Kawasaki

JET SKI® watercraft

1100 STX D.I.

JET SKI® Watercraft Service Manual

Quick Reference Guide

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.

Kawasaki

1100 STX D.I.

JET SKI Watercraft Service Manual

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LIST OF ABBREVIATIONS

A	ampere(s)	lb	pound(s)
ABDC	after bottom dead center	m	meter(s)
AC	alternating current	min	minute(s)
ATDC	after top dead center	N	newton(s)
BBDC	before bottom dead center	Pa	pascal(s)
BDC	bottom dead center	PS	horsepower
BTDC	before top dead center	psi	pound(s) per square inch
°C	degree(s) Celsius	r	revolution
DC	direct current	rpm	revolution(s) perminute
F	farad(s)	TDC	top dead center
°F	degree(s) Fahrenheit	TIR	total indicator reading
ft	foot,feet	V	volt(s)
g	gram(s)	W	watt(s)
h	hour(s)	Ω	ohm(s)
L	liter(s)		

Read OWNER'S MANUAL before operating.

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 REGULAR GRADE GASOLINE ONLY.

A minimum of 87 octane of the antifknock 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.

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.

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 consitute tampering are the acts listed below:

Do not tamper with the original emission related parts.

* Engine Management Module (EMM)
* Fuel Pump
* Spark Plugs
* Fuel Injectors

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 Special Tool 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 spark plug 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 spark plug 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.

General Information

Table of Contents

1-2 GENERAL INFORMATION

Before Servicing

Before starting to service watercraft, careful reading of the applicable section is recommended to eliminate unnecessary work. Photographs, diagrams, notes, cautions, warnings, and detailed descriptions have been included wherever necessary. Nevertheless, even a detailed account has limitations, a certain amount of basic knowledge is also required for successful work.

Especially note the following:

(1) Diagnostic Software “KADIAG”

The “KADIAG” is a useful tool to aid a technician in solving direct fuel injection service problems. To use this “KADIAG” you should prepare the Communication Cable, a laptop computer, and the Software Manual.

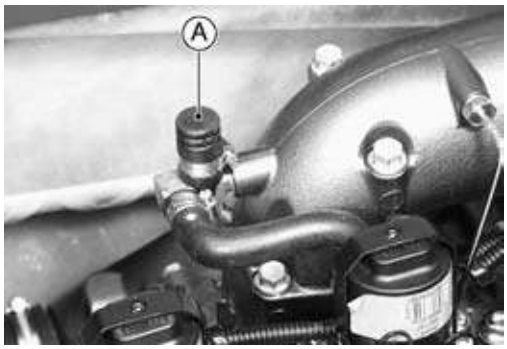
(2) Adjustments

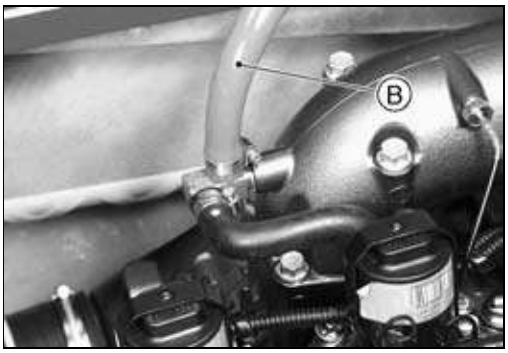
Adjustments shall be made in accordance with the Periodic Maintenance Chart or whenever troubleshooting or presence of symptoms indicate that adjustments may be required. Whenever running of the engine is required during maintenance it is best to have the watercraft in water.

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.

(3) Auxiliary Cooling

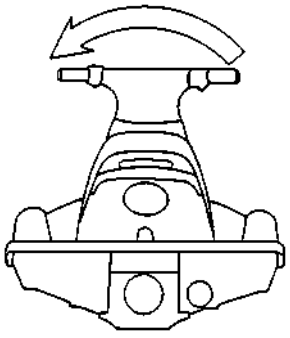
An auxiliary cooling supply may be used if the watercraft cannot be operated in water during adjustments. If possible, always operate the watercraft in water rather than use an auxiliary cooling supply.





- Loosen the clamp and remove the cap [A].
- Connect the garden hose [B] to the hose fitting (see above).
- 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 1800 rpm and 7.0 L/min (7.4 qts/min) at 6000 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. **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.**



Before Servicing

(4) Dirt

Before removal and disassembly, clean the "Jet Ski" watercraft. Any sand entering the engine, injector, or other parts will work as an abrasive and shorten the life of the watercraft. For the same reason, before installing a new part, clean off any dust or metal filings.

(5) Battery Ground

Remove the ground (–) lead from the battery before performing any disassembly operations on the watercraft. This prevents:

(a) the possibility of accidentally turning the engine over while partially disassembled.

(b) sparks at electrical connections which will occur when they are disconnected.

(c) damage to electrical parts.

(6) Tightening Sequence

Generally, when installing a part with several bolts, nuts, or screws, they should all be started in their holes and tightened to snug fit. Then tighten them evenly in a cross pattern. This is to avoid distortion of the part and/or causing gas or oil leakage. Conversely when loosening the bolts, nuts, or screws, first loosen all of them by about a quarter of turn and then remove them.

Where there is a tightening sequence indication in this Service Manual, the bolts, nuts, or screws must be tightened in the order and method indicated.

(7) Torque

The torque values given in this Service Manual should always be adhered to. Either too little or too much torque may lead to serious damage. Use a good quality, reliable torque wrench.

(8) Force

Common sense should dictate how much force is necessary in assembly and disassembly. If a part seems especially difficult to remove or install, stop and examine what may be causing the problem. Whenever tapping is necessary, tap lightly using a wooden or plastic faced mallet. Use an impact driver for screws (particularly for the removal of screws held by a locking agent) in order to avoid damaging the screw heads.

(9) Edges

Watch for sharp edges, especially during major engine disassembly and assembly. Protect your hands with gloves or a piece of thick cloth when lifting the engine or turning it over.

(10) High Flash-Point Solvent

A high flash-point solvent is recommended to reduce fire danger. A commercial solvent commonly available in North America is Standard solvent (generic name). Always follow manufacturer and container directions regarding the use of any solvent.

(11) Gasket, O-Ring

Do not reuse a gasket or O-ring once it has been in service. The mating surfaces around the gasket should be free of foreign matter and perfectly smooth to avoid oil or compression leaks.

(12) Liquid Gasket, Non-Permanent Locking Agent

Follow manufacturer's directions for cleaning and preparing surfaces where these compounds will be used. Apply sparingly. Excessive amounts may block engine cooling passages and cause serious damage. An example of a non-permanent locking agent commonly available in North America is Loctite Lock N' Seal (Blue).

(13) Press

A part installed using a press or driver, such as a seal, should first be coated with oil on its outer or inner circumference so that it will go into place smoothly.

(14) Ball Bearing

When installing a ball bearing, the bearing race which is affected by friction should be pushed by a suitable driver. This prevents severe stress on the balls and races, and prevents races and balls from being dented. Press a ball bearing until it stops at the stop in the hole or on the shaft.

(15) Oil Seal and Grease Seal

Replace any oil or grease seals that were removed with new ones, as removal generally damages seals. When pressing in a seal which has manufacturer's marks, press it in with the marks facing out. Seals should be pressed into place using a suitable driver, which contacts evenly with the side of seal, until the face of the seal is even with the end of the hole.

(16) Seal Guide

A seal guide is required for certain oil or grease seals during installation to avoid damage to the seal lips. Before a shaft passes through a seal, apply a little lubricant, preferably high temperature grease on the lips to reduce rubber to metal friction.

(17) Circlip, Retaining Ring

Replace any circlips and retaining rings that were removed with new ones, as removal weakens and deforms them. When installing circlips and retaining rings, take care to compress or expand them only enough to install them and no more.

(18) Cotter Pin

Replace any cotter pins that were removed with new ones, as removal deforms and breaks them.

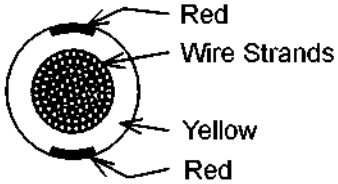
(19) Lubrication

Engine wear is generally at its maximum while the engine is warming up and before all the rubbing surfaces have an adequate lubricative film. During assembly, oil or grease (whichever is more suitable) should be applied to any rubbing surface which has lost its lubricative film. Old grease and dirty oil should be cleaned off. Deteriorated grease has lost its lubricative quality and may contain abrasive foreign particles.

Don't use just any oil or grease. Some oils and greases in particular should be used only in certain applications and may be harmful if used in an application for which they are not intended.

(20) Electrical Wires

All the electrical wires are either single-color or two-color and, with only a few exceptions, must be connected to wires of the same color. On any of the two-color wires there is a greater amount of one color and a lesser amount of a second color, so a two-color wire is identified by first the primary color and then the secondary color. For example, a yellow wire with thin red stripes is referred to as a "yellow/red" wire; it would be a "red/yellow" wire if the colors were reversed to make red the main color.

Wire (cross-section)	Name of Wire Color
	Yellow/Red

(21) Replacement Parts

When there is a replacement instruction, replace these parts with new ones every time they are removed. These replacement parts will be damaged or lose their original function once removed.

(22) Inspection

When parts have been disassembled, visually inspect these parts for the following conditions or other damage. If there is any doubt as to the condition of them, replace them with new ones.

Abrasion	Crack	Hardening	Warp
Bent	Dent	Scratch	Wear
Color change	Deterioration	Seizure	

(23) Service Data

Numbers of service data in this text have following meanings:

"Standards": Show dimensions or performances which brand-new parts or systems have.

"Service Limits": Indicate the usable limits. If the measurement shows excessive wear or deteriorated performance, replace the damaged parts.

Model Identification

JT1100-G1 Left Side View:

JT1100-G1 Right Side View:

1-6 GENERAL INFORMATION

General Specifications

Items		JT1100-G1
Engine:		
Type		2-stroke, 3-cylinder, crankcase reed valve, water cooled
Displacement		1 071 mL (65.4 cu in.)
Bore and stroke		80 × 71 mm (3.15 × 2.80 in.)
Compression ratio		6.6 : 1
Maximum horsepower		96 kW (130 PS) @7 000 r/min (rpm)
Maximum torque		144 N·m (14.6 kg·m, 106 ft·lb) @6 250 r/min (rpm)
Ignition system		DC-CDI
Lubrication system		Superlube oil injection (break-in period: Oil injection and fuel mixture 50 : 1)
Fuel system		FICHT Direct Fuel Injection
Starting system		Electric starter
Tuning Specifications:		
Spark plug:	Type	NGK PZFR7G-G
	Gap	0.7 ∼ 0.8 mm (0.028 ~ 0.031 in.)
	Terminal	Solid post
Ignition timing		17° BTDC @1 100 r/min ∼ 24° BTDC @3 000 r/min (rpm)
Idle speed:	in water	1 100 ± 100 r/min (rpm)
	out of water	1 100 ± 100 r/min (rpm)
Compression pressure		755 ∼ 1 177 kPa (7.7 ∼ 12.0 kg/cm^2, 109 ∼ 171 psi)
Drive System:		
Coupling		Direct drive from engine
Jet pump:	Type	Axial flow single stage
	Thrust	3 790 N (386 kgf, 851 lb)
Steering		Steerable nozzle
Braking		Water drag
Performance:		
†Minimum turning radius		4.0 m (13.1 ft)
†Fuel consumption		41 L/h (10.8 us gal/h) @full throttle
†Cruising range		122 km (76 mile) @full throttle 1 hour and 19 minutes
Dimensions:		
Overall length		3 120 mm (122.83 in.)
Overall width		1 180 mm (46.46 in.)
Overal height		1 020 mm (40.16 in.)
Dry weight		308 kg (679 lb)
Fuel tank capacity		54 L (14.3 us gal)
Engine Oil:		
Type		2-stroke, N.M.M.A. Certified for Service TC-W3
Oil tank capacity		5.0 L (1.3 us gal)
Electrical Equipment:		
Battery		12 V 18 Ah
Maximum generator out put		12.3 A/13V @6 000 r/min (rpm)

†: 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.

Technical Information - Theory of Direct Fuel Injection

1. DFI Overview

The function of Kawasaki Direct Fuel Injection (DFI) sequential, direct-injection fuel system is to efficiently supply fuel under all engine load, temperature, and RPM conditions. The benefits of DFI include quick starting, improved fuel economy, excellent throttle response, and greatly reduced exhaust emissions. DFI involves the interaction of various fuel, ignition, and electrical components. All work together under the direction of an EMM (Engine Management Module).

Kawasaki DFI system has a number of unique features:

(1) Alternator output is dual-voltage; both 12 and 45 volts DC are produced.

(2) EMM contains ignition and charging system components (regulator/rectifier).

(3) The fuel injectors are a German concept (FICHT); fuel is injected under high pressure directly into each combustion chamber. The fuel distribution system is regulated at approximately 196 kPa (2.0 kg/cm^2, 28 psi).

(4) Technician diagnostic procedures are simple; the EMM stores service codes and delivers real-time data.

(5) Various sensors monitor engine running conditions; operator waring systems like “CHECK ENG.” light and S.L.O.W. are standard features.

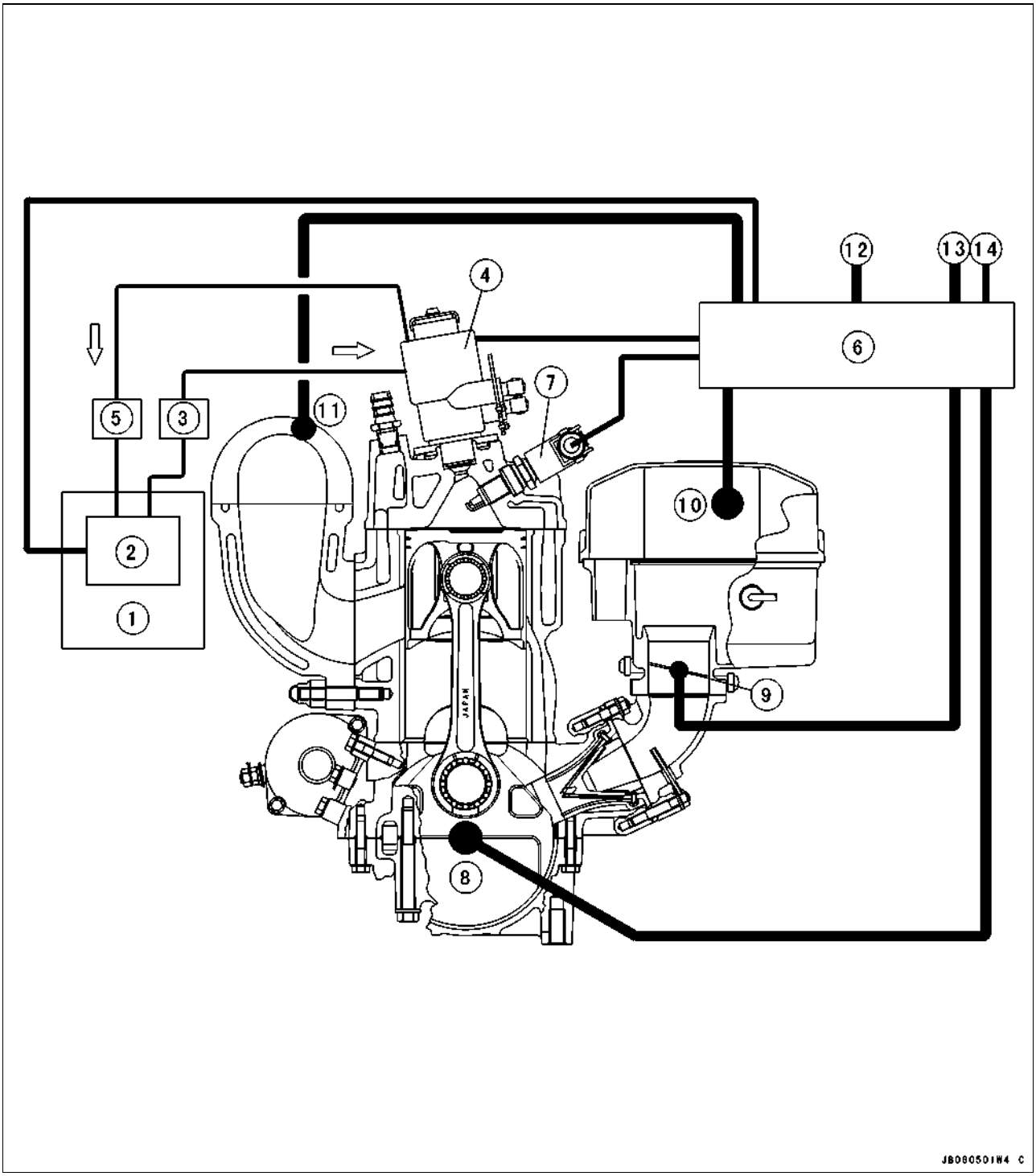
(6) The ignition system is a high-frequency, multi-strike CD system that generates a variable spark profile to exactly meet combustion requirements.

These are only a few of Kawasaki DFI system features. The pages that follow will cover all in more detail.

Technical Information - Theory of Direct Fuel Injection

2. System Operation

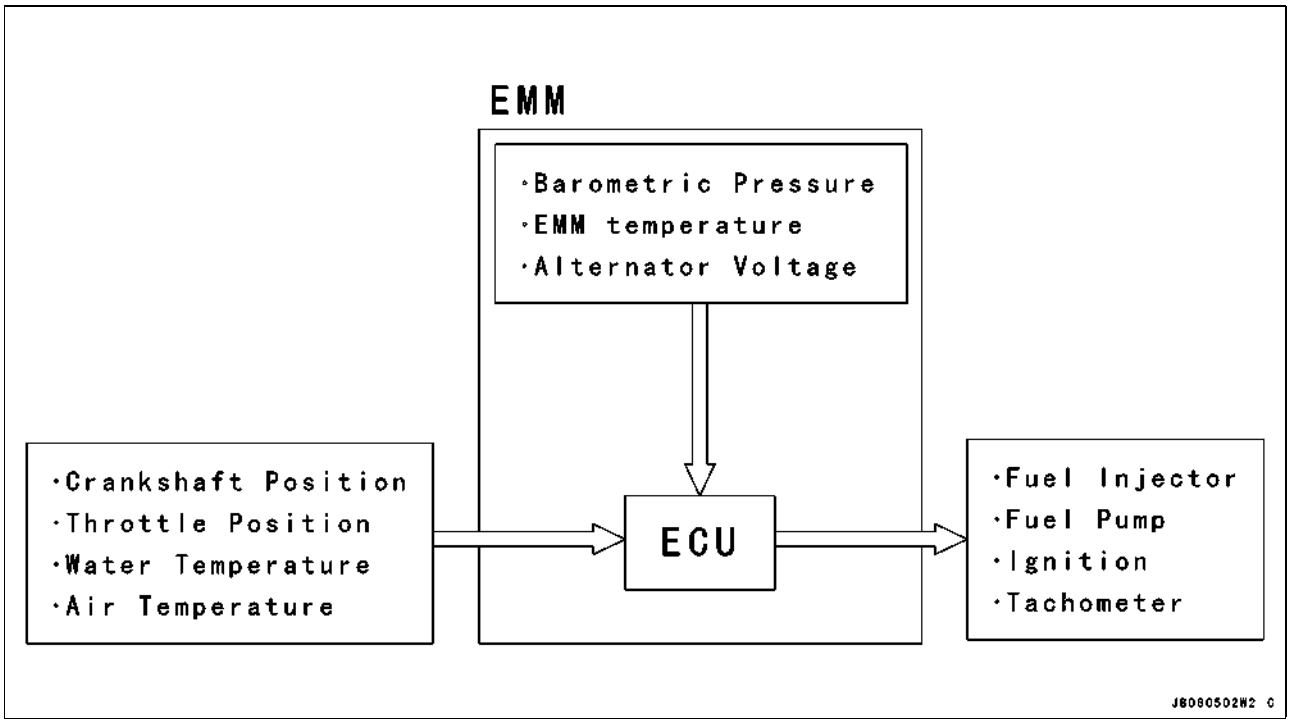
2. 1 DFI System Diagram



1. Fuel Tank
2. Fuel Pump
3. Fuel Filter
4. Injector
5. Fuel Regulator
6. EMM (Engine Management Module)
7. Spark Plug
8. CPS (Crank Position Sensor)
9. TPS (Throttle Position Sensor)
10. ATS (Air Temperature Sensor)
11. WTS (Water Temperature Sensor)
12. BPS (Barometric Pressure Sensor)
13. EMM Temperature Sensor
14. Tach. Meter

Technical Information - Theory of Direct Fuel Injection

2. 2 Imputs and Outputs



2. 3 Operation

(1) A low-pressure pump inside the fuel tank supplies fuel to the injectors at a regulated pressure of 196 kPa (2.0 kg/cm^2, 28 psi). The injector is fitted directly to the cylinder head (one injector per cylinder). The electromagnetic injector operates very much like a solenoid.

(2) When the EMM operates the injector, a small stainless-steel piston (located within a gasoline-filled chamber and surrounded by energized copper windings) travels downward and squirts fuel into the combustion chamber at approximately 1724 kPa (17.6 kg/cm^2, 250 psi). The amount of fuel injected is controlled by the EMM and is timed with the ignition spark.

(3) The ignition system is a rapid-fire type. The high-freguency, high-energy, multi-spark DC-CD ignition is designed to fire the spark plug about 10 times per cycle. At idle and low rpm, the DFI system produces a stratified charge, meaning that combustion takes place as soon as the fuel reaches the spark plug. At this point the combustion chamber is extremely lean. The spark plug fires multiple times for three reasons:
   (a) the plume of fuel is rich and is hard to ignite
   (b) keeps the spark plug tip clean
   (c) ensures proper timing of the spark and fuel discharge

(4) At these low rpms, the plume of gasoline containing just enough energy to keep the piston moving is emitted into the cylinder. The position of the fuel plume is maintained by a machined cavity in the piston dome.

(5) At higher rpm, the mixture changes from stratified to homogeneous, meaning that combustion doesn't take place until the fuel and air have mixed in the combustion chamber.

(6) Lubrication for the engine is supplied by a variable-rate oil injection system. Because the oil is not diluted with gasoline in the crankcases with the DFI system, less oil is required for engine lubrication.

3. EMM (Engine Management Module)

3. 1 Features of Function or Operation

(1) Water cooled
Hose routing: from the stator cooling cover, to the EMM, and then exits into the exhaust chamber

(2) Sets idle rpm by controlling the fuel supply to the engine

(3) Stores service codes when a failure is detected

(4) Will not operate with less than 8 volts supplied operating voltage

(5) Contains ignition and charging system components (regulator/rectifier)

(6) Activates Speed Limiting Operational Warning - S.L.O.W.
(a) As long as S.L.O.W. is activated, the engine will run normally below 3500 rpm. Above 3500 rpm, the engine will surge.
(b) To recover from S.L.O.W., two conditions must be satisfied; sensor or switch parameters must be back within limits, and engine rpm must be reduced to an idle.
(c) Failures that initiate S.L.O.W.

Code 18: Alternator voltage above expected range
Code 25: EMM temperature above expected range
Code 35: Low oil level
Code 43: Water temperature sensor above expected range
Code 49: Air temperature sensor above expected range

(7) Provides the cold starting system
(8) Generates tachometer signal
(9) Controls fuel pump operation
(10) Records engine operating hours

3. 2 Internal EMM Sensors

Five sensors are located inside the EMM; barometric pressure, EMM temperature, alternator 45 volts, battery 12 volts, and ROM verification. Since none are serviceable parts, failure correction would require replacement of the EMM.

(1) Barometric Pressure (BP) sensor - is a silicon pressure sensor having a diaphram-sealed air passage that generates an AC voltage signal. It senses ambient air pressure through a screened port that is open to atmosphere. The BP signal enables the EMM to compensate for changes in altitude and air density up to 14,000 ft. (4267 m) so it can adjust fuel flow accordingly.
(2) EMM Temperature Sensor – monitors fuel injector driver circuitry temperature to prevent overheat. If an overheat occurs, the EMM will turn on the “CHECK ENG.” light, and store a service code. The EMM will also initiate S.L.O.W..
(3) 45 - volt Circuit Sensor – monitors rectifier/regulator 45 volt output. This is the circuit that powers the fuel injectors and the ignition. If voltage exceeds the expected range, the EMM will initiate S.L.O.W., store a service code, and turn on the “CHECK ENG.” light. Voltage below the expected range will store a service code and turn on the “CHECK ENG.” light, but will not put the engine into S.L.O.W.
(4) RPM Limiter – this feature of EMM programming prevents engine damage due to excessive RPM. At 7650 rpm, fuel to cylinder #2 is shut off. Normal engine operation automatically returns as soon as engine RPM drops down to the specified range.
(5) Idle Governor – changes fuel pulse width to maintain an idle of 1100 rpm.
(6) 12 - volt Circuit Sensor – monitors rectifier/regulator 12 - volt output. This is the circuit that supplies all 12 - volt component/circuit requirements.
(7) ROM Verification – is a continual EMM self - test of factory programming. The EMM will turn on the “CHECK ENG.” light and store a service code if, at any time, a program failure is detected.

3. 3 External EMM Sensors

(1) Air Temperature (AT) Sensor

The air temperature sensor is located on the flame arrestor. It monitors the temperature of air entering the air silencer/throttle body. The AT sensor is a thermister, a resistor whose resistance changes with temperature and alters voltage values accordingly. When temperature increases, both resistance and voltage also increase. When temperature decreases, resistance and voltage likewise decrease.

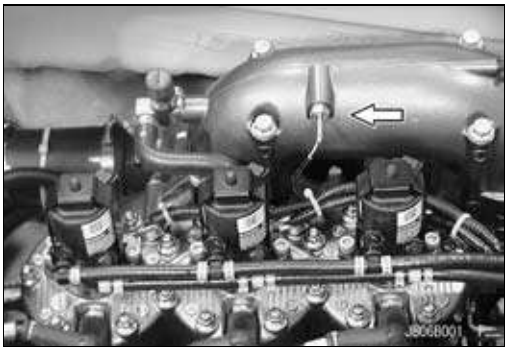
Technical Information - Theory of Direct Fuel Injection

The sensor receives a voltage signal from the EMM, and another wire provides a ground circuit back to the EMM. The EMM uses this signal to adjust the air/fuel ratio in accordance with changes in incoming air temperatures.

If sensor values are above expected range, the EMM will initiate S.L.O.W., store a service code, and turn on the “CHECK ENG.” light. AT sensor value below the expected range will store a service code and turn on the “CHECK ENG.” light, but will not put the engine into S.L.O.W.

(2) Water Temperature (WT) Sensor -

The water temperature sensor is located on the exhaust pipe, and it does not actually contact the water. The WT sensor monitors engine temperature.



The WT sensor is a thermistor, a resister whose resistance changes with temperature . When temperature increases, both resistance and voltage also increase. When temperature decreases, resistance and voltage likewise decrease.

The sensor receives a voltage signal from the EMM, and another wire provides a ground circuit back to the EMM. The EMM uses this exhaust pipe water temperature.

If sensor values are above the limits (engine overheat), the EMM will initiate S.L.O.W., store a service code, and turn on the “Water Temperature” light and the “CHECK ENG.” light.

If the sensor circuit malfunctions, the EMM will store a service code, and turn on the “CHECK ENG.” light.

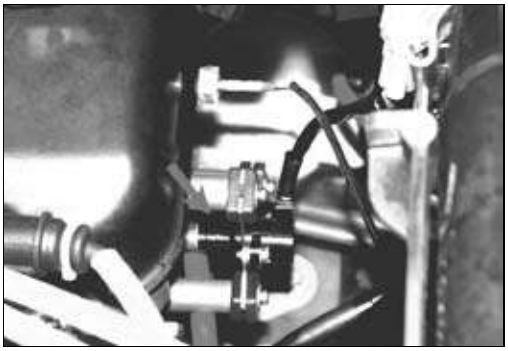
If sensor values are below the limit, the EMM will store a service code, and turn on the “CHECK ENG.” light. The engine will not go into S.L.O.W.

(3) Throttle Position (TP) Sensor

The TP sensor is a rotary potentiometer. It is located on the end of the throttle shaft. The sensor receives a voltage signal from the EMM. As the throttle lever is rotated , the EMM receives a return voltage signal through a second wire. This signal is relative to the position of the throttle shaft. As the throttle opens, voltage increases. As the throttle closes, voltage decreases. A third wire completes the ground circuit back to the EMM.

If sensed value is above expected range, the EMM will store a service code, and turn on the “CHECK ENG.” light.

If the sensor circuit malfunctions, the EMM will turn on the “CHECK ENG.” light.



(4) Crankshaft Position (CP) Sensor –

The Crankshaft Position sensor is a magnetic device. It generates a magnetic field that is interrupted by the flywheel encorder ribs passing through it. This produces an AC voltage signal directly related to flywheel RPM. Crankshaft TDC is determined by encorder rib spacing.

If the crank position sensor is mis-adjusted or damaged, the EMM will turn on the “CHECK ENG.” light.

The sensor feeds the flywheel encorder data to the EMM, which calculates crank position and engine speed. The EMM generates a tachometer signal, and controls fuel injector and ignition operation. The sensor is located on the stator cover at the 12 o’clock position, and requires a 1.15 mm (0.045 in.) sensor-to-flywheel air gap to operate properly.

If the crankshaft sensor of its circuit fails, the engine will not run. If the air gap is incorrect, the engine will run erratically. A sensor that is damaged or out of adjustment will turn on the “CHECK ENG.” light but store a service code, only if the failure occurs while the engine is running.

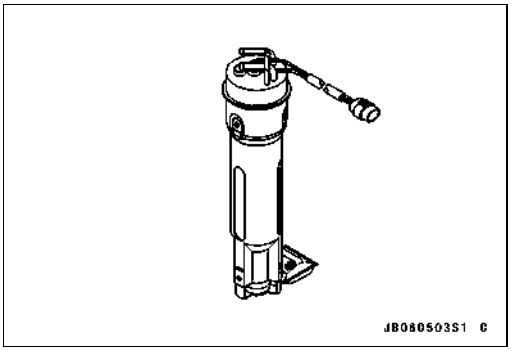
NOTE

- *Crankshaft sensor operation can be verified by the Engine Monitoring Screen of the KADIAG Program. RPM on the screen should reflect engine RPM while cranking.*

4. Fuel System Components

4. 1 Fuel Pump

(1) Roller-cell type located inside the fuel tank
(2) Operation is controlled by the EMM

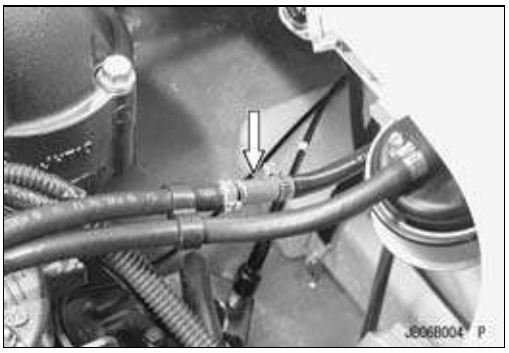


4. 2 Fuel Filter

(1) Located on the fuel feed hose under the cowl
(2) Prevents debris clogging vital parts of the fuel system

4. 3 Fuel Regulator

(1) Maintains fuel pressure at approximately 196 kpa (2.0 kg/cm^2, 28 psi)
(2) Located on the fuel return line



4. 4 Fuel Injector

(1) A 45 volt solenoid – type that injects fuel directly into the combustion chamber (Direct Injection)
(2) Produced about 1724 kpa (17.6 kg/cm^2, 250 psi) of discharge fuel pressure
(3) 173 kPa (1.76 kg/cm^2, 25 psi) of fuel pressure is circulated through the injector at all times to cool the injector during operation

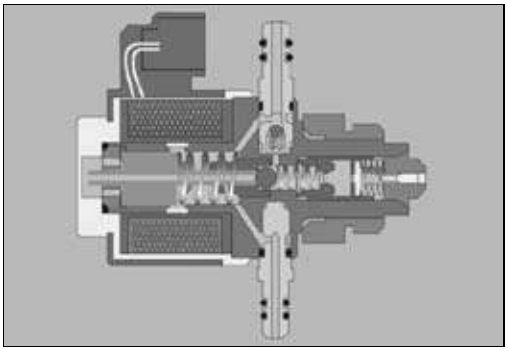
Technical Information - Theory of Direct Fuel Injection

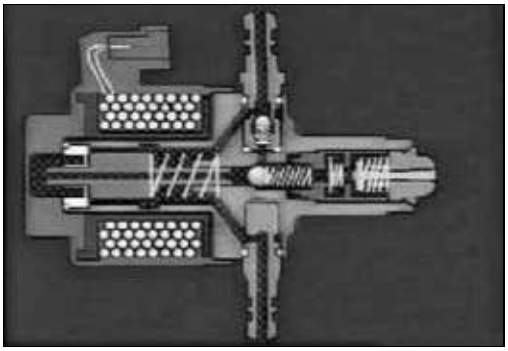
4. 5 Fuel Injection Operation

(1) When the electromagnet is energized by the EMM closing the controlling side wire (not a ground wire), the armature moves towards the nozzle at a high rate of speed. The armature is hollow which allows the armature to move easily through the fuel until it contacts the ball valve.

(2) As the ball seats on the armature, the armature acts like a piston pressursing the fuel in the nozzle end of the injector. When the fuel pressure in the nozzle area is greater than the nozzle's spring pressure, the poppet valve opens spraying fuel into the combustion chamber. The amount of fuel delivered is determined by the current and duration of the electrical pulse to the coil.

(3) The inlet check valve seals the armature cavity during operation and allows cooling fuel to continue. The outlet check valve keeps a reservoir of fuel in the nozzle.



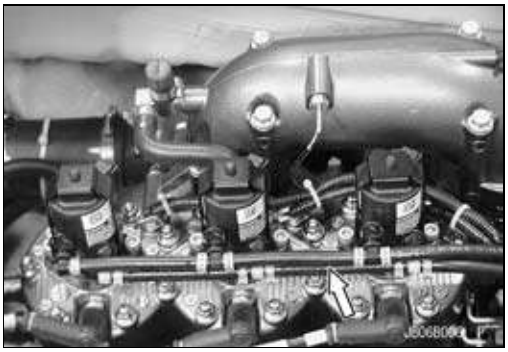


If a fuel injector electrical circuit becomes open or disconnected while the engine is running, the EMM will store a specific injector service code in memory, and will turn on the "CHECK ENG." light.

4. 6 Fuel Rails

(1) The DFI system has two fuel rails, one for fuel supply and one for fuel return. They are semilar in appearance and functionally the same. Each rail has three fittings that attach directly to either the inlet or outlet nipples of the fuel injectors.

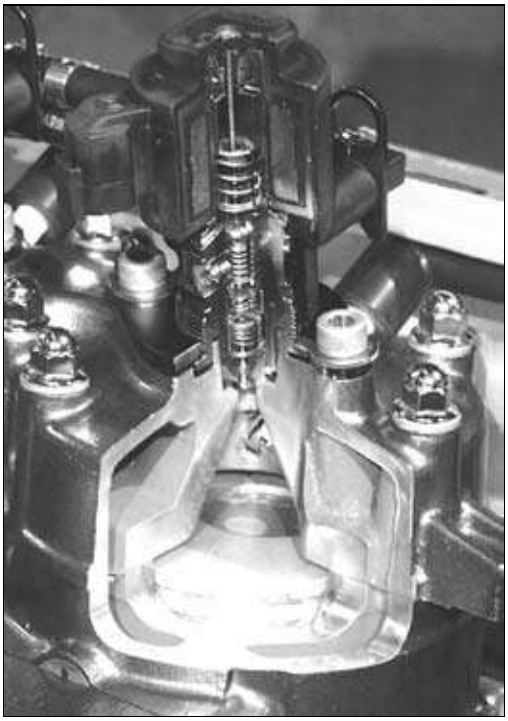
(2) A wire retainer spans each injector to connect the inlet and outlet fittings. The retainer securely holds both fittings to the injector to prevent them from accidentally disengaging.



Technical Information - Theory of Direct Fuel Injection

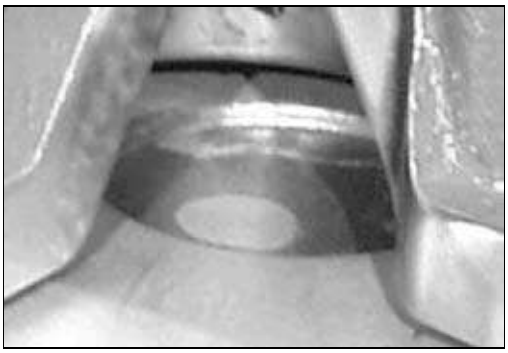
4. 7 Cylinder Heads

Each head mounts one fuel injector and one spark plug per cylinder. Their positioning is designed to permit complete combustion and maximum power from each air/fuel charge. This results in greatly reduced exhaust emissions and increased fuel economy.



4. 8 Piston

The top of each piston has a unique configuration. Each is slightly domed, and features a small cylindrical " splash port". Injector fuel spray is directed into the splash port which in turn reflects it upward through out the combustion chamber. This provides a finely atomized fuel/air mixture for easier ignition and cleaner burning.



5. Ignition

5. 1 High-Frequency Multi-Strike DC-CDI system

The DFI ignition system is a high frequency, multi–strike DC-CDI system that generates a variable spark profile to exactly meet combustion requirement.

5. 2 Coils are rising field type.

(1) Primary voltage is approximately 250 volts.
(2) Secondary voltage is 35 – 40 kV.

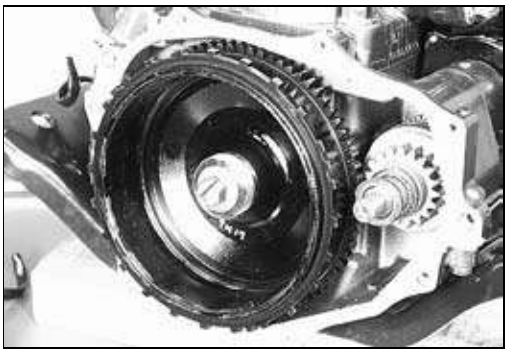
5. 3 Variable spark count

(1) Spark timing is determined in conjunction with injector timing. The ribs on the flywheel time the injector (through the EMM), ignition timing is on this EMM map.
(2) Stratified mode
  (a) At idle and low engine rpms, combustion takes place as the fuel spray contacts the spark plug's tip.
  (b) There are about 10 sparks in this mode.
(3) Homogeneous mode
  (a) The engine starts in this mode to conserve voltage for the injectors. At approximately 500 r/min (rpm) the switches to stratified.
  (b) The homogeneous mode starts at approximately 5500 r/min (rpm).
  (c) There is one spark in this mode.
  (d) Ignition occurs after the fuel has contacted to the piston and has atomized.

6. Electrical system component

6. 1 Flywheel

EMM uses ribs on the outer circumference of the flywheel to time injectors. The ribs are unevenly spaced, and the EMM determines crankshaft position and engine rpm by the rib spacing.



The flywheel houses magnets that work in conjunction with the stator to provide battery charging (12 volts) and injector operation (45 volts). Within approximately one crankshaft revolution, the EMM will learn crankshaft positioning to enable it to fire the cylinders and control spark advance.

6. 2 Stator

The stator, in conjunction with the flywheel and rectifier/regulator, makes up the DFI system alternator.

The stator consists of 12 poles with 5 sets of windings that are all connected to the EMM (10 wires). Switches are located in the EMM switching circuit.

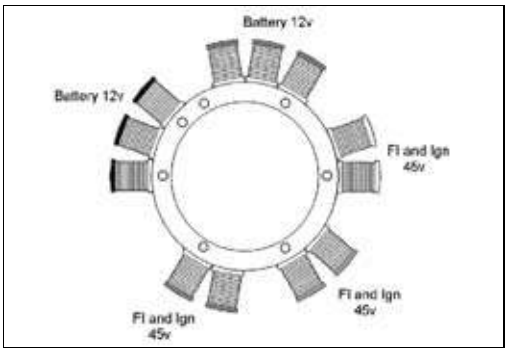
(1) The ignition system receives its operating voltage from the stator (45 V), not the battery.

(2) During engine starting, a switch closes and connect all 5 windings in series. This maximises the available power for the EMM and injectors.

(3) The battery operates the starter, fuel pump, and instrumentation during starting.

(4) At approximately 500 r/min (rpm), the switch opens isolating the battery charging windings from the EMM and injector windings. This is normal operation.

To satisfy power requirements at higher rpms, the stator switches windings 3 – 5 from series to parallel at 2500 r/min (rpm).



6. 3 Capacitor

The capacitor is a dampening device that prevents erratic operations of the injections.

A faulty capacitor will cause the engine to surge or sharply miss.

7. S.L.O.W. ™ Warning System

DFI engines have a protective feature that prevents cylinder-head damage due to an engine cooling system overheat, alternator output exceeding 45 volts, excessive EMM temperature, or TP/WT/AT sensor circuit malfunction/above expected range. This feature is called S.L.O.W. (Speed Limiting Operational Warning). A number of device monitor engine operating conditions. All are liked directly to the EMM, which in turn is connected to the multi-function meter, “CHECK ENG.” light.

7. 1 Initiation

When the appropriate sensor or switch is activated, the EMM responds by interrupting fuel injector operation. It begins a gradual drop in engine RPM to a threshold limit of approximately 3 500 r/min (rpm). This is accomplished by cutting out one cylinder at a time, until a total if two are affected. The EMM simultaneously turns on the “CHECK ENG.” or “Water Temperature” light. As long as S.L.O.W is activated, the engine will run normally below 3500 r/min (rpm). Above 3 500 r/min (rpm), the engine will run poorly.

7. 2 Recovery

The engine will operate as described as long as the condition that activated S.L.O.W. continues to exist. To recover from S.L.O.W., two conditions must be satisfied; sensor or switch parameters must be back within limits, and engine RPM must be reduced to idle. The system will now immediately recover and the EMM will return engine operation to normal.

7. 3 Failures That Iniciate S.L.O.W.

Code 18 - Alternator valtage above expected range
Code 25 - EMM temperature above expected range
Code 35 - Low oil level
Code 43 - WT sensor above expected range
Code 49 - AT sensor above expected range

8. KADIAG Software

When using KADIAG Software, refer to the KADIAG Software Manual.

8. 1 Computer requirements

Lap top, 286 MHz minimum, 4 meg memory minimum, 1.44 meg drive. Program is DOS based running under windows.

Special Tools - Communication Cable (Part No. 57001– 1460)
KADIAG Software (Part No. 57001–1461)
KADIAG Software Manual (Part No. 99929–1412–01)

8. 2 Main Menu selection

CAUTION
Caution: Do not disconnect the battery or turn off the ignition switch the software has been properly shut down.

(1) Diagnostic Session

Retrieves stored service codes.

Hard Codes:	Displayed first. A hard code means that the problem that created the malfunction now exists.
Intermittent Codes:	Displayed second. An intermittent code means that the problem that created the code is not occurring at this time.
Repaired Codes:	Displayed last. A hard code that was causing the cause at the beginning of the session is no longer occurring.

(2) Statistic Tests (engine off)

Tests fuel injectors, ignition coils, and fuel pump.

(3) Cylinder Drop Test (engine running)

Momentarily shuts off one cylinder for troubleshooting a dead cylinder.

(4) EMM Information

Records the unit's engine model, engine serial number, EMM serial number, software version, map version, and engine hours.

(5) RPM profile

Using total engine hours, records 8 rpm ranges and the percentage the engine has operated at each range.

8. 3 Service Utilities Program

This program must be used when monitoring the engine or replacing an Injector or EMM.

(1) Service Reports

The purpose of the Service Report menu is to provide a method of creating and printing a service report.

(2) Injector Information

The purpose of the Injector Information is to display the serial numbers of injectors and to allow the technician to install a Service Replacement Injector.

Technical Information - Theory of Direct Fuel Injection

CAUTION
Do not take a replacement injector from another engine or switch injectors on the same engine.

(3) Service EMM (When the EMM can communicate with a laptop computer)
The purpose of this Service EMM is to provide a simple method of loading engine specific informations into a Service Replacement EMM.

(4) Engine Monitoring
This screen is a highly useful diagnostic tool. This allows you to see engine conditions as they are occurring.

(5) Adjust Fuel Map
This allows you to adjust fuel amount at + 5%, 0, or – 5%.

8. 4 EMM Replacement

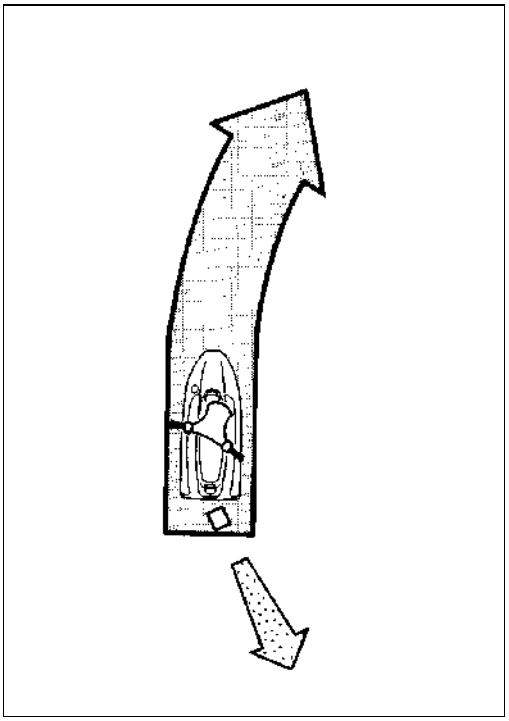
When the EMM cannot communicate with a laptop computer, please consult with the distributor about the matter.

Technical Information – Kawasaki Smart Steering System

Outline

The Kawasaki Smart Steering system provides turning action under certain conditions when the throttle is released. There must be thrust at the jet nozzle to initiate and complete turns. This is supplemental steering system which assists operators in learning to negotiate turns and maneuver.

The Kawasaki Smart Steering system continuously detects the operator's steering input as well as the boat's speed. When the throttle is released while boat speed is high and a turn is initiated, the smart steering system automatically increases engine speed to provide additional thrust. The system does not work when the engine is off or the boat speed is low.

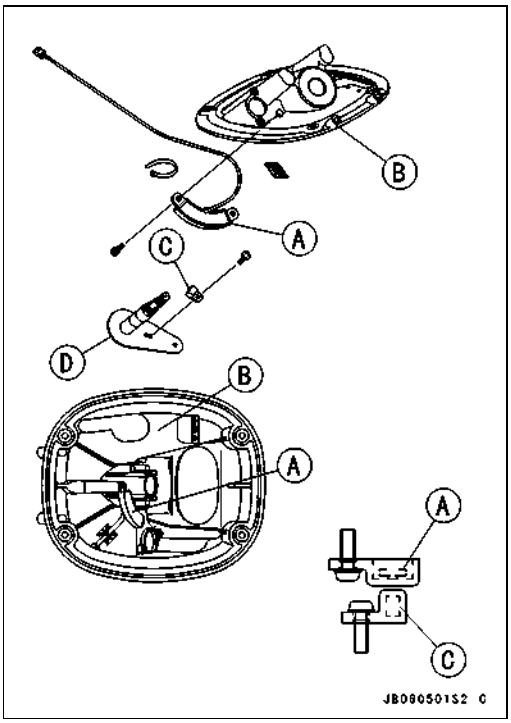


The Kawasaki Smart Steering system functions when all of these conditions are present:
— engine speed averages more than 3 000 r/min (rpm) for a specified time
— the throttle is released completely
— and the handlebars are held fully to the left or right.

Construction and Operation

The main component parts for the Kawasaki Smart Steering system are the following.

1. Steering Position Sensor and Magnet
2. EMM
3. Throttle Position Sensor



The steering position sensor [A] is installed on the reverse side of the steering holder [B]. Left and right sensors are built into the steering position sensor [A]. And magnet [C] is installed on the steering shaft [D].

When the handlebar is fully turned in either direction, the magnet [C] under the steering position sensor [A] signals the steering position sensor [A] to switch ON.

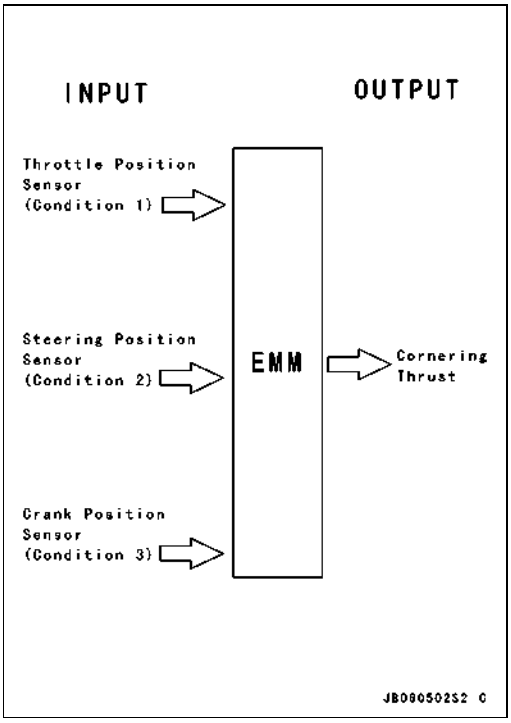
Technical Information – Kawasaki Smart Steering System

Kawasaki Smart Steering system provides thrust (approx. 2 900 r/min (rpm) in water) when the these three conditions exist.

condition 1:
Throttle is release - The throttle opening angle of throttle position sensor is at idle.

condition 2:
The handlebar is fully turned in either direction - The steering position sensor switches ON.

condition 3:
The average engine speed for a period of time before the system operates is 3 000 r/min (rpm) or more - The EMM calculates the average engine speed based on the data sent from the crank position sensor.

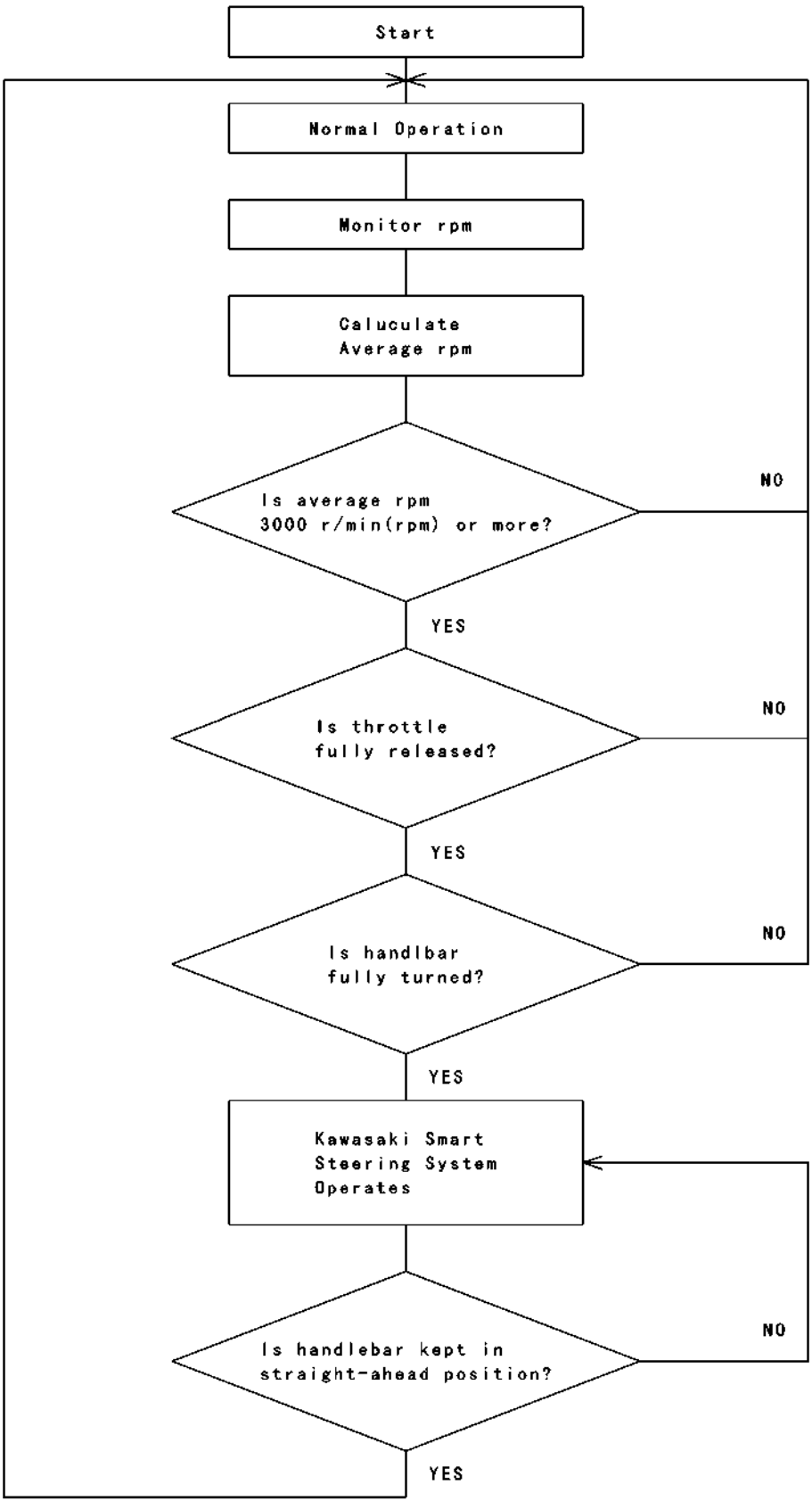


How To Release Kawasaki Smart Steering System

	IN WATER	OUT OF WATER
Engine Speed (When the Kawasaki Smart Steering system operates)	approx. 2 900 r/min (rpm)	6 000 r/min (rpm) or more
How To Release Kawasaki Smart Steering System	Keep the handlebar in the straight - ahead position	Keep the handlebar in the straight - ahead position

Technical Information – Kawasaki Smart Steering System

Flow Chart of Kawasaki Smart Steering System



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

Units of Pressure:

kPa	×	0.01020	=	kg/cm^2
kPa	×	0.1450	=	psi
kPa	×	0.7501	=	cmHg
kg/cm^2	×	98.07	=	kPa
kg/cm^2	×	14.22	=	psi
cm Hg	×	1.333	=	kPa

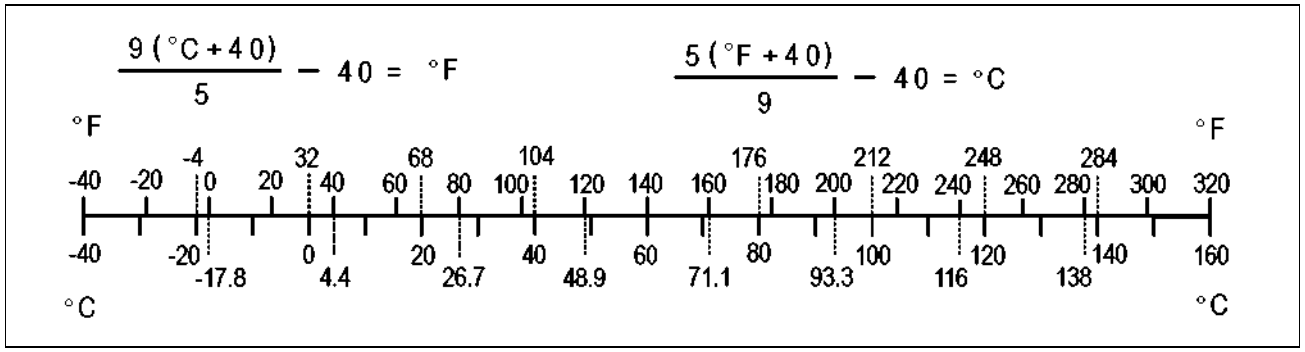
Units of Speed:

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

Table of Contents

2-2 PERIODIC MAINTENANCE

Periodic Maintenance Chart

Description / Frequency	Initial 10 Hours	Every 25 Hours	Every 100 Hours	See Page
Inspect all hoses, hose clamps, nuts, bolts, and fasteners	●	●		2-6
Lubricate throttle body cable fitting at throttle body		●		2-14
Lubricate throttle control cable and throttle cable fitting at throttle case		●		2-13 ~ 14
Lubricate steering cable/shift cable ball joints and steering nozzle/revers bucket pivots		●		2-14
Lubricate handlebar pivot (disassemble)		●		2-12
Clean fuel pump screen		●		2-9
Clean and gap spark plugs (replace if necesary)		●		2-13
Inspect fuel vent check system		●		2-9
Inspect throttole control system		●		2-7 ~ 9
Inspect battery charging condition		●		2-7
Flush bilge line and filter		●		2-11
Flush cooling system (after each use in salt water)		●		2-10
Inspect /clean flame arrester		●		2-9
Inspect impeller blade for damage (remove)			●	2-11
Inspect/replace coupling damper			●	2-12
Inspect steering cable/shift cable			●	2-12
Inspect throttle shaft spring (replace throttle body if necessary)			●	2-10

Torque and Locking Agent

The following table list the tightening torque for the major fasteners, and the parts requiring use of a non-permanent locking agent or silicone sealant.

Letters used in the “Remarks” column mean:
L: Apply a non-permanent locking agent to the threads.
SS: Apply silicone sealant to the threads.
S: Tighten the fasteners following the specified sequence.

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Fuel System:				
Injector Mounting Bolts	22	2.2	16	L
Intake Manifold Mounting Nuts	9.8	1.0	87 in·lb	
Air Intake Cover Bolts	7.8	0.8	69 in·lb	L
Cable Holder Mounting Bolts	20	2.0	14	L
Throttle Case Mounting Screws	3.9	0.4	35 in·lb	
Clamps for High Pressure Fuel Hose	0.69 ∼ 0.78	0.07 ∼ 0.08	6.1 ∼ 6.9 in·lb	
Throttle Body Mounting Bolts	8.8	0.9	78 in·lb	L
Mounting Bolts for EMM 40-pin Connector	2.84 ∼ 3.04	0.29 ∼ 0.31	25.1 ∼ 26.9 in·lb	
Engine Lubrication System:				
Air Bleeder Bolt	4.9	0.5	43 in·lb	
Oil Pump Mounting Bolts	8.8	0.9	78 in·lb	L
Oil Pump Cable Mounting Bolt	4.9	0.5	43 in·lb	L
Exhaust System:				
Exhaust Pipe Mounting Bolts	49	5.0	36	L
Exhaust Manifold Mounting Nuts	27	2.8	20	S
Expansion Chamber Mounting Bolts	49	5.0	36	L
Water Pipe Joint	11	1.1	95 in·lb	SS
Engine Top End:				
Cylinder Head Nuts	29	3.0	22	S
Water Pipe Joint	11	1.1	95 in·lb	SS
Cylinder Base Nuts	34	3.5	25	S
Bolts for Injector Wire Brackets	8.8	0.9	78 in·lb	L
Engine Removal/Installation:				
Engine Mounting Bolts	36	3.7	27	L
Engine Damper Mounting Bolts	16	1.6	12	L
Engine Mount Bolts	44	4.5	32	L
Engine Bottom End:				
Flywheel Bolt	132	13.5	98	L
Stator Mounting Bolts	12	1.2	104 in·lb	L
Coupling	132	13.5	98	L
Magneto Cover Mounting Bolts	8.8	0.9	78 in·lb	L
Cover Mounting Bolts on Magneto Cover	8.8	0.9	78 in·lb	L
Grommet Plate Mounting Bolts	8.8	0.9	78 in·lb	L
Water Pipe Joint	11	1.1	95 in·lb	SS
Crankcase Bolts - 6 mm Dia	8.8	0.9	78 in·lb	L, S
Crankcase Bolts - 8 mm Dia	29	3.0	22	L, S
Cooling and Bilge Systems:				
Breather Mounting Bolt	—	—	—	L

2-4 PERIODIC MAINTENANCE

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kgf·m	ft·lb	
Drive System:				
Coupling	39	4.0	29	
Drive Shaft Holder Mounting Bolts	22	2.2	16	L
Pump and Impeller:				
Steering Nozzle Pivot Bolts	19	1.9	14	L
Reverse Bucket Pivot Bolts	19	1.9	14	L
Steering Cable Joint Bolts	9.8	1.0	87 in·lb	L
Pump Mounting Bolts	36	3.7	27	L
Pump Outlet Mounting Bolts	19	1.9	14	L
Pump Cap Bolts	9.8	1.0	87 in·lb	L
Impeller	98	10	72	
Pump Bracket Mounting Bolts (Inside Hull)	19	1.9	14	L
Pump Bracket Mounting Bolts (Pump Cover Side)	9.8	1.0	87 in·lb	L
Pump Cover Mounting Bolts	7.8	0.8	69 in·lb	L
Grate Mounting Bolts	9.8	1.0	87 in·lb	L
Steering:				
Handlebar Clamp Bolts	16	1.6	12	L
Steering Neck Mounting Bolts	16	1.6	12	L
Steering Holder Mounting Bolts	16	1.6	12	L
Steering Shaft Locknut	49 ~ 59	5.0 ~ 6.0	36 ~ 43	
Steering Shaft Nut	Hand-Tight	←	←	
Steering Cable Nuts	39	4.0	29	
Shift Cable Nut	39	4.0	29	
Hull/Engine Hood:				
Stabilizer Mounting Bolts	9.8	1.0	87 in·lb	
Crossmember Mounting Bolts	7.8	0.8	69 in·lb	L
Rear Grip Mounting Bolts	9.8	1.0	87 in·lb	L
Electrical System:				
Spark Plugs	24 ~ 29	2.5 ~ 3.0	18 ~ 22	
Water Temperature Sensor	20	2.0	14	
Air Temperature Sensor	20	2.0	14	
Starter Motor Mounting Bolts	8.8	0.9	78 in·lb	L
Starter Cable Mounting Nut	7.8	0.8	69 in·lb	
Battery Ground Cable Mounting Bolt	8.8	0.9	78 in·lb	L
Crank Position Sensor Mounting Bolt	8.8	0.9	78 in·lb	L

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.

General Fasteners (stainless bolt and nut)

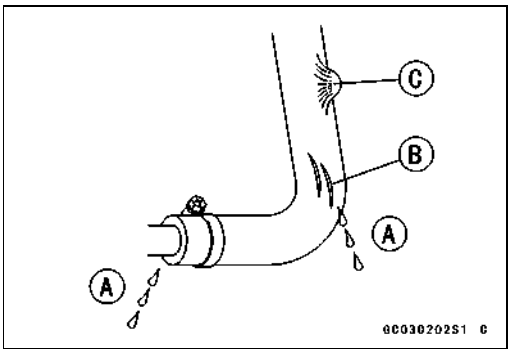
Threads dia. mm	Torque		
	N·m	kgf·m	ft·lb
6 (0.24 in.)	5.9 ∼ 8.8	0.60 ∼ 0.90	52 ∼ 78 in·lb
8 (0.31 in.)	16 ∼ 22	1.6 ∼ 2.2	11.6 ∼ 15.9
10 (0.39 in.)	30 ∼ 41	3.1 ∼ 4.2	22 ∼ 30

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

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 Hoses
Fuel Vent Hose
Oil Hoses
Cooling Hoses
Bilge Hoses

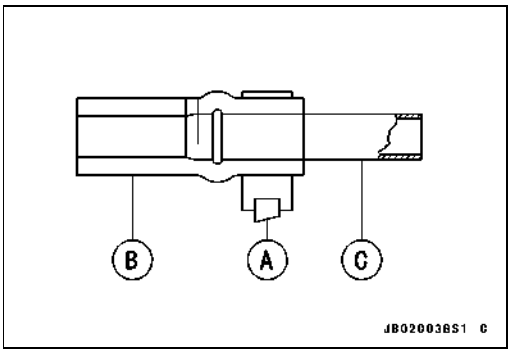
★If a hose is damaged in any way, replace it immediately and check all the others for damage.



● Make sure the above hoses are routed properly and secured with the clamps away from any moving parts and sharp edged portions.
[A] Plastic Clamp
[B] Hose
[C] Hose Fitting

NOTE

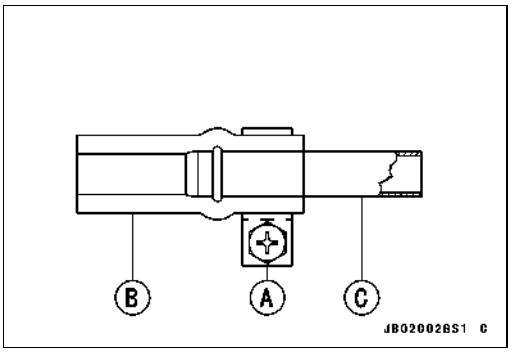
○ *The majority of bilge hoses have no clamps at the hose ends.*



[A] Metal Clamp
[B] Hose
[C] Hose Fitting

NOTE

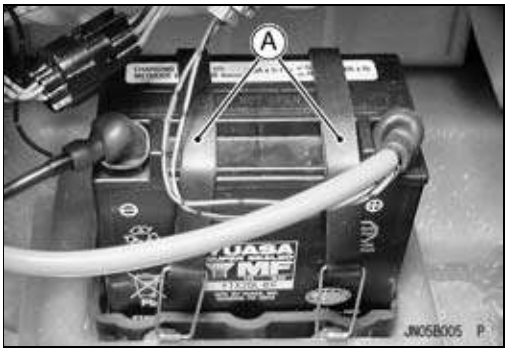
○ *Check the fuel and oil filler tubes and exhaust tubes for signs of wear, deterioration, damage or leakage. Replace if necessary.*
○ *Make sure the above tubes are secured with the metal gear clamps away from any parts.*



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 and Oil Tank Straps
Water Box Muffler Straps

★If a strap is damage in any way, replace it.



Maintenance Procedure

Electrical System

Battery Charging Condition Inspection

Battery charging condition can be checked by measuring battery terminal voltage.

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

CAUTION
Be sure to disconnect the negative terminal lead first.

- Measure the battery terminal voltage.

NOTE

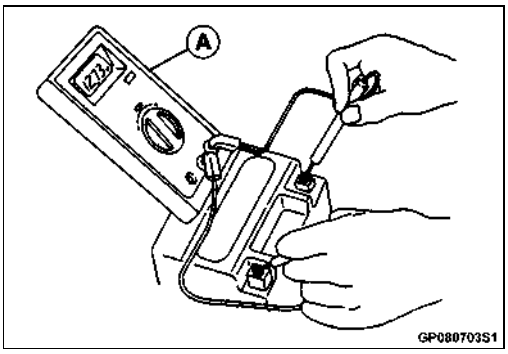
○ *Measure with a digital voltmeter [A] which can be read one decimal place voltage.*

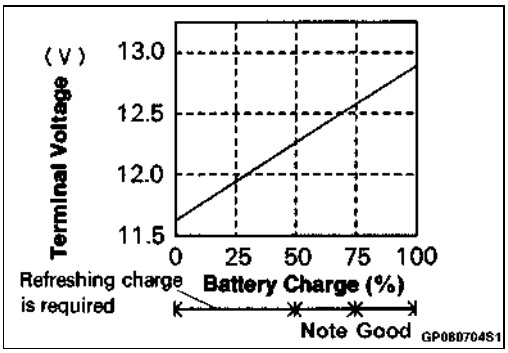
★If the reading is below the specified, refreshing charge is required (see Refreshing Charge in the Electrical System chapter).

Battery Terminal Voltage

Standard: 12.6 V or more

- Connect the battery leads, positive first.





Fuel System

Idle Speed Inspection

The normal idle speed is controlled by the EMM.

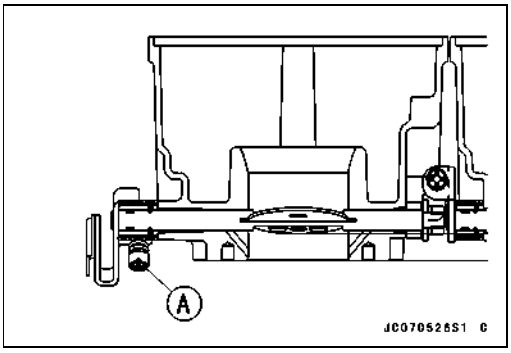
Idle Speed

1 100 ± 100 r/min (rpm): (in water)

1 100 ± 100 r/min (rpm): (out of water)

NOTE

○ *Do not tamper the stop screw [A] because the throttle opening angle will be out of the specified range.*



Throttle Control Cable

The throttle control cable is actually an assembly of three cables: the throttle cable, the throttle body cable, and the oil pump cable. The throttle cable runs from the throttle lever to the cable assembly junction where it connects to both the throttle body cable which leads to the throttle body, and the oil pump cable which leads to the oil pump.

Since the throttle lever controls both the throttle body and the oil pump simultaneously, it is important that each cable be adjusted to its designed base position so that the oil and air mixture reach the engine in the correct proportion at all throttle openings. Cable stretch creates excess play at the throttle lever and alters the base positions of the cables at the throttle body and the oil pump, necessitating periodic adjustment.

NOTE

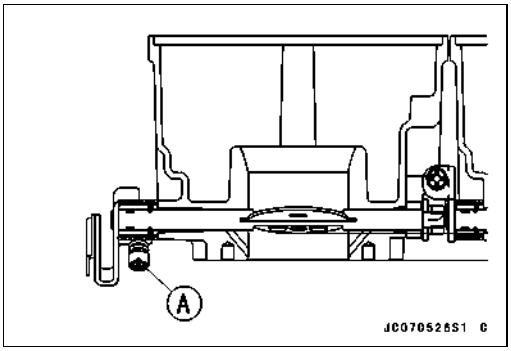
○ *Be sure to inspect and adjust the throttle body and oil pump cables at the same time.*

Maintenance Procedure

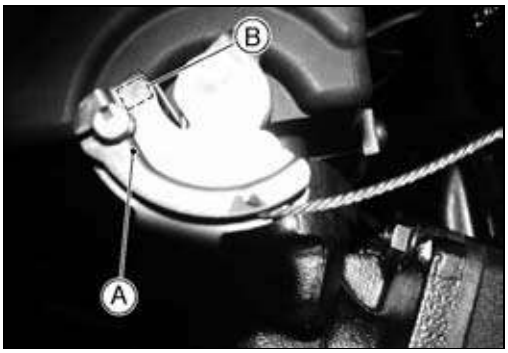
Throttle Body Cable Adjustment

NOTE

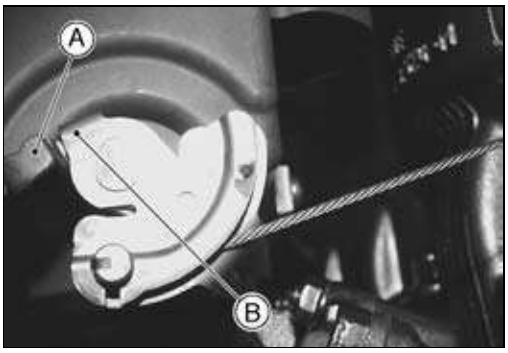
○ *Do not tamper the stop screw [A] because the throttle opening angle will be out of the specified range.*



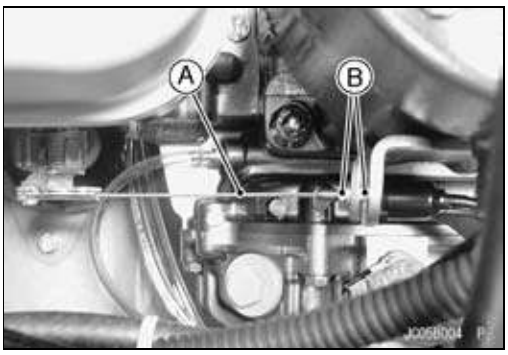
● Check throttle body cable adjustment.
○ With the throttle lever released, the stop screw on the throttle pivot arm [A] should rest against the stopper [B] on the throttle body, and there should be slight slack in the throttle body cable.



○ When the throttle lever is fully applied (pulled), the upper stop on the pivot arm [B] should be all the way up against the stopper [A] on the throttle body.

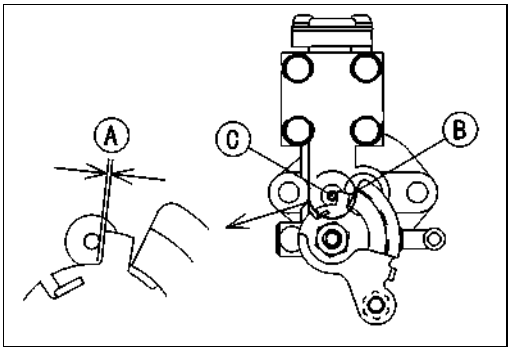


● If necessary, adjust the throttle body cable [A].
○ Loosen and turn the locknuts [B] at the cable holder until the stop screw on the pivot arm hits against the stopper on the throttle body with slight cable slack.
○ Tighten the locknuts securely.
● Check the oil pump cable adjustment (see Oil Pump Cable Adjustment).
★ If necessary, adjust the oil pump cable.



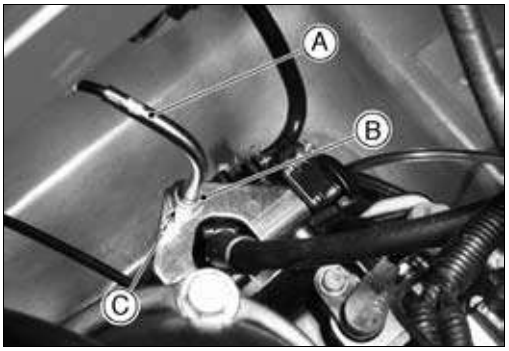
Oil Pump Cable Adjustment

● Check throttle body cable adjustment.
● If necessary, adjust the throttle body cable.
● Check oil pump cable adjustment.
○ When the throttle lever is fully applied (pulled), check to see that there is a clearance [A] approx. 0.6 mm (0.024 in.) between stop [B] on the oil pump pulley and the stopper pin [C] on the oil pump body.



Maintenance Procedure

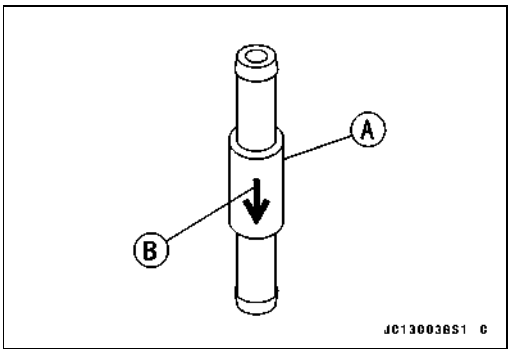
★If necessary, adjust the oil pump cable [A].
○ Hold the throttle lever fully applied (pulled).
○ Turn the oil pump pulley till the stop on the pulley contacts to the stopper pin on the oil pump body. At this time, the oil pump pulley is fully open. And then give the oil pump cable tension by turning the upper adjusting nut clockwise.
○ Loosen the upper adjusting nut [B] by turning counterclockwise 1/2 turn and then fix the oil pump cable by tightening the lower adjusting nut [C] securely.



Fuel Vent Check Valve Mounting

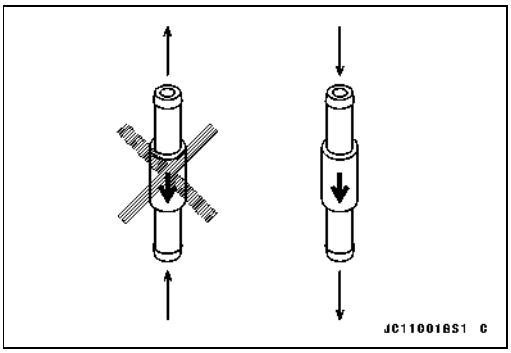
The fuel vent check valve is mounted in the fuel tank vent hose to prevent fuel from spilling during riding. Air can flow into the tank to allow fuel to be drawn out by the fuel pump, but fuel cannot flow out the check valve.

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



Fuel Vent Check Valve Inspection

● Remove the check valve and blow through it 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.

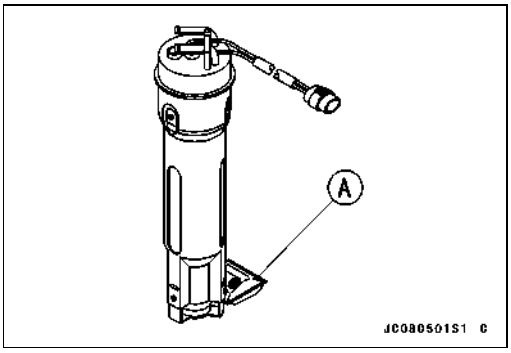


Fuel Pump Screen Cleaning

● Remove the fuel pump.
● Wash the fuel pump screen [A] in non-flammable or high flash-point solvent. Use a brush to remove any contaminants trapped in the screens.

⚠WARNING

Clean the fuel pump screens 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.



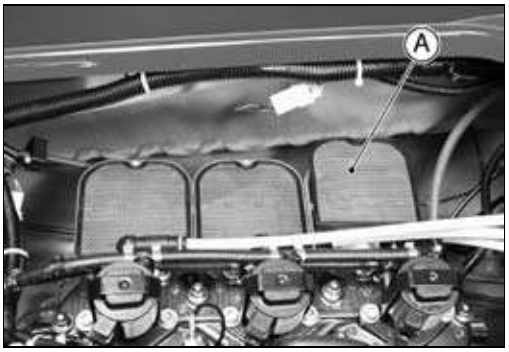
Flame Arrester Cleaning

● Remove the flame arrester [A] (see Flame Arrester Removal).
● Blow the flame arrester clean with compressed air.

⚠WARNING

Eye protection should be worn when compressed air is used to dry ports. Do not direct air toward anyone. Use 172 kPa (1.75 kg/cm^2, 25 psi) maximum nozzle pressure.

● Install the flame arrester (see Flame Arrester Installation Notes).



Maintenance Procedure

Throttle Shaft Spring Inspection

- Check the throttle shaft springs [A] by pulling the throttle lever.

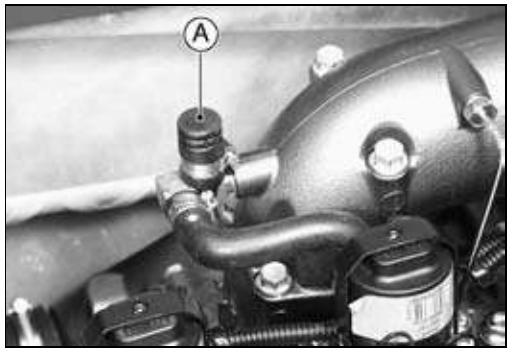
★If the springs are damaged or weak, replace the throttle assy.

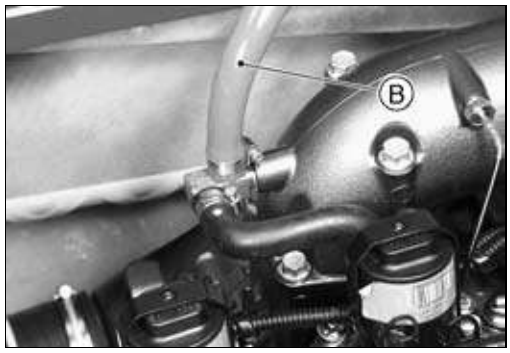
Cooling and Bilge System Flushing

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.

- Remove the fitting cap [A] on the cylinder head.
- Connect a garden hose [B] to the fitting.





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

- 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.

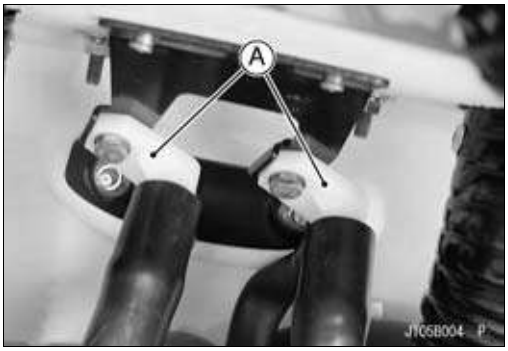
- Switch off the engine, remove the garden hose, install the fitting cap.

Maintenance Procedure

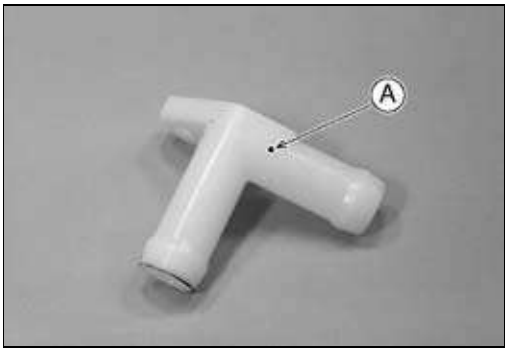
Bilge System Flushing

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

- Disconnect both bilge hoses at the plastic breather fitting [A].



- Connect the bilge filter hoses (from the hull bottom) to the garden hoses, 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.
- Connect the other hoses (from the hull bulkhead) to the garden hose, turn the water on, and flush it out for several minutes.
- Before reconnecting the hoses to the plastic breather fitting make sure the small hole [A], on top of the breather fitting is clear.
- Reconnect the bilge hoses.



Filter Cleaning and Inspection

- Flush the filter thoroughly with fresh water and shake it dry (see filter removal/installation in the Cooling and Bilge System chapter).
- 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.

Pump and Impeller

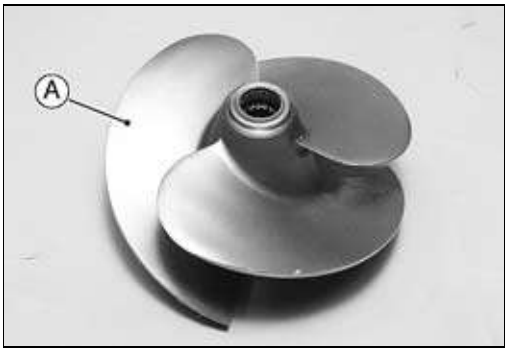
Pump and Impeller Inspection

- Examine the impeller [A].

★ If there is pitting, deep scratches, nicks or other damage, replace the impeller.

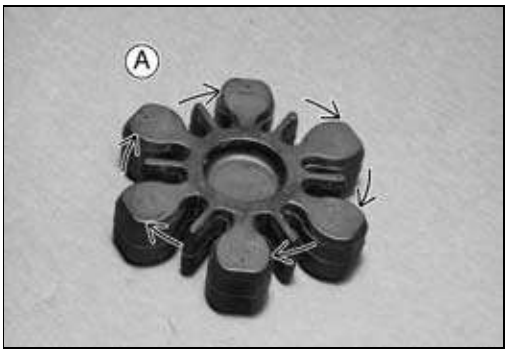
NOTE

○ *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.*



Engine Bottom End

Coupling Damper Inspection



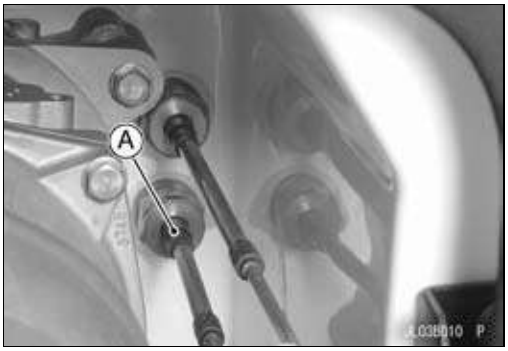
- With the engine removed, remove the coupling damper and inspect it for wear [A] and deterioration.

★If it is grooved or misshapen, replaced it with a new damper.

★If there is any doubt as to coupler condition, replace it.

Steering

Steering Cable Inspection



- Examine the steering cable.

★If the cable or cable housing is kinked or frayed, replace the cable.

★If the seal [A] at either end of the cable is damaged in any way, replace the cable.

- Be certain that the cable moves freely in both directions.
- Disconnect the cable joint at each end of the cable.

○ Take out the cable joint bolt and disconnect the cable joint.

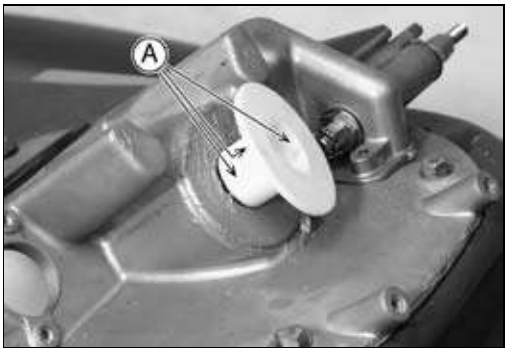
CAUTION

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 and forth [A] in the cable housing.

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

Handlebar Pivot Lubrication



- Check the bushings for damage and wear.

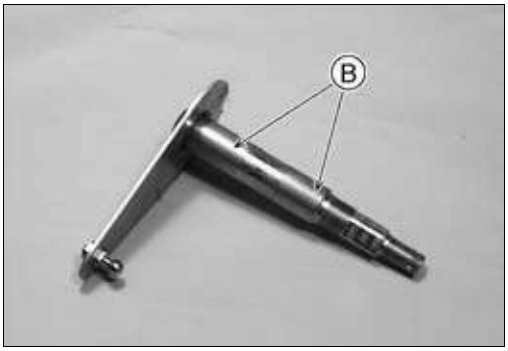
★If the bushings are damaged or worn, replace them.

- Grease:

  Bushings [A]

Maintenance Procedure

Steering Shaft [B]



Spark Plug Inspection

- Remove the spark plugs (see Spark Plug Removal).
- Examine the ceramic insulator [C] and electrodes [A] [B].

★If the insulator appears glazed or very white, or if there are gray metallic deposits on the electrodes, combustion chamber temperatures are too high. Refer to Troubleshooting.

★If the insulator appears dry and sooty the fuel/air mixture is overly rich.

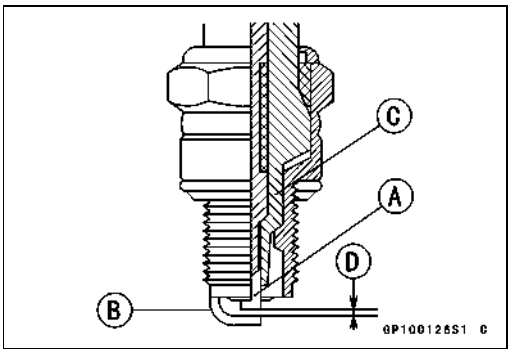
- If the insulator and electrodes are wet and oily, an improper oil type or an excess oil output may be the cause.

★If the ceramic insulator is cracked, replace the plug.

★If the electrodes are badly worn or burned, replace the plug.

- Examine the spark plug threads.

★If the threads are damaged, replace the plug.



Spark Plug Adjustment

- Measure the spark plug gap [D].

○ Check the distance between the electrodes with a feeler gauge or a wire gauge.

Spark Plug Gap
Standard: 0.7 ~ 0.8 mm (0.028 ~ 0.031 in.)

★If the gap is not within specifications, adjust it.

- Adjust the gap by carefully bending the side electrode with a tool designed for this purpose.

Spark Plug Cleaning

- Clean the electrodes and the ceramic insulator around the center electrode with an abrasive blasting device.

○ Be certain that all abrasive particles are removed from the plug.

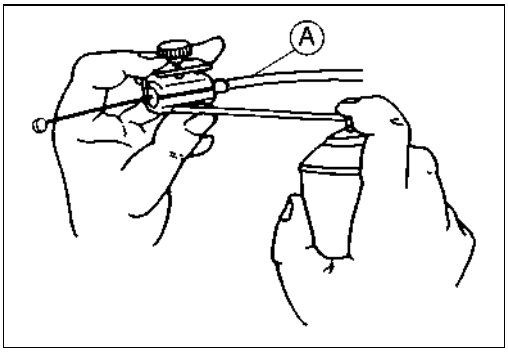
- Clean the entire plug in a high flash-point solvent.

General Lubrication

As in all marine craft, adequate lubrication and corrosion protection is an absolute necessity to provide long, reliable service.

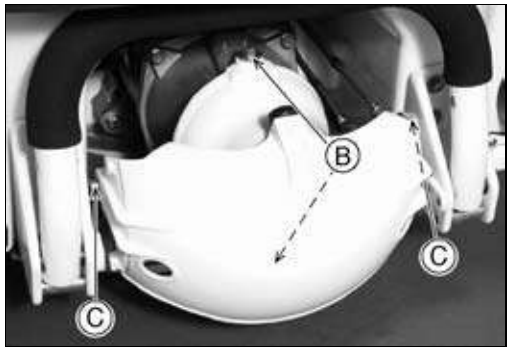
- Lubricate the penetrating rust inhibitor.

Throttle Control Cable [A]

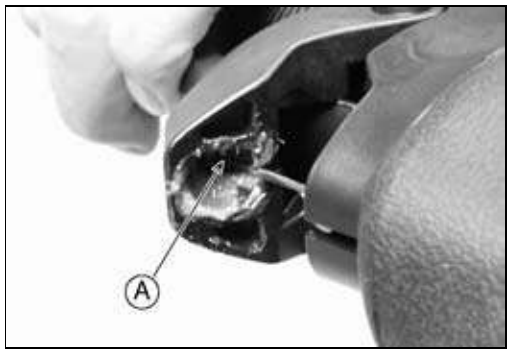


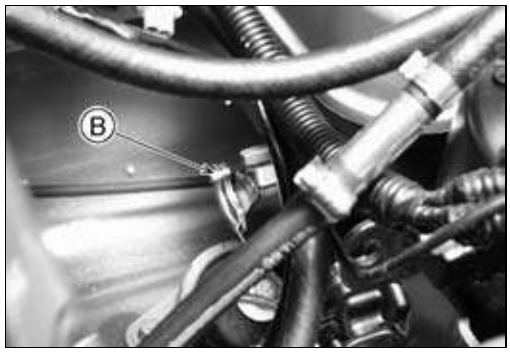
Maintenance Procedure

● Lubricate the following with a high quality waterproof grease.
Steering Nozzle Pivots [B]
Reverse Bucket Pivots [C]



Throttle Cable Ends [A] at Throttle Case
Throttle Body Cable End [B] at Throttle Body





Maintenance Procedure

All 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 faster, 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:
- Engine Bed Mounting Bolts
- Engine Mounting Bolts
- Engine Mount Bolts
- Air Intake Cover Bolts
- Throttle Body Mounting Bolts
- Intake and Exhaust Manifold Nuts
- Exhaust Pipe Mounting Bolts
- Exhaust Chamber Mounting Bolts
- Cylinder Head Nuts
- Cylinder Base Nuts

Drive Shaft, Pump, and Impeller:
- Drive Shaft Coupling
- Drive Shaft Holder Mounting Bolts
- Pump Mounting Bolts
- Pump Cover Mounting Bolts
- Pump Grate Mounting Bolts
- Impeller
- Steering Nozzle Pivot Bolts

Steering:
- Handlebar Clamp Bolts
- Throttle Case Screws
- Switch Case Screws
- Steering Neck Mounting Bolts
- Steering Cover Mounting Bolts
- Handlebar Cover and Bracket Mounting Bolts

Hull and Engine Hood:
- Towing Eyes
- Bumper Nut or Rivets
- All Cable Joint Balls (Threads) and Joint Bolts

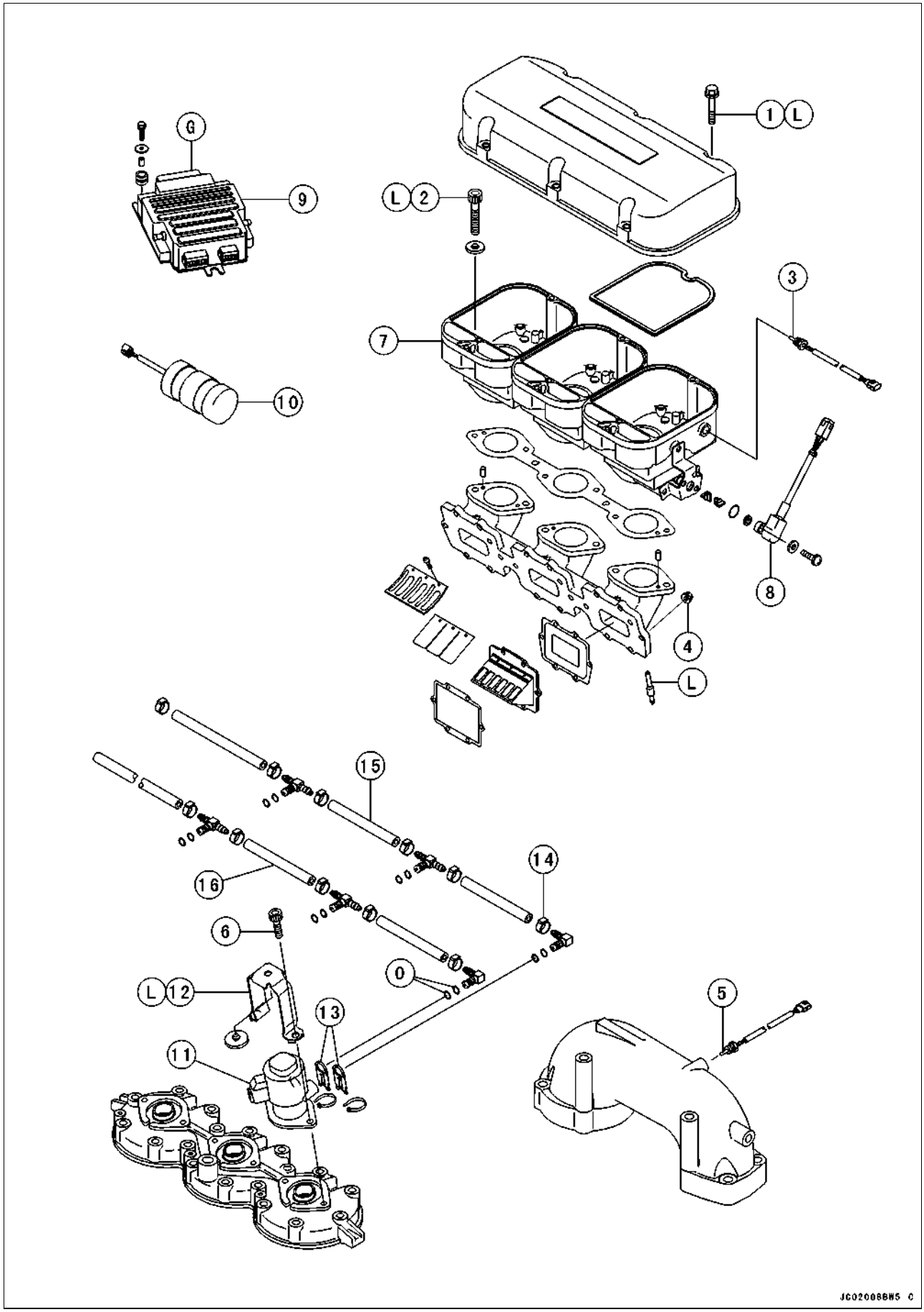
Electrical System:
- Spark Plugs
- Starter Motor Mounting Bolts
- Battery Terminal
- Ground Cable Mounting Bolts

Fuel System (DFI)

Table of Contents

Exploded View

Exploded View



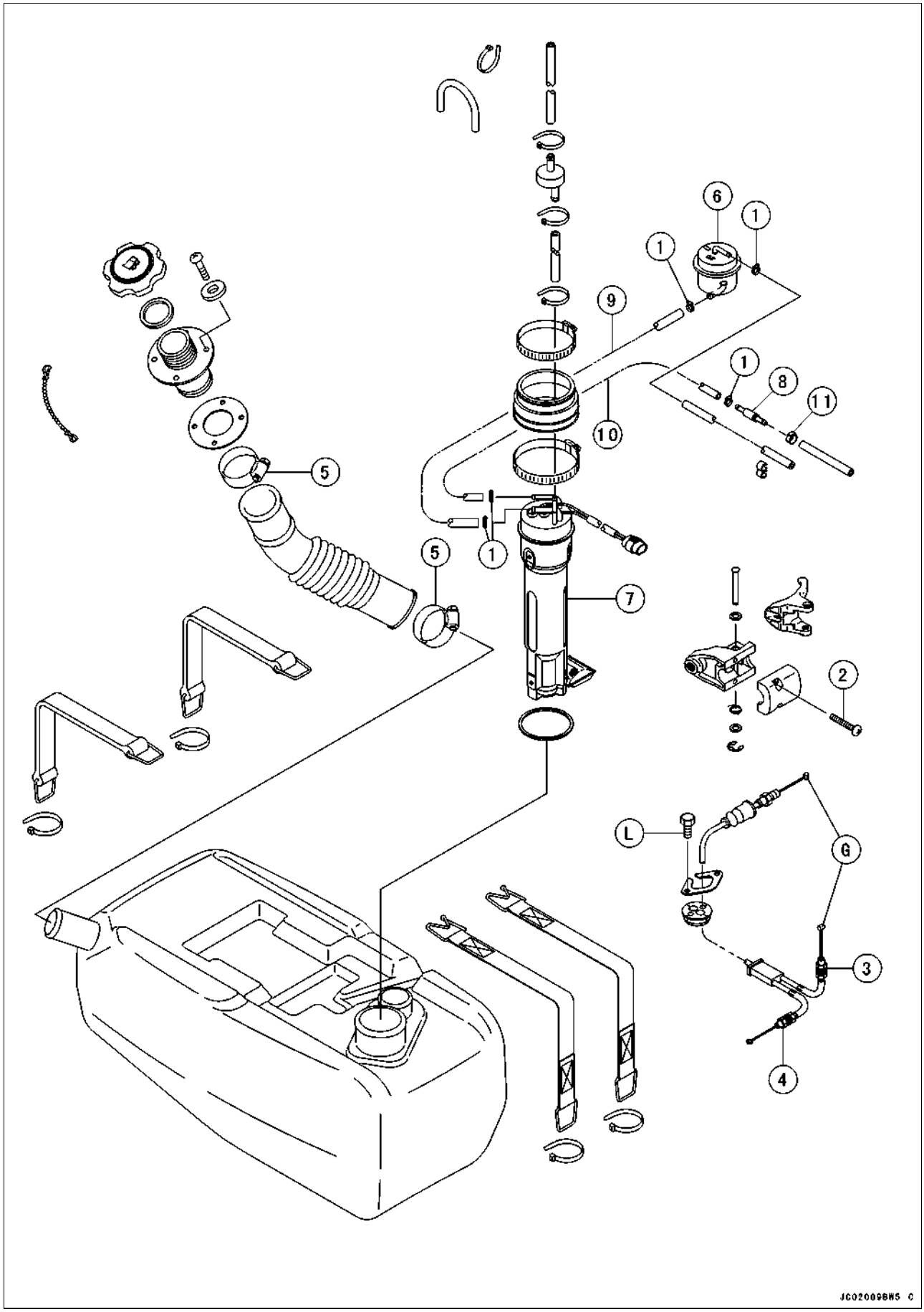
Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Air Intake Cover Mounting Bolts	7.8	0.8	69 in·lb	L
2	Throttle Body Mounting Bolts	8.8	0.9	78 in·lb	L
3	Air Temperature Sensor	20	2.0	14	
4	Intake Manifold Mounting Nuts	9.8	1.0	87 in·lb	
5	Water Temperature Sensor	20	2.0	14	
6	Injector Mounting Bolts	22	2.2	16	L

7. Throttle Body
8. Throttle Position Sensor
9. Engine Management Module (EMM)
10. Capacitor
11. Injector
12. Band
13. Retainer
14. Ear Type Clamp
15. Return Fuel Hose
16. Supply Fuel Hose

G: Apply grease.
L: Apply a non-permanent locking agent.
O: Apply 2–stroke oil.

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Fuel Hose Clamps Screw	0.69 ~ 0.73	0.07 ~ 0.08	6.1 ~ 6.9 in·lb	
2	Throttle Case Mounting Screws	3.9	0.4	35 in·lb	
3	Throttle Cable Mounting Nut	20	2.0	14	
4	Oil Pump Cable Mounting Nut	20	2.0	14	
5	Fuel Filler Tube Clamp Screws	2.9	0.3	26 in·lb	

6. Fuel Filter
7. Fuel Pump
8. Pressure Regulator
9. Main Fuel Hose
10. Return Fuel Hose
11. Ear Type Clamp

G: Apply grease.
L: Apply a non-permanent locking agent.

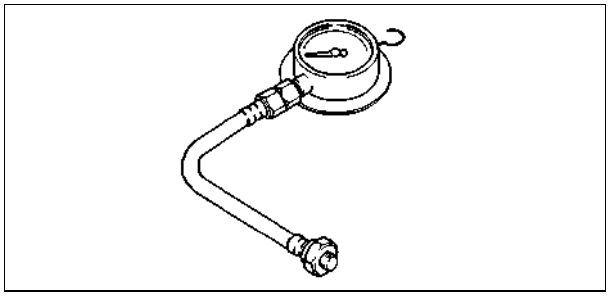
3-8 FUEL SYSTEM (DFI)

Specifications

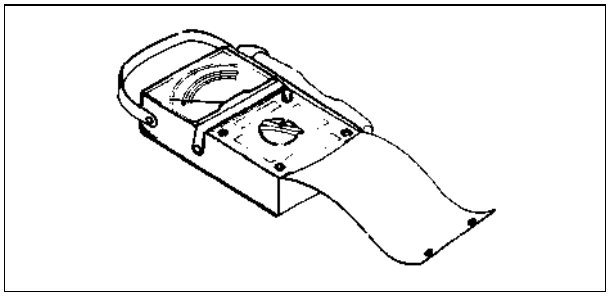
Item	Standard	Service Limit
Direct Fuel Injection System:		
Idle Speed:	1 100 r/min (rpm) — in water	– – –
	1 100 r/min (rpm) — out of water	– – –
Throttle Body:		
Type	Three barrel type	
Bore	ϕ40 mm (ϕ1.57 in.)	– – –
Throttle Valve Opening Angle at Idle Speed	1 deg.	– – –
EMM (Engine Management Module):		
Type	Digital memory type, with built in igniter, and regulator/rectifier	
Sensor Internal to EMM	EMM Temperature Sensor, Barometric Pressure Sensor	
Fuel Filter:		
Filtration area	More than 550 cm^2 (85.3 in^2)	– – –
Rated flow	1.4 L/min (0.37 US gal/min)	– – –
Regulated fuel pressure	157 ∼ 235 kPa (1.6 ∼ 2.4 kg/cm^2, 23 ∼ 34 psi)	– – –
Fuel Flow Amount	60 mL (0.23 US oz) or more for 3 seconds	– – –
Pressure Regulator Opening Pressure	196 ± 20 % kPa (2.0 ± 20 % kg/cm^2, 28 ± 20 % psi)	– – –
Fuel Pump Type	Roller-cell type	– – –
TPS (Throttle Position Sensor)		
Input voltage	approx. 5 V DC between BK/BL and BK/W leads	– – –
Output voltage at idle throttle opening	0.2 ± 0.1 V DC between BK/Y and BK/W leads	– – –
Output voltage at full throttle opening	3.75 ∼ 4.00 V DC between BK/Y and BK/W leads	– – –
Air Temperature Sensor:		
Resistance	828 ± 19 Ω at 0°C	– – –
	1 201 ± 29 Ω at 50°C	– – –
	1 663 ± 59 Ω at 100°C	– – –
	2 211 ± 96 Ω at 150°C	– – –
Water Temperature Sensor:		
Resistance	828 ± 19 Ω at 0°C	– – –
	1 201 ± 29 Ω at 50°C	– – –
	1 663 ± 59 Ω at 100°C	– – –
	2 211 ± 96 Ω at 150°C	– – –
Fuel Injectors:		
Make	FICHT	
Type	Solenoid Type	
Discharge Fuel Pressure	1 724 kPa (17.6 kgf/cm^2, 250 psi)	– – –
Coil Resistance	0.684 ∼ 0.710 Ω at 25°C	– – –
Reed Valve:		
Reed warp	– – –	0.2 mm (0.08 in.)
Fuel Tank:		
Capacity	54 L (14.3 us gal)	– – –

Special Tools

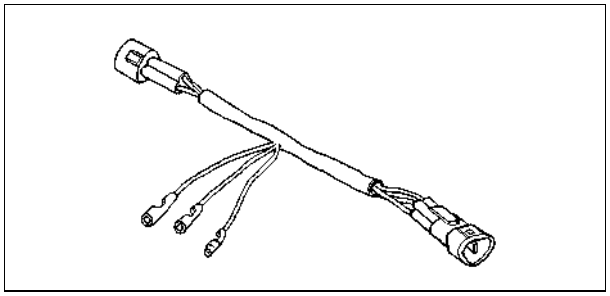
Oil Pressure Gauge: 57001–125



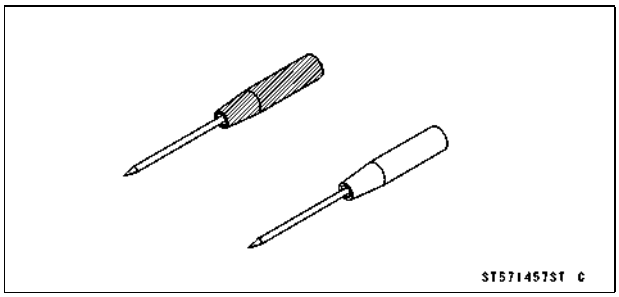
Hand Tester: 57001–1394



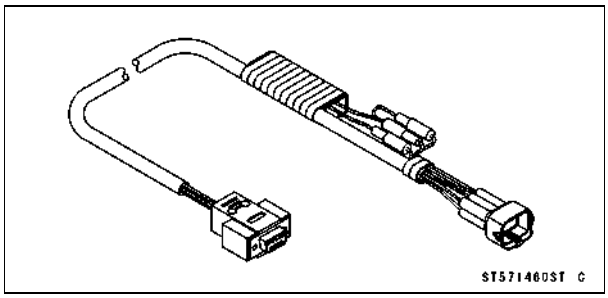
Throttle Sensor Setting Adapter: 57001–1400



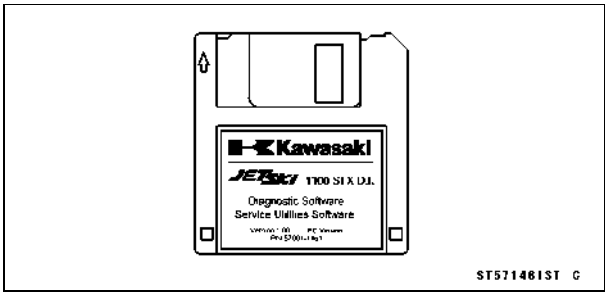
Needle Adapter Set: 57001–1457



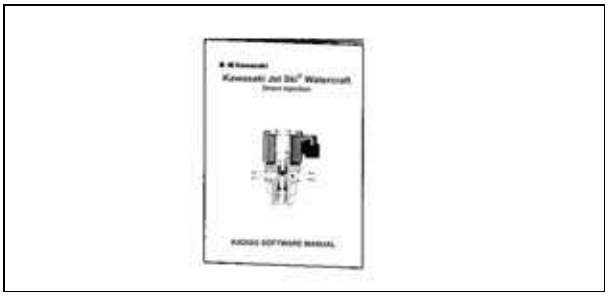
Communication Cable: 57001–1460



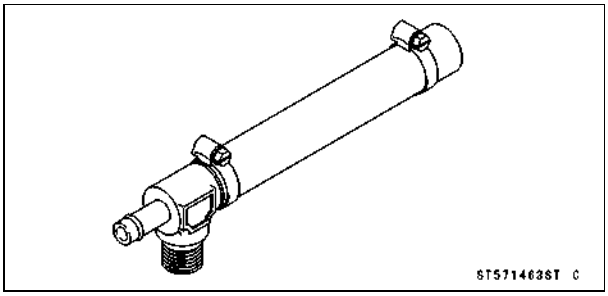
KADIAG Software: 57001–1461



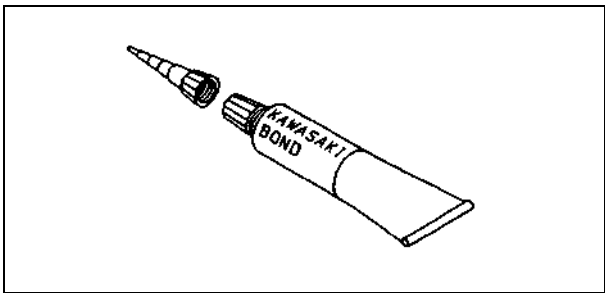
KADIAG Software Manual: 57001–1462



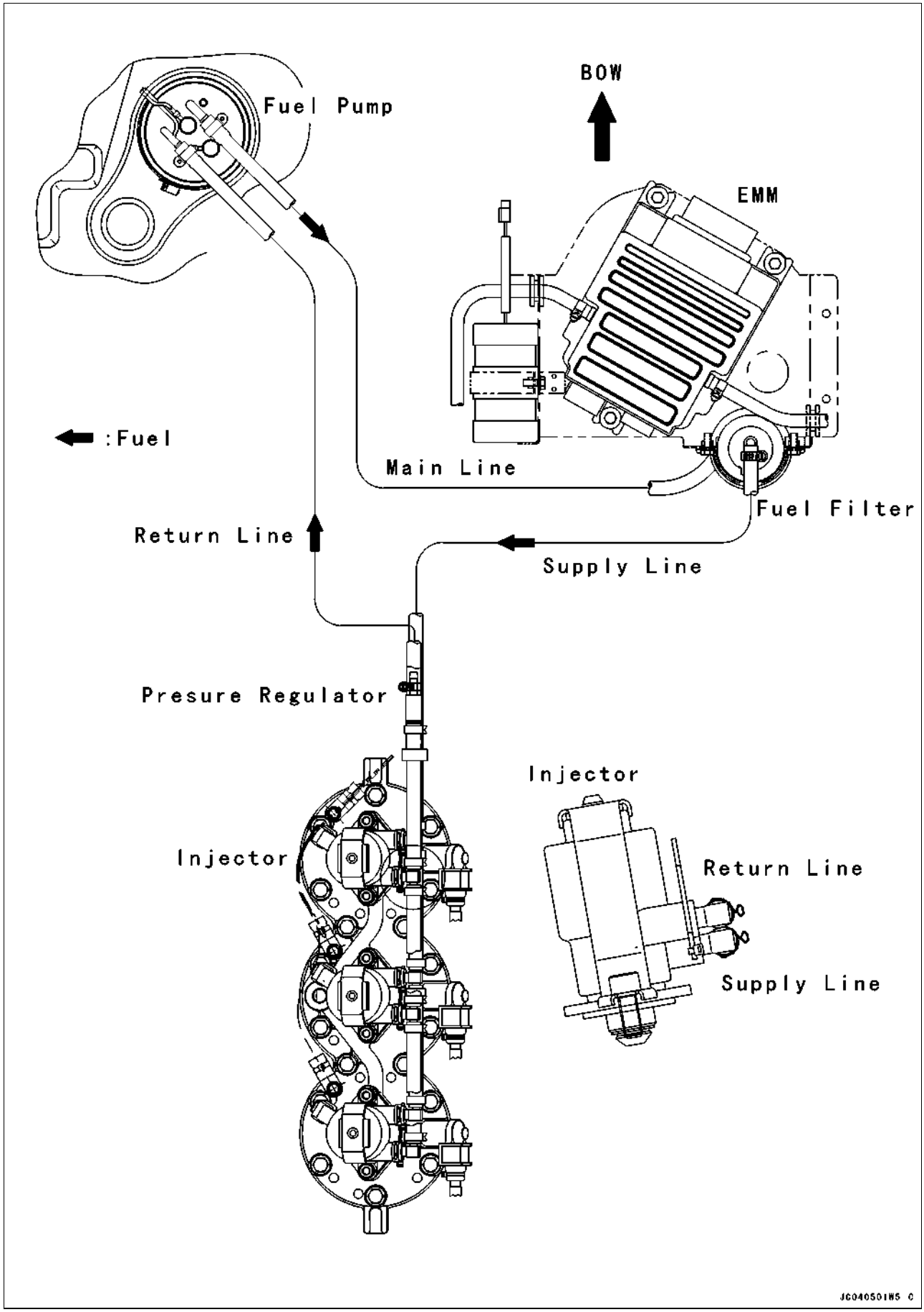
Fuel Pressure Gauge Adapter: 57001–1463



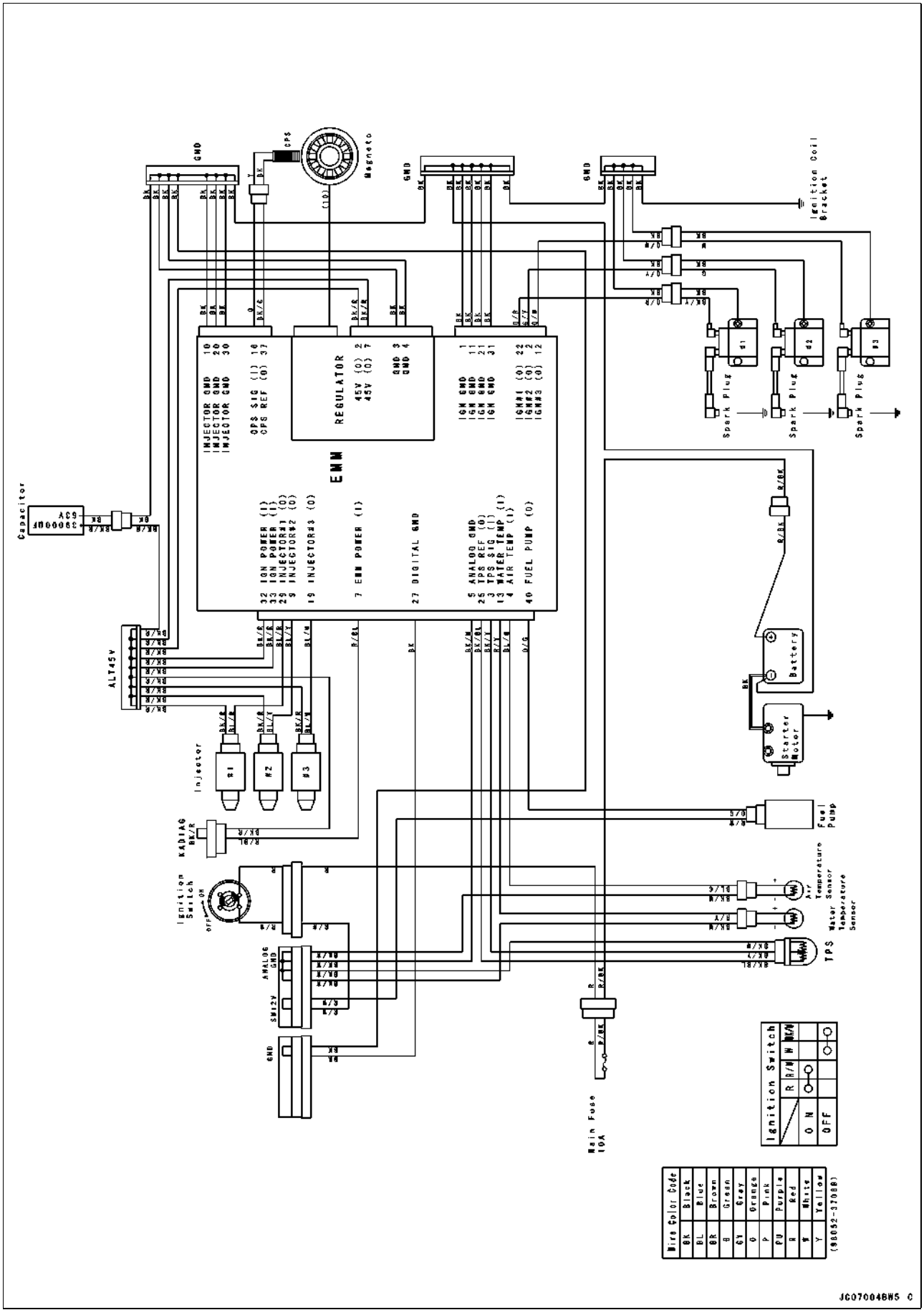
Kawasaki Bond (Silicone Sealant): 56019–120



DFI Wiring Diagram



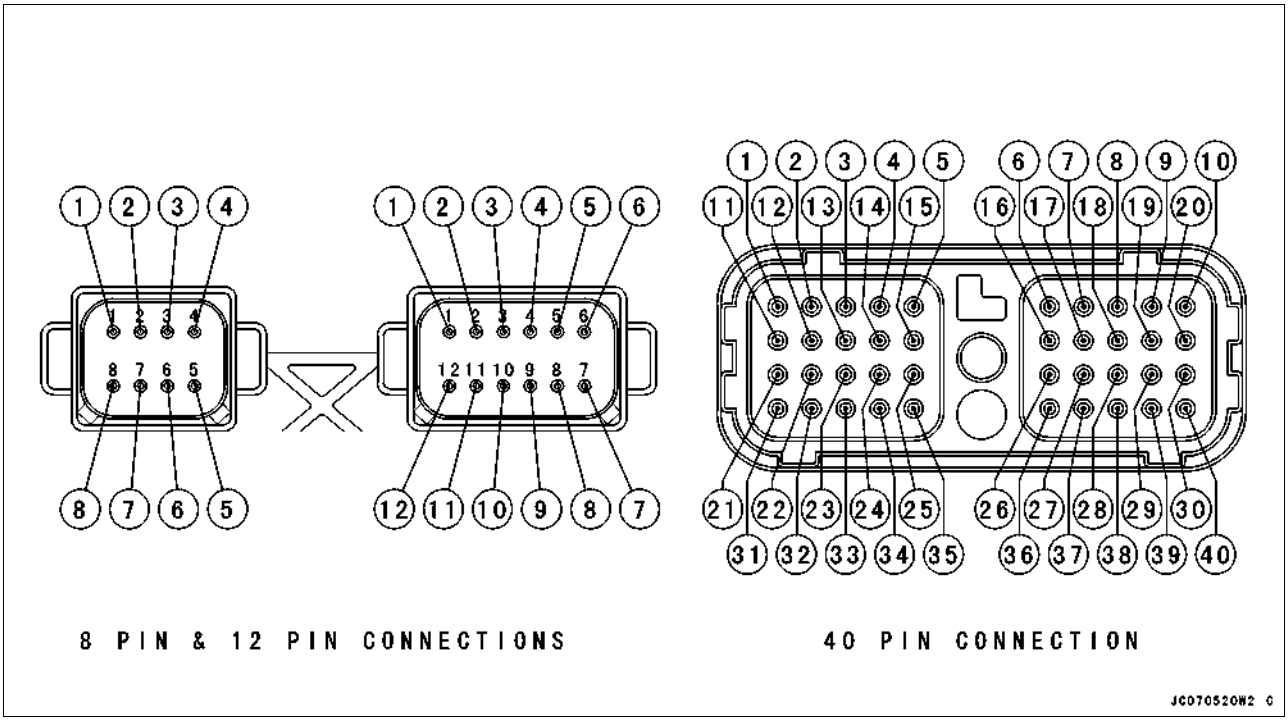
DFI Wiring Diagram



3-12 FUEL SYSTEM (DFI)

DFI Wiring Diagram

Pin Numbers of EMM Connectors



40 Pin Connection

1. Ignition Ground
2. Ignition #2
3. Throttle Position Sensor IN
4. Air Temperature Sensor IN
5. Analog Ground
6. Empty
7. Power into EMM
8. Kill Line
9. Injector #2
10. Injector Ground
11. Ignition Ground
12. Ignition #3
13. Water Temperature Sensor IN
14. Empty
15. Check Engine Warning
16. Crank Position Sensor IN
17. RS232 Rx IN
18. Empty
19. Injector #3
20. Injector Ground
21. Ignition Ground
22. Ignition #1
23. Empty
24. Overheat Warning
25. 5VA
26. R232 Tx OUT
27. Digital Ground
28. Oil Switch IN
29. Injector #1
30. Injector Ground
31. Ignition Ground
32. Ignition Charge Transformer Power IN
33. Ignition Charge Transformer Power IN
34. Empty
35. Tachometer Signal (6 pluses per rev.)
*36. Steering Position Sensor IN
37. Crank Position Sensor Ground
38. Empty
39. Empty
40. Fuel Pump

8 Pin Connection

1. Battery Pos.
2. Injector
3. Ground
4. Ground
5. Ground
6. Ground
7. Injector
8. Battery Pos.

12 Pin Connection

1. Battery A/C
2. Battery A/C
3. Injector A/C
4. Injector A/C
5. Injector A/C
6. Empty
7. Empty
8. Injector A/C
9. Injector A/C
10. Injector A/C
11. Battery A/C
12. Battery A/C

DFI Servicing Precautions

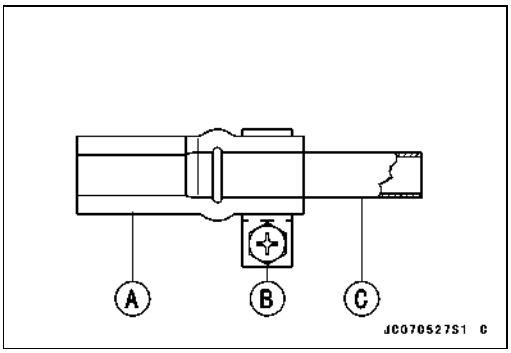
There are a number of important precautions that should be followed servicing the DFI system.

- This DFI system is designed to be used with a 12 V MF battery as its power source. Do not use any other battery except for a 12 V MF battery as a power source.
- Do not reverse the battery lead connections. This will damage the EMM.
- To prevent damage to the DFI parts, do not disconnect the battery leads or any other electrical connections when the ignition SW (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 hull. This is to prevent EMM damage by excessive voltage.
- Whenever the DFI electrical connections are to be disconnected, first turn off the ignition SW (switch), and disconnect the battery (–) terminal. Conversely, make sure that all the DFI electrical connections are firmly reconnected before starting the engine.
- Do not turn the ignition SW ON while any of the DFI electrical connectors are disconnected.
- Do not spray water on the electrical parts, DFI parts, connectors, leads, and wiring.
- 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 route the fuel hoses with a minimum of bending so that the fuel flow will not be obstructed.
- Route the hoses according to Cable, Wire, and Hose Routing section in the General Information chapter.

- Install the hose clamps in the position shown, and securely tighten the clamp screws to the specified torque. Check the fuel system for leaks after hose installation.
  Fuel Hose [A]
  Clamp [B]
  Fuel Pipe [C]

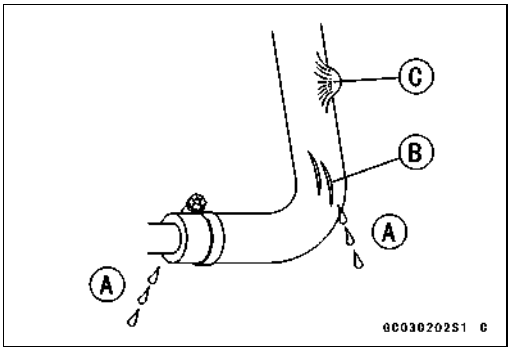
  Torque - Fuel Hose Clamp Screws: 0.69 ~ 0.78 N·m (0.07 ~ 0.08 kgf·m, 6.1 ~ 6.9 in·lb)

- Replace the fuel hose if it has been sharply bent or kinked.



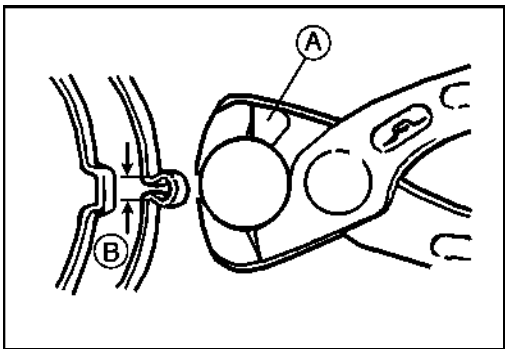
DFI Servicing Precautions

○ If the watercraft is not properly operated, the high pressure inside the fuel line can cause fuel to leak [A] or the hose to burst. Bend and twist the fuel hose while examining it.
★Replace the hose if any cracks [B] or bulges [C] are noticed

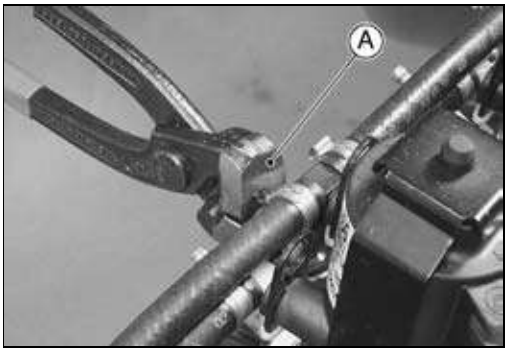


○ When you need to remove a fuel tube from a fitting or elbow, grip the outer edge of ear firmly and cut through it with pincers, and then remove. When installing ear type clamps, please note that each ear must be crimped as recommended to obtain proper seal. Position clamp on hose and give each ear a firm squeeze with your OETIKER Pincers [A] or a similar style of pincer (Refer to the Appendix, Cable, Wire and Hose Routing section).

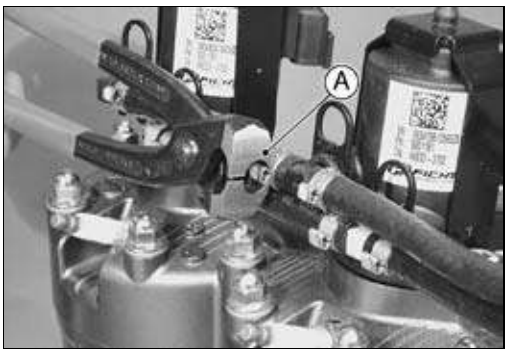
Recommended clamp installation tools [A]:
OETIKER's Side Jaw Pincers Model 1099 (USA)
KNIPEX 1099 Hose Band Pliers (Europe)
[B]: 1.2 ~ 1.7 mm (0.05 ~ 0.07 in.)



○ Where access to ear type clamp is easy, use the tool [A] as shown right.

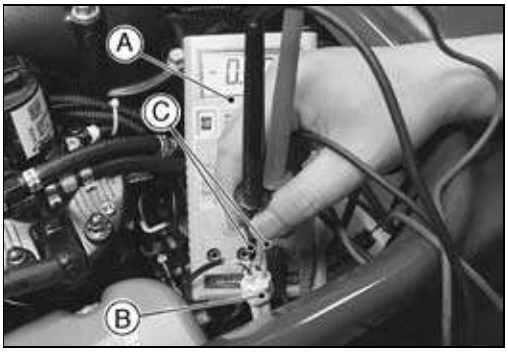


○ Where access to ear type clamp is difficult, use the tool [A] as shown right.



○ When checking the DFI parts, use a digital meter which can be read two decimal place voltage or resistance.
○ The DFI part connectors have seals, including the EMM. When measuring the input or output voltage with the connector joined, use the needle adapter set. Insert the needle adapter inside the seal until the needle adapter reaches the terminal (for example, Water Temperature Sensor is shown.).
Digital Meter [A]
Connector [B]
Needle Adapter Set [C]

Special Tool - Needle Adapter Set: 57001–1457

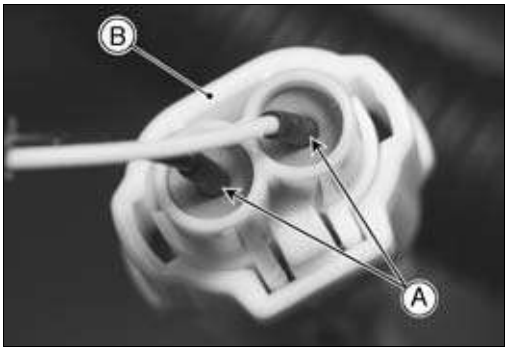


DFI Servicing Precautions

CAUTION
Tape the wires to prevent short circuit of the wires.

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

Sealant - Silicone Sealant (Kawasaki Bond: 56019–120) - Seals of Connector



Throttle Control Cable

The throttle control cable is actually an assembly of three cables: the throttle cable, the throttle body cable, and the oil pump cable. The throttle cable runs from the throttle lever to the cable assembly junction where it connects to both the throttle body cable which leads to the throttle body, and the oil pump cable which leads to the oil pump.

Since the throttle lever controls both the throttle body and the oil pump simultaneously, it is important that each cable be adjusted to its designed base position so that the oil and air mixture reach the engine in the correct proportion at all throttle openings. Cable stretch creates excess play at the throttle lever and alters the base positions of the cables at the throttle body and the oil pump, necessitating periodic adjustment.

NOTE

○ *Be sure to inspect and adjust the throttle body and oil pump cables at the same time.*

Throttle Body Cable Adjustment

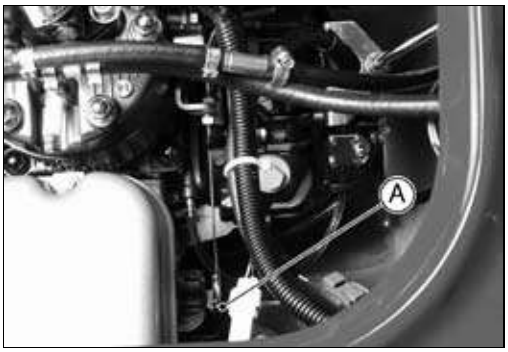
● Refer to the Fuel System in the Periodic Maintenance chapter.

Oil Pump Cable Adjustment

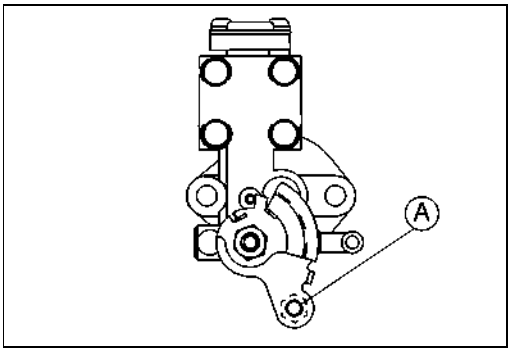
● Refer to the Fuel System in the Periodic Maintenance chapter.

Throttle Case and Throttle Control Cable Removal

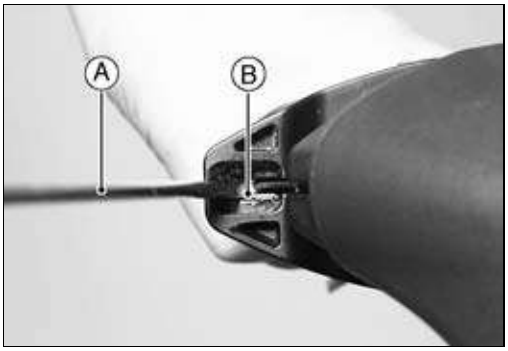
● Disconnect the throttle body cable from the throttle body.
○ Unscrew the adjuster locknuts and slide the cable from the cable holder.
○ Slide the cable tip [A] from the throttle pivot arm.



● Disconnect the oil pump cable from the oil pump.
○ Unscrew the adjuster locknuts and slide the cable from the cable holder.
○ Take out the bolt [A] and disconnect the oil pump cable end.

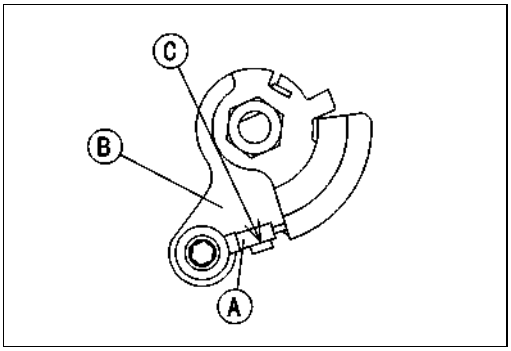


● Disconnect the throttle cable from case.
○ Use a screw driver [A] to separate the tip of the cable end [B] from the case body.
○ Slide the rubber boot out of the place.
○ Unscrew the throttle cable fitting nut.
● Remove:
Handlebar (see Handlebar Removal in the Steering Chapter.)
Steering Cover (see Steering Removal in the Steering Chapter.)
Grommet Mounting Plate
● Pull down the throttle control cable.



Throttle Control Cable

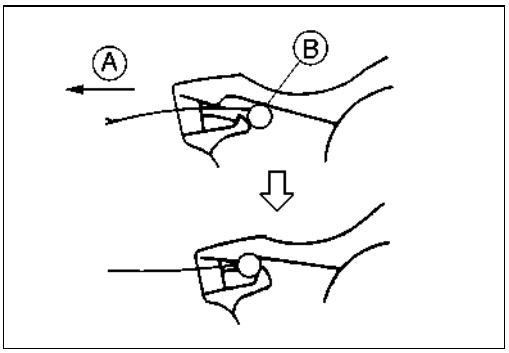
Throttle Case and Throttle Control Cable Installation



- Install the oil pump cable [A] on the pulley [B].
- ○ Apply a non-permanent locking agent to the oil pump cable mounting bolt and torque it.

  Torque - Oil Pump Cable Mounting Bolt: 4.9 N·m (0.5 kgf·m, 43 in·lb)

- ○ Be sure the cable portion indicated in the illustration is in contact [C] with the pulley portion indicated in the illustration.



- Pulling the throttle cable [A], position the tips of the cable end [B] as shown.

- Route the following correctly (see Cable, Wire, and Hose Routing in the Appendix chapter).
  Throttle Cable
  Throttle Body Cable
  Oil Pump Cable
- Adjust the following.
  Throttle Cable
  Throttle Body Cable
  Oil Pump Cable

Throttle Body

Idle Speed Adjustment

- Refer to the Fuel System in the Periodic Maintenance chapter.

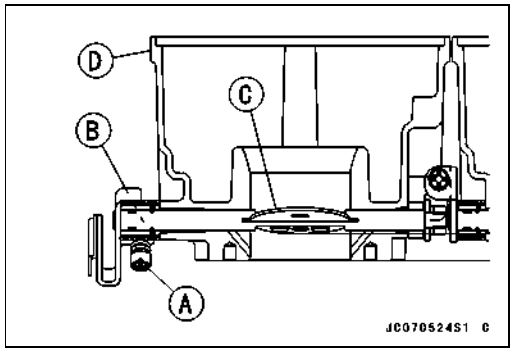
High Altitude Performance Adjustment

High altitude adjustment is not required as the EMM controls the air/fuel mixture automatically.

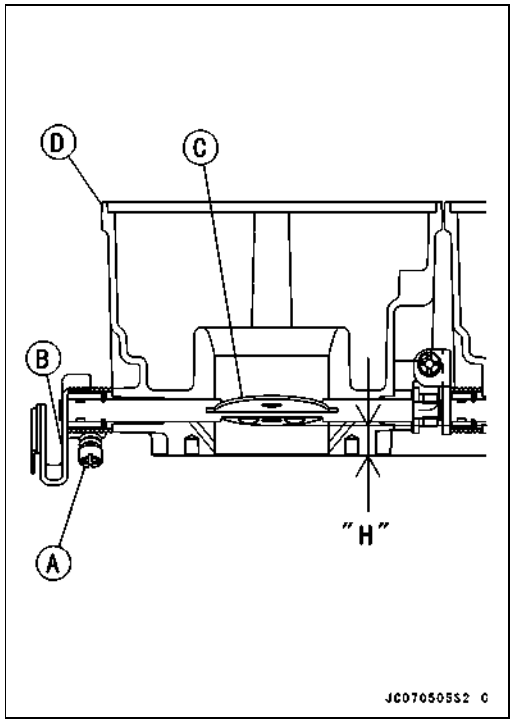
Synchronization

- Turn out the stop screw [A] until there is a clearance between the stop screw and throttle body boss [B].
- Turn in the stop screw until the stop screw end just touches the throttle body boss.
- Turn in the stop screw 1 1/8 turn from the point to keep the specified throttle valve [C] opening angle in the front throttle body [D].

Throttle Valve Opening Angle at Idle Speed
Standard: 1 deg.



- Measure the distance from the bottom of the throttle body bore lower end to the valve edge shown as “H”.



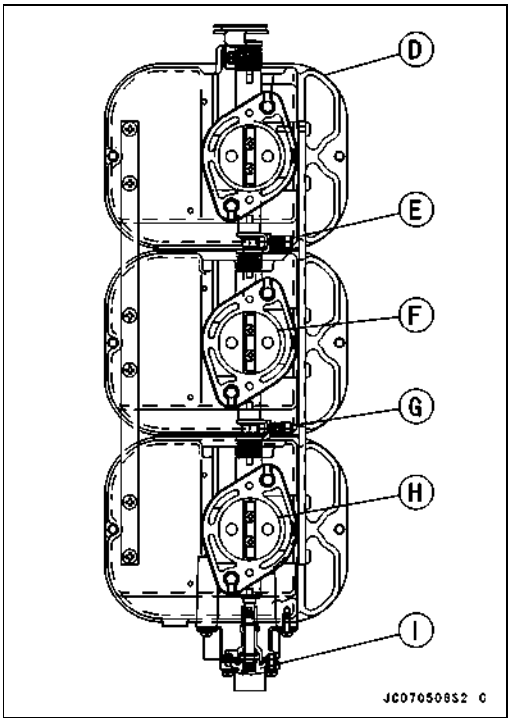
Throttle Body

- Turn the synchronizing screw [E] so that the valve edge in the middle throttle body [F] keeps the same distance within ± 0.2 mm (0.008 in.) tolerance as that in the front throttle body [D].
- Turn the synchronizing screw [G] so that the valve edge in the rear throttle body [H] keeps the same distance within ± 0.2 mm (0.008 in.) tolerance as in the front throttle body.
- Install the throttle body.
- Adjust the throttle control cable.
- Check throttle position sensor [I] output voltage (see Throttle Position Sensor section in this chapter).

Throttle Position Sensor Output Voltage

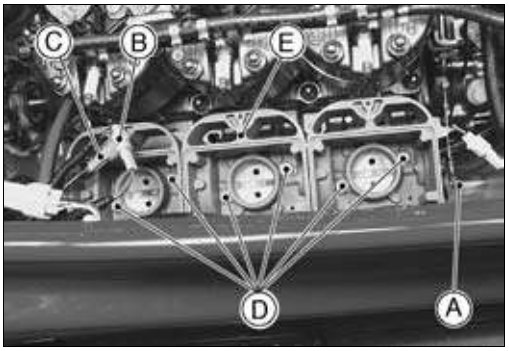
Standard: **0.2 ± 0.1 V DC (at idle throttle opening - 1 deg.)**
3.75 ~ 4.00 V DC (at full throttle opening - 78 deg.)

★If the output voltage is out of the range, adjust the throttle position sensor (see Throttle Position Sensor Adjustment).



Throttle Body Removal

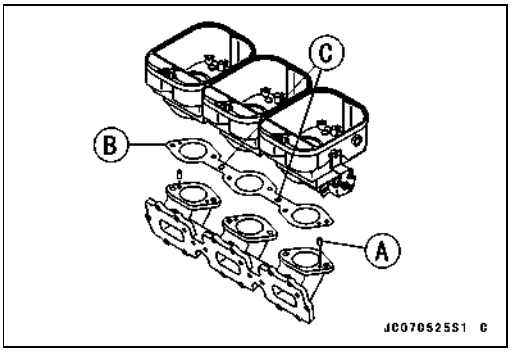
- Remove or disconnect:
  Intake Air Cover
  Flame Arrester
  Throttle Body Cable End [A]
  Air Temperature Sensor Lead Connector [B]
  Throttle Position Sensor Lead Connector [C]
  Throttle Body Mounting Bolts [D]
  Throttle Body [E]



Throttle Body Installation

- Install the throttle body on the intake manifold.
  - Be sure the dowel pins [A] are in place.
  - install the new gasket [B] so that its “UP” mark [C] faces upward.
  - Apply a non-permanent locking agent to the throttle body mounting bolts and torque them.

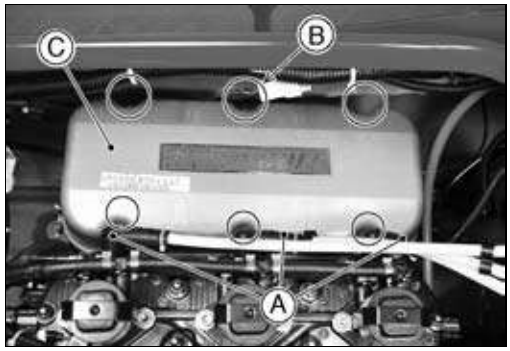
Torque - Throttle Body Mounting Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)



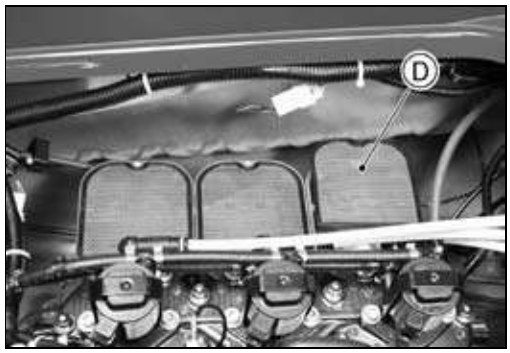
Flame Arrester

Removal

● Remove:
Spark Plug Caps [A]
Air Intake Cover Mounting Bolts [B]
Air Intake Cover [C]



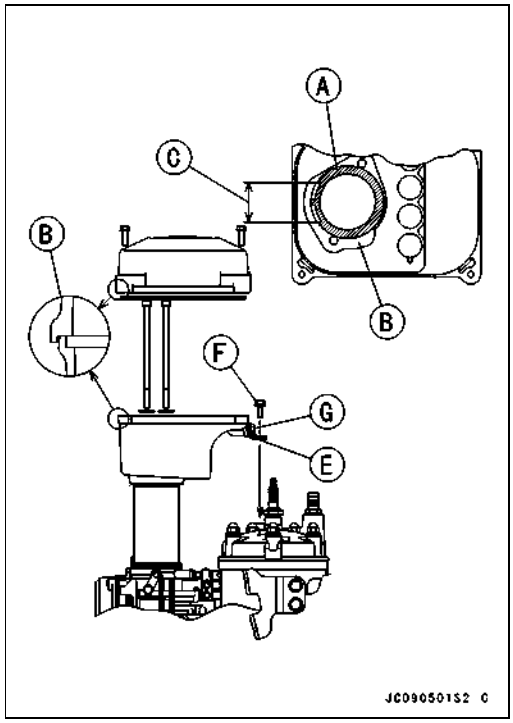
Flame Arrester [D]



Installation Notes

● Certainly, insert the air intake cover [A] on the flame arrester case [B].
● Apply a non-permanent locking agent to the air intake cover mounting bolts and torque them.

Torque - Air Intake Cover Mounting Bolts: 7.8 N·m (0.8 kgf·m, 69 in·lb)



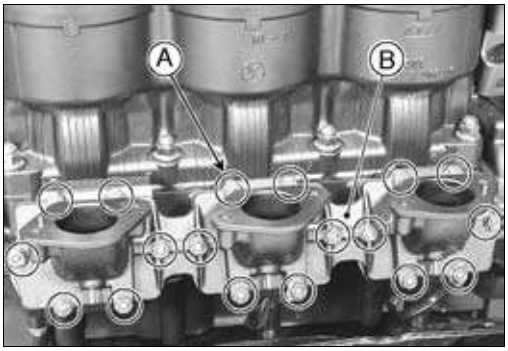
Cleaning

● Refer to the Fuel System in the Periodic Maintenance chapter.

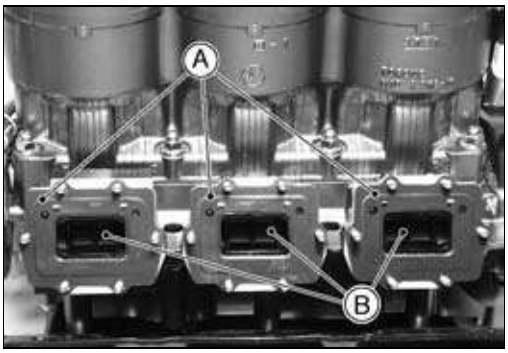
Intake Manifold, Reed Valves

Removal

- Remove:
  Air Intake Cover
  Throttle Body (see Throttle Body Removal)
- Remove the intake manifold mounting nut [A] and remove the intake manifold [B].

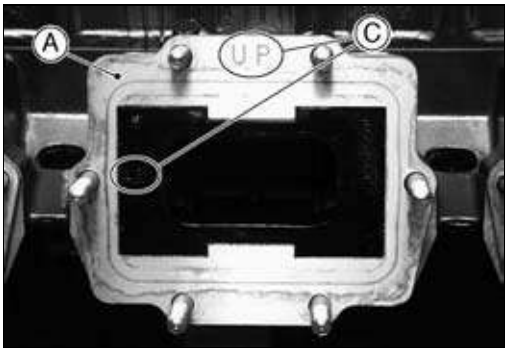


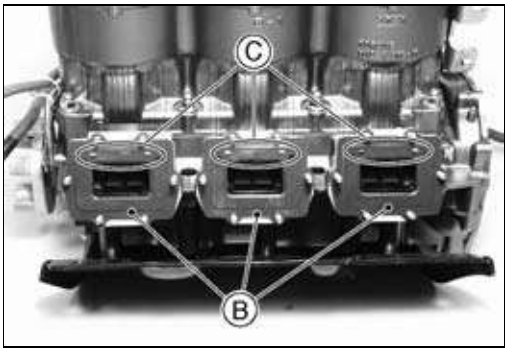
- Pull out the gaskets [A] and the reed valves [B].



Installation Notes

- Replace the gasket with new ones.
- Install the reed valve [A] and gasket [B] so that the “UP” mark [C] is up.

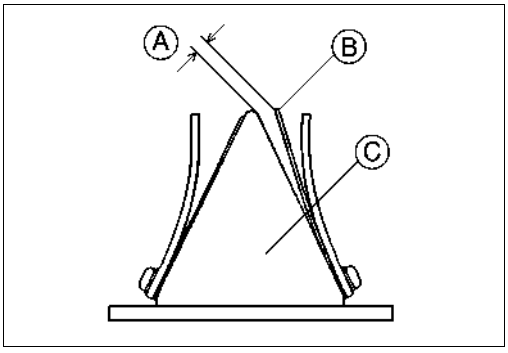




Reed Valve Inspection

- Check reed warp by measuring the clearance [A] between each reed [B] and the valve holder [C].
- ★If any one of the clearance measurements exceeds the service limits, replace the reed valve assembly with a new one.

Reed Warp
Service Limit: 0.2 mm (0.008 in.)



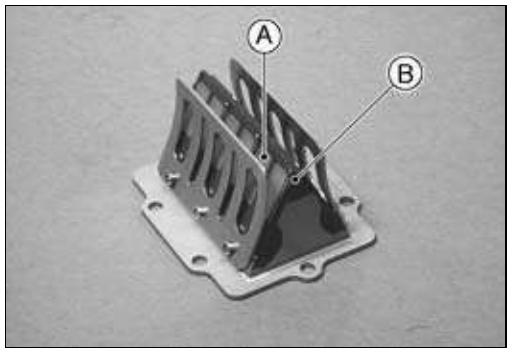
- Check the mounting screw tightness.
- Visually inspect the reeds for cracks, folds, or other damage.
- ★If there is any doubt as to the condition of a reed, replace the reed valve assembly.

★If a reed becomes wavy, replace the reed valve assembly with a new one even if reed warp is less than the service limit.

Valve Holder Inspection

- Check the reed [A] contact areas of the valve holder for grooves scratches, or other damage.
- Check that the rubber coating [B] on the valve holder does not show any sings of separation from the holder.

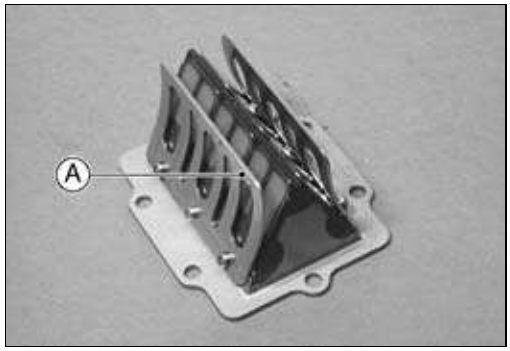
★If there is any doubt as to the condition of the rubber coating, replace the reed valve assembly with a new one.



Valve Stop Inspection

- Check the valve stops [A] for deformation, cracks, or other damage.

★If there is any doubt as to the condition of a stop, replace the reed valve assembly with a new one.



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.

Fuel Filter

Fuel Filter Removal

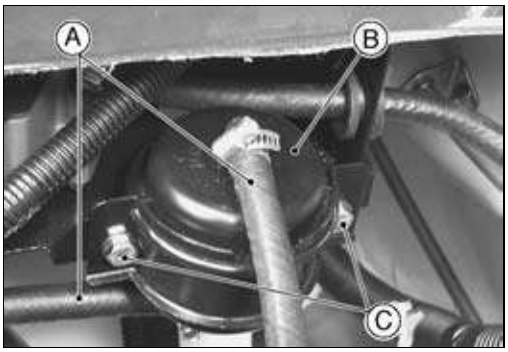
NOTE

○ *The fuel filter is designed to be used throughout the watercraft's life without any maintenance if it is used under normal conditions.*

⚠ 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.

● Remove:
Fuel Hoses [A] at Fuel Filter [B]
Bracket Mounting Bolts [C]
Fuel Filter [B]

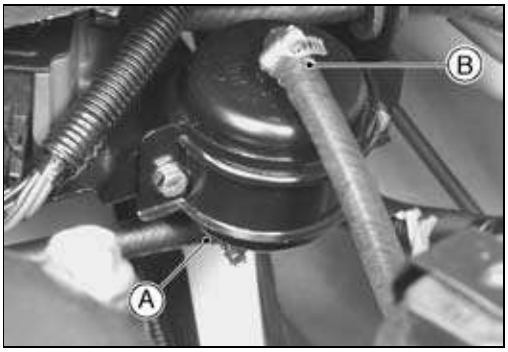


Fuel Filter Installation

● Route the hose correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).

○ Install the fuel hose to the fuel filter, noting its "IN" fitting [A] and "OUT" fitting [B].

Torque - Fuel Hose Clamp Screws: 0.69 ∼ 0.78 N·m (0.07 ∼ 0.08 kgf·m, 6.1 ∼ 6.9 in·lb)



Fuel Pump

Fuel Pump Removal

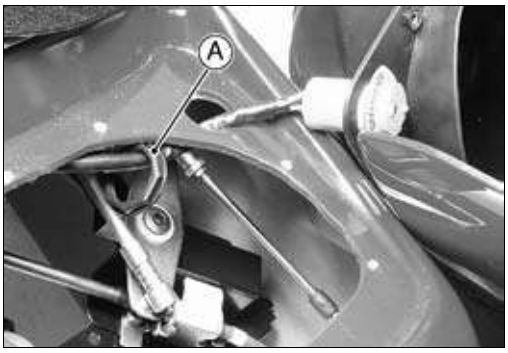
CAUTION

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

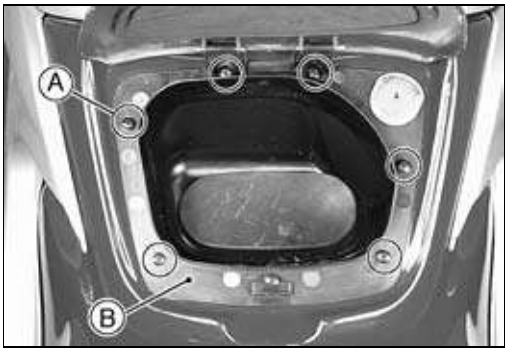
⚠ WARNING

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.

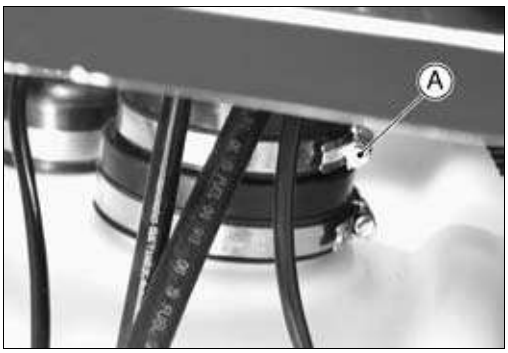
- Disconnect the ignition switch lead connector.
- Unscrew the ignition switch mounting nut [A] inside the hull.



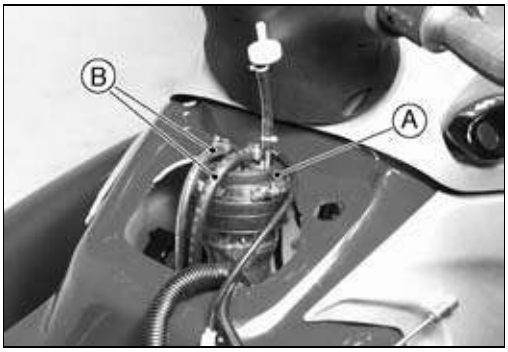
- Take out the screws [A] and remove the storage case [B].



- Disconnect the fuel vent hose at the upper fitting of the fuel vent check valve.
- Disconnect the fuel pump connector.
- Loosen the upper clamp [A] holding the fuel pump.



- Pull the fuel pump [A] out of the hull.
- Disconnect the fuel main and return hoses [B].



Fuel Pump

Fuel Pump Installation

● Route the hose correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).

○ Install the fuel hoses to the fuel pump and torque the clamp screws.

Torque - Fuel Hose Clamp Screws: 0.69 ∼ 0.78 N·m (0.07 ∼ 0.08 kgf·m, 6.1 ∼ 6.9 in·lb)

Fuel Pump Screen Cleaning

● Refer to the Fuel System in the Periodic Maintenance chapter.

Fuel Pump Inspection

See #39 Fuel Pump Open Load and #59 Fuel Pump Driver Overheat in this chapter.

Fuel Tank

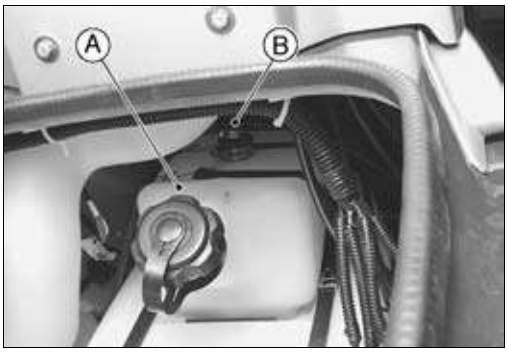
Fuel Tank Removal

- If the level of the fuel is above the filler neck, siphon some fuel out to prevent spilling it.

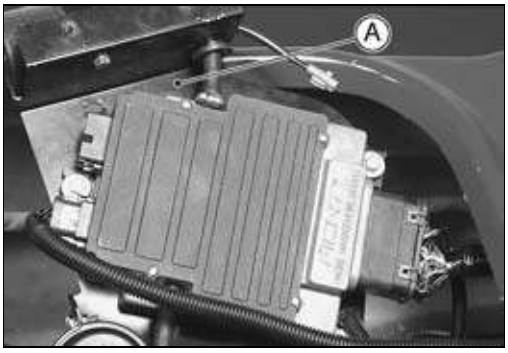
⚠ WARNING

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.

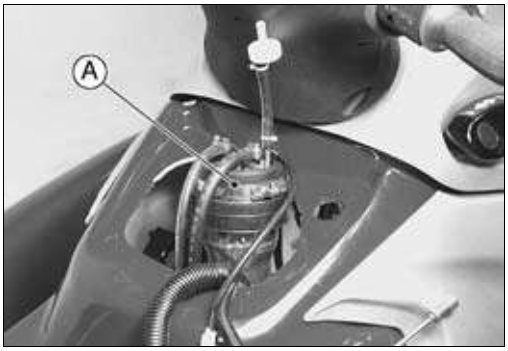
- Remove the engine.
- Disconnect the oil level sensor lead connector.
- Remove the oil tank [A] with the oil level sensor [B] (see Oil Tank Removal section in the Engine Lubrication System chapter).



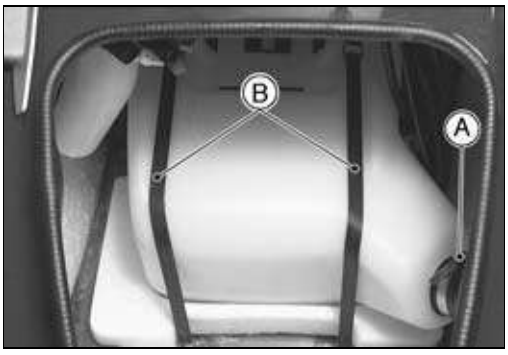
- Remove the bracket [A] holding the EMM, fuel filter and capacitor.



- Remove the fuel pump [A] (see Fuel Pump Removal section in this chapter).

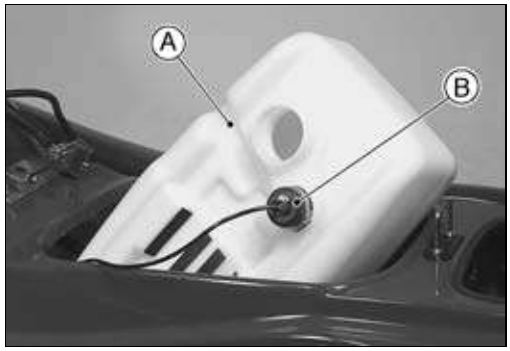


- Disconnect the fuel level sensor lead connector.
- Loosen the lower clamp [A] on the fuel filler tube.
- Unhook the fuel tank strap [B].



Fuel Tank

- Remove the fuel tank [A] out of the hull.
- Remove the fuel level sensor [B] from the fuel tank.



Fuel Tank Installation

- Connect the following correctly (see Cable, Wire and Hose Routing section in the Appendix chapter).
  - Fuel Hose
  - Air Vent Hose
  - Fuel Level Sensor Lead Connector
  - Other Wire and Harness
- ○ Torque the fuel hose clamp screws.

Torque - Fuel Hose Clamp Screws: 0.69 ~ 0.78 N·m (0.07 ~ 0.08 kgf·m, 6.1 ~ 6.9 in·lb)

Fuel Tank Cleaning

- Remove the fuel tank (see Fuel Tank Removal).
- Drain the tank into a suitable container.

⚠ 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 spark; this includes any appliance with a pilot light.

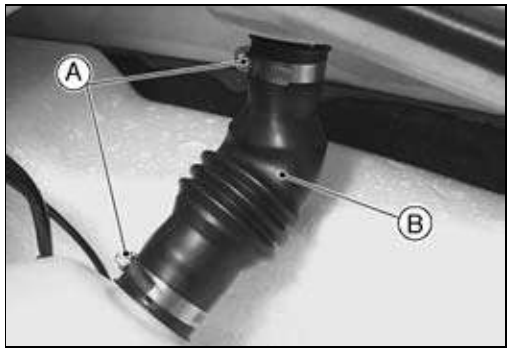
- Flush the tank repeatedly with high flash-point solvent until it is clean. It may be necessary to put a few marbles or pieces of clean gravel into the tank and shake it, to knock loose any foreign matter in the bottom.

⚠ 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.

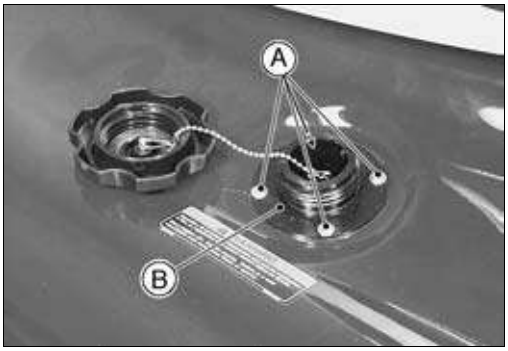
Fuel Filler and Tube Removal

- Loosen the tube clamps [A] and remove the fuel tube [B].



Fuel Tank

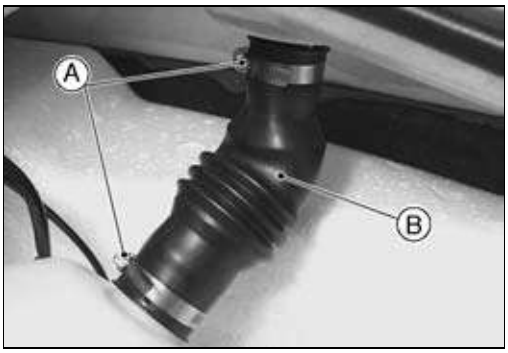
- Take out the screws [A] in the filler flange and remove the fuel filler [B].



Fuel Filler and Tube Installation

- Torque the clamp screws [A] on the filler tube [B].

Torque - Clamps Screw on Filler Tube: 2.9 N·m (0.3 kgf·m, 26 in·lb)



Fuel Line

Fuel Pressure Inspection

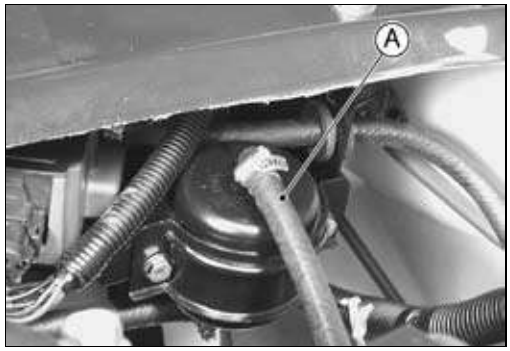
NOTE

○ *Be sure the battery is fully charged.*

● Be sure to place a piece of cloth under the fuel supply pipe of the fuel filter.

⚠WARNING

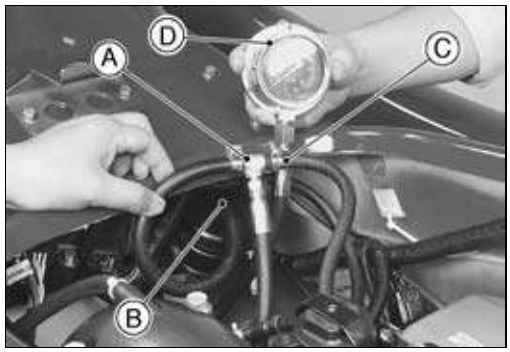
Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.
When the fuel hose is disconnected, fuel spills out from the hose and the pipe because of residual pressure. Cover the hose connection with a piece of clean cloth to prevent fuel spillage.



● Loosen the clamp bolt and pull out the fuel supply hose [A].

● Quickly install the fuel pressure gauge adapter [A] between the fuel supply pipe [B] and the fuel supply hose [C].
● Connect the pressure gauge [D] to the fuel pressure gauge adapter.

Special Tools - Fuel Pressure Gauge Adapter: 57001–1463
Oil Pressure Gauge: 57001–125



⚠WARNING

Do not try to start the engine with the fuel hoses disconnected.

● Start the engine, and let it idle.
● Measure the fuel pressure with the engine idling.

Fuel Pressure (idling)
Standard: approx. 172 kPa (1.8 kg/cm^2, 25 psi)

NOTE

○ *The gauge needle will fluctuate. Read the pressure at the average of the maximum and minimum indications.*

★If the fuel pressure is much higher than the specified, check the following:
Fuel Hose from Gauge Adapter to Fuel Pump Return Pipe for Sharp Bend, Kinking, or Clogging
Pressure Regulator (see Pressure Regulator Inspection)
★If the fuel pressure is much lower than specified, check the following:
Fuel Line Leakage
Fuel Injectors
Pressure Regulator (see Pressure Regulator Inspection)
Amount of Fuel Flow (see Fuel Flow Rate Inspection)
★If the fuel pressure is much lower than specified, and if inspection above checks out good, replace the fuel filter and measure the fuel pressure again.
● Remove the fuel pressure gauge and adapter.
● Run the fuel hoses in accordance with the Cable, Wire, and Hose Routing section in the Appendix chapter.

Torque - Fuel Hose Clamp Screw: 0.69 ∼ 0.78 N·m (0.07 ∼ 0.08 kgf·m, 6.1 ∼ 6.9 in·lb)

Fuel Line

Fuel Flow Rate Inspection

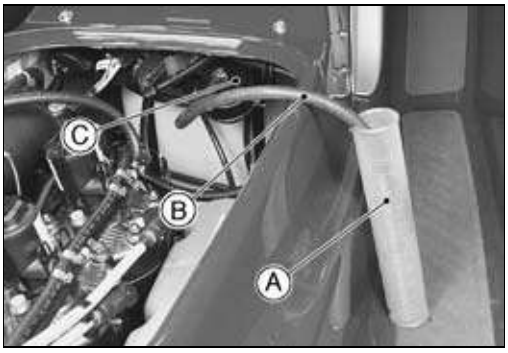
NOTE

○ *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.

- Turn the ignition switch OFF.
- Wait until the engine cools down.
- Open the fuel tank cap [A] to lower the pressure in the tank.



- Prepare a measuring cylinder and a fuel hose.
- Disconnect the fuel supply hose from the fuel filter [C], and connect a fuel hose [B], and set the measuring cylinder [A] as shown.
- Close the fuel tank cap.

⚠WARNING

Wipe off spilled out fuel immediately.
Be sure to hold the measuring cylinder vertical.

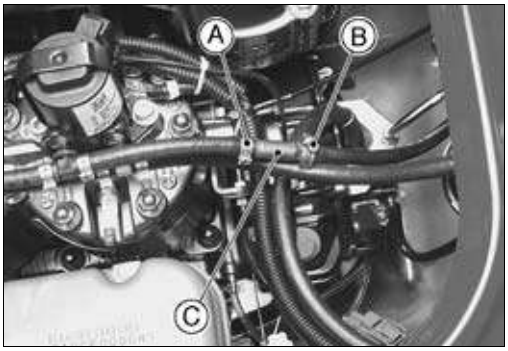
- Turn the ignition switch ON.
- Push the starter button for 3 seconds.
- Measure the discharge for 3 seconds.

Amount of Fuel Flow
Standard: 60 mL (0.23 US oz) or more for 3 seconds

★If the fuel flow is much less than the specified, check the following:
Fuel Hose from Fuel Pump Supply Pipe to Fuel Filter for Sharp Bend, Kinking, or Clogging
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.

Pressure Regulator Removal



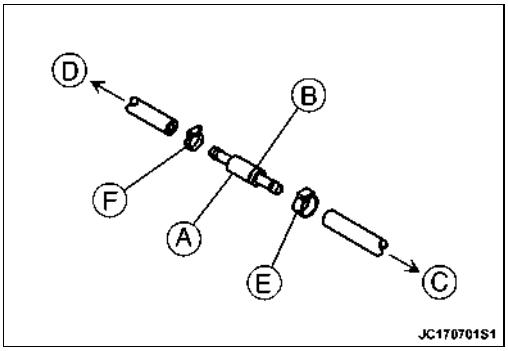
- Remove:
  Ear Type Clamp [A]
  Clamp [B]
  Fuel Hoses
  Pressure Regulator [C]

Fuel Line

Pressure Regulator Installation

- Install the pressure regulator [A] in the fuel return line.
- ○ The groove [B] of the regulator faces to the injectors [C]
  [D] Fuel Pump Return Pipe
- Tighten:
  Ear Type Clamp [E] (see DFI Servicing Precautions)
  Clamp [F]

Torque - Fuel Hose Clamp Screw: 0.69 ∼ 0.78 N·m (0.07 ∼ 0.08 kgf·m, 6.1 ∼ 6.9 in·lb)

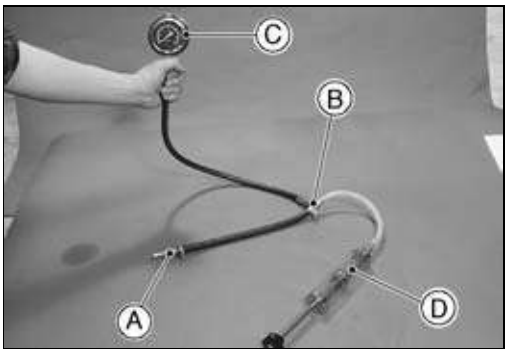


Pressure Regulator Inspection

- Remove the pressure regulator (see Pressure Regulator Removal).
- Connect the following tools to the pressure regulator [A] as shown.

Special Tools - Fuel Pressure Gauge Adapter: 57001–1463 [B]
Oil Pressure Gauge: 57001–125 [C]

Suitable Syringe [D]



- Watching the pressure gauge, pump the fork oil level gauge to build up the pressure until the pressure regulator opens: the gauge needle flicks downward.
- Stop pumping at once. The pressure regulator must open within the specified range in the table below.

Pressure Regulator Opening Pressure
Standard: 196 ± 20 % kPa
(2.0 ± 20 % kg/cm^2, 28 ± 20 % psi)

★If the opening pressure is not within the specified range, replace the regulator with a new one.

Diagnostic

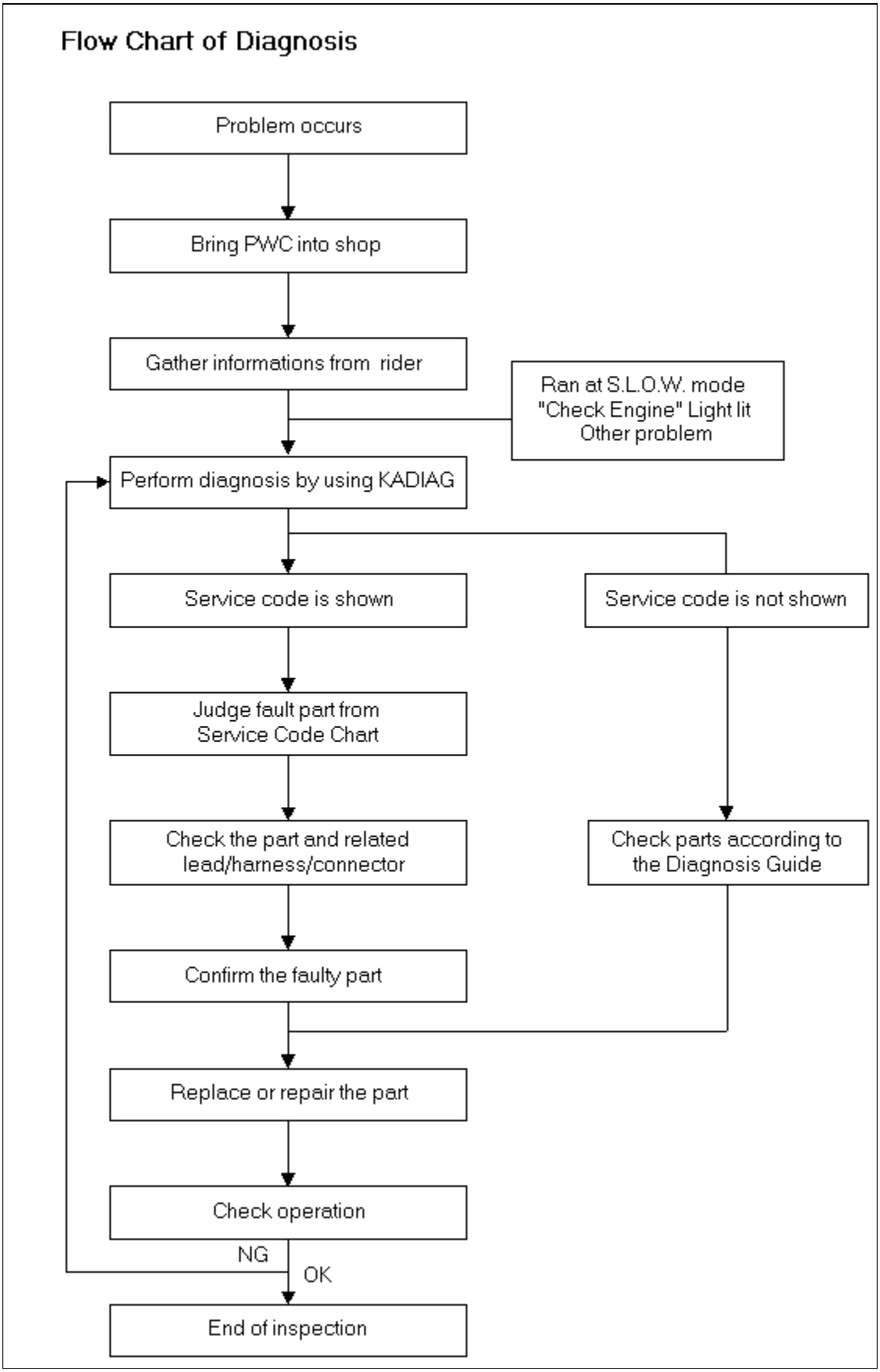
SERVICE CODE CHART

Service codes are identified as either Priority Level A, B, or C. Solve all Priority Level A problems before going on to those identified as Level B or C. In some instances, an “A” level code may set a “B” or “C” level codes. Fixing an “A” level code may eliminate a “B” or “C” level code, thus saving troubleshooting time and effort.

CODE NUMBER	FAULT	INITIATES S.L.O.W.	INSTRUMENT LIGHT
Priority Level A			
12	TP sensor circuit malfunction	×	Check Eng.
13	TP sensor below expected range	×	×
14	TP sensor above expected range	×	Check Eng.
15	ROM "check sum" verification	×	Check Eng.
16	Crank sensor mis-adjustment or damaged	×	Check Eng.
17	Alternator voltage below expected range	×	Check Eng.
18	Alternator voltage above expected range	YES	Check Eng.
23	EMM temperature sensor circuit malfunction	×	×
24	EMM temperature below expected range	×	×
25	EMM temperature above expected range	YES	Check Eng.
35	Low oil level	YES	Engine Oil
39	Fuel pump open load	×	Check Eng.
59	Fuel pump driver overheat	×	Check Eng.
Priority Level B			
41	WT sensor circuit malfunction	×	Check Eng.
42	WT sensor below expected range	×	Check Eng.
43	WT sensor above expected range	YES	Water Temp, Check Eng.
44	BP sensor circuit malfunction	×	Check Eng.
45	BP sensor below expected range	×	Check Eng.
46	BP sensor above expected range	×	Check Eng.
51	Injector #1 open load	×	Check Eng.
52	Injector #2 open load	×	Check Eng.
53	Injector #3 open load	×	Check Eng.
Priority Level C			
47	AT sensor circuit malfunction	×	Check Eng.
48	AT sensor below expected range	×	Check Eng.
49	AT sensor above expected range	YES	Check Eng.
81	Ignition coil #1 open primary	×	Check Eng.
82	Ignition coil #2 open primary	×	Check Eng.
83	Ignition coil #3 open primary	×	Check Eng.

TP: Throttle Position
WT: Water Temperature
BP: Barometric Pressure
AT: Air Temperature

When “NO STORED CODE” is displayed, the D.I. system has no fault.



Diagnostic

Diagnostics Code-Action

CODE	FAULT	CAUSES	ACTION
Priority Level A			
12	TP sensor circuit malfunction	Circuit open/short/loose/corroded, Sensor damaged	Check circuit or sensor Visually check
13	TP sensor below expected range	Circuit short, Sensor damaged	Check circuit or sensor Visually check
14	TP sensor above expected range	Ground lead cut or loose	Check circuit or sensor
15	ROM "check sum "verification	EMM malfunction or damaged	Check visually, EMM replace
16	Crank position sensor mis-adjustment or damaged	Sensor mis-adjustment/loose /damaged Circuit short	Check gap, sensor resistance, Visually check
17	Alternator voltage below expected range	Stator/rectifier/regulator circuit faulty, open or short	Check components' resistance, Check visually, Alternator replace
18	Alternator voltage above expected range	Stator/rectifier/regulator malfunction	Check components' resistance, Alternator replace
23	EMM temperature sensor circuit malfunction	Circuit open/short/loose/corroded, Sensor damaged	EMM replace
24	EMM temperature below expected range	Circuit open/short	EMM replace
25	EMM temperature above expected range	Weeds or debris in jet pump Cooling water line clogged or leaked EMM electrical parts malfunction	Check jet pump Check cooling line EMM replace
35	Low oil level	Dangerously low oil in oil tank Circuit open/short Sensor damaged	Add engine oil Check circuit or sensor
39	Fuel pump open load	Circuit open/short	Check circuit
59	Fuel pump driver overheat	Pump screen clogged, less fuel Pump coil short	Check pump screen Check pump
Priority Level B			
41	WT sensor circuit malfunction	Circuit open/short/loose/corroded, Sensor damaged	Check circuit, sensor resistance Visually check
42	WT sensor below expected range	Circuit open/short	Check circuit, sensor resistance
43	WT sensor above expected range	Weeds or debris in jet pump Cooling water line clogged or leaked Engine overheating Check jet pump Injector malfunc-tion Incorrect type of gas or oil	Check jet pump Check cooling line Check injector Check gas or oil
44	BP sensor circuit malfunction	Circuit open/short, Sensor damaged	EMM replace EMM replace
45	BP sensor below expected range	Circuit open/short	EMM replace
46	BP sensor above expected range	Circuit open/sheet	EMM replace
51	Injector #1 open load	Coil, circuit open	Check circuit
52	Injector #2 open load	Coil, circuit open	Check circuit
53	Injector #3 open load	Coil, circuit open	Check circuit
Priority Level C			
47	AT sensor circuit malfunction	"Circuit open/shortage, Sensor damaged	Check circuit or sensor
48	AT sensor below expected range	Circuit open/shortage	Check circuit or sensor
49	AT sensor above expected range	Air temperature too high	Check circuit or sensor
81	Ignition coil #1 open primary	Coil or circuit open/shortage	Check coil or circuit
82	Ignition coil #2 open primary	Coil or circuit open/shortage	Check coil or circuit
83	Ignition coil #3 open primary	Coil or circuit open/shortage	Check coil or circuit

When “NO STORED CODE” is displayed, the D.I. system has no fault.

Diagnostic

Diagnostic Guide

1. Engine Won't Crank

SYSTEM/COMPONENT	CAUSES	ACTIONS
Battery and Cables	Dead or Low Battery	Charge and test battery
	Loose/Corroded Connections	Perform start system Volt Drop Test Clean and repair as necessary
	Ignition Switch Not ON	Ignition switch ON
	Broken, Loose or Corroded Wire in Harness	Clean and repair as necessary
Electrical	Failed Ignition Switch	Test Ignition Switch
	Failed Start Switch	Test Start Circuit
	Broken, Loose or Corroded Wire or Ground	Clean and repair as necessary
	Failed Starter Relay	Perform operational test
	Failed Starter Motor or Reduction Gear	Repair or replace

Diagnostic

2. Engine Cranks but Won't Start

SYSTEM/COMPONENT	CAUSES	ACTIONS
Fuel System	Water in Fuel	Check fuel tank and screen
	Old/stale Fuel	Substitute known good fuel
	Restricted or Broken Lines, Fittings, Filter, or Pressure Regulator	Check fuel lines /components Repair or replace as necessary
	Failed Fuel Pump	Fuel pump should run for seconds using KADIAG Software See Fuel Pump section
	EMM - No Signal to Injectors	Monitor injector signal wires while cranking or use KADIAG Software to activate injectors See Injector Static/Dynamic Test
Electrical System	Emergency Stop Circuit - No switched to EMM or Ignition	Test emergency stop circuit See Stop Circuit Inspection
	Lanyard Key not pushed under stop button	Push lanyard key under stop button
	Crank Position Sensor - No Output	KADIAG Software should indicate at least 200 RPM while cranking Adjust or test crank position sensor See Electrical System/Engine Bottom End chapter
	Ignition Coils - No Output to Coils	Measure voltage at ign. coils using a peak voltage adapter at cranking or use KADIAG Software to activate ignition See Electrical System chapter
	Failed Main (10 A) Fuse	Replace
	Failed or Disconnected Capacitor	Verify capacitor operation See Electrical System chapter
	Low Cranking Voltage	Low battery, loose connection, weak starter, failing solenoid, inadequate battery cables, etc
	Battery, Capacitor, EMM connection loose	Check connector, make sure connection
Mechanical	Scored Cylinders	Perform compression test or visual inspection See Engine Top End chapter

3. Engine Starts, But Stops Again

SYSTEM/COMPONENT	CAUSES	ACTIONS
Fuel System	Fuel Level Low	Refill fuel
	Restricted or Broken Lines, Fittings, Filter, or Pressure Regulator	Check fuel lines /components Repair or replace as necessary
	Poor Quality or Spoiled Fuel or Water in Fuel	Substitute known good fuel
	Damaged or Inoperable Fuel Pump - Low or No Pressure	Fuel pump should run for seconds using KADIAG Software - Perform fuel pressure test See Fuel Pump/Fuel Line section
	Loss of EMM Signals to Injectors	Monitor injector signal wires while cranking or use KADIAG Software to activate injectors See Injector Static/Dynamic Test
	Injector Malfunction	Check injector, Replace injector as necessary
Ignition System	Worn Spark Plug	Check plugs and replace as necessary
	Poor Ground Connections	Check using an ohmmeter or disassemble and inspect
	Loss of EMM Signals to Ignition Coils	Measure voltage at ign. coils using a peak voltage adapter at cranking See Electrical System
	Failed Ignition Module	Measure voltage at ign. coils using a peak voltage adapter at cranking See Electrical System
Electrical System	Faulty Ignition Switch	Intermittent switched, Test ignition switch
Mechanical	Damaged Cylinder Head	Perform compression test and/or visual inspection

Diagnostic

4. Engine Surge/Runs Rough

SYSTEM/COMPONENT	CAUSES	ACTIONS
Fuel System	Contaminated Fuel	Substitute known good fuel
	Restricted or Broken Lines, Fittings, Filter, or Pressure Regulator	Check fuel lines /components Repair or replace as necessary
	Damaged or Inoperable Fuel Pump - Low or No Pressure	Perform Fuel System Pressure Test See Fuel Line section
	Pressure Regulator Stuck Open Low or Unsteady Pressure	Perform Fuel System Pressure Test See Fuel Line section
	Failed Injectors	Perform cylinder drop test to isolate using KADIAG Software Verify signal from EMM using timing light - See Injector Static/Dynamic Test
	Erratic EMM Signals to Injectors	Verify signal from EMM using timing light - See Injector Static/Dynamic Test
Ignition System	Damaged, Worn, Fouled, or Incorrect Spark Plug	Check and replace with correct type as necessary
	Damaged or Loose Coil or Lead	Repair or replace as necessary
	Loose/Broken Wire or Connection	Repair or replace as necessary
	Misadjusted or Damaged Crank Position Sensor - Erratic Ignition and Fuel	Check adjustment Perform visual inspection See Electrical System/Engine Bottom End chapter
Electrical System	Loose Battery Connections	Clean and tighten
	Loose or Damaged Wire Connection or Ground	Measure ground with an ohmmeter or disassemble and inspect - repair or replace as necessary
	Low 45 volts Output - Low Voltage at Injectors and Ignition Coils	Monitor voltage using KADIAG Software while running engine
	Faulty or Disconnected Capacitor	Check capacitor See Electrical System
Mechanical	Damaged Cylinder Head	Perform compression test Do visual inspection

5. Engine Activates S.L.O.W. Mode

SYSTEM/COMPONENT	CAUSES	ACTIONS
Throttle Position Sensor above expected range (Service Code = 14)	Ground lead open circuit Sensor misalignment	 Check circuit/sensor Repair or replace as necessary
Alternator voltage above expected range (Service Code = 18)	Alternator voltage too high : Stator/rectifier/regulator malfunction	 Check circuit/components' resistance Repair or replace as necessary
EMM temperature above expected range (Service Code = 25)	EMM temperature too high : Weeds or debris in jet pump Cooling water line clogged, leaked EMM inner parts malfunction (Service Code = 15)	 Check jet pump Check cooling water line Clean, repair, or replace as necessary If code = 15, replace EMM
Water temperature sensor circuit malfunction (Service Code = 41)	Circuit open/short/loose/corrode Sensor damaged	 Check circuit/sensor Repair or replace as necessary
Water temperature sensor above expected range (Service Code = 43)	Cooling water temperature too high Weeds or debris in jet pump Cooling water line clogged, leaked Engine overheating Injector malfunction Incorrect type of gas or oil	 Check jet pump Check cooling water line Clean, repair, or replace as necessary Check injector Substitute known good gas or oil
Air temperature sensor circuit malfunction (Service Code = 47)	Circuit open/short/loose/corrode Sensor damaged	 Check circuit/sensor Repair or replace as necessary
Air temperature sensor above expected range (Service Code = 49)	Circuit open/short/loose/corrode Sensor damaged	 Check circuit/sensor Repair or replace as necessary

Diagnostic

6. Low Maximum RPM

SYSTEM/COMPONENT	CAUSES	ACTIONS
Fuel System	Restricted or Broken Lines, Fittings, Filter, or Pressure Regulator	Check fuel lines /components Repair or replace as necessary
	Poor Quality/Spoil Fuel	Substitute known good fuel
	Faulty Injector or Injector Signal - Possible Lean or Rich Cylinder	Isolate using cylinder drop test in KADIAG Software
	Faulty Fuel Pump Low Fuel Pressure	Monitor fuel system pressure See Fuel Line/Fuel Pump section
	Pressure Regulator Stuck Open or Missing. Low Pressure - Possible Lean Top Cylinders	Monitor fuel system pressure See Fuel Line section
Ignition System	Faulty or Incorrect Spark Plug	Check and replace with correct type and number as necessary
	Faulty Ignition Coils - No Output to Some Cylinders	Check coil and lead
	Loss of Throttle Position Sensor Signal - Engine stays at Idle RPM	Check service code Check TP sensor/circuit
	Loss of EMM Signals to Ignition Coils	Perform static test of ignition firing
Electrical System	Low Output from 45 V regulator Affects Fuel and Ignition	Monitor Voltage using KADIAG Software Possible code 17
	Faulty EMM Software	Possible code 15 - reprogram or replace EMM
Mechanical System	Damaged Impeller	Check impeller
	Damaged Cylinder Head	Perform compression test Do visual inspection
	Throttle Valves not Opening Enough	Check operation

7. Engine Won't Shut Off

SYSTEM/COMPONENT	CAUSES	ACTIONS
Electrical System	Faulty Ignition Switch	Test Ignition Switch
	Faulty Emergency Stop Switch	Test Stop Circuit See Stop Circuit Inspection
	Broken Wire or Connection in Stop Circuit	Test Stop Circuit See Stop Circuit Inspection

8. Excessive Smoking

SYSTEM/COMPONENT	CAUSES	ACTIONS
Fuel System	Poor Quality Fuel	Substitute known good oil
	Injector Stuck Open	Isolate using KADIAG Software and/or pressure test
	Improperly Connected Fuel/Oil Hoses at Fittings	Engine may start if fuel and oil hoses are swapped, but fuel system will be filled with oil
EMM	Firing Fuel Injector too often	Check for loose connection or damaged crank position sensor Possible code 15 - replace EMM

9. Engine Overheats

SYSTEM/COMPONENT	CAUSES	ACTIONS
Water Supply System	Blocked Intake Line	Visual inspection - clean
	Damaged/Worn Pump Impeller	Check pump, impeller
Water Cooling Line	Damaged Water Temperature Sensor	Check water temperature sensor operation See Water Temperature section
	Blocked or Restricted Cooling Passage	Do visual inspection Check water drain
	Blown Cylinder Head Gasket	Perform compression test/visual inspection
	False Indication from Defective Temperature Sensor or Pinched Wire	Test temperature sensor, visual inspection

10. Faulse Warning Light

SYSTEM/COMPONENT	CAUSES	ACTIONS
Electrical System	Standard spark plugs and/or plug caps not installed	Install standard plugs and caps
	Damaged/Shorted Wire or Connection	Check circuit meter See Multifunction Meter Circuit
Engine Electrical System	Faulty Sensor or Circuit	Test appropriate circuit and components Check service codes
	Faulty EMM	Check service codes and eliminate possibility of being a genuine problem
	EMM Affected by Electronic Noise	Verify all Spark Plugs and Wires are of the correct type and check plug caps installed

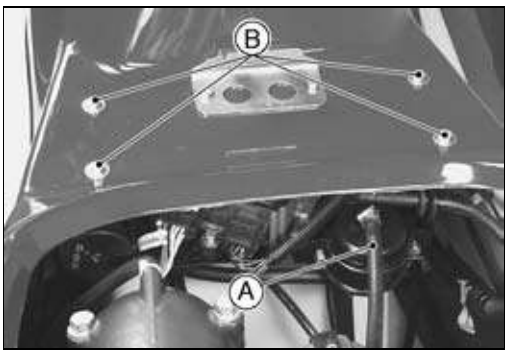
EMM (Engine Management Module)

CAUTION

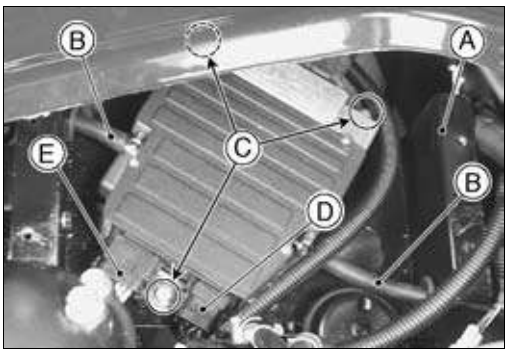
Never drop the EMM, especially on a hard surface. Such a shock to the EMM can damage it.

EMM Removal

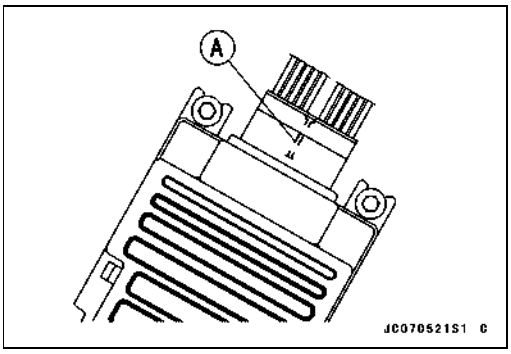
- Disconnect [A] the supply fuel hose at the fuel filter.
- Unscrew the bracket mounting bolts [B].



- Slide the bracket [A] backwards.
- Disconnect the cooling hoses [B].
- Remove the EMM mounting bolts [C].
- Take the EMM off the bracket and disconnect the 8-pin [D] and 12–pin [E] connectors.



- Unscrew the 40–pin connector mounting bolt [A], disconnect the connector.
- Remove the EMM.



EMM Installation

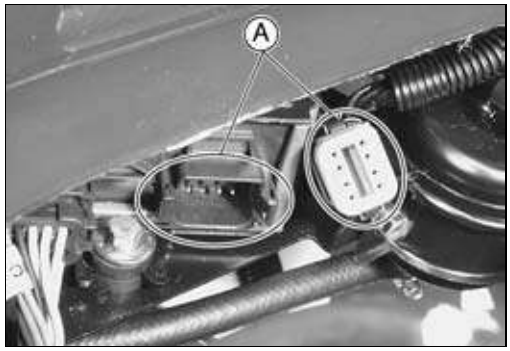
- Apply grease to the 40-pin connector (see Cable, Wire and Hose Routing in the General Information chapter).
- ○ Torque the 40-pin connector mounting bolt.

Torque - EMM 40-pin Connector Mounting Bolt: 2.84 ∼ 3.04 N·m (0.29 ∼ 0.31 kgf·m, 25.1 ∼ 26.9 in·lb)

- Apply a non-permanent locking agent to the bracket mounting bolts and tighten securely.

EMM (Engine Management Module)

EMM Power Supply Inspection



- Visually inspect the terminals [A] of the EMM connectors.

★If the connector is clogged with mud or dust, blow it off with compressed air.

★Replace the main harness if the terminals of the main harness connectors are cracked, bent, or otherwise damaged.

★Replace the EMM if the terminals of the EMM connectors are cracked, bent, or otherwise damaged.

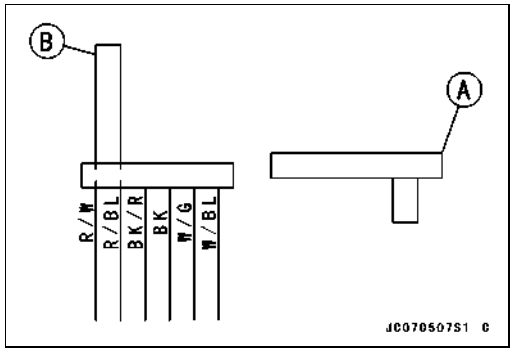
- With the EMM connectors connected, check the following ground leads for continuity with the ignition switch OFF, using the hand tester (see EMM Power Source Circuit).

EMM Grounding Inspection

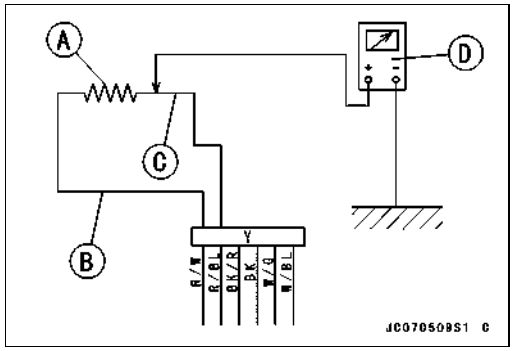
27 DIGITAL GND (BK) Terminal ←→ Battery (–) Terminal: 0 Ω
Engine Ground Terminal ←→ Battery (–) Terminal: 0 Ω

★If no continuity, check the connector, the engine ground lead, or main harness, and repair or replace them if necessary.

Special Tool - Hand Tester: 57001–1394



- Before inspecting the EMM power supply voltage, perform the following procedure. Supply battery voltage to the EMM employing two methods indicated afterward (You can employ whichever ones).
- Supply battery voltage employing jumping lead.
  - Disconnect the KADIAG male connector [A].
  - Connect the R/W terminal with the R/BL terminal of the female connector employing auxiliary wire [B].



- Supply battery voltage to the EMM employing the above method.
- Connect the 10 kΩ rheostat [A] between the R/W lead [B] and the R/BL lead [C].
- Check the EMM power source voltage with the hand tester [D].
  - Connect the hand tester as shown.
  - Turn the ignition switch ON.

EMM Power Source Inspection

Tester Connection:	**Meter (+) → R/BL Wire**
	Meter (–) → Ground
Standard:	**Approx. 6V**

★If the tester does not read as specified, check the following.
Power Source Wiring (see EMM Power Source Circuit in this chapter)
Main Fuse 10 A
Battery Voltage

★If the inspection checks good, recheck the EMM power source voltage with the hand tester.

★If the tester reading is 0 V, the internal circuit of the EMM power source is short. Replace the EMM.

★If the tester reading is 12 V, the internal circuit of the EMM power source is open. Replace the EMM.

EMM (Engine Management Module)

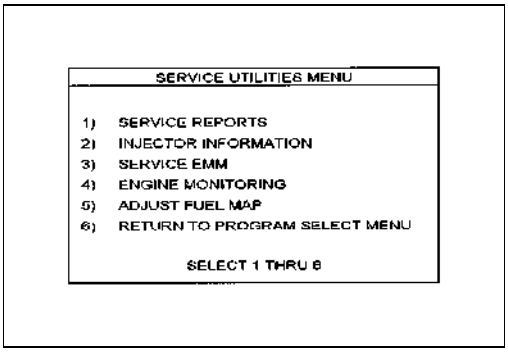
EMM Replacement

You must use KADIAG Software, newest version, when you perform the replacing an EMM.

NOTE

○ *Each fuel injector's serial number and flow characteristics are loaded into the EMM during production. This means that there is a unique relationship between the engine's EMM and its fuel injectors.*

- Prepare:
  Communication Cable
  Laptop Computer
  KADIAG Software
  KADIAG Software Manual
  Service Replacement EMM
- Start the KADIAG Software according to the Software Manual.
- Select 2) Service Utilities from the Main menu and then select 3) Service EMM.

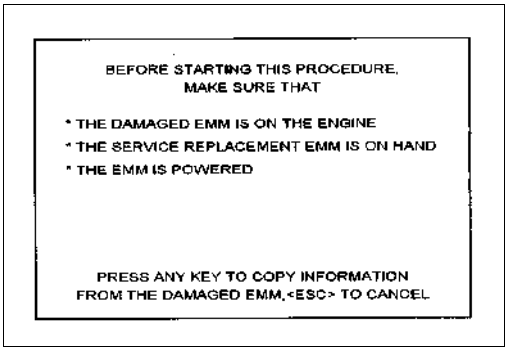


- This is the Service EMM screen. You get to this screen by typing "3" at the Service Utilities Menu.

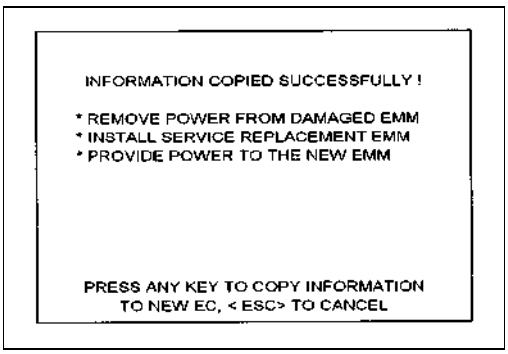
NOTE

○ *The purpose of this screen is to provide a simple method of loading engine specific information into a Service Replacement EMM. This option allows you to copy the engine model number, serial number, operating hours, RPM profile, and other engine specific information from the original into a service replacement EMM.*

- Before beginning this procedure, you must have a Service Replacement EMM. The damaged EMM you are going to replace should still be on the engine.
- When you see this screen, press any key to copy the engine specific information from the damaged EMM into your computer.

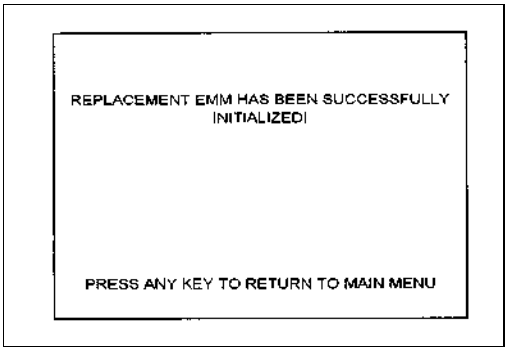


- When the information is successfully copied into your computer, the computer will display the right screen.
- DO NOT SHUT OFF YOUR COMPUTER. Turn the engine key switch to the OFF position.
- Remove the damaged EMM and install the Service Replacement EMM.



EMM (Engine Management Module)

- Once the Service replacement EMM has been installed, turn the key switch to the ON position and press any key to load the engine specific information from your computer into the Service Replacement EMM. This will take a few seconds. Wait for the procedure to finish.
- When the program is finished loading the Service Replacement EMM, the screen will display this message. Press any key to the Service Utilities Menu.



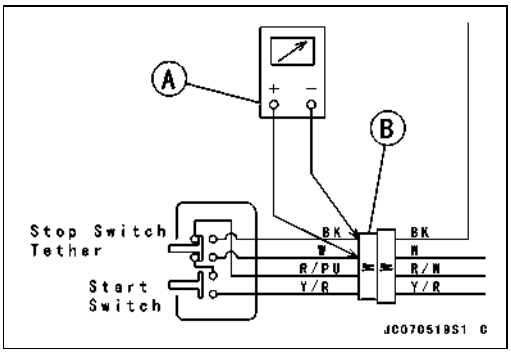
NOTE

○ *When the EMM cannot communicate with a laptop computer, please consult with the distributor about the matter.*

Stop Circuit Inspection

- Supply battery voltage to the EMM in the same way as EMM power supply inspection (see EMM Power Supply Inspection).
- Connect the hand tester [A] to the start/stop switch connector [B], using the needle adapter set.

Special Tools - Hand Tester: 57001–1394
Needle Adapter Set: 57001–1457



- Turn the ignition switch ON.
- Measure the output voltage with the connector joined.

Output Voltage from EMM
Connections
Meter (+) → BK Wire
Meter (–) → W Wire

Output Voltage from EMM
Standard: 12 V or higher

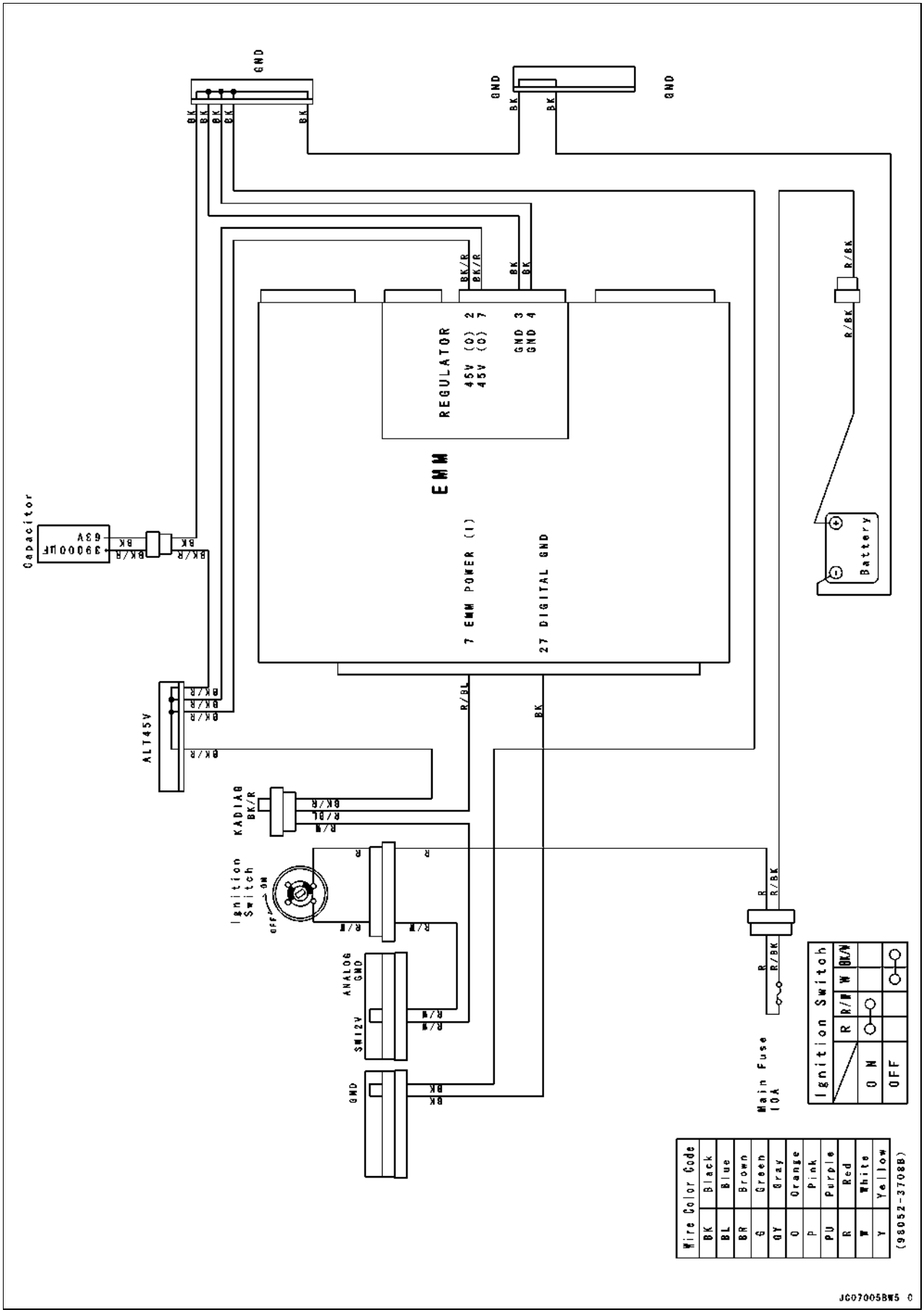
★if the output voltage is out of the standard range, check the following.
Battery Voltage
Stop Circuit (see Start/Stop Circuit)
Stop Switch
EMM (see EMM section)

★If the Output voltage is within the standard range, perform the next procedure.

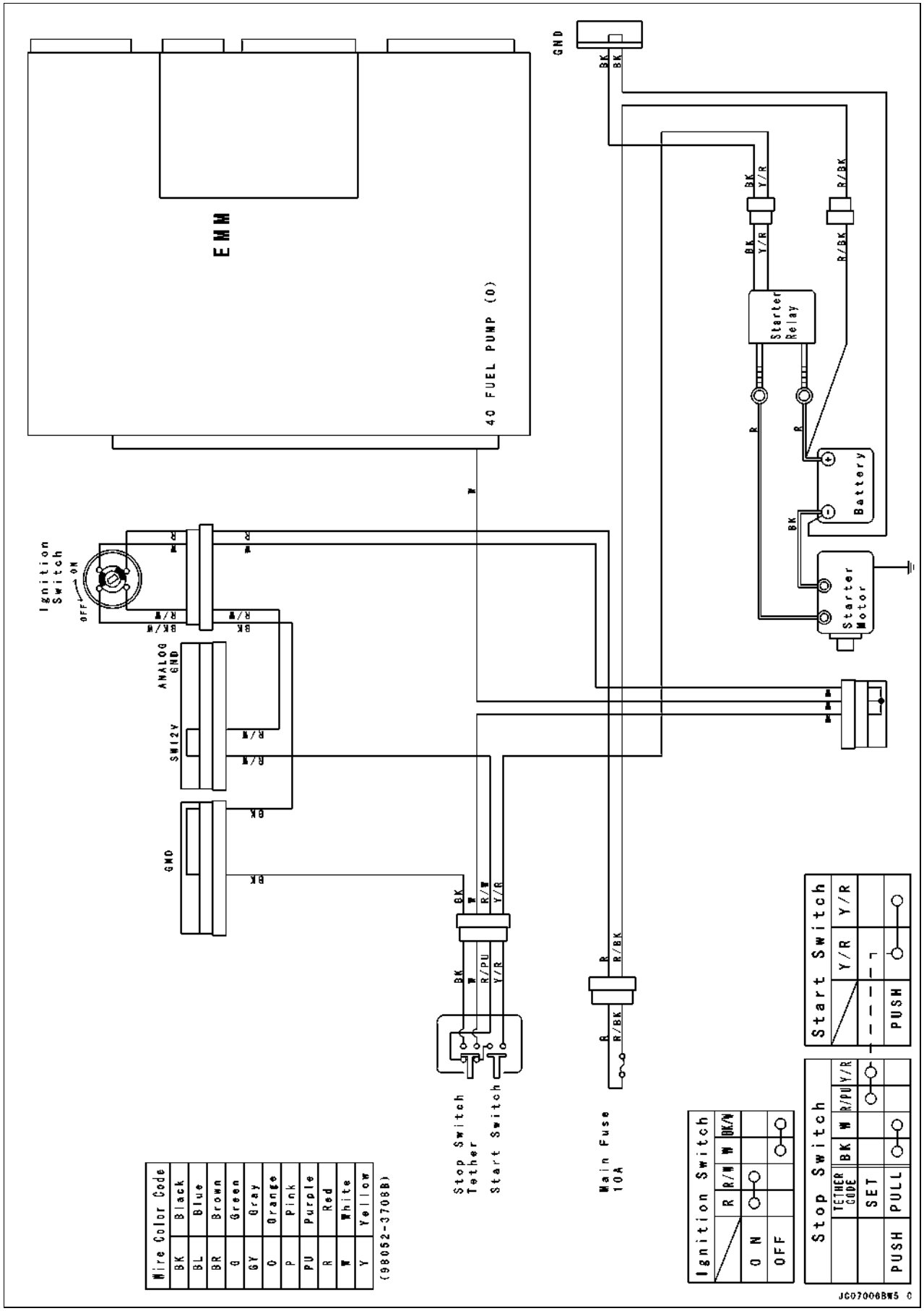
- Monitor the voltage when pushing the stop button or pulling the tether cord off the stop button.

★If the voltage drops from 12 V to 0 V, the circuit is OK.
★If the voltage does not drop, check the following.
Stop Circuit (see Start/Stop Circuit)
Stop Switch

EMM Power Source Circuit



Start/Stop (Tether) Circuit



Throttle Position Sensor (Service Code 12, 13, 14)

Service Code 12 - TP sensor circuit malfunction
Service Code 13 - TP sensor below expected range
Service Code 14 - TP sensor above expected range

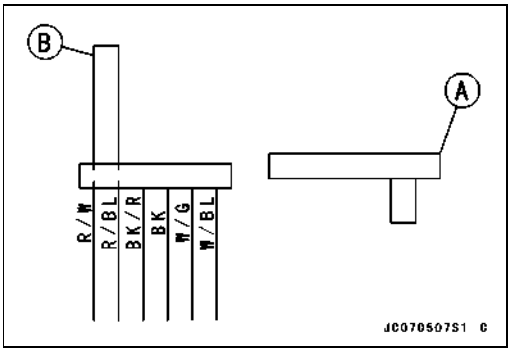
Throttle Position Sensor Removal

CAUTION

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

Input Voltage Inspection

Supply battery voltage to the EMM employing two methods indicated afterward (You can employ whichever ones) before inspecting input or output voltages, throttle position sensor circuit and other wirings for any damage or other abnormal conditions.



- Supply battery voltage employing jumping lead.
- ○ Disconnect the KADIAG male connector [A].
- ○ Connect the R/W connector with the R/BL terminal of the female connector employing auxiliary wire [B].
- ○ Turn the ignition switch ON.

NOTE

○ *Be sure the battery is fully charged.*

- Turn the ignition switch OFF.
- Connect a digital voltmeter to the connector, using the throttle sensor setting adapter.

Special Tool - Throttle Sensor Setting Adapter: 57001–1400 [A]

- Measure the input voltage with the engine stopped.
- Turn the ignition switch ON.

Connections to Throttle Sensor Setting Adapter
Meter (+) → BK/BL lead (Wire Color of TPS)
Meter (–) → BK/W lead (Wire Color of TPS)

Throttle Sensor Input Voltage
Standard: approx. 5.0 V

- Turn the ignition switch OFF.
- ★ If the reading of input voltage is less than the standard, check the EMM for its ground, and power supply. If the ground and power supply are good, the EMM is defective.
- ★ If the reading is good, check the output voltage of the sensor.

Throttle Position Sensor (Service Code 12, 13, 14)

Output Voltage Inspection

- Measure the output voltage in the same way as input voltage inspection. Note the following.
- Start the engine and warm it up thoroughly.

CAUTION

Do not run the engine without cooling water supply for more than 15 seconds or severe engine and exhaust system damage will occur.

- Check idle speed.

Idle Speed
Standard: 1100 ± 100 r/min (rpm)

- Turn off the ignition switch.
- Check the throttle body synchronization (see Throttle Body section).
- Measure the output voltage with the engine stopped.
- Turn the ignition switch ON.

Connections to Throttle Sensor Setting Adapter
Meter (+) → BK/Y lead (Wire Color of TPS)
Meter (–) → BK/W lead (Wire Color of TPS)

Throttle Position Sensor Output Voltage
Standard: 0.2 ± 0.1 V DC (at idle throttle opening - 1 deg.)
3.75 ∼ 4.00 V DC (at full throttle opening - 78 deg.)

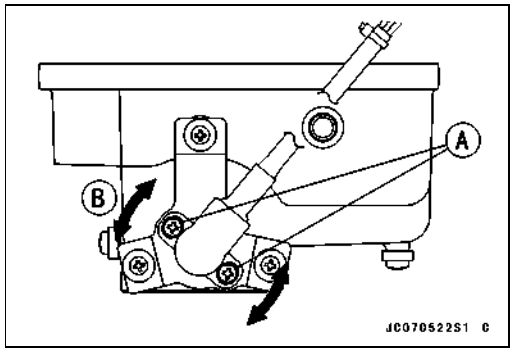
★If it is not within the specified voltage, adjust the sensor (see Throttle Position Sensor Adjustment).
★If the sensor cannot be adjusted, replace sensor.

Throttle Position Sensor Adjustment

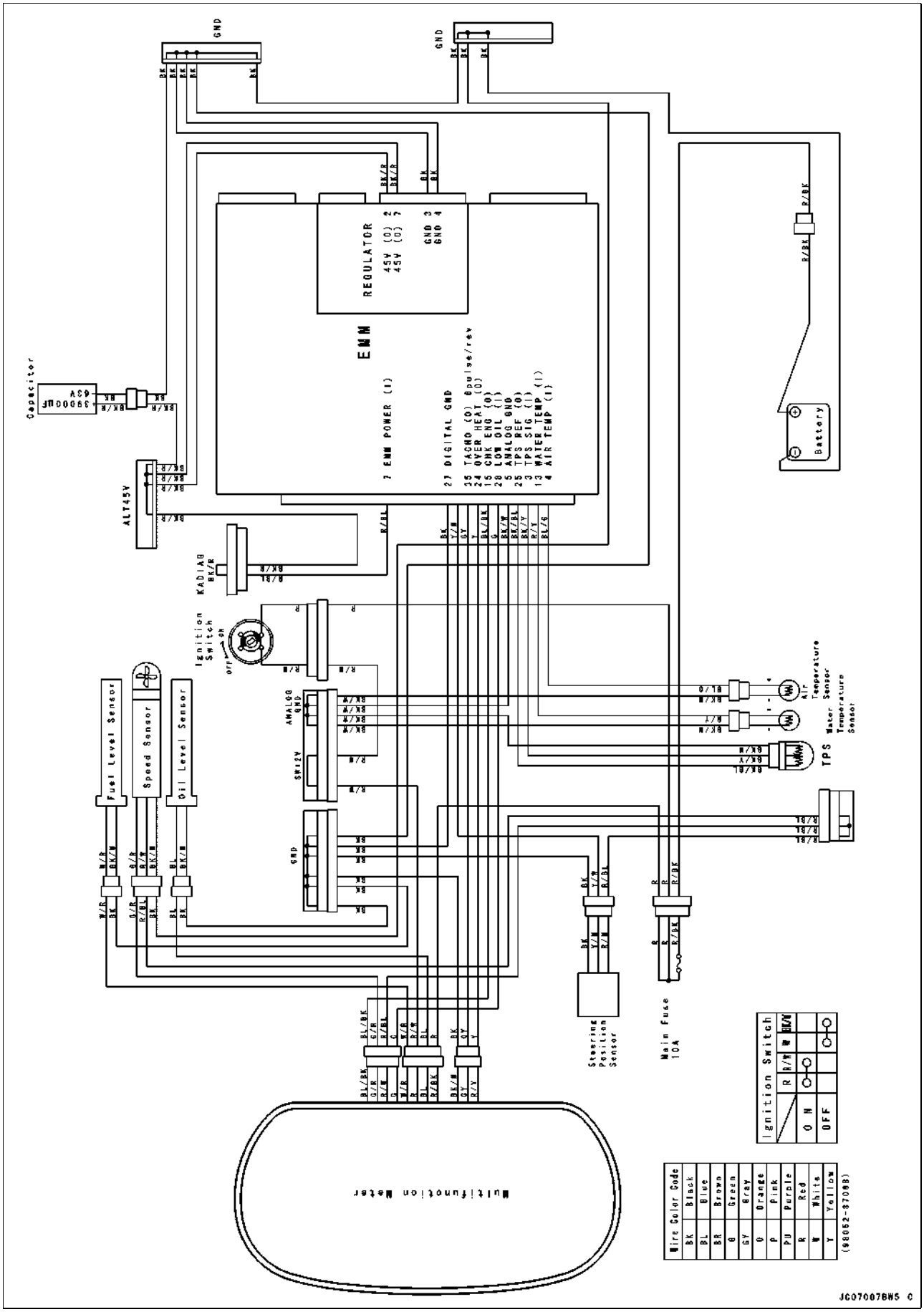
- Check the throttle position sensor output voltage (see Throttle Position Sensor Inspection).

★If the output voltage is out of the range, adjust it as follows.

- Loosen the sensor mounting screws [A].
- Adjust [B] the position of the sensor until the output voltage is within the specified range.



Sensor Circuit



Crank Position Sensor, Alternator (Service Code 16, 17, 18)

Service Code 16 - Crank position sensor mis-adjustment or damage
Service Code 17 - Alternator voltage below expected range
Service Code 18 - Alternator voltage above expected range

- Regarding to the crank position sensor, see Stator section in the Engine Bottom End and Crank Position Sensor Inspection in the Electrical System.
- Regarding to the alternator, see Charging System section in the Electrical System.

EMM (Service Code 15)

Service Code 15 - ROM ”check sum” verification

ROM verification is a continual EMM self-test of factory programming. The EMM will turn on the “CHECK ENGINE” light and store a service code if, at any time, a program failure is detected.

Check the EMM visually and replace the EMM (see EMM Replacement).

EMM Temperature Sensor (Service Code 23, 24, 25)

Service Code 23 - EMM temperature sensor circuit malfunction
Service Code 24 - EMM temperature below expected range
Service Code 25 - EMM temperature above expected range

The EMM temperature sensor is installed in EMM body. It is therefore impossible to check the internal sensor or circuit for defect corresponding to the fault code 23 and 24. Replace the EMM as a unit (see EMM Replacement).

Check the cooling lines indicated below for clogging or leakage relative to the fault code 25.

Weeds or debris in the jet pump
Cooling water line of EMM for clogged or leaked

Fuel Pump (Service Code 39, 59)

Service Code 39 - Fuel pump open load
Service Code 59 - Fuel pump driver overheat

Fuel Pump Operation Inspection

NOTE

○ *Be sure the battery is fully charged.*

● Inspect the operation using KADIAG Software (see KADIAG Software Manual).
○ The fuel pump motor makes an audible whining sound while running.
★ If you hear the fuel pump running the pump is okay.
★ If the pump does not work, inspect the power source voltage.

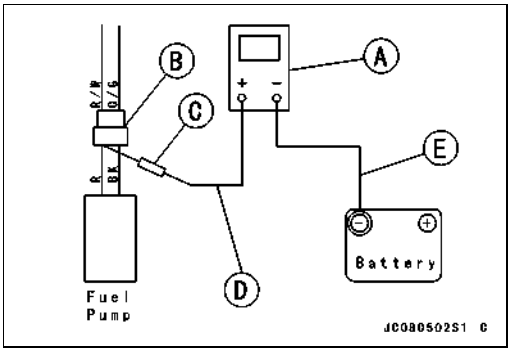
Power Source Voltage Inspection

NOTE

○ *Be sure the battery is fully charged.*

● Connect the hand tester [A] to the fuel pump connector [B], using the needle adapter set [C].

Special Tools - Hand Tester: 57001-1394
Needle Adapter Set: 57001–1457



○ Measure the power source voltage with the engine stopped, and with the pump connector joined.
○ Turn the ignition switch ON.

Pump Power Source Voltage
Connections
Tester (+) → R lead [D]
Tester (–) → Battery (–) Terminal [E]

Power Source Voltage at Pump Connector
Standard: Battery Voltage

★ If the reading is good, the power source voltage is normal. Inspect the operating voltage.
★ If there is no battery voltage, check the following:
Main Fuse 10 A
Wiring for Fuel Pump Power Source (see Fuel Pump Circuit in this chapter)

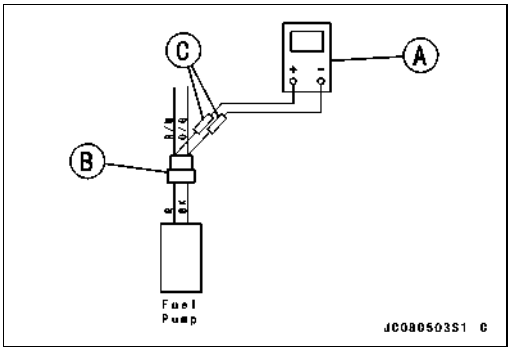
Operating Voltage Inspection

NOTE

○ *Be sure the battery is fully charged.*

● Connect the hand tester [A] to the connectors [B], using the needle adapter set [C].

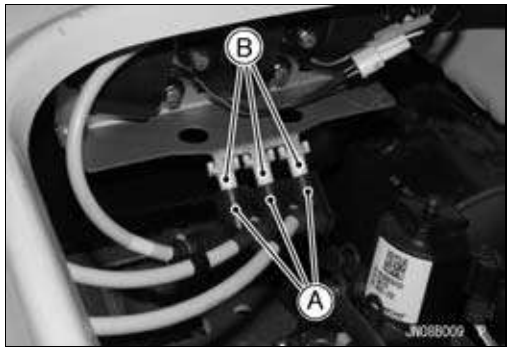
Special Tools - Hand Tester: 57001-1394
Needle Adapter Set: 57001–1457



○ Measure the operating voltage with the engine cranking, and with the connector joined.

Fuel Pump (Service Code 39, 59)

● Pull all the spark plug caps from the spark plugs and push the caps [A] fully onto the spark plug cap holder [B].



⚠WARNING

To avoid extremely high voltage shocks, do not touch the spark plugs or tester connections.

● Turn the ignition switch on and push the lanyard key under the stop button.
● Pushing the starter button, crank the engine 4 ~ 5 seconds.
○ Do not operate the starter for longer than 5 seconds. Wait 15 seconds.

Pump Operating Voltage
Connections
Tester (+) → R/W lead
Tester (–) → O/G lead

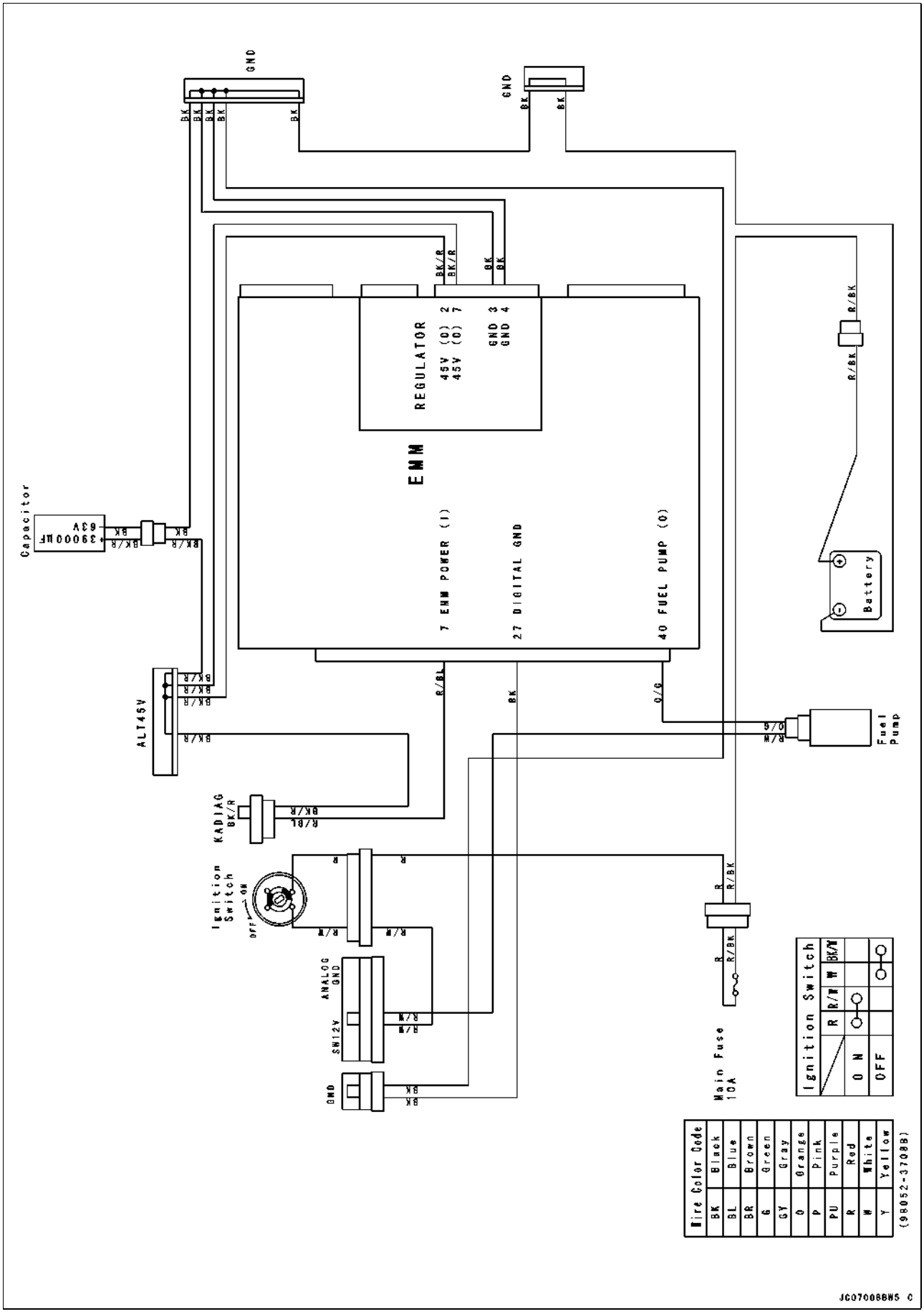
Operating Voltage
Standard: Battery Voltage

★If the reading stays on battery voltage but the pump doesn't work, replace the pump.
★If there is no battery voltage at all, check the EMM for its ground and power supply (see this chapter).
★If the ground and power supply are good, check the fuel pump wiring.

CAUTION

When the fuel pump is overheat (Service Code 59), Do not measure the operating voltage between R/W lead and O/G lead. Hand tester could be damaged.

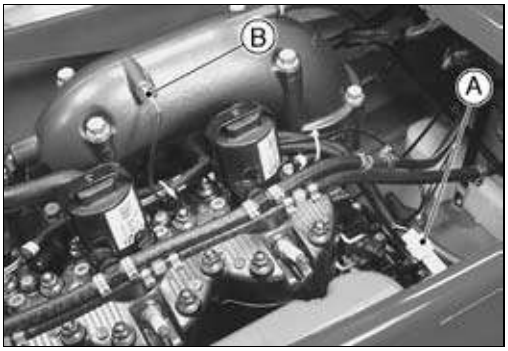
Fuel Pump Circuit



Water Temperature Sensor (Service Code 41, 42, 43)

Service Code 41 - WT sensor circuit malfunction
Service Code 42 - WT sensor below expected range
Service Code 43 - WT sensor above expected range

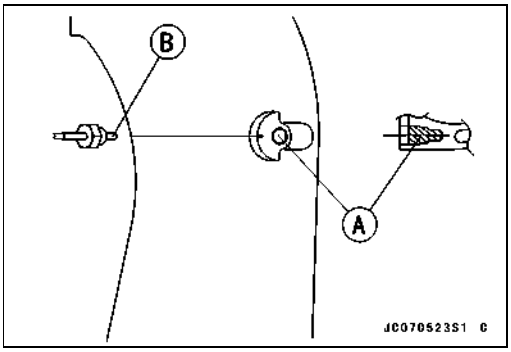
Water Temperature Sensor Removal/Installation



CAUTION

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

- Disconnect the connector [A], and unscrew the water temperature sensor [B].

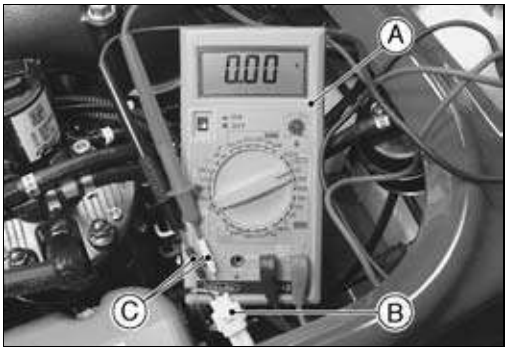


- Fill the hollow of the exhaust pipe with transmission oil [A], before installing the water temperature sensor [B].

Oil Viscosity: 5W30 or 40

Torque - Water Temperature Sensor: 20 N·m (2.0 kgf·m, 14 ft·lb)

Output Voltage Inspection



NOTE

○ *Be sure the battery is fully charged.*

- Connect the connector for the KADIAG to the main harness.
○ Connect the R/BL lead and R/W (STOP) lead in the connector.
- Connect a digital voltmeter [A] to the water temperature sensor connector [B], using needle adapter set [C].

Special Tool - Needle Adapter Set: 57001–1457

Connections to Water Temperature Sensor Connector
Meter (+) R/Y lead
Meter (–) BK/W lead

- Turn the ignition switch ON.
- Measure the sensor output voltage.

Water Temperature Sensor Output Voltage
Standard: approx. 0.9 V at 20 °C (68 °F)

NOTE

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

- Turn the ignition switch OFF.
★If the output voltage is out of the specified, check the following.
Wiring for Water Temperature Sensor Circuit
Power supply and ground for EMM (see EMM section in this chapter).
★If the wiring and power supply are good, check the sensor resistance.
- Remove the needle adapter set, and apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant - Kawasaki Bond: 56019–120

Water Temperature Sensor (Service Code 41, 42, 43)

Sensor Resistance Inspection

- Remove the water temperature sensor (see water 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

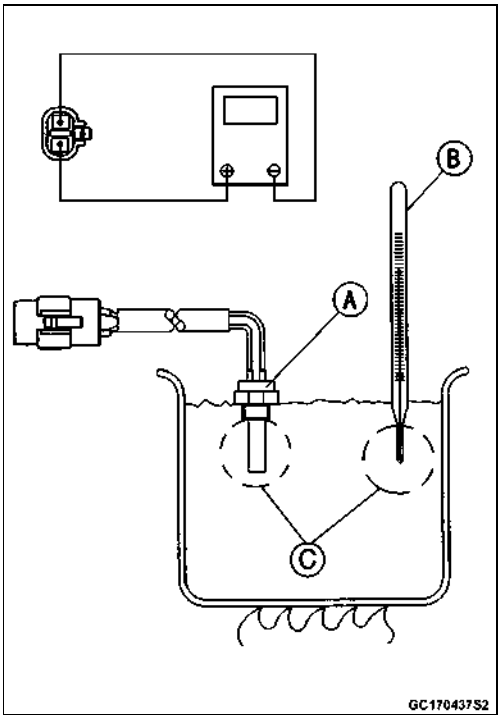
○ *The sensor and thermometer must not touch the container side or bottom.*

- 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 table.

Water Temperature Sensor Resistance

Standard:	**809 ~ 847 Ω at 0 °C (32 °F)**
	1172 ~ 1230 Ω at 50 °C (122 °F)
	1604 ~ 1722 Ω at 100 °C (212 °F)
	2115 ~ 2307 Ω at 150 °C (302 °F)

★If the measurement is out of the range, replace the sensor.
★If the measurement is within the specified, replace the EMM.



Barometric Pressure Sensor (Service Code 44, 45, 46)

Service Code 44 - BP sensor circuit malfunction
Service Code 45 - BP sensor below expected range
Service Code 46 - BP sensor above expected range

The barometric pressure sensor is installed in EMM body. It is therefore impossible to check the internal sensor or circuit for defect corresponding to the service code 44, 45 and 46. Replace the EMM as a unit (see EMM Replacement).

As for the service code 45, 46, these codes can be caused by a plugged barometric pressure sensor tube on the EMM. Inspect the tube on under-side of EMM for blockage.

Injector (Service Code 51, 52, 53)

Service Code 51 - Injector #1 open load
Service Code 52 - Injector #2 open load
Service Code 53 - Injector #3 open load

NOTE

○ *When you need to replace an injector, you must order a Service Replacement Injector. DO NOT take an injector from another engine or cylinder. Moving an injector to another engine or cylinder will affect air/fuel mixture on that cylinder. This could affect exhaust emissions, cause the engine to run poorly, and cause engine damage.*
You must use KADIAG software, when you replace an injector.

Injector Removal

- Cut off clamps [A] to remove the retainer.
- Remove the retainers [B].
- Remove the fuel hose assemblies (supply side [C], return side [D]).

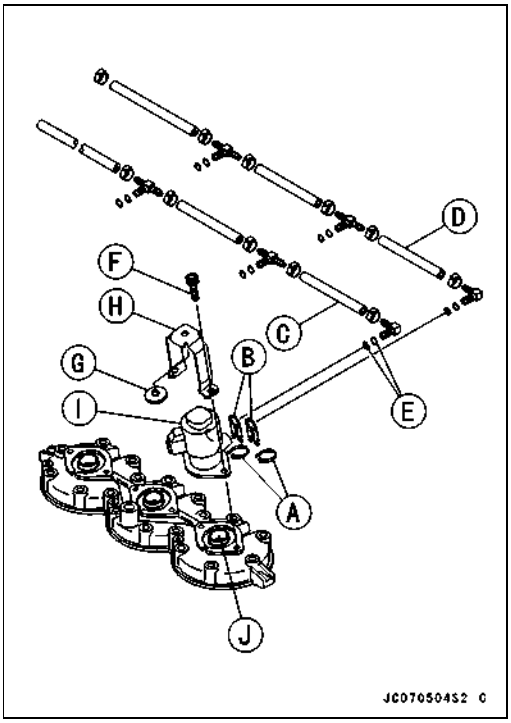
CAUTION

Be careful not to stick debris or foreign particles onto the O-ring.

- Remove the mounting bolts [F].
- Remove the band [H] with a damper [G] mounted.
- Remove the injector [I].

CAUTION

Be careful not to enter foreign particles or residuums of non-permanent locking agent into the mounting holes [J] for injector installation.



Injector Installation

CAUTION

Remove foreign particles or residuums of non-permanent locking agent stuck onto cylinder heads, or around them employing a high flash-point solvent with a clean cloth. Be careful not to enter them into the mounting holes of injector.

- Install the fuel hose assemblies (both supply side and return side) into the injector in advance.
○ Make sure that there are no debris on the installing ports of fuel hoses and O-rings.
★ Blow it by air to wipe with a clean cloth if some debris were found.

CAUTION

Do not blow by are facing toward the installing hole of fuel hose. Some debris may enter into it.

○ Apply a thin coat of 2 stroke engine oil on overall surfaces of O-rings.
○ Install fuel hose assemblies to injector.

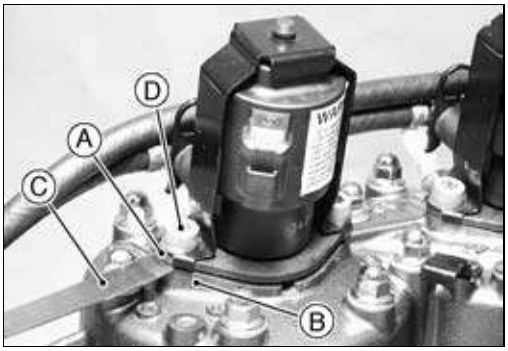
NOTE

○ *Install the fuel hose assembly (return side) to injector (upper installing port), while supply side to the lower.*

○ Fix with a clamp after the retainer is installed.

Injector (Service Code 51, 52, 53)

- Mount a band onto the injector with a fuel hose connected. Install it to the cylinder head following the procedure described below.
- ○ Apply a non-permanent locking agent to the injector mounting bolt before tightening temporarily by hand.
- ○ Insert a thickness gauge [C], t = 1.0 mm (0.04 in.) between the injector bracket [A] of the hole for bolt tightening located in front of the engine and the cylinder head [B]. This will be applied to each injector.
- ○ Tighten the bolt [D] of engine front side (side with thickness gauge inserted) to the extent the thickness gauge can not easily move.



- Tighten the bolt [A] of engine rear side temporarily.

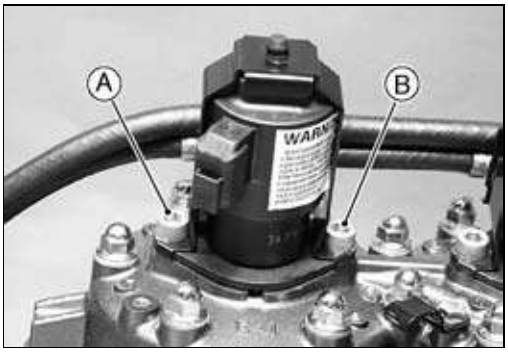
Temporal Tightening Torque - Injector Mounting Bolt: 20 N·m (2.0 kgf·m, 14 ft·lb)

Cylinder Head [B]
Injector Bracket [C]

- Remove the thickness gauge to tighten the bolt [A] mounted on front side of engine to the specified torque.

Torque - Injector Mounting Bolt: 22 N·m (2.2 kgf·m, 16 ft·lb)

- Tighten the bolt [B] mounted on rear side of engine to the specified torque.
- Tighten the bolt [A] mounted on front side of engine to the specified torque securely.
- Be sure that the clearance between the cylinder head and the injector is 0.6 mm (0.024 in.) or less in addition the difference of this front side and the rear side in clearance is 0.3 mm (0.012 in.) or less.
- Start the engine to inspect the engine for fuel leakage.



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.

Injector replacement

CAUTION

If you need to replace an injector, you must order a Replacement Injector. DO NOT take an injector from another engine or cylinder. Moving an injector to another engine or cylinder will affect air/fuel mixture on that cylinder. This could affect exhaust emissions, cause the engine to run poorly, and cause engine damage.

NOTE

- ○ *Each Replacement Injector has one floppy disk in which the flow characteristic are stored and one software instruction sheet.*
- ○ *You can replace an injector following the software instruction sheet independently from the KADIAG software.*

- Follow the instruction in Diagnostic Software Manual to connect the communication cable to the laptop computer and replace injectors.

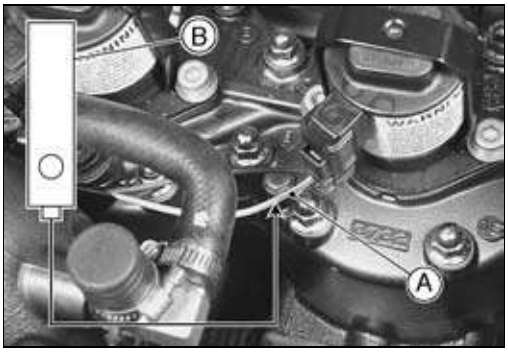
Injector (Service Code 51, 52, 53)

Injector Static Test

- Use KADIAG software to actuate injectors while listening for an audible click (see KADIAG Software Manual).

★If no injector clicks, inspect the injector supply voltage.
★If all injectors react correctly, perform the Injector Dynamic Test.
★If some injectors do not operate, monitor EMM signal lead at injector using an inductive timing light.

○ Monitor EMM signal lead [A] (#1-BL/R, #2-BL/Y, #3-BL/W) using an inductive timing light [B].
○ Be sure to clip onto only one wire and crank the engine.
★If light flashes indicating signal, replace the injector.
★If light does not flash, suspect the following.
Injector Coil Open Circuit (see Injector Resistance Inspection)
Signal Lead Open Circuit (see Injector Circuit)
Damaged EMM (see EMM section in this chapter)



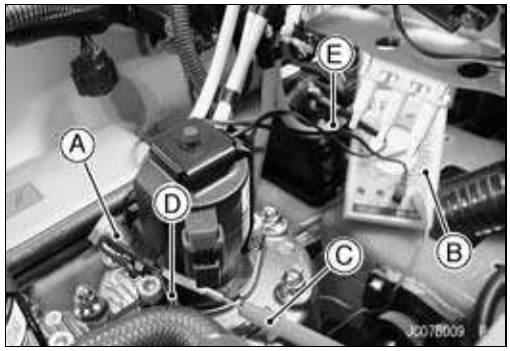
Injector Dynamic Test

- Monitor voltages using KADIAG software while performing the following tests. If voltage drop as RPM increases, check charging system (see Charging System section in the Electrical System).
- While running or cranking engine, monitor EMM signal lead at each injector using an inductive timing light.

○ Be sure to clip onto only one wire.
★If regular/steady light on all injectors and voltages are steady, injection system is OK.
★If irregular or no firing on some injectors suspect the following.
Crank Position Sensor (see Stator section in the Engine Bottom End and Crank Position Sensor Inspection in the Electrical System)
Low Voltage (see Charging System in the Electrical System)
Damaged Injector (see Injector Visual Inspection)
Open Circuit (see Injector Circuit in this chapter
Damaged EMM (see EMM section in this chapter)
★If no injector fires suspect the following.
Crank Position Sensor (see Stator section in the Engine Bottom End and Crank Position Sensor Inspection in the Electrical System)
45-V Charging System (see Charging System in the Electrical system)

Injector (Service Code 51, 52, 53)

Injector Supply Voltage Inspection



NOTE

○ *Be sure the battery is fully charged.*

- Check the injector supply voltage at the injector connector [A].
- Disconnect the connector at the injector.
- Measure the power source voltage with the engine stopped, and the connector disconnected, using a digital meter [B] and the needle adapter set [C].

Special Tool - Needle Adapter Set: 57001–1457

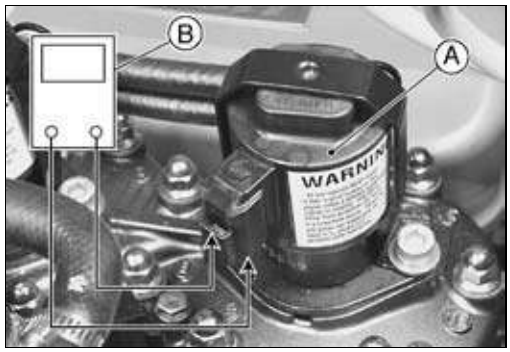
- Crank or run the engine.

Injector Supply Voltage at Injector
Connections to injector #1, #2, #3
Meter (+) →BK/R lead [D]
Meter (–) → Battery (–) Terminal [E]

Injector Supply Voltage at Injector Connector
Standard: Cranking Approx. 20 V
Running Approx. 45 V

★If the reading is out of the standard, check the wiring (see Injector Circuit in this section) and 45-volt charging system (see Charging System Inspection in the Electrical System).

Injector Resistance Inspection



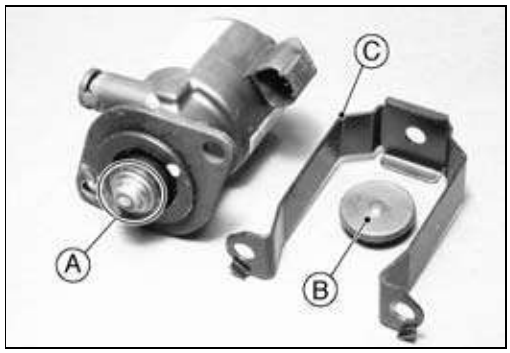
- Disconnect the connector form the injector [A].
- Measure the injector resistance with a digital meter [B].

Injector Resistance
Connections to injector
#1: BK/R ← → BL/R Terminal
#2: BK/R ← → BL/Y Terminal
#3: BK/R ← → BL/W Terminal

Standard: 0.684 ∼ 0.710 Ω at 25 °C

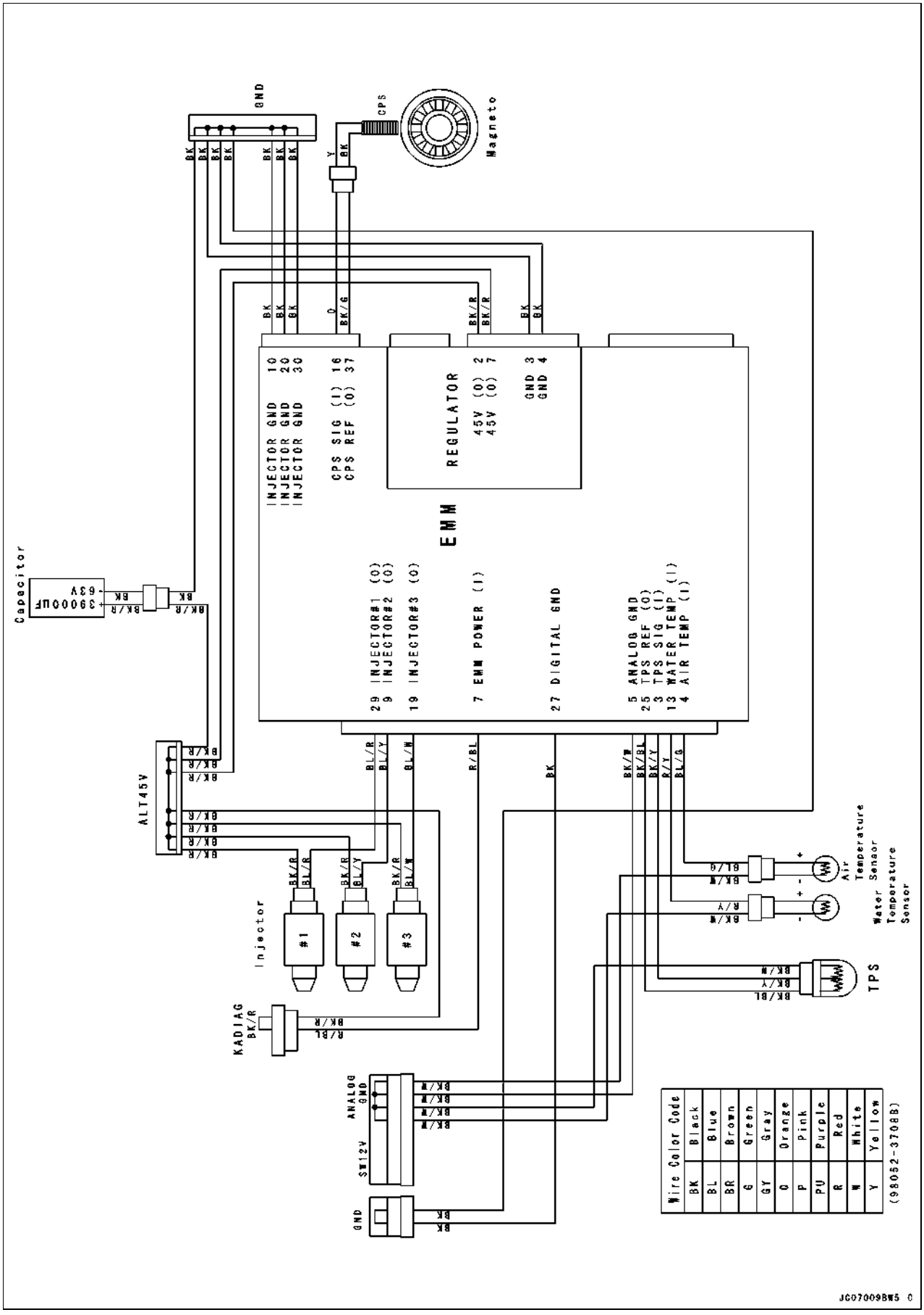
★If the reading is out of the range, replace the injector.

Injector Visual Inspection



- Check the injector nozzle [A] for damage, wear or other damage.
★If there is any doubt as to the injector condition, replace it.
- Check the damper [B] for damage.
★If damper is not in good condition, replace it.
- Check the band [C] for deformation, cracks or other damage.
★If there is any doubt as to the band condition, replace it.

Injector Circuit



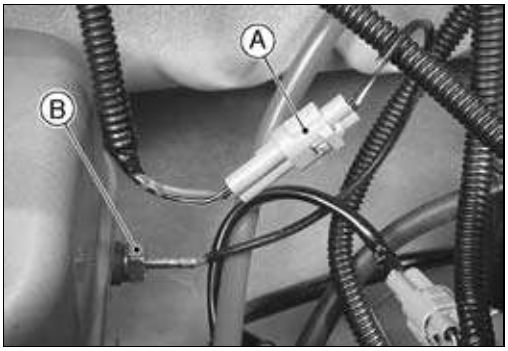
Air Temperature Sensor (Service Code 47, 48, 49)

Service Code 47 - AT sensor circuit malfunction
Service Code 48 - AT sensor below expected range
Service Code 49 - AT sensor above expected range

Air Temperature Sensor Removal/Installation

CAUTION

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



- Disconnect the connector [A] from the air temperature sensor
- Unscrew the nut [B] and remove the air temperature sensor.

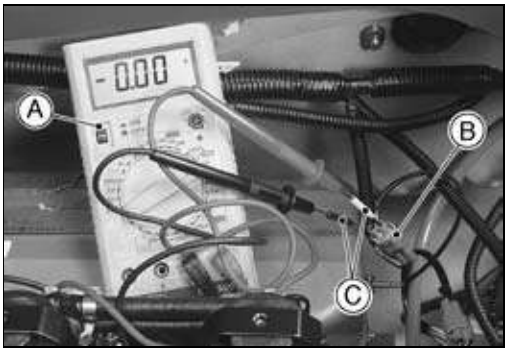
Torque - Air Temperature Sensor Nut: 20 N·m (2.0 kgf·m, 14 ft·lb)

Output Voltage Inspection

NOTE

○ *Be sure the battery is fully charged.*

- Connect the connector for the KADIAG to the main harness.
○ Connect the R/BL lead and R/W (STOP) lead in the connector.
- Connect a digital voltmeter [A] to the air temperature sensor connector [B], using needle adapter set [C].



Special Tool - Needle Adapter Set: 57001-1457

Connections to Air Temperature Sensor Connector
Meter (+) BL/G lead
Meter (–) BK/W lead

- Turn the ignition switch ON.
- Measure the sensor output voltage.

Air Temperature Sensor Output Voltage
Standard: approx. 0.9 V at 20 °C (68 °F)

NOTE

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

- Turn the ignition switch OFF.
★ If the output voltage is out of the specified, check the following.
Wiring for Air Temperature Sensor Circuit
Power supply and ground for EMM (see EMM section in this chapter).
★ If the wiring and power supply are good, check the sensor resistance.
- Remove the needle adapter set, and apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant - Kawasaki Bond: 56019–120

Air Temperature Sensor (Service Code 47, 48, 49)

Sensor Resistance Inspection

- Remove the air temperature sensor (see 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

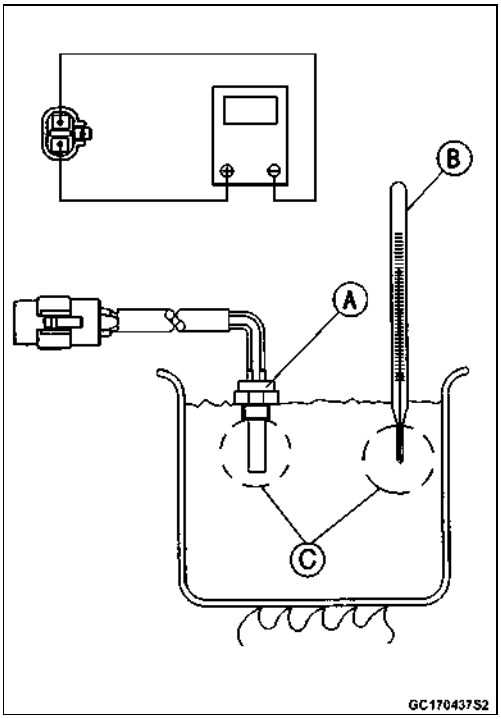
○ *The sensor and thermometer must not touch the container side or bottom.*

- 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 table.

Air Temperature Sensor Resistance

Standard:	**809 ~ 847 Ω at 0°C (32°F)**
	1172 ~ 1230 Ω at 50°C (122°F)
	1604 ~ 1722 Ω at 100°C (212°F)
	2115 ~ 2307 Ω at 150°C (302°F)

★If the measurement is out of the range, replace the sensor.
★If the measurement is within the specified, replace the EMM.



Ignition Coil (Service Code 81, 82, 83)

Service Code 81 - Ignition coil #1 open primary
Service Code 82 - Ignition coil #2 open primary
Service Code 83 - Ignition coil #3 open primary

- See Ignition Coil Inspection and Ignition Circuit in the Electrical System chapter.

Engine Lubrication System

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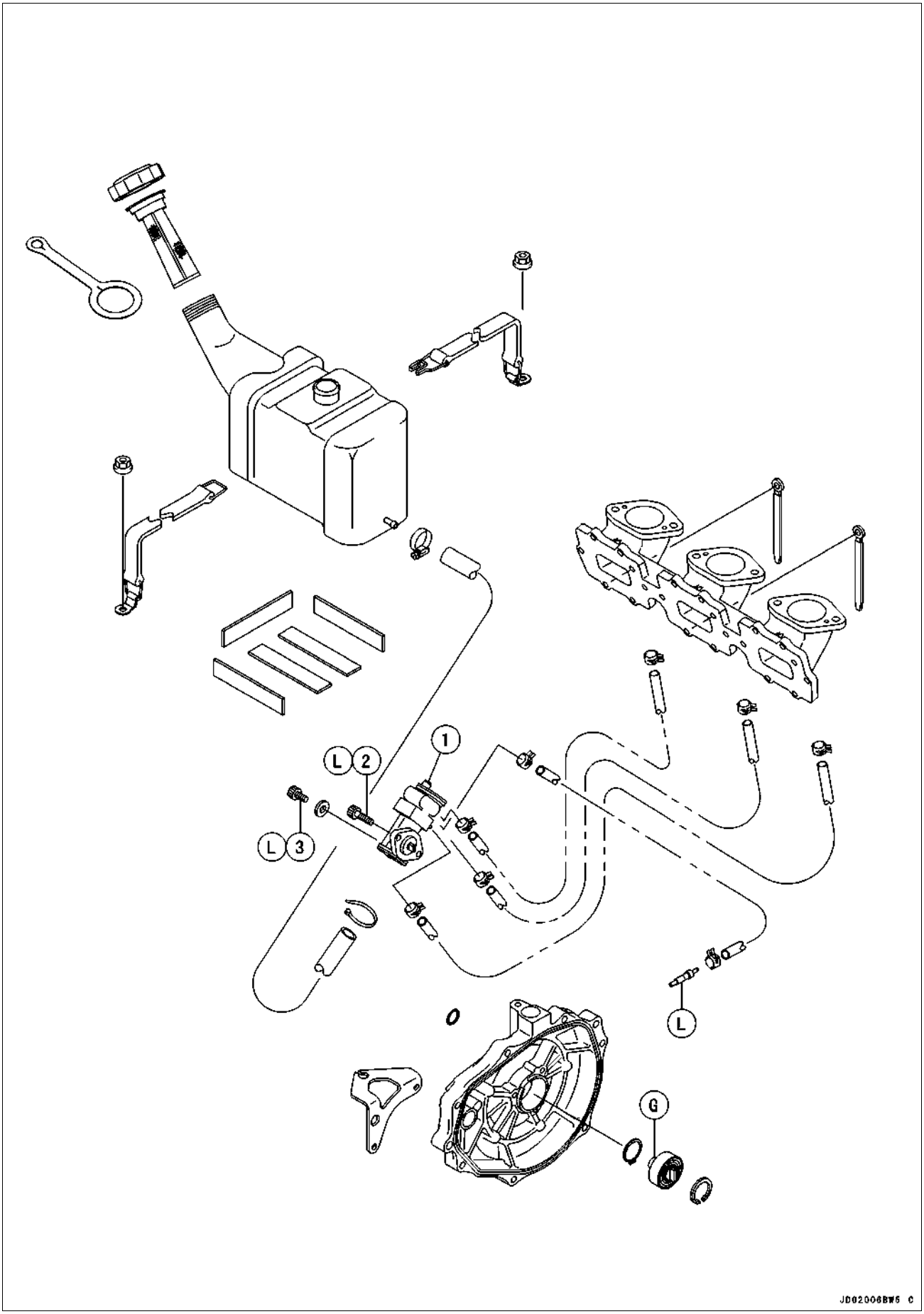
4-2 ENGINE LUBRICATION SYSTEM

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Air Bleeder Bolt	4.9	0.5	43 in·lb	
2	Oil Pump Mounting Bolts	8.8	0.9	78 in·lb	L
3	Oil Pump Cable Mounting Bolt	4.9	0.5	43 in·lb	L

G: Apply grease.
L: Apply a non-permanent locking agent.

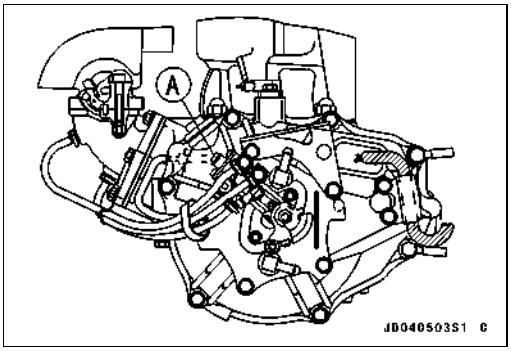
4-4 ENGINE LUBRICATION SYSTEM

Specifications

Item	Standard
Engine Oil:	
Type	2-stroke, N.M.M.A. Certified for Service TC-W3
Capacity	5.0 L (1.3 US gal)
Engine Oil Pump:	
Oil pump output when oil pump pulley is fully opened	
@3 000r/min (rpm), 2 min, per one line:	
Output to #1 Bearing	2.23 mL (0.076 US oz) ± 10%
Output to #1 Nozzle	2.23 mL (0.076 US oz) ± 10%
Output to #2 Nozzle	3.73 mL (0.126 US oz) ± 10%
Output to #3 Nozzle	3.73 mL (0.126 US oz) ± 10%

Oil Pump

Oil Pump Bleeding



- Make sure that there is plenty of engine oil in the oil tank and that oil flow is not restricted.
- Place a container under the oil pump.
- Loosen the air bleeder bolt [A] on the oil pump a couple of turns, wait until oil flows out, and then tighten the bleeder screw securely.

Torque - Air Bleeder Bolt: 4.9 N·m (0.5 kgf·m, 43 in·lb)

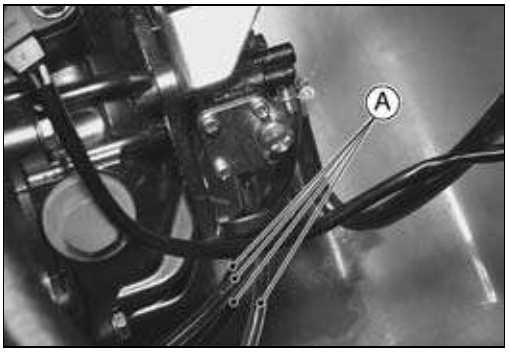
CAUTION

Do not turn on the water until the engine is running and turn it off immediately when the engine stops.

- Supply the cooling system with water (see Auxiliary Cooling in the General Information chapter).
- Start the engine, keep is at idling speed and check the oil flow through the transparent outlet hoses.
- Keep the engine running until any air bubbles in the outlet hoses disappear.

Oil Pump Performance Test

If a drop in oil pump performance is suspected, check the rate at which the oil is being pumped.



- Disconnect the oil pump outlet hoses [A] at the pump body.
- Plug the ends of the oil pump outlet hoses.
- Reserve suitable transparent hoses and connect them with the oil pump outlets.
- Inject oil into the transparent hoses.
- Run each hose into a measuring glass.
- Reinstall the cable holder. If necessary, adjust control cables.
- Supply the cooling system with water (see Auxiliary Cooling in the General Information chapter).
- Hold the oil pump pulley fully opened.
- Start the engine, and run it at a steady 3 000 r/min (rpm).
- Collect the oil that is being pumped for 2 minutes. If the quantity of oil collected is within the specification, the oil pump is operating properly.

Oil Pump Output when oil pump pulley is fully opened (3 000 r/min (rpm) for 2 minutes)

Standard:	**Output to #1 Bearing**	**2.23 mL (0.075 US oz) ± 10%**
	Output to #1 Nozzle	**2.23 mL (0.75 US oz) ± 10%**
	Output to #2 Nozzle	**3.73 mL (0.126 US oz) ± 10%**
	Output to #3 Nozzle	**3.73 mL (0.126 US oz) ± 10%**

NOTE

○ *See Oil Hose Routing in the Appendix chapter.*

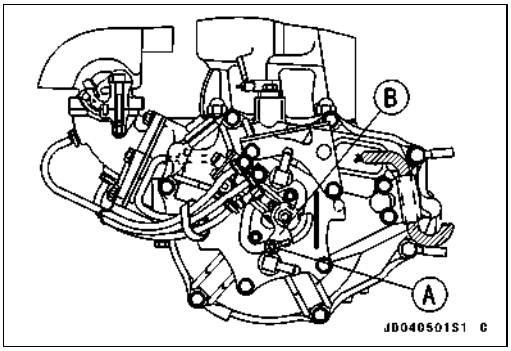
★ If the oil pump output is subnormal, inspect the oil pump, and the inlet and output hoses for oil leaks.

★ If oil leaks are not found, replace the oil pump.

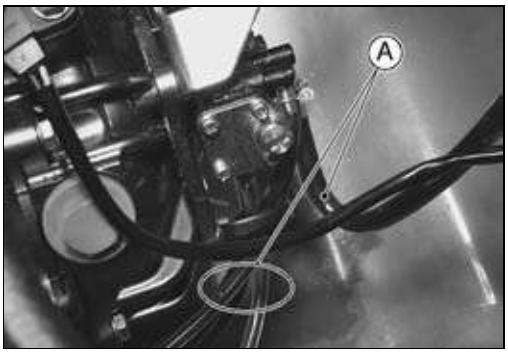
Oil Pump

Oil Pump Removal

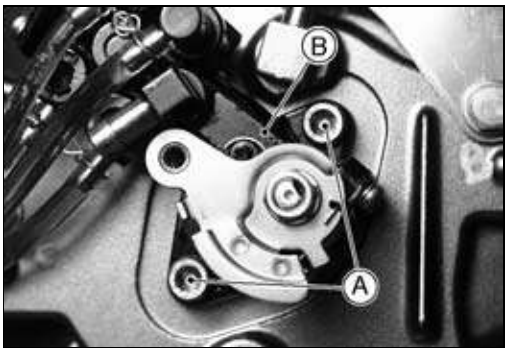
- Unscrew the oil pump mounting bolt [A] and disconnect the oil pump cable at the pulley [B].



- Disconnect the hoses [A].

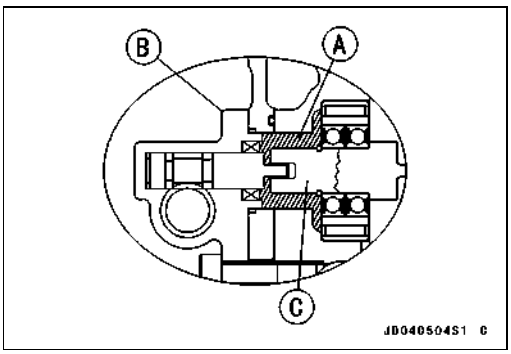


- Unscrew the oil pump mounting bolts [A] and take out the oil pump [B].

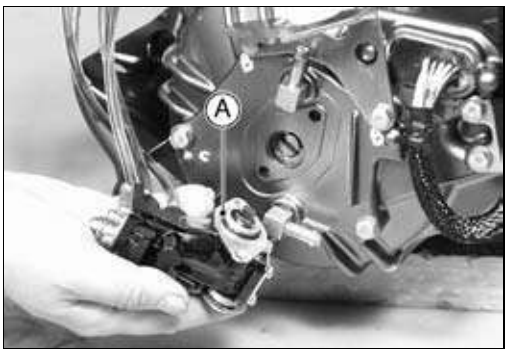


Oil Pump Installation

- Grease the hole of the connecting shaft, as shown.
  [A] Grease
  [B] Oil Pump
  [C] Connecting Shaft



- Be sure the O-ring [A] is in place.

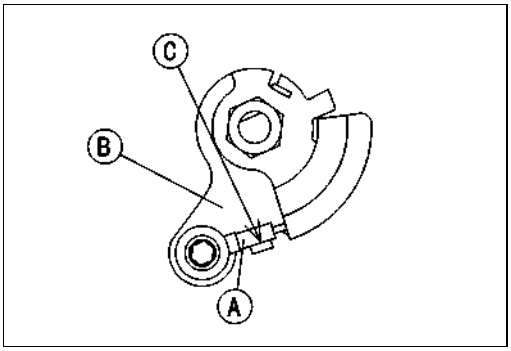


Oil Pump

● Install the oil pump cable [A] on the pulley [B].
○ Apply a non-permanent locking agent to the oil pump cable mounting bolt and torque it.

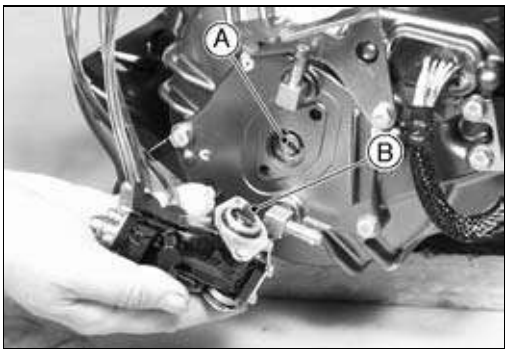
Torque - Oil Pump Cable Mounting Bolt: 4.9 N·m (0.5 kgf·m, 43 in·lb)

○ Be sure the cable portion indicated in the illustration is in contact [C] with the pulley portion indicated in the illustration.



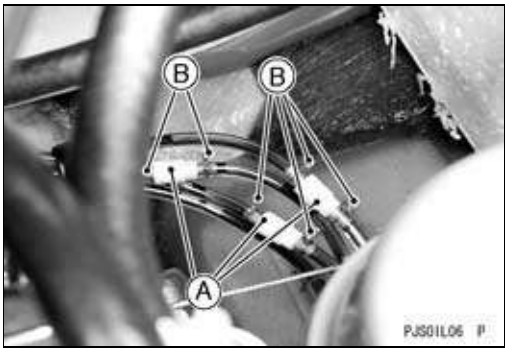
● Initially inject oil into the oil pump body and the hoses, and connect the hoses with the oil pump.
● Install the oil pump on the magneto cover.
○ When mounting the oil pump, note the position of the slot [A] in the connecting shaft, and then turn oil pump shaft [B] so that it will fit into the slot.
○ Apply a non-permanent locking agent to the oil pump mounting bolts and torque them.

Torque - Oil Pump Mounting Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)



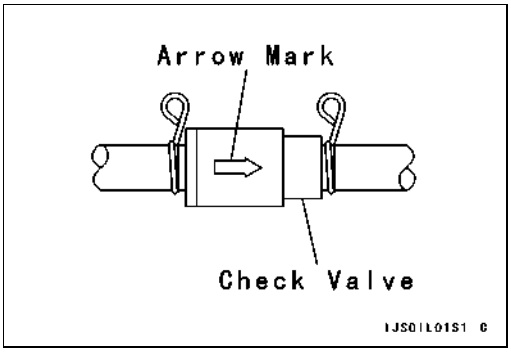
● Route the oil hoses correctly (see Cable, Wire and Hose Routing in the Appendix chapter).

★If removed the check valves, install them as follows:
○ Install the check valve [A] and clamps [B].



NOTE

○ *Install the check valve with its allow mark pointing toward the intake manifold.*



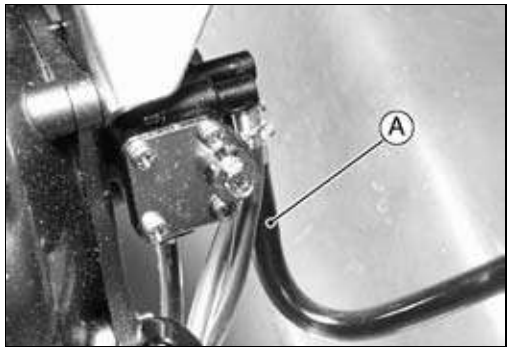
● Bleed the air from the system (see Oil Pump Bleeding).
● Adjust the oil pump cable (see Oil Pump Cable Adjustment in the Fuel System).

4-8 ENGINE LUBRICATION SYSTEM

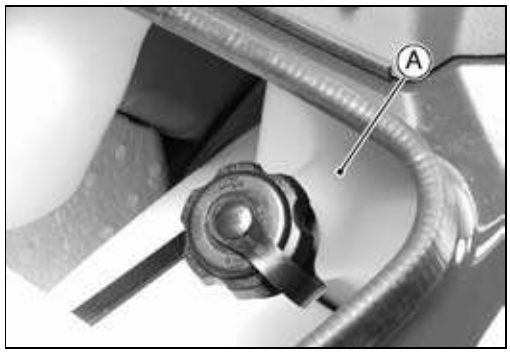
Oil Tank

Oil Tank Removal

- Drain the engine oil.
- Remove:
  Oil Inlet Hose [A] (disconnect)
  Oil Level Sensor Connector (disconnect)
  Oil Tank Straps



- Take out the oil tank [A] out of the hull.
- Remove the oil level sensor from the oil tank.



Oil Tank Installation

- Initially inject oil into the oil inlet hose.

Oil Tank Cleaning

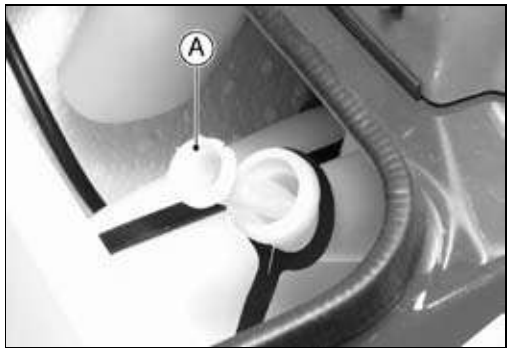
- Flush the tank repeatedly with high flash-point solvent until it is clean.

⚠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.

Oil Filter Cleaning

- Take out the oil filter [A].
- Wash the oil filter in a non-flammable or high flash-point solvent. Use a brush to remove any contaminates trapped in the filter.



⚠WARNING

Clean the oil filter 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 filter. A fire or explosion could result.

Exhaust System

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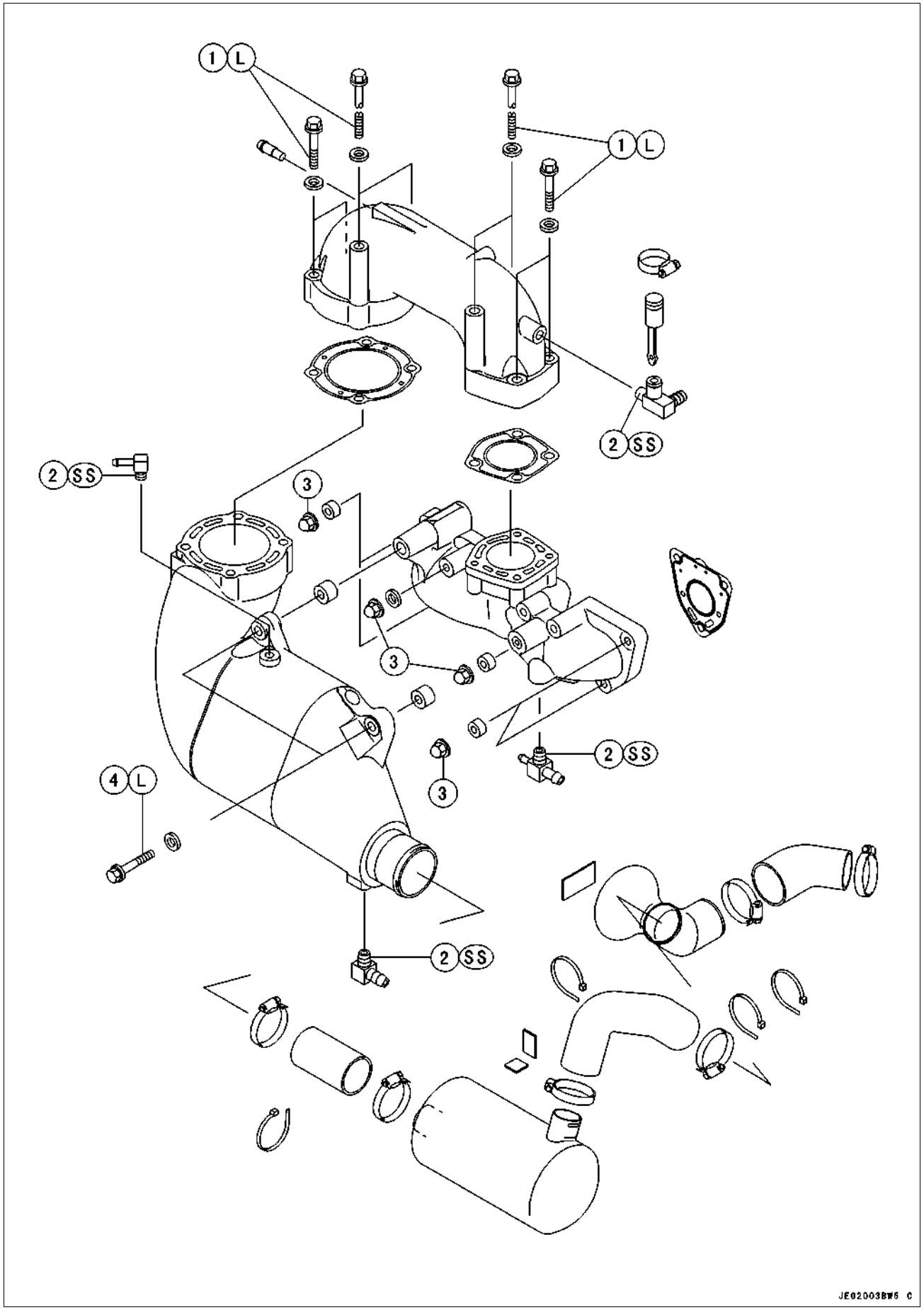
5-2 EXHAUST SYSTEM

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Exhaust Pipe Mounting Bolts	49	5.0	36	L
2	Water Pipe Joint	11	1.1	95 in·lb	SS
3	Exhaust Maniforld Mounting Nuts	27	2.8	20	
4	Exhaust Chamber Mounting Bolts	49	5.0	36	L

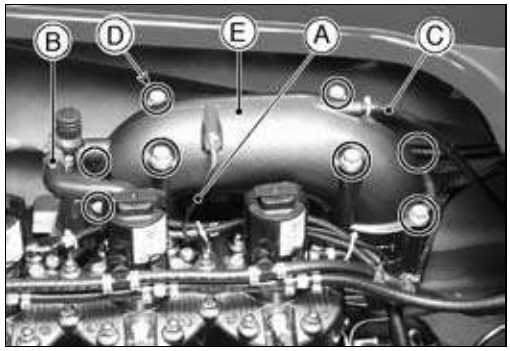
L: Apply a non-permanent locking agent.
SS: Apply silicone sealant.

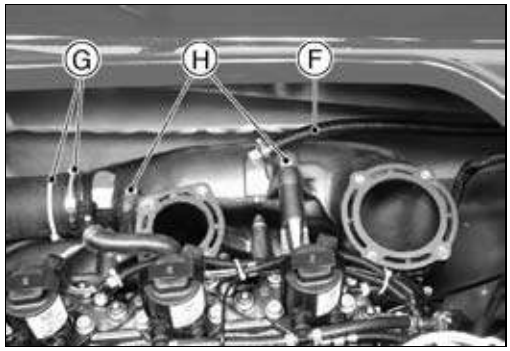
5-4 EXHAUST SYSTEM

Expansion Chamber

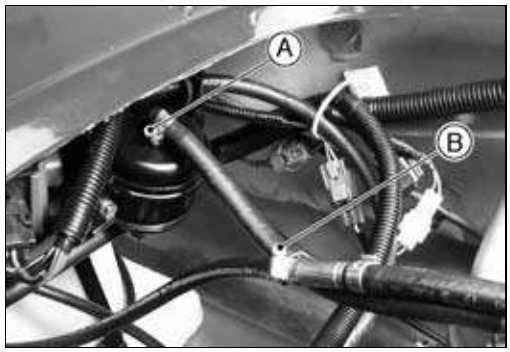
Expansion Chamber Removal

- Remove or disconnect:
  Overheat Sensor [A] Connector
  Cooling Hose [B]
  Bypass Hose [C]
  Exhaust Pipe Mounting Bolts [D]
  Exhaust Pipe [E]
  Magneto Cooling Hose [F]
  Connecting Tube Clamps [G]
  Expansion Chamber Mounting Bolts [H]

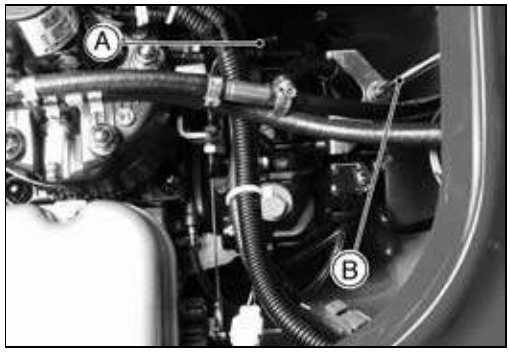




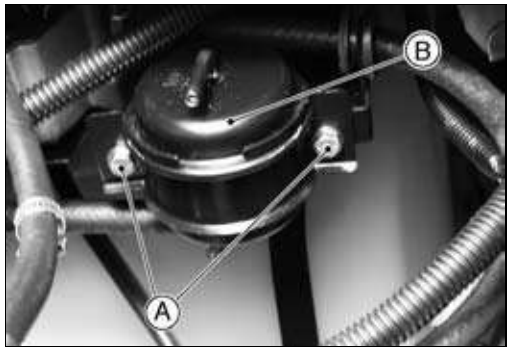
- Loosen the clamp [A] and disconnect the supply fuel hose.
- Loosen the clamp [B] and disconnect the return fuel hose.



- Disconnect the throttle body cable [A] and the oil pump cable [B] at the oil pump.

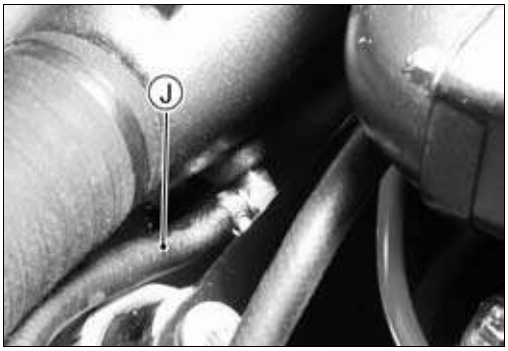


- Take out the mounting bolts [A] and take the fuel filter [B] off the bracket.



Expansion Chamber

● Pull the cooling hose (Chamber ~ Hull) [J] off the exhaust chamber .

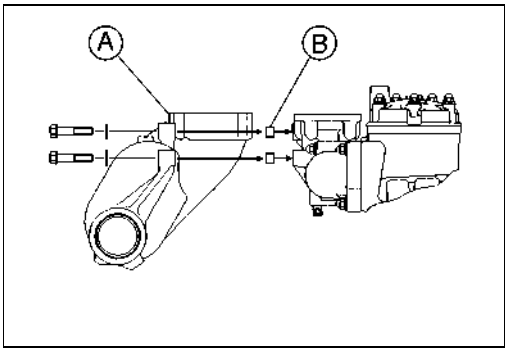


● Remove the exhaust chamber out of the hull.

Expansion Chamber Installation Notes

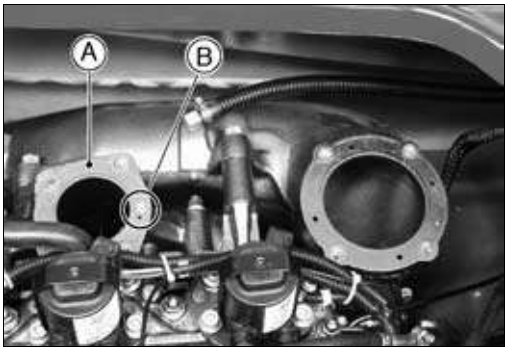
● Install the expansion chamber [A] on the engine with the pins [B].
● Apply a non-permanent locking agent to the expansion chamber mounting bolts.

Torque - Expansion Chamber Mounting Bolts: 49 N·m (5.0 kgf·m, 36 ft·lb)



● Fix the gasket [A] so that “UP” – mark [B] faces upside.
● Install the exhaust pipe on the expansion chamber.
○ Apply a non-permanent locking agent to the exhaust pipe mounting bolts.

Torque - Exhaust Pipe Mounting Bolts : 49 N·m (5.0 kgf·m, 36 ft·lb)



● Torque the fuel hose clamp screws.

Torque - Fuel Hose Clamp Screws: 0.69 ~ 0.78 N·m (0.07 ~ 0.08 kgf·m, 6.1 ~ 6.9 in·lb)

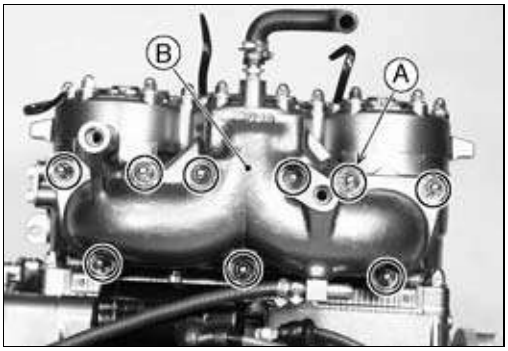
Exhaust Pipe/Exhaust Chamber Cleaning and Inspection

● Remove the exhaust pipe and chamber.
● Clean the carbon deposits out of the exhaust passages with a blunt, roundedged 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 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.

5-6 EXHAUST SYSTEM

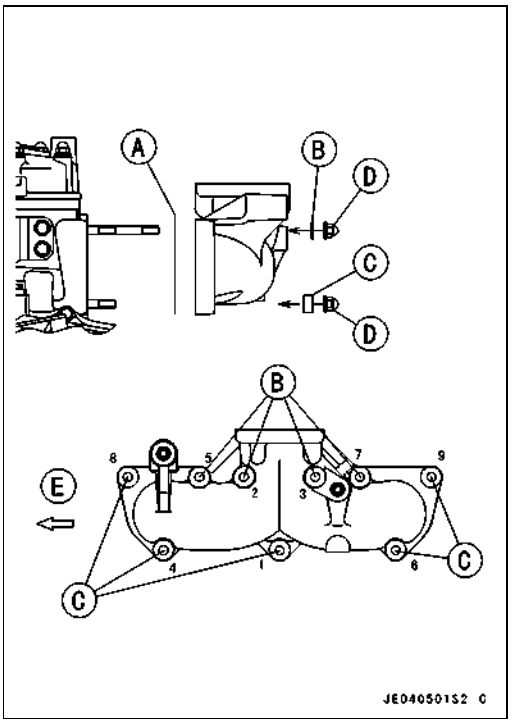
Exhaust Manifold

Exhaust Manifold Removal



- Remove or disconnect:
  Expansion Chamber (see Expansion Chamber Removal)
  Exhaust Manifold Mounting Nuts [A]
  Exhaust Manifold [B]
  Inlet Cooling Hose
  Magneto Cooling Hose

Exhaust Manifold Installation Notes



- Install the exhaust manifold gasket [A].
- Install the exhaust manifold and the washers [B] and collars [C] as shown.
- Torque the exhaust manifold mounting nuts [D], following the specified tightening sequence.

Torque - Exhaust Manifold Mounting Nuts : 27 N·m (2.8 kgf·m, 20 ft·lb)

[E] Forward

Exhaust Manifold Cleaning and Inspection

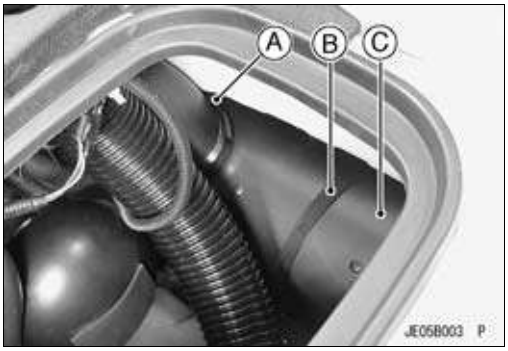
- Remove the exhaust manifold parts.
- Clean the carbon deposits out of the exhaust passages with a blunt, roundedged tool.
- Flush foreign matter out of the water passages with fresh water.
- Check the insides of the water passage for corrosion. Check the gasket surface for nicks or other damage.

★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

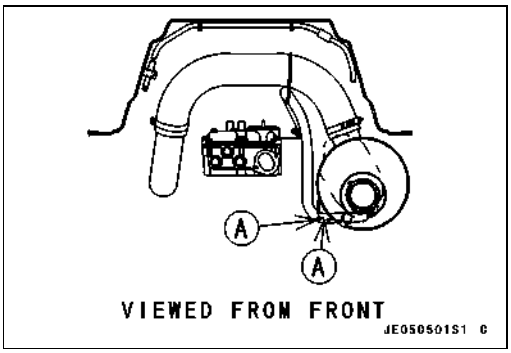
Water Box Muffler Removal

- Remove the expansion chamber (see Expansion Chamber Removal).
- Remove the exhaust manifold (see Exhaust Manifold Removal).
- Loosen the clamp [A] on the exhaust tube and pull off it.
- Remove the straps [B], and slide off the water box muffler [C] toward the front.



Water Box Muffler Installation Notes

- Be sure the damper [A] is in the position.



Water Box Muffler Inspection

- Remove the water box muffler.
- Empty water out of the water box.
- Check the inlet spigot for damage caused by excessive heat.

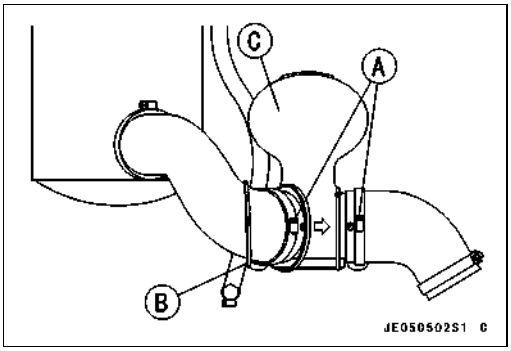
★ If there is heat damage to the inlet spigot, check the cooling system for blockage (see Cooling System Flushing).

5-8 EXHAUST SYSTEM

Resonator

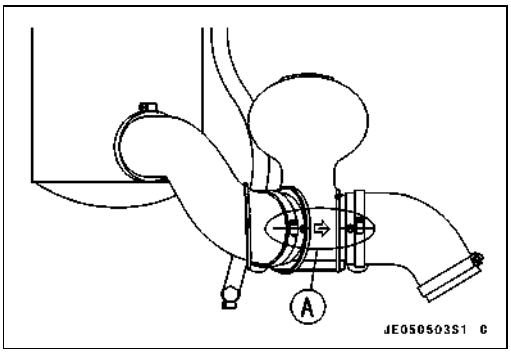
Resonator Removal

- Loosen the clamps [A] on both ends of the resonator.
- Remove the clamp [B].
- Pull the resonator [C] out to the front.



Resonator Installation

- Install the resonator, aligning [A] the arrow mark with the clamp screw as shown.
- Tighten the resonator clamps securely.



Resonator Inspection

- Remove the resonator.
- Check the resonator for corrosion and heat damage or cracks.

★If the resonator is damaged, it should be replaced.

Engine Top End

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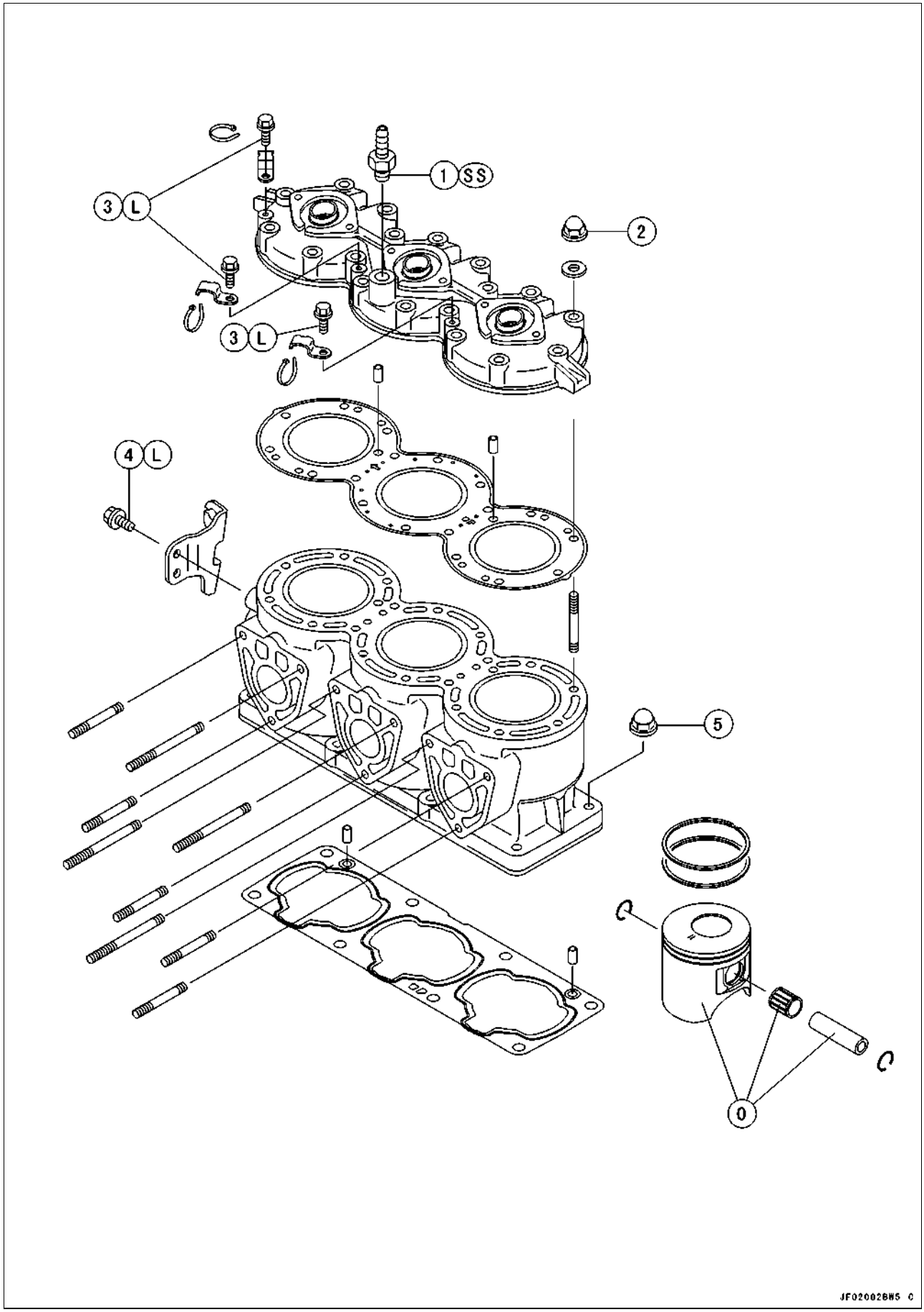
Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Water Pipe Joint	11	1.1	95 in·lb	SS
2	Cylinder Head Nuts	29	3.0	22	
3	Bolts for Injector Wire Brackets	8.8	0.9	78 in·lb	L
4	Cable Holder Mounting Bolts	20	2.0	14	L
5	Cylinder Base Nuts	34	3.5	25	

L: Apply a non-permanent locking agent.
SS: Apply silicone sealant.
O: Apply engine oil.

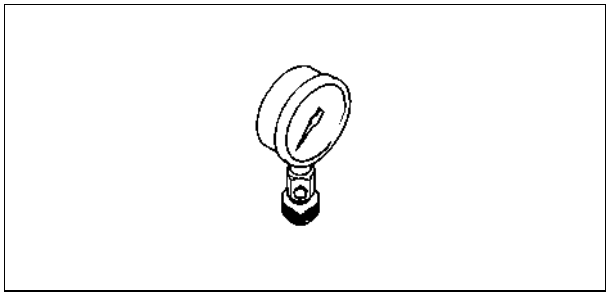
6-4 ENGINE TOP END

Specifications

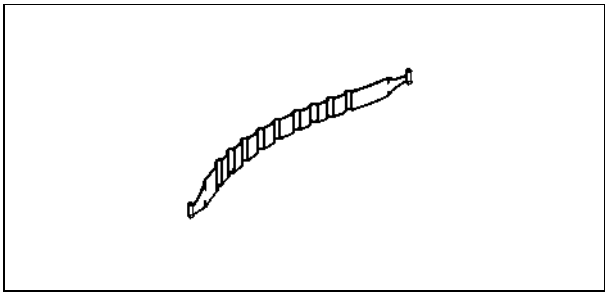
Item	Standard	Service Limit
Cylinder Head:		
Cylinder compression	(Usable range) 755 ~ 1 177 kPa (7.7 ~ 12.0 kg/cm^2, 109 ~ 171 psi) (Open throttle)	– – –
Cylindrer head warp	– – –	0.05 mm (0.002 in.)
Cylinder, Piston:		
Cylinder inside diameter	80.000 ~ 80.015 mm (3.1496 ~ 3.1502 in.)	80.10 mm (3.154 in.)
Piston diameter (15 mm (0.6 in.) up from bottom of skirt)	79.865 ~ 79.880 mm (3.1443 ~ 3.1449 in.)	79.72 mm (3.139 in.)
Piston/cylinder clearance	0.130 ~ 0.140 mm (0.0051 ~ 0.0055 in.)	– – –
Oversize piston and rings	+ 0.5 mm (0.02 in.) and + 1.0 mm (0.04 in.)	– – –
Piston ring/groove clearance:		
Top (keystone)	– – –	– – –
Second (keystone)	– – –	– – –
Piston ring groove width:		
Top (keystone)	– – –	– – –
Second (keystone)	– – –	– – –
Piston ring thickness:		
Top (keystone)	– – –	– – –
Second keystone)	– – –	– – –
Piston ring end gap:		
Top	0.25 ~ 0.40 mm (0.010 ~ 0.016 in.)	0.7 mm (0.03 in.)
Second	0.25 ~ 0.40 mm (0.010 ~ 0.016 in.)	0.7 mm (0.03 in.)

Special Tools

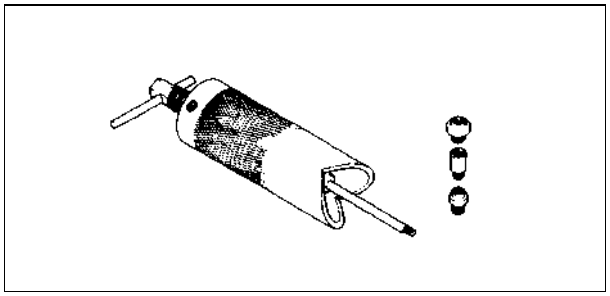
Compression Gauge: 57001–221



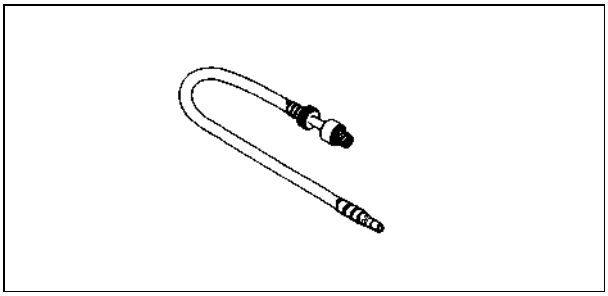
Piston Ring Compressor Belt, ϕ67 ~ ϕ79: 57001–1097



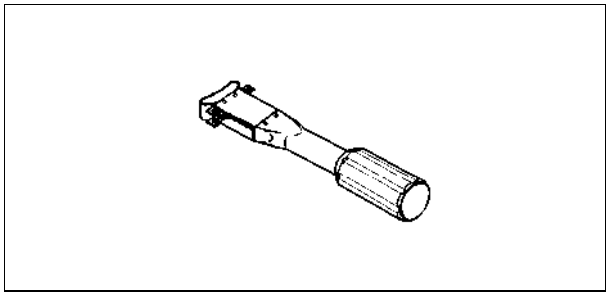
Piston Pin Puller Assembly: 57001–910



Compression Gauge Adapter, M14 x 1.25: 57001–1159



Piston Ring Compressor Grip: 57001–1095

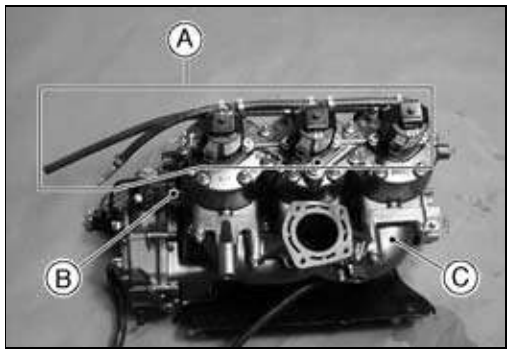


Engine Top End

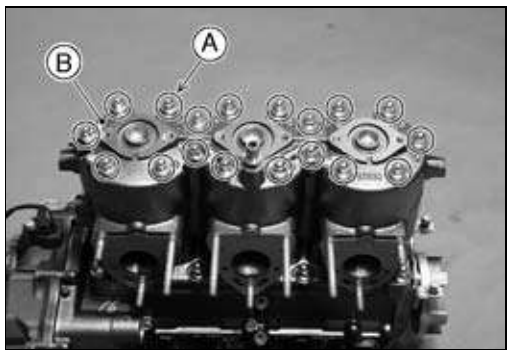
Disassembly and Assembly:

Disassembly

- Remove the engine (see Engine Removal/Installation chapter).
- Remove:
  Spark Plugs
  Fuel Injectors with Fuel Hoses [A] (see Injector Removal in the Fuel System chapter).
  Cable Holder [B]
  Exhaust Manifold [C]

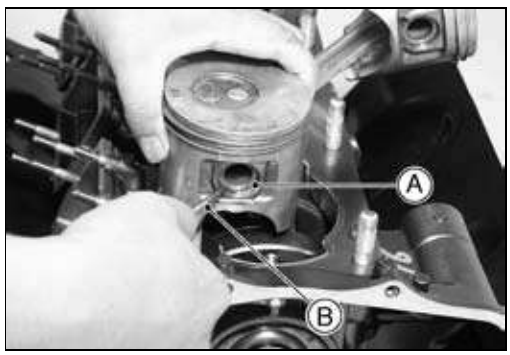


- Remove the cylinder head nuts [A], and take off the cylinder head [B].



- Remove the cylinder base nuts [A], and lift off the cylinder [B].

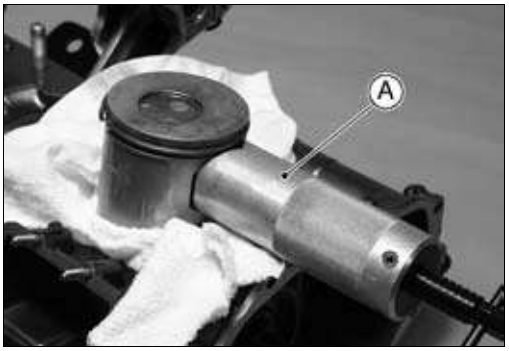
- Stuff clean rags into the crankcase opening to prevent dirt or foreign objects from falling into the crankcase.
- Remove the piston pin snap ring [A] with a pliers [B].



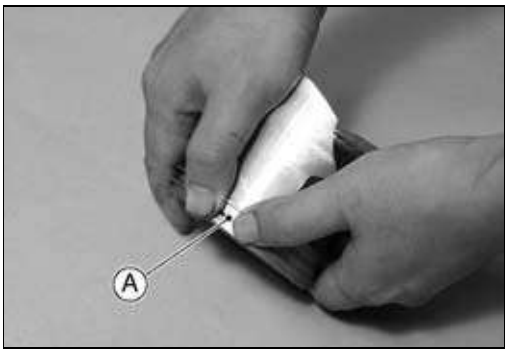
Engine Top End

- Remove the piston by pushing its pin out the side that the circlip was removed. Use a piston pin puller assembly, if the pin is tight.

  Special Tool - Piston Pin Puller Assembly: 57001-910 [A]



- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.

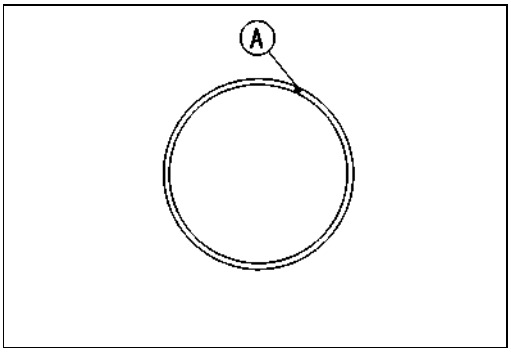


Assembly Notes

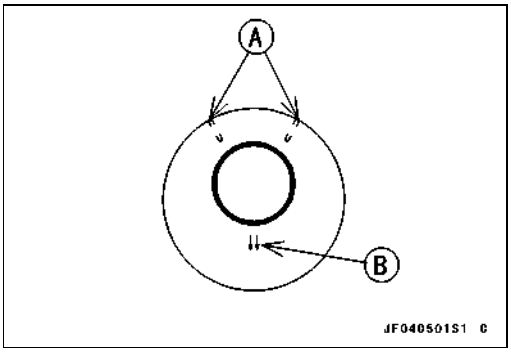
- If any parts in the piston assemblies require replacement, or if the cylinder is replaced, be sure to check the critical clearances of the new parts against the values given in Specifications.
- Install the piston rings so that the “R” mark [A] faces upward as shown.
- When the piston rings are reinstalled to the piston ring grooves reinstall them as follows for fitting.

  Top Piston Ring → Top Piston Ring Groove

  Second Piston Ring → Second Piston Ring Groove



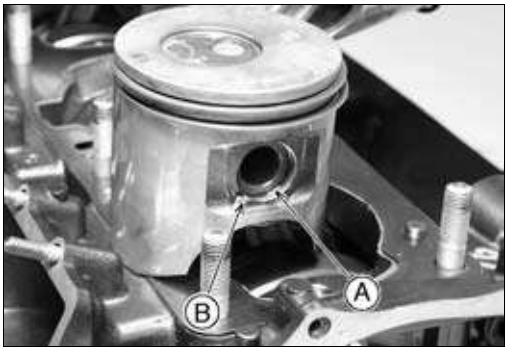
- When installing the piston rings by hand, first fit one end of the piston ring against the pin in the ring groove, spread the ring opening with the other hand and then slip the ring into the groove.
- Check to see that the pin [A] in each piston ring groove is between the ends of the piston ring.
- Using engine oil, lubricate the small end bearing and insert into the connecting rod eye.
- Using engine oil, lubricate the piston pin and the pin holes.
- Mount the pistons on the connecting rods with the arrow [B] on its crown pointing to the left (exhaust) side of engine.



- When installing a piston pin snap ring, compress it only enough to install it and no more.

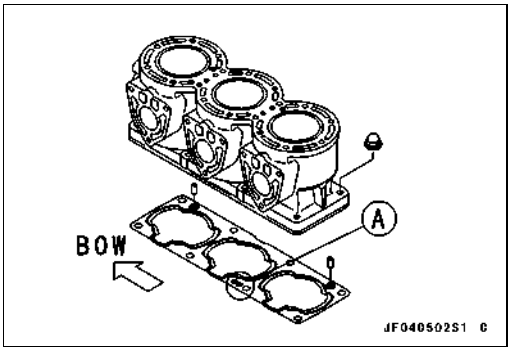
CAUTION
Do not reuse snap rings, as removal weakens and deforms them. They could fall out and score the cylinder wall.

- Fit a new piston pin snap ring into the side of each piston so that the snap ring opening [A] does not coincide with the slits [B] of the piston pin hole.



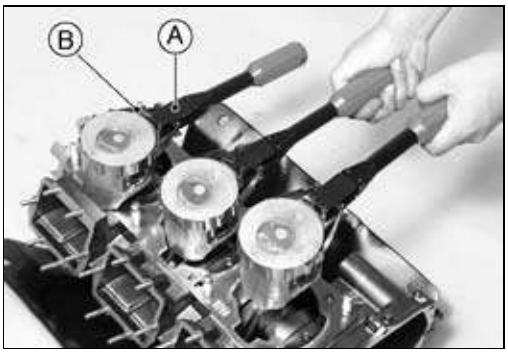
Engine Top End

● Set the new cylinder base gasket in place on the crankcase.
○ The “UP” mark [A] must face upward.



● Apply engine oil to the surface of the pistons.
● Compress the piston rings.

Special Tools - Piston Ring Compressor Grip: 57001–1095 [A]
Piston Ring Compressor Belt, ϕ67 ~ ϕ79: 57001–1097 [B]



● Thoroughly oil the cylinder bores.
● Slide the cylinder block down over the crankcase studs onto the crankcace.

CAUTION

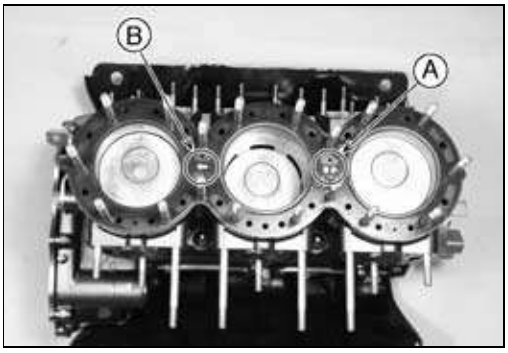
Do not force the cylinder block. Make sure the rings are in position.

● Install the cylinder base nuts.
○ Temporarily torque the cylinder base nuts and torque them.
○ The tightening sequence numbers are marked on the cylinder.

Initial Torque for Temporal Tightening - Cylinder Base Nuts: 7.8 N·m (0.8 kgf·m, 69 in·lb)

Torque - Cylinder Base Nuts: 34 N·m (3.5 kgf·m, 25 ft·lb)

● Place a new cylinder head gasket on the cylinder head.
○ The “UP” mark [A] of the gasket must face upward and arrow mark [B] must face forward.

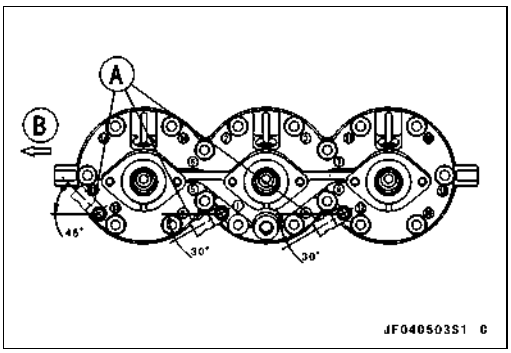


● Install the cylinder head.
○ Temporarily torque the cylinder head nuts and torque them.
○ The tightening sequence numbers are marked on the cylinder head.

Initial Torque for Temporal Tightening - Cylinder Head Nuts: 7.8 N·m (0.8 kgf·m, 69 in·lb)

Torque - Cylinder Head Nuts: 29 N·m (3.0 kgf·m, 22 ft·lb)

○ Be sure the injector lead clamps [A] are in position, as shown.
BOW [B]



Engine Top End

- Start the engine to check for fuel and oil leaks, exhaust leaks, and excessive vibration.

⚠ 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 for more than 15 seconds without cooling water.

Maintenance and Inspection:

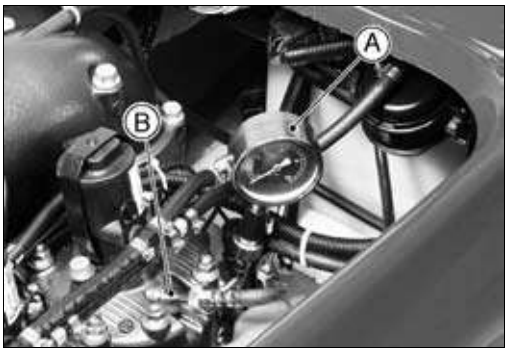
Compression Measurement

- 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.
- Remove the spark plugs and screw a compression gauge firmly into the spark plug hole.



Special Tools - Compression Gauge: 57001-221 [A]
Compression Gauge Adapter, M14 × 1.25: 57001-1159 [B]

- 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.
- Repeat the measurement for the other two cylinders.

Cylinder Compression (Usable Range)
755 ~ 1079 kPa (7.7 ~ 12.0 kg/cm^2, 109 ~ 156 psi) (open throttle)

★ If the cylinder compression is higher than the usable range, check the following.
○ Carbon buildup on the piston head and cylinder head - clean off any carbon on the piston head and cylinder head.
○ Cylinder head gasket, cylinder base gaskets - use only the proper gaskets. The use of a gasket of incorrect thickness will change the compression.
★ If cylinder compression is lower than the usable range, check the following:
○ Gas leakage around the cylinder head - replace the damaged gasket and check the cylinder head for warp.
○ Piston/cylinder clearance, piston seizure.
○ Piston rings, piston ring grooves wear.

Engine Top End

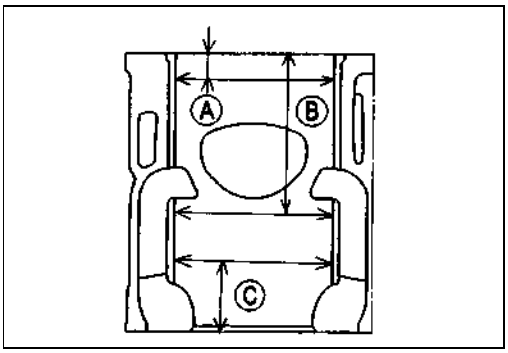
Cylinder Head Warp Inspection

- Lay a straightedge [A] across the lower surface of the head [B] at several different points, and measure warp by inserting a thickness gauge between the straightedge and the head.

★If warp exceeds the service limit, repair the mating surface. Replace the cylinder head if the mating surface is badly damaged.

Cylinder Head Warp
Service Limit: 0.05 mm (0.002 in.)

Cylinder Wear Inspection



- Inspect the inside of the cylinder for scratches and abnormal wear.

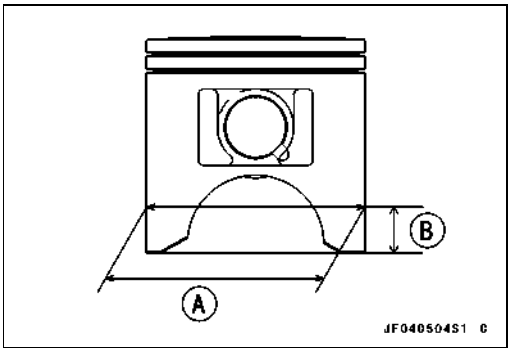
★If the cylinder is damaged or badly worn, replace it with a new one.

- 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 3 locations (total of 6 measurements) shown in the figure.
  [A] 10 mm (0.39 in.)
  [B] 80 mm (3.15 in.)
  [C] 35 mm (1.38 in.)

★If any of the cylinder inside diameter measurements exceeds the service limit, the cylinder will have to be replaced with a new one.

Cylinder Inside Diameter
Standard: 80.000 ~ 80.015 mm (3.1496 ~ 3.1502 in.) and less than 0.01 mm (0.0004 in.) difference between any two measurements
Service Limit: 80.10 mm (3.154 in.), or more than 0.05 mm (0.002 in.) difference between any two measurements

Piston Diameter Measurement



- Measure the outside diameter [A] of the piston 16.9 mm (0.67 in.) up [B] from the bottom of the piston at a right angle to the direction of the piston pin.

Piston Diameter
Standard: 79.865 ~ 79.880 mm (3.1443 ~ 3.1449 in.)
Service Limit: 79.72 mm (3.139 in.)

○ If the measurement is less than the service limit, replace the piston.

NOTE

○ *Abnormal wear such as a marked diagonal pattern across the piston skirt may mean a bent connecting rod or a misaligned crankshaft.*

Piston/Cylinder Clearance

The piston-to-cylinder clearance must be checked, and the standard value maintained anytime a piston or the cylinder block are replaced with new parts.

○ The most accurate way to find the piston clearance is by making separate piston and cylinder diameter measurements and then computing the difference between the two values.

○ Measure the piston diameter as just described, and subtract this value from the cylinder inside diameter measurement. The difference is the piston clearance.

Piston/Cylinder Clearance
0.130 ~ 0.140 mm (0.0051 ~ 0.0055 in.)

Engine Top End

Piston Ring, Piston Ring Groove Inspection

- Visually inspect the piston rings and the piston ring grooves.

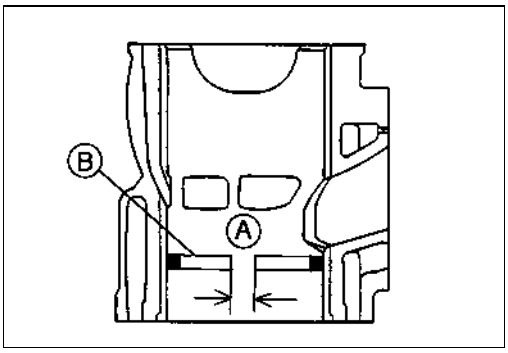
★If the rings are worn unevenly or damaged, they must be replaced.

★If the piston ring groove are worn unevenly or damaged, the piston must be replaced and fitted with new rings.

Piston Ring End Gap

- Place the piston ring 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 [A] between the ends of the ring [B] with a thickness gauge.

★If the gap is wider than the service limit, the ring is worn excessively and must be replace.



Piston Ring End Gap

	Top	Second
Standard:	**0.25 ∼ 0.40 mm (0.010 ~ 0.016 in.)**	**0.25 ∼ 0.40 mm (0.010 ~ 0.016 in.)**
Service Limit	**0.70 mm (0.03 in.)**	**0.70 mm (0.03 in.)**

Engine Removal/Installation

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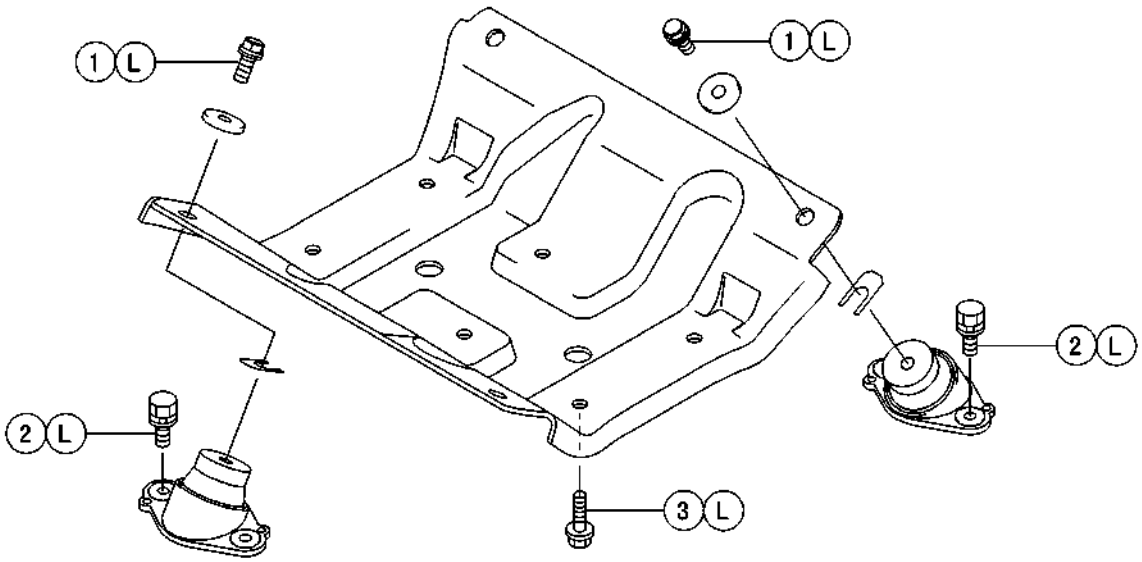
Exploded View



J602001BW5 C

Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Engine Mounting Bolts	36	3.7	27	L
2	Engine Damper Mounting Bolts	16	1.6	12	L
3	Engine Mount Bolts	44	4.5	32	L

L: Apply a non-permanent locking agent.

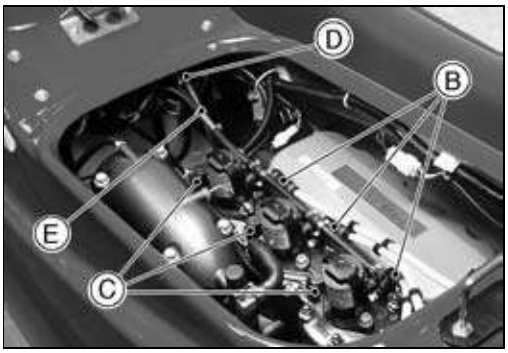
7-4 ENGINE REMOVAL/INSTALLATION

Engine Removal/Installation

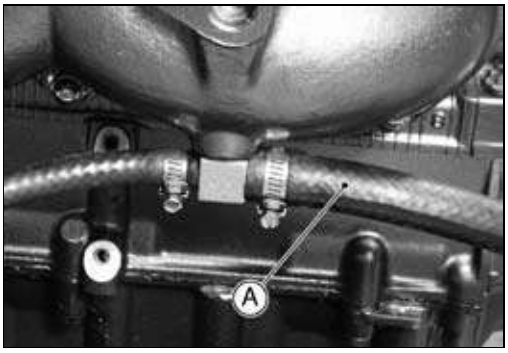
Removal

- Disconnect:
  Battery (–) Cable
  Starter Motor Cable at Starter Relay [A]

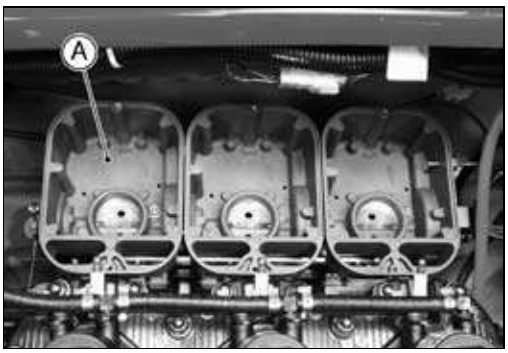
  Spark Plug Leads [B]
  Injector Lead Connectors [C]
  Fuel Inlet Hose (Loosen the clamp [D])
  Fuel Return Hose (Loosen the clamp [E])
- Remove the coupling cover.



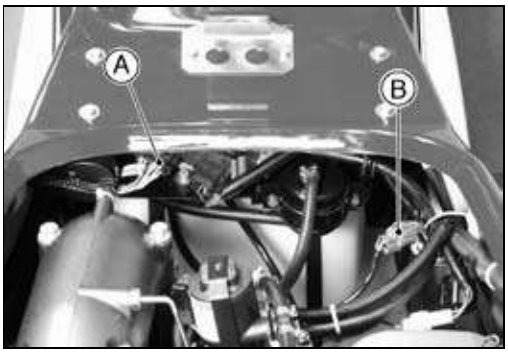
- Remove or disconnect:
  Exhaust Pipe (see Exhaust System chapter)
  Exhaust Chamber (see Exhaust System chapter)
  Inlet Cooling Hose [A] at Exhaust Manifold



- Remove throttle body assembly [A] (see Fuel System chapter).



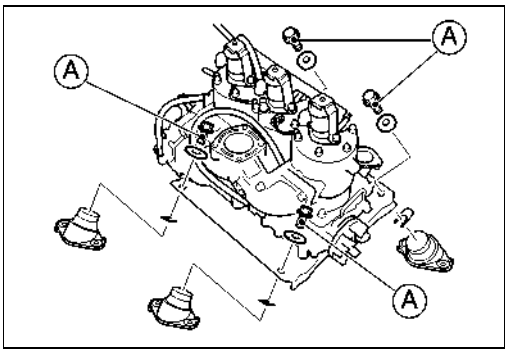
- Disconnect:
  Magneto Lead Connector [A]
  CPS (Crank Position Sensor) Lead Connector [B]



Engine Removal/Installation

- Disconnect:
  Cooling Inlet Hose [A] at Cover on Magneto Cover
  Oil Pump Cable [B] (see Fuel System)
  Oil Inlet Hose [C]

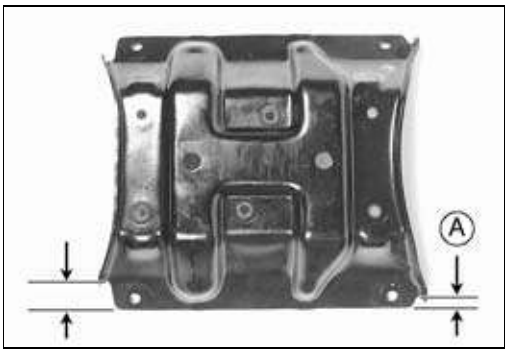
- Remove the engine mounting bolts [A].



- Slide the engine toward the front to disengage the couplings, and then life the engine out of the hull.
- Remove the engine mount bolts and separate the engine bed and the 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).
- Check the coupling damper for wear and damage (see Coupling Damper Inspection in the Engine Bottom End chapter).
- Install the engine bed so that the small notches [A] are on the magneto end of the engine as shown.



Engine Removal/Installation

- Apply a non-permanent locking agent to the engine mount bolts and torque them.

Torque - Engine Mount Bolts: 44 N·m (4.5 kgf·m, 32 ft·lb)

- Check the gap between the engine bed and the dampers by rocking the engine.
- If there is a gap, insert a suitable shim between the engine bed and the damper to achieve a good fit.

Shim Selection

Shim No.	Thickness
92025-3705	t 0.3 mm (0.01 in.)
92025-3706	t 0.5 mm (0.02 in.)
92025-3707	t 1.0 mm (0.04 in.)
92025-3708	t 1.5 mm (0.06 in.)

- Apply a non-permanent locking agent to the engine mounting bolts, and torque them.

Torque - Engine Mounting Bolts: 36 N·m (3.7 kgf·m, 27 ft·lb)

- After installing the engine in the hull, check the following.
  Throttle Control Cable
  Oil Pump Bleeding
  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

Operate the engine only for short periods without cooling water.

Engine Bottom End

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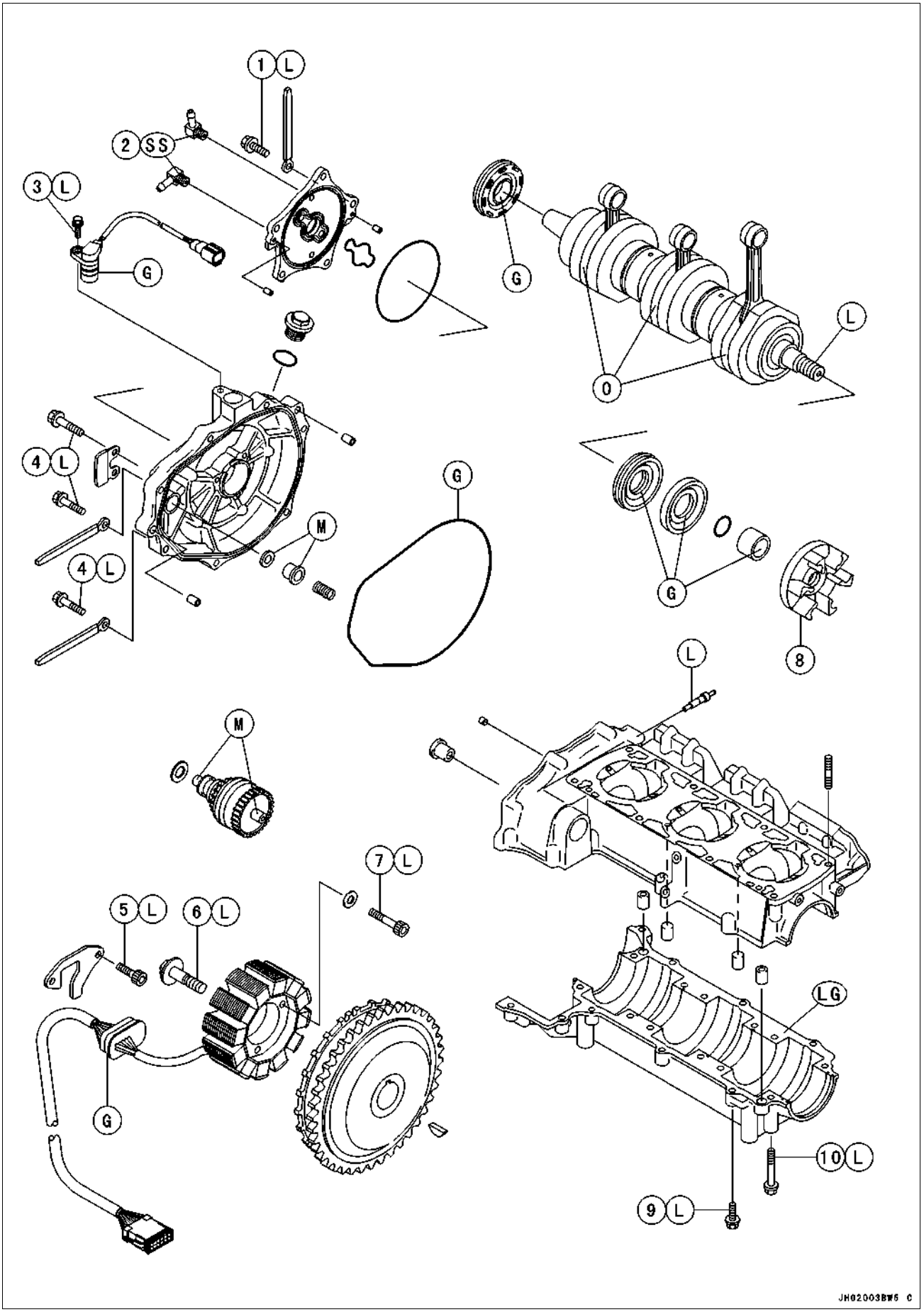
8-2 ENGINE BOTTOM END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Cover Mounting Bolts on Magneto Cover	8.8	0.9	78 in·lb	L
2	Water Pipe Joint	11	1.1	95 in·lb	SS
3	Crank Position Sensor Mounting Bolt	8.8	0.9	78 in·lb	L
4	Magneto Cover Mounting Bolts	8.8	0.9	78 in·lb	L
5	Grommet Plate Mounting Bolts	8.8	0.9	78 in·lb	L
6	Flywheel Bolt	132	13.5	96	L
7	Stator Mounting Bolts	12	1.2	104 in·lb	L
8	Coupling	132	13.5	96	
9	Crankcase Bolts - 6 mm (0.24 in.) Dia.	8.8	0.9	78 in·lb	L, S
10	Crankcase Bolts - 8 mm (0.31 in.) Dia.	29	3.0	22	L, S

L: Apply a non-permanent locking agent.
M: Apply molybdenum disulfide grease.
SS: Apply silicone sealant.
LG: Apply liquid gasket.
G: Apply grease.
S: Tighten the fasteners the specified sequence.

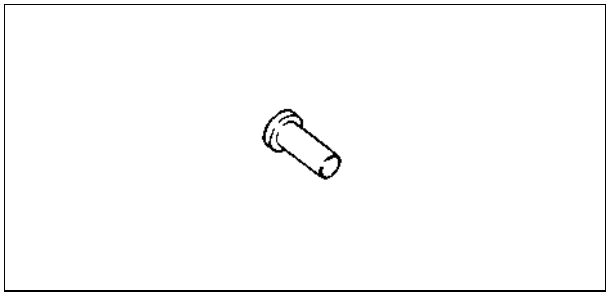
8-4 ENGINE BOTTOM END

Specifications

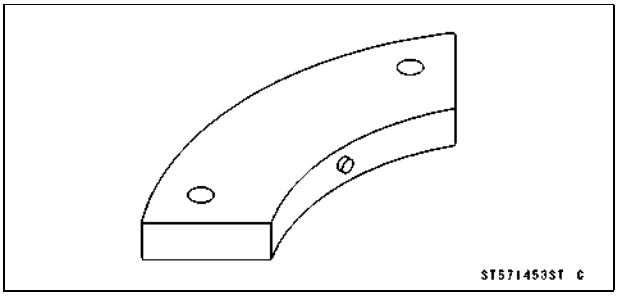
Item	Standard	Service Limit
Crankshaft, Connecting Rods:		
Crankshaft runout	0.04 mm (0.0016 in.)	0.10 mm (0.004 in.) TIR
Connecting rod side clearance	0.45 ~ 0.55 mm (0.0177 ~ 0.0217 in.)	0.8 mm (0.031 in.)
Connecting rod radial clearance:	0.018 ~ 0.030 mm (0.0007 ~ 0.0012 in.)	0.080 mm (0.0031 in.)
Connecting rod bend	0.05/100 mm (0.0020/3.937 in.)	0.2/100 mm (0.008/3.937 in.)
Connecting rod twist	0.15/100 mm (0.0059/3.937 in.)	0.2/100 mm (0.008/3.937 in.)

Special Tools

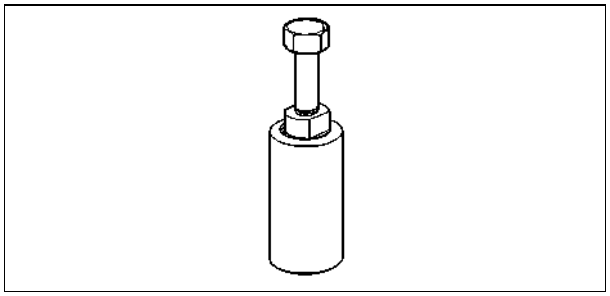
Rotor Puller Adapter: 57001–1279



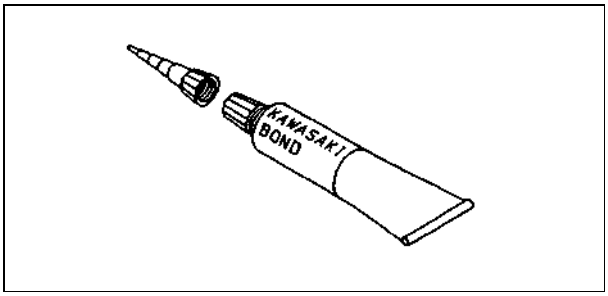
Rotor Holder: 57001–1453



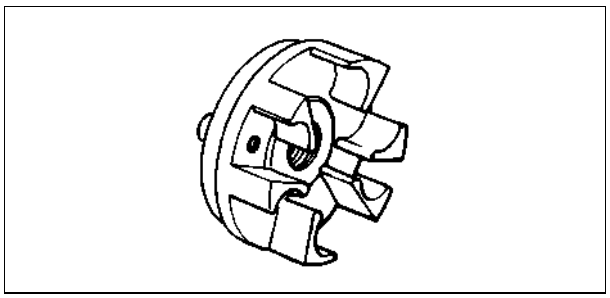
Flywheel Puller Assy, M35 × M38: 57001–1405



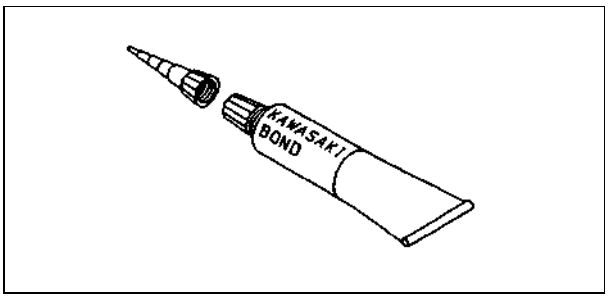
Kawasaki Bond (Silicone Sealant): 56019–120



Coupling Holder: 57001–1423



Kawasaki Bond (Liquid Gasket – Black): 92104–1003

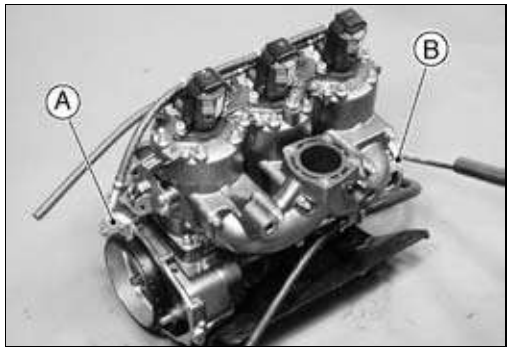


Coupling

Removal

- Remove:
  Engine (see Engine Removal/Installation chapter)
  Coupling Damper
  Magneto Cover
- Holding the flywheel, unscrew the coupling.

Special Tools - Rotor Holder: 57001–1453 [A]
Coupling Holder: 57001–1423 [B]



○ Refer to Magneto Flywheel Removal for the usage of the special tool, Rotor Holder (57001–1453).

Installation

- Apply a thin coat of silicone sealant to the coupling threads.

Sealant - Kawasaki Bond (Silicone Sealant): 56019-120

- Screw the coupling onto the crankshaft and tighten it.

Torque - Coupling: 132 N·m (13.5 kgf·m, 98 ft·lb)

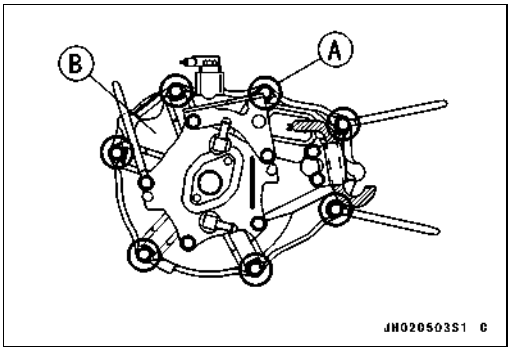
Coupling Damper Inspection

- Refer to the Coupling Damper Inspection in the Periodic Maintenance chapter.

Magneto Flywheel

Removal

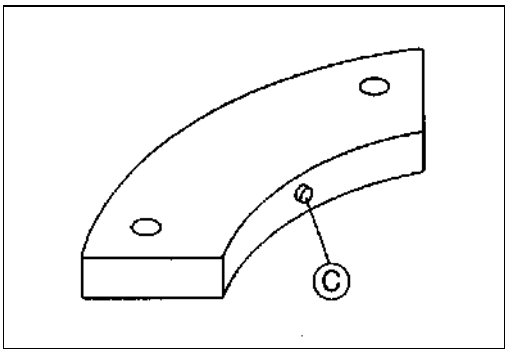
- Remove the engine.
- Unscrew the magneto cover mounting bolts [A] and remove the magneto cover [B].

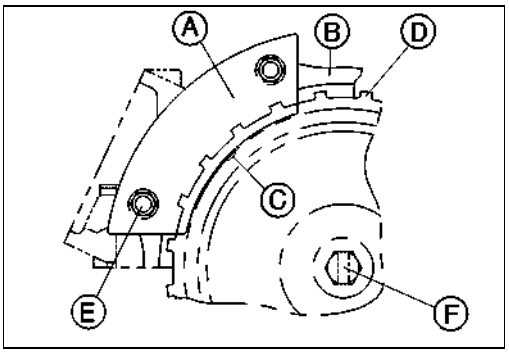


- Holding the flywheel with the rotor holder [A], remove the flywheel bolts [F].

  Special Tool - Rotor Holder: 57001–1453 [A]

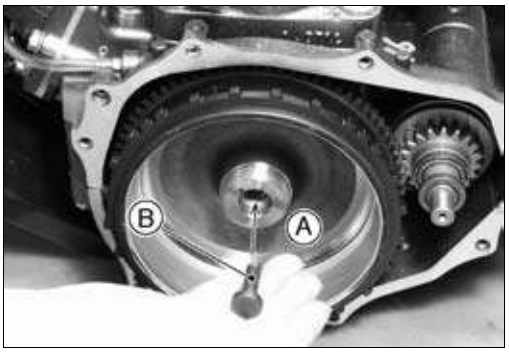
- ○ Install rotor holder [A] on the upper crank case [B] by putting the knock pin (ϕ 4) [C] of rotor holder to the hole (ϕ5) of the flywheel [D] together.
- ○ Fix rotor holder to the upper crank case by using bolts [E] for installing the magneto cover. Then, remove the flywheel bolt.





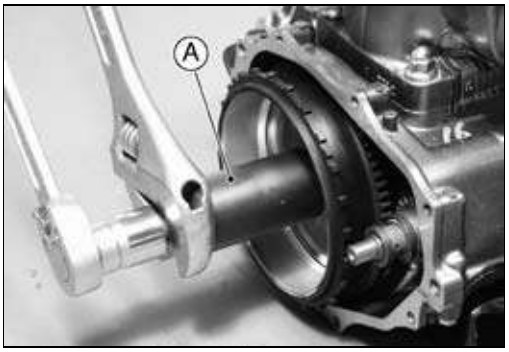
- Pull the flywheel off the crankshaft.
- ○ Put [A] the rotor puller adapter [B] into the thread hole of flywheel.

  Special Tool - Rotor Puller Adapter: 57001–1279



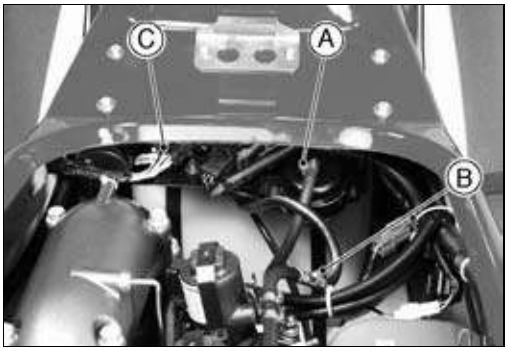
- ○ Using the special tool, pull off the flywheel.

  Special Tool - Flywheel Puller Assy [A]: 57001–1405

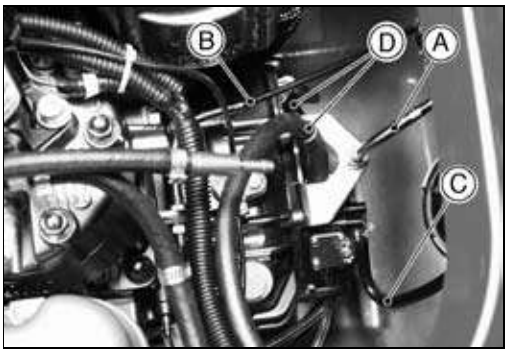


Magneto Flywheel

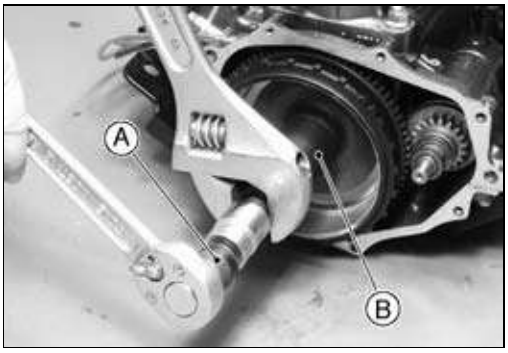
● To remove the magneto flywheel with the engine mounted in the hull, perform the following.
○ Remove the oil pump.
○ Disconnect:
Fuel Inlet Hose [A]
Fuel Return Hose [B]
Magneto Lead Connector [C] on EMM

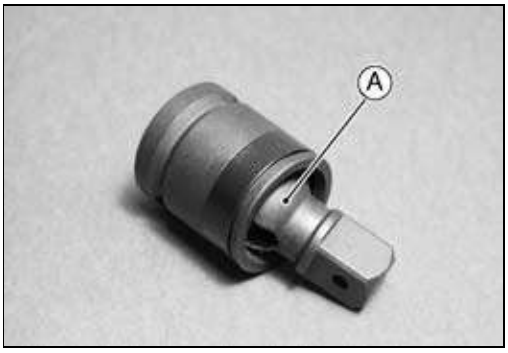


○ Disconnect:
Oil Pump Cable [A]
Throttle Body Cable [B]
Oil Inlet Hose [C]
Cooling Hoses [D] at magneto cover

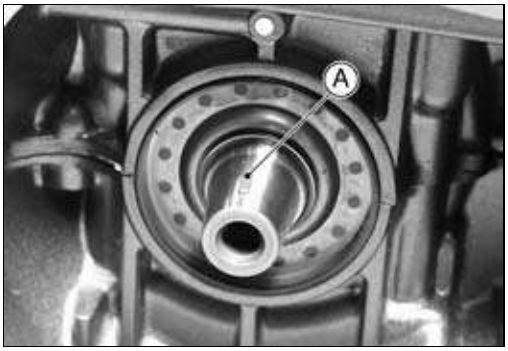


○ Using the special tools and universal joint [A], pull off the flywheel.
Special Tool - Flywheel Puller Assy [B]: 57001–1405





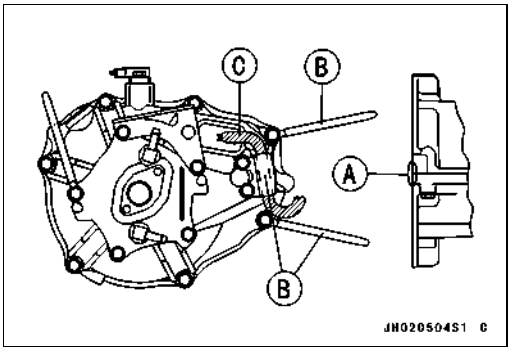
Installation
● Using a high flash-points solvents, clean off any oil or dirt that may be on the flywheel bolt, the crankshaft taper, or in the tapered hole in the flywheel.
● Fit the woodruff key [A] securely in the crankshaft, before installing the magneto flywheel.



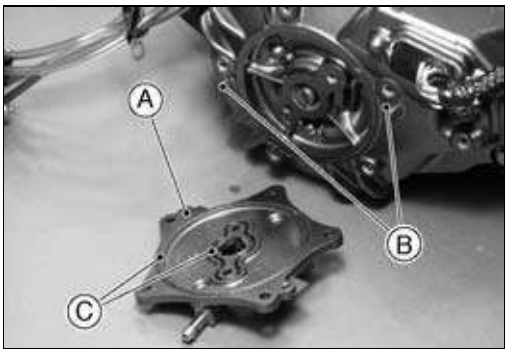
Magneto Flywheel

● When installing the magneto cover, noting the following.
○ Apply liquid gasket to the mating surface [A] of the crankcase as shown.
○ Be sure the clamps [B] are in position.
○ Apply a non-permanent locking agent to the magneto cover mounting bolts and torque them.
○ Route the magneto leads [C] as shown.

Torque - Magneto Cover Mounting Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)

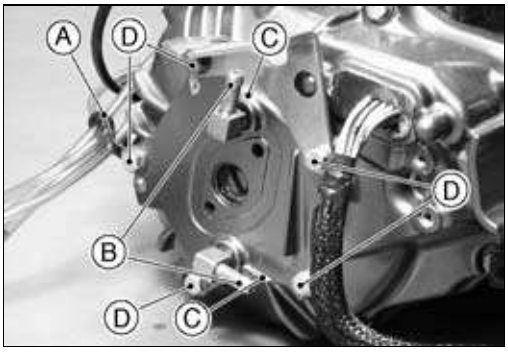


● When removing the cover on the magneto cover [A], install the following.
○ Be sure the dowel pins [B] and O-rings [C] are in position.



○ Be sure the clamp [A] and plate are in position.
○ Align the water pipe joints [B] with the marks [C] on the cover.
○ Apply a non-permanent locking agent to the cover mounting bolts [D] and apply silicone sealant to the water pipe joints and torque them.

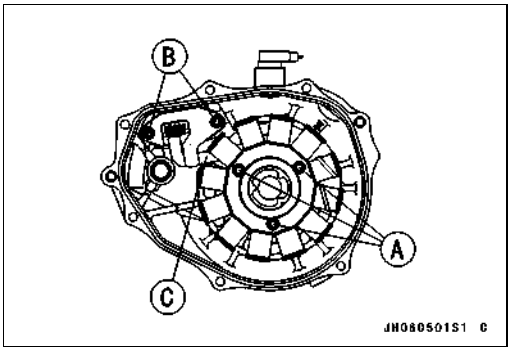
Torque - Cover Mounting Bolts on Magneto Cover: 8.8 N·m (0.9 kgf·m, 78 in·lb)



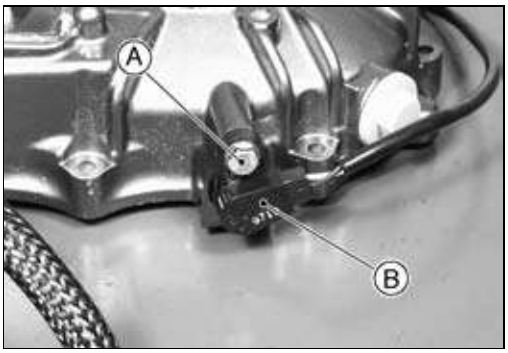
Stator

Removal

- Remove the magneto cover (see Magneto Flywheel Removal).
- Remove:
  Stator Mounting bolts [A] and shims.
  Grommet Plate Mounting Bolts [B]
- Remove the stator assembly [C].

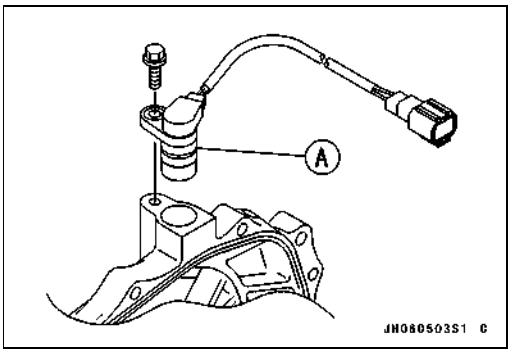


- Unscrew the crank position sensor mounting bolt [A] and remove the crank position sensor [B].



Installation

- Install the crank position sensor on the magneto cover, noting following.
  - Apply water resistant grease to the O-ring [A] on the crank position sensor.



  - Apply a non-permanent locking agent to the crank position sensor mounting bolt and torque it.

    Torque - Crank Position Sensor Mounting Bolt: 8.8 N·m (0.9 kgf·m, 78 in·lb)

  - Be sure the core height [A] is approx. 1.5 mm (0.06 in.).

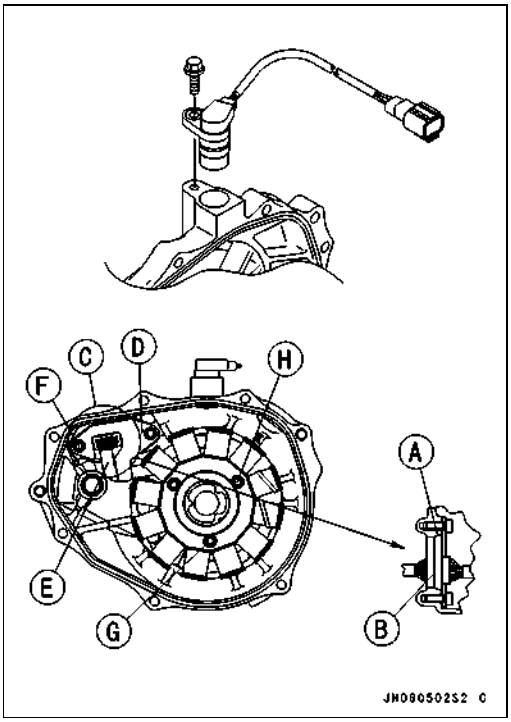
Stator

● Install the stator assembly on the magneto cover, noting the following.
○ Apply water resistant grease [A] to the grommet [B] and put it as shown [C].
○ Install the grommet plate [D] so as not to bite the stator lead [E] between the plate and cover.
○ Apply a non-permanent locking agent to the grommet plate mounting bolts [F] and torque them.

Torque - Grommet Plate Mounting Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)

○ Be sure the shims [G] is in position and apply a non-permanent locking agent to the stator mounting bolts [H] and torque them.

Torque - Stator Mounting Bolts: 12 N·m (1.2 kgf·m, 104 in·lb)



Crankcase

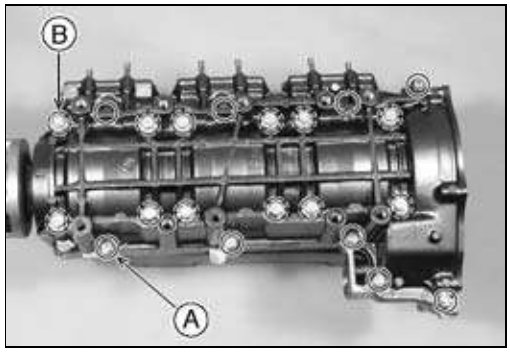
Splitting

- Remove the engine (see Engine Removal/Installation chapter).
- Remove the following from the engine.
  Starter Motor
  Cylinder Head
  Cylinder Block
  Pistons
  Oil Pump
  Coupling
  Magneto Flywheel
  Reduction Gear

NOTE

○ *Always remove the coupling before removing the magneto flywheel, or there won't be any way to hold the crankshaft while unscrewing the coupling.*

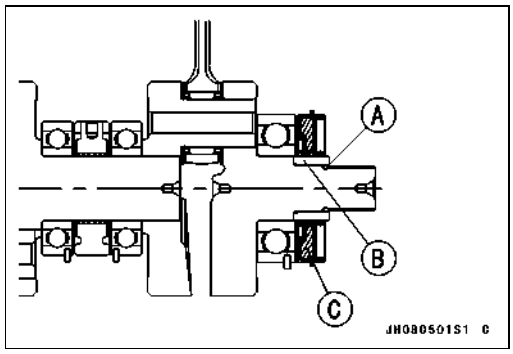
- Remove the 6 mm (0.24 in.) crankcase bolts [A] first and the 8 mm (0.31 in.) bolts [B].



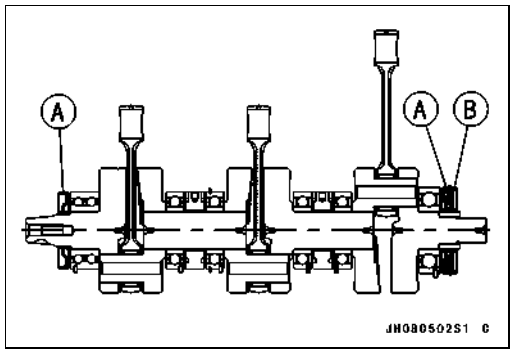
- Tap with a soft hammer to split the crankcase halves apart, and then remove the lower crankcase half.
- Lift the crankshaft assembly out of the upper crankcase half.

Assembly

- Visually inspect the crankshaft O-ring [A], and replace it if necessary.
- Grease the inner surface of the collar [B].
- Grease the lips of the oil seals.
- Pack grease [C] between the rear oil seals (coupling side).

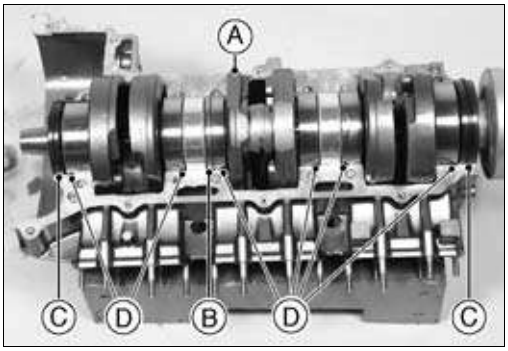


- Install the oil seals as shown.
  Double Lips Seals [A]
  Single Lip Seals [B]

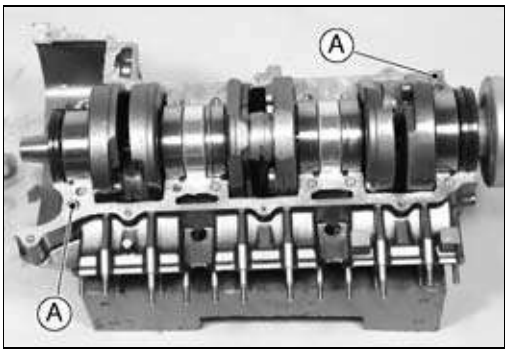


Crankcase

● Place the crankshaft assembly [A] in the upper crankcase half.
○ The position ring [B] and the projected outer circumference [C] of the oil seals on the crankshaft assembly fit into the grooves in the crankcase.
○ The pins [D] on the bearings and labyrinth packing on the crankshaft assembly fit into the grooves in the crankcase.



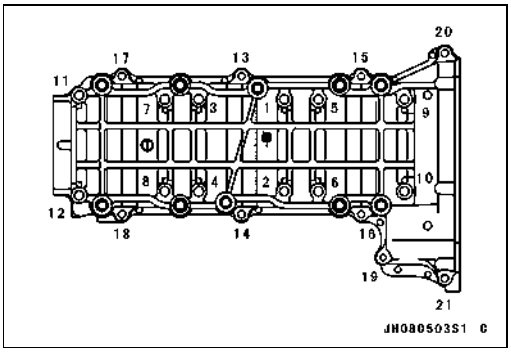
● Check that the knock pins [A] are in place.
● With a high flash-point solvent, clean off the mating surfaces of the crankcase halves and wipe dry.
● Apply liquid gasket to the mating surface of the lower crankcase half.
● Install the lower crankcase half onto the upper half.



● Apply a non-permanent locking agent to the crankcase bolts, and tighten them.

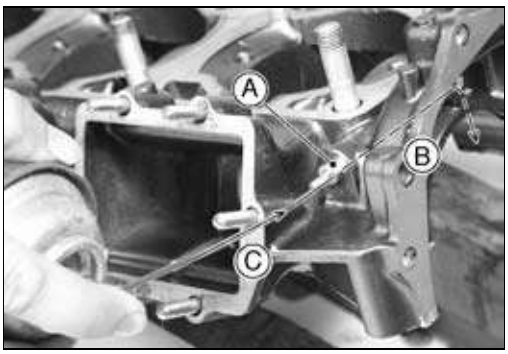
Torque - Crankcase M8 Bolts: 29 N·m (3.0 kgf·m, 22 ft·lb)
Crankcase M6 Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)

○ The tightening sequence numbers are marked on the lower crankcase half.



Crankcase Check Valves Inspection

● Split the crankcase.
● Inspect the check valves.
○ The check valve [A] allows oil flow in the direction of the arrow [B].
○ Inspect the normal oil flow by injecting [C] a high flash-point solvent in a squirt can or syinge.
★ In the following case, replace the check valves.
1. Oil will not pass through the check valve in the normal direction.
2. Oil will pass through the check valve in both direction.



CAUTION
Do not use compressed air on the valve since doing so would damage the valve spring.

Crankcase

Check Valve Removal/Installation

- Remove the check valve on the upper crankcase half with pliers.
- Note the following when installing
  - Apply a non-permanent locking agent to the check valve.
  - Press the check valve until it is bottomed. At this time, do not plug up the hole of the check valve with a locking agent.

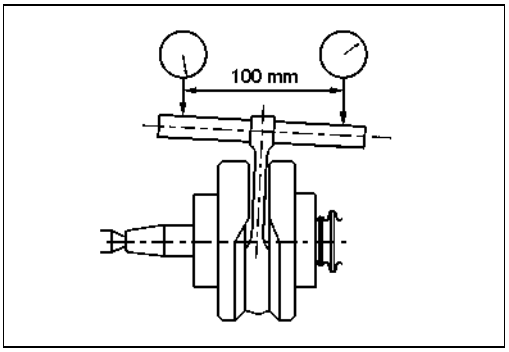
Crankshaft Maintenance

The crankshaft changes the reciprocating motion the piston into rotating motion to drive the jet pump. Crankshaft trouble, such as excessive play or runout, will multiply the stress caused by the intermittent force on the piston and will result in not only rapid crankshaft bearing wear, but also noise, power loss, vibration, and shortened engine life. A defective crankshaft should always detected at an early stage and repaired immediately.

The following explanation concerns the most common crankshaft problems and the method for measuring play, runout and con-rod alignment. It does not cover crankshaft disassembly because of the highly specialized equipment that is required. If crankshaft components become damaged or worn, the entire crankshaft should be replaced as an assembly.

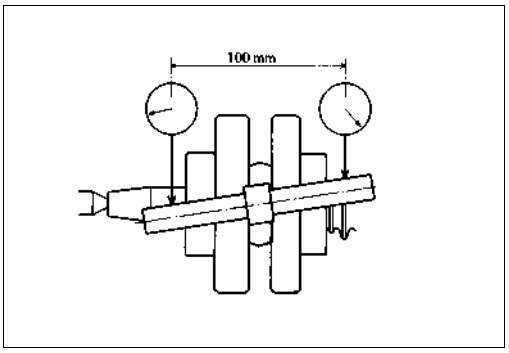
Connecting Rod Bend/Twist

○ Set the crankshaft in an alignment jig or in V blocks on a surface plate.
○ Select an arbor of the same diameter as the connecting rod small end and at least 100 mm long , and insert the arbor through the connecting rod small end.
○ With the connecting rod held vertically, use a height gauge to measure the difference in the height of the arbor above the surface plate over a 100 mm length to determine the amount of connecting rod bend.
★ If connecting rod bend exceeds the service limit, the crankshaft must be replaced.



Connecting Rod Bend
Standard: Under 0.05/100 mm (0.0020/3.937 in.)
Service Limit: 0.2/100 mm (0.008/3.937 in.)

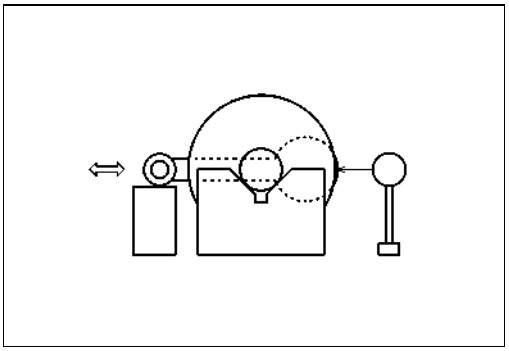
● Measure connecting rod twist.
○ With the crankshaft still in the alignment jig, hold the connecting rod horizontally and measure the amount that the arbor varies from being parallel with the crankshaft over a 100 mm length of the arbor to determine the amount of connecting rod twist.
★ If connecting rod twist exceeds the service limit, the crankshaft must be replaced.



Connecting Rod Twist
Standard: Under 0.15/100 mm (0.0059/3.937 in.)
Service Limit: 0.2/100 mm (0.0081/3.937 in.)

Connecting Rod Big End Radial Clearance

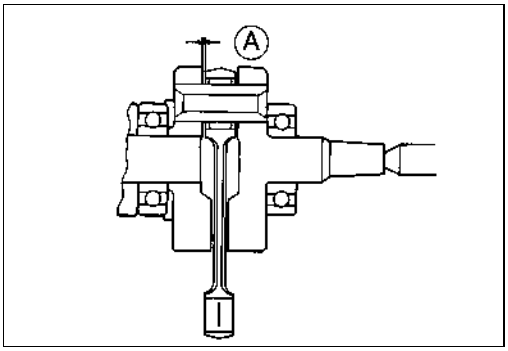
● Check big end radial clearance.
○ Set the crankshaft in an alignment jig or on V blocks, and place a dial gauge against the connecting rod big end.
○ Push the connecting rod first towards the gauge and then in the opposite direction. The difference between the two gauge readings is the radial clearance.
★ If the radial clearance exceeds the service limit, the crankshaft assembly must be replaced or disassembled and the crankpin, needle bearing, and connecting rod big end examined for wear.



Connecting Rod Big End Radial Clearance
Standard: 0.018 ~ 0.030 mm (0.0007 ~ 0.0012 in.)
Service Limit: 0.080 mm (0.0031 in.)

Crankshaft Maintenance

Connecting Rod Big End Side Clearance



- Measure big end side clearance [A].
- ○ Insert feeler gauges between the big end and either crank half to determine clearance.
- ★ If the measured value exceeds the service limit, the crankshaft should be replaced.

Connecting Rod Big End Side Clearance
Standard: **0.45 ~ 0.55 mm (0.0177 ~ 0.0217 in.)**
Service Limit: **0.8 mm (0.031 in.)**

Crankshaft Main Bearing Wear

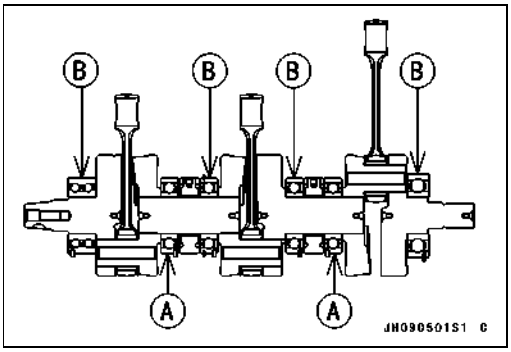
- Wash the bearings in high flash-point solvent, blow them dry (DO NOT SPIN THEM), and lubricate them with engine oil.

CAUTION

Solvent is toxic and flammable. Avoid prolonged contact with skin and keep away from open flame. Use only in a well ventilated area. Eye protection should be worn when compressed air is used to dry parts. Do not direct air towards anyone. Use 172 kPa (1.75 kg/cm^2, 25 psi) maximum nozzle pressure.

- Turn each bearing over by hand and see that it makes no noise, turns smoothly, and has no rough spots.
- ★ If any of the bearings are defective, the crankshaft should be replaced.

Crankshaft Runout



- Check crankshaft alignment by measuring runout.
- ○ With the crankshaft on V blocks [A], rotate the crankshaft slowly and measure runout at each of the locations shown.
- ★ If the runout at any point exceeds the service limit, the crankshaft must be replaced.

Crankshaft Runout [B]
Standard: **Under 0.04 mm (0.0016 in.) TIR**
Service Limit: **0.10 mm (0.004 in.) TIR**

Cooling and Bilge Systems

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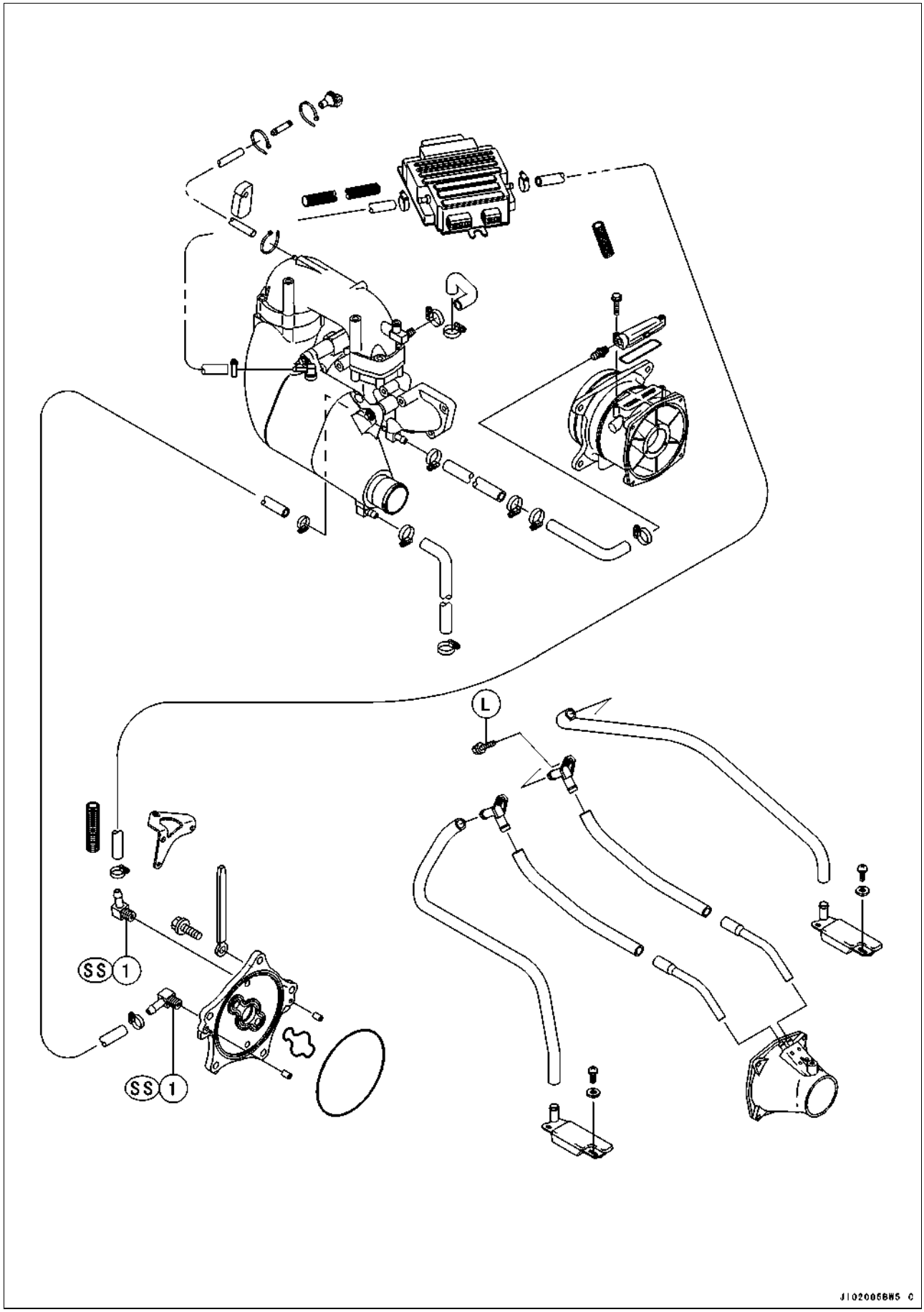
Exploded View



Exploded View

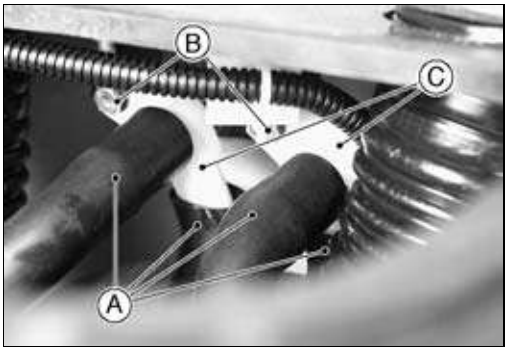
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Water Pipe Joint	11	1.1	95 in·lb	SS

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

Bilge System

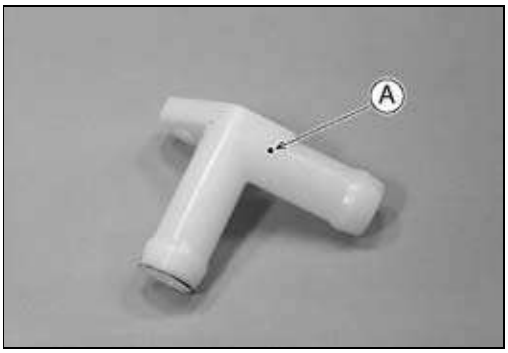
Breather Removal

- Pull the hoses [A] off the breather.
- Unscrew the mounting bolts [B], and remove the breathers [C].



Breather Installation

- Be sure the small hole [A] in the breather is open before installing it.
- Apply a non-permanent locking agent to the breather mounting bolt and tighten it.



Breather Cleaning and Inspection

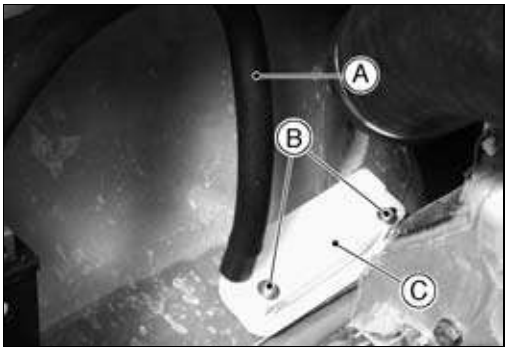
- Check that the small hole in the top of the breather is open by blowing in one end of the breather and plugging the other.

★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/Installation

- Pull the hose [A] off the filter.
- Unscrew the mounting screws [B], and remove the filter [C].

○ To remove the left side filter, remove the water box muffler.



Filter Cleaning and Inspection

- Refer to the cooling and Bilge System Flushing in the Periodic Maintenance chapter.

Cooling and Bilge System Hoses

Hose Removal

- None of the bilge system hoses has a clamp. The bilge system hoses may be simply pulled off their fittings.
- 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.
- 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

- Check the hoses for hardening, cracking, checking, cuts, abrasions, and breaks.

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

Cooling and Bilge System Flushing

Cooling System Flushing

- Refer to the Cooling and Bilge System Flushing in the Periodic Maintenance chapter.

Bilge System Flushing

- Refer to the Cooling and Bilge System Flushing in the Periodic Maintenance chapter.

Drive System

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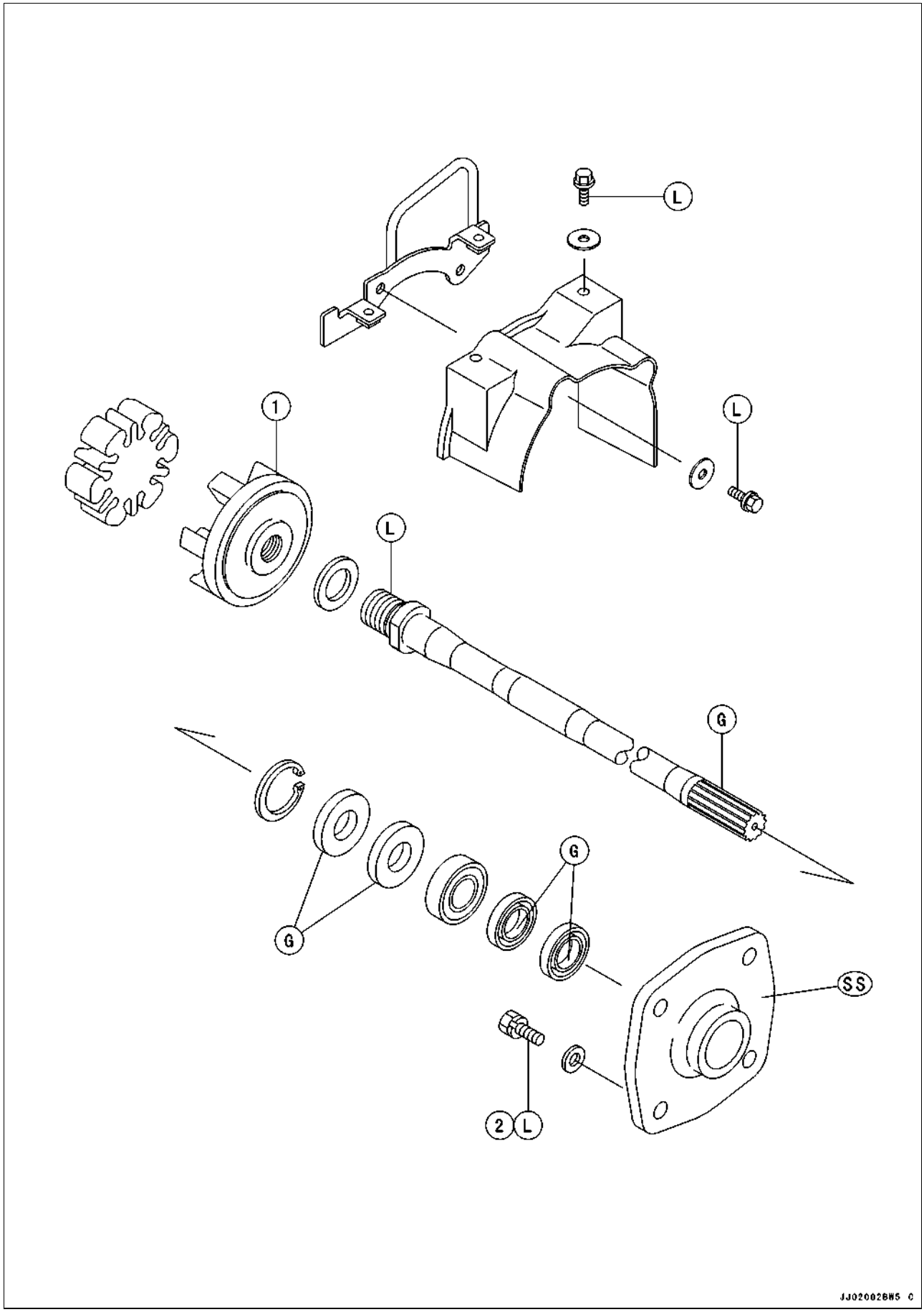
Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Coupling	39	4.0	29	
2	Drive Shaft Holder Mounting Bolts	22	2.2	16	L

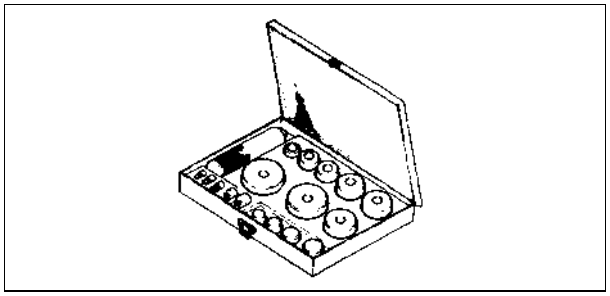
L: Apply a non-permanent locking agent.
G: Apply grease.
SS: Apply silicone sealant.

Specification

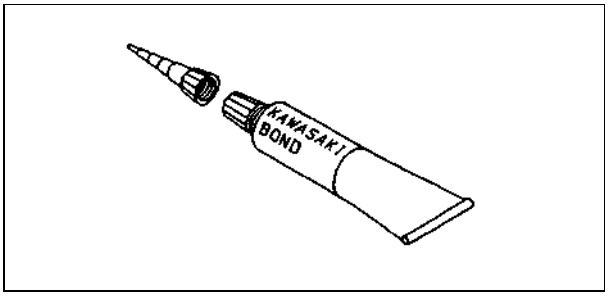
Item	Standard	Service Limit
Drive Shaft		
Runout	[A] less than 0.1 mm (0.004 in.)	0.2 mm (0.008 in.)
	[B] less than 0.2 mm (0.008 in.)	0.6 mm (0.0024 in.)

Special Tools

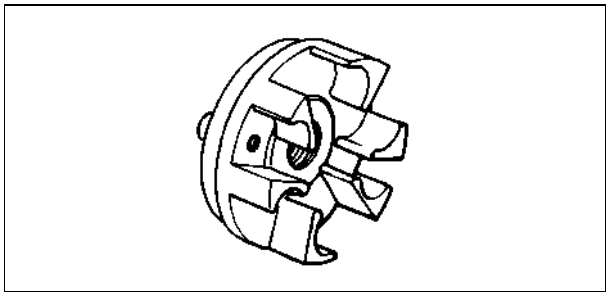
Bearing Driver Set: 57001–1129



Kawasaki Bond (Silicone Sealant): 56019–120



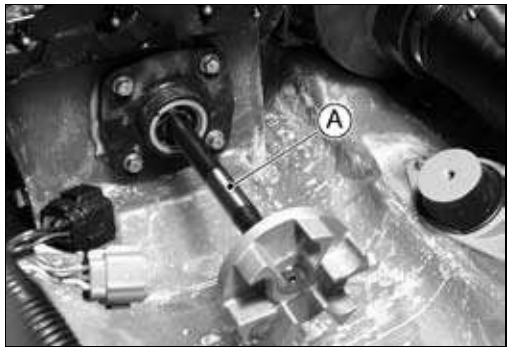
Coupling Holder: 57001–1423



Drive Shaft/Drive Shaft Holder

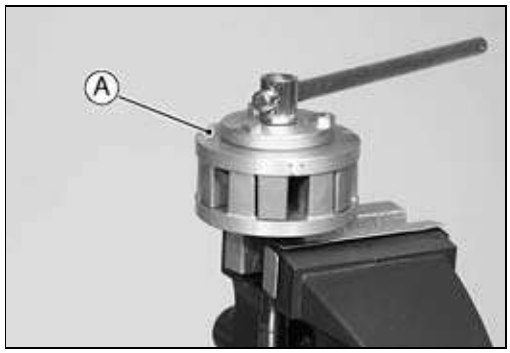
Drive Shaft Removal/Installation

- Remove the engine (see Engine Removal/Installation chapter).
- Pull the drive shaft [A] out of the hull.



- Hold the drive shaft in a vice, and unscrew the coupling.

  Special Tool - Coupling Holder : 57001–1423 [A]



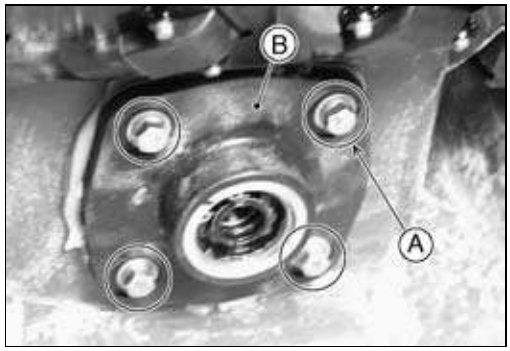
- When installing the drive shaft, be careful of the following items.
  - Apply a thin coat to the coupling threads and tighten it.

    Sealant - Kawasaki Bond (Silicone Sealant): 56019–120

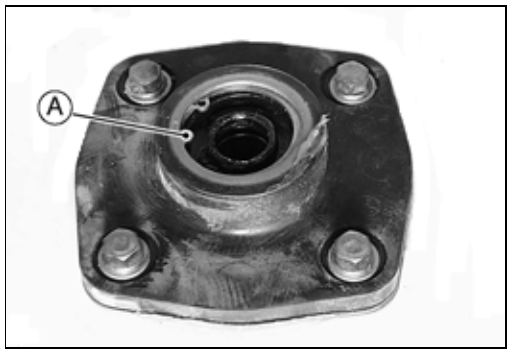
    Torque - Coupling: 39 N·m (4.0 kgf·m, 29 ft·lb)
  - Apply grease to the grease seal lips and the drive shaft spline.

Drive Shaft Holder Removal/Disassembly

- Remove the drive shaft.
- Unscrew the mounting bolts [A] and remove the drive shaft holder [B] from the bulkhead.

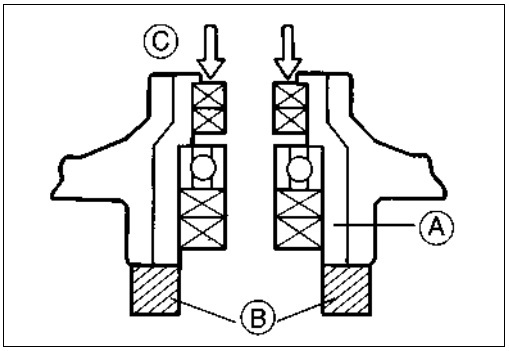


- Disassemble the drive shaft holder.
  - Remove the circlip [A].



Drive Shaft/Drive Shaft Holder

○ Press the small grease seal, and the large grease seals, bearing, and small grease seals come out of the holder.
[A] Sleeve
[B] Blocks
[C] Press



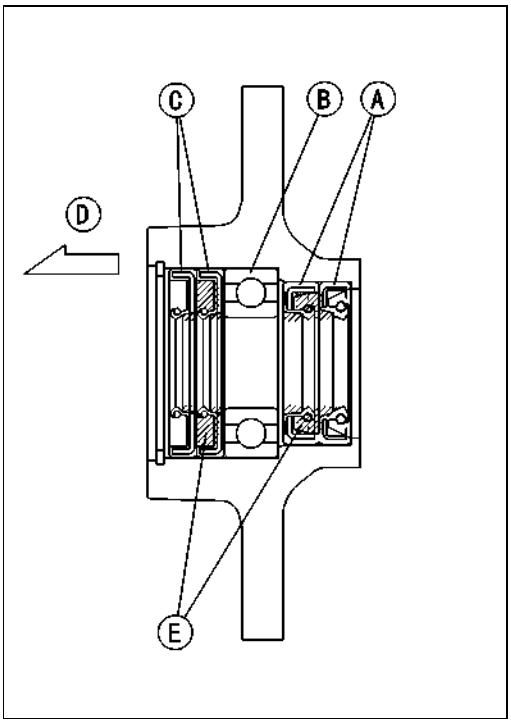
Drive Shaft Holder Assembly/Installation

● Replace the grease seals with new ones.
● Press the bearing and grease seals into the drive shaft holder, noting the following.
○ Install the parts in this order.
Two Small Grease Seals [A]
One Bearing [B]
Two Large Grease Seals [C]

Front [D]

Special Tool - Bearing Driver Set: 57001-1129

○ Install the seals so that the sides with the spring face outward.
○ Fill the gaps between the seals with grease [E].
● Install the circlip.
● Grease to the bearing inner surface and grease seal lips.



● Install the drive shaft holder on the bulkhead so that the circlip side face toward the front.
● Apply a non-permanent locking agent to the drive shaft holder mounting bolts, tighten them loosely.
● Install the drive shaft.
● After installing the engine, tighten the drive shaft holder mounting bolts to the specified torque to give proper coupling alignment.

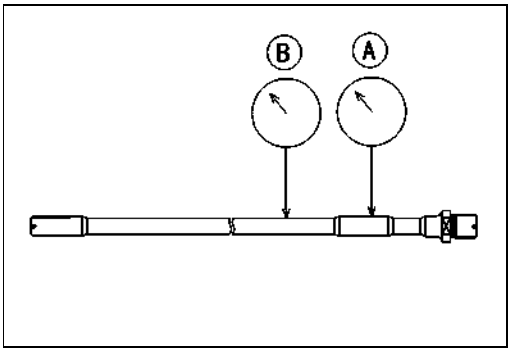
Torque - Drive Shaft Holder Mounting Bolts: 22 N·m (2.2 kgf·m, 16 ft·lb)

Drive Shaft Runout

● Measure drive shaft runout by supporting the shaft on V blocks 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

Standard:	**Less than 0.1 mm (0.004 in.)**	**[A]**
	Less than 0.2 mm (0.008 in.)	**[B]**
Service Limit:	**0.2 mm (0.008 in.)**	**[A]**
	0.6 mm (0.0024 in.)	**[B]**



Pump and Impeller

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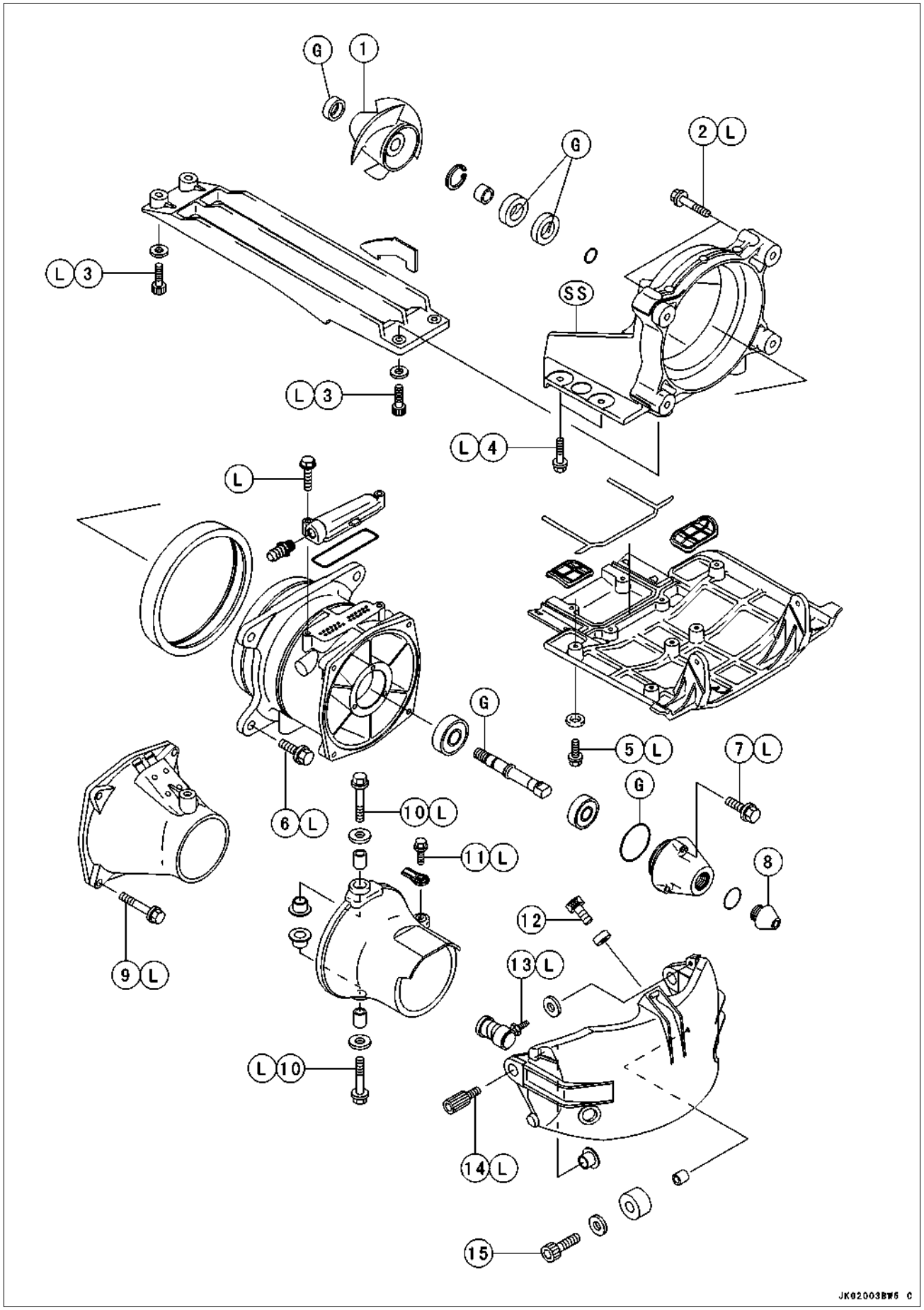
11-2 PUMP AND IMPELLER

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Impeller	98	10	72	
2	Pump Bracket Mounting Bolts (Inside Hull)	19	1.9	14	L
3	Grate Mounting Bolts	9.8	1.0	87 in·lb	L
4	Pump Bracket Mounting Bolts (Pump Cover Side)	9.8	1.0	87 in·lb	L
5	Pump Cover Mounting Bolts	7.8	0.8	69 in·lb	L
6	Pump Mounting Bolts	36	3.7	27	L
7	Pump Cap Bolts	9.8	1.0	87 in·lb	L
8	Pump Cap End	4.0	0.4	35 in·lb	
9	Pump Outlet Mounting Bolts	19	1.9	14	L
10	Steering Nozzle Pivot Bolts	19	1.9	14	L
11	Steering Cable Joint Bolts	9.8	1.0	87 in·lb	L
12	Dumper Fitting Bolt	9.8	1.0	87 in·lb	
13	Ball Joint	9.8	1.0	87 in·lb	L
14	Reverse Bucket Pivot Bolts	19	1.9	14	L
15	Dumper Fitting Bolts	9.8	1.0	87 in·lb	

L: Apply a non-permanent locking agent.
G: Apply grease.
SS: Apply silicone sealant.

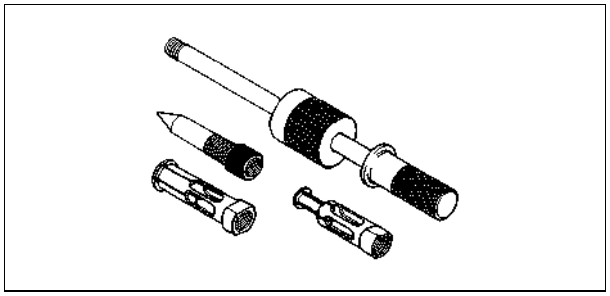
11-4 PUMP AND IMPELLER

Specifications

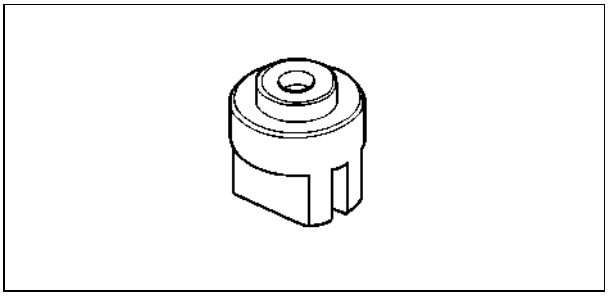
Item	Standard	Service Limit
Jet Pump:		
Impeller Outside Diameter	147.5 ~ 147.7 mm (5.787 ~ 5.815 in.)	146.5 mm (5.768 in.)
Pump Case Inside Diameter	148.0 ~ 148.1 mm (5.827 ~ 5.831 in.)	149.1 mm (5.870 in.)
Impeller Clearance	0.15 ~ 0.3 mm (0.006 ~ 0.012 in.)	0.6 mm (0.024 in.)

Special Tools

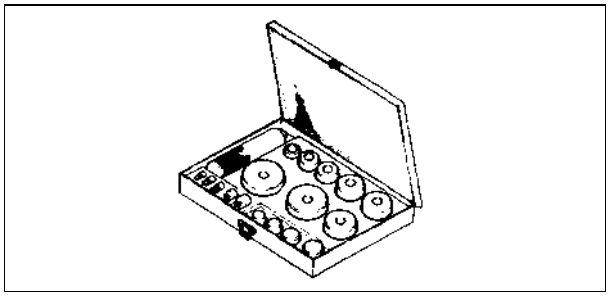
Oil Seal & Bearing Remover: 57001–1058



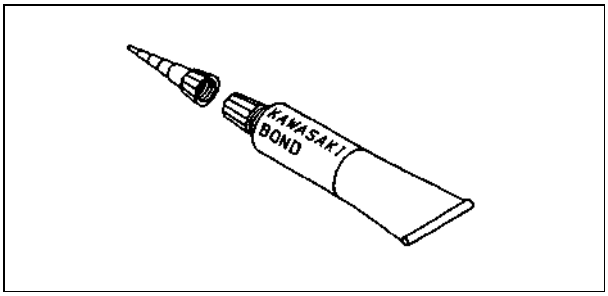
Impeller Holder: 57001–1393



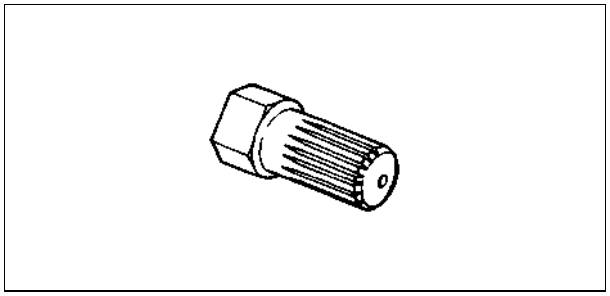
Bearing Driver Set: 57001–1129



Kawasaki Bond (Silicone Sealant): 56019–120



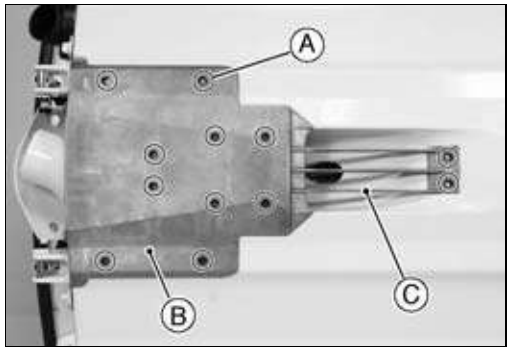
Impeller Wrench: 57001–1228



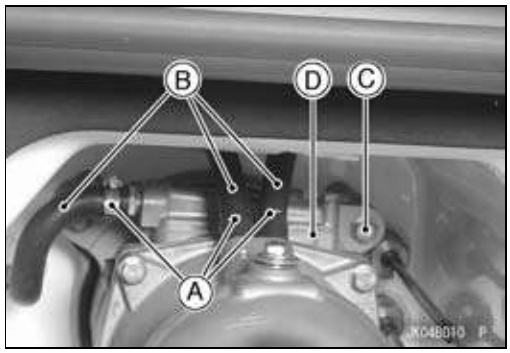
Pump and Impeller

Pump Removal

- Turn the craft on its left side.
- Slip the shift cable connector off the ball.
- Unscrew the mounting bolts [A], and remove the pump cover [B] with the reverse bracket and grate [C].

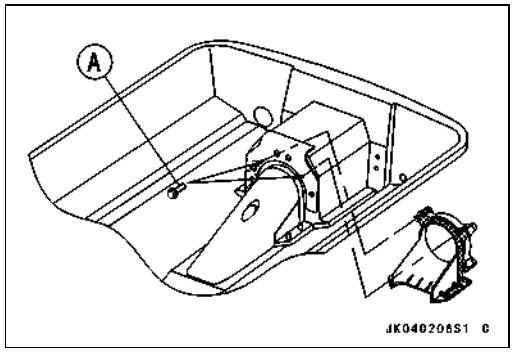


- Remove the steering cable joint bolt.
- Loosen the clamps [A] on the hoses and pull of the hoses [B].
- Unscrew the pump mounting bolts [C].
- Slide the pump [D] to the rear to disengage the drive shaft, and remove it from the hull.

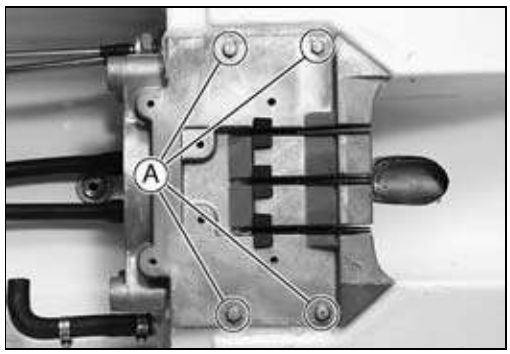


- To remove the pump bracket, perform the following procedures.

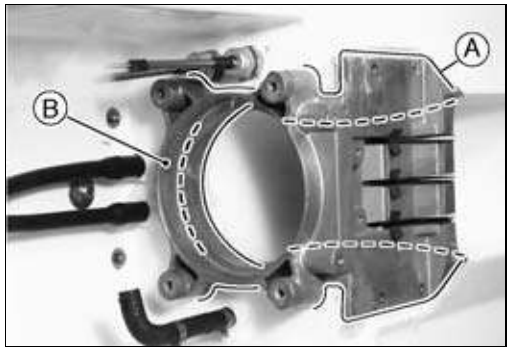
○ Take out the mounting bolts [A] in the hull.



○ Take out the mounting bolts [A].



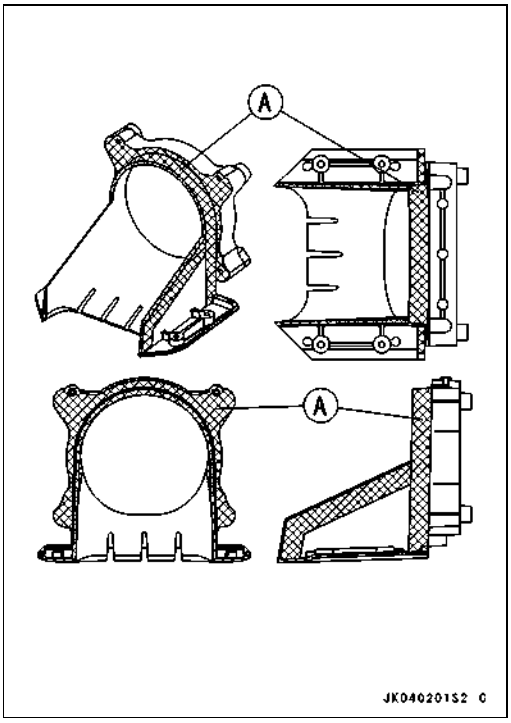
○ Cut the sealant at the indicated area [A] in the figure and remove the pump bracket [B].



Pump and Impeller

Pump Installation

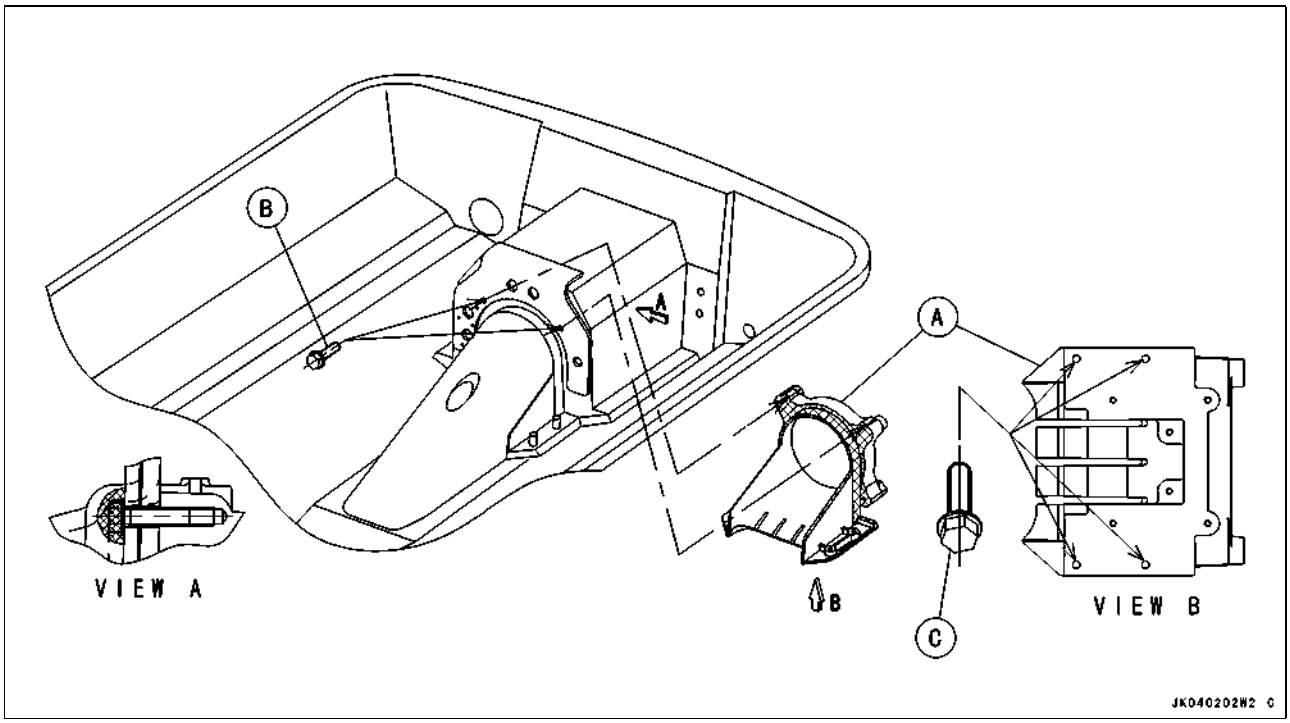
- Strip off all the old sealant around the pump intake.
- Liberally coat the outside edge of the pump bracket with silicon sealant [A] to from a seal between the bracket and the hull.



- Install the pump bracket [A] to the hull.
- ○ Apply a non-permanent locking agent to the following bolts and torque them.

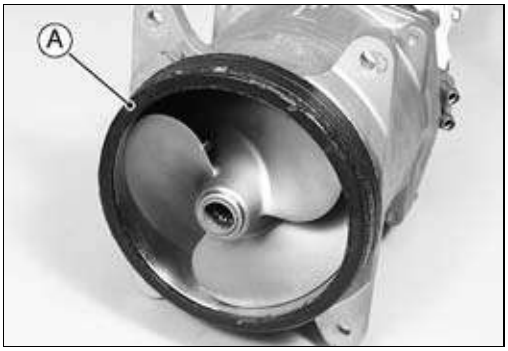
Torque - Pump Bracket Mounting Bolts (2) [B] : 19 N·m (1.9 kgf·m, 14 ft·lb)
Pump Bracket Mounting Bolts (4) [C] : 9.8 N·m (1.0 kgf·m, 87 in·lb)

- ○ As for the pump bracket mounting bolts (2) in the hull, the bolt heads should be wrapped in silicone sealant.



Pump and Impeller

● Be sure trim seal [A] is in place.

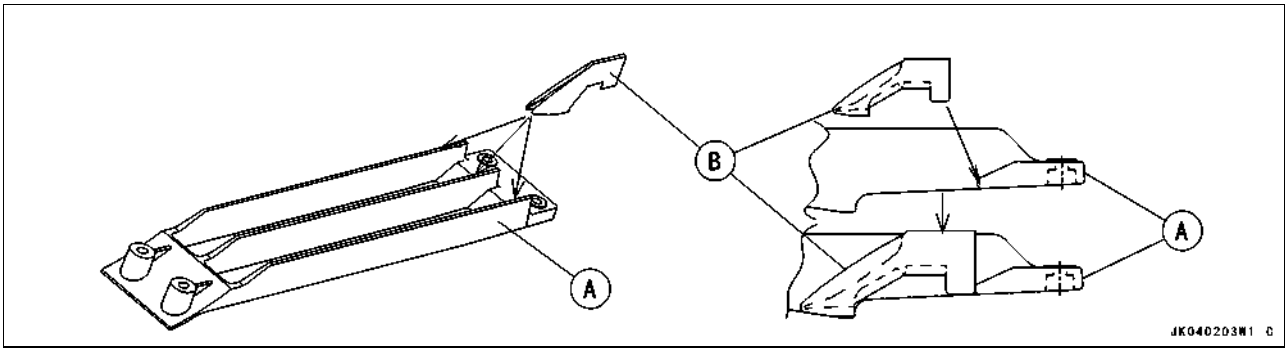


● Grease the splines on the drive shaft with water resistant grease.
● Install the pump case.
○ Apply a non-permanent locking agent to the pump mounting bolts and torque them.

Torque - Pump Mounting Bolts: 36 N·m (3.7 kgf·m, 27 ft·lb)

● Install the grate [A].
○ Be sure the trim seals [B] are in the position.
○ Apply a non-permanent locking agent to the grate mounting bolts and torque them.

Torque - Grate Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

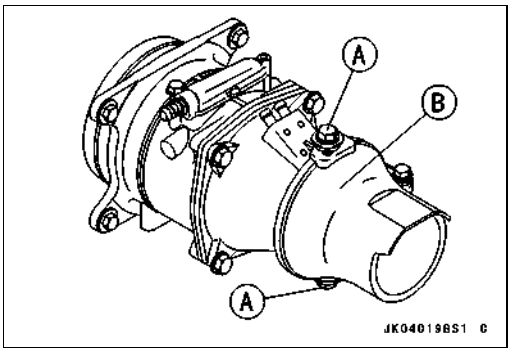


● Install the pump cover.
○ Apply a non-permanent locking agent to the pump cover mounting bolts and torque them.

Torque - Pump Cover Mounting Bolts: 7.8 N·m (0.8 kgf·m, 69 in·lb)

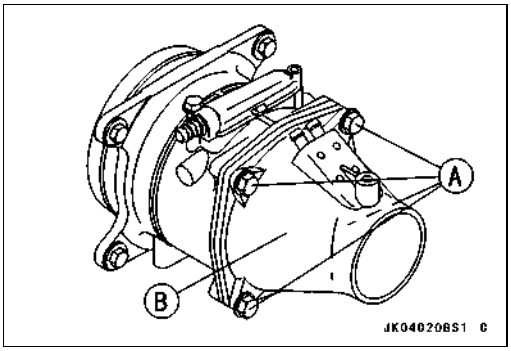
Pump Disassembly

● Unscrew the mounting bolts [A], and remove the steering nozzle [B].

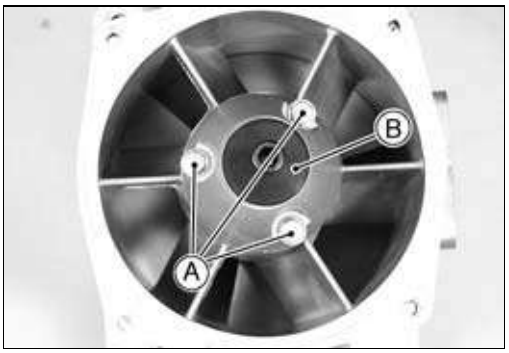


Pump and Impeller

- Unscrew the mounting bolts [A], and remove the pump outlet [B].

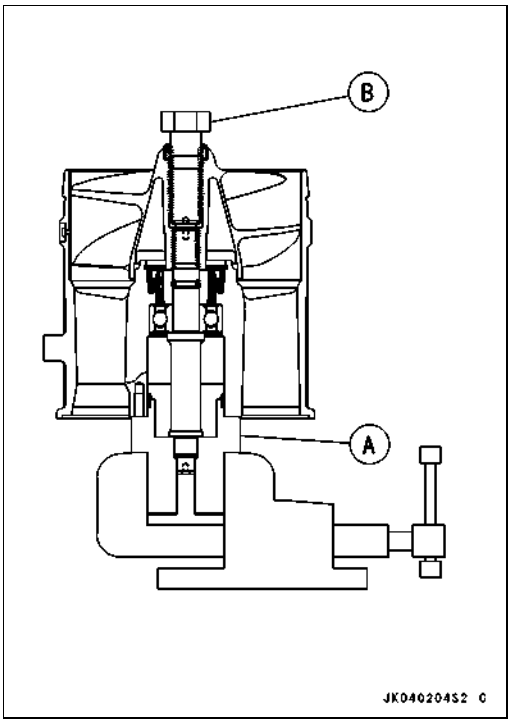


- Unscrew the cap bolts [A], and remove the pump cap [B].



- Hold the shaft in the impeller holder, taking care not to damage it. Remove the impeller from the pump shaft and then pull out the pump shaft.

  Special Tools - Impeller Holder: 57001–1393 [A]
  Impeller Wrench: 57001–1228 [B]

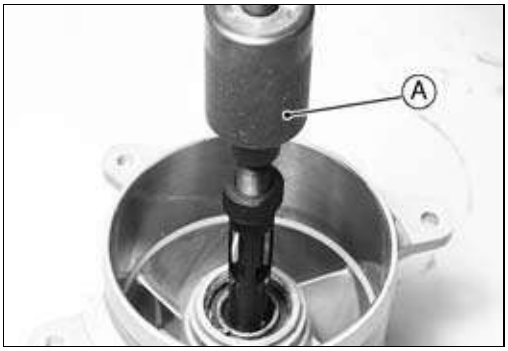


- Pull out the bushing [A].

Pump and Impeller

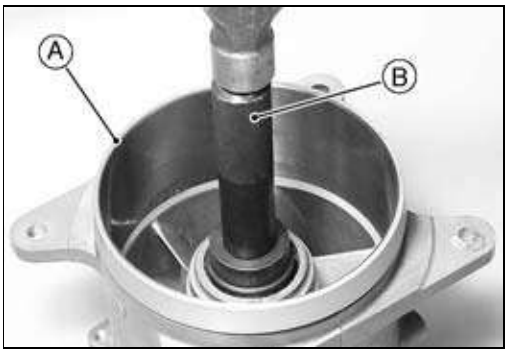
- Remove the grease seals.

  Special Tool - Oil Seal & Bearing Remover: 57001–1058 [A]

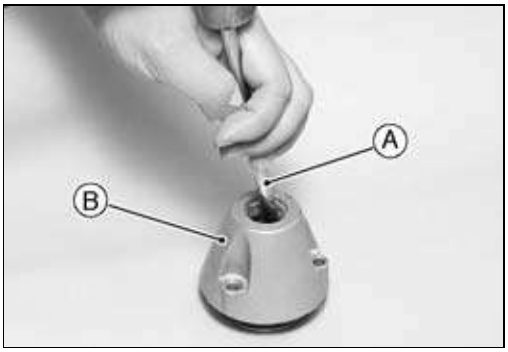


- Remove the bearing by tapping evenly around the bearing inner race from the front end of the pump case [A].

  Special Tool - Bearing Driver Set: 57001–1129 [B]



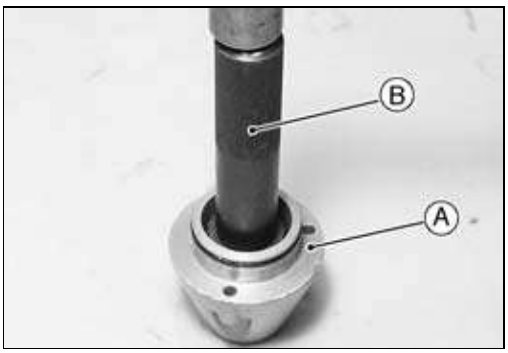
- Insert a metal rod [A] into the pump cap [B] from the rear end, remove the bearing by tapping evenly around the bearing inner race from the rear end of the pump cap.



Pump Assembly

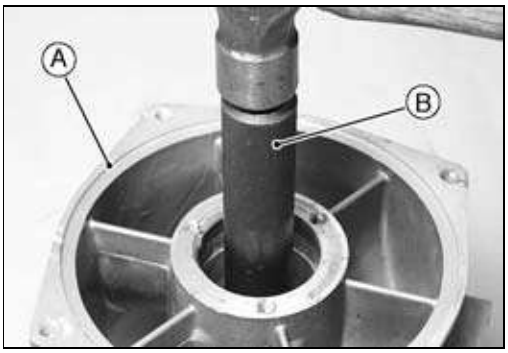
- Before installing the cap bearing, blow any dirt or foreign particles out of the pump cap [A] with compressed air.
- Install new bearing into the cap as far as it will go.

  Special Special Tool - Bearing Driver Set: 57001–1129 [B]



- Before installing the pump bearing, blow any dirt or foreign particles out of the pump case with compressed air.
- Install new bearing into the pump case [A] as far as it will go.

  Special Tool - Bearing Driver Set: 57001–1129 [B]



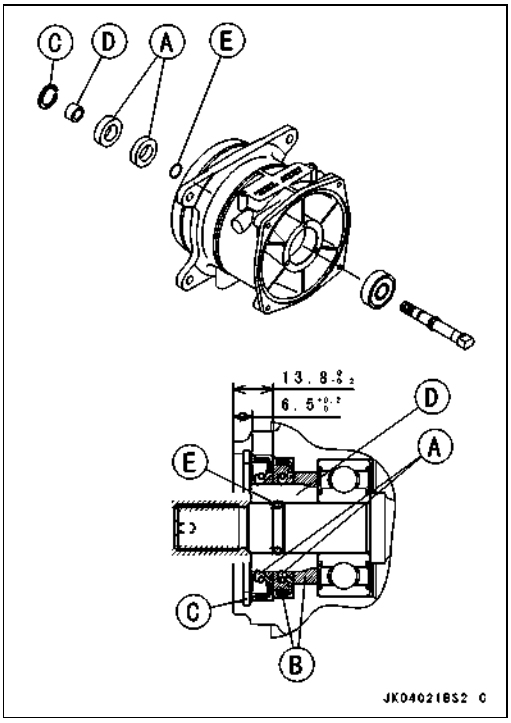
Pump and Impeller

- Replace the grease seals with new ones, if necessary, and install them.

Special Tool - Bearing Driver Set: 57001–1129

○ Press each seal [A] into the pump case so that the side with the spring faces outward. Fill [B] the gap between the seals, and between the seal and the bearing with grease.

- Install the circlip [C].
- Push the bushing [D] into the pump case.
- Visually inspect into the pump shaft O-rings [E], and replace them if necessary .
- Grease the pump shaft and insert it from rear of the pump case.

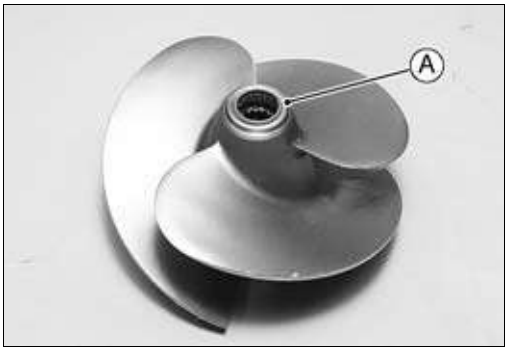


- Screw on the impeller and torque.

Special Tools - Impeller Holder: 57001–1393
Impeller Wrench: 57001–1228

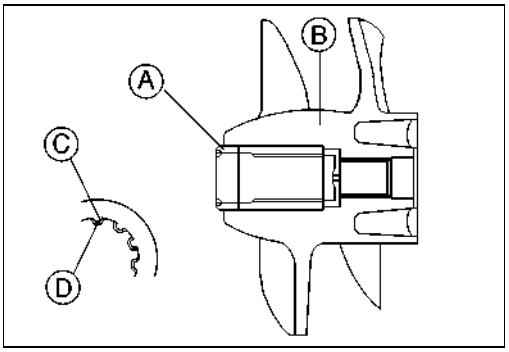
Torque - Impeller: 98 N·m (10 kgf·m, 72 ft·lb)

- Visually inspect impeller grease seal [A], and replace it if necessary.



- When installing the grease seal, follow this procedure.

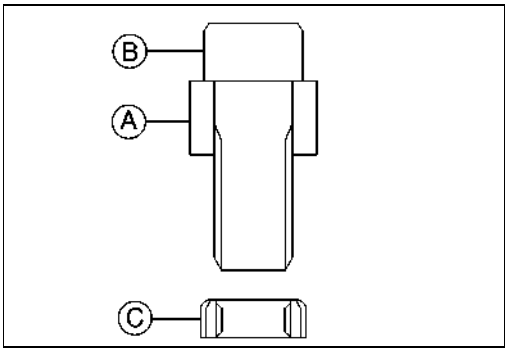
○ Press the grease seal [A] into the impeller [B], aligning the seal teeth [C] with the sleeve teeth [D].



○ To protect the seal teeth from damage, insert a suitable collar [A] that is longer than the non-splined length including the spline starting area into the impeller wrench [B].

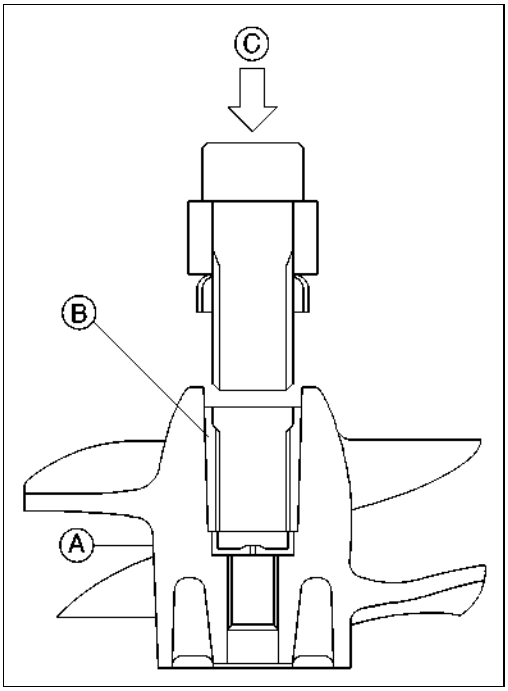
Special Tool - Impeller Wrench: 57001–1228

○ Insert the grease seal [C] deeply into the impeller wrench, aligning the seal teeth with the wrench teeth.



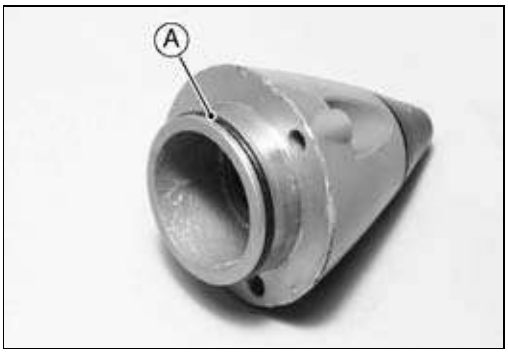
Pump and Impeller

○ Push the above wrench assembly into the impeller [A], and then lightly press [C] the wrench assembly to seat the grease seal into the impeller sleeve [B].



CAUTION
Do not press the grease seal heavily. You could damage the grease seal.

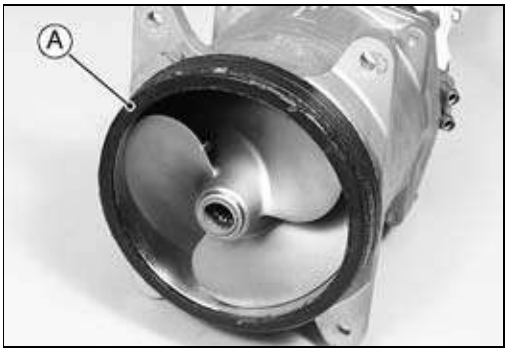
● Be sure the O-ring [A] is in place on the pump cap.



● Install the following.
  Pump Cap
  Pump Outlet
  Steering Nozzle
● Apply a non-permanent locking agent to the thread of the following.
  Pump Cap Bolts
  Pump Outlet Mounting Bolts
  Steering Nozzle Pivot Bolts

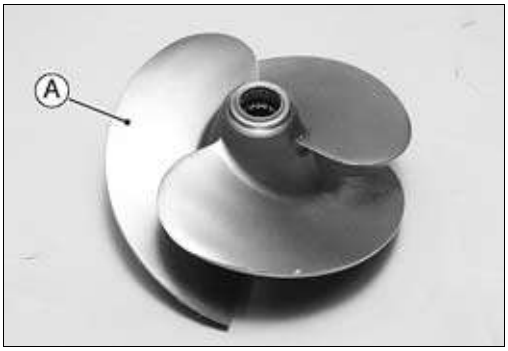
Torque - Pump Cap Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)
Pump Outlet Mounting Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)
Steering Nozzle Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)

● Be sure the pump seal [A] is in place on the pump case.



Pump and Impeller

Pump and Impeller Inspection



- Examine 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.*

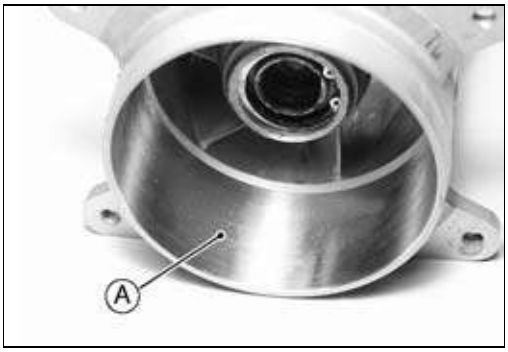
○ Measure the impeller outside diameter.

★If the impeller is worn smaller than the service limit, replace it.

Impeller Outside Diameter

Standard: 147.5 ~ 147.7 mm (5.787 ~ 5.815 in.)

Service Limit: 146.5 mm (5.768 in.)



- Examine the pump case [A].

★If there are deep scratches inside the pump case, replace it.

○ Measure the inside diameter of the pump case.

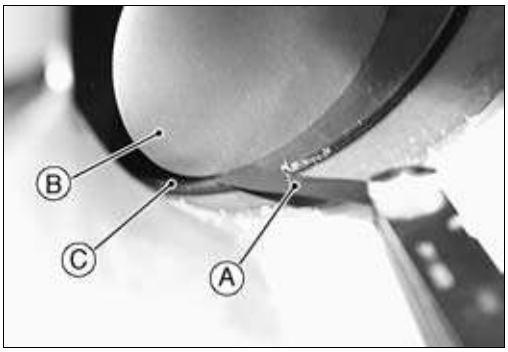
★If the pump case is worn beyond the service limit, replace it.

Pump Case Inside Diameter

Standard: 148.0 ~ 148.1 mm (5.827 ~ 5.831 in.)

Service Limit: 149.1 mm (5.870 in.)

Impeller Clearance



- 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 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 (0.006 ~ 0.012 in.)

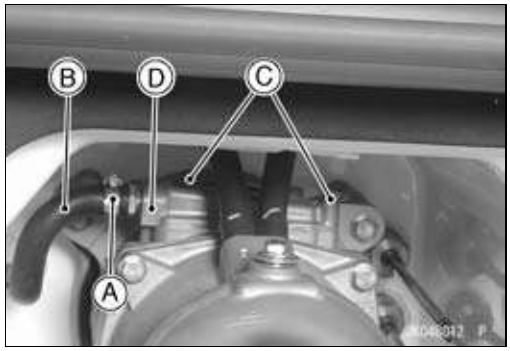
Service Limit: 0.6 mm (0.024 in.)

★If impeller clearance is incorrect, determine if it is due to wear or damage (see Pump and Impeller Inspection).

Pump and Impeller

Water Filter Cover Removal/Installation

- Loosen the clamp [A] and pull off the hose [B].
- Remove the filter cover mounting bolts [C].
- Take out the filter cover [D].
- Replace the gasket with a new one.
- Installation is the revers order of removal.



Steering

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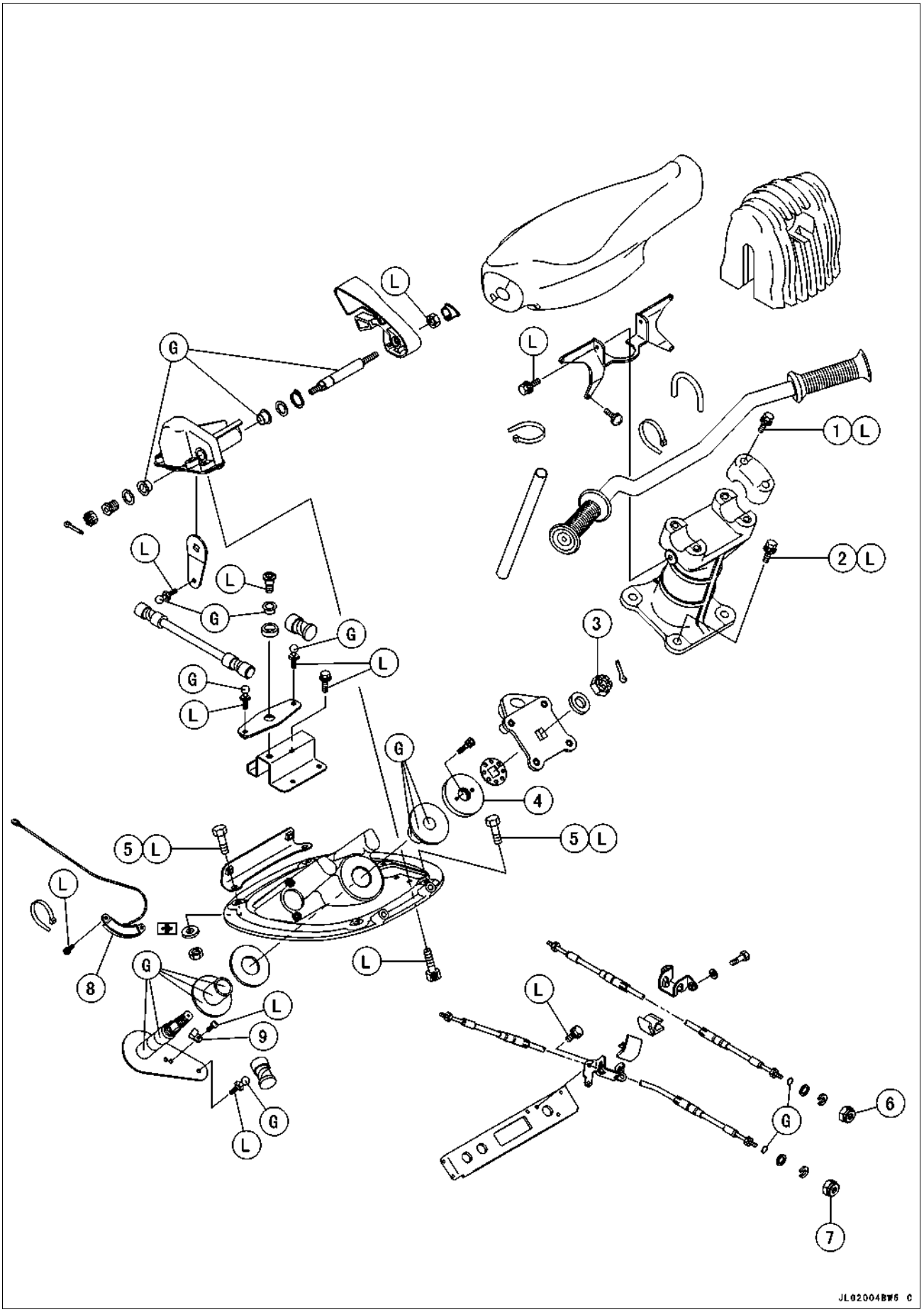
Exploded View



Exploded View

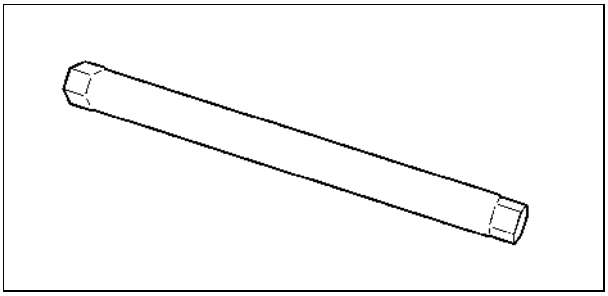
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Handlebar Clamp Bolts	16	1.6	12	L
2	Steering Neck Mounting Bolts	16	1.6	12	L
3	Steering Shaft Locknut	45 ~ 59	5.0 ~ 6.0	36 ~ 43	
4	Steering Shaft Nut	Hand-Tight			
5	Steering Holder Mounting Bolts	16	1.6	12	L
6	Shift Cable Nut	39	4.0	29	
7	Steering Cable Nut	39	4.0	29	

8. Steering Position Sensor
9. Magnet

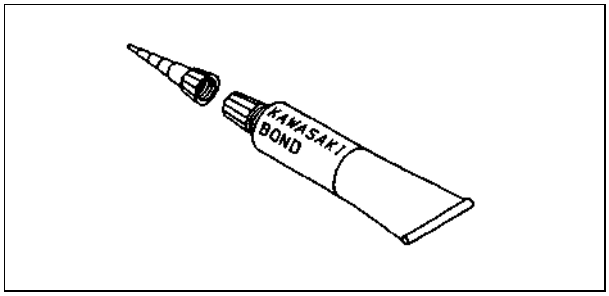
L: Apply a non-permanent locking agent.
G: Apply grease.

Special Tools

Box Wrench: 57001–1451



Kawasaki Bond (Silicone Sealant): 56019–120

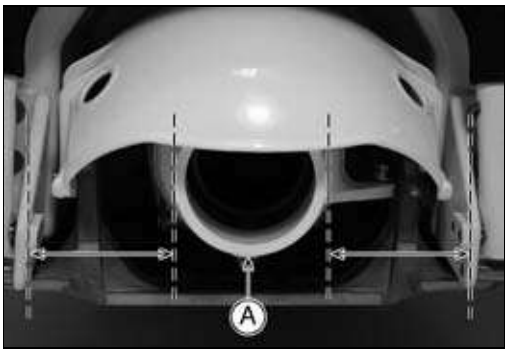


Steering Cable

Steering Cable Adjustment

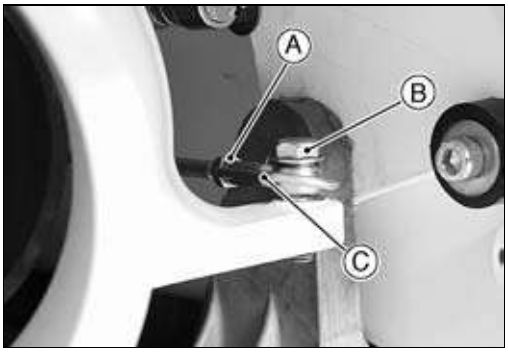
● Check the steering cable adjustment.
○ Center the handlebar in the straight-ahead position.

● Check that the steering nozzle [A] is centered in the pump cavity.



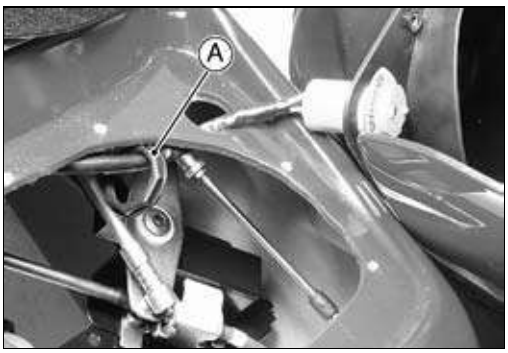
● If necessary adjust the steering cable.
○ Loosen the locknut [A] on the steering cable.
○ Take out the cable joint bolt [B] and disconnect the cable joint [C] from the steering nozzle.
○ Turn the joint on the cable to adjust the steering.
○ Temporarily tightening the cable joint bolt, connect the joint with the nozzle and check 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 - Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)

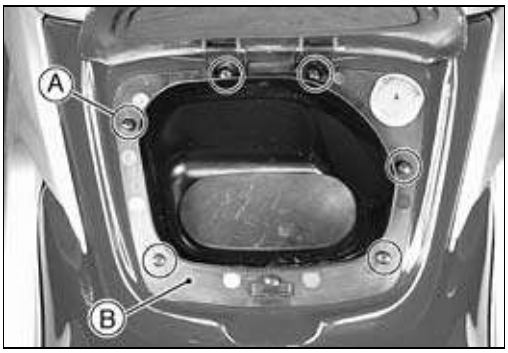


Steering Cable Removal

● Disconnect the ignition switch lead connector.
● Unscrew the ignition switch mounting nut [A] inside the hull.

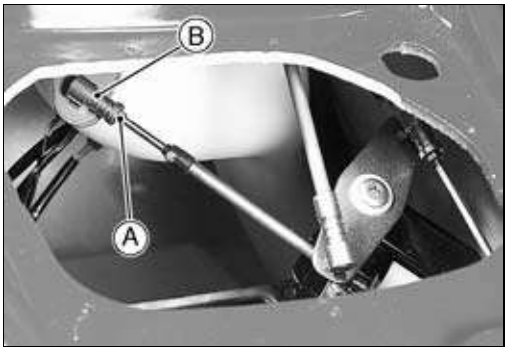


● Take out the screws [A] and remove the storage case [B].

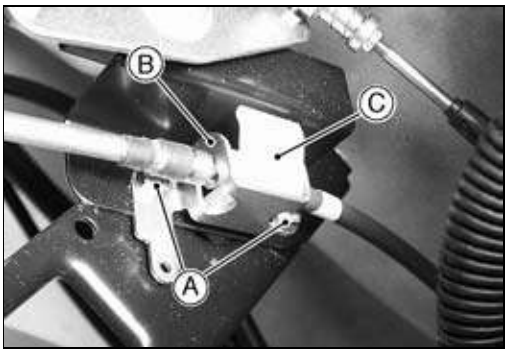


Steering Cable

- Loosen the locknut [A], and remove the ball joint [B] and locknut from the cable front end.



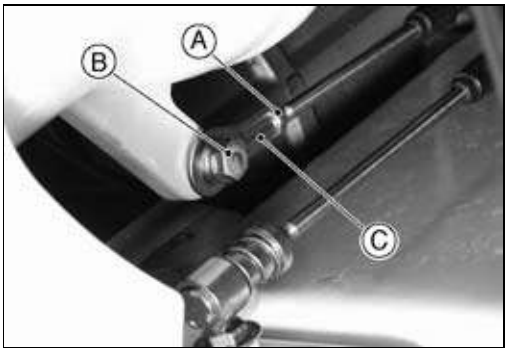
- Unscrew the mounting bolts [A] and nuts, and remove the cable bracket [B].
- Pull the holder [C] off the cable bracket.
- Remove the cable bracket out of the cable front end.



- Turn the watercraft on its left side and remove the pump cover (see Pump Removal in the Pump/Impeller chapter)

CAUTION

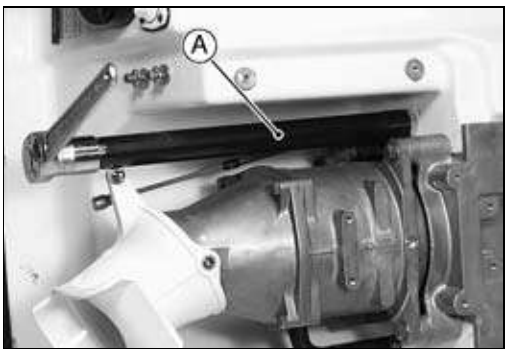
Never lay the watercraft on the right side. Water in the exhaust system may drain back into the engine, causing serious damage.



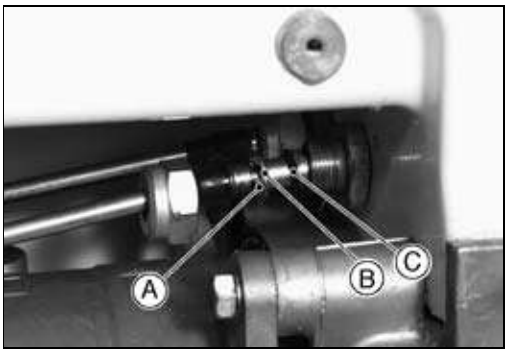
- Loosen the locknut [A] at the rear end of the steering cable, and remove the joint bolt [B].
- Remove the joint [C] and locknut from the cable end.

- Disconnect the steering cable from the fitting at the rear of the hull.
- ○ Unscrew the large nut in the hull with a wrench.
- ○ Special tool, box wrench [A] is useful to remove the large nut (steering cable nut).

Special Tool - Box Wrench: 57001–1451



- ○ Slide off the snap ring [A], washer [B], and O-ring [C].



Steering Cable

- Pull the steering cable from the cable detent in the engine compartment.
- Pull out the steering cable toward the front.

Steering Cable Installation

- Slide a short piece of rubber or plastic tubing over the rear cable end to guide the cable through the hull.
- Lubricate the outside of the new cable to ease cable installation.
- Torque:

Torque - Steering Cable Nut: 39 N·m (4.0 kgf·m, 29 ft·lb)

- Apply a non-permanent locking agent to the cable joint bolt and the steering cable bracket mounting bolts.

Torque - Cable Joint Bolt: 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 Inspection in the Periodic Maintenance chapter.

Steering Cable Lubrication

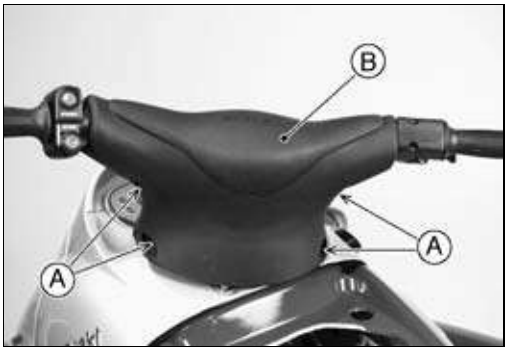
NOTE

○ *The steering cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.*

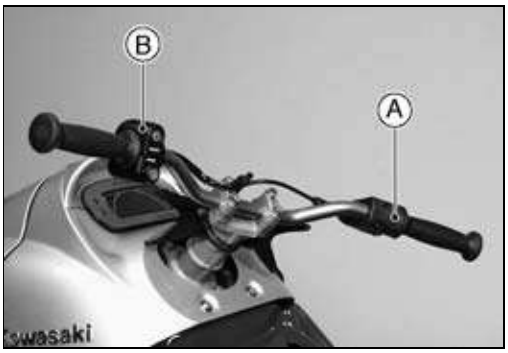
Handlebar

Handlebar Removal

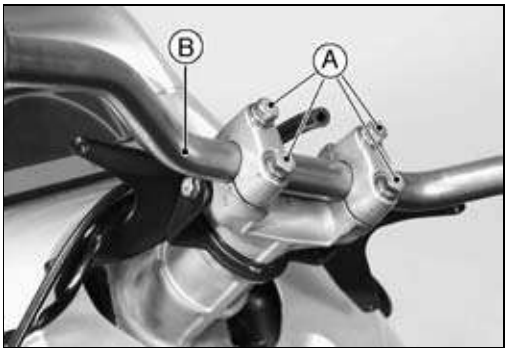
- Remove the handlebar cover.
- Unscrew the mounting screws [A] and remove the handlebar pad [B].
- Take out the inner pad.



- Take out the throttle case clamp screws and remove the throttle case [A].
- Take out the switch case clamp screws and remove the switch case [B].



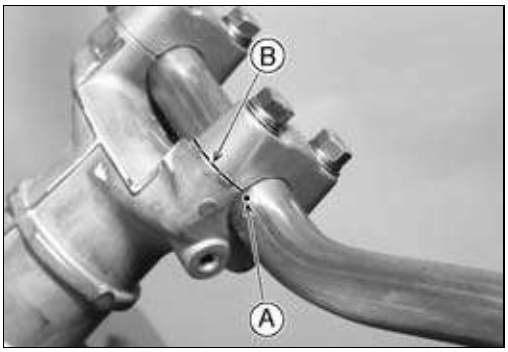
- Take out the handle clamp bolts [A] and remove the handlebar [B].



Handlebar Installation Note

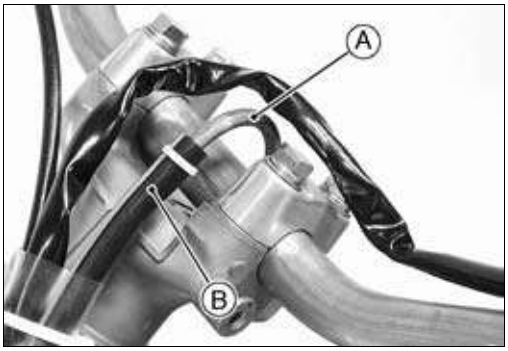
- Apply a non-permanent locking agent to the handlebar clamp bolts.
- Install the handlebar on the holders of the steering neck with clamp bolts.
- Align the punch mark [A] on the left side of the handlebar with the parting line [B].
- Tighten the front and then rear handlebar clamp bolts to the specified torque.

Torque - Handlebar Clamp Bolts: 16 N·m (1.6 kgf·m, 12 ft·lb)

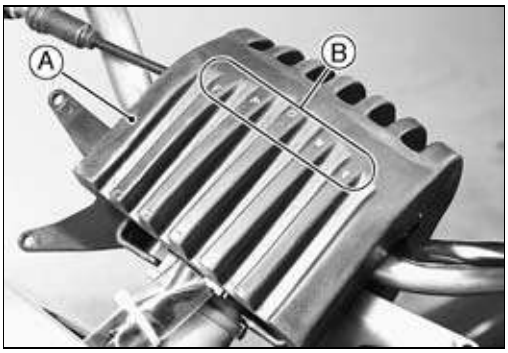


Handlebar

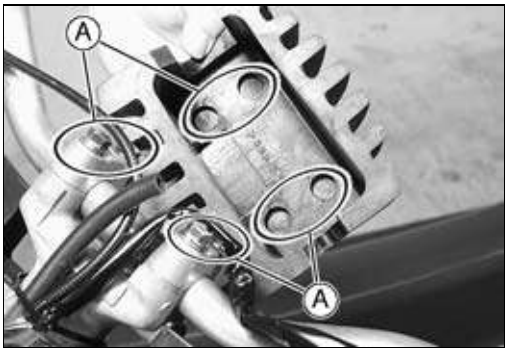
- Be sure the pipe [A] is installed on the top end of the fuel vent hose [B].



- Install the inner pad [A] so that its raised letters “FRONT” [B] faces frontward.



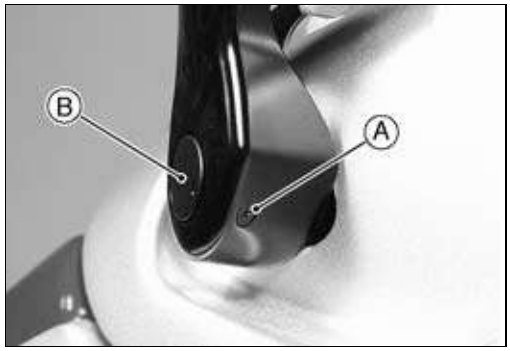
- Align [A] the handlebar clamp bolt heads with the hollows on the inner pad.



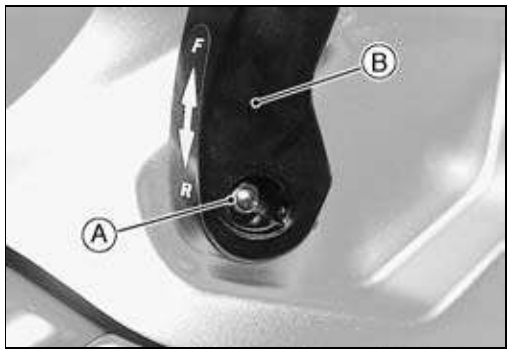
Steering

Removal

- Remove the handlebar (see Handlebar Removal).
- Unscrew the set screw [A] and take out the cap [B].



- Unscrew the nut [A] and remove the shift lever [B].

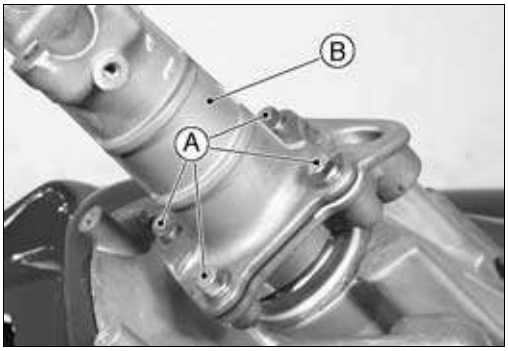


○ Unscrew the mounting bolts [A] [B] and lift up the steering cover.

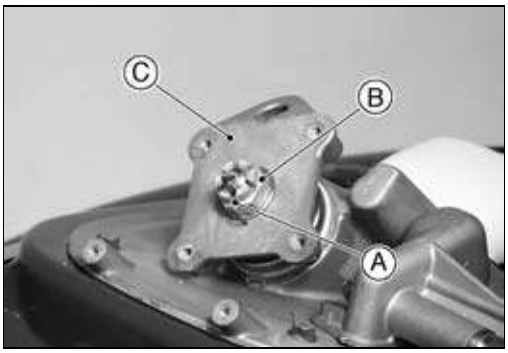
○ Disconnect:
  Multifunction Meter Lead Connectors
  Steering Cable Ball Joint at Upper End
○ Take out the grommet mounting plate [A], and pull out the multifunction meter leads.
- Remove the steering cover [B].

Steering

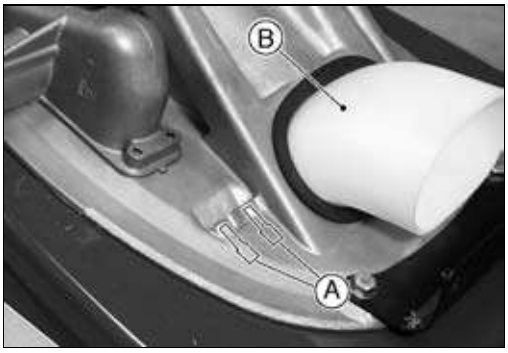
- Unscrew the mounting bolts [A] and remove the steering neck [B].



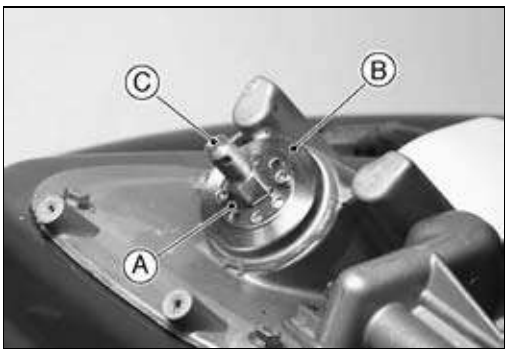
- Remove the cotter pin [A] and locknut [B].
- Take out the holder [C].



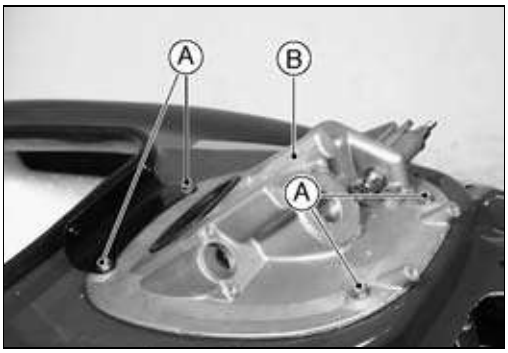
- Take out the mounting bolts [A] and remove the air intake duct [B].



- Remove the lock plate [A].
- Take out the nut [B] and pull down the steering shaft [C].



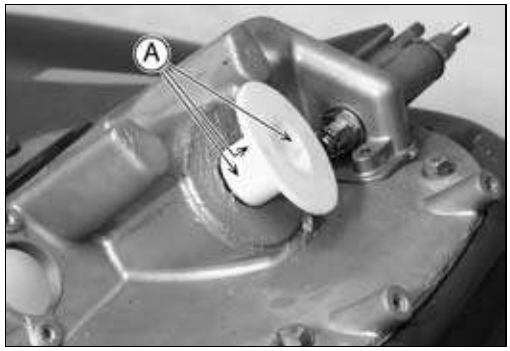
- Disconnect and pull out:
  Throttle Control Cable
  Start/Stop Switch Leads
  Fuel Vent Hose
- Unscrew the mounting bolts [A], nuts, washers, and remove the steering holder [B].



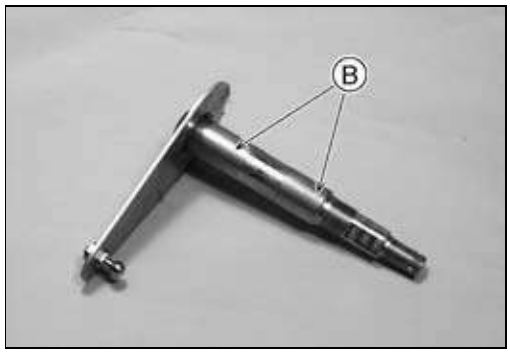
Steering

Installation Notes

● Check the bushings for damage and wear.
★If the bushings are damaged or worn, replace them.
● Grease:
Bushings [A]



Steering Shaft [B]



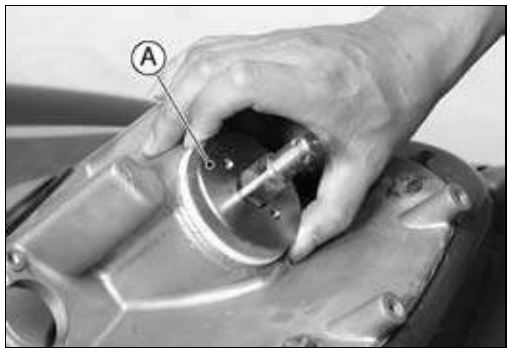
● Apply a non-permanent locking agent to the steering holder mounting bolts and torque them.

Torque - Steering Holder Mounting Bolts: 16 N·m (1.6 kgf·m, 12 in·lb)

● Install the steering shaft nut (Hand-Tighten) [A].
○ If steering is too tight, turn the steering shaft nut counterclockwise to loosen.
○ If steering is too loose, turn the steering shaft nut clockwise to tighten.

NOTE

○ *The steering shaft must be turned smoothly when the cable is connected. Turn the steering shaft nut 1/6 or less turn at a time.*



● Apply silicone sealant to the grommet [A].

Sealant - Kawasaki Bond (silicone sealant): 56019–120

Steering

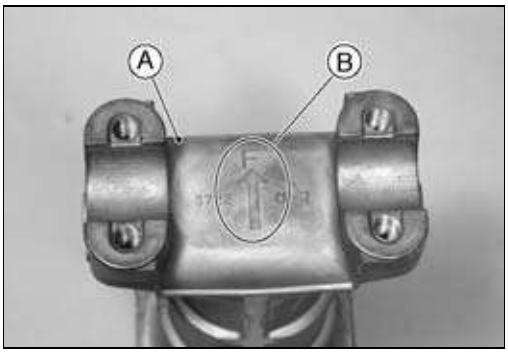
- Torque the steering shaft locknut [A].

  Torque - Steering Shaft Locknut: 49 ~ 59 N·m (5.0 ~ 6.0 kgf·m, 36 ~ 43 ft·lb)

- Replace the cotter pin with a new one.

- Install the steering neck [A] so that its arrow mark [B] points toward the front.
- Apply a non permanent locking agent to the steering neck mounting bolts and torque them.

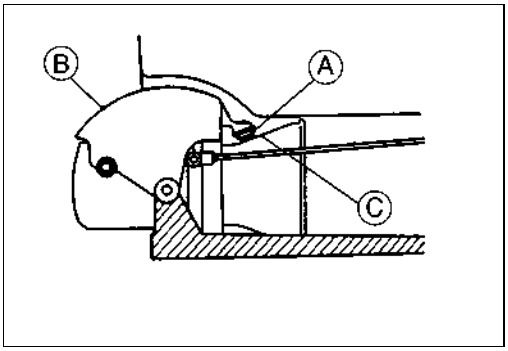
  Torque - Steering Neck Mounting Bolts: 16 N·m (1.6 kgf·m, 12 ft·lb)



Reverse System

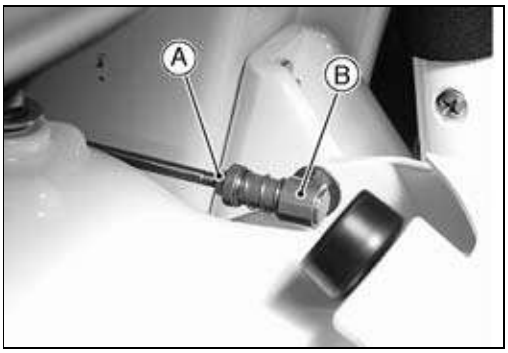
Shift Cable Adjustment

- Check the shift cable adjustment.
- When the shift lever is in the “F” position, the damper [A] on the top of the reverse bucket [B] should stop against the top [C] of the pump outlet.
- When the shift lever is in the “F” position, the lower edge [D] of bucket should be held above the top [E] of the steering nozzle with slight play so it doesn’t interfere with the waterflow the jet pump.



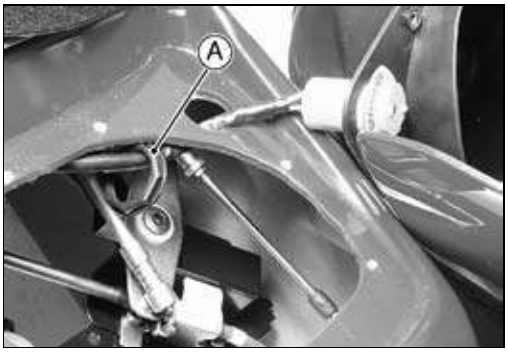
★If the damper does not stop where it should the shift cable must be adjusted.

- Put the shift lever in the “R” position.
- Loosen the locknut [A] on the end of the shift cable.
- Slide back the outer sleeve [B] and take the ball joint off the ball.
- Turn the ball joint on the cable to adjust the shift cable.
- Connect the ball joint and check cable adjustment again.
- When adjustment is correct, tighten the shift cable locknut.



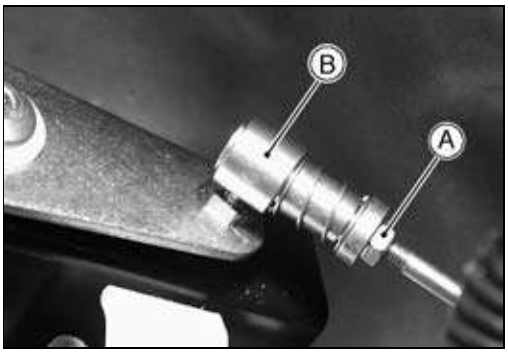
Shift Cable Removal

- Disconnect the ignition switch lead connector.
- Unscrew the ignition switch mounting nut [A] inside the hull.



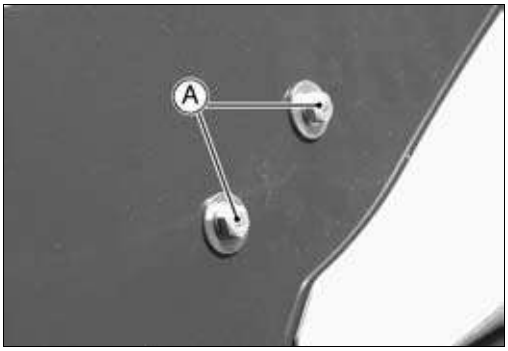
- Take out the screws [A] and remove the storage case [B].

- Loosen the locknut [A], and remove the ball joint [B] and locknut from the cable front end.



Reverse System

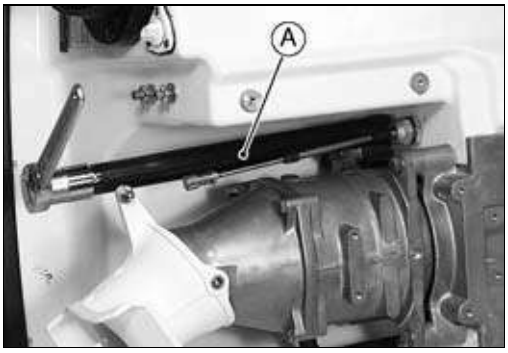
● Unscrew the mounting bolts [A], and remove the cable bracket.



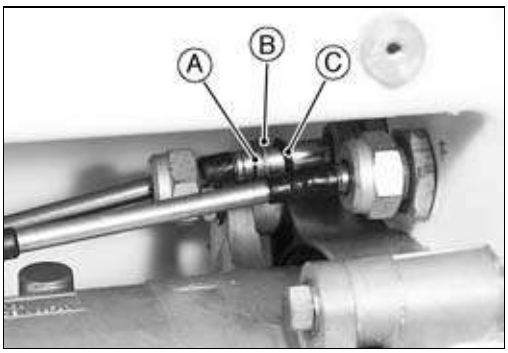
○ Pull the holder [A] off the cable bracket.
○ Remove the cable bracket out of the cable front end.

● Disconnect the shift cable from the fitting at the rear of the hull.
○ Unscrew the large nut in the hull with a wrench.
○ Special tool, box wrench [A] is useful to remove the large nut (shift cable nut).

Special Tool - Box Wrench: 57001–1451



○ Slide off the snap ring [A], washer [B], and O-ring [C].



● Pull the cable from the cable detente in the engine compartment.
● Pull out the shift cable toward the front.

Shift Cable Installation Notes

● Lubricate the outside of the new cable to ease cable installation.
● Slide a piece of rubber or plastic tubing over the rear end of the cable to guide the cable through the hull.
● Torque the shift cable nut.

Torque - Shift Cable Nut: 39 N·m (4.0 kgf·m, 29 ft·lb)

● Adjust the shift cable.

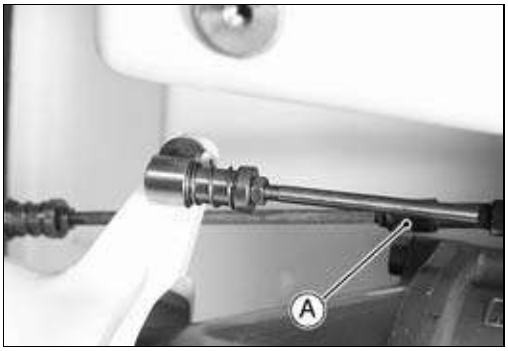
Reverse System

Shift Cable Inspection

- Examine the shift cable.

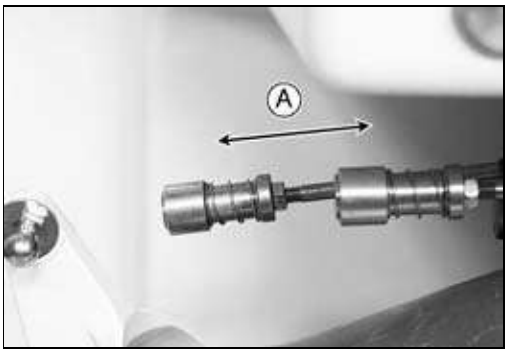
★If the cable or cable housing is kinked or frayed, replace the cable.

★If the seal [A] at either end of the cable is damaged in any way, replace the cable.



- Be certain that the cable moves freely in both directions.
- Disconnect the ball joint at each end of the cable.

○ Slide the outer sleeve away from the ball slightly, and lift the cable from the ball.



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 and forth [A] in the cable housing.

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

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.*

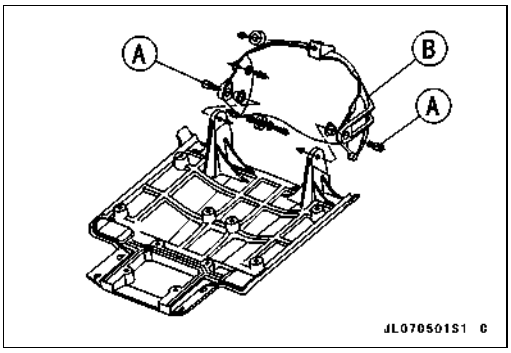
Reverse Bucket Removal/Installation

- Disconnect the ball joint at rear end of the shift cable.
- Remove the pump cover.
- 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 to the reverse bucket pivot bolts, and torque them.

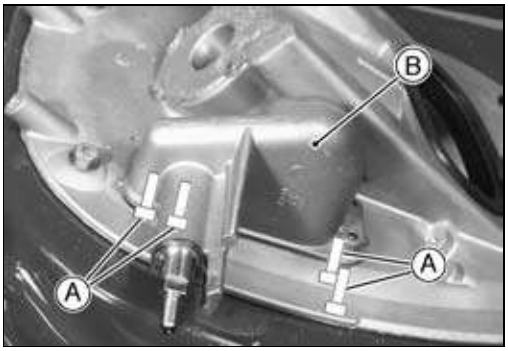
Torque - Reverse Bucket Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)

○ After installation, check the shift cable adjustment.



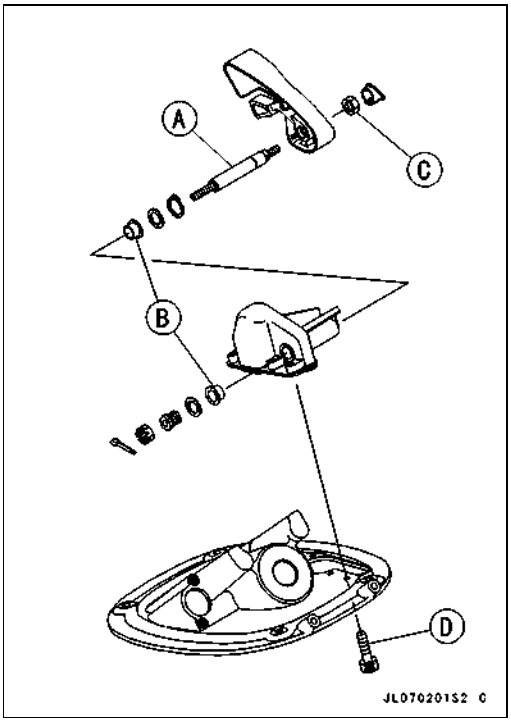
Shift Lever Shaft Removal/Installation

- Remove:
  Steering Cover
  Air Intake Duct
  Shift Link Rod Ball Joint (disconnect)
- Unscrew the mounting bolts [A] on the inside of the hull and remove the shift lever holder [B].



Reverse System

● Assemble the shift lever holder, noting the following.
○ Grease:
Shift Lever Shaft [A]
Bushings [B]
○ Apply a non-permanent locking agent to the lever nut [C] and the shift lever holder mounting bolts [D] and tighten them.



Hull/Engine Hood

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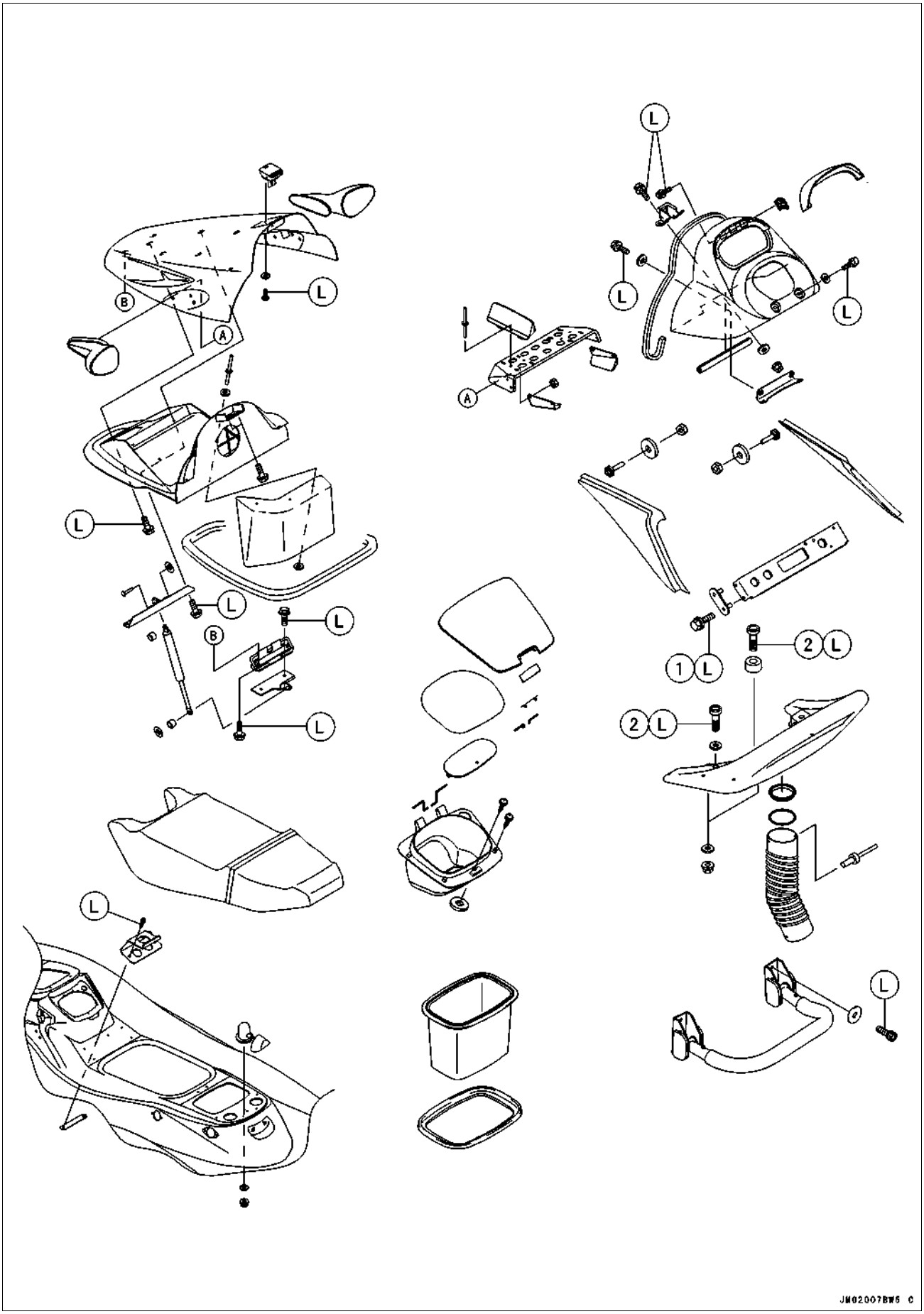
Exploded View



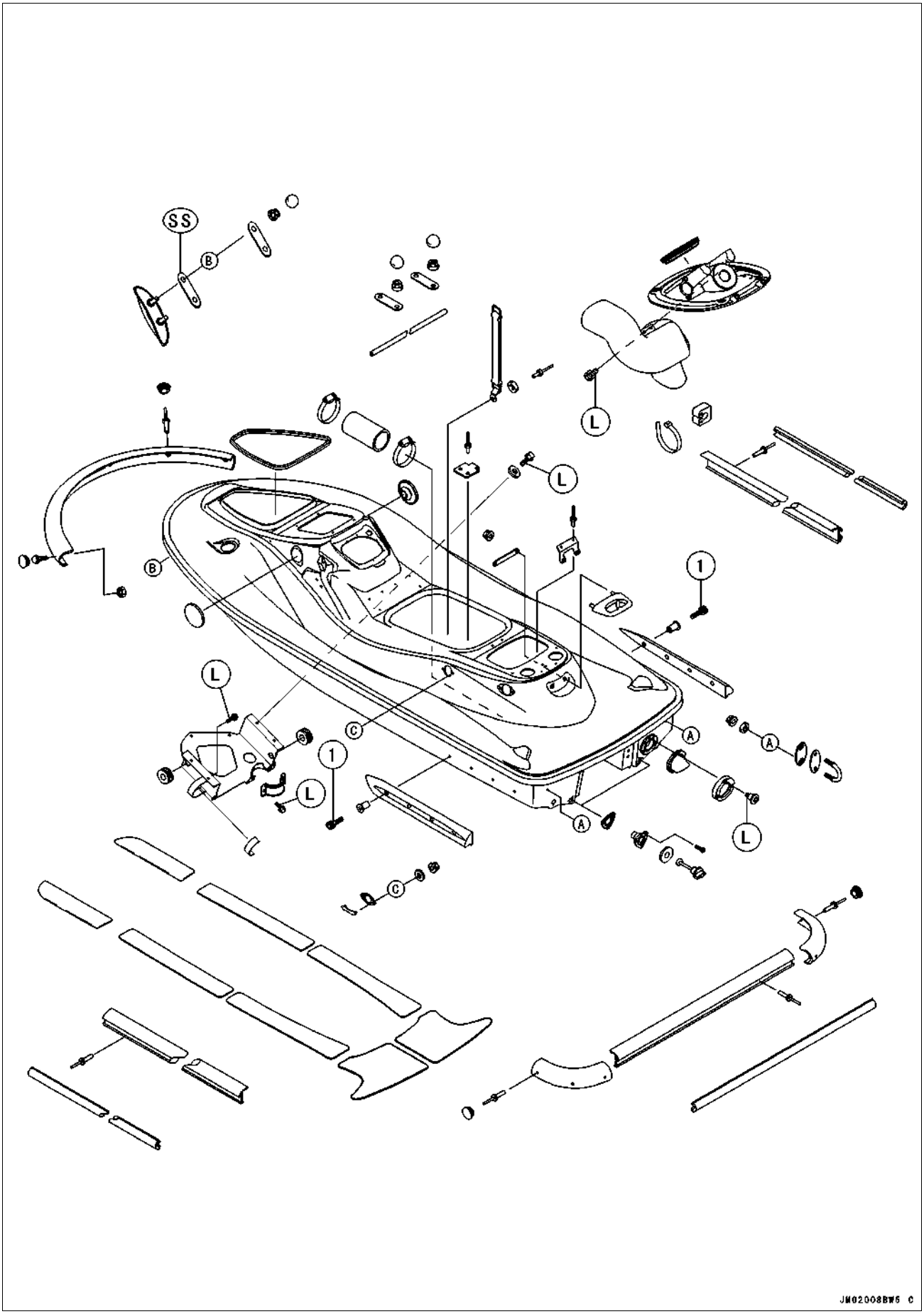
Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Crossmember Mounting Bolts	7.8	0.8	69 in·lb	L
2	Rear Grip Mounting Bolts	9.8	1.0	87 in·lb	L

L : Apply a non-permanent locking agent.

13-4 HULL/ENGINE HOOD

Exploded View



Exploded View

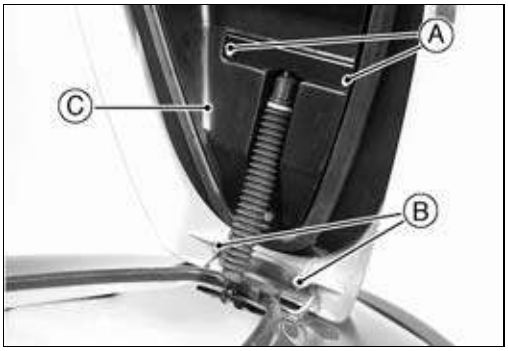
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Stabilizer Mounting Bolts	9.8	1.0	87 in·lb	

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

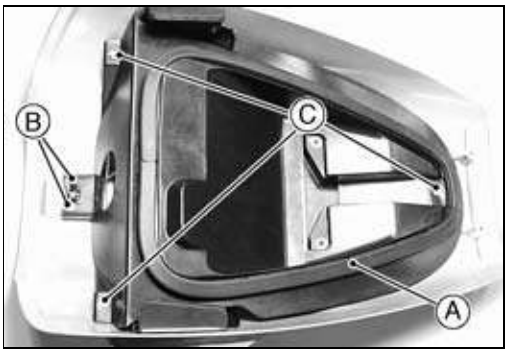
Fittings

Hatch Cover Removal

● Remove:
Damper Bracket Mounting Bolts [A]
Hatch Cover Bracket Mounting Bolts [B]
Hatch Cover Assembly [C]

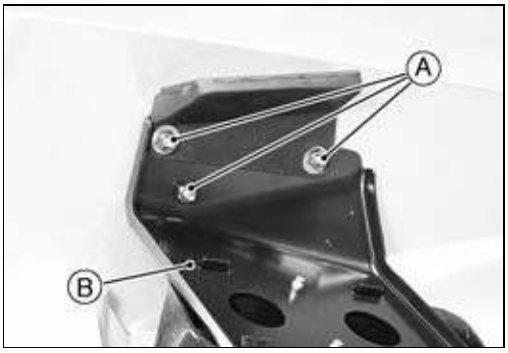


● To remove the air intake duct [A], unscrew the mounting screws [B] and bolts [C].

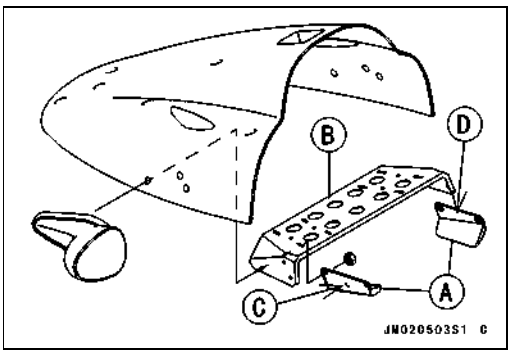


Rear View Mirror Removal/Installation

● Open the hatch cover.
● Unscrew the mounting nuts [A], remove the mirror stay [B] and the rear view mirror.



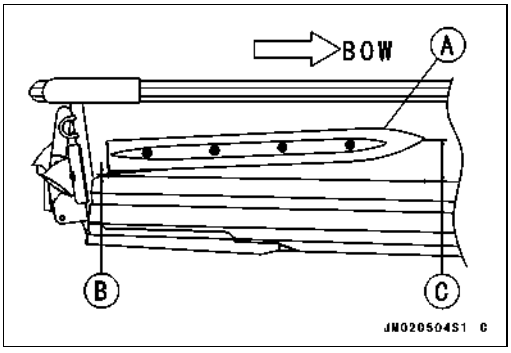
● When installing the stay brackets [A], nothing the following.
○ Install the stay brackets [A] to the stay [B] nothing the mark “L” [C] or the mark “R” [D].



Stabilizer Installation

● Install the stabilizer [A] on the hull as shown.
5 ± 2 mm [B]
92 ± 3 mm [C]
● Torque:

Torque - Stabilizer Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

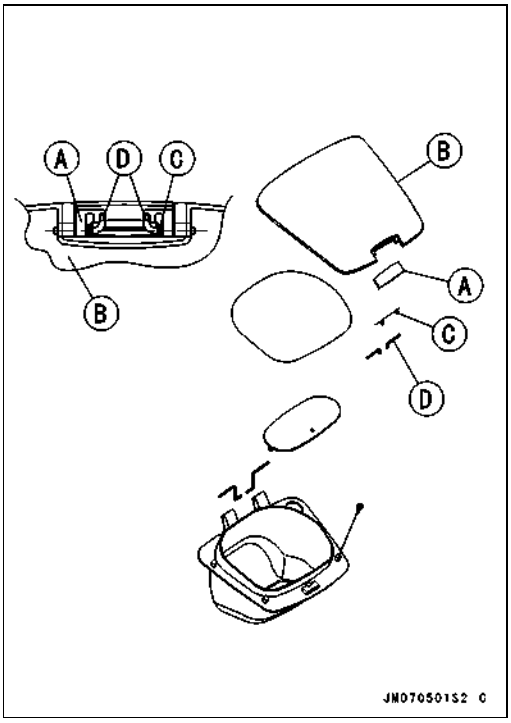


Fittings

Storage Cover Assembly

- When disassembling the lock [A] from the storage cover [B], assemble the storage cover, as shown.
  Storage Cover [B]
  Lock [A]
  Spring [C]
  Shaft [D]

○ Push down the shaft [D] into the lock [A].

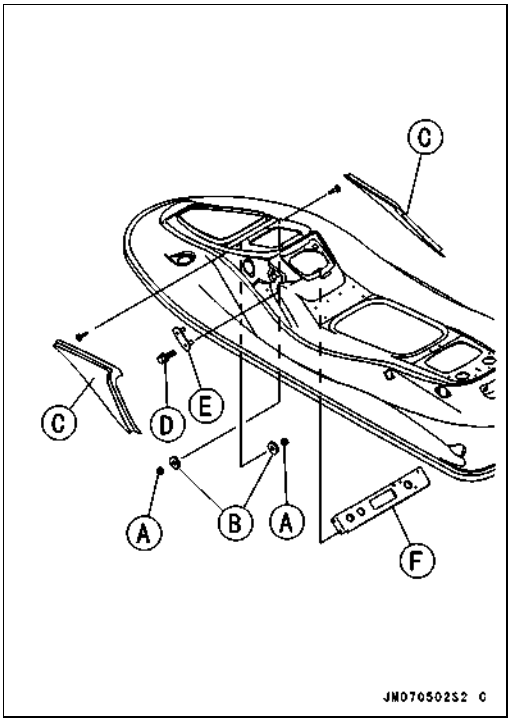


Crossmember Removal/Installation

- Remove the oil tank (see Oil Tank Removal in Engine Lubrication chapter).
- Unscrew the mounting nuts [A] and washers [B], and remove the covers [C].
- Unscrew the mounting bolts [D] and bracket [E], and remove the crossmember [F].
- When installing the crossmember to the hull, note the following.

○ Apply a non-permanent locking agent to the crossmember mounting bolts and torque them.

Torque - Crossmember Mounting Bolts: 7.8 N·m (0.8 kgf·m, 69 in·lb)



13-8 HULL/ENGINE HOOD

Hull Replacement

To replace the hull, remove the various parts in the following suggested order.

Battery and Pad
Exhaust Pipe and Expansion Chamber
Throttle Body Assembly
EMM, Condenser, Fuel Filter
Engine and Mounts
Oil Tank
Ignition Coil Assembly
Water Box Muffler
Drive Shaft and Shaft Holder
Steering Cover
Pump and Hoses
Handlebar and Steering
Fuel Tank and Filler
Steering Cable
Shift Cable
Crossmember
Bilge and Cooling System Hose
Bypass Hose and Outlet
Bumpers
Engine Hood Latch
Hatch Cover and Brackets
Handgrip

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.

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 Engine Hood Gasket Hatch Cover Trim Seal	Synthetic Rubber Adhesive (P/N: 92104-3701)
Detents Handlebar Grips	Cyanoacrylate Cement

CAUTION

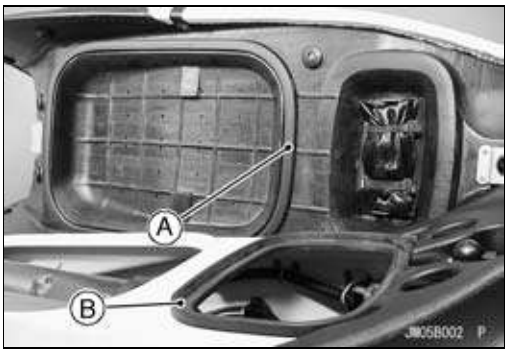
Be very careful that the part is positioned correctly when you apply the cement. It may be impossible to reposition the part.

⚠ WARNING

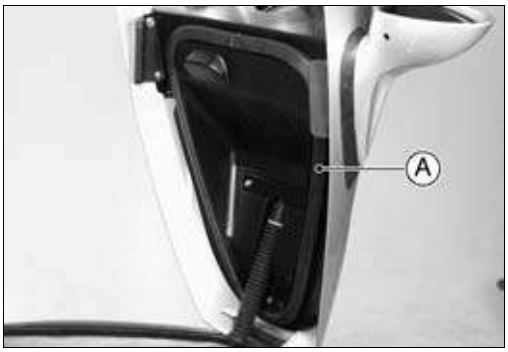
Do not get any cyanoacrylate cement in your eyes or on your skin. If you do get some in your eyes, do not try to wash it out. Contact a physician immediately! If you do get some on your fingers, do not touch any other part of your body; your fingers will stick to anything they touch. Allow the cement to cure and it will eventually wear off.

Rubber Parts Location

Engine Hood Gasket [A]
Rear Storage Seal [B]

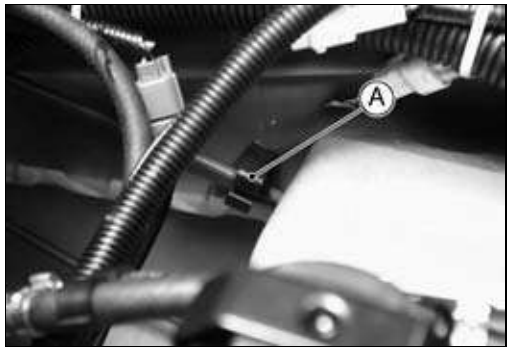


Trim Seal [A]

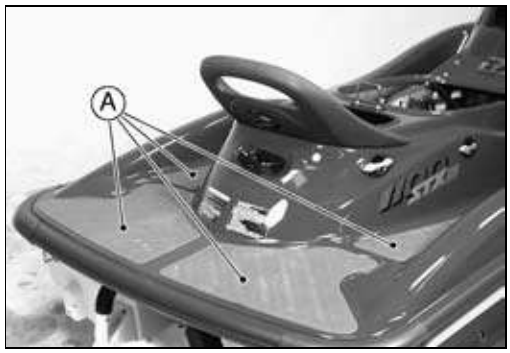


Rubber Parts

Detent [A]



Mats [A]



Front Bumper Removal/Installation

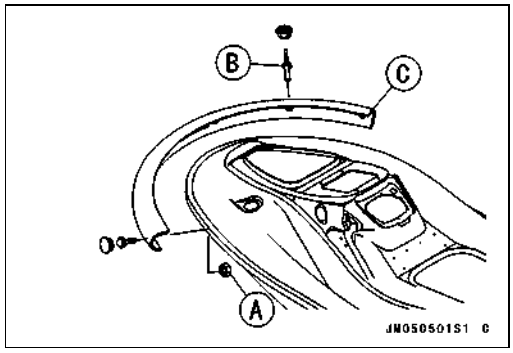
- Take out the mounting nuts [A].
- Drill out the pop rivets [B] with a drill bit of the correct size.

Pop Rivet Removal Drill Bit Size
5.0 mm

NOTE

- *Stop drilling when the rivet head starts to turn with drill bit.*
- *Tap the rivet out of the hull flange with a suitable punch and hammer.*

- Remove the front bumper [C].
- When installing the front bumper, noting following.
- Secure the bumper to the hull flange with a pop rivet.



Rear Bumper Removal/Installation

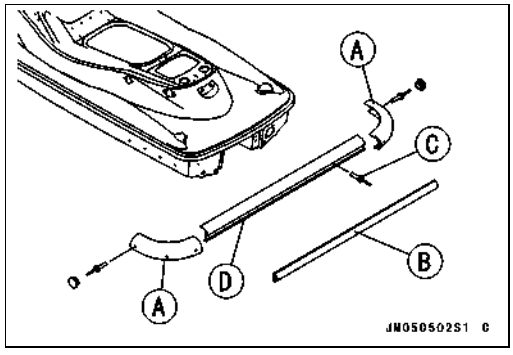
- Remove the corner bumpers [A] and trim strip [B].
- Drill out the pop rivets [C] with a drill bit of the correct size.

Pop Rivet Removal Drill Bit Size
5.0 mm

NOTE

- *Stop drilling when the rivet head starts to turn with drill bit.*
- *Tap the rivet out of the hull flange with a suitable punch and hammer.*

- Remove the rear bumper [D].
- When installing the rear bumper, noting following.
- Secure the bumper to the hull flange with a pop rivet.



Rubber Parts

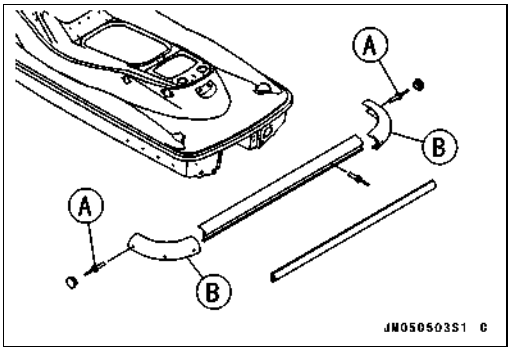
Side Bumper Removal

- Drill out the pop rivets [A] with a drill bit of the correct size.

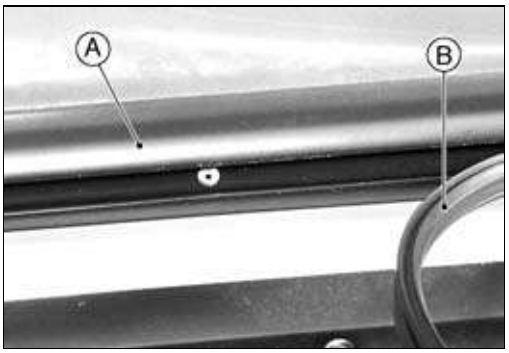
Pop Rivet Removal Drill Bit Size
5.0 mm

NOTE

- *Stop drilling when the rivet head [A] starts to turn with drill bit.*
- *Tap the rivet out of the hull flange with a suitable punch and hammer.*



- Remove the corner bumper [B].
- Remove the trim strip [A] from the side bumper [B].

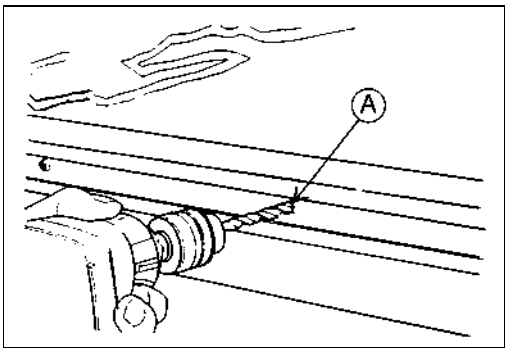


- Drill out the pop rivets with a drill bit of the correct size.

Pop Rivet Removal Drill Bit Size
5.0 mm

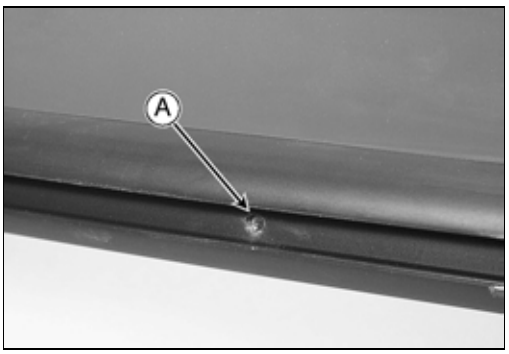
NOTE

- *Stop drilling when the rivet head [A] starts to turn with drill bit.*
- *Tap the rivet out of the hull flange with a suitable punch and hammer.*

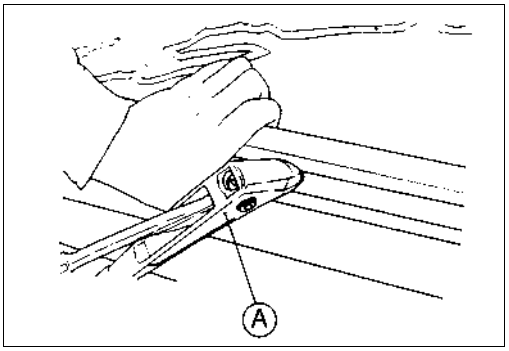


Side Bumper Installation

- Align [A] the hole on the bumper with the mounting hole on the hull.



- Secure [A] the bumper to the hull flange with a pop rivet.
- Install the trim strip pushing on the both sides of the strip.



Electrical System

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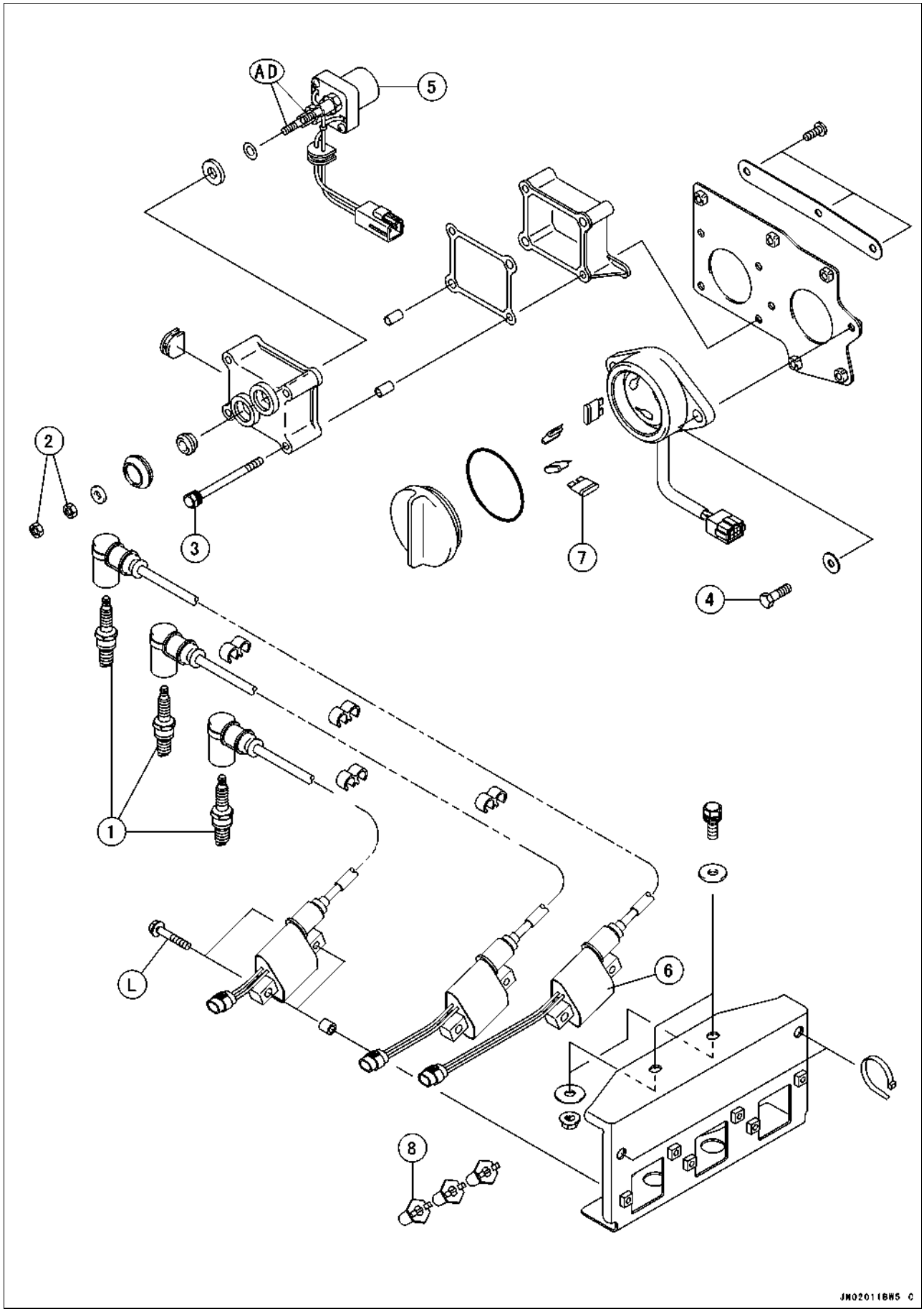


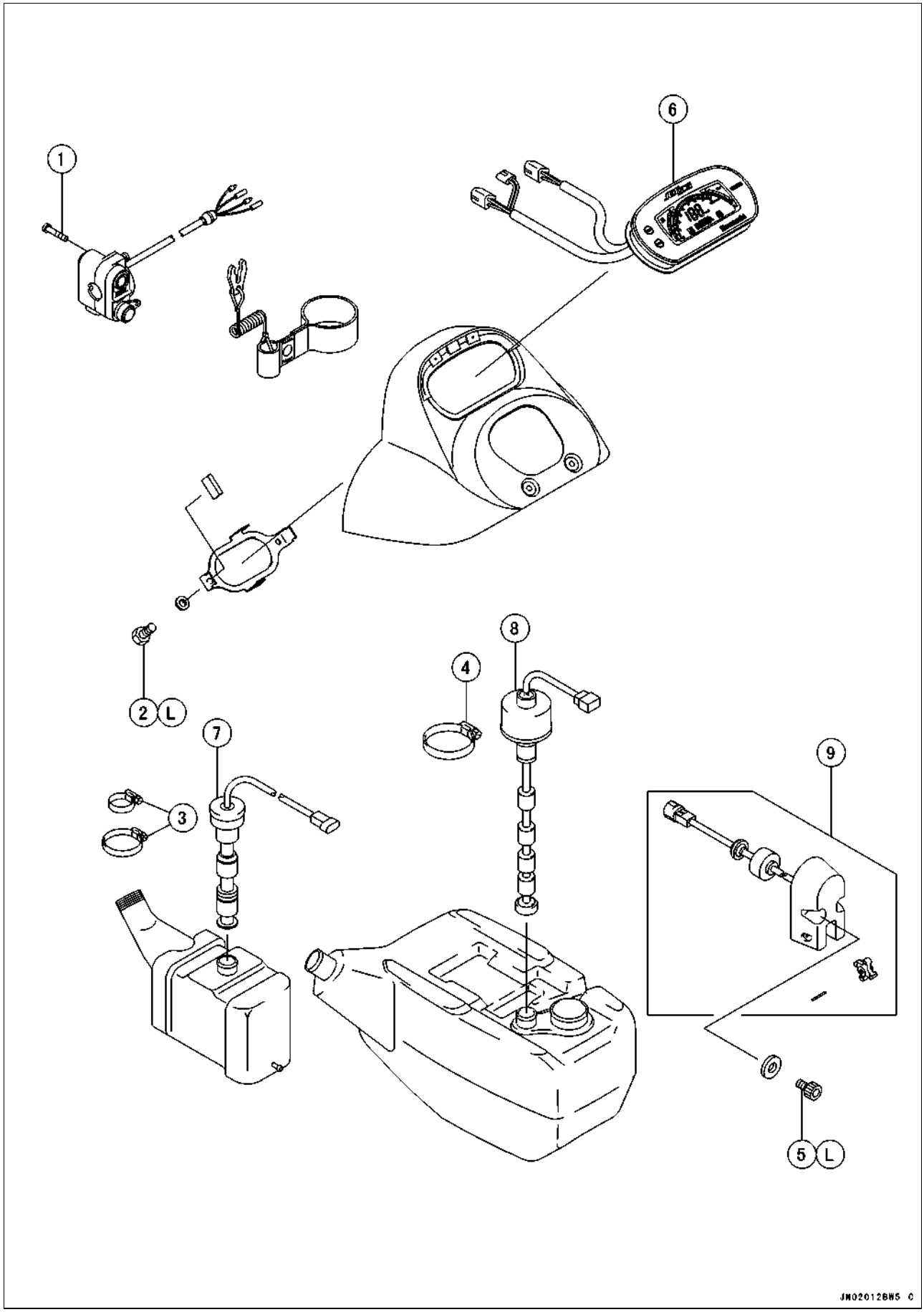
Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Spark Plugs	24 ~ 29	2.5 ~ 3.0	18 ~ 22	
2	Starter Relay Nut	4.4	0.4	39 in·lb	AD
3	Electric Case Mounting Bolts	7.8	0.8	69 in·lb	
4	Fuse Case Mounting Bolts	7.8	0.8	69 in·lb	

5. Starter Relay
6. Ignition Coils
7. Fuse
8. Spark Plug Cap Holder

L: Apply a non-permanent locking agent.
AD: Apply adhesive (3M DP-270 BLACK) to the terminals to prevent the terminals from galvanic corrosion.

Exploded View

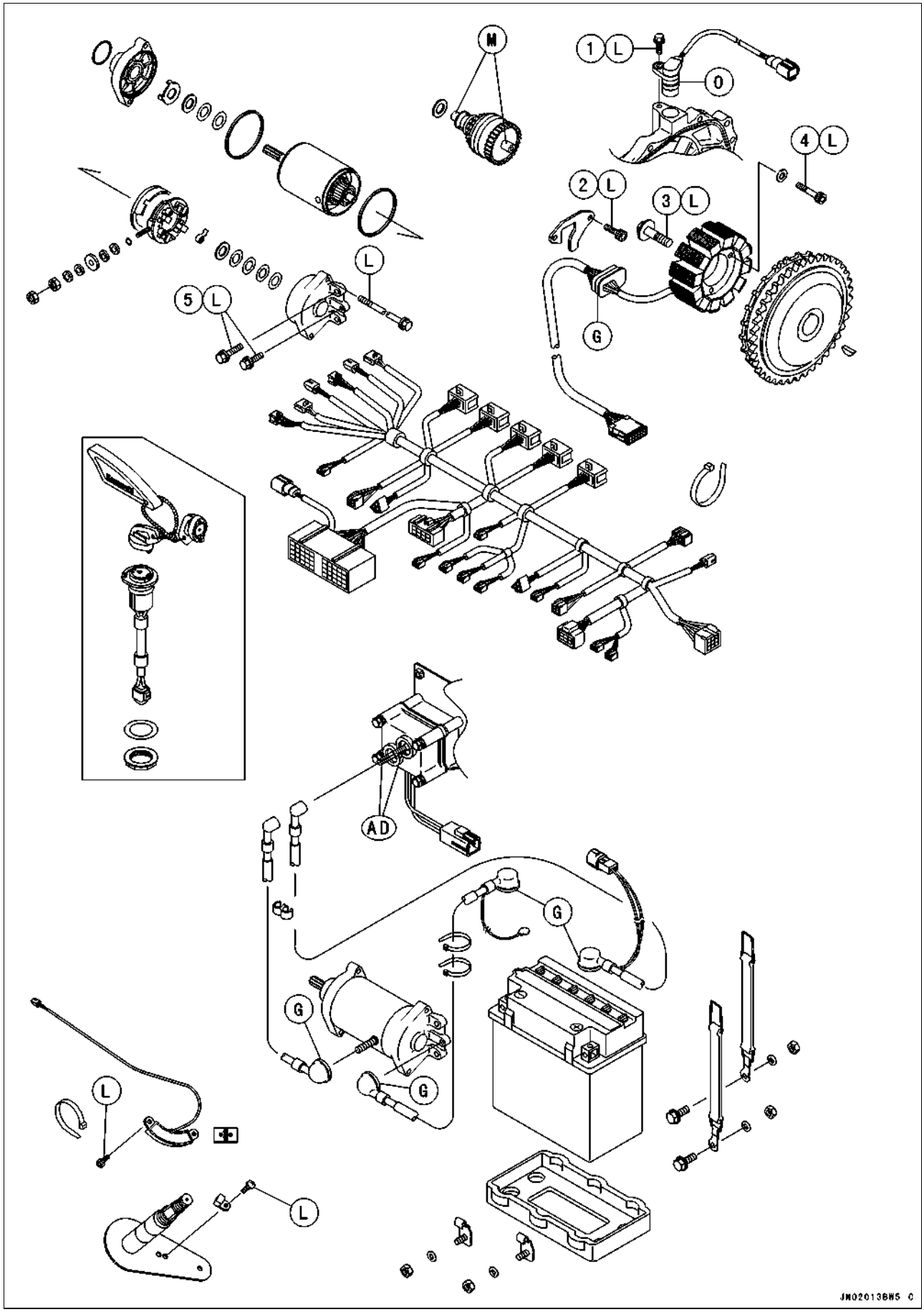


Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Start/Stop Switch Mounting Screw	3.9	0.4	35 in·lb	
2	Multifunction Meter Mounting Bolts	3.9	0.4	35 in·lb	L
3	Oil Level Sensor Clamp Screw	2.9	0.3	26 in·lb	
4	Fuel Level Sensor Clamp Screw	2.9	0.3	26 in·lb	
5	Speed Sensor Mounting Bolts	3.9	0.4	35 in·lb	L

6. Multifunction Meter
7. Oil Level Sensor
8. Fuel Level Sensor
9. Speed Sensor

Exploded View

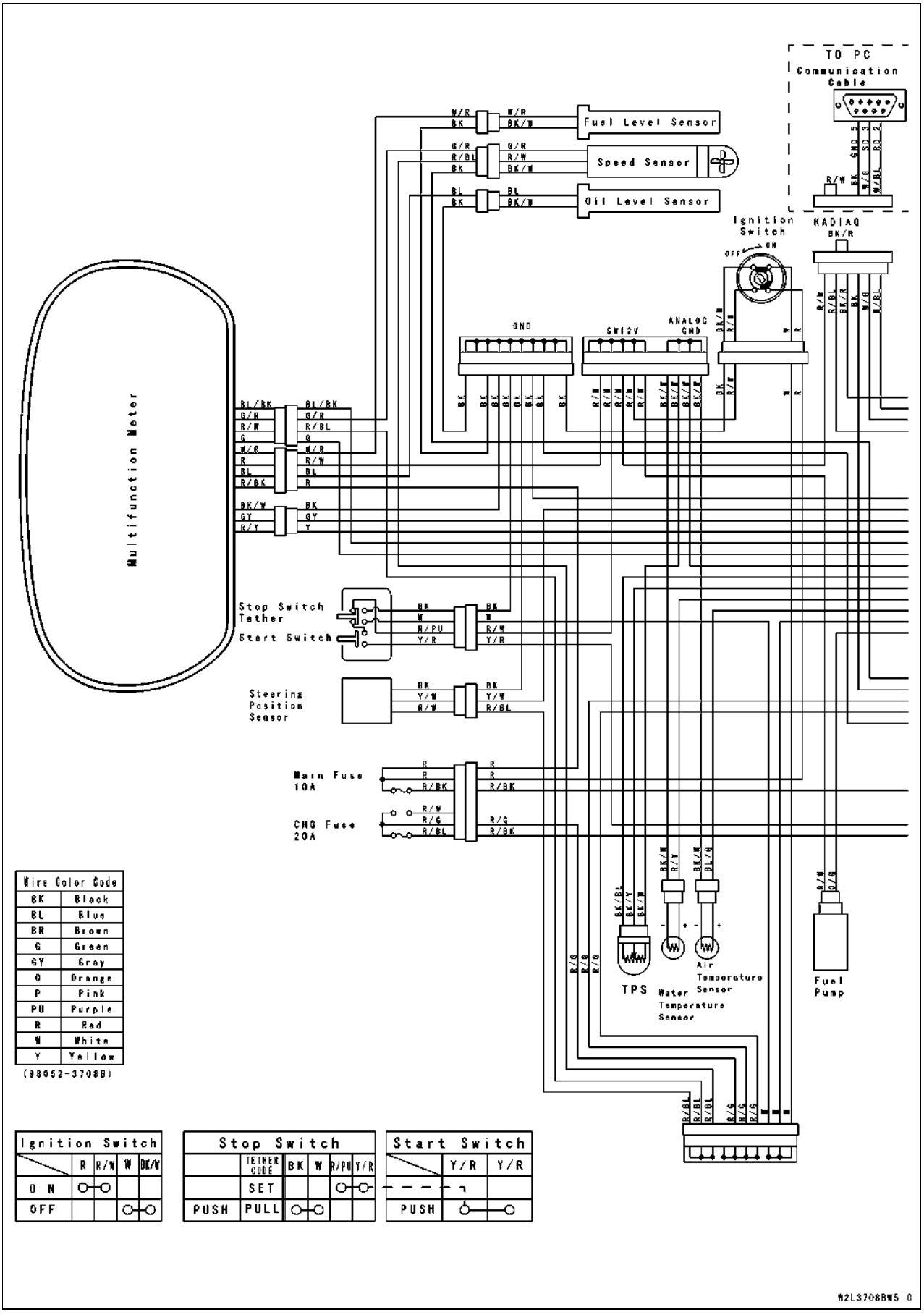


Exploded View

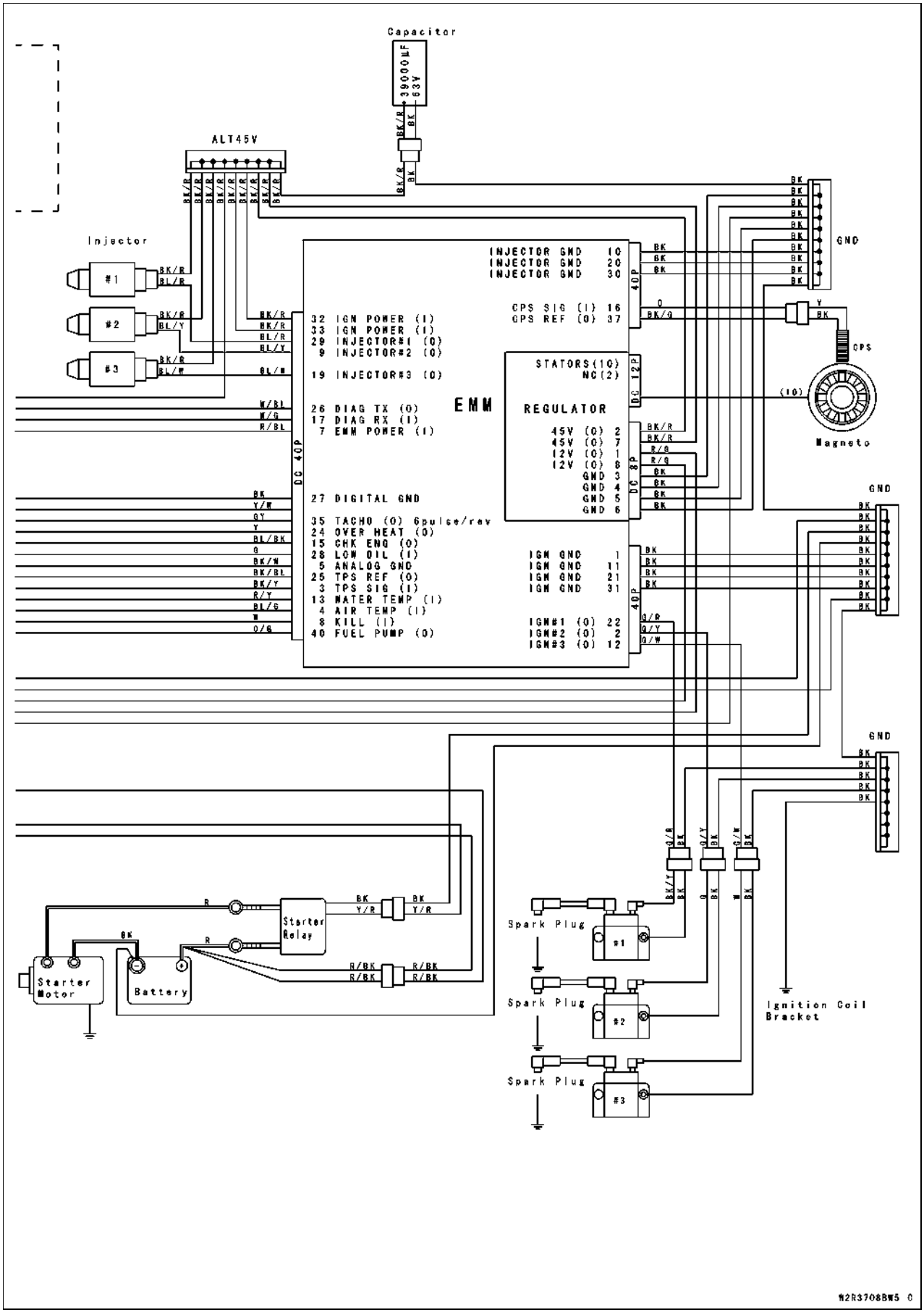
No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Crank Position Sensor Mounting Bolt	8.8	0.9	78 in·lb	L
2	Grommet Plate Mounting Bolts	8.8	0.9	78 in·lb	L
3	Flywheel Bolt	132	13.5	96	L
4	Stator Mounting Bolts	12	1.2	104 in·lb	L
5	Stator Motor Mounting Bolts	8.8	0.9	98 in·lb	L

G: Apply grease.
L: Apply a non-permanent locking agent.
M: Apply molybdenum disulfide grease.
O: Apply 2–stroke oil.
AD: Apply adhesive (3M DP-270 BLACK) to the terminals to prevent the terminals from galvanic corrosion.

Wiring Diagram



Wiring Diagram

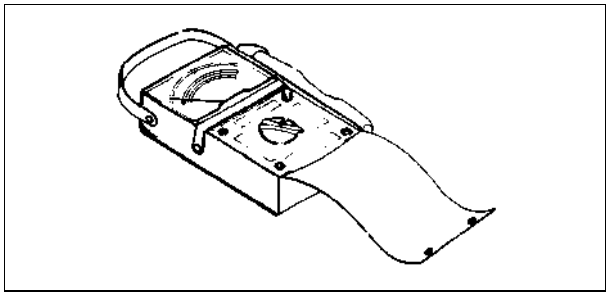


Specifications

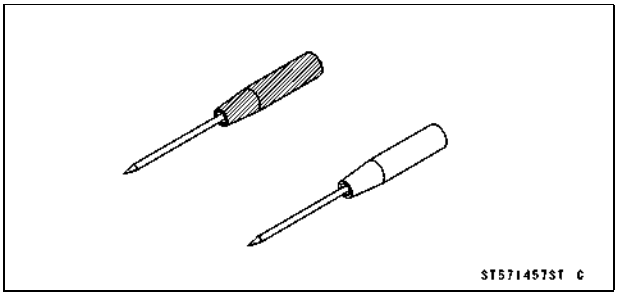
Item	Standard	Service Limit
Battery:		
Type	12 V 18 Ah, Sealed Battery	– – –
Electric Starter System:		
Starter motor:		
Brush length	12.5 mm (0.49 in.)	6.5 mm (0.02 in.)
Commutator diameter	28 mm (1.10 in.)	27 mm (1.06 in.)
Charging System:		
Type	Dual Output Voltage: 12 V (Battery Charging) and 45 V (Injector and Ignition Operation)	– – –
Charging Coil Output Voltage (through EMM):		
Battery Charging Voltage	approx. 13 V @2 400 r/min (rpm)	– – –
Charging Voltage for Injector and Ignition Operation	approx. 45 V @2 400 r/min (rpm)	– – –
Charging coil resistance:		
Battery Charging		
White/Brown ← → White	0.531 ± 0.40 Ω	– – –
White/Black ← → White/Green	0.531 ± 0.40 Ω	– – –
Injector and Ignition Operation		
Yellow ← → Blue	0.380 ± 0.30 Ω	– – –
Black ← → Purple	0.380 ± 0.30 Ω	– – –
Gray ← → Green	0.380 ± 0.30 Ω	– – –
Ignition System:		
Ignition timing	17° BTDC @1 100 r/min (rpm) ∼ 24° BTDC @3 000 r/min (rpm)	– – –
Ignition coil:		
Primary winding resistance	0.90 ± 0.01 Ω	– – –
Secondary winding resistance (with plug caps):		
#1 Coil	11.61 ± 2.52 kΩ	– – –
#2 Coil	11.16 ± 2.43 kΩ	– – –
#3 Coil	10.28 ± 2.24 kΩ	– – –
Spark plug:		
Type	NGK PZFR7G-G	– – –
Gap	0.7 ~ 0.8 mm (0.028 ~ 0.031 in.)	– – –
Terminal	Solid post	– – –
CPS (Crankshaft Position Sensor)		
Coil Resistance	430 ± 30 Ω	– – –
Air Gap (Clearance between the rotor projection and the core)	1.15 ± 0.2 mm (0.045 ± 0.008 in.)	– – –
Capacitor:		
Rated Voltage	63 V	– – –
Capacitance	39 000 μF	– – –

Special Tools

Hand Tester: 57001–1394



Needle Adapter Set: 57001–1457



Battery

Removal

● Disconnect the battery cables.

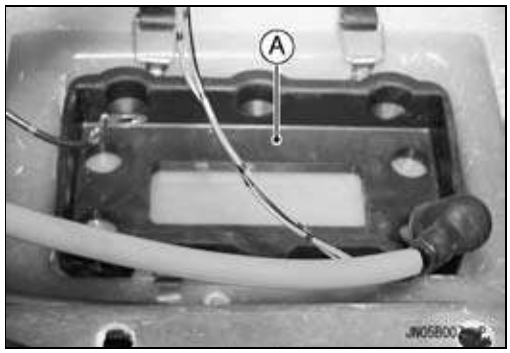
⚠WARNING

To prevent possible personal injury and damage to electrical components, always disconnect the grounded cable first.

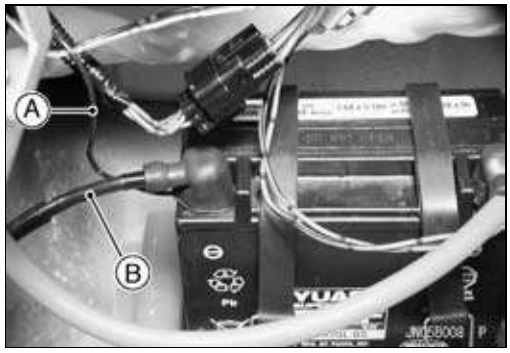
● Unhook the battery straps [A].
● Carefully lift the battery from the engine compartment.

Installation

● Be sure the battery damper [A] is in position in the battery compartment.
● Hook the battery straps.



● Connect the battery cables, positive first.
○ Connect the sub grounded lead [A] to the negative terminal when connecting the grounded cable [B].
○ After attaching both cables, coat the terminals and cable ends with grease to prevent corrosion.
○ Slide the protective boot 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

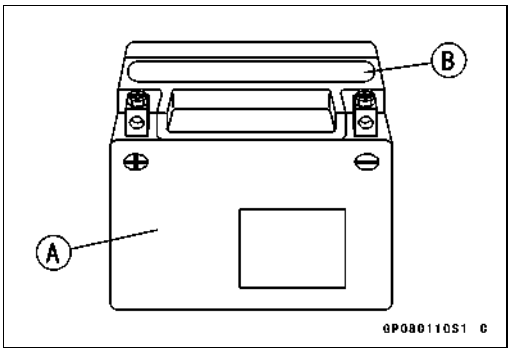
Charging Condition Inspection

● Refer to the Battery in the Periodic Maintenance chapter.

Refreshing Charge

● Remove the battery [A].

● Refresh-charge by following method according to the battery terminal voltage.



CAUTION

This battery is sealed type. Never remove sealing caps [B] even at charging. Never add water. Charge with current and time as stated below.

○ Terminal Voltage: **11.5 ∼ 12.8 V or less**

Standard Charge: **1.8 A × 5 ∼ 10 h (see following chart)**
Ouick Charge: **9.0 A × 1.0 h**

CAUTION

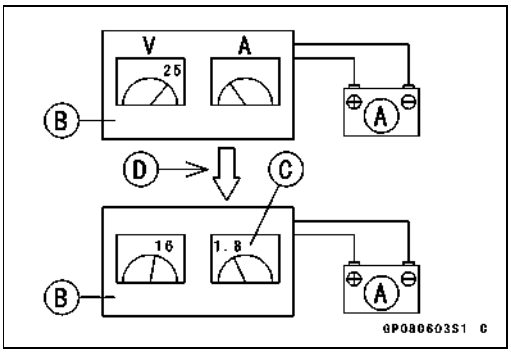
If possible, do not quick charge. If the quick charge is done due to unavoidable circumstances, do standard charge later on.

○ Terminal Voltage: **11.5 V or less**

Charging Method: **1.8 A × 20 h**

NOTE

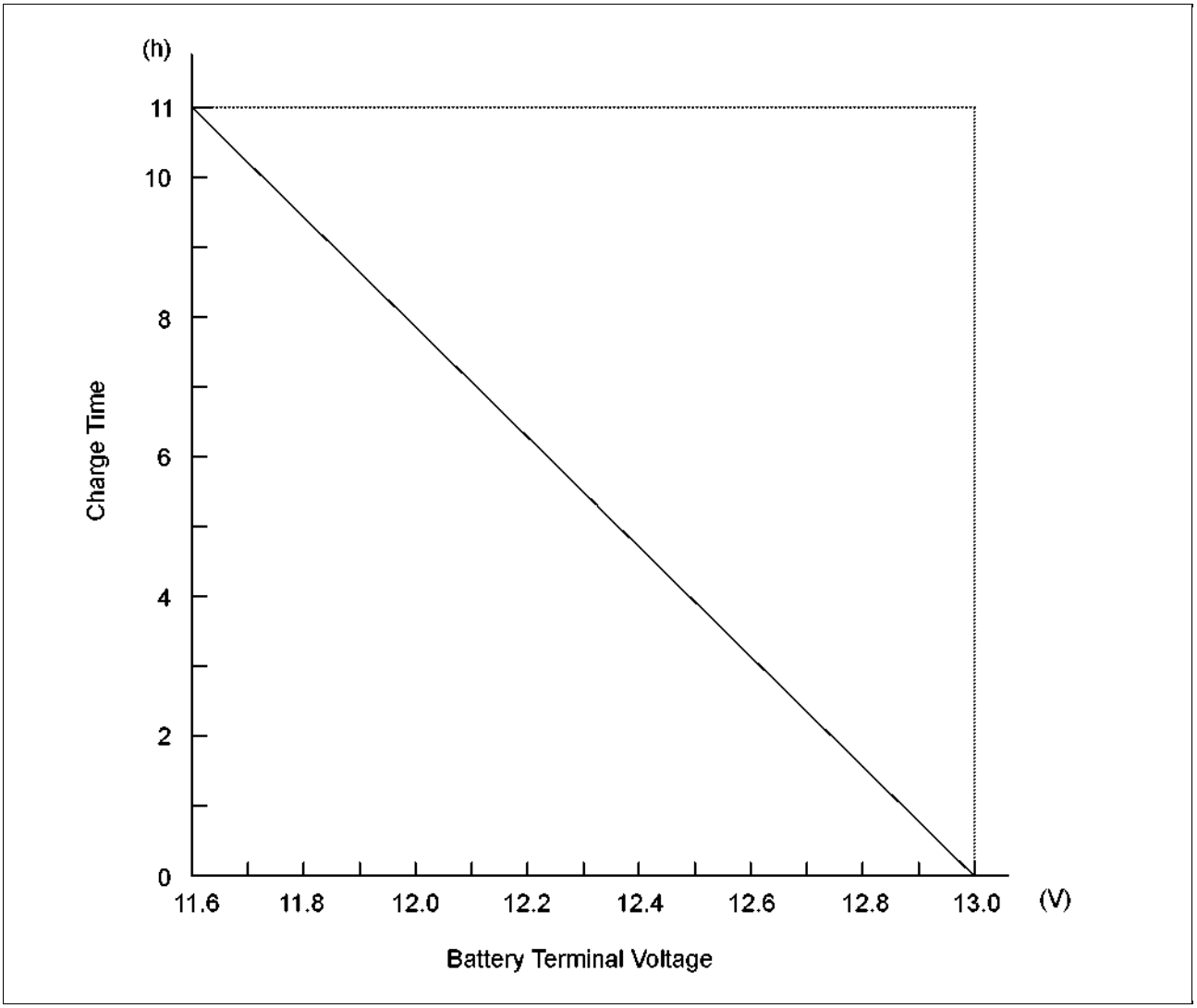
○ *Raise the voltage initially (25 V as maximum), and charge for about 5 minutes as a yardstick. (If ammeter shows no change in current after 5 minutes, you need a new battery.) The current, if it can flow into the battery, tends to become excessive. Adjust the voltage as often as possible to keep the current at standard value (1.8 A).*



Battery [A]
Battery Charger [B]
Standard Value [C]
Current Starts to flow [D]

Battery

Battery Standard Charge Time Chart-For Reference



● 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.

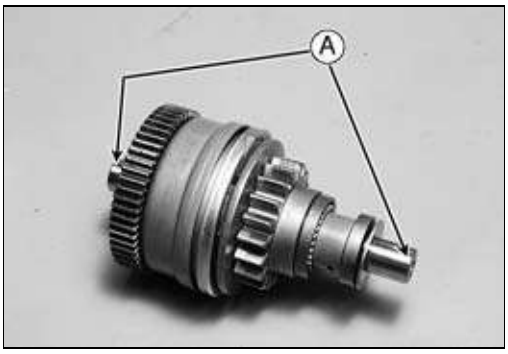
Criteria	Judgement
12.8 V or higher	Good
12.0 ∼ 12.6 V or lower	Charge Insufficient → Recharge
12.0 V or lower	Unserviceable → Replace

Electric Starter System

Reduction Gear:

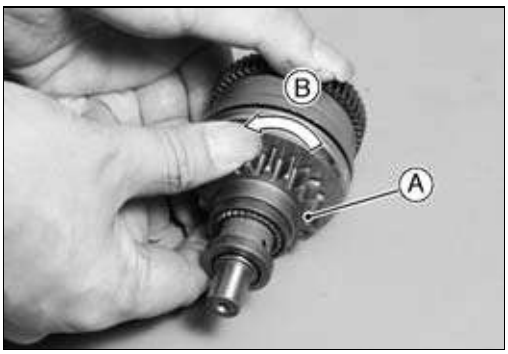
Removal/Installation Notes

- Before removing the reduction gear, remove the magneto flywheel (see Engine Bottom End chapter).
- When installing the reduction gear, apply a molybdenum disulfide grease [A] to both ends of its shaft.



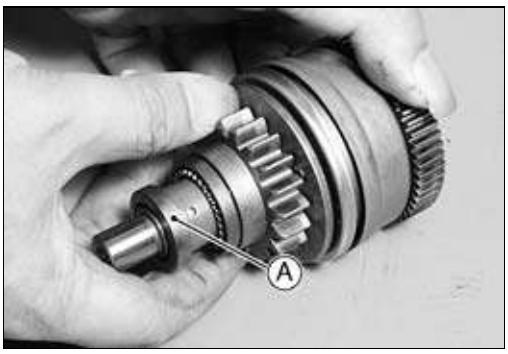
Inspection

- Rotate the pinion gear [A] counterclockwise. The gear must be rotate freely [B].



- Rotate the pinion gear clockwise all the way. The pinion gear will be advanced along the reduction gear shaft, and stopped against the stopper [A].
- Release the pinion gear. The pinion gear must return to the initial position rapidly.

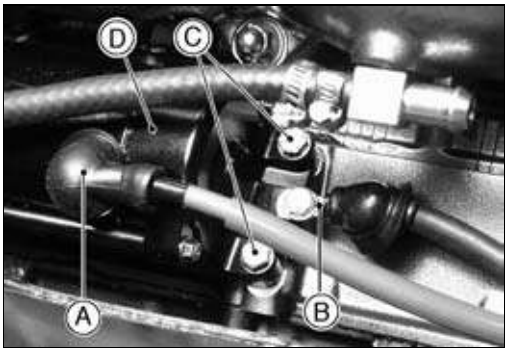
★If the pinion gear does not function properly, replace it.



Starter Motor:

Removal

- Disconnect:
  - Battery Ground Cable [B]
  - Exhaust Pipe
  - Expansion Chamber
  - Exhaust Manifold
  - Starter Motor Cable [A]
- Remove the starter motor mounting bolts [C] and pull off the starter motor [D].



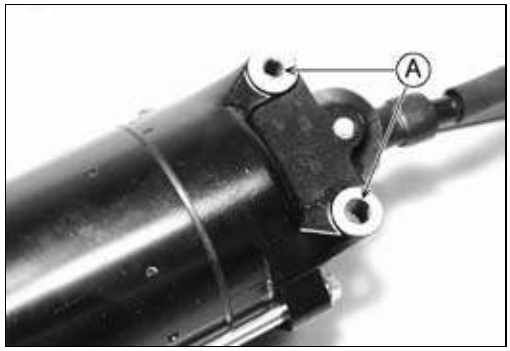
CAUTION
Do not tap the starter motor shaft or body. Tapping on the shaft or body could damage the motor.

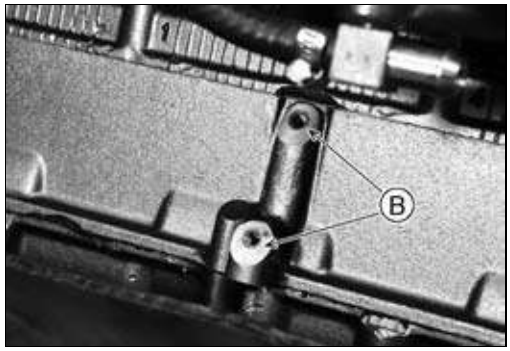
Electric Starter System

Installation Notes

- Clean the starter motor lugs [A] and crankcase [B] where the starter motor is grounded.
- Apply a small amount of engine oil to the O-ring .
- Apply a non-permanent locking agent to the starter motor mounting bolt and the battery ground cable mounting bolt.
- Connect the battery ground cable.
- Torque:

Torque - Starter Motor Mounting Bolts: 8.8 N·m (0.9 kgf·m, 78 in·lb)
Battery Ground Cable Mounting Bolt: 8.8 N·m (0.9 kgf·m, 78 in·lb)

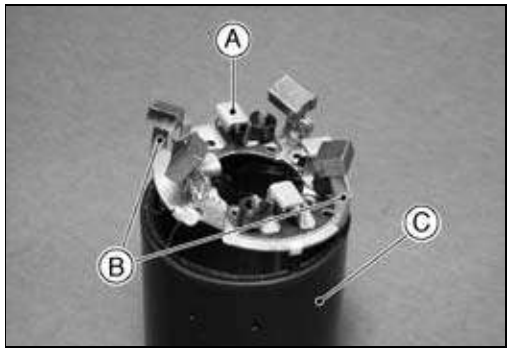




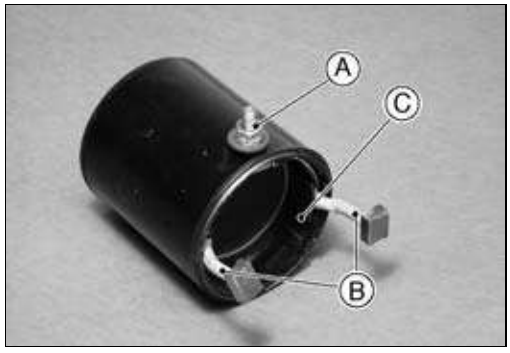
Disassembly

- Unscrew the retaining screws [A] and remove the both end covers.

- Pull the armature out the pinion gear end.
- Remove the brush plate [A] from the leads [B].
  Yoke [C]



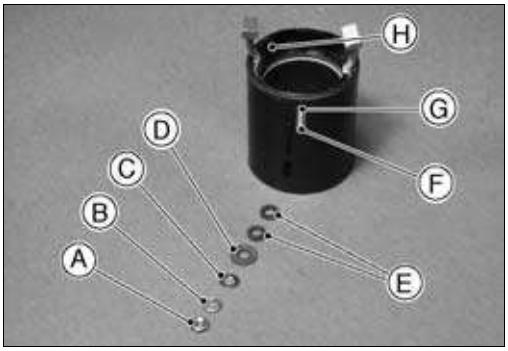
- Remove the nut and terminal bolt [A], and then remove the brush [B] and the plastic holder [C].



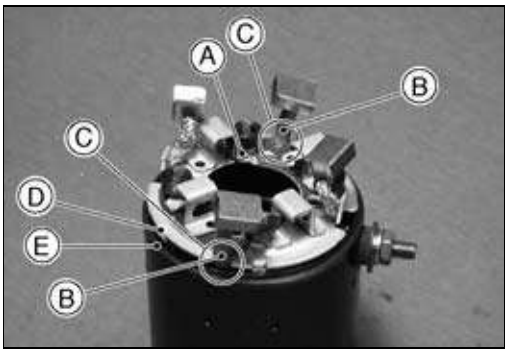
Electric Starter System

Assembly

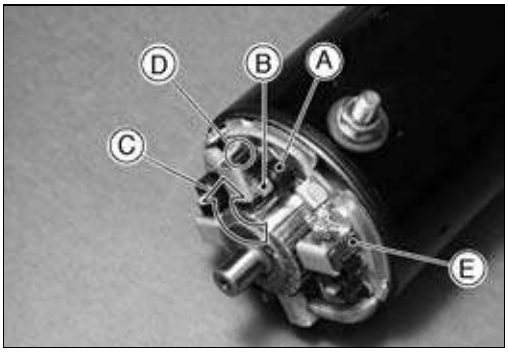
● Install the terminal bolt as shown.
Nut [A]
Spring Washer [B]
Washer [C]
Large Insulator [D]
Small Insulators [E]
Terminal Bolt [F]
O-ring [G]
Plastic Holder [H]



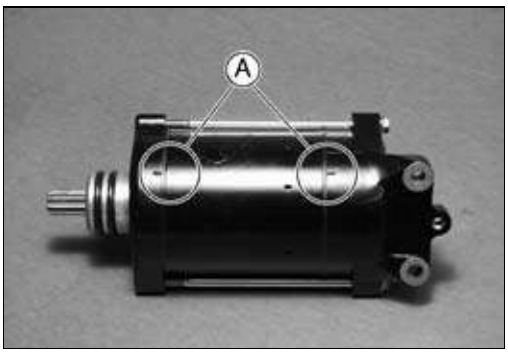
● Install the brush plate as follows.
○ Install the brush plate [A] on the yoke fitting the brush leads [B] into the notches [C] in the plate. Fit the brush plate tongue [D] into the yoke notch [E].



○ Insert the armature into the yoke.
○ Keeping the motor upright, install the brush spring [A]. Fit the spring on the spring post [B] halfway; the post must be positioned in the D-shaped end of the spring. Turn the other end of the spring a half turn clockwise [C], and fit the end in the brush groove [D]. Push the spring onto the post to the stepped portion.
Brush [E]



○ To install the end covers on the yoke, align [A] the mark on the each end cover with the marks on the yoke.

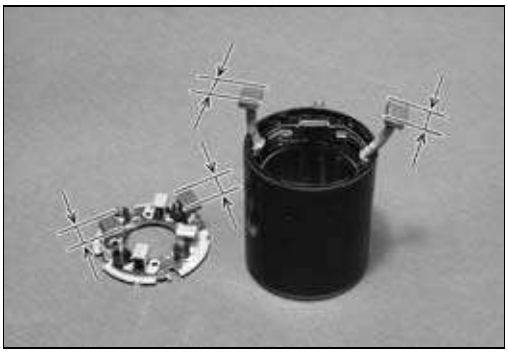


Brush Inspection

● Measure the length of each brush.
★ If any is worn down to the service limit, replace all the brushes.

Starter Motor Brush Length

Standard:	**12.5 mm (0.49 in.)**
Service Limit:	**6.5 mm (0.256 in.)**



Electric Starter System

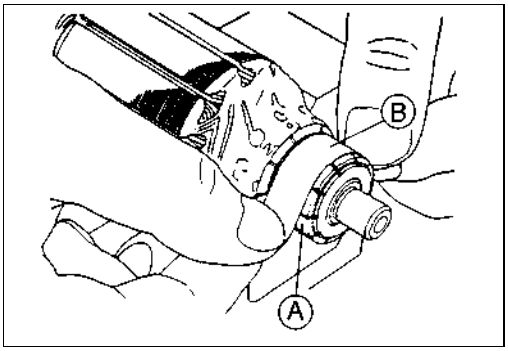
Brush Spring Inspection

- Check that the brush springs are in place and will snap the brushes firmly into place.

★If not, reinstall or replace the spring.

Commutator Cleaning and Inspection

- Smooth the commutator surface [A] if necessary with fine emery cloth [B], and clean out the grooves.

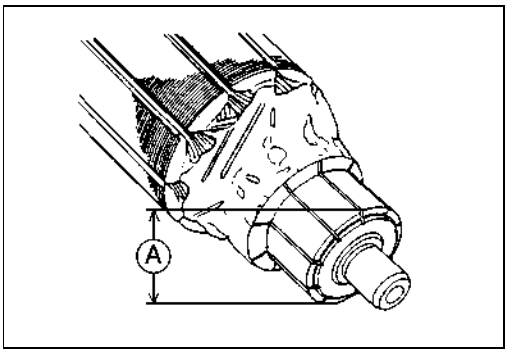


- Measure the diameter of the commutator.

★Replace the starter motor with a new one if the commutator diameter [A] is less than the service limit.

Commutator Diameter

Standard:	**28 mm (1.10 in.)**
Service Limit:	**27 mm (1.06 in.)**



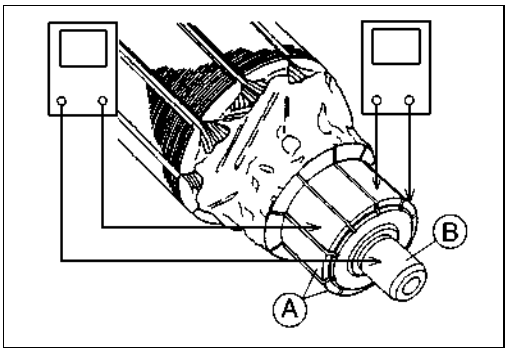
Armature Inspection

- Using the × 1 Ω ohmmeter range, measure the resistance between any two commutator segments [A].

★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 ohmmeter range, measure the resistance between the commutator and the shaft [B].

★If there is any reading at all, the armature has a short and the starter motor must be replaced.



Even if the foregoing checks show the armature to be good, it may be defective in some manner not readily detectable with an ohmmeter. If all other starter motor and stater 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.

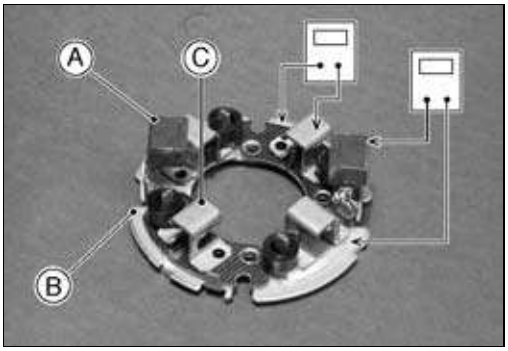
Brush Plate Inspection

- Using the × 1 Ω ohmmeter range, measure the resistance between the brush [A] and the brush plate [B].

★If there is not close to zero ohms, the brush plate has an open and the brush plate must be replaced.

- Using the highest ohmmeter range, measure the resistance between the brush plate [B] and the brush holders [C].

★If there is any reading at all, the brush holder has a short and the brush plate must be replaced.

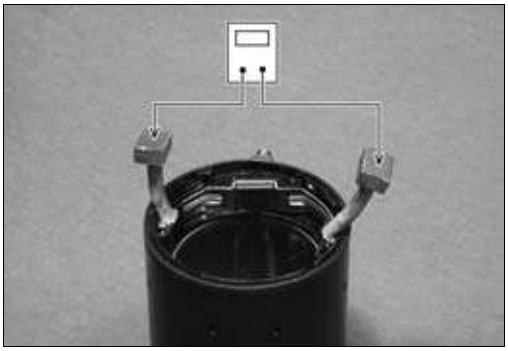


Electric Starter System

Brush and Lead Assembly Inspection

- Using the × 1Ω ohmmeter range, measure the resistance between the brushes.

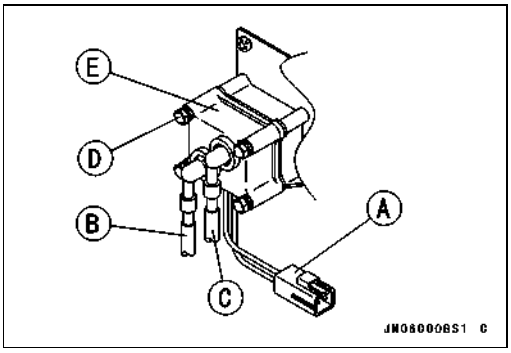
★If there is high resistance or no reading (∞), a lead is open and the brush and lead assembly must be replaced.



Starter Relay:

Removal

- Remove:
  Starter Relay Lead Connector [A] (Disconnect)
  Starter Motor Cable [B]
  Battery (+) Cable [C]
  Starter Relay Case Mounting Bolts [D]
  Starter Relay Case Assy [E]

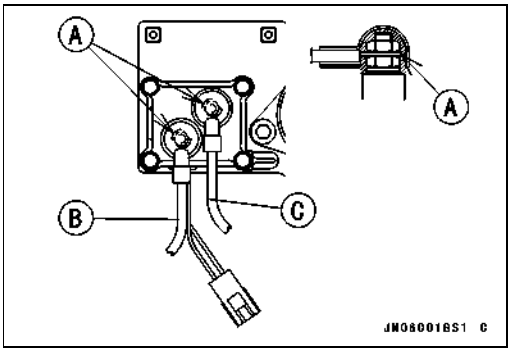


Installation

- Apply adhesive [A] to the terminals to prevent the terminals from galvanic corrosion.

  Adhesive Type: **3M DP-270 BLACK**

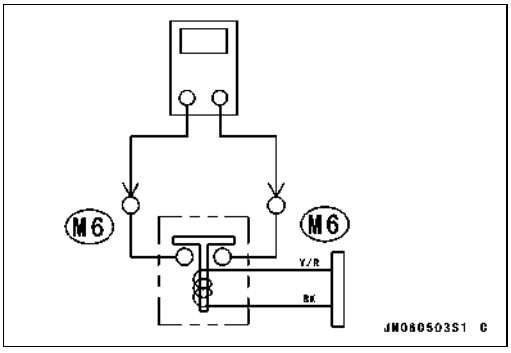
- Route the starter motor and battery (+) cables correctly (see Cable, Wire and Hose Routing in the Appendix chapter).
  [B] To Starter Motor
  [C] To Battery (+) Terminal



Inspection

- Set ohmmeter to R × 1 Ω scale.
- Connect meter leads to starter relay as shown.

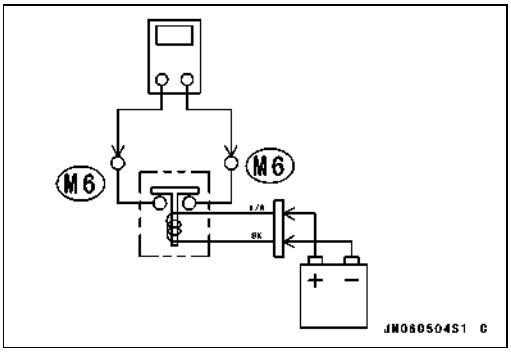
★If resistance is less than infinite, the starter relay switch is not returning and must be replaced.



- Set ohmmeter to R × 1 Ω scale.
- Connect meter leads to starter relay as shown.
- Activate starter relay switch by connecting a 12 V battery as shown.

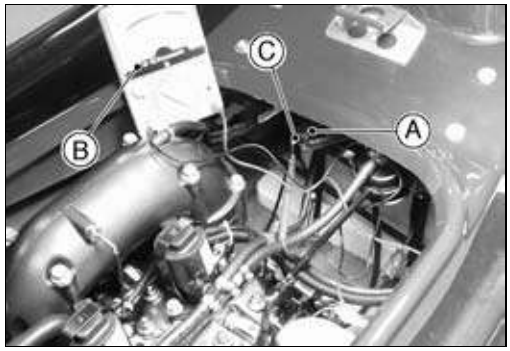
★If the starter relay switch clicks and the ohmmeter indicates zero resistance, the starter relay switch is good.

★If the meter indicates high or infinite (∞) resistance, the starter relay switch is defective and must be replaced.



Charging System

Charging System Inspection



● Connect the hand tester to the EMM 8-pin connector [A], using the needle adapter set.

Special Tools - Hand Tester: 57001–1394 [B]
Needle Adapter Set: 57001–1457 [C]

⚠ 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.

● With the hand tester, check the stator functional inspection according to the following table with engine running at approximately 2,400 rpm.

Charging Voltage Test (Battery Charging)

Meter Setting	Connections		Standard Value
	Meter (+) to	Meter (–) to	
25 VDC	Red/Green lead	Ground	Approx. 13 V

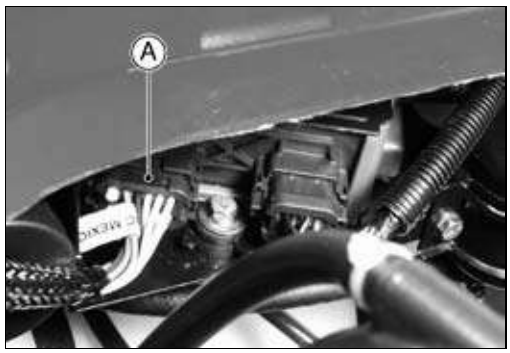
Charging Voltage Test (Injector and Ignition Operation)

Meter Setting	Connections		Standard Value
	Meter (+) to	Meter (–) to	
250 VDC	Black/Red lead	Ground	Approx. 45 V

○ You also can perform charging voltage test (Injector and Ignition Operation) with engine cranking.

Charging Voltage Test (Injector and Ignition Operation) with Engine Cranking

Meter Setting	Connections		Standard Value
	Meter (+) to	Meter (–) to	
250 VDC	Black/Red lead	Ground	Approx. 20 V



★If the changing voltage is zero or almost zero, check the charging system circuit and 20 A fuse. And check that the charging coil is open or not.

★If the charging voltage is low, check the charging coil resistance with hand tester according to the following table.

● Disconnect the 12-pin charging coil lead connector [A] on the EMM.

Charging Coil Resistance Test

Battery Charging:

White/Brown ← → White: 0.531 ± 0.40 Ω

White/Black ← → White/Green: 0.531 ± 0.40 Ω

Injector and Ignition Operation:

Yellow ← → Blue: 0.380 ± 0.30 Ω

Black ← → Purple: 0.380 ± 0.30 Ω

Gray ← → Green: 0.380 ± 0.30 Ω

★If the coil has normal resistance, but the voltage check shows the out of the specified value, charging system to be defective, then the permanent magnets in the flywheel have probably weakened or the regulator in the EMM is defective, necessitating flywheel or EMM replacement.

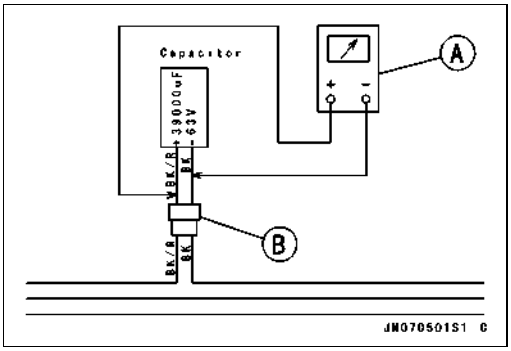
Charging System

Capacitor Inspection

- Connect the hand tester (× 50 V DC) [A] to the capacitor connector [B], using the needle adapter set.

Special Tools - Hand Tester: 57001–1394
Needle Adapters Set: 57001–1457

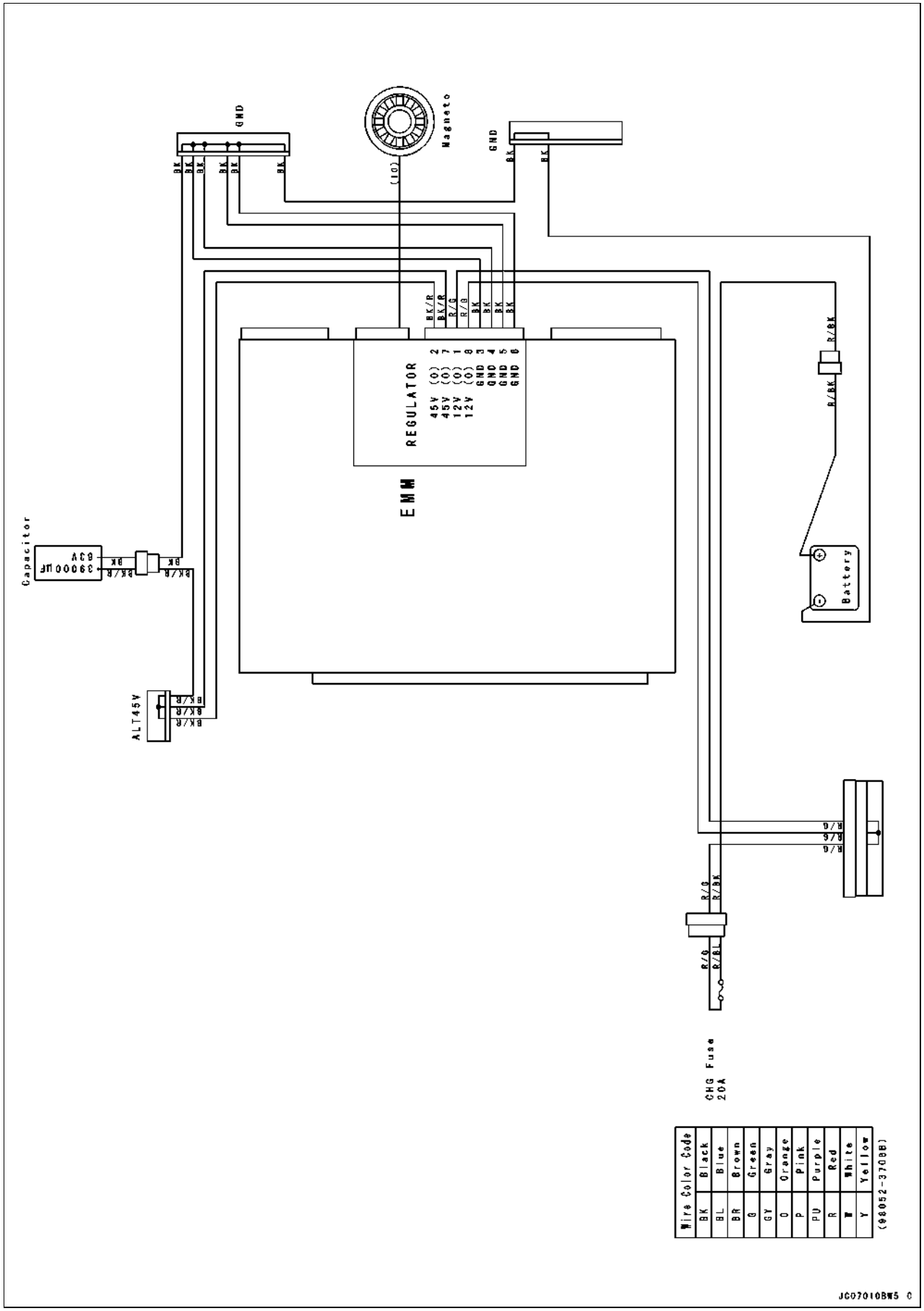
Connection to Capacitor Connector
Tester (+) → BK/R lead
Tester (–) → BK lead



- Pull all the spark plug caps from the spark plugs and push the caps fully onto the spark plug cap holder.
- Turn the ignition switch on and push the lanyard key under the stop button.
- Pushing the starter button, crank the engine 4 ~ 5 seconds.
- Monitor voltage while stopping the cranking.

★If voltage quickly bleeds to near 0 V, the capacitor is OK.
★If voltage drops to 0 V immediately, replace the capacitor.

Charging System Circuit



Ignition System

⚠WARNING

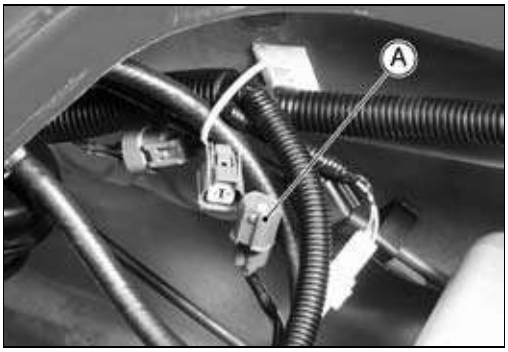
The ignition system produces extremely high voltage. Do not touch the spark plugs, ignition coils, or spark plug leads while the engine is running, or you could receive a severe electrical shock.

Crank Position Sensor (CPS) Inspection

- Disconnect the 2-pin CPS coil leads connector (Blue) [A].
- Set the hand tester to the × 100 Ω range, zero it, and connect it to the CPS lead terminals (Orange and Black) in the connector.

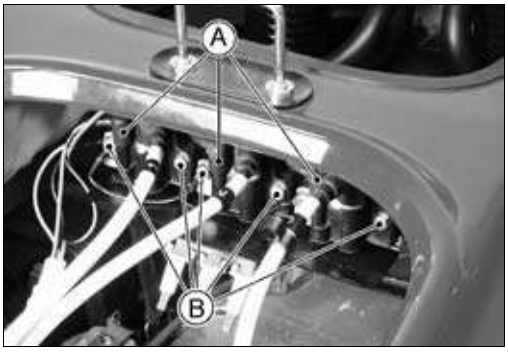
★If there is more resistance than the specified value, the coil has an open lead and must be replaced. Much less than this resistance means the coil is shorted, and must be replaced.

Crank Position Sensor (CPS) Resistance
Standard: 430 ± 30 Ω



Ignition Coil Removal

- Pull the spark plug cap.
- Pull the primary lead connector [A] off the ignition coil.
- Unscrew the mounting bolts [B] and remove the ignition coil.



Ignition Coil Installation Notes

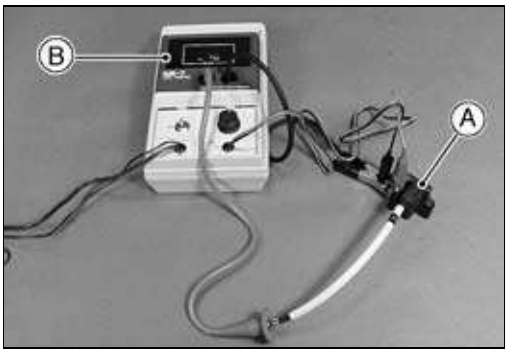
- Route the spark plug leads and primary leads correctly (see Cable, Wire and Hose Routing in the General Information chapter).

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.
- 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.



⚠WARNING

To avoid extremely high voltage shocks, do not touch the coil or lead.

★If the distance reading is less than the specified value, the ignition coil or spark plug cap is defective.

3 Needle Arcing Distance
Standard: 7 mm (0.28 in.) or more

- To determine which part is defective, measure the arcing distance again with the spark plug caps removed from the ignition coil.

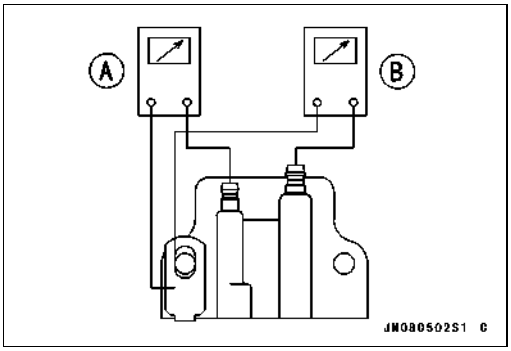
★If the arcing distance is subnormal as before, the trouble is with the ignition coil itself. If the arcing distance is now normal, the trouble is with the spark plug caps.

Ignition System

Measuring coil resistance:

If the Coil Tester is not available, the coil can be checked for a broken or badly shorted winding with a hand tester. However, a hand 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].
○ Connect the tester between the coil terminals.
○ Set the tester to the × 1 Ω range, and read the tester.
● Measure the secondary winding resistance as follows [B].
○ Remove the plug caps by turning them counterclockwise.
○ Connect the tester between the spark plug leads.
○ Set the tester to the × 100 Ω range, and read the tester.
★If the hand tester does not read as specified, replace the coil.



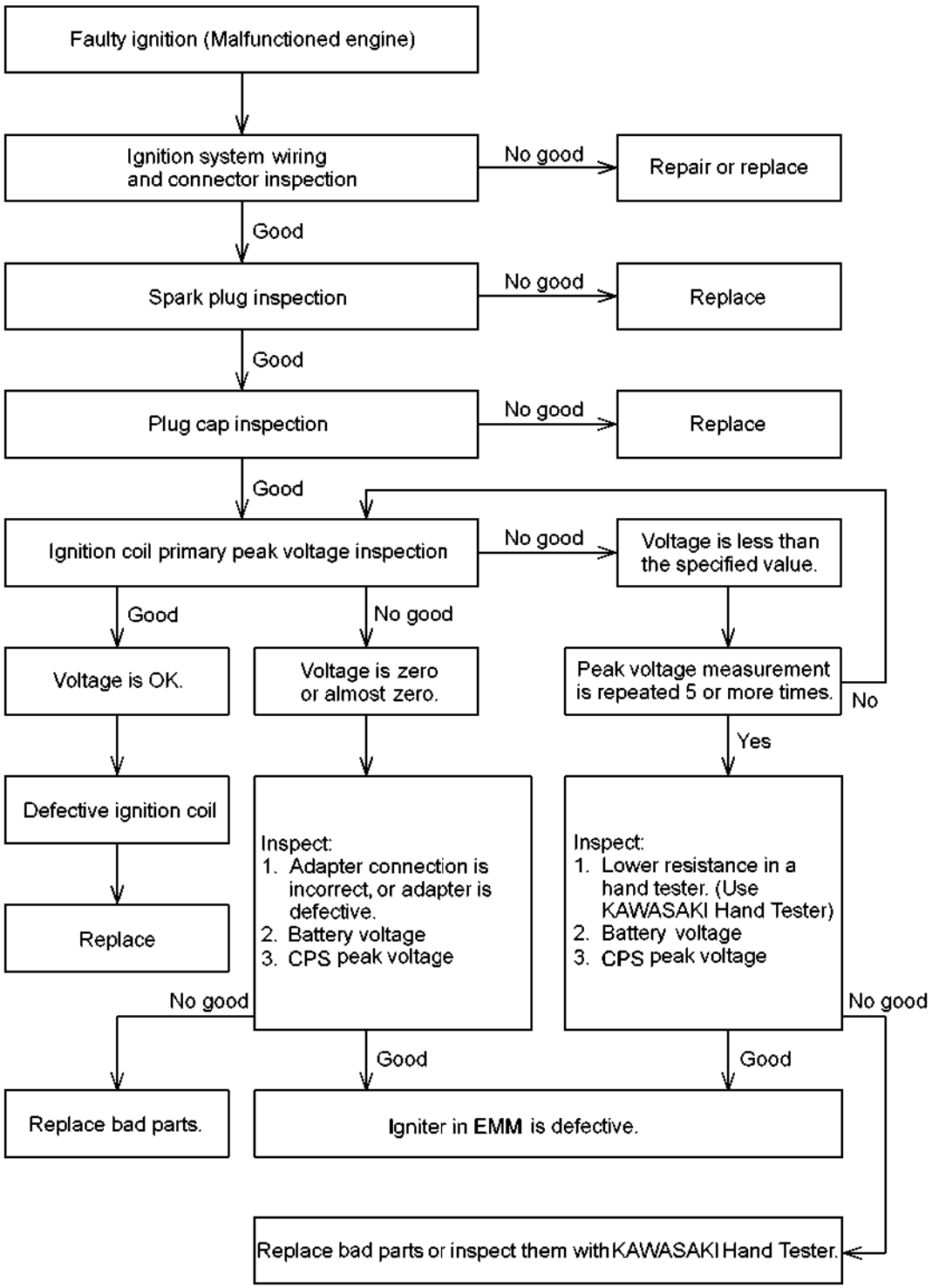
Winding Resistance

Standard:	**Primary windings 0.90 ± 0.05 Ω**
	Secondary windings 288 ± 7 Ω

★If the tester reads 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.
● Check the spark plug lead for visible damage.
★If the spark plug lead is damaged, replace the coil.

Ignition System

Ignition System Troubleshooting



Ignition System

Igniter Inspection

○ The igniter is built in the EMM.

CAUTION

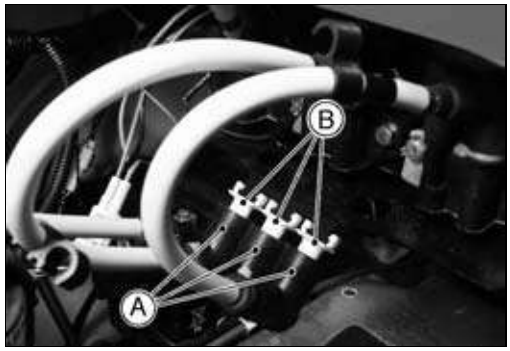
Do not disconnect the battery leads or any other electrical connections when the ignition switch is on, or while the engine is running. This is to prevent igniter in the EMM damage.

Ignition Coil Primary Peak Voltage Check:

NOTE

○ *Be sure the battery is fully charged.*

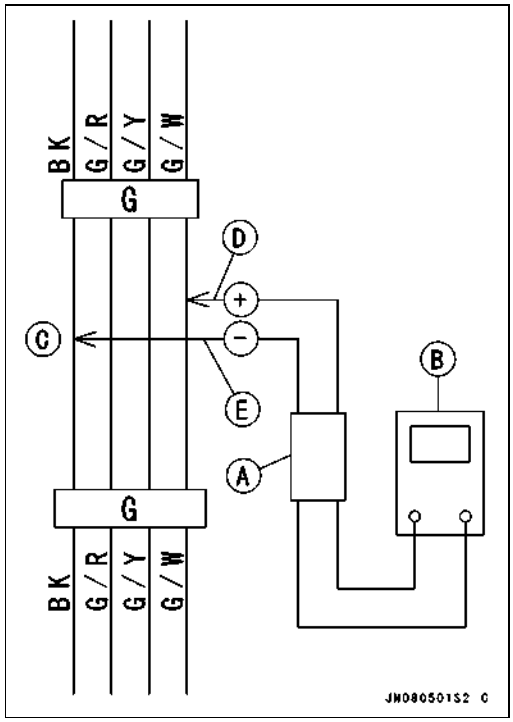
● Pull all the spark plug caps from the spark plugs and push the caps [A] fully onto the spark plug cap holder [B].



NOTE

○ *Maintain the correct value of compression pressure for the cylinder (Be sure to measure the voltage with the spark plug installed to the cylinder head).*

● Install a commercially available peak voltage adapter [A] into the hand tester [B].
● Disconnect the ignition coil primary lead connector. And the connector is reconnected mutually by using four auxiliary wires [C].
● Connect the adapter between the ignition coil primary lead terminal [D] and the black lead (ground) [E] with the primary lead left connected.



Recommended Tool: Peak Voltage Adapter
Type: KEK-54-9-B
Brand: KOWA SEIKI

Special Tool - Hand Tester: 57001-1394
Hand Tester Range: × DC 250 V

Primary Lead Connections:

	Adapter (R, +)		Adapter (BK, –)
#1 Coil:	G/R	←→	BK (Ground)
#2 Coil:	G/Y	←→	BK (Ground)
#3 Coil:	G/W	←→	BK (Ground)

⚠WARNING

To avoid extremely high voltage shocks, do not touch the spark plugs or tester connections.

● Turn the ignition switch on and push the lanyard key under the stop button.
● Pushing the starter button, crank the engine 4 ~ 5 seconds to measure the primary peak voltage.
○ Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.
● Repeat the measurements 5 or more times for one ignition coil.

Ignition Coil Primary Peak Voltage
Standard: 140 V or more

● Repeat the test for the other ignition coil.
★If the reading is less than the specified value, see “Igniter Troubleshooting” table to determine whether igniter in the EMM is good or no good.

Ignition System

Crank Position Sensor (CPS) Peak Voltage Check:

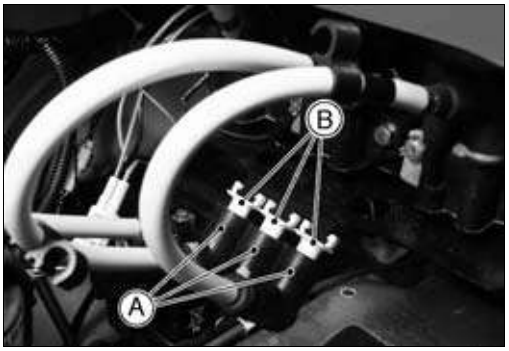
NOTE

○ *Be sure the battery is fully charged.*

● Disconnect the CPS lead connector.
● Pull all the spark plug caps from the spark plugs and push the caps [A] fully onto the spark plug cap holder [B].

NOTE

○ *Maintain the correct value of compression pressure for the cylinder (Be sure to measure the voltage with the spark plug installed to the cylinder head).*



● Connect a commercially available peak voltage adapter [B] to the hand tester [A].

Recommended Tool: Peak Voltage Adapter
Type: KEK-54-9-B
Brand: KOWA SEIKI

● Insert the adapter probes into the connector [C] of the magneto cover side for the CPS as shown.

Special Tool - Hand Tester: 57001-1394

Connections:

	Adapter (R, +)		Adapter (BK, –)
CPS Coil:	**O (Orange)**	**←→**	**BK**

Hand Tester Range: × DC 10 V

● Turn the ignition switch on and push the lanyard key under the stop button.
● Pushing the starter button, crank the engine 4 ∼ 5 seconds to measure the CPS peak voltage.
○ Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.
● Repeat the measurements 5 or more times.

CPS Peak Voltage
Standard: 2.7 V or more

★ If the reading is less than the specified value, check the CPS (see CPS Inspection).

Spark Plug Removal

● Pull off the spark plug caps.
● Unscrew the spark plugs.
○ Be careful to avoid breaking the ceramic on the spark plugs.

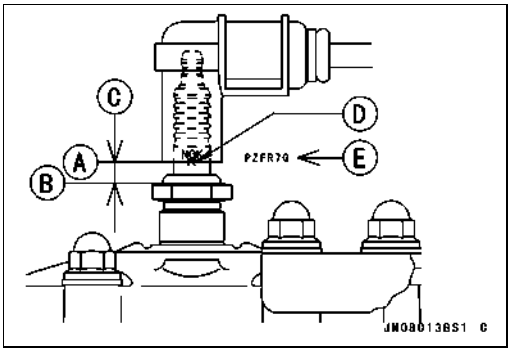
Spark Plug Installation

● Be sure the spark plug threads are clean and dry.
● Torque the spark plugs.

Torque - Spark Plugs: 24 ∼ 29 N·m (2.5 ∼ 3.0 kgf·m, 18 ∼ 22 ft·lb)

○ Be careful to avoid breaking the ceramic on the spark plugs.

● Install the spark plug cap onto the spark plug securely.
○ Push the cap onto the plug so that the distance between the lower end [A] of the cap and the upper surface [B] of the plug hexagonal nut is 6 mm (0.24 in.) [C].



NOTE

○ *For easier correct installtion of the spark plug cap, push the cap onto the plug until the figures "NGK" of "NGK/R" [D] printed on plug are half covered with the cap or the figures "PZFR7G" [E] are completely covered.*

Ignition System

Spark Plug Inspection

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

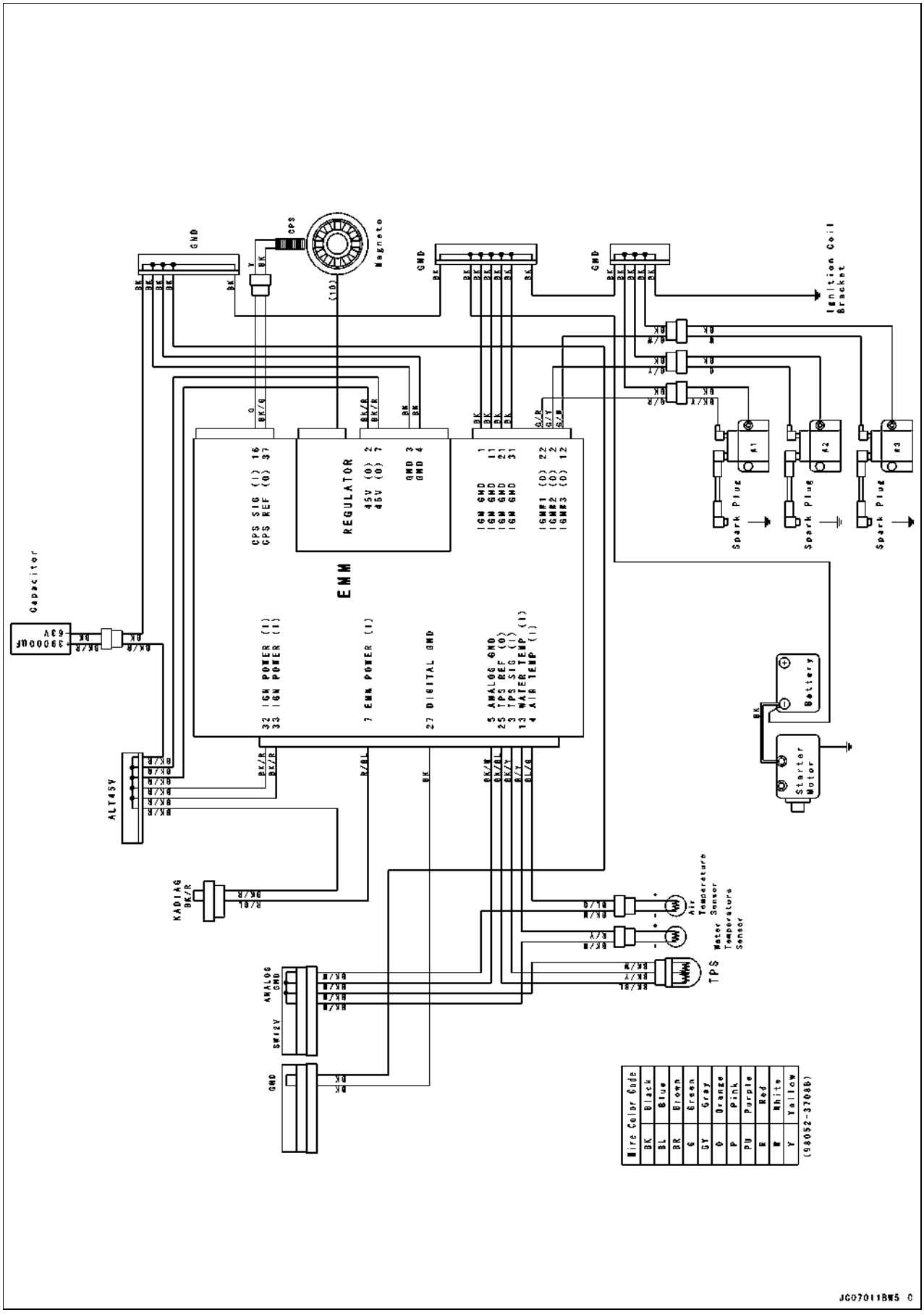
Spark Plug Adjustment

- Refer to the Spark Plug Adjustment in the Periodic Maintenance chapter.

Spark Plug Cleaning

- Refer to the Spark Plug Cleaning in the Periodic Maintenance chapter.

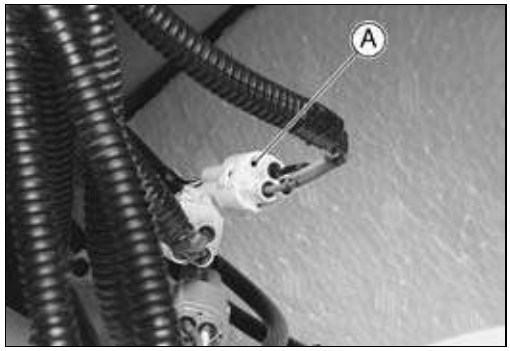
Ignition Circuit



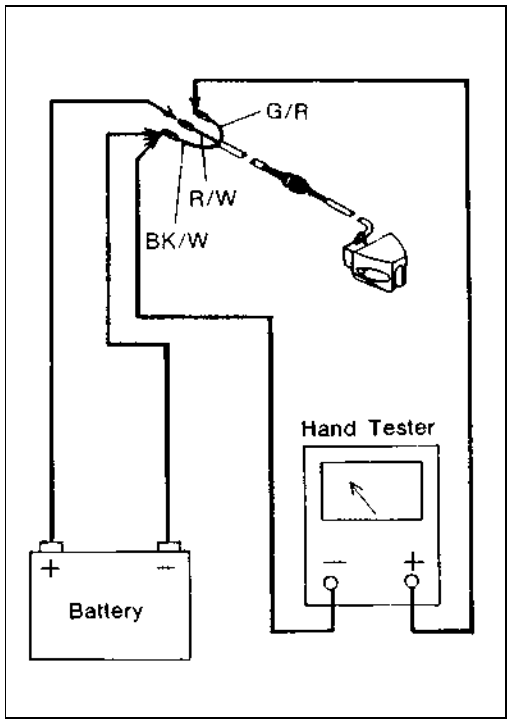
Sensors

Speed Sensor Inspection

● Disconnect the speed sensor connectors [A] (see Wiring Diagram).



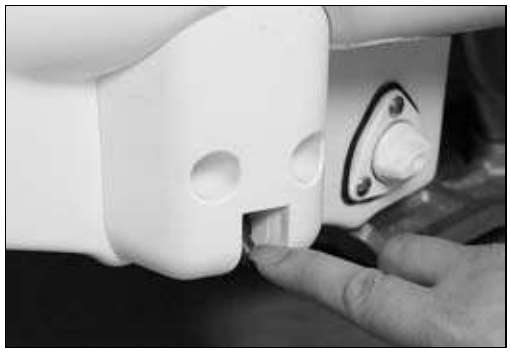
● Connect the battery and tester leads to the sensor as shown.



● Rotate the waterwheel by hand slowly.
● Measure the output voltage of a speed sensor.

G/R (+), BK/W (–) → 0 ∼ 10 V; twice a rotation (Rotate it slowly.)

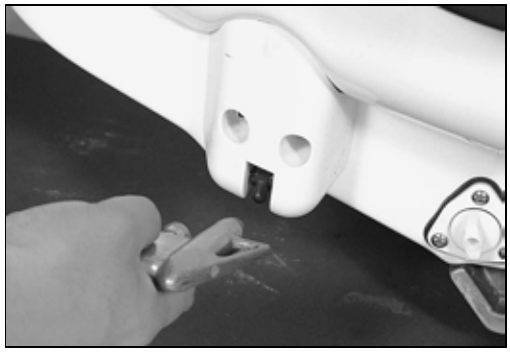
★If the voltage does not rise from zero to about 10 volts twice a rotation, replace the sensor.



● Measure the output voltage of the sensor at higher speeds.
○ Rotate the waterwheel in a fair speed by air.

G/R (+), BK/W (–) → approx. 5 V

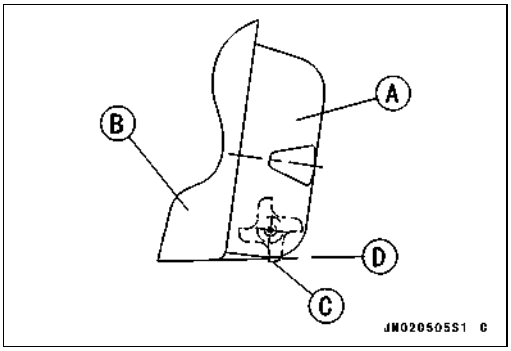
★If the sensor voltage does not reach 5 volts when spun with compressed air, replace the sensor.



Sensors

Speed Sensor Installation

- When installing the speed sensor [A] on the hull bottom [B], align the water wheel end [C] with the hull bottom line [D], as shown.



Fuel Level Sensor Inspection

- Open the hatch cover.
- Disconnect the fuel level sensor 2 - pin connector.
- Loosen the clamp, and remove the fuel level sensor out of the fuel tank.
- Set the hand tester (ohmmeter) to the × 1 kΩ range.

  Special Tool - Hand Tester: 57001–1394

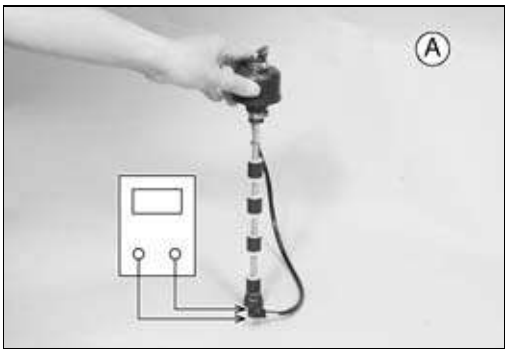
- Connect the tester leads the W/R and BK/W leads to check the switching operation of the float.

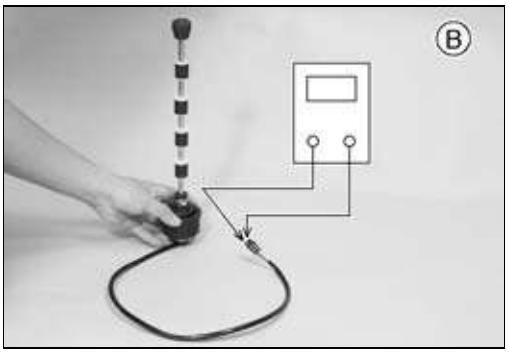
  Meter Reading

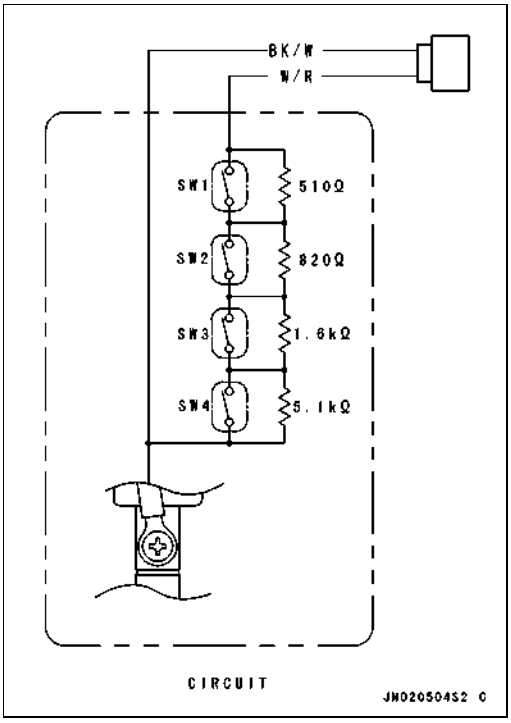
  When sensor is held upright [A]: approx. 8.03 kΩ

  When sensor is held upside down [B]: approx. 0 Ω

★The meter should read as specified. If it does not, replace the fuel level sensor.







Sensors

Oil Level Sensor Inspection

- Disconnect the oil level sensor 2–pin connector.
- Remove the oil level sensor out of the oil tank.
- Set the hand tester (ohmmeter) to the × 1 kΩ range.

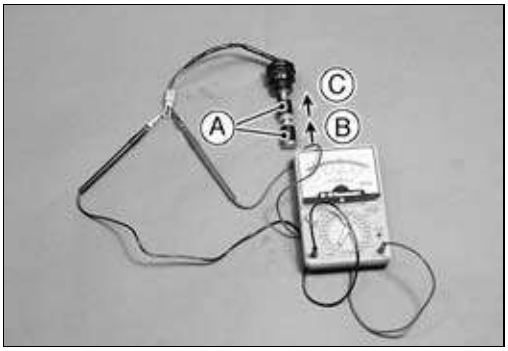
Special Tool - Hand Tester: 57001–1394

- Connect the tester leads to the BK/W and BL leads to check the switching operation of the float.

Meter Reading

When the two floats are held downward [A]:	**approx. 4 kΩ**
When one float is held upward [B]:	**approx. 2 Ω**
When the two floats are held upward [C]:	**approx. 0 Ω**

★The meter should read as specified. If it does not, replace the oil level sensor.



Multifunction Meter

Display Function Inspection

- Using the auxiliary wires, connect the 12 V battery [A] to the meter unit [B] connector as follows.

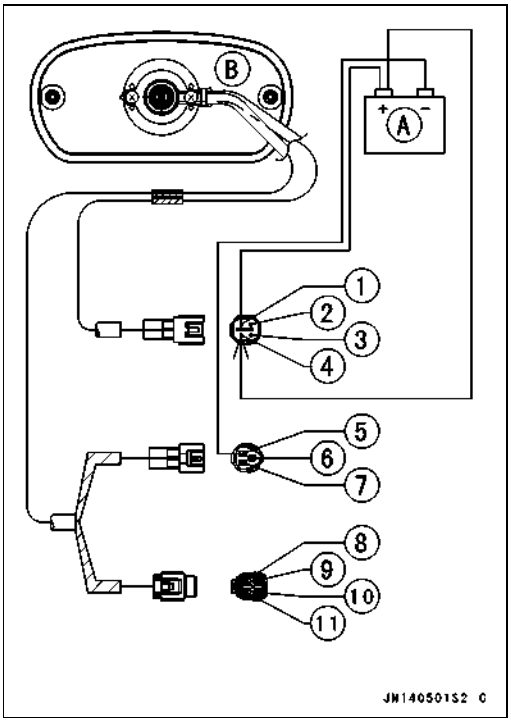
○ Connect the battery positive terminal to the terminal [1].
○ Connect the battery negative terminal to the terminal [5].

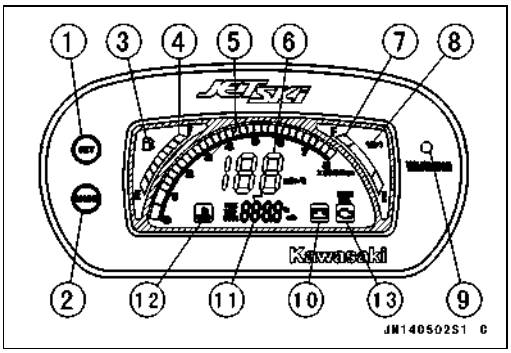
[1] R/BK, Battery (+)
[2] BL, Oil Level Sensor
[3] W/R, Fuel Level Sensor
[4] R, Ignition Switch (+)
[5] BK/W, Ground (–)
[6] R/Y, Water Temperature Sensor
[7] GY, Tachometer Pulse
[8] R/W, Speed Sensor Power Source (+)
[9] BL/BK, CHECK ENGINE
[10] G, Oil Warning
[11] G/R, Speed Sensor

Battery Voltage Range: 10 ~ 16 V

- Check that when the battery positive terminal is connected to the terminal [4] using the auxiliary wire, all the LCD segments and LED warning light appear for seconds.
- Check that when the terminals are disconnected , all the LCD segments and LED warning light disappear.

★If the LCD segments and LED warning light will not appear, replace the meter assembly.





[1] SET Button
[2] MODE Button
[3] Fuel Symbol
[4] Fuel Level Gauge
[5] Tachometer
[6] Speedometer
[7] Oil Level Gauge
[8] Engine Oil Symbol
[9] LED Warning Light
[10] Battery Symbol
[11] Clock/Time/Trip/Hour Meter
[12] Water Temperature Symbol
[13] Engine Symbol

CAUTION

Do not drop the meter unit. Do not short the terminals.
If the multifunction meter displays incorrectly while the engine is running, first disconnect the (–) battery terminal lead 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.

Multifunction Meter

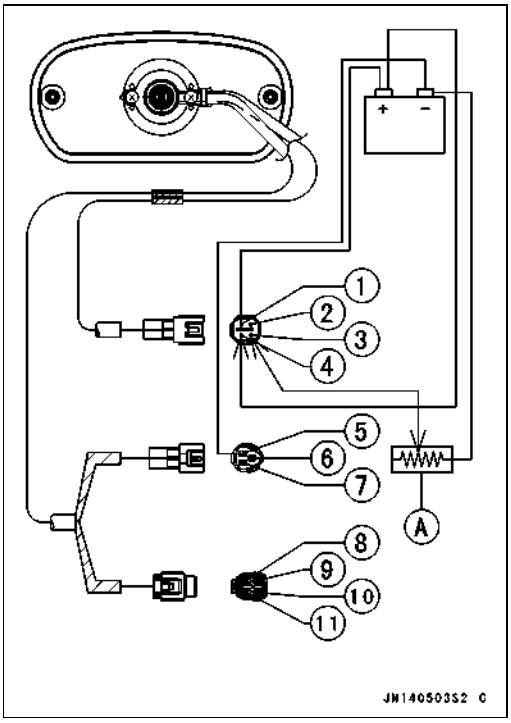
Fuel Level Gauge/Symbol/FUEL Characters/Warning Light Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Connect the variable rheostat [A] to the terminal [3] as shown.
- Check that the number of segments matches the resistance value of the variable rheostat.

Resistance Value (Ω)	Display Segments
8030	0*
2930	1 ~ 2
1330	3 ~ 4
510	5 ~ 6
0	7 ~ 8

*: The LED warning light, fuel symbol and FUEL characters flash at the same time.

★If any display function does not work, replace the meter assembly.



Oil Level Gauge/Symbol/OIL Characters/Warning Light Inspection

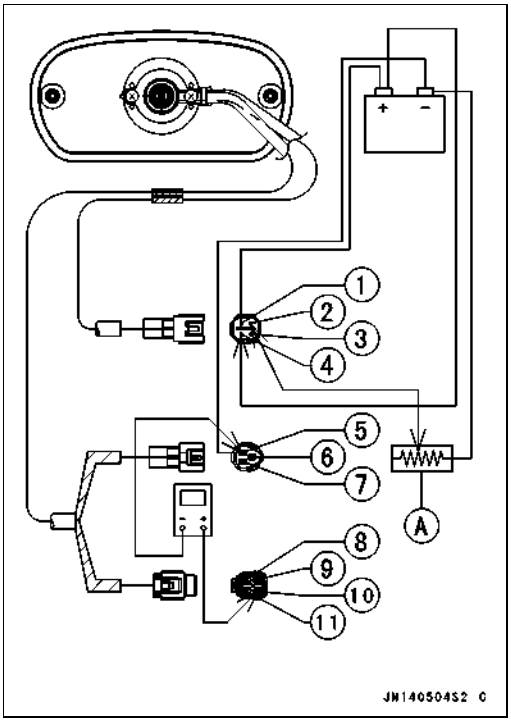
- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Connect the variable rheostat [A] to the terminal [2] as shown.
- Check that the number of segments matches the resistance value of the variable rheostat.

Resistance Value (Ω)	Display Segments
4000	1*
2000	2
0	3

*: The LED warning light, oil symbol, OIL characters and one segment flash at the same time.

- Set the hand tester [B] to the DC 25 V range and connect it to the terminals [5] and [10] when the LED warning light, oil symbol, OIL characters and one segment flash.

★If any display function does not work or the voltage between the terminal [5] and [10] is out of the specified range, replace the meter assembly.

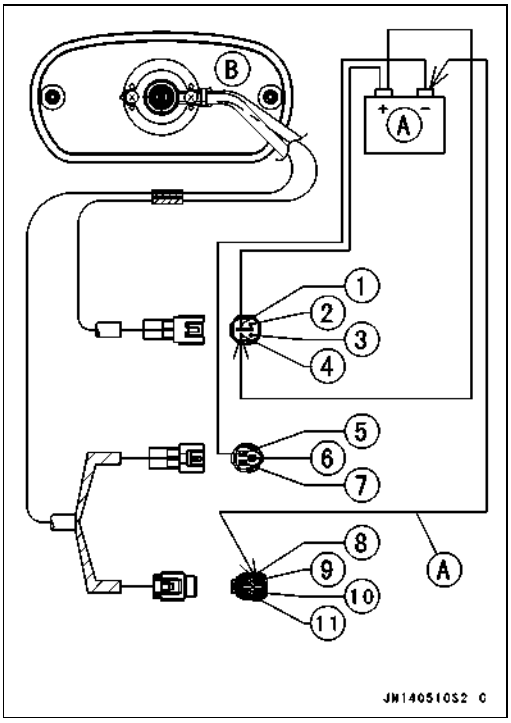


Multifunction Meter

Engine Symbol/Eng Characters/Warning Light Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Check that the engine symbol/Eng characters/warning light flash when the CHECK ENGINE terminal [9] is connected to the battery (–) terminal [5] using auxiliary wire [A] as shown.
- Check that the engine symbol/Eng characters/warning light disappear when the terminals are disconnected.

★If any display function does not work, replace meter assembly.

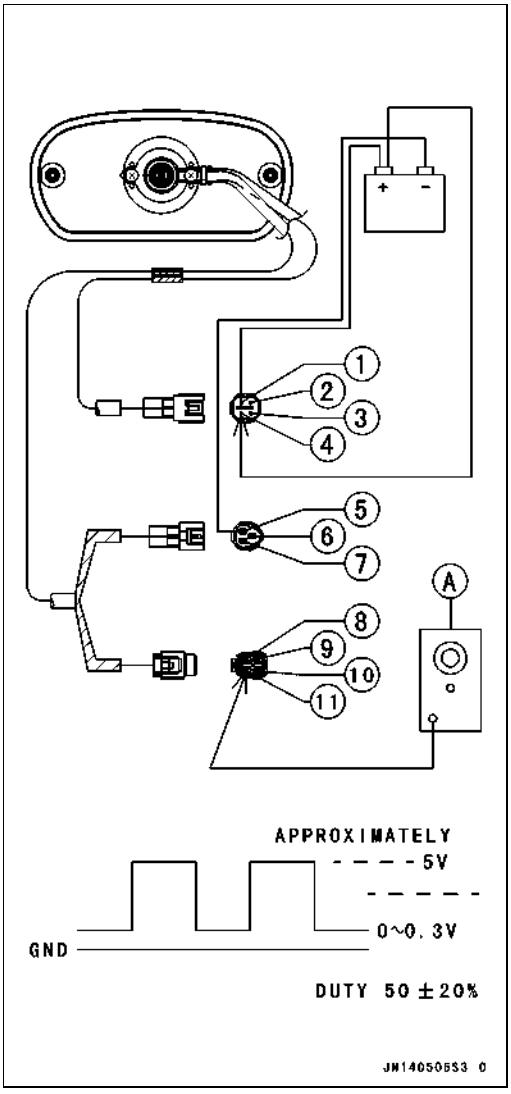


Speedometer Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- The speed equivalent to the input frequency is indicated in the oscillator [A] if the square wave (illustrated as shown) would be input into the terminal [11].

○ Indicates approximately 60 mph in case the input frequency would be approximately 292 Hz.

○ Indicates approximately 60 km/h in case the input frequency would be approximately 182 Hz.

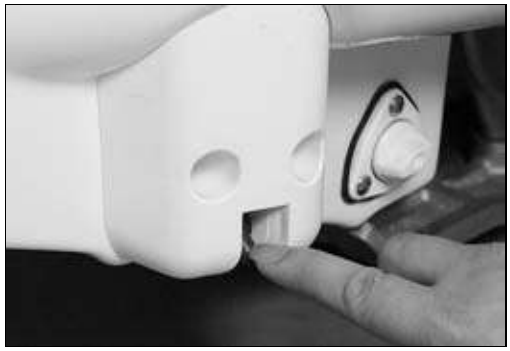


Multifunction Meter

- If the oscillator is not available, the speedometer can be checked as follows.

○ Install the meter unit.
○ Turn on the ignition switch.
○ Rotate the waterwheel by hand.
○ Check that the speedometer shows the speed.

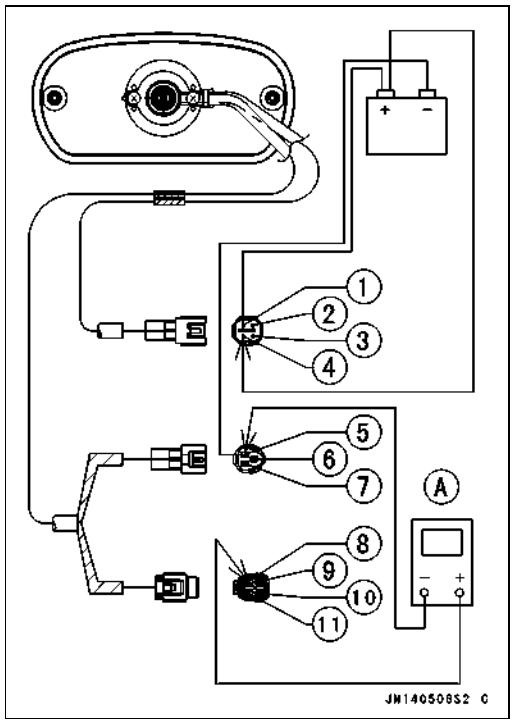
★If the speedometer does not work, check the speed sensor electric source voltage and speed sensor.



Speed Sensor Electric Source Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Set the hand tester [A] to the DC25 V range and connect it to the terminals [5] and [8].

★If the voltage is less than 7 V, replace the meter assembly.



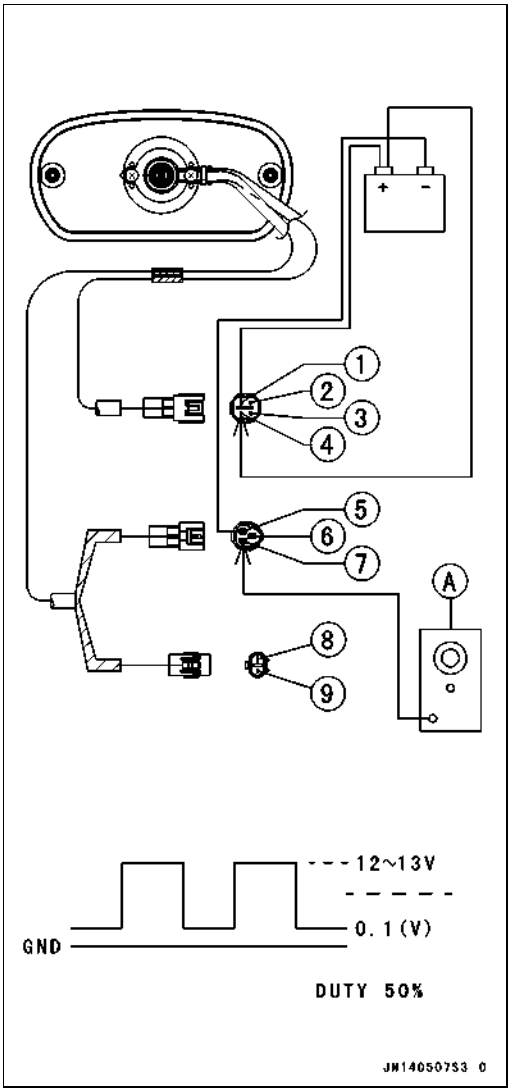
Multifunction Meter

Tachometer Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- The revolutions per minute (rpm) equivalent to the input frequency is indicated in the oscillator [A] if the square wave (illustrated as shown) would be input into the terminal [7].

○ The tachometer indicates approximately 3 000 r/min (rpm) in case the input frequency would be approximately 300 Hz.

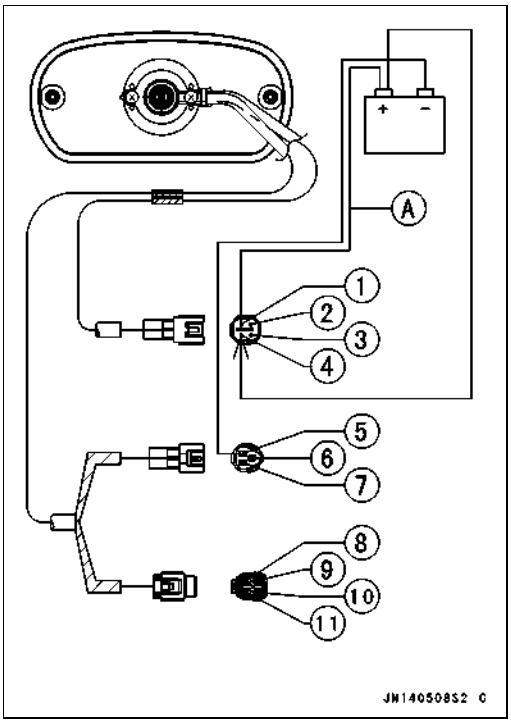
★ If the tachometer does not work normally, replace the meter assembly.



Battery Symbol/bAt Characters/Warning Light Inspection

- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Check that the battery symbol/bAt characters/warning light flash when the input voltage to the terminal [A] is lowered to 12 ± 0.1 volts or less. And check that the meter returns in the state of normality when the input voltage to the black lead terminal is raised to 12.5 V or more.

★ If any display function does not work, replace meter assembly.

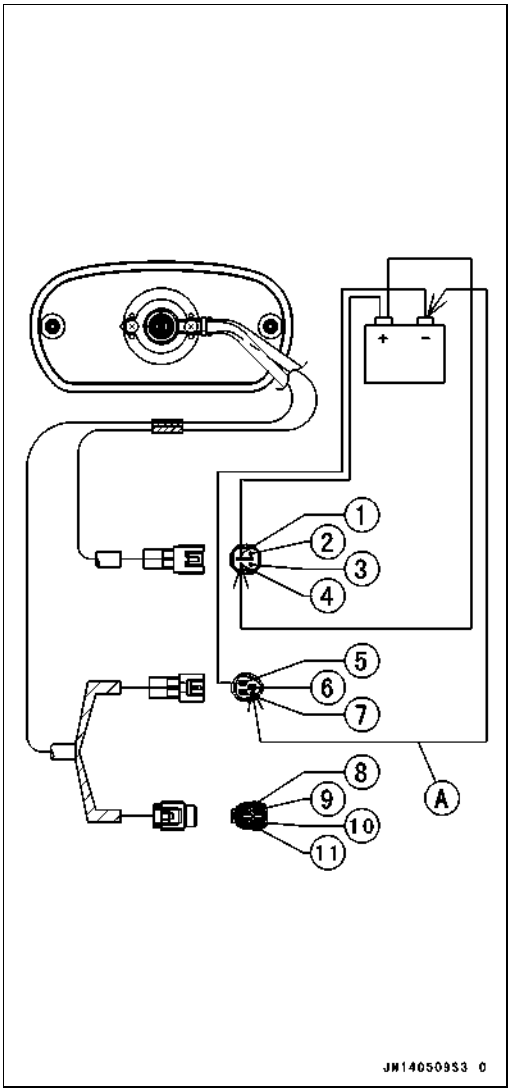


Multifunction Meter

Heat Symbol/HEAt Characters/Warning Light Inspection

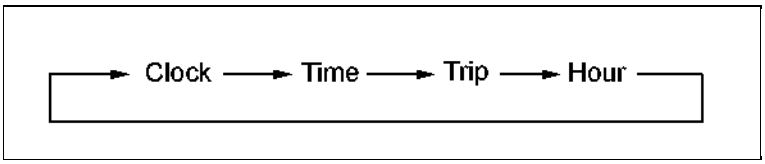
- Connect the 12 V battery and terminals in the same manner as specified in the “Display Function Inspection”.
- Check that the heat symbol/HEAt characters/warning light flash when the water temperature sensor terminal [6] is connected to the battery (–) terminal [5] using auxiliary wire [A] as shown.
- Check that the heat symbol/HEAt characters/warning light disappear when the terminals are disconnected.

★If any display function does not work, replace meter assembly.



MODE/SET Button Inspection

- Check that when the MODE button is pushed and held continuously, the display rotates through the four modes.



- Indicate the clock mode.
- Check that when the SET button is pushed for more than two seconds, the meter display turns to the clock set mode.

★If the display function does not work, replace the meter assembly.

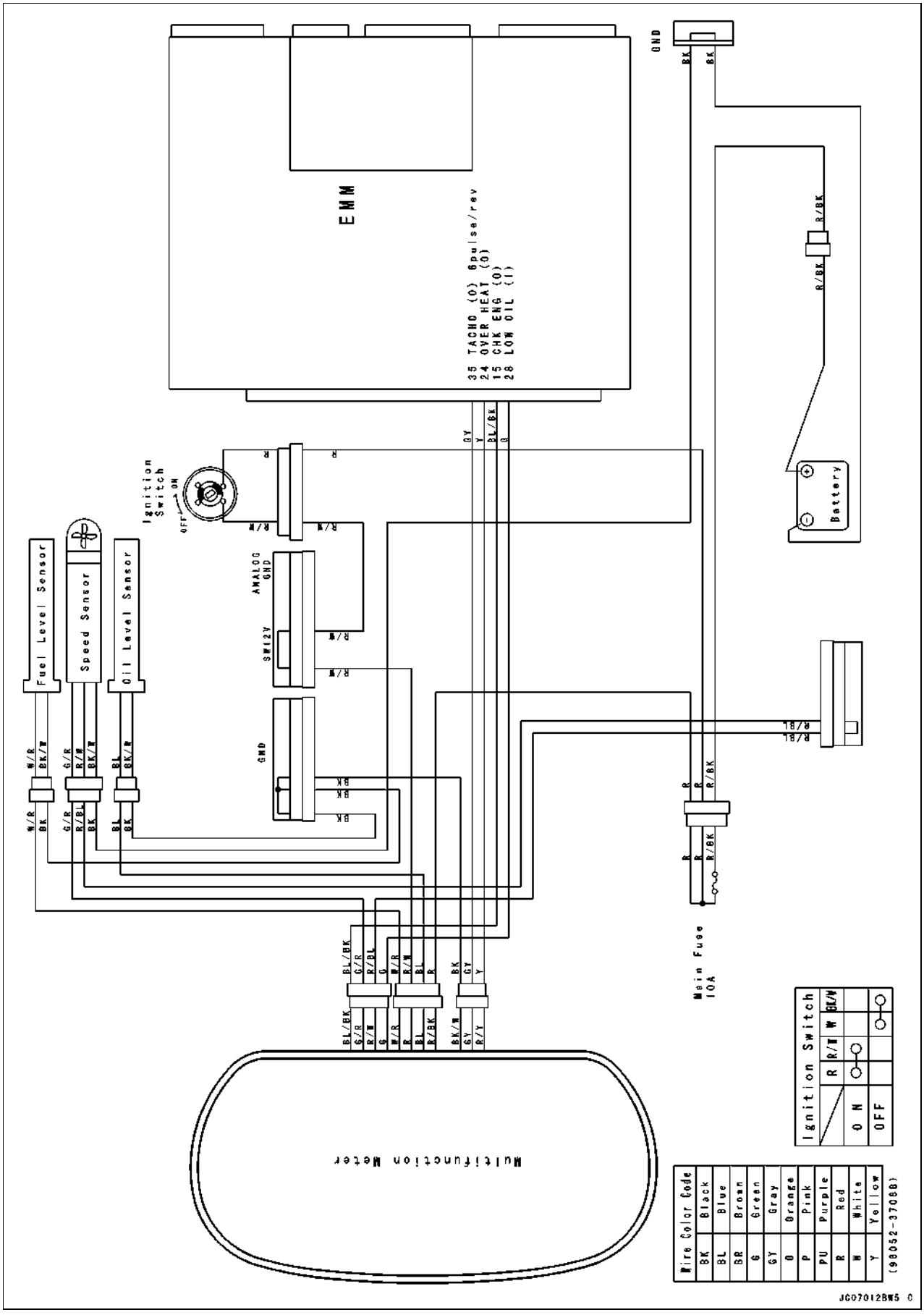
- Indicate the time mode.
- Check that when the SET button is pushed for more than two seconds, the meter display turns to “00:00”.

★If the display function does not work, replace the meter assembly.

- Indicate the trip mode.
- Check that when the SET button is pushed for more than two seconds, the meter display turns to “000.0”.

★If the display function does not work, replace the meter assembly.

Multifunction Meter Circuit



Switches

Switch Inspection

- Using an ohmmeter, check to see that only the connections shown in the table have continuity (about zero ohms).

★If the switch has an open or short, repair it or replace it with new one.

Ignition Switch

	R	R/W	W	BK/W
ON	○———	———○		
OFF			○———	———○

Start Switch

	Y/R	Y/R
PUSH	○———	———○

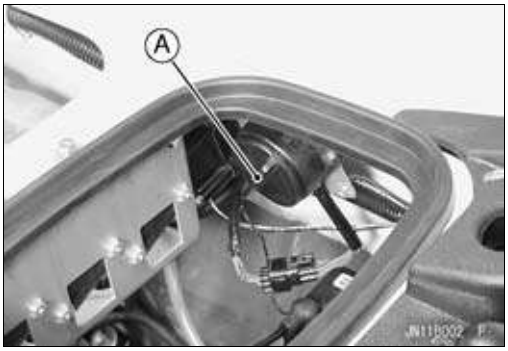
Stop Switch

	TETHER CODE	BK	W	R/PU	Y/R
	SET			○———	———○
PUSH	PULL	○———	———○		

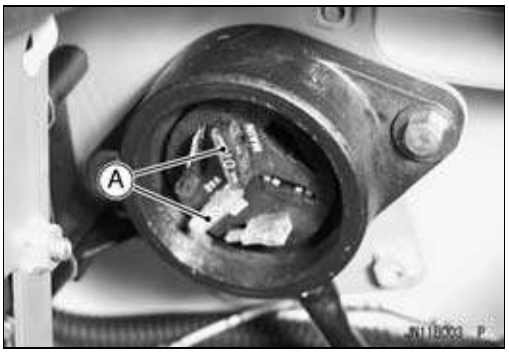
Fuse

Inspection

● Remove the fuse plug [A].



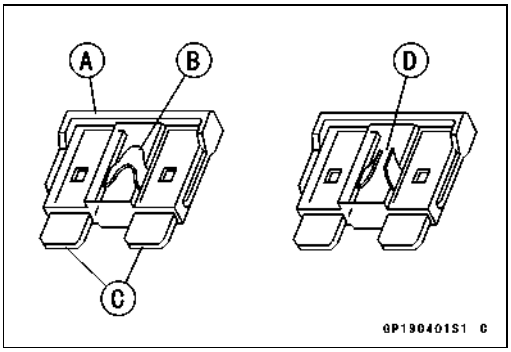
● Take out the fuse [A].



● Inspect the fuse element.

★If it is 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]

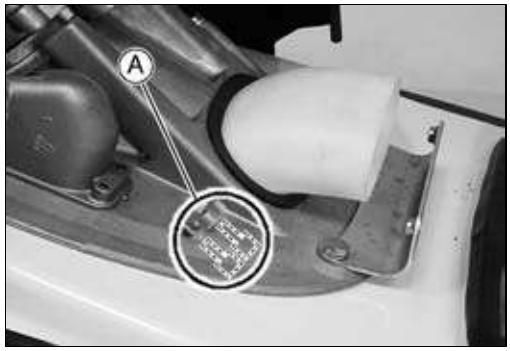


CAUTION

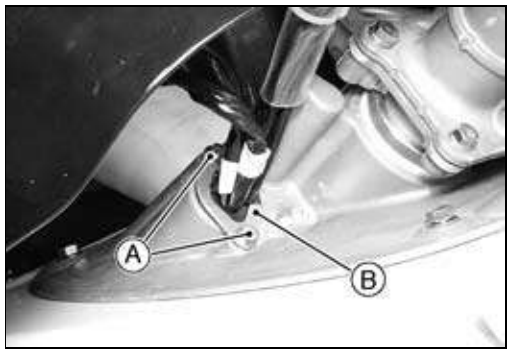
When replacing a fuse, be sure the new fuse matches the specified fuse rating for that circuit. Installation of a fuse with a higher rating may cause damage to wiring and components.

Steering Position Sensor and Magnet Removal

- Disconnect:
  Steering Cable Ball Joint at Upper End
  Shift Link Rod Ball joint
- Remove the steering cover mounting bolts and lift it (see JT1100-C1 Steering chapter).
- Remove the air intake duct mounting bolts [A].



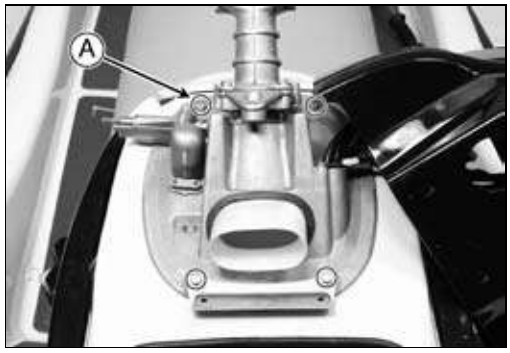
- Unscrew the mounting bolts [A], and remove the grommet plate [B] to free the harness and cable.



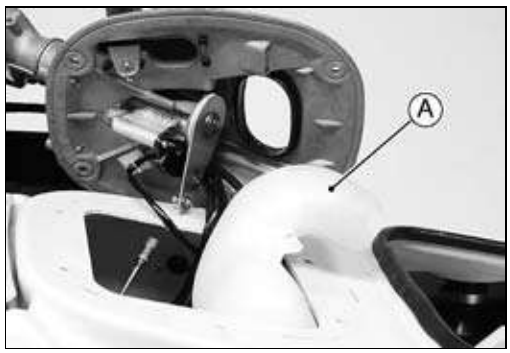
- Remove the steering holder mounting bolts and nuts [A], and lift the steering holder.

NOTE

○ *The washers on the inside of the hull will drop down when the nuts are removed.*



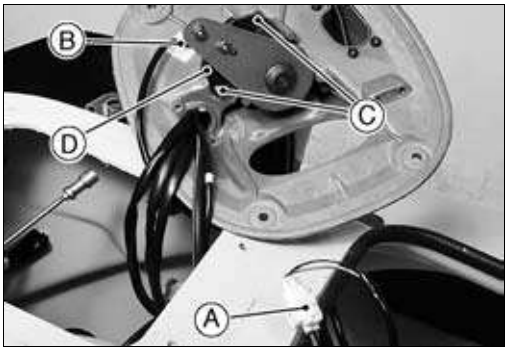
- Pull out the air intake duct [A] from the hull.



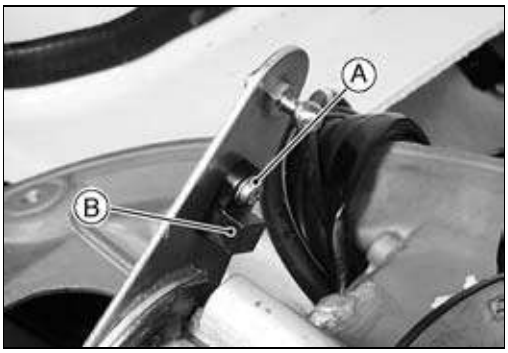
- Cut off the clamp [A] to free the harness and leads.

Kawasaki Smart Steering System

- Remove or disconnect:
  Steering Position Sensor Lead Connector [A]
  Clamp [B]
  Steering Position Sensor Mounting Screws [C]
  Steering Position Sensor [D]



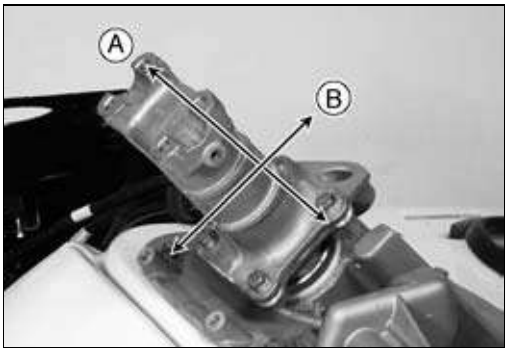
- Unscrew the mounting screw [A] and remove the magnet [B].



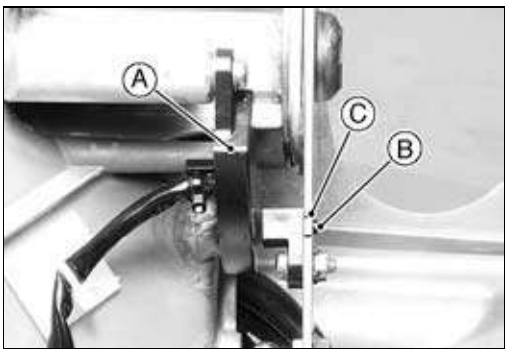
Steering Position Sensor and Magnet Installation

- Moving the steering shaft in the direction [A] and [B], check the steering shaft for excessive play.

★If necessary, adjust the steering shaft nut or replace the bushings (see JT1100–C1 Steering chapter).



- Apply a non-permanent locking agent to the steering position sensor mounting screws and magnet mounting screw.
- Install the steering position sensor [A] to the steering holder and align the projection [B] on the magnet with the hole [C] on the steering shaft plate.

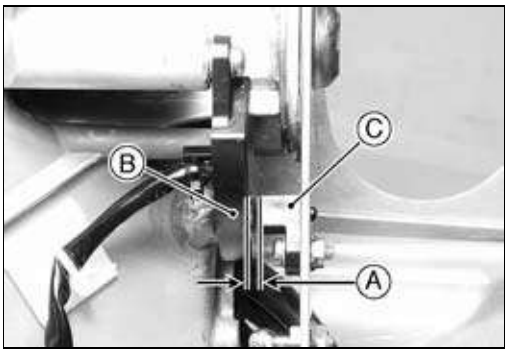


- Turning the steering shaft fully in left and right direction, check whether the steering position sensor comes in contact with the magnet.
- Check the clearance [A] between the steering position sensor [B] and the magnet [C] with feeler gauge.

Steering Position Sensor Clearance
Standard: 0.5 ~ 1.5 mm (0.02 ~ 0.06 in.)

★If necessary, adjust the steering shaft nut (see JT1100–C1 Steering chapter).

- Check the operation of Kawasaki Smart Steering system.



Kawasaki Smart Steering System

Inspection of Kawasaki Smart Steering System

- Center the handlebar in the straight-ahead position.
- Start the engine and allow it to an idle for 4 seconds or above.

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.

- Turn the handlebar all the way to the left or right, and check the engine speed does not change, i.e. the engine maintain an idle.

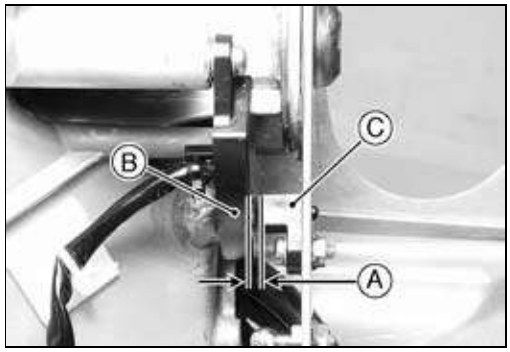
- Center the handlebar in the straight-ahead position .
- Squeeze the throttle lever and allow it to approx. 4 000 r/min (rpm) or above for 4 seconds or above.
- Release the throttle lever.
- Within 1 second, turn the handlebar all the way to the left or right and check the engine speed increases to approx. 6 000 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, check the steering position sensor clearance.

Steering Position Sensor Clearance

- 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, inspect steering position sensor input voltage.

★If necessary, adjust the steering shaft nut.

Steering Position Sensor Input Voltage Inspection

- Measure the input voltage to the steering position sensor.

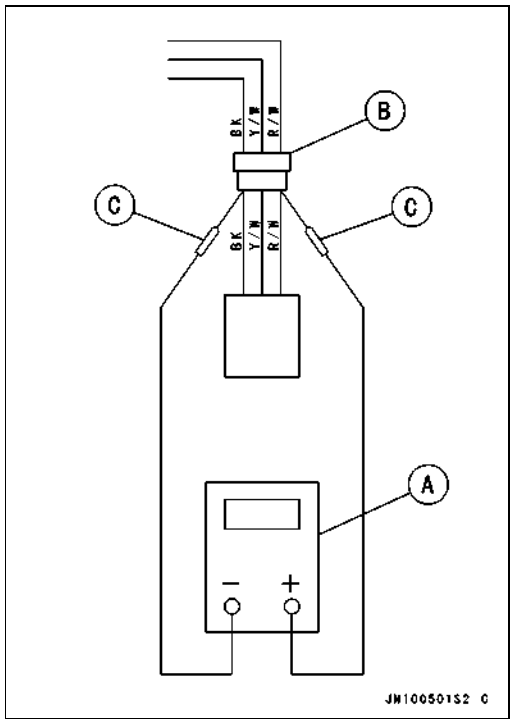
NOTE

○ *Be sure the battery is fully charged.*

○ Connect a digital voltmeter [A] to the lead connector [B] of the steering position sensor using the needle adapter set [C].

Special Tool - Needle Adapter Set : 57001–1457

Connections to Steering Position Sensor Connector
Meter (+) → R/W Terminal
Meter (–) → BK Terminal



Kawasaki Smart Steering System

○ Turn the ignition switch ON.
○ Center the handlebar in the straight-ahead position.
○ Measure the input voltage.

Steering Position Sensor Input Voltage
Standard: Battery Voltage

○ Turn the ignition switch OFF.
★ If the reading is good, inspect steering position sensor output voltage.
★ If the reading is out of the standard, check the following.
Battery Voltage
Main Fuse 10 A
Power Source Wiring (see Steering Position Sensor Circuit)

Steering Position Sensor Output Voltage Inspection
● Measure the output voltage from the steering position sensor.

NOTE

○ *Be sure the battery is fully charged*

○ Connect a digital voltmeter [A] to the lead connector [B] of the steering position sensor using the needle adapter set [C].

Special Tool - Needle Adapter Set: 57001–1457

Connections to steering Position Sensor Connector
Meter (+) → Y/W Terminal
Meter (–) → BK Terminal

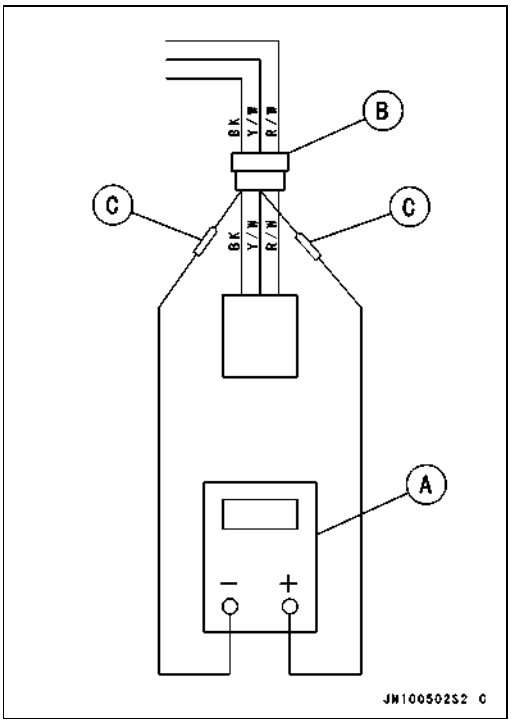
○ Turn the ignition switch ON.
○ Turn the handlebar fully left or right.
○ Measure the output voltage.

Steering Position Sensor Output Voltage
Standard: approx. 0V

NOTE

○ *When the handlebar is centered in straight-ahead position the output voltage standard value is battery voltage.*

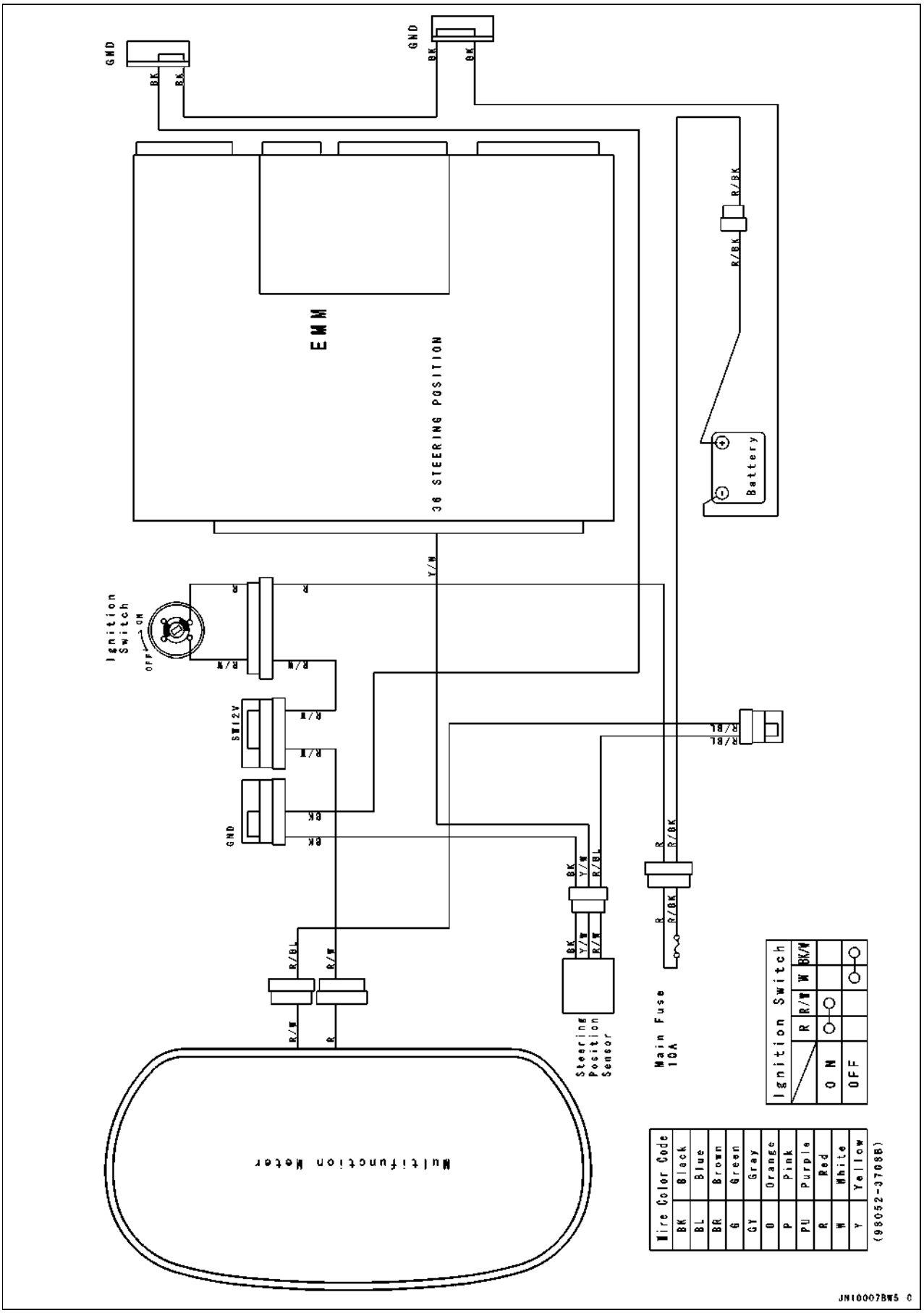
○ Turn the ignition switch OFF.



★ If the reading is out of the standard, suspect the following.
Damaged Steering Position Sensor
Open Sensor Circuit
★ If the reading is the standard, but the Kawasaki Smart Steering system does not operate, suspect the EMM.

Kawasaki Smart Steering System

Steering Position Sensor Circuit



Storage

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Preparation for Storage

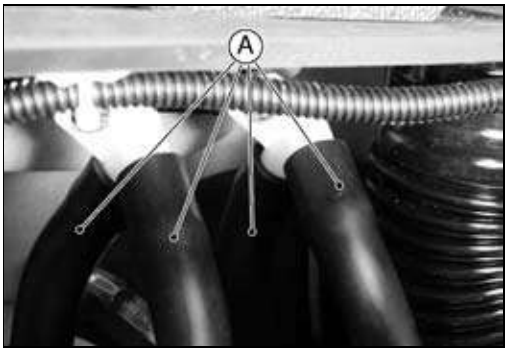
During the winter, or whenever the watercraft will not be in use for a long period of time, proper storage is essential. It consists of checking and replacing missing or worn parts; lubricating parts to ensure that they do not become rusted; and, in general, preparing the watercraft so that when the time comes to use it again, it will be in top condition.

Cooling System

- Clean the cooling system (see Cooling System Flushing in the Cooling and Bilge Systems chapter).

Bilge System

- Clean the bilge system (see Bilge System Flushing in the Cooling and Bilge Systems 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.



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.
  [A] Siphon Hose

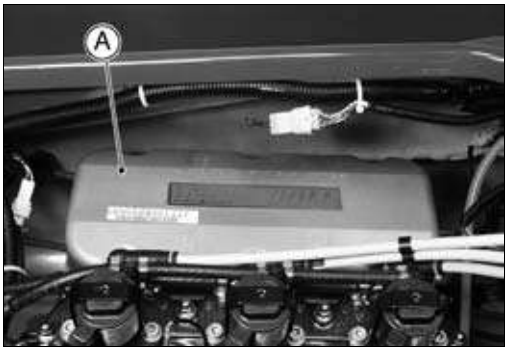
- Clean the fuel pump screen (see Fuel Pump Screen Cleaning in the Fuel System chapter).

- Refill the fuel tank with fresh fuel approximately 10 L.
- Turn the ignition switch on.
- Push the lanyard key under the stop button, and start the engine and run it in 15 second periods until the fuel in the fuel system is changed with the fresh fuel.
- Pull the lanyard key off the stop button and turn the ignition switch off.
- Drain the fuel tank.
- Leave the fuel filler cap loose to prevent condensation in the tank.

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.

Preparation for Storage



- Remove the air intake cover [A] from the throttle body.
- Lift out the flame arresters and clean them, if necessary (see Flame Arrester Cleaning in the Fuel System chapter).
- Spray a penetrating rust inhibitor down the throttle body bore.
- Install the flame arrester.
- Reinstall the cover, apply a non-permanent locking agent to the threads of the air intake cover bolts and tighten securely.

Engine

- Remove the spark plugs and push the plug caps fully onto the plug cap holder on the electric case.
- Pour one ounce of motor oil into each cylinder.

CAUTION
Do not use too much oil, or the crank seals may be damaged when the engine is next started.

- Turn the ignition switch 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.
- Pull the lanyard key off the stop button and turn the ignition switch off.
- Reinstall the spark plugs and caps.

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 Removal 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.

- Cover 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 the Appendix chapter).

15-4 STORAGE

Preparation for Storage

General

- 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 spacers to insure adequate ventilation, and prevent corrosion.
- Cover the watercraft and store it in a clean, dry place.

Removal from Storage

Lubrication

- Carry out all recommended lubrication procedures (see Lubrication in the Appendix 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 Cleaning and Spark Plug Adjustment in the Electrical System 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 the Electrical System chapter).

Fuel System

- Check and clean or replace the fuel pump screen as necessary (see Fuel Pump Screen Cleaning in the Fuel System 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 tank with the specified oil.

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 or severe engine and exhaust system damage will occur.

- Install the seat making sure it is locked.

Appendix

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Troubleshooting

Starting difficulty or failure to start

Ignition System

Ignition Spark Present

- Fault in fuel system
- Lack of compression

No Spark

- Faulty or fouled spark plug
- Faulty plug wire insulation
- Faulty igniter in EMM
- Faulty ignition coil
- Faulty magneto
- Battery voltage low

Fuel System (check that fuel tank contains fuel)

- Fuel feed line leaking or clogged
- Fuel pump screen and/or fuel filter clogged
- Vent line clogged
- Faulty fuel pump
- Injector malfunction
- EMM connection loose
- EMM malfunction

Battery/Starter System

- Faulty magneto solenoid switch
- Battery voltage low
- Starter motor brushes worn
- Faulty reduction gear
- Ignition switch turned OFF and/or lanyard key not pushed under stop button

Engine starts but stops right away

Compression

- Faulty crankshaft oil seal
- Crankcase joint leak
- Worn piston and rings
- Head gasket leak
- Spark plug leak

Fuel System

- Fuel pump screen and/or fuel filter clogged
- Fuel feed line leaking or clogged
- Vent line clogged
- Faulty fuel pump
- Injector malfunction
- EMM connection loose
- EMM malfunction

Electrical System

- Faulty or fouled spark plug
- Poor wiring connection
- Faulty magneto

Troubleshooting

Engine misfires, does not run smoothly

Fuel System

Fuel mixture too lean

- Obstruction in fuel passage or outlet
- Injector (PDS) malfunction
- EMM malfunction
- Poor fuel supply (fuel pump screens, fuel filter, hoses, or vent line clogged)
- Faulty fuel pump

Fuel mixture too rich

- Injector (PDS) malfunction
- EMM malfunction
- Flame arrester clogged

Electrical System

Weak Spark

- Reduced ignition coil output
- High voltage insulation breakdown
- Spark plug fouled
- Spark plug gap wrong
- Poor wiring connection, spark plug cap
- Faulty magneto
- Battery voltage low

Engine Lubrication System

- Oil line clogged
- Faulty oil pump
- Oil Pump Cable maladjustment

Abnormal engine sound

During normal cruising

- Slight piston seizure
- Piston ring broken or sticking
- Main bearing worn or damaged

During sudden acceleration

- Excessive clearance between connecting rod small end and piston pin, or between pin and piston
- Excessive connecting rod big end clearance

Pinging

- EMM malfunction
- Carbon accumulation in cylinder head
- Poor quality gasoline
- Spark plug wrong heat range

When the engine is idling while cold

- Excessive piston clearance
- Piston rings worn
- Piston worn
- Connecting rod bent, twisted

Troubleshooting

Low engine power (This trouble often has more than one cause, and trouble symptoms may not be clear)

Ignition System

- Spark plug gap or heat range wrong
- Igniter in EMM trouble
- Reduced ignition coil output
- Loose wiring connection in ignition circuit

Fuel System

- Insufficient fuel supply to injector (PDS)
- Throttle valve does not fully open
- Fuel pump screen and/or fuel filter clogged
- Faulty fuel pump

Other

- Flame arrester clogged
- Muffler or exhaust system clogged
- Water or foreign matter in gasoline or engine oil
- Exhaust gas leak in engine compartment

Overheating

- Igniter in EMM trouble
- Throttle body not adjusted
- Flame arrester or exhaust system clogged
- Carbon accumulation in combustion chamber
- Wrong type of gasoline or oil
- Obstruction in oil pump hoses
- Cooling water line leaking or clogged

Heavy Fuel Consumption

- Throttle body not adjusted
- Flame arrester clogged
- Muffler or exhaust system clogged
- Worn cylinder, piston or piston ring
- Fuel feed line leaking
- EMM malfunction

Poor performance though 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
- Bushings damaged or cracked
- Steering shaft bent
- No lubricant on steering pivot
- Steering cable damaged or improperly routed

Troubleshooting

Engine activates S.L.O.W. mode

Cooling water temperature gets high

- Weeds or debris in jet pump
- Cooling water line clogged
- Water temperature sensor circuit malfunction/Faulty water temperature sensor

EMM temperature gets high

- Weeds or debris in jet pump
- Cooling water line of EMM clogged or leaked
- Engine overheat

Alternator voltage too high

- EMM (regulator/rectifier) malfunction
- Faulty alternator

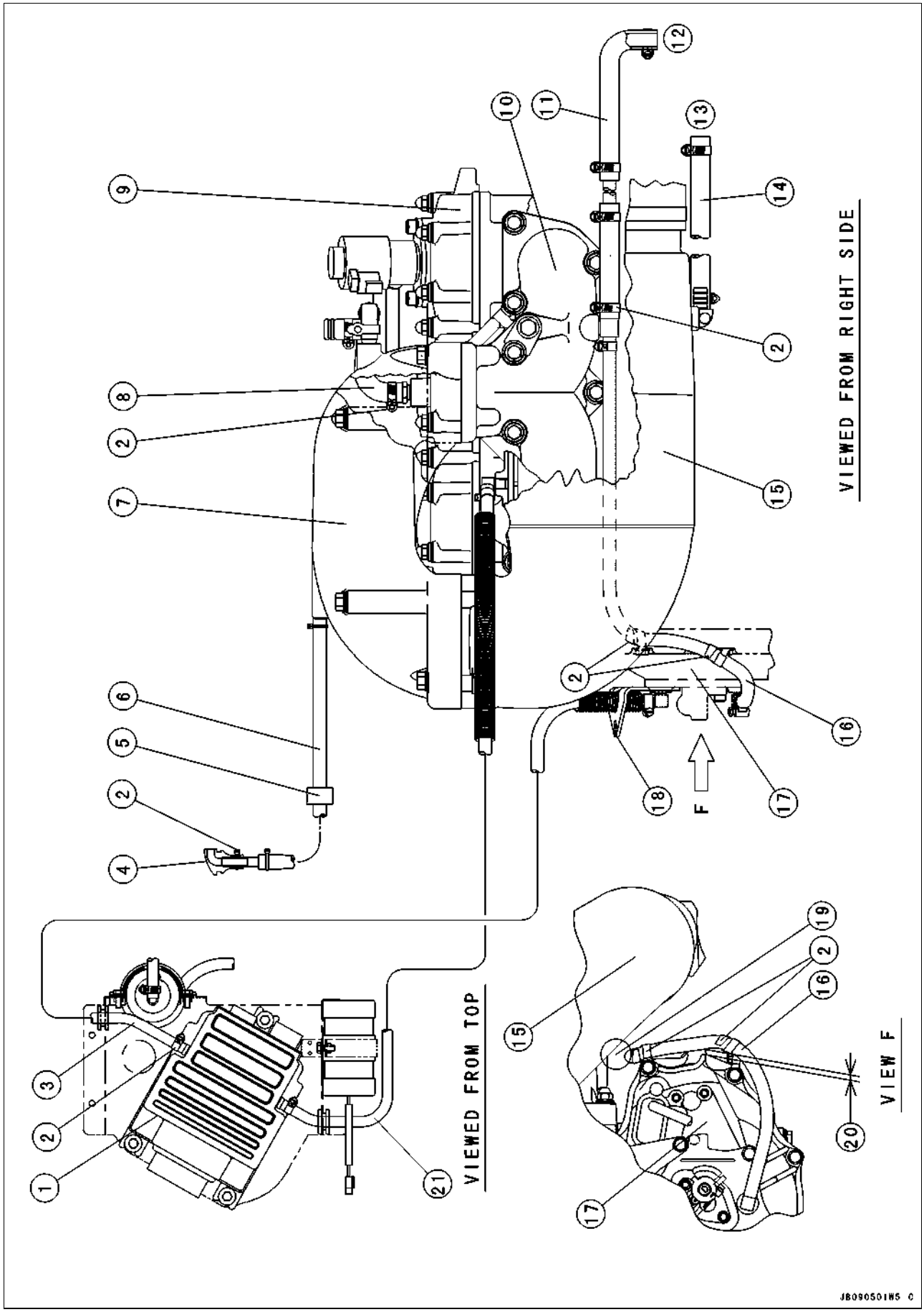
Air temperature sensor output high

- Air temperature sensor circuit malfunction
- Faulty air temperature sensor
- Too hot intake air temperature

Low oil level

- Dangerously low oil in oil tank
- Oil level sensor circuit malfunction/Faulty oil level sensor

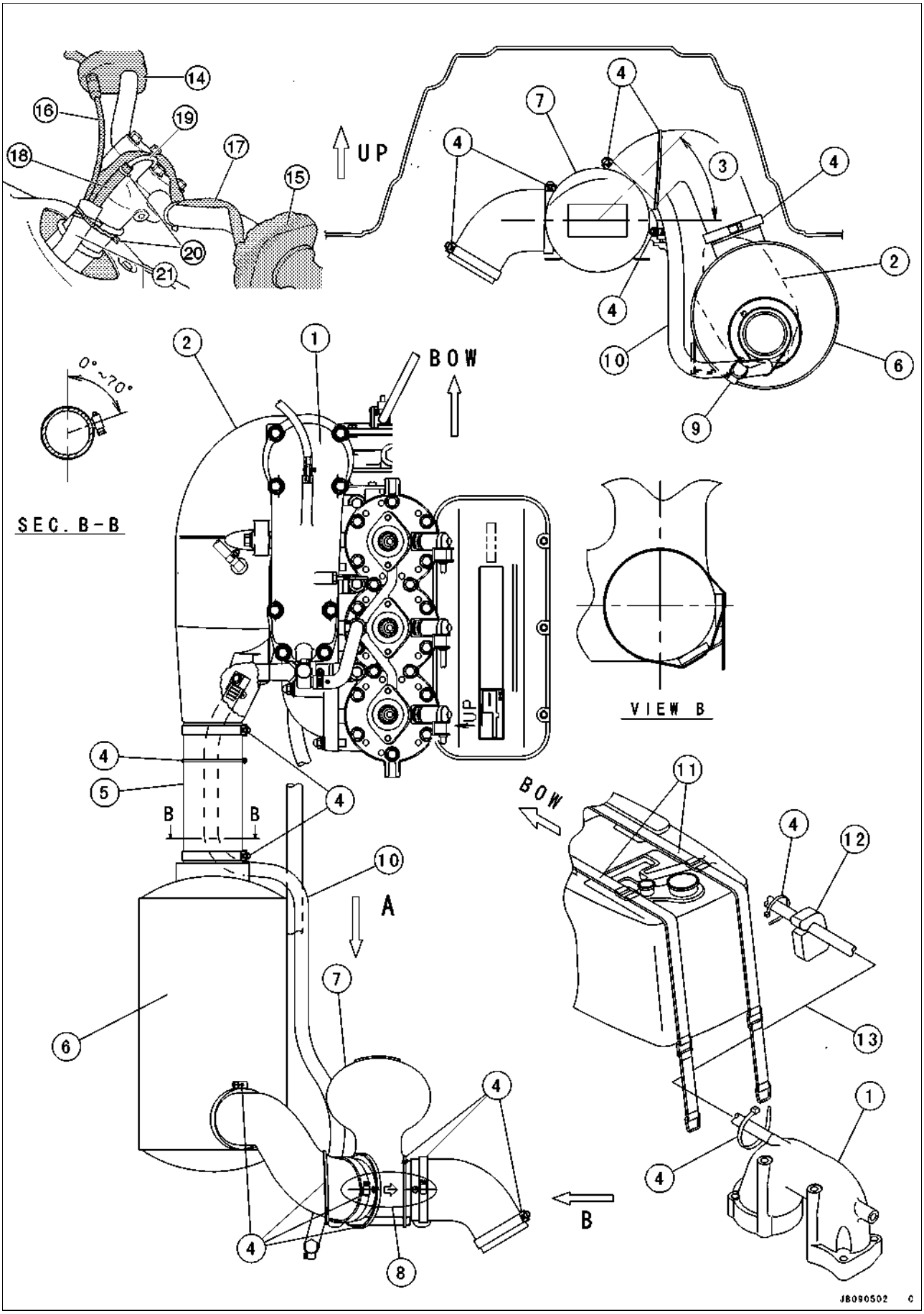
Cable, Wire and Hose Routing



Cable, Wire and Hose Routing

1. EMM (Engine Management Module)
2. Clamp
3. Cooling Hose (Magneto Cover ∼ EMM)
4. Bypass Outlet
5. Detent
6. Bypass Hose
7. Exhaust Pipe
8. Cooling Hose (Cylinder Head ∼ Exhaust Pipe) The hose end with white mark should be installed to the fitting of exhaust pipe.
9. Cylinder Head
10. Exhaust Manifold
11. Inlet Cooling Hose
12. To Jet Pump
13. To Hull
14. Cooling Hose (Expansion Chamber ∼ Hull)
15. Expansion Chamber
16. Cooling Hose (Exhaust Manifold ∼ Magneto Cover)
17. Magneto Cover
18. Oil Pump Cable Bracket
19. Route the cooling hose near the magneto cover so as not to come in contact with the exhaust manifold and chamber.
20. Approximately 10 mm (0.4 in.)
21. Cooling Hose (EMM ∼ Expansion Chamber)

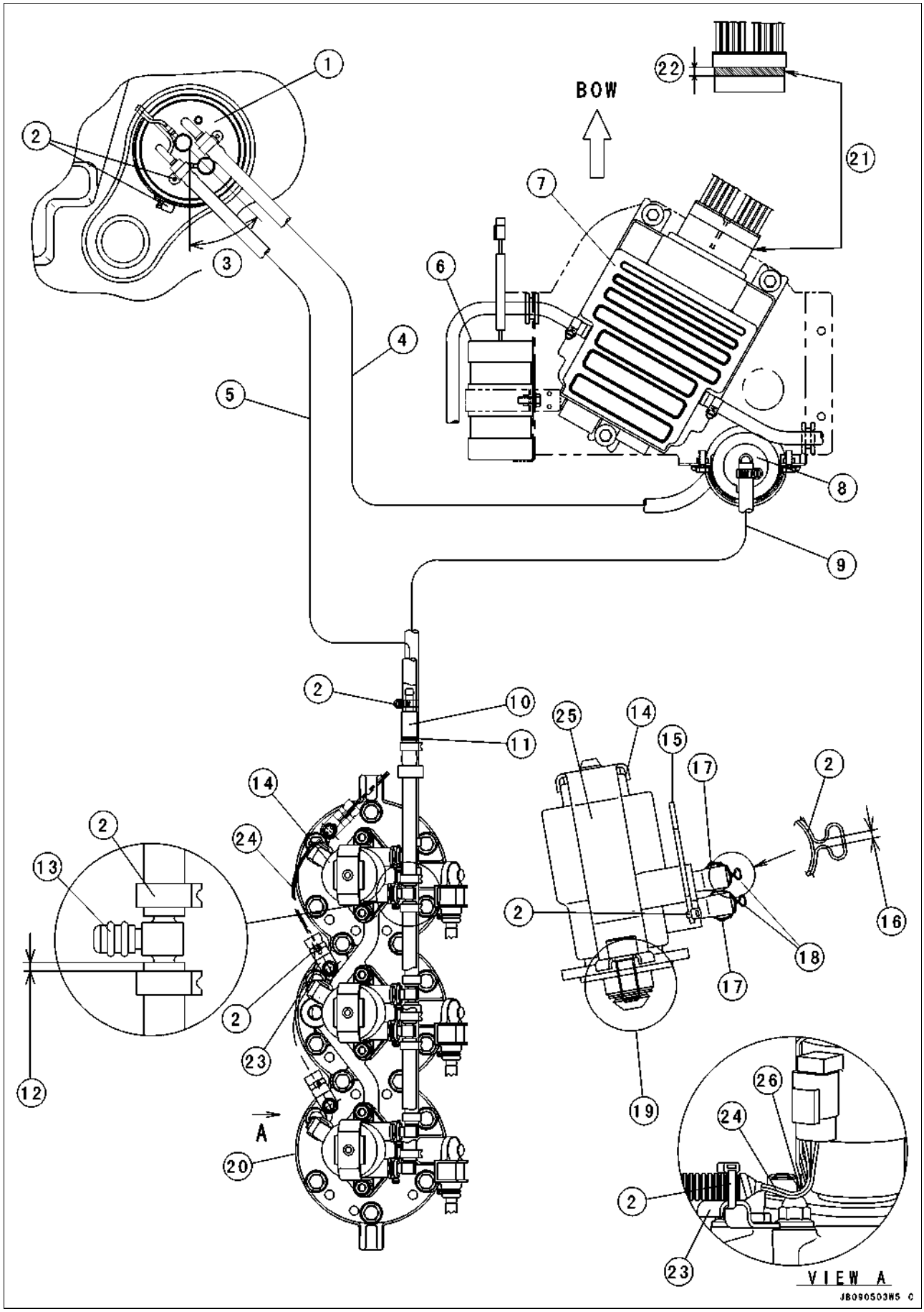
Cable, Wire and Hose Routing



Cable, Wire and Hose Routing

1. Exhaust Pipe
2. Exhaust Chamber
3. 45°
4. Clamp
5. Connecting Tube
6. Water Box Muffler
7. Resonator
8. Align the arrow mark on the resonator with the clamp screws.
9. Position the clamp screw as shown.
10. Cooling Hose (Expansion Chamber ~ Hull)
11. Fuel Tank Straps
12. Detent
13. Bypass Hose
14. Throttle Case
15. Start/Stop Switch
16. Throttle Cable
17. Start/Stop Switch Lead
18. Fuel Vent Hose
19. Pipe
20. Clamps
21. Tube

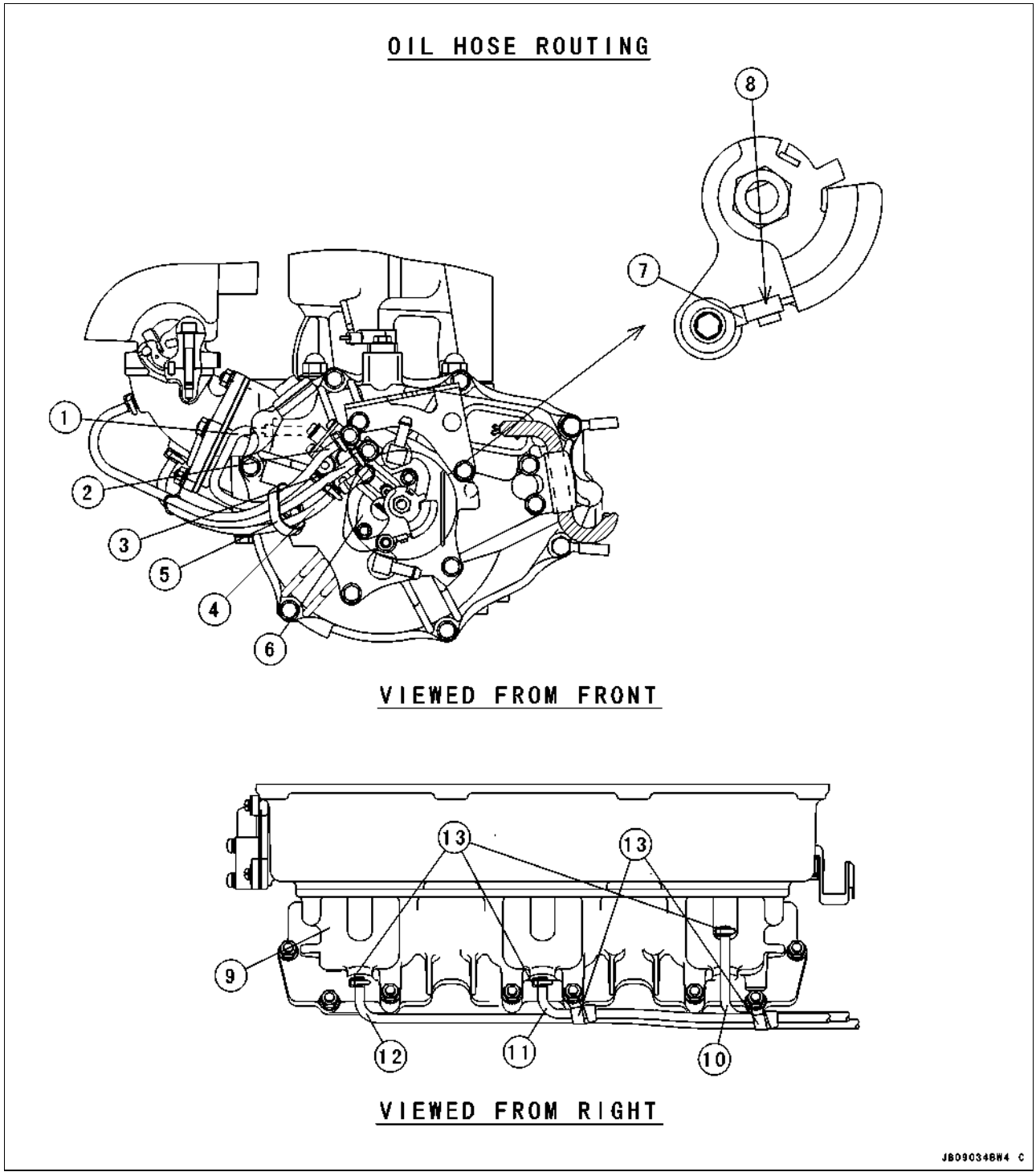
Cable, Wire and Hose Routing



Cable, Wire and Hose Routing

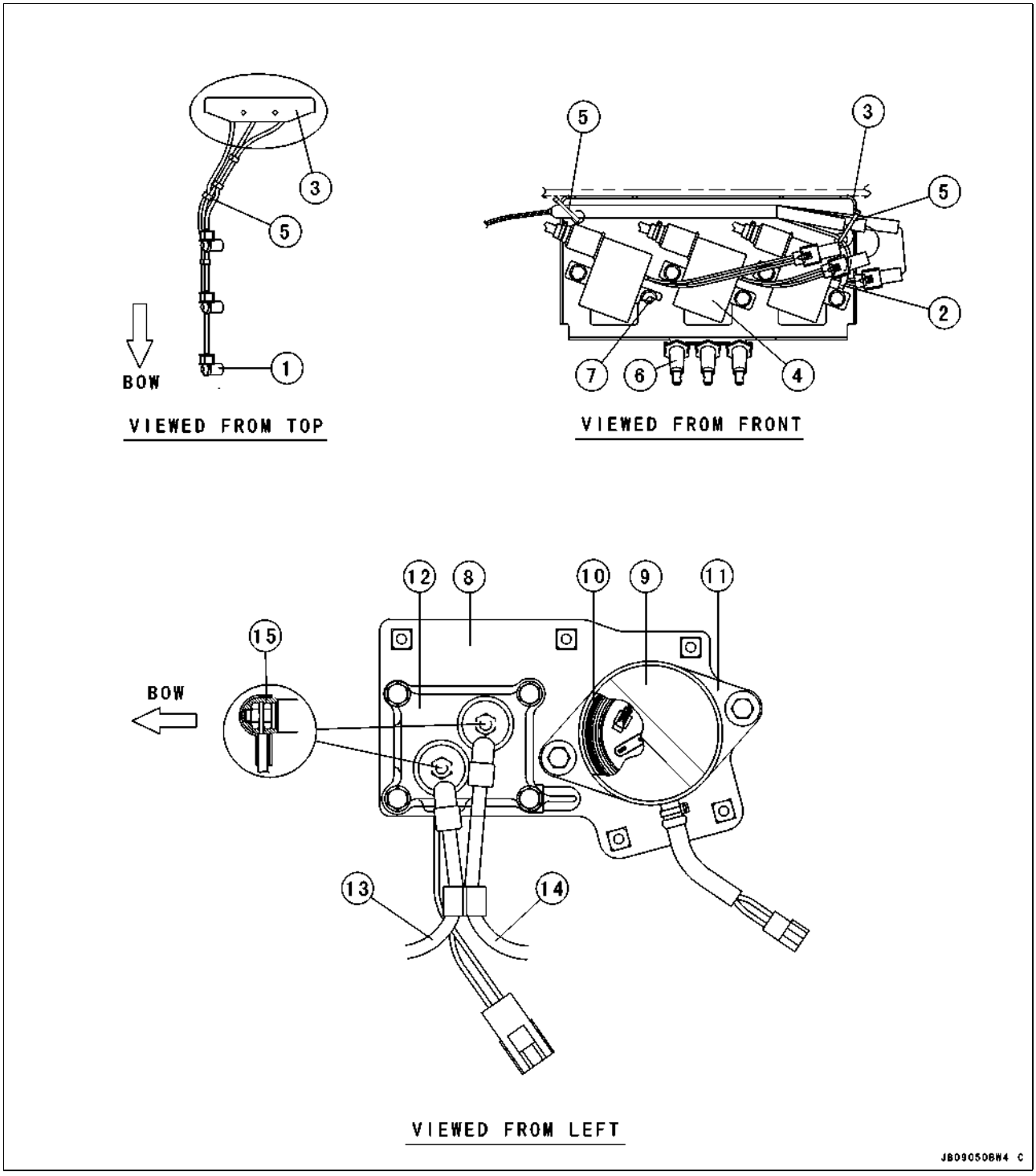
1. Fuel Pump
2. Ear Type Clamp
3. 45°
4. Main Fuel Hose (to Fuel Filter)
5. Return Fuel Hose (to Fuel Pump)
6. Capacitor
7. EMM
8. Fuel Filter
9. Supply Fuel Hose (to Injectors)
10. Fuel Regulator
11. Install the fuel regulator so that its groove side faces toward the injectors.
12. Approximately 1 ∼ 3 mm
13. Apply 2 stroke oil to the O-rings
14. Injector
15. Retainer
16. 1.2 ∼ 1.7 mm
17. Stopper (jagged) Portion
18. Stake the ear type clamps with positioning the stopper (jagged) portions of clamps oppositely.
19. Do not damage the injector nozzle and the seat surface of the cylinder head.
20. Cylinder Head
21. Apply water resistant grease.
22. Approximately 10 mm
23. Bracket
24. Injector harness
25. Band
26. Loosen the harness remaining.

Cable, Wire and Hose Routing



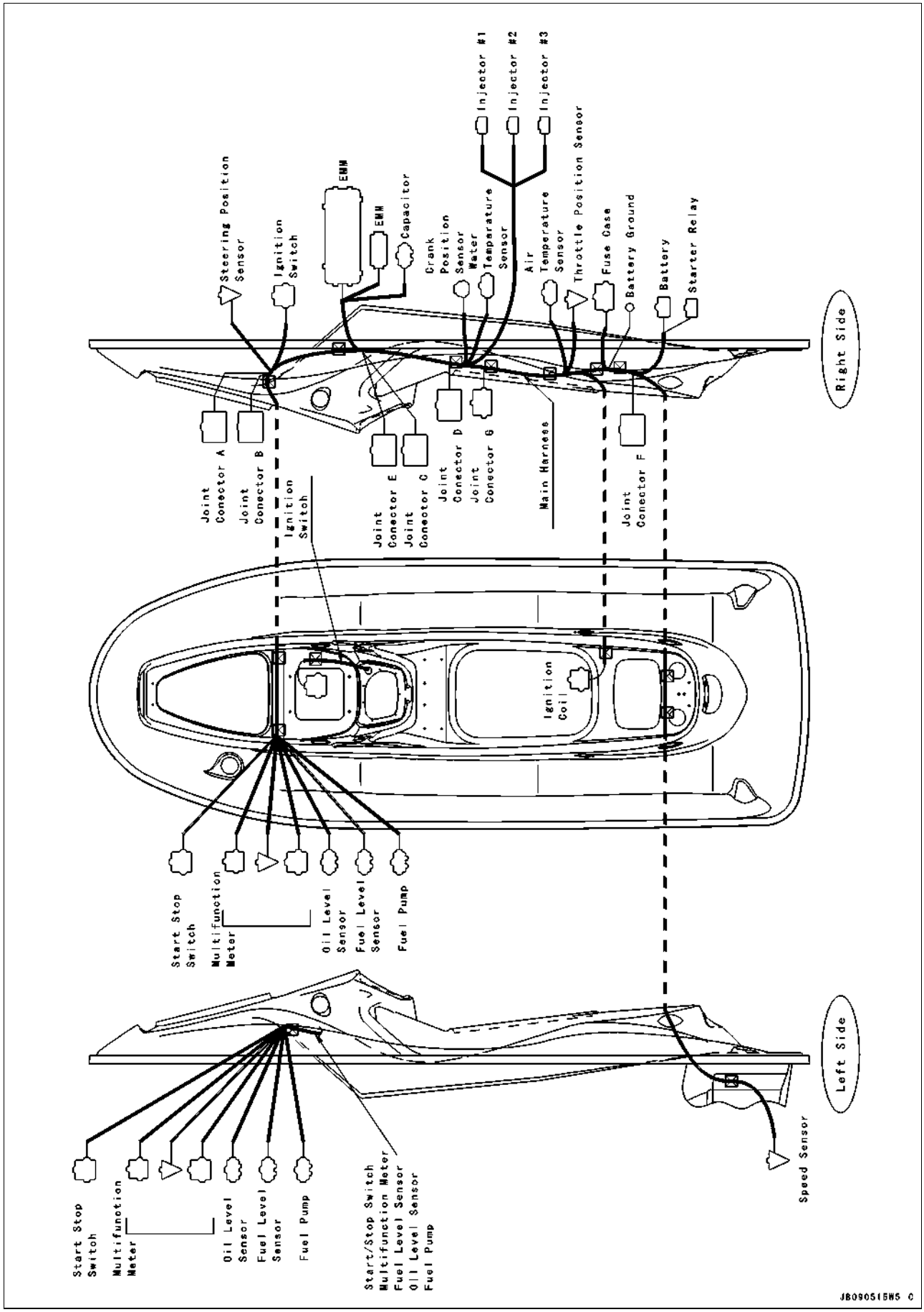
1. Oil Hose to Nozzle for #1 Bearing
2. Oil Hose to #1 Nozzle on Intake Manifold
3. Oil Hose to #2 Nozzle on Intake Manifold
4. Oil Hose to #3 Nozzle on Intake Manifold
5. Clamp the 4 oil hoses so as not to come in contact with the bolt head.
6. Oil Pump
7. Oil Pump Cable
8. Be sure the cable portion indicated in the figure is in contact with the pulley portion indicated in the figure.
9. Intake Manifold
10. #1 Oil Hose
11. #2 Oil Hose
12. #3 Oil Hose
13. Clamp

Cable, Wire and Hose Routing



1. Spark Plug Cap
2. Apply water resistance grease.
3. Bracket for ignition coils
4. Ignition Coil
5. Clamp
6. Spark Plug Cap Holder
7. Collar
8. Starter Relay and Fuse Bracket
9. Cap
10. O-ring
11. Fuse Assembly
12. Starter Relay
13. To Starter Motor
14. To Battery (+)
15. Apply adhesive (3M DP-270 BLACK) to the terminals to prevent the terminals from galvanic corrosion.

Cable, Wire and Hose Routing



MODEL APPLICATION

Year	Model	Beginning Hull No.
2003	JT1100-G1	KAW70001□203

□ : This digit in the hull number changes from one machine to another.

KAWASAKI HEAVY INDUSTRIES, LTD.
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