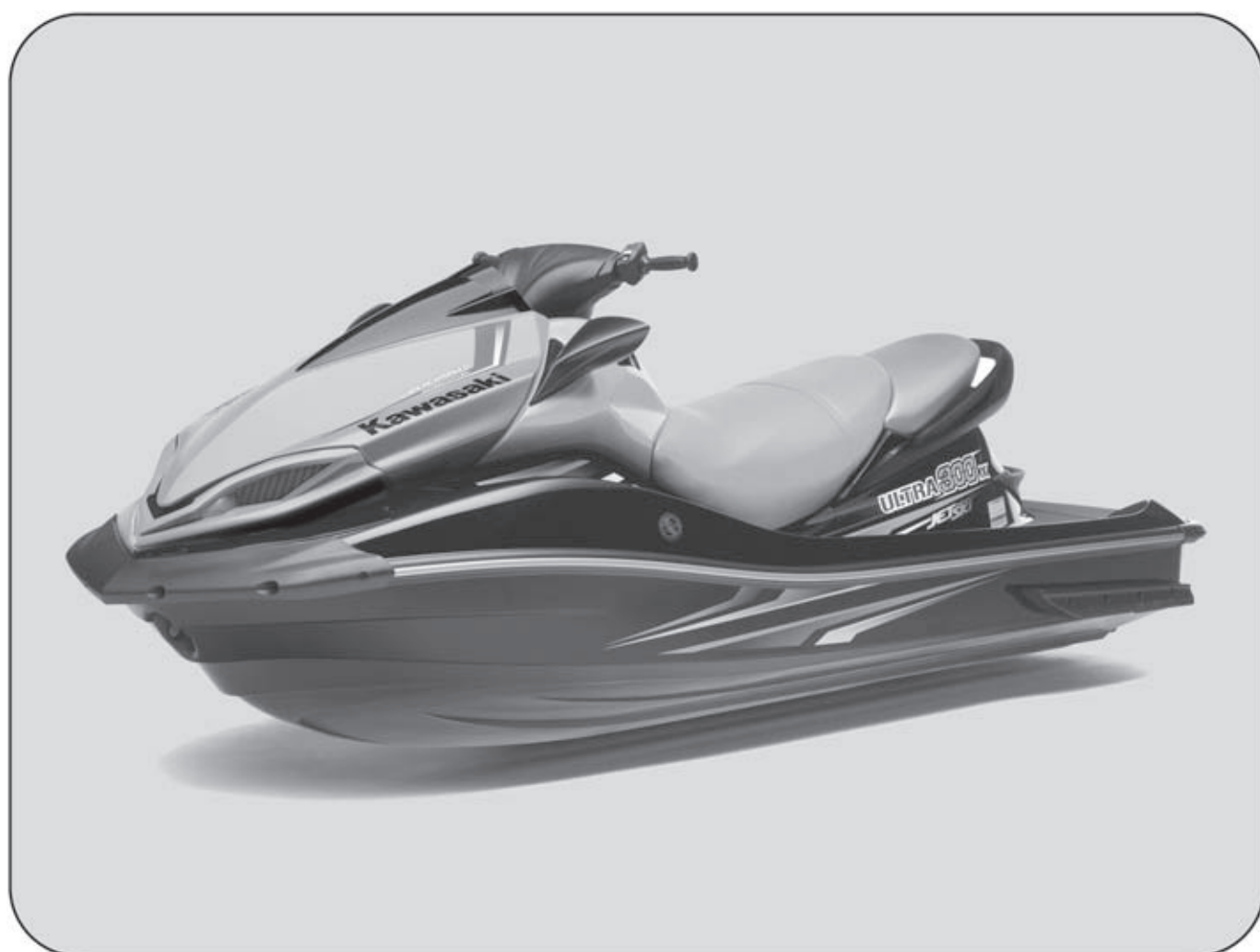




JETSKI®
watercraft

ULTRA 300X
ULTRA 300LX



JET SKI® Watercraft Service Manual

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Quick Reference Guide

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This quick reference guide will assist you in locating a desired topic or procedure.

- Bend the pages back to match the black tab of the desired chapter number with the black tab on the edge at each table of contents page.
- Refer to the sectional table of contents for the exact pages to locate the specific topic required.



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JET SKI® Watercraft Service Manual

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The right is reserved to make changes at any time without prior notice and without incurring an obligation to make such changes to products manufactured previously. See your JET SKI® watercraft dealer for the latest information on product improvements incorporated after this publication.

All information contained in this publication is based on the latest product information available at the time of publication. Illustrations and photographs in this publication are intended for reference use only and may not depict actual model component parts.

LIST OF ABBREVIATIONS

A	ampere(s)	KDS	Kawasaki Diagnostic System
ABDC	after bottom dead center	km/h	kilometers per hour
AC	alternating current	L	liter(s)
Ah	ampere hour	lb	pound(s)
APS	Accelerator Position Sensor	LCD	Liquid Crystal Display
ATDC	after top dead center	LED	Light Emission Diode
BBDC	before bottom dead center	LSI	Large Scale Integration
BDC	bottom dead center	m	meter(s)
BTDC	before top dead center	min	minute(s)
°C	degree(s) Celsius	mph	miles per hour
cmHg	centimeters of mercury	N	newton(s)
CPU	Central Processing Unit	O.D.	Outside Diameter
cu in	Cubic inch(s)	oz	ounce(s)
DC	direct current	Pa	pascal(s)
DFI	Digital Fuel Injection	PS	horsepower
ECU	Electronic Control Unit	psi	pound(s) per square inch
ETV	Electronic Throttle Valve	qt	quart(s)
F	farad(s)	r	revolution
°F	degree(s) Fahrenheit	rpm	revolution(s) perminute
FPO	Full Power Operation	s	second(s)
ft	foot, feet	SLO	Smart Learning Operation
g	gram(s)	TDC	top dead center
gal	gallon(s)	TIR	total indicator reading
h	hour(s)	TPS	Throttle Position Sensor
HP	horsepower(s)	TVS	Twin Vortices Series
IC	Integrated Circuit	V	volt(s)
in.	inch(s)	W	watt(s)
ISC	Idle Speed Control	Ω	ohm(s)

COUNTRY AND AREA CODES

AT	Austria	DE	Germany
AU	Australia	EUR	Europe
CA	Canada	GB	United Kingdom
CAL	California	US	United States
CH	Switzerland	WVTA	Whole Vehicle Type Approval

MAINTENANCE AND ADJUSTMENTS

Maintenance, replacement, or repair of the emission control devices and systems may be performed by any marine SI engine repair establishment or individual.

EMISSION CONTROL INFORMATION

Fuel Information

THIS ENGINE IS CERTIFIED TO OPERATE ON UNLEADED GRADE GASOLINE ONLY.

A minimum of 90 octane (US, CA Models), 95 octane (Other than US, CA Models) of the antiknock index is recommended. The antiknock index is posted on service station pumps.

Emission Control Information

To protect the environment in which we all live, Kawasaki has incorporated an exhaust emission control system in compliance with applicable regulations of the United States Environmental Protection Agency and California Air Resources Board.

Exhaust Emission Control System

This system reduces the amount of pollutants discharged into the atmosphere by the exhaust of this engine. The fuel, ignition and exhaust systems of this engine have been carefully designed and constructed to ensure an efficient engine with low exhaust pollutant levels.

Evaporative Emission Control System

The evaporative emission control system for this watercraft consists of low permeation fuel hoses.

Maintenance

Proper maintenance and repair are necessary to ensure that watercraft will continue to have low emission levels. This Service Manual contains those maintenance and repair recommendations for this engine. Those items identified by the Periodic Maintenance Chart are necessary to ensure compliance with the applicable standards.

Tampering with Emission Control System Prohibited

Federal law prohibits the following acts or the causing thereof: (1) the removal or rendering inoperative by any person other than for purposes of maintenance, repair, or replacement, of any device or element of design incorporated into any new engine for the purposes of emission control prior to its sale or delivery to the ultimate purchaser or while it is in use, or (2) the use of the engine after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the acts listed below:

Do not tamper with the original emission related parts.

- * Fuel Pump
- * Spark Plugs
- * Fuel Injectors
- * ECU
- * Supercharger with intercooler & relief-valves

Foreword

This manual is designed primarily for use by trained mechanics in a properly equipped shop. However, it contains enough detail and basic information to make it useful to the owner who desires to perform his own basic maintenance and repair work. A basic knowledge of mechanics, the proper use of tools, and workshop procedures must be understood in order to carry out maintenance and repair satisfactorily. Whenever the owner has insufficient experience or doubts his ability to do the work, all adjustments, maintenance, and repair should be carried out only by qualified mechanics.

In order to perform the work efficiently and to avoid costly mistakes, read the text, thoroughly familiarize yourself with the procedures before starting work, and then do the work carefully in a clean area. Whenever special tools or equipment are specified, do not use makeshift tools or equipment. Precision measurements can only be made if the proper instruments are used, and the use of substitute tools may adversely affect safe operation.

For the duration of the warranty period, we recommend that all repairs and scheduled maintenance be performed in accordance with this service manual. Any owner maintenance or repair procedure not performed in accordance with this manual may void the warranty.

To get the longest life out of your JET SKI® watercraft:

- Follow the Periodic Maintenance Chart in the Service Manual.
- Be alert for problems and non-scheduled maintenance.
- Use proper tools and genuine Kawasaki JET SKI® watercraft parts. Special tools, gauges, and testers that are necessary when servicing Kawasaki JET SKI® watercraft are introduced by the Service Manual. Genuine parts provided as spare parts are listed in the Parts Catalog.

- Follow the procedures in this manual carefully. Don't take shortcuts.
- Remember to keep complete records of maintenance and repair with dates and any new parts installed.

How to Use This Manual

In this manual, the product is divided into its major systems and these systems make up the manual's chapters. The Quick Reference Guide shows you all of the product's system and assists in locating their chapters. Each chapter in turn has its own comprehensive Table of Contents.

For example, if you want ignition coil information, use the Quick Reference Guide to locate the Electrical System chapter. Then, use the Table of Contents on the first page of the chapter to find the Ignition Coil section.

Whenever you see these WARNING and CAUTION symbols, heed their instructions! Always follow safe operating and maintenance practices.

WARNING

This warning symbol identifies special instructions or procedures which, if not correctly followed, could result in personal injury, or loss of life.

CAUTION

This caution symbol identifies special instructions or procedures which, if not strictly observed, could result in damage to or destruction of equipment.

This manual contains four more symbols (in addition to WARNING and CAUTION) which will help you distinguish different types of information.

NOTE

○ *This note symbol indicates points of particular interest for more efficient and convenient operation.*

● Indicates a procedural step or work to be done.

○ Indicates a procedural sub-step or how to do the work of the procedural step it follows. It also precedes the text of a NOTE.

★ Indicates a conditional step or what action to take based on the results of the test or inspection in the procedural step or sub-step it follows.

In most chapters an exploded view illustration of the system components follows the Table of Contents. In these illustrations you will find the instructions indicating which parts require specified tightening torque, oil, grease or a locking agent during assembly.

This model, JT1500H/J, is mounted with a four-stroke engine with supercharger.

When the JET SKI® watercraft is submerged and swamped, the four-stroke engine needs special care and systematic procedure for recovery compared with the two-stroke engine. Therefore in this manual, such procedures, which are not shown in SMs for two-stroke engines, are explained thoroughly to cope with the cases.

Refer to the section, After submerging in Chapter 9, Cooling and Bilge Systems for the summary and detailed procedures.

General Information

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1-2 GENERAL INFORMATION

Before Servicing

Before starting to perform an inspection service or carry out a disassembly and reassembly operation on watercraft, read the precautions given below. To facilitate actual operations, notes, illustrations, photographs, cautions, and detailed descriptions have been included in each chapter wherever necessary. This section explains the items that require particular attention during the removal and reinstallation or disassembly and reassembly of general parts.

Especially note the following:

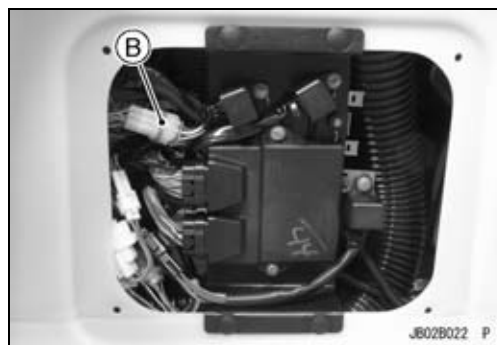
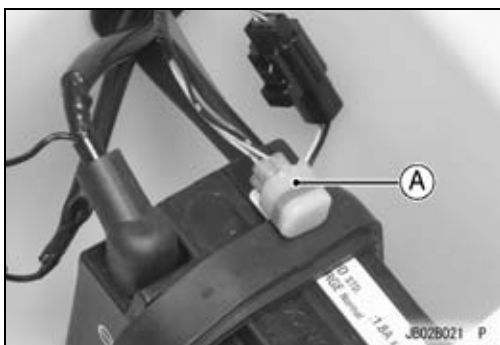
Kawasaki Diagnostic System (KDS) Software

KDS software that runs on Windows personal computer (PC) will be available as a diagnostic tool for watercraft with Kawasaki DFI system.

You need the following items to use the KDS.

Item	P/No.
KDS Software Version 3.□ (CD-ROM, Updated Version)	57001-1650
KDS3 Adapter	57001-1725
Communication Cables	57001-1745
KDS Adapter Cable	57001-1696

The connectors for the communication cable and KDS adapter cable are located in the front. Connect the communication cable to the KDS connector (4-pin) [A] and the KDS adapter cable between the ignition switch (immobilizer amplifier) lead connectors (6-pin) [B].



Adjustments

Adjustments shall be made in accordance with the Periodic Maintenance Chart or whenever troubleshooting or presence of symptoms indicate that adjustments may be required. Whenever running of the engine is required during maintenance it is best to have the watercraft in water.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.

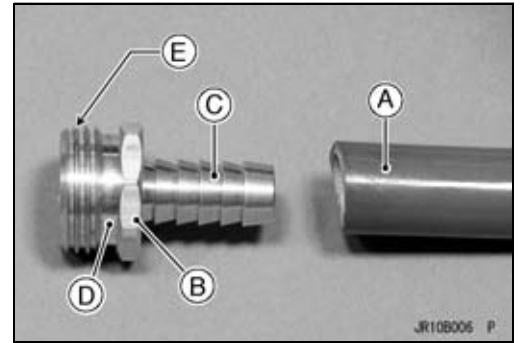
Auxiliary Cooling

An auxiliary cooling supply may be used if the watercraft cannot be operated in water during adjustments. If possible, always operate the watercraft in water rather than use an auxiliary cooling supply.

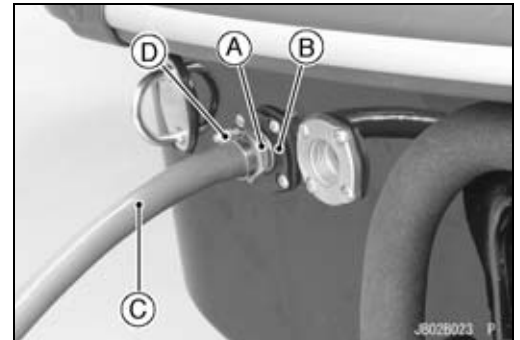
Before Servicing

- Obtain a standard garden hose [A] and a garden hose adapter [B] as shown.
C: Garden Hose Fitting of Adapter
D: Flushing Fitting of Adapter
E: Thread: Rp 3/4

○ Optional part (P/No. 92005-3748) is available as a garden hose adapter.



- Screw a garden hose adapter [A] onto the flushing fitting [D].
- Attach a garden hose [C] to a garden hose adapter and secure the hose clamp [B].



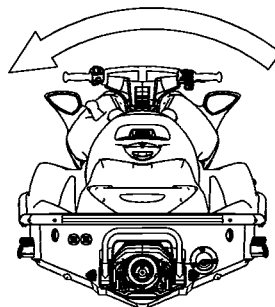
- Attach the garden hose to a faucet. Do not turn on the water until the engine is running and turn it off immediately when the engine stops. The engine requires 2.4 L/min (2.5 qts/min) at 1 800 rpm and 7.0 L/min (7.4 qts/min) at 6 000 rpm.

CAUTION

Insufficient cooling supply will cause the engine and/or exhaust system to overheat and severe damage will occur. Excessive cooling supply may kill the engine and flood the cylinders, causing hydraulic lock. Hydraulic lock will cause severe damage to the engine. If the engine dies while using an auxiliary cooling supply, the water must be shut off immediately.

CAUTION

Always turn the boat on its left side. Rolling to the right side can cause water in the exhaust system to run into the engine, with possible engine damage.



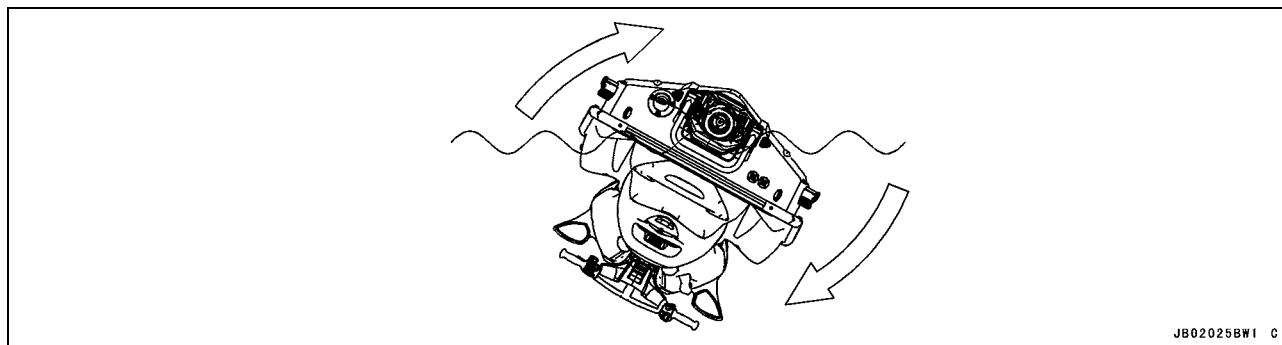
JB02024BW1 C

CAUTION

Turn the capsized boat clockwise so that the port side always faces downward. Turning counterclockwise can cause water in the exhaust system to run into the engine, with possible engine damage.

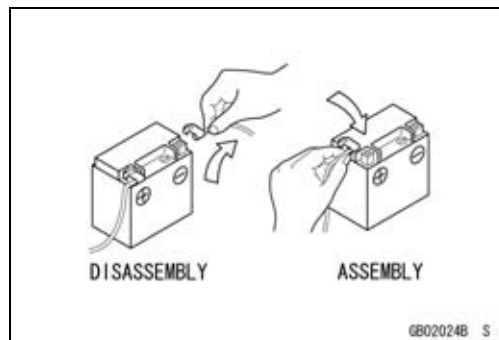
1-4 GENERAL INFORMATION

Before Servicing



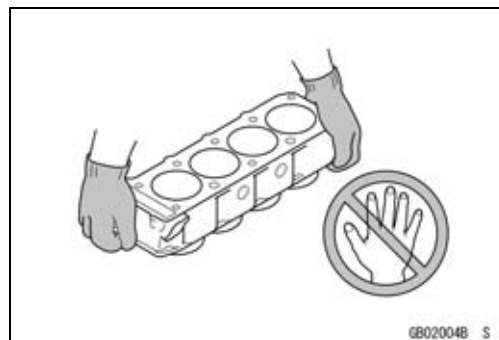
Battery Ground

Before completing any service on the watercraft, disconnect the battery wires from the battery to prevent the engine from accidentally turning over. Disconnect the ground wire (–) first and then the positive (+). When completed with the service, first connect the positive (+) wire to the positive (+) terminal of the battery then the negative (–) wire to the negative terminal.



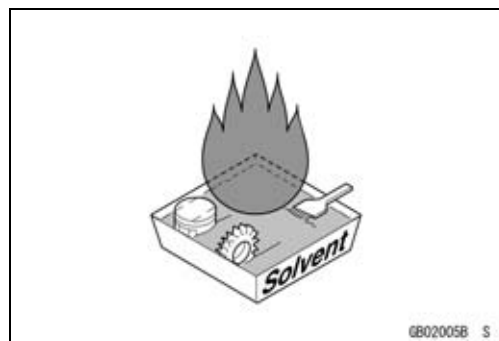
Edges of Parts

Lift large or heavy parts wearing gloves to prevent injury from possible sharp edges on the parts.



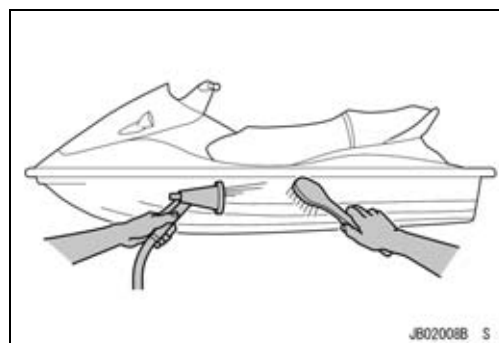
Solvent

Use a high-flash point solvent when cleaning parts. High-flash point solvent should be used according to directions of the solvent manufacturer.



Cleaning Watercraft before Disassembly

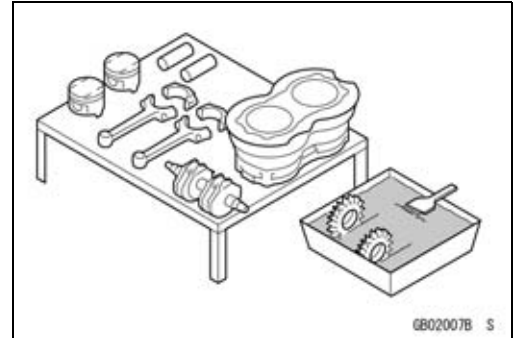
Clean the watercraft thoroughly before disassembly. Dirt or other foreign materials entering into sealed areas during watercraft disassembly can cause excessive wear and decrease performance of the watercraft.



Before Servicing

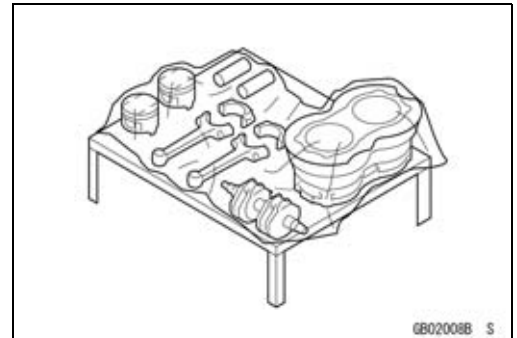
Arrangement and Cleaning of Removed Parts

Disassembled parts are easy to confuse. Arrange the parts according to the order the parts were disassembled and clean the parts in order prior to assembly.



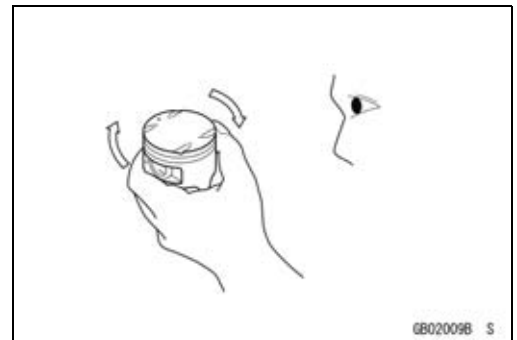
Storage of Removed Parts

After all the parts including subassembly parts have been cleaned, store the parts in a clean area. Put a clean cloth or plastic sheet over the parts to protect from any foreign materials that may collect before re-assembly.



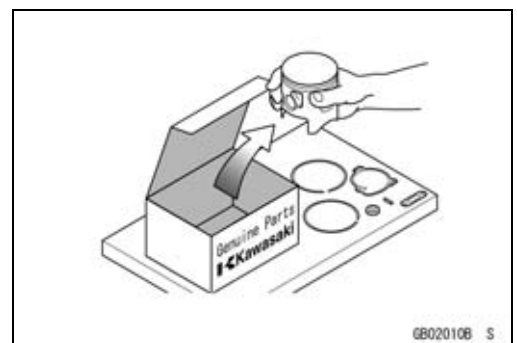
Inspection

Reuse of worn or damaged parts may lead to serious accident. Visually inspect removed parts for corrosion, discoloration, or other damage. Refer to the appropriate sections of this manual for service limits on individual parts. Replace the parts if any damage has been found or if the part is beyond its service limit.



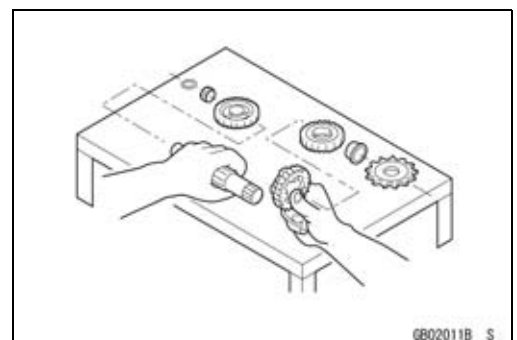
Replacement Parts

Replacement parts must be KAWASAKI genuine or recommended by KAWASAKI. Gaskets, O-rings, oil seals, grease seals, circlips, cotter pins or self-locking nuts must be replaced with new ones whenever disassembled.



Assembly Order

In most cases assembly order is the reverse of disassembly, however, if assembly order is provided in this Service Manual, follow the procedures given.

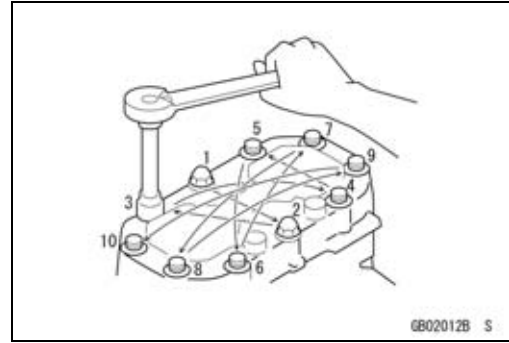


1-6 GENERAL INFORMATION

Before Servicing

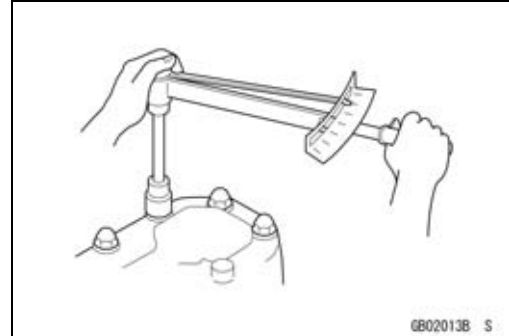
Tightening Sequence

Generally, when installing a part with several bolts, nuts, or screws, start them all in their holes and tighten them to a snug fit. Then tighten them according to the specified sequence to prevent case warpage or deformation which can lead to malfunction. Conversely when loosening the bolts, nuts, or screws, first loosen all of them by about a quarter turn and then remove them. If the specified tightening sequence is not indicated, tighten the fasteners alternating diagonally.



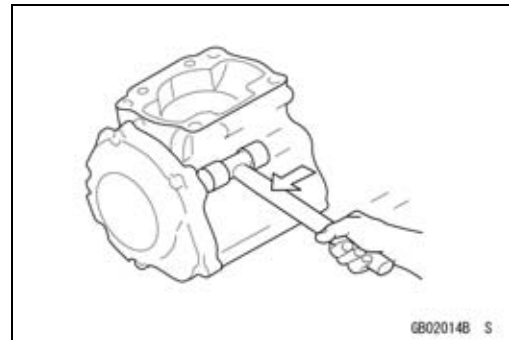
Tightening Torque

Incorrect torque applied to a bolt, nut, or screw may lead to serious damage. Tighten fasteners to the specified torque using a good quality torque wrench.



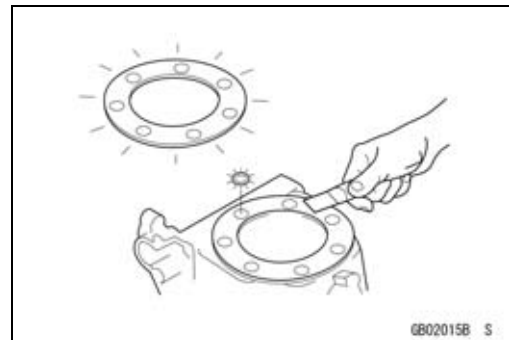
Force

Use common sense during disassembly and assembly, excessive force can cause expensive or hard to repair damage. When necessary, remove screws that have a non-permanent locking agent applied using an impact driver. Use a plastic-faced mallet whenever tapping is necessary.



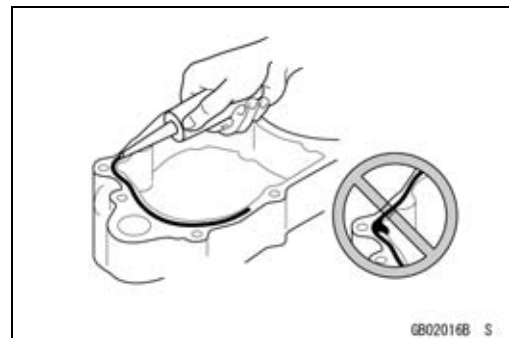
Gasket, O-ring

Hardening, shrinkage, or damage of both gaskets and O-rings after disassembly can reduce sealing performance. Remove old gaskets and clean the sealing surfaces thoroughly so that no gasket material or other material remains. Install new gaskets and replace used O-rings when re-assembling.



Liquid Gasket, Locking Agent

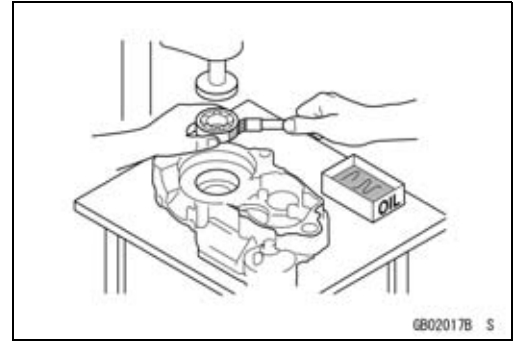
For applications that require Liquid Gasket or a Locking agent, clean the surfaces so that no oil residue remains before applying liquid gasket or locking agent. Do not apply them excessively. Excessive application can clog oil passages and cause serious damage.



Before Servicing

Press

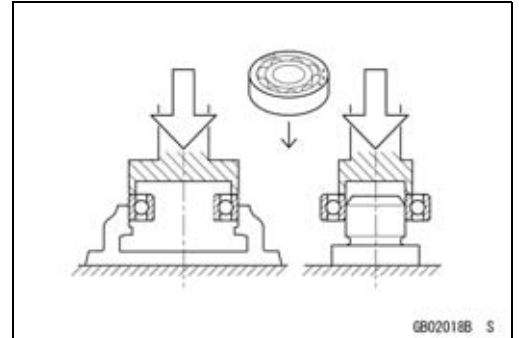
For items such as bearings or oil seals that must be pressed into place, apply small amount of oil to the contact area. Be sure to maintain proper alignment and use smooth movements when installing.



Ball Bearing

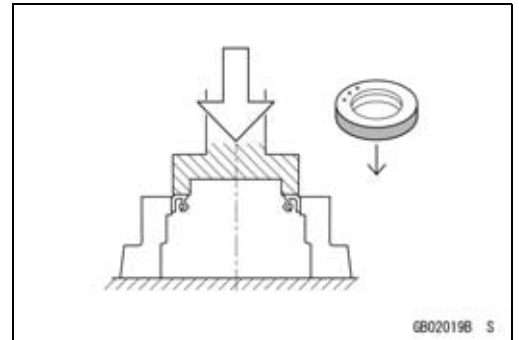
Do not remove pressed ball or needle unless removal is absolutely necessary. Replace with new ones whenever removed. Press bearings with the manufacturer and size marks facing out. Press the bearing into place by putting pressure on the correct bearing race as shown.

Pressing the incorrect race can cause pressure between the inner and outer race and result in bearing damage.

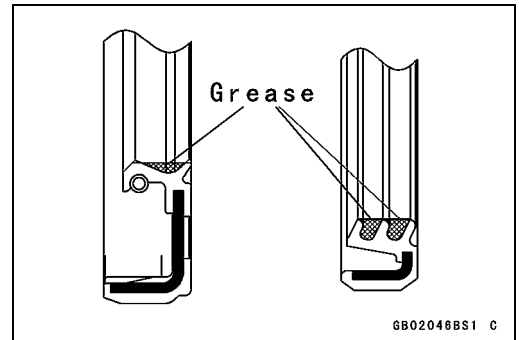


Oil Seal, Grease Seal

Do not remove pressed oil or grease seals unless removal is necessary. Replace with new ones whenever removed. Press new oil seals with manufacture and size marks facing out. Make sure the seal is aligned properly when installing.

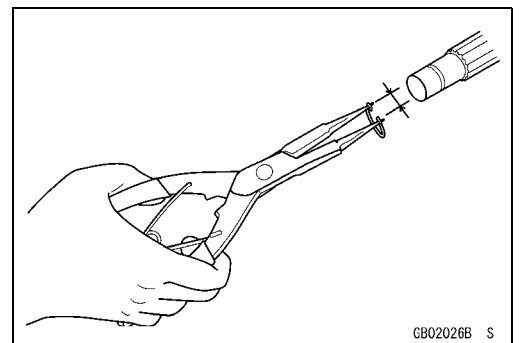


Apply specified grease to the lip of seal before installing the seal.



Circlips, Cotter Pins

Replace circlips or cotter pins that were removed with new ones. Take care not to open the clip excessively when installing to prevent deformation.



1-8 GENERAL INFORMATION

Before Servicing

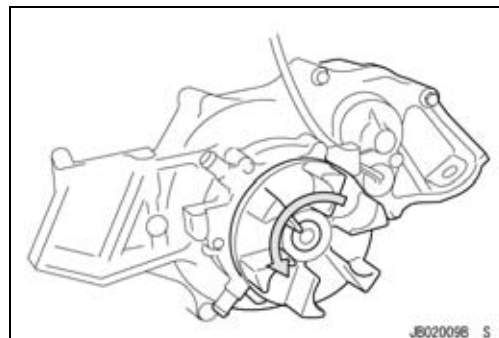
Lubrication

It is important to lubricate rotating or sliding parts during assembly to minimize wear during initial operation. Lubrication points are called out throughout this manual, apply the specific oil or grease as specified.



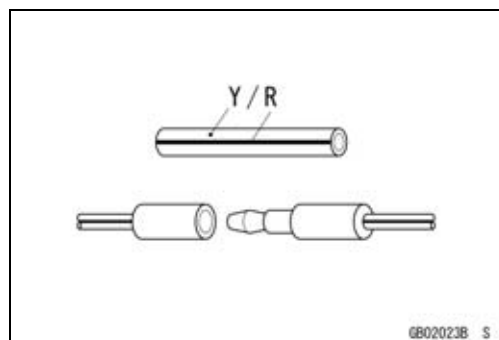
Direction of Engine Rotation

When rotating the crankshaft, by hand, the free play amount of rotating direction will affect the adjustment. Rotate the crankshaft to positive direction (counter-clockwise viewed from stern side).



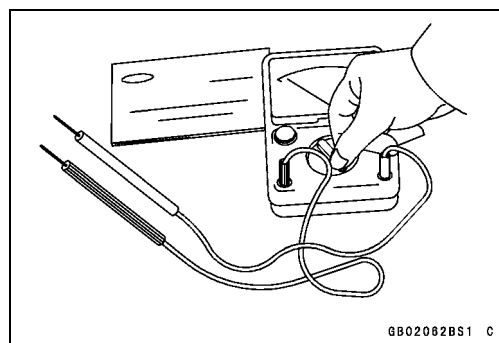
Electrical Wires

A two-color wire is identified first by the primary color and then the stripe color. Unless instructed otherwise, electrical wires must be connected to those of the same color.



Instrument

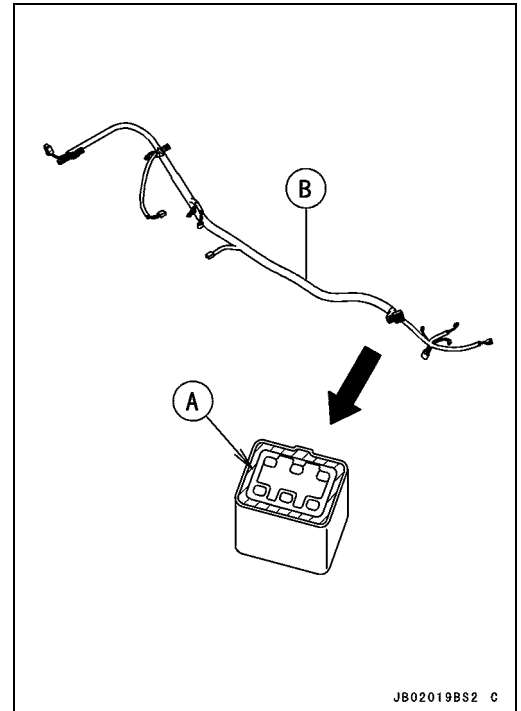
Use a meter that has enough accuracy for an accurate measurement. Read the manufacture's instructions thoroughly before using the meter. Incorrect values may lead to improper adjustments.



Before Servicing

Harness Connector

Apply grease [A] on all connectors of harness [B] for water resistance. Do not apply grease on the only connector of inlet air pressure sensor.



1-10 GENERAL INFORMATION

Model Identification

JT1500HBF Left Side View



JT1500HBF Right Side View



Hull Identification Number (HIN)



Engine Number



Model Identification

JT1500JBF Left Side View



JT1500JBF Right Side View



1-12 GENERAL INFORMATION

General Specifications

Items	JT1500HBF/JBF
Engine	
Type	4-stroke, DOHC, 4-cylinder, water cooled
Displacement	1 498 cm ³ (91.4 cu in.)
Bore and Stroke	83 × 69.2 mm (3.27 × 2.72 in.)
Compression Ratio	8.4:1
Maximum Horsepower	213 kW (290 PS) @7 750 r/min (rpm) (AU) 221 kW (300 PS) @7 750 r/min (rpm) (CA, US) – – –
Maximum Torque	263 N·m (26.8 kgf·m, 193 ft·lb) @7 250 r/min (rpm) (AU) 272 N·m (27.7 kgf·m, 201 ft·lb) @7 250 r/min (rpm) (CA, US) – – –
Ignition System	Digital transistor
Lubrication System	Forced lubrication (semi-dry sump)
Carburetion System	FI (fuel injection) MIKUNI EAC 60 × 1
Starting System	Electric starter
Cylinder Numbering Method	Front (bow) to rear (stern), 1-2-3-4
Firing Order	1-2-4-3
Valve Timing:	
Intake:	
Open	22.5° BTDC
Close	67.5° ABDC
Duration	270°
Exhaust:	
Open	75.5° BBDC
Close	15.5° ATDC
Duration	271°
Tuning Specifications	
Spark plug:	
Type	NGK PMR9B
Gap	0.6 ~ 0.7 mm (0.024 ~ 0.028 in.)
Ignition Timing	0° ATDC @1 300 r/min ~ 17° BTDC @3 000 r/min (rpm)
Idle Speed	1 300 ±100 r/min (rpm) -in water 1 300 ±100 r/min (rpm) -out of water
Compression Pressure	843 ~ 1 298 kPa (8.57 ~ 13.2 kgf/cm ² , 122 ~ 188 psi) @383 r/min (rpm)
Drive System	
Coupling	Direct drive from engine
Jet Pump:	
Type	Axial flow single stage
Thrust	7 871 N (803 kgf, 1 769 lb)
Steering	Steerable nozzle
Braking	Water drag
Performance	
†Minimum Turning Radius	4.0 m (13.1 ft)
†Fuel Consumption	88.3 L/h (23.3 US gal/h) @full throttle

General Specifications

Items	JT1500HBF/JBF
†Cruising Range EUR Models Other than EUR Models	88.8 km (55.2 mile) @full throttle 50.3 minutes (3 person) 92.2 km (57.3 mile) @full throttle 50.3 minutes (3 person)
Dimensions Overall Length Overall Width Overall Height Curb Mass Fuel Tank Capacity	3 370 mm (132.7 in.) 1 195 mm (47.0 in.) 1 150 mm (45.3 in.) 462 kg (1018.7 lb) 78 L (20.6 US gal)
Engine Oil Grade Viscosity Capacity	API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2 SAE 10W-40 5.5 L (5.8 US qt)
Electrical Equipment Battery Maximum Generator Output	12 V 18 Ah 16 A @14 V

†: This information shown here represents results under controlled conditions, and the information may not be correct under other conditions.

Specifications subject to change without notice, and may not apply to every country.

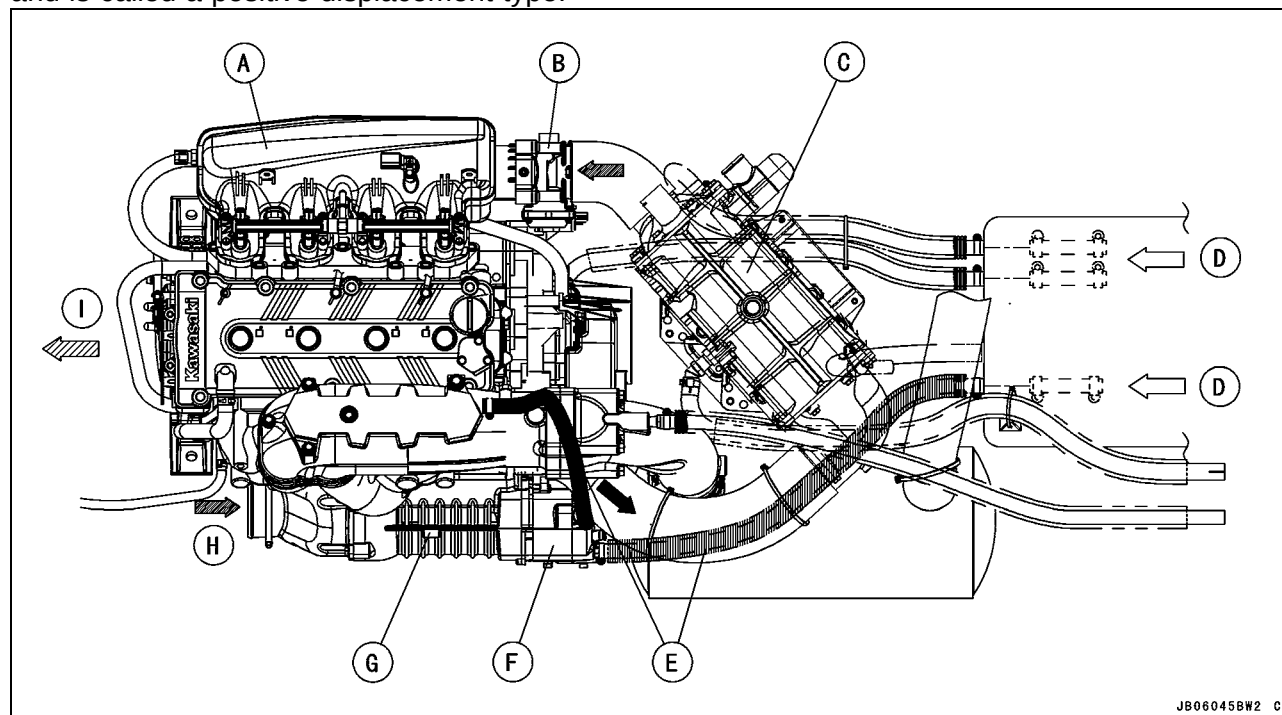
1-14 GENERAL INFORMATION

Technical Information - Supercharger

Overview

The supercharger, an air compressor, is used for forced induction of an internal combustion engine. The greater mass flow rate provides more oxygen to support combustion than would be available in a naturally-aspirated engine, which allows more fuel to be burned and more work to be done per cycle, increasing the power output of the engine.

The model uses a Roots-type supercharger. A pair of rotors whirling within a rotor case traps air and carries it around and out the opposite side. This type runs about two times faster than the engine and is called a positive displacement type.



A. Intake Manifold

B. Throttle Valve

C. Intercooler

D. Jet Pump

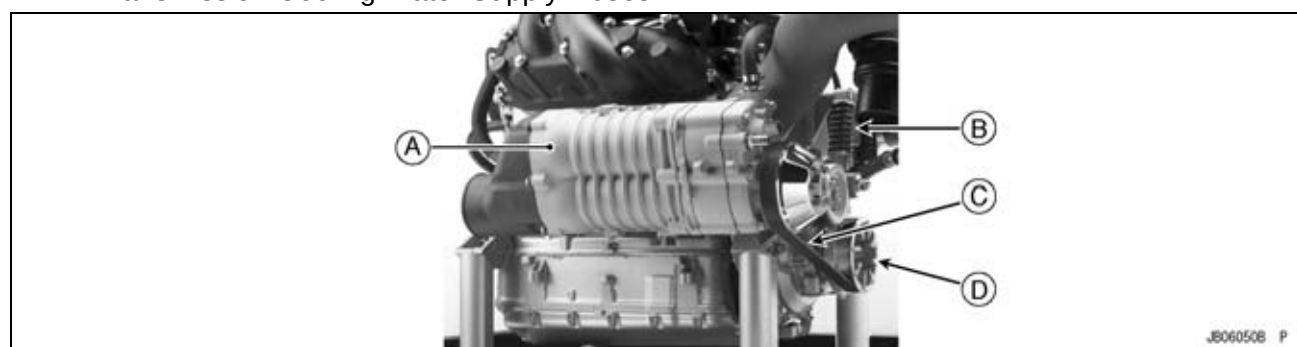
E. Transmission Cooling Water Supply Hoses

F. Transmission

G. Supercharger

H. Air

I. BOW



A. Supercharger

B. Automatic Belt Tensioner

C. Drive Belt

D. Drive Pulley on Engine's Crankshaft

Although the internal parts of the supercharger are shown to explain the construction and function of them in this section, do not disassemble the supercharger and transmission.

Supercharger Construction

Developed in collaboration with Kawasaki, the all-new Eaton Twin Vortices Series (TVS) supercharger uses twin four-lobe rotors to produce a continuous delivery of air for smoother throttle response and a significant increase in performance.

The Eaton Roots-type supercharger is a positive displacement pump (no internal compression) that moves air from the inlet to the outlet of the supercharger. The supercharger creates boost by moving more air into the intake system than the engine can naturally use.

Technical Information - Supercharger

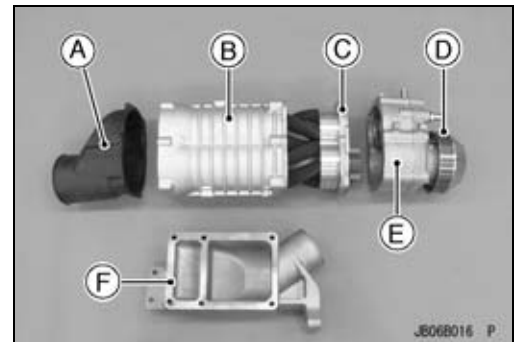
When boost is not required, a series of bypass valves allow the supercharger to operate with negligible parasitic loss.

Eaton specifications:

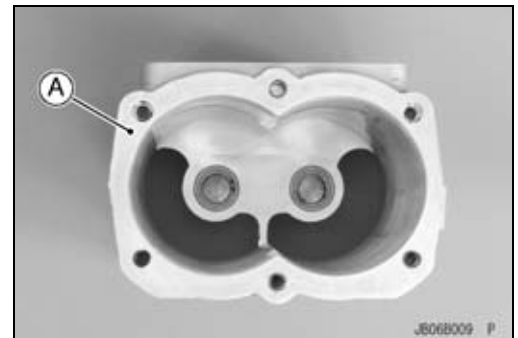
- Model type: R1040
- Output volume: 2019.3 cm³ per one engine revolution
- Rotor coating: proprietary powder coat process mates surfaces during break in for very close clearances
- Rotor twist angle: 160 degrees
- Boost pressure 119.5 kPa (1.219 kgf/cm², 17.33 psi)
- Mass 13.5 kg (29.8 lb)

Intake and outlet manifolds, transmission and pulley are Kawasaki parts, and the rotor case and rotors are Eaton parts.

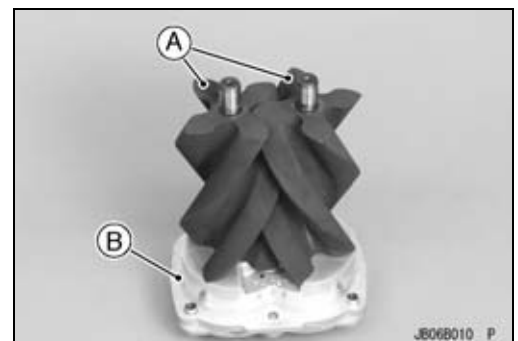
- A. Intake Manifold
- B. Rotor Case
- C. Case Cover
- D. Pulley
- E. Transmission
- F. Outlet Manifold



- Rotor Case
 - Made of aluminum alloy
 - Houses needle bearings which support rotors
- A. Rotor Case

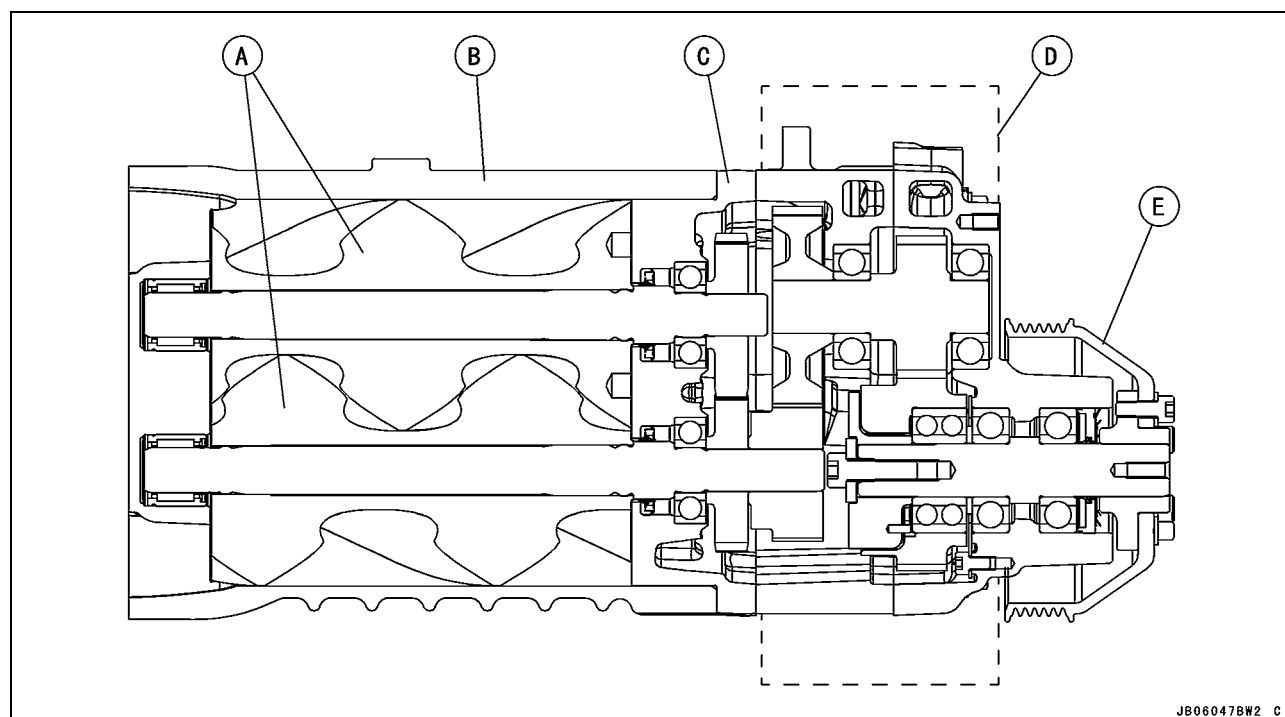


- Case Cover
 - Made of aluminum alloy
 - Houses ball bearings and seals
 - Support for rotor drive side
- A. Rotors
- B. Case Cover



1-16 GENERAL INFORMATION

Technical Information - Supercharger

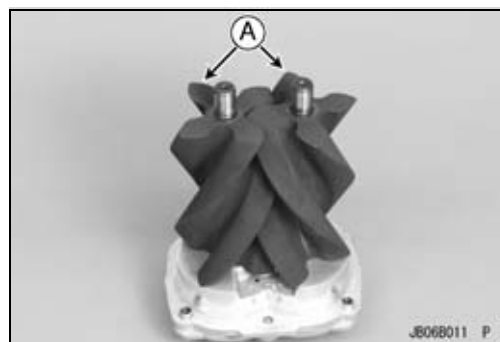


A. Rotors
B. Rotor Case
C. Case Cover

D. Transmission
E. Pulley

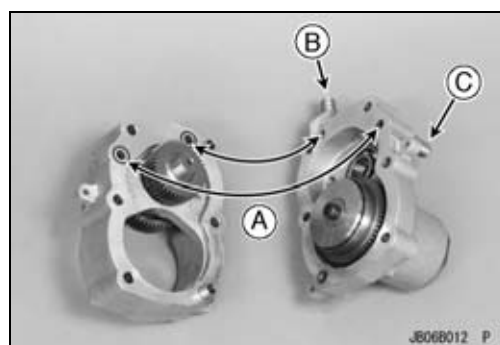
- Twin four lobe rotors
 - Lobe twist is 160°
 - Less back pressure
 - Smoother throttle response, especially at lower throttle settings
 - The rotors are coated to prevent galling by rotor-to-case contact during initial start up. The dark gray coating wears to mate the rotors to the case allowing tighter clearances

A. 4 Lobe Rotors

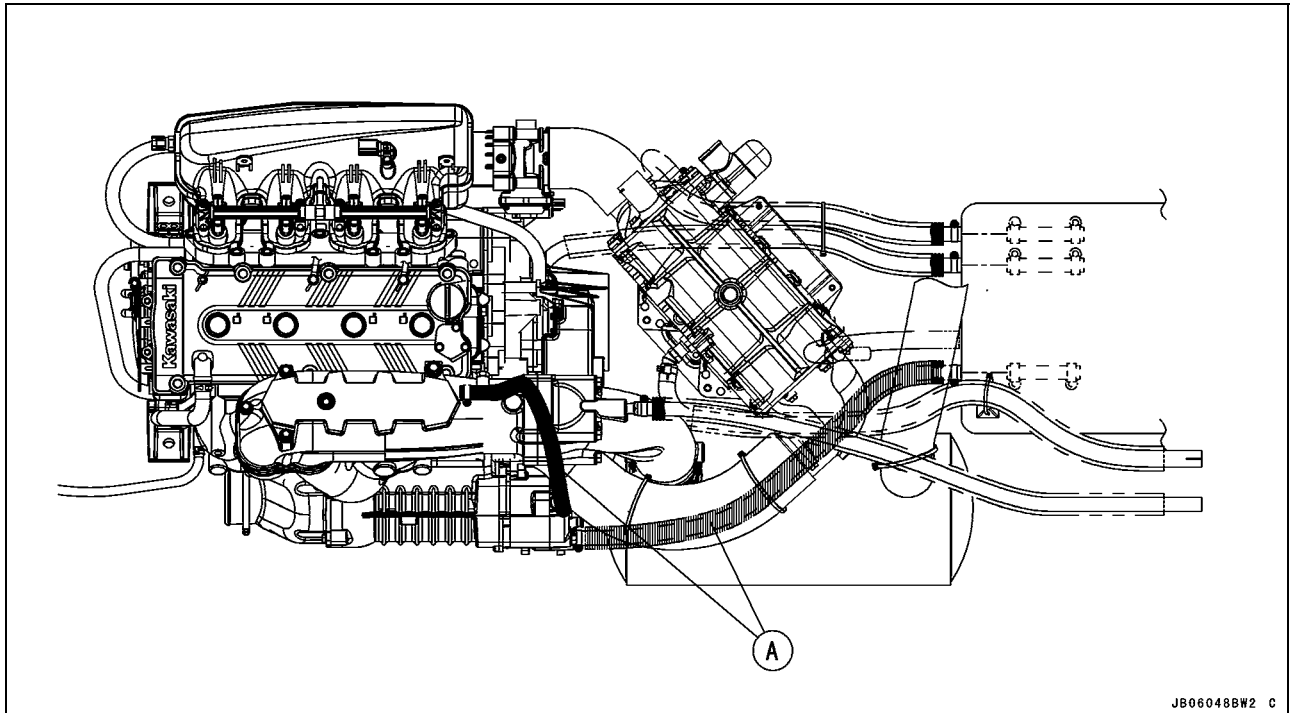


- Transmission
 - Reduces belt load and increases the speed of the supercharger
 - The new cooling system helps control the temperature of the oil and components. The cooling passageway is located in the case cover
 - Cooling water originates at the jet pump, travels through the transmission then to the engine

A. Cooling Passageway
B. Cooling Water Outlet
C. Cooling Water Inlet



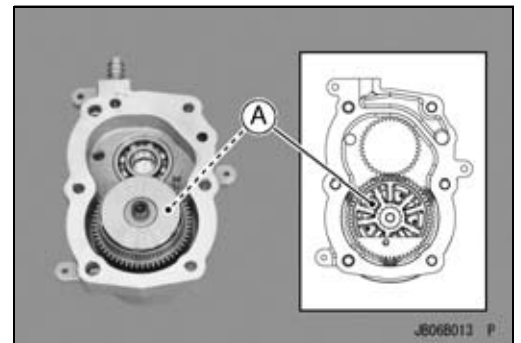
Technical Information - Supercharger



A. Transmission Cooling Water Supply Hoses

- Gear set increases supercharger speed by a ratio of 2.1.
 - A rubber damper reduces drive line shock and vibration
 - The transmission gears are lubricated with oil. No maintenance is required for the oil

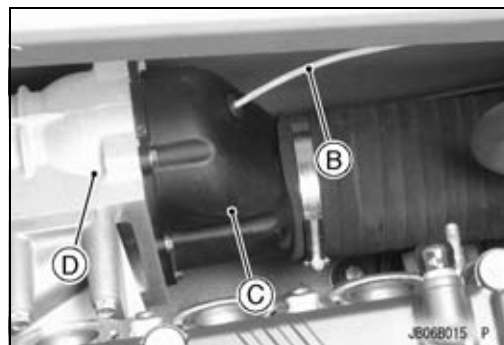
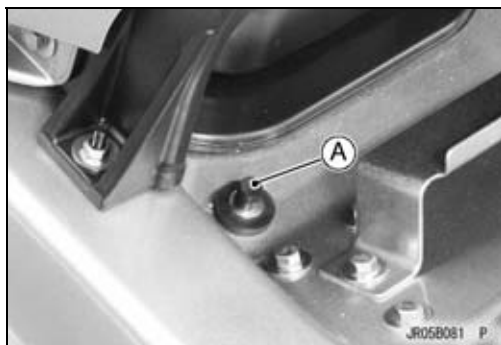
A. Rubber Damper (Built-in)



● Fogging Port

At the end of each day's use, the supercharger should be oiled to prevent the formation of mineral deposits (see Apply Corrosion Protection Coating to the Supercharger Rotors in the Periodic Maintenance).

- Inject fogging oil at the service port
- Run engine at idle for ten seconds while injecting fogging oil



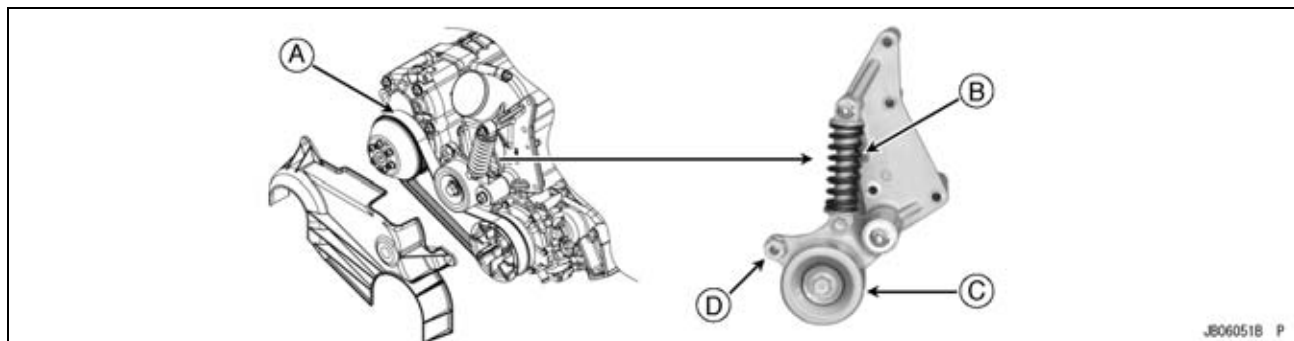
- A. Fogging Port
- B. Hose
- C. Intake Manifold
- D. Supercharger

1-18 GENERAL INFORMATION

Technical Information - Supercharger

- Supercharger Drive Belt
 - Drive system reduction ratio is 0.9.
 - All-new automatic drive belt tensioner
 - No maintenance required
 - Less belt backlash for smoother operation and less vibration

Automatic Belt Tensioner



A. Drive Belt

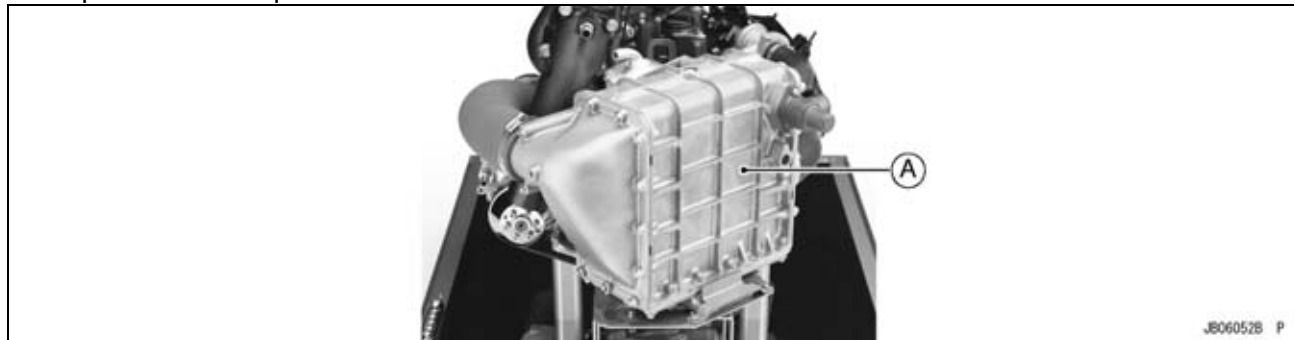
B. Tensioner Spring with Damper

C. Roller

D. Leverage Point for Belt Removal

Intercooler

The intercooler is designed to remove heat from the compressed air coming from the supercharger before it enters the engine's induction system. The intercooler works just like a heat exchanger - air is cooled by fins and plates inside the intercooler (water-cooled) that are cooler than the compressed air coming from the supercharger. The reduction in air temperature increases the density of the air (more air molecules per unit volume), which consequently increases engine's ability to make more horsepower and torque.



A. Intercooler (Water Cooled)

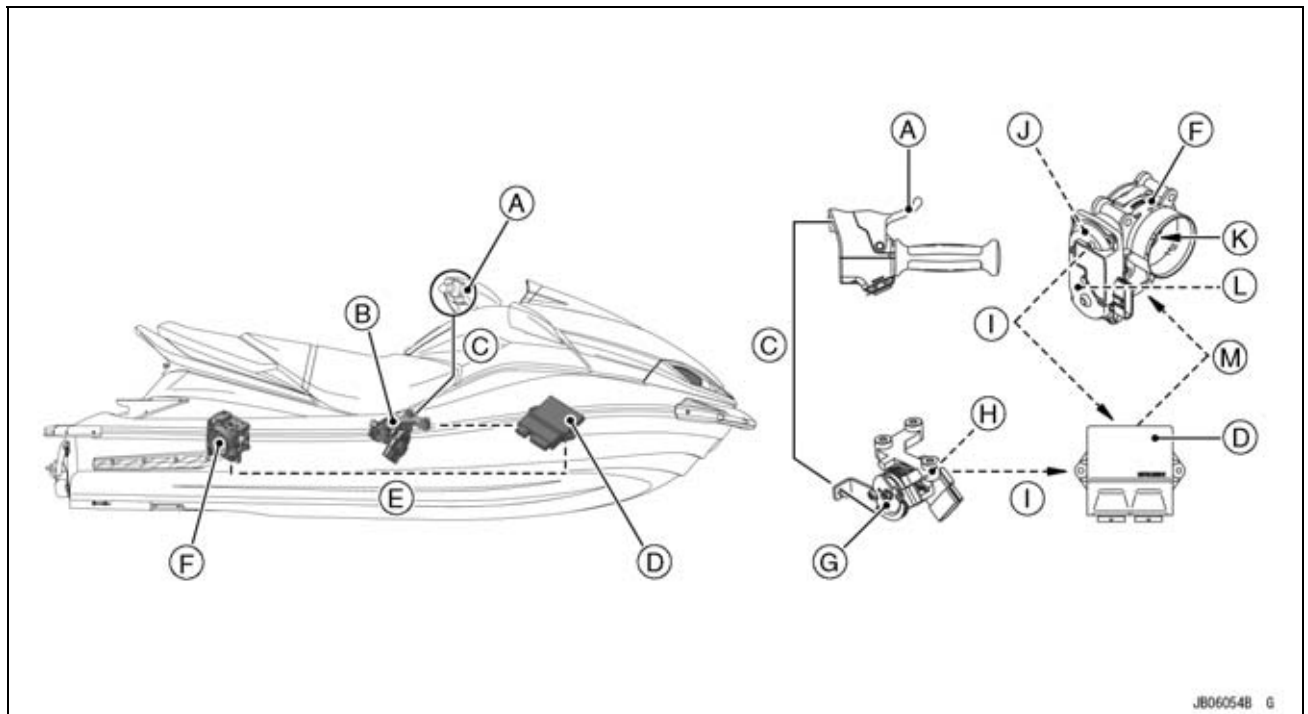
Technical Information - Electronic Throttle Valve (ETV) System

Overview

The JT1500H and JT1500J are equipped with an electronically-controlled throttle valve system called the Electronic Throttle Valve (ETV). The throttle pulley and the throttle valve of this system are not connected mechanically, and the throttle valve is electrically operated. The throttle lever on the handlebar is connected to the throttle pulley on the accelerator position sensor (APS) with a single throttle cable to ensure natural throttle operation feel. The accelerator position sensors (APS) that detect the throttle lever opening angle are located below the steering cowl to ensure adequate protection from water and vibration. The ETV system also features high durability due to the adoption of highly-durable contact-free throttle position sensors (TPS) and the duplex circuitry for the critical APS and TPS sensors.

The JT1500H and JT1500J are equipped with electronic cruise control, 5-mph mode, and idle speed control (ISC) systems as an auxiliary function of this system.

Related Parts and Function



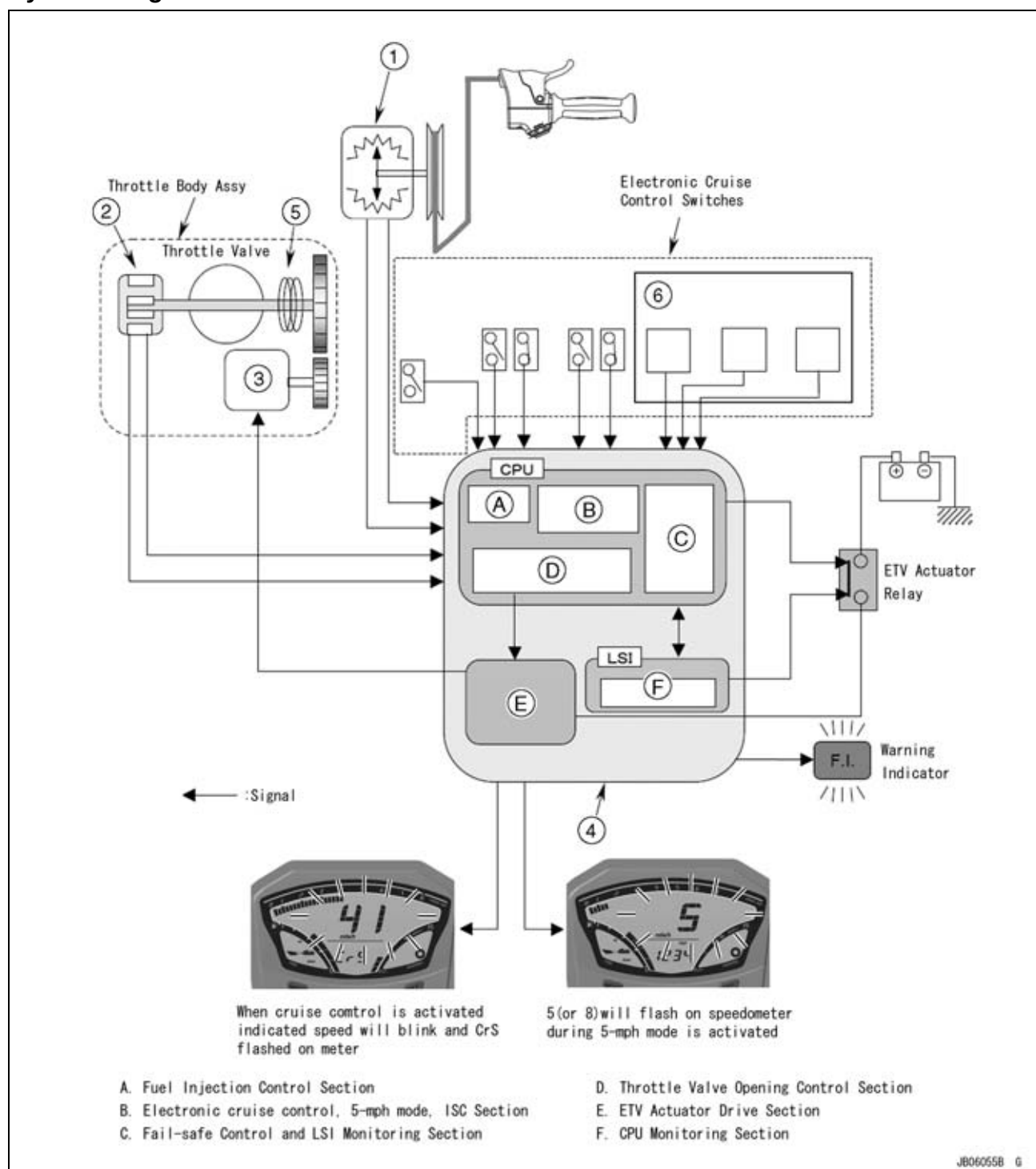
- A. Throttle Lever
- B. APS (Accelerator Position Sensor) Unit
- C. Throttle Cable
- D. ECU
- E. Electric Wire
- F. Throttle Body
- G. Throttle Pulley

- H. APS (Accelerator Position Sensor)
- I. ECU Input (TPS Signal)
- J. TPS (Throttle Position Sensor)
- K. Throttle Valve
- L. ETV Actuator (DC Motor)
- M. ECU Output

1-20 GENERAL INFORMATION

Technical Information - Electronic Throttle Valve (ETV) System

System Diagram



1. Accelerator Position Sensor 1 and 2

The accelerator position sensor senses the rider's intention on throttle operation and transmits it to the ECU as an electrical signal. Each incorporates a built-in variable resistor, and the two sensors work independently to detect the position of the pulley shaft.

2. Throttle Position Sensor 1 and 2

The two contact-free, Hall-element type sensors work independently to detect the opening angle of the throttle valve.

3. ETV Actuator (DC Motor)

In response to the signal from the ECU, the ETV actuator (DC motor) moves the throttle valve quickly to the target position via three gears.

Technical Information - Electronic Throttle Valve (ETV) System

4. DFI ECU

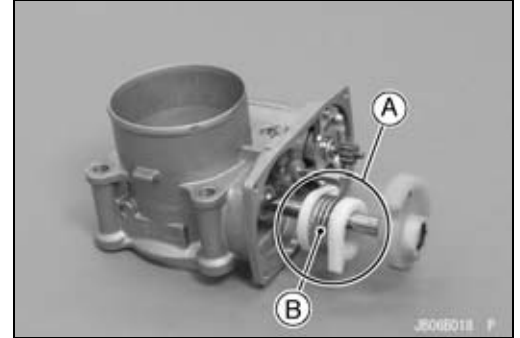
Receiving the accelerator position sensor signal, the ECU operates the ETV actuator to move the throttle valve to the target opening angle, and verifies that the valve is in the target position by the throttle position sensor signals. The ECU has fail-safe control in case of a system failure. It also performs the electronic cruise control function, 5-mph mode, and idle speed control (ISC) function.

The ECU has a large scale integration (LSI) to monitor its central processing unit (CPU), and the CPU also monitors the LSI – they mutually monitor with each other for their correct operations.

5. Partial Opening Holding Device

When the ETV actuator (DC motor) becomes incapable of throttle valve control, this device holds the throttle valve at a predetermined partially-open position by balancing the forces of the return spring and the open spring which pulls the throttle valve in the opening direction.

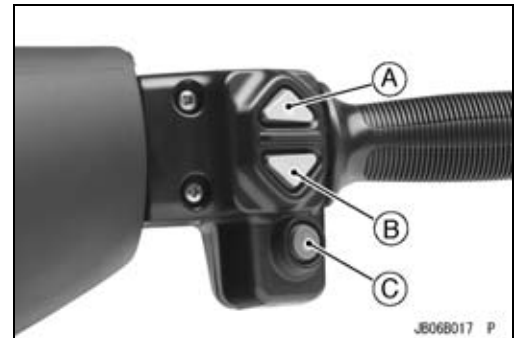
- A. Partial Opening Holding Device
- B. Open and Return Spring



6. Right Handlebar Switch Housing

On the JT1500H and JT1500J the switches of the system are collectively installed to the right handlebar switch housing to facilitate the activation of the system during running.

- A. UP Button
- B. DN Button
- C. Set Button



Fail-safe Provision against System Failure

When the warning indicator light goes on, the FI indicator and the "FI" character blink, and buzzer sounds, there may be a fault in the ETV system. If the ETV system has a fault, the maximum speed and the engine speed are controlled to certain limits. The watercraft can be driven only at low speed even if the throttle lever is squeezed.



There are three fail-safe modes in accordance with the failure conditions: power limitation mode, limp home mode, and idle mode.

1) Power Limitation Mode

If the ECU determines that one of the sensor signals from the accelerator position sensors or the throttle position sensors is incorrect but the ECU can control the ETV system using the other (correct) sensor signal, the ECU limits the engine output.

Maximum engine speed is limited to 3,400 rpm.

2) Limp Home Mode

If the ECU cannot control the throttle valve correctly due to the failure of the actuator, both throttle position sensors or the like, the ECU cuts off the power to the ETV actuator and fixes the throttle valve at a partially-open position using the partial opening holding device to maintain the minimum driving capability.

Maximum engine speed is limited to 3,200 rpm.

1-22 GENERAL INFORMATION

Technical Information - Electronic Throttle Valve (ETV) System

3) Idle Mode

If the ECU determines that both of the accelerator position sensor signals are incorrect and therefore it cannot notice the rider's intention on throttle operation, the ECU fixes the engine speed to the idling speed. However engine speed can be increased up to 2,500 rpm by using the cruise control UP button (1 push 250 rpm increment). Push the DN button once to return to idle rpm.

Unit Conversion Table**Prefixes for Units**

Prefix	Symbol	Power
mega	M	× 1 000 000
kilo	k	× 1 000
centi	c	× 0.01
milli	m	× 0.001
micro	μ	× 0.000001

Units of Mass

kg	×	2.205	=	lb
g	×	0.03527	=	oz

Units of Volume

L	×	0.2642	=	gal (US)
L	×	0.2200	=	gal (IMP)
L	×	1.057	=	qt (US)
L	×	0.8799	=	qt (IMP)
L	×	2.113	=	pint (US)
L	×	1.816	=	pint (IMP)
mL	×	0.03381	=	oz (US)
mL	×	0.02816	=	oz (IMP)
mL	×	0.06102	=	cu in

Units of Force

N	×	0.1020	=	kg
N	×	0.2248	=	lb
kg	×	9.807	=	N
kg	×	2.205	=	lb

Units of Length

km	×	0.6214	=	mile
m	×	3.281	=	ft
mm	×	0.03937	=	in.

Units of Torque

N·m	×	0.1020	=	kgf·m
N·m	×	0.7376	=	ft·lb
N·m	×	8.851	=	in·lb
kgf·m	×	9.807	=	N·m
kgf·m	×	7.233	=	ft·lb
kgf·m	×	86.80	=	in·lb

Units of Pressure

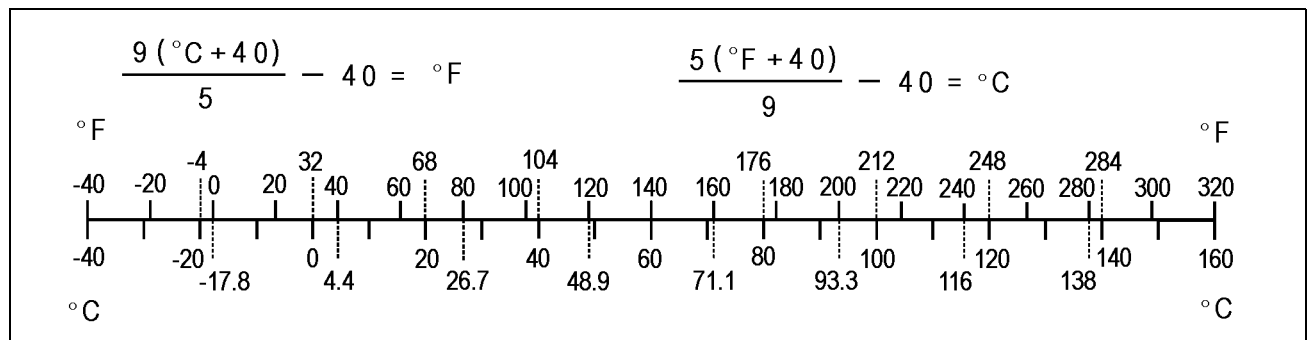
kPa	×	0.01020	=	kgf/cm ²
kPa	×	0.1450	=	psi
kPa	×	0.7501	=	cmHg
kgf/cm ²	×	98.07	=	kPa
kgf/cm ²	×	14.22	=	psi
cmHg	×	1.333	=	kPa

Units of Speed

km/h	×	0.6214	=	mph
------	---	--------	---	-----

Units of Power

kW	×	1.360	=	PS
kW	×	1.341	=	HP
PS	×	0.7355	=	kW
PS	×	0.9863	=	HP

Units of Temperature

Periodic Maintenance

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2-2 PERIODIC MAINTENANCE

Periodic Maintenance Chart

The scheduled maintenance must be done in accordance with this chart to keep the watercraft in good running condition. **The initial maintenance is vitally important and must not be neglected.**

Description	Frequency	Initial 10 Hours	Every 25 Hours	Every 50 Hours	Every 100 Hours	Reference
Inspect throttle control system (e)			●			2-12
Inspect/clean air box drain cap			●			2-13
Inspect supercharger drive belt for wear/damage		●	●			2-13
Inspect fuel vent check valve			●			2-15
Clean fuel pump screen (e)			●			2-16
Inspect throttle shaft spring (replace accelerator position sensor assembly if necessary) (e)					●	2-17
Replace engine oil			● (or every year)			2-17
Replace engine oil filter					●	2-18
Inspect filter at muffler body (replace if necessary)			●			2-19
Inspect/adjust valve clearance (e)					●	2-20
Inspect/tighten engine mounting bolts				● (or every year)		2-23
Inspect/replace coupling damper					●	2-24
Flush cooling system (after each use in salt water)			●			2-24
Flush bilge line and filter			●			2-25
Inspect impeller blades for damage (remove)					●	2-26
Lube jet pump bearings and seals; inspect and replace bearings/seals if necessary		Initial 20 hours, then every 50 hours or every year whichever comes first				2-26
Inspect steering cable/shift cable					●	2-26
Lubricate handlebar pivot (disassemble)			●			2-28
Inspect hull drain plugs (replace if necessary)				●		2-28
Inspect battery charging condition			●			2-29
Inspect battery terminals			●			2-29
Inspect spark plugs (replace if necessary) (e)			●			2-30
Lubricate throttle cable fitting at accelerator position sensor assembly			●			2-30
Lubricate throttle cable and throttle fitting at throttle case			●			2-30
Lubricate steering cable/shift cable ball joints and steering nozzle/reverse bucket pivots			●			2-30

PERIODIC MAINTENANCE 2-3

Periodic Maintenance Chart

Description	Frequency				Reference
	Initial 10 Hours	Every 25 Hours	Every 50 Hours	Every 100 Hours	
Inspect all hoses, hose clamps, nuts, bolts, and fasteners	●	●			2-33
Replace fuel hose	Every 5 years				2-35
Apply corrosion protection coating to the supercharger rotors	Every ride				2-36

(e): Emission Related Items

2-4 PERIODIC MAINTENANCE

Torque and Locking Agent

The following tables list the tightening torque for the major fasteners requiring use of a non-permanent locking agent or silicone sealant etc.

Letters used in the "Remarks" column mean:

G: Apply grease.

L: Apply a non-permanent locking agent (Medium Strength: Loctite 242 Equivalent).

LN: Apply a non-permanent locking agent (High Strength: Loctite 271 Equivalent).

MO: Apply molybdenum disulfide oil solution.

(mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10:1)

R: Replacement Part

S: Follow the specified tightening sequence.

SS: Apply silicone sealant.

WG: Apply water-resistance grease.

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Fuel System (DFI)				
Accelerator Position Sensor Assembly Bolts	8.8	0.90	78 in·lb	L
Air Bypass System Clamp Screws	4.9	0.50	43 in·lb	
Air Box Bolts	8.8	0.90	78 in·lb	L
Air Box Bracket Bolts	8.8	0.90	78 in·lb	L
Blow off Valve Bolts	7.8	0.80	69 in·lb	
Bracket Bolts	8.8	0.90	78 in·lb	L
Camshaft Position Sensor Bolt	10	1.0	89 in·lb	L
Crankshaft Sensor Screws	4.5	0.46	40 in·lb	L
Delivery Pipe Assy Mounting Screws	3.5	0.36	31 in·lb	
ECU Mounting Bolts	3.0	0.31	27 in·lb	L
Fuel Filler Hose Clamp Screws	2.9	0.30	26 in·lb	
Fuel Pump Rubber Holder Clamp Screws	2.9	0.30	26 in·lb	
Gear Oil Drain Bolt	10.5	1.1	93 in·lb	
Intake Air Temperature Sensor	15	1.5	11	
Intake Duct Clamp Screws	4.9	0.50	43 in·lb	
Intake Manifold Mounting Bolts	25	2.5	18	
Lower Intake Pipe Bolts	4.9	0.50	43 in·lb	L
Oil Separator Tank Mounting Bolts	8.8	0.90	78 in·lb	L
Oil Temperature Sensor	15	1.5	11	
Pulley Mounting Bolts	12	1.2	106 in·lb	L
Relay Mounting Bolts	2.5	0.25	22 in·lb	L
Supercharger Drive Belt Cover Bolts	4.9	0.50	43 in·lb	L
Supercharger Drive Belt Tensioner Assy Mounting Bolts	35	3.6	26	
Supercharger Drive Belt Tensioner Nut (M8)	30	3.1	22	
Supercharger Drive Belt Tensioner Nut (M10)	45	4.6	33	
Water Hose Joints (Straight Shape)	20	2.0	15	L
Supercharger Mounting Bolts	45	4.6	33	
Supercharger Mounting Nut	45	4.6	33	
Throttle Body Assy Mounting Bolts	13	1.3	115 in·lb	
Throttle Cable Locknut	19.6	2.0	14	

PERIODIC MAINTENANCE 2-5

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Upper Intake Pipe Bolts	30	3.1	22	
Vehicle-down Sensor Mounting Screws	1.5	0.15	13 in·lb	
Water Temperature Sensor	14.7	1.5	11	
Engine Lubrication System				
Breather Plate Bolts	7.8	0.80	69 in·lb	
Dipstick Tube Bolts	8.8	0.90	78 in·lb	L, S
Oil Catch Cover Bolts	7.8	0.80	69 in·lb	
Oil Cooler Assembly Bolts (L = 20 mm)	7.8	0.80	69 in·lb	
Oil Cooler Assembly Bolts (L = 40 mm)	7.8	0.80	69 in·lb	
Oil Cooler Assembly Bolts (L = 45 mm)	7.8	0.80	69 in·lb	
Oil Cooler Positioning Bolt	20	2.0	15	S
Oil Filler Cap	—	—	—	Hand -tighten
Oil Filter	18	1.8	13	G, R
Oil Jet Nozzles	3.0	0.31	27 in·lb	
Oil Pan Bolts	20	2.0	15	S
Oil Passage Bolt	78	8.0	58	S
Oil Passage Joints	7.8	0.80	69 in·lb	L
Oil Passage Plug (R1/4)	20	2.0	15	L
Oil Passage Plug (R3/8)	20	2.0	15	L
Oil Pressure Relief Valve	15	1.5	11	LN
Oil Pressure Switch	15	1.5	11	L
Oil Pressure Switch Fitting	20	2.0	15	L
Oil Pump Body Bolts	7.8	0.80	69 in·lb	
Oil Pump Body Plug	20	2.0	15	L
Oil Pump Cover Bolts	7.8	0.80	69 in·lb	
Oil Pump Sprocket Bolt	16	1.6	12	LN
Oil Screen Bolts	7.8	0.80	69 in·lb	
Oil Separator Tank Mounting Bolts	8.8	0.90	78 in·lb	L
Thermostat	8.0	0.82	71	
Exhaust System				
Exhaust Manifold Mounting Bolts (L = 120 mm)	30	3.1	22	
Exhaust Manifold Mounting Bolts (L = 140 mm)	30	3.1	22	
Exhaust Manifold Mounting Nuts	30	3.1	22	
Exhaust Pipe Mounting Bolt (L = 150 mm)	45	4.6	33	
Exhaust Pipe Mounting Bolts (L = 120 mm)	35	3.6	26	
Exhaust Pipe Mounting Bolt (L = 95 mm)	35	3.6	26	
Front Exhaust Hose Clamp Screws	4.9	0.50	43 in·lb	
Mark Plate Bolts	5.0	0.51	44 in·lb	
Muffler Body Bolts	45	4.6	33	
Rear Exhaust Hose Clamp Screws	4.9	0.50	43 in·lb	
Water Hose Joint	20	2.0	15	L

2-6 PERIODIC MAINTENANCE

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Engine Top End				
Camshaft Cap Bolts (L = 40 mm)	12	1.2	106 in·lb	S
Camshaft Cap Bolts (L = 50 mm)	12	1.2	106 in·lb	S
Camshaft Chain Tensioner Cap Bolt	20	2.0	15	
Camshaft Chain Tensioner Mounting Bolts	10	1.0	89 in·lb	L
Camshaft Position Sensor Rotor Bolt	12	1.2	106 in·lb	LN
Cylinder Head Bolts (M11, Final)	70	7.1	52	MO, S
Cylinder Head Bolts (M11, First)	22.5	2.3	17	MO, S
Cylinder Head Bolts (M6)	12	1.2	106 in·lb	S
Cylinder Head Bolts (M7)	20	2.0	15	S
Cylinder Head Cover Bolts	10	1.0	89 in·lb	
Cylinder Head Cover Plate Bolts	7.8	0.80	69 in·lb	
Exhaust Side Camshaft Chain Guide Bolt (Lower)	12	1.2	106 in·lb	
Exhaust Side Camshaft Chain Guide Bolt (Upper)	25	2.5	18	
Harness Clamp Mounting Bolts	8.8	0.90	78 in·lb	L
Intake Side Camshaft Chain Guide Bolt	12	1.2	106 in·lb	L
Oil Filler Cap	—	—	—	Hand-tighten
Oil Passage Joints	7.8	0.80	69 in·lb	L
Spark Plugs	13	1.3	115 in·lb	
Upper Camshaft Chain Guide Bolts	12	1.2	106 in·lb	S
Water Jacket Plugs	19.6	2.0	14	L
Engine Removal/Installation				
Engine Damper Mounting Bolts	15.7	1.6	12	L
Engine Mounting Bolts	36.3	3.7	27	L
Engine Bottom End				
Alternator Cover Bolts (L = 40 mm)	20	2.0	15	
Alternator Cover Bolts (L = 60 mm)	20	2.0	15	
Connecting Rod Nuts	see text	←	←	MO, R
Coupling	265	27.0	195	L
Crankcase Bolts (M6)	12	1.2	106 in·lb	S
Crankcase Bolts (M8, L = 45 mm)	30	3.1	22	S
Crankcase Bolts (M8, L = 55 mm)	30	3.1	22	S
Crankcase Bolts (M9)	45	4.6	33	MO, S
Crankcase Bolts (M11)	60	6.1	44	MO, S
Engine Bracket Mounting Bolts	32	3.3	24	L
Oil Passage Plug (R1/4)	20	2.0	15	L
Oil Passage Plug (R3/8)	20	2.0	15	L
Output Cover Bolts	7.8	0.80	69 in·lb	
Output Shaft	265	27.0	195	
Oil Catch Cover Bolts	7.8	0.80	69 in·lb	
Stator Coil Grommet Holder Plate Bolts	12	1.2	106 in·lb	L
Stator Coil Mounting Bolts	12	1.2	106 in·lb	L

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Cooling and Bilge Systems				
Flushing Fitting Screws	3.0	0.31	27 in·lb	L
Intercooler Bracket Bolts	8.8	0.90	78 in·lb	
Intercooler Cover Bolts	10	1.0	89 in·lb	
Intercooler Mounting Bolts	30	3.1	22	
Intercooler Plate Bolts	8.8	0.90	78 in·lb	
Water Hose Clamp Screws	1.5	0.15	13 in·lb	
Water Hose Clamp Screws	2.5	0.26	22 in·lb	
Water Hose Clamp Screws	3.9	0.40	35 in·lb	L
Water Hose Joint (L Shape)	11	1.1	97 in·lb	
Water Hose Joint (Straight Shape)	20	2.0	15	
Drive System				
Coupling	265	27.0	195	L
Drive Shaft Holder Mounting Bolts	22	2.2	16	
Pump and Impeller				
Filter Cover Mounting Bolts	9.8	1.0	87 in·lb	L
Grate Mounting Bolts	9.8	1.0	87 in·lb	L
Impeller	147	15.0	108	LN, SS
Pump Bracket Mounting Bolts (M6)	9.8	1.0	87 in·lb	
Pump Bracket Mounting Bolts (M8)	19	1.9	14	
Pump Cap Bolts	3.9	0.40	35 in·lb	
Pump Cap Plug	3.9	0.40	35 in·lb	L
Pump Cover Mounting Bolts	7.8	0.80	69 in·lb	L
Pump Mounting Bolts	36	3.7	27	L
Pump Outlet Mounting Bolts	19	1.9	14	L
Pump Shaft Nut	98	10	72	L
Steering Cable Joint Bolt	9.8	1.0	87 in·lb	
Steering Nozzle Pivot Bolt (Lower)	19	1.9	14	
Steering Nozzle Pivot Bolt (Upper)	19	1.9	14	
Trim Control Ring Pivot Bolts	19	1.9	14	
Trim Control Cable Joint Bolt	9.8	1.0	87 in·lb	L
Trim Cotrol Shaft Joint Bolt	9.8	1.0	87 in·lb	LN
Trim Cotrol Shaft Pivot Bolt	19	1.9	14	L
Steering				
Adjustable Steering Holder Nut	4.9	0.50	43 in·lb	L, S LN
Handlebar Clamp Bolts	15.7	1.6	12	
Reverse Bucket Pivot Bolts	19	1.9	14	
Start/Stop Switch Case Mounting Screws	3.9	0.40	35 in·lb	
Shift Cable End Nut	9.8	1.0	87 in·lb	L
Shift Cable Nut	39.2	4.0	29	
Steering Cable Bracket Bolts	9.8	1.0	87 in·lb	
Steering Cable Joint Bolt	9.8	1.0	87 in·lb	
Steering Cable Nut	39.2	4.0	29	

2-8 PERIODIC MAINTENANCE

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Steering Holder Mounting Nuts	19.6	2.0	14	L LN, WG
Steering Neck Mounting Bolts	15.7	1.6	12	
Steering Nozzle Pivot Bolt (Lower)	19	1.9	14	
Steering Shaft Locknut	29.4 ~ 34.3	3.0 ~ 3.5	22 ~ 25	
Steering Shaft Nut	2.9	0.30	26 in·lb	
Throttle Case Mounting Screws	3.9	0.40	35 in·lb	L
Trim Control Cable Joint Bolt	9.8	1.0	87 in·lb	
Trim Control Cable Nut	39.2	4.0	29	
Trim Control Shaft Joint Bolt	9.8	1.0	87 in·lb	LN, WG
Hull/Engine Hood				
Bracket Bolts	8.8	0.90	78 in·lb	L
Front Hatch Mounting Screws	2.0	0.20	18 in·lb	L
Handrail Mounting Screws	4.0	0.41	35 in·lb	
Handrail Plate Nuts	9.8	1.0	87 in·lb	
Latch Handle Screws	2.0	0.20	18 in·lb	L
Seat Lock Ratchet Pins	27	2.8	20	L
Stabilizer Bolts	15.7	1.6	12	LN
Electrical System				
Bracket Bolts	8.8	0.90	78 in·lb	L
Camshaft Position Sensor Bolt	10	1.0	89 in·lb	L
Crankshaft Sensor Cover Bolts	7.8	0.80	69 in·lb	L
Crankshaft Sensor Screws	4.5	0.46	40 in·lb	
ECU Mounting Bolts	3.0	0.31	27 in·lb	
Ignition Coil Mounting Bolts	8.8	0.90	78 in·lb	L
Meter Unit Mounting Bolts	9.8	1.0	87 in·lb	L
Oil Temperature Sensor	15	1.5	11	L
Regulator/Rectifier Bolts	7.8	0.80	69 in·lb	
Relay Bracket Bolt	2.5	0.25	22 in·lb	
Relay Mounting Bolts	2.5	0.25	22 in·lb	L
Rubber Grommet Holder Screws	4.5	0.46	40 in·lb	L
Spark Plugs	13	1.3	115 in·lb	L
Speed Sensor Mounting Screws	3.9	0.40	35 in·lb	
Starter Motor Ground Bolt	8.8	0.90	78 in·lb	
Starter Motor Mounting Bolts	8.8	0.90	78 in·lb	L
Starter Motor Terminal Nut	8.8	0.90	78 in·lb	L, R
Starter Motor Through Bolts	6.4	0.65	57 in·lb	
Starter Relay Terminal Bolts	3.6	0.37	32 in·lb	
Stator Coil Bolts	12	1.2	106 in·lb	L
Stator Coil Grommet Holder Plate Bolts	12	1.2	106 in·lb	L
Timing Rotor Bolt	39	4.0	29	L
Vehicle-down Sensor Mounting Screws	1.5	0.15	13 in·lb	L
Water Temperature Sensor	14.7	1.5	11	
Water Temperature Sensor (for Meter Unit)	8.8	0.90	78 in·lb	

Torque and Locking Agent

The table below, relating tightening torque to thread diameter, lists the basic torque for the bolts and nuts. Use this table for only the bolts and nuts which do not require a specific torque value. All of the values are for use with dry solvent-cleaned threads.

Basic Torque for General Fasteners (stainless bolt and nut)

Threads Diameter (mm)	Torque		
	N·m	kgf·m	ft·lb
6	5.9 ~ 8.8	0.60 ~ 0.90	52 ~ 78 in·lb
8	16 ~ 22	1.6 ~ 2.2	12 ~ 16
10	30 ~ 41	3.1 ~ 4.2	22 ~ 30

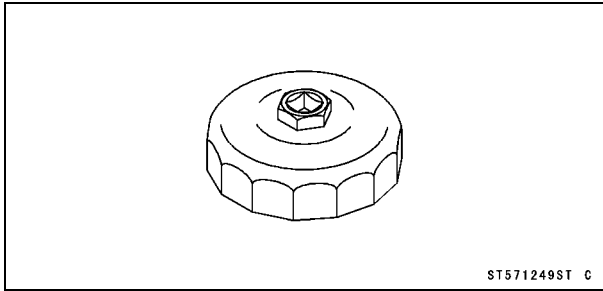
2-10 PERIODIC MAINTENANCE

Specifications

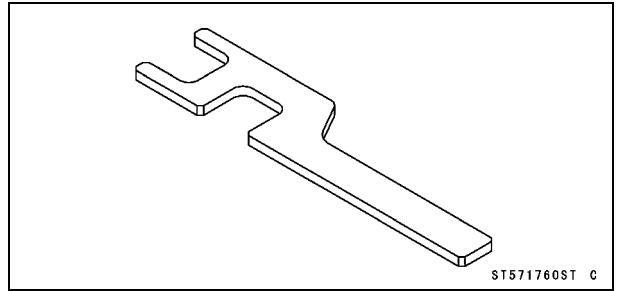
Item	Standard	Service Limit
Fuel System		
Throttle Lever Free Play	About 2 mm (0.08 in.)	— — —
Engine Lubrication System		
Engine Oil:		
Type	API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2	— — —
Viscosity	SAE 10W-40	— — —
Capacity	4.5 L (4.8 US qt, with or without the filter) 5.5 L (5.8 US qt, when engine is completely dry)	— — —
Engine Top End		
Valve Clearance:		
Intake	0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.)	— — —
Exhaust	0.47 ~ 0.55 mm (0.0185 ~ 0.0217 in.)	— — —
Electrical System		
Spark Plug:		
Type	NGK PMR9B	— — —
Gap	0.6 ~ 0.7 mm (0.024 ~ 0.028 in.)	— — —

Special Tools

Oil Filter Wrench:
57001-1249



Shaft Wrench:
57001-1760



2-12 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

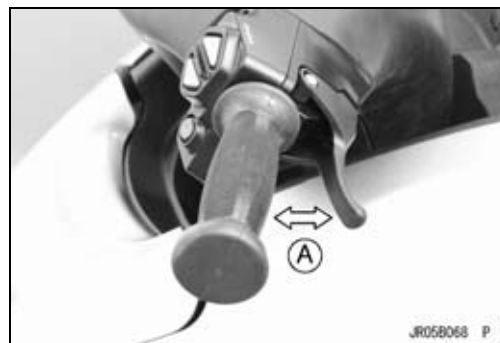
Fuel System

Throttle Control System Inspection

- Check the throttle lever free play [A].

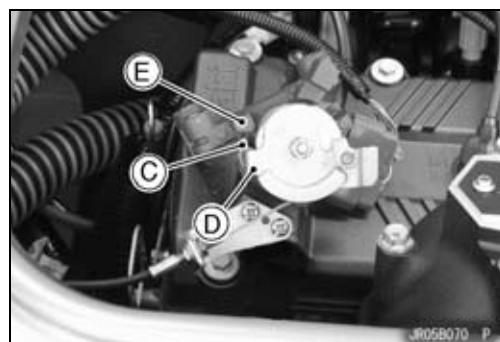
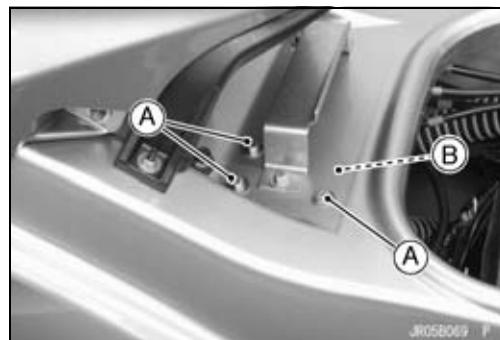
Throttle Lever Free Play

Standard: About 2 mm (0.08 in.)



★If the free play is incorrect, check the throttle cable condition as follows.

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Bolts [A] and Washers
 - Accelerator Position Sensor Assembly [B]
- When the throttle lever is fully applied (pulled), the lower stop [C] on the pivot arm [D] should be all the way up against the stopper [E].



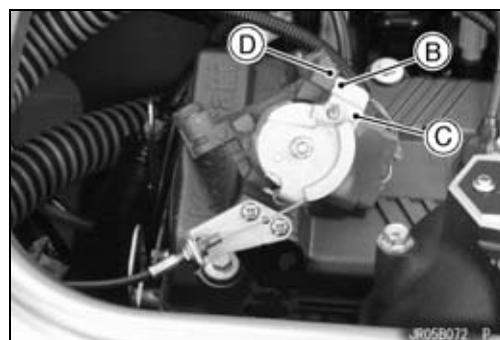
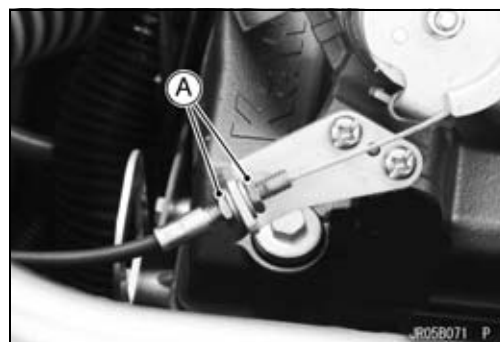
★If the lower stop on the pivot arm is not all the way up against the stopper, adjust the throttle cable.

- Loosen and turn the locknuts [A] at the bracket until the upper stop [B] on the pivot arm [C] hits against the stopper [D] with slight cable slack.
- Tighten the locknut securely.

Torque - Throttle Cable Locknut: 20 N·m (2.0 kgf·m, 14 ft·lb)

NOTE

○Make sure that the throttle pivot arm stops against the stopper with the throttle lever released.



Periodic Maintenance Procedures

- Check that the throttle lever moves smoothly from full open to close, and the throttle closes quickly and completely by the return spring at the accelerator position sensor assembly in all steering positions.
- ★ If the throttle lever does not return properly, check the throttle cable routing, lever free play, and cable damage. Then lubricate the throttle cable.
- Run the engine at the idle speed, and turn the handlebar all the way to the right and left to ensure that the idle speed does not change.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.

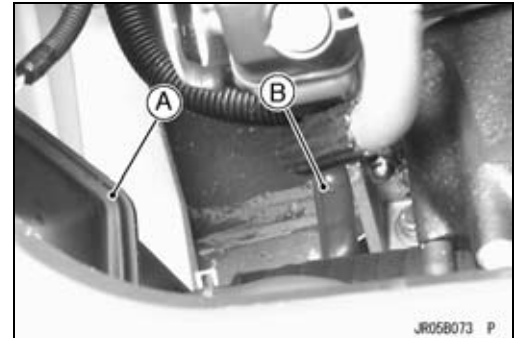
- ★ If the idle speed increase, check the free play and the cable routing.

Air Box Drain Cap Inspection and Cleaning

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Inspect the air box [A] for water inside with its drain cap [B].
- ★ If there is water in the cap, remove the cap and discharge the water.

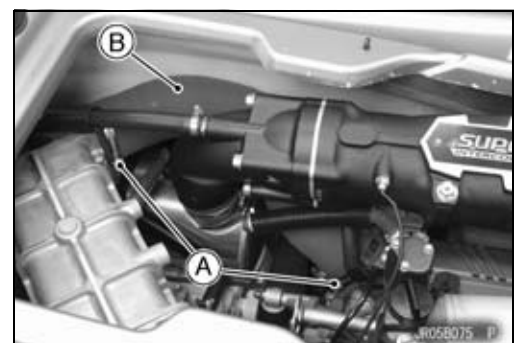
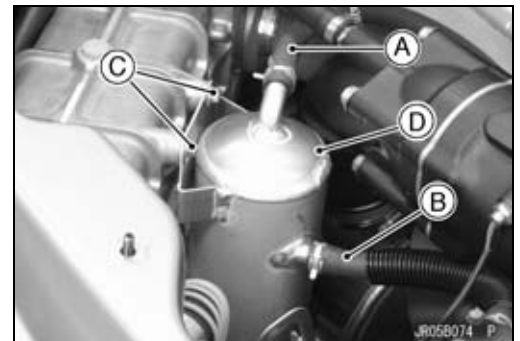
NOTE

○ Be sure to have a rag or cloth underneath for possible oily water.



Supercharger Drive Belt for Wear/Damage Inspection

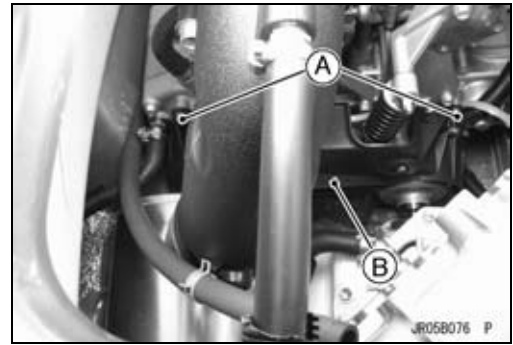
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Breather Hose [A] (from Oil Separator Tank)
 - Breather Hose [B] (from Cylinder Head Cover)
 - Oil Separator Tank Mounting Bolts [C] and Washers
 - Oil Separator Tank [D]
- Remove:
 - Intercooler Duct Clamp Screws [A] (Loosen)
 - Intercooler Duct [B]



2-14 PERIODIC MAINTENANCE

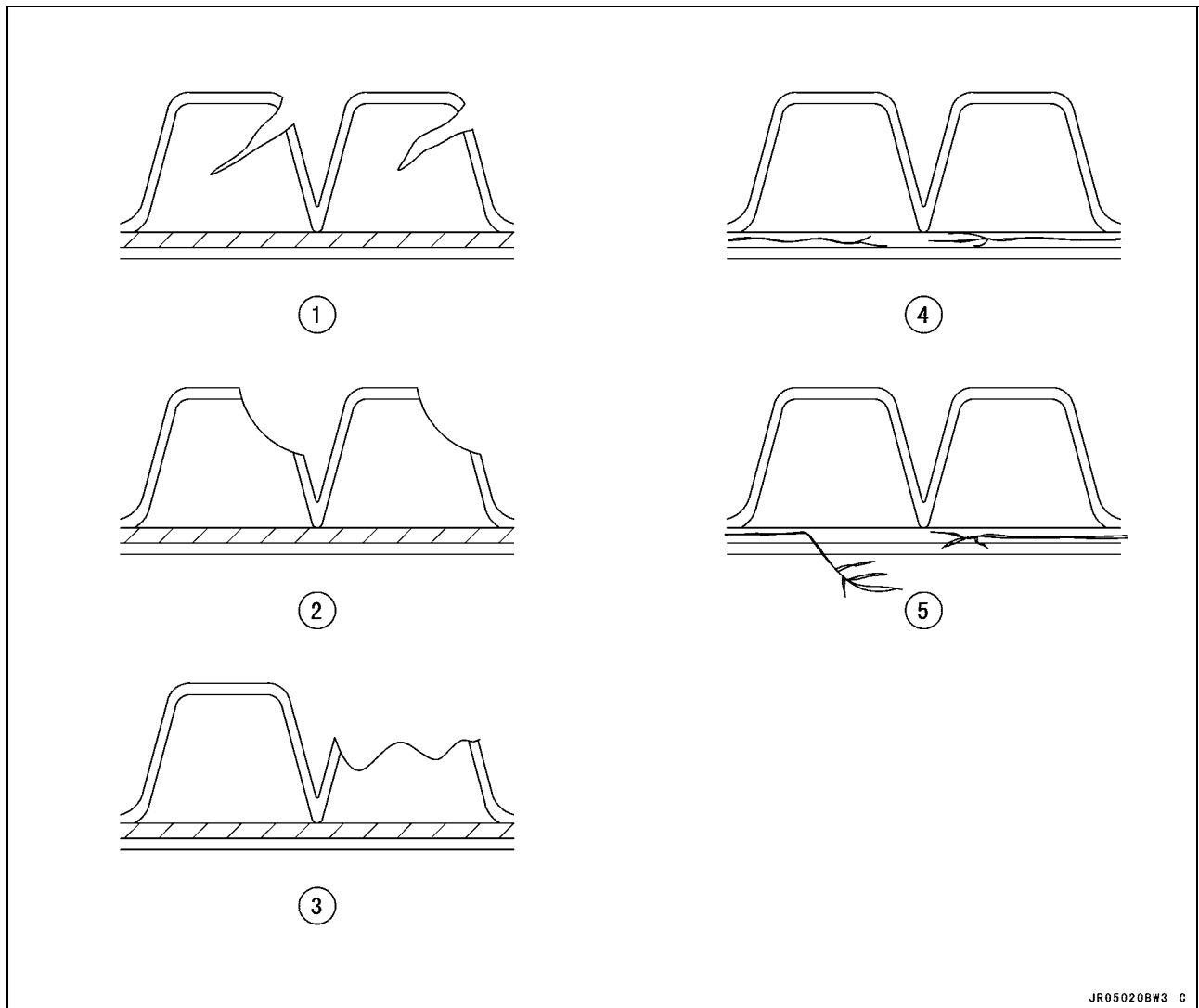
Periodic Maintenance Procedures

- Remove:
 - Supercharger Drive Belt Cover Bolts [A]
 - Supercharger Drive Belt Cover [B]
- Visually inspect the belt [A] for wear and damage.
- ★ If the nylon fabric facing of any portion is worn off, and the polyurethane compound is exposed, or belt is damaged, replace the belt with a new one (see Supercharger Drive Belt Replacement in the Fuel System (DFI) chapter).
- Otherwise, refer to the Drive Belt Tooth Wear and Damage Patterns and perform the according to the table of Drive Belt Wear and Damage Analysis.



Periodic Maintenance Procedures

Drive Belt Tooth Wear and Damage Patterns



Drive Belt Wear and Damage Analysis

Pattern	Condition	Required Action
1	External tooth cracks (more than half the height of the rib)	Replace the drive belt.
2	Tooth hook wear	Replace the drive belt.
3	Severe fractured or missing teeth	Replace the drive belt.
4	Separated cord (partially missing)	Replace the drive belt.
5	Separated cord (broken and sticking out of the rib)	Replace the drive belt.

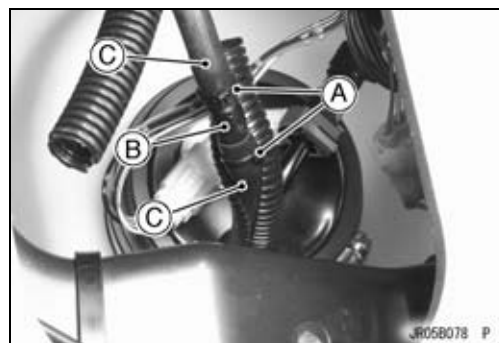
Fuel Vent Check Valve Inspection

The fuel vent check valve is mounted in the fuel tank vent hose to prevent fuel from spilling during riding. Air can flow into the tank to allow fuel to be drawn out by the fuel pump, but fuel cannot flow out the check valve.

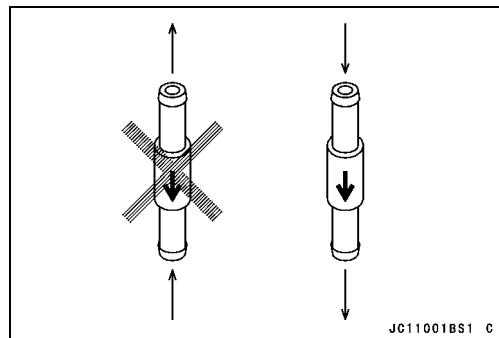
2-16 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

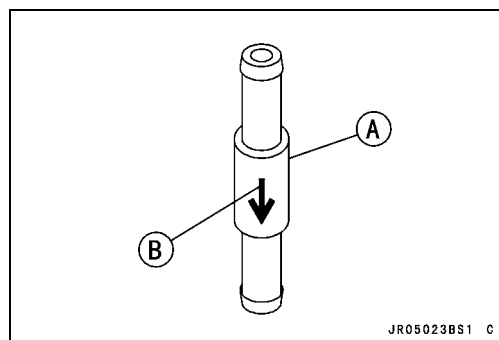
- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Cut off the bands [A].
- Pull out each end of the fuel vent check valve [B] from the vent hoses [C].



- Blow through the fuel vent check valve from each end.
- ★ If the check valve will allow air to flow as shown, it is OK.
- ★ If air will flow through the check valve in both direction or in neither direction, the check valve must be replaced.



- The fuel vent check valve [A] must be mounted so that the arrow [B] on its case is pointing toward the fuel tank.



Fuel Pump Screen Cleaning

- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Wash the fuel pump screen [A] in non-flammable or high flash point solvent. Use a soft brush to remove any contaminants trapped in the screens.

WARNING

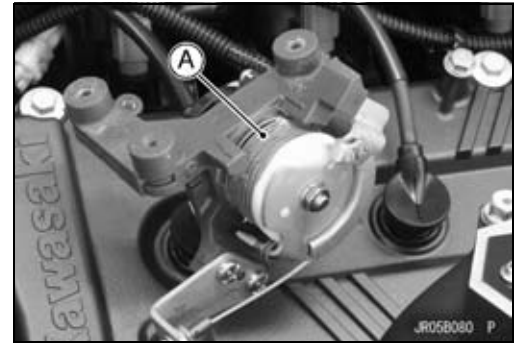
Clean the fuel pump screen in a well-ventilated area, and take ample care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low flash-point solvent. A fire or explosion could result.



Periodic Maintenance Procedures

Throttle Shaft Spring Inspection

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Accelerator Position Sensor Assembly (see Throttle Control System Inspection)
- Check the throttle shaft spring [A] by pulling the accelerator position sensor assembly.
- ★ If the springs are damaged or weak, replace the accelerator position sensor assembly.



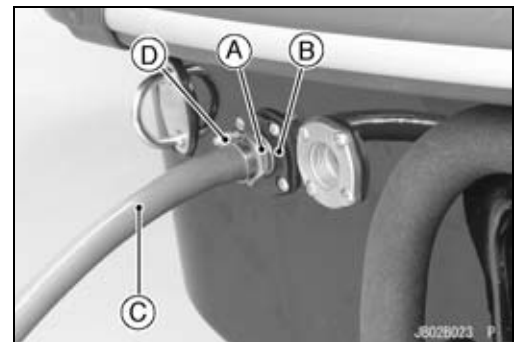
Engine Lubrication System

Engine Oil Change

- Level the watercraft port to starboard as well as fore to aft.
 - Level Ground [A]
 - Side Bumper [B]
 - Parallel [C]



- In a well-ventilated area, start the engine while cooling the cooling system.
- Obtain a standard garden hose and a garden hose adapter (see Cooling System Flushing).
- Screw a garden hose adapter [A] onto the flushing fitting [B].
- Attach a garden hose [C] to a garden hose adapter and secure the hose clamp [D].
- Warm up the engine and stop it.
- Remove the garden hose and garden hose adapter.



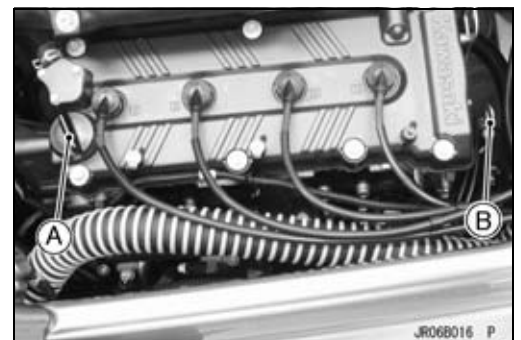
CAUTION

The engine must be running before the water is turned on and the water must be turned off before the engine is stopped.
Do not run the engine without cooling water flow for more than 15 seconds.

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the oil filler cap [A] and the dipstick [B].

CAUTION

Be careful not to allow any dirt or foreign materials to enter the engine.



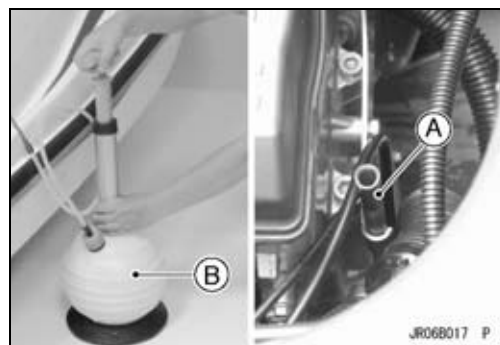
2-18 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

- Drain the oil thoroughly from the dipstick tube [A] using a commercially-available vacuum pump [B].

WARNING

Do not discard the engine oil as the engine oil is toxic substance and will pollute the environment. Contact your local authority for approved disposal methods.



- Pour in the specified type and amount of oil through the oil filler opening [A].

Engine Oil

Grade: API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2

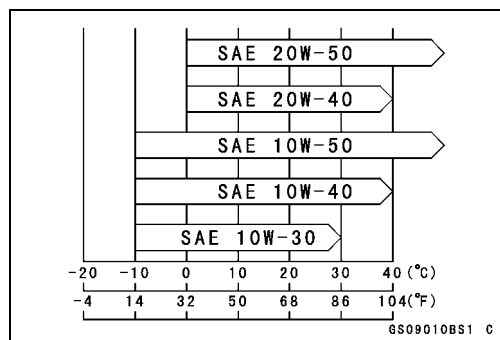
Viscosity: SAE 10W-40

Amount: 4.5 L (4.8 US qt, with or without the filter)
5.5 L (5.8 US qt, when engine is completely dry)



NOTE

- Do not add any chemical additive to the oil. Oils fulfilling the above requirements are fully formulated and provide adequate lubrication for the engine.
- Although 10W-40 engine oil is the recommended oil for most conditions, the oil viscosity may need to be changed to accommodate atmospheric conditions in your riding area.

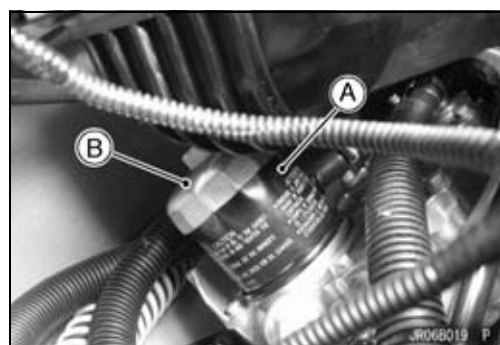


- Install the filler cap.
- Check the oil level (see Oil Level Inspection in the Engine Lubrication System chapter).

Oil Filter Replacement

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
- Drain the engine oil (see Engine Oil Change).
- Place a rag or cloth under the oil filter to receive the remaining oil.
- Remove the oil filter [A] with the oil filter wrench [B].

Special Tool - Oil Filter Wrench: 57001-1249

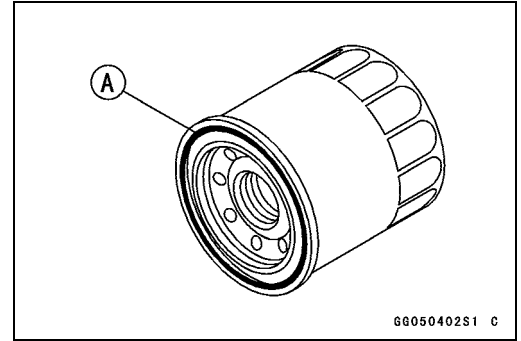


Periodic Maintenance Procedures

- Replace the filter with a new one.
- Apply engine oil to the gasket [A] before installation.
- Tighten the filter with the oil filter wrench.

Torque - Oil Filter: 18 N·m (1.8 kgf·m, 13 ft·lb)

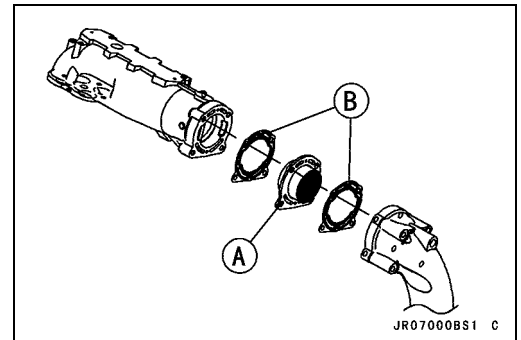
- Pour in the specified type and amount of oil (see Engine Oil Change).



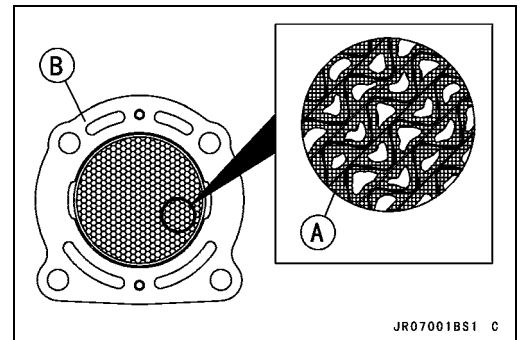
Exhaust System

Muffler Body Filter Inspection

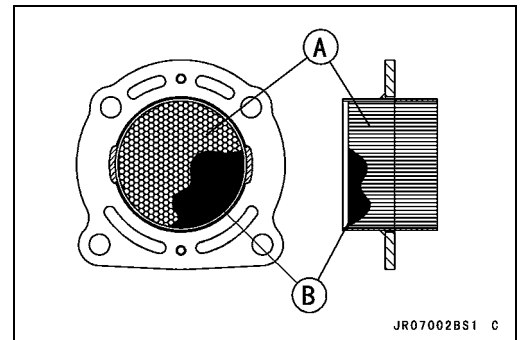
- Remove the muffler body (see Exhaust Pipe and Muffler Body Removal in the Exhaust System chapter).
- Remove the filter [A] and gaskets [B] between the exhaust pipe and muffler body.



- Visually inspect exhaust gas passages for clogging [A] and partition walls for damage.
- ★ If gas passages are clogged more than one third of exhaust passage area, replace the filter [B] with a new one.



- ★ If the partition walls [A] is dented [B], chipped away, or damaged, replace the filter with a new one. In case of minor deforming in some of partition walls that would not obstruct exhaust gas flows so much, filter replacement is not required.



- Install the muffler body (see Exhaust Pipe and Muffler Body Installation in the Exhaust System chapter).

2-20 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Engine Top End

Valve Clearance Inspection

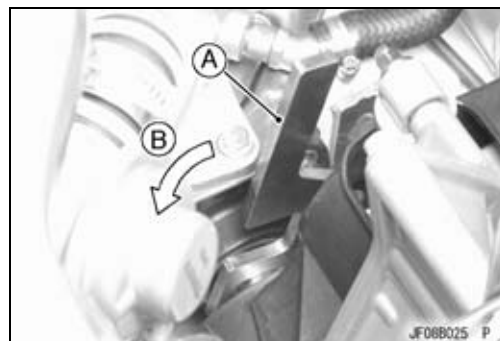
NOTE

○ Valve clearance must be checked and adjusted when the engine is cold (at room temperature).

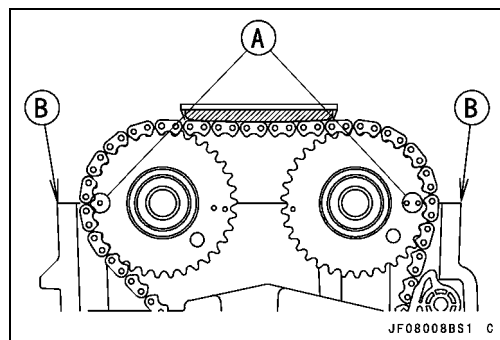
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Cylinder Head Cover (see Cylinder Head Cover Removal in the Engine Top End chapter)
 - Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
- Position the crankshaft at #1, #4 piston TDC as follows.

○ Using the shaft wrench [A], turn the crankshaft counter-clockwise [B] and set the crankshaft at #1, 4 piston TDC.

Special Tool - Shaft Wrench: 57001-1760



○ The timing marks [A] must be aligned with the cylinder head upper surface [B] as shown in the figure.



- Measure the valve clearance between the cam and the valve lifter with a thickness gauge [A].

Valve Clearance

Standard:

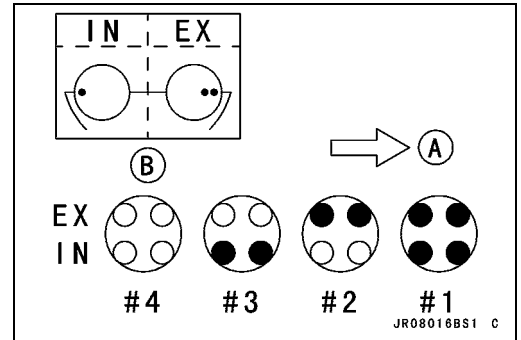
IN	0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.)
EX	0.47 ~ 0.55 mm (0.0185 ~ 0.0217 in.)



Periodic Maintenance Procedures

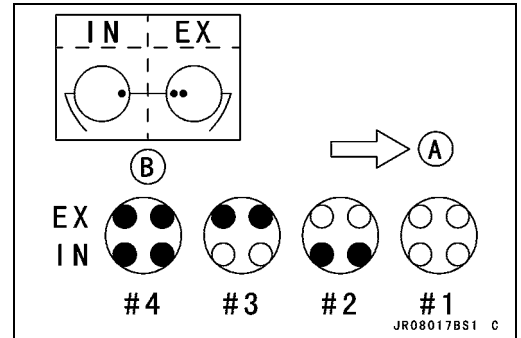
○When positioning #1 piston TDC at the end of the compression stroke:

- Intake Valve Clearance of #1 and #3 Cylinders
- Exhaust Valve Clearance of #1 and #2 Cylinders
- Measuring Valve [●]
- Bow [A]
- Camshaft Sprocket Position [B]



○When positioning #4 piston TDC at the end of the compression stroke:

- Intake Valve Clearance of #2 and #4 Cylinders
- Exhaust Valve Clearance of #3 and #4 Cylinders
- Measuring Valve [●]
- Bow [A]
- Camshaft Sprocket Position [B]

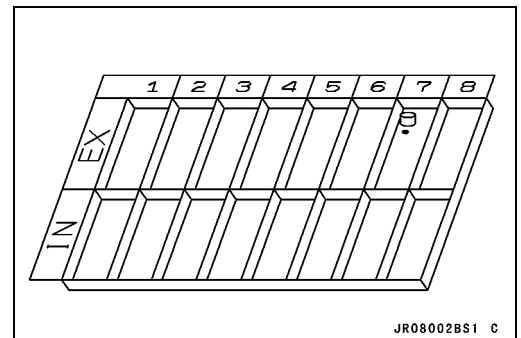


★If the valve clearance is not within the specified range, first record the clearance, and then adjust it.

- To change the valve clearance, remove the camshaft chain tensioner, camshafts and valve lifters. Replace the shim with one of a different thickness.

NOTE

○Mark and record the locations of the valve lifter and shim so that they can be reinstalled in their original positions.



- Clean the shim to remove any dust or oil.
- Measure the thickness of the removed shim [A].
- Select a new shim thickness calculation as follows.

$$a + b - c = d$$

[a] Present Shim Thickness

[b] Measured Valve Clearance

[c] Specified Valve Clearance (Mean Value = 0.275 mm (Exhaust), 0.160 mm (Inlet))

[d] Replace Shim Thickness

Example (Exhaust):

$$1.600 + 0.33 - 0.275 = 1.655 \text{ mm}$$

○Exchange the shim for the 1.675 size shim.

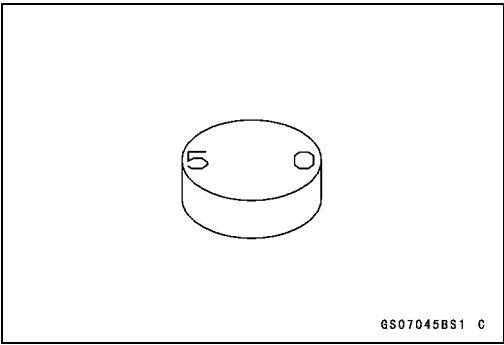


2-22 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Adjustment Shims

Thickness	Part Number	Mark
2.000	92025-1870	0
2.025	92180-0209	3
2.050	92025-1871	5
2.075	92180-0210	8
2.100	92025-1872	10
2.125	92180-0211	13
2.150	92025-1873	15
2.175	92180-0212	18
2.200	92025-1874	20
2.225	92180-0213	23
2.250	92025-1875	25
2.275	92180-0214	28
2.300	92025-1876	30
2.325	92180-0215	33
2.350	92025-1877	35
2.375	92180-1058	38
2.400	92025-1878	40
2.425	92025-1982	43
2.450	92025-1879	45
2.475	92025-1983	48
2.500	92025-1880	50
2.525	92025-1984	53
2.550	92025-1881	55
2.575	92025-1985	58
2.600	92025-1882	60
2.625	92180-1059	63
2.650	92025-1883	65
2.675	92180-1194	68
2.700	92025-1884	70
2.725	92180-1195	73
2.750	92025-1885	75
2.775	92180-1196	78
2.800	92025-1886	80
2.850	92025-1887	85
2.900	92025-1888	90
2.950	92025-1889	95
3.000	92025-1890	00



Periodic Maintenance Procedures

CAUTION

Be sure to remeasure the clearance after selecting a shim. The clearance can be out of the specified range because of the shim tolerance.

- If there is no valve clearance, use a shim that is a few sizes smaller, and remeasure the valve clearance.
- When installing the shim, face the marked side toward the valve lifter. At this time, apply engine oil to the shim or the valve lifter to keep the shim in place during camshaft installation.

CAUTION

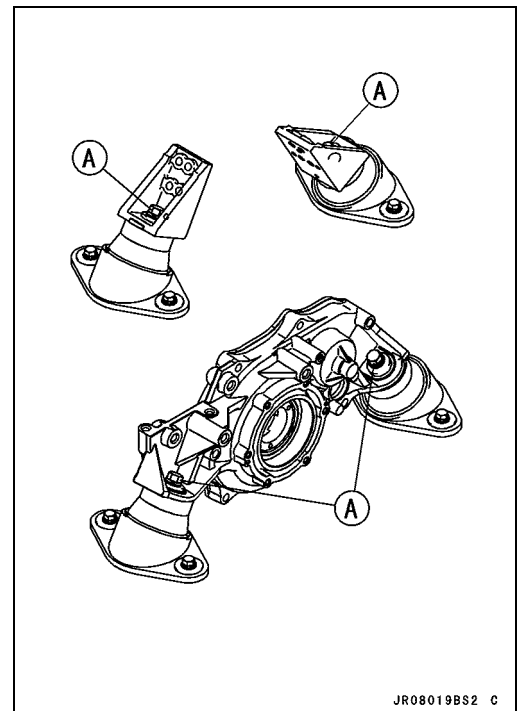
Do not put shim stock under the shim. This may cause the shim to pop out at high rpm, causing extensive engine damage.
Do not grind the shim. This may cause it to fracture, causing extensive engine damage.

- Apply molybdenum disulfide oil solution to the valve lifter surface and install the lifter.
- Install the camshafts (see Camshaft Installation in the Engine Top End chapter).
- Recheck the valve clearance and readjust if necessary.
- Install the removed parts (see appropriate chapters).

Engine Mounting Bolts Inspection and Tightness

- Remove:
 Supercharger (see Supercharger Removal in the Fuel System (DFI) chapter)
- Check the tightness of the engine mounting bolts [A].
- ★ If there are loose bolts, remove the bolts.
- Apply a non-permanent locking agent to the engine mounting bolts and tighten them.

Torque - Engine Mounting Bolts: 36.3 N·m (3.7 kgf-m, 27 ft-lb)



JR08019BS2 C

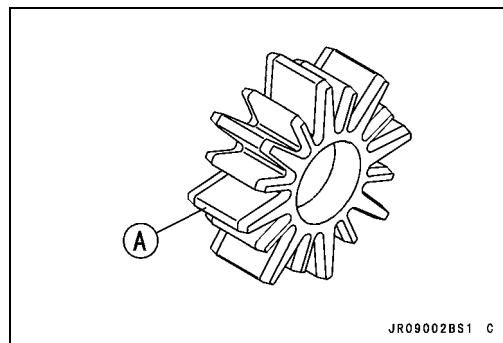
2-24 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Engine Bottom End

Coupling Damper Inspection

- Remove:
Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Remove the coupling damper [A] and inspect it for wear and deterioration.
- ★ If it is grooved or misshapen, replace it with a new damper (see Coupling Installation in the Engine Bottom End chapter).
- ★ If there is any doubt as to coupler condition, replace it.



Cooling and Bilge Systems

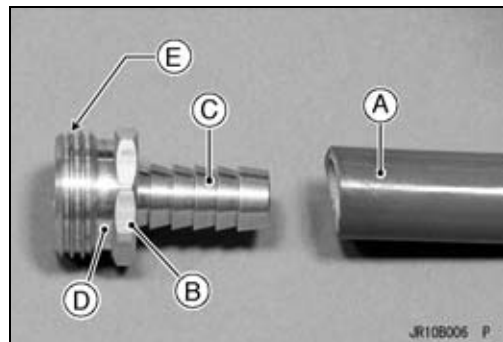
Cooling System Flushing

To prevent sand or salt deposits from accumulating in the cooling system, it must be flushed occasionally. Flush the system according to the Periodic Maintenance Chart, after each use in salt water, or whenever there is reduced water flow from the bypass outlet on the right side of the hull.

- Obtain a standard garden hose [A] and a garden hose adapter [B] as shown.
Garden Hose Fitting of Adapter [C]
Flushing Fitting of Adapter [D]
Thread: Rp 3/4 [E]

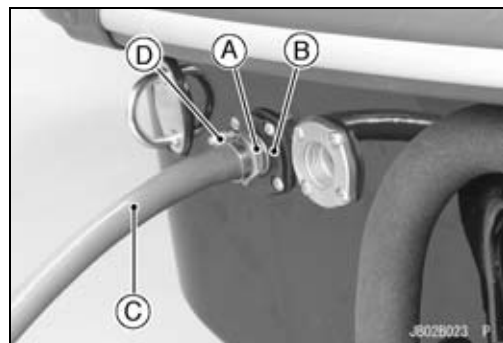
NOTE

○ Optional part (P/No. 92005-3748) is available as a garden hose adapter.



To Flush the Engine Cooling System

- Screw a garden hose adapter [A] onto the engine flushing fitting [B].
- Attach a garden hose [C] to a garden hose adapter and secure the hose clamp [D].



- Start the engine and allow it to idle before turning on the water.

CAUTION

The engine must be running before the water is turned on or water may flow back through the exhaust pipe into the engine, resulting in the possibility of severe internal damage.

- Immediately turn on the water and adjust the flow so that a little trickle of water comes out of the bypass outlet [A] on the right side of the hull.



Periodic Maintenance Procedures

- Leave the engine idle for several minutes with the water running.
- Turn off the water. Leave the engine idling.
- Rev the engine a few times to clear the water out of the exhaust system.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.

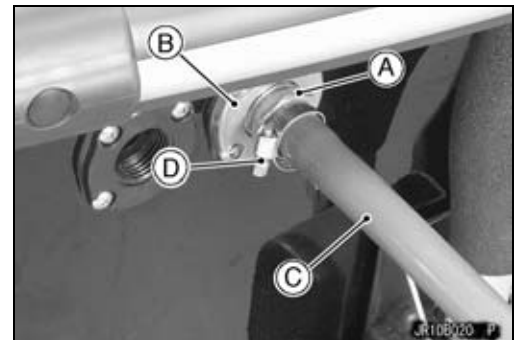
- Stop the engine, remove the garden hose and the adapter.

To Flush the Intercooler Cooling System

- Screw a garden hose adapter [A] onto the intercooler flushing fitting [B].
- Attach a garden hose [C] to a garden hose adapter and secure the hose clamp [D]
- Turn on the water to flush the intercooler cooling system.

NOTE

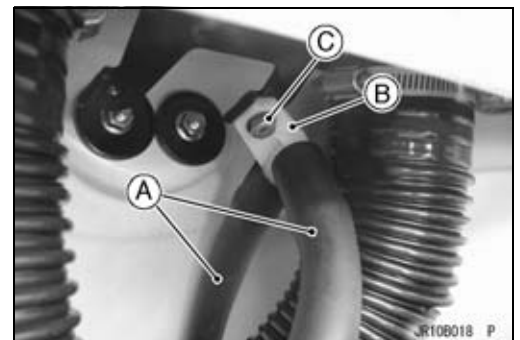
○When flushing the intercooler cooling system, it is not necessary to start the engine.



Bilge System Flushing

To prevent clogging, the bilge system should be flushed out according to the Periodic Maintenance Chart, or whenever you suspect it is blocked.

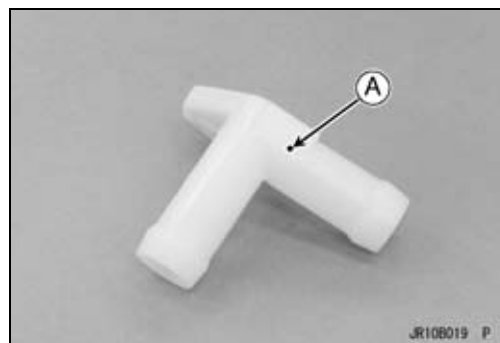
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
- Remove the bilge hoses [A] from the breather [B].
- Remove:
 - Bolt [C]
 - Breather
- Install the bilge hose (from the hull bottom) to the garden hose, turn the water on, and flush it out for about a minute. During this procedure, water will flow into the engine compartment. Do not allow a large amount of water to accumulate in the engine compartment. Remove the drain screws in the stern to drain the engine compartment.
- Install the other hose (from the hull bulkhead) to the garden hose, turn the water on, and flush it out for several minutes.



2-26 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

- Be sure the small hole [A] in the breather is open before installation.
- Install:
 - Breather
 - Bolt
 - Bilge Hoses



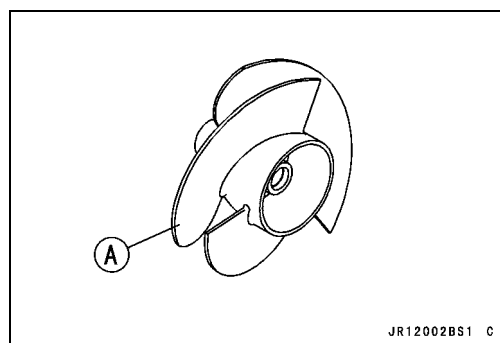
Pump and Impeller

Impeller Inspection

- Remove:
 - Impeller (see Pump Disassembly in the Pump and Impeller chapter)
- Visually inspect the impeller. [A]
- ★ If there is pitting, deep scratches, nicks or other damage, replace the impeller.

NOTE

○ Minor nicks and gouges in the impeller blades can be removed with abrasive paper or careful filing. Smooth leading edges are especially important to avoid cavitation.

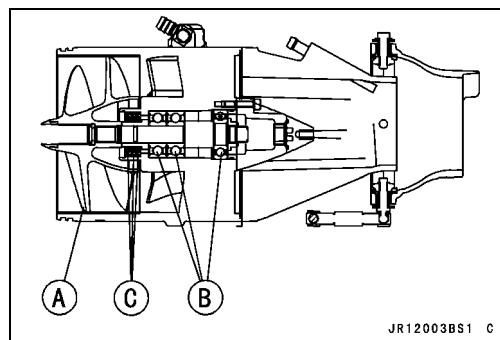


Lube Jet Pump Bearing and Seal Inspection

- Remove:
 - Pump (see Pump Removal in the Pump and Impeller chapter)
- Spin the impeller [A] lightly, and check for smooth turn, roughness, binding or noise.
- ★ If roughness, binding or noise is found, replace the lube jet pump bearings [B] and grease seals [C] (see Pump Disassembly in the Pump and Impeller chapter).

NOTE

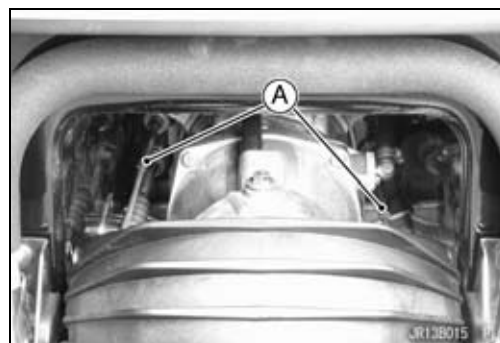
○ It is not necessary to remove the lube jet pump bearing for inspection. If the bearing is removed, it will need to be replaced with a new one.



Steering

Steering Cable/Shift Cable Inspection

- Check the steering cable or shift cable.
- ★ If each cable or cable housing is kinked or frayed, replace the cables.
- ★ If the each seal [A] at either end of each cable is damaged in any way, replace the cables.



Periodic Maintenance Procedures

- Be certain that each cable moves freely in both directions.
- Remove the cable joints at each end of each cable.
- Remove the cable joint bolt or ball joint from the cable joint.

CAUTION

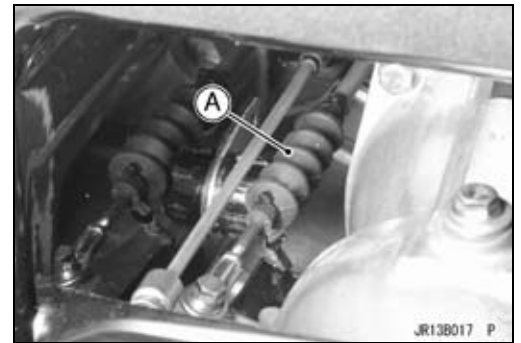
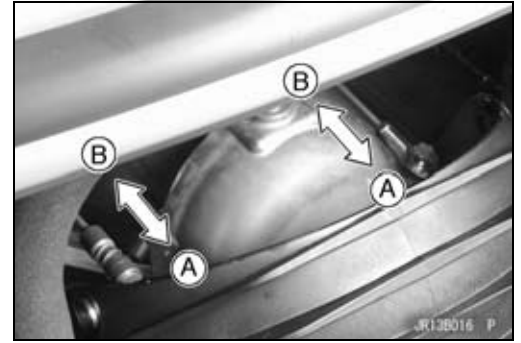
Never lay the watercraft on the right side. Water in the exhaust system may drain back into the engine causing serious damage.

- Slide the inner cable back [A] and forth [B] in each cable housings.

★ If each cable does not move freely, replace it.

Trim Control Cable Inspection

- Check the trim control cable.
- ★ If the cable or cable housing is kinked or frayed, replace the actuator.
- ★ If the boot [A] at end of cable is damaged in any way, replace the boot.



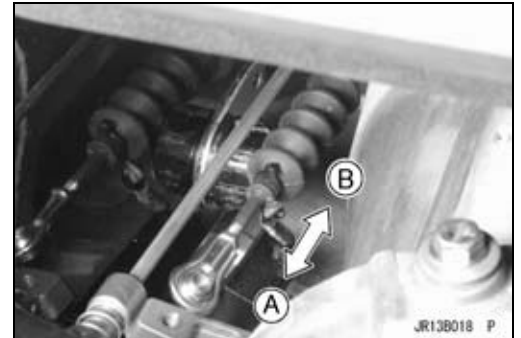
- Be certain that the cable moves freely in both directions.
- Remove the cable joint at end of cable.
- Remove the cable joint bolt from the cable joint.

CAUTION

Never lay the watercraft on the right side. Water in the exhaust system may drain back into the engine causing serious damage.

- Slide the inner cable back [A] and forth [B] in cable housing.

★ If the cable does not move freely, replace the electric trim control actuator.

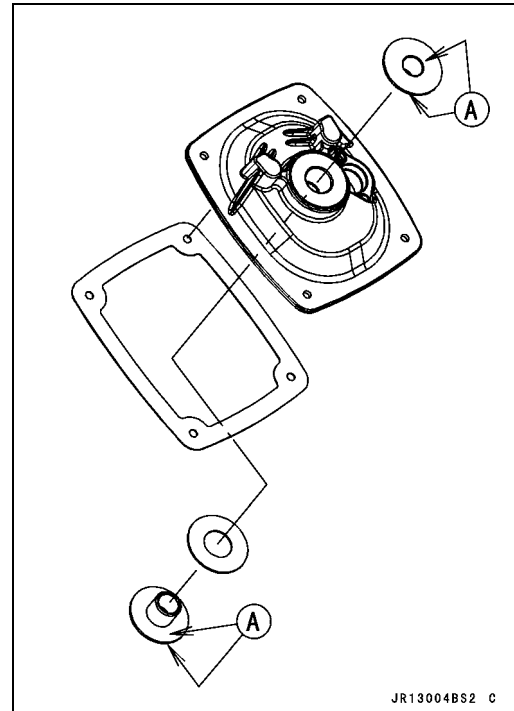


2-28 PERIODIC MAINTENANCE

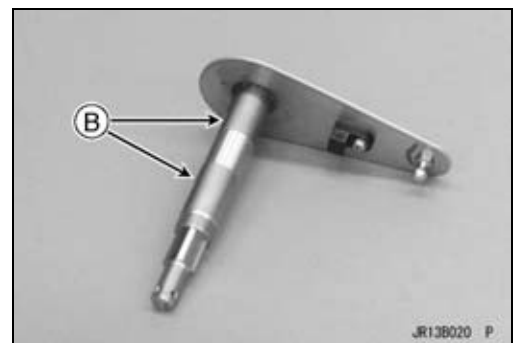
Periodic Maintenance Procedures

Handlebar Pivot Lubrication

- Remove:
 - Steering Holder (see Steering Removal in the Steering chapter)
- Check the bushings for damage and wear.
- ★ If the bushings are damaged or worn, replace them.
- Grease:
 - Bushings [A]



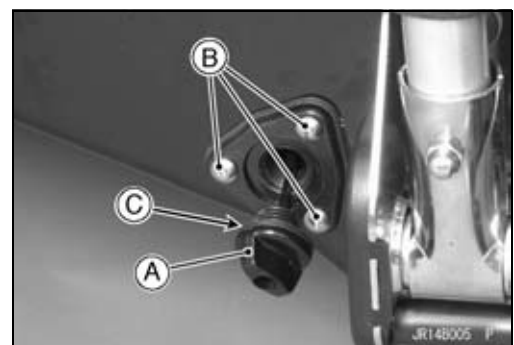
Steering Shaft [B]



Hull/Engine Hood

Drain Plug Inspection

- Check the drain plugs [A] for cracks or damage and make sure the drain plug mounting screws [B] are tightened securely.
- Check the seals [C] for damage.
- ★ If necessary, replace the drain plugs or seals.



Periodic Maintenance Procedures

Electrical System

Battery Charging Condition Inspection

Battery charging condition can be checked by measuring battery terminal voltage with a digital voltmeter [A].

- Disconnect the battery cables (see Battery Removal in the Electrical System chapter).

CAUTION

Be sure to disconnect the negative (-) cable first.

- Measure the battery terminal voltage.

NOTE

○ Measure with a digital voltmeter which can be read one decimal place voltage.

- ★ If the reading is 12.8 V or more, no refresh charge is required, however, if the read is below the specified, refresh charge is required (see Refreshing Charge in the Electrical System chapter).

Battery Terminal Voltage

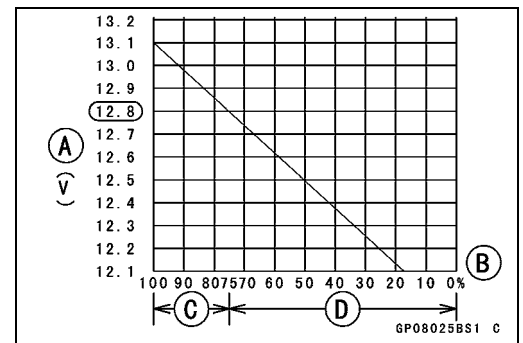
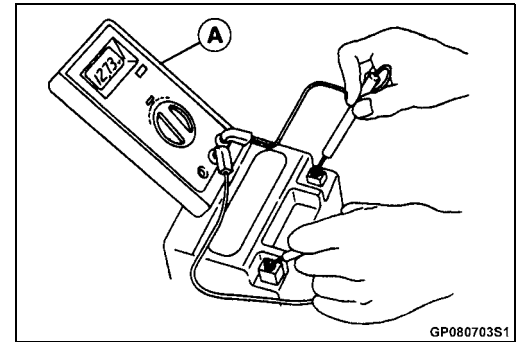
Standard: 12.8 V or more

Terminal Voltage (V) [A]

Battery Charge Rate (%) [B]

Good [C]

Refresh charge is required [D]



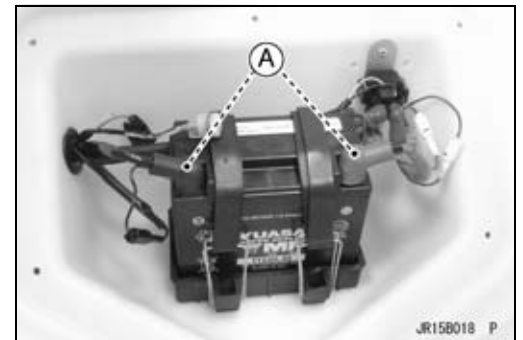
Battery Terminals Inspection

- Check the battery terminal screws [A] for tightness and make sure the terminal covers are in place.

WARNING

Loose battery cables can create sparks which can cause a fire or explosion resulting in injury or death. Make sure the battery terminal screws are tightened securely and the covers are installed over the terminals.

- Check that the battery terminals are not corroded.
- ★ If necessary, remove the battery (see Battery Removal in the Electrical System chapter) and clean the terminals and cable ends using a solution of baking soda and water.
- After attaching both cables, coat the terminals and cable ends with grease to prevent corrosion.



2-30 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Spark Plug Inspection

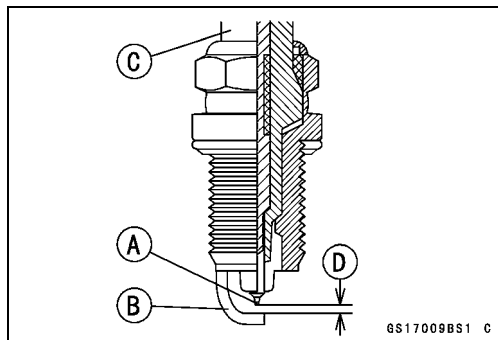
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Spark Plug Caps
- Remove the spark plugs using the 16 mm (0.63 in.) plug wrench [A] vertically.

Owner's Tool - Spark Plug Wrench, 16 mm: 92110-3706



- Visually inspect the spark plugs.
- ★ If the spark plug center electrode [A] and/or side electrode [B] are corroded or damaged, or if the insulator [C] is cracked, replace the spark plug.
- Measure the gap [D] with a wire-type thickness gauge.
- ★ If the gap is incorrect, replace the spark plug.

Spark Plug Gap: 0.6 ~ 0.7 mm (0.024 ~ 0.028 in.)



- Insert the spark plug vertically into the plug hole with the spark plug installed in the plug wrench [A], and finger-tighten it first.

Owner's Tool - Spark Plug Wrench, 16 mm: 92110-3706



CAUTION

If tightening the spark plug with the wrench inclined, the insulator of the spark plug may break.

- Tighten:
 - Torque - Spark Plugs: 13 N·m (1.3 kgf·m, 115 in·lb)**
- Be sure to install the plug caps so that the plug cap leads are positioned at a right angle to the engine center line (see Cable, Wire and Hose Routing section in the Appendix chapter).
- Be sure the spark plug caps are installed by pulling up it lightly.

Lubrication

As in all marine craft, adequate lubrication and corrosion protection is an absolute necessity to provide long, reliable service. Refer to the Periodic Maintenance Chart for the frequency of the following items:

Periodic Maintenance Procedures

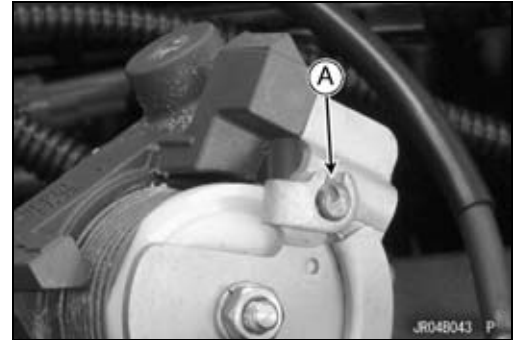
- Lubricate the following with grease.
- Pull the throttle lever and hold it.

Throttle Cable End [A] at Throttle Lever



- Remove the accelerator position sensor assembly (Throttle Control System Inspection).

Throttle Cable End [A] at Accelerator Position Sensor Assembly



- Remove the steering holder (see Steering Removal in the Steering chapter).

Steering Cable Ball Joint [A] at Steering Shaft

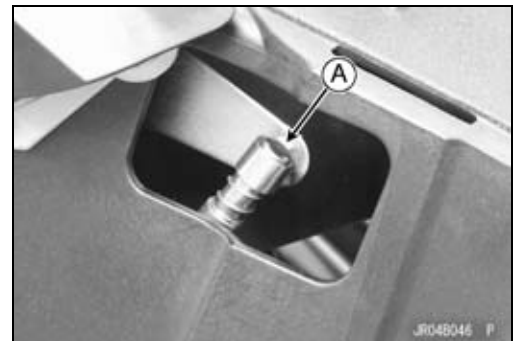


Steering Cable Joint [A]



- Remove the left side cover (see Side Cover Removal in the Hull/Engine Hood chapter).

Shift Cable Ball Joint [A] at Shift Lever



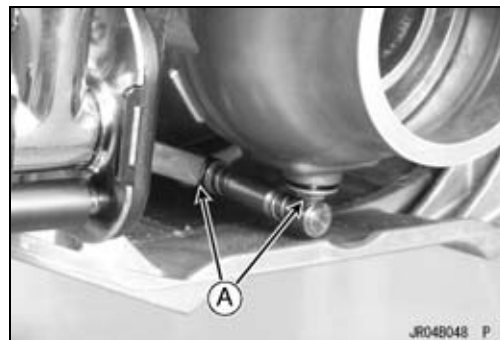
2-32 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

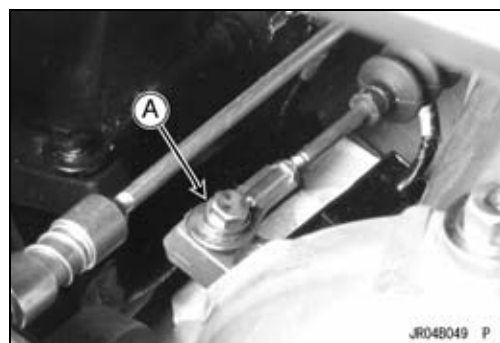
Shift Cable Ball Joint [A] at Reverse Bucket



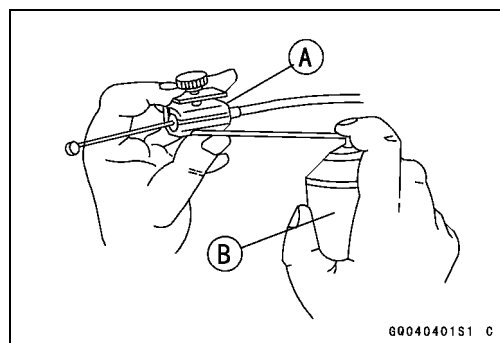
Trim Control Cable Ball Joint [A]



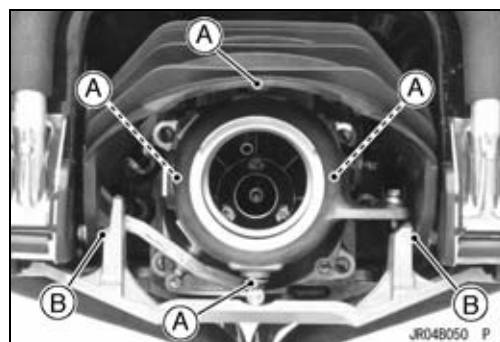
Trim Control Cable Joint [A]



- Lubricate the following with a penetrating rust inhibitor [B].
Throttle Cable [A]

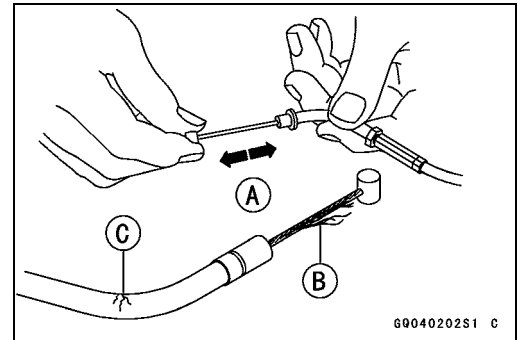


Steering Nozzle Pivots [A]
Reverse Bucket Pivots [B]



Periodic Maintenance Procedures

- With the cable disconnected at both ends, the cable should move freely [A] within the cable housing.
- ★ If cable movement is not free after lubricating, if the cable is frayed [B], or if the cable housing is kinked [C], replace the cable.



All Hoses, Hose Clamps, Nuts, Bolts and Fasteners Check

Nuts, Bolts, and Fasteners Tightness Inspection

- Check the tightness of the bolts and nuts listed here. Also, check to see that each cotter pin is in place and in good condition.

NOTE

○ For the engine fasteners, check the tightness of them when the engine is cold (at room temperature).

- ★ If there are loose fasteners, retighten them to the specified torque following the specified tightening sequence. Refer to the appropriate chapter for torque specifications. If torque specifications are not in the appropriate chapter, see the Standard Torque Table. For each fastener, first loosen it by 1/2 turn, then tighten it.
- ★ If cotter pins are damaged, replace them with new ones.

Nut, Bolt and Fastener to be checked

Engine:

- Oil Filter
- Engine Mounting Bolts (and bracket bolts)
- Engine Damper Mounting Bolts
- Cylinder Head Cover Bolts
- Cylinder Head Bolts
- Crankcase Bolts

Drive Shaft, Pump, and Impeller:

- Drive Shaft Holder Mounting Bolts
- Pump Mounting Bolts
- Pump Cover Mounting Bolts
- Grate Mounting Bolts
- Steering Nozzle Pivot Bolts
- Reverse Bucket Pivot Bolts

Steering:

- Handlebar Clamp Bolts
- Steering Neck Mounting Bolts
- Steering Holder Mounting Nuts
- Steering Shaft Locknut
- Steering Cable Nut
- Steering Cable Joint Bolt
- Shift (reverse) Cable Nut

Hull and Engine Hood:

- Stabilizer Bolts
- Handrail Plate Nuts

Electrical System:

- Spark Plugs
- Battery Terminal

2-34 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Hose and Hose Connect Inspection

- Check the following hoses for leakage [A], hardening, cracking [B], checking, cuts, abrasions, breaks and bulges [C]. And make sure the hoses are not kinked or pinched.

Fuel Vent Hose

Oil Hoses

Water Hoses

Bilge Hoses

- ★ If a hose is damaged in any way, replace it immediately and check all the others for damage.

- Make sure the above hoses are routed properly and secured with the clamps away from any moving parts and sharp edged portions.

Plastic Clamp [A]

Hose [B]

Hose Fitting [C]

NOTE

- The majority of bilge hoses have no clamps at the hose ends.

Metal Clamp [A]

Hose [B]

Hose Fitting [C]

NOTE

- Check the fuel and exhaust hoses for signs of wear, deterioration, damage or leakage. Replace if necessary.
- Make sure the above hoses are secured with the metal gear clamps away from any parts.

- If the watercraft is not properly handled, the high pressure inside the fuel line can cause fuel to leak [A] or the hose to burst.

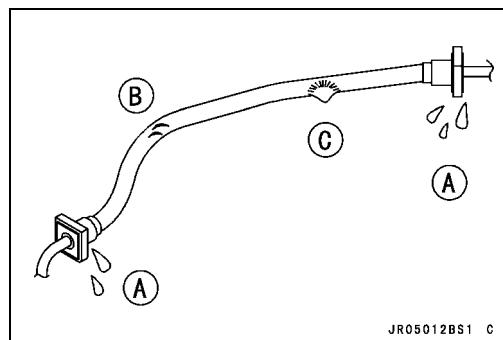
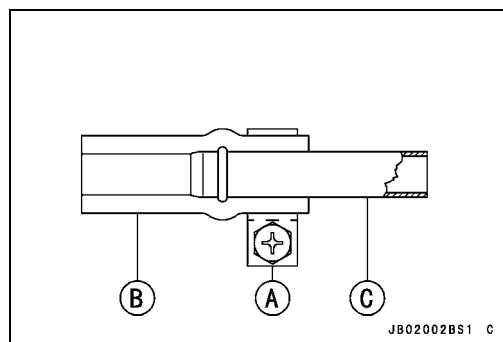
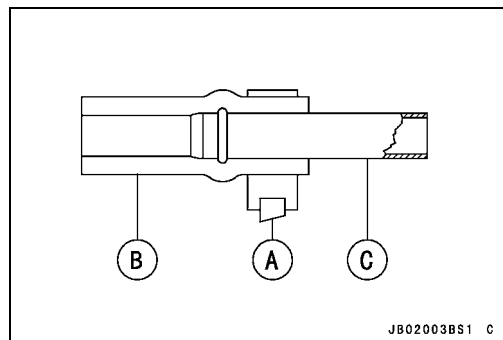
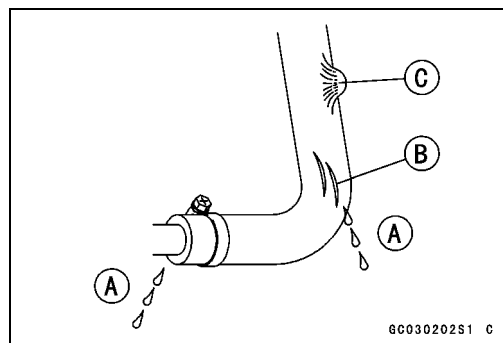
- Remove:

Seats (see Seat Removal in the Hull/Engine Hood chapter)

Center Access Cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter)

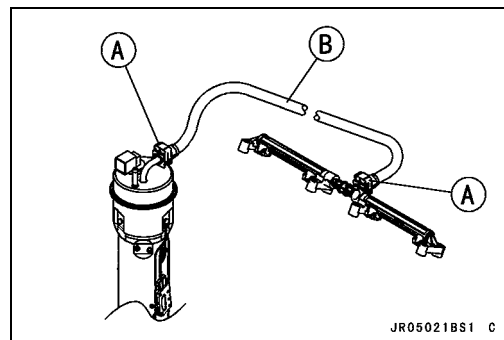
- Check the fuel hose.

- ★ Replace the fuel hose if any fraying, cracks [B] or bulges [C] are noticed.



Periodic Maintenance Procedures

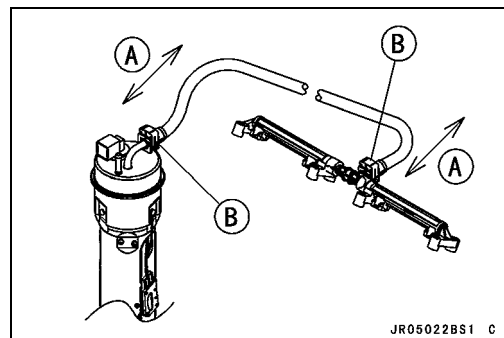
- Check that the hoses are routed according to Cable, Wire, and Hose Routing section in the Appendix chapter.
- ★ Replace the hose if it has been sharply bent or kinked.
- Hose Joints [A]
- Fuel Hose [B]



- Check that the hose joints are securely connected.
- Push and pull [A] the hose joint [B] back and forth more than two times, and make sure it is locked.
- ★ If it does not locked, reinstall the hose joint.

WARNING

Make sure the hose joint is installed correctly on the delivery pipe by sliding the joint, or the fuel could leak.



Rubber Strap Inspection

- Check the following rubber straps for any deterioration or damage. Pull on squeeze the straps and look for cracks.
- Battery Straps [A]
- Fuel Tank Straps
- Water Box Muffler Strap
- Electric Trim Control Actuator Straps
- ★ If a strap is damage in any way, replace it.



Fuel Hose Replacement

WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

- Remove the fuel hose (see Fuel Hose Removal in the Fuel System (DFI) chapter).
- Replace the fuel hose with a new one.
- When installing the fuel hose, route the hose according to Cable, Wire, and Hose Routing section in the Appendix chapter.
- When installing the fuel hose, avoid sharp bending, kinking, flattening or twisting, and route the fuel hose with a minimum of bending so that the fuel flow will not be obstructed.
- Check that the hose joints are securely connected (see Hose and Hose Connect Inspection).
- Start the engine and check the fuel hose for leaks.

2-36 PERIODIC MAINTENANCE

Periodic Maintenance Procedures

Apply Corrosion Protection Coating to the Supercharger Rotors

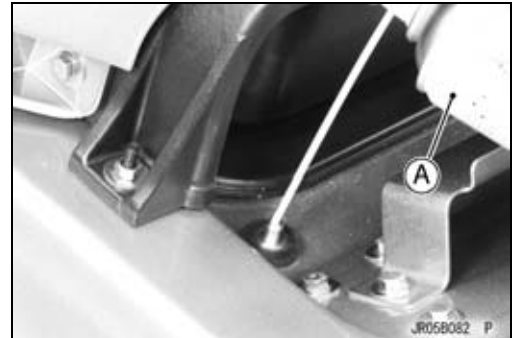
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
- Remove the cap [A] of the filler opening.



- Start the engine and run it at idle speed.
- Apply the commercially available fogging oil [A] to the supercharger from the filler opening for 10 seconds.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.



- Stop the engine.
- Install:
 - Cap
 - Seats (see Seat Installation in the Hull/Engine Hood chapter)

Fuel System (DFI)

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3-2 FUEL SYSTEM (DFI)

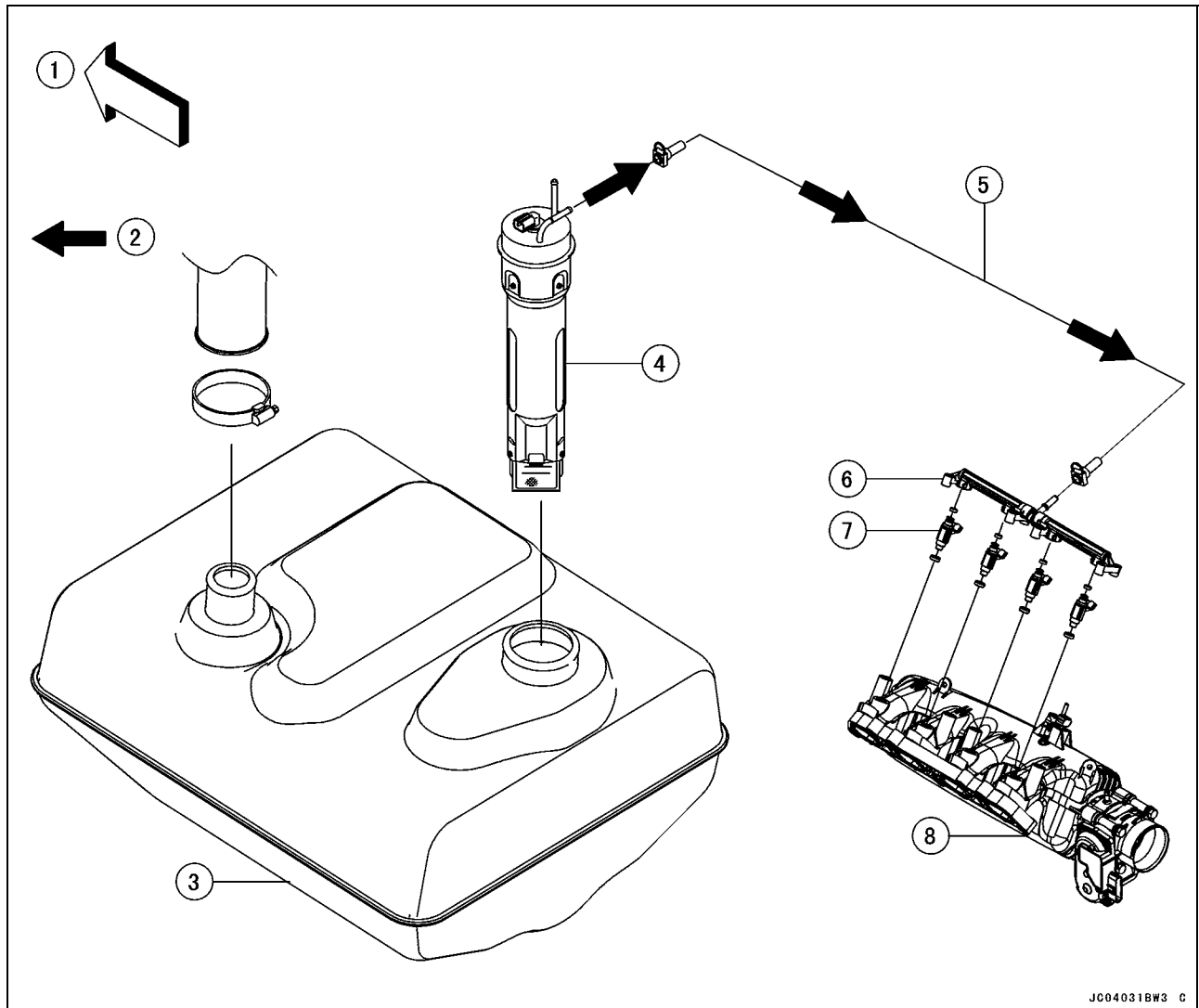
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3-4 FUEL SYSTEM (DFI)

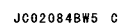
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Fuel System Diagram



1. Bow
2. Fuel Flow
3. Fuel Tank
4. Fuel Pump
5. Fuel Hose
6. Delivery Pipe Assy
7. Fuel Injectors
8. Throttle Body Assy

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Bracket Bolts	8.8	0.90	78 in·lb	L
2	Intake Air Temperature Sensor	15	1.5	11	
3	Delivery Pipe Assy Mounting Screws	3.5	0.36	31 in·lb	
4	Intake Manifold Mounting Bolts	25	2.5	18	
5	Vehicle-down Sensor Mounting Screws	1.5	0.15	13 in·lb	
6	Throttle Cable Locknut	19.6	2.0	14	
7	Accelerator Position Sensor Assembly Bolts	8.8	0.90	78 in·lb	L
8	Throttle Body Assy Mounting Bolts	13	1.3	115 in·lb	
9	Crankshaft Sensor Screws	4.5	0.46	40 in·lb	L
10	ECU Mounting Bolts	3.0	0.31	27 in·lb	L
11	Relay Mounting Bolts	2.5	0.25	22 in·lb	L
12	Camshaft Position Sensor Bolt	10	1.0	89 in·lb	L
13	Water Temperature Sensor	14.7	1.5	11	
14	Oil Temperature Sensor	15	1.5	11	

DG: Fill the hollow with the heat transfer grease (Heat Transfer Grease, SCH-20: 92137-1002 or equivalent).

EO: Apply engine oil.

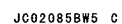
G: Apply grease.

L: Apply a non-permanent locking agent.

R: Replacement Parts

WG: Apply water-resistance grease.

Exploded View



Exploded View

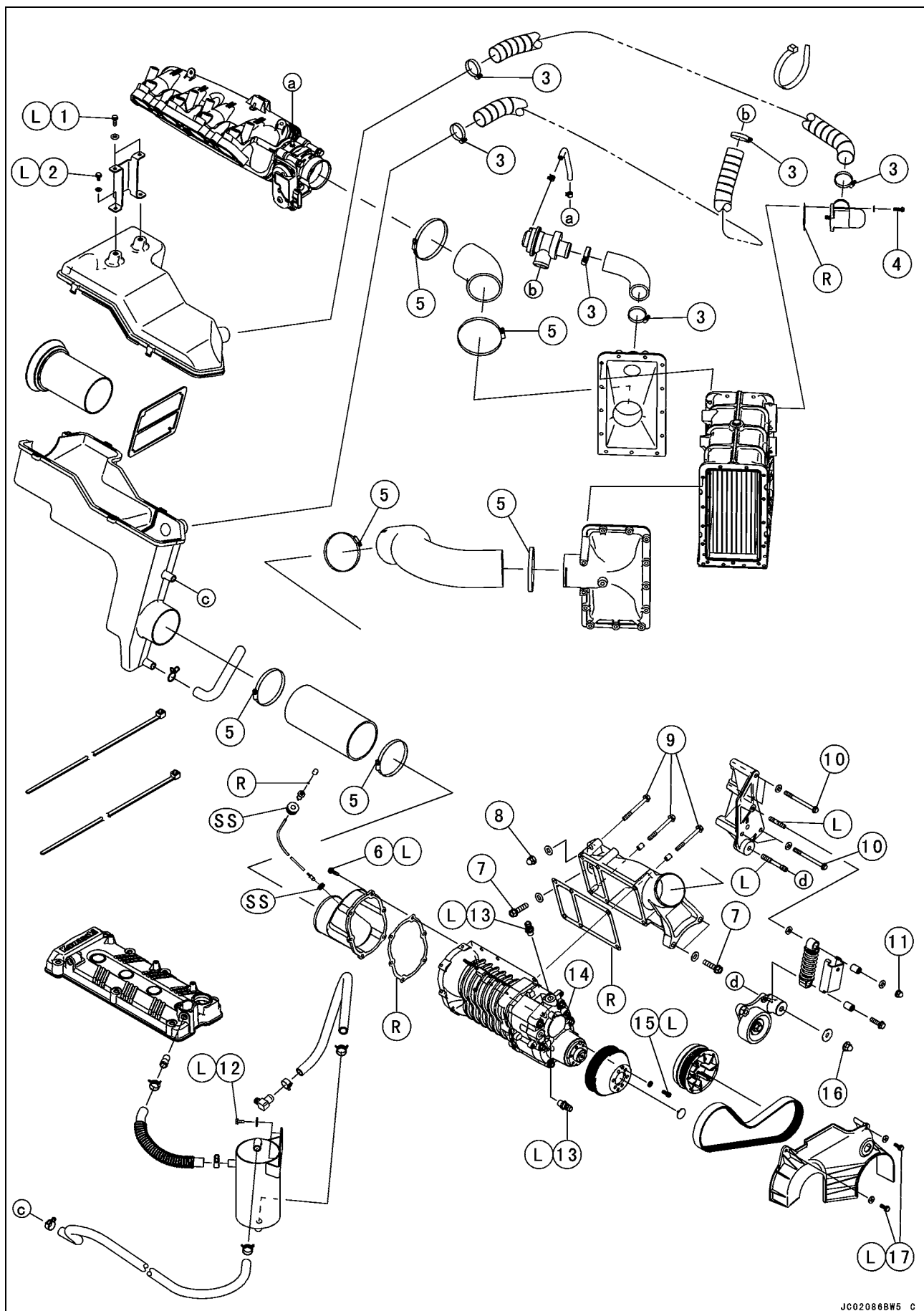
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Fuel Filler Hose Clamp Screws	2.9	0.30	26 in·lb	
2	Fuel Pump Rubber Holder Clamp Screws	2.9	0.30	26 in·lb	

3. AU and EUR Models

R: Replacement Parts

3-10 FUEL SYSTEM (DFI)

Exploded View



Exploded View

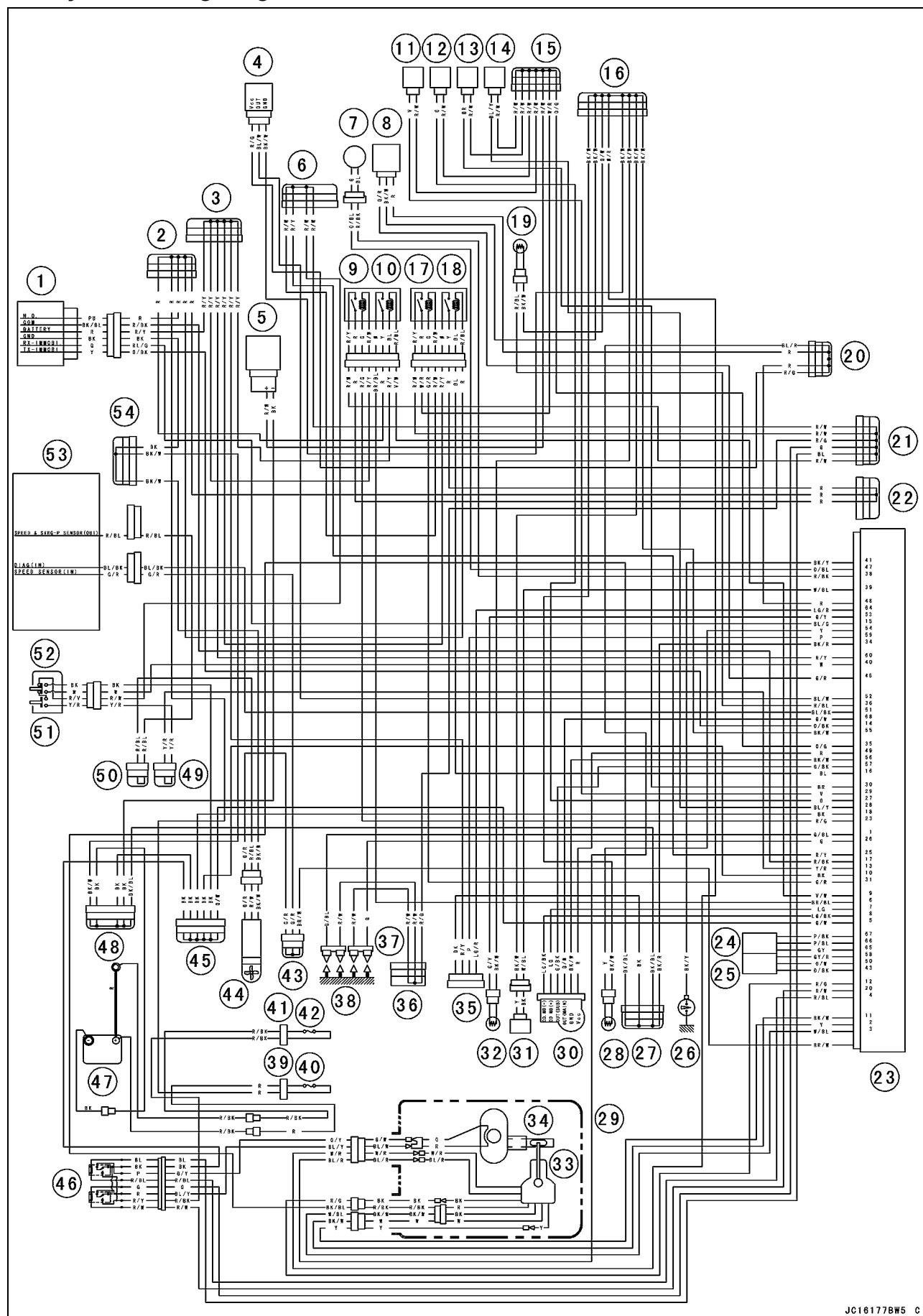
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Air Box Bracket Bolts	8.8	0.90	78 in·lb	L
2	Air Box Bolts	8.8	0.90	78 in·lb	L
3	Air Bypass System Clamp Screws	4.9	0.50	43 in·lb	
4	Blow off Valve Bolts	7.8	0.80	69 in·lb	
5	Intake Duct Clamp Screws	4.9	0.50	43 in·lb	
6	Lower Intake Pipe Bolts	4.9	0.50	43 in·lb	L
7	Supercharger Mounting Bolts	45	4.6	33	
8	Supercharger Mounting Nut	45	4.6	33	
9	Upper Intake Pipe Bolts	30	3.1	22	
10	Supercharger Drive Belt Tensioner Assy Mounting Bolts	35	3.6	26	
11	Supercharger Drive Belt Tensioner Nut (M8)	30	3.1	22	
12	Oil Separator Tank Mounting Bolts	8.8	0.90	78 in·lb	L
13	Water Hose Joints (Straight Shape)	20	2.0	15	L
14	Gear Oil Drain Bolt	10.5	1.1	93 in·lb	
15	Pulley Mounting Bolts	12	1.2	106 in·lb	L
16	Supercharger Drive Belt Tensioner Nut (M10)	45	4.6	33	
17	Supercharger Drive Belt Cover Bolts	4.9	0.50	43 in·lb	L

L: Apply a non-permanent locking agent.
 R: Replacement Parts
 SS: Apply silicone sealant.

3-12 FUEL SYSTEM (DFI)

DFI System

DFI System Wiring Diagram



DFI System

Part Names

1. Ignition Switch (Immobilizer Amplifier)
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Vehicle-down Sensor
5. Fuel Pump
6. Joint Connector T (12 V)
7. Crankshaft Sensor
8. Intake Air Pressure Sensor
9. ECU Main Relay
10. ETV Actuator Relay
11. Injector #1
12. Injector #2
13. Injector #3
14. Injector #4
15. Joint Connector L (12 V)
16. Joint Connector B (Ground)
17. Fuel Pump Relay
18. System Relay
19. Intake Air Temperature Sensor
20. Joint Connector F (5 V)
21. Joint Connector D (12 V)
22. Joint Connector C (12 V)
23. ECU
24. Accelerator Position Sensor 1
25. Accelerator Position Sensor 2
26. Oil Pressure Switch
27. Joint Connector E (Ground)
28. Oil Temperature Sensor
29. Electric Trim Control Actuator
30. ETV Actuator
31. Camshaft Position Sensor (Exhaust)
32. Water Temperature Sensor
33. Electric Trim Control Sensor
34. Electric Trim Control Motor
35. Immobilizer/Kawasaki Diagnostic System Connector
36. Joint Connector M (12 V)
37. Ignition Coils
38. Spark Plugs
39. Fuse Box 1
40. Main Fuse 20 A
41. Fuse Box 2
42. Electric Trim Control Relay Fuse 20 A
43. Joint Connector J (Speed Sensor Signal)
44. Speed Sensor
45. Joint Connector Y (Ground)
46. Electric Trim Control Relay
47. Battery
48. Joint Connector S (Ground)
49. Joint Connector X (12 V)
50. Joint Connector W (10 V)
51. Engine Start Switch
52. Engine Stop Switch/Tether
53. Meter Unit
54. Joint Connector Q (Ground)

3-14 FUEL SYSTEM (DFI)

DFI System

○Color Codes:

BK: Black

BL: Blue

BR: Brown

CH: Chocolate

DG: Dark Green

G: Green

GY: Gray

LB: Light Blue

LG: Light Green

O: Orange

P: Pink

PU: Purple

R: Red

V: Violet

W: White

Y: Yellow

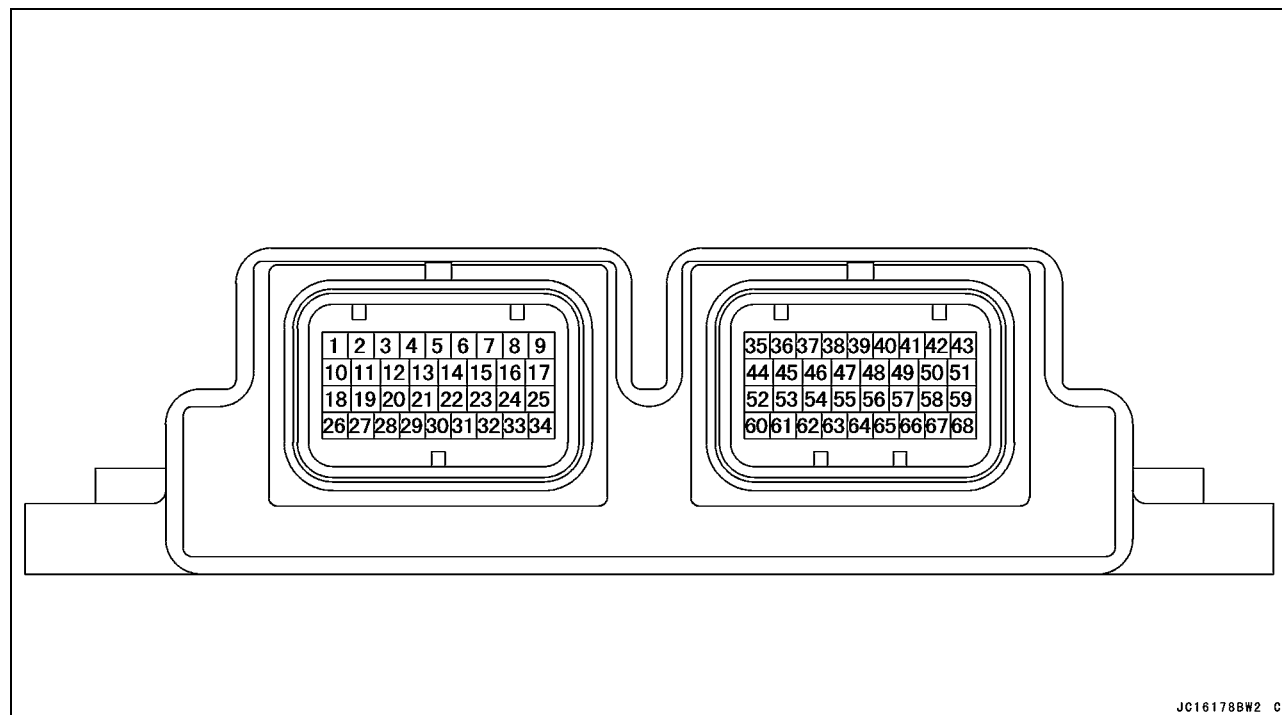
DFI System

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3-16 FUEL SYSTEM (DFI)

DFI System

Terminal Numbers of ECU Connectors



Terminal Names

1. Ignition Coil #1, #4: G/BL
2. Electric Trim Control Sensor (Horizontal Position): Y
3. Electric Trim Control Sensor (Up Position): W/BL
4. Electric Trim Control Relay (Down): R/BL
5. Ground for ETV Actuator: G/W
6. Power Supply to ETV Actuator (from ETV Actuator Relay): BR/BL
7. ETV Actuator (+): LG
8. ETV Actuator (-): LG/BK
9. ETV Actuator Relay: V/W
10. Ground for Power: BK
11. Electric Trim Control Sensor (Down Position): BK/W
12. Electric Trim Control Position Sensor: R/G
13. Start Switch: Y/R
14. Immobilizer Amplifier: O/BK
15. Immobilizer Amplifier: BL/G
16. System Relay: BL
17. Entry Switch (from Ignition Switch): R/BK
18. Ground for Power: BK
19. Unused
20. Electric Trim Control Relay (Up): R/W
21. Fuel Economy Assistance Mode Button: BK/BL
22. Unused
23. ECU Main Relay: R/G
24. Electronic Cruise Control Button (Up): Y/BK
25. Main Switch: R/Y
26. Ignition Coil #2, #3: G
27. Fuel Injector #2: O
28. Fuel Injector #4: BL/Y
29. Fuel Injector #1: V
30. Fuel Injector #3: BR
31. Fuel Pump Relay: G/R
32. Electronic Cruise Control Button (Down): P
33. Electronic Cruise Control Button (Set): BL/R
34. Ground for Control System: BK/R

DFI System

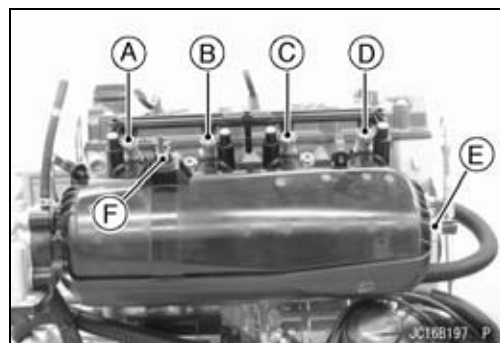
- 35. Battery Monitor Voltage Line: O/G
- 36. Intake Air Temperature Sensor: R/BL
- 37. Speed Sensor: BR/W
- 38. Crankshaft Sensor (+): R/BK
- 39. Camshaft Position Sensor: W/BL
- 40. Engine Stop Switch: W
- 41. Oil Pressure Switch: BK/Y
- 42. Steering Position Sensor: Y/W
- 43. Power Supply to Accelerator Position Sensor 2: O/BK
- 44. Electric Trim Control Button (Up): BL/W
- 45. Electric Trim Control Button (Down): G/W
- 46. Intake Air Pressure Sensor: G/R
- 47. Crankshaft Sensor (–): O/BL
- 48. Power Supply to Sensors: R
- 49. Power Supply to Throttle Position Sensor 1/2: R
- 50. Accelerator Position Sensor 2: O/W
- 51. ECU Communication Line (to Meter Unit): BL/BK
- 52. Vehicle-down Sensor: BL/W
- 53. Water Temperature Sensor: G/Y
- 54. Oil Temperature Sensor: Y
- 55. Ground for Sensors: BK/W
- 56. Ground for Throttle Position Sensor 1/2: BK/W
- 57. Throttle Position Sensor 2: G/BK
- 58. Ground for Accelerator Position Sensor 2: GY/R
- 59. External Communication Line (*KDS): P
- 60. Power Supply to ECU: R/Y
- 61. Unused
- 62. Unused
- 63. Unused
- 64. External Communication Line (Immobilizer System): LG/R
- 65. Ground for Accelerator Position Sensor 1: GY
- 66. Accelerator Position Sensor 1: P/BL
- 67. Power Supply to Accelerator Position Sensor 1: P/BK
- 68. Throttle Position Sensor 1: G/W

*: KDS (Kawasaki Diagnostic System)

3-18 FUEL SYSTEM (DFI)

DFI Parts Location

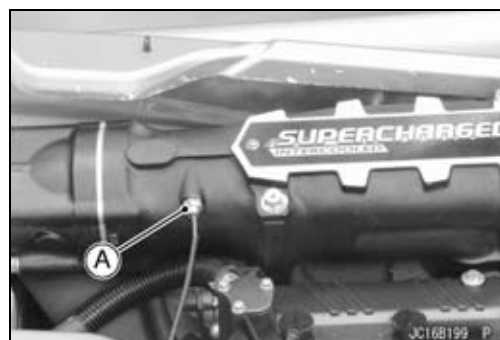
Fuel Injector #4 [A]
Fuel Injector #3 [B]
Fuel Injector #2 [C]
Fuel Injector #1 [D]
Intake Air Temperature Sensor [E]
Intake Air Pressure Sensor [F]



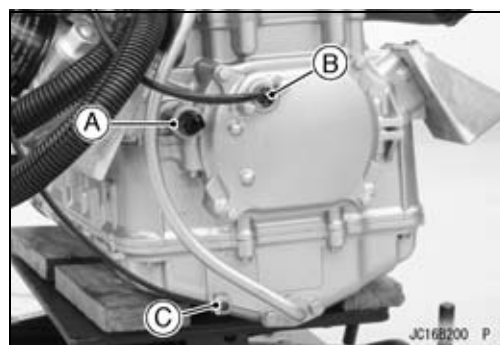
Camshaft Position Sensor [A]



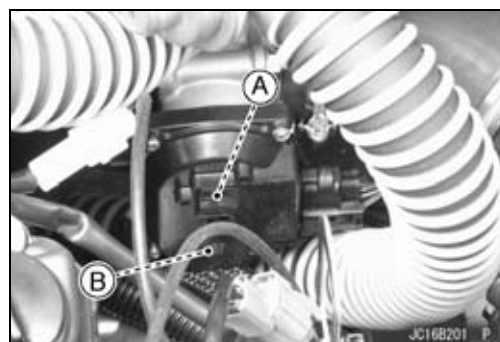
Water Temperature Sensor [A]



Oil Pressure Switch [A]
Crankshaft Sensor [B]
Oil Temperature Sensor [C]

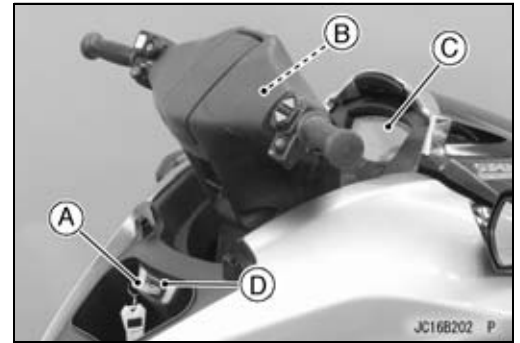


Throttle Position Sensor [A]
ETV Actuator [B]

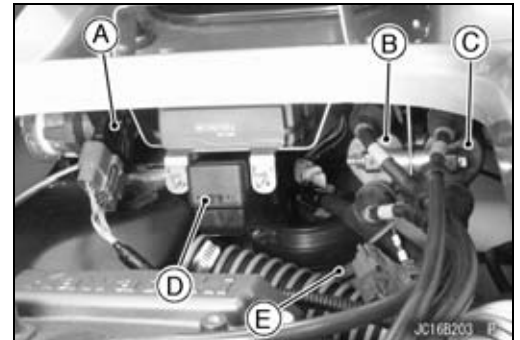


DFI Parts Location

Ignition Key [A] (Transponder)
 Buzzer [B]
 Meter Unit [C]
 Ignition Switch [D] (Immobilizer Amplifier)



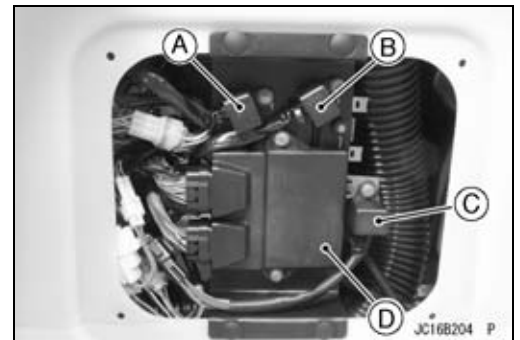
Accelerator Position Sensor [A]
 Ignition Coil #2, #3 [B]
 Ignition Coil #1, #4 [C]
 Vehicle-down Sensor [D]
 Fuel Pump [E]



Relay Assy 2 [A] (ECU Main Relay, ETV Actuator Relay)
 Relay Assy 1 [B] (Fuel Pump Relay, System Relay)
 Relay Assy 3 [C] (Electric Trim Control Relay)
 ECU [D]

NOTE

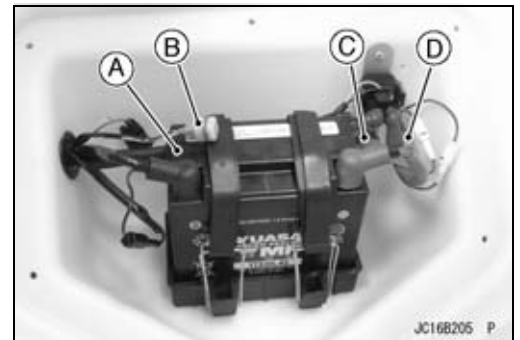
○In this photo, the front access cover has been removed.



Battery [A]
 Immobilizer/Kawasaki Diagnostic System Connector [B]
 Fuse Box 1 [C] (Main Fuse 20 A)
 Fuse Box 2 [D] (Electric Trim Control Relay Fuse 20 A)

NOTE

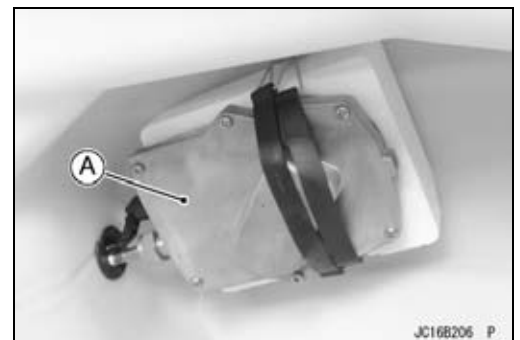
○In this photo, the battery cover has been removed.



Electric Trim Control Actuator [A]

NOTE

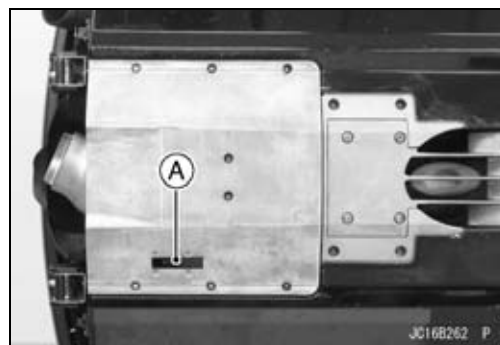
○In this photo, the front storage compartment cover has been opened.



3-20 FUEL SYSTEM (DFI)

DFI Parts Location

Speed Sensor [A]



Specifications

Item	Standard
Digital Fuel Injection System	
Idle Speed	1 300 ±100 r/min (rpm) - both in and out of water
Throttle Body Assy:	
Throttle Valve	Single type
Bore	φ60 mm (2.36 in.)
ECU:	
Make	Mitsubishi Electric
Type	Digital memory type, with built in IC igniter, sealed with resin
Fuel Pressure (High Pressure Line)	294 kPa (3.0 kgf/cm ² , 43 psi) with engine idling
Fuel Pump:	
Type	Impeller type
Discharge	83 mL (2.8 US oz.) or more for 3 seconds
Fuel Injectors:	
Type	INP-290
Nozzle Type	One spray type with 4 holes
Resistance	About 11.7 ~ 12.3 Ω at 20°C (68°F)
Throttle Position Sensor:	
Input Voltage	DC 4.75 ~ 5.25 V
Main Output Voltage	DC 0.37 ~ 0.63 V at idle throttle opening (for reference)
Sub Output Voltage	DC 2.4 ~ 2.6 V at idle throttle opening (for reference)
Intake Air Pressure Sensor:	
Input Voltage	DC 4.75 ~ 5.25 V
Output Voltage	DC 1.43 ~ 1.55 V at standard atmospheric pressure (101.32 kPa, 76 cmHg)
Intake Air Temperature Sensor:	
Output Voltage	About DC 2.25 ~ 2.50 V at 20°C (68°F)
Resistance	5.4 ~ 6.6 kΩ at 0°C (32°F) 0.29 ~ 0.39 kΩ at 80°C (176°F)
Water Temperature Sensor:	
Output Voltage	About DC 3.5 ~ 4.0 V at 20°C (68°F)
Accelerator Position Sensor:	
Output Voltage (1)	DC 0.50 ~ 0.90 V at ordinary throttle position DC 3.75 ~ 4.35 V at full throttle opening (for reference)
Output Voltage (2)	DC 0.35 ~ 1.05 V at ordinary throttle position DC 3.60 ~ 4.50 V at full throttle opening (for reference)
Input Voltage	DC 4.75 ~ 5.25 V
Resistance	4 ~ 6 kΩ
Speed Sensor:	
Input Voltage	DC 9 ~ 11 V
Output Voltage	About DC 0.05 ~ 0.09 V or DC 4.5 ~ 4.9 V at ignition switch ON and 0 km/h

3-22 FUEL SYSTEM (DFI)

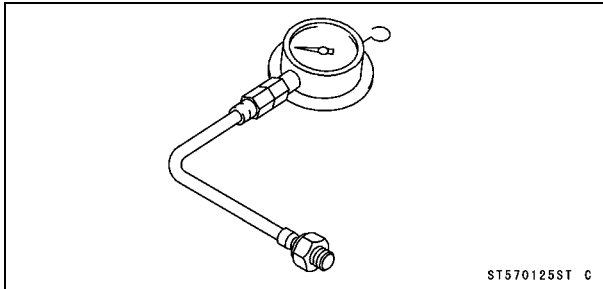
Specifications

Item	Standard
Vehicle-down Sensor: Input Voltage Output Voltage ETV Actuator: Input Voltage Oil Temperature Sensor: Output Voltage Electric Trim Control Sensor: Resistance	DC 4.75 ~ 5.25 V With sensor tilted 110 ~ 130° or more right or left: DC 0.65 ~ 1.35 V With sensor arrow mark pointed up: DC 3.55 ~ 4.45 V About DC 1 ~ 2 V About DC 3.5 ~ 4.0 V at 20°C (68°F) 479 ~ 718 Ω
Throttle Lever and Cable Throttle Lever Free Play	About 2 mm (0.08 in.)
Air Bypass System Relief Valve Opening Pressure (Close → Open) Blow off Valve Opening Pressure (Close → Open)	−53.3 ±4 kPa (−0.54 ±0.04 kgf/cm ²) More than 117 kPa (1.19 kgf/cm ²)

Special Tools and Sealant

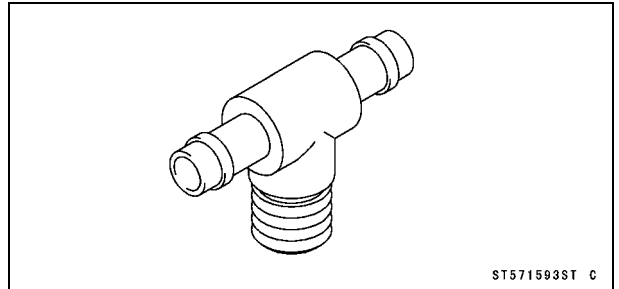
Oil Pressure Gauge, 5 kgf/cm²:

57001-125



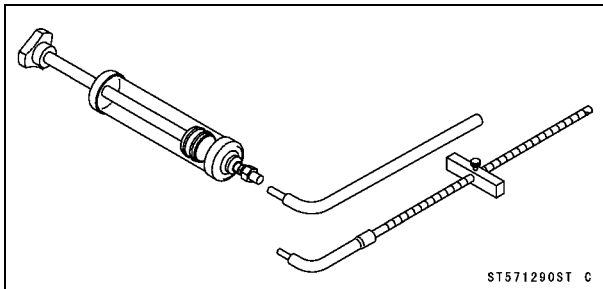
Fuel Pressure Gauge Adapter:

57001-1593



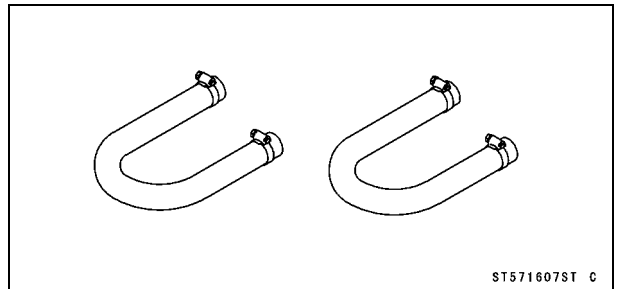
Fork Oil Level Gauge:

57001-1290



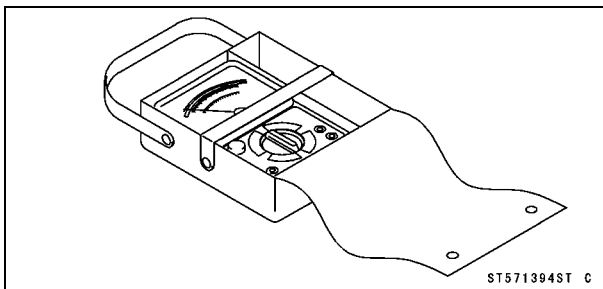
Fuel Hose:

57001-1607



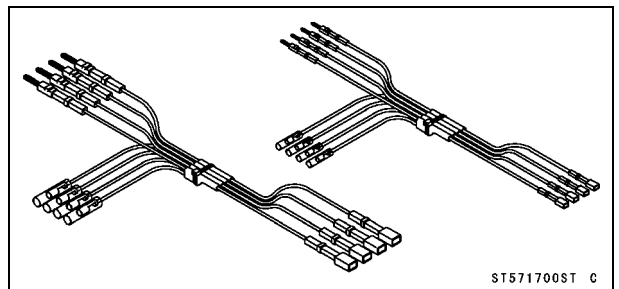
Hand Tester:

57001-1394



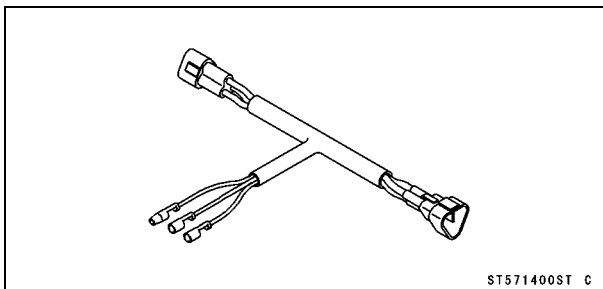
Measuring Adapter:

57001-1700



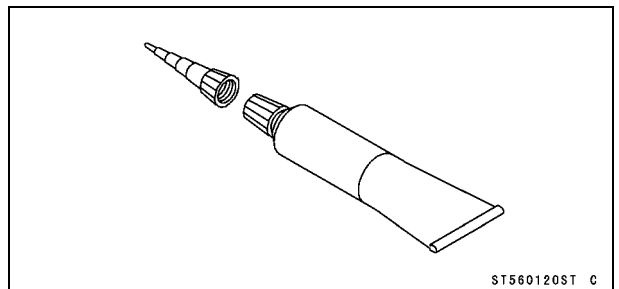
Throttle Sensor Setting Adapter #1:

57001-1400



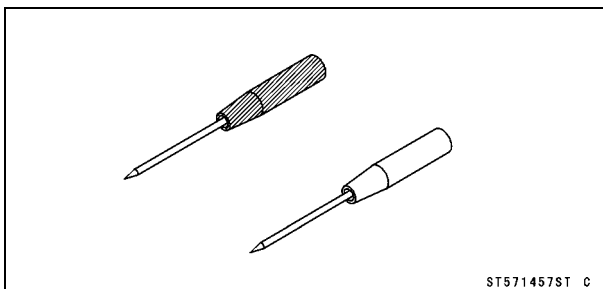
Liquid Gasket, TB1211:

56019-120



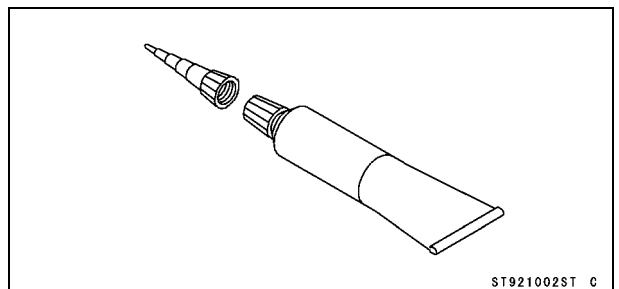
Needle Adapter Set:

57001-1457



Heat Transfer Grease, SCH-20:

92137-1002



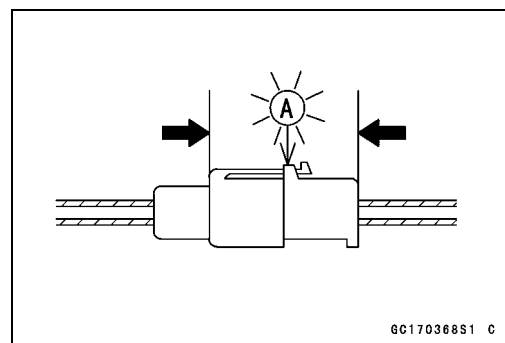
3-24 FUEL SYSTEM (DFI)

DFI Servicing Precautions

DFI Servicing Precautions

There are a number of important precautions that should be followed servicing the DFI system.

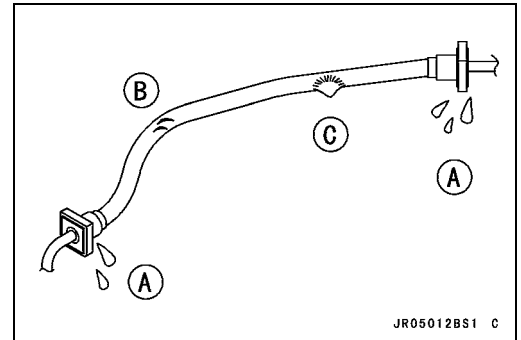
- This DFI system is designed to be used with a 12 V sealed battery as its power source. Do not use any other battery except for a 12 V sealed battery as a power source.
- Do not reverse the battery cable connections. This will damage the ECU.
- To prevent damage to the DFI parts, do not disconnect the battery cables or any other electrical connections when the ignition switch is on or while the engine is running.
- Take care not to short the leads that are directly connected to the battery positive (+) terminal to the engine ground.
- When charging, remove the battery from the vehicle. This is to prevent ECU damage by excessive voltage.
- Whenever the DFI electrical connections are to be disconnected, first turn off the ignition switch, and disconnect the battery (–) terminal. Do not pull the lead, only the connector. Conversely, make sure that all the DFI electrical connections are firmly reconnected before starting the engine.
- Connect these connectors until they click [A].



- Do not turn the ignition switch to ON while any of the DFI electrical connectors are disconnected. The ECU memorizes service codes.
- Do not spray water on the electrical parts, DFI parts, connectors, leads and wiring.
- If a transceiver is installed on the vehicle, make sure that the operation of the DFI system is not influenced by electric wave radiated from the antenna. Check operation of the system with the engine at idle. Locate the antenna as far as possible away from the ECU.
- When any fuel hose is disconnected, do not turn on the ignition switch. Otherwise, the fuel pump will operate and fuel will spout from the fuel hose.
- Do not operate the fuel pump if the pump is completely dry. This is to prevent pump seizure.
- Before removing the fuel system parts, blow the outer surfaces of these parts clean with compressed air.
- When any fuel hose is disconnected, fuel may spout out by residual pressure in the fuel line. Cover the hose joint with a piece of clean cloth to prevent fuel spillage.
- When installing the fuel hoses, avoid sharp bending, kinking, flattening or twisting, and run the fuel hoses with a minimum of bending so that the fuel flow will not be obstructed.
- Run the hoses according to Cable, Wire, and Hose Routing section in the Appendix chapter.
- To prevent corrosion and deposits in the fuel system, do not add to fuel any fuel antifreeze chemicals.

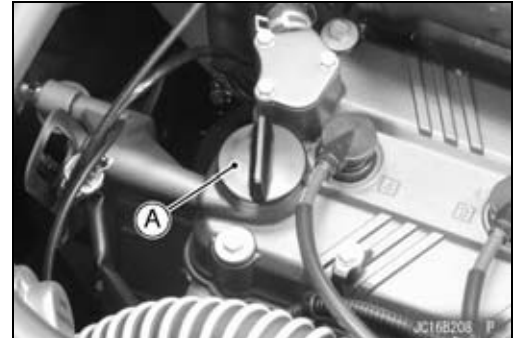
DFI Servicing Precautions

- If the watercraft is not properly handled, the high pressure inside the fuel line can cause fuel to leak [A] or the hose to burst. Check the fuel hose.
- ★ Replace the fuel hose if any fraying, cracks [B] or bulges [C] are noticed.



- To maintain the correct fuel/air mixture (F/A), there must be no intake air leaks in the DFI system. Be sure to install the oil filler cap [A] after filling the engine oil.

Torque - Oil Filler Cap: Hand-tighten



- When checking the DFI parts, do not run the engine for 15 seconds or more without auxiliary cooling (see Before Servicing section in the General Information chapter).

CAUTION

If running the engine without the auxiliary cooling for 15 seconds or more (even at idle speed), the rubber component relative to the Exhaust System may be damaged.

- Execute the auxiliary cooling securely in case that frequent engine running is required.

3-26 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

The warning indicator light (LED) [A] is used for the following warnings.

- Fuel Level
- Low Battery Voltage
- Engine Cooling Water Temperature
- Engine Oil Pressure
- Oil Temperature Sensor
- Engine Oil Overheat
- FI
- Immobilizer

Outline

When a problem occurs with DFI system and immobilizer system, the warning indications to alert the rider are as follows. In addition, the condition of the problem is stored in the memory of the ECU.

DFI System

"FI" Character [A]/Service Code Characters	Warning Indicator Light (LED) [B]	FI Warning Indicator [C]	Buzzer
Blinks	Goes on	Blinks	Sounds

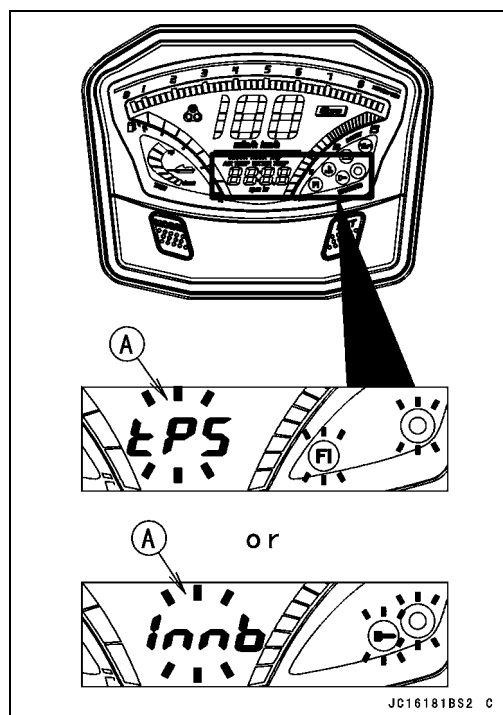
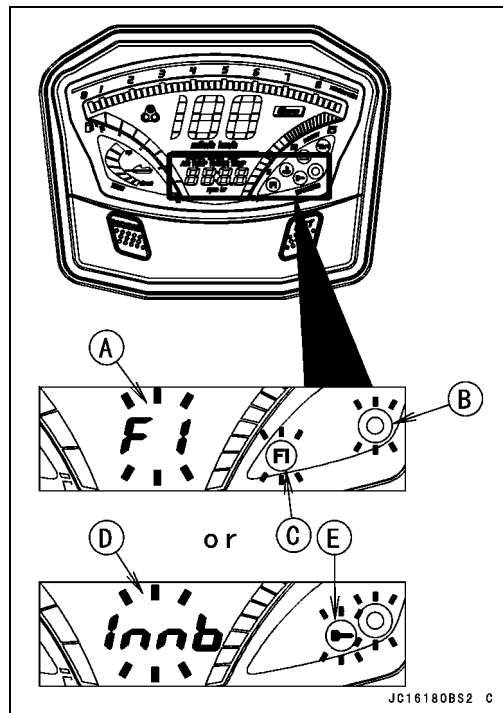
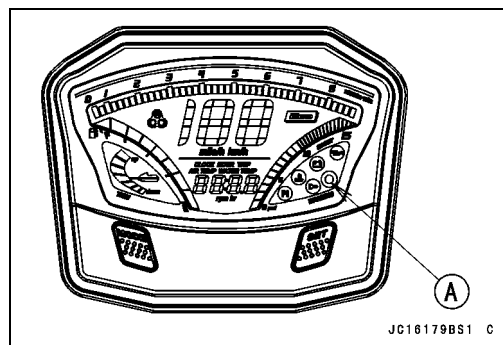
Immobilizer System

Service Code Characters [D]	Warning Indicator Light (LED)	Immobilizer Warning Indicator [E]	Buzzer
Blinks	Blinks	Blinks	Sounds

With the engine stopped and turned in the self-diagnosis mode, the service code characters [A] are displayed on the LCD (Liquid Crystal Display).

If the problem is with the following parts, the ECU can not recognize these problem. Therefore, the "FI" character, warning indicator light (LED), FI and/or immobilizer warning indicators do not go on and/or blink, the buzzer does not sound, and service code characters are not displayed.

- LCD for Meter Unit
- Fuel Pump
- Fuel Injectors
- Ignition Coil Secondary Wiring and Ground Wiring
- ECU Power Source Wiring and Ground Wiring

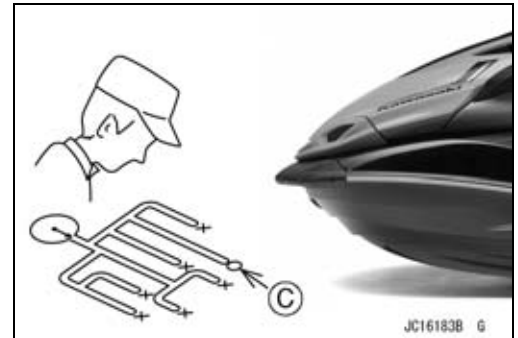


Troubleshooting the DFI System

When the service code character [A] is displayed, for first ask the rider about the conditions [B] of trouble, and then start to determine the cause [C] of problem.

As a pre-diagnosis inspection, check the ECU for ground and power supply, the fuel line for no fuel leaks, and for correct pressure. The pre-diagnosis items are not indicated by the "FI" character, warning indicator light (LED), FI warning indicator and buzzer sound.

Don't rely solely on the DFI self-diagnosis function, use common sense.



Even when the DFI system is operating normally, the warning indicator light (LED) may go on, "FI" character and FI warning indicator may blink, and the buzzer may sound under strong electrical interference. Additional measures are not required. Turn the ignition switch OFF to stop the character, indicator light, indicator, and buzzer sound.

If the warning indicator light (LED) still go on, "FI" character and FI warning indicator blink and buzzer sounds when the vehicle is brought in for repair, check the service code characters.

When the repair has been done, all warning indications go off. But the service code characters stored in memory of the ECU are not erased to preserve the problem history. The problem history can be referred using the KDS (Kawasaki Diagnostic System) when solving unstable problems.

When the watercraft is down, the vehicle-down sensor operates and the ECU shuts off the fuel pump relay, fuel injectors and ignition system. To start the engine again, raise the watercraft, turn the ignition switch OFF, and then ON.

Much of the DFI system troubleshooting work consists of confirming continuity of the wiring. The DFI parts are assembled and adjusted with precision, and it is impossible to disassemble or repair them.

3-28 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

- When checking the DFI parts, use a digital meter which can be read two decimal place voltage or resistance.
- The DFI part connectors [A] have seals [B], including the ECU. When measuring the input or output voltage with the connector joined, use the needle adapter set [C]. Insert the needle adapter inside the seal until the needle adapter reaches the terminal.

Special Tool - Needle Adapter Set: 57001-1457

CAUTION

Insert the needle adapter straight along the terminal in the connector to prevent short-circuit between terminals.

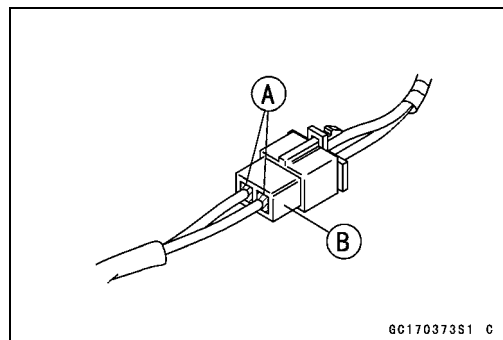
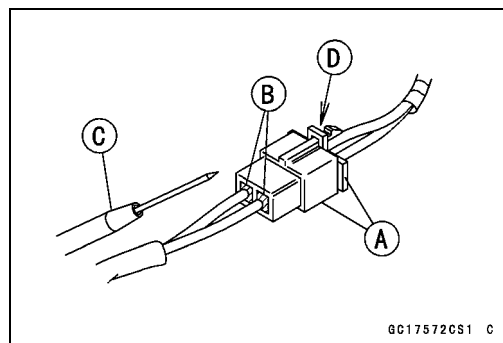
- Make sure that measuring points are correct in the connector, noting the position of the lock [D] and the lead color before measurement. Do not reverse connections of a digital meter.
- Be careful not to short-circuit the leads of the DFI or electrical system parts by contact between adapters.
- Turn the ignition switch ON and measure the voltage with the connector joined.

CAUTION

Incorrect, reverse connection or short circuit by needle adapters could damage the DFI or electrical system parts.

- After measurement, remove the needle adapters and apply silicone sealant to the seals [A] of the connector [B] for waterproofing.

Sealant - Liquid Gasket, TB1211: 56019-120



- Always check battery condition before replacing the DFI parts. A fully charged battery is a must for conducting accurate tests of the DFI system.
 - Trouble may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the problem. If the problem was caused by some other item or items, they too must be repaired or replaced, or the new replacement part will soon fail again.
 - Measure coil winding resistance when the DFI part is cold (at room temperature).
 - Make sure all connectors in the circuit are clean and tight, and examine wires for signs of burning, fraying, short, etc. Deteriorated wires and bad connections can cause reappearance of problems and unstable operation of the DFI system.
- ★ If any wiring is deteriorated, replace the wiring.

Troubleshooting the DFI System

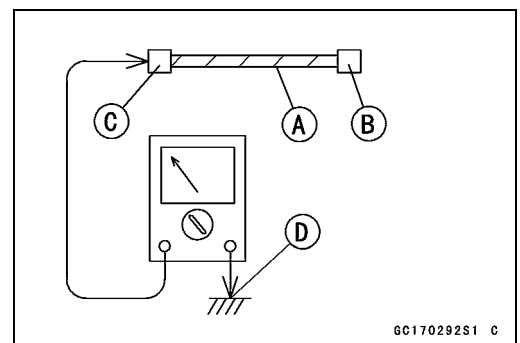
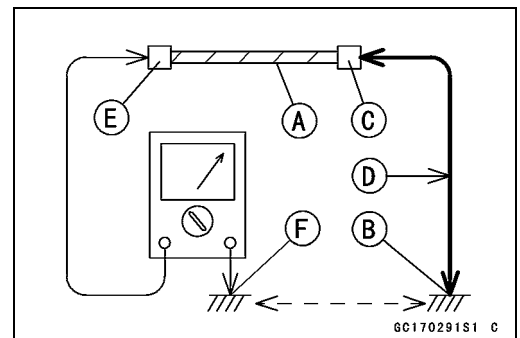
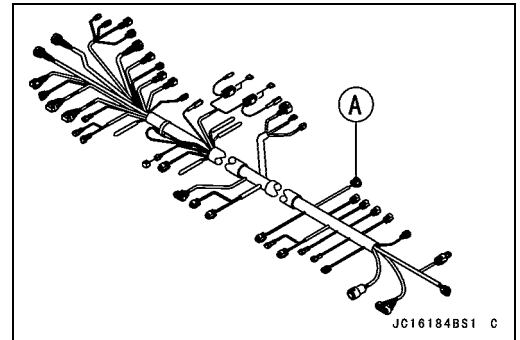
- Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.
- ★ If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it. Connect the connectors securely.
- Check the wiring for continuity.
- Use the wiring diagram to find the ends of the lead which is suspected of being a problem.
- Connect the hand tester between the ends of the leads.

Special Tool - Hand Tester: 57001-1394

- Set the tester to the $\times 1 \Omega$ range, and read the tester.
- ★ If the tester does not read 0Ω , the lead is defective. Replace the lead or the main harness.
- If both ends of a harness [A] are far apart, ground [B] the one end [C], using a jumper lead [D] and check the continuity between the end [E] and the ground [F]. This enables to check a long harness for continuity. If the harness is open, repair or replace the harness.

- When checking a harness [A] for short circuit, open one end [B] and check the continuity between the other end [C] and ground [D]. If there is continuity, the harness has a short circuit to ground, and it must be repaired or replaced.

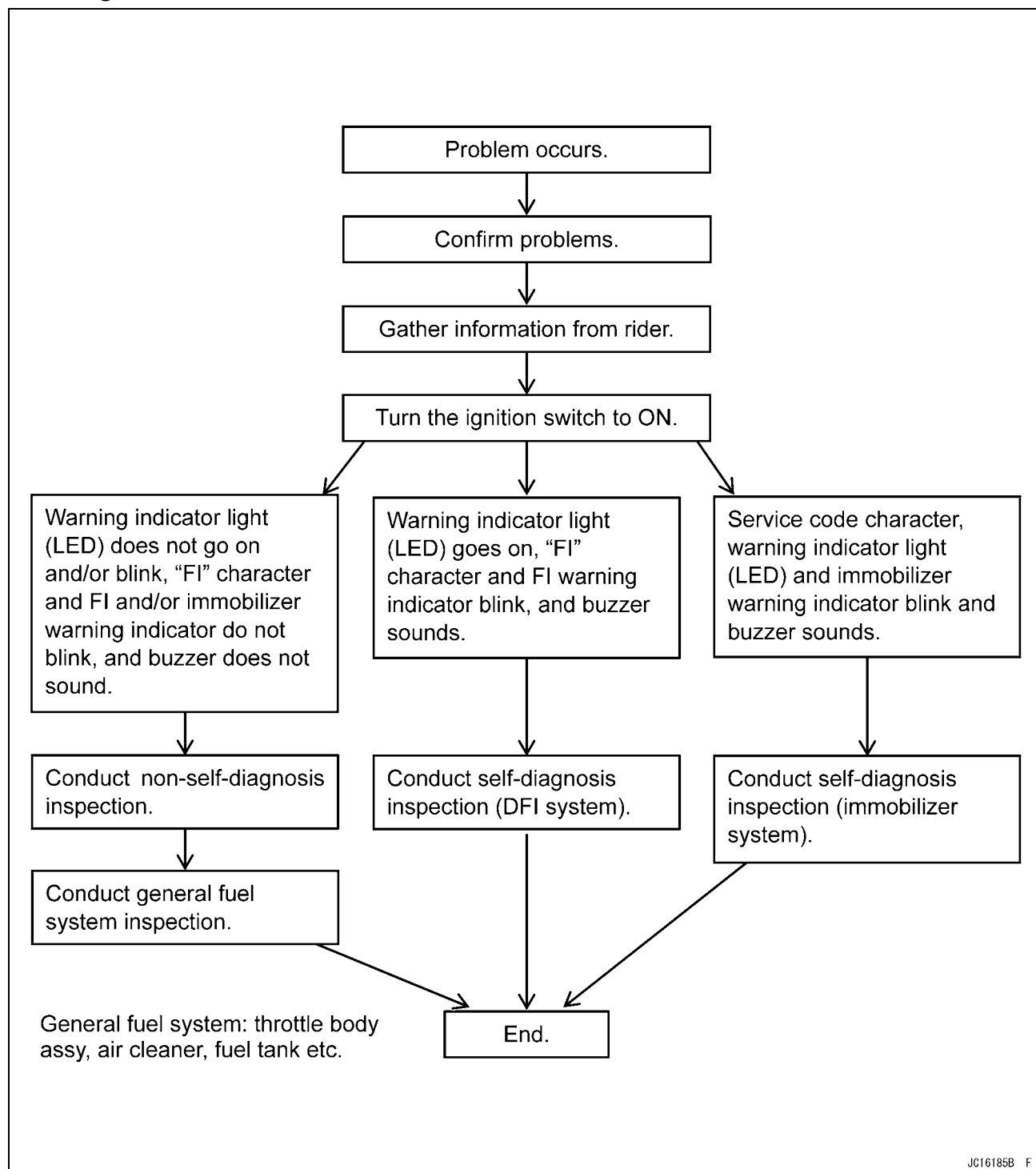
- Narrow down suspicious locations by repeating the continuity tests from the ECU connectors.
- ★ If no abnormality is found in the wiring or connectors, the DFI parts are the next likely suspects. Check the part, starting with input and output voltages. However, there is no way to check the ECU itself.
- ★ If an abnormality is found, replace the affected DFI part.
- ★ If no abnormality is found in the wiring, connectors, and DFI parts, replace the ECU.



3-30 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

DFI Diagnosis Flow Chart



Inquiries to Rider

- Each rider reacts to problems in different ways, so it is important to confirm what kind of symptoms the rider has encountered.
- Try to find out exactly what problem occurred under exactly what conditions by asking the rider; knowing this information may help you reproduce the problem.
- The following sample diagnosis sheet will help prevent you from overlooking any areas, and will help you decide if it is a DFI system problem, or a general engine problem.

Troubleshooting the DFI System

Sample Diagnosis Sheet

Rider name:	Registration No. (license plate No.):	Year of initial registration:
Model:	Engine No.:	Hull No.:
Date problem occurred:		Mileage:
Environment when problem occurred.		
Weather	☐ fine, ☐ cloudy, ☐ rain, ☐ snow, ☐ always, ☐ other:	
Temperature	☐ hot, ☐ warm, ☐ cold, ☐ very cold, ☐ always, ☐ other:	
Problem frequency	☐ chronic, ☐ often, ☐ once	
Altitude	☐ normal, ☐ high (about 1 000 m or more)	
Watercraft conditions when problem occurred.		
“FI” character, warning indicator light (LED), FI/immobilizer warning indicator	☐ Goes on immediately after ignition switch ON, and goes off after 2 ~ 3 seconds (normal).	
	☐ Goes on immediately after ignition switch ON, and the “FI” character and FI warning indicator on the LCD starts blinking (DFI system problem).	
	☐ Start blinks immediately after ignition switch ON, and the service code character and immobilizer warning indicator on the LCD starts blinking (immobilizer system problem).	
	☐ Does not go on or blink after ignition switch ON.	
	☐ light up (ECU or meter unit replace).	
Starting difficulty	☐ starter motor not rotating.	
	☐ starter motor rotating but engine does not turn over.	
	☐ starter motor and engine do not turn over.	
	☐ no fuel flow (☐ no fuel in tank, ☐ no fuel pump sound).	
	☐ no spark.	
	☐ other:	
Engine stalls	☐ right after starting.	
	☐ when opening throttle lever.	
	☐ when closing throttle lever.	
	☐ when moving off.	
	☐ when stopping the watercraft.	
	☐ when cruising.	
	☐ other:	
Poor running at low speed	☐ very low idle speed, ☐ very high idle speed, ☐ rough idle speed.	
	☐ battery voltage is low (charge the battery).	
	☐ spark plug loose (tighten it).	
	☐ spark plug dirty, broken, or gap maladjusted (remedy it).	
	☐ backfiring.	
	☐ afterfiring.	
	☐ hesitation when acceleration.	
	☐ engine oil viscosity too high.	
	☐ engine overheating.	
☐ other:		

3-32 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

Poor running or no power at high speed	☐ spark plug loose (tighten it).
	☐ spark plug dirty, broken, or gap maladjusted (remedy it).
	☐ spark plug incorrect (replace it).
	☐ knocking (fuel poor quality or incorrect, → use high-octane gasoline).
	☐ engine overheating.
	☐ engine oil level too high.
	☐ engine oil viscosity too high.
	☐ other:

DFI System Troubleshooting Guide

NOTE

- This is not an exhaustive list, giving every possible cause for each problem listed. It is meant simply as a rough guide to assist the troubleshooting for some of the more common difficulties in DFI system.
- The ECU may be involved in the DFI electrical, ETV and ignition system troubles. If these parts and circuits are checked out good, be sure to check the ECU for ground and power supply. If the ground and power supply are checked good, replace the ECU.

Engine Won't Turn Over

Symptoms or Possible Causes	Actions
Immobilizer system trouble	Inspect (see chapter 14).
Vehicle-down sensor operated	Turn ignition switch OFF (see chapter 3).
Vehicle-down sensor trouble	Inspect (see chapter 3).
Crankshaft sensor trouble	Inspect (see chapter 14).
Ignition coil shorted or not in good contact	Inspect or reinstall (see chapter 14).
Ignition coil trouble	Inspect (see chapter 14).
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Spark plug incorrect	Replace it with the correct plug (see chapter 2).
ECU ground and power supply trouble	Inspect (see chapter 3).
ECU trouble	Inspect (see chapter 3).
No or little fuel in tank	Supply fuel (see Owner's Manual).
Fuel injector trouble	Inspect and replace (see chapter 3).
Fuel pump not operating	Inspect (see chapter 3).
Fuel pump relay trouble	Inspect and replace (see chapter 3).
Fuel filter or pump screen clogged	Inspect and replace fuel pump (see chapter 3).
Fuel pressure regulator trouble	Inspect fuel pressure and replace fuel pump (see chapter 3).
Fuel line clogged	Inspect and repair (see chapter 3).

Poor Running at Low Speed

Symptoms or Possible Causes	Actions
Spark weak:	
Ignition coil shorted or not in good contact	Inspect or reinstall (see chapter 14).
Ignition coil trouble	Inspect (see chapter 14).
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Spark plug incorrect	Replace it with the correct plug (see chapter 2).
ECU trouble	Inspect (see chapter 3).
Fuel/air mixture incorrect:	
Little fuel in tank	Supply fuel (see Owner's Manual).
Air cleaner clogged, poorly sealed, or missing	Replace element or inspect sealing (see chapter 3).
Intake manifold loose	Reinstall (see chapter 3).
Throttle body assy loose	Reinstall (see chapter 3).
Throttle body assy gasket damage	Replace (see chapter 3).
Fuel injector O-ring damage	Replace (see chapter 3).
Fuel filter or pump screen clogged	Inspect and replace fuel pump (see chapter 3).

3-34 FUEL SYSTEM (DFI)

DFI System Troubleshooting Guide

Symptoms or Possible Causes	Actions
Fuel pressure regulator trouble	Inspect fuel pressure and replace fuel pump (see chapter 3).
Fuel line clogged	Inspect and repair (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Unstable (rough) idling:	
Fuel pressure too low or too high	Inspect (see chapter 3).
Fuel injector trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Engine stalls easily:	
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Ignition coil trouble	Inspect (see chapter 14).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Fuel pump trouble	Inspect (see chapter 3).
Fuel injector trouble	Inspect (see chapter 3).
Fuel pressure too low or too high	Inspect (see chapter 3).
Fuel pressure regulator trouble	Inspect fuel pressure and replace fuel pump (see chapter 3).
Fuel line clogged	Inspect and repair (see chapter 3).
Poor acceleration:	
Fuel pressure too low	Inspect (see chapter 3).
Water or foreign matter in fuel	Change fuel. Inspect and clean fuel system (see chapter 3).
Fuel filter or pump screen clogged	Inspect and replace fuel pump (see chapter 3).
Fuel pump trouble	Inspect (see chapter 3).
Fuel injector trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).

DFI System Troubleshooting Guide

Symptoms or Possible Causes	Actions
Intake air temperature sensor trouble	Inspect (see chapter 3).
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Ignition coil trouble	Inspect (see chapter 14).
Supercharger trouble	Inspect (see chapter 2) or reinstall (see chapter 3).
Stumble:	
Fuel pressure too low	Inspect (see chapter 3).
Fuel injector trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Surge:	
Unstable fuel pressure	Fuel pressure regulator trouble (Inspect and replace fuel pump) or kinked fuel line (Inspect and replace fuel pump) (see chapter 3).
Fuel injector trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Backfiring when deceleration:	
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Fuel pressure too low	Inspect (see chapter 3).
Fuel pump trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
After fire:	
Spark plug burned or gap maladjusted	Replace (see chapter 2).
Fuel injector trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Other:	
Intermittent any DFI fault and its recovery	Check that DFI connectors are clean and tight, and examine leads for signs of burning or fraying (see chapter 3).

Poor Running or No Power at High Speed

Symptoms or Possible Causes	Actions
Firing incorrect:	
Ignition coil shorted or not in good contact	Inspect or reinstall (see chapter 14).

3-36 FUEL SYSTEM (DFI)

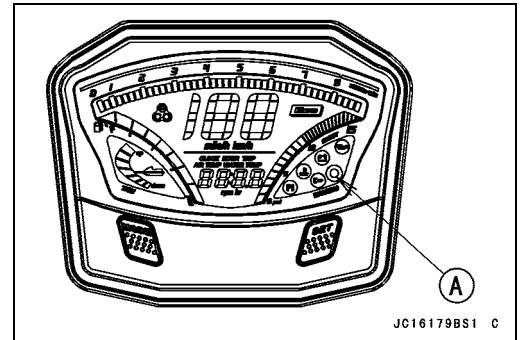
DFI System Troubleshooting Guide

Symptoms or Possible Causes	Actions
Ignition coil trouble	Inspect (see chapter 14).
Spark plug dirty, broken or gap maladjusted	Inspect and replace (see chapter 2).
Spark plug incorrect	Replace it with the correct plug (see chapter 2).
ECU trouble	Inspect (see chapter 3).
Fuel/air mixture incorrect:	
Air cleaner clogged, poorly sealed, or missing	Replace element or inspect sealing (see chapter 3).
Intake manifold loose	Reinstall (see chapter 3).
Throttle body assy loose	Reinstall (see chapter 3).
Throttle body assy gasket damage	Replace (see chapter 3).
Water or foreign matter in fuel	Change fuel. Inspect and clean fuel system (see chapter 3).
Fuel injector O-ring damage	Replace (see chapter 3).
Fuel injector clogged	Inspect and repair (see chapter 3).
Fuel line clogged	Inspect and repair (see chapter 3).
Fuel pump operates intermittently.	Fuel pump bearings may wear. Replace the fuel pump (see chapter 3).
Fuel pump trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Cracked or obstructed intake air pressure sensor vacuum hose	Inspect and repair or replace (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Accelerator position sensor trouble	Inspect (see chapter 3).
Throttle position sensor trouble	Inspect (see chapter 3).
ETV actuator trouble	Inspect (see chapter 3).
Knocking:	
Fuel poor quality or incorrect	Fuel change (Use the gasoline recommended in the Owner's Manual).
Spark plug incorrect	Replace it with the correct plug (see chapter 2).
Ignition coil trouble	Inspect (see chapter 14).
ECU trouble	Inspect (see chapter 3).
Intake air pressure sensor trouble	Inspect (see chapter 3).
Water temperature sensor trouble	Inspect (see chapter 3).
Intake air temperature sensor trouble	Inspect (see chapter 3).
Miscellaneous:	
Throttle valve will not fully open	Inspect throttle cable and ETV system (see chapter 3).
Engine overheating - Water temperature sensor, crankshaft sensor or speed sensor trouble	(see Overheating of Troubleshooting Guide in chapter 16)

Self-Diagnosis

The warning indicator light (LED) [A] is used for the following warnings.

- Fuel Level
- Low Battery Voltage
- Engine Cooling Water Temperature
- Engine Oil Pressure
- Oil Temperature Sensor
- Engine Oil Overheat
- FI
- Immobilizer



Self-diagnosis Outline

The self-diagnosis system has two modes and can be switched to another mode by operating the meter unit.

User Mode

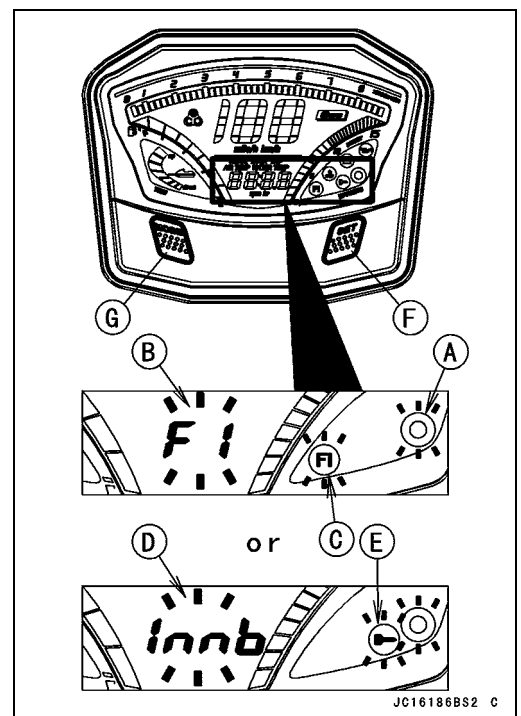
The ECU notifies the rider of troubles in DFI system and ignition system by turning on the warning indicator light (LED) [A], by blinking the "FI" character [B] and FI warning indicator [C], and sounding the buzzer.

The ECU notifies the rider of troubles in the immobilizer system by blinking the service code character [D], warning indicator light (LED) and immobilizer warning indicator [E], and sounding the buzzer.

When DFI, ignition and immobilizer system parts are faulty, the ECU initiates fail-safe function. In case of serious troubles ECU stops the injection/ignition/starter motor operation.

NOTE

- The buzzer sound can be stopped by pushing either "SET" [F] or "MODE" [G] button.

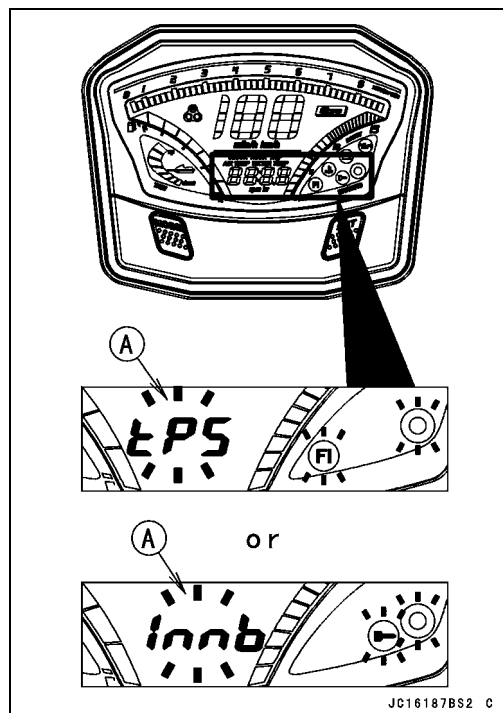


3-38 FUEL SYSTEM (DFI)

Self-Diagnosis

Dealer Mode

The LCD (Liquid Crystal Display) display the service code character(s) [A] to show the problem(s) which the DFI system, ignition system and immobilizer system has at the moment of diagnosis.



Self-diagnosis Procedures

○When a problem occurs with the DFI system, ignition system and immobilizer system, the warning indications are as follows.

DFI/Ignition System

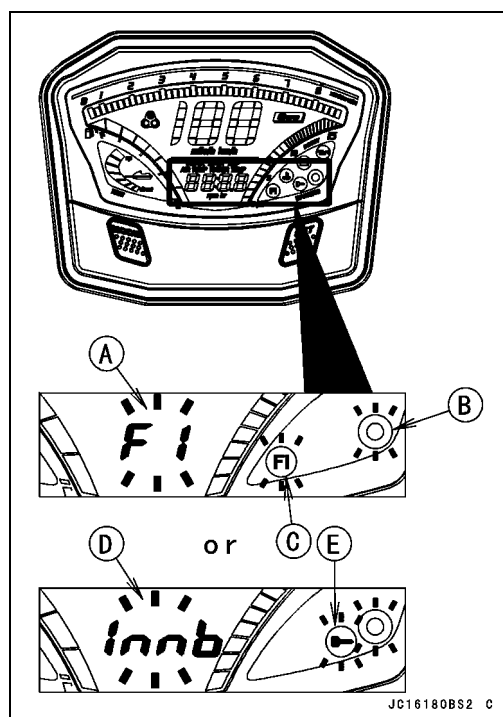
"FI" Character [A]/Service Code Characters	Warning Indicator Light (LED) [B]	FI Warning Indicator [C]	Buzzer
Blinks	Goes on	Blinks	Sounds

Immobilizer System

Service Code Characters [D]	Warning Indicator Light (LED)	Immobilizer Warning Indicator [E]	Buzzer
Blinks	Blinks	Blinks	Sounds

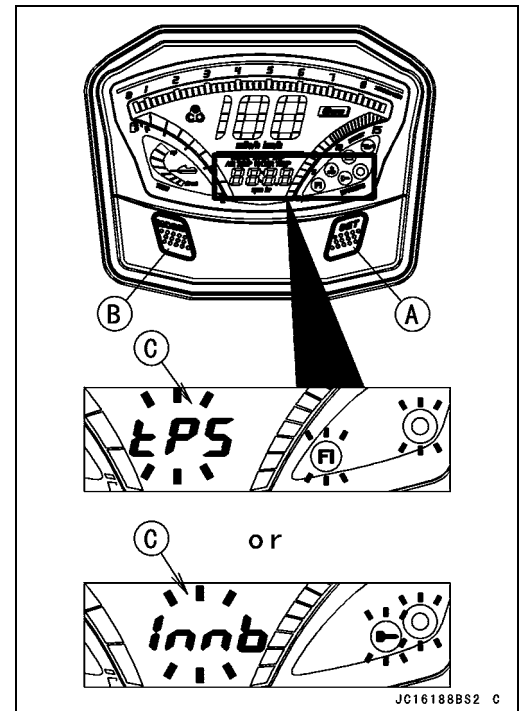
NOTE

○Use a fully charged battery when conducting self-diagnosis. Otherwise, the character, indicator light and indicators do not go on or blink very slowly.



Self-Diagnosis

- Turn the ignition switch to ON.
- If the immobilizer system has trouble, the service code character is displayed immediately on the LCD.
- Push the “SET” button [A] with “MODE” button [B] for more than three seconds.
- The service code character [C] is displayed on the LCD.

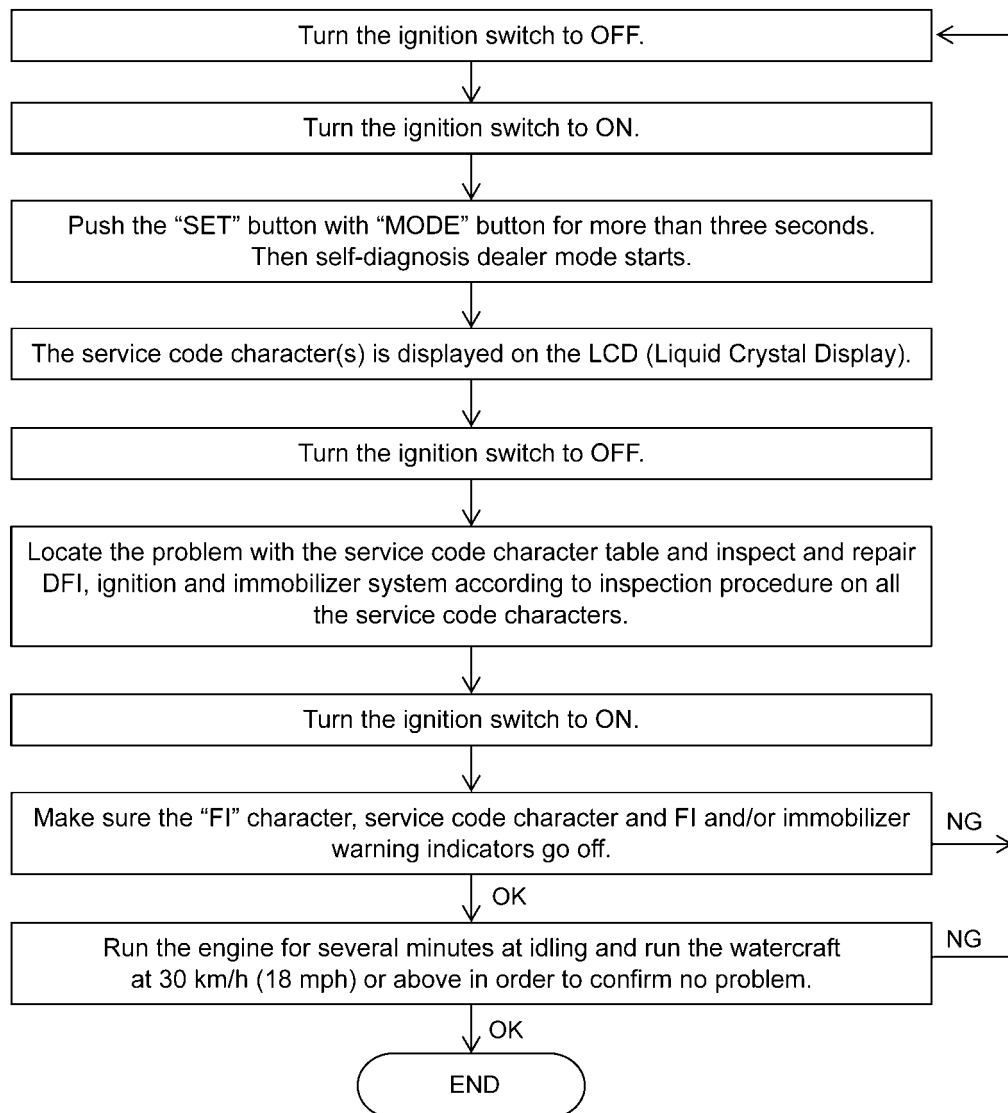


- Any of the following procedures ends self-diagnosis.
- When the service code character is displayed on the LCD, push either “SET” or “MODE” button for more than one second.
- When the ignition switch is turned OFF.

3-40 FUEL SYSTEM (DFI)

Self-Diagnosis

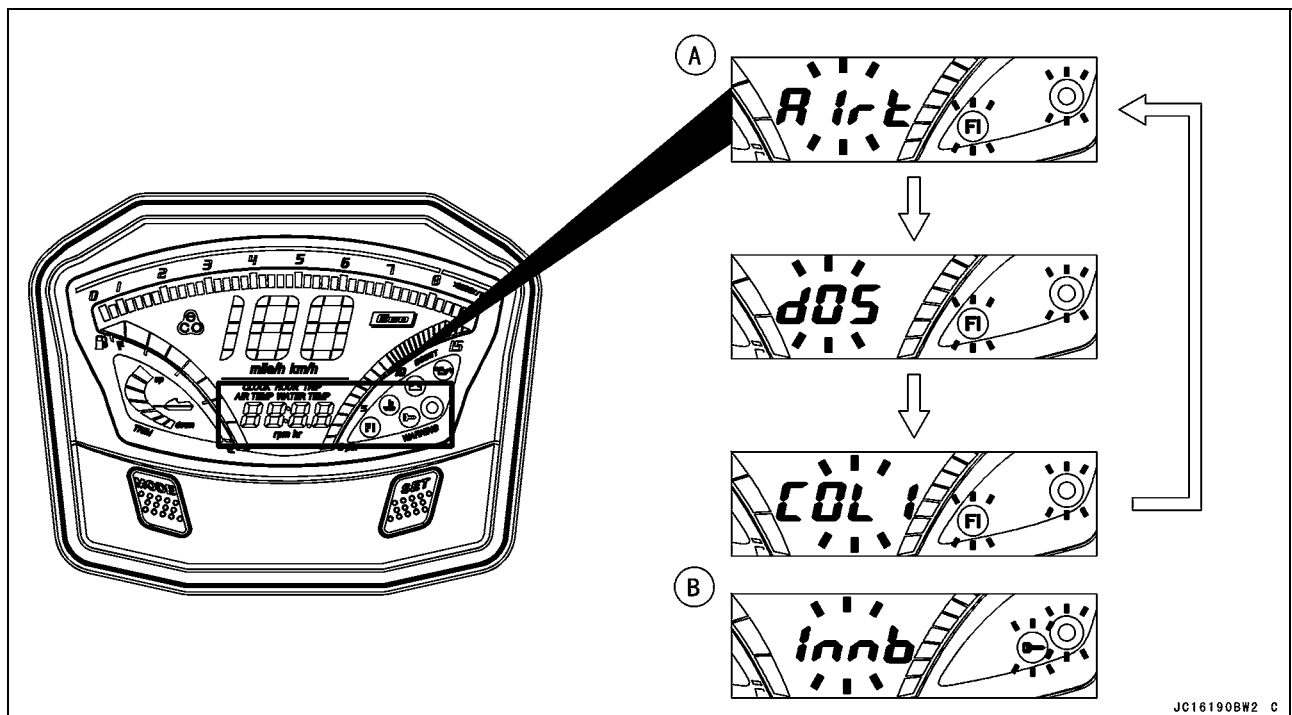
Self-Diagnosis Flow Chart



Self-Diagnosis

Service Code Character Reading

- The service code character(s) is displayed on the LCD.
 - When there are a character of problems, all the service code characters can be stored and the display will begin starting from the lowest number service code character.
 - Then after completing all codes, the display is repeated until the ignition switch is turned OFF or either "SET" or "MODE" button is pushed for more than one second.
 - For example, if three problems occurred in the order of 51, 13, 31, the service code characters are displayed (each one second) from the lowest number service code character in the order listed as shown below.
- 13 (Alrt) → 31 (dOS) → 51 (COL1) → 13 (Alrt) → 31 (dOS) → 51 (COL1) → . . . (repeated)
- FI Trouble [A]
Immobilizer Trouble [B]



- If there is no problem or when the repair has been done, FI and/or immobilizer warning indicators go off and "FI" character and/or service code character is not displayed.

Service Code Erasing

- When repair has been done, FI and/or immobilizer warning indicators go off and "FI" character and/or service code character is not displayed.
- ★But the service code characters stored in memory of the ECU are not erased to preserve the problem history. In this model, the problem history can not be erased. However, the past service code characters can be erased using the KDS 3 version kit.

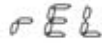
3-42 FUEL SYSTEM (DFI)

Self-Diagnosis

Service Code Character Table

Service Code (used in ECU)	Service Code Character (displayed on Meter Unit)	Problems	Backups by ECU
11		Throttle position sensor malfunction, wiring open or short.	If both throttle position sensor 1 and 2 fail, the ECU sets the DFI in the D-J method (see Note 1) and sets to the limp mode (see Note 2). If either sensor fails, the ECU sets to the power limitation mode (see Note 3).
12		Intake air pressure sensor malfunction, wiring open or short.	The ECU sets the DFI in the α-N method (see Note 4).
13		Intake air temperature sensor malfunction, wiring open or short.	The ECU sets the intake air temperature at 40°C.
14		Water temperature sensor malfunction, wiring open or short.	The ECU sets the water temperature at 70°C. The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition (Engine activates Slow Down Mode).
18		Accelerator position sensor malfunction, wiring open or short.	If both accelerator position sensor 1 and 2 fail, the ECU sets to the idle mode (see Note 5). If either sensor fails, the ECU sets to the power limitation mode (see Note 3).
21		Crankshaft sensor malfunction, wiring open or short.	The engine stops by itself.
23		Camshaft position sensor malfunction, wiring open or short.	The ECU continues to ignite cylinders in the same sequence following the last good signal.
24		Speed sensor malfunction, wiring open or short.	The speedometer shows 0.
31		Vehicle-down sensor malfunction, wiring open or short.	The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition.
35		Immobilizer amplifier malfunction.	—
36		Blank key detection.	—
45		Fuel pump relay malfunction, wiring open.	—
46		Fuel pump relay malfunction, relay is stuck.	—
49		Return spring malfunction.	—
51		Ignition coil #1, #4 malfunction, wiring open or short.	The ECU shuts off the injectors #1/#4 to stop fuel to the cylinders #1/#4.
52		Ignition coil #2, #3 malfunction, wiring open or short.	The ECU shuts off the injectors #2/#3 to stop fuel to the cylinders #2/#3.

Self-Diagnosis

Service Code (used in ECU)	Service Code Character (displayed on Meter Unit)	Problems	Backups by ECU
57		System relay malfunction, relay is stuck.	—
58		ETV actuator malfunction, wiring open or short.	If the ETV actuator fails (the signal is out to the usable range, wiring short or open), the ECU stops the current to the actuator, and sets to the limp home mode (see Note 2).
71		Engine overheat	The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition.
72		Engine oil pressure too low	The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition.
73		Oil temperature sensor malfunction, wiring open or short.	The ECU sets the oil temperature at 60°C. The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition.
75		ECU main relay malfunction, wiring is open or relay is stuck.	—
76		Engine oil overheat	The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition.
77		Electric trim control sensor malfunction, wiring open or short.	The ECU sets the electric trim at top position.
97		Battery monitor voltage is low.	The ECU sets to the limp home mode (see Note 2).
98		ECU/ETV circuit malfunction, wiring open or short.	The ECU sets to the limp home mode (see Note 2).

Note:

- (1): D-J Method: When the engine load is light like at idling or low speed, the ECU determines the injection quantity by calculating from the throttle vacuum (intake air pressure sensor output voltage) and engine speed (crankshaft sensor output voltage).
- (2): Limp Home Mode: ETV is not operational. Power is controlled by ignition timing.
- (3): Power Limitation Mode: ETV is in operational condition by redundant system.
- (4): α -N Method: As the engine speed increases, and the engine load turns middle to heavy, the ECU determines the injection quantity by calculating from the throttle opening (throttle position sensor output voltage) and the engine speed.
- (5): Idle Mode: ECU sets the engine speed at the idle speed.

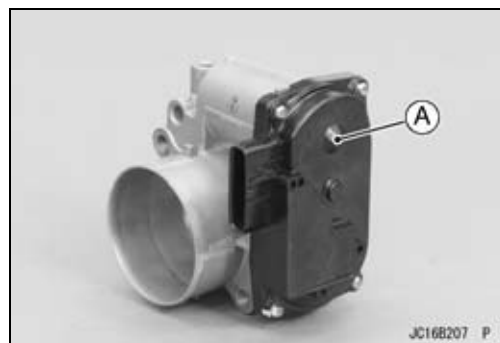
3-44 FUEL SYSTEM (DFI)

Throttle Position Sensor (Service Code/Character - 11/tPS)

Throttle Position Sensor Removal

CAUTION

Do not remove the throttle position sensor in the gear case [A] since it has been adjusted and set with precision at the factory.
Never drop the throttle body assy especially on a hard surface. Such a shock to the throttle position sensor can damage it.



Throttle Position Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.
- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Throttle Position Sensor Output Voltage Connections to ECU Connector:

- (1) Digital Meter (+) → G/W lead (ECU terminal 68)
Digital Meter (-) → BK/W lead (ECU terminal 56)
- (2) Digital Meter (+) → G/BK lead (ECU terminal 57)
Digital Meter (-) → BK/W lead (ECU terminal 56)

- Measure the output voltage with the full throttle opened.
- Turn the ignition switch to ON.

Output Voltage

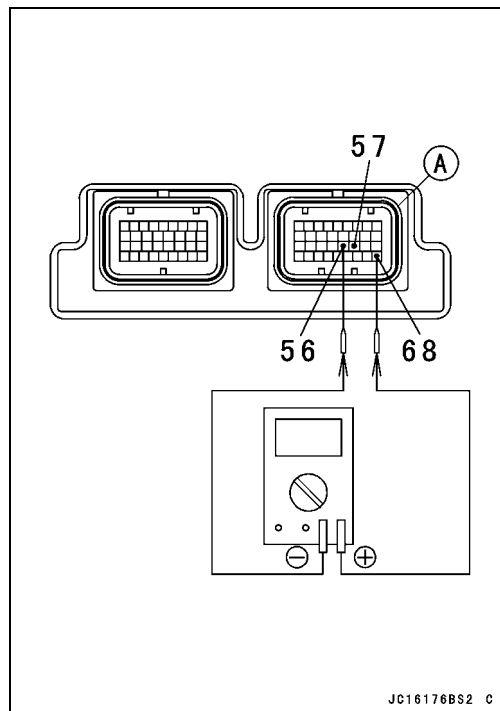
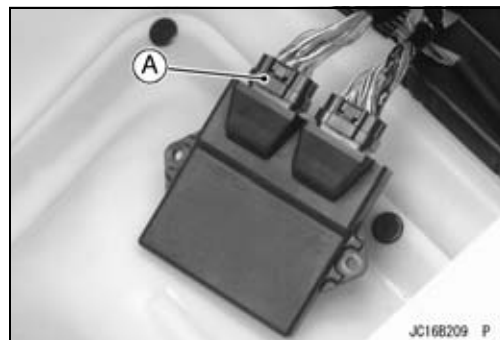
- Standard:**
- (1) DC 0.37 ~ 0.63 V at idle throttle opening (for reference)
 - (2) DC 2.4 ~ 2.6 V at idle throttle opening (for reference)

NOTE

○Open the throttle, confirm the output voltage will be raise.

○When the throttle is ordinary position, the standard value is not determined because there is some uncertain elements, e.g. water temperature, throttle valve initial opening, etc.

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the input voltage (see Throttle Position Sensor Input Voltage Inspection).
- ★ If the reading is within the standard, replace the ECU (see ECU Removal/Installation).



Throttle Position Sensor (Service Code/Character - 11/tPS)

Throttle Position Sensor Input Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.

- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Throttle Position Sensor Input Voltage

Connections to ECU Connector:

Digital Meter (+) → R lead (ECU terminal 49)

Digital Meter (–) → BK/W lead (ECU terminal 56)

- Turn the ignition switch to ON.
- Measure the input voltage with the engine stopped and with the connector joined.

Input Voltage

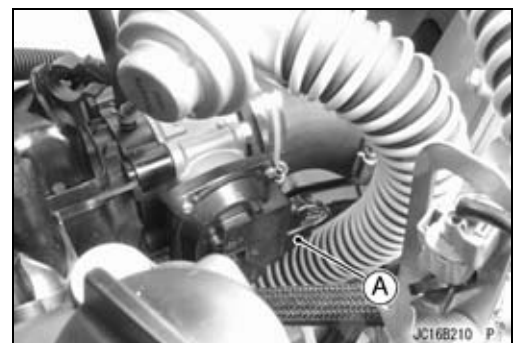
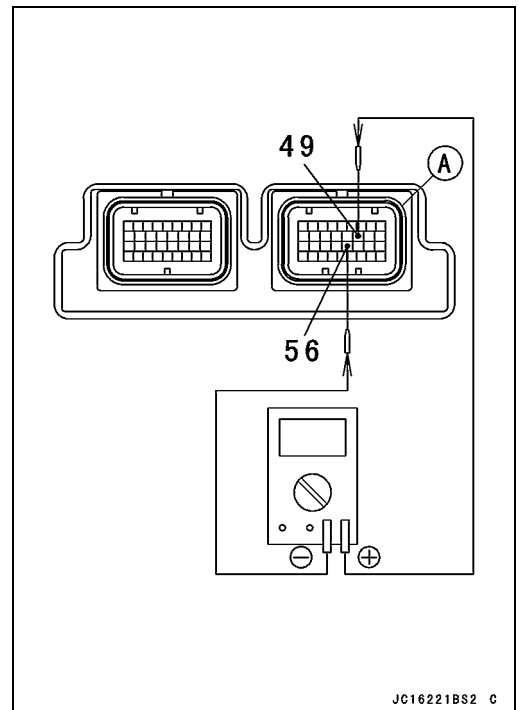
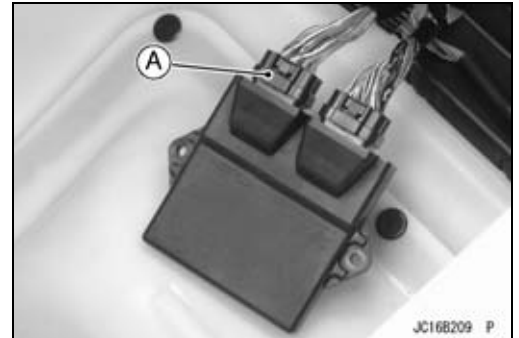
Standard: DC 4.75 ~ 5.25 V

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is within the standard, check the wiring for continuity between the main harness connectors according to the following procedure.
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)

- Disconnect the throttle position sensor connector [A].
- Set the hand tester to the $\times 1 \Omega$ range and check the wiring for continuity.

Special Tool - Hand Tester: 57001-1394

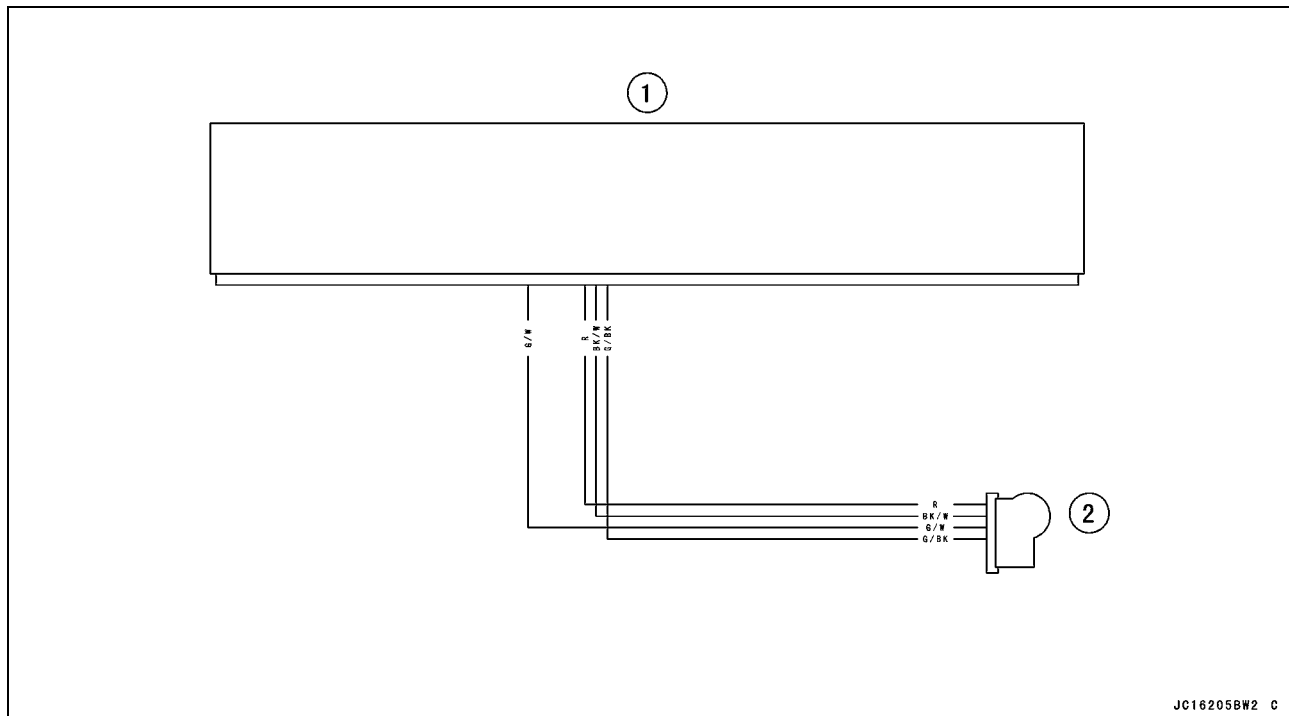
- ★ If the wiring is good, replace the throttle body assy (see Throttle Body Assy Removal/Installation).
- ★ If the wiring is not good, replace the main harness.



3-46 FUEL SYSTEM (DFI)

Throttle Position Sensor (Service Code/Character - 11/tPS)

Throttle Position Sensor Circuit



1. ECU
2. Throttle Position Sensor/ETV Actuator

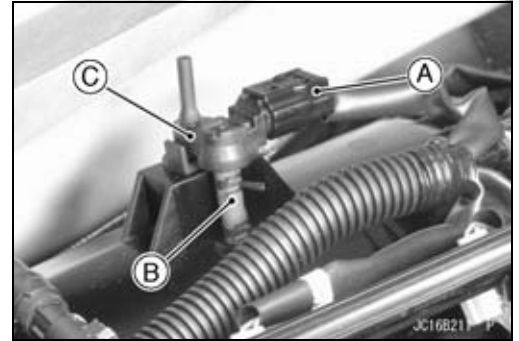
Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

Intake Air Pressure Sensor Removal

CAUTION

Never drop the intake air pressure sensor especially on a hard surface. Such a shock to the sensor can damage it.

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Intake Air Pressure Sensor Connector [A]
 - Hose [B]
 - Intake Air Pressure Sensor [C]



Intake Air Pressure Sensor Installation

- Install the vacuum hose.
- Put the intake air pressure sensor in the stay of the intake manifold.

Intake Air Pressure Sensor Input Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the intake air pressure sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
 - Main Harness [B]
 - Intake Air Pressure Sensor [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.

Intake Air Pressure Sensor Input Voltage

Connections to Adapter:

Digital Meter (+) → R (sensor R) lead

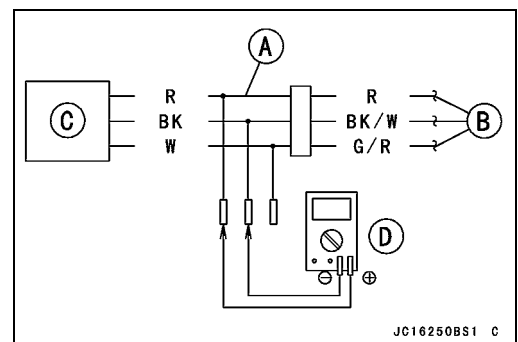
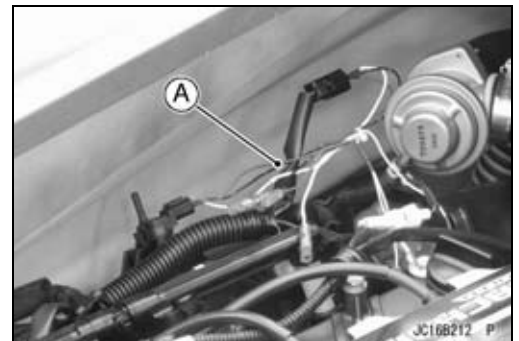
Digital Meter (–) → BK (sensor BK/W) lead

- Measure the input voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Input Voltage

Standard: DC 4.75 ~ 5.25 V

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the output voltage (see Intake Air Pressure Sensor Output Voltage Inspection).



3-48 FUEL SYSTEM (DFI)

Intake Air Pressure Sensor (Service Code/Character - 12/b0St)

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

○Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

ECU Connector [A] ↔

Intake Air Pressure Sensor Connector [B]

R lead (ECU terminal 48) [C]

BK/W lead (ECU terminal 55) [D]

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

Intake Air Pressure Sensor Output Voltage Inspection

● Measure the output voltage at the intake air pressure sensor in the same way as input voltage inspection, note the following.

○Disconnect the intake air pressure sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]

Intake Air Pressure Sensor [C]

Digital Meter [D]

Special Tool - Measuring Adapter: 57001-1700

Intake Air Pressure Sensor Output Voltage Connections to Adapter:

Digital Meter (+) → W (sensor G/R) lead

Digital Meter (–) → BK (sensor BK/W) lead

● Measure the output voltage with the engine stopped and with the connector joined.

● Turn the ignition switch to ON.

Output Voltage

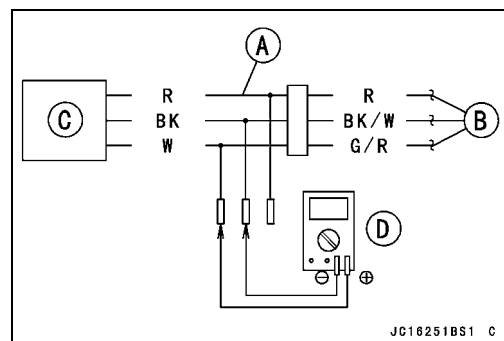
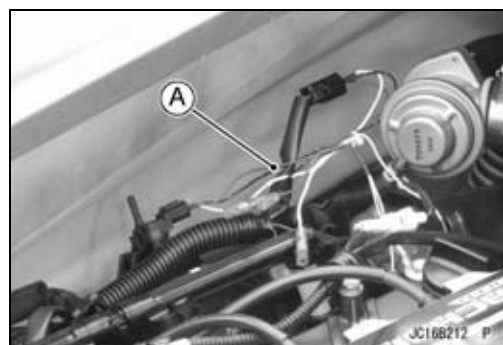
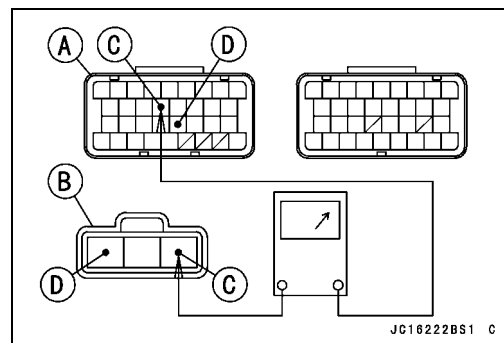
Usable Range: DC 1.43 ~ 1.55 V at standard atmospheric pressure (101.32 kPa, 76 cmHg)

NOTE

○The output voltage changes according to local atmospheric pressure.

● Turn the ignition switch to OFF.

★If the reading is out of the usable range, replace the sensor.



Intake Air Pressure Sensor (Service Code/Character - 12/b0St)

★If the reading is within the usable range, remove the ECU and check the wiring for continuity between main harness connector.

Special Tool - Hand Tester: 57001-1394

○Disconnect the ECU and sensor connectors.

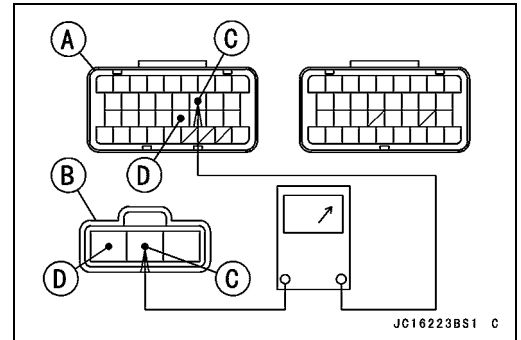
Wiring Continuity Inspection

ECU Connector [A] ↔

Intake Air Pressure Sensor Connector [B]

G/R lead (ECU terminal 46) [C]

BK/W lead (ECU terminal 55) [D]



★If the wiring is good, check the sensor for various vacuum.

● Remove the intake air pressure sensor [A] and disconnect the vacuum hose from the sensor.

● Connect an auxiliary hose [B] to the intake air pressure sensor.

● Connect a digital meter [C], pressure gauge [D], the fork oil level gauge [E] and the measuring adapter [F] to the intake air pressure sensor as shown in the figure.

Special Tools - Oil Pressure Gauge, 5 kgf/cm²: 57001-125

Fork Oil Level Gauge: 57001-1290

Measuring Adapter: 57001-1700

Intake Air Pressure Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → W (sensor G/R) lead

Digital Meter (-) → BK (sensor BK/W) lead

- Turn the ignition switch to ON.
- Measure the intake air pressure sensor output voltage from various vacuum readings, while pushing the handle of the fork oil level gauge.
- Check the intake air pressure sensor output voltage, using the following formula and chart.

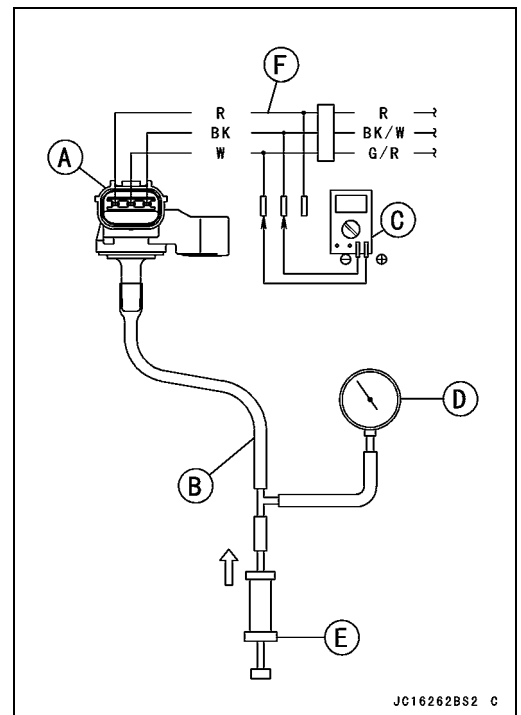
Suppose:

Pg: Vacuum Pressure (Gauge) of Intake Manifold

Pl: Local Atmospheric Pressure (Absolute) measured by a barometer

Pv: Vacuum Pressure (Absolute) of Intake Manifold

Vv: Sensor Output Voltage (V)



3-50 FUEL SYSTEM (DFI)

Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

then

$$P_v = P_i + P_g$$

For example, suppose the following data is obtained:

$P_g = 151.95$ kPa (Vacuum Gauge Reading)

$P_i = 101.32$ kPa (Barometer Reading)

$V_v = 3.8$ V (Digital Meter Reading)

then

$$P_v = 101.32 + 151.95 = 253.27 \text{ kPa (Absolute)}$$

Plot this P_v (253.27 kPa) at a point [1] on the chart and draw a vertical line through the point. Then, you can get the usable range [2] of the sensor output voltage.

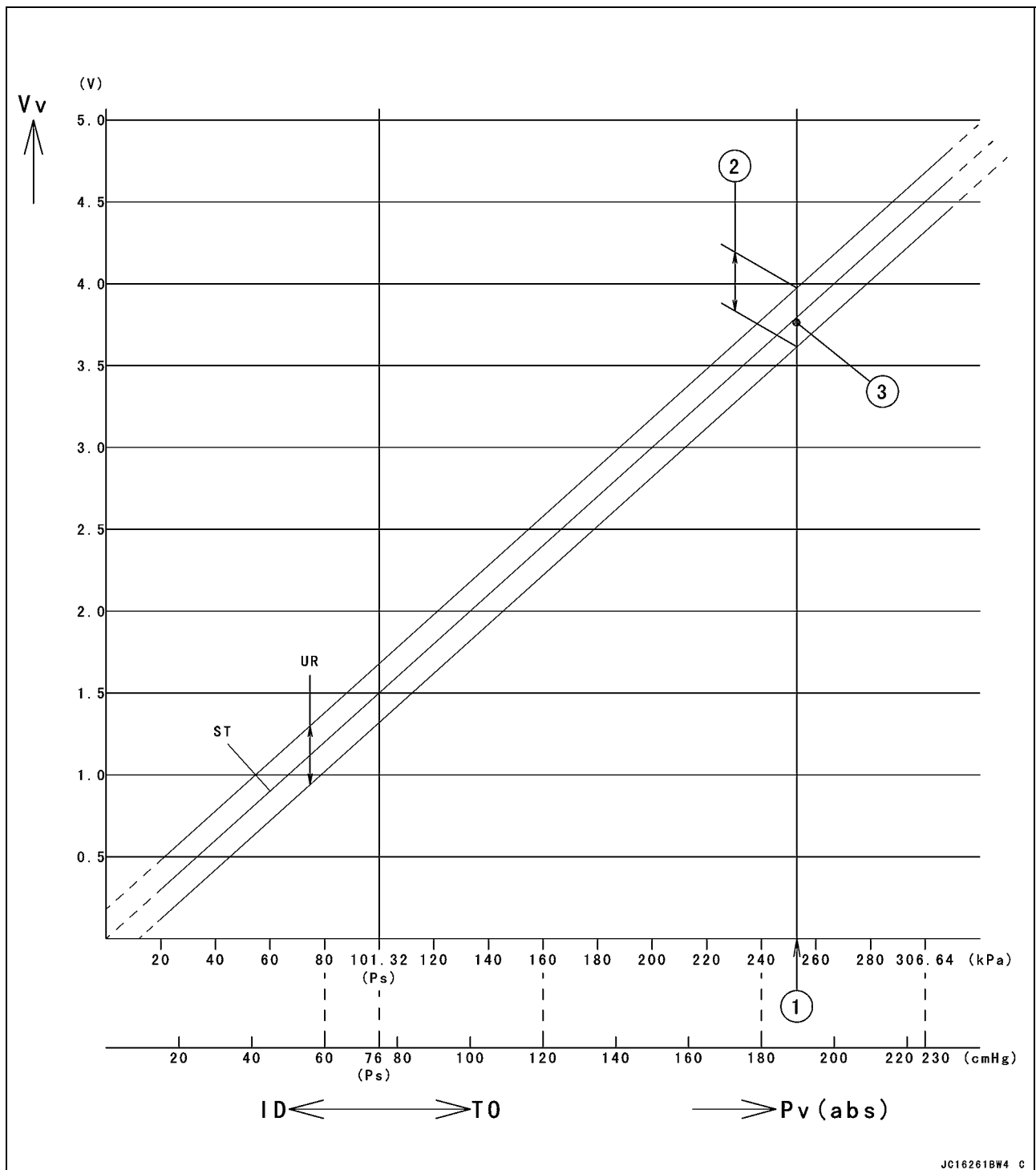
Usable range = 3.6 ~ 4.0 V

Plot V_v (3.8 V) on the vertical line. → Point [3].

Results: In the chart, V_v is within the usable range and the sensor is normal.

- ★If the reading is out of the usable range, replace the sensor.
- ★If the reading is within the usable range, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)



JC16261BW4 C

ID: Idling

Ps: Standard Atmospheric Pressure (Absolute)

Pv: Vacuum Pressure (Absolute)

ST: Standard of Sensor Output Voltage (V)

TO: Throttle Full Open

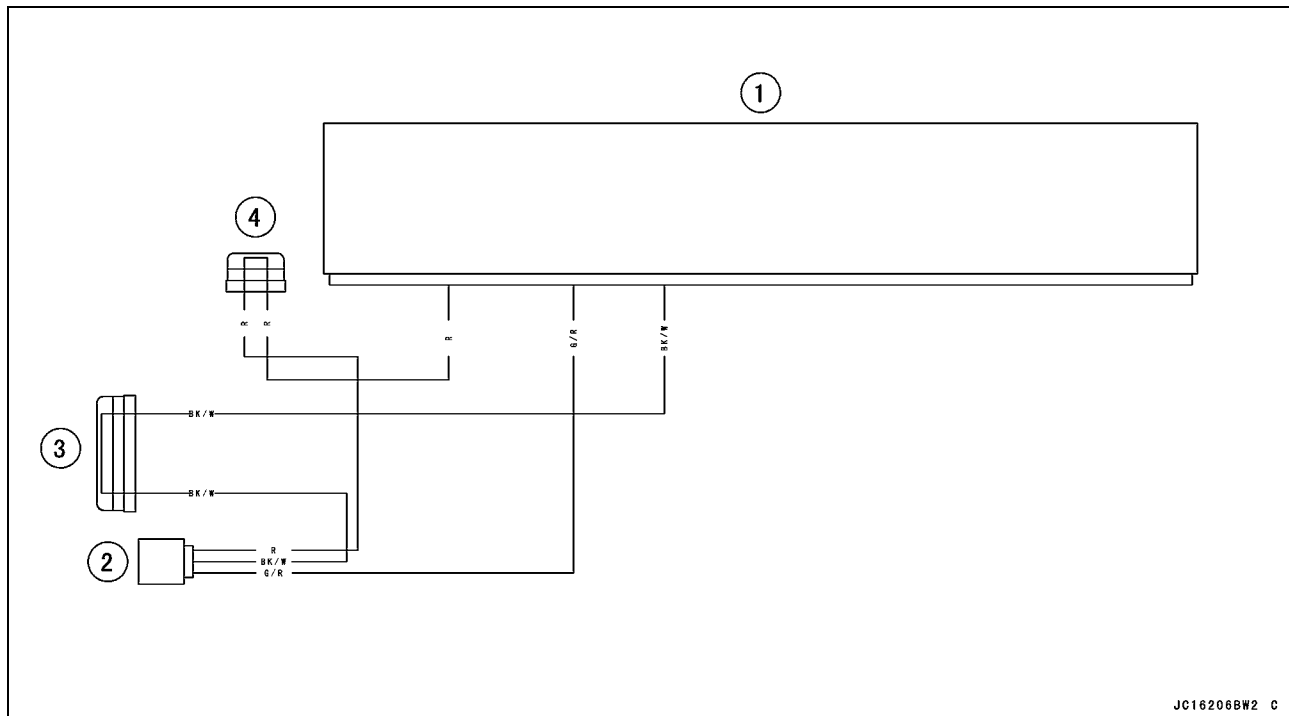
UR: Usable Range of Sensor Output Voltage (V)

V_v : Intake Air Pressure Sensor Output Voltage (V) (Digital Meter Reading)

3-52 FUEL SYSTEM (DFI)

Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

Intake Air Pressure Sensor Circuit



1. ECU
2. Intake Air Pressure Sensor
3. Joint Connector B (Ground)
4. Joint Connector F (5 V)

Intake Air Temperature Sensor (Service Code/Character - 13/Airt)

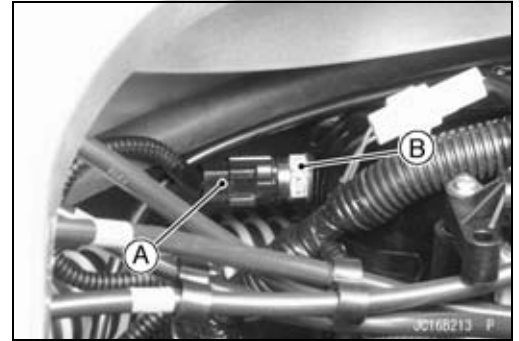
Intake Air Temperature Sensor Removal/Installation

CAUTION

Never drop the intake air temperature sensor especially on a hard surface. Such a shock to the sensor can damage it.

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the connector [A].
- Remove the intake air temperature sensor [B] and washer.
- Install the intake air temperature sensor and washer [A].
- Tighten:

Torque - Intake Air Temperature Sensor: 15 N·m (1.5 kgf·m, 11 ft·lb)



Intake Air Temperature Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the intake air temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]

Intake Air Temperature Sensor [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.

Intake Air Temperature Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → R (sensor R/BL) lead

Digital Meter (–) → BK (sensor BK/W) lead

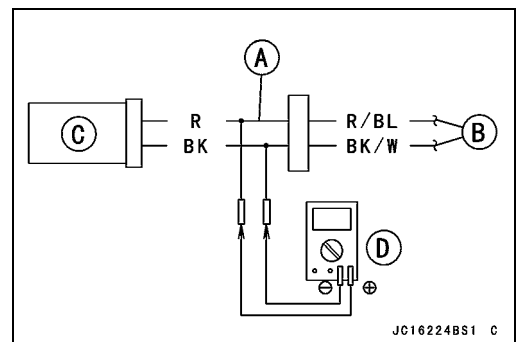
- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Output Voltage

Standard: About DC 2.25 ~ 2.50 V at intake air temperature 20°C (68°F)

NOTE

○The output voltage changes according to the intake air temperature.



3-54 FUEL SYSTEM (DFI)

Intake Air Temperature Sensor (Service Code/Character - 13/Airt)

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

- ★ If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

- Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

ECU Connector [A] ↔

Intake Air Temperature Sensor Connector [B]

R/BL lead (ECU terminal 36) [C]

BK/W lead (ECU terminal 55) [D]

- ★ If the wiring is good, check the intake air temperature sensor resistance (see Intake Air Temperature Sensor Resistance Inspection).

Intake Air Temperature Sensor Resistance Inspection

- Remove the intake air temperature sensor (see Intake Air Temperature Sensor Removal/Installation).
- Suspend the sensor [A] in a container of machine oil so that the heat-sensitive portion and threaded portion are submerged.
- Suspend a thermometer [B] with the heat-sensitive portion [C] located in almost the same depth with the sensor.

NOTE

- The sensor and thermometer must not touch the container side or bottom.

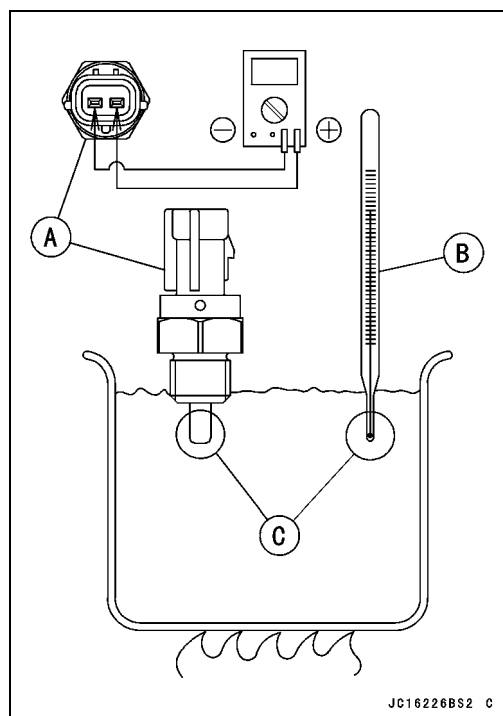
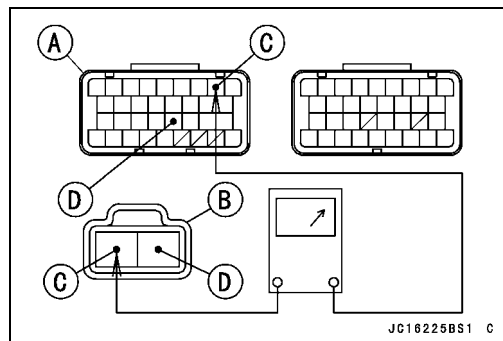
- Place the container over a source of heat and gradually raise the temperature of the oil while stirring the oil gently for even temperature.
- Using a digital meter, measure the internal resistance of the sensor across the terminals at the temperatures shown in the following.

Intake Air Temperature Sensor Resistance

Standard: 5.4 ~ 6.6 k Ω at 0°C (32°F)

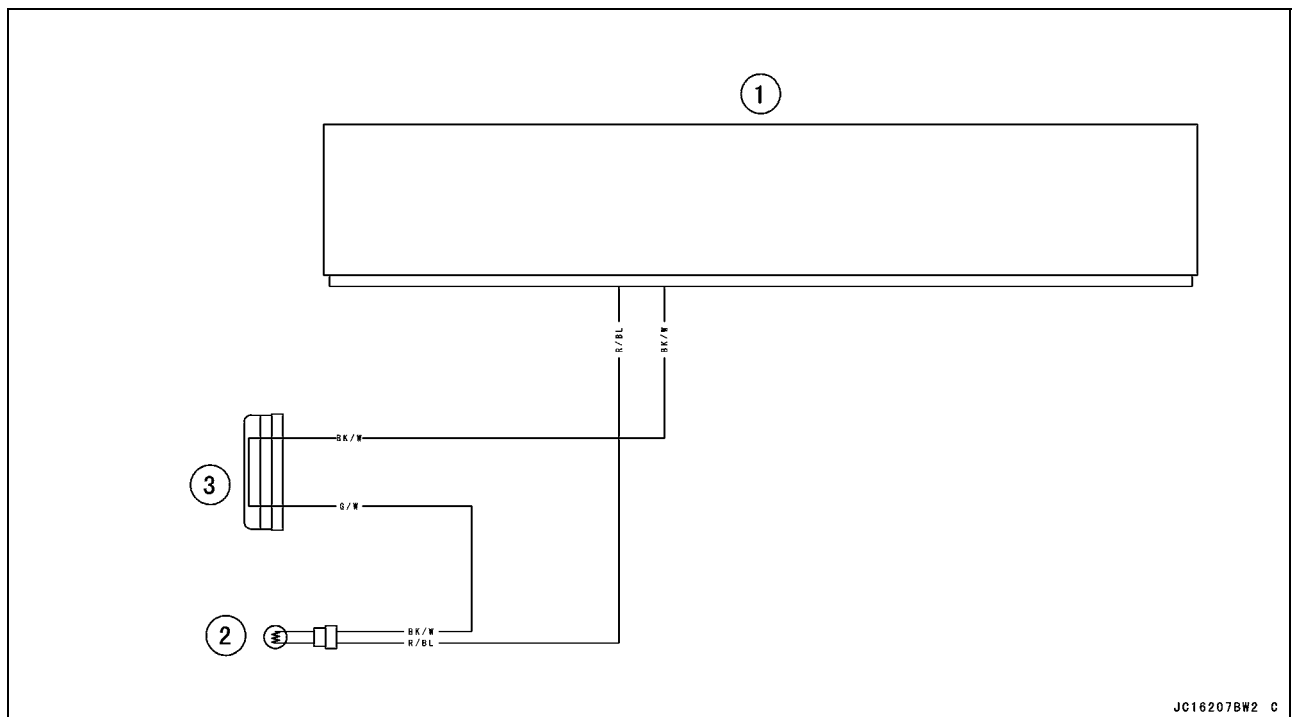
0.29 ~ 0.39 k Ω at 80°C (176°F)

- ★ If the reading is out of the standard, replace the sensor.
- ★ If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).



Intake Air Temperature Sensor (Service Code/Character - 13/Airt)

Intake Air Temperature Sensor Circuit



3-56 FUEL SYSTEM (DFI)

Water Temperature Sensor (Service Code/Character - 14/AqUt)

Water Temperature Sensor Removal/Installation

CAUTION

Never drop the water temperature sensor especially on a hard surface. Such a shock to the sensor can damage it.

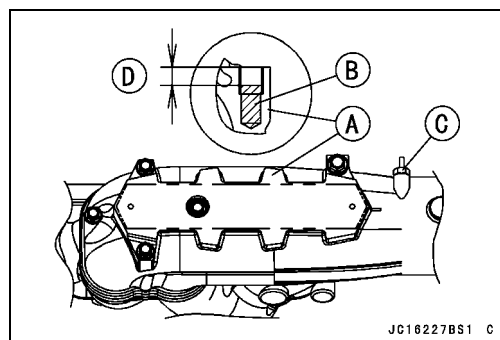
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the connector [A].
- Unscrew the water temperature sensor [A].



- Fill the hollow of the exhaust pipe [A] with the engine oil (10W-30) [B] as shown in the figure, before installing the water temperature sensor [C].
5 ~ 10 mm (0.2 ~ 0.4 in.) [D]

NOTE

○When filling the engine oil in the hollow of the exhaust pipe, remove the exhaust pipe. Fill the engine oil and install the water temperature sensor.



CAUTION

Do not overfill the engine oil, or fitting boss could be damaged.

- Tighten:
Torque - Water Temperature Sensor: 14.7 N·m (1.5 kgf·m, 11 ft·lb)

Water Temperature Sensor (Service Code/Character - 14/AqUt)

Water Temperature Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the water temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]

Water Temperature Sensor [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.

Water Temperature Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → R (sensor G/Y) lead

Digital Meter (-) → BK (sensor BK/W) lead

- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Output Voltage

Standard: About DC 3.5 ~ 4.0 V at 20°C (68°F)

NOTE

○The output voltage changes according to the water temperature in the engine.

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

○Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

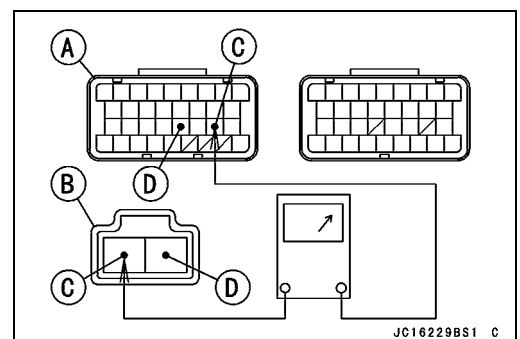
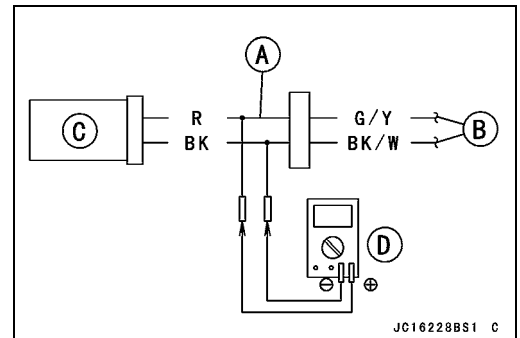
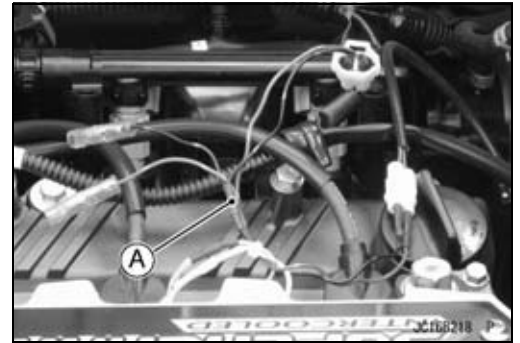
ECU Connector [A] ↔

Water Temperature Sensor Connector [B]

G/Y lead (ECU terminal 53) [C]

BK/W lead (ECU terminal 55) [D]

- ★ If the wiring is good, check the water temperature sensor resistance (see Water Temperature Sensor Resistance Inspection).



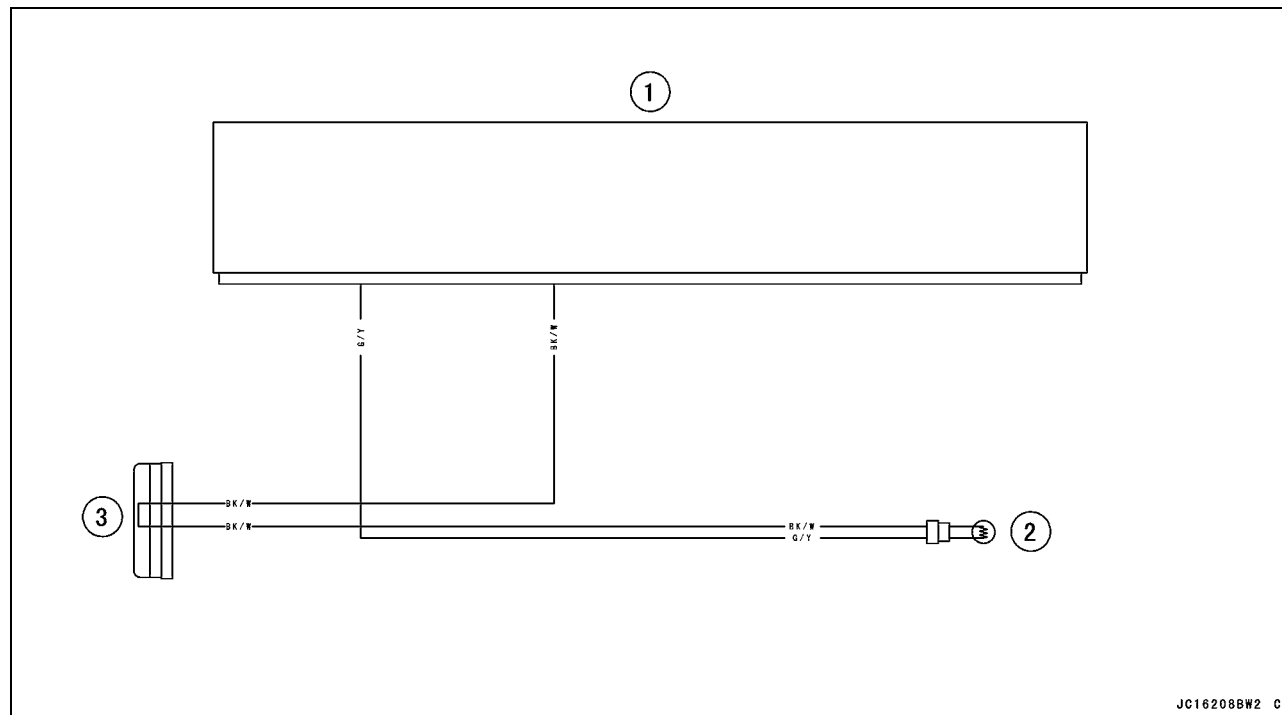
3-58 FUEL SYSTEM (DFI)

Water Temperature Sensor (Service Code/Character - 14/AqUt)

Water Temperature Sensor Resistance Inspection

- Refer to the Water Temperature Sensor Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

Water Temperature Sensor Circuit



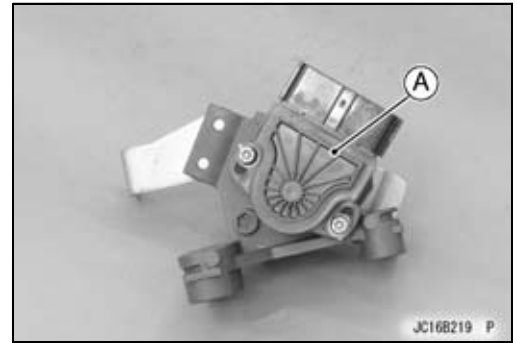
1. ECU
2. Water Temperature Sensor
3. Joint Connector B (Ground)

Accelerator Position Sensor (Service Code/Character - 18/APS)

Accelerator Position Sensor Removal

CAUTION

Do not remove the accelerator position sensor [A] since it has been adjusted and set with precision at the factory.
Never drop the accelerator position sensor assembly especially on a hard surface. Such a shock to the accelerator position sensor can damage it.



Accelerator Position Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.

- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Accelerator Position Sensor Output Voltage Connections to ECU Connector:

- (1) Digital Meter (+) → P/BL lead (ECU terminal 66)
Digital Meter (-) → GY lead (ECU terminal 65)
- (2) Digital Meter (+) → O/W lead (ECU terminal 50)
Digital Meter (-) → GY/R lead (ECU terminal 58)

- Measure the output voltage with the ordinary throttle position and full throttle opened.
- Turn the ignition switch to ON.

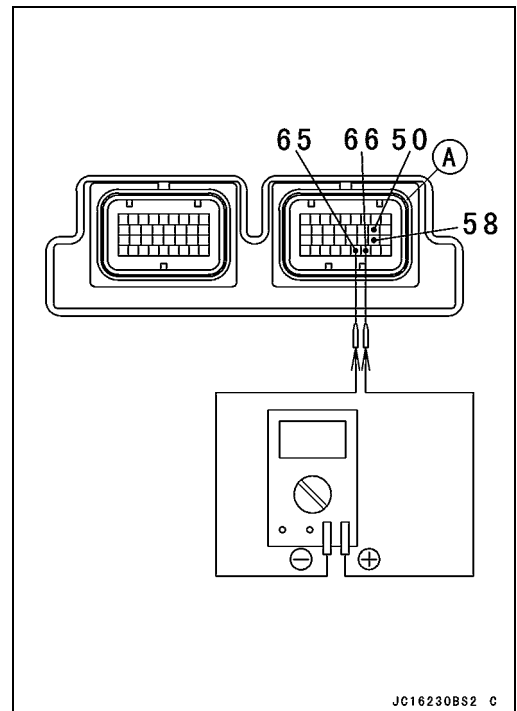
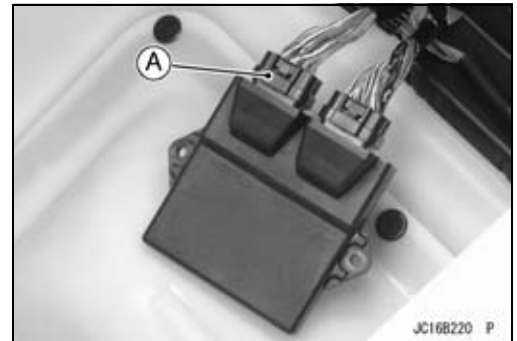
Output Voltage

- Standard:**
- (1) DC 0.50 ~ 0.90 V at ordinary throttle position
DC 3.75 ~ 4.35 V at full throttle opening (for reference)
 - (2) DC 0.35 ~ 1.05 V at ordinary throttle position
DC 3.60 ~ 4.50 V at full throttle opening (for reference)

NOTE

○Open the throttle, confirm the output voltage will be raise.

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the input voltage (see Accelerator Position Sensor Input Voltage Inspection).
- ★ If the reading is within the standard, replace the ECU (see ECU Removal/Installation).



3-60 FUEL SYSTEM (DFI)

Accelerator Position Sensor (Service Code/Character - 18/APS)

Accelerator Position Sensor Input Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.
- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Accelerator Position Sensor Input Voltage

Connections to ECU Connector:

- (1) Digital Meter (+) → P/BK lead (ECU terminal 67)
Digital Meter (-) → GY lead (ECU terminal 65)
- (2) Digital Meter (+) → O/BK lead (ECU terminal 43)
Digital Meter (-) → GY/R lead (ECU terminal 58)

- Turn the ignition switch to ON.
- Measure the input voltage with the engine stopped and with the connector joined.

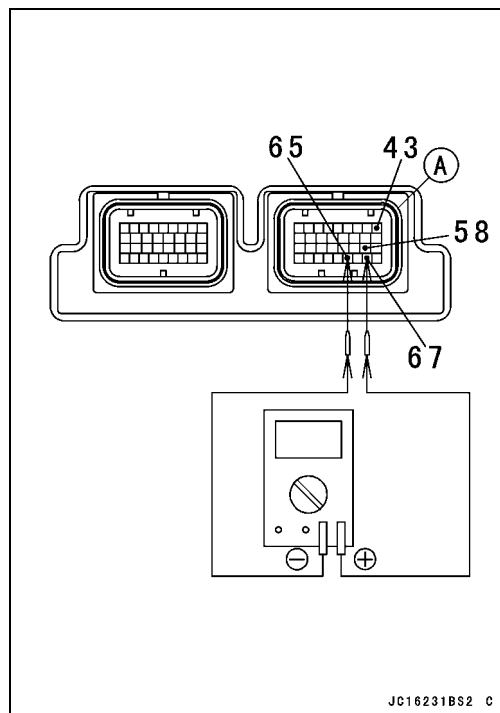
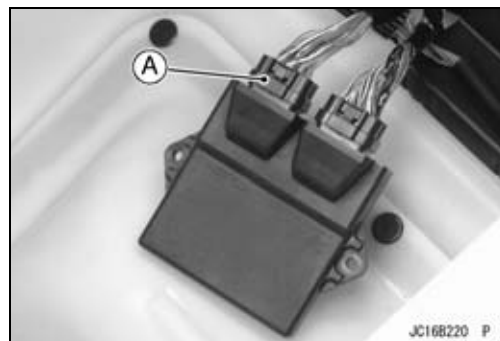
Input Voltage

Standard: (1) and (2) DC 4.75 ~ 5.25 V

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is within the standard, check the accelerator position sensor resistance (see Accelerator Position Sensor Resistance Inspection).
- ★ If the resistance is the standard, check the wiring for continuity between the main harness connectors using the Accelerator Position Sensor Circuit.

Special Tool - Hand Tester: 57001-1394

- ★ If the wiring is not good, replace the main harness.
- ★ If the wiring is good, replace the ECU (see ECU Removal/Installation).



Accelerator Position Sensor (Service Code/Character - 18/APS)

Accelerator Position Sensor Resistance Inspection

- Remove the accelerator position sensor assembly (see Accelerator Position Sensor Assembly Removal).
- Connect the digital meter [A] to the terminals of the accelerator position sensor connector [B].

Accelerator Position Sensor Resistance Connection:

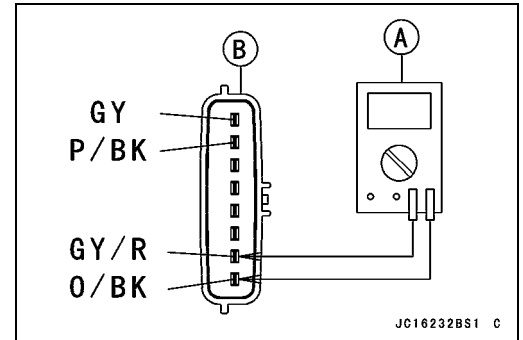
- (1) P/BK lead terminal $\longleftrightarrow$ GY lead terminal
- (2) O/BK lead terminal $\longleftrightarrow$ GY/R lead terminal

- Measure the accelerator position sensor resistance.

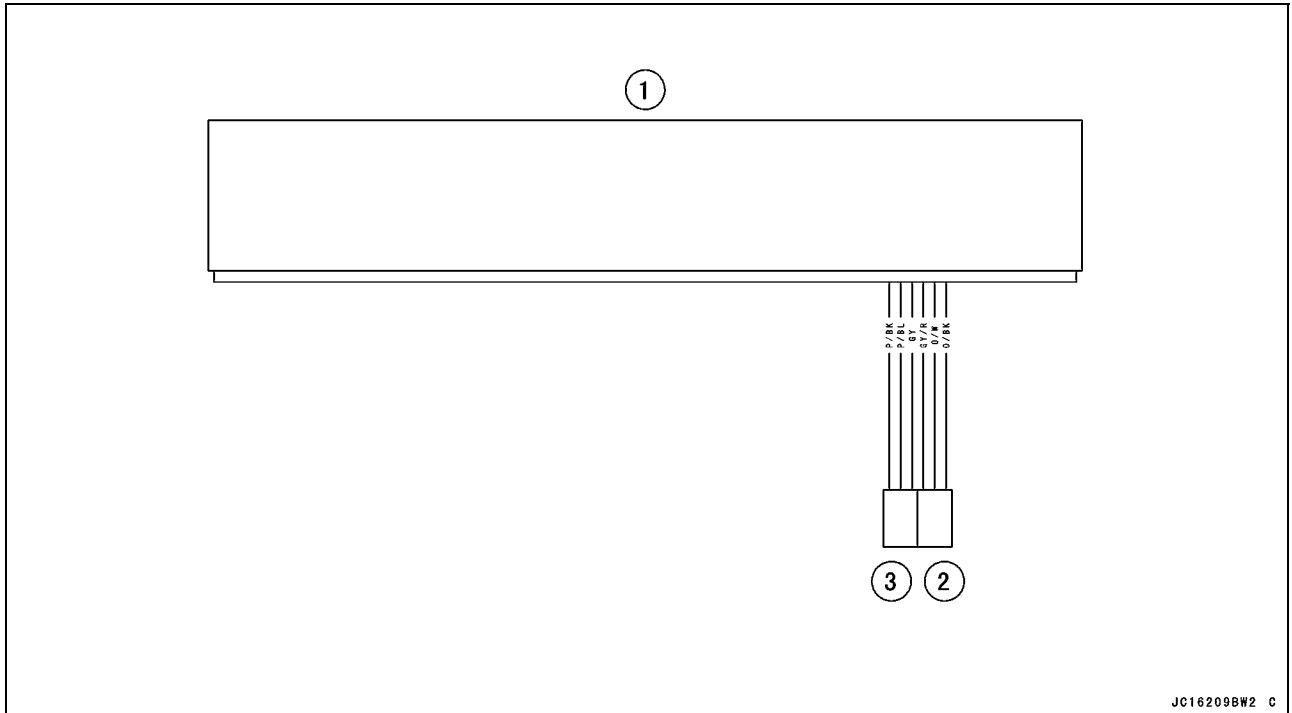
Accelerator Position Sensor Resistance

Standard: (1) and (2) 4 ~ 6 k Ω

- ★ If the reading is out of the standard, replace the accelerator position sensor assembly.



Accelerator Position Sensor Circuit



1. ECU
2. Accelerator Position Sensor 2
3. Accelerator Position Sensor 1

3-62 FUEL SYSTEM (DFI)

Crankshaft Sensor (Service Code/Character - 21/CrAg)

The crankshaft sensor has no power source, and when the engine stops, the crankshaft sensor generates no signals.

Crankshaft Sensor Removal/Installation

- Refer to the Crankshaft Sensor Removal/Installation in the Electrical System chapter.

Crankshaft Sensor Resistance Inspection

- Refer to the Crankshaft Sensor Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, check the peak voltage (see Crankshaft Sensor Peak Voltage Inspection).

Crankshaft Sensor Peak Voltage Inspection

- Refer to the Crankshaft Sensor Peak Voltage Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

- Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

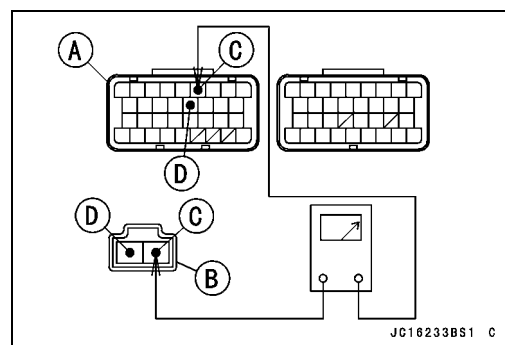
ECU Connector [A] ↔

Crankshaft Sensor Connector [B]

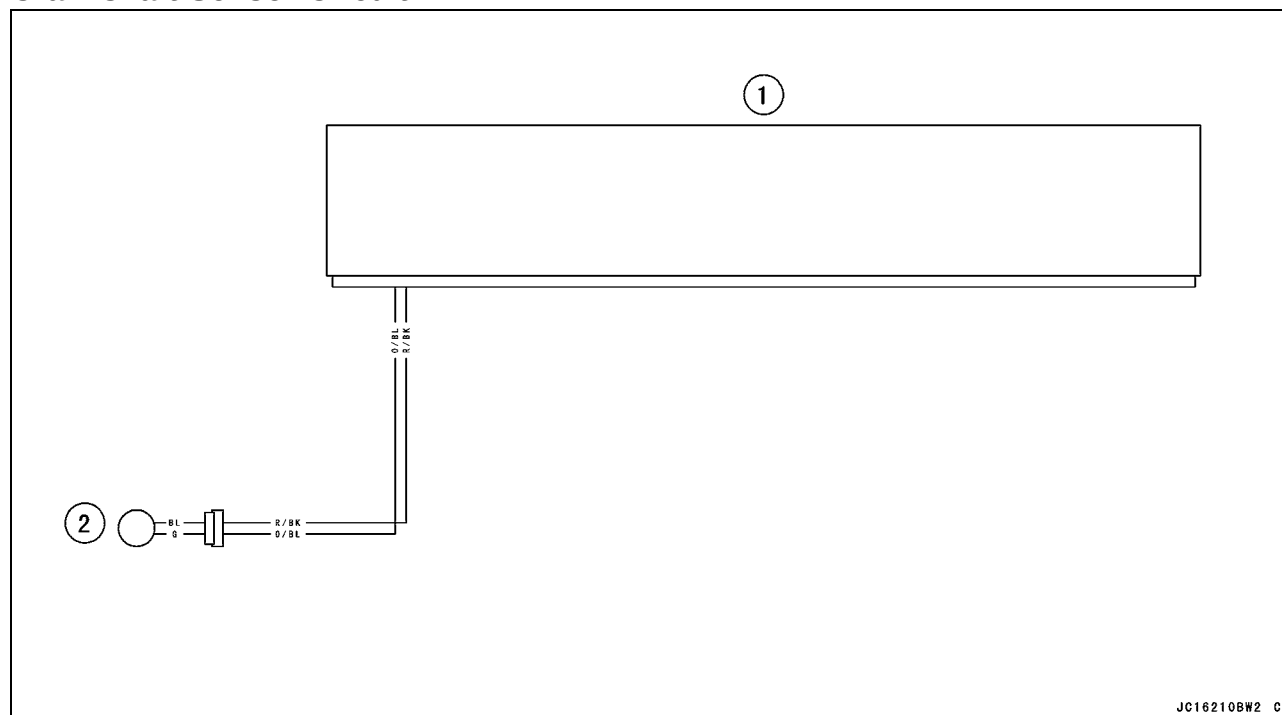
R/BK lead (ECU terminal 38) [C]

O/BL lead (ECU terminal 47) [D]

- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



Crankshaft Sensor Circuit



1. ECU
2. Crankshaft Sensor

Camshaft Position Sensor (Service Code/Character - 23/CAA1)

The camshaft position sensor detects the position of the camshaft, and distinguishes the cylinder.

Camshaft Position Sensor Removal/Installation

- Refer to the Camshaft Position Sensor Removal/Installation in the Electrical System chapter.

Camshaft Position Sensor Resistance Inspection

- Refer to the Camshaft Position Sensor Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, check the peak voltage (see Camshaft Position Sensor Peak Voltage Inspection).

Camshaft Position Sensor Peak Voltage Inspection

- Refer to the Camshaft Position Sensor Peak Voltage Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

- Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

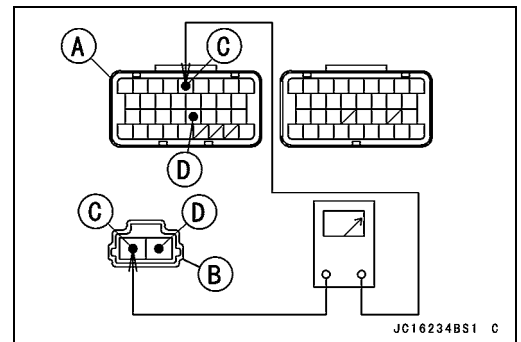
ECU Connector [A] ↔

Camshaft Position Sensor Connector [B]

W/BL lead (ECU terminal 39) [C]

BK/W lead (ECU terminal 55) [D]

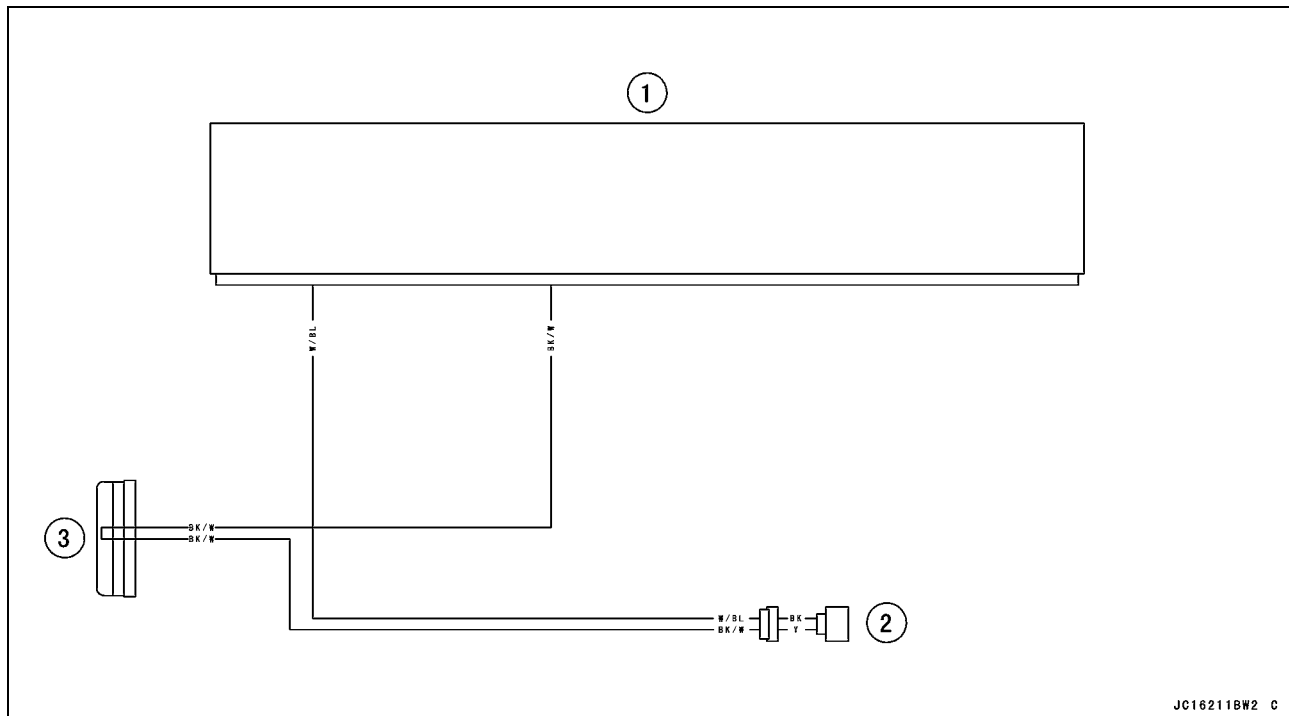
- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



3-64 FUEL SYSTEM (DFI)

Camshaft Position Sensor (Service Code/Character - 23/CAA1)

Camshaft Position Sensor Circuit



1. ECU
2. Camshaft Position Sensor
3. Joint Connector B (Ground)

Speed Sensor (Service Code/Character - 24/SPSE)

Speed Sensor Removal/Installation

- Refer to the Speed Sensor Removal/Installation in the Electrical System chapter.

Speed Sensor Inspection

- Refer to the Speed Sensor Inspection in the Electrical System chapter.

Speed Sensor Input Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
- Cut the band.
- Disconnect the speed sensor lead connector [A].
- Connect the harness adapter [A] between the main harness connector and speed sensor connector.

Special Tool - Throttle Sensor Setting Adapter #1: 57001-1400

- Connect a digital meter to the harness adapter leads.

Speed Sensor Input Voltage

Connections to Adapter:

Digital Meter (+) → BL (sensor R/W) lead

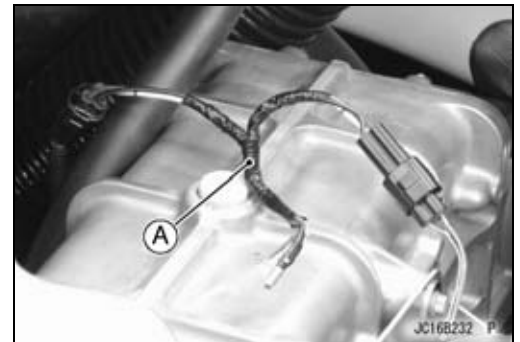
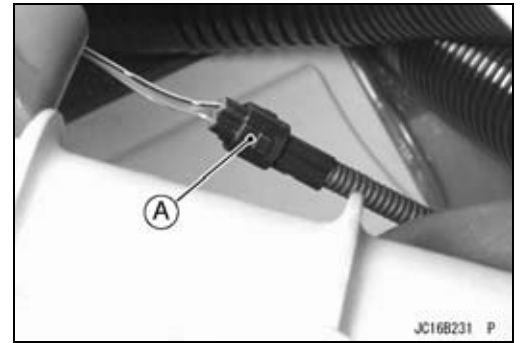
Digital Meter (–) → BK/BL (sensor BK/W) lead

- Measure the input voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Input Voltage

Standard: DC 9 ~ 11 V

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the output voltage (see Speed Sensor Output Voltage Inspection).
- ★ If the reading is out of the range, check the wiring (see wiring diagram in this section) and meter unit (see Meter Unit Inspection in the Electrical System chapter).
- ★ If the wiring and meter unit are good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



3-66 FUEL SYSTEM (DFI)

Speed Sensor (Service Code/Character - 24/SPSE)

Speed Sensor Output Voltage Inspection

- Measure the output voltage at the speed sensor in the same way as input voltage inspection, note the following.
- Disconnect the speed sensor connector and connect the harness adapter [A] between these connectors.

Special Tool - Throttle Sensor Setting Adapter #1: 57001-1400

Speed Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → Y/W (sensor G/R) lead

Digital Meter (-) → BK/BL (sensor BK/W) lead

- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Output Voltage

Standard: About DC 0.05 ~ 0.09 V or DC 4.5 ~ 4.9 V at ignition switch ON and 0 km/h

NOTE

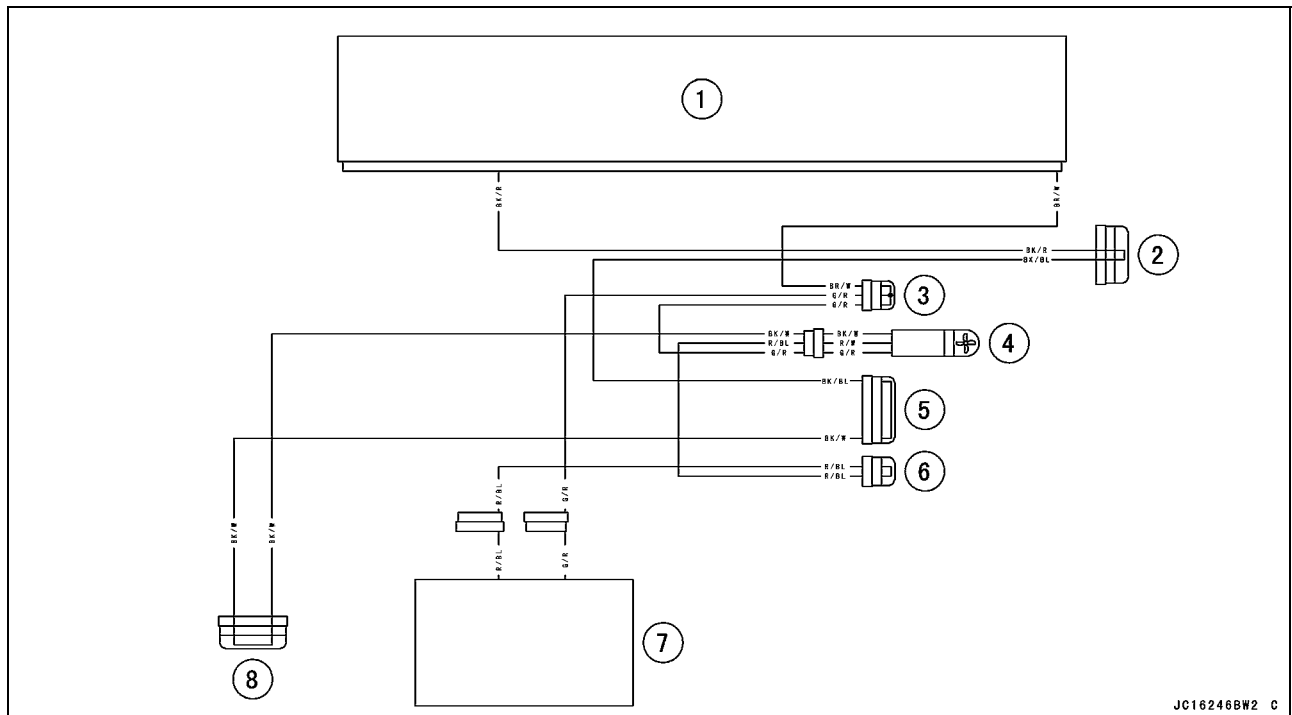
○ Rotate the waterwheel by hand, confirm the output voltage will be raise or lower.

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the wiring (see wiring diagram in this section) and speed sensor (see Speed Sensor Inspection in the Electrical System chapter).
- ★ If the wiring and speed sensor are good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



Speed Sensor (Service Code/Character - 24/SPSE)

Speed Sensor Circuit



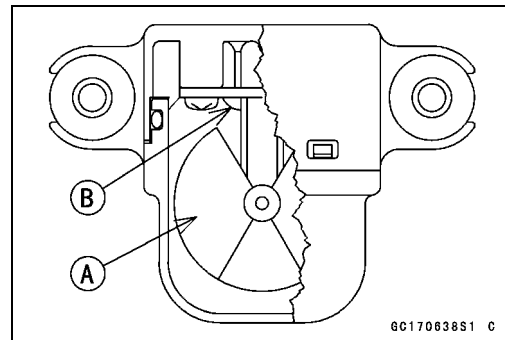
1. ECU
2. Joint Connector E (Ground)
3. Joint Connector J (Speed Sensor Signal)
4. Speed Sensor
5. Joint Connector S (Ground)
6. Joint Connector W (10 V)
7. Meter Unit
8. Joint Connector Q (Ground)

3-68 FUEL SYSTEM (DFI)

Vehicle-down Sensor (Service Code/Character - 31/dOS)

This sensor has a weight [A] with two magnets inside, and sends a signal to the ECU. But when the watercraft banks 110 ~ 130° or more to either side (in fact falls down), the weight turns and shuts off the signal. The ECU senses this change, and stops the fuel pump, the fuel injectors, and the ignition system.

Hall IC [B]

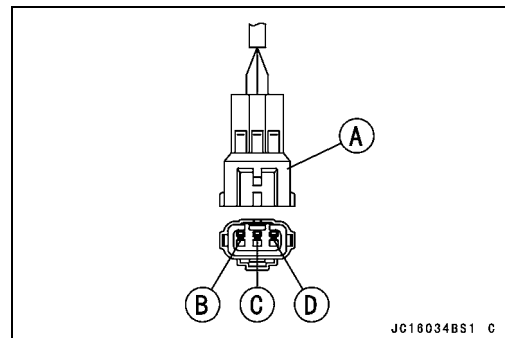


Vehicle-down Sensor Connector [A]

Ground Terminal BK/W [B]

Output Terminal BL/W [C]

Power Source Terminal R/G [D]

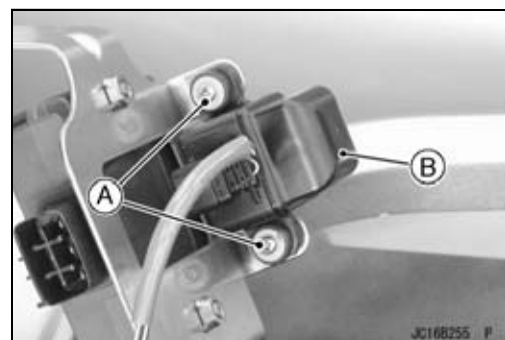
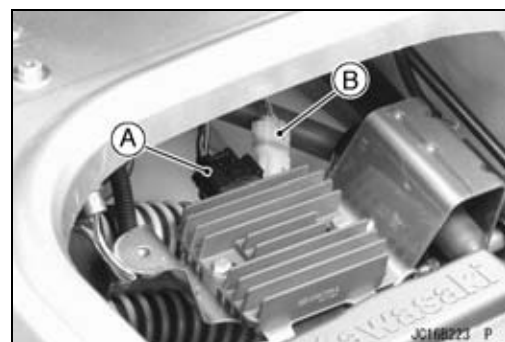
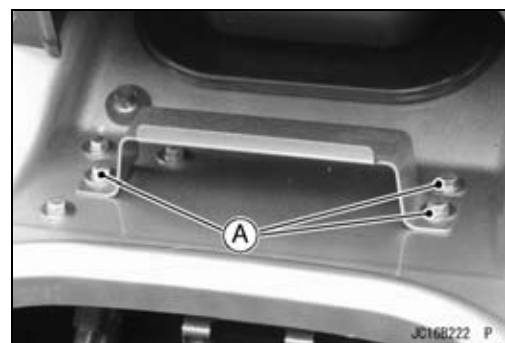


Vehicle-down Sensor Removal

CAUTION

Never drop the vehicle-down sensor especially on a hard surface. Such a shock to the sensor can damage it.

- Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Bracket Bolts [A] and Washers
- Remove:
Regulator/Rectifier Lead Connector [A]
Vehicle-down Sensor Lead Connector [B]
- Remove:
Screws [A]
Vehicle-down Sensor [B]



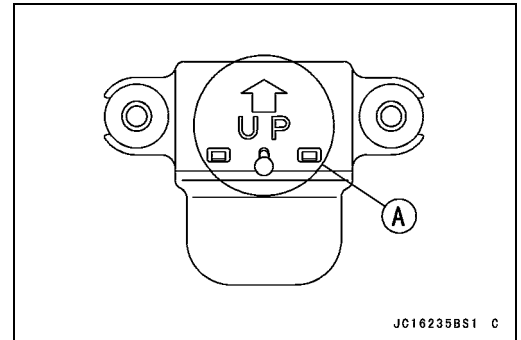
Vehicle-down Sensor (Service Code/Character - 31/dOS)

Vehicle-down Sensor Installation

- The UP mark [A] of the sensor should face upward.

⚠ WARNING

Incorrect installation of the vehicle-down sensor could cause sudden loss of engine power. The rider could lose balance during certain riding situations, like leaning over in a turn, with the potential for an accident resulting in injury or death. Ensure that the vehicle-down sensor is held in place by the sensor bracket.



- Tighten:
Torque - Vehicle-down Sensor Mounting Screws: 1.5 N·m
(0.15 kgf·m, 13 in·lb)

- Connect the connectors.
- Apply a non-permanent locking agent to the threads of the bracket bolts, and tighten them.

Torque - Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

Vehicle-down Sensor Input Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

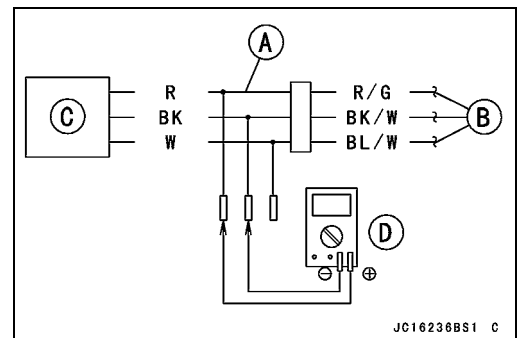
- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the vehicle-down sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]

Vehicle-down Sensor [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.



Vehicle-down Sensor Input Voltage

Connections to Adapter:

Digital Meter (+) → R (sensor R/G) lead

Digital Meter (-) → BK (sensor BK/W) lead

- Measure the input voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Input Voltage

Standard: DC 4.75 ~ 5.25 V

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the output voltage (see Vehicle-down Sensor Output Voltage Inspection).

3-70 FUEL SYSTEM (DFI)

Vehicle-down Sensor (Service Code/Character - 31/dOS)

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

○Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

ECU Connector [A] ↔

Vehicle-down Sensor Connector [B]

R/G lead (ECU terminal 48 (R lead)) [C]

BK/W lead (ECU terminal 55) [D]

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

Vehicle-down Sensor Output Voltage Inspection

- Remove the vehicle-down sensor (see Vehicle-down Sensor Removal).
- Connect the measuring adapter [A] to the vehicle-down sensor connectors as shown in the figure.

Special Tool - Measuring Adapter: 57001-1700

Main Harness [B]

Vehicle-down Sensor [C]

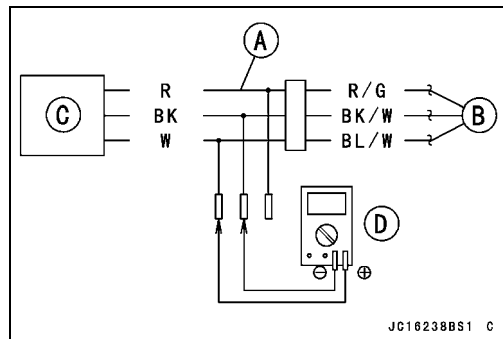
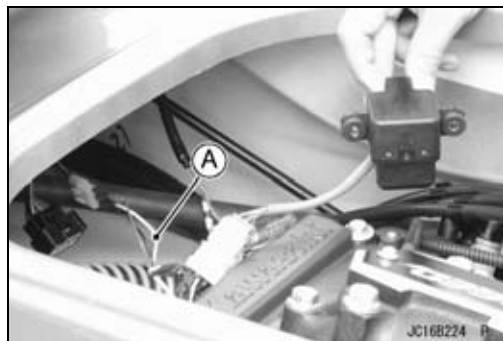
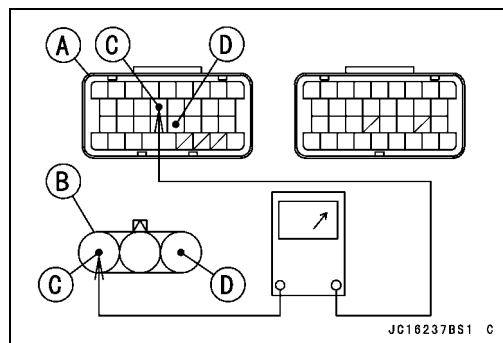
- Connect a digital meter [D] to the measuring adapter leads.

Vehicle-down Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → W (sensor BL/W) lead

Digital Meter (-) → BK (sensor BK/W) lead



Vehicle-down Sensor (Service Code/Character - 31/dOS)

- Hold the sensor vertically.
- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.
- Tilt the sensor 110 ~ 130° or more [A] right or left, then hold the sensor almost vertical with the arrow mark pointed up [B], and measure the output voltage.

Output Voltage

Standard: With sensor tilted 110 ~ 130° or more right or left: DC 0.65 ~ 1.35 V

With sensor arrow mark pointed up: DC 3.55 ~ 4.45 V

NOTE

○If you need to test again, turn the ignition switch to OFF, and then ON.

- Turn the ignition switch to OFF.
- ★If the reading is out of the standard, replace the sensor.

- ★If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

- Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

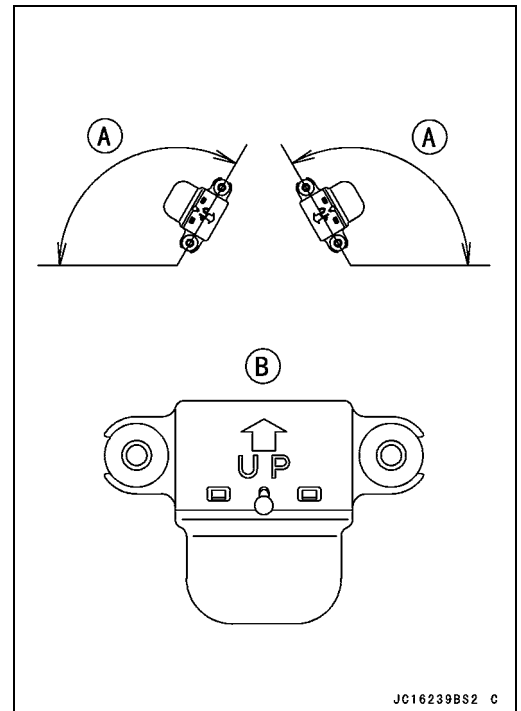
ECU Connector [A] ↔

Vehicle-down Sensor Connector [B]

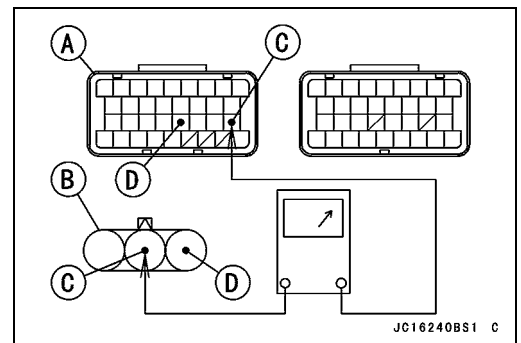
BL/W lead (ECU terminal 52) [C]

BK/W lead (ECU terminal 55) [D]

- ★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



JC16239BS2 C

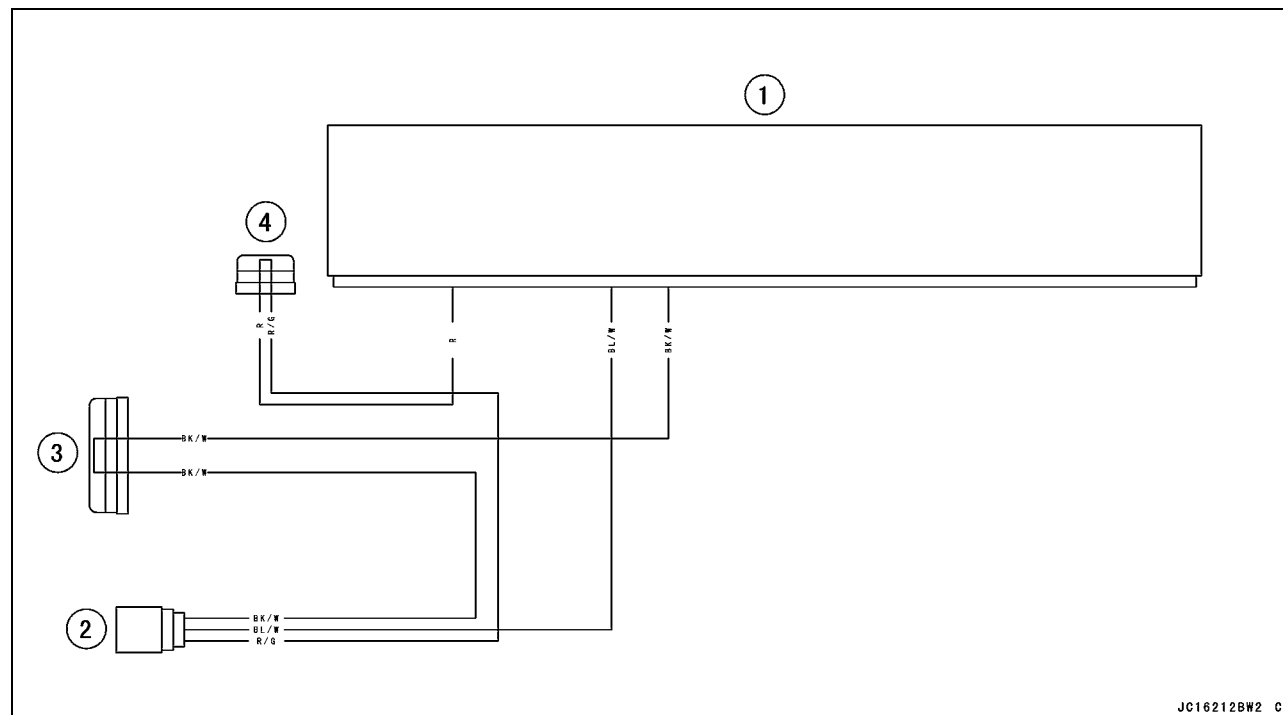


JC16240BS1 C

3-72 FUEL SYSTEM (DFI)

Vehicle-down Sensor (Service Code/Character - 31/dOS)

Vehicle-down Sensor Circuit



Immobilizer Amplifier (Service Code/Character - 35/Innb)

Amplifier Input Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU bracket (see Air Temperature Sensor (for Meter Unit) Removal/Installation in the Electrical System chapter).
- Connect a digital meter to the ignition switch connector [A] with needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Amplifier Input Voltage

Connections to Ignition Switch Connector:

Digital Meter (+) → R lead

Digital Meter (–) → BK lead

- Measure the input voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Input Voltage

Standard: Battery Voltage

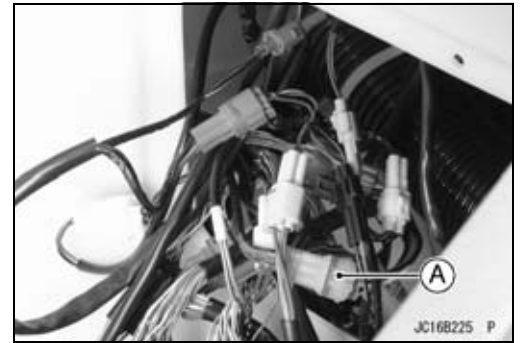
- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the wiring (see wiring diagram in next section).

Special Tool - Hand Tester: 57001-1394

- ★ If the reading is within the standard, check the wiring to ECU (see wiring diagram in next section).

Special Tool - Hand Tester: 57001-1394

- ★ If the wiring is good, replace the ignition switch (see Immobilizer System Parts Replacement in the Electrical System chapter).



3-74 FUEL SYSTEM (DFI)

Blank Key Detection (Service Code/Character - 36/Ignl)

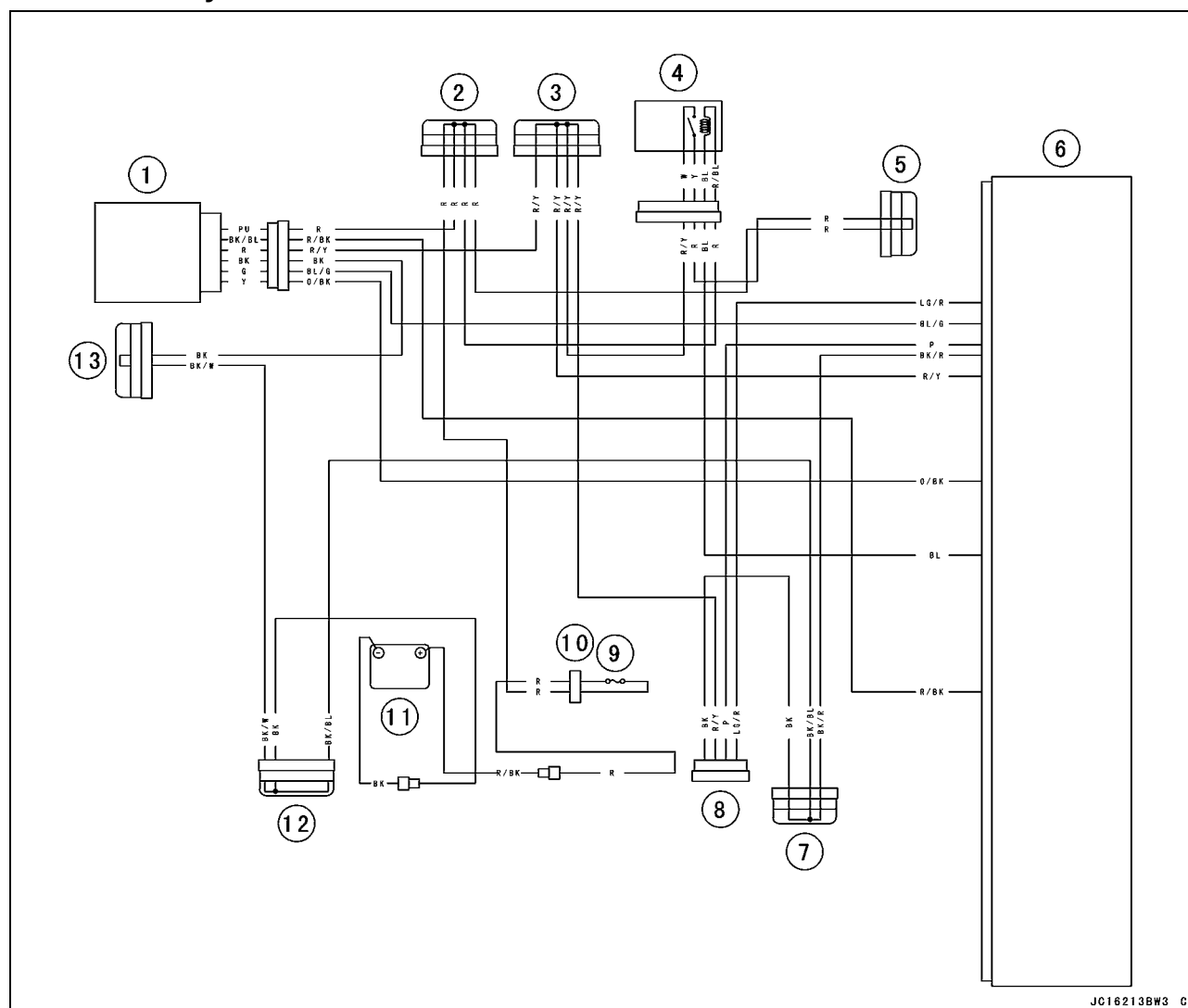
- This code appears in the following conditions.
 - The transponder [A] in the FPO mode and/or SLO mode key is malfunction.
 - When the spare key of unregistration is used.
- Therefore, the service code character "Ignl" will disappear when the above issue is solved.



User Key Inspection

- Register the user key correctly (see Key Registration in the Electrical System chapter).
- ★ If the service code character "Ignl" appears again, the transponder in the key is malfunction, replace it.

Immobilizer System Circuit



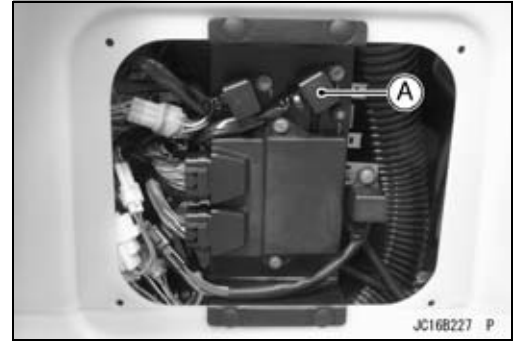
1. Ignition Switch (Immobilizer Amplifier)
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. System Relay
5. Joint Connector C (12 V)
6. ECU
7. Joint Connector E (Ground)

8. Immobilizer/Kawasaki Diagnostic System Connector
9. Main Fuse 20 A
10. Fuse Box 1
11. Battery
12. Joint Connector S (Ground)
13. Joint Connector Q (Ground)

Fuel Pump Relay (Service Code/Character - 45, 46/F-P1, F-P2)

Fuel Pump Relay Removal/Installation

- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.
Fuel Pump Relay [A]



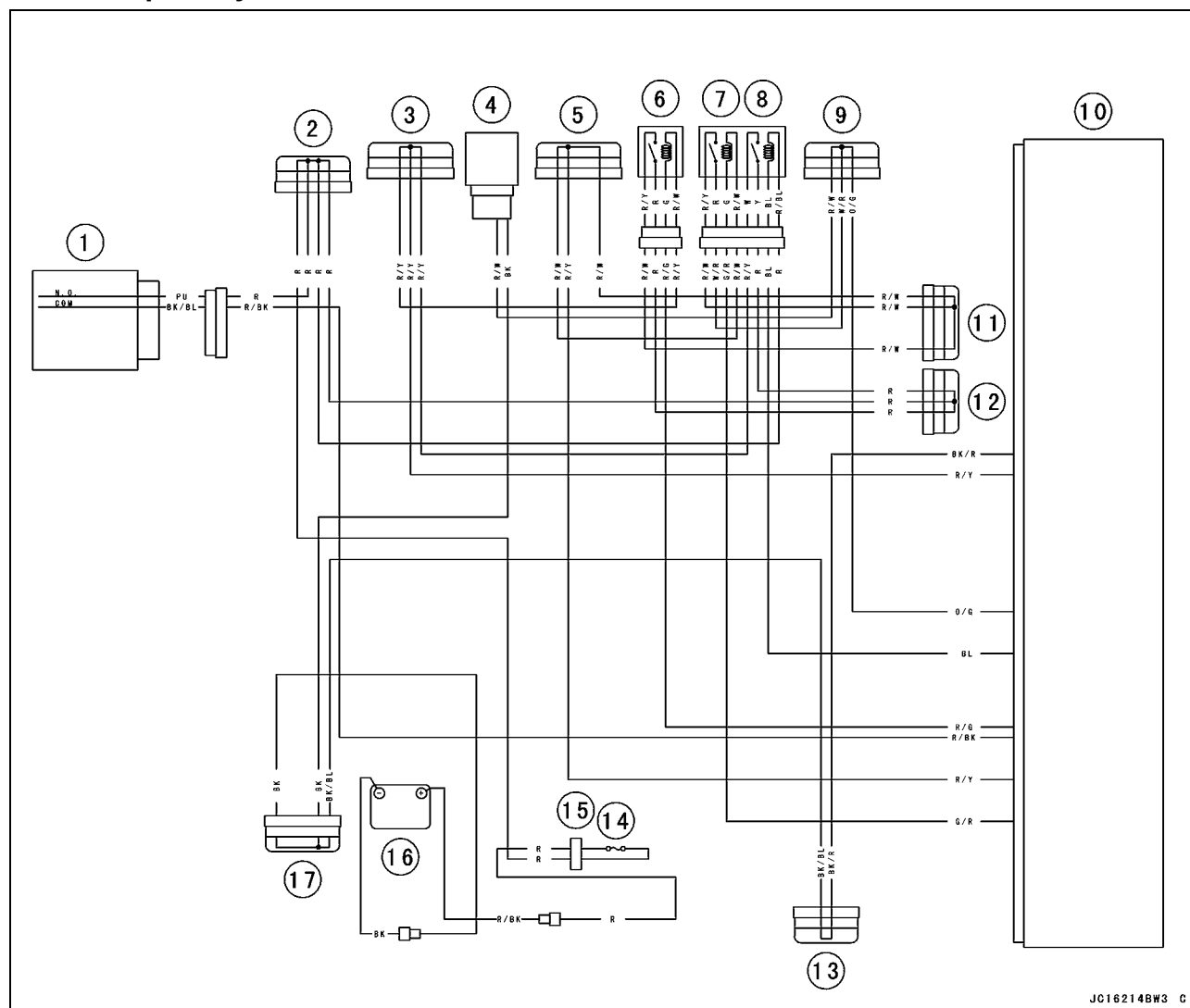
Fuel Pump Relay Inspection

- Refer to the Relay Assembly Inspection in the Electrical System chapter.
- ★ If the fuel pump relay is normal, check the wiring for continuity (see wiring diagram in this section).
Special Tool - Hand Tester: 57001-1394
- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

3-76 FUEL SYSTEM (DFI)

Fuel Pump Relay (Service Code/Character - 45, 46/F-P1, F-P2)

Fuel Pump Relay Circuit

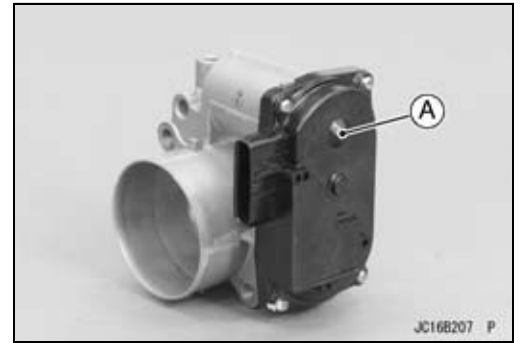


JC16214BW3 G

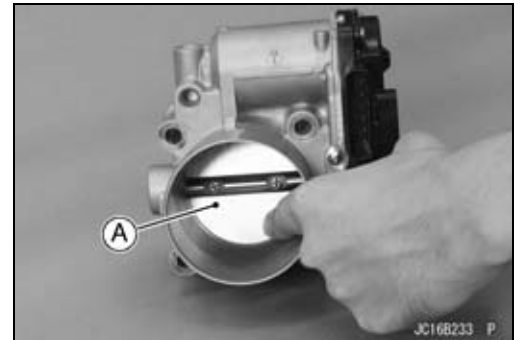
- | | |
|-----------------------------|--------------------------------|
| 1. Ignition Switch | 10. ECU |
| 2. Joint Connector P (12 V) | 11. Joint Connector D (12 V) |
| 3. Joint Connector R (12 V) | 12. Joint Connector C (12 V) |
| 4. Fuel Pump | 13. Joint Connector E (Ground) |
| 5. Joint Connector T (12 V) | 14. Main Fuse 20 A |
| 6. ECU Main Relay | 15. Fuse Box 1 |
| 7. Fuel Pump Relay | 16. Battery |
| 8. System Relay | 17. Joint Connector S (Ground) |
| 9. Joint Connector L (12 V) | |

Return Spring (Service Code/Character - 49/SPrl)**Return Spring Removal****CAUTION**

Do not remove the return spring in the gear case [A] since it has been set with precision at the factory.

**Return Spring Inspection**

- Remove the throttle body assy (see Throttle Body Assy Removal).
- Check that the throttle valve [A] move lightly by pushing finger without the spring force.
- ★ If the throttle valve move lightly, the return spring is broken, replace the throttle body assy (see Throttle Body Assy Removal/Installation).
- ★ If the throttle valve move hardly and return them by the return spring, check the output voltage of the throttle position sensor (see Throttle Position Sensor Output Voltage Inspection).
- ★ If the output voltage is good, replace the ECU (see ECU Removal/Installation).



3-78 FUEL SYSTEM (DFI)

Ignition Coils (Service Code/Character - 51, 52/COL1, COL2)

Ignition Coil #1, #4: Service Code/Character - 51/COL1

Ignition Coil #2, #3: Service Code/Character - 52/COL2

Ignition Coil Removal/Installation

- Refer to the Ignition Coil Removal/Installation in the Electrical System chapter.

Ignition Coil Primary Winding Resistance Inspection

- Refer to the Ignition Coil Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, check the input voltage (see Ignition Coil Input Voltage Inspection).

Ignition Coil Input Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.
- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Ignition Coil Input Voltage

Connections to ECU Connector:

For Ignition Coil #1, #4

Digital Meter (+) → G/BL lead (terminal 1)

Digital Meter (-) → Battery (-) terminal

For Ignition Coil #2, #3

Digital Meter (+) → G lead (terminal 26)

Digital Meter (-) → Battery (-) terminal

- Measure the input voltage to each primary winding of the ignition coils with the engine stopped and with the connectors joined.
- Turn the ignition switch to ON.

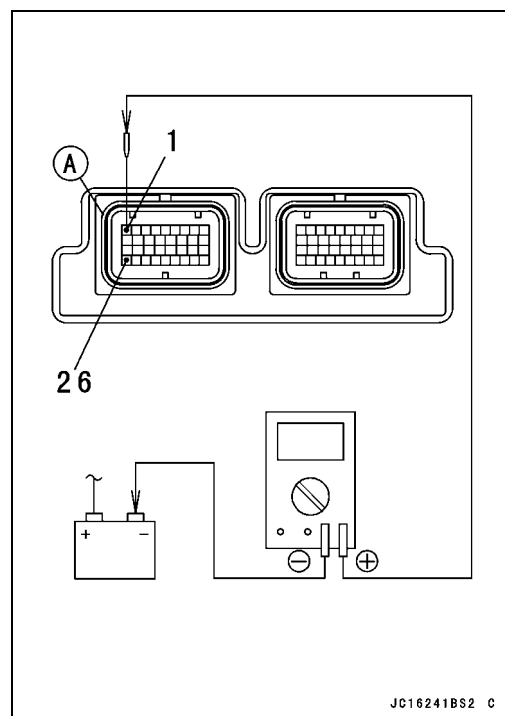
Input Voltage

Standard: About Battery Voltage

- Turn the ignition switch to OFF.
- If the input voltage is within the standard, replace the ECU (see ECU Removal/Installation).
- ★ If the input voltage is out of the standard, check the wiring for continuity (see wiring diagram in this section).

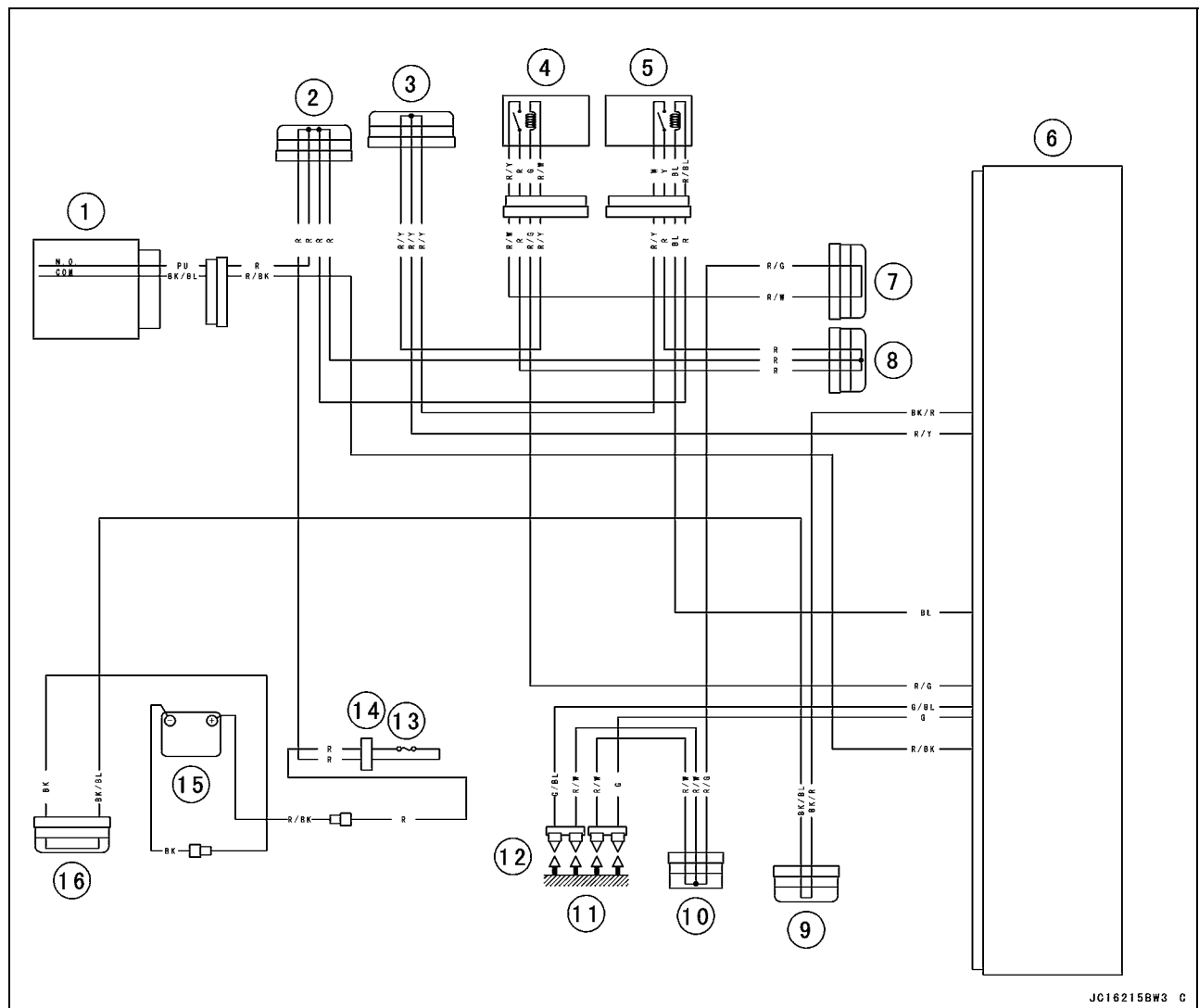
Special Tool - Hand Tester: 57001-1394

- ★ If the wiring is good, replace the ECU (see ECU Removal/Installation).
- ★ If the wiring is not good, replace the main harness.



Ignition Coils (Service Code/Character - 51, 52/COL1, COL2)

Ignition Coil Circuit



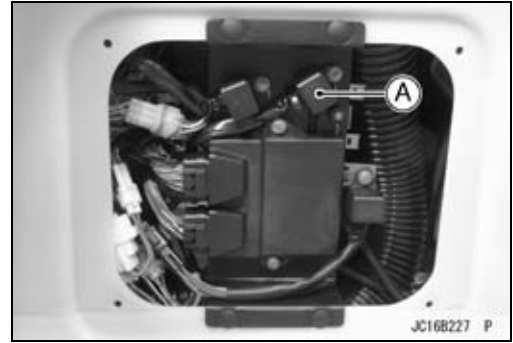
1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. ECU Main Relay
5. System Relay
6. ECU
7. Joint Connector D (12 V)
8. Joint Connector C (12 V)
9. Joint Connector E (Ground)
10. Joint Connector M (12 V)
11. Spark Plugs
12. Ignition Coils
13. Main Fuse 20 A
14. Fuse Box 1
15. Battery
16. Joint Connector S (Ground)

3-80 FUEL SYSTEM (DFI)

System Relay (Service Code/Character - 57/rEL2)

System Relay Removal/Installation

- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.
System Relay [A]

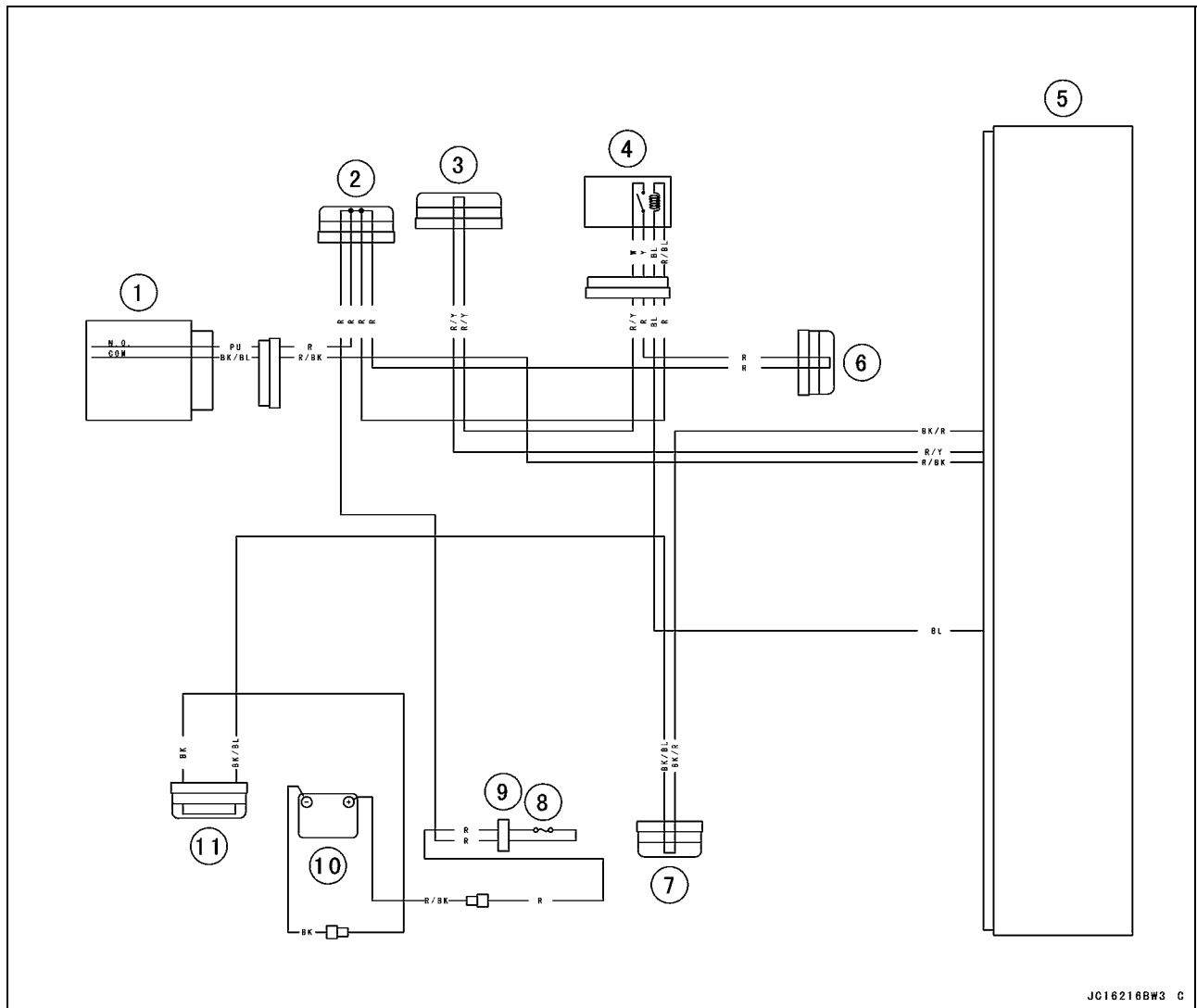


System Relay Inspection

- Refer to the Relay Assembly Inspection in the Electrical System chapter.
- ★ If the system relay is normal, check the wiring for continuity (see wiring diagram in this section).
Special Tool - Hand Tester: 57001-1394
- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

System Relay (Service Code/Character - 57/rEL2)

System Relay Circuit



1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. System Relay
5. ECU
6. Joint Connector C (12 V)

7. Joint Connector E (Ground)
8. Main Fuse 20 A
9. Fuse Box 1
10. Battery
11. Joint Connector S (Ground)

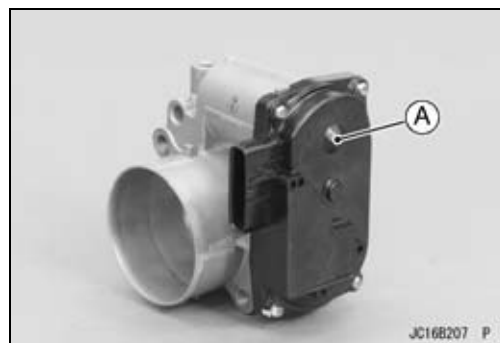
3-82 FUEL SYSTEM (DFI)

ETV Actuator (Service Code/Character - 58/Etl)

ETV Actuator Removal

CAUTION

Do not remove the ETV actuator in the gear case [A] since it has been set with precision at the factory.



ETV Actuator Input Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connectors.

- Connect the digital meter to the connector [A] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

ETV Actuator Input Voltage

Connections to ECU Connector:

Digital Meter (+) → LG lead (ECU terminal 7)

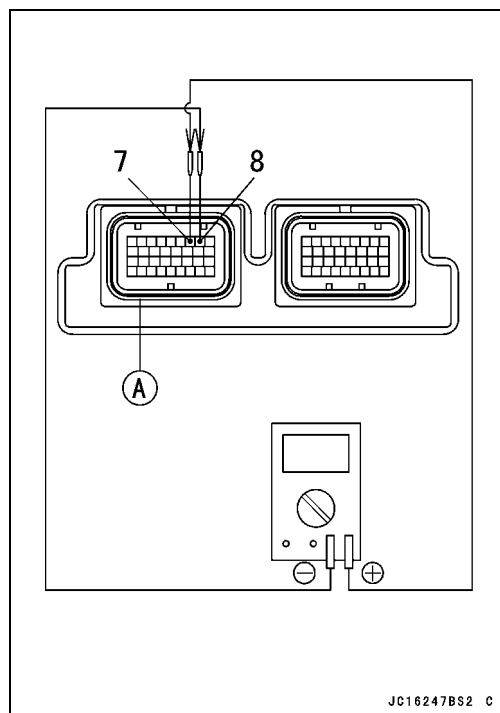
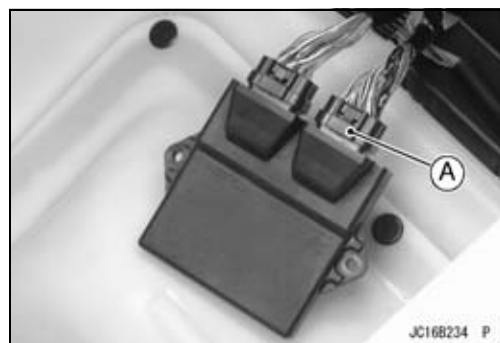
Digital Meter (-) → LG/BK lead (ECU terminal 8)

- Measure the input voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Input Voltage

Standard: About DC 1 ~ 2 V

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the following items.
 - ETV Actuator Relay (see ETV Actuator Relay Inspection)
 - Wiring (using the ETV Actuator Circuit)
- ★ If the above items are good, replace the throttle body assy (see Throttle Body Assy Removal/Installation) and/or the ECU (see ECU Removal/Installation).

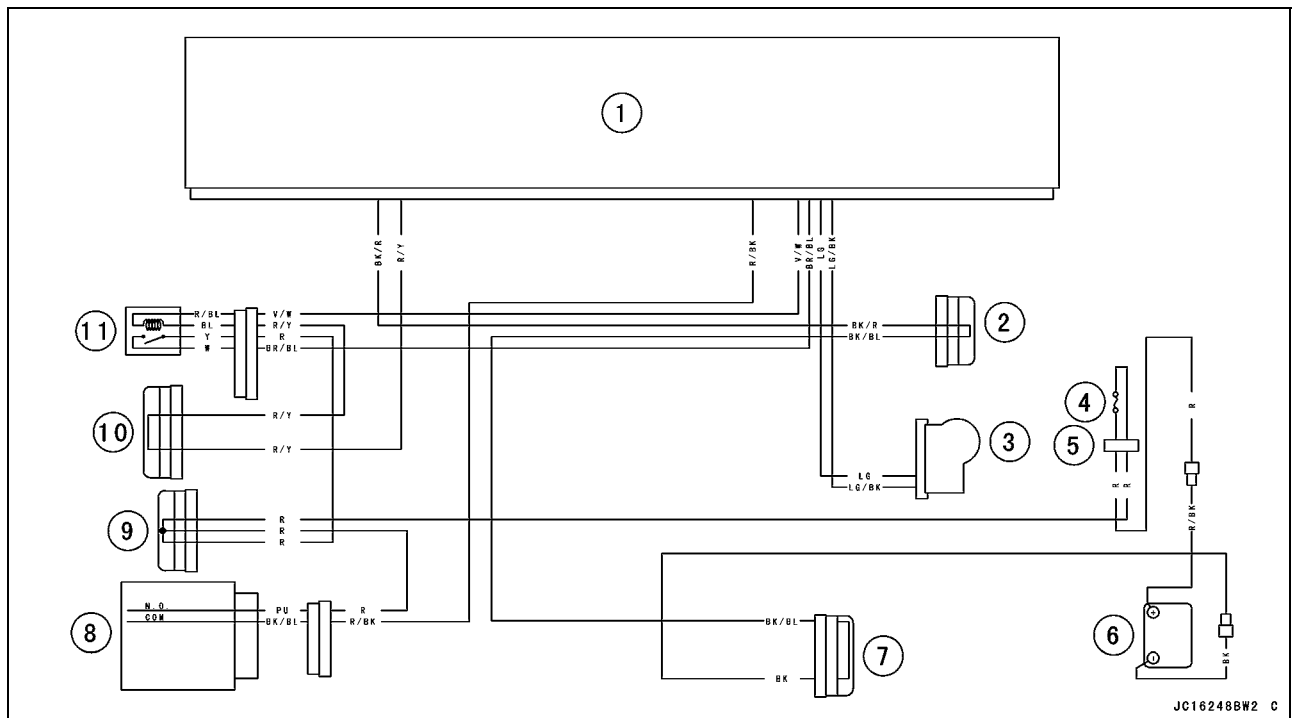


ETV Actuator Relay Inspection

- Refer to the Relay Assembly Inspection in the Electrical System chapter.

ETV Actuator (Service Code/Character - 58/Etl)

ETV Actuator Circuit



1. ECU
2. Joint Connector E (Ground)
3. ETV Actuator
4. Main Fuse 20 A
5. Fuse Box 1
6. Battery
7. Joint Connector S (Ground)
8. Ignition Switch
9. Joint Connector P (12 V)
10. Joint Connector R (12 V)
11. ETV Actuator Relay

3-84 FUEL SYSTEM (DFI)

Engine Overheating (Service Code/Character - 71/HEAt)

- If the service code character “HEAt” is displayed, check the doubtful parts referring to the following table.

Possible Causes	Actions
Water passage clogged, loosened or damaged	Inspect (see chapter 9).
Incorrect engine oil level	Inspect (see chapter 4).
Engine oil poor quality or incorrect	Change (see chapter 4).
Water temperature sensor broken	Inspect (see chapters 3 and 14).
Jet pump or impeller damaged	Inspect (see chapter 11).
Oil cooler clogged	Clean (see chapter 4).
Carbon build-up on combustion chamber	Clean (see chapter 6).

Low Engine Oil Pressure (Service Code/Character - 72/OILP)

- If the service code character "OILP" is displayed, check the doubtful parts referring to the following table.

Possible Causes	Actions
Oil leak	Inspect (see chapter 4).
Engine oil level too low	Inspect (see chapter 4).
Engine oil viscosity too low	Inspect (see chapter 4).
Oil filter clogged	Clean (see chapter 4).
Oil pressure switch damaged	Inspect (see chapters 3 and 14).
Oil cooler clogged	Inspect (see chapter 4).
Camshaft bearing worn	Inspect (see chapter 6).
Crankshaft bearing worn	Inspect (see chapter 8).
Oil pressure relief valve stuck open	Change (see chapter 4).
Oil pump damaged	Change (see chapter 4).
Oil screen clogged	Clean (see chapter 4).
O-ring at the oil passage in the crankcase damaged	Change (see chapter 4).

3-86 FUEL SYSTEM (DFI)

Oil Temperature Sensor (Service Code/Character - 73/OILt)

Oil Temperature Sensor Removal/Installation

CAUTION

Never drop the oil temperature sensor especially on a hard surface. Such a shock to the sensor can damage it.

- Remove:
Engine (see Engine Removal in the Engine Removal/Installation chapter)
Oil Temperature Sensor [A]
- Fill the hollow of the oil pan [A] with heat transfer grease [B] to 80% volume as shown in the figure, before installing the oil temperature sensor [C].

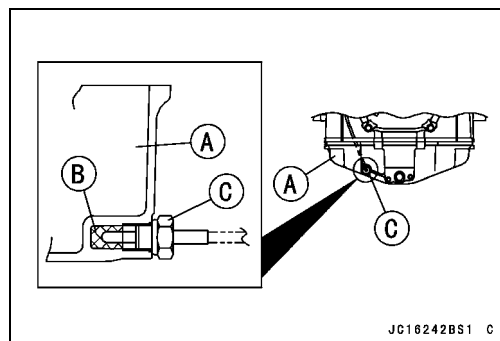
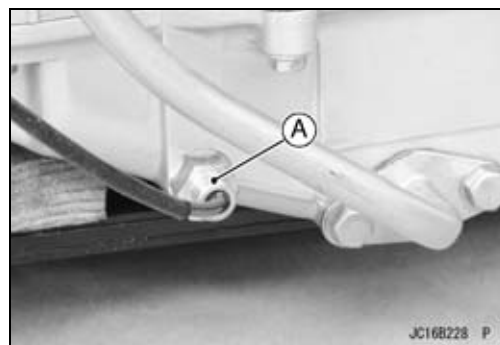
Heat Transfer Grease -

Heat Transfer Grease, SCH-20: 92137-1002 or equivalent

CAUTION

Do not overfill the grease, or fitting boss could be damaged.

- Tighten:
Torque - Oil Temperature Sensor: 15 N·m (1.5 kgf·m, 11 ft·lb)



Oil Temperature Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the oil temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
Main Harness [B]
Oil Temperature Sensor [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.

Oil Temperature Sensor Output Voltage

Connections to Adapter:

Digital Meter (+) → R (sensor Y) lead

Digital Meter (−) → BK (sensor BK/W) lead

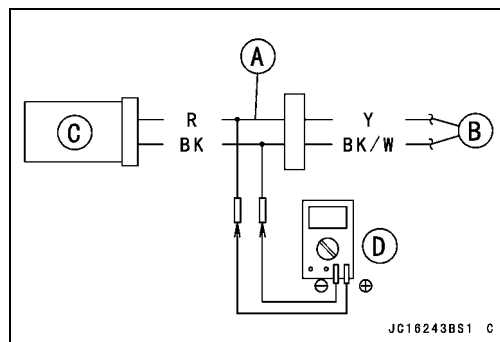
- Measure the output voltage with the engine stopped and the connector joined.
- Turn the ignition switch to ON.

Output Voltage

Standard: About DC 3.5 ~ 4.0 V at 20°C (68°F)

NOTE

○The output voltage changes according to the oil temperature in the engine.



Oil Temperature Sensor (Service Code/Character - 73/OILT)

- Turn the ignition switch to OFF.
- ★ If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

- Disconnect the ECU and sensor connectors.

Wiring Continuity Inspection

ECU Connector [A] ←→

Oil Temperature Sensor Connector [B]

Y lead (ECU terminal 54) [C]

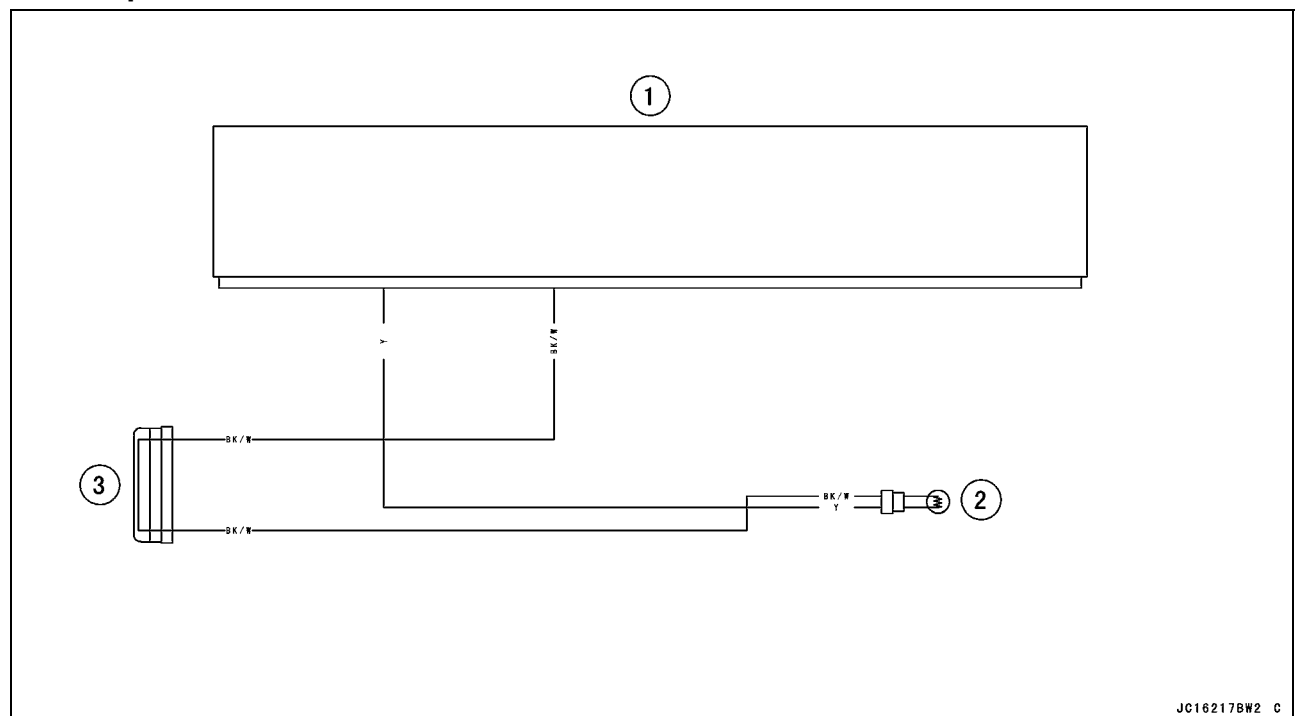
BK/W lead (ECU terminal 55) [D]

- ★ If the wiring is good, check the oil temperature sensor resistance (see Oil Temperature Sensor Resistance Inspection).

Oil Temperature Sensor Resistance Inspection

- Refer to the Oil Temperature Sensor Inspection in the Electrical System chapter.
- ★ If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

Oil Temperature Sensor Circuit



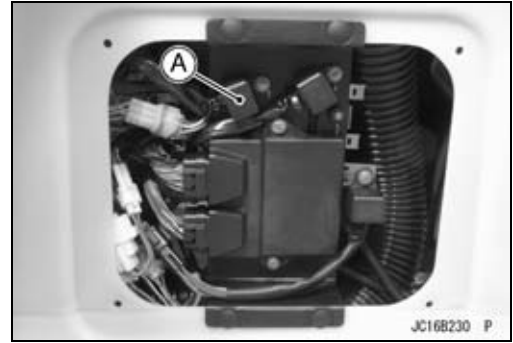
1. ECU
2. Oil Temperature Sensor
3. Joint Connector B (Ground)

3-88 FUEL SYSTEM (DFI)

ECU Main Relay (Service Code/Character - 75/rEL)

ECU Main Relay Removal/Installation

- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.
ECU Main Relay [A]

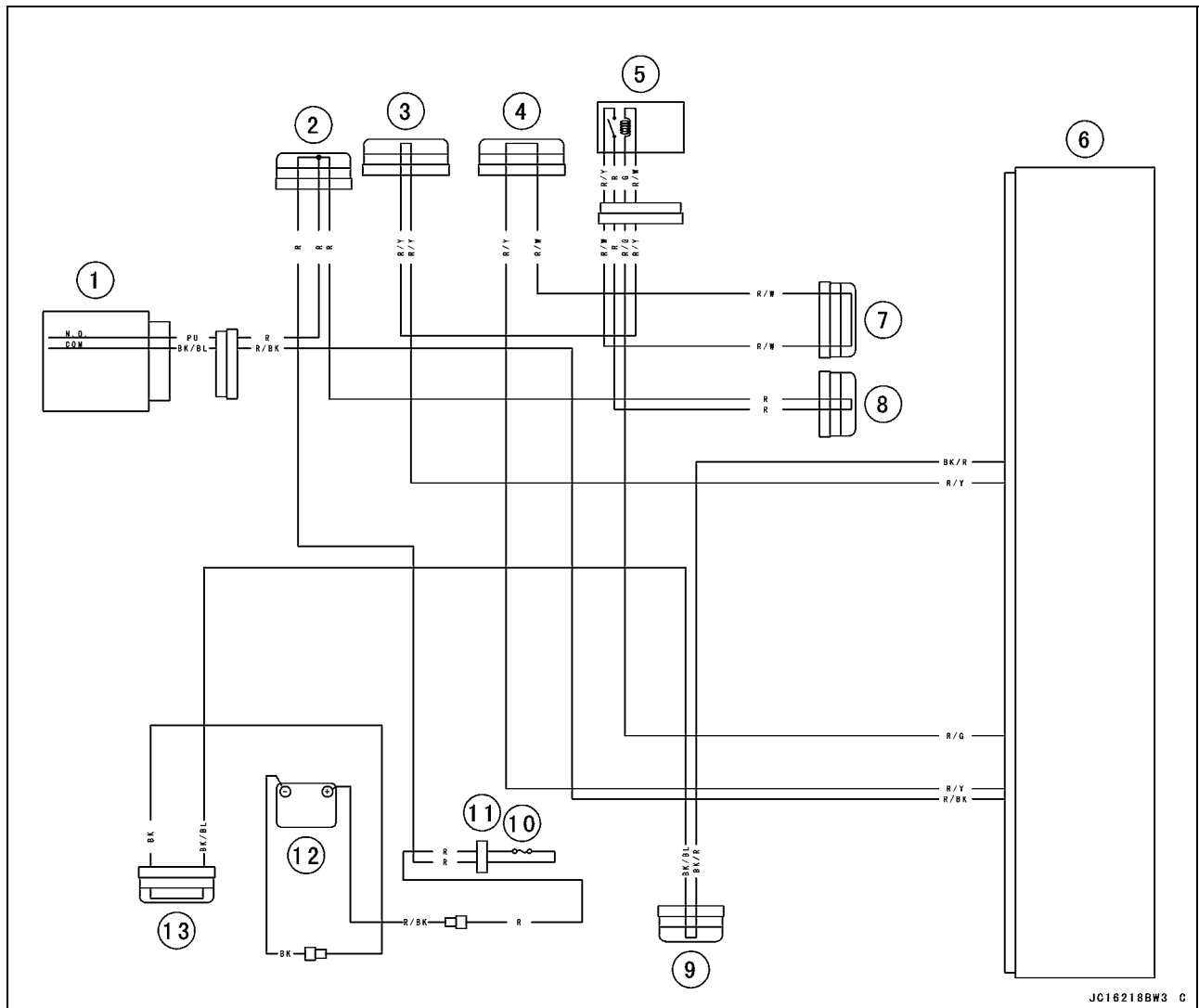


ECU Main Relay Inspection

- Refer to the Relay Assembly Inspection in the Electrical System chapter.
 - ★ If the ECU main relay is normal, check the wiring for continuity (see wiring diagram in this section).
- Special Tool - Hand Tester: 57001-1394**
- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
 - ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

ECU Main Relay (Service Code/Character - 75/rEL)

ECU Main Relay Circuit



JC16218BW3 C

1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. ECU
7. Joint Connector D (12 V)

8. Joint Connector C (12 V)
9. Joint Connector E (Ground)
10. Main Fuse 20 A
11. Fuse Box 1
12. Battery
13. Joint Connector S (Ground)

3-90 FUEL SYSTEM (DFI)

Engine Oil Overheating (Service Code/Character - 76/OILH)

- If the service code character "OILH" is displayed, check the doubtful parts referring to the following table.

Possible Causes	Actions
Incorrect engine oil level	Inspect (see chapter 4).
Engine oil poor quality or incorrect	Change (see chapter 4).
Oil temperature sensor broken	Inspect (see chapters 3 and 14).
Oil cooler clogged	Clean (see chapter 4).
Oil pump malfunction	Inspect (see chapter 4).
Relief valve malfunction	Inspect (see chapter 4).
Water passage clogged, loosened or damaged	Inspect (see chapter 9).
Weeds or debris in jet pump	Inspect (see chapter 11).

Electric Trim Control Sensor (Service Code/Character - 77/PoSI)

Electric Trim Control Sensor Removal/Installation

CAUTION

Do not remove the electric trim control sensor since it has been adjusted and set with precision at the factory.

Never drop the electric trim control actuator especially on a hard surface. Such a shock to the electric trim control sensor can damage it.

Electric Trim Control Sensor Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to ON.
- Push the electric trim control button.
- Check to see that the steering nozzle [A] moves to the full up and the full down positions smoothly.

○The electric trim control actuator stops automatically when the steering nozzle gets to the horizontality [A].

- Turn the ignition switch to OFF.
- ★ If the steering nozzle operates properly, check the following.

Wiring (see wiring diagram in this section)

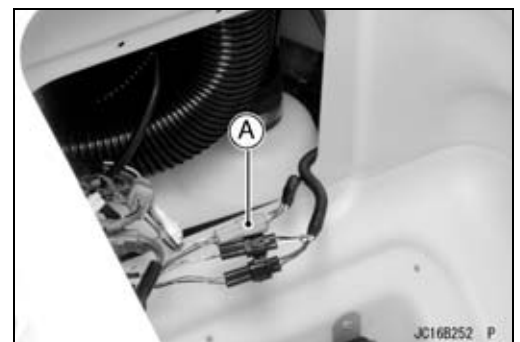
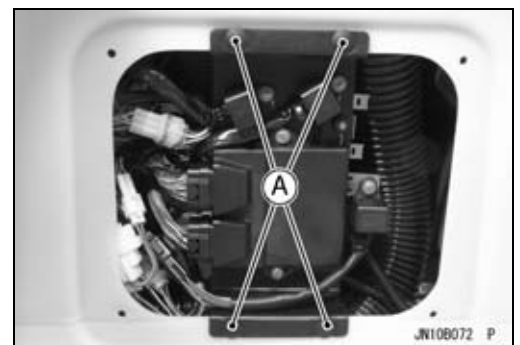
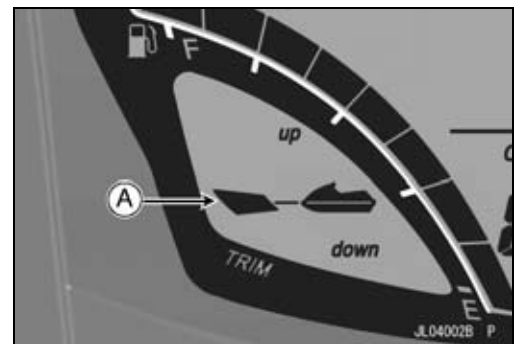
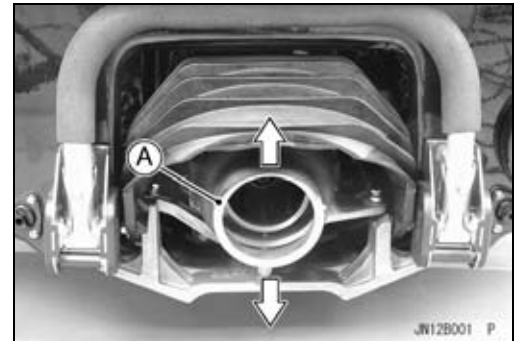
ECU (see ECU Power Supply Inspection)

- ★ If the steering nozzle does not operate, check the resistance (see Electric Trim Control Sensor Resistance Inspection).

Electric Trim Control Sensor Resistance Inspection

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Remove the rivets [A].

- Disconnect the electric trim control actuator lead connector (green, 4-pin) [A].



3-92 FUEL SYSTEM (DFI)

Electric Trim Control Sensor (Service Code/Character - 77/PoSI)

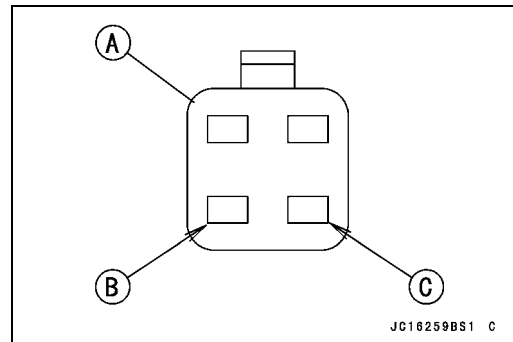
- Connect a digital meter to the electric trim control actuator lead connector [A].
- Measure the electric trim control sensor resistance.

Electric Trim Control Sensor Resistance

Connections: W/R lead [B] $\longleftrightarrow$ BL/R lead [C]

Standard: 479 ~ 718 Ω

- ★ If the reading is out of the standard, replace the electric trim control actuator.
- ★ If the reading is within the standard, check the output voltage (see Electric Trim Control Sensor Output Voltage Inspection).

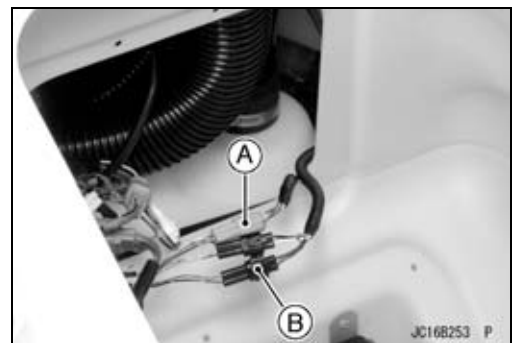


Electric Trim Control Sensor Output Voltage Inspection

- Disconnect the electric trim control actuator lead connectors.

Green, 4-pin [A]

Black, 2-pin [B]

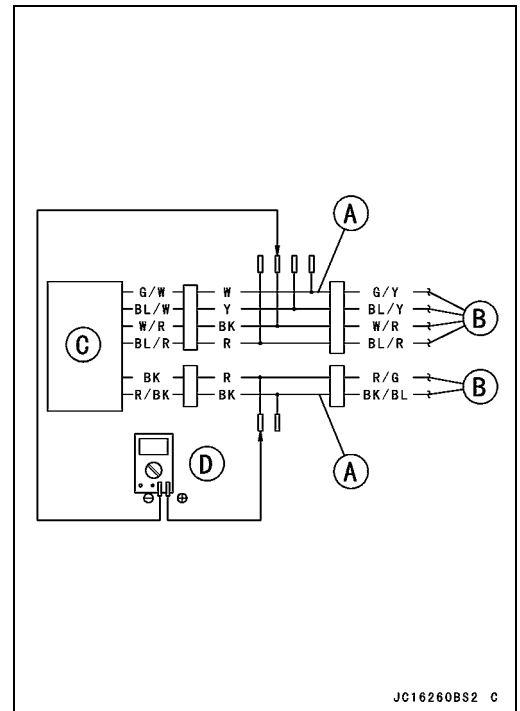
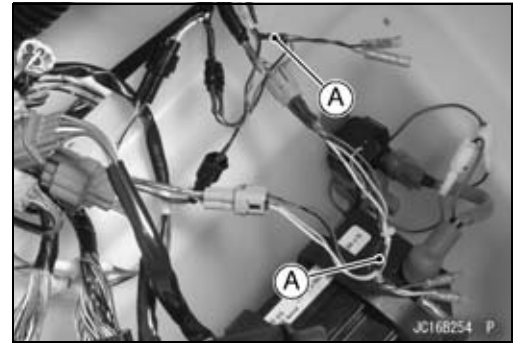


Electric Trim Control Sensor (Service Code/Character - 77/PoSI)

- Connect the measuring adapters [A] between these connectors as shown in the figure.
Main Harness [B]
Electric Trim Control Actuator [C]

Special Tool - Measuring Adapter: 57001-1700

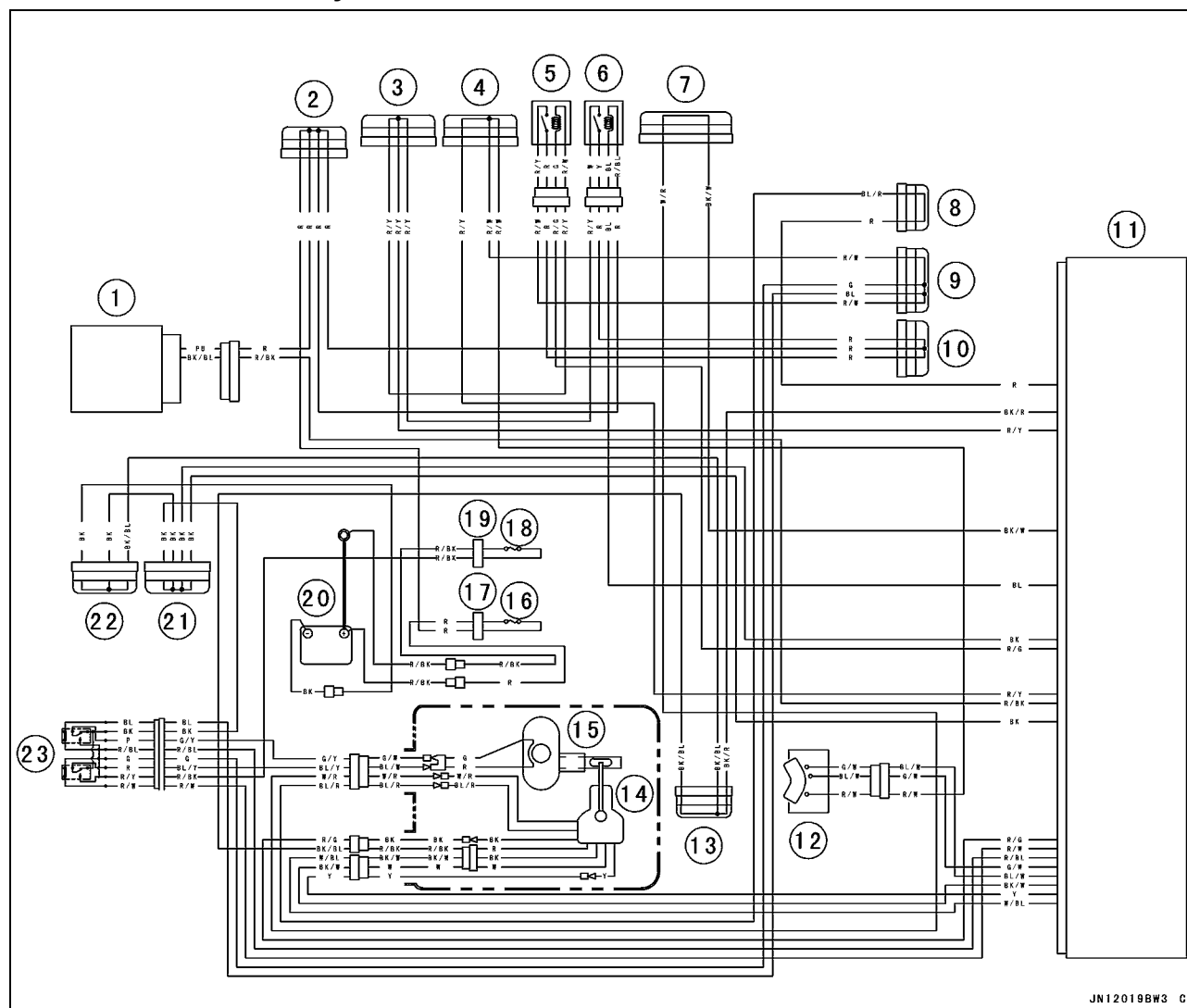
- Connect a digital meter [D] to the measuring adapter leads.
- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.
- Check that the output voltage is variable when the electric trim control button is pushed in.
- When the UP button is pushed in, the output voltage increases.
- When the DOWN button is pushed in, the output voltage decreases.
- Turn the ignition switch to OFF.
- ★ If the reading is not variable, replace the electric trim control actuator.
- ★ If the reading is variable, check the following.
Wiring (see wiring diagram in this section)
ECU (see ECU Power Supply Inspection)



3-94 FUEL SYSTEM (DFI)

Electric Trim Control Sensor (Service Code/Character - 77/PoSI)

Electric Trim Control System Circuit



JN12019BW3 C

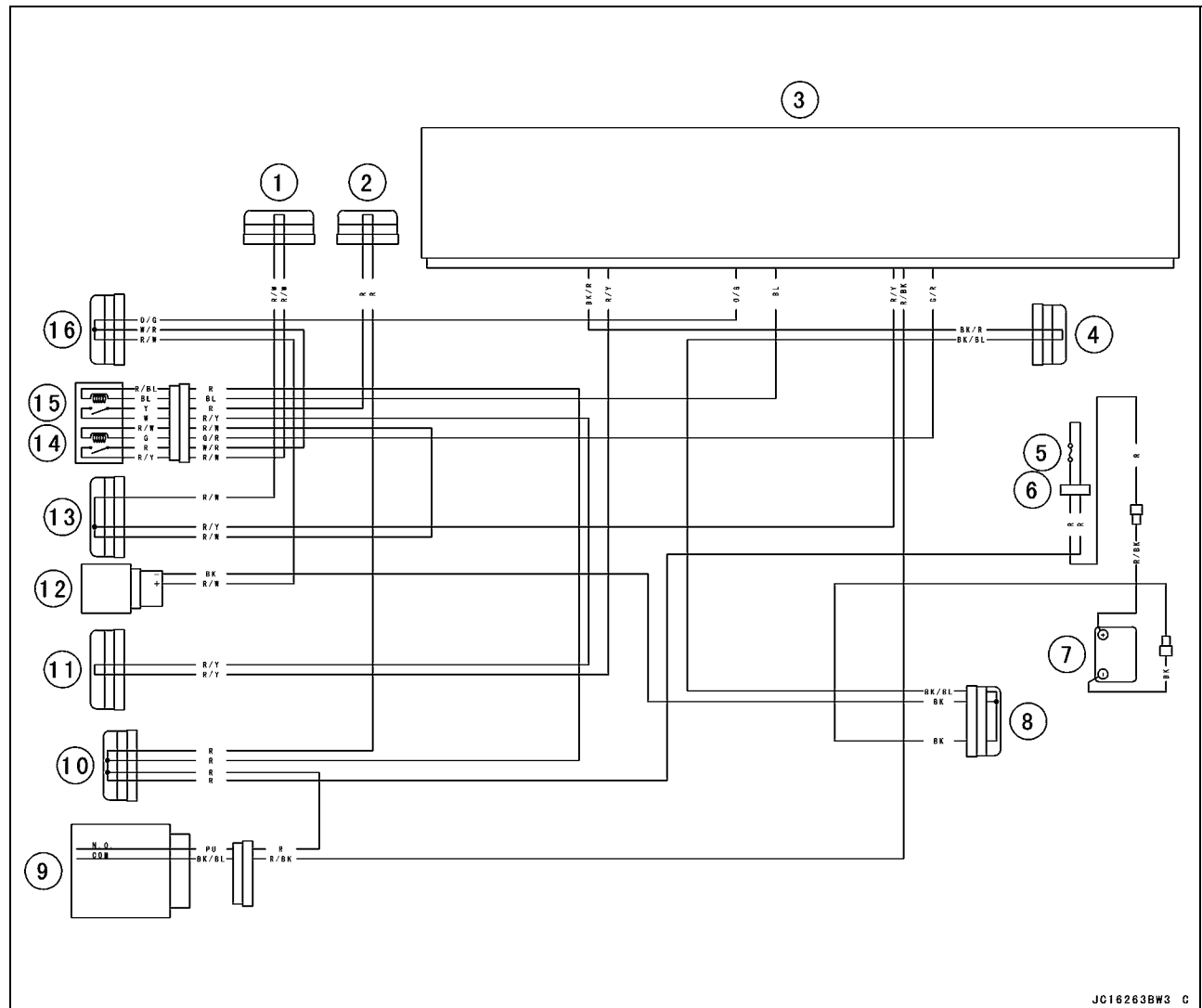
1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector B (Ground)
8. Joint Connector F (5 V)
9. Joint Connector D (12 V)
10. Joint Connector C (12 V)
11. ECU
12. Electric Trim Control Button
13. Joint Connector E (Ground)
14. Electric Trim Control Sensor
15. Electric Trim Control Motor
16. Main Fuse 20 A
17. Fuse Box 1
18. Electric Trim Control Relay Fuse 20 A
19. Fuse Box 2
20. Battery
21. Joint Connector Y (Ground)
22. Joint Connector S (Ground)
23. Electric Trim Control Relay

Battery Voltage (Service Code/Character - 97/bAt2)

Battery Voltage Inspection

- Refer to the Charging Condition Inspection in the Electrical System chapter for battery voltage inspection.
- ★ If the battery voltage is good condition, replace the ECU (see ECU Removal/Installation).

Battery Monitor Circuit



1. Joint Connector D (12 V)
2. Joint Connector C (12 V)
3. ECU
4. Joint Connector E (Ground)
5. Main Fuse 20 A
6. Fuse Box 1
7. Battery
8. Joint Connector S (Ground)

9. Ignition Switch
10. Joint Connector P (12 V)
11. Joint Connector R (12 V)
12. Fuel Pump
13. Joint Connector T (12 V)
14. Fuel Pump Relay
15. System Relay
16. Joint Connector L (12 V)

JC16263BW3 C

3-96 FUEL SYSTEM (DFI)

ETV Control Circuit (Service Code/Character - 98/Cont)

ETV Control Circuit Inspection

- The ETV control circuit is controlled in the ECU [A].
So, the ETV control circuit cannot be inspected.
- When the service code character “Cont” is displayed on the LCD, replace the ECU (see ECU Removal/Installation).

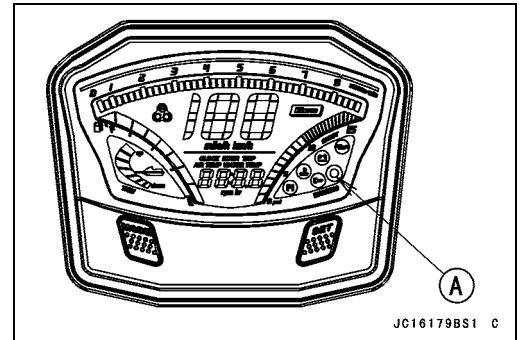


Warning Indicator Light (LED)

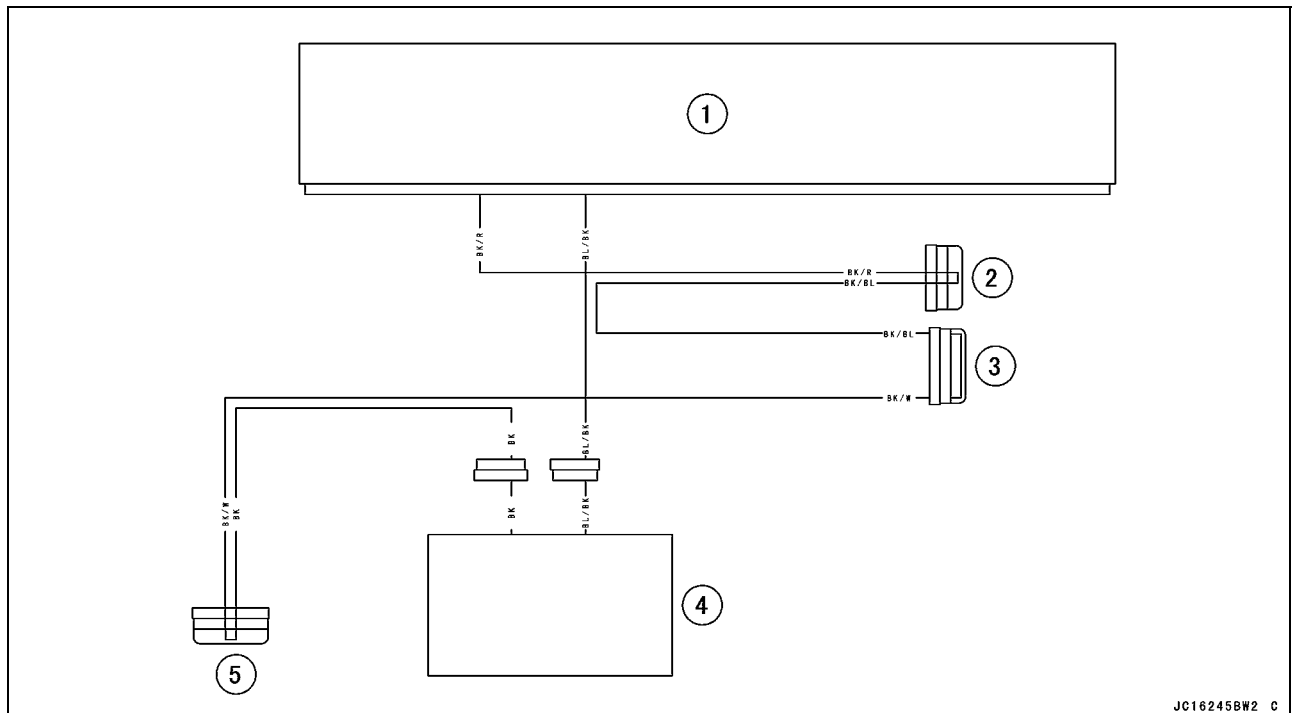
Light (LED) Inspection

The warning indicator light (LED) [A] is used for the following warnings.

- Fuel Level
- Low Battery Voltage
- Engine Cooling Water Temperature
- Engine Oil Pressure
- Oil Temperature Sensor
- Engine Oil Overheat
- FI
- Immobilizer



Warning Indicator Light (LED) (FI/Immobilizer) Circuit



1. ECU
2. Joint Connector E (Ground)
3. Joint Connector S (Ground)
4. Meter Unit
5. Joint Connector Q (Ground)

3-98 FUEL SYSTEM (DFI)

Fuel Injectors

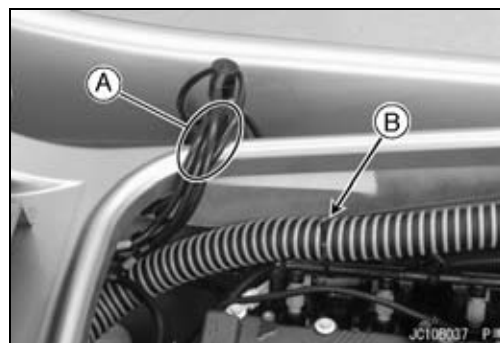
Fuel Injector Removal

WARNING

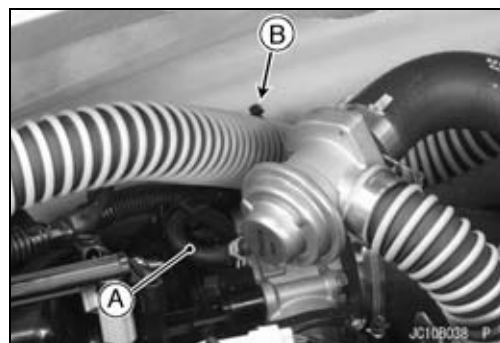
Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Disconnect the battery (-) cable terminal. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

Be prepared for fuel spillage: any spilled fuel must be completely wiped up immediately.

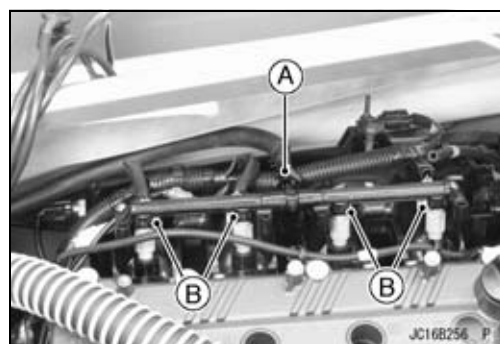
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the spark plug leads and place them [A] out of the engine compartment.
- Cut the band [B].



- Remove the hose [A].
- Cut the band [B].



- Disconnect:
 - Fuel Hose [A] (see Fuel Hose Removal)
 - Fuel Injector Connectors [B]

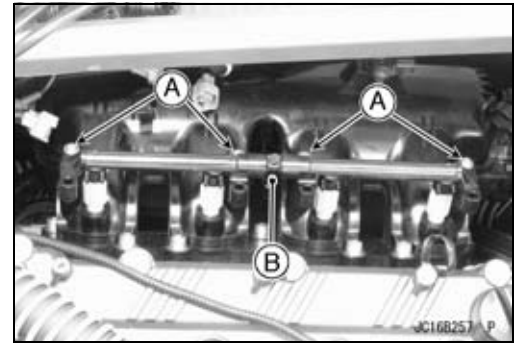


Fuel Injectors

- Remove the screws [A] to pull out the fuel injectors from the intake manifold together with the delivery pipe assy [B].

NOTE

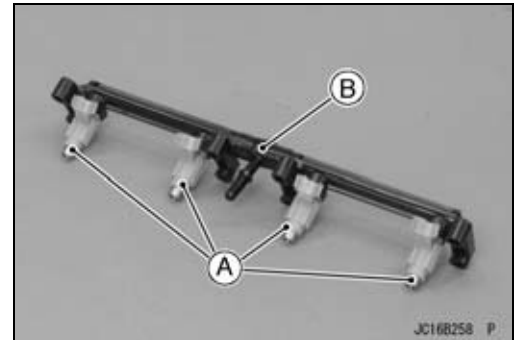
○Do not damage the insertion portions of the injectors when they are pulled out from the intake manifold.



- Pull out the fuel injectors [A] from the delivery pipe assy [B].

NOTE

○Do not damage the insertion portions of the injectors when they are pulled out from the delivery pipe assy.

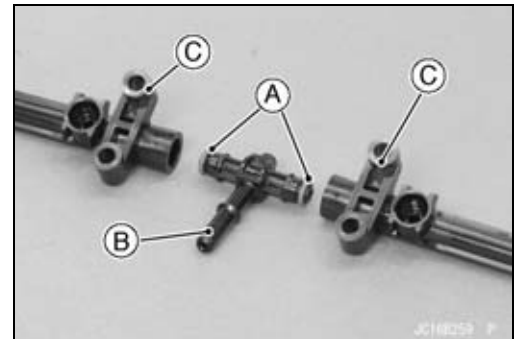


CAUTION

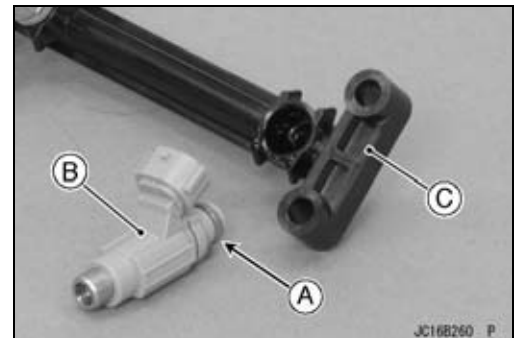
Never drop the fuel injector especially on a hard surface. Such a shock to the injector can damage it.

Fuel Injector Installation

- Before installation, blow away dirt or dust from the intake manifold and delivery pipe assy by applying compressed air.
- Replace the O-rings [A] of the joint pipe [B] with new ones.
- Insert the new O-rings to the delivery pipes [C].
- Left and right delivery pipes are identical.



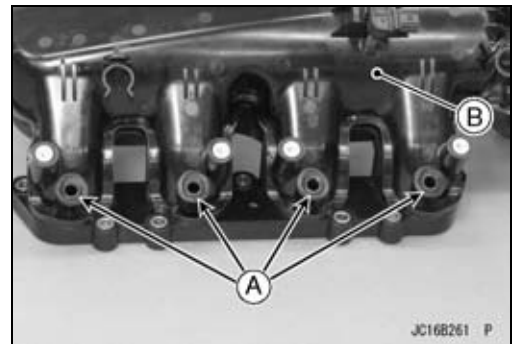
- Replace the O-rings [A] of each fuel injector [B] with new ones.
- Insert each fuel injectors to the delivery pipe assy [C] and confirm whether the injectors turn smoothly or not.



3-100 FUEL SYSTEM (DFI)

Fuel Injectors

- Replace the dust seals [A] with new ones.
- Insert the new dust seals to the intake manifold [B].
- In this photo, the intake manifold has been removed.



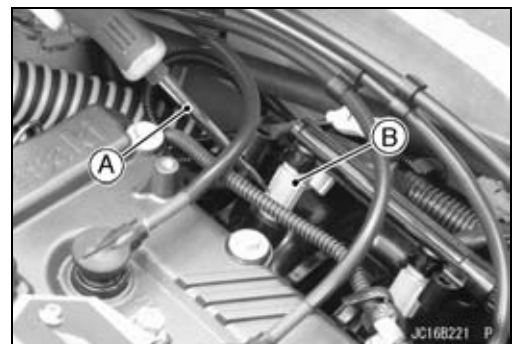
- Install the fuel injectors along with the delivery pipe assy to the intake manifold.
- Tighten:
Torque - Delivery Pipe Assy Mounting Screws: 3.5 N·m (0.36 kgf·m, 31 in·lb)
- Run the ducts, hoses, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the removed parts (see appropriate chapters).

Fuel Injector Audible Inspection

NOTE

○ Be sure the battery is fully charged.

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Start the engine.
- Apply the tip of a screwdriver [A] to the fuel injector [B]. Put the grip end onto your ear, and listen whether the fuel injector is clicking or not.
- A sound scope can also be used.
- The click interval becomes shorter as the engine speed rises.
- Do the same for the other fuel injectors.
- ★ If all the fuel injectors click at a regular intervals, the fuel injectors are normal.
- Turn the ignition switch to OFF.
- ★ If any fuel injector does not click, check the fuel injector resistance (see Fuel Injector Resistance Inspection).



Fuel Injector Resistance Inspection

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the fuel injector connector [A].



Fuel Injectors

- Connect a digital meter to the terminals in each fuel injector [A].
- Measure the fuel injector resistance.

Fuel Injector Resistance

Standard: **About 11.7 ~ 12.3 Ω at 20°C (68°F)**

- ★ If the reading is out of the standard, replace the fuel injector.
- ★ If the reading is within the standard, check the power source voltage (see Fuel Injector Power Source Voltage Inspection).



3-102 FUEL SYSTEM (DFI)

Fuel Injectors

Fuel Injector Power Source Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the injector connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]
Fuel Injector #1 [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter lead.

Fuel Injector Power Source Voltage

Connections to Adapter:

For Fuel Injector #1, #2, #3, #4

Digital Meter (+) → R (injector R/W) lead

Digital Meter (-) → Battery (-) terminal

- Measure the power source voltage with the engine stopped.
- Turn the ignition switch to ON.

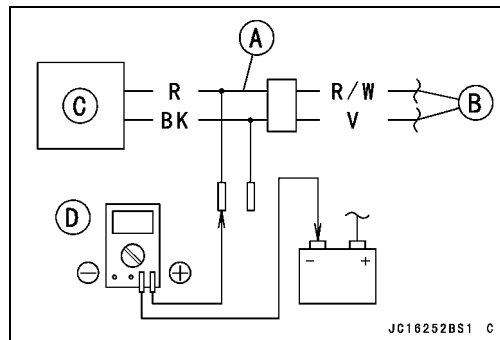
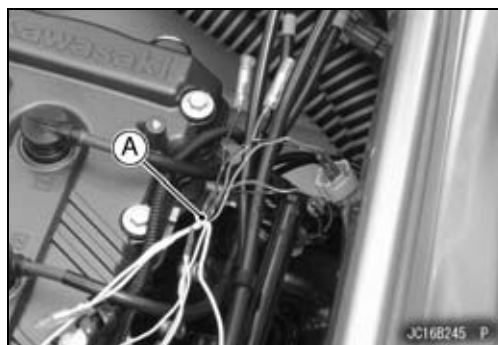
Power Source Voltage

Standard: Battery Voltage for 3 seconds, and then 0 V

- Turn the ignition switch to OFF.
- ★ If the reading stays on battery voltage and never shows 0 V, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).
- ★ If the fuel pump relay is normal, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If there is still no battery voltage, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).
- ★ If the fuel pump relay is normal, check the power source wiring (see wiring diagram in this section).

Special Tool - Hand Tester: 57001-1394

- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is in specification, check the output voltage (see Fuel Injector Output Voltage Inspection).



Fuel Injectors

Fuel Injector Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the ECU (see ECU Removal).
- Do not disconnect the ECU connector.
- Connect a digital meter [A] to the connector [B] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

Fuel Injector Output Voltage

Connections to ECU Connector:

For Fuel Injector #1

Digital Meter (+) → V lead (ECU terminal 29)

Digital Meter (-) → Battery (-) terminal

For Fuel Injector #2

Digital Meter (+) → O lead (ECU terminal 27)

Digital Meter (-) → Battery (-) terminal

For Fuel Injector #3

Digital Meter (+) → BR lead (ECU terminal 30)

Digital Meter (-) → Battery (-) terminal

For Fuel Injector #4

Digital Meter (+) → BL/Y lead (ECU terminal 28)

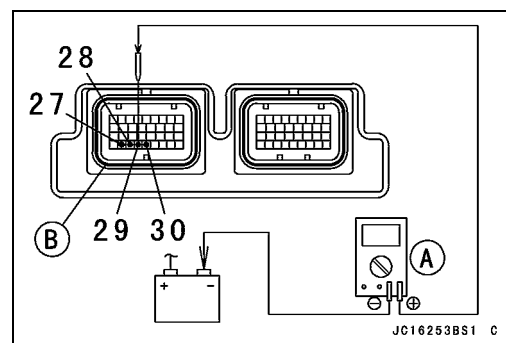
Digital Meter (-) → Battery (-) terminal

- Measure the output voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

Output Voltage

Standard: Battery Voltage for 3 seconds, and then 0 V

- Turn the ignition switch to OFF.
- ★ If the reading is in specification, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



3-104 FUEL SYSTEM (DFI)

Fuel Injectors

★If the reading is out of the specification, remove the ECU and check the wiring for continuity between main harness connectors.

Special Tool - Hand Tester: 57001-1394

○Disconnect the ECU and injector connectors.

Wiring Continuity Inspection

ECU Connector [A] ↔ Fuel Injector Connector [B]

For Fuel Injector #1

V lead (ECU terminal 29) [C]

For Fuel Injector #2

O lead (ECU terminal 27)

For Fuel Injector #3

BR lead (ECU terminal 30)

For Fuel Injector #4

BL/Y lead (ECU terminal 28)

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

Fuel Injector Fuel Line Inspection

● Remove:

Seats (see Seat Removal in the Hull/Engine Hood chapter)

Fuel Hose (see Fuel Hose Removal)

● Check the injector fuel line for leakage as follows.

○Connect a commercially available vacuum/pressure pump [A] to the nipple of the delivery pipe [B] with the fuel hose [C] (supply end with the clamps [D]) as shown in the figure.

○Apply soap and water solution to the areas [E] as shown in the figure.

○Watching the pressure gauge, squeeze the pump lever, and build up the pressure until the pressure reaches the maximum pressure.

Injector Fuel Line Maximum Pressure

Standard: 300 kPa (3.06 kgf/cm², 43 psi)

CAUTION

During pressure testing, do not exceed the maximum pressure for which the system is designed.

○Watch the gauge for at least 6 seconds.

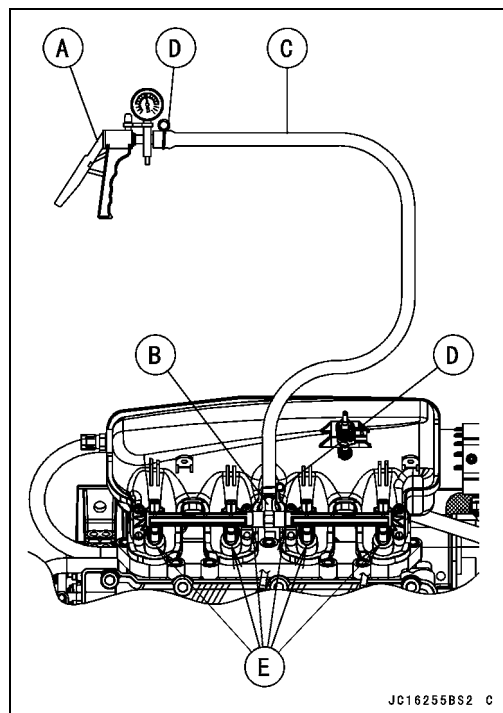
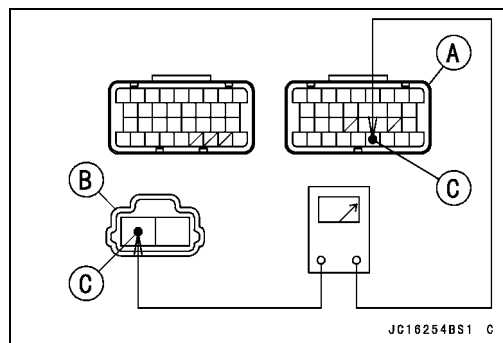
★If the pressure holds steady, the fuel line is good.

★If the pressure drops at once or if bubbles are found in the area, the fuel line is leaking. Replace the delivery pipe assy, injectors and related parts.

○Repeat the leak test, and check the fuel line for no leakage.

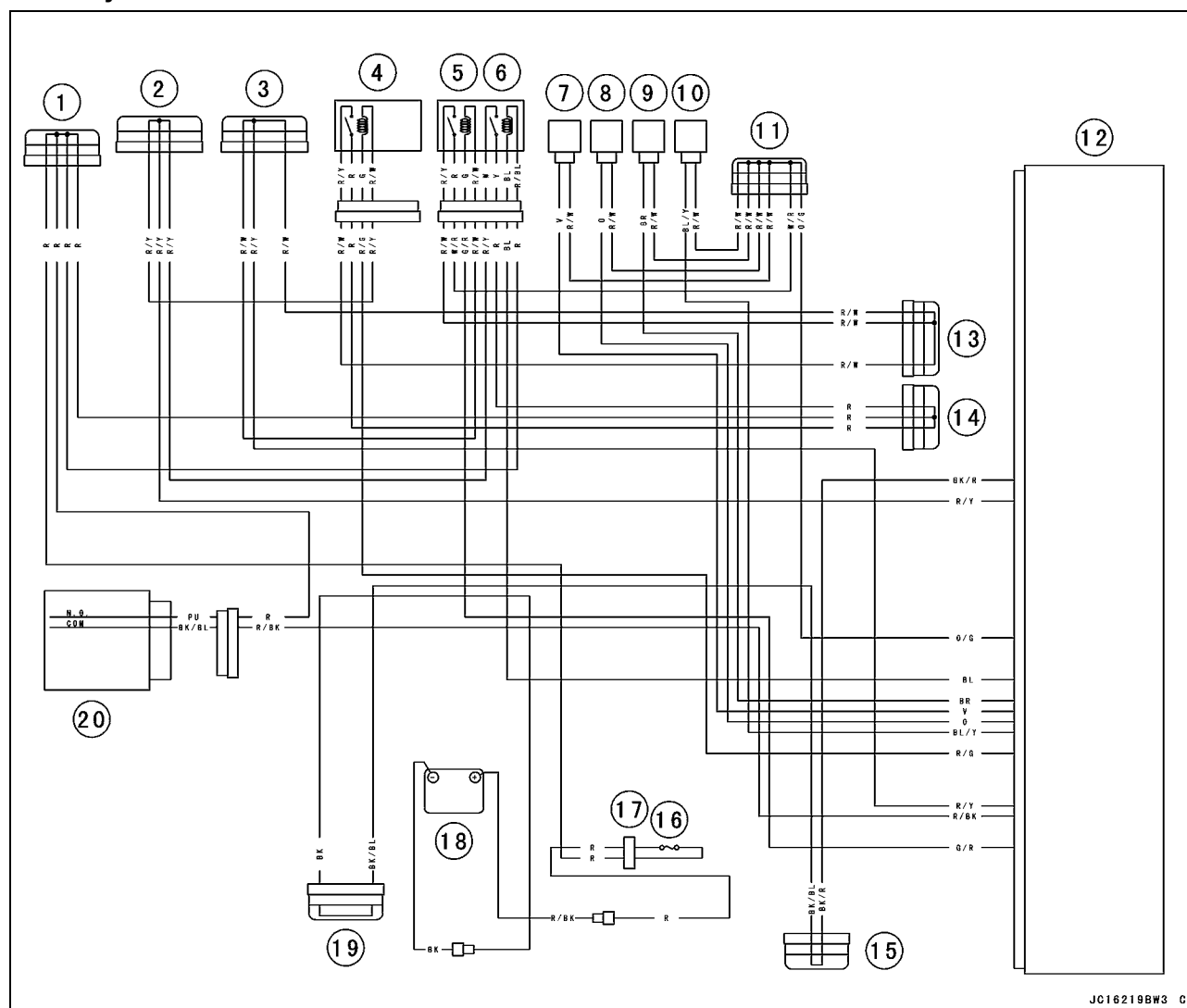
● Install the fuel hose (see Fuel Hose Installation).

● Start the engine and check for fuel leakage.



Fuel Injectors

Fuel Injector Circuit



1. Joint Connector P (12 V)
2. Joint Connector R (12 V)
3. Joint Connector T (12 V)
4. ECU Main Relay
5. Fuel Pump Relay
6. System Relay
7. Fuel Injector #1
8. Fuel Injector #2
9. Fuel Injector #3
10. Fuel Injector #4
11. Joint Connector L (12 V)
12. ECU
13. Joint Connector D (12 V)
14. Joint Connector C (12 V)
15. Joint Connector E (Ground)
16. Main Fuse 20 A
17. Fuse Box 1
18. Battery
19. Joint Connector S (Ground)
20. Ignition Switch

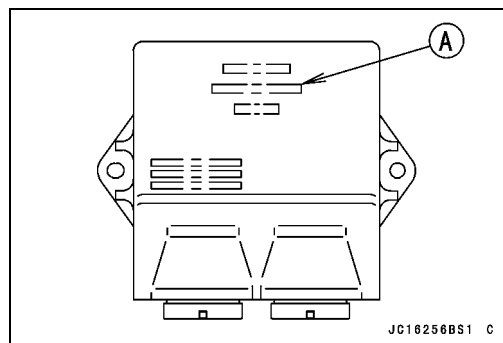
3-106 FUEL SYSTEM (DFI)

ECU

ECU Identification

○Most countries have their own regulations, so each ECU has different characteristics. So, do not confuse ECU with each other and use only the ECU for your model. Otherwise, the watercraft cannot clear the regulation.

Model	Part Number [A]	Specification
JT1500HBF/JBF	21175-3744	US
		CA
		AU
	21175-0711	EUR

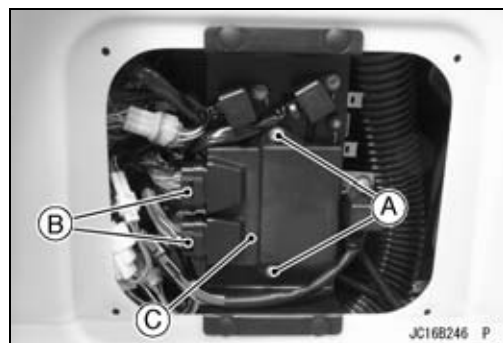


ECU Removal

CAUTION

Never drop the ECU especially on a hard surface. Such a shock to the ECU can damage it.

- Remove:
 - Front Access Cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter)
 - Mounting Bolts [A]
 - ECU Connectors [B]
 - ECU [C]



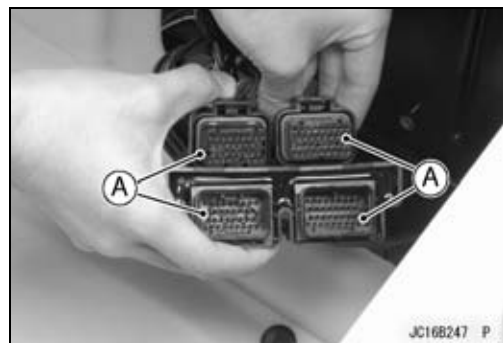
ECU Installation

- Connect the ECU connectors and install it.
- Apply a non-permanent locking agent to the threads of the ECU mounting bolts, and tighten them.

Torque - ECU Mounting Bolts: 3.0 N·m (0.31 kgf·m, 27 in·lb)

ECU Power Supply Inspection

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Visually inspect the ECU connectors.
- ★ If the connector is clogged with mud or dust, blow it off with compressed air.
- Remove the ECU (see ECU Removal).
- Visually inspect the terminals [A] of the ECU connectors.
- ★ If the terminals of the main harness connectors are damaged, replace the main harness.
- ★ If the terminals of the ECU connectors are damaged, replace the ECU.



ECU

- Turn the ignition switch to OFF.
- Disconnect the ECU connector [A].
- Set the hand tester [B] to the $\times 1 \Omega$ range and check the following wiring for continuity.

Special Tool - Hand Tester: 57001-1394

ECU Grounding Inspection

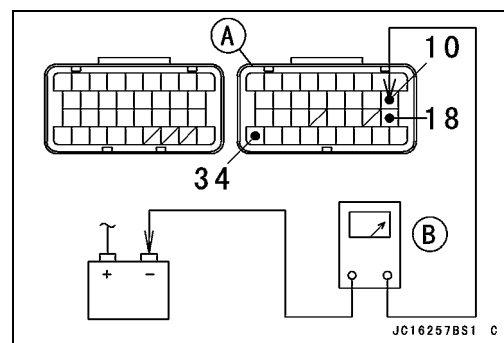
Connections:

- | | | |
|--------------------------------------|---|----------------------|
| (I) BK leads (ECU terminal 10 or 18) | ↔ | Battery (-) Terminal |
| (II) BK/R lead (ECU terminal 34) | ↔ | Battery (-) Terminal |
| (III) Engine Ground | ↔ | Battery (-) Terminal |

Criteria:

Both: 0Ω

- ★ If no continuity, check the connectors, the starter motor (-) cable for engine ground, or main harness, and repair or replace them if necessary.



3-108 FUEL SYSTEM (DFI)

ECU

- ★ If the wiring is good, check the power source voltage of the ECU.

NOTE

○ Be sure the battery is fully charged.

- Connect the ECU connectors.
- Connect a digital meter [A] to the connectors [B] with the needle adapter set.

Special Tool - Needle Adapter Set: 57001-1457

ECU Power Supply Inspection

Connections:

- (I) Digital Meter (+) → Terminal 17 (R/BK)
Digital Meter (–) → Battery (–) terminal
- (II) Digital Meter (+) → Terminal 25 (R/Y)
Digital Meter (–) → Battery (–) terminal
- (III) Digital Meter (+) → Terminal 60 (R/Y)
Digital Meter (–) → Battery (–) terminal

Ignition Switch OFF:

Terminal 17 (R/BK): 0 V

Terminal 25 (R/Y): 0 V

Terminal 60 (R/Y): 0 V

Ignition Switch ON:

Terminal 17 (R/BK): Battery Voltage (while pushing ignition switch)

Terminal 25 (R/Y): Battery Voltage

Terminal 60 (R/Y): Battery Voltage

- ★ If the reading is out of the specification, check the following.

Main Fuse 20 A (see Fuse Inspection in the Electrical System chapter)

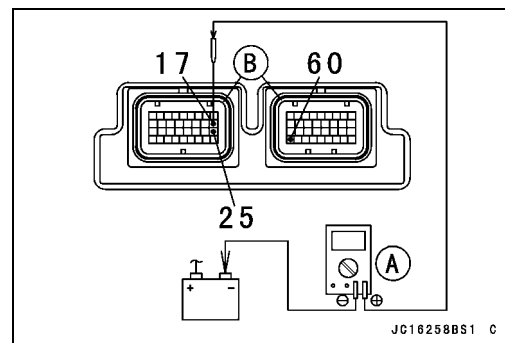
Ignition Switch (see Switch Inspection in the Electrical System chapter)

System Relay (see Relay Assembly Inspection in the Electrical System chapter)

ECU Main Relay (see Relay Assembly Inspection in the Electrical System chapter)

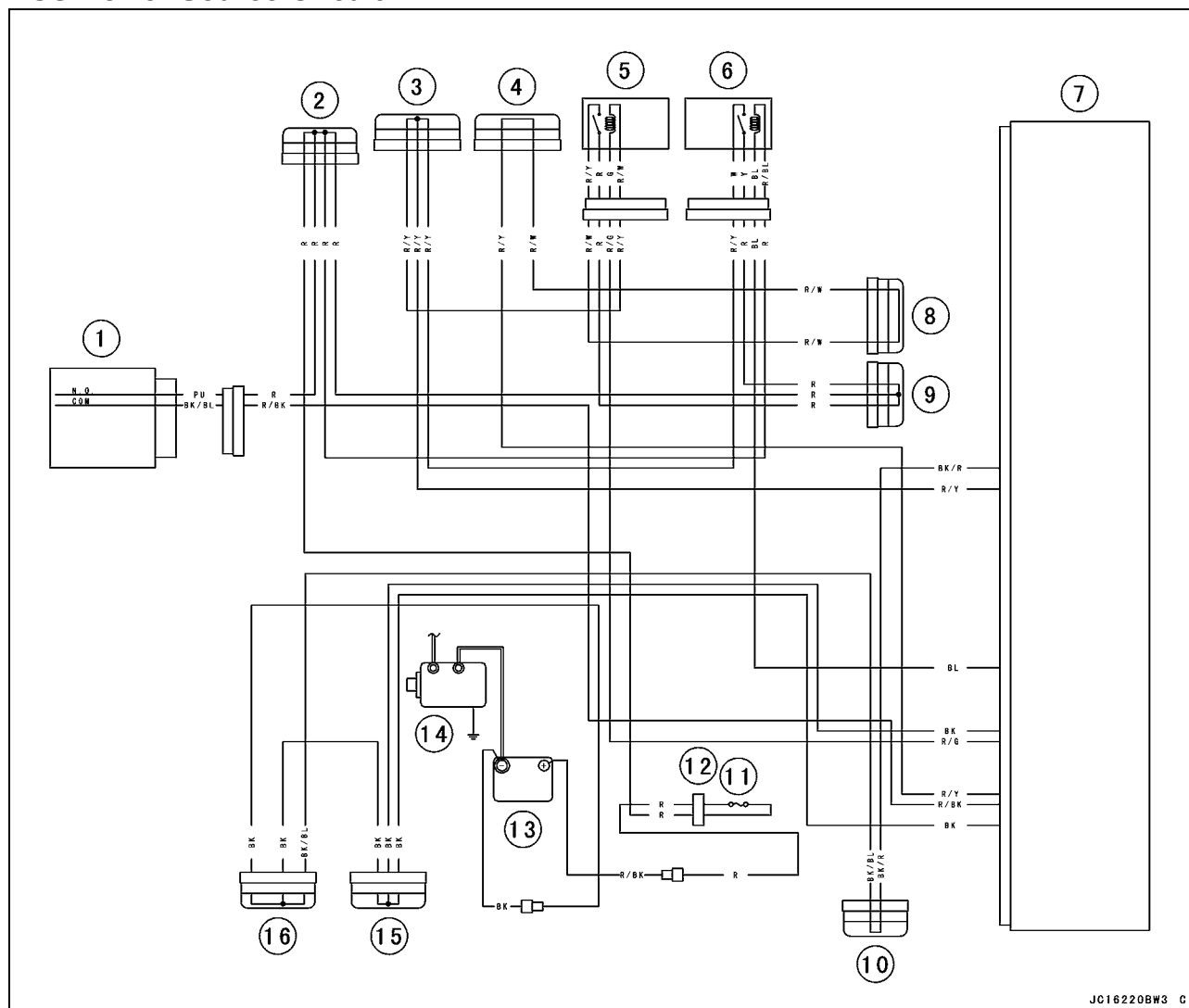
Power Source Wiring (see wiring diagram in this section)

- ★ If the fuse, ignition switch, relay and wiring are good, replace the ECU (see ECU Removal/Installation).



ECU

ECU Power Source Circuit



JC16220BW3 C

- | | |
|-----------------------------|--------------------------------|
| 1. Ignition Switch | 9. Joint Connector C (12 V) |
| 2. Joint Connector P (12 V) | 10. Joint Connector E (Ground) |
| 3. Joint Connector R (12 V) | 11. Main Fuse 20 A |
| 4. Joint Connector T (12 V) | 12. Fuse Box 1 |
| 5. ECU Main Relay | 13. Battery |
| 6. System Relay | 14. Starter Motor |
| 7. ECU | 15. Joint Connector Y (Ground) |
| 8. Joint Connector D (12 V) | 16. Joint Connector S (Ground) |

3-110 FUEL SYSTEM (DFI)

DFI Power Source

Main Fuse Removal

- Refer to the Fuse Inspection in the Electrical System chapter.

Main Fuse Installation

- ★ If a fuse fails during operation, inspect the DFI system to determine the cause, and then replace it with a new fuse of proper amperage.
- Refer to the Fuse Inspection in the Electrical System chapter.

Main Fuse Inspection

- Refer to the Fuse Inspection in the Electrical System chapter.

Throttle Lever, Cable and Case

Free Play Inspection

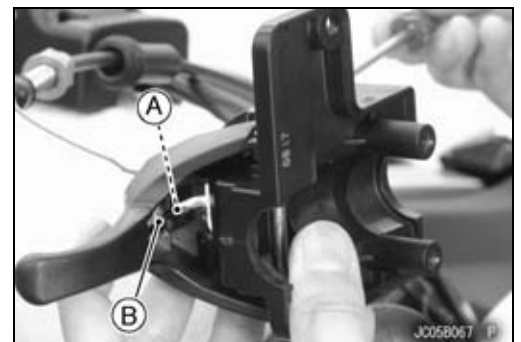
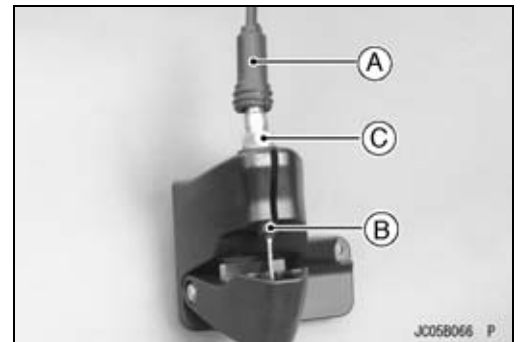
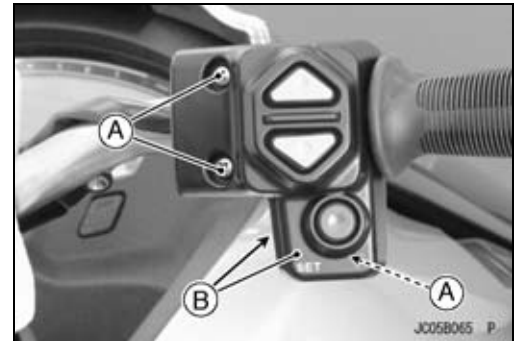
- Refer to the Throttle Control System Inspection in the Periodic Maintenance chapter.

Free Play Adjustment

- Refer to the Throttle Control System Inspection in the Periodic Maintenance chapter.

Throttle Case Removal/Disassembly

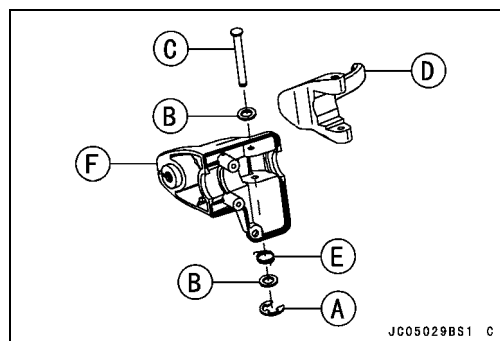
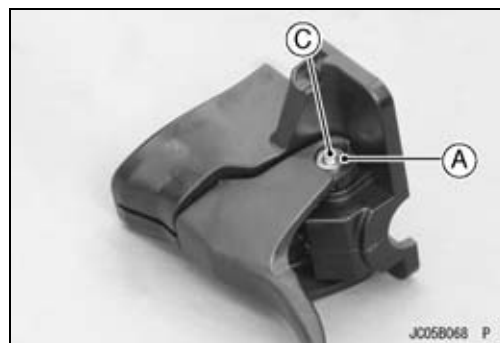
- Remove the handlebar pad (see Handlebar Removal).
- Remove the throttle case.
- Unscrew the throttle case mounting screws [A] separate the case halves [B].
- Remove the throttle cable from the case.
- Slide the rubber boot [A] and rubber cap [B] out of the place.
- Unscrew the throttle cable fitting nut [C].
- Use a screwdriver [A] to separate the tip [B] of the cable end from the case body.



3-112 FUEL SYSTEM (DFI)

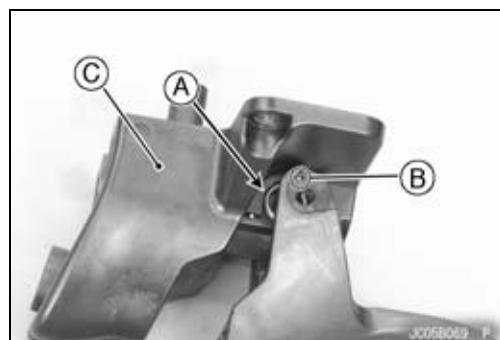
Throttle Lever, Cable and Case

- Disassemble the throttle case.
- Remove the circlip [A], flat washers [B], pin [C], throttle lever [D] and return spring [E] from the case [F].

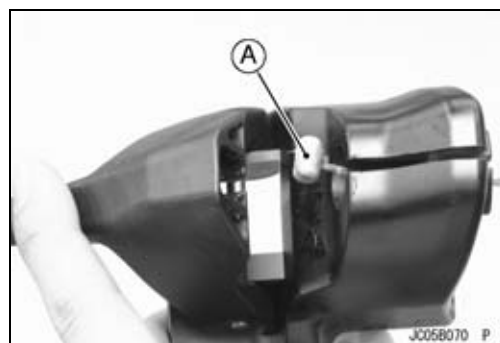


Throttle Case Assembly/Installation

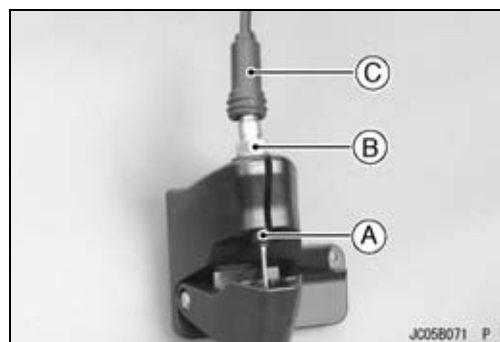
- Insert the end of the return spring [A] in the throttle lever hole [B] and set the spring in the throttle case [C] as shown in the figure.
- Install the throttle lever to the case.



- Lubricate the throttle cable before assembly/installation.
- Apply water-resistance grease to the tips of the throttle cable end.
- Pulling the throttle cable, set the tip [A] of the cable end.
- Tighten the cable fitting nut.



- Be sure the rubber cap [A] is in place on the throttle cable fitting nut end.
- Cover the cable fitting nut [B] with the rubber boot [C].



Throttle Lever, Cable and Case

- Tighten:
Torque - Throttle Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)
- Swing the throttle lever so that the throttle cable pulley is fully open.

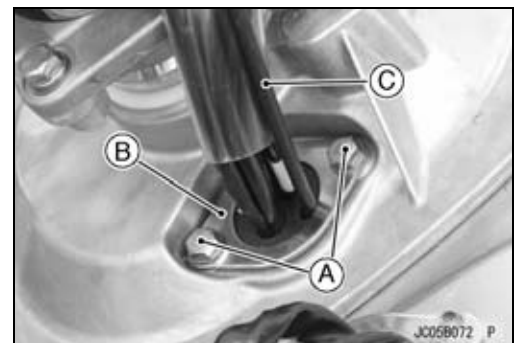
WARNING

Operation with an improperly assembled throttle case could result in an unsafe riding condition.

- Adjust the throttle cable (see Throttle Control System Inspection in the Periodic Maintenance chapter).

Throttle Cable Removal

- Remove:
Throttle Cable Upper End (see Throttle Case Removal/Disassembly)
Throttle Cable Lower End (see Accelerator Position Sensor Assembly Removal)
Steering Cover (see Steering Removal in the Steering chapter)
- Remove:
Grommet Mounting Plate Bolts [A]
Grommet Mounting Plate [B]
- Pull up the grommet, and take the throttle cable [C] off the grommet.
- Pull down the throttle cable.



Throttle Cable Installation

- Apply water-resistance grease to the throttle cable ends.
- Install the throttle cable in accordance with the Cable, Wire, and Hose Routing section in the Appendix chapter.
- Install the throttle cable lower end (see Accelerator Position Sensor Assembly Installation).
- Install the throttle cable upper end (see Throttle Case Assembly/Installation).
- Install the removed parts (see appropriate chapters).
- After installation, adjust the cable properly (see Throttle Control System Inspection in the Periodic Maintenance chapter).

Throttle Cable Lubrication

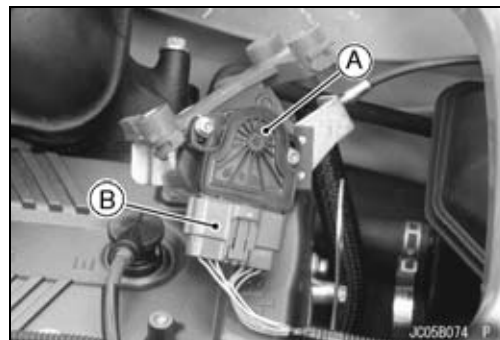
- Refer to the Lubrication in the Periodic Maintenance chapter.

3-114 FUEL SYSTEM (DFI)

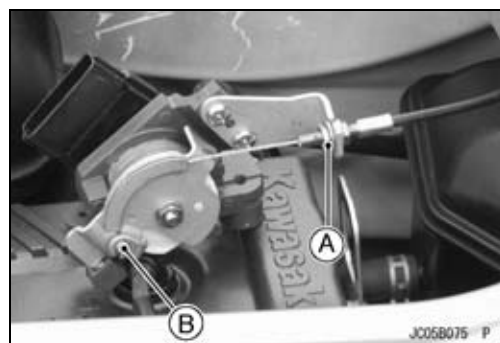
Throttle Lever, Cable and Case

Accelerator Position Sensor Assembly Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Bolts [A] and Washers
- Pull the accelerator position sensor assembly [A] slightly.
- Disconnect the connector [B].



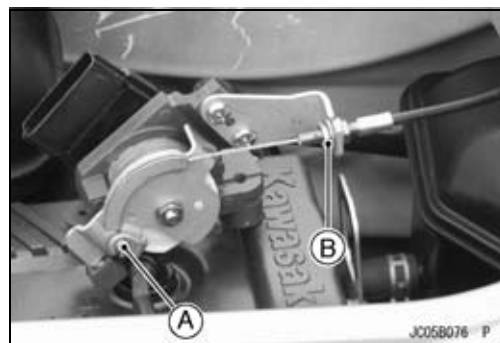
- Remove:
 - Throttle Cable Locknut [A]
 - Throttle Cable Lower End [B]



Accelerator Position Sensor Assembly Installation

- Apply water-resistance grease to the throttle cable lower end [A].
- Fit the cable lower end into the pulley assembly.
- Tighten:

Torque - Throttle Cable Locknut [B]: 19.6 N·m (2.0 kgf·m, 14 ft·lb)



- Connect the connector.
- Set the accelerator position sensor assembly on the original position.
- Apply a non-permanent locking agent to the threads of the pulley assembly bolts [A], and tighten them.

Torque - Accelerator Position Sensor Assembly Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

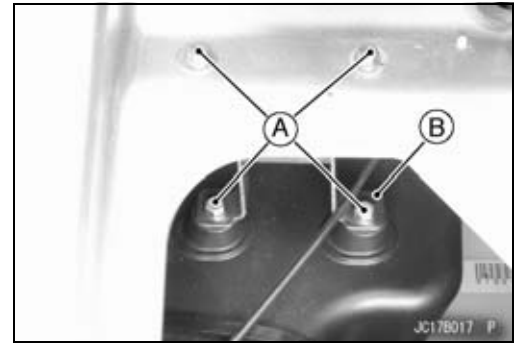
- After installation, adjust the cable properly (see Throttle Control System Inspection in the Periodic Maintenance chapter).



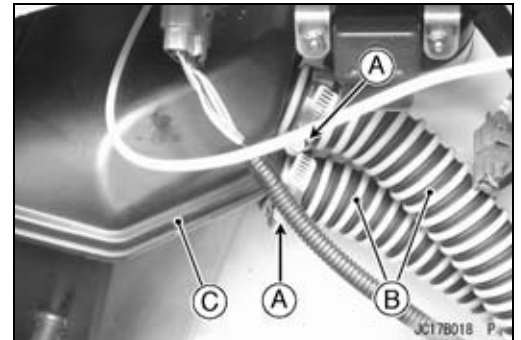
Air Box

Air Box Removal

- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Fuel Pump (see Fuel Pump Removal)
 - Bolts [A]
 - Bracket [B]



- Remove:
 - Clamp Screws [A] (Loosen)
 - Ducts [B]
 - Air Box [C]



Air Box Installation

- Installation is the reverse of removal, note the following.
 - Run the ducts, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
 - Apply a non-permanent locking agent to the threads of the bracket bolts and air box bolts, and tighten them.

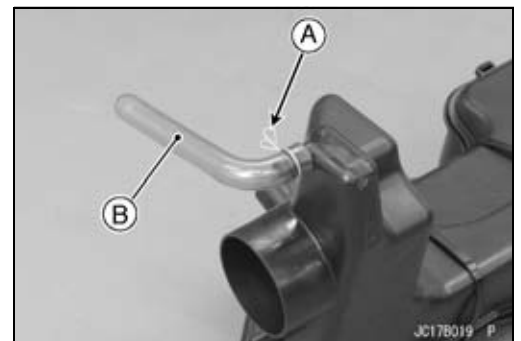
Torque - Air Box Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

Air Box Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

Air Bypass System Clamp Screws: 4.9 N·m (0.50 kgf·m, 43 in·lb)

Air Box Disassembly

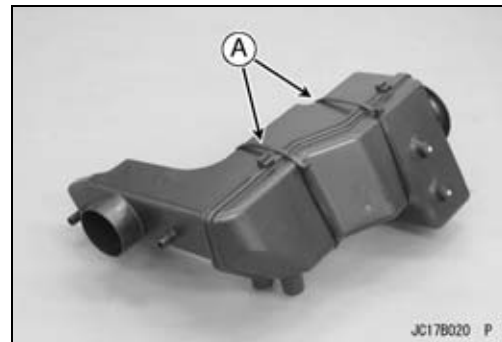
- Remove:
 - Air Box (see Air Box Removal)
 - Clamp [A]
 - Drain Cap [B]



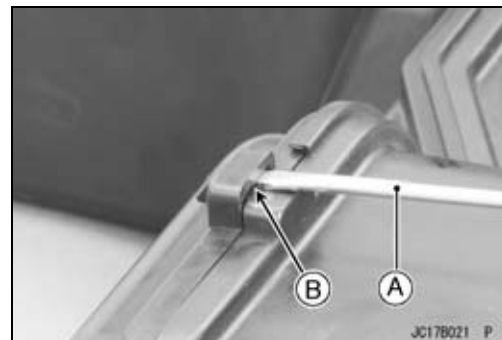
3-116 FUEL SYSTEM (DFI)

Air Box

- Cut the bands [A].

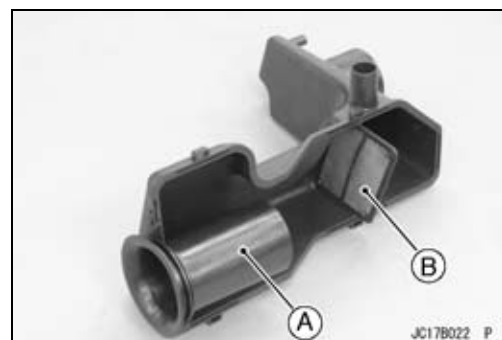


- Insert a thin blade screwdriver [A] into the slot [B].
- Unlock the hooks, and separate the air box.
- Remove the duct and air filter.

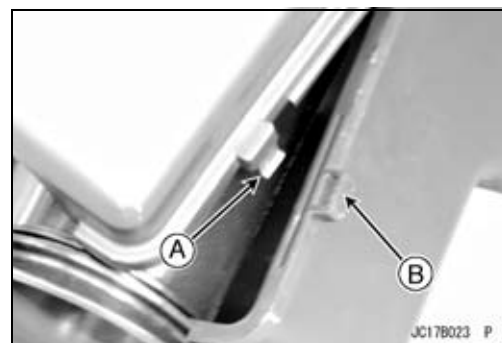


Air Box Assembly

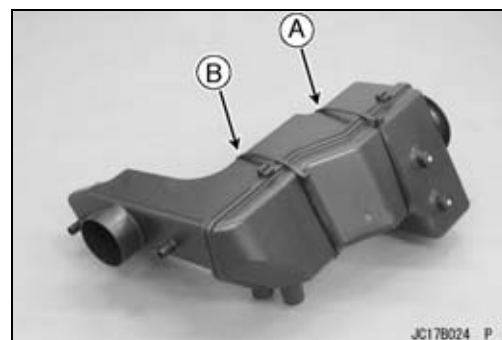
- Set the duct [A] and air filter [B] as shown in the figure.



- Insert and lock the hook portions [A] into the slots [B].



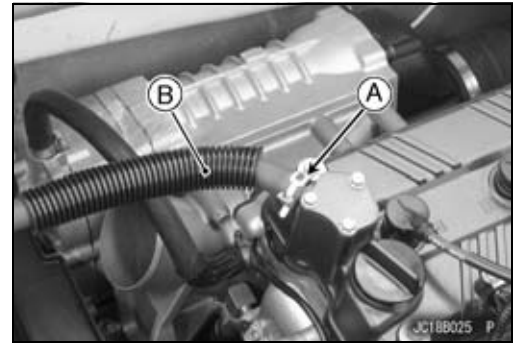
- Install the bands as shown in the figure.
Band [A] L = 914 mm (36.0 in.)
Band [B] L = 619 mm (24.4 in.)



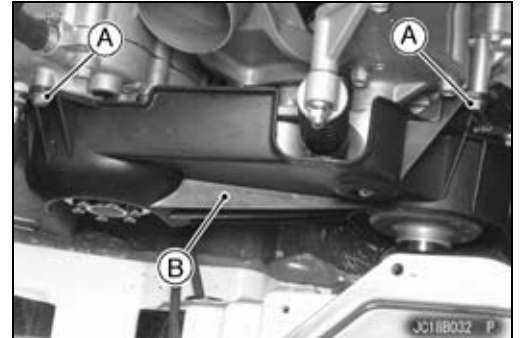
Supercharger

Supercharger Removal

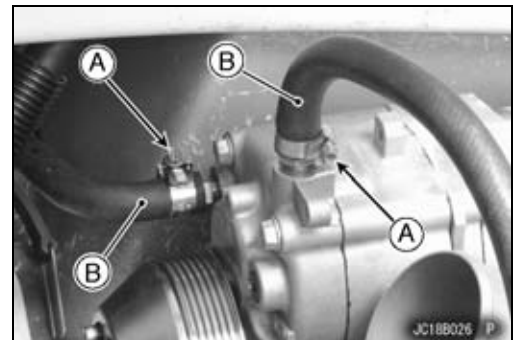
- Remove:
Water Box Muffler (see Water Box Muffler Removal in the Exhaust System chapter)
Clamp [A]
Hose [B]



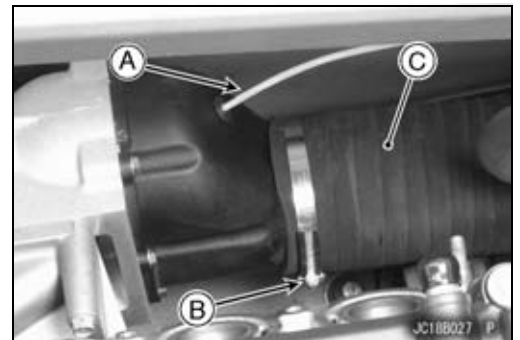
- Remove:
Supercharger Drive Belt Cover Bolts [A] and Washers
Supercharger Drive Belt Cover [B]
Supercharger Drive Belt Tensioner (see Supercharger Drive Belt Tensioner Removal)
Drive Belt (from Pulley)



- Remove:
Clamp Screws [A] (Loosen)
Hoses [B]



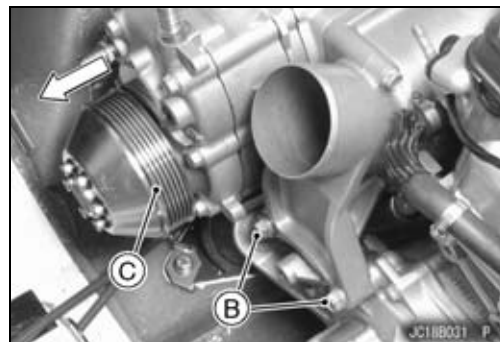
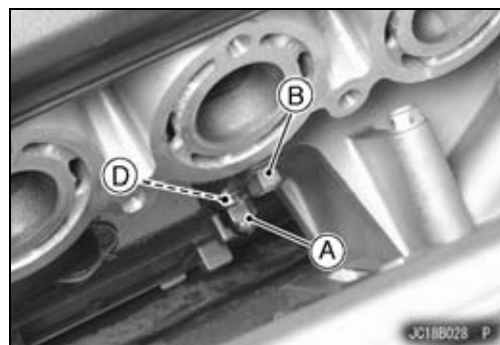
- Remove:
Hose [A]
Clamp Screw [B] (Loosen)
Duct [C]



3-118 FUEL SYSTEM (DFI)

Supercharger

- Remove:
 - Nut [A] and Washer
 - Bolts [B] and Washers
- Free the supercharger [C] from the stud [D], and remove it backward.



Supercharger Installation

- Installation is the reverse of removal, note the following.
- Run the ducts, hoses, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply a non-permanent locking agent to the threads of the belt cover bolts.
- Tighten:

Torque - Supercharger Mounting Bolts: 45 N·m (4.6 kgf·m, 33 ft·lb)

Supercharger Mounting Nut: 45 N·m (4.6 kgf·m, 33 ft·lb)

Intake Duct Clamp Screw: 4.9 N·m (0.50 kgf·m, 43 in·lb)

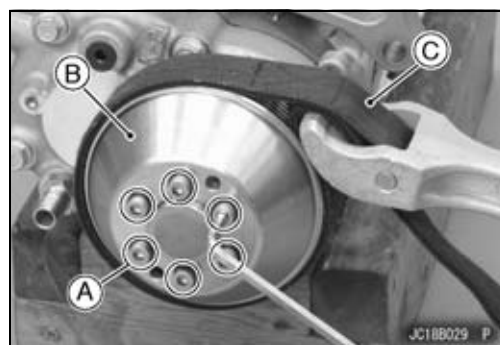
Water Hose Clamp Screw: 3.9 N·m (0.40 kgf·m, 35 in·lb)

Water Hose Clamp Screw: 2.5 N·m (0.26 kgf·m, 22 in·lb)

Supercharger Drive Belt Cover Bolts: 4.9 N·m (0.50 kgf·m, 43 in·lb)

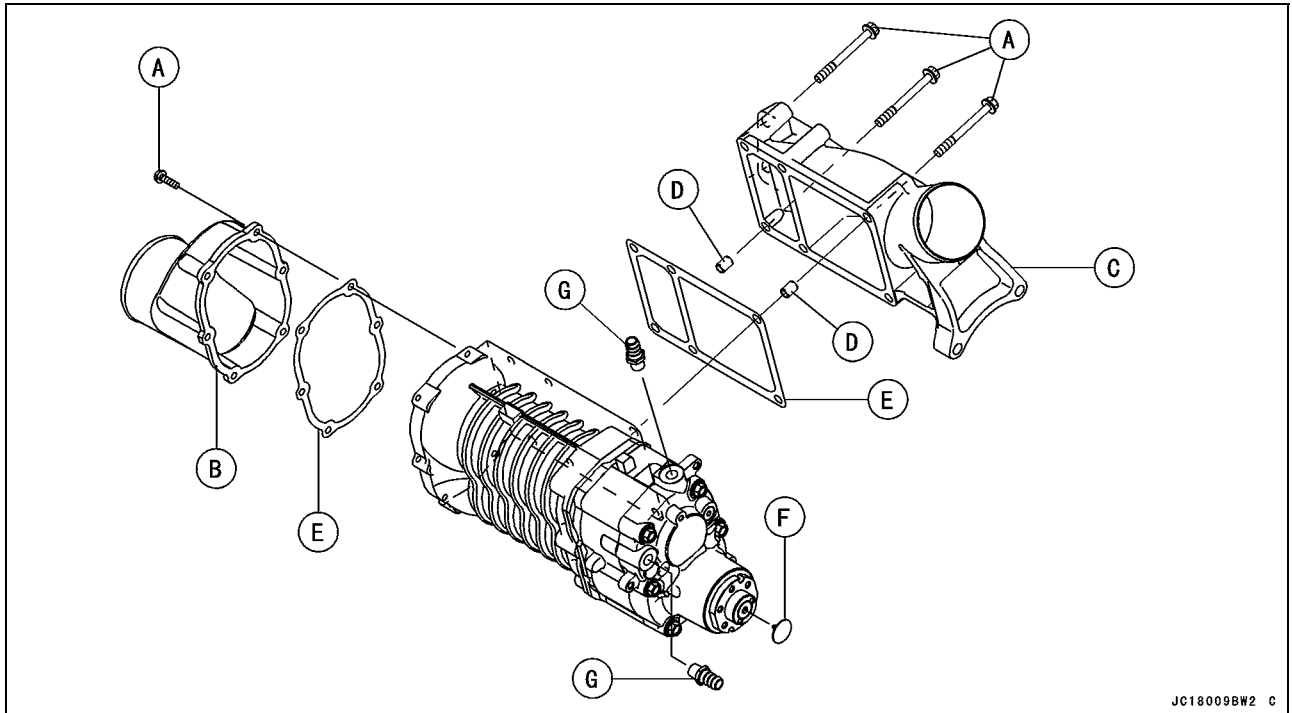
Supercharger Disassembly

- Remove the supercharger (see Supercharger Removal).
- Remove the pulley mounting bolts [A] while holding the pulley [B] steady with the suitable tool [C].
- Remove the pulley.



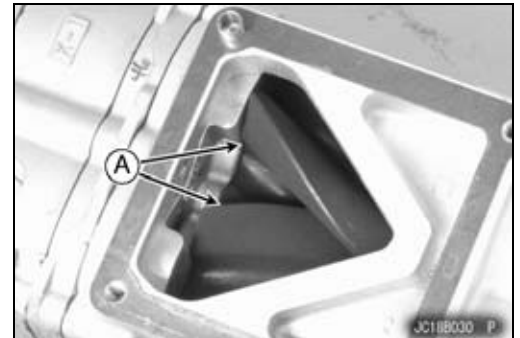
Supercharger

- Remove:
 - Bolts [A]
 - Lower Intake Pipe [B]
 - Upper Intake Pipe [C]
 - Dowel Pins [D]
 - Gaskets [E]
 - Rivet [F]
 - Hose Joints [G]



Supercharger Assembly

- Check that salt deposit is on the rotors [A].
- Clean the rotors with cloth and blow the air, turning slowly the pulley.
- ★ If necessary, replace the supercharger assembly.



3-120 FUEL SYSTEM (DFI)

Supercharger

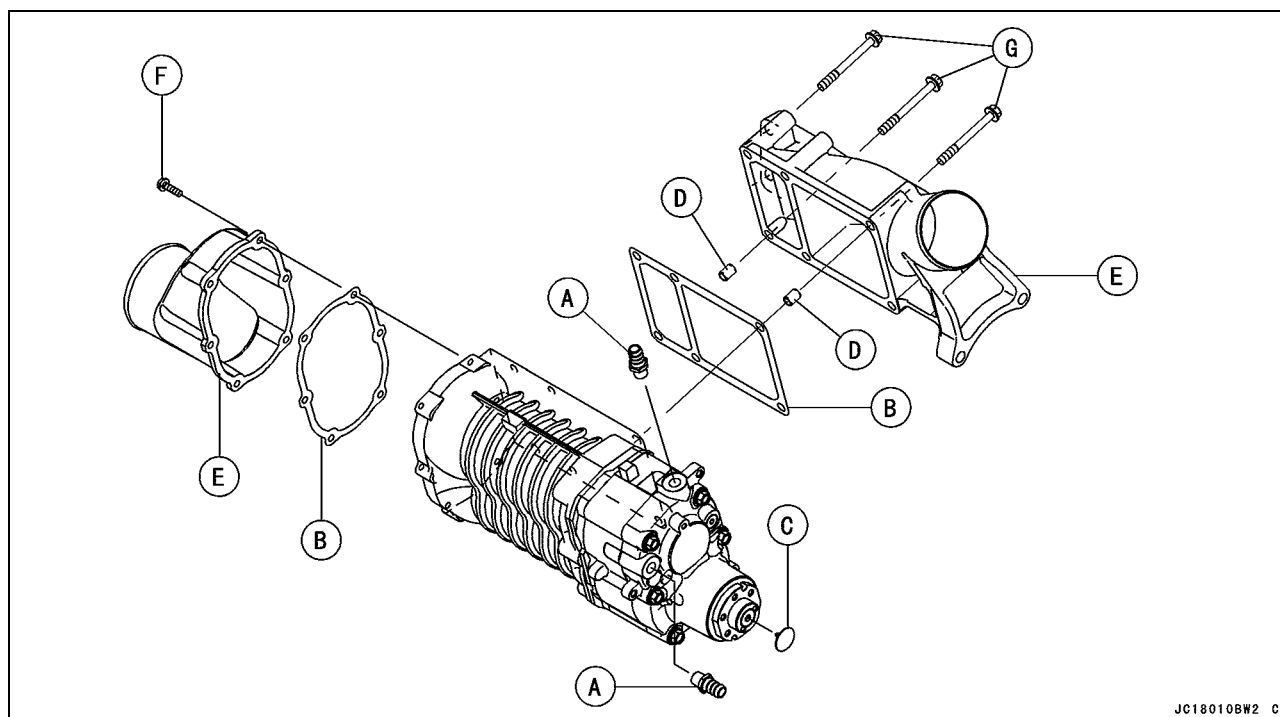
- Apply a non-permanent locking agent to the threads of the hose joints [A], and tighten them.

Torque - Water Hose Joints (Straight Shape): 20 N·m (2.0 kgf·m, 15 ft·lb)

- Replace the gaskets [B] with new ones.
- Install the rivet [C], new gaskets, dowel pins [D] and intake pipes [E].
- Apply a non-permanent locking agent to the threads of the lower intake pipe bolts [F].
- Tighten:

Torque - Upper Intake Pipe Bolts [G]: 30 N·m (3.1 kgf·m, 22 ft·lb)

Lower Intake Pipe Bolts: 4.9 N·m (0.50 kgf·m, 43 in·lb)



- Install the pulley.
- Apply a non-permanent locking agent to the threads of the pulley mounting bolts.
- Tighten the pulley mounting bolts while holding the pulley steady with the suitable tool.

Torque - Pulley Mounting Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)

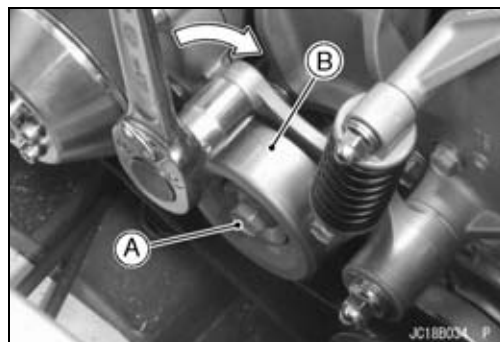
Supercharger Drive Belt Replacement

- Refer to the Engine Removal/Installation in the Engine Removal/Installation chapter.

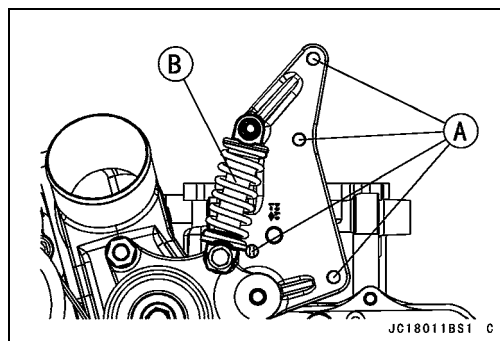
Supercharger

Supercharger Drive Belt Tensioner Removal

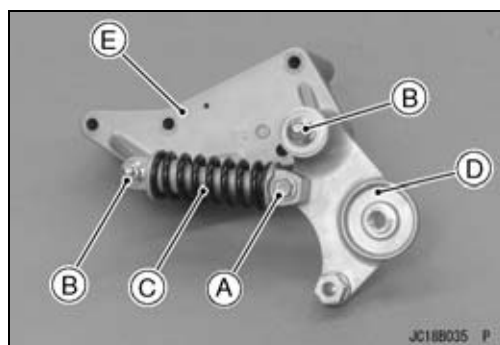
- Remove:
 - Supercharger Drive Belt Cover (see Supercharger Removal)
 - Pulley Bolt [A] and Washer
 - Pulley [B]
- Attach the tool to the hexagon boss [C], and turn the tool clockwise.



- Remove:
 - Bolts [A] and Washers
 - Supercharger Drive Belt Tensioner Assy [B]

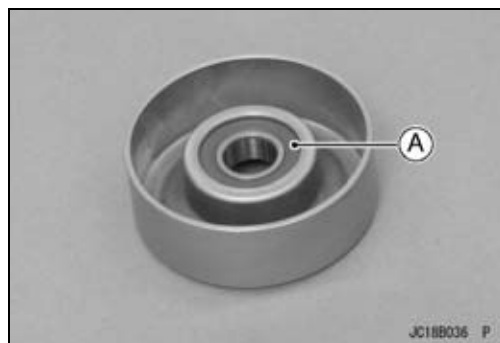


- Remove:
 - Bolt [A]
 - Nuts [B]
 - Spring Assy [C]
 - Pulley Bracket [D]
 - Holder [E]



Supercharger Drive Belt Tensioner Installation

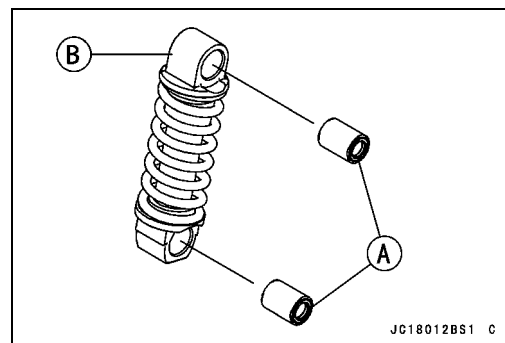
- Spin the bearing [A] by hand to check its condition.
- ★ If it is noisy, does not spin smoothly, or has any rough spots, replace the pulley assy.
- Confirm whether the bearing absorbs water or salt water.
- ★ If it absorbs water or salt water, replace the pulley assy.



3-122 FUEL SYSTEM (DFI)

Supercharger

- Visually inspect the bushings [A].
- ★ If there are any signs of damage, replace it.
- Visually inspect the spring assy [B].
- Check the smooth stroke, crack or dent.
- ★ If there are any signs of damage, replace it.



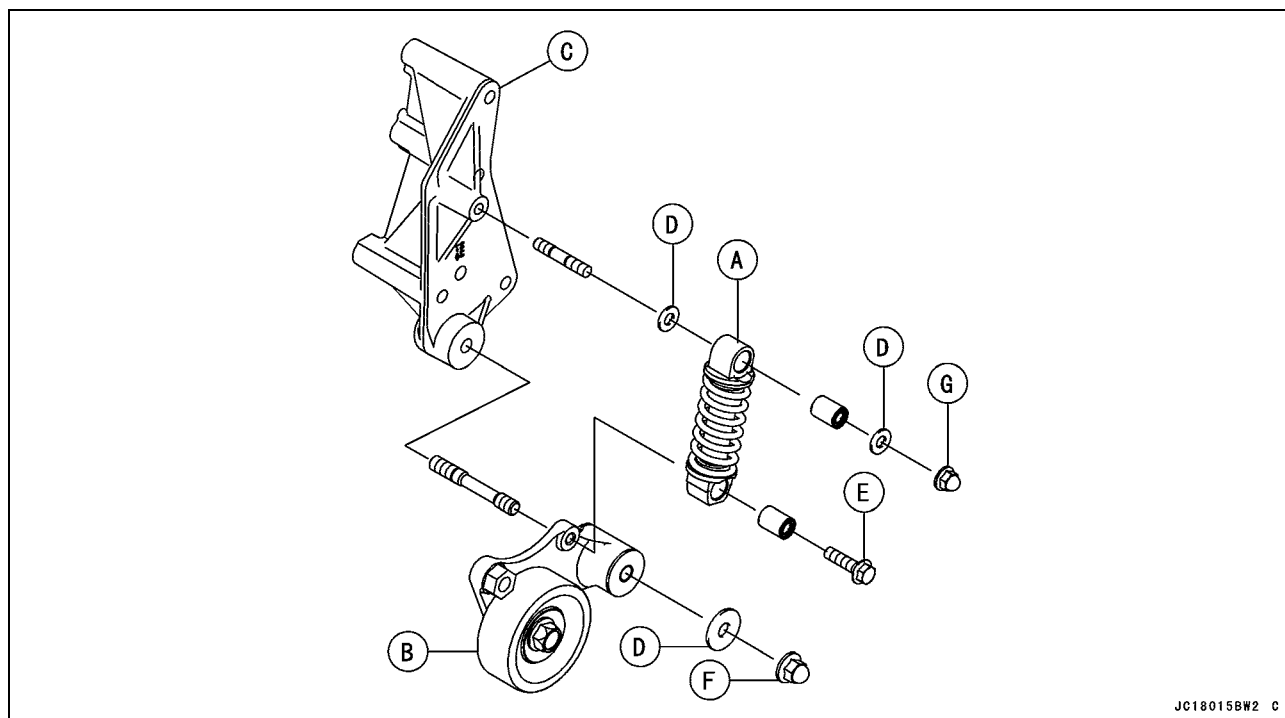
- Install the spring assy [A], pulley bracket [B], holder [C] and washers [D].
- Tighten the bolt [E] and nuts.

Torque - Supercharger Drive Belt Tensioner Nut (M10) [F]:

45 N·m (4.6 kgf·m, 33 ft·lb)

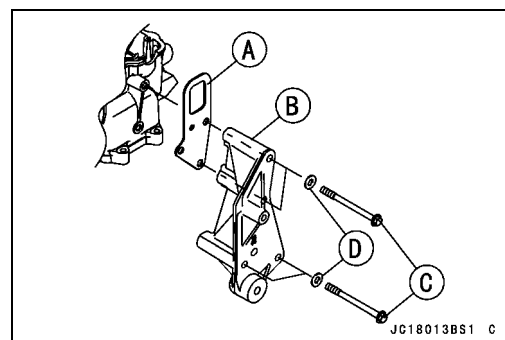
Supercharger Drive Belt Tensioner Nut (M8) [G]:

30 N·m (3.1 kgf·m, 22 ft·lb)



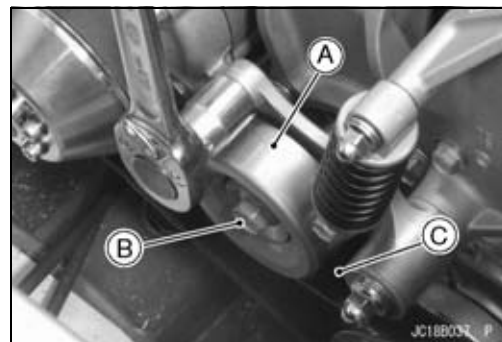
- Install:
 - Engine Hook [A]
 - Holder [B] (Supercharger Drive Belt Tensioner Assy)
 - Bolts [C] with Washers [D]
- Tighten:

Torque - Supercharger Drive Belt Tensioner Assy Mounting Bolts: 35 N·m (3.6 kgf·m, 26 ft·lb)



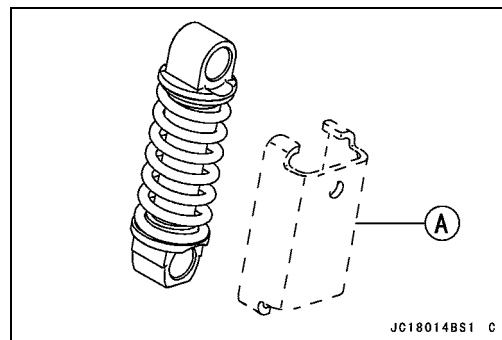
Supercharger

- Attach the tool to the hexagon boss, and turn the tool clockwise.
- Install the pulley [A], washer and bolt [B].
- Set the drive belt [C] under the pulley securely.
- Tighten the pulley bolt securely.



NOTE

- The new tensioner assy has bracket [A]. After installation, remove the bracket.

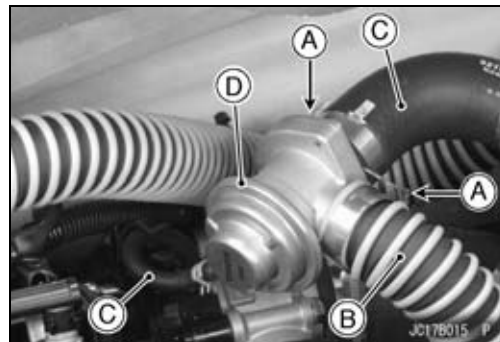


3-124 FUEL SYSTEM (DFI)

Air Bypass System

Relief Valve Removal/Installation

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Clamp Screws [A] (Loosen)
 - Duct [B]
 - Hoses [C]
 - Relief Valve [D]



- Run the hoses and duct correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).

- Tighten:

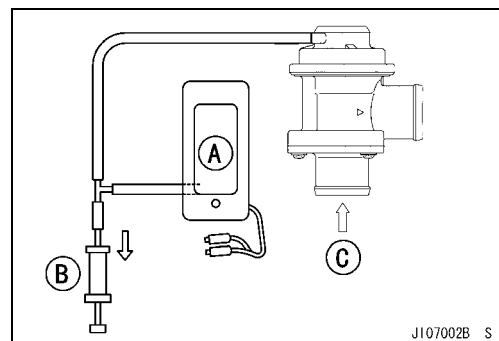
Torque - Air Bypass System Clamp Screws: 4.9 N·m (0.50 kgf·m, 43 in·lb)

Relief Valve Inspection

- Remove the relief valve (see Relief Valve Removal/Installation).
- Connect a vacuum gauge [A] and syringe [B] or fork oil level gauge to the vacuum hoses as shown in the figure.

Special Tool - Fork Oil Level Gauge: 57001-1290

Air Flow [C]



- Gradually raise the vacuum (lower the pressure) applied to the relief valve, and check the valve operation. When the vacuum is high, the relief valve should permit air to flow. When the vacuum lowers to valve closing pressure, it should stop air flow.

Spring [A]

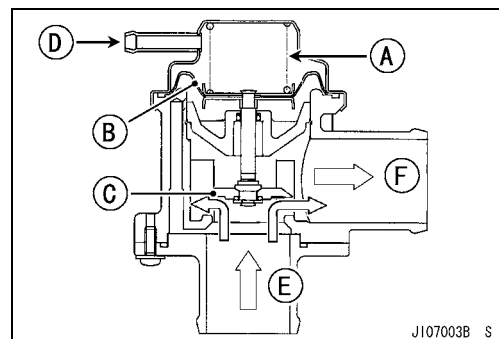
Diaphragm [B]

Valve [C]

High Vacuum [D]

Compressed Air Flow [E]

To Air Box [F]



- ★ If the relief valve does not operate as described, replace it with a new one.

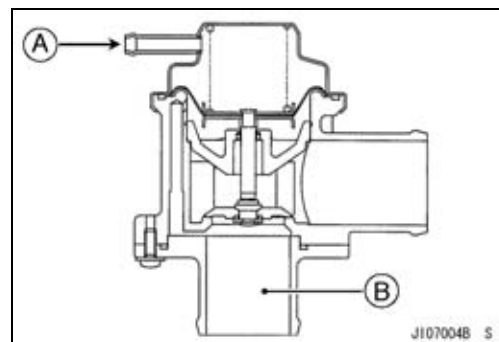
Low Vacuum [A]

Compressed air can not flow [B]

NOTE

○ If the portion of B is in atmospheric pressure, the portion of A becomes negative pressure. The standard of the above relief valve opening pressure can be calculated by the following.

$$\text{Standard} = \text{Negative Pressure (Portion of A)} - \text{Atmospheric Pressure (Portion of B)}$$



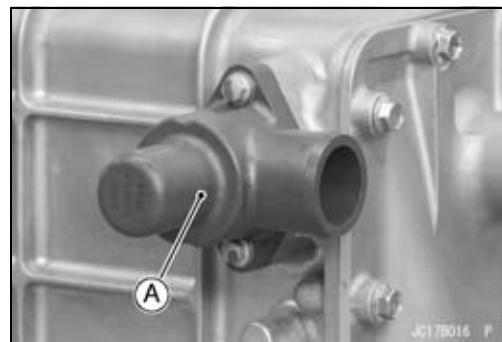
Relief Valve Opening Pressure (Close → Open)

Standard: $-53.3 \pm 4 \text{ kPa}$ ($-0.54 \pm 0.04 \text{ kgf/cm}^2$)

Air Bypass System

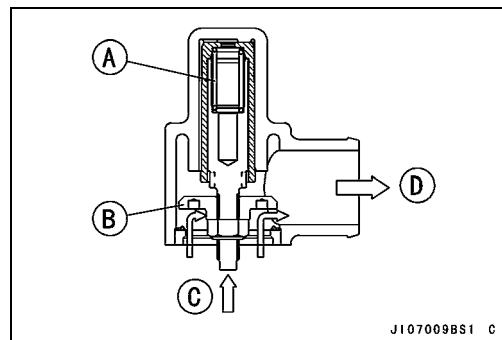
Blow off Valve Removal/Installation

- Refer to the Intercooler Disassembly/Assembly in the Cooling and Bilge Systems chapter.
Blow off Valve [A]



Blow off Valve Inspection

- Remove the blow off valve (see Blow off Valve Removal/Installation).
- Gradually raise the pressure applied to the blow off valve, and check the valve operation. When the pressure is low, the blow off valve should not permit air to flow. When the pressure raises to valve opening pressure, it should permit air flow.
Spring [A]
Valve [B]
High Compressed Air [C]
Air Flow [D]



- ★ If the blow off valve does not operate as described, replace it with a new one.

Blow off Valve Opening Pressure (Close → Open)

Standard: More than 117 kPa (1.19 kgf/cm²)

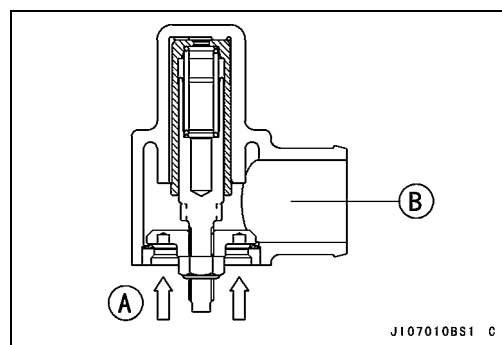
Low Compressed Air [A]

Air can not flow [B]

NOTE

○ If the portion of B is in atmospheric pressure, the portion of A becomes charging pressure. The standard of the above blow off valve opening pressure can be calculated by the following.

Standard = Charging Pressure (Portion of A) – Atmospheric Pressure (Portion of B)



3-126 FUEL SYSTEM (DFI)

Throttle Body Assy

Idle Speed Inspection

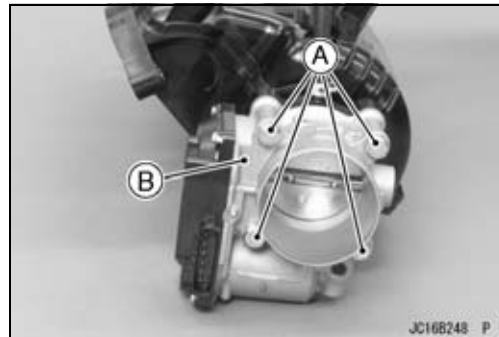
The normal idle speed is controlled by the ECU.

Idle Speed

Standard: 1 300 $\pm$ 100 r/min (rpm) - both in and out of water

Throttle Body Assy Removal

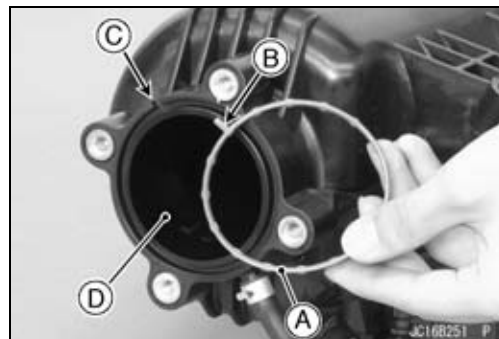
- Remove:
 - Intake Manifold (see Intake Manifold Removal)
 - Throttle Body Assy Mounting Bolts [A] and Washers
 - Throttle Body Assy [B]
 - Gasket



Throttle Body Assy Installation

- Replace the gasket [A] with a new one.
- Fit the projection [B] of the gasket into the slit [C] on the intake manifold [D].
- Tighten:

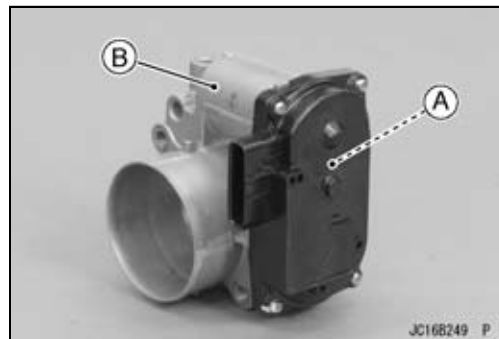
Torque - Throttle Body Assy Mounting Bolts: 13 N·m (1.3 kgf·m, 115 in·lb)



Throttle Body Assy Disassembly

CAUTION

Do not remove, disassemble or adjust the throttle position sensor/ETV actuator [A] and throttle body assy [B], because they are adjusted or set surely at the manufacturer. Adjustment of these parts could result in poor performance, requiring replacement of the throttle body assy.

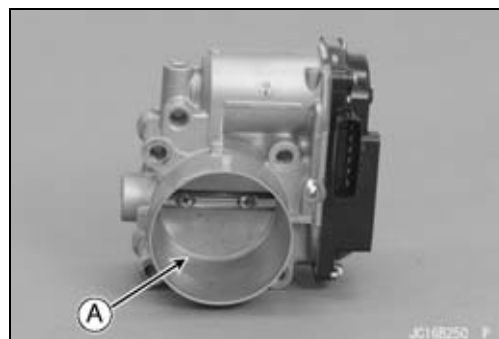


Throttle Bore Cleaning

- Remove the throttle body assy (see Throttle Body Assy Removal).
- Check the throttle bore [A] for carbon deposits by opening the valve.
- ★ If any carbon accumulates, wipe the carbon off the throttle bore and throttle valve, using a cotton pad.

CAUTION

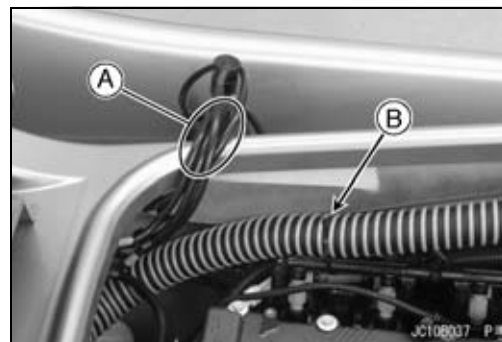
Do not rub these surfaces hard and do not use a carburetor cleaning solution.



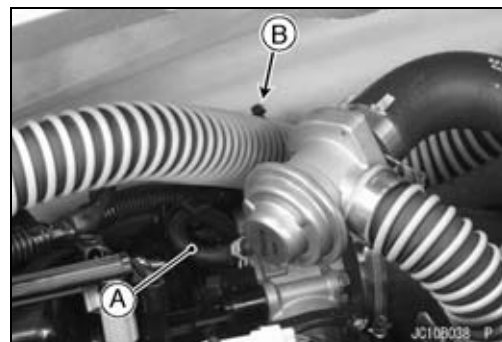
Intake Manifold

Intake Manifold Removal

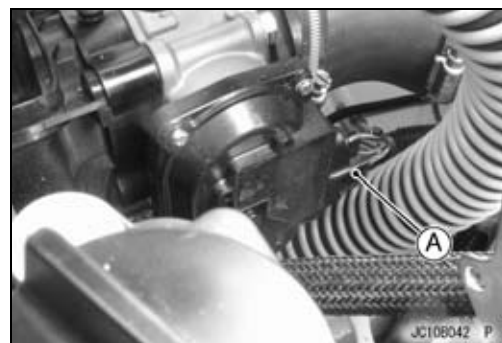
- Remove the intercooler (see Intercooler Removal in the Cooling and Bilge Systems chapter).
- Remove the spark plug leads and place them [A] out of the engine compartment.
- Cut the band [B].



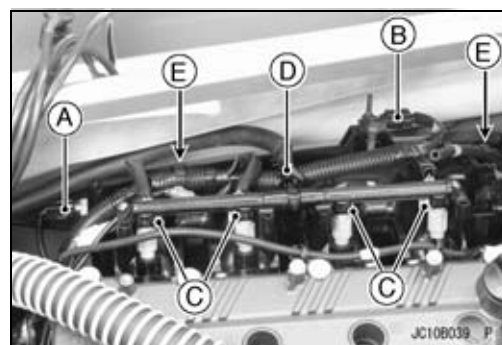
- Remove the hose [A].
- Cut the band [B].



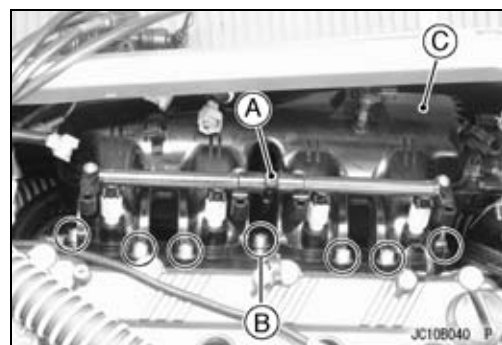
- Disconnect the throttle position sensor connector [A].



- Disconnect:
 - Intake Air Temperature Sensor Connector [A]
 - Intake Air Pressure Sensor Connector [B]
 - Fuel Injector Connectors [C]
 - Fuel Hose [D] (see Fuel Hose Removal)
- Free the main harness from the clamps [E].



- Remove:
 - Fuel Injectors with Delivery Pipe Assy [A] (see Fuel Injector Removal)
 - Intake Manifold Mounting Bolts [B] and Washers
 - Intake Manifold [C] with Throttle Body Assy

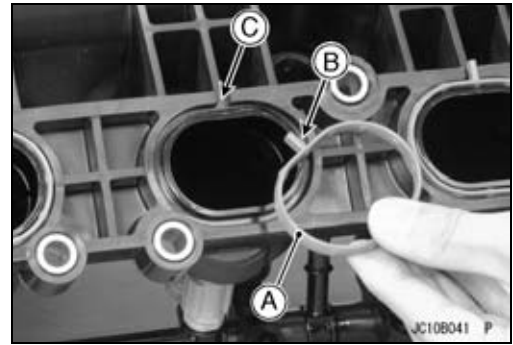


3-128 FUEL SYSTEM (DFI)

Intake Manifold

Intake Manifold Installation

- Replace the gaskets [A] with new ones.
- Fit the projection [B] of the gasket into the slit [C] on the intake manifold.



- Run the ducts, hoses, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the intake manifold, and tighten the mounting bolts.
Torque - Intake Manifold Mounting Bolts: 25 N·m (2.5 kgf·m, 18 ft·lb)
- Install the removed parts (see appropriate chapters).

Fuel Line

Fuel Hose Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Center Access Cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter)
- Be sure to place a piece of cloth [A] around the fuel hose joint.

WARNING

Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately. When the fuel hose is disconnected, fuel spills out from the hose and the pipe because of residual pressure. Cover the hose connection with a piece of clean cloth to prevent fuel spillage.

- Wipe off the dirt of the surface [A] around the connection using a cloth or a soft brush.

- Open and push up [A] the joint lock [B] with your fingers or thin blade screwdriver [C].

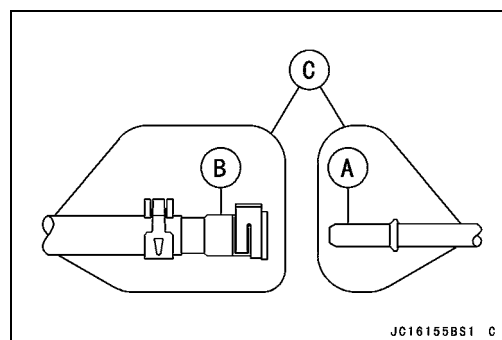
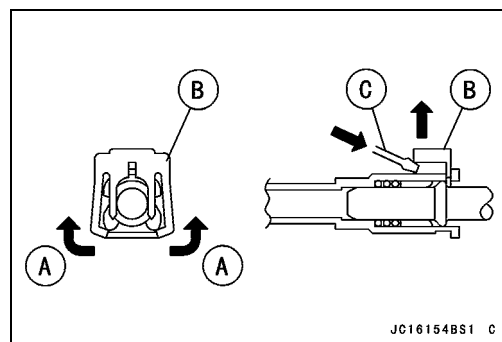
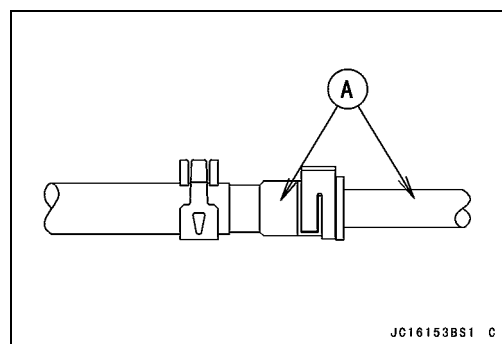
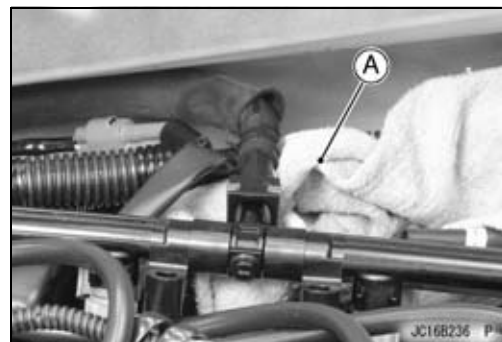
CAUTION

The joint lock has a retaining edge that locks around the housing. Do not pry or excessively widen the joint lock ends for fuel hose removal, it will permanently deform the joint lock, resulting in a loose or incomplete lock.

- Remove the fuel hose.
- Cover the pipe [A] and the hose joint [B] with the vinyl bags [C] to avoid becoming dirty.

NOTE

○ Do not attempt to check the joint lock with fuel hose removed from the pipe. It will not lock into position unless the hose is attached to the pipe.

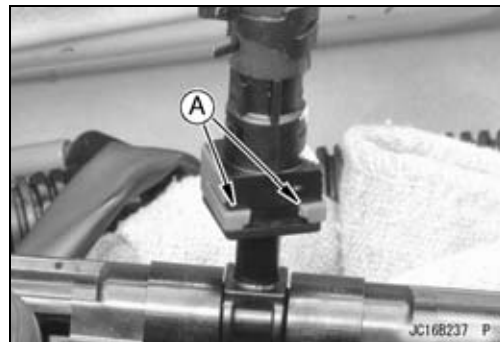


3-130 FUEL SYSTEM (DFI)

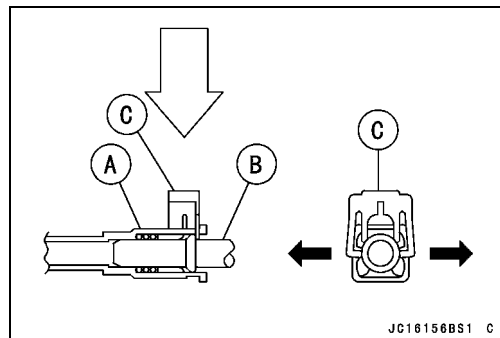
Fuel Line

Fuel Hose Installation

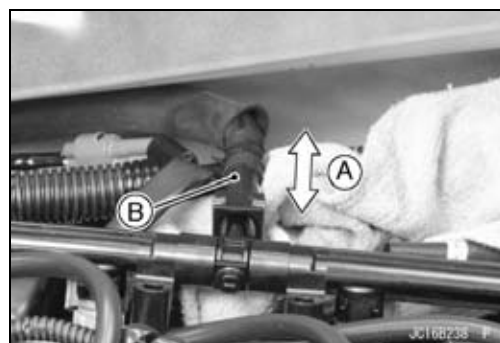
- Check the joint lock for deformation and wear.
- ★ If the joint lock is deformed [A], replace the fuel hose with a new one.



- Insert the hose joint [A] securely onto the pipe [B], and push down the joint lock [C].



- Push and pull [A] the hose joints [B] back and forth more than two times and make sure they are locked and don't come off.
- ★ If it comes off, reinstall the hose joint.



Fuel Pressure Inspection

NOTE

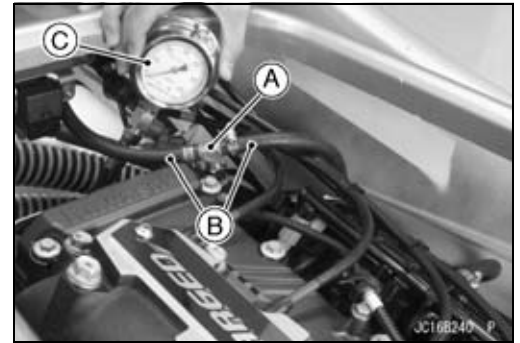
○ Be sure the battery is fully charged.

- Remove the fuel hose (see Fuel Hose Removal).

Fuel Line

- Install the fuel pressure gauge adapter [A] and fuel hoses (Special Tool: 57001-1607) [B] between the fuel outlet pipe and delivery pipe.
- Secure the fuel hoses with the clamps.
- Connect the pressure gauge [C] to the fuel pressure gauge adapter.

Special Tools - Oil Pressure Gauge, 5 kgf/cm²: 57001-125
Fuel Pressure Gauge Adapter: 57001-1593
Fuel Hose: 57001-1607



WARNING

Do not try to start the engine with the fuel hoses disconnected.

- Turn the ignition switch to ON.
- Start the engine, and let it idle.
- Measure the fuel pressure with the engine idling.

Fuel Pressure (with Engine Idling)

Standard: 294 kPa (3.0 kgf/cm², 43 psi)

NOTE

○The gauge needle will fluctuate. Read the pressure at the average of the maximum and minimum indications.

- Turn the ignition switch to OFF.
- ★ If the fuel pressure is much higher than specified, replace the fuel pump because the fuel pressure regulator in the fuel pump have been clogged or stuck.
- ★ If the fuel pressure is much lower than specified, check the following.

Fuel Line Leakage (see Fuel Injector Fuel Line Inspection)

Amount of Fuel Flow (see Fuel Flow Rate Inspection)

- After above checks, measure the fuel pressure again.
- Remove the fuel pressure gauge, hoses and adapter.
- Install the removed parts (see appropriate chapters).
- Start the engine and check for fuel leakage.

Fuel Flow Rate Inspection

NOTE

○Be sure the battery is fully charged.

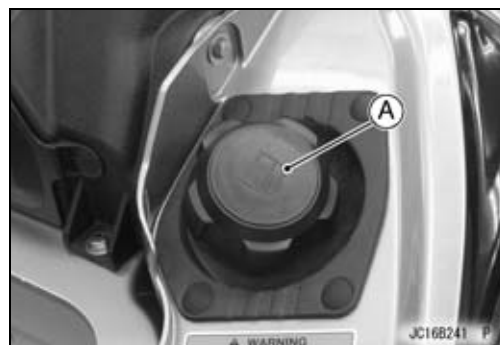
WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke. Turn the ignition switch OFF. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.

3-132 FUEL SYSTEM (DFI)

Fuel Line

- Turn the ignition switch to OFF.
- Wait until the engine cools down.
- Prepare a measuring cylinder.
- Open the fuel tank cap [A] to lower the pressure in the tank.



- Remove the fuel hose from the delivery pipe (see Fuel Hose Removal).
- Insert the fuel hose [A] into the measuring cylinder [B].

WARNING

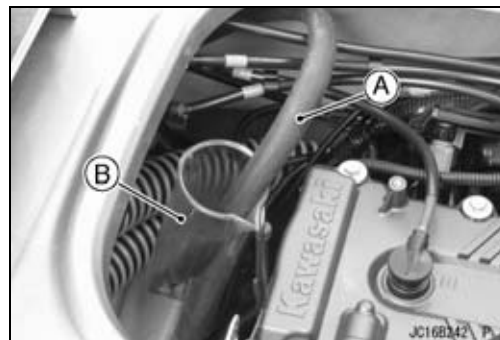
**Wipe off spilled out fuel immediately.
Be sure to hold the measuring cylinder vertical.**

- Close the fuel tank cap.
- Turn the ignition switch to ON.
- Push the start button for 3 seconds.
- Measure the discharge for 3 seconds.

Amount of Fuel Flow

Standard: 83 mL (2.8 US oz.) or more for 3 seconds

- Turn the ignition switch to OFF.
- ★ If the fuel flow is much less than the specified, check the following.
 - Fuel Pump Operation (see Fuel Pump Operation Inspection)
 - Fuel Pump Screen (see Fuel Pump Screen Cleaning)
- ★ If above inspection checks out good, replace the fuel pump, and measure the amount of fuel flow again.
- After inspection, connect the fuel hose.
- Start the engine and check for fuel leakage.



Fuel Vent Check Valve

Fuel Vent Check Valve Mounting

- Refer to the Fuel Vent Check Valve Inspection in the Periodic Maintenance chapter.

Fuel Vent Check Valve Inspection

- Refer to the Fuel Vent Check Valve Inspection in the Periodic Maintenance chapter.

3-134 FUEL SYSTEM (DFI)

Fuel Pump

Fuel Pump Removal

WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Pull the lanyard key off the stop button. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke.

CAUTION

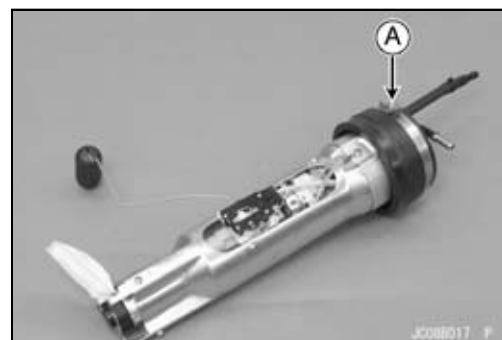
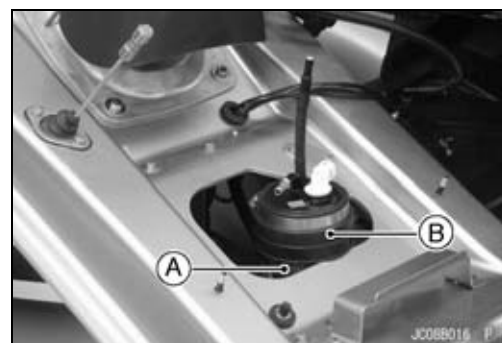
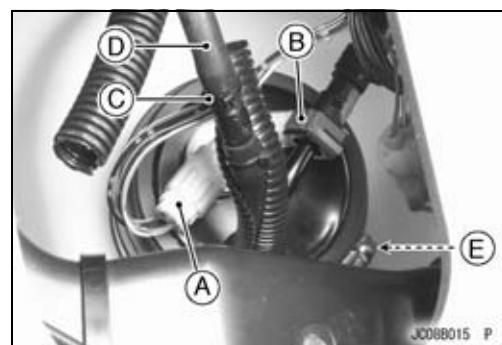
Never drop the fuel pump especially on a hard surface. Such a shock to the pump can damage it.

- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the fuel pump connector [A].
- Pull the fuel hose joint [B] out of the fuel pump pipe (see Fuel Hose Removal).

WARNING

Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately. When the fuel hose is disconnected, fuel spills out from the hose and the pipe because of residual pressure. Cover the hose connection with a piece of clean cloth to prevent fuel spillage.

- Cut the band [C] and pull out the fuel tank vent hose [D].
- Loosen the lower side clamp screw [E] on the fuel pump rubber holder.
- Pull the fuel pump [A] and rubber holder [B] through the opening gained after removal of the access hole on the deck.
- Loosen the upper side clamp screw [A] and remove the rubber holder from the fuel pump.



Fuel Pump

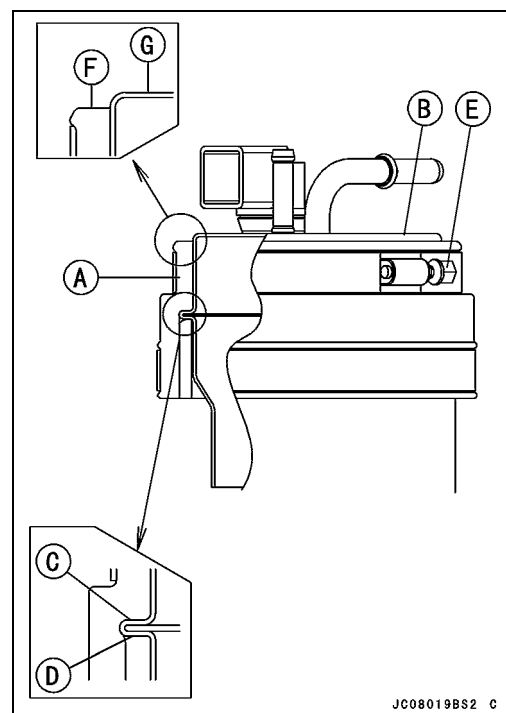
Fuel Pump Installation

- Press down the rubber holder [A] onto the fuel pump [B] so the stepped part [C] of the holder completely contacts the flanged part [D] of the pump.
- Pressing down the rubber holder onto the fuel pump.
- Set the upper side clamp (small diameter) onto the groove (for clamp installation) of the rubber holder securely, tighten the upper side clamp screw [E].

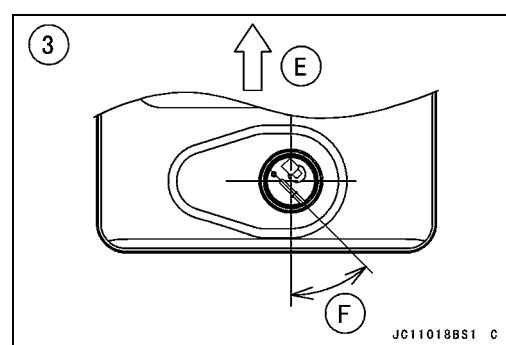
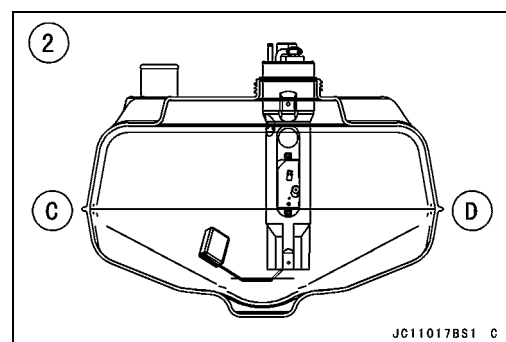
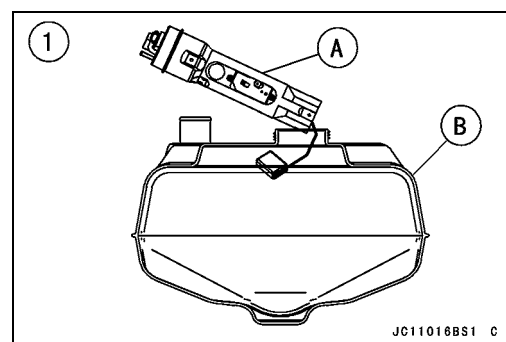
**Torque - Fuel Pump Rubber Holder Clamp Screw: 2.9 N·m
(0.30 kgf·m, 26 in·lb)**

NOTE

○ Install the rubber holder onto the fuel pump so the rubber holder top surface [F] must be below the top surface [G] of the fuel pump to prevent any water from collecting on top of the pump.



- Insert the fuel pump [A] in the fuel tank [B].
Port Side [C]
Starboard Side [D]
Bow [E]
45° [F]

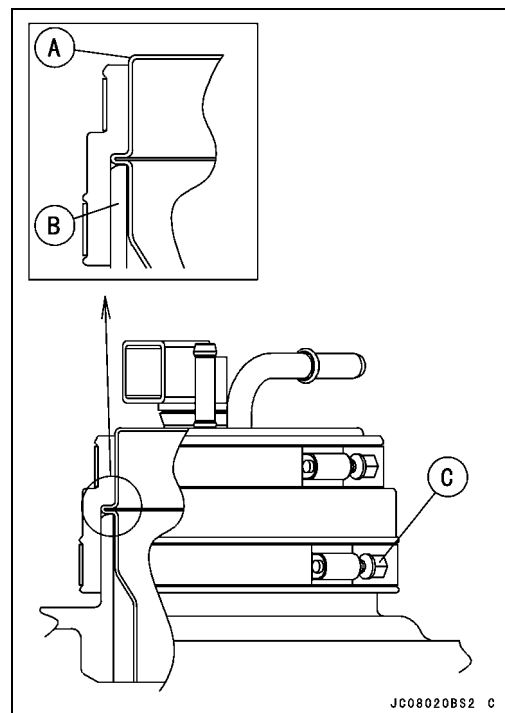


3-136 FUEL SYSTEM (DFI)

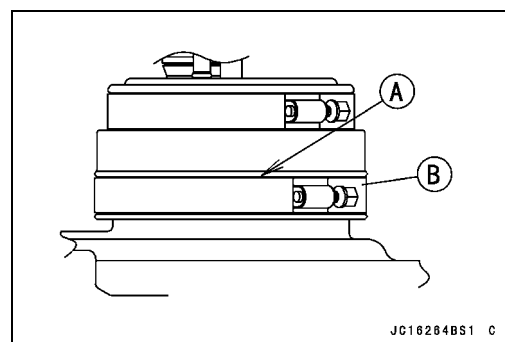
Fuel Pump

- Press down the pump [A] so that the fuel pump completely contacts the top surface of the tank [B].
- Set the lower side clamp (large diameter) onto the groove (for clamp installation) of the rubber holder securely, tighten the lower side clamp screw [C].

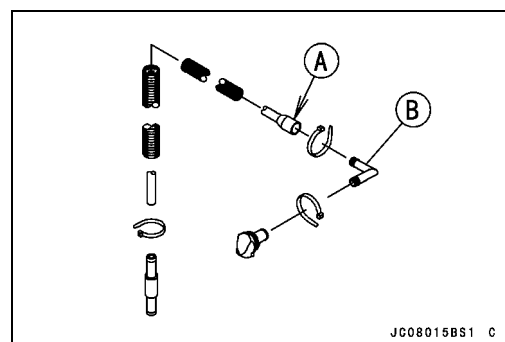
**Torque - Fuel Pump Rubber Holder Clamp Screw: 2.9 N·m
(0.30 kgf·m, 26 in·lb)**



- Check the position [A] of the lower side clamp [B] around the entire circumference.



- Install the following to the fuel pump.
 - Fuel Hose (see Fuel Hose Installation)
 - Fuel Tank Vent Hose
 - Fuel Pump Connector
- Install the vent hose so that the large side [A] of the hose fits the joint [B].



Fuel Pump Operation Inspection

NOTE

○ Be sure the battery is fully charged.

- Turn the ignition switch to ON and make sure that the fuel pump operates (make light sounds) for 3 seconds, and then stops.
- Turn the ignition switch to OFF.
- ★ If the pump does not operate as described above, check the operating voltage (see Fuel Pump Operating Voltage Inspection).

Fuel Pump

Fuel Pump Operating Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Turn the ignition switch to OFF.
- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the fuel pump connector and connect the measuring adapter [A] between these connectors as shown in the figure.

Main Harness [B]

Fuel Pump [C]

Special Tool - Measuring Adapter: 57001-1700

- Connect a digital meter [D] to the measuring adapter leads.

Fuel Pump Operating Voltage

Connections to Adapter:

Digital Meter (+) → R (pump R/W) lead

Digital Meter (–) → BK (pump BK) lead

- Measure the operating voltage with the engine stopped and with the connector joined.
- Turn the ignition switch to ON.

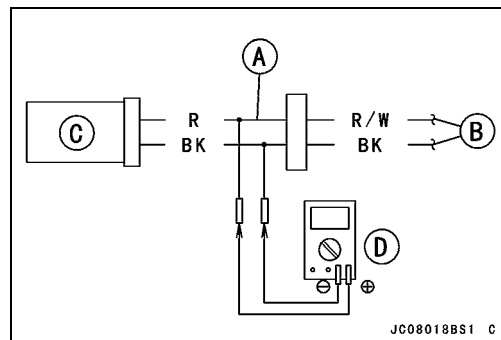
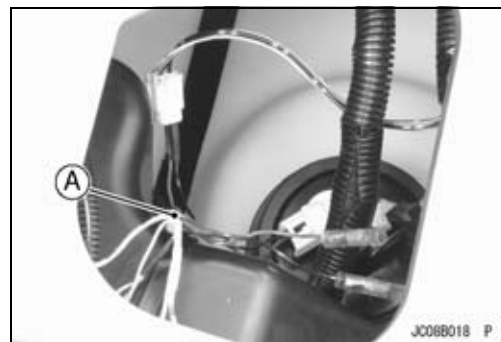
Operating Voltage

Standard: Battery Voltage for 3 seconds, and then 0 V

- Turn the ignition switch to OFF.
- ★ If the reading stays on battery voltage and never shows 0 V, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).
- ★ If the fuel pump relay is normal, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If there is still no battery voltage, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).
- ★ If the fuel pump relay is normal, check the wiring for continuity (see wiring diagram in this section).

Special Tool - Hand Tester: 57001-1394

- ★ If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
- ★ If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).
- ★ If the reading is in specification, but the pump does not operate, replace the fuel pump (see Fuel Pump Removal/Installation).

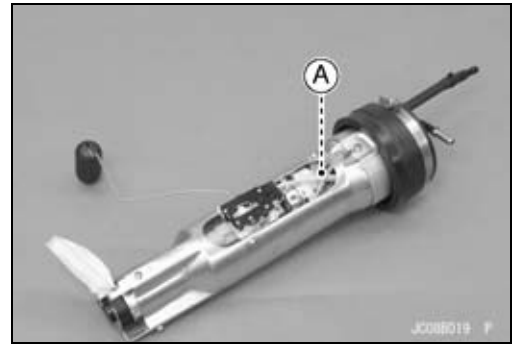


3-138 FUEL SYSTEM (DFI)

Fuel Pump

Pressure Regulator Removal

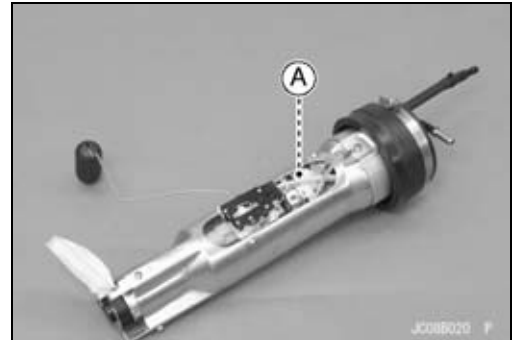
○The pressure regulator [A] is built into the fuel pump and can not be removed.



Fuel Filter Cleaning

○The fuel filter [A] is built into the fuel pump and can not be cleaned or checked.

★If the fuel filter is suspected of clogging or being damaged, replace it with the fuel pump as a set.

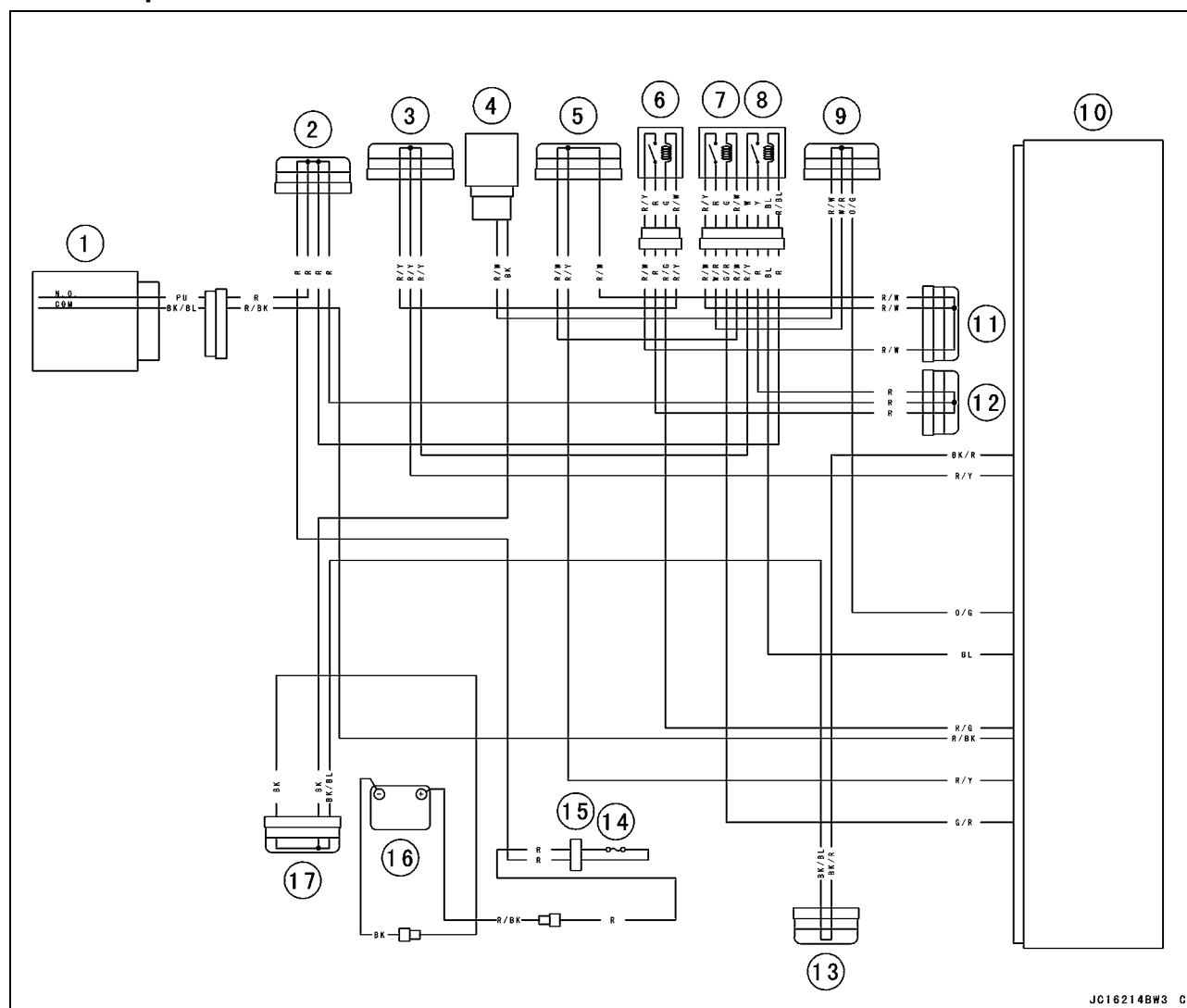


Fuel Pump Screen Cleaning

●Refer to the Fuel Pump Screen Cleaning in the Periodic Maintenance chapter.

Fuel Pump

Fuel Pump Circuit



JC16214BW3 C

- | | |
|-----------------------------|--------------------------------|
| 1. Ignition Switch | 10. ECU |
| 2. Joint Connector P (12 V) | 11. Joint Connector D (12 V) |
| 3. Joint Connector R (12 V) | 12. Joint Connector C (12 V) |
| 4. Fuel Pump | 13. Joint Connector E (Ground) |
| 5. Joint Connector T (12 V) | 14. Main Fuse 20 A |
| 6. ECU Main Relay | 15. Fuse Box 1 |
| 7. Fuel Pump Relay | 16. Battery |
| 8. System Relay | 17. Joint Connector S (Ground) |
| 9. Joint Connector L (12 V) | |

3-140 FUEL SYSTEM (DFI)

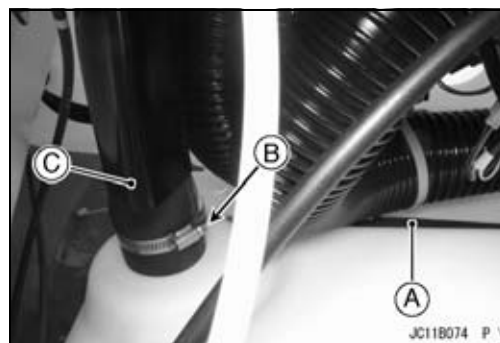
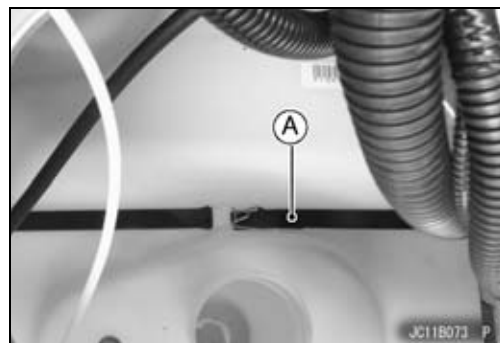
Fuel Tank

Fuel Tank Removal

WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Pull the lanyard key off the stop button. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

- Draw the fuel out from the fuel tank with a commercially available pump.
- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation)
 - Fuel Pump (see Fuel Pump Removal)
 - Air Box (see Air Box Removal)
 - Accelerator Position Sensor Assembly (see Accelerator Position Sensor Assembly Removal)
 - Bracket (for Vehicle-down Sensor, Ignition Coils and Regulator/Rectifier) (see Vehicle-down Sensor Removal)
- Unhook the fuel tank straps [A].
- Loosen the clamp screw [B], and remove the hose [C].



- Remove the fuel tank [A] out of the hull as shown in the figure.



Fuel Tank

Fuel Tank Installation

- Installation is the reverse of removal, note the following.
- Be sure the float [A] is in place before putting the fuel tank into the hull.



Fuel Tank Cleaning

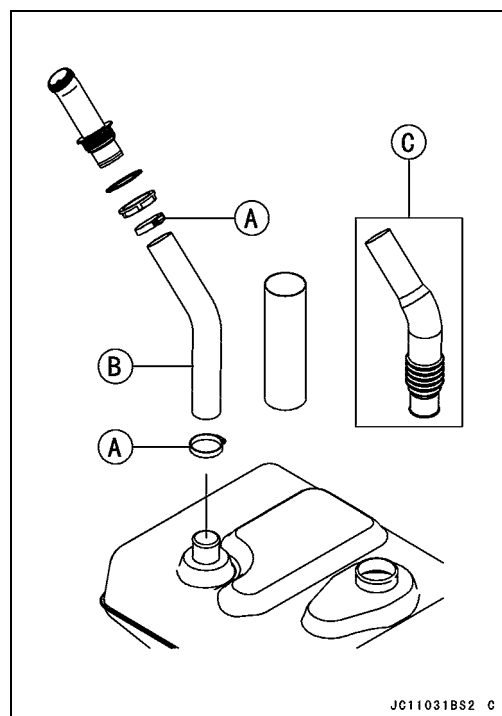
WARNING

Clean the tank in a well-ventilated area, and take ample care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low-flash point solvent to clean the tank. A fire or explosion could result.

- Remove the fuel tank (see Fuel Tank Removal).
- Flush the tank repeatedly with high-flash point solvent until it is clean. It may be necessary to put a few marbles or pieces of clean gravel into the tank and shake it, to knock loose any foreign matter in the bottom.

Fuel Filler and Hose Removal

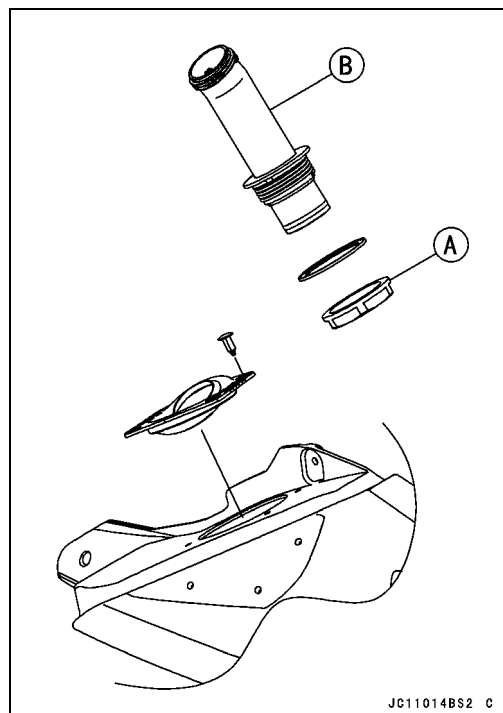
- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Loosen the fuel filler hose clamp screws [A] and remove the fuel filler hose [B].
AU and EUR Models [C]



3-142 FUEL SYSTEM (DFI)

Fuel Tank

- Remove the left side cover (see Side Cover Removal in the Hull/Engine Hood chapter).
- Take out the nut [A] in the filler flange and remove the fuel filler [B].



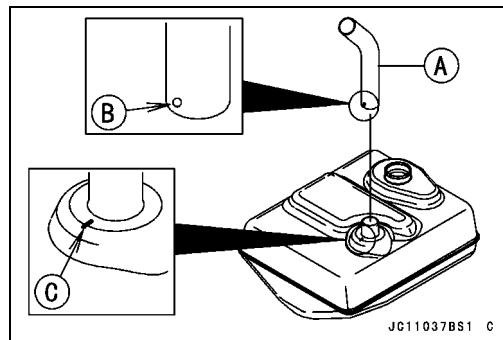
Fuel Filler and Hose Installation

- Clean the deck and filler on their mating surfaces with greaseless, high-flash point solvent.

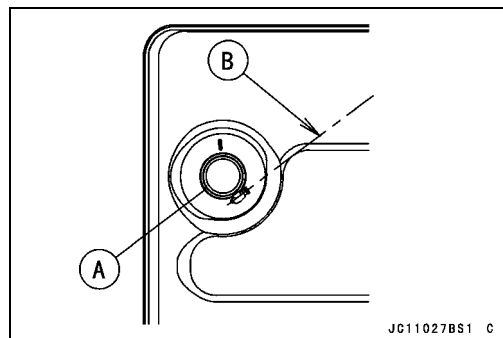
WARNING

Clean the parts in a well-ventilated area, and take ample care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low-flash point solvent. A fire or explosion could result.

- Note the following when installing the hose [A].
- Fit the white mark [B] of the hose to the mark [C] of the tank.



- Install the lower clamp [A] so that its screw head screw points inclined line [B].



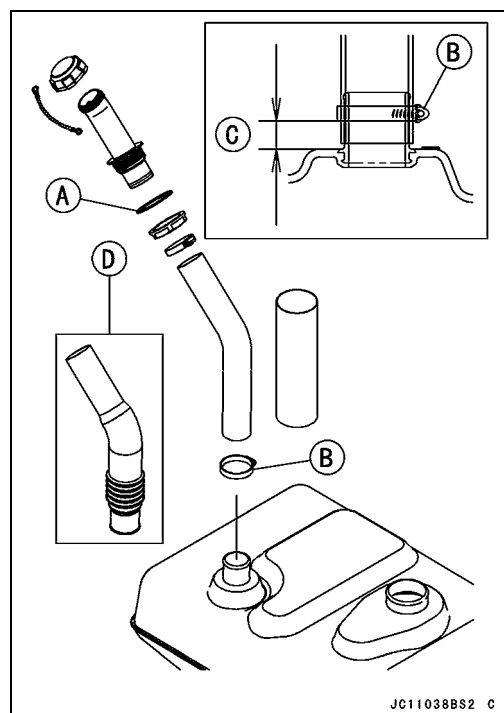
Fuel Tank

- Replace the fuel filler gasket [A] with a new one.
- Tighten the lower [B] and upper fuel filler hose clamp screws.

Torque - Fuel Filler Hose Clamp Screws: 2.9 N·m (0.30 kgf·m, 26 in·lb)

Parallel with Fuel Tank at 20 ~ 25 mm (0.79 ~ 0.98 in.) height [C]

AU and EUR Models [D]



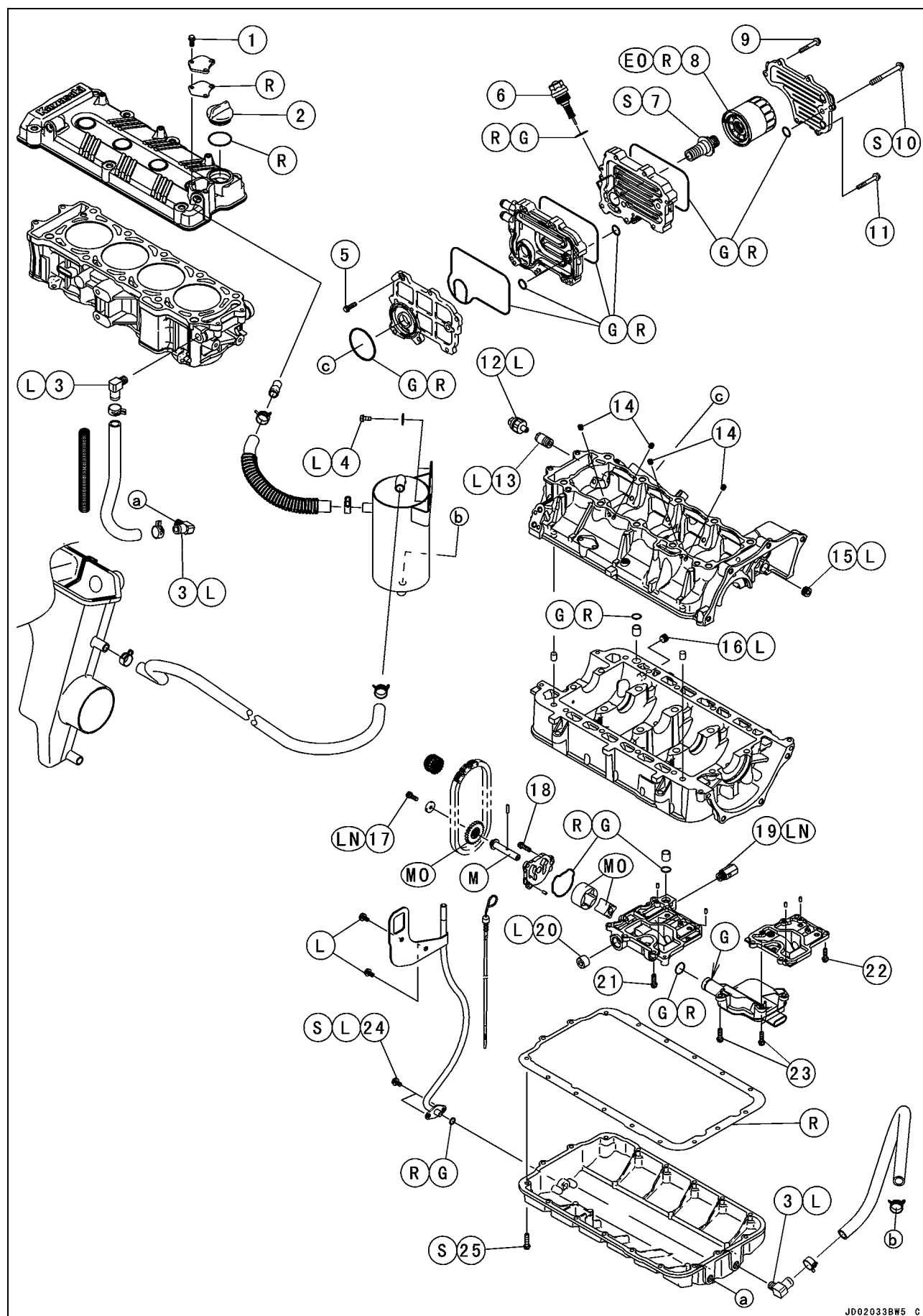
Engine Lubrication System

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4-2 ENGINE LUBRICATION SYSTEM

Exploded View



ENGINE LUBRICATION SYSTEM 4-3

Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Breather Plate Bolts	7.8	0.80	69 in·lb	
2	Oil Filler Cap	—	—	—	Hand-tighten
3	Oil Passage Joints	7.8	0.80	69 in·lb	L
4	Oil Separator Tank Mounting Bolts	8.8	0.90	78 in·lb	L
5	Oil Cooler Assembly Bolts (L = 20 mm)	7.8	0.80	69 in·lb	
6	Thermostat	8.0	0.82	71 in·lb	
7	Oil Passage Bolt	78	8.0	58	S
8	Oil Filter	18	1.8	13	G, R
9	Oil Cooler Assembly Bolts (L = 40 mm)	7.8	0.80	69 in·lb	
10	Oil Cooler Positioning Bolt	20	2.0	15	S
11	Oil Cooler Assembly Bolts (L = 45 mm)	7.8	0.80	69 in·lb	
12	Oil Pressure Switch	15	1.5	11	L
13	Oil Pressure Switch Fitting	20	2.0	15	L
14	Oil Jet Nozzles	3.0	0.31	27 in·lb	
15	Oil Passage Plug (R3/8)	20	2.0	15	L
16	Oil Passage Plug (R1/4)	20	2.0	15	L
17	Oil Pump Sprocket Bolt	16	1.6	12	LN
18	Oil Pump Cover Bolts	7.8	0.80	69 in·lb	
19	Oil Pressure Relief Valve	15	1.5	11	LN
20	Oil Pump Body Plug	20	2.0	15	L
21	Oil Pump Body Bolts	7.8	0.80	69 in·lb	
22	Oil Catch Cover Bolts	7.8	0.80	69 in·lb	
23	Oil Screen Bolts	7.8	0.80	69 in·lb	
24	Dipstick Tube Bolts	8.8	0.90	78 in·lb	L, S
25	Oil Pan Bolts	20	2.0	15	S

EO: Apply engine oil.

G: Apply grease.

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent. (High Strength: Loctite 271 equivalent).

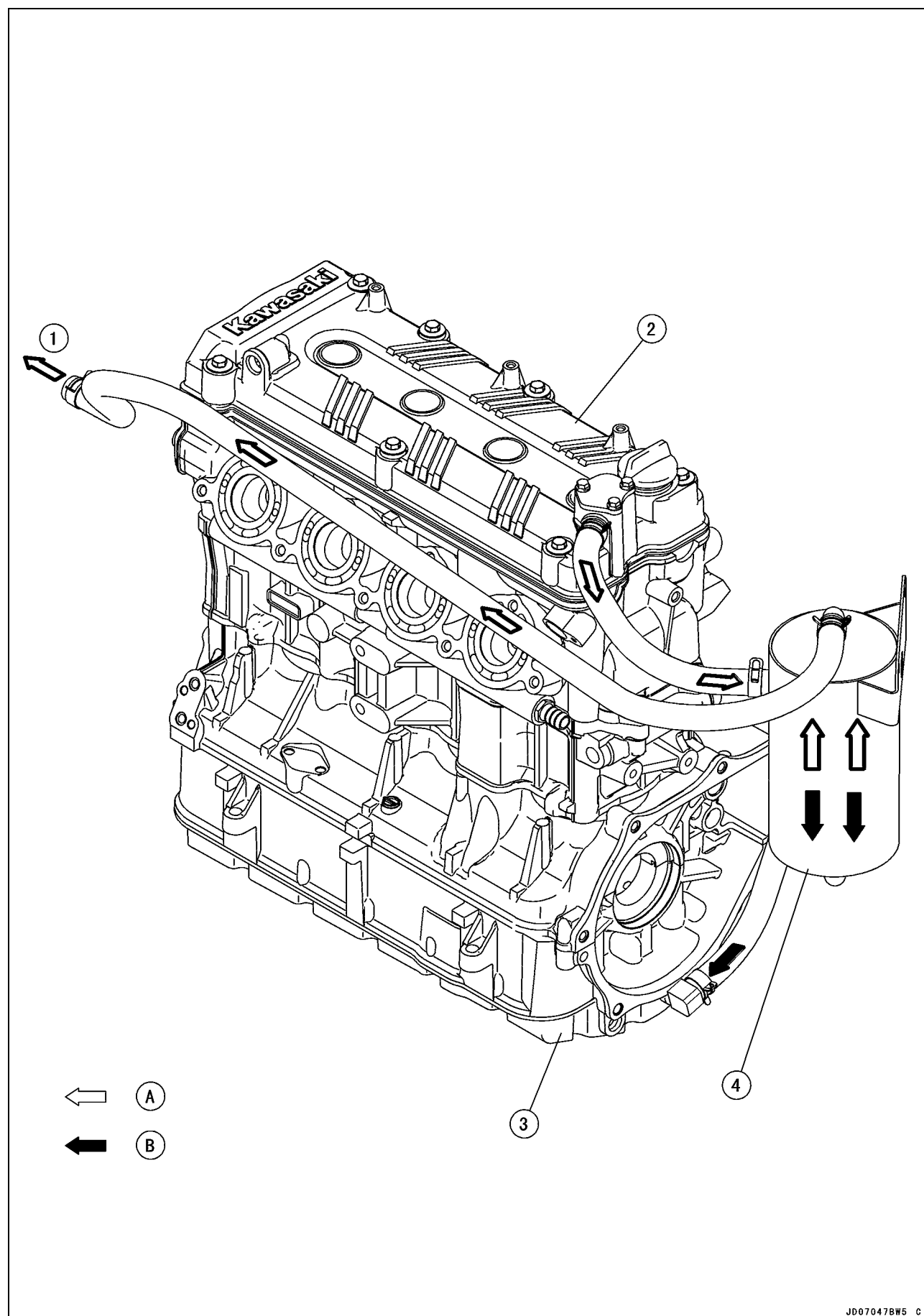
M: Apply molybdenum disulfide grease.

R: Replacement Parts

S: Follow the specified tightening sequence.

4-4 ENGINE LUBRICATION SYSTEM

Engine Oil Flow Chart

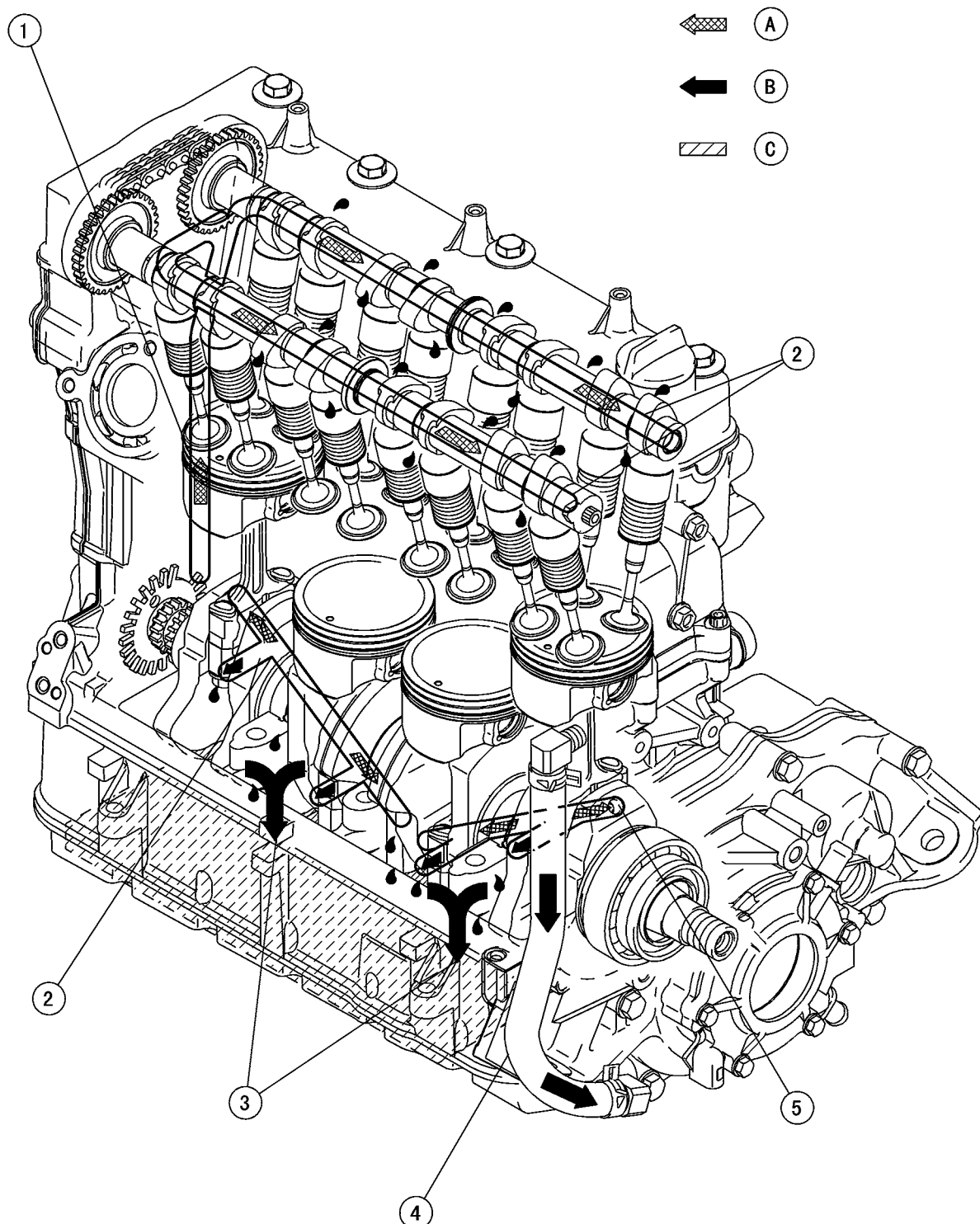


Engine Oil Flow Chart

1. To Air Filter
 2. Cylinder Head
 3. Oil Pan
 4. Oil Separator Tank
- A. Blowby Gas
B. Return Engine Oil Flow

4-6 ENGINE LUBRICATION SYSTEM

Engine Oil Flow Chart

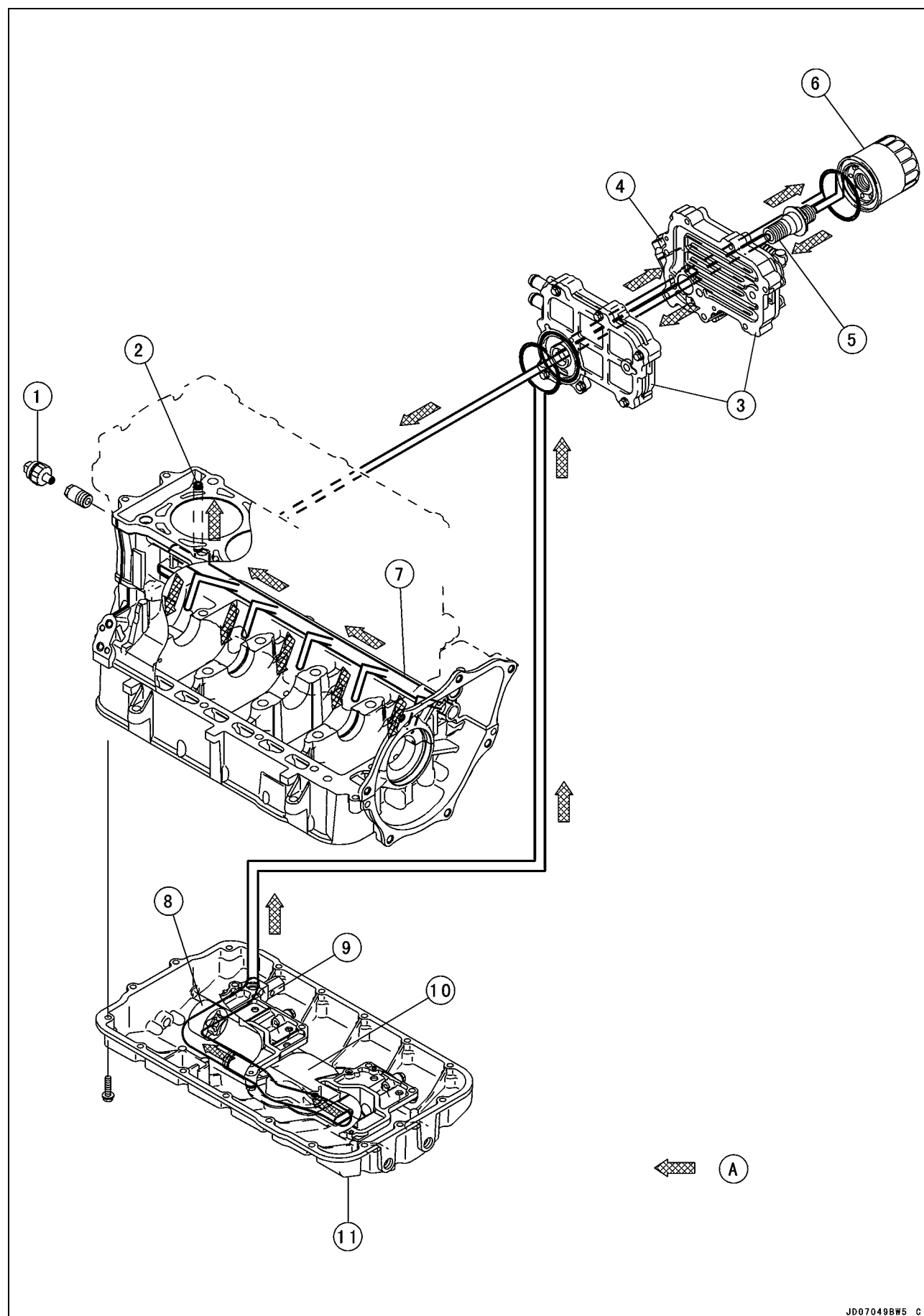


Engine Oil Flow Chart

1. Oil Passage (From Oil Pipe to Camshaft Cap)
 2. Camshaft Oil Passage
 3. To Oil Pan
 4. Oil Hose (From Cylinder to Oil Pan)
 5. Crankshaft Oil Passage
- A. Supply Engine Oil Flow
 - B. Return Engine Oil Flow
 - C. Oil Sump

4-8 ENGINE LUBRICATION SYSTEM

Engine Oil Flow Chart



Engine Oil Flow Chart

1. Oil Pressure Switch
2. Oil Pipe
3. Oil Cooler
4. Thermostat
5. Oil Passage Bolt
6. Oil Filter
7. Main Oil Passage
8. Oil Pump
9. Relief Valve
10. Oil Screen
11. Oil Pan
- A. Supply Engine Oil Flow

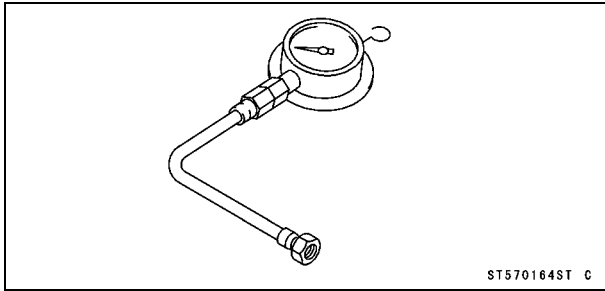
4-10 ENGINE LUBRICATION SYSTEM

Specifications

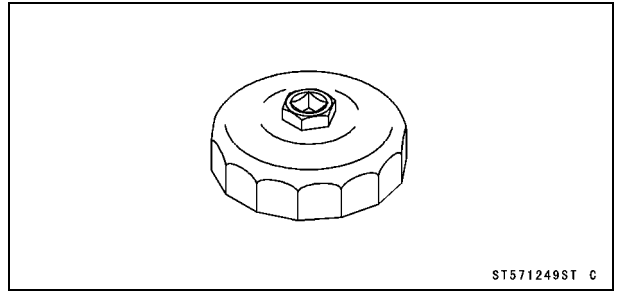
Item	Standard
Engine Oil Grade Viscosity Capacity Level	API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2 SAE 10W-40 4.5 L (4.8 US qt, with or without the filter) 5.5 L (5.8 US qt, when engine is completely dry) Between upper and lower level lines (see text)
Thermostat Poppet Valve Lift	More than 5.0 mm (0.20 in.) at 133°C (271°F)
Oil Pressure Measurement Oil pressure @3 000 r/min (rpm), oil temperature 78°C (172°F)	410 kPa (4.2 kgf/cm ² , 59 psi)

Special Tool and Sealant

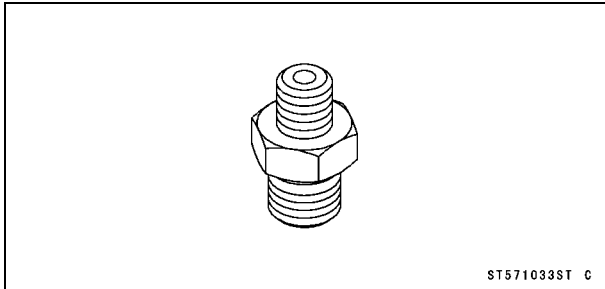
**Oil Pressure Gauge, 10 kgf/cm²:
57001-164**



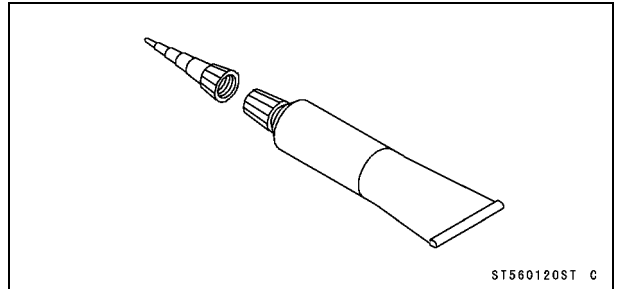
**Oil Filter Wrench:
57001-1249**



**Oil Pressure Gauge Adapter, PT 1/8:
57001-1033**



**Liquid Gasket, TB1211:
56019-120**



4-12 ENGINE LUBRICATION SYSTEM

Engine Oil and Oil Filter

WARNING

Watercraft operation with insufficient, deteriorated, or contaminated engine oil will cause accelerated wear and may result in engine seizure, accident, and injury.

Oil Level Inspection

This watercraft engine is equipped with a semi-dry sump. In the semi-dry sump engine, the oil level difference is very large between the level measured after just stopping and that after leaving for a long time.

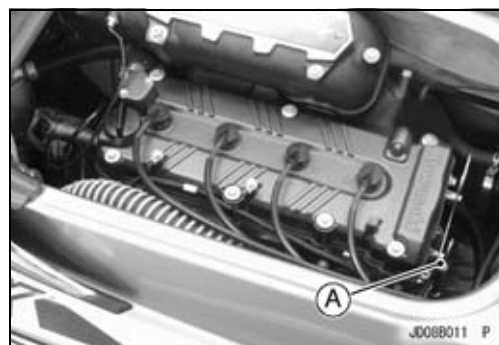
It is necessary to check the specified amount of oil is in the engine before starting the engine every day. At this time use the cold mark of the level gauge. Then run the engine to lubricate the engine parts sufficiently. After that it is necessary to check the level by using hot mark of the level gauge.

Preliminary Check

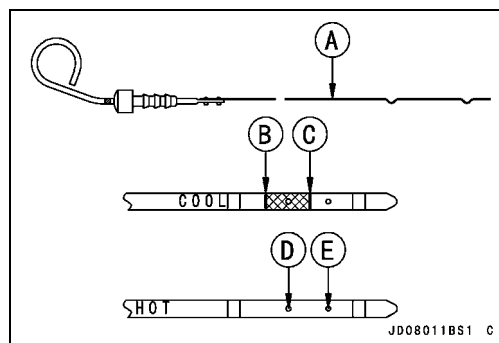
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Whenever checking the engine oil level, keep the watercraft level side to side and fore to aft as much as possible.
Level Ground [A]
Side Bumper [B]
Parallel [C]



- Remove the dipstick [A], wipe it dry and insert it back to the dipstick tube, and then remove it again to check the oil level.



- The oil level must be between the High and Low level lines on the dipstick (Use level lines when engine is cold).
Dipstick [A]
High Level Line when Cold [B]
Low Level Line when Cold [C]
High Level Line when Hot [D]
Low Level Line when Hot [E]



Engine Oil and Oil Filter

CAUTION

Racing the engine before the oil reaches every part can cause engine seizure.

If the engine oil gets extremely low or if the oil pump or oil passages clog up or otherwise do not function properly, the oil pressure warning light will light. If this light stays on when the engine is running above idle speed, stop the engine immediately and find the cause.

- ★ If the oil level is too high, remove the excess oil using a syring or some other suitable device.
- ★ If the oil level is too low, add the oil to the low level line through the oil filler opening (see Engine Oil Change in the Periodic Maintenance chapter). Use the same type and make of oil that is already in the engine.

NOTE

○ If the engine oil type and make are unknown, use any brand of the specified oil to top off the level in preference to running the engine with the oil level low. Then at your earliest convenience, change the oil completely.

Ordinary (standard) Check

- Perform the preliminary check before the ordinary check.
- Install the removed parts.
- Launch the watercraft.
- Start the engine for several minutes.
- Ride the watercraft and run the engine at about 5 000 rpm for 5 minutes.
- Stop the engine and let it cool down for 10 minutes.
- Steady the watercraft in calm water to prevent movement, or on the ground, keep the watercraft level side to side and fore to aft as much as possible.

NOTE

○ Since the trim and list of the watercraft will significantly affect the oil level, be sure that the operator and/or cargo are not aboard the watercraft when measuring the oil level.

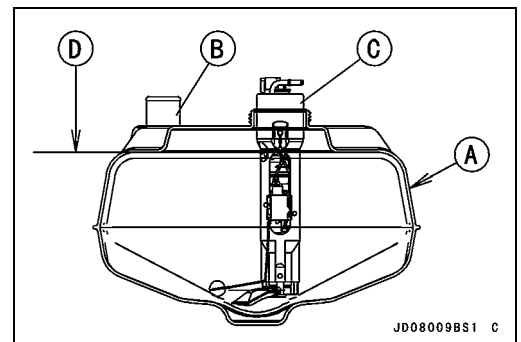
○ Also make the fuel tank [A] full if it is not full as shown to keep the watercraft level.

Fuel Tank Filler Neck [B]

Fuel Pump [C]

Fuel Full Level [D]

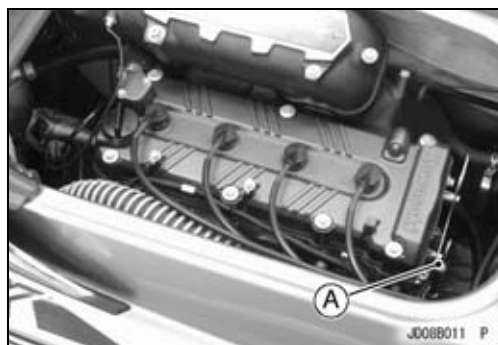
○ This measuring procedure with the watercraft afloat should be followed when the oil level is found low and to be added.



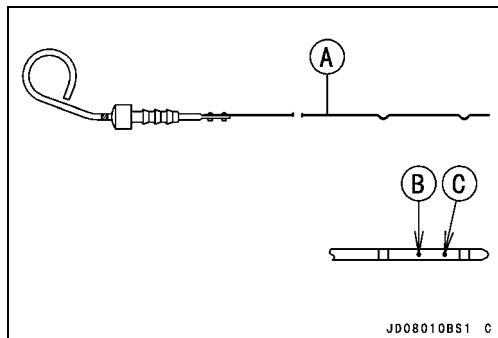
4-14 ENGINE LUBRICATION SYSTEM

Engine Oil and Oil Filter

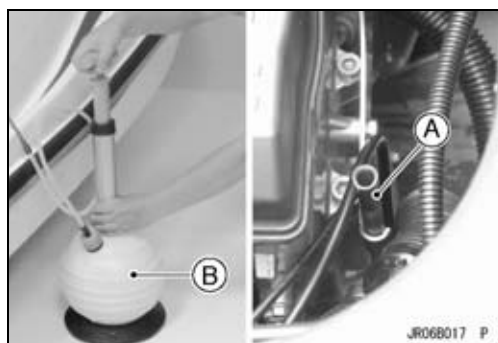
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the dipstick [A], wipe it dry and insert it back to the dipstick tube, and then remove it again to check the oil level.



- Check the oil level using the hot level mark on the dipstick [A].
High Level Line when Hot [B]
Low Level Line when Hot [C]



- ★ If the oil level is too high, drain the excess oil thoroughly from the dipstick tube [A] using a commercially-available vacuum pump [B].



- ★ If the oil level is too low, add the oil to the high level line through the oil filler opening (see Engine Oil Change in the Periodic Maintenance chapter). Use the same type and make of oil that is already in the engine.

NOTE

○ If the engine oil type and make are unknown, use any brand of the specified oil to top off the level in preference to running the engine with the oil level low. Then at your earliest convenience, change the oil completely.

Engine Oil Change

- Refer to Engine Oil Change in the Periodic Maintenance chapter.

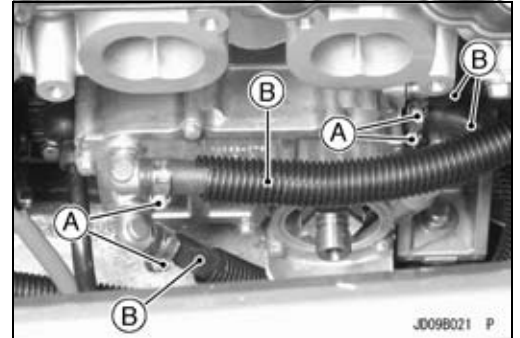
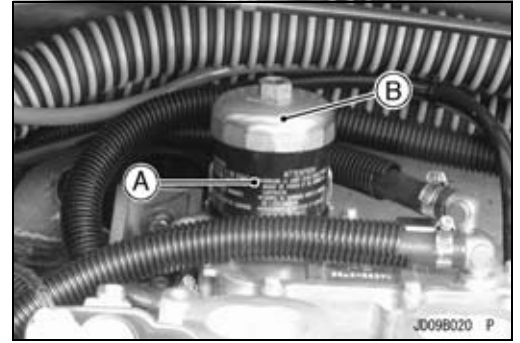
Oil Filter Replacement

- Refer to Oil Filter Replacement in the Periodic Maintenance chapter.

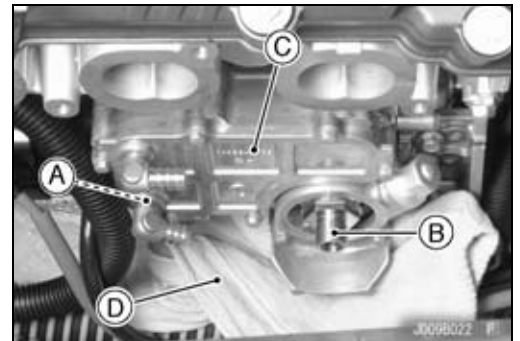
Oil Cooler

Oil Cooler Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
- Remove the oil filter [A] with the oil filter wrench [B].
- Place a rag or cloth under the oil filter to receive the remaining oil.
- Special Tool - Oil Filter Wrench: 57001-1249**
- Loosen the clamp screws [A] and remove the oil cooler water hoses [B] from the oil cooler.

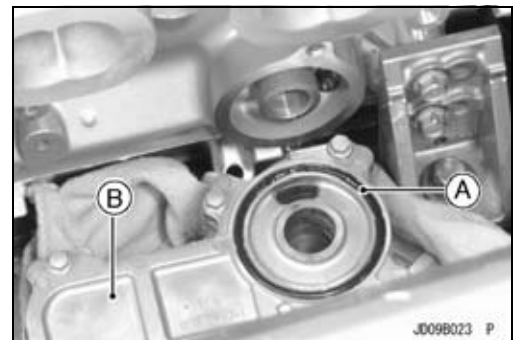


- Remove the oil cooler positioning bolt [A].
- Remove the oil passage bolt [B] and remove the oil cooler [C].
- Place a rag or cloth [D] under the oil cooler to receive the remaining oil.



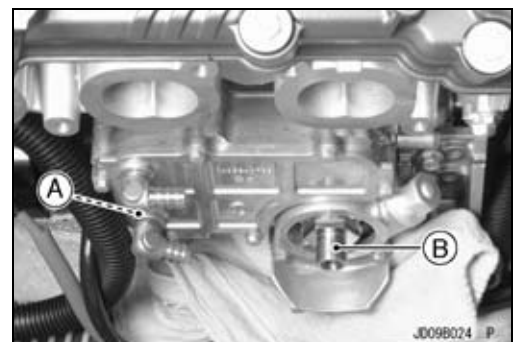
Oil Cooler Installation

- Replace the O-ring [A] with a new one and apply grease to new O-ring.
- Fit the O-ring on the oil cooler [B] securely.



- Install the oil cooler positioning bolt [A] and the oil passage bolt [B] temporarily.
- First, tighten the oil passage bolt.
- Next, tighten the oil cooler positioning bolt.

Torque - Oil Passage Bolt: 78 N·m (8.0 kgf·m, 58 ft·lb)
Oil Cooler Positioning Bolt: 20 N·m (2.0 kgf·m, 15 ft·lb)



4-16 ENGINE LUBRICATION SYSTEM

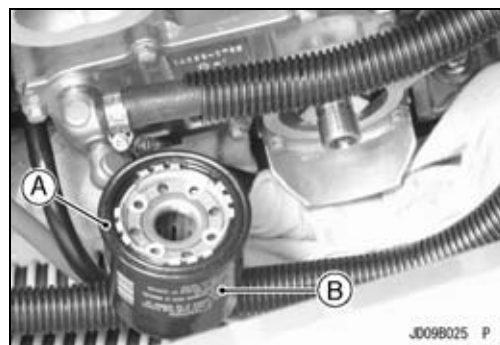
Oil Cooler

- Install the water hoses (see Cable, Wire and Hose Routing section in the Appendix chapter).
- Replace the oil filter with a new one.
- Apply engine oil to the O-ring [A] of the new oil filter [B].
- Tighten the oil filter with the oil filter wrench.

Special Tool - Oil Filter Wrench: 57001-1249

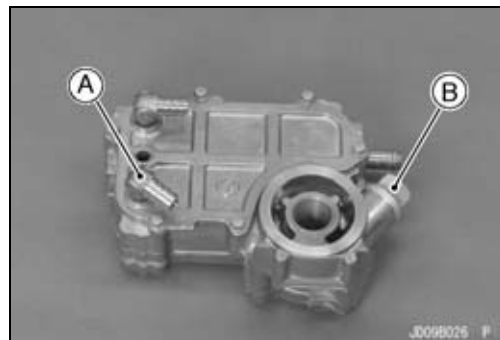
Torque - Oil Filter: 18 N·m (1.8 kgf·m, 13 ft·lb)

- Install the intake manifold (see Intake Manifold installation in the Fuel System (DFI) chapter).

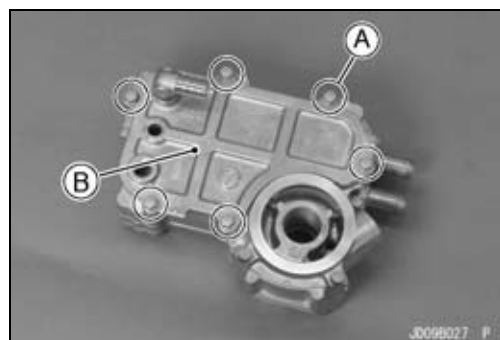


Oil Cooler Disassembly

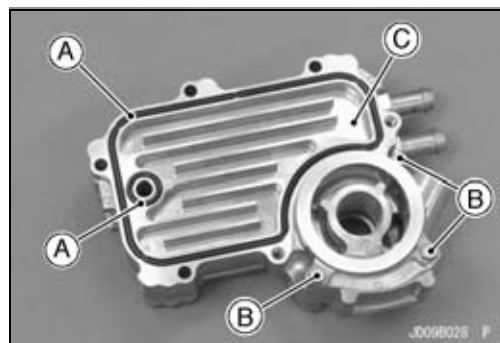
- Remove:
 - Oil Cooler (see Oil Cooler Removal)
 - Elbow [A]
 - Thermostat [B]



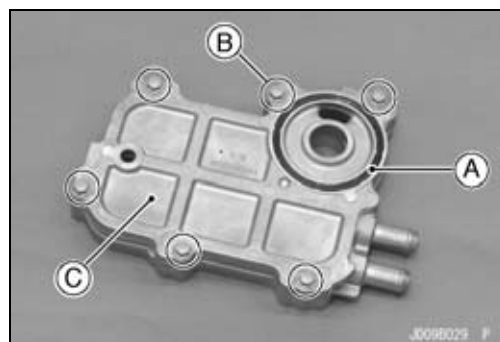
- Remove:
 - Oil Cooler Assembly Bolts [A]
 - Outside Oil Cooler Cover [B]



- Remove:
 - O-rings [A]
 - Oil Cooler Assembly Bolts [B]
 - Outside Oil Cooler [C]
 - O-rings



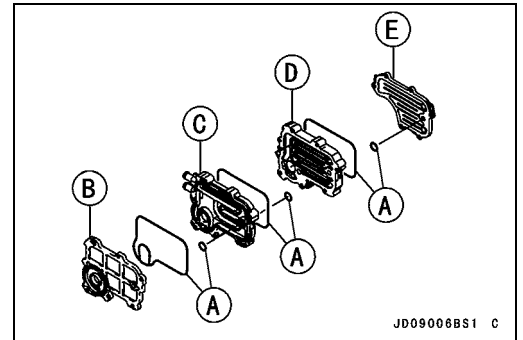
- Turn the oil cooler up side down.
- Remove:
 - O-ring [A]
 - Oil Cooler Assembly Bolts [B]
 - Inside Oil Cooler Cover [C]
 - O-rings



Oil Cooler

Oil Cooler Assembly

- Replace the O-rings [A] with new ones.
- Apply grease to new O-rings, and fit them on to each groove of the coolers securely.
- Assemble the oil cooler.
 - Inside Oil Cooler Cover [B]
 - Inside Oil Cooler [C]
 - Outside Oil Cooler [D]
 - Outside Oil Cooler Cover [E]



- Tighten the oil cooler assembly bolts as shown in the figure.

Torque - Oil Cooler Assembly Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

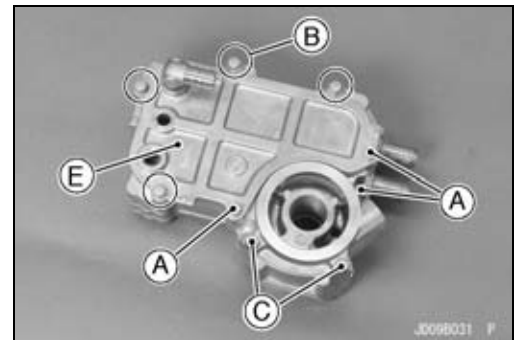
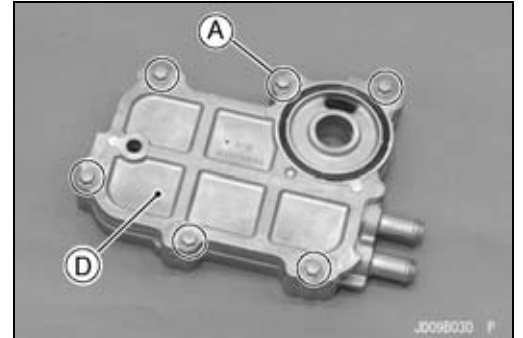
L = 20 mm (0.79 in.) [A]

L = 40 mm (1.6 in.) [B]

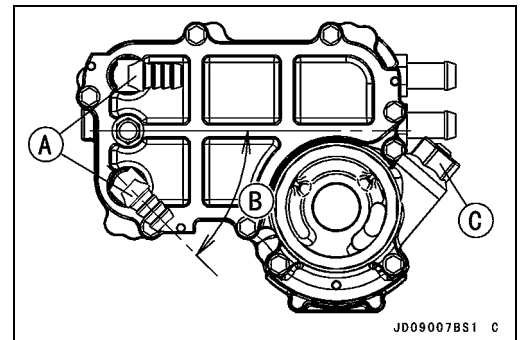
L = 45 mm (1.8 in.) [C]

Inside Oil Cooler Cover [D]

Outside Oil Cooler Cover [E]



- Install the elbows [A] as shown in the figure. 45° [B]
- Install the thermostat [C] (see Thermostat Installation).
 - Torque - Thermostat: 8.0 N·m (0.82 kgf·m, 71 in·lb)**
- Install the oil cooler (see Oil Cooler Installation).



Oil Cooler Inspection

- Start the engine to check for water and oil leaks.
- ★ If the water and oil leak, replace the O-rings.

WARNING

Do not run the engine in a closed area. Exhaust gases contain carbon monoxide, a colorless, odorless, poisonous gas which can be lethal.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.

4-18 ENGINE LUBRICATION SYSTEM

Thermostat

Thermostat Removal

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the thermostat [A].

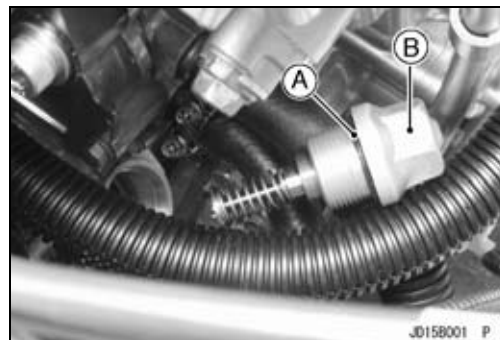


Thermostat Installation

- Replace the O-ring [A] with a new one.
- Apply grease to the new O-ring and install it.
- Install the thermostat [B].

Torque - Thermostat: 8.0 N·m (0.82 kgf·m, 71 in·lb)

- Install the seats (see Seat Installation in the Hull/Engine Hood chapter).



Thermostat Inspection

- Remove the thermostat (see Thermostat Removal).
- Raise the temperature of the oil to 150°C (302°F) while stirring the oil gently.
- Suspend the thermostat [A] and an accurate thermometer [B] in a container of hot oil for five minutes with the heat-sensitive portions [C] in almost the same depth.
- Check to see if the poppet valve [D] is coming down as the thermostat is heated.

CAUTION

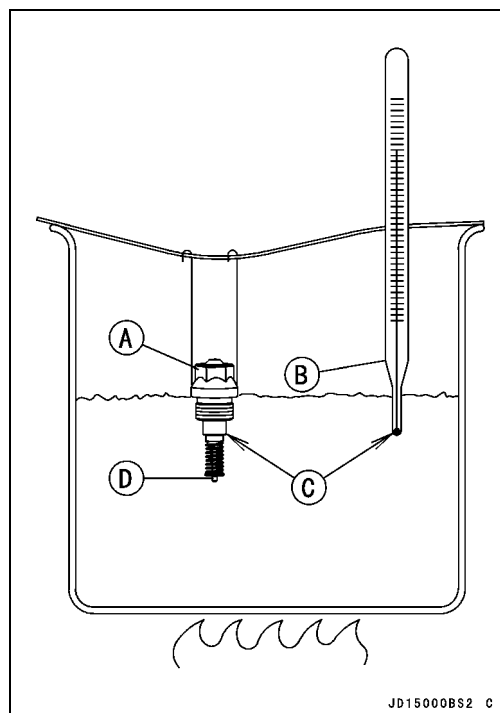
Keep to the specified time soaking the thermostat in the hot oil.

If the thermostat is soaked in the hot oil for a long time, it will malfunction.

NOTE

○The thermostat must be completely submerged and the thermostat and thermometer must not touch the container sides or bottom.

- ★ If the poppet valve does not move, replace the thermostat with a new one.
- Soak the thermostat in the room temperature oil and cool down it until it is at room temperature.
- Repeat above operation twice.



Thermostat

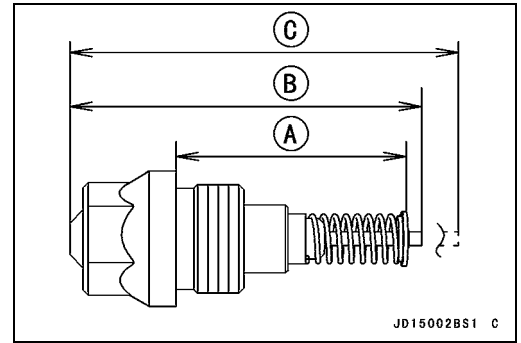
- Measure the poppet valve length [A] as shown in the figure at room temperature.

Standard: 45.4 ~ 47.4 mm (1.79 ~ 1.87 in.)

- ★ If the measurement is out of the standard, replace the thermostat with a new one.
- ★ If the thermostat length is good, go to next inspection.
- Measure and record the thermostat overall length [B] at room temperature.
- Soak the thermostat in the oil of the temperature 133°C (271°F) while stirring the oil gently.
- Suspend the thermostat and an accurate thermometer in a container of oil for five minutes with the heat-sensitive portions in almost the same depth.
- Take out the thermostat from the container and measure the overall length [C] immediately.
- Calculate $[C] - [B]$ to know the poppet valve lift and check if the poppet valve lift is within the standard.

Standard: more than 5.0 mm (0.20 in.)

- ★ If the measurement is shorter than the standard, replace the thermostat with a new one.

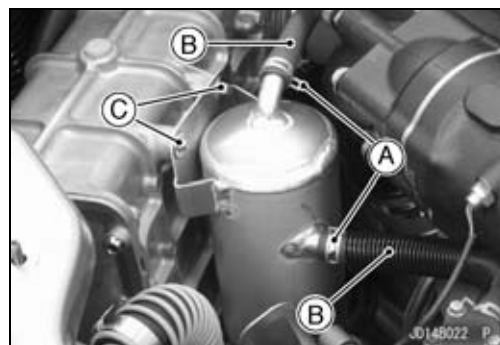


4-20 ENGINE LUBRICATION SYSTEM

Oil Separator Tank

Oil Separator Tank Removal

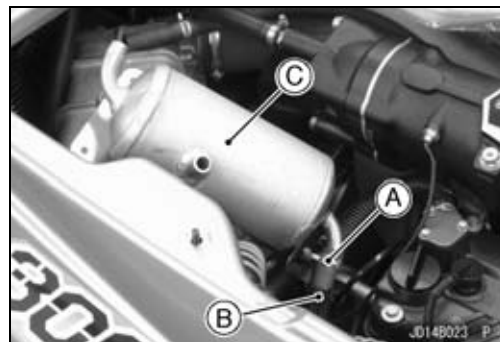
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Breather Hose Clamps [A]
 - Breather Hoses [B]
 - Oil Separator Tank Mounting Bolts [C] and Washers



- Remove:
 - Breather Hose Clamp [A]
 - Breather Hose [B]
 - Oil Separator Tank [C]

NOTE

○ Hold the hose end to the upward. The oil will flow out if the hose lies at the bottom.



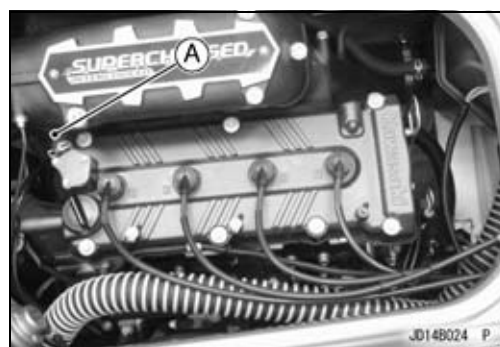
Oil Separator Tank Installation

- When installing the breather hoses, avoid sharp bending, kicking, flattening or twisting, and run the hoses according to Hose Routing section in Appendix chapter.
 - Apply a non-permanent locking agent to the oil separator tank mounting bolts, and tighten them.
- Be careful not to drop the nuts.

Torque - Oil Separator Tank Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

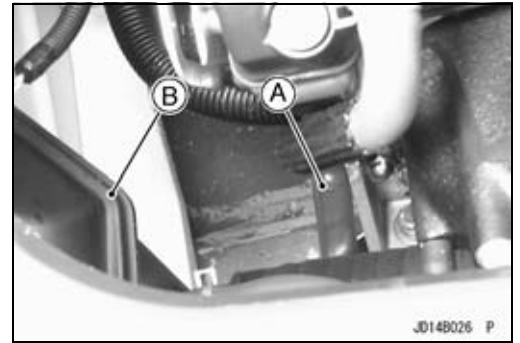
Blowby Gas System Inspection

- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly.
- ★ If they are not, correct them.
- Inspect the breather hoses [A], breather pipes and the air filter drain caps for damage or signs of deterioration. Squeeze the hoses. These hoses should not be hard and brittle, nor should be soft or swollen.
- ★ Replace any damaged hoses.
- Check that the hoses and clamps are securely connected.



Oil Separator Tank

- The drain cap [A] is provided beneath the air box [B]. The drain cap catches the water or oil from the bottom of the air box housing. Usually water or oil does not collect at the bottom of the housing. In the event that water is drawn in through the duct, or if engine oil is blown back, drain the housing.
- Pull the drain cap to drain the water or breather oil when changing engine oil.

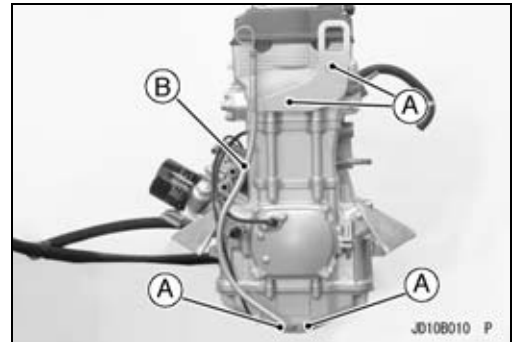


4-22 ENGINE LUBRICATION SYSTEM

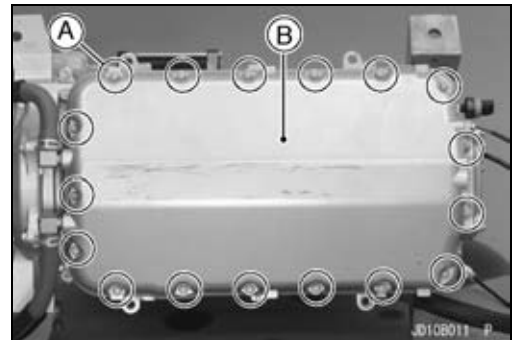
Oil Pan

Oil Pan Removal

- Remove:
 - Engine Oil (drain, see Engine Oil Change in the Periodic Maintenance chapter)
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Turn the engine to the side.
- Remove the dipstick tube bolts [A] and pull out the dipstick tube [B].



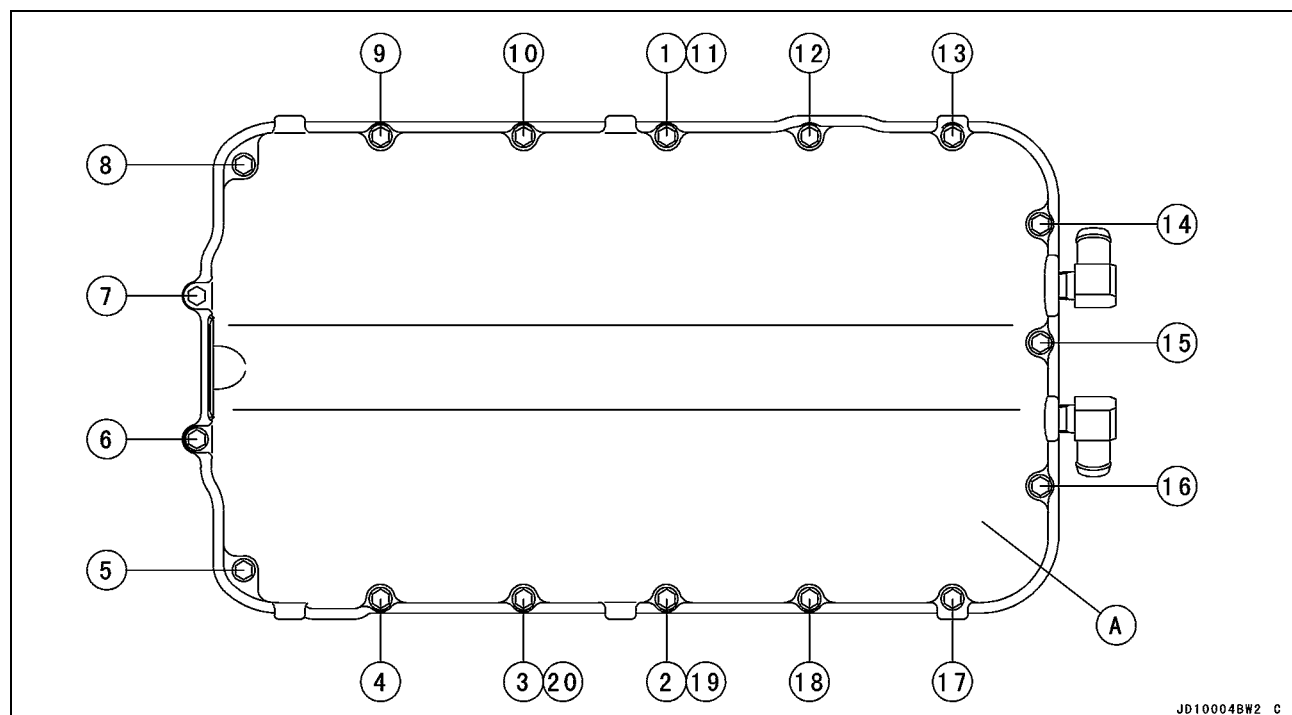
- Remove:
 - Oil Pan Bolts [A]
 - Oil Pan [B]
 - Oil Pan Gasket



Oil Pan Installation

- Replace the oil pan gasket with a new one.
- Install the oil pan [A].
- Tighten the oil pan bolts following the tightening sequence [1 ~ 20].

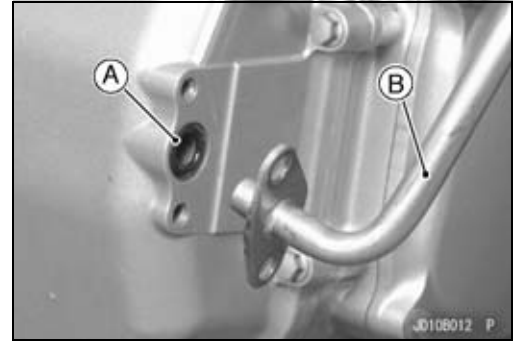
Torque - Oil Pan Bolts: 20 N·m (2.0 kgf·m, 15 ft·lb)



Oil Pan

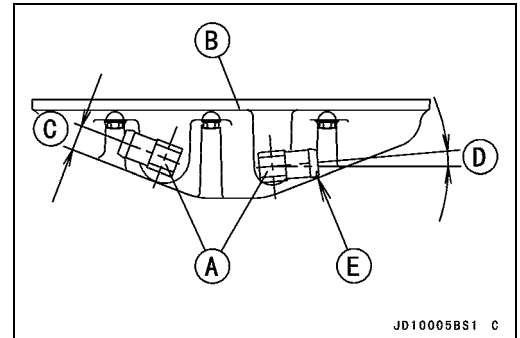
- Apply grease to the O-ring [A] on the dipstick tube [B].
- Apply a non-permanent locking agent to the dipstick tube bolts.
- Tighten the dipstick tube bolts temporary.
 - First, tighten the oil pan side bolt.
 - Next, tighten the cylinder head side bolts.

Torque - Dipstick Tube Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)



- When installing the oil passage joints [A] to the oil pan [B], note the following as shown in the figure.
 - Parallel [C] (Oil Passage Joint and Bottom Surface of Oil Pan)
 - 5° [D]
 - Do not protrude the oil passage joint from the oil pan [E].
- Apply a non-permanent locking agent to the oil passage joints and tighten them.

Torque - Oil Passage Joints: 7.8 N·m (0.80 kgf·m, 69 in·lb)

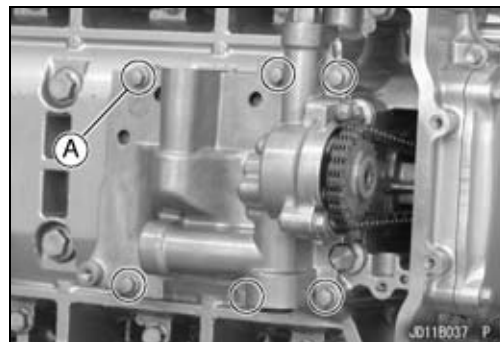
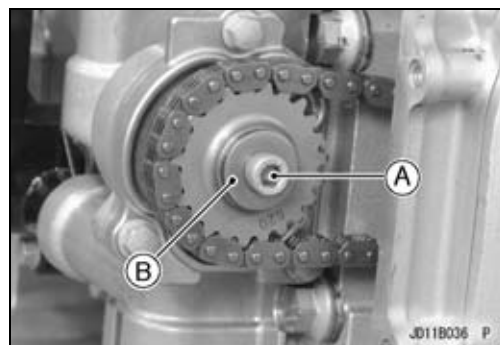


4-24 ENGINE LUBRICATION SYSTEM

Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

Oil Pump Sprocket Removal

- Drain:
Engine Oil (see Engine Oil Change in the Periodic Maintenance chapter)
- Remove:
Engine (see Engine Removal in the Engine Removal/Installation chapter)
Oil Pan (see Oil Pan Removal)
Oil Pump Sprocket Bolt [A]
Washer [B]
- Remove the oil pump body bolts [A].

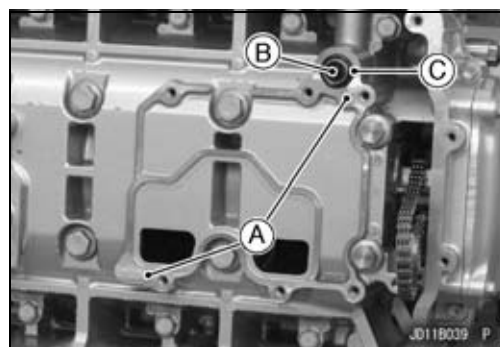


- Pull out the oil pump body [A] and remove the oil pump sprocket [B].



Oil Pump Sprocket Installation

- Check that dowel pins [A] and oil pipe [B] are in place on the crankcase.
- Replace the O-ring [C] with a new one.



- Engage the oil pump chain with the oil pump sprocket [A].
- Install the oil pump sprocket so that the “620” Mark [B] faces outward on the oil pump body [C].
- Install the oil pump body.
- Tighten:

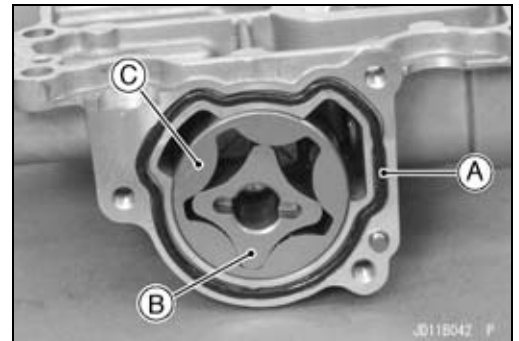
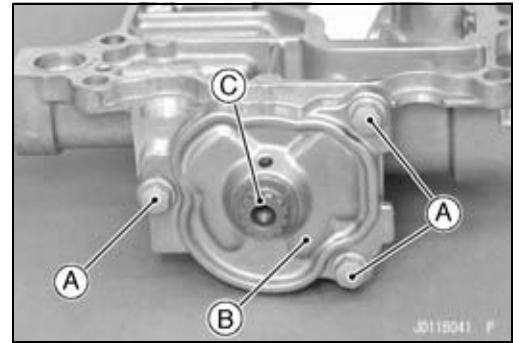
Torque - Oil Pump Body Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)



Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

Oil Pump Removal

- Drain:
Engine Oil (see Engine Oil Change in the Periodic Maintenance chapter)
- Remove:
Engine (see Engine Removal in the Engine Removal/Installation chapter)
Oil Pan (see Oil Pan Removal)
Oil Pump Body (see Oil Pump Sprocket Removal)
Oil Pump Cover Bolts [A]
- Pull out the oil pump cover [B] and oil pump shaft [C].
- Remove:
O-ring [A]
Inner Rotor [B]
Outer Rotor [C]



Oil Pump Installation

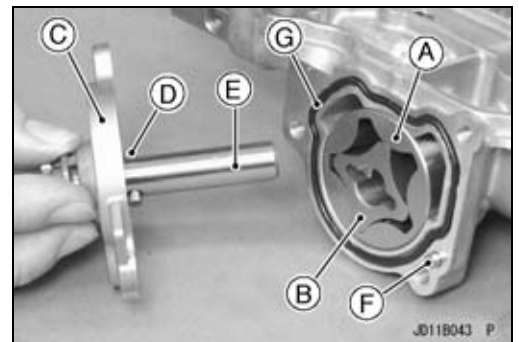
- Replace the O-ring with a new one.
- Apply molybdenum disulfide oil solution to the outer and the inner rotors out side.
- Install the outer rotor [A] and inner rotor [B] into the oil pump body.
- Apply molybdenum disulfide oil solution to the shaft.
- Assemble the oil pump cover [C], pin [D] onto the oil pump shaft [E].
- Fit the pin into the slot of the inner rotor.
- Insert the shaft assembly.
- Be sure the dowel pin [F] is in place in the oil pump body.
- Apply grease to the new O-ring [G] and fit the O-ring to the groove of the oil pump body.
- Fit the oil pump cover and tighten the oil pump cover bolts.

Torque - Oil Pump Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

- Install:
Oil Pump Sprocket (see Oil Pump Sprocket Installation)
Oil Pan (see Oil Pan Installation)

Oil Pump Inspection

- Remove the oil pump parts.
- Visually inspect the oil pump outer, inner rotors and cover.
- ★ If there is any damage or uneven wear, replace the rotors and cover.

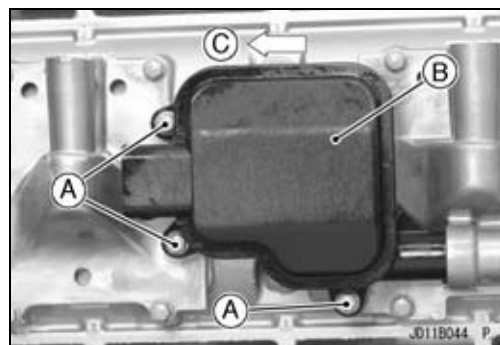


4-26 ENGINE LUBRICATION SYSTEM

Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

Oil Screen Removal

- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Oil Pan (see Oil Pan Removal)
 - Oil Screen Bolts [A]
- Pull out the oil screen [B] to the coupling side [C].

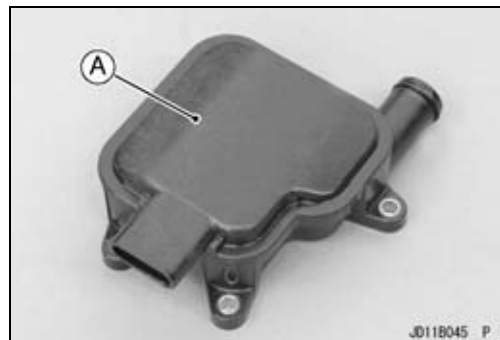


Oil Screen Installation

- Clean the oil screen [A] with high-flash point solvent and remove any particles stuck to it.

WARNING

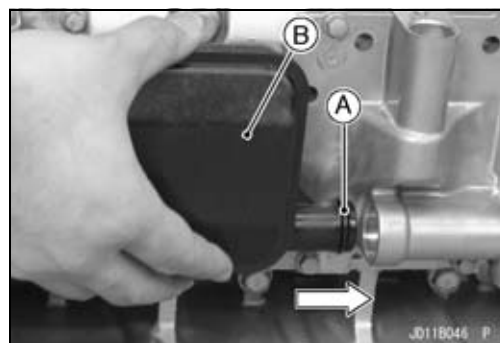
Clean the screen in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvents.



NOTE

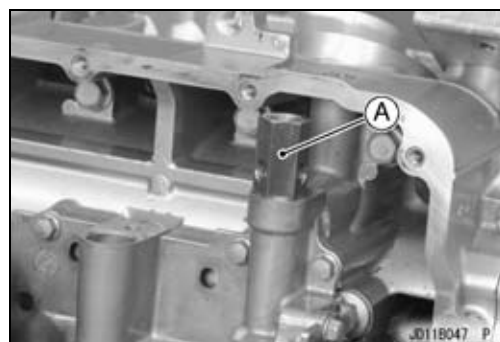
○While cleaning the screen, check for any metal particles that might indicate internal engine damage.

- Replace the O-ring [A] with a new one.
- Apply grease to the O-ring and install it.
- Install the oil screen [B].
- Tighten:
 - Torque - Oil Screen Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)
- Install:
 - Oil Pan (see Oil Pan Installation)



Oil Pressure Relief Valve Inspection

- Remove:
 - Oil Pan (see Oil Pan Removal)
 - Oil Pressure Relief Valve [A]



Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

- Check to see if the valve [A] slides smoothly when pushing it in with a wooden or other soft rod, and see if it comes back to its seat by spring [B] force.

NOTE

Inspect the valve in its assembled state. Disassembly and assembly may change the valve performance.

- ★ If any rough spots are found during above inspection, wash the valve clean with a high-flash point solvent and blow out any foreign particles that may be in the valve with compressed air.

⚠ WARNING

Clean the relief valve in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvent.

- ★ If cleaning does not solve the problem, replace the oil pressure relief valve as an assembly. The oil pressure relief valve is precisely made with no allowance for replacement of individual parts.
- Apply a non-permanent locking agent (high strength: Loc-tite 271 equivalent) to the oil pressure relief valve.

CAUTION

Do not apply too much non-permanent locking agent to the threads. This may block the oil passage.

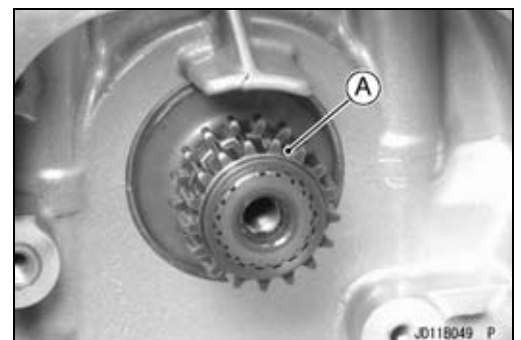
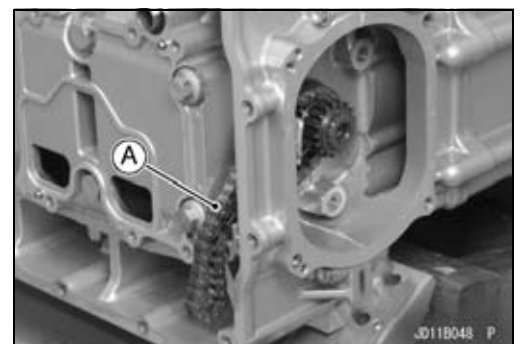
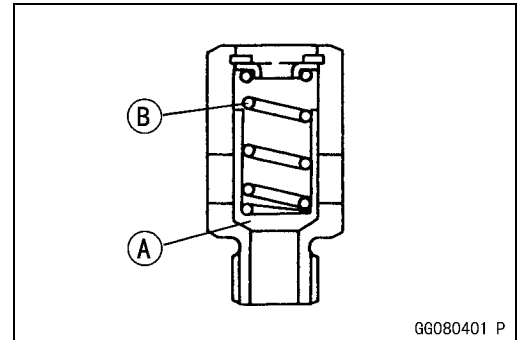
- Install the oil pressure relief valve.
- Torque - Oil Pressure Relief Valve: 15 N·m (1.5 kgf·m, 11 ft·lb)**

Oil Pump Chain Removal/Installation

- Remove:
 - Camshaft Chain (see Camshaft Chain Removal in the Engine Top End chapter)
 - Oil Pump Sprocket (see Oil Pump Sprocket Removal)
- Remove the oil pump chain [A].
- Installation is reverse of removal.

Crankshaft Sprocket Removal

- Remove the oil pump chain (see Oil Pump Chain Removal).
- Remove the crankshaft sprocket [A].

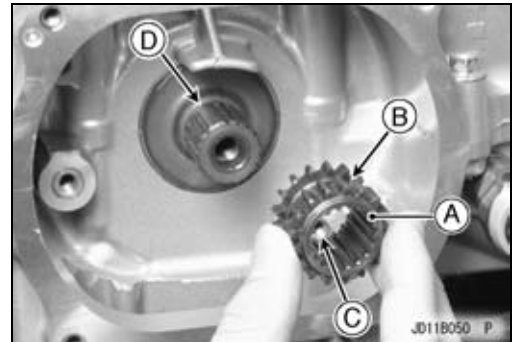


4-28 ENGINE LUBRICATION SYSTEM

Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

Crankshaft Sprocket Installation

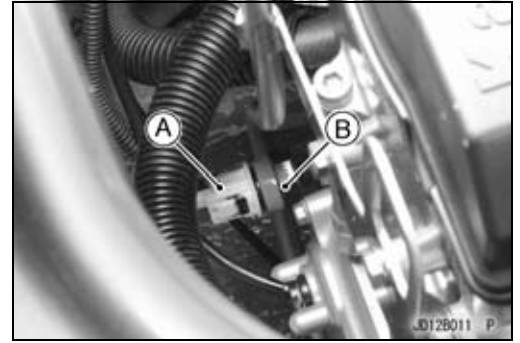
- Install the crankshaft sprocket [A] so that the wide gear [B] of the sprocket faces outward and fit the wide groove [C] of the sprocket onto the wide spline [D] of the crank shaft.
- Install the removed parts.



Oil Pressure Measurement

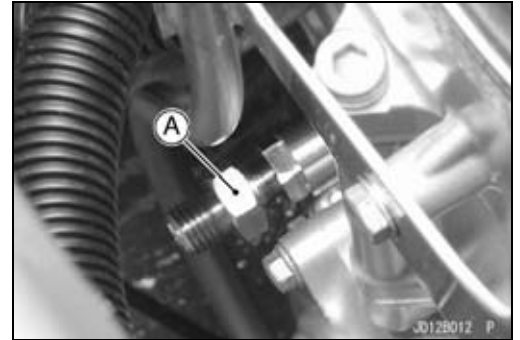
Oil Pressure Measurement

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Oil Pressure Switch Connector [A] (disconnect)
 - Oil Pressure Switch [B]



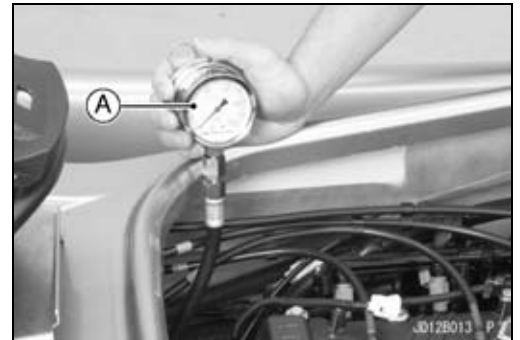
- Install the oil pressure gauge adapter [A] to the switch hole.

Special Tool - Oil Pressure Gauge Adapter, PT 1/8: 57001-1033



- Install the oil pressure gauge [A] to the adapter.

Special Tool - Oil Pressure Gauge, 10 kgf/cm²: 57001-164



- Launch the watercraft.
- Start the engine for several minutes.
- Run the engine at the specified speed, and read the oil pressure gauge.
- ★ If the oil pressure is significantly below the specification, inspect the oil pump and relief valve.
- ★ If the oil pump and relief valve are not at fault, inspect the rest of the lubrication system.

Oil Pressure

Standard: 410 kPa (4.2 kgf/cm², 59 psi) @3 000 r/min (rpm), oil temperature 78°C (172°F)

- Stop the engine.
- Raise the watercraft to the land.
- Remove the oil pressure gauge and adapter.

WARNING

Take care against burns from hot engine oil that will drain through the oil passage when the gauge adapter is removed.

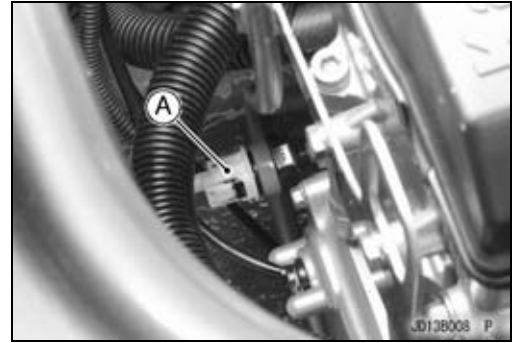
- Install:
 - Oil Pressure Switch (see Oil Pressure Switch Installation)

4-30 ENGINE LUBRICATION SYSTEM

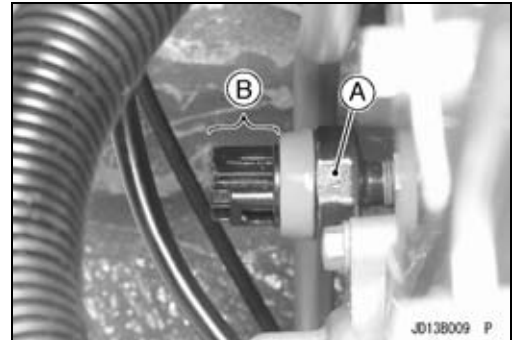
Oil Pressure Switch

Oil Pressure Switch Removal

- Remove:
 - Seals (see Seal Removal in the Hull/Engine Hood chapter)
 - Oil Pressure Switch Connector [A] (disconnect)



- Place a rag or cloth under the oil pressure switch [A] and remove the oil pressure switch.
- Do not damage the connect part [B] of the switch.



Oil Pressure Switch Installation

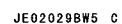
- Apply a non-permanent locking agent to the threads of the oil pressure switch and tighten it.
 - Torque - Oil Pressure Switch: 15 N·m (1.5 kgf·m, 11 ft·lb)**
- Connect the oil pressure switch connector.
- Install the removed parts.

Exhaust System

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Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Exhaust Pipe Mounting Bolt (L = 95 mm)	35	3.6	26	
2	Exhaust Pipe Mounting Bolts (L = 120 mm)	35	3.6	26	
3	Mark Plate Bolts	5.0	0.51	44 in·lb	
4	Exhaust Pipe Mounting Bolt (L = 150 mm)	45	4.6	33	
5	Exhaust Manifold Mounting Nuts	30	3.1	22	
6	Exhaust Manifold Mounting Bolts (L = 120 mm)	30	3.1	22	
7	Exhaust Manifold Mounting Bolts (L = 140 mm)	30	3.1	22	
8	Water Hose Joint	20	2.0	15	L
9	Muffler Body Bolts	45	4.6	33	
10	Front Exhaust Hose Clamp Screws	4.9	0.50	43 in·lb	
11	Rear Exhaust Hose Clamp Screws	4.9	0.50	43 in·lb	

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent (High Strength).

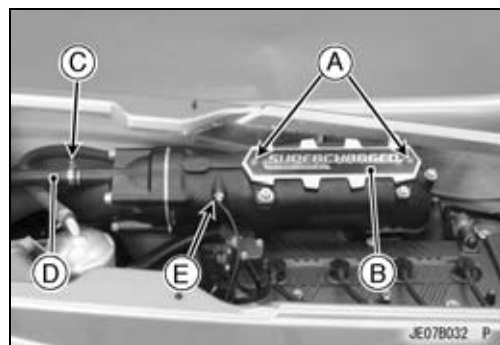
R: Replacement Parts

5-4 EXHAUST SYSTEM

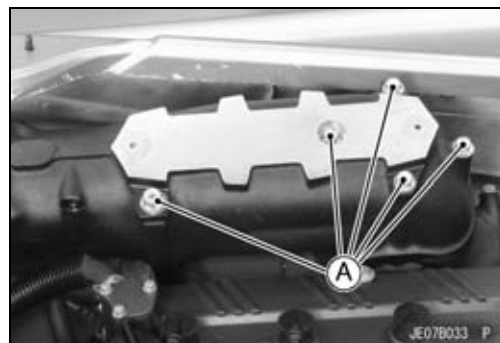
Exhaust Pipe and Muffler Body

Exhaust Pipe and Muffler Body Removal

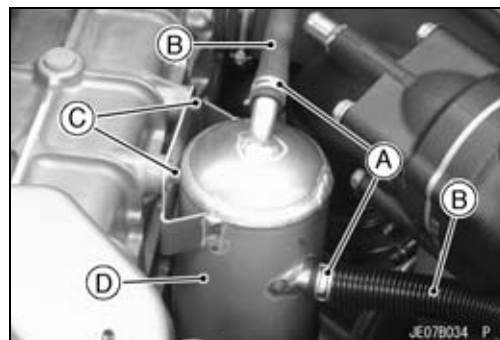
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Mark Plate Bolts [A]
 - Mark Plate [B]
 - Clamp Screw [C] (Loosen)
 - Water Hose [D]
 - Water Temperature Sensor [E] (see Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter)



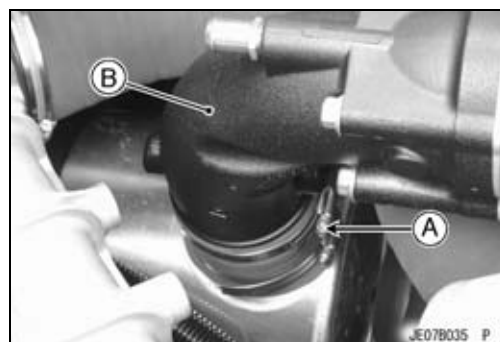
- Remove the exhaust pipe bolts [A] and washers.



- Remove:
 - Clamps [A]
 - Breather Hoses [B]
 - Bolts and Washers [C]
- Put the oil separator tank [D] forward.

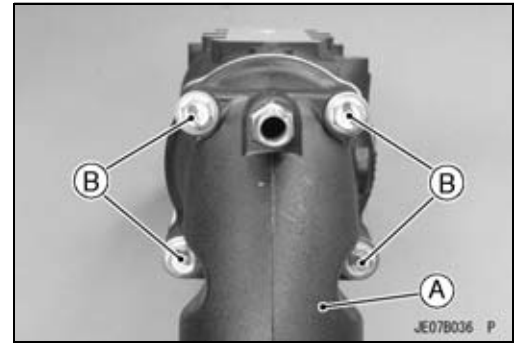


- Loosen the clamp [A].
- Remove the exhaust pipe and muffler body [B] as a set.



Exhaust Pipe and Muffler Body

- To remove the muffler body [A] from the exhaust pipe, remove the bolts [B] and washers.



5-6 EXHAUST SYSTEM

Exhaust Pipe and Muffler Body

Exhaust Pipe and Muffler Body Installation

- Replace the exhaust pipe gasket [A] and muffler body gaskets [B] with new ones.
- Install the exhaust pipe and muffler body parts as shown in the figure.

“R” Mark [C]

View L [D]

Port Side [E]

Starboard Side [F]

Filter [G]

Blue Mark [H]

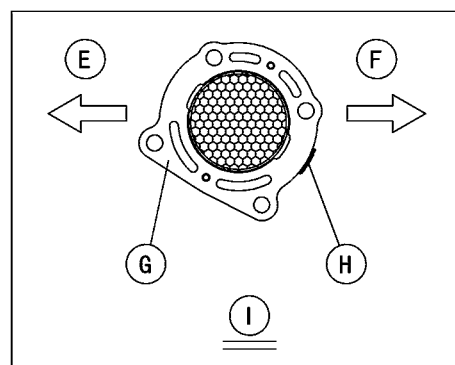
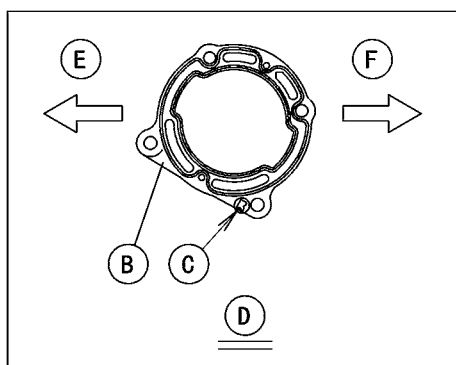
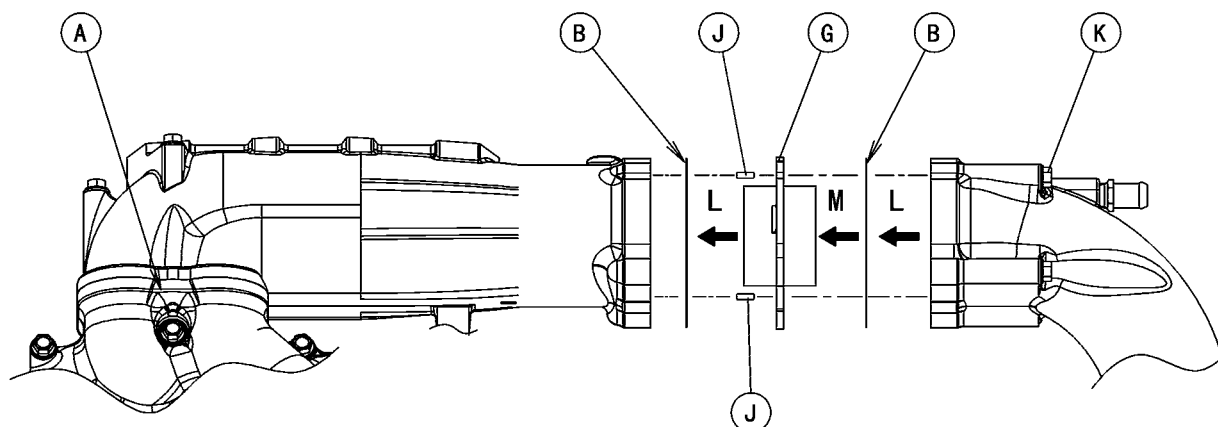
View M [I]

Pins [J]

Muffler Body Bolts [K] and Washers

- Tighten:

Torque - Muffler Body Bolts: 45 N·m (4.6 kgf·m, 33 ft·lb)



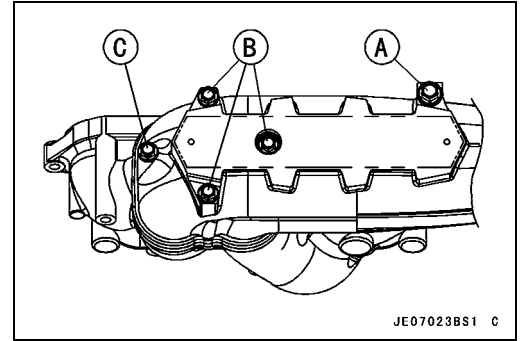
Exhaust Pipe and Muffler Body

- Install the exhaust pipe and muffler body securely.
- Install the exhaust pipe mounting bolts and washers as follows, and tighten them.

Torque - Exhaust Pipe Mounting Bolt (L = 150 mm) [A]: 45 N·m (4.6 kgf·m, 33 ft·lb)

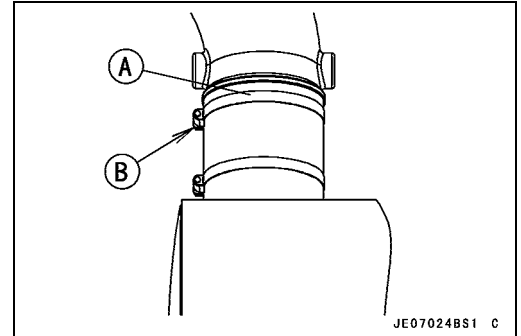
Exhaust Pipe Mounting Bolts (L = 120 mm) [B]: 35 N·m (3.6 kgf·m, 26 ft·lb)

Exhaust Pipe Mounting Bolt (L = 95 mm) [C]: 35 N·m (3.6 kgf·m, 26 ft·lb)



- Install the clamp [A] as shown in the figure.
- Tighten:

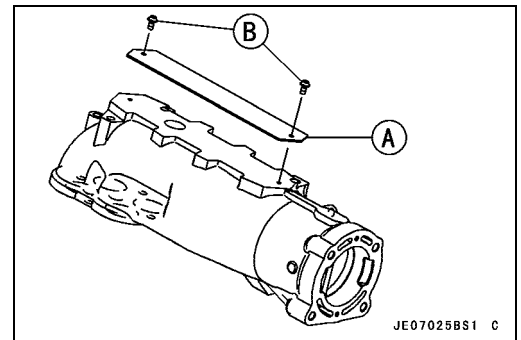
Torque - Front Exhaust Hose Clamp Screws [B]: 4.9 N·m (0.50 kgf·m, 43 in·lb)



- Install the mark plate [A].
- Tighten:

Torque - Mark Plate Bolts [B]: 5.0 N·m (0.51 kgf·m, 44 in·lb)

- Install the removed parts (see appropriate chapters).



Exhaust Pipe and Muffler Body Cleaning and Inspection

- Remove the exhaust pipe and muffler body parts (see Exhaust Pipe and Muffler Body Removal).
- Clean the carbon deposits out of the exhaust passages with a blunt, round edged tool.
- Flush foreign matter out of the water passages with fresh water.
- Check the insides of the water passages for corrosion.
- Check the gasket surfaces of the exhaust pipe and muffler body for nicks or other damage.
- ★ If there is excessive corrosion or if the gasket surfaces are so badly damaged that they will not seal properly, replace the part.

Muffler Body Filter Inspection

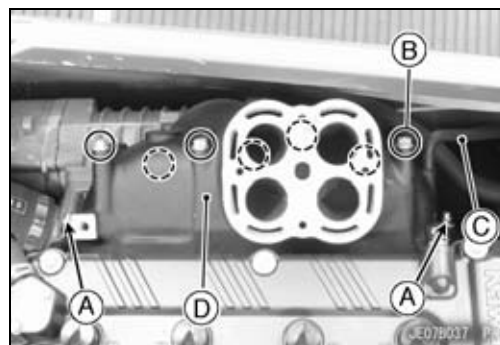
- Refer to the Muffler Body Filter Inspection in the periodic Maintenance chapter.

5-8 EXHAUST SYSTEM

Exhaust Manifold

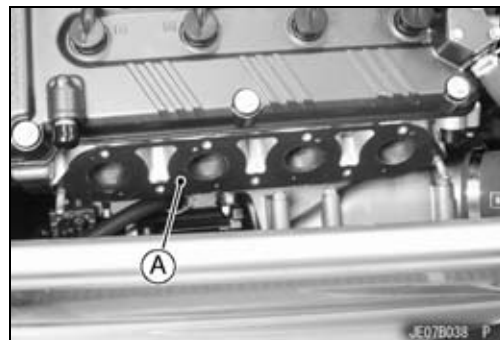
Exhaust Manifold Removal

- Remove the exhaust pipe and muffler body (see Exhaust Pipe and Muffler Body Removal).
- Remove the exhaust manifold mounting nuts [A], bolts [B] and washers.
- Disconnect the flushing hose [C].
- Remove the exhaust manifold [D].



Exhaust Manifold Installation

- Replace the exhaust manifold gasket with a new one.
- Install the new gasket [A] and the exhaust manifold.



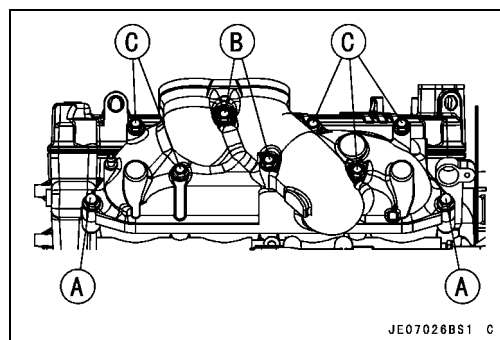
- Install the exhaust manifold mounting nuts, bolts and washers as follows, and tighten them.

Torque - Exhaust Manifold Mounting Nuts [A]: 30 N·m (3.1 kgf·m, 22 ft·lb)

Exhaust Manifold Mounting Bolts (L = 140 mm)
[B]: 30 N·m (3.1 kgf·m, 22 ft·lb)

Exhaust Manifold Mounting Bolts (L = 120 mm)
[C]: 30 N·m (3.1 kgf·m, 22 ft·lb)

- Install the removed parts (see appropriate chapters).



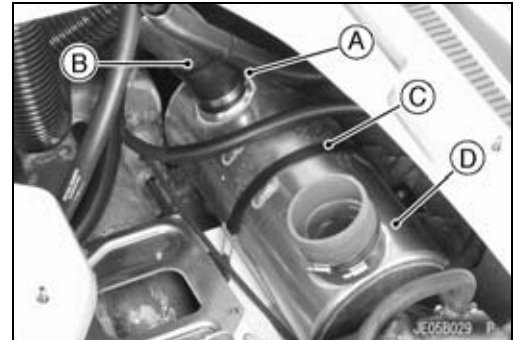
Exhaust Manifold Cleaning and Inspection

- Remove the exhaust manifold (see Exhaust Manifold Removal).
- Clean the carbon deposits out of the exhaust passages with a blunt, round edged tool.
- Flush foreign matter out of the water passages with fresh water.
- Check the insides of the water passages for corrosion.
- Check the gasket surfaces of the exhaust manifold for nicks or other damage.
- ★ If there is excessive corrosion or if the gasket surfaces are so badly damaged that they will not seal properly, replace the part.

Water Box Muffler

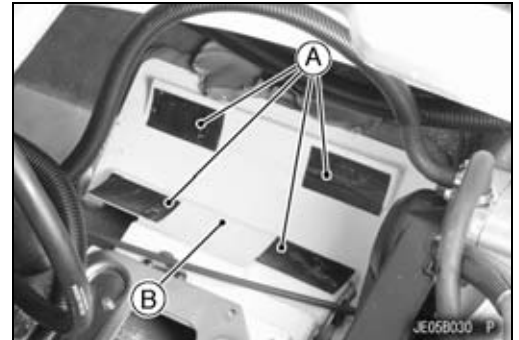
Water Box Muffler Removal

- Remove:
Exhaust Pipe and Muffler Body (see Exhaust Pipe and Muffler Body Removal)
Intercooler (see Intercooler Removal in the Cooling and Bilge System chapter)
- Loosen the clamp [A], and remove the exhaust hose [B].
- Unhook the rubber strap [C] from the water box muffler [D].
- Remove the water box muffler.

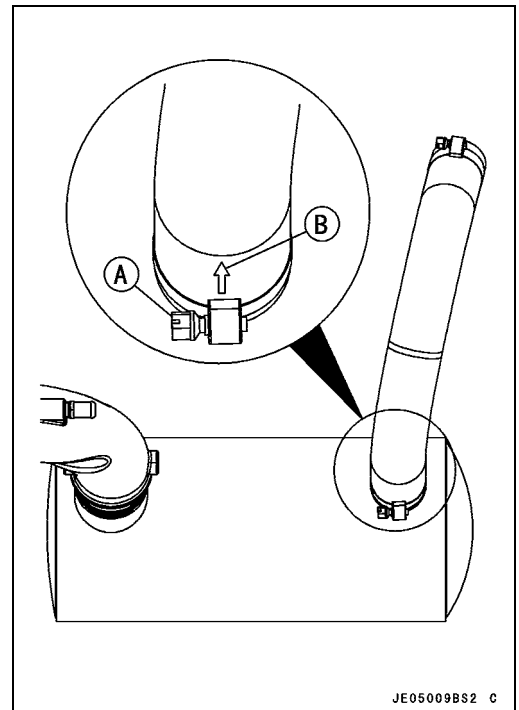


Water Box Muffler Installation

- Be sure the dampers [A] on the hull [B] are in place.



- Install the exhaust hose so that the arrow mark [B] are left side.
- Install the clamp [A] as shown in the figure.
- Tighten:
Torque - Rear Exhaust Hose Clamp Screws: 4.9 N·m (0.50 kgf·m, 43 in·lb)
- For other clamps, tighten the clamp securing the front exhaust hose, noting its screw position, and check the hose routing and clamp screw position (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the removed parts (see appropriate chapters).

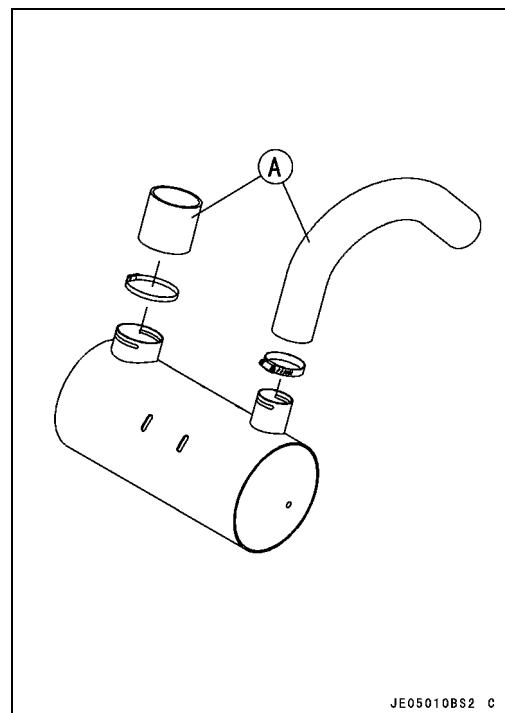


5-10 EXHAUST SYSTEM

Water Box Muffler

Exhaust Hose Inspection

- Remove the exhaust hoses [A] (see Water Box Muffler Removal).
- Check the exhaust hoses for damage caused by excessive heat.
- ★ If there is heat damage to the exhaust hose, check the cooling system for blockage (see Cooling and Bilge System Flow Diagram section in the Cooling and Bilge Systems chapter).



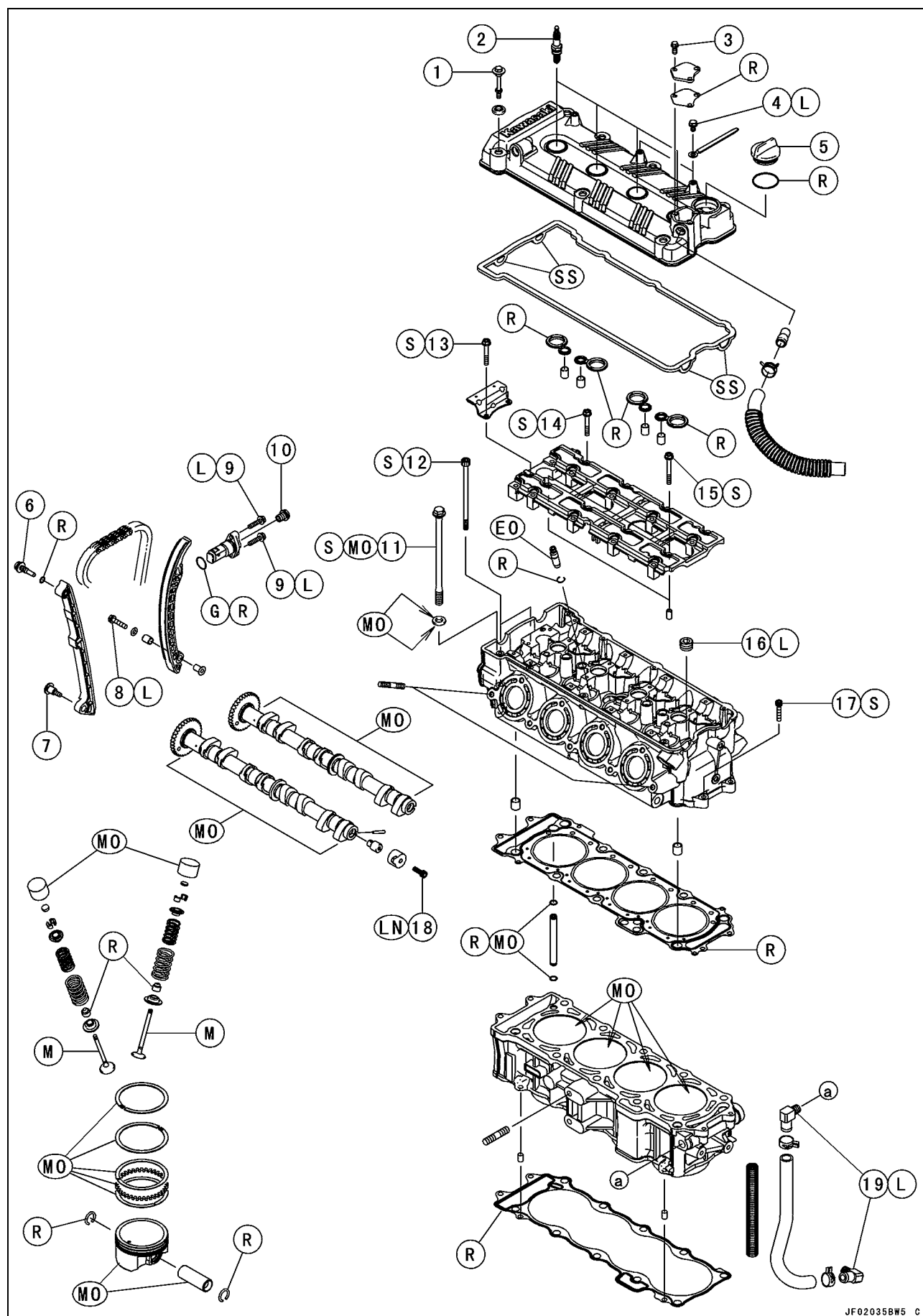
Engine Top End

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6-2 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Cylinder Head Cover Bolts	10	1.0	89 in·lb	
2	Spark Plugs	13	1.3	115 in·lb	
3	Cylinder Head Cover Plate Bolts	7.8	0.80	69 in·lb	
4	Harness Clamp Mounting Bolts	8.8	0.90	78 in·lb	L
5	Oil Filler Cap	—	—	—	Hand-tighten
6	Exhaust Side Camshaft Chain Guide Bolt (Upper)	25	2.5	18	
7	Exhaust Side Camshaft Chain Guide Bolt (Lower)	12	1.2	106 in·lb	
8	Intake Side Camshaft Chain Guide Bolt	12	1.2	106 in·lb	L
9	Camshaft Chain Tensioner Mounting Bolts	10	1.0	89 in·lb	L
10	Camshaft Chain Tensioner Cap Bolt	20	2.0	15	
11	Cylinder Head Bolts (M11, First)	22.5	2.3	17	MO, S
	Cylinder Head Bolts (M11, Final)	70	7.1	52	MO, S
12	Cylinder Head Bolts (M7)	20	2.0	15	S
13	Upper Camshaft Chain Guide Bolts	12	1.2	106 in·lb	S
14	Camshaft Cap Bolts (L = 40 mm)	12	1.2	106 in·lb	S
15	Camshaft Cap Bolts (L = 50 mm)	12	1.2	106 in·lb	S
16	Water Jacket Plugs	19.6	2.0	14	L
17	Cylinder Head Bolts (M6)	12	1.2	106 in·lb	S
18	Camshaft Position Sensor Rotor Bolt	12	1.2	106 in·lb	LN
19	Oil Passage Joints	7.8	0.80	69 in·lb	L

EO: Apply engine oil.

G: Apply grease.

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).

M: Apply molybdenum disulfide grease.

MO: Apply molybdenum disulfide oil solution.

(mixture of engine oil and molybdenum disulfide grease in a weight ratio is 10:1)

R: Replacement Parts

S: Follow the specified tightening sequence.

SS: Apply silicone sealant.

6-4 ENGINE TOP END

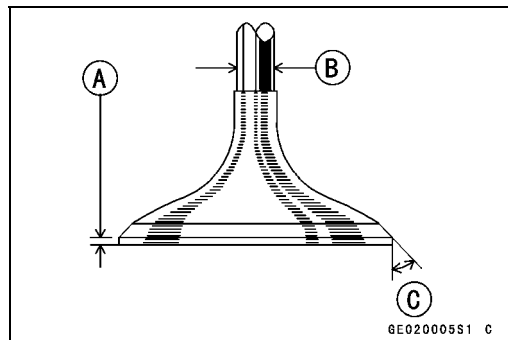
Specifications

Item	Standard	Service Limit
Camshafts		
Cam Height:		
Exhaust	36.042 ~ 36.156 mm (1.4190 ~ 1.4235 in.)	35.94 mm (1.415 in.)
Intake	36.442 ~ 36.556 mm (1.4347 ~ 1.4392 in.)	36.34 mm (1.431 in.)
Camshaft Journal, Camshaft Cap Clearance	0.028 ~ 0.071 mm (0.0011 ~ 0.0028 in.)	0.16 mm (0.0063 in.)
Camshaft Journal Diameter	23.950 ~ 23.972 mm (0.9429 ~ 0.9438 in.)	23.92 mm (0.942 in.)
Camshaft Bearing Inside Diameter	24.000 ~ 24.021 mm (0.9449 ~ 0.9457 in.)	24.08 mm (0.948 in.)
Camshaft Runout	TIR 0.02 mm (0.0008 in.) or less	TIR 0.1 mm (0.004 in.)
Cylinder Head		
Cylinder Compression	(Usable Range) 840 ~ 1 298 kPa (8.6 ~ 13.2 kgf/cm ² , 122 ~ 188 psi) @383 r/min. (rpm)	— — —
Cylinder Head Warp	— — —	0.05 mm (0.0020 in.)
Valves		
Valve Clearance:		
Exhaust	0.47 ~ 0.55 mm (0.0185 ~ 0.0217 in.)	— — —
Intake	0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.)	— — —
Valve Head Thickness:		
Exhaust	0.8 mm (0.03 in.)	0.4 mm (0.02 in.)
Intake	0.5 mm (0.02 in.)	0.3 mm (0.012 in.)
Valve Stem Bend	TIR 0.01 mm (0.0004 in.) or less	TIR 0.05 mm (0.002 in.)
Valve Stem Diameter:		
Exhaust	4.945 ~ 4.960 mm (0.1947 ~ 0.1953 in.)	4.93 mm (0.194 in.)
Intake	4.975 ~ 4.990 mm (0.1959 ~ 0.1965 in.)	4.96 mm (0.195 in.)
Valve Guide Inside Diameter:		
Exhaust	5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.)	5.08 mm (0.200 in.)
Intake	5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.)	5.08 mm (0.200 in.)
Valve/Valve Guide Clearance (Wobble Method):		
Exhaust	0.11 ~ 0.18 mm (0.0043 ~ 0.0071 in.)	0.37 mm (0.015 in.)
Intake	0.03 ~ 0.10 mm (0.0012 ~ 0.0039 in.)	0.29 mm (0.011 in.)
Valve Seat Cutting Angle	32°, 45°, 55°, 60°	— — —
Valve Seating Surface:		
Outside Diameter:		
Exhaust	28.5 ~ 28.7 mm (1.122 ~ 1.130 in.)	— — —
Intake	32.6 ~ 32.8 mm (1.283 ~ 1.291 in.)	— — —
Width:		
Exhaust	1.8 ~ 2.2 mm (0.071 ~ 0.087 in.)	— — —
Intake	0.5 ~ 1.0 mm (0.020 ~ 0.039 in.)	— — —
Valve Spring Free Length:		
Exhaust (Inner)	38.1 mm (1.50 in.)	36.7 mm (1.44 in.)
Exhaust (Outer)	46.0 mm (1.81 in.)	44.5 mm (1.75 in.)
Intake (Inner)	38.0 mm (1.50 in.)	36.5 mm (1.44 in.)

Specifications

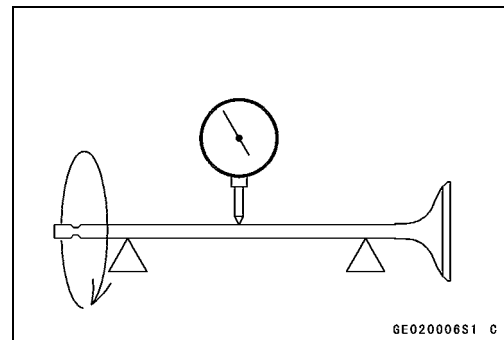
Item	Standard	Service Limit
Intake (Outer)	45.8 mm (1.80 in.)	44.2 mm (1.74 in.)
Cylinder, Piston		
Cylinder Inside Diameter	82.994 ~ 83.006 mm (3.2675 ~ 3.2679 in.)	83.09 mm (3.271 in.)
Piston Diameter	82.919 ~ 82.934 mm (3.2645 ~ 3.2651 in.)	82.77 mm (3.259 in.)
Piston/Cylinder Clearance	0.060 ~ 0.087 mm (0.0024 ~ 0.0034 in.)	— — —
Piston Ring/Groove Clearance:		
Top	0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)	0.17 mm (0.0067 in.)
Second	0.02 ~ 0.06 mm (0.0008 ~ 0.0024 in.)	0.16 mm (0.0063 in.)
Piston Ring Groove Width:		
Top	0.92 ~ 0.94 mm (0.0362 ~ 0.0370 in.)	1.02 mm (0.0402 in.)
Second	1.01 ~ 1.03 mm (0.0398 ~ 0.0406 in.)	1.11 mm (0.0437 in.)
Piston Ring Thickness:		
Top	0.87 ~ 0.89 mm (0.0343 ~ 0.0350 in.)	0.80 mm (0.0315 in.)
Second	0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)	0.90 mm (0.0354 in.)
Piston Ring End Gap:		
Top	0.25 ~ 0.40 mm (0.0098 ~ 0.0157 in.)	0.7 mm (0.0276 in.)
Second	0.40 ~ 0.55 mm (0.0157 ~ 0.0217 in.)	0.8 mm (0.0315 in.)

Valve Head Thickness



Valve Head Thickness [A]
Valve Stem Diameter [B]
45° [C]

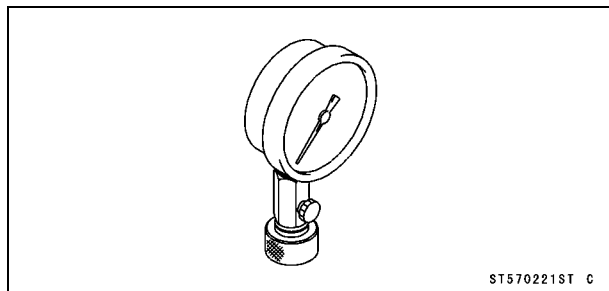
Valve Stem Bend



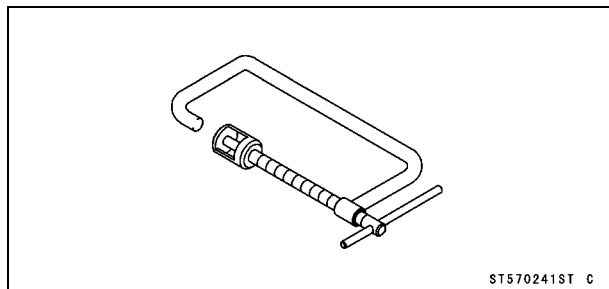
6-6 ENGINE TOP END

Special Tools and Sealant

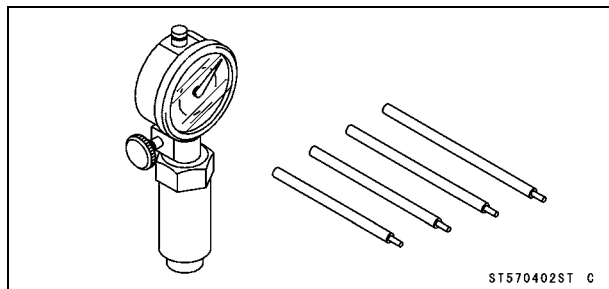
Compression Gauge, 20 kgf/cm²:
57001-221



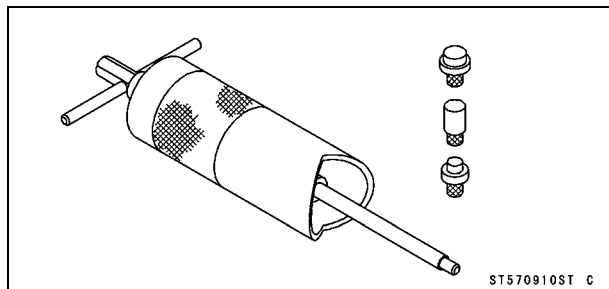
Valve Spring Compressor Assembly:
57001-241



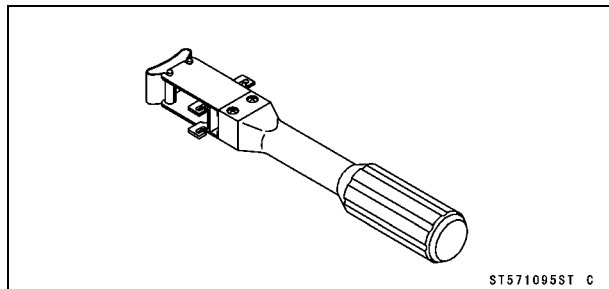
Top Dead Center Finder:
57001-402



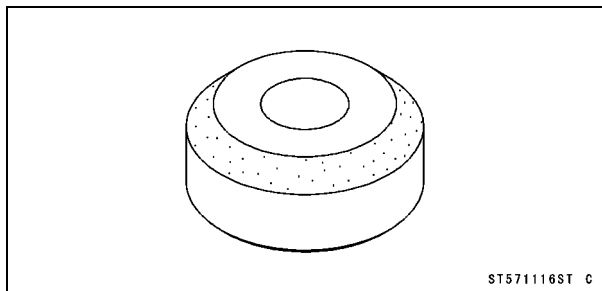
Piston Pin Puller Assembly:
57001-910



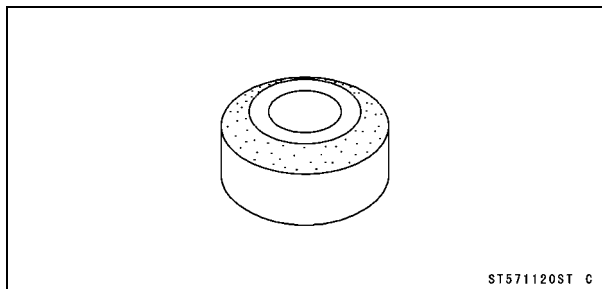
Piston Ring Compressor Grip:
57001-1095



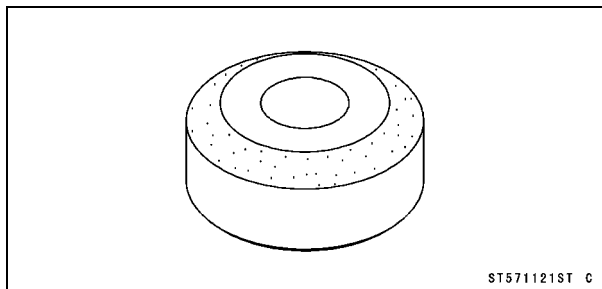
Valve Seat Cutter, 45° - ϕ 35:
57001-1116



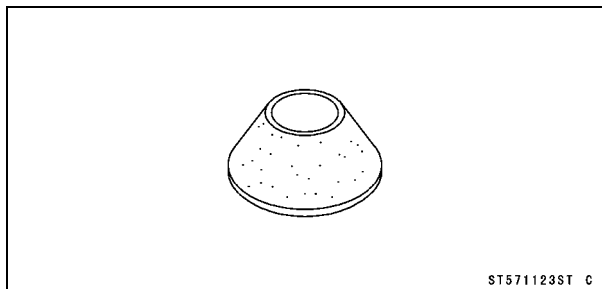
Valve Seat Cutter, 32° - ϕ 30:
57001-1120



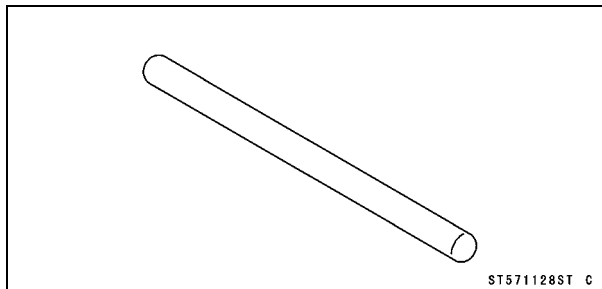
Valve Seat Cutter, 32° - ϕ 35:
57001-1121



Valve Seat Cutter, 60° - ϕ 30:
57001-1123

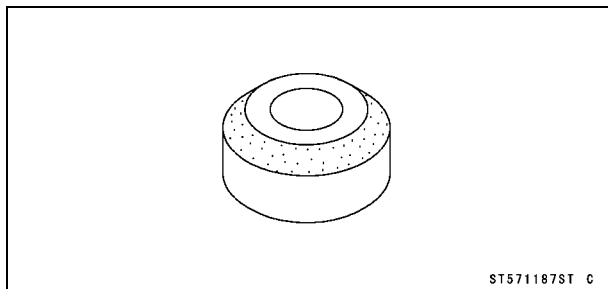


Valve Seat Cutter Holder Bar:
57001-1128

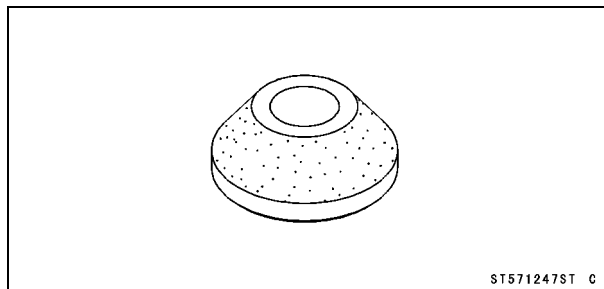


Special Tools and Sealant

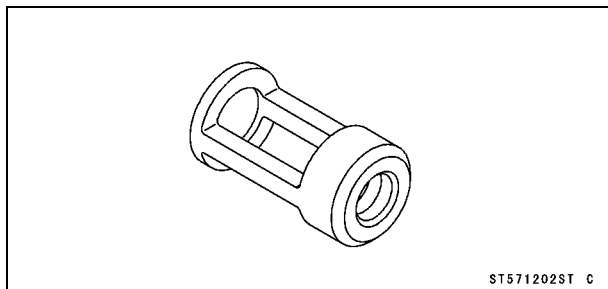
Valve Seat Cutter, 45° - $\phi 30$:
57001-1187



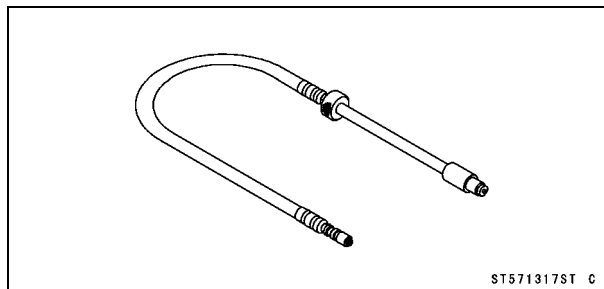
Valve Seat Cutter, 55° - $\phi 35$:
57001-1247



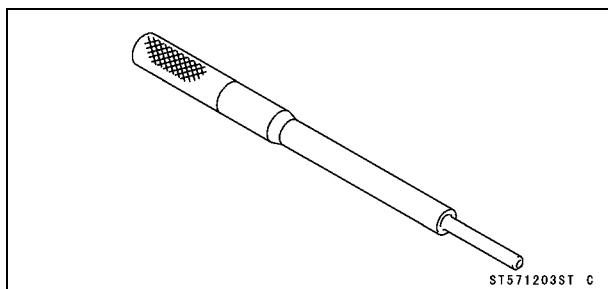
Valve Spring Compressor Adapter, $\phi 22$:
57001-1202



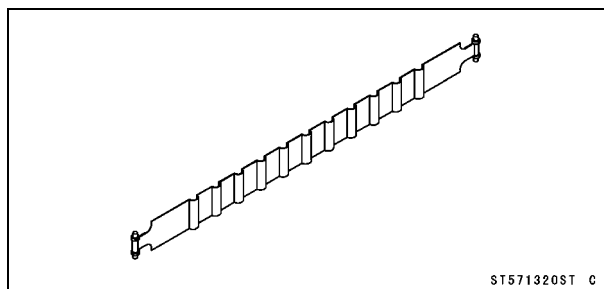
Compression Gauge Adapter, M10 × 1.0:
57001-1317



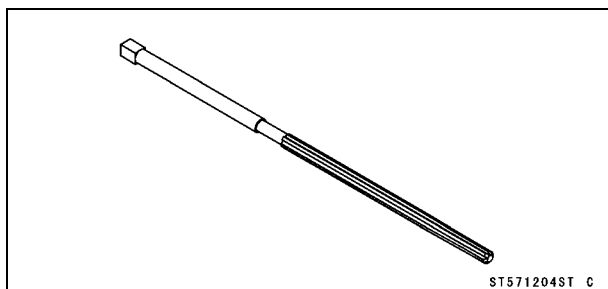
Valve Guide Arbor, $\phi 5$:
57001-1203



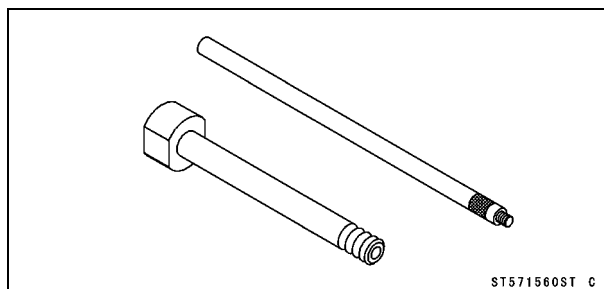
Piston Ring Compressor Belt, $\phi 80 \sim \phi 91$:
57001-1320



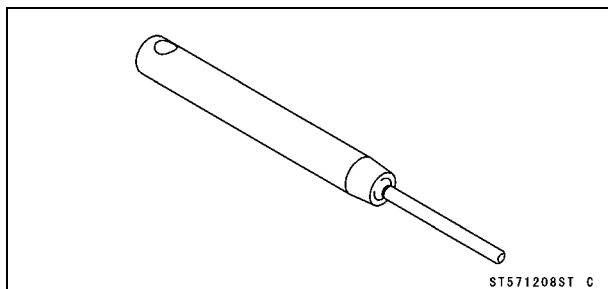
Valve Guide Reamer, $\phi 5$:
57001-1204



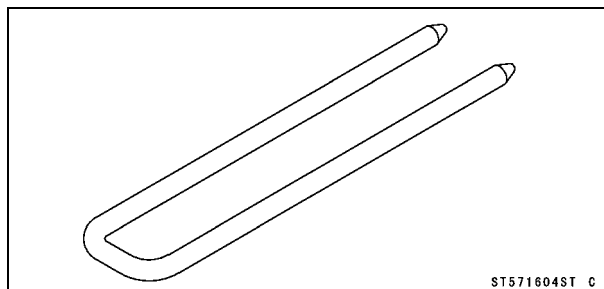
TDC Measurement Tool:
57001-1560



Valve Seat Cutter Holder, $\phi 5$:
57001-1208



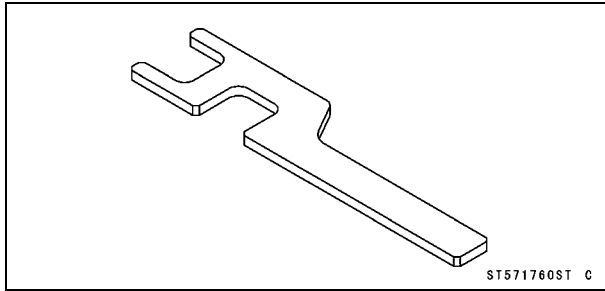
Piston Base, $\phi 8$:
57001-1604



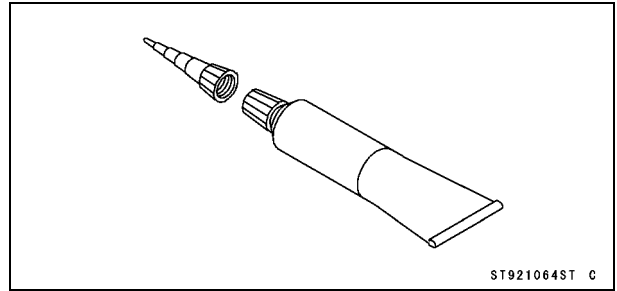
6-8 ENGINE TOP END

Special Tools and Sealant

Shaft Wrench:
57001-1760



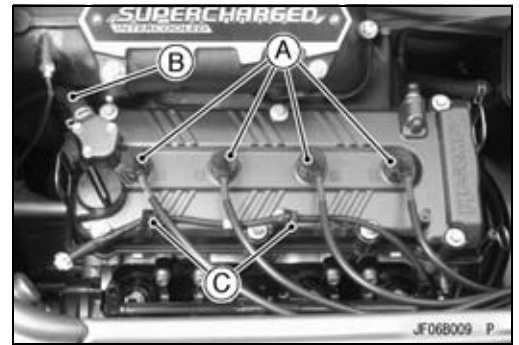
Liquid Gasket, TB1216B:
92104-1064



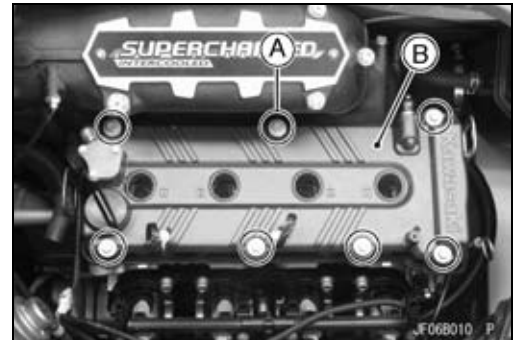
Cylinder Head Cover

Cylinder Head Cover Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Spark Plug Caps [A]
 - Breather Hose [B]
- Open the clamps [C].

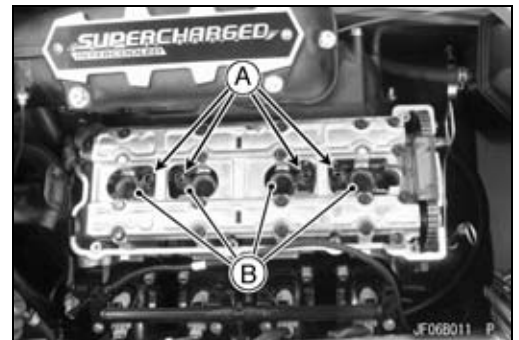


- Remove:
 - Cylinder Head Cover Bolts [A] with Rubber Washers
 - Cylinder Head Cover [B]

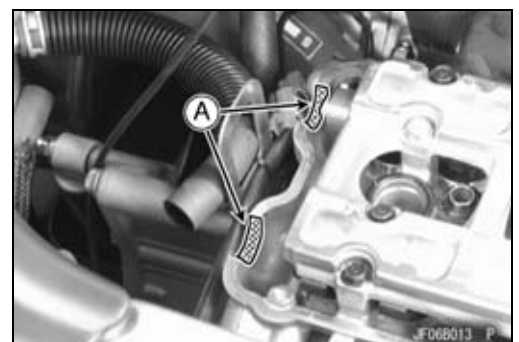


Cylinder Head Cover Installation

- Be sure to install the following parts.
 - Dowel Pins [A]
 - Plug Hole Gaskets [B]



- Using a high-flash point solvent, clean off any oil or dirt that may be on the liquid gasket coating area. Dry them with a clean cloth.
- Apply liquid gasket [A] to the cylinder head as shown.
 - Sealant - Liquid Gasket, TB1216B: 92104-1064



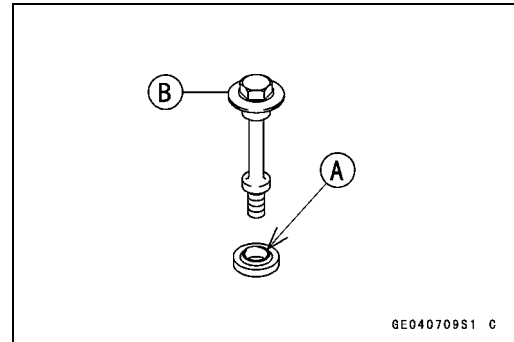
6-10 ENGINE TOP END

Cylinder Head Cover

- Replace the cylinder head cover gasket with a new one.
- Install the new cylinder head cover gasket and cylinder head cover.
- Install the rubber washers with the metal side [A] faces upward.
- Tighten:

Torque - Cylinder Head Cover Bolts [B]: 10 N·m (1.0 kgf·m, 89 in·lb)

- Run the hoses correctly (see Cable, Wire and Hose Routing section in the Appendix chapter).



Camshaft Chain Tensioner

Camshaft Chain Tensioner Removal

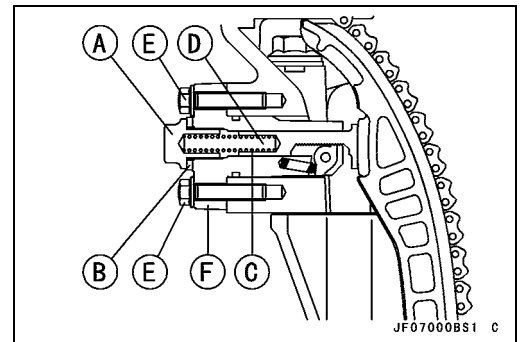
CAUTION

This is a non-return type camshaft chain tensioner. The push rod does not return to its original position once it moves out to take up camshaft chain slack. Observe all the rules listed below.

When removing the tensioner, do not take out the mounting bolts only halfway. Retightening the mounting bolts from this position could damage the tensioner and the camshaft chain. Once the bolts are loosened, the tensioner must be removed and reset as described in "Camshaft Chain Tensioner installation".

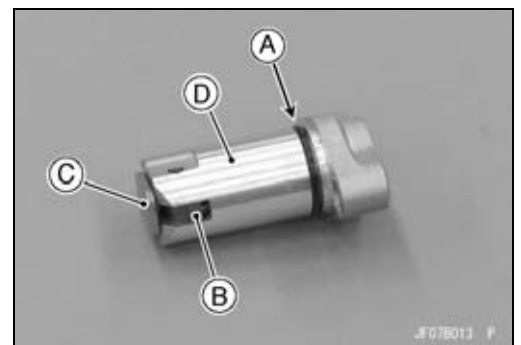
Do not turn over the crankshaft while the tensioner is removed. This could upset the camshaft chain timing, and damage the valves.

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Cap Bolt [A]
 - Washer [B]
 - Spring [C]
 - Rod [D]
 - Mounting Bolts [E]
 - Camshaft Chain Tensioner Body [F]



Camshaft Chain Tensioner Installation

- Replace the O-ring [A] with a new one.
- Apply grease to the new O-ring.
- Release the stopper [B] and push the push rod [C] into the tensioner body [D].
- Install the tensioner body so that the stopper faces downward.

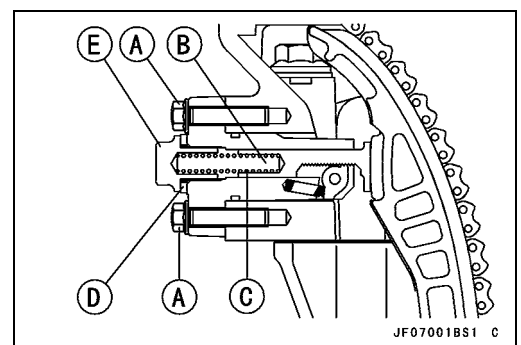


- Apply a non-permanent locking agent to the threads of the tensioner mounting bolts [A], and tighten them.

Torque - Camshaft Chain Tensioner Mounting Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)

- Install:
 - Rod [B]
 - Spring [C]
 - Washer [D]
- Tighten the cap bolt [E].

Torque - Camshaft Chain Tensioner Cap Bolt: 20 N·m (2.0 kgf·m, 15 ft·lb)



6-12 ENGINE TOP END

Camshaft, Camshaft Chain

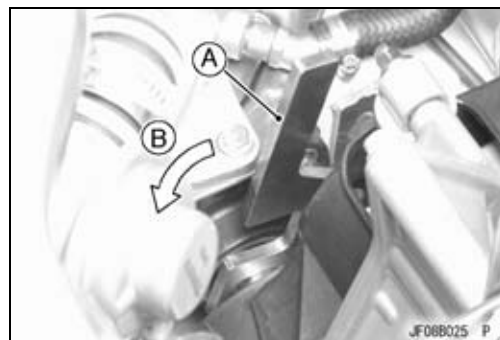
Camshaft Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Spark Plugs (see Spark Plug Inspection in the Periodic Maintenance chapter)
 - Cylinder Head Cover (see Cylinder Head Cover Removal)
 - Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)

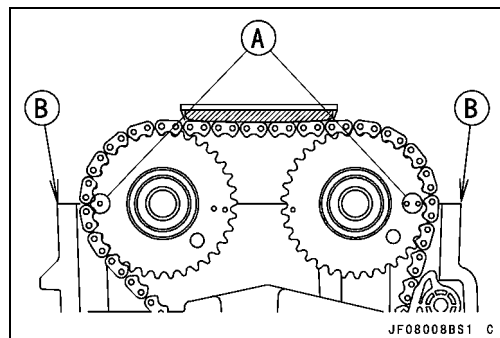
- Position the crankshaft at #1, #4 piston TDC as follows.

○ Using the shaft wrench [A], turn the crankshaft counter-clockwise [B] and set the crankshaft at #1, 4 piston TDC.

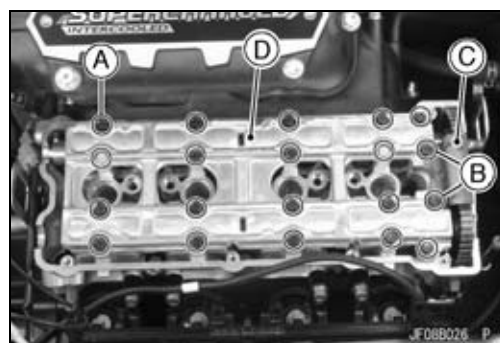
Special Tool - Shaft Wrench: 57001-1760



○ The timing marks [A] must be aligned with the cylinder head upper [B] as shown in the figure.



- Remove:
 - Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
 - Camshaft Cap Bolts [A] and Upper Camshaft Chain Guide Bolts [B]
 - Upper Camshaft Chain Guide [C]
 - Camshaft Cap [D]
 - Camshafts
- Stuff a clean cloth into the chain tunnel to keep any parts from dropping into the crankcase.



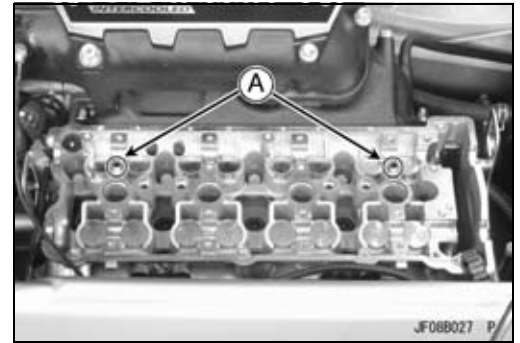
CAUTION

The crankshaft may be turned while the camshafts are removed. Always pull the chain taut while turning the crankshaft. This avoids kinking the chain on the lower (crankshaft) sprocket. A kinked chain could damage both the chain and the sprocket.

Camshaft, Camshaft Chain

Camshaft Installation

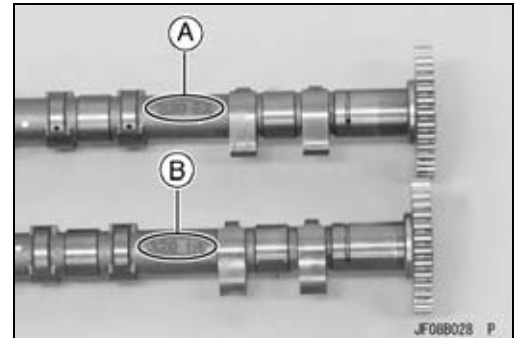
- Be sure to install the following parts.
Dowel Pins [A]



- Apply molybdenum disulfide oil solution to all cam parts, journals and tappets.

NOTE

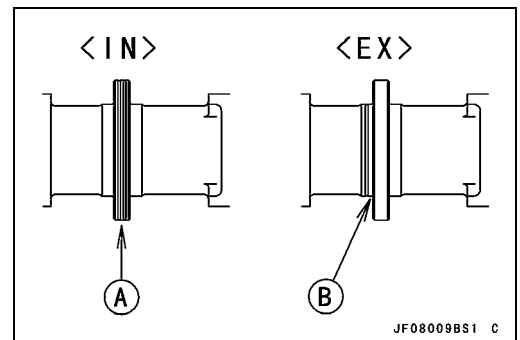
○The exhaust camshaft has a 320 EX mark [A] and the intake camshaft has a 320 IN mark [B]. Be careful not to mix up these shafts.



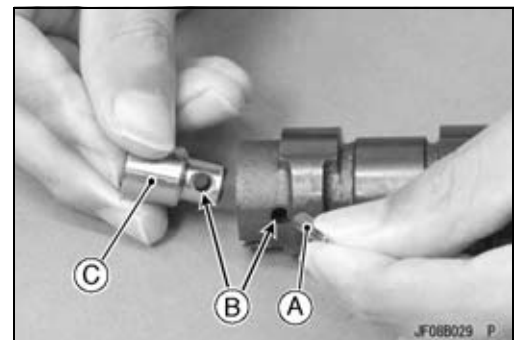
NOTE

○Also the intake and exhaust camshafts have the groove identification.

Groove [A] of Intake Camshaft
Groove [B] of Exhaust Camshaft

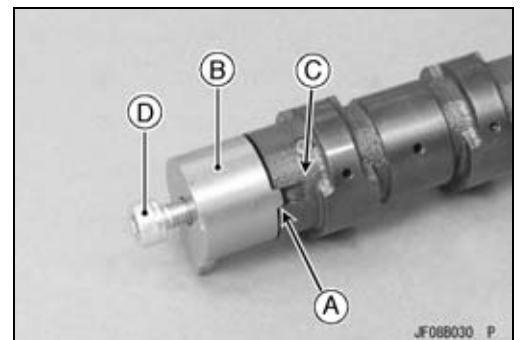


- ★If the camshaft position sensor rotor is removed, install it as follows.
- Insert the pin [A] into the holes [B] in the camshaft and boss [C].



- Fit the projection [A] of the rotor [B] on the camshaft recess [C].
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the threads of the camshaft position sensor rotor bolt [D], and tighten it.

Torque - Camshaft Position Sensor Rotor Bolt: 12 N·m (1.2 kgf·m, 106 in·lb)

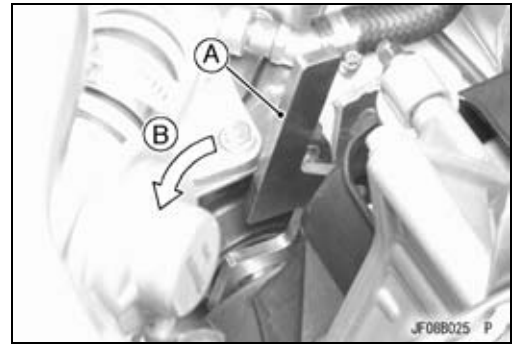


6-14 ENGINE TOP END

Camshaft, Camshaft Chain

- Remove the spark plugs (see Spark Plug Inspection in the Periodic Maintenance chapter).
- Using the shaft wrench [A], turn the crankshaft counterclockwise [B] and set the crankshaft at #1, 4 piston TDC (see Piston TDC Finding).

Special Tool - Shaft Wrench: 57001-1760



- Pull the tension side (exhaust side) of the chain taut to install the chain.
 - Engage the camshaft chain with the camshaft sprockets so that the timing marks on the sprockets are positioned as shown in the figure.
- The timing marks must be aligned with the cylinder head upper surface [A].

EX mark [B]

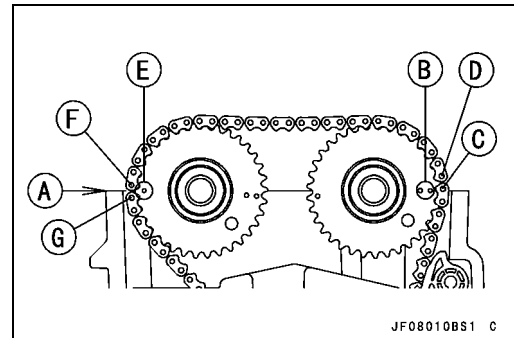
#1 Pin [C]

#2 Pin [D]

IN mark [E]

#31 Pin [F]

#32 Pin [G]



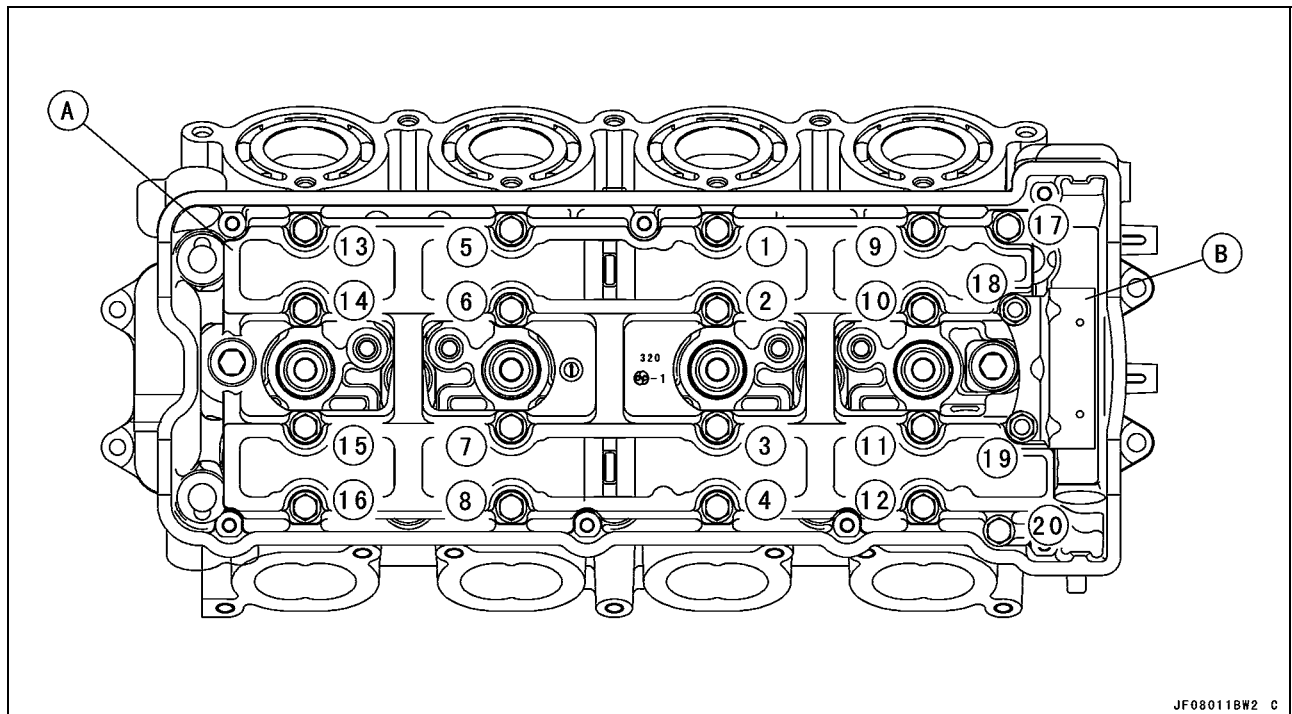
Camshaft, Camshaft Chain

- Install the camshaft cap [A] and upper camshaft chain guide [B]. While pushing the camshaft chain, tighten all camshaft bolts and chain guide bolts.
- Install the longer (white) bolts to the #10 and #14 position shown by triangle marks.
- First tighten the all camshaft cap and chain guide bolts evenly to seat the camshaft in place, then tighten all bolts following the specified tightening sequence [1 ~ 20].

Torque - Camshaft Cap Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)

Upper Camshaft Chain Guide Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)

- Install the camshaft chain tensioner (see Camshaft Chain Tensioner installation).
- Turn the crankshaft 2 turns counterclockwise to allow the tensioner to expand and recheck the camshaft chain timing.
- Install the cylinder head cover (see Cylinder Head Cover installation).



JF08011BW2 C

Piston TDC Finding

This job can be done when the engine is on the hull and during camshaft installation.

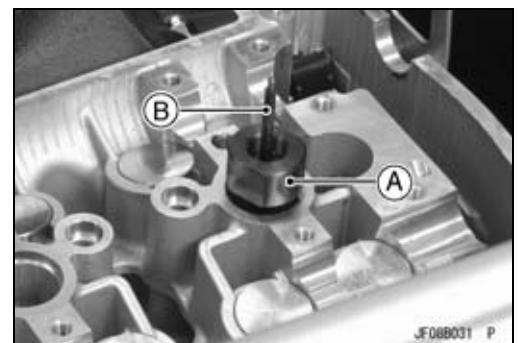
- Install the piston top detector [A] in the hole of the #1 spark plug.

Special Tool - TDC Measurement Tool: 57001-1560

- Insert the gauge extender [B] into the detector.
- Using the shaft wrench, turn the crankshaft counterclockwise until the gauge extender reaches its highest point.

Special Tool - Shaft Wrench: 57001-1760

- Remove the extender and install it to the gauge.



JF080031 P

6-16 ENGINE TOP END

Camshaft, Camshaft Chain

- Install the top dead center finder [A] and the gauge [B] with the extender.

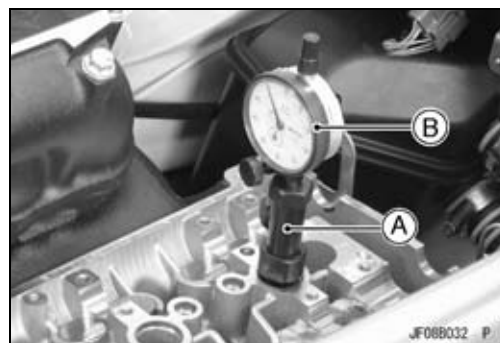
Special Tool - Top Dead Center Finder: 57001-402

- Set the gauge to the "0".
- Using the shaft wrench, turn the crankshaft counterclockwise and read a maximum scale value of the dial gauge.

Special Tool - Shaft Wrench: 57001-1760

NOTE

○The scale value of the dial gauge reaches a maximum at the TDC.



Camshaft, Camshaft Cap Wear Inspection

- Remove the camshaft caps (see Camshaft Removal).
- Cut strips of plastigage (press gauge) to journal width. Place a strip on each journal parallel to the camshaft installed in the correct position.
- Tighten the camshaft cap bolts and upper camshaft chain guide bolts to the specified torque (see Camshaft Installation).

NOTE

○Do not turn the camshaft when the plastigage is between the journal and camshaft cap.



- Remove the camshaft cap again, measure each clearance between the camshaft journal and the camshaft cap using plastigage [A].

Camshaft Journal, Camshaft Cap Clearance

Standard: 0.028 ~ 0.071 mm (0.0011 ~ 0.0028 in.)

Service Limit: 0.16 mm (0.0063 in.)

- ★If any clearance exceeds the service limit, measure the diameter of each camshaft journal with a micrometer.

Camshaft Journal Diameter

Standard: 23.950 ~ 23.972 mm (0.9429 ~ 0.9438 in.)

Service Limit: 23.92 mm (0.942 in.)

- ★If the camshaft journal diameter is less than the service limit, replace the camshaft with a new one and measure the clearance again.
- ★If the clearance still remains out of the limit, replace the cylinder head unit.

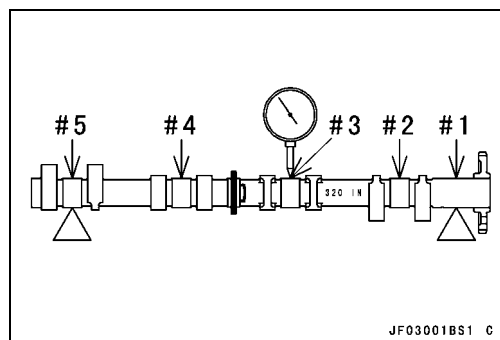
Camshaft Runout Inspection

- Remove the camshaft (see Camshaft Removal).
- Set the camshaft in a camshaft alignment jig or on V blocks.
- Measure runout with a dial gauge at the specified place as shown.
- ★If the runout exceeds the service limit, replace the camshaft.

Camshaft Runout

Standard: TIR 0.02 mm (0.0008 in.) or less

Service Limit: TIR 0.1 mm (0.004 in.)



Camshaft, Camshaft Chain

Cam Wear Inspection

- Remove the camshaft (see Camshaft Removal).
- Measure the height [A] of each cam with a micrometer.
- ★ If the cams are worn down past the service limit, replace the camshaft.

Cam Height

Standard:

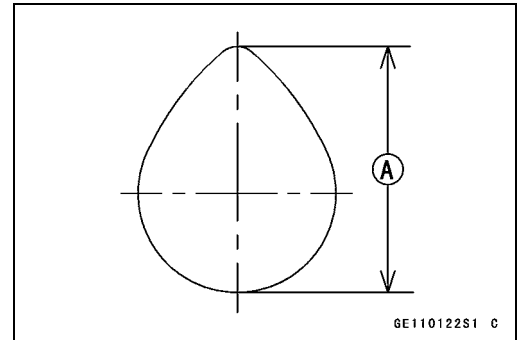
Exhaust 36.042 ~ 36.156 mm (1.4190 ~ 1.4235 in.)

Intake 36.442 ~ 36.556 mm (1.4347 ~ 1.4392 in.)

Service Limit:

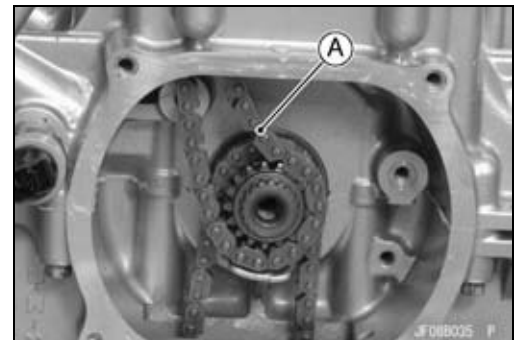
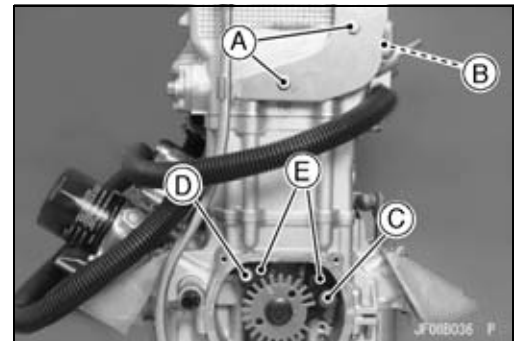
Exhaust 35.94 mm (1.415 in.)

Intake 36.34 mm (1.431 in.)



Camshaft Chain Removal

- Remove:
 - Camshaft (see Camshaft Removal)
 - Timing Rotor (see Timing Rotor Removal in the Electrical System chapter)
 - Upper Dipstick Tube Bolts [A]
 - Exhaust Side Camshaft Chain Guide Bolt (Upper) [B]
 - Exhaust Side Camshaft Chain Guide Bolt (Lower) [C]
 - Intake Side Camshaft Chain Guide Bolt [D]
 - Camshaft Chain Guides [E]
- Remove the camshaft chain [A] from the crankshaft sprocket.



6-18 ENGINE TOP END

Cylinder Head

Cylinder Compression Measurement

NOTE

○Use the battery which is fully charged.

- Thoroughly warm up the engine, while checking that there is no compression leakage from around the spark plugs or the cylinder head gasket.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damaged will occur.

- Stop the engine.
- Disconnect the ignition coil primary lead connectors (see Ignition Coil Removal in the Electrical System chapter).
- Remove:
 - Spark Plugs (see Spark Plug Inspection in the Periodic Maintenance chapter)
- Attach the compression gauge [A] and adapter [B] firmly into the spark plug hole.
- Using the starter motor, turn the engine over with the throttle fully open until the compression gauge stops rising; the compression is the highest reading obtainable.

Special Tools - Compression Gauge, 20 kgf/cm²: 57001-221
Compression Gauge Adapter, M10 × 1.0: 57001-1317

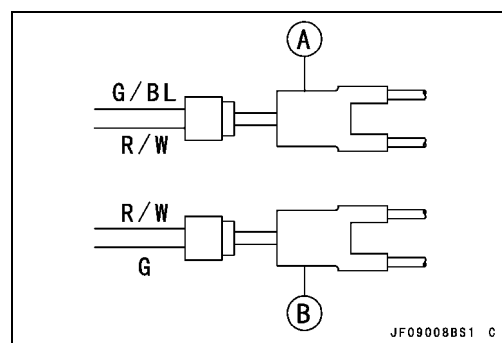
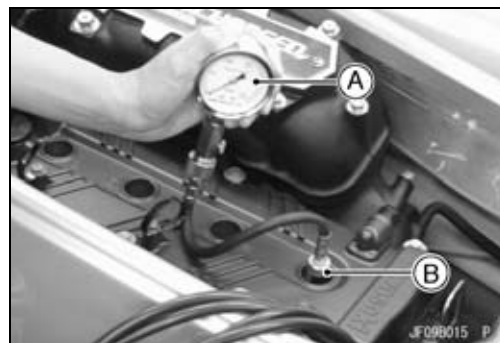
Cylinder Compression

Usable Range: 840 ~ 1 298 kPa (8.6 ~ 13.2 kgf/cm², 122 ~ 188 psi) @383 r/min (rpm)

- Repeat the measurement for the other cylinders.
- Install the spark plugs (see Spark Plug Inspection in the Periodic Maintenance chapter).
- Reconnect the primary ignition coil lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. the #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.

NOTE

○The service codes (COL1 and COL2) caused by this procedure are stored in the ECU. If necessary, these service codes can be erased by using the Kawasaki Diagnostic System (KDS).



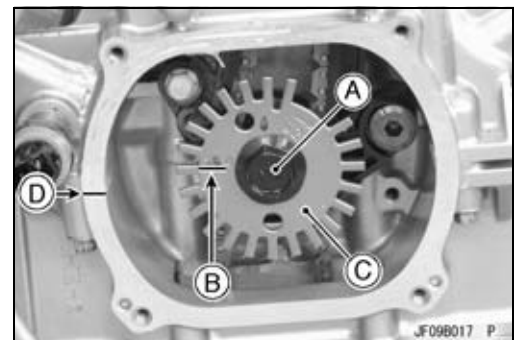
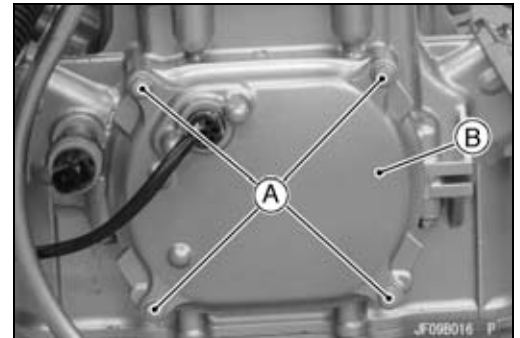
Cylinder Head

The following table should be consulted if the obtainable compression reading is not within the usable range.

Problem	Diagnosis	Remedy (Action)
Cylinder compression is higher than usable range.	Carbon accumulation on piston and in combustion chamber possibly due to damaged valve stem oil seal and/or damaged piston oil rings (This may be indicated by white exhaust smoke).	Remove the carbon deposits and replace damaged parts if necessary.
	Incorrect cylinder head gasket thickness	Replace the gasket with a standard part.
Cylinder compression is lower than usable range.	Gas leakage around cylinder head	Replace damaged gasket and check cylinder head warp.
	Bad condition of valve seating	Repair if necessary.
	Incorrect valve clearance	Adjust the valve clearance.
	Incorrect piston/cylinder clearance	Replace the piston and/or cylinder.
	Piston seizure	Inspect the cylinder and replace/repair the cylinder and/or piston as necessary.
	Bad condition of piston ring and/or piston ring grooves	Replace the piston and/or the piston rings.

Cylinder Head Removal

- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Cylinder Head Cover (see Cylinder Head Cover Removal)
 - Crankshaft Sensor Cover Bolts [A]
 - Crankshaft Sensor Cover [B]
- Using a wrench on the timing rotor bolt [A], turn the crankshaft clockwise until the line [B] (TDC mark for #1, 4 position) on the timing rotor [C] is aligned with the mating surface [D] of the crankcase.
- Remove:
 - Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
 - Camshafts (see Camshaft Removal)



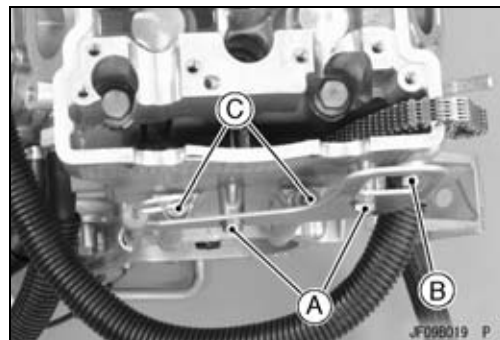
6-20 ENGINE TOP END

Cylinder Head

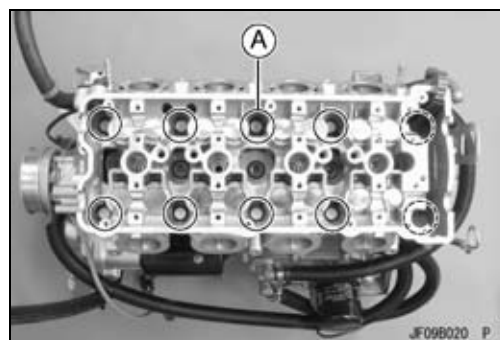
- Remove:
M6 Cylinder Head Bolts [A]



- Remove:
Upper Dipstick Tube Bolts [A]
Exhaust Side Camshaft Chain Guide Bolt (Upper) [B]
M7 Cylinder Head Bolts [C]



- Remove the M11 cylinder head bolts [A] and washers.
- Remove:
Cylinder Head
Oil Pipe

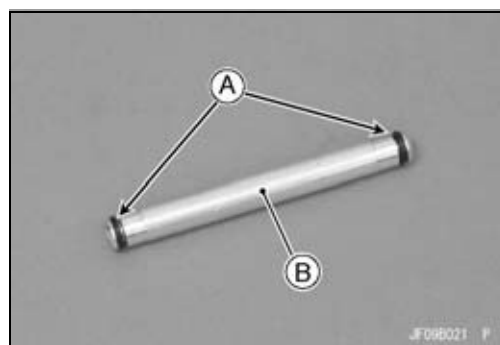


Cylinder Head Installation

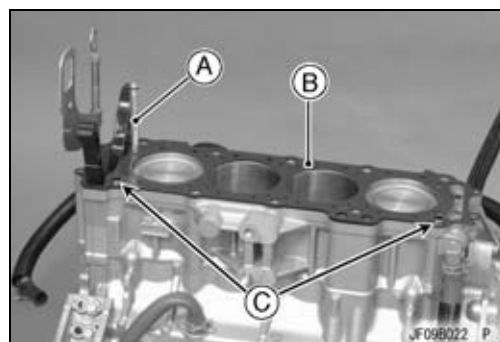
NOTE

○The camshaft cap is machined with the cylinder head, so if a new cylinder head is installed, use the cap that is supplied with the new head.

- Replace the O-rings [A] of the oil pipe [B] with new ones.
- Apply molybdenum disulfide oil solution to O-rings.

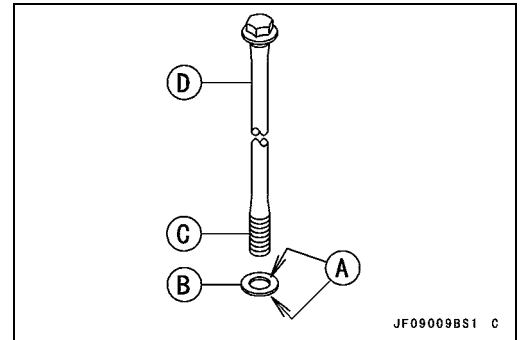


- Install that the oil pipe [A].
- Install a new cylinder head gasket [B], and dowel pins [C].



Cylinder Head

- Apply molybdenum disulfide oil solution to both sides [A] of the cylinder head bolt washers [B] and the thread [C] of head bolts [D].



- Install the cylinder head.
- Tighten the M11 cylinder head bolts following the tightening sequence [1 ~ 10].

Torque - Cylinder Head Bolts (M11):

First: 22.5 N·m (2.3 kgf·m, 17 ft·lb)

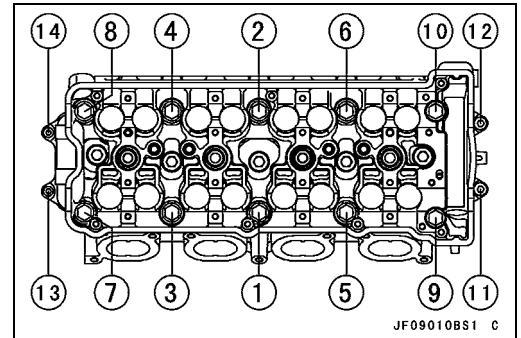
Final: 70 N·m (7.1 kgf·m, 52 ft·lb)

- Tighten the M7 cylinder head bolts following the tightening sequence [11, 12].

Torque - Cylinder Head Bolts (M7): 20 N·m (2.0 kgf·m, 15 ft·lb)

- Tighten the M6 cylinder head bolts following the tightening sequence [13, 14].

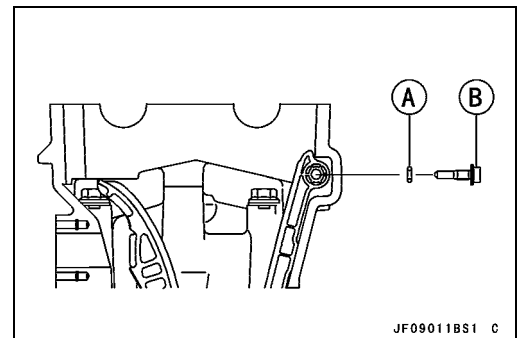
Torque - Cylinder Head Bolts (M6): 12 N·m (1.2 kgf·m, 106 in·lb)



- Replace the O-ring [A] with a new one.
- Install:
New O-ring
Exhaust Side Camshaft Chain Guide Bolt (Upper) [B]
- Tighten:

Torque - Exhaust Side Camshaft Chain Guide Bolt (Upper): 25 N·m (2.5 kgf·m, 18 ft·lb)

- Install the removed parts (see appropriate chapters).



Cylinder Head Warp

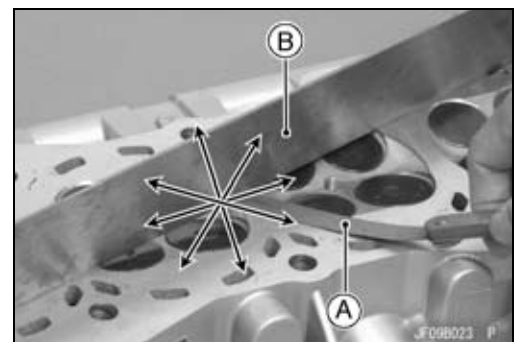
- Remove the cylinder head (see Cylinder Head Removal).
- Clean the cylinder head.
- Lay a straightedge across the lower surface of the cylinder head at several positions.
- Use a thickness gauge [A] to measure the space between the straightedge [B] and the head.

Cylinder Head Warp

Standard: - - -

Service Limit: 0.05 mm (0.0020 in.)

- ★ If the cylinder head is warped more than the service limit, replace it.
- ★ If the cylinder head is warped less than the service limit, repair the head by rubbing the lower surface on emery paper secured to a surface plate (first No. 200, then No. 400).



6-22 ENGINE TOP END

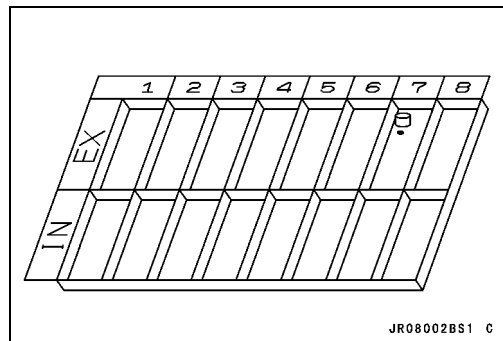
Valves

Valve Clearance Inspection

- Refer to Valve Clearance Inspection in the Periodic Maintenance chapter.

Valve Removal

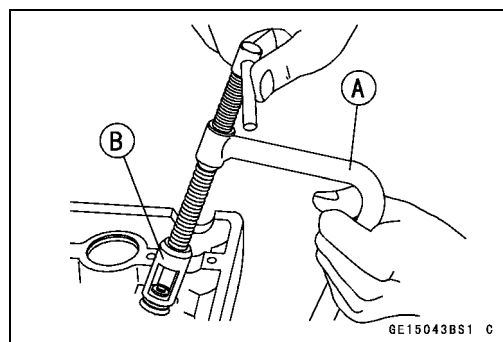
- Remove the cylinder head (see Cylinder Head Removal).
- Remove the valve lifter and shim.
- Mark and record the valve lifter and shim locations so they can be installed in their original positions.



- Using the valve spring compressor assembly, remove the valve.

Special Tools - Valve Spring Compressor Assembly: 57001-241 [A]

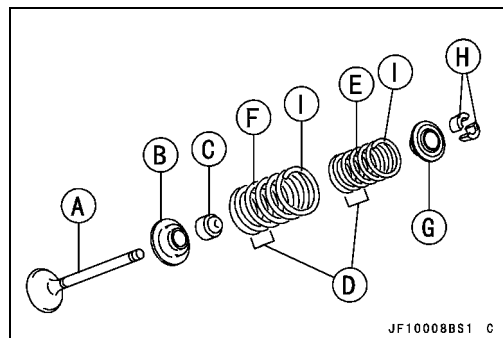
Valve Spring Compressor Adapter, $\phi 22$: 57001-1202 [B]



Valve Installation

- Replace the oil seal with a new one.
- Apply a thin coat of molybdenum disulfide grease to the valve stem before valve installation.
- Install the springs so that the closed coil end faces downwards.
- Painted side faces upward.

Valve Spring Paint Color: EX-Red
IN-Blue



Valve Stem [A]
Spring Seat [B]
Oil Seal [C]
Closed Coil End [D]
Valve Spring (Inner) [E]
Valve Spring (Outer) [F]
Retainer [G]
Split Keepers [H]
Paint Mark [I]

Valves

Valve Guide Removal

- Remove:
 - Valve (see Valve Removal)
 - Oil Seal
 - Spring Seat
- Heat the area around the valve guide to 120 ~ 150°C (248 ~ 302°F), and hammer lightly on the valve guide arbor [A] to remove the guide from the top of the head.

CAUTION

Do not heat the cylinder head with a torch. This will warp the cylinder head. Soak the cylinder head in oil and heat the oil.

Special Tool - Valve Guide Arbor, ϕ 5: 57001-1203

Valve Guide Installation

- Apply engine oil to the valve guide outer surface before installation.
- Heat the area around the valve guide hole to about 120 ~ 150°C (248 ~ 302°F).

CAUTION

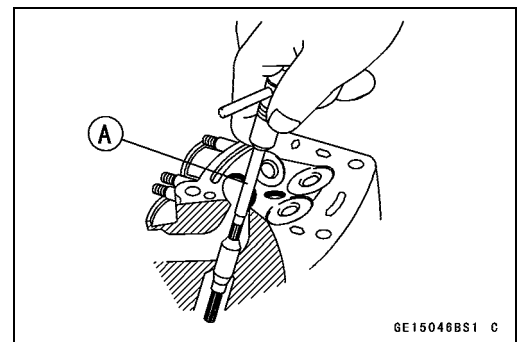
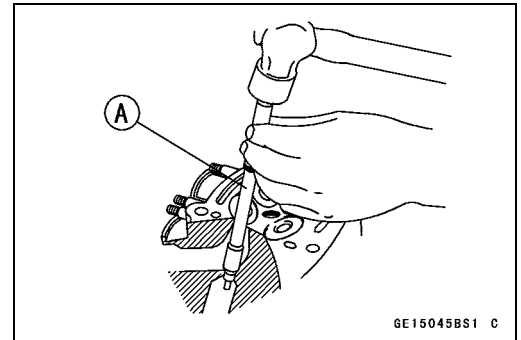
Do not heat the cylinder head with a torch. This will warp the cylinder head. Soak the cylinder head in oil and heat the oil.

- Drive the valve guide in from the top of the head using the valve guide arbor. The flange stops the guide from going in too far.

Special Tool - Valve Guide Arbor, ϕ 5: 57001-1203

- Wait until the cylinder head cools down and then ream the valve guide with the valve guide reamer [A] even if the old guide is reused.
- Turn the reamer in a clockwise direction until the reamer turns freely in the guide. Never turn the reamer counter-clockwise or it will be dulled.
- Once the guides are reamed they must be cleaned thoroughly.

Special Tool - Valve Guide Reamer, ϕ 5: 57001-1204



6-24 ENGINE TOP END

Valves

Valve-to-Guide Clearance Measurement (Wobble Method)

If a small bore gauge is not available, inspect the valve guide wear by measuring the valve to valve guide clearance with the wobble method as indicated below.

- Insert a new valve [A] into the guide [B] and set a dial gauge against the stem perpendicular to it as close as possible to the cylinder head mating surface.
- Move the stem back and forth [C] to measure valve/valve guide clearance.
- Repeat the measurement in a direction at a right angle to the first.
- ★ If the reading exceeds the service limit, replace the guide.

NOTE

○ The reading is not actual valve/valve guide clearance because the measuring point is above the guide.

Valve/Valve Guide Clearance (Wobble Method)

Standard:

Exhaust 0.11 ~ 0.18 mm (0.0043 ~ 0.0071 in.)

Intake 0.03 ~ 0.10 mm (0.0012 ~ 0.0039 in.)

Service Limit:

Exhaust 0.37 mm (0.015 in.)

Intake 0.29 mm (0.011 in.)

Valve Seat Inspection

- Remove the valve (see Valve Removal).
- Check the valve seating surface [A] between the valve [B] and valve seat [C].
- Measure the outside diameter [D] of the seating pattern on the valve seat.
- ★ If the outside diameter is too large or too small, repair the seat (see Valve Seat Repair).

Valve Seating Surface Outside Diameter

Standard:

Exhaust 28.5 ~ 28.7 mm (1.122 ~ 1.130 in.)

Intake 32.6 ~ 32.8 mm (1.283 ~ 1.291 in.)

- Measure the seat width [E] of the portion where there is no build-up carbon (white portion) of the valve seat with a vernier caliper.

Good [F]

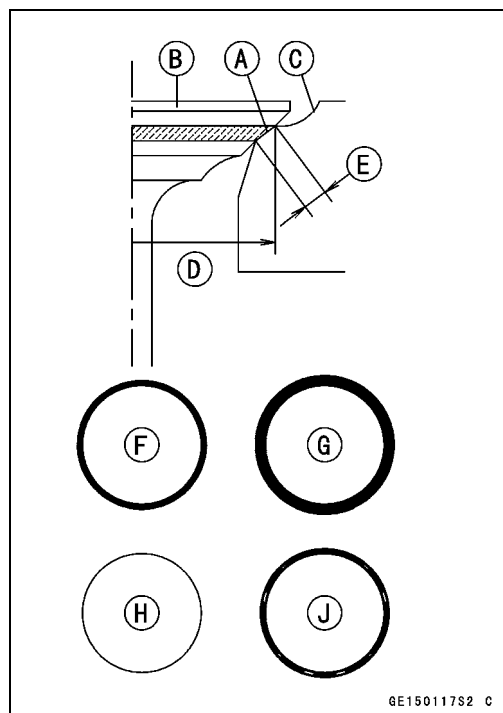
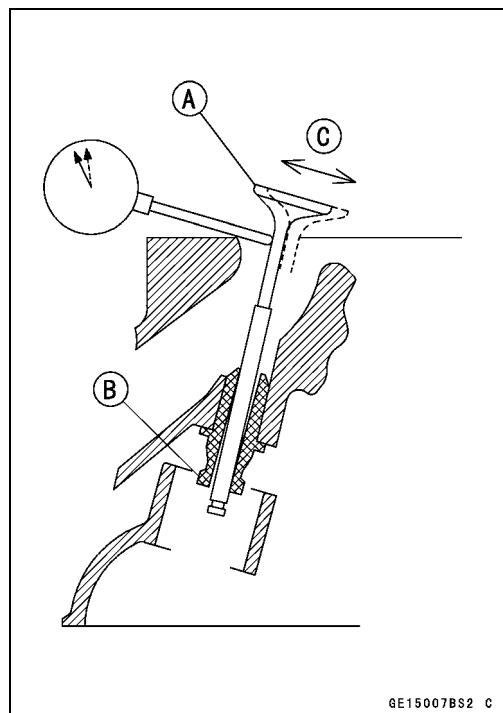
- ★ If the width is too wide [G], too narrow [H] or uneven [J], repair the seat (see Valve Seat Repair).

Valve Seating Surface Width

Standard:

Exhaust 1.8 ~ 2.2 mm (0.071 ~ 0.087 in.)

Intake 0.5 ~ 1.0 mm (0.020 ~ 0.039 in.)



Valves

Valve Seat Repair

- Repair the valve seat with the valve seat cutters [A].

Special Tools- Valve Seat Cutter Holder, $\phi 5$:
57001-1208 [B]
Valve Seat Cutter Holder Bar:
57001-1128 [C]

[For Intake Valve Seat]

Valve Seat Cutter, $45^\circ - \phi 35$:
57001-1116

Valve Seat Cutter, $32^\circ - \phi 35$:
57001-1121

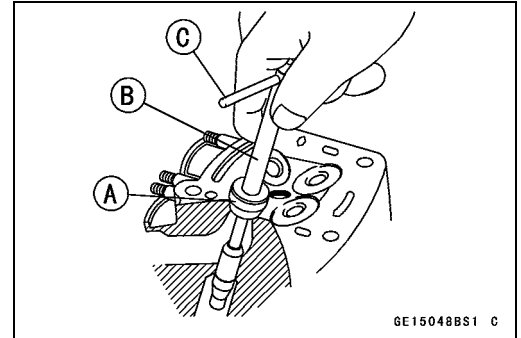
Valve Seat Cutter, $55^\circ - \phi 35$:
57001-1247

[For Exhaust Valve Seat]

Valve Seat Cutter, $45^\circ - \phi 30$:
57001-1187

Valve Seat Cutter, $32^\circ - \phi 30$:
57001-1120

Valve Seat Cutter, $60^\circ - \phi 30$:
57001-1123



- ★ If the manufacturer's instructions are not available, use the following procedure.

Seat Cutter Operation Care

1. This valve seat cutter is developed to grind the valve for repair. Therefore the cutter must not be used for other purposes than seat repair.
2. Do not drop or shock the valve seat cutter, or the diamond particles may fall off.
3. Do not fail to apply engine oil to the valve seat cutter before grinding the seat surface. Also wash off ground particles sticking to the cutter with washing oil.

NOTE

○ Do not use a wire brush to remove the metal particles from the cutter. It will take off the diamond particles.

4. Setting the valve seat cutter holder in position, operate the cutter in one hand. Do not apply too much force to the diamond portion.

NOTE

○ Prior to grinding, apply engine oil to the cutter and during the operation, wash off any ground particles sticking to the cutter with washing oil.

5. After use, wash it with washing oil and apply thin layer of engine oil before storing.

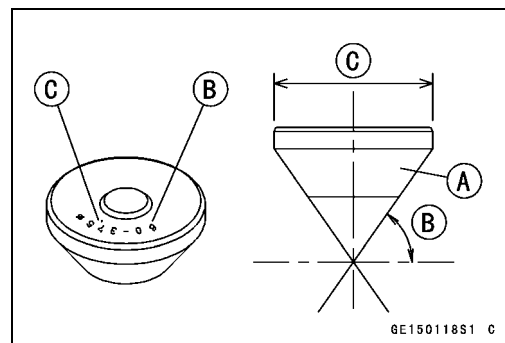
6-26 ENGINE TOP END

Valves

Marks Stamped on the Cutter

The marks stamped on the back of the cutter [A] represent the following.

60° Cutter angle [B]
37.5φ Outer diameter of cutter [C]



Operating Procedures

- Clean the seat area carefully.
- Coat the seat with machinist's dye.
- Fit a 45° cutter into the holder and slide it into the valve guide.
- Press down lightly on the handle and turn it right or left. Grind the seating surface only until it is smooth.

CAUTION

Do not grind the seat too much. Overgrinding will reduce valve clearance by sinking the valve into the head. If the valve sinks too far into the head, it will be impossible to adjust the clearance, and the cylinder head must be replaced.

- Measure the outside diameter of the seating surface with a vernier caliper.
- ★ If the outside diameter of the seating surface is too small, repeat the 45° grind until the diameter is within the specified range.

Widened Width [A] of engagement by machining with 45° cutter

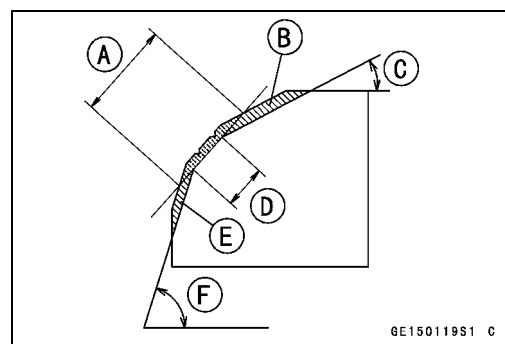
Ground Volume [B] by 32° cutter

32° [C]

Correct Width [D]

Ground Volume [E] by 60° or 55° cutter

60° or 55° [F]



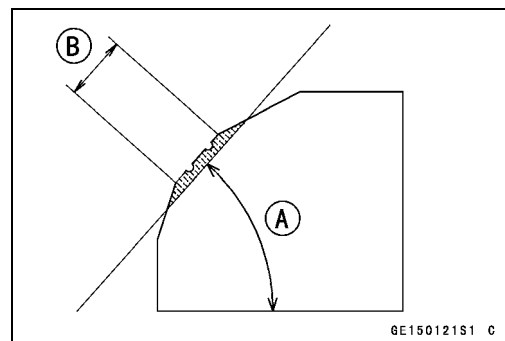
- Measure the outside diameter of the seating surface with a vernier caliper.

- ★ If the outside diameter of the seating surface is too small, repeat the 45° grind [A] until the diameter is within the specified range.

Original Seating Surface [B]

NOTE

- Remove all pittings of flaws from 45° ground surface.
- After grinding with 45° cutter, apply thin coat of machinist's dye to seating surface. This makes seating surface distinct and 32° and 60° grinding operation easier.
- When the valve guide is replaced, be sure to grind with 45° cutter for centering and good contact.



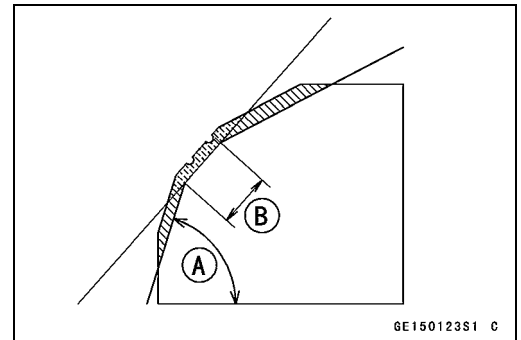
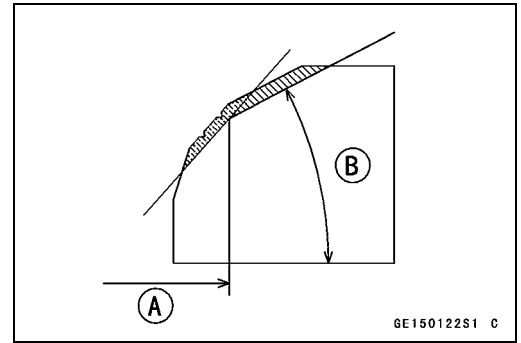
Valves

- ★ If the outside diameter [A] of the seating surface is too large, make the 32° grind described below.
- ★ If the outside diameter of the seating surface is within the specified range, measure the seat width as described below.
- Grind the seat at a 32° angle [B] until the seat outside diameter is within the specified range.
- To make the 32° grind, fit a 32° cutter into the holder, and slide it into the valve guide.
- Turn the holder one turn at a time while pressing down very lightly. Check the seat after each turn.

CAUTION

The 32° cutter removes material very quickly. Check the seat outside diameter frequently to prevent overgrinding.

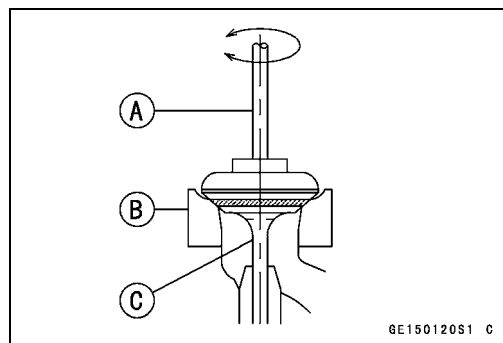
- After making the 32° grind, return to the seat outside diameter measurement step above.
 - To measure the seat width, use a vernier caliper to measure the width of the 45° angle portion of the seat at several places around the seat.
 - ★ If the seat width is too narrow, repeat the 45° grind until the seat is slightly too wide, and then return to the seat outside diameter measurement step above.
 - ★ If the seat width is too wide, make the 60° or 55° [A] grind described below.
 - ★ If the seat width is within the specified range, lap the valve to the seat as described below.
 - Grind the seat at a 60° or 55° angle until the seat width is within the specified range.
 - To make the 60° or 55° grind, fit 60° or 55° cutter into the holder, and slide it into the valve guide.
 - Turn the holder, while pressing down lightly.
 - After making the 60° or 55° grind, return to the seat width measurement step above.
- Correct Width [B]



6-28 ENGINE TOP END

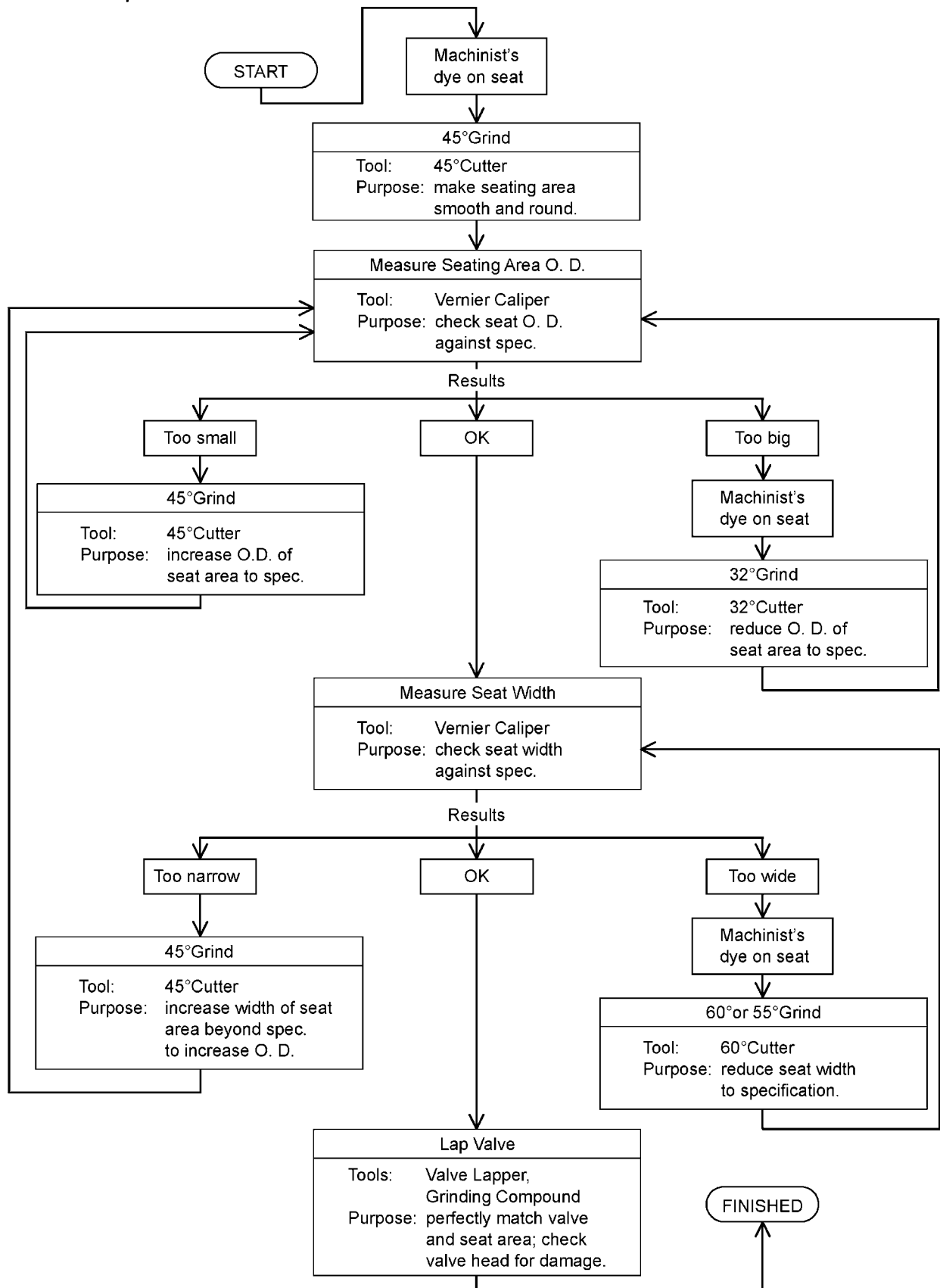
Valves

- Lap the valve to the seat, once the seat width and outside diameter are within the ranges specified above.
- Put a little coarse grinding compound on the face of the valve in a number of places around the valve head.
- Spin the valve against the seat until the grinding compound produces a smooth, matched surface on both the seat and the valve.
- Repeat the process with a fine grinding compound.
 - Lapper [A]
 - Valve Seat [B]
 - Valve [C]
- The seating area should be marked about in the middle of the valve face.
- ★ If the seat area is not in the right place on the valve, check to be sure the valve is the correct part. If it is, it may have been refaced too much; replace it.
- Be sure to remove all grinding compound before assembly.
- When the engine is assembled, be sure to adjust the valve clearance (see Valve Clearance Inspection in the Periodic Maintenance chapter).



Valves

Valve Seat Repair

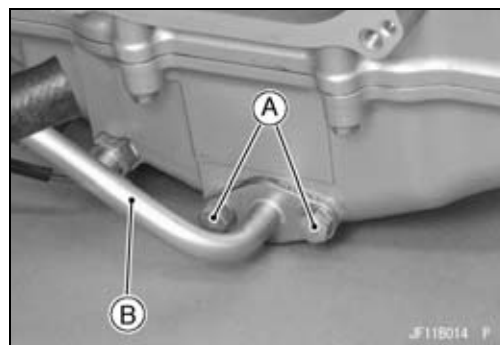


6-30 ENGINE TOP END

Cylinder, Pistons

Cylinder Removal

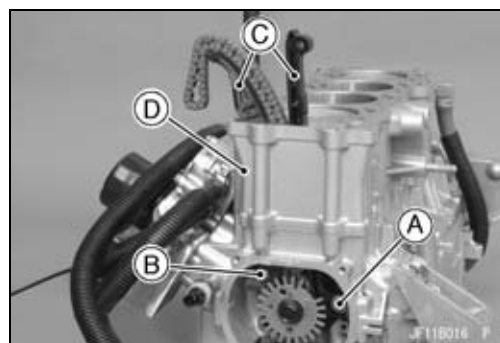
- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Cylinder Head (see Cylinder Head Removal)
 - Dipstick Tube Bolts [A]
 - Dipstick Tube [B]



- Remove:
 - Clamp [A]
 - Oil Hose [B]



- Remove:
 - Exhaust Side Camshaft Chain Guide Bolt (Lower) [A]
 - Intake Side Camshaft Chain Guide Bolt [B]
 - Camshaft Chain Guides [C]
 - Cylinder [D]

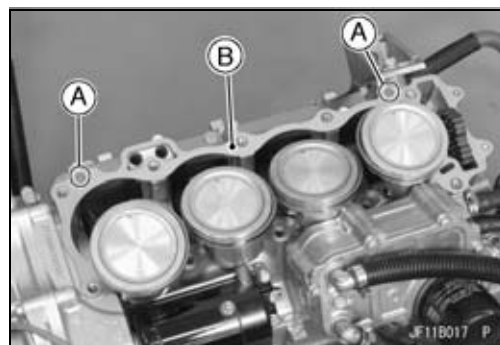


Cylinder Installation

NOTE

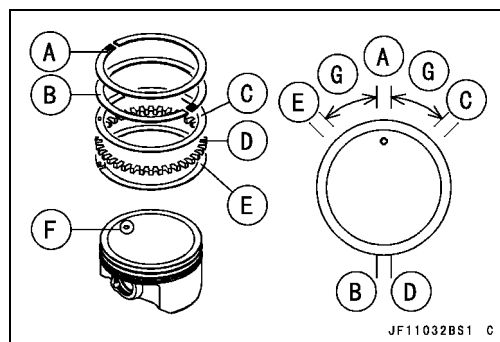
If a new cylinder is used, use new piston ring.

- Install the knock pins [A] and new cylinder gasket [B].



- The piston ring openings must be positioned as shown in the figure. The openings of the oil ring steel rails must be about 30 ~ 40° of angle from the opening of the top ring.

Top Ring [A]
Second Ring [B]
Oil Ring Steel Rail [C]
Oil Ring Expander [D]
Oil Ring Steel Rail [E]
Dent [F]
30 ~ 40° [G]

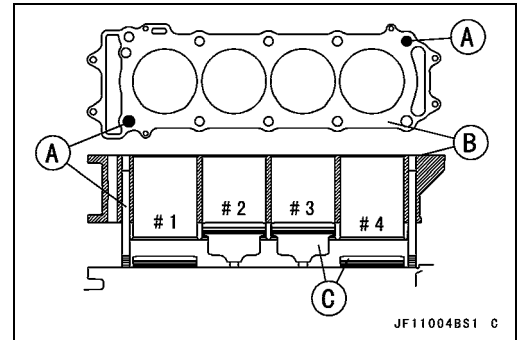


Cylinder, Pistons

- Apply molybdenum disulfide oil solution to the cylinder bore, piston rings and piston skirt.
- Insert the piston in the cylinder by two methods.

With the Hand

- Position the crankshaft at #2, #3 piston TDC.
- Prepare two auxiliary head bolts with their head cut.
- Install the two bolts [A] diagonally in the crankcase.
- Install the cylinder block [B].
- Pistons [C]
- First insert the #2, #3 pistons, and then rotate the crankshaft at 90° angle.
- Insert the piston rings with your thumbs or the thin (–) screw driver.



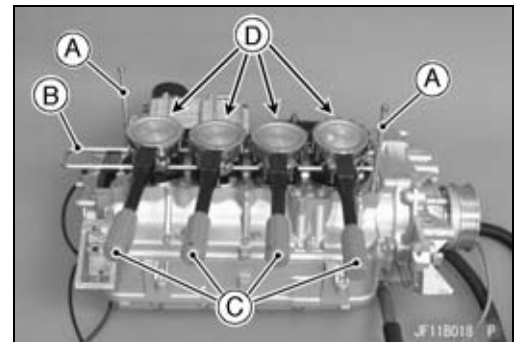
With the Special Tools

- Prepare two auxiliary head bolts with their head cut.
- Install the two bolts [A] diagonally in the crankcase.
- Slip the piston base [B] under the pistons to hold them level.
- Compress the piston rings using the piston ring compressor grips [C] and piston ring compressor belts [D].

Special Tools - Piston Base, $\phi 8$: 57001-1604

Piston Ring Compressor Grip: 57001-1095

Piston Ring Compressor Belt, $\phi 80 \sim \phi 91$: 57001-1320



- Push down vigorously the cylinder aligning the cylinder bores with all the piston heads.
- Install the cylinder so that its angle aligns the piston angle after removing the piston ring compressor belts and piston base.
- Remove the two bolts.
- Install the removed parts (see appropriate chapters).

Piston Removal

- Remove the cylinder (see Cylinder Removal).
- Place a clean cloth under the pistons and remove the piston pin snap ring [A] from the outside of each piston.

CAUTION

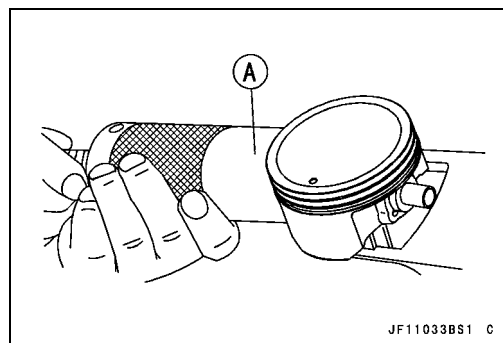
Do not reuse the snap rings, as removal weakens and deforms them. They fall out and score the cylinder wall.



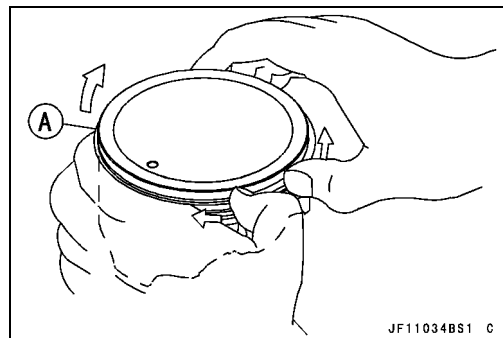
6-32 ENGINE TOP END

Cylinder, Pistons

- Using the piston pin puller [A], remove the piston pins.
Special Tool - Piston Pin Puller Assembly: 57001-910
- Remove the pistons from the connecting rods.

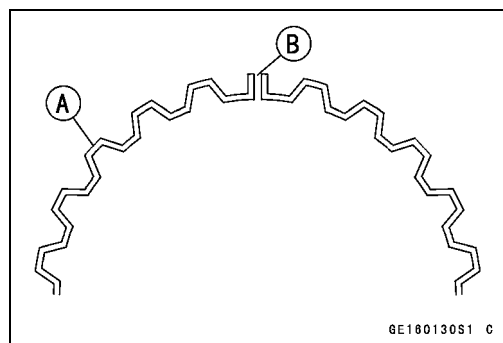


- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.
- Remove the 3-piece oil ring with your thumbs in the same manner.



Piston Installation

- Apply molybdenum disulfide oil solution to the oil ring expander, and install the oil ring expander [A] in the bottom piston ring groove so the ends [B] butt together.
- Apply molybdenum disulfide oil solution to the oil ring steel rails, and install the oil ring steel rails, one above the expander and one below it.
- Spread the rail with your thumbs, but only enough to fit the rail over the piston.
- Release the rail into the bottom piston ring groove.



NOTE

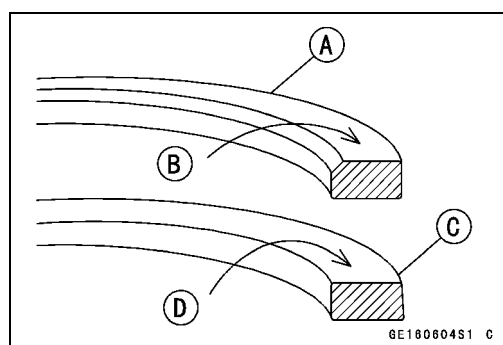
○The oil ring rails have no “top” or “bottom”.

- Apply molybdenum disulfide oil solution to the top and second rings.

NOTE

○Do not mix up the top and second ring.

- Install the top ring [A] so that the “R” mark [B] faces up.
- Install the second ring [C] so that the “RN” mark [D] faces up.

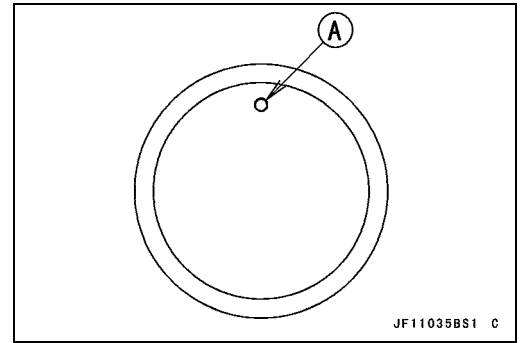


Cylinder, Pistons

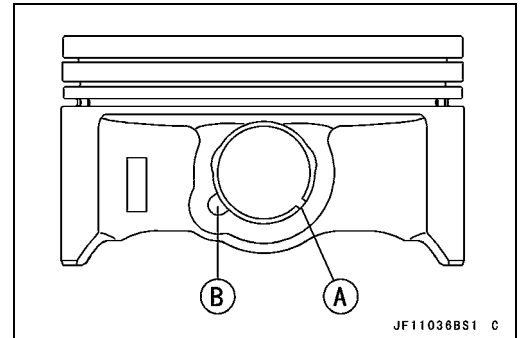
NOTE

○If a new piston is used, use new piston ring.

- Install the piston with its dent mark [A] facing exhaust side.



- Fit a new piston pin snap ring into the side of the piston so that the ring opening [A] does not coincide with the slit [B] of the piston pin hole.
- Apply molybdenum disulfide oil solution to the piston pins and piston journals.
- When installing the piston pin snap ring, compress it only enough to install it and no more.



CAUTION

**Do not reuse snap rings, as removal weakens and deforms them.
They could fall out and score the cylinder wall.**

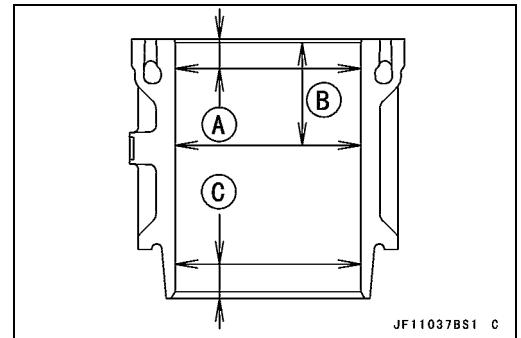
- Install the cylinder (see Cylinder Installation).

Cylinder Wear Inspection

- Since there is a difference in cylinder wear in different directions, take a side-to-side and a front-to-back measurement at each of the two locations (total of four measurements) shown in the figure.

- ★ If any of the cylinder inside diameter measurements exceeds the service limit, replace the cylinder.

10 mm (0.39 in.) [A]
60 mm (2.36 in.) [B]
20 mm (0.79 in.) [C]



Cylinder Inside Diameter

Standard: 82.994 ~ 83.006 mm (3.2675 ~ 3.2679 in.)

Service Limit: 83.09 mm (3.271 in.)

Piston Wear Inspection

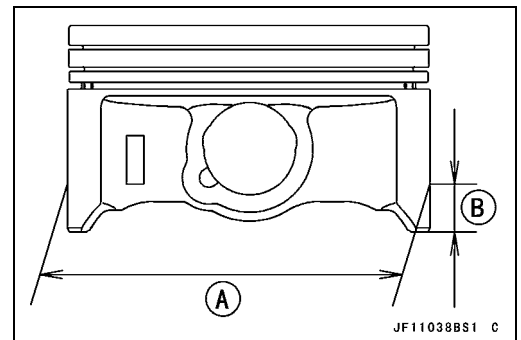
- Measure the outside diameter [A] of each piston 16 mm (0.63 in.) [B] up from the bottom of the piston at a right angle to the direction of the piston pin.

- ★ If the measurement is under service limit, replace the piston.

Piston Diameter

Standard: 82.919 ~ 82.934 mm (3.2645 ~ 3.2651 in.)

Service Limit: 82.77 mm (3.259 in.)



6-34 ENGINE TOP END

Cylinder, Pistons

Piston Ring, Piston Ring Groove Wear Inspection

- Check for uneven groove wear by inspecting the ring seating.
- ★ The rings should fit perfectly parallel to groove surfaces. If not, replace the piston and all the piston rings.
- With the piston rings in their grooves, make several measurements with a thickness gauge [A] to determine piston ring/groove clearance.

Piston Ring/Groove Clearance

Standard:

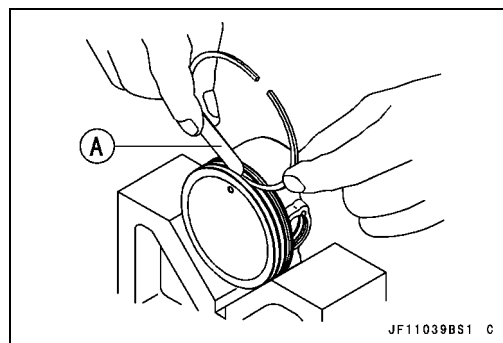
Top 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)

Second 0.02 ~ 0.06 mm (0.0008 ~ 0.0024 in.)

Service Limit:

Top 0.17 mm (0.0067 in.)

Second 0.16 mm (0.0063 in.)



Piston Ring Groove Width Inspection

- Measure the piston ring groove width.
- Use a vernier caliper at several points around the piston.

Piston Ring Groove Width

Standard:

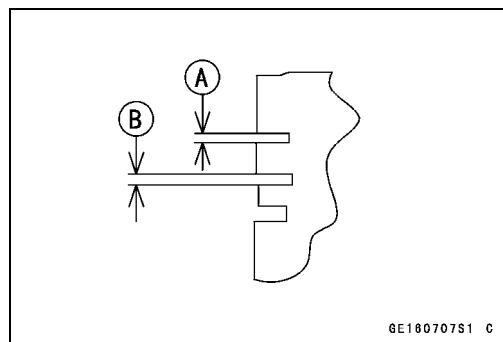
Top [A] 0.92 ~ 0.94 mm (0.0362 ~ 0.0370 in.)

Second [B] 1.01 ~ 1.03 mm (0.0398 ~ 0.0406 in.)

Service Limit:

Top [A] 1.02 mm (0.0402 in.)

Second [B] 1.11 mm (0.0437 in.)



- ★ If the width of any of the two grooves is wider than the service limit at any point, replace the piston.

Piston Ring Thickness Inspection

- Measure the piston ring thickness.
- Use the micrometer to measure at several points around the ring.

Piston Ring Thickness

Standard:

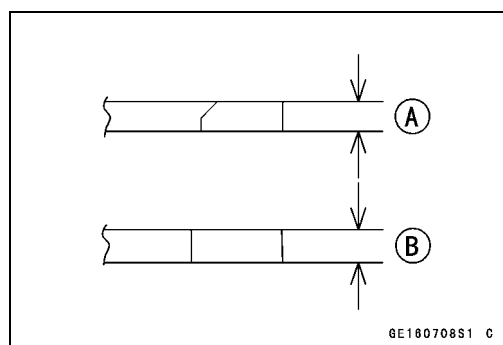
Top [A] 0.87 ~ 0.89 mm (0.0343 ~ 0.0350 in.)

Second [B] 0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)

Service Limit:

Top [A] 0.80 mm (0.0315 in.)

Second [B] 0.90 mm (0.0354 in.)



- ★ If any of the measurements is less than the service limit on either of the rings, replace all the rings.

NOTE

- When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.

Cylinder, Pistons

Piston Ring End Gap Inspection

- Place the piston ring [A] inside the cylinder, using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low.
- Measure the gap between the ends of the ring with a thickness gauge [B].

Piston Ring End Gap

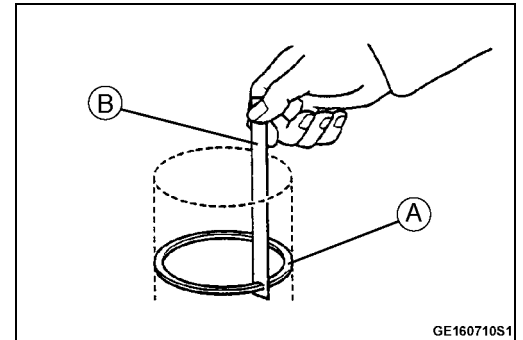
Standard:

Top	0.25 ~ 0.40 mm (0.0098 ~ 0.0157 in.)
Second	0.40 ~ 0.55 mm (0.0157 ~ 0.0217 in.)

Service Limit:

Top	0.7 mm (0.0276 in.)
Second	0.8 mm (0.0315 in.)

- ★ If the end gap of either ring is greater than the service limit, replace all the rings.



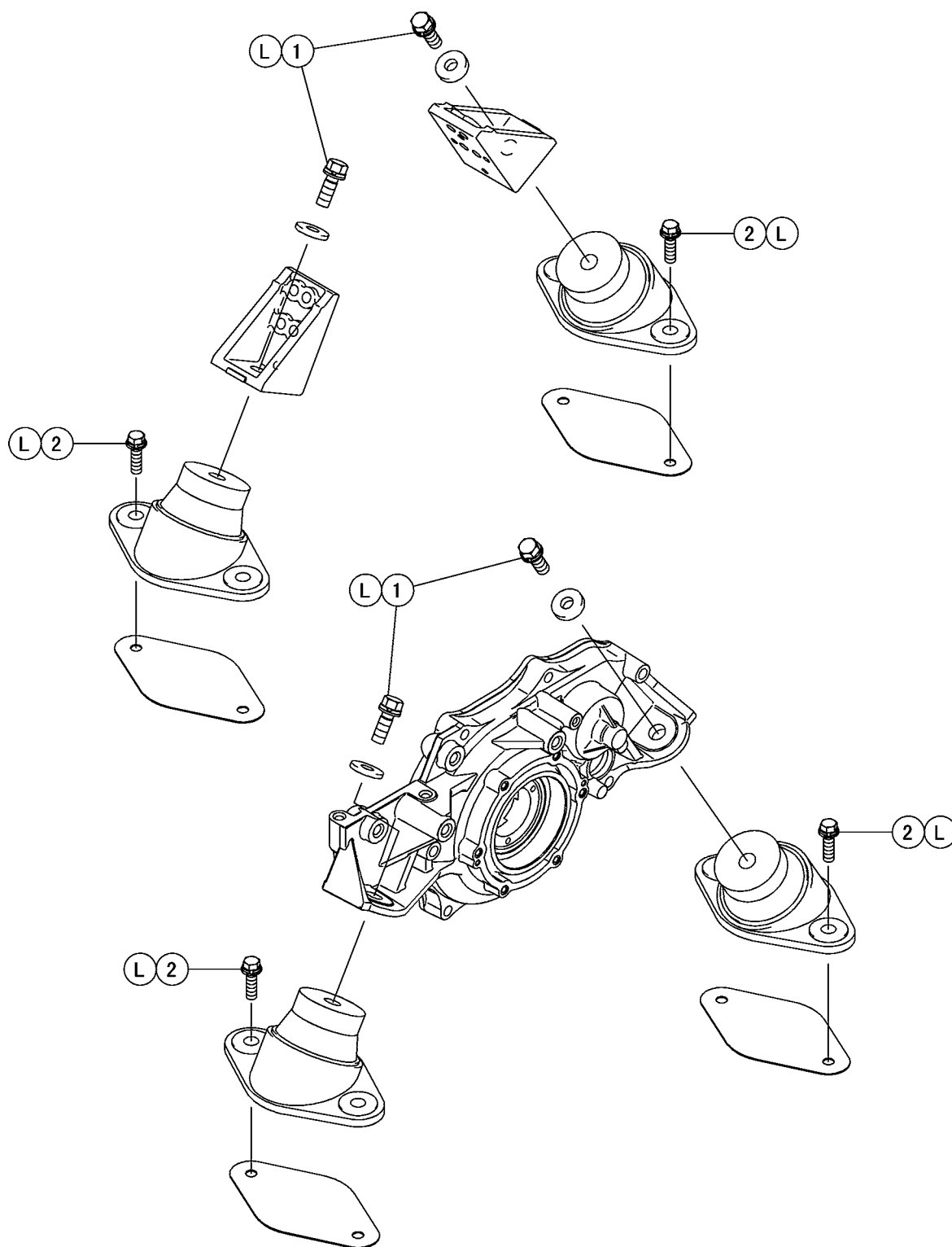
Engine Removal/Installation

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7-2 ENGINE REMOVAL/INSTALLATION

Exploded View



ENGINE REMOVAL/INSTALLATION 7-3

Exploded View

No	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Engine Mounting Bolts	36.3	3.7	27	L
2	Engine Damper Mounting Bolts	15.7	1.6	12	L

L: Apply a non-permanent locking agent.

7-4 ENGINE REMOVAL/INSTALLATION

Engine Removal/Installation

Engine Removal

★If the engine is to be disassembled after removal, drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).

● Remove:

Seat (see Seat Removal in the Hull/Engine Hood chapter)

Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)

Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)

Intercooler (see Intercooler Removal in the Cooling and Bilge Systems chapter)

Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)

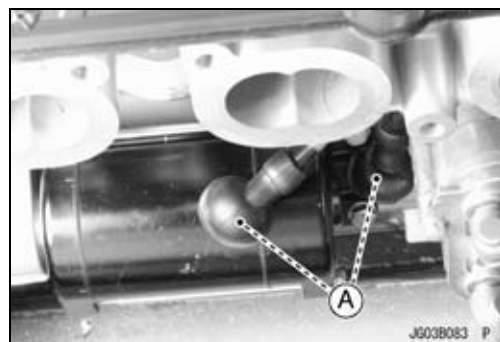
Exhaust Pipe and Muffler Body (see Exhaust Pipe and Muffler Body Removal in the Exhaust System chapter)

Water Box Muffler (see Water Box Muffler Removal in the Exhaust System chapter)

Supercharger (see Supercharger Removal in the Fuel System (DFI) chapter)

● Disconnect:

Starter Motor Terminals [A]

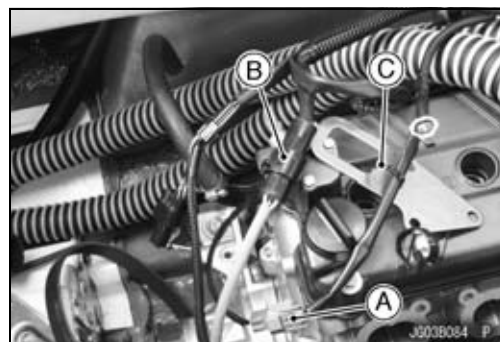


● Disconnect:

Camshaft Sensor Lead Connector [A]

Alternator Lead Connector [B]

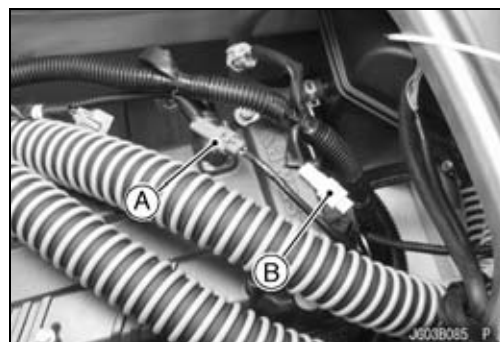
● Cut the band [C].



● Disconnect:

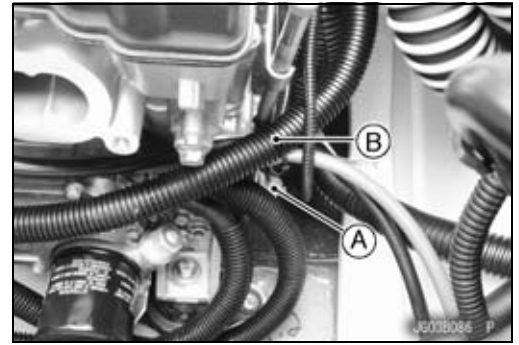
Crankshaft Sensor Lead Connector [A]

Oil Temperature Sensor Lead Connector [B]



Engine Removal/Installation

- Disconnect:
 - Oil Pressure Switch Connector [A]
- Cut the band [B].



- Remove the intake duct [A].

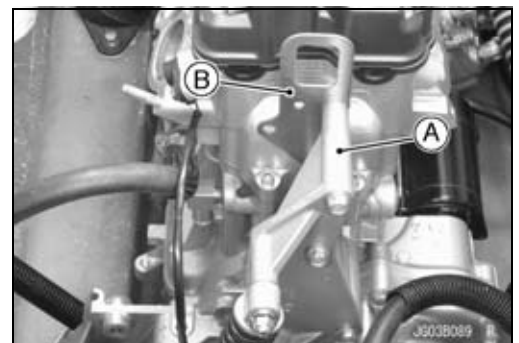


- Remove the water hose [A].

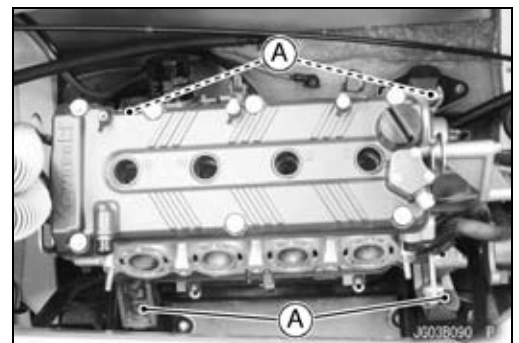


- Install the supercharger drive belt tensioner holder [A] and the engine hook [B].
- Tighten:

Torque - Supercharger Drive Belt Tensioner Holder Bolts:
35 N·m (3.6 kgf·m, 26 ft·lb)



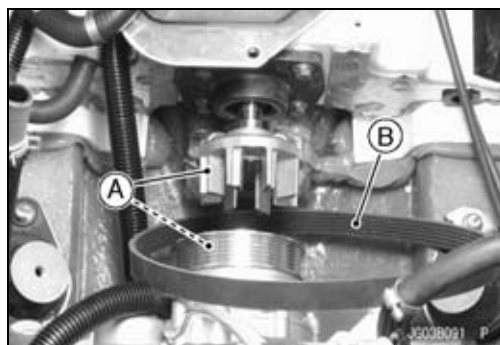
- Remove the engine mounting bolts [A].



7-6 ENGINE REMOVAL/INSTALLATION

Engine Removal/Installation

- Move the engine forward to separate the couplings [A].
- Remove the supercharger drive belt [B].



- Lift the engine with a lifter [A] and remove the engine as shown in the figure.

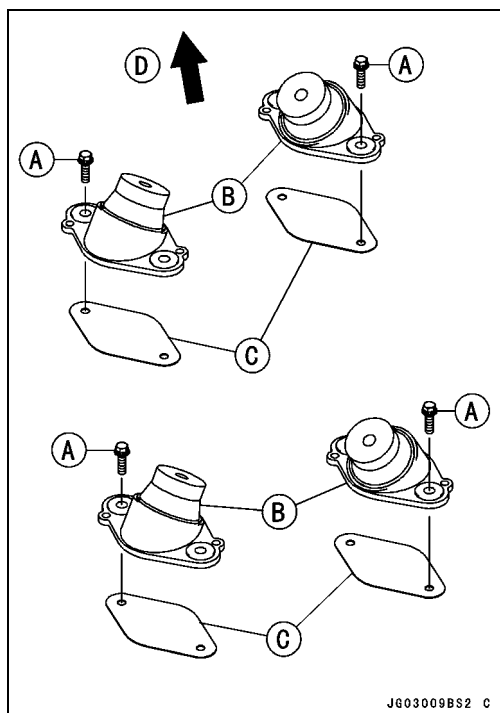


Engine Damper Removal

- Remove:
 - Engine Damper Mounting Bolts [A]
 - Engine Damper [B]
 - Shim [C] (0 ~ 2 pieces)
 - Bow [D]
- Record the number of shims of four positions so that they can be put back in the same position.

CAUTION

Install the shims to the same position. Incorrect shims could cause drive shaft misalignment.



Engine Damper Installation

- Install the shim(s) of the same number.
- Apply a non-permanent locking agent to the engine damper mounting bolts, and tighten them.

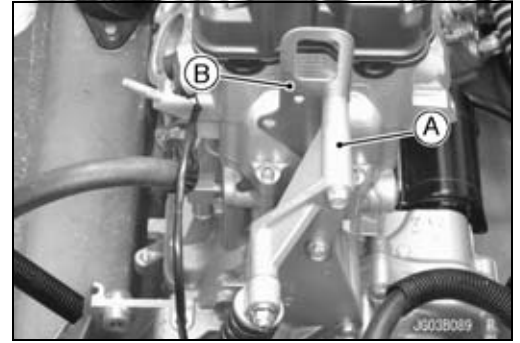
Torque - Engine Damper Mounting Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)

Engine Installation

- Be sure there are no foreign objects and parts inside of the hull.
- Clean the bilge filter (see Filter Cleaning and Inspection in the Cooling and Bilge Systems chapter).
- Inspect the coupling damper (see Coupling Damper Inspection in the Periodic Maintenance chapter).

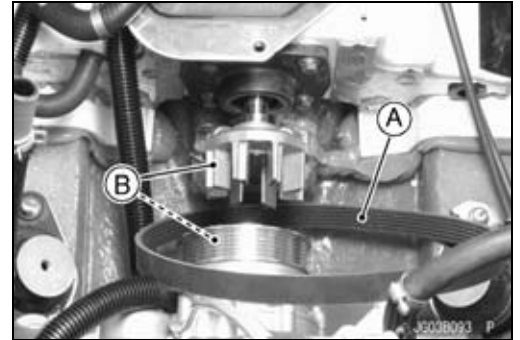
Engine Removal/Installation

- Installation is the reverse of removal. Note the following.
- Put the engine onto the hull with a lifter.
- Remove the supercharger drive belt tensioner holder [A] and the engine hook [B].



- Install the supercharger drive belt [A].
- Move the engine backward to engage the couplings [B].
- Tighten:

Torque - Engine Mounting Bolts: 36.3 N·m (3.7 kgf·m, 27 ft·lb)



- Run the leads and the hoses properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the removed parts (see appropriate chapters).
- After installing the engine in the hull, check the following.
 - Throttle Cable
 - Fuel and Exhaust Leaks

WARNING

Do not run the engine in a closed area. Exhaust gases contain carbon monoxide, a colorless, odorless, poisonous gas which can be lethal.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds, especially in high revolutionary speed or severe engine and exhaust system damage will occur.

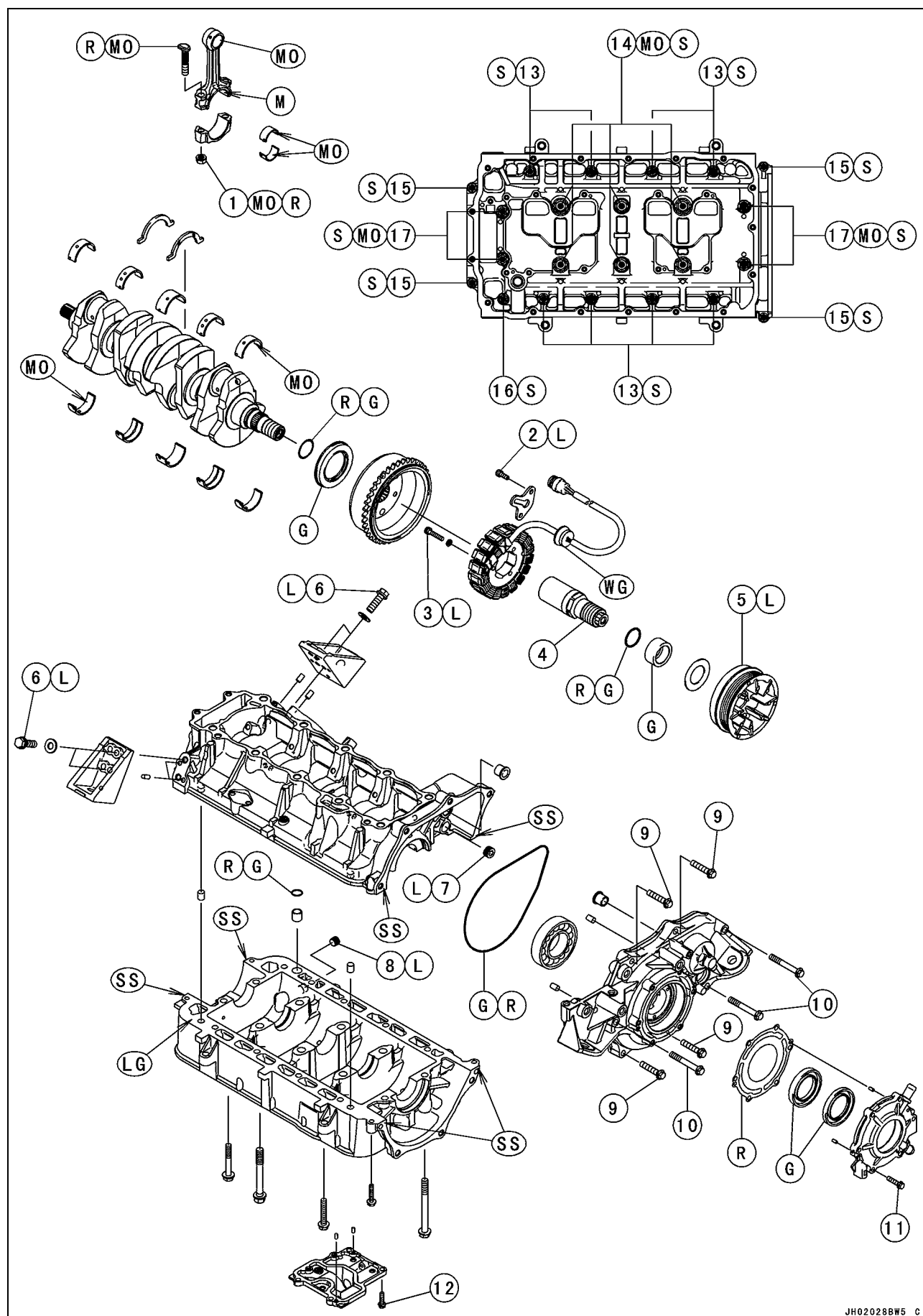
Engine Bottom End

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8-2 ENGINE BOTTOM END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Connecting Rod Nuts	see text	←	←	MO, R
2	Stator Coil Grommet Holder Plate Bolts	12	1.2	106 in·lb	L
3	Stator Coil Mounting Bolts	12	1.2	106 in·lb	L
4	Output Shaft	265	27.0	195	
5	Coupling	265	27.0	195	L
6	Engine Bracket Mounting Bolts	32	3.3	24	L
7	Oil Passage Plug (R3/8)	20	2.0	15	L
8	Oil Passage Plug (R1/4)	20	2.0	15	L
9	Alternator Cover Bolts (L = 40 mm)	20	2.0	15	
10	Alternator Cover Bolts (L = 60 mm)	20	2.0	15	
11	Output Cover Bolts	7.8	0.80	69 in·lb	
12	Oil Catch Cover Bolts	7.8	0.80	69 in·lb	
13	Crankcase Bolts (M8, L = 45 mm)	30	3.1	22	S
14	Crankcase Bolts (M11)	60	6.1	44	MO, S
15	Crankcase Bolts (M6)	12	1.2	106 in·lb	S
16	Crankcase Bolt (M8, L = 55 mm)	30	3.1	22	S
17	Crankcase Bolts (M9)	45	4.6	33	MO, S

G: Apply grease.

L: Apply a non-permanent locking agent.

LG: Apply liquid gasket.

M: Apply molybdenum disulfide grease.

MO: Apply molybdenum disulfide oil solution. (mixture of engine oil and molybdenum disulfide grease in a weight ratio is 10 : 1)

R: Replacement Parts

S: Follow the specified tightening sequence.

SS: Apply silicone sealant.

WG: Apply water resistant grease.

8-4 ENGINE BOTTOM END

Specifications

Item	Standard	Service Limit																				
Crankshaft, Connecting Rods																						
Connecting Rod Bend	— — —	0.2/100 mm (0.008/3.94 in.)																				
Connecting Rod Twist	— — —	0.2/100 mm (0.008/3.94 in.)																				
Connecting Rod Big End Side Clearance	0.13 ~ 0.38 mm (0.0051 ~ 0.0150 in.)	0.6 mm (0.024 in.)																				
Connecting Rod Big end Bearing Insert/Crankpin Clearance	0.041 ~ 0.071 mm (0.0016 ~ 0.0028 in.)	0.11 mm (0.0043 in.)																				
Crankpin Diameter:	38.984 ~ 39.000 mm (1.5348 ~ 1.5354 in.)	38.97 mm (1.534 in.)																				
Marking:																						
None	38.984 ~ 38.992 mm (1.5348 ~ 1.53512 in.)	— — —																				
○	38.993 ~ 39.000 mm (1.53515 ~ 1.5354 in.)	— — —																				
Connecting Rod Big End Inside Diameter:	42.000 ~ 42.016 mm (1.6535 ~ 1.6542 in.)	— — —																				
Marking																						
None	42.000 ~ 42.008 mm (1.6535 ~ 1.65385 in.)	— — —																				
○	42.009 ~ 42.016 mm (1.65389 ~ 1.6542 in.)	— — —																				
Connecting Rod Big End Bearing Insert Thickness:																						
Pink	1.475 ~ 1.480 mm (0.05807 ~ 0.05827 in.)	— — —																				
Yellow	1.480 ~ 1.485 mm (0.05827 ~ 0.05846 in.)	— — —																				
Green	1.485 ~ 1.490 mm (0.05846 ~ 0.05866 in.)	— — —																				
Connecting Rod Big End Bearing Insert Selection																						
<table><tr><th rowspan="2">Connecting Rod Big End Inside Diameter Marking</th><th rowspan="2">Crankpin Diameter Marking</th><th colspan="2">Bearing Insert</th></tr><tr><th>Size Color</th><th>Part Number</th></tr><tr><td>None</td><td>○</td><td>Pink</td><td>92139-0724</td></tr><tr><td>None</td><td>None</td><td rowspan="2">Yellow</td><td rowspan="2">92139-0723</td></tr><tr><td>○</td><td>○</td></tr><tr><td>○</td><td>None</td><td>Green</td><td>92139-0722</td></tr></table>			Connecting Rod Big End Inside Diameter Marking	Crankpin Diameter Marking	Bearing Insert		Size Color	Part Number	None	○	Pink	92139-0724	None	None	Yellow	92139-0723	○	○	○	None	Green	92139-0722
Connecting Rod Big End Inside Diameter Marking	Crankpin Diameter Marking	Bearing Insert																				
		Size Color	Part Number																			
None	○	Pink	92139-0724																			
None	None	Yellow	92139-0723																			
○	○																					
○	None	Green	92139-0722																			
Crankshaft Side Clearance	0.05 ~ 0.24 mm (0.0020 ~ 0.0094 in.)	0.44 mm (0.017 in.)																				
Crankshaft #3 Main Journal Width	27.45 ~ 27.55 mm (1.081 ~ 1.085 in.)	— — —																				
Crankshaft Runout	TIR 0.03 mm (0.0012 in.) or less	TIR 0.07 mm (0.0028 in.)																				

Specifications

Item	Standard	Service Limit
Crankshaft Main Bearing Insert/Journal Clearance	0.030 ~ 0.054 mm (0.0012 ~ 0.0021 in.)	0.08 mm (0.0031 in.)
Crankshaft Main Journal Diameter:	40.984 ~ 41.000 mm (1.6135 ~ 1.6142 in.)	40.96 mm (1.613 in.)
Marking		
None	40.984 ~ 40.992 mm (1.6135 ~ 1.61386 in.)	— — —
1	40.993 ~ 41.000 mm (1.61389 ~ 1.6142 in.)	— — —
Crankcase Main Bearing Inside Diameter:	44.000 ~ 44.016 mm (1.7323 ~ 1.7329 in.)	— — —
Marking		
○	44.000 ~ 44.008 mm (1.7323 ~ 1.73259 in.)	— — —
None	44.009 ~ 44.016 mm (1.73263 ~ 1.7329 in.)	— — —
Crankshaft Main Bearing Insert Thickness:		
Pink	1.490 ~ 1.494 mm (0.05866 ~ 0.05882 in.)	— — —
Yellow	1.494 ~ 1.498 mm (0.05882 ~ 0.05898 in.)	— — —
Green	1.498 ~ 1.502 mm (0.05898 ~ 0.05913 in.)	— — —

Crankshaft Main Bearing Insert Selection

Crankcase Main Bearing Inside Diameter Marking	Crankshaft Main Journal Diameter Marking	Bearing Insert*		
		Size Color	Part Number	Journal Nos.
○	1	Pink	92139-0727	1, 5
			92139-0730	2, 4
			92139-0733	3
○	None	Yellow	92139-0726	1, 5
None	1		92139-0729	2, 4
			92139-0732	3
None	None	Green	92139-0725	1, 5
			92139-0728	2, 4
			92139-0731	3

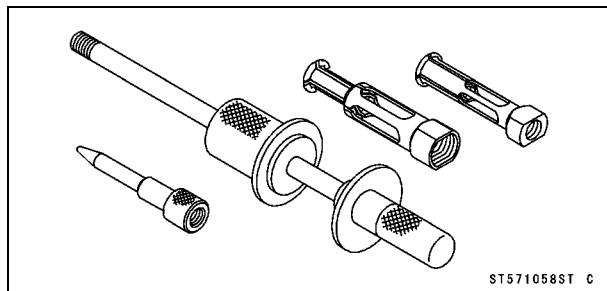
*The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

8-6 ENGINE BOTTOM END

Special Tools and Sealant

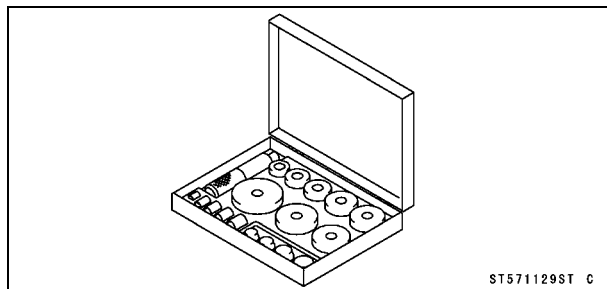
Oil Seal & Bearing Remover:

57001-1058



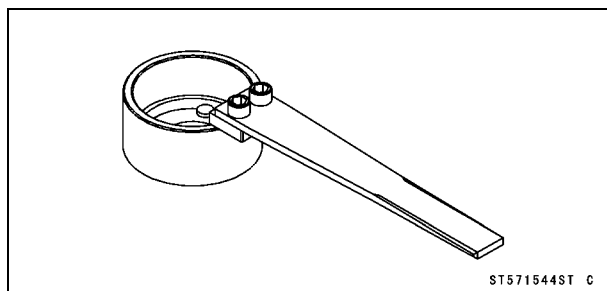
Bearing Driver Set:

57001-1129



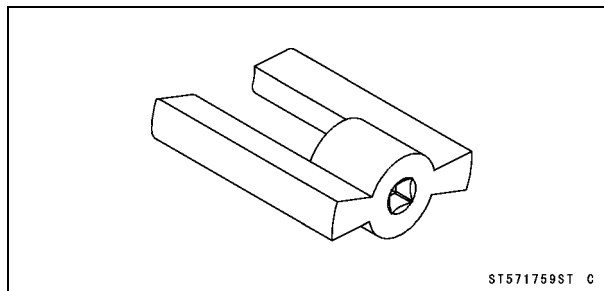
Rotor Holder:

57001-1544



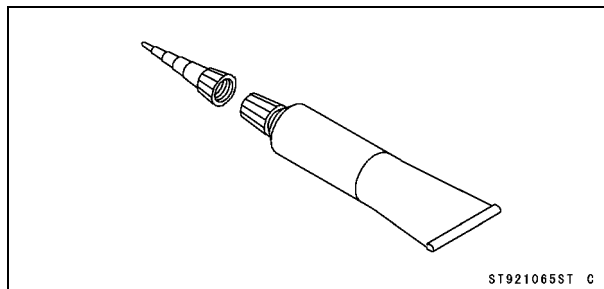
Coupling Holder:

57001-1759



Liquid Gasket, TB1215:

92104-1065



Coupling/Output Shaft

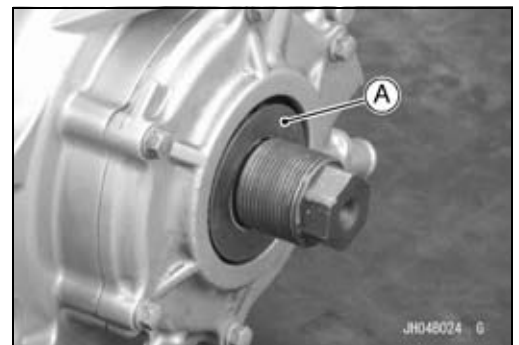
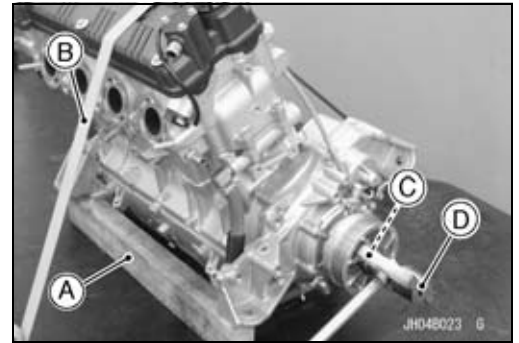
Coupling Removal

- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Starter Motor (see Starter Motor Removal in the Electrical System chapter)
 - Oil Cooler (see Oil Cooler Removal in the Engine Lubrication System chapter)
- Place the wooden block [A] under the engine mounting brackets on the exhaust side.
- Hold the engine with a suitable belt [B] tightly.
- While holding the output shaft [C], loosen the coupling with the coupling holder [D].

Special Tool - Coupling Holder: 57001-1759

Coupling Installation

- Install the washer [A] to the output shaft.



- Place the wooden block [A] under the engine mounting brackets on the intake side.
- Hold the engine with a suitable belt [B] tightly.
- Apply a non-permanent locking agent to the thread of the coupling.
- While holding the output shaft, tighten the coupling [C] with the coupling holder [D].

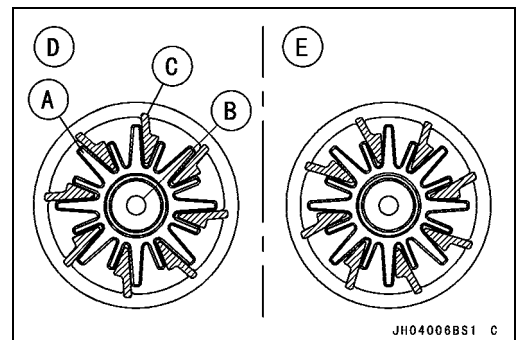
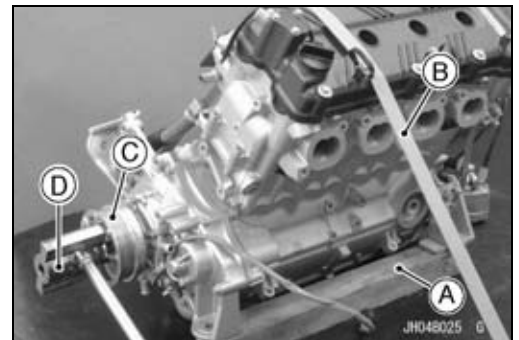
Special Tool - Coupling Holder: 57001-1759

Torque - Coupling: 265 N·m (27.0 kgf·m, 195 ft·lb)

- Install the coupling damper [A] to the engine so that the center projection [B] faces outward and fit the damper into the coupling [C] as shown.

[D] Correct

[E] Wrong

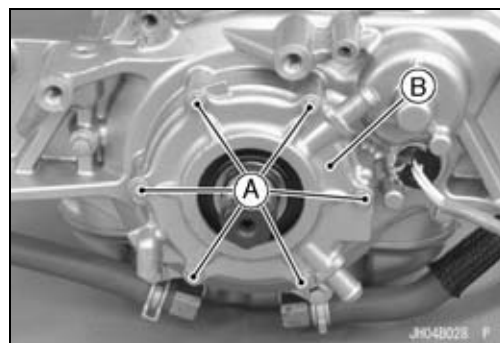


8-8 ENGINE BOTTOM END

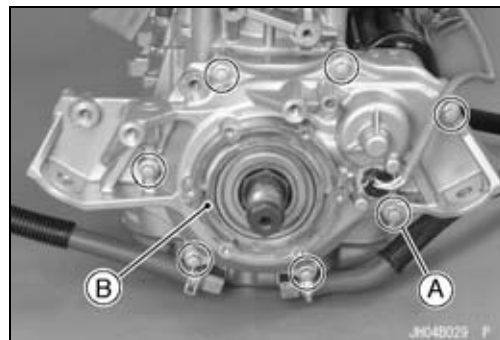
Coupling/Output Shaft

Output Shaft Removal

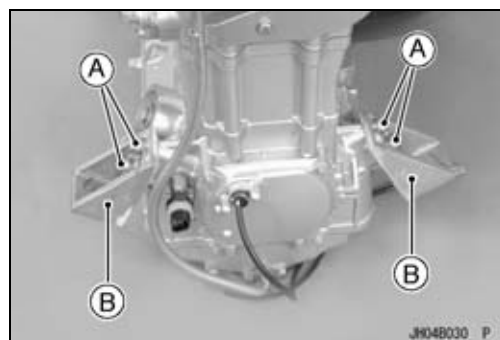
- Remove:
 - Coupling (see Coupling Removal)
 - Output Cover Bolts [A]
 - Output Cover [B]



- Remove:
 - Alternator Cover Bolts [A]
 - Alternator Cover [B]



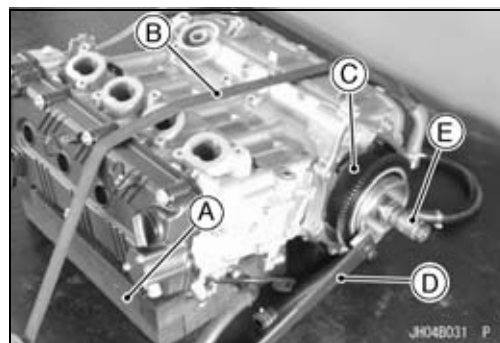
- Remove:
 - Engine Bracket Mounting Bolts [A]
 - Engine Brackets [B]



○ Place the wooden block [A] under the engine to avoid damage to the engine.

- Turn the engine so that the intake ports face upward.
- Hold the engine with a suitable belt [B] tightly.
- While holding the alternator rotor [C] with the rotor holder [D], remove the output shaft [E].

Special Tool - Rotor Holder: 57001-1544

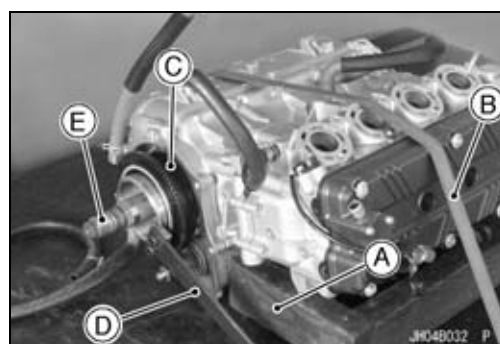


Output Shaft Installation

- Turn the engine so that the exhaust ports face upward.
- Place the wooden block [A] under the engine to avoid damage to the engine.
- Hold the engine with a suitable belt [B] tightly.
- While holding the alternator rotor [C] with the rotor holder [D], tighten the output shaft [E].

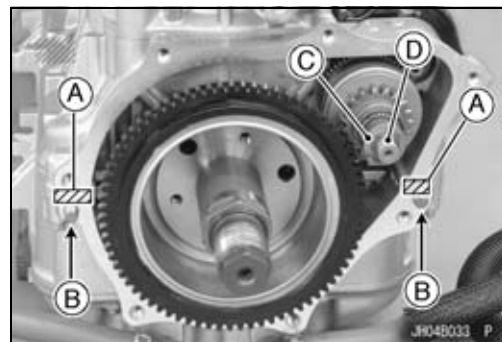
Special Tool - Rotor Holder: 57001-1544

Torque - Output Shaft: 265 N·m (27.0 kgf·m, 195 ft·lb)



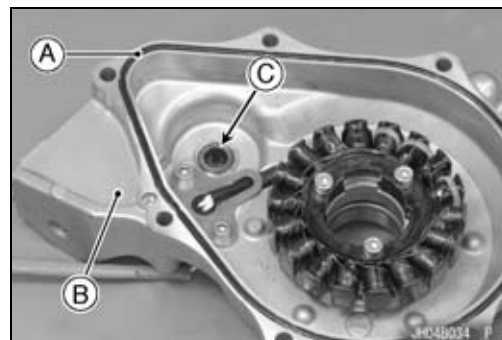
Coupling/Output Shaft

- Apply silicone sealant [A] to the crankcase halves mating surfaces on the alternator cover.
- Be sure to install the dowel pins [B].
- Be sure to install the washer [C] on the reduction gear shaft.
- Apply molybdenum disulfide grease to the reduction gear shaft [D].

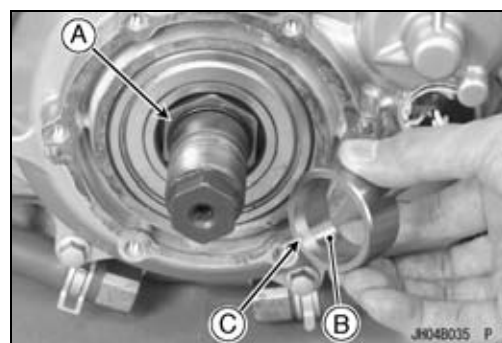


- Replace the O-ring [A] with a new one.
- Apply grease to the O-ring, and fit the O-ring onto the groove of the alternator cover [B].
- Install the alternator cover.
- Be sure to install the bushing [C] into the hole.

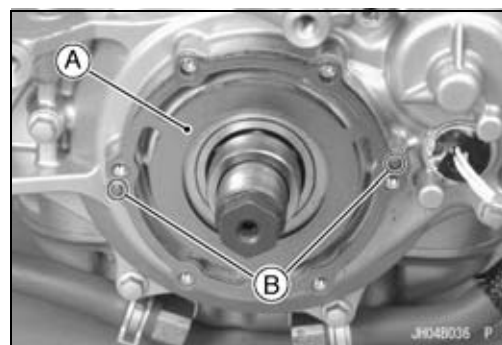
Torque - Alternator Cover Bolts: 20 N·m (2.0 kgf·m, 15 ft·lb)



- Replace the O-ring [A] with a new one.
- Apply grease to the O-ring and collar inside [B].
- Install the collar so that the chamfer side [C] faces inward.



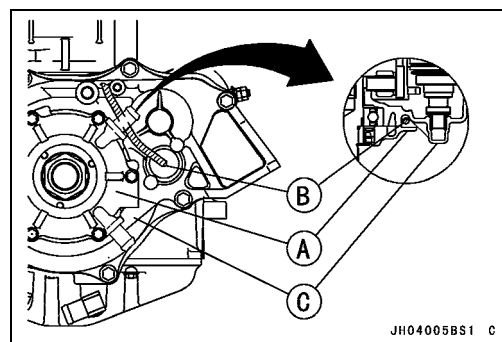
- Replace the gasket [A] with a new one.
- Install:
 - Dowel Pins [B]
 - Gasket



- Apply grease to the oil seal lip on the output cover.
- Install the output cover [A].
- Tighten:

Torque - Output Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

- Run the stator coil lead [B] between the alternator cover [C] and the output cover as shown.

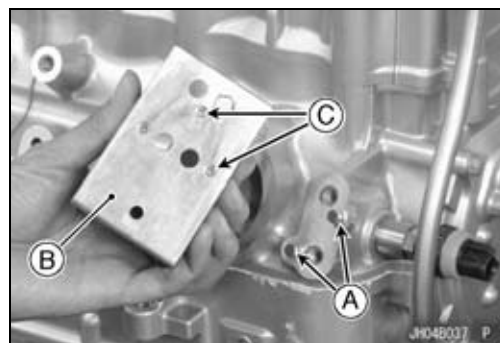


8-10 ENGINE BOTTOM END

Coupling/Output Shaft

- Install the dowel pins [A].
- Install the engine brackets [B] so that the holes [C] fit the dowel pins.
- Apply a non-permanent locking agent to the thread of the engine bracket mounting bolts.
- Tighten:

Torque - Engine Bracket Mounting Bolts: 32 N·m (3.3 kgf·m, 24 ft·lb)



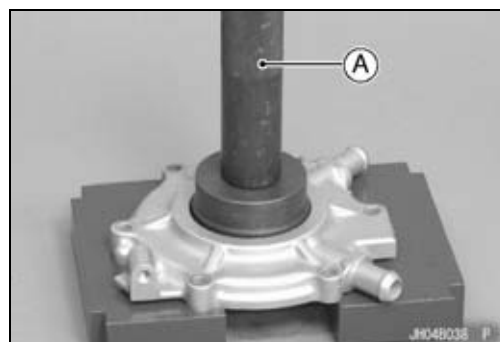
Coupling Damper Inspection

- Refer to Coupling Damper Inspection in the Periodic Maintenance chapter.

Output Cover Oil Seal Replacement

- Remove:
Output Cover (see Output Shaft Removal)
- Using the bearing driver [A], remove the oil seals as a set.

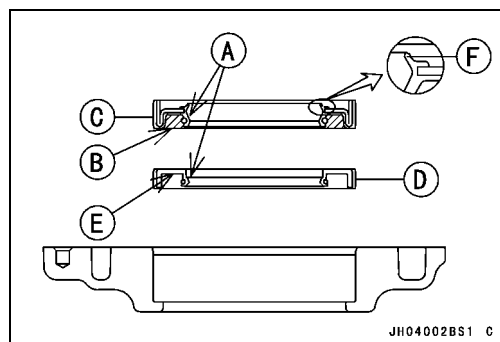
Special Tool - Bearing Driver Set: 57001-1129



- Replace the oil seals with new ones.
- Apply thin coat grease to the oil seal lips [A].
- Pack grease [B] between the oil seal lip and housing of the oil seal (engine inside oil seal [C]).
- Press in the oil seals until they are bottomed.

Special Tool - Bearing Driver Set: 57001-1129

- Install the oil seal [D] so that the manufacturer's mark [E] faces outside.
- Install the engine inside oil seal so that the dust seal [F] side faces outside.



Oil Seal Inspection

- Inspect the oil seal.
- ★ Replace it if the lips are misshapen, discolored (indicating that the rubber has deteriorated), hardened or otherwise damaged.

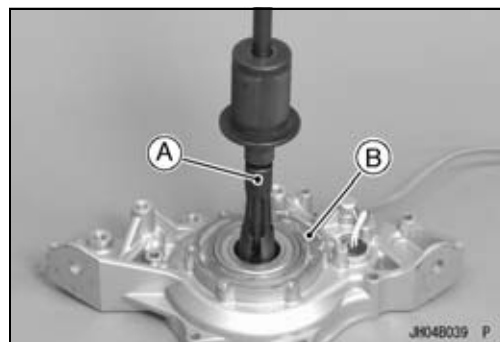
Alternator Cover Bearing Replacement

CAUTION

Do not remove the ball bearing unless it is necessary. Removal may damage it.

- Remove:
Alternator Cover (see Output Shaft Removal)
- Using the oil seal and bearing remover [A], remove the ball bearing from the alternator cover [B].
- When removing the ball bearing, hold the alternator cover.

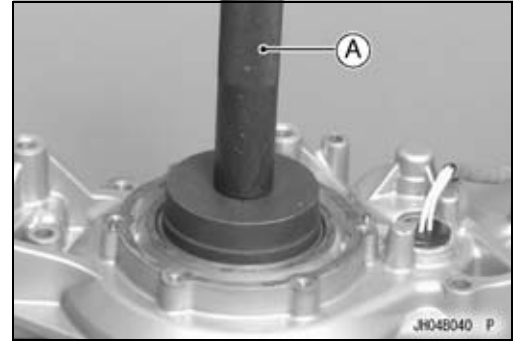
Special Tool - Oil Seal & Bearing Remover: 57001-1058



Coupling/Output Shaft

- Using a press and the bearing driver set [A], install the new bearing until it stops at the bottom of its housing.

Special Tool - Bearing Driver Set: 57001-1129



Ball Bearing Lubrication

NOTE

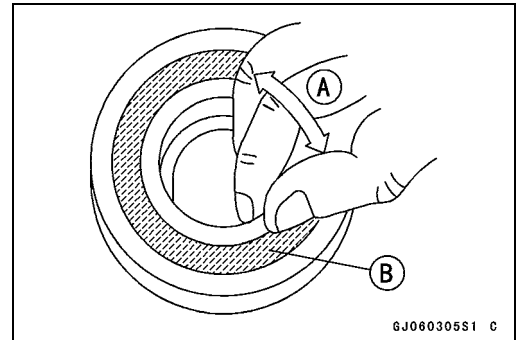
- Since the bearings are packed with grease and sealed on both sides, lubrication is not required.

Ball Bearing Inspection

NOTE

- It is not necessary to remove the bearings for inspection. If the bearing is removed, it will need to be replaced with a new one.

- Spin [A] it by hand to check its condition.
- ★ If it is noisy, does not spin smoothly, or has any rough spots, it must be replaced.
- Examine the bearing seal [B] for tears or leakage.
- ★ If the seal is torn or is leaking, replace the bearing.

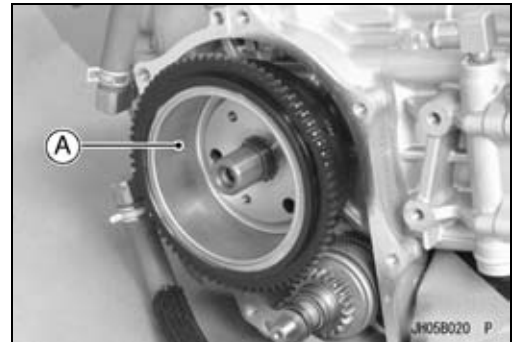


8-12 ENGINE BOTTOM END

Alternator Rotor

Alternator Rotor Removal

- Remove:
 - Output Shaft (see Output Shaft Removal)
 - Alternator Rotor [A]

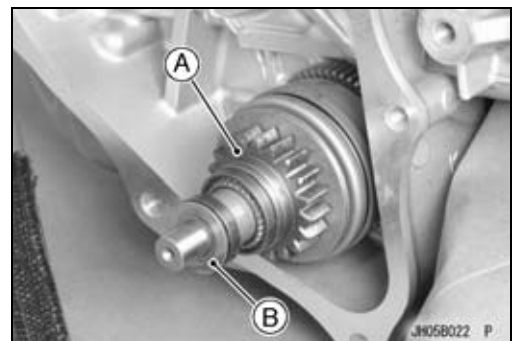


Alternator Rotor Installation

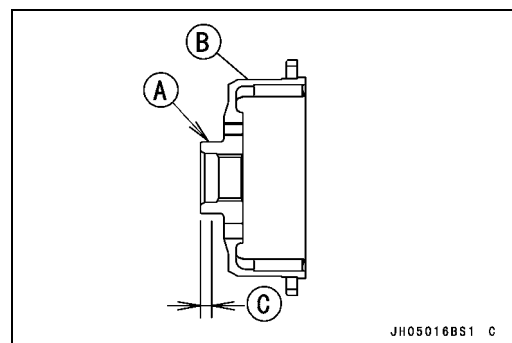
- Replace the O-ring [A] with a new one, and apply grease to it.



- ★ If the reduction gear [A] is removed, apply a molybdenum disulfide grease to both ends of its shaft.
- Install the reduction gear and the washer [B].



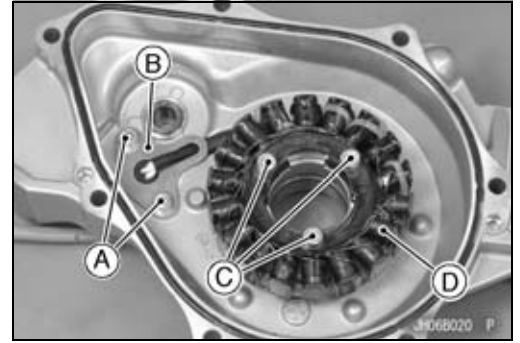
- Apply grease to the boss outside [A] of the alternator rotor [B].
 - 10 mm (0.39 in.) [C]
- Install the alternator rotor to the crankshaft.
- Install the output shaft (see Output Shaft Installation).



Stator Coil

Stator Coil Removal

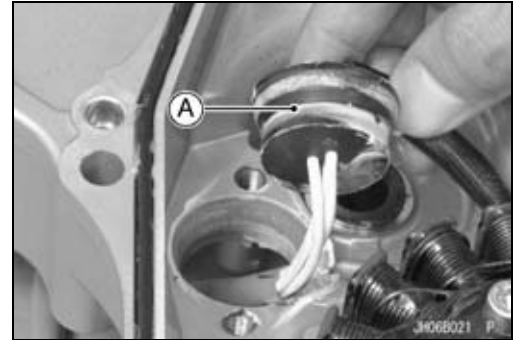
- Remove:
 - Alternator Cover (see Output Shaft Removal)
 - Stator Coil Grommet Holder Plate Bolts [A]
 - Grommet Holder Plate [B]
 - Stator Coil Mounting Bolts [C] with Washers
 - Stator Coil [D]



Stator Installation

- Apply water resistant grease to the outside of the grommet [A].
- Apply a non-permanent locking agent to the stator coil grommet holder plate bolts.
- Tighten:

Torque - Stator Coil Grommet Holder Plate Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)



- Apply a non-permanent locking agent to the stator coil mounting bolts and put the washers.
- Tighten:

Torque - Stator Coil Mounting Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)

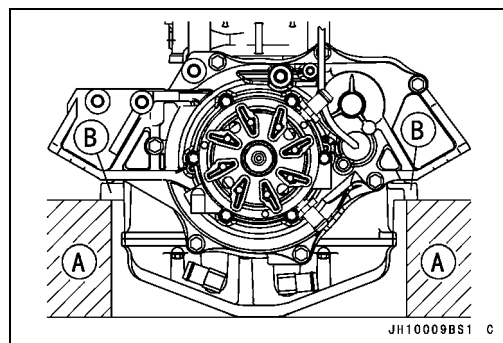
- When installing the stator coil, fix the stator lead to the groove of the magneto cover.
- Be sure the stator coil lead has no slack and bite.

8-14 ENGINE BOTTOM END

Crankcase Splitting

Crankcase Splitting

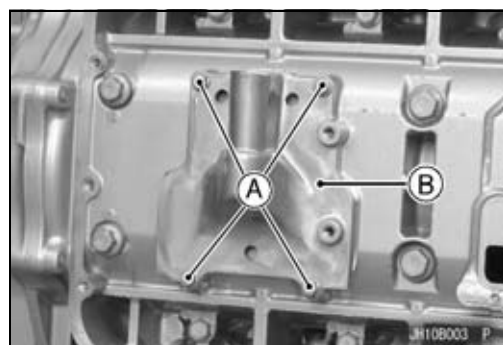
- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter).
- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Set the engine on a clean surface and hold the engine steady while parts are being removed.
 - Suitable Blocks [A]
 - Lower Crankcase Projections [B]



- Remove:
 - Oil Cooler (see Oil Cooler Removal in the Engine Lubrication System chapter)
 - Piston (see Piston Removal in the Engine Top End chapter)
 - Starter Motor (see Starter Motor Removal in the Electrical System chapter)
 - Oil Pump Sprocket (see Oil Pump Sprocket Removal in the Engine Lubrication System chapter)
 - Oil Pump Chain (see Oil Pump Chain Removal in the Engine Lubrication System chapter)
 - Alternator Rotor (see Alternator Rotor Removal)

- Turn the engine upside down.

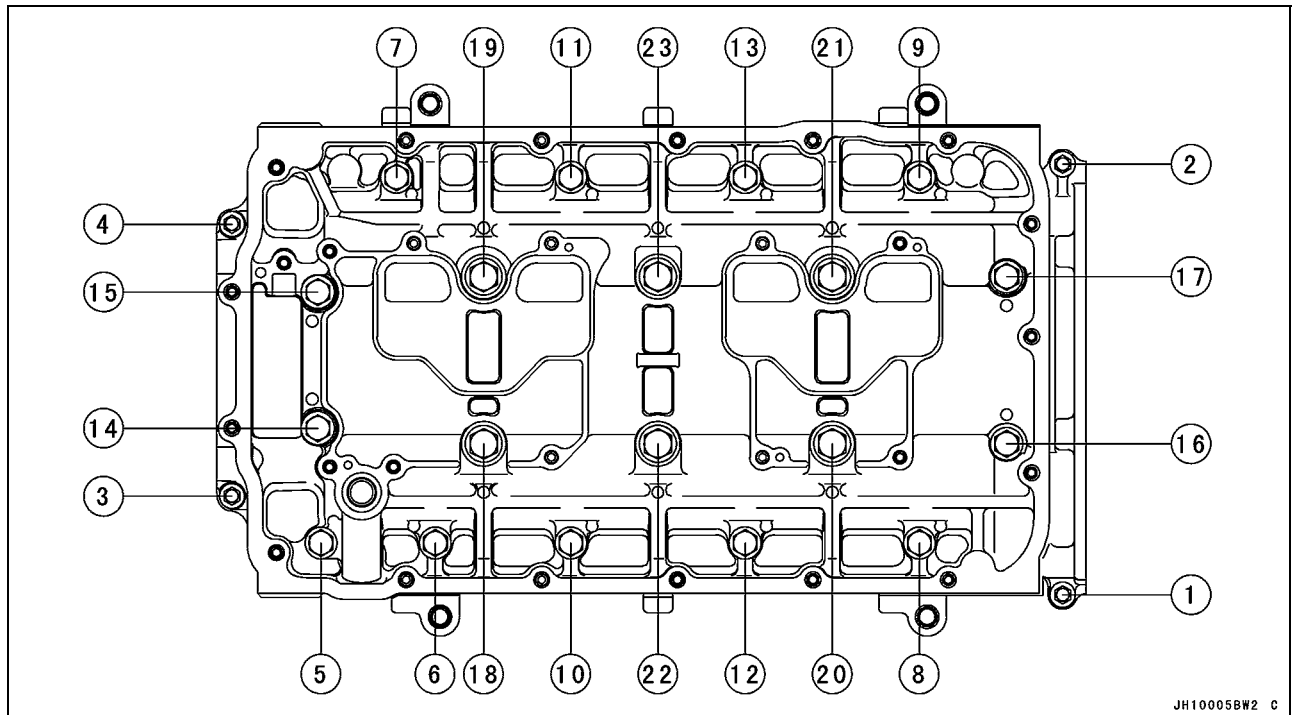
- Remove:
 - Bolts [A]
 - Oil Catch Cover [B]



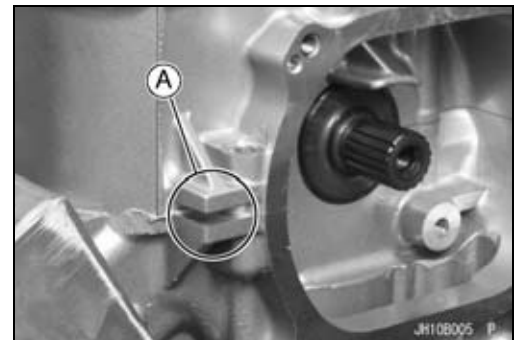
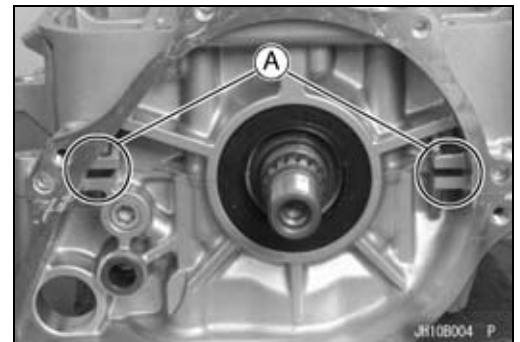
- Remove the crankcase bolts following the specified sequence.

- First, loosen the M6 bolts [1 ~ 4].
- Second, loosen the M8 bolts [5 ~ 13].
- Third, loosen the M9 bolts [14 ~ 17].
- Lastly, loosen the M11 bolts [18 ~ 23].

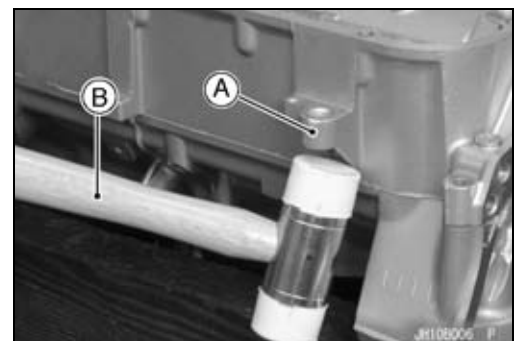
Crankcase Splitting



- Using the pry points [A], split the crankcase halves.



- Tap lightly at the lower crankcase projections [A] with a plastic mallet [B].
- Lift off the lower crankcase half to remove it.



8-16 ENGINE BOTTOM END

Crankcase Splitting

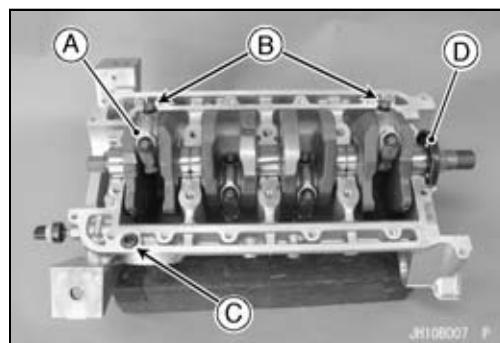
Crankcase Assembly

CAUTION

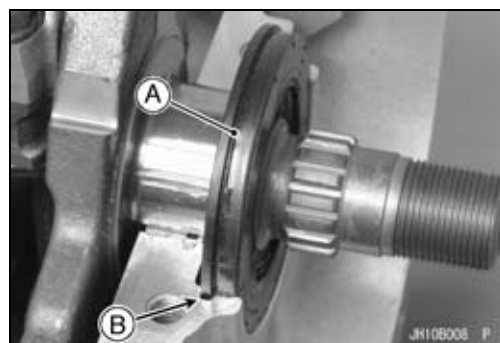
The upper and lower crankcase halves are machined at the factory in the assembled state, so the crankcase halves must be replaced as a set.

- With high-flash point solvent, clean off the mating surfaces of the crankcases halves and wipe dry.
- Using compressed air, blow out the oil passages in the crankcase halves.

- Install:
 - Crankshaft and Connecting Rods [A] (see Crankshaft Installation)
 - Dowel Pins [B]
 - Oil Passage Pipe [C] with O-ring
 - Oil Seal [D]



- Check to see that the oil seal [A] is in the groove [B] of the crankcase.



- Apply liquid gasket [A] to the mating surface of the lower crankcase half.

NOTE

○Make the application finish within 60 minutes when the liquid gasket to the mating surface of the lower crankcase half is applied.

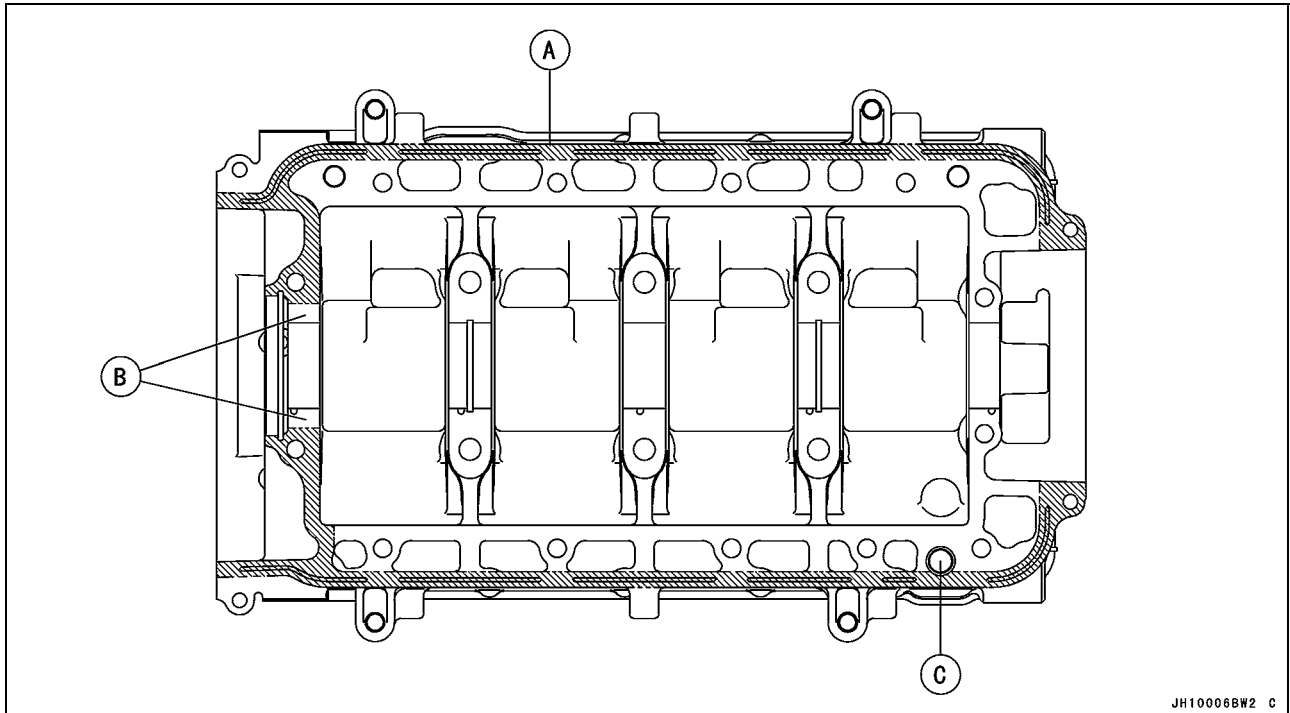
○Moreover fit the case and tighten the case bolts just after finishing the application of the liquid gasket.

Sealant - Liquid Gasket, TB1215: 92104-1065

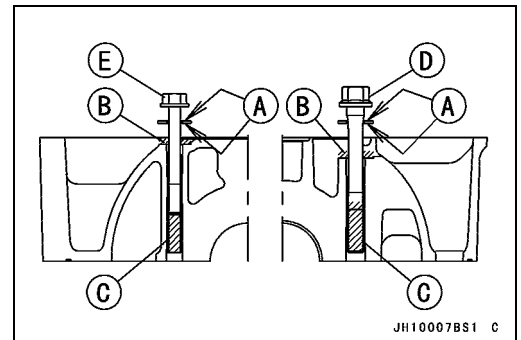
CAUTION

Do not apply liquid gasket around the crankshaft main bearing inserts [B], and oil passage hole [C].

Crankcase Splitting



- Apply molybdenum disulfide oil solution to the both surface of the washers [A] bolt seating surfaces [B] and threads [C] on the lower crankcase for the M11 bolts [D] and M9 bolts [E].



8-18 ENGINE BOTTOM END

Crankcase Splitting

- Tighten the crankcase bolts.
- Following the sequence numbers on the lower crankcase half, tighten the M11 bolts [1 ~ 6].

Torque - Crankcase Bolts (M11): 60 N·m (6.1 kgf·m, 44 ft·lb)

- Following the sequence numbers, tighten the M9 bolts [7 ~ 10].

Torque - Crankcase Bolts (M9): 45 N·m (4.6 kgf·m, 33 ft·lb)

- Following the sequence numbers, tighten the M8 bolts [11 ~ 19].

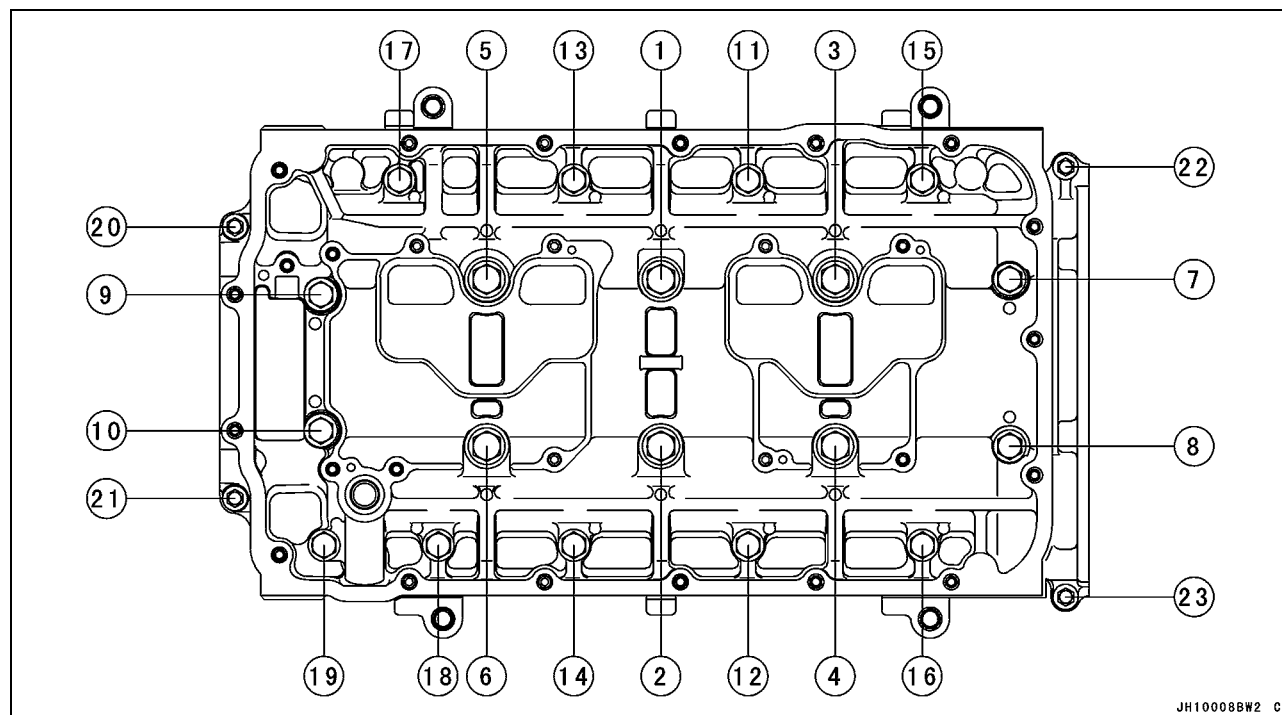
[11 ~ 18]: L = 45 mm (1.8 in.)

[19]: L = 55 mm (2.2 in.)

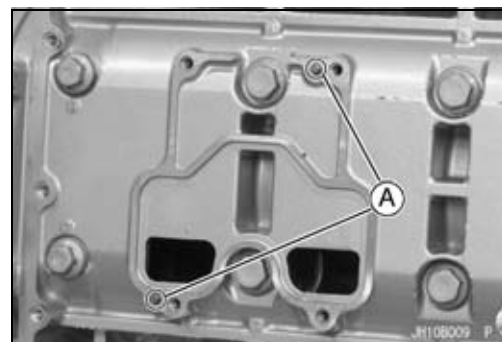
Torque - Crankcase Bolts (M8): 30 N·m (3.1 kgf·m, 22 ft·lb)

- Following the sequence numbers, tighten the M6 bolts [20 ~ 23].

Torque - Crankcase Bolts (M6): 12 N·m (1.2 kgf·m, 106 in·lb)

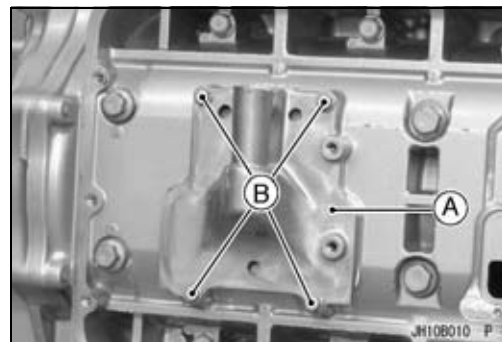


- After tightening all crankcase bolts, check that the crankshaft turn freely.
- Install the dowel pins [A].



Crankcase Splitting

- Install the oil catch cover [A].
- Tighten:
Torque - Oil Catch Cover Bolts [B]: 7.8 N·m (0.80 kgf·m, 69 in·lb)

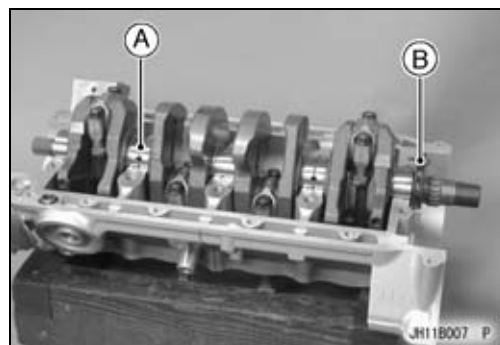


8-20 ENGINE BOTTOM END

Crankshaft and Connecting Rods

Crankshaft Removal

- Split the crankcase (see Crankcase Splitting).
- Remove the crankshaft [A] with the oil seal [B].



Crankshaft Installation

CAUTION

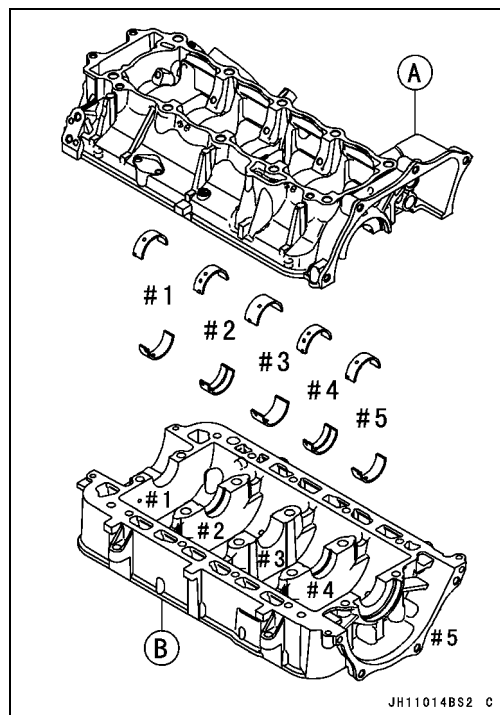
If the crankshaft, bearing inserts, or crankcase halves are replaced with new ones, select the bearing inserts and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.

- Fit the crankshaft main bearing inserts on the upper [A] and lower [B] crankcase halves.
 - #1, 5 Bearing Inserts (no Groove, same)
 - #2, 4 Bearing Inserts (Groove, same)
 - #3 Bearing Insert (no Groove)

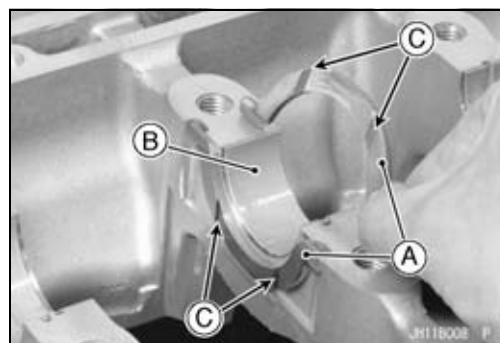
NOTE

○Be sure the bearing inserts are seated in the saddles, and the tangs in the bearing inserts are aligned with the notches in the saddles.

- Apply molybdenum disulfide oil solution to the crankshaft main bearing inserts.

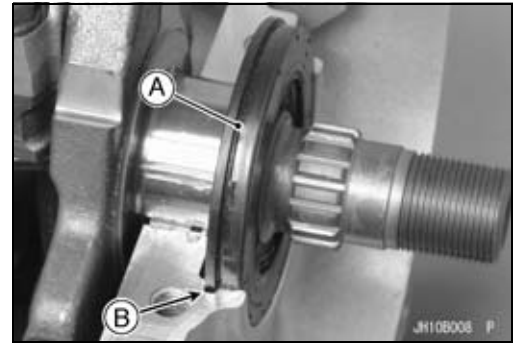


- Fit the thrust washers [A] to both sides of the upper crankcase #3 main bearing [B].
 - Install the thrust washer so that the oil grooves [C] face outward.



Crankshaft and Connecting Rods

- Fit the oil seal [A] into the groove [B] of the crankcase.
- Assemble the crankcase (see Crankcase Assembly).



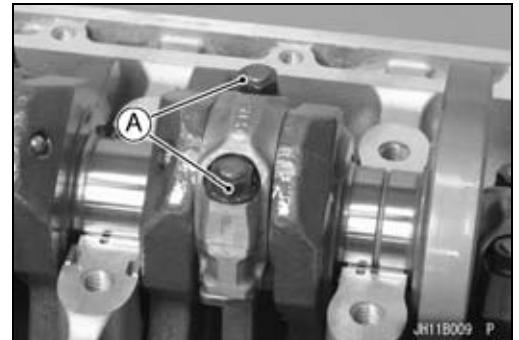
Connecting Rod Removal

- Split the crankcase (see Crankcase Splitting).
- Remove the connecting rod nuts [A].
- Remove the crankshaft.

NOTE

○ Mark and record the locations of the connecting rods and their big end caps so that they can be reassembled in their original positions.

- Remove the connecting rods from the crankshaft.
- Remove the piston (see Piston Removal in the Engine Top End chapter).



Connecting Rod Installation

⚠ WARNING

Clean the crankshaft, bolts, nuts, and connecting rods in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. This includes any appliance with a pilot light. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvents to clean them.

- After removing the connecting rods from the crankshaft, clean them with high-flash point solvent.
- Blow the crankshaft oil passages with compressed air to remove any foreign particles or residue that may have accumulated in the passages.

CAUTION

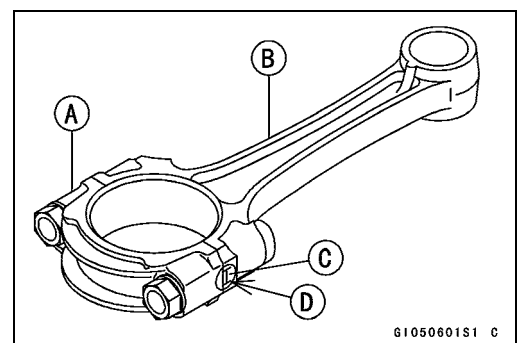
To minimize vibration, the connecting rods should have the same weight mark.

Big End Cap [A]
Connecting Rod [B]
Weight Mark, Alphabet [C]
Diameter Mark [D]

- ★ If the connecting rods, big end bearing inserts, or crankshaft are replaced with new ones, select the bearing insert and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.

CAUTION

The connecting rod bolts are designed to stretch when tightened. Never reuse them. See the table below for correct bolt and nut usage.



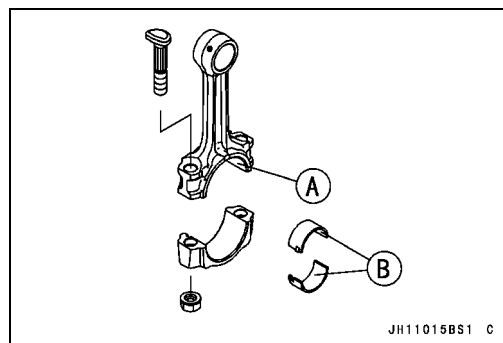
8-22 ENGINE BOTTOM END

Crankshaft and Connecting Rods

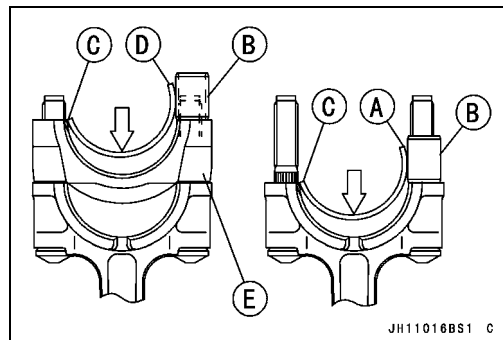
- Apply molybdenum disulfide grease to the connecting rod upper bearing [A].
- Apply molybdenum disulfide oil solution to the inner surfaces [B] of the bearing inserts.

CAUTION

Do not apply grease to the inner surface of the lower big end cap or to the outer surface of the lower bearing insert.



- Install the bearing insert as shown to prevent its outer surface from scratch damage with connecting rod edge.
 - Connecting Rod Side Bearing Insert [A]
 - Dowel Pin [B]
 - Claw Side [C]
 - Cap Side Bearing Insert [D]
 - Connecting Rod Cap [E]
- Apply molybdenum disulfide oil solution to the inner surfaces of the upper and lower bearing inserts.



- Replace the connecting rod big end bolts and nuts with new ones.
- Be sure to clean the bolts, nuts, and connecting rods thoroughly with high-flash point solvent, because the new connecting rods, bolts, and nuts are treated with anti-rust solution.

CAUTION

**Immediately dry the bolts and nuts with compressed air after cleaning.
Clean and dry the bolts and nuts completely.**

- Install the crankshaft (see Crankshaft Installation).
- Install each connecting rod on its original crankpin.
- Install the cap on the connecting rod, aligning the weight and diameter marks.
- The connecting rod big end is bolted using the “plastic region fastening method”.
- This method precisely achieves the needed clamping force without exceeding it unnecessarily, allowing the use of thinner, lighter bolts further decreasing connecting rod weight.
- There are two types of the plastic region fastening. One is a bolt length measurement method and other is a rotation angle method. Observe one of the following two, but the bolt length measurement method is preferable because this is a more reliable way to tighten the big end nuts.

Crankshaft and Connecting Rods

CAUTION

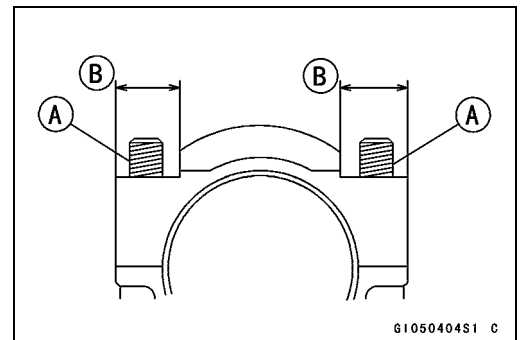
The connecting rod bolts are designed to stretch when tightened. Never reuse the connecting rod bolts. See the table below for correct bolt and nut usage.

CAUTION

Be careful not to overtighten the nuts. The bolts must be positioned on the seating surface correctly to prevent the bolt heads from hitting the crankcase.

(1) Bolt Length Measurement Method

- Install new bolts and nuts in reused connecting rods.
- Dent both bolt head and bolt tip with a punch.
- Apply molybdenum disulfide oil solution to the threads [A] and seating surfaces [B] of the connecting rod nuts.



- Before tightening, use a point micrometer to measure the length of new connecting rod bolts and record the values to find the bolt stretch.

Connecting Rod [A]

Dent here with a punch [B].

Nuts [C]

Fit micrometer pins into dents [D].

- Apply a small amount of molybdenum disulfide oil to the following.

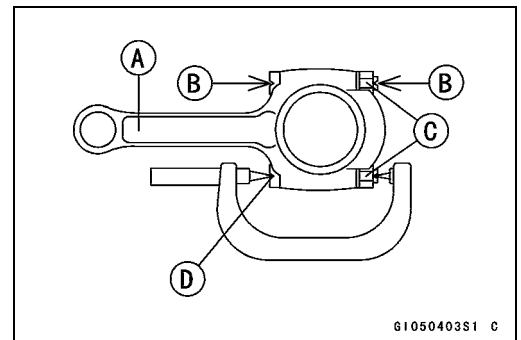
Threads of Nuts and Bolts

Seating Surfaces of Nuts and Connecting rods

- Tighten the big end nuts until the bolt elongation reaches the length specified in the table.

- Check the length of the connecting rod bolts.

★ If the stretch is more than the usable range, the bolt has stretched too much. An overelongated bolt may break in use.



$$\text{Bolt Length after tightening} - \text{Bolt Length before tightening} = \text{Bolt Stretch}$$

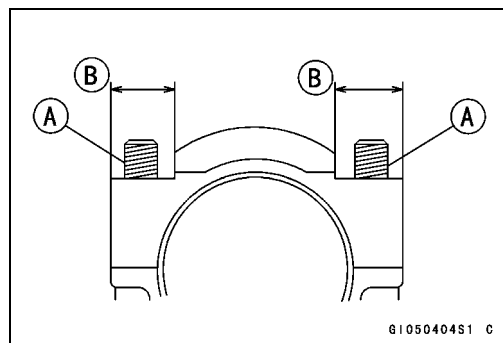
Connect- ing Rod Assy	Bolt	Nut	Usable Range of Connecting Rod Bolt Stretch
New	Use the bolts attached to new con-rod.	Attached to new con-rod	0.20 ~ 0.29 mm (0.0098 ~ 0.0134 in.)
	New	New	
Used	Replace the bolts with new ones.	Replace the nuts with new ones.	0.20 ~ 0.29 mm (0.0098 ~ 0.0134 in.)

8-24 ENGINE BOTTOM END

Crankshaft and Connecting Rods

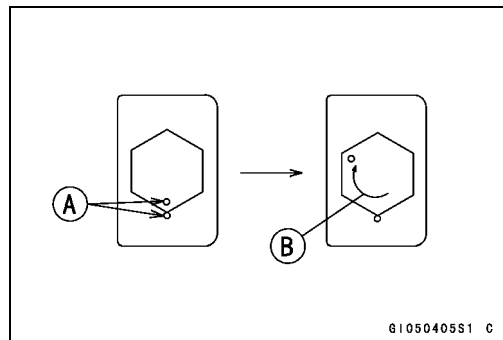
(2) Rotation Angle Method

- ★ If you don't have a point micrometer, you may tighten the nuts using the "Rotation Angle Method".
- Install new bolts and nuts in reused connecting rod.
- Apply molybdenum disulfide oil solution to the threads [A] and seating surfaces [B] of the connecting rod nuts.



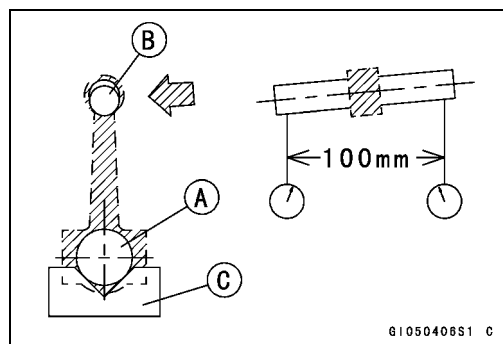
- First, tighten the nuts to the specified torque. See the table below.
- Next, tighten the nuts $120^\circ \pm 5^\circ$.
- Mark [A] the connecting rod big end caps and nuts so that nuts can be turned 120° [B] properly.

Connecting Rod Assy	Bolt	Nut	Torque + Angle N·m (kgf·m, ft·lb)
New	Use the bolts attached to new con-rod.	Attached to new con-rod	18 (1.8, 13) + 120°
	New	New	18 (1.8, 13) + 120°
Used	Replace the bolts with new ones	Replace the nuts with new ones	18 (1.8, 13) + 120°



Connecting Rod Bend Inspection

- Remove the connecting rod big end bearing inserts, and reinstall the connecting rod big end caps.
- Select an arbor [A] of the same diameter as the connecting rod big end, and insert the arbor through the connecting rod big end.
- Select an arbor of the same diameter as the piston pin at least 100 mm (3.94 in.) long, and insert the arbor [B] through the connecting rod small end.
- On a surface plate, set the big-end arbor on V blocks [C].
- Measure the difference in the heights of the arbor above the surface plate over a 100 mm (3.94 in.) distance-on the arbor to determine the amount of connecting rod bend with the connecting rod held vertically, and using a height gauge.
- ★ If connecting rod bend exceeds the service limit, the connecting rod must be replaced.



Connecting Rod Bend

Service Limit: 0.2/100 mm (0.008/3.94 in.)

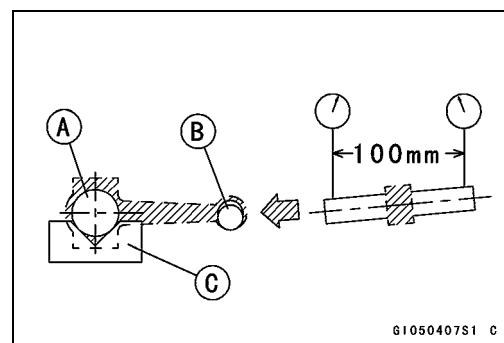
Crankshaft and Connecting Rods

Connecting Rod Twist Inspection

- On surface plate, set the big-end arbor [A] on V block [C].
- Measure the difference in the heights of the arbor [B] above the surface plate over a 100 mm (3.94 in.) distance on the arbor to determine the amount of connecting rod twist with the connecting rod held horizontally, and using a height gauge.
- ★ If connecting rod twist exceeds the service limit, the connecting rod must be replaced.

Connecting Rod Twist

Service Limit: 0.2/100 mm (0.008/3.94 in.)



Connecting Rod Big End Side Clearance

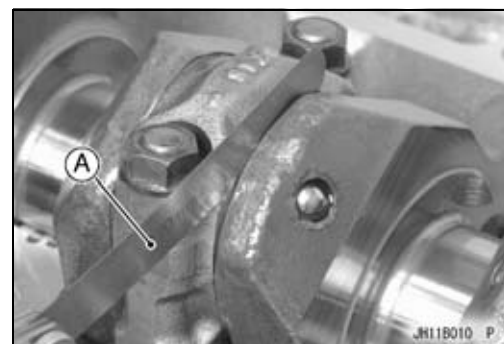
- Measure connecting rod big end side clearance.
- Insert a thickness gauge [A] between the big end and either crank web to determine clearance.

Connecting Rod Big End Side Clearance

Standard: 0.13 ~ 0.38 mm (0.0051 ~ 0.0150 in.)

Service Limit: 0.6 mm (0.024 in.)

- ★ If the clearance exceeds the service limit, replace the connecting rod with a new one and then check clearance again. If clearance is too large after connecting rod replacement, the crankshaft also must be replaced.

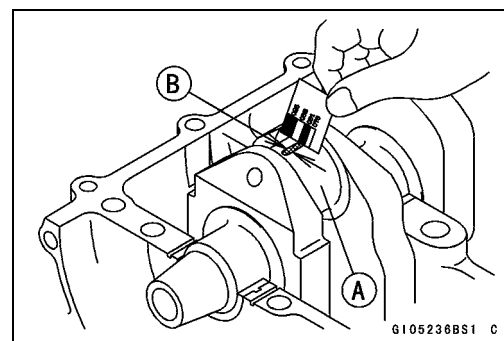


Connecting Rod Big End Bearing Insert/Crankpin Wear Inspection

- Measure the bearing insert/crankpin [A] clearance with a plastigage [B].

NOTE

- Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).
- Do not move the connecting rod and crankshaft during clearance measurement.



Connecting Rod Big End Bearing Insert/Crankpin Clearance

Standard: 0.041 ~ 0.071 mm (0.0016 ~ 0.0028 in.)

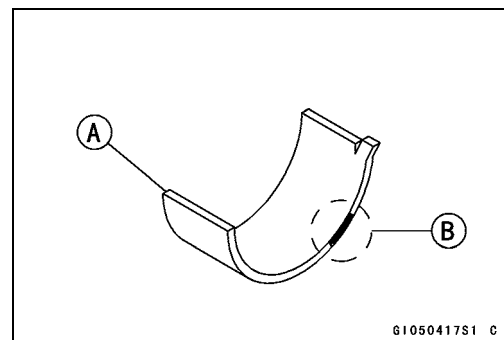
Service Limit: 0.11 mm (0.0043 in.)

- ★ If clearance is within the standard, no bearing replacement is required.
- ★ If clearance is between 0.072 mm (0.00284 in.) and the service limit 0.11 mm (0.0043 in.), replace the bearing inserts [A] with inserts painted green [B]. Check insert/crankpin clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
- ★ If the clearance exceeds the service limit, measure the diameter of the crankpins.

Crankpin Diameter

Standard: 38.984 ~ 39.000 mm (1.5348 ~ 1.5354 in.)

Service Limit: 38.97 mm (1.534 in.)



8-26 ENGINE BOTTOM END

Crankshaft and Connecting Rods

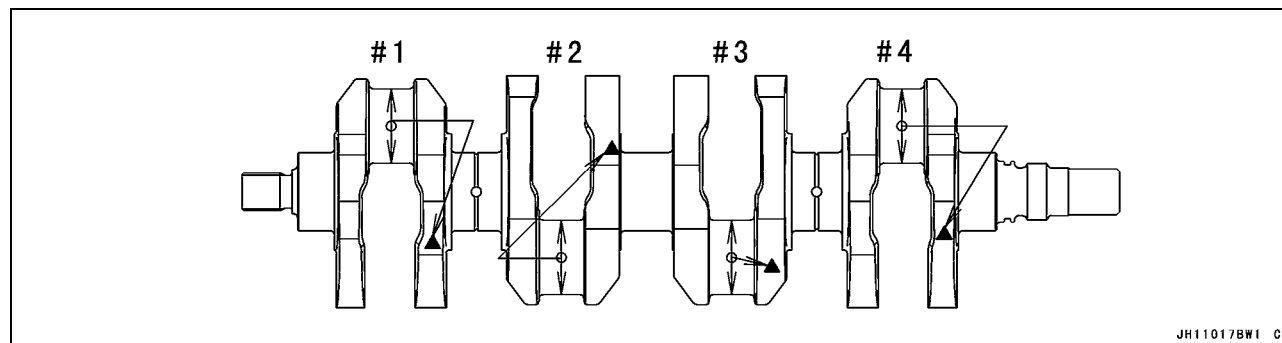
- ★ If any crankpin has worn past the service limit, replace the crankshaft with a new one.
- ★ If the measured crankpin diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

Crankpin Diameter Marks

None 38.984 ~ 38.992 mm (1.5348 ~ 1.53512 in.)

○ 38.993 ~ 39.000 mm (1.53515 ~ 1.5354 in.)

Δ: Crankpin Diameter Marks, “○” mark or no mark.



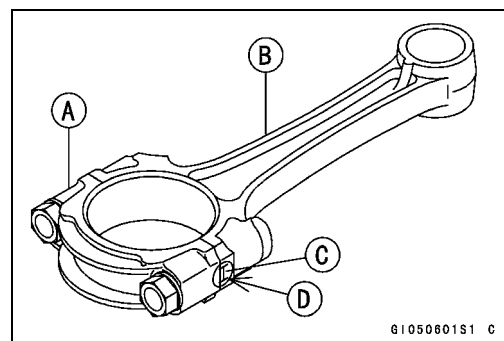
- Measure the connecting rod big end inside diameter, and mark each connecting rod big end in accordance with the inside diameter.

Big End Cap [A]

Connecting Rod [B]

Weight Mark [C]: A letter of the alphabet

Inside Diameter Mark (Around Weight Mark) [D]: “○” or no mark.



NOTE

- Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).
- The mark already on the big end should almost coincide with the measurement.

Connecting Rod Big End Inside Diameter Marks

None 42.000 mm ~ 42.008 mm (1.6535 ~ 1.65385 in.)

○ 42.009 ~ 42.016 mm (1.65389 ~ 1.6542 in.)

- Select the proper bearing insert in accordance with the combination coding of the connecting rod and crankshaft.
- Install the new inserts in the connecting rod and check insert/crankpin clearance with the plastigage.

Connecting Rod Big End Inside Diameter Marking	Crankpin Diameter Marking	Bearing Insert	
		Size Color	Part Number
None	○	Pink	92139-0724
None	None	Yellow	92139-0723
○	○		
○	None	Green	92139-0722

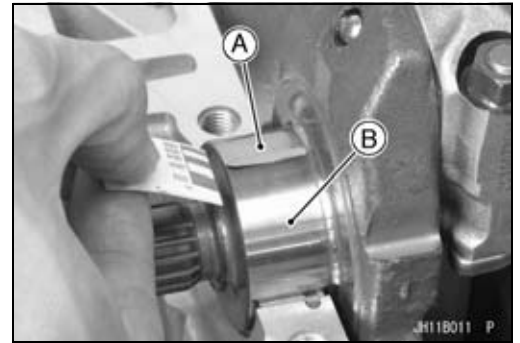
Crankshaft and Connecting Rods

Crankshaft Main Bearing Insert/Journal Wear Inspection

- Measure the bearing insert/journal [B] clearance with a plastigage [A].

NOTE

- Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).
- Do not turn the crankshaft during clearance measurement.
- Journal clearance less than 0.025 mm (0.0010 in.) can not be measured by plastigage, however, using genuine parts maintains the minimum standard clearance.

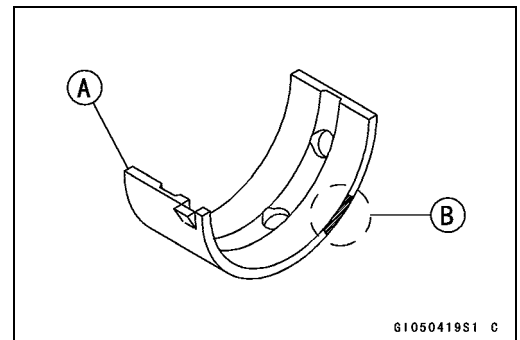


Crankshaft Main Bearing Insert/Journal Clearance

Standard: 0.030 ~ 0.054 mm (0.0012 ~ 0.0021 in.)

Service Limit: 0.08 mm (0.0031 in.)

- ★ If clearance is within the standard, no bearing replacement is required.
- ★ If clearance is between 0.055 mm (0.022 in.) and the service limit 0.08 mm (0.0031 in.), replace the bearing inserts [A] with inserts painted green [B]. Check insert/journal clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
- ★ If clearance exceeds the service limit, measure the diameter of the crankshaft main journal.



Crankshaft Main Journal Diameter

Standard: 40.984 ~ 41.000 mm (1.6135 ~ 1.6142 in.)

Service Limit: 40.96 mm (1.613 in.)

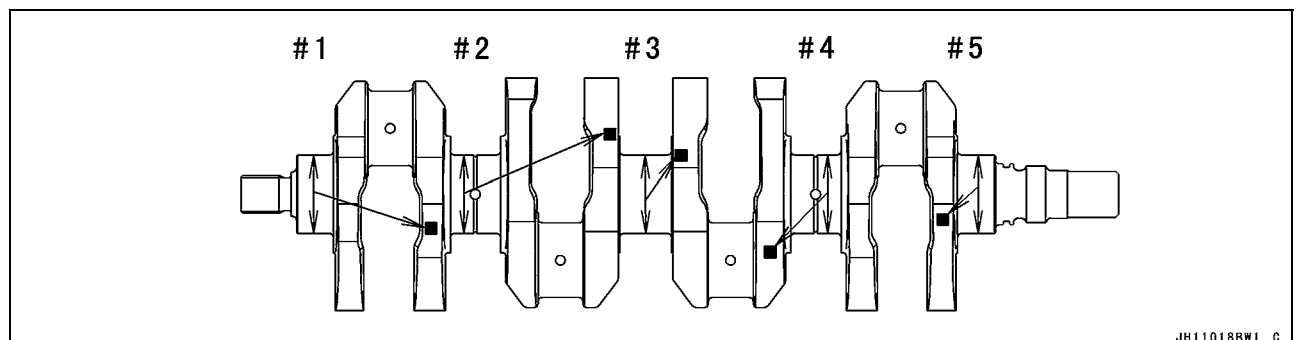
- ★ If any journal has worn past the service limit, replace the crankshaft with a new one.
- ★ If the measured journal diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

Crankshaft Main Journal Diameter Marks

None 40.984 ~ 40.992 mm (1.6135 ~ 1.61386 in.)

1 40.993 ~ 41.000 mm (1.61389 ~ 1.6142 in.)

- : Crankshaft Main Journal Diameter Marks, "1" mark or no mark.



8-28 ENGINE BOTTOM END

Crankshaft and Connecting Rods

- Measure the main bearing inside diameter, and mark [B] the upper crankcase half [A] in accordance with the inside diameter.
- Crankcase main bearing inside diameter marks are "○" mark and no mark.

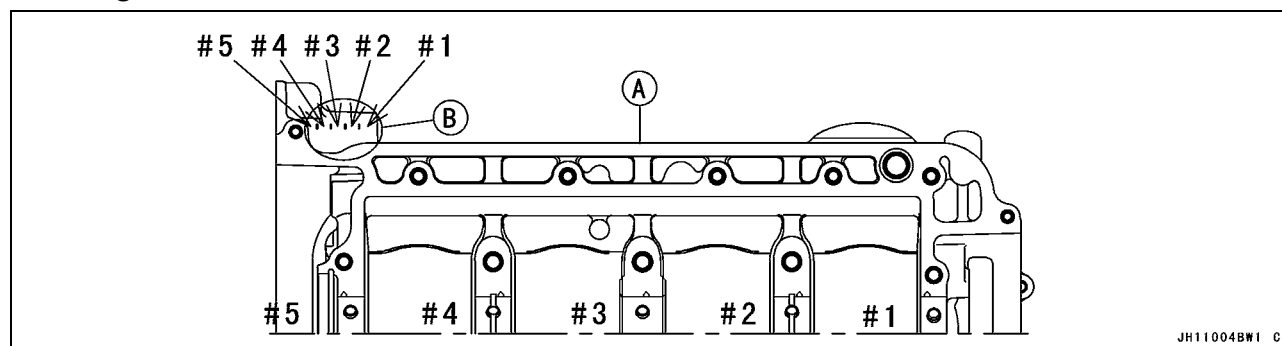
NOTE

- Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).
- The mark already on the upper crankcase half should almost coincide with the measurement.

Crankcase Main Bearing Inside Diameter Marks

- 44.000 ~ 44.008 mm (1.7323 ~ 1.73259 in.)
- None 44.009 ~ 44.016 mm (1.73263 ~ 1.7329 in.)

Marking Position



- Select the proper bearing insert in accordance with the combination coding of the crankcase and crankshaft.
- Install the new inserts in the crankcase halves and check insert/journal clearance with the plastigage.

Crankcase Main Bearing Inside Diameter Marking	Crankshaft Main Journal Diameter Marking	Bearing Insert*		
		Size Color	Part Number	Journal No.
○	1	Pink	92139-0727	1, 5
			92139-0730	2, 4
			92139-0733	3
○	None	Yellow	92139-0726	1, 5
			92139-0729	2, 4
None	1		92139-0732	3
None	None	Green	92139-0725	1, 5
			92139-0728	2, 4
			92139-0731	3

*The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

Crankshaft and Connecting Rods

Crankshaft Side Clearance Inspection

- Insert a thickness gauge [A] between the thrust washer [B] and the crank web [C] at the No. 3 main journal to determine clearance.
- ★ If the clearance exceeds the service limit, replace the thrust washer as a set and check the width of the crankshaft #3 main journal.

Crankshaft Side Clearance

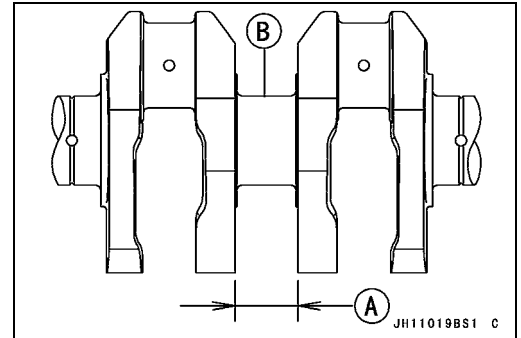
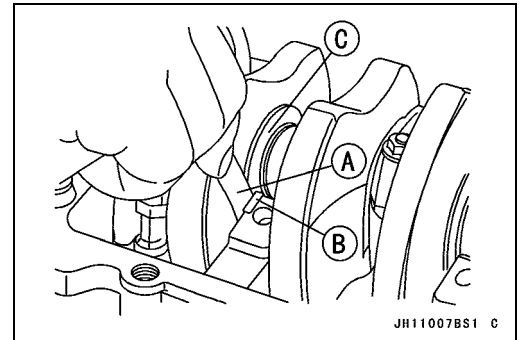
Standard: 0.05 ~ 0.24 mm (0.0020 ~ 0.0094 in.)

Service Limit: 0.44 mm (0.017 in.)

- Measure the crankshaft #3 main journal width [A].
- ★ If the measurement exceeds the standard, replace the crankshaft [B].

Crankshaft #3 Main Journal Width

Standard: 27.45 ~ 27.55 mm (1.081 ~ 1.085 in.)



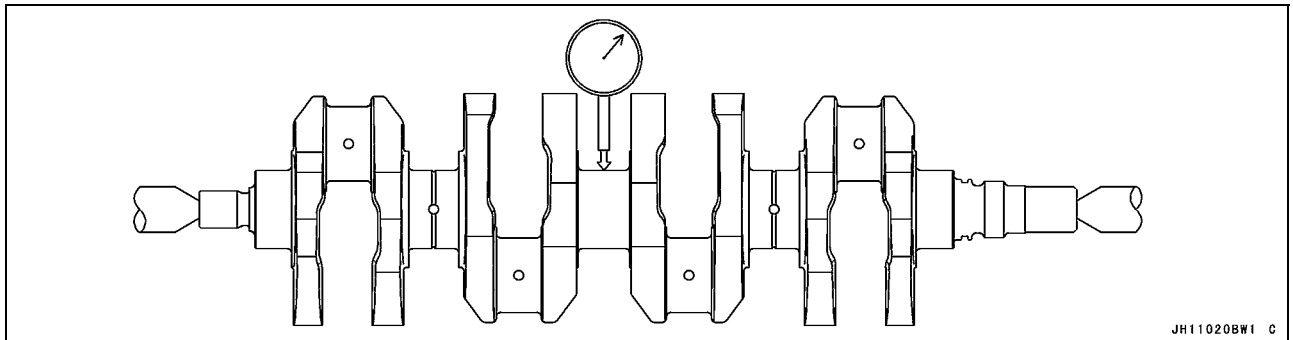
Crankshaft Runout Inspection

- Measure the crankshaft runout.
- ★ If the measurement exceeds the service limit, replace the crankshaft.

Crankshaft Runout

Standard: TIR 0.03 mm (0.0012 in.) or less

Service Limit: TIR 0.07 mm (0.0028 in.)



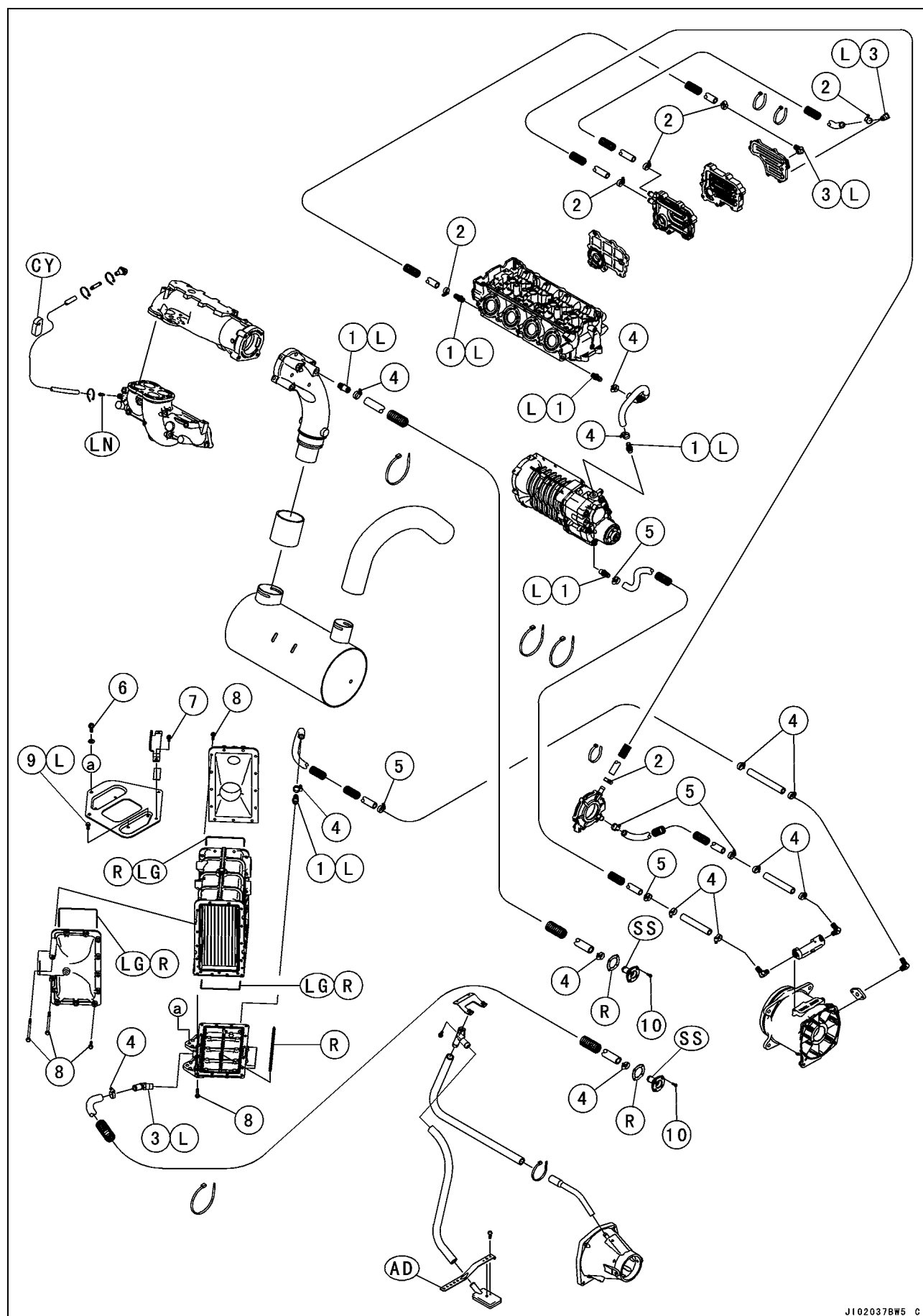
Cooling and Bilge Systems

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9-2 COOLING AND BILGE SYSTEMS

Exploded View



COOLING AND BILGE SYSTEMS 9-3

Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Water Hose Joints (Straight Shape)	20	2.0	15	L
2	Water Hose Clamp Screws	1.5	0.15	13 in·lb	
3	Water Hose Joint (L Shape)	11	1.1	97 in·lb	L
4	Water Hose Clamp Screws	2.5	0.26	22 in·lb	
5	Water Hose Clamp Screws	3.9	0.40	35 in·lb	
6	Intercooler Mounting Bolts	30	3.1	22	
7	Intercooler Bracket Bolts	8.8	0.90	78 in·lb	
8	Intercooler Cover Bolts	10	1.0	89 in·lb	
9	Intercooler Plate Bolts	8.8	0.90	78 in·lb	L
10	Flushing Fitting Screws	3.0	0.31	27 in·lb	

AD: Apply adhesive.

CY: Apply cyanoacrylate cement.

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent (High Strength).

LG: Apply liquid gasket.

R: Replacement Parts

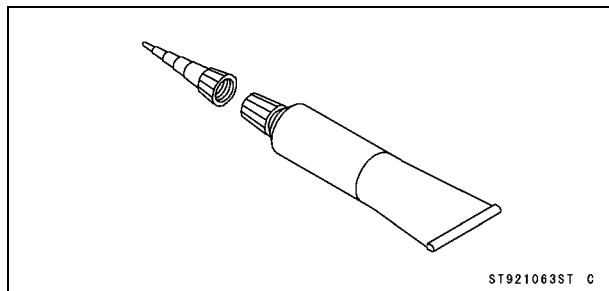
SS: Apply silicone sealant.

9-4 COOLING AND BILGE SYSTEMS

Sealant

Liquid Gasket, TB1216:

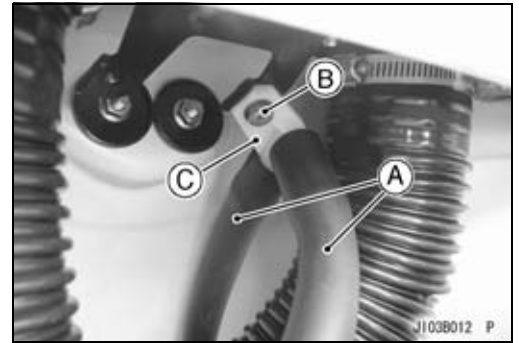
92104-1063



Bilge System

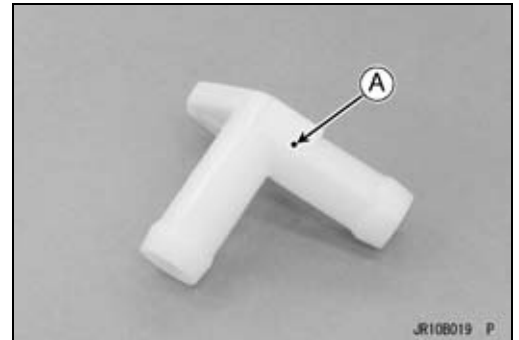
Breather Removal

- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
- Pull the hoses [A] off the breather.
- Unscrew the mounting bolt [B], and remove the breather [C].



Breather Installation

- Be sure the small hole [A] in the breather is open before installing it.
- Tighten the breather mounting bolt.

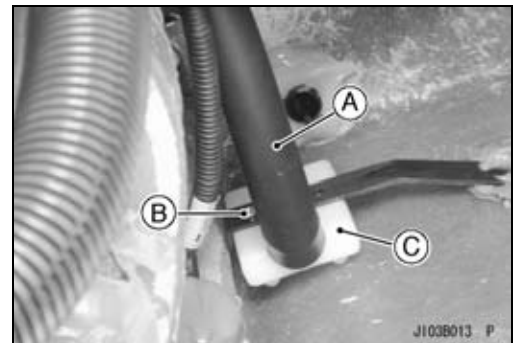


Breather Cleaning and Inspection

- Check that the small hole in the top of the breather is open by blowing in one end of the breather and plugging the other.
- ★ If the hole is plugged, clean it with compressed air. Do not open it with a pointed object (like a needle or a piece of wire), because the hole may be enlarged. If the hole is too large, the bilge system may not suck water out of the hull as it should.

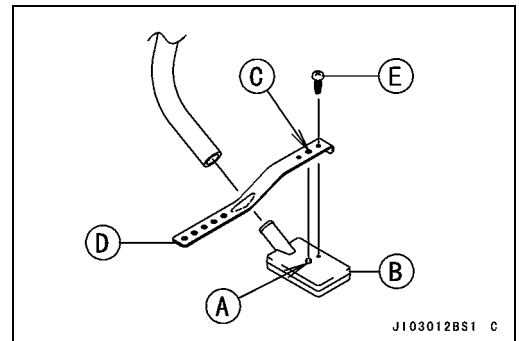
Filter Removal

- Remove the engine (see Engine Removal/Installation chapter).
- Pull the hose [A] off the filter.
- Unscrew the mounting screw [B] and remove the filter [C].



Filter Installation

- Align the projection [A] on the filter [B] with the hole [C] on the bracket [D].
- Tighten the filter mounting screw [E].



9-6 COOLING AND BILGE SYSTEMS

Bilge System

Filter Cleaning and Inspection

- Flush the filter thoroughly with fresh water and shake it dry.
- Water must flow freely through the filter, but large debris must not.
- ★ If the filter cannot be cleaned, or if it is broken and allows debris to pass through, replace it.

Cooling and Bilge System Hoses

Hose Removal

- The majority of bilge hoses have no clamps at the hose ends. The majority of bilge system hoses may be simply pulled off their fittings.

NOTE

○ *Some of the bilge system hoses have plastic clamps at hose ends.*

- All the cooling system hoses are clamped at both ends. Loosen the clamps and pull the hoses off.

Hose Installation

- To install the bilge filter hose, push the hose over the end of the filter.

NOTE

○ *Some of the bilge system hoses have plastic clamps at hose ends.*

- When installing the cooling system hoses, be sure to use the same kind of clamp as the original. Some of the clamps are metal for tighter clamping ability (required when smooth fittings are used). Plastic clamps are used where tight clamping is not required.

Hose Inspection

- Refer to the Hose and Hose Connect Inspection in the Periodic Maintenance chapter.

9-8 COOLING AND BILGE SYSTEMS

Cooling and Bilge System Flushing

Cooling System Flushing

- Refer to the Cooling System Flushing in the Periodic Maintenance chapter.

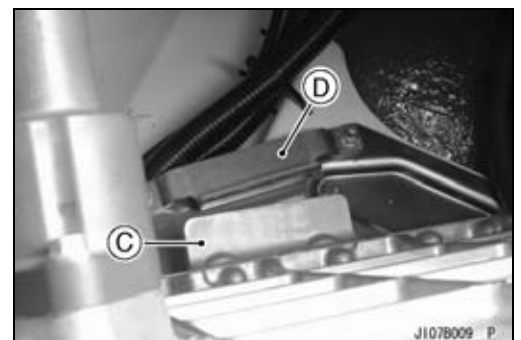
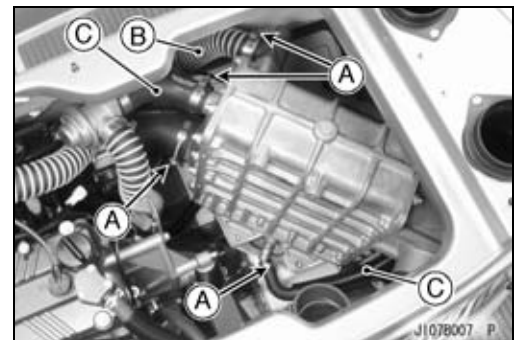
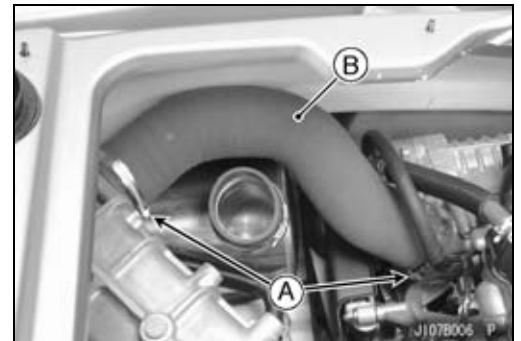
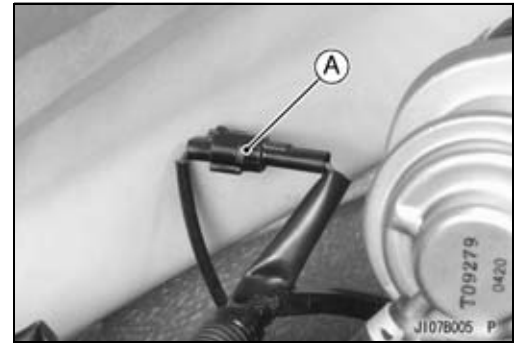
Bilge System Flushing

- Refer to the Bilge System Flushing in the Periodic Maintenance chapter.

Intercooler

Intercooler Removal

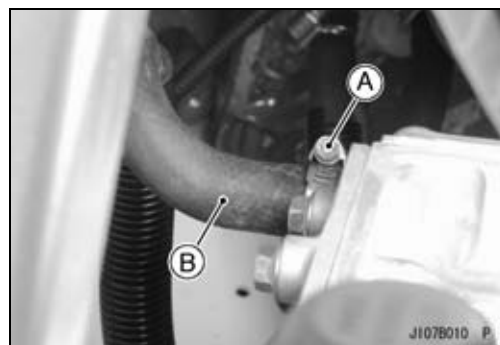
- Remove:
 - Seats (see Seat Removal in the Hull/Engine Hood chapter)
 - Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
 - Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
 - Exhaust Pipe and Muffler Body (see Exhaust Pipe and Muffler Body Removal in the Exhaust System chapter)
 - Connector [A]
- Remove:
 - Clamp Screws (Loosen) [A]
 - Intercooler Duct [B]
- Remove:
 - Clamp Screws (Loosen) [A]
 - Duct [B]
 - Hoses [C]
- Remove the bolts [A].
- Move the intercooler [B] to pull the plate [C] of intercooler from the bracket [D].
- Remove the duct [E].



9-10 COOLING AND BILGE SYSTEMS

Intercooler

- Remove:
 - Clamp Screw (Loosen) [A]
 - Hose [B]
 - Intercooler



Intercooler Installation

- Install the bracket [A], plate [B] and damper [C] as shown in the figure.
 - Bow [D]
- Apply a non-permanent locking agent to the threads of the intercooler plate bolts [E].
- Tighten:

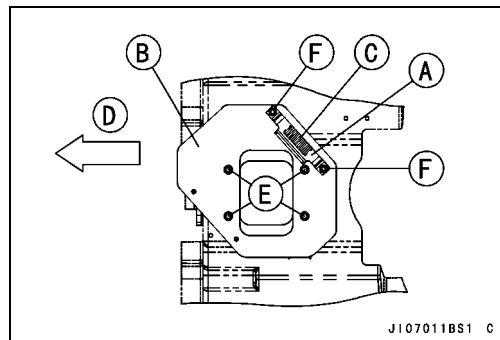
Torque - Intercooler Plate Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

Intercooler Bracket Bolts [F]: 8.8 N·m (0.90 kgf·m, 78 in·lb)

- Run the lead, hoses and ducts correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Tighten:

Torque - Intercooler Mounting Bolts: 30 N·m (3.1 kgf·m, 22 ft·lb)

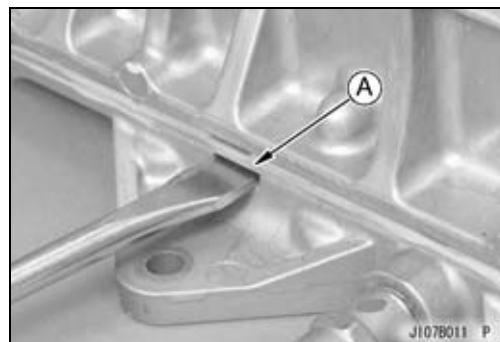
- Install the removed parts (see appropriate chapters).



Intercooler Disassembly/Assembly

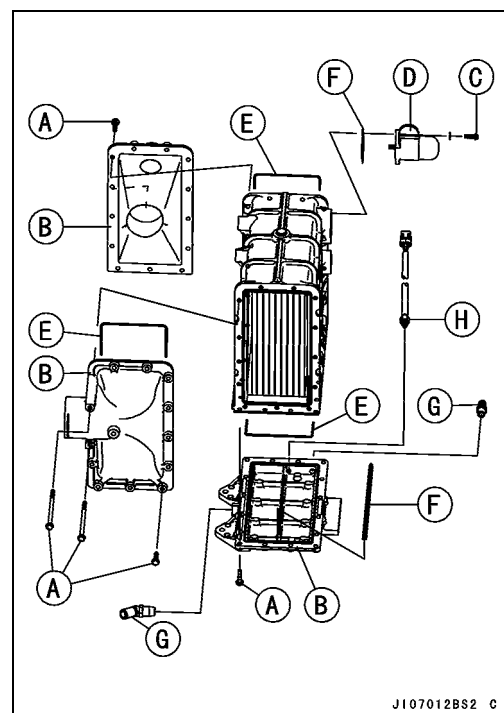
NOTE

- There are seals between the intercooler case and covers. Pry the points [A] to split the intercooler cover.



Intercooler

- Remove:
 - Intercooler Cover Bolts [A]
 - Intercooler Cover [B]
 - Blow off Valve Bolts [C]
 - Blow off Valve [D]
 - O-rings [E]
 - Gaskets [F]
 - Hose Joints [G]
 - Water Temperature Sensor (for Meter Unit) [H]



- When assembling, note the following.
 - Replace the O-rings [A] and gaskets [B] with new ones.
 - Apply liquid gasket on the O-rings.

Sealant - Liquid Gasket, TB1216: 92104-1063

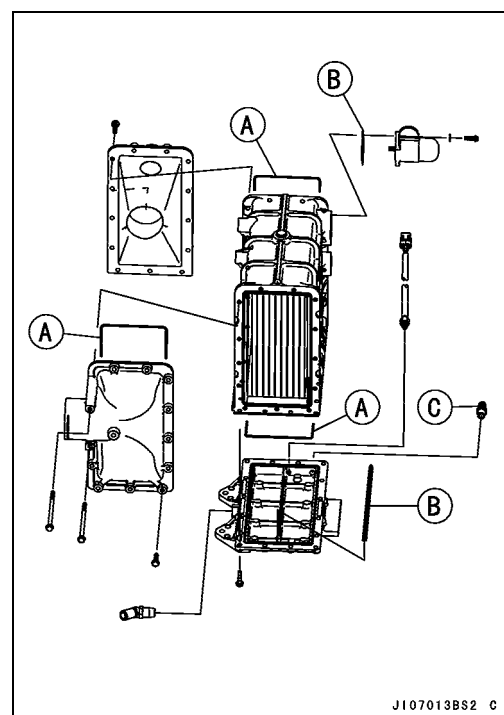
- Apply a non-permanent locking agent to the threads of the water hose joint [C].
- Tighten:

Torque - Intercooler Cover Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)

Blow off Valve Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

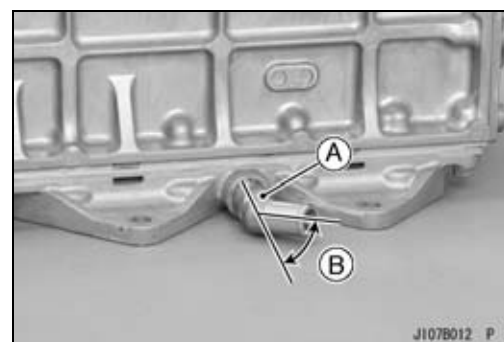
Water Hose Joint (Straight Shape): 20 N·m (2.0 kgf·m, 15 ft·lb)

Water Temperature Sensor (for Meter Unit): 8.8 N·m (0.90 kgf·m, 78 in·lb)



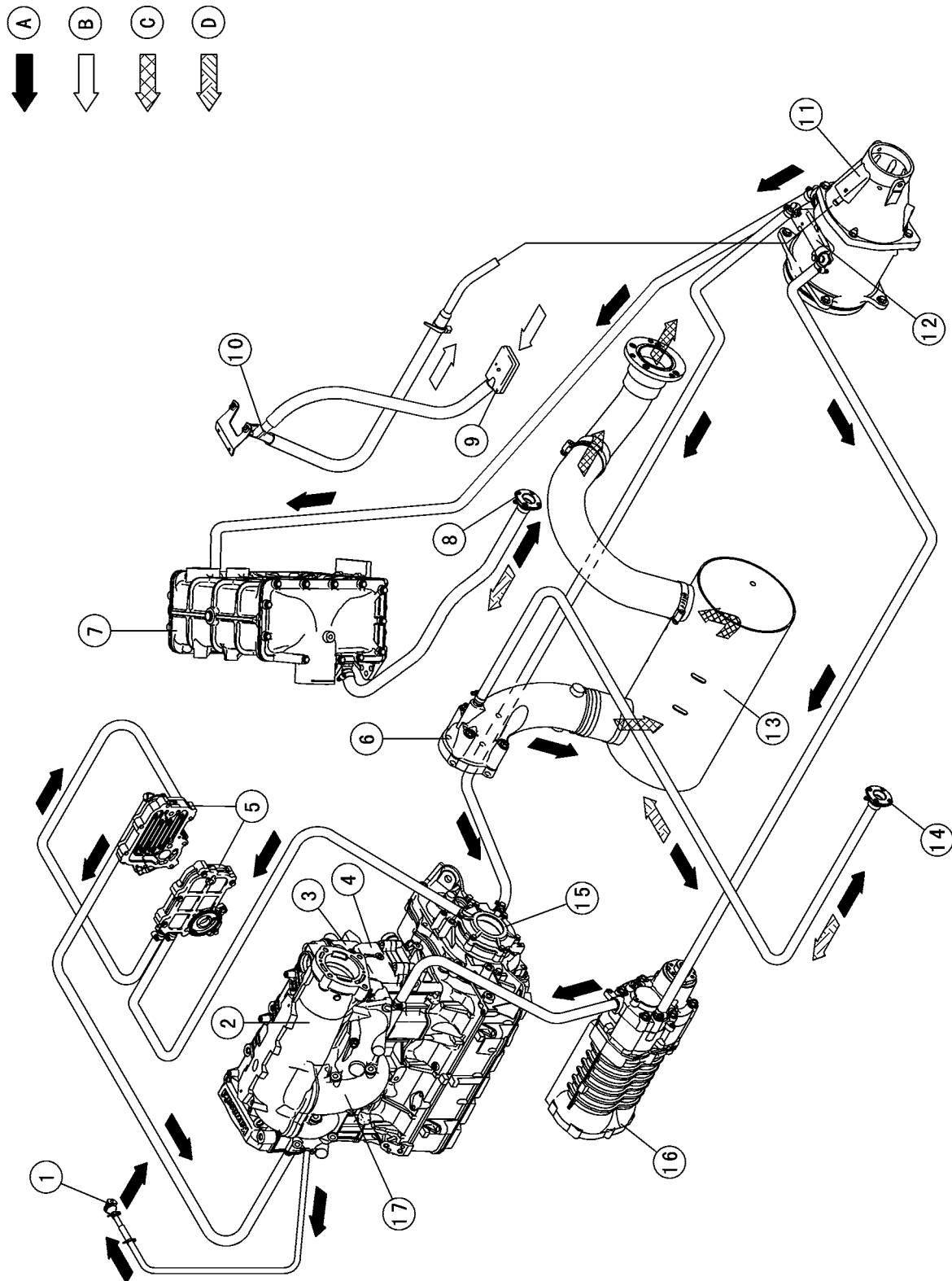
- Apply a non-permanent locking agent to the threads of the water hose joint [A].
- Tighten and set the water hose joint at an angle of 15° [B] from the horizontal plane as shown in the figure.

Torque - Water Hose Joint (L Shape): 11 N·m (1.1 kgf·m, 97 in·lb)



9-12 COOLING AND BILGE SYSTEMS

Cooling and Bilge System Flow Diagram



Cooling and Bilge System Flow Diagram

1. Bypass Outlet
 2. Exhaust Pipe
 3. Cylinder Head
 4. Cylinder
 5. Oil Cooler
 6. Muffler Body
 7. Intercooler
 8. Intercooler Flushing Port
 9. Bilge Filter
 10. Bilge Breather
 11. Pump
 12. Cooling Water Filter Cover
 13. Water Box Muffler
 14. Engine Flushing Port
 15. Output Cover
 16. Supercharger
 17. Exhaust Manifold
-
- A. Direction of Cooling System Flow
 - B. Direction of Bilge System Flow
 - C. Direction of Combined Exhaust Gas and Cooling Water Flow
 - D. Direction of Flushing System Flow

9-14 COOLING AND BILGE SYSTEMS

After Submerging

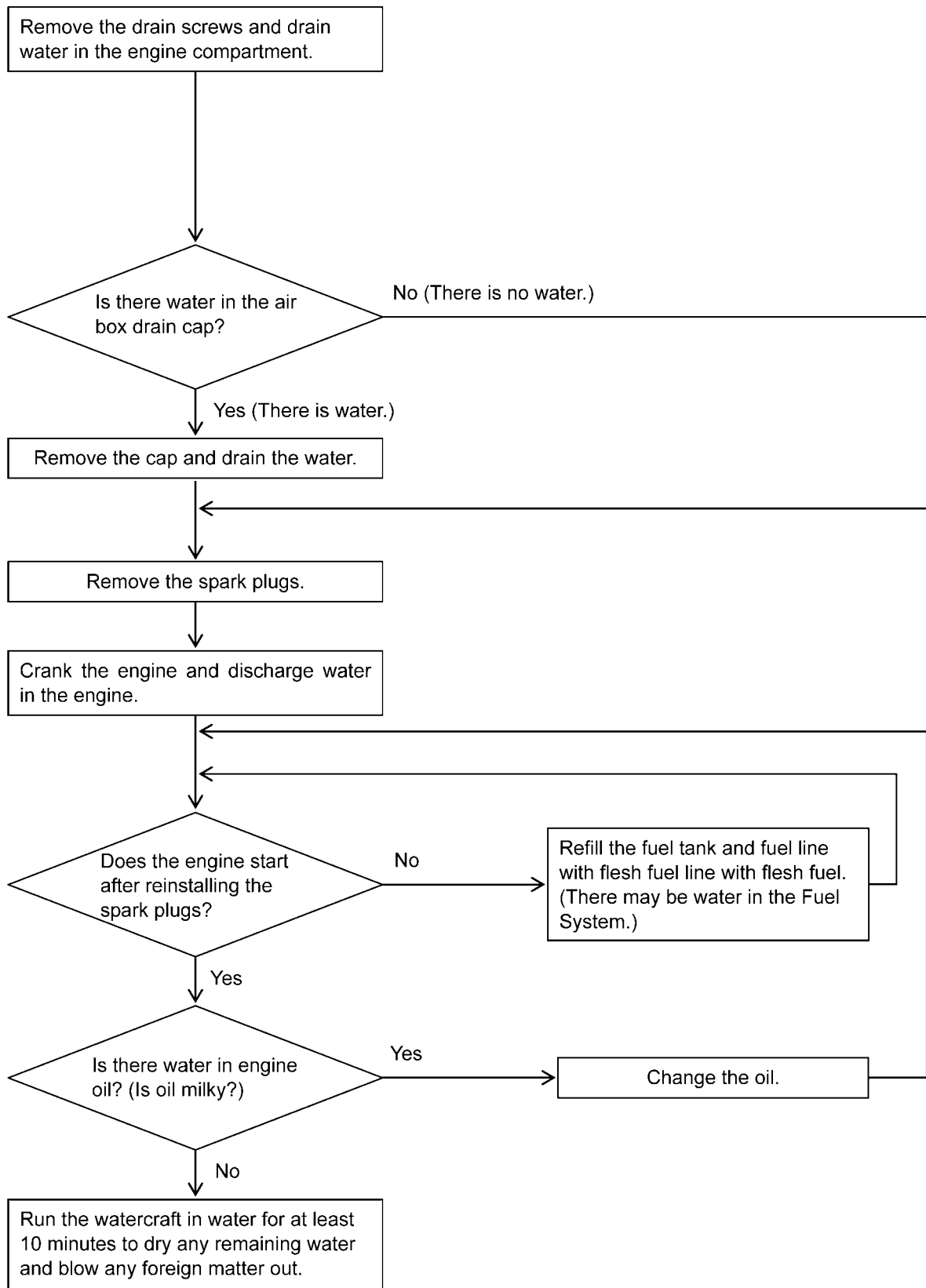
CAUTION
Do not operate the watercraft with water in the engine. Do not try to start the engine until it is completely empty of water; internal engine parts could be severely and immediately damaged. If water gets into the engine, follow this procedure immediately! If water is left in the engine more than a few hours, it will destroy the crankshaft bearings and damage other internal engine parts.

If the watercraft becomes swamped, water may enter the engine and the supercharger. Water may also enter the fuel tank.

The following procedures explain the necessary steps you must provide.

Read the summary of the procedure first and then their detailed procedures carefully.

After Submerging

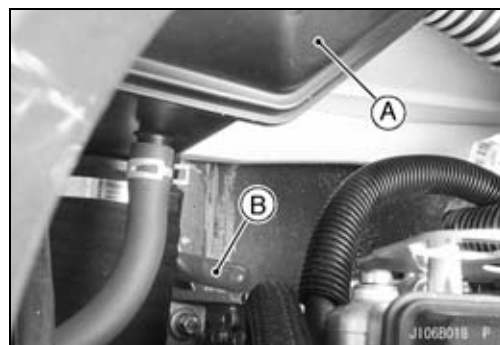
Summary Procedures after Submerging

9-16 COOLING AND BILGE SYSTEMS

After Submerging

Detailed Procedures after Submerging

1. Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
2. Remove the drain screws in the stern to drain water out of the engine compartment.
3. Check the air box [A] for water inside with its drain cap [B].
4. If you see water in the cap, remove the cap and discharge the water. Be sure to have a rag or cloth underneath for possible oily water.
5. Disconnect both two connection on the ignition coil primary lead connectors [A].
6. Pull and remove all the spark plug caps.
7. Remove all spark plugs (see Spark Plug Cleaning and Inspection in the Periodic Maintenance chapter).
8. Turn the ignition switch to ON, push the lanyard key under the stop button, and push the start button.
9. If there is any water in the engine, it will be pumped out of the spark plug holes. Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again. Be sure that all the water is out of the engine.
10. Spray the spark plugs clean and install them with their plug caps.



⚠ WARNING

Do not lean over the engine when performing this procedure. A water and gasoline mixture will be forcibly ejected from the spark plug holes and could get into your eyes. If you do get some in your eyes, wash your eyes immediately with liberal amounts of clean, fresh water. Consult a physician as soon as possible.

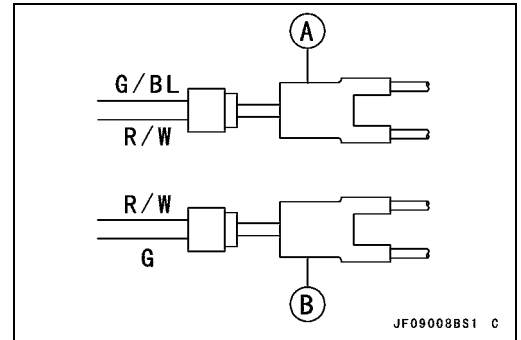
After Submerging

11. Reconnect the primary ignition coil lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. The #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.

NOTE

○The service codes (51 and 52) caused by this procedure are stored in the ECU. If necessary, these service codes can be erased by using the Kawasaki Diagnostic System (KDS).

12. Start the engine by pressing the start button and run less than 15 seconds.



CAUTION

Do not run the engine with the watercraft out of the water for more than 15 seconds at a time. Overheating will cause severe engine and exhaust system damage.

Never operate the engine at maximum speed out of the water. Severe engine damage may occur.

13. If the engine does not start, there may be water in the fuel system.
14. If the fuel tank has water in it, it must be emptied by pump or siphon. Refill the tank with fresh fuel. Do not dump contaminated fuel in places not designated for that purpose.
15. Continued trouble may require cleaning of the fuel line to drain water.
16. Remove the dipstick and check for the water presence in the engine oil (If there is water in it, oil looks milky.).
17. If the oil looks milky, then change the oil and repeat procedures 12 and 16 until the oil does not turn milky any more.

⚠ WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Pull the lanyard key off the stop button. Do not smoke.

Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

⚠ WARNING

Gasoline is toxic substance. Dispose of gasoline properly. Contact your local authorities for approved disposal methods.

18. Reinstall the seat and secure it.
19. Reinstall the drain screws in the stern.
20. Finally, run the watercraft IN WATER for at least 10 minutes to dry any remaining water and blow any foreign matter (like salt) out through the exhaust.

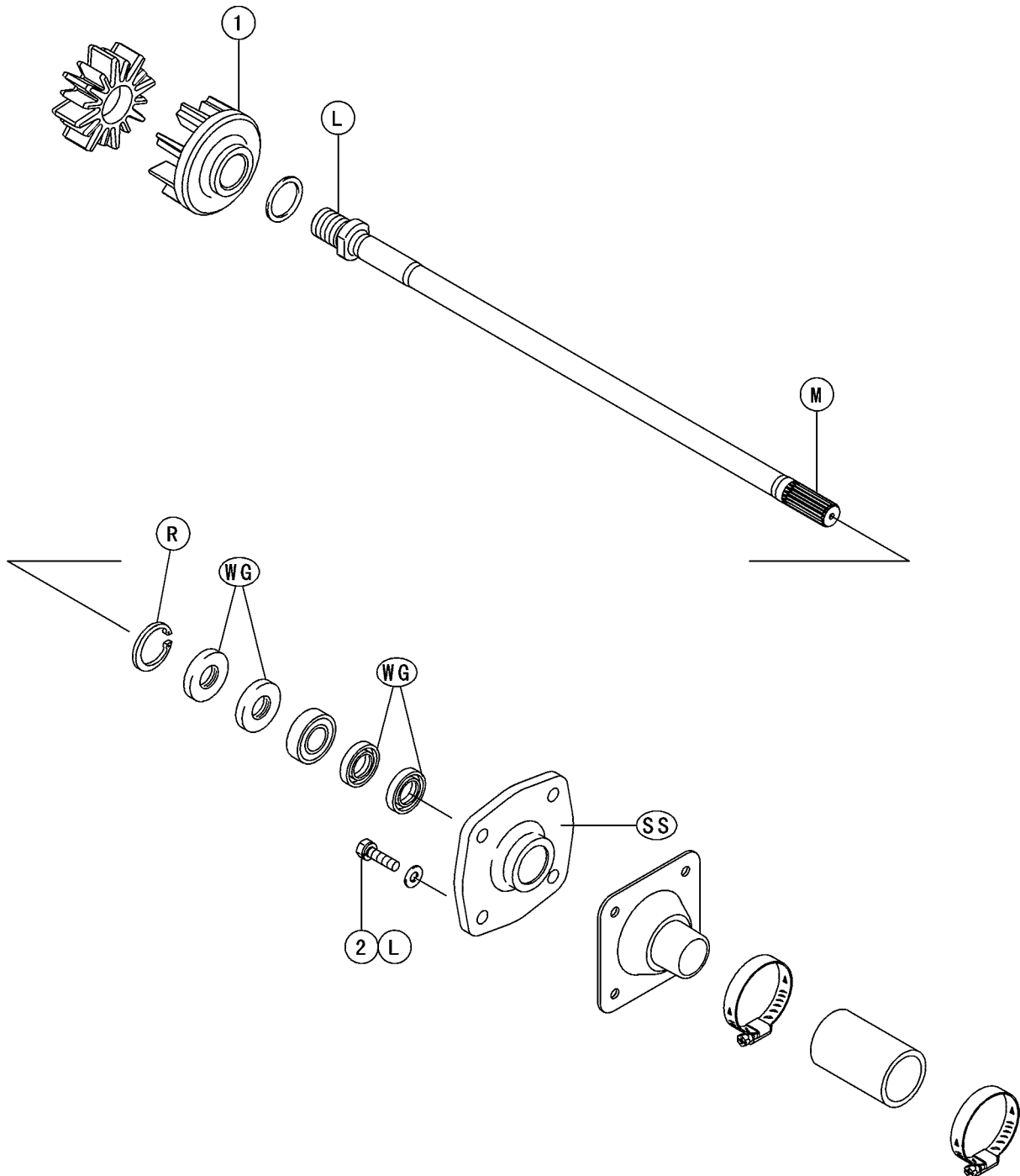
Drive System

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10-2 DRIVE SYSTEM

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Coupling	265	27.0	195	
2	Drive Shaft Holder Mounting Bolts	22	2.2	16	L

L: Apply a non-permanent locking agent.

R: Replacement Parts

M: Apply molybdenum disulfide grease.

SS: Apply silicone sealant.

WG: Apply water resistance grease.

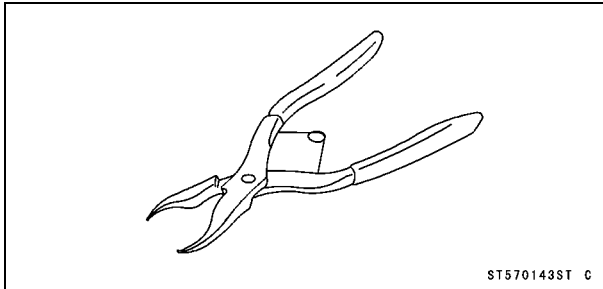
10-4 DRIVE SYSTEM

Specification

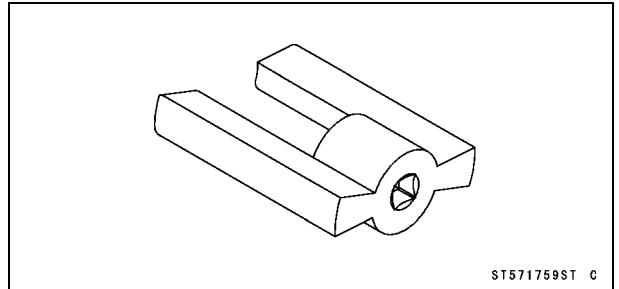
Item	Standard	Service Limit
Drive Shaft		
Runout (at ϕ 19.7 ~ 19.8 mm (0.776 ~ 0.780 in.) position)	— — —	0.1 mm (0.0039 in.)
(at ϕ 18.8 ~ 19.2 mm (0.740 ~ 0.756 in.) position)	— — —	0.2 mm (0.0079 in.)

Special Tools

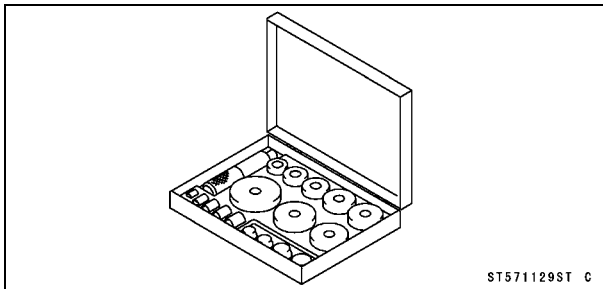
Inside Circlip Pliers:
57001-143



Coupling Holder:
57001-1759



Bearing Driver Set:
57001-1129

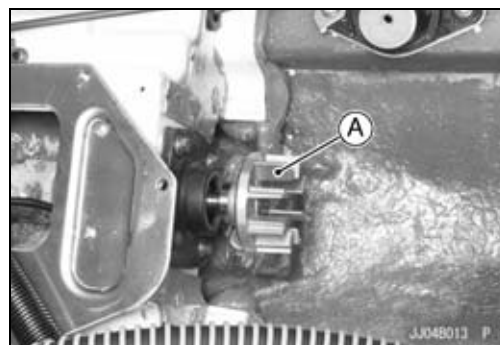


10-6 DRIVE SYSTEM

Drive Shaft/Drive Shaft Holder

Drive Shaft Removal

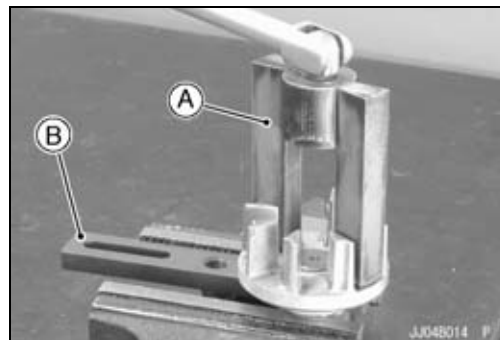
- Remove the engine (see Engine Removal in the Engine Removal/Installation chapter).
- Remove the drive shaft together with the coupling [A] out of the hull.



- Hold the drive shaft in a vise, and loosen the coupling with the coupling holder [A].

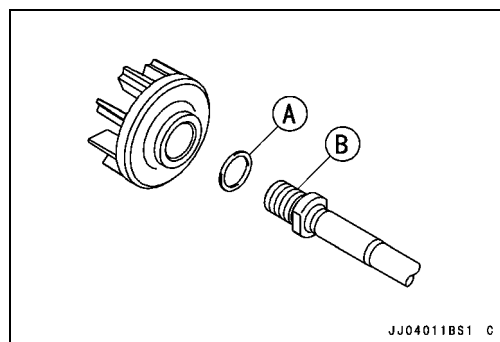
Special Tool - Coupling Holder: 57001-1759

- In the photo, install the suitable tool [B] between the drive shaft and vise so that the drive shaft might set straight.



Drive Shaft Installation

- Install the washer [A] on the drive shaft.
- Apply a non-permanent locking agent to the threads [B] of the drive shaft.

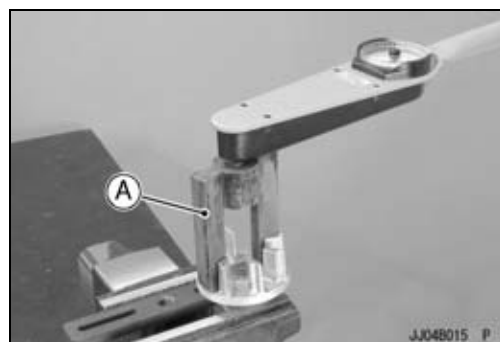


- Tighten:

Torque - Coupling: 265 N·m (27.0 kgf·m, 195 ft·lb)

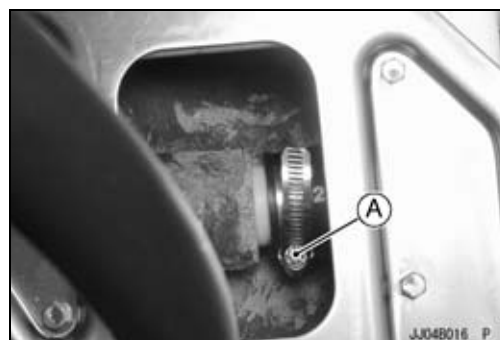
Special Tool - Coupling Holder: 57001-1759 [A]

- Apply molybdenum disulfide grease to the drive shaft spline.
- Install the drive shaft to the hull.



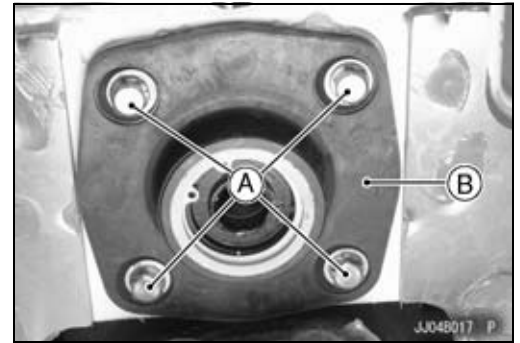
Drive Shaft Holder Removal/Disassembly

- Loosen the clamp screw [A].

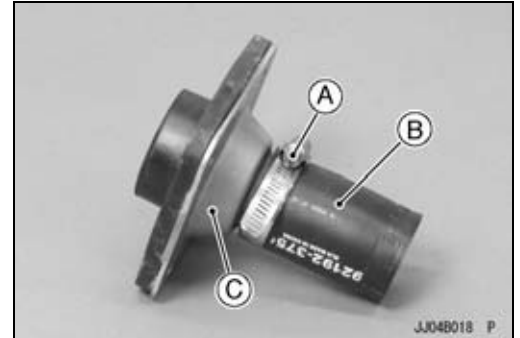


Drive Shaft/Drive Shaft Holder

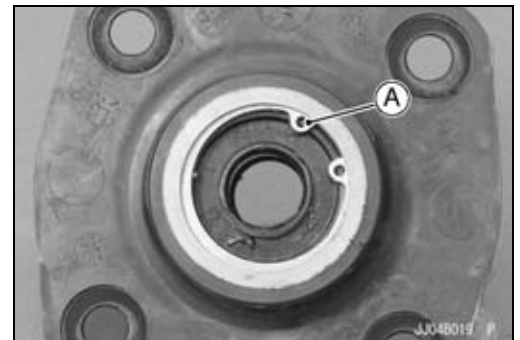
- Remove:
Drive Shaft (see Drive Shaft Removal)
Drive Shaft Holder Mounting Bolts [A]
- Remove the drive shaft holder [B] together with the pipe and tube.



- Loosen the clamp screw [A].
- Remove:
Tube [B]
Pipe [C]

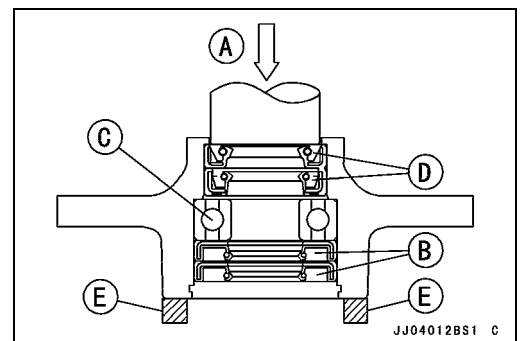


- Remove the circlip [A].
Special Tool - Inside Circlip Pliers: 57001-143



- Using the press, press [A] the small grease seal, to remove the large grease seals [B], bearing [C] and small grease seals [D] come out of the holder.
[E] Blocks

Special Tool - Bearing Driver Set: 57001-1129



10-8 DRIVE SYSTEM

Drive Shaft/Drive Shaft Holder

Drive Shaft Holder Assembly/Installation

- Replace the grease seals, bearing and circlip [A] with new ones.
- Using a press, press the bearing and grease seals into the drive shaft holder, noting the following.

Special Tool - Inside Circlip Pliers: 57001-143

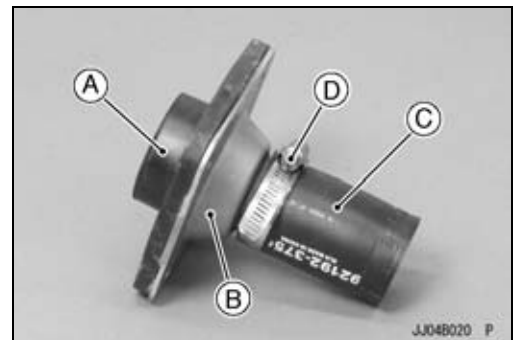
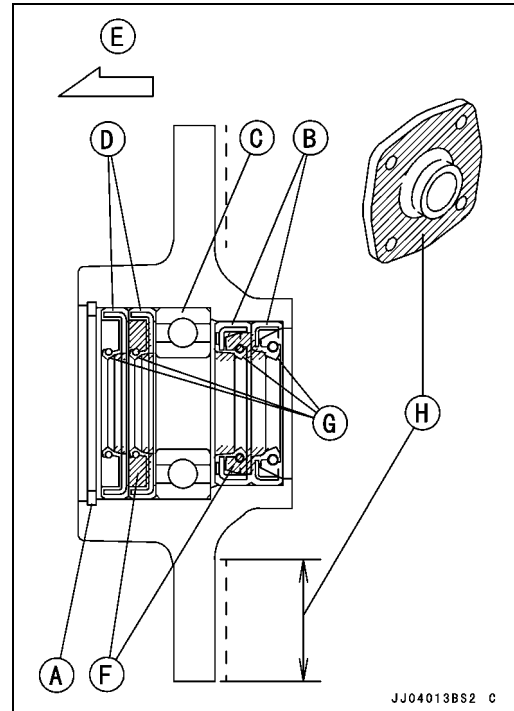
- Install the parts in this order.
 - Two Small Grease Seals [B]
 - One Bearing [C]
 - Two Large Grease Seals [D]
 - Front [E]
- Install the seals so that the sides with the spring face outward.
- Fill the gaps between the seals with water resistance grease [F].
- Install the circlip.

Special Tool - Bearing Driver Set: 57001-1129

- Apply water resistance grease to the bearing inner surface and grease seal lips [G].
- Strip off the old sealant on the mating surface.
- Apply silicone sealant to the mating surface [H] of the drive shaft holder.
- Stick the drive shaft holder [A] and pipe [B].
- Install the tube [C] securely.
- Tighten the clamp screw [D].

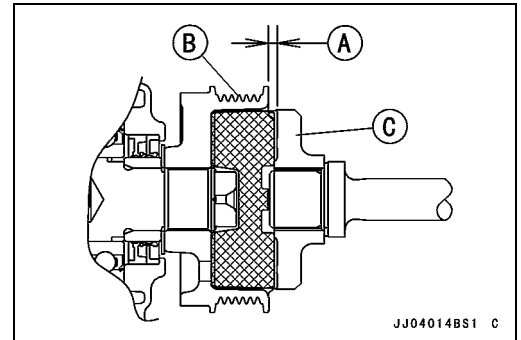
- Install the drive shaft holder on the bulkhead so that the circlip side face toward the front.
- Tighten the clamp screw [A].
- Apply a non-permanent locking agent to the drive shaft holder mounting bolts, tighten them loosely.
- Install the drive shaft (see Drive Shaft Installation).
- After installing the engine, tighten the drive shaft holder mounting bolts to the specified torque to give proper coupling alignment.

Torque - Drive Shaft Holder Mounting Bolts: 22 N·m (2.2 kgf·m, 16 ft·lb)



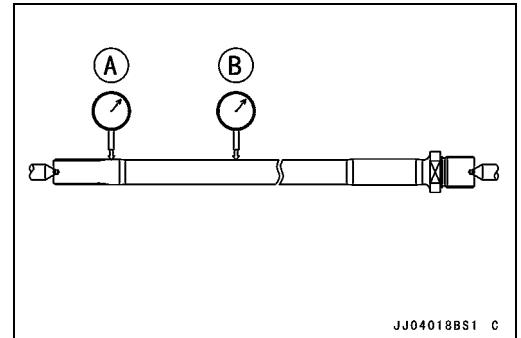
Drive Shaft/Drive Shaft Holder

- Make sure the clearance [A] between the engine coupling [B] and the drive shaft coupling [C] is less than 5 mm (0.20 in.).



Drive Shaft Runout Inspection

- Measure drive shaft runout by supporting the shaft in alignment jig and setting a dial gauge against the shaft at each point shown.
- Turn the drive shaft slowly. The difference between the highest and lowest dial gauge reading is the runout.
- ★ If any measurement exceeds the service limit, replace the shaft.



Drive Shaft Runout

Service Limit: 0.1 mm (0.0039 in.) [A]
 at $\phi 19.7 \sim 19.8$ mm (0.776 ~ 0.780 in.)
 position
 0.2 mm (0.0079 in.) [B]
 at $\phi 18.8 \sim 19.2$ mm (0.740 ~ 0.756 in.)
 position

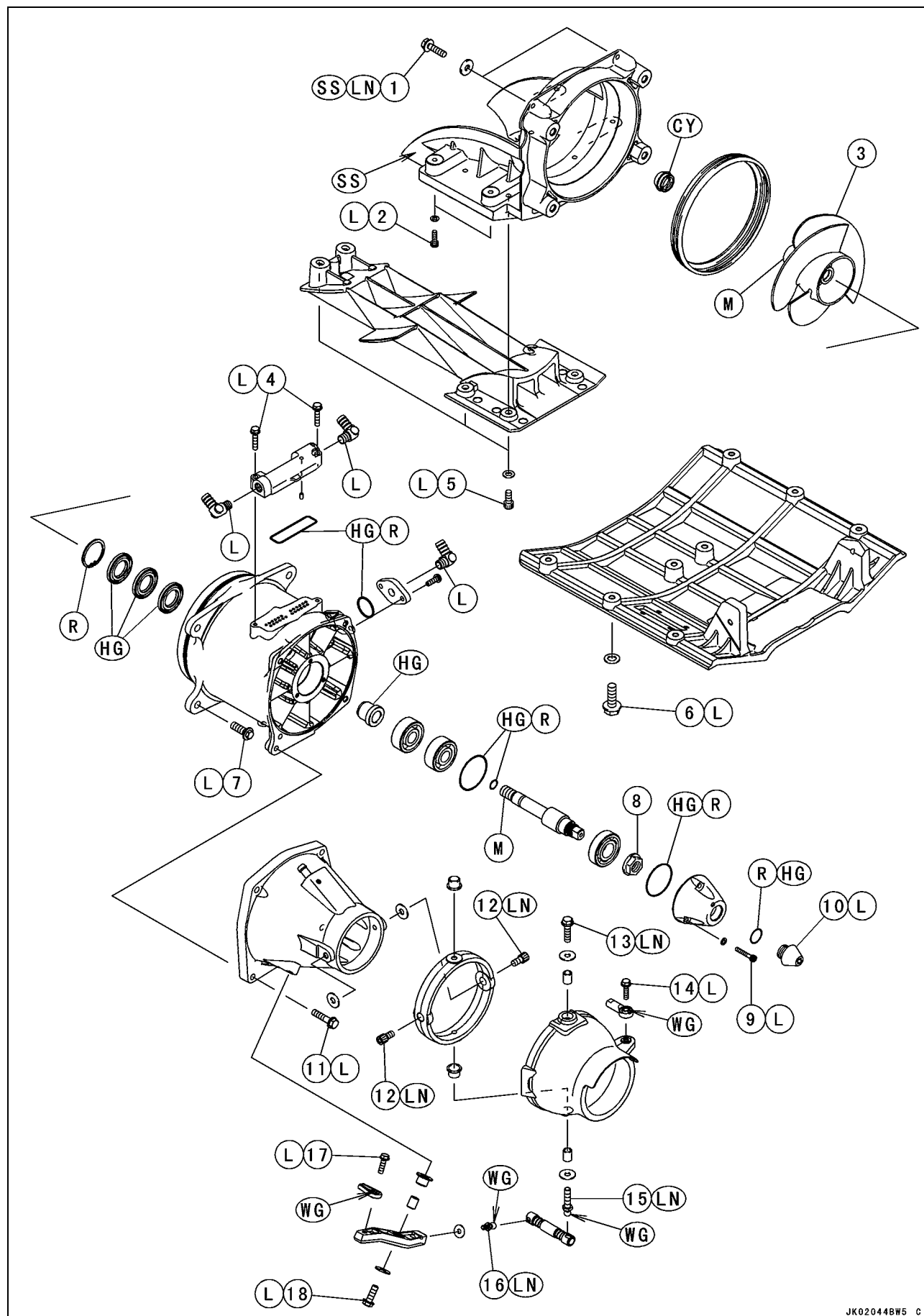
Pump and Impeller

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11-2 PUMP AND IMPELLER

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Pump Bracket Mounting Bolts (M8)	19	1.9	14	LN, SS
2	Pump Bracket Mounting Bolts (M6)	9.8	1.0	87 in·lb	L
3	Impeller	147	15.0	108	
4	Filter Cover Mounting Bolts	9.8	1.0	87 in·lb	L
5	Grate Mounting Bolts	9.8	1.0	87 in·lb	L
6	Pump Cover Mounting Bolts	7.8	0.80	69 in·lb	L
7	Pump Mounting Bolts	36	3.7	27	L
8	Pump Shaft Nut	98	10	72	
9	Pump Cap Bolts	3.9	0.40	35 in·lb	L
10	Pump Cap Plug	3.9	0.40	35 in·lb	L
11	Pump Outlet Mounting Bolts	19	1.9	14	L
12	Trim Cotrol Ring Pivot Bolts	19	1.9	14	LN
13	Steering Nozzle Pivot Bolt (Upper)	19	1.9	14	LN
14	Steering Cable Joint Bolt	9.8	1.0	87 in·lb	L
15	Steering Nozzle Pivot Bolt (Lower)	19	1.9	14	LN, WG
16	Trim Cotrol Shaft Joint Bolt	9.8	1.0	87 in·lb	LN
17	Trim Control Cable Joint Bolt	9.8	1.0	87 in·lb	L
18	Trim Cotrol Shaft Pivot Bolt	19	1.9	14	L

CY: Apply cyanoacrylate cement.

HG: Apply high grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent).

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).

M: Apply molybdenum disulfide grease.

R: Replacement Parts

SS: Apply silicone sealant.

WG: Apply water resistance grease.

11-4 PUMP AND IMPELLER

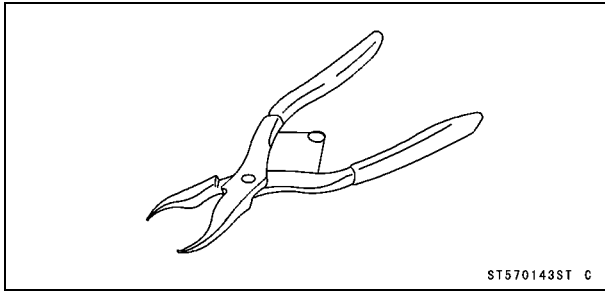
Specifications

Item	Standard	Service Limit
Jet Pump		
Impeller Outside Diameter	159.5 ~ 159.7 mm (6.280 ~ 6.287 in.)	158.5 mm (6.240 in.)
Pump Case Inside Diameter	160.0 ~ 160.1 mm (6.299 ~ 6.303 in.)	161.1 mm (6.342 in.)
Impeller Clearance	0.15 ~ 0.3 mm (0.0059 ~ 0.012 in.)	0.6 mm (0.024 in.)

Special Tools and Sealant

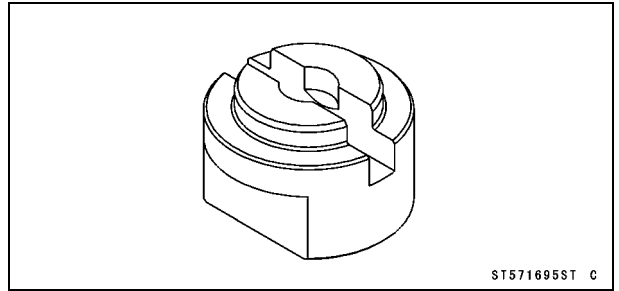
Inside Circlip Pliers:

57001-143



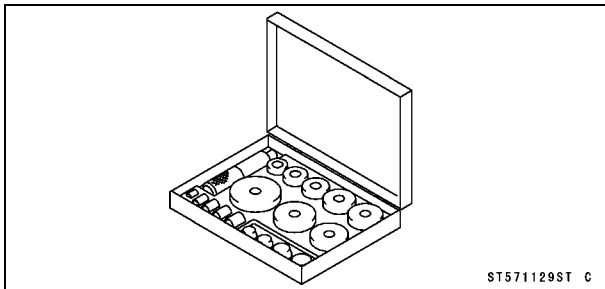
Impeller Holder:

57001-1695



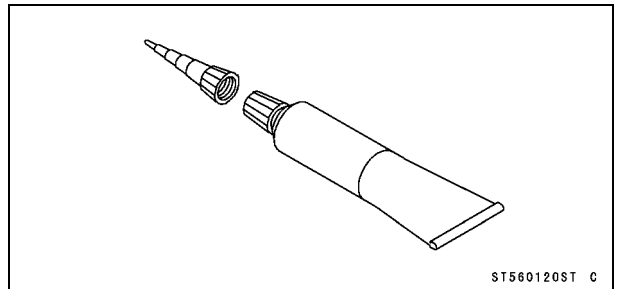
Bearing Driver Set:

57001-1129



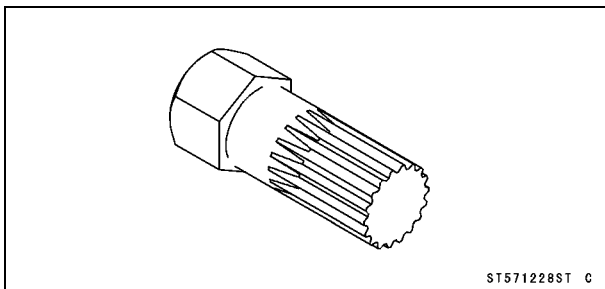
Liquid Gasket, TB1211:

56019-120



Impeller Wrench:

57001-1228

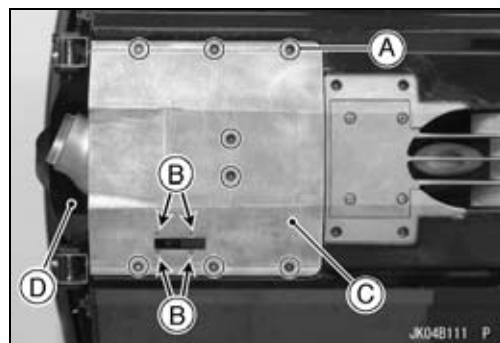


11-6 PUMP AND IMPELLER

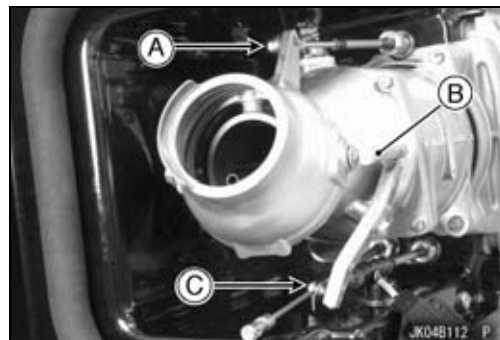
Pump and Impeller

Pump Removal

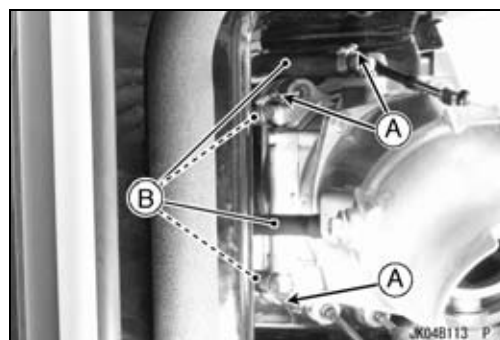
- Turn the craft on its left side.
- Disconnect the shift cable ball joint at the rear end (see Shift Cable Removal in the Steering chapter).
- Remove:
 - Pump Cover Mounting Bolts [A] and Washers
 - Speed Sensor Screws [B]
- Remove the pump cover [C] with the reverse bucket [D].



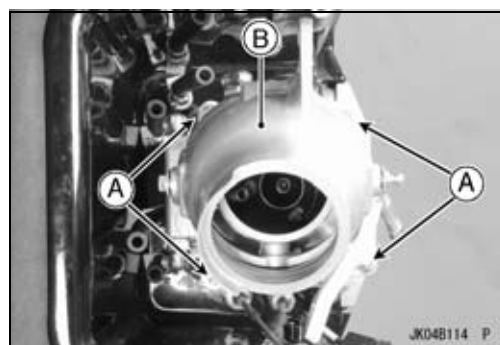
- Remove the joint bolt [A] to free the steering cable joint.
- Remove the trim control joint lower end [B].
- Remove the joint bolt [C] to free the trim control cable joint.



- Loosen the clamps [A] on the intake water hose, and pull off the hoses [B].

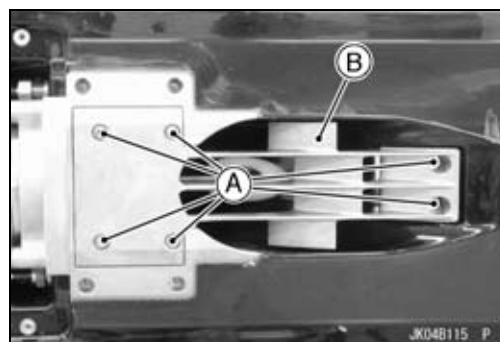


- Remove the pump mounting bolts [A].
- Slide the pump [B] rearward to disengage the drive shaft, and remove it from the hull.



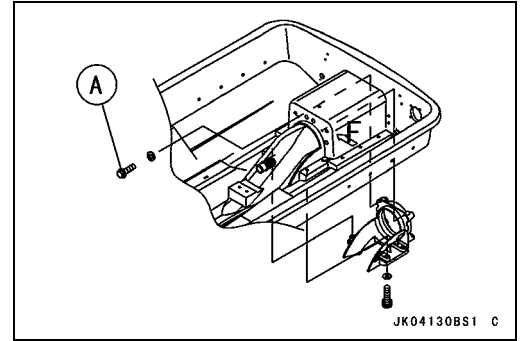
- To remove the pump bracket, perform the following procedures.

- Remove:
 - Bolts [A] and Washers
 - Grate [B]

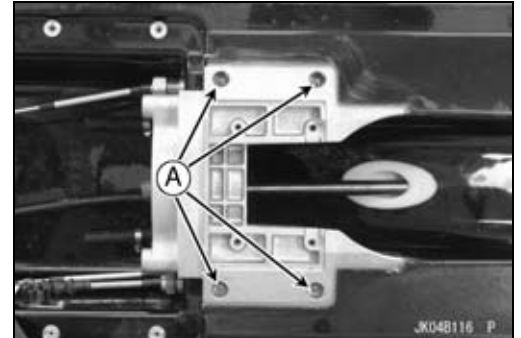


Pump and Impeller

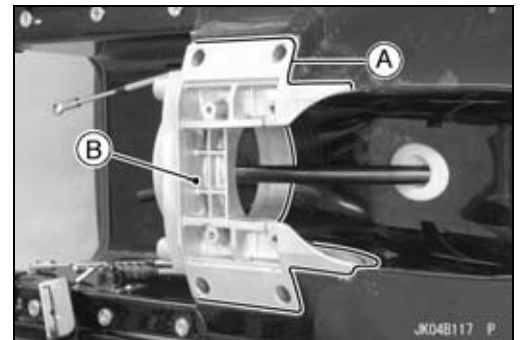
○Take out the pump bracket mounting bolts [A] and washers in the hull.



○Take out the pump bracket mounting bolts [A] and washers.



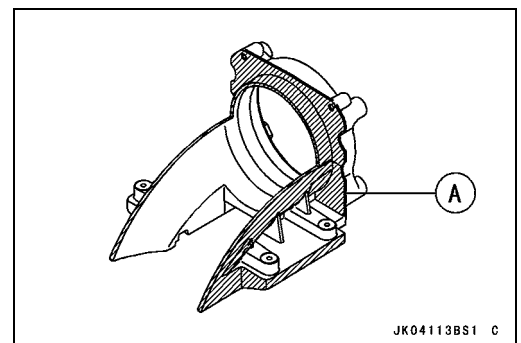
○Cut the sealant at the indicated area [A] in the figure and remove the pump bracket [B].



Pump Installation

- Strip off all the old sealant around the pump bracket.
- Liberally coat the outside edge of the pump bracket with silicon sealant [A] to form a seal between the bracket and the hull.

Sealant - Liquid Gasket, TB1211: 56019-120



11-8 PUMP AND IMPELLER

Pump and Impeller

- Install the pump bracket [A] to the hull.
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the pump bracket mounting bolts (M8) [B], and tighten them and washers.

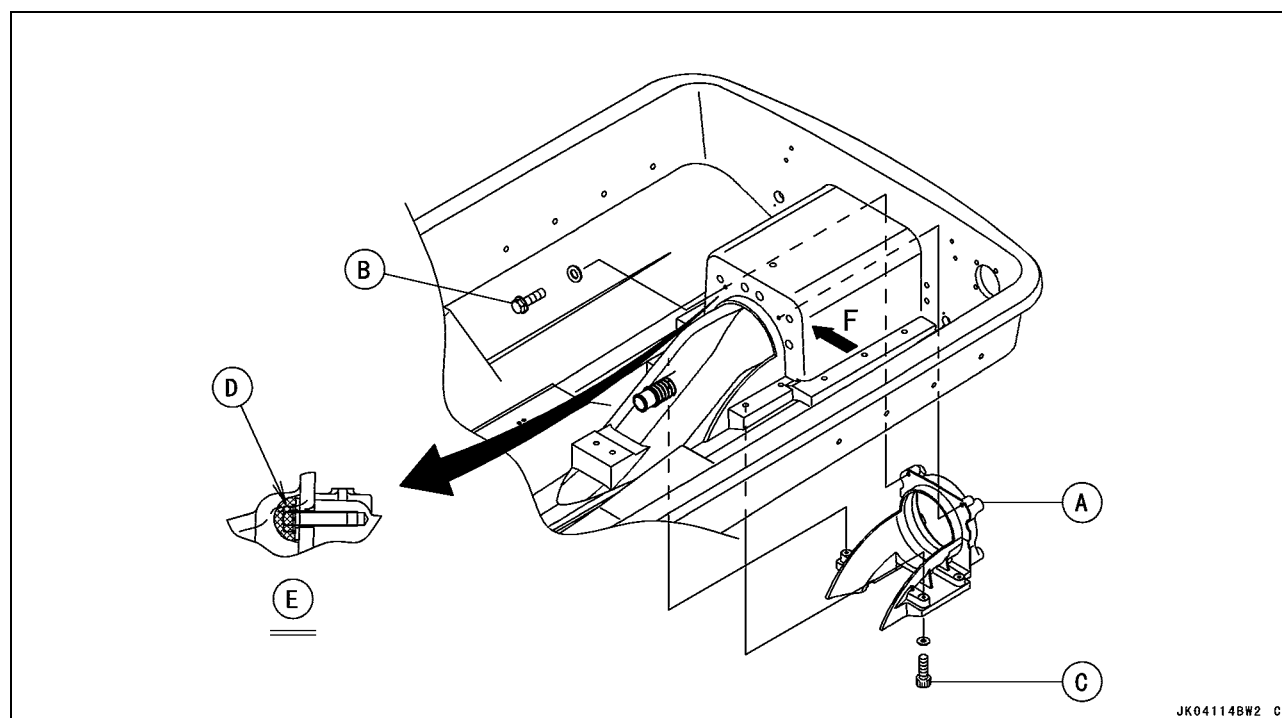
Torque - Pump Bracket Mounting Bolts (M8): 19 N·m (1.9 kgf·m, 14 ft·lb)

- Apply a non-permanent locking agent to the pump bracket mounting bolts (M6) [C], and tighten them and washers.

Torque - Pump Bracket Mounting Bolts (M6): 9.8 N·m (1.0 kgf·m, 87 in·lb)

- As for the pump bracket mounting bolts (M8) in the hull, the bolt heads should be wrapped in silicone sealant [D].

[E] View F



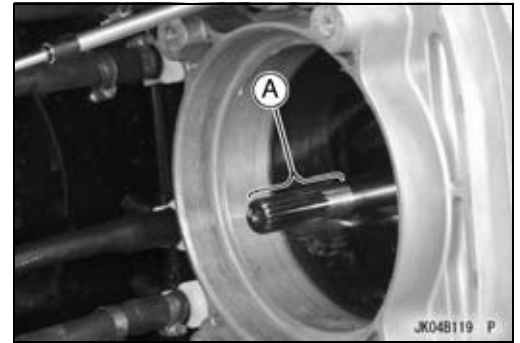
- Be sure trim seal [A] is in place.



Pump and Impeller

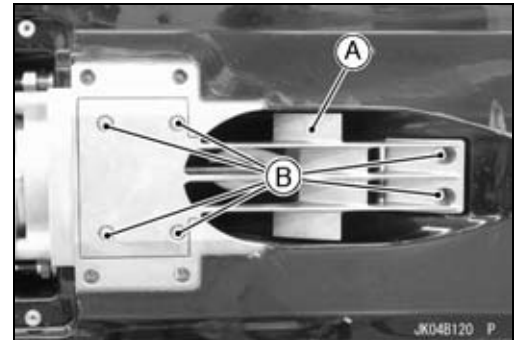
- Apply molybdenum disulfide grease to the spline [A] on the drive shaft.
- Install the pump.
- Apply a non-permanent locking agent to the pump mounting bolts, and tighten them and washers.

Torque - Pump Mounting Bolts: 36 N·m (3.7 kgf·m, 27 ft·lb)



- Install the grate [A].
- Apply a non-permanent locking agent to the grate mounting bolts [B], and tighten them and washers.

Torque - Grate Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

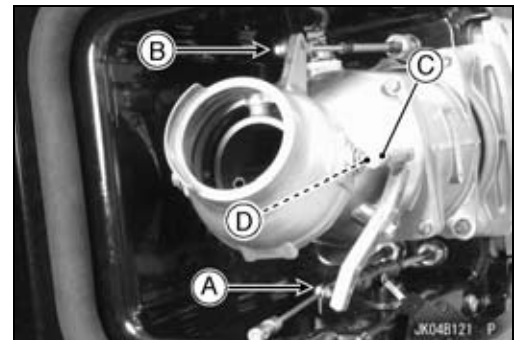


- Apply a non-permanent locking agent to the trim control cable joint bolt [A] and steering cable joint bolt [B], and tighten them.

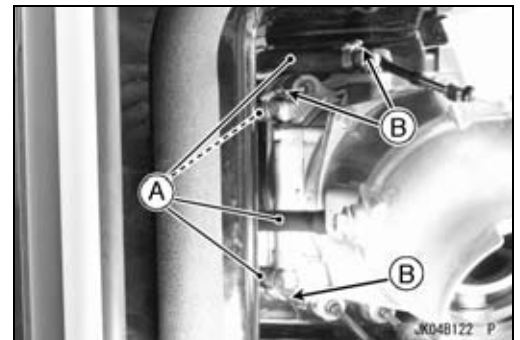
Torque - Trim Control Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

- Apply water resistance grease to the ball portion [C] of the steering nozzle pivot bolt (lower).
- Install the trim control joint [D] to the steering nozzle.

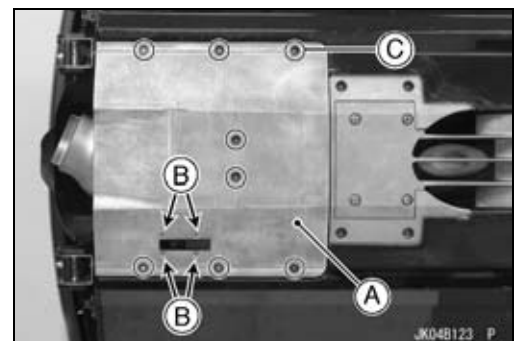


- Install the intake water hoses [A] to the pump, and tighten the clamp screws [B].



- Install the speed sensor to the pump cover [A] with the screws [B].
- Install the pump cover.
- Apply a non-permanent locking agent to the pump cover mounting bolts [C], and tighten them.

Torque - Pump Cover Mounting Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

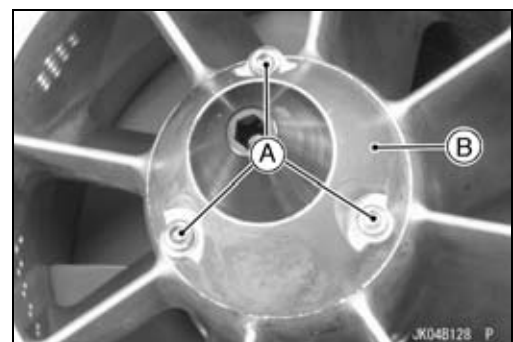
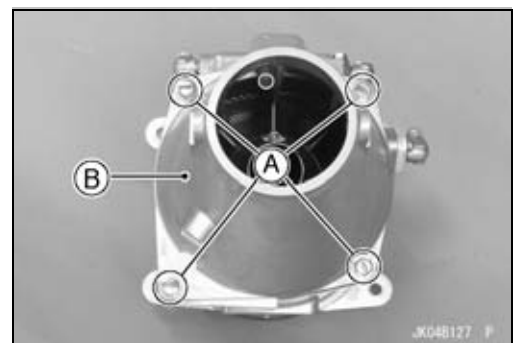
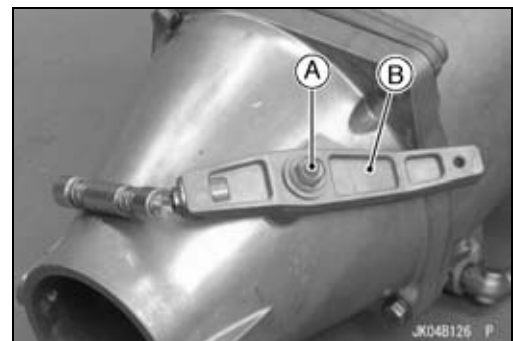
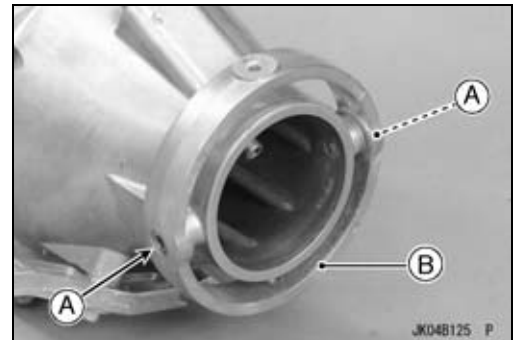
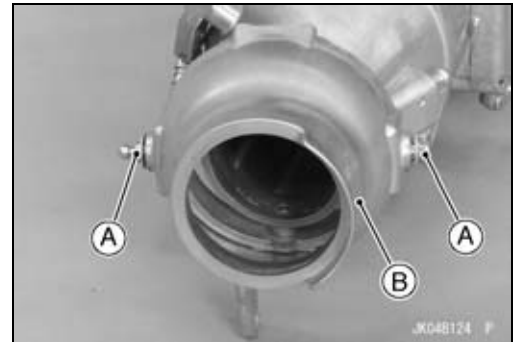


11-10 PUMP AND IMPELLER

Pump and Impeller

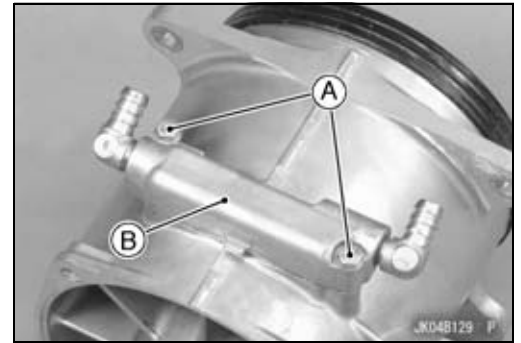
Pump Disassembly

- Remove:
 - Steering Nozzle Pivot Bolts [A] and Washers
 - Steering Nozzle [B]
- Remove:
 - Trim Control Ring Pivot Bolts [A]
 - Trim Control Ring [B] and Washers
- Remove:
 - Trim Control Shaft Pivot Bolts [A] and Washers
 - Trim Control Shaft [B]
- Remove:
 - Pump Outlet Mounting Bolts [A]
 - Pump Outlet [B]
- Remove:
 - Pump Cap Bolts [A] and Washers
 - Pump Cap [B]

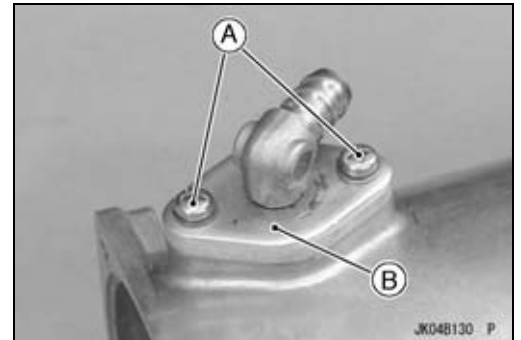


Pump and Impeller

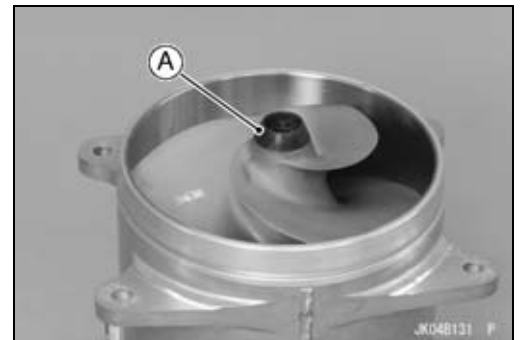
- Remove:
Filter Cover Mounting Bolts [A]
Filter Cover [B]
O-ring
Dowel Pin



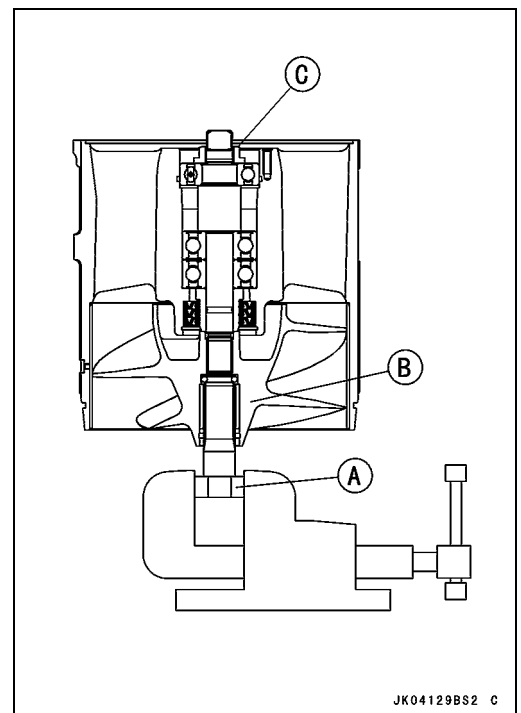
- Remove:
Screws [A]
Cover [B]



- Remove the impeller seal [A] from the impeller.



- Install the impeller wrench [A] into the impeller [B].
Special Tool - Impeller Wrench: 57001-1228
- Turn the pump case upside down, and hold the impeller wrench with a vise.
- Remove the pump shaft nut [C].



11-12 PUMP AND IMPELLER

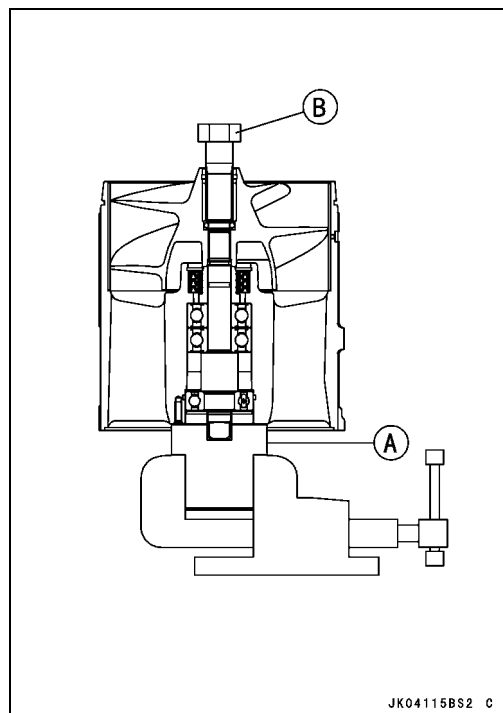
Pump and Impeller

- Using a vise, hold the shaft in the impeller holder [A], taking care not to damage it.
- Insert the impeller wrench [B] to the impeller.

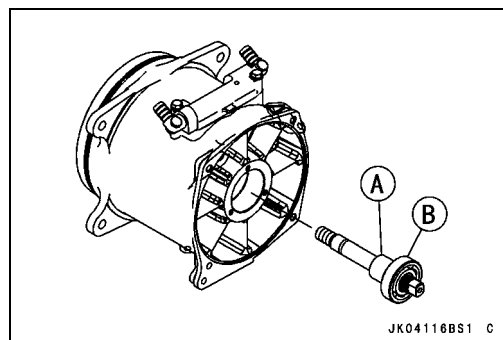
Special Tools - Impeller Holder: 57001-1695

Impeller Wrench: 57001-1228

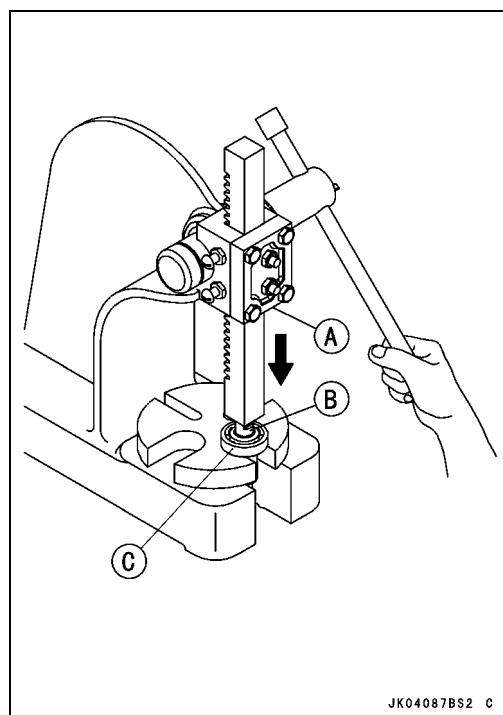
- Loosen the impeller wrench to remove the impeller from the pump shaft.



- Pull the pump shaft [A] together with the bearing [B] from the pump case.

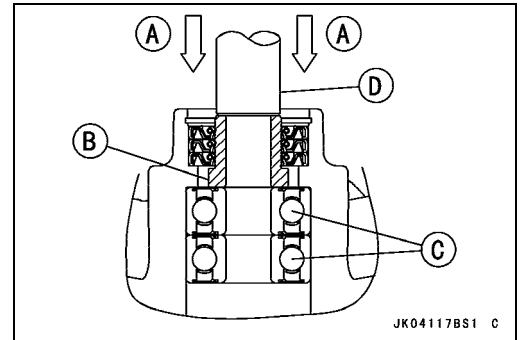


- Remove the bearing [C] from the pump shaft [B] with a press [A].



Pump and Impeller

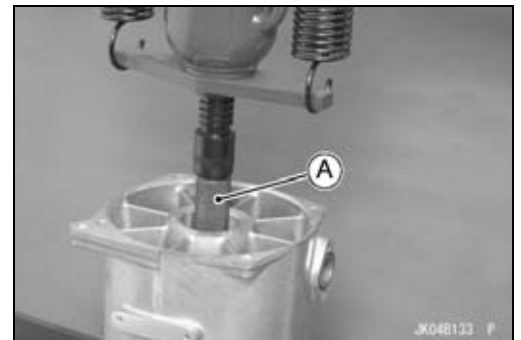
- Using a press, press [A] the bushing [B] and the ball bearings [C] with a suitable bar [D] of $\phi 25$ mm (0.98 in.) $\times$ L = 65 mm (2.6 in.) over. They come out of the pump case.
- Discard the removed bearings.



- Remove the circlip [A].
Special Tool - Inside Circlip Pliers: 57001-143



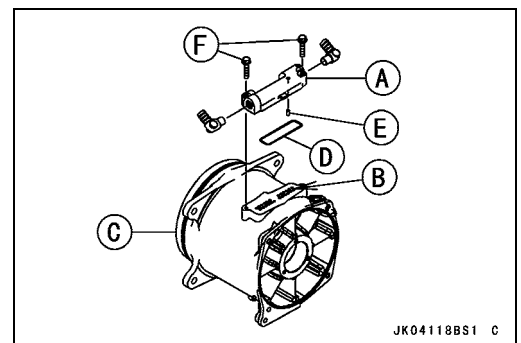
- Using a press, remove the grease seals.
Special Tool - Bearing Driver Set: 57001-1129 [A]



Pump Assembly

- Before installing the pump bearing, blow any dirt or foreign particles out of the pump case with compressed air.
- Before installing the pump bearing, remove the filter cover [A], and check the filter inside or outside [B] on the pump case [C] if the foreign particles do not cling to the filter.
- Replace the O-ring [D] with a new one, and install it.
- Install the dowel pin [E].
- Apply high-grade water resistant grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) to the O-ring.
- Apply a non-permanent locking agent to the filter cover mounting bolts [F], and tighten them.

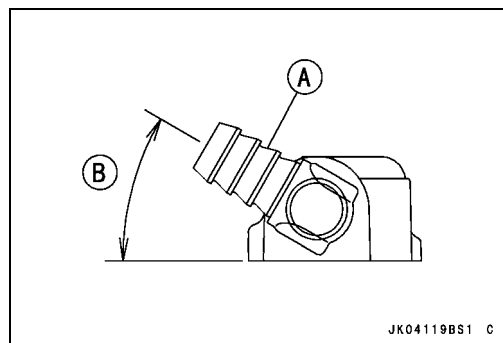
Torque - Filter Cover Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)



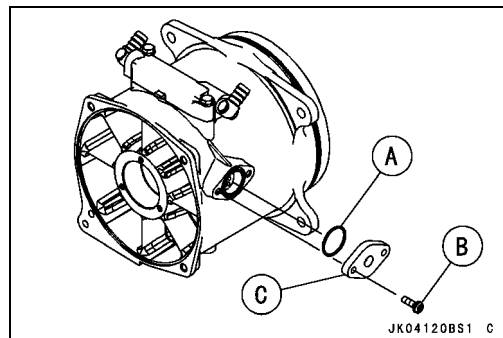
11-14 PUMP AND IMPELLER

Pump and Impeller

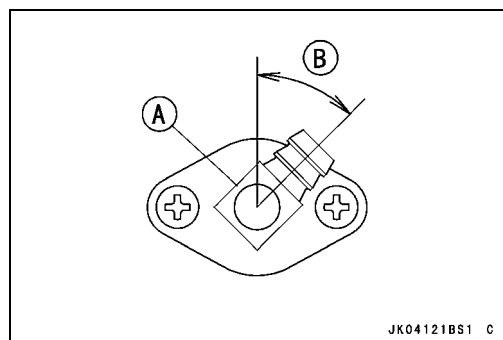
- Apply a non-permanent locking agent to the threads of the hose joints [A].
- Install the hose joints as shown.
[B] 30°



- Replace the O-ring [A] with a new one.
- Apply high-grade water resistant grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) to the O-ring, and install it.
- Apply a non-permanent locking agent to the screws [B].
- Install the cover [C] with the screws.



- Apply a non-permanent locking agent to the threads of the hose joints [A].
- Install the hose joints as shown.
[B] 45°



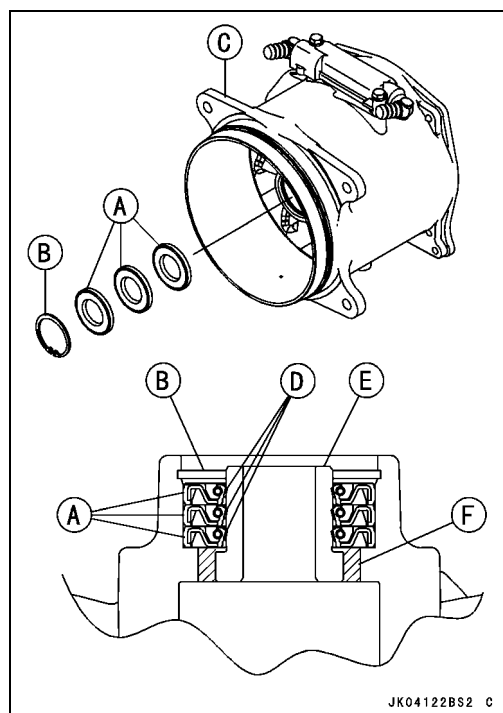
- Replace the grease seals [A] and circlip [B] with new ones.
- Using a press, press each seal into the pump case [C] so that the side with the spring faces outward.

Special Tool - Bearing Driver Set: 57001-1129

- Fill the gap between the grease seals with high-grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) and apply it each grease seal lip [D].
- Install the circlip.

Special Tool - Inside Circlip Pliers: 57001-143

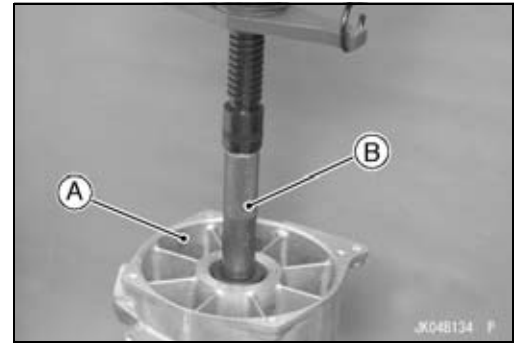
- Install the bushing [E] into the pump case.
- Fill with high-grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) [F].



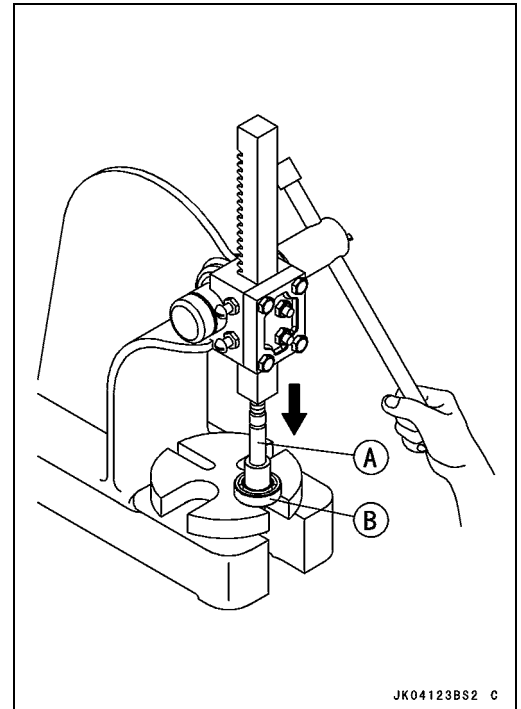
Pump and Impeller

- Using a press, press the new bearings into the pump case [A] until they bottom out.

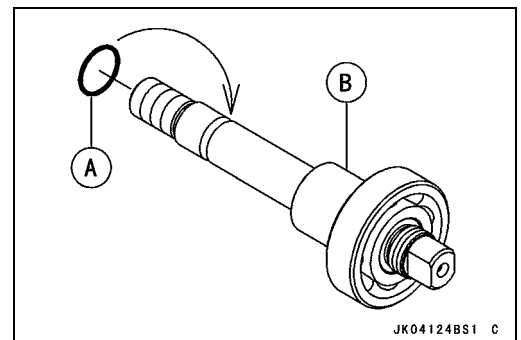
Special Tool - Bearing Driver Set: 57001-1129 [B]



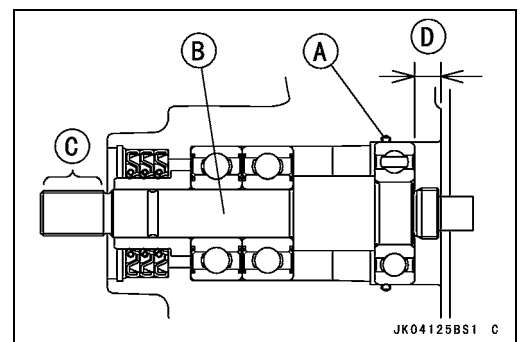
- Using a press, install the pump shaft [A] into the bearing [B] until it bottoms out.



- Replace the O-ring [A] with a new one.
- Install the O-ring over the pump shaft [B].
- Apply high grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) to the O-ring.



- Replace the O-ring [A] with a new one, and install it.
- Apply high grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) to the O-ring.
- Install the pump shaft [B] into the pump case.
- Apply molybdenum disulfide grease [C] to the thread of the pump shaft
- Make sure the gap [D] between the bearing surface and pump case surface is over than 9 mm (0.35 in.).



11-16 PUMP AND IMPELLER

Pump and Impeller

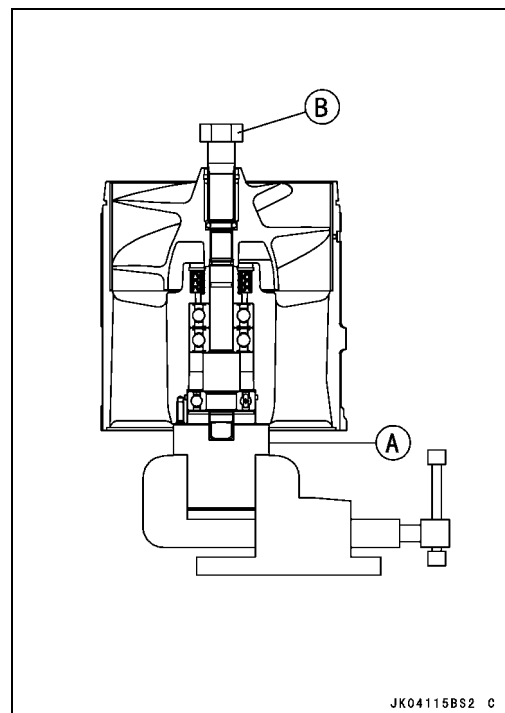
- Using a vise, hold the pump shaft in the impeller holder [A], taking care not to damage it.
- Insert the impeller wrench [B] to the impeller.

Special Tools - Impeller Holder: 57001-1695

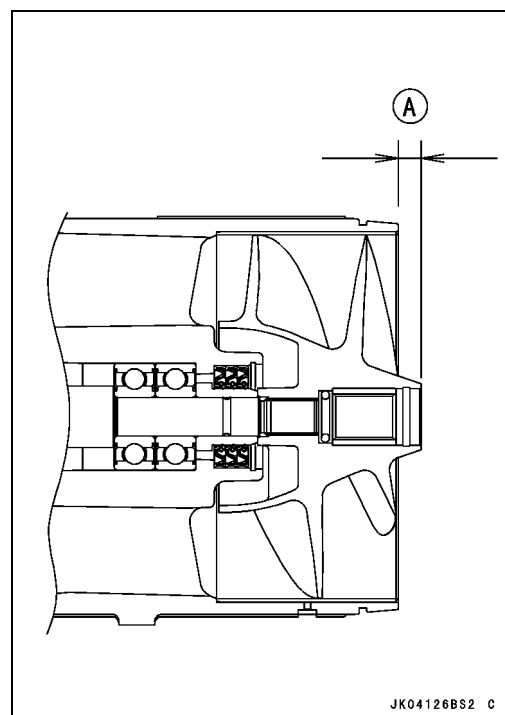
Impeller Wrench: 57001-1228

- Tighten the impeller wrench with specified torque.

Torque - Impeller: 147 N·m (15.0 kgf·m, 108 ft·lb)



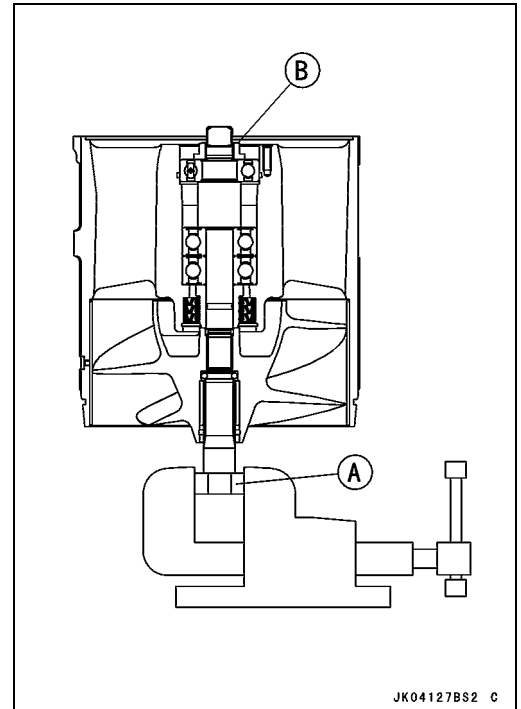
- Measure the gap [A] between impeller end and pump case end.
- ★ If the gap is not less than 10.5 mm (0.413 in.), disassemble the pump again.



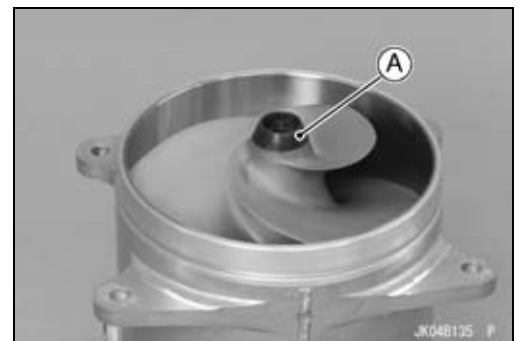
Pump and Impeller

- Turn the pump case upside down.
- Using a vise, hold the pump shaft in the impeller wrench [A].
- Tighten:

Torque - Pump Shaft Nut [B]: 98 N·m (10 kgf·m, 72 ft·lb)



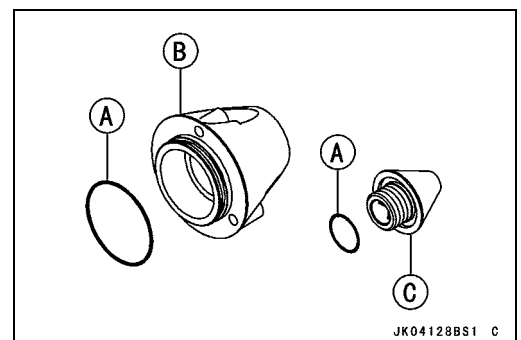
- Visually inspect impeller seal [A], and replace it if necessary.
- Apply cyanoacrylate cement to the impeller seal.
- Install the seal on the impeller.



- Replace the O-rings [A] with new ones, and install them.
- Apply high-grade water resistance grease (Chevron: Black Pearl Grease EP NLGI2 or equivalent) to the O-rings.

[B] Pump Cap

[C] Pump Cap Plug

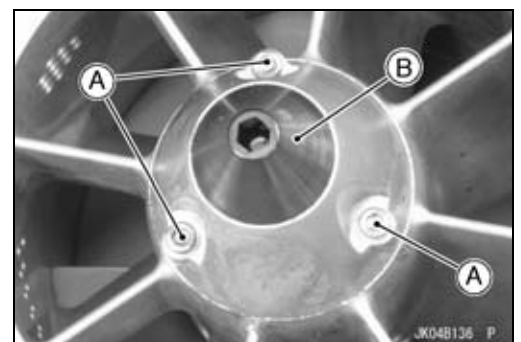


- Apply a non-permanent locking agent to the threads of the pump cap bolts [A].
- Install the pump cap bolts and washers.
- Tighten:

Torque - Pump Cap Bolts: 3.9 N·m (0.40 kgf·m, 35 in·lb)

- Apply a non-permanent locking agent to the threads of the pump cap plug [B].
- Tighten:

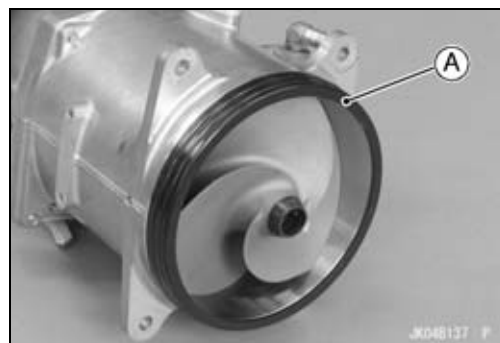
Torque - Pump Cap Plug: 3.9 N·m (0.40 kgf·m, 35 in·lb)



11-18 PUMP AND IMPELLER

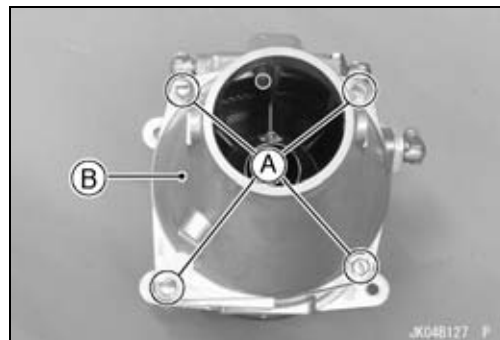
Pump and Impeller

- Install the trim seal [A] to the pump case.



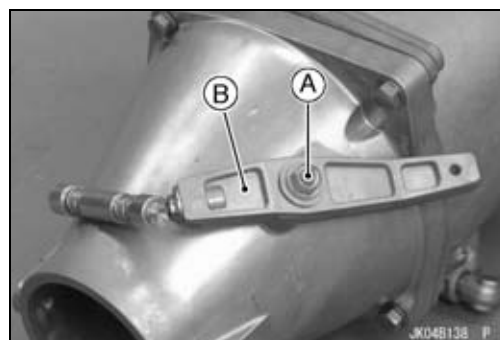
- Apply a non-permanent locking agent to the thread of the pump outlet mounting bolts [A].
- Install the pump outlet [B].
- Tighten:

Torque - Pump Outlet Mounting Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)



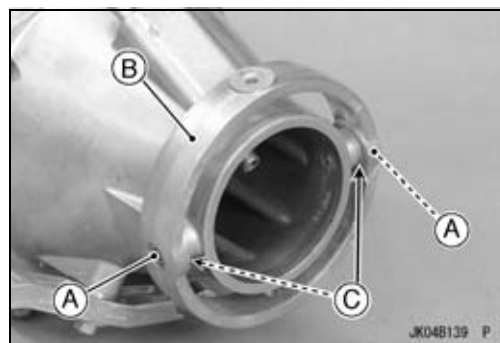
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the thread of the trim control shaft pivot bolt [A].
- Install the trim control shaft [B] and washer.
- Tighten:

Torque - Trim Control Shaft Pivot Bolt: 19 N·m (1.9 kgf·m, 14 ft·lb)



- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the thread of the trim control ring pivot bolts [A].
- Install the trim control ring [B], and washers [C].
- Tighten:

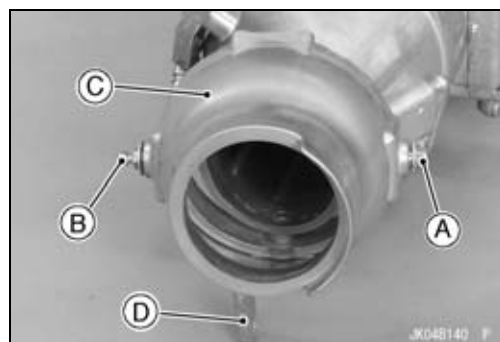
Torque - Trim Control Ring Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)



- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the thread of the steering nozzle pivot bolt (upper) [A] and (lower) [B].
- Install the steering nozzle [C] so that the projection [D] faces leftward.
- Install the washers.
- Tighten:

Torque - Steering Nozzle Pivot Bolt (Upper): 19 N·m (1.9 kgf·m, 14 ft·lb)

Steering Nozzle Pivot Bolt (Lower): 19 N·m (1.9 kgf·m, 14 ft·lb)



Impeller Inspection

- Refer to Impeller Inspection in the Periodic Maintenance chapter.

Pump and Impeller

Impeller Outside Diameter Measurement

- Remove the impeller (see Pump Disassembly).
- Measure the impeller outside diameter.
- ★ If the impeller is worn smaller than the service limit, replace it.

Impeller Outside Diameter

Standard: 159.5 ~ 159.7 mm (6.280 ~ 6.287 in.)

Service Limit: 158.5 mm (6.240 in.)

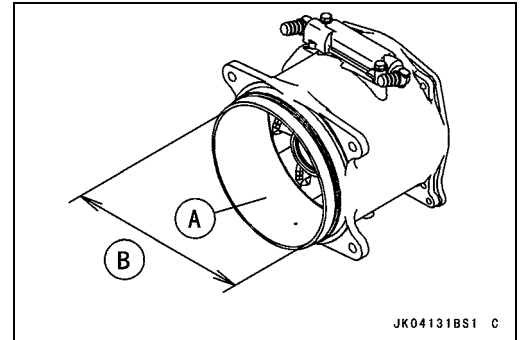
Pump Inspection

- Visually inspect the pump case [A].
- ★ If there are deep scratches inside the pump case, replace it.
- Measure the inside diameter [B] of the pump case.
- ★ If the pump case is worn beyond the service limit, replace it.

Pump Case Inside Diameter

Standard: 160.0 ~ 160.1 mm (6.299 ~ 6.303 in.)

Service Limit: 161.1 mm (6.342 in.)



Impeller Clearance Inspection

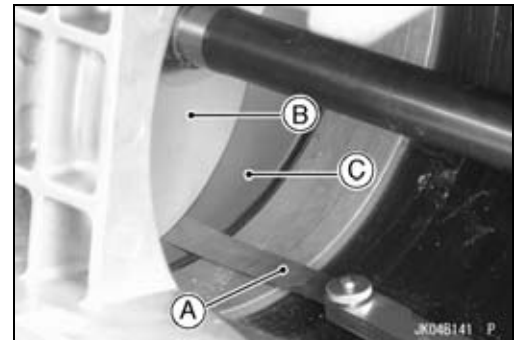
- Impeller clearance is critical to proper performance. If the pump case and impeller are not visibly damaged, poor performance may be caused by too much impeller clearance.
- To check the impeller clearance, remove the grate and insert a feeler gauge [A] between the tip of the impeller blade [B] and the pump case [C].

Impeller Clearance

Standard: 0.15 ~ 0.3 mm (0.0059 ~ 0.012 in.)

Service Limit: 0.6 mm (0.024 in.)

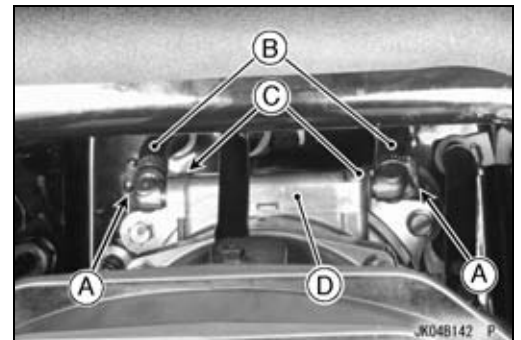
- ★ If impeller clearance is incorrect, determine if it is due to wear or damage (see Pump and Impeller Inspection).



Water Filter Cover Removal/Installation

- Loosen the clamps [A] and pull off the water hoses [B].
- Remove the filter cover mounting bolts [C].
- Take out the filter cover [D].
- Replace the O-ring with a new one.
- Apply high-grade water resistance grease (Chevron: Black Pearl Grease NLGI2 or equivalent) to the O-ring.
- Installation is the reverse order of removal.
- Apply a non-permanent locking agent to the filter cover mounting bolts, and tighten them.

Torque - Filter Cover Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)



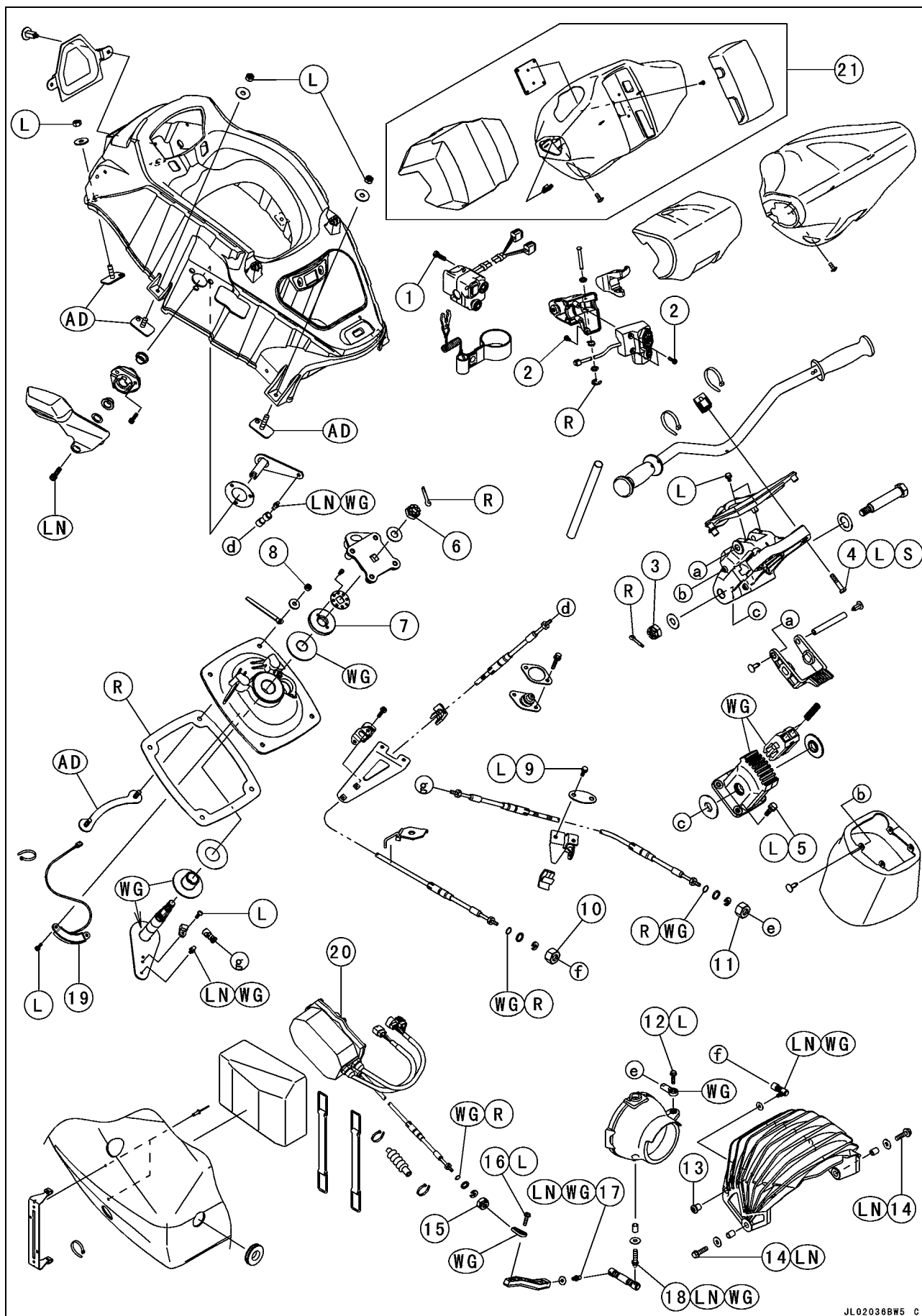
Steering

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12-2 STEERING

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Start/Stop Switch Case Mounting Screws	3.9	0.40	35 in·lb	
2	Throttle Case Mounting Screws	3.9	0.40	35 in·lb	
3	Adjustable Steering Holder Nut	4.9	0.50	43 in·lb	
4	Handlebar Clamp Bolts	15.7	1.6	12	L, S
5	Steering Neck Mounting Bolts	15.7	1.6	12	L
6	Steering Shaft Locknut	29.4 ~ 34.3	3.0 ~ 3.5	22 ~ 25	
7	Steering Shaft Nut	2.9	0.30	26 in·lb	
8	Steering Holder Mounting Nuts	19.6	2.0	14	
9	Steering Cable Bracket Bolts	9.8	1.0	87 in·lb	L
10	Shift Cable Nut	39.2	4.0	29	
11	Steering Cable Nut	39.2	4.0	29	
12	Steering Cable Joint Bolt	9.8	1.0	87 in·lb	L
13	Shift Cable End Nut	9.8	1.0	87 in·lb	
14	Reverse Bucket Pivot Bolts	19	1.9	14	LN
15	Trim Control Cable Nut	39.2	4.0	29	
16	Trim Control Cable Joint Bolt	9.8	1.0	87 in·lb	L
17	Trim Control Shaft Joint Bolt	9.8	1.0	87 in·lb	LN, WG
18	Steering Nozzle Pivot Bolt (Lower)	19	1.9	14	LN, WG

19. Steering Position Sensor

20. Electric Trim Control Actuator

21. JT1500J Model

AD: Apply adhesive.

L: Apply a non-permanent locking agent.

LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).

R: Replacement Parts

S: Follow the specific tightening sequence.

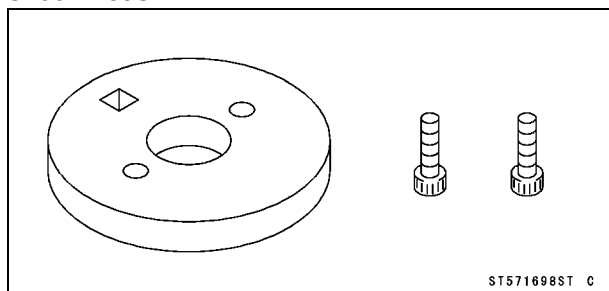
WG: Apply water-resistance grease.

12-4 STEERING

Special Tools

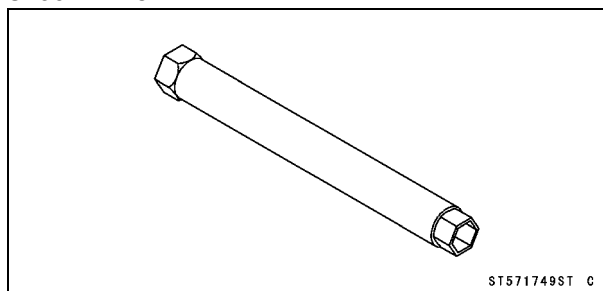
Nut Tightening Plate:

57001-1698



Box Wrench (27 mm):

57001-1749



Steering Cable

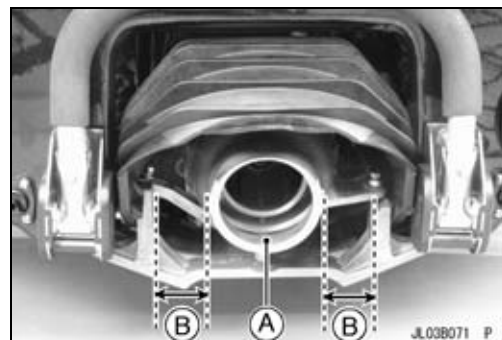
Steering Cable Adjustment

- Check the steering cable adjustment.
- Center the handlebar [A] in the straight-ahead position.



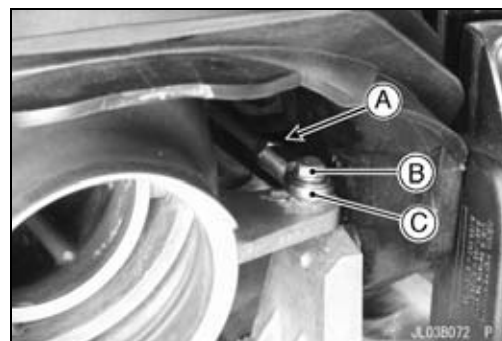
- Check that the steering nozzle [A] is centered in the pump cavity.

Same Distance [B]



★ If the nozzle position is incorrect, adjust the steering cable.

- Loosen the locknut [A] of the steering cable.
- Take out the steering cable joint bolt [B] and disconnect the cable joint [C] from the steering nozzle.
- Center the handlebar in the straight-ahead position.
- Turn the cable joint to adjust the steering.
- Temporarily tighten the cable joint bolt, and check the cable adjustment again.
- When adjustment is correct, unscrew the cable joint bolt and apply a non-permanent locking agent to it. And tighten the cable joint bolt and the steering cable locknut securely.

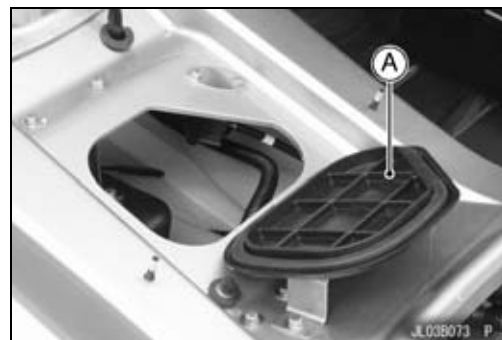


Torque - Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

- As an additional check, turn the handlebar all the way to the left and right, and measure the distance between the nozzle and the edge of the pump cavity. It should be equal at both extremes.

Steering Cable Removal

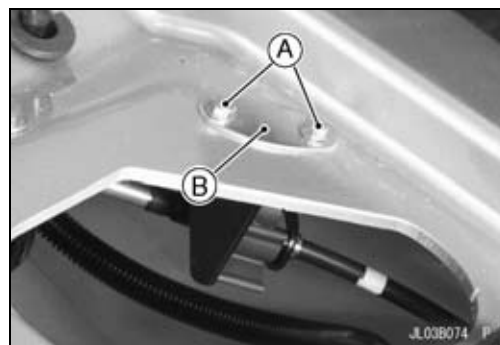
- Remove:
Steering Cover (see Steering Removal)
Center Access Cover [A]



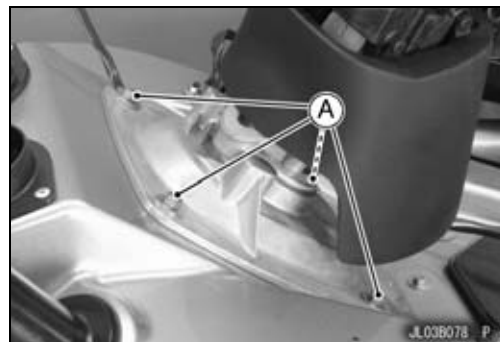
12-6 STEERING

Steering Cable

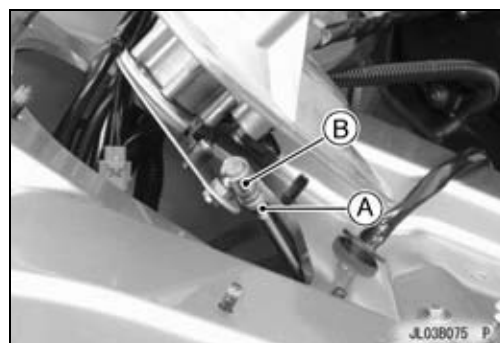
- Remove:
Steering Cable Bracket Bolts [A]
Plate [B]



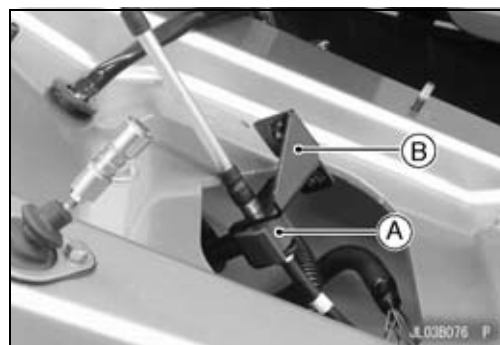
- Remove the steering holder mounting nuts [A].
- Raise the steering holder.



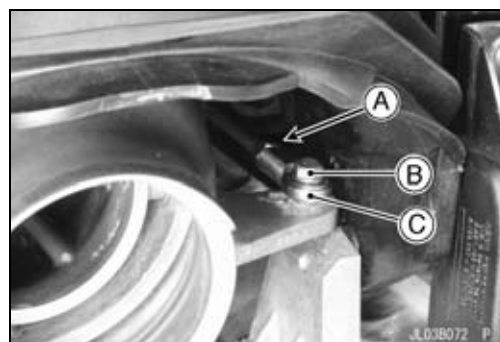
- Loosen the locknut [A].
- Slide the outer sleeve [B] to take the ball joint off the steering shaft.
- Remove the steering cable ball joint and locknut from the steering cable.



- Remove:
Holder [A]
Steering Cable Bracket [B]



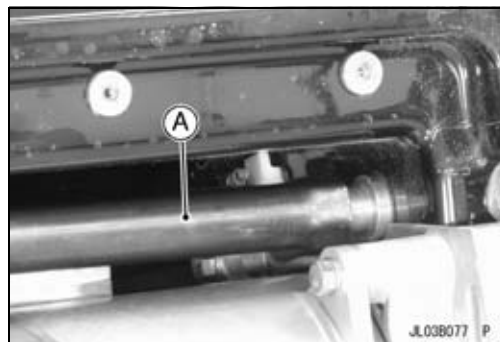
- Loosen the locknut [A].
- Remove:
Steering Cable Joint Bolt [B]
Steering Cable Joint [C]
Pump Cover (see Pump Removal in the Pump and Impeller chapter)



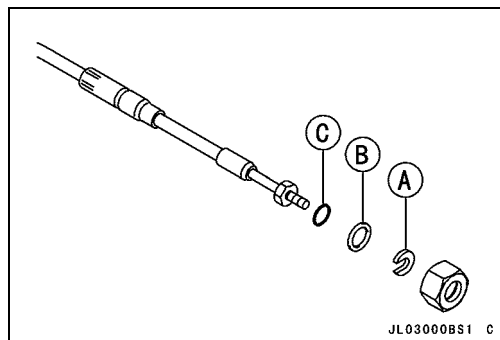
Steering Cable

- Unscrew the large nut (steering cable nut) in the hull with the box wrench.
- Special tool, box wrench [A] is useful to remove the large nut (steering cable nut).

Special Tool - Box Wrench (27 mm): 57001-1749



- Slide off the snap ring [A], washer [B] and O-ring [C].
- Pull out the steering cable toward the rear.



Steering Cable Installation

- Installation is the reverse of removal. Note the following.
- Slide a short piece of rubber or plastic tubing over the front cable end to guide the cable through the hull.
- Lubricate the outside of the new cable to ease cable installation.
- Replace the O-ring with a new one.
- Apply water-resistance grease to the new O-ring.
- Tighten the steering cable nut with the box wrench.

Special Tool - Box Wrench (27 mm): 57001-1749

Torque - Steering Cable Nut: 39.2 N·m (4.0 kgf·m, 29 ft·lb)

- Engage the groove [A] on the steering cable with the opening portion [B] on the cable bracket as shown.
- Apply water-resistance grease to the joint ball.
- Install the steering cable both end to the joints. The steering cable ends must be inserted to the joints a minimum of 5 mm (0.2 in.).
- Apply a non-permanent locking agent to the cable joint bolt and the steering cable bracket bolts.
- Tighten:

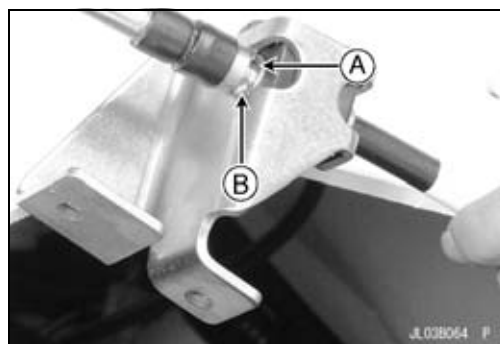
Torque - Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

Steering Cable Bracket Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

- Adjust the steering cable (see Steering Cable Adjustment).

Steering Cable Inspection

- Refer to the Steering Cable/Shift Cable Inspection in the Periodic Maintenance chapter.



12-8 STEERING

Steering Cable

Steering Cable Lubrication

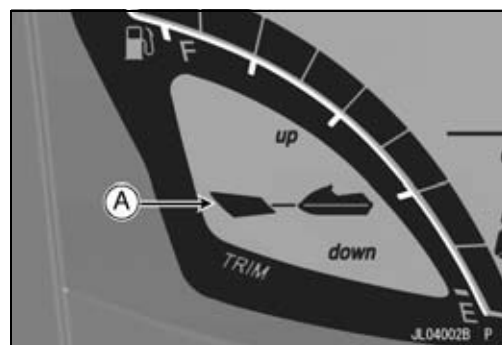
NOTE

- *The steering cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.*

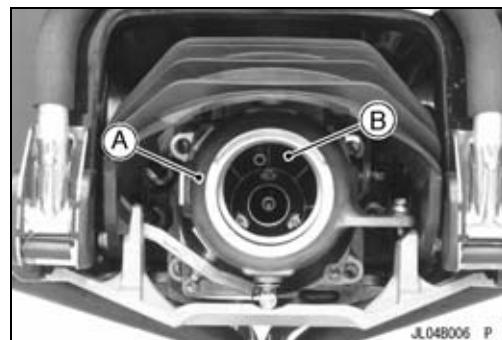
Trim Control Cable

Trim Control Cable Adjustment

- Check the trim control cable adjustment.
- Center the steering nozzle angle by pushing the electric trim control button.
- The electric trim control actuator stops automatically when the steering nozzle gets to the horizontality [A].



- Check that the steering nozzle [A] is centered in the pump outlet [B].

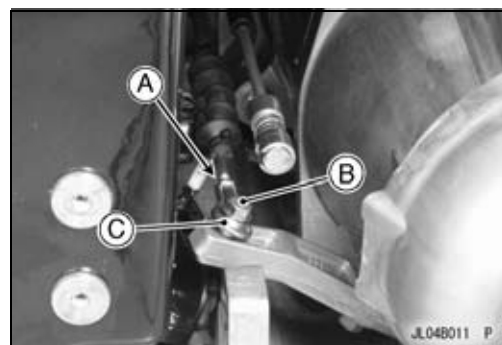


- ★ If the nozzle position is incorrect, adjust the trim control cable.

- Take the shift cable ball joint [A] off the reverse bucket.



- Loosen the locknut [A] of the trim control cable.
- Take out the trim control cable joint bolt [B] and disconnect the cable joint [C] from the trim control lever.
- Turn the cable joint to adjust the steering nozzle angle.
- Temporarily tighten the cable joint bolt, and check the cable adjustment again.
- When the adjustment is correct, unscrew the cable joint bolt and apply a non-permanent locking agent to it. And tighten the cable joint bolt and the trim control cable locknut securely.



Torque - Trim Control Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

12-10 STEERING

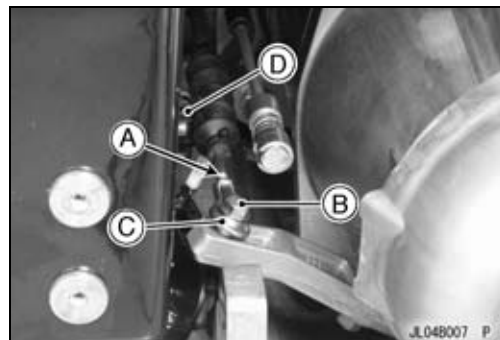
Trim Control Cable

Trim Control Cable Removal

- Take the shift cable ball joint [A] off the reverse bucket.

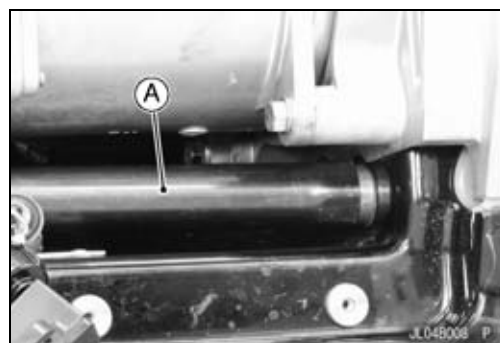


- Loosen the locknut [A].
- Remove:
 - Trim Control Cable Joint Bolt [B]
 - Trim Control Cable Joint [C]
 - Pump Cover (see Pump Removal in the Pump and Impeller chapter)
 - Speed Sensor Lead Cap [D]

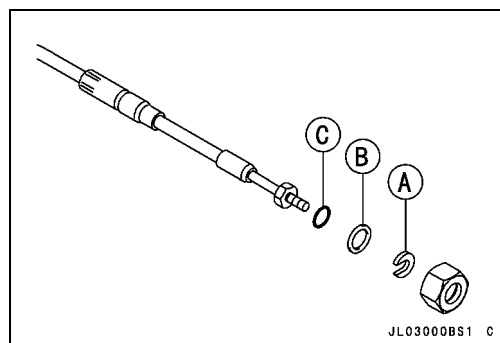


- Unscrew the large nut (trim control cable nut) in the hull with the box wrench.
- Special tool, box wrench [A] is useful to remove the large nut (trim control cable nut).

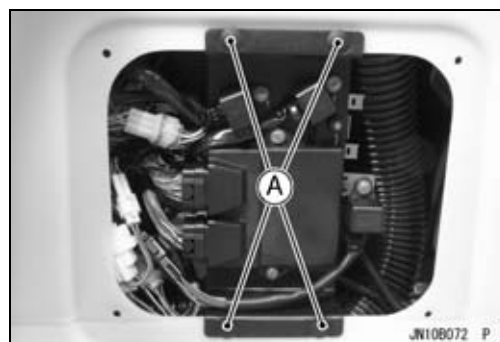
Special Tool - Box Wrench (27 mm): 57001-1749



- Slide off the snap ring [A], washer [B] and O-ring [C].

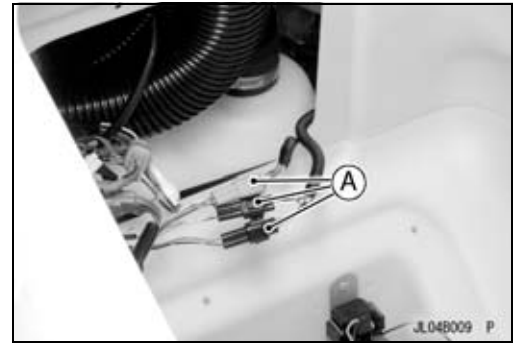


- Remove:
 - Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
 - Rivets [A]

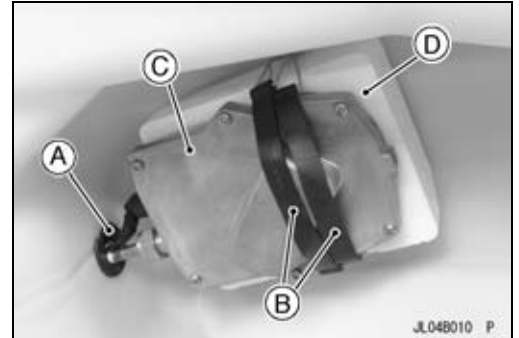


Trim Control Cable

- Disconnect the electric trim control actuator lead connectors [A].



- Remove:
 - Grommet [A]
 - Bands [B]
 - Electric Trim Control Actuator [C] with Trim Control Cable
 - Float [D]



Trim Control Cable Installation

- Installation is the reverse of removal. Note the following.
 - Slide a short piece of rubber or plastic tubing over the front cable end to guide the cable through the hull.
 - Lubricate the outside of the new cable to ease cable installation.
 - Replace the O-ring with a new one.
 - Apply water-resistance grease to the new O-ring.
 - Tighten the trim control cable nut with the box wrench.

Special Tool - Box Wrench (27 mm): 57001-1749

Torque - Trim Control Cable Nut: 39.2 N·m (4.0 kgf·m, 29 ft·lb)

- Apply water-resistance grease to the joint ball.
- Apply a non-permanent locking agent to the cable joint bolt.
- Tighten:

Torque - Trim Control Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

- Adjust the trim control cable (see Trim Control Cable Adjustment).

Trim Control Cable Inspection

- Refer to the Trim Control Cable Inspection in the Periodic Maintenance chapter.

Trim Control Cable Lubrication

NOTE

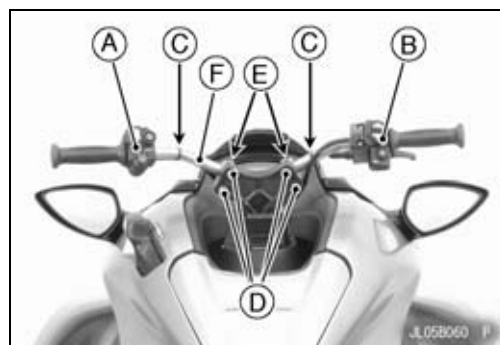
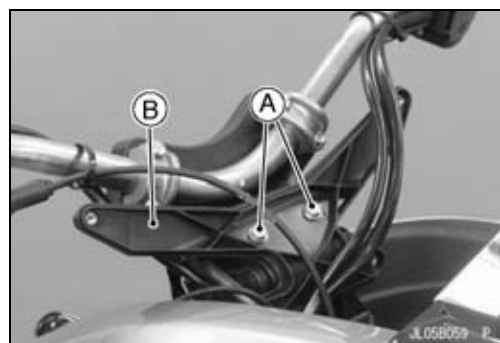
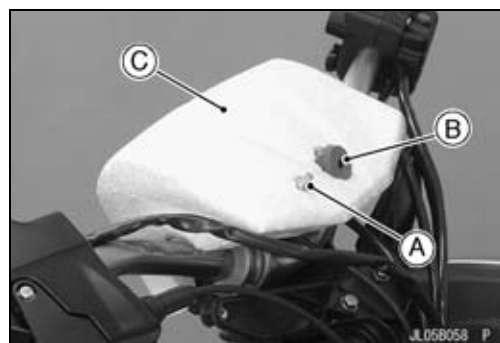
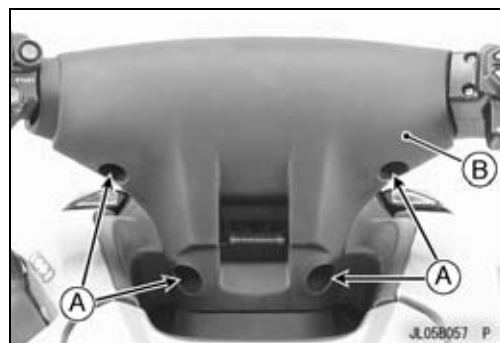
- The trim control cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.

12-12 STEERING

Handlebar

Handlebar Removal

- Remove:
 - Screws [A]
 - Handlebar Pad [B]
- Remove:
 - Air Temperature Sensor (for Meter Unit) [A]
 - Buzzer [B]
 - Inner Pad [C]
- Remove:
 - Bolts [A]
 - Handlebar Pad Holder [B]
- Remove:
 - Start/Stop Switch Case [A]
 - Throttle Case [B]
 - Clamps [C]
 - Handlebar Clamp Bolts [D]
 - Handlebar Clamps [E]
 - Handlebar [F]



Handlebar Installation

- Installation is the reverse of removal. Note the following.
- Align the hole [A] on the handlebar and the line [B] on the steering shaft holder.



Handlebar

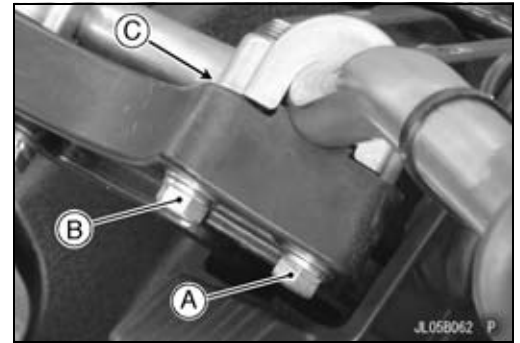
○Apply a non-permanent locking agent to the handlebar clamp bolts.

○Tighten:

Torque - Handlebar Clamp Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)

○Tighten the lower clamp bolt [A] first, and then the upper clamp bolt [B].

○There will be a gap [C] at the upper part of the clamp after tightening.



○Run the cable and wires (see Cable, Wire, and Hose Routing section in the Appendix chapter).

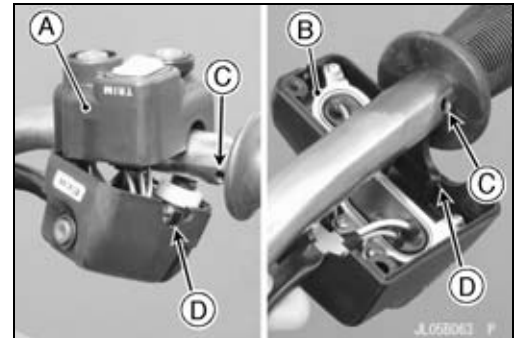
○Install the start/stop switch case [A] and the throttle case [B].

○Fit the hole [C] and the projection [D].

○Tighten:

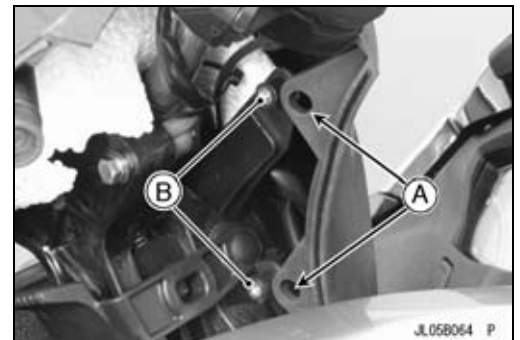
Torque - Start/Stop Switch Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)

Throttle Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)

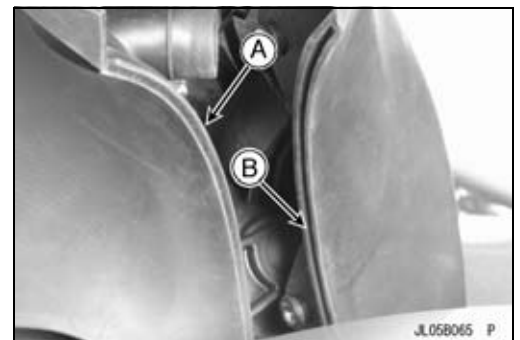


○Install the handlebar pad.

○Fit the holes [A] and the bosses [B] on both sides.



○Align the projection [A] and the groove [B].

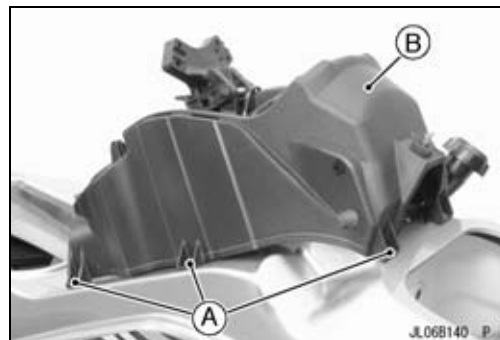
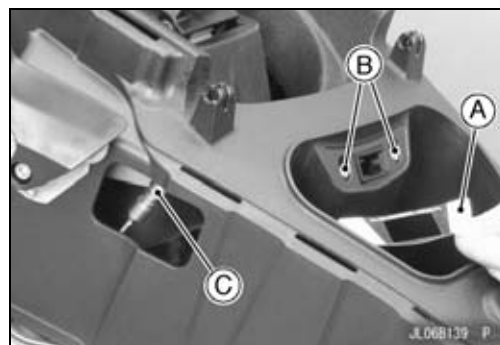


12-14 STEERING

Steering

Steering Removal

- Remove:
 - Center Storage Lid (see Center Storage Lid Removal in the Hull/Engine Hood chapter)
 - Side Covers (see Side Cover Removal in the Hull/Engine Hood chapter)
 - Handlebar (see Handlebar Removal)
 - Plate [A]
 - Bolts [B]
- Disconnect the shift cable ball joint [C].
- Remove the steering cover nuts [A] and washers on both sides.
- Take the steering cover [B] off the hull.



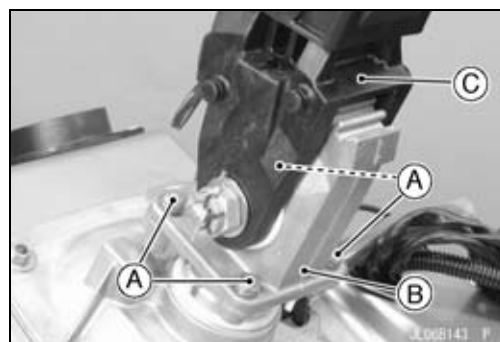
- Open the clamp [A].



- Remove:
 - Rivets [A]
 - Steering Pad [B]

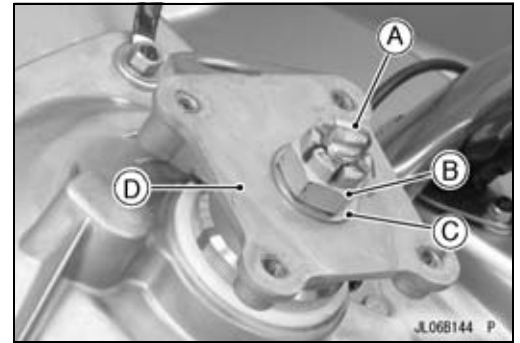


- Remove:
 - Steering Neck Mounting Bolts [A]
 - Steering Neck [B] with Adjustable Steering Holder [C]

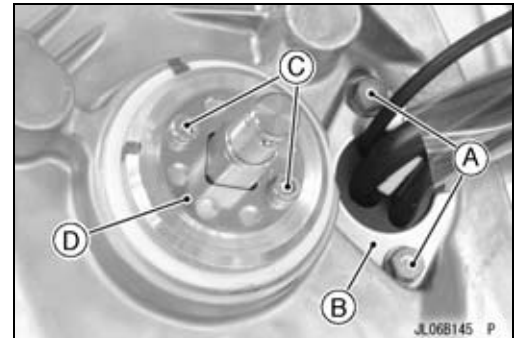


Steering

- Remove:
Cotter Pin [A]
Steering Shaft Locknut [B]
Washer [C]
Holder [D]

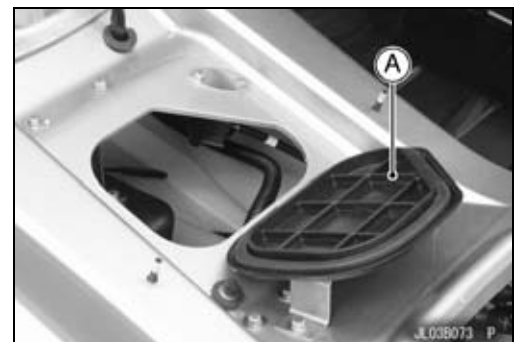


- Remove:
Grommet Mounting Plate Bolts [A]
Grommet Mounting Plate [B]
Lock Plate Mounting Bolts [C]
Lock Plate [D]

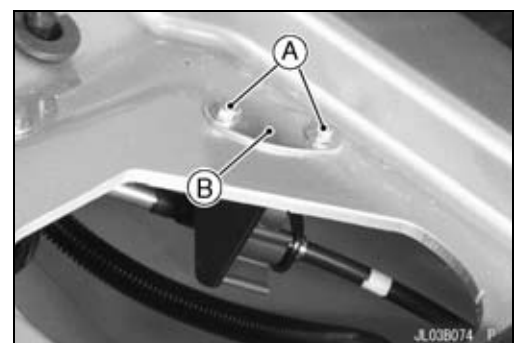


- Disconnect:
Steering Position Sensor Lead Connector
Buzzer Lead Connector
Air Temperature Sensor (for Meter Unit) Lead Connector
Throttle Case Lead Connectors
Start/Stop Switch Case Lead Connector
Throttle Cable Upper End at Throttle Case

- Remove the center access cover [A].



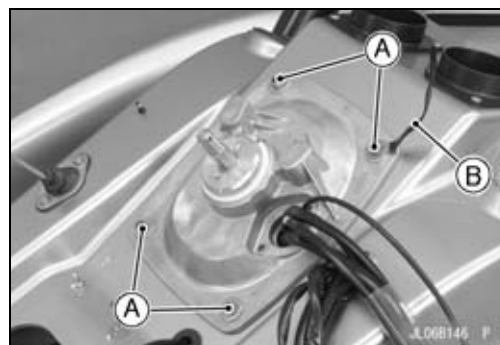
- Remove:
Steering Cable Bracket Bolts [A]
Plate [B]



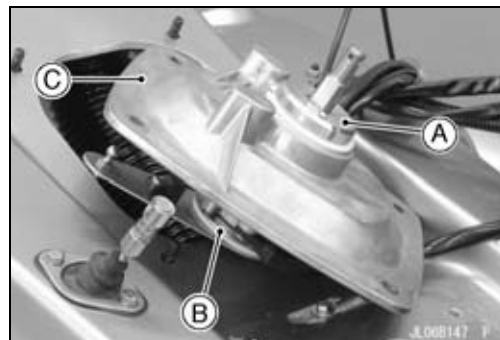
12-16 STEERING

Steering

- Remove:
 - Steering Holder Nuts [A] and Washer Clamp [B]
- Raise the steering holder.
- Take the steering cable ball joint off the steering shaft.

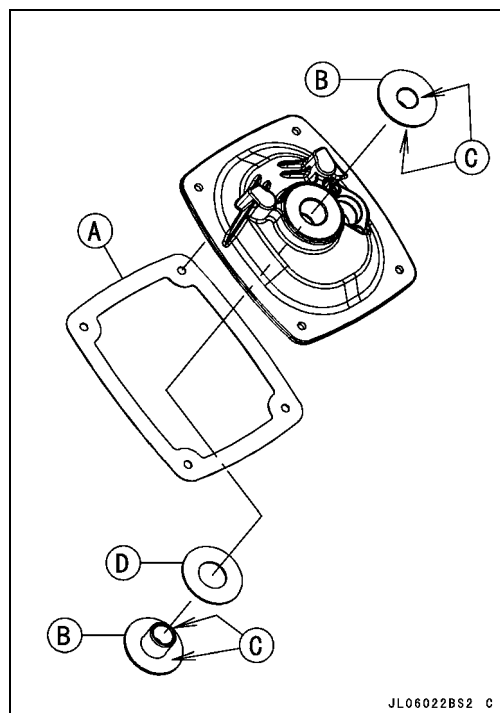


- Remove:
 - Steering Shaft Nut [A]
 - Steering Shaft [B]
 - Steering Holder [C]

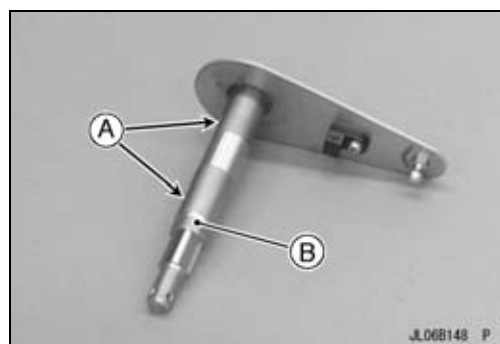


Steering Installation

- Replace the steering holder gasket [A] with a new one.
- Check the bushings [B] for damage and wear.
- ★ If the bushings are damaged or worn, replace them with new ones.
- Apply water-resistance grease [C] to the bushings.
- Install the bushings and the washer [D].



- Apply water-resistance grease [A] to the steering shaft [B].



Steering

- Install the steering shaft [A].
- Tighten the steering shaft nut [B] by hand, and then loosen.

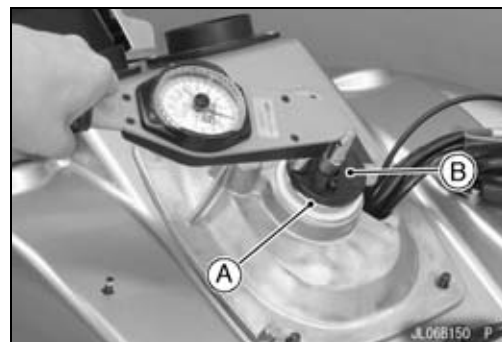


- Tighten the steering shaft nut [A] with the nut tightening plate [B].

Special Tool - Nut Tightening Plate: 57001-1698

- Torque (2.6 N·m, 0.27 kgf·m, 23 in·lb) the plate with nut.

Torque - Steering Shaft Nut: 2.9 N·m (0.30 kgf·m, 26 in·lb)



- Remove the special tool.
- Loosen the steering shaft nut so that the threads [A] of the steering shaft nut are aligned with the holes [B] of the plate within second chance.
- Tighten the bolts [C] and check steering shaft turns freely with no play.
- Inspect the steering position sensor clearance (see Steering Position Sensor Clearance Inspection in the Electrical System chapter).
- Apply water-resistance grease to the joint ball.
- Install the steering cable to the steering shaft.
- Apply a non-permanent locking agent to the steering cable bracket bolts.
- Tighten:

Torque - Steering Cable Bracket Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

Steering Holder Mounting Nuts: 19.6 N·m (2.0 kgf·m, 14 ft·lb)

Steering Shaft Locknut: 29.4 ~ 34.3 N·m (3.0 ~ 3.5 kgf·m, 22 ~ 25 ft·lb)

- Apply a non-permanent locking agent to the grommet mounting plate bolts.
- Install the grommet and the grommet mounting plate.
- Replace the cotter pin [A] with a new one.

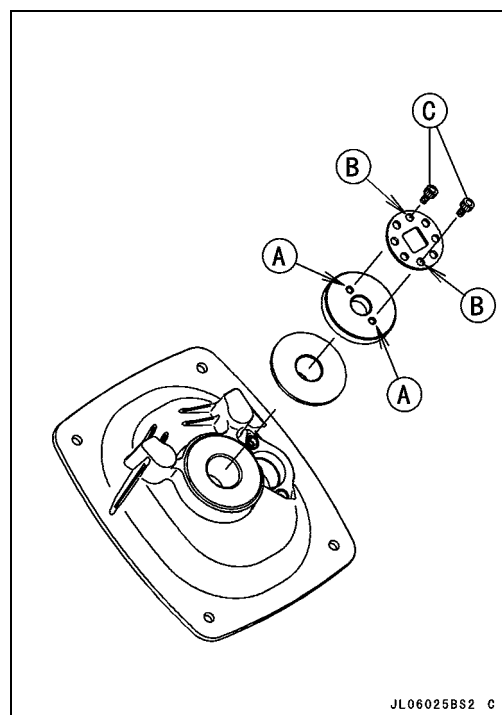
NOTE

○ When inserting the cotter pin, if the slots in the locknut do not align with the cotter pin hole in the steering shaft, tighten the locknut clockwise [B] up to next alignment.

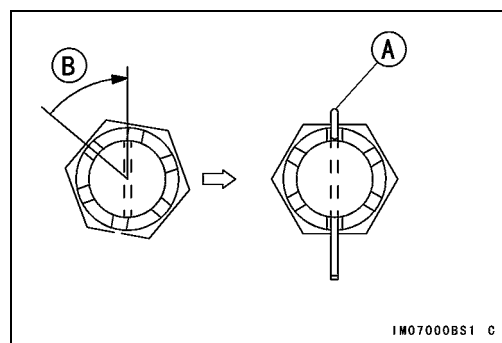
○ It should be within 30 degree.

○ Loosen once and tighten again when the slot goes past the nearest hole.

- Bend the cotter pin over the nut.



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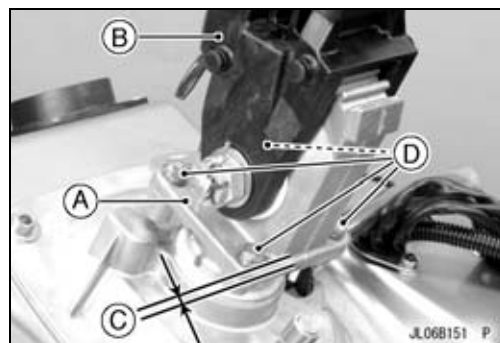
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12-18 STEERING

Steering

- Install the steering neck [A] with the adjustable steering holder [B] so that its narrow side [C] faces the rear as shown in the figure.
- Apply a non-permanent locking agent to the steering neck mounting bolts [D].
- Tighten:

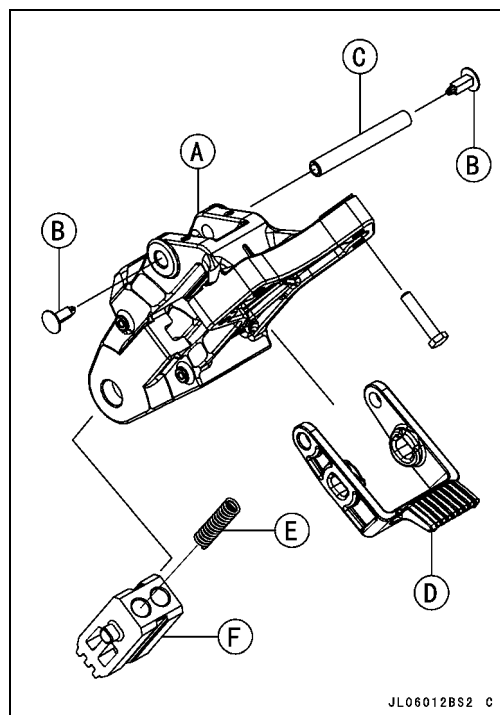
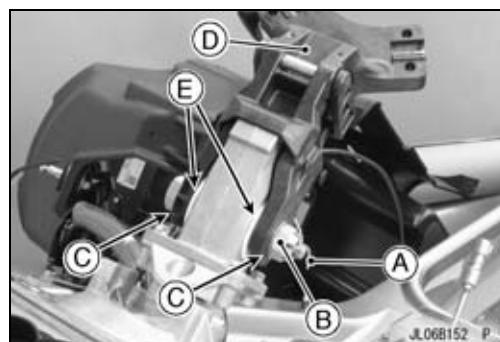
Torque - Steering Neck Mounting Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)



- Adjust the steering cable (see Steering Cable Adjustment).
- Install the removed parts (see appropriate chapters).

Adjustable Steering Holder Disassembly

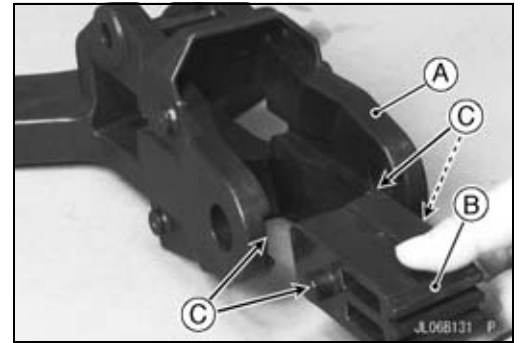
- Remove:
 - Steering Pad (see Steering Removal)
 - Cotter Pin [A]
 - Adjustable Steering Holder Nut [B] and Bolt
 - Washers [C]
 - Adjustable Steering Holder [D]
 - Bushings [E]
- Take the followings off the adjustable steering holder [A].
 - Rivets [B]
 - Shaft [C]
 - Tilt Lever [D]
 - Springs [E]
 - Rod [F]



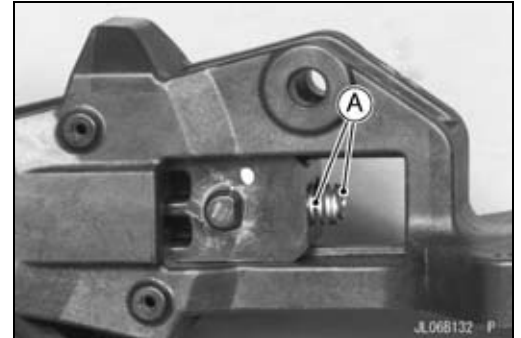
Steering

Adjustable Steering Holder Assembly

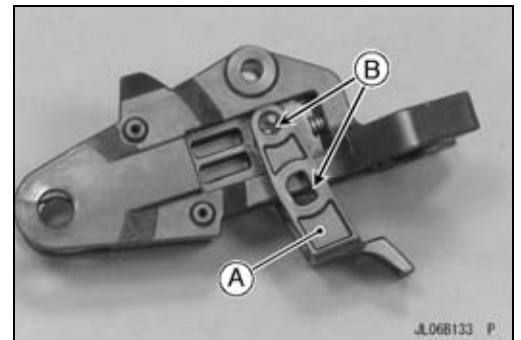
- Insert the rod [B] into the adjustable steering holder [A].
- Align [C] the projections on the rod with the grooves on the holder.



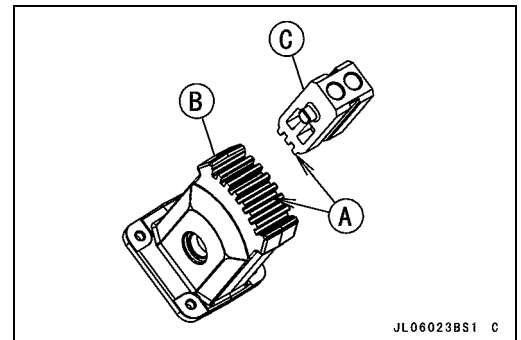
- Be sure that the springs [A] are in place.



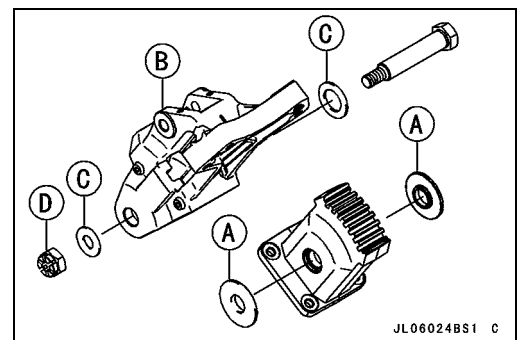
- Install the tilt lever [A] on the adjustable steering holder.
- Align [B] the projection on the rod with the hole on the tilt lever.



- Apply water-resistance grease [A] to the steering neck [B] and the adjustable rod [C].



- Install:
 - Bushings [A]
 - Adjustable Steering Holder [B]
 - Washers [C]
 - Adjustable Steering Holder Nut [D] and Bolt
- Tighten:
 - Torque - Adjustable Steering Holder Nut: 4.9 N·m (0.50 kgf·m, 43 in·lb)**



12-20 STEERING

Steering

- Insert a new cotter pin [A].

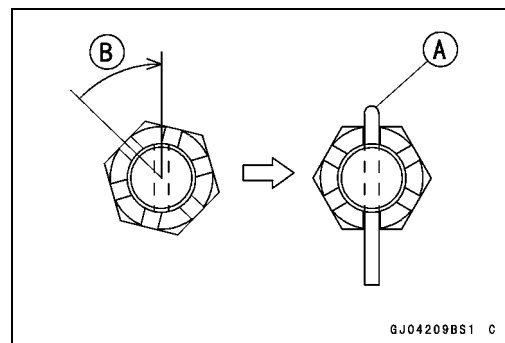
NOTE

○ When inserting the cotter pin, if the slots in the nut do not align with the cotter pin hole in the adjustable steering holder bolt, tighten the locknut clockwise [B] up to next alignment.

○ It should be within 30°.

○ Loosen once and tighten again when the slot goes past the nearest hole.

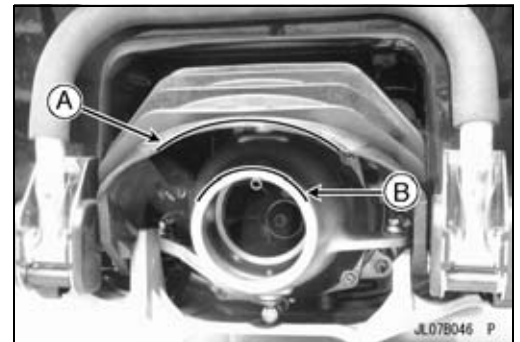
- Bend the cotter pin over the nut.



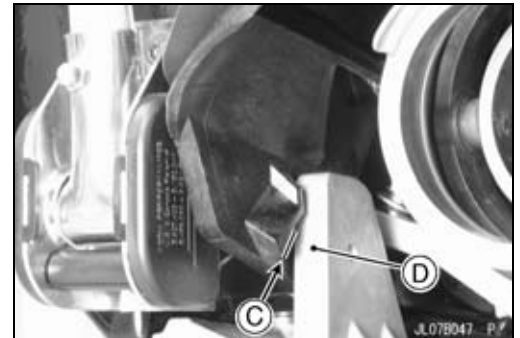
Reverse System

Shift Cable Adjustment

- Check the shift cable adjustment.
- When the shift lever is in the “F” position, the lower edge [A] of the bucket should be held above the top [B] of the steering nozzle with slight play so it doesn’t interfere with the water flow from the jet pump.

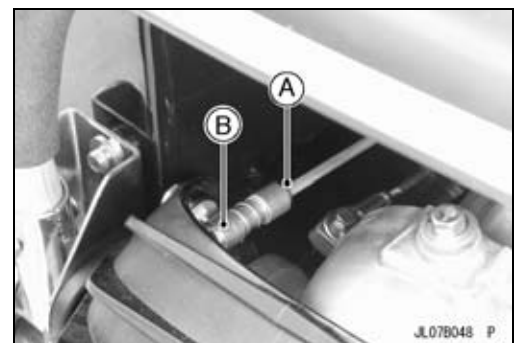


- When the shift lever is in the “R” position, the lower stopper [C] on the bucket should rest against the bottom [D] of the pump cover.



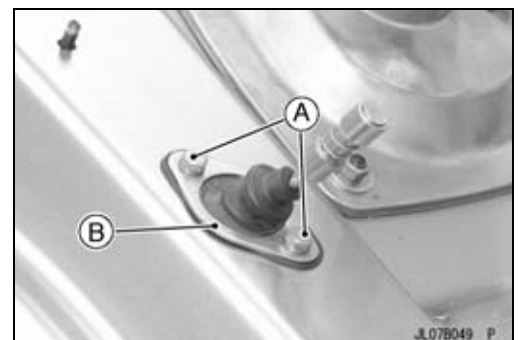
★ If either position is incorrect, adjust the shift cable.

- Put the shift lever in the “R” position.
- Loosen the locknut [A] of the shift cable.
- Slide back the outer sleeve and take the ball joint [B] off the ball.
- Turn the ball joint to adjust the shift cable.
- Connect the ball joint and check the cable adjustment again.
- When adjustment is correct, tighten the shift cable locknut.

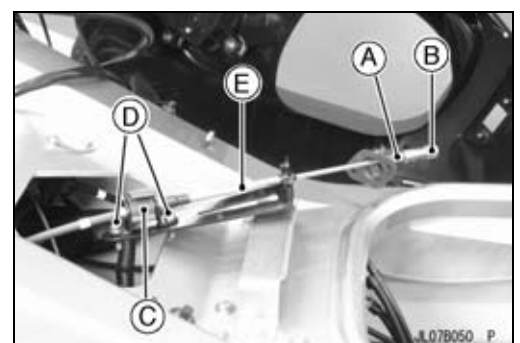


Shift Cable Removal

- Lift up the steering cover (see Steering Removal).
- Remove:
 - Plate Bolts [A]
 - Plate [B]



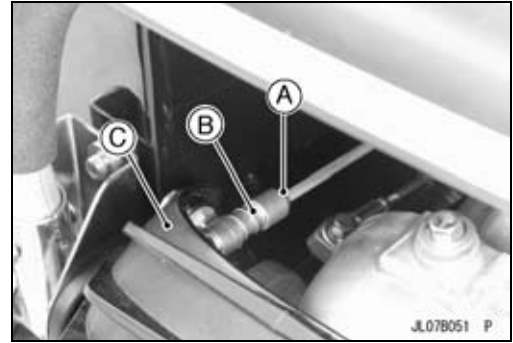
- Loosen the locknut [A] at the front end of the shift cable and take off the ball joint [B], and remove the locknut from the cable front end.
- Take the holder [C] off the cable bracket.
- Remove the cable bracket mounting bolts [D].
- Slide the shift cable [E] off the cable bracket.



12-22 STEERING

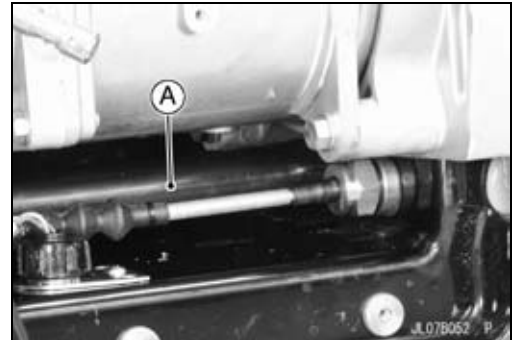
Reverse System

- Loosen the locknut [A] at the rear end of the shift cable, and remove the ball joint [B] from the reverse bucket [C],

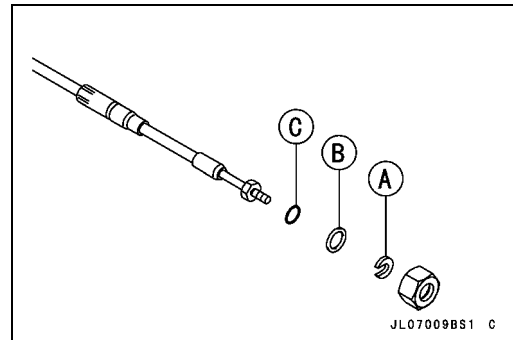


- Unscrew the large nut (shift cable nut) in the hull with the box wrench.
- Special tool, box wrench [A] is useful to remove the large nut (shift cable nut).

Special Tool - Box Wrench (27 mm): 57001-1749



- Slide off the snap ring [A], washer [B] and O-ring [C].
- Pull out the shift cable toward the rear.



Shift Cable Installation

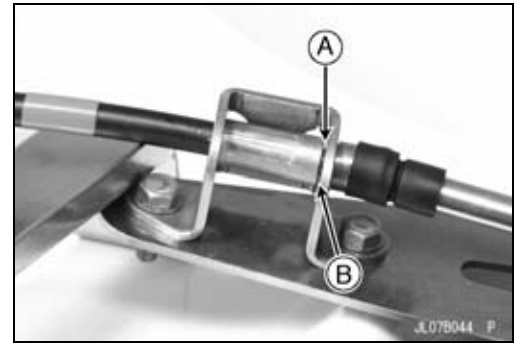
- Installation is the reverse of removal. Note the following.
- Slide a short piece of rubber or plastic tubing over the front cable end to guide the cable through the hull.
- Lubricate the outside of the new cable to ease cable installation.
- Replace the O-ring with a new one.
- Apply water-resistance grease to the new O-ring.
- Tighten the shift cable nut with the box wrench.

Special Tool - Box Wrench (27 mm): 57001-1749

Torque - Shift Cable Nut: 39.2 N·m (4.0 kgf·m, 29 ft·lb)

Reverse System

- Engage the groove [A] on the steering cable with the opening portion [B] on the cable bracket as shown.
- Apply water-resistance grease to the joint ball at each end of shift cable.
- Adjust the shift cable (see Shift Cable Adjustment).



Shift Cable Inspection

- Refer to the Steering Cable/Shift Cable Inspection in the Periodic Maintenance chapter.

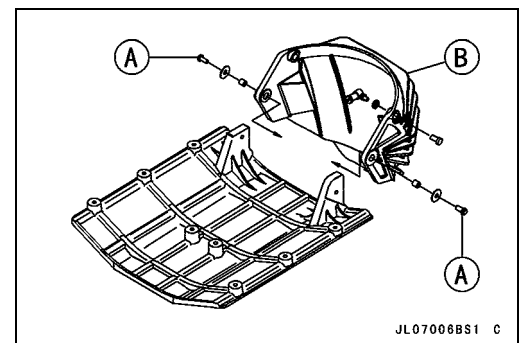
Shift Cable Lubrication

NOTE

- The shift cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.

Reverse Bucket Removal/Installation

- Disconnect the ball joint at rear end of the shift cable.
- Remove the pump cover (see Pump Removal in the Pump/Impeller chapter).
- Unscrew the pivot bolts [A] and remove the reverse bucket [B].



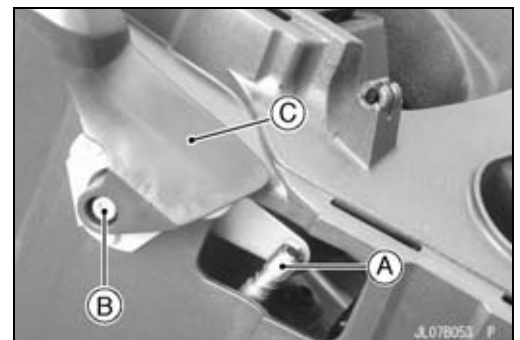
- Installation is the reverse of removal. Note the following.
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the reverse bucket pivot bolts, and torque them.

Torque - Reverse Bucket Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)

- After installation, check the shift cable adjustment (see Shift Cable Adjustment).

Shift Lever Shaft Removal/Installation

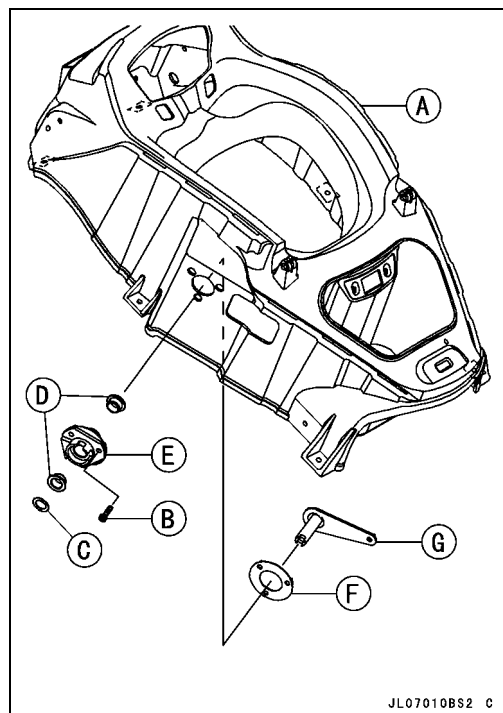
- Remove the side covers (see Side Cover Removal in the Hull/Engine Hood chapter).
- Disconnect the shift cable ball joint [A] at upper end.
- Unscrew the shift lever bolt [B] and remove the shift lever [C].



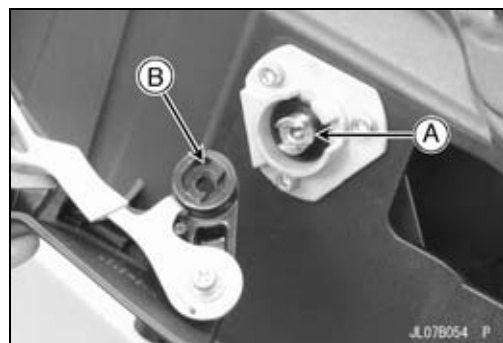
12-24 STEERING

Reverse System

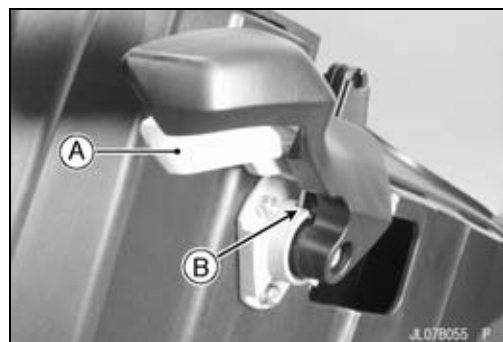
- Lift up the steering cover [A] (see Steering Removal).
- Remove:
 - Bolts [B]
 - Washer [C]
 - Collars [D]
 - Shift Lever Holder [E]
 - Shift Lever Bracket [F]
 - Shift Lever Shaft [G]



- Installation is the reverse of removal. Note the following.
 - Align the slot [A] on the shift lever shaft with the projection [B] on the shift lever.
 - Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the shift lever bolt.
 - Before connecting the shift cable, apply a water-resistance grease to its joint ball.



- Inspect the reverse lever [A] is properly locked [B] to forward.
- Adjust the position if necessary (see Shift Cable Adjustment).



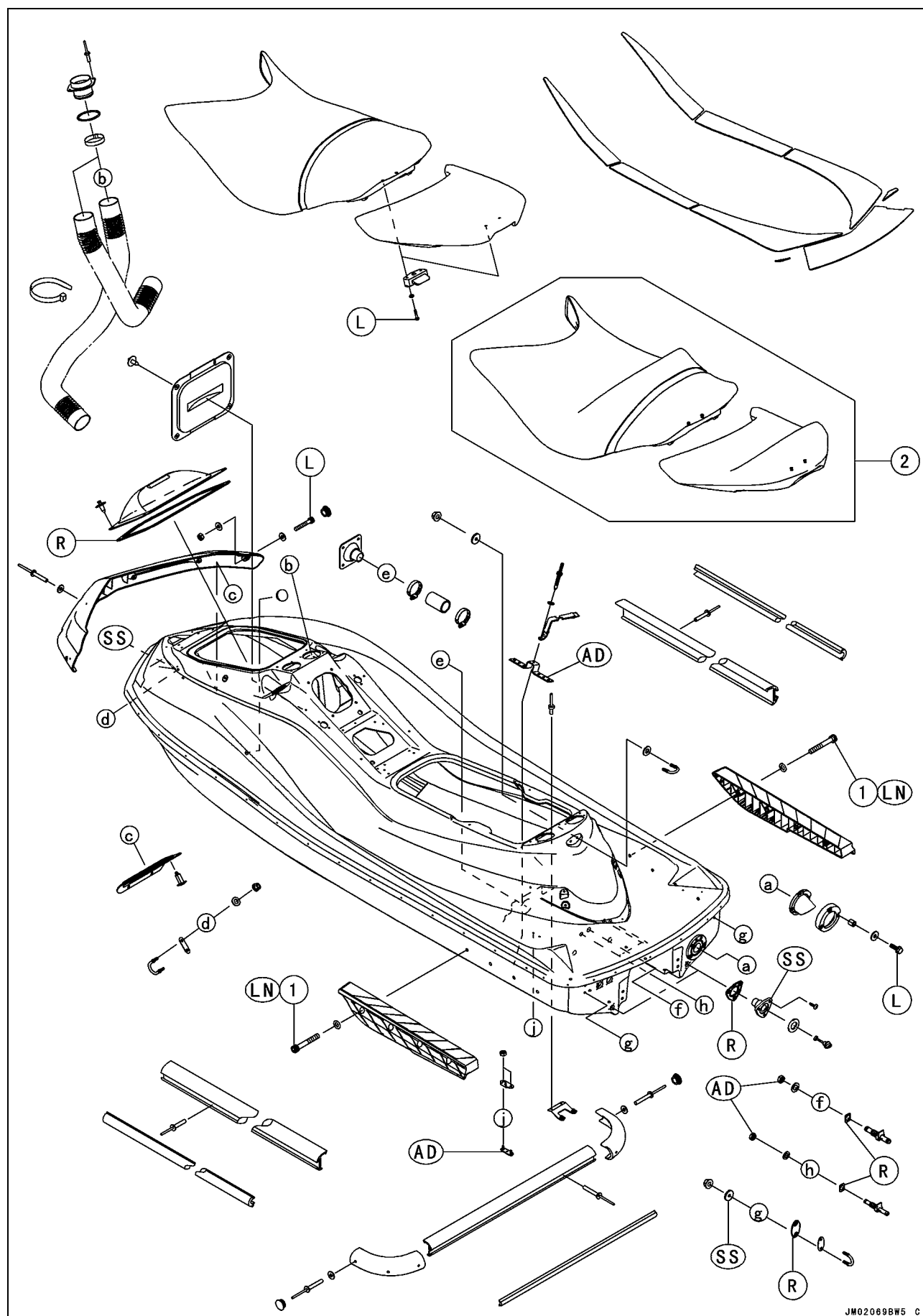
Hull/Engine Hood

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13-2 HULL/ENGINE HOOD

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Stabilizer Bolts	15.7	1.6	12	LN

2. JT1500JBF Model

AD: Apply adhesive.

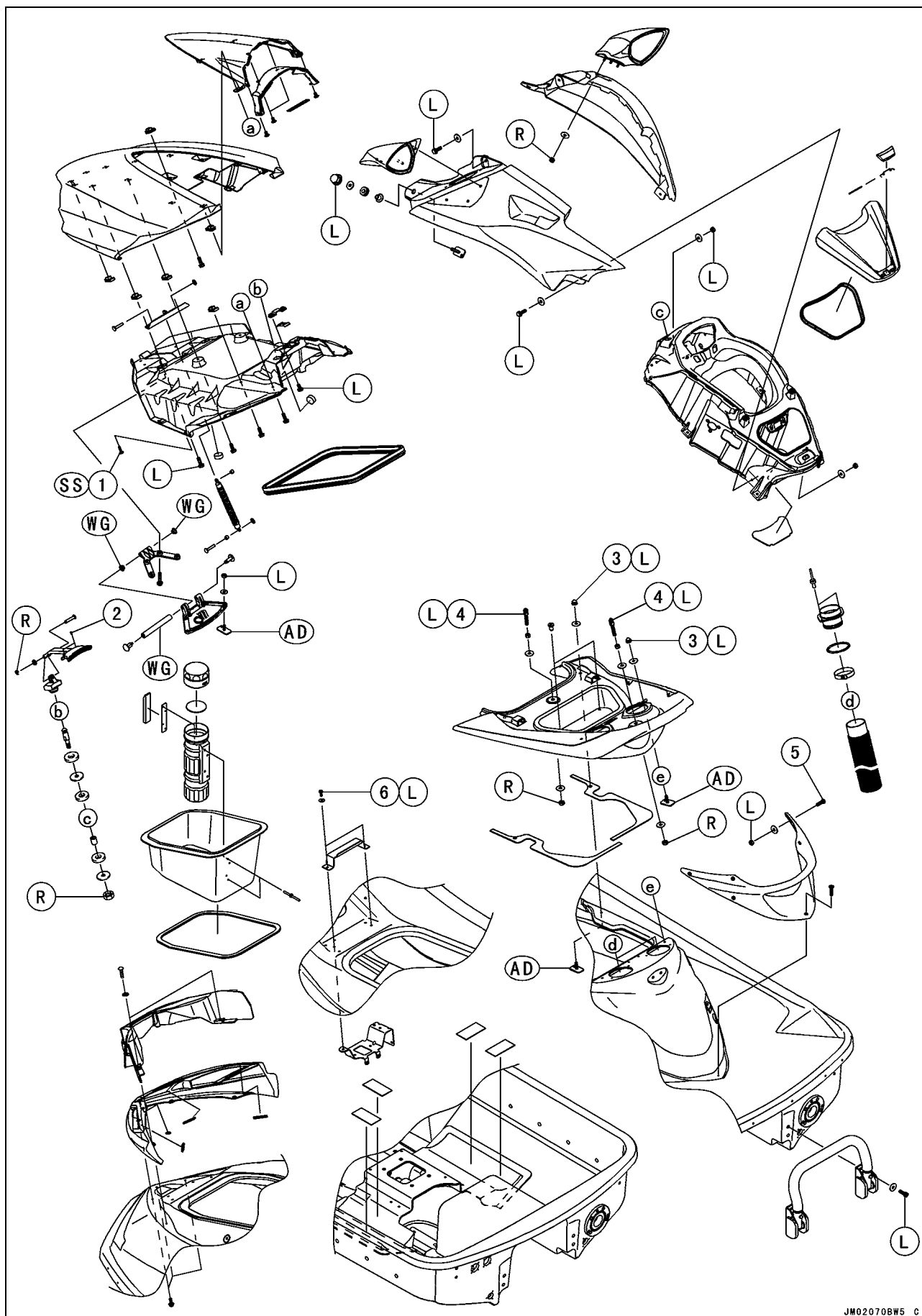
LN: Apply a non-permanent locking agent.(High Strength: Loctite 271 equivalent).

R: Replacement Parts

SS: Apply silicone sealant.

13-4 HULL/ENGINE HOOD

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Front Hatch Mounting Screws	2.0	0.20	18 in·lb	SS
2	Latch Handle Screws	2.0	0.20	18 in·lb	
3	Handrail Plate Nuts	9.8	1.0	87 in·lb	L
4	Seat Lock Ratchet Pins	27	2.8	20	L
5	Handrail Mounting Screws	4.0	0.41	35 in·lb	
6	Bracket Bolts	8.8	0.90	78 in·lb	L

AD: Apply adhesive.

G: Apply grease.

L: Apply a non-permanent locking agent.

R: Replacement Parts

SS: Apply silicone sealant.

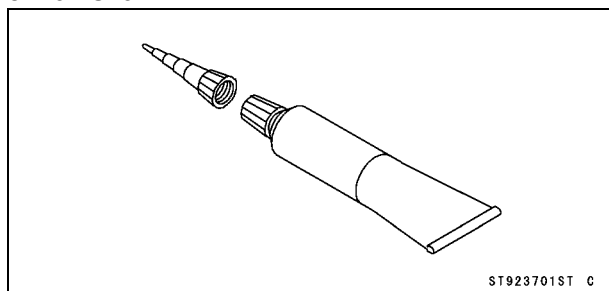
WG: Apply water resistance grease.

13-6 HULL/ENGINE HOOD

Sealant

Adhesive, TB1521:

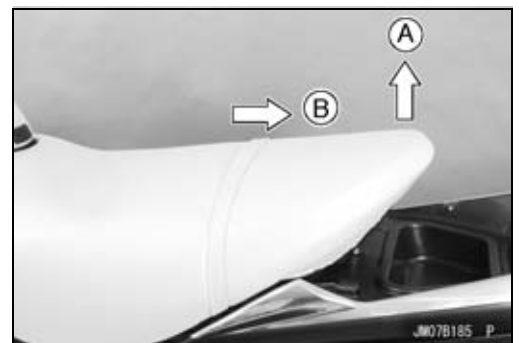
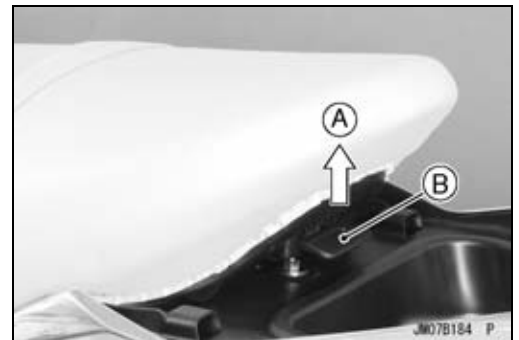
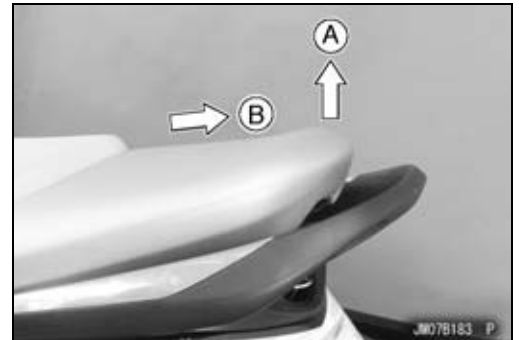
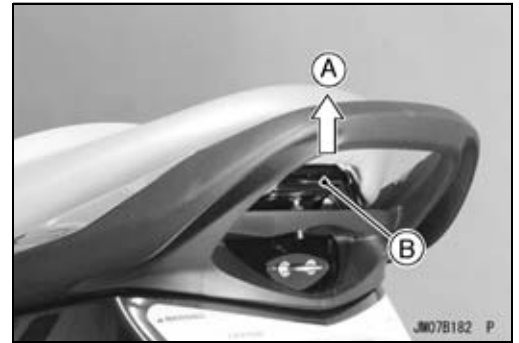
92104-3701



Fittings

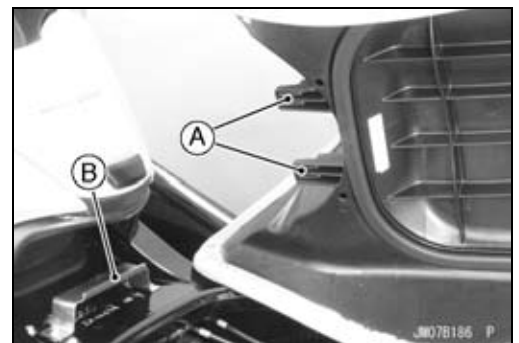
Seat Removal (JT1500HBF Models)

- Pull up [A] the latch handle [B].
- Remove the rear seat up [A] and to the rear [B].
- Pull up [A] the latch handle [B].
- Remove the front seat up [A] and to the rear [B].



Seat Installation (JT1500HBF Models)

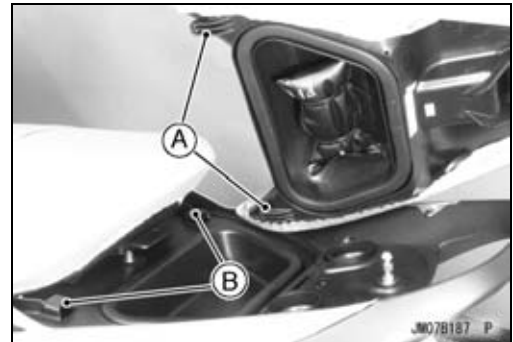
- Insert the seat hook [A] into the bracket [B] on the deck and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.



13-8 HULL/ENGINE HOOD

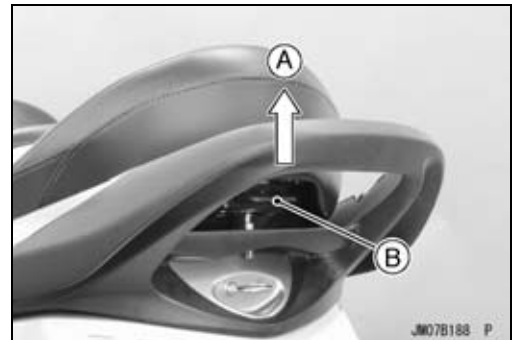
Fittings

- Insert the seat hook [A] into the brackets [B] on the handrail plate and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.

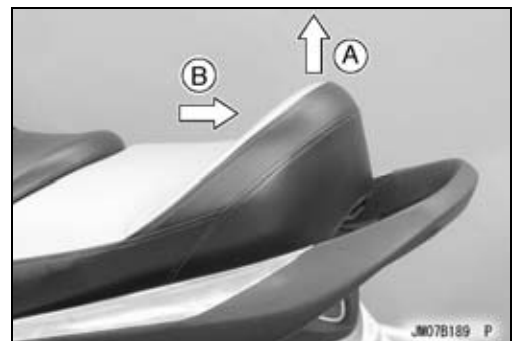


Seat Removal (JT1500JBF Models)

- Pull up [A] the latch handle [B].



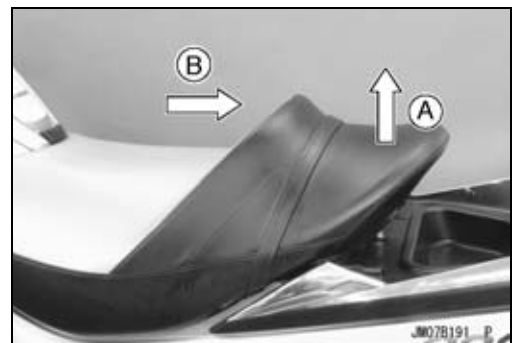
- Remove the rear seat up [A] and to the rear [B].



- Pull up [A] the latch handle [B].



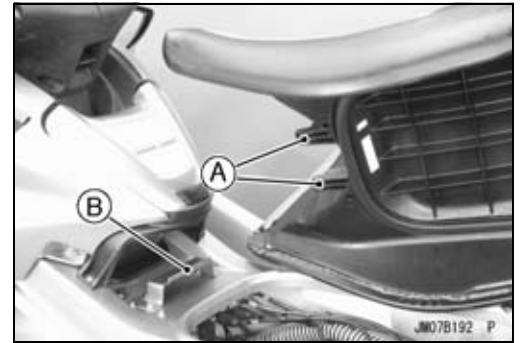
- Remove the front seat up [A] and to the rear [B].



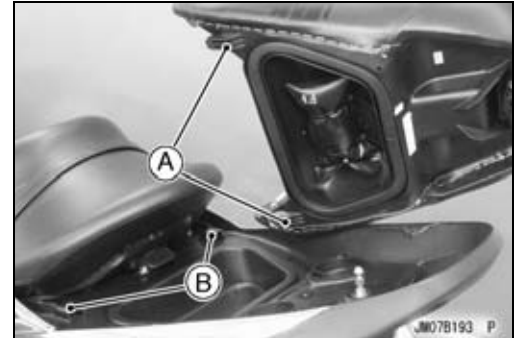
Fittings

Seat Installation (JT1500JBF Models)

- Insert the seat hook [A] into the bracket [B] on the deck and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.

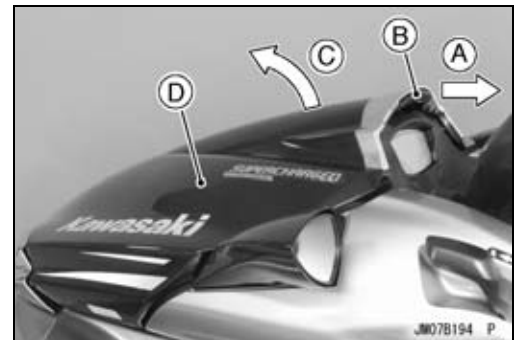


- Insert the seat hook [A] into the brackets [B] on the handrail plate and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.

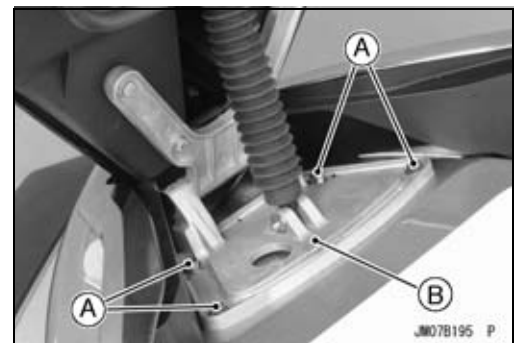


Front Storage Compartment Cover Removal/Installation

- Pull [A] the latch handle [B].
- Open [C] the front storage compartment cover [D].



- Remove:
 - Hinge Bracket Nuts [A] and Washers
 - Front Storage Compartment Cover Assembly [B]
- Installation is the reverse of removal.

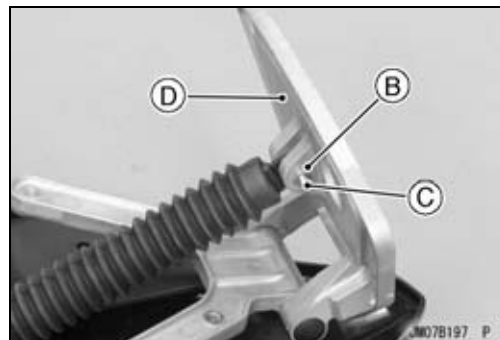
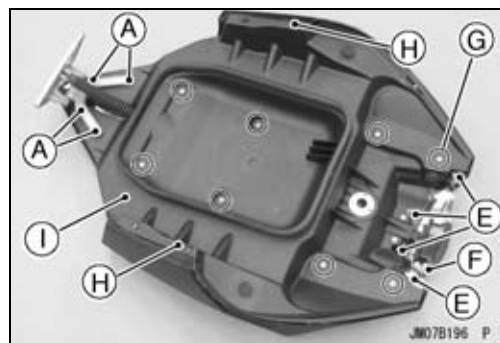


13-10 HULL/ENGINE HOOD

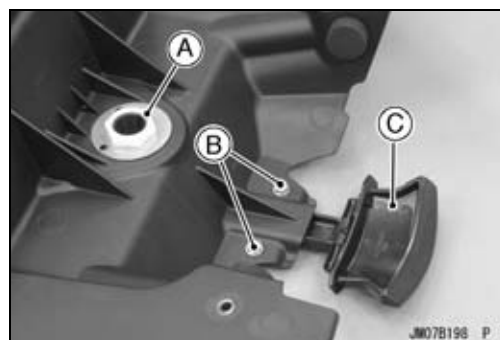
Fittings

Front Storage Compartment Cover Disassembly

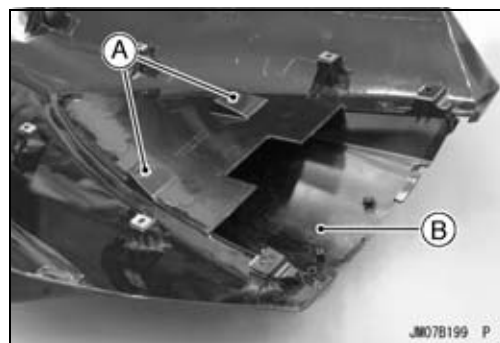
- Remove:
 - Hinge Bolts [A]
 - Damper Washer [B]
 - Damper Pin [C]
 - Hinge [D]
 - Screws [E]
 - Meter Cover [F]
 - Front Duct Bolts [G]
 - Front Hatch Mounting Screws [H]
 - Front Duct [I]



- Remove:
 - Lock Assembly Nut [A]
 - Lock Assembly Bolts [B]
 - Bracket
 - Lock Assembly [C]

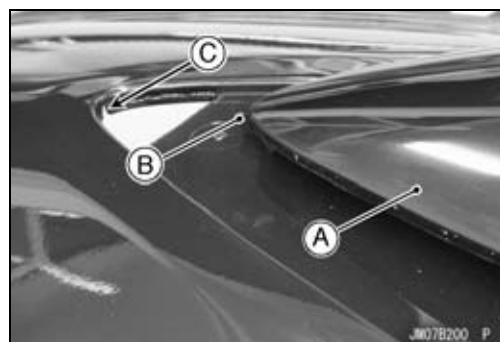


- Remove:
 - Screen Bolts [A]
 - Screen [B]



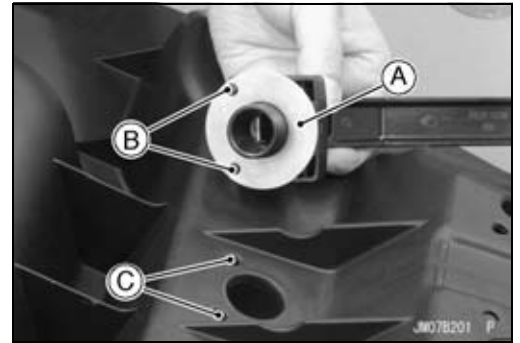
Front Storage Compartment Cover Assembly

- When installing the screen [A] on the front storage compartment cover, insert its projection [B] into the recess [C] on the front storage compartment cover.
- Apply a non-permanent locking agent to the screen bolts and tighten them securely.



Fittings

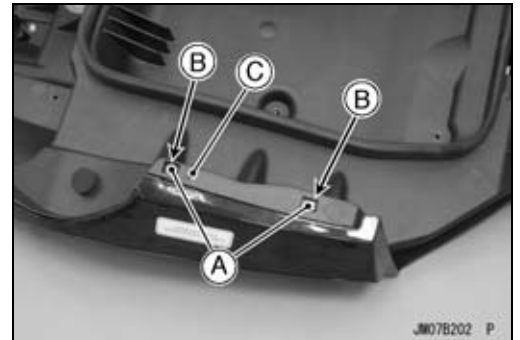
- Install the washer [A] on the lock assembly.
- Align the projections [B] on the lock assembly with the holes [C] on the front duct.
- Apply a non-permanent locking agent to lock assembly bolts and tighten them securely.
- Tighten the lock assembly nut.



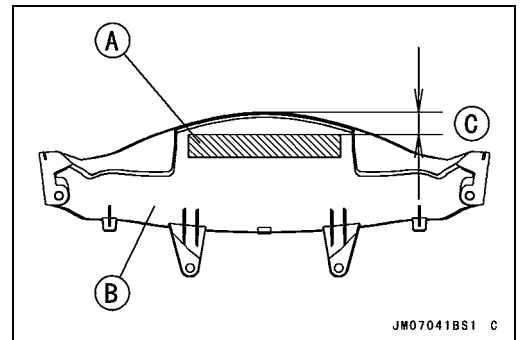
- Insert the front storage cover projections [A] into the ribs [B] of the front duct.
- Tighten the front hatch mounting screws [C].

Torque - Front Hatch Mounting Screws: 2.0 N·m (0.20 kgf·m, 18 in·lb)

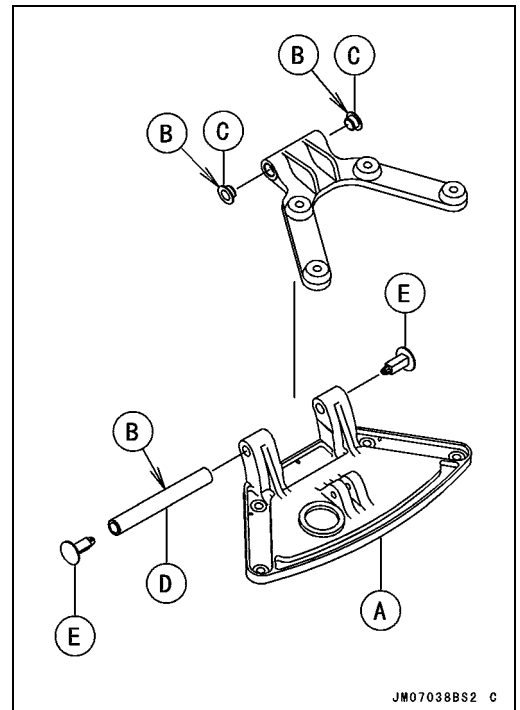
- Apply a non-permanent locking agent to the front duct bolts and tighten them securely.



- Install the damper [A] on the meter cover [B], and install the meter cover.
15 mm (0.59 in.) [C]



- If the hinge bracket [A] is disassembled, apply a water-resistance grease [B] to the following.
Bushings [C]
Shaft [D]
- Replace the rivets [E] with new ones.

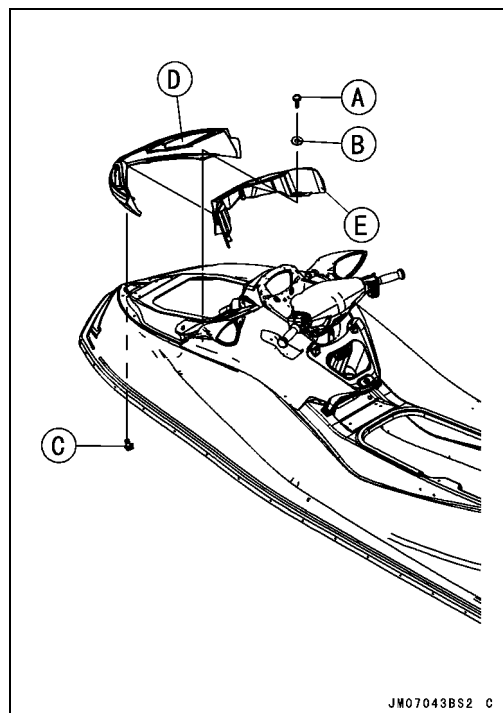


13-12 HULL/ENGINE HOOD

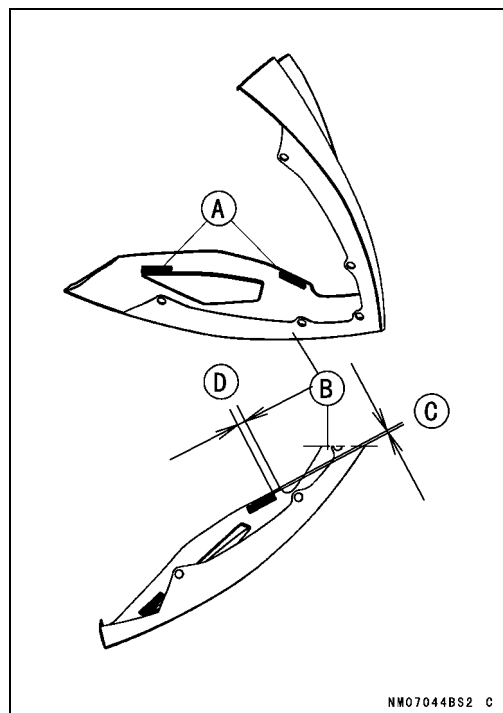
Fittings

Front Cover Removal/Installation

- Remove:
 - Front Storage Compartment Cover (see Front Storage Compartment Cover Removal/installation)
 - Screws [A]
 - Washers [B]
 - Bolts [C]
 - Front Cover [D]
 - Front Inner Cover [E]
- Be careful not to drop the bolts.



- Installation is the reverse of removal. Note the following.
- Install the dampers [A] on the front cover [B] as shown in the figure.
 - 5 mm (0.20 in.) [C]
 - 15 mm (0.59 in.) [D]



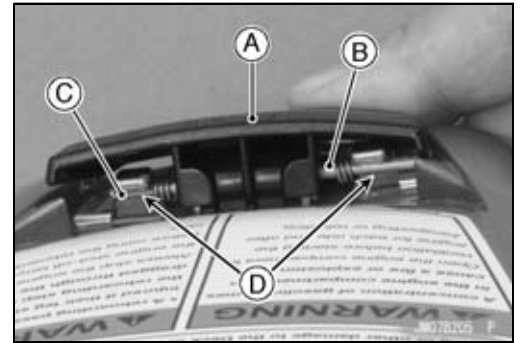
Center Storage Lid Removal/Installation

- Open the middle storage lid [A].
- Pull up [B] the lid.
- Installation is the reverse of removal.



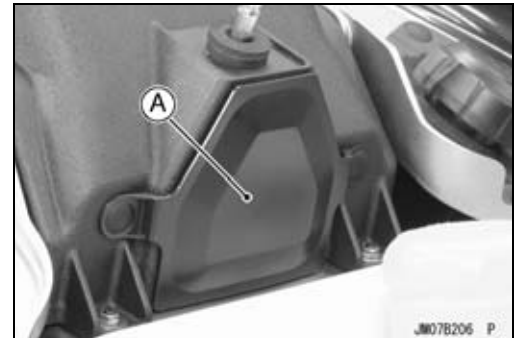
Fittings

- To remove the lock [A] from the center storage lid, turn and pull out the shaft [B] (both sides).
- When installing the shafts, push the shaft end [C] (both sides) into the hollows [D] on the lock.

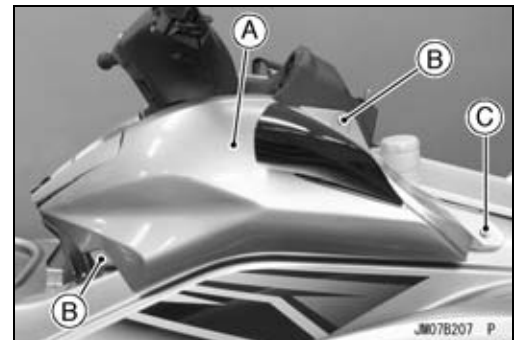


Side Cover Removal

- Remove the steering front cover [A].



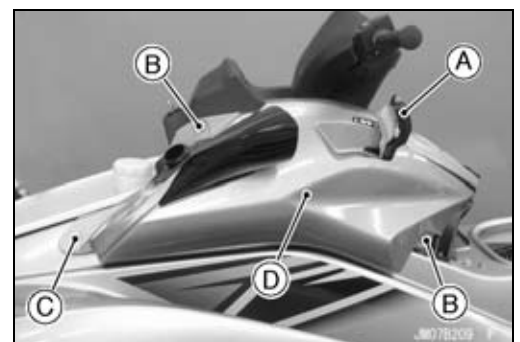
- To remove the right side cover [A], remove the following.
Center Storage Lid (see Center Storage Lid Removal/Installation)
Bolts [B], Nuts and Washers
Nut [C] and Washer



- To remove the left side cover, remove the following.
- Remove the fuel filler cap [A].



- Pull up the tilt lever [A].
- Remove:
Bolts [B], Nuts and Washers
Nut [C] and Washer
Left Side Cover [D]



Side Cover Installation

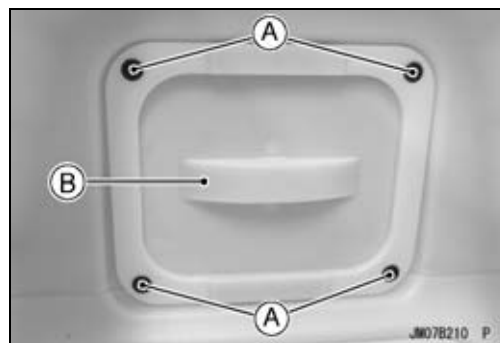
- Installation is the reverse of removal, noting the following.
- Be sure that the rear end of flushing line is connected with its fitting surely.

13-14 HULL/ENGINE HOOD

Fittings

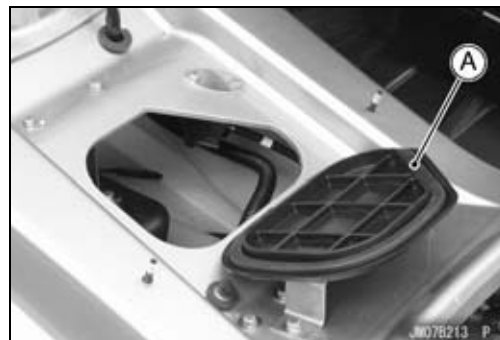
Front Access Cover Removal/Installation

- Open the front storage compartment cover.
- Remove the front storage case.
- Push in the pins [A] and remove the front access cover [B].
- Installation is the reverse of removal.



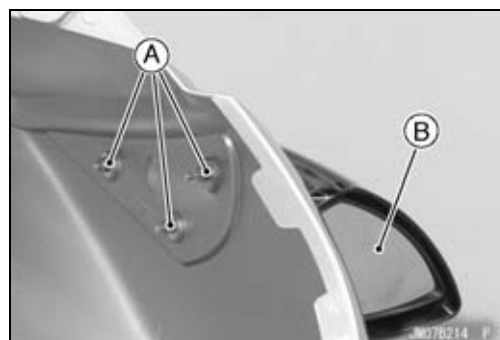
Center Access Cover Removal/Installation

- Remove the steering cover (see Steering Removal in the Steering chapter).
- Pull out the center access cover [A].
- Installation is the reverse of removal.



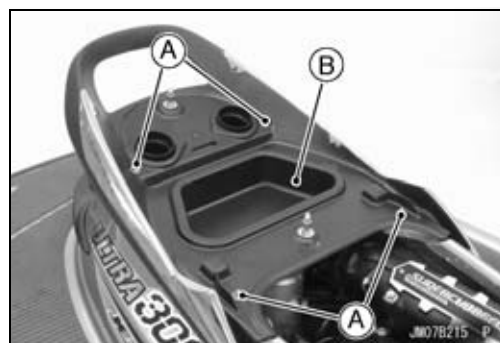
Mirror Removal/Installation

- Remove the side cover (see Side Cover Removal).
- Remove the nuts [A] and washers and remove the mirrors [B] (both sides).
- Installation is the reverse of removal.



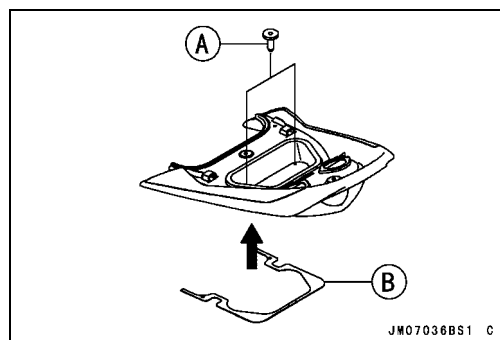
Handrail Plate Removal

- Remove the rear and front seats (see Seat Removal).
- Remove the handrail plate nuts [A] and washers and remove the handrail plate [B].



Handrail Plate Installation

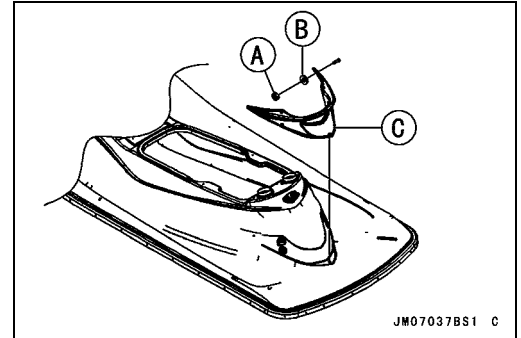
- Be sure that the plugs [A] and the damper [B] are in position.



Fittings

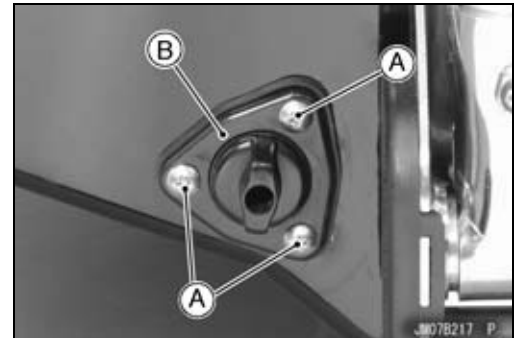
Handrail Removal/Installation

- Remove the rear and front seats (see Seat Removal).
- Disconnect the bilge hoses from the breather fitting.
- Remove the rear air ducts (see Air Duct Removal).
- Remove the nuts [A] and washers [B], and remove the handrail [C].



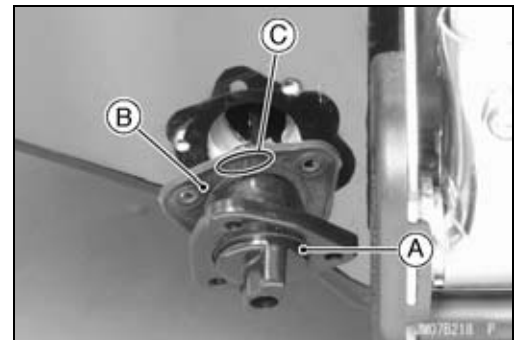
Drain Plug Housing Removal

- Remove the screws [A] and remove the drain plug housing [B].



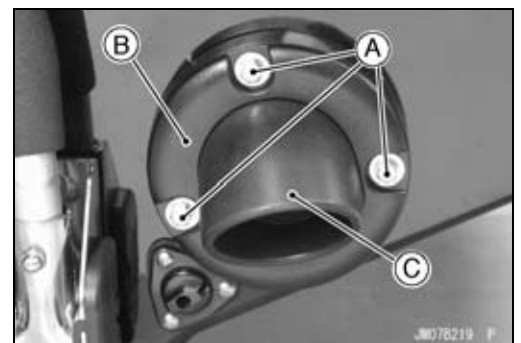
Drain Plug Housing Installation

- Check the seal [A] for damage.
- ★ If necessary, replace it with a new one.
- Install the new gasket [B] so that its "OUT" mark [C] faces outwards.



Exhaust Outlet Removal

- Remove the mounting bolts [A] and washers, and remove the holder [B] and exhaust outlet [C].



Exhaust Outlet Installation

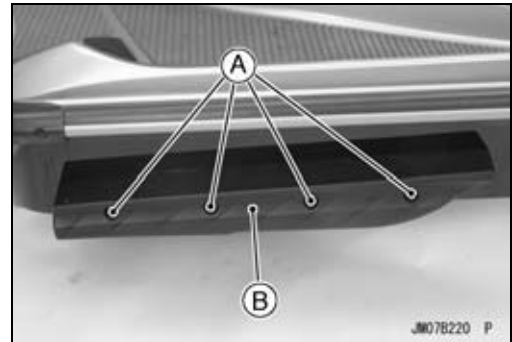
- Installation is the reverse of removal.
- Apply a non-permanent locking agent to the mounting bolts and tighten them securely.

13-16 HULL/ENGINE HOOD

Fittings

Stabilizer Removal

- Remove the stabilizer bolts [A] and washers, and remove the stabilizer [B].



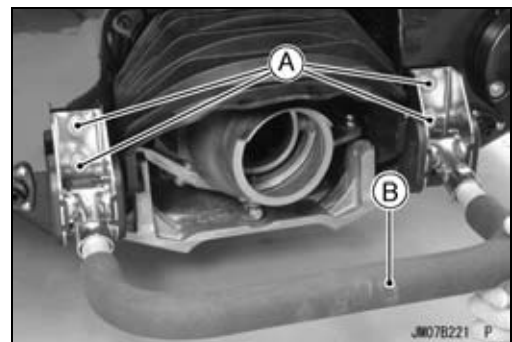
Stabilizer Installation

- Installation is the reverse of removal.
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the stabilizer bolt and tighten them.

Torque - Stabilizer Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)

Reboarding Step Removal

- Remove the reboarding step bolts [A] and washers, and remove the reboarding step [B].



Reboarding Step Installation

- Installation is the reverse of removal.
- Apply a non-permanent locking agent to the reboarding step bolts and tighten them securely.

Hull Replacement

To replace the hull, remove the various parts in the following suggested order.

- Battery and Pad
- Exhaust Pipe
- Intake Manifold
- Engine and Mounts
- Air Filter
- Water Box Muffler
- Drive Shaft and Shaft Holder
- Pump and Hoses
- Steering Cover
- Handlebar and Steering
- Steering Cable
- Reverse Cable
- Fuel Tank and Filler
- Bilge and Cooling System Hose
- Bypass Hose and Outlet
- Bumpers
- Engine Hood Latch
- Front Storage Compartment Cover and Brackets
- Air Ducts
- Handrail

The following parts cannot be removed from the hull and must be replaced.

- Decals
- Labels
- Mats
- Registration Number (if any)

If the new hull is to be painted, do that first. Then install removed parts in the reverse order of their removal. Finally, install the labels, decals, mats and the registration numbers.

13-18 HULL/ENGINE HOOD

Rubber Parts

NOTE

○The rubber parts on the watercraft are fastened in place with various adhesives. To replace a rubber part, use a cement in the following table, or an equivalent.

⚠ WARNING

Read all warnings and cautions on any solvents and adhesives used. Many of these products are flammable, may be harmful to the skin and eyes, and may give off harmful vapors. Use these solvents and adhesives only in a well-ventilated area and never near an open flame.

For this Application	Type
Mats Front and Rear Seats Gasket Front Storage Compartment Cover Gasket	Synthetic Rubber Adhesive (P/N: 92104-3701)
Detent Handlebar Grips	Cyanoacrylate Cement

CAUTION

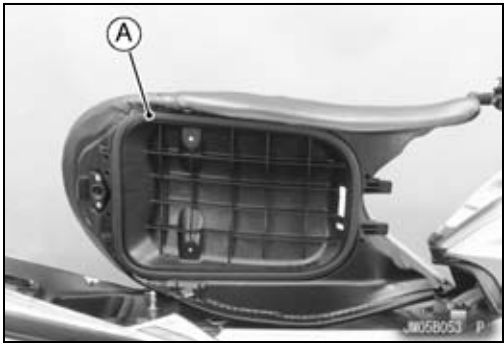
Be very careful that the part is positioned correctly when you apply the cement. It may be impossible to reposition the part.

⚠ WARNING

Do not get any cyanoacrylate cement in your eyes or on your skin. If you do get some in your eyes, do not try to wash it out. Contact a physician immediately! If you do get some on your fingers, do not touch any other part of your body; your fingers will stick to anything they touch. Allow the cement to cure and it will eventually wear off.

Rubber Parts Location

Front Seat Gasket [A]



Rubber Parts

Rear Seat Gasket [A]



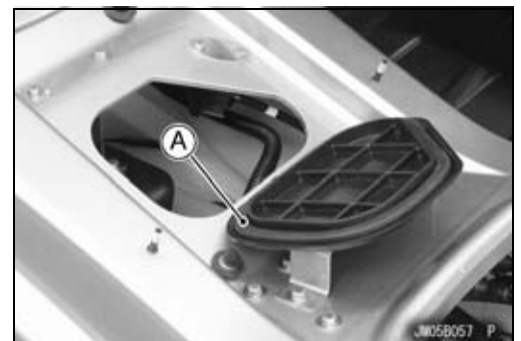
Front Storage Compartment Gasket [A]



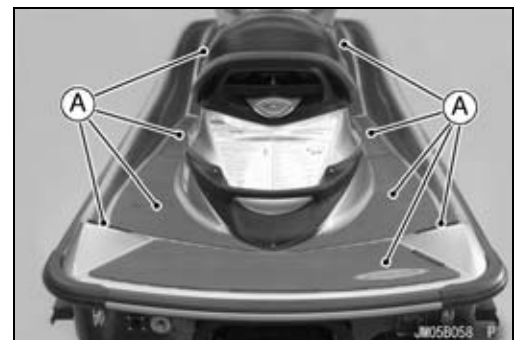
Center Storage Compartment Gasket [A]



Center Access Cover Gasket [A]



Mats [A]



13-20 HULL/ENGINE HOOD

Rubber Parts

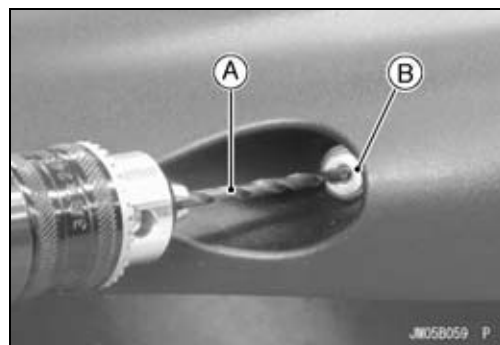
Blind Rivet Removal

- Drill out the rivet with a drill bit [A] of the correct size.

Rivet Removal Drill Bit Size
5.0 mm (0.2 in.)

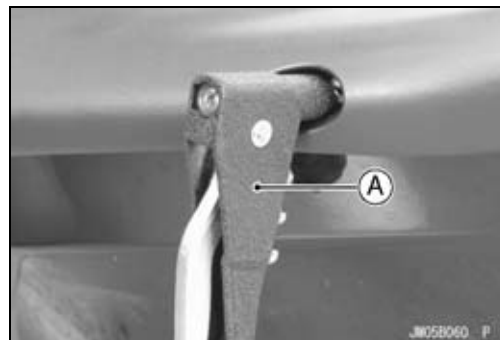
NOTE

- Stop drilling when the rivet head [B] starts to turn with drill bit.
- Tap the rivet out with a suitable punch and hammer.



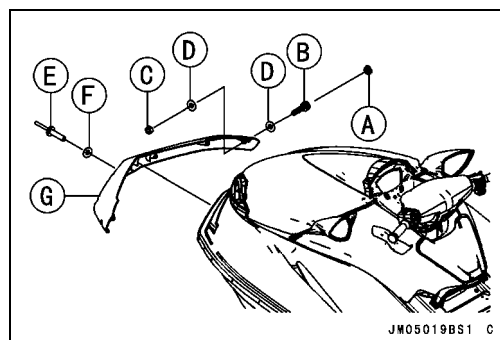
Blind Rivet Installation

- Secure the parts to the hull with the rivets using a blind rivet fastening tool [A].



Front Bumper Removal

- Remove the plugs [A].
- Remove the mounting bolts [B], nuts [C] and washers [D].
- Drill out the rivets [E] and washers [F] (see Blind Rivet Removal).
- Remove the front bumper [G].

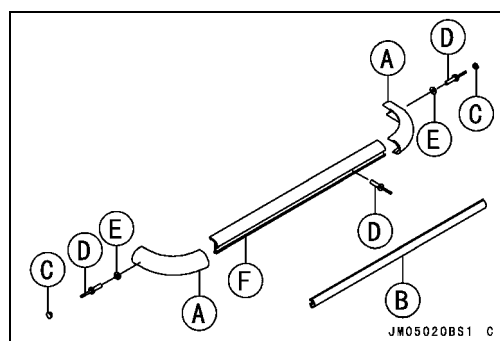


Front Bumper Installation

- Secure the front bumper to the hull flange with the rivets (see Blind Rivet Installation).

Rear Bumper Removal

- Remove the corner bumpers [A] and trim strip [B].
- Remove the plugs [C].
- Drill out the rivets [D] and washers [E] (see Blind Rivet Removal).
- Remove the rear bumper [F].



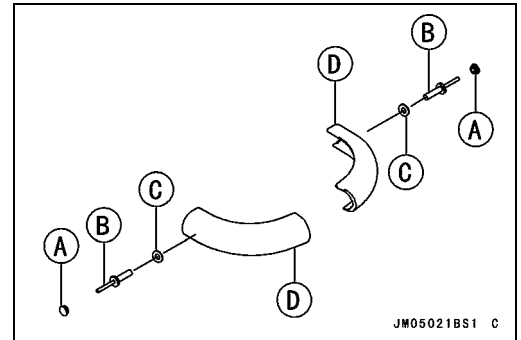
Rear Bumper Installation

- Secure the bumpers to the hull flange with the rivets (see Blind Rivet Installation).

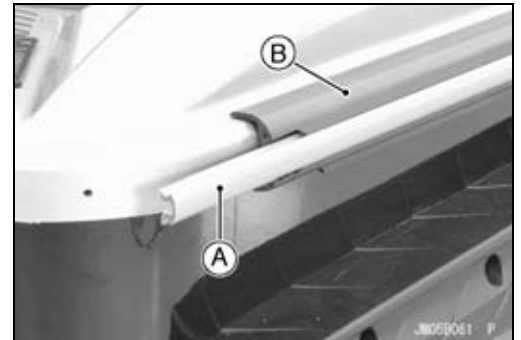
Rubber Parts

Side Bumper Removal

- Remove the plugs [A].
- Drill out the rivets [B] and washers [C] (see Blind Rivet Removal).
- Remove the corner bumper [D].



- Remove the trim strip [A] from the side bumper [B].
- Drill out the rivets (see Blind Rivet Removal).
- Remove the side bumper.

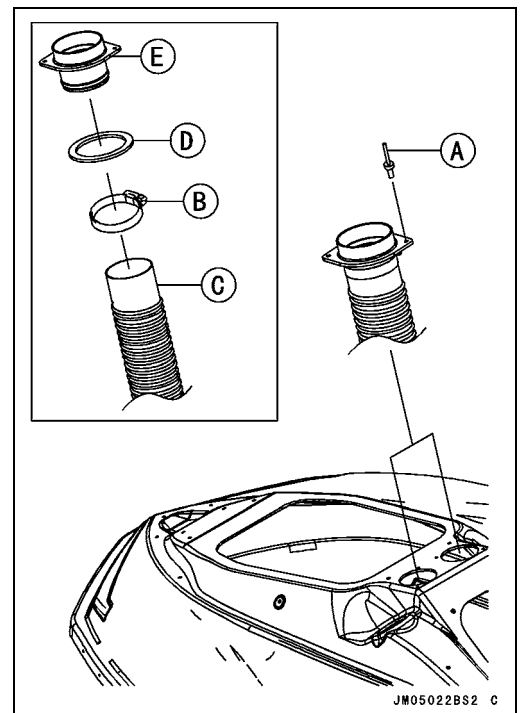


Side Bumper Installation

- Secure the side bumpers to the hull flange with the rivets (see Blind Rivet Installation).
- Install the trim strip.

Air Duct Removal

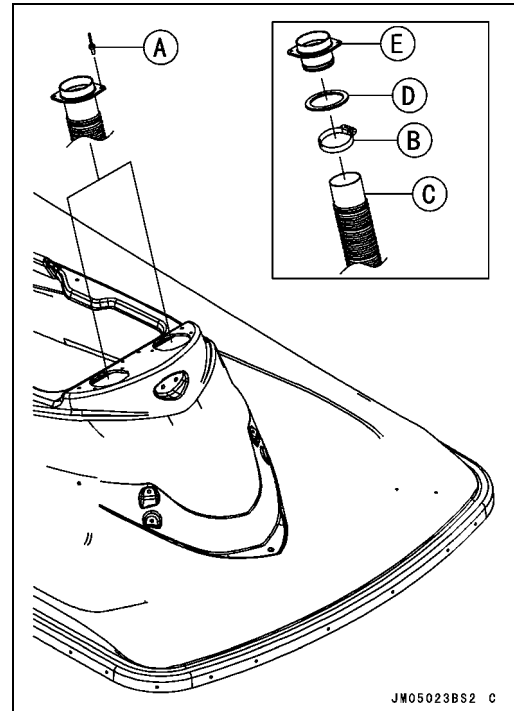
- To remove the front air ducts from the deck, remove the steering cover (see Steering Removal in the Steering chapter).
- Drill out the rivets [A] (see Blind Rivet Removal).
- Remove:
 - Clamp [B]
 - Front Air Duct [C]
 - Damper [D]
 - Duct [E]



13-22 HULL/ENGINE HOOD

Rubber Parts

- To remove the rear air ducts from the deck, remove the handrail plate (see Handrail Plate Removal).
- Drill out the rivets [A] (see Blind Rivet Removal).
- Remove:
 - Clamp [B]
 - Rear Air Duct [C]
 - Damper [D]
 - Duct [E]



Air Duct Installation

- Secure the air duct to the deck with the rivets (see Blind Rivet Installation).

Electrical System

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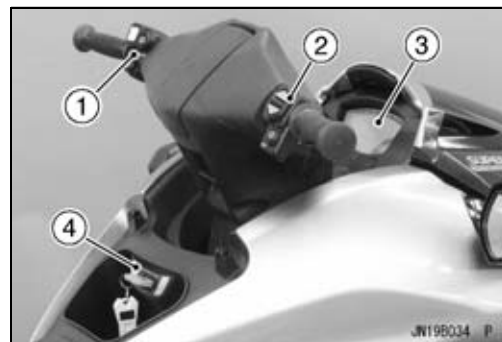
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14-2 ELECTRICAL SYSTEM

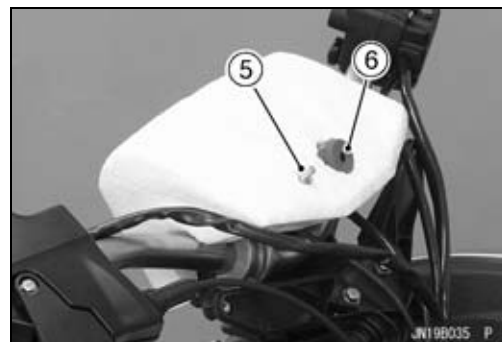
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Parts Location

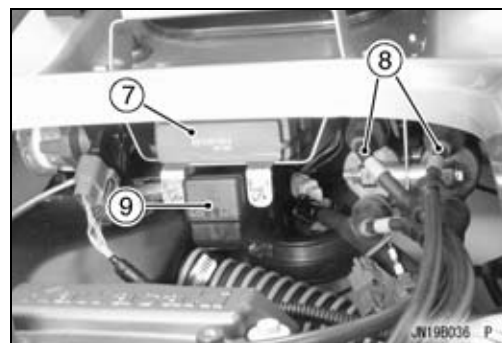
1. Start/Stop Switch Case
2. Throttle Case
3. Meter Unit
4. Ignition Switch/Immobilizer Amplifier



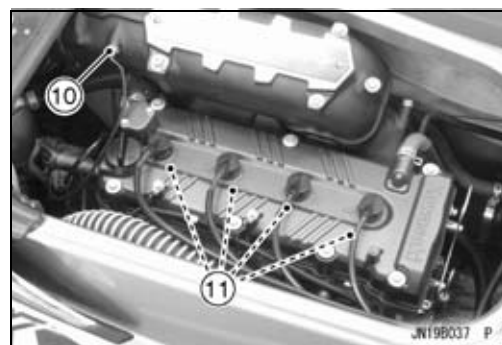
5. Air Temperature Sensor (for Meter Unit)
6. Buzzer



7. Regulator/Rectifier
8. Ignition Coils
9. Vehicle-down Sensor



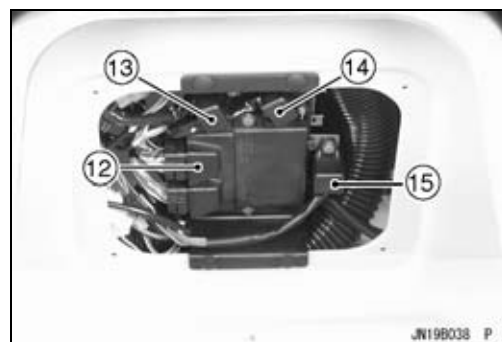
10. Water Temperature Sensor
11. Spark Plugs



12. ECU
13. ECU Main/ETV Relay
14. Fuel Pump/System Relay
15. Electric Trim Control Relay

NOTE

On this photo, the front access cover has been removed.



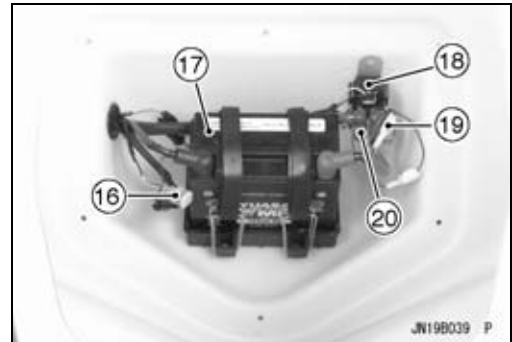
14-4 ELECTRICAL SYSTEM

Parts Location

- 16. Immobilizer/Kawasaki Diagnostic System Connector
- 17. Battery 12 V/18 Ah
- 18. Starter Relay
- 19. Fuse Box 2
- 20. Fuse Box 1

NOTE

○In this photo, the battery cover has been removed.



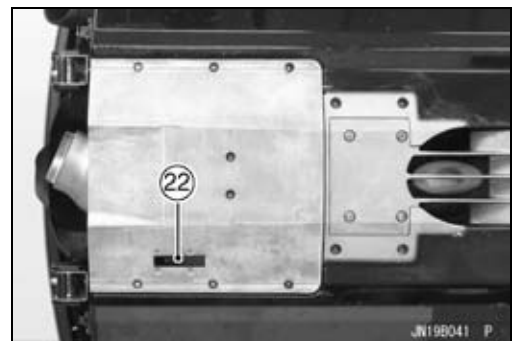
- 21. Electric Trim Control Actuator

NOTE

○In this photo, the front storage compartment cover has been opened.



- 22. Speed Sensor



- 23. Intake Air Pressure Sensor
- 24. Intake Air Temperature Sensor

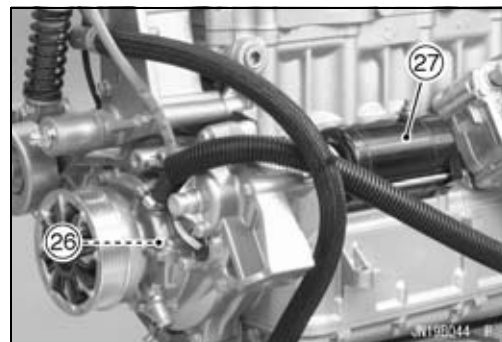


- 25. Camshaft Position Sensor

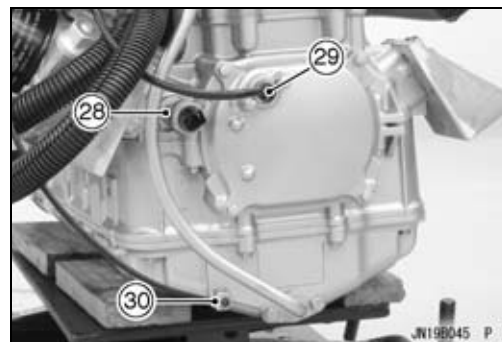


Parts Location

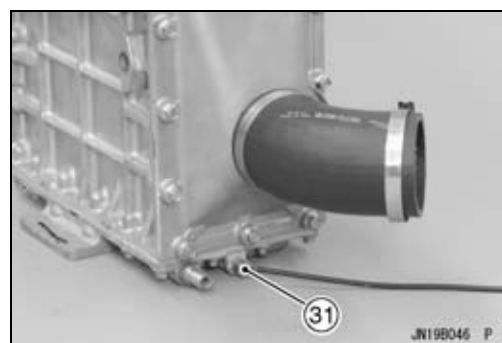
- 26. Alternator
- 27. Starter Motor



- 28. Oil Pressure Switch
- 29. Crankshaft Sensor
- 30. Oil Temperature Sensor



- 31. Water Temperature Sensor (for Meter Unit)



- 32. Fuel Level Sensor

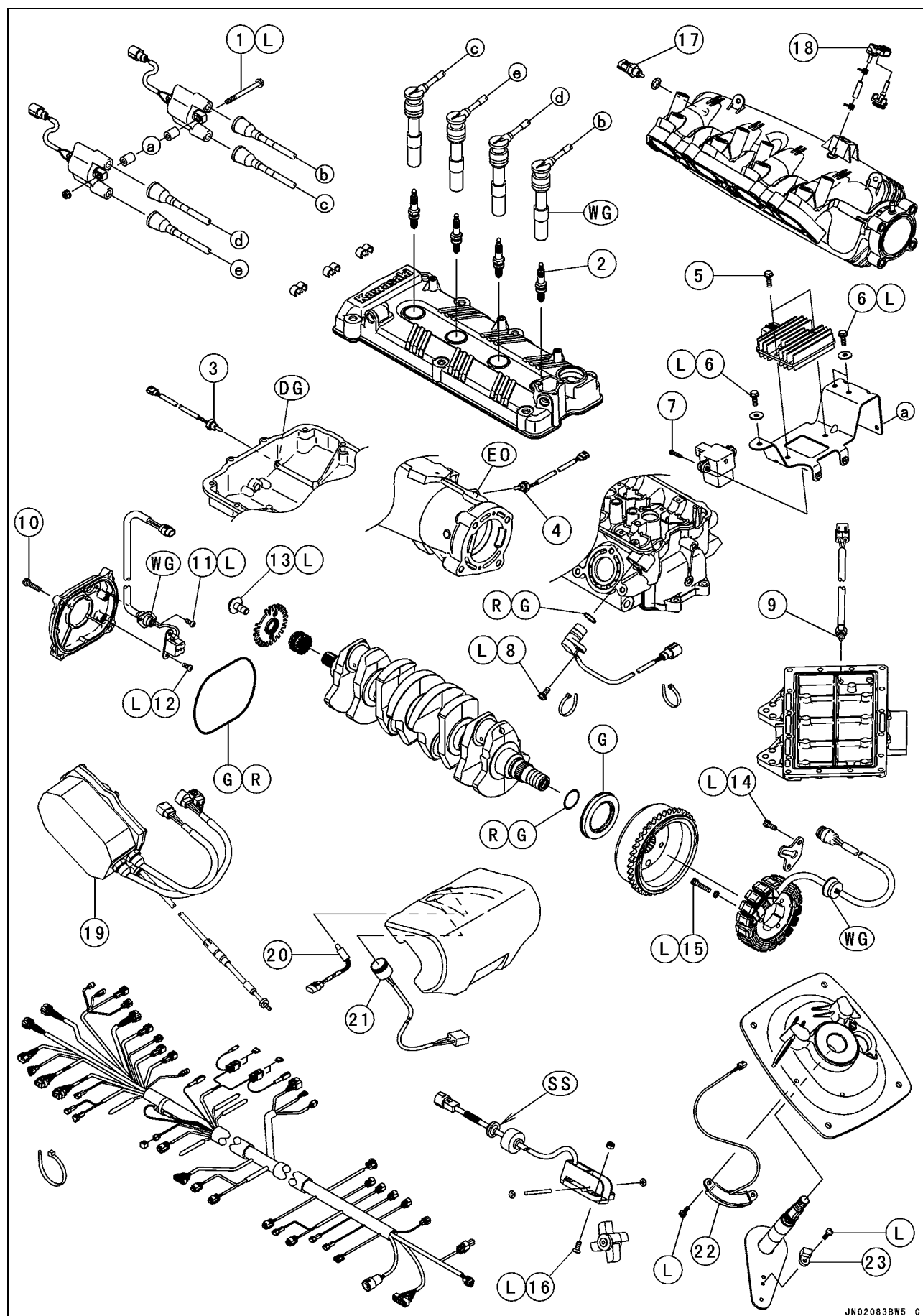


- 33. Steering Position Sensor



14-6 ELECTRICAL SYSTEM

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Ignition Coil Mounting Bolts	8.8	0.90	78 in·lb	L
2	Spark Plugs	13	1.3	115 in·lb	
3	Oil Temperature Sensor	15	1.5	11	
4	Water Temperature Sensor	14.7	1.5	11	
5	Regulator/Rectifier Bolts	7.8	0.80	69 in·lb	
6	Bracket Bolts	8.8	0.90	78 in·lb	L
7	Vehicle-down Sensor Mounting Screws	1.5	0.15	13 in·lb	
8	Camshaft Position Sensor Bolt	10	1.0	89 in·lb	L
9	Water Temperature Sensor (for Meter Unit)	8.8	0.90	78 in·lb	
10	Crankshaft Sensor Cover Bolts	7.8	0.80	69 in·lb	
11	Rubber Grommet Holder Screws	4.5	0.46	40 in·lb	L
12	Crankshaft Sensor Screws	4.5	0.46	40 in·lb	L
13	Timing Rotor Bolt	39	4.0	29	L
14	Stator Coil Grommet Holder Plate Bolts	12	1.2	106 in·lb	L
15	Stator Coil Bolts	12	1.2	106 in·lb	L
16	Speed Sensor Mounting Screws	3.9	0.40	35 in·lb	L

17. Intake Air Temperature Sensor

18. Intake Air Pressure Sensor

19. Electric Trim Control Actuator

20. Air Temperature Sensor (for Meter Unit)

21. Buzzer

22. Steering Position Sensor

23. Magnet

DG: Fill the hollow with the heat transfer grease (Heat Transfer Grease, SCH-20: 92137-1002 or equivalent).

EO: Apply engine oil.

G: Apply grease.

L: Apply a non-permanent locking agent.

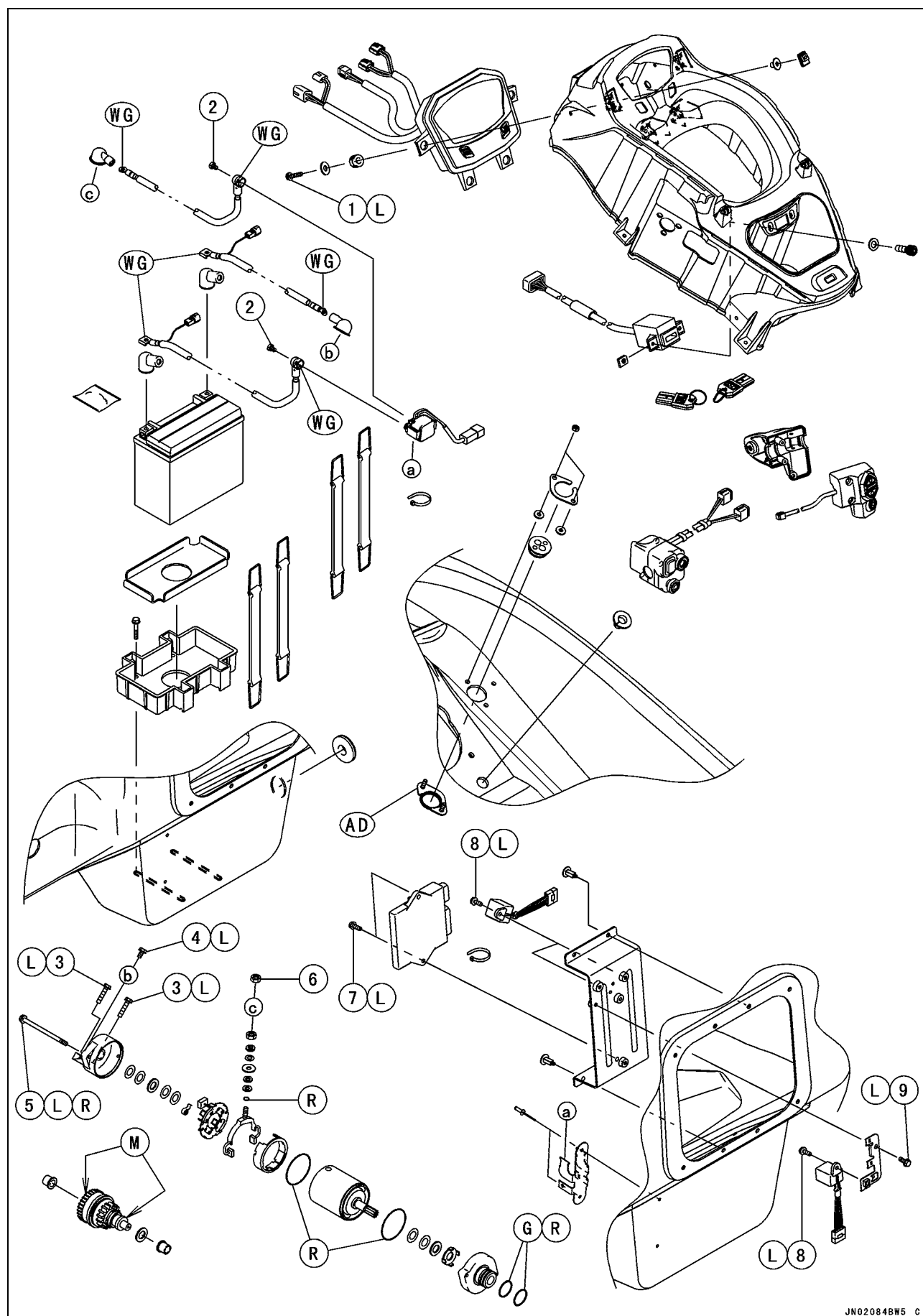
R: Replacement Parts

SS: Apply silicone sealant.

WG: Apply water-resistant grease.

14-8 ELECTRICAL SYSTEM

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Meter Unit Mounting Bolts	9.8	1.0	87 in·lb	L
2	Starter Relay Terminal Bolts	3.6	0.37	32 in·lb	
3	Starter Motor Mounting Bolts	8.8	0.90	78 in·lb	L
4	Starter Motor Ground Bolt	8.8	0.90	78 in·lb	L
5	Starter Motor Through Bolts	6.4	0.65	57 in·lb	L, R
6	Starter Motor Terminal Nut	8.8	0.90	78 in·lb	
7	ECU Mounting Bolts	3.0	0.31	27 in·lb	L
8	Relay Mounting Bolts	2.5	0.25	22 in·lb	L
9	Relay Bracket Bolt	2.5	0.25	22 in·lb	L

AD: Apply adhesive.

G: Apply grease.

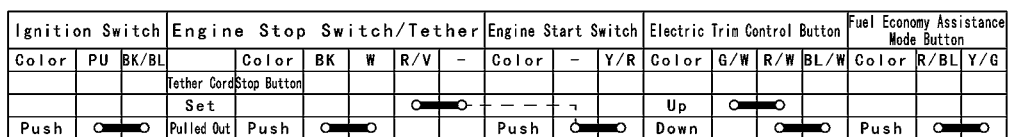
L: Apply a non-permanent locking agent.

M: Apply molybdenum disulfide grease.

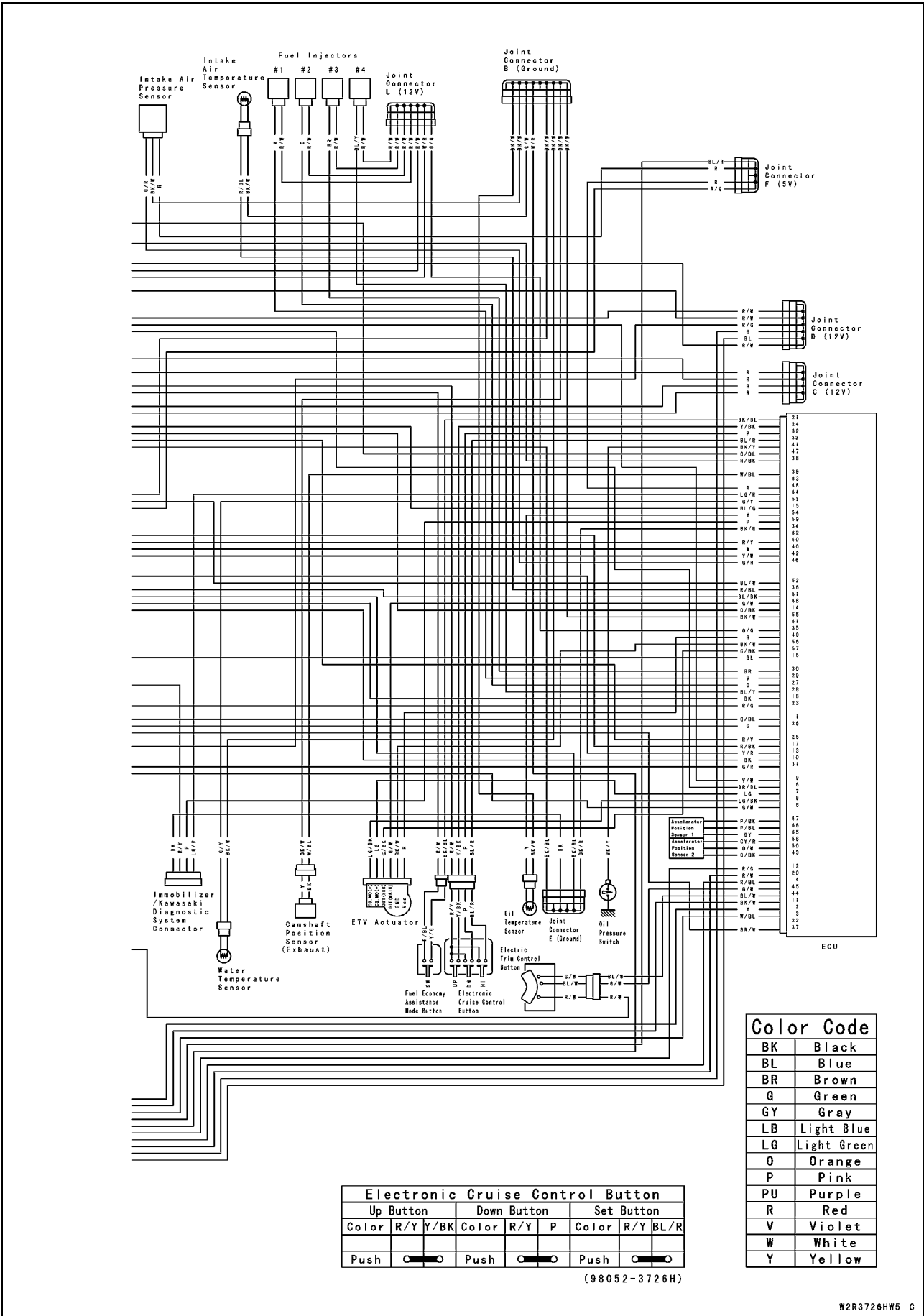
R: Replacement Parts

WG: Apply water-resistance grease.

Wiring Diagram



Wiring Diagram



14-12 ELECTRICAL SYSTEM

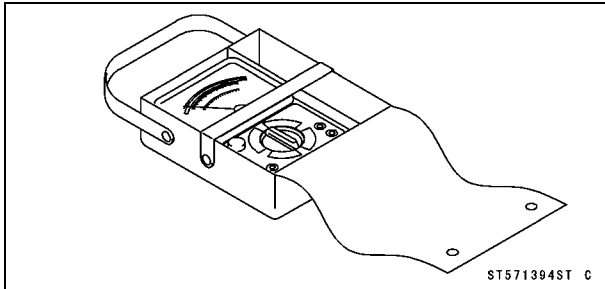
Specifications

Item	Standard
Battery Type Model Name Capacity Voltage	Sealed Battery YTX20L-BS 12 V 18 Ah 12.8 V or more
Electric Starter System Starter Motor: Brush Length Commutator Diameter	 12 mm (0.47 in.) (Service Limit: 6.5 mm, 0.26 in.) 28 mm (1.10 in.) (Service Limit: 27 mm, 1.06 in.)
Charging System Type Regulator/Rectifier Output Voltage Alternator Output Voltage Stator Coil Resistance	Three-phase AC 14.2 ~ 15.2 V 63.9 ~ 64.2 V at 3 000 r/min (rpm) 0.432 ~ 0.648 Ω
Ignition System Ignition Coil: Primary Winding Resistance Secondary Winding Resistance Primary Peak Voltage Spark Plug: Type Gap Crankshaft Sensor Resistance Crankshaft Sensor Peak Voltage Camshaft Position Sensor Resistance Camshaft Position Sensor Peak Voltage	 1.44 ~ 2.16 Ω 11.76 ~ 17.64 k Ω 250 V or more NGK PMR9B 0.6 ~ 0.7 mm (0.024 ~ 0.028 in.) 408 ~ 612 Ω 2.5 V or more 344 ~ 516 Ω 0.4 V or more
Kawasaki Smart Steering (KSS) System Steering Position Sensor Clearance	 0.5 ~ 1.5 mm (0.02 ~ 0.06 in.)
Electric Trim Control System Electric Trim Control Relay Resistance	 134 ~ 200 Ω
Sensors Fuel Level Sensor Resistance: Full Position Empty Position Water Temperature Sensor Resistance Oil Temperature Sensor Resistance Air Temperature Sensor Resistance	 2 ~ 4 Ω 117 ~ 123 Ω see text. see text. see text.

Special Tools and Sealant

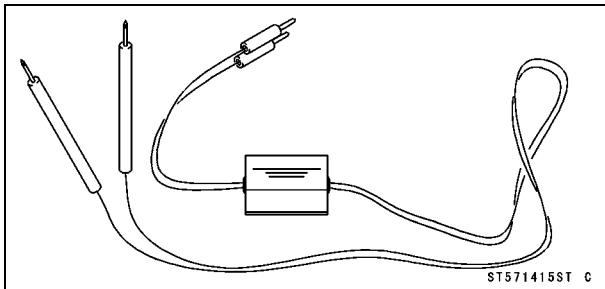
Hand Tester:

57001-1394



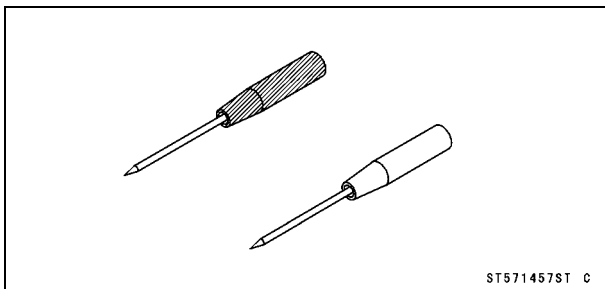
Peak Voltage Adapter:

57001-1415



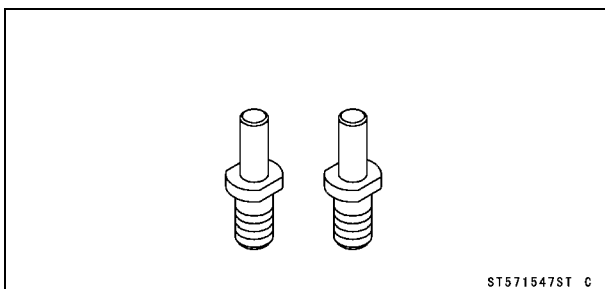
Needle Adapter Set:

57001-1457



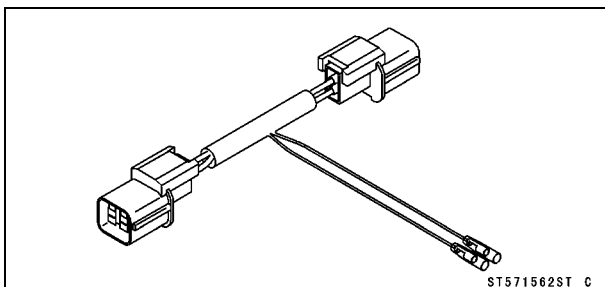
Holder Attachment:

57001-1547



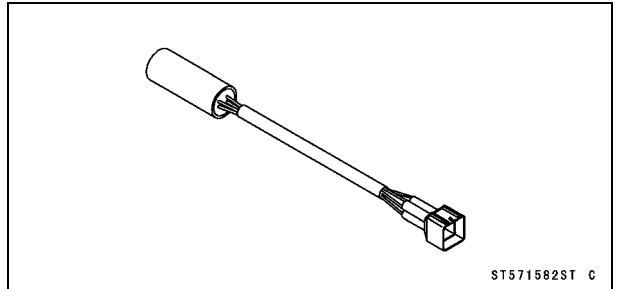
Harness Adapter:

57001-1562



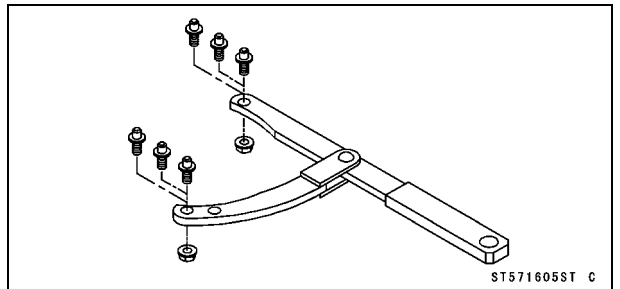
Key Registration Unit:

57001-1582



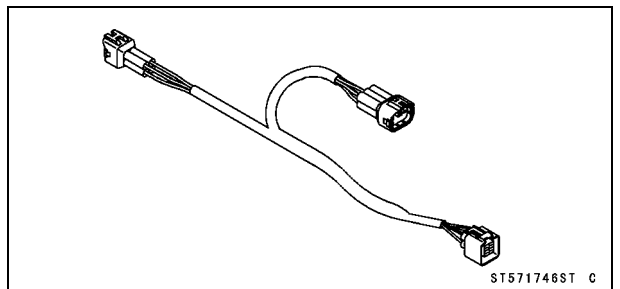
Flywheel & Pulley Holder:

57001-1605



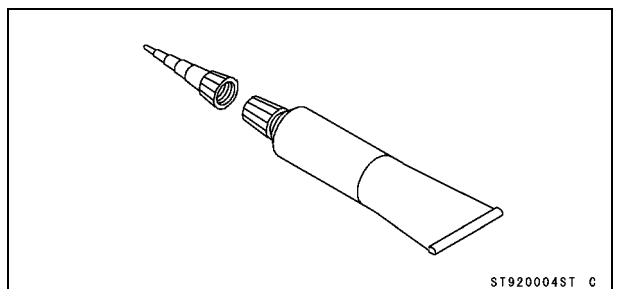
Key Registration Adapter:

57001-1746



Liquid Gasket, TB1211F:

92104-0004



14-14 ELECTRICAL SYSTEM

Precautions

There are a number of important precautions that are musts when servicing electrical systems. Learn and observe all the rules below.

- Do not reverse the battery cable connections. This will burn out the diodes on the electrical parts.
- Always check battery condition before condemning other parts of an electrical system. A fully charged battery is a must for conducting accurate electrical system tests.
- The electrical parts should never be struck sharply, as with a hammer, or allowed to fall on a hard surface. Such a shock to the parts can damage them.
- To prevent damage to electrical parts, do not disconnect the battery cables or any other electrical connections when the ignition switch is ON, or while the engine is running.
- Because of the large amount of current, never keep the starter button pushed when the starter motor will not turn over, or the current may burn out the starter motor windings.
- Take care not to short the cables that are directly connected to the battery positive (+) terminal to the chassis ground.
- Troubles may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the failure. If the failure was caused by some other item or items, they must be repaired or replaced, or the new replacement will soon fail again.
- Make sure all connectors in the circuit are clean and tight, and examine leads for signs of burning, fraying, etc. Poor leads and bad connections will affect electrical system operation.
- Measure coil and winding resistance when the part is cold (at room temperature).

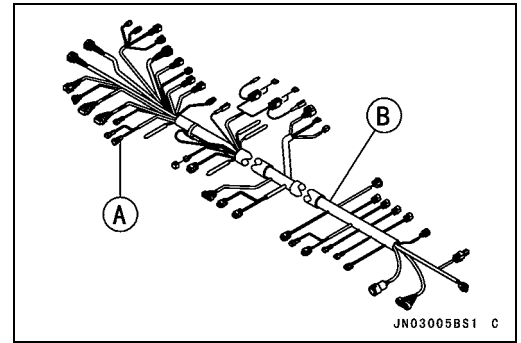
Electrical Wiring

Wiring Inspection

- Visually inspect the wiring for signs of burning, fraying, etc.
- ★ If any wiring is poor, replace the damaged wiring.
- Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.
- ★ If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it.
- Check the wiring for continuity.
- Use the wiring diagram to find the ends of the lead which is suspected of being a problem.
- Connect the hand tester between the ends of the leads.

Special Tool - Hand Tester: 57001-1394

- Set the tester to the $\times 1 \Omega$ range, and read the tester.
- ★ If the tester does not read 0Ω , the lead is defective. Replace the lead or the wiring harness [B] if necessary.

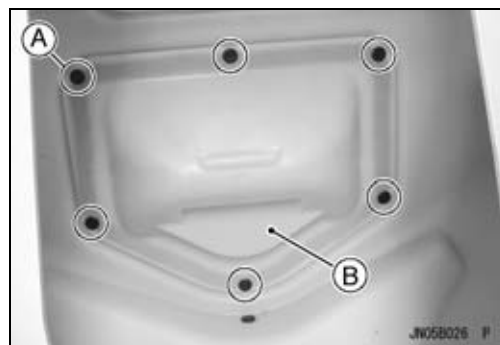


14-16 ELECTRICAL SYSTEM

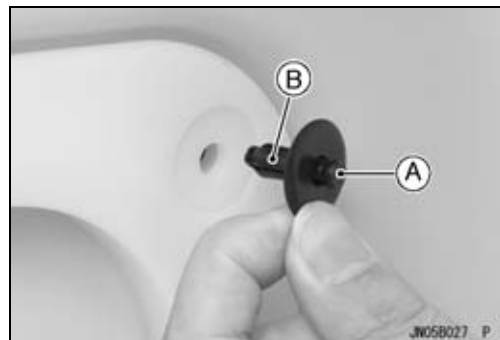
Battery

Battery Cover Removal/Installation

- Open the front storage compartment cover (see Front Storage Compartment Cover Removal in the Hull/Engine Hood chapter).
- Remove the front storage case.
- Push in the pin heads [A] and remove the battery cover [B].



- To install the battery cover, pull up the pin head [A] as shown and install the rivet [B].



- Push in the pin head [A].



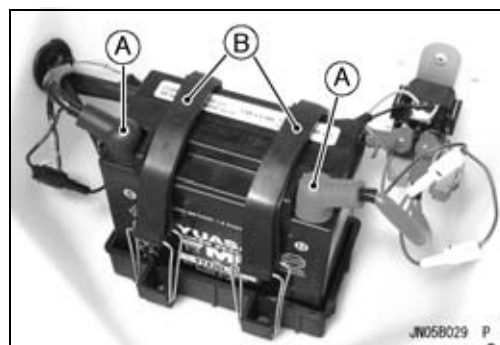
Battery Removal

- Disconnect the battery cables [A].

⚠ WARNING

To prevent possible personal injury and damage to electrical components, always disconnect the grounded cable first.

- Unhook the battery straps [B].
- Carefully lift the battery from the battery compartment.



Battery

Battery Installation

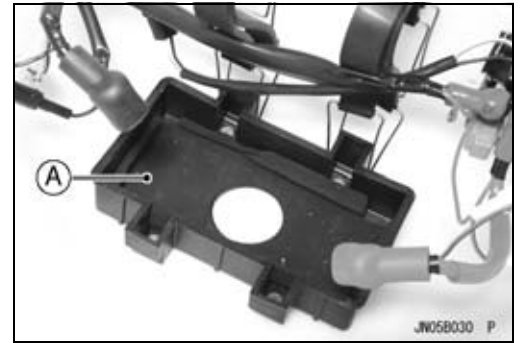
- Be sure the battery damper [A] is in position in the battery compartment.
- Hook the battery straps.
- Connect the battery cables, positive first.
- After attaching both cables, coat the terminals and cable ends with water-resistance grease to prevent corrosion.
- Slide the rubber caps over each terminal.

⚠ WARNING

Loose battery cables can create sparks which can cause a fire or explosion resulting in injury or death. Make sure the battery terminal screws are tightened securely and the covers are installed over the terminals.

CAUTION

Do not reverse the battery connections.



Battery Activation

Electrolyte Filling

- Make sure that the model name [A] of the electrolyte container matches the model name [B] of the battery. These names must be the same.

Battery Model Name

JT1500H/J: YTX20L-BS

CAUTION

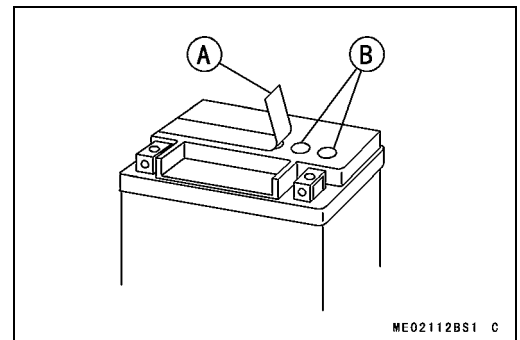
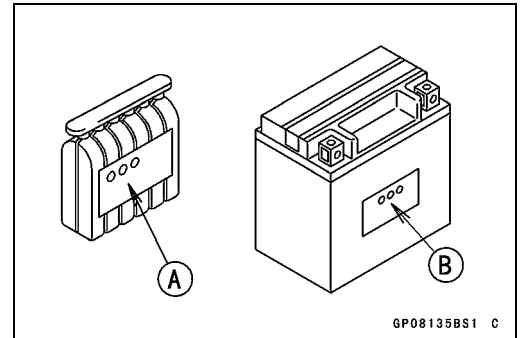
Be sure to use the electrolyte container with the same model name as the battery since the electrolyte volume and specific gravity vary with the battery type. This is to prevent overfilling of the electrolyte, shorting the battery life, and deterioration of the battery performance.

CAUTION

Do not remove the aluminum sealing sheet [A] from the filler ports [B] until just prior to use. Be sure to use the dedicated electrolyte container for correct electrolyte volume.

⚠ WARNING

The electrolyte contains sulfuric acid, which can cause severe burns. To avoid sulfuric acid burns, wear protective clothing and safety glasses when handling electrolyte. If the electrolyte touches the skin or eyes, wash the area with liberal amounts of water and seek medical attention for more severe burns.



14-18 ELECTRICAL SYSTEM

Battery

- Place the battery on a level surface.
- Check to see that the sealing sheet has no peeling, tears, or holes in it.
- Remove the sealing sheet.

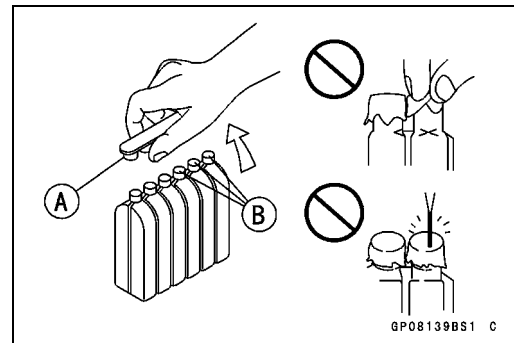
NOTE

○The battery is vacuum sealed. If the sealing sheet has leaked air into the battery, it may require a longer initial charge.

- Remove the electrolyte container from the vinyl bag.
- Detach the strip of caps [A] from the container and set aside, these will be used later to seal the battery.

NOTE

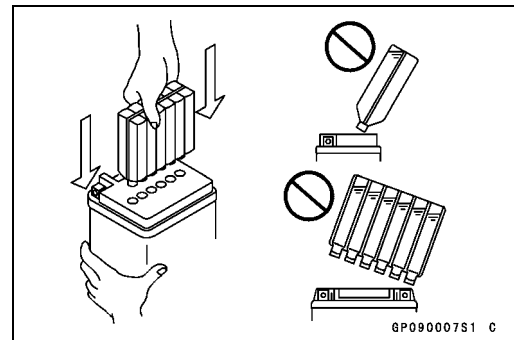
○Do not pierce or otherwise open the sealed cells [B] of the electrolyte container. Do not attempt to separate individual cells.



- Place the electrolyte container upside down with the six sealed cells into the filler ports of the battery. Hold the container level, push down to break the seals of all six cells. You will see air bubbles rising into each cell as the ports fill.

NOTE

○Do not tilt the electrolyte container.

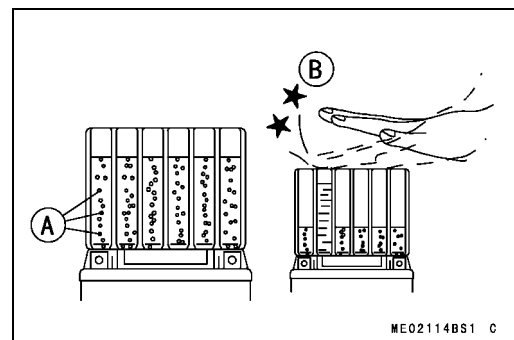


- Check the electrolyte flow.
- ★If no air bubbles [A] are coming up from the filler ports, or if the container cells have not emptied completely, tap the container [B] a few times.

NOTE

○Be careful not to have the battery fall down.

- Keep the container in place. Don't remove the container from the battery, the battery requires all the electrolyte from the container for proper operation.



CAUTION

Removal of the container before it is completely empty can shorten the service life of the battery.

- After filling, let the battery sit for 20 ~ 60 minutes with the electrolyte container kept in place, which is required for the electrolyte to fully permeate into the plates.
- Make sure that the container cells have emptied completely, and remove the container from the battery.

Battery

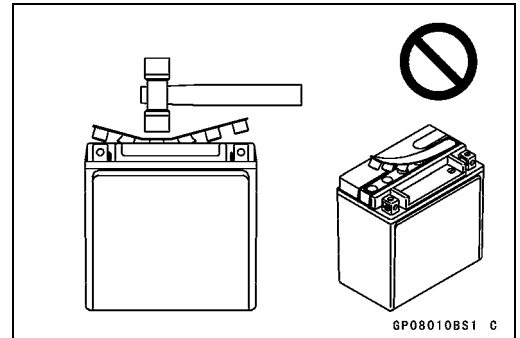
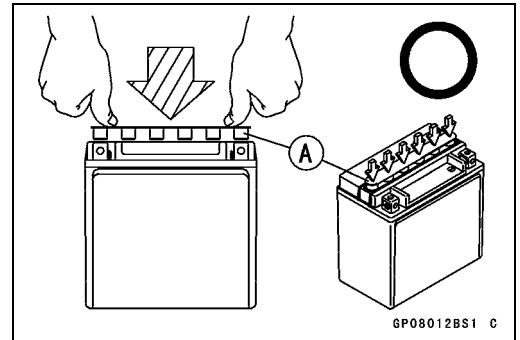
- Place the strip of caps [A] loosely over the filler ports, press down firmly with both hands to seat the strip of caps into the battery (don't pound or hammer). When properly installed, the strip of caps will be level with the top of the battery.

CAUTION

Once the strip of caps is installed onto the battery, never remove the caps, nor add water or electrolyte to the battery.

NOTE

○Charging the battery immediately after filling can shorten service life.



Initial Charge

- Newly activated sealed batteries require an initial charge.

Standard Charge: 1.8 A × 5 ~ 10 hours

- ★ If using a recommended battery charger, follow the charger's instructions for newly activated sealed battery.

Kawasaki-recommended chargers:

Battery Mate 150-9

OptiMate PRO 4-S/PRO S/PRO2

Yuasa MB-2040/2060

Christie C10122S

- ★ If the above chargers are not available, use equivalent one.
- Let battery sit 30 minutes after initial charge, then check voltage using a voltmeter. (Voltage immediately after charging becomes temporarily high. For accurate measuring, let the battery sit for given time.)

NOTE

○Charging rates will vary depending on how long the battery has been stored, temperature, and the type of charger used. If voltage is not at least 12.8 V, repeat charging cycle.

○To ensure maximum battery life and customer satisfaction, it is recommended the battery be load tested at three times its amp-hour rating for 15 seconds.

Re-check voltage and if less than 12.8 V repeat the charging cycle and load test. If still below 12.8 V the battery is defective.

Precautions

- 1) No need of topping-up

No topping-up is necessary in this battery until it ends its life under normal use. Forcibly prying off the seal cap to add water is very dangerous. Never do that.

14-20 ELECTRICAL SYSTEM

Battery

2) Refreshing charge

If an engine will not start, it indicates the battery has been discharged. Give refresh charge for 5 to 10 hours with charge current shown in the text (see Refreshing Charge).

When a fast charge is inevitably required, do it following precisely the maximum charge current and time conditions indicated on the battery.

CAUTION

This battery is designed to sustain no unusual deterioration if refresh-charged according to the method specified above. However, the battery's performance may be reduced noticeably if charged under conditions other than given above. Never remove the seal cap during refresh charge.

If by chance an excessive amount of gas is generated due to overcharging, the relief valve releases the gas to keep the battery normal.

3) When you do not use the watercraft for months:

Give a refresh charge before you store the watercraft and store it with the negative lead removed. Give a refresh charge **once a month** during storage.

4) Battery life:

If the battery will not start the engine even after several refresh charges, the battery has exceeded its useful life. Replace it (Provided, however, the watercraft's starting system has no problem).

WARNING

Keep the battery away from sparks and open flames during charging, since the battery gives off an explosive gas mixture of hydrogen and oxygen. When using a battery charger, connect the battery to the charger before turning on the charger.

This procedure prevents sparks at the battery terminals which could ignite any battery gases.

No fire should be drawn near the battery, or no terminals should have the tightening loosened.

The electrolyte contains sulfuric acid. Be careful not to have it touch your skin or eyes. If touched, wash it off with liberal amount of water. Get medical attention if severe.

Interchange

A sealed battery can fully display its performance only when combined with a proper watercraft electric system. Therefore, replace a sealed battery only on watercraft which was originally equipped with a sealed battery.

Be careful, if a sealed battery is installed on watercraft which had an ordinary battery as original equipment, the sealed battery's life will be shortened.

Charging Condition Inspection

- Refer to Battery Charging Condition Inspection in the Periodic Maintenance chapter.

Battery

Refreshing Charge

- Remove the battery [A] (see Battery Removal).
- Refresh-charge by following method according to the battery terminal voltage.

⚠ WARNING

This battery is sealed type. Never remove the strip of cap [B] even at charging. Never add water. Charge with current and time as stated below.

Terminal Voltage: 11.5 ~ less than 12.8 V

Standard Charge: 1.8 A × 5 ~ 10 h (see following chart)

Quick Charge: 9.0 A × 1.0 h

CAUTION

If possible, do not quick charge. If the quick charge is done due to unavoidable circumstances, do standard charge later on.

Terminal Voltage: less than 11.5 V

Charging Method: 1.8 A × 20 h

NOTE

- Increase the charging voltage to a maximum voltage of 25 V if the battery will not accept current initially. Charge for no more than five minutes at the increased voltage then check if the battery is drawing current.
- If the battery will accept current, decrease the voltage and charge by the standard charging method described on the battery case. If the battery will not accept current after 5 minutes, replace the battery.

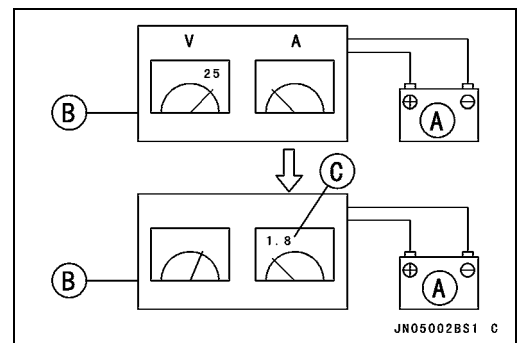
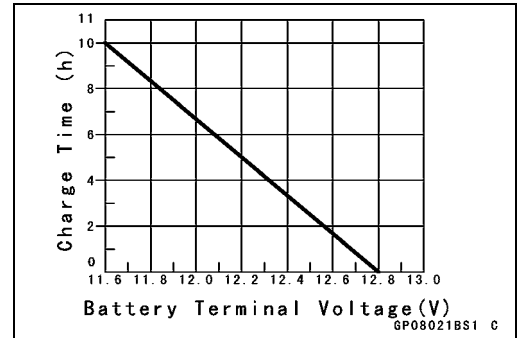
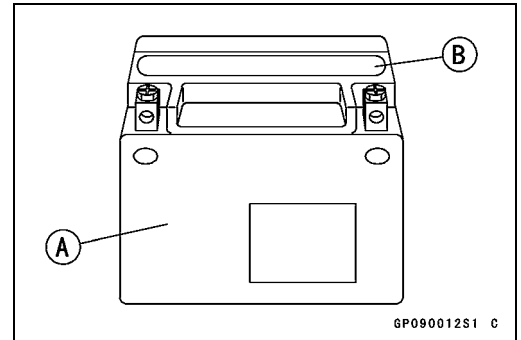
Battery [A]

Battery Charger [B]

Standard Value [C]

- Determine battery condition after refreshing charge.
- Determine the condition of the battery 30 minutes after completion of the charge by measuring the terminal voltage according to the table below.

Criteria	Judgement
12.8 V or more	Good
12.0 ~ less than 12.8 V	Charge insufficient → Recharge
less than 12.0 V	Unserviceable → Replace

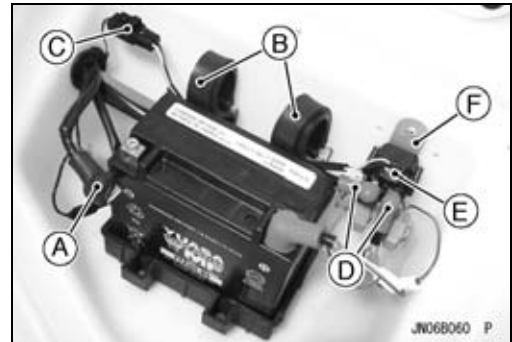


14-22 ELECTRICAL SYSTEM

Electric Starter System

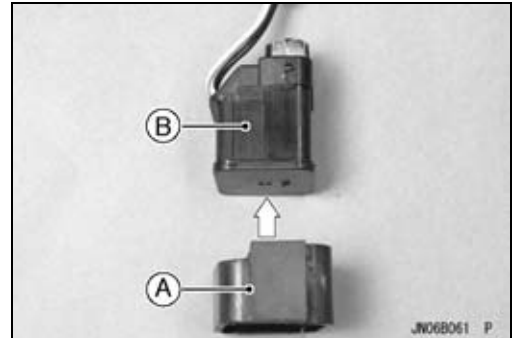
Starter Relay Removal

- Remove:
 - Battery Cover (see Battery Cover Removal/Installation)
- Disconnect the negative battery cable [A].
- Unhook the battery straps [B].
- Disconnect the starter relay lead connector [C].
- Slide out the rubber caps [D] and remove the starter relay terminal bolts.
- Take the starter relay [E] off the bracket [F].



Starter Relay Installation

- Install the rubber damper [A] to the starter relay [B] as shown in the figure.



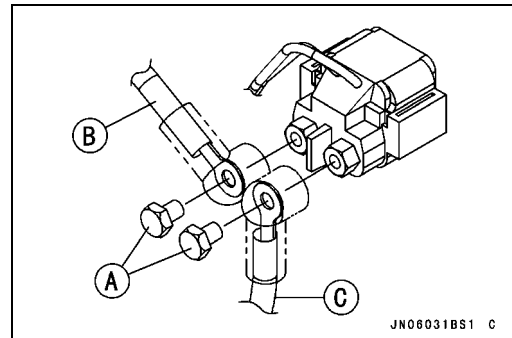
- Install the starter relay, and tighten the starter relay terminal bolts [A].

Starter Motor Cable [B]

Battery Positive Cable [C]

Torque - Starter Relay Terminal Bolts: 3.6 N·m (0.37 kgf·m, 32 in·lb)

- Apply water-resistance grease to both terminals.
- Install the rubber caps, and connect the starter relay lead connector.
- Hold the starter relay lead and the starter motor cable with the battery strap.

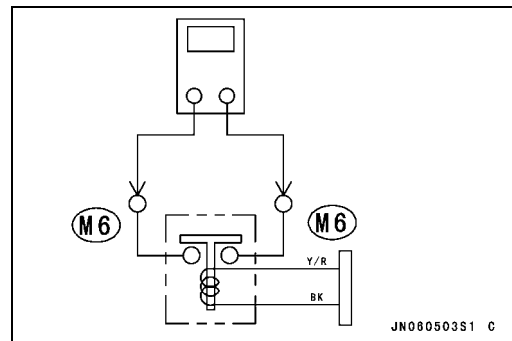


Starter Relay Inspection

- Remove the starter relay (see Starter Relay Removal).
- Set the hand tester to $\times 1 \Omega$ range.

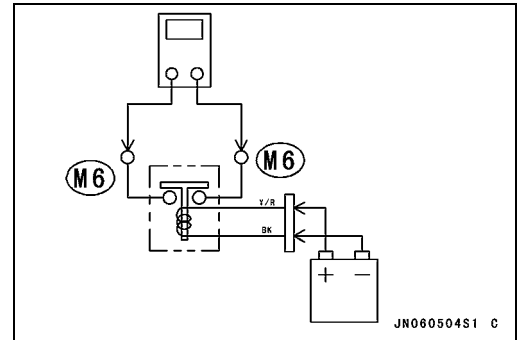
Special Tool - Hand Tester: 57001-1394

- Connect the tester leads as shown in the figure.
- ★ If resistance is less than infinite, the starter relay switch is not returning and must be replaced.



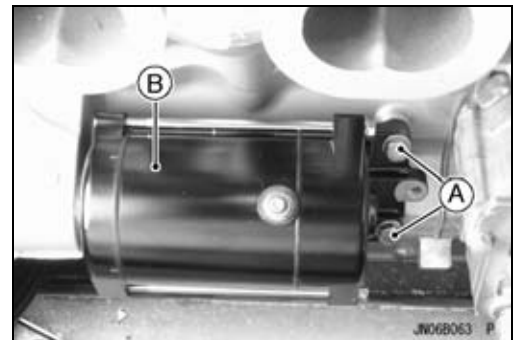
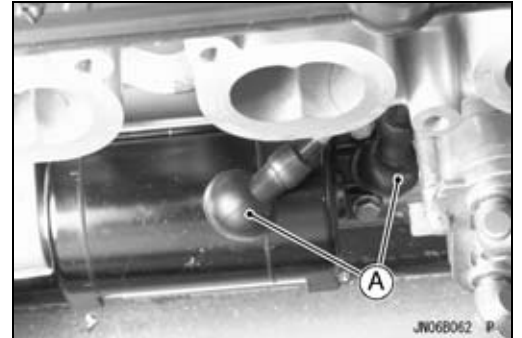
Electric Starter System

- Connect the tester leads as shown in the figure.
- Activate starter relay switch by connecting a 12 V battery as shown in the figure.
- ★ If the starter relay switch clicks and the hand tester indicates zero resistance, the starter relay switch is good.
- ★ If the tester indicates high or infinite (∞) resistance, the starter relay switch is defective and must be replaced.



Starter Motor Removal

- Remove:
Seat (see Seat Removal in the Hull/Engine Hood chapter)
Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
- Slide out the rubber caps [A] and remove the starter motor ground bolt and starter motor terminal nut.
- Remove:
Starter Motor Mounting Bolts [A]
Starter Motor [B]

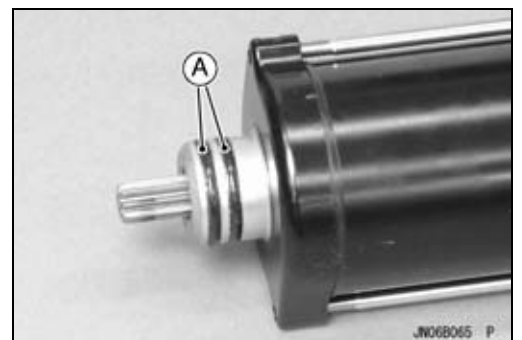
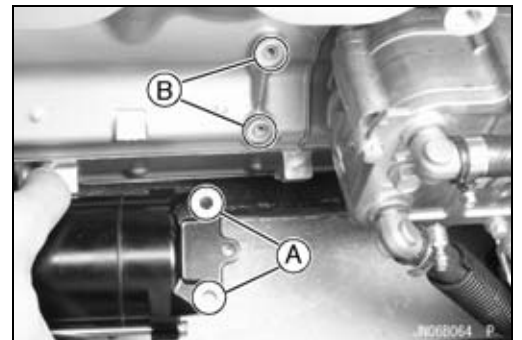


Starter Motor Installation

CAUTION

Do not tap the starter motor shaft or body. Tapping the shaft or body could damage the motor.

- When installing the starter motor, clean the starter motor legs [A] and crankcase [B] where the starter motor is grounded.
- Apply grease to the new O-rings [A].
- Install the starter motor.
- Apply a non-permanent locking agent to the starter motor mounting bolts.
- Tighten:
Torque - Starter Motor Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)



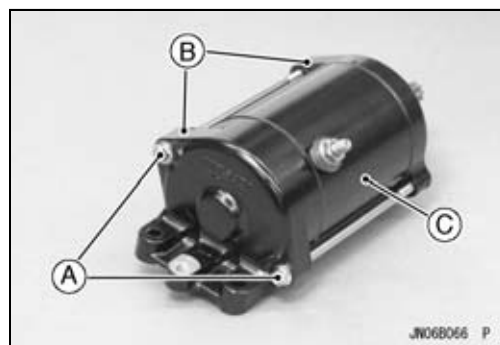
14-24 ELECTRICAL SYSTEM

Electric Starter System

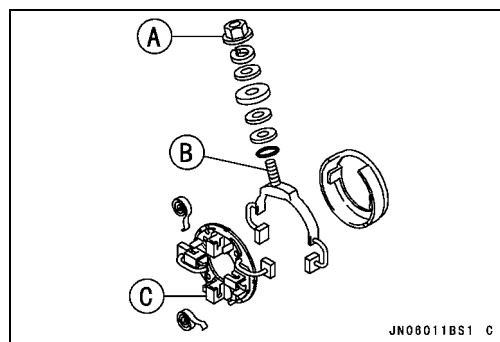
- Apply a non-permanent locking agent to the starter motor ground bolt.
- Tighten:
 - Torque - Starter Motor Ground Bolt: 8.8 N·m (0.90 kgf·m, 78 in·lb)**
 - Starter Motor Terminal Nut: 8.8 N·m (0.90 kgf·m, 78 in·lb)**
- Apply water-resistance grease to the ground bolt and the terminal nut.

Starter Motor Disassembly

- Remove the starter motor (see Starter Motor Removal).
- Take off the starter motor through bolts [A] and remove both end covers [B] and pull the armature out of the yoke [C].

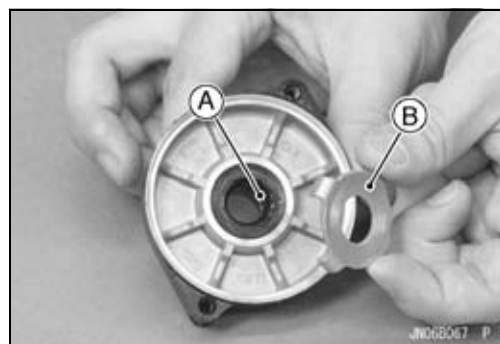


- Remove the terminal locknut [A] and terminal bolt [B], and then remove the brush with the brush plate [C] from the yoke.

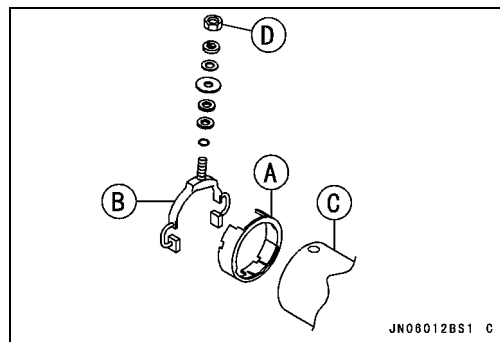


Starter Motor Assembly

- Apply a thin coat of grease to the oil seal [A].
- Fit the toothed washer [B] into the end cover.

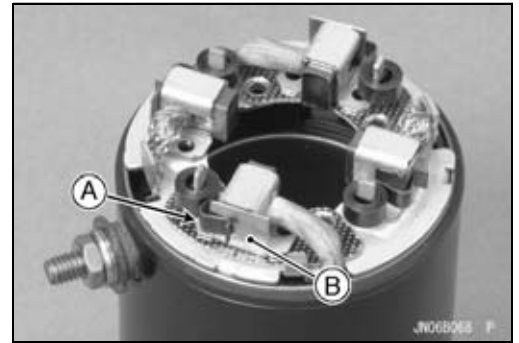


- Install the plate cover [A] and the positive brush assembly [B] in the yoke [C].
- Tighten the terminal nut [D] securely.

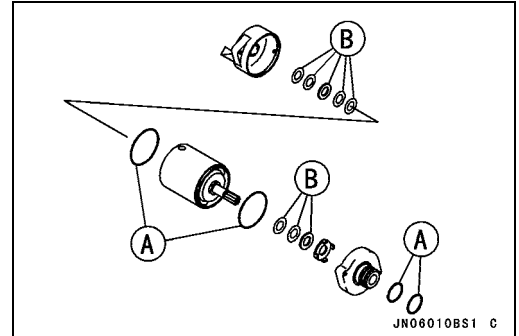


Electric Starter System

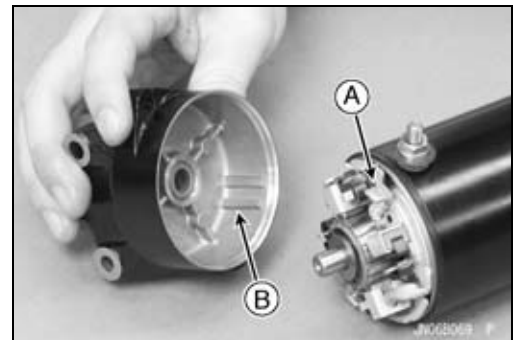
- Holding the spring ends [A] with suitable plates [B], put the armature among the brushes.



- Install the new O-rings [A] and the washers [B] as shown.



- Fit the tongue [A] on the brush plate into the end cover groove [B].



- Replace the starter motor through bolts with new ones.
- Apply a non-permanent locking agent to the starter motor through bolts.
- Tighten:

Torque - Starter Motor Through Bolts: 6.4 N·m (0.65 kgf·m, 57 in·lb)

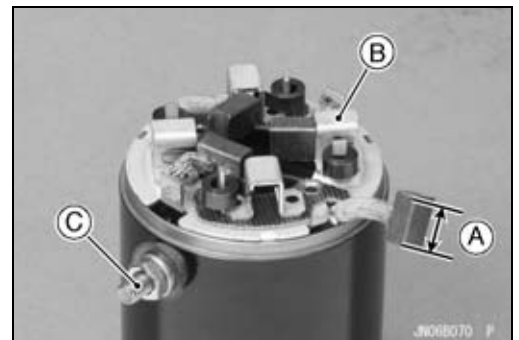
Brush Inspection

- Measure the minimum length [A] of each brush.
- ★ If any is worn down to the service limit, replace the negative brush assembly [B] and the positive brush assembly [C].

Starter Motor Brush Length

Standard: 12 mm (0.4724 in.)

Service Limit: 6.5 mm (0.2559 in.)

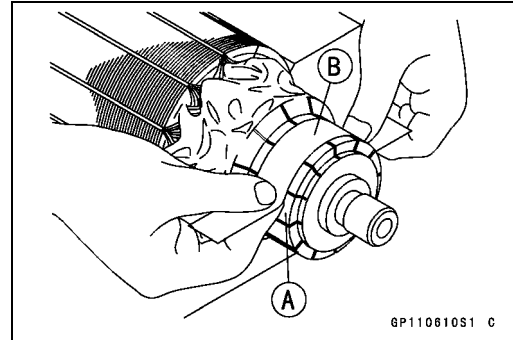


14-26 ELECTRICAL SYSTEM

Electric Starter System

Commutator Cleaning and Inspection

- Smooth the commutator surface [A] if necessary with fine emery cloth [B], and clean out the grooves.

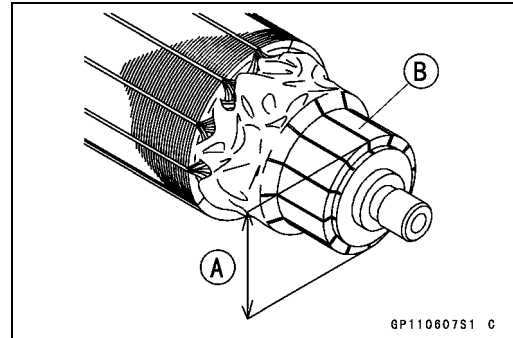


- Measure the diameter [A] of the commutator [B].
- ★ Replace the starter motor with a new one if the commutator diameter is less than the service limit.

Commutator Diameter

Standard: 28 mm (1.1024 in.)

Service Limit: 27 mm (1.063 in.)

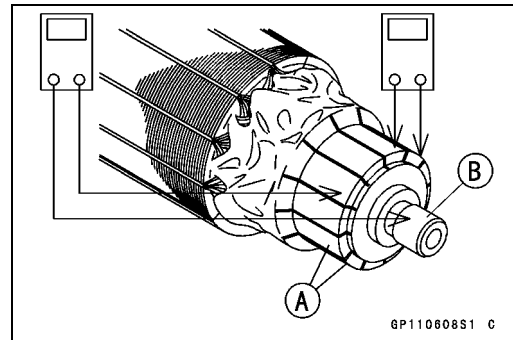


Armature Inspection

- Using the $\times 1 \Omega$ hand tester range, measure the resistance between any two commutator segments [A].

Special Tool - Hand Tester: 57001-1394

- ★ If there is a high resistance or no reading (∞) between any two segments, a winding is open and the starter motor must be replaced.
- Using the highest hand tester range, measure the resistance between the segments and the shaft [B].
- ★ If there is any reading at all, the armature has a short and the starter motor must be replaced.



NOTE

○ Even if the foregoing checks show the armature to be good, it may be defective in some manner not readily detectable within the hand tester. If all other starter motor and starter motor circuit components check good, but the starter motor still does not turn over or only turns over weakly, replace the starter motor with a new one.

Brush Lead Inspection

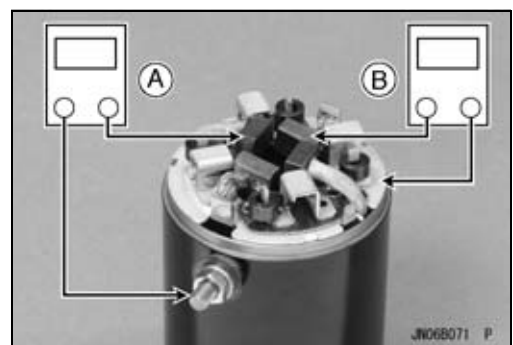
- Using the $\times 1 \Omega$ hand tester range, measure the resistance as shown.

[A] Terminal and Positive Brush

[B] Brush Plate and Negative Brush

Special Tool - Hand Tester: 57001-1394

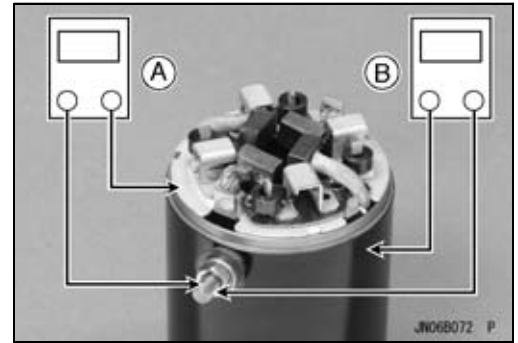
- ★ If there is not close to zero ohms, the brush lead has an open. Replace the positive brush assembly and/or the negative brush assembly.



Electric Starter System

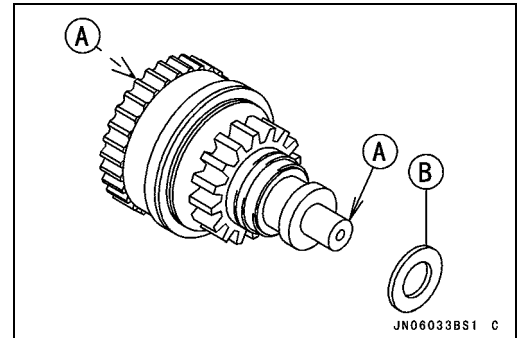
Brush Plate and Terminal Bolt Inspection

- Using the highest hand tester range, measure the resistance as shown.
 - [A] Terminal Bolt and Brush Plate
 - [B] Terminal Bolt and Yoke
- ★ If there is any reading, the negative brush assembly and/or positive brush assembly have a short. Replace the negative and positive brush assemblies.



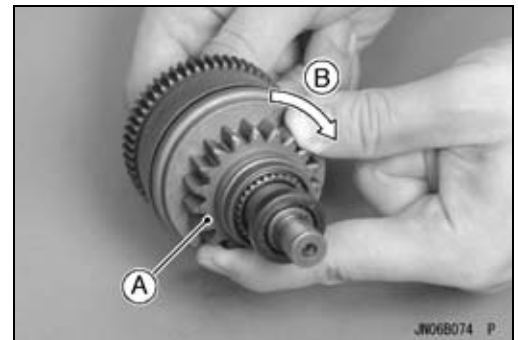
Reduction Gear Removal/Installation

- Remove the alternator rotor (see Alternator Rotor Removal in the Engine Bottom End chapter).
- When installing the reduction gear, apply a molybdenum disulfide grease [A] to both ends of its shaft.
- Be sure to install the washer [B].

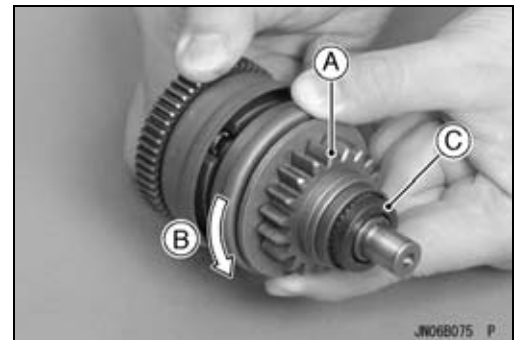


Reduction Gear Inspection

- Check that the pinion gear [A] turns freely clockwise [B].



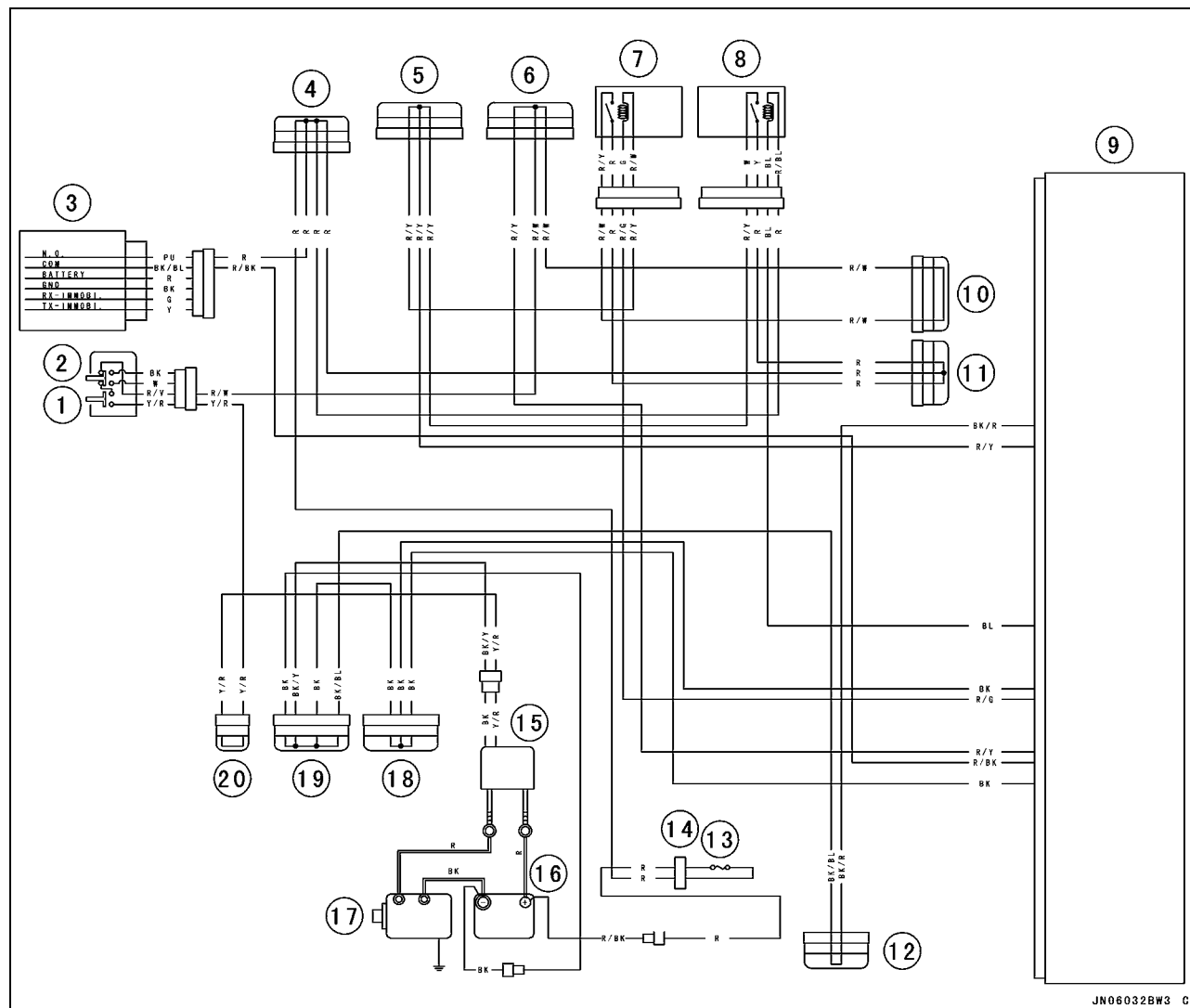
- When the pinion gear [A] turns counterclockwise [B], check that it advances along the shaft, and the gear stops against the stopper [C].
- Check that the pinion gear returns to the initial position quickly.
- ★ If the pinion gear does not function properly, replace it.



14-28 ELECTRICAL SYSTEM

Electric Starter System

Electric Starter Circuit



JN06032BW3 C

1. Engine Start Switch
2. Engine Stop Switch/Tether
3. Ignition Switch
4. Joint Connector P (12 V)
5. Joint Connector R (12 V)
6. Joint Connector T (12 V)
7. ECU Main Relay
8. System Relay
9. ECU
10. Joint Connector D (12 V)
11. Joint Connector C (12 V)
12. Joint Connector E (Ground)
13. Main Fuse 20 A
14. Fuse Box 1
15. Starter Relay
16. Battery
17. Starter Motor
18. Joint Connector Y (Ground)
19. Joint Connector S (Ground)
20. Joint Connector X (12 V)

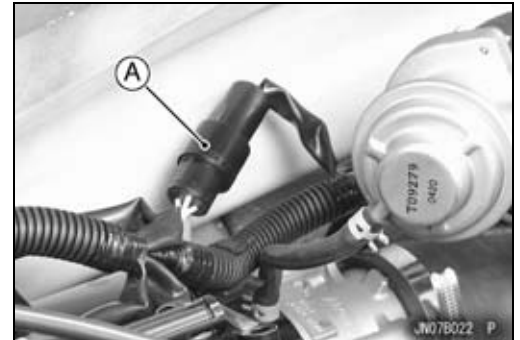
Charging System

Alternator Removal/Installation

- Refer to the Alternator Rotor Removal and Installation in the Engine Bottom End chapter.

Alternator Output Voltage Inspection

- Remove:
Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Disconnect the stator coil lead connector [A].



- With the hand tester [A], check the alternator output (in circuit) according to the following table.

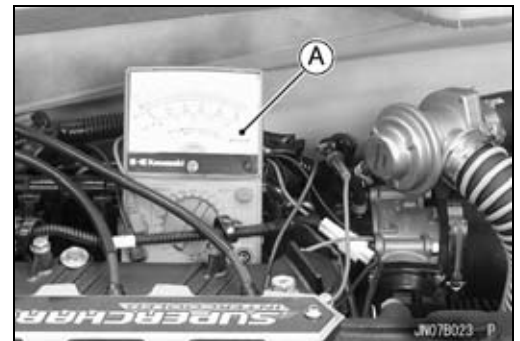
Special Tool - Hand Tester: 57001-1394

WARNING

To avoid electrical shock, do not perform this test with the watercraft in the water.

CAUTION

Do not run the engine over 15 seconds without cooling water.



Alternator Output Voltage at 3 000 r/min (rpm)

Tester Range	Connections		Reading
	Tester (+) to	Tester (–) to	
250 V AC	W lead	W lead	63.9 ~ 64.2 V

★ If the alternator output voltage is correct, check the regulator (see Regulator/Rectifier Inspection).

★ If the alternator output voltage is low, check the stator coil resistance with a digital meter according to the following table.

Stator Coil Resistance at 20°C (68°F)

Tester Range	Connections		Reading
	Tester (+) to	Tester (–) to	
$\times 1 \Omega$	W lead	W lead	0.432 ~ 0.648 Ω

★ If the coil has normal resistance, but the voltage check shows the charging system to be defective, then the permanent magnets in the alternator rotor have probably weakened, necessitating alternator rotor replacement.

14-30 ELECTRICAL SYSTEM

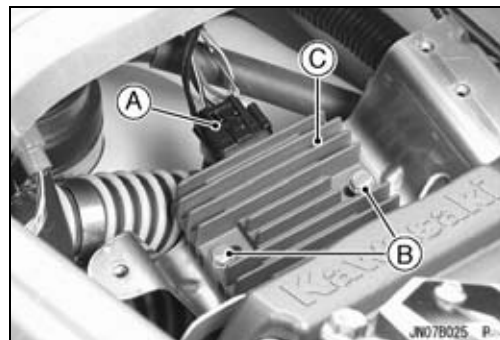
Charging System

Regulator/Rectifier Removal/Installation

- Remove the seat (see Seat Removal in the Hull/Engine Hood chapter).
- Remove:
 - Bracket Bolts [A]



- Disconnect the connector [A].
- Remove:
 - Regulator/Rectifier Bolts [B]
 - Regulator/Rectifier [C]



- Installation is the reverse of removal. Note the following.
- Apply a non-permanent locking agent to the bracket bolts.
- Tighten:

Torque - Regulator/Rectifier Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)

Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

Regulator/Rectifier Inspection

- With the hand tester set to the $\times 1$ k Ω range, test the regulator/rectifier according the following table.

Special Tool - Hand Tester: 57001-1394

Regulator/Rectifier Inspection

Unit: k Ω

	Tester (+) Lead Connection					
	Terminal	+	~	~	~	-
(-)*	+	-	500 ~ ∞	500 ~ ∞	500 ~ ∞	500 ~ ∞
	~	2 ~ 20	-	500 ~ ∞	500 ~ ∞	500 ~ ∞
	~	2 ~ 20	500 ~ ∞	-	500 ~ ∞	500 ~ ∞
	~	2 ~ 20	500 ~ ∞	500 ~ ∞	-	500 ~ ∞
	-	2 ~ 40	2 ~ 20	2 ~ 20	2 ~ 20	-

(-)*: Tester (-) lead Connection

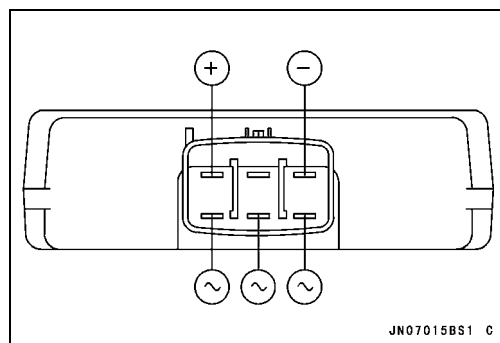
- ★ If any of the values obtained does not match with the above table, the regulator/rectifier must be replaced.

Regulator Inspection

- To test the regulator out of circuit, use three 12 V batteries and a test light (12 V 3 ~6 W bulb in a socket with leads).

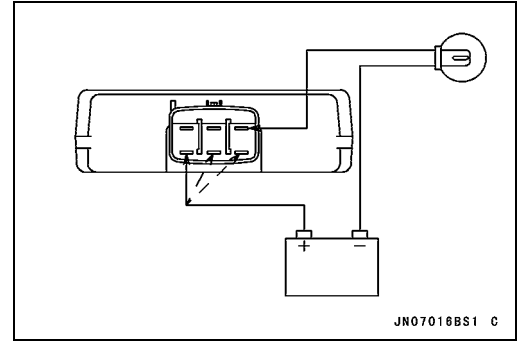
CAUTION

The test light works as an indicator and also as a current limiter to protect the regulator/rectifier from excessive current. Do not use an ammeter instead of a test light.

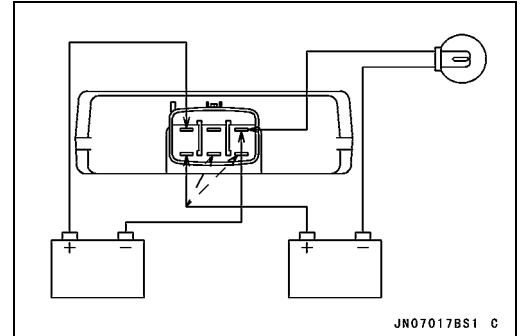


Charging System

- Do the 1st step regulator circuit test.
- Connect the test light and the 12 V battery to the regulator/rectifier as shown.
- Check infinity (∞) terminals respectively.
- ★ If the test light turns on, the regulator/rectifier is defective. Replace it.
- ★ If the test light does not turn on, continue the test.



- Do the 2nd step regulator circuit test.
- Connect the test light and the 12 V battery in the same manner as specified in the "1st step regulator circuit test".
- Apply 12 V to the positive (+) terminal.
- Check infinity (∞) terminals respectively.
- ★ If the test light turns on, the regulator/rectifier is defective. Replace it.
- ★ If the test light does not turn on, continue the test.

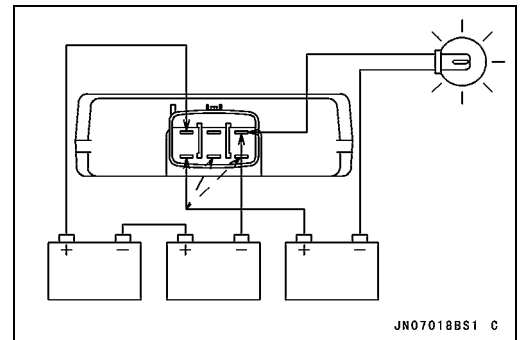


- Do the 3rd step regulator circuit test.
- Connect the test light and the 12 V battery in the same manner as specified in the "2nd step regulator circuit test".
- Momentarily apply 24 V to the positive (+) terminal by adding a 12 V battery.
- Check infinity (∞) terminals respectively.

CAUTION

Do not apply more than 24 volts. If more than 24 volts is applied, the regulator/rectifier may be damaged. Do not apply 24 V more than a few seconds. If 24 volts is applied for more than a few seconds, the regulator/rectifier may be damaged.

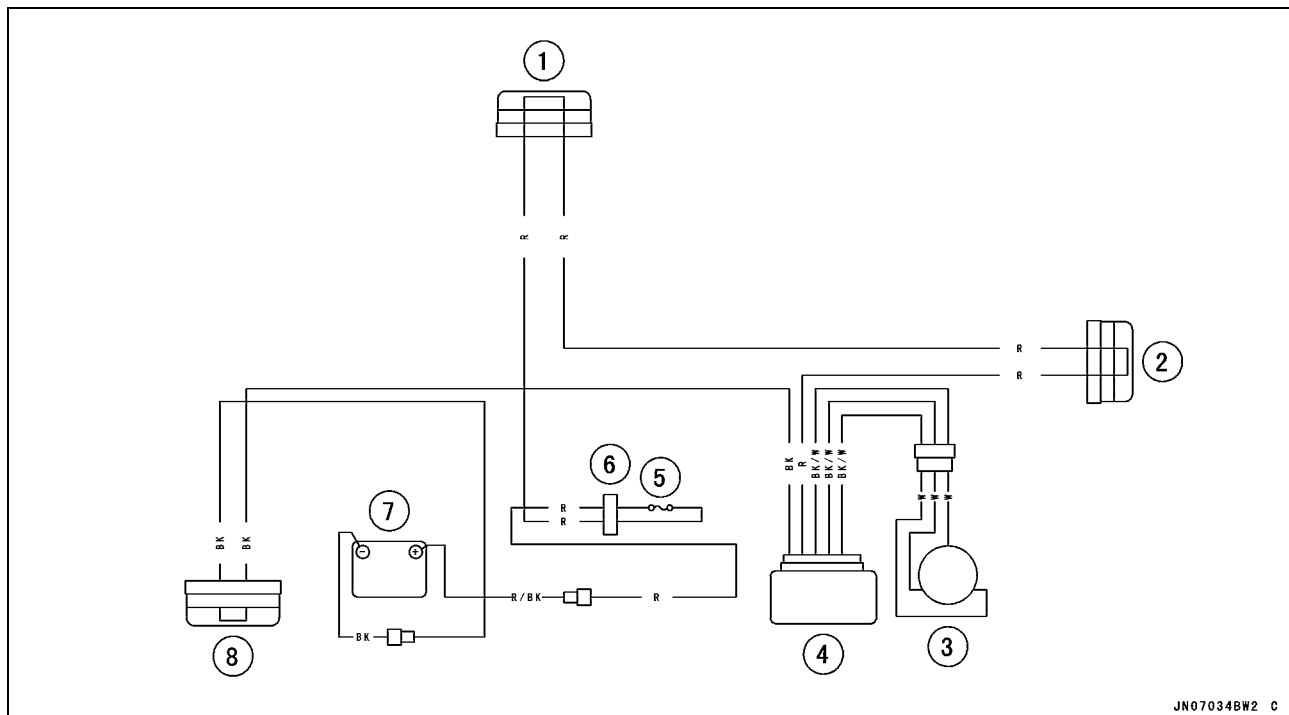
- ★ If the test light does not light when 24 V is applied momentarily to the positive (+) terminal, the regulator/rectifier is defective. Replace it.
- ★ If the regulator/rectifier passes all the tests described, it may still be defective. If the charging system still does not work properly after checking all the components and the battery, test the regulator/rectifier by replacing it with a known good unit.
- Repeat the test for another regulator/rectifier.



14-32 ELECTRICAL SYSTEM

Charging System

Charging System Circuit



1. Joint Connector P (12 V)
2. Joint Connector C (12 V)
3. Alternator
4. Regulator/Rectifier
5. Main Fuse 20 A
6. Fuse Box 1
7. Battery
8. Joint Connector S (Ground)

Ignition System

⚠ WARNING

The ignition system produces extremely high voltage. Do not touch the spark plugs, ignition coils, or spark plug leads while the engine is running, or you could receive a severe electrical shock.

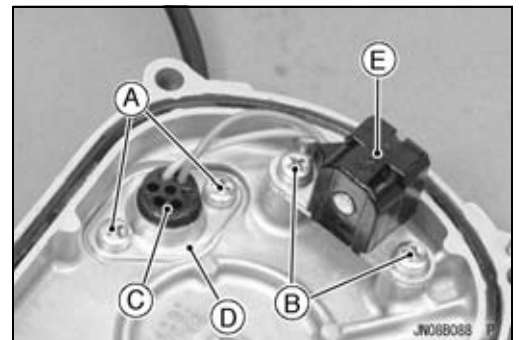
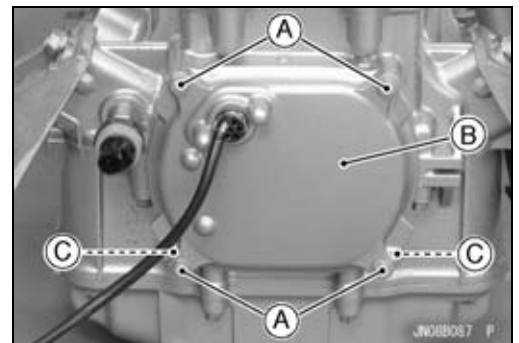
CAUTION

Do not disconnect the battery cables or any other electrical connections when the ignition switch is on, or while the engine is running. This is to prevent ECU (Electronic Control Unit) damage.

Do not install the battery backwards. The negative side is grounded. This is to prevent damage to the diodes and ECU.

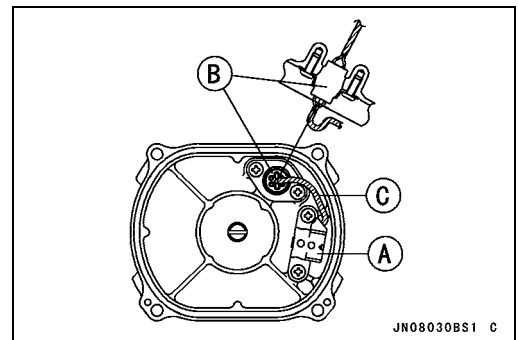
Crankshaft Sensor Removal

- Remove:
 - Engine (see Engine Removal in the Engine Removal/Installation chapter)
 - Crankshaft Sensor Cover Bolts [A]
 - Crankshaft Cover [B]
 - Dowel Pins [C]
- Remove:
 - Rubber Grommet Holder Screws [A]
 - Crankshaft Sensor Screws [B]
 - Rubber Grommet [C] and Holder [D]
 - Crankshaft Sensor [E]



Crankshaft Sensor Installation

- Run the sensor lead through the cover hole.
- Install the crankshaft sensor [A].
- Apply a non-permanent locking agent to the sensor screws.
- Tighten:
 - Torque - Crankshaft Sensor Screws: 4.5 N·m (0.46 kgf·m, 40 in·lb)**
- Install the rubber grommet [B] in the sensor cover hole.
- Run the sensor lead [C] as shown in the figure.
- Apply water-resistance grease to the grommet outside.
- Apply a non-permanent locking agent to the grommet holder screws.
- Tighten:
 - Torque - Rubber Grommet Holder Screws: 4.5 N·m (0.46 kgf·m, 40 in·lb)**
- Replace the crankshaft sensor cover O-ring with a new one.
- Apply grease to the new O-ring and install it.



14-34 ELECTRICAL SYSTEM

Ignition System

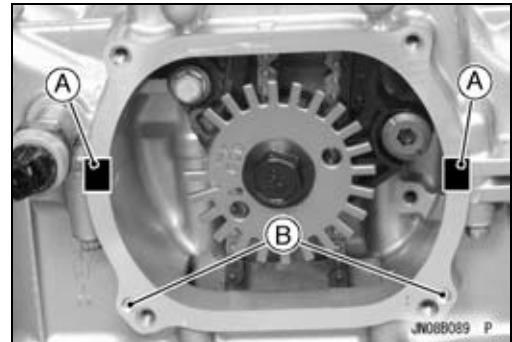
- Apply sealant to the crankcase halves mating surface [A] as shown in the figure.

Sealant - Liquid Gasket, TB1211F: 92104-0004

- Install:
 - Dowel Pins [B]
 - Crankshaft Sensor Cover

- Tighten:

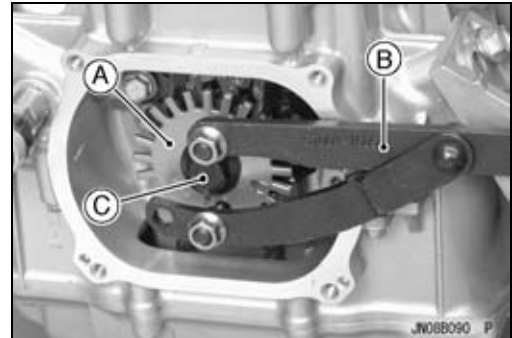
Torque - Crankshaft Sensor Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)



Timing Rotor Removal

- Remove the crankshaft sensor cover (see Crankshaft Sensor Removal).
- Hold the timing rotor [A] steady with the flywheel & pulley holder [B] and unscrew the bolt [C].

Special Tools - Flywheel & Pulley Holder: 57001-1605
Holder Attachment: 57001-1547

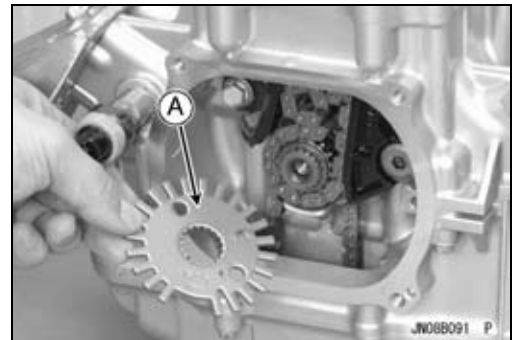


Timing Rotor Installation

- Fit the rotor to the crankshaft.
- Face the flat side [A] (marked side) to the outside.
- Apply a non-permanent locking agent to the rotor bolt.
- Tighten:

Torque - Timing Rotor Bolt: 39 N·m (4.0 kgf·m, 29 ft·lb)

- Install the crankshaft sensor cover (see Crankshaft Sensor Cover Installation).



Crankshaft Sensor Inspection

- Remove:
 - Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Disconnect the crankshaft sensor lead connector (Blue, 2-pin) [A].
- Set the hand tester [B] to the $\times 100 \Omega$ range, and connect it to the crankshaft sensor lead terminals (G and BL).

Special Tool - Hand Tester: 57001-1394

Crankshaft Sensor Resistance

Standard: 408 ~ 612 Ω

- ★ If there is more resistance than the standard value, the sensor has an open lead and must be replaced. Much less than this resistance means the sensor is shorted, and must be replaced.



Ignition System

Crankshaft Sensor Peak Voltage Inspection

NOTE

- Be sure the battery is fully charged.
- Using the peak voltage adapter is a more reliable way to determine the condition of the crankshaft sensor than crankshaft sensor internal resistance measurements.

- Disconnect the crankshaft sensor lead connector [A].
- Set the hand tester [A] to the $\times$ DC 10 V range, and connect the peak voltage adapter [B].

Special Tools - Hand Tester: 57001-1394

Peak Voltage Adapter: 57001-1415

Type: KEK-54-9-B

Connections:

Crankshaft Sensor Lead Connector [C]		Peak Voltage Adapter		Hand Tester
BL	←	BK	→	(-)
G	←	R	→	(+)

- Turn the ignition switch to ON and insert the lanyard key under the stop button.
- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the crankshaft sensor peak voltage.
- Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.
- Repeat the measurement 5 or more times.

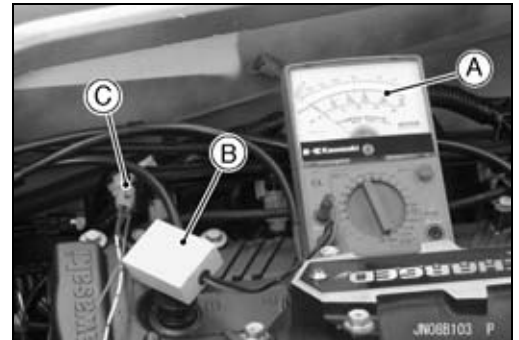
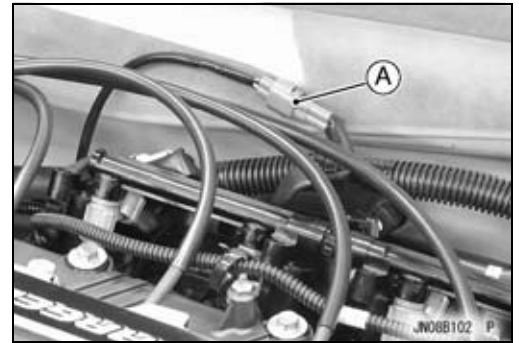
Crankshaft Sensor Peak Voltage

Standard: 2.5 V or more

- ★ If the tester reading is not specified one, check the crankshaft sensor (see Crankshaft Sensor Inspection).

Ignition Coil Removal

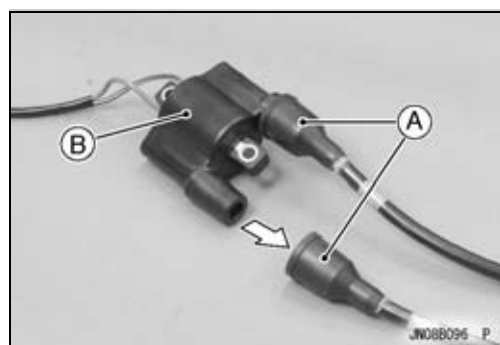
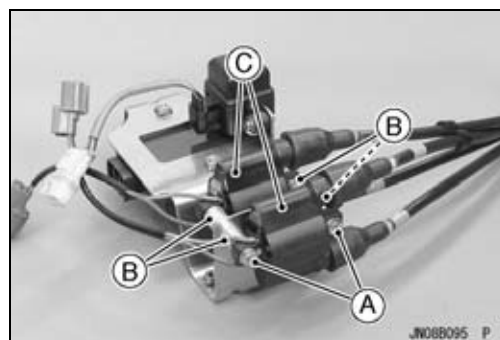
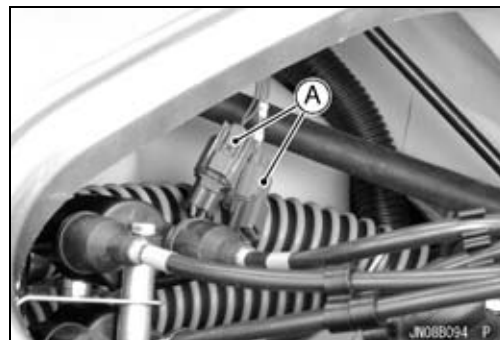
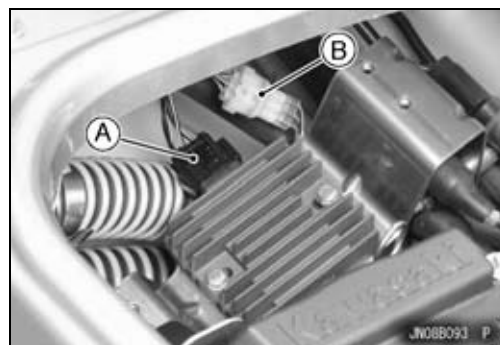
- Remove:
Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Remove the bracket bolts [A].



14-36 ELECTRICAL SYSTEM

Ignition System

- Disconnect:
 - Regulator/Rectifier Connector [A]
 - Vehicle-down Sensor Lead Connector [B]
- Disconnect the ignition coil primary lead connectors [A].
- Take the spark plug caps off the engine.
- Remove:
 - Bolts [A] and Nuts
 - Collars [B]
 - Ignition Coils [C]
- Take the spark plug leads [A] off the ignition coil [B].



Ignition System

Ignition Coil Installation

- Lubricate the spark plug leads with the penetrating rust inhibitor.
- Connect the spark plug lead to each ignition coil as follows.

#1 Spark Plug Lead Length 340 mm (13.4 in.) [A]

#2 Spark Plug Lead Length 450 mm (17.7 in.) [B]

#3 Spark Plug Lead Length 540 mm (21.3 in.) [C]

#4 Spark Plug Lead Length 600 mm (23.6 in.) [D]

- Apply a non-permanent locking agent to the ignition coil mounting bolts [E].

- Install the ignition coils [F] to the bracket [G].

BK/W Leads [H]

R Leads [I]

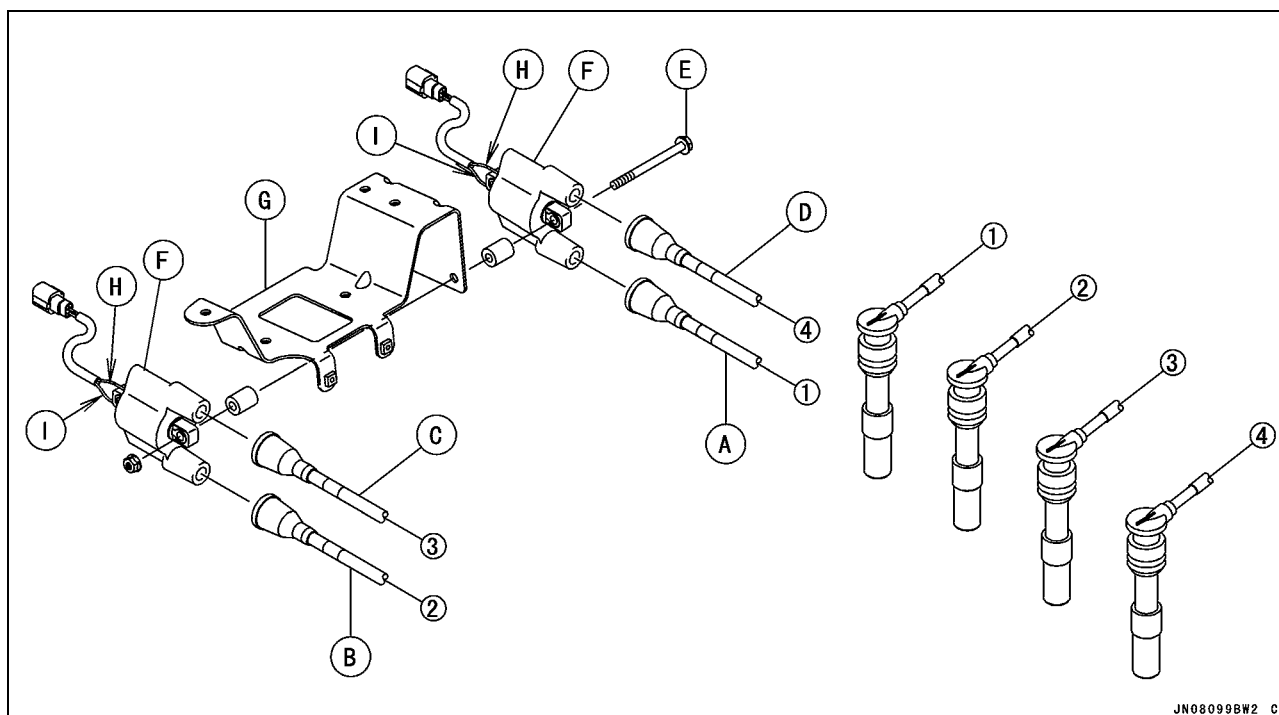
- Tighten:

Torque - Ignition Coil Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

- Apply a non-permanent locking agent to the bracket bolts.

- Tighten:

Torque - Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)



14-38 ELECTRICAL SYSTEM

Ignition System

Ignition Coil Inspection

Measuring arcing distance

The most accurate test for determining the condition of the ignition coil is made by measuring arcing distance.

- Remove the ignition coil (see Ignition Coil Removal).
- Connect the ignition coil [A] (with the spark plug cap left installed on the spark plug lead) to the tester [B], and measure the arcing distance.

Auxiliary Wires [C]

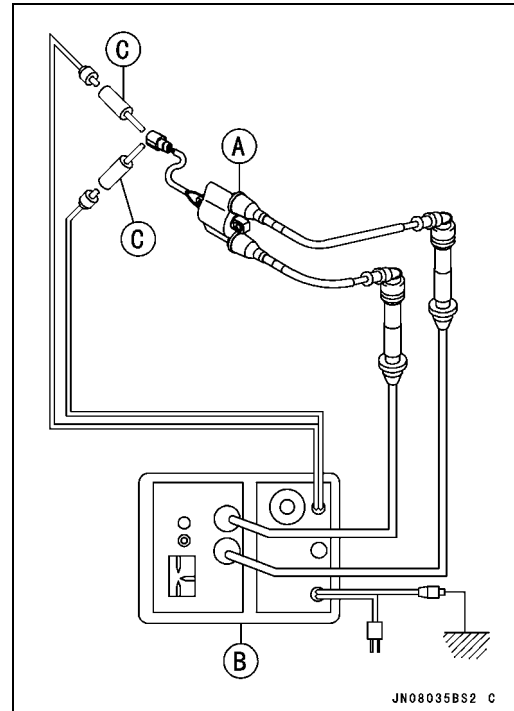
WARNING

To avoid extremely high voltage shocks, do not touch the coil or lead.

3 Needle Arcing Distance

Standard: 7 mm (0.28 in.) or more

- ★ If the distance reading is less than the specified value, the ignition coil or spark plug cap is defective.



- To determine which part is defective, measure the arcing distance again with the spark plug leads removed from the ignition coil (see Ignition Coil Removal).

- ★ If the arcing distance is subnormal as before, the trouble is with the ignition coil itself. If the arcing distance is now normal, the trouble is with the spark plug lead.

Measuring coil resistance

If the Coil Tester is not available, the coil can be checked for a broken or badly shorted winding with a tester. However, a tester can not detect layer shorts and shorts resulting from insulation breakdown under high voltage.

- Disconnect the primary leads from the coil terminals.
- Measure the primary winding resistance as follows [A].

Special Tool - Hand Tester: 57001-1394

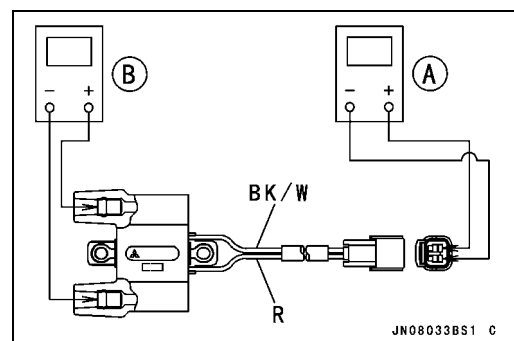
- Connect the hand tester between the coil terminals.
- Set the tester to the $\times 1 \Omega$ range, and read the tester.
- Measure the secondary winding resistance as follows [B].
- Remove the spark plug leads (see Ignition Coil Removal).
- Connect the hand tester between the secondary lead terminals.
- Set the tester to the $\times 1 \text{ k}\Omega$ range, and read the tester.

Winding Resistance

Standard: Primary windings 1.44 ~ 2.16 Ω

Secondary windings 11.76 ~ 17.64 $\text{k}\Omega$

- ★ If the hand tester does not read as specified, replace the coil.
- ★ If the tester reads are as specified, the ignition coil windings are probably good. However, if the ignition system still does not perform as it should after all other components have been checked, test replace the coil with one known to be good.



Ignition System

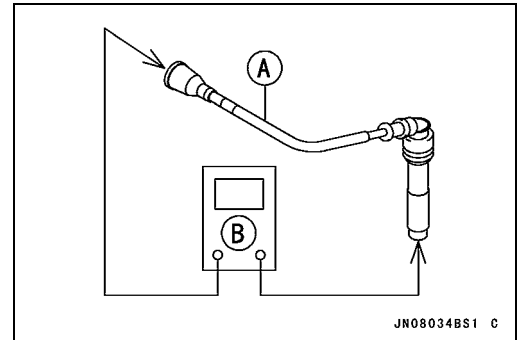
Measuring spark plug lead resistance

- Check the spark plug lead [A] for visible damage.
- ★ If the spark plug lead is damaged, replace the spark plug lead.
- Measure the lead resistance with the hand tester [B].

Spark Plug Lead Resistance

Standard:	(#1)	2.80 ~ 4.79 kΩ
	(#2)	3.55 ~ 6.07 kΩ
	(#3)	4.16 ~ 7.11 kΩ
	(#4)	4.57 ~ 7.81 kΩ

- ★ If the hand tester does not read as specified, replace the lead.

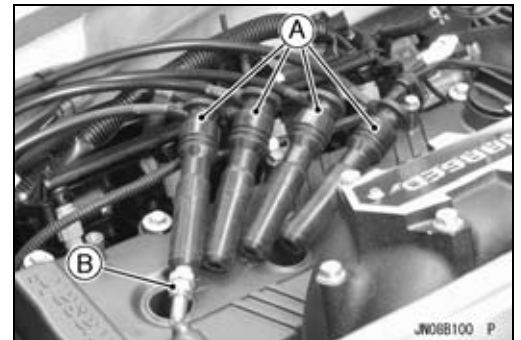


Ignition Coil Primary Peak Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

- Remove the seat (see Seat Removal in the Hull/Engine Hood chapter).
- Take the spark plug caps [A] but do not remove the spark plugs.
- Install new spark plug [B] into the spark plug cap.



- Connect the peak voltage adapter [A] to the hand tester [B] and the harness adapter [C].

Hand Tester Range: DC 1 000 V

Special Tools - Hand Tester: 57001-1394

Harness Adapter: 57001-1562

Peak Voltage Adapter: 57001-1415

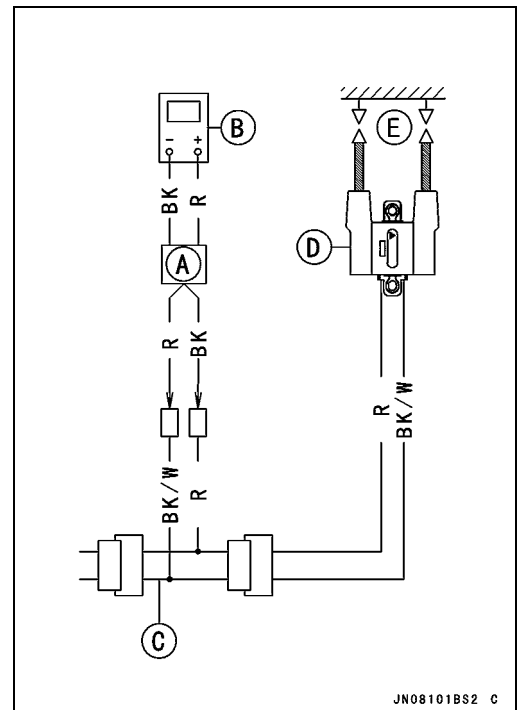
Type: KEK-54-9-B

Primary Lead Connections:

Harness Aapter		Peak Voltage Adapter		Hand Tester
R	←	BK	→	(-)
BK/W	←	R	→	(+)

Ignition Coil [D]

Spark Plug [E]



⚠ WARNING

To avoid extremely high voltage shocks, do not touch the spark plugs or tester connections.

14-40 ELECTRICAL SYSTEM

Ignition System

- Turn the ignition switch to ON and insert the lanyard key under the stop button.
- Ground the new spark plug [A] onto the engine.
- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the primary peak voltage.
- Do not operate the starter for longer 5 seconds. Wait 15 seconds before using it again.
- Repeat the measurements 5 times for one ignition coil.

Ignition Coil Primary Peak Voltage

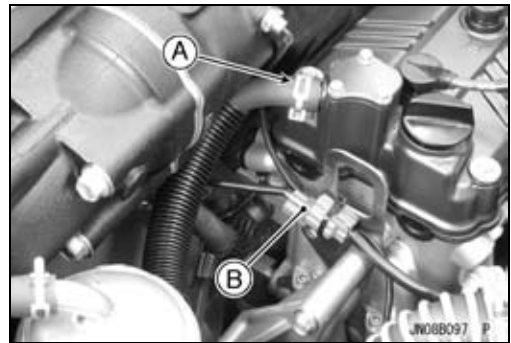
Standard: 250 V or more



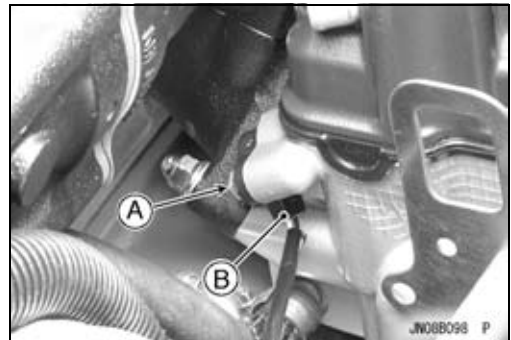
- Repeat the test for the other ignition coil.
- ★ If the reading is less than the specified value, check the following:
 - Ignition Coils (see Ignition Coil Inspection)
 - Crankshaft Sensor (see Crankshaft Sensor Inspection)
- ★ If the ignition coils and crankshaft sensor are normal, check the ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter).

Camshaft Position Sensor Removal/Installation

- Remove:
 - Seat (see Seat Removal in the Hull/Engine Hood chapter)
 - Breather Hose End [A]
- Disconnect the camshaft position sensor lead connector [B].



- Remove:
 - Camshaft Position Sensor Bolt [A]
 - Camshaft Position Sensor [B]



- Installation is the reverse of removal. Note the following.
- Replace the camshaft position sensor O-ring with a new one.
- Apply grease to the new O-ring.
- Apply a non-permanent locking agent to the camshaft position sensor bolt.
- Tighten:
 - Torque - Camshaft Position Sensor Bolt: 10 N·m (1.0 kgf·m, 89 in·lb)

Ignition System

Camshaft Position Sensor Inspection

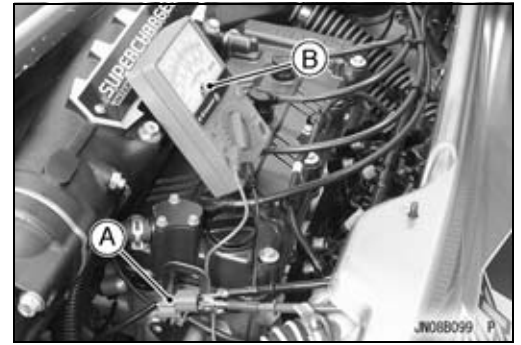
- Remove:
 - Seat (see Seat Removal in the Hull/Engine Hood chapter)
 - Camshaft Position Sensor Lead Connector [A] (Disconnect)
- Set the hand tester [B] to the $\times 100 \Omega$ range and connect it to the yellow and black leads in the connector.

Special Tool - Hand Tester: 57001-1394

Camshaft Position Sensor Resistance

Standard: 400 ~ 460 Ω at 20°C (68°F)

- ★ If there is more resistance than the specified value, the sensor coil has an open lead and must be replaced. Much less than this resistance means the sensor coil is shorted, and must be replaced.
- Using the highest resistance range of the tester, measure the resistance between the camshaft position sensor leads and chassis ground.
- ★ Any tester reading less than infinity (∞) indicates a short, necessitating replacement of the camshaft position sensor.



Camshaft Position Sensor Peak Voltage Inspection

- Disconnect the camshaft position sensor lead connector (see Camshaft Position Sensor Removal).
- Set the hand tester [A] to the DC 2.5 V range, and connect it peak voltage adapter [B].

Special Tool - Hand Tester: 57001-1394

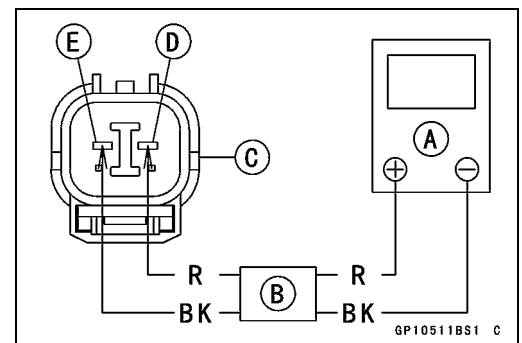
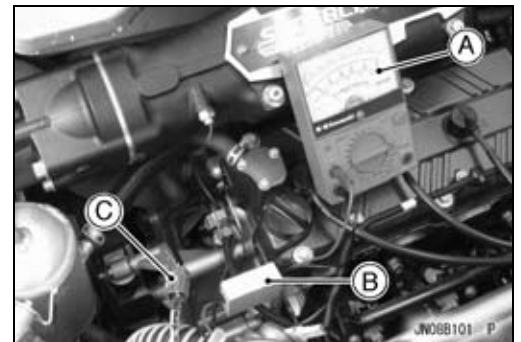
Peak Voltage Adapter: 57001-1415

Type: KEK-54-9-B

- Connect the adapter to the terminals of the camshaft position sensor lead connector [C].

Connections:

Camshaft Position Sensor Lead Connector		Peak Voltage Adapter		Hand Tester
BK [D]	←	R	→	(+)
Y [E]	←	BK	→	(-)



- Turn the ignition switch to ON and insert the lanyard key under the stop button.
- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the peak voltage.
- Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.
- Repeat the measurements 5 times or more times.

Camshaft Position Sensor Peak Voltage

Standard: 0.4 V or more

- ★ If the reading is less than the standard, inspect the camshaft position sensor (see Camshaft Position Sensor Inspection).

14-42 ELECTRICAL SYSTEM

Ignition System

IC Igniter Inspection

○The igniter is built in the ECU.

- Refer to the following items.
 - Ignition System Troubleshooting (see Ignition System Troubleshooting)
 - ECU Power Supply Inspection (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)

CAUTION
Do not disconnect the battery cables or any other electrical connections when the ignition switch is on, or while the engine is running. This is to prevent igniter in the ECU damage.

Spark Plug Removal

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

Spark Plug Installation

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

Spark Plug Inspection

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

Spark Plug Adjustment

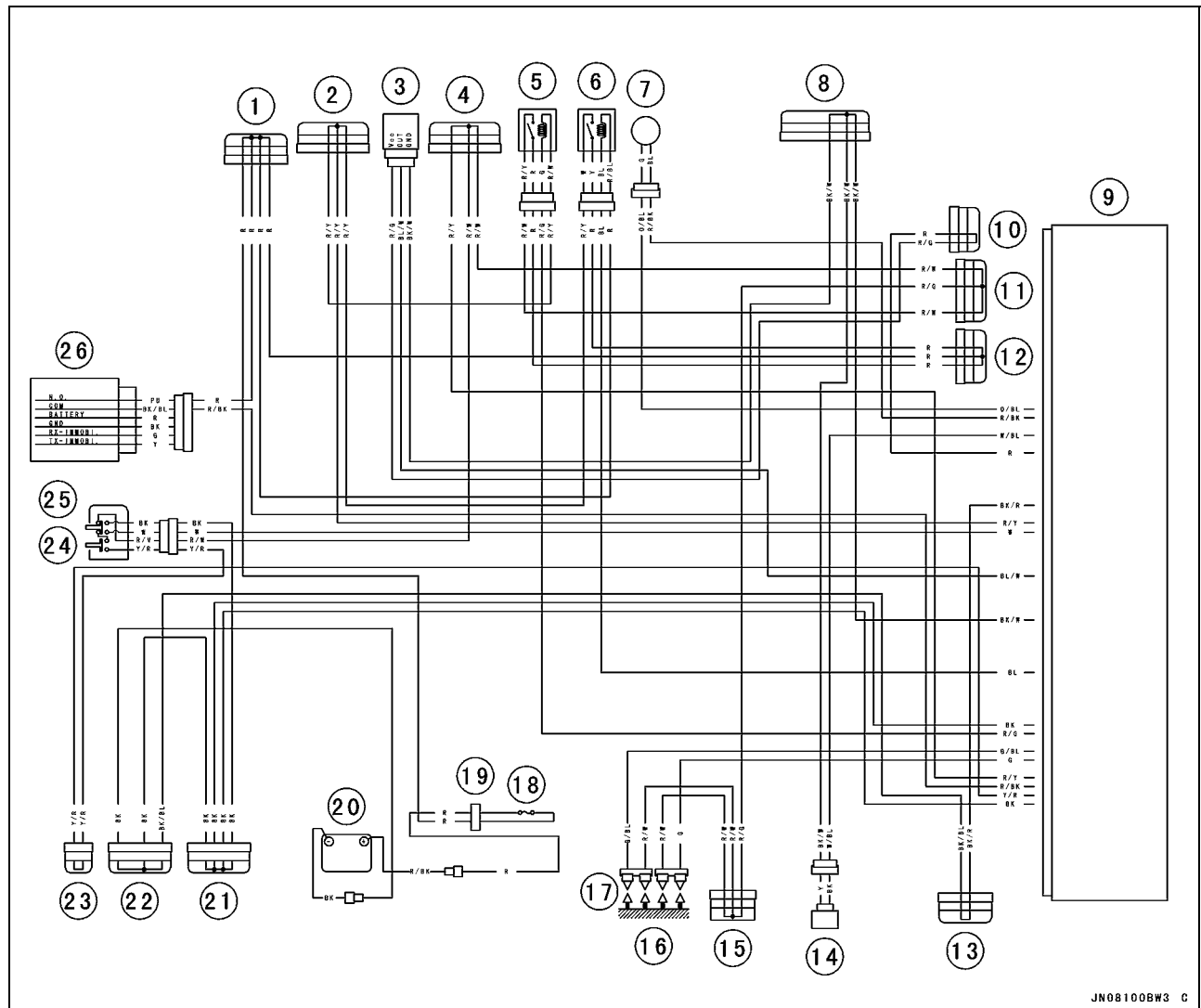
- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

Spark Plug Cleaning

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

Ignition System

Ignition System Circuit

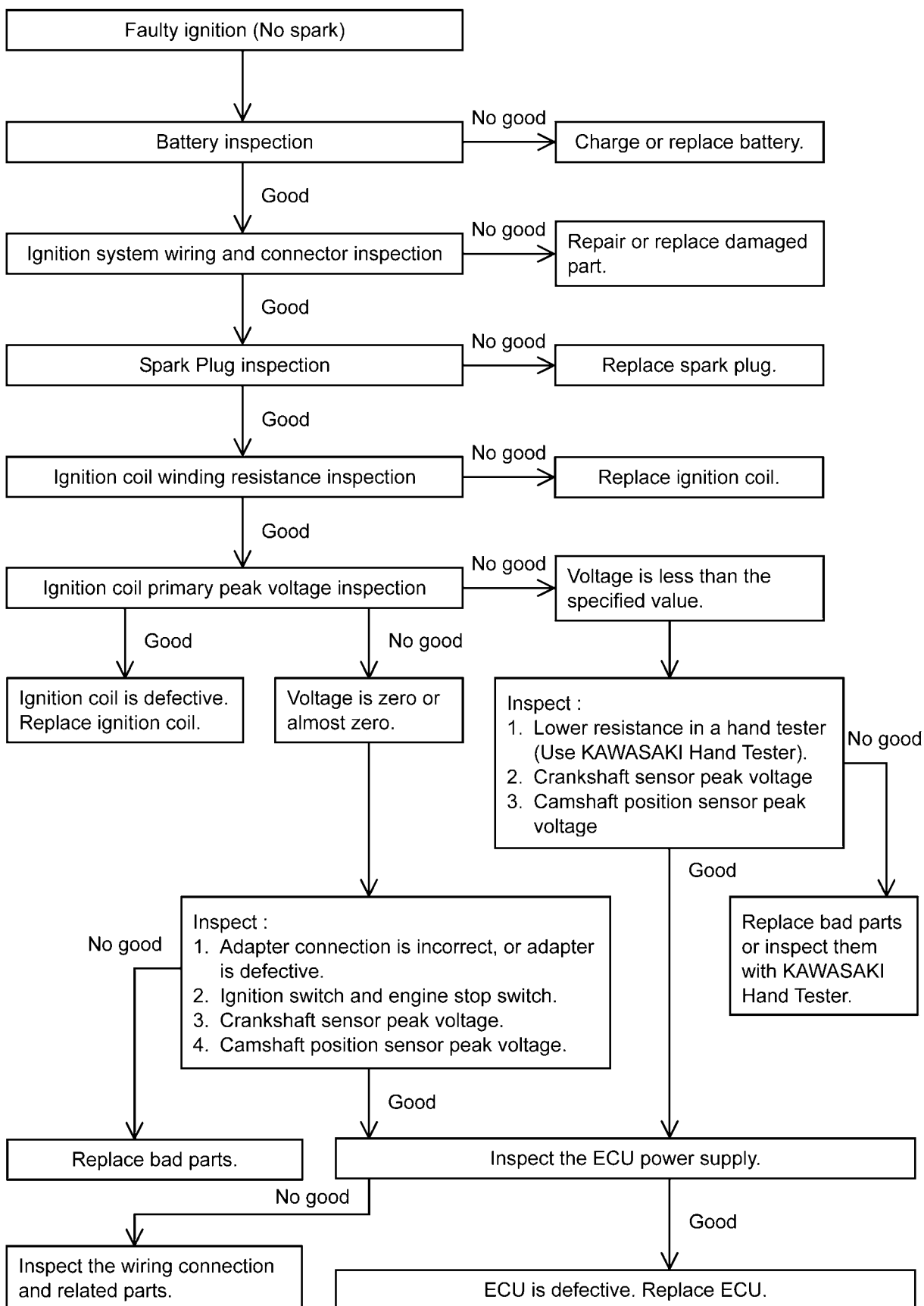


- | | |
|--------------------------------|--------------------------------|
| 1. Joint Connector P (12 V) | 14. Camshaft Position Sensor |
| 2. Joint Connector R (12 V) | 15. Joint Connector M (12 V) |
| 3. Vehicle-down Sensor | 16. Spark Plugs |
| 4. Joint Connector T (12 V) | 17. Ignition Coils |
| 5. ECU Main Relay | 18. Main Fuse 20 A |
| 6. System Relay | 19. Fuse Box 1 |
| 7. Crankshaft Sensor | 20. Battery |
| 8. Joint Connector B (Ground) | 21. Joint Connector Y (Ground) |
| 9. ECU | 22. Joint Connector S (Ground) |
| 10. Joint Connector F (5 V) | 23. Joint Connector X (12 V) |
| 11. Joint Connector C (12 V) | 24. Engine Start Switch |
| 12. Joint Connector D (12 V) | 25. Engine Stop Switch/Tether |
| 13. Joint Connector E (Ground) | 26. Ignition Switch |

14-44 ELECTRICAL SYSTEM

Ignition System

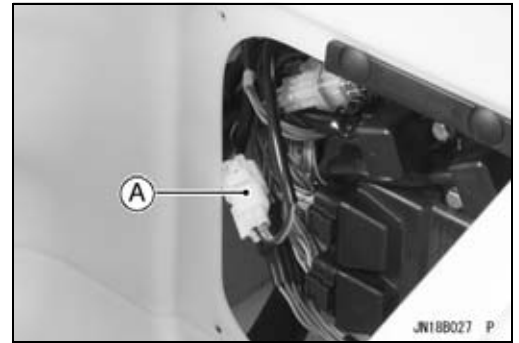
Ignition System Troubleshooting



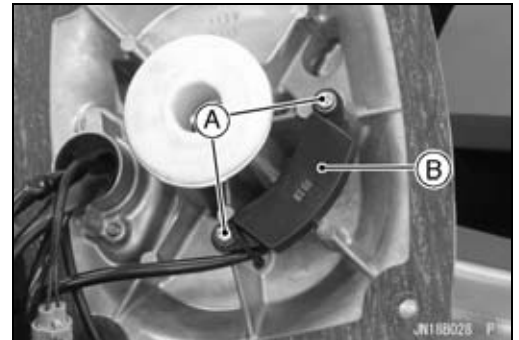
Kawasaki Smart Steering (KSS) System

Steering Position Sensor and Magnet Removal

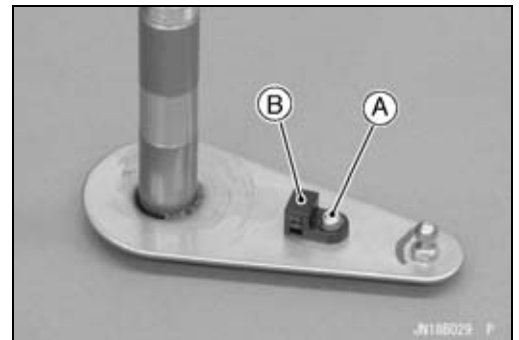
- Remove:
Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
- Disconnect the steering position sensor lead connector [A].



- Remove:
Steering Shaft (see Steering Removal in the Steering chapter)
Steering Position Sensor Mounting Screws [A]
Steering Position Sensor [B]

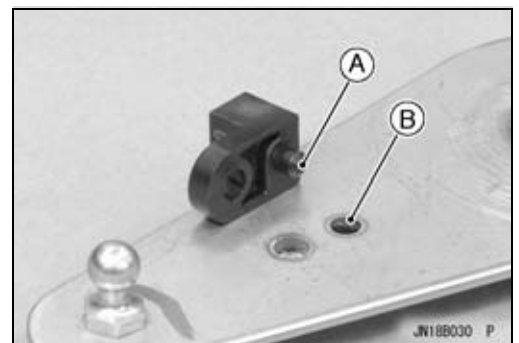


- Remove:
Magnet Mounting Screw [A]
Magnet [B]

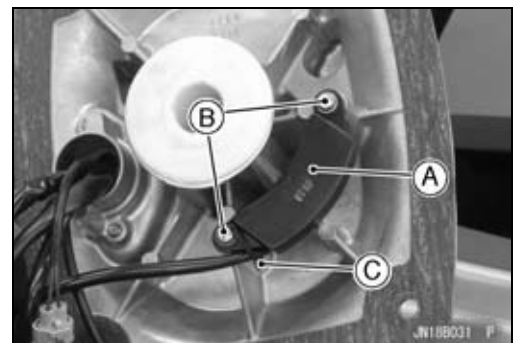


Steering Position Sensor and Magnet Installation

- Install the magnet.
- Fit the projection [A] and the hole [B].
- Apply a non-permanent locking agent to the magnet mounting screw.
- Tighten the magnet mounting screw.



- Install the steering position sensor [A].
- Apply a non-permanent locking agent to the steering position sensor mounting screws [B].
- Tighten the steering position sensor mounting screws.
- Install the clamp [C].
- Hold the steering position sensor and its lead.
- Install the steering shaft and the steering shaft nut (see Steering Installation in the Steering chapter).



14-46 ELECTRICAL SYSTEM

Kawasaki Smart Steering (KSS) System

Kawasaki Smart Steering System Inspection

- Inspect the smart steering system with the watercraft in the water.
- Center the handlebar in the straight-ahead position .
- Squeeze the throttle lever and allow it to approx. 4 000 r/min (rpm) or above for 4 seconds or more.
- Release the throttle lever.
- Within 1 second, turn the handlebar all the way to the left or right and check the engine speed increases to approx. 3 300 r/min (rpm), and then decreases to approx. 2 600 r/min (rpm).
- Center the handlebar in the straight-ahead position, and check the engine speed decreases to an idle speed.
- ★ If the Kawasaki Smart Steering system does not operate normally, inspect the steering position sensor clearance.

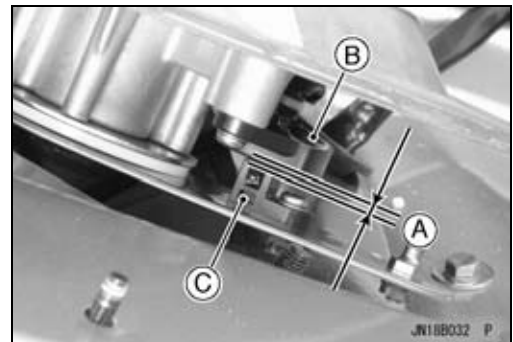
Steering Position Sensor Clearance Inspection

- Take the steering holder off the hull (see Steering Removal in the Steering chapter).
- Check the clearance [A] between the steering position sensor [B] and the magnet [C] with feeler gauge.

Steering Position Sensor Clearance

Standard: 0.5 ~1.5 mm (0.02 ~ 0.06 in.)

- ★ If the clearance is the specified value but the smart steering system does not work, inspect steering position sensor input voltage (see Steering Position Sensor Input Voltage Inspection).
- ★ If necessary, adjust the steering shaft nut (see Steering Installation in the Steering chapter).



Steering Position Sensor Input Voltage Inspection

NOTE

○ Be sure the battery is fully charged.

- Remove the front access cover (see Front Access Cover Removal in the Hull/Engine Hood chapter).
- Connect a digital meter [A] to the steering position sensor lead connector [B] with the needle adapter set [C].

Special Tool - Needle Adapter Set: 57001-1457

Connections to Steering Position Sensor Lead Connector

Digital Meter (+) → R/W (main harness R/BL)

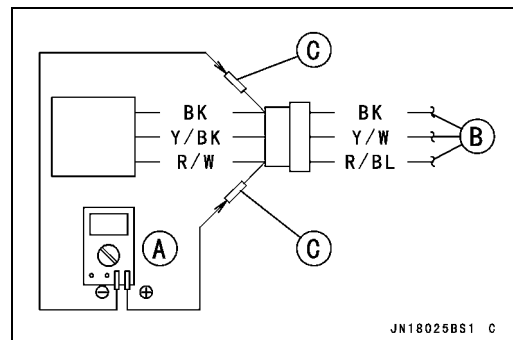
Digital Meter (-) → BK (main harness BK)

- Turn the ignition switch to ON.
- Center the steering shaft in the straight-ahead position.
- Measure the input voltage.

Steering Position Sensor Input Voltage

Standard: Battery Voltage

- Turn the ignition switch to OFF.
- ★ If the reading is the standard, inspect the steering position sensor output voltage (see Steering Position Sensor Output Voltage Inspection).
- ★ If the reading is out of the standard, check the following.
 - Main Fuse 20 A (see Fuse Inspection)
 - Power Source Wiring (see Steering Position Sensor Circuit)



Kawasaki Smart Steering (KSS) System

Steering Position Sensor Output Voltage Inspection

NOTE

○Be sure the battery is fully charged.

- Connect a digital meter [A] to the steering position sensor lead connector [B] with the needle adapter set [C].

Special Tool - Needle Adapter Set: 57001-1457

Connections to Steering Position Sensor Lead Connector

Digital Meter (+) → Y/BK (main harness Y/W)

Digital Meter (-) → BK (main harness BK)

- Turn the ignition switch to ON.
- Turn the steering shaft fully left or right.
- Measure the output voltage.

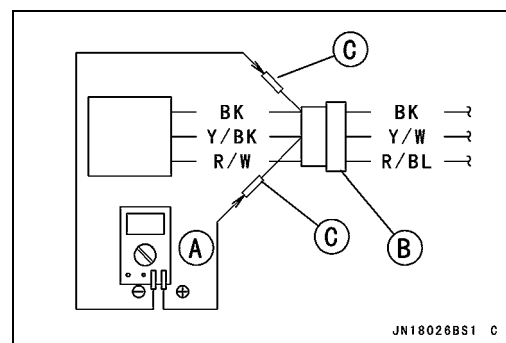
Steering Position Sensor Output Voltage

Standard: Approx. 0 V

NOTE

○When the steering shaft is centered in straight-ahead position, the output voltage standard value is battery voltage.

- Turn the ignition switch to OFF.
- ★ If the reading is out of the standard, check the wiring (see Steering Position Sensor Circuit). Then if the wiring is good, replace the steering position sensor.
- ★ If the reading is the standard, but the Kawasaki Smart Steering system does not operate, inspect the following.
ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)



Kawasaki Smart Steering (KSS) System

[illegible]

1. Joint Connector Q (Ground)
2. Ignition Switch
3. Joint Connector P (12 V)
4. Joint Connector R (12 V)
5. Joint Connector T (12 V)
6. ECU Main Relay
7. System Relay
8. ECU
9. Joint Connector D (12 V)
10. Joint Connector C (12 V)
11. Joint Connector E (Ground)
12. Main Fuse 20 A
13. Fuse Box 1
14. Battery
15. Joint Connector Y (Ground)
16. Joint Connector S (Ground)
17. Joint Connector W (10 V)
18. Steering Position Sensor
19. Meter Unit

Electric Trim Control System

Electric Trim Control Actuator Removal/Installation

- Refer to the Trim Control Cable Removal/Installation in the Steering chapter.

Electric Trim Control Motor Removal

CAUTION

Do not remove the electric trim control motor since it has been adjusted and set with precision at the factory.

Never drop the electric trim control actuator, especially on a hard surface. Such a shock to the electric trim control motor can damage it.

Electric Trim Control Motor Inspection

NOTE

○ Be sure the battery is fully charged.

- Turn the ignition switch to ON.
- Push the electric trim control button.
- Check to see that the steering nozzle [A] moves to the full up and the full down positions smoothly.

○ The electric trim control actuator stops automatically when the steering nozzle gets to the horizontality [A].

- Turn the ignition switch to OFF.

★ If the steering nozzle operates properly, check the following.

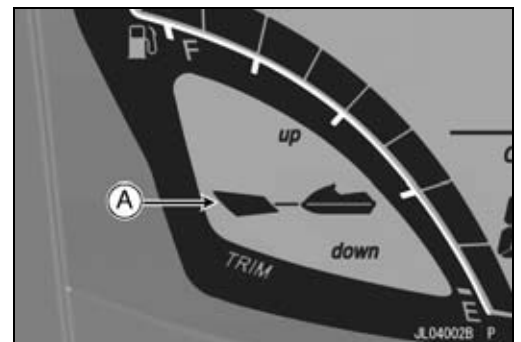
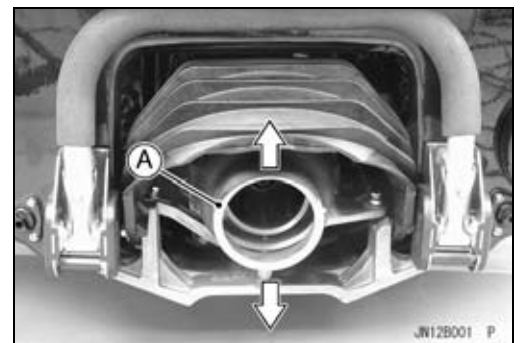
Wirings (see Electric Trim Control System Circuit)

ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)

★ If the steering nozzle does not operate, check the following.

Wirings (see Electric Trim Control System Circuit)

Electric Trim Control Relay (see Electric Trim Control Relay Inspection)



Electric Trim Control Sensor Removal

CAUTION

Do not remove the electric trim control sensor since it has been adjusted and set with precision at the factory.

Never drop the electric trim control actuator, especially on a hard surface. Such a shock to the electric trim control motor can damage it.

Electric Trim Control Sensor Inspection

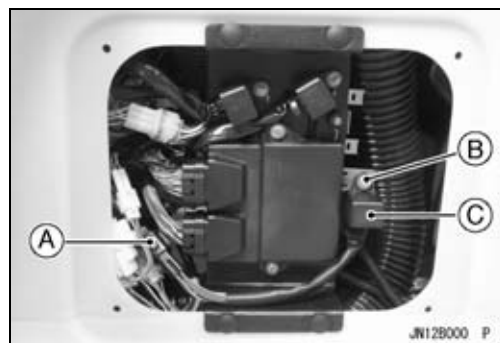
- Refer to the Electric Trim Control Sensor Inspection in the Fuel System (DFI) chapter.

14-50 ELECTRICAL SYSTEM

Electric Trim Control System

Electric Trim Control Relay Removal/Installation

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the connector [A].
- Remove:
 - Relay Mounting Bolt [B]
 - Electric Trim Control Relay [C]



- Installation is the reverse of removal. Note the following.
- Apply a non-permanent locking agent to the relay mounting bolt.
- Tighten:

Torque - Relay Mounting Bolt: 2.5 N·m (0.25 kgf·m, 22 in·lb)

Electric Trim Control Relay Inspection

- Remove the electric trim control relay (see Electric Trim Control Relay Removal/Installation).
- Connect the hand tester [A] to the electric trim control relay lead connector [B].

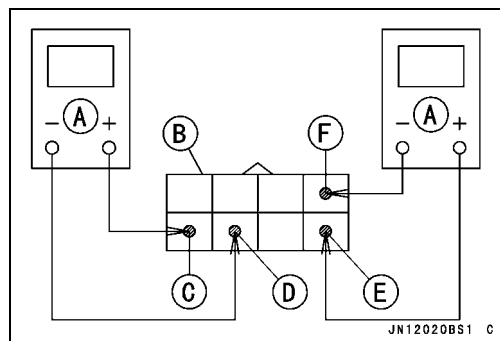
Special Tool - Hand Tester: 57001-1394

Electric Trim Control Relay Resistance

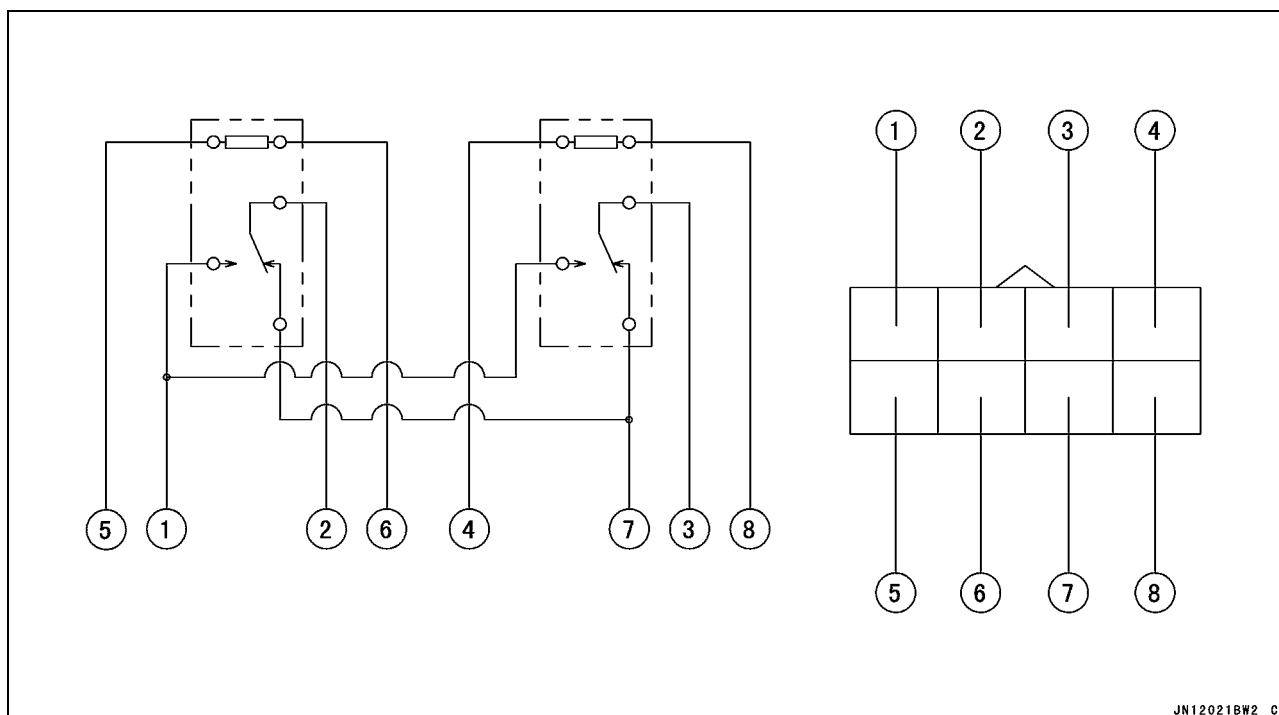
Connections: R/W lead [C] ↔ G lead [D]
 BL lead [E] ↔ R/BL lead [F]

Standard: 134 ~ 200 Ω

- ★ If the reading is out of the standard, replace the electric trim control relay.
- ★ If the reading is within the standard, check conductivity of the following numbered terminals by connecting the hand tester and one 12 V battery to the relay assembly as shown.



Electric Trim Control System



Electric Trim Control Relay Circuit Inspection

Battery Connection (-) - (+)	Tester Connection	Tester Reading (Ω)
- - -	1-2, 1-3, 1-7	∞
	2-3, 2-7, 3-7	0
5-6	1-3, 1-7, 2-3, 2-7	∞
	1-2, 3-7	0
4-8	1-2, 1-7, 2-3, 3-7	∞
	1-3, 2-7	0

(+): Apply positive lead.

(-): Apply negative lead.

Electric Trim Control System

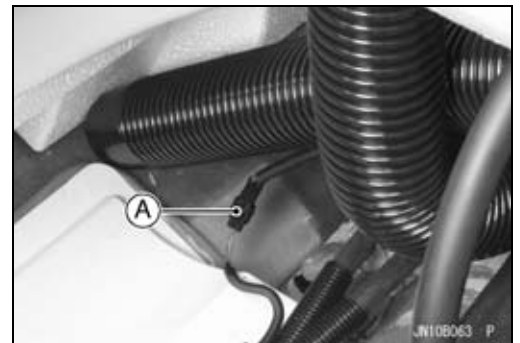
Wiring diagram for the JN12019BW3 unit, showing connections for 23 numbered components. The diagram includes a power supply (1), various relays (2-10), switches (11-13), a control unit (14), a motor (15), and other components (16-23). Wires are color-coded and labeled with abbreviations like R/BK, G/Y, and B/L.

1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector B (Ground)
8. Joint Connector F (5 V)
9. Joint Connector D (12 V)
10. Joint Connector C (12 V)
11. ECU
12. Electric Trim Control Button
13. Joint Connector E (Ground)
14. Electric Trim Control Sensor
15. Electric Trim Control Motor
16. Main Fuse 20 A
17. Fuse Box 1
18. Electric Trim Control Relay Fuse 20 A
19. Fuse Box 2
20. Battery
21. Joint Connector Y (Ground)
22. Joint Connector S (Ground)
23. Electric Trim Control Relay

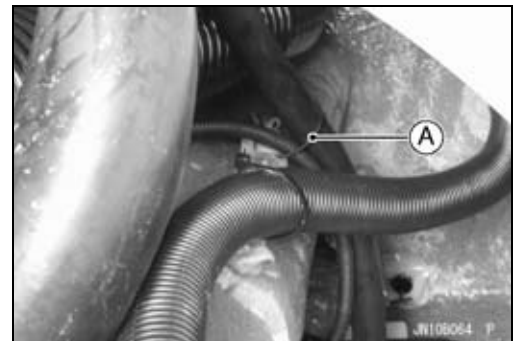
Sensors

Speed Sensor Removal

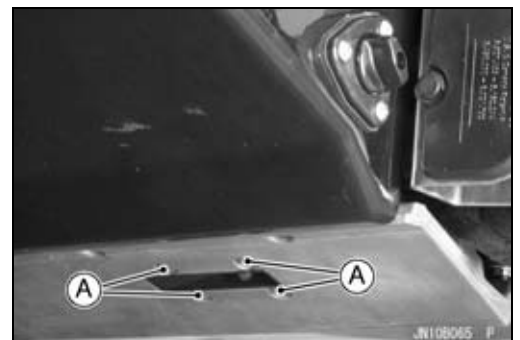
- Remove:
 - Reboarding Step (see Reboarding Step Removal in the Hull/Engine Hood chapter)
 - Reverse Bucket (see Reverse Bucket Removal in the Steering chapter)
 - Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
 - Intercooler (see Intercooler Removal in the Cooling and Bilge Systems chapter)
 - Exhaust Pipe and Muffler Body (see Exhaust Pipe and Muffler Body Removal in the Exhaust System chapter)
 - Water Box Muffler (see Water Box Muffler Removal in the Exhaust System chapter)
- Disconnect the speed sensor lead connector [A].



- Remove the band [A].



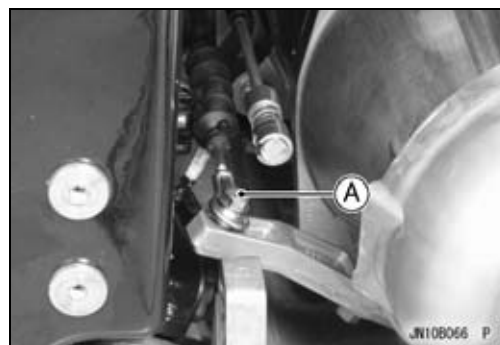
- Remove the speed sensor mounting screws [A].



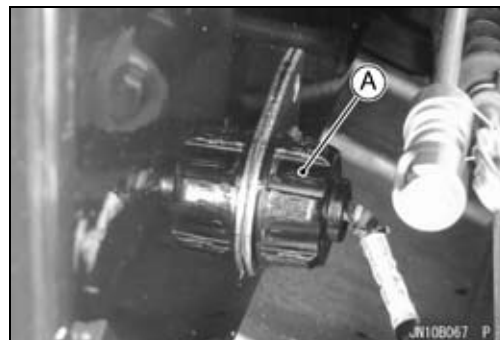
14-54 ELECTRICAL SYSTEM

Sensors

- Remove the trim control cable joint bolt [A].

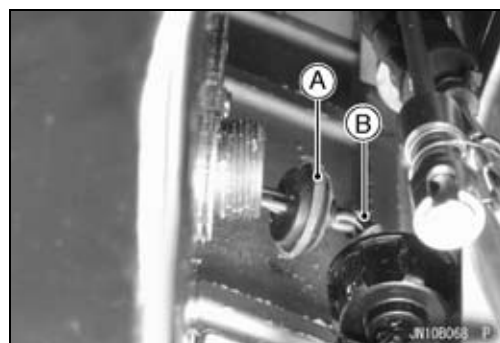


- Remove the cap [A] and take the speed sensor lead off the hull.

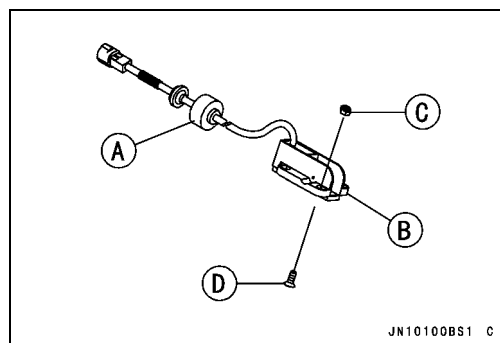


Speed Sensor Installation

- Run the speed sensor lead properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply silicone sealant around the grommet [A] and lead wires [B].



- Install:
 - Cap [A]
 - Speed Sensor [B]
 - Nuts [C]
- Apply a non-permanent locking agent to the speed sensor mounting screws [D].
- Tighten:
 - Torque - Speed Sensor Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)**
- Apply a non-permanent locking agent to the trim control cable joint bolt.
- Tighten:
 - Torque - Trim Control Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)**
- Install the removed parts (see appropriate chapters).



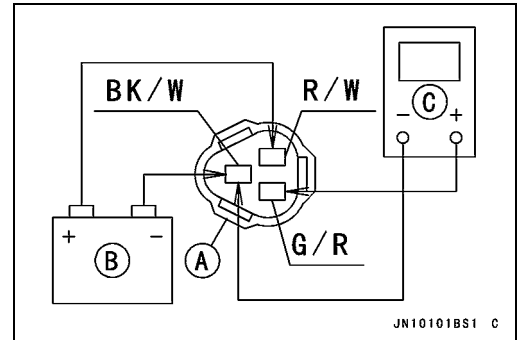
Sensors

Speed Sensor Inspection

- Remove the speed sensor (see Speed Sensor Removal).
- Connect the speed sensor lead connector [A] to the battery [B] and the hand tester [C] as shown in the figure.

Special Tool - Hand Tester: 57001-1394

- Set the hand tester to DC 25 V range.

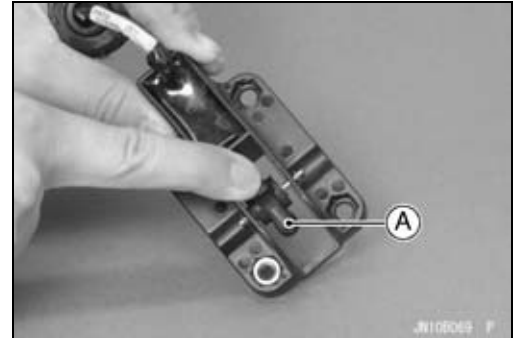


- Measure the speed sensor output voltage in low speed.
- Rotate the waterwheel [A] by hand slowly.

Output Voltage (in Low Speed)

G/R (+), BK/W (-) → 0 ~ battery voltage; twice a rotation

- ★ If the voltage does not rise from zero to battery voltage twice a rotation, replace the speed sensor.

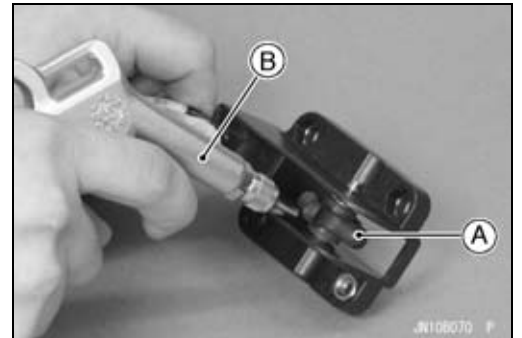


- Measure the speed sensor output voltage in high speed.
- Rotate the waterwheel [A] in a fair speed by compressed air [B].

Output Voltage (in High Speed)

G/R (+), BK/W (-) → approx. 5 V

- ★ If the voltage does not reach 5 volts when spun with compressed air, replace the speed sensor.



Fuel Level Sensor Inspection

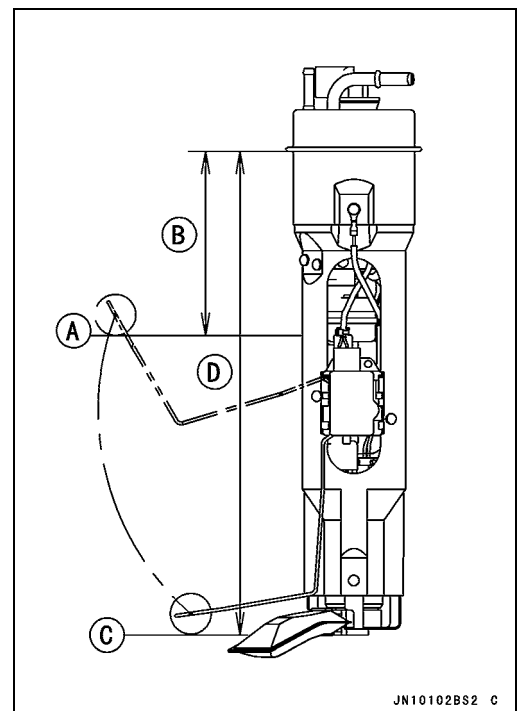
- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Check that the float moves smoothly without binding, and it should lower fully by own weight.
- ★ If the float does not move smoothly, replace the sensor.

Float in Full Position [A]

121.5 ± 6 mm (4.783 ± 0.2 in.) [B]

Float in Empty Position [C]

318.5 ± 6 mm (12.54 ± 0.2 in.) [D]



14-56 ELECTRICAL SYSTEM

Sensors

- Using the hand tester [A], measure the resistance across the terminals in the fuel level sensor lead connector.

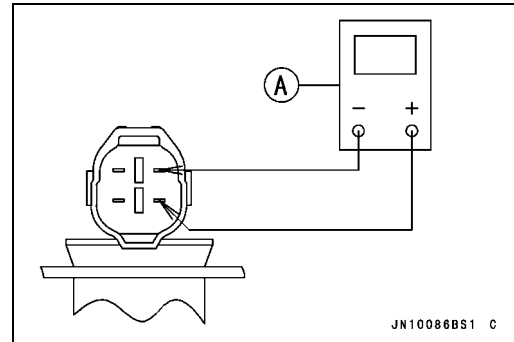
Special Tool - Hand Tester: 57001-1394

Fuel Level Sensor Resistance

Standard: Full position: 2 ~ 4 Ω

Empty position [C]: 117 ~ 123 Ω

- ★ If the tester readings are not as specified, or do not change smoothly according as the float moves up and down, replace the sensor.



Throttle Position Sensor Removal/Installation

- Refer to the Throttle Position Sensor Removal in the Fuel System (DFI) chapter.

Throttle Position Sensor Inspection

- Refer to the Throttle Position Sensor Output Voltage Inspection in the Fuel System (DFI) chapter.

Accelerator Position Sensor Removal/Installation

- Refer to the Accelerator Position Sensor Removal in the Fuel System (DFI) chapter.

Accelerator Position Sensor Inspection

- Refer to the Accelerator Position Sensor Output Voltage Inspection in the Fuel System (DFI) chapter.

Water Temperature Sensor Removal/Installation

- Refer to the Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter.

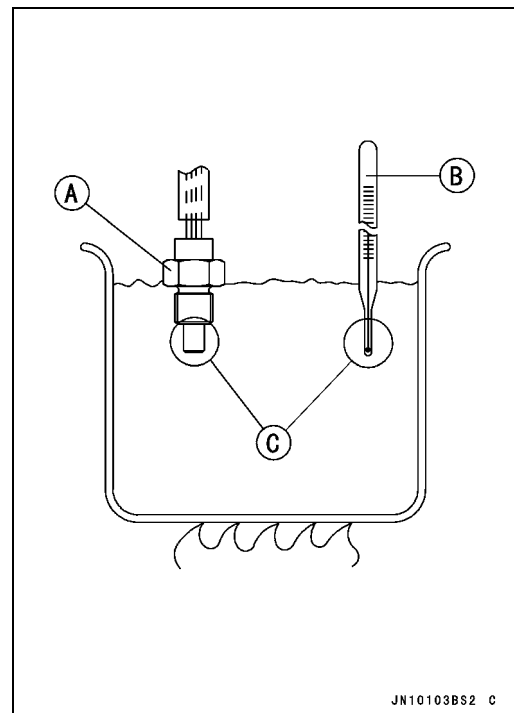
Water Temperature Sensor Inspection

- Remove the water temperature sensor (see Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

NOTE

○ The sensor and thermometer must not touch the container side or bottom.

- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.



Sensors

- Measure the internal resistance of the sensor with a digital meter.
- The sensor sends electric signals to the ECU.
- Measure the resistance across the terminals and the body (for the gauge) at the temperatures shown in the table.

Water Temperature Sensor Resistance

Water Temperature	Sensor Resistance
20°C (68°F)	12.17 ~ 13.92 kΩ
50°C (122°F)	4.025 ~ 4.810 kΩ
90°C (194°F)	1.182 ~ 1.481 kΩ
100°C (212°F)	0.9025 ~ 1.142 kΩ

- ★ If the digital meter does not show the specified values, replace the sensor.

Oil Temperature Sensor Removal/Installation

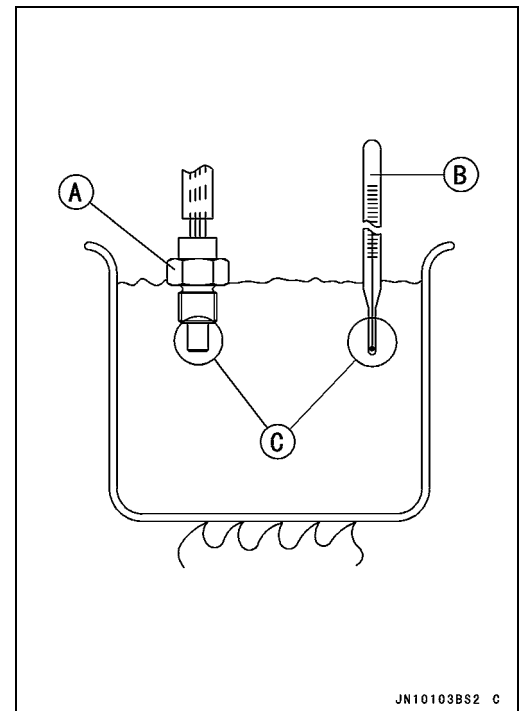
- Refer to the Oil Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter.

Oil Temperature Sensor Inspection

- Remove the oil temperature sensor (see Oil Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

NOTE

- The sensor and thermometer must not touch the container side or bottom.
- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.



JN10103BS2 C

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Oil Temperature Sensor Resistance

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100°C (212°F)	0.9025 ~ 1.142 kΩ

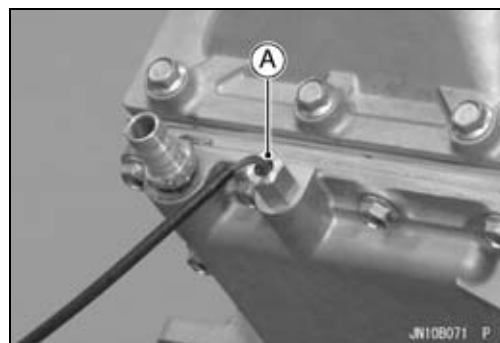
- ★ If the digital meter does not show the specified values, replace the sensor.

14-58 ELECTRICAL SYSTEM

Sensors

Water Temperature Sensor (for Meter Unit) Removal/Installation

- Remove:
 - Intercooler (see Intercooler Removal in the Cooling and Bilge Systems chapter)
 - Water Temperature Sensor (for Meter Unit) [A]



- Installation is the reverse of removal. Note the following.
- Tighten:

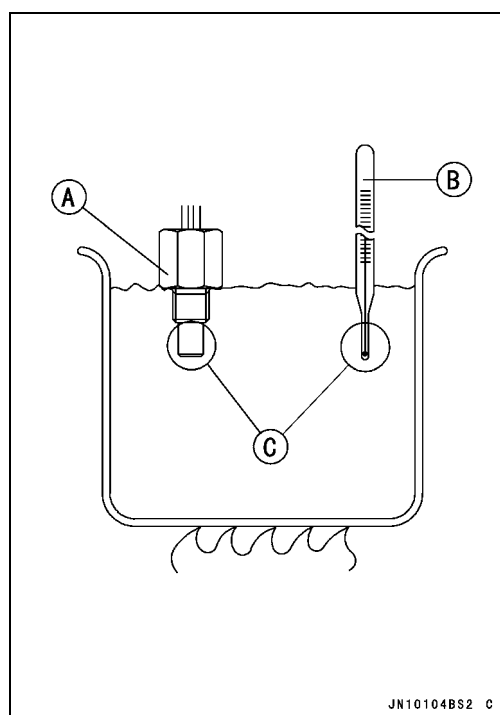
Torque - Water Temperature Sensor (for Meter Unit): 8.8 N·m (0.90 kgf-m, 78 in·lb)

Water Temperature Sensor (for Meter Unit) Inspection

- Remove the water temperature sensor (for meter unit) (see Water Temperature Sensor (for Meter Unit) Removal/Installation).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

NOTE

- The sensor and thermometer must not touch the container side or bottom.
- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.



- Measure the internal resistance of the sensor with a digital meter.
- The sensor sends electric signals to the meter unit.
- Measure the resistance across the terminals at the temperatures shown in the table.

Water Temperature Sensor (for Meter Unit) Resistance

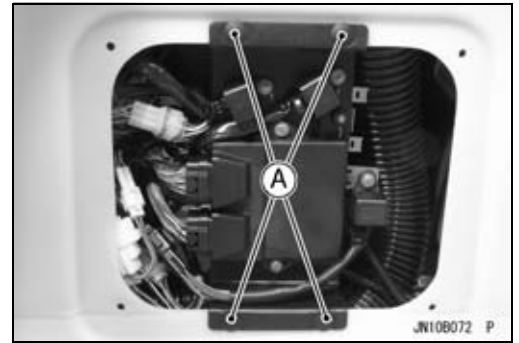
Water Temperature	Sensor Resistance
20°C (68°F)	12.17 ~ 13.92 kΩ
50°C (122°F)	4.025 ~ 4.810 kΩ
90°C (194°F)	1.182 ~ 1.481 kΩ
100°C (212°F)	0.9025 ~ 1.142 kΩ

- ★ If the digital meter does not show the specified values, replace the sensor.

Sensors

Air Temperature Sensor (for Meter Unit) ***Removal/Installation***

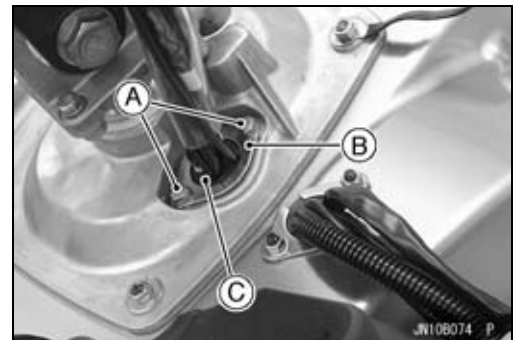
- Remove:
 - Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
 - Steering Pad (see Steering Removal in the Steering chapter)
 - Rivets [A]



- Disconnect the air temperature sensor (for meter unit) lead connector (Green, 2-pin) [A].



- Remove:
 - Grommet Holding Plate Bolts [A]
 - Plate [B]
 - Grommet [C]
- Take the air temperature sensor (for meter unit) off the tube.



- Installation is the reverse of removal. Note the following.
 - Run the sensor properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
 - Apply a non-permanent locking agent to the grommet holding plate bolts.

14-60 ELECTRICAL SYSTEM

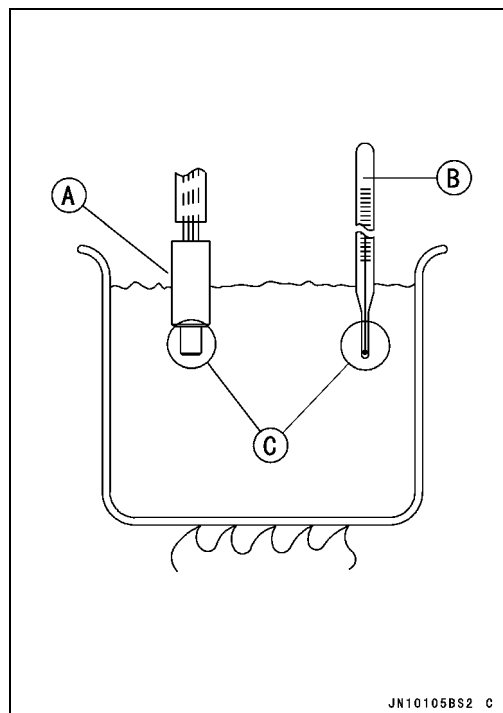
Sensors

Air Temperature Sensor (for Meter Unit) Inspection

- Remove the air temperature sensor (for meter unit) (see Air Temperature Sensor (for Meter Unit) Removal/Installation).
- Suspend the sensor [A] in a container of machine oil so that the heat-sensitive portion is submerged.
- Suspend an accurate thermometer [B] with heat-sensitive portions [C] located in almost the same depth.

NOTE

- The sensor and thermometer must not touch the container side or bottom.
- Place the container over a source of heat and gradually raise the temperature of the oil while stirring the oil gently.



- Measure the internal resistance of the sensor with a digital meter.
- The sensor sends electric signals to the meter unit.
- Measure the resistance across the terminals at the temperatures shown in the table.

Air Temperature Sensor (for Meter Unit) Resistance

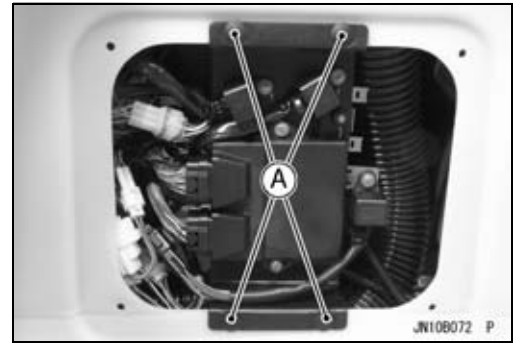
Oil Temperature	Sensor Resistance
20°C (68°F)	12.17 ~ 13.92 kΩ
50°C (122°F)	4.025 ~ 4.810 kΩ
90°C (194°F)	1.182 ~ 1.481 kΩ
100°C (212°F)	0.9025 ~ 1.142 kΩ

- ★ If the digital meter does not show the specified values, replace the sensor.

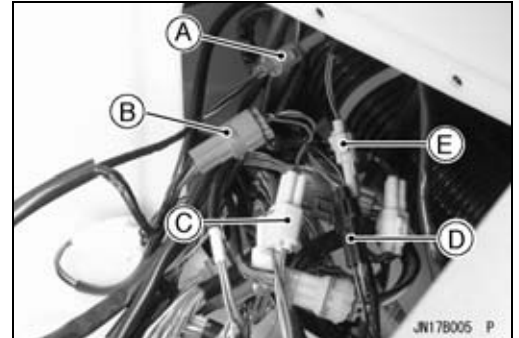
Multifunction Meter

Meter Unit Removal

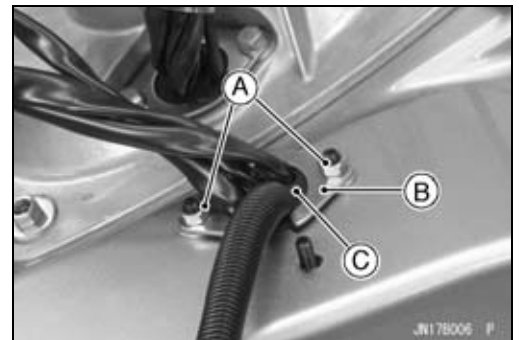
- Remove:
 - Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
 - Steering Cover (see Steering Removal in the Steering chapter)
 - Rivets [A]



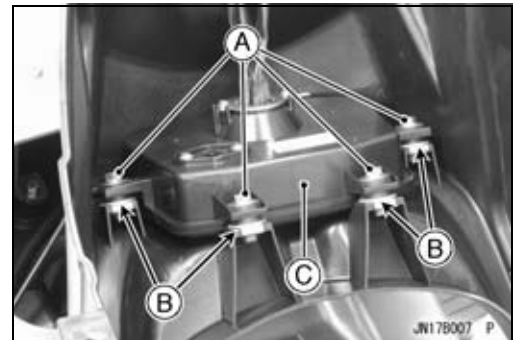
- Disconnect the meter unit lead connectors.
 - Blue, 2-pin [A]
 - Blue, 4-pin [B]
 - Yellow, 4-pin [C]
 - Black, 2-pin [D]
 - Green, 2-pin [E]



- Remove:
 - Nuts [A]
 - Plate [B]
 - Grommet [C]



- Remove:
 - Bolts [A]
 - Washers and Collars [B]
 - Meter Unit [C]

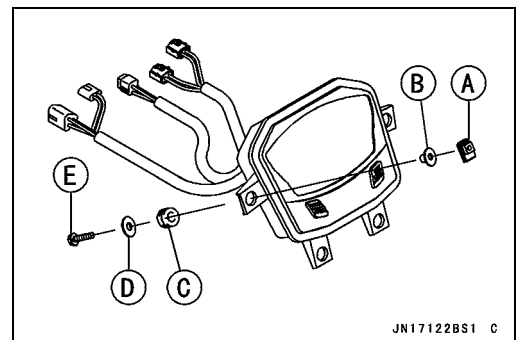


Meter Unit Installation

- Installation is the reverse of removal. Note the following.
 - Be sure the nuts [A], collars [B], rubber dampers [C] and the washers [D] are in place.
 - Apply a non-permanent locking agent to the meter unit mounting bolts [E].
 - Tighten:

Torque - Meter Unit Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

- Run the meter unit leads properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).



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Multifunction Meter

Meter Unit Operation Inspection

CAUTION

If the meter unit displays incorrectly while engine is running, first disconnect the battery negative (-) cable and reconnect it again to recover the meter display.

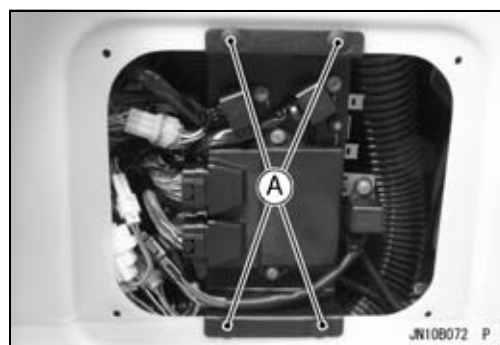
Then check to see that the standard plugs and/or plug caps are installed. Install only the standard plugs and/or plug caps. The resistors are embedded in both parts.

NOTE

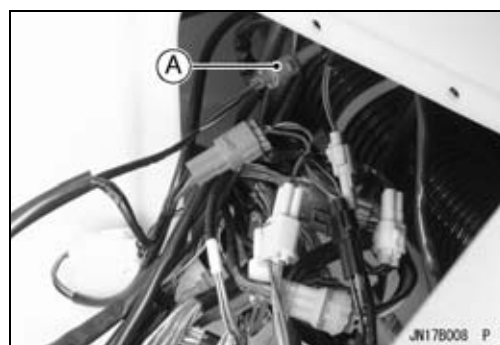
- Be sure the battery is fully charged.
- Be sure the wiring is normality (see Meter Unit Circuit).

Check 1-1: Switching Inspection

- Turn the ignition switch to ON and check the following.
- Following LCD segments appear gradually.
 - Speedometer [A]
 - Multifunction Meter [B]
 - Fuel Level Gauge [C]
 - Boost Meter [D]
 - Tachometer [E]
- Other LCD segments appear for 2 seconds.
- The warning indicator light (LED) [F] goes on for 2 seconds.
- The buzzer sounds twice.
- ★If the LCD segments do not work, replace the meter unit.
- ★If the buzzer does not work, inspect the buzzer.
- Remove:
 - Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
 - Rivets [A]



- Disconnect the buzzer connector (blue, 2-pin) [A].



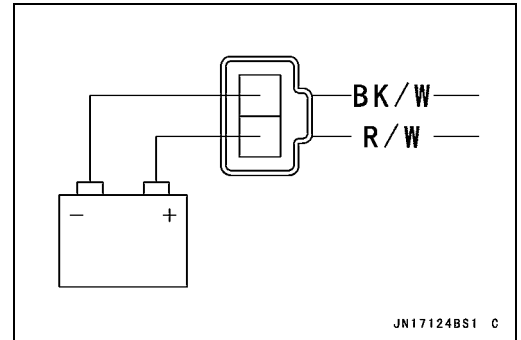
Multifunction Meter

- Connect the battery to the buzzer lead as shown in the figure.

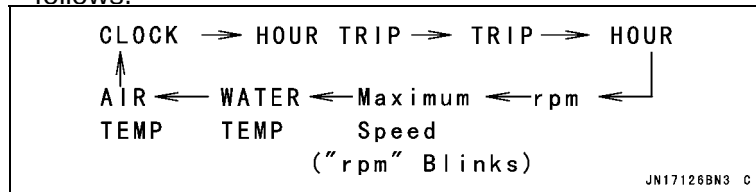
Connections:

Battery (+) ↔ **R/W lead**
Battery (-) ↔ **BK/W lead**

- ★ If the buzzer does not work, replace the buzzer.



- By pushing the MODE button [A] less than a second each time, check that the multifunction display [B] changes as follows.



NOTE

- These modes will shift in series when the MODE button pushed for 2 seconds or more.
- When the multifunction meter displays a warning, push the MODE or SET button for 1 second to return to the normal display.
- The MODE button operates when the engine is running slower than 3 000 r/min (rpm).

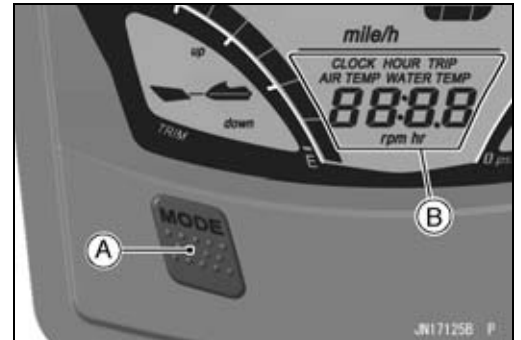
- ★ If the display function does not work, replace the meter unit.

- In the Hour mode, check that the Mile/Km display [A] switches to the "km/h" or "mile/h" by pushing the SET button [B] for more than 3 seconds.
- The Mile/Km display starts blinking, and the multifunction meter disappears.

NOTE

- Mile/Km Display can alternate between English and metric modes (mile and km) in the digital meter. Make sure that km or mile according to local regulations is correctly displayed before riding.

- ★ If the display function does not work, replace the meter unit.



14-64 ELECTRICAL SYSTEM

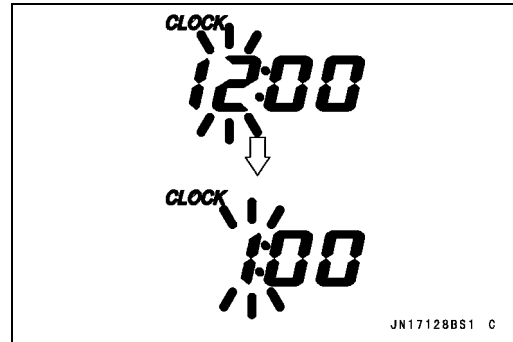
Multifunction Meter

Check 1-2: Clock Setting Inspection

- In the Clock mode, check that the clock display switches to the Hour-setting mode by pushing the SET button for 2 seconds or more.

○ The hour display starts blinking when the mode switches.

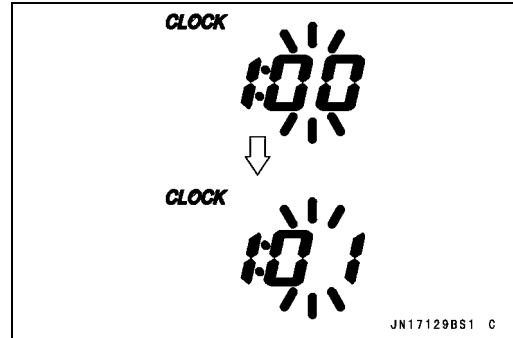
- Check that the hour display changes by pushing the MODE button.



- In the Hour-setting mode, check that the clock display switches to the Minute-setting mode by pushing the SET button.

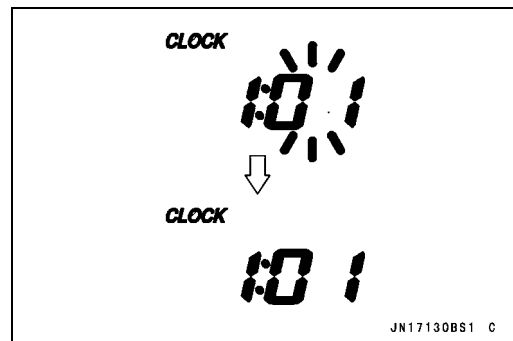
○ The minute display starts blinking.

- Check that the minute display changes by pushing the MODE button.



- In the Minute-setting mode, check that the clock setting process completes by pushing the SET button.

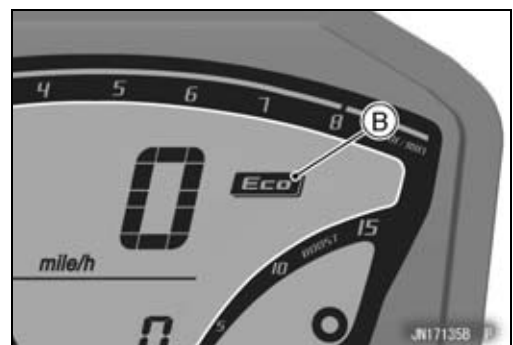
★ If the display function does not work, replace the meter unit.



Check 1-3: Fuel Economy Assistance Indicator Inspection

- Turn the ignition switch to ON.
- By pushing the fuel economy assistance mode button [A], check that the fuel economy assistance indicator [B] appears.
- By pushing the fuel economy assistance mode button for 2 seconds or more, check that the fuel economy assistance indicator disappears.
- Turn the ignition switch to OFF.

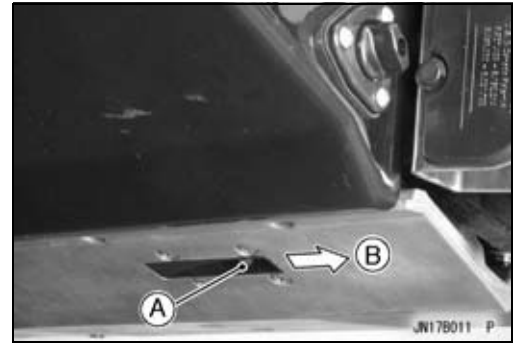
★ If the meter does not work, check the following.
Fuel Economy Assistance Mode Button (see Switch Inspection)



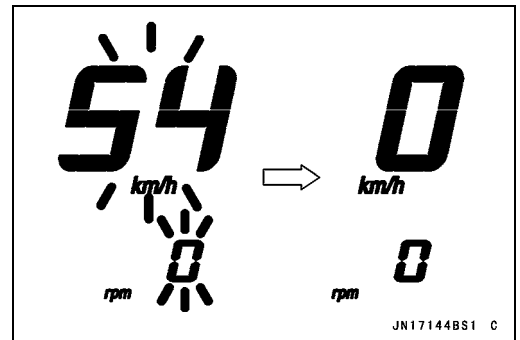
Multifunction Meter

Check 1-4: Maximum Speed/Engine RPM Display Inspection

- Turn the ignition switch to ON.
- Rotate the water wheel [A] by hand or compressed air.
Rotatory Direction [B]
- In the Maximum Speed/Engine RPM mode, check that the speedometer [A] shows maximum speed.
- First, the display shows "0 km/h or 0 mile/h" and "0 rpm".
- ★ If the display function does not work, inspect the speed sensor (see Speed Sensor Inspection).
- ★ If the speed sensor is good, check the speed sensor power supply (see Check 2-3).

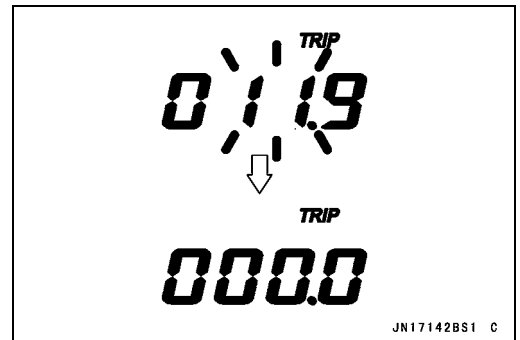


- Check that the display turns to "0" by pushing the SET button for 2 seconds or more.
- The speedometer and engine speed display starts blinking.
- ★ If the display function does not work, replace the meter unit.



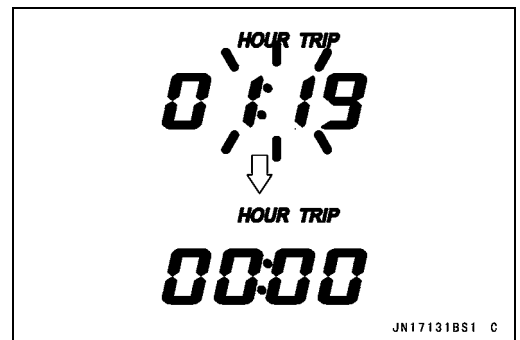
Check 1-5: Trip Meter Inspection

- In the Trip Meter mode, check it by the same way as Check 1-4.
- ★ If the display function does not work, replace the meter unit.
- Check that the display turns to "000.0" by pushing the SET button for 2 seconds or more.
- The Trip Meter blinks until the display is reset.
- ★ If the display function does not work, replace the meter unit.



Check 1-6: Time Meter Inspection

- In the Time Meter mode, check that the display turns to "00:00" by pushing the SET button for 2 seconds or more.
- The Time Meter blinks until the display is reset.
- ★ If the display function does not work, replace the meter unit.

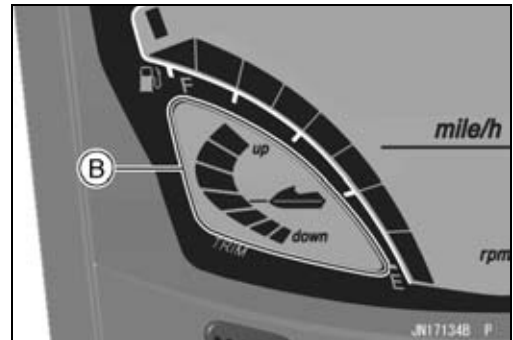
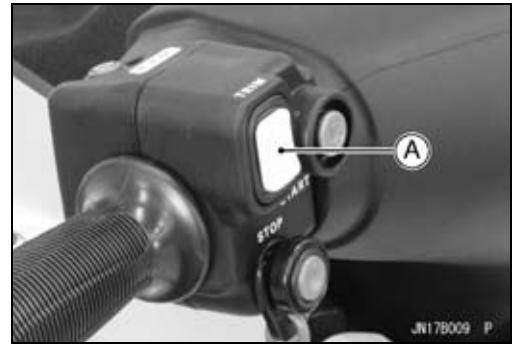


14-66 ELECTRICAL SYSTEM

Multifunction Meter

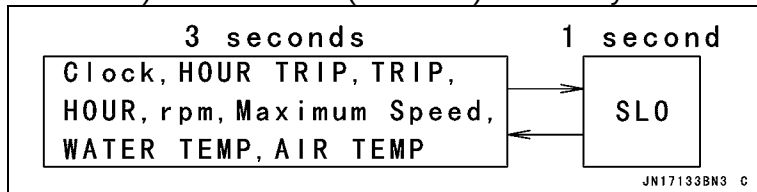
Check 1-7: Trim Position Indicator Inspection

- Turn the ignition switch to ON.
- By pushing the electric trim control button [A], check that the display [B] indicates the trim position.
- Turn the ignition switch to OFF.
- ★ If the display function does not work, inspect the following.
 - Electrical Trim Control Button (see Switch Inspection)
 - Electrical Trim Control Sensor (see Electrical Trim Control Sensor Inspection in the Fuel System (DFI) chapter)
 - ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)
- ★ If these parts are good, replace the meter unit.



Check 1-8: SLO (Smart Learning Operation) Mode Display Inspection

- Using the SLO key (yellow-colored and marked SLO), turn the ignition switch to ON.
- Check that the display [A] switch to the normal display (3 seconds) and the "SLO" (1 second) alternately as follows.



NOTE

○ Under the SLO mode, all the meter displays and other functions work in the same manner as the FPO (Full Power Operation) mode.

- ★ If the display function does not work, replace the meter unit.

Check 1-9: FPO (Full Power Operation) Mode Display Inspection

- Using the FPO key (orange-colored), turn the ignition switch to ON.
- Check that the "FPO" appears in the display [A] for 2 seconds before the normal display appears.
- ★ If the display function does not work, replace the meter unit.



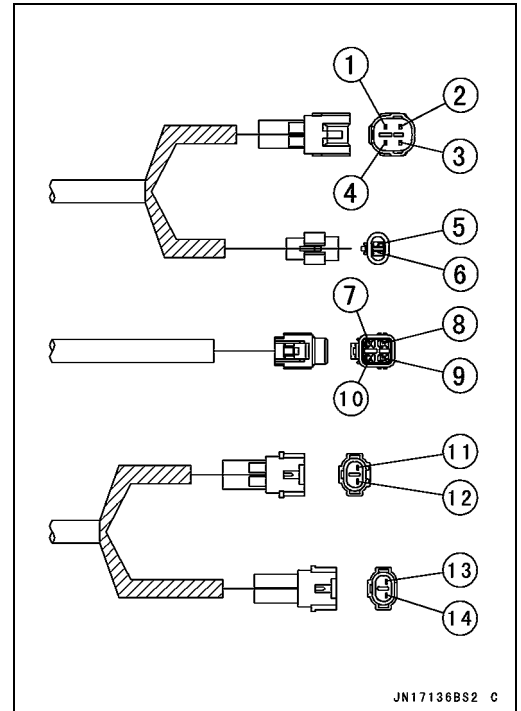
Multifunction Meter

Meter Unit Inspection

- Remove the meter unit (see Meter Unit Removal).
 - [1] Battery (+): R
 - [2] Ground (-): BK
 - [3] Speed Sensor/Steering Position Sensor (+): R/BL
 - [4] Ignition Switch (+): R/W
 - [5] Buzzer (-): BK/W
 - [6] Buzzer (+): R/BK
 - [7] Fuel Level Sensor: W/R
 - [8] ECU communication Signal: BL/BK
 - [9] Unused
 - [10] Speed Sensor Signal: G/R
 - [11] Water Temperature Sensor (+): BR
 - [12] Water Temperature Sensor (-): BK/BR
 - [13] Air Temperature Sensor (+): LG
 - [14] Air Temperature Sensor (-): BK/R

CAUTION

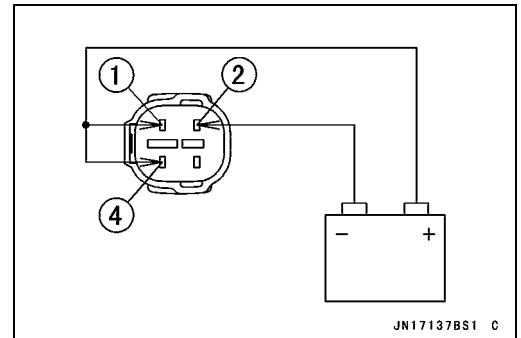
Do not drop the meter unit. Place the meter unit so that it faces upward. If the meter unit is left upside down or sideways for a long time or dropped, it will malfunction. Do not short each terminal.



JN17136BS2 C

Check 2-1: Meter Unit Power Supply Inspection

- Using auxiliary leads, connect the 12 V battery to the meter unit connector as follows.
 - Connect the battery (+) terminal to the terminal [1].
 - Connect the battery (-) terminal to the terminal [2].
- Connect the terminal [4] to the battery (+) terminal.



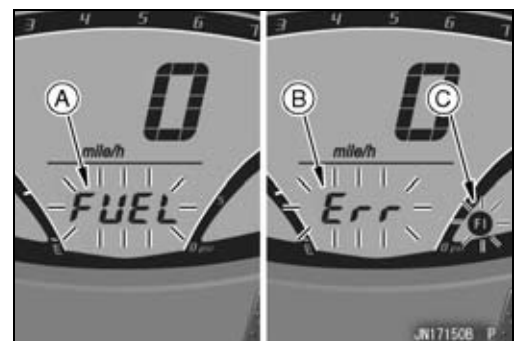
JN17137BS1 C

- Check the following items.
 - Following LCD segments appear gradually.
 - Speedometer [A]
 - Multifunction Meter [B]
 - Fuel Level Gauge [C]
 - Boost Meter [D]
 - Tachometer [E]
 - Other LCD segments appear for 2 seconds.
 - The warning indicator light (LED) [F] goes on.



JN17123B P

- The "FUEL" [A] blinks for 5 seconds, and then the "Err" [B] and the FI warning symbol [C] start blinking.
- Push the MODE or SET button for 1 second, the multifunction meter switches to the normal display.
- ★ If the meter does not work, replace the meter unit.



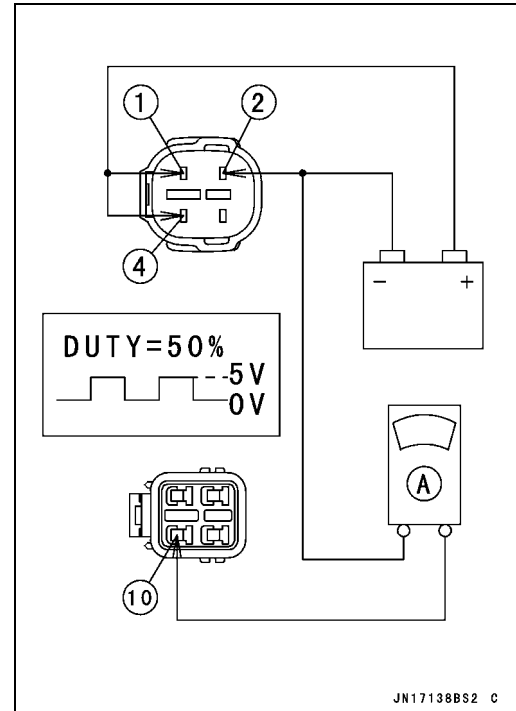
JN17150B P

14-68 ELECTRICAL SYSTEM

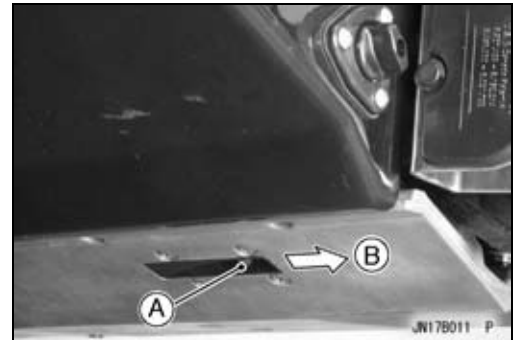
Multifunction Meter

Check 2-2: Speedometer Inspection

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect an oscillator [A] to the terminal [10] and the ground.
- The speedometer displays the speed that rests on the frequency when the square wave is input.
- The speedometer indicates approximately 40 mph (64 km/h) when the input frequency is approximately 203.7 Hz.
- ★ If the display function does not work, replace the meter unit.



- ★ If the oscillator is not available, the speedometer can be checked as follows.
- Install the meter unit (see Meter Unit Installation).
- Turn the ignition switch to ON.
- Rotate the water wheel [A] by hand.
- Rotatory Direction [B]
- Check that the speedometer shows the speed.
- ★ If the display function does not work, inspect the speed sensor (see Speed Sensor Inspection).
- ★ If the speed sensor is good, check the speed sensor power supply (see Check 2-3).

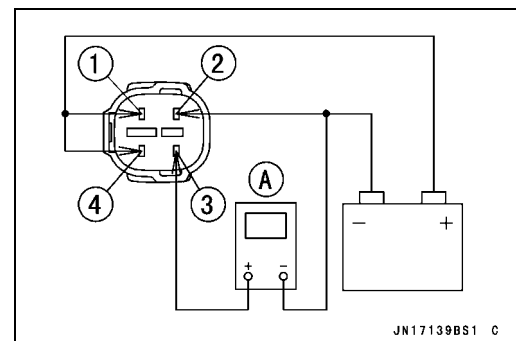


Check 2-3: Speed Sensor Power Supply Inspection

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Set the hand tester [A] to the DC 25 V range and connect it to the meter unit as follows.

Special Tool - Hand Tester: 57001-1394

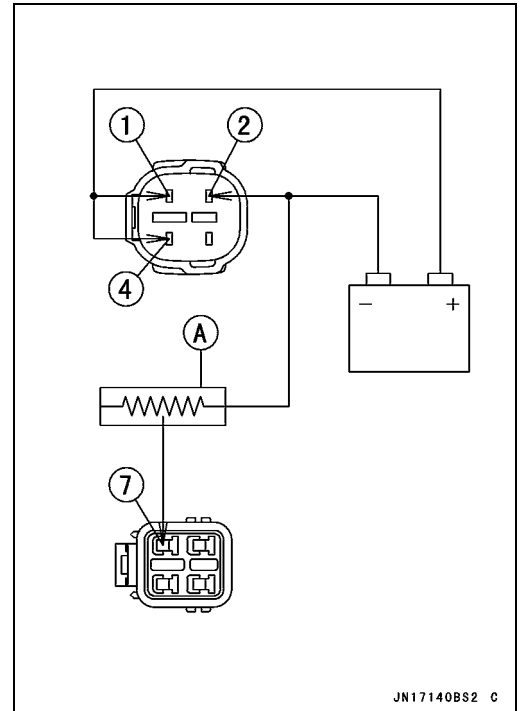
- Connect the tester (+) terminal to the terminal [3].
- Connect the tester (-) terminal to the terminal [2].
- ★ If the power supply voltage shows a much lower than 10.8 V, replace the meter unit.



Multifunction Meter

Check 2-4: Fuel Level Gauge Inspection

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [7] and the battery (-) terminal.

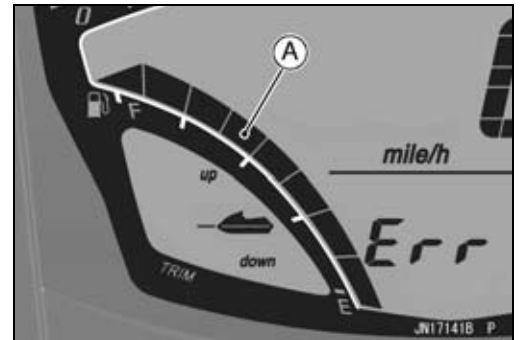


- Check that the segments number of the fuel level gauge [A] matches the resistance value of the variable rheostat.

Variable Rheostat Resistance (Ω)	Fuel Level Gauge
5	8 Segments Appear
60	1 Segment Blinks
100	All Segments Disappear

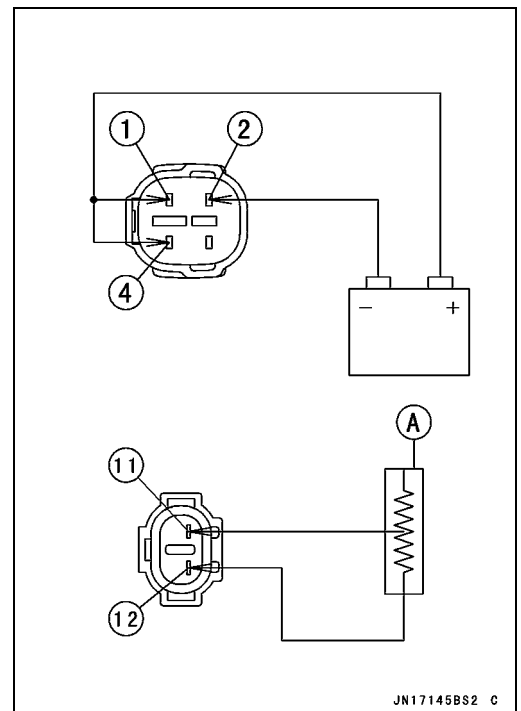
○The fuel level gauge is updated every 10 seconds.

★If the display function does not work, replace the meter unit.



Check 2-5: Water Temperature Meter Inspection

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [11] and the terminal [12].



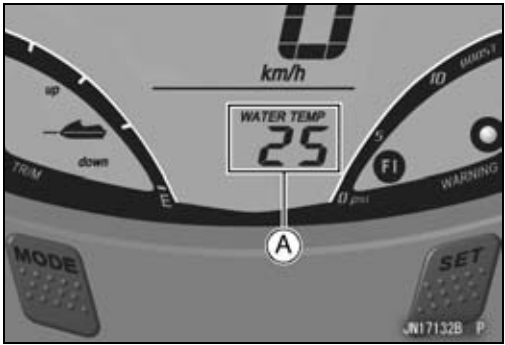
14-70 ELECTRICAL SYSTEM

Multifunction Meter

- Check that the water temperature meter [A] matches the resistance value of the variable rheostat.

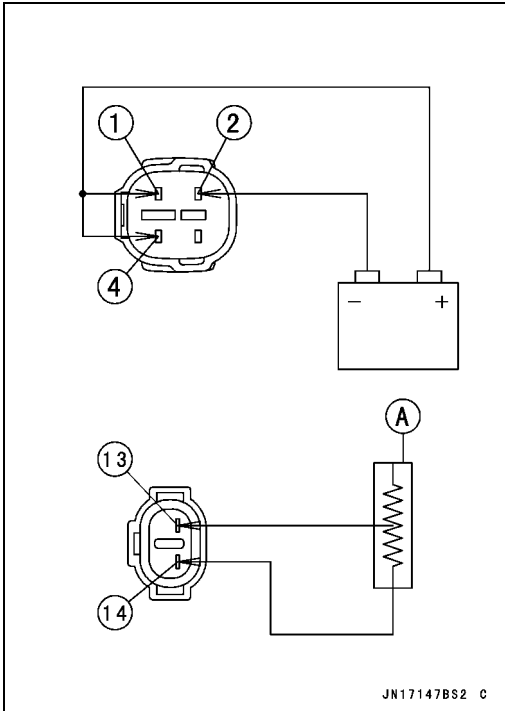
Variable Rheostat Resistance (kΩ)	Water Temperature Meter
30.00	About 0°C (32°F)
10.74	About 25°C (77°F)

★If the display function does not work, replace the meter unit.



Check 2-6: Air Temperature Meter Inspection

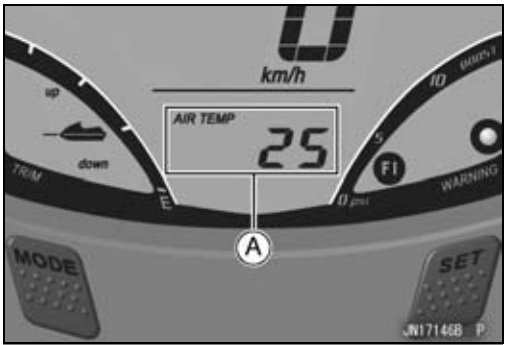
- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [13] and the terminal [14].



- Check that the air temperature meter [A] matches the resistance value of the variable rheostat.

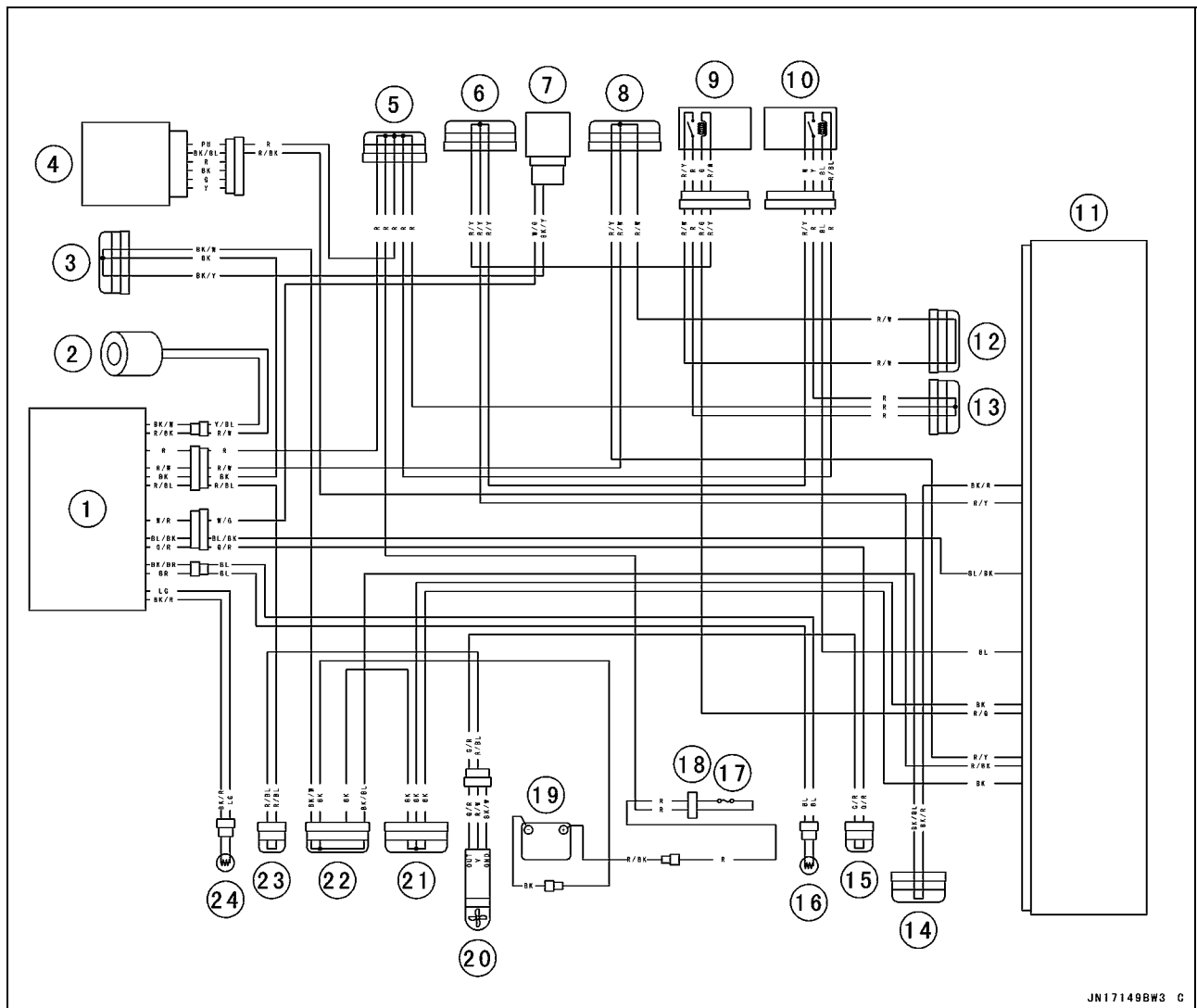
Variable Rheostat Resistance (kΩ)	Air Temperature Meter
30.00	About 0°C (32°F)
10.74	About 25°C (77°F)

★If the display function does not work, replace the meter unit.



Multifunction Meter

Multifunction Meter Circuit



JN17149BW3 C

- | | |
|----------------------------------|---|
| 1. Meter Unit | 13. Joint Connector C (12 V) |
| 2. Buzzer | 14. Joint Connector E (Ground) |
| 3. Joint Connector Q | 15. Joint Connector J (Speed Sensor Signal) |
| 4. Ignition Switch | 16. Water Temperature Sensor (for Meter Unit) |
| 5. Joint Connector P (12 V) | 17. Main Fuse 20 A |
| 6. Joint Connector R (12 V) | 18. Fuse Box 1 |
| 7. Fuel Level Sensor (Fuel Pump) | 19. Battery |
| 8. Joint Connector T (12 V) | 20. Speed Sensor |
| 9. ECU Main Relay | 21. Joint Connector Y (Ground) |
| 10. System Relay | 22. Joint Connector S (Ground) |
| 11. ECU | 23. Joint Connector W (10 V) |
| 12. Joint Connector D (12 V) | 24. Air Temperature Sensor (for Meter Unit) |

14-72 ELECTRICAL SYSTEM

Immobilizer System

This watercraft is equipped with an immobilizer system to protect the watercraft from theft. This system provides a theft proof device by means of matching a code between the inbuilt key transponder and ECU (Electronic Control Unit). If the code does not match, ignition system, injectors and fuel pump will not operate and the engine will not start.

Abstract

- If the warning indicator light (LED), immobilizer warning symbol and the following character blink on the meter unit, and the buzzer sound goes off after the key is pressed, this shows a fault in the immobilizer system.

Imb-Immobilizer Amplifier Failure (Service Code: 35)

Ignl-Not Matching Key Code (Service Code: 36)

- Refer to the service code or character to identify the faulty component.

- If all coded keys (FPO key: orange-colored and SLO key: yellow-colored and marked SLO) are lost, the ECU will have to be replaced.

- The immobilizer system can not function until the user key code is registered in the ECU.

- A total of six keys can be registered in the ECU at any one time.

Operational Cautions

1. Do not expose the keys to excessively high temperature.
2. Do not place keys close to magnets.
3. Do not place a heavy item on any key.
4. Do not damage the plastic covers.
5. Do not give shocks to the keys.
6. One registered key is needed to have a new key (or keys) registered to ECU.
7. If both registered keys have been lost, renew the ECU.

NOTE

○ Since the immobilizer system uses the electric wave for communication, key identification error may occur where other electric waves abound.

Key Registration

Case 1: When the user key has been lost or additional spare user key is required.

NOTE

○ Be sure the battery is fully charged.

- Prepare a new spare user key.
- Remove the battery cover (see Battery Cover Removal/Installation).
- Disconnect the immobilizer/Kawasaki diagnostic system connector [A].
- Connect the key registration unit [A].

Special Tools - Key Registration Unit: 57001-1582

Key Registration Adapter: 57001-1746



Pre-registration of User Key 1

NOTE

○ Keep the other user key away from the ignition switch.

- Insert the registered key (user key 1) to the ignition switch and press it for a short time (within 2 seconds).

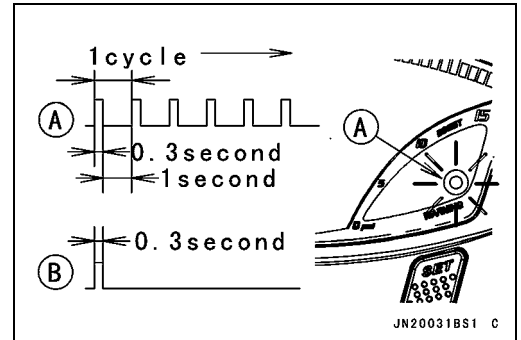
Immobilizer System

Verified

- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
 - The inserted key is the registered one.
- All user key codes in ECU are eliminated.
- The user key 1 is successfully pre-registered in the ECU, and ECU starts the key registration mode.
- The warning indicator light (LED) [A] blinks 1 time and stops for 1 second and then repeats this cycle.

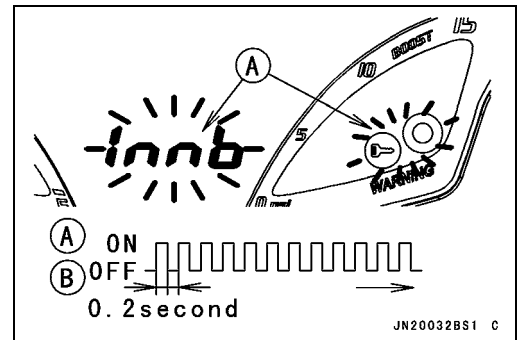
NOTE

- Only the first one cycle, the buzzer sound [B] goes off synchronizing with the blink of warning indicator light (LED).

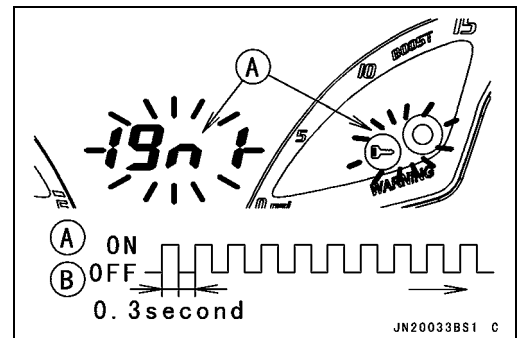


Not Verified

- The warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).
- Immobilizer Amplifier Failure (Service Code/Character -35/lmb)



Key Collation Error (Service Code/Character-36/lgnl)



Pre-registration of User Key n (2 ~ 6)

- Remove the user key 1.
- Insert the unregistered key (user key 2) and press it for a short time (within 2 seconds).

NOTE

- Continue with the procedure to register the second and later keys before the 15 seconds period has elapsed, the registration mode automatically finishes and the warning indicator light (LED) will switch off.
- At this procedure, the unregistered key (user key 2) is pressed for a long time (2 seconds or more), the procedure goes to the regular registration of user key (see Regular Registration of User Key).
- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
 - The inserted key is the unregistered one.
 - The number of the registered key is six or less.

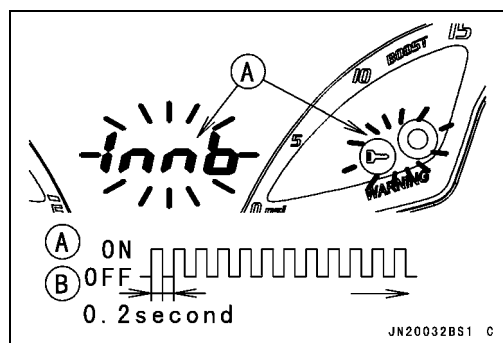
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Immobilizer System

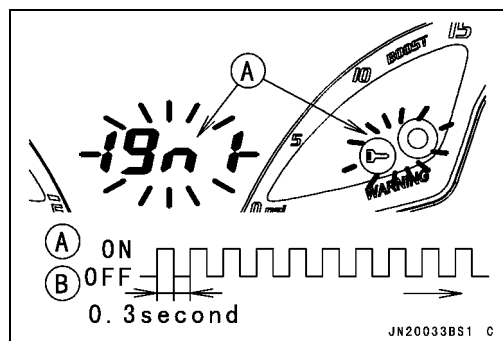
Not Verified

○The warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).

Immobilizer Amplifier Failure (Service Code/Character -35/Imb)



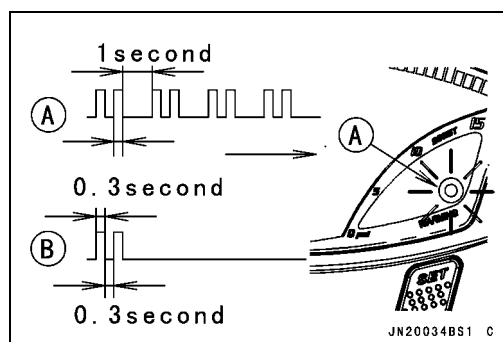
Key Collation Error (Service Code/Character-36/Ignl)



- The user key 2 is successfully pre-registered in the ECU.
- The warning indicator light (LED) [A] blinks 2 times and stops for 1 second and then repeats this cycle.

NOTE

○Only the first one cycle, the buzzer sounds [B] goes off synchronizing with the blink of the warning indicator light (LED).



- Continue the procedures to register additional 4 user keys.

NOTE

○The ECU can store up the six key codes (FPO key × n and SLO key × n).

Warning Indicator Light (LED) Blink and Buzzer Sound

	Warning Indicator Light (LED) Blinks and Buzzer Sound	Warning Indicator Light (LED) Blinks and Buzzer Sound Stop	Remarks
User Key 3	3 times	1 second	Repeat
User Key 4	4 times	1 second	Repeat
User Key 5	5 times	1 second	Repeat
User Key 6	6 times	1 second	Repeat

NOTE

○Only the first cycle, the buzzer sound goes off synchronizing with the blink of warning indicator light (LED).

Immobilizer System

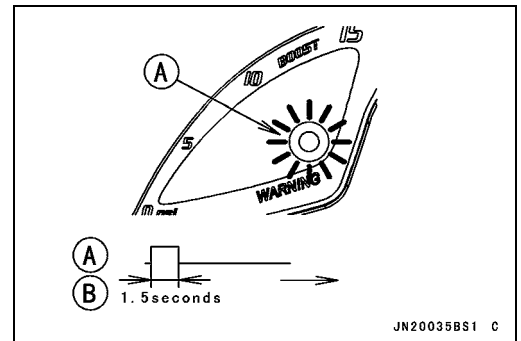
Regular Registration of User Key

- Leave the user key (1 ~ 6) in the ignition switch.
- Press key for a long time (2 seconds or more).
- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
 - The inserted key is the pre-registered one lastly.

NOTE

○ If the inserted key is not the pre-registered one lastly, the key registration mode will end instantaneously. Start the procedure again, pre-registration of user key 1.

- The pre-registered keys are registered regularly in the ECU.
- The warning indicator light (LED) [A] blinks 1 time for 1.5 seconds and the buzzer sound [B] goes off 1 time synchronizing with the blink of the warning indicator light (LED).

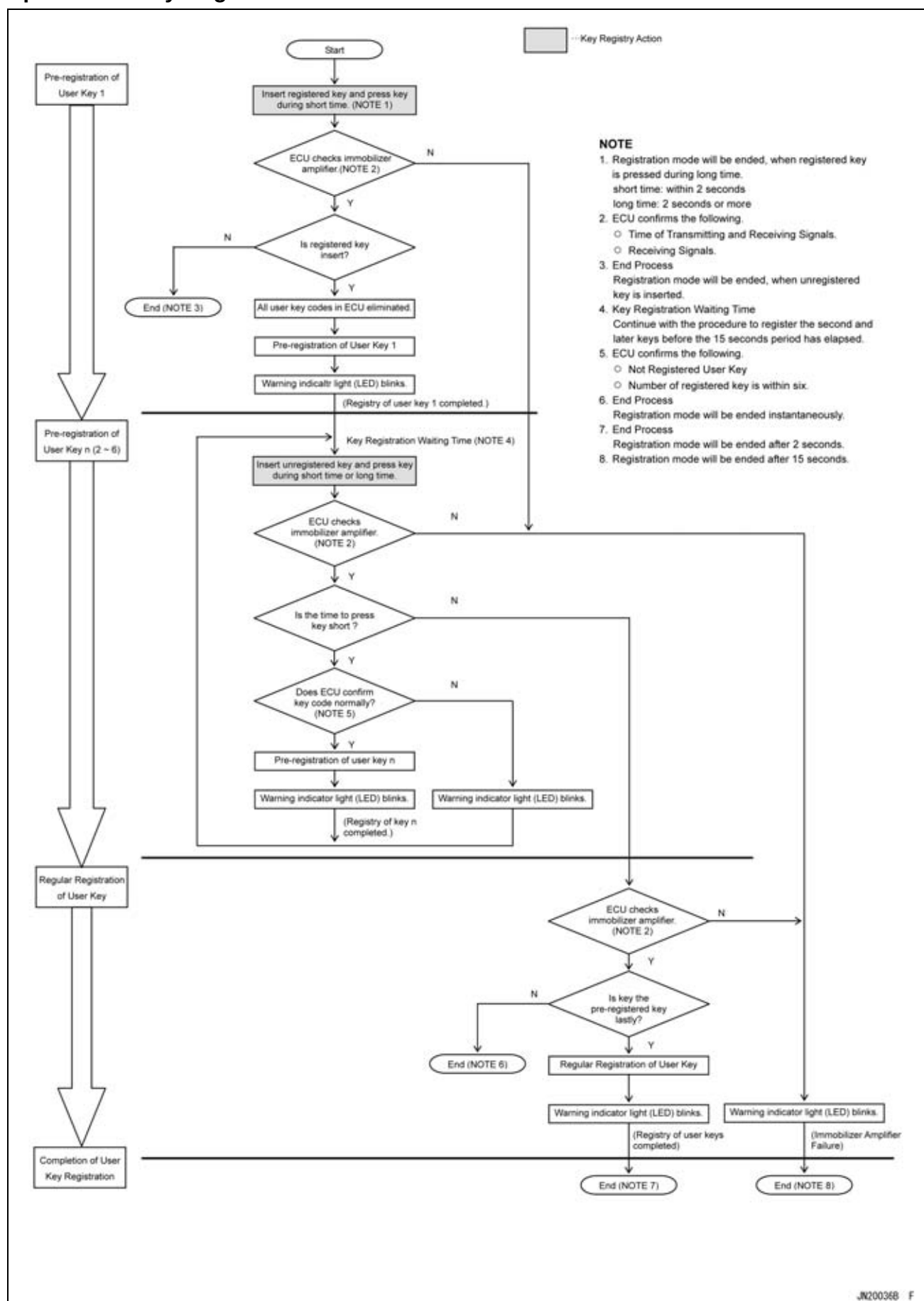


- The key registration mode automatically ends.
- Remove the key registration unit and connect the immobilizer/Kawasaki diagnostic system connector.

NOTE

○ Check that the engine can be started using all registered user keys.

Spare User Key Registration Flow Chart



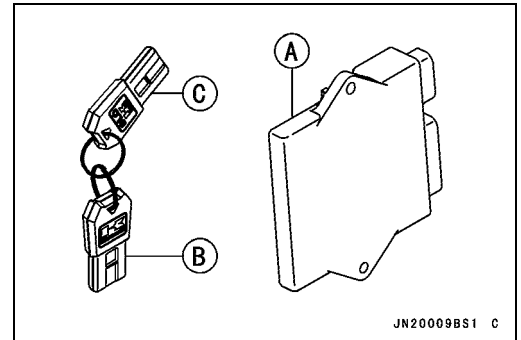
Immobilizer System

Case 2: When the ECU is faulty and has to be replaced.

NOTE

- Be sure the battery is fully charged.
- The key registration unit is not required.

- Prepare the following.
 - New ECU [A]
 - Current FPO Key [B] (orange-colored)
 - Current SLO Key [C] (yellow-colored and marked SLO)
- Replace:
 - ECU (see ECU Removal and Installation in the Fuel System (DFI) chapter)



Pre-registration of User Key 1

NOTE

- Keep the other user key away from the ignition switch.

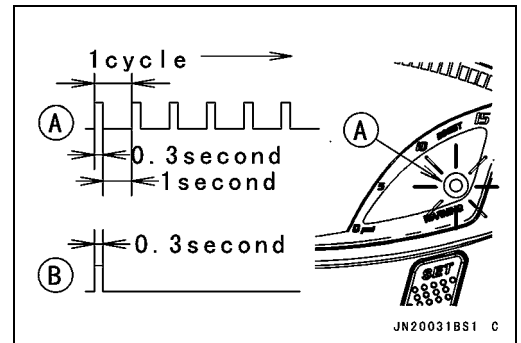
- Insert the current key (user key 1) to the ignition switch and press it for a short time (within 2 seconds) or long time (2 seconds or more).

Verified

- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
- The user key 1 is successfully pre-registered in the ECU, and ECU starts the key registration mode.
- The warning indicator light (LED) [A] blinks 1 time and stops for 1 second and then repeats this cycle.

NOTE

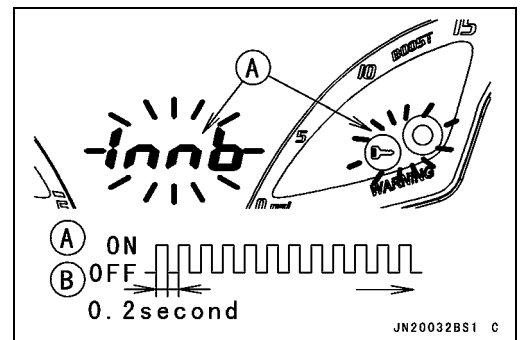
- Only the first one cycle, the buzzer sound [B] goes off synchronizing with the blink of the warning indicator light (LED).



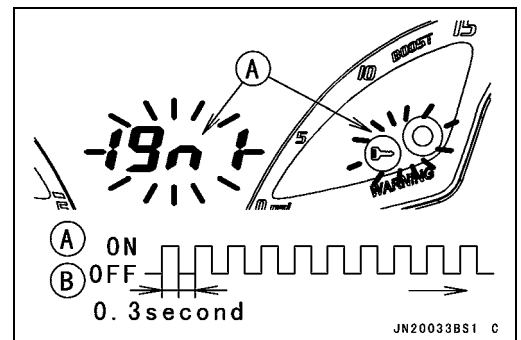
Not Verified

- The warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).

Immobilizer Amplifier Failure (Service Code/Character -35/Imb)



Key Collation Error (Service Code/Character-36/IgnI)



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Immobilizer System

Pre-registration of User Key 2

- Remove the user key 1.
- Insert the user key 2 and press it for a short time (within 2 seconds) or long time (2 seconds or more).

NOTE

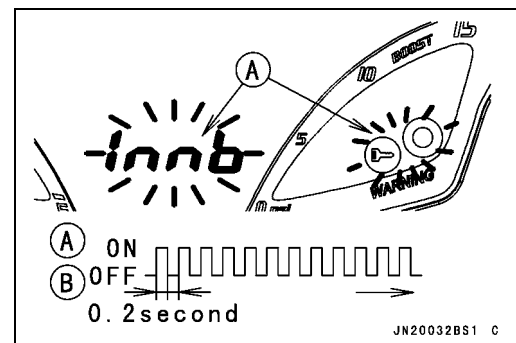
○Continue with the procedure to register the first and second keys before the 15 seconds period has elapsed the registration mode automatically finishes and the warning indicator light (LED) will switch off.

- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
 - The inserted key is the unregistered one.

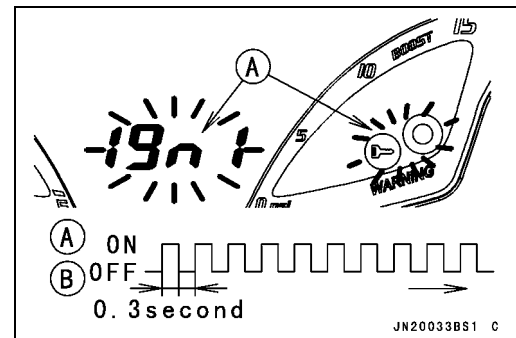
Not Verified

- The warning indicator light (LED), immobilizer symbol and letters [A] blinks to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).

Immobilizer Amplifier Failure (Service Code/Character -35/Imb)



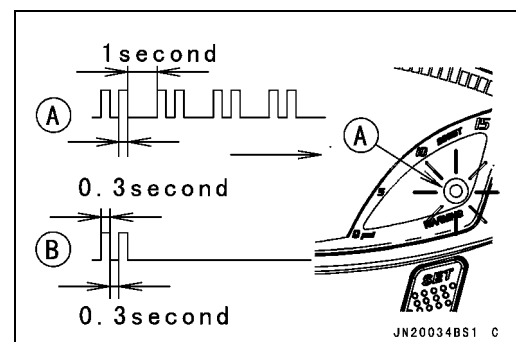
Key Collation Error (Service Code/Character-36/Ign1)



- The user key 2 is successfully pre-registered in the ECU.
- The warning indicator light (LED) [A] blinks 2 times and stops for 1 second and then repeats this cycle.

NOTE

○Only the first one cycle, the buzzer sounds [B] goes off synchronizing with the blink of the warning indicator light (LED).



Regular Registration of User Key

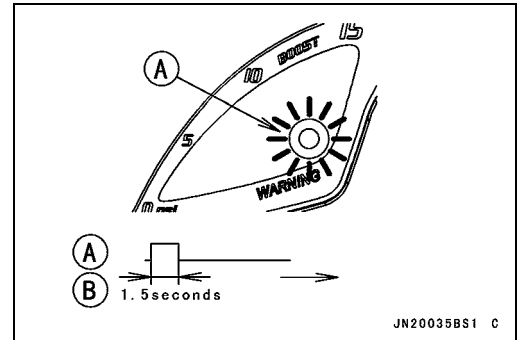
- Leave the user key 2 in the ignition switch.
- Press key for a long time (2 seconds or more).
- The ECU confirms the following.
 - Receiving signals from immobilizer amplifier are correct.
 - The inserted key is the user key 2.

NOTE

○If the inserted key is not the user key 2, the key registration mode will be end instantaneously. Start the procedure again, pre-registration of user key 1.

Immobilizer System

- The pre-registered keys are registered regularly in the ECU.
- The warning indicator light (LED) [A] blinks 1 time for 1.5 seconds and the buzzer sound [B] goes off 1 time synchronizing with the blink of the warning indicator light (LED).



- The key registration mode automatically ends.

NOTE

- Check that the engine can be started using all registered user keys.

Case 3: When the following both keys are faulty or lost.

FPO Key (orange-colored)

SLO Key (yellow-colored and marked SLO)

If they are required, the following are necessary.

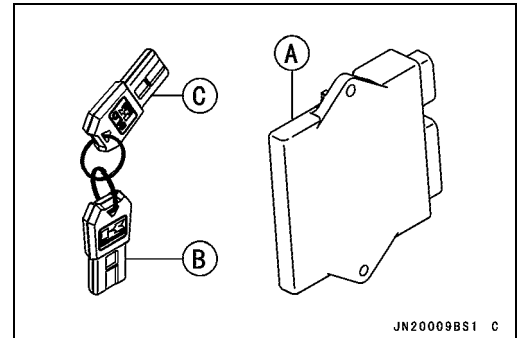
NOTE

- The ECU must be replaced with a new one because the registration mode can not start in the state with no key.

- Prepare a new ECU [A], new FPO key [B] and new SLO key [C].

NOTE

- The key registration unit is not required.
- The key registration process is same as the electric control unit replacement.



Case 4: When replacing the immobilizer amplifier (ignition switch).

- Prepare a new immobilizer amplifier (ignition switch).
- Refer to the Immobilizer System Parts Replacement.

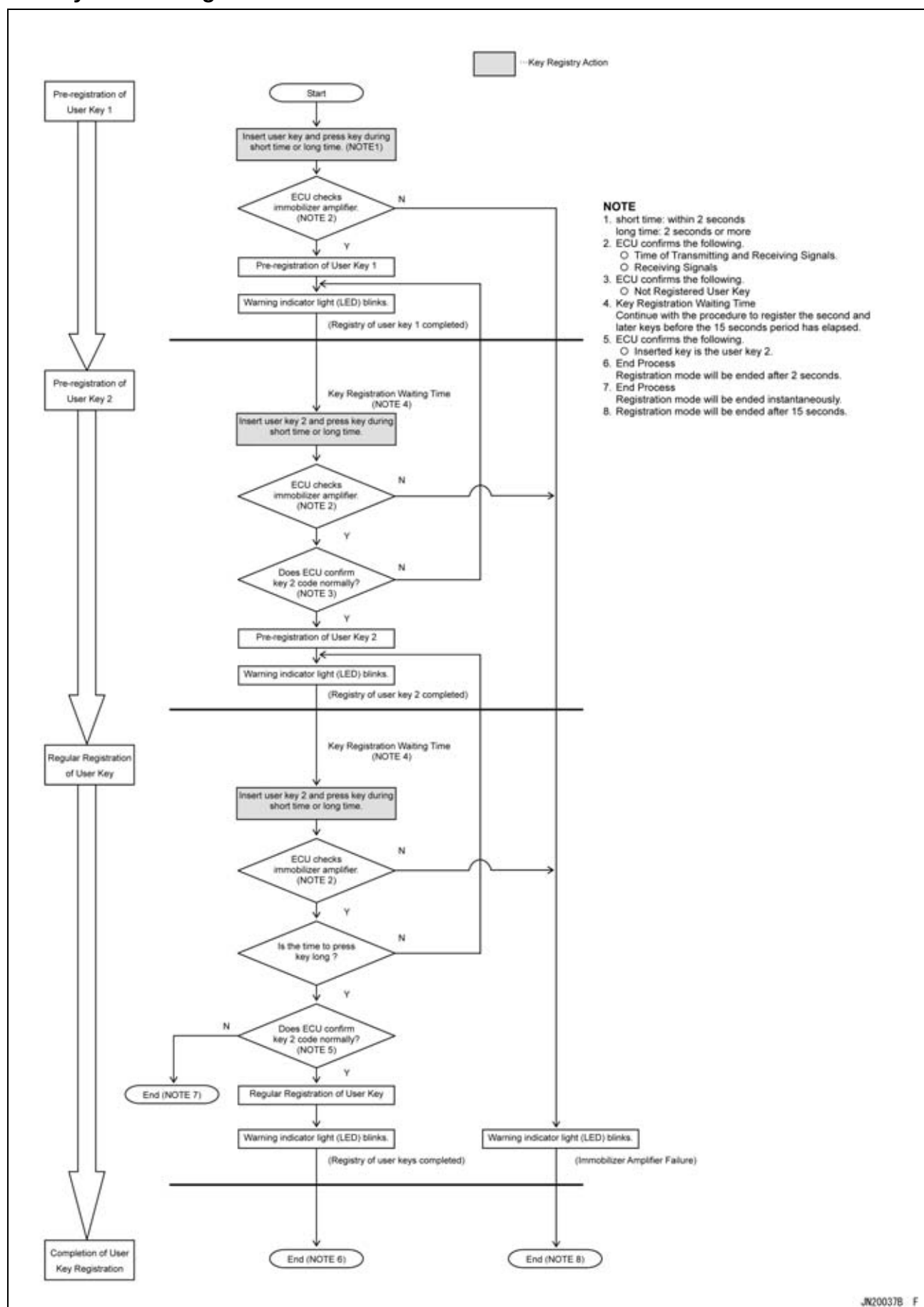
NOTE

- The key registration unit is not required.

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Immobilizer System

All Keys Initial Registration Flow Chart



Immobilizer System

Immobilizer System Parts Replacement

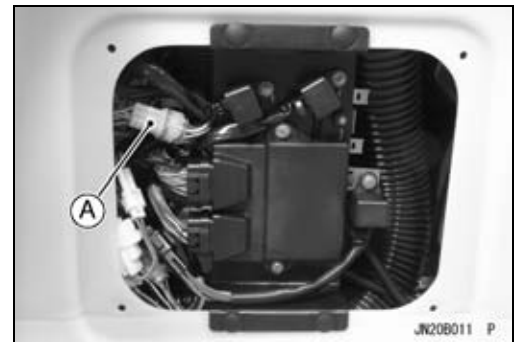
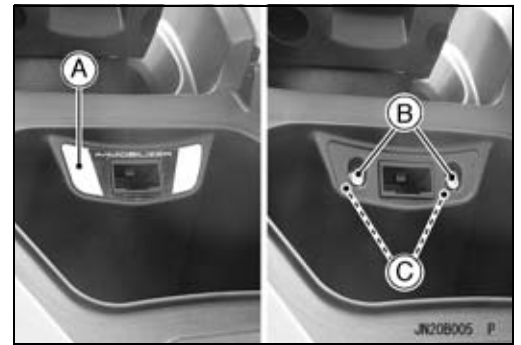
Immobilizer Amplifier (Ignition Switch) Replacement

- Move the handlebar to full forward position.
- Remove the center storage lid (see Center Storage Lid Removal/Installation in the Hull/Engine Hood chapter).
- Remove:
 - Plate [A]
 - Bolts [B] and Washers

NOTE

○ Hold the clip nuts [C] on the immobilizer amplifier (ignition switch).

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the immobilizer amplifier (ignition switch) lead connector [A].



- Remove the grommet [A] from the immobilizer amplifier (ignition switch) lead.
- Pull out the immobilizer amplifier (ignition switch).



- Installation is the reverse of removal. Note the following.

NOTE

○ Route the immobilizer amplifier (ignition switch) lead not to interfere with the steering cable and shaft.

○ Install the immobilizer amplifier (ignition switch) so that the letters of the switch faces upward.

- Replace the seal with a new one.

ECU (Electric Control Unit) Replacement

- Refer to ECU Removal and Installation in the Fuel System (DFI) chapter.

14-82 ELECTRICAL SYSTEM

Immobilizer System

Immobilizer Relational Parts Replacement Chart

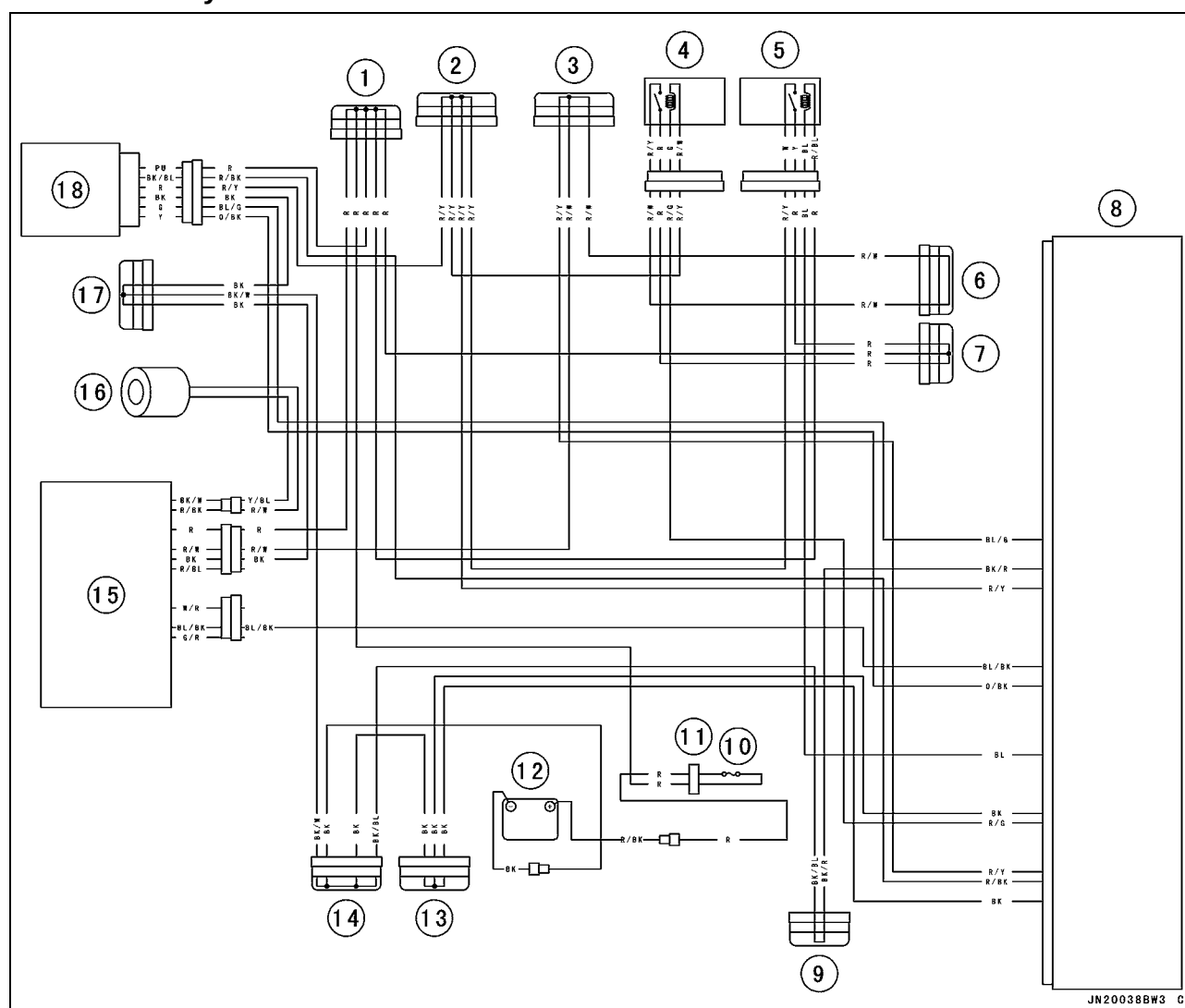
		Failed or Lost Part			
		FPO Key (Orange)	SLO Key (Yellow)	Immobilizer Amplifier	ECU
*	FPO Key (Orange)	●			
	SLO Key (Yellow)		●		
	Immobilizer Amplifier			●	
	ECU				●
*		Replacement Part			
●		Main Replacement Part			

Immobilizer System Inspection

- Refer to the Amplifier Input Voltage Inspection in the Fuel System (DFI) chapter.
- Refer to the User Key Inspection in the Fuel System (DFI) chapter.

Immobilizer System

Immobilizer System Circuit



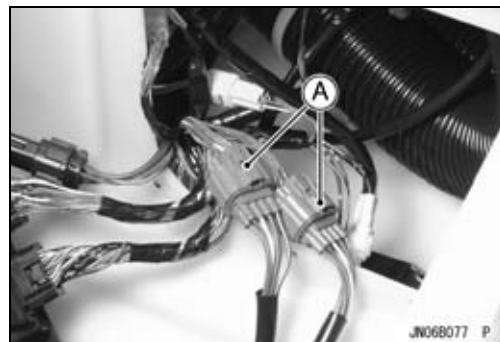
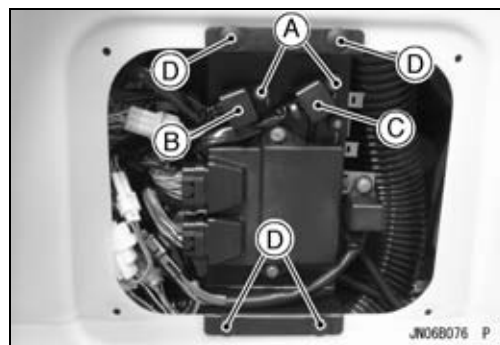
1. Joint Connector P (12 V)
2. Joint Connector R (12 V)
3. Joint Connector T (12 V)
4. ECU Main Relay
5. System Relay
6. Joint Connector D (12 V)
7. Joint Connector C (12 V)
8. ECU
9. Joint Connector E (Ground)
10. Main Fuse 20 A
11. Fuse Box 1
12. Battery
13. Joint Connector Y (Ground)
14. Joint Connector S (Ground)
15. Meter Unit
16. Buzzer
17. Joint Connector Q (Ground)
18. Ignition Switch (Immobilizer Amplifier)

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Relay Assembly

Relay Assembly Removal

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Remove:
 - Relay Mounting Bolts [A]
 - ECU Main/ETV Relay [B]
 - Fuel Pump/System Relay [C]
 - Rivets [D]
- Disconnect the relay assembly connectors [A].



Relay Assembly Installation

- Installation is the reverse of removal. Note the following.
- Run the leads properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply a non-permanent locking agent to the relay mounting bolts.
- Tighten:
 - Torque - Relay Mounting Bolts: 2.5 N·m (0.25 kgf·m, 22 in·lb)**

Relay Assembly Inspection

- Remove the relay assembly (see Relay Assembly Removal).
- Check conductivity of the following numbered terminals by connecting the hand tester and one 12 V battery to the relay assembly as shown in the figure.

Special Tool - Hand Tester: 57001-1394

- ★ If the tester does not read as specified, replace the relay assembly.

Relay Assembly

Relay Assembly Circuit Inspection (with the battery disconnected)

	Tester Connection	Tester Reading (Ω)
Main ECU Relay [A] Fuel Pump Relay [A]	3-4	∞
	1-2	Not ∞^*
ETV Relay [B] System Relay [B]	7-8	∞
	5-6	Not ∞^*

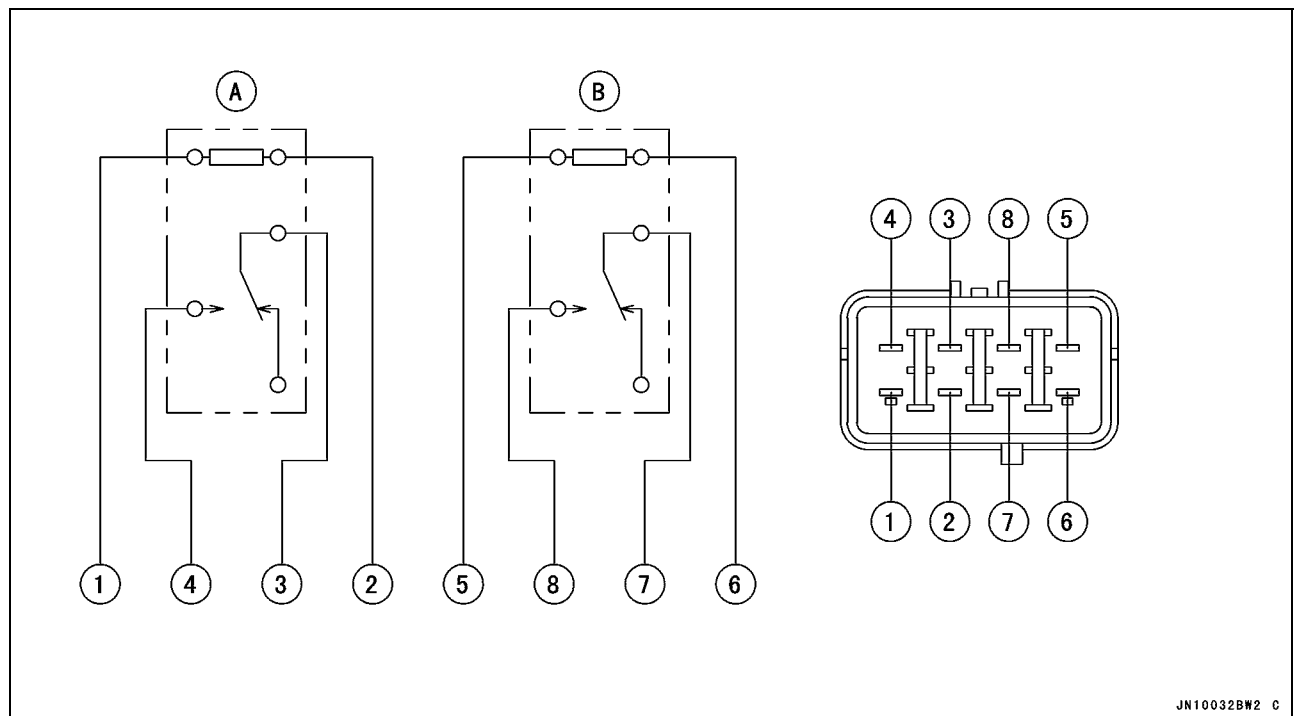
(*): The actual reading varies with the hand tester used.

Relay Assembly Circuit Inspection (with the battery connected)

	Battery Connection (+) (-)	Tester Connection	Tester Reading (Ω)
Main (ECU) Relay [A] Fuel Pump Relay [A]	1-2	3-4	0
ETV Relay [B] System Relay [B]	5-6	7-8	0

(+): Apply positive lead.

(-): Apply negative lead.



14-86 ELECTRICAL SYSTEM

Switches

Switch Inspection

- Using the hand tester, check to see that only the connections shown in the table have continuity.

Special Tool - Hand Tester: 57001-1394

○ For the switches on the handlebar, refer to the tables in the Wiring Diagram.

- ★ If the switch has an open or short, repair it or replace it with a new one.

Oil Pressure Switch Connections*

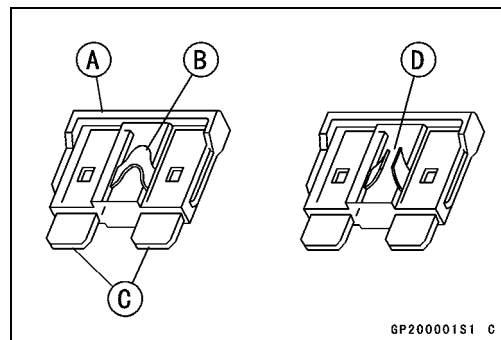
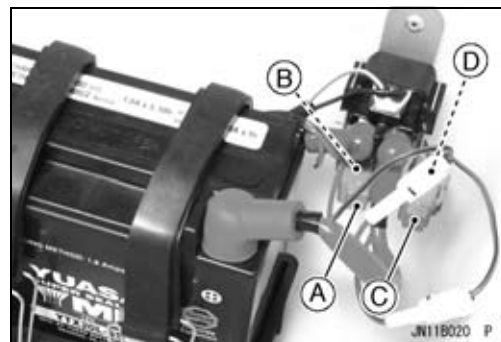
Oil Pressure Switch Connections *		
Color	SW. Terminal	Ground
When engine is stopped	○ —	— ○
When engine is running		

*: Engine lubrication system is in good condition.

Fuse

Fuse Inspection

- Remove:
 - Battery Cover (see Battery Removal)
 - Fuse Box 1 [A]
 - Main Fuse 20 A [B]
 - Fuse Box 2 [C]
 - Electrical Trim Control Relay Fuse [D]
- Inspect the fuse element.
- ★ If it blown out, replace the fuse. Before replacing a blown fuse, always check the amperage in the affected circuit. If the amperage is equal to or greater than the fuse rating, check the wiring and related components for a short circuit.
 - Housing [A]
 - Fuse Element [B]
 - Terminals [C]
 - Blown Element [D]



CAUTION

When replacing a fuse, be sure the new fuse matches the specified fuse rating for that circuit. Installation of a fuse with a higher rating may cause damage to wiring and components.

Storage

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15-2 STORAGE

Preparation for Storage

During the winter, or whenever the watercraft will not be in use for a long period of time, proper storage is essential. It consists of checking and replacing missing or worn parts; lubricating parts to ensure that they do not become rusted; and, in general, preparing the watercraft so that when the time comes to use it again, it will be in top condition.

CAUTION

Since Jet Ski personal watercraft are not designed to be docked in the water for extended periods, prolonged immersion in water will cause the hull paint to bubble and peel, as well as electrolytic erosion of some metal parts in the jet pump. To prevent paint damage and electrolytic erosion, remove your Jet Ski watercraft from the water at the end of each day's use; do not leave it in the water overnight. Your Jet Ski watercraft will last longer and look better if you remove it from the water at the end of every day's use.

Cooling System

- Clean the cooling system (see Cooling System Flushing in the Periodic Maintenance chapter).

Bilge System

- Clean the bilge system (see Bilge System Flushing in the Periodic Maintenance chapter). Before reconnecting the hoses to the plastic breather fitting, blow air through both hoses [A] to force all water out of the bilge system.



Engine Oil

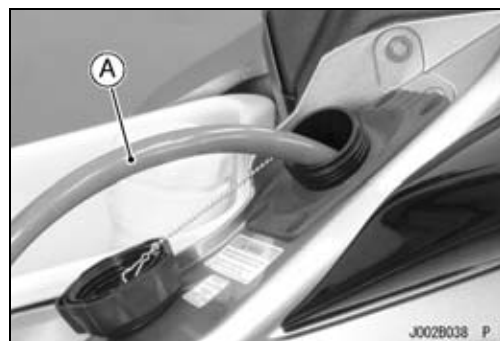
- Change the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).

Fuel System

⚠ WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Pull the lanyard key off the stop button. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

- Drain the fuel tank. This should be done with a siphon or pump.
Siphon Hose [A]



NOTE

○ Lift the stern upward a little so that fuel and water in the bottom of the fuel tank may flow toward the fuel filter to completely drain the fuel tank.

Preparation for Storage

- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Clean the fuel pump screen [A] (see Fuel Pump Screen Cleaning in the Periodic Maintenance chapter).
- Refill the fuel tank with fresh fuel approximately 10 L (2.6 gal U.S.).
- Turn the ignition switch to on.
- Push the lanyard key under the stop button, and start the engine and run it in 15 second periods until all fuel in the fuel system is with fresh fuel. Wait 5 minutes between 15 seconds running periods.



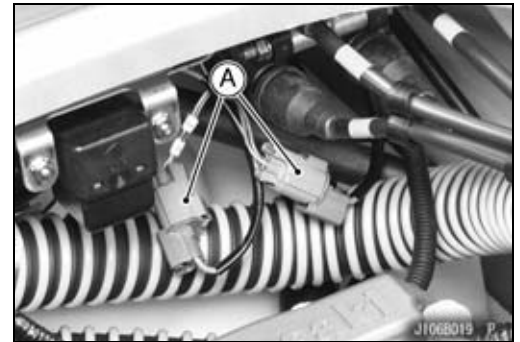
CAUTION

Do not run the engine without cooling water supply for more than 15 seconds at a time or severe engine and exhaust system damage will occur.

- Pull the lanyard key off the stop button and turn the ignition switch to off.
- Drain the fuel tank.
- Leave the fuel filler cap loose to prevent condensation in the tank.

Engine

- Remove the seat (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect both two connection on the ignition coil primary lead connectors [A].
- Remove the spark plugs (see Spark Plug Inspection in the Periodic Maintenance chapter).
- Spray fogging oil directly into each cylinder.
- Turn the ignition switch to on.
- Push the lanyard key under the stop button. Turn the engine over several times with the start button to coat the cylinder walls with oil.



⚠ WARNING

Do not lean over the engine when performing this procedure. An air/oil mist may be forcibly ejected from the spark plug holes and could get into your eyes. If you do get some in your eyes, wash your eyes immediately with liberal amounts of clean, fresh water. Consult a physician as soon as possible.

- Pull the lanyard key off the stop button and turn the ignition switch to off.
- Spray the spark plugs with fogging oil, and reinstall the spark plugs and caps (see Spark Plug Inspection in the Periodic Maintenance chapter).

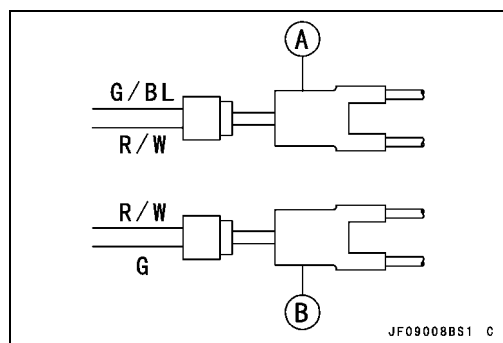
15-4 STORAGE

Preparation for Storage

- Reconnect the primary ignition coil lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. The #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.

NOTE

○The service codes (51 and 52) caused by this procedure are stored in the ECU. If necessary, these service codes can be erased by using the Kawasaki Diagnostic System (KDS).



Battery

- Give a refresh charge before you store the watercraft and store it with the negative lead removed. Give a refresh charge once a month during storage.
- Remove the battery (see Battery Remove in the Electrical System chapter).
- Clean the exterior with a solution of baking soda and water (one heaping tablespoon of baking soda in one cup of water). Rinse thoroughly with water.

CAUTION

Do not allow any soda solution to enter the battery.

- Coat both battery terminals with grease.
- Store the battery in a cool, dry place. Do not expose it to freezing temperatures.

Lubrication

- Carry out all recommended lubrication procedures (see Lubrication in Periodic Maintenance chapter).

Supercharger

- Carry out all recommended corrosion protection coating procedures (see Apply Corrosion Protection Coating to the Supercharger Rotors in the Periodic Maintenance chapter).
- Visually inspect the supercharger drive belt for wear/damage (see Supercharger Drive Belt for Wear/Damage Inspection in the Periodic Maintenance chapter).

Lube Jet Pump Bearings/Seals

CAUTION

The jet pump bearings and seals should be serviced prior to prolonged storage to prevent any water that may be left in the pump from corroding the bearings and causing premature failure. Major engine damage can occur if the jet pump bearings fail due to lack of maintenance.

- Clean the pump (see Lube Jet Pump Bearing and Seal Inspection in the Periodic Maintenance chapter).

Preparation for Storage

Cleaning

- Wash the engine compartment with fresh water and remove the drain screw in the stern to drain the water. Wipe up any water left in the compartment.

CAUTION
Use only a mild detergent in water to wash the hull. Harsh solvents may attack the surface or smear the colors.

- Apply a good grade of wax to all exterior hull surfaces.
- Lightly spray all exposed metal parts with a penetrating rust inhibitor.
- Remove the seat, or block the seat up with 10 mm (0.39 in.) spacers to insure adequate ventilation, and prevent corrosion.
- Cover the watercraft and store it in a clean, dry place.

15-6 STORAGE

Removal from Storage

Lubrication

- Carry out all recommended lubrication procedures (see the Periodic Maintenance chapter).

General Inspection

- Check for binding or sticking throttle, steering or shift mechanism. The throttle lever must return fully when released.
- Clean and gap spark plugs (see Spark Plug in the Periodic Maintenance chapter).
- Check all rubber hoses for weathering a cracking, or looseness.
- Check that the drain screw in the stern is securely tightened.
- Check the fire extinguisher for a full charge.
- Check the battery, charge if necessary, and clean the terminals. Install the battery (see Battery Installation in Electrical System chapter).

Fuel System

- Check and clean or replace the fuel pump screens as necessary (see Fuel Pump Screen Cleaning in the Periodic Maintenance chapter).

⚠ WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Pull the lanyard key off the stop button. Do not smoke. Make sure the area is well ventilated and free from source of flame or spark; this includes any appliance with a pilot light.

- After refueling and before starting the engine, tilt the seat to the rear for several minutes to ventilate the engine compartment.

⚠ WARNING

A concentration of gasoline fumes in the engine compartment can cause a fire or explosion.

- Check for fuel leaks. Repair if necessary.
- Check the engine oil level. Fill the oil with the specified oil.

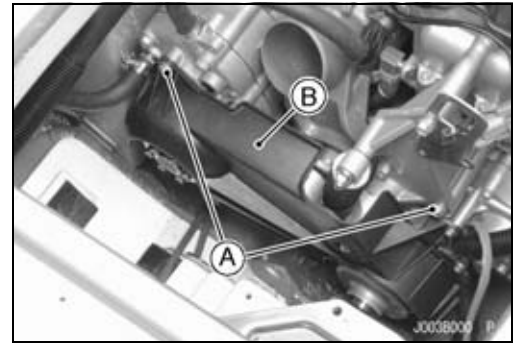
Supercharger

- Disconnect both connections on ignition coil primary lead connectors [A].



Removal from Storage

- Remove the belt cover bolts [A] and belt cover [B] (see Supercharger Drive Belt for Wear/Damage Inspection in the Periodic Maintenance chapter).



- Crank the engine for several times and check that the engine pulley and supercharger pulley rotate with the drive belt.
- ★ If the drive belt slips or the supercharger pulley does not rotate, check the supercharger (see Supercharger Drive Belt for Wear/Damage Inspection in the Periodic Maintenance chapter).

Test Run

WARNING

Do not run the engine in a closed area. Exhaust gases contain carbon monoxide, a colorless, odorless, poisonous gas. Breathing exhaust gas leads to carbon monoxide poisoning, asphyxiation, and death.

- Start the engine and run it only for 15 seconds. Check for fuel, oil and exhaust leaks. Any leaks must be repaired.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds at a time or severe engine and exhaust system damage will occur.

- Install the seat making sure it is locked.

Appendix

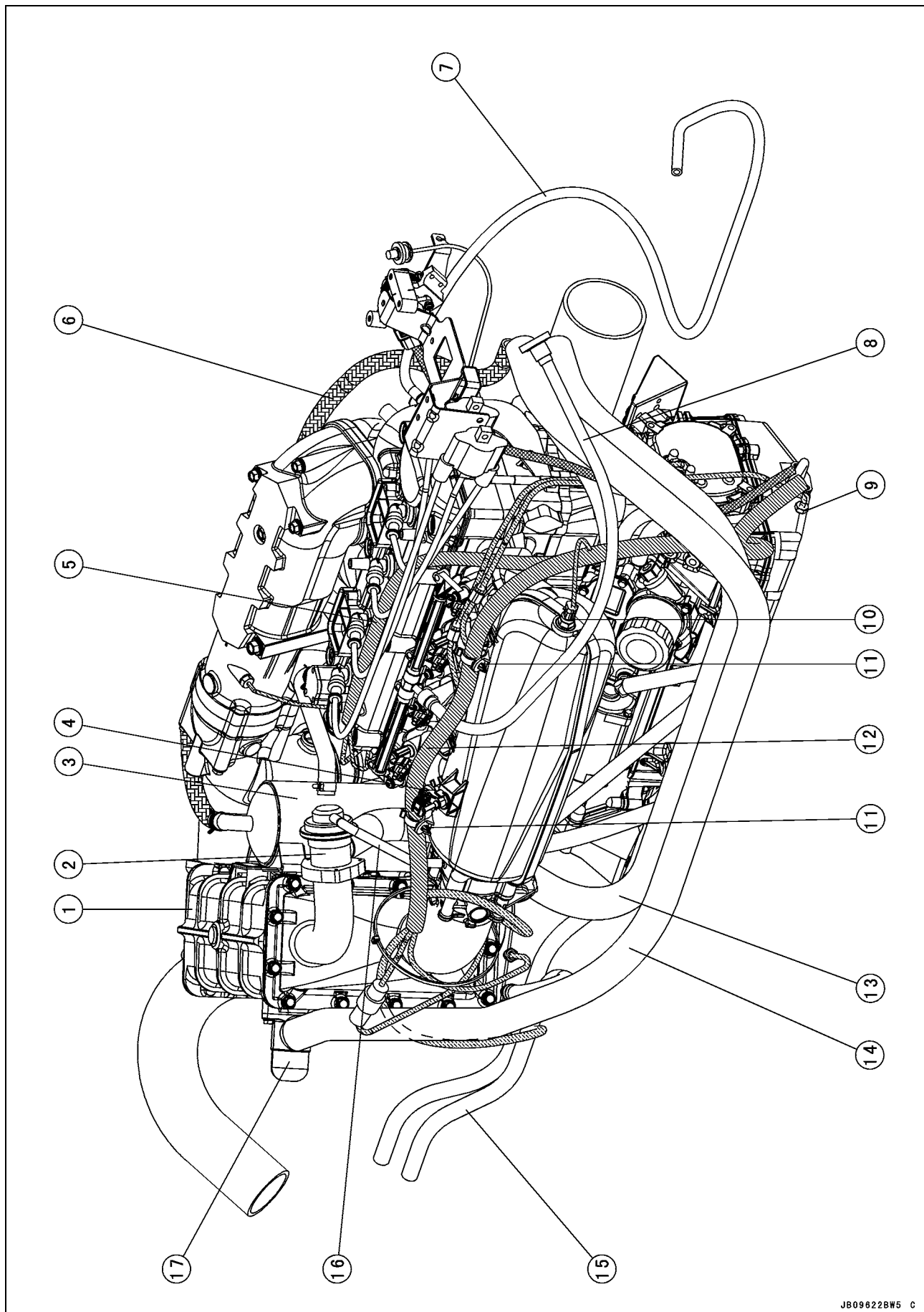
Table of Contents

Cable, Wire and Hose Routing	16-2
Troubleshooting Guide	16-38

16-2 APPENDIX

Cable, Wire and Hose Routing

Water Hose, Air Duct and Harness Routing



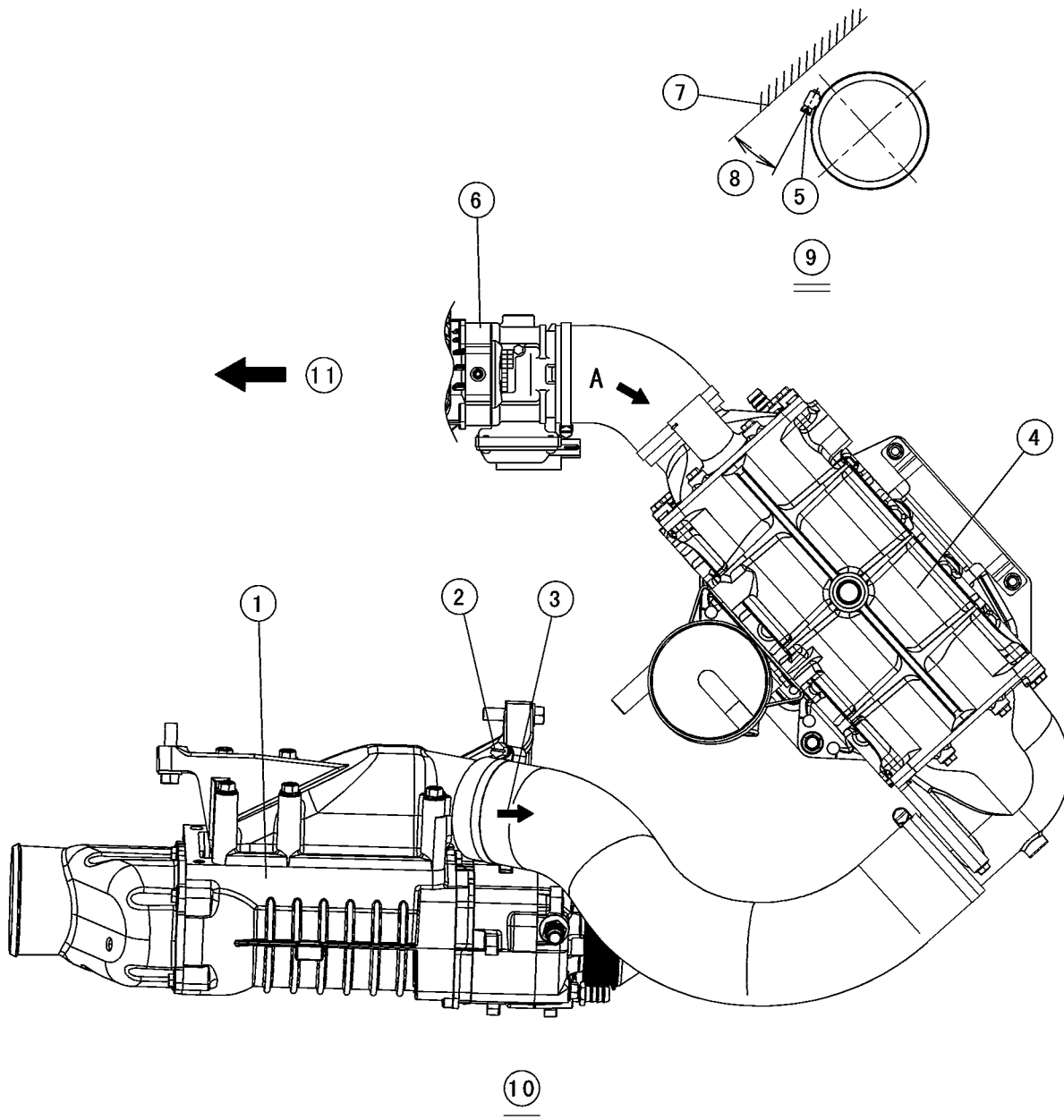
Cable, Wire and Hose Routing

1. Intercooler
2. Relief Valve
3. Oil Separator Tank
4. Intake Air Pressure Sensor
5. Run the main harness under the spark plug leads.
6. Breather Hose (Oil Separator Tank ~ Air Box)
7. Bypass Outlet Hose
8. Fuel Hose
9. Oil Temperature Sensor
10. Air Temperature Sensor
11. Clamps
12. Main Harness (Run the main harness over the fuel hose.)
13. Air Bypass Duct (Relief Valve ~ Air Box)
14. Air Bypass Duct (Blow off Valve ~ Air Box)
15. Water Hose (Pump ~ Intercooler)
16. Pulse Hose (Relief Valve ~ Throttle Body Assy)
17. Blow off Valve

16-4 APPENDIX

Cable, Wire and Hose Routing

Intake Duct Routing



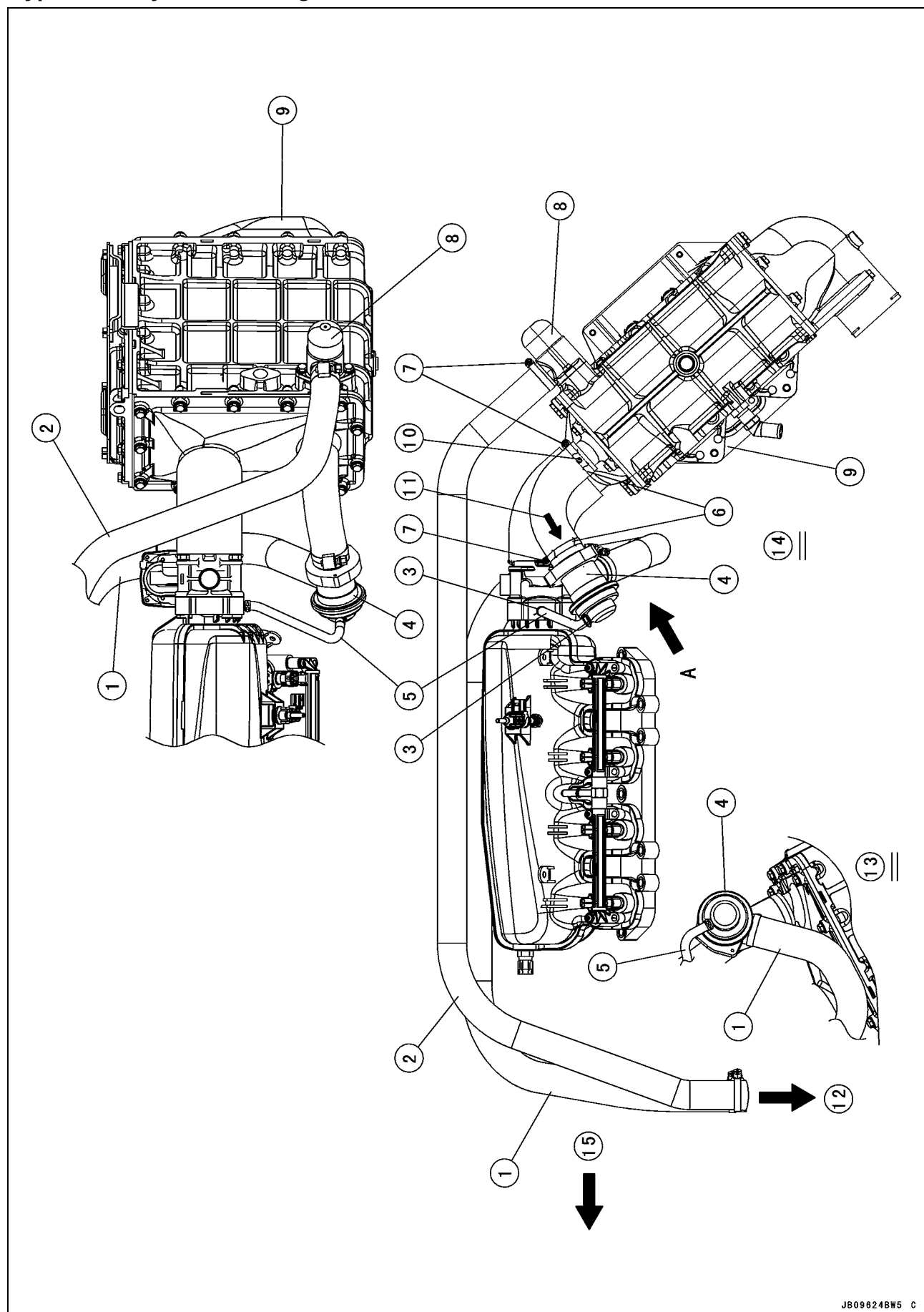
Cable, Wire and Hose Routing

1. Supercharger
2. Position the clamp screw rightward as shown.
3. White Arrow Mark
4. Intercooler
5. Position the clamp screw downward as shown.
6. Throttle Body
7. Horizontal Level
8. 20°
9. View A
10. View from Top
11. Bow

16-6 APPENDIX

Cable, Wire and Hose Routing

Bypass Air System Routing



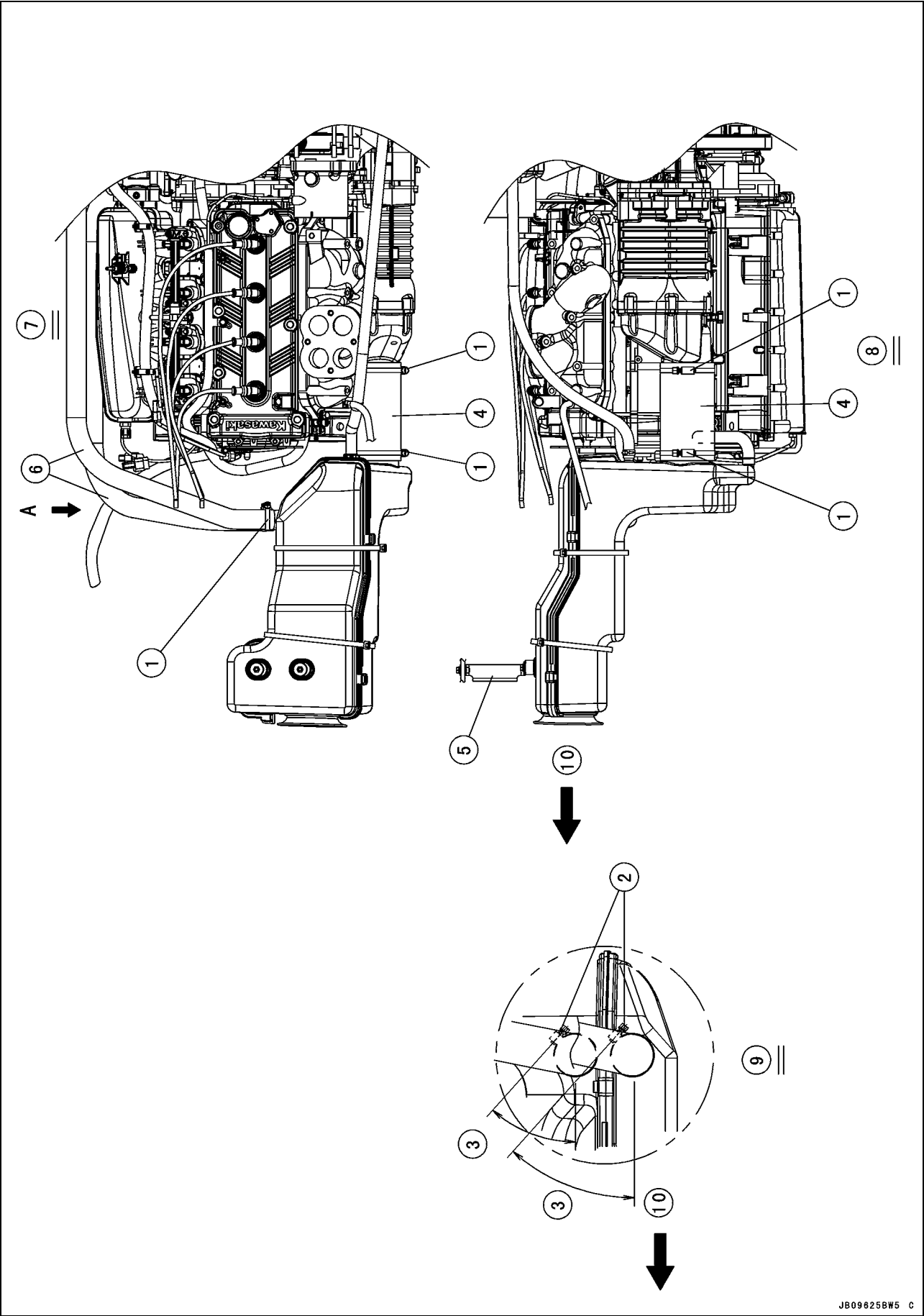
Cable, Wire and Hose Routing

1. Duct (Relief Valve ~ Air Box)
2. Duct (Blow off Valve ~ Air Box)
3. Clamps
4. Relief Valve
5. Pulse Hose
6. Clamps
7. Face the clamp screw upward.
8. Blow off Valve
9. Intercooler
10. White Mark
11. Arrow Mark
12. To Air Box
13. View A
14. View from Top
15. Bow

16-8 APPENDIX

Cable, Wire and Hose Routing

Air Box Routing



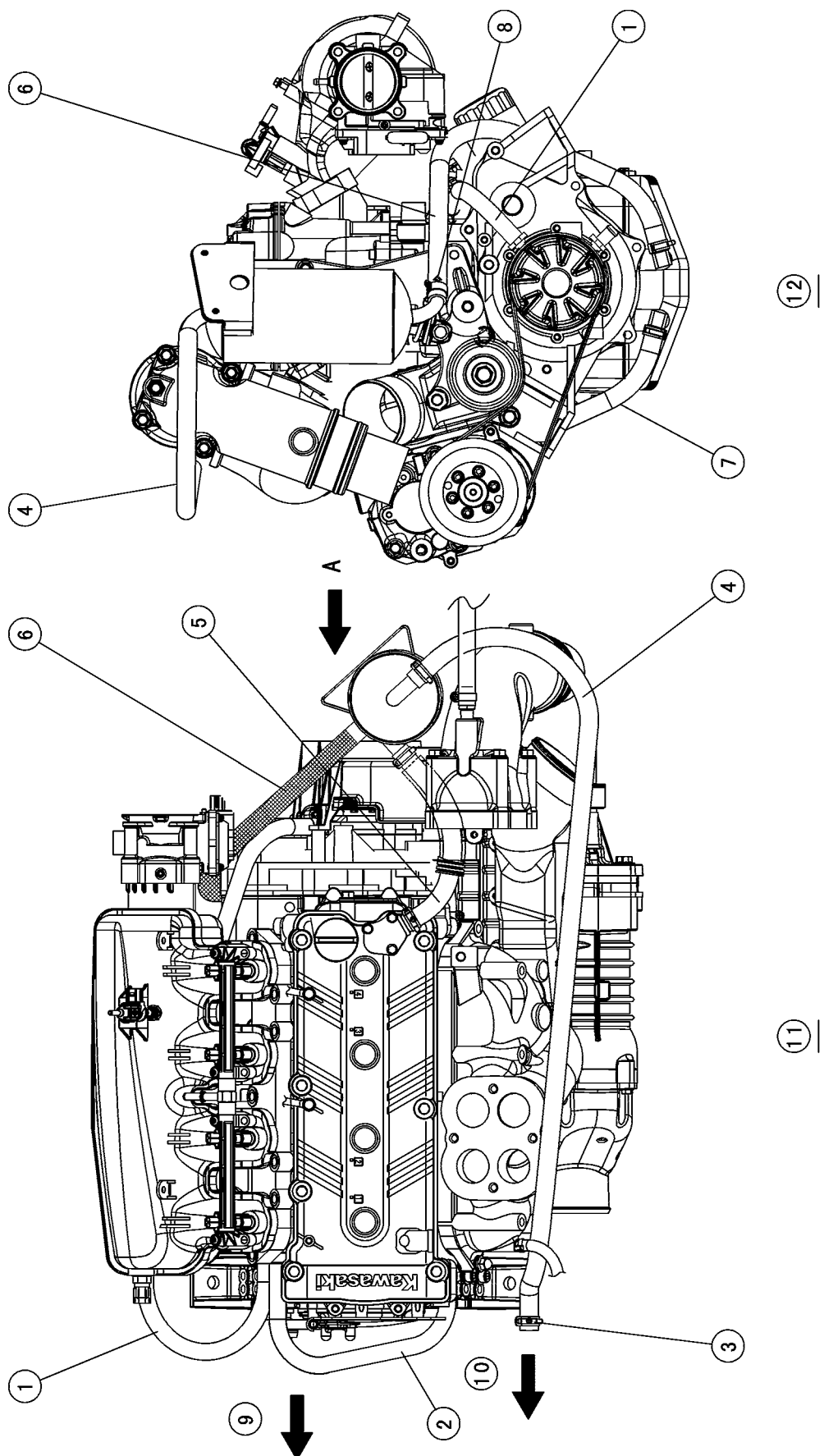
Cable, Wire and Hose Routing

1. Clamps (Face the clamp screw upward.)
2. Clamps
3. 45°
4. Duct
5. Bracket
6. Run the air bypass ducts under the intake manifold.
7. View from Top
8. View from Starboard Side
9. View A
10. Bow

16-10 APPENDIX

Cable, Wire and Hose Routing

Oil Hose and Water Hose Routing



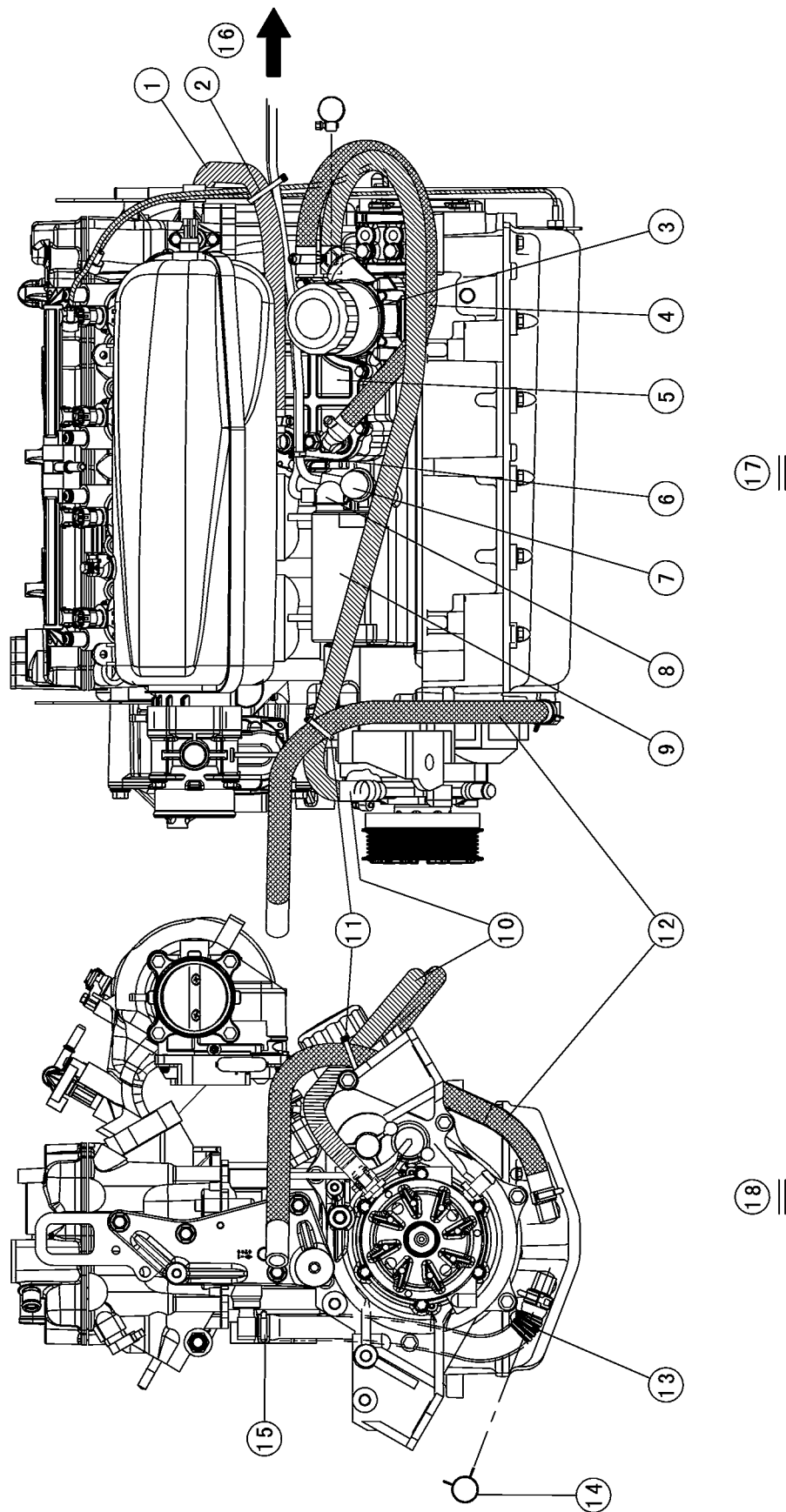
Cable, Wire and Hose Routing

1. Water Hose (Output Cover ~ Oil Cooler)
2. Water Hose (Oil Cover ~ Front of Cylinder Head)
3. White Mark
4. Oil Separator Hose (Oil Separator Tank ~ Air Box)
5. Oil Separator Hose (Oil Separator Tank ~ Cylinder Head Cover)
6. Oil Separator Hose (Oil Separator Tank ~ Oil Pan)
7. Return Oil Hose (Cylinder ~ Oil Pan)
8. Arrow Mark
9. Bow
10. To Air Box
11. View from Top
12. View A

16-12 APPENDIX

Cable, Wire and Hose Routing

Water Hose, Oil Hose and Wire Routing



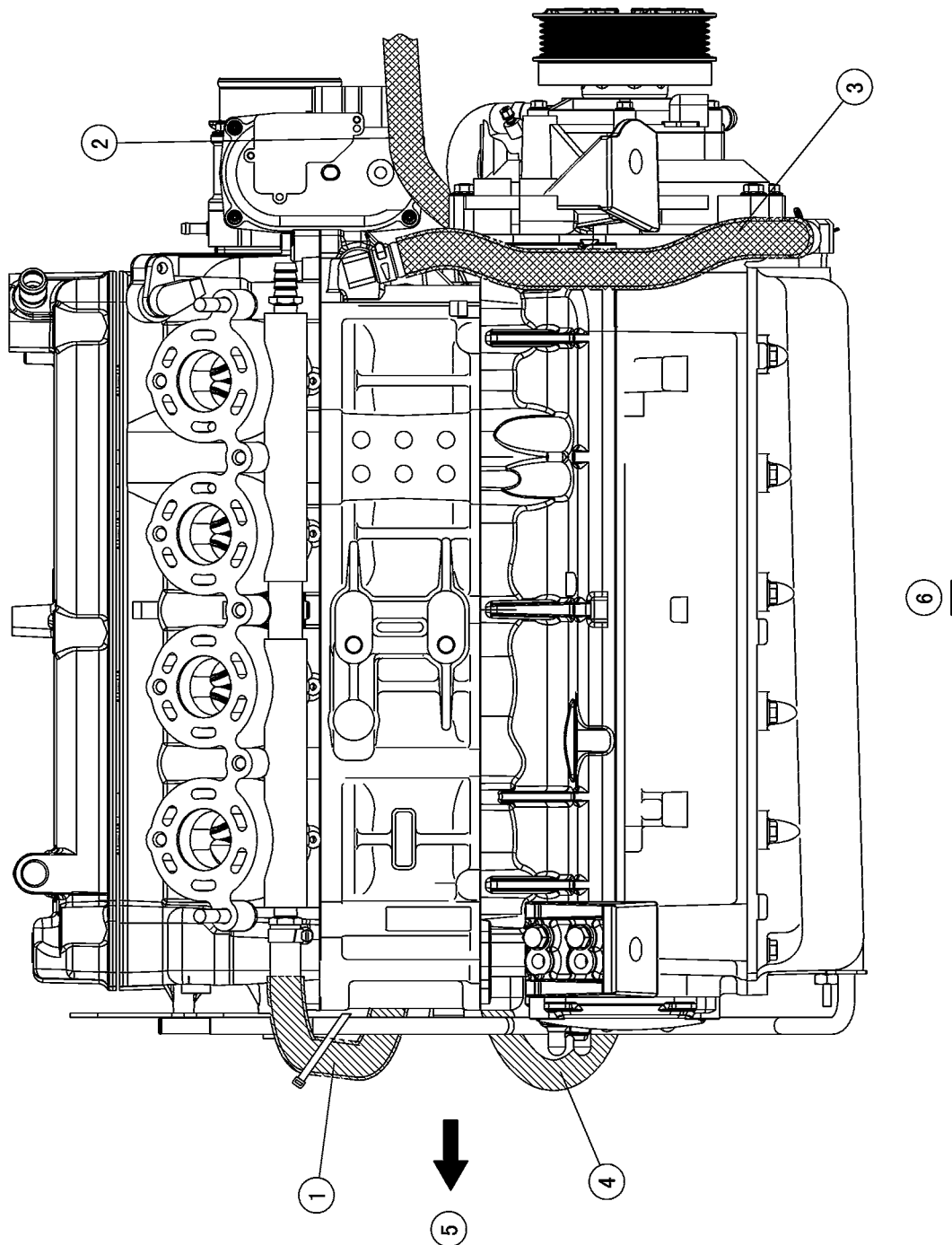
Cable, Wire and Hose Routing

1. Water Hose (Oil Cooler ~ Front of Cylinder Head)
2. Clamp the two cables, sensor leads and the water hose to the oil pipe with the band.
3. Oil Filter
4. Oil Hose
5. Oil Cooler
6. Clamp the starter motor and battery (–) cables with the band.
7. Battery (–) Cable
8. Starter Motor Cable
9. Starter Motor
10. Water Hose (Output Cover ~ Oil Cooler)
11. Clamp the oil separator tank hose and cooling hose with the band.
12. Oil Separator Tank Hose (Oil Separator Tank ~ Oil Pan)
13. Return Oil Hose (Cylinder ~ Oil Pan)
14. Clamp (Face the clamp tab upward and backward.)
15. Clamp (Face the clamp tab backward.)
16. Bow
17. View from Starboard Side
18. View from Stern

16-14 APPENDIX

Cable, Wire and Hose Routing

Water Hose and Oil Hose Rotuing

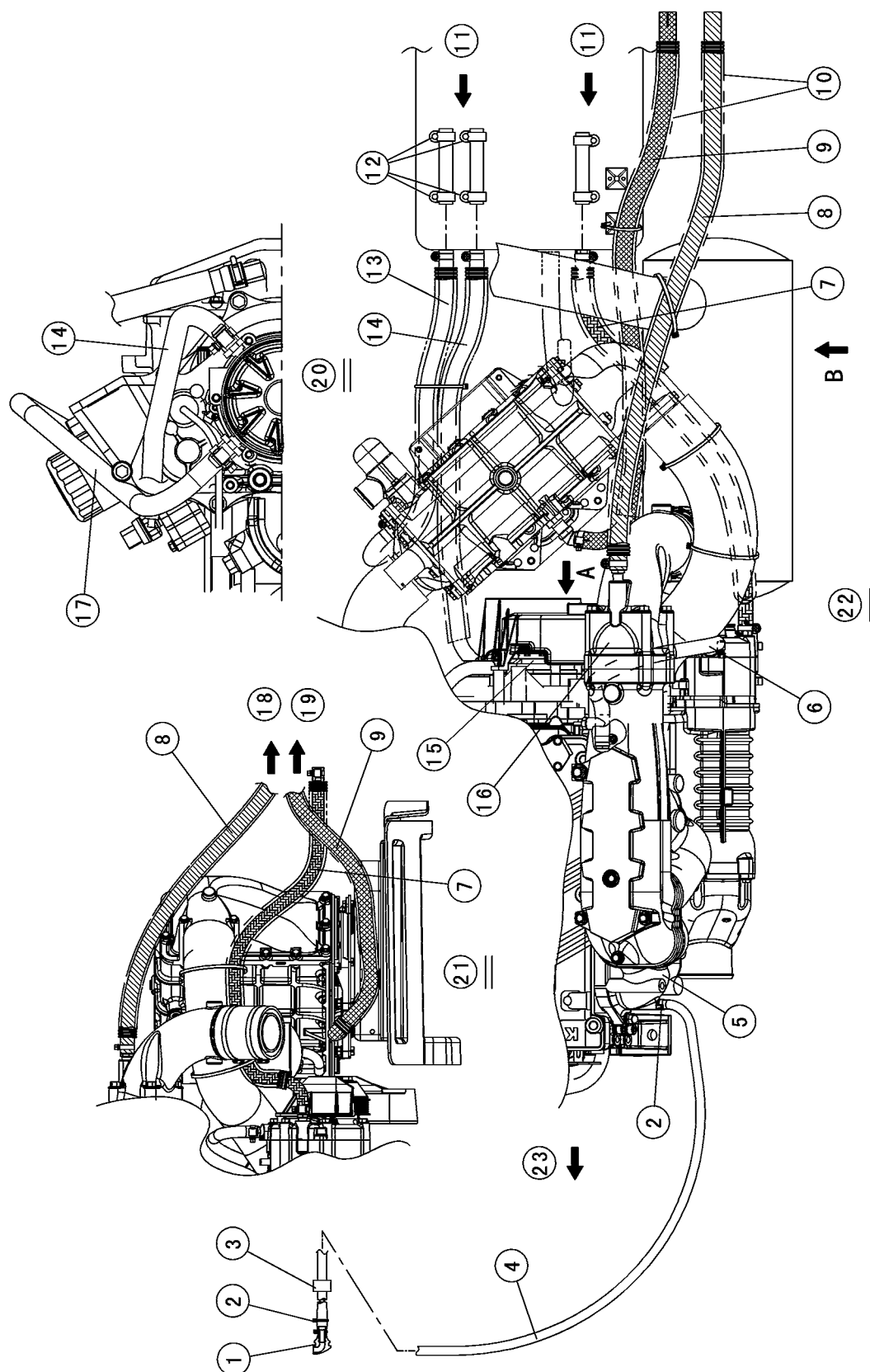


Cable, Wire and Hose Routing

1. Water Hose (Oil Cooler ~ Front of Cylinder Head)
2. Oil Separator Tank Hose (Oil Separator Tank ~ Oil Pan)
3. Return Oil Hose (Cylinder ~ Breather Case)
4. Water Hose (Oil Cooler ~ Output Cover)
5. Bow
6. View from Port Side

Cable, Wire and Hose Routing

Water Hose Routing



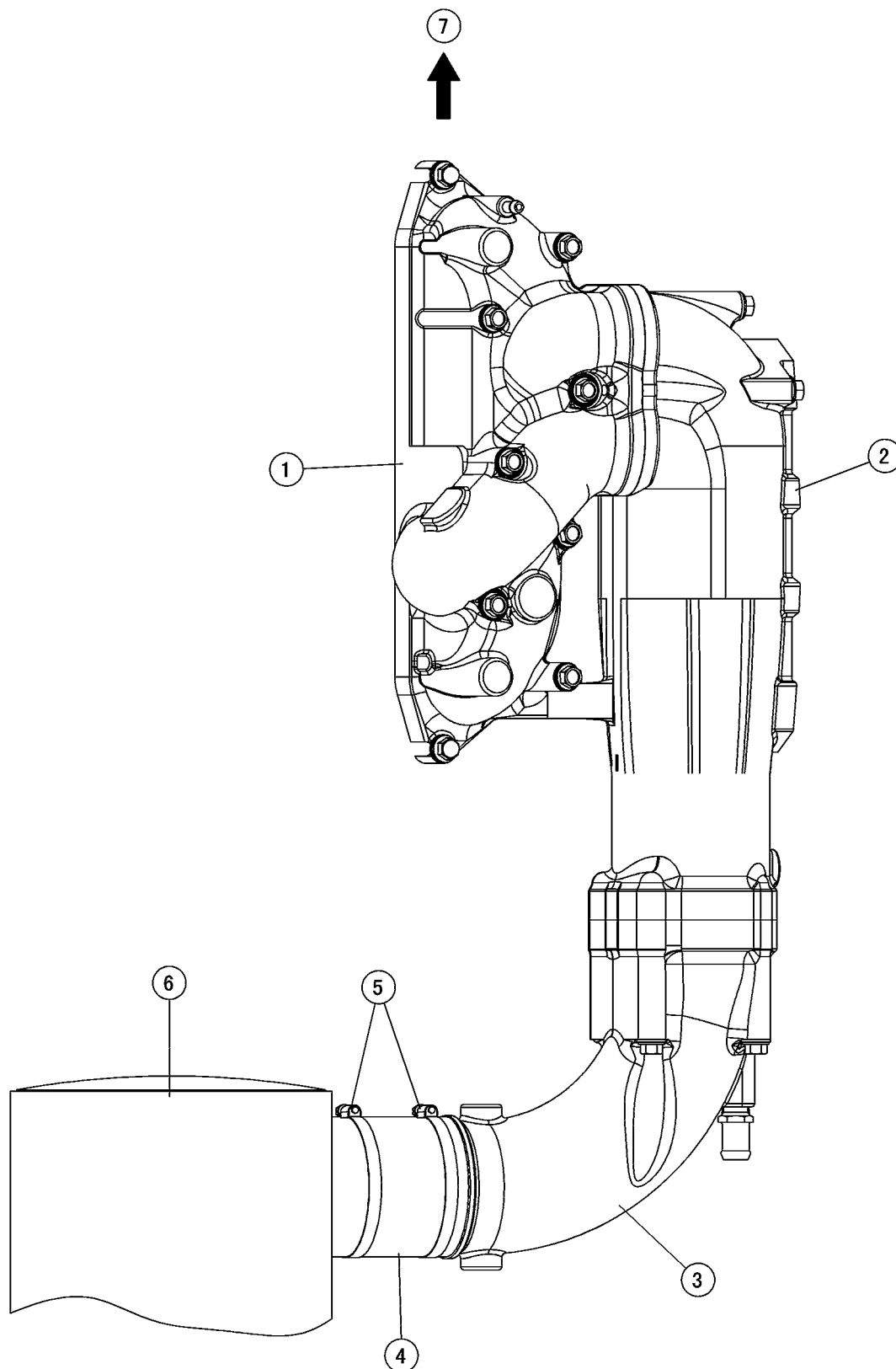
Cable, Wire and Hose Routing

Refer to the Exploded View and Flow Diagram in the Cooling and Bilge Systems chapter.
Install the clamp as shown, noting its clamp screw direction.

1. Bypass Outlet
2. Clamps
3. Holder
4. Bypass Outlet Hose
5. Exhaust Manifold
6. Water Hose (Cylinder Head ~ Super Charger)
7. Water Hose (Super Charger ~ Pump)
8. Water Hose (Muffler Body ~ Fitting (Black) on the Stern)
9. Water Hose (Intercooler ~ Fitting (Gray) on the Stern)
10. Protective Tubes
11. From Pump
12. Position the clamps so that its clamp screw faces downward and outside.
13. Water Hose (Pump ~ Intercooler)
14. Water Hose (Pump ~ Output Cover)
15. Output Cover
16. Muffler Body
17. Water Hose (Output Cover ~ Oil Cooler)
18. To Fitting (Black) on the Stern
19. To Fitting (Gray) on the Stern
20. View A
21. View B
22. View from Top
23. Bow

16-18 APPENDIX

Cable, Wire and Hose Routing

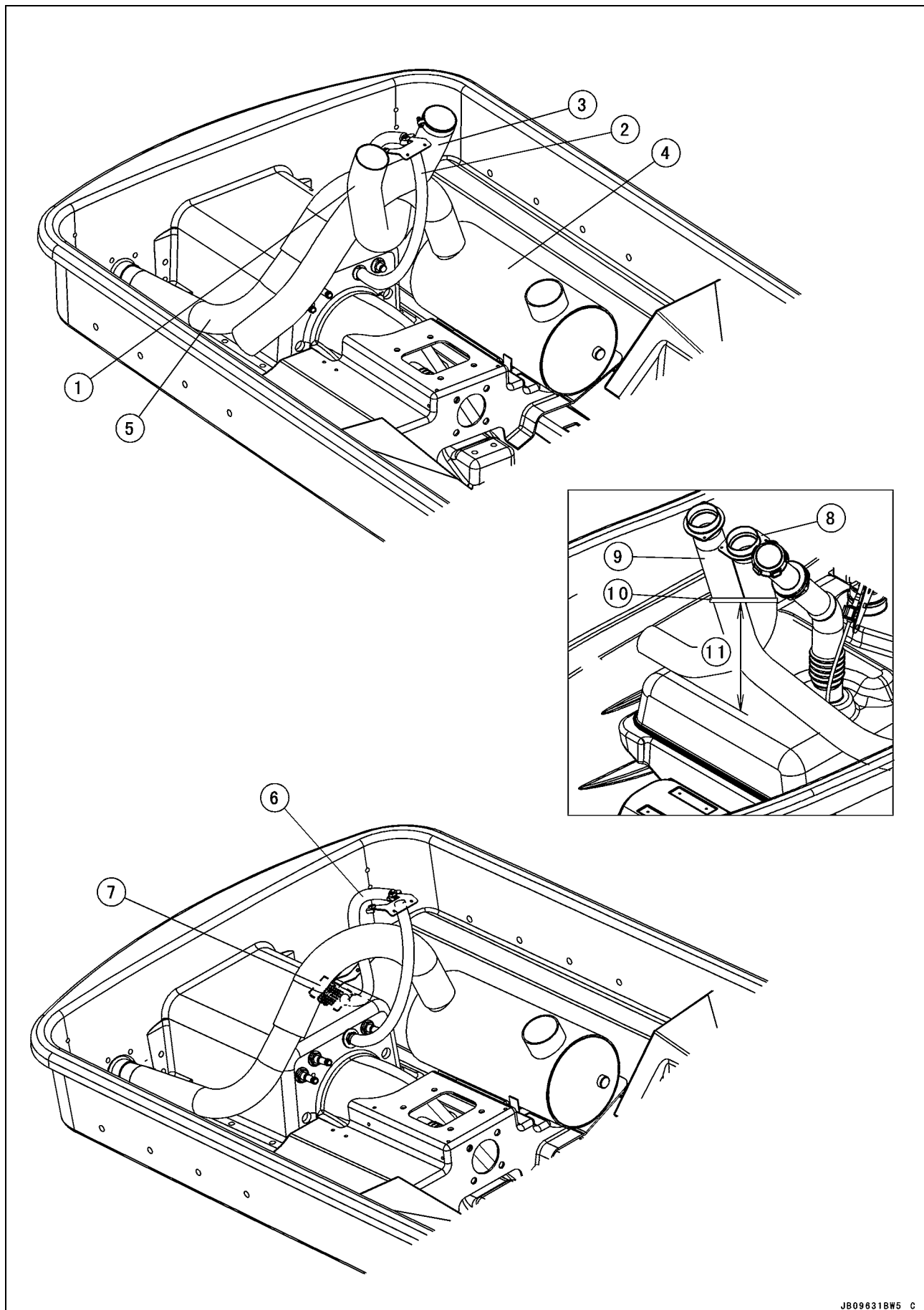


Cable, Wire and Hose Routing

1. Exhaust Manifold
2. Exhaust Pipe
3. Muffler Body
4. Duct
5. Clamps (Position the clamp head to the starboard.)
6. Water Box Muffler
7. Bow

16-20 APPENDIX

Cable, Wire and Hose Routing

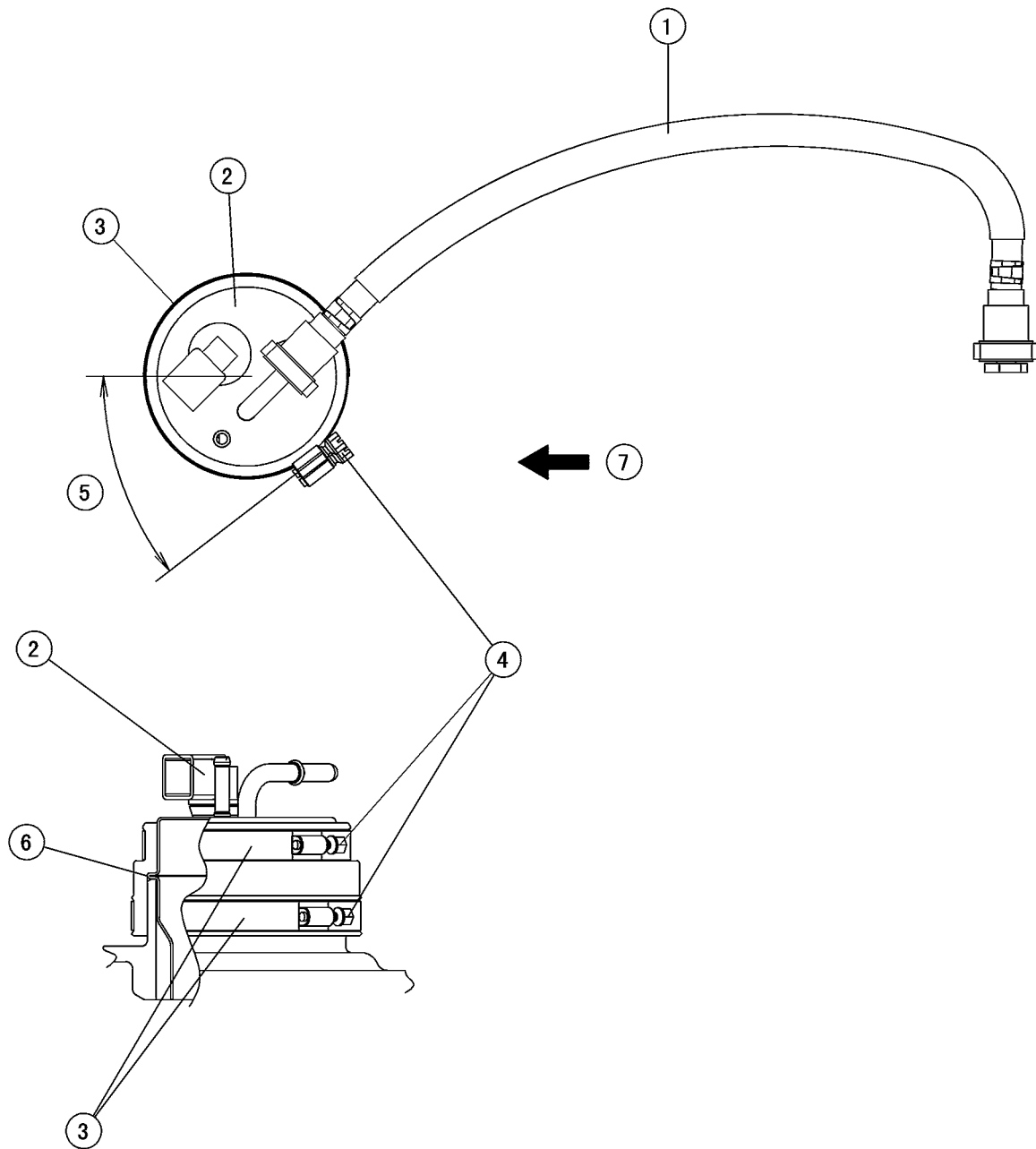


Cable, Wire and Hose Routing

1. Right Rear Duct
2. Bilge Hose
3. Left Rear Duct
4. Water Box Muffler
5. Tail Pipe
6. Bilge Breather
7. Bilge Filter
8. Left Front Duct (Run the left front duct through the right front duct rearward.)
9. Right Front Duct
10. Band
11. 225 mm (8.86 in.)

16-22 APPENDIX

Cable, Wire and Hose Routing

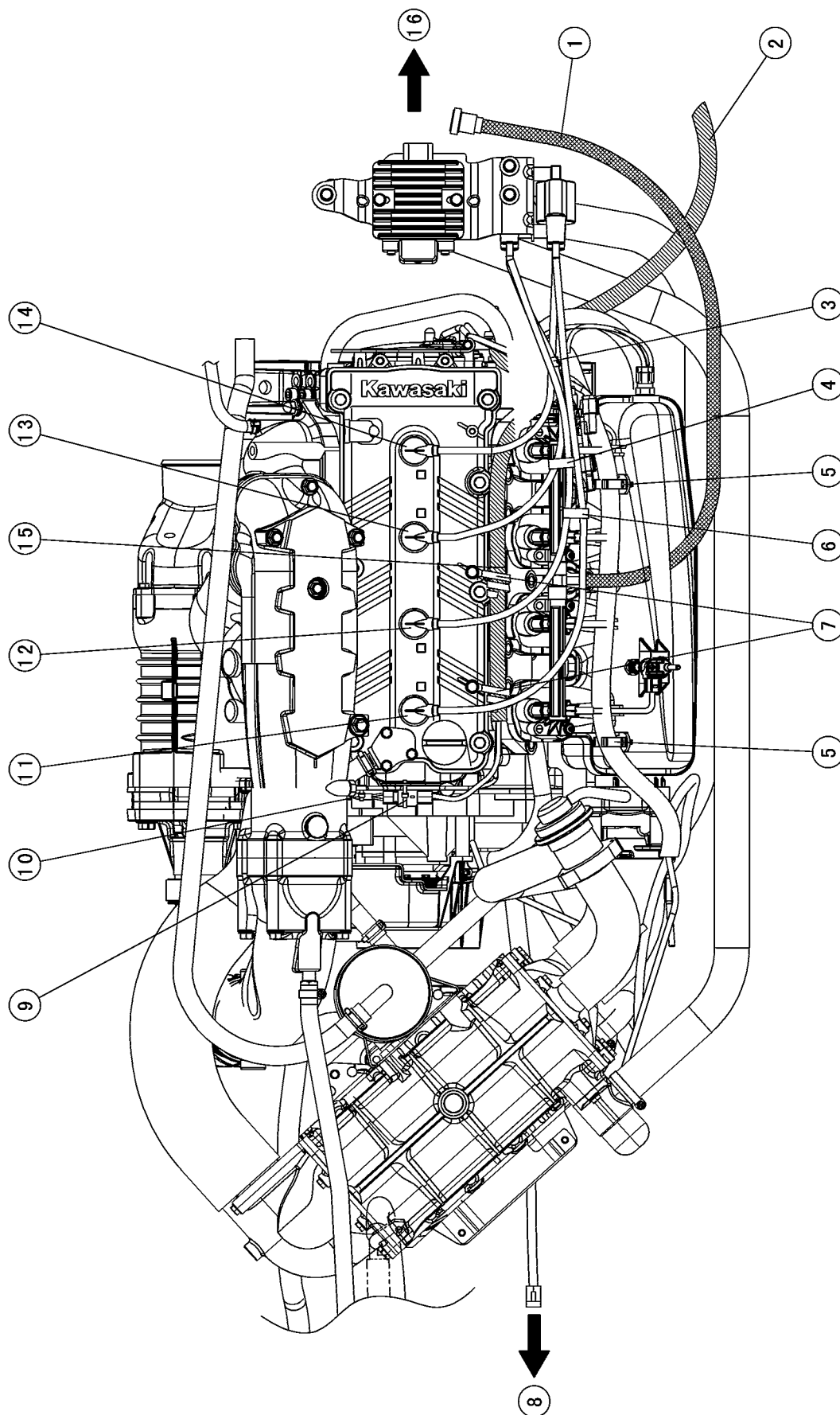


Cable, Wire and Hose Routing

1. Fuel Hose
2. Fuel Pump
3. Clamps
4. Position the clamp screws as shown.
5. 40°
6. Holder
7. Bow

16-24 APPENDIX

Cable, Wire and Hose Routing

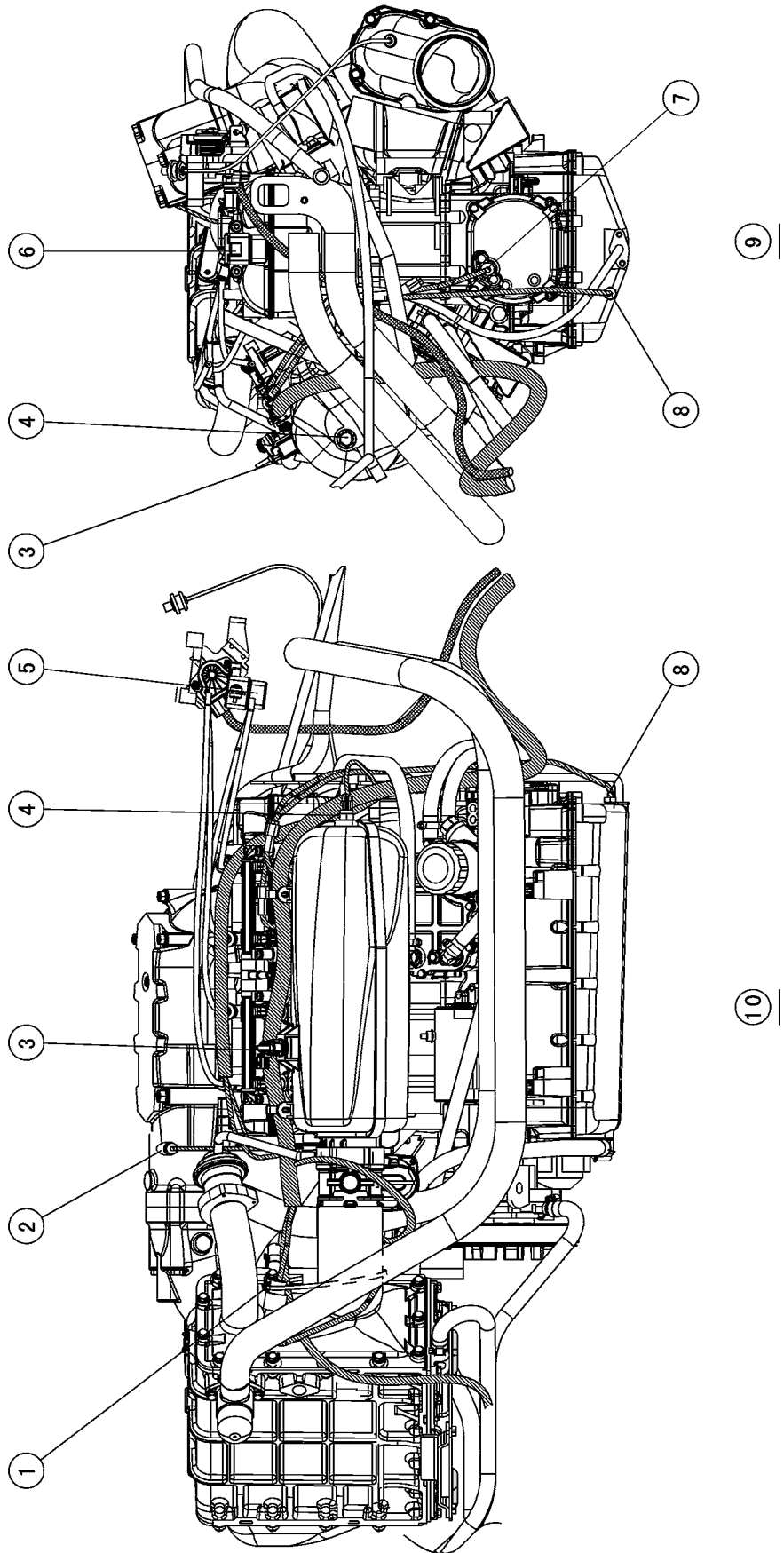


Cable, Wire and Hose Routing

1. Fuel Hose
2. Main Harness
3. Fix the #1 and #2 spark plug leads with the clamp.
4. Fix the #2 and #3 spark plug leads with the clamp.
5. Clamps
6. Fix the #3 and #4 spark plug leads with the clamp.
7. Fix the main harness with the clamps.
8. To Speed Sensor
9. Band
10. Fix the camshaft position sensor connector and water temperature sensor leads with the band.
11. The #4 spark plug lead must be positioned at a right angle to the engine center line.
12. The #3 spark plug lead must be positioned at a right angle to the engine center line.
13. The #2 spark plug lead must be positioned at a right angle to the engine center line.
14. The #1 spark plug lead must be positioned at a right angle to the engine center line.
15. White Tape
16. Bow

16-26 APPENDIX

Cable, Wire and Hose Routing

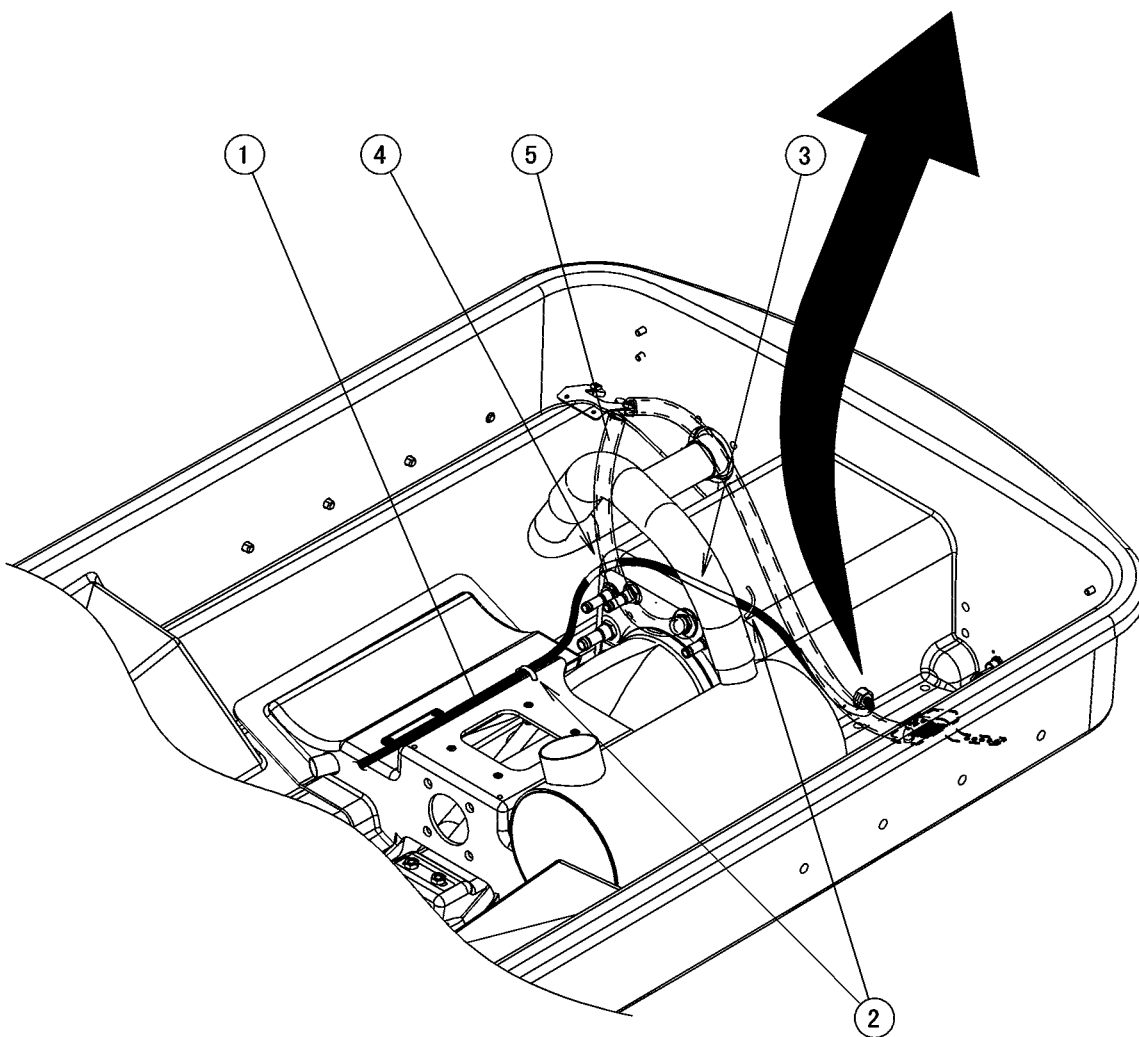
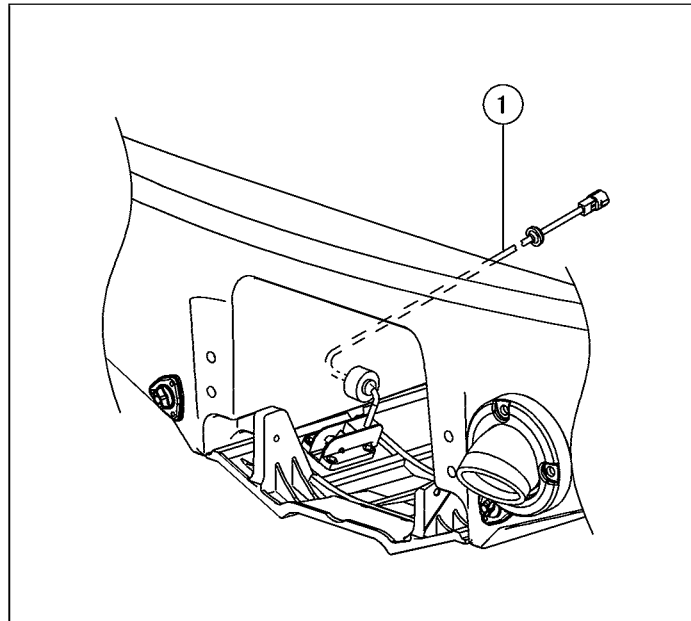


Cable, Wire and Hose Routing

1. Fix the duct and stator coil leads with the band.
2. Water Temperature Sensor
3. Intake Air Pressure Sensor
4. Air Temperature Sensor
5. Accelerator Position Sensor
6. Vehicle-down Sensor
7. Crankshaft Sensor
8. Oil Temperature Sensor
9. View from Bow
10. View from Starboard Side

16-28 APPENDIX

Cable, Wire and Hose Routing

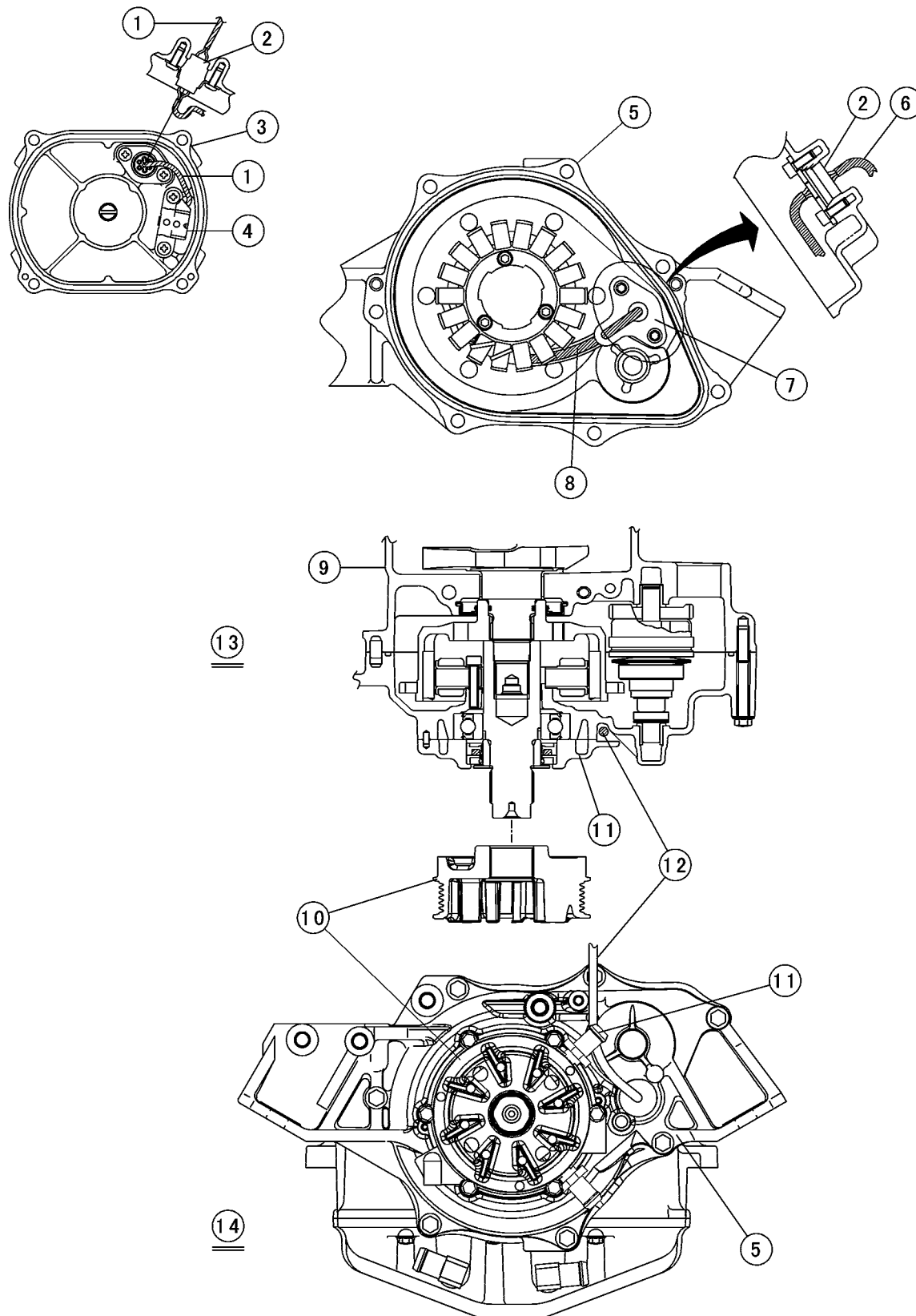


Cable, Wire and Hose Routing

1. Speed Sensor Leads
2. Bands
3. Run the speed sensor leads through the exhaust hose rearward.
4. Run the speed sensor leads through the bilge hose rearward.
5. Bilge Hose

16-30 APPENDIX

Cable, Wire and Hose Routing

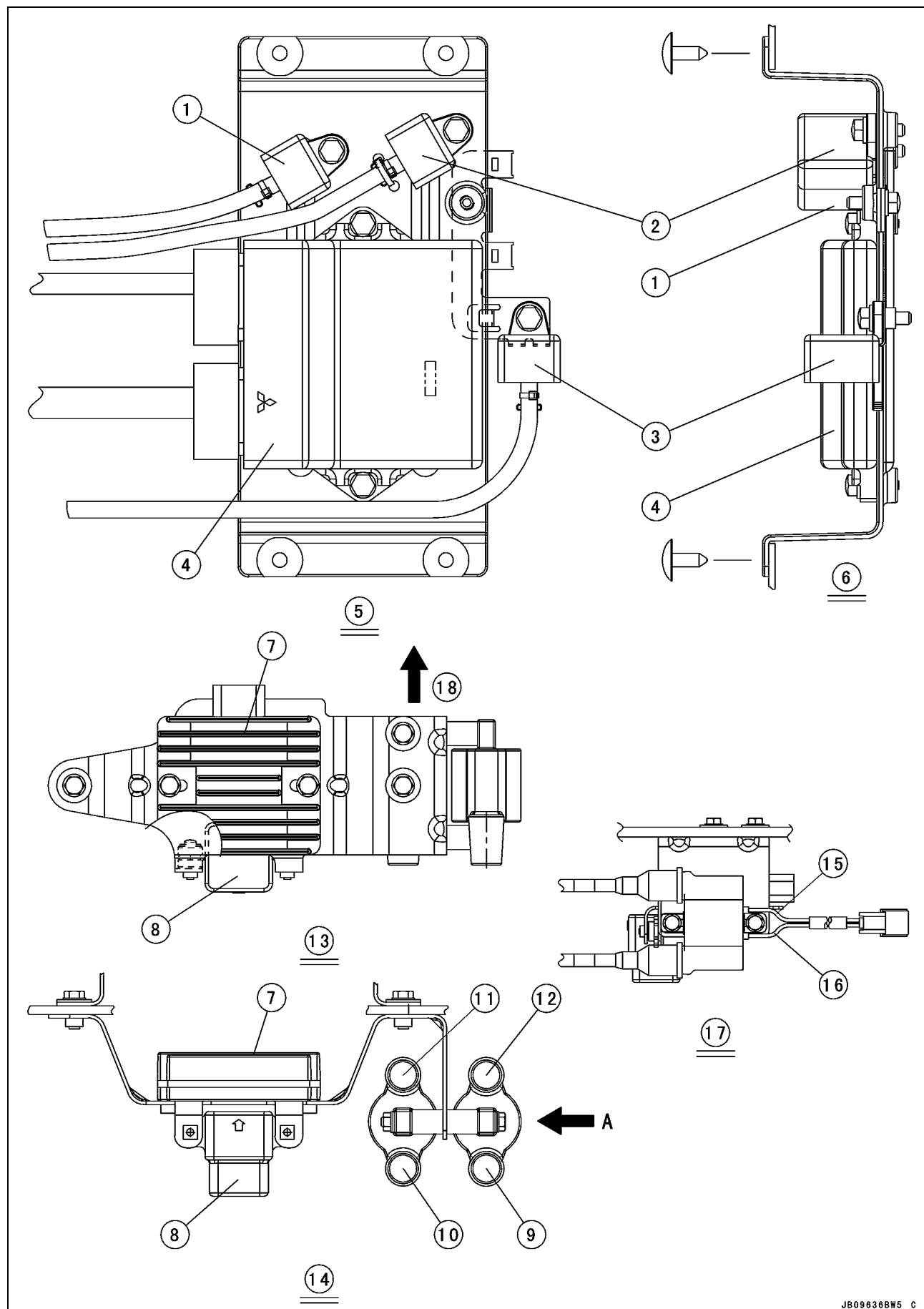


Cable, Wire and Hose Routing

1. Crankshaft Sensor Leads
2. Grommet
3. Crankshaft Sensor Cover
4. Crankshaft Sensor
5. Alternator Cover
6. Stator Coil Leads
7. Plate for holding the stator coil leads: Do not place the leads between the plate and alternator cover.
8. Run the stator coil leads along the hollow of the alternator cover.
9. Crankcase
10. Coupling
11. Output Cover
12. Run the stator coil leads between the alternator cover and output cover. Do not pinch the leads.
13. View from Top
14. View from Stern

16-32 APPENDIX

Cable, Wire and Hose Routing

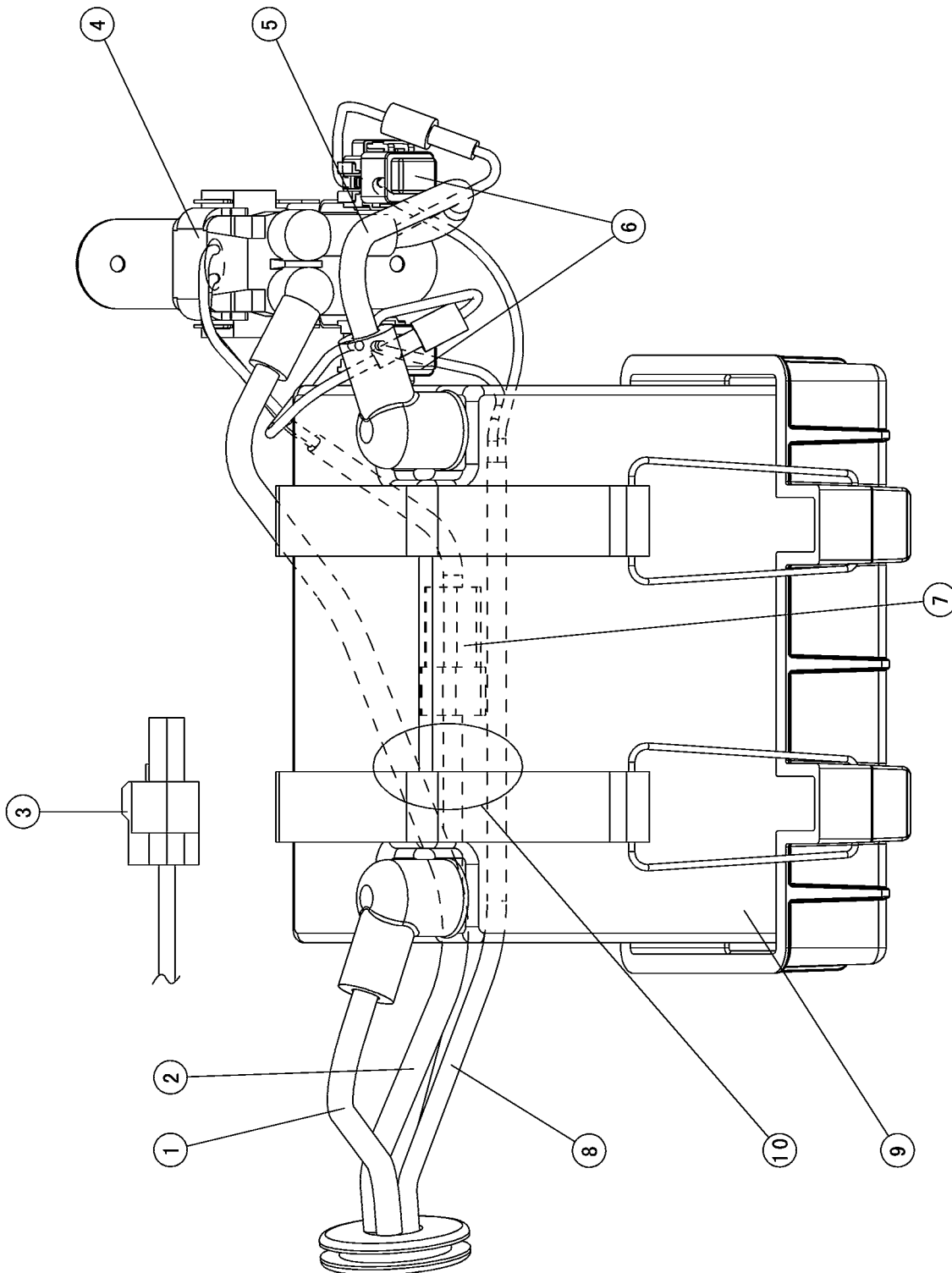


Cable, Wire and Hose Routing

1. ECU Main Relay/ETV Actuator Relay
2. Fuel Pump Relay/System Relay
3. Electric Trim Control Relay
4. ECU
5. View from Bow
6. View from Port Side
7. Regulator/Rectifier
8. Vehicle-down Sensor
9. #1 Ignition Coil Lead
10. #2 Ignition Coil Lead
11. #3 Ignition Coil Lead
12. #4 Ignition Coil Lead
13. View from Top
14. View from Stern
15. Black Lead
16. Red Lead
17. View A
18. Bow

16-34 APPENDIX

Cable, Wire and Hose Routing

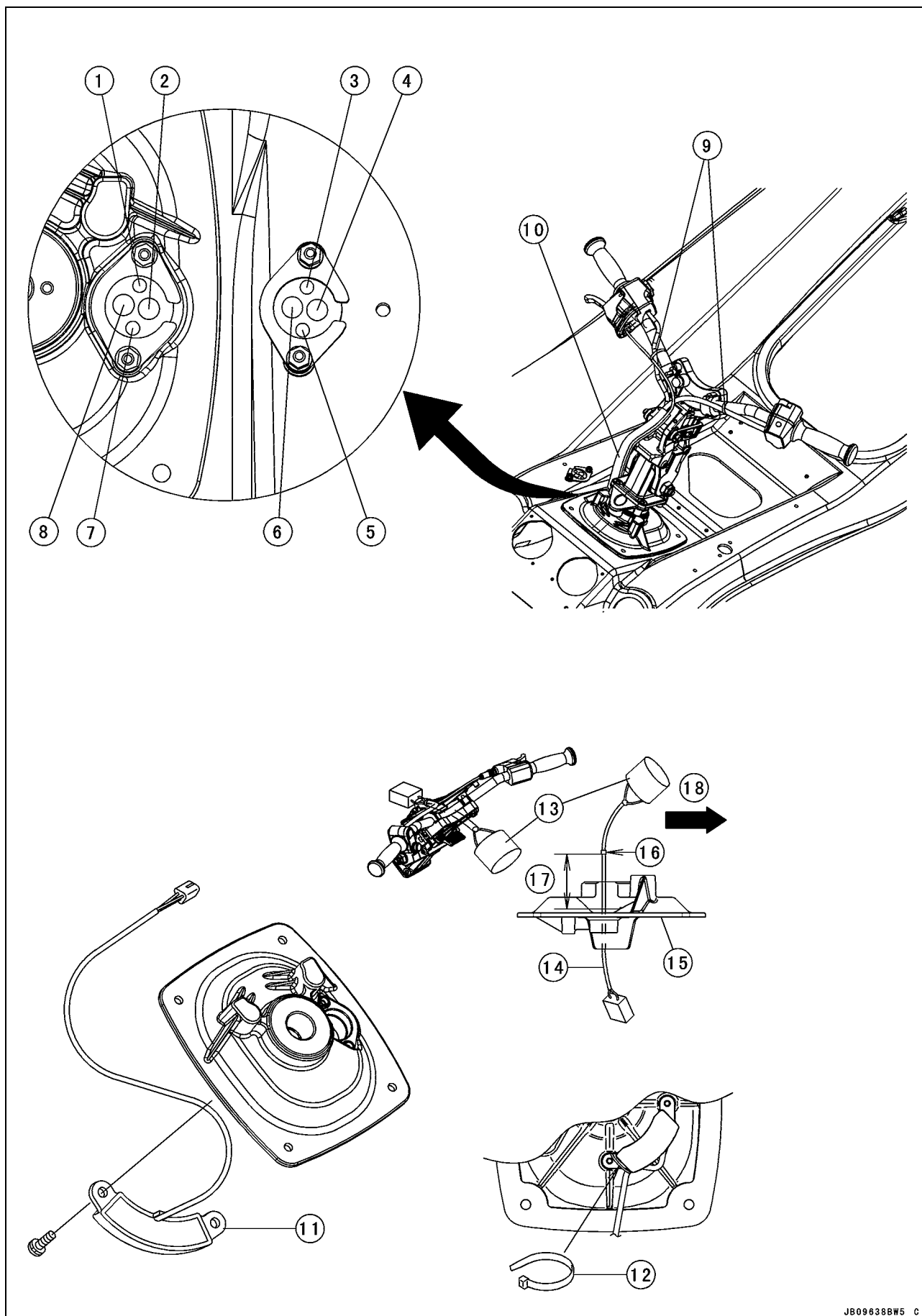


Cable, Wire and Hose Routing

1. Battery (–) Cable
2. Starter Relay Cable
3. Immobilizer/Kawasaki Diagnostic System Connector
4. Starter Relay
5. Battery (+) Cable
6. Fuse Boxes
7. Starter Relay Connector
8. Fuse Box Leads
9. Battery
10. Run the cables and leads through the battery rearward.
11. View from Bow

16-36 APPENDIX

Cable, Wire and Hose Routing



Cable, Wire and Hose Routing

1. Throttle Cable
2. Air Temperature Sensor Leads/Left Handlebar Switch Leads
3. Meter Unit Leads (Yellow Connector)
4. Fuel Vent Hose
5. Meter Unit Leads (Black and Green Connectors)
6. Meter Unit Leads (Blue Connectors)
7. Right Handlebar Switch Leads
8. Horn Leads/Throttle Cable
9. Bands
10. Protective Tube
11. Steering Position Sensor
12. Band
13. Buzzer
14. Buzzer Leads
15. Steering Holder
16. White Tape
17. 50 mm (1.97 in.)
18. Bow

Troubleshooting Guide

NOTE

- Refer to the *Fuel System (DFI)* chapter for most of DFI troubleshooting guide.
- This is not an exhaustive list, giving every possible cause for each problem listed. It is meant simply as a rough guide to assist the troubleshooting for some of the more common difficulties.

Engine Doesn't Start, Starting Difficulty

Starter motor not rotating

- Starter motor trouble (brushes worn)
- Battery voltage low
- Starter relay not contacting or operating
- Start button not contacting
- Wiring open or shorted
- Ignition switch trouble
- Engine stop switch trouble
- Fuse blown
- Immobilizer system trouble

Starter motor rotating but engine doesn't turn over

- Reduction gear trouble
- Vehicle-down sensor (DFI) coming off

Engine won't turn over

- Supercharger rotors locked-up
- Valve seizure
- Valve lifter seizure
- Cylinder, piston seizure
- Crankshaft seizure
- Connecting rod small end seizure
- Connecting rod big end seizure
- Camshaft seizure

No fuel flow

- No fuel in tank
- Fuel tank air vent obstructed
- Fuel pump screen and/or fuel filter clogged
- Fuel injector trouble
- Fuel line clogged

Engine flooded

- Clean spark plug and adjust plug gap
- Starting technique faulty (When flooded, do not crank the engine with the throttle fully opened. This promotes engine flood because more fuel is supplied automatically by DFI.)

No spark; spark weak

- Ignition coil faulty
- Vehicle-down sensor (DFI) coming off
- Vehicle-down sensor trouble
- Ignition switch turned OFF and/or lanyard key not pushed under stop button
- Battery voltage low
- Spark plug dirty, broken, or gap maladjusted
- Ignition coil shorted or not in good contact

- Ignition coil trouble
- Spark plug incorrect
- Spark plug cap trouble
- Spark plug cap shorted or not in good contact
- IC igniter in ECU trouble
- Camshaft position sensor trouble
- Crankshaft sensor trouble
- Wiring shorted or open
- Fuse blown

Fuel/air mixture incorrect

- Air passage clogged
- Air filter poorly sealed
- Air bypass system (relief valve, blow off valve) malfunction
- Fuel injector trouble
- Water or foreign matter in fuel
- Throttle sensor trouble
- Fuel pressure may be low
- Fuel pump trouble
- Intake air pressure sensor trouble
- Intake air temperature sensor trouble
- Water temperature sensor trouble
- Crankshaft sensor trouble

Compression Low

- Spark plug loose
- Cylinder head not sufficiently tightened down
- No valve clearance
- Cylinder, piston worn
- Piston ring bad (worn, weak, broken, or sticking)
- Piston ring/groove clearance excessive
- Cylinder head gasket damaged
- Cylinder head warped
- Valve spring broken or weak
- Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)

Poor Running at Low Speed

Spark weak

- Battery voltage low
- Spark plug dirty, broken, or maladjusted
- Ignition coil shorted or not in good contact
- Ignition coil trouble
- Spark plug incorrect
- Spark plug cap trouble
- Spark plug cap shorted or not in good contact
- IC igniter in ECU trouble
- Camshaft position sensor trouble
- Crankshaft sensor trouble

Fuel/air mixture incorrect

- Air passage clogged
- Air filter poorly sealed

Troubleshooting Guide

Air bypass system (relief valve, blow off valve) malfunction
 Fuel tank air vent obstructed
 Fuel pump trouble
 Intake air duct loose
 Fuel pump screen and/or fuel filter clogged
 Throttle body assy loose
 Throttle body assy gasket damage
 Fuel line clogged
 Intake air pressure sensor trouble
 Air temperature sensor trouble

Engine stalls easily

Fuel pump trouble
 Fuel injector trouble
 Throttle sensor malfunction
 Camshaft position sensor trouble
 Fuel pressure too low or too high
 Intake air pressure sensor trouble
 Water temperature sensor trouble
 Air temperature sensor trouble
 Fuel line clogged
 Crankshaft sensor trouble
 Ignition coil trouble

Compression low

Spark plug loose
 Cylinder head not sufficiently tightened down
 No valve clearance
 Cylinder, piston worn
 Piston ring bad (worn, weak, broken, or sticking)
 Piston ring/groove clearance excessive
 Cylinder head warped
 Cylinder head gasket damaged
 Valve spring broken or weak
 Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)

Hesitation

Too low fuel pressure
 Clogged fuel line
 Fuel pump trouble
 Fuel injector trouble
 Air temperature sensor trouble
 Throttle sensor trouble
 Water temperature sensor trouble
 Intake air pressure sensor trouble
 Loose injector connectors
 Crankshaft sensor trouble
 Ignition coil trouble
 Loose terminal of battery (–) lead or engine ground lead

Poor acceleration

Too low fuel pressure
 Water or foreign matter in fuel
 Clogged fuel filter or pump screen
 Fuel pump trouble

Fuel injector trouble
 Air temperature sensor trouble
 Water temperature sensor trouble
 Ignition coil trouble
 Engine oil level too high
 Spark plug dirty, broken or gap maladjusted
 Supercharger malfunction (belt trouble, duct leakage)

Stumble

Too low fuel pressure
 Fuel injector trouble
 Throttle sensor malfunction
 Water temperature sensor trouble
 Intake air pressure sensor trouble

Surge

Unstable fuel pressure
 Fuel injector trouble
 Water temperature sensor trouble

Backfiring when deceleration

Spark plug dirty, broken or gap maladjusted
 Too low fuel pressure
 Fuel pump trouble
 Throttle sensor trouble
 Air temperature sensor trouble
 Water temperature sensor trouble
 Intake air pressure sensor trouble

After fire

Crankshaft sensor trouble
 Spark plug burned or gap maladjusted
 Air temperature sensor trouble
 Water temperature sensor trouble
 Intake air pressure sensor trouble
 Fuel injector trouble

Run-on (dieseling)

Ignition switch trouble
 Engine stop switch trouble
 Fuel injector trouble
 Loose terminal of battery (–) lead or ECU ground lead
 Carbon accumulating on valve seating surface
 Engine overheating

Other

IC igniter in ECU trouble
 Engine oil viscosity too high
 Engine overheating
 Intermittent any DFI fault and its recovery

Poor Running or No Power at High Speed

Firing incorrect

Spark plug dirty, broken, or maladjusted
 Ignition coil shorted or not in good contact
 Ignition coil trouble
 Spark plug incorrect
 Spark plug cap trouble
 Spark plug cap shorted not in good contact

Troubleshooting Guide

Camshaft position sensor trouble

IC igniter in ECU trouble

Crankshaft sensor trouble

Fuel/air mixture incorrect

Air filter poorly sealed

Air filter O-ring damaged

Intake air duct loose

Water or foreign matter in fuel

Fuel to injector insufficient (DFI)

Fuel tank air vent obstructed

Fuel line clogged

Fuel pump trouble (DFI)

Injector clogged

Throttle body assy loose

Throttle body assy gasket damaged

Fuel line clogged

Fuel pump operates intermittently

Air temperature sensor trouble

Throttle sensor trouble

Intake air pressure sensor trouble

Compression low

Spark plug loose

Cylinder head not sufficiently tightened down

No valve clearance

Cylinder, piston worn

Piston ring bad (worn, weak, broken, or sticking)

Piston ring/groove clearance excessive

Cylinder head gasket damaged

Cylinder head warped

Valve spring broken or weak

Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface.)

Knocking

Carbon built up in combustion chamber

Fuel poor quality or incorrect

Spark plug incorrect

IC igniter in ECU trouble

Camshaft position sensor trouble

Crankshaft sensor trouble

Ignition coil trouble

Air temperature sensor trouble

Miscellaneous

Throttle valve won't fully open

Engine overheating

Engine oil level too high

Engine oil viscosity too high

Camshaft cam worn

Overheating

Firing incorrect

Spark plug dirty, broken, or maladjusted

Spark plug incorrect

IC igniter in ECU trouble

Fuel/air mixture incorrect

Intake air duct loose

Air filter poorly sealed

Air filter O-ring damaged

Compression high

Carbon built up in combustion chamber

Engine load faulty

Engine oil level too high

Engine oil viscosity too high

Lubrication inadequate

Engine oil level too low

Engine oil poor quality or incorrect

Oil cooler incorrect

Oil cooler clogged

Thermostat trouble

Sensor incorrect

Water temperature sensor broken

Over Cooling

Sensor incorrect

Water temperature sensor broken

Abnormal Engine Noise

Knocking

IC igniter in ECU trouble

Carbon built up in combustion chamber

Fuel poor quality or incorrect

Spark plug incorrect

Overheating

Piston slap

Cylinder/piston clearance excessive

Cylinder, piston worn

Connecting rod bent

Piston pin, piston pin hole worn

Valve noise

Valve clearance incorrect

Valve spring broken or weak

Camshaft bearing worn

Valve lifter worn

Other noise

Connecting rod small end clearance excessive

Connecting rod big end clearance excessive

Piston ring/groove clearance excessive

Piston ring worn, broken, or stuck

Piston ring groove worn

Piston seizure, damage

Cylinder head gasket leaking

Crankshaft runout excessive

Engine mount loose

Crankshaft bearing worn

Camshaft chain tensioner trouble

Camshaft chain, sprocket, guide worn

Alternator rotor loose

Troubleshooting Guide

Oil Pressure Warning Indicator Light Goes On

- Oil pump damaged
- Oil screen clogged
- Oil filter clogged
- Engine oil level too low
- Engine oil viscosity too low
- Camshaft bearing worn
- Crankshaft bearing worn
- Oil pressure switch damaged
- Wiring faulty
- O-ring at the oil passage in the crankcase damaged

Battery Trouble

Battery discharged

- Charge insufficient
- Battery faulty (too low terminal voltage)
- Battery cable making poor contact
- Alternator trouble
- Wiring faulty
- Regulator/rectifier trouble

Battery overcharged

- Alternator trouble
- Regulator/rectifier trouble
- Battery faulty

Poor Performance through Engine Runs Properly

Jet pump

- Intake area obstructed
- Impeller or pump case damaged
- Excessive clearance between impeller and pump case

Poor Steering Control (Since faulty steering is dangerous, this problem

should be examined by an authorized Jet Ski dealer)

Handlebar hard to turn

- Steering maladjusted
- Bushing damaged or cracked
- Steering shaft bent
- No lubricant on steering pivot
- Steering cable damaged or improperly routed

Engine Activates Slow Down Mode

Cooling water temperature gets high

- Weeds or debris in jet pump
- Cooling water line clogged

Low oil pressure

- Low oil level
- Improper engine oil quality

Water temperature sensors malfunction, wiring open or short

Vehicle-down sensor malfunction, wiring open or short

Oil temperature sensor gets high

- Low oil level
- Oil pump malfunction
- Oil pressure relief valve malfunction
- Weeds or debris in jet pump
- Cooling water line clogged
- Thermostat trouble

Oil temperature sensor malfunction, wiring open or short

Charging temperature gets high

- Cooling water line clogged
- Charging temperature sensor trouble
- Impeller or pump case damaged
- Intercooler clogged
- Air bypass system (relief valve, blow off valve) malfunction

MODEL APPLICATION

Year	Model	Beginning Hull No.
2011	JT1500HBF	US-KAW30001□111 US-KAW39001□111
2011	JT1500JBF	US-KAW40001□111 US-KAW49001□111

□:This digit in the hull number changes from one machine to another.



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