPR6E		
Ignition system		Full-transistorized ignition		
Fuel supply system		Multi-point sequential electronic fuel injection		
Exhaust system		Through prop exhaust		
Cooling system		Water cooled		
Lubrication system		Wet sump by trochoid pump		
Starting system		Electric		
Throttle control		Remote control		

Fuel and Oil

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
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.		

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Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
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)	4.0 (4.2 / 3.5): Oil change only 4.3 (4.5 / 3.8): Oil filter change		
Gear oil		SUZUKI Outboard Motor Gear Oil or SAE 90 hypoid gear oil, API classification GL-5.		
Gearcase oil capacity	ml (US/Imp. oz)	850 (28.7/30.0)		

Bracket

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
Trim angle	degree	0 – 20 (–6 to 14)		
Number of trim position		PTT system		
Maximum tilt angle	degree	75 (–6 to 69)		

Lower unit

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
Reversing system		Gear		
Transmission		Forward-Neutral-Reverse		
Reduction system		Bevel gear		
Gear ratio		12 : 25 (2.08)		
Drive line impact protection		Spline drive rubber hub		
Propeller shaft rotation (when shift into forward)		Clockwise		
Propeller		Blade x Dia. (in.) x Pitch (in.)		
		3 x 14 x 13 3 x 13 and 7/8 x 15 3 x 13 and 3/4 x 17 3 x 13 and 3/4 x 19 3 x 13 and 3/4 x 21 3 x 13 and 3/4 x 23 3 x 13 and 1/2 x 15 3 x 14 x 17 3 x 14 x 19 3 x 14 x 21 3 x 14 x 23		

Reduction system

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
1st reduction gear ratio (Crankshaft drive gear: Driven gear)		29 : 36 (1.24)		
2nd reduction gear ratio (Lower unit gear)		12 : 25 (2.08)		
Total reduction gear ratio		2.59 (36/29 x 25/12)		

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Service Data

Z9J0110107002

NOTE

These service data are subject to change without notice.

Powerhead

Item	Unit	Data		
		DF70AT	DF80AT	DF90AT
Recommended operating range	r/min	5 000 – 6 000	5 000 – 6 000	5 500 – 6 300
Idle speed	r/min	600 ± 50 (in-gear: Approx. 600)		
**Cylinder compression pressure	kPa (kgf/cm², psi.)	1 200 – 1 800 (12 – 18, 171 – 256)		
**Cylinder compression pressure max. difference between cylinders	kPa (kgf/cm², psi.)	100 (1.0, 14)		
**Engine oil pressure	kPa (kgf/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)	4.0 (4.2 / 3.5): Oil change only 4.3 (4.5 / 3.8): Oil filter change		
Thermostat operating temperature	°C (°F)	58 – 62 (136 – 144)		

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

Cylinder Head / Camshaft

Item			Unit	Data		
				DF70AT	DF80AT	DF90AT
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.)	38.620 – 38.780 (1.5205 – 1.5268)	39.620 – 39.780 (1.5598 – 1.5661)	41.120 – 41.280 (1.6189 – 1.6252)
		Limit	mm (in.)	38.520 (1.5165)	39.520 (1.5559)	41.020 (1.6150)
	EX	std.	mm (in.)	40.920 – 41.080 (1.6110 – 1.6173)		
		Limit	mm (in.)	40.820 (1.6071)		
Camshaft journal oil clearance	Top, 2nd, 3rd, 4th, 5th	std.	mm (in.)	0.045 – 0.087 (0.0018 – 0.0034)		
		Limit	mm (in.)	0.120 (0.0047)		
Camshaft journal (housing) inside diameter	Top, 2nd, 3rd, 4th	std.	mm (in.)	23.000 – 23.021 (0.9055 – 0.9063)		
		Limit	mm (in.)	—		
	5th	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.)	22.934 – 22.955 (0.9029 – 0.9037)		
		Limit	mm (in.)	—		
	5th	std.	mm (in.)	25.936 – 25.957 (1.0211 – 1.0291)		
		Limit	mm (in.)	—		
Camshaft runout		Limit	mm (in.)	0.10 (0.004)		
Cylinder head bore to tappet clearance		std.	mm (in.)	0.025 – 0.062 (1.0010 – 1.0024)		
		Limit	mm (in.)	0.150 (0.0059)		
Tappet outer diameter		std.	mm (in.)	27.959 – 27.975 (1.1007 – 1.1014)		
Cylinder head tappet bore		std.	mm (in.)	28.000 – 28.021 (1.1024 – 1.1032)		

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Valve / Valve Guide

Item			Unit	Data		
				DF70AT	DF80AT	DF90AT
Valve diameter		IN	mm (in.)	27.5 (1.08)		
		EX	mm (in.)	22.9 (0.90)		
Tappet clearance (Cold engine condition)	IN	std.	mm (in.)	0.23 – 0.27 (0.009 – 0.011)		
	EX	std.	mm (in.)	0.30 – 0.34 (0.012 – 0.013)		
Valve seat angle	IN		—	30°, 45°, 60°		
	EX		—	15°, 45°		
Valve guide to valve stem clearance	IN	std.	mm (in.)	0.020 – 0.047 (0.0008 – 0.0019)		
		Limit	mm (in.)	0.070 (0.0028)		
	EX	std.	mm (in.)	0.045 – 0.072 (0.0018 – 0.0028)		
		Limit	mm (in.)	0.090 (0.0035)		
Valve guide inside diameter	IN, EX	std.	mm (in.)	5.500 – 5.512 (0.2165 – 0.2170)		
Valve guide protrusion	IN, EX	std.	mm (in.)	10.8 – 11.6 (0.43 – 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.)	0.75 (0.03)		
		Limit	mm (in.)	0.5 (0.02)		
	EX	std.	mm (in.)	0.95 (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.)	33.1 (1.30)		
		Limit	mm (in.)	31.8 (1.25)		
Valve spring preload		std.	N (kg, lbs)	95 – 111 (9.6 – 11.2, 21.1 – 24.6) at 28.5 mm (1.12 in)		
		Limit	N (kg, lbs)	87 (8.8, 19.4) at 28.5 mm (1.12 in)		
Valve spring squareness		Limit	mm (in.)	2.0 (0.08)		

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Cylinder / Piston / Piston Ring

Item			Unit	Data		
				DF70AT	DF80AT	DF90AT
Cylinder distortion		Limit	mm (in.)	0.03 (0.001)		
Piston to cylinder clearance		std.	mm (in.)	0.020 – 0.040 (0.0008 – 0.0016)		
		Limit	mm (in.)	0.100 (0.0039)		
Cylinder bore		std.	mm (in.)	75.000 – 75.020 (2.9598 – 2.9535)		
Cylinder measuring position			mm (in.)	50 (1.969) from cylinder top surface		
Piston skirt diameter		std.	mm (in.)	74.970 – 74.990 (2.9516 – 2.9524)		
Piston measuring position			mm (in.)	13 (0.512) from piston skirt end		
Cylinder bore wear		Limit	mm (in.)	0.10 (0.039)		
Piston ring end gap	1st	std.	mm (in.)	0.15 – 0.30 (0.0059 – 0.0118)		
		Limit	mm (in.)	0.70 (0.028)		
	2nd	std.	mm (in.)	0.30 – 0.45 (0.0118 – 0.0177)		
		Limit	mm (in.)	1.00 (0.039)		
Piston ring free end gap	1st	std.	mm (in.)	Approx 9.9 (0.3898)		
		Limit	mm (in.)	7.9 (0.3110)		
	2nd	std.	mm (in.)	Approx 9.7 (0.3819)		
		Limit	mm (in.)	7.8 (0.3070)		
Piston ring to groove clearance	1st	std.	mm (in.)	0.030 – 0.070 (0.0012 – 0.0028)		
		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.)	1.02 – 1.04 (0.040 – 0.041)		
	2nd	std.	mm (in.)	1.21 – 1.23 (0.048 – 0.048)		
	Oil	std.	mm (in.)	2.01 – 2.03 (0.079 – 0.080)		
Piston ring thickness	1st	std.	mm (in.)	0.97 – 0.99 (0.038 – 0.039)		
	2nd	std.	mm (in.)	1.17 – 1.19 (0.046 – 0.047)		
Pin clearance in piston pin hole		std.	mm (in.)	0.006 – 0.019 (0.0002 – 0.0007)		
		Limit	mm (in.)	0.005 (0.0019)		
Piston pin outside diameter		std.	mm (in.)	17.995 – 18.000 (0.7085 – 0.7087)		
		Limit	mm (in.)	17.980 (0.7079)		
Piston pin hole diameter		std.	mm (in.)	18.006 – 18.014 (0.7089 – 0.7092)		
		Limit	mm (in.)	18.030 (0.7098)		
Pin clearance in conrod small end		std.	mm (in.)	0.003 – 0.016 (0.0001 – 0.0006)		
		Limit	mm (in.)	0.050 (0.0020)		
Conrod small end bore		std.	mm (in.)	18.003 – 18.011 (0.7088 – 0.7091)		

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Crankshaft / Conrod

Item		Unit	Data		
			DF70AT	DF80AT	DF90AT
Conrod small end inside diameter	std.	mm (in.)	18.003 – 18.011 (0.7088 – 0.7091)		
Conrod big end oil clearance	std.	mm (in.)	0.032 – 0.050 (0.0013 – 0.0020)		
	Limit	mm (in.)	0.080 (0.0031)		
Conrod big end inside diameter	std.	mm (in.)	45.000 – 45.018 (1.7717 – 1.7724)		
Crank pin outside diameter	std.	mm (in.)	41.982 – 42.000 (1.6528 – 1.6535)		
Crank pin outside diameter difference (out-of-round and taper)	Limit	mm (in.)	0.010 (0.0004)		
Conrod bearing thickness	std.	mm (in.)	1.487 – 1.502 (0.0585 – 0.0591)		
Conrod big end side clearance	std.	mm (in.)	0.100 – 0.250 (0.0039 – 0.0098)		
	Limit	mm (in.)	0.350 (0.0138)		
Conrod big end width	std.	mm (in.)	21.950 – 22.000 (0.8642 – 0.8661)		
Crank pin width	std.	mm (in.)	22.100 – 22.200 (0.8071 – 0.8740)		
Crankshaft center journal runout	Limit	mm (in.)	0.04 (0.002)		
Crankshaft journal oil clearance	std.	mm (in.)	0.016 – 0.032 (0.0006 – 0.0014)		
	Limit	mm (in.)	0.056 (0.0022)		
Crankcase bearing holder inside diameter	std.	mm (in.)	56.000 – 56.018 (2.2047 – 2.2054)		
Crankshaft journal outside diameter	std.	mm (in.)	51.994 – 52.012 (2.0470 – 2.0477)		
Crankshaft journal outside diameter difference (out-of-round and taper)	Limit	mm (in.)	0.010 (0.0004)		
Crankshaft bearing thickness	std.	mm (in.)	1.992 – 2.008 (0.0784 – 0.0791)		
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.)	2.47 – 2.52 (0.0972 – 0.0992)		

Electrical

Item		Unit	Data		
			DF70AT	DF80AT	DF90AT
Ignition timing		Degrees at r/min	BTDC 0 – 26		BTDC 0 – 27
Over revolution limiter		r/min	6 200		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	0.10 – 0.30		
Battery charge coil output (12 V)		Watt	324		
Standard spark plug	Type	NGK	DCPR6E		
	Gap	mm (in.)	0.8 – 0.9 (0.031 – 0.035)		
Fuse amp. rating		A	Main fuse: 40 Starter motor: 30 Ignition coil, Injector, ECM, Fuel pump: 30 PTT switch: 10 IAC: 10		
Recommended battery capacity (12 V)		Ah (kC)	100 (360) or larger		
Fuel injector resistance		Ω at 20 °C	10 – 14		
IAC valve resistance		Ω at 20 °C	25 – 34		
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		

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Starter Motor

Item		Unit	Data		
			DF70AT	DF80AT	DF90AT
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)		

PTT Motor

Item		Unit	Data		
			DF70AT	DF80AT	DF90AT
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 Code

0: OFF, 1: ON

Failed item	Code	Lamp flashing pattern	Fail-safe system activating
MAP sensor 1	3 – 4	 MCODE00D34-0-01	YES
Cylinder temp. sensor	1 – 4	 MCODE00D14-0-01	YES
IAT sensor	2 – 3	 MCODE00D23-0-01	YES
CKP sensor	4 – 2	 MCODE00D42-0-01	NO
CMP sensor	2 – 4	 MCODE00D24-0-01	NO
Air intake system	2 – 2	 MCODE00D22-0-01	YES
MAP sensor 2	3 – 2	 MCODE00D32-0-01	NO
Exhaust manifold temp. sensor	1 – 5	 MCODE00D15-0-01	YES
Fuel injector	4 – 3	 MCODE00D43-0-01	NO
Throttle position sensor	2 – 1	 MCODE00D21-0-01	YES
Shift position sensor	1 – 2	 MCODE00D12-0-01	YES
Neutral switch	3 – 3	 MCODE00D33-0-01	NO

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Failed item	Code	Lamp flashing pattern	Fail-safe system activating
Trim sensor	3 – 7	 MCODE00D37-0-01	NO
Oil pressure switch	5 – 3	 MCODE00D53-0-01	NO
Rectifier/Regulator (Over-charging)	1 – 1	 MCODE00D11-0-01	NO

Tightening Torque Specifications

Z9J0110107003

Important Fasteners

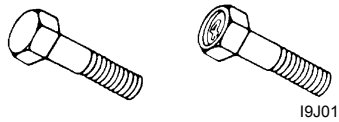
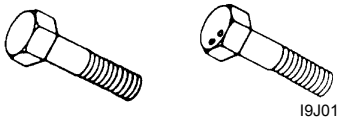
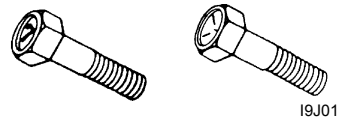
Item		Thread Diameter	Tightening Torque		
			N·m	kgf-m	lbf-ft
Cylinder head cover bolt		6 mm	11	1.1	8.0
Cylinder head bolt		8 mm	23	2.3	16.6
		10 mm	70	7.0	51.0
Crankcase bolt	Outside	8 mm	25	2.5	18.0
	Inside	10 mm	52	5.2	37.5
Conrod cap bolt		9 mm	47	4.7	40.0
Camshaft housing bolt		6 mm	11	1.1	8.0
Oil pump bolt		6 mm	15	1.5	11.0
IN. camshaft timing sprocket		—	78	7.8	56.0
EX. camshaft timing sprocket		6 mm	11	1.1	8.0
Chain tensioner adjuster bolt		6 mm	11	1.1	8.0
Timing chain guide bolt		8 mm	23	2.3	16.6
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		16 mm	196	19.7	142.0
Starter motor mounting bolt		8 mm	23	2.3	16.6
Engine oil filter		—	14	1.4	10.0
Engine oil drain plug		12 mm	13	1.3	9.5
Power unit mounting bolt		8 mm	23	2.3	16.5
		10 mm	50	5.0	36.0
Driveshaft housing bolt		10 mm	50	5.0	36.0
Upper mount nut		12 mm	80	8.0	57.8
Upper mount cover bolt		10 mm	50	5.0	36.0
Lower mount bolt		12 mm	60	6.0	43.4
Clamp bracket shaft nut		7/8-14 UNF	43	4.3	31.0
Water pump case bolt		8 mm	17	1.7	12.3
Driveshaft oil seal housing		8 mm	23	2.3	16.5
Gearcase bolt		10 mm	55	5.5	40.0
Propeller shaft bearing housing bolt		8 mm	23	2.3	16.6
Pinion gear nut		14 mm	120	12.0	86.8
Propeller nut		18 mm	55	5.5	40.0

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General Bolt

NOTE

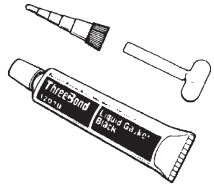
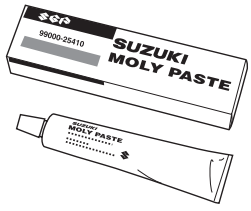
These value are only applicable when torque for a general bolt is not listed in the "Important Fasteners" table.

Type of Bolt	Thread Diameter	Tightening Torque		
		N·m	kgf-m	lbf-ft
 I9J011010014-01 **(Conventional or "4" marked bolt)**	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	4 – 7	0.4 – 0.7	3.5 – 5.0
	8 mm	10 – 16	1.0 – 1.6	7.0 – 11.5
	10 mm	22 – 35	2.2 – 3.5	16.0 – 25.5
 I9J011010015-01 **(Stainless steel bolt)**	5 mm	2 – 4	0.2 – 0.4	1.5 – 3.0
	6 mm	6 – 10	0.6 – 1.0	4.5 – 7.0
	8 mm	15 – 20	1.5 – 2.0	11.0 – 14.5
	10 mm	34 – 41	3.4 – 4.1	24.5 – 29.5
 I9J011010016-01 **("7" marked bolt)**	5 mm	3 – 6	0.3 – 0.6	2.0 – 4.5
	6 mm	8 – 12	0.8 – 1.2	6.0 – 8.5
	8 mm	18 – 28	1.8 – 2.8	13.0 – 20.0
	10 mm	40 – 60	4.0 – 6.0	29.0 – 43.5

Special Tools and Equipment

Recommended Service Material

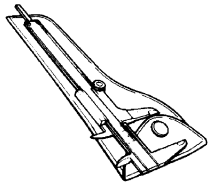
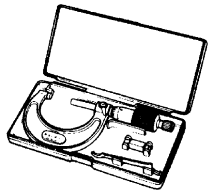
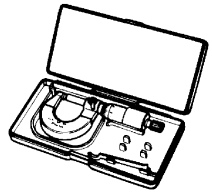
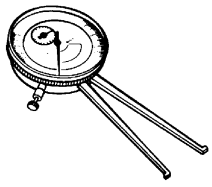
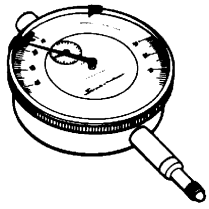
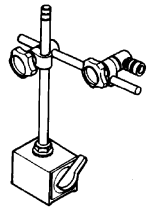
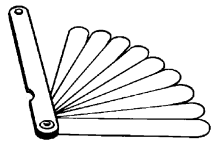
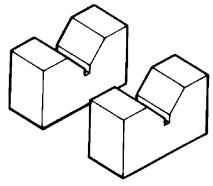
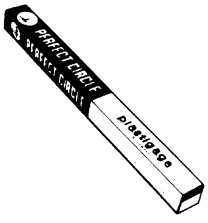
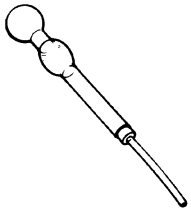
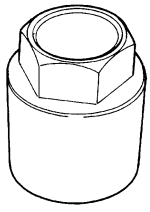
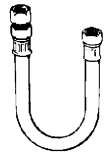
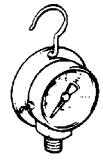
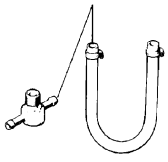
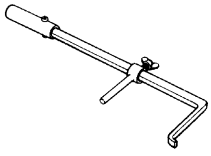
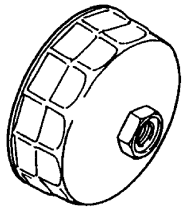
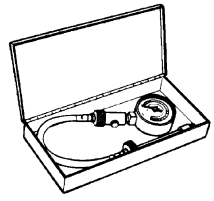
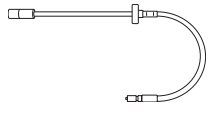
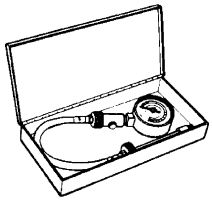
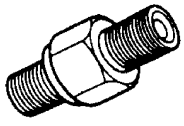
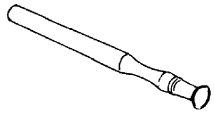
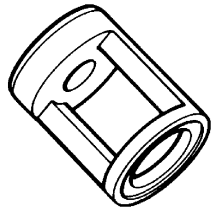
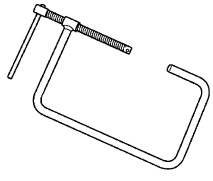
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 **99000–22540** SUZUKI Outboard Motor Gear Oil	 **99000–25161** SUZUKI Water Resistant Grease (250 g)	 **99000–31120** SUZUKI Silicone Seal (50 g)	 **99000–31140** SUZUKI Bond 1207B (100 g)	 **99000–32020** SUZUKI Thread Lock 1333B (50 g)
 **99000–32050** SUZUKI Thread Lock 1342 (50 g)	 **99000–25140** SUZUKI Moly Paste (50g)			

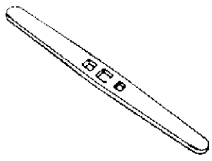
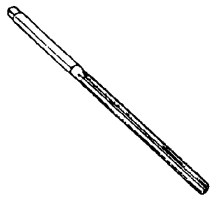
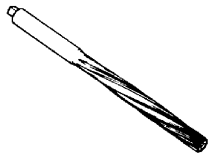
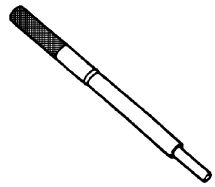
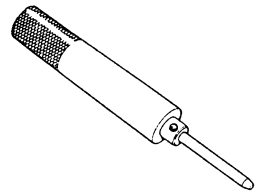
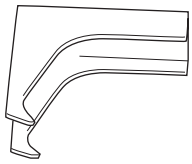
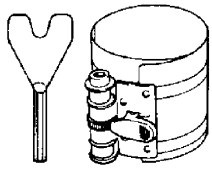
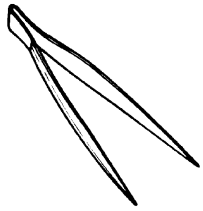
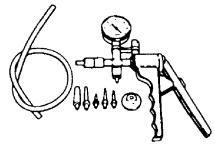
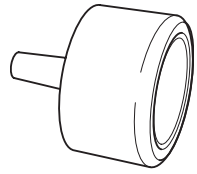
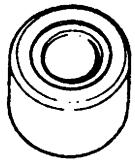
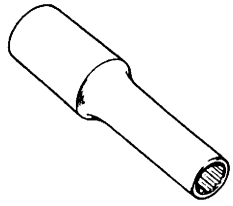
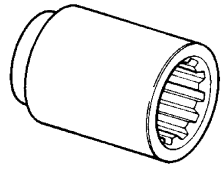
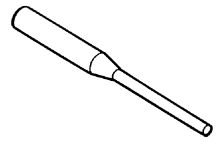
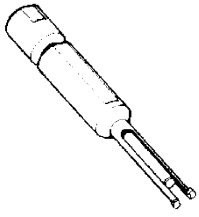
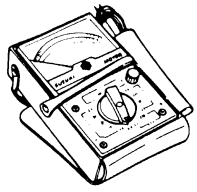
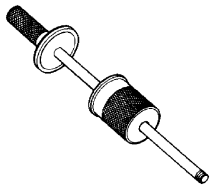
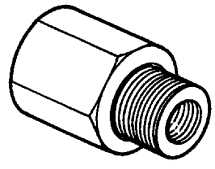
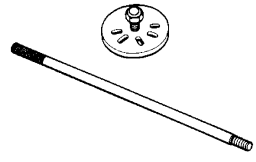
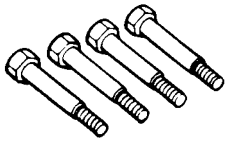
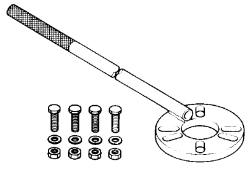
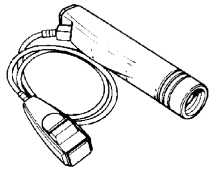
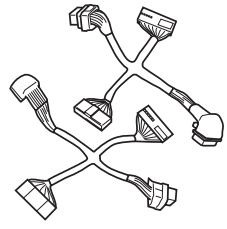
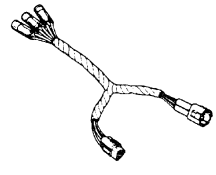
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Special Tool

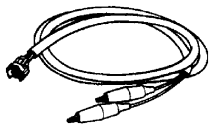
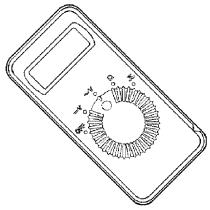
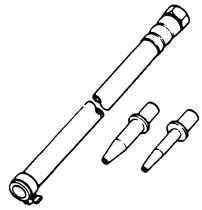
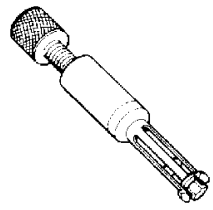
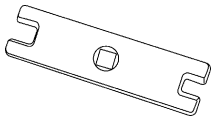
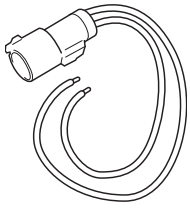
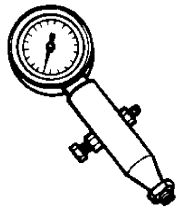
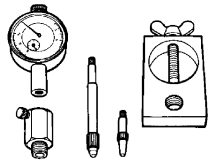
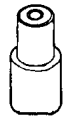
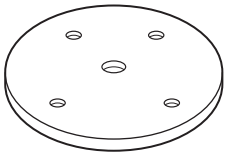
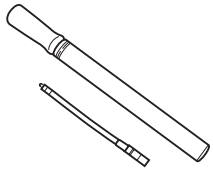
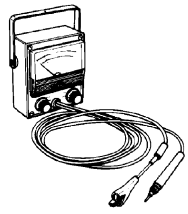
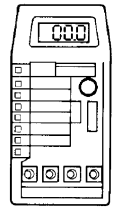
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 **01500–08403** Bolt	 **09900–20101** Vernier calipers (150 mm)	 **09900–20202** Micrometer (25 – 50 mm)	 **09900–20203** Micrometer (50 – 75 mm)	 **09900–20205** Micrometer (0 – 25 mm)
 **09900–20605** Dial calipers (10 – 34 mm)	 **09900–20606** Dial gauge	 **09900–20701** Magnetic stand	 **09900–20803** Thickness gauge	 **09900–21304** Steel “V” block set
 **09900–22301** Plastigauge (0.025 – 0.076 mm)	 **09900–28403** Hydrometer	 **09911–49910** Crankshaft holder	 **09912–58432** Fuel pressure hose	 **09912–58442** Fuel pressure gauge
 **09912–58490** 3-way joint & hose	 **09913–50121** Oil seal remover	 **09915–47341** Oil filter wrench	 **09915–64512** Compression gauge	 **09915–69910** Compression gauge attachment
 **09915–77311** Oil pressure gauge	 **09915–78211** Oil pressure gauge adapter	 **09916–10911** Valve lapper	 **09916–14521** Valve lifter attachment	 **09916–19030** Valve lifter

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 **09916–34542** Valve guide reamer handle	 **09916–34550** Valve guide reamer (ϕ 5.5 mm)	 **09916–37320** Valve guide reamer (ϕ 10.5 mm)	 **09916–44310** Valve guide remover	 **09916–58210** Valve guide installer handle
 **09916–68710** Tappet holder	 **09916–77310** Piston ring compressor	 **09916–84511** Tweezers	 **09917–47011** Vacuum pump gauge	 **09917–49610** Vacuum pump adapter
 **09917–87010** Valve guide installer attachment	 **09917–98221** Valve guide stem seal installer attachment	 **09919–16010** Deep socket wrench (10 mm)	 **09921–28710** Driveshaft holder	 **09922–89810** Shift lock pin remover
 **09923–73210** Bearing remover	 **09930–25002** Pocket tester	 **09930–30104** Sliding hammer	 **09930–30161** Propeller shaft remover	 **09930–39411** Flywheel remover
 **09930–39420** Flywheel remover bolts	 **09930–48720** Flywheel holder	 **09930–76420** Timing light	 **09930–88730** 36-pin test cord set	 **09930–89220** 3-pin connector test cord

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 **09930–89260** Injector test cord (A)	 **09930–99320** Digital tester	 **09940–44121** Air pressure gauge	 **09940–44130** Attachment	 **09941–64511** Bearing remover
 **09945–69010** PTT rod holder	 **09945–79310** PTT cable extension	 **09950–69512** Gearcase oil leakage tester	 **09951–09530** Gear adjusting gauge	 **09951–18730** Attachment
 **09951–38710** Plate	 **09951–59910** Shaft (removal and installation)	 **09952–99310** Hand air pump	 **99954–53873*** Stevens peak reading voltmeter CD-77	 **99954–53008–820*** Digital voltmeter
 **99954–53883*** Gear oil filler				

NOTE

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

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Maintenance and Tune-Up

Precautions

Precautions for Maintenance

Z9J0110200001

The “Periodic Maintenance Schedule Chart” 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.

General Description

Recommended Oil and Lubricants

Z9J0110201001

Refer to “Fuel and Oil Recommendations” in Section 0A (Page 0A-3).

Scheduled Maintenance

Periodic Maintenance Schedule Chart

Z9J0110205001

NOTE

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

Item to serviced	Interval			
	Initial 20 hrs. or 1 month	Every 50 hrs. or 3 months	Every 100 hrs. or 6 months	Every 200 hrs. or 12 months
Spark plug	—	—	I	R
Breather hose and fuel line	I	I	I	I
	Replace every 2 years.			
Engine oil	R	—	R	R
Gear oil	R	—	R	R
Lubrication	—	I	I	I
Anodes and bonding wires	—	I	I	I
Battery	—	I	I	I
Engine oil filter	R	—	—	R
Low pressure fuel filter	—	I	I	I
	Replace every 400 hours or 2 years.			
High pressure fuel filter	Replace every 1000 hours.			
Ignition timing	—	—	—	I
Idle speed	I	—	—	I
Tappet clearance	—	—	—	I
Water pump	—	—	—	I
Water pump impeller	—	—	—	R
Propeller nut and pin	I	—	I	I
Bolt and Nuts	T	—	T	T

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Lubrication Point

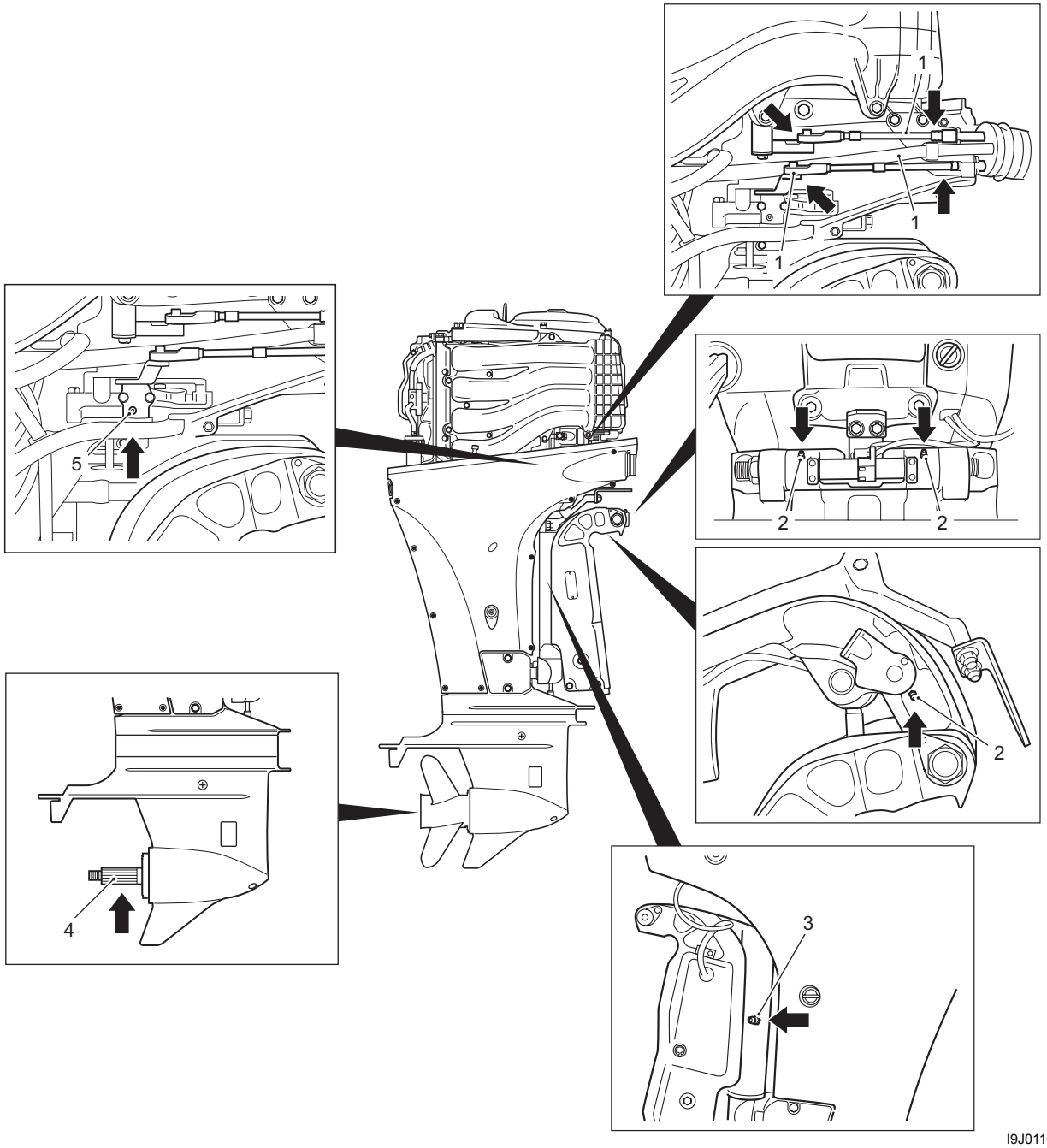
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Proper lubrication is important for the safe, smooth operation and long life of each working part of the outboard motor. Apply Suzuki Water Resistant Grease to the following point.

Lubricate

Every 50 hours (3 months)

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011020034-04

1. Throttle and shift linkage	3. Grease nipple, swivel bracket	5. Grease nipple, shift lever
2. Grease nipple, swivel bracket	4. Propeller shaft	

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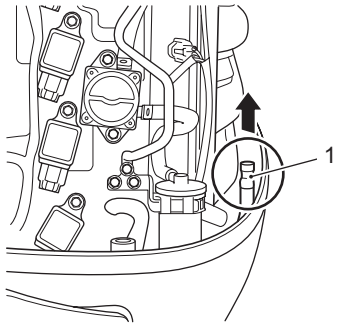
Service Instructions

Engine Oil Level Check

Z9J0110206039

Inspect oil level
Before every use

1) Place outboard motor upright on a level surface.
2) Remove motor cover.
3) Remove oil level dipstick (1) and wipe it clean.

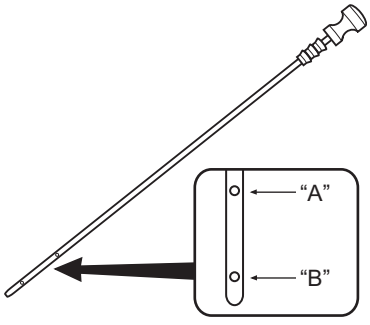


I9J011020002-02

4) Reinsert dipstick fully into dipstick tube, then remove it to check oil level.
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.

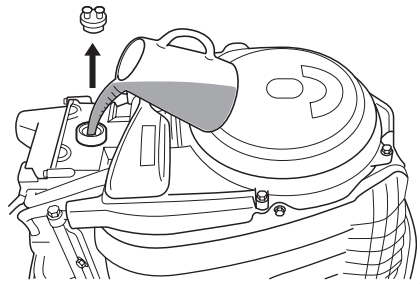
Recommended Engine Oil

- **4 stroke motor oil**
- **NMMA FC-W classification:**
  SG, SH, SJ, SL, SM.
  or API classification:
  SG, SH, SJ, SL, SM.
- **Viscosity rating:**
  NMMA FC-W 10W-40 or SAE 10W-40



I9J011020035-01

"A": Max. mark (hole)	"B": Min. mark (hole)



I9J011020036-01

Engine Oil Change and Engine Oil Filter Replacement

Z9J0110206008

Change engine oil
Initially after 20 hours (1 month) and every 100 hours (6 months)

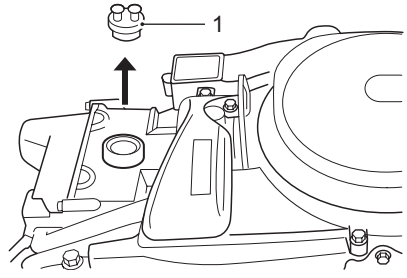
Replace Engine oil filter
Initially after 20 hours (1 month) and every 200 hours (12 months)

NOTE

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

Engine Oil Change

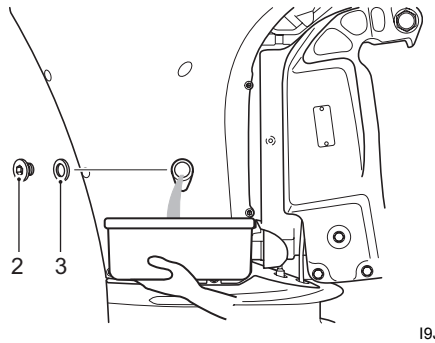
1) Place outboard motor upright on a level surface.
2) Remove oil filler cap (1).



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3) Place a container under engine oil drain plug.
4) Remove engine oil drain plug (2) and gasket (3) to drain engine oil.



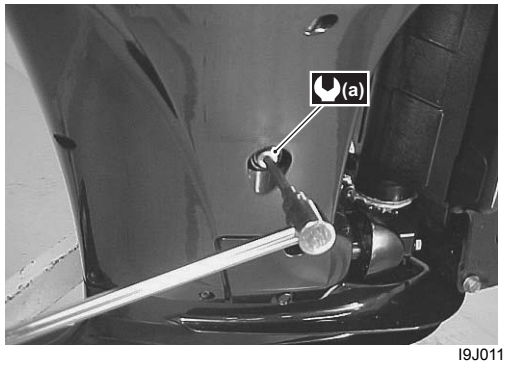
I9J011020038-01

5) Install new gasket and oil drain plug.
Tighten engine oil drain plug to specified torque.

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.

Tightening torque
Engine oil drain plug (a): 13 N·m (1.3 kgf-m, 9.5 lbf-ft)



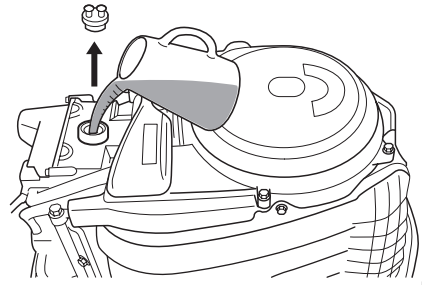
I9J011020042-01

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

Recommended Engine Oil

- **4 stroke motor oil**
- **NMMA FC-W classification: SG, SH, SJ, SL, SM. or API classification: SG, SH, SJ, SL, SM.**
- **Viscosity rating: NMMA FC-W 10W-40 or SAE 10W-40**

Engine oil amounts
Oil change only: 4.0 L (4.2/3.5 US/Imp.qt)
Oil filter change: 4.3 L (4.5/3.8 US/Imp.qt)



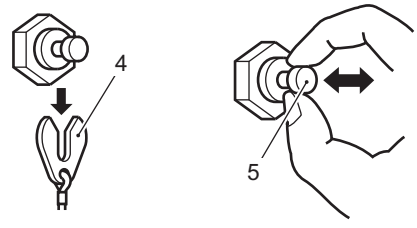
I9J011020039-01

7) To reset oil change reminder system's operation time to zero (cancellation).

NOTE

Refer to "Oil Change Reminder System Description" in Section 1A (Page 1A-14).

a) Turn ignition key to "ON" position.
b) Pull out emergency stop switch plate (4).
c) Pull up emergency stop switch knob (5) three times in ten seconds. A short beep will be heard if cancellation is successfully finished.
d) Turn ignition key to "OFF" position, then set emergency stop switch plate (4) in original position.



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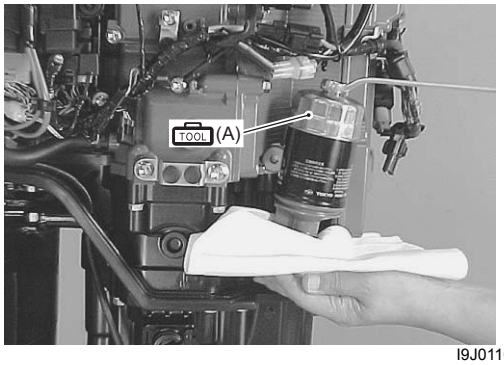
8) Start engine and allow it to run for several minutes at idle speed.
Check oil drain plug for oil leakage.
Turn off engine and wait for approx. two minutes, then recheck engine oil level.

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Engine Oil Filter Replacement

1) Drain engine oil in the same manner of engine oil change procedure.
2) Remove STBD and PORT side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
3) Place a shop cloth under the oil filter before removal to absorb any oil released.
4) Using an oil filter wrench to loosen the oil filter, then remove the filter and O-ring.

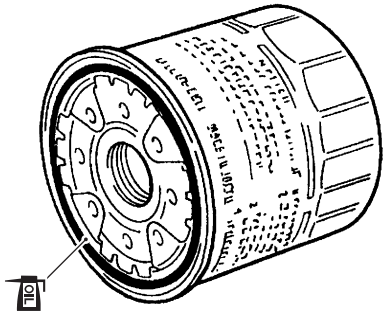
   Special tool
   TOOL (A): 09915–47341 (Oil filter wrench)



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NOTE

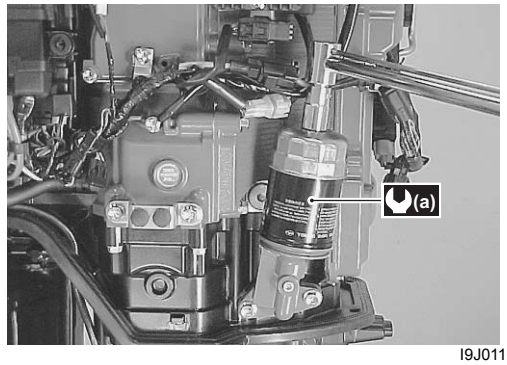
Before fitting a new oil filter, be sure to oil the O-ring.



I9J011020004-01

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

   Tightening torque
   Engine oil filter (a): 14 N·m (1.4 kgf-m, 10.0 lbf-ft)



I9J011020044-01

7) Install PORT and STBD side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
8) Pour the recommended engine oil into the oil filler opening, then install oil filler cap. Check the oil level in the same manner of engine oil change procedure.

   Recommended Engine Oil

   - **4 stroke motor oil**
   - **NMMA FC-W classification: SG, SH, SJ, SL, SM. or API classification: SG, SH, SJ, SL, SM.**
   - **Viscosity rating: NMMA FC-W 10W-40 or SAE 10W-40**

   Engine oil amounts
   Oil change only: 4.0 L (4.2/3.5 US/Imp.qt)
   Oil filter change: 4.3 L (4.5/3.8 US/Imp.qt)

9) Reset oil change reminder system’s operation time to zero (cancellation). Refer to “Engine Oil Change” (Page 0B-3).
10) 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.

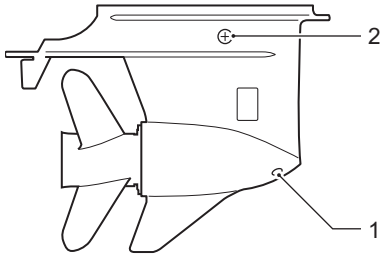
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Gear Oil Change

Z9J0110206040

Change gear oil
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 (1) first, then remove gear oil level plug (2) and drain gear oil.



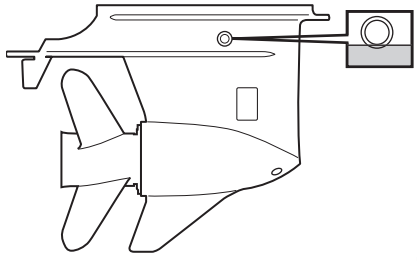
I9J011020040-01

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

Recommended Gear Oil

- **Suzuki Outboard Motor Gear Oil or API classification GL5, Viscosity rating SAE # 90 Hypoid gear oil.**

Gear oil amount
850 ml (28.7/30.0 US/Imp. oz)



I9J011020041-01

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.

Spark Plug Removal and Installation

Z9J0110206004

Inspect spark plug
Every 100 hours (6 months)

Replace spark plug
Every 200 hours (12 months)

Standard spark plug
NGK DCPR6E

CAUTION

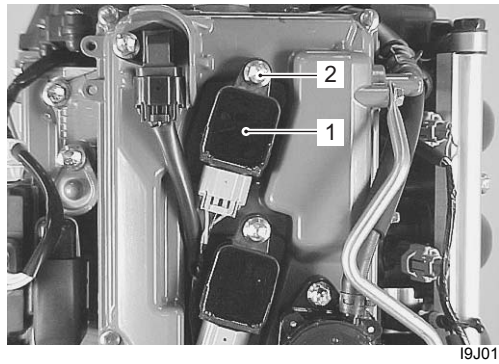
Only resistor (R) type spark plugs must be used with this engine. Using a non-resistor spark plug will cause ignition and fuel injection system malfunctions.

Removal

⚠ WARNING

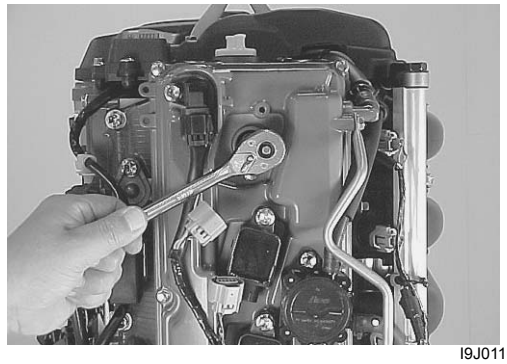
The hot engine can burn you. Wait until the engine is cool enough to touch.

1) Disconnect wiring harness connector from ignition coil (1), then remove the bolt (2) securing the ignition coil.



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2) Remove the ignition coil and spark plug.



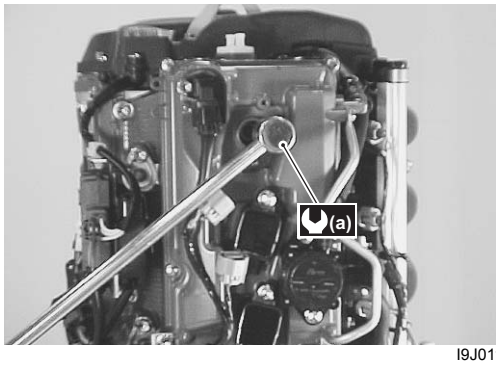
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Installation
Installation is reverse order of removal.
Pay attention to the following:

- Tighten the spark plug to specified torque.

Tightening torque
Spark plug (a): 18 N·m (1.8 kgf-m, 13 lbf-ft)



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Spark Plug Inspection and Cleaning

Z9J0110206005

CAUTION

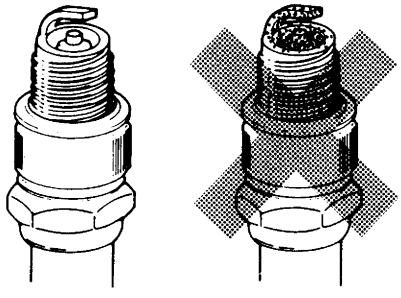
Only resistor (R) type spark plugs must be used with this engine. Using a non-resistor spark plug will cause ignition and fuel injection system malfunctions.

Inspect spark plug
Every 100 hours (6 months)

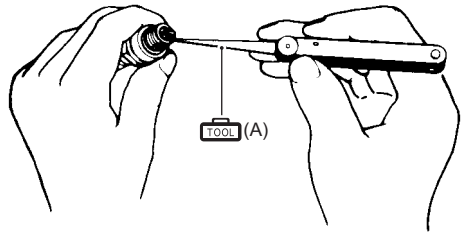
Replace spark plug
Every 200 hours (12 months)

Standard spark plug
NGK DCPR6E

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



I9J011020005-01

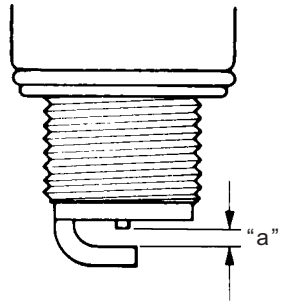


I9J011020006-01

Spark Plug Gap
Measure spark plug gap with a thickness gauge. Adjust to within specified range if gap is out of specification.

Special tool
TOOL : 09900–20803 (Thickness gauge)

Spark plug gap "a" (Standard)
0.8 – 0.9 mm (0.031 – 0.035 in.)



I9J011020007-01

Condition of Electrodes
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.

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Tappet Clearance Inspection and Adjustment

Z9J0110206041

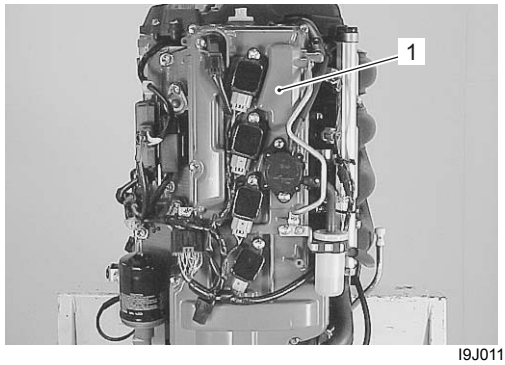
Inspect tappet clearance
Every 200 hours (12 months)

Inspection

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.

1) Remove following parts:
   - Engine lower side cover.
     Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
   - Ring gear cover.
     Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
   - Ignition coils and spark plugs.
     Refer to “Spark Plug Removal and Installation” (Page 0B-6) and “Spark Plug Inspection and Cleaning” (Page 0B-7).
2) Remove the cylinder head cover (1).
   Refer to “Cylinder Head Cover Removal and Installation” in Section 1D (Page 1D-2).



I9J011020048-01

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.

CAUTION

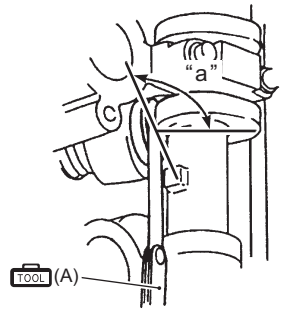
This is a left hand (LH) rotation powerhead. Rotate crankshaft counterclockwise to prevent water pump impeller damage.

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.**

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

Tappet clearance (cold engine condition)
IN.: 0.23 – 0.27 mm (0.009 – 0.011 in.)
EX.: 0.30 – 0.34 mm (0.012 – 0.013 in.)



I9J011020008-01

“a”: 90°

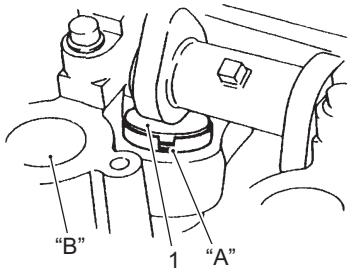
5) If out of specification, adjust tappet clearance by changing shim.

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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.



I9J011020009-01

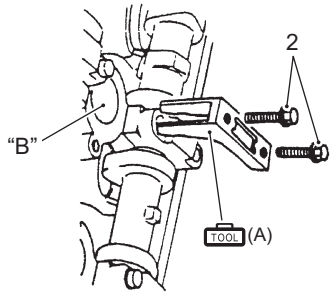
1.	Shim
"A":	Cut section of the tappet
"B":	Spark plug hole

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.

Special tool

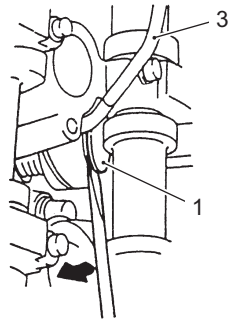
TOOL (A): 09916–68710 (Tappet holder)



I9J011020010-01

2.	Camshaft housing bolt
"B":	Spark 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)



I9J011020011-01

1.	Shim
3.	Magnet

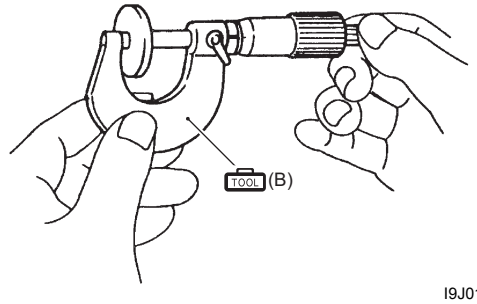
CAUTION

- **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).**

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

Special tool

TOOL (B): 09900–20205 (Micrometer (0 – 25 mm))

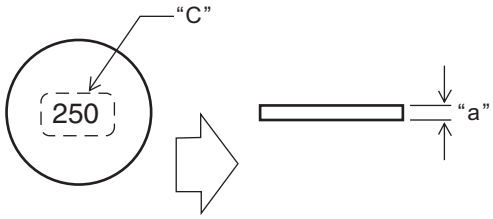


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Tappet clearance specifications

IN. side: A = B + (C – 0.25 mm)
EX. side: A = B + (C – 0.32 mm)
A: Correct thickness of shim for proper tappet clearance (mm)
B: Thickness of original shim (mm)
C: Original tappet clearance (mm)

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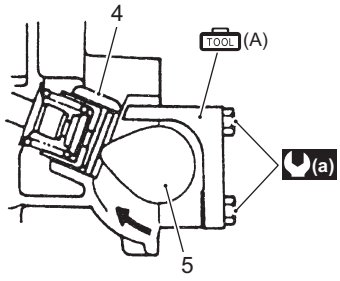
"C": I.D No.
"a": 2.50 mm

Shim size chart

I.D. No.	Thickness (mm)	I.D. No.	Thickness (mm)
208	2.080	250	2.500
210	2.100	252	2.520
212	2.120	254	2.540
214	2.140	256	2.560
216	2.160	258	2.580
218	2.180	260	2.600
220	2.200	262	2.620
222	2.220	264	2.640
224	2.240	266	2.660
226	2.260	268	2.680
228	2.280	270	2.700
230	2.300	272	2.720
232	2.320	274	2.740
234	2.340	276	2.760
236	2.360	278	2.780
238	2.380	280	2.800
240	2.400	282	2.820
242	2.420	284	2.840
244	2.440	286	2.860
246	2.460	288	2.880
248	2.480	290	2.900

6) Install shim with the identification number facing down (towards tappet).
7) Rotate crankshaft to open (lift up) valve.
8) Remove tappet holder (A) and tighten camshaft housing bolts (a) to specified torque.

Tightening torque
Camshaft housing bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



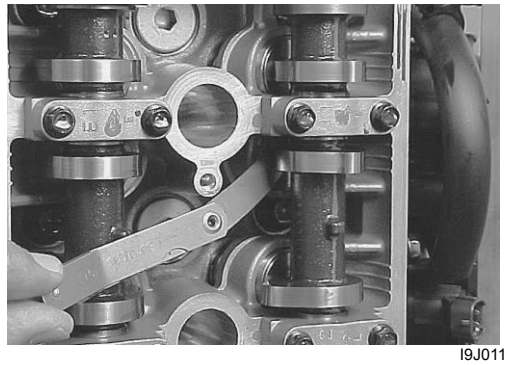
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4. Tappet
5. Camshaft

9) Recheck tappet clearance.

NOTE

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



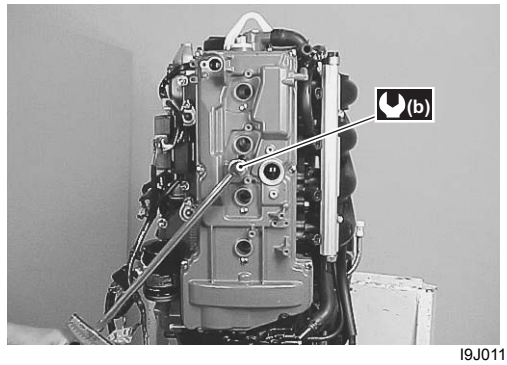
I9J011020015-02

10) After checking and adjusting all valves, reinstall parts removed earlier.
Installation is reverse order of removal.
a) Cylinder Head Cover Installation.
- Install the cylinder head cover.
Refer to "Cylinder Head Cover Removal and Installation" in Section 1D (Page 1D-2).

NOTE

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

Tightening torque
Cylinder head cover bolts (b): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



I9J011020049-01

b) Final assembly check
- All parts removed have been returned to their original positions.
- Check hose and wire routing.
Refer to "Wiring Harness Routing Diagram" in Section 4A (Page 4A-3).
- Check oil leakage.

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TAPPET SHIM SELECTION CHART [IN. side]

Shim I.D. No. / Present shim size (mm) / Tappet clearance (mm)	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290
	2.08	2.10	2.12	2.14	2.16	2.18	2.20	2.22	2.24	2.26	2.28	2.30	2.32	2.34	2.36	2.38	2.40	2.42	2.44	2.46	2.48	2.50	2.52	2.54	2.56	2.58	2.60	2.62	2.64	2.66	2.68	2.70	2.72	2.74	2.76	2.78	2.80	2.82	2.84	2.86	2.88	2.90
0.00 – 0.04														210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266
0.05 – 0.09										208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272
0.10 – 0.14								208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276
0.15 – 0.19					208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282		
0.20 – 0.22			208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	
0.23 – 0.27	Specified clearance / No adjustment required.																																									
0.28 – 0.32	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290		
0.33 – 0.37	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290					
0.38 – 0.42	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290							
0.43 – 0.47	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290										
0.48 – 0.52	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290												
0.53 – 0.57	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290															
0.58 – 0.62	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																	
0.63 – 0.67	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																				
0.68 – 0.72	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																						
0.73 – 0.77	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																									
0.78 – 0.82	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																											
0.83 – 0.87	268	270	272	274	276	278	280	282	284	286	288	290																														
0.88 – 0.92	272	274	276	278	280	282	284	286	288	290																																

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

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TAPPET SHIM SELECTION CHART [EX. side]

Tappet clearance (mm) \ Present shim size (mm) \ Shim ID No.	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290
	2.08	2.10	2.12	2.14	2.16	2.18	2.20	2.22	2.24	2.26	2.28	2.30	2.32	2.34	2.36	2.38	2.40	2.42	2.44	2.46	2.48	2.50	2.52	2.54	2.56	2.58	2.60	2.62	2.64	2.66	2.68	2.70	2.72	2.74	2.76	2.78	2.80	2.82	2.84	2.86	2.88	2.90
0.00 – 0.04																208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260
0.05 – 0.09														208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264
0.10 – 0.14											208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270
0.15 – 0.19									208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274
0.20 – 0.24						208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280
0.25 – 0.29				208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284
0.30 – 0.34	Specified clearance / No adjustment required.																																								
0.35 – 0.39	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290		
0.40 – 0.44	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290					
0.45 – 0.49	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290							
0.50 – 0.54	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290										
0.55 – 0.59	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290												
0.60 – 0.64	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290															
0.65 – 0.69	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																	
0.70 – 0.74	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																				
0.75 – 0.79	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																						
0.80 – 0.84	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																									
0.85 – 0.89	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290																											
0.90 – 0.94	268	270	272	274	276	278	280	282	284	286	288	290																														

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 — 2.50 mm

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Idle Speed and Idle Air Control (IAC) Duty Inspection

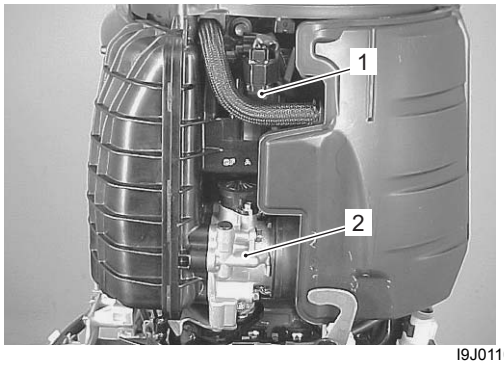
Z9J0110206030

Inspect idle speed and IAC Duty
Initially after 20 hours (1 month) and every 200 hours (12 months)

NOTE

Before checking idle speed / IAC duty, make sure of the following.

- **Engine must be warmed up.**
- **Check idle speed after engine speed has stabilized.**
- **Check throttle link mechanism and throttle valve for smooth operation.**
- **Lead wire and hoses of electronic fuel injection and engine control systems are connected securely.**
- **Ignition timing is within specification.**
- **Tappet clearance is checked according to maintenance schedule.**
- **No abnormal air drawn in from air intake system. After all items are confirmed, check idle speed and IAC duty.**



I9J011020050-01

1. IAC valve	2. Throttle body

Check idle speed and IAC duty as follows. To perform idle speed and IAC duty inspection, use personal computer and SDS tool.

1) Connect SDS tool to engine.
   Refer to SDS operation manual for the step 1 procedure.
2) Start engine and allow to warm up.
3) Check engine speed and IAC duty by using “Service data / Engine data” mode on SDS.
4) If IAC duty and / or idle speed is out of specification, inspect idle speed control system referring to “Idle air control system check”.

   Idle speed in neutral gear (IAC duty)
   550 – 650 r/min (Duty: Approx. 0 – 30%)

5) Shift into forward, Check in-gear idle speed.
   If not, check idle air control system.

NOTE

- **Trolling speed (in-gear idle speed) is same as idle speed.**
- **Idling / trolling speed of 550 – 650 r/min. is controlled by IAC system.**

Idle speed in gear (IAC duty)
550 – 650 r/min (Duty: Approx. 0 – 30%)

Ignition Timing Inspection

Z9J0110206042

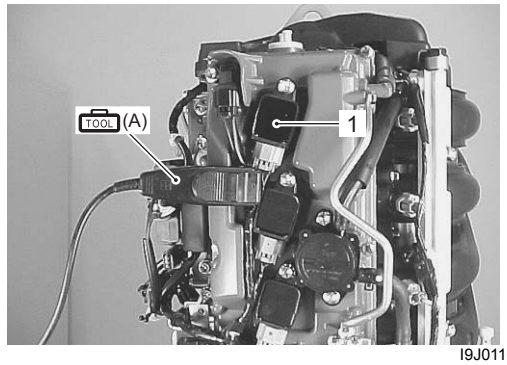
Inspect ignition timing
Every 200 hours (12 months)

NOTE

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

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

   Special tool
   (A): 09930–76420 (Timing light)



I9J011020051-02

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

   Ignition timing
   Approx. BTDC 2° ± 5° at 1 000 r/min



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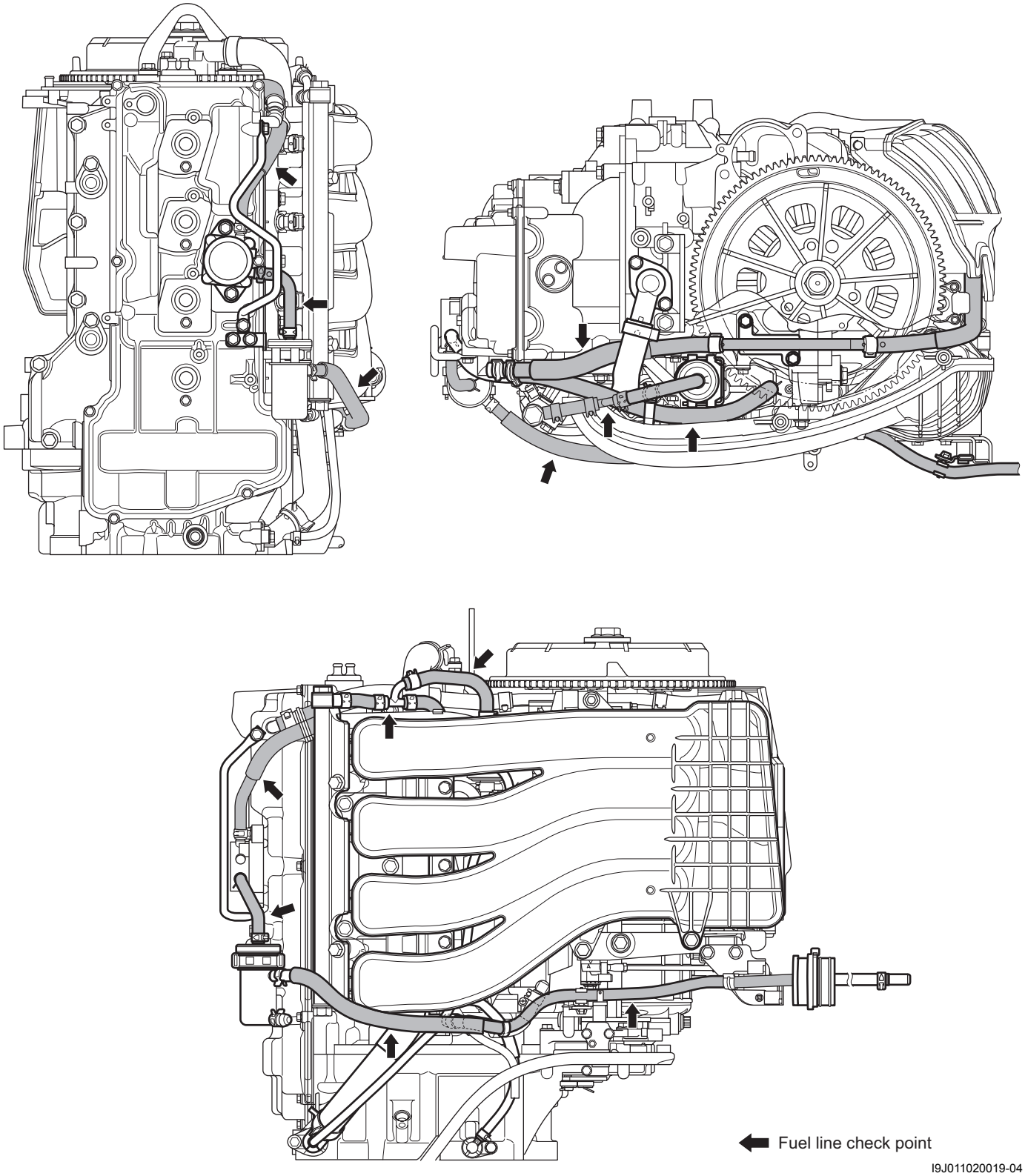
Breather Line and Fuel Line Inspection

Z9J0110206043

Inspect breather line and fuel line
Initially after 20 hours (1 month) and every 50 hours (3 months)

Replace breather line and fuel line
Every 2 years

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



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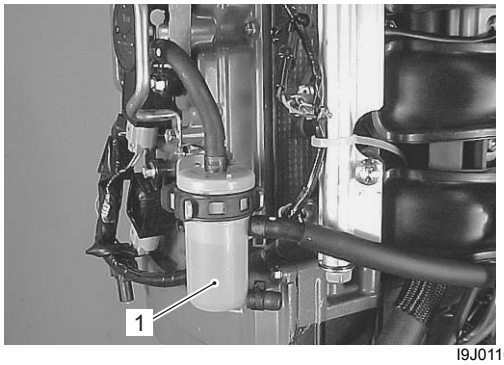
Low Pressure Fuel Filter Inspection

Z9J0110206044

Inspect low pressure fuel filter
Every 50 hours (3 months)

Replace low pressure fuel filter
Every 400 hours or 2 years

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



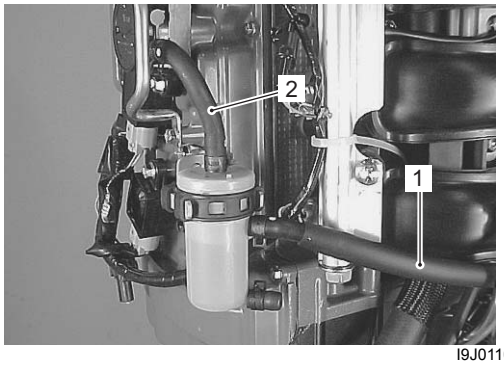
I9J011020052-01

1. Low pressure fuel filter

⚠ WARNING

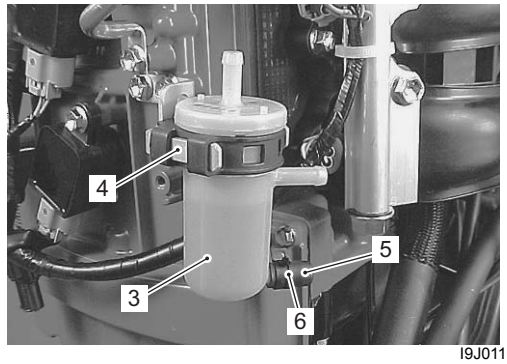
- **Stop the motor before cleaning the fuel filter.**
- **Do not smoke and keep open flames and sparks away while working near any part of the fuel system.**

1) Turn the engine off.
2) Disconnect the inlet hose (1) and outlet hose (2) from fuel filter.



I9J011020053-01

3) Remove the fuel filter (3) from filter bracket (4).
4) Remove the cap (5), then drain and clean fuel filter.
5) Install the cap, then secure it with clamp (6).



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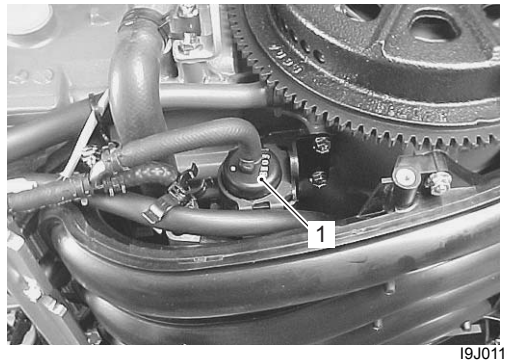
6) Install fuel filter to filter bracket properly.
7) Connect the fuel inlet and outlet hose to fuel filter, then secure the fuel hoses to the fuel filter with the hose clamp.
8) Restart the engine and check that there are no leaks around the fuel filter.

High Pressure Fuel Filter Replacement

Z9J0110206045

Replace high pressure fuel filter
Every 1 000 hours

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



I9J011020055-01

1. High pressure fuel filter

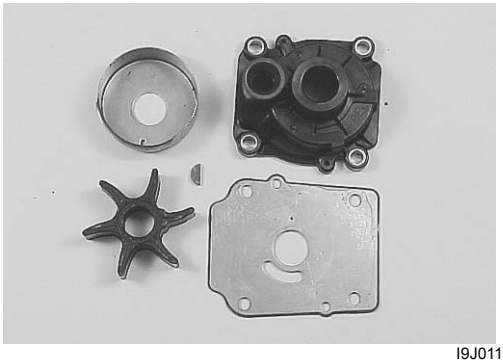
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Water Pump and Water Pump Impeller Inspection

Z9J0110206046

Inspect water pump
Every 200 hours (12 months)

Replace water pump impeller
Every 200 hours (12 months)



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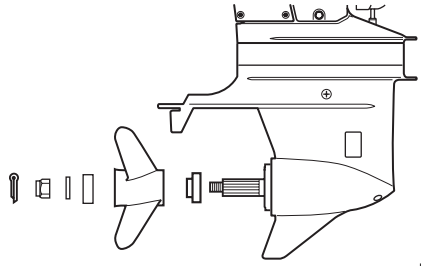
1) Remove the lower unit and water pump case.
   Refer to “Water Pump Removal and Installation” in Section 3A (Page 3A-6).
2) Inspect water pump case, inner sleeve and under panel. Replace if wear, cracks, distortion or corrosion is found.
3) Inspect water pump impeller.
   Replace if vanes are cut, torn or worn.
   SUZUKI recommends that replacing the water pump impeller every 200 hours (12 months).
4) Assemble the water pump related items.
   Refer to “Water Pump Removal and Installation” in Section 3A (Page 3A-6).
5) Install the lower unit assembly.
   Refer to “Lower Unit Removal and Installation” in Section 3A (Page 3A-5).

Propeller / Propeller Nut and Cotter Pin Inspection

Z9J0110206047

Inspect propeller / propeller nut and cotter pin
Initially after 20 hours (1 month) and every 100 hours (6 months).

1) Inspect propeller for bent, chipped or broken blades. Replace propeller if damage noticeably affects operation.
2) Remove the propeller.
   Refer to “Propeller Removal and Installation” in Section 3A (Page 3A-4).
3) Inspect propeller splines. Replace propeller if splines are worn, damaged or twisted.
4) Inspect propeller bush for slippage.
   Replace if necessary.



I9J011020021-01



I9J011020056-01

5) Install the propeller and related parts.
   Refer to “Propeller Removal and Installation” in Section 3A (Page 3A-4).
6) Make sure that propeller nut is torqued to specification and cotter pin is installed securely.

   Tightening torque
   Propeller nut: 55 N·m (5.5 kgf-m, 40.0 lbf-ft)

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Anodes Inspection

Z9J0110206048

Inspect anodes
Every 50 hours (3 months)

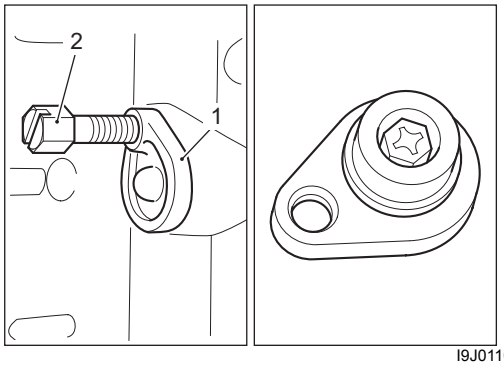
If 2/3 of zinc anode has corroded away, replace anode. The anode should be periodically cleaned with a wire brush to ensure maximum effectiveness.

CAUTION

Never paint the anode.

NOTE

The anode cover (1) may be separated from the power unit body by inserting and turning a 10 mm bolt (2) to function as a screw jack.

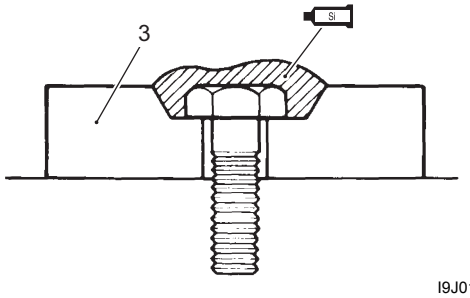


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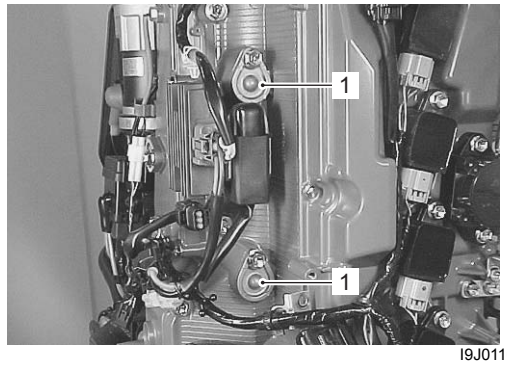
NOTE

The anode (3) securing bolt should be covered with suzuki silicone seal.

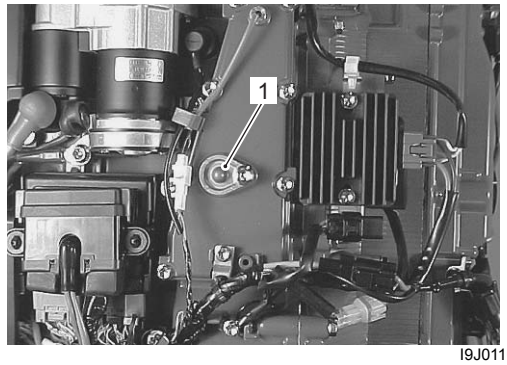
Si : Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))



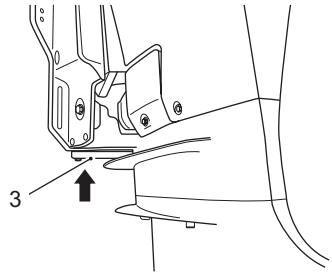
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I9J011020057-01



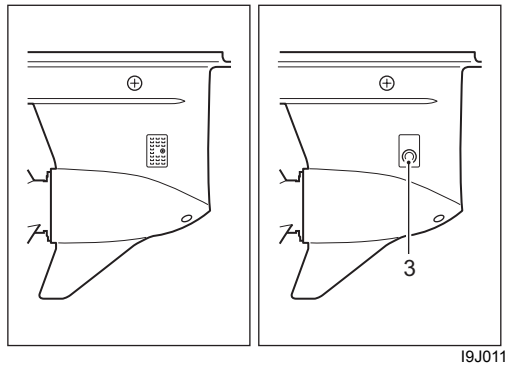
I9J011020058-01



I9J011020025-02

NOTE

To access the anode in the gearcase, remove the water inlet filter.



I9J011020026-02

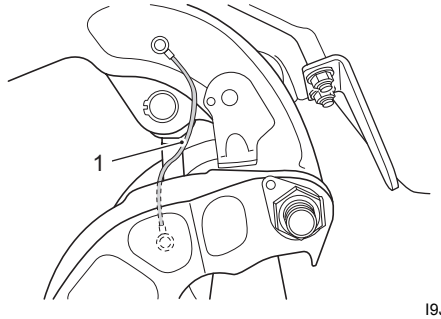
http://SelfFixer.com

Bonding Wires Inspection

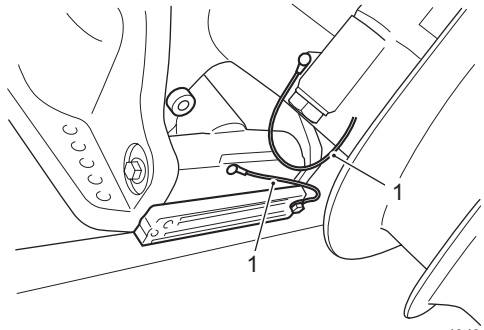
Z9J0110206049

Inspect bonding wires
Every 50 hours (3 months)

1) If breakage or other damage is found on bonding wire (1), replace the wire.
2) If rust, corrosion or other damage is found on terminal, clean with cleaning solvent or replace wire.



I9J011020027-02



I9J011020028-01

Battery Inspection

Z9J0110206050

Inspect battery
Every 50 hours (3 months)

⚠ WARNING

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

Recommended battery
12 V 100 AH (360 kC) or larger

Refer to “Battery Requirement” in Section 0A (Page 0A-5).

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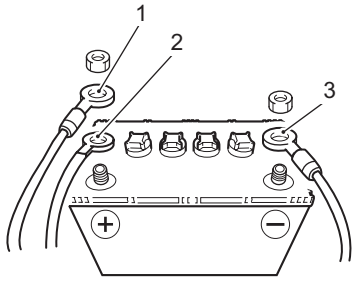
Connecting Battery

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.**

How to connect

1) Connect positive (+) terminal first.
2) Connect negative (–) terminal second.
3) Upon completion of connection, lightly apply grease to battery terminals.

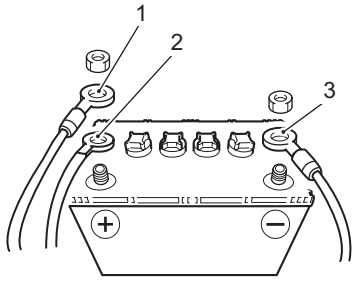


I9J011020029-03

1.	Red lead
2.	Sub battery cable
3.	Black lead

How to disconnect

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



I9J011020030-02

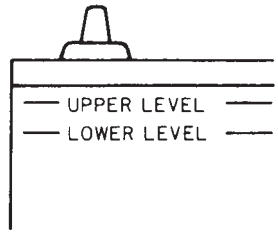
1.	Red lead
2.	Sub battery cable
3.	Black lead

Battery Solution Level Check

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

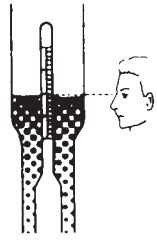


I9J011020031-01

Battery Solution Specific Gravity Check
Measure the specific gravity of battery solution using a hydrometer.

Battery solution specific gravity (temperature)
1.28 (20 °C)

Special tool
TOOL : 09900–28403 (Hydrometer)



I9J011020032-01

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Bolts and Nuts Inspection

Z9J0110206025

Inspect bolts and nuts
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.
Refer to “Tightening Torque Specifications” in Section 0A (Page 0A-13).

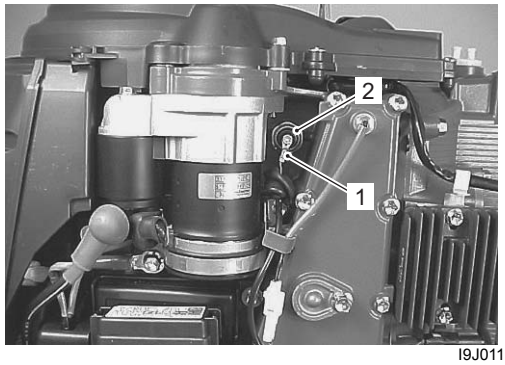
- Cylinder head cover bolts
- Intake manifold bolts and nuts
- Exhaust manifold cover bolts
- Flywheel bolt
- ECM ground bolt
- Power unit mounting bolts
- Clamp bracket shaft nut
- Gearcase bolts
- Propeller nut

Oil Pressure Check

Z9J0110206027

Check the engine oil pressure periodically.

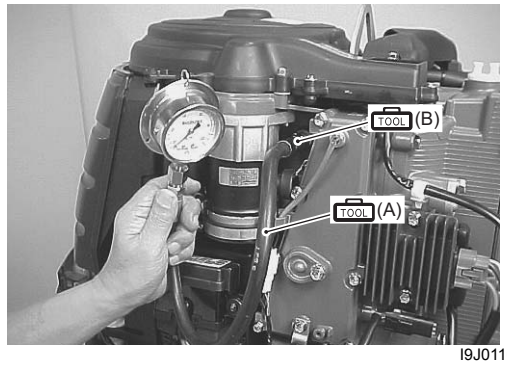
1) Check the engine oil level.
2) Loosen screw and disconnect blue lead wire (1) from oil pressure switch (2).
   Remove the oil pressure switch.



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

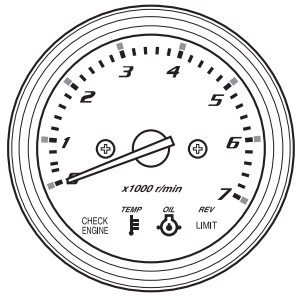
   Special tool
   TOOL (A): 09915–77311 (Oil pressure gauge)
   TOOL (B): 09915–78211 (Oil pressure gauge adapter)



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4) Start engine and warm up.

   Engine warm up (engine speed)
   Summer: 5 min. (2 000 r/min.)
   Winter: 10 min. (2 000 r/min.)



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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.

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

   Oil pressure
   400 – 600 kPa (4.0 – 6.0 kg/cm^2, 57 – 85 psi.)

6) If oil pressure is lower or higher than specification, the following causes may be considered.
   Low oil pressure
   - Clogged oil filter
   - Leakage from oil passages
   - Defective oil pump
   - Defective oil pressure regulator
   - Damaged O-ring
   - Combination of above items

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High oil pressure

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

7) After testing, reinstall oil pressure switch. Refer to “Oil Pressure Switch Removal and Installation” in Section 1E (Page 1E-5).

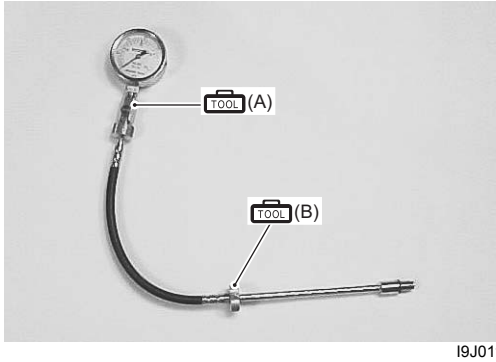
Cylinder Compression Pressure Check

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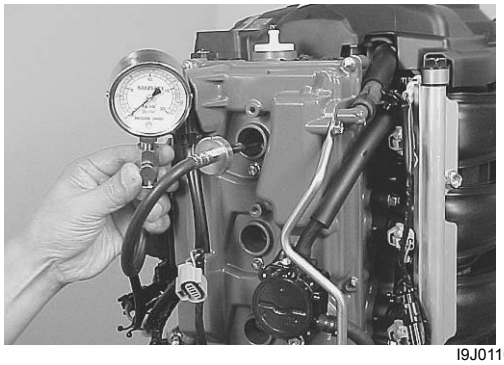
The compression pressure reading of cylinder is good indicator of its internal condition.
The decision to overhaul the power unit is often based on the results of a compression test.
Periodic maintenance records kept at your dealership should include compression readings for each maintenance service.

1) Start engine and allow to warm up, then shut engine off.
2) Disconnect all fuel injector connectors at fuel injector.
3) Disconnect all ignition coil connectors.
4) Remove the bolts securing the ignition coil, then remove all ignition coils and spark plugs.
5) Install compression gauge attachment into spark plug hole, then connect compression gauge attachment to compression gauge.

Special tool
TOOL (A): 09915–64512 (Compression gauge)
TOOL (B): 09915–69910 (Compression gauge attachment)

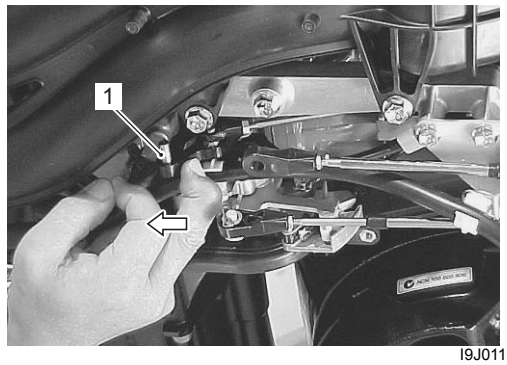


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I9J011020062-01

6) Disconnect remote control throttle cable from throttle lever.
7) Move and hold throttle lever (1) in full-open position.



I9J011020063-02

8) While cranking engine with starter motor, note maximum compression pressure reading on gauge for each cylinder.

NOTE

Figures shown are guidelines only, not absolute service limits.

Cylinder compression pressure
Standard: 1 200 – 1 800 kPa (12 – 18 kgf/cm^2, 171 – 256 psi.)

Cylinder compression pressure max. difference between cylinders
100 kPa (1.0 kgf/cm^2, 14 psi.)

Low compression pressure can indicate one or more of following:

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

9) Reinstall parts removed earlier (spark plugs, ignition coils, etc.).

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Section 1

Power Head

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Precautions

Precautions

Precautions for Powerhead

Z9J0111000001

Refer to “General Precautions” in Section 00 (Page 00-1).

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Engine General Information and Diagnosis

Precautions

Precautions on Engine Diagnosis

Z9J0111100001

⚠ WARNING

To prevent any unexpected engine starting, 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 the fuel pressure in the fuel lines. Refer to "Fuel Pressure Relief Procedure" in Section 1G (Page 1G-15).**
  - **Disconnect the high pressure fuel pump wire connector located on the fuel vapor separator.**

CAUTION

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

NOTE

- **To troubleshoot the ECM, and the engine control system, consisting of sensors and actuators, use the Suzuki Diagnostic System.**
- **The self-diagnostic codes memory in the ECM will remain even if the battery is disconnected.**
- **Each electrical circuit 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.**

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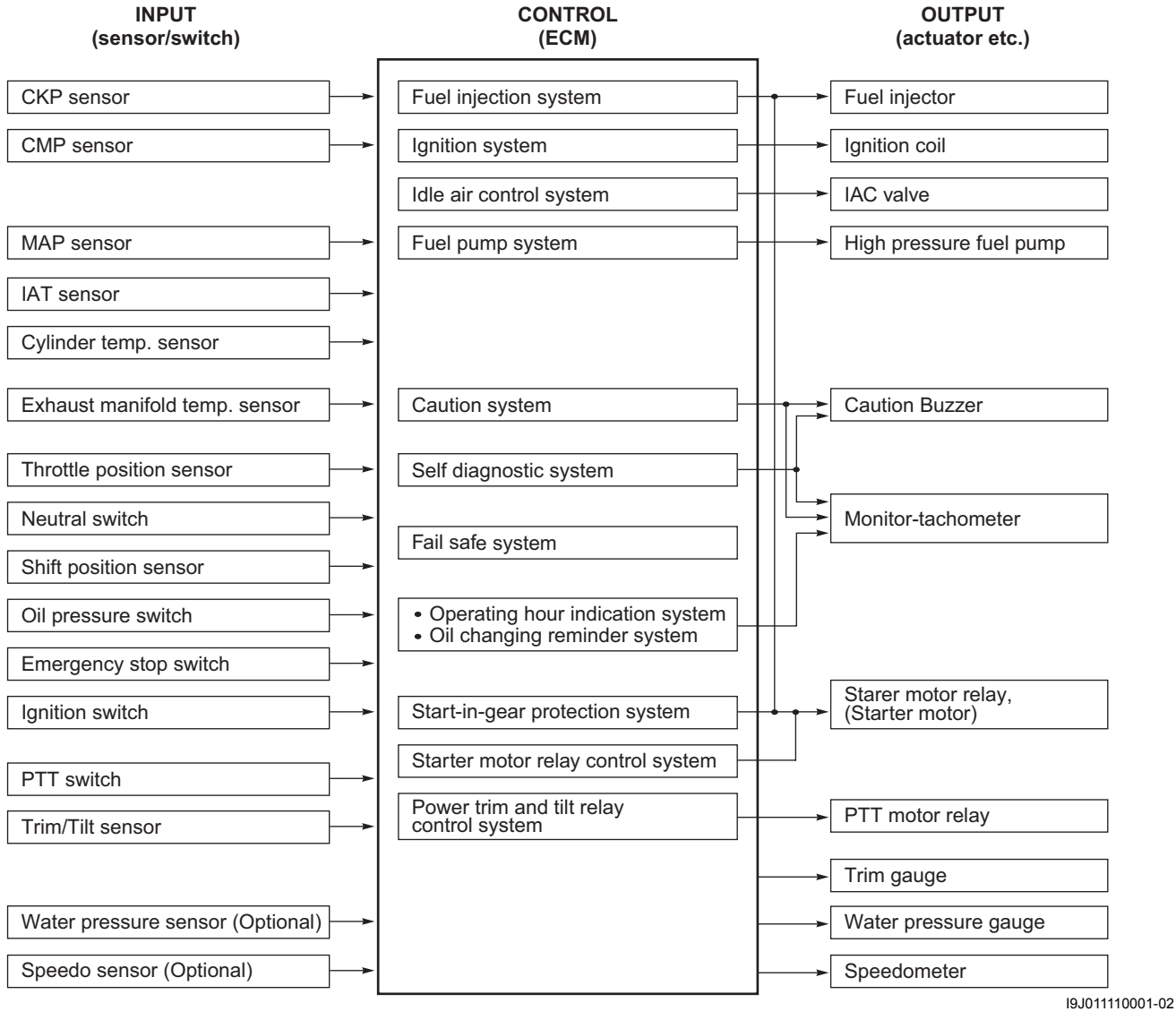
General Description

Engine Control System Description

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The DF70 / 80 / 90 models employ an integrated system which performs the control functions for fuel injection, ignition, idle / trolling speed (idle air), etc. through the ECM (Engine Control Module).

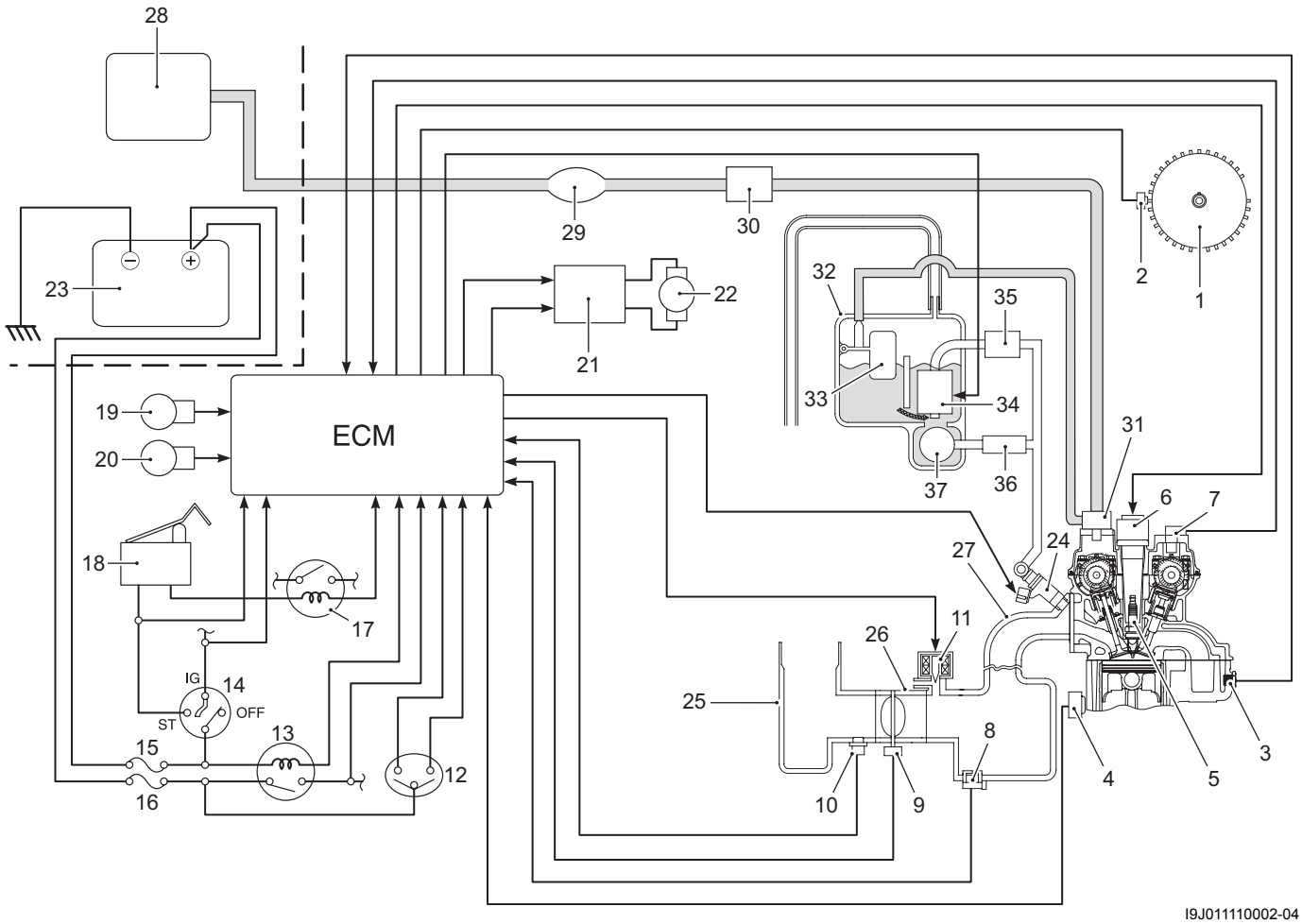
System Structure



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Engine Control System Flow Diagram



I9J011110002-04

1. Flywheel	11. IAC valve	21. PTT relay	31. Low pressure fuel pump
2. CKP sensor	12. PTT switch	22. PTT motor	32. Fuel vapor separator
3. Ex. manifold temp. sensor	13. ECM main relay	23. Battery	33. Float
4. Cylinder temp. sensor	14. Ignition switch	24. Fuel injector	34. High pressure fuel pump
5. Spark plug	15. Fuse (30 amp.)	25. Air intake silencer	35. High pressure fuel filter
6. Ignition coil	16. Fuse (15 amp.)	26. Throttle body	36. Fuel cooler
7. CMP sensor	17. Starter relay	27. Intake manifold	37. Fuel pressure regulator
8. MAP sensor	18. Neutral switch	28. Fuel tank	
9. Throttle position sensor	19. Trim/Tilt sensor	29. Fuel primer bulb	
10. IAT sensor	20. Shift position sensor	30. Low pressure fuel filter	

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Engine Control Module (ECM)

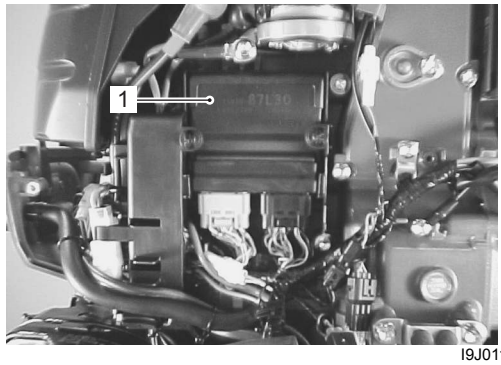
Z9J0111101002

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

Name of Control	Description
Fuel injection control	• Controls fuel injection amount and timing.
Ignition control	• Controls ignition timing.
Idle air control	• Controls idling / trolling speed by adjusting the intake air volume through the IAC valve.
Fuel pump control	• Controls the high pressure fuel pump drive.
Caution system control	• Informs the operator of abnormal engine conditions. • Controls engine speed, if activated.
Self-diagnostic system control	• Informs the operator of sensor / switch malfunction.
Fail-safe system control	• Allows engine operation with a back-up system during sensor / switch malfunction.
Total operating hour indication system control.	• Informs the operator of the total operating time.
Oil changing reminder system control	• Informs the operator that it is time to replace the engine oil, based on the maintenance schedule.
Start-in-gear protection system control	• Prevents engine starting when the shift lever is positioned in forward or reverse.
Starter motor relay control system	• Prevents starter motor operation when the engine is already operating.
Power trim and tilt relay control system	• Controls On / Off for the PTT relay's up and down circuits.

NOTE

Information related to the Caution System, Self-Diagnostic System, and Total Operating Hours System is retained in the ECM memory.

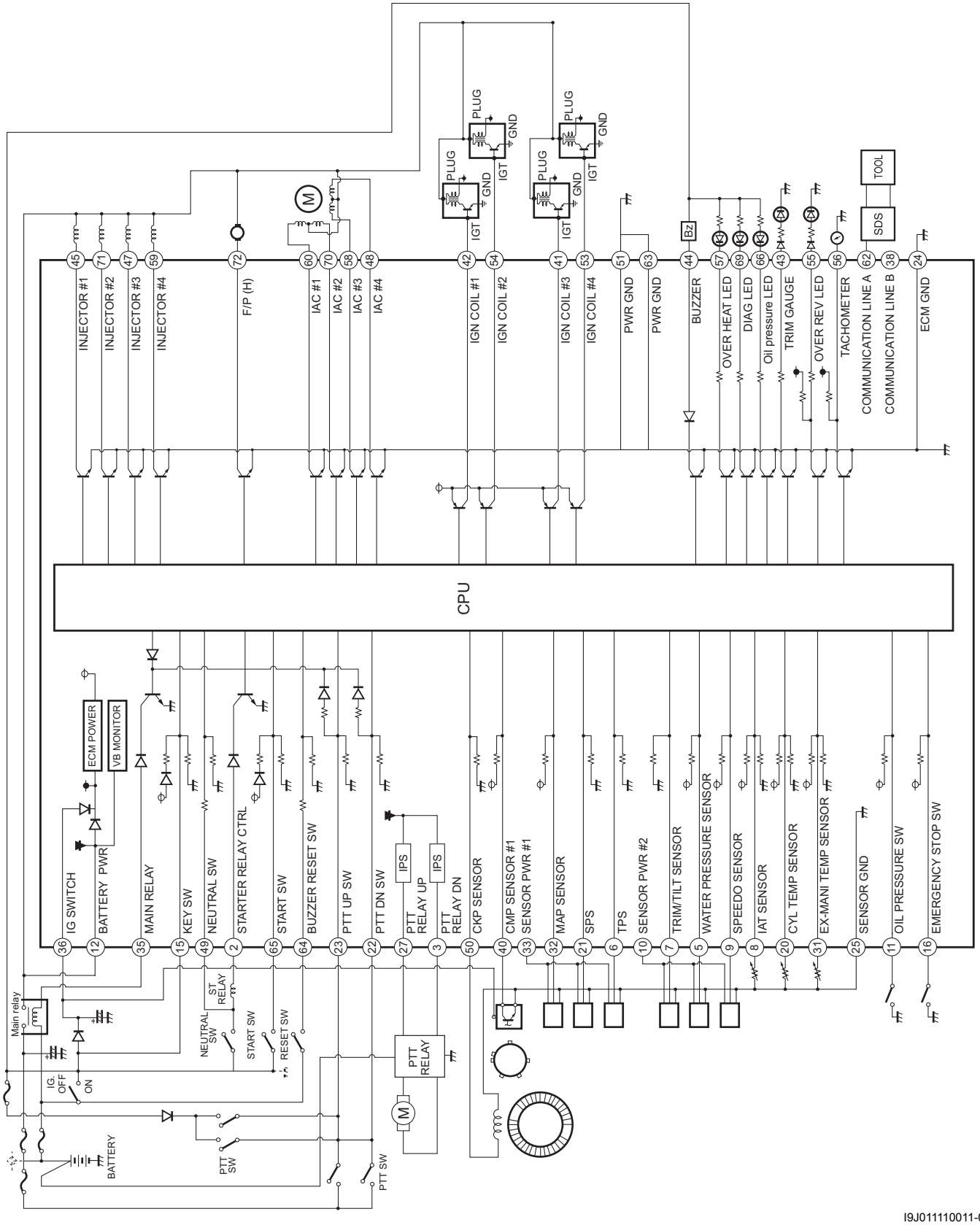


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1. ECM

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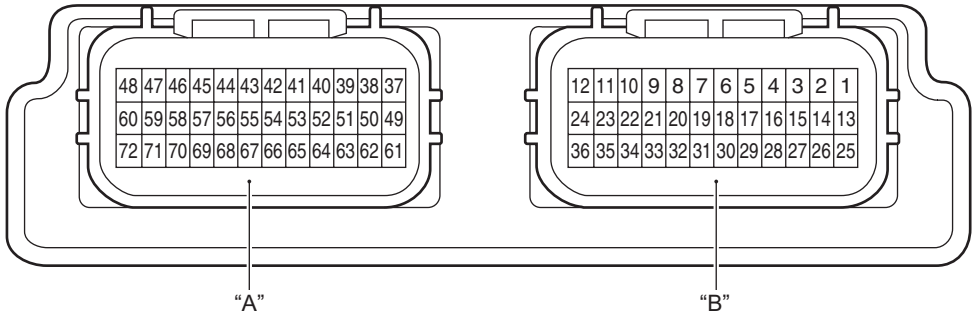
ECM Input / Output Circuit Diagram



I9J011110011-04

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ECM Connector / Terminals Layout



I9J011110003-02

"A": Gray connector	"B": Black connector

Terminal	Wire Color	Circuit	Terminal	Wire Color	Circuit
1	—	—	37	—	—
2	G	Starter relay control	38	Y	PC communication line (B)
3	P/W	PTT relay DN	39	—	—
4	—	—	40	Y/Bl	CMP sensor
5	Bl/B	Water pressure sensor	41	Gr/Y	No.3 Ignition coil
6	Br/Y	Throttle position sensor	42	O	No.1 Ignition coil
7	W/Y	Trim / Tilt sensor	43	W/Y	Trim gauge
8	Lg/B	IAT sensor	44	Bl/W	Buzzer
9	Bl/W	Speedo sensor	45	O/B	No.1 Fuel injector
10	R/W	Power source for sensor	46	—	—
11	Bl	Oil pressure switch	47	R/W	No.3 Fuel injector
12	Gr	Power source for ECM	48	W/Bl	IAC valve #4
13	—	—	49	Y/G	Neutral switch
14	—	—	50	R/B	CKP sensor
15	B/G	Ignition key switch	51	B	Ground for power
16	Bl/R	Emergency stop switch	52	—	—
17	—	—	53	Lg/R	No.4 Ignition coil
18	—	—	54	Bl	No.2 Ignition coil
19	—	—	55	P/W	Rev – Limit lamp
20	Lg/W	Cylinder temp. sensor	56	Y/B	Tachometer
21	P/Bl	Shift position sensor	57	G/Y	TEMP lamp
22	P	PTT switch "DN"	58	R/G	IAC valve #3
23	Lbl	PTT switch "UP"	59	Lg	No.4 Fuel injector
24	B	Ground for ECM	60	W/B	IAC valve #1
25	B/W	Ground for Sensor	61	—	—
26	—	—	62	O/Y	PC communication line (A)
27	Lg/W	PTT relay UP	63	B	Ground for power
28	—	—	64	O/W	Buzzer cancel
29	—	—	65	Br	Start switch
30	—	—	66	Bl/B	Oil lamp
31	V/W	Ex. Manifold temp. sensor	67	—	—
32	W	MAP sensor	68	—	—
33	R	Power source #1 for sensor	69	G/W	CHECK ENGINE lamp
34	—	—	70	R/Y	IAC valve #2
35	R/B	Ground for ECM main relay	71	B/Br	No.2 Fuel injector
36	B/Bl	Ignition switch	72	B/R	High pressure fuel pump (–)

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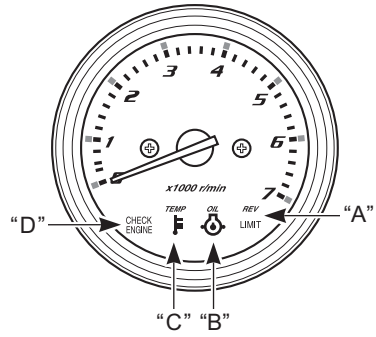
Caution System Description

Z9J0111101003

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

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

Monitor-Tachometer



I9J011110004-02

"A": "REV LIMIT" lamp	"C": "TEMP" lamp
"B": "OIL" lamp	"D": "CHECK ENGINE" lamp

Caution Type	Caution Lamp	Caution Buzzer	Engine RPM Limited
Over-revolution	Yes "A"	No	Yes
Low oil pressure	Yes "B" ("A")	Yes	Yes
Overheat	Yes "C" ("A")	Yes	Yes
Low battery voltage	Yes "D"	Yes	No

Lamp check / Buzzer Check

When the ignition key is turned to the "ON" position:

- Four Caution lamps turns on for two seconds.
- Caution buzzer sounds for two seconds.

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

DF70 / 80: 6 200 r/min.

DF90: 6 400 r/min.

Action:

Engine speed	• Automatically reduced to approx. 3 000 r/min. by an intermittent fuel injection signal. • If the operator decreases the engine speed below the over revolution system maximum preset value, within 10 seconds, the over-revolution caution control will be canceled.
Caution lamp	"REV-LIMIT" lamp lights continuously.
Caution buzzer	No buzzer sounds.

Reset:

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

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Low Oil Pressure Caution System

Condition:

Immediate activation of the 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.) while the engine is running.

Action:

Engine speed	• Automatically reduced to approx. 1 000 r/min. maximum by an intermittent fuel injection signal. • The engine automatically stops 3 minutes after the caution system is activated.
Caution lamp	• “OIL” lamp lights continuously. • “REV-LIMIT” lamp lights continuously during engine speed rev-limiter activation (1 000 r/min, or higher).
Caution buzzer	• Sounds in a series of long (1.5 sec.) beeps.

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 the engine and check the engine oil level. Refill the engine oil to the correct level if it is below the low oil level 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 will reset when the oil pressure is restored to over 100 kPa (1.0 kg/cm^2, 14 psi.) at approx. 1 000 r/min. or less engine speed operation.
The engine must be stopped and checked immediately once the system is activated.

Overheat Caution System

Condition 1 (Maximum temperature)

Immediate activation of the system when:

- Cylinder temperature reaches 120 °C (248 °F)
- Exhaust manifold temperature reaches 114 °C (237.2 °F)

Condition 2 (Gradient temperature – Temp. rise vs. Time)

Immediate activation of the system when:

- The average temperature difference between 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 (14.4 °F)
99 °C – (210 °F –)	Approx. 1.5 °C (2.7 °F)

- The average temperature difference between 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 (25.2 °F)
95 °C – (203 °F –)	Approx. 1.7 °C (3.1 °F)

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Action:

Engine speed	• Automatically reduced to approx. 3 000 r/min. maximum by intermittent fuel injection and ignition signals. • The engine automatically stops 3 minutes after the caution system is activated.
Caution lamp	• "TEMP" lamp lights continuously. • "REV-LIMIT" lamp lights continuously during engine speed rev-limiter activation (3 000 r/min. or higher).
Caution buzzer	• Sounds in a series of long (1.5 sec.) beeps.

NOTE

If the engine is automatically stopped due to the caution system, the engine can be started again. The caution system will repeatedly activate until the cause is eliminated.

Reset:

Close the throttle completely and then shift into neutral.

System reset will occur when the 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 (Gradient temp. – Temp. rise vs. Time)	Approx. 76 °C (169 °F)

Low Battery Voltage Caution System

Condition 1:

The system is activated when the battery voltage decreases to less than 9 volts for 30 seconds.

Condition 2:

The system is activated if the battery voltage is less than 2 Volts for more than 2 seconds when the ignition switch is turned "ON" and the engine is not running.

Action:

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

Reset:

Condition 1:

The 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 a deteriorated battery, poor battery cable connection, battery switch in the "OFF" position, etc., must be inspected.

To cancel the caution system activation for these conditions, check all power source related items and eliminate the problem.

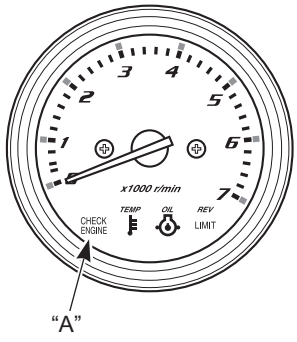
http://SelfFixer.com

Self-Diagnostic System Description

Z9J0111101004

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

Monitor-Tachometer



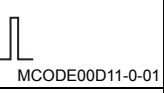
I9J011110005-01

“A”: “CHECK ENGINE” lamp

Priority / Code / Pattern for Self-Diagnostic System Operation
0: OFF, 1: ON

Priority	Failed Item	Code	Lamp Flashing Pattern	Fail-Safe System Active
1	MAP sensor 1	3 – 4	 MCODE00D34-0-01	Yes
2	Cylinder temp. sensor	1 – 4	 MCODE00D14-0-01	Yes
3	IAT sensor	2 – 3	 MCODE00D23-0-01	Yes
4	CKP sensor	4 – 2	 MCODE00D42-0-01	No
5	CMP sensor	2 – 4	 MCODE00D24-0-01	No
6	Air intake system	2 – 2	 MCODE00D22-0-01	Yes
7	MAP sensor 2	3 – 2	 MCODE00D32-0-01	No
8	Exhaust manifold temp. sensor	1 – 5	 MCODE00D15-0-01	Yes
9	Fuel injector	4 – 3	 MCODE00D43-0-01	No
10	Throttle position sensor	2 – 1	 MCODE00D21-0-01	Yes
11	Shift position sensor	1 – 2	 MCODE00D12-0-01	Yes
12	Neutral switch	3 – 3	 MCODE00D33-0-01	No

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Priority	Failed Item	Code	Lamp Flashing Pattern	Fail-Safe System Active
13	Rectifier/Regulator (Over-charging)	1 – 1	 MCODE00D11-0-01	No
14	Oil pressure switch	5 – 3	 MCODE00D53-0-01	No
15	Trim sensor	3 – 7	 MCODE00D37-0-01	No

NOTE

- **If two or more items fail at once, the self-diagnostic indication appears according to the priority order. The indication repeats three times.**
- **If the failed item remains, the self-diagnostic indication appears again after turning the ignition switch "ON".**
- **After correcting the failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running.**
- **Cancellation of the self-diagnostic indication is automatically performed when the failure is corrected and a normal signal is received by the ECM for a period of 20 – 30 seconds.**
- **The Rectifier/Regulator self-diagnostic indication may not be displayed when the ignition switch is turned "ON" because the ECM cannot detect rectifier/regulator charging output if the engine is not running.**
  Under this condition, the buzzer will not sound a 1 – 1 code.
  However, if the rectifier/regulator has failed, the self diagnostic indication will appear again after starting the engine.

Condition for Self-Diagnostic System Operation

Failed Item	Condition
MAP sensor 1	• No signal (With engine running). • Receiving an out of range "38 – 855 mmHg (1.49 – 33.66 inHg) (0.2 – 4.5 V)" signal (With the engine running.).
Cylinder temp. sensor	• No signal. • Receiving an out of range "– 46 to + 170 °C (– 114.8 – +338 °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, 32 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 three crankshaft rotations, the normal CMP sensor signal pattern is not received by the ECM.
Air intake system	• The engine operates at an abnormally high speed when the ECM is receiving a completely closed signal from the throttle position sensor. (Criteria: 2 100 r/min minimum)
MAP sensor 2	• From TPS sensor, the full close signal is inputted, but from the MAP sensor, the signal voltage exceeds 2.4 V.
Exhaust manifold temp. sensor	• No signal. • Receiving an out of range "– 46 to + 170 °C (– 114.8 – +338 °F) (0.10 – 4.6 V)" signal.
Fuel injector	• No operation signal from the ECM.
Throttle position sensor	• No signal. • Receiving an out of range "0.2 – 4.8 V" signal.
Shift position sensor	• No signal. • Receiving an out of range "0.2 – 4.8 V" signal.

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Failed Item	Condition
Neutral switch	• While the shift sensor outputs a forward or reverse signal, the ECM receives a neutral signal from the neutral switch.
Rectifier/Regulator (Over-charging)	• Receiving 16 volts or higher signal.
Oil pressure switch	• While the engine is stopped and the ignition switch is on, the ECM receives an “off” signal from the oil pressure switch.
Trim sensor	• Receiving an out of range “0.2 – 4.8 V” signal.

Fail-Safe System Description

Z9J0111101005

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	• 150 – 758 mmHg / (5.9 – 30 inHg.) (The value will change according to the current engine speed.)
Air intake system	• The control is executed with the maximum engine speed of 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 control is executed with the throttle opening at 5 degrees.
Shift position sensor	• The shift position (Fwd / Neu / Rev) is detected with the neutral switch signal.
Trim sensor	• The control is continued with fixed sensor output as 3.5 V.

NOTE

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

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Operating Hour Indication System Description

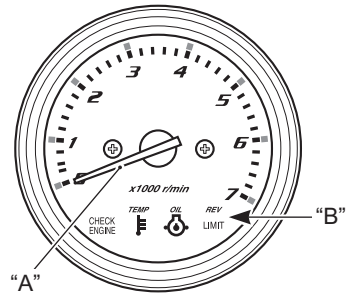
Z9J0111101006

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

NOTE

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

Monitor-Tachometer



I9J011110006-01

“A”: Needle	“B”: “REV-LIMIT” lamp

Chart of Total Operating Hours Indication

Total Operating Hours	Monitor-Tachometer	
	Needle “A” Indication	REV-LIMIT Lamp “B” Flashing*
0 h – (49 h)	No	No
50 h	500 r/min.	
60 h	600 r/min.	
↓	↓	
540 h	5 400 r/min.	
550 h	500 r/min.	1 time
560 h	600 r/min.	
↓	↓	
1 040 h	5 400 r/min.	
1 050 h	500 r/min.	2 times
↓	↓	
1 540 h	5 400 r/min.	
1 550 h	500 r/min.	3 times
↓	↓	
2 030 h	5 300 r/min.	
2 040 h or over	5 400 r/min.	3 times

*: One lamp flash corresponds to 500 hours.

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Oil Change Reminder System Description

Z9J0111101007

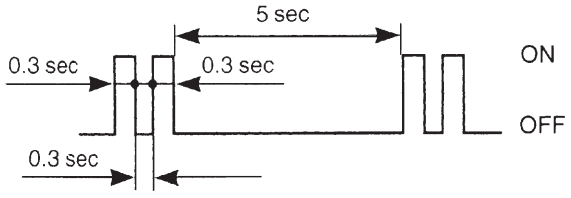
This system informs the operator that it is time to change the ENGINE OIL based on the recommended maintenance schedule.
When the total motor operating hours has reached the pre-programmed hours, the “OIL” lamp will flash, and the buzzer will begin a series of double beeps if the engine is not running (but ignition switch is “ON”).
The above mentioned indication will repeat until the activated system is manually canceled.

NOTE

This system will activate up to 2 100 hour’s operation.

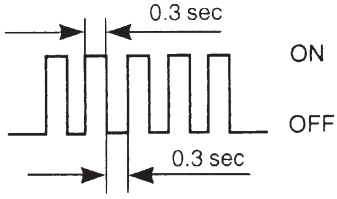
Indication of System Activation

Buzzer

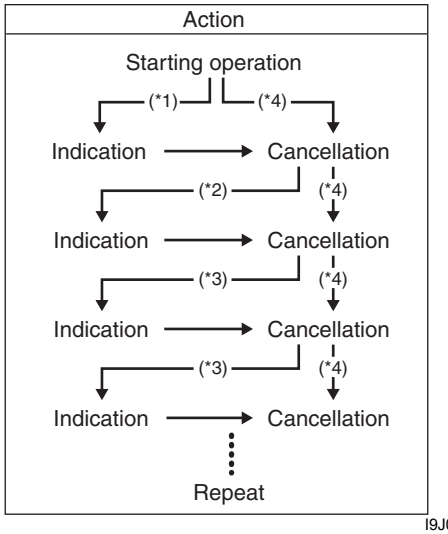


I9J011110008-01

Oil lamp



I9J011110009-01

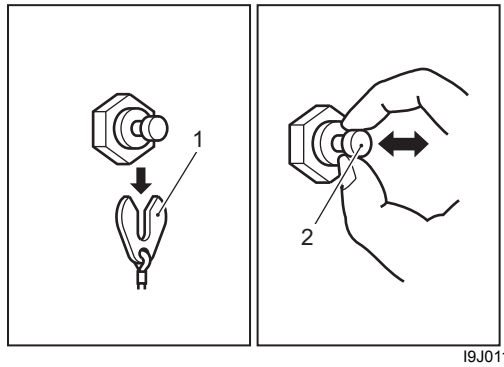


I9J011110010-03

*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 ignition key to the “ON” position.
2) Remove the emergency stop switch plate (1).
3) Pull out the emergency stop switch knob (2) three times in ten seconds.
   A short beep will be heard if the cancellation is successful.
4) Turn the ignition key to the “OFF” position.
5) Set the emergency stop switch plate (1) into the original position.



I9J011110007-02

NOTE

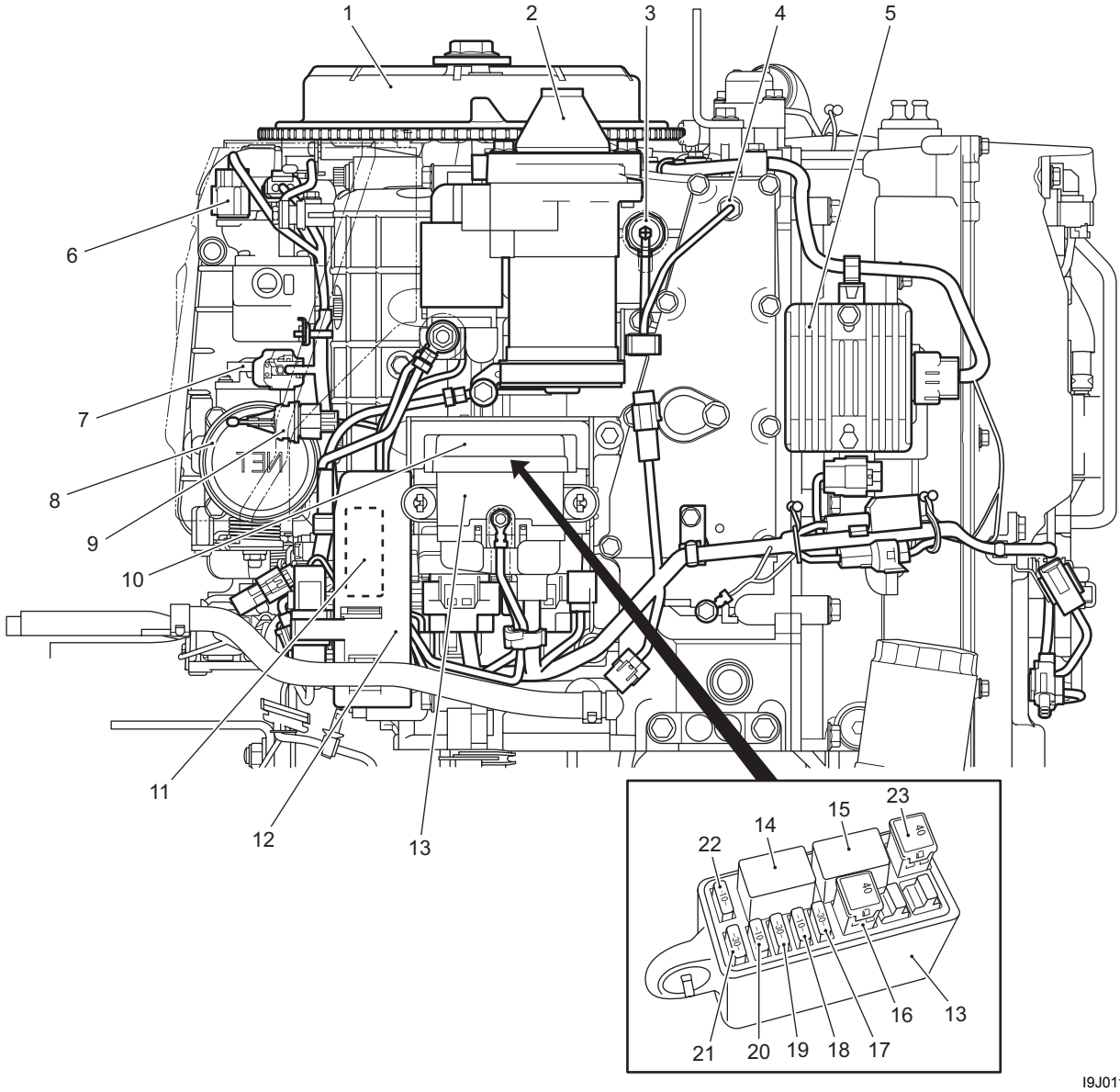
- **Cancellation of the system is possible whether or not the engine oil has been replaced.**
  Once the system has been activated, SUZUKI strongly recommends that the engine oil be replaced before canceling the system.
- **If the engine oil has been replaced with the system not activated, it is still necessary to perform the cancellation procedure to reset the Oil Change Reminder System.**

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Component Location

Engine Control System Components / Engine Electrical Device Location

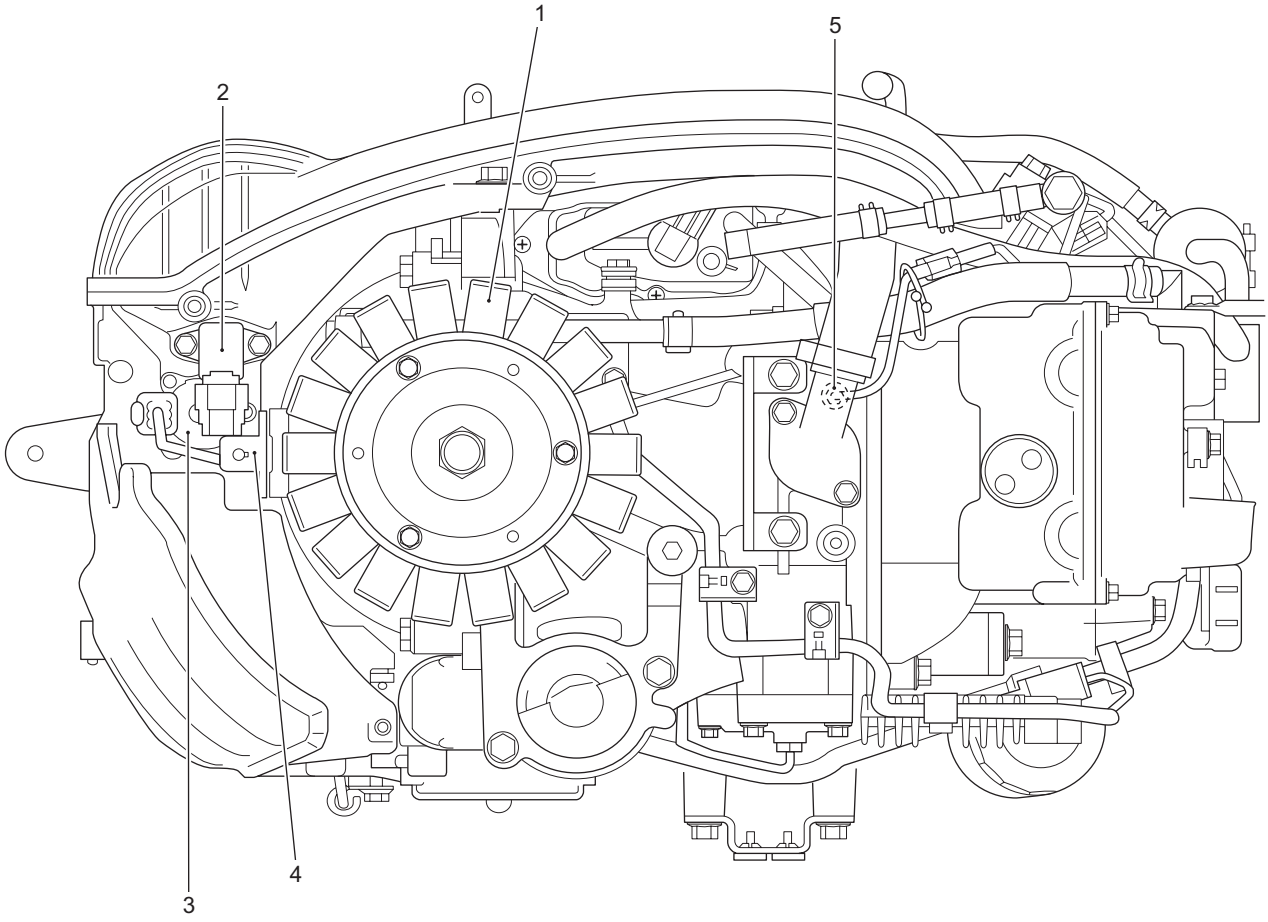
Z9J0111103001



I9J011110012-03

1. Flywheel	7. Throttle position sensor	13. Fuse box	19. Starter motor fuse (30 amp.)
2. Starter motor	8. Throttle body	14. Starter relay	20. PTT switch fuse (10 amp.)
3. Oil pressure switch	9. IAT sensor	15. Main relay	21. ECM, Ign, etc., fuse (30 amp.)
4. Ex. manifold temp. sensor	10. ECM	16. Main fuse (40 amp.)	22. IAC fuse (10 amp.)
5. Rectifier/Regulator	11. PTT motor relay	17. Spare fuse (30 amp.)	23. Spare fuse (40 amp.)
6. IAC valve	12. Electric parts holder	18. Spare fuse (10 amp.)	

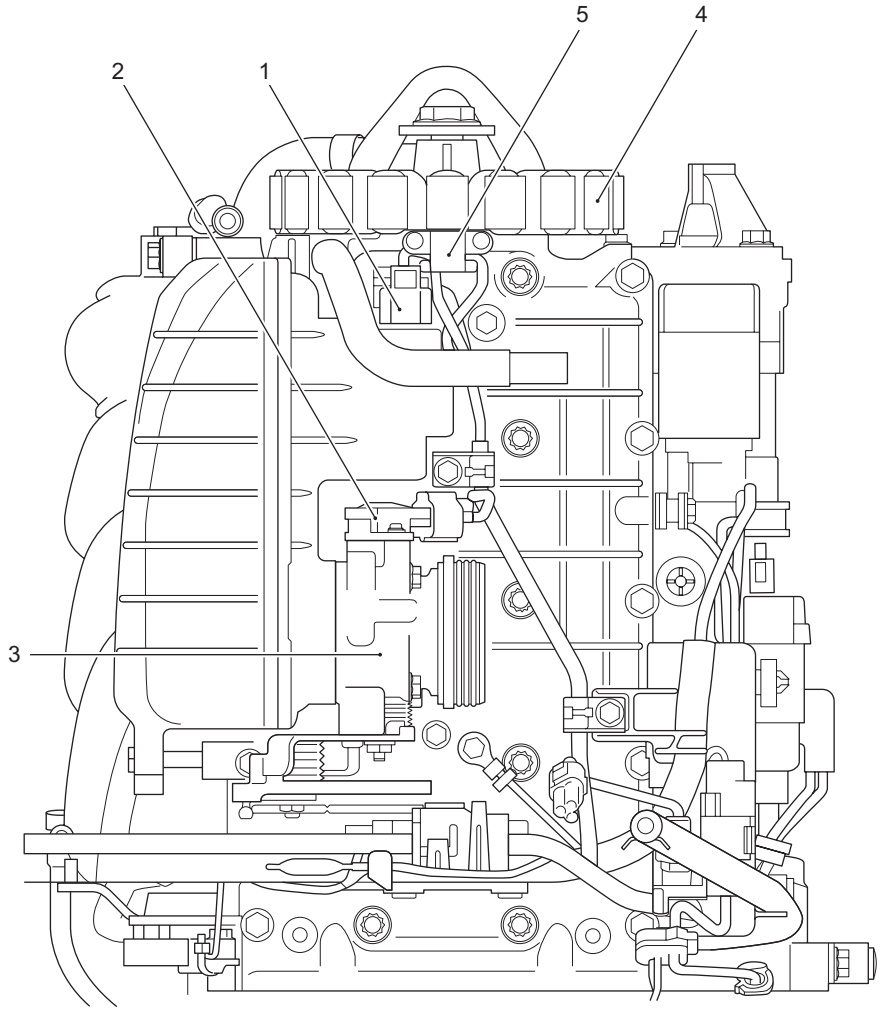
http://SelfFixer.com



I9J011110013-02

1. Battery charge coil	3. IAC valve	5. Cylinder temp. sensor
2. MAP sensor	4. CKP sensor	

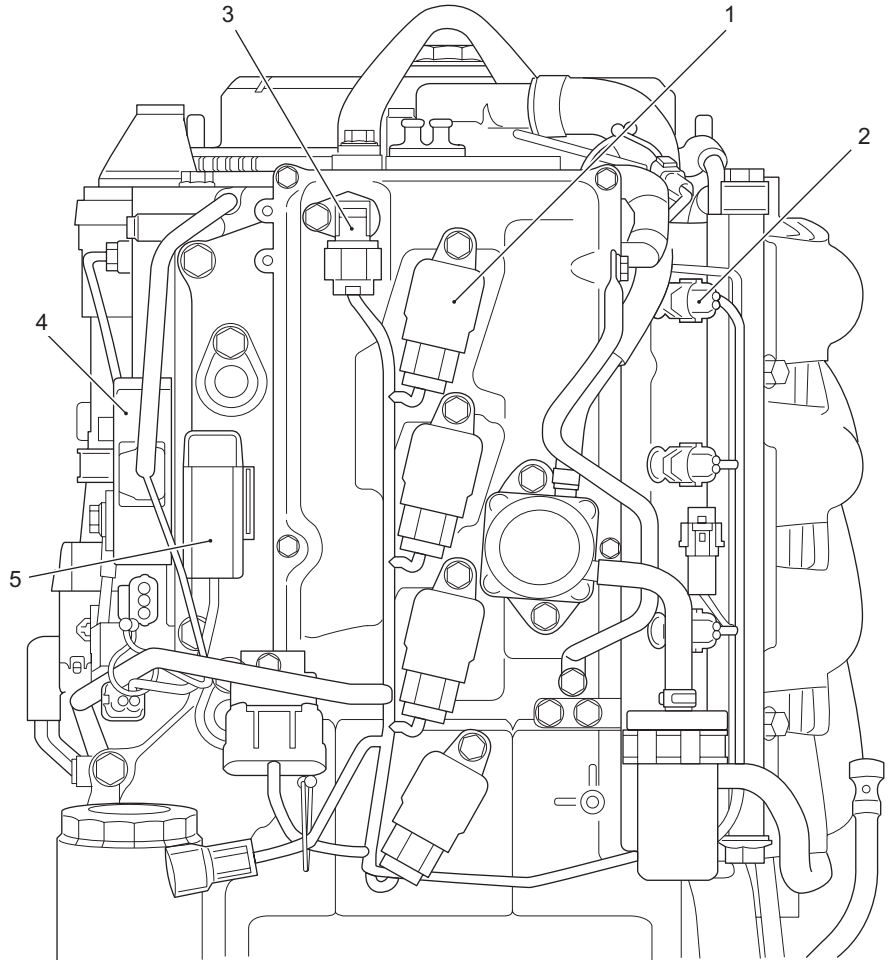
http://SelfFixer.com



I9J011110014-01

1. IAC valve	3. Throttle body	5. CKP sensor
2. Throttle position sensor	4. Battery charge coil	

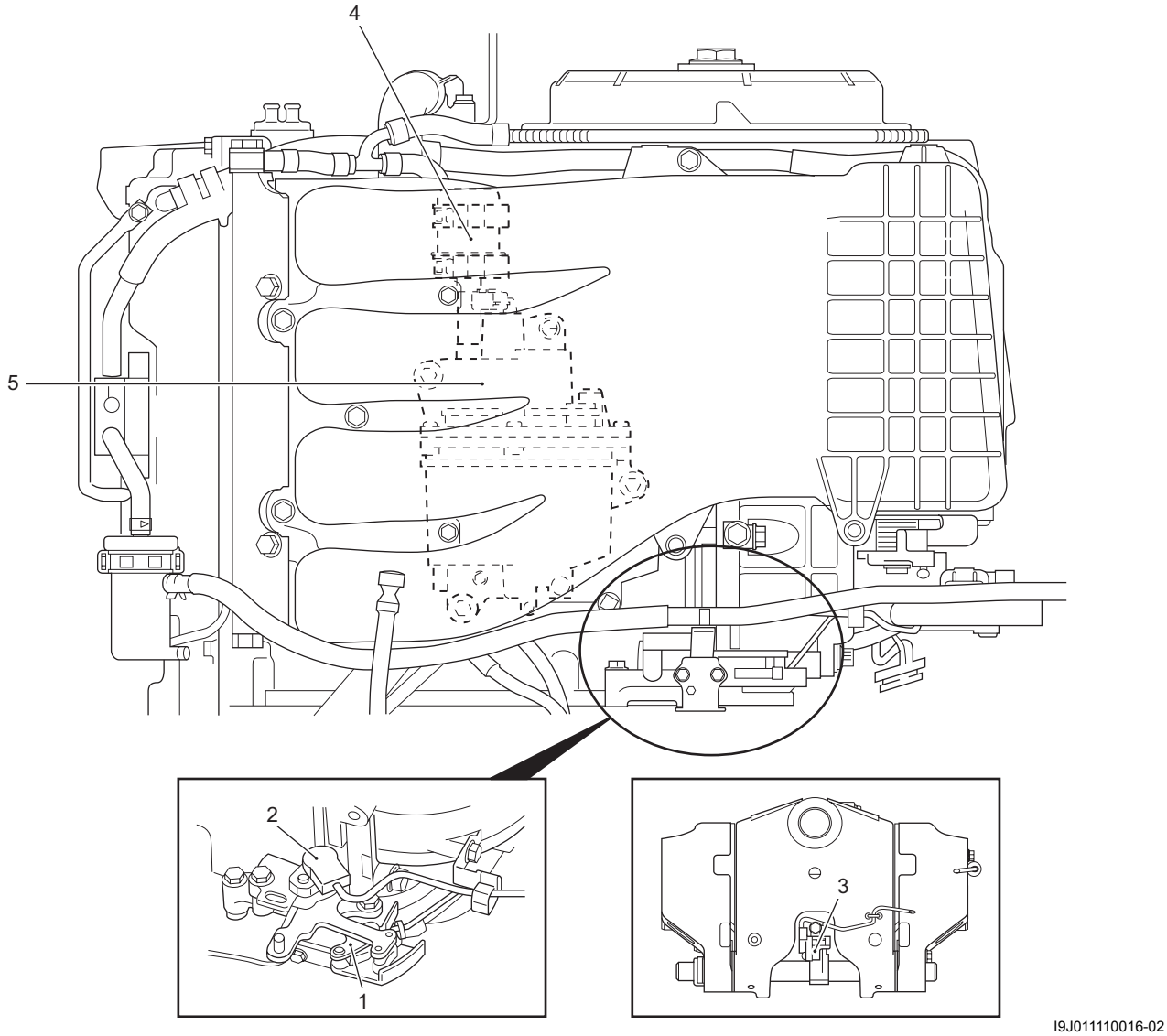
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I9J011110015-01

1. Ignition coil	3. CMP sensor	5. Main harness capacitor
2. Fuel injector	4. Rectifier/Regulator	

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I9J011110016-02

1. Neutral switch	3. Trim and tilt sensor	5. Fuel vapor separator
2. Shift position sensor	4. High pressure fuel filter	

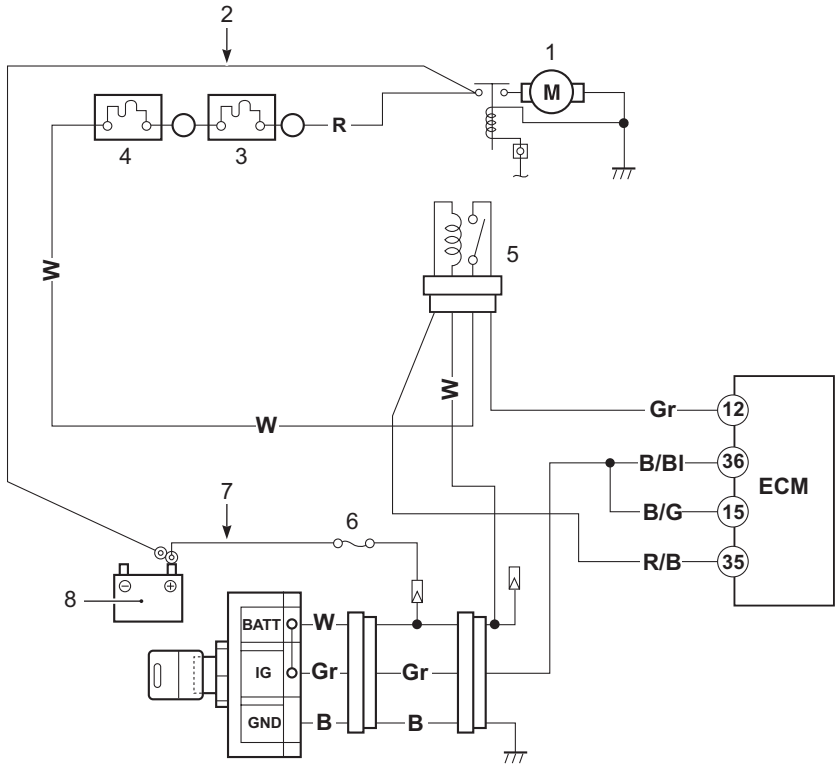
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Diagnostic Information and Procedure

ECM Power and Ground Circuit Check

Z9J0111104001

Wiring Diagram



I9J011110018-03

1. Starter motor	3. 40 amp. fuse	5. ECM main relay	7. Sub-battery cable
2. Main battery cable	4. 30 amp. fuse	6. 15 amp. fuse	8. Battery

Circuit Description

When the ignition switch is turned “ON”, the main relay turns “ON” (the contact point closes) and the main power is supplied to the ECM.

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Troubleshooting

Step	Action	Yes	No
1	*Is operation of the main relay heard when the ignition switch is turned "ON"?*	Go to step 4.	Go to step 2.
2	*Are the main fuses (40 amp. and 30 amp.), (for Ignition and ECM), and the sub battery cable fuse (15 amp.) in good condition?*	Go to step 3.	Replace.
3	1) Disconnect the ECM connector at the ECM with the ignition switch "OFF". 2) Measure the voltage between the No. 35 terminal of the ECM connector and body ground. *Is the voltage 12 V (Battery Voltage)?*	Go to step 4.	• Check the ECM main relay. Refer to "ECM Main Relay Inspection" (Page 1A-42). • Poor ECM main relay connection. • R/B wire open, shorted or poor connection.
4	1) Turn the ignition switch "OFF". 2) Connect the 36 pin test cord set between the ECM and the main wire harness. 3) Turn the ignition switch "ON". 4) Measure the voltage between the No. 36 terminal and body ground, and the No. 15 terminal and body ground. *Is the voltage 12 V (Battery Voltage)?*	Go to step 5.	• Check the ignition switch. Refer to "Ignition Switch Inspection" in Section 1I (Page 1I-13). • Gr, B/Bl, B/G wire open circuit or poor connection.
5	1) Turn the ignition switch "OFF". 2) Connect the 36 pin test cord set between the ECM and the main wire harness. 3) Turn the ignition switch "ON". 4) Measure the voltage between the No. 35 terminal and body ground. *Is the voltage approx. 0.5 V?*	Go to step 6.	• R/B wire open, shorted or poor connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.
6	1) Turn the ignition switch "ON". 2) Measure the voltage between the No. 12 terminal and body ground. *Is the voltage 12 V (Battery Voltage)?*	ECM power and ground circuit are in good condition.	• Gr wire open, shorted or poor connection. • Faulty ECM main relay.

Troubleshooting with Self-Diagnostic Code

Z9J0111104002

⚠ WARNING

Before troubleshooting, read and follow the "Precautions on Engine Diagnosis" (Page 1A-1).

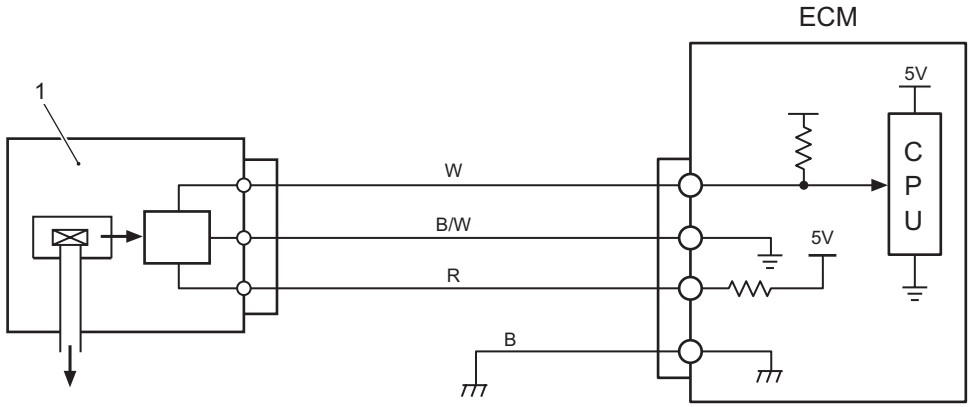
In this section, troubleshooting procedures are based on the assumption that the "low pressure fuel system" and "mechanical components (power unit, lower unit, etc.)" are normal.

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Self-Diagnostic Code “3 – 4” MAP Sensor

Z9J0111104003

Wiring Diagram



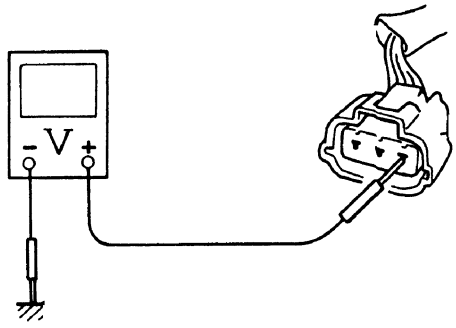
I9J011110019-02

1. MAP sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the MAP sensor connector. 2) With the ignition switch “ON”, Check the voltage at the “R” wire terminal of the MAP sensor connector. *Is the voltage approx. 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground or a poor wire connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the MAP sensor output voltage change. Refer to “MAP Sensor Output Voltage Inspection” in Section 1C (Page 1C-13). *Is it in good condition?*	• Substitute a good ECM and recheck.	• Faulty MAP sensor. • “R” wire shorted to “W” wire, “B/W” wire open, poor “B/W” wire connection, poor “W” wire connection, “W” wire open or poor MAP sensor connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

For step 1



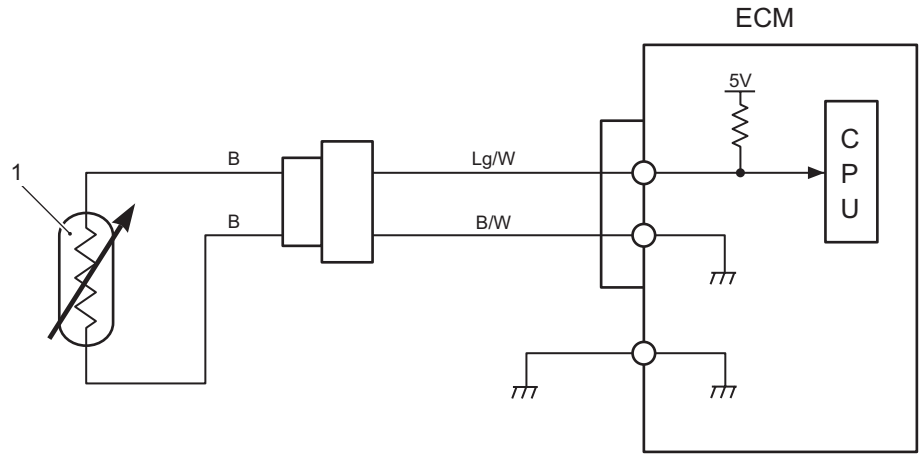
I9J011110043-02

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Self-Diagnostic Code “1 – 4” Cylinder Temp. Sensor

Z9J0111104004

Wiring Diagram



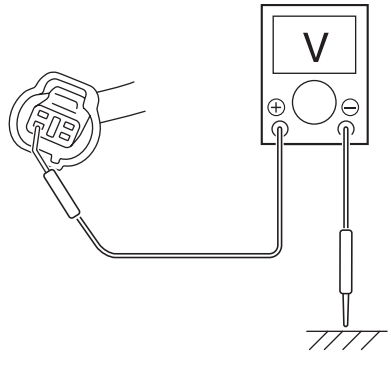
I9J011110021-03

1. Cylinder temp. sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the Cylinder Temp. Sensor connector. 2) With the ignition switch “ON”, check the voltage at the “Lg/W” wire terminal of the Cylinder Temp. Sensor connector. *Is the voltage 4 V or more?*	Go to step 2.	• “Lg/W” wire shorted to the “B/W” wire or ground circuit. • If the wiring is OK, substitute a known-good ECM and recheck.
2	1) Check the Cylinder Temp. Sensor. Refer to “Cylinder Temp. Sensor Inspection” in Section 1C (Page 1C-8). *Is it in good condition?*	Poor Cylinder Temp. Sensor connection, intermittent trouble or a faulty ECM may be the cause.	Faulty Cylinder Temp. Sensor.

For step 1



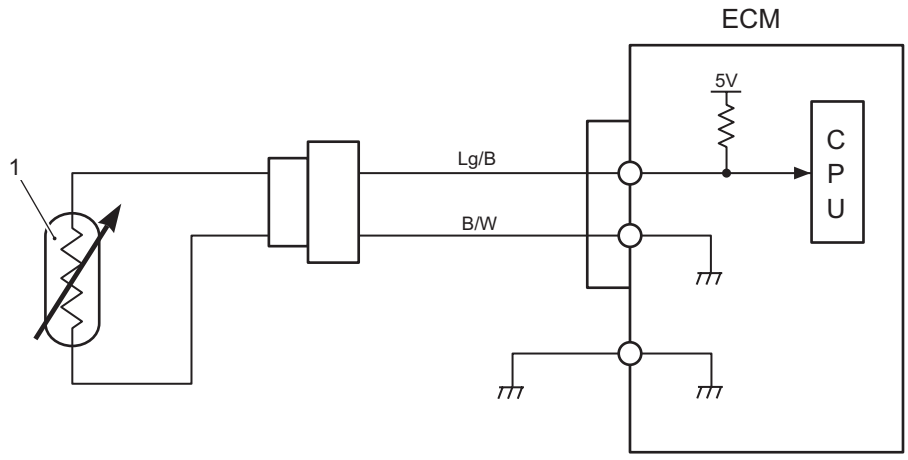
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Self-Diagnostic Code “2 – 3” IAT Sensor

Z9J0111104005

Wiring Diagram



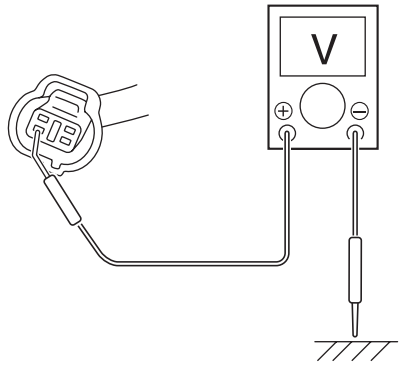
I9J011110024-03

1. IAT sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the IAT sensor connector. 2) With the ignition switch “ON”, check the voltage at the “Lg/B” wire terminal of the IAT sensor connector. *Is the voltage 4 V more?*	Go to step 2.	• “Lg/B” wire shorted to “B/W” wire or ground circuit. • If the wiring is OK, substitute a known-good ECM and recheck.
2	1) Check the IAT sensor. Refer to “IAT Sensor Inspection” in Section 1C (Page 1C-11). *Is it in good condition?*	Poor IAT sensor connection, intermittent trouble or a faulty ECM may be cause.	Faulty IAT sensor.

For step 1



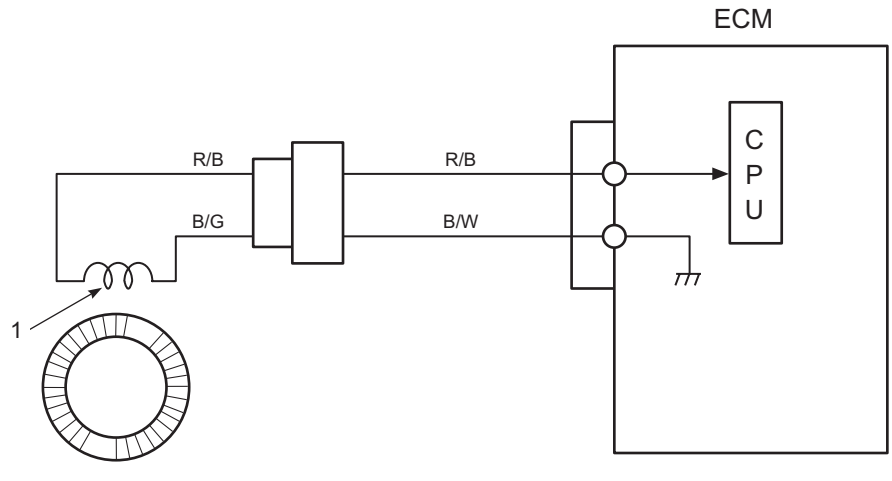
I9J011110046-01

http://SelfFixer.com

Self-Diagnostic Code “4 – 2” CKP Sensor

Z9J0111104006

Wiring Diagram



I9J011110025-03

1. CKP sensor

Troubleshooting

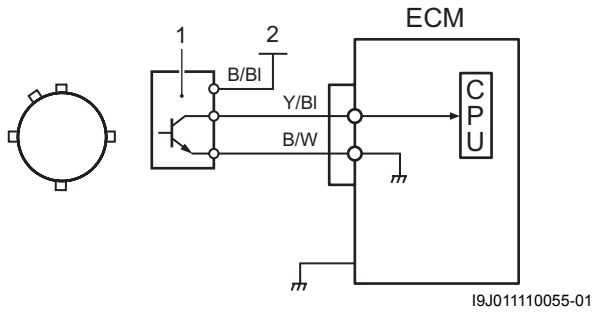
Step	Action	Yes	No
1	1) Check the CKP sensor air gap. Refer to “CKP Sensor Removal and Installation” in Section 1C (Page 1C-10). *Is it in good condition?*	Go to step 2.	Incorrectly adjusted air gap.
2	1) Check the CKP sensor resistance. Refer to “Resistance Check” in Section 1C (Page 1C-7). *Is it in good condition?*	Open wire between the CKP sensor and the ECM, poor lead wire connection or sensor lead wires are shorted to each other. If lead wire and connection are ok, intermittent trouble or a faulty ECM may be the cause.	Faulty CKP sensor.

http://SelfFixer.com

Self-Diagnostic Code “2 – 4” CMP Sensor

Z9J0111104007

Wiring Diagram



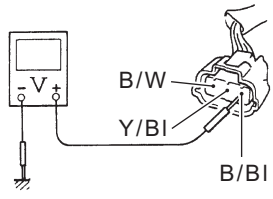
I9J011110055-01

1. CMP sensor	2. + 12 V (From Ign. switch)

Troubleshooting

Step	Action	Yes	No
1	*Is the CMP sensor installed properly and the wire harness connected securely?*	Go to step 2.	Correct.
2	1) Disconnect the connector from the CMP sensor. 2) Check for proper connection to the CMP sensor at “B/Bl”, “Y/Bl” and “B/W” wire terminals. 3) If OK, turn the ignition switch “ON” and check the voltage at the “B/Bl”, “Y/Bl” and “B/W” wire terminals of the CMP sensor connector. **CMP sensor voltage** **Terminal “B/Bl”: 10 – 14 V** **Terminal “Y/Bl”: 4 – 5 V** **Terminal “B/W”: 0 V** *Is the voltage satisfactory?*	Go to step 5.	Go to step 3.
3	*Was terminal “Y/Bl” voltage in step 2 within specification?*	Go to step 4.	“Y/Bl” wire open or shorted to ground / power supply circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.
4	*Was terminal “B/Bl” voltage in step 2 within specification?*	Go to step 5.	“B/Bl” wire open circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.
5	Check the CMP sensor and sensor trigger vane. Refer to “CMP Sensor Inspection” in Section 1C (Page 1C-11). *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	Replace CMP sensor.

For step 2



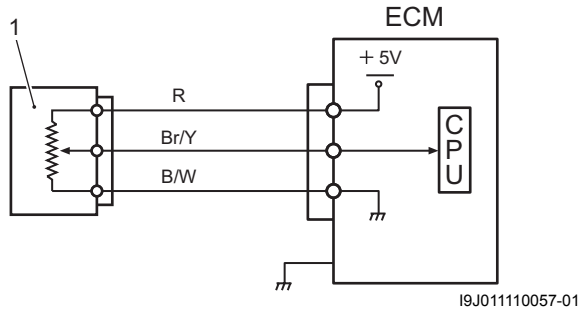
I9J011110056-01

http://SelfFixer.com

Self-Diagnostic Code “2 – 2” Air Intake System

Z9J0111104008

Wiring Diagram



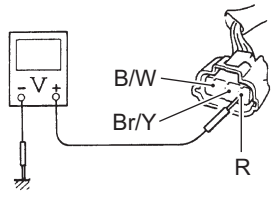
I9J011110057-01

1. TPS

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the TPS connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of TPS connector. *Is the voltage approx. 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground circuit or poor wire connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-15). *Is it in good condition?*	Go to step 3.	• Faulty TPS. • “R” wire shorted to “Br/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “Br/Y” wire connection, “Br/Y” wire open or poor TPS connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.
3	1) Check the MAP sensor, IAC system and intake manifold (system) for air leakage. *Is the result OK?*	Intermittent trouble or faulty ECM. Substitute a known-good ECM and recheck.	Faulty air intake system.

For step 1



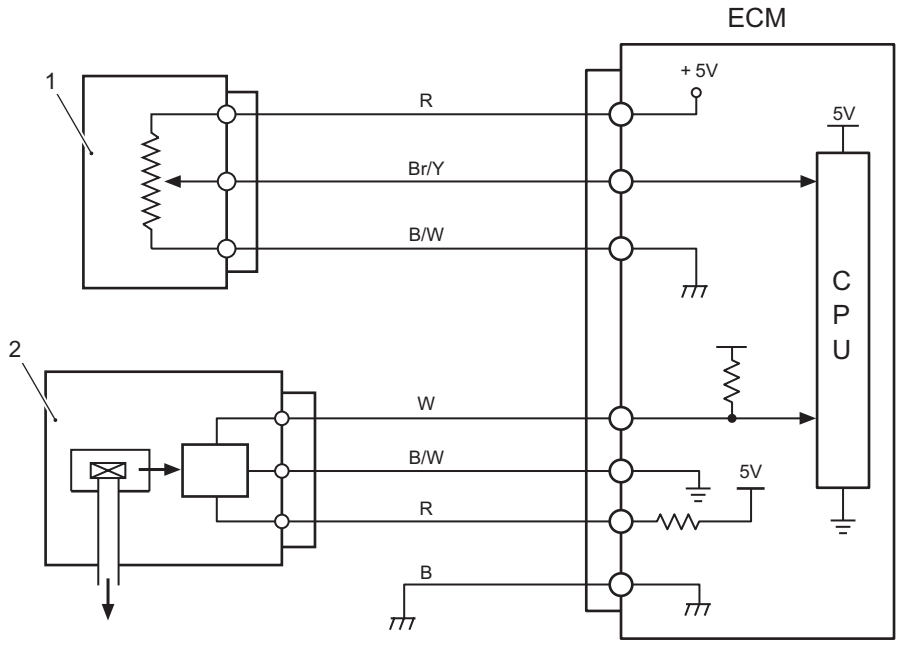
I9J011110058-01

http://SelfFixer.com

Self-Diagnostic Code “3 – 2” MAP Sensor 2

Z9J0111104009

Wiring Diagram



I9J011110029-03

1. TPS	2. MAP sensor

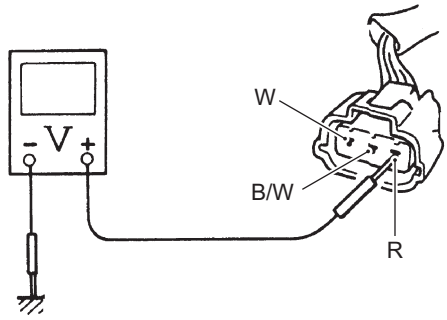
Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the MAP sensor connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of the MAP sensor connector. *Is the voltage approx 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground circuit or poor wire connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the MAP sensor output voltage change. Refer to “MAP Sensor Output Voltage Inspection” in Section 1C (Page 1C-13). *Is it in good condition?*	Go to step 3.	Faulty MAP sensor.
3	1) With the ignition switch “OFF”, disconnect the TPS connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of the TPS connector. *Is the voltage approx. 4 – 5 V?*	Go to step 4.	• “R” wire open, “R” wire shorted to ground circuit or poor wire connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.

http://SelfFixer.com

Step	Action	Yes	No
4	1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-15). *Is it in good condition?*	Intermittent trouble, substitute a known-good ECM and recheck.	• Faulty TPS. • “R” wire shorted to “Br/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “Br/Y” wire connection, “Br/Y” wire open or poor TPS connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

For step 1



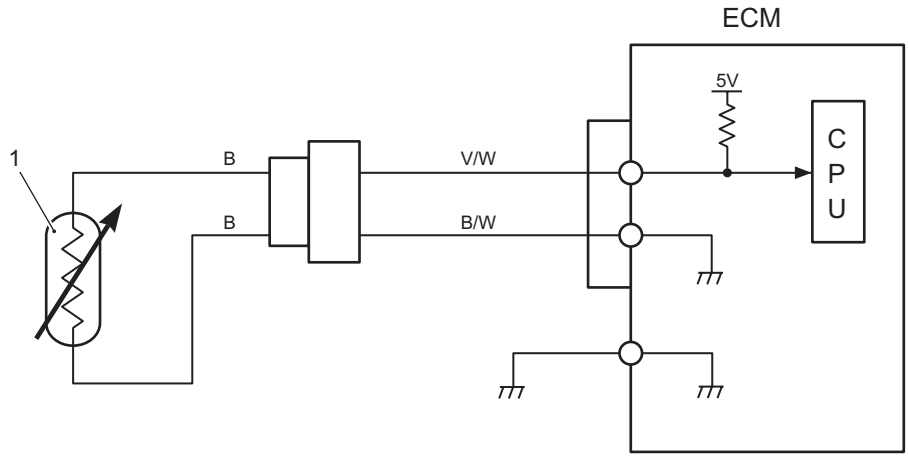
I9J011110048-02

http://SelfFixer.com

Self-Diagnostic Code “1 – 5” Ex. Manifold Temp. Sensor

Z9J0111104010

Wiring Diagram



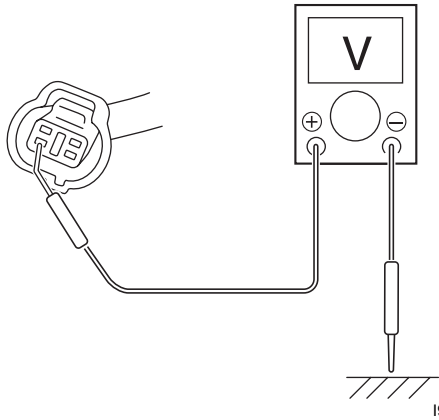
I9J011110030-02

1. Ex. manifold temp. sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the Ex. Manifold Temp sensor connector. 2) With the ignition switch “ON”, check the voltage at the “V/W” wire terminal of the Ex. Manifold Temp. sensor connector. *Is the voltage 4 V or more?*	Go to step 2.	• “V/W” wire shorted to “B/W” wire or ground circuit. • If the wiring is OK, substitute a known-good ECM and recheck.
2	1) Check the Ex. Manifold Temp. sensor. Refer to “Ex. Manifold Temp. Sensor Inspection” in Section 1C (Page 1C-9). *Is it in good condition?*	Poor Ex. Manifold Temp. sensor connection, intermittent trouble or a faulty ECM may be the cause.	Faulty Ex. manifold temp sensor.

For step 1



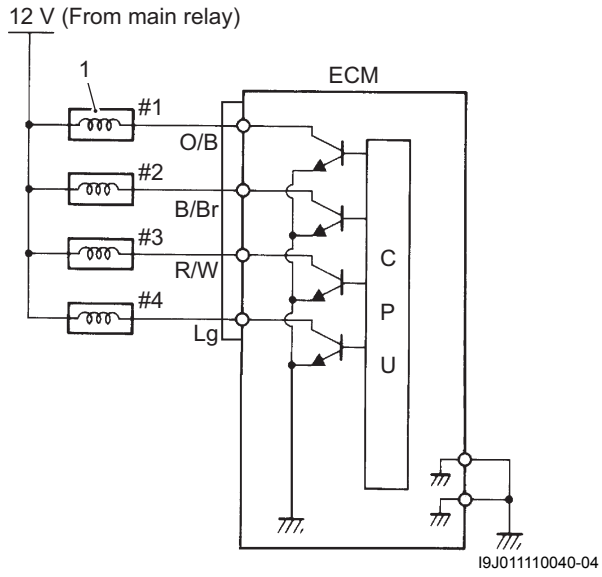
I9J011110049-01

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Self-Diagnostic Code “4 – 3” Fuel Injector

Z9J0111104011

Wiring Diagram

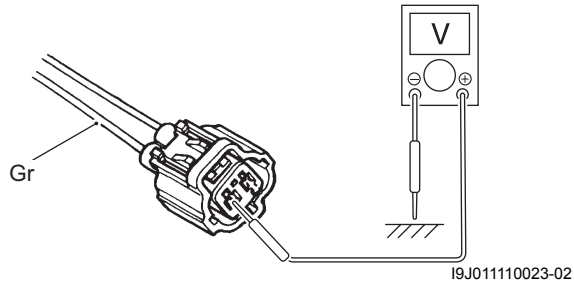


1. Fuel injector

Troubleshooting

Step	Action	Yes	No
1	1) Using a sound scope, check that each injector has an operating sound when the engine is cranking. *Do all injectors make an operating sound?*	Fuel injector and its circuit are in good condition.	Go to step 2.
2	1) Check the fuel injector, the wiring connection and the wire harness of the fuel injector not making the operating sound. *Are all of the above OK?*	Substitute a known-good ECM and recheck.	Faulty injector or its circuit.
3	1) With the ignition switch “OFF”, disconnect the connector from the fuel injector. 2) Check the voltage at “Gr” wire terminal with the ignition switch “ON”. *Is the voltage 12 V (battery voltage)?*	Go to step 4.	Power circuit open.
4	1) Disconnect the ECM connector with the ignition switch “OFF”, and check all of the injectors for resistance. Refer to “Resistance Check” in Section 1C (Page 1C-7). *Is the resistance 10 – 14 Ω for each injector?*	Substitute a known-good ECM and recheck.	Faulty injector or its circuit.

For step 3

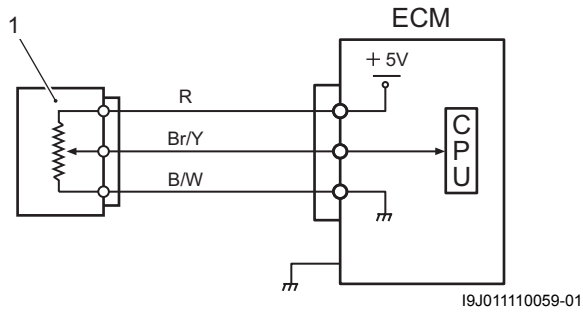


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Self-Diagnostic Code “2 – 1” TPS (Throttle Position Sensor)

Z9J0111104012

Wiring Diagram

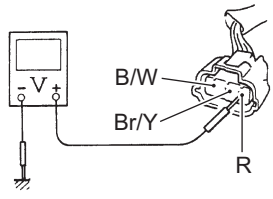


1. TPS

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the TPS connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of the TPS connector. *Is the voltage approx. 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground circuit or poor connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-15) *Is it in good condition?*	Substitute a known-good ECM and recheck.	• Faulty TPS. • “R” wire shorted to “Br/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “Br/Y” wire connection, “Br/Y” wire open or poor TPS connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

For step 1

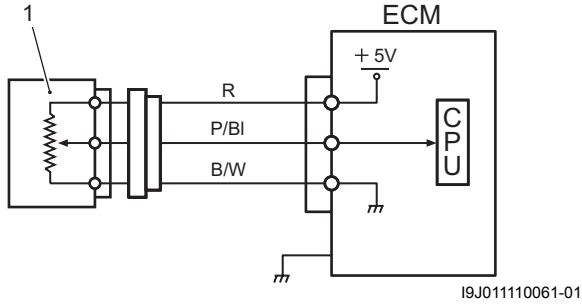


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Self-Diagnostic Code “1 – 2” Shift Position Sensor

Z9J0111104013

Wiring Diagram



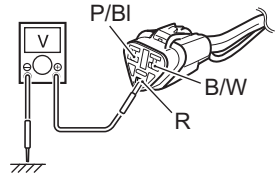
I9J011110061-01

1. Shift position sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the shift position sensor connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of the shift position sensor connector. *Is the voltage approx. 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground circuit or poor connection. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the shift position sensor output voltage change. Refer to “Shift Position Sensor Inspection” in Section 1C (Page 1C-16). *Is it in good condition?*	Poor shift position sensor connection, intermittent trouble or a faulty ECM may be the cause.	• “R” wire shorted to “P/BI” wire, “B/W” wire open, poor “B/W” wire connection, poor “P/BI” wire connection, “P/BI” wire open or poor shift position sensor connection. • If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause. • Faulty shift position sensor.

For step 1



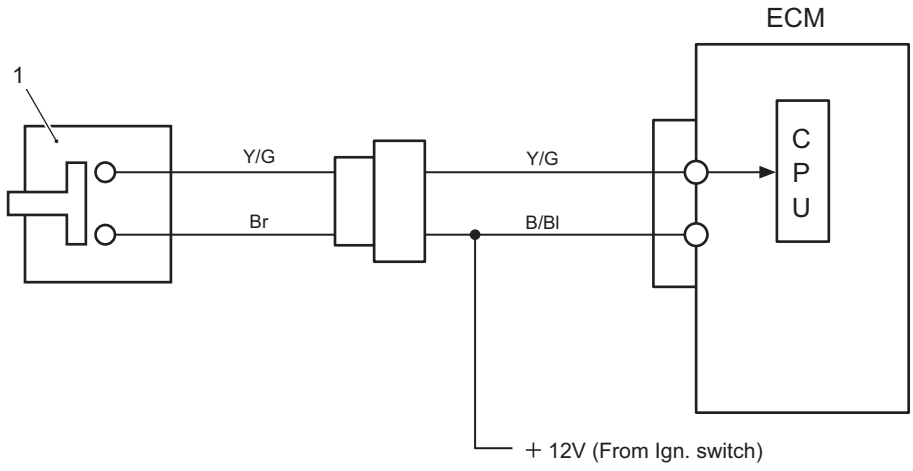
I9J011110062-01

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Self-Diagnostic Code “3 – 3” Neutral Switch

Z9J0111104014

Wiring Diagram



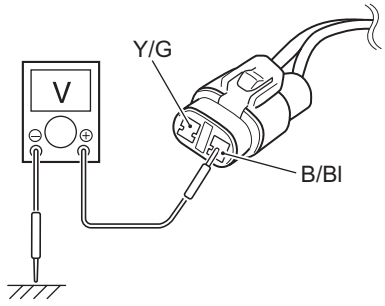
I9J011110033-04

1. Neutral switch

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the neutral switch connector. 2) With the ignition switch “ON”, check the voltage at the “B/Bl” wire terminal of the neutral switch connector. *Is the voltage 12 V or more?*	Go to step 2.	• “B/Bl” wire shorted to “Y/G” wire or ground circuit. • If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the Neutral Switch. Refer to “Neutral Switch Inspection” in Section 1I (Page 1I-14). *Is it in good condition?*	• Poor neutral switch connection, intermittent trouble or a faulty ECM. • Shift position sensor lever damage.	Faulty neutral switch.

For step 1



I9J011110051-02

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Self-Diagnostic Code “1 – 1” Rectifier/Regulator (Over Charging)

Z9J0111104015

NOTE

- **This self-diagnostic code indication may be canceled when turning the ignition switch “ON” (engine not running), because ECM detects battery voltage.**
- **It is difficult to thoroughly check the rectifier/regulator. Before replacing it with new one, check that the ground point has good electrical contact.**

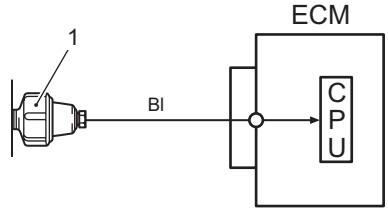
Troubleshooting

Step	Action	Yes	No
1	1) Check the Rectifier/Regulator resistance. Refer to “Rectifier/Regulator Inspection” in Section 1K (Page 1K-8). *Is the result OK?*	Go to step 2.	Faulty Rectifier/ Regulator.
2	1) With the engine running, check charging voltage at idle speed. *Is the result 16 V or higher?*	Faulty Rectifier/ Regulator.	Faulty ECM or wire continuity / connection failure.

Self-Diagnostic Code “5 – 3” Oil Pressure Switch

Z9J0111104016

Wiring Diagram



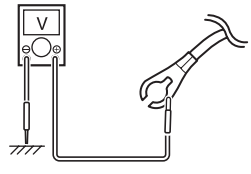
I9J011110063-01

1. Oil pressure switch

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, remove the oil pressure switch wire. 2) With the ignition switch “ON”, check the voltage between the oil pressure switch wire terminal and body ground. *Is the voltage approx. 5 V?*	Go to step 2.	• Oil pressure switch wire open or poor connection. • If wire and connection are OK, substitute a known-good ECM and recheck.
2	1) Check the oil pressure switch operation. Refer to “Oil Pressure Switch Inspection” in Section 1E (Page 1E-6). *Is it in good condition?*	Poor oil pressure switch wire connection, intermittent trouble or a faulty ECM may be the cause.	Faulty oil pressure switch.

For step 1



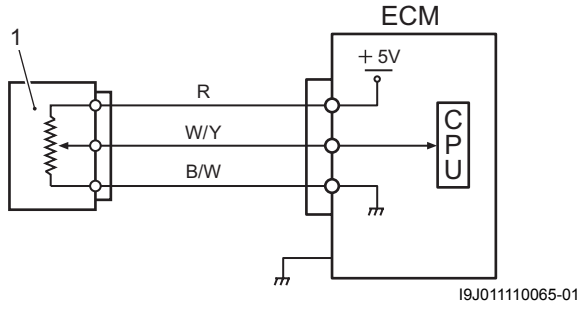
I9J011110064-01

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Self-Diagnostic Code “3 – 7” Trim Sensor

Z9J0111104017

Wiring Diagram



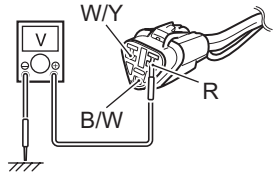
I9J011110065-01

1. Trim sensor

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect trim sensor connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of trim sensor connector. *Is the voltage approx. 4 – 5 V?*	Go to step 2.	• “R” wire open, “R” wire shorted to ground circuit or poor wire connection. • If the wire and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the trim sensor output voltage change. Refer to “Trim Sensor Inspection” in Section 1C (Page 1C-17). *Is it in good condition?*	Poor trim sensor connection, intermittent trouble or a faulty ECM.	• “R” wire shorted to “W/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “W/Y” wire connection, “W/Y” wire open or poor trim sensor connection. • If the wire and connection is OK, intermittent trouble or a faulty ECM may be the cause. • Faulty trim sensor.

For step 1



I9J011110066-01

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Troubleshooting Without Self-Diagnostic Code

Z9J0111104018

Before troubleshooting, make sure that there is not a self-diagnostic code indication.

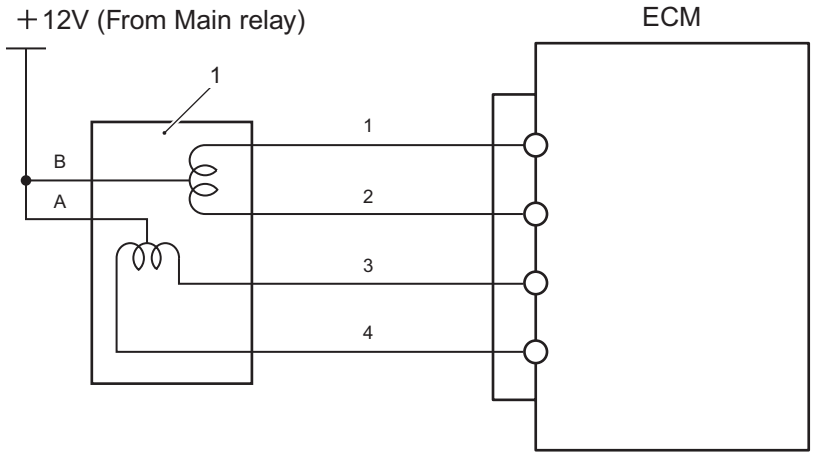
Condition	Possible cause	Correction / Reference Item
Unstable idling / trolling (or engine tends to stall)	Clogged MAP sensor vacuum passage.	*Check the vacuum passage.*
	Malfunctioning TPS.	*Check the TPS sensor.*
	Faulty IAC system.	*Check the IAC system.*
	Fuel pressure out of specification.	*Check the fuel pressure.*
	Faulty injector or its circuit.	*Check the injector and its circuit.*
	Poor performance of the IAT sensor, TPS or MAP sensor.	*Check each sensor.*
	Faulty ECM.	*Replace.*
	Faulty spark plug.	*Replace.*
	Faulty ignition coil or its circuit.	*Check the ignition coil and its circuit.*

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IAC System Troubleshooting

Z9J0111104019

Wiring Diagram



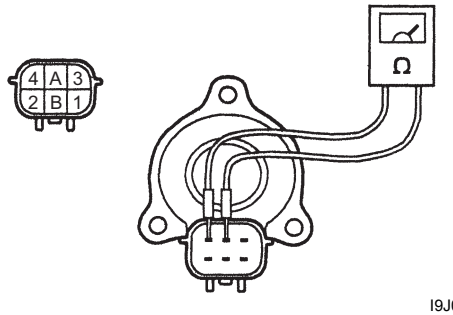
I9J011110036-02

1. IAC valve

Troubleshooting

Step	Action	Yes	No
1	1) Warm up the engine to normal operating temperature and keep it idling. 2) Using the SDS tool, check the IAC duty cycle and idle speed. **Idle speed (IAC duty cycle):** **550 – 650 r/min (approx. 0 – 30%)** *Is result OK?*	IAC system is in good condition.	Go to step 2.
2	1) Disconnect the IAC connector at the IAC valve with ignition switch “OFF”. 2) Check the resistance between following terminals. / IAC “1” terminal – “B” terminal / IAC “2” terminal – “B” terminal / IAC “3” terminal – “A” terminal / IAC “4” terminal – “A” terminal *Is the resistance 25 – 34 Ω for each test?*	Proceed to “Unstable Idling / Trolling” in “Troubleshooting Without Self-Diagnostic Code” (Page 1A-37) and check items except for “Faulty IAC System”.	• Faulty IAC valve. • Poor connection. • Open wire harness.

For step 2



I9J011110041-01

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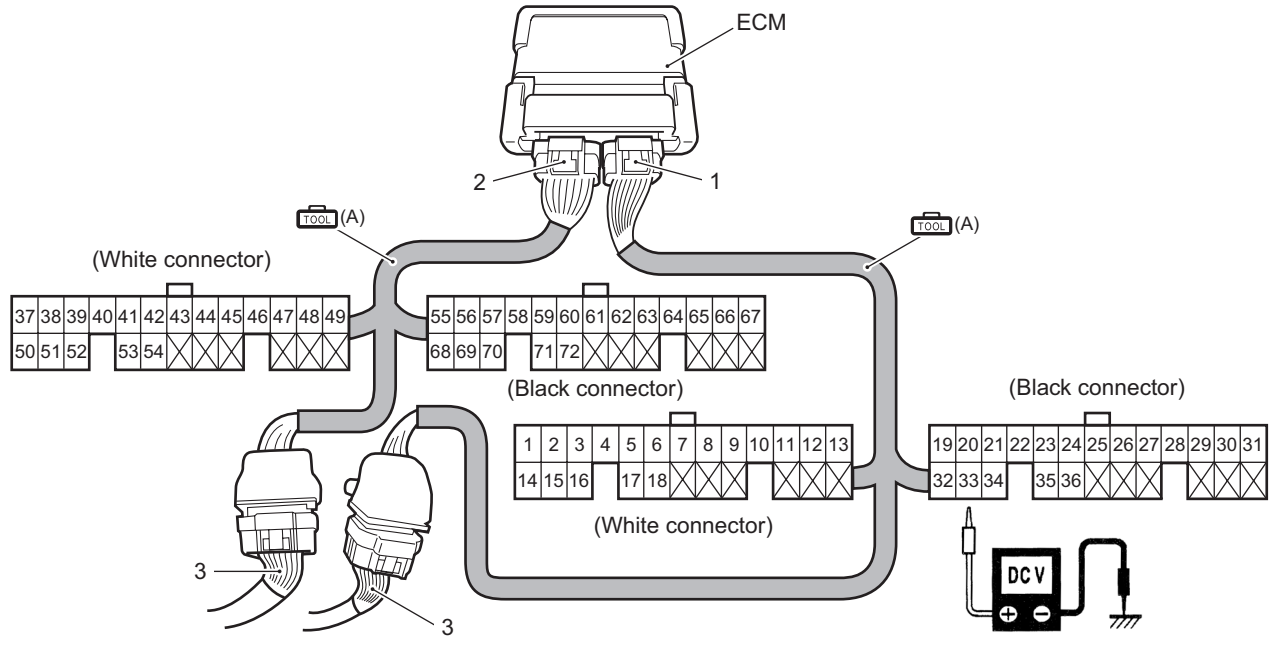
Service Instructions

How to Use the 36 Pin Test Cord Set

Z9J0111106001

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

Special tool
TOOL (A): 09930–88730 (36-pin test cord set)



I9J011110037-02

1. Black connector side	2. Gray connector side	3. Wire harness

Inspection of the ECM and Its Circuit

Z9J0111106002

CAUTION

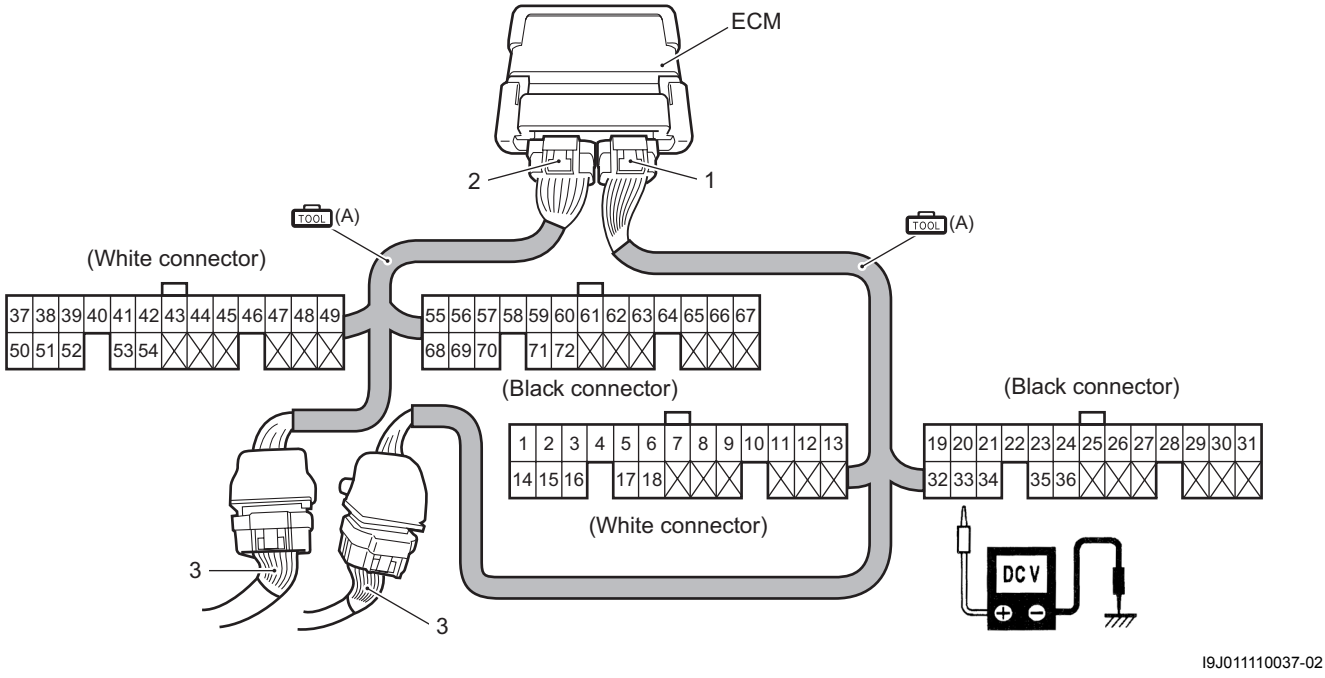
The ECM cannot be bench checked. It is strictly prohibited to connect any tester (voltmeter or ohmmeter) to an ECM which has been disconnected from the engine wiring harness.

Special tool
TOOL : 09930–88730 (36-pin test cord set)
TOOL : 09930–99320 (Digital tester)

Tester knob indication
Voltage (⎓)

1) Turn the ignition switch “OFF”.
2) Pull and remove the fuse box from electric parts holder.
3) Connect the 36-pin test cord set between the ECM and wire harness as shown in figure.
4) Turn the ignition switch “ON”.
5) Connect the tester probe (“–”, Black) to body ground, and measure the voltage according to the “Circuit Voltage Table” (Page 1A-40).

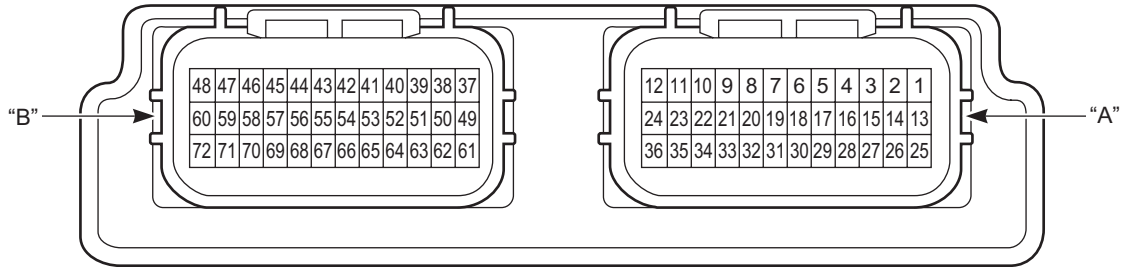
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I9J011110037-02

1. Black connector side	2. Gray connector side	3. Wire harness

Circuit Voltage Table



I9J011110017-02

"A": Black connector	"B": Gray connector

Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
1	—	—	—	—
2	G	Starter relay control	Approx. 0.5 V	Ignition switch ON, Cranking.
			Approx. 12 V	Ignition switch ON, Normal.
3	P/W	PTT relay DN	Approx. 0 V	PTT switch DN, free.
			Approx. 12 V	PTT switch DN, Push.
4	—	—	—	—
5	Bl/B	Water pressure sensor	0.5 – 4.5 V	Ignition switch ON.
6	Br/Y	Throttle position sensor	Approx. 3.8 V	Ignition switch ON, Throttle WOT.
			Approx. 0.7 V	Ignition switch ON, Throttle FCT.
7	W/Y	Trim and Tilt sensor	Approx. 0.9 – 4.0 V	Ignition switch ON.
8	Lg/B	IAT sensor	0.04 – 4.46 V	Ignition switch ON.
9	Bl/W	Speedo sensor	0.5 – 4.5 V	Ignition switch ON.
10	R/W	Power source #2 for sensor	Approx. 5 V	Ignition switch ON.
11	Bl	Oil pressure switch	Approx. 5 V	While engine running.
			Approx. 0 V	Engine stopped (Ignition switch ON.)
12	Gr	ECM power source	Approx. 12 V	Ignition switch ON.
13	—	—	—	—
14	—	—	—	—
15	B/G	Ignition switch key	Approx. 12 V	Ignition switch ON.

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Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
16	Bl/R	Emergency stop switch	Approx. 5 V	Ignition switch ON, Stop switch plate IN.
			Approx. 0 V	Ignition switch ON, Stop switch plate OUT.
17	—	—	—	—
18	—	—	—	—
19	—	—	—	—
20	Lg/W	Cylinder temp. sensor	0.14 – 4.75 V	Ignition switch ON.
21	P/Bl	Shift position sensor	Approx. 2.5 V	Ignition switch ON, shift in Neutral.
			Approx. 3.7 V	Ignition switch ON, shift in Forward.
			Approx. 1.2 V	Ignition switch ON, shift in Reverse.
22	P	PTT switch DOWN	Approx. 12 V	Ignition switch ON, PTT DN switch ON.
			Approx. 0 V	Ignition switch ON, PTT DN switch OFF.
23	Lbl	PTT switch UP	Approx. 12 V	Ignition switch ON, PTT UP switch ON.
			Approx. 0 V	Ignition switch ON, PTT UP switch OFF.
24	B	Ground for ECM	—	—
25	B/W	Ground for sensor	—	—
26	—	—	—	—
27	Lg/W	PTT relay UP	Approx. 0 V	PTT switch UP free.
			Approx. 12 V	PTT switch UP Push.
28	—	—	—	—
29	—	—	—	—
30	—	—	—	—
31	V/W	Ex-manifold temp. sensor	0.14 – 4.75 V	Ignition switch ON.
32	W	MAP sensor	0.79 – 4.2 V	Ignition switch ON.
33	R	Power source #1 for sensor	Approx. 5 V	Ignition switch ON.
34	—	—	—	—
35	R/B	Ground for ECM main relay	Approx. 12 V	Ignition switch OFF.
			Approx. 0.5 V	• Ignition switch ON. • Engine cranking.
36	B/Bl	Ignition switch	Approx. 12 V	Ignition switch ON.
37	—	—	—	—
38	Y	PC communication line (B)	—	—
39	—	—	—	—
40	Y/Bl	CMP sensor	Approx. 0.3 V or 5 V	Ignition switch ON.
41	Gr/Y	No.3 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
42	O	No.1 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
43	W/Y	Trim gauge	—	—
44	Bl/W	Buzzer	—	—
45	O/B	No.1 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
46	—	—	—	—
47	R/W	No.3 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
48	W/Bl	IAC valve #4	Approx. 12 V or 0 V	Ignition switch ON.
49	Y/G	Neutral switch	Approx. 12 V	Ignition switch ON, Shift into Neutral.
			Approx. 0 V	Ignition switch ON, Shift into Forward or Reverse.
50	R/B	CKP sensor	—	—
51	B	Ground for ECM power	—	—
52	—	—	—	—
53	Lg/R	No.4 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
54	Bl	No.2 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
55	P/W	REV-LIMIT lamp	—	—
56	Y/B	Tachometer	—	—
57	G/Y	TEMP lamp	—	—
58	R/G	IAC valve #3	Approx. 12 V or 0 V	Ignition switch ON.
59	Lg	No.4 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
60	W/B	IAC valve #1	Approx. 12 V or 0 V	Ignition switch ON.
61	—	—	—	—
62	O/Y	PC communication line (A)	—	—
63	B	Ground for power	—	—

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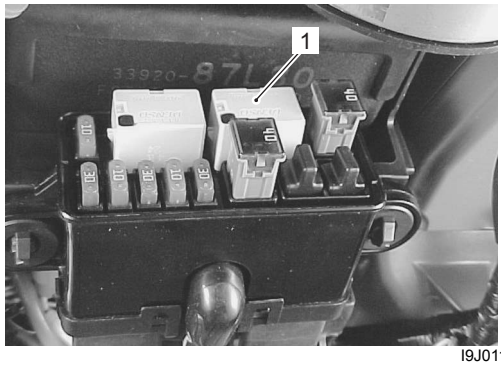
Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
64	O/W	Buzzer cancel	Approx. 12 V	Ignition switch ON. Key pushed in.
			Approx. 0 V	Ignition switch ON. Key not pushed in.
65	Br	Starter switch	Approx. 2.5 V	Ignition switch ON.
			Approx. 12 V	Ignition switch START position.
66	Bl/B	OIL lamp	—	—
67	—	—	—	—
68	—	—	—	—
69	G/W	CHECK ENGINE lamp	—	—
70	R/Y	IAC Valve #2	Approx. 12 V or 0 V	Ignition switch ON.
71	B/Br	No.2 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
72	B/R	High pressure fuel pump (–)	Approx. 0 V	• Stop switch plate IN, Shift into NEUTRAL. For 3 sec after ignition switch ON. • While engine running.
			Approx. 12 V	Engine stopped. Ignition switch ON. Stop switch plate IN, Shift into NEUTRAL.

ECM Main Relay Inspection

Z9J0111106003

Inspect the ECM main relay using the following procedures:

1) Disconnect the ECM main relay from the fuse box.



I9J011110054-02

1. ECM main relay

2) Check continuity between terminal (2) and (3) each time 12 V power supply is applied to terminal (4) and (5).
Connect the positive (+) lead to terminal (5), and negative (–) lead to terminal (4).

CAUTION

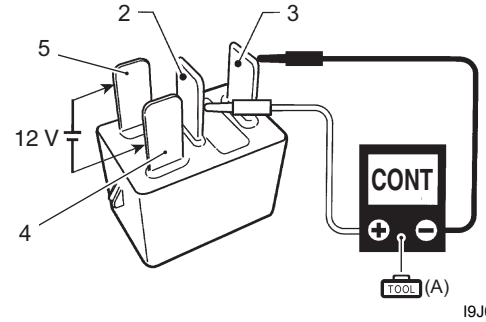
Be careful not to touch 12 V power supply wires to each other or with other terminals.

Special tool
TOOL (A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•)))

ECM main relay function

	Continuity
12 V power applied	**Yes**
12 V power not applied	**No**

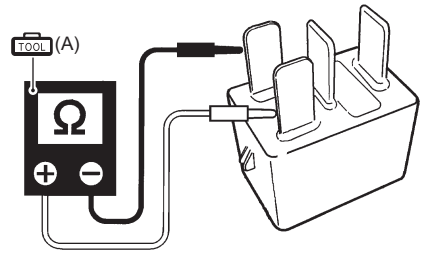


I9J011110038-02

3) Measure the resistance between relay terminals (4) and (5).
If out of specification, replace ECM main relay.

Tester knob indication
Resistance (Ω)

ECM Main relay solenoid coil resistance
Standard: 145 – 190 Ω



I9J011110039-01

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Engine Electrical Devices

Precautions

Precaution for Engine Electrical Device

Z9J0111300001

Refer to “General Precautions” in Section 00 (Page 00-1) and “Precautions on Engine Diagnosis” in Section 1A (Page 1A-1).

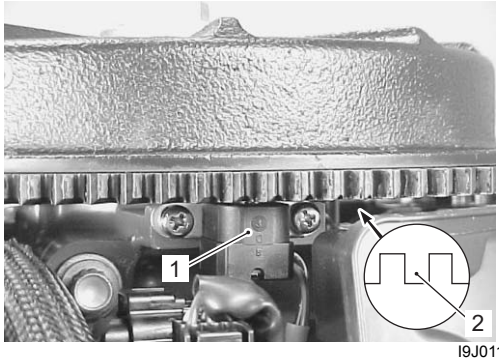
General Description

Sensor and Switch Description

Z9J0111301001

CKP Sensor

- There is one 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 32 reluctor bars. They are located 10 degrees apart, except at two positions where they are 30 degrees apart.
  During one crankshaft rotation, 32 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.



I9J011130026-01

1. CKP sensor	2. Reluctor bar

CMP Sensor

- The CMP sensor is mounted on the cylinder head cover and the trigger vanes are pressed onto the end of the exhaust camshaft.
  This sensor is used to detect piston position.
- Signals received from this sensor are also used by the ECM to determine sequential fuel injection and ignition control.
- The 12 V power to the CMP sensor is supplied through the Ign (Gr) line of the ignition switch.

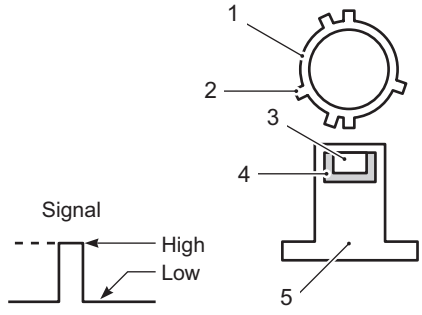


I9J011130027-01

1. CMP sensor

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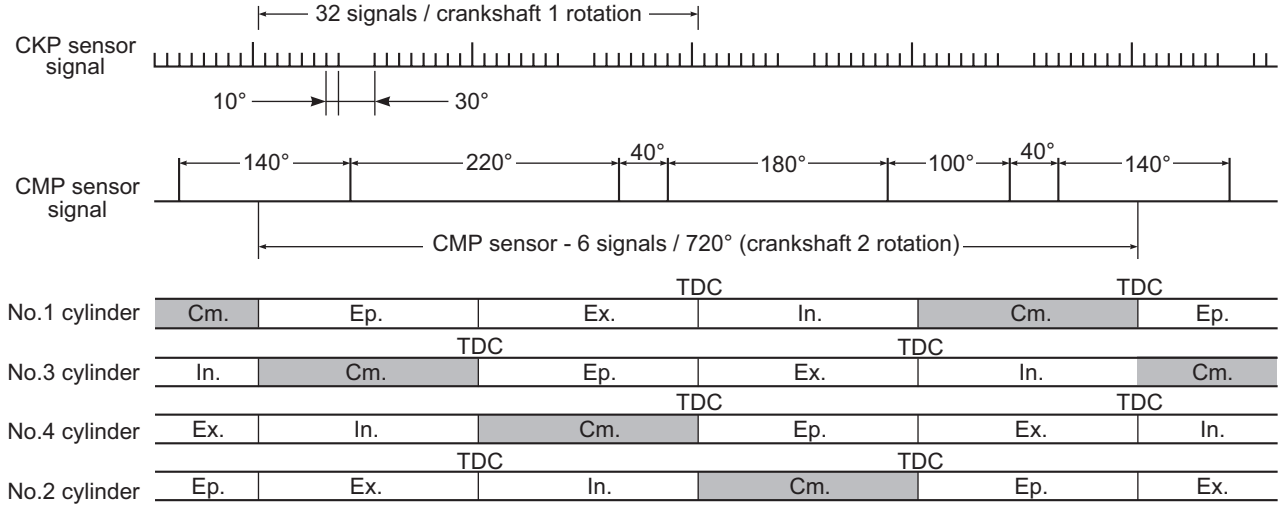
- The CMP sensor is a GMR (Giant Magnet Resistive) semiconductor type sensor.
  The GMR semiconductor has the property of varying the electrical resistance depending on the intensity of the magnetic force applied.
  When the line of magnetic force from the magnet to the GMR semiconductor is increased or decreased, the electrical resistance of the GMR semiconductor will change. The changes in resistance as the magnets pass create the sensors waveform.
  When a trigger vane on the camshaft reluctor aligns with the sensors internal magnet, the electrical resistance of the GMR will decrease.
  When a trigger vane moves away from the sensor, the electrical resistance of the GMR will increase.
  When the GMR semiconductor voltage becomes higher than the standard value, the sensors signal will be lower. And when the voltage becomes lower than the standard value, the sensors signal will be higher.
  The six camshaft trigger vanes provide six high voltage signals from the CMP sensor to the ECM during one camshaft rotation (two rotations of crankshaft).



I9J011130001-01

1. Camshaft	4. Magnet
2. Trigger vane	5. CMP sensor
3. Magnet resistive semiconductor	

- **Failure symptom:**
  Without the CMP sensor signal input, the ECM does not output the ignition and fuel injection signals.
- **ECM cylinder identification:**
  The cylinders are identified by a calculation of two signals; one from the CKP sensor and one from the CMP sensor.
  The ECM measures the time interval of the signals inputted from the CKP sensor.
  When the ECM detects a signal interval that is longer than normal, it determines that the wide space between the reluctor bars (30 degree spaced apart section) has passed through the CKP sensor.
  The ECM identifies the cylinder by the number of CMP sensor signal inputs and the input timing (pattern) within the gap of the widely spaced reluctors that have passed the CKP sensor. There are 2 CMP sensor signal inputs to the ECM when the #1 or #4 cylinders are on the compression stroke, but the input timing (pattern) is different.
  Thus the cylinder identification is established.
  When a compression stroke takes place either in the #2 or the #3 cylinder, the number of CMP sensor signal inputs is 1. Likewise, the cylinder identification is established by the CMP sensor input timing (pattern).



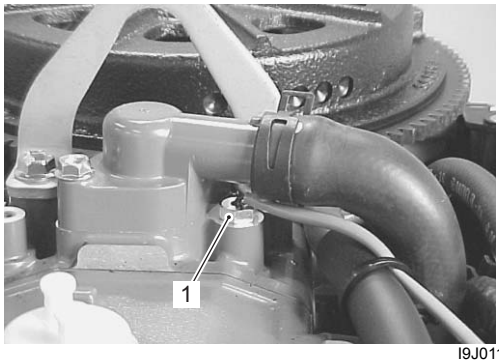
Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake

I9J011130002-04

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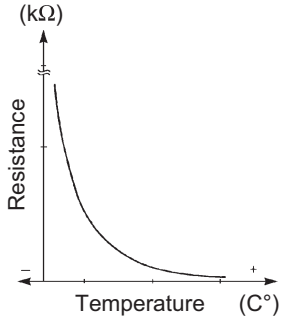
Cylinder Temperature Sensor

The cylinder temperature sensor is installed on the cylinder (top side) and is 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 duration, ignition timing, etc.
This sensor is also used to detect engine over-heat as the ECM detects both the temperature and temperature change rate (gradient temp.-temperature rise vs. time).



I9J011130028-01

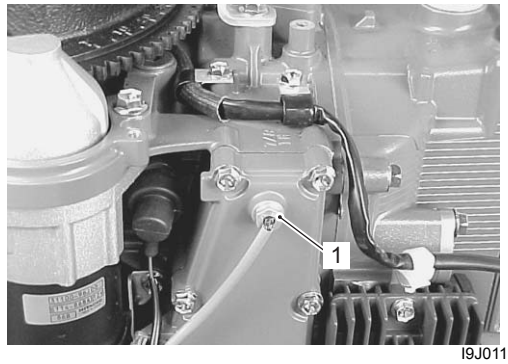
1. Cylinder temp. sensor



I9J011130003-02

Exhaust Manifold Temperature Sensor

The exhaust manifold temperature sensor is installed on the exhaust manifold 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.

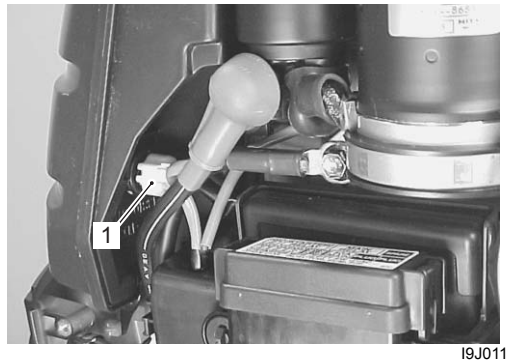


I9J011130029-01

1. Exhaust manifold temp. sensor

IAT Sensor

The IAT sensor is installed on the air intake silencer case and is 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 duration.



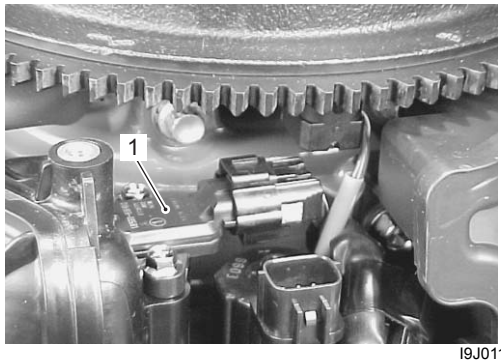
I9J011130030-01

1. IAT sensor

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MAP Sensor

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



I9J011130031-01

1. MAP sensor

Throttle Position Sensor (TPS)

The TPS is installed on the throttle body and detects the degree of throttle opening. The throttle shaft is interlocked with the TPS shaft.
This sensor is a variable resistor, changing resistance (Ohms) in accordance with the throttle opening.
The varying resistance value is converted to voltage and input to the ECM.
Based on the TPS voltage, the ECM calculates the idle and throttle opening positions to determine the control modes of the various controls systems (Idle air control, fuel injection control system, etc.).



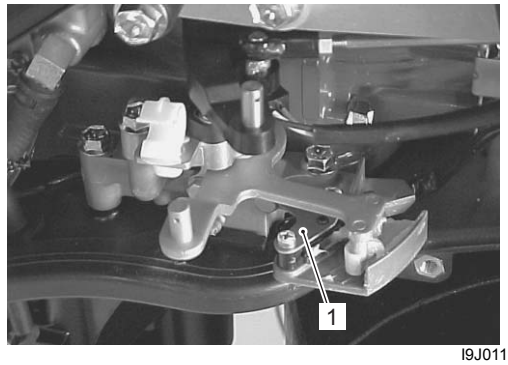
I9J011130032-01

1. TPS

Neutral Switch

The neutral switch is installed on the clutch lever holder and is used to detect the shift position.
This switch is “ON” in neutral and “OFF” in forward or reverse.
The ECM performs the following control based on the neutral switch signal:

- When the shift lever is in forward or reverse at the time of engine start, the ECM will not supply power to the starter motor relay, thus preventing starter motor engagement.
  (Start-in-gear protection. Refer to “Start-In-Gear Protection System Description” in Section 1I (Page 1I-2).)



I9J011130033-01

1. Neutral switch

Shift Position Sensor (SPS)

The SPS is installed on the clutch lever holder and detects the shift position. The clutch lever is interlocked with the SPS shaft.
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, the ECM determines the shift position and executes the following controls.

- When the shift lever is in neutral, fuel injection is controlled to prevent engine speed from exceeding 3 000 r/min.
- After shifting into forward or reverse from neutral, the IAC valve is controlled to increase intake air to prevent unstable engine idle or stalling.



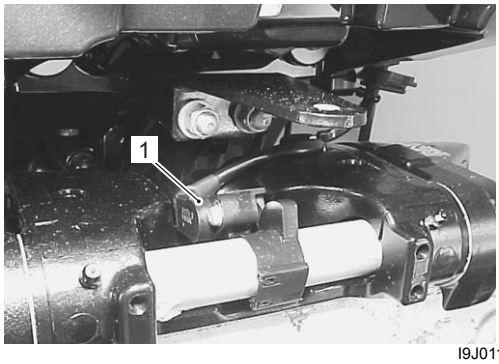
I9J011130034-01

1. SPS

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Trim Sensor

The trim sensor is variable resistor type.
With the sensor signal received, the ECM performs the learning of the trim/tilt position and it controls the position of both the trim down limit and the tilt up limit.
The trim sensor signal also operates the trim meter through the ECM.



I9J011130035-01

1. Trim sensor

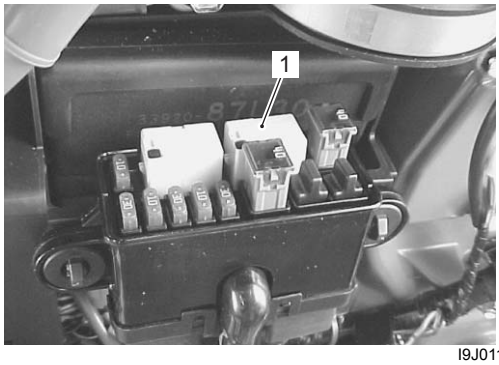
- **Failure symptom:**
  In the event of sensor failure:
  - The ECM performs the control on the assumption that the sensor output is 3.9 V.
  - The control of the trim down limit and the tilt up limit becomes inoperative.
  - The trim gauge indicates a full trim position.

NOTE

When the ECM has been replaced, the trim sensor removed/reinstalled, or the mid unit overhauled, resetting of both the tilt up limit and trim down limit must be performed.

ECM Main Relay

The ECM main relay is installed in the fuse box.
When energized by turning the ignition switch “ON”, battery voltage is supplied to the ECM, fuel injector, ignition coil, IAC valve and high pressure fuel pump.
With the ignition switch in the “OFF” position, and the UP or DOWN button of the PTT switch pressed, the main relay turns “ON” to supply 12 V power to the ECM, which then performs the on / off control of the PTT motor relay.

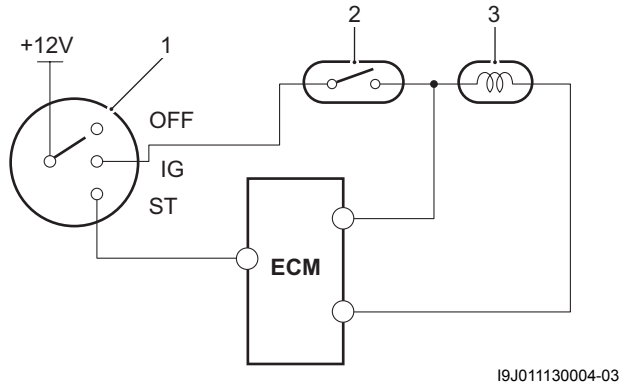


I9J011130036-02

1. ECM main relay

Cranking Switch Signal

The ECM detects if the engine is being started by the position of ignition switch. When the ignition key is turned to ST position, a voltage (12 V) signal is input to the ECM.
The ECM in turn sets the ignition, fuel injection, IAC, etc. to the starting mode.
When the key is turned to the IG position, after the engine has been started, the input voltage becomes approx. 2.5 V.

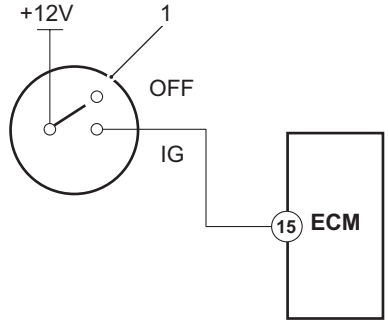


I9J011130004-03

1. Ignition switch	3. Starter motor relay
2. Neutral switch	

Ignition switch Signal

The ECM receives a power signal when the ignition switch is turned “ON”, then sets the IAC valve to the standard starting position.



I9J011130037-01

1. Ignition switch

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ECM Power Source Line

Z9J0111301002

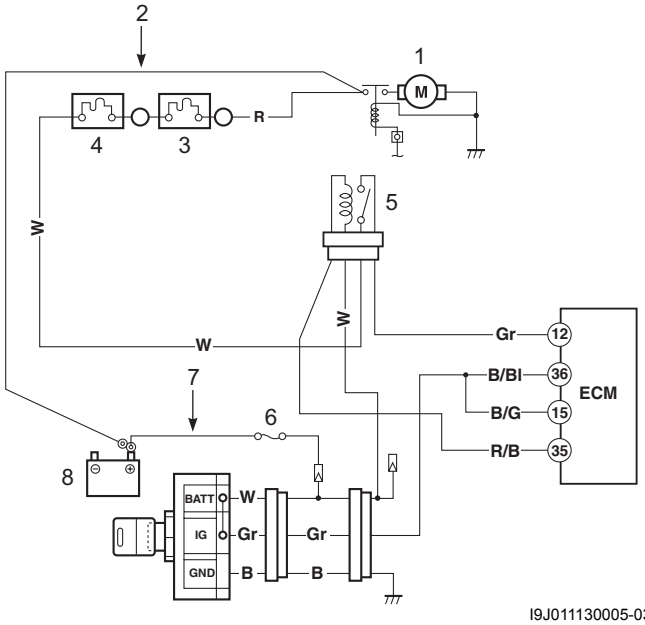
The ECM is battery dependent and must be provided with its own dedicated 12 V power supply. The electrical circuits which provide this supply are:

1. The sub battery cable to the white lead wire in the remote control extension harness to the ignition switch.
   When the ignition switch is turned “ON”, battery power passes from the white lead wire, through the ignition switch contacts to the gray output lead wire to the No. 15 and 36 terminals of the ECM.

   NOTE

   Ensure that the battery cable connections are clean and secure.
   A failure at the battery connection will cause incorrect operation of the ECM and starter motor cranking system.

2. The engine wiring harness to the main relay.
   When the ECM main relay is energized, by turning the ignition switch “ON”, battery voltage is supplied to the No. 12 terminal of the ECM.



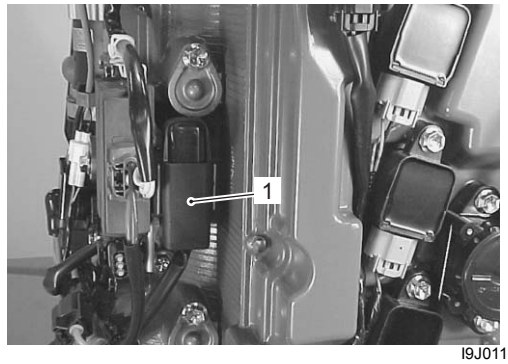
I9J011130005-03

1. Starter motor	5. ECM main relay
2. Main battery cable	6. 15 amp. fuse
3. 40 amp. fuse	7. Sub-battery cable
4. 30 amp. fuse	8. Battery

Main Harness Capacitor

This capacitor stabilizes the voltage in the engine control system circuit.

- If a “short” occurs in this circuit, the sub battery cable fuse will blow causing the engine control system to be inoperative.
- If an “open” occurs in this circuit, the cranking system will not function.



I9J011130038-01

1. Main harness capacitor

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Component Location

Location of Sensor and Switch

Z9J0111303001

Refer to “Engine Control System Components / Engine Electrical Device Location” in Section 1A (Page 1A-15).

Service Instructions

Resistance Check

Z9J0111306001

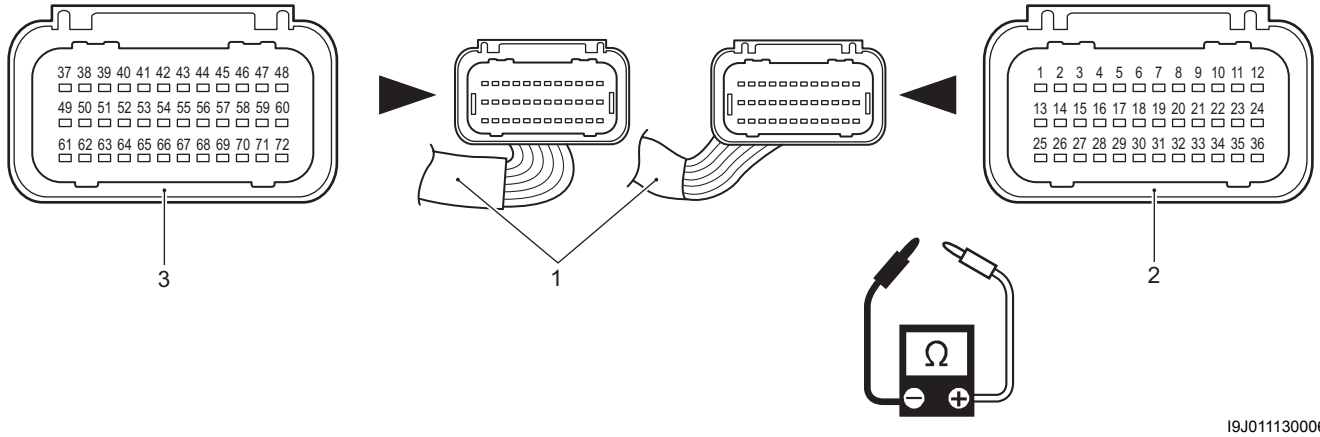
Special tool
(TOOL) : 09930–99320 (Digital tester)

Tester knob indication
Resistance (Ω)

NOTE

Make sure ignition switch is always OFF when measuring resistance.

1) Turn ignition 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” (Page 1C-7).



I9J011130006-04

1. Engine main wire harness	2. Black connector	3. Gray connector

Resistance Table

Circuit	Terminal for Tester Probe Connection	Standard Resistance (at 20 °C)
CKP sensor	50 (R/B) to 25 (B/W)	168 – 252 Ω
Fuel injector No. 1	45 (O/B) to 12 (Gr)	10 – 14 Ω
Fuel injector No. 2	71 (B/Br) to 12 (Gr)	
Fuel injector No. 3	47 (R/W) to 12 (Gr)	
Fuel injector No. 4	59 (Lg) to 12 (Gr)	
IAC Valve #1	60 (W/B) to 12 (Gr)	25 – 34 Ω (Including IAC fuse 10 amp resistance)
IAC Valve #2	70 (R/Y) to 12 (Gr)	
IAC Valve #3	58 (R/G) to 12 (Gr)	
IAC Valve #4	48 (W/Bl) to 12 (Gr)	
IAT sensor	8 (Lg/B) to 25 (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	20 (Lg/W) to 25 (B/W)	
Ex-manifold temperature sensor	31 (V/W) to 25 (B/W)	

http://SelfFixer.com

Cylinder Temp. Sensor Removal and Installation

Z9J0111306002

Removal

1) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
2) Remove the thermostat cover.
   Refer to “Thermostat Removal and Installation” in Section 1F (Page 1F-3).
3) Disconnect the cylinder temp. sensor lead wire connector.
   Loosen and remove the cylinder temp. sensor (1).



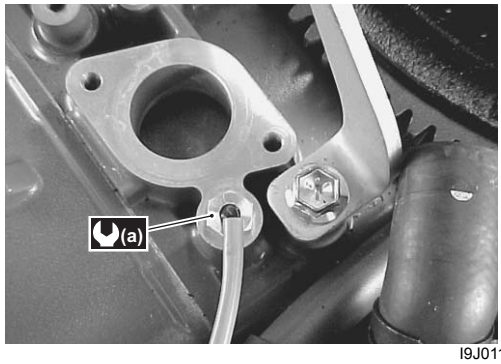
I9J011130039-01

Installation

Installation is reverse order of removal.

- Clean mating surface of sensor and cylinder.
- Tighten sensor to specified torque.

Tightening torque
Cylinder temp. sensor (a): 8 N·m (0.8 kgf-m, 5.8 lbf-ft)



I9J011130040-01

- Connect connector to sensor securely.
- Check to ensure that all removed parts are back in original position.
- Check wire routing.
  Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).

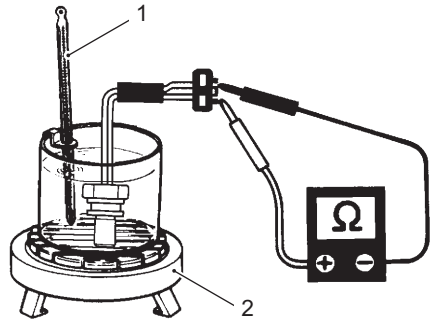
Cylinder Temp. Sensor Inspection

Z9J0111306003

1) Remove the cylinder temperature sensor.
   Refer to “Cylinder Temp. Sensor Removal and Installation” (Page 1C-8).
2) Immerse temperature sensing part of cylinder temp. sensor in water.
3) Measure resistance between sensor terminals while heating water gradually.
4) If measured resistance does not change in the proportion indicated, replace sensor.

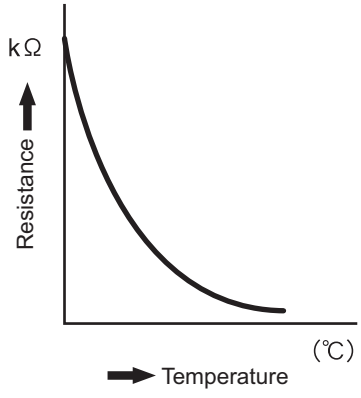
Cylinder temp. sensor specification

Water temperature: °C (°F)	0 (32)	25 (77)	50 (122)	75 (135)
Resistance (kΩ)	5.3 – 6.6	1.8 – 2.3	0.73 – 0.96	0.33 – 0.45



I9J011130051-01

1. Thermometer	2. Heater



I9J011130008-02

5) Reinstall the cylinder temp. sensor.
   Refer to “Cylinder Temp. Sensor Removal and Installation” (Page 1C-8).

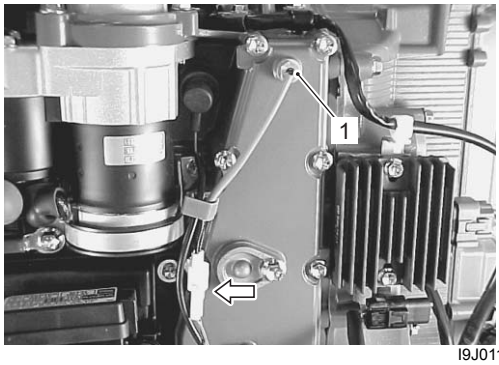
http://SelfFixer.com

Ex. Manifold Temp. Sensor Removal and Installation

Z9J0111306004

Removal

1) Disconnect the Ex. manifold temp. sensor lead wire connector.
2) Loosen and remove the Ex. manifold temp. sensor (1).



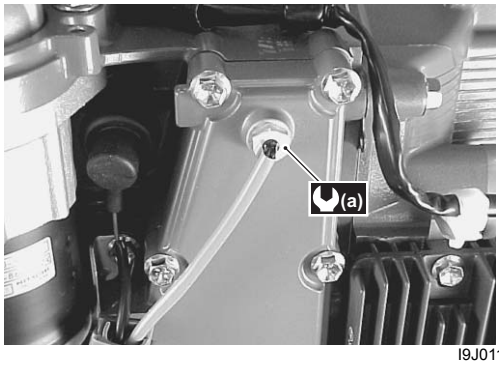
I9J011130041-01

Installation

Installation is reverse order of removal.

- Clean mating surface of sensor and exhaust cover.
- Tighten sensor to specified torque.

Tightening torque
Ex. manifold temp. sensor (a): 8 N·m (0.8 kgf-m, 5.8 lbf-ft)



I9J011130042-01

- Connect connector to sensor securely.

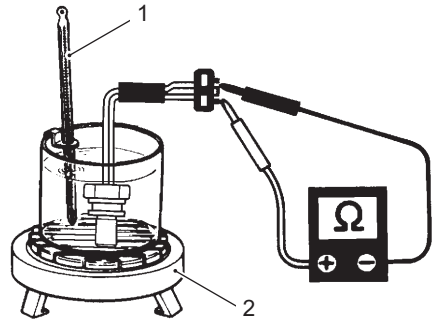
Ex. Manifold Temp. Sensor Inspection

Z9J0111306005

1) Remove the Ex. manifold temp. sensor.
Refer to “Ex. Manifold Temp. Sensor Removal and Installation” (Page 1C-9).
2) Immerse temperature sensing part of Ex. manifold temp. sensor in water.
3) Measure resistance between sensor terminals while heating water gradually.
4) If measured resistance does not change in the proportion indicated, replace sensor.

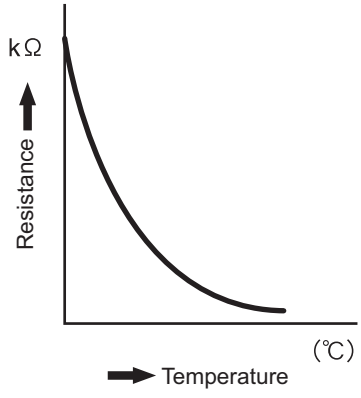
Ex. manifold temp. sensor specification

Water temperature: °C (°F)	0 (32)	25 (77)	50 (122)	75 (135)
Resistance (kΩ)	5.3 – 6.6	1.8 – 2.3	0.73 – 0.96	0.33 – 0.45



I9J011130051-01

1. Thermometer	2. Heater



I9J011130008-02

5) Reinstall the Ex. manifold temp. sensor.
Refer to “Ex. Manifold Temp. Sensor Removal and Installation” (Page 1C-9).

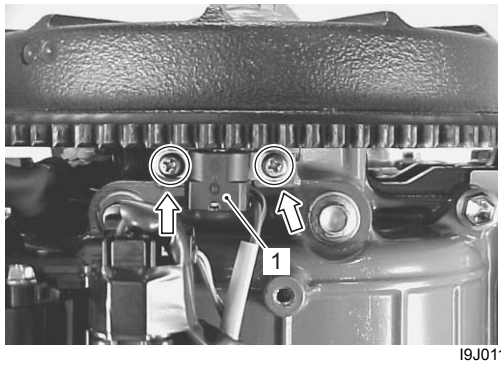
http://SelfFixer.com

CKP Sensor Removal and Installation

Z9J0111306006

Removal

1) Remove the ring gear cover and air intake silencer case.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2) and “Air Intake Silencer Case Removal and Installation” in Section 1D (Page 1D-5).
2) Disconnect the CKP sensor lead wire connector.
3) Remove the two screws and CKP sensor (1).



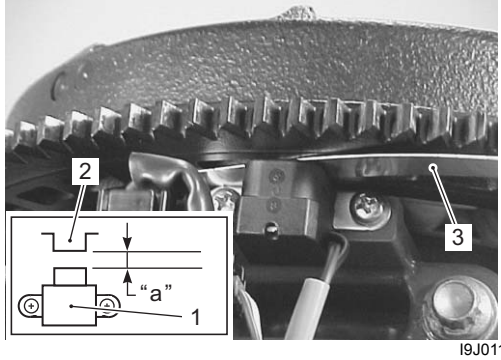
I9J011130043-01

Installation

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

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

  CKP sensor air gap “a”
  0.75 mm (0.030 in.)



I9J011130044-01

1. CKP sensor	3. Thickness gauge
2. Reluctor bar	

- Check to ensure that all removed parts are back in original position.
- Check wire routing.
  Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).

CKP Sensor Inspection

Z9J0111306007

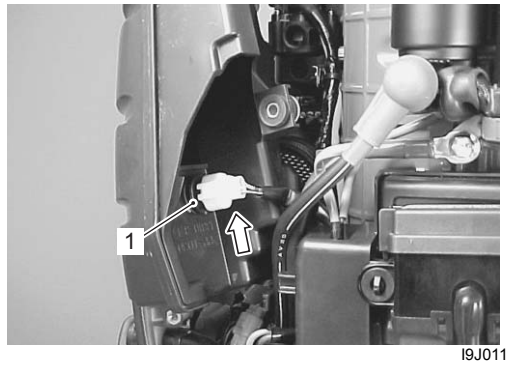
Inspect the CKP sensor.
Refer to “Resistance Check” (Page 1C-7).

IAT Sensor Removal and Installation

Z9J0111306008

Removal

1) Remove the ring gear cover and air intake silencer case.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2) and “Air Intake Silencer Case Removal and Installation” in Section 1D (Page 1D-5).
2) Disconnect the IAT sensor lead wire connector.
3) Remove IAT sensor (1).



I9J011130045-01

Installation

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

- Check to ensure that all removed parts are back in original position.
- Check wire routing.
  Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).

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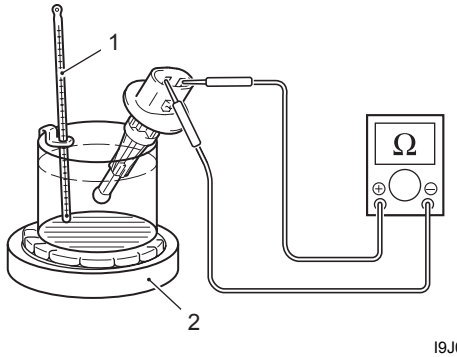
IAT Sensor Inspection

Z9J0111306009

1) Remove the IAT sensor.
   Refer to "IAT Sensor Removal and Installation" (Page 1C-10).
2) Immerse temperature sensing part of IAT sensor in water.
3) Measure resistance between sensor terminals while heating water gradually.
4) If measured resistance does not change in the proportion indicated, replace sensor.

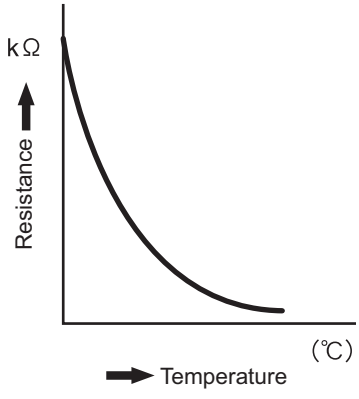
IAT sensor specification

Water temperature: °C (°F)	0 (32)	25 (77)	50 (122)	75 (135)
Resistance (kΩ)	5.3 – 6.6	1.8 – 2.3	0.73 – 0.96	0.33 – 0.45



I9J011130007-03

1. Thermometer	2. Heater



I9J011130008-02

5) Reinstall the IAT sensor.
   Refer to "IAT Sensor Removal and Installation" (Page 1C-10).

CMP Sensor Removal and Installation

Z9J0111306010

Removal

1) Disconnect the CMP sensor lead wire connector at sensor.
2) Remove the bolt and CMP sensor (1).



I9J011130046-01

Installation

Installation is reverse order of removal.

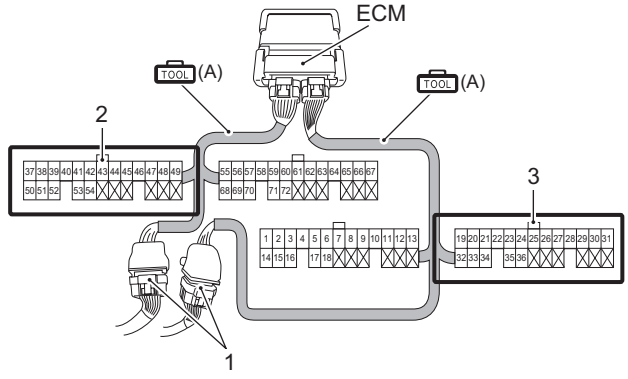
- Install CMP sensor, then tighten mounting screw securely.
- Connect sensor lead wire connector to CMP sensor.

CMP Sensor Inspection

Z9J0111306011

1) Turn ignition switch OFF.
2) Remove the bolt and CMP sensor.
3) Connect the 36-pin test cord set between ECM and wire harness as shown in figure.

Special tool
TOOL (A): 09930–88730 (36-pin test cord set)



I9J011130052-02

1. Wire harness	3. Black connector
2. White connector	

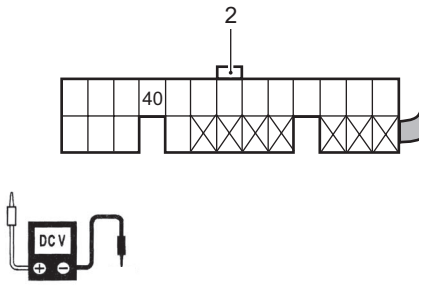
4) Connect the tester probe ("+", Red) to No. 40 terminal.
5) Connect the tester probe ("–", Black) to No. 25 terminal (or to body ground).

Special tool
TOOL : 09930–99320 (Digital tester)

http://SelfFixer.com

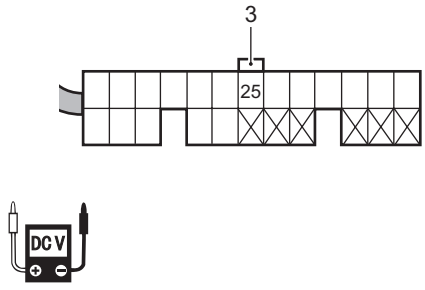
Tester knob indication
DC Voltage (⎓)

36-pin test cord (White connector)



I9J011130011-03

36-pin test cord (Black connector)

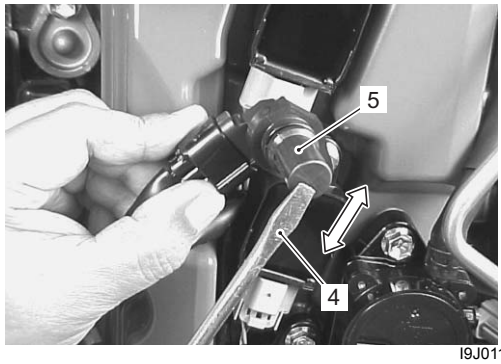


I9J011130012-02

6) Turn Ignition 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. 5.0 V

When screwdriver is pulled away
Approx. 0.3 V



I9J011130013-03

4. Screw driver	5. CMP sensor

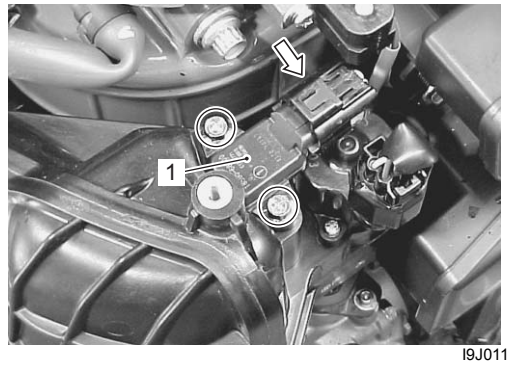
8) If the voltage does not change in the above test, check wire harnesses for open and short.
If wire harnesses are in good condition, replace CMP sensor and recheck.
9) Reinstall CMP sensor.

MAP Sensor Removal and Installation

Z9J0111306012

Removal

1) Remove the flywheel.
Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).
2) Disconnect lead wire connector at MAP sensor.
3) Remove the two screws and MAP sensor (1).



I9J011130047-01

Installation

Installation is reverse order of removal.

- Install MAP sensor, then tighten mounting screw securely.
- Connect sensor lead wire connector to MAP sensor.
- Install flywheel and tighten flywheel bolts to specified torque.
Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).

Tightening torque
Flywheel bolt: 196 N·m (19.7 kgf-m, 142 lbf-ft)

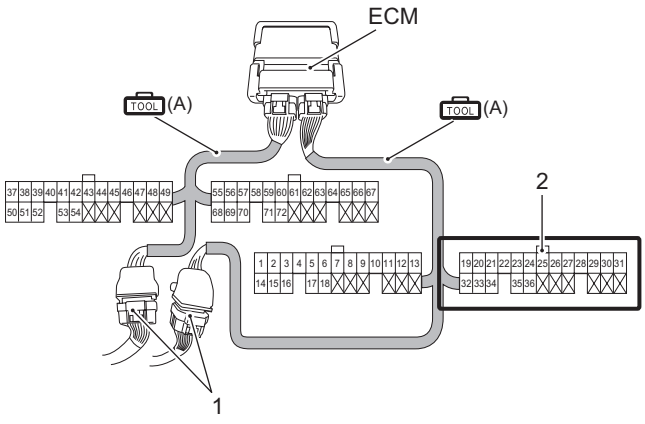
http://SelfFixer.com

MAP Sensor Output Voltage Inspection

Z9J0111306013

1) Remove the flywheel.
   Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).
2) Connect the 36-pin test cord set between ECM and wire harness as shown in figure.

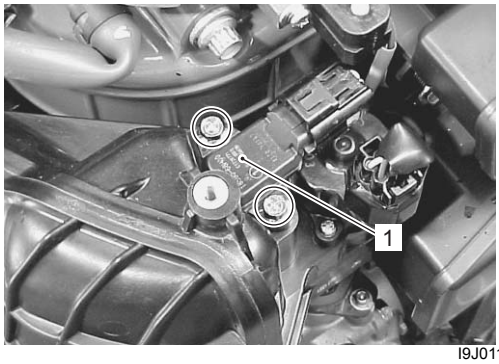
Special tool
TOOL (A): 09930–88730 (36-pin test cord set)



I9J011130048-02

1. Wire harness	2. Black connector

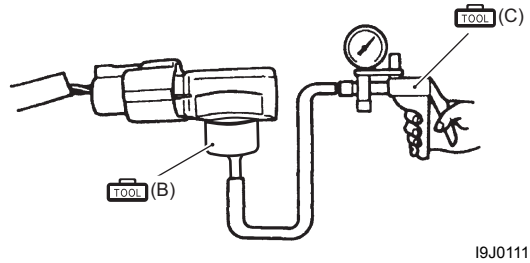
3) Remove the screws and MAP sensor (1) from intake manifold.



I9J011130014-02

4) Install MAP sensor into special tool.
5) Connect vacuum pump gauge (with hose) to MAP sensor (special tool) as shown in figure.

Special tool
TOOL (B): 09917–49610 (Vacuum pump adapter)
TOOL (C): 09917–47011 (Vacuum pump gauge)



I9J011130015-01

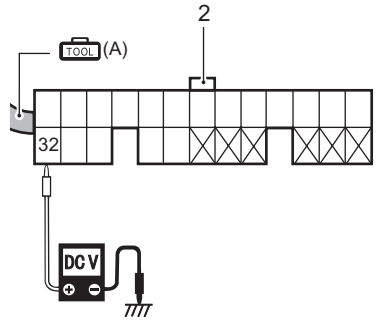
6) Turn ignition switch ON.
7) While applying negative pressure (vacuum) to MAP sensor, measure “32” terminal voltage.

MAP sensor output voltage change

Negative pressure: kPa (kg/cm², mmHg)	0 (0, 0)	40 (0.4, 300)	80 (0.8, 600)
“32” terminal voltage (V)	4.00	2.42	0.84

(at 759.8 mmHg, 101.3 kPa, 29.91 inHg barometric pressure.)

36-pin test cord (Black connector)



I9J011130016-02

Special tool
TOOL : 09930–99320 (Digital tester)

Tester knob indication
DC Voltage (⎓)

8) If out of specification, Check wire harnesses for open and short. If wire harnesses are in good condition, replace MAP sensor and recheck.
9) Reinstall MAP sensor.
   Refer to “MAP Sensor Removal and Installation” (Page 1C-12).

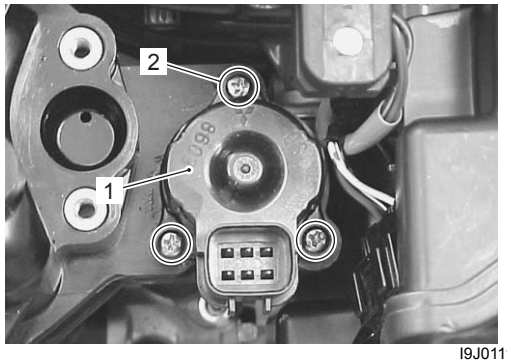
http://SelfFixer.com

IAC Valve Removal and Installation

Z9J0111306014

Removal

1) Remove the flywheel.
   Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).
2) Disconnect IAC valve lead wire connector at IAC valve (1).
3) Remove the MAP sensor.
   Refer to “MAP Sensor Removal and Installation” (Page 1C-12).
4) Remove screws (2) and IAC valve.



I9J011130049-02

Installation

Installation is reverse order of removal.

- Install IAC valve, then tighten mounting screw securely.
- Connect IAC valve lead wire connector to IAC valve.
- Install the MAP sensor.
  Refer to “MAP Sensor Removal and Installation” (Page 1C-12).
- Install flywheel and tighten flywheel bolts to specified torque.
  Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).

IAC Valve Inspection

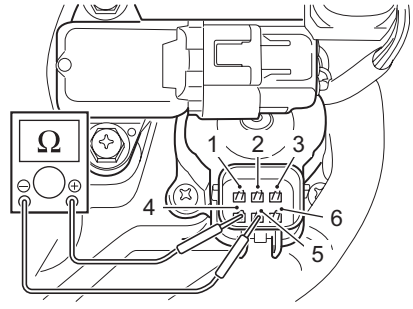
Z9J0111306015

1) Disconnect connector from IAC valve.
2) Check each coil of IAC valve for resistance.

IAC valve resistance

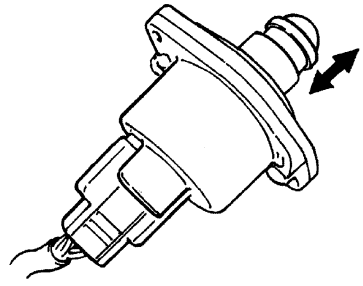
Terminals	Resistance
Between “1” and “2”	25 – 34 Ω
Between “3” and “2”	
Between “4” and “5”	
Between “6” and “5”	

If out of specification, replace IAC valve.



I9J011130017-04

3) Remove the flywheel.
   Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).
4) Remove the screws securing IAC valve, then detach the IAC valve from intake manifold.
5) Connect the connector to IAC valve.
6) When the ignition switch is turned “ON” and “OFF”, check that the rotary valve turns to open and returns to closed.



I9J011130018-01

7) If the valve does not turn, check the wiring harness for continuity (between ECM and IAC valve and connector contact condition.
8) Reinstall IAC valve.
   Refer to “IAC Valve Removal and Installation” (Page 1C-14).

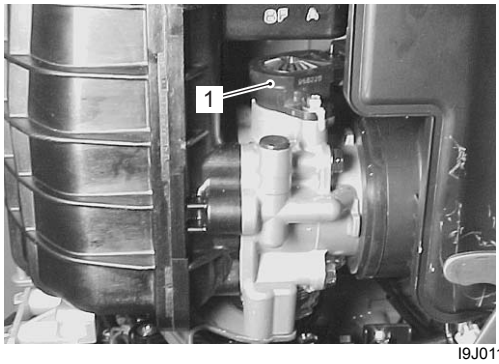
http://SelfFixer.com

TPS Inspection

Z9J0111306016

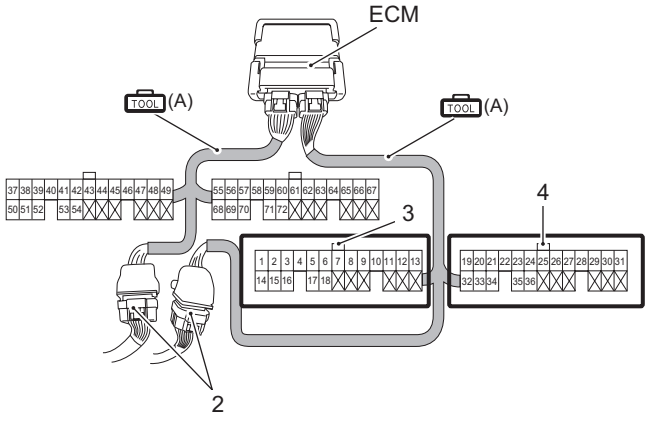
1) Turn ignition switch OFF.
2) Connect the 36-pin test cord set between ECM and wire harness as shown in figure.

Special tool
TOOL (A): 09930–88730 (36-pin test cord set)



I9J011130019-02

1. TPS	

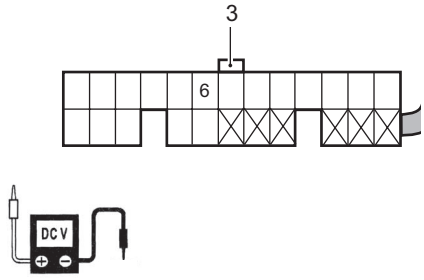


I9J011130020-03

2. Wire harness	4. Black connector
3. White connector	

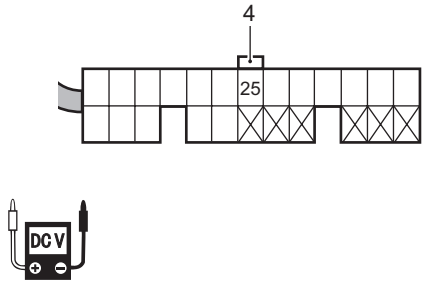
3) Connect tester probe (“+”, Red) to No. 6 terminal.
4) Connect tester probe (“–”, Black) to No. 25 terminal (or to body ground).

36-pin test cord (White connector)



I9J011130021-02

36-pin test cord (Black connector)



I9J011130022-02

5) Turn the ignition switch ON.
6) Check for sensor output voltage.
Slowly move the throttle lever to open, and check if voltage changes linearly within specification, according to throttle valve opening angle.

Sensor output voltage
FCT position: Approx. 0.7 V
WOT position: Approx. 3.8 V

Special tool
TOOL : 09930–99320 (Digital tester)

Tester knob indication
DC Voltage (⎓)

NOTE

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

7) If out of specification, check wire harnesses for open and short. If wire harnesses are in good condition, replace the throttle body and recheck.

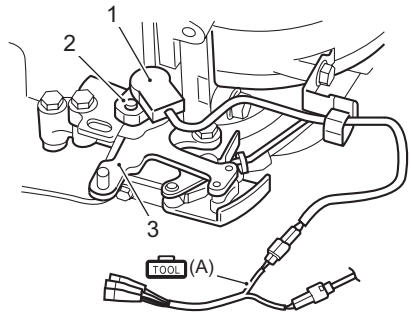
http://SelfFixer.com

Shift Position Sensor Inspection

Z9J0111306017

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

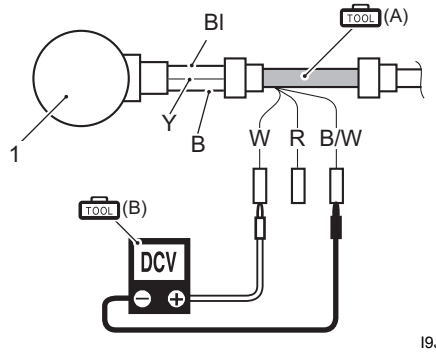
Sensor power source voltage
Standard: Approx. 5 V



I9J011130023-02

1. Shift position sensor	3. Clutch lever
2. Adjust screw	

Power source voltage



I9J011130053-01

Special tool
TOOL (A): 09930–89220 (3-pin connector test cord)
TOOL (B): 09930–99320 (Digital tester)

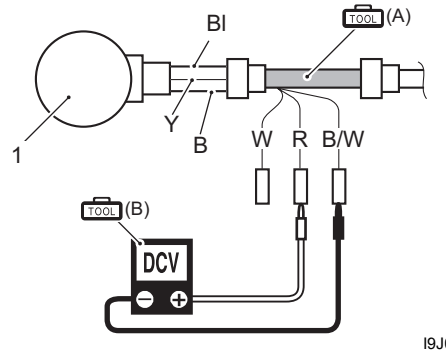
Tester knob indication
DC Voltage (⎓)

5) Connect tester probe as shown in the illustration. Check for sensor output voltage while operating remo-con handle.

Sensor output voltage

Shift position	Output voltage
Forward	Approx. 3.7 V
Neutral	Approx. 2.5 V
Reverse	Approx. 1.2 V

Output voltage



I9J011130054-01

If out of specification:

- 1st; Check remo-con cable adjustment, readjust if necessary.
- 2nd; Check wire harnesses for open and short. If wire harnesses are in good condition, replace shift position sensor and recheck.

NOTE

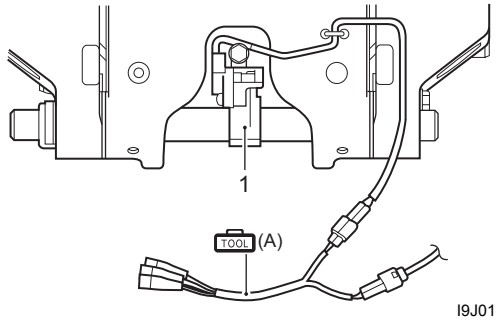
After installing shift position sensor, check for proper correct function by operating remo-con handle.

http://SelfFixer.com

Trim Sensor Inspection

Z9J0111306018

1) Turn ignition switch OFF.
2) Connect 3-pin test cord between trim sensor and wire harness as shown in figure.



I9J011130050-03

1. Trim sensor

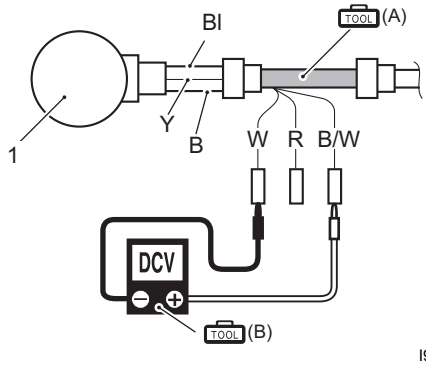
3) Turn the ignition switch ON.
4) Connect tester probe as shown in the illustration and check for sensor power source voltage.

Sensor power source voltage
Standard: Approx. 5 V

Special tool
TOOL (A): 09930–89220 (3-pin connector test cord)
TOOL (B): 09930–99320 (Digital tester)

Tester knob indication
DC Voltage

Power source voltage



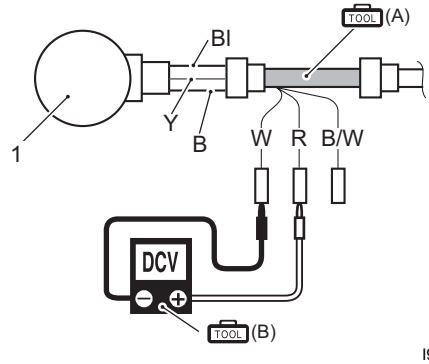
I9J011130024-03

5) Connect tester probe as shown in the illustration. Check for sensor output voltage.
Operate the PTT switch, and check if voltage changes linearly within specification, according to trim/tilt position.

Sensor output voltage

Trim/Tilt position	Output voltage
Full trim down	Approx. 0.9 V
Full tilt up	Approx. 4.0 V

Output voltage



I9J011130025-03

6) If out of specification, check wire harnesses for open and short. If wire harnesses are in good condition, replace trim sensor and recheck.

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Power Unit Mechanical

General Description

Power Unit Construction Description

Z9J0111401001

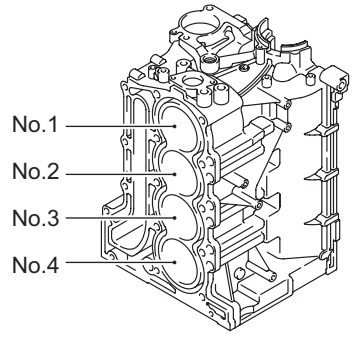
The power unit is direct water cooled, in line 4 cylinder, 4 stroke gasoline unit with its DOHC (Double overhead camshaft) valve mechanism for “V” type valve configuration and 16 valves (4 valves/one cylinder).
The double overhead camshaft is mounted over the cylinder head, it is driven from crankshaft through driven gear and timing chain, and no pushed rods are provided in the valve train system.

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.

Cylinder Number

Cylinder number is as mentioned in figure.



I9J011140077-01

Diagnostic Information and Procedures

Cylinder Compression Check

Z9J0111404001

Refer to “Cylinder Compression Pressure Check” in Section 0B (Page 0B-21).

Oil Pressure Check

Z9J0111404002

Refer to “Oil Pressure Check” in Section 0B (Page 0B-20).

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Service Instructions

Tappet Clearance Inspection

Z9J0111406028

Refer to “Tappet Clearance Inspection and Adjustment” in Section 0B (Page 0B-8).

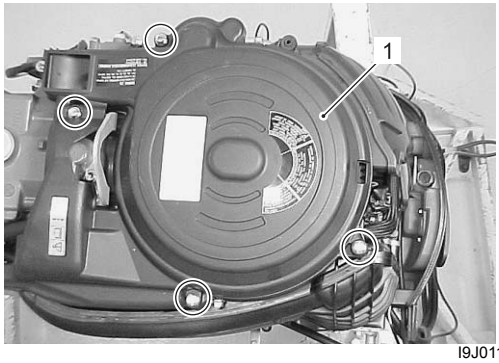
Ring Gear Cover Removal and Installation

Z9J0111406001

Removal

Prior to removing ring gear cover, disconnect battery cables from battery.

1) Loosen the four bolts securing ring gear cover (1).



I9J011140078-01

2) Remove the ring gear cover.

Installation

Installation is reverse order of removal.

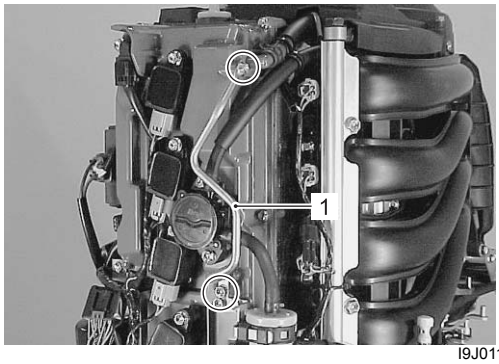
Cylinder Head Cover Removal and Installation

Z9J0111406002

Removal

Before removing cylinder head cover, disconnect battery cables from battery.

1) Remove both lower side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
2) Remove the two bolts securing fuel pump guard (1).



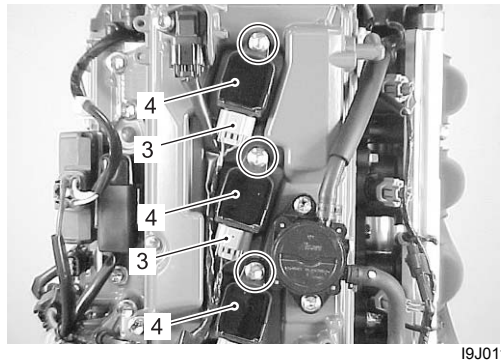
I9J011140079-01

3) Loosen the clamp securing breather hose (2), then remove the breather hose from cylinder head cover.



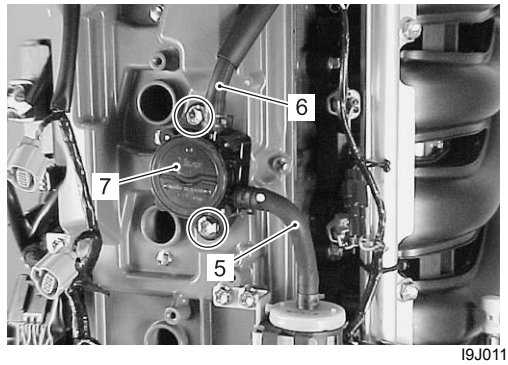
I9J011140080-01

4) Disconnect ignition coil connectors (3).
   Remove the bolts securing the ignition coils (4).
   Remove all ignition coils and spark plugs.



I9J011140081-01

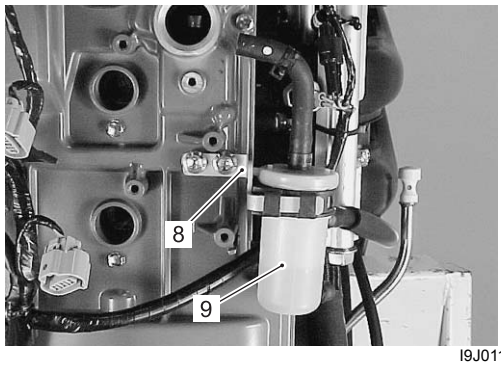
5) Disconnect inlet hose (5) and outlet hose (6) from low pressure fuel pump (7).
   Remove bolts and low pressure fuel pump.



I9J011140082-01

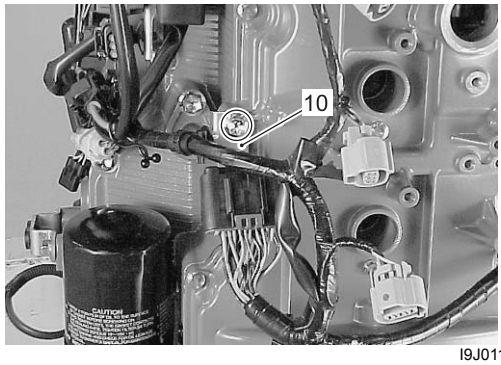
http://SelfFixer.com

6) Remove the two bolts securing filter bracket (8), then remove low pressure fuel filter (9) and filter bracket.



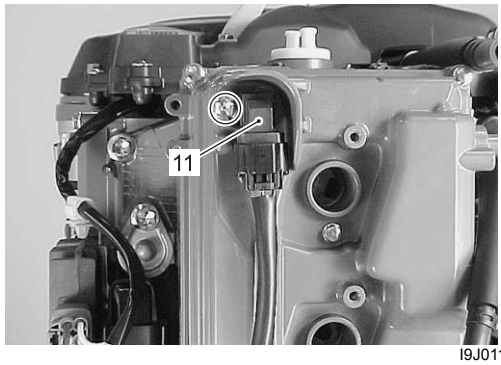
I9J011140083-01

7) Remove the bolt and joint connector bracket (10).



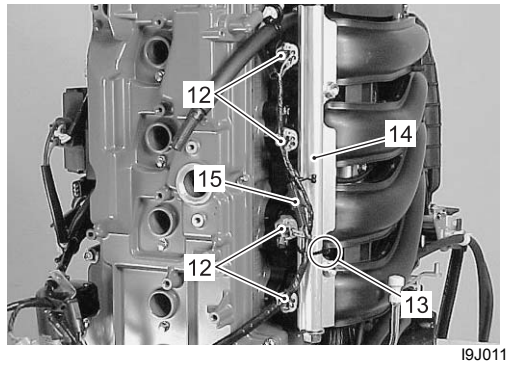
I9J011140084-01

8) Disconnect CMP sensor lead wire connector at CMP sensor (11).
Remove bolt and CMP sensor.



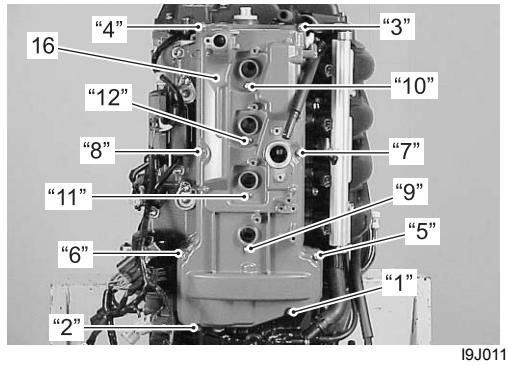
I9J011140085-01

9) Disconnect fuel injector lead wire connector at all fuel injectors (12).
Cut the cable tie (13) binding injector lead wire to fuel delivery pipe (14).
Disconnect high pressure fuel pump lead wire connector (15).



I9J011140086-01

10) Remove the twelve bolts securing cylinder head cover (16) to the cylinder head, then remove the cylinder head cover.



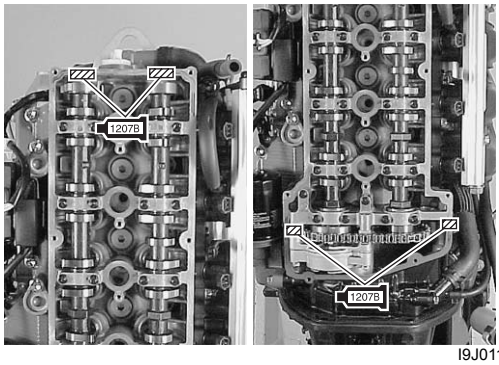
I9J011140087-01

http://SelfFixer.com

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

- Clean sealing surface on cylinder head and cover.
- Remove oil, old sealant, and dust from sealing surfaces.
- After cleaning, apply sealant to cylinder head sealing surface area as shown in figure.

1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))

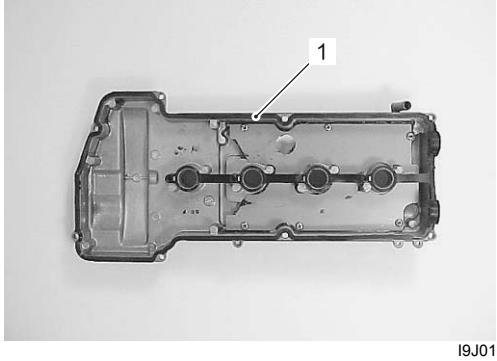


I9J011140088-01

- Install new cylinder head cover gasket (1) to head cover.

NOTE

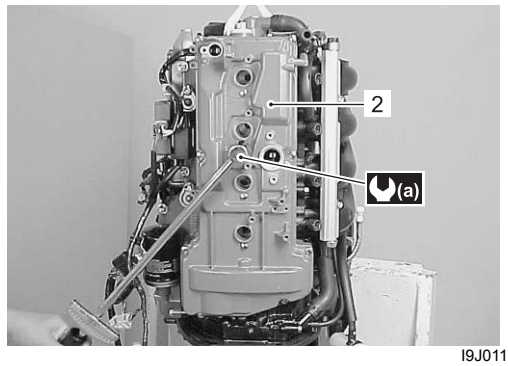
Examine cylinder head cover gasket for damage.
Always replace gasket with new one.



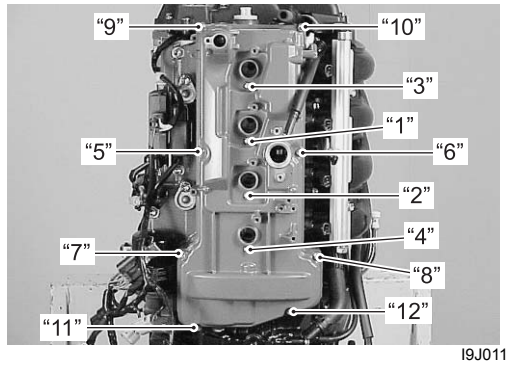
I9J011140089-01

- Install cylinder head cover (2) to cylinder head, then tighten cylinder head cover bolts to specified torque.

Tightening torque
Cylinder head cover bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



I9J011140090-01



I9J011140091-01

- Perform the following final assembly checks to ensure proper and safe operation.
  - All parts removed have been returned to their original positions.
  - Wire and hose routing matches service manual illustration. Refer to “Fuel Hose Routing” in Section 4B (Page 4B-1) and “Water Hose Routing” in Section 4B (Page 4B-5).
  - No oil leakage is evident during final test running.

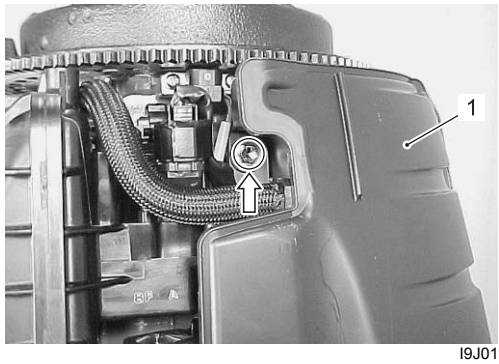
http://SelfFixer.com

Air Intake Silencer Case Removal and Installation

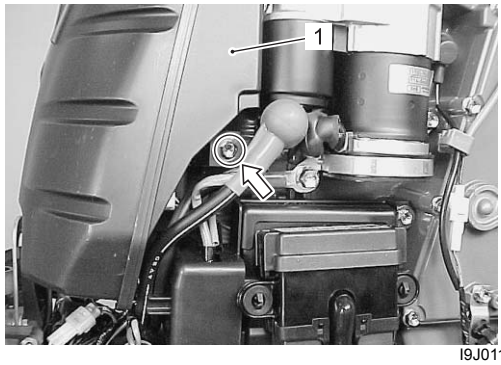
Z9J0111406003

Removal

1) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” (Page 1D-2).
2) Remove the two bolts securing air intake silencer case (1).
3) Remove the air intake silencer case.

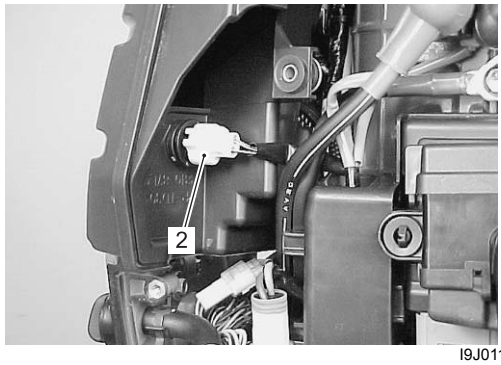


I9J011140092-01



I9J011140093-01

4) Disconnect the intake air temp. sensor lead wire connector (2) at sensor.



I9J011140094-01

Installation

Installation is reverse order of removal.

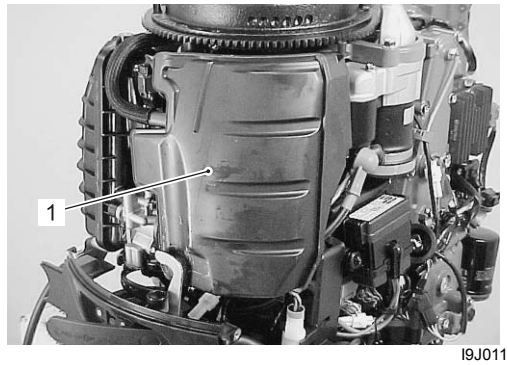
Electric Parts Holder Removal and Installation

Z9J0111406004

Removal

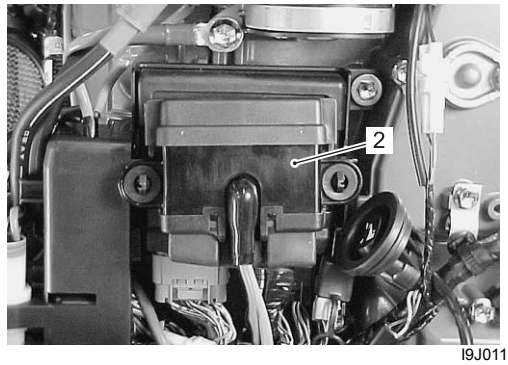
Before removing electric parts holder, disconnect battery cables from battery.

1) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” (Page 1D-2).
2) Remove the air intake silencer case (1).
   Refer to “Air Intake Silencer Case Removal and Installation” (Page 1D-5).



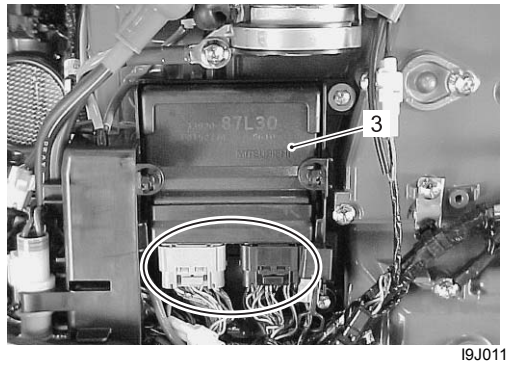
I9J011140095-01

3) Pull and remove the fuse box (2) from electric parts holder.



I9J011140096-01

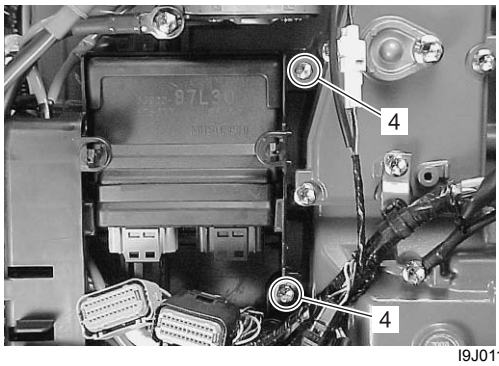
4) Disconnect lead wire connectors from ECM (3).



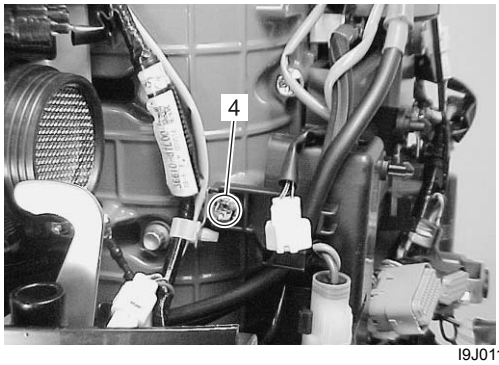
I9J011140097-01

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5) Remove the three bolts (4) securing electric parts holder to cylinder block.
6) Remove ECM from electric parts holder.

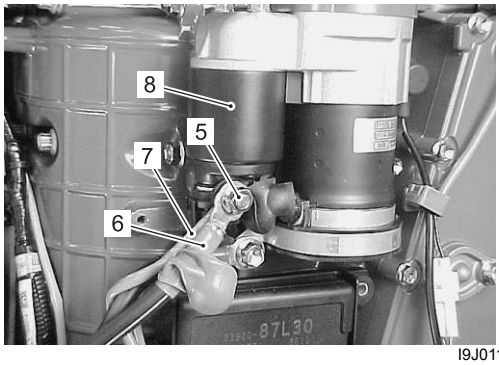


I9J011140099-01



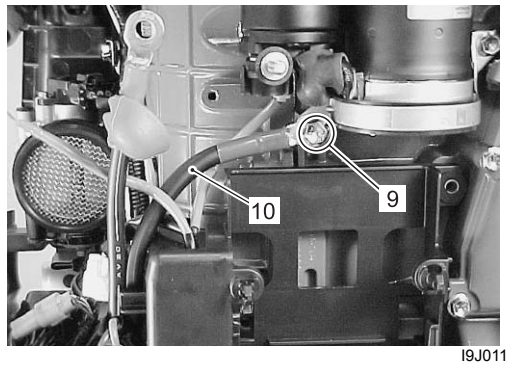
I9J011140100-01

7) To remove the electric parts holder, refer to following.
   a) Remove nut (5), positive (+) battery cable (6) and positive lead wire (7) from magnetic switch (8) of starter motor.



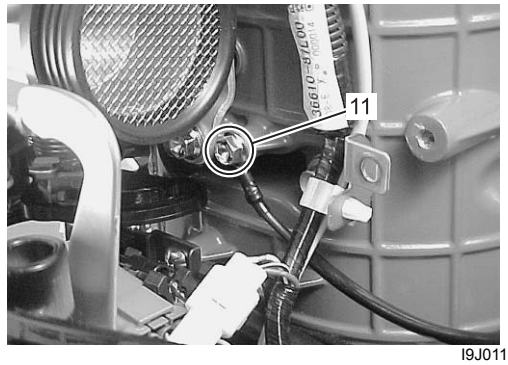
I9J011140101-01

   b) Remove the bolt (9) securing negative (–) battery cable (10).
   Pull battery cable out of electric parts holder.



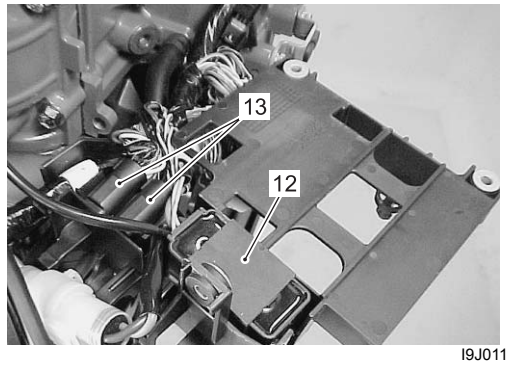
I9J011140102-01

   c) Remove the bolt (11) securing PTT motor relay GND lead wire.



I9J011140103-04

   d) Remove PTT motor relay (12) and joint connectors (13) from electric parts holder.



I9J011140104-01

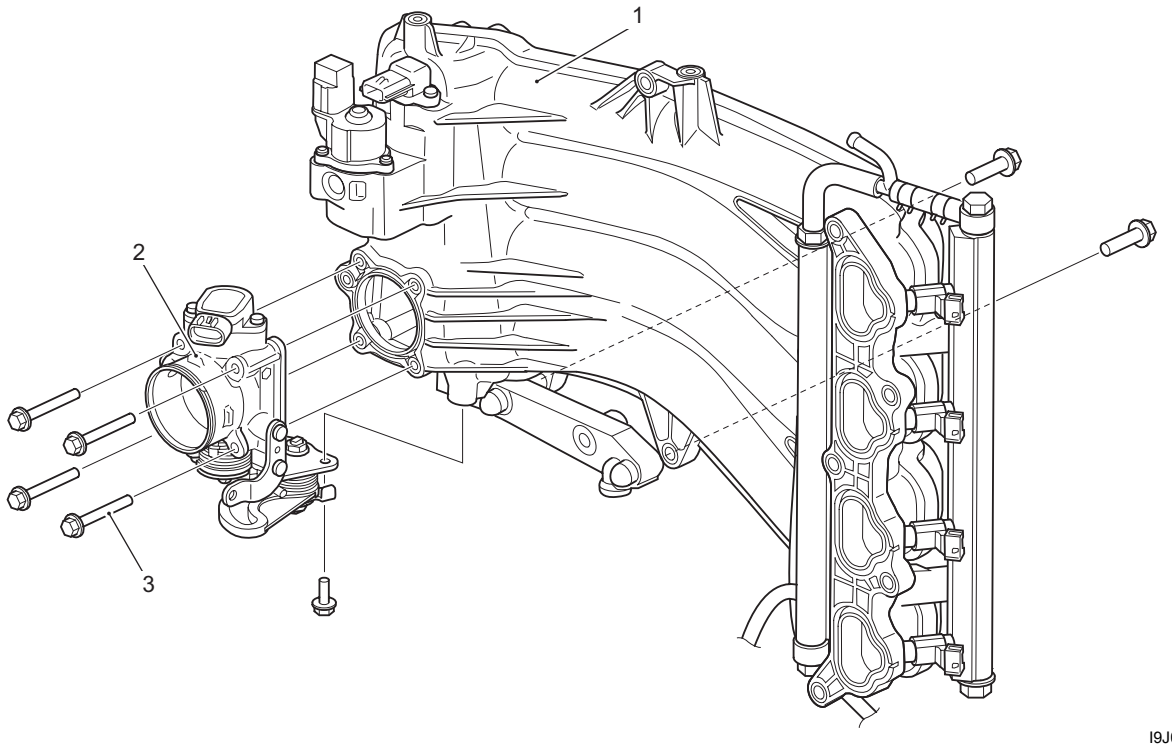
Installation
Installation is reverse order.
Perform the following final assembly checks to ensure proper and safe operation.

- All parts removed have been returned to their original positions.
- Wire routing matches service manual illustration. Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3) and “Fuel Hose Routing” in Section 4B (Page 4B-1).

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Intake Manifold and Throttle Body Components

Z9J0111406005



I9J011140001-01

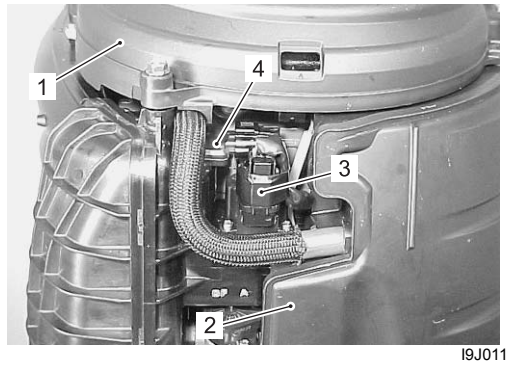
1. Intake manifold assembly	2. Throttle body assembly	3. Bolt

Intake Manifold Removal and Installation

Z9J0111406006

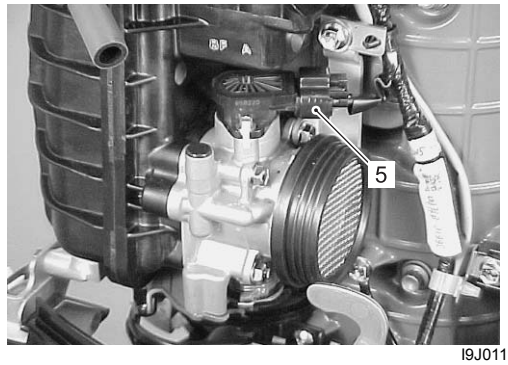
Removal

1) Relieve fuel pressure.
   Refer to “Fuel Pressure Relief Procedure” in Section 1G (Page 1G-15).
2) Disconnect battery cables from battery.
3) Remove both lower side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
4) Remove the ring gear cover (1).
   Refer to “Ring Gear Cover Removal and Installation” (Page 1D-2).
5) Remove the air intake silencer case (2).
   Refer to “Air Intake Silencer Case Removal and Installation” (Page 1D-5).
6) Disconnect the IAC valve lead wire connector (3) at IAC valve.
7) Disconnect the MAP sensor lead wire connector (4) at sensor.



I9J011140105-01

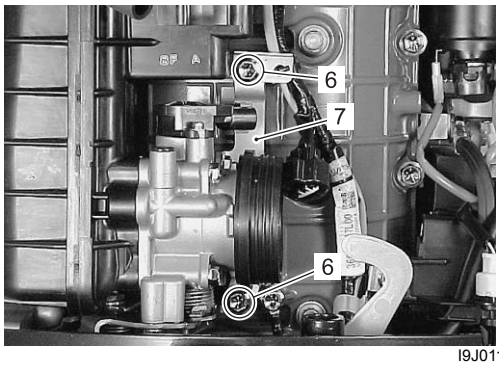
8) Disconnect the throttle position sensor lead wire connector (5) at sensor.



I9J011140106-01

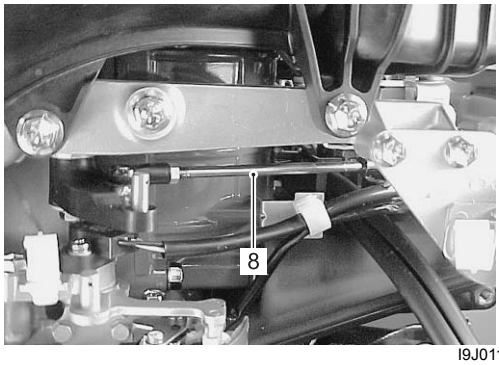
http://SelfFixer.com

9) Remove the bolts (6) securing throttle body bracket (7) to crankcase.



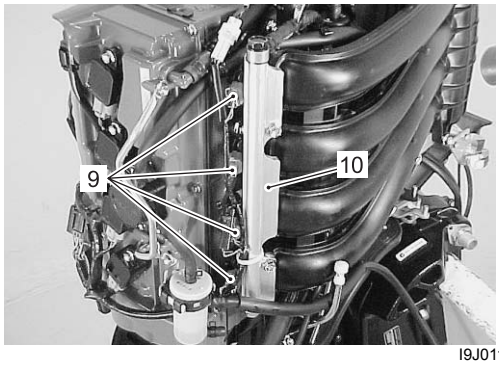
I9J011140108-01

10) Remove the throttle link rod (8).



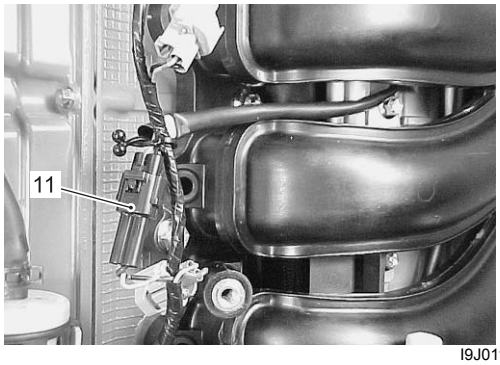
I9J011140109-01

11) Remove the fuel injector (9) and fuel delivery pipe (10).
Refer to “Fuel Injector Removal and Installation” in Section 1G (Page 1G-23).



I9J011140110-01

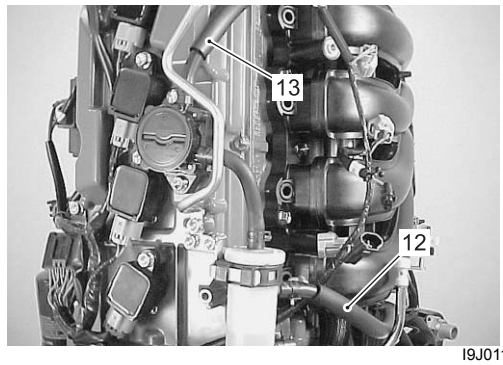
12) Disconnect the high pressure fuel pump lead wire connector (11).



I9J011140111-01

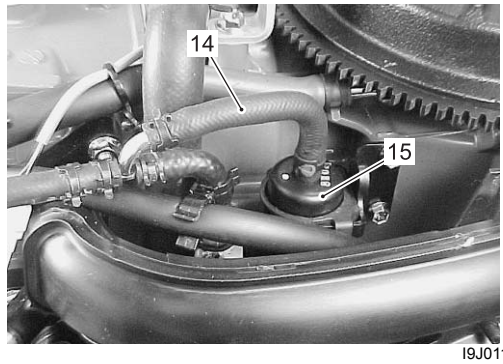
13) Disconnect fuel inlet hose (12) from low pressure fuel filter.

14) Disconnect fuel outlet hose (13) from low pressure fuel pump.



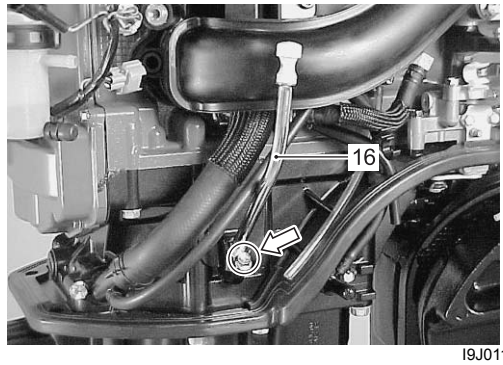
I9J011140112-01

15) Disconnect fuel outlet hose (14) from high pressure fuel filter (15).



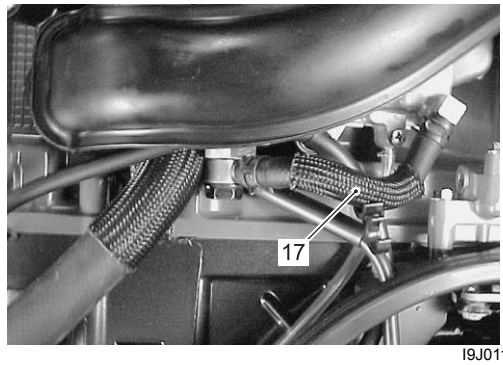
I9J011140113-01

16) Remove the bolt and oil level dipstick tube (16).



I9J011140114-01

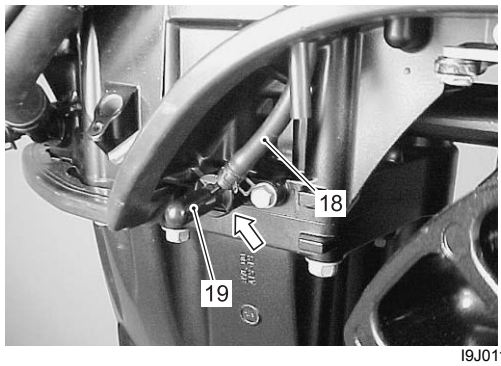
17) Disconnect fuel return hose (17) from fuel cooler.



I9J011140115-01

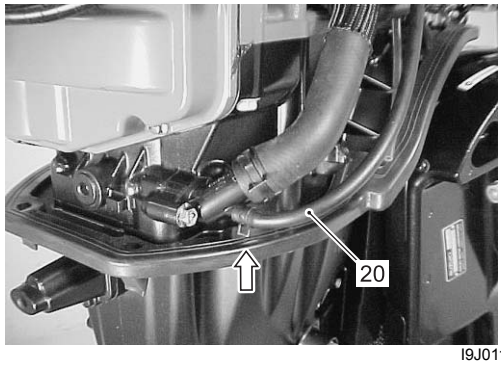
http://SelfFixer.com

18) Disconnect the fuel cooler water inlet hose (18) from the pilot water indicator (19).



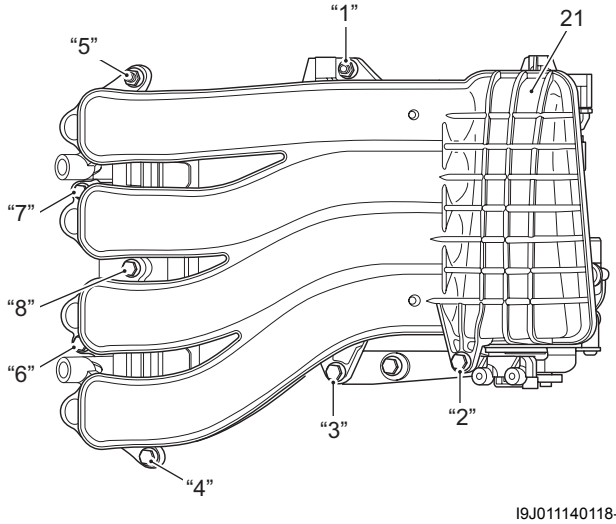
I9J011140116-01

19) Disconnect the fuel cooler water outlet hose (20) from the water return union.



I9J011140117-01

20) Remove the six bolts and two nuts and then remove the intake manifold assembly (21).



I9J011140118-01

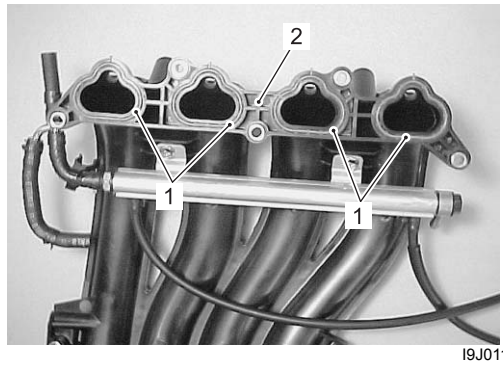
Installation

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

CAUTION

Do not reuse gasket once removed.
Always use a new gasket.

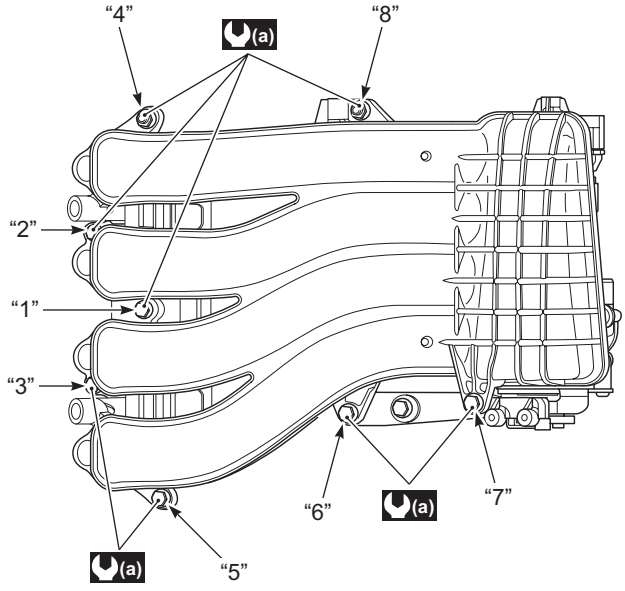
- Install gaskets (1) into groove of intake manifold assembly (2).



I9J011140119-01

- Install the intake manifold assembly (2), then tighten bolts and nuts securely.

Tightening torque
Intake manifold bolt / nut (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)



I9J011140002-02

- Install fuel injectors and fuel delivery pipe.
  Refer to "Fuel Injector Removal and Installation" in Section 1G (Page 1G-23).
- Perform the following final assembly checks to ensure proper and safe operation.
  - All parts removed have been returned to their original positions.
  - Wire and hose routing matches service manual illustration.
    Refer to "Wiring Harness Routing Diagram" in Section 4A (Page 4A-3) and "Fuel Hose Routing" in Section 4B (Page 4B-1).
  - No fuel leakage is evident during final test running.

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Throttle Body Removal and Installation

Z9J0111406007

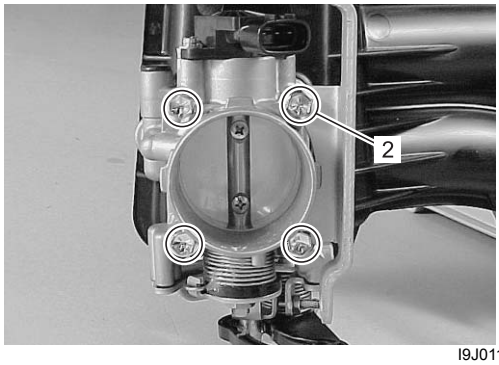
Removal

1) Remove the Intake manifold assembly.
   Refer to “Intake Manifold Removal and Installation” (Page 1D-7).
2) Remove the flame arrester (1).



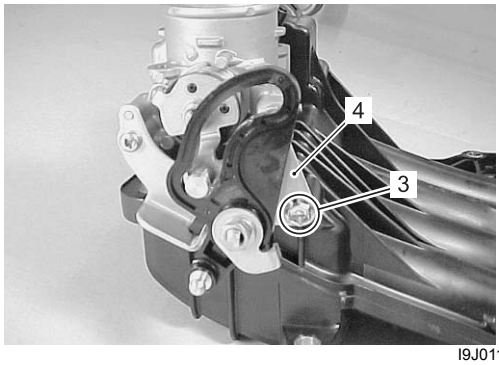
I9J011140120-01

3) Remove the four bolts (2) securing throttle body to intake manifold.



I9J011140121-01

4) Remove the bolt (3) securing bracket (4).



I9J011140122-01

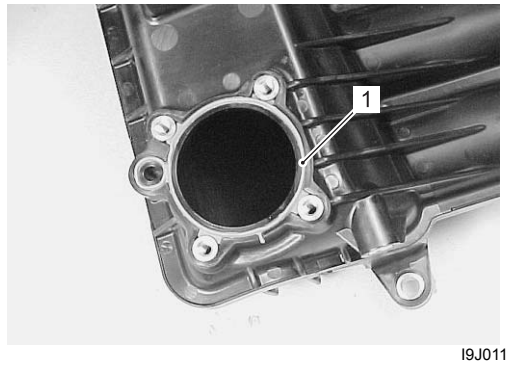
Installation

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

CAUTION

Do not reuse gaskets, always replace with new one.

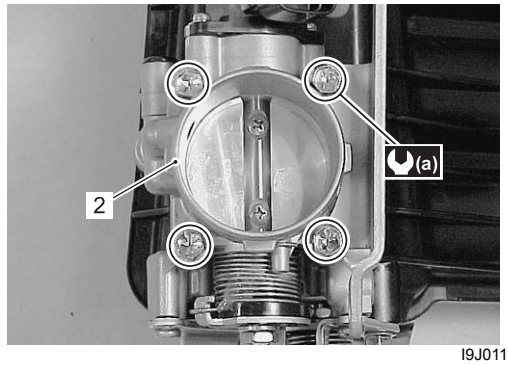
- Clean mating surface and install the seal ring (1).



I9J011140123-01

- Install the throttle body (2), then securely tighten the four throttle body bolts to specified torque.

  Tightening torque
  Throttle body bolt (a): 10 N·m (1.0 kgf-m, 7.2 lbf-ft)



I9J011140124-01

- Install the intake manifold.
  Refer to “Intake Manifold Removal and Installation” (Page 1D-7).

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Throttle Body Inspection

Z9J0111406008

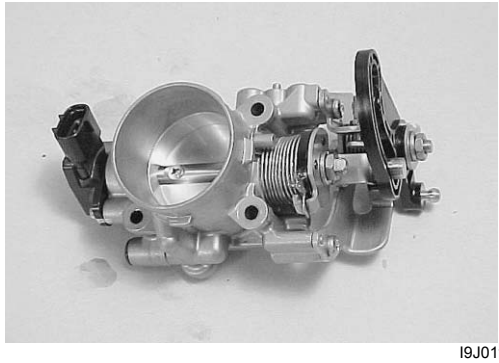
CAUTION

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

- Clean throttle body bore by compressed air.
- Check that throttle lever and throttle valve moves smoothly.
- Replace throttle body if necessary.



I9J011140125-01



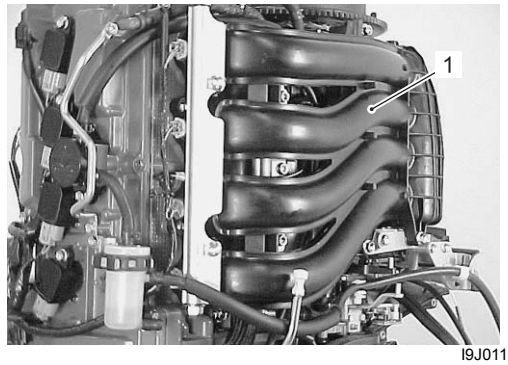
I9J011140126-01

Power Unit Removal and Installation

Z9J0111406009

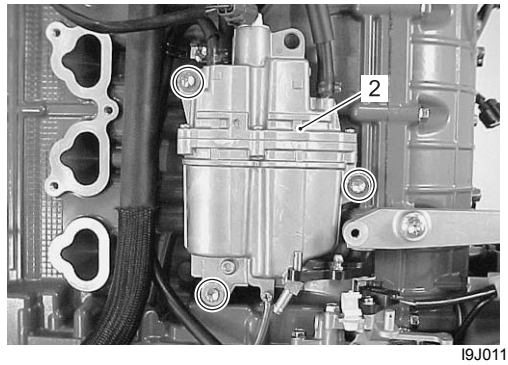
Removal

1) Relieve fuel pressure.
   Refer to “Fuel Pressure Relief Procedure” in Section 1G (Page 1G-15).
2) Drain engine oil.
3) Disconnect battery cables from battery.
4) Remove the fuel injectors and intake manifold assembly (1).
   Refer to “Intake Manifold Removal and Installation” (Page 1D-7).



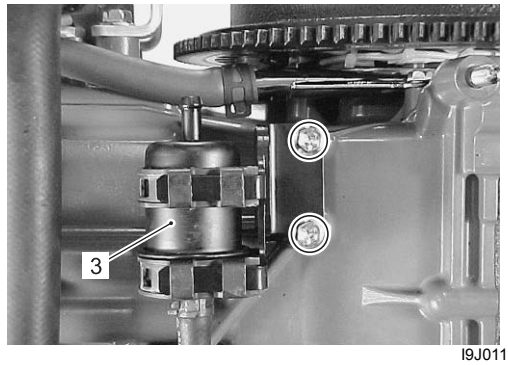
I9J011140127-01

5) Remove the fuel vapor separator (2).
   Refer to “Fuel Vapor Separator Removal and Installation” in Section 1G (Page 1G-17).



I9J011140128-01

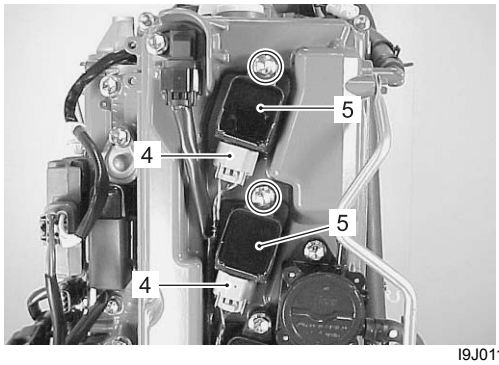
6) Remove the high pressure fuel filter (3).



I9J011140129-01

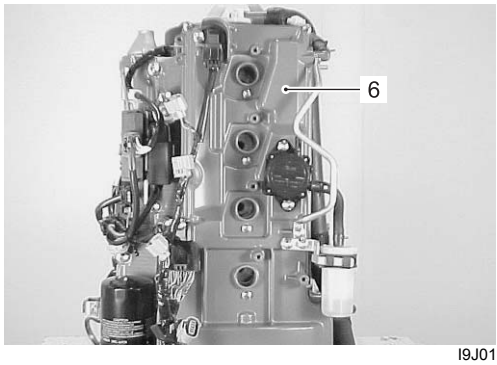
http://SelfFixer.com

7) Disconnect ignition coil connectors (4).
Remove the bolts securing the ignition coils (5).
Remove all ignition coils and spark plugs.



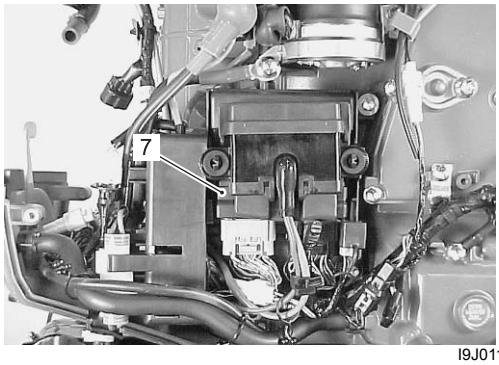
I9J011140130-01

8) Remove the cylinder head cover (6).
Refer to “Cylinder Head Cover Removal and Installation” (Page 1D-2).



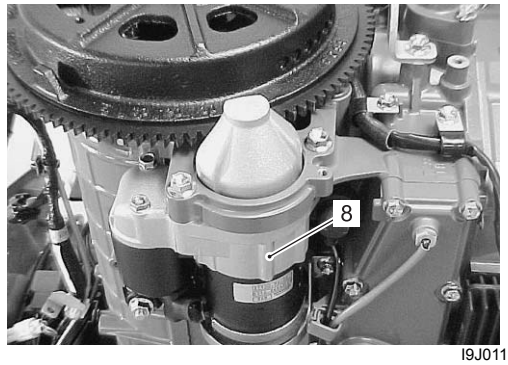
I9J011140131-01

9) Remove the electric parts holder (7).
Refer to “Electric Parts Holder Removal and Installation” (Page 1D-5).



I9J011140132-01

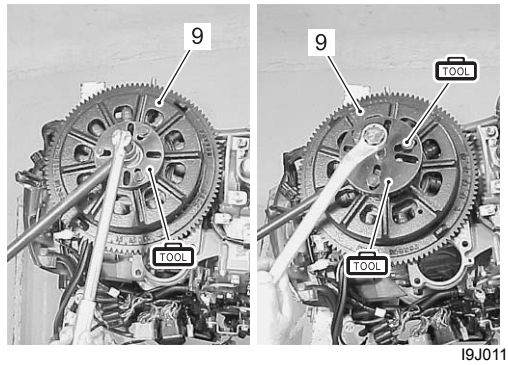
10) Remove the starter motor (8).
Refer to “Starter Motor Removal and Installation” in Section 1I (Page 1I-4).



I9J011140133-01

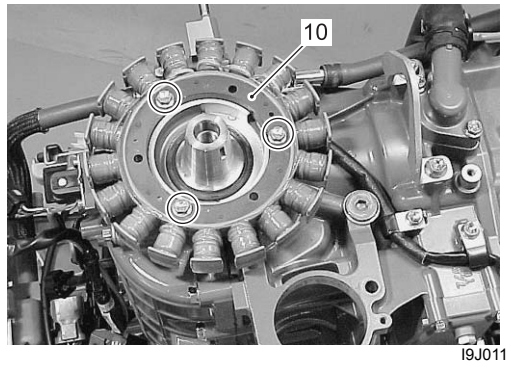
11) Remove the flywheel (9).
Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).

Special tool
TOOL : 09930–48720 (Flywheel holder)
TOOL : 09930–39411 (Flywheel remover)
TOOL : 09930–39420 (Flywheel remover bolts)



I9J011140134-01

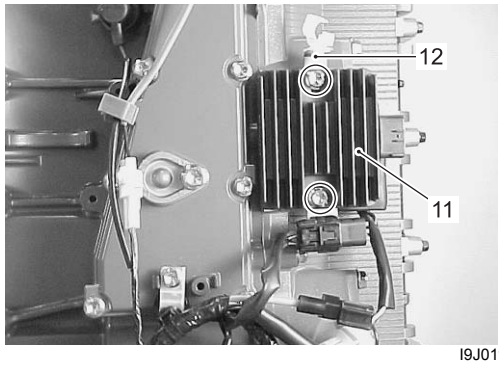
12) Remove the battery charge coil (10).
Refer to “Battery Charge Coil Removal and Installation” in Section 1K (Page 1K-6).



I9J011140135-01

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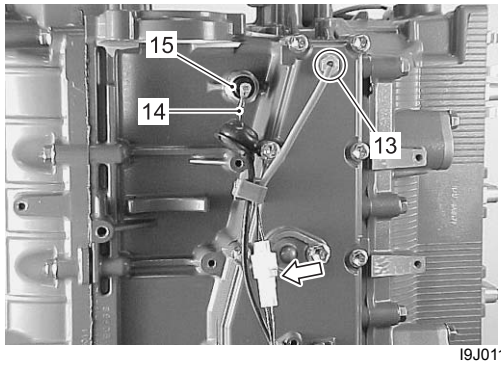
13) Remove the bolts and rectifier/regulator (11). Remove the bolt securing lead wire clamp plate (12). Refer to “Rectifier/Regulator Removal and Installation” in Section 1K (Page 1K-7).



I9J011140136-01

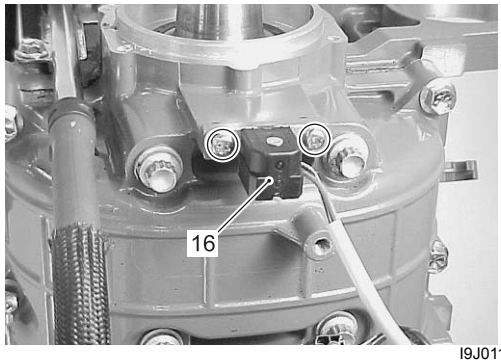
14) Disconnect EX. manifold temperature sensor lead wire connector.
Remove EX. manifold temperature sensor (13).

15) Loosen screw and disconnect blue lead wire (14) from oil pressure switch (15).



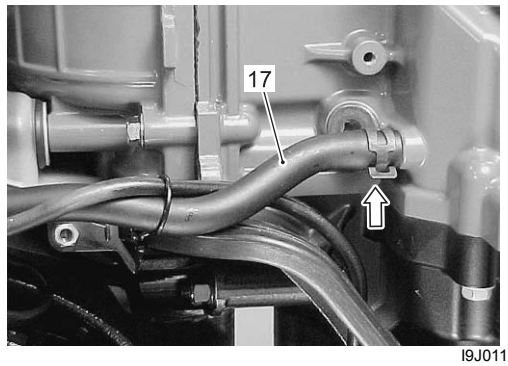
I9J011140137-01

16) Remove screws and CKP sensor (16). Disconnect CKP sensor lead wire connector.



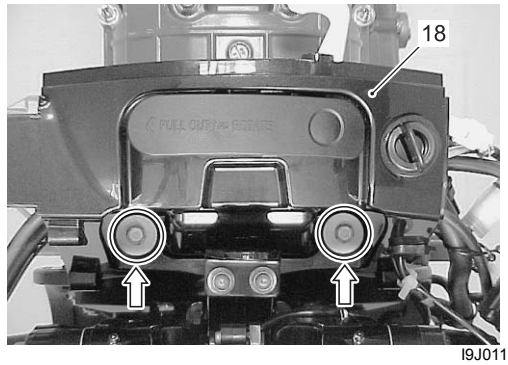
I9J011140138-01

17) Disconnect water flush hose (17) from cylinder block.



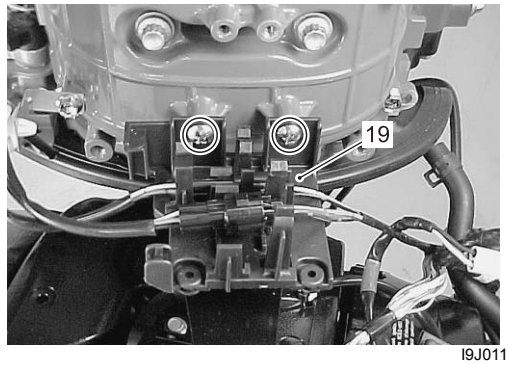
I9J011140139-01

18) Remove the two bolts securing front panel (18).



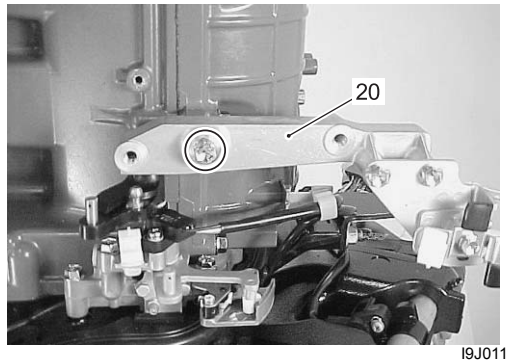
I9J011140140-01

19) Remove the screws securing the hose and harness holder (19).



I9J011140141-01

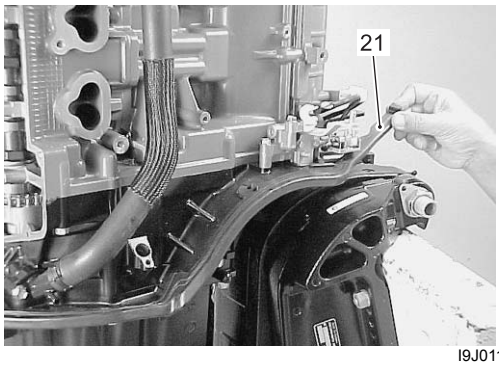
20) Remove the bolt and throttle lever holder (20).



I9J011140142-01

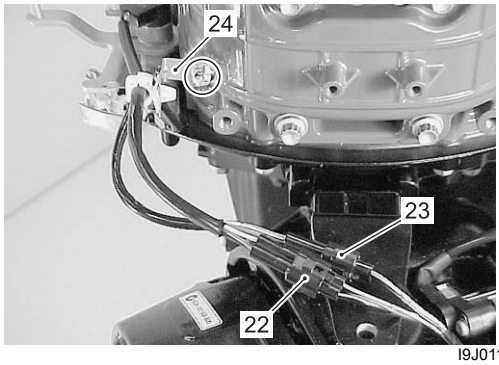
http://SelfFixer.com

21) Remove the side cover seal (21).



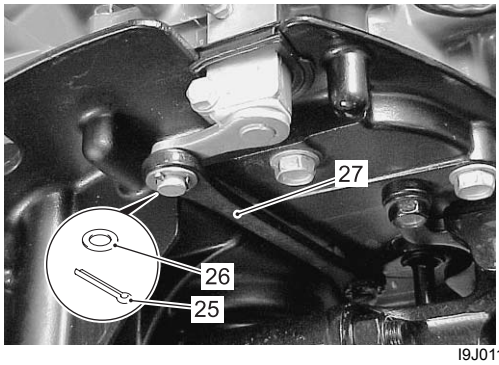
I9J011140143-01

22) Disconnect shift position sensor lead wire connector (22).
Disconnect neutral switch lead wire connector (23).
Remove the bolt and lead wire clamp plate (24).



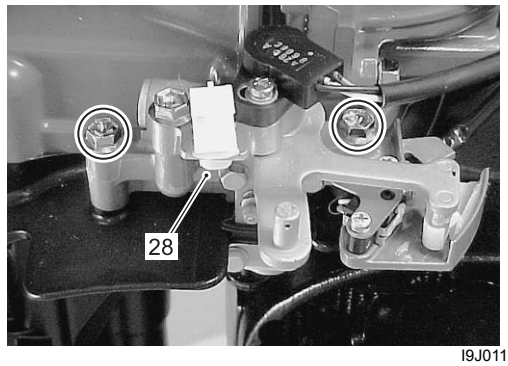
I9J011140144-01

23) Remove the cotter pin (25) and washer (26).
Remove the clutch lever link (27) from the clutch link holder assembly.



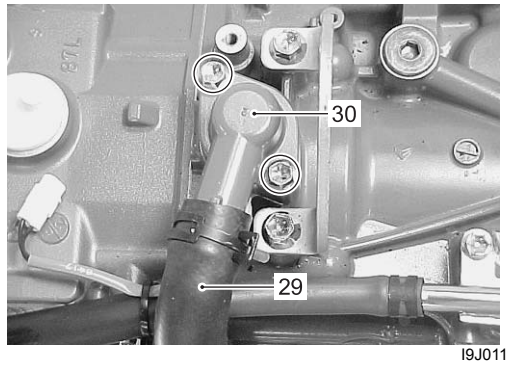
I9J011140145-01

24) Remove the two bolts and clutch link holder assembly (28).



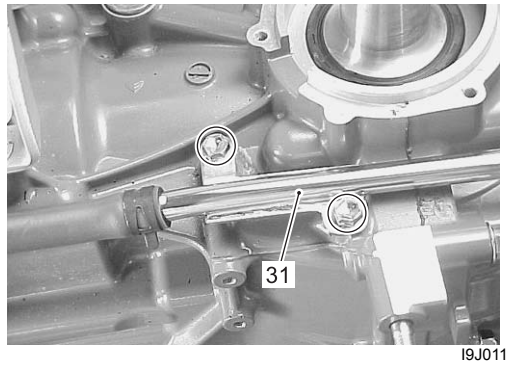
I9J011140146-03

25) Disconnect the water return hose (29), then remove the thermostat cover (30) and thermostat.



I9J011140147-01

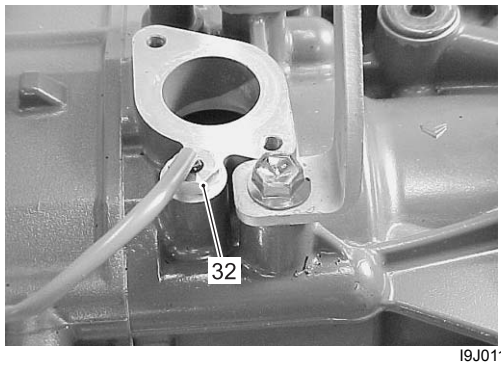
26) Remove the two bolts and breather pipe (31).



I9J011140148-01

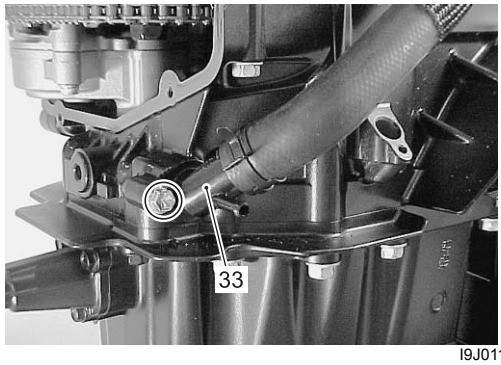
http://SelfFixer.com

27) Remove the cylinder temperature sensor (32).



I9J011140149-01

28) Remove the bolt and water return union (33).



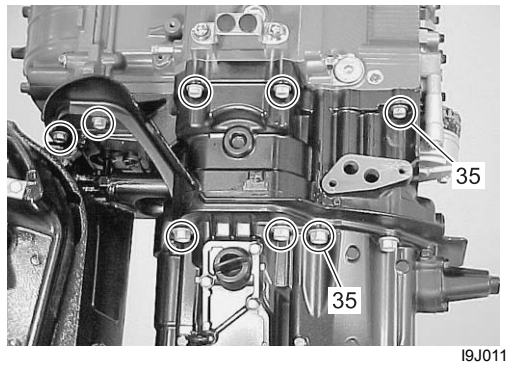
I9J011140150-01

29) Remove the two bolts and oil filter adapter case (34).

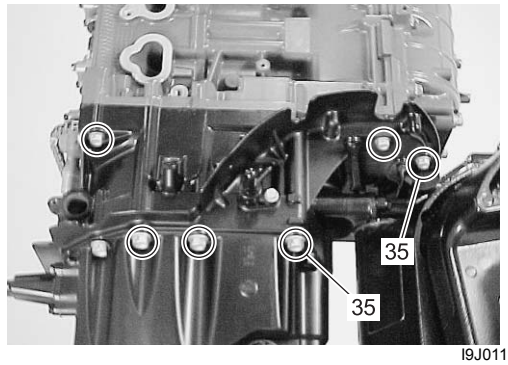


I9J011140151-01

30) Remove the fourteen bolts (35).



I9J011140152-03



I9J011140153-03

31) Lift up and remove power unit from engine holder.

Installation

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

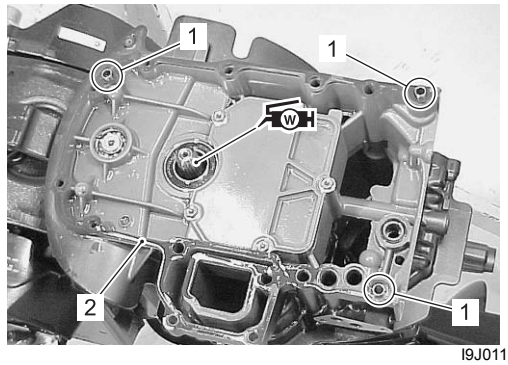
CAUTION

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.

  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



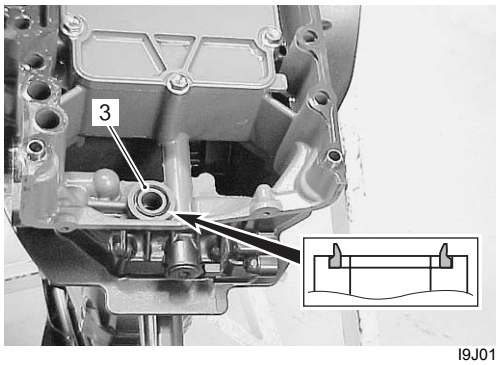
I9J011140154-01

http://SelfFixer.com

- Install the engine holder seal (3).

NOTE

Install seal (3) with lip facing upward.

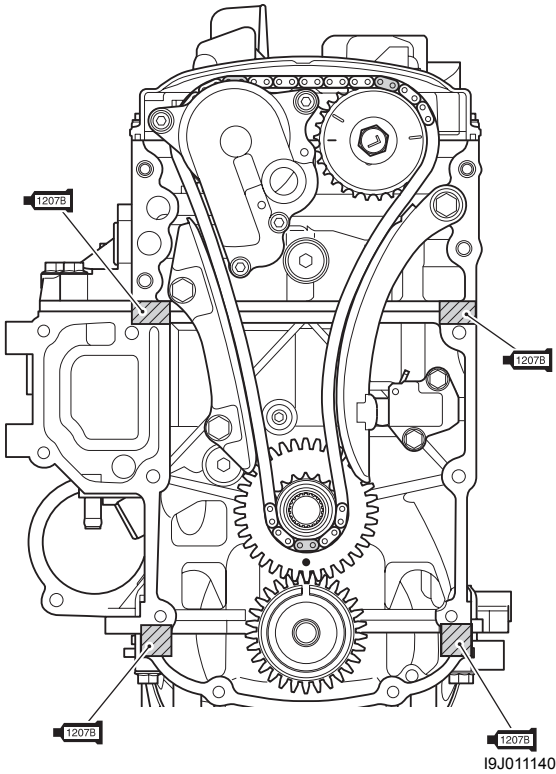


I9J011140155-01

NOTE

Before installing power unit, apply sealant to the four hatched areas shown in the illustration at below.

1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))



I9J011140022-02

- Lower the power unit onto engine holder.

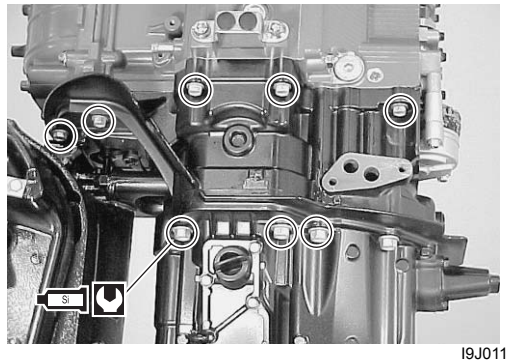
NOTE

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

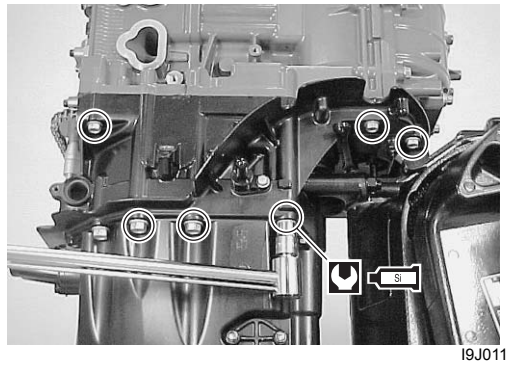
- Apply suzuki silicone seal to power unit mounting bolts and tighten bolts to specified torque.

Si : Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))

Tightening torque
Power unit mounting bolt (8 mm): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)
Power unit mounting bolt (10 mm): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)



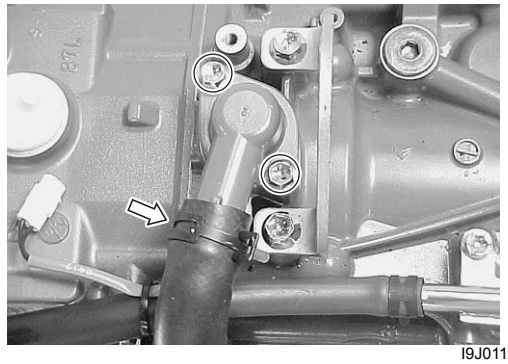
I9J011140156-03



I9J011140157-03

Thermostat

- Assemble thermostat, seal and thermostat cover to cylinder block and secure with bolts.
  Refer to “Thermostat Removal and Installation” in Section 1F (Page 1F-3).

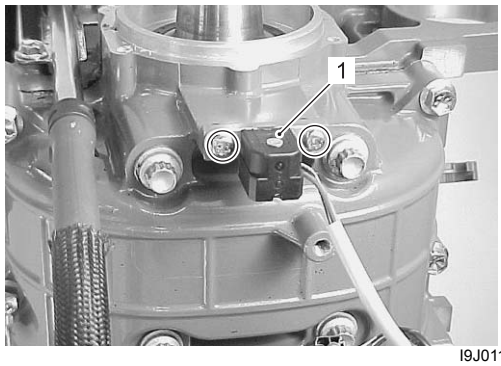


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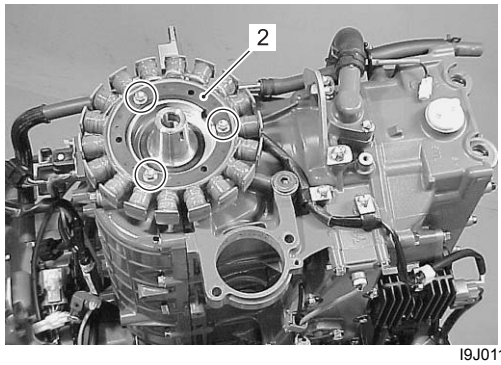
Flywheel

- Install CKP sensor (1).
  Refer to “CKP Sensor Removal and Installation” in Section 1C (Page 1C-10).



I9J011140159-01

- Install battery charge coil (2).
  Refer to “Battery Charge Coil Removal and Installation” in Section 1K (Page 1K-6).

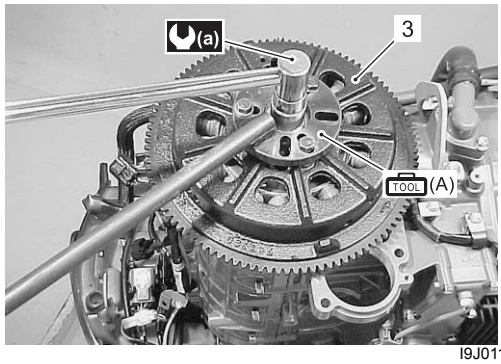


I9J011140160-01

- Install flywheel (3) and tighten flywheel bolts to specified torque.
  Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-5).

  Tightening torque
  Flywheel bolt (a): 196 N·m (19.7 kgf-m, 142 lbf-ft)

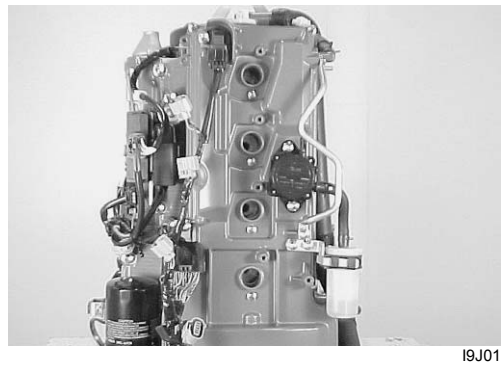
  Special tool
  TOOL (A): 09930–48720 (Flywheel holder)



I9J011140161-01

Cylinder head cover

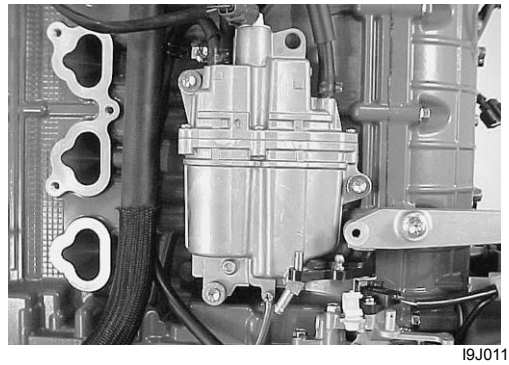
- Install cylinder head cover.
  Refer to “Cylinder Head Cover Removal and Installation” (Page 1D-2).



I9J011140162-02

Vapor separator

- Install vapor separator.
  Refer to “Fuel Vapor Separator Removal and Installation” in Section 1G (Page 1G-17).



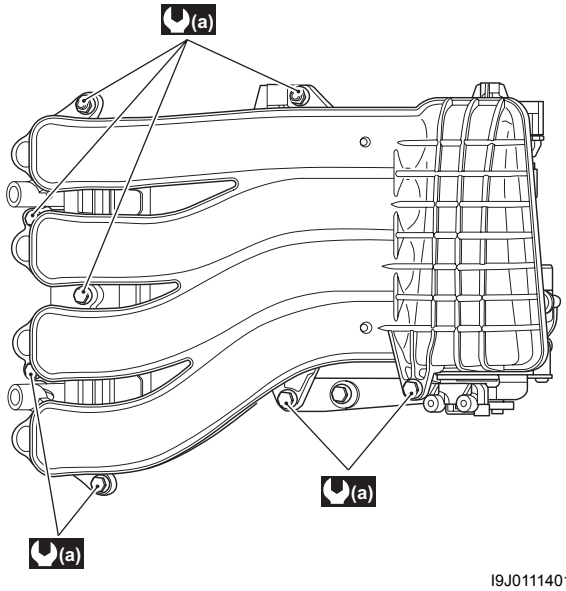
I9J011140163-01

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Intake manifold

- Install gaskets and intake manifold, then tighten bolts and nuts to specified torque.
  Refer to “Intake Manifold Removal and Installation” (Page 1D-7).

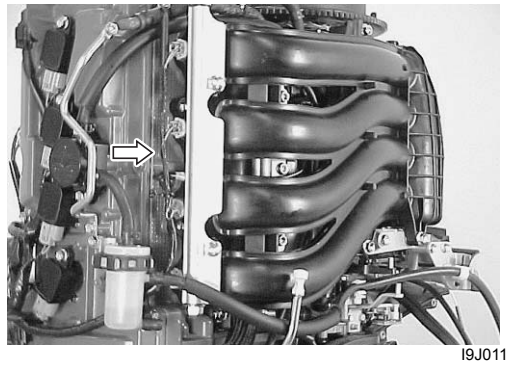
  Tightening torque
  Intake manifold bolt / nut (8 mm) (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)



I9J011140164-01

Fuel injectors

- Install fuel injectors and fuel delivery pipe.
  Refer to “Fuel Injector Removal and Installation” in Section 1G (Page 1G-23).



I9J011140165-01

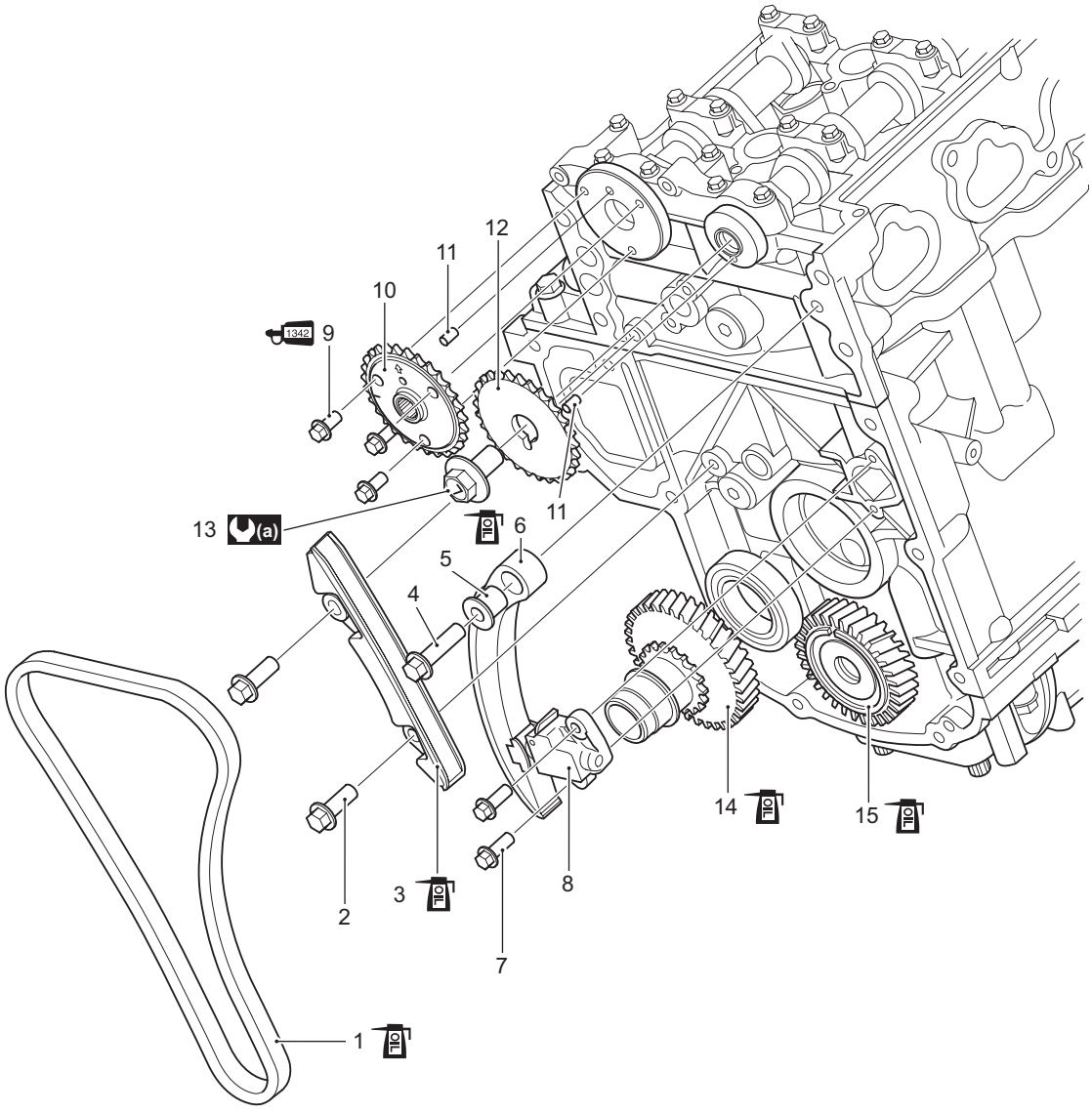
Perform the following final assembly checks to ensure proper and safe operation.

- All parts removed have been returned to their original positions.
- Fuel and water hose routing matches service manual illustration.
  Refer to “Fuel Hose Routing” in Section 4B (Page 4B-1) and “Water Hose Routing” in Section 4B (Page 4B-5).
- Wire routing matches service manual illustration.
  Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).
- No fuel leakage is evident when fuel system is pressurized.
  Refer to “Fuel Leakage Check Procedure” in Section 1G (Page 1G-16).
- No water leakage is evident during final test running.

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Timing Chain, Chain Tensioner and Camshaft Sprockets Components

Z9J0111406010



I9J011140003-04

1. Timing chain	6. Chain tensioner	11. Dowel pin	(a) : 78 N·m (7.8 kgf-m, 56 lbf-ft)
2. Bolt	7. Bolt	12. Intake camshaft sprocket	OIL : Apply oil.
3. Chain guide	8. Tensioner adjuster	13. Bolt (L.H. thread)	1342 : Apply thread lock.
4. Bolt	9. Bolt	14. Driven gear	
5. Spacer	10. Exhaust camshaft sprocket	15. Crankshaft	

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Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation

Z9J0111406011

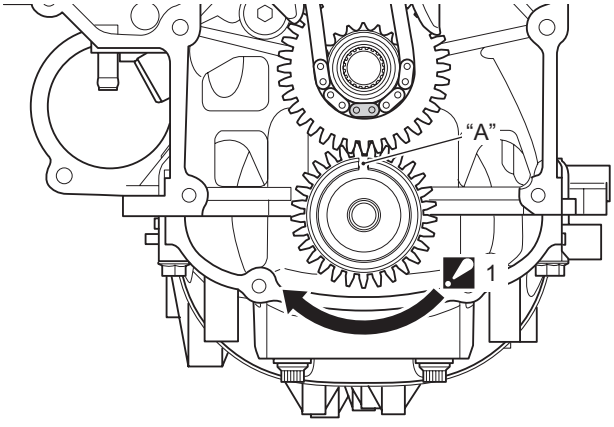
Removal

1) Remove the oil pump.
   Refer to “Oil Pump Removal and Installation” in Section 1E (Page 1E-3).
2) Turn the crankshaft in its normal running direction (LH direction) until the match mark “A” on the crankshaft drive gear points to 12 o’clock position (toward cylinder head).

CAUTION

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

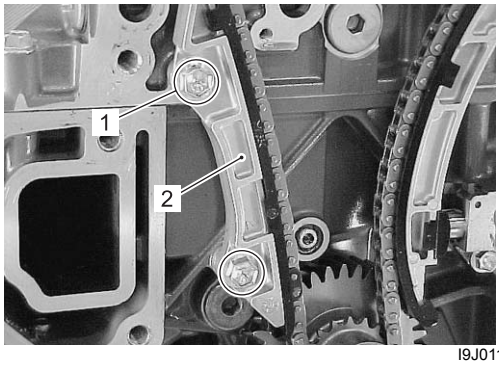
Special tool
TOOL : 09911–49910 (Crankshaft holder)



I9J011140007-05

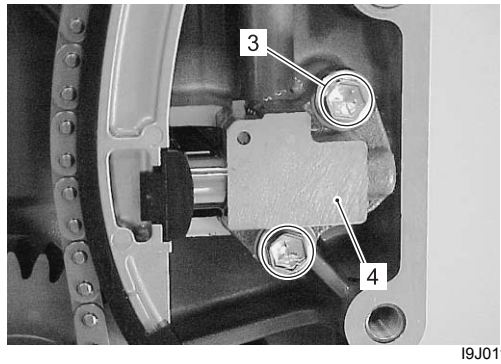
1. Engine normal running direction

3) Remove two bolts (1) and timing chain guide (2).



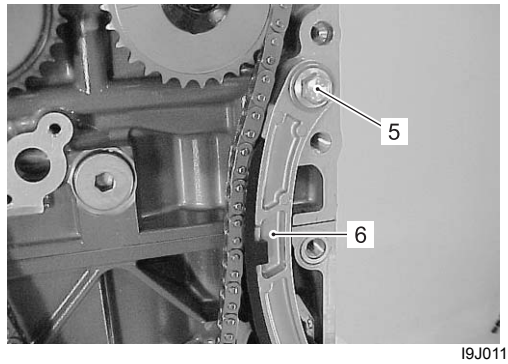
I9J011140166-01

4) Remove the two bolts (3) and chain tensioner adjuster (4).



I9J011140167-01

5) Remove bolt (5) and timing chain tensioner (6).

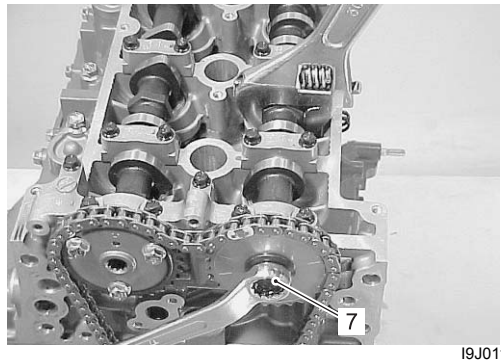


I9J011140168-01

6) Loosen and remove the bolt (7) securing IN. camshaft timing sprocket to camshaft.

NOTE

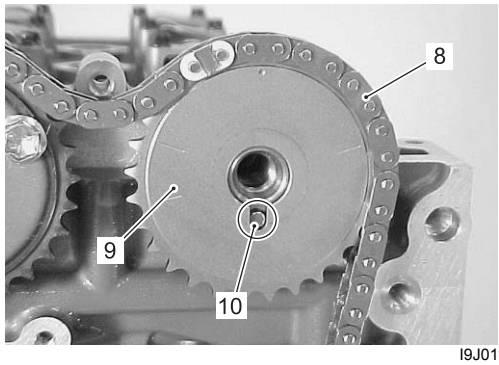
- **Intake sprocket bolt is LH thread.**
- **Hold camshaft by placing a wrench on the hexagon area of the camshaft.**



I9J011140169-01

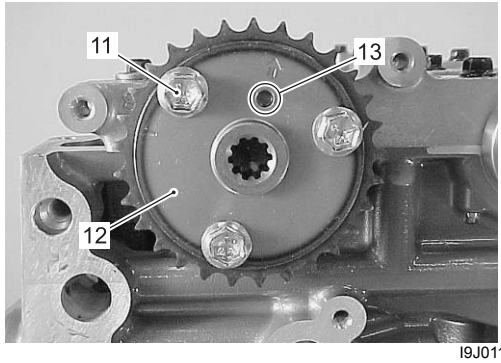
http://SelfFixer.com

7) Remove timing chain (8), IN. camshaft timing sprocket (9) and dowel pin (10).



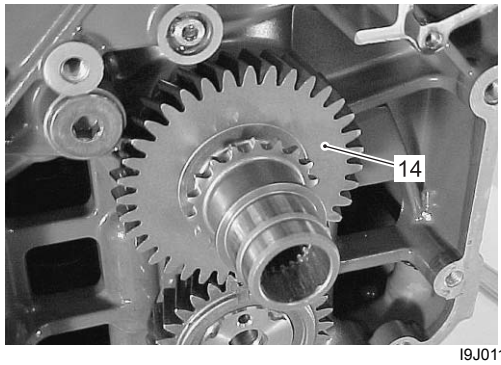
I9J011140170-02

8) Remove three bolts (11) and EX. camshaft timing sprocket (12) and dowel pin (13).



I9J011140171-01

9) Remove driven gear (14).

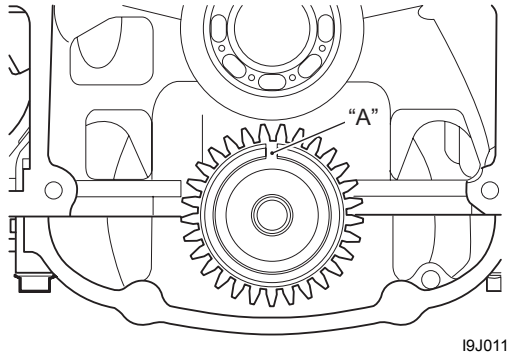


I9J011140172-01

Installation

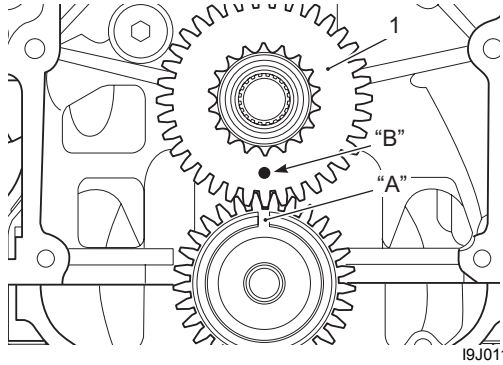
Installation is reverse order of removal with special attention to the following steps.

1) Check that match mark “A” on the crankshaft drive gear points to 12 o’clock position (towards cylinder head).



I9J011140023-05

2) Install the driven gear (1) on the cylinder block so that match mark “A” aligns with match mark “B” on the driven gear as shown in illustration.



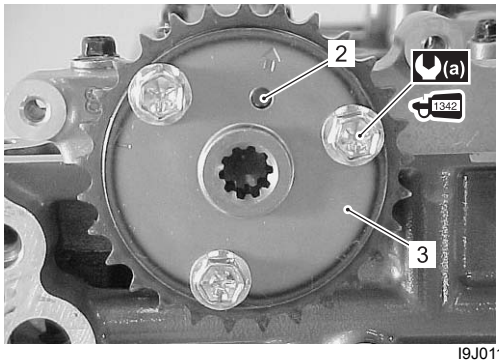
I9J011140024-04

http://SelfFixer.com

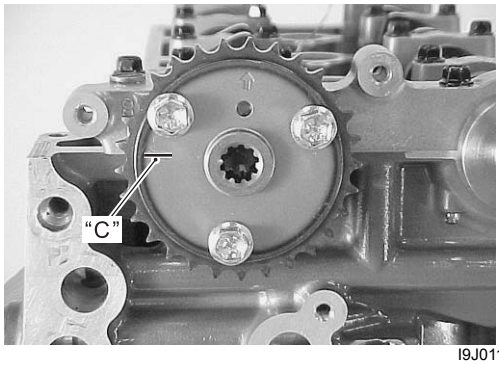
3) Fit the dowel pin (2) onto EX. camshaft.
Install EX. camshaft timing sprocket (3), then tighten sprocket bolts, pre-coated with thread lock, to specified torque.
Check that engraved line “C” on sprocket is correctly aligned with mating face of cylinder head cover.

Tightening torque
EX. timing sprocket bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)

1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011140173-01



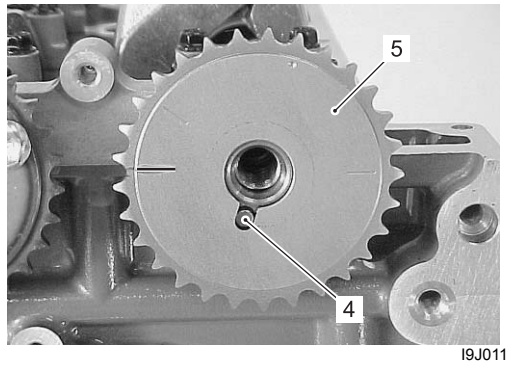
I9J011140174-02

4) Install dowel pin (4) and IN. camshaft timing sprocket (5), then tighten sprocket bolt to specified torque.
Check that engraved line “D” on sprocket is correctly aligned with mating face of cylinder head cover.

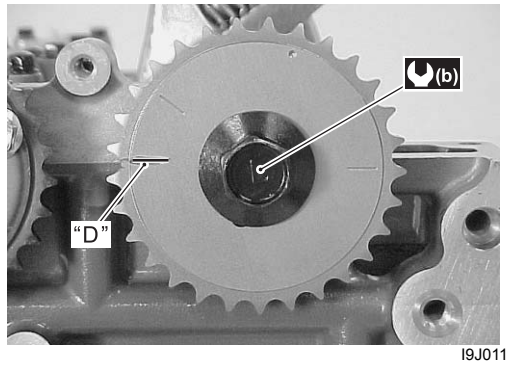
NOTE

When installing camshaft sprocket, position side of sprocket with two engraved lines facing down toward engine holder as shown figure.

Tightening torque
IN. timing sprocket bolt (b): 78 N·m (7.8 kgf-m, 56 lbf-ft)

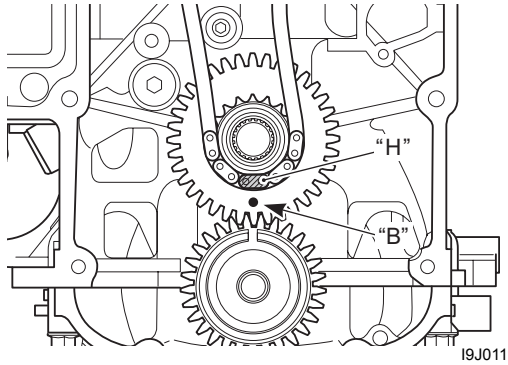


I9J011140175-02



I9J011140176-03

5) As shown in figure, position timing chain on driven gear sprocket with yellow plate “H” of chain aligned with match mark “B” on driven gear.

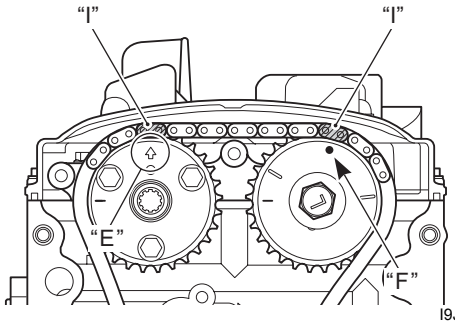


I9J011140026-01

6) As shown in figure, engage timing chain with exhaust sprocket with one BLUE plate “I” of chain aligned with match mark (arrow) “E” of exhaust sprocket.

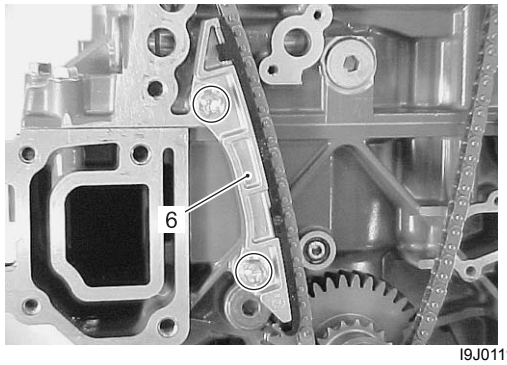
7) As shown in figure, engage timing chain with intake sprocket with another BLUE plate “I” of chain aligned with match mark (●) “F” of intake sprocket.

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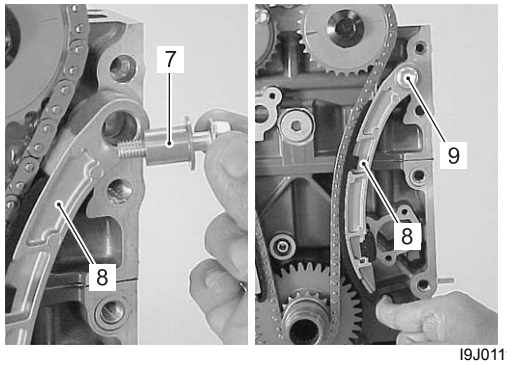
I9J011140025-01

8) Install timing chain guide (6), then tighten bolt securely.



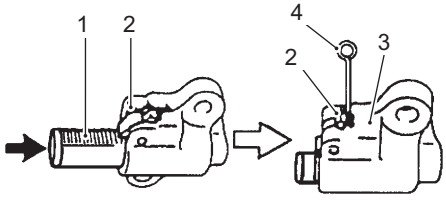
I9J011140177-01

9) Insert the spacer (7) into the chain tensioner (8). Install chain tensioner, then tighten bolt (9) securely. Apply engine oil to chain tensioner.



I9J011140178-01

10) With latch of tensioner adjuster (10) 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.

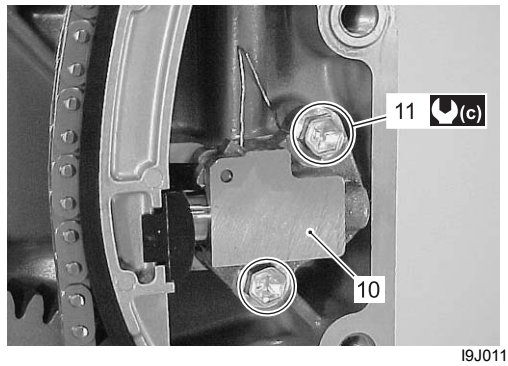


I9J011140179-02

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

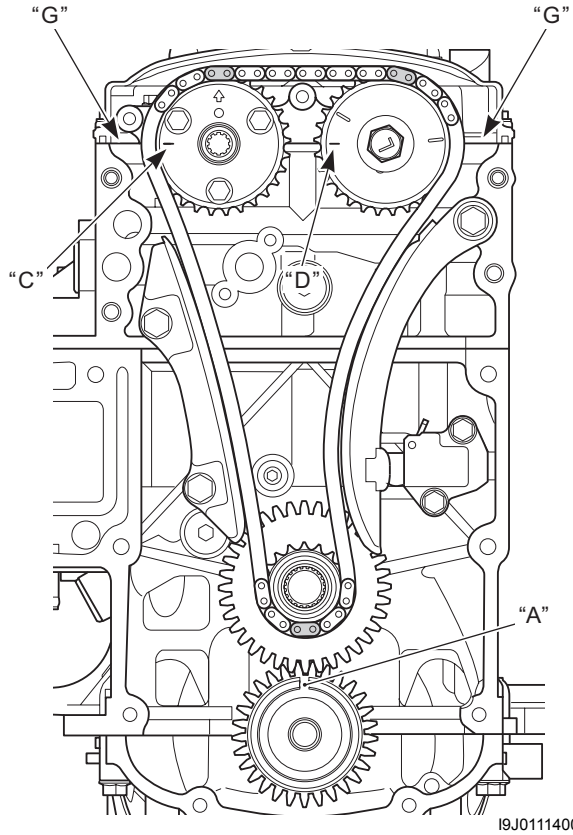
11) Install timing chain tensioner adjuster (10), then tighten bolts (11) to specified torque.

Tightening torque
Tensioner adjuster bolt (c): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



I9J011140180-01

12) Apply engine oil to timing chain.
13) Remove the stopper from tensioner adjuster to release plunger.
14) Turn crankshaft in normal running direction two complete turns and check that crankshaft match mark "A" points toward the top and at the same time, engraved lines "C" and "D" on sprockets aligns with cylinder head cover mating face "G".



I9J011140008-04

15) Install oil pump.
Refer to "Oil Pump Removal and Installation" in Section 1E (Page 1E-3).

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Timing Chain, Chain Tensioner and Camshaft Sprockets Inspection

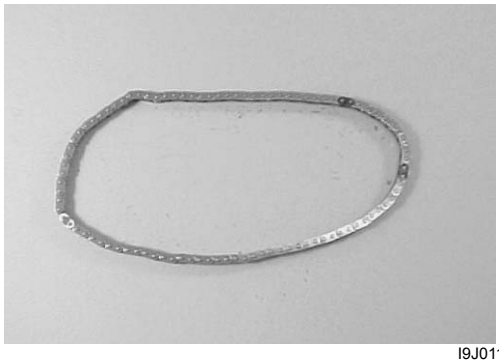
Z9J0111406012

NOTE

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

Timing Chain

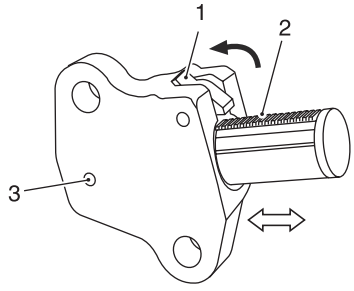
Inspect timing chain for wear or damage.
If excessive wear or other damage is found, replace it.



I9J011140181-01

Tensioner Adjuster

Inspect tensioner adjuster for smooth operation.
Replace if fault is noted.
Check oil delivery passage to tensioner.



I9J011140182-01

1. Latch	3. Oil passage
2. Tooth surface	

Timing Chain Tensioner/Chain Guide

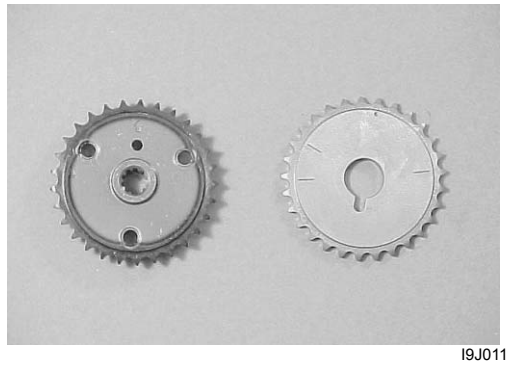
- Check chain tensioner shoe for wear or damage.
  If excessive wear or other damage is found, replace it.
- Check chain guide shoe for wear or damage.
  If excessive wear or other damage is found, replace it.



I9J011140183-01

Camshaft Timing Sprocket

Check teeth of sprocket for wear or damage.
If excessive wear or other damage is found, replace it.



I9J011140184-01

Driven Gear and Driven Gear Bearing

- Inspect driven gear.
  Replace gear if damaged or worn excessively.
- Check driven gear bearing.
  Replace bearing if pitted, noisy, or rough condition.



I9J011140185-01

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Camshaft, Tappet and shim Removal and Installation

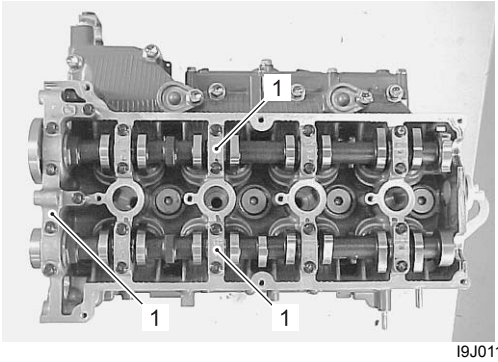
Z9J0111406013

Removal

1) Remove the oil pump.
   Refer to “Oil Pump Removal and Installation” in Section 1E (Page 1E-3).
2) Remove the timing chain and chain tensioner.
   Refer to “Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation” (Page 1D-20).
3) Remove the bolts securing camshaft housing (1) to cylinder head, then remove each camshaft housing.

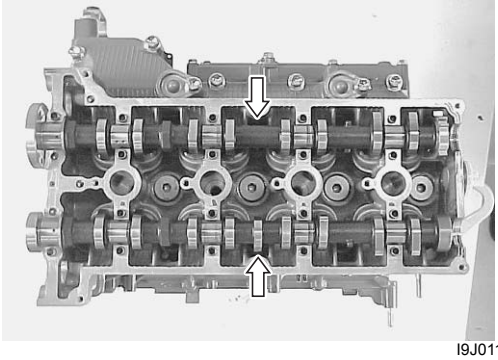
NOTE

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



I9J011140186-01

4) Remove intake and exhaust camshaft.



I9J011140187-01

5) Remove tappets and tappet shims.

NOTE

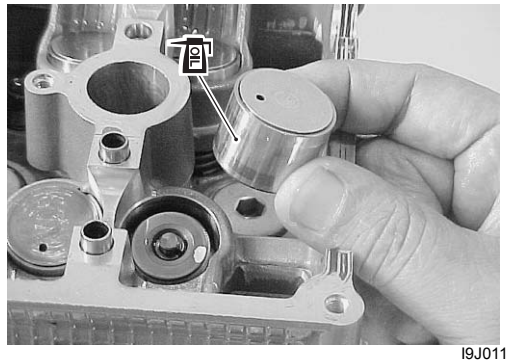
All tappets and tappet shims must be installed in their original positions.
For ease of assembly, lay out tappets and record shim thickness for each individual cylinder / valve position.



I9J011140188-01

Installation

1) Apply engine oil around tappets and install them.
2) Install tappet shims.



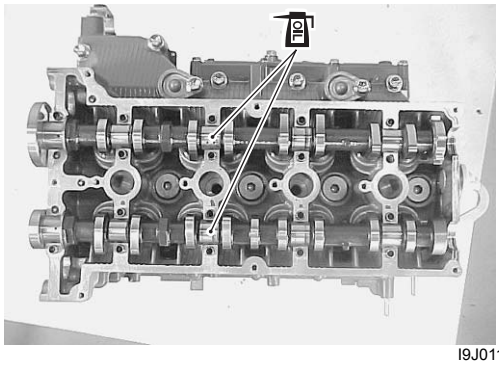
I9J011140189-01

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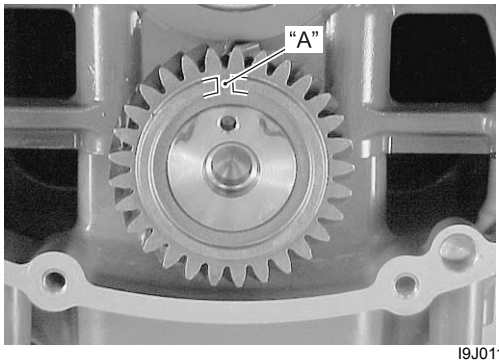
3) Apply engine oil to surface of each camshaft lobe and journal, then install them.

NOTE

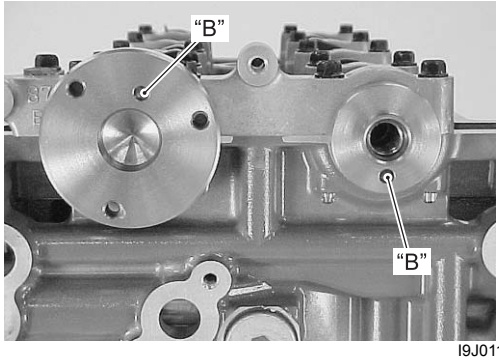
- **Before installing camshafts, turn crankshaft until the match mark "A" on the crankshaft drive gear points to 12 o'clock (toward cylinder head).**
- **Install camshaft so that dowel pin hole "B" on the camshaft is positioned as shown.**



I9J011140190-01

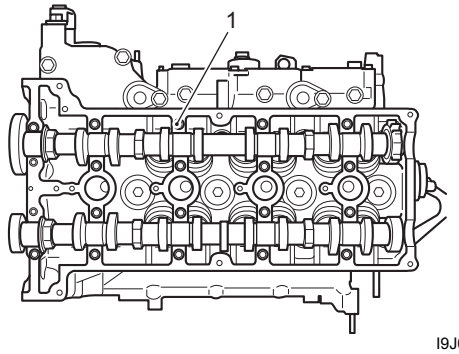


I9J011140191-01



I9J011140192-01

4) Install camshaft housing pins as shown figure.



I9J011140193-05

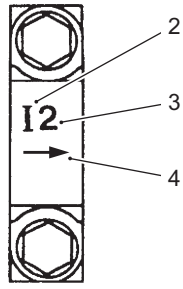
1.	Pin

5) Check position of camshaft housing.

NOTE

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

6) Install housing as indicated by these marks.



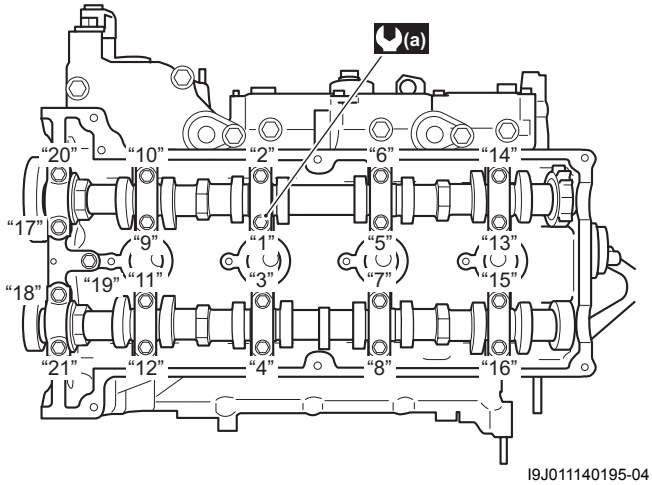
I9J011140194-03

2.	I: Intake side E: Exhaust side
3.	Position from flywheel magneto side
4.	pointing to flywheel magneto side

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7) Apply engine oil lightly to housing bolts.
8) Lightly seat all housing bolts.
According to numerical order in figure, tighten bolts to 1/3 of specified torque, then 2/3 of specified torque and finally to full specified torque.

Tightening torque
Camshaft housing bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



I9J011140195-04

9) Install timing chain.
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-20).
10) Adjust tappet clearance.
11) Install oil pump.
Refer to "Oil Pump Removal and Installation" in Section 1E (Page 1E-3).

Camshaft, Tappet and Shim Inspection

Z9J0111406014

NOTE

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

Cam Face
Inspect cam face for scratches and wear.
If any of the above conditions are found, replace camshaft.

Cam Wear
Using micrometer, measure cam height.
If measurement exceeds service limit, replace camshaft.

Cam height "a" (for DF70A)

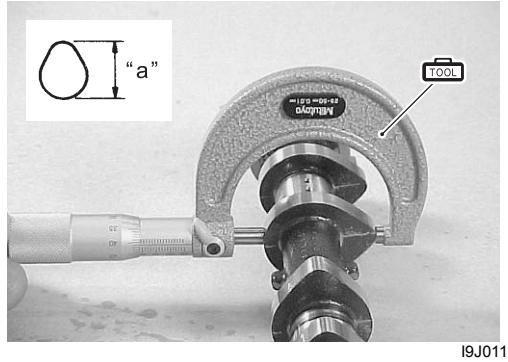
	Standard	Service limit
IN	38.620 – 38.780 mm (1.5205 – 1.5268 in)	38.520 mm (1.5165 in)
EX	40.920 – 41.080 mm (1.6110 – 1.6173 in)	40.820 mm (1.6071 in)

Cam height "a" (for DF80A)

	Standard	Service limit
IN	39.620 – 39.780 mm (1.5598 – 1.5661 in)	39.520 mm (1.5559 in)
EX	40.920 – 41.080 mm (1.6110 – 1.6173 in)	40.820 mm (1.6071 in)

Cam height "a" (for DF90A)

	Standard	Service limit
IN	41.120 – 41.280 mm (1.6189 – 1.6252 in)	41.020 mm (1.6150 in)
EX	40.920 – 41.080 mm (1.6110 – 1.6173 in)	40.820 mm (1.6071 in)



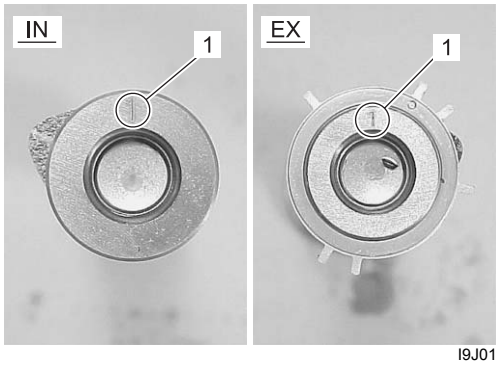
I9J011140196-01

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Camshaft Identification
DF70A, DF80A and DF90A camshafts differ as indicated below.

Identification mark

Model	Identification mark	
	Intake	Exhaust
DF70A	2	0
DF80A	0	0
DF90A	1	1



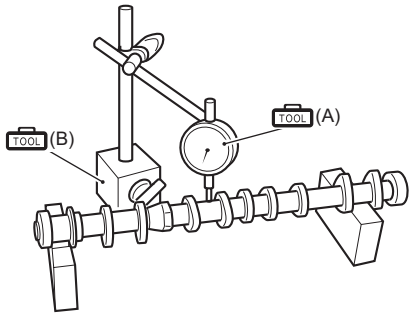
I9J011140197-01

1. Identification mark

Camshaft Runout
Support camshaft on a surface plate using a set of V-blocks.
Measure runout using a dial gauge.
If measurement exceeds service limit, replace camshaft.

Special tool
TOOL (A): 09900–20606 (Dial gauge)
TOOL (B): 09900–20701 (Magnetic stand)

Camshaft runout
Service limit: 0.10 mm (0.0039 in.)

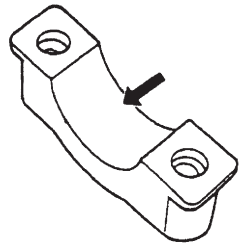


I9J011140198-02

Camshaft Journal Wear
Check camshaft journals and camshaft housings 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.

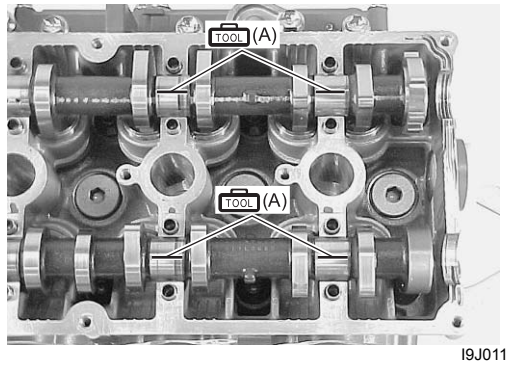


I9J011140030-01

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).

Special tool
TOOL (A): 09900–22301 (Plastigauge (0.025 – 0.076 mm))



I9J011140199-02

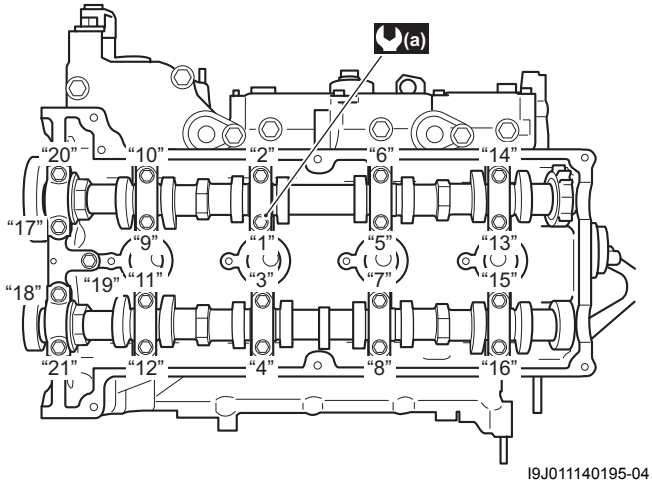
http://SelfFixer.com

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.

Tightening torque
Camshaft housing bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)

NOTE

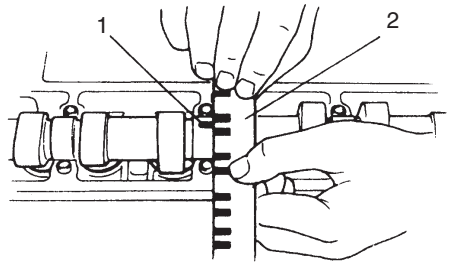
Do not rotate camshaft while Plastigauge is installed.



I9J011140195-04

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

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



I9J011140075-01

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.

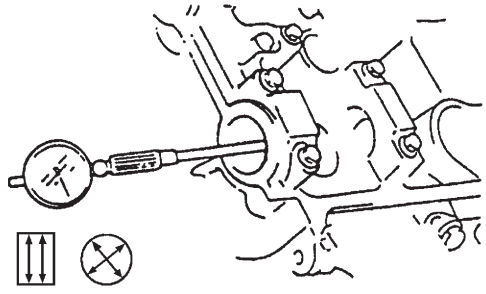
Camshaft journal outside diameter No. 1 – No. 4
Standard: 22.934 – 22.955 mm (0.9029 – 0.9037 in.)

Camshaft journal outside diameter No. 5
Standard: 25.936 – 25.957 mm (1.0211 – 1.0219 in.)

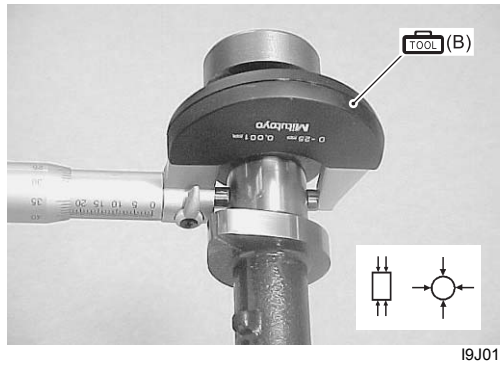
Camshaft journal (housing) inside diameter No. 1 – No. 4
Standard: 23.000 – 23.021 mm (0.9055 – 0.9063 in.)

Camshaft journal (housing) inside diameter No. 5
Standard: 26.000 – 26.021 mm (1.0236 – 1.0244 in.)

Special tool
TOOL (B): 09900–20202 (Micrometer (25 – 50 mm))
TOOL (B): 09900–20205 (Micrometer (0 – 25 mm))



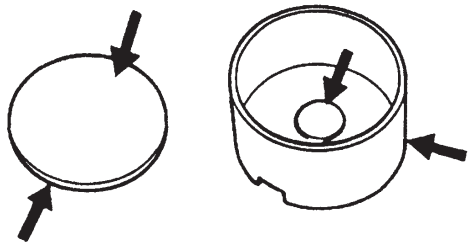
I9J011140200-02



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



I9J011140076-01

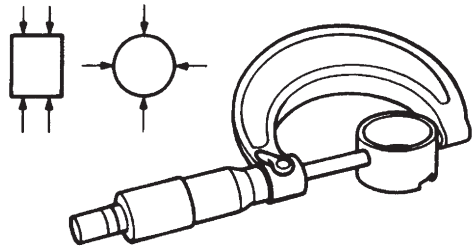
Measure cylinder head bore and tappet outside diameter to determine cylinder head to tappet clearance.
If clearance exceeds service limit, replace tappet or cylinder head.

Special tool
TOOL : 09900–20202 (Micrometer (25 – 50 mm))

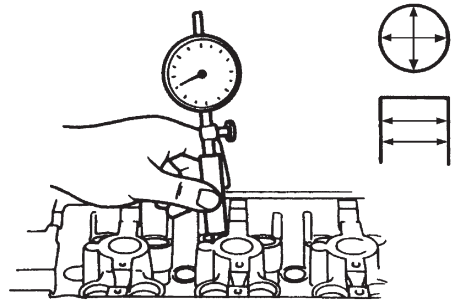
Cylinder head bore to tappet clearance
Standard: 0.025 – 0.062 mm (0.0010 – 0.0024 in.)
Service limit: 0.150 mm (0.0059 in.)

Tappet outer diameter
Standard: 27.959 – 27.975 mm (1.1007 – 1.1014 in.)

Cylinder head tappet bore
Standard: 28.000 – 28.021 mm (1.1024 – 1.1032 in.)



I9J011140031-01

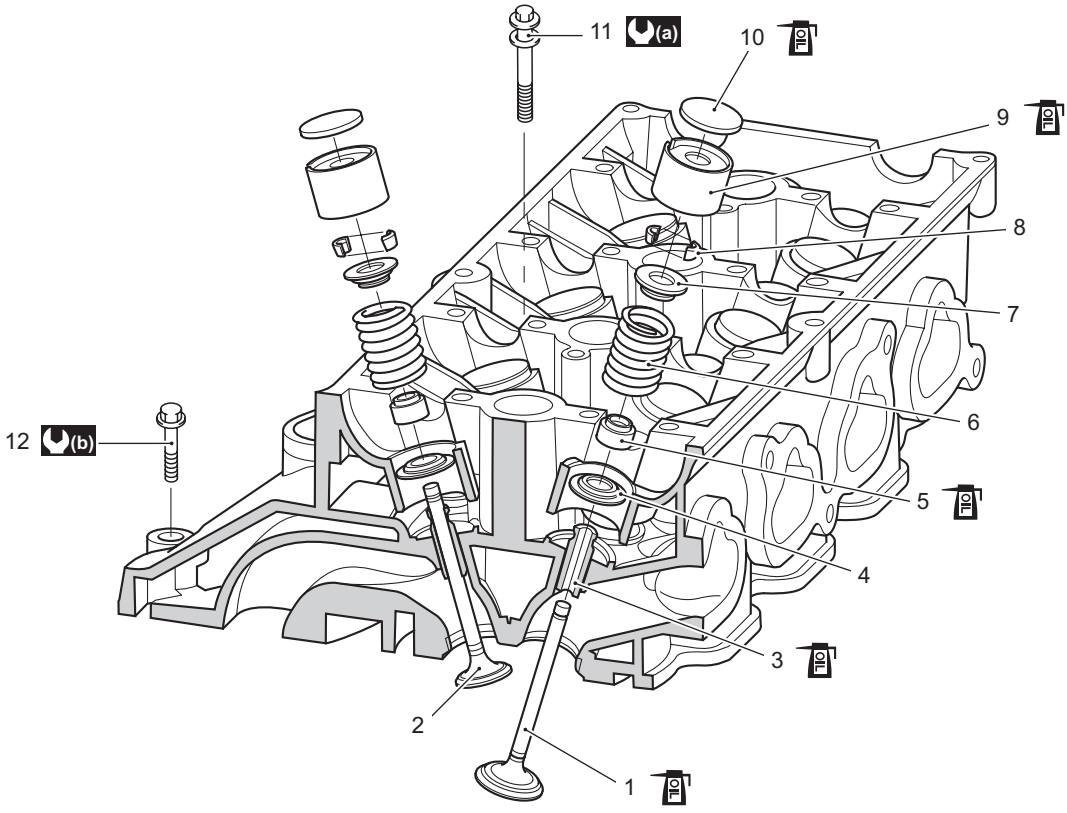


I9J011140032-01

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Cylinder Head Assembly Components

Z9J0111406015



I9J011140004-04

1. Intake valve	5. Valve stem seal	9. Tappet	(a) : 70 N·m (7.0 kgf-m, 50.5 lbf-ft)
2. Exhaust valve	6. Valve spring	10. Tappet shim	(b) : 23 N·m (2.3 kgf-m, 16.5 lbf-ft)
3. Valve guide	7. Valve spring retainer	11. Cylinder head bolt (10 mm)	OIL : Apply engine oil.
4. Valve spring seat	8. Valve cotter	12. Cylinder head bolt (8 mm)	

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Cylinder Head Removal and Installation

Z9J0111406016

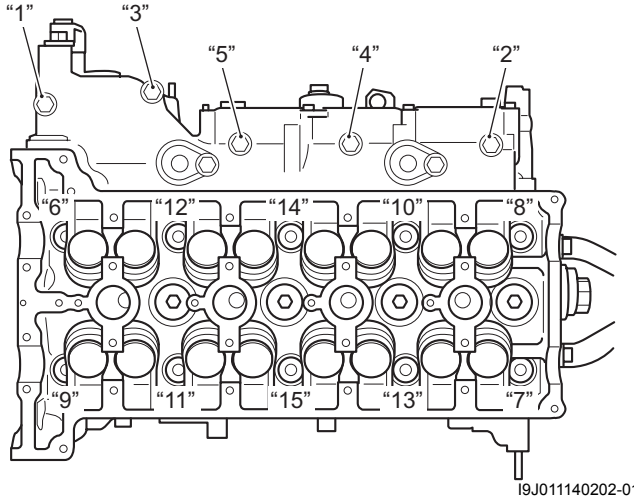
Removal

1) Prior to removing cylinder head assembly;
   - Remove the power unit.
     Refer to “Power Unit Removal and Installation” (Page 1D-11).
   - Remove the timing chain.
     Refer to “Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation” (Page 1D-20).
   - Remove the IN. and EX. camshafts.
     Refer to “Camshaft, Tappet and shim Removal and Installation” (Page 1D-25).
2) Loosen and remove fifteen cylinder head bolts in the order indicated in figure.
   Remove cylinder head assembly and head gasket.

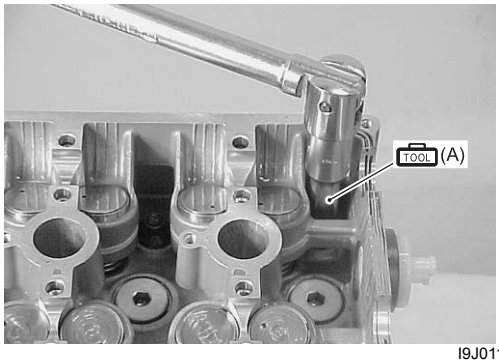
NOTE

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

Special tool
TOOL (A): 09919–16010 (Deep socket wrench (10 mm))



I9J011140202-01



I9J011140203-01

Installation

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

CAUTION

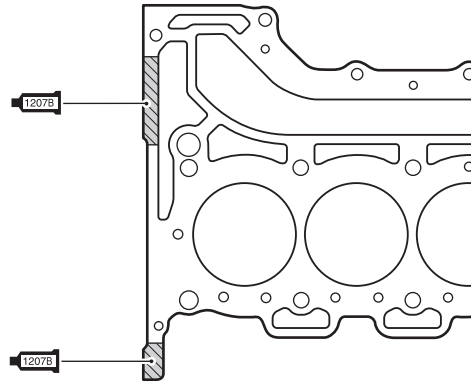
Do not reuse gasket. Always use a new gasket.

1) Insert the dowel pins (1) and place a new cylinder head gasket (2) into position on the cylinder.

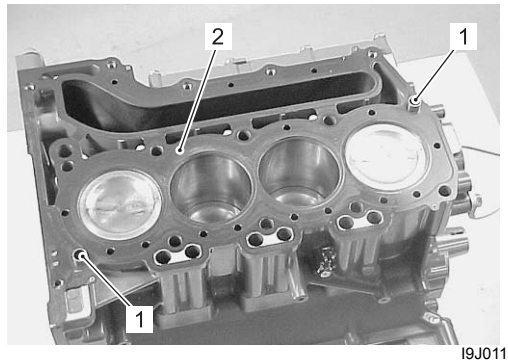
NOTE

Before installing cylinder head gasket, apply sealant to both surfaces of the hatched areas shown in illustration.

1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))



I9J011140027-02



I9J011140204-01

2) Position cylinder head on cylinder.

NOTE

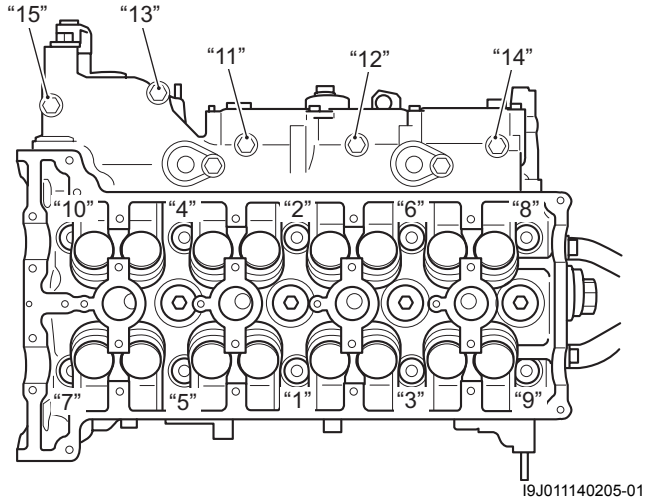
Use special tool (10 mm deep socket wrench) when tightening cylinder head bolts.

Special tool
TOOL : 09919–16010 (Deep socket wrench (10 mm))

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3) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
   a) Tighten all cylinder head bolts to 50 percent (%) of specified torque according to sequence in figure.

      Tightening torque
      Cylinder head bolt (1st step) [10 mm]: 35 N·m (3.5 kgf-m, 25.5 lbf-ft)
      Cylinder head bolt (1st step) [8 mm]: 12 N·m (1.2 kgf-m, 8.5 lbf-ft)



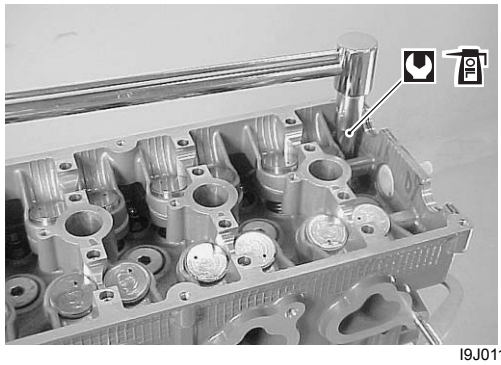
I9J011140205-01

   b) Loosen all cylinder head bolts to 0 N·m (0 kgf-m, 0 lbf-ft.) according to reverse sequence in figure.
   c) Again tighten all cylinder head bolts to 50 percent (%) of specified torque according to sequence in figure.

      Tightening torque
      Cylinder head bolt (3rd step) [10 mm]: 35 N·m (3.5 kgf-m, 25.5 lbf-ft)
      Cylinder head bolt (3rd step) [8 mm]: 12 N·m (1.2 kgf-m, 8.5 lbf-ft)

   d) Finally tighten all cylinder head bolts to specified torque according to sequence in figure.

      Tightening torque
      Cylinder head bolt (Final step) [10 mm]: 70 N·m (7.0 kgf-m, 50.5 lbf-ft)
      Cylinder head bolt (Final step) [8 mm]: 23 N·m (2.3 kgf-m, 16.5 lbf-ft)



I9J011140206-01

4) Install the IN. and EX. camshafts.
   Refer to "Camshaft, Tappet and shim Removal and Installation" (Page 1D-25).
5) Install the timing chain.
   Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-20).

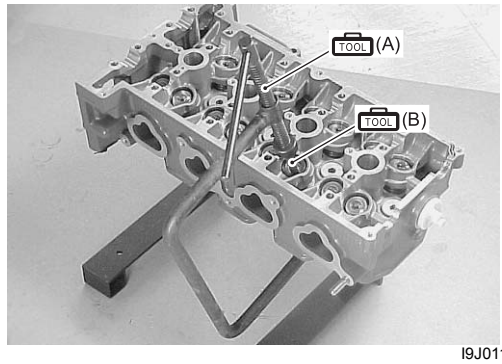
Cylinder Head Disassembly and Assembly

Z9J0111406017

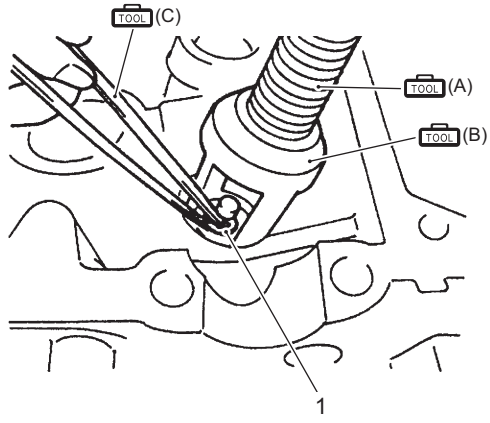
Disassembly

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

   Special tool
   TOOL (A): 09916–19030 (Valve lifter)
   TOOL (B): 09916–14521 (Valve lifter attachment)
   TOOL (C): 09916–84511 (Tweezers)

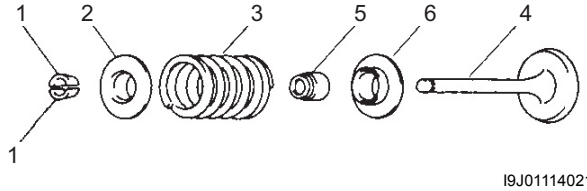


I9J011140207-01



I9J011140209-01

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



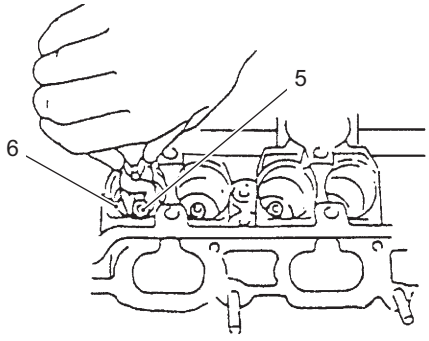
I9J011140210-01

http://SelfFixer.com

3) Remove valve stem seal (5) and valve spring seat (6).

NOTE

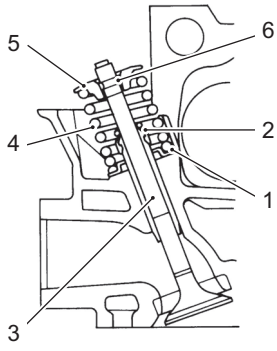
Reassemble each valve and valve spring in their original positions.



I9J011140211-02

Assembly

Reassemble in reverse order of disassembly paying special attention to the following steps.



I9J011140212-03

1) Install valve spring seat (1) to cylinder head.
2) After applying engine oil to stem seal (2) and spindle of special tool (A), 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.

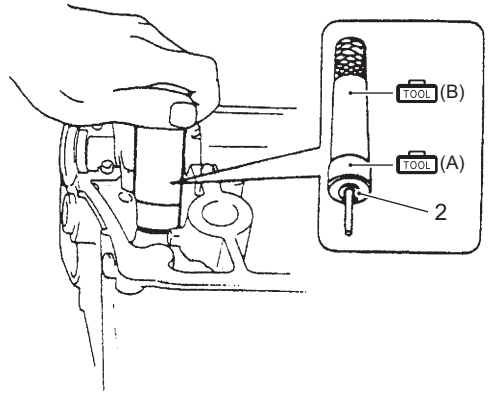
CAUTION

Do not reuse stem seal once removed. Always install new seal.

Special tool

TOOL (A): 09917–98221 (Valve guide stem seal installer attachment)

TOOL (B): 09916–58210 (Valve guide installer handle)

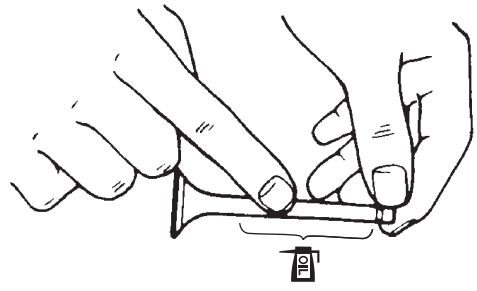


I9J011140033-03

3) Apply engine oil to stem seal, valve guide bore and valve stem.
4) Install valve (3) to valve guide.

NOTE

Reassemble each valve and valve spring to their original position.

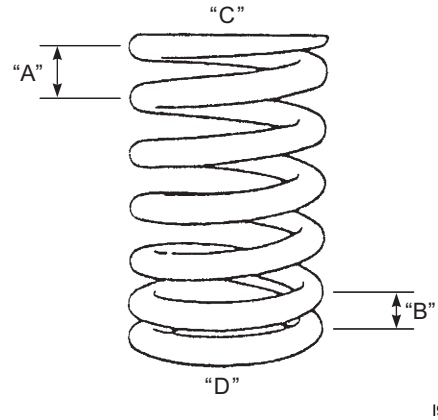


I9J011140034-01

5) Install valve spring (4), and valve retainer (5).

NOTE

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



I9J011140035-01

"A": Large-pitch	"C": Valve spring retainer side
"B": Small-pitch	"D": Valve spring seat side

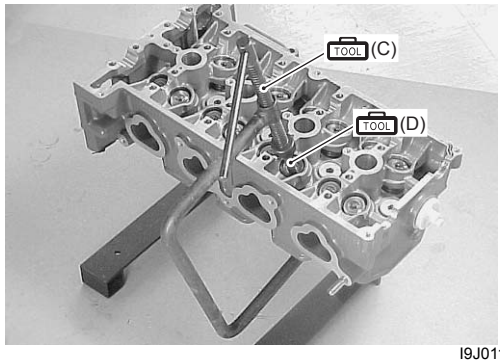
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6) Hold valve spring compressed with special tool and install valve cotters (6).
Make sure valve cotters are properly seated in groove “A”.

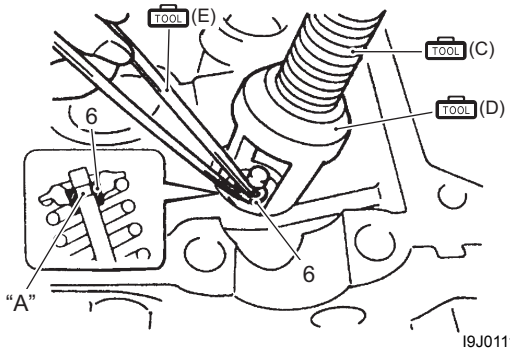
NOTE

When compressing the valve spring, be careful not to damage the tappet hole.

Special tool
(C): 09916–19030 (Valve lifter)
(D): 09916–14521 (Valve lifter attachment)
(E): 09916–84511 (Tweezers)



I9J011140213-02



I9J011140036-02

Cylinder Head Components Inspection and Servicing

Z9J0111406018

NOTE

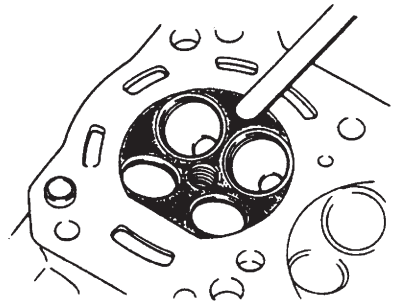
If cracks, excessive wear or other damage is found on any component, replace component.

Cylinder Head

- Remove all carbon from combustion chambers.

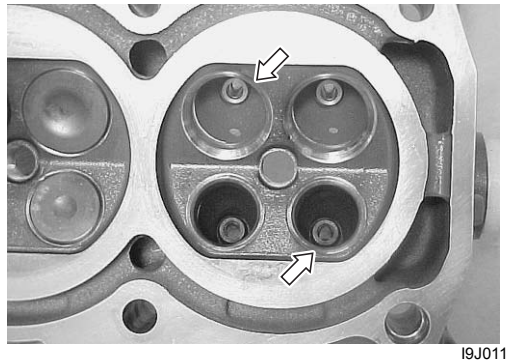
NOTE

- **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 decarbonizing.**



I9J011140037-01

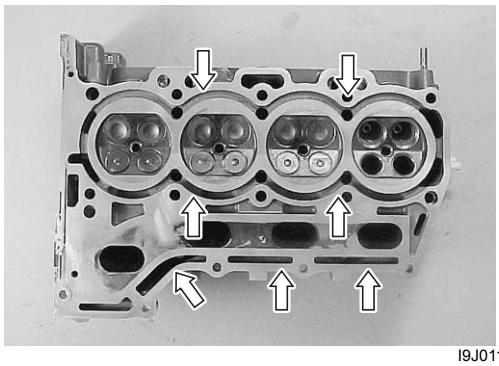
- Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.
- Check valve seat, if cracks or other damage is found, replace cylinder head.



I9J011140214-01

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



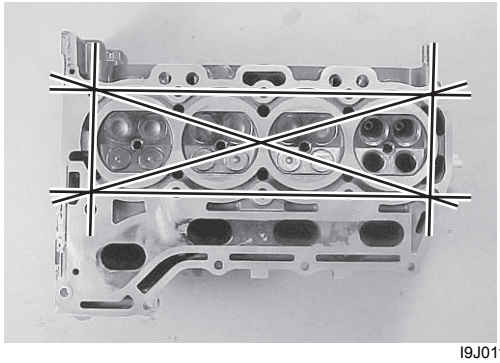
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Cylinder head distortion

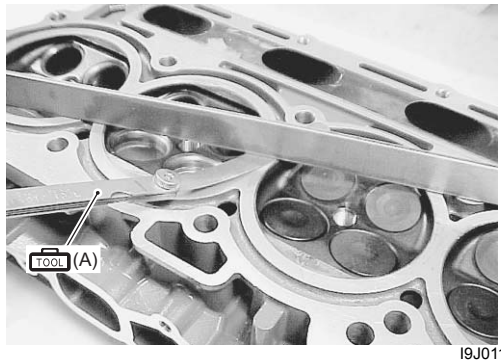
- Using a straightedge and thickness gauge, measure cylinder head distortion (gasket surface) at a total of six locations as shown.
  If measurement exceeds service limit, resurface or replace cylinder head.

  Special tool
  TOOL (A): 09900–20803 (Thickness gauge)

  Cylinder head distortion
  Service limit: 0.03 mm (0.001 in.)



I9J011140216-03

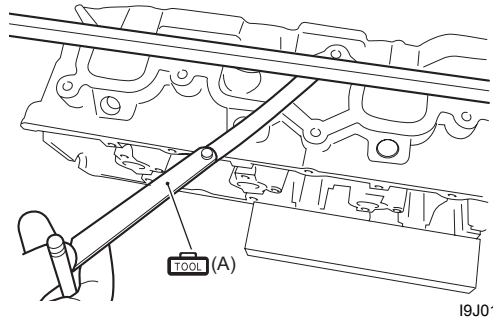


I9J011140217-01

Manifold seating faces distortion
Using a straightedge and thickness gauge, check cylinder head to manifold seating faces.
If measurement exceeds service limit, resurface or replace cylinder head.

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

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



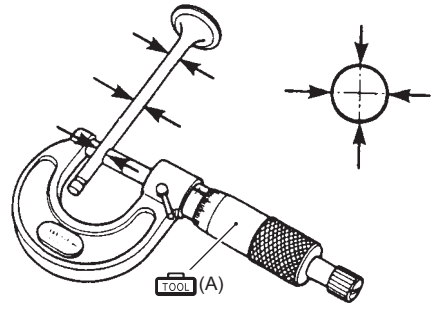
I9J011140038-01

Valve and 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.
If measurement exceeds service limit, replace valve and/or valve guide. Refer to “Valve guide replacement” (Page 1D-40).

Special tool
TOOL (A): 09900–20205 (Micrometer (0 – 25 mm))

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.)
Standard (EX.): 5.440 – 5.455 mm (0.2142 – 0.2148 in.)

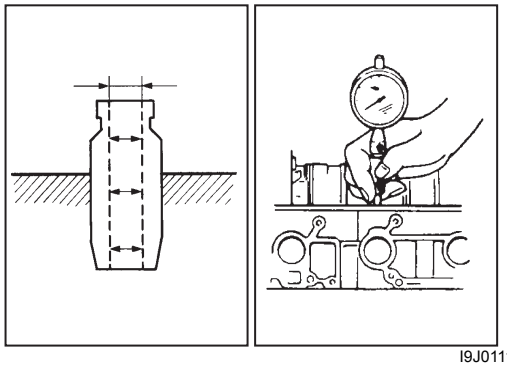


I9J011140039-02

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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.)
Standard (EX.): 5.500 – 5.512 mm (0.2165 – 0.2170 in.)


I9J011140040-01

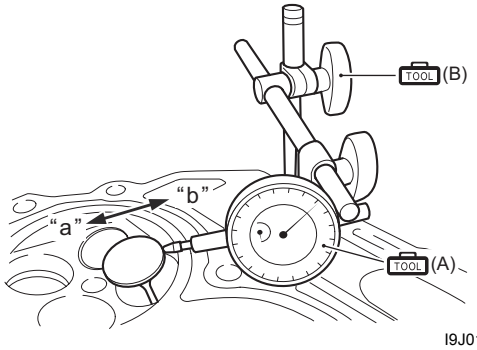
Valve guide to valve stem clearance
Standard (IN.): 0.020 – 0.047 mm (0.0008 – 0.0019 in.)
Standard (EX.): 0.045 – 0.072 mm (0.0018 – 0.0028 in.)
Service limit (IN.): 0.070 mm (0.0028 in.)
Service limit (EX.): 0.090 mm (0.0035 in.)

Valve stem deflection
If unable to measure valve guide inside diameter, check "Valve stem deflection".
If measurement exceeds service limit, replace valve.
If measurement still exceeds service limit with new valve, replace valve guide.
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 "a" – "b", and measure deflection.

Special tool
TOOL (A): 09900–20606 (Dial gauge)
TOOL (B): 09900–20701 (Magnetic stand)

Valve stem deflection
Service limit (IN.): 0.14 mm (0.0055 in.)
Service limit (EX.): 0.18 mm (0.0071 in.)



I9J011140218-01

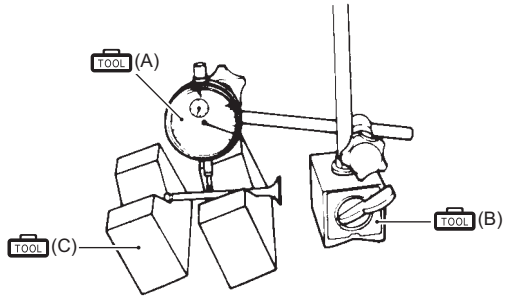
Valve stem end
Inspect valve stem end face for pitting and wear.
If pitting or wear is found, valve stem end may be resurfaced.
Use caution when resurfacing, do not grind away stem end chamfer.
When chamfer has been worn away, replace valve.


I9J011140041-01

Valve stem runout
Measure valve stem runout.
If measurement exceeds service limit, replace valve.

Special tool
TOOL (A): 09900–20606 (Dial gauge)
TOOL (B): 09900–20701 (Magnetic stand)
TOOL (C): 09900–21304 (Steel "V" block set)

Valve stem runout
Service limit: 0.05 mm (0.0020 in.)



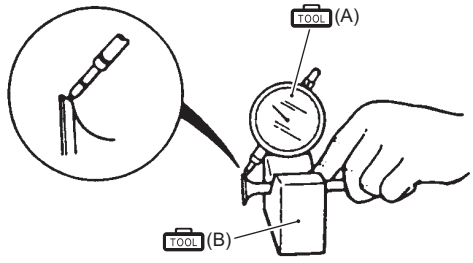
I9J011140042-02

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Valve head radial runout
Measure valve head radial runout.
To measure runout, rotate valve slowly.
If measurement exceeds service limit, replace valve.

Special tool
(A): 09900–20606 (Dial gauge)
(B): 09900–21304 (Steel "V" block set)
: 09900–20701 (Magnetic stand)

Valve head radial runout
Service limit: 0.08 mm (0.0031 in.)

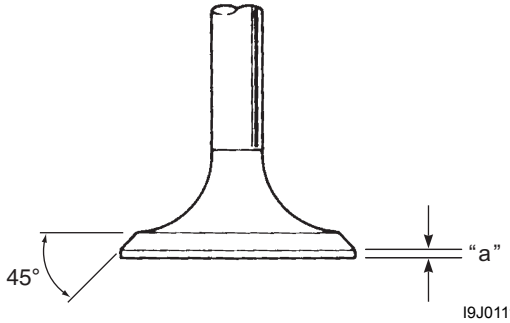


I9J011140043-03

Valve head thickness
Measure thickness "a" of valve head.
If measurement exceeds service limit, replace valve.

Special tool
: 09900–20101 (Vernier calipers (150 mm))

Valve head thickness
Standard (IN.): 0.75 mm (0.03 in.)
Standard (EX.): 0.95 mm (0.04 in.)
Service limit (IN.): 0.5 mm (0.02 in.)
Service limit (EX.): 0.7 mm (0.03 in.)

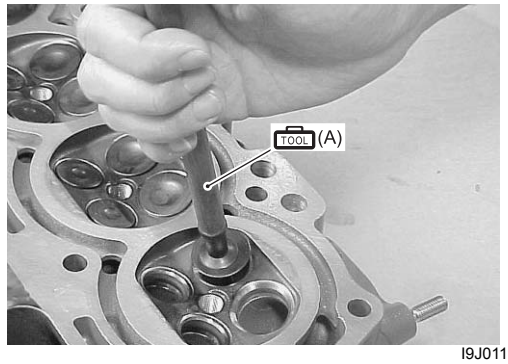


I9J011140044-01

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.

Special tool
(A): 09916–10911 (Valve lapper)



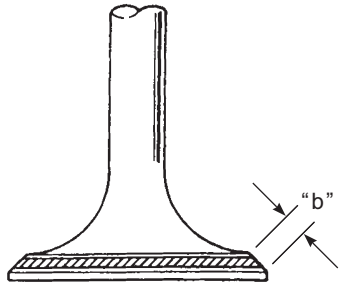
I9J011140219-01

5) Rotate valve while gently tapping valve contact area against seat.
6) Continue until a pattern is on valve seat face with prussian blue.
7) Measure valve seat contact width "b".

Special tool
: 09900–20101 (Vernier calipers (150 mm))

Valve seat contact width "b"
Standard (IN., EX.): 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

If measurement exceeds specification, repair valve seat. Refer to "Valve seat servicing" (Page 1D-39).

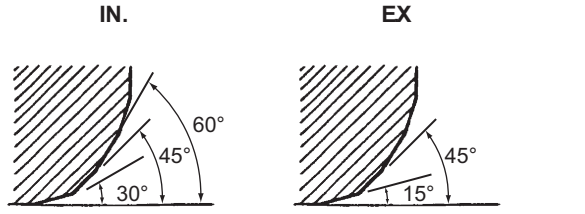


I9J011140045-01

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

Valve seat angle
Intake side: 30° / 45° / 60°
Exhaust side: 15° / 45°



I9J011140046-02

To reface a valve seat, use the following valve seat cutting tool.

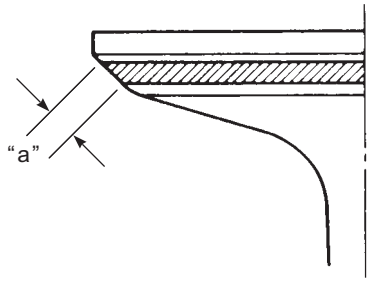
- Valve seat cutter 45° (Neway 122)
- Valve seat cutter 30° (Neway 126)
- Valve seat cutter 15° (Neway 120)
- Valve seat cutter 60° (Neway 111)
- Solid pilot (Neway, N-100-5.52) (09916-24450)
- Handle (Neway, N-505) (09916-54910)

NOTE

Turn cutter clockwise, never counterclockwise.

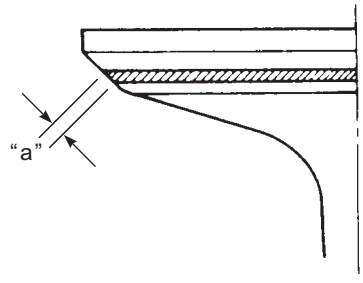
1) Remove all carbon from valve and valve seat.
2) Using 45° angle cutter, reface valve seat.
3) Check valve seat contact width “a”.
   Refer to “Valve seat contact width” (Page 1D-38).

Too high (wide)



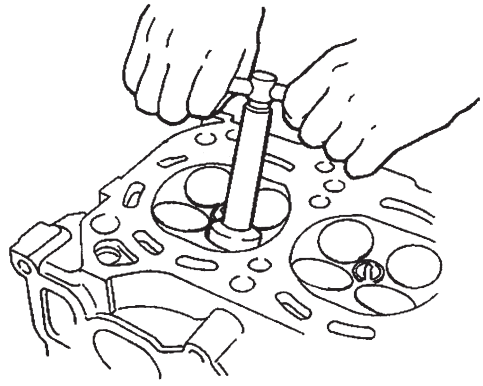
I9J011140047-01

Too low (narrow)



I9J011140048-01

- If width “a” is too high (or wide), reface valve seat using small angle cutter (Intake side: 30°, Exhaust side: 15°).
- If width “a” is too low (or narrow), reface valve seat using 60° angle cutter (Intake side).
- If width “a” is too low (or narrow), reface valve seat using 45° angle cutter (Exhaust side).


I9J011140049-01

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

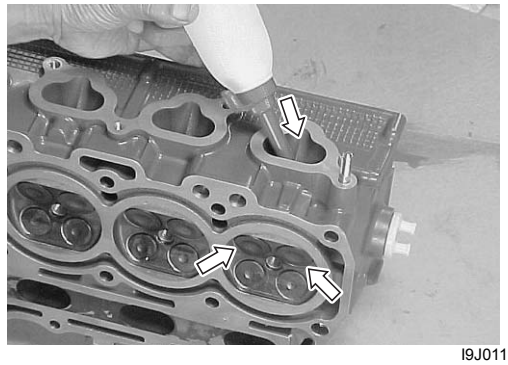
CAUTION

Cut seat areas minimally only.
Do not cut more than necessary.

5) Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.
6) Recheck valve seat contact width “a”.

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.


I9J011140220-01

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Valve guide replacement

CAUTION

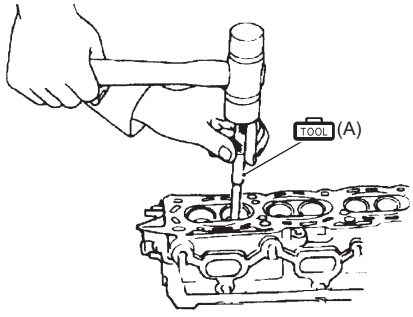
Be careful not to damage cylinder head when replacing valve guide.

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

NOTE

Do not reuse valve guide once it has been removed.
Always use a new valve guide (oversize) when assembling.

Special tool
(A): 09916–44310 (Valve guide remover)



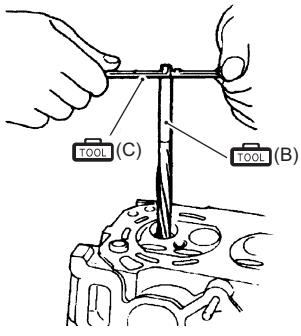
I9J011140050-01

2) Ream valve guide hole with ϕ 10.5 mm reamer to true hole and remove burrs.

NOTE

Turn reamer clockwise, never counterclockwise.

Special tool
(B): 09916–37320 (Valve guide reamer (ϕ 10.5 mm))
(C): 09916–34542 (Valve guide reamer handle)



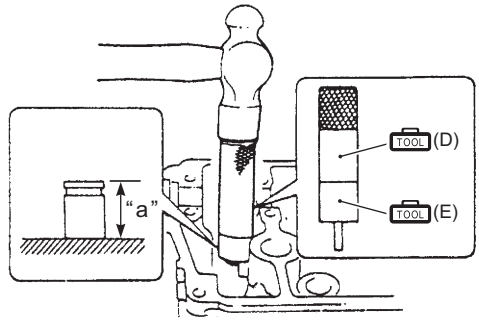
I9J011140051-01

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 “a”.

Special tool
(D): 09916–58210 (Valve guide installer handle)
(E): 09917–87010 (Valve guide installer attachment)

Valve guide protrusion “a”
Standard (IN., EX.): 10.8 – 11.6 mm (0.43 – 0.46 in.)



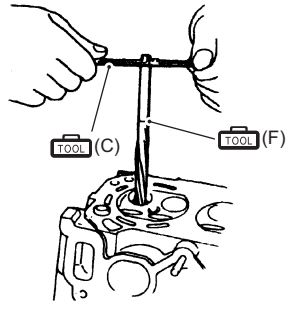
I9J011140052-01

4) Ream valve guide bore with ϕ 5.5 mm reamer.

NOTE

Clean and oil valve guide bore after reaming.

Special tool
(F): 09916–34550 (Valve guide reamer (ϕ 5.5 mm))
(C): 09916–34542 (Valve guide reamer handle)



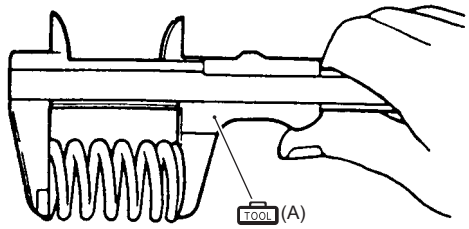
I9J011140053-02

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Valve spring free length
Check spring strength by measuring free length.
If lower than service limit, replace valve spring.

Special tool
TOOL (A): 09900–20101 (Vernier calipers (150 mm))

Valve spring free length
Standard (IN., EX.): 33.1 mm (1.30 in.)
Service limit (IN., EX.) 31.8 mm (1.25 in.)

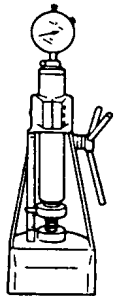


I9J011140054-02

Valve spring preload
Measure valve spring preload.
If lower than service limit, replace valve spring.

Special tool
TOOL : 09900–20101 (Vernier calipers (150 mm))

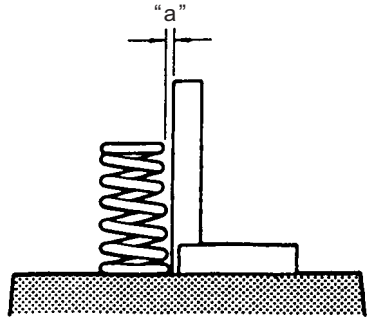
Valve spring preload
Standard (IN., EX.): 95 – 111 N (9.6 – 11.2 kg, 21.1 – 24.6 lbs.) at 28.5 mm (1.22 in.)
Service limit (IN., EX.): 87 N (8.8 kg, 19.4 lbs.) at 28.5 mm (1.22 in.)


I9J011140055-01

Valve spring squareness
Use a square and surface plate to check each spring for squareness (clearance between end of valve spring and square).
If measurement exceeds service limit, replace valve spring.

Special tool
TOOL : 09900–20101 (Vernier calipers (150 mm))

Valve spring squareness “a”
Service limit (IN., EX.): 2.0 mm (0.079 in.)

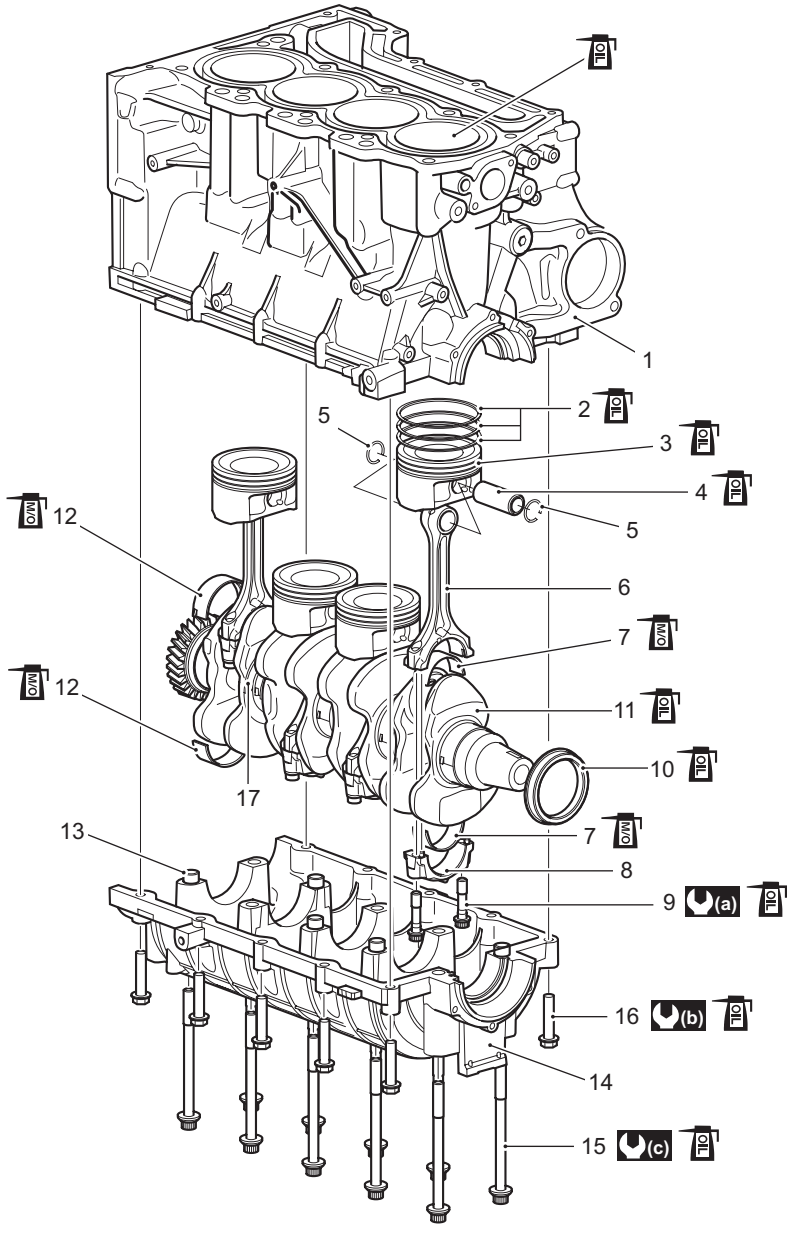


I9J011140056-02

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Pistons, Piston Rings, Connecting Rods, Cylinder and Crankshaft Components

Z9J0111406019



I9J011140005-03

1. Cylinder block	7. Conrod bearing	13. Dowel pin	(b) : 25 N·m (2.5 kgf-m, 18.1 lbf-ft)
2. Piston ring set	8. Conrod cap	14. Crankcase	(c) : 52 N·m (5.2 kgf-m, 37.5 lbf-ft)
3. Piston	9. Conrod bolt	15. Bolt, inside	OIL : Apply engine oil.
4. Piston pin	10. Oil seal	16. Bolt, outside	M/O : Apply Molybdenum oil solution.
5. Circlip	11. Crankshaft	17. Thrust bearing	
6. Conrod	12. Crankshaft main bearing	(a) : 47 N·m (4.7 kgf-m, 34 lbf-ft)	

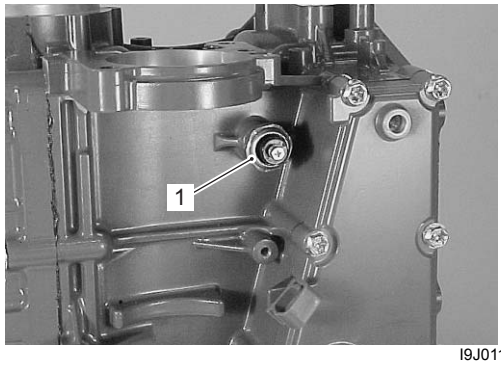
http://SelfFixer.com

Pistons, Piston Rings, Connecting Rods, Cylinder and Crankshaft Disassembly and Assembly

Z9J0111406020

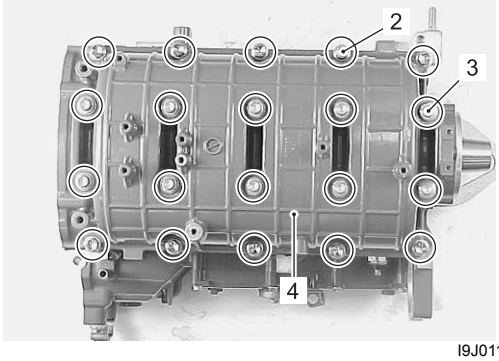
Disassembly

1) Before performing service work in this section:
   - Remove power unit.
     Refer to “Power Unit Removal and Installation” (Page 1D-11).
   - Remove timing chain.
     Refer to “Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation” (Page 1D-20).
   - Remove cylinder head.
     Refer to “Cylinder Head Removal and Installation” (Page 1D-32).
2) Remove oil pressure switch (1).



I9J011140221-02

3) Remove ten bolts (2).
   Remove ten bolts (3).
   Remove crankcase (4) from cylinder block.



I9J011140222-02

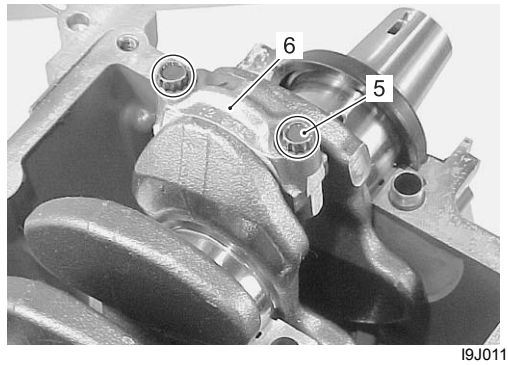
NOTE

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



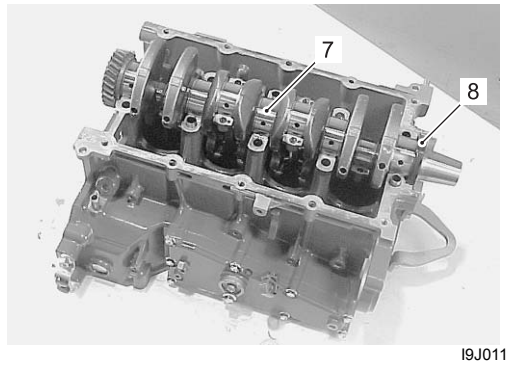
I9J011140223-03

4) Remove all conrod cap bolts (5) and conrod caps (6).



I9J011140224-01

5) Remove crankshaft (7).
   Remove oil seal (8) from crankshaft.



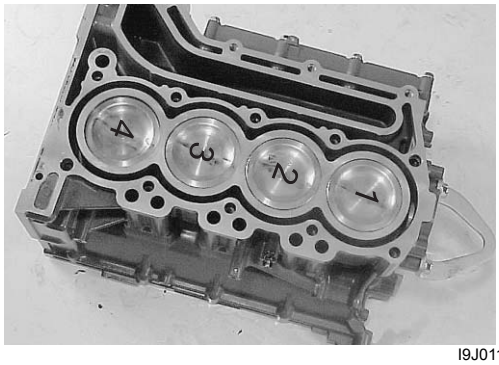
I9J011140225-01

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6) 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.**



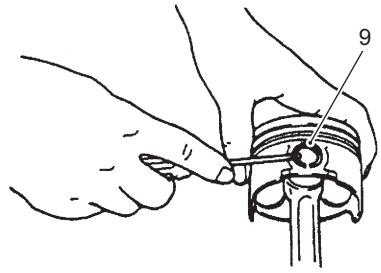
I9J011140226-02

7) Remove two compression rings (top and 2nd) and oil ring from piston. Mark cylinder number on conrod using quick dry paint.



I9J011140227-01

8) Remove piston pin circlips (9) as shown.

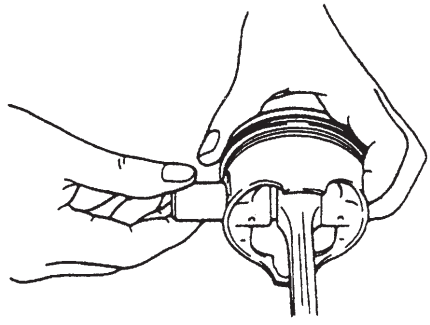


I9J011140057-01

9) Remove piston pin from conrod.

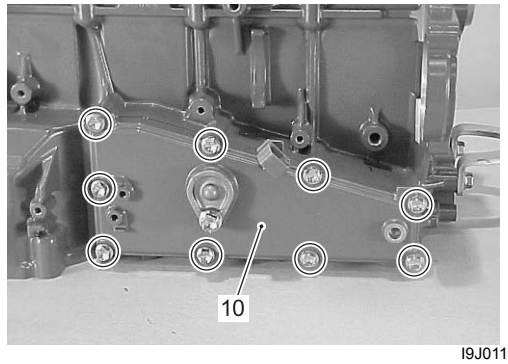
NOTE

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



I9J011140058-01

10) Remove the bolts and exhaust cover (10) (if necessary.).



I9J011140228-01

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Assembly

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

CAUTION

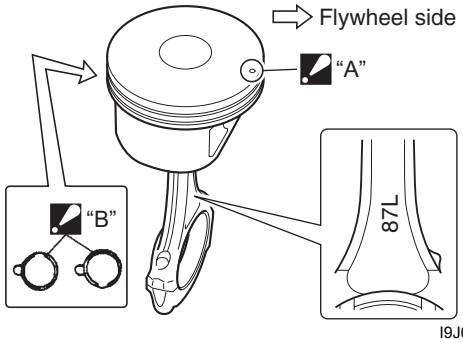
If original components are not replaced, each piston, piston pin and conrod is to be assembled and installed in its original order and position.

Piston to conrod

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

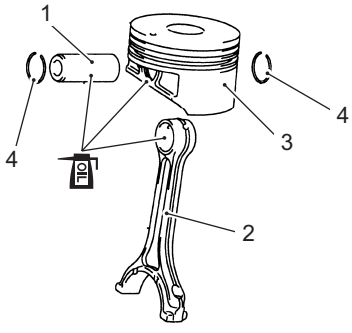
NOTE

- **"87L" mark on conrod and up mark "A" on piston dome must face toward flywheel side.**
- **Always use new piston pin circlip.**
- **Install so that circlip end gap comes within such range as indicated by arrow. End gap of the circlip should not be aligned with the cutaway in the piston pin bore.**



I9J011140009-01

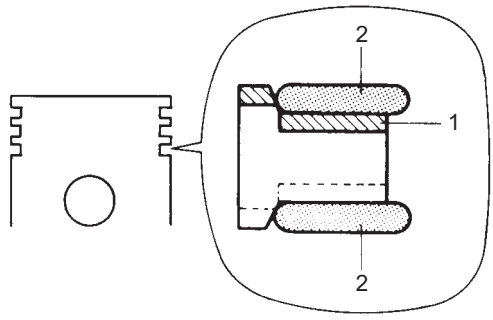
"A": Up mark	"B": Circlip end gap direction



I9J011140010-01

Piston ring to piston

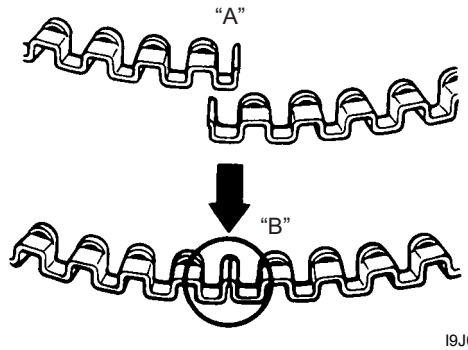
1) Install the oil ring.
   - Apply engine oil to piston rings.
   - Install spacer (1) first, then side rails (2) to piston.



I9J011140011-01

CAUTION

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

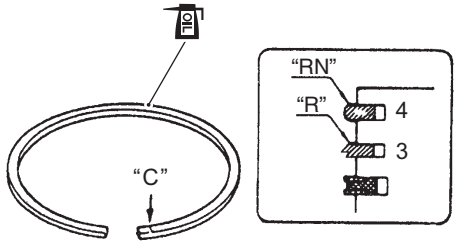


I9J011140012-01

"A": Incorrect	"B": Correct

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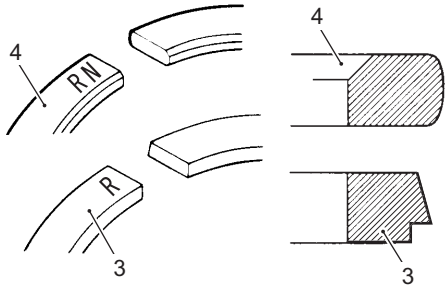
2) Install the piston rings.
   - Apply engine oil to piston ring.
   - Install 2nd ring (3) and 1st ring (4) to piston.



I9J011140013-02

NOTE

- **1st ring (4) and 2nd ring (3) differ in shape and color as shown in figure.**
- **Also indicated in figure, the 1st and 2nd ring are marked "C" with the letter "R" or "RN" which must face towards top of piston.**

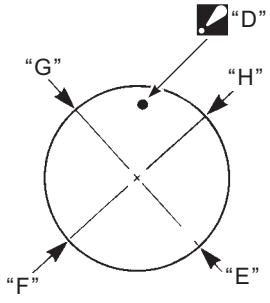


I9J011140014-02

3) Position piston rings so gaps are staggered at approximately 90 degree angles as shown.

CAUTION

Failure to stagger piston ring gaps may result in crankcase oil dilution.



I9J011140016-01

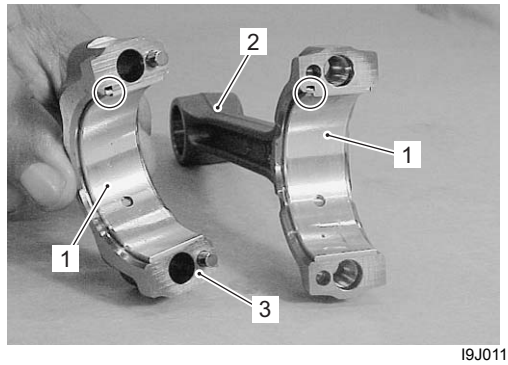
"D": Up mark	"G": 2nd ring
"E": 1st ring	"H": Oil ring upper side rail
"F": Oil ring lower side rail	

Piston to cylinder

1) Install conrod bearing (1) to conrod (2) and cap (3).

CAUTION

- **Assemble each conrod bearing to it's original position.**
- **Do not apply oil between conrod and bearing or between bearing cap and bearing.**



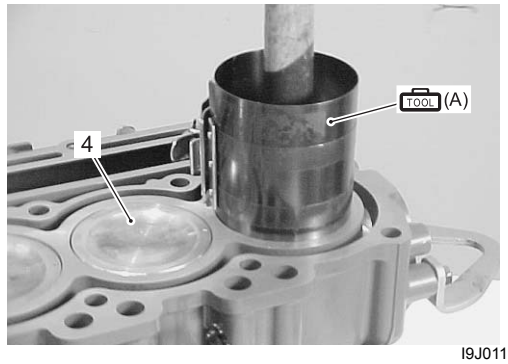
I9J011140229-03

2) Apply engine oil to piston and cylinder walls.
3) Insert piston and conrod assembly (4) into cylinder bore from cylinder head side using special tool.

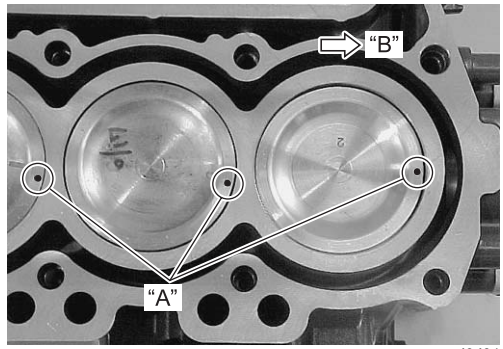
NOTE

Position the circle mark "A" on piston head to flywheel side "B".

Special tool
TOOL (A): 09916–77310 (Piston ring compressor)



I9J011140230-01



I9J011140231-01

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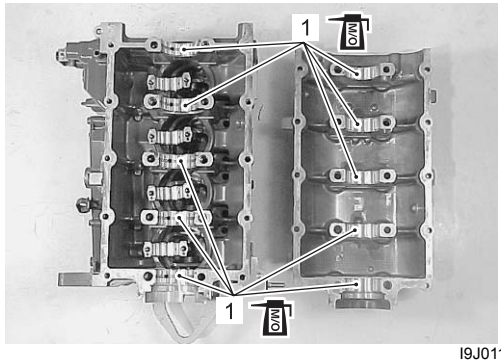
Crankshaft to cylinder
Install crankshaft main bearings (1) in cylinder and crankcase.
Apply molybdenum oil solution to bearings.

CAUTION

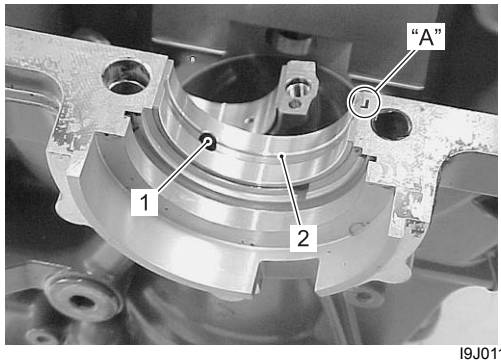
- **Assemble each bearing to its original position.**
- **Assemble main bearing half containing oil groove / hole to cylinder block. Assemble the main bearing half without oil groove to crankcase.**
- **Do not apply molybdenum oil solution between crank bearing holder and crank main bearing.**

NOTE

Align bearing tab "A" with notch in cylinder and crankcase.



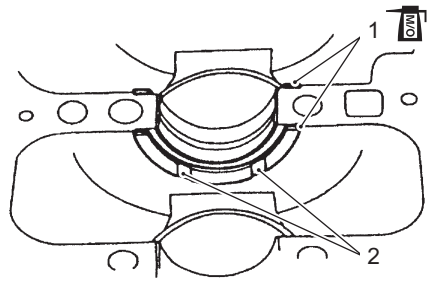
I9J011140232-01



I9J011140233-01

1. Oil hole	2. Oil groove

Thrust bearing
Apply molybdenum oil solution to the thrust bearing and install in cylinder block overlapping both sides of the No.4 main journal.
Oil groove on the thrust bearing must face towards crank webs.



I9J011140059-03

1. Thrust bearing	2. Oil groove

Crankshaft

CAUTION

Do not reuse seal removed. Be sure to use new seal.

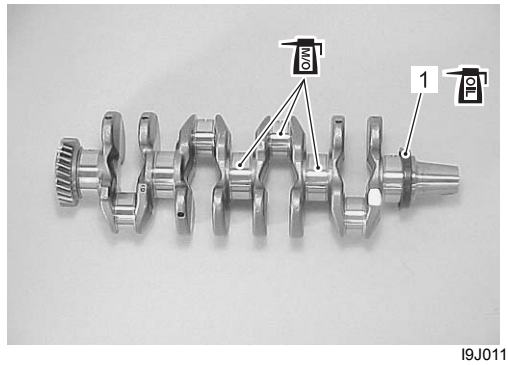
NOTE

Install upper oil seal with its spring / lipped side facing inward.

1) Apply engine oil to upper oil seal lip.
   Install upper oil seal (1) to crankshaft.
2) Apply molybdenum oil solution to crank pin and crankshaft main journal and install crankshaft in cylinder.

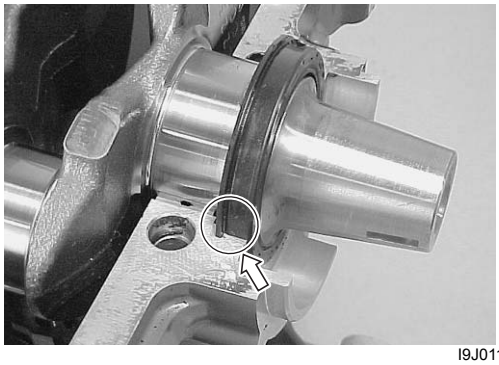
NOTE

When installing crankshaft to cylinder, be sure to fit tab of seal in groove of cylinder.



I9J011140234-01

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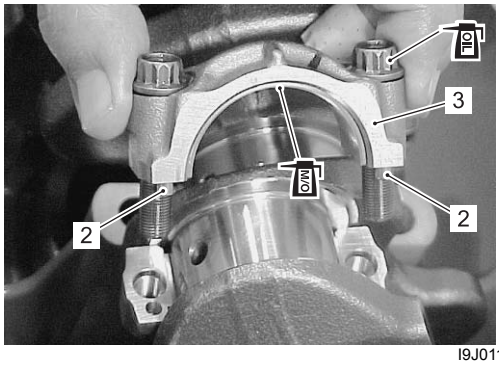


I9J011140235-02

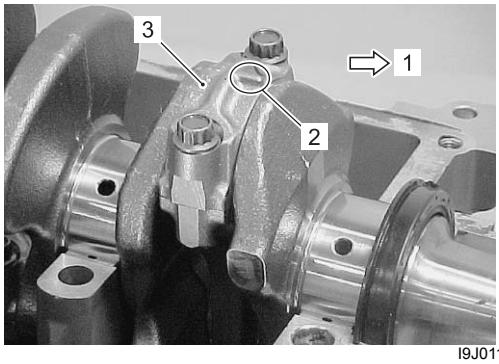
3) Install conrod cap.
   a) Apply molybdenum oil solution to crank pin and conrod bearing.
   b) Install dowel pins (2) and conrod cap (3) (with bearing) to conrod with embossed mark on the cap toward flywheel side.

CAUTION

Reassemble each conrod cap to its original position.
Do not mix them in position.



I9J011140236-01



I9J011140237-01

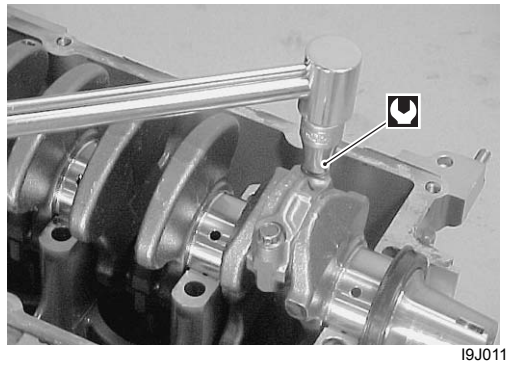
1. Flywheel side	3. Conrod cap
2. Embossed mark	

4) Apply engine oil to conrod bolts.
   Tighten conrod cap bolts in three steps as follows.
   a) Lightly seat all conrod bolts at first, then tighten bolts 12 N·m (1.2 kgf-m, 8.7 lbf-ft) of specified torque.

      Tightening torque
      Conrod cap bolt (1st step): 12 N·m (1.2 kgf-m, 8.7 lbf-ft)

   b) Tighten bolts 17 N·m (1.7 kgf-m, 12.3 lbf-ft) of specified torque.

      Tightening torque
      Conrod cap bolt (2nd step): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)



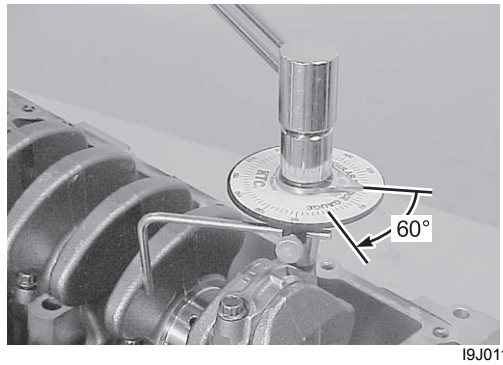
I9J011140238-01

   c) Finally tighten bolts 60 degrees turn from the point of step (b) using an angular torque gauge.

      Tightening torque
      Conrod cap bolt (Final step): 60 degrees (47 N·m, 4.7 kgf-m, 34 lbf-ft)

NOTE

Purchase a commercially available angular torque gauge for this step of tightening bolts.



I9J011140239-03

   d) Pour approx. 2 ml of engine oil to each side surface of the conrod big end for initial lubrication.

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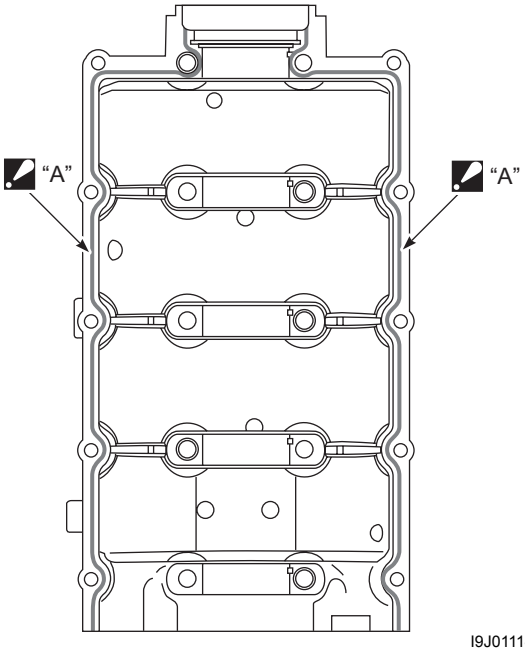
Crankcase to cylinder

1) 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.

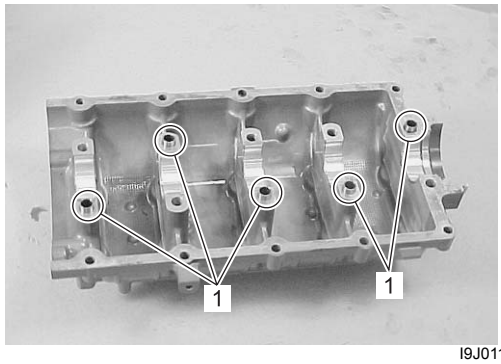
1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))



I9J011140017-03

"A": Apply bond "–" marked line.

2) Install five dowel pins (1).



I9J011140240-01

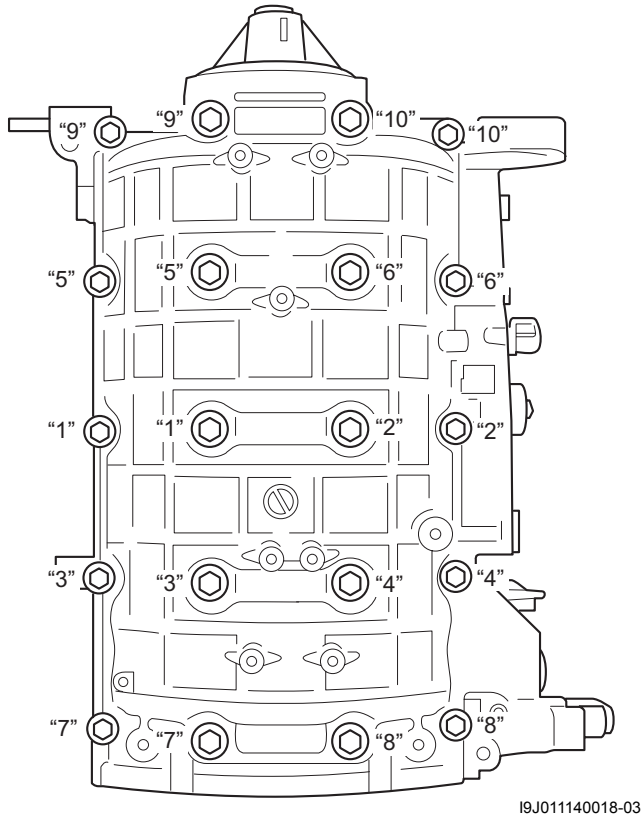
3) Install crankcase to cylinder.
Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three steps following the order indicated below.

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.

Tightening torque
Crankcase inside bolt (10 mm thread diameter) [1st step]: 11 N·m (1.1 kgf-m, 8.0 lbf-ft)
Crankcase inside bolt (10 mm thread diameter) [2nd step]: 45 N·m (4.5 kgf-m, 32.5 lbf-ft)
Crankcase inside bolt (10 mm thread diameter) [Final step]: 52 N·m (5.2 kgf-m, 37.5 lbf-ft)

Tightening torque
Crankcase outside bolt (8 mm thread diameter) [1st step]: 6 N·m (0.6 kgf-m, 4.3 lbf-ft)
Crankcase outside bolt (8 mm thread diameter) [2nd step]: 21 N·m (2.1 kgf-m, 15.0 lbf-ft)
Crankcase outside bolt (8 mm thread diameter) [Final step]: 25 N·m (2.5 kgf-m, 18.1 lbf-ft)

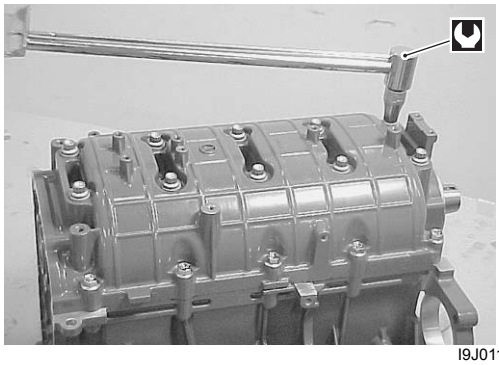


I9J011140018-03

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NOTE

After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.



I9J011140241-01

Cylinder head
Refer to “Cylinder Head Removal and Installation” (Page 1D-32).

Timing chain
Refer to “Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation” (Page 1D-20).

Oil pump
Refer to “Oil Pump Removal and Installation” in Section 1E (Page 1E-3).

Powerhead
Refer to “Power Unit Removal and Installation” (Page 1D-11).

Cylinder, Piston and Piston Ring Inspection and Servicing

Z9J0111406021

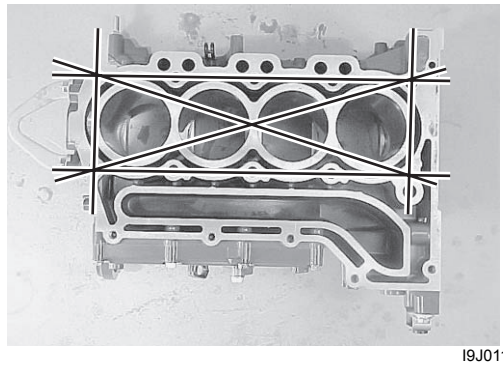
NOTE

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

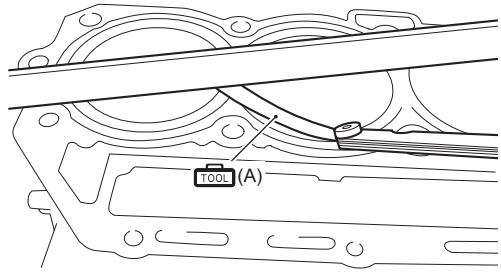
Cylinder Distortion
Using a straightedge and thickness gauge, measure cylinder distortion (gasket surface) at a total of six locations as shown.
If measurement exceeds service limit, resurface or replace cylinder.

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

Cylinder distortion
Service limit: 0.03 mm (0.0011 in.)

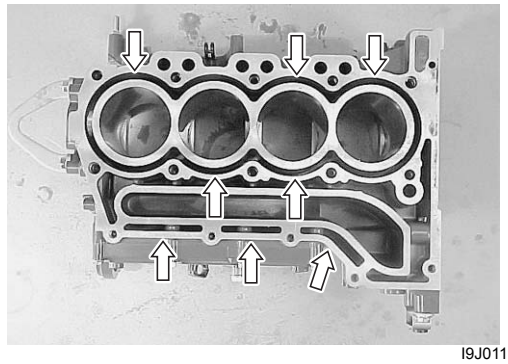


I9J011140242-03



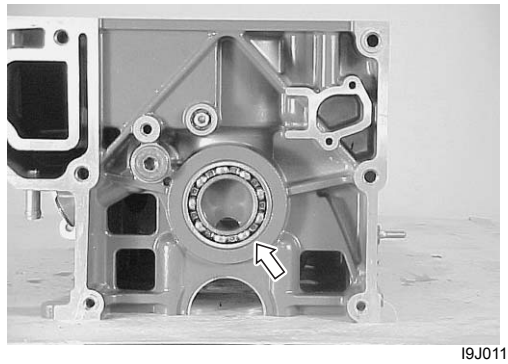
I9J011140244-01

Water Jackets
Check water jackets.
If clogged or obstruction is found, clean water jacket.



I9J011140245-01

Driven Gear Bearing
Inspect driven gear bearing. Replace bearing if pitted, noisy or rough.



I9J011140246-01

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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 (1), 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

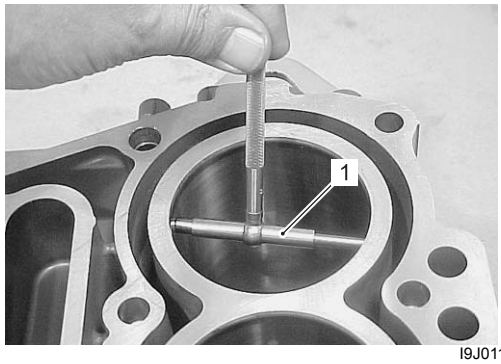
Purchase a commercially available telescoping gauge for this measurement.

Check the following:

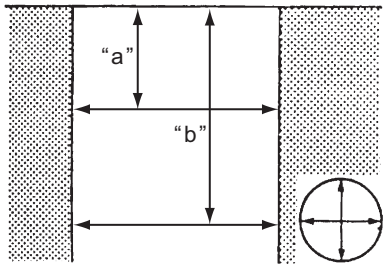
- Difference between measurements at the two positions (taper).
- Difference between axial and transverse measurement (out-of-round).

If measurement exceeds service limit, bore or replace cylinder.

Cylinder bore wear (difference)
Service limit: 0.10 mm (0.039 in.)



I9J011140247-01



I9J011140060-01

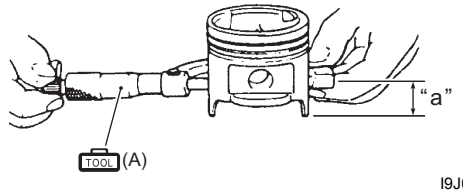
“a”: 50 mm (1.96 in)	“b”: 90 mm (3.54 in)

Piston to Cylinder Clearance

1) Measure the piston diameter at a point 13 mm (0.512 in.) above the piston skirt at a right angle to the piston pin bore.

Special tool
TOOL (A): 09900–20203 (Micrometer (50 – 75 mm))

Piston skirt diameter
Standard: 74.970 – 74.990 mm (2.9516 – 2.9524 in.)



I9J011140061-02

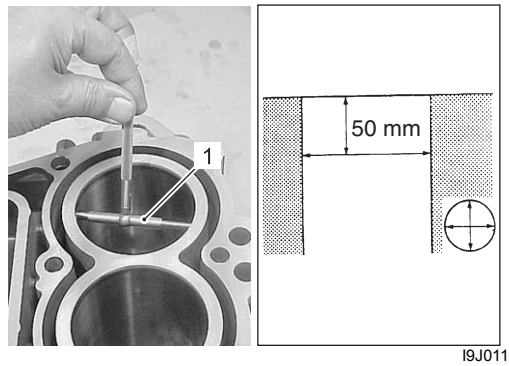
“a”: 13 mm

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 gauge (1) for this measurement.

Cylinder bore diameter
Standard: 75.000 – 75.020 mm (2.9528 – 2.9535 in.)



I9J011140248-02

3) Calculate the piston / cylinder clearance (Clearance equals difference between piston diameter and cylinder bore measurements).
If clearance exceeds service limit, replace piston and/or cylinder or bore cylinder.

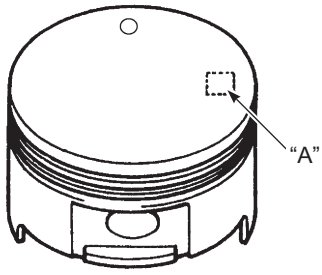
Piston to cylinder clearance
Standard: 0.020 – 0.040 mm (0.0008 – 0.0016 in.)
Service limit: 0.100 mm (0.0039 in.)

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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



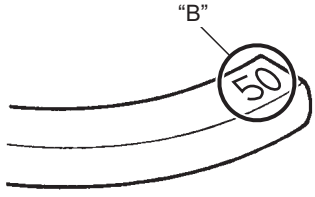
I9J011140062-02

"A": I.D. mark: 50

1st and 2nd Piston ring

Oversize	I.D. mark
0.50 mm	50

1st, 2nd ring



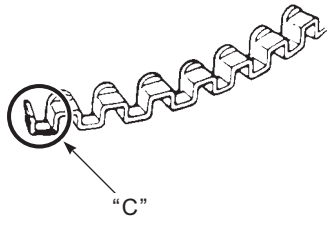
I9J011140063-03

"B": I.D. mark

Oil ring

Oversize	I.D. mark
0.50 mm	One Red paint

Oil ring spacer



I9J011140064-02

"C": I.D. mark

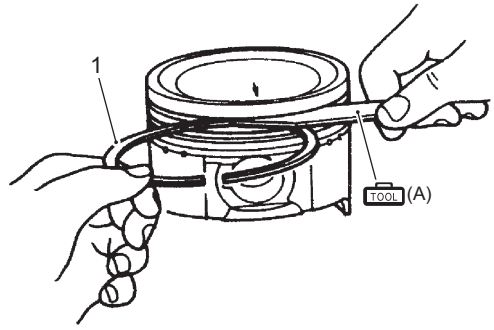
Piston

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

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

Piston ring to groove clearance
Standard (1st): 0.030 – 0.070 mm (0.0012 – 0.0028 in.)
Standard (2nd): 0.020 – 0.060 mm (0.0008 – 0.0024 in.)
Service limit (1st): 0.12 mm (0.0047 in.)
Service limit (2nd): 0.10 mm (0.0039 in.)



I9J011140065-03

1. Piston ring

Piston ring groove width
Standard (1st): 1.02 – 1.04 mm (0.040 – 0.041 in.)
Standard (2nd): 1.21 – 1.23 mm (0.048 – 0.048 in.)
Standard (Oil): 2.01 – 2.03 mm (0.079 – 0.080 in.)

Piston ring thickness
Standard (1st): 0.97 – 0.99 mm (0.038 – 0.039 in.)
Standard (2nd): 1.17 – 1.19 mm (0.046 – 0.047 in.)

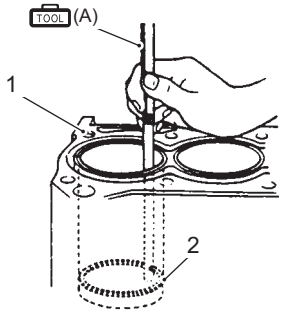
Piston Ring

Piston ring end gap
Measure piston ring end gap with piston ring in the lowest position of cylinder bore.
If measurement exceeds service limit, replace piston ring.

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

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Piston ring end gap
Standard (1st): 0.15 – 0.30 mm (0.0059 – 0.0118 in.)
Standard (2nd): 0.30 – 0.45 mm (0.0118 – 0.0177 in.)
Service limit (1st): 0.70 mm (0.028 in.)
Service limit (2nd): 1.00 mm (0.039 in.)



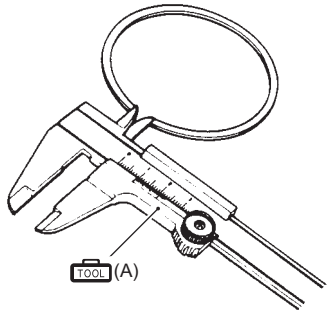
I9J011140066-02

1. Cylinder	2. Piston ring

Piston ring free end gap
Measure piston ring free end gap using vernier calipers. If measurement exceeds service limit, replace piston ring.

Special tool
TOOL (A): 09900–20101 (Vernier calipers (150 mm))

Piston ring free end gap
Standard (1st): Approx. 9.9 mm (0.3898 in.)
Standard (2nd): Approx. 9.7 mm (0.3819 in.)
Service limit (1st): 7.9 mm (0.311 in.)
Service limit (2nd): 7.8 mm (0.307 in.)



I9J011140067-02

Piston Pin and Conrod Inspection

Z9J0111406022

Piston Pin
Visual inspection

- Check piston pin, conrod small end bore and piston pin hole for wear or damage.
  If badly worn or damaged, replace component.
- Apply engine oil on piston pin so that the piston pin can move smoothly in the piston pin hole.
  If improper condition is found, replace the piston pin and/or piston.

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.
Measure the following item:

Special tool
TOOL (A): 09900–20205 (Micrometer (0 – 25 mm))
TOOL (B): 09900–20605 (Dial calipers (10 – 34 mm))

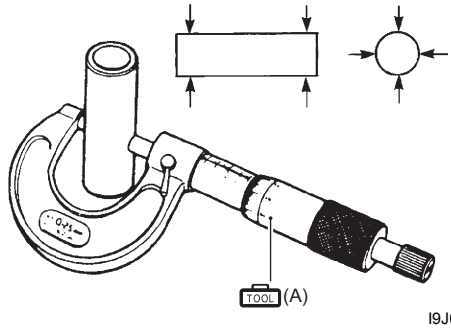
Piston pin outside diameter
Standard: 17.995 – 18.000 mm (0.7085 – 0.7087 in.)
Service limit: 17.980 (0.7079 in.)

Piston pin hole diameter
Standard: 18.006 – 18.014 mm (0.7089 – 0.7092 in.)
Service limit: 18.030 (0.7098 in.)

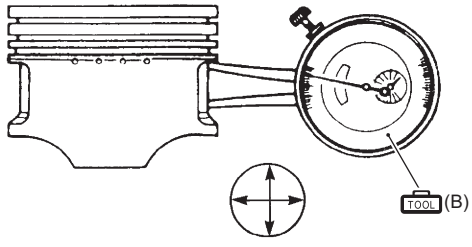
Conrod small end bore
Standard: 18.003 – 18.011 mm (0.7088 – 0.7091 in.)

Pin clearance in piston pin hole
Standard: 0.006 – 0.019 mm (0.0002 – 0.0007 in.)
Service limit: 0.05 (0.0019 in.)

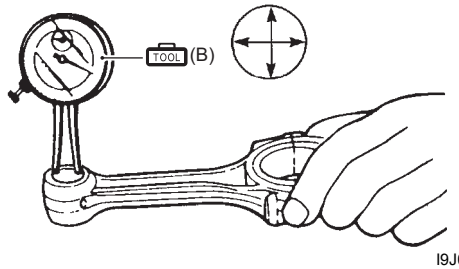
Pin clearance in conrod small end
Standard: 0.003 – 0.016 mm (0.0001 – 0.0006 in.)
Service limit: 0.05 (0.0020 in.)



I9J011140068-02



I9J011140069-02



I9J011140070-02

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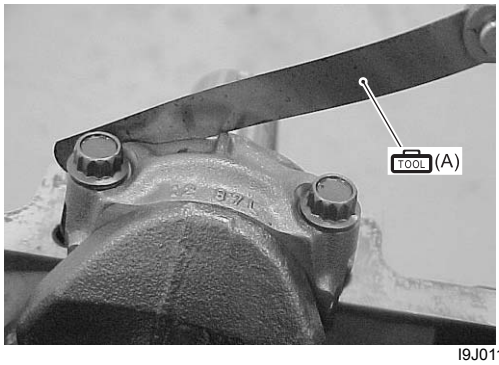
Conrod big end side clearance
Measure conrod big end side clearance with conrod installed on crank pin as shown.
If measurement exceeds service limit, replace conrod and/or crankshaft.

Special tool
TOOL (A): 09900–20803 (Thickness gauge)

Conrod big end side clearance
Standard: 0.100 – 0.250 mm (0.0039 – 0.0098 in.)
Service limit: 0.35 mm (0.0138 in.)

Conrod big end width
Standard: 21.950 – 22.000 mm (0.8642 – 0.8661 in.)

Crank pin width
Standard: 22.100 – 22.200 mm (0.8071 – 0.8740 in.)



I9J011140249-01

Crank Pin and Conrod Bearing Inspection

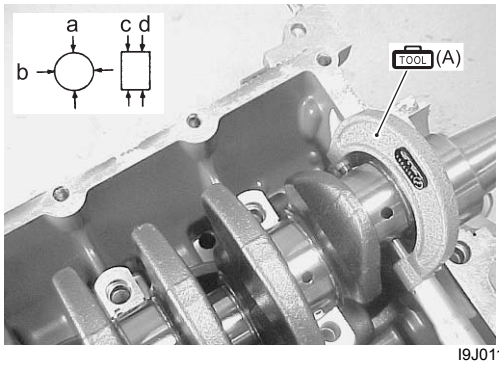
Z9J0111406023

Crank Pin Diameter
Inspect crank pin for uneven wear or damage.
Measure crank pin for out-of-round “a” – “b” or taper “c” – “d” with micrometer.
If crank pin is damaged, out-of-round “a” – “b” or taper “c” – “d” is out of service limit, replace crankshaft.

Special tool
TOOL (A): 09900–20202 (Micrometer (25 – 50 mm))

Crank pin diameter
Standard: 41.982 – 42.000 mm (1.6528 – 1.6535 in.)

Out-of-round and taper
Service limit: 0.01 mm (0.0004 in.)



I9J011140250-01

Conrod Bearing Visual Inspection
Inspect bearing shell for proper contact pattern and signs of fusion, pitting, burning or flaking.
Bearing shells found in defective condition must be replaced.



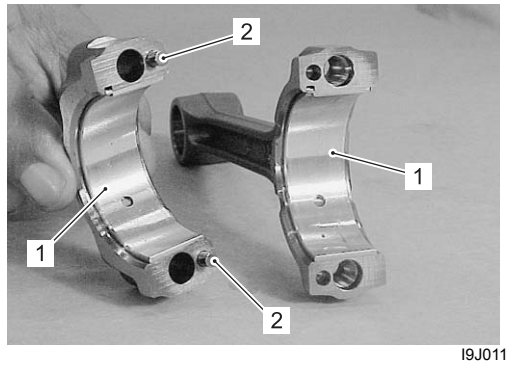
I9J011140071-01

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.**

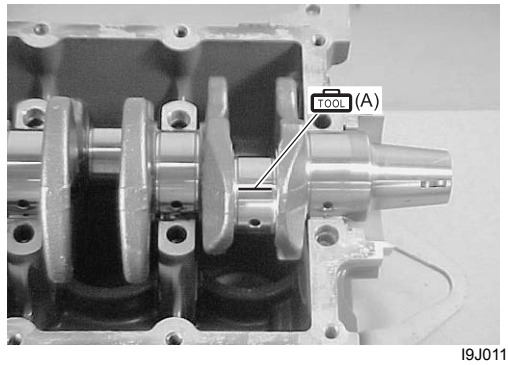


I9J011140251-01

1. Conrod bearing	2. Dowel pin

3) Place a piece of Plastigauge on crank pin parallel to crankshaft. Avoid placing Plastigauge over oil hole.

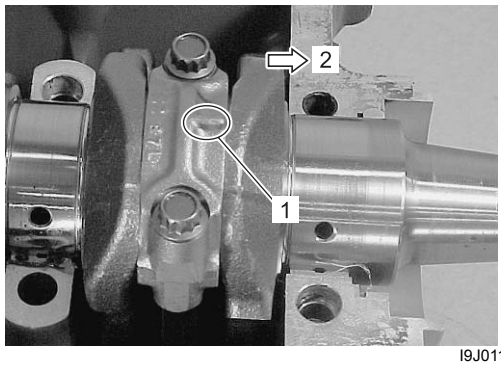
Special tool
TOOL (A): 09900–22301 (Plastigauge (0.025 – 0.076 mm))



I9J011140252-02

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4) Install conrod cap (with bearing) to conrod with the embossed mark on cap toward flywheel side.



I9J011140253-01

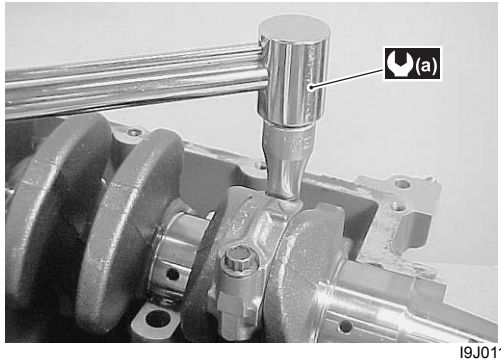
1. Embossed mark	2. Flywheel side

5) Apply engine oil to conrod bolts.
Tighten conrod cap bolts in three steps as follows.
a) Lightly seat all conrod bolts at first, then tighten bolts 12 N·m (1.2 kgf-m, 8.7 lbf-ft) of specified torque.

Tightening torque
Conrod cap bolt (1st step): 12 N·m (1.2 kgf-m, 8.7 lbf-ft)

b) Tighten bolts 17 N·m (1.7 kgf-m, 12.3 lbf-ft) of specified torque.

Tightening torque
Conrod cap bolt (2nd step) (a): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)



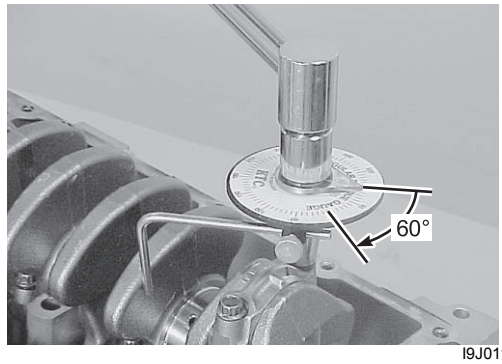
I9J011140254-01

c) Finally tighten bolts 60 degrees turn from the point of step b) using an angular torque gauge.

Tightening torque
Conrod cap bolt (Final step): 60 degrees (47 N·m, 4.7 kgf-m, 34 lbf-ft)

NOTE

Purchase a commercially available angular torque gauge for this step of tightening bolts.



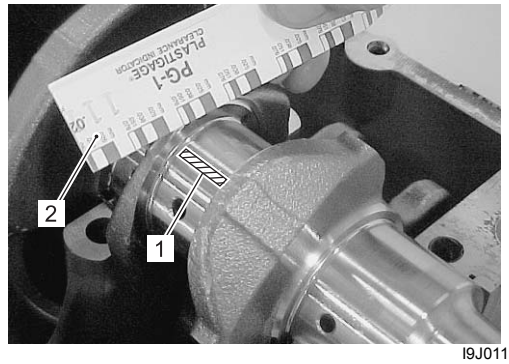
I9J011140255-03

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.
If measurement exceeds service limit, replace conrod bearing.

Conrod big end oil clearance
Standard: 0.032 – 0.050 mm (0.0013 – 0.0020 in.)
Service limit: 0.080 mm (0.0031 in.)



I9J011140256-01

1. Plastigauge	2. Scale

NOTE

For bearing replacement, see the “Selection of Conrod Bearing” (Page 1D-56).

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Selection of Conrod Bearing

Z9J0111406029

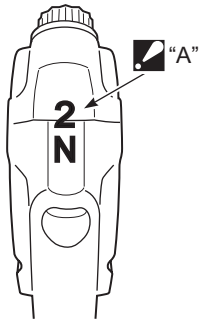
NOTE

- **If bearing is in malfunction, or bearing clearance is not in specification, select a new standard bearing according to the following procedure.**
- **When replacing crankshaft, conrod and its bearing due to any reason, select a new standard bearing to be installed by referring to numbers stamped on conrod and its cap and alphabets stamped on crank web No.1.**

1) Check stamped numbers on conrod and its cap as shown.
Three kinds of number (“1”, “2” or “3”) represent the conrod big end inside diameter.For example, stamped number “1” indicates that corresponding its big end inside diameter is 45.000 – 45.006 mm (1.7717 – 1.7719 in.).

Conrod big end inside diameter

Stamped No.	Conrod big end inside diameter
1	45.0000 – 45.0060 mm (1.7717 – 1.7719 in.)
2	45.0061 – 45.0120 mm (1.7719 – 1.7721 in.)
3	45.0121 – 45.0180 mm (1.7721 – 1.7723 in.)



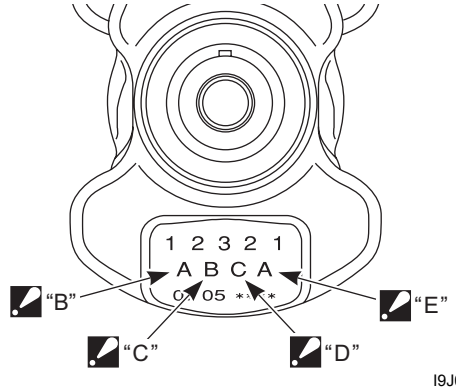
I9J011140266-01

“A”: Conrod big end inside dia. code

2) Next, check crankshaft pin outside diameter. On crank web No.1, four alphabets are stamped as shown in the figure.
Three kinds of alphabet (“A”, “B” or “C”) represent the crankshaft pin diameter respectively. For example, stamped “A” indicates that corresponding crankshaft pin diameter is 41.994 – 42.000 mm (1.6533 – 1.6535 in.).

Crankshaft pin outside diameter

Stamped alphabet	Crank pin diameter
A	41.9940 – 42.0000 mm (1.6533 – 1.6535 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6533 in.)
C	41.9820 – 41.9879 mm (1.6528 – 1.6531 in.)



I9J011140267-01

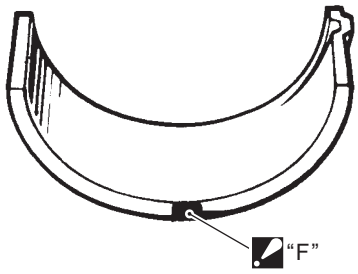
“B”: No.1 Crank pin dia. code	“D”: No.3 Crank pin dia. code
“C”: No.2 Crank pin dia. code	“E”: No.4 Crank pin dia. code

3) There are five kinds of standard bearing differing in thickness available. To distinguish them, they are painted in four colors at the position indicated in the figure.
Each color indicates the following thickness at the center of bearing.

Size of conrod bearing thickness

Color painted	Bearing thickness
Blue	1.4990 – 1.5020 mm (0.05901 – 0.05913 in.)
Yellow	1.4960 – 1.4990 mm (0.05890 – 0.05901 in.)
Nothing	1.4930 – 1.4960 mm (0.05878 – 0.05889 in.)
Black	1.4900 – 1.4930 mm (0.05867 – 0.05877 in.)
Green	1.4870 – 1.4900 mm (0.05854 – 0.05866 in.)

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I9J011140268-01

"F": Color mark

4) From number stamped on conrod and its cap and alphabets stamped on crank web No.1, Determine new standard bearing to be installed into conrod big end, by referring to the table.
For example, if number stamped on conrod and its cap is "1" and alphabet stamped on crank web No.1 is "B", install the bearing painted "Black" as a new standard bearing to conrod big end.

Matching chart of conrod bearing

		Number stamped on conrod and its cap (Big end diameter)		
		1	2	3
Alphabet stamped on crank web No.1 (Crank pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue

NOTE

Measure conrod big end oil clearance again after installing new bearing selected.
Refer to "Conrod Big End Oil Clearance" under "Crank Pin and Conrod Bearing Inspection" (Page 1D-54)

Crankshaft Inspection

Z9J0111406024

Crankshaft Runout

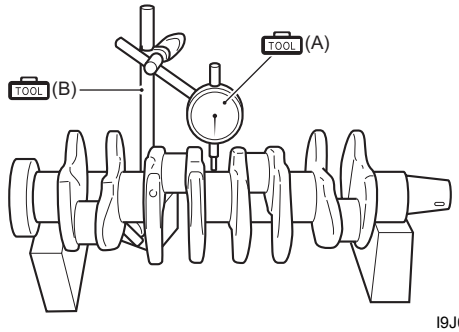
Using a dial gauge, measure runout at center journal.
If measurement exceeds service limit, replace crankshaft.

Special tool

TOOL (A): 09900–20606 (Dial gauge)
TOOL (B): 09900–20701 (Magnetic stand)

Crankshaft runout

Service limit: 0.04 mm (0.0016 in.)



I9J011140257-02

Crankshaft Thrust Play

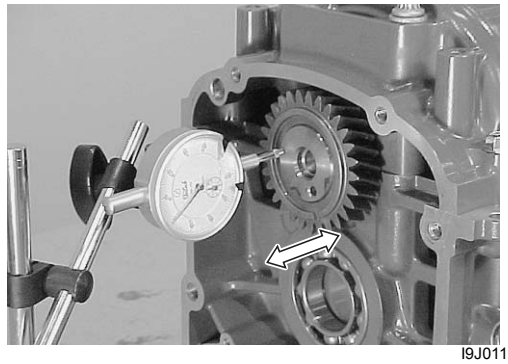
1) Measure thrust play with crankshaft, thrust bearing, journal bearing and crankcase / cylinder block assembled in a normal manner.
Tighten crankcase bolts to specified torque.

Tightening torque
Crankcase bolt (Inside 10 mm): 52 N·m (5.2 kgf-m, 37.5 lbf-ft)
Crankcase bolt (Outside 8 mm): 25 N·m (2.5 kgf-m, 18.1 lbf-ft)

2) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
If measurement exceeds service limit, replace crankshaft thrust bearing.

Crankshaft thrust play
Standard: 0.11 – 0.31 mm (0.0043 – 0.0122 in.)
Service limit: 0.35 mm (0.0138 in.)

Crankshaft thrust bearing thickness
Standard: 2.47 – 2.52 mm (0.0972 – 0.0992 in.)



I9J011140258-02

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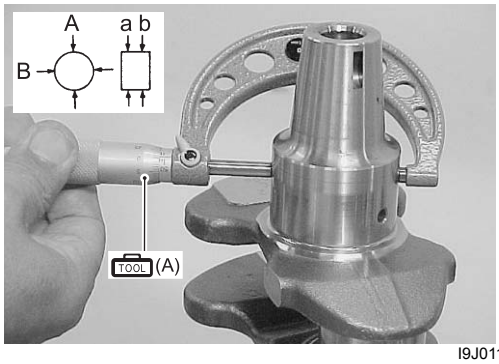
Out-of-Round and Taper (Uneven Wear) of Journals
An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both).
This difference, if any, is determined by taking micrometer readings.
If any journal is badly damaged or if measurements exceed service limit, replace crankshaft.

Special tool
TOOL (A): 09900–20203 (Micrometer (50 – 75 mm))

Out-of-round and taper
Service limit: 0.01 mm (0.0004 in.)

Out-of-round: A – B
Taper: a – b

Crankshaft journal outside diameter
Standard: 51.994 – 52.012 mm (2.0470 – 2.0477 in.)

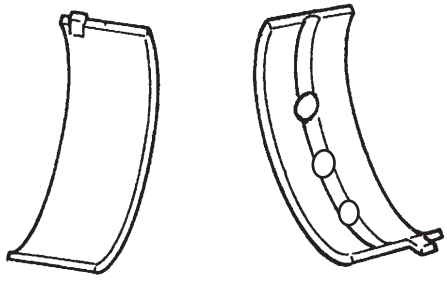


I9J011140072-02

Crankshaft Main Bearing Inspection

Z9J0111406025

Crankshaft Main Bearing Visual Inspection
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.


I9J011140073-01

Crankshaft Journal Oil Clearance
Check clearance using Plastigauge according to the following procedure.

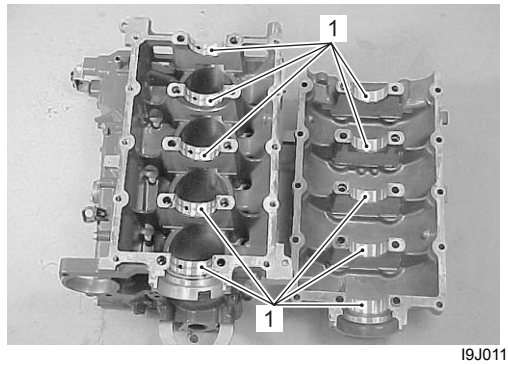
NOTE

Assemble each bearing in its original position before checking clearance.

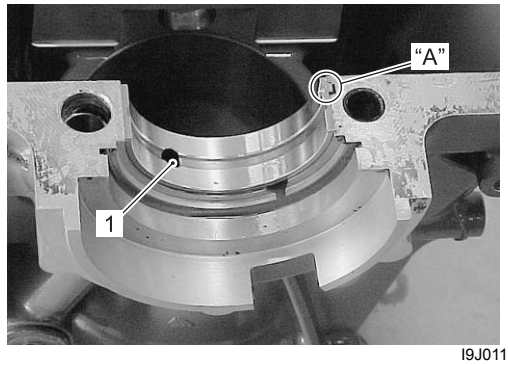
1) Clean surface of bearing holder (crankcase, and cylinder), bearing, and main bearing journal.
2) Install main bearing (1) to cylinder and crankcase.

NOTE

- **Align tab “A” 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.**



I9J011140259-01



I9J011140260-01

1. Oil hole / groove

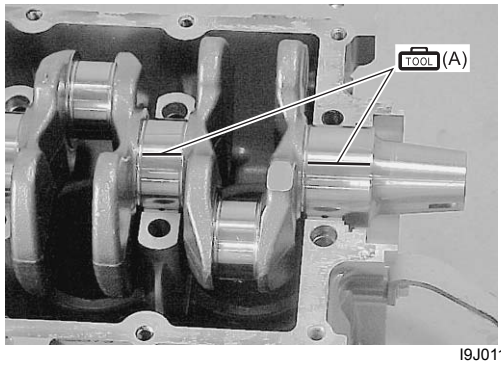
http://SelfFixer.com

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.

Special tool
TOOL (A): 09900–22301 (Plastigauge (0.025 – 0.076 mm))

NOTE

Do not rotate crankshaft while Plastigauge is installed.



I9J011140261-02

5) Assemble crankcase to cylinder.
6) Apply engine oil to crankcase bolts.
Tighten crankcase bolts in three steps following the order indicated below.

NOTE

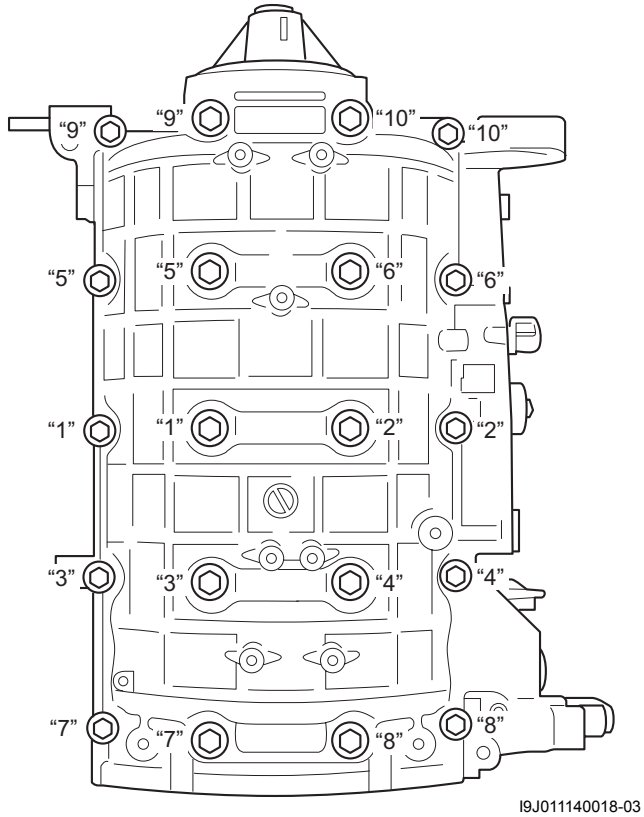
Tighten 10 mm (0.394 in.) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in.) thread diameter bolts.

Tightening torque
Crankcase inside bolt (10 mm thread diameter) [1st step]: 11 N·m (1.1 kgf-m, 8.0 lbf-ft)
Crankcase inside bolt (10 mm thread diameter) [2nd step]: 45 N·m (4.5 kgf-m, 32.5 lbf-ft)
Crankcase inside bolt (10 mm thread diameter) [Final step]: 52 N·m (5.2 kgf-m, 37.5 lbf-ft)

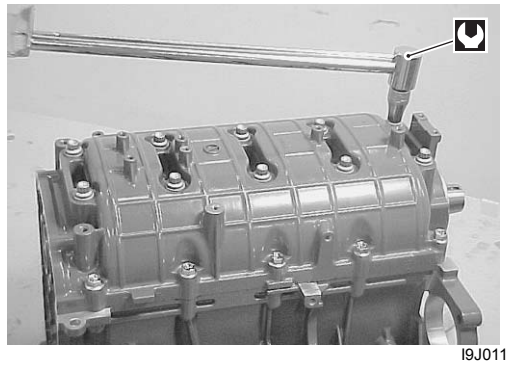
Tightening torque
Crankcase outside bolt (8 mm thread diameter) [1st step]: 6 N·m (0.6 kgf-m, 4.3 lbf-ft)
Crankcase outside bolt (8 mm thread diameter) [2nd step]: 21 N·m (2.1 kgf-m, 15.0 lbf-ft)
Crankcase outside bolt (8 mm thread diameter) [Final step]: 25 N·m (2.5 kgf-m, 18.1 lbf-ft)

NOTE

Crankcase must be torqued to specification in order to assure proper compression of plastigauge and accurate reading of clearance.



I9J011140018-03

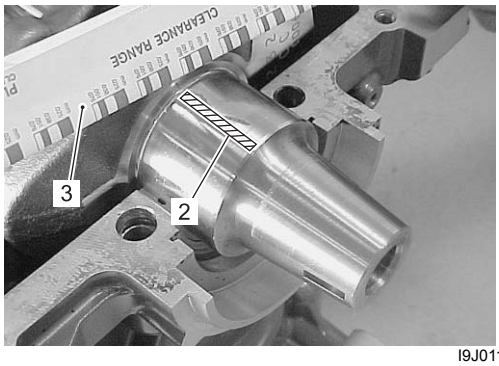

I9J011140262-01

7) Remove crankcase from cylinder.

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8) Using scale on Plastigauge envelope, measure plastigauge width at its widest point.

Crankshaft journal oil clearance
Standard: 0.016 – 0.036 mm (0.0012 – 0.0020 in.)
Service limit: 0.056 mm (0.0022 in.)



I9J011140263-01

2. Plastigauge	3. Scale

9) If measurement exceeds service limit, replace crankshaft main bearing.

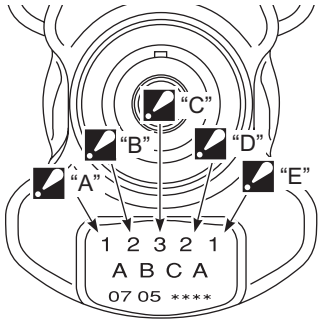
NOTE

For bearing replacement, see the "Selection of Main Bearings" (Page 1D-60).

Selection of Main Bearings
Whenever a bearing requires replacement, select a new bearing according to following procedure.

1) First, check journal diameter.
As shown in figure, upper (flywheel side) crank web of No.1 cylinder has five stamped code numerals.
The numerals (1, 2 and 3) represent the journal diameters shown below.

Numeral stamped	Journal diameter
1	52.006 – 52.012 mm (2.0475 – 2.0477 in.)
2	52.000 – 52.006 mm (2.0472 – 2.0475 in.)
3	51.994 – 52.000 mm (2.0470 – 2.0472 in.)

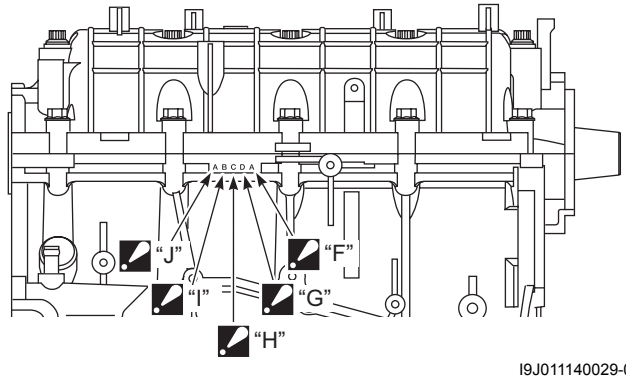


I9J011140028-02

"A": No. 1 Journal code	"D": No. 4 Journal code
"B": No. 2 Journal code	"E": No. 5 Journal code
"C": No. 3 Journal code	

2) Next, check bearing holder inside diameter without bearing.
As shown in figure, the cylinder block PORT side has five stamped code letters or numerals.
The letters (A, B and C) or numerals (1, 2 and 3) represent the bearing holder inside diameters shown below.

Code	Crank bearing holder inside diameter (w/o bearing)
A or 1	56.000 – 56.006 mm (2.2047 – 2.2050 in.)
B or 2	56.006 – 56.012 mm (2.2050 – 2.2052 in.)
C or 3	56.012 – 56.018 mm (2.2052 – 2.2054 in.)



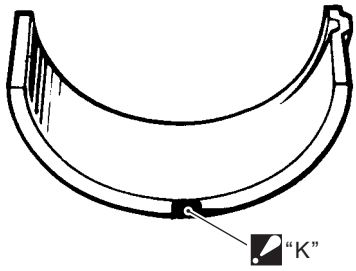
I9J011140029-01

"F": No. 1 Holder code	"I": No. 4 Holder code
"G": No. 2 Holder code	"J": No. 5 Holder code
"H": No. 3 Holder code	

3) There are five 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
Purple	1.992 – 1.996 mm (0.0784 – 0.0786 in.)
Brown	1.995 – 1.999 mm (0.0785 – 0.0787 in.)
Green	1.998 – 2.002 mm (0.0787 – 0.0788 in.)
Black	2.001 – 2.005 mm (0.0788 – 0.0789 in.)
No color mark	2.004 – 2.008 mm (0.0789 – 0.0791 in.)

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I9J011140074-01

"K": Color mark

4) Select crankshaft main bearing referring to the below table.
For example, If number stamped on crank web is "1" and alphabet stamped on cylinder block is "B", install a new bearing painted in "Brown" to it's journal.

		Numeral stamped on crank web (journal outside diameter)		
		1	2	3
Code stamped on cylinder block (Bearing holder inside diameter)	A or 1	Purple	Brown	Green
	B or 2	Brown	Green	Black
	C or 3	Green	Black	No color

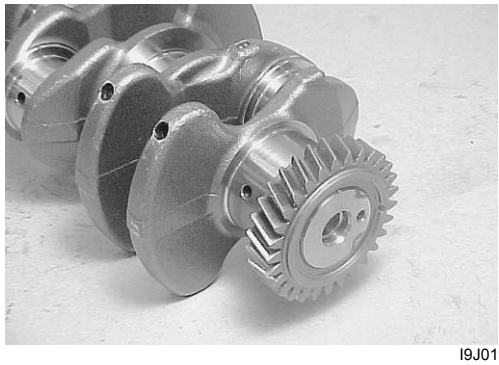
NOTE

Measure crankshaft journal oil clearance again after installing new bearing selected. Refer to "Crankshaft Journal Oil Clearance" (Page 1D-58).

Crankshaft Drive Gear Inspection

Z9J0111406026

Inspect drive gear. Replace gear if damaged or worn.



I9J011140264-01

Crankshaft Oil Seal Inspection

Z9J0111406027

Inspect condition. If cracked, cut or damaged, replace.



I9J011140265-01

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Power Unit Lubrication

General Description

Engine Lubrication Description

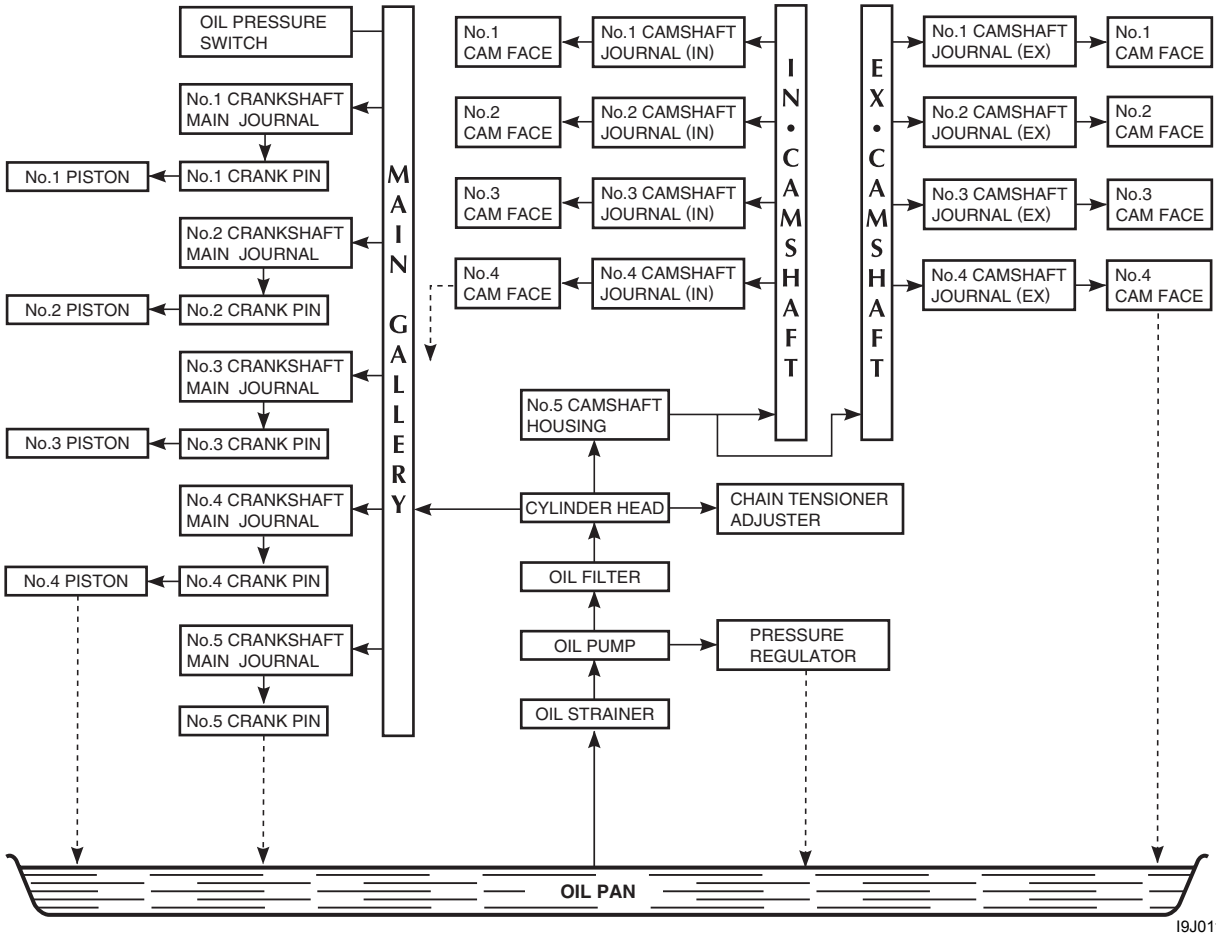
Z9J0111501001

A camshaft driven trochoid type pump provides engine oil to all power unit components requiring lubrication.
Oil from the oil pan is drawn through the oil strainer and passed through a spin-on type oil filter before entering the main oil gallery.
A pressure regulator (relief valve) is positioned between the oil pump and oil filter to maintain oil pressure at a constant level.
From the main gallery, oil flow is directed through either drilled internal passages or by splash method to those surfaces requiring lubrication.

Schematic and Routing Diagram

Engine Oil Lubrication Chart

Z9J0111502001



I9J011150001-02

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Diagnostic Information and Procedures

Oil Pressure Check

Z9J0111504001

Refer to “Oil Pressure Check” in Section 0B (Page 0B-20).

Oil Change Reminder System

Z9J0111504003

Refer to “Oil Change Reminder System Description” in Section 1A (Page 1A-14).

Low Oil Pressure Caution System

Z9J0111504004

The system operates when the engine lubricating oil pressure drops below the correct level (100 kPa, 1.0 kg/cm^2, 14 psi.). If this system activates, the red oil lamp will light and caution buzzer will begin a series of beeps.
In addition, when this system is activated at 1 000 r/min. or higher, engine speed will automatically be reduced to approx. 1 000 r/min with REV Limit lamp lit.
The engine automatically stops 3 minutes after the control of this CAUTION system starts the activation.
If this system activates, stop the engine immediately.
Check the engine oil level and add oil if necessary.
Refer to “Engine Oil Level Check” in Section 0B (Page 0B-3).

NOTE

In case that the engine is automatically stopped due to the CAUTION system, the engine can be started again. However the CAUTION system will repeatedly activate until eliminating the cause.

Powerhead Lubrication System Diagnosis

Z9J0111504002

Condition	Possible cause	Correction / Reference Item
Low oil pressure	Clogged oil filter.	*Replace.*
	Leakage from oil passages.	*Repair or replace.*
	Defective oil pump.	*Replace.*
	Defective oil pressure regulator.	*Replace.*
	Damaged O-ring.	*Replace.*
	Combination of above item.	*Repair or replace.*
High oil pressure	Using an engine oil of too high viscosity.	*Replace.*
	Clogged oil passage.	*Clean or replace.*
	Clogged oil pressure regulator.	*Replace.*
	Combination of above items.	*Repair or replace*

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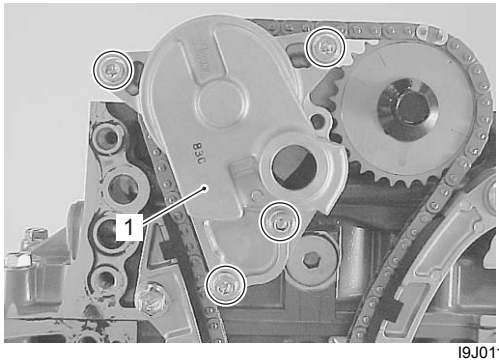
Service Instructions

Oil Pump Removal and Installation

Z9J0111506001

Removal

1) Remove the power unit.
   Refer to “Power Unit Removal and Installation” in Section 1D (Page 1D-11).
2) Remove the four bolts securing oil pump (1), then remove the oil pump.



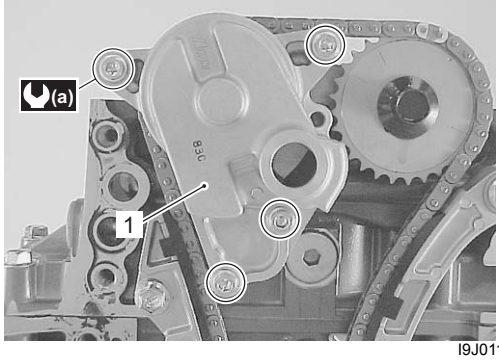
I9J011150004-01

Installation

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

- Install oil pump assembly (1), then tighten four bolts securely.

  Tightening torque
  Oil pump (a): 15 N·m (1.5 kgf-m, 11 lbf-ft)



I9J011150005-01

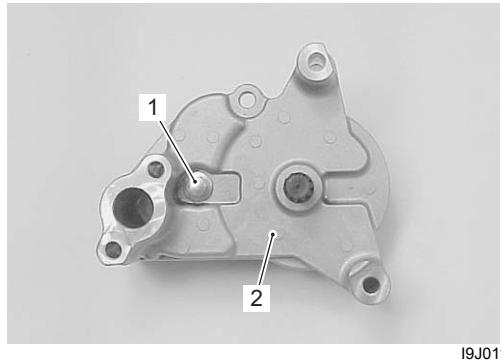
- Pour approx. 20 ml (0.7 oz.) of engine oil into pump case for initial lubrication.

Oil Pump Disassembly and Assembly

Z9J0111506002

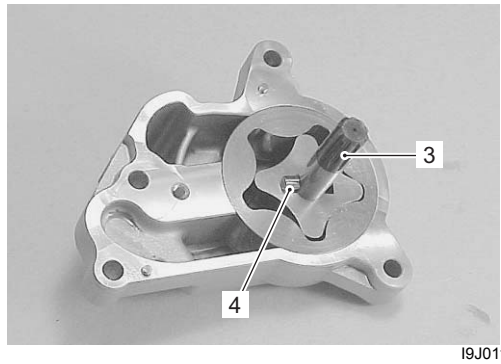
Disassembly

1) Remove the screw (1) securing oil pump rotor plate (2) to the oil pump case, then remove oil pump rotor plate.



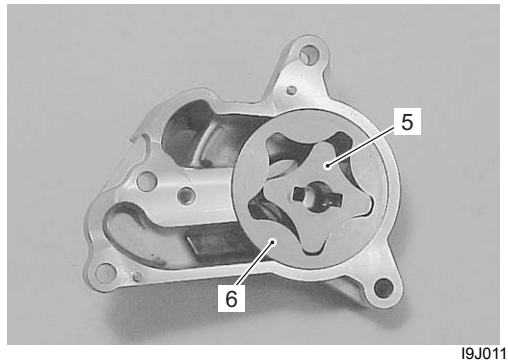
I9J011150006-01

2) Remove the shaft (3) and pin (4).



I9J011150007-01

3) Take out inner rotor (5) and outer rotor (6).



I9J011150008-01

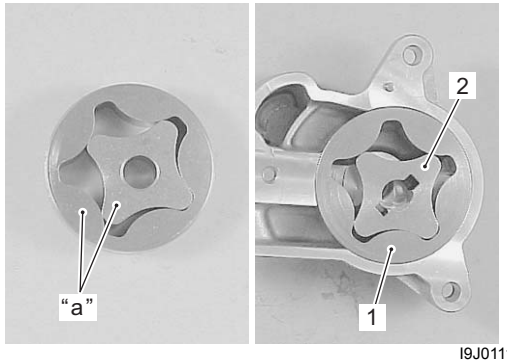
http://SelfFixer.com

Assembly

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

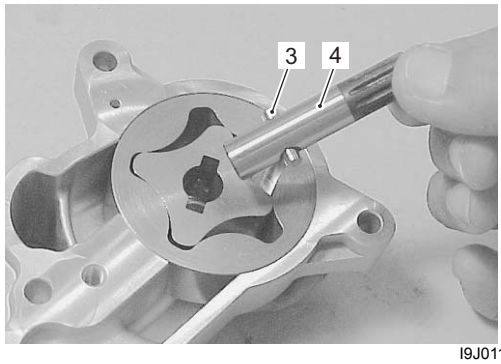
NOTE

When installing outer and inner rotors, the punch mark "a" on each rotor must face original direction.



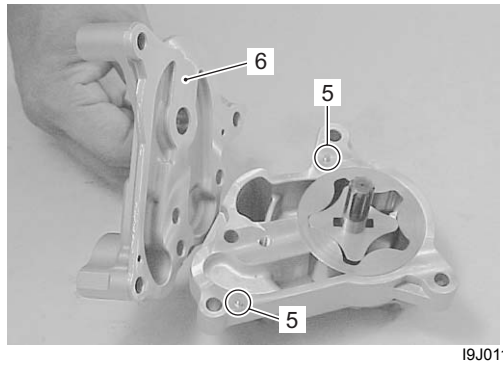
I9J011150009-02

4) Assemble the pin (3) to oil pump shaft (4), then install oil pump shaft.

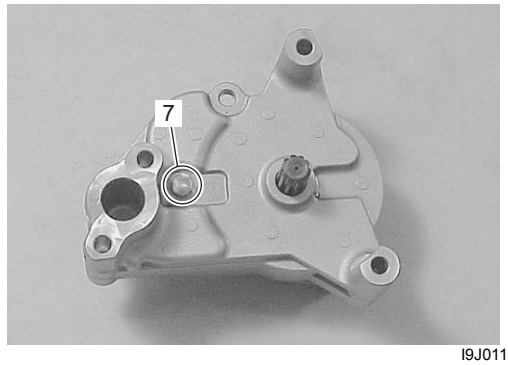


I9J011150010-01

5) Install dowel pins (5) and rotor plate (6), and then tighten screw (7) securely.
After mounting the rotor plate, make sure that each rotor turns smoothly by hand.



I9J011150011-01



I9J011150012-01

6) Pour approx. 20 ml (0.7 oz.) of engine oil into pump case for initial lubrication.

Inspection Oil Pump Component Parts

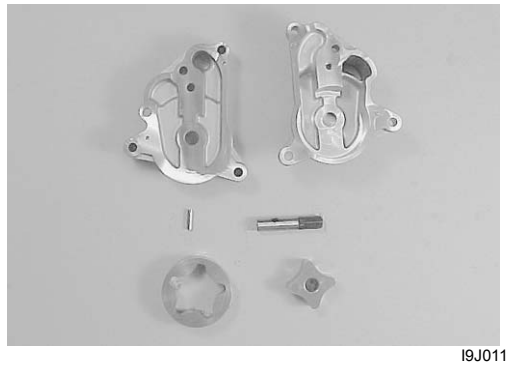
Z9J0111506003

NOTE

If any repair is required on outer rotor, inner rotor and oil pump case / plate, replace them as an oil pump assembly.

Oil Pump Component Parts

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

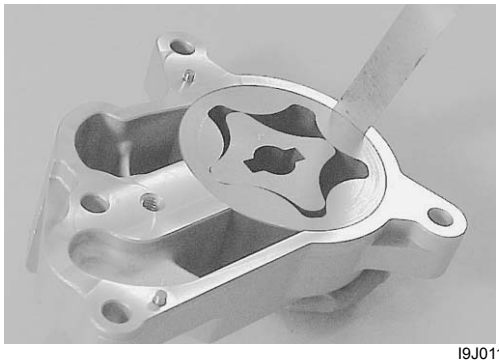


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Measuring Radial Clearance
Using a feeler gauge, measure radial clearance between outer rotor and case.
If measurement is not within specifications, replace oil pump assembly.

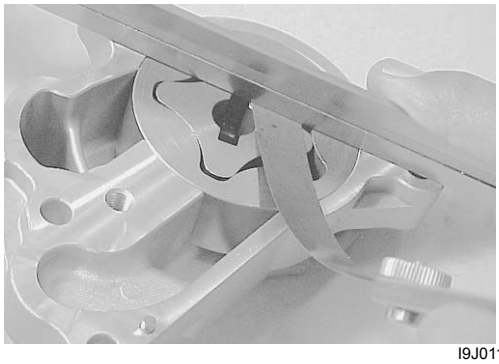
Radial clearance
Service limit: 0.31 mm (0.0122 in.)



I9J011150014-01

Measuring Side Clearance
Using Straightedge and feeler gauge, measure side clearance.
If measurement is not within specifications, replace oil pump assembly.

Side clearance
Service limit: 0.15 mm (0.0059 in.)



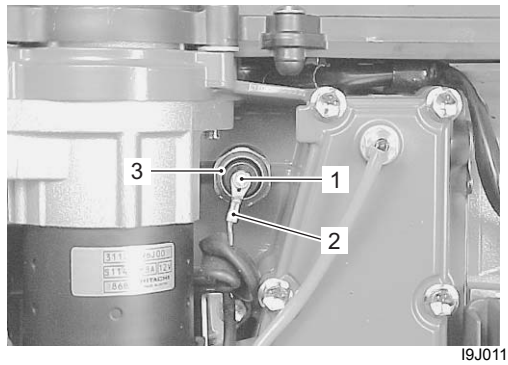
I9J011150015-01

Oil Pressure Switch Removal and Installation

Z9J0111506004

Removal

1) Loosen screw (1) and disconnect blue lead wire (2) from oil pressure switch (3).



I9J011150016-01

2) Remove oil pressure switch from cylinder block.

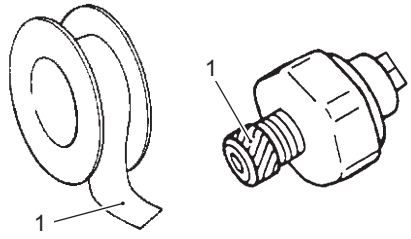
Installation
Installation is reverse order of removal with special attention to the following steps.

- Before installing oil pressure switch, wrap screw threads with sealing tape (1) then tighten switch to specified torque.

NOTE

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

Tightening torque
Oil pressure switch (a): 13 N·m (1.3 kgf-m, 9.5 lbf-ft)



I9J011150002-01



I9J011150017-01

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

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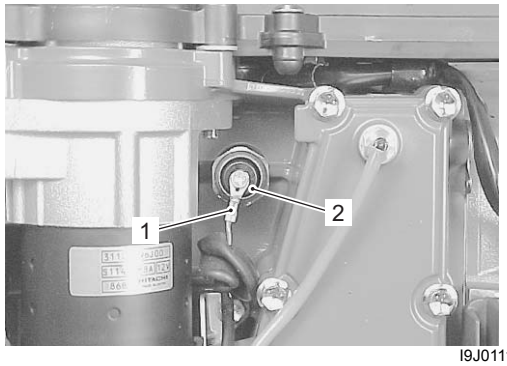
Oil Pressure Switch Inspection

Z9J0111506005

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).



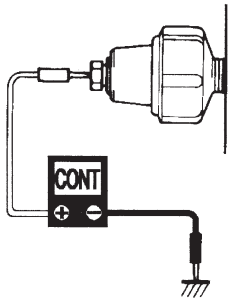
I9J011150018-01

2) Check the continuity between the switch terminal and engine body ground.

Special tool
(TOOL) : 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))

Oil pressure switch continuity
Engine running: Infinity
Engine stopped: Continuity



I9J011150003-01

3) If measurement exceeds specification, replace oil pressure switch.
4) Reinstall parts removed earlier.

Oil Strainer Removal and Installation

Z9J0111506006

Removal
Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” in Section 2A (Page 2A-6).

Installation
Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” in Section 2A (Page 2A-9).

Oil Strainer Related Parts Inspection

Z9J0111506007

- Inspect oil strainer. Replace strainer if cracked, damaged or other abnormal conditions.
  If clog or obstruction, clean oil strainer.
- Check condition of O-ring. Replace O-ring if nicked, cut, worn or other abnormal condition.



I9J011150019-01

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Power Unit Cooling System

General Description

Water Cooling System Description

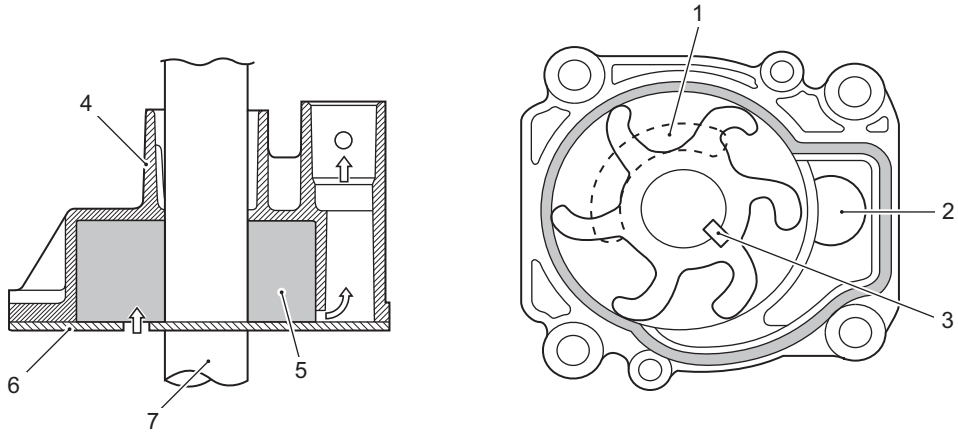
Z9J0111601001

The cooling system uses a displacement type flexible vane impeller to supply cooling water to the powerhead assembly.
To prevent incomplete combustion due to an overcooled engine, and to ensure proper water flow during cold engine operation, there is a thermostat in the cylinder block.
Motor temperature and cooling system efficiency are monitored by cylinder temp. sensor and exhaust manifold temp. sensor in the cylinder. If temperature higher than normal is detected by a sensor, an advance caution of overheat condition is provided.

Displacement Type Water Pump Description

Z9J0111601002

In this displacement type water pump, the water pressure is increased by the change in volume between the impeller and the pump case. As a result, the increased water pressure enables the water pump to circulate the cooling water.



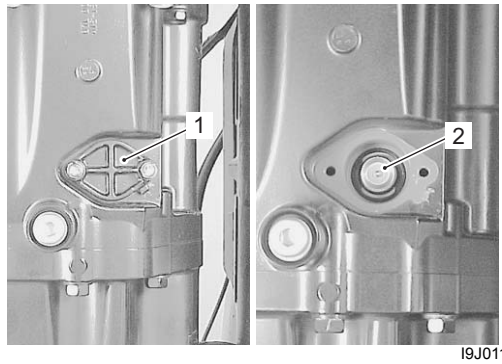
I9J011160003-01

1. Water inlet	3. Key	5. Water pump impeller	7. Driveshaft
2. Water outlet	4. Water pump case	6. Under panel	

Water Pressure Valve Description

Z9J0111601003

If cylinder water pressure is high when thermostat is closed, the valve will open to relieve the pressure.



I9J011160004-01

1. Water pressure valve cover	2. Water pressure valve

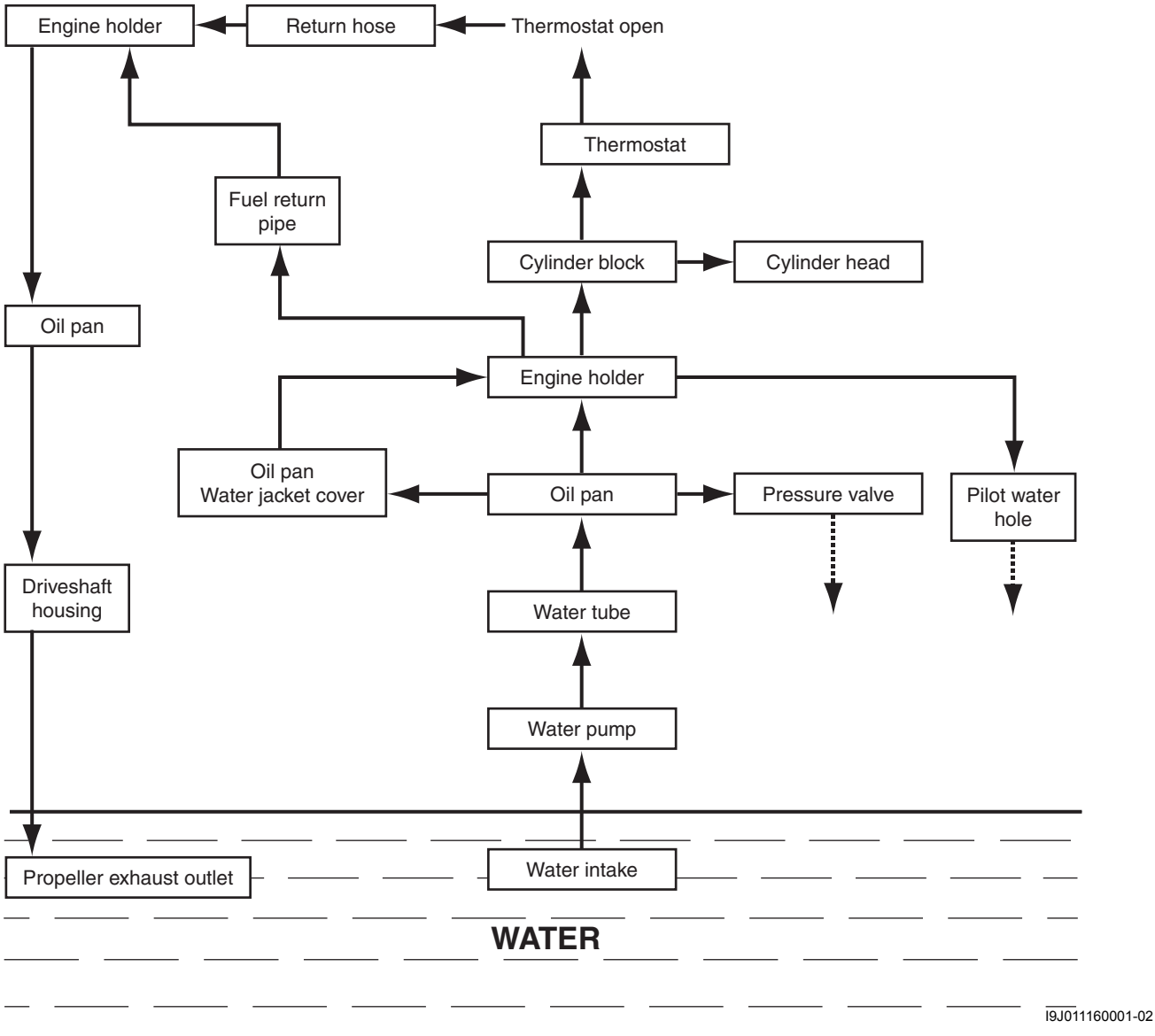
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Schematic and Routing Diagram

Cooling Water Circulation Chart

Z9J0111602001

The water cooling system includes the lower unit water pump, lower unit to power unit water supply tube, oil pan water pressure valve, power unit water passages and thermostat.
This system cools both the power unit and exhaust and is shown in schematic form below.
If overheating occurs, the components of the cooling system must be inspected for blockage, corrosion build-up or component damage.



I9J011160001-02

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Diagnostic Information and Procedures

Powerhead Cooling System Diagnosis

Z9J0111604001

Condition	Possible cause	Correction / Reference Item
Overheating powerhead	Water inlet screen obstructed.	*Clean.*
	Water passage obstructed.	*Clean or replace.*
	Pump plate not sealing.	*Check and repair.*
	Water pump impeller damage.	*Replace.*
	Water pump housing and/or plate worn.	*Replace.*
	Water pump housing seal worn.	*Replace.*
	Water tube grommet damaged.	*Replace.*
	Thermostat damaged / defective.	*Replace.*
	Water pressure valve damaged / defective.	*Replace.*
Overcooling powerhead	Thermostat damaged / defective.	*Replace.*

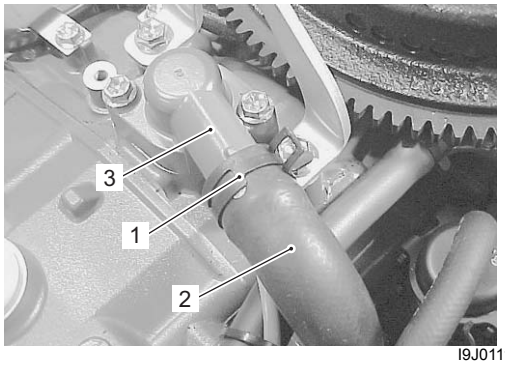
Service Instructions

Thermostat Removal and Installation

Z9J0111606001

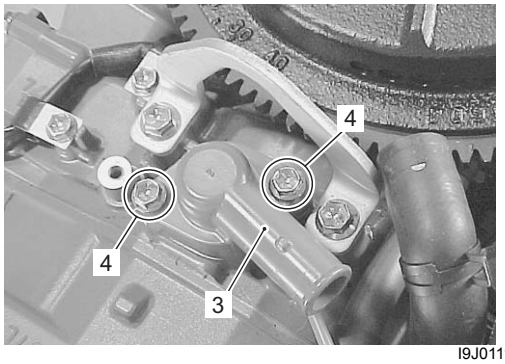
Removal

1) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
2) Loosen the clip (1) and remove the water return hose (2) from thermostat cover (3).



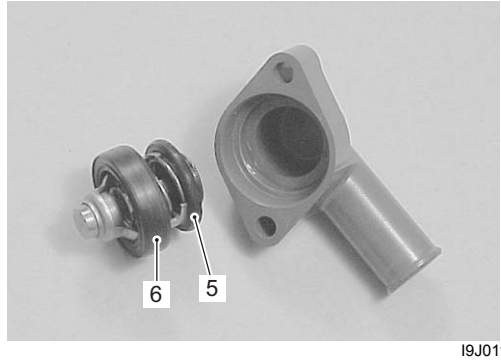
I9J011160005-01

3) Remove the two bolts (4) securing the thermostat cover (3), then remove the cover with thermostat.



I9J011160006-01

4) Remove the thermostat (5) and cover seal (6) from thermostat cover.

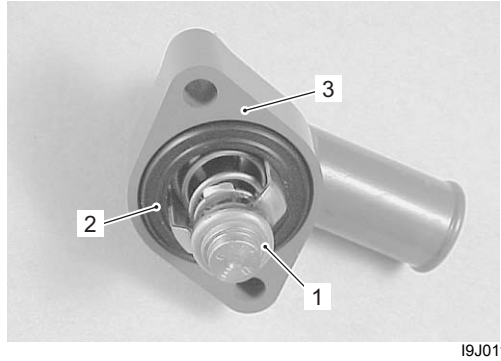


I9J011160007-01

Installation

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

- Assemble thermostat (1), cover seal (2) and thermostat cover (3).

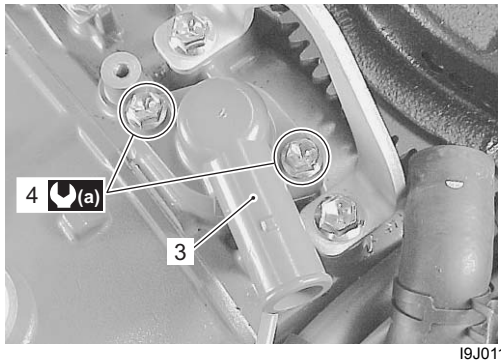


I9J011160008-01

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- Install the thermostat cover and thermostat assembly, then secure thermostat cover (3) with bolts (4).

  Tightening torque
  Thermostat cover bolt (a): 10 N·m (1.0 kgf-m, 7.2 lbf-ft)



I9J011160009-03

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

Thermostat Inspection

Z9J0111606002

Inspect the thermostat in the following procedures:

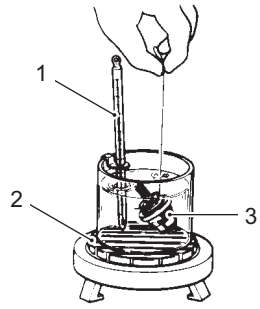
1) Remove the thermostat.
   Refer to “Thermostat Removal and Installation” (Page 1F-3).
2) Inspect the thermostat.
   If salt deposits, corrosion, wear or other damage is found, clean or replace.



I9J011160010-01

3) Check thermostat opening temperature as follows:
   a) Insert a length of thread between thermostat valve / body and suspend thermostat in a container filled with water.
   b) 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)



I9J011160002-01

1. Thermometer	3. Thermostat
2. Heater	

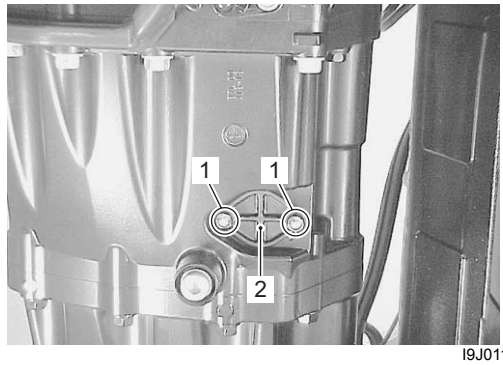
4) Install the thermostat.
   Refer to “Thermostat Removal and Installation” (Page 1F-3).

Water Pressure Valve Removal and Installation

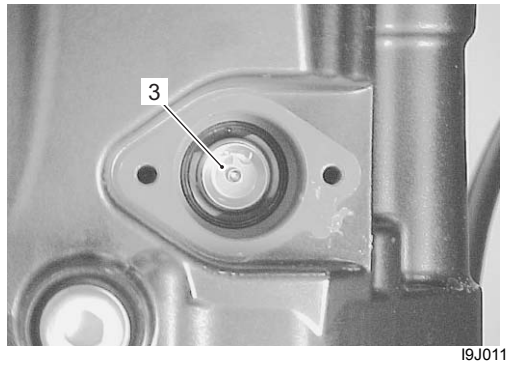
Z9J0111606003

Removal

1) Remove lower side cover.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
2) Remove two bolts (1), pressure valve cover (2) and water pressure valve (3).



I9J011160011-01

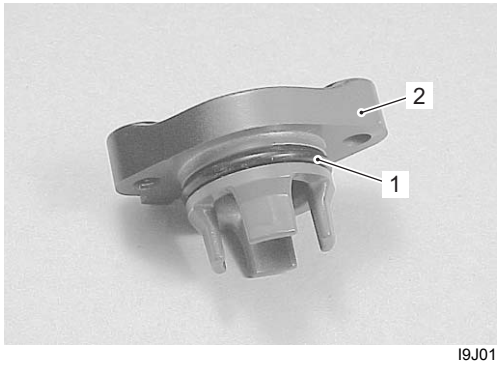


I9J011160012-01

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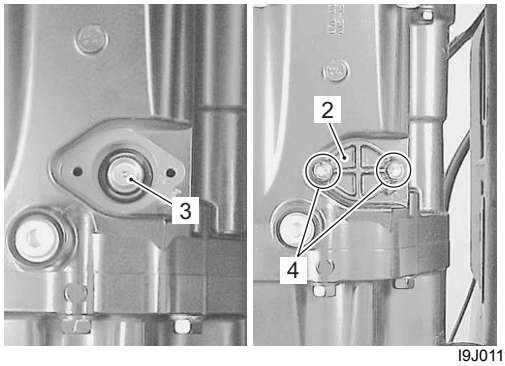
Installation

1) Install O-ring (1) to pressure valve cover (2).



I9J011160013-01

2) Install pressure valve (3) and pressure valve cover (2) to oil pan and secure with bolts (4).



I9J011160014-01

3) Install lower side cover.
Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).

Water Pressure Valve Related Item Inspection

Z9J0111606004

Inspect the water pressure valve in the following procedures:

1) Remove the water pressure valve.
Refer to “Water Pressure Valve Removal and Installation” (Page 1F-4).

2) Inspect the water pressure valve.
If salt deposits, corrosion, wear or other damage is found, clean or replace.
Inspect O-ring. Replace if nicked, cut or torn.



I9J011160015-01

3) Install the water pressure valve.
Refer to “Water Pressure Valve Removal and Installation” (Page 1F-4).

Water Pump Removal and Installation

Z9J0111606005

Refer to “Water Pump Removal and Installation” in Section 3A (Page 3A-6).

Water Pump Related Item Inspection

Z9J0111606006

Refer to “Water Pump and Related Items Inspection” in Section 3A (Page 3A-8).

Water Tube Removal and Installation

Z9J0111606007

Removal

Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” in Section 2A (Page 2A-6).

Installation

Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” in Section 2A (Page 2A-9).

Water Tube Related Item Inspection

Z9J0111606008

Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Related Component Inspection” in Section 2A (Page 2A-13).

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Fuel System

Precautions

Precautions on Fuel System Service

Z9J0111700001

⚠ 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 readily available for use.**
- **Always use appropriate safety equipment and wear safety glasses when working around a 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.**
- **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.**

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General Description

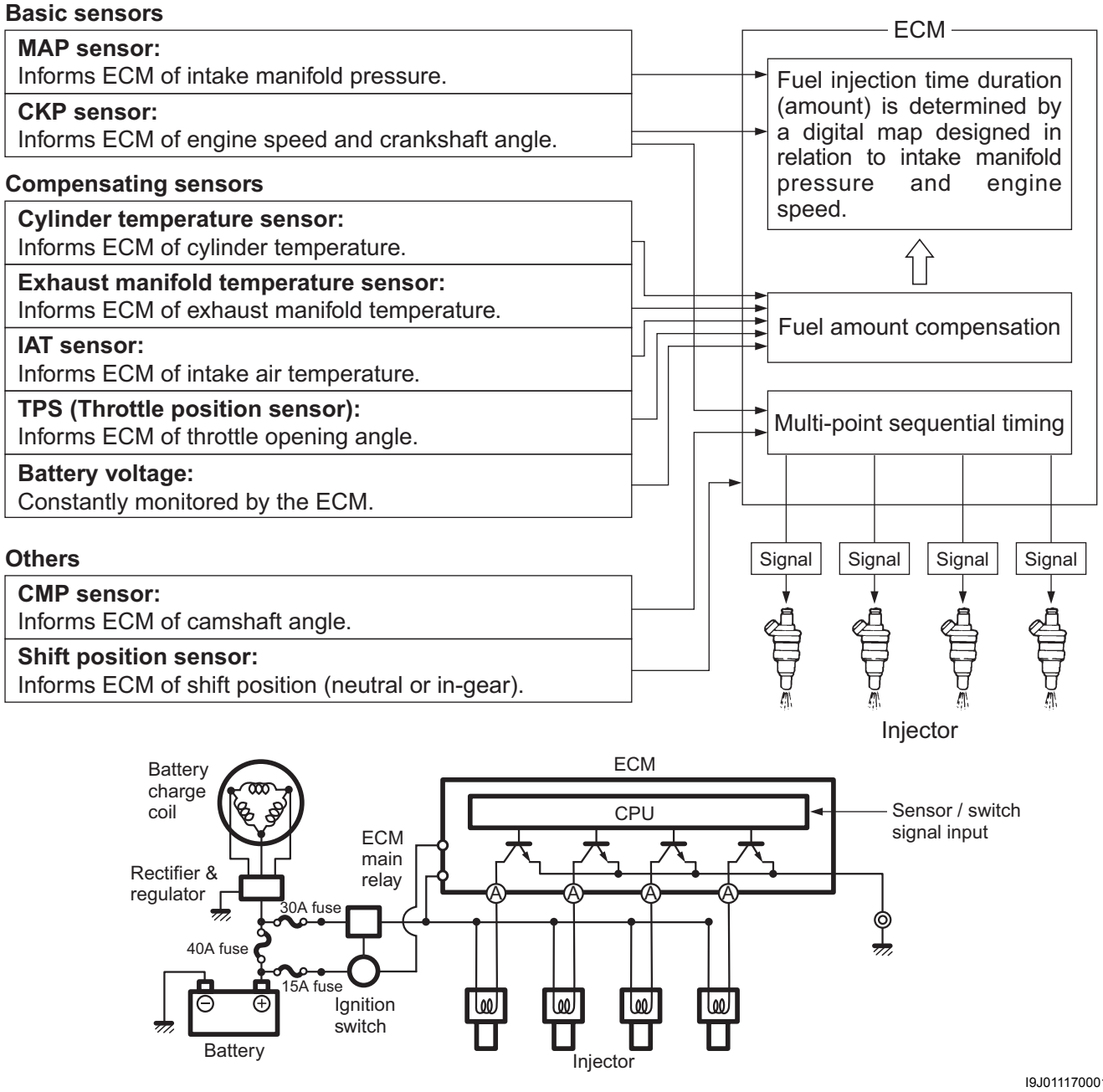
Electronic Fuel Injection System Description

Z9J0111701001

The fuel injection system used by the DF70 / 80 / 90 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.).

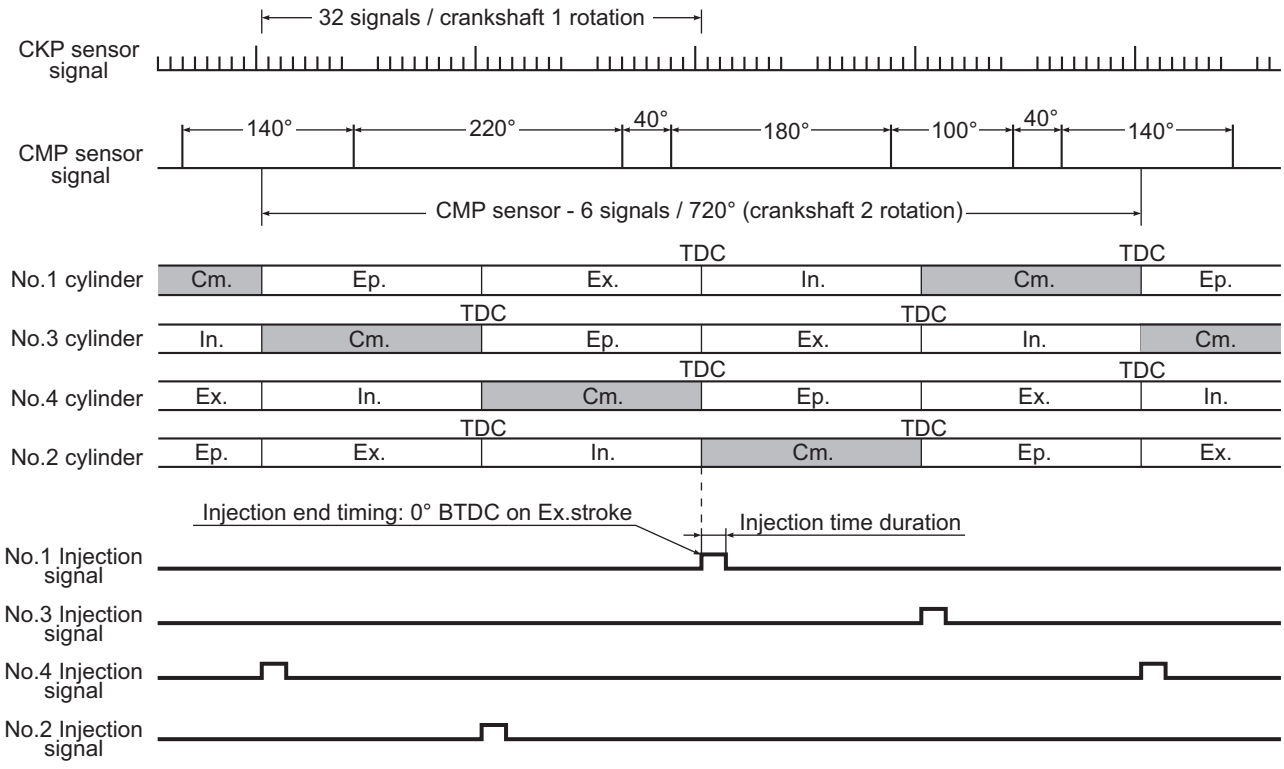
Fuel Injection Control System Outline

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.
In regards to fuel injection timing, the fuel injection end timing is set depending on engine rpm. The ECM calculates the amount of fuel injection based on the engines operating conditions, and determines the fuel injection start timing.
In the injection timing chart below, the injection end timing is set at 0° BTCD on the exhaust stroke.



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Fuel Injection Timing Chart



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

I9J011170002-05

Fuel Injection Control Mode

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 so that the engine rpm stays within the fast idle speed map until the cylinder temperature reaches normal operating temperature.

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:

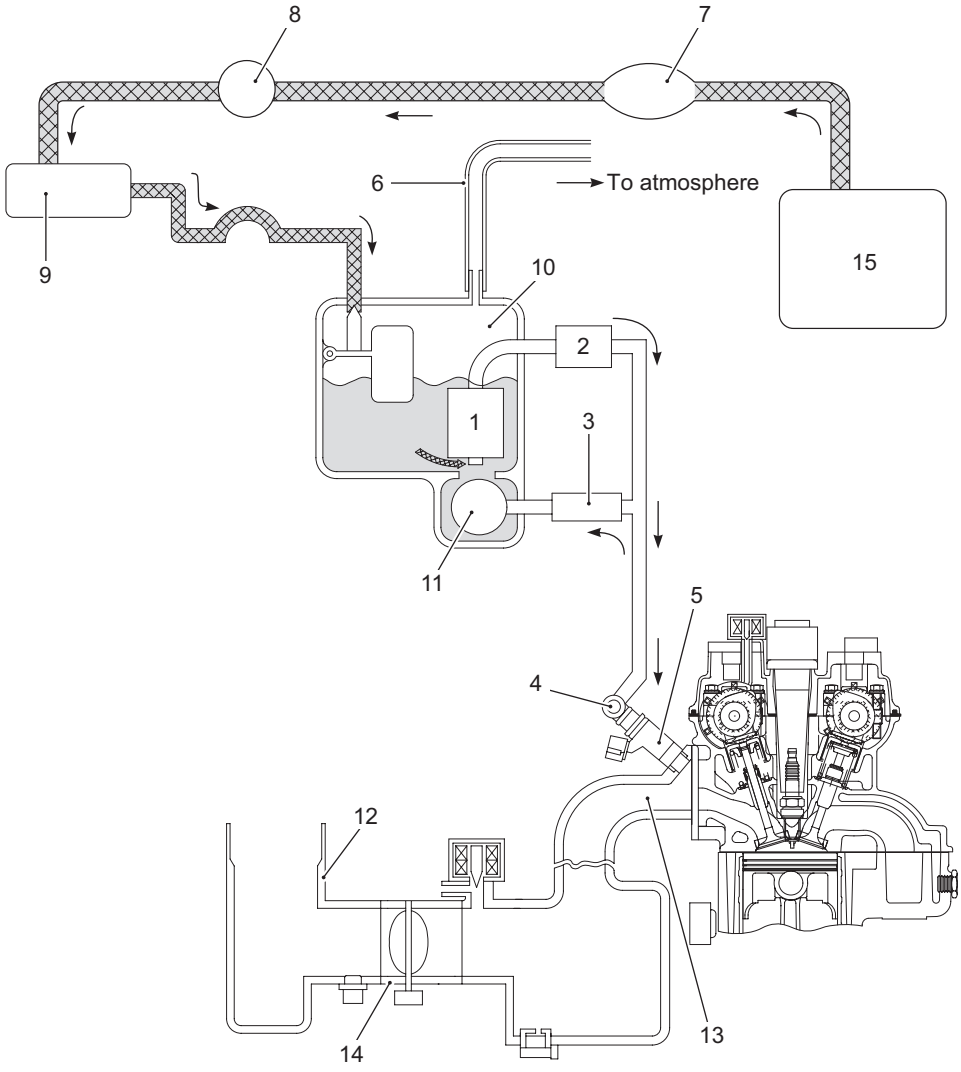
The fuel injection amount is controlled to decrease.
The fuel injection is also cut off on very rapid engine deceleration.

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Fuel Delivery System Components Description

Z9J0111701002

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 injectors 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. 250 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.



I9J011170003-03

1. High pressure fuel pump	5. Fuel injector	9. Low pressure fuel pump	13. Intake manifold
2. High pressure fuel filter	6. Evaporation hose	10. Fuel vapor separator	14. Throttle body
3. Fuel cooler	7. Primer bulb	11. Fuel pressure regulator	15. Fuel tank
4. Fuel delivery pipe	8. Low pressure fuel filter	12. Intake silencer	

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Fuel Vapor Separator

The fuel vapor separator incorporates a float system that maintains a constant fuel level inside the separator chamber. As the fuel level decreases, fuel flows into the vapor separator from the low pressure fuel pump.

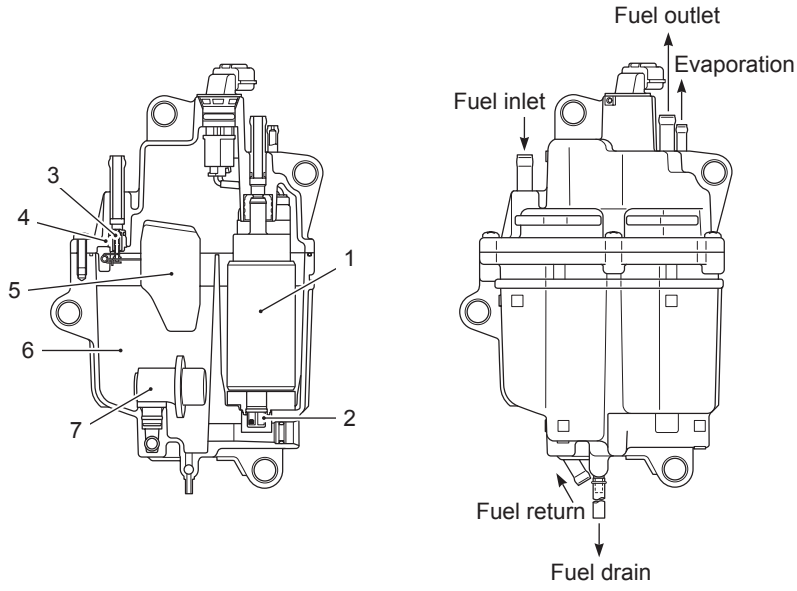
The function of this unit is to separate vapors from fuel delivered by the low pressure fuel pump or fuel returned from the fuel pressure regulator.

This vapor is routed through the evaporation hose to the atmosphere.

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 the ECM.



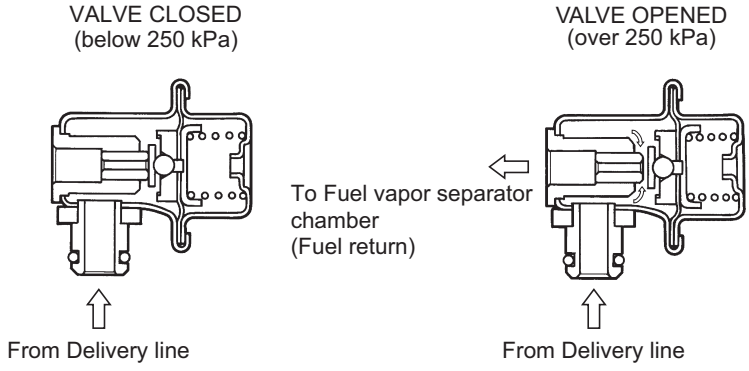
I9J011170016-03

1. High pressure fuel pump	3. Needle valve	5. Float	7. Fuel pressure regulator
2. Suction filter	4. Valve seat	6. Chamber	

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Fuel Pressure Regulator

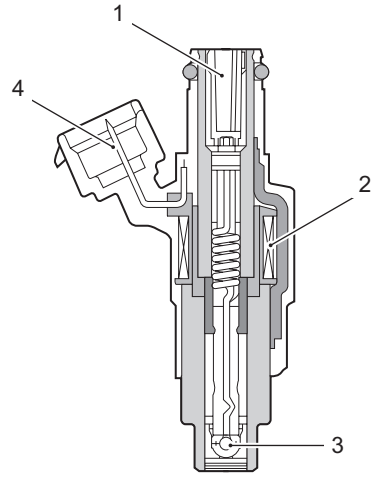
The fuel pressure regulator is located in the fuel vapor separator.
The regulator's function in the system is to maintain constant fuel pressure to the injectors while the engine is operating.
The regulator diaphragm chamber is open to the fuel vapor separator chamber to keep the pressure balanced.
Fuel 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.).
By-pass fuel is returned to the fuel vapor separator chamber.



I9J011170004-02

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 electromagnetic valve is open.



I9J011170005-02

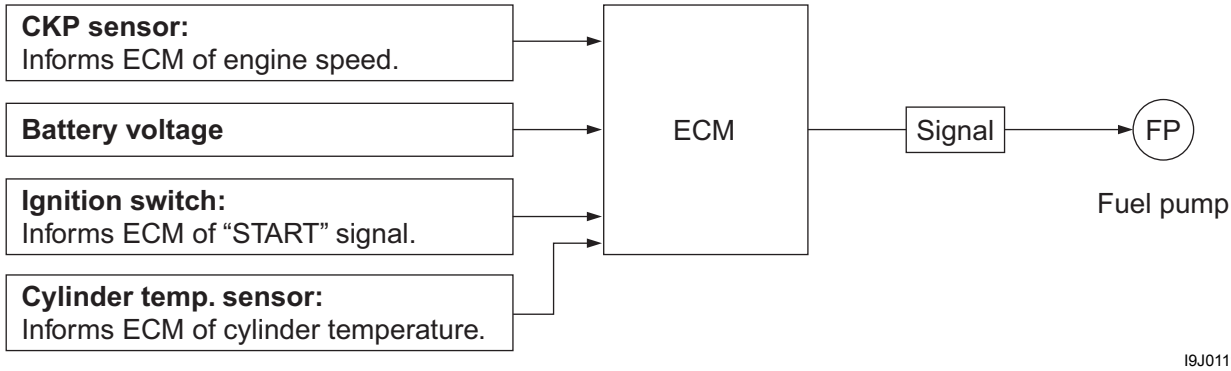
1. Filter	3. Ball valve
2. Solenoid coil	4. Terminal

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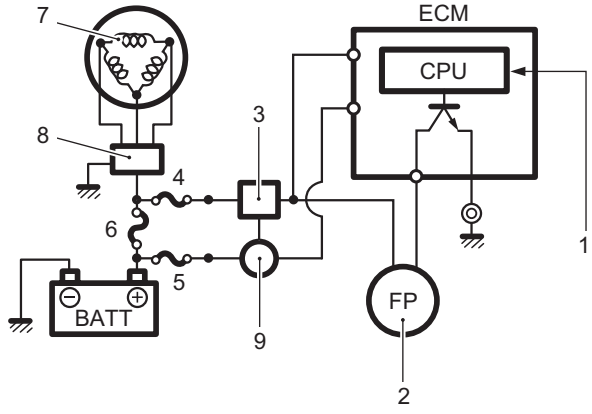
High Pressure Fuel Pump Control System Description

Z9J0111701003

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 cycle (repeating “ON” time rate within a cycle) and sends this signal to the fuel pump.



I9J011170006-01

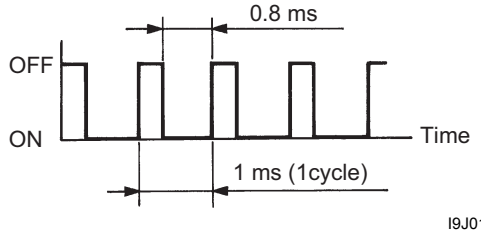


I9J011170007-01

1. Sensor/switch signal input	6. 40 A fuse
2. Fuel pump	7. Battery charge coil
3. ECM main relay	8. Rectifier/Regulator
4. 30 A fuse	9. Ignition switch
5. 15 A fuse	

Duty cycle signal for fuel pump (example: 80% duty)

$$\frac{\text{“ON” time}}{\text{1 cycle time}} \times 100 = \text{duty (\%)}$$



I9J011170008-01

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Control Modes

Before start:

For 3 seconds after the ignition switch is turned “ON”, the fuel pump is controlled to operate at a 100% duty cycle to initially pressurize the high pressure fuel line.

When cranking:

The fuel pump is controlled to operate at a 50 – 100% duty cycle.
The duty cycle changes depending on cylinder temperature.

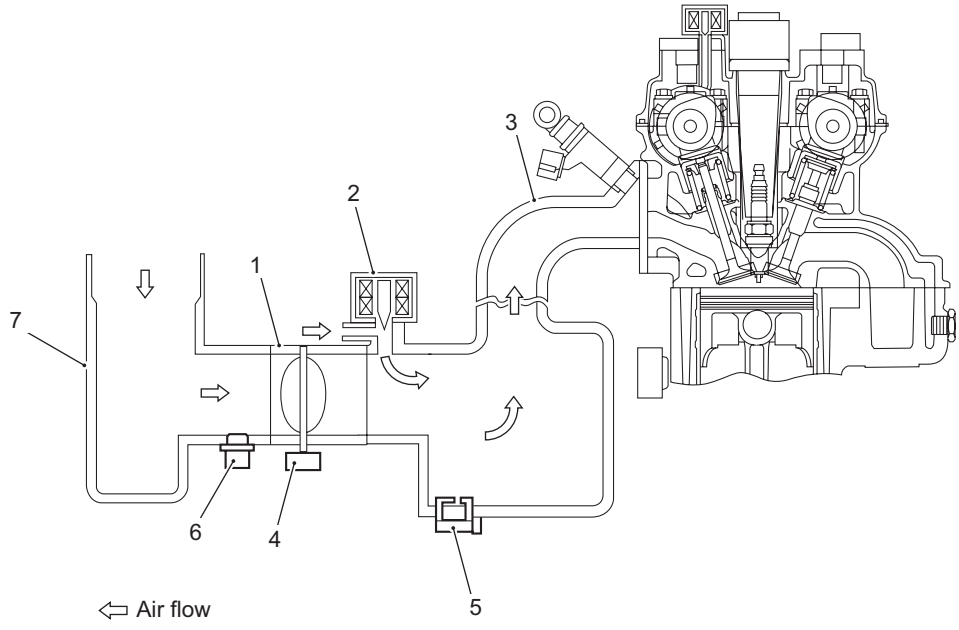
When running (normal operation):

The fuel pump is controlled to operate at a 50 – 100% duty cycle based on the current engine speed and battery voltage.

Air Intake Components Description

Z9J0111701004

Air, after entering through the silencer case, passes through the throttle body and flows into the surge tank where it is then distributed to the intake manifold.
Intake manifold pressure, monitored by the MAP sensor, is an indirect measurement of the intake air amount.
When the throttle is fully closed, the main supply of intake manifold air necessary to sustain engine idle passes through the by-pass air passage.
To maintain engine idle speed at specification, the ECM controlled IAC valve supplies a regulated amount of additional air through the IAC (Idle Air Control) passage.



I9J011170009-01

1. Throttle body	3. Intake manifold	5. MAP sensor	7. Air intake silencer
2. IAC valve	4. Throttle position sensor	6. IAT sensor	

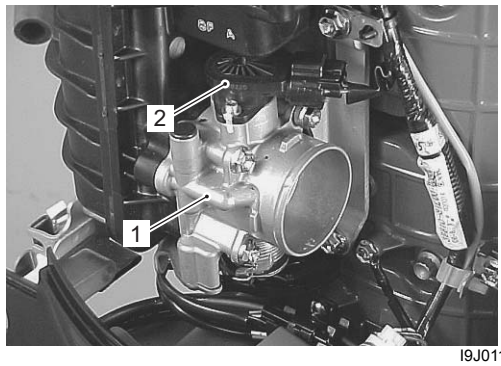
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Throttle Body

- The throttle body assembly consists of the main bore, throttle valve and TPS (Throttle Position Sensor).
- The throttle body adjusts the intake air amount with the throttle valve which is connected to the throttle lever linkage.
- The TPS installed on the throttle body informs the ECM of the throttle valve opening angle.

NOTE

Do not try to adjust or remove any of the throttle body component parts (Throttle Position Sensor, throttle valve, throttle stop screw, etc.).
These components have been factory adjusted to precise specifications.



I9J011170025-01

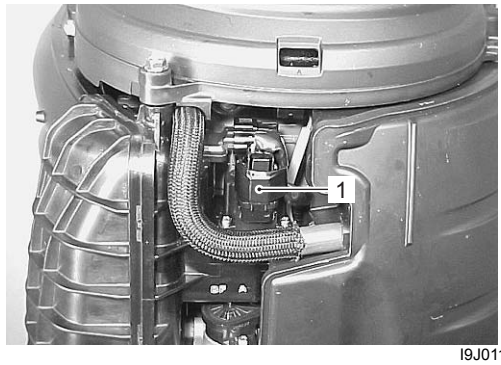
1. Throttle body assembly	2. TPS

Idle Air Control System Description

Z9J0111701005

IAC Valve/Passage

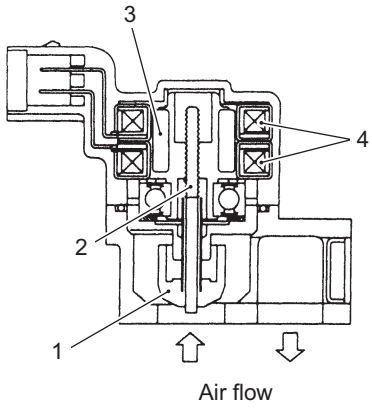
The IAC valve is a stepper motor type mounted on the intake manifold.
Its purpose is to control the amount of intake air flowing through the IAC passage.
The IAC valve consists of a stepper motor, rod, valve and other parts.
As the stepper motor is controlled by signals from the ECM, valve position changes will increase or decrease the air flow through the IAC passage.

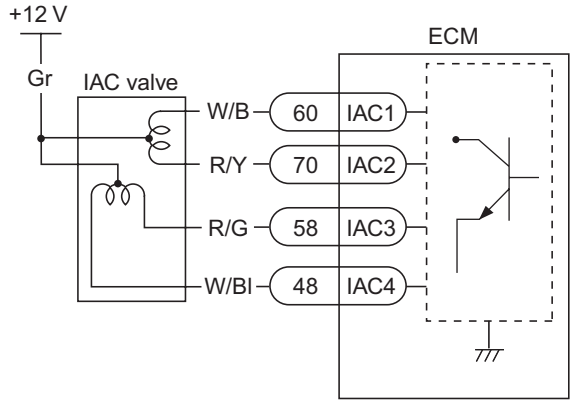


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1. IAC valve

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I9J011170010-02

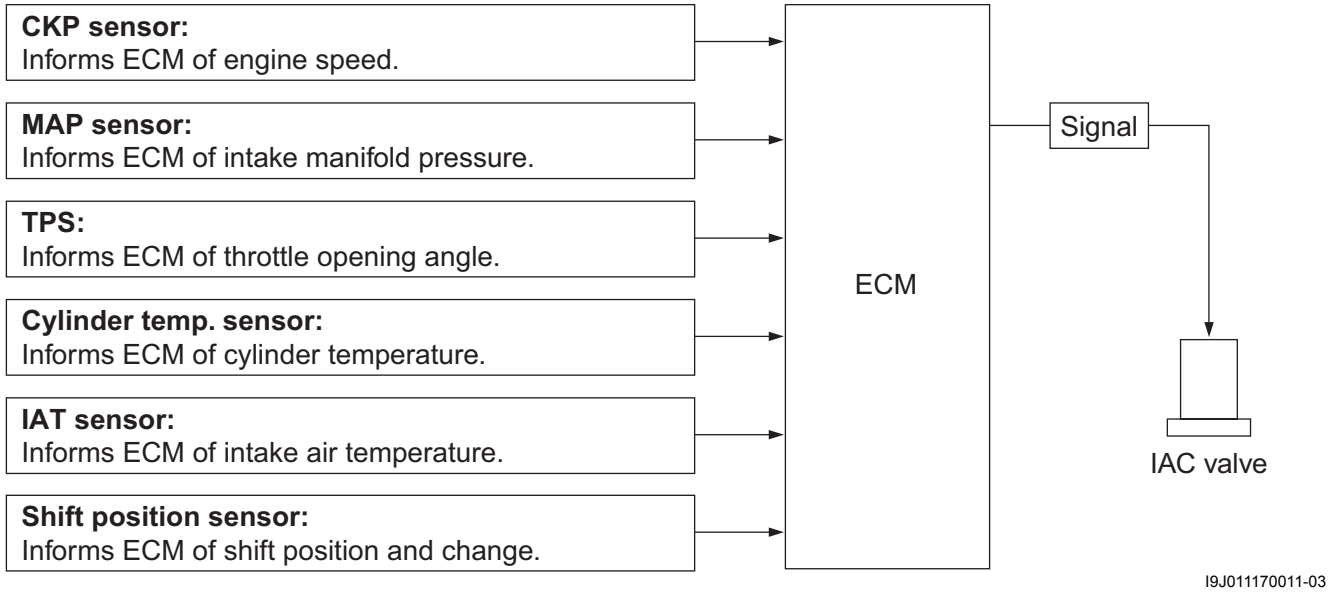
1. Valve pintle	2. Screw shaft	3. Rotor	4. Coil

Idle Air Control System Outline

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

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

The sensors and switch shown below monitor the current engine condition and send signals to the ECM.
Based on these signals, the ECM determines the IAC valve setting necessary to achieve the target engine speed and outputs the signal for actuating the stepper motor inside the IAC valve.
The rotor of the stepper motor then turns in an amount equal to the steps of the signal supplied from the ECM, moving the valve via a screw shaft.



I9J011170011-03

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IAC Valve Control Mode

Before started:
The IAC valve is initialized at a 70% opening position when engine is not running. (Ignition switch “OFF”).

When cranking:
The IAC valve is controlled to operate at approx. 60 – 90% open position.
The open position changes depending on the cylinder temperature.

After start (fast-idle function):
The IAC valve is controlled to operate at approx. 60 – 90% open position until the timer, (set according to cylinder temperature at cranking) expires. Then the open position gradually decreases until the engine rpm slows to the preset idle speed.

When idling / trolling:
The IAC valve is controlled so that the engine speed is stable at the idling / trolling speed specified.
During this period, the IAC valve has an open position of approx. 0 – 30%, but will vary slightly as idling / trolling conditions change.

When running (normal operation):
The IAC valve is controlled to operate at a 0 – 90% open position, dependent on current engine operating conditions.

When decelerating (dash-pot effect):
When the throttle valve is suddenly returned to fully closed, and the throttle position sensor signal changes to “fully closed”, the IAC valve is controlled to gradually return to an idle / troll operating position to prevent engine stalling or unstable running.

NOTE

Due to the limited intake air flow from the IAC passage, and in order to effectively use both the “Dash-pot effect” and the “Fast-idle function”, an IAC valve operating position of 0 – 30% at idling / trolling speed is required.

Diagnostic Information and Procedures

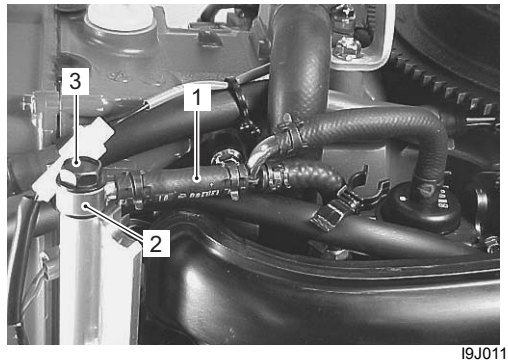
Fuel Pressure Inspection

Z9J0111704001

⚠ WARNING

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service” (Page 1G-1) in order to reduce the risk or fire and personal injury.

1) Relieve fuel pressure in fuel feed line.
   Refer to “Fuel Pressure Relief Procedure” (Page 1G-15).
2) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
3) Disconnect the high pressure fuel feed hose (1) from the fuel delivery pipe upper union (2).
   Loosen the delivery pipe upper plug (3).



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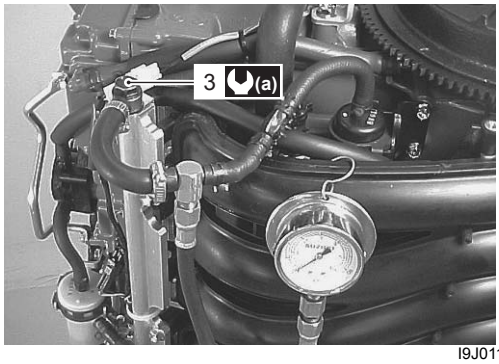
4) Connect special tools (pressure gauge, pressure hose and pressure joint) between fuel feed hose (1) and fuel delivery pipe upper union as shown in figure. Tighten the delivery pipe upper plug (3) to specified torque.
Clamp the hose securely to ensure that no leaks occur during checking.

CAUTION

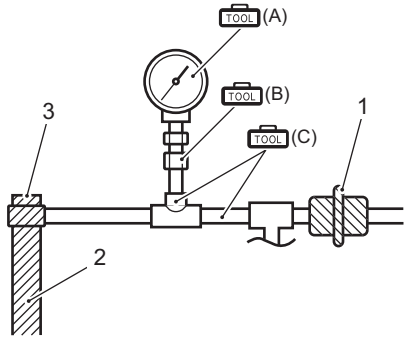
A small amount of fuel may be released when the fuel feed hose is disconnected.
Place container under the fuel feed hose or fuel delivery pipe upper union with a shop cloth so that the released fuel is caught in the container or absorbed by the cloth. Place the fuel soaked cloth in an approved container.

Special tool
(A): 09912–58442 (Fuel pressure gauge)
(B): 09912–58432 (Fuel pressure hose)
(C): 09912–58490 (3-way joint & hose)

Tightening torque
Delivery pipe upper plug (a): 35 N·m (3.5 kgf-m, 25.5 lbf-ft)



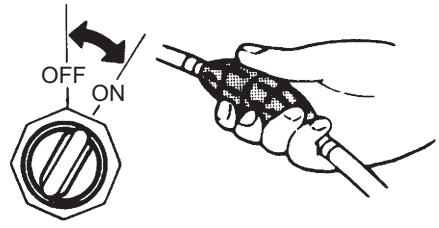
I9J011170027-03



I9J011170017-01

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

5) Ensure the emergency stop switch lock plate is in place.
Shift into “Neutral” position.
6) Squeeze fuel primer bulb until you feel resistance.
7) Turn ignition switch “ON” for 3 seconds (to operate the 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 the fuel pressure.



I9J011170018-01

9) Check for any signs of fuel leakage.

⚠ WARNING

When the engine is running, keep your hands, hair, clothing, etc., away from the engine.

10) Measure fuel pressure at cranking or idle speed operation.

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

11) Stop engine and wait 5 minutes.
Check the residual fuel pressure in line.

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

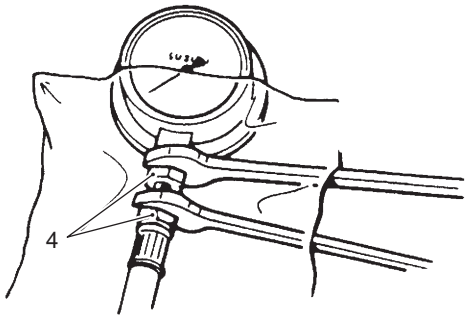
CAUTION

The fuel feed line is under high fuel pressure, make sure to release fuel pressure according to the fuel pressure relief procedures mentioned earlier.
Use the following procedures to remove the fuel pressure gauge.

- **Place a container under the joint to catch the fuel.**
- **Cover the joint with rag and loosen joint nut slowly to gradually release any residual fuel pressure.**

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12) After checking fuel pressure, remove fuel pressure gauge.



I9J011170019-01

4. Joint nut

13) Reconnect fuel line.

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

Fuel System Diagnosis

Z9J0111704002

Condition	Possible cause	Correction / Reference Item
Engine will not start or hard to start (Fuel does not reach the fuel delivery pipe).	Clogging, bending or improper routing of fuel hose.	*Clean, repair or replace.*
	Fuel pump failure.	*Replace.*
	Fuel pressure regulator failure.	*Replace.*
	Fuel injector(s) failure.	*Replace.*
	Wiring connection failure.	*Repair or replace.*
Engine will not start or hard to start.	Throttle position sensor failure.	*Replace.*
	MAP sensor failure.	*Replace.*
	ECM failure.	*Replace.*
	Cylinder temp. sensor failure.	*Replace.*
	IAT sensor failure.	*Replace.*
	High pressure fuel pump failure.	*Replace.*
	Fuel hose improperly routed.	*Reroute properly.*
Unstable idling / trolling or engine tends to stall.	Shift position sensor failure.	*Replace.*
	Throttle position sensor failure.	*Replace.*
	IAC control system failure.	*Check idle air control system.*
	IAC passage clogged.	*Clean.*
	ECM failure.	*Replace.*
	Wire continuity / connection failure.	*Repair or replace.*
	Fuel injector(s) clogged.	*Clean.*
	Fuel pressure regulator failure.	*Check fuel pressure. Replace if necessary.*
	High pressure fuel pump failure.	*Check fuel pump and its circuit. Replace.*
	Fuel filter clogged.	*Clean or replace.*
	Clogging, bending or improper routing of fuel hose.	*Clean, reroute, repair or replace.*
Insufficient engine power in high speed range (Air intake system failure).	Air leakage from air intake system.	*Repair or replace.*
Insufficient engine power in high speed range (Control circuit or sensor failure).	Fuel pressure too low.	*Check fuel pressure. Repair or replace.*
	Throttle position sensor failure.	*Replace.*
	ECM failure.	*Replace.*
Insufficient engine power in high speed range (Engine internal parts or electrical equipment failure).	Fuel injector(s) clogged.	*Clean.*
	Throttle position sensor failure.	*Replace.*
	ECM failure.	*Replace.*

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Fuel Injection System Troubleshooting

Z9J0111704003

Before starting the troubleshooting, make sure that:

- There is no self-diagnostic code indication.
- Emergency stop switch plate is set in place.

Step	Action	Yes	No
1	**Check fuel injector operating sound.** • Check each injector for operating sound at engine cranking. (☞(Page 1G-21)) *Do all 4 injector make operating sound?*	Fuel injector circuit is in good condition.	Go to step 2.
2	**Check fuel injector resistance.** • Turn ignition switch off, disconnect connectors from fuel injectors. • Check for proper connection to fuel injector at each terminal. • If good condition, check all fuel injector for resistance. (☞(Page 1G-21)) *Are all injectors in good condition?*	Go to step 3.	Faulty fuel injector.
3	**Check fuel injector power supply.** • Measure voltage between each “Gray” wire terminal of fuel injector connector and engine body ground with ignition switch turned “ON”. *Is voltage 10 – 14 V?*	Go to step 4.	• “Gray” wire open or shorted. • If it is in good condition, check ECM power source and ground circuit.
4	**Check Wire circuit.** • Turn “OFF” ignition switch. • Disconnect connector from ECM. • Measure resistance between each “O/B”, “B/Br”, “R/W”, “Lg” wire terminal of the fuel injector connector and body ground. *Is resistance infinity?*	Go to step 5.	“O/B”, “B/Br”, “R/W”, and/or “Lg” wire(s) are shorted to ground.
5	**Check Wire circuit.** • Connect connector to ECM. • Measure voltage between each “O/B”, “B/Br”, “R/W”, “Lg” wire terminal of fuel injector connector and body ground with ignition switch turned “ON”. *Is voltage 0 V?*	Go to step 6.	“O/B”, “B/Br”, “R/W”, and/or “Lg” wire(s) are shorted to power supply circuit.
6	**Check fuel injector operating signal.** • Connect connectors to each fuel injector and ECM with ignition switch turned “OFF”. • Measure fuel injector operating signal between each “45”, “71”, “47”, “59” terminal of ECM and body ground. (☞(Page 1G-22)) *Is voltage 6 – 10 V or over?*	If check result is satisfactory, substitute a known-good ECM and recheck.	“O/B”, “B/Br”, “R/W”, and/or “Lg” wire(s) are open circuit.

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Service Instructions

Fuel Pressure Relief Procedure

Z9J0111706001

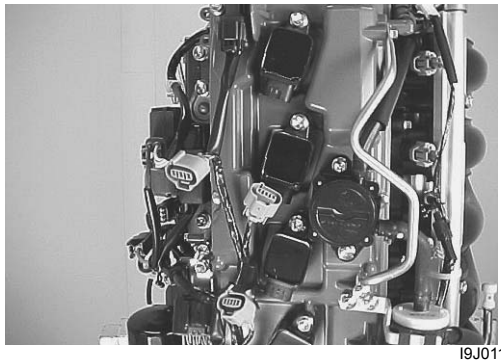
After making sure that engine is cold, relieve fuel pressure as follows:

1) Turn “OFF” ignition switch.
2) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
3) Disconnect the high pressure fuel pump lead wire connector at high pressure fuel pump.



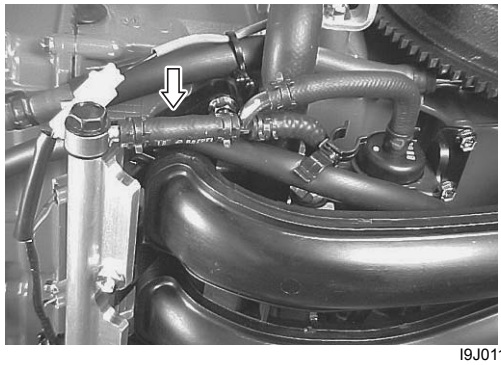
I9J011170028-01

4) Disconnect the ignition coil primary lead wire connectors from all of the ignition coils.



I9J011170029-01

5) Crank the engine 5 – 10 times (3 seconds each time) to dissipate the fuel pressure in lines.
6) Make sure fuel pressure has been relieved by pinching the high pressure fuel hose between finger tips (the line should feel soft, without pressure).



I9J011170030-01

7) Upon completion of servicing, connect the ignition coil primary lead wire and the high pressure fuel pump lead wire.
8) Install the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).

Fuel Line Removal and Installation

Z9J0111706002

Pay special attention to the following points 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 the fuel line pressure before disconnecting or removing components.

CAUTION

- **Do not over bend (kink) or twist hoses when installing.**
- **When installing hose clamps, position the 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 the clamps.**

- The fuel feed line is under high pressure, use special care when servicing it.
- Spilled gasoline should be wiped off immediately.
- Perform the following checks to ensure proper and safe operation of the repaired unit.
  – Check fuel hose routing.
    Refer to “Fuel Hose Routing” in Section 4B (Page 4B-1).
  – Check for fuel leakage.
    Refer to “Fuel Leakage Check Procedure” (Page 1G-16).

Fuel Line Inspection

Z9J0111706003

Visually inspect fuel lines for evidence of fuel leakage, cracking, deterioration, or damage. Make sure all clamps are secure. Replace parts as needed.

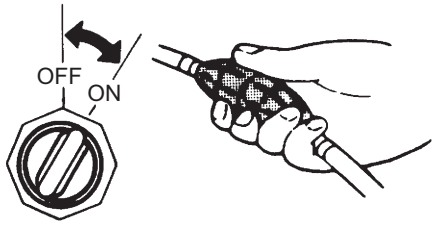
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Fuel Leakage Check Procedure

Z9J0111706004

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.
2) Shift into “Neutral” position.
3) Ensure emergency stop switch lock plate is in place.
4) Turn ignition switch “ON” for 3 seconds (to operate fuel pump), then turn it “OFF”.
   Repeat this (“ON” and “OFF”) procedure 3 or 4 times to pressurize the fuel system.
5) Once pressurized, check all connections and components for any signs of leakage.



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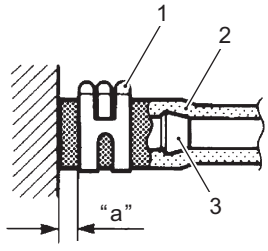
Inspection of Fuel Hose Connections

Z9J0111706005

Note that the 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, the hose must completely cover pipe.

Type “A”

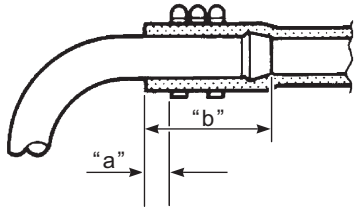


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1. Clamp (Clip)	3. Joint pipe
2. Hose	“a”: 3 – 7 mm (0.1 – 0.3 in)

- For type “B” (bent end) pipe, hose must cover the straight part of pipe by 20 – 30 mm (0.8 – 1.2 in.).

Type “B”

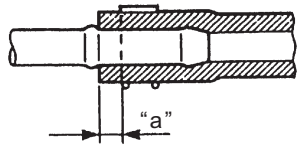


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“a”: 3 – 7 mm (0.1 – 0.3 in)	“b”: 20 – 30 mm (0.8 – 1.2 in)

- For type “C” pipe, hose must fit up against the flanged part of pipe.

Type “C”

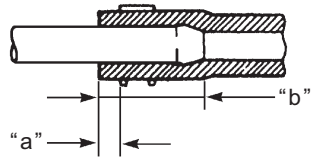


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“a”: 3 – 7 mm (0.1 – 0.3 in)

- For type “D” pipe, the hose must cover the pipe by 20 – 30 mm (0.8 – 1.2 in.).

Type “D”



I9J011170015-01

“a”: 3 – 7 mm (0.1 – 0.3 in)	“b”: 20 – 30 mm (0.8 – 1.2 in)

High Pressure Fuel Pump Operating Sound Inspection

Z9J0111706006

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

NOTE

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

Fuel pump operating sound
Sounds for approx. 3 seconds only (each time the ignition is turned to the “ON” position)



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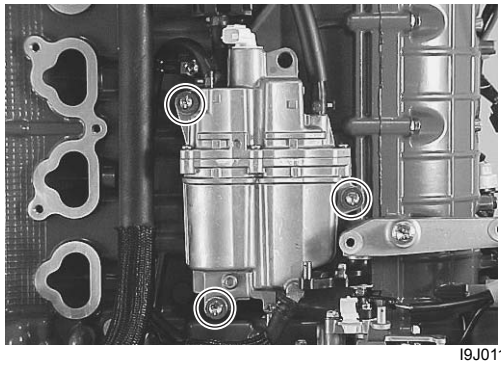
4) If no pump operating sound is heard:
   a) Turn ignition key to the “OFF” position, check for contact failure in the lead wire connector.
   b) Check that the drive voltage is outputting from the ECM and no abnormal conditions exist in the engine main wiring harness.
   c) If inspection in steps “a” and “b” are OK, replace the high pressure fuel pump.

Fuel Vapor Separator Removal and Installation

Z9J0111706007

Removal

1) Remove the intake manifold assembly.
   Refer to “Intake Manifold Removal and Installation” in Section 1D (Page 1D-7).
2) Remove the bolts and fuel vapor separator.
   Disconnect fuel outlet hose and evaporation hose from fuel vapor separator.



I9J011170032-01

Installation

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

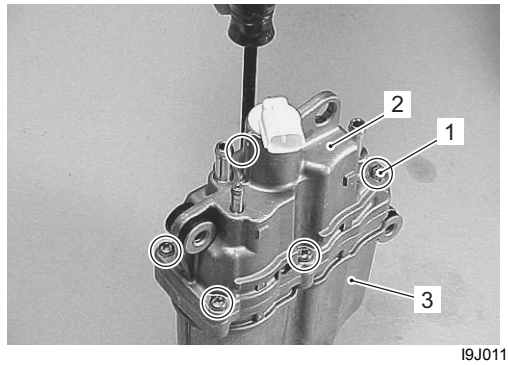
- Install the fuel vapor separator, then tighten the bolts securely.
- Install the intake manifold assembly.
  Refer to “Intake Manifold Removal and Installation” in Section 1D (Page 1D-7).
- Check to ensure that all removed parts are back in place.
- Check hose and wire routing.
  Refer to “Fuel Hose Routing” in Section 4B (Page 4B-1) and “Water Hose Routing” in Section 4B (Page 4B-5).
- Check for fuel leakage.
  Refer to “Fuel Leakage Check Procedure” (Page 1G-16).

Fuel Vapor Separator Disassembly and Assembly

Z9J0111706008

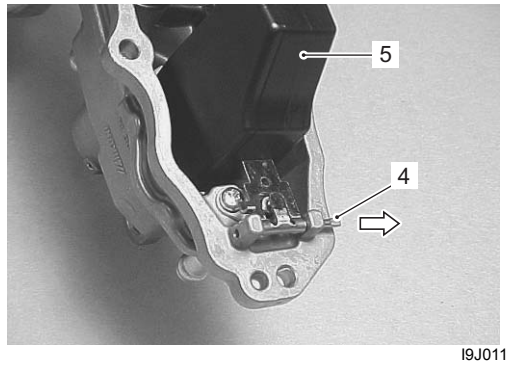
Disassembly

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

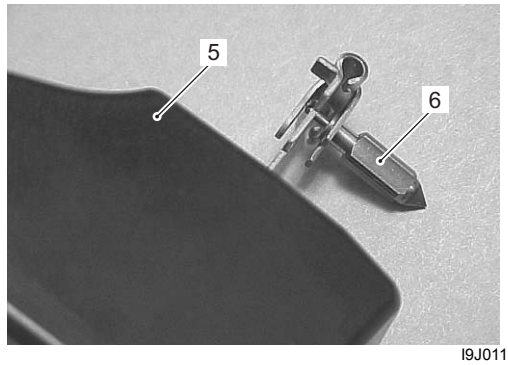


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2) Remove the float pin (4).
   Remove the float (5) and needle valve (6).



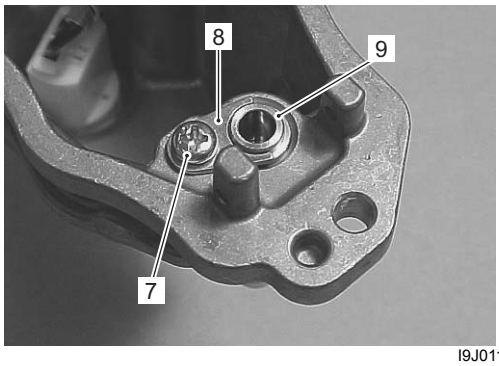
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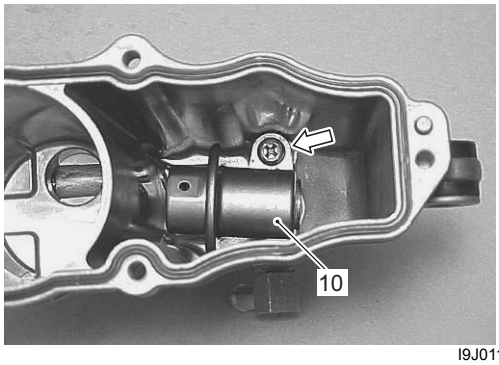
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3) Remove screw (7), plate (8) and valve seat (9).



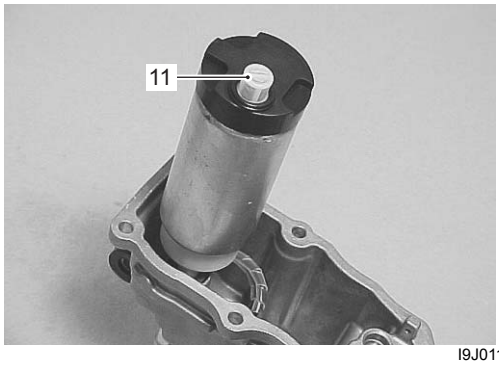
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4) Remove screw and fuel pressure regulator (10) from the separator case.



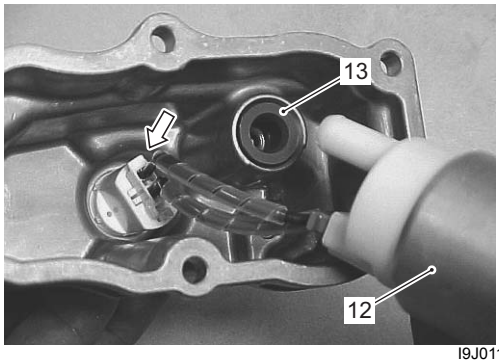
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5) Remove suction filter (11).



I9J011170038-01

6) Remove the high pressure fuel pump (12) and grommet (13) from the separator cover and then disconnect the pump lead wire connector.



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Assembly

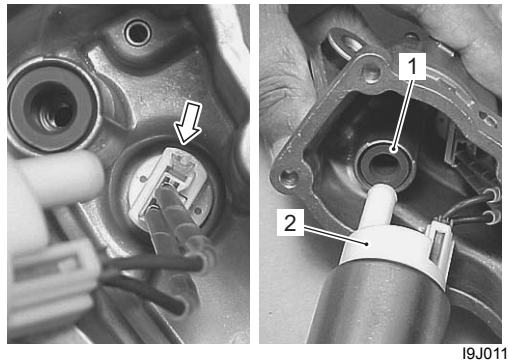
Assembly is in the reverse order of disassembly with special attention to the following steps.

High pressure fuel pump

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

NOTE

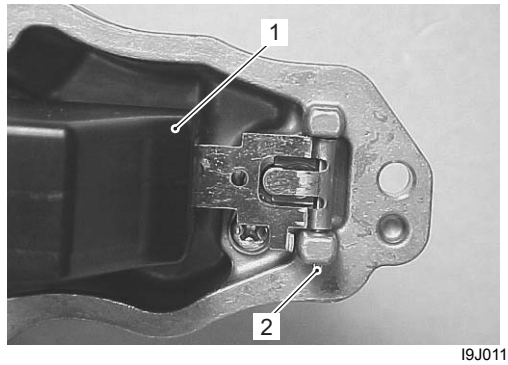
Apply fuel to the grommet before installing.



I9J011170040-01

Float / Float pin

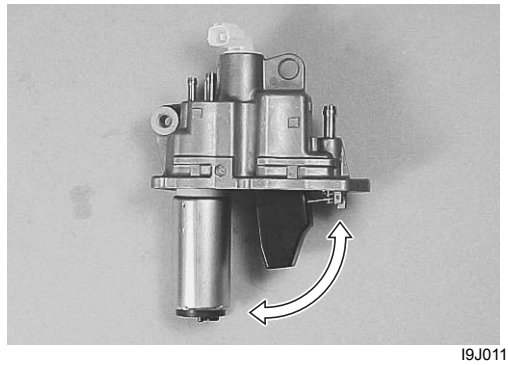
Install the float (1) and float pin (2).



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NOTE

After assembling, check for smooth and free float movement.



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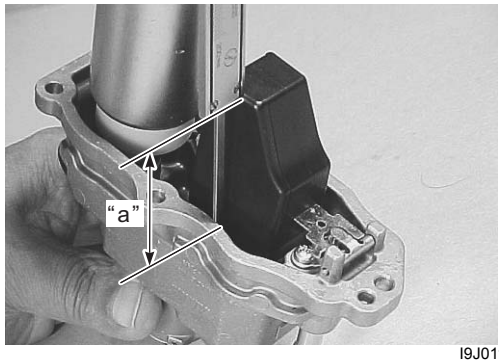
Checking float height
Measure the float height.

Special tool
TOOL : 09900–20101 (Vernier calipers (150 mm))

Float height "a"
Standard: 43 ± 3.0 mm

NOTE

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

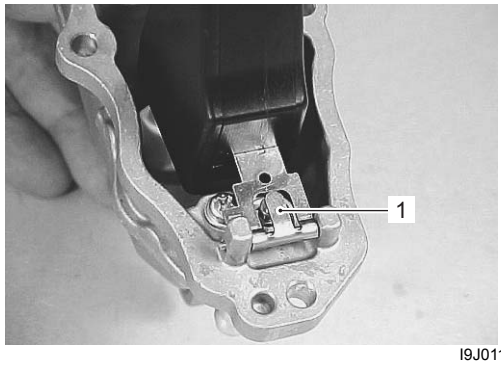


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Setting float height
To correct specification, bend only adjustment tab (1).

CAUTION

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

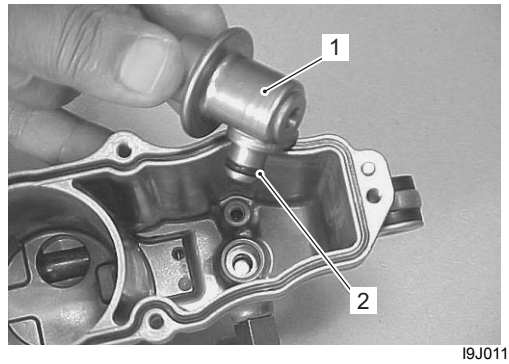


I9J011170044-01

Fuel pressure regulator
Install the fuel pressure regulator (1) and tighten the screw securely.

NOTE

Apply fuel to the O-ring (2) before installing the regulator.



I9J011170045-01

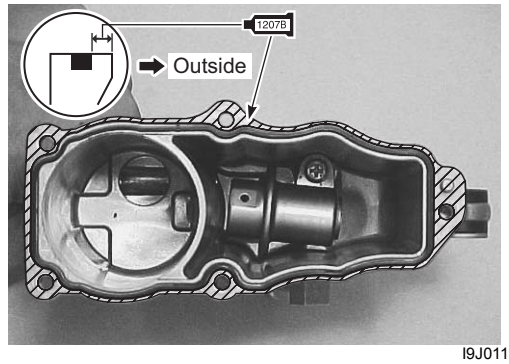
Separator cover / Separator case

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

1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))

NOTE

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



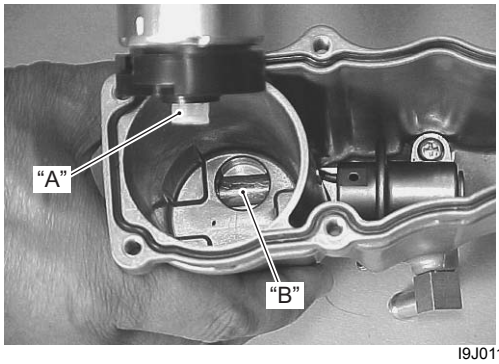
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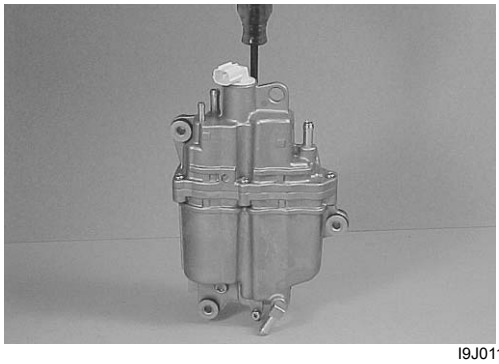
2) Install the separator case and then tighten the screws securely.

NOTE

When installing the separator case, align suction hole “A” with hole “B” of separator case.



I9J011170047-01



I9J011170048-01

Final assembly check

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

Inspection of Fuel Vapor Separator Component Parts

Z9J0111706009

NOTE

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

Needle Valve / Valve Seat

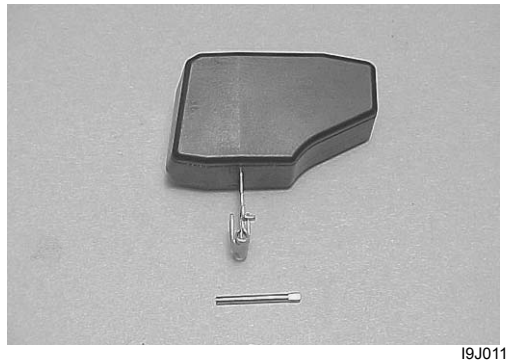
Inspect the needle valve and valve seat for grooves, other damage or dirt.
Replace or clean if necessary.



I9J011170049-01

Float

Inspect the float for cracks or other damage.
Replace if necessary.



I9J011170050-01

Filter

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



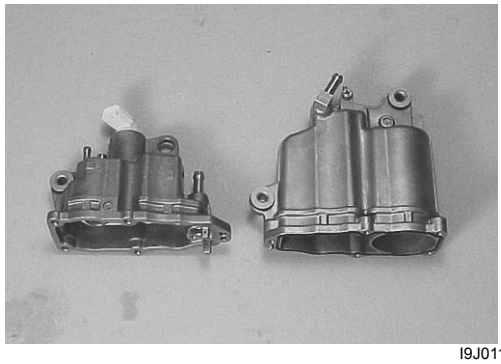
I9J011170051-01

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Separator Cover and Case
Inspect the separator cover and case.
Replace if cracked, damaged or other abnormal conditions.

NOTE

Separator cover and case are a set.
If any repair is required on the cover or case, replace them as a fuel vapor separator assembly.

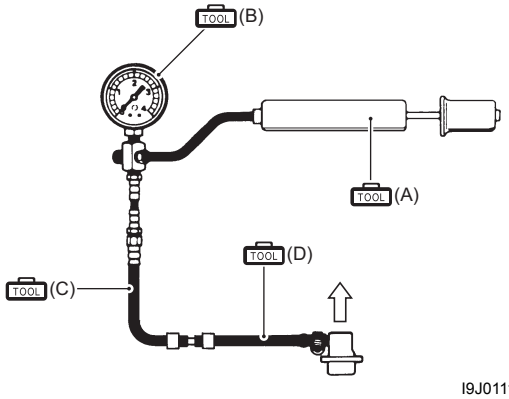


I9J011170052-01

Fuel Pressure Regulator
Inspect the fuel pressure regulator for damage or corrosion.
Check the fuel pressure regulator operation.

Special tool
(A): 09952–99310 (Hand air pump)
(B): 09940–44121 (Air pressure gauge)
(C): 09940–44130 (Attachment)
(D): 09912–58490 (3-way joint & hose)

1) Connect the special tools to the inlet side of the regulator as shown in the figure.
2) Pump air into the regulator using pump until air is released through outlet side.



I9J011170021-01

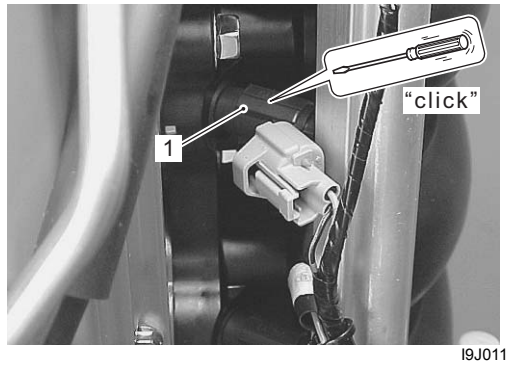
3) Read the pressure on the gauge when air is released.
If out of specification, replace regulator.

Regulator operating pressure
Standard: 240 – 270 kPa (2.4 – 2.7 kg/cm^2, 34.1 – 38.4 psi.)

Fuel Injector Inspection with Injector in place

Z9J0111706010

1) Using a sound scope or equivalent, check the operating sound of the fuel injector when the 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.



I9J011170053-03

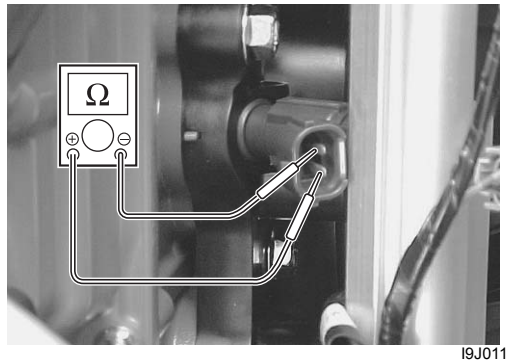
1. Injector body

2) Disconnect the lead wire connector from the fuel injector.
3) Connect a digital tester between the terminals of the injector and measure resistance.
If out of specification, replace the fuel injector.

Special tool
: 09930–99320 (Digital tester)

Tester knob indication
Resistance (Ω)

Fuel injector resistance
Standard: 10 – 14.0 Ω



I9J011170054-01

4) Connect the lead wire connector to the fuel injector securely.

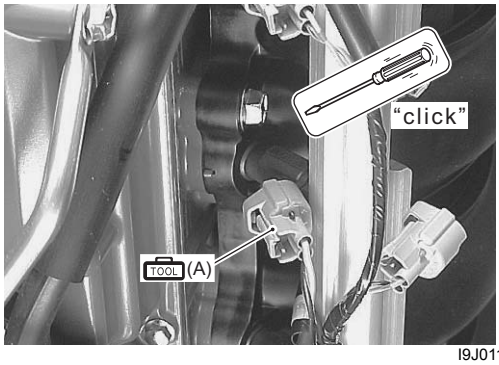
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Individual Fuel Injector Operating Sound Inspection

Z9J0111706011

1) Disconnect the ignition coil lead wire connectors from all of the ignition coils.
2) Disconnect the fuel injector lead wire connector and connect the test cord.

Special tool
TOOL (A): 09930–89260 (Injector test cord (A))



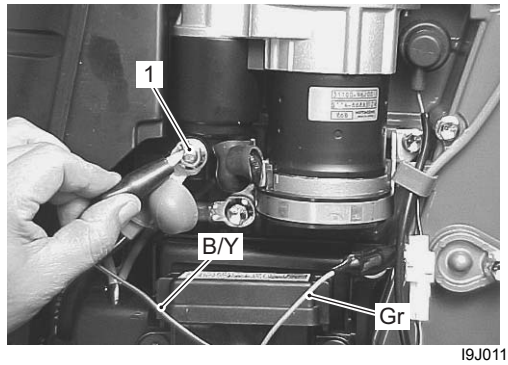
I9J011170055-01

3) Connect the Gray wire to body ground.
4) Momentarily touch the Black/Yellow wire to the starter motor magnetic switch terminal "B" (connected to battery positive (+) terminal) and check for injector operating sound.
If out of specification, replace fuel injector.

CAUTION

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

Fuel injector operating sound
"click"

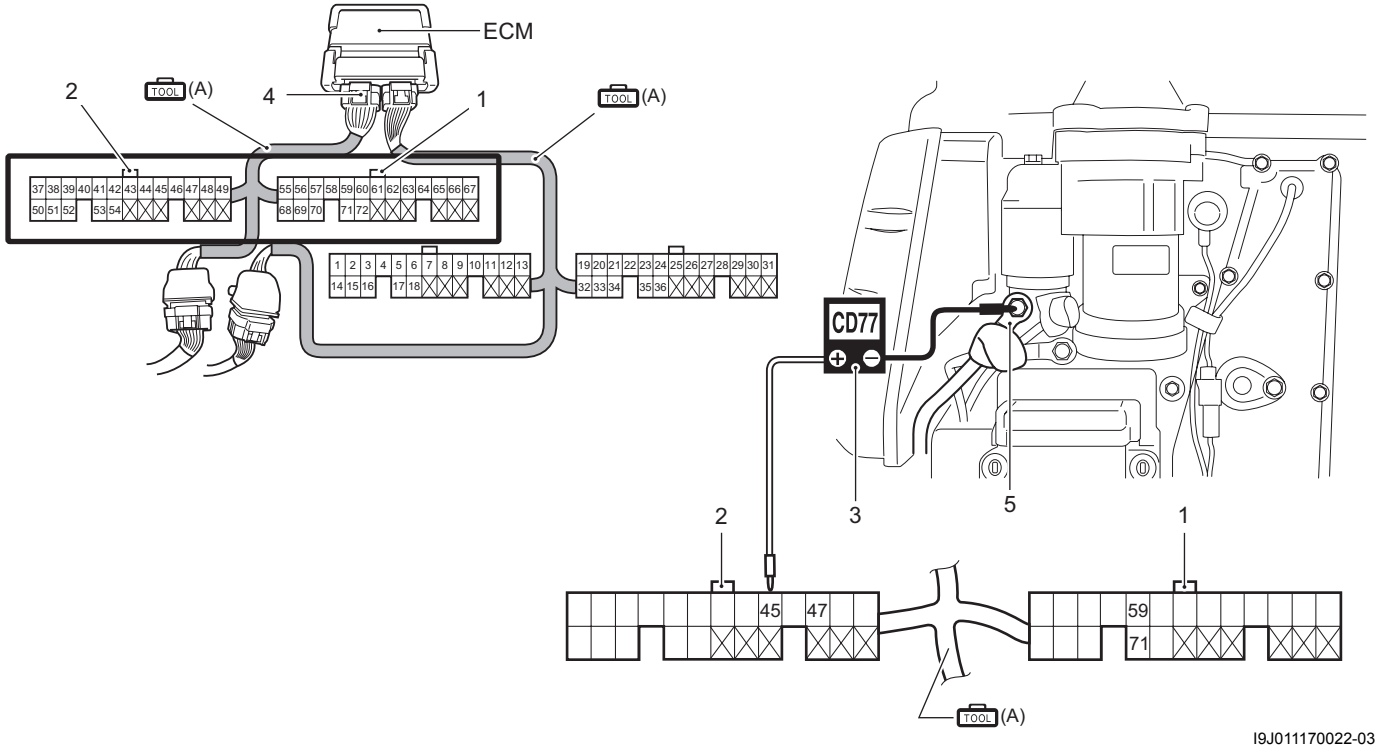


I9J011170056-01

1. Starter motor magnetic switch "B" terminal

Fuel Injector Operating Signal Inspection

Z9J0111706012



I9J011170022-03

1. Black connector	3. Peak voltmeter stevens CD-77	5. Starter motor magnetic switch "B" terminal
2. White connector	4. Gray test cord connector side	

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Special tool
TOOL (A): 09930–88730 (36-pin test cord set)
CD-77 : Stevens peak reading voltmeter CD-77

Tester knob indication
NEG 50

1) Disconnect all ignition coil connectors from the ignition coils.
2) Connect the test cord between the ECM and wire harness as shown in figure, then turn ignition switch “ON”.
3) Connect the tester probe (“–”, Black) to the starter motor magnetic switch terminal “B” (connected to battery positive (+) terminal) as shown in figure.
4) Connect the tester probe (“+”, Red) to each terminal.

Injector	Terminal	Wire color (Engine harness)
No.1	45	O/B
No.2	71	B/Br
No.3	47	R/W
No.4	59	Lg

5) Crank the engine and measure the voltage.
If out of specification, inspect the related parts as described in “Fuel System Diagnostic Information / Fuel Injection System Troubleshooting”.
Refer to “Fuel System Diagnosis” (Page 1G-13) and “Fuel Injection System Troubleshooting” (Page 1G-14).

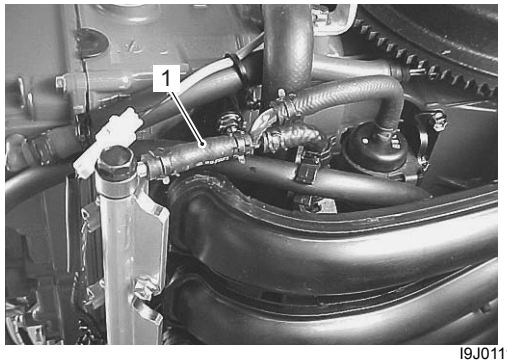
Fuel injector operating signal
Standard: Approx. 6 – 10 V or over

Fuel Injector Removal and Installation

Z9J0111706013

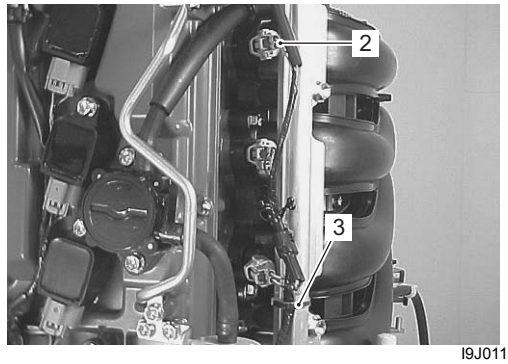
Removal

1) Relieve the fuel pressure in the fuel feed line according to “Fuel Pressure Relief Procedure”.
Refer to “Fuel Pressure Relief Procedure” (Page 1G-15).
2) Remove the ring gear cover.
Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
3) Loosen the clamp and place a large cloth over the end of the fuel feed hose (1).
Slowly pull the fuel feed hose from the fuel delivery pipe.
Drain any excess fuel in the hose into a small container.



I9J011170057-01

4) Disconnect the four fuel injector connectors (2).
Cut the cable tie (3) binding the fuel injector lead wire to the fuel delivery pipe.



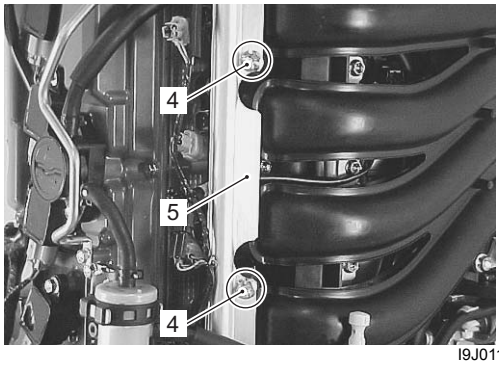
I9J011170058-02

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5) Remove the two bolts (4) and the fuel delivery pipe (5) (with the fuel injectors).

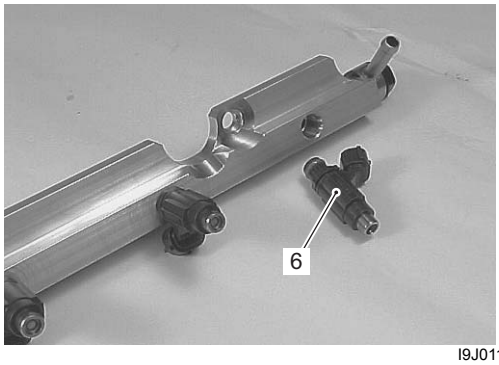
CAUTION

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



I9J011170059-02

6) Remove each injector (6) from the delivery pipe.



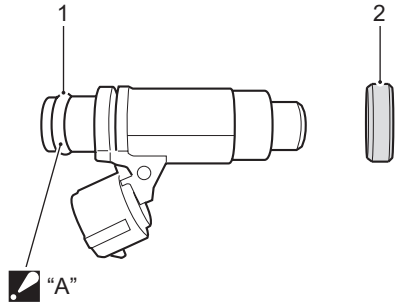
I9J011170060-01

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

CAUTION

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

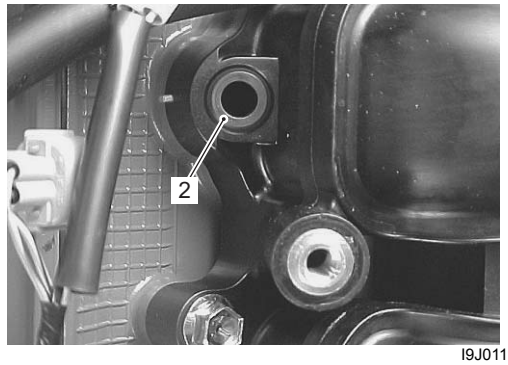
1) Replace the injector O-ring (1) with a new one using care to avoid nicks or cuts during installation.



I9J011170024-01

"A": Apply fuel to O-ring.

2) Replace the injector cushion (2) with a new one and install to the cylinder head.

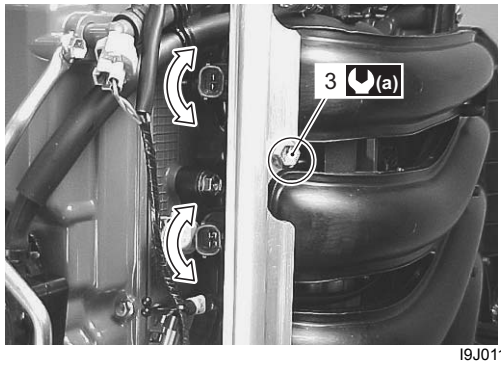


I9J011170063-01

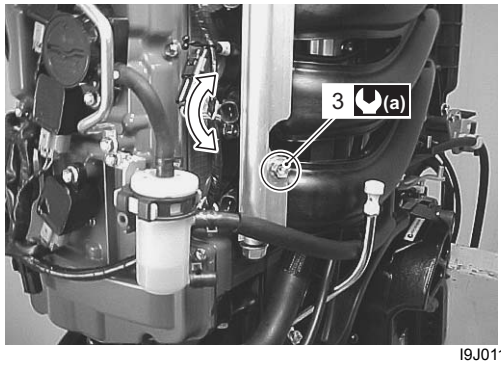
http://SelfFixer.com

3) Apply a thin coat of fuel to injector O-rings, then install the injectors into the delivery pipe and cylinder head.
   Make sure that the injectors rotate smoothly.
4) Tighten the delivery pipe bolts (3) and make sure that the injectors rotate smoothly.

   Tightening torque
   Fuel delivery pipe bolt (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)

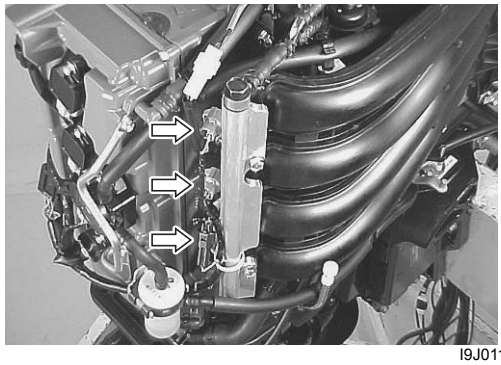


I9J011170064-01



I9J011170065-01

5) Reconnect the fuel feed hose and fuel line securely.
6) Connect the lead wire connector to the injectors securely.


I9J011170066-01

7) Make sure the emergency stop switch lock plate is in place.
   Shift into “Neutral” position.
8) Squeeze the fuel primer bulb until you feel resistance.
   Turn ignition switch “ON” for 3 seconds (to operate fuel pump), then turn it “OFF”.
   Repeat this (“ON” and “OFF”) procedure 3 or 4 times to pressurize the fuel system.
   Check for fuel leaks around the fuel injectors.

Low Pressure Fuel Pump Removal and Installation

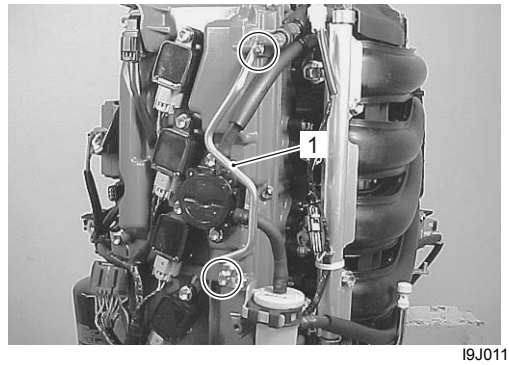
Z9J0111706014

NOTE

The low pressure fuel pump is a non-repairable component.
Do not attempt to disassemble the low pressure fuel pump.
It must be replaced as a complete unit if it is defective.

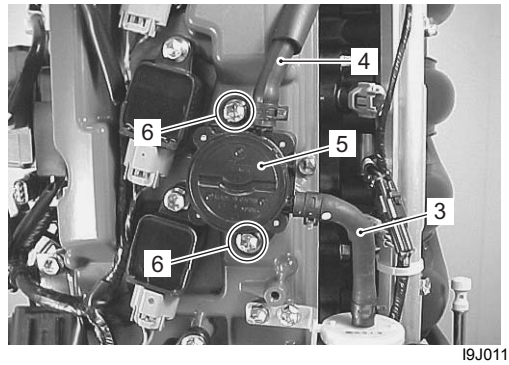
Removal

1) Remove the two bolts securing the fuel pump guard (1).



I9J011170067-01

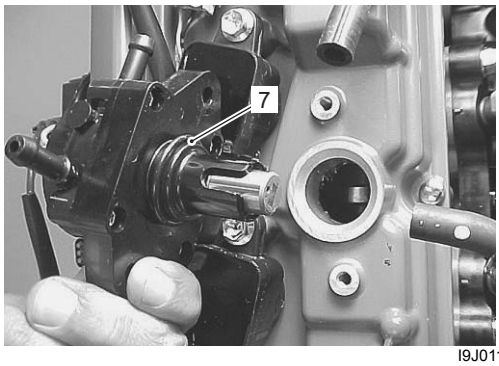
2) Disconnect the inlet hose (3) and outlet hose (4) from low pressure fuel pump (5).
3) Remove two bolts (6).



I9J011170068-01

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4) Remove fuel pump. Note the position before removing the O-ring (7).



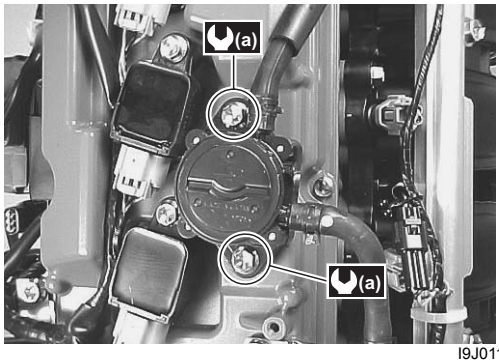
I9J011170069-01

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

CAUTION

- **Before installing the fuel pump, rotate the crankshaft to bring the No.1 (top cylinder) piston to Top Dead Center on the compression stroke.**
- **Do not reuse O-ring once removed. Always use a new O-ring.**

Tightening torque
Low pressure fuel pump bolt (a): 10 N·m (1.0 kgf-m, 7.0 lbf-ft)



I9J011170070-01

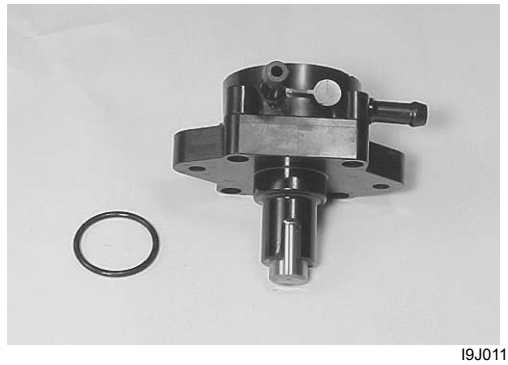
Low Pressure Fuel Pump Inspection

Z9J0111706015

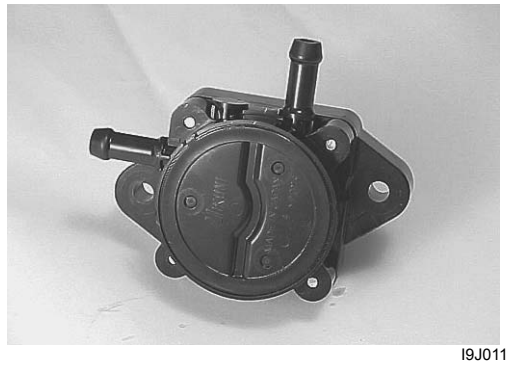
NOTE

The low pressure fuel pump is a non-repairable component.
Do not attempt to disassemble the low pressure fuel pump.
It must be replaced as a complete unit if it is defective.

Fuel Pump Assembly
Inspect the fuel pump.
If leakage, cracks, damage or other abnormal condition is found, replace fuel pump assembly.



I9J011170071-01



I9J011170072-01

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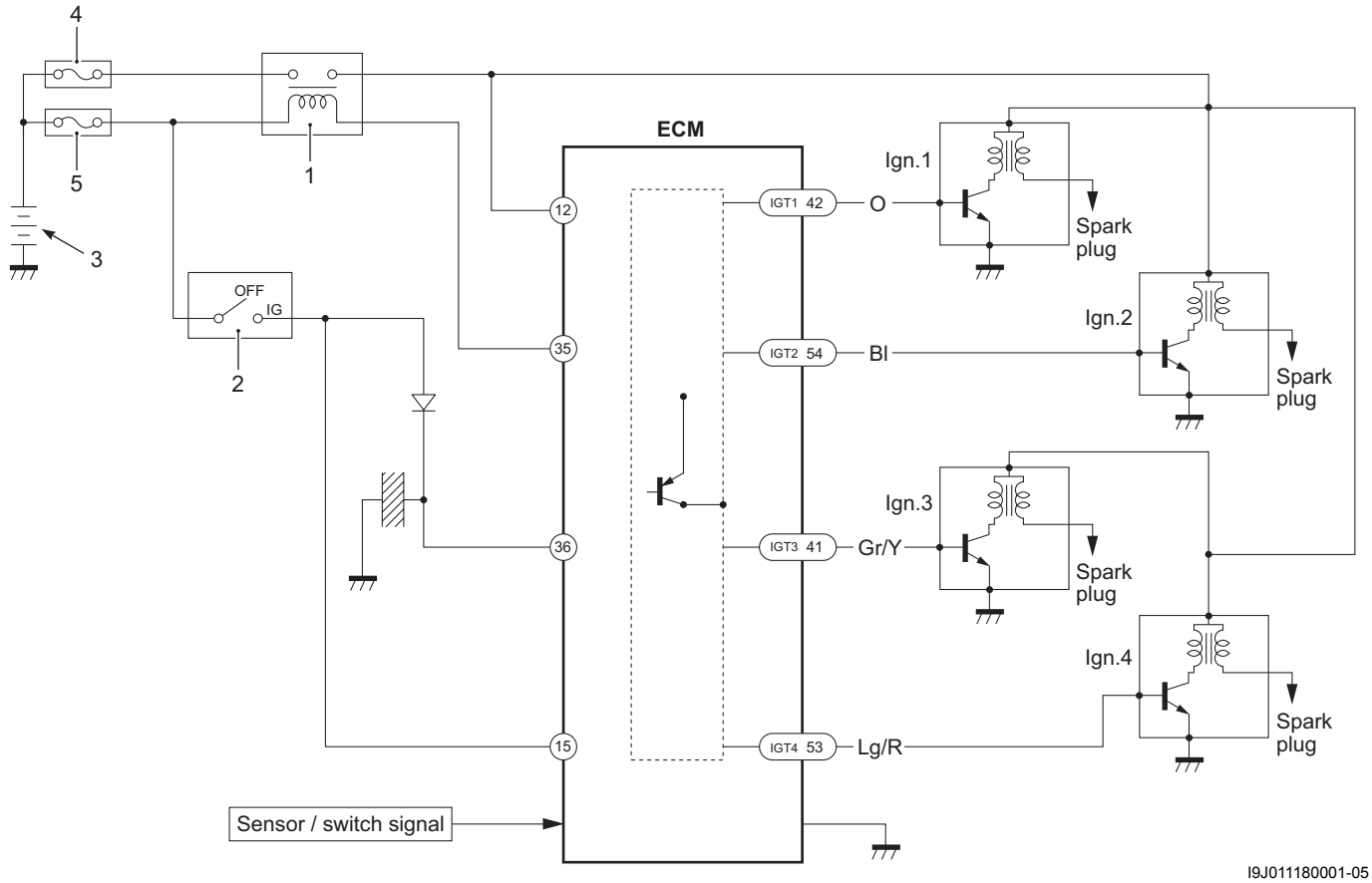
Ignition System

General Description

Ignition System Description

Z9J0111801001

The ignition system used by the DF70 / 80 / 90 is a fully transistorized, electronic microcomputer timing advanced type.
This system is battery powered, with the ECM controlling all of the ignition timing functions.
The ignition system is composed of the ignition coil, spark plug and components for system control (ECM, sensor, switch etc.).
When the ignition switch is “ON”, battery voltage (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 the ignition coil. In this way, a mutual induction high voltage occurs in the ignition coil secondary side and spark is generated.



I9J011180001-05

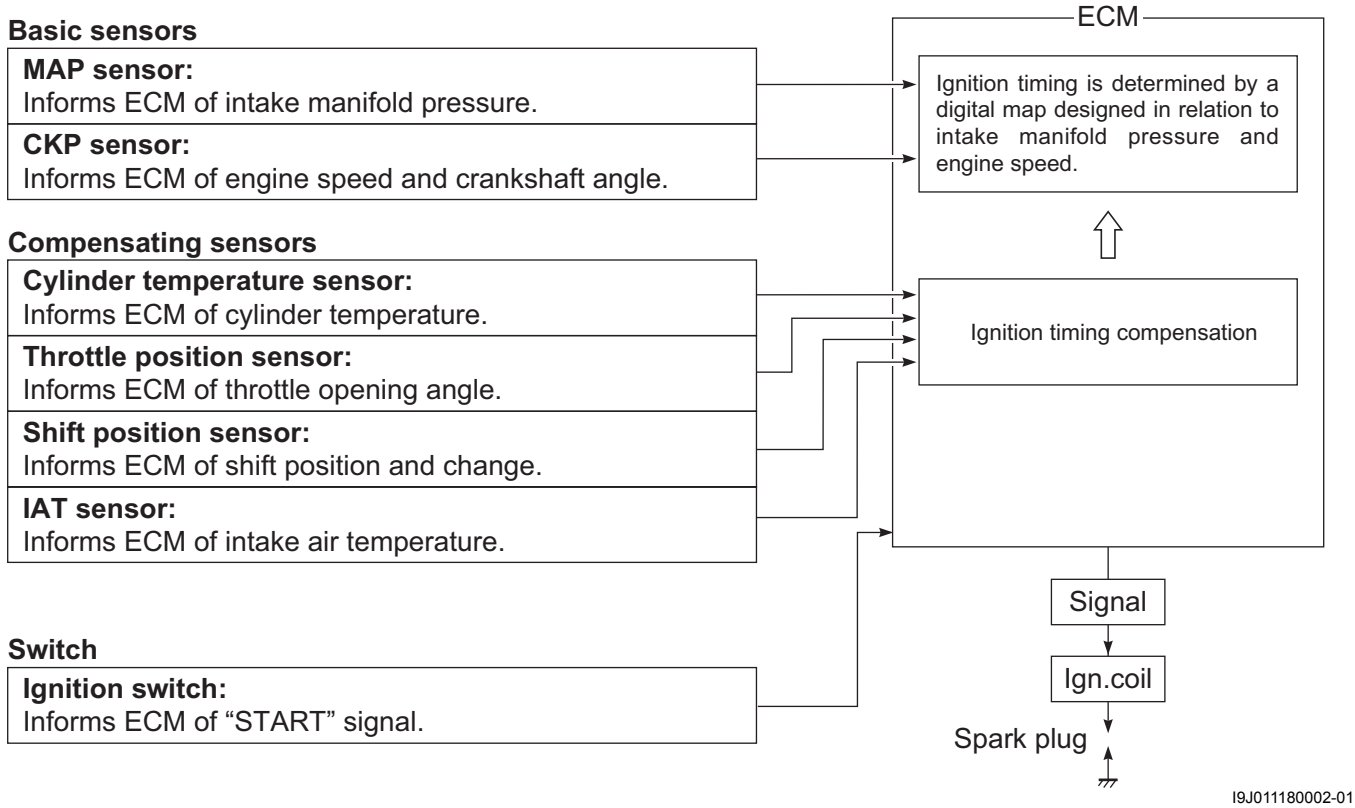
1. Main relay	3. Battery	5. Fuse 15 A
2. Ignition switch	4. Fuse 30 A	

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Ignition Control Description

Z9J0111801002

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



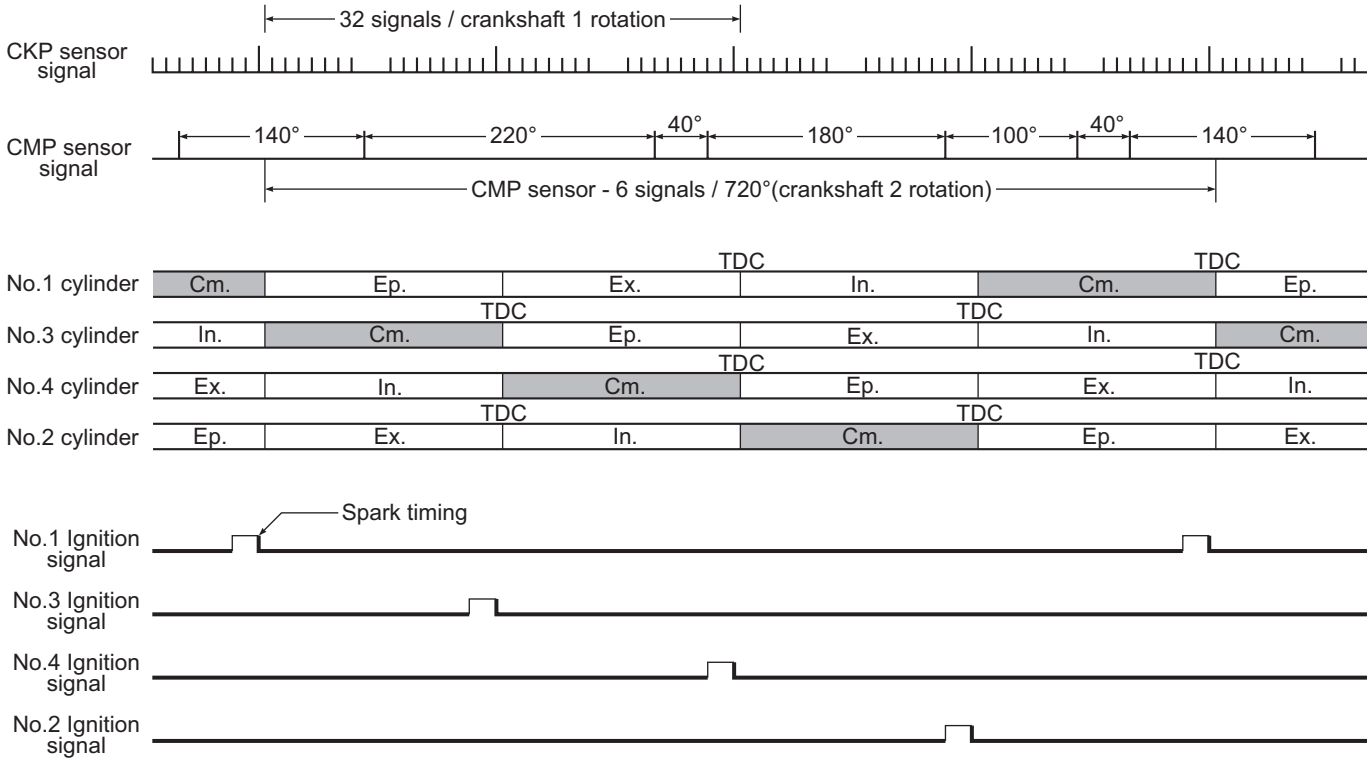
Ignition specification

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	BTDC 0° ± 5° – BTDC 26° ± 5° (DF70 / 80) BTDC 0° ± 5° – BTDC 27° ± 5° (DF90)
Firing order	1 — 3 — 4 — 2

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Ignition Timing Chart

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



Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake, TDC: Top Dead Center

I9J011180003-05

Ignition Timing Control Mode

- **When Cranking**
  The ignition timing is fixed at 5° BTDC until the engine starts.
- **When Idling / Trolling**
  The ignition timing is controlled within the range of 0° ± 5° BTDC to provide stable engine operation at the specified idling / trolling speed.
- **When Running (Normal Operation)**
  The ignition timing ranges between 0° – 27° BTDC, depending on engine operating conditions.

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Component Location

Ignition System Components Location

Z9J0111803001

Refer to “Engine Control System Components / Engine Electrical Device Location” in Section 1A (Page 1A-15).

Diagnostic Information and Procedures

Ignition System Symptom Diagnosis

Z9J0111804001

Condition	Possible cause	Correction / Reference Item
Engine cranks, but will not start or weak spark. (No spark)	Blown fuse for ignition system.	*Replace.*
	Loose connection or disconnection of lead wire.	*Connect securely.*
	Faulty spark plug(s).	*Replace.*
	Faulty ignition coil.	*Replace.*
	Faulty CKP sensor.	*Replace.*
	Faulty CMP sensor or sensor trigger vane of camshaft.	*Replace.*
	Faulty ECM.	*Replace.*
Spark plug is wet or quickly becomes fouled with carbon.	Incorrect gasoline.	*Change.*
	Incorrect spark plug.	*Replace.*
Spark plug quickly become fouled with oil or carbon.	Worn piston ring.	*Replace.*
	Worn piston.	*Replace.*
	Worn cylinder.	*Replace.*
	Excessive valve stem to valve guide clearance.	*Replace.*
	Worn valve stem seal.	*Replace.*
Spark plug electrodes overheat or burn.	Incorrect spark plug.	*Change.*
	Overheated engine.	*Tune-up.*
	Loose spark plug.	*Tighten.*

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Ignition System Troubleshooting

Z9J0111804002

Before starting the troubleshooting, make sure that:

- There is not self-diagnostic code indication.
- Emergency stop switch plate is set in place.

Perform the following ignition system tests when the engine is hard to start in order to determine if the cause is in the ignition or another system.

Step	Action	Yes	No
1	*Check the ignition system connector for poor connections. Is there connection in the ignition system connectors?*	Go to step 2.	Poor connection of connectors.
2	*Check spark condition.*	Go to step 3.	No or weak sparks.
3	*Check if the spark plugs are in good condition.*	Go to step 4.	Replace spark plug with a new one.
4	*Check ignition coil assembly power supply and ground circuits for open and short. Are circuits in good condition?*	Go to step 5.	Repair or replace.
5	*Check ignition coil operating signal. Is result OK?*	Go to step 6.	Check ignition coil operating signal wire for open, short and poor connection.
6	*Measure the battery voltage between input lead wire at ECM with the ignition switch in "ON" position. Is result OK?*	Go to step 7.	• Faulty ignition switch. • Faulty ECM main relay. • Broken wire harness or poor connection of related circuit connector.
7	*Check CKP sensor. Refer to "CKP Sensor Inspection" in Section 1C (Page 1C-10). Is result OK?*	Go to step 8.	• Check air gap between CKP sensor and flywheel reluctor bars. • Adjust CKP sensor air gap. • Replace CKP sensor or flywheel.
8	*Check CMP sensor. Refer to "CMP Sensor Inspection" in Section 1C (Page 1C-11). Is result OK?*	Go to step 9.	• Check CMP sensor. • Check CMP sensor trigger vane. • Replace CMP sensor or Ex. camshaft.
9	*Substitute a known-good ignition coil assembly then repeat step 2. Is check result of step 2 satisfactory?*	Go to step 10.	Substitute a known good ECM, then repeat step 2.
10	*Check the ignition timing by using timing light ($2° \pm 5°$ DTBC at 1 000 r/min). Is result OK?*	System is in good condition.	Check input signals related to this system.

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Service Instructions

Spark Plug Removal and Installation

Z9J0111806001

Refer to “Spark Plug Removal and Installation” in Section 0B (Page 0B-6).

Spark Plug Inspection

Z9J0111806002

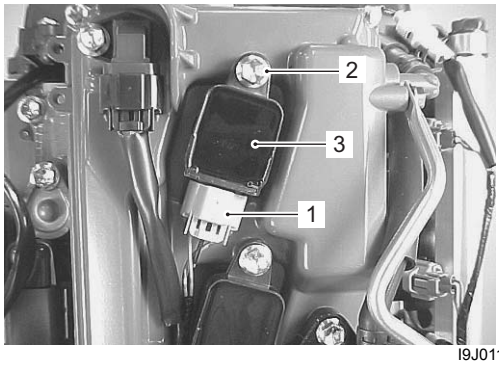
Refer to “Spark Plug Inspection and Cleaning” in Section 0B (Page 0B-7).

Ignition Coil Removal and Installation.

Z9J0111806003

Removal

1) Disconnect the battery cables at the battery.
2) Disconnect the ignition coil connector (1).
3) Remove the bolt (2) securing the ignition coil, then pull out the ignition coil (3).



I9J011180006-01

Installation

1) Install the ignition coil, then secure the ignition coil with its mounting bolt.
2) Connect the ignition coil connector.
3) Connect the battery cables to battery.

Ignition Coil Inspection

Z9J0111806004

NOTE

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

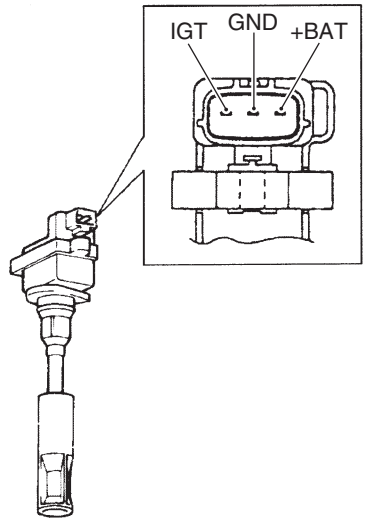
Special tool

TOOL : 09930–99320 (Digital tester)

Tester knob indication

DCV

1) Turn the ignition key OFF.
2) Disconnect the ignition coil connector.
3) Check for continuity between the GND (–) terminal on the wiring harness side connector and the engine body ground.
4) Turn the ignition key to the ON position. Check for battery voltage by measuring between the BAT (+) terminal and GND terminal on the wiring harness side connector.
5) Connect the wiring harness connector to the ignition coil and measure the ignition operating signal. Refer to “Ignition Coil Operating Signal Inspection” (Page 1H-7).
   - If any failure exists, check for open circuit, short circuited battery, short circuited lead and connector’s contact condition for each circuit.
   - If there is no spark even with the wiring harness and spark plug in sound condition, perform the inspection again using an ignition coil that is known to be in good condition (new or used from another cylinder that is operating properly).
   - If there is still no spark even with the wiring harness, spark plug and ignition coil in sound condition, replace the ECM and perform the inspection again.



I9J011180004-03

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Ignition Coil Operating Signal Inspection

Z9J0111806009

Special tool
TOOL (A): 09930–88730 (36-pin test cord set)
CD-77 : Stevens peak reading voltmeter CD-77

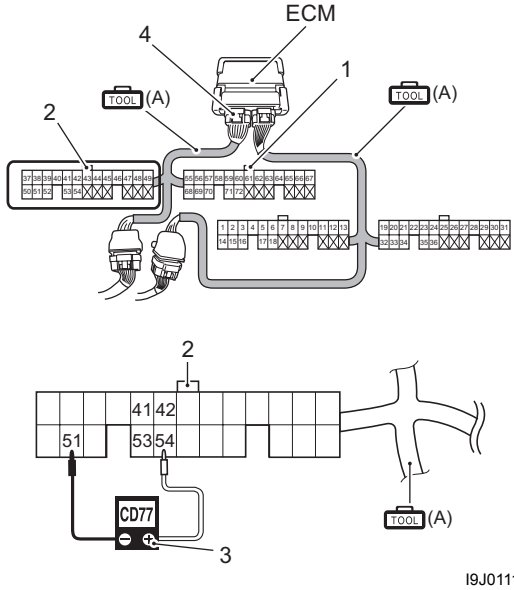
Tester knob indication
SEN 50

1) Disconnect all injector connectors from the fuel injectors.
2) Connect the test cord between the ECM and the wire harness as shown in figure then turn ignition switch ON.
3) Connect the tester probe Red (+) to each terminal, one at a time to test each circuit.

	Terminal	Wire color (engine harness)
No.1 Ignition coil	42	O
No.2 Ignition coil	54	Bl
No.3 Ignition coil	41	Gr/Y
No.4 Ignition coil	53	Lg/R

4) Connect the tester probe Black (–) to No. 51 terminal (or to body ground).
5) Crank the engine and measure the voltage.
If out of specification, inspect the related parts.
Refer to “Ignition System Symptom Diagnosis” (Page 1H-4) and “Ignition System Troubleshooting” (Page 1H-5).

Ignition coil operating signal
Standard: Approx. 5 V



I9J011180007-03

1. Black connector	3. Peak voltmeter stevens CD-77
2. White connector	4. Gray test cord connector side

CKP Sensor Inspection

Z9J0111806005

Refer to “CKP Sensor Inspection” in Section 1C (Page 1C-10).

CMP Sensor Inspection

Z9J0111806006

Refer to “CMP Sensor Inspection” in Section 1C (Page 1C-11).

Ignition Switch Inspection

Z9J0111806007

Refer to “Ignition Switch Inspection” in Section 1I (Page 1I-13).

ECM Main Relay Inspection

Z9J0111806008

Refer to “ECM Main Relay Inspection” in Section 1A (Page 1A-42).

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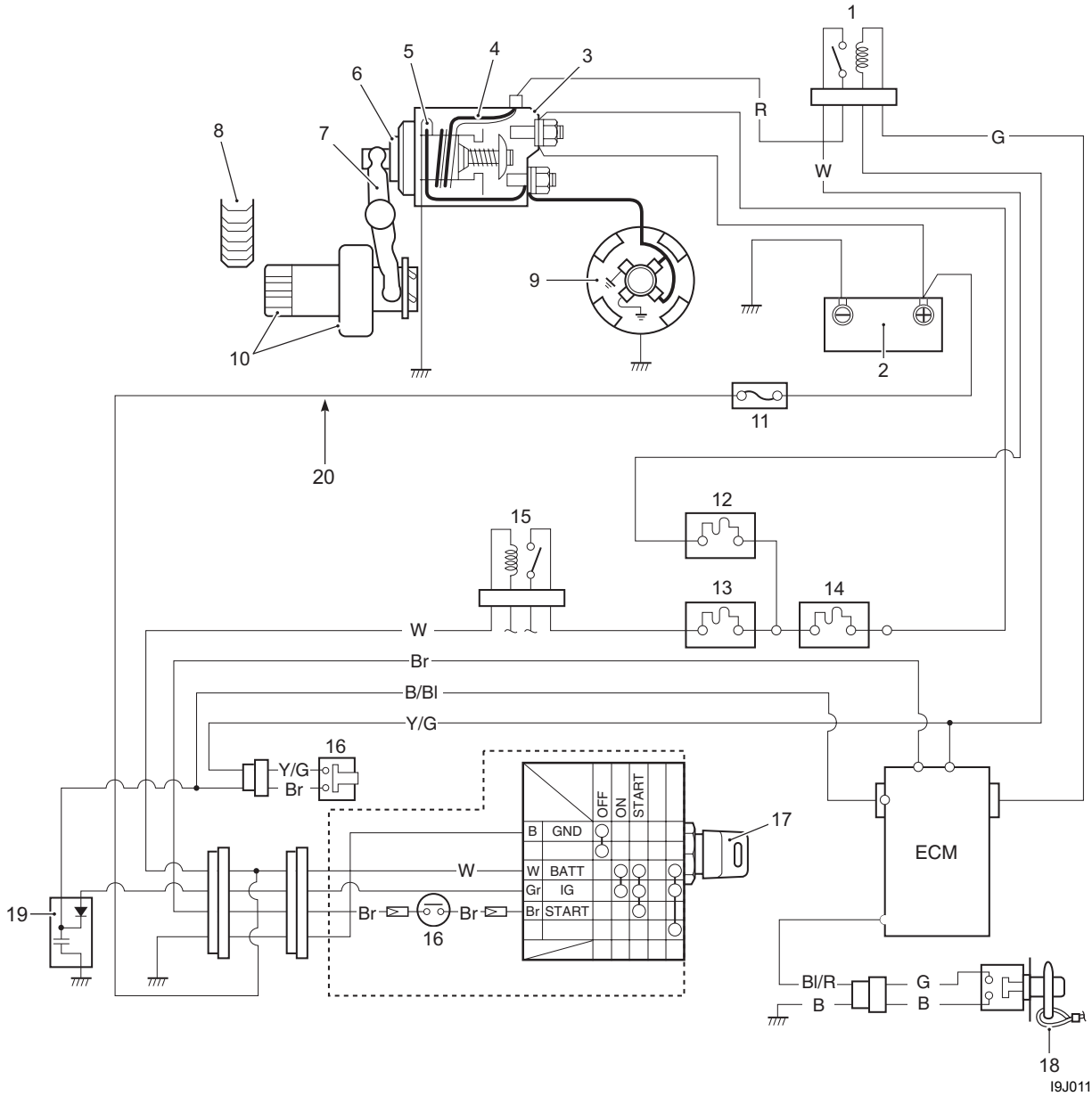
Starting System

General Description

Electric Starter System Description

Z9J0111901001

The starting circuit consists of the battery, starting motor, ignition switch, neutral switch, starter relay, ECM and related electrical wiring.
These components are connected electrically as shown in the figure below.
In the circuit shown in the figure below, the magnetic switch coils and starter relay coil are magnetized when the ignition switch is closed (turned to “START”).
The resulting plunger and pinion shift lever movement causes the pinion to engage the engine flywheel gear, the magnetic switch main contacts to close, and engine cranking to take place.
When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the switch is opened, at which time the torsion spring causes the pinion to disengage.



I9J011190001-06

1. Starter relay	6. Plunger	11. 15 A Fuse	16. Neutral switch
2. Battery	7. Shift lever	12. 30 A Fuse (Starter)	17. Ignition switch
3. Magnetic switch	8. Ring gear	13. 30 A Fuse (ECM)	18. Emergency stop switch
4. Pull-in coil	9. Starter motor	14. 40 A Fuse (Main)	19. Capacitor
5. Hold-in coil	10. Pinion and over-running clutch	15. Main relay	20. Sub battery cable

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Starter Motor Operation Condition Description

Z9J0111901002

The starter motor relay is controlled by the ECM.

- The starter motor relay will only engage when the ignition switch is turned to the “START” position if the all of the following conditions are satisfied.
  - – Lock plate is attached to emergency stop switch.
  - – Neutral switch is in the “ON” position.
  - – Engine is not already operating.
- After returning the ignition key to the “ON” position from “START”, the starter motor continues to run for 4 seconds until engine starts.

NOTE

If a failure exists in the sub-battery cable or the 15 amp. fuse in its circuit, the starter motor relay circuit will not function.

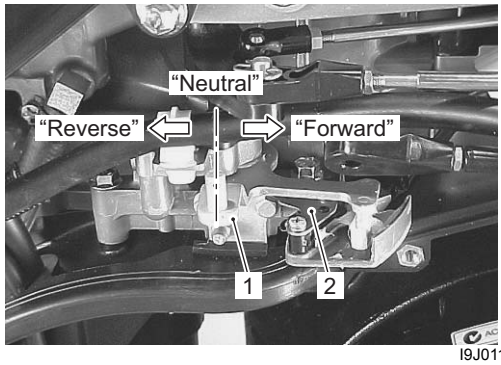
Start-In-Gear Protection System Description

Z9J0111901003

To avoid accidental movement of the boat at the time of engine starting, the system prohibits starter motor operation when the shift lever is “IN” gear.

Control by Neutral Switch

A switch to detect “Neutral” gear position is located on the clutch lever holder and operated by the clutch control lever.
This ON/OFF type switch is ON in “Neutral” and OFF in “Forward” or “Reverse”.
When attempting to start the engine, the ECM detects the shift position using the neutral switch.
When the neutral switch is OFF, the ECM does not provide a starter motor relay operating signal.

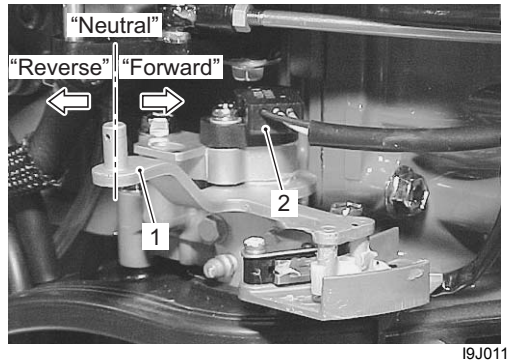


I9J011190050-02

1. Clutch lever	2. Neutral switch

Control by Shift Position Sensor

A shift position sensor is installed on the clutch lever holder and detects the shift position as the clutch lever is interlocked with the SPS shaft.
This sensor is a variable resistor that changes resistance in accordance with the shift position.
The resistance changes (increase / decrease) the voltage signal output from the sensor to the ECM. Based on the sensor voltage, the ECM calculates and detects shift position.
When attempting to start the engine, the ECM does not provide an injector operating signal when a shift lever in-gear position is detected.



I9J011190051-03

1. Clutch lever	2. Shift position sensor

Operation by neutral switch on engine starting

Shift position	Operation			
	Fuel injection	Ignition	High pressure fuel pump	Starter motor
Neutral	Yes	Yes	Yes	Yes
Forward / Reverse	No (*1:Yes)	No (*1:Yes)	Yes	No

*1: If it is in neutral judged by the ECM according to the shift position sensor signal.

Operation by shift position sensor on engine starting

Shift position	Operation			
	Fuel injection	Ignition	High pressure fuel pump	Starter motor
Neutral	Yes	Yes	Yes	Yes
Forward / Reverse	No (*2:Yes)	No (*2:Yes)	Yes	Yes

*2: If it is in neutral judged by the ECM according to ON signal from the neutral switch.

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Component Location

Starting System Components Location

Z9J0111903001

Refer to “Engine Control System Components / Engine Electrical Device Location” in Section 1A (Page 1A-15).

Diagnostic Information and Procedures

Starter System Troubleshooting

Z9J0111904001

CAUTION

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

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.**

Condition	Possible cause	Correction / Reference Item
Motor not running. (No operating sound of magnetic switch.)	Poor or broken battery connection.	*Replace.*
	Loose or corroded battery connection.	*Repair or retighten.*
	Weak or shorted battery.	*Replace or recharge battery.*
	Defective neutral switch.	*Neutral switch inspection. Replace.*
	Fuse blown.	*Replace.*
	Defective ignition switch.	*Ignition switch inspection. Replace.*
	Open circuit between ignition switch and magnetic switch.	*Repair.*
	Defective emergency stop switch.	*Replace. Emergency stop switch inspection.*
	Lead wire disconnected or loose.	*Retighten.*
	Poor contacting action of ignition switch and magnetic switch.	*Replace. Ignition switch inspection. Magnetic switch inspection.*
	Defective starter motor control relay.	*Main relay and starter motor relay inspection.*
	Defective ECM and its circuit.	*Inspection of ECM and its circuit.*
	Open circuit in pull-in coil.	*Replace magnetic switch. Magnetic switch inspection.*
	Brushes are seating poorly or worn.	*Repair or replace. Brushes inspection.*
Motor not running. (Operating sound of magnetic switch heard.)	Weak or shorted battery.	*Replace or recharge battery.*
	Battery voltage too low due to battery deterioration.	*Replace battery.*
	Loose or corroded battery connection.	*Repair or retighten.*
	Burnt main contact point, or poor contacting action of magnetic switch.	*Replace magnetic switch. Magnetic switch inspection.*
	Brushes are seating poorly or worn.	*Replace or repair. Brushes inspection.*
	Weakened brush spring.	*Replace.*
	Burnt commutator.	*Replace armature. Commutator inspection.*
	Shorted or open winding in armature.	*Replace. Armature inspection.*
	Excessive friction in engine.	*Repair.*
Starter motor running but too slow. (Low torque) (If battery and wiring are satisfactory, inspect starting motor.)	Insufficient contact of magnetic switch main contacts.	*Replace magnetic switch. Magnetic switch inspection.*
	Shorted armature.	*Replace. Armature inspection.*
	Dirty or corroded commutator.	*Repair commutator or replace armature. Armature inspection.*
	Worn brushes.	*Replace brushes.*
	Weakened brush spring.	*Replace.*

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Condition	Possible cause	Correction / Reference Item
Starter motor running, but not cranking engine.	Worn pinion tip.	*Replace over-running clutch.*
	Poor sliding of over-running clutch.	*Repair.*
	Over-running clutch slipping.	*Replace over-running clutch.*
	Worn teeth of ring gear.	*Replace flywheel.*
Starter motor does not stop running.	Broken contact point of magnetic switch.	*Replace magnetic switch.*
	Short-circuit magnetic switch coil.	*Replace magnetic switch.*

Service Instructions

Starter Motor Removal and Installation

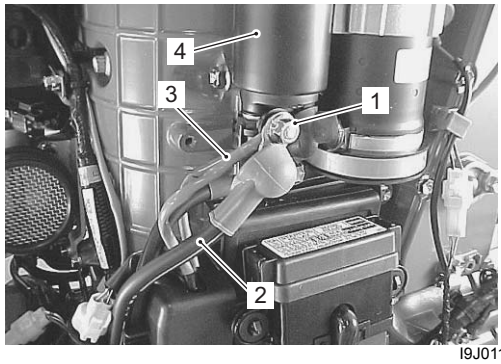
Z9J0111906001

Removal

CAUTION

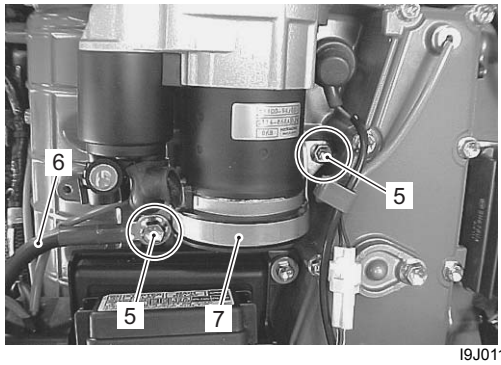
Prior to removing the starter motor, disconnect the battery cables from the battery.

1) Remove the PORT lower side cover.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
2) Remove the ring gear cover and air intake silencer case.
   Refer to “Air Intake Silencer Case Removal and Installation” in Section 1D (Page 1D-5).
3) Remove nut (1), positive (+) battery cable (2) and positive (Gray) cable (3) from the magnetic switch (4) of starter motor.



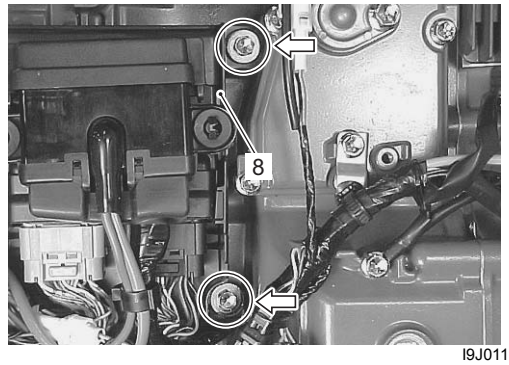
I9J011190052-01

4) Remove the two bolts (5), negative (–) battery cable (6) and starter motor band (7).

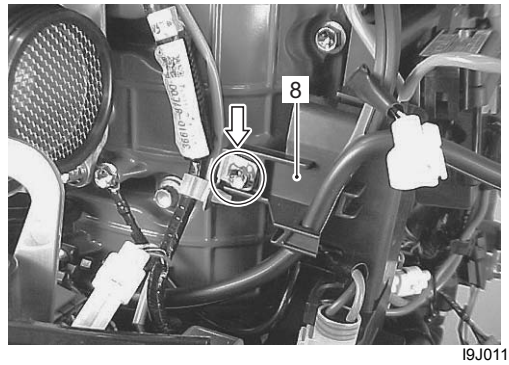


I9J011190053-01

5) Remove the three bolts securing the electric parts holder (8).

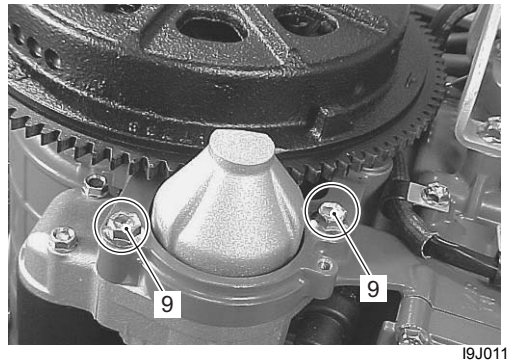


I9J011190054-02



I9J011190055-02

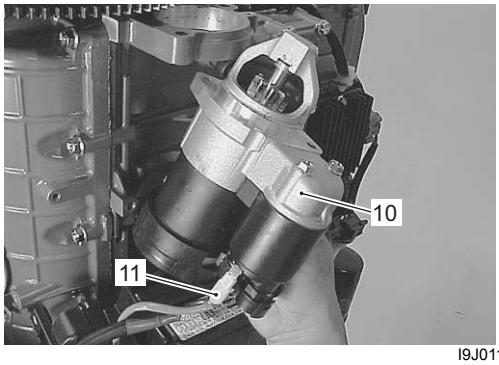
6) Remove the two bolts (9) securing the starter motor.



I9J011190056-02

http://SelfFixer.com

7) Remove the starter motor (10), then disconnect the red lead wire (11) from “S” terminal of starter magnetic switch.



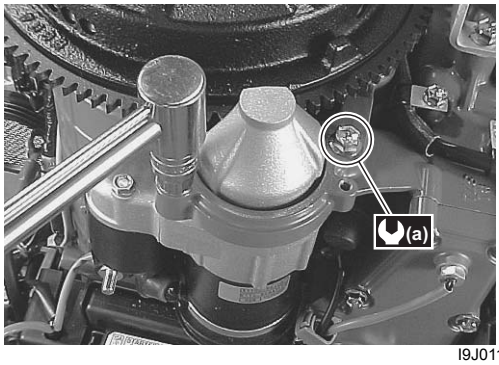
I9J011190057-01

Installation

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

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

  Tightening torque
  Starter motor mounting bolt (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)



I9J011190058-01

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

Starter Motor Test

Z9J0111906002

⚠ 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.

CAUTION

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

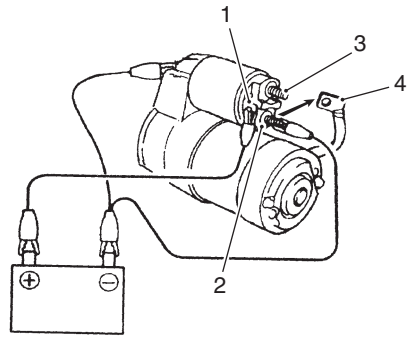
Pull-In / Hold-In Test

NOTE

Before testing, disconnect the brush lead from terminal “M”.

Connect the battery to the magnetic switch as shown in the figure.

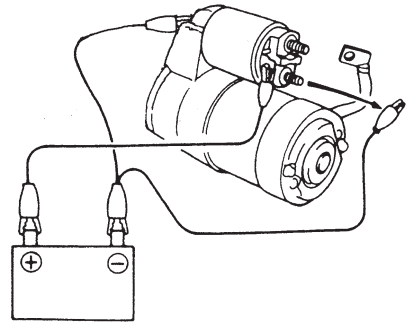
- Check that the plunger and pinion (over-running clutch) move outward.
  If the plunger and pinion don’t move, replace the magnetic switch.



I9J011190002-02

1. Terminal “S”	3. Terminal “B”
2. Terminal “M”	4. Brush lead

- While connected as above with the plunger out, disconnect the negative lead from terminal “M”. Check that the plunger and pinion remain out. If the plunger and pinion return inward, replace the magnetic switch.

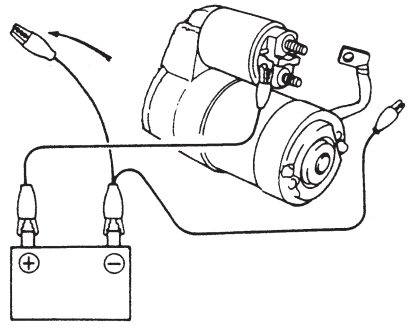


I9J011190003-01

Plunger and Pinion Return Test

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

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I9J011190004-01

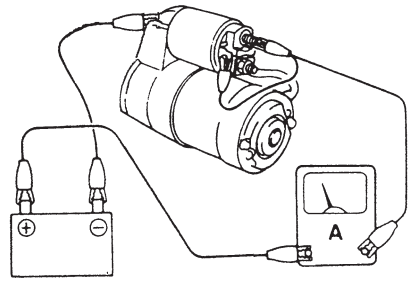
No-Load Performance Test

CAUTION

Before performing the following test, secure the starter motor to the test bench.

1) Connect a battery and ammeter to the starter motor as shown.
2) Check that the starter rotates smoothly and steadily with the pinion moving out. Check that the ammeter indicates the specified current.

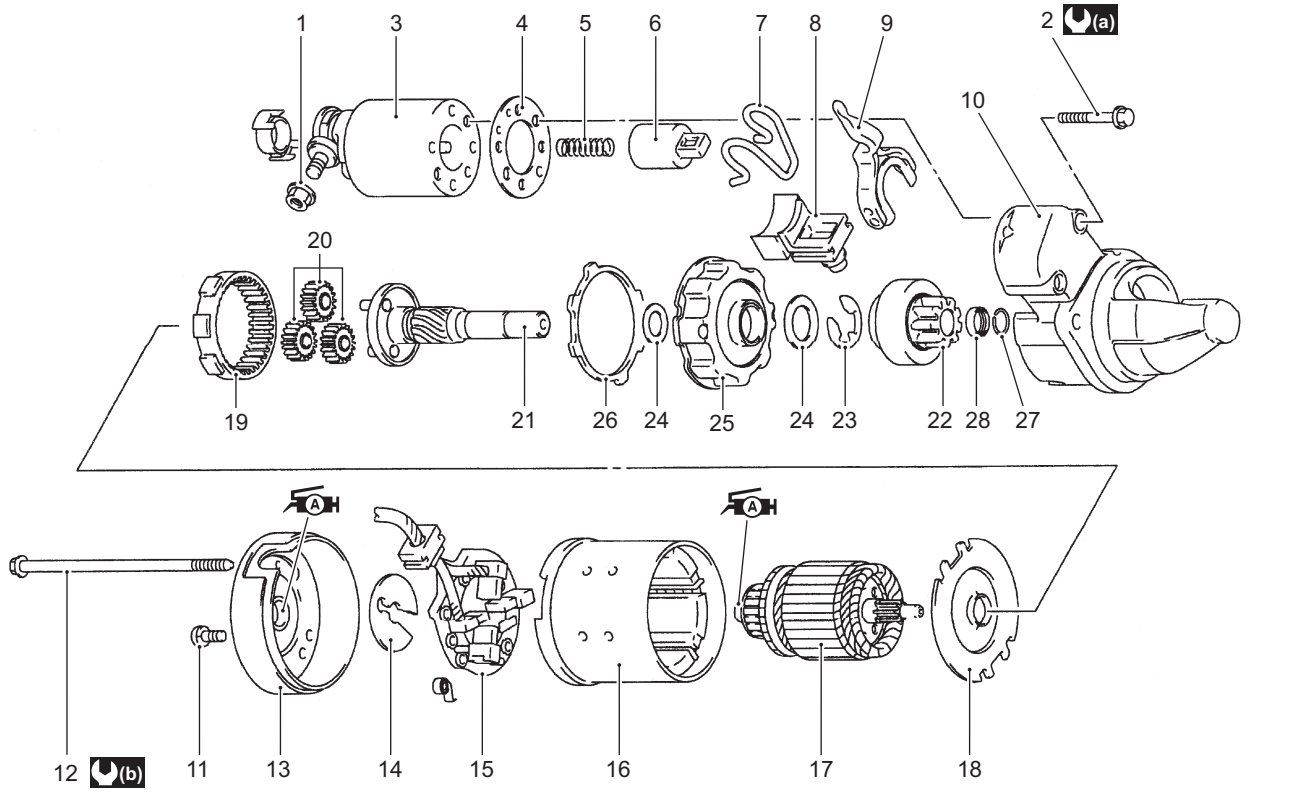
Specified current (No-load performance test)
Within 90 A at 11 V



I9J011190005-01

Starter Motor Components

Z9J0111906003



I9J011190006-02

1. Nut	9. Shift lever	17. Armature	25. Center bracket
2. Bolt	10. Front housing	18. Center cover plate	26. Rubber ring
3. Magnetic switch	11. Screw	19. Internal gear	27. Stopper ring
4. Gasket	12. Through bolt	20. Planetary gear	28. Pinion stopper
5. Spring	13. Rear cover	21. Pinion shaft	(a) : 7 N·m (0.7 kgf-m, 5.1 lbf-ft)
6. Plunger	14. Thrust washer	22. Pinion	(b) : 5.5 N·m (0.55 kgf-m, 4.0 lbf-ft)
7. Torsion spring	15. Brush holder	23. E-ring	A : Apply grease.
8. Rubber packing	16. Yoke	24. Washer	

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Starter Motor Disassembly and Assembly

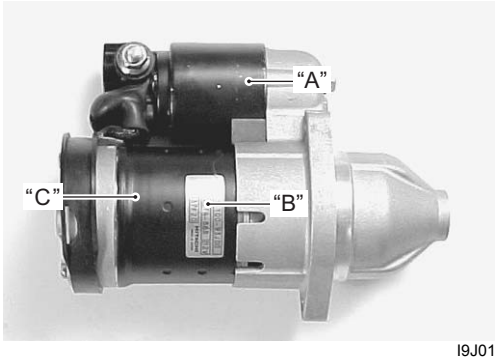
Z9J0111906004

Disassembly

When overhauling the starting motor, it is recommended that the 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.

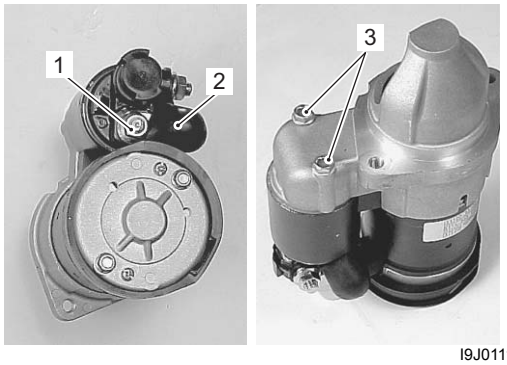
NOTE

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



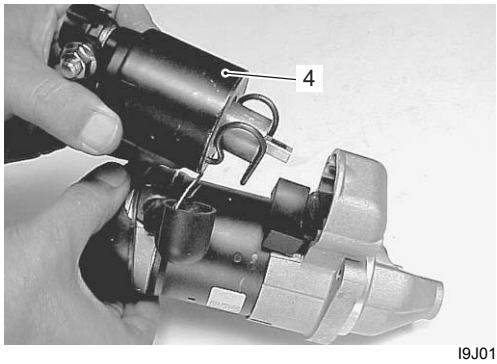
I9J011190007-01

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



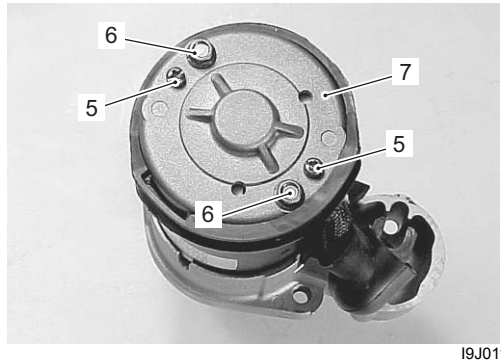
I9J011190008-01

3) Remove the magnetic switch (4).



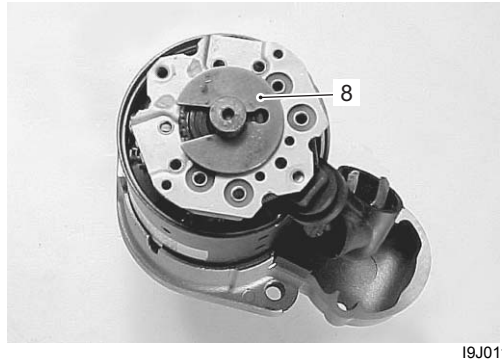
I9J011190009-01

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



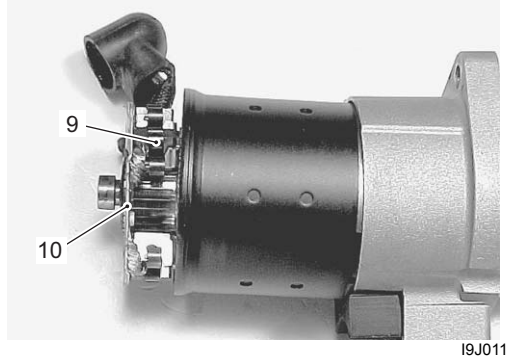
I9J011190010-01

5) Remove thrust washer (8) with a screwdriver.



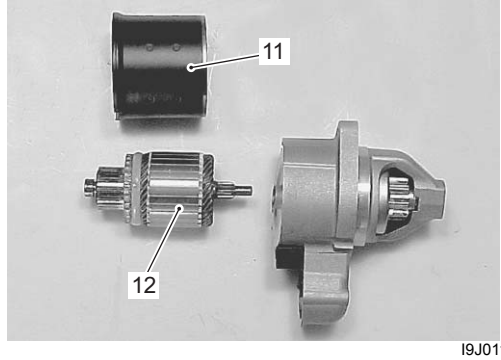
I9J011190011-01

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



I9J011190012-01

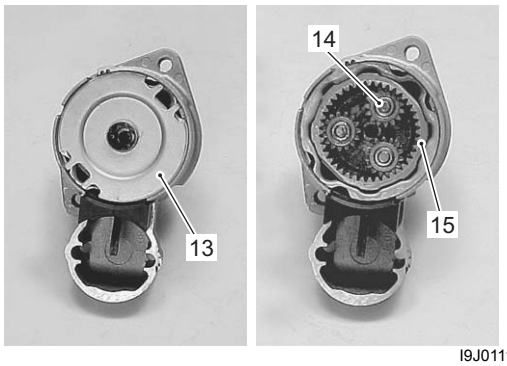
7) Remove the yoke (11) and armature (12).



I9J011190013-01

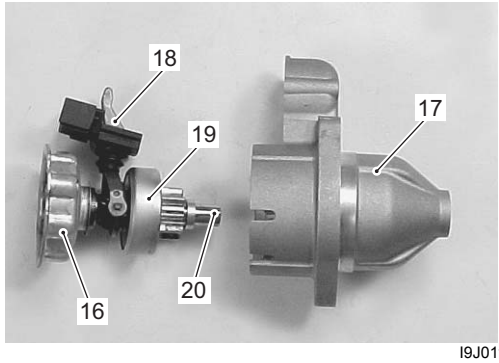
http://SelfFixer.com

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



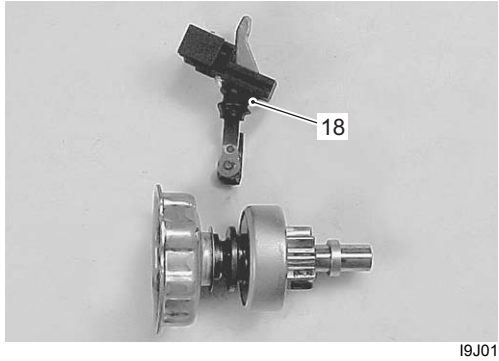
I9J011190014-01

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



I9J011190015-02

11) Remove the shift lever (18).



I9J011190016-01

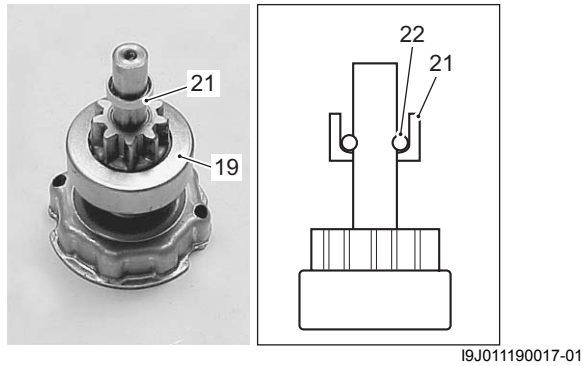
⚠ WARNING

Wear safety glasses when disassembling and assembling the stopper ring.

NOTE

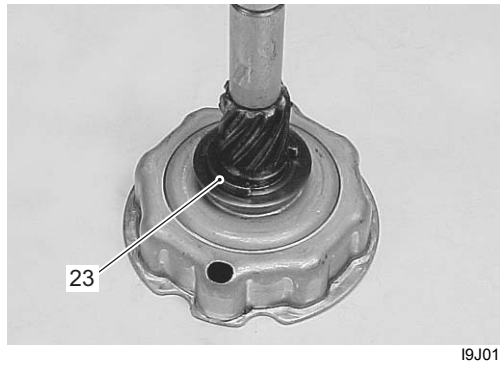
Using a screw-driver, pry off the stopper ring.

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



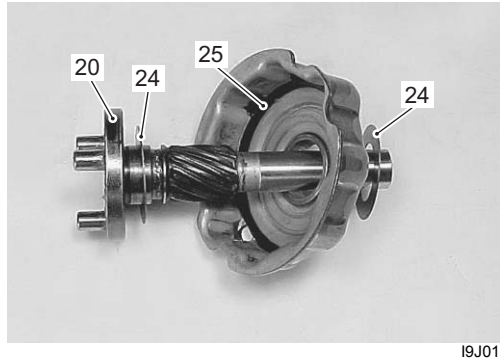
I9J011190017-01

13) Remove the E-ring (23).



I9J011190019-01

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



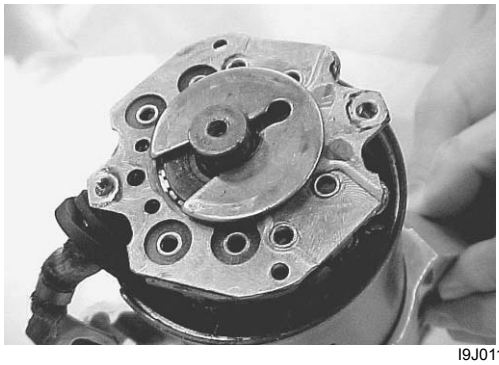
I9J011190020-01

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Assembly
Assembly is in the reverse order of disassembly with special attention to the following steps.
Reassemble the starter motor, refer to “Starter Motor Components” (Page 1I-6).

CAUTION

When installing the armature, use care to avoid breaking the brushes.



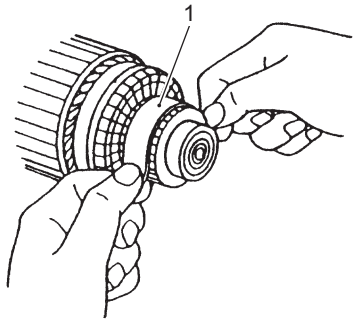
I9J011190021-01

Starter Motor Components Inspection and Servicing

Z9J0111906005

Armature and Commutator

- Inspect the commutator surface. If surface is gummy or dirty, clean with # 500 grit emery paper (1).

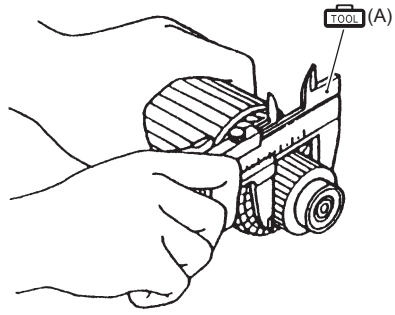


I9J011190022-01

- Measure the commutator outside diameter. If the measurement exceeds the service limit, replace the armature.

Special tool
(A): 09900–20101 (Vernier calipers (150 mm))

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



I9J011190023-01

- Check that the mica (insulator) between the segments is undercut to specified depth.
If the measurement exceeds the service limit, cut to the specified depth.

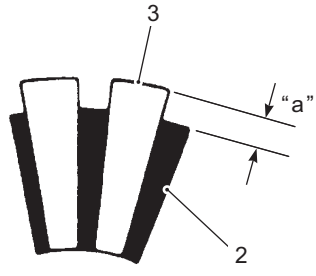
⚠ WARNING

Wear safety glasses when using compressed air.

NOTE

Remove all particles of mica and metal using compressed air.

Commutator undercut “a”
Standard: 0.5 – 0.8 mm (0.02 – 0.03 in.)
Service limit: 0.2 mm (0.01 in.)



I9J011190024-01

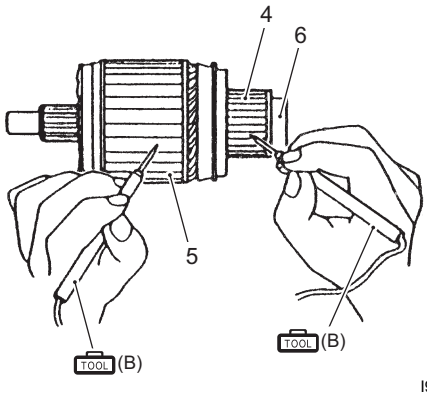
2. Mica	3. Segment

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- Check for continuity between the commutator (4) and the armature core (5) / shaft (6).
  Replace the armature if continuity is indicated.

  Special tool
  TOOL (B): 09930–99320 (Digital tester)

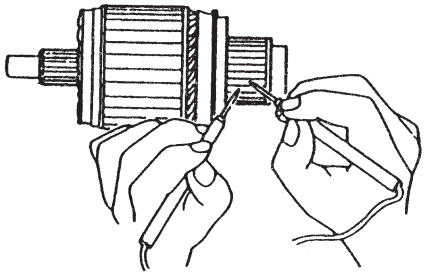
  Tester knob indication
  Continuity (•))))



I9J011190025-01

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

  Tester knob indication
  Continuity (•))))

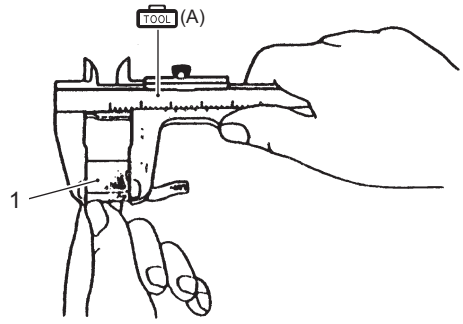


I9J011190026-01

Brushes
Check the length of each brush (1).
If brushes are worn down to the service limit, they must be replaced.

Special tool
TOOL (A): 09900–20101 (Vernier calipers (150 mm))

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



I9J011190027-01

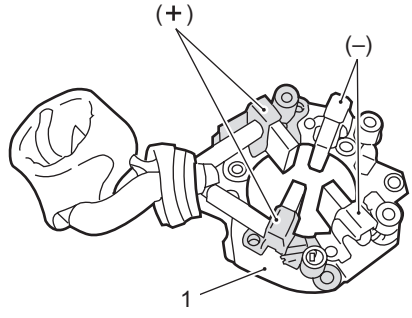
Brush Holder
Check brush holder continuity.
Replace the brush holder if the tester doesn't show the below.

Special tool
TOOL : 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))

Brush holder continuity

	Continuity
Brush holder positive (+) to brush holder negative (–)	**No**
Brush holder positive (+) to base plate (ground)	**No**

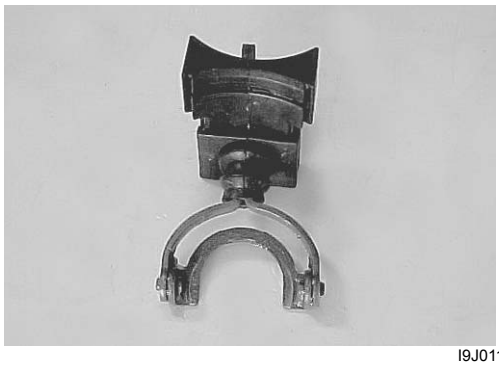


I9J011190028-01

1. Base plate

http://SelfFixer.com

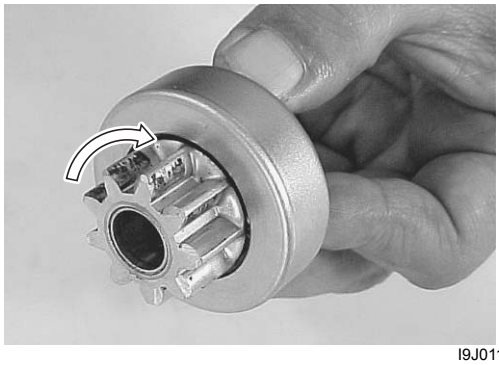
Shift Lever
Inspect the shift lever for wear. Replace if necessary.



I9J011190029-01

Pinion and Over-Running Clutch

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



I9J011190030-01

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



I9J011190031-01

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



I9J011190032-01

Pinion Shaft / Pinion Shaft Bushing

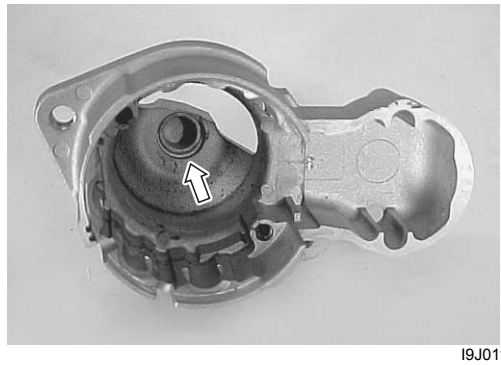
- Inspect the pinion shaft for wear, damage or other abnormal conditions. Replace if necessary.
- Inspect the pinion shaft bushing for wear or other damage.
  Replace if necessary.



I9J011190033-01

Front Housing

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



I9J011190034-01

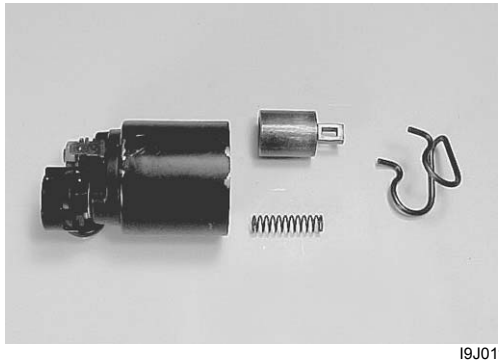
http://SelfFixer.com

Armature Shaft Bush
Inspect the bushing for wear or other damage.
Replace if necessary.



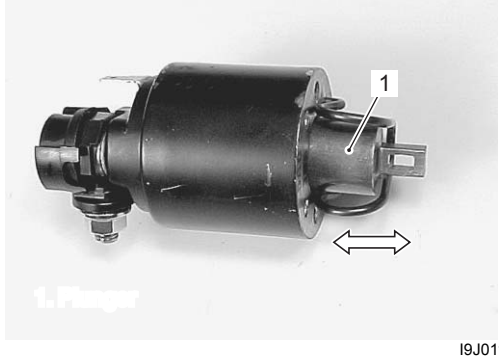
I9J011190035-01

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



I9J011190036-01

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



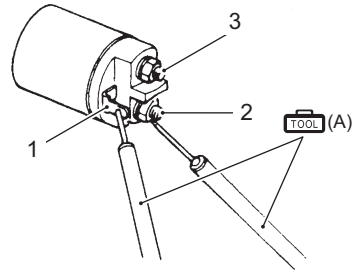
I9J011190037-01

1. Plunger	

Pull-in coil open circuit test
Check for continuity across the magnetic switch “S” terminal (1) and “M” terminal (2).
If no continuity exists, the coil is open and should be replaced.

Special tool
TOOL (A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•)))



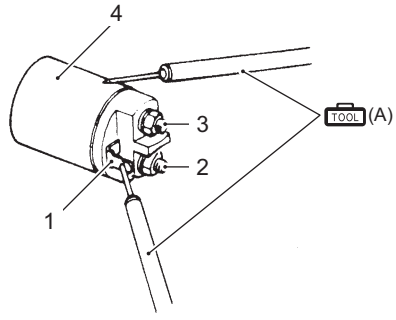
I9J011190038-02

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

Hold-in coil open circuit test
Check for continuity across the magnetic switch “S” terminal (1) and coil case (4).
If no continuity exists, the coil is open and should be replaced.

Special tool
TOOL (A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•)))



I9J011190039-01

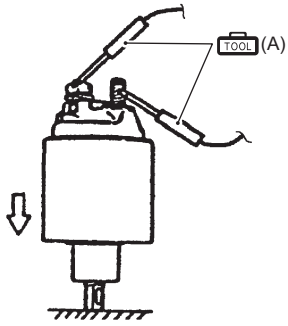
1. Terminal “S”	3. Terminal “B”
2. Terminal “M”	4. Coil case

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Contact points test
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.

Special tool
(A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))



I9J011190040-01

Ignition Switch Inspection

Z9J0111906006

Inspect the ignition switch using the following procedures:

1) Disconnect the ignition switch from remo-con box wiring harness.
2) Check continuity between wiring leads at the key positions shown in the chart.
3) If out of specification, replace the ignition switch.

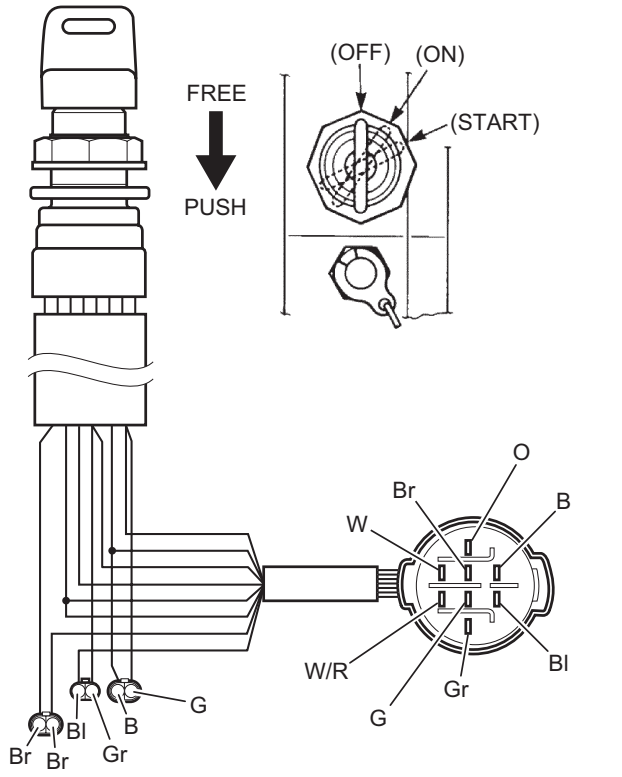
Special tool
: 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))

Key position	Switch Lead Wires					
	B	G	W	Gr	Br	O
OFF	○—○					
ON			○—○			
START			○—○—○			
FREE						
PUSH			○—○	——		○

○—○ : Continuity

I9J011190041-03



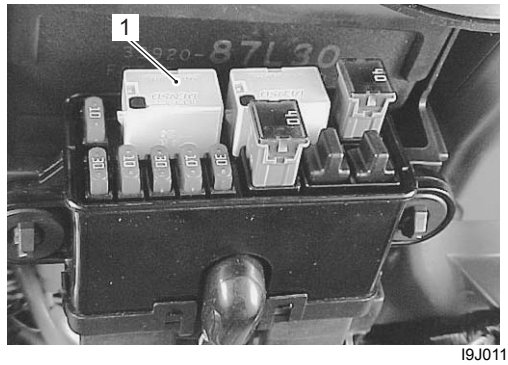
I9J011190042-02

Starter Motor Relay Inspection

Z9J0111906007

Inspect the starter motor relay using the following procedures:

1) Disconnect the starter motor relay from the fuse box.



I9J011190059-02

1. Starter motor relay

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2) Check continuity between terminal (2) and (3) each time 12 V power supply is applied to terminal (4) and (5).
Connect the positive (+) lead to terminal (5), and negative (–) lead to terminal (4).

CAUTION

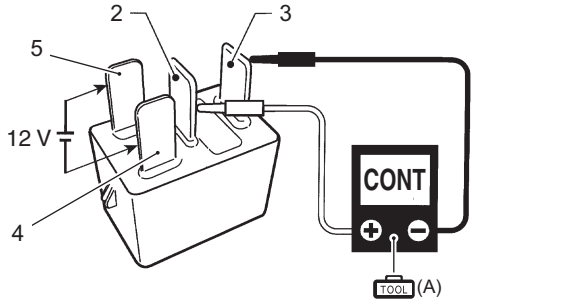
Be careful not to touch 12 V power supply wires to each other or with other terminals.

Special tool
(A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•)))

Starter motor relay function

	Continuity
12 V power applied	Yes
12 V power not applied	No

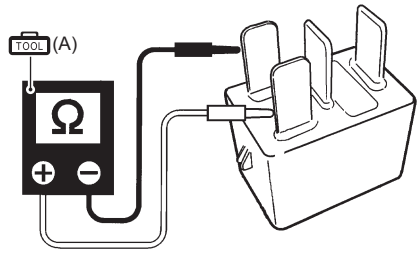


I9J011190043-03

3) Measure the resistance between relay terminals (4) and (5).
If out of specification, replace starter motor relay.

Tester knob indication
Resistance (Ω)

Starter motor relay solenoid coil resistance
Standard: 145 – 190 Ω



I9J011190044-02

Neutral Switch Inspection

Z9J0111906008

Check for continuity / infinity of the neutral switch.

Special tool
(A): 09930–99320 (Digital tester)

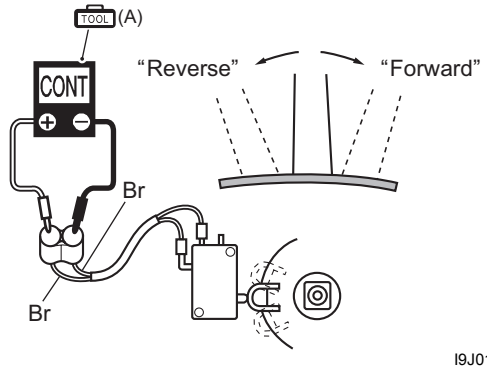
Tester knob indication
Continuity (•)))

Neutral switch in remo-con box

1) Disconnect the neutral switch lead wire connector from the ignition switch.
2) Check continuity / infinity between the switch brown wire leads while operating the remo-con handle.
If out of specification, replace the neutral switch.

Neutral switch function

Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity



I9J011190045-03

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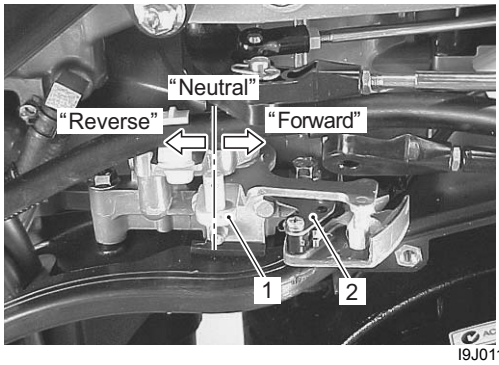
Neutral switch on engine side

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

Special tool
(A): 09930–99320 (Digital tester)

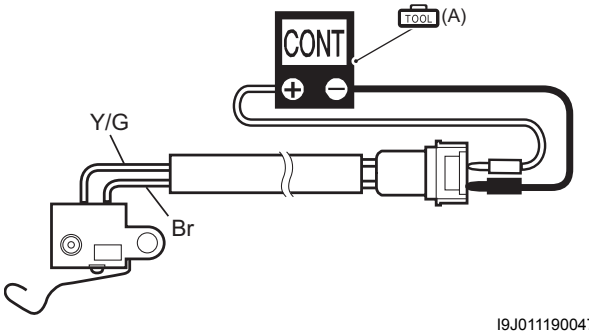
Neutral switch function

Shift position	Tester indicates
Neutral	Continuity
Forward	Infinity
Reverse	Infinity



I9J011190046-02

1. Clutch lever	2. Neutral switch



I9J011190047-03

3) If out of specification:
- 1st:
  Check the remo-con cable adjustment, readjust if necessary.
- 2nd:
  Check the wire harnesses for open and short circuits.
  If the wire harnesses are in good condition, replace the neutral switch and recheck.

NOTE

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

Emergency Stop Switch Inspection

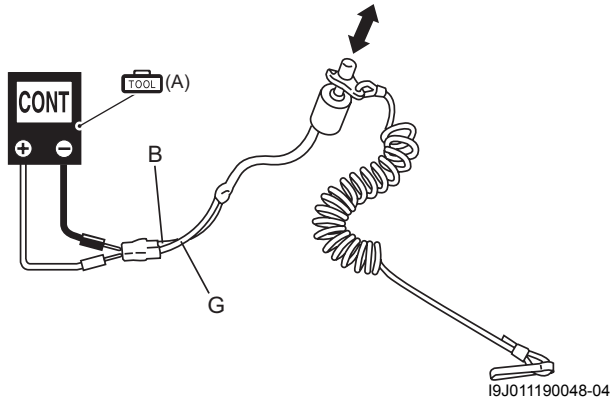
Z9J0111906009

1) Disconnect the emergency stop switch lead wire.
2) Check the continuity / infinity between the wiring leads under the condition shown below.

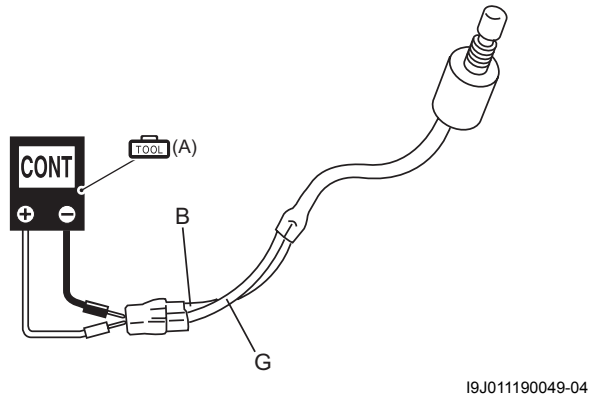
Special tool
(A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))

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



I9J011190048-04



I9J011190049-04

3) If out of specification, replace the switch.

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Charging System

General Description

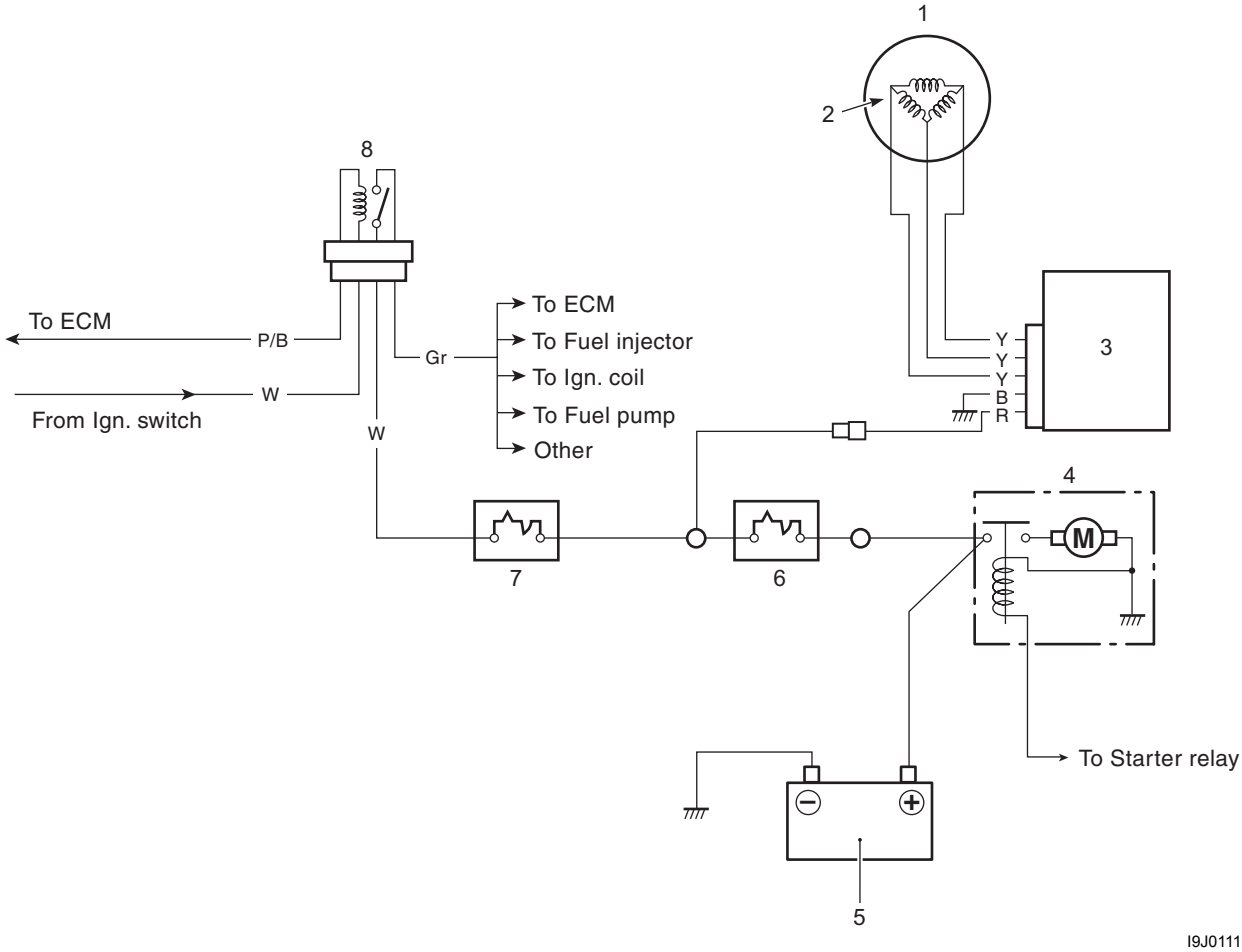
Charging System Description

Z9J0111B01001

The battery charging system circuit is illustrated below.
It is composed of the Battery Charge Coil, Rectifier/regulator and Battery. The three phase AC current generated from the battery charge coil is converted by the rectifier/regulator into regulated DC current which is used to charge the battery.

Battery Charge coil Output
Standard: 12 V 27 A (324 W) at 3 000 r/min

Regulated Voltage
Standard: 14.5 – 15.2 Volts



I9J0111B0001-03

1. Alternator (Magneto)	4. Starter motor	7. ECM fuse 30 A
2. Battery charge coil	5. Battery	8. Main relay
3. Rectifier/Regulator	6. Main fuse 40 A	

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Battery Requirement Description

Z9J0111B01002

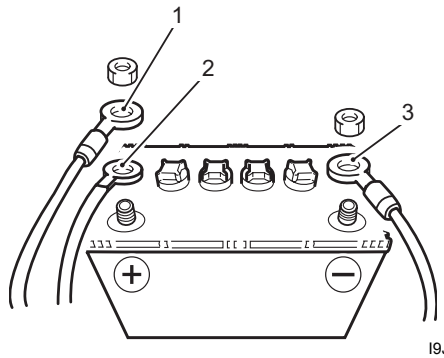
Suzuki recommends 12-volt cranking-type lead acid battery for the DF70 / 80 / 90.
Minimum battery requirement for starting the engine is provided below.
The battery must satisfy one of the specifications described below.

Recommended battery size

650 Marine Cranking Amps (MCA)/ABYC
or 512 Cold Cranking Amps (CCA)/SAE
or 160 Reserve Capacity (RC) Minutes/SAE
or 12 V 100 AH

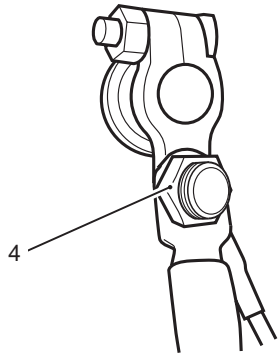
NOTE

- **The specifications listed above are the minimum battery rating requirements for starting the engine.**
- **Additional electrical loads from the boat will require larger capacity batteries.**
- **Dual-purpose (Cranking / Deep-Cycle) batteries can be used if they meet the minimum specifications listed above (MCA, CCA, or RC).**
- **Do not use a Deep Cycle battery for the main cranking battery.**
- **The use of Maintenance-Free, sealed, or Gel-Cell batteries is not recommended because they may not be compatible with Suzuki's charging system.**
- **When connecting batteries in parallel, they must be of the same type, capacity, manufacturer, and of similar age. When replacement is necessary, they should be replaced as a set.**
- **When connecting batteries, hex nuts must be used to secure battery leads to battery posts.**
- **It is recommended that the battery be installed in an enclosed case.**



I9J0111B0002-02

1. Red lead	3. Black lead
2. Sub battery cable	



I9J0111B0003-02

4. Hexagon-nut

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Component Location

Charging System Components Location

Z9J0111B03001

Refer to “Engine Control System Components / Engine Electrical Device Location” in Section 1A (Page 1A-15).

Diagnostic Information and Procedures

Charging System Diagnosis

Z9J0111B04001

Condition	Possible cause	Correction / Reference Item
Alternator (Battery charge coil) does not charge.	Open or short circuit lead wires.	*Repair or replace.*
	Open or short circuit battery charge coil.	*Replace.*
	Rectifier/Regulator failure.	*Replace.*
	Main fuse blown out.	*Replace.*
	Poor or broken battery connection.	*Repair or Replace.*
Alternator (Battery charge coil) overcharge.	Rectifier/Regulator failure.	*Replace.*
	Poorly grounded rectifier/regulator.	*Repair or Retighten.*
Unstable charging	Short circuit battery charge coil.	*Replace.*
	Loose lead wire connection.	*Repair or replace.*
	Rectifier/regulator failure.	*Replace.*
	Poor or broken battery connection.	*Repair or replace.*

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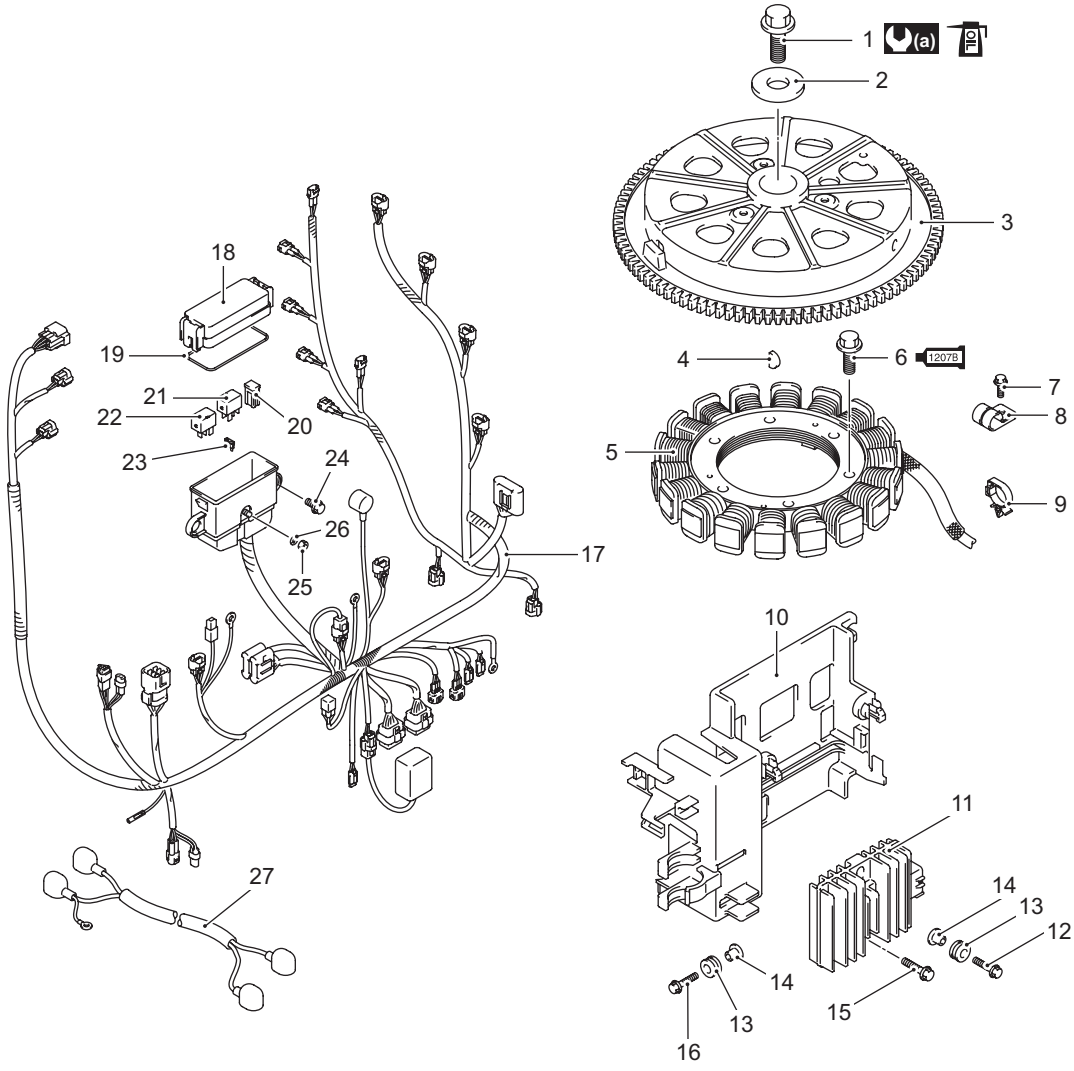
Service Instructions

Charging System Construction

Z9J0111B06001

CAUTION

Flywheel bolt (1) is a left hand thread.



I9J0111B0004-04

1. Bolt	9. Clamp	17. Wiring harness assembly	25. Nut
2. washer	10. Electric parts holder	18. Fuse case upper cover	26. washer
3. Flywheel	11. Rectifier/Regulator	19. O-ring	27. Battery cable
4. Key	12. Bolt	20. Fuse (40 amp.)	(a) : 196 N·m (19.7 kgf-m, 142 lbf-ft)
5. Battery charge coil	13. Cushion	21. Main relay	FIO : Apply engine oil.
6. Bolt	14. Washer	22. Starter motor relay	1207B : Apply SUZUKI Bond 1207B.
7. Bolt	15. Bolt	23. Fuse	
8. Clamp	16. Bolt	24. Bolt	

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Flywheel Removal and Installation

Z9J0111B06002

Removal

CAUTION

Prior to removing flywheel, disconnect battery cables from battery.

1) Remove the ring gear cover.
   Refer to “Ring Gear Cover Removal and Installation” in Section 1D (Page 1D-2).
2) Loosen flywheel bolt 2 – 3 turns in clockwise direction.

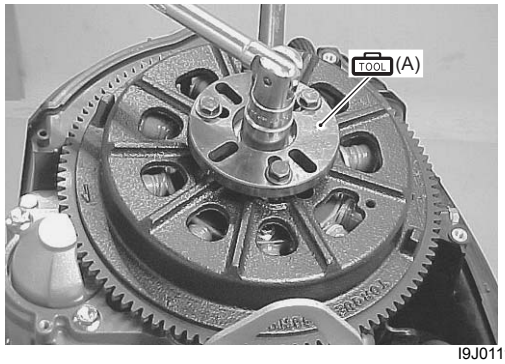
CAUTION

Flywheel bolt is LH thread.

NOTE

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

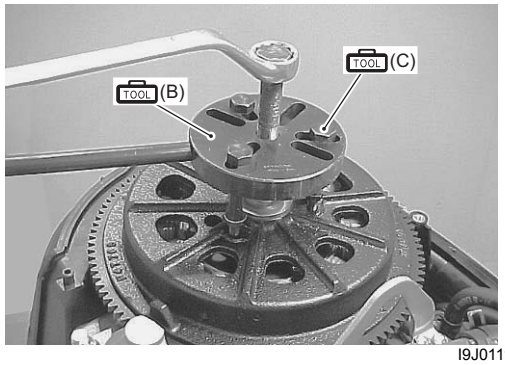
Special tool
TOOL (A): 09930–48720 (Flywheel holder)



I9J0111B0009-01

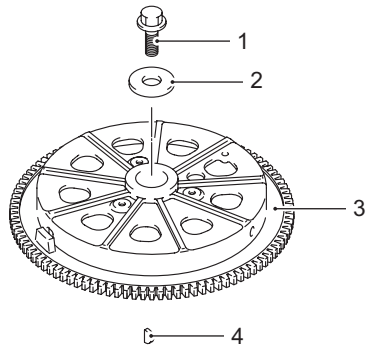
3) Using special tools, loosen flywheel from crankshaft.

Special tool
TOOL (B): 09930–39411 (Flywheel remover)
TOOL (C): 09930–39420 (Flywheel remover bolt)



I9J0111B0010-02

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

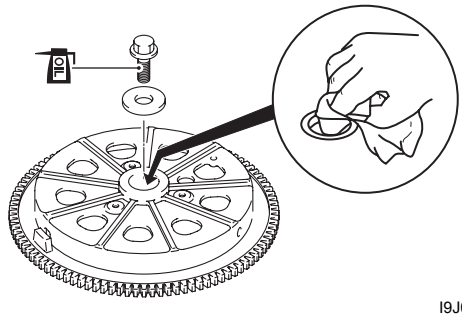


I9J0111B0011-01

Installation

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

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

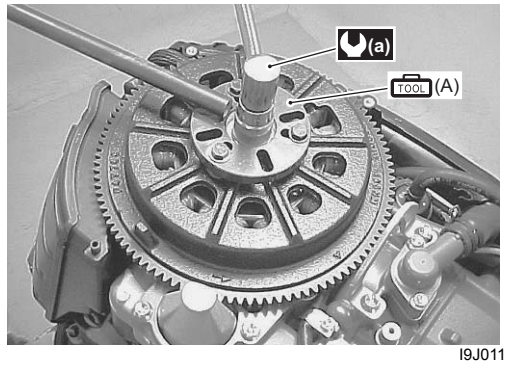


I9J0111B0013-01

- Tighten flywheel bolt to specified torque.

Special tool
TOOL (A): 09930–48720 (Flywheel holder)

Tightening torque
Flywheel bolt (a): 196 N·m (19.7 kgf-m, 142 lbf-ft)



I9J0111B0014-01

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Battery Charge Coil Removal and Installation

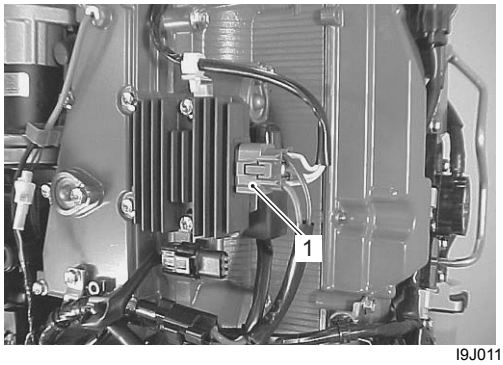
Z9J0111B06003

Removal

CAUTION

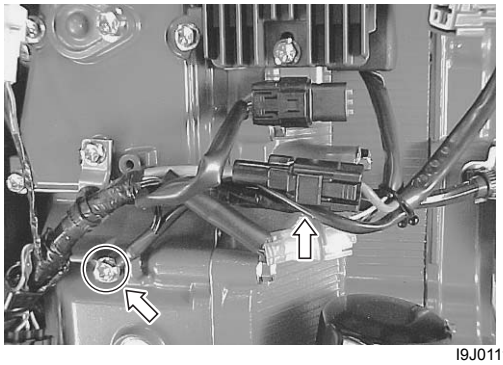
Prior to removing electrical parts, disconnect battery cables from battery.

1) Remove flywheel.
   Refer to “Flywheel Removal and Installation” (Page 1K-5).
2) Disconnect battery charge coil lead wire connector (1) at rectifier/regulator.



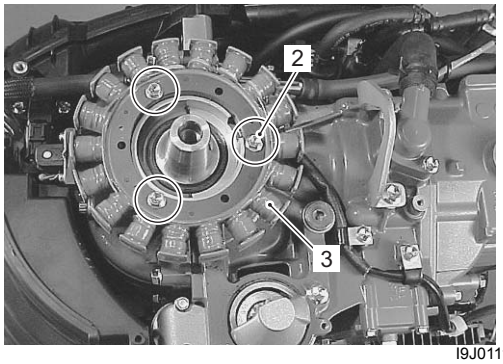
I9J0111B0015-01

3) Disconnect the charge output (red) lead wire connector.
4) Remove the bolt securing rectifier GND lead wire.



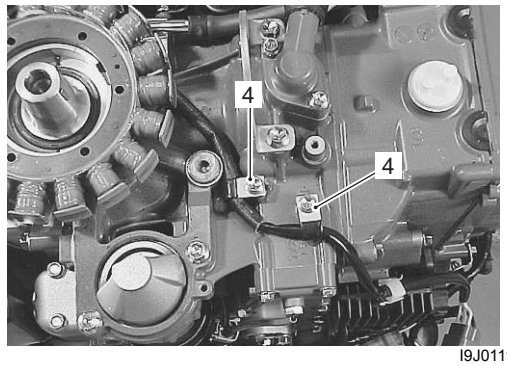
I9J0111B0016-01

5) Remove three screws (2) securing the battery charge coil (3).



I9J0111B0017-01

6) Remove the bolts securing lead wire clamp (4).



I9J0111B0018-01

7) Remove the battery charge coil (3).

Installation

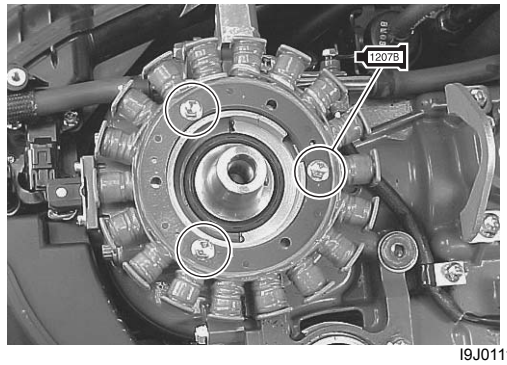
Installation is reverse order of removal with special attention to the following steps.

Battery charge coil

- Apply suzuki bond No. 1207B to the coil securing screws.

  1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))

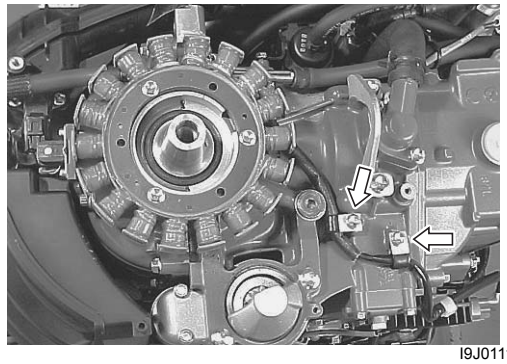
- Install battery charge coil, then tighten coil screws securely.



I9J0111B0019-02

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, refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).



I9J0111B0020-01

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Flywheel
Install flywheel and tighten flywheel bolt to specified torque.
Refer to “Flywheel Removal and Installation” (Page 1K-5).

Special tool
: 09930–48720 (Flywheel holder)

Tightening torque
Flywheel bolt: 196 N·m (19.7 kgf-m, 142 lbf-ft)

Battery Charge Coil Inspection

Z9J0111B06004

Measure battery charge coil resistance in the following procedure.

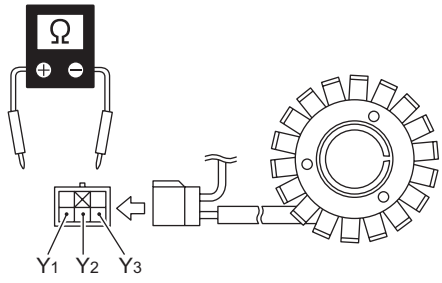
1) Disconnect battery charge coil leads from rectifier/regulator.
2) Measure resistance between leads in the combinations shown.
   If measurement exceeds specification, replace battery charge coil.

   Special tool
   : 09930–99320 (Digital tester)

   Tester knob indication
   Resistance (Ω)

   Battery charge coil resistance

Terminal for tester probe connection	Resistance
Yellow 1 to Yellow 2	0.1 – 0.3 Ω
Yellow 2 to Yellow 3	
Yellow 3 to Yellow 1	



I9J0111B0005-02

Rectifier/Regulator Removal and Installation

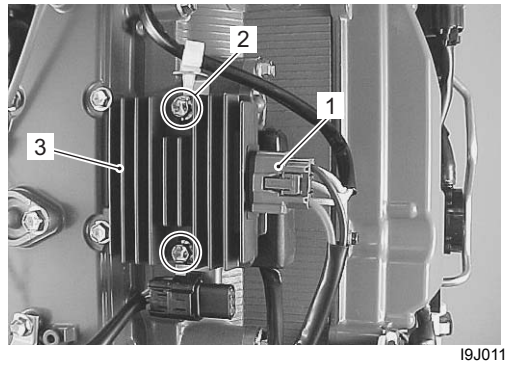
Z9J0111B06005

Removal

CAUTION

Prior to removing electrical parts, disconnect battery cables from battery.

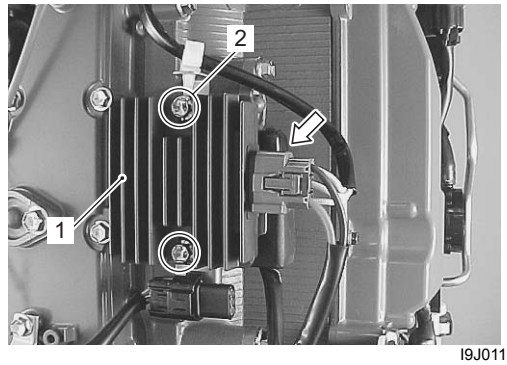
1) Disconnect lead wire connector (1) from rectifier/regulator.
2) Remove the bolts (2) and rectifier/regulator (3).



I9J0111B0021-01

Installation

1) Install rectifier/regulator (1), then tighten bolts (2) securely.
2) Connect lead wire connector to rectifier/regulator. Check that lead wire routed properly.



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Rectifier/Regulator Inspection

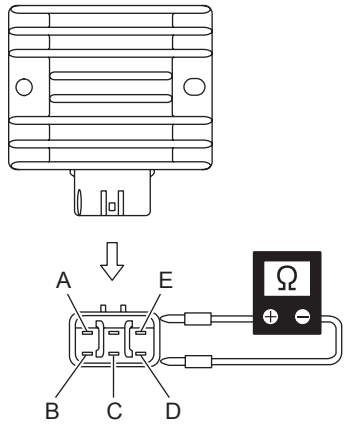
Z9J0111B06006

Inspect the rectifier/regulator in the following procedures:

1) Disconnect all lead wires of rectifier/regulator.
2) Measure resistance between terminals in the combinations shown.
   If measurement exceeds specification, replace rectifier/regulator.

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.



I9J0111B0006-02

Special tool
TOOL : 09930–25002 (Pocket tester)

Tester knob indication
Resistance (x 1 kΩ)

Rectifier and regulator resistance

Unit: kΩ

		Tester probe (+) (Red) connection				
		A	*B*	*C*	*D*	*E*
Tester probe (—) (Black) connection	*A*	—	*0.8 – 7.5*	*0.8 – 7.5*	*0.8 – 7.5*	*13 – 27*
	B	∞	—	∞	∞	*0.8 – 7.5*
	C	∞	∞	—	∞	*0.8 – 7.5*
	D	∞	∞	∞	—	*0.8 – 7.5*
	E	∞	∞	∞	∞	—

∞ : Infinity

I9J0111B0008-06

Main Fuse Inspection

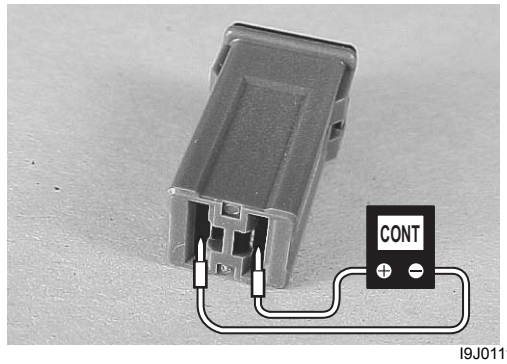
Z9J0111B06007

Inspect the main fuse in the following procedures.

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

Special tool
TOOL : 09930–99320 (Digital tester)

Tester knob indication
Continuity (•)))



I9J0111B0023-01

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Section 2

Mid Unit

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Precautions

Precautions

Precaution for Mid Unit

Z9J0112000001

Refer to “General Precautions” in Section 00 (Page 00-1).

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Housing and Bracket

Precautions

Precaution for Housing and Bracket

Z9J0112100001

CAUTION

Do not break or cut bonding wires, as they perform an important function in the prevention of galvanic corrosion or build up of static charges.
Replace any damaged wire.

NOTE

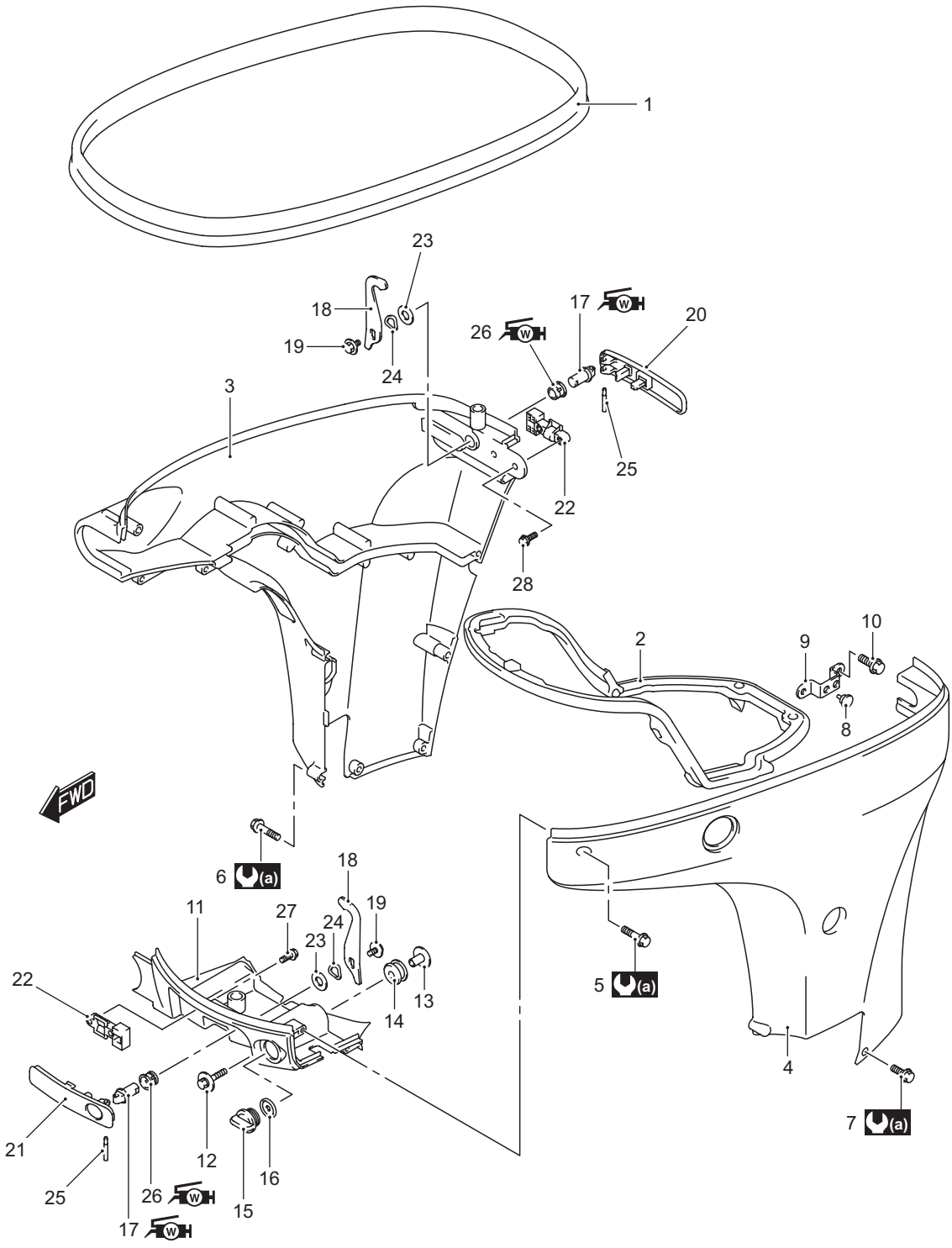
- **When dismantling housing and bracket, inspect mountings and bolts for damage and wear. Replace if necessary.**
- **Check the condition of the zinc anodes on lower section of mid unit. Replace if necessary.**

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Service Instructions

Lower Side Cover Components

Z9J0112106001



I9J011210003-05

1. Side cover rubber	9. Side cover holder	17. Engine cover hook shaft	25. Pin
2. Side cover seal	10. Bolt	18. Engine cover hook	26. Bush
3. Lower side cover STBD	11. Front panel	19. Bolt	27. Bolt
4. Lower side cover PORT	12. Bolt	20. Rear hook lever	28. Bolt
5. Screw	13. Washer	21. Front hook lever	W : Apply water resistance grease.
6. Screw	14. Cushion	22. Hook lever latch	(a) : 7 N·m (0.7 kgf-m, 5.0 lbf-ft)
7. Screw	15. Water plug	23. Washer	
8. Cushion	16. Gasket	24. Wave washer	

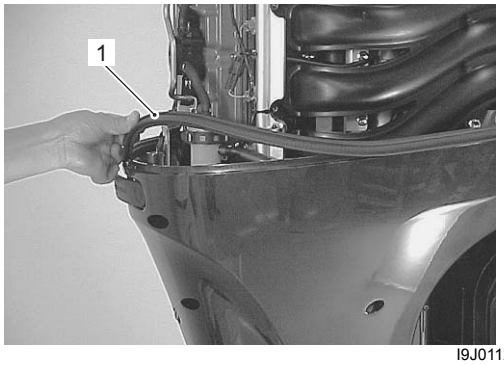
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Lower Side Cover Removal and Installation

Z9J0112106002

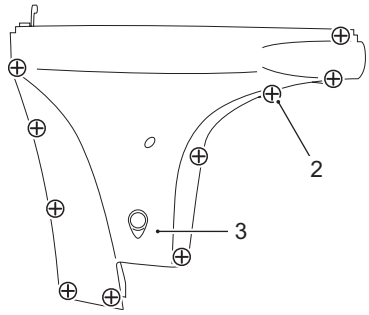
Removal

1) Remove the side cover rubber (1).



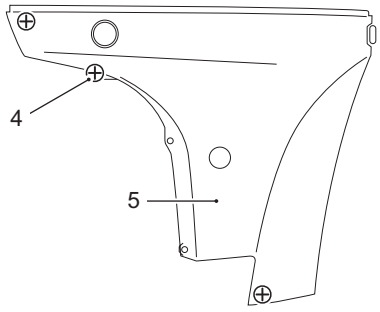
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2) Remove ten screws (2) and STBD side cover (3).



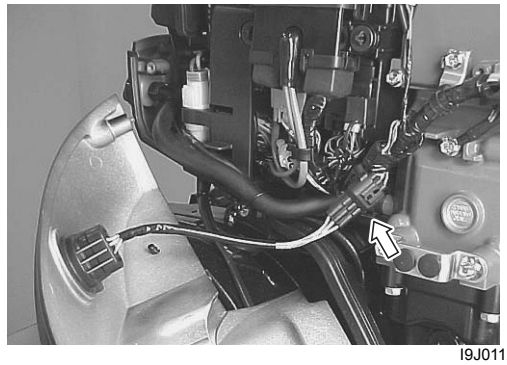
I9J011210007-02

3) Remove three screws (4) and PORT side cover (5).



I9J011210008-02

4) Disconnect PTT switch lead connector.



I9J011210010-01

Installation

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

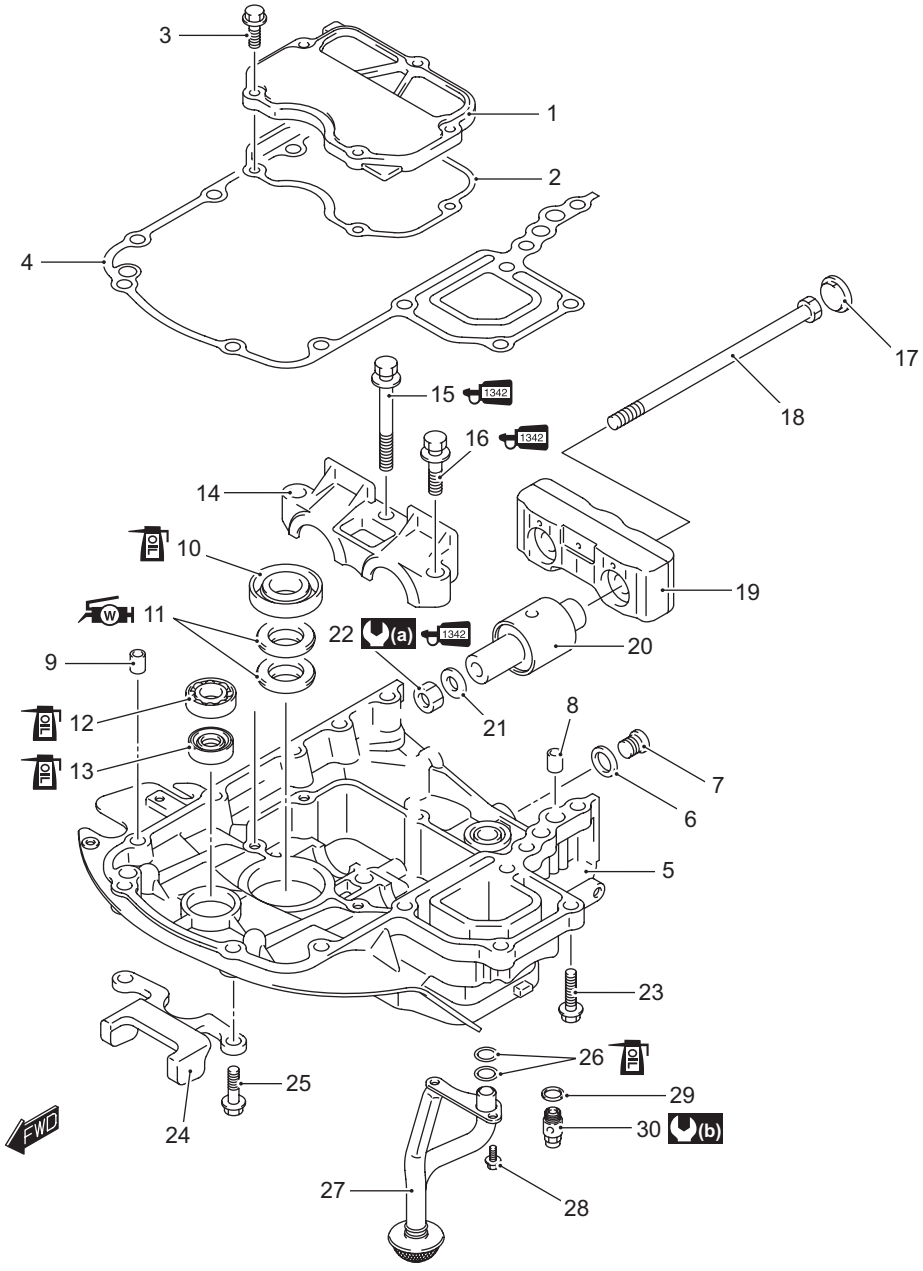
- Tighten side cover screws, pre-coated with thread lock, to specified torque.

  Tightening torque
  Side cover screw: 7 N·m (0.7 kgf-m, 5 lbf-ft)

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Engine Holder / Oil Pan / Driveshaft Housing / Mounts Components

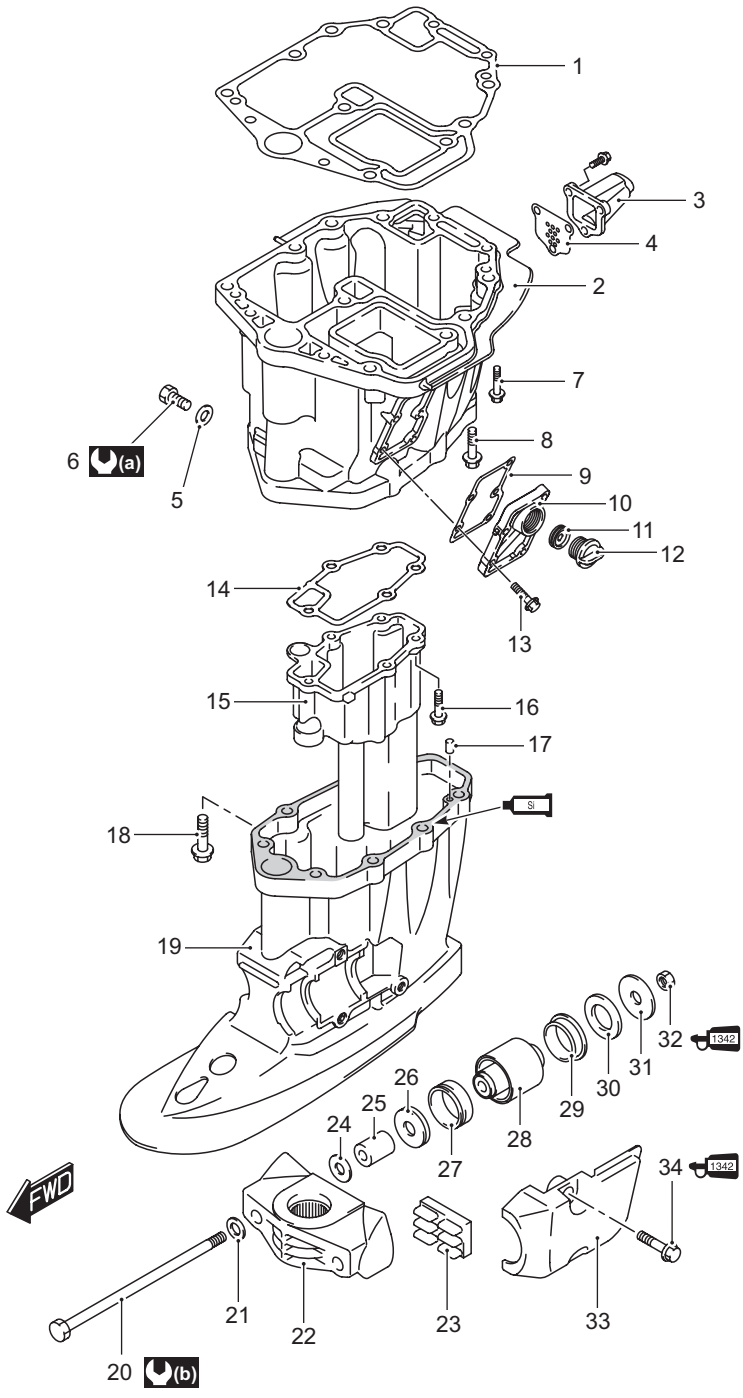
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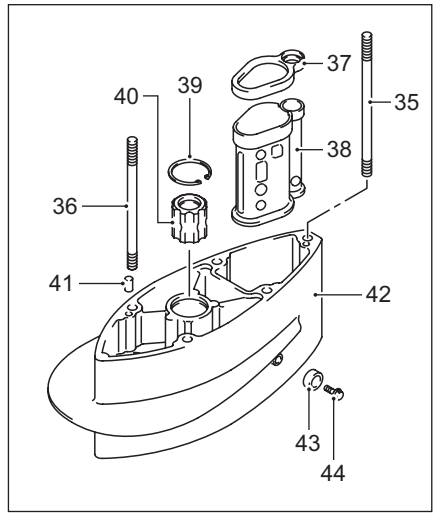
I9J011210004-01

1. Mount case cover	10. Driven gear seal	19. Upper thrust mount	28. Bolt
2. Gasket	11. Oil seal	20. Upper mount	29. Gasket
3. Bolt	12. Clutch shaft bearing	21. Washer	30. Oil relief valve
4. Gasket	13. Oil seal	22. Nut	(a) : 80 N·m (8.0 kgf-m, 57.8 lbf-ft)
5. Engine holder	14. Upper mount cover	23. Bolt	(b) : 27 N·m (2.7 kgf-m, 19.5 lbf-ft)
6. Gasket	15. Bolt	24. Upper unit stopper	OIL : Apply engine oil.
7. Plug	16. Bolt	25. Bolt	W : Apply SUZUKI water resistant grease.
8. Dowel pin	17. Spacer	26. O-ring	1342 : Apply SUZUKI thread lock 1342.
9. Dowel pin	18. Upper mount bolt	27. Oil strainer	

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TRANSOM X TYPE



I9J011210005-03

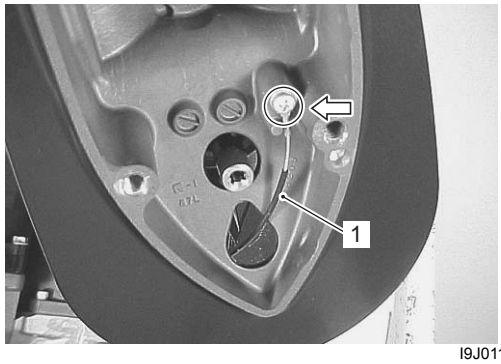
1. Gasket	13. Bolt	25. Lower mount spacer	37. Seal
2. Oil pan	14. Gasket	26. Damper	38. Exhaust tube Extension
3. Exhaust pipe	15. Exhaust tube housing	27. Lower side mount FWD	39. Circlip
4. Gasket	16. Bolt	28. Lower mount	40. Bush
5. Gasket	17. Dowel pin	29. Lower side mount	41. Dowel pin
6. Oil drain plug	18. Bolt	30. Damper	42. Extension case
7. Bolt	19. Driveshaft housing	31. Washer	43. Anode
8. Bolt	20. Lower mount bolt	32. Nut	44. Bolt
9. Gasket	21. Washer	33. Lower mount cover	(a) : 13 N·m (1.3 kgf-m, 9.5 lbf-ft)
10. Water jacket cover	22. Lower mount bracket	34. Bolt	(b) : 60 N·m (6.0 kgf-m, 43.4 lbf-ft)
11. Gasket	23. Lower thrust mount	35. Bolt	1342 : Apply SUZUKI thread lock 1342.
12. Water plug	24. Washer	36. Bolt	Si : Apply SUZUKI silicon seal.

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Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly

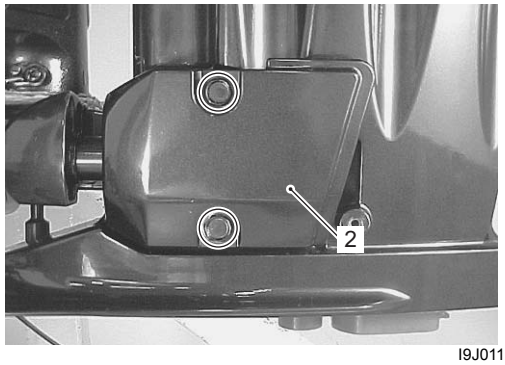
Z9J0112106004

1) Remove the power unit. Refer to “Power Unit Removal and Installation” in Section 1D (Page 1D-11).
2) Remove the lower unit. Refer to “Lower Unit Removal and Installation” in Section 3A (Page 3A-5).
3) Remove the screw and bonding wire (1).



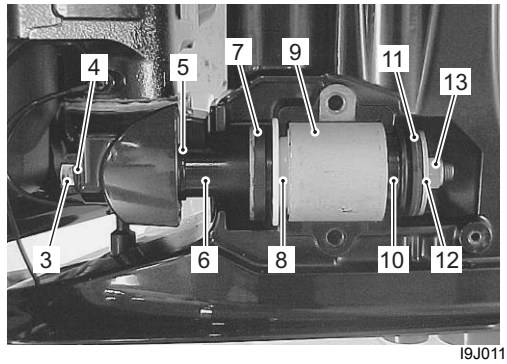
I9J011210011-01

4) Remove the four bolts securing the STBD / PORT lower mount covers, then detach the mount covers (2).

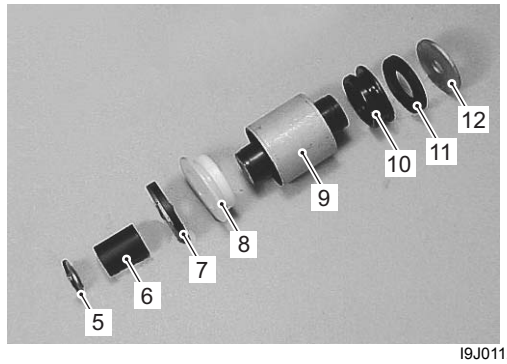


I9J011210012-01

5) Unscrew and remove the STBD / PORT lower mount bolts (3). Account for washers (4), (5), mount spacer (6), forward damper (7), white side mount (8), lower mount (9), black side side mount (10), damper (11), washer (12) and nut (13).

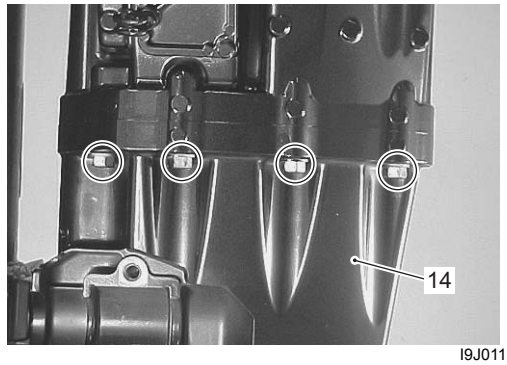


I9J011210013-02

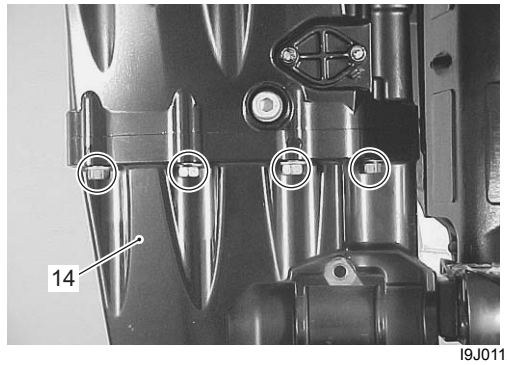


I9J011210014-01

6) Remove the eight bolts securing the driveshaft housing (14) to the oil pan, then remove the driveshaft housing.



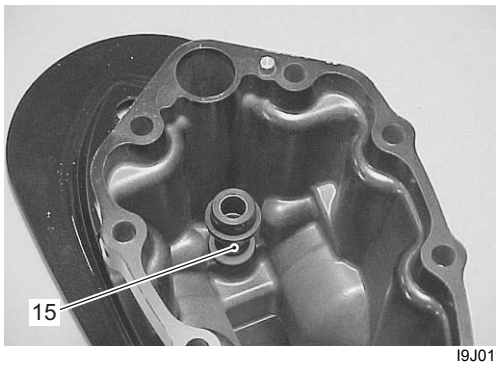
I9J011210015-02



I9J011210016-01

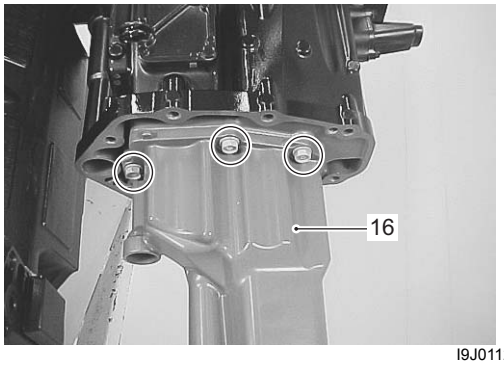
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7) Remove the water tube (15).



I9J011210018-01

8) Remove five bolts and exhaust tube housing (16).



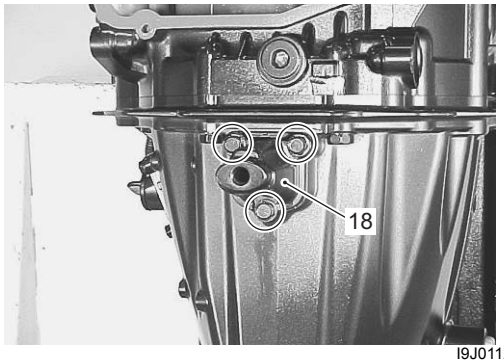
I9J011210019-01

9) Remove bolt and water indicator union (17) (if necessary).



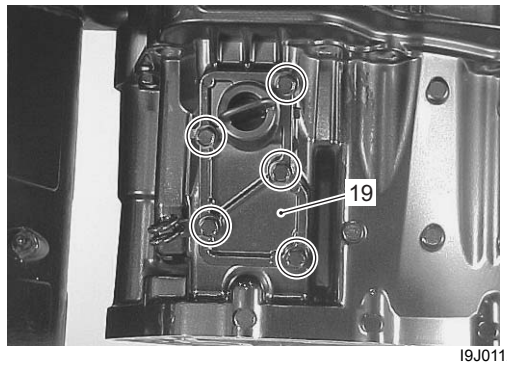
I9J011210020-01

10) Remove the three bolts securing exhaust pipe (18), then remove exhaust pipe (if necessary).



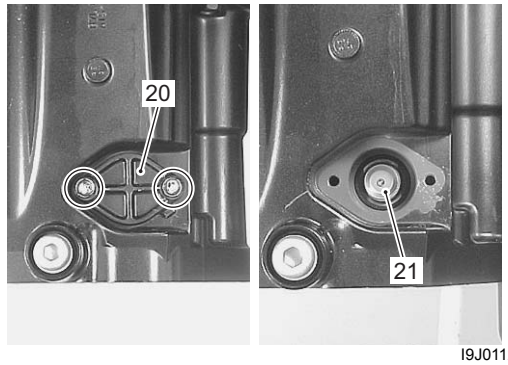
I9J011210022-01

11) Remove five bolts and oil pan water jacket cover (19) (if necessary).



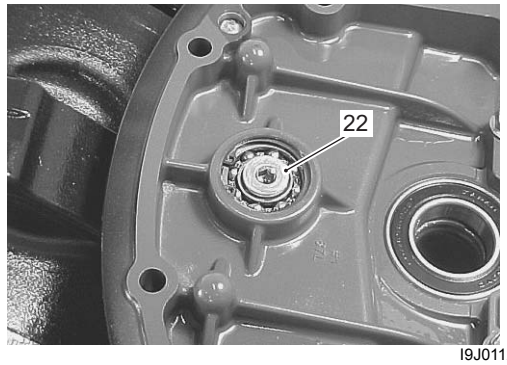
I9J011210023-01

12) Remove bolts, water pressure valve cover (20), and water pressure valve (21).



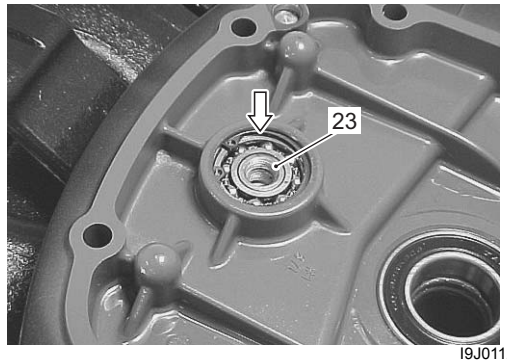
I9J011210024-01

13) Loosen and remove the clutch shaft plug (22).



I9J011210025-01

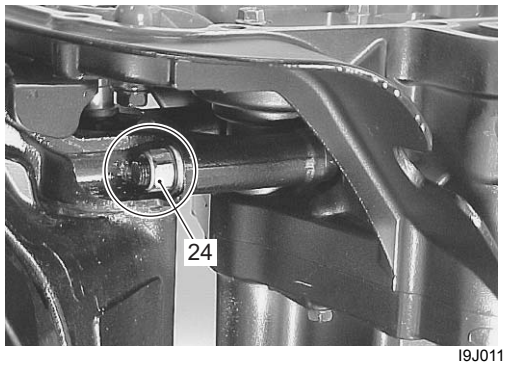
14) Push the clutch rod (23) down to free it from the engine holder.



I9J011210026-01

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15) Remove STBD / PORT upper mount nuts (24) and washers.



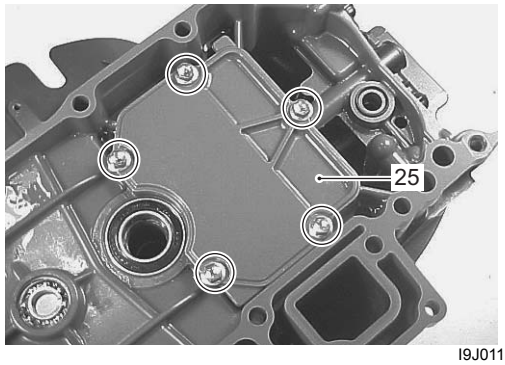
I9J011210027-01

16) Remove engine holder with oil pan.



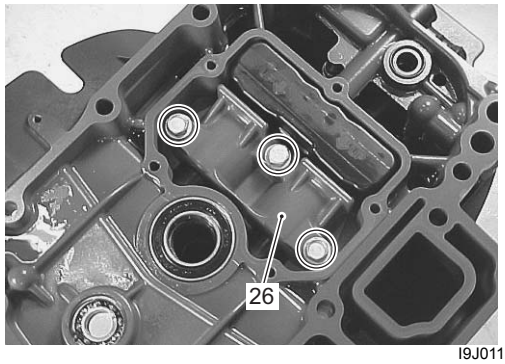
I9J011210028-01

17) Remove five bolts and the mount case cover (25).



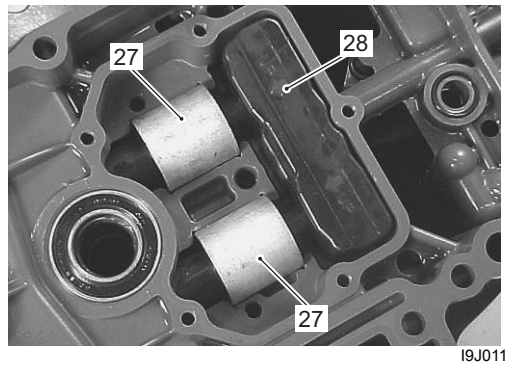
I9J011210029-01

18) Remove three bolts and upper mount cover (26).

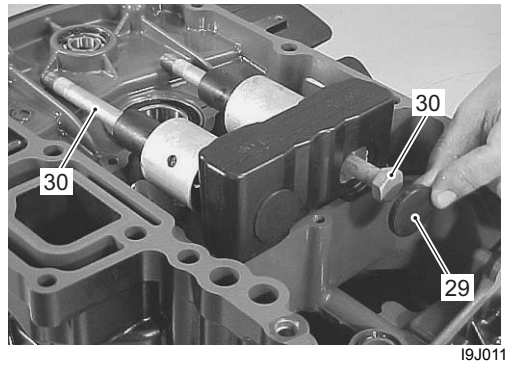


I9J011210030-01

19) Remove the upper mounts (27), upper thrust mount (28), damper (29) and mount bolts (30).

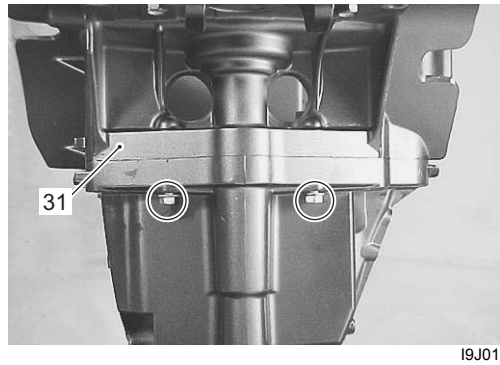


I9J011210031-01

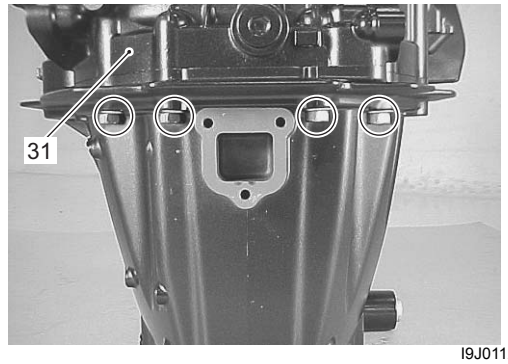


I9J011210032-02

20) Remove the six bolts and the engine holder (31) from the oil pan.



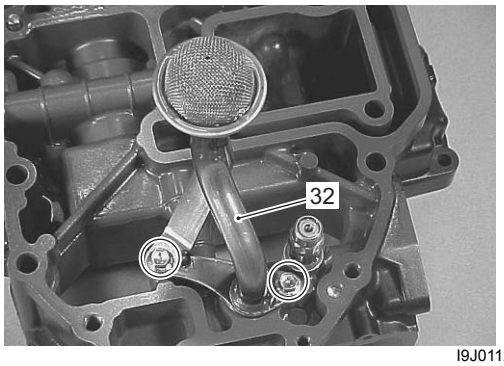
I9J011210033-02



I9J011210034-02

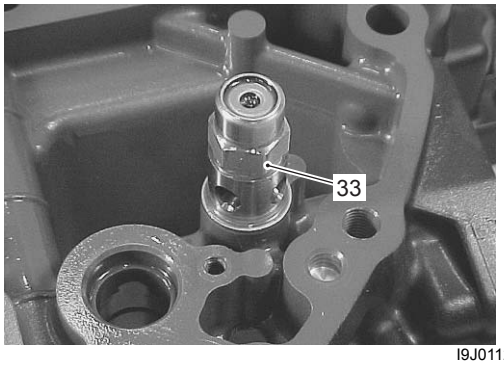
http://SelfFixer.com

21) Remove two bolts and oil strainer (32).



I9J011210035-01

22) Remove the oil relief valve (33) and gasket.



I9J011210036-02

Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly

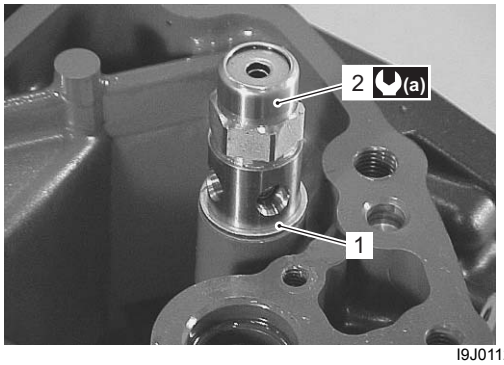
Z9J0112106005

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

Engine Holder to Oil Pan

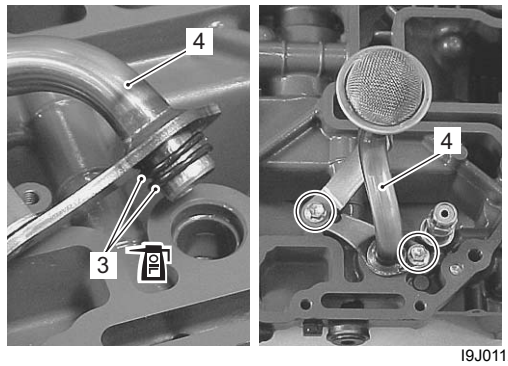
- Install the gasket (1) and oil relief valve (2) to the engine holder, then tighten the valve securely.

  Tightening torque
  Oil relief valve (a): 27 N·m (2.7 kgf-m, 19.5 lbf-ft)



I9J011210037-01

- Apply engine oil to O-rings (3), then install O-rings to oil strainer (4).
- Install oil strainer to engine holder, then tighten bolts securely.

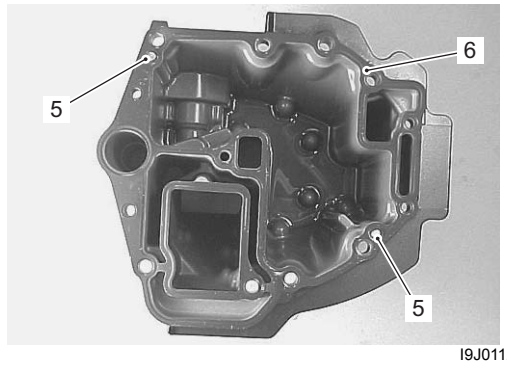


I9J011210038-01

- Install two dowel pins (5) and gasket (6) to oil pan.

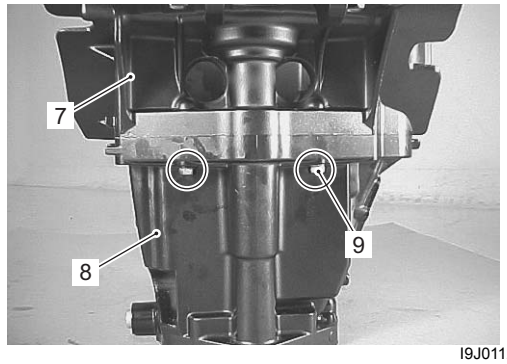
CAUTION

Do not reuse gasket. Always assemble with a new gasket.

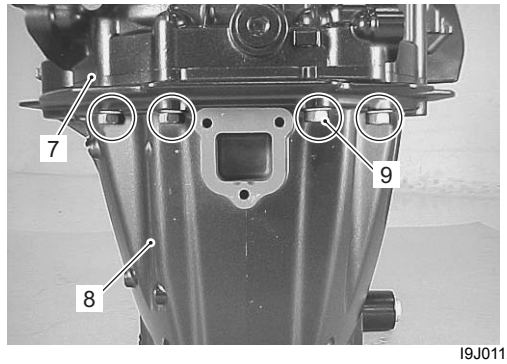


I9J011210039-03

- Install engine holder (7) to oil pan (8), then securely tighten it with engine holder bolts (9).



I9J011210040-01



I9J011210041-02

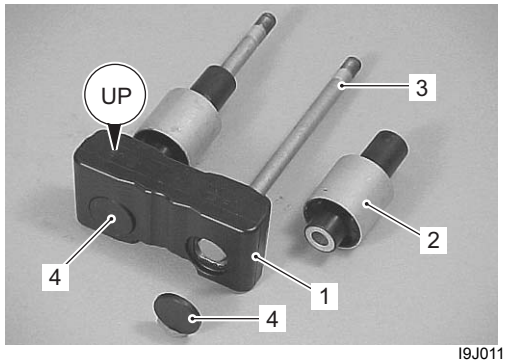
http://SelfFixer.com

Upper Mount and Mount Cover

- Assemble these items in the following sequence: Place upper thrust mount (1) and upper mounts (2) on upper mount bolts (3).
- Install dampers (4) to thrust mount.

NOTE

Install upper thrust mount with the lettered mark “UP” facing upward.



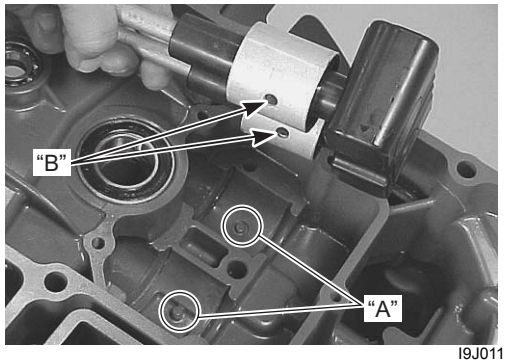
I9J011210042-01

- Place upper mount / thrust mount assembly into position.

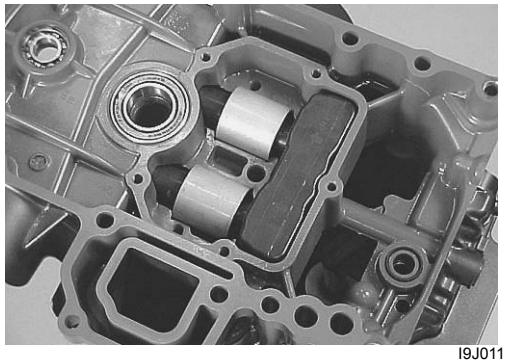
NOTE

Position the retaining pin hole on upper mount facing downward.

- Be sure the retaining pin “A” on the engine holder properly fits into the retaining pin hole “B” on the mount.



I9J011210043-01

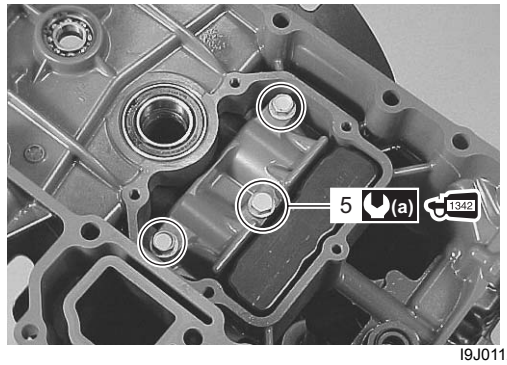


I9J011210044-01

- Install the upper mount cover (5).
- Tighten upper mount cover bolts, pre-coated with thread lock, to specified torque.

Tightening torque
Upper mount cover bolt (a): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)

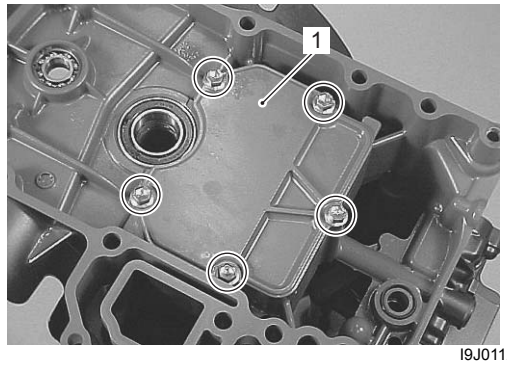
1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011210045-02

Mount Case Cover

- Install the gasket and mount case cover (1), then tighten five cover bolts securely.

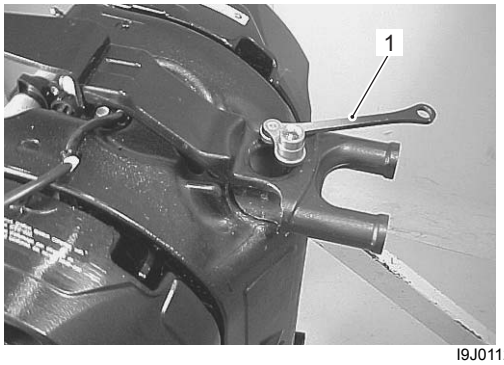


I9J011210046-01

http://SelfFixer.com

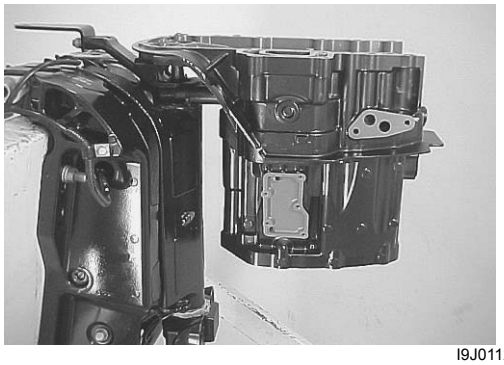
Engine Holder / Oil Pan

- Position the clutch rod (1) into place.



I9J011210047-01

- Install engine holder / oil pan to steering bracket.

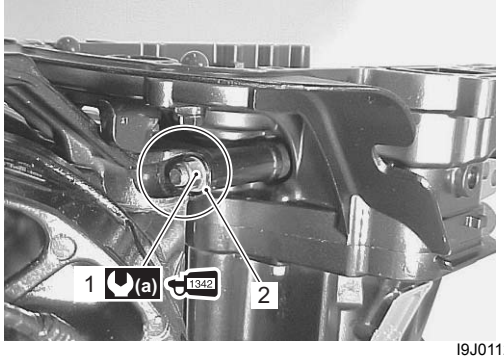


I9J011210048-01

- Install washer (2) and upper mount nut (1), then tighten two nuts, pre-coated with thread lock, to specified torque.

  Tightening torque
  Upper mount nut (a): 80 N·m (8.0 kgf-m, 57.8 lbf-ft)

  1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011210049-01

Clutch Rod

- Slide the clutch rod (1) into place.

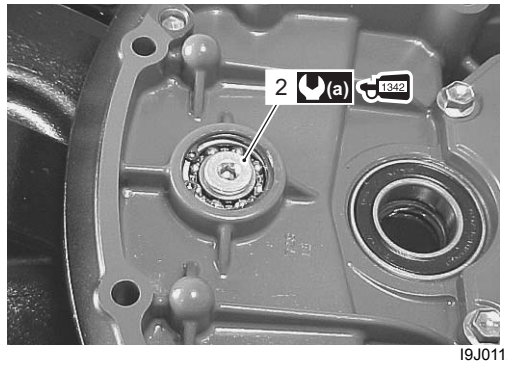


I9J011210050-01

- Tighten the clutch shaft plug (2), pre-coated with thread lock, to specified torque.

  Tightening torque
  Clutch shaft plug (a): 22 N·m (2.2 kgf-m, 16.0 lbf-ft)

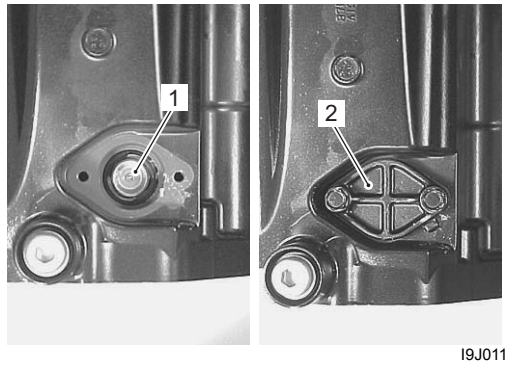
  1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011210051-01

Water Pressure Valve

- Install water pressure valve (1) and cover (2). Refer to “Water Pressure Valve Removal and Installation” in Section 1F (Page 1F-4).

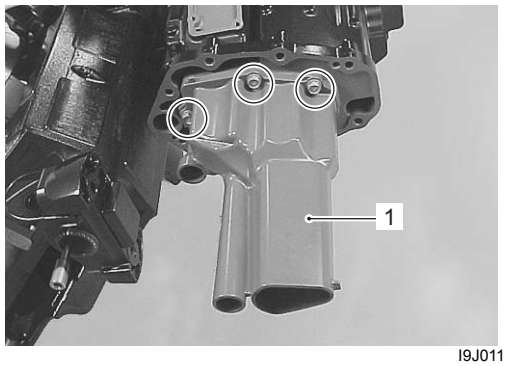


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http://SelfFixer.com

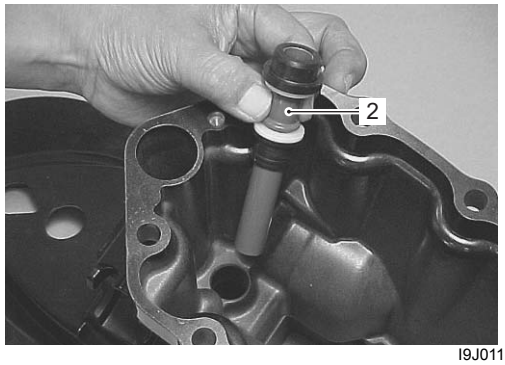
Driveshaft Housing / Oil Pan

- Install the gasket and exhaust tube housing (1), then tighten bolts securely.



I9J011210053-01

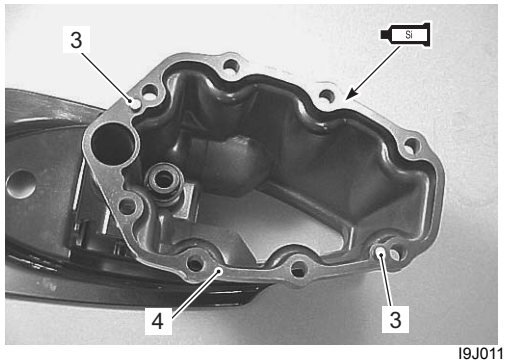
- Install water tube (2).



I9J011210054-01

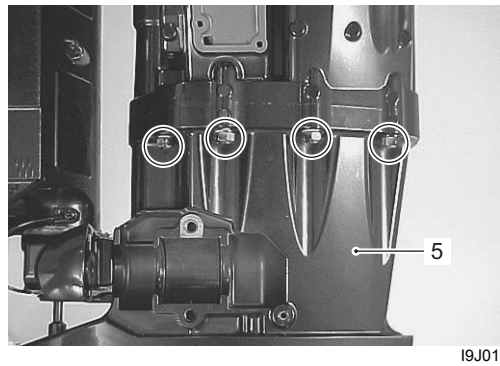
- Install two dowel pins (3) to driveshaft housing (4). Apply sealant to mating surfaces of driveshaft housing and oil pan.

Si : Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))



I9J011210055-02

- Install driveshaft housing (5) to oil pan, then tighten eight bolts securely.



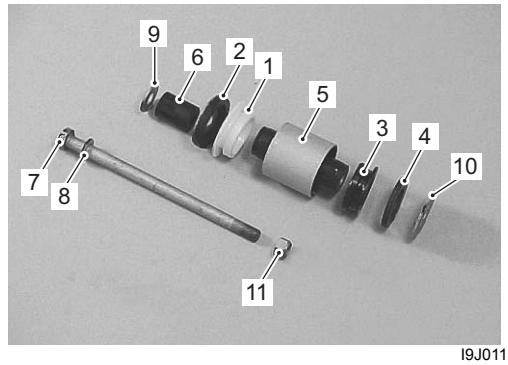
I9J011210056-02

Lower Mount / Bolt / Nut

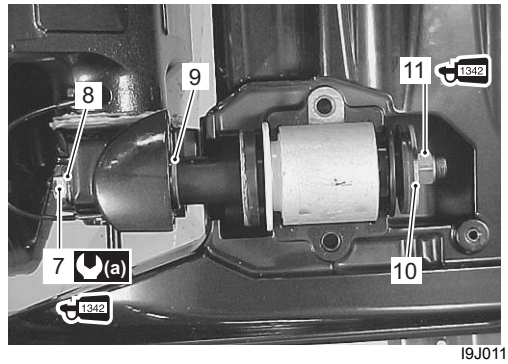
- Assemble the white lower side mount (1), lower thrust damper (2), black lower side mount (3) and damper (4) to the lower mount (5) as shown in figure.
- Place the spacer (6) and lower mount assembly into driveshaft housing.
- Install the lower mount bolt (7), washer (8), washer (9), washer (10) and nut (11), then tighten bolt, pre-coated with thread lock, to specified torque.

Tightening torque
Lower mount bolt (a): 60 N·m (6.0 kgf-m, 43.4 lbf-ft)

1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011210057-01

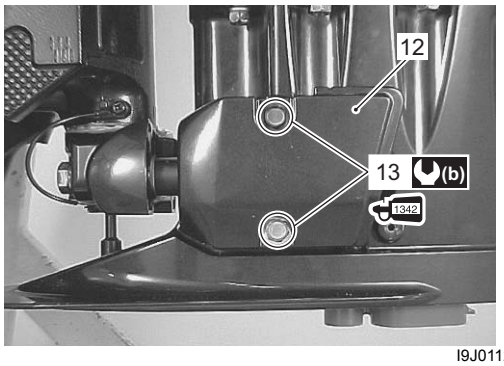


I9J011210058-02

http://SelfFixer.com

- Install lower mount cover (12) and cover bolts (13), then tighten bolts, pre-coated with thread lock, to specified torque.

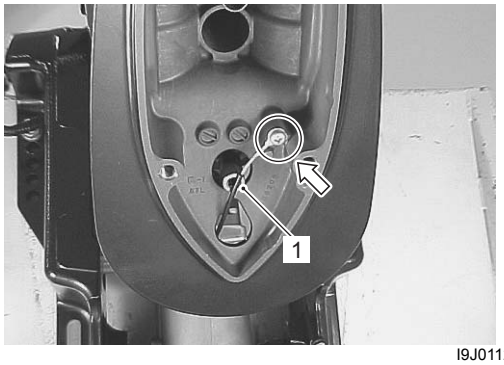
  Tightening torque
  Lower mount cover bolt (b): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)



I9J011210059-01

Bonding Wire

- Reattach the bonding wire (1), then tighten screw securely.



I9J011210060-01

Engine Holder / Oil Pan / Driveshaft Housing / Mounts Related Component Inspection

Z9J0112106006

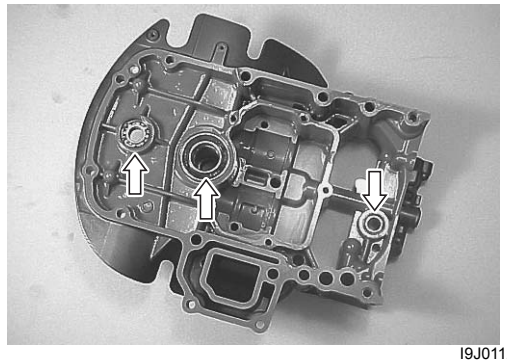
Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” (Page 2A-6) and “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” (Page 2A-9).

NOTE

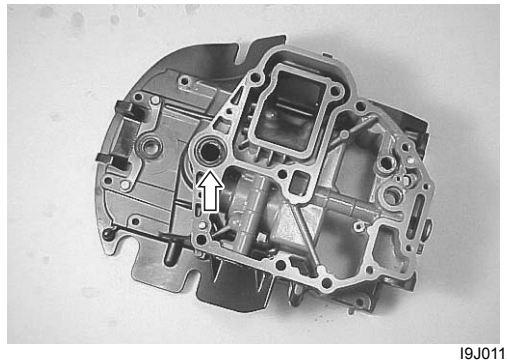
If any component is found to be excessively worn, cracked, defective or damaged in any way, it must be replaced.

Engine Holder

- Inspect the 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 conditions are found.
- Check the clutch shaft oil seal. Replace the oil seal if nicked, cut, worn or other abnormal conditions are found.



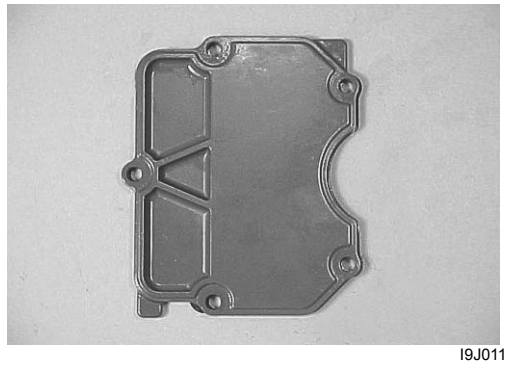
I9J011210061-01



I9J011210062-01

Mount Case Cover

- Inspect the mount case cover. Replace the mount case cover if cracked, damaged or other abnormal conditions are found.



I9J011210063-01

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Oil Strainer

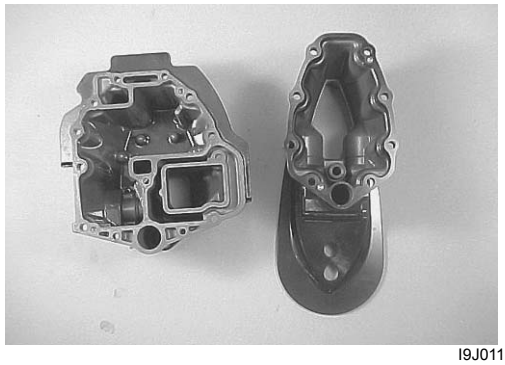
- Inspect the oil strainer. Replace the strainer if cracked, damaged or other abnormal conditions are found.
  If clogged or obstructed, clean the oil strainer.
- Check condition of O-ring. Replace O-ring if nicked, cut, worn or other abnormal condition are found.



I9J011210064-01

Oil Pan / Driveshaft Housing

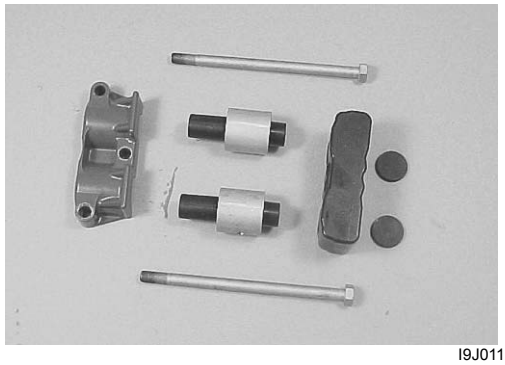
- Check oil pan, driveshaft housing.
  If cracks, defects or other damage is found, replace it.



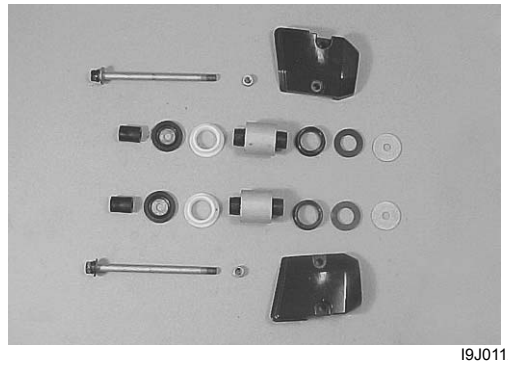
I9J011210065-01

Mount

- Check upper, lower and thrust mounts.
  If excessive wear, corrosion or other damage is found, replace mount.
- Inspect mount cover. Replace mount cover if cracked, damaged or other abnormal conditions are found.



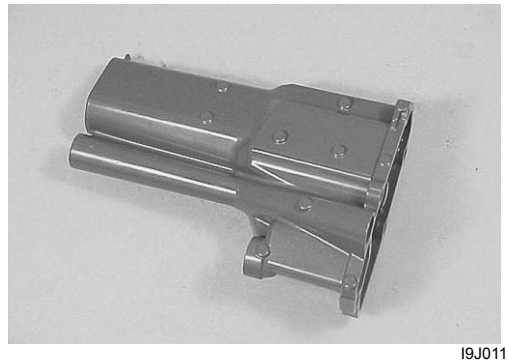
I9J011210066-01



I9J011210067-01

Exhaust Tube Housing

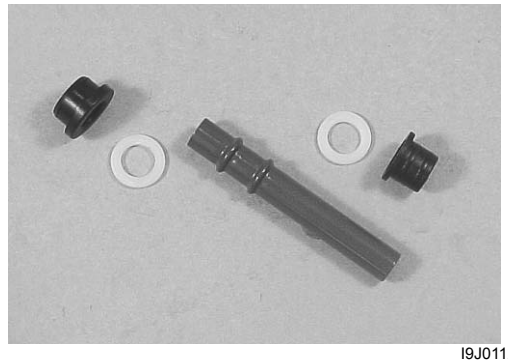
- Inspect exhaust tube housing.
  Replace housing if cracked, damaged or other abnormal conditions are found.



I9J011210069-01

Water Tube / Water Tube Grommet

- 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.



I9J011210070-01

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Clutch Shaft Bearing and Oil Seal Replacement

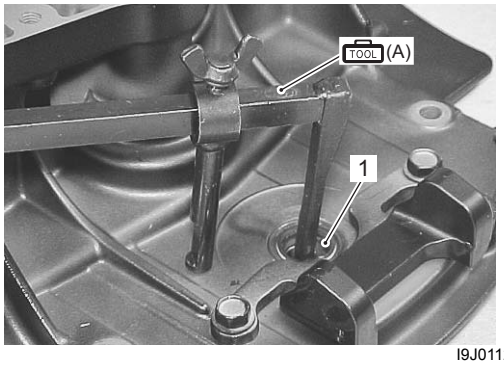
Z9J0112106007

1) Remove the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” (Page 2A-6).
2) Extract oil seal (1) with oil seal remover.

CAUTION

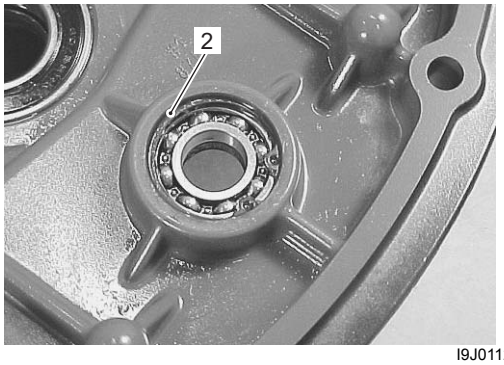
Do not reuse oil seal once removed.
Always use a new oil seal.

Special tool
TOOL (A): 09913–50121 (Oil seal remover)



I9J011210071-01

3) Remove circlip (2).



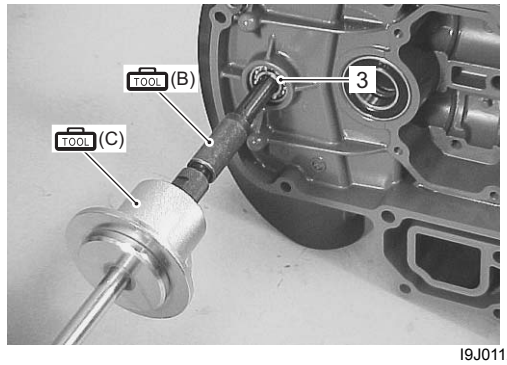
I9J011210072-01

4) Remove bearing (3) with special tool and sliding hammer.

CAUTION

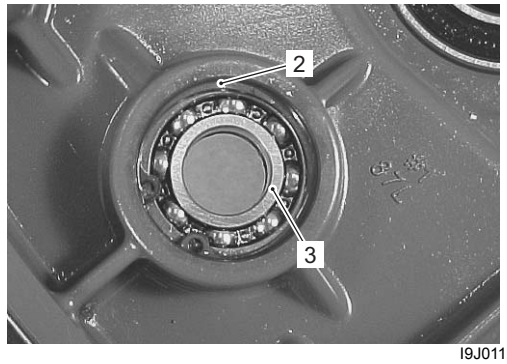
Do not reuse the bearing once removed.
Always use a new bearing.

Special tool
TOOL (B): 09923–73210 (Bearing remover)
TOOL (C): 09930–30104 (Sliding hammer)



I9J011210073-01

5) Apply engine oil to outer circumference of bearing (3).
Install bearing into engine holder.
6) Install circlip (2).



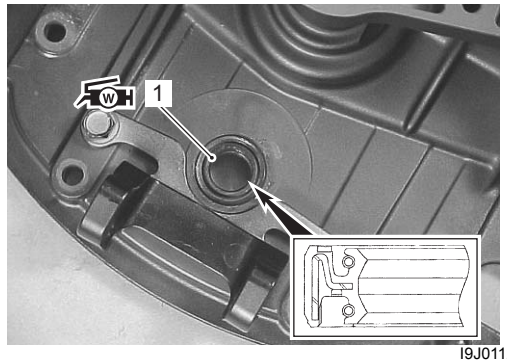
I9J011210074-01

7) Apply water resistant grease to outer circumference of oil seal (1).
Drive oil seal into engine holder.
Apply water resistant grease to the seal lip.

NOTE

Install oil seal as shown in the figure.

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011210075-02

8) Reassemble the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” (Page 2A-9).

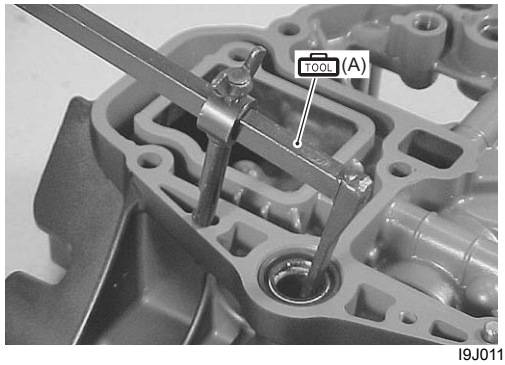
http://SelfFixer.com

Driveshaft Upper Oil Seal Replacement

Z9J0112106008

1) Remove the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” (Page 2A-6).
2) Extract oil seals with oil seal remover.

Special tool
(A): 09913–50121 (Oil seal remover)



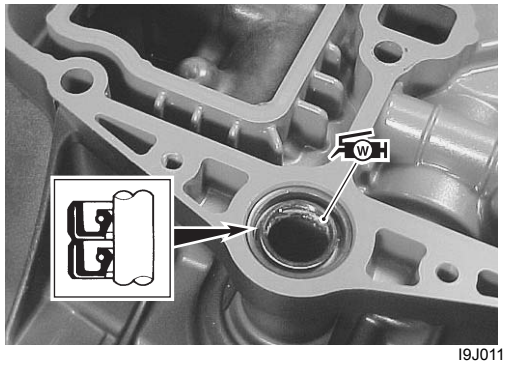
I9J011210076-01

3) Apply water resistant grease to outer circumference of oil seal.
4) Drive the two oil seals (one at a time) into the engine holder.

NOTE

Install oil seal with lip (spring side) facing downward (oil pan side).

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011210121-01

5) Reassemble the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” (Page 2A-9).

Driven Gear Bearing and Oil Seal Replacement

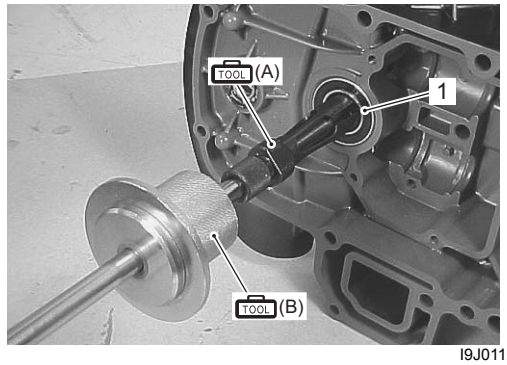
Z9J0112106009

1) Remove the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” (Page 2A-6).
2) Remove bearing (1) with special tool and sliding hammer.

CAUTION

Do not re-use the bearing once removed. Always use a new bearing.

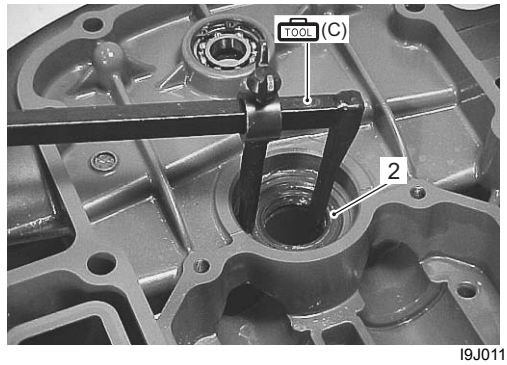
Special tool
(A): 09941–64511 (Bearing remover)
(B): 09930–30104 (Sliding hammer)



I9J011210078-01

3) Extract oil seal (2) with oil seal remover.

Special tool
(C): 09913–50121 (Oil seal remover)



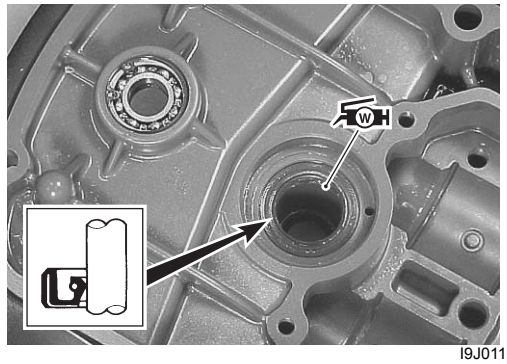
I9J011210079-01

4) Apply water resistant grease to outer circumference of oil seal.
5) Drive the oil seal into the engine holder.

NOTE

Install oil seal with lip (spring side) facing upward (Driven gear bearing side).

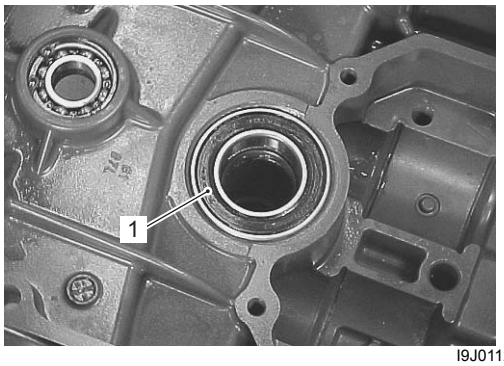
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011210081-01

http://SelfFixer.com

6) Apply engine oil to outer circumference of bearing (1). Install bearing into engine holder.

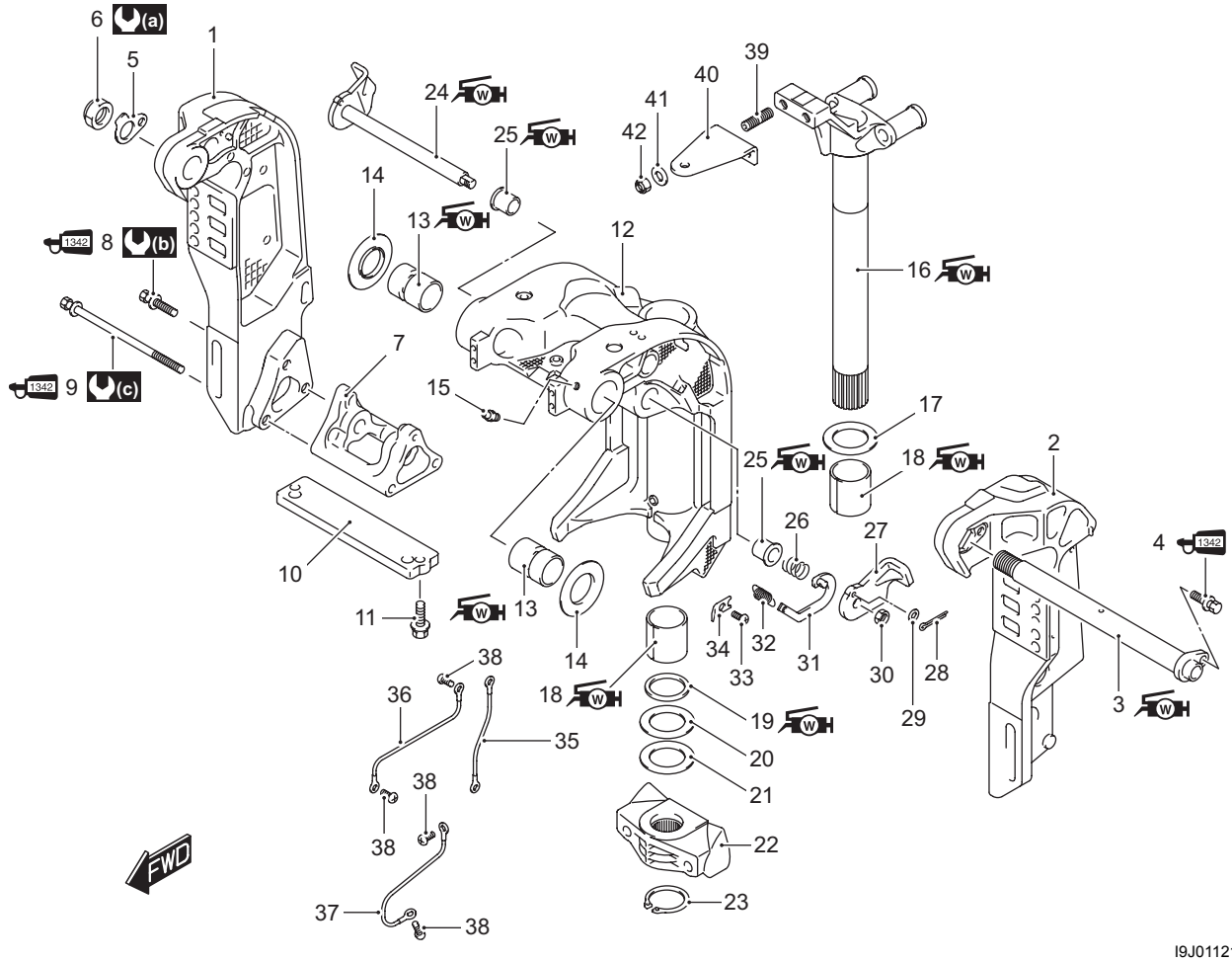


I9J011210080-03

7) Reassemble the engine holder. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Assembly” (Page 2A-9).

Clamp / Swivel / Steering Brackets Components

Z9J0112106010



I9J011210006-03

1. Clamp bracket STBD	13. Bush	25. Bush	37. Bonding wire
2. Clamp bracket PORT	14. Washer	26. Spring	38. Screw
3. Clamp bracket shaft	15. Grease nipple	27. Tilt lock lever PORT	39. Bolt
4. Bolt	16. Steering bracket	28. Pin	40. Steering bracket attachment
5. Washer	17. Washer	29. Washer	41. Washer
6. Nut	18. Bush	30. Nut	42. Nut
7. Lower clamp bracket	19. Seal	31. Tilt lock lever link	(a) : 43 N·m (4.3 kgf-m, 31.0 lbf-ft)
8. Bolt	20. Washer	32. Spring	(b) : 50 N·m (5.0 kgf-m, 36.0 lbf-ft)
9. Bolt	21. Shim	33. Screw	(c) : 50 N·m (5.0 kgf-m, 36.0 lbf-ft)
10. Anode	22. Lower mount bracket	34. Bracket	W : Apply SUZUKI water resistance grease.
11. Bolt	23. Circlip	35. Bonding wire	1342 : Apply SUZUKI thread lock 1342.
12. Swivel bracket	24. Tilt lock lever	36. Bonding wire	

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Clamp / Swivel / Steering Brackets Disassembly

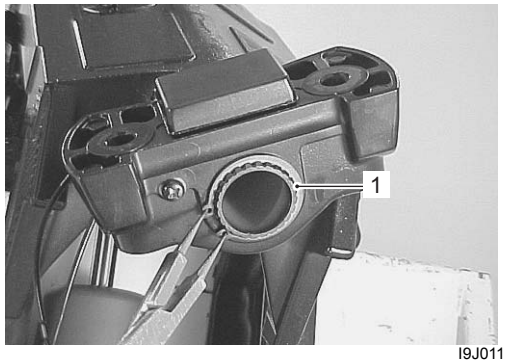
Z9J0112106011

1) Remove engine holder / oil pan and driveshaft housing. Refer to “Engine Holder / Oil Pan / Driveshaft Housing / Mounts Disassembly” (Page 2A-6).
2) Remove screw and bonding wire from lower mount bracket.



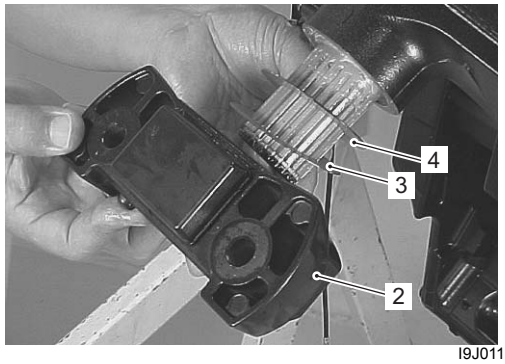
I9J011210082-01

3) Remove circlip (1).



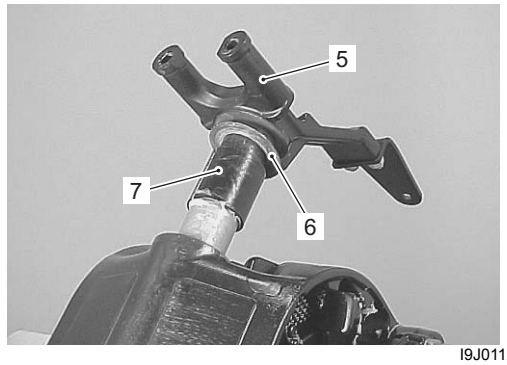
I9J011210083-01

4) Remove lower mount bracket (2), shims (3), and washer (4) from the steering shaft.



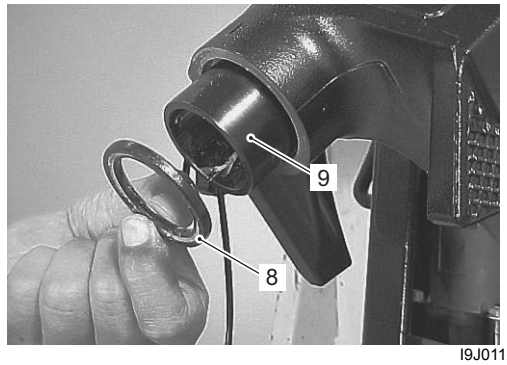
I9J011210085-01

5) Lift steering bracket (5) upward to remove from swivel bracket.
Remove washer (6) and upper bushing (7).



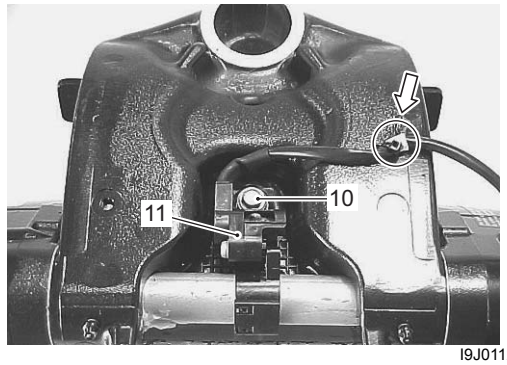
I9J011210084-01

6) Remove swivel bracket seal (8) and lower bushing (9).



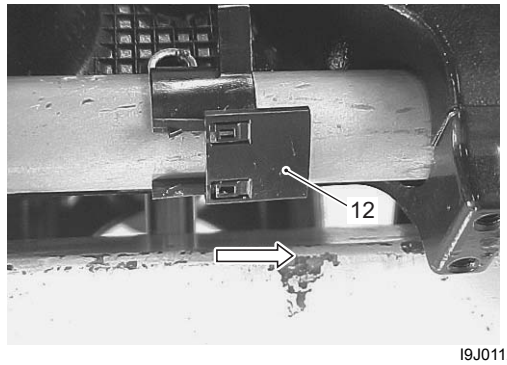
I9J011210086-01

7) Remove bolt (10) and trim sensor assembly (11). Cut the cable tie securing sensor lead wire.



I9J011210087-01

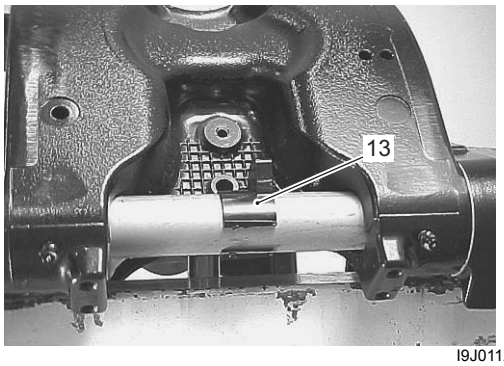
8) Slide the lower trim sensor cam plate (12) off.



I9J011210088-01

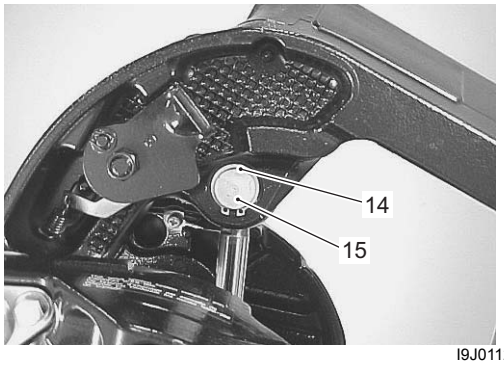
http://SelfFixer.com

9) Remove the upper trim sensor cam (13) from clamp bracket shaft.



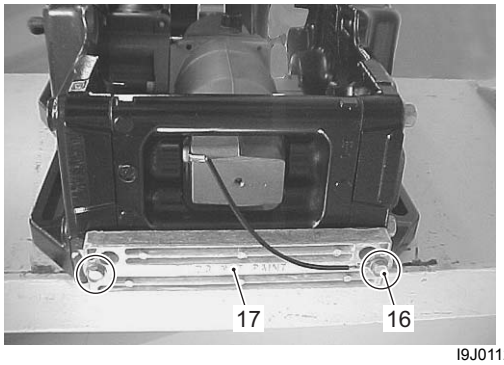
I9J011210089-01

10) Remove circlip (14) and push out tilt cylinder upper rod (15).



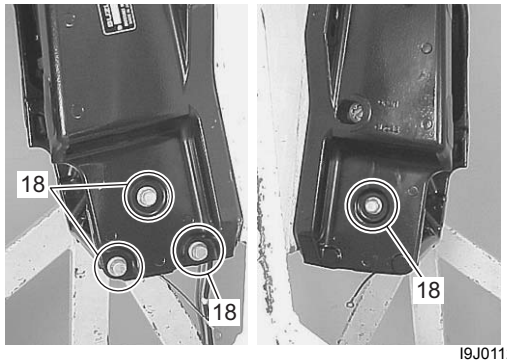
I9J011210090-01

11) Remove bolts (16) and anode (17).



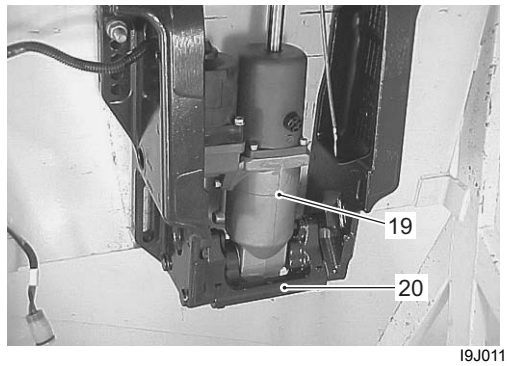
I9J011210091-01

12) Remove the four bolts (18) securing lower clamp bracket to STBD and PORT clamp brackets.



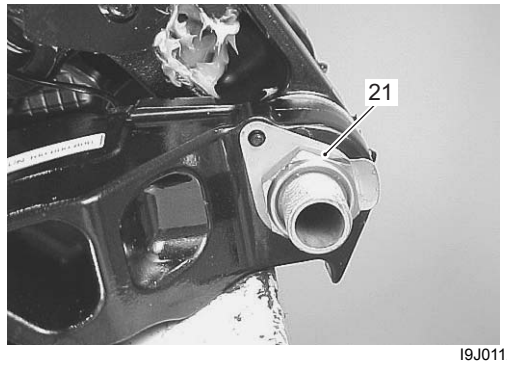
I9J011210092-02

13) Remove the PTT unit (19) and lower clamp bracket (20) from between the clamp brackets.



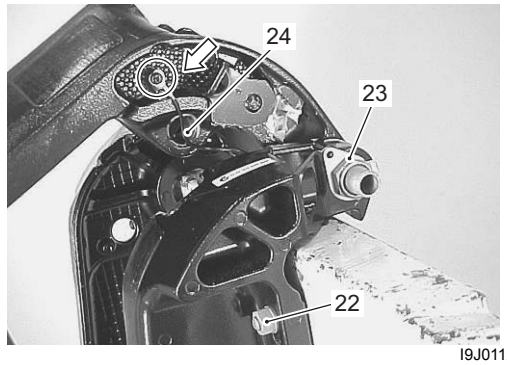
I9J011210093-01

14) Using flat blade screw driver, drive locking edge of lock washer (21) to clamp bracket side.



I9J011210094-01

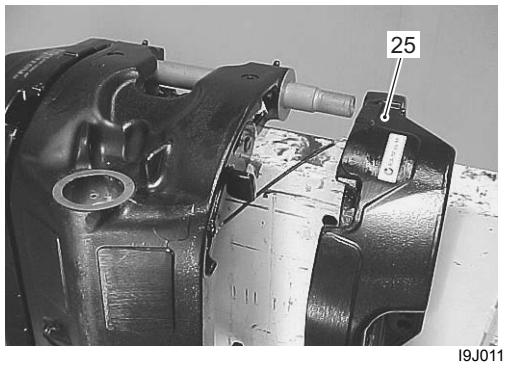
15) Remove the two STBD motor mounting bolts (22). Remove the clamp bracket shaft nut (23) and washer.
Remove the screw and bonding wire (24) from swivel bracket.



I9J011210095-02

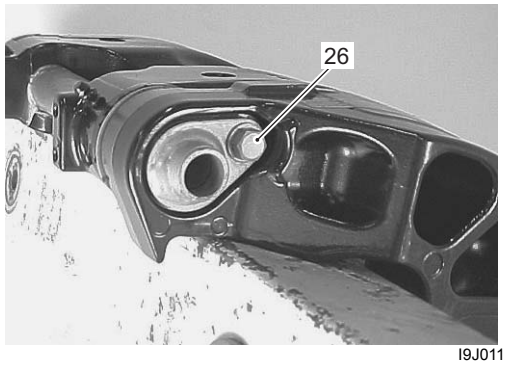
http://SelfFixer.com

16) Slide STBD clamp bracket (25) off clamp bracket shaft.



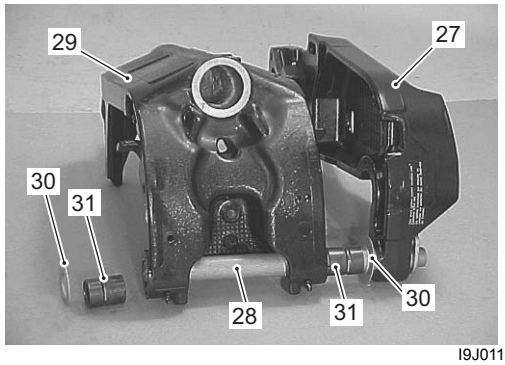
I9J011210096-02

17) Remove the bolt (26) securing clamp bracket shaft to PORT clamp bracket.



I9J011210097-02

18) Pull PORT clamp bracket (27) outward to remove clamp bracket and bracket shaft (28) from swivel bracket (29). Remove washer (30) and bushing (31) from each side of swivel bracket.



I9J011210098-02

Clamp / Swivel / Steering Brackets Assembly

Z9J0112106012

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

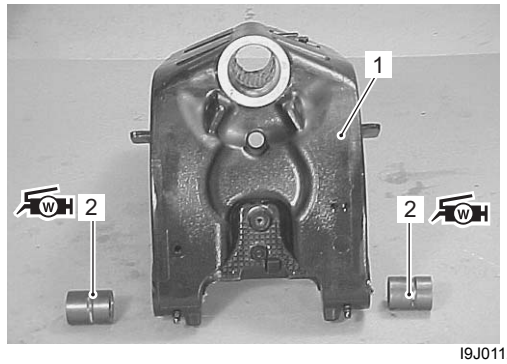
Clamp Bracket / Swivel Bracket

NOTE

Before installing clamp bracket to swivel bracket, apply grease to clamp bracket shaft and bushings.

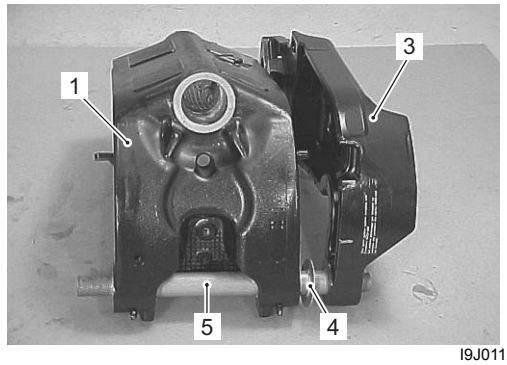
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

- Insert PORT and STBD bushings (2) into the swivel bracket (1).



I9J011210099-01

- Assemble port clamp bracket (3), washer (4), clamp bracket shaft (5) and swivel bracket (1).



I9J011210100-01

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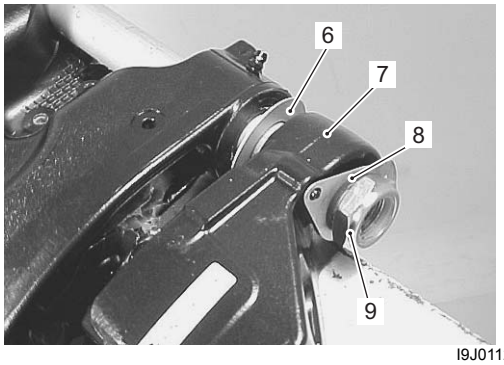
- Apply Thread Lock 1342 to threads of shaft bolt (5) before threading it to PORT clamp bracket. Install the shaft bolt (5), then tighten it securely.

  1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))



I9J011210101-01

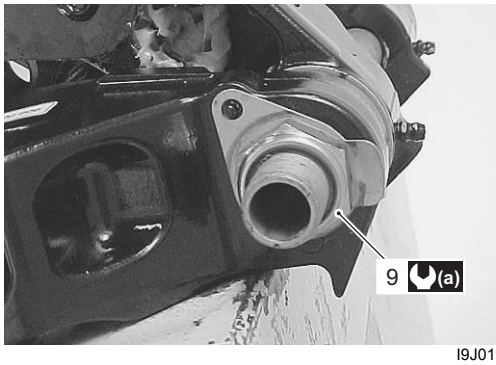
- Install washer (6), STBD clamp bracket (7), lock washer (8) and clamp bracket shaft nut (9).



I9J011210102-01

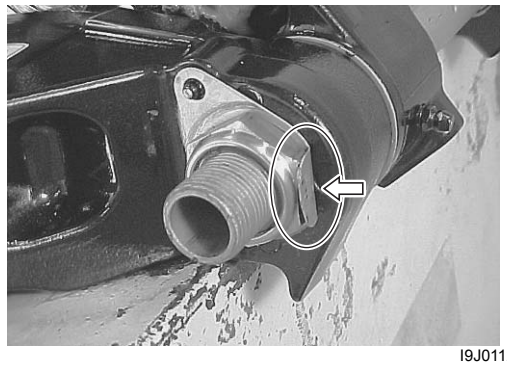
- Tighten clamp bracket shaft nut (9) to specified torque.

  Tightening torque
  Clamp bracket shaft nut (a): 43 N·m (4.3 kgf-m, 31.0 lbf-ft)



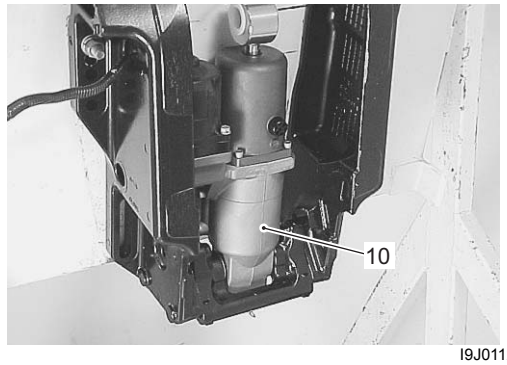
I9J011210103-01

- After tightening clamp bracket shaft nut to specified torque, bend lock washer edge toward nut.



I9J011210104-01

- Install PTT unit and lower clamp bracket assembly (10). Refer to “Power Trim and Tilt Unit Removal and Installation” in Section 2B (Page 2B-13).

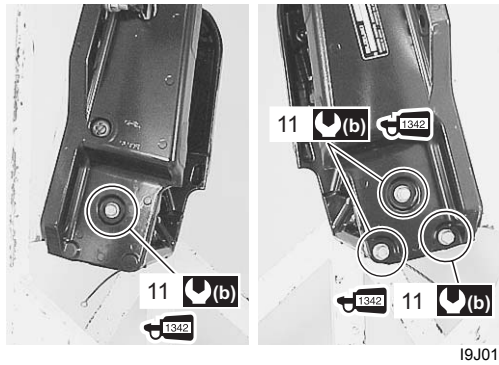


I9J011210105-01

- Tighten four lower clamp bracket bolts (11), pre-coated with thread lock, to specified torque.

  Tightening torque
  Lower clamp bracket bolt (b): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)

  1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))

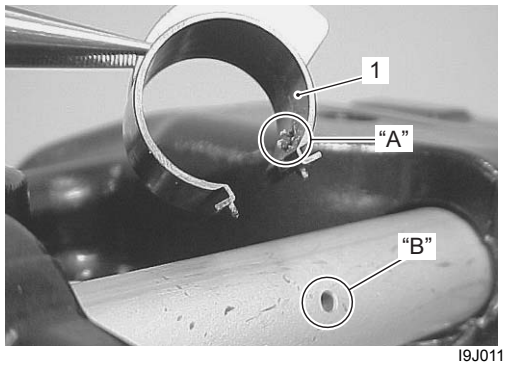


I9J011210106-01

http://SelfFixer.com

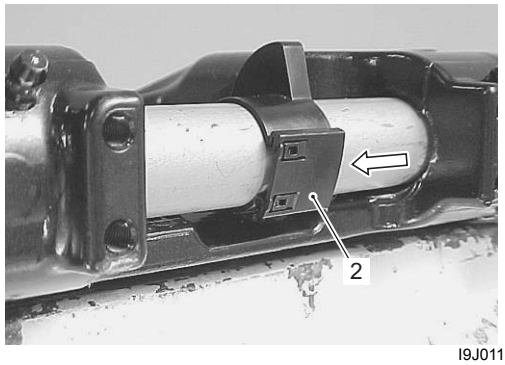
Trim Sensor and Trim Sensor Cam

- Install the upper trim sensor cam (1) engaging its locating pin “A” with the clamp bracket shaft hole “B”.



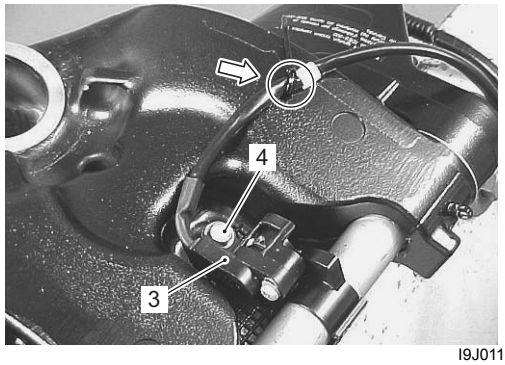
I9J011210107-01

- Install the lower trim sensor cam plate (2).



I9J011210108-01

- Install the trim sensor assembly (3), then secure it with bolts (4).
- Secure switch lead wire with cable tie.



I9J011210109-02

Steering Bracket

- Apply water resistant grease to steering bracket shaft.

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

NOTE

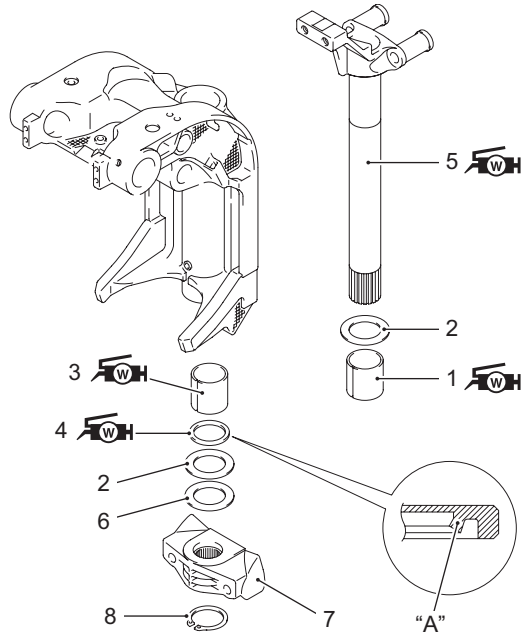
Apply grease to bushings, oil seal lip and pilot shaft portion of steering bracket.

- Install upper bushing (1) and washer (2) to swivel bracket.
- Install lower bushing (3) and swivel bracket seal (4) to swivel bracket.

NOTE

Install bracket seal (4) with oil seal lip (spring side) facing downward.

- Install steering bracket (5) to swivel bracket.



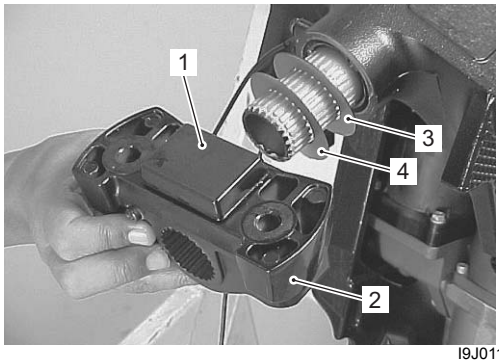
I9J011210002-04

1. Upper bushing	6. Shim
2. Washer	7. Lower mount bracket
3. Lower bushing	8. Circlip
4. Swivel bracket seal	“A”: Seal lip
5. Steering bracket	

http://SelfFixer.com

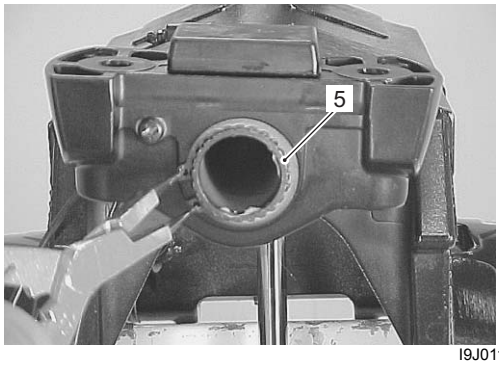
Lower Mount Bracket

- Install lower thrust mount (1) to lower mount bracket (2).
- Install washer (3) and shim (4), and then slide the lower mount bracket (2) upward on the splines until it contacts the shim.



I9J011210110-01

- Install circlip (5) to retain bracket.



I9J011210111-01

Bonding Wire

Reattach bonding wire to swivel bracket and tighten screw securely.



I9J011210112-01

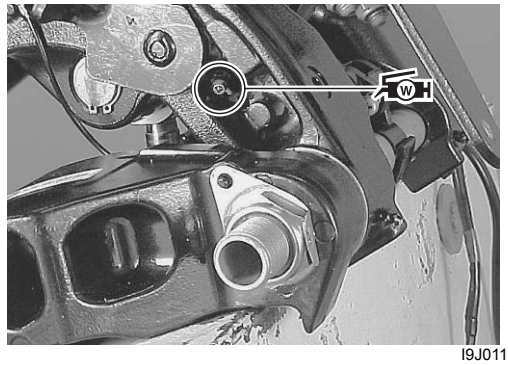


I9J011210113-01

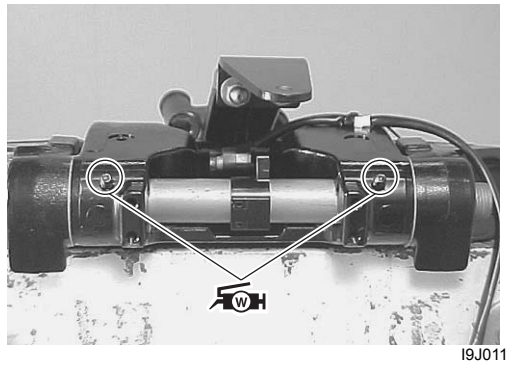
Lubrication

After completing reassembly of the mid unit, apply grease through each grease nipple.

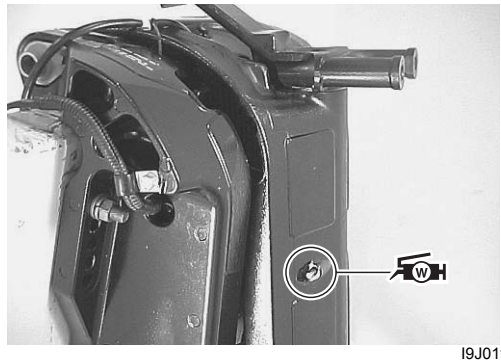
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011210114-01



I9J011210115-01



I9J011210116-01

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Clamp / Swivel / Steering Brackets Related Components Inspection

Z9J0112106013

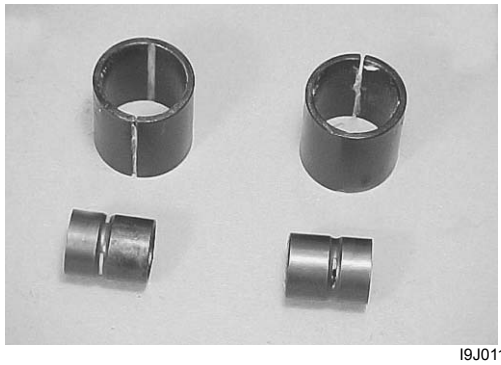
Refer to “Clamp / Swivel / Steering Brackets Disassembly” (Page 2A-18) and “Clamp / Swivel / Steering Brackets Assembly” (Page 2A-20).

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.



I9J011210117-01

Oil Seal

Check swivel bracket seal. If excessive wear or other damage is found, replace seal.



I9J011210118-01

Clamp Bracket Shaft

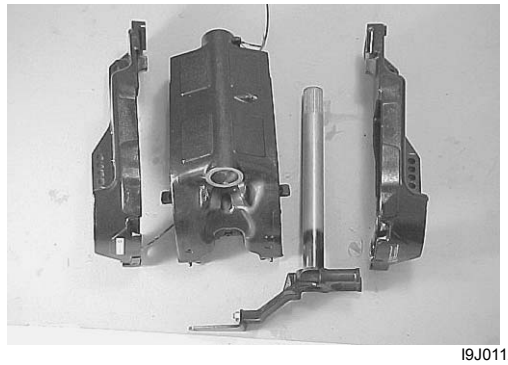
Check clamp bracket shaft.
If clamp bracket shaft is bent or twisted, replace shaft.



I9J011210120-01

Bracket

Check clamp brackets, steering bracket and swivel bracket.
If cracks or other damage is found, replace bracket (s).



I9J011210119-01

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Power Trim and Tilt

Precautions

Precaution for Power Trim and Tilt

Z9J0112200001

⚠ WARNING

Before removing the PTT unit, the motor should be fully supported to prevent personal injury.

CAUTION

- **To prevent system malfunctions, ensure that all components are kept free from dirt or contamination.**
- **To unscrew the trim / tilt cylinder head, use only the special cylinder cap tool.**
- **Pull rams out by hand; do not attempt to leverage with a screwdriver blade etc.**

NOTE

Reinstall all O-rings, seals, springs etc. with the component(s) to which they belong. This will prevent possible confusion and will ensure correct reassembly.

General Description

Power Trim and Tilt Description

Z9J0112201001

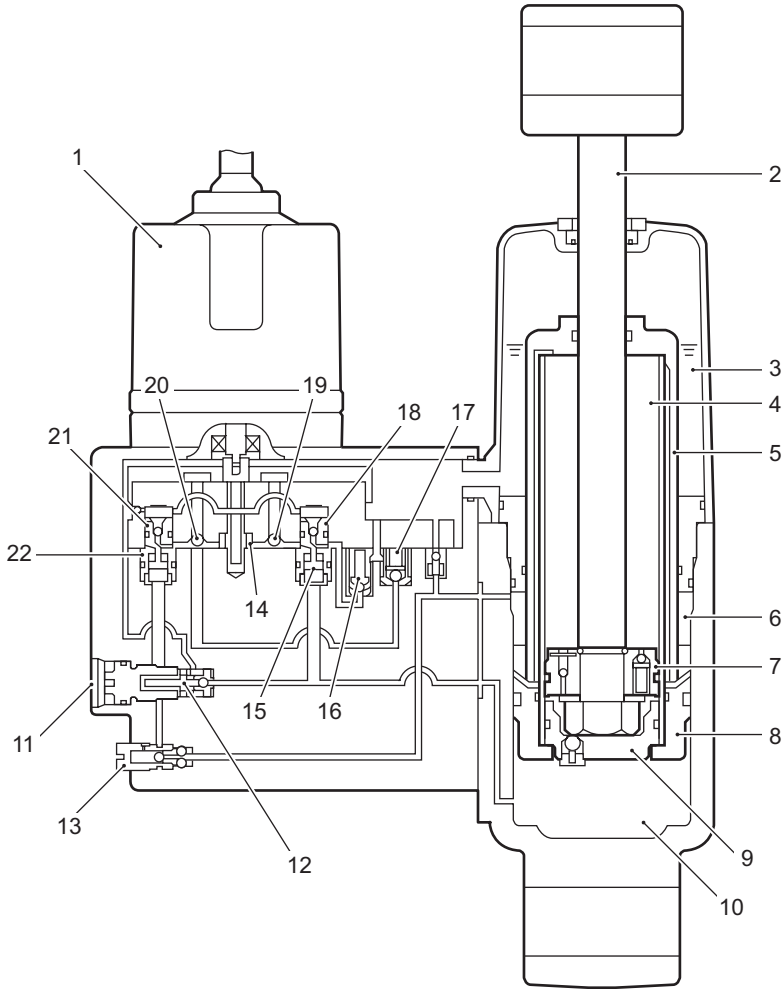
- The power trim and tilt system components are an electric motor, a pump unit, a fluid reservoir and one tilt cylinder. The outboard can be trimmed “UP” or “DOWN” while under way, and can be tilted for beaching, operating in shallow water or trailering.
  Trim and tilt “UP” or “DOWN” is obtained by supplying power to a permanent magnet type motor. This motor will rotate clockwise for “UP” or counterclockwise for “DOWN”, according to power delivered via the PTT relay, which is mounted on the electric part holder.
- The PTT relay is controlled by the ECM.
  The ON/OFF signal for the PTT UP or DOWN is inputted to the ECM PTT relay drive circuit from ECM terminals No. 22 or 23 and the output signal from terminals No. 3 or 27.

NOTE

- **A PTT relay control circuit has been added to the ECM for the tilt/trim function.**
  The PTT switch is powered by the main battery, the same as other models, but battery voltage must also be supplied to the ECM by the sub battery cable for the system to operate.
- **With the ignition switch in the OFF position, and the PTT switch operated, the tilt/trim will operate.**
  With the ignition switch in the OFF position, operating the PTT switch will supply a 12 V power signal to the ECM.
  When this signal is received, the ECM operates the main relay (ON), allowing the ECM drive signal to feedback to the ECM and the PTT relay circuit.
  Thus the PTT system functions only if 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.

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Power Trim and Tilt Hydraulic Diagram



I9J011220001-02

1. PTT motor	9. Free piston	17. “DOWN” relief valve
2. Tilt rod	10. Lower cylinder chamber	18. Spool valve No. 1
3. Oil reservoir	11. Manual release valve	19. Check valve No. 1
4. Tilt cylinder Upper chamber	12. Thermal valve	20. Check valve No. 2
5. Floating tube	13. 2-way valve	21. Spool valve No. 2
6. Trim cylinder upper chamber	14. Gear pump	22. “DOWN” pressure main check valve
7. Tilt piston	15. “UP” pressure main check valve	
8. Trim piston	16. “UP” relief valve	

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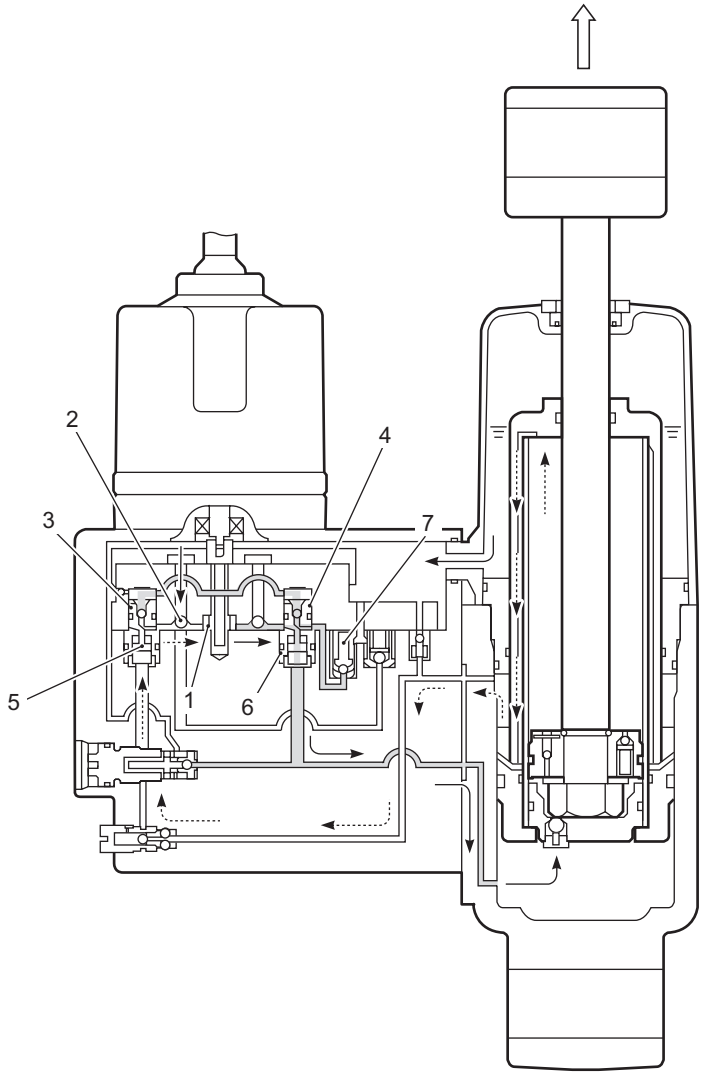
Principles of Power Trim and Tilt Operation Description

Z9J0112201002

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. This causes “UP” and “DOWN” movements of the piston rod of the tilt cylinder.

Trim / Tilt Up Circuit

- When the PTT switch is operated “UP” position, the electric motor and gear pump (1) will operation on clockwise direction.
- Pressurized oil will open check valve (2), oil will flow from the reservoir to spool valve (3) via the pump and spool valve (4).
- Operation of spool valve (3) in the “DOWN” direction will cause the main check valve (5) to open.
- Oil in the upper chamber of the cylinder will return to the pump via a 2-way valve.
  Then the oil pressure will rise and open the “UP” pressure main check valve (6), then allowing oil to flow to the lower chamber of cylinder.
  This makes the piston rod push up and the engine tilt up.
- Oil flows from the reservoir to the pump through check valve (2).
  Oil flows through the “DOWN” pressure main check valve (5) and returns to the pump.
- When the trim motor stops, both the “DOWN” pressure main check valve (5) and the “UP” pressure main check valve (6) will close to retain tilt/trim position.
- In the trim area, the trim piston and floating tube are moving with the piston rod.
- When full tilt up position is attained, sustained operation of the “UP” relay will cause oil flow to be returned to the reservoir through the “UP” relief valve (7).

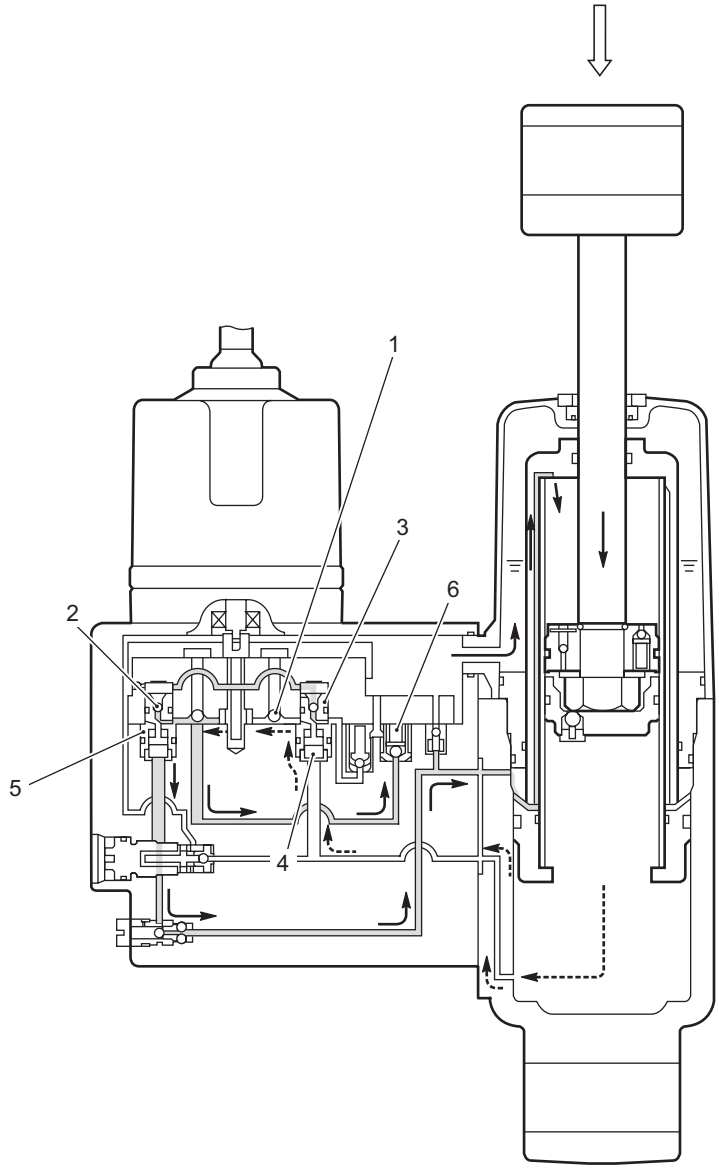


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Trim / Tilt Down Circuit

- When the PTT switch is operated in the “DOWN” position, the electric motor will rotate in a counterclockwise direction and turn the gear pump.
- Check valve (1) will open; oil will flow from the reservoir to the spool valve (2).
  This makes spool valve (3) move to downward, and causes the “UP” pressure main check valve (4) to open.
- Oil in the lower chamber will return to pump, and then oil pressure increase will open the “DOWN” pressure main check valve (5), allowing oil flow to the upper chamber of cylinder.
  This makes the piston rod push down and the engine will tilt down.
- Oil flows from the reservoir to the pump through check valve (1).
  Surplus oil in the pump flows through the “DOWN” relief valve (6) and returns to the reservoir.
- When the trim motor stops, both the “DOWN” pressure main check valve (5) and the “UP” pressure main check valve (4) will close to retain tilt/trim position.
- In the trim area, the trim piston and floating tube are moving with the piston rod.
- When full trim/tilt down position is attained, sustained operation of the “DOWN” relay will cause oil to be returned to the reservoir through the “DOWN” relief valve (6).



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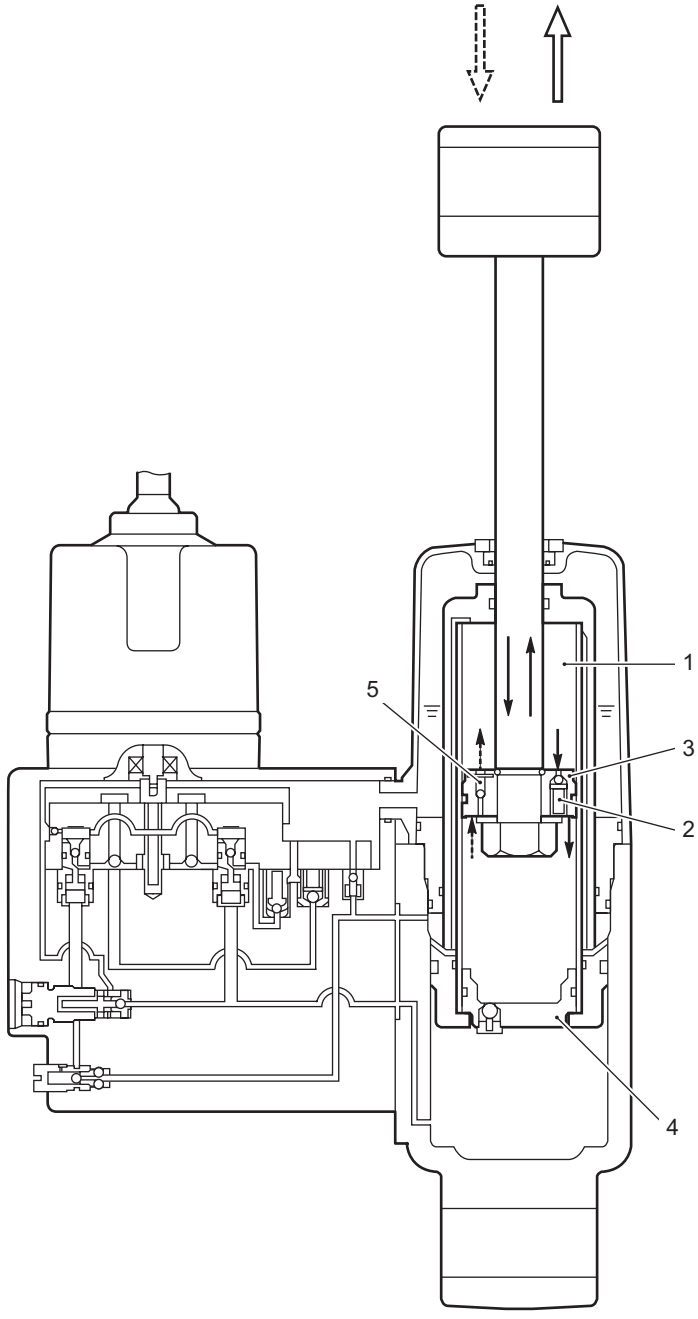
Shock Absorber Circuit

Shock valve

Should the lower unit strike an underwater object while in motion, the piston will rise abruptly, creating a sudden high impact pressure in the upper cylinder chamber (1). The shock valve (2) will then open, allowing oil to flow into the area between the tilt ram piston (3) and the free piston (4), thereby dampening (absorbing) the impact.

Return valve

When the point of impact has passed, propeller thrust and motor weight will force the tilt ram piston back downward. The oil from between the ram piston (3) and the free piston (4) is then expelled through the return valve (5) before flowing into the upper cylinder chamber (1).



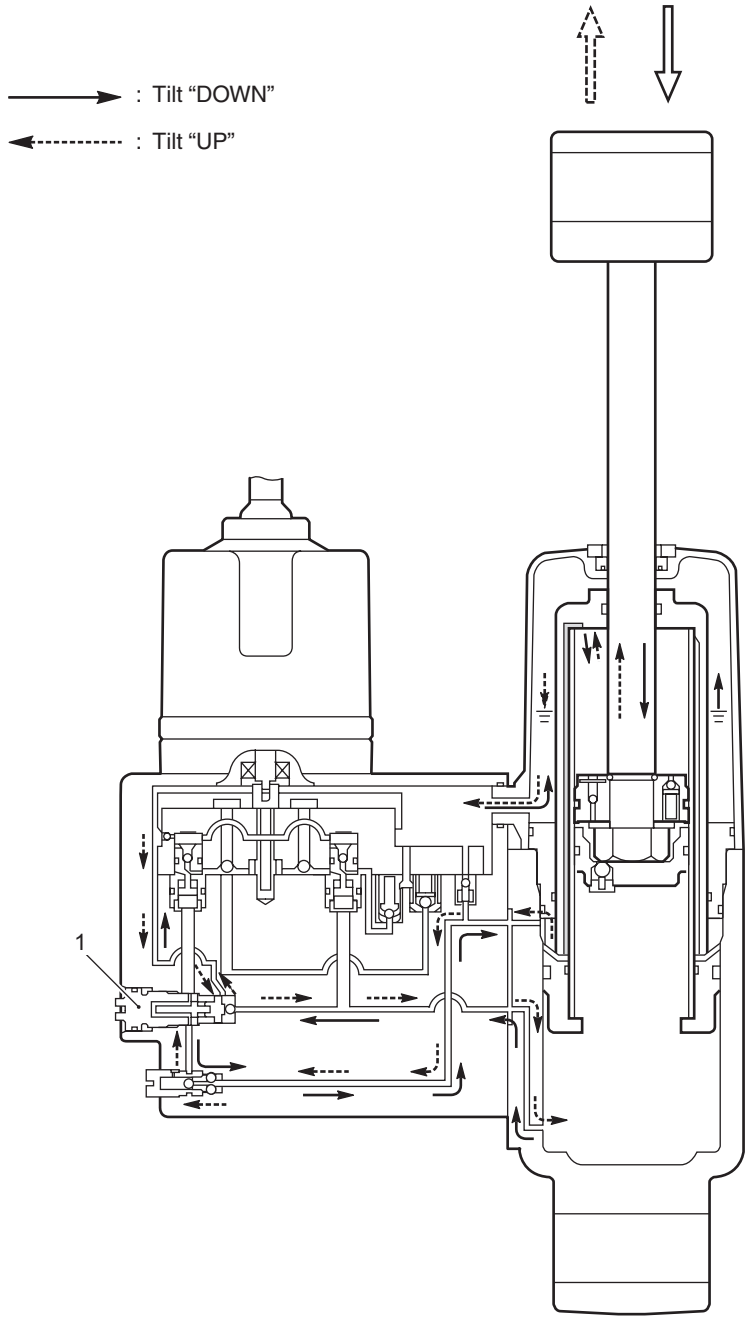
I9J011220004-01

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Manual Release Circuit (Manual Valve)

Turn the manual valve a maximum of three full turns counterclockwise.

When the manual release valve (1) is loosened, oil will flow unimpeded (without resistance) through the internal pump tubes, thereby facilitating manual tilting or lowering of the outboard. To hold the engine in a selected position, the manual valve must be closed again.

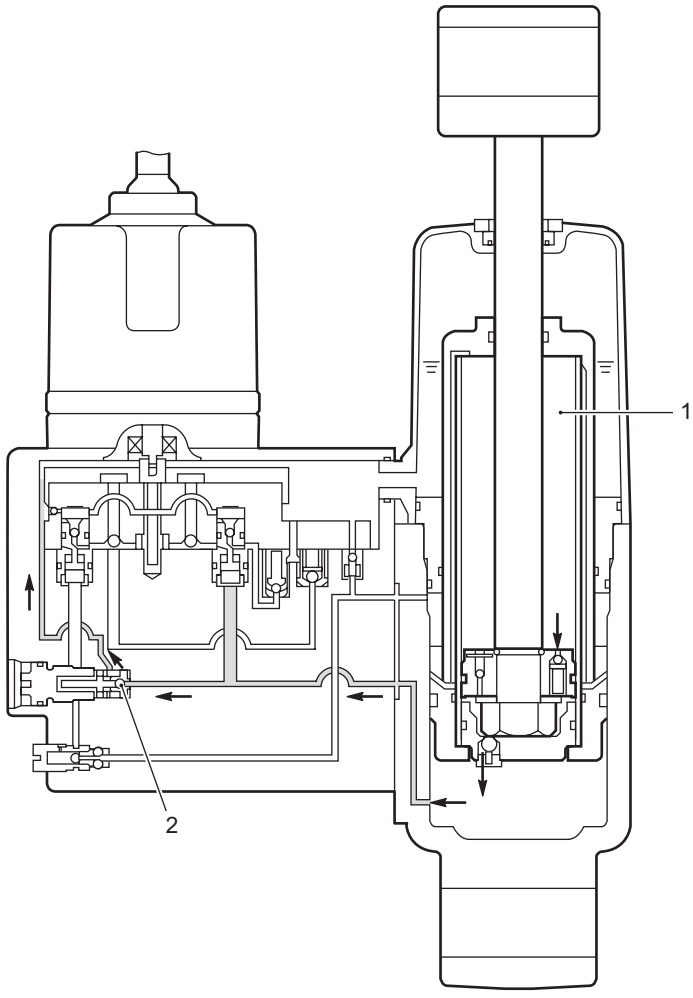


I9J011220005-02

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Thermal Valve

As temperature goes up, oil pressure will increase and the oil in PTT unit will expand.
High oil pressure in the upper cylinder chamber (1) caused by rising temperature will release the thermal valve (2) and make the oil flow to the reservoir to prevent damage to the PTT unit.



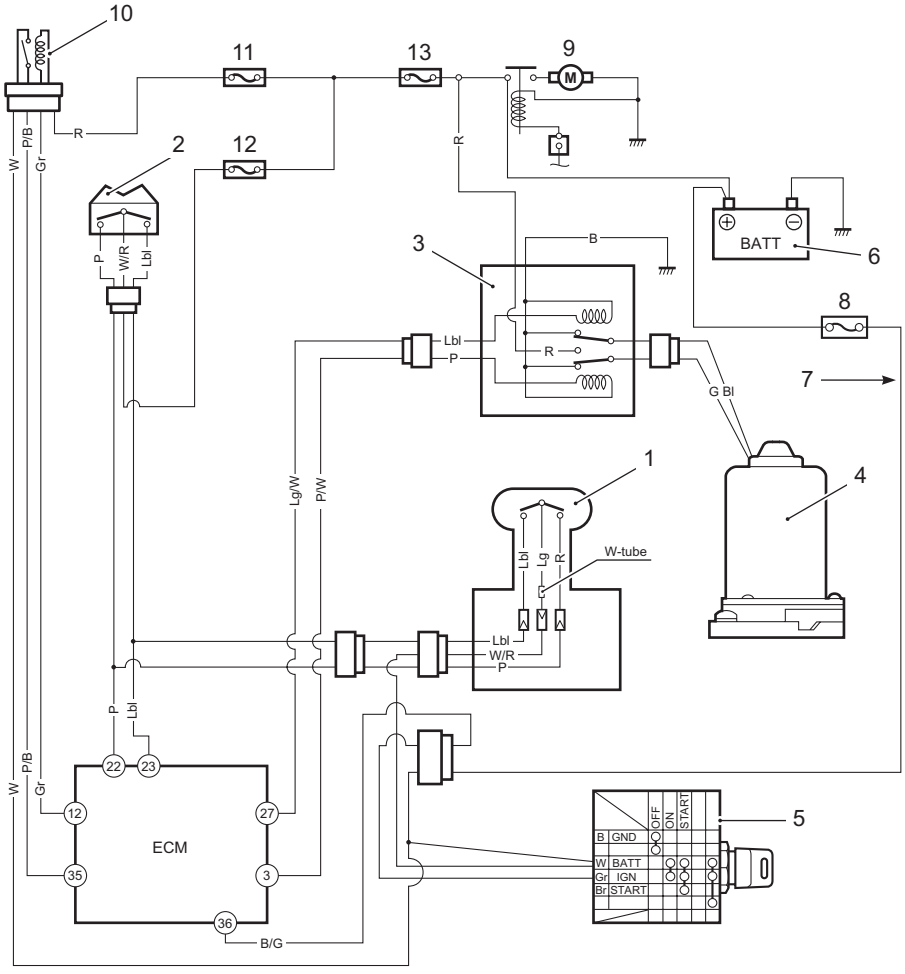
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Schematic and Routing Diagram

Power Trim and Tilt System Diagram

Z9J0112202001



I9J011220007-04

1. PTT switch (Remote control box)	6. Battery	11. ECM fuse 30 amp.
2. PTT switch (Side cover)	7. Sub battery cable	12. PTT switch fuse 10 amp.
3. PTT motor relay	8. Sub battery cable fuse 15 amp.	13. Main fuse 40 amp.
4. PTT motor	9. Starter motor	
5. Ignition switch	10. ECM main relay	

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Diagnostic Information and Procedures

Diagnose PTT System Malfunction

Z9J0112204001

Condition	Possible cause	Correction / Reference Item
Motor will not trim / tilt at all (no up, no down).	Blown fuse for PTT system. (Sub battery cable: 15 A, Main: 40 A, PTT switch: 10 A, ECM: 30 A).	*Inspection and replace.*
	Defective PTT switch.	*Replace.*
	Open circuit between main fuse 40 A and PTT relay.	*Repair.*
	Defective main relay.	*Replace.*
	Defective PTT relay.	*Replace.*
	Defective ECM and/or PTT system circuit.	*Inspection of ECM and its circuit in section 1A.*
	Loose or corroded sub battery cable connection.	*Repair or retighten.*
	Open circuit between main fuse and starter motor magnetic switch.	*Repair.*
	Defective PTT motor armature.	*Replace.*
	Defective PTT motor armature brushes.	*Replace.*
	Defective PTT pump.	*Replace.*
	Manual release valve leaking.	• *Ensure that valve is fully closed.* • *Inspect manual release valve.*
Motor will not trim / tilt up.	Defective PTT switch.	*Replace.*
	Defective PTT relay.	*Replace.*
	Open light blue lead wire circuit.	*Repair or replace.*
	Defective ECM.	*Replace.*
Motor will not trim / tilt down.	Defective PTT switch.	*Replace.*
	Defective PTT relay.	*Replace.*
	Open pink lead wire circuit.	*Repair or replace.*
	Defective ECM.	*Replace.*
PTT motor operates, but no motor trim / tilt movement.	Low PTT fluid level.	*Added PTT fluid.*
	Manual release valve leaking.	• *Ensure that valve is fully closed.* • *Inspect manual release valve.*
	Debris in system.	*Inspect for debris.*
	Broken drive joint in PTT pump.	*Replace.*
	Broken PTT pump.	*Replace.*
	Tilt piston leaking.	*Replace PTT unit assembly.*
Motor will not retain selected trim and tilt setting, creeps downward.	Manual release valve leaking.	• *Ensure that valve is fully closed.* • *Inspect manual release valve.*
	Tilt piston leaking.	*Replace PTT unit assembly.*
	Debris in system.	*Inspect for debris.*
PTT motor operates at higher than normal speed, or with high pitched "squealing" sound. No trim / tilt action.	Low PTT fluid level.	*Added PTT fluid.*
	Manual release valve leaking.	• *Ensure that valve is fully closed.* • *Inspect manual release valve.*
	Broken drive joint in PTT pump.	*Replace.*

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Service Instructions

Checking PTT Fluid Level

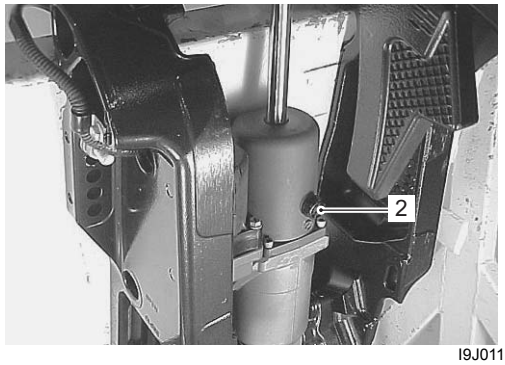
Z9J0112206001

1) Raise the engine to a full-tilt up position.
2) Lower the manual tilt lock lever (1).



I9J011220050-01

3) Remove the oil filler plug (2).



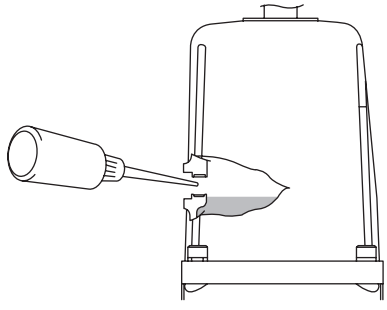
I9J011220051-01

4) If fluid can be seen at filler plug level, the reservoir is full.
5) If fluid level is low, refill with the recommended PTT fluid.

CAUTION

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

Recommended PTT fluid
Dexron III automatic transmission fluid or equivalent



I9J011220008-01

6) Reinstall oil filler plug.

Air Bleeding from PTT Unit

Z9J0112206002

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

CAUTION

Do not over tighten manual release valve.

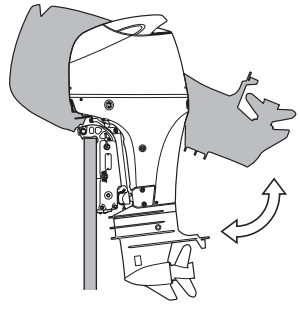
Tightening torque
Manual release valve (a): 3.5 N·m (0.36 kgf-m, 2.6 lbf-ft)

Direction of rotation
Counterclockwise: Open
Clockwise: Close



I9J011220052-03

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.



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3) Check PTT fluid level, topping off if necessary.
4) Reinstall oil filler plug.

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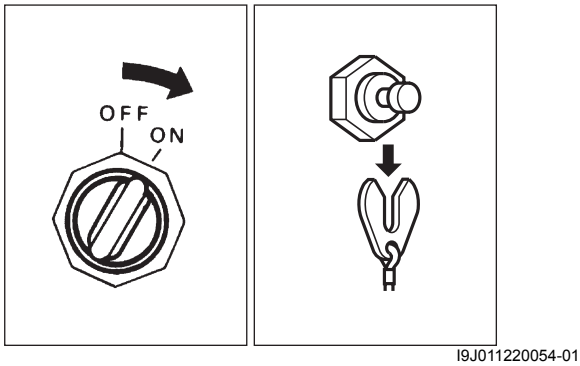
Setting of Trim Down Position Limit

Z9J0112206003

Once the ECM has been replaced or the trim sensor removed and reinstalled, the resetting of the trim lower position limit should be performed.
Perform this set-up after the current position setting has been cancelled, as explained in the following procedures.

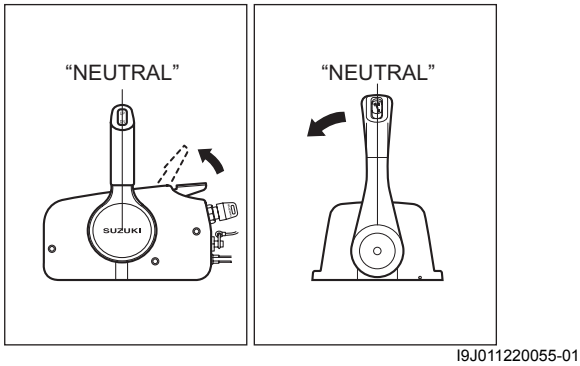
Canceling Trim Down Position Limit Setting

1) Turn the ignition key to the “ON” position.
2) Pull out the emergency stop switch lock plate.
3) Make sure that remote control handle is in “Neutral”. (Check that the neutral switch is in the “ON” position.)



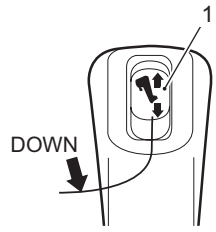
I9J011220054-01

4) **Top mount type:**
Using the throttle only function of the remote control box, move the control handle forward until the caution buzzer sounds one time.
Side mount type:
Using the throttle only function of the remote control box, move the warm-up lever upward until the caution buzzer sounds one time.



I9J011220055-01

5) Press the “DOWN” side of the PTT switch for three seconds and the buzzer will sound two times briefly indicating the setting has been canceled.



I9J011220056-03

1. PTT switch

6) Return the throttle to the fully closed position.

Setting Trim Down Position Limit

1) Press the “DOWN” side of the PTT switch so that the full trim down position is obtained.
2) Turn the ignition key to the “ON” position.
3) Pull out the emergency stop switch lock plate.
4) Make sure that remote control handle is in “Neutral”. (Check that the neutral switch is in the “ON” position.)
5) **Top mount type:**
Using the throttle only function of the remote control box, move the control handle forward until the caution buzzer sounds one time verifying the set mode is active.
Side mount type:
Using the throttle only function of the remote control box, move the warm-up lever upward until the caution buzzer sounds one time verifying the set mode is active.
6) 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.
7) With the throttle fully closed, install the lock plate on the emergency switch.
Press the “UP” side of the PTT switch to obtain the full tilt up position and then press the “DOWN” switch to obtain the full trim down position. Check that the positions are set.

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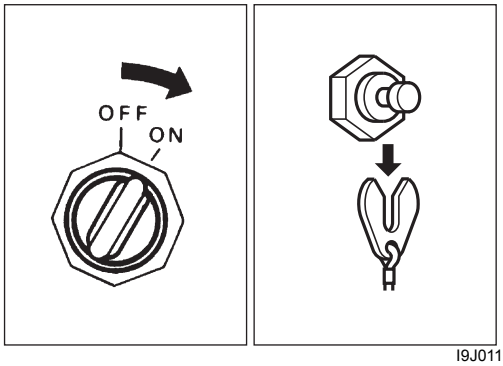
Setting Tilt Up Limit Position

Z9J0112206012

If the outboard motor contacts the motor well of the boat during full tilt up operation, the upper limit setting should be reset. Perform this set-up after the current position setting has been canceled, as explained in the following procedure.

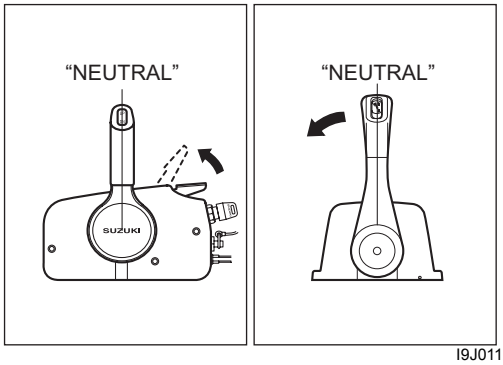
Canceling Tilt Up Position Limit Setting

1) Turn the ignition key to the “ON” position.
2) Pull out the emergency stop switch lock plate.
3) Make sure that remote control handle is in “Neutral”. (Check that the neutral switch is in “ON” position.)



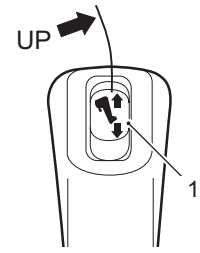
I9J011220057-01

4) **Top mount type:**
   Using the throttle only function of the remote control box, move the control handle forward until the caution buzzer sounds one time.
   Side mount type:
   Using the throttle only function of the remote control box, move the warm-up lever upward until the caution buzzer sounds one time.



I9J011220058-01

5) Press the “UP” side of the PTT switch for three seconds and the buzzer will sound twice briefly indicating the setting has been canceled.



I9J011220059-02

1. PTT switch

6) Return the throttle to the fully closed position.

Setting Tilt Up Position Limit

1) Press the UP side of the PTT switch so that the optimum full tilt up position for the boat can be obtained.
2) Turn the ignition key to the “ON” position.
3) Pull out the emergency stop switch lock plate.
4) Make sure that remote control handle is in “Neutral”. (Check that the neutral switch is in “ON” position.)
5) **Top mount type:**
   Using the throttle only function of the remote control box, move the control handle forward until the caution buzzer sounds one time.
   Side mount type:
   Using the throttle only function of the remote control box, move the warm-up lever upward until the caution buzzer sounds one time.
6) Press the “UP” side of PTT switch three times within three seconds.
   The buzzer will sound one time briefly indicating the setting has been accepted.
7) 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 settings of both the trim down limit and tilt up limit is properly set.

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Power Trim and Tilt Unit Removal and Installation

Z9J0112206004

Removal

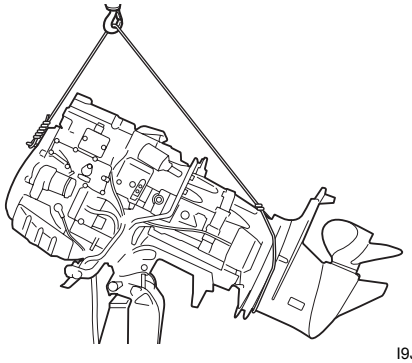
1) Remove the lower side cover.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-3).
2) Raise the engine to the full tilt up position and lower the manual tilt lock levers (1).

⚠ WARNING

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

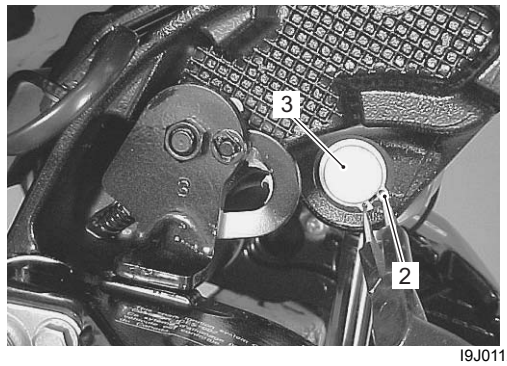


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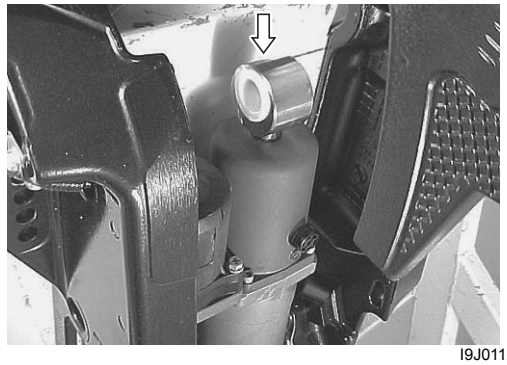
I9J011220061-02

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



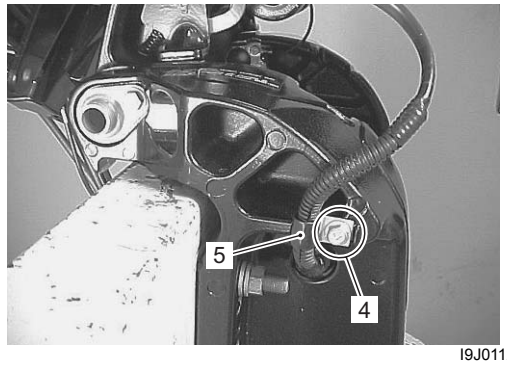
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4) Lower the tilt rod to the full down position and disconnect the battery cable.



I9J011220063-01

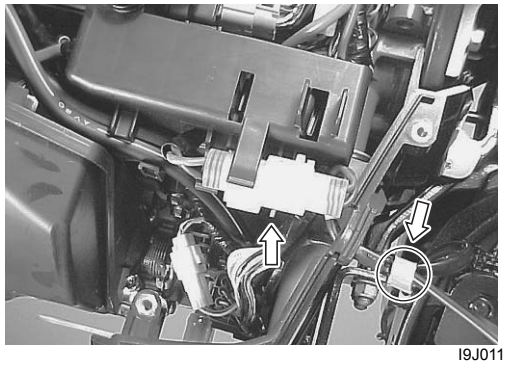
5) Remove the bolt (4) and cable clamp (5).



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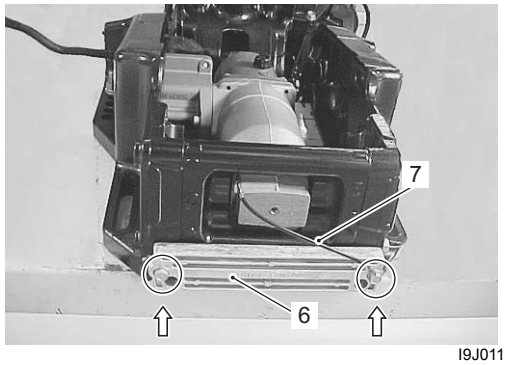
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6) Disconnect the PTT motor cable wire connector from the PTT relay. Cut the cable tie binding PTT motor cable and trim sensor lead. Remove the PTT motor cable from engine lower cover.



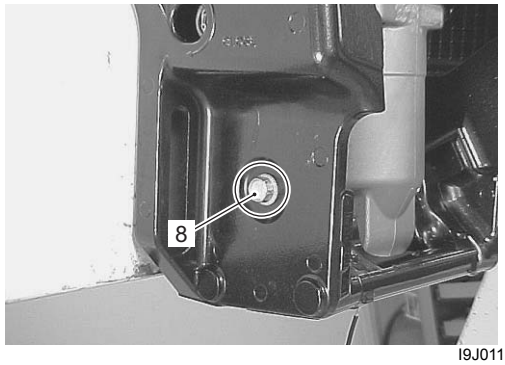
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7) Remove two bolts and anode (6). Remove the screw securing bonding wire (7).

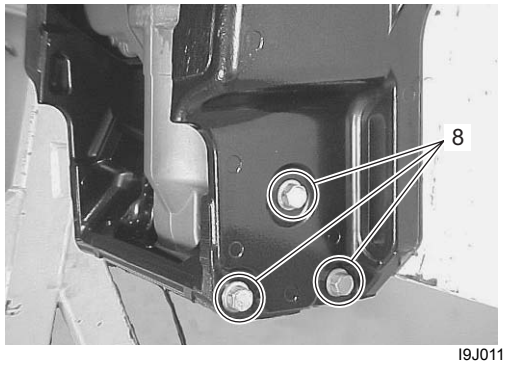


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8) Remove the four bolts (8) securing lower clamp bracket to STBD / PORT clamp brackets.

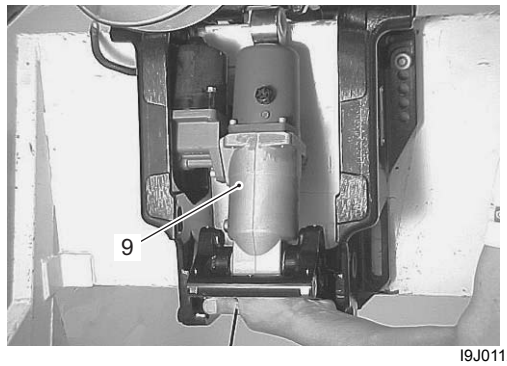


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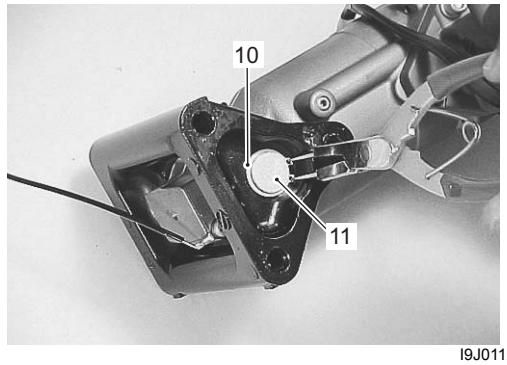
I9J011220068-01

9) Remove the PTT unit (9) and lower clamp bracket from between the clamp brackets.



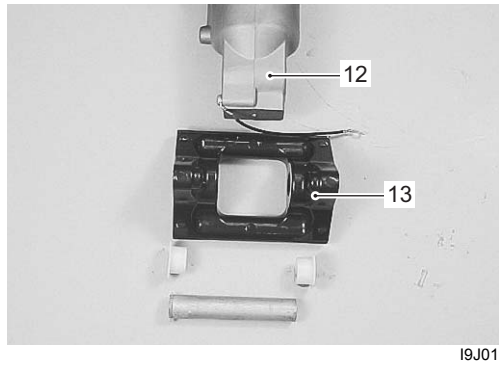
I9J011220069-01

10) Remove the snap ring (10) and push tilt cylinder lower shaft (11) out.



I9J011220070-01

11) Remove the PTT unit (12) from the lower clamp bracket (13).



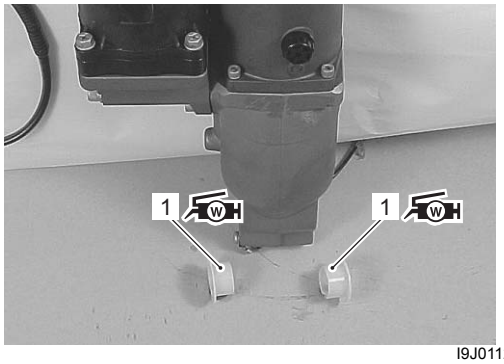
I9J011220071-01

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

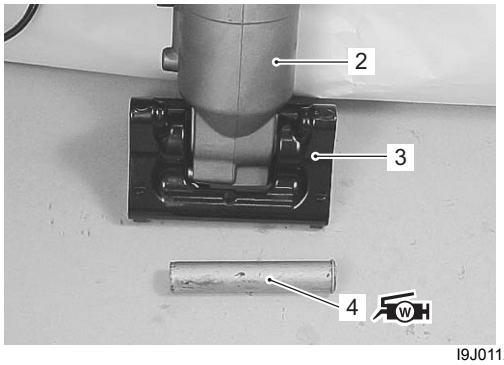
- Lower tilt rod to full down position.
- Apply water resistant grease to the tilt cylinder lower shaft and lower shaft bushings.
  Install the lower shaft bushings (1) to PTT unit.

  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

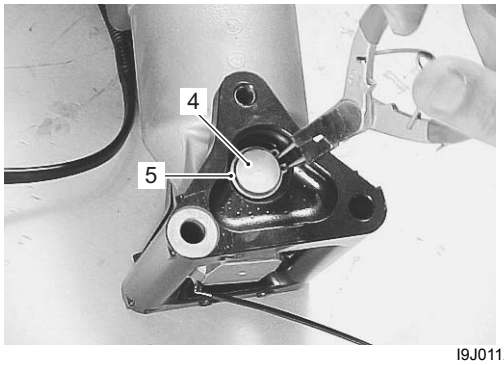


I9J011220072-01

- Fit the PTT unit (2) to the lower clamp bracket (3) as shown in figure and insert the tilt cylinder lower shaft (4) through the lower clamp bracket and PTT unit. Secure the tilt cylinder lower shaft with the snap rings (5).

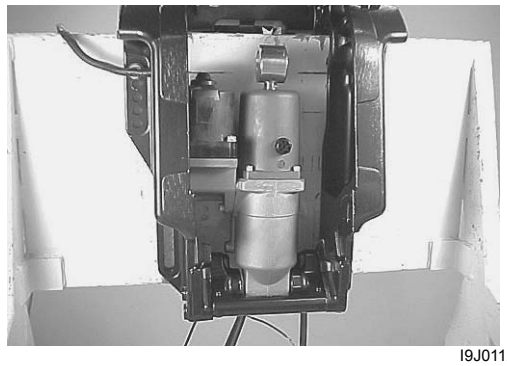


I9J011220073-01



I9J011220074-00

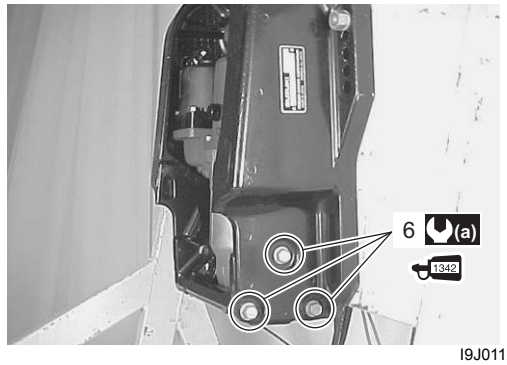
- Place the PTT unit (with lower clamp bracket) in position between the clamp brackets.


I9J011220075-01

- Tighten four lower clamp bracket bolts (6), pre-coated with thread lock, to specified torque.

  : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))

  Tightening torque
  Lower clamp bracket bolt (a): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)



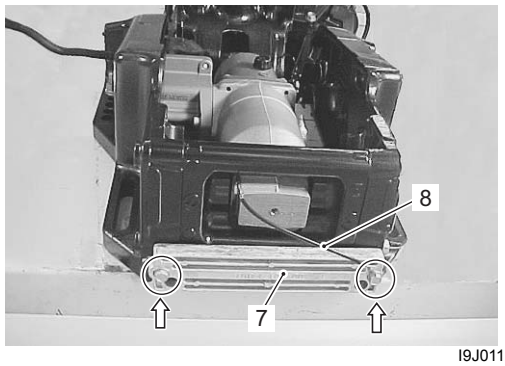
I9J011220076-01



I9J011220077-01

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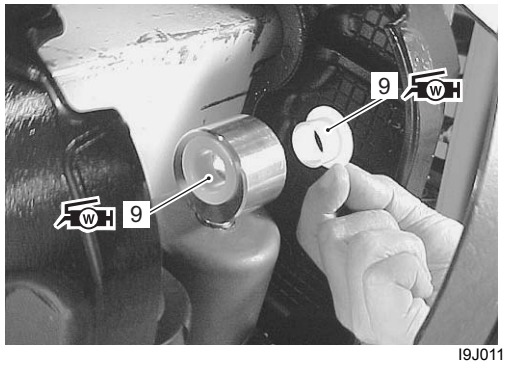
- Install anode (7), then tighten bolts securely. Install bonding wire (8), then tighten screw securely.



I9J011220078-01

- Apply water resistant grease to tilt rod upper bushings (9), then install bushings 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.

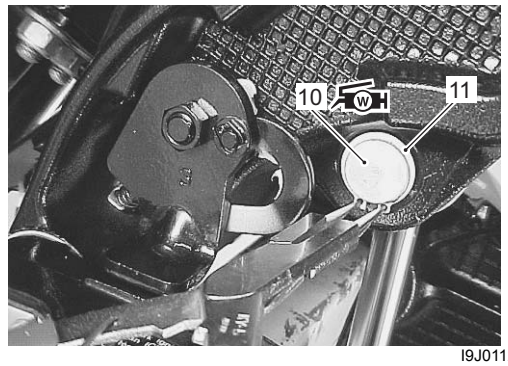
  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011220079-01

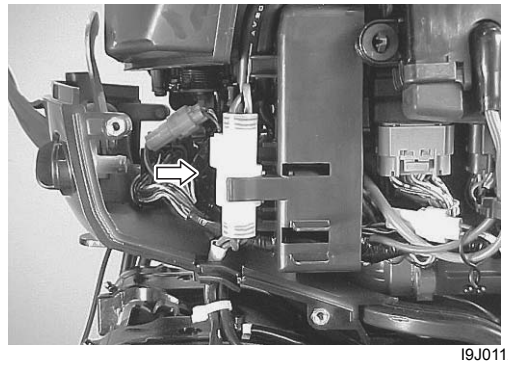
- Apply water resistant grease to the PTT rod upper shaft (10), then insert the shaft through the swivel bracket and tilt rod.
  Secure the upper shaft with the snap ring (11).

  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



I9J011220080-01

- Route the PTT motor cable in through the lower cover and connect the PTT cable connector to the PTT relay.
  Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).



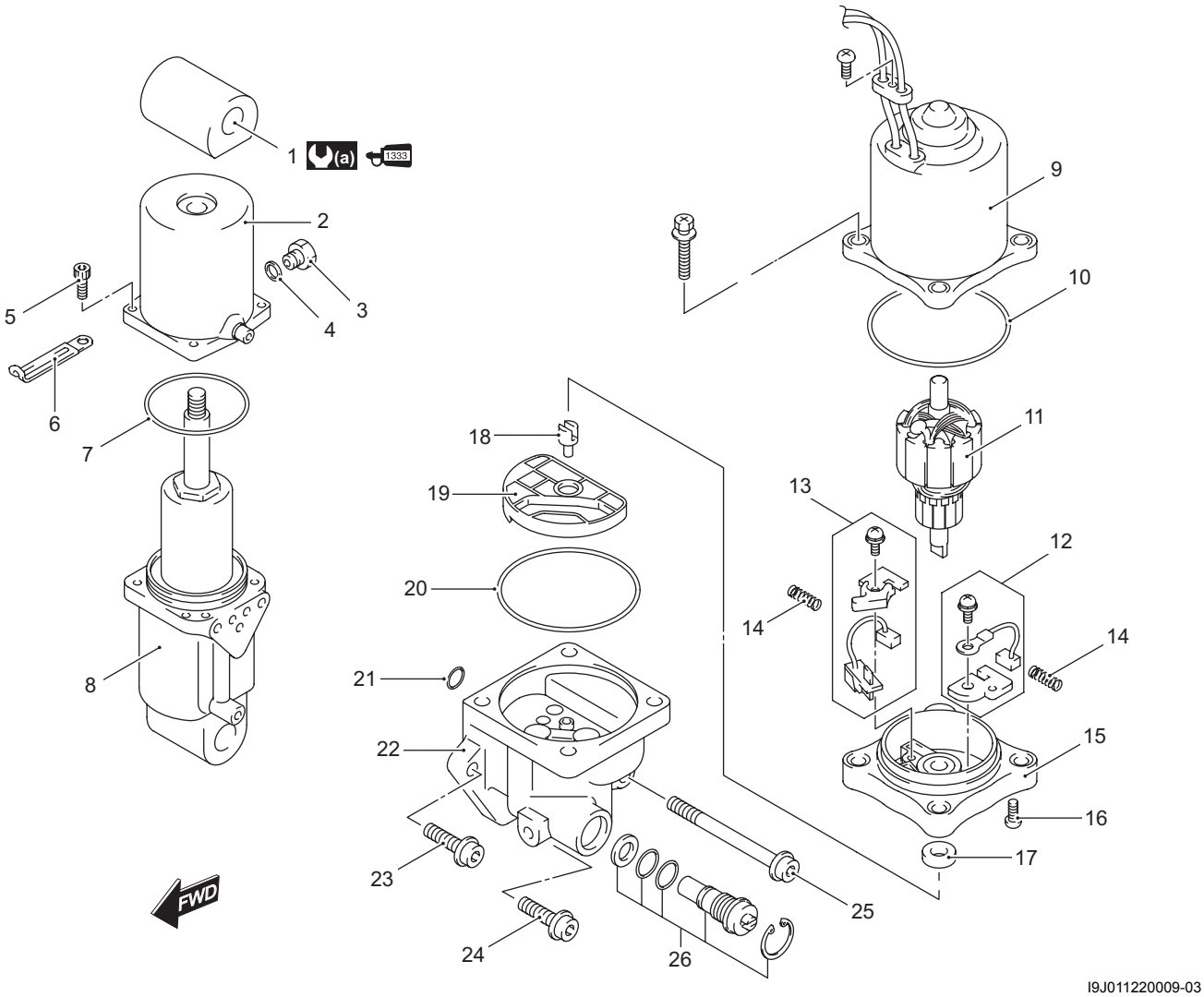
I9J011220081-01

- Final assembly check
  Perform the following checks to ensure proper and safe operation of repaired unit:
  - All parts removed have been returned to their original positions.
  - Wire routing matchs service manual illustration.

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Power Trim and Tilt Unit Components

Z9J0112206005



I9J011220009-03

1. Joint	8. Manifold assembly	15. Brush holder	22. Pump assembly
2. Tank	9. Field case	16. Screw	23. Bolt
3. Plug	10. O-ring	17. Oil seal	24. Bolt
4. O-ring	11. Armature	18. Drive joint	25. Bolt
5. Bolt	12. Brush set	19. Filter	26. Manual valve
6. Clamp	13. Breaker assembly	20. O-ring	(a) : 108 N·m (10.8 kgf-m, 78.0 lbf-ft)
7. O-ring	14. Spring	21. O-ring	1333 : Apply thread lock to the thread area.

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Power Trim and Tilt Unit Disassembly

Z9J0112206006

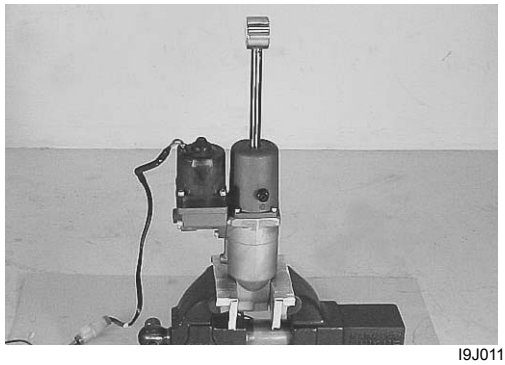
NOTE

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

1) Place the lower section 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.

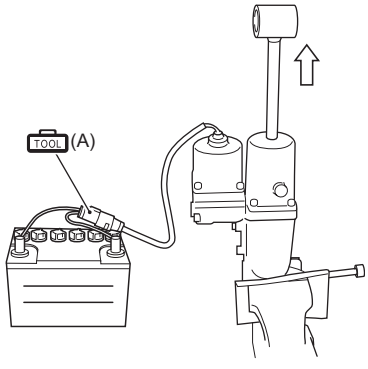


I9J011220010-02

2) Connect the PTT cable extension to PTT motor cable connector.

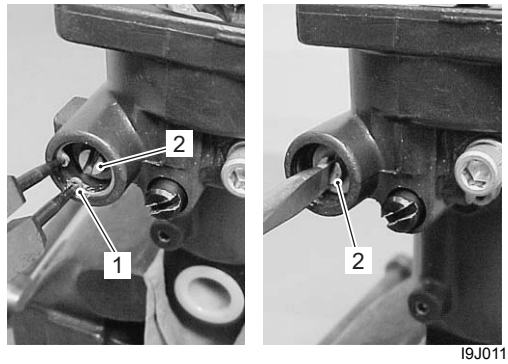
Special tool
(A): 09945–79310 (PTT cable extension)

3) Connect the PTT cable extension leads (G, Bl) to battery and operate PTT motor until tilt rod is at maximum stroke (full-tilt up position). Unscrew the filler plug and drain PTT oil into a suitable container.



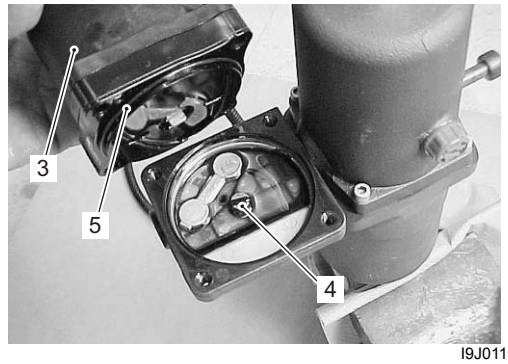
I9J011220011-01

4) Remove the manual release valve snap ring (1), then unscrew the manual release valve (2).



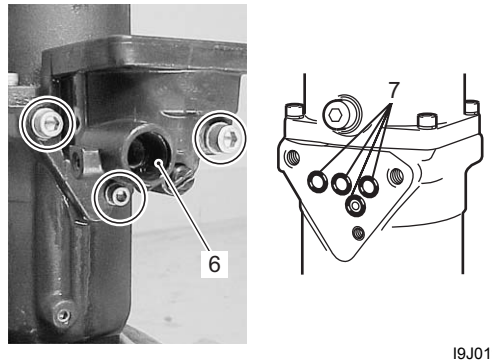
I9J011220012-01

5) Remove the PTT motor assembly (3).
Refer to “Power Trim and Tilt Motor Removal and Installation” (Page 2B-22).
Note the position of drive joint (4) and O-ring (5), before removing them.



I9J011220013-01

6) Remove the three screws securing the PTT pump assembly (6), then detach the PTT pump assembly from PTT cylinder body.
Note the position of O-rings (7), before removing them.

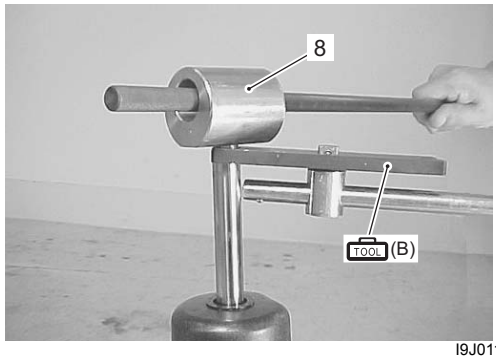


I9J011220014-01

http://SelfFixer.com

7) Using special tool, unscrew the upper eye (8).

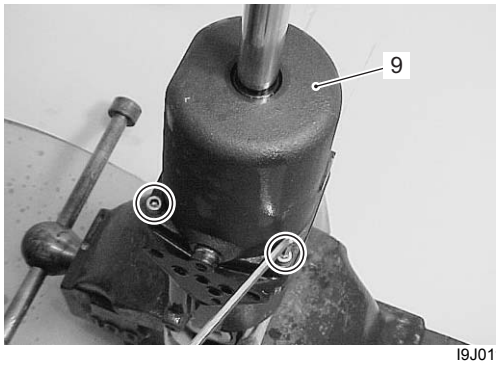
Special tool
(B): 09945–69010 (PTT rod holder)



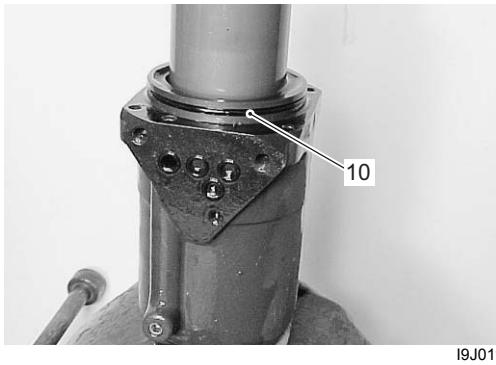
I9J011220016-01

8) Remove the four bolts securing the reservoir (9), then detach the reservoir from the PTT body.

9) Remove the O-ring (10).



I9J011220015-01



I9J011220017-01

Power Trim and Tilt Unit Reassembly

Z9J0112206007

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

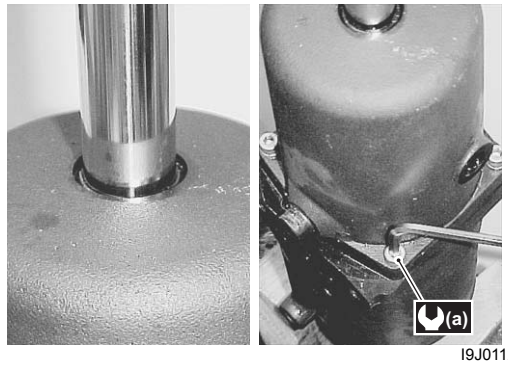
CAUTION

- **Do not reuse O-rings and seals once removed.**
  Always use new parts.
- **Lubricate all components and O-rings with PTT fluid before assembly.**
- **Do not reuse PTT fluid, always refill with new fluid.**

Reservoir

- Apply PTT fluid to reservoir seal, then install reservoir.
- Tighten four bolts securely.

Tightening torque
Reservoir bolt (a): 5.0 N·m (0.5 kgf-m, 3.6 lbf-ft)



I9J011220018-01

Upper Eye

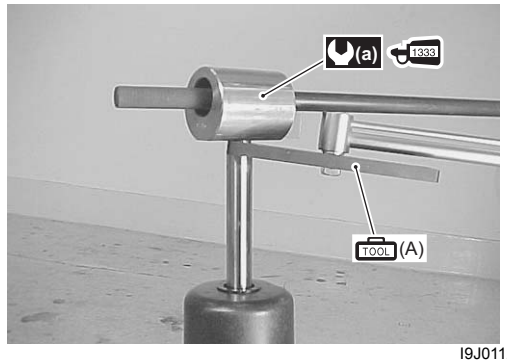
- Apply thread lock super 1333B to threads of upper eye before threading it onto tilt rod.

1333 : Thread lock cement 99000–32020 (SUZUKI Thread Lock Super 1333B (50 g))

- Tighten upper eye to specified torque.

Tightening torque
Upper eye (a): 108 N·m (10.8 kgf-m, 78.0 lbf-ft)

Special tool
(A): 09945–69010 (PTT rod holder)



I9J011220019-01

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PTT Pump Assembly

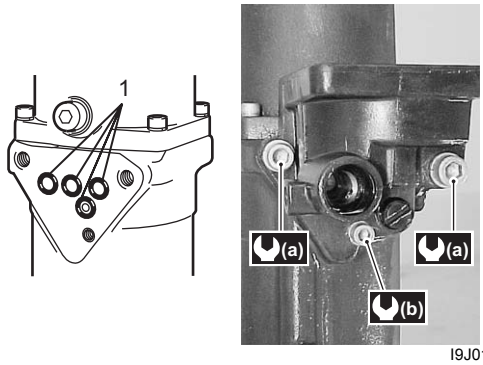
- Install four O-rings (1) to PTT body assembly.

NOTE

Lubricate O-rings with PTT fluid before installing.

- Install PTT pump assembly, then tighten three screws (a) (b) to specified torque.

Tightening torque
PTT pump assembly bolt (a): 8.0 N·m (0.8 kgf-m, 5.8 lbf-ft)
PTT pump assembly bolt (b): 5.5 N·m (0.55 kgf-m, 4.0 lbf-ft)

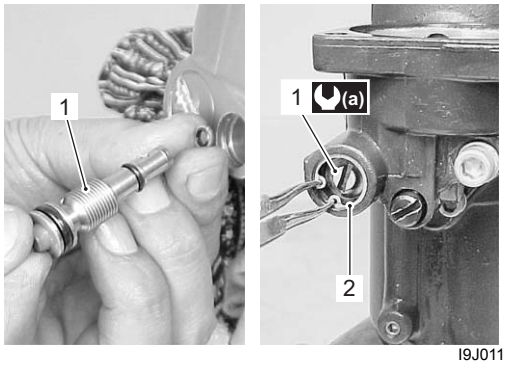


I9J011220020-01

Manual Release Valve

- Oil and install the manual release valve (1). Tighten the valve to specified torque.
- Install snap ring (2).

Tightening torque
Manual release valve (a): 3.6 N·m (0.36 kgf-m, 2.6 lbf-ft)



I9J011220021-01

PTT Motor

- Install the PTT motor.
  Refer to “Power Trim and Tilt Motor Removal and Installation” (Page 2B-22).

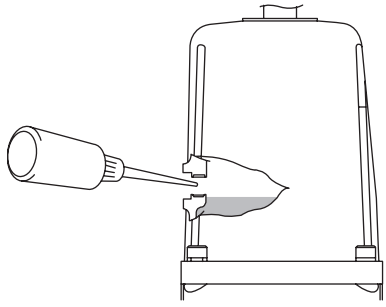
PTT Fluid

- Pour recommended PTT fluid into reservoir to specified level.
  Refer to “Checking PTT Fluid Level” (Page 2B-10).

Air Bleeding

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 fluid to the specified level, then install oil filler plug.

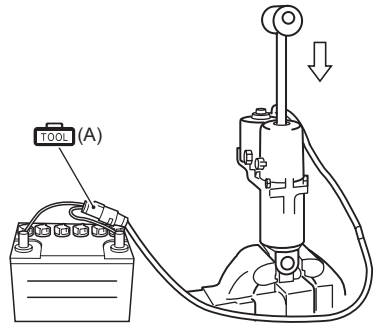


I9J011220022-01

3) Tighten the manual release valve to the specified torque.
4) Connect the PTT cable extension to the PTT motor cable connector.

Special tool
TOOL (A): 09945–79310 (PTT cable extension)

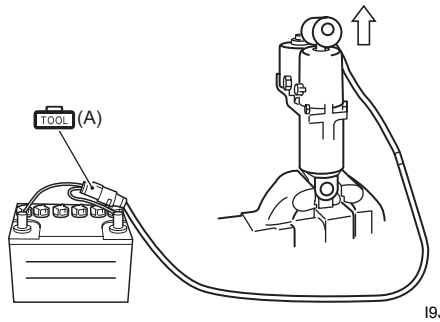
5) Connect the two extension cable lead wires (Bl to positive / G to negative) to the battery as shown in the illustration.
   Operate the PTT motor until the PTT rod is in the fully trimmed down position (completely retracted). If the rod does not come down completely, push it in by hand while operating the motor.



I9J011220023-01

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6) Reverse the two extension cable lead wires (G to positive / Bl to negative).
   Operate the PTT motor until the PTT rod is in the full tilt up position (fully extended).
   If the rod does not come up completely, pull it up by hand while operating the motor.



I9J011220024-01

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 level.

NOTE

Repeat the air bleeding procedure after the PTT unit has been installed on the outboard motor. Refer to "Air Bleeding from PTT Unit" (Page 2B-10).

Power Trim and Tilt Unit Components Cleaning and Inspecting

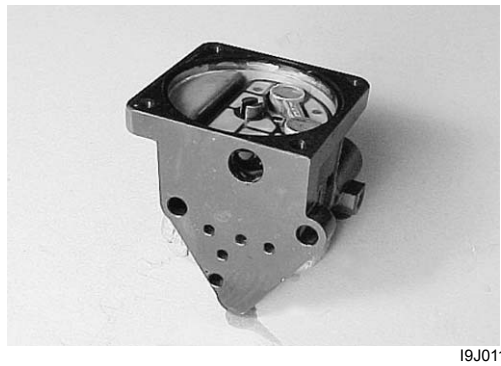
Z9J0112206008

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.**
- **If excessive wear, cracks, defective or other damage is found on any component, replace component.**

- Inspect PTT pump assembly for cracks, nicks, stripped threads and any other imperfections. Replace if necessary.



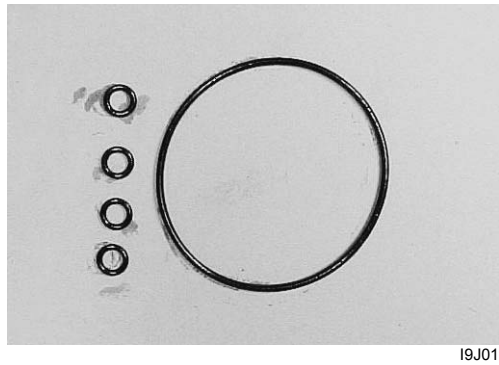
I9J011220025-01

- Inspect reservoir for cracks, nicks or damage. Replace if necessary.
- Inspect reservoir seal for cuts, nicks or wear.



I9J011220026-01

- Inspect all O-rings for cuts, nicks or tears.



I9J011220027-01

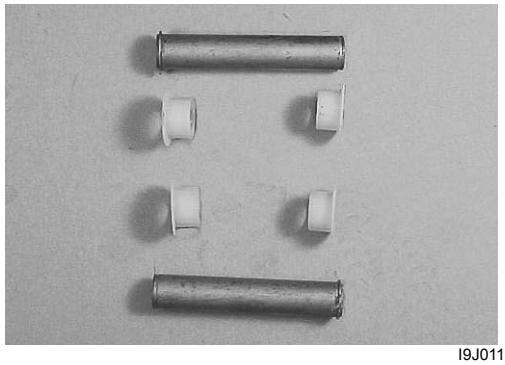
http://SelfFixer.com

- Inspect manual release valve for damage. Replace if necessary.
- Inspect O-rings for cuts, nicks or tears.



I9J011220028-01

- Inspect lower shaft and upper shaft for bends, twists 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.
- Inspect upper and lower shaft for bent, twist or other damage. Replace if necessary.



I9J011220082-01

Power Trim and Tilt Motor Removal and Installation

Z9J0112206009

Removal

1) Remove Power Trim and Tilt unit.
   Refer to “Power Trim and Tilt Unit Removal and Installation” (Page 2B-13).

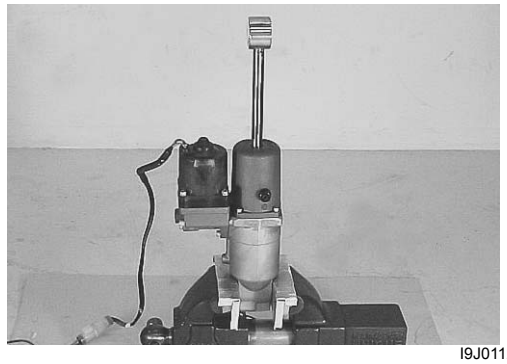
NOTE

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

2) Place the lower section of the PTT unit in a vise. Tighten the vise only enough to secure the PTT unit, DO NOT OVER TIGHTEN.

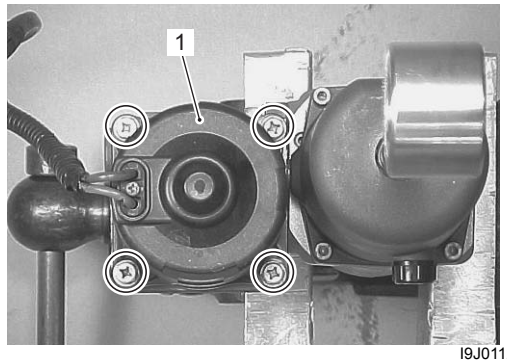
NOTE

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



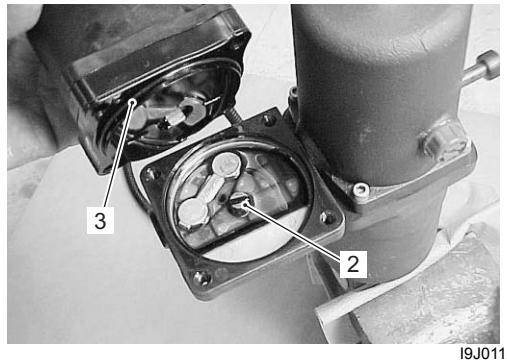
I9J011220029-02

3) Remove the four screws securing the PTT motor (1) to the PTT pump assembly.



I9J011220030-02

4) Detach the PTT motor from PTT pump assembly. Note the position of drive joint (2) and O-ring (3) and remove them.

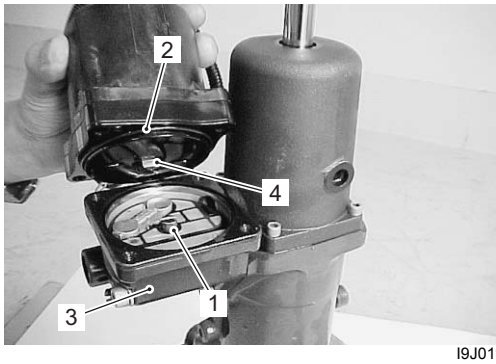


I9J011220031-01

http://SelfFixer.com

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

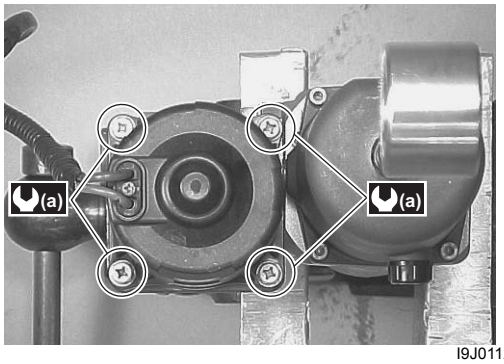
- Ensure that the drive joint (1) is aligned and firmly inserted into the gear pump assembly.
- Fit O-ring (2) to PTT motor.



I9J011220032-02

- Check the level of PTT fluid contained in the PTT pump assembly. If level is low, add recommended PTT fluid until level with mating surface of PTT motor.
- Ensure that the faces of the PTT motor and pump unit are free of dirt or debris.
  When attaching the PTT motor to the PTT pump assembly (3), ensure that the tip of armature shaft (4) fits firmly into the drive joint (1).
- Tighten the four screws (a) to specified torque.

  Tightening torque
  PTT motor screw (a): 5 N·m (0.5 kgf-m, 3.6 lbf-ft)



I9J011220033-02

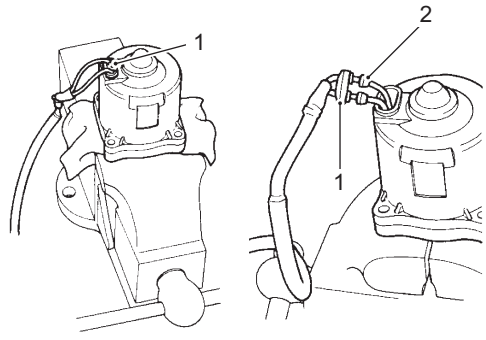
- Pour recommended PTT fluid into reservoir until specified level.
- Perform the air bleeding procedure.
  Refer to “Power Trim and Tilt Unit Reassembly” (Page 2B-19).

Power Trim and Tilt Motor Disassembly and Assembly

Z9J0112206010

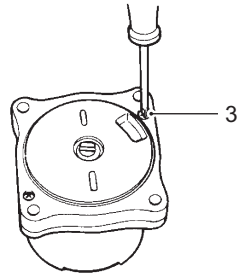
Disassembly

1) For correct assembly, scribe an alignment mark on the field case and brush holder.
2) Slide cable protector tube upward.
3) Remove the screw securing the motor cable holder (1), then slide motor cable holder and grommets (2) out as shown in figure.



I9J011220034-01

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

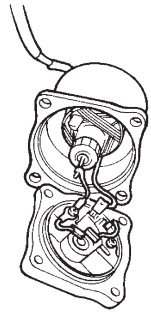


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5) Slide the field case upward and away from the brush holder.

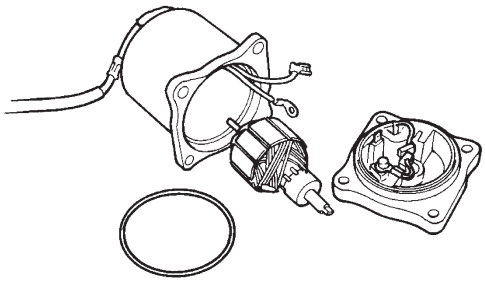
NOTE

When separating field case from brush holder, push the PTT motor cables into brush holder as the field case is removed.


I9J011220036-01

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

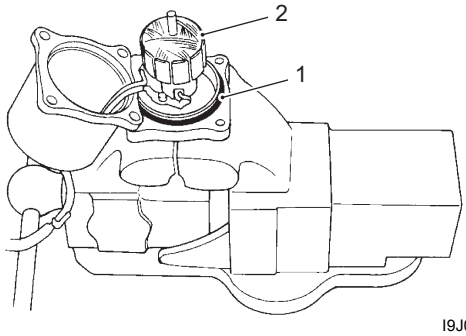


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Assembly

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

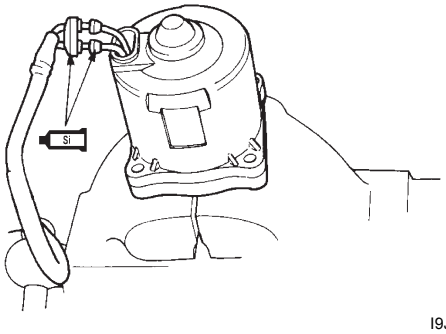
- Install O-ring (1).
- Install armature (2) to brush holder first. When installing the armature, use care to avoid breaking the brushes.



I9J011220038-01

- 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.

Si : Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))



I9J011220039-01

PTT Motor Related Items Inspection

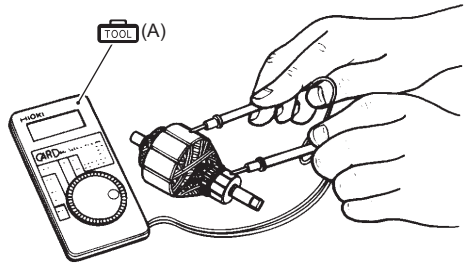
Z9J0112206011

Armature and Commutator

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

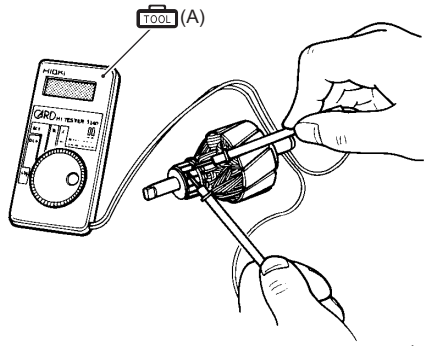
Special tool
TOOL (A): 09930–99320 (Digital tester)

Tester knob indication
Continuity (•))))



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



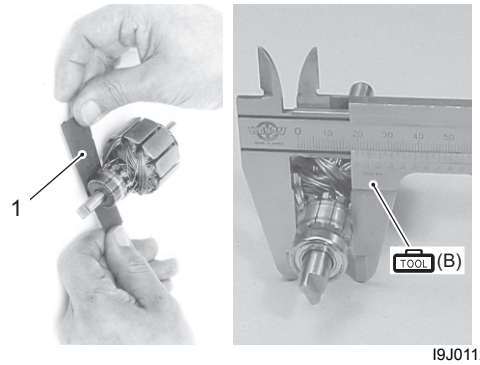
I9J011220041-01

- Inspect the commutator surface.
  If surface is gummy or dirty, clean with 400 grit emery paper (1).
- Measure commutator outside diameter.
  If measurement exceeds service limit, replace armature.

Special tool
TOOL (B): 09900–20101 (Vernier calipers (150 mm))

Commutator outside diameter
Standard: 22.0 mm (0.87 in)
Service limit: 21.0 mm (0.83 in)

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I9J011220042-01

- Ensure that the mica (insulator) between commutator segments are undercut “a” to specified depth.
  If undercut is less than service limit, cut to specified depth.

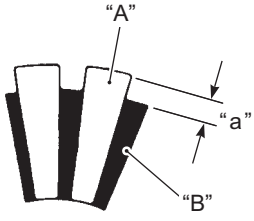
⚠ WARNING

Wear safety glasses when using compressed air.

NOTE

Remove all particles of mica and metal using compressed air.

Commutator undercut
Standard: 1.6 – 1.9 mm (0.06 – 0.07 in.)
Service limit: 1.0 mm (0.04 in.)



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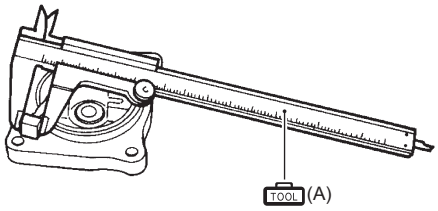
“A”: Segment	“B”: Mica

Brushes

- Check the length of each brush.
  If brushes are worn down to the service limit, they must be replaced.

Special tool
TOOL (A): 09900–20101 (Vernier calipers (150 mm))

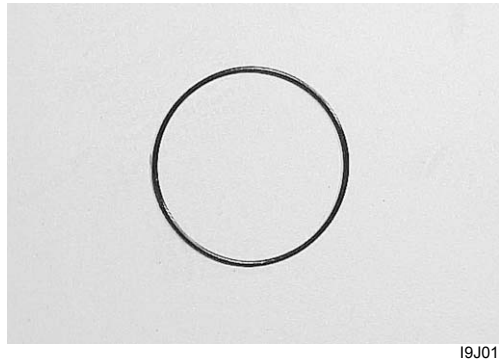
Brush length
Standard: 9.8 mm (0.39 in.)
Service limit: 5.5 mm (0.22 in.)



I9J011220044-01

O-ring

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



I9J011220045-01

PTT Motor Relay Inspection

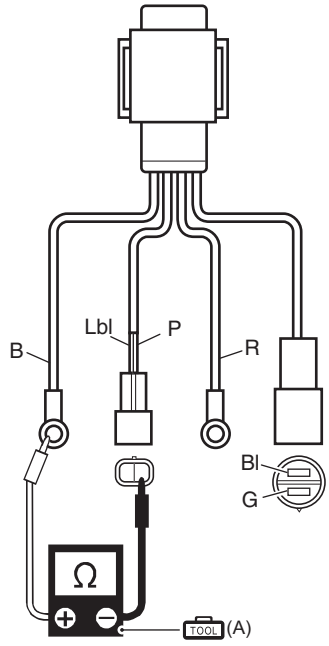
Z9J0112206013

1) Remove the PTT motor relay from the electric parts holder.
   Refer to “Electric Parts Holder Removal and Installation” in Section 1D (Page 1D-5).
2) Check the resistance between each two lead wires.

Special tool
TOOL (A): 09930–99320 (Digital tester)

Tester knob indication
Resistance (Ω)

PTT relay coil resistance
Between “P” wire and “B” wire: 25 – 37 Ω
Between “Lbl” wire and “B” wire: 25 – 37 Ω



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3) Connect the “R” (red) wire to positive (+) terminal, and the “B” (black) wire to negative (–) terminal of a 12 V battery.

CAUTION

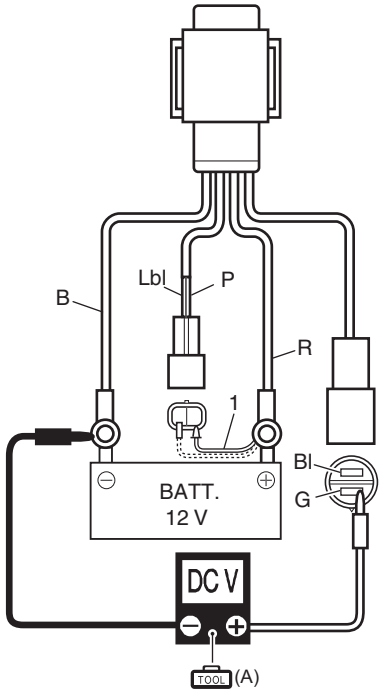
Each operation test must be performed within 3 to 5 seconds to avoid overheat damage to the relay coil.

4) Temporarily connect a jumper wire (1) from the “P” lead wire to the battery positive (+) terminal, then check the voltage between the “G” wire and the “B” wire.

Special tool
(TOOL) (A): 09930–99320 (Digital tester)

Tester knob indication
Voltage (⎓)

Voltage between “G” wire and “B” wire
12 V (Battery voltage)



I9J011220047-01

5) Temporarily connect a jumper wire from the “Lbl” lead wire to the battery positive (+) terminal, then check the voltage between the “Bl” wire and the “B” wire.

Voltage between “Bl” wire and “B” wire
12 V (Battery voltage)

6) If inspection in step 2 and/or step 4, 5 fails, replace PTT motor relay.

7) Install the PTT motor relay to the electric parts holder.
Refer to “Electric Parts Holder Removal and Installation” in Section 1D (Page 1D-5).

PTT Switch Inspection

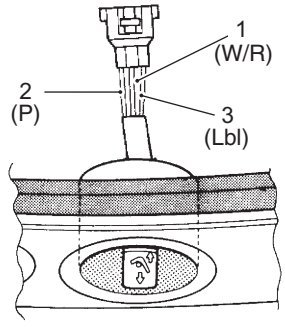
Z9J0112206014

Test continuity between the switch lead wires at each of the three switch positions.
If out of specification, replace PTT switch.

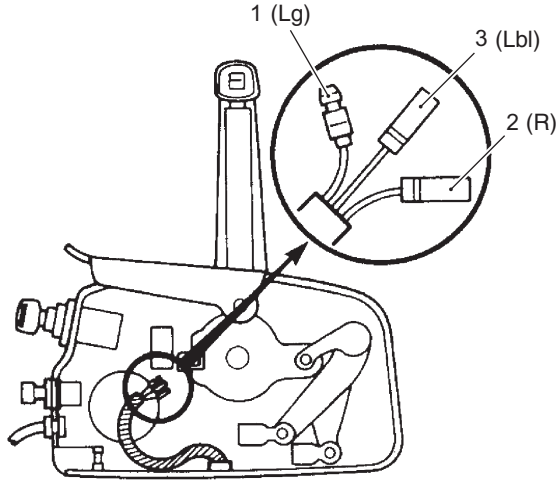
Special tool
(TOOL) : 09930–99320 (Digital tester)

Tester knob indication
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)		



I9J011220048-02



I9J011220049-03

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Section 3

Lower Unit

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Precautions

Precautions

General Precautions

Z9J0113000001

Refer to “General Precautions” in Section 00 (Page 00-1).

Precaution for Lower Unit

Z9J0113000002

⚠ WARNING

- **When installing or removing the propeller, shift into “Neutral” and remove the emergency stop switch lock plate so that the motor cannot be started accidentally.**
- **Wear safety glasses if using compressed air.**

CAUTION

- **When draining lower unit gear oil, check the following points.**
  - **– Water ingress (white, milky appearance)**
  - **– Overheating or burning (black appearance, charred smell)**
  - **– Metal filings or deposits**
- **If reassembling with original components and gears, do not omit or add any shims or thrust washers.**

NOTE

To simplify reassembly and to prevent confusion, note the positions and quantities of all shims and thrust washers. Retain these items next to the gears or bearings to which they belong.

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Right Hand Rotation Unit

Diagnostic Information and Procedures

Diagnose Lower Unit Malfunction

Z9J0113104001

Trouble Check Chart

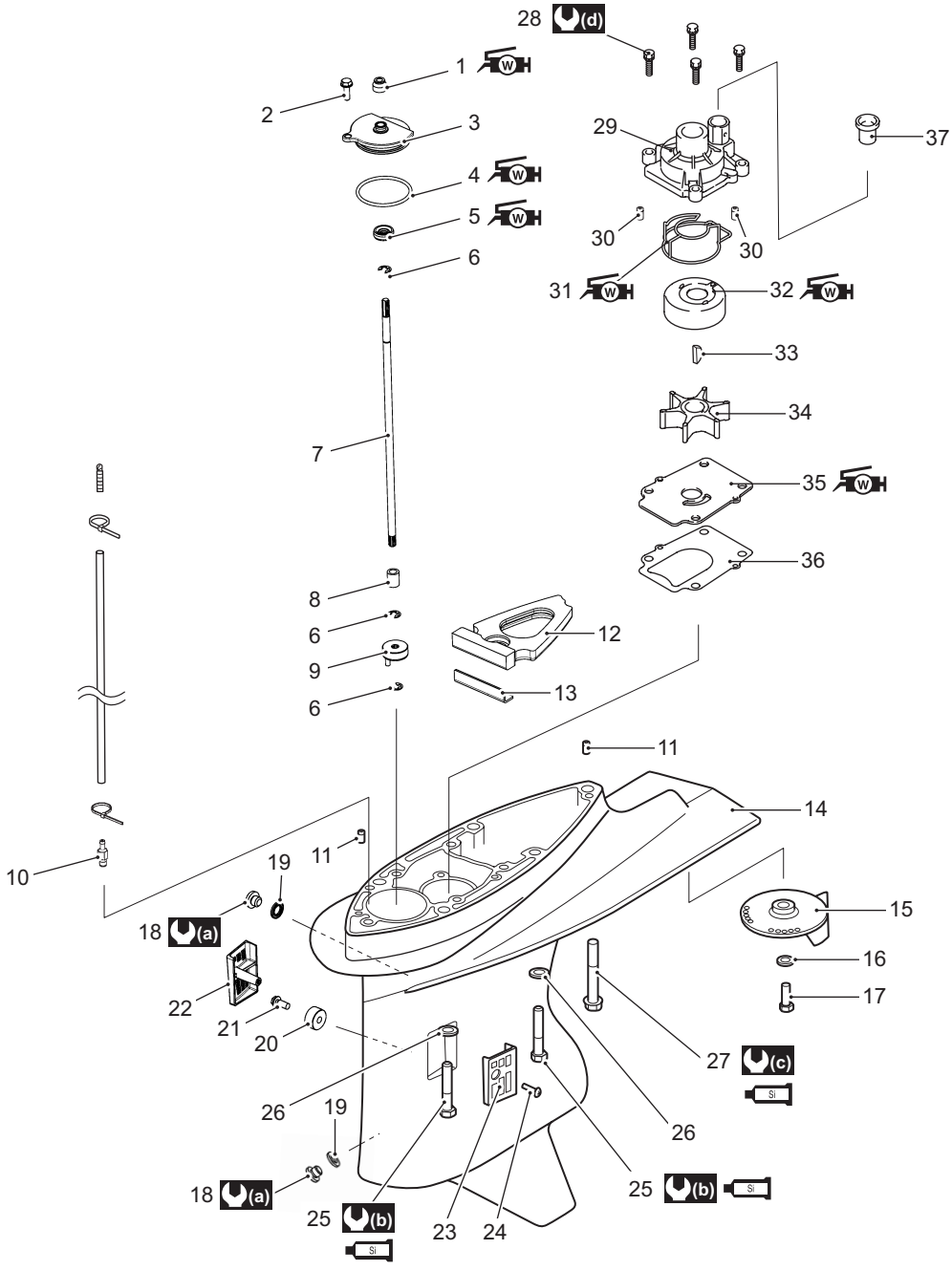
Condition	Possible cause	Correction / Reference Item
Engine stalls when engaging gear	Idling speed set too low.	*Adjustment.*
	Propeller shaft bearings damaged, lacking lubrication or seized.	*Replace.*
Engaging gear(s) has no effect on propulsion	Clutch out of adjustment.	*Adjustment.*
	Driveshaft broken or splines damaged.	*Replace.*
	Chipped or worn dog clutches.	*Replace.*
	Propeller not secured correctly (fallen off).	*Inspection or retighten.*
Loss of power. (Assuming engine is OK)	Propeller bush slipping.	*Replace.*
	Bent or worn propeller.	*Repair or replace.*
Engine shakes the boat	Failed propeller bush.	*Replace.*
	Bent driveshaft or propeller shaft.	*Replace.*
	Damaged propeller.	*Replace.*
Clutch will not engage or disengage	Seized shift rod.	*Inspection.*
	Clutch shaft and clutch rod have become detached.	*Inspection.*
	Seized / broken remote control cable.	*Replace.*
	Problem at control box end.	*Inspection or replace.*

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Service Instructions

Lower Unit Components

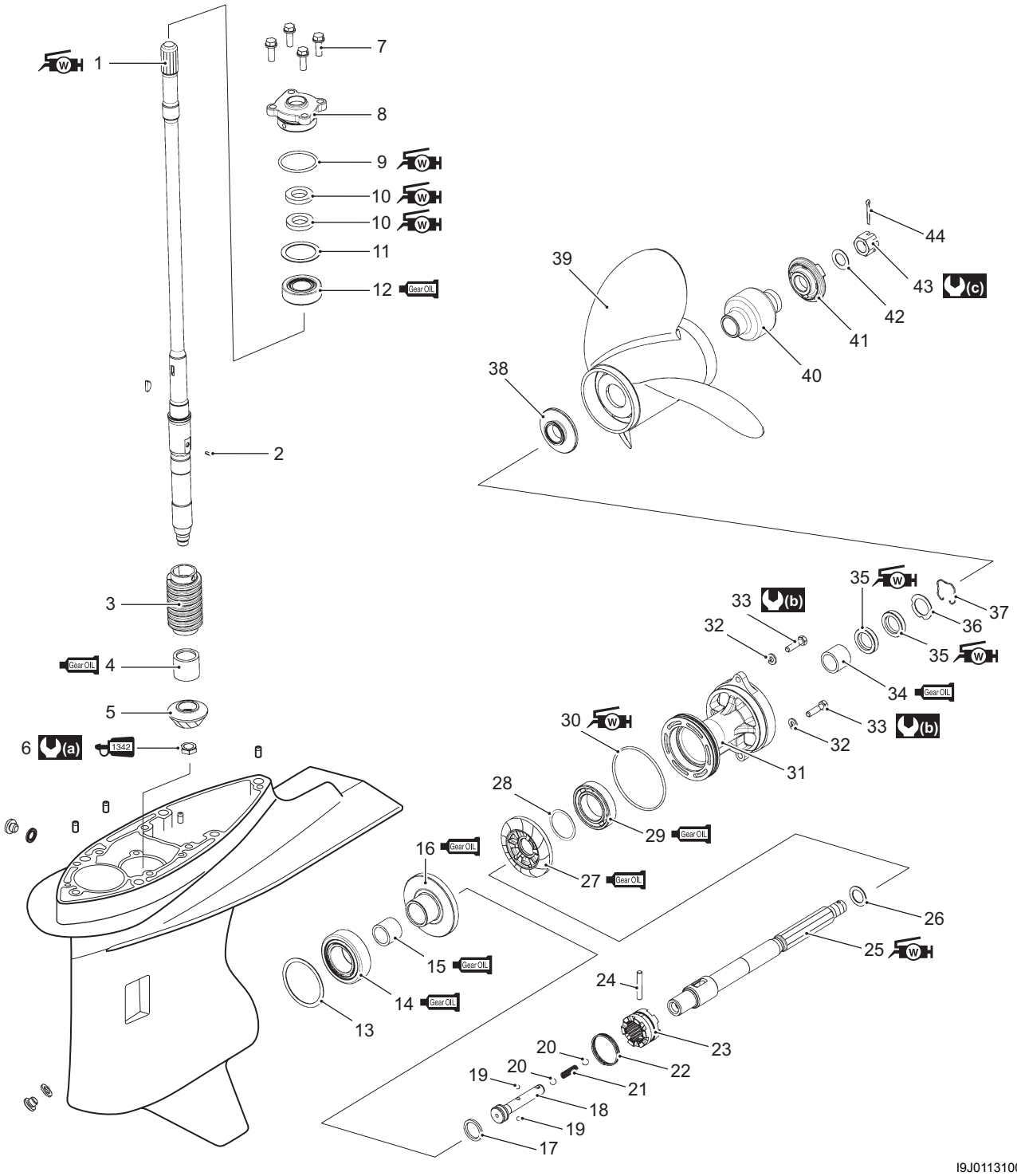
Z9J0113106001



I9J011310019-07

1. Cover	12. Exhaust tube housing seal	23. Water filter PORT	34. Water pump impeller
2. Bolt	13. Exhaust seal plate	24. Screw	35. Under panel
3. Shift rod guide housing	14. Gearcase	25. Bolt	36. Gasket
4. O-ring	15. Trim tab	26. Washer	37. Bush
5. Oil seal	16. Washer	27. Bolt	(a) : 10 N·m (1.1 kgf-m, 7.2 lbf-ft)
6. E-ring	17. Bolt	28. Bolt	(b) : 55 N·m (5.5 kgf-m, 40 lbf-ft)
7. Shift rod	18. Plug	29. Water pump case	(c) : 55 N·m (5.5 kgf-m, 40 lbf-ft)
8. Magnet	19. Gasket	30. Dowel pin	(d) : 17 N·m (1.7 kgf-m, 12.3 lbf-ft)
9. Shifter yoke	20. Anode	31. Case sealing	(W) : Apply SUZUKI Water Resistant Grease.
10. Nipple	21. Bolt	32. Inner sleeve	Si : Apply SUZUKI Silicon seal.
11. Dowel pin	22. Water filter STBD	33. Key	

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I9J011310020-03

1. Driveshaft	14. Forward gear bearing	27. Reverse gear	40. Propeller bush
2. Pin	15. Bearing	28. Shim	41. Spacer
3. Driveshaft collar	16. Forward gear	29. Bearing	42. Washer
4. Pinion bearing	17. Thrust washer	30. O-ring	43. Nut
5. Pinion gear	18. Connector pin	31. Propeller shaft bearing housing	44. Pin
6. Pinion nut	19. Small detent ball	32. Washer	(a) : 120 N·m (12 kgf-m, 86.8 lbf-ft)
7. Bolt	20. Large detent ball	33. Bolt	(b) : 23 N·m (2.3 kgf-m, 16.6 lbf-ft)
8. Driveshaft oil seal housing	21. Spring	34. Bearing	(c) : 55 N·m (5.5 kgf-m, 40 lbf-ft)
9. O-ring	22. Dog spring	35. Oil seal	: Apply SUZUKI Water Resistant Grease.
10. Oil seal	23. Clutch dog shifter	36. Protector	Gear OIL : Apply SUZUKI Outboard Motor Gear Oil.
11. Shim	24. Dog pin	37. Ring	1342 : Apply SUZUKI Thread Lock 1342.
12. Driveshaft bearing	25. Propeller shaft	38. Stopper	
13. Shim	26. Thrust washer	39. Propeller	

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Propeller Removal and Installation

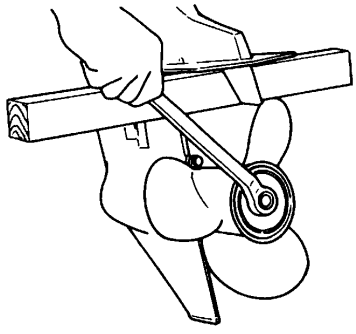
Z9J0113106002

⚠ WARNING

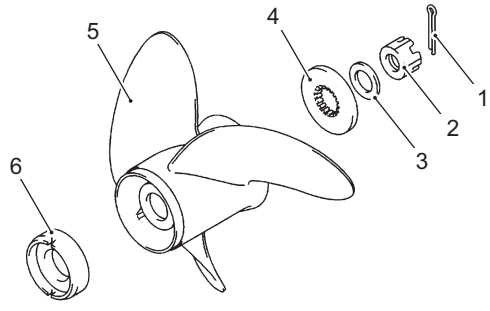
- **When installing or removing the propeller, shift into "Neutral" and remove the emergency stop switch lock plate so that the motor cannot be started accidentally.**
- **To prevent injury from propeller blades, wear gloves and place a block of wood between the anti-cavitation plate and the propeller blade tips to lock the propeller in place before attempting to remove or install propeller nut.**

Removal

1) Shift to "Neutral" position.
2) Remove cotter pin (1) from propeller nut and remove propeller nut (2).
3) Remove washer (3), spacer (4), propeller (5) and stopper (6) from the propeller shaft.



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I9J011310002-02

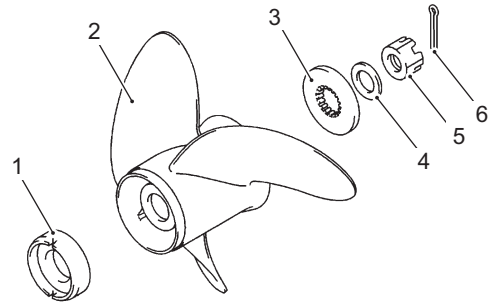
Installation

1) Coat the propeller shaft splines liberally with Suzuki water resistant grease.

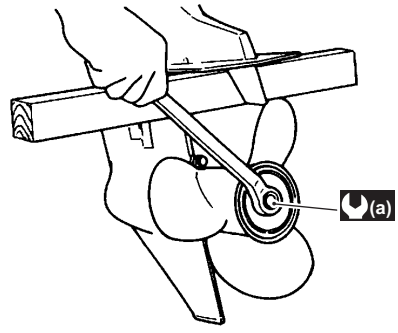
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

2) Install propeller stopper (1) onto propeller shaft, then slide on the propeller (2).
3) Fit spacer (3), washer (4) and nut (5), then tighten nut to specified torque.
4) Push cotter pin (6) through nut and shaft, then bend to secure.

Tightening torque
Propeller nut (a): 55 N·m (5.5 kgf-m, 40.0 lbf-ft)



I9J011310017-01



I9J011310003-04

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Propeller / Nut / Cotter Pin Inspection

Z9J0113106010

Refer to “Propeller / Propeller Nut and Cotter Pin Inspection” in Section 0B (Page 0B-16).

Lower Unit Removal and Installation

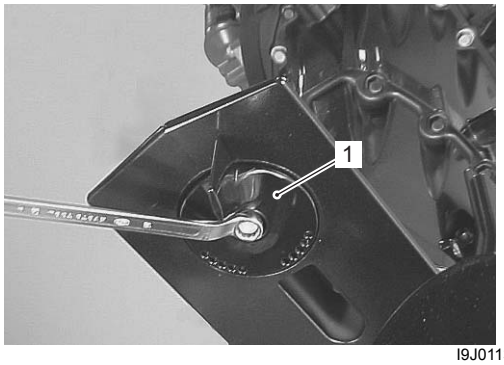
Z9J0113106020

Removal

⚠ WARNING

Always disconnect the battery cable, before removing lower unit.

1) Shift to “Neutral” position. Remove bolt and trim tab (1) (if necessary).

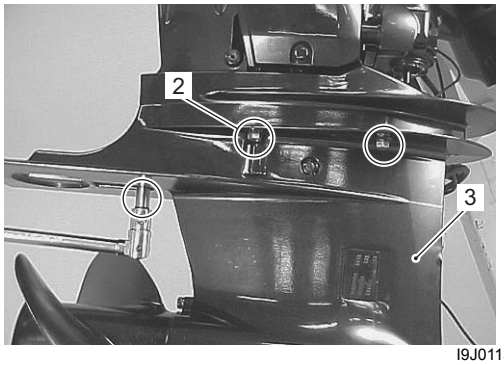


I9J011310021-01

2) Remove five bolts (2) and separate gearcase (3) from driveshaft housing.

NOTE

Before gearcase is removed completely, disconnect speedometer pick up tube (4) from gearcase.



I9J011310022-01



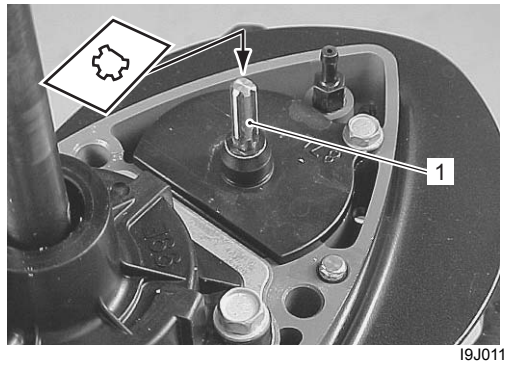
I9J011310023-01

Installation

1) Ensure that shift rod (1) is at “Neutral” position.

NOTE

Before installing lower unit assembly, bring shift to Neutral position by turning shift rod right or left.



I9J011310024-01

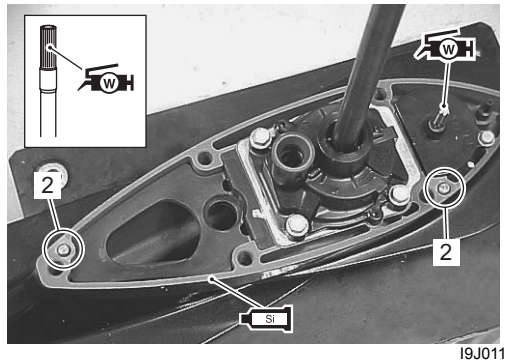
2) Insert two dowel pins (2).

3) Apply water resistant grease to driveshaft and shift rod splines.

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

4) Apply a light coating of suzuki silicone seal to mating surfaces of gearcase and driveshaft housing.

: Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))



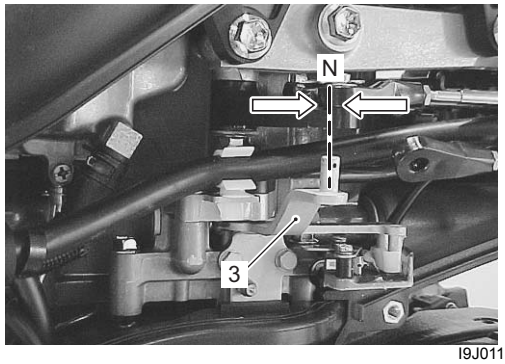
I9J011310025-01

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5) Set the clutch control lever (3) at “Neutral” position, then slide the lower unit (4) 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.

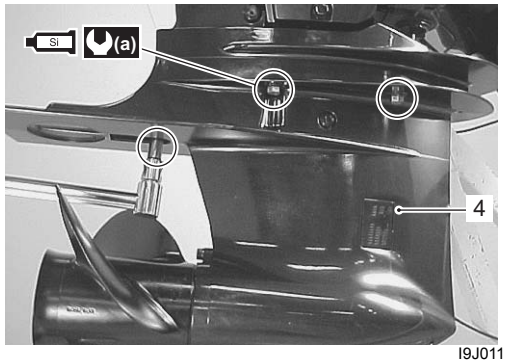


I9J011310026-01

6) Apply suzuki silicone seal to five gearcase bolts and tighten them to specified torque.

Si : Sealant 99000–31120 (SUZUKI Silicone Seal (50 g))

Tightening torque
Gearcase bolt (a): 55 N·m (5.5 kgf-m, 40.0 lbf-ft)



I9J011310027-01

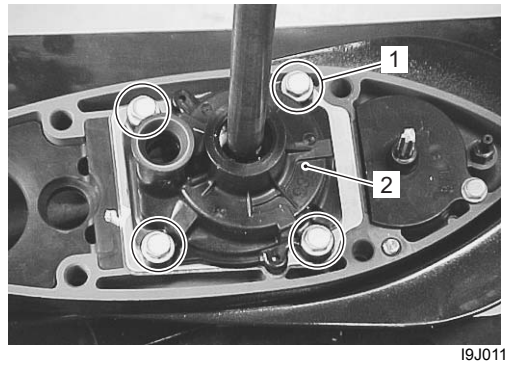
7) Shift the clutch control lever to “Forward” and “Reverse” position from “Neutral” position to check proper gear engagement.

Water Pump Removal and Installation

Z9J0113106012

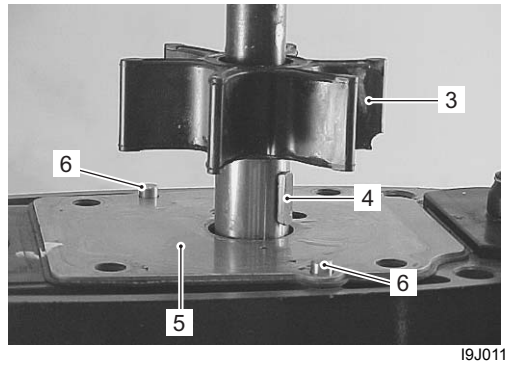
Removal

1) Remove the lower unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).
2) Loosen four bolts (1), then remove water pump case (2).



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

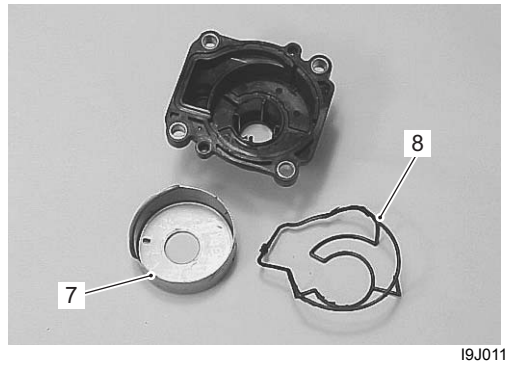


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NOTE

To facilitate the removal of inner sleeve from pump case, warm up the entire case using a heater like hair dryer.

4) Remove inner sleeve (7) and rubber seal ring (8).

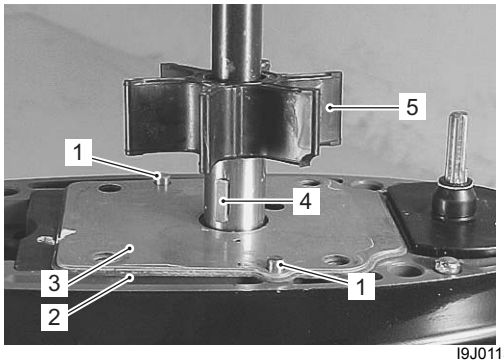


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Installation

1) Place the dowel pins (1), under panel gasket (2) and under panel (3) into position.
2) Insert the key (4) in the driveshaft and slide the impeller (5) onto driveshaft, ensuring that key and keyway is aligned.

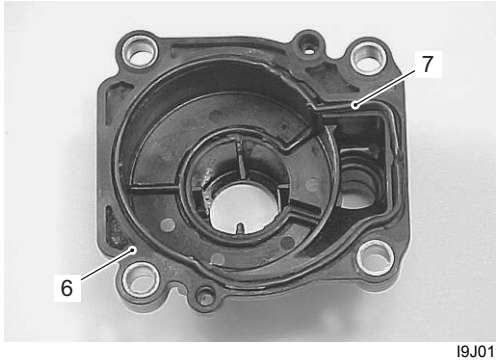


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3) Place the seal ring (7) into groove of the pump case (6).

CAUTION

Do not reuse seal ring once removed. Always use new ring.



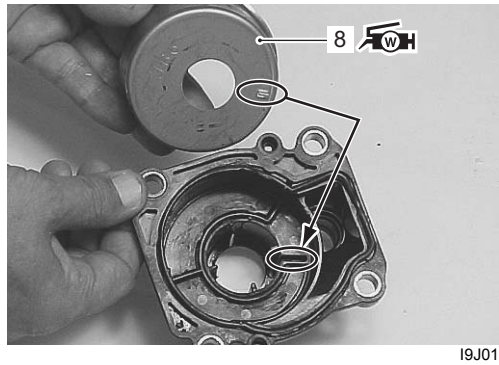
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NOTE

Before installing pump inner sleeve, apply water resistant grease lightly between inner sleeve and pump case mating surfaces.

4) Install inner sleeve (8) into the pump case, ensuring that projection of inner sleeve and groove of pump case are aligned.

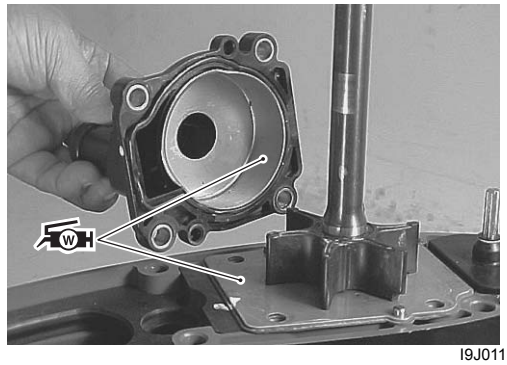
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



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NOTE

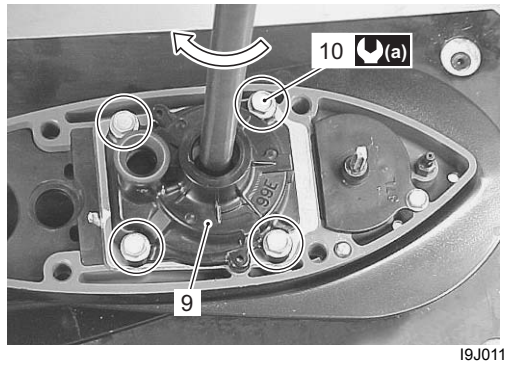
Before installing water pump case assembly, apply water resistant grease lightly on pump case inner sleeve and under panel for initial lubrication.



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5) Install the pump case assembly (9) while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
Securely tighten the four pump case bolts (10) to the specified torque.

Tightening torque
Water pump case bolt (a): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)



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6) Install the Lower Unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).

Water Pump and Related Items Inspection

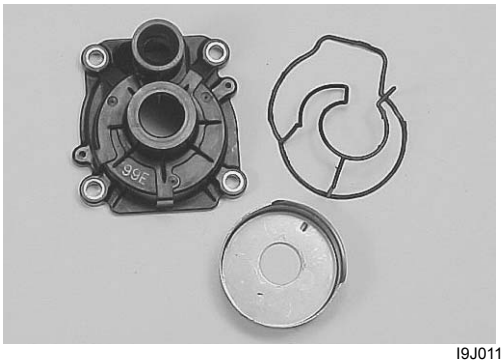
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Inspect the following parts.

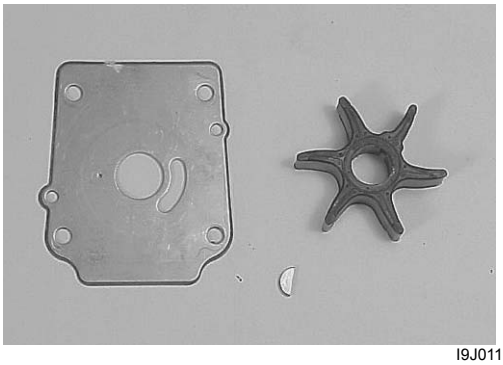
- Inspect impeller. Replace if vanes are cut, torn, worn or other abnormal conditions.
- Inspect pump case. Replace if cracked, distorted or other abnormal conditions are noted.
- Inspect pump inner sleeve. Replace if worn, cracked, distorted, corroded or other abnormal conditions are noted.
- Inspect under panel. Replace if cracked, distorted, corroded or other abnormal conditions are noted.

CAUTION

Do not reuse seal ring once removed. Always use new ring.



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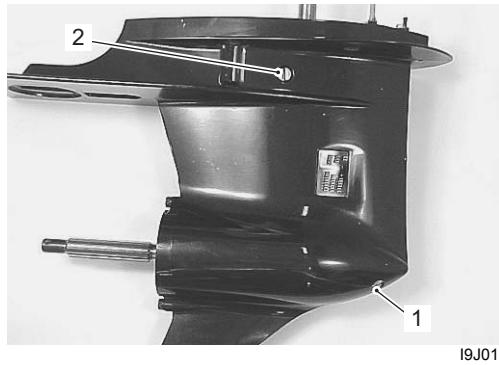


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Lower Unit Disassembly

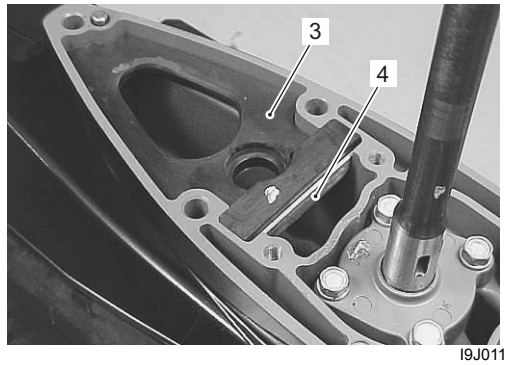
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1) Remove the lower unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).
2) Remove the propeller. Refer to “Propeller Removal and Installation” (Page 3A-4).
3) Remove the water pump and related parts. Refer to “Lower Unit Removal and Installation” (Page 3A-5) and “Water Pump Removal and Installation” (Page 3A-6).
4) Place a drain pan under oil drain plug. Remove oil drain plug (1) first then oil level plug (2) and allow gear oil to drain.
   Inspect oil for water, contaminates or metal.



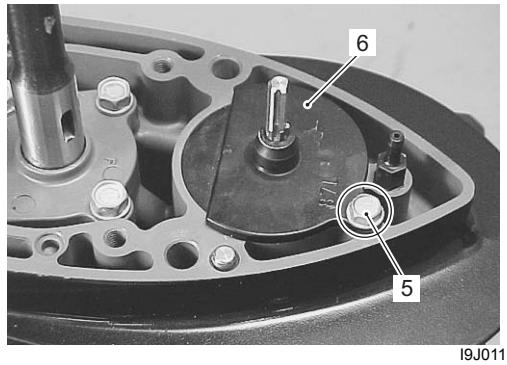
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5) Remove the exhaust tube housing seal (3) and seal plate (4).



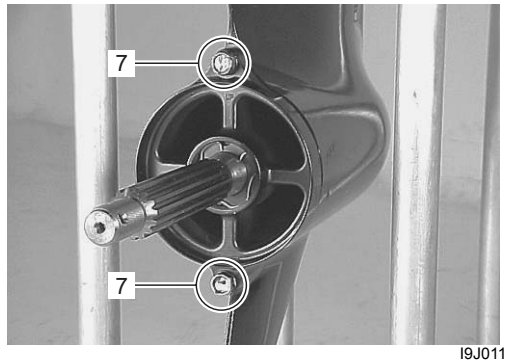
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6) Remove the bolt (5) and shift rod guide housing assembly (6).



I9J011310040-01

7) Remove two bolts (7) securing the propeller shaft bearing housing to the gearcase.

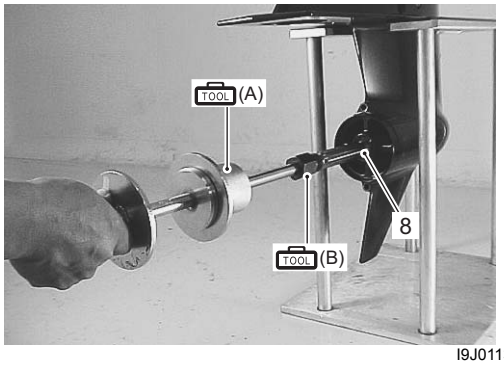


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8) Using special tools, pull out the propeller shaft bearing housing.
Remove the propeller shaft and bearing housing assembly (8).

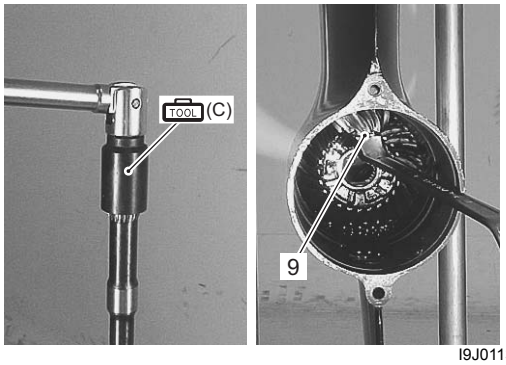
Special tool
(A): 09930–30104 (Sliding hammer)
(B): 09930–30161 (Propeller shaft remover)



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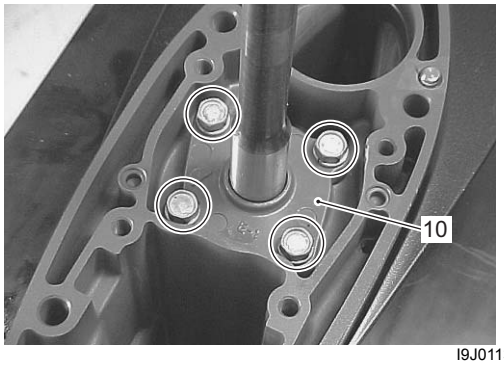
9) Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut. Remove pinion nut (9).

Special tool
(C): 09921–28710 (Driveshaft holder)



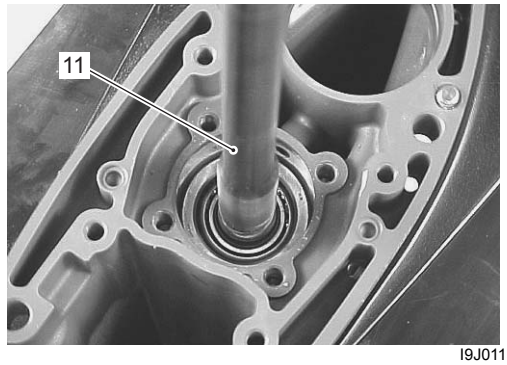
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10) Remove the four bolts securing driveshaft oil seal housing (10), then remove oil seal housing and pinion shim.



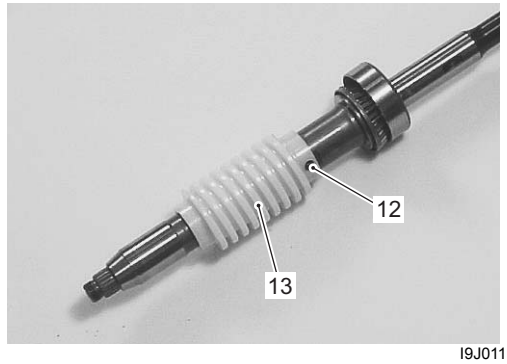
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11) Lift out driveshaft assembly (11).



I9J011310046-01

12) Remove the pin (12) and driveshaft collar (13) from driveshaft (if necessary).

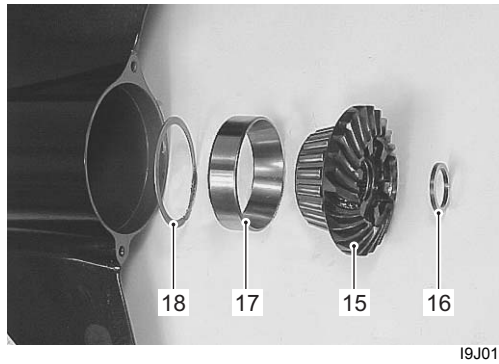


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13) Remove the pinion gear (14).
Remove the forward gear (15) (with thrust washer (16)).
Remove the forward gear bearing outer race (17) and back-up shim (18).



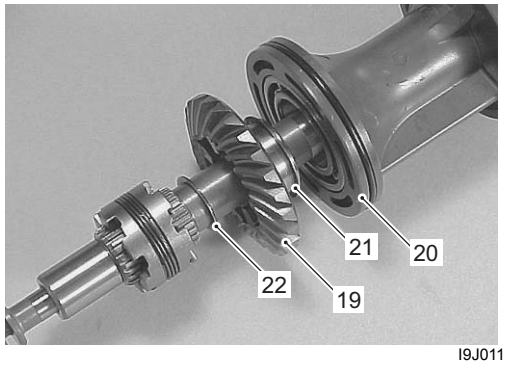
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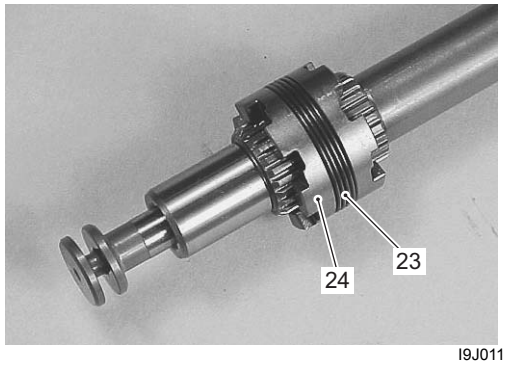
http://SelfFixer.com

14) To disassemble propeller shaft components, refer to following.
   a) Slide propeller shaft away from reverse gear (19) and bearing housing assembly (20).
   Account for the reverse gear back-up shim (21) and reverse gear thrust washer (22).



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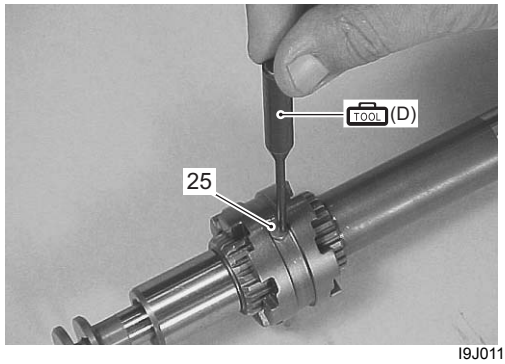
   b) Remove spring (23) from clutch dog shifter (24).



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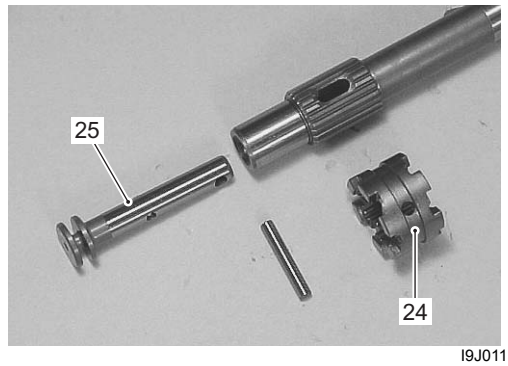
   c) Use special tool to push the dog pin (25) out of the clutch dog shifter.

Special tool
TOOL (D): 09922–89810 (Shift lock pin remover)



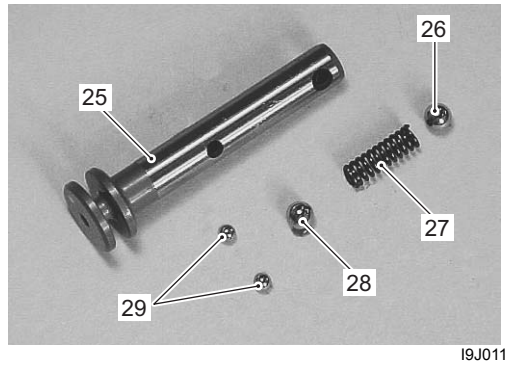
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   d) Remove clutch dog shifter (24) and connector pin (25) from propeller shaft.



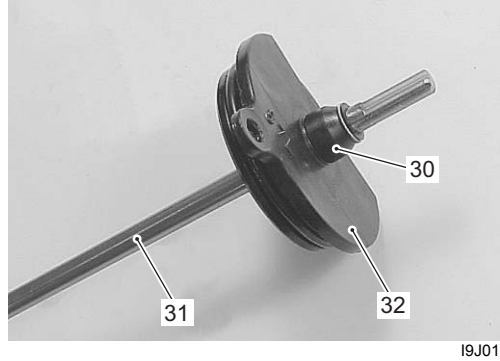
I9J011310052-01

   e) Remove large detent ball (26), detent spring (27), large detent ball (28) and two small detent balls (29) from connector pin (25).



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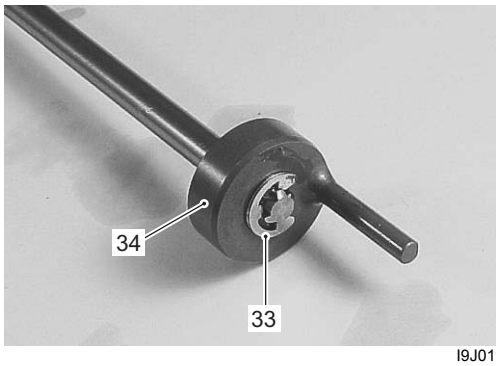
15) To disassemble shift rod components, refer to following.
   a) Remove oil seal cover (30).
   b) Slide shift rod (31) out of shift rod guide housing (32).



I9J011310054-01

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c) Remove E-ring (33) and shifter yoke (34).



I9J011310055-01

Pinion Bearing Removal and Installation

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CAUTION

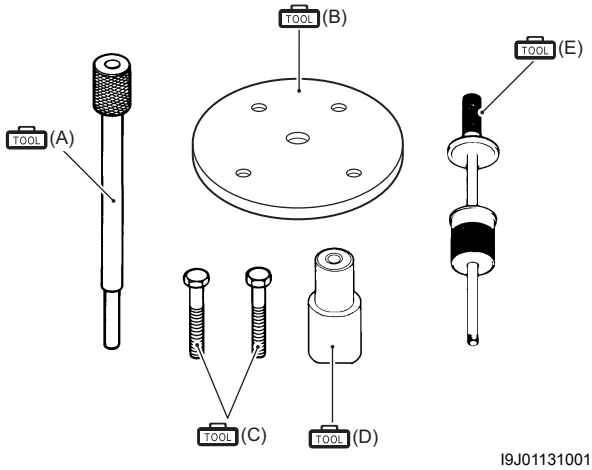
- **When removing the pinion bearing, use care to avoid damaging the gearcase.**
- **Do not reuse pinion bearing once removed. Always use a new pinion bearing.**

Removal and Installation Tools

To remove the pinion bearing from the gearcase, use the following special tools.

Special tool

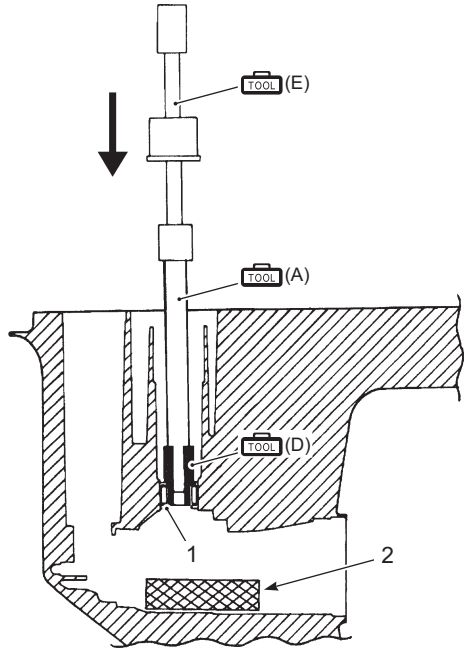
TOOL (A): 09951–59910 (Shaft (removal and installation))
TOOL (B): 09951–38710 (Plate)
TOOL (C): 01500–08403 (Bolt)
TOOL (D): 09951–18730 (Attachment)
TOOL (E): 09930–30104 (Sliding hammer)



I9J011310018-03

Removal

1) Disassemble the lower unit. Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Place the attachment (D) inside the pinion bearing.
3) Insert the removal shaft (A) into attachment (D).
4) Thread sliding hammer (E) into top of removal shaft (A).
5) Put wood block under pinion bearing.
6) Drive the pinion bearing out downwards by striking top of shaft (A) with sliding hammer (E).



I9J011310005-03

1. Pinion bearing	2. Wood block

Installation

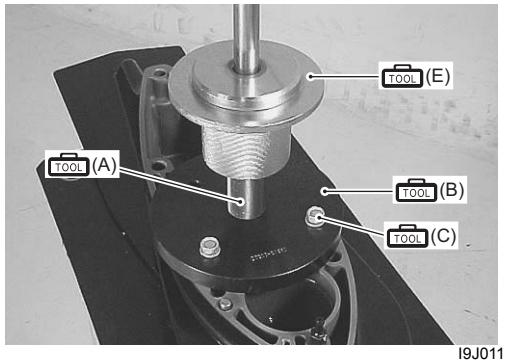
CAUTION

- **Before installing bearing, ensure that inside of gearcase is clean and free of debris.**
- **Ensure that the bearing stamped mark faces upward.**

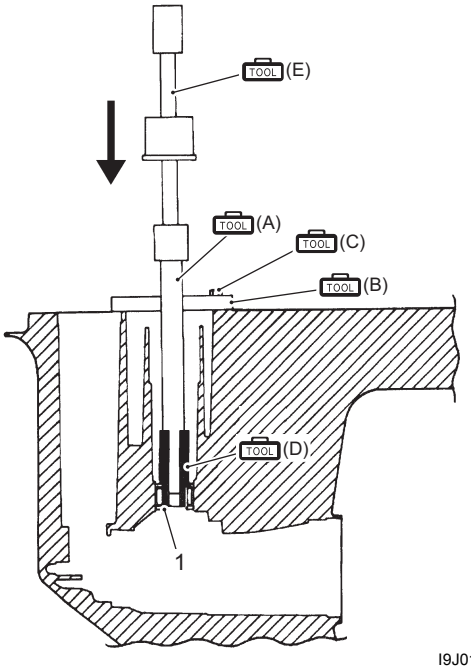
1) Set the installer shaft (A), plate (B), attachment (D) and pinion bearing as shown in the figure.

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2) Place the installer shaft (A) (with pinion bearing on end of installer shaft) into the gearcase.
3) Secure the plate (B) by tightening the bolt (C).
4) Thread the sliding hammer (E) into the top of the installer shaft (A).
5) Drive the pinion bearing down into position by gently striking the installer shaft (A) until the coupler touches plate.
6) Assemble the lower unit. Refer to “Lower Unit Assembly” (Page 3A-16).



I9J011310056-01



I9J011310006-04

1. Pinion bearing

Lower Unit Related Items Inspection

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⚠ WARNING

Wear safety glasses when using compressed air.

NOTE

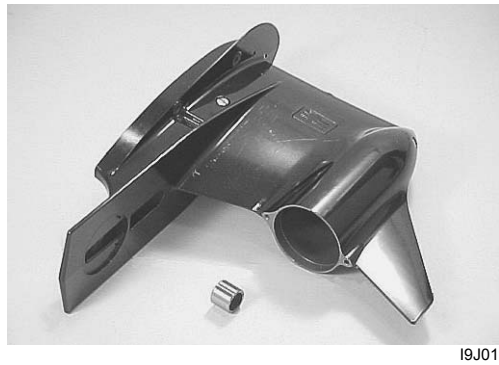
- **If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.**
- **Thoroughly wash all metal components with cleaning solvent and dry with compressed air.**

Gearcase

- Inspect the gearcase. Replace if cracked, damaged or other abnormal conditions are noted.
- Visually check the pinion bearing. Replace bearing if pitted, rough or other abnormal conditions are noted.

NOTE

For the removal and installation of pinion bearing, refer to Pinion bearing removal and installation.

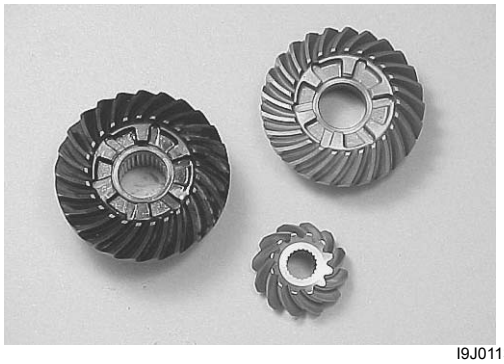


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Gears / Bearing

- 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.



I9J011310058-01



I9J011310059-01

Propeller Shaft Components

- Inspect 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.



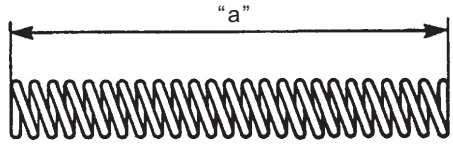
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I9J011310061-01

- Check detent spring by measuring its free length. If free length is not within specifications, replace detent spring.

Detent spring free length “a”
Standard: 24.8 mm (0.98 in.)
Service limit: 24 mm (0.94 in.)

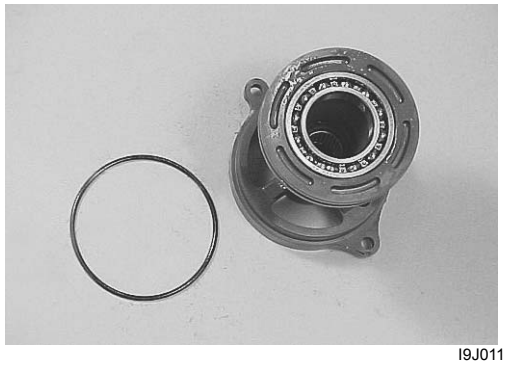


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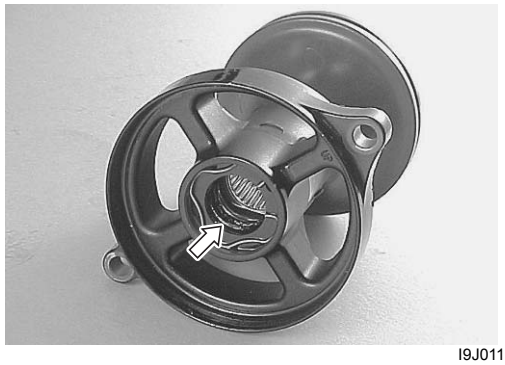
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Propeller Shaft Bearing Housing

- Inspect housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect reverse gear 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.



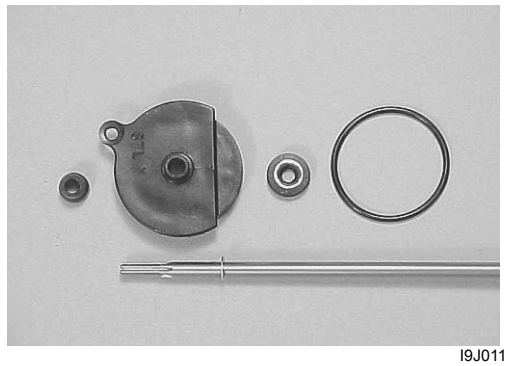
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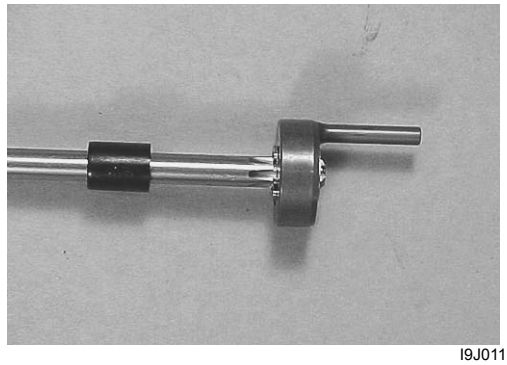
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Shift Rod Guide Housing Components

- Inspect shift rod guide housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect shifter yoke. Replace if worn, 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 and oil seal cover. Replace if nicked, cut, worn or other abnormal conditions are noted.



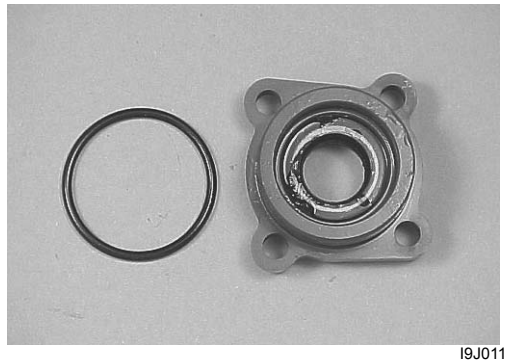
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Driveshaft Oil Seal Housing

- 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.

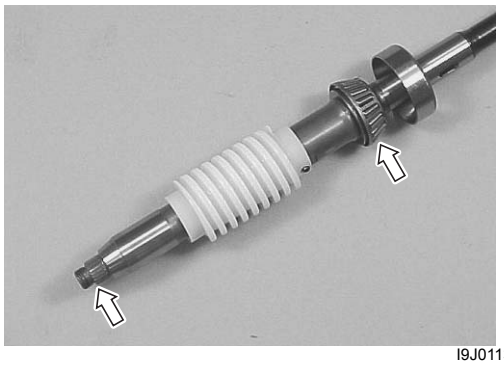


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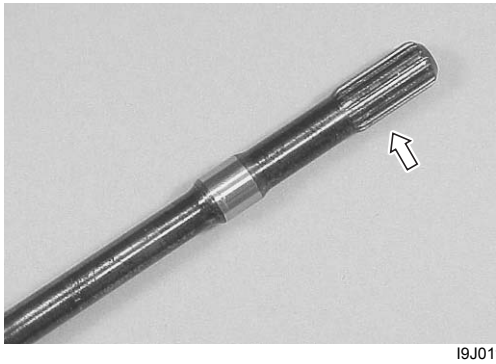
http://SelfFixer.com

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.



I9J011310068-01

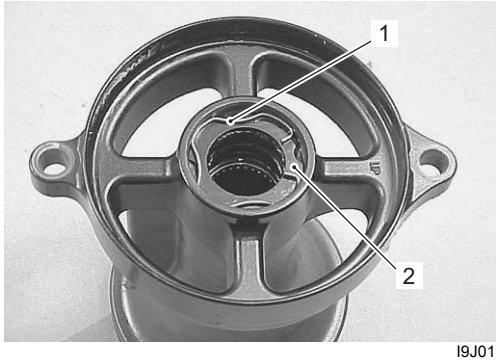


I9J011310069-01

Propeller Shaft Oil Seal Replacement

Z9J0113106025

1) Remove the propeller shaft bearing housing. Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Remove retaining ring (1) and washer (2).



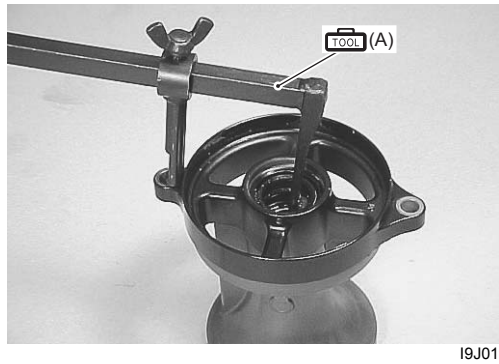
I9J011310070-02

3) Extract seals (3) with oil seal remover.

CAUTION

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

Special tool
(A): 09913–50121 (Oil seal remover)

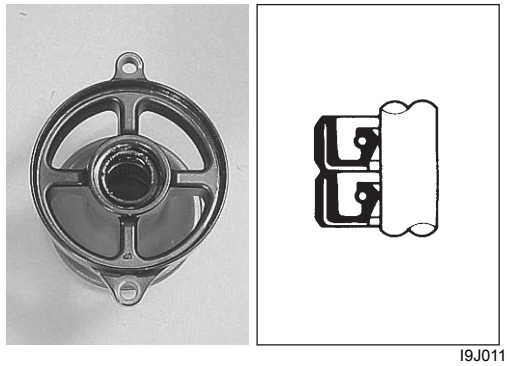


I9J011310071-01

4) Apply water resistant grease to the inner circumference of the housing.

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

5) 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.



I9J011310072-02

6) Install the washer and retaining ring.
7) Assemble the propeller shaft bearing housing. Refer to “Lower Unit Assembly” (Page 3A-16).

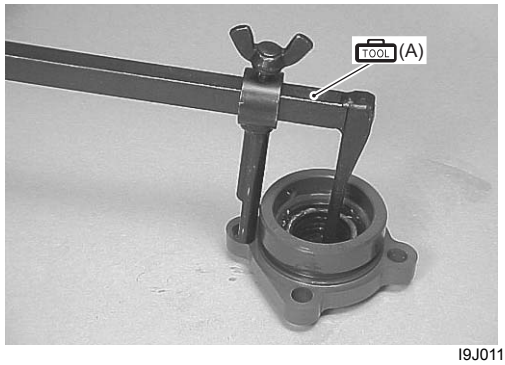
http://SelfFixer.com

Driveshaft Oil Seal Replacement

Z9J0113106026

1) Remove the driveshaft oil seal housing. Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Using special tool, remove two oil seals out of the driveshaft oil seal housing.

Special tool
TOOL (A): 09913–50121 (Oil seal remover)

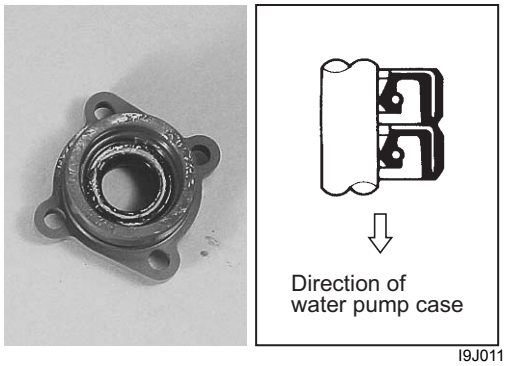


I9J011310073-01

3) Apply water resistant grease to inner circumference of driveshaft oil seal housing.

: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

4) 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.



I9J011310074-02

5) Assemble the driveshaft oil seal housing. Refer to “Lower Unit Assembly” (Page 3A-16).

Lower Unit Assembly

Z9J0113106027

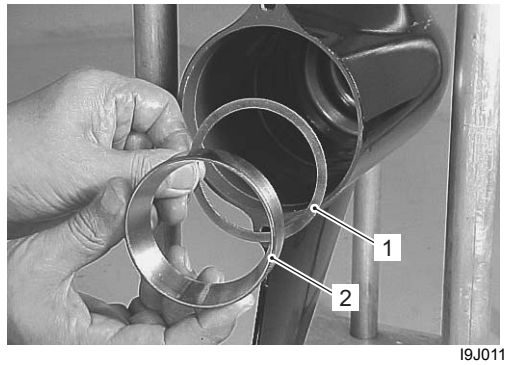
Assembly is in reverse order of disassembly with special attention to the following steps.

CAUTION

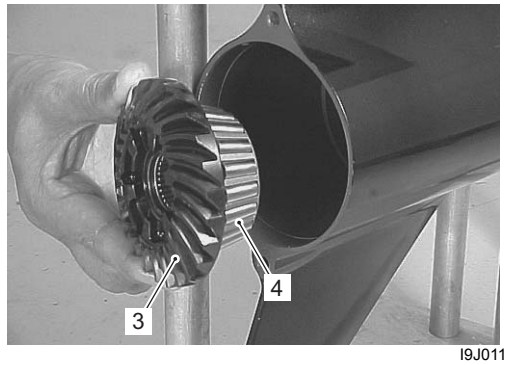
- **Make sure that all parts used in assembly are clean and lubricated.**
- **It is recommended that all seals, gaskets and O-rings be replaced with new on assembly.**
- **After assembly, check parts for tightness and smoothness of operation.**
- **Before final assembly, be absolutely certain that all gear contact, shim adjustments and tolerances are correct. Failure to correctly adjust these areas will result in lower unit damage. Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-24).**

Forward Gear

Place the forward gear back-up shim (1), forward gear bearing outer race (2) in position, then install forward gear (3) with forward gear bearing (4).



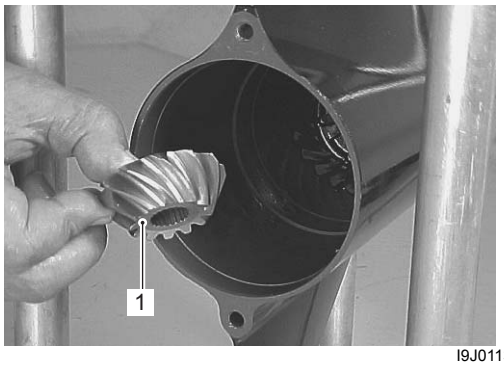
I9J011310075-01



I9J011310076-01

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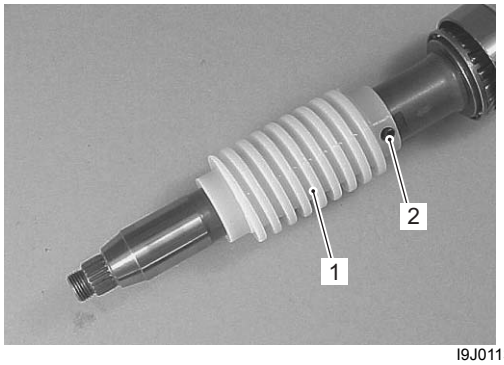
Pinion Gear
Place pinion gear (1) in gearcase.



I9J011310077-01

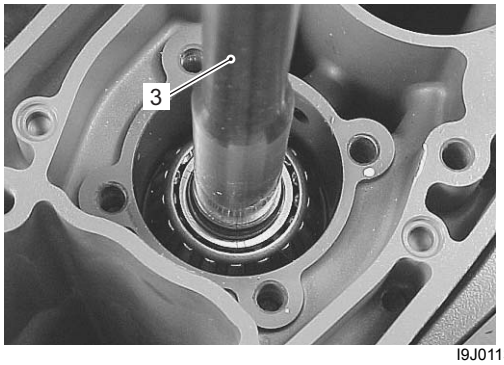
Driveshaft

- Assemble the driveshaft collar (1) to driveshaft.
- Install the pin (2).



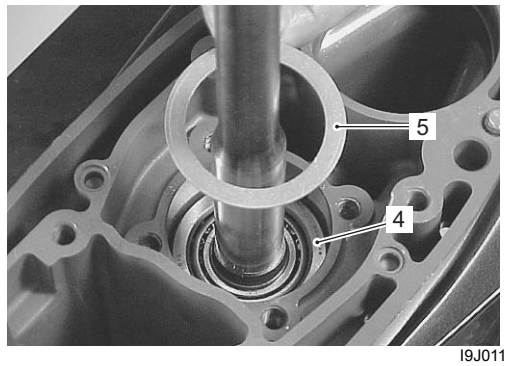
I9J011310078-01

- Lower the driveshaft assembly (3) down into the gearcase until the bottom of shaft protrudes through center of pinion.



I9J011310079-01

- Install the bearing outer race (4) and pinion shim (5) to driveshaft.



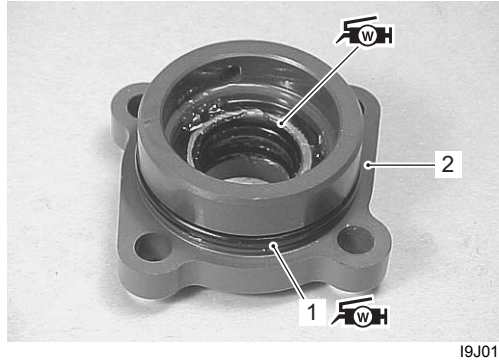
I9J011310080-01

Driveshaft Oil Seal Housing

- Apply water resistant grease to the driveshaft oil seal.

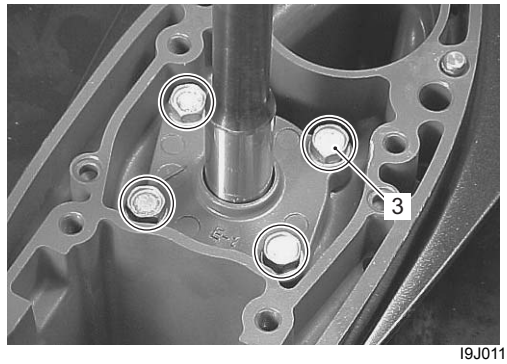
  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

- Apply water resistant grease to O-ring (1), then install O-ring into groove on the driveshaft oil seal housing (2).



I9J011310081-01

- Install the driveshaft oil seal housing on the gearcase, then tighten four bolts (3) securely.



I9J011310082-01

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Pinion Nut

- Apply thread lock 1342 to the threads of pinion nut (1) before threading it onto driveshaft.

  1342 : Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))

- Tighten pinion nut to specified torque.

NOTE

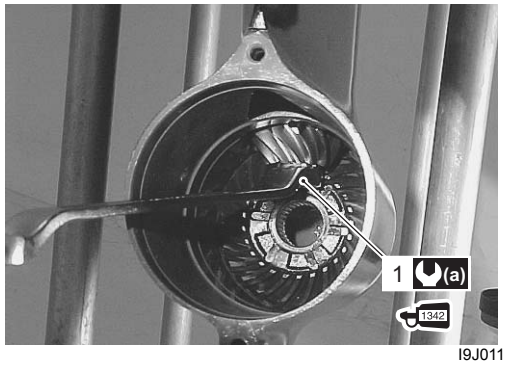
It is recommended the original pinion nut be used for the purposes of shimming during repair. A new pinion nut should be used on final assembly.

Special tool
TOOL (A): 09921–28710 (Driveshaft holder)

Tightening torque
Pinion nut (a): 120 N·m (12.0 kgf-m, 86.8 lbf-ft)



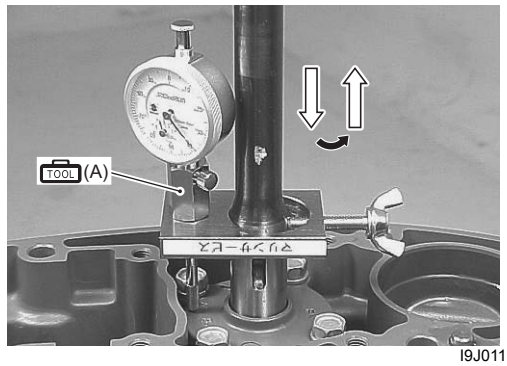
I9J011310083-02



I9J011310084-02

Checking Driveshaft Thrust Play
Before installing reverse gear, driveshaft thrust play should checked. Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-24).

Special tool
TOOL (A): 09951–09530 (Gear adjusting gauge)



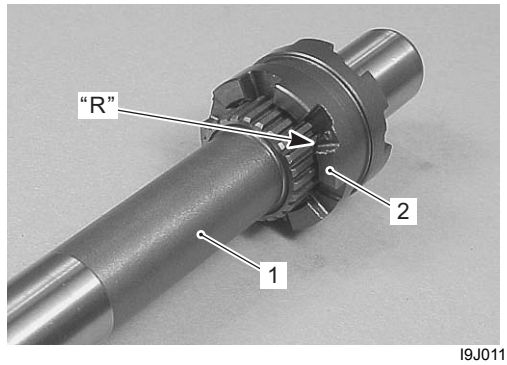
I9J011310085-01

Propeller Shaft

- Slide the clutch dog shifter (2) onto the propeller shaft (1).

NOTE

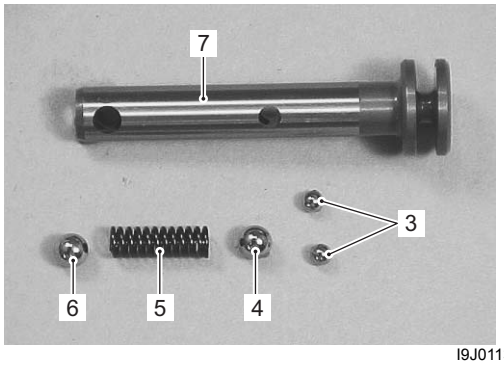
The side of the clutch dog shifter marked with the letter “R” must face towards reverse gear.



I9J011310086-01

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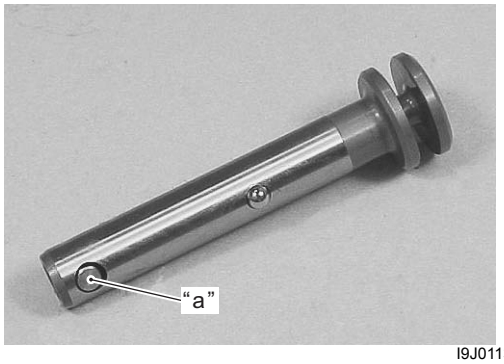
- Insert two small detent balls (3), large detent ball (4), detent spring (5) and large detent ball (6) into connector pin (7). Then depress detent ball (6) and temporarily insert stopper pin “a” into dog pin hole of connector pin, as shown in figure.



I9J011310087-01

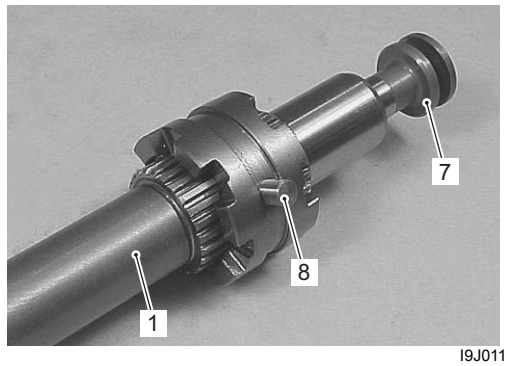
NOTE

Temporarily insert a water pump case dowel pin into the connector pin to prevent the detent ball from falling out.

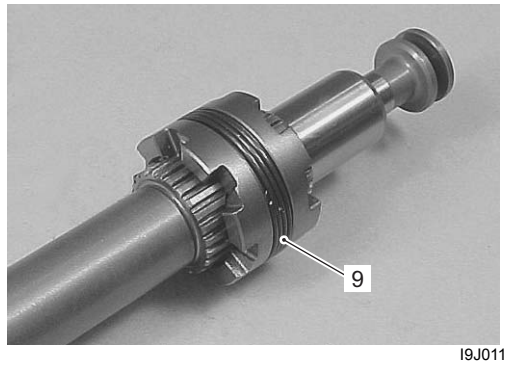


I9J011310088-01

- Insert the connector pin (7) (with detent balls) into propeller shaft (1).
- Align the holes in the shifter dog and connector pin and then slide the dog pin (8) through both dog and connector pin. (save the temporarily installed dowel pin pushed out as the dog pin is inserted.)
- Install the dog pin retaining spring (9), ensuring that it fits snugly into the groove on the dog shifter.



I9J011310089-01

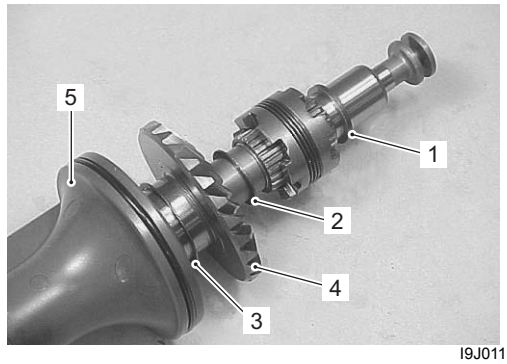


I9J011310090-01

Propeller Shaft / Bearing Housing

- Place the forward thrust washer (1) and reverse thrust washer (2) on the propeller shaft.
- Install back-up shim (3) and reverse gear (4) to propeller shaft bearing housing (5).
- Slide propeller shaft into reverse gear and propeller shaft bearing housing.

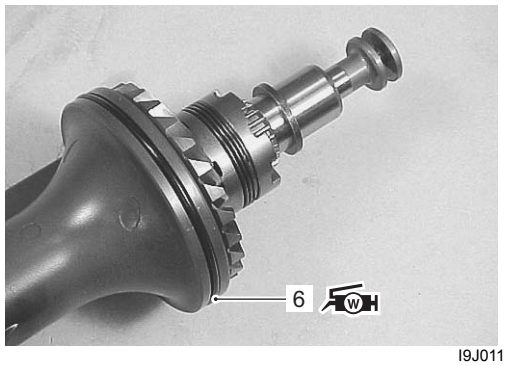
: Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))
: Gear Oil 99000–22540 (SUZUKI Outboard Motor Gear Oil)



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- Apply water resistant grease to the bearing housing O-ring (6).



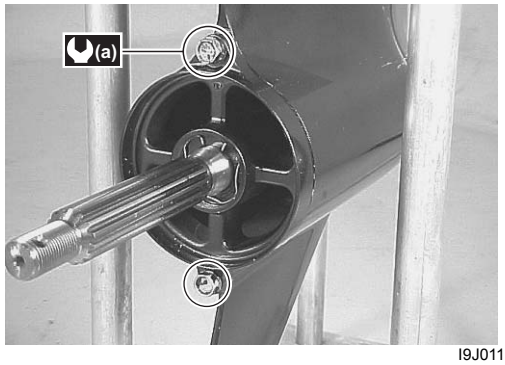
I9J011310092-01

NOTE

Before installing the propeller shaft / bearing housing assembly, move the shifter dog to bring the connector pin to the "Neutral" position.

- Install the propeller shaft and housing assembly in the gearcase.
- When the housing is fully seated, tighten both retaining bolts to the specified torque.

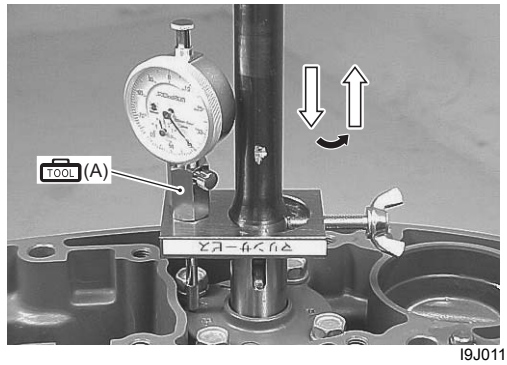
Tightening torque
Bearing housing bolt (a): 23 N·m (2.3 kgf-m, 16.6 lbf-ft)



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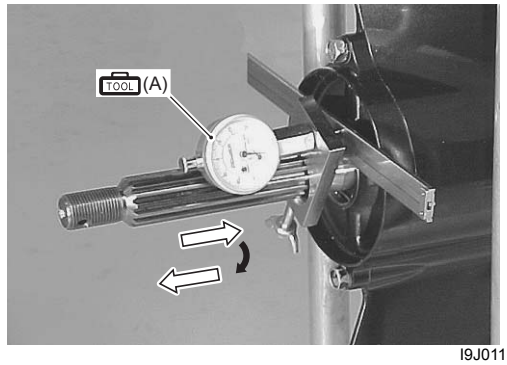
Rechecking Driveshaft Thrust Play
Recheck the driveshaft thrust play. This should not be less than previously checked. If less, reduce the number / thickness of the reverse gear back-up shims. Refer to "Lower Unit Gears - Shimming and Adjustment" (Page 3A-24).

Special tool
TOOL (A): 09951–09530 (Gear adjusting gauge)



I9J011310085-01

Checking Propeller Shaft Thrust Play
Check propeller shaft thrust play. Refer to "Lower Unit Gears - Shimming and Adjustment" (Page 3A-24).



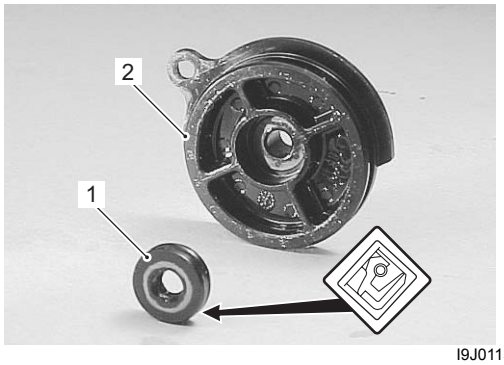
I9J011310094-02

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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.

  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))

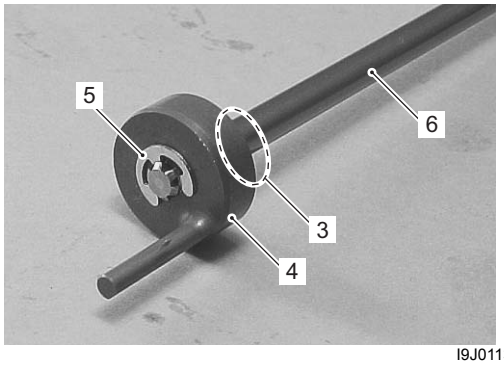


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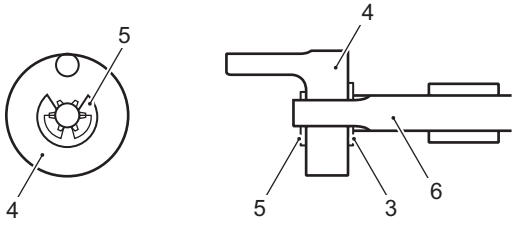
- Install the E-ring (3), shifter yoke (4) and E-ring (5) to shift rod (6).

NOTE

E-ring should be installed with gap facing as shown in the figure.

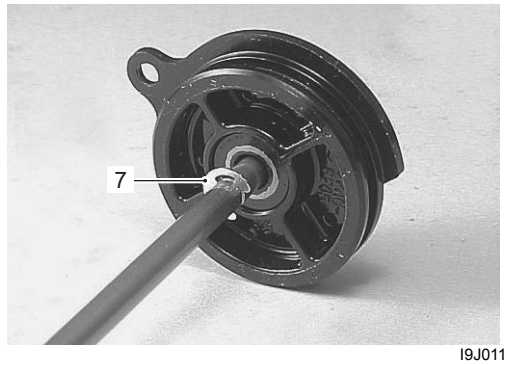


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I9J011310007-03

- Install the E-ring (7) to the shift rod, then slide the shift rod guide housing onto the shift rod.

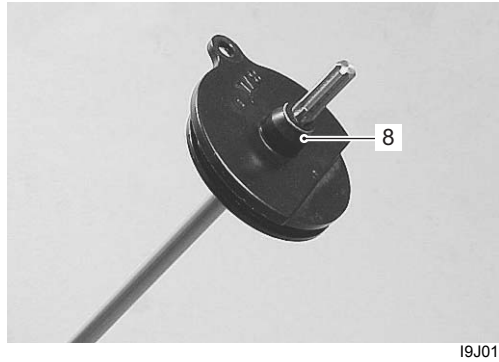


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- Install the oil seal cover (8) to the shift rod guide housing.

NOTE

Be sure the connector pin is in the “Neutral” position before installing the shift unit (shift rod guide housing assembly).

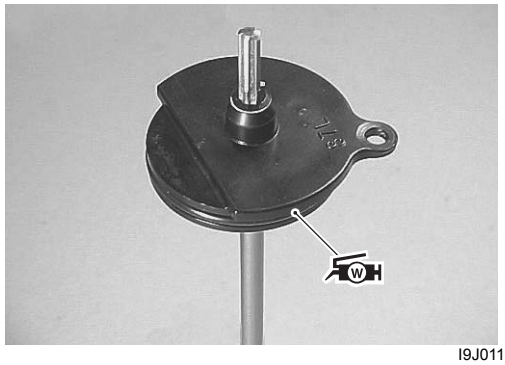


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- Apply water resistant grease to the shift rod guide housing O-ring.

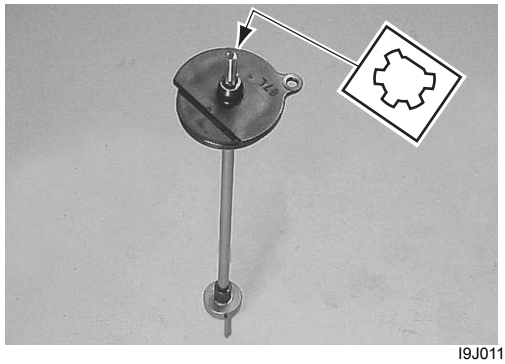
  : Grease 99000–25161 (SUZUKI Water Resistant Grease (250 g))



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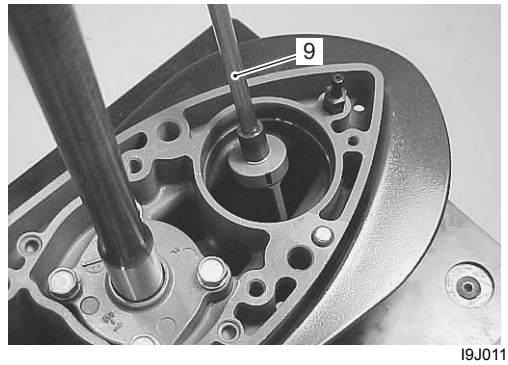
NOTE

Before installing the shift rod guide housing assembly, bring the shifter yoke to the "Neutral" position by turning the shift rod right or left.

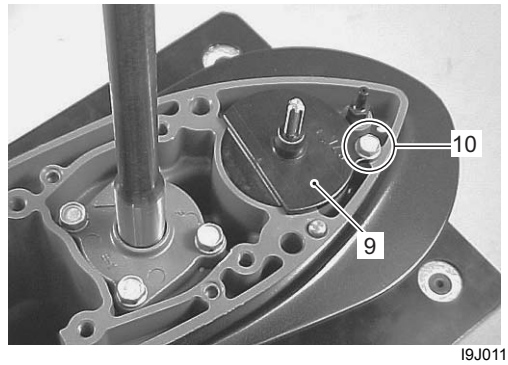


I9J011310100-01

- Install the shift rod guide housing assembly (9) by aligning the shifter yoke with the groove in the connector pin, then tighten the housing bolt (10) securely.



I9J011310101-02



I9J011310102-01

- Turn the shift rod from the "Neutral" position to the "Forward" and "Reverse" position to check proper gear engagement.

Leakage Check

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

1) Install the test tool into the oil level hole.
2) Connect the air pump to the tester.

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3) Rotate driveshaft and propeller shaft clockwise several times and then apply specified pressure for the test.

CAUTION

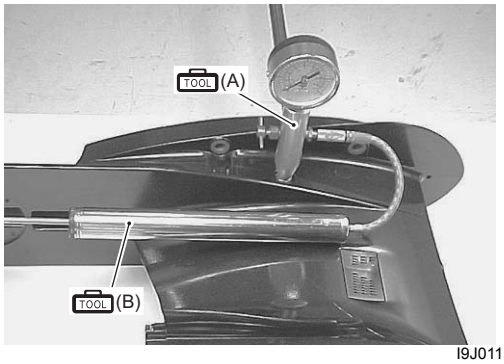
Do not exceed pressure of 110 kPa (1.1 kg/cm², 15.6 psi.) or damage to oil seals will result.

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.

Special tool
TOOL (A): 09950–69512 (Gearcase oil leakage tester)
TOOL (B): 09952–99310 (Hand air pump)

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



I9J011310103-01

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

Water Pump
Install the water pump and related parts.
Refer to “Lower Unit Removal and Installation” (Page 3A-5) and “Water Pump Removal and Installation” (Page 3A-6).

Propeller
Install the propeller.
Refer to “Propeller Removal and Installation” (Page 3A-4).

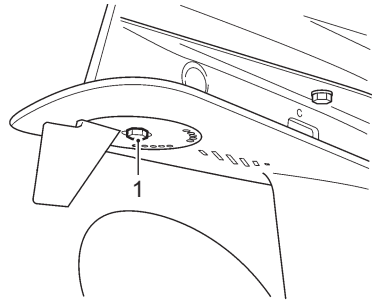
Lower Unit
Install the Lower Unit.
Refer to “Lower Unit Removal and Installation” (Page 3A-5).

Trim Tab Adjustment

Z9J0113106028

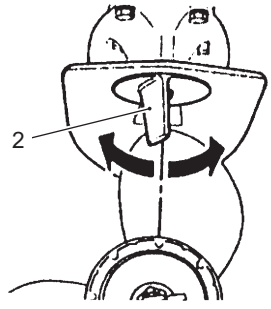
The trim tab counteracts or minimizes propeller torque pull felt through the steering system.
If the steering is pulls to the starboard or port side, adjust the trim tab with the following procedure.

1) Loosen the trim tab bolt (1).



I9J011310009-03

2) Changing the trim tab setting.
   - To compensate for a veer to starboard, set the trailing edge of tab (2) to the right (as viewed from behind).
   - To compensate for a veer to port, set the trailing edge of tab to the left.



I9J011310010-03

3) Tighten the bolt of trim tab.
4) Test drive 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.

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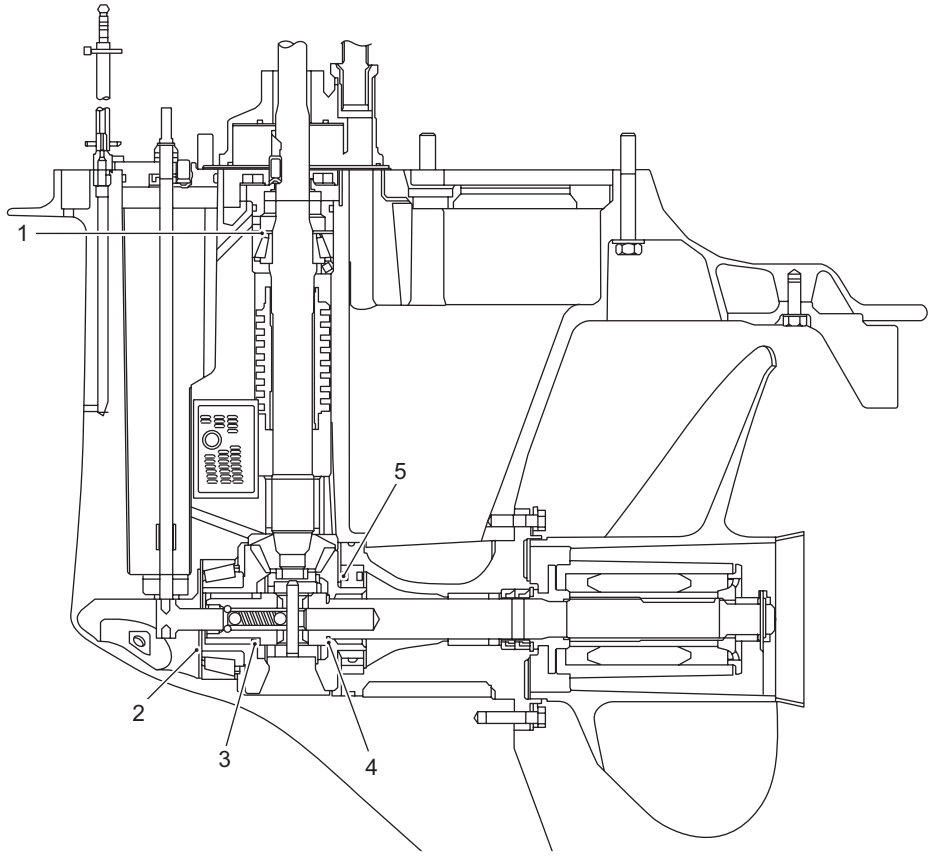
Lower Unit Gears - Shimming and Adjustment

Z9J0113106029

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

Shim / Washer and Mounting Position

Item	Available thickness (mm)	Design specification thickness (mm)
Pinion gear back up shim	**0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15**	**1.0**
Forward gear back up shim	**0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00**	**1.0**
Forward gear thrust washer	**3.0**	**3.0**
Propeller shaft reverse thrust washer	**0.5, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7**	**1.3**
Reverse gear back up shim	**0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05**	**1.0**



I9J011310011-04

1. Pinion gear back up shim	3. Forward gear thrust washer	5. Reverse gear back up shim
2. Forward gear back up shim	4. Propeller shaft reverse thrust washer	

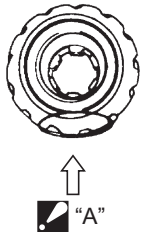
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Forward Gear / Pinion Gear Back-Up Shim Adjustment

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

Prior to adjustment

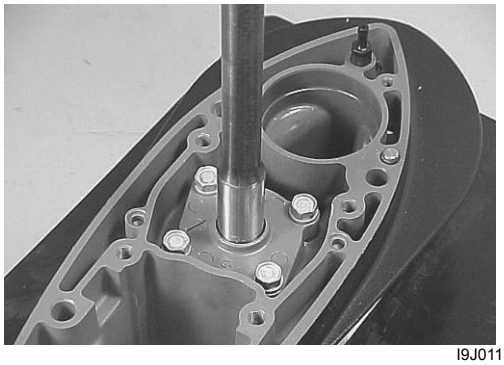
1) Install standard pinion gear back-up shim thickness according to ± design specification mark on the gear.



I9J011310012-01

"A":	± design spec. mark

2) Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. Refer to "Lower Unit Assembly" (Page 3A-16).
Do not install reverse gear at this time.



I9J011310104-01

3) Tighten pinion nut to specified torque.

Tightening torque
Pinion nut: 120 N·m (12.0 kgf-m, 86.8 lbf-ft)

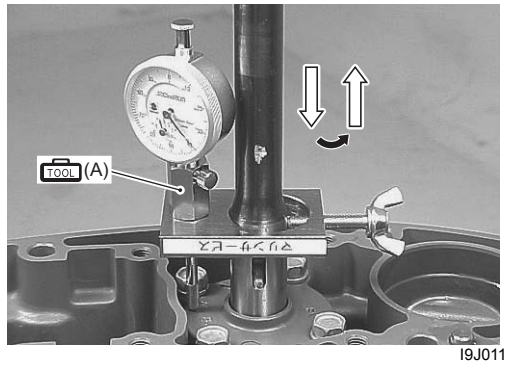
Checking driveshaft thrust play

1) Affix the gear adjusting gauge to driveshaft.

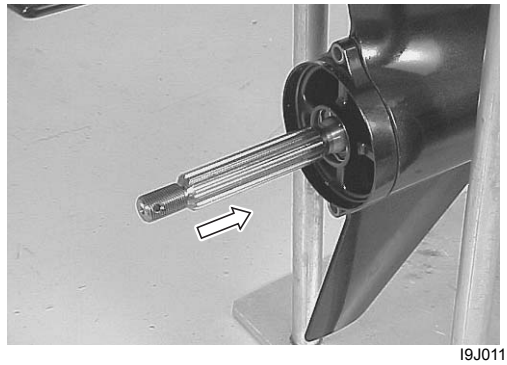
Special tool
TOOL (A): 09951–09530 (Gear adjusting gauge)

2) To check driveshaft thrust play, push the forward gear inward and hold it in this position. Slowly push the driveshaft downward completely, then slowly pull the driveshaft up and read the maximum thrust play.

Driveshaft thrust play
0.4 – 0.6 mm (0.016 – 0.023 in.)



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I9J011310105-01

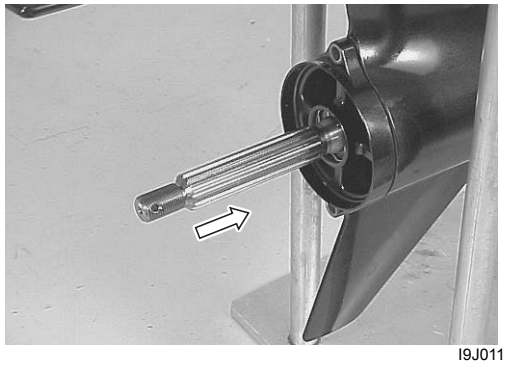
- If thrust play is larger than specified, the forward gear back-up shim thickness must be increased.
- If thrust play is smaller than specified, the forward gear back-up shim thickness must be decreased.

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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 the forward gear.
2) Install the propeller shaft and housing assembly (minus reverse gear and internal components).
3) Push the propeller shaft inward and hold it in position.

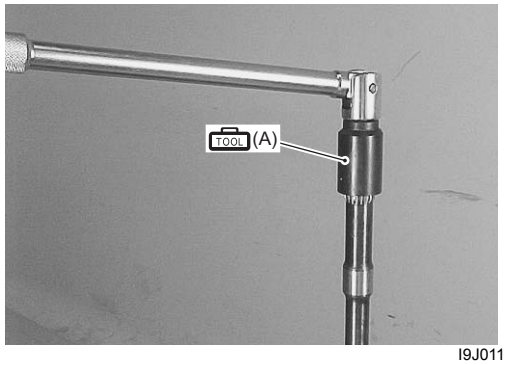


I9J011310105-01

4) Using the driveshaft holder tool, rotate the driveshaft 5 – 6 times.

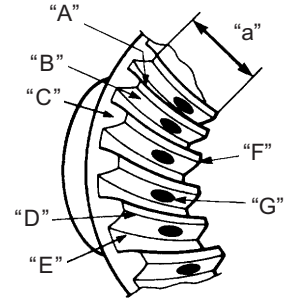
Special tool

TOOL (A): 09921–28710 (Driveshaft holder)



I9J011310106-01

5) Carefully remove the propeller shaft and housing to check the tooth contact pattern.



I9J011310013-02

“A”: Concave side	“E”: Tooth bottom
“B”: Convex side	“F”: Toe
“C”: Heel	“G”: Tooth contact pattern
“D”: Tooth top	“a”: Tooth width

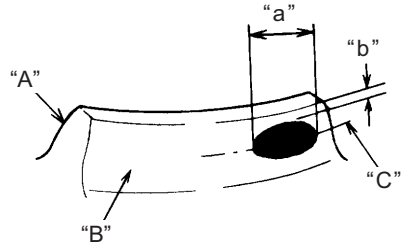
Optimum tooth contact

The optimum tooth contact is shown in the figure. A shim adjustment may be necessary to obtain this contact pattern.

CAUTION

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

Optimum tooth contact



I9J011310014-02

“A”: Heel	“a”: Approx. 1/3 of tooth width
“B”: Convex side	“b”: Approx. 1 mm
“C”: Toe	

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Example [A]
Incorrect topside toe contact.
Correction measures.

- Decrease thickness of forward gear shim.
- Slightly increase pinion gear shim thickness.

CAUTION

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

Example of incorrect



I9J011310015-01

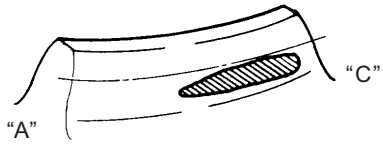
Example [B]
Incorrect bottom side toe contact.
Correction measures.

- Increase thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.

CAUTION

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

Example of incorrect

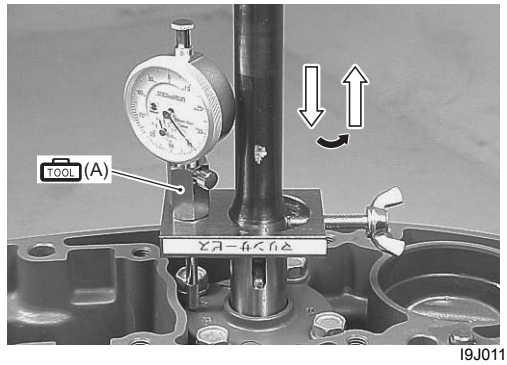


I9J011310016-01

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

1) Affix the gear adjusting gauge to the driveshaft.

Special tool
(A): 09951–09530 (Gear adjusting gauge)



I9J011310085-01

2) To check driveshaft thrust play, push the forward gear inward and hold it in this position.
Push the driveshaft down completely, then slowly pull the driveshaft up and read the maximum thrust play.
Designate this amount of play as "A".

NOTE

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

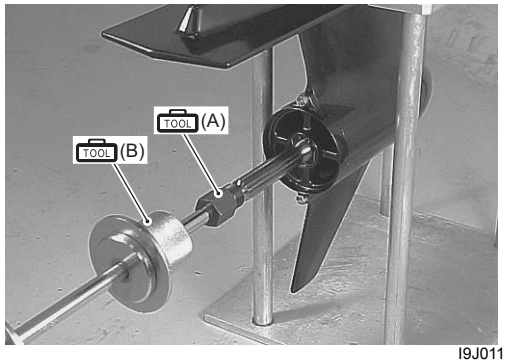
Driveshaft thrust play
0.4 – 0.6 mm (0.016 – 0.023 in.)

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Reverse Gear Back-Up Shim Adjustment
After adjusting the forward gear tooth contact pattern, follow the procedure below to adjust the reverse gear.

1) Correctly assemble and install reverse gear, propeller shaft, propeller shaft bearing housing and related components.
2) Screw a slide hammer assembly onto the propeller shaft and strike it a few gentle outward taps.

Special tool
(A): 09930–30161 (Propeller shaft remover)
(B): 09930–30104 (Sliding hammer)

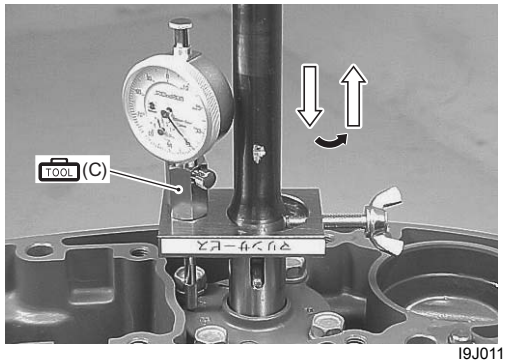


I9J011310107-01

3) Affix the gear adjusting gauge to driveshaft.

Special tool
(C): 09951–09530 (Gear adjusting gauge)

4) Slowly push the driveshaft downward completely, then slowly pull the driveshaft up and read the maximum thrust play. Designate this measurement as play “B”.



I9J011310108-01

5) Compare play “B” to play “A”.
Refer to “Rechecking driveshaft thrust play” (Page 3A-27).
6) Reverse gear back-up shim adjustment is correct if “B” is equal to “A”.
If “B” is less than “A”, reduce reverse gear back-up shim thickness.

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

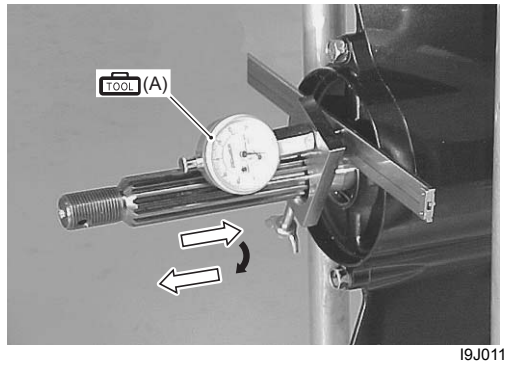
NOTE

Maintain the forward gear thrust washer at standard thickness (3.0 mm) and use only the reverse gear thrust washer to adjust thrust play.

Propeller shaft thrust play
Approx. 0.2 – 0.4 mm (0.01 – 0.02 in.)

1) Assemble the gear adjusting gauge to the propeller shaft.

Special tool
(A): 09951–09530 (Gear adjusting gauge)



I9J011310094-02

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

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Section 4

Wire / Hose Routing

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Precautions

Precautions

Precautions for Wire / Hose Routing

Z9J0114000001

Refer to “General Precautions” in Section 00 (Page 00-1).

Component Location

Electrical Component Location

Z9J0114003001

Refer to “Engine Control System Components / Engine Electrical Device Location” in Section 1A (Page 1A-15).

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Wire Routing

Schematic and Routing Diagram

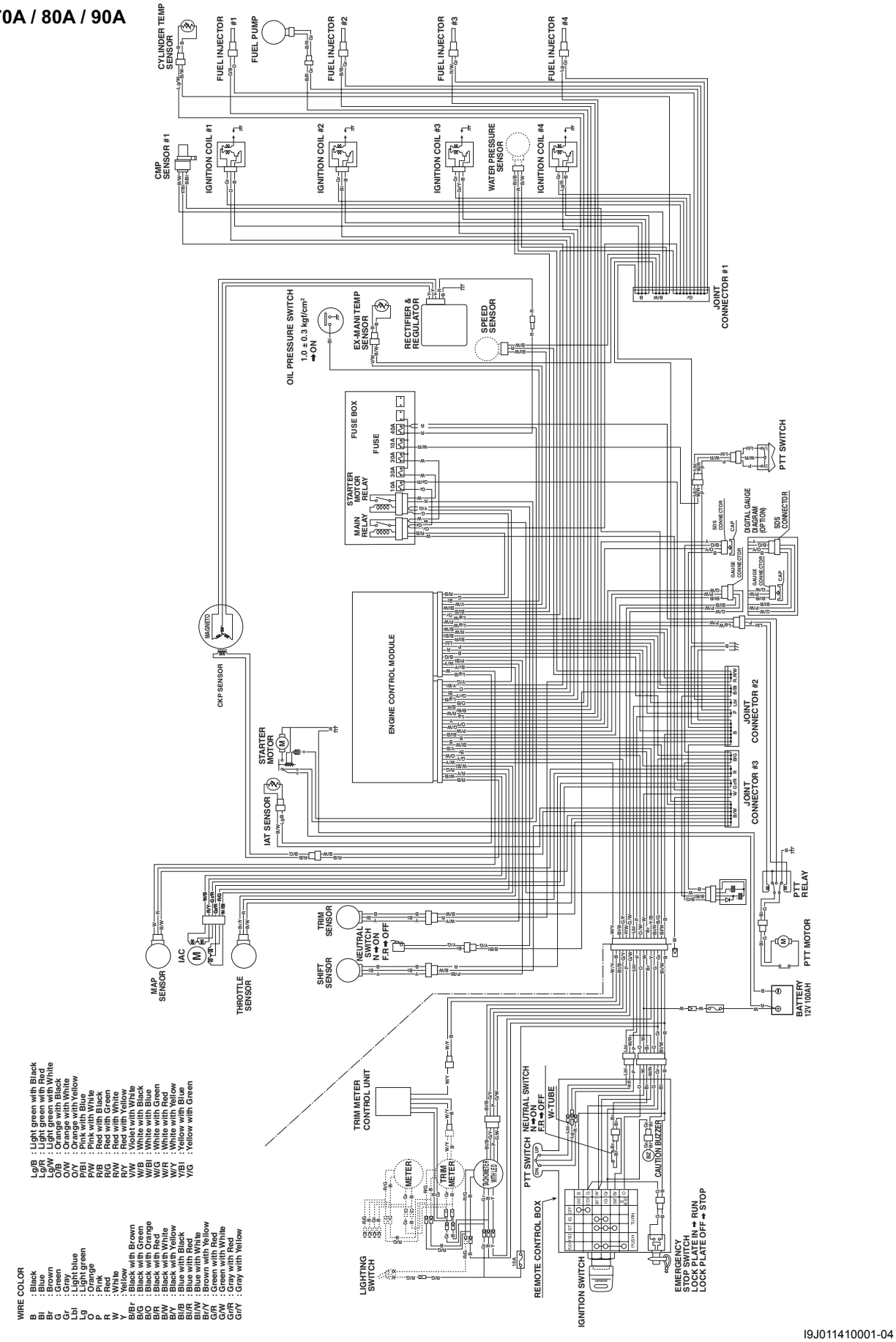
Wiring Diagram

Z9J0114102004

Refer to “Wire Color Symbols” in Section 0A (Page 0A-2).

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DF70A / 80A / 90A

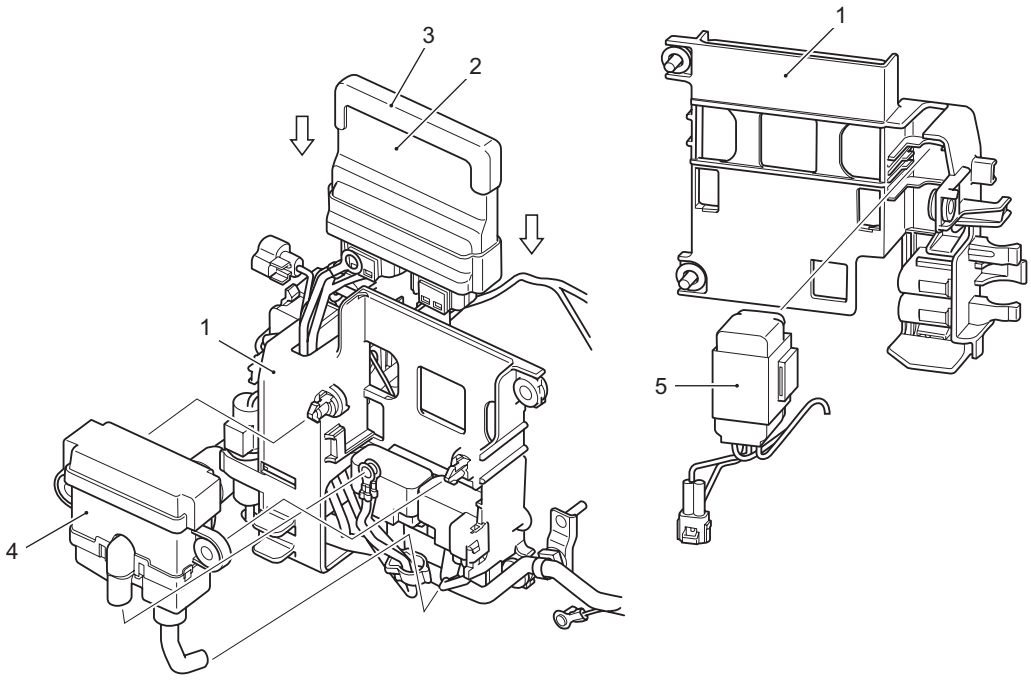


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Wiring Harness Routing Diagram

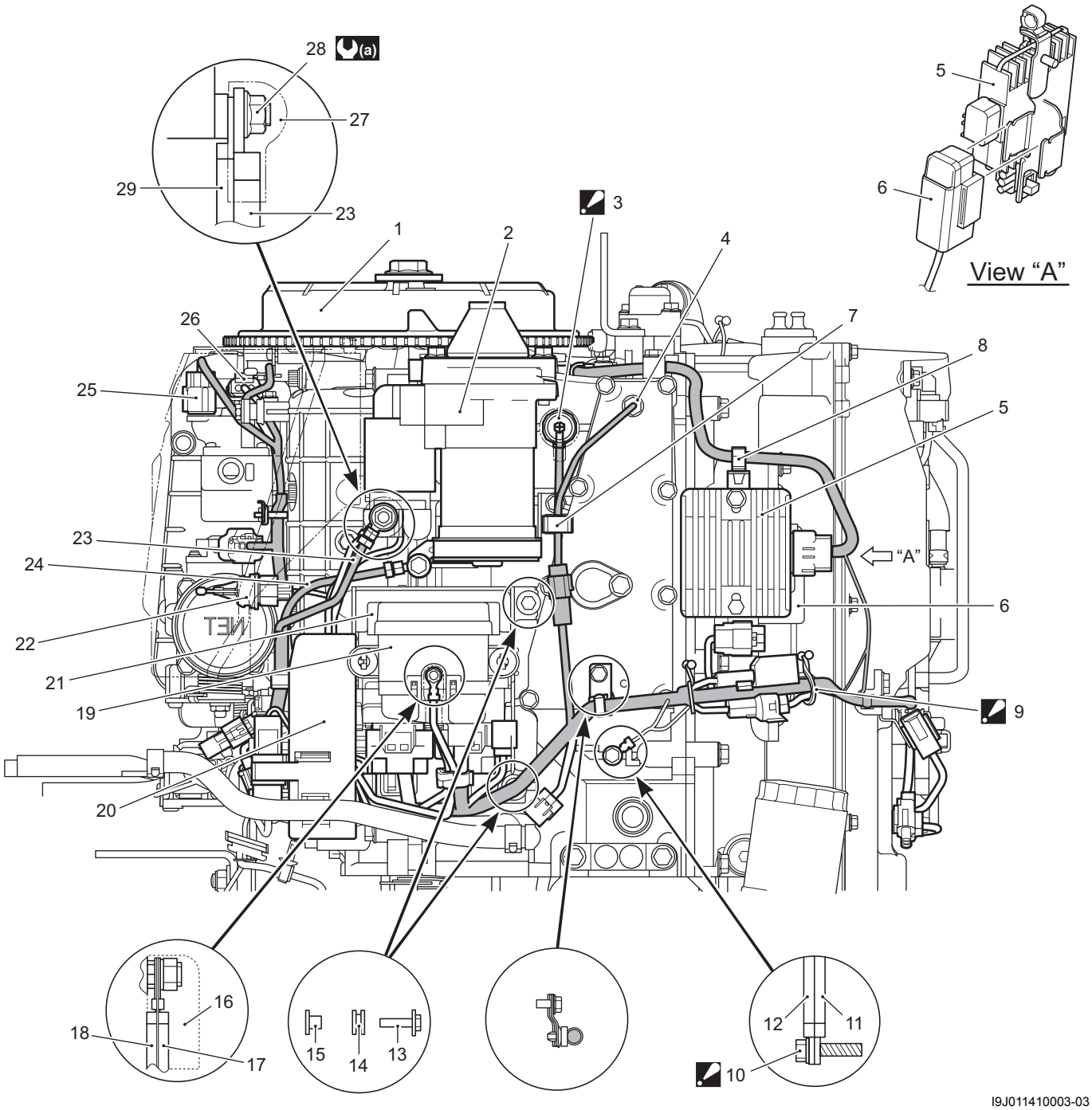
Z9J0114102003



I9J011410002-01

1. Electric parts holder	3. Cushion	5. PTT motor relay
2. ECM	4. Fuse box	

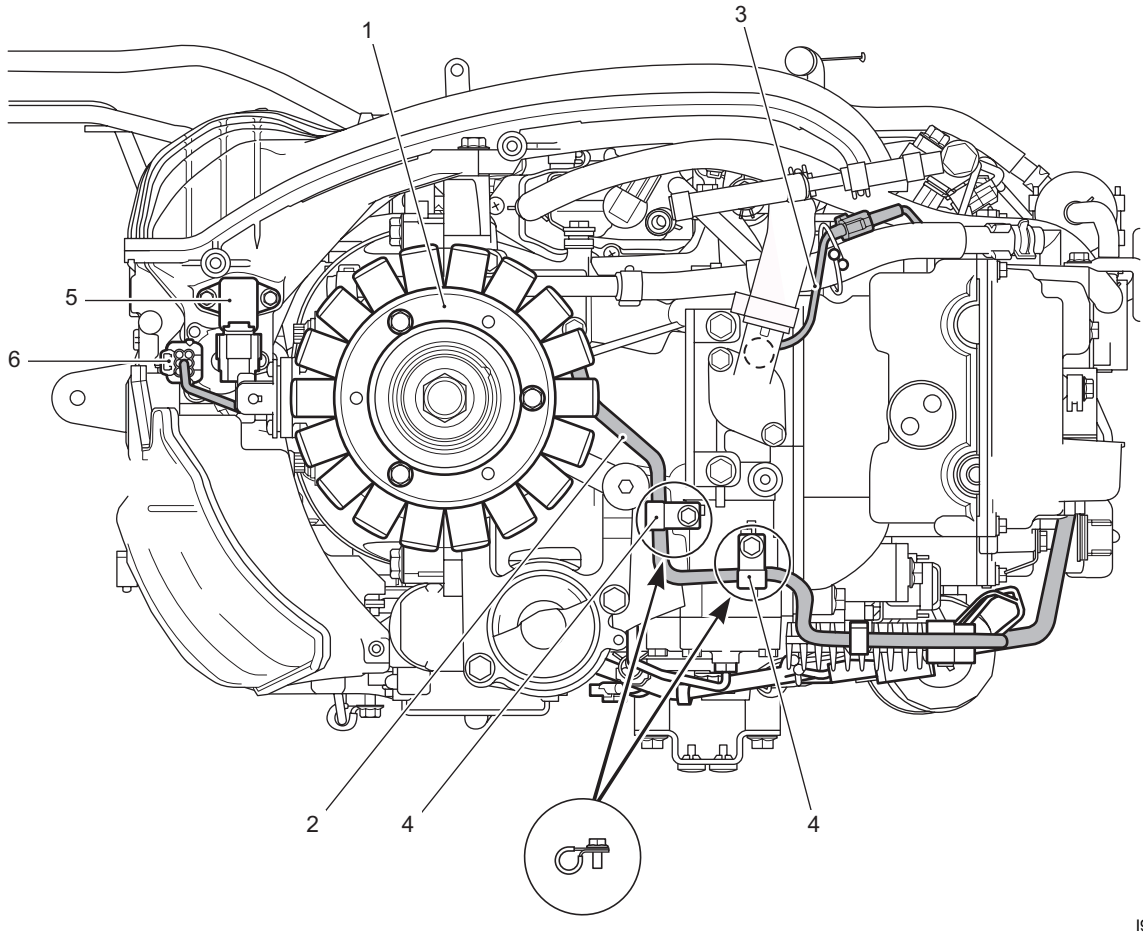
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I9J011410003-03

1. Flywheel	11. Rectifier/Regulator GND lead wire	21. ECM
2. Starter motor	12. Main harness GND lead wire	22. IAT sensor
3. Oil pressure switch : Cover the oil pressure switch with cap.	13. Bolt	23. Battery cable (+)
4. Ex. mani. temp. sensor	14. Cushion	24. Battery cable (–)
5. Rectifier/Regulator	15. Washer	25. IAC valve
6. Main harness capacitor	16. Cap	26. MAP sensor
7. Clamp	17. Main harness (Red)	27. Cap
8. Clamp	18. PTT relay lead wire (Red)	28. Nut
9. Clamp : Bind the main harness, rectifier lead wire and capacitor harness.	19. Fuse box	29. Main harness (Red)
10. Bolt : Tighten bolt with harness GND lead and Rectifier GND lead wire.	20. Electric parts holder	(a) : 8.6 N·m (0.86 kgf-m, 6.2 lbf-ft)

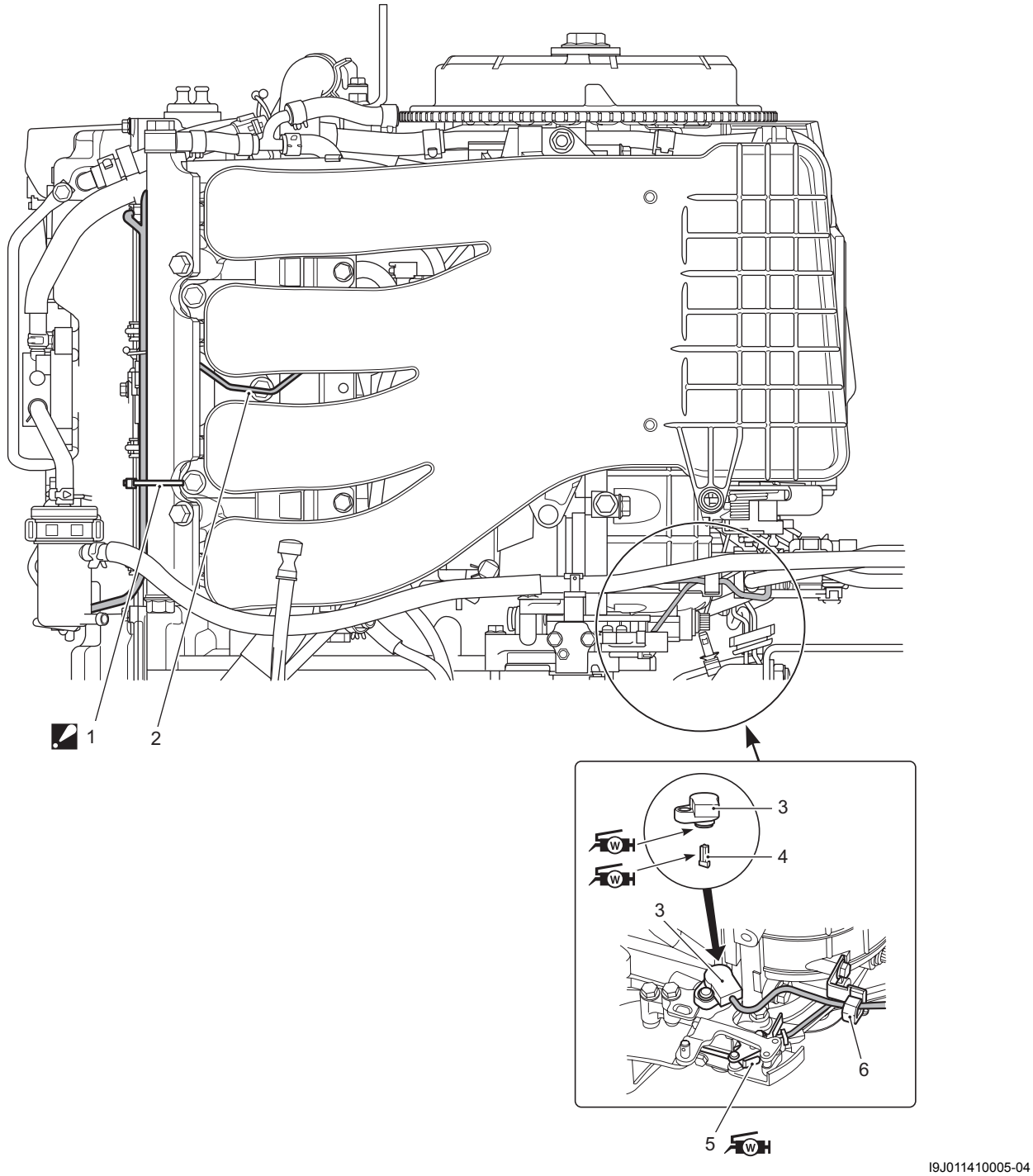
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I9J011410004-02

1. Battery charge coil	3. Cylinder temp. sensor lead wire	5. MAP sensor
2. Battery charge coil lead wire	4. Clamp	6. IAC valve

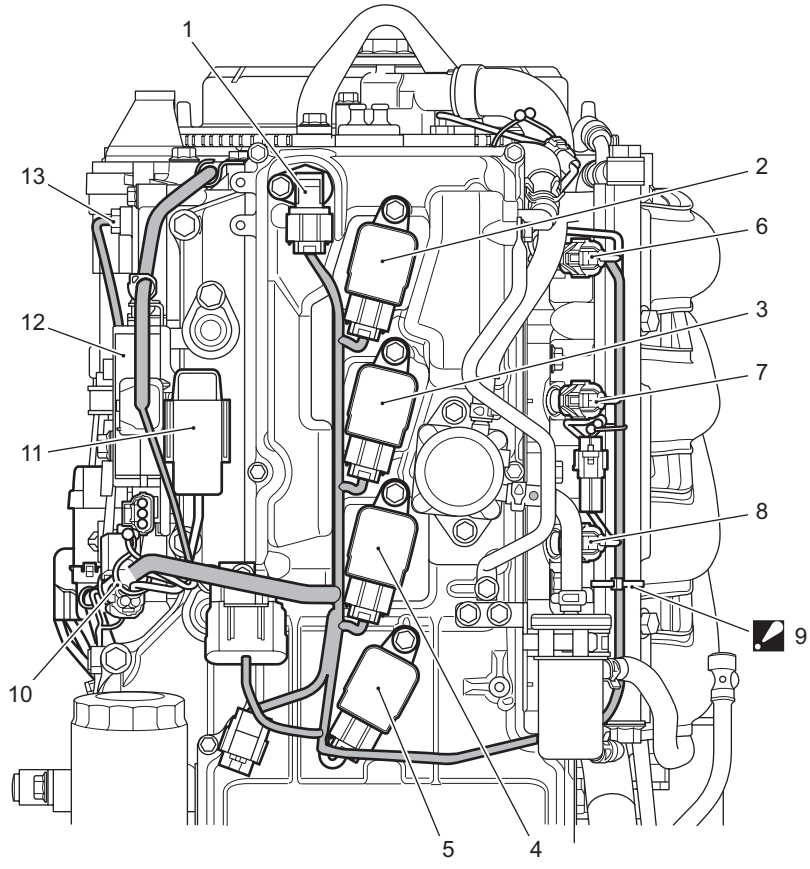
http://SelfFixer.com



I9J011410005-04

1. Clamp : Fix the harness with clamp.	3. Shift position sensor	5. Neutral switch
2. High pressure fuel pump sub lead wire	4. Shift position sensor lever	6. Clamp

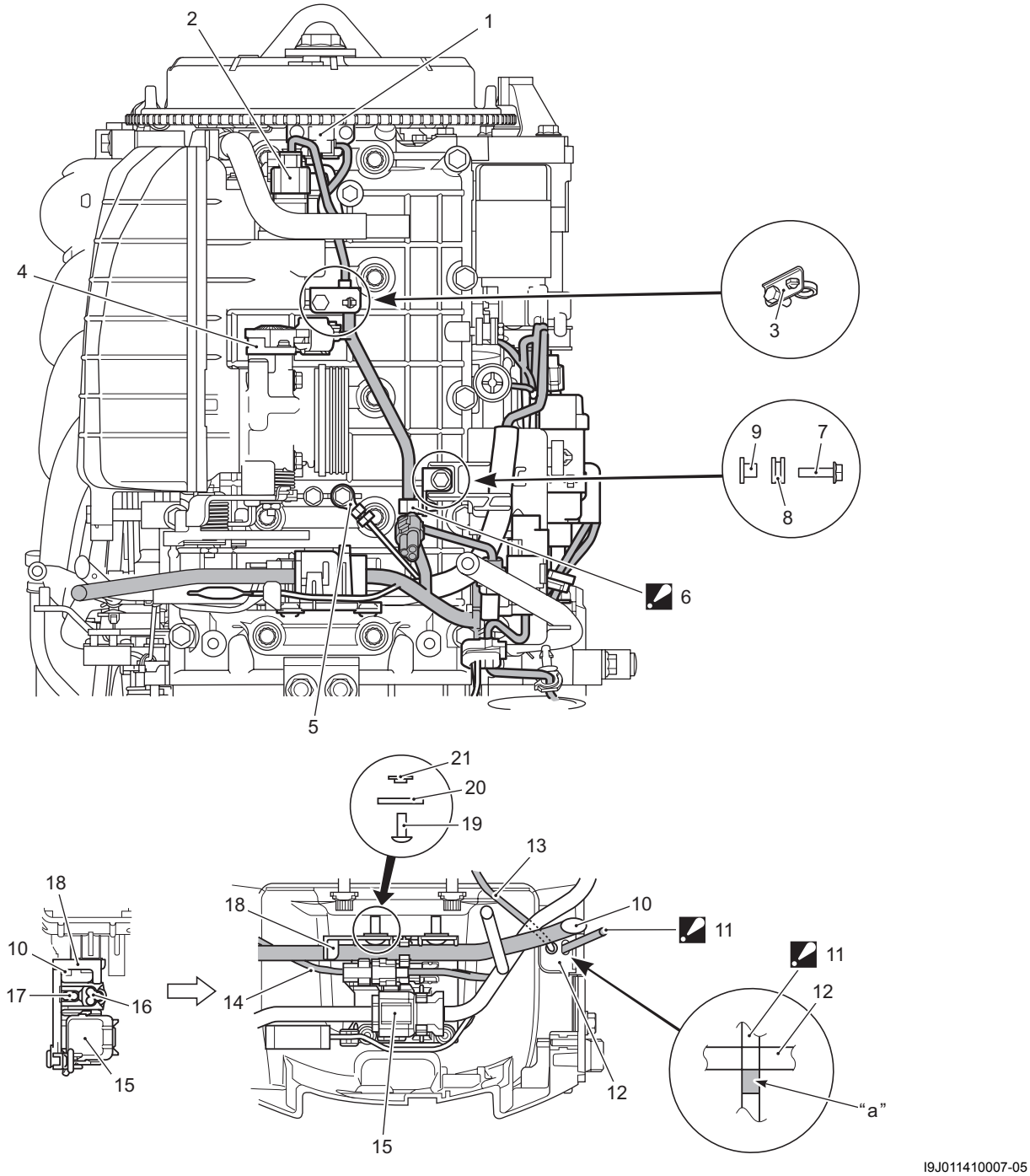
http://SelfFixer.com



I9J011410006-02

1. CMP sensor	5. No.4 Ign. coil	9. Clamp : Fix the harness with clamp.	13. Ex. mani. temp. sensor
2. No.1 Ign. coil	6. No.1 fuel injector	10. Clamp	
3. No.2 Ign. coil	7. No.2 fuel injector	11. Main harness capacitor	
4. No.3 Ign. coil	8. No.3 fuel injector	12. Rectifier/Regulator	

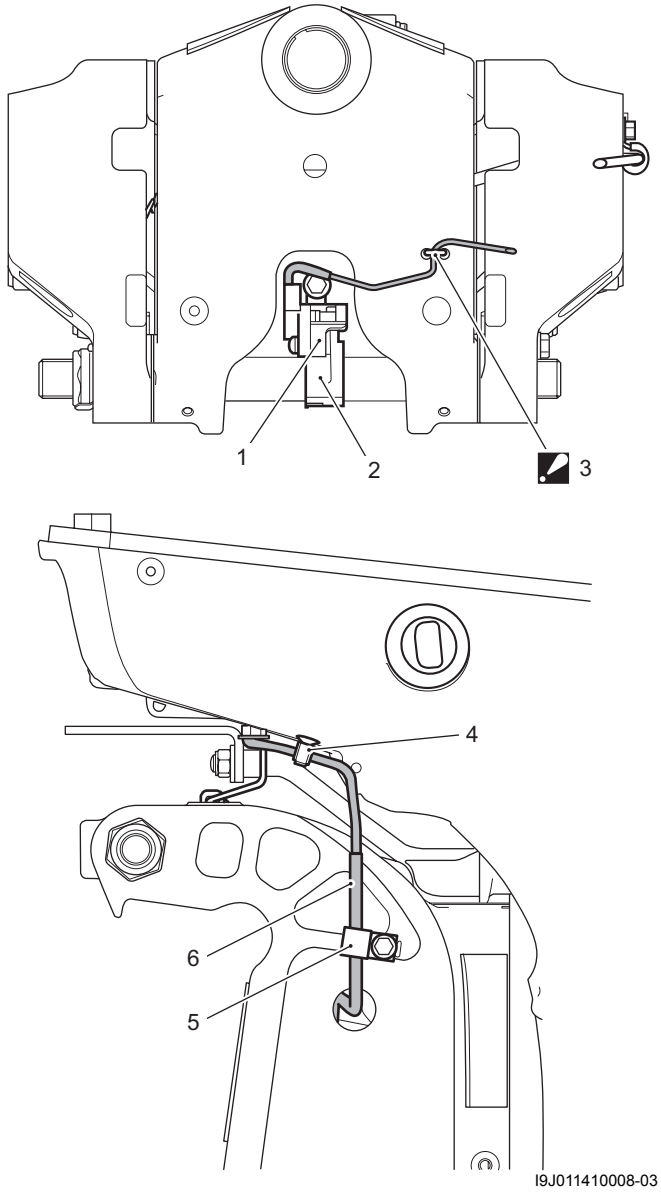
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I9J011410007-05

1. CKP sensor	8. Cushion	15. Remote control harness connector
2. IAC valve	9. Washer	16. 3-pin connector
3. Harness clamp	10. Battery cable	17. 2-pin connector
4. TPS	11. PTT cable : Set the taping position “a” as shown.	18. Cable holder
5. PTT relay GND lead wire	12. Grommet	19. Screw
6. Clamp : Bind CKP sensor lead wire and main harness.	13. Trim sensor lead wire	20. Holder
7. Bolt	14. Neutral switch and shift sensor lead wire	21. Washer

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1. Trim sensor	3. Clamp : Fix the trim sensor lead wire at white taping position.	5. Clamp
2. Trim sensor cam	4. Clamp	6. PTT motor cable

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Fuel / Water Hose Routing

Precautions

Precautions for Fuel / Water Hose Routing

Z9J0114200001

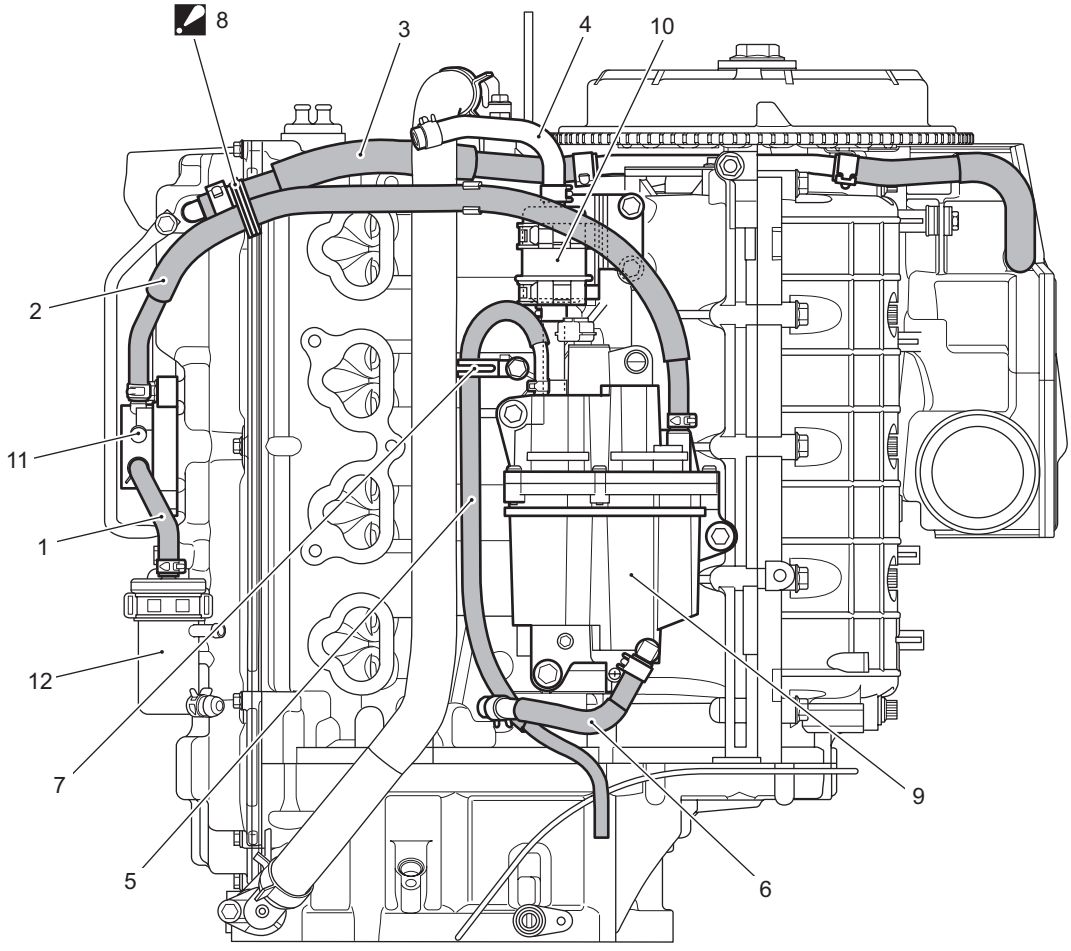
CAUTION

- **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.**

Schematic and Routing Diagram

Fuel Hose Routing

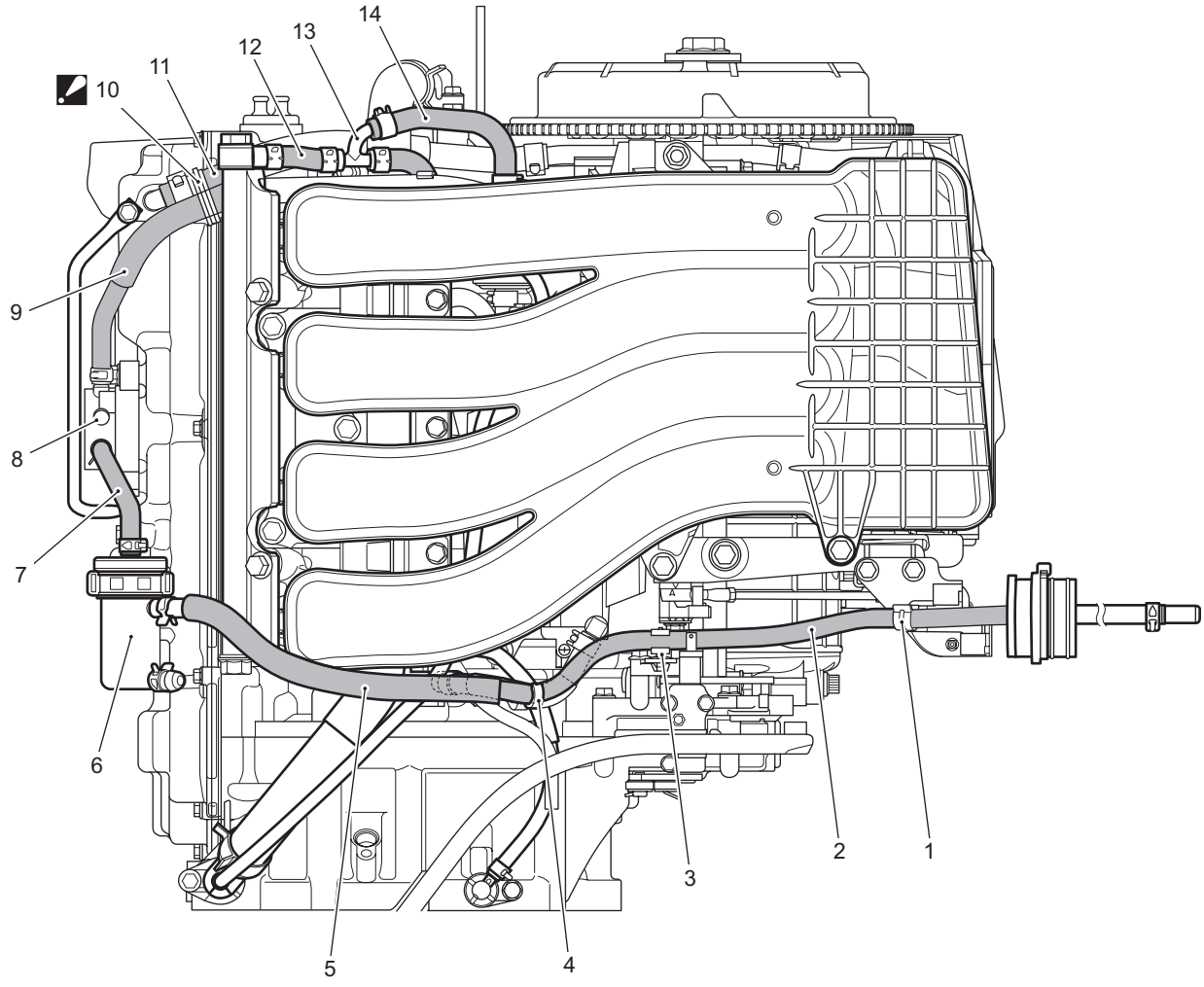
Z9J0114202001



I9J011420001-02

1. Fuel hose (Filter to fuel pump)	5. Evaporation hose / protector	9. Fuel vapor separator
2. Fuel hose / protector (Pump to fuel vapor separator)	6. Fuel hose (Fuel cooler to fuel vapor separator)	10. High pressure fuel filter
3. Breather hose / protector	7. Clamp	11. Low pressure fuel pump
4. Fuel hose (High pressure fuel filter to 3-way joint)	8. Clamp : Clamp the fuel hose (2) and (3).	12. Low pressure fuel filter

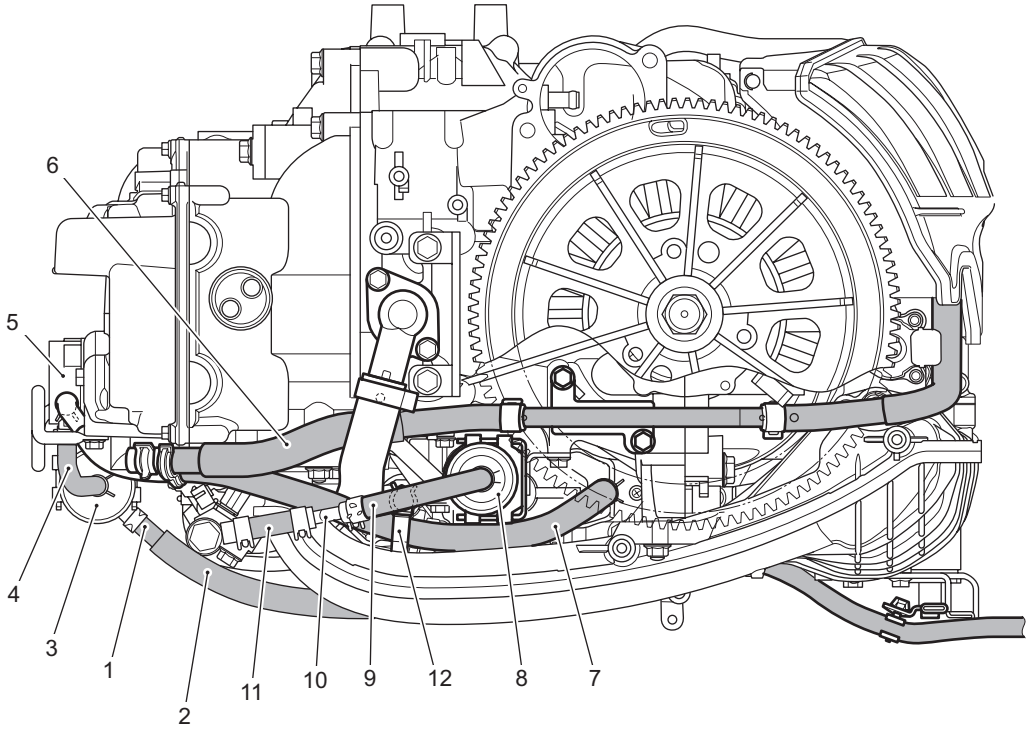
http://SelfFixer.com



I9J011420002-02

1. Clamp	6. Low pressure fuel filter	11. Breather hose
2. Fuel hose (Joint to low pressure fuel filter)	7. Fuel hose (Filter to fuel pump)	12. Fuel hose (3-way joint to fuel delivery pipe)
3. Clamp	8. Low pressure fuel pump	13. 3-way joint
4. Clamp	9. Fuel hose / protector (Fuel pump to fuel vapor separator)	14. Fuel hose (High pressure fuel filter to 3-way joint)
5. Fuel hose protector	10. Clamp : Clamp the fuel hose (9) and breather hose (11).	

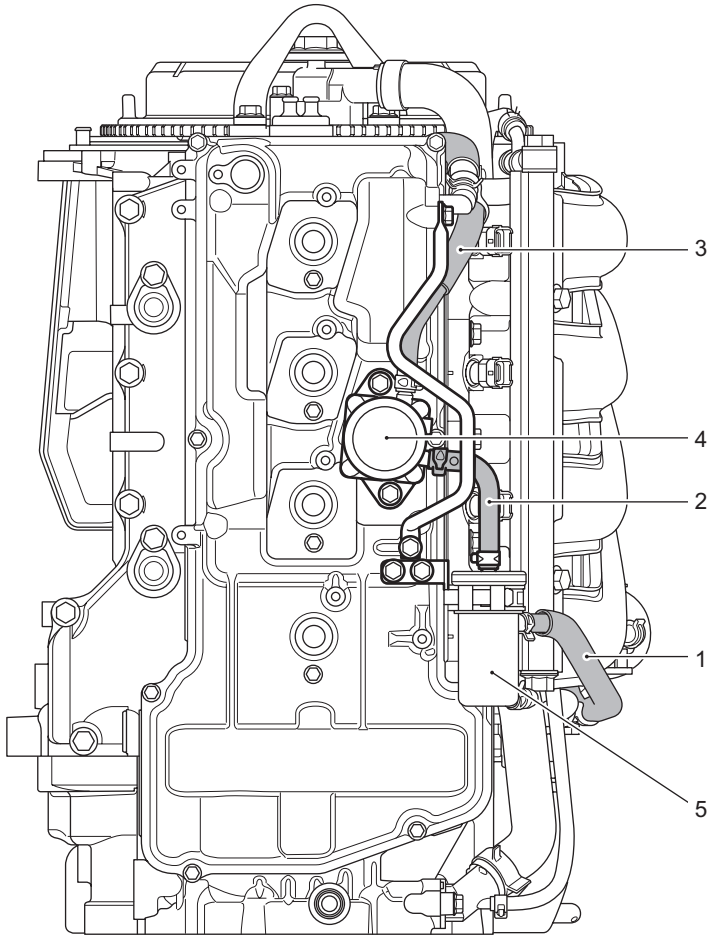
http://SelfFixer.com



I9J011420003-01

1. Fuel hose (Joint to low pressure fuel filter)	5. Low pressure fuel pump	9. Fuel hose (High pressure fuel filter to 3-way joint)
2. Fuel hose protector	6. Breather hose/protector	10. 3-way joint
3. Low pressure fuel filter	7. Fuel hose (Fuel pump to fuel vapor separator)	11. Fuel hose (3-way joint to fuel delivery pipe)
4. Fuel hose (Fuel filter to fuel pump)	8. High pressure fuel filter	12. Clip

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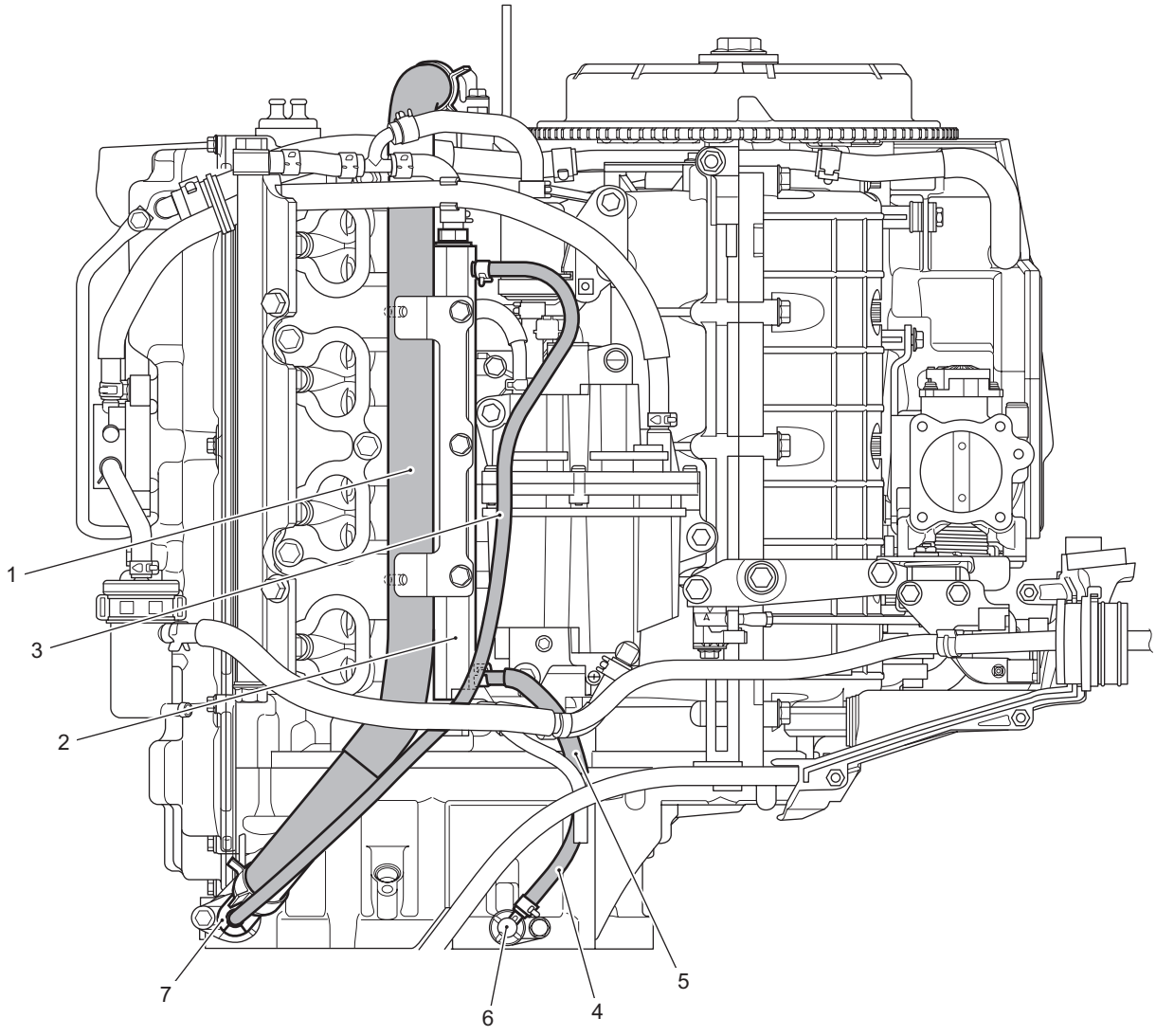
I9J011420004-01

1. Fuel hose / protector (Joint to low pressure fuel filter)	3. Fuel hose (Fuel pump to fuel vapor separator)	5. Low pressure fuel filter
2. Fuel hose (Fuel filter to fuel pump)	4. Low pressure fuel pump	

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Water Hose Routing

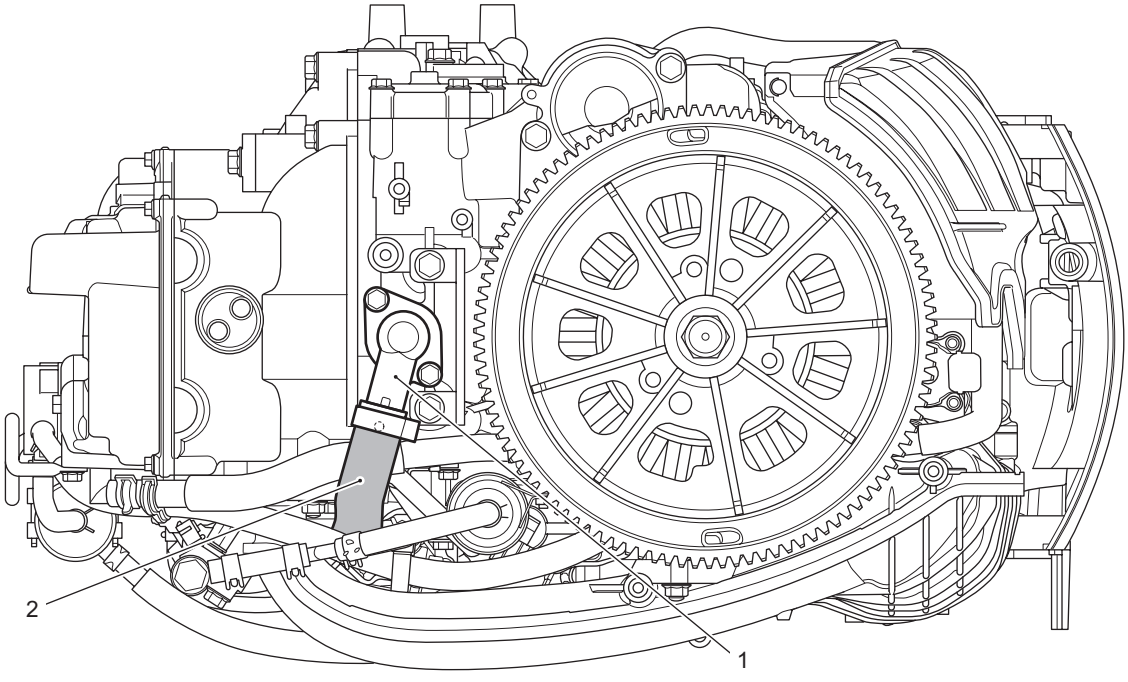
Z9J0114202002



I9J011420005-02

1. Water return hose	4. Water hose (Union to fuel cooler)	7. Water return union
2. Fuel cooler	5. Water hose protector	
3. Water hose (Fuel cooler to water return union)	6. Water union	

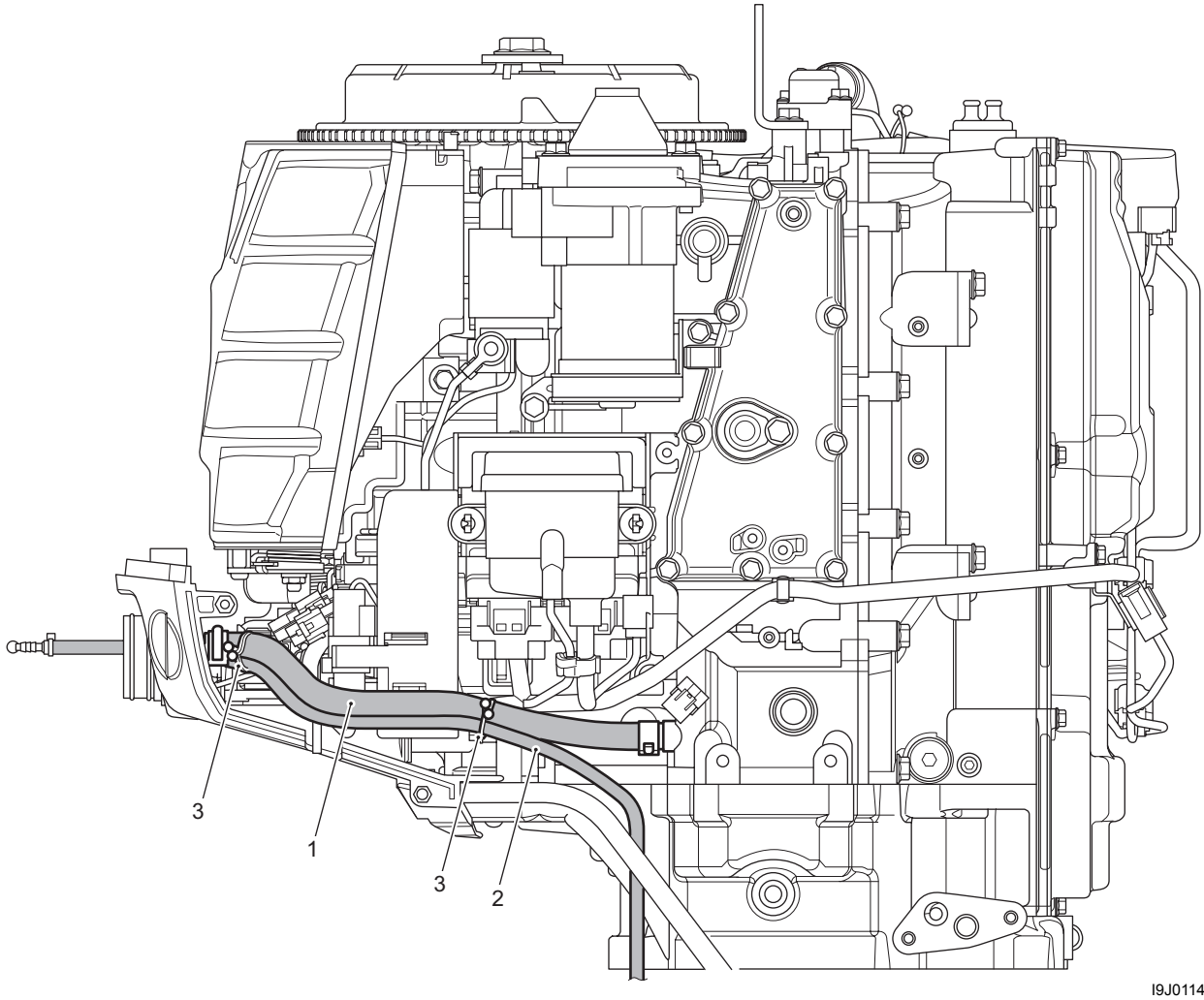
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I9J011420006-02

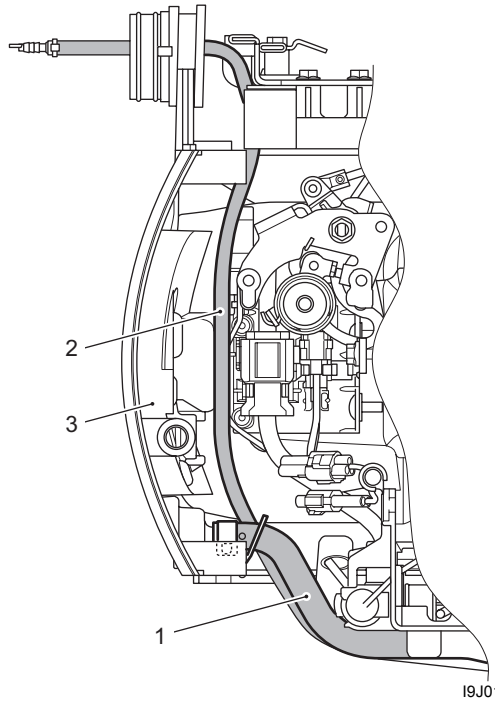
1. Thermostat cover	2. Water return hose

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I9J011420007-01

1. Water flush hose	2. Speed meter hose	3. Clamp



I9J011420008-01

1. Water flush hose	2. Speed meter hose	3. Front panel

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