

Kawasaki

**VULCAN 1500 DRIFTER
VN 1500 DRIFTER**



Motorcycle Service Manual

Quick Reference Guide

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

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

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 vehicle:

- Follow the Periodic Maintenance Chart in the Service Manual.
- Be alert for problems and non-scheduled maintenance.
- Use proper tools and genuine Kawasaki Motorcycle parts. Special tools, gauges, and testers that are necessary when servicing Kawasaki motorcycles are introduced by the Special Tool Catalog or 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 preparing this manual, we divided the product into its major systems. These systems became the manual's chapters. All information for a particular system from adjustment through disassembly and inspection is located in a single chapter.

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.

The Periodic Maintenance Chart is located in the General Information chapter. The chart gives a time schedule for required maintenance operations.

If you want spark plug information, for example, go to the Periodic Maintenance Chart first. The chart tells you how frequently to clean and gap the plug. Next, 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.

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) per minute
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.

TAMPERING WITH NOISE 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 vehicle for the purpose of noise control prior to its sale or delivery to the ultimate purchaser or while it is in use, or (2) the use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

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

- Replacement of the original exhaust system or muffler with a component not in compliance with Federal regulations.
- Removal of the muffler(s) or any internal portion of the muffler(s).
- Removal of the air box or air box cover.
- Modifications to the muffler(s) or air inlet system by cutting, drilling, or other means if such modifications result in increased noise levels.

General Information

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1-2 GENERAL INFORMATION

Before Servicing

Before starting to service a motorcycle, 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) Dirt

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

(2) Battery Leads

Remove the ground (–) lead from the battery before performing any disassembly operations on the motorcycle. When installing, connect the positive (+) lead first, then the negative (–) lead to the battery. 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.

(3) Installation, Assembly

Generally, installation or assembly is the reverse of removal or disassembly. But if this Service Manual has installation or assembly procedures, follow them. Note parts locations and cable, wire, and hose routing during removal or disassembly so they can be installed or assembled in the same way. It is preferable to mark and record the locations and routing as much as possible.

(4) Tightening Sequence

Generally, when installing a part with several bolts, nuts, or screws, start them all in their holes and tighten them to a snug fit. Then tighten them 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 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.

(5) Torque

When torque values are given in this Service Manual, use them. Either too little or too much torque may lead to serious damage. Use a good quality, reliable torque wrench.

(6) 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.

(7) 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.

(8) High-Flash Point Solvent

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

(9) 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 leakage.

(10) 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 oil passages and cause serious damage. An example of a non-permanent locking agent commonly available in North America is Loctite Lock'n Seal (Blue).

(11) Press

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

(12) Ball Bearing and Needle Bearing

Do not remove a ball bearing or a needle bearing unless it is absolutely necessary. Replace any ball or needle bearings that were removed with new ones, as removal generally damages bearings. Install bearings with the marked side facing out applying pressure evenly with a suitable driver. Only press on the race that forms the press fit with the base component to avoid damaging the bearings. This prevents severe stress on the balls or needles and races, and prevent races and balls or needles from being dented. Press a ball bearing until it stops at the stops in the hole or on the shaft.

(13) 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. Before a shaft passes through a seal, apply a little high temperature grease on the lips to reduce rubber to metal friction.

Before Servicing

(14) Circlip, Retaining Ring, and Cotter Pin

Replace any circlips and retaining rings, and cotter pins 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. Install the circlip with its chamfered side facing load side as well.

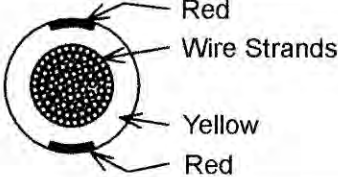
(15) Lubrication

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. This manual makes reference to molybdenum disulfide grease (MoS_2) in the assembly of certain engine and chassis parts. Always check manufacturer recommendations before using such special lubricants.

(16) 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

(17) 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.

(18) 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	

(19) Specifications

Specification terms are defined as follows:

"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.

1-4 GENERAL INFORMATION

Model Identification

VN1500-R1 (US, and Canada) Left Side View:



VN1500-R1 (US, and Canada) Right Side View:



Model Identification

VN1500-R1 (Other than US, Canada) Left Side View:



VN1500-R1 (Other than US, Canada) Right Side View:



1-6 GENERAL INFORMATION

General Specifications

Items		VN1500-R1
Dimensions:		
Overall length		2545 mm
Overall width		980 mm
Overall height		1115 mm
Wheelbase		1655 mm
Road clearance		125 mm
Seat height		730 mm
Dry mass		304 kg (CA) 304.5 kg
Curb mass:	Front	147 kg
	Rear	178 kg, (CA) 178.5 kg
Fuel tank capacity		19 L
Fuel		High-octane gasoline (see VN1500-R1 Owner's Manual)
Performance:		
Minimum turning radius		3.0 m
Engine:		
Type		4-stroke, SOHC, V2-cylinder
Cooling system		Liquid-cooled
Bore and stroke		102 × 90 mm
Displacement		1470 mL
Compression ratio		9.0 : 1
Maximum horsepower		47 kW (64 PS) @4700 r/min (rpm), (CN) (US) –
Maximum torque		113 N·m (11.5 kg·m, 83.1 ft·lb) @2800 r/min (rpm), (CN) (US) –
Carburetion system		DFI (Digital Fuel Injection) System
Starting system		Electric starter
Ignition system		Battery and coil (transistorized)
Timing advance		Electronically advanced (digital)
Ignition timing		From 5° BTDC @950 r/min (rpm) ~ 27° BTDC @3750 r/min (rpm)
Spark plugs		NGK DPR6EA-9 or ND X20EPR-U9
Cylinder numbering method		Front to Rear, 1-2
Firing order		1-2
Valve timing:		
Inlet	Open	22° BTDC
	Close	66° ABDC
	Duration	268°
Exhaust	Open	66° BBDC
	Close	26° ATDC
	Duration	272°
Lubrication system		Forced lubrication (wet sump)
Engine oil:	Grade	API Service Classification: SE, SF, SG, class or SH JASOMA, SJ JASO MA class
	Viscosity	SAE10W-40, 10W-50, 20W-40, or 20W-50
	Capacity	3.5 L (when engine is completely disassembled and dry)

General Specifications

Items	VN1500-R1
Drive Train: Primary reduction system: Type Reduction ratio Clutch type Transmission: Type Gear ratios: 1st 2nd 3rd 4th 5th Final drive system: Type Reduction ratio Overall drive ratio Final gear case oil: Type Capacity	Gear 1.517 (85/56) Wet multi disc 5-speed, constant mesh, return shift 2.500 (40/16) 1.590 (35/22) 1.192 (31/26) 0.965 (28/29) 0.781 (25/32) Shaft 2.619 (15/21 × 33/9) 3.105 @Top gear API GL-5 Hypoid gear oil SAE90 (above 5°C) SAE80 (below 5°C) 200 mL
Frame: Type Caster (rake angle) Trail Front tire: Type Size Rear tire: Type Size Front suspension: Type Wheel travel Rear suspension: Type Wheel travel Brake Type: Front Rear	Tubular, double cradle 32° 165 mm Tube type 130/90-16 67H Tube type 150/80B16 71H Telescopic fork 150 mm Swingarm 100 mm Single disc Single disc
Electrical Equipment: Battery Headlight: Type Bulb Tail/brake light Alternator: Type Rated output	12 V 18 Ah Semi-sealed beam 12 V 60/55 W (quartz-halogen) 12 V 5/21 W Three-phase AC 23 A × 14 V @6000 r/min (rpm)

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

CA: California Model

US: United States Model

CN: Canadian Model

1-8 GENERAL INFORMATION

Periodic Maintenance Chart

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

FREQUENCY	Which ever comes first → ↓	* ODOMETER READING						
		1 000 km (600 mile)	6 000 km (4 000 mile)	12 000 km (7 500 mile)	18 000 km (12 000 mile)	24 000 km (15 000 mile)	30 000 km (20 000 mile)	36 000 km (24 000 mile)
OPERATION	Every							
Idle speed - check † (DFI)		•	•	•	•	•	•	•
Spark plug - clean and gap †			•	•	•	•	•	•
Air suction valve - check †			•	•	•	•	•	•
Air cleaner element - clean † #			•		•		•	
Throttle control system - check † (DFI)		•	•	•	•	•	•	•
Evaporative emission control system (CA) - check †		•	•	•	•	•	•	•
Engine oil - change #	6 months	•	•	•	•	•	•	•
Oil filter - replace		•	•		•		•	
Radiator hoses, connections - check †		•						
Coolant - change	2 years				•			
Final gear case oil level - check †			•		•		•	
Final gear case oil - change		•						•
Propeller shaft joint - lubricate			•					•
Clutch fluid level - check †	month	•	•	•	•	•	•	•
Clutch fluid - change	2 years				•			
Clutch master cylinder cup and dust seal - replace	4 years							
Clutch slave cylinder piston seal - replace	4 years							
Brake lining or pad wear - check † #			•	•	•	•	•	•
Brake/clutch hose connections - check †			•	•	•	•	•	•
Fuel/hose connections - check †			•	•	•	•	•	•
Brake fluid level - check †	month	•	•	•	•	•	•	•
Brake fluid - change	2 years				•			
Brake master cylinder cup and dust seal - replace	4 years							
Caliper piston seal and dust seal - replace	4 years							
Brake light switch - check †		•	•	•	•	•	•	•
Steering - check †		•	•	•	•	•	•	•
Steering stem bearing - lubricate	2 years				•			
Front fork oil - change	2 years				•			
Rear shock absorber oil leak - check †			•		•		•	
Front fork oil leak - check †			•		•		•	
Tire wear - check †			•	•	•	•	•	•
Spoke tightness and rim runout - check †		•	•	•	•	•	•	•
Swingarm pivot - lubricate			•					•
General lubrication - perform			•		•		•	
Nut, bolt, and fastener tightness - check †		•	•		•		•	•

: Service more frequently when operating in severe conditions; dusty, wet, muddy, high speed, or frequent starting / stopping.

* : For higher odometer readings, repeat at the frequency interval established here.

† : Replace, add, adjust, clean, or torque if necessary.

(CA): California model only

(DFI): Digital Fuel Injection

Torque and Locking Agent

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

Letters used in the "Remarks" column mean:

- G:** Apply grease to the threads.
- EO:** Apply engine oil to the threads and the seating surface.
- L:** Apply a non-permanent locking agent to the threads.
- Lh:** Left-hand threads.
- MO:** Apply molybdenum disulfide oil to the threads and the seating surface. (The molybdenum disulfide oil is mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10 : 1.)
- S:** Tighten the fasteners following the specified sequence.
- SS:** Apply silicone sealant.
- St:** Stake the fasteners to prevent loosening.
- R:** Replacement parts

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

Basic Torque for General Fasteners of Engine Parts

Threads dia. (mm)	Torque		
	N·m	kg·m	ft·lb
5	5.9 ~ 7.9	0.60 ~ 0.80	52 ~ 69 in·lb
6	8.8 ~ 10.8	0.90 ~ 1.10	78 ~ 96 in·lb

Basic Torque for General Fasteners of Frame Parts

Threads dia. (mm)	Torque		
	N·m	kg·m	ft·lb
5	3.4 ~ 4.9	0.35 ~ 0.50	30 ~ 43 in·lb
6	5.9 ~ 7.8	0.60 ~ 0.80	52 ~ 69 in·lb
8	14 ~ 19	1.4 ~ 1.9	10.0 ~ 13.5
10	25 ~ 34	2.6 ~ 3.5	19.0 ~ 25
12	44 ~ 61	4.5 ~ 6.2	33 ~ 45
14	73 ~ 98	7.4 ~ 10.0	54 ~ 72
16	115 ~ 155	11.5 ~ 16.0	83 ~ 115
18	165 ~ 225	17.0 ~ 23.0	125 ~ 165
20	225 ~ 325	23 ~ 33	165 ~ 240

Fastener	Torque			Remarks
	N·m	kg·m	ft·lb	
Fuel System:				
Vacuum Sensor Nut	9.8	1.0	87 in·lb	Throttle Body L, LH L Right Side on Cylinder Head
Atmospheric Pressure Sensor Nut	9.8	1.0	87 in·lb	
High Pressure Fuel Hose Clamp Screws	1.5	0.15	13 in·lb	
Inlet Manifold Bolts	12	1.2	104 in·lb	
Pressure Regulator Screws	4.9	0.5	43 in·lb	
Delivery Joint Screws	3.4	0.35	30 in·lb	
Full Throttle Stopper Screw	—	—	—	
Throttle Cable Holder Screw	3.4	0.35	30 in·lb	
Throttle Body Flange Bolts	4.9	0.5	43 in·lb	
Throttle Assy Holder Bolts	12	1.2	104 in·lb	
ISC Pipe Mounting Bolts	9.8	1.0	87 in·lb	Lower Duct Throttle Body L, Throttle Body
Air Cleaner Duct Holder Bolts	9.8	1.0	87 in·lb	
Right and Left Air Cleaner Base Bolts	12	1.2	104 in·lb	
Right and Left Air Cleaner Base Screws	2.2	0.22	19 in·lb	
Left Air Cleaner Duct Tapping Screws	2.2	0.22	19 in·lb	
Right and Left Air Cleaner Cover Allen Bolt $\phi 8$	16	1.6	12	
Right Air Cleaner Allen Bolts	11	1.1	95 in·lb	
Choke Cable Plate Screw	3	0.3	22 in·lb	
Inlet Air Temperature Sensor Nut (DFI)	7.8	0.8	69 in·lb	
Water Temperature Sensor (DFI)	18	1.8	13	
Fuel Pump Bolts	6.9	0.7	61 in·lb	SS
Return Fuel Check Valve	20	2.0	15	S, L
Cooling System:				
Radiator Hose Clamp Screws	2.5	0.25	22 in·lb	
Coolant Air Bleeder Bolt	7.8	0.8	69 in·lb	
Radiator Fan Switch	18	1.8	13	

1-10 GENERAL INFORMATION

Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kg·m	ft·lb	
Water Temperature Switch	7.8	0.8	69 in·lb	SS
Water Pump Impeller Bolt	8	0.9	87 in·lb	Lh
Water Pump Cover Bolts	9.8	1.0	87 in·lb	
Water Pump Drain Bolt	9.8	1.0	87 in·lb	
Water Pipe Bolts	9.8	1.0	87 in·lb	
Radiator Drain Bolt	7.4	0.75	65 in·lb	
Engine Top End:				
Spark Plugs	18	1.8	13	
Spark Plug Retainer	12	1.2	104 in·lb	
Air Suction Valve Cover Bolts	7.4	0.75	65 in·lb	
Chain Tensioner Mounting Bolts	9.8	1.0	87 in·lb	S
Chain Tensioner Cap	20	2.0	14	S
Chain Tensioner Lockbolt (Front)	4.9	0.50	43 in·lb	S
Chain Tensioner Lockbolt (Rear)	9.8	1.0	87 in·lb	
Timing Inspection Plug	1.5	0.15	13 in·lb	
Rotor Bolt Plug	1.5	0.15	13 in·lb	
Camshaft Sprocket Bolts	15	1.5	11	L
Oil Hose Flange Bolts	9.8	1.0	87 in·lb	
Rocker Shafts	25	2.5	18	
Rocker Case Nuts	12 mm	78	8.0	58
	8 mm	25	2.5	18
Rocker Case Bolts	6 mm	8.8	0.9	78 in·lb
Cylinder Head Nuts		25	2.5	18
Cylinder Head Jacket Plug		20	2.0	15
Rocker Case Cover Bolts		8.8	0.9	78 in·lb
Camshaft Chain Guide Bolts		9.8	1.0	87 in·lb
Cylinder Nuts		25	2.5	18
Inlet Manifold Bolts		12	1.2	104 in·lb
Exhaust Pipe Cover Clamp Bolts		6.9	0.7	61 in·lb
Silenser Stay Bolts		34	3.5	25
Clutch:				
Clutch Lever Pivot Bolt		1.0	0.10	8.7 in·lb
Clutch Lever Pivot Bolt Locknut		5.9	0.60	52 in·lb
Clutch Reservoir Cap Screws		1.5	0.15	13 in·lb
Clutch Slave Cylinder Bleed Valve		7.8	0.80	69 in·lb
Clutch Slave Cylinder Bolts		9.8	1.0	87 in·lb
Clutch Hose Banjo Bolts		25	2.5	18
Clutch Master Cylinder Clamp Bolts		9.8	1.0	87 in·lb
Starter Lockout Switch Screws		1.2	0.12	10 in·lb
Push Rod Guide Bolts		9.8	1.0	87 in·lb
Clutch Cover Bolts		9.8	1.0	87 in·lb
Clutch Cover Damper Bolts (outside)		9.8	1.0	87 in·lb
Clutch Cover Damper Bolts (inside)		9.8	1.0	87 in·lb
Clutch Cover Damper Screws		4.9	0.50	43 in·lb
Clutch Hub Nut		147	15.0	108
Engine Lubrication System:				
Oil Filler Plug		1.5	0.15	13 in·lb
Oil Screen Plug		20	2.0	15
Engine Oil Drain Plug		20	2.0	15
Oil Filter (Cartridge type)		18	1.8	13
Oil Filter Bolt		25	2.5	18

Torque and Locking Agent

Fastener		Torque			Remarks
		N-m	kg-m	ft-lb	
Oil Pressure Relief Valve		15	1.5	11	L
Oil Pressure Switch Terminal Bolt		1.5	0.15	13 in-lb	
Oil Pressure Switch		15	1.5	11	SS
Oil Pump Cover Screws		9.8	1.0	87 in-lb	
Oil Pump Mounting Bolts		9.8	1.0	87 in-lb	
Oil Hose Banjo Bolts		9.8	1.0	87 in-lb	
Oil Hose Flange Bolt (outside)		9.8	1.0	87 in-lb	
Oil Pipe Holder Bolts (inside)		8.8	0.90	78 in-lb	L
Oil Pipe Clamp Bolts (inside)		9.8	1.0	87 in-lb	L
Right & Left Crankcase Oil Nozzle		3.4	0.35	30 in-lb	× 3
Right Crankcase Oil Nozzle		3.4	0.35	30 in-lb	× 1, Lh
Oil Reserve Tank Bolts		8.8	0.9	78 in-lb	L
Engine Removal/Installation:					
Downtube Bolts		44	4.5	33	
Engine Mounting Bolts and Nuts		44	4.5	33	
Engine Mounting Bracket Bolts		25	2.5	18	
Engine Ground Terminal Bolt		7.8	0.8	69 in-lb	
Crankshaft/Transmission:					
Crankcase Bolts	10 mm	39	4.0	29	S
	8 mm	21	2.1	15	S
	6 mm	9.8	1.0	87 in-lb	S
Jumper Cable Ground Bracket Bolt		9.8	1.0	87 in-lb	Left Crankcase
Crankcase Bearing Retainer Bolts		9.8	1.0	87 in-lb	L
Camshaft Chain Guide Bolts		9.8	1.0	87 in-lb	L
Right & Left Crankcase Oil Nozzles		3.4	0.35	30 in-lb	× 3
Left Crankcase Oil Nozzle		3.4	0.35	30 in-lb	× 1, Lh
Connecting Rod Big End Nuts		59	6.0	43	EO
Oil Pressure Relief Valve		15	1.5	11	L
Oil Hose Banjo Bolts		9.8	1.0	87 in-lb	
Primary Gear Bolt		147	15.0	108	MO
Water Pump Chain Guide Spring Hook Bolt		2.9	0.30	26 in-lb	
Water Pump Chain Guide Bolt		7.8	0.80	69 in-lb	
Idle Shaft Holder Bolts		7.8	0.80	69 in-lb	
Oil Pressure Switch Terminal Bolt		1.5	0.15	13 in-lb	
Oil Pressure Switch		15	1.5	11	SS
Oil Pipe Clamp Bolts (inside)		9.8	1.0	87 in-lb	L
Left Balancer Gear Bolt		85	8.7	63	MO
Starter Clutch Bolt		85	8.7	63	MO
Starter Clutch Coupling Bolts		15	1.5	11	L
Gear Set Lever Bolt		9.8	1.0	87 in-lb	
Shift Shaft Return Spring Pin (Bolt)		20	2.0	15	L
Front Shift Pedal Clamp Bolts		17	1.7	12	
Rear Shift Pedal Clamp Bolt		17	1.7	12	
Shift Lever Clamp Bolts (Rear)		9.8	1.0	87 in-lb	
Shift Rod Locknuts		9.8	1.0	87 in-lb	(Rear: Lh)
Shift Drum Bearing Holder Bolts		9.8	1.0	87 in-lb	L
Shift Drum Cam Screw		—	—	—	L
Damper Cam Nut (Front Gear)		224	23	165	MO (threads)
Push Rod Guide Bolts		9.8	1.0	87 in-lb	L
Wheels/Tires:					
Front Axle Clamp Bolt		34	3.5	25	S

1-12 GENERAL INFORMATION

Torque and Locking Agent

Fastener		Torque			Remarks
		N·m	kg·m	ft·lb	
Front Axle Nut		110	11	79.6	S
Rear Axle Nut		110	11	79.6	
Tire Air Valve Nuts		1.5	0.15	13 in·lb	
Spoke Nipples		2.9 ~ 7.4	0.30 ~ 0.75	26 ~ 65 in·lb	
Final Drive:					
Oil Pipe Banjo Bolts (Front Gear)		12	1.2	104 in·lb	MO (threads) MO, St
Oil Nozzle (Front Gear)		2.9	0.30	26 in·lb	
Oil Nozzle (Front Gear)		18	1.8	13	
Neutral Switch		15	1.5	11	
Front Gear Case Bolts:	6 mm	12	1.2	104 in·lb	
	8 mm	29	3.0	22	
Damper Cam Nut (Front Gear)		226	23	166	
Drive Gear Nut (Front Gear)		265	27	195	
Driven Gear Assy Mounting Bolts		25	2.5	18	
Driven Gear Bolt (Front Gear)		137	14	101	
Bearing Retainer Bolts (Front Gear)		8.8	0.90	78 in·lb	MO, St
Final Gear Case Drain Plug		8.8	0.90	78 in·lb	
Final Gear Case Mounting Nuts		34	3.5	25	
Final Gear Case Studs		—	—	—	
Final Gear Case Cover Bolts:	8 mm	23	2.3	17	L
	10 mm	34	3.5	25	
Pinion Gear Nut (Final Gear)		128	13.1	94	St, EO
Pinion Bearing Retainer (Final Gear)		245	25	181	Lh
Retainer Stop Screw		16	1.6	12	L
Brakes:					
Caliper Bleed Valves		7.8	0.8	69 in·lb	S
Brake Hose Banjo Bolts		25	2.5	18	
Brake Lever Pivot Bolt		1.0	0.10	8.7 in·lb	
Brake Lever Pivot Bolt Locknut		5.9	0.60	52 in·lb	
Front Brake Reservoir Cap Screws		1.5	0.15	13 in·lb	
Front Brake Light Switch Screw		1.2	0.12	10 in·lb	
Front Master Cylinder Clamp Bolts		9.8	1.0	87 in·lb	
Front Caliper Mounting Bolts		34	3.5	25	
Rear Caliper Mounting Bolts		34	3.5	25	
Rear Caliper Holder Bolt		64	6.5	47	
Brake Disc Bolts		27	2.8	20	L
Rear Master Cylinder Mounting Bolts		25	2.5	18	
Rear Master Cylinder Push Rod Locknut		18	1.8	13	
Brake Pedal Clamp Bolt		25	2.5	18	
Suspension:					
Upper Front Fork Clamp Bolts		20	2.0	15	L
Lower Front Fork Clamp Bolts		34	3.5	25	
Front Fork Cover Screws		4.4	0.45	39 in·lb	
Front Fork Bottom Allen Bolts		20	2.0	15	
Front Axle Clamp Bolts		34	3.5	25	S
Spacer Bolt		3.9	0.40	35 in·lb	G
Rear Shock Absorber Nuts		34	3.5	25	
Swingarm Pivot Shaft		110	11	79.6	
Steering:					
Steering Stem Head Nut		54	5.5	40	G
Steering Stem Nut		4.9	0.5	43 in·lb	

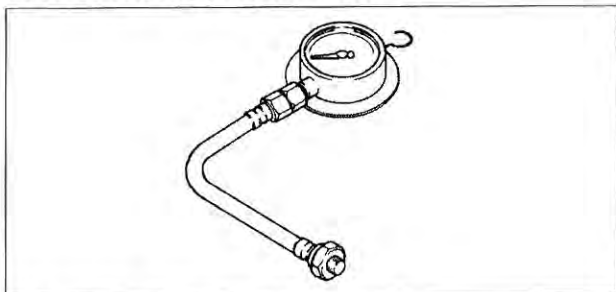
Torque and Locking Agent

Fastener	Torque			Remarks
	N·m	kg·m	ft·lb	
Handlebar Clamp Bolts	34	3.5	25	S
Handle Holder Nuts	34	3.5	25	
Handlebar End Caps	—	—	—	Lh, L
Handlebar Switch Housing Screws	3.4	0.35	30 in·lb	
Upper Front Fork Clamp Bolts	20	2.0	14	
Lower Front Fork Clamp Bolts	34	3.5	25	
Upper Fork Cover Screws $\phi 5$	4.4	0.45	39 in·lb	
Turn Signal Light Holder Bolts	7.4	0.75	65 in·lb	
Frame:				
Rear Fender Stay Bolts	44	4.5	32	
Downtube Bolts	44	4.5	32	
Front Footboard Bolts	34	3.5	25	
Rear Footpeg Bracket Bolts (right side)	27	2.8	20	L
Sidestand Nut and Bolt	44	4.5	32	
Electrical System:				
Spark Plugs	18	1.8	13	
Pickup Coil Screws	2.9	0.30	26 in·lb	
Stator Wire Holder Screw	9.8	1.0	87 in·lb	L
Pickup Coil Wire Holder Bolt	9.8	1.0	87 in·lb	L
Alternator Outer Cover Joint Bolt	12	1.2	104 in·lb	
Alternator Outer Cover Bolts	12	1.2	104 in·lb	
Alternator Outer Cover Damper Bolts	9.8	1.0	87 in·lb	EO (tip)
Alternator Cover Bolts	9.8	1.0	87 in·lb	
Alternator Inner Cover Bolts	9.8	1.0	87 in·lb	
Alternator Rotor Bolt	78	8.0	57	MO
Alternator Stator Bolts	13	1.3	113 in·lb	L
Timing Inspection Plug	1.5	0.15	13 in·lb	
Rotor Bolt Pug	1.5	0.15	13 in·lb	
Starter Motor Terminal Locknut	11	1.1	95 in·lb	
Starter Motor Terminal Nut	4.9	0.50	43 in·lb	
Starter Motor Assy Bolts	4.9	0.50	43 in·lb	
Starter Motor Mounting Bolts	9.8	1.0	87 in·lb	
Headlight Body Mounting Screws (inside)	2.9	0.30	26 in·lb	L
Headlight Rim Screws	1.0	0.10	8.7 in·lb	
Handlebar Switch Housing Screws	3.4	0.35	30 in·lb	
Starter Lockout Switch Screw	1.2	0.12	10 in·lb	
Front Brake Light Switch Screw	1.2	0.12	10 in·lb	
Sidestand Switch Bolt	8.8	0.9	78 in·lb	L
Radiator Fan Switch	18	1.8	13	
Water Temperature Switch	7.4	0.75	65 in·lb	SS
Oil Pressure Switch Terminal Bolt	1.5	0.15	13 in·lb	
Oil Pressure Switch	15	1.5	11	SS
Neutral Switch	15	1.5	11	
Turn Signal Light Lens Screws	1.0	0.10	8.7 in·lb	
Turn Signal Light Mounting Nuts	5.9	0.60	52 in·lb	
Speed Sensor Bolt	9.8	1.0	87 in·lb	

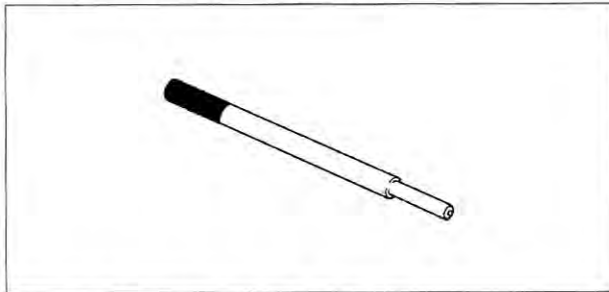
1-14 GENERAL INFORMATION

Special Tools and Sealant

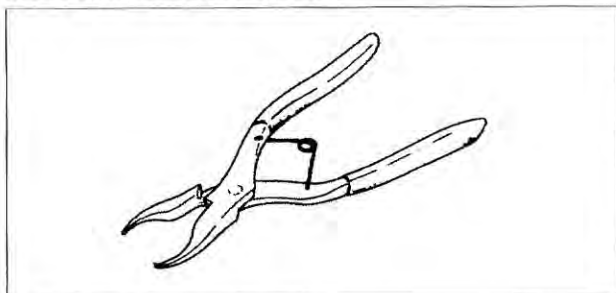
Oil Pressure Gauge, 5 kg/cm²: 57001-125



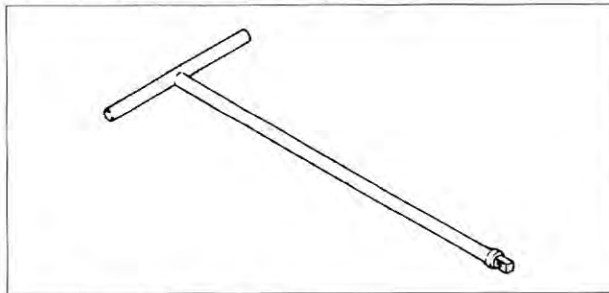
Valve Guide Arbor, $\phi 7$: 57001-163



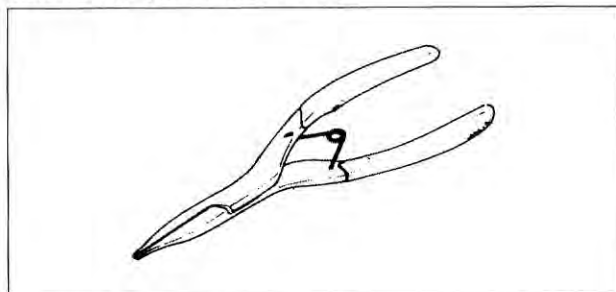
Inside Circlip Pliers: 57001-143



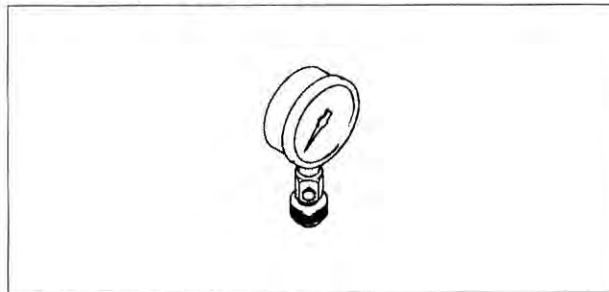
Fork Cylinder Holder Handle: 57001-183



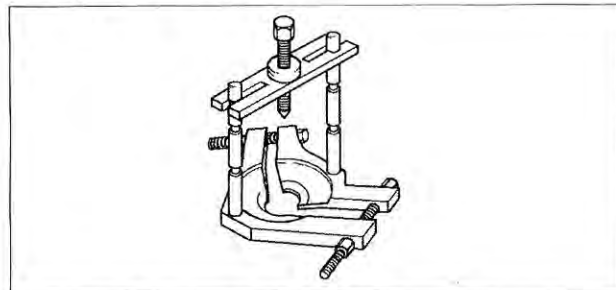
Outside Circlip Pliers: 57001-144



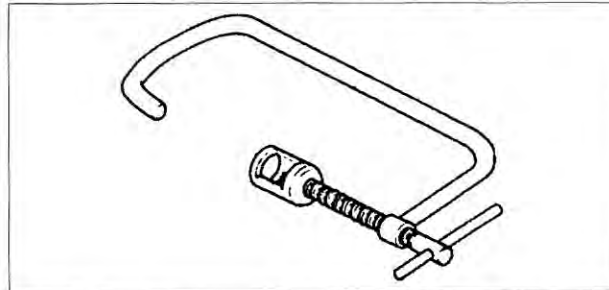
Compression Gauge: 57001-221



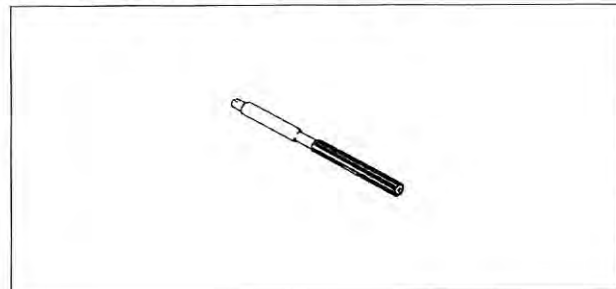
Bearing Puller: 57001-158



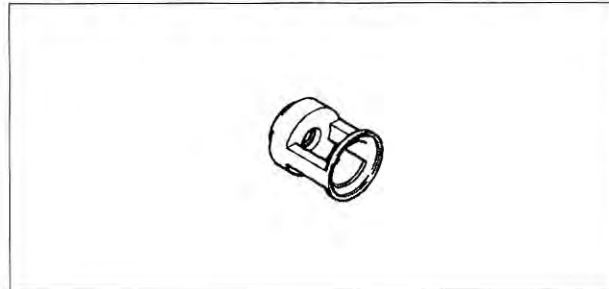
Valve Spring Compressor Assembly: 57001-241



Valve Guide Reamer, $\phi 7$: 57001-162

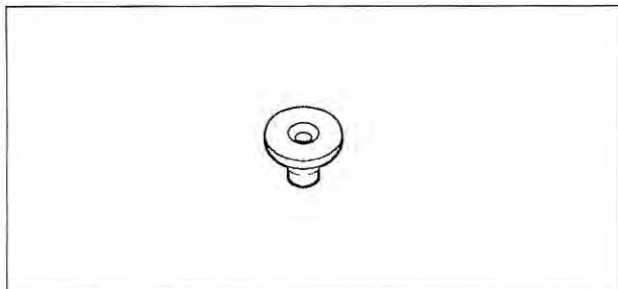


Valve Spring Compressor Adapter, $\phi 28.2$: 57001-243

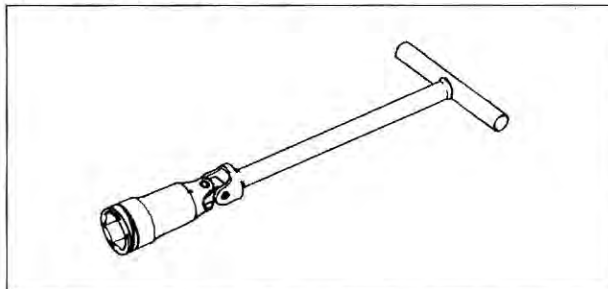


Special Tools and Sealant

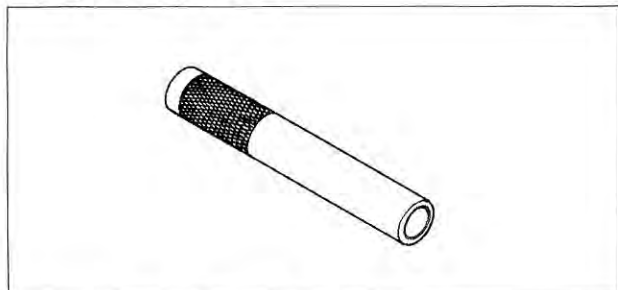
Bearing Puller Adapter: 57001-317



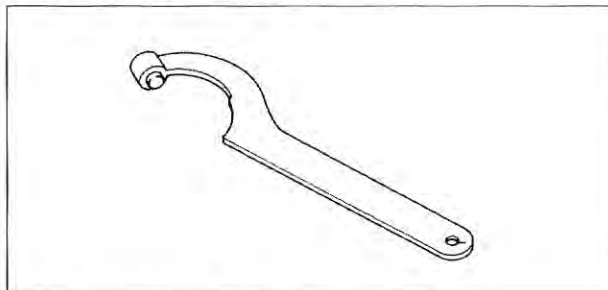
Spark Plug Wrench, Hex 18: 57001-1024



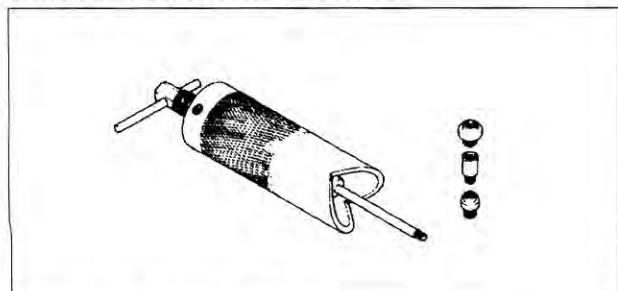
Bearing Driver: 57001-382



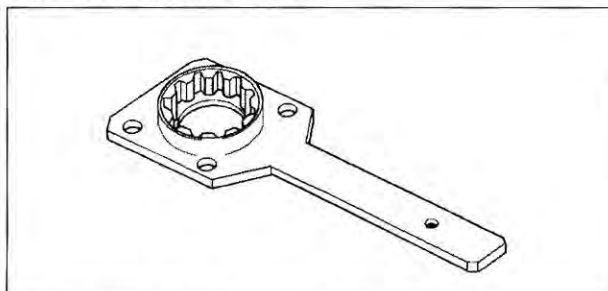
Damper Cam Holder: 57001-1025



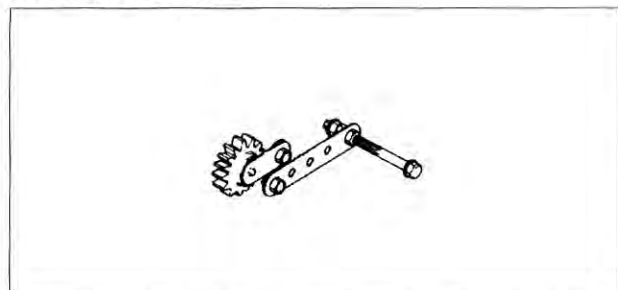
Piston Pin Puller Assembly: 57001-910



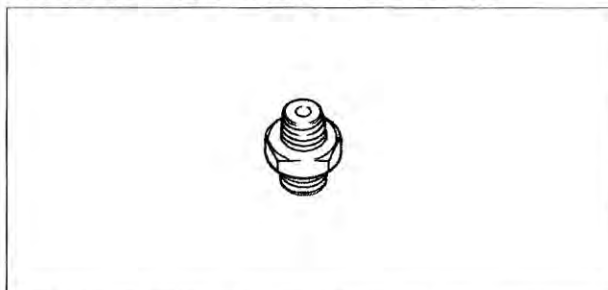
Driven Gear Holder: 57001-1027



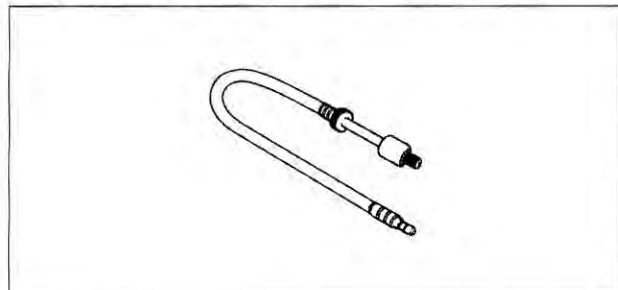
Gear Holder: 57001-1015



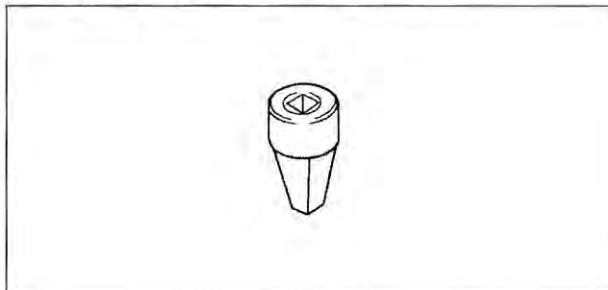
Oil Pressure Gauge Adapter, PT 1/8: 57001-1033



Compression Gauge Adapter, M12 × 1.25: 57001-1018



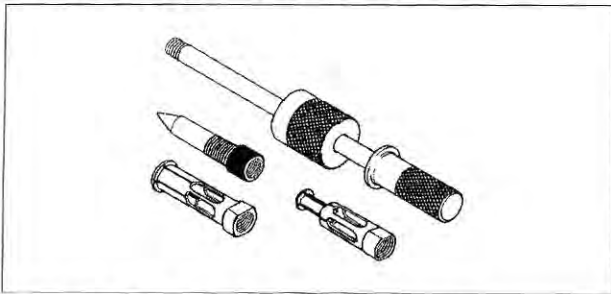
Fork Cylinder Holder Adapter: 57001-1057



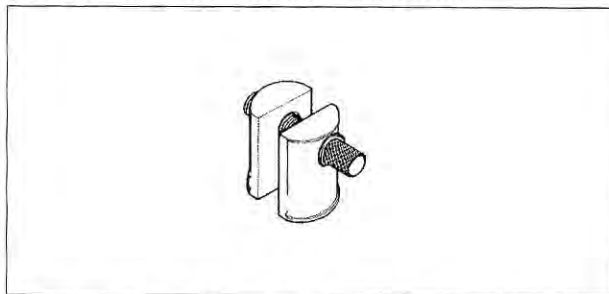
1-16 GENERAL INFORMATION

Special Tools and Sealant

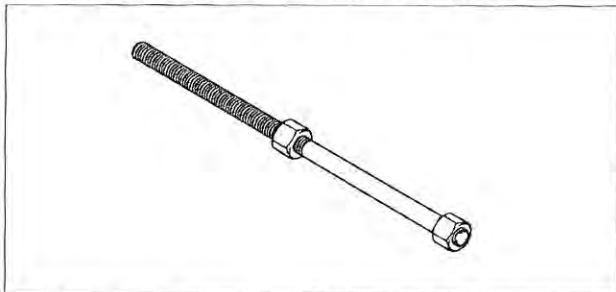
Oil Seal & Bearing Remover: 57001-1058



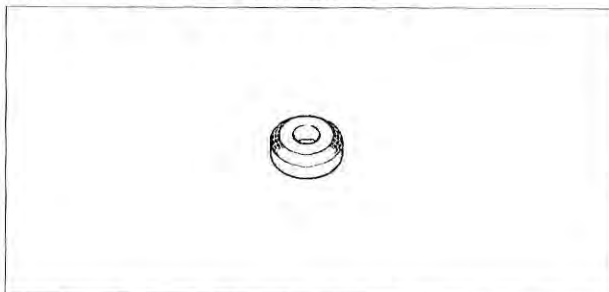
Head Pipe Outer Race Remover: 57001-1107



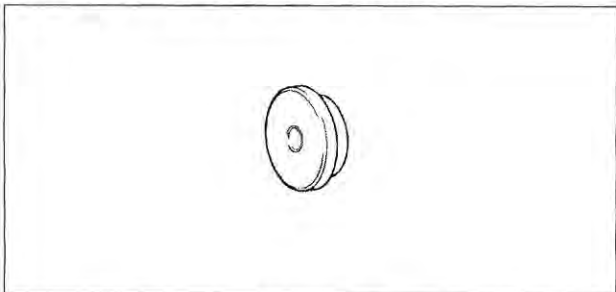
Head Pipe Outer Race Press Shaft: 57001-1075



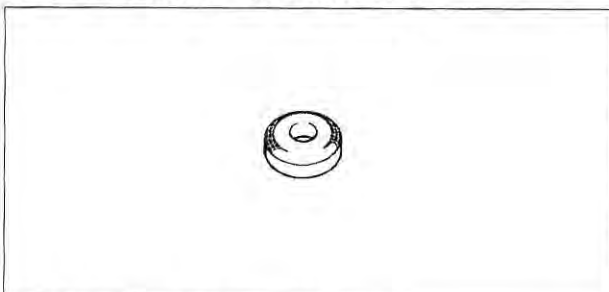
Valve Seat Cutter, 45° - $\phi 32$: 57001-1115



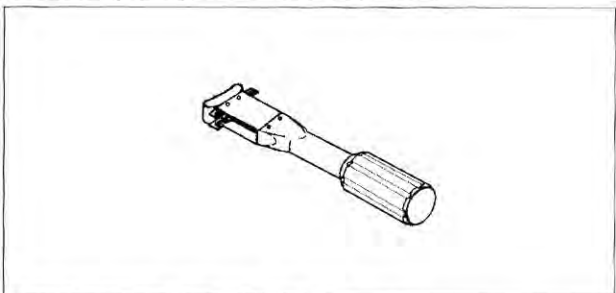
Head Pipe Outer Race Driver: 57001-1077



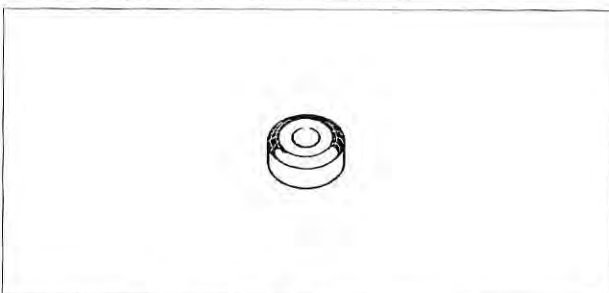
Valve Seat Cutter, 45° - $\phi 35$: 57001-1116



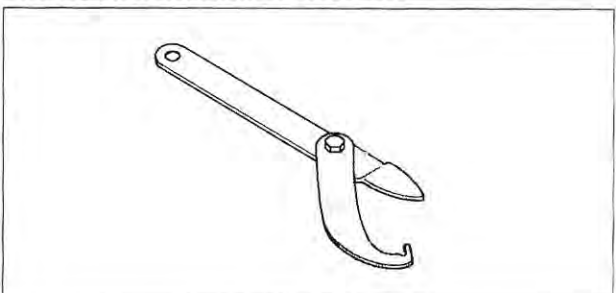
Piston Ring Compressor Grip: 57001-1095



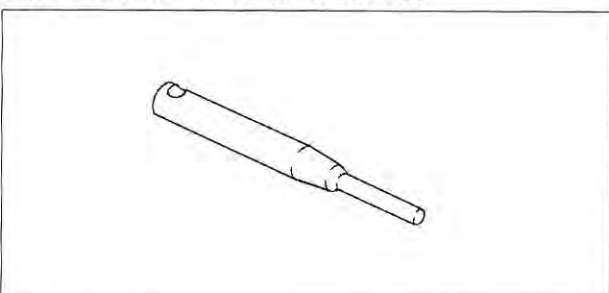
Valve Seat Cutter, 32° - $\phi 35$: 57001-1121



Steering Stem Nut Wrench: 57001-1100

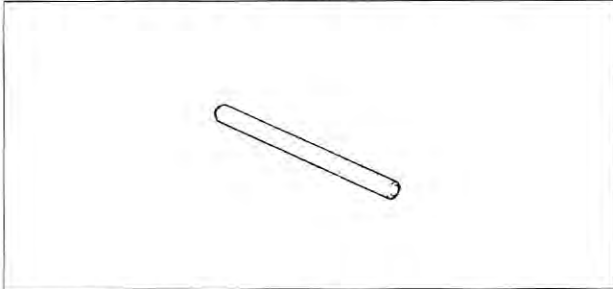


Valve Seat Cutter Holder, $\phi 7$: 57001-1126



Special Tools and Sealant

Valve Seat Cutter Holder Bar: 57001-1128



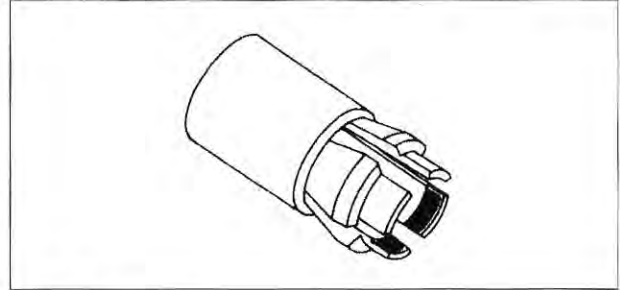
Fork Outer Tube Weight: 57001-1218



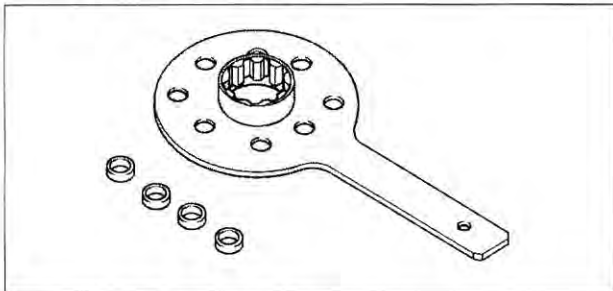
Bearing Driver Set: 57001-1129



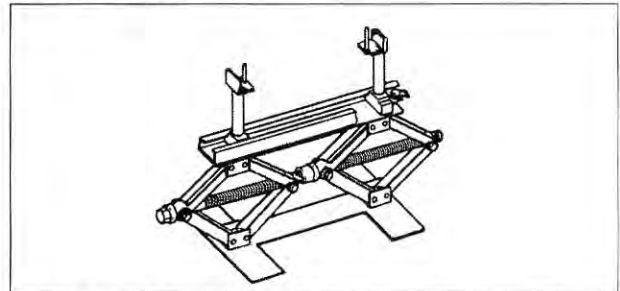
Front Fork Oil Seal Driver: 57001-1219



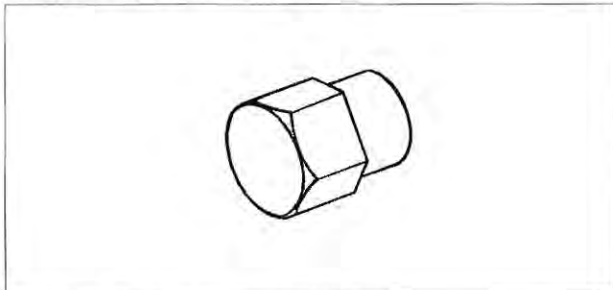
Pinion Gear Holder: 57001-1165



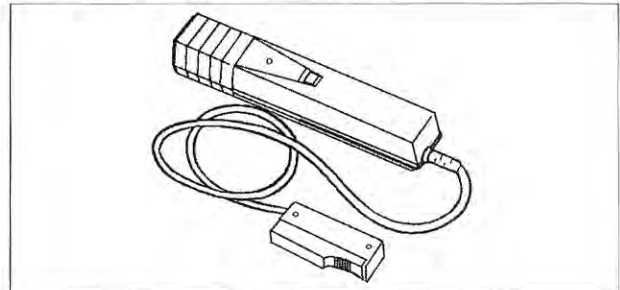
Jack: 57001-1238



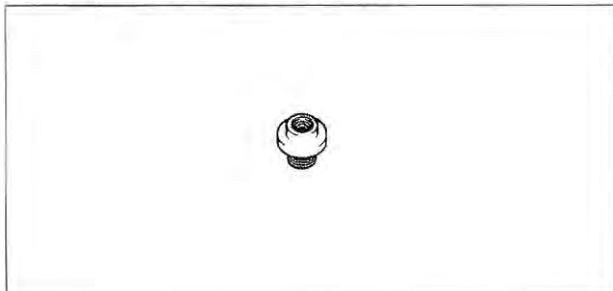
Hexagon Wrench, Hex 27: 57001-1210



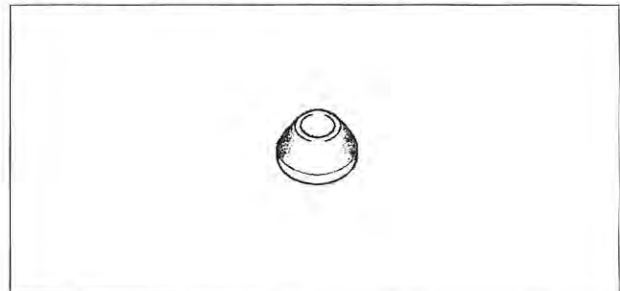
Timing Light: 57001-1241



Piston Pin Puller Adapter: 57001-1211



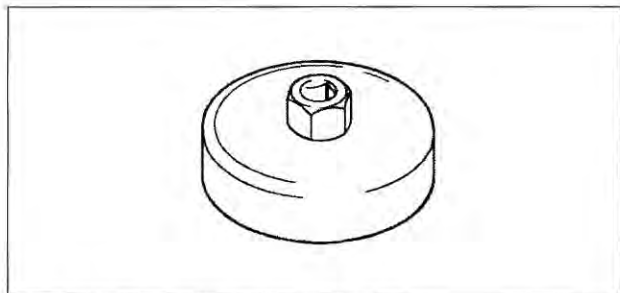
Valve Seat Cutter, 55° - ϕ 35: 57001-1247



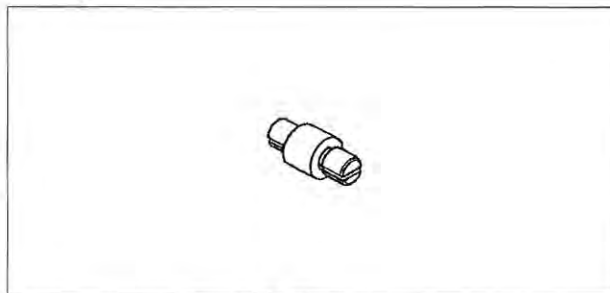
1-18 GENERAL INFORMATION

Special Tools and Sealant

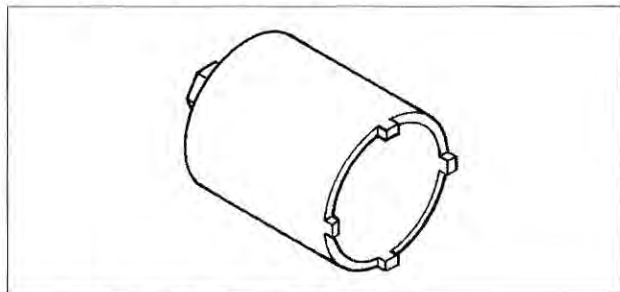
Oil Filter Wrench: 57001-1249



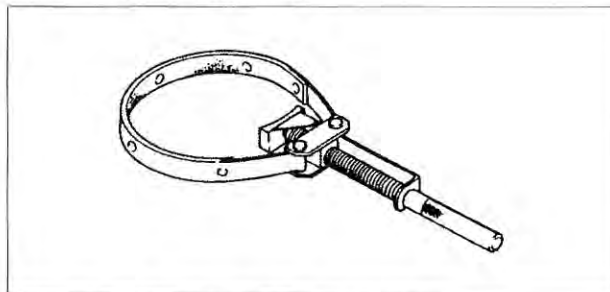
Bearing Remover Head, $\phi 20 \times \phi 22$: 57001-1293



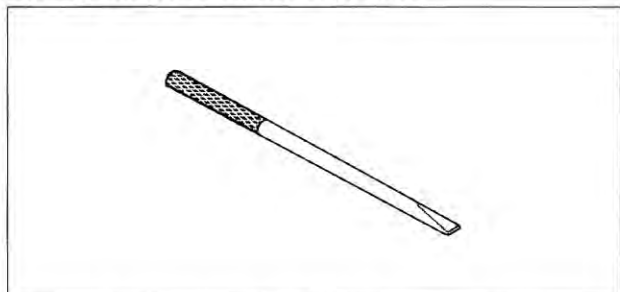
Bearing Retainer Wrench: 57001-1251



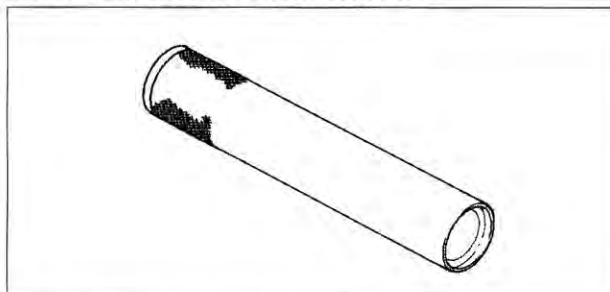
Flywheel Holder: 57001-1313



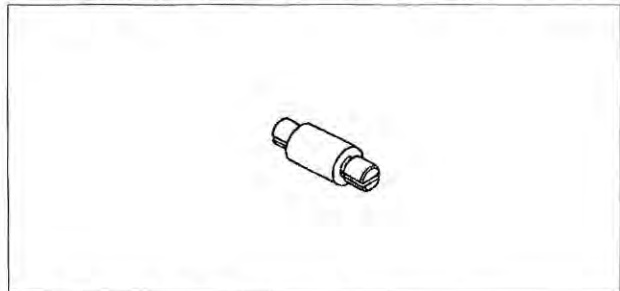
Bearing Remover Shaft, $\phi 9$: 57001-1265



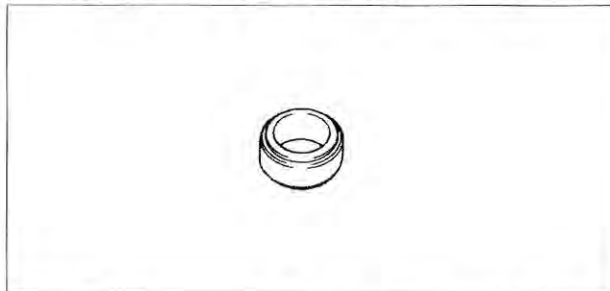
Steering Stem Bearing Driver: 57001-1344



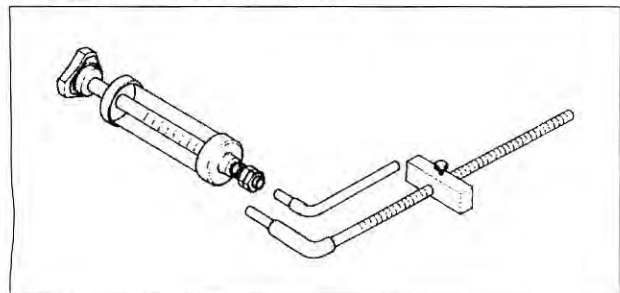
Bearing Remover Head, $\phi 10 \times \phi 12$: 57001-1266



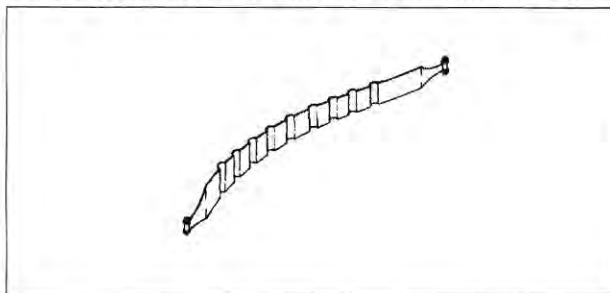
Steering Stem Bearing Driver Adapter: 57001-1345



Fork Oil Level Gauge: 57001-1290

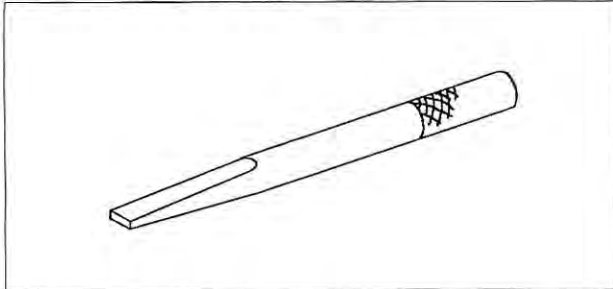


Piston Ring Compressor Belt, $\phi 95 \sim \phi 108$: 57001-1358

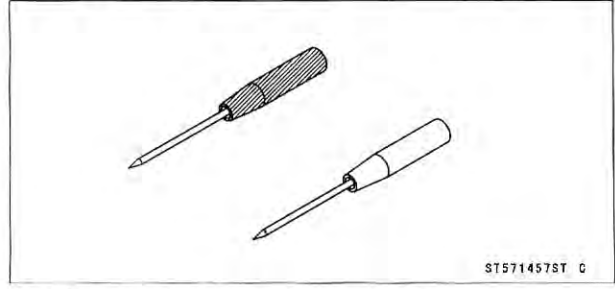


Special Tools and Sealant

Bearing Remover Shaft, $\phi 13$: 57001-1377

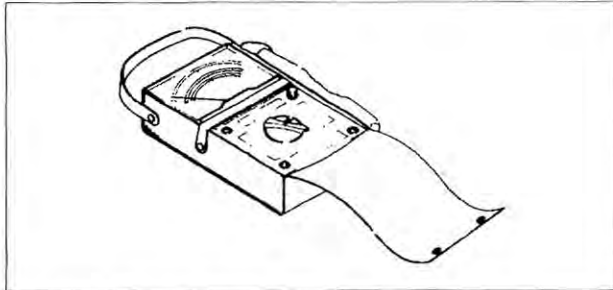


Needle Adapter Set: 57001-1457

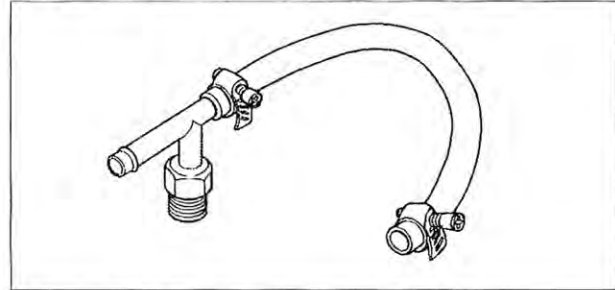


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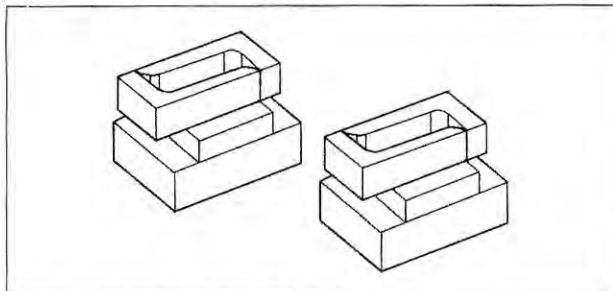
Hand Tester: 57001-1394



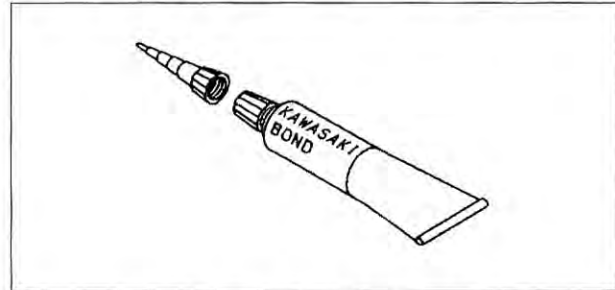
Fuel Pressure Gauge Adapter: 57001-1417



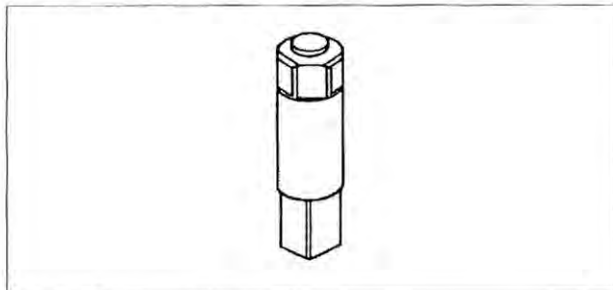
Attachment Jack: 57001-1398



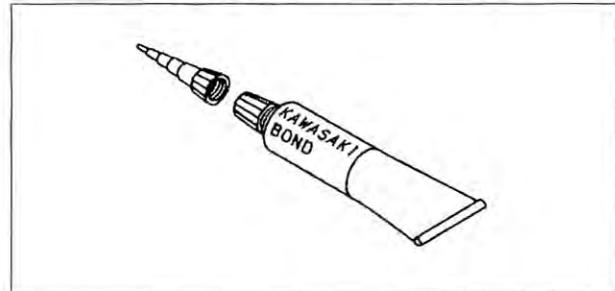
Kawasaki Bond (Silicone Sealant): 56019-120



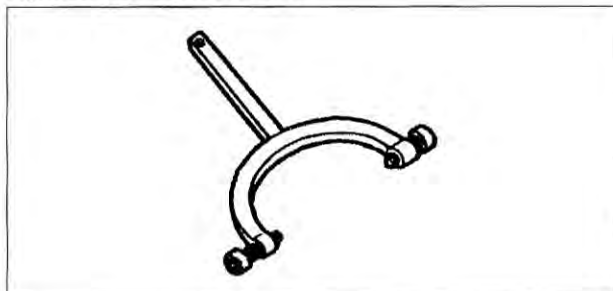
Drive Shaft Holder: 57001-1407



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

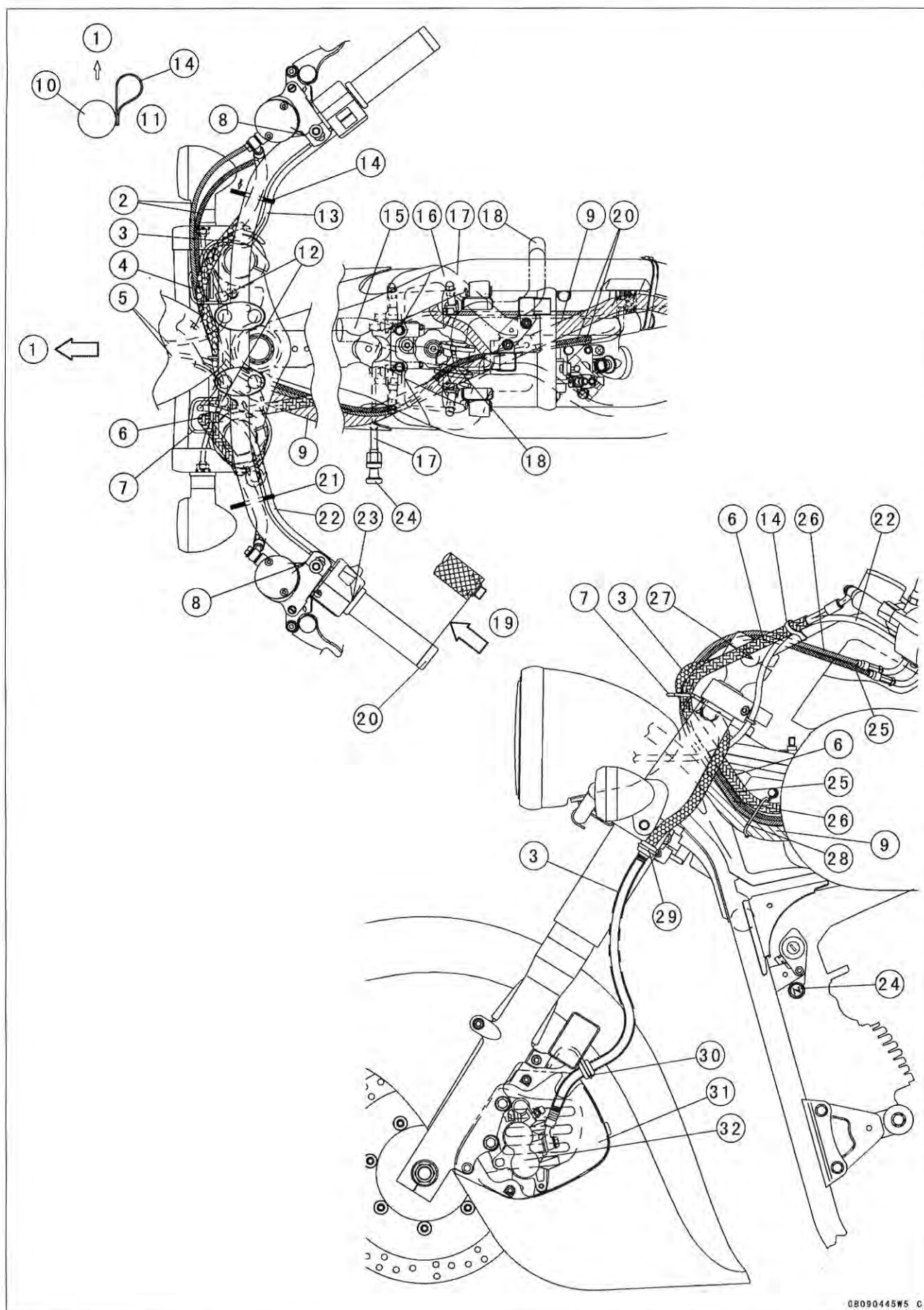


Flywheel Holder: 57001-1410



1-20 GENERAL INFORMATION

Cable, Wire, and Hose Routing



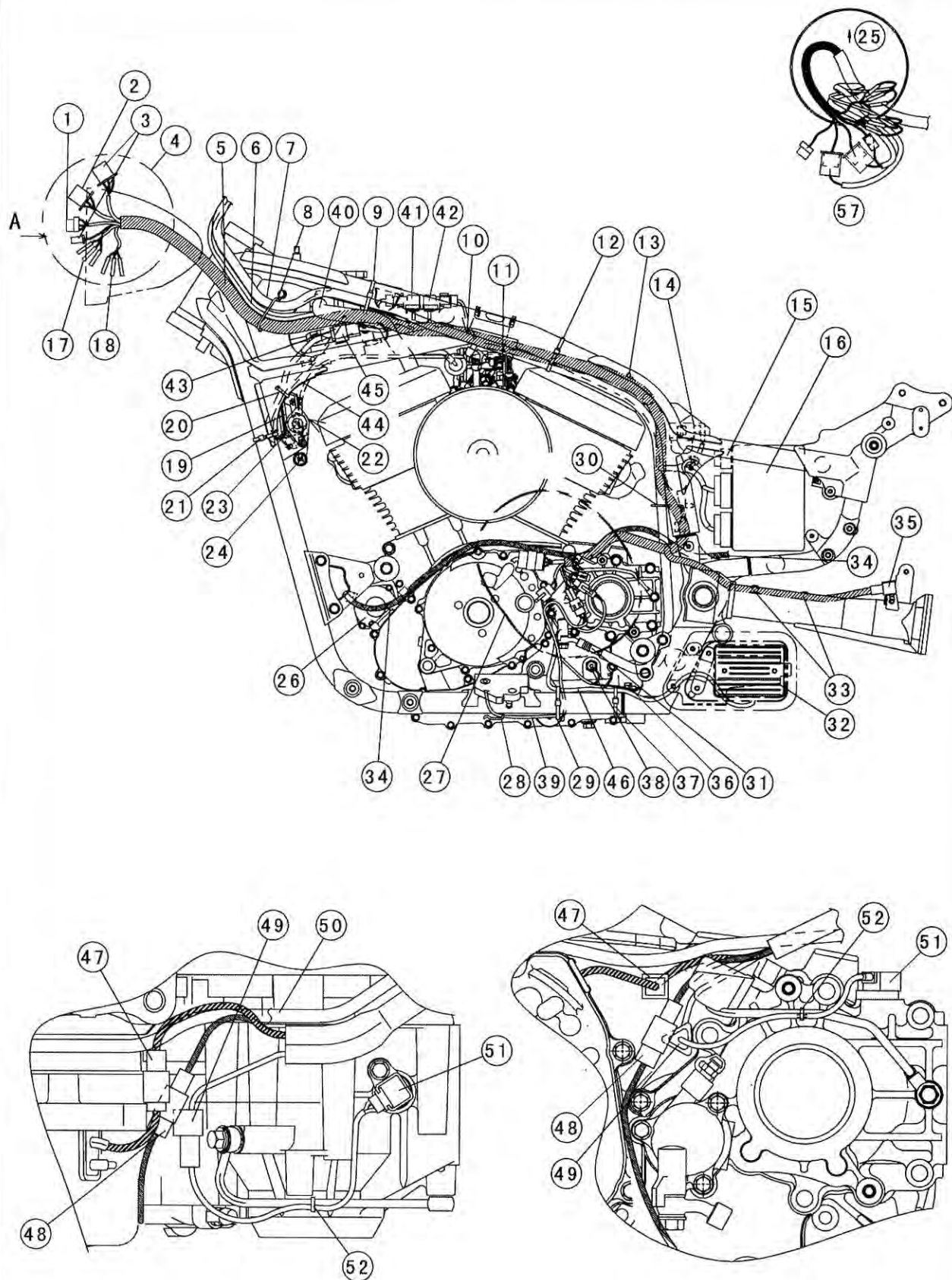
08090445W5 C

Cable, Wire, and Hose Routing

1. Front
2. Throttle Cables
3. Front Brake Hose
4. Clamp (holds the hose [3], cable [2], and the wire [13])
5. Front Turn Signal Light Wires
6. Clutch Hose
7. Clamp (holds the hose [6], and the wire [22])
8. Punch Mark: Align the punch marks with the mating surface.
9. Main Harness
10. Handlebar
11. Section A
12. Clamps (holds the wires [5])
13. Right Handlebar Switch Wire
14. Snap-on Strap (holds the wire [13], and the hose [3], except for the throttle cables)
15. Radiator Hose
16. Water Hose (for rear cylinder)
17. Choke Cable: Run the cable over the hose [15], then under the hose [16], over the hose [18], and then outside the hose [16], and connect the cable to the throttle pulley.
18. Sensor Bracket Hook (Run the throttle cables inside the hook.)
19. Point of the grip edge.
20. Apply adhesive to the grip end cap and screw it in counterclockwise to the grip end fully.
21. Snap-on Strap (holds the hose [6] and the wire [22])
22. Left Handlebar Switch Wire
23. Punch Mark: Insert the grip until its edge aligns with the mark.
24. Choke Knob
25. Throttle Cable (accelerator)
26. Throttle Cable (decelerator)
27. Punch Mark: Align the punch marks with the gap.
28. Clamp (holds the hose [6], the cables [25], [26] and the harness [9])
29. Grommet
30. Grommet
31. Front Brake Caliper Cover
32. Front Brake Caliper

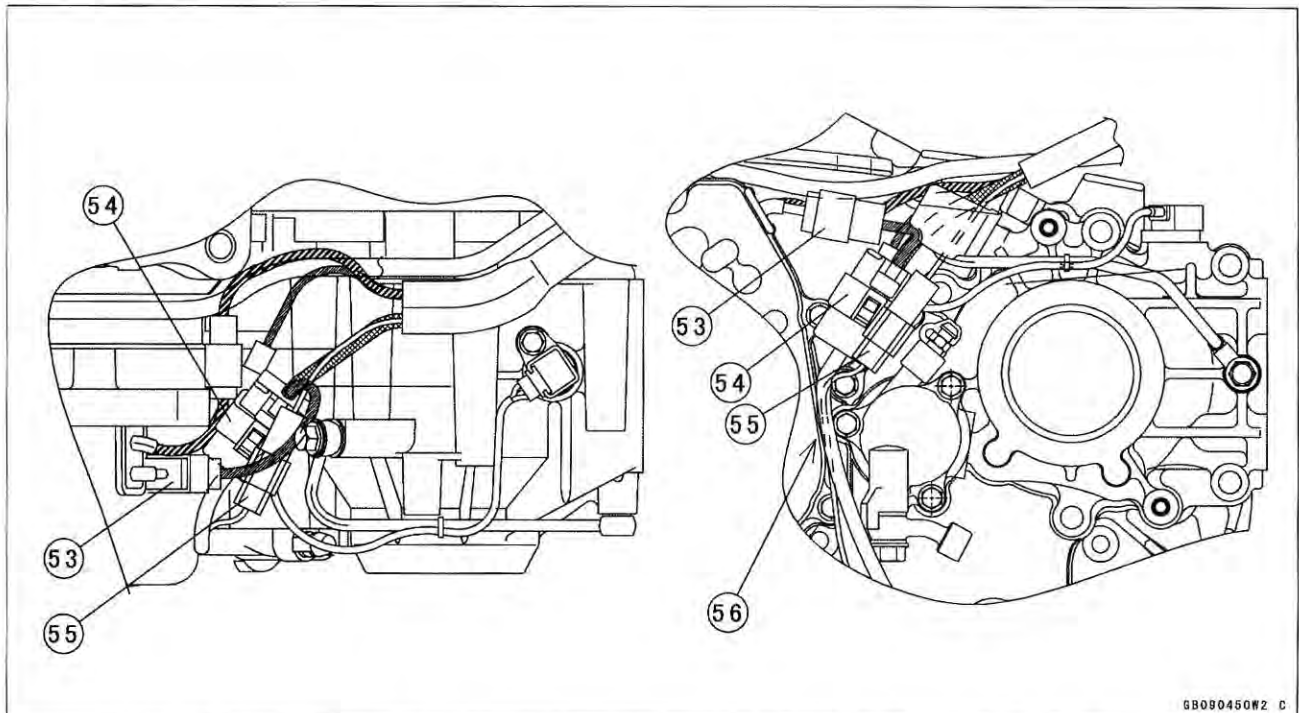
1-22 GENERAL INFORMATION

Cable, Wire, and Hose Routing



GB090449W5 D

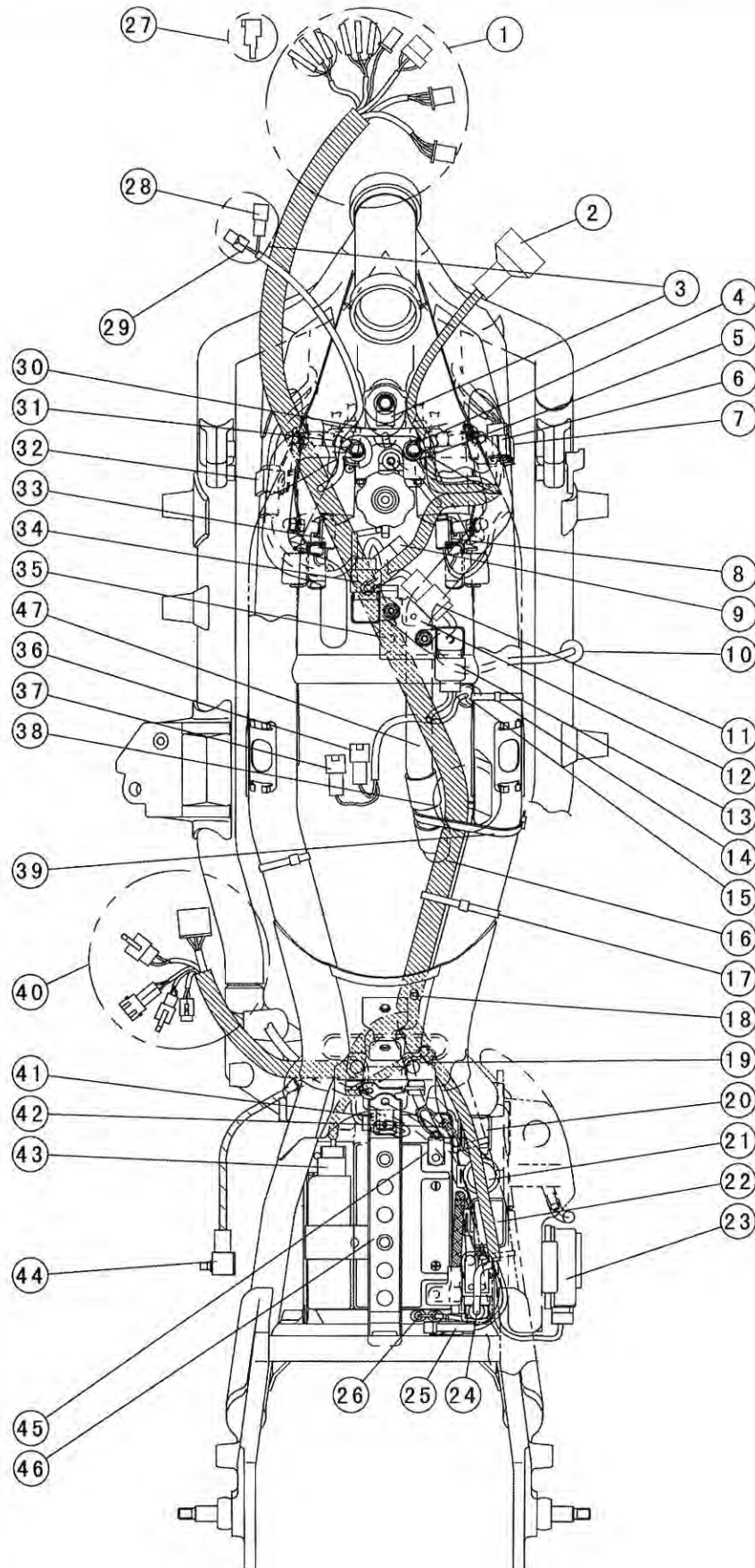
Cable, Wire, and Hose Routing



1. Headlight Connector
2. Right Handlebar Switch Connector
3. Left Handlebar Switch Connector
4. Connect the connectors within the headlight body.
5. Main Harness
6. Throttle Cables
7. Clutch Hose
8. Run the main harness, throttle cables and clutch hose and then install the holder (insert the end to the hole).
9. Strap ([5], [7], Run them outside the frame pipe around here)
10. Run the clutch hose outside the frame pipe.
11. White Mark on the Clutch Hose (align with the back of the damper)
12. Strap (vacuum switch valve hose and hose [7], CA: canister purge hose-green, vacuum switch valve and hose [7])
13. Right Frame Hole: Put the main harness clamp into this hole.
14. Vehicle-down sensor
15. Self-diagnosis Connector Cap
16. ECU
17. Front Right Turn Signal Light
18. Front Left Turn Signal Light
19. Horn
20. Strap (ignition switch and left horn wires) bound to the frame away from the horn.
21. Strap (ignition switch wire)
22. Horn Wires (Insert the horn terminals so that both wires hang down.)
23. Ignition Switch
24. Choke Knob
25. Upper
26. Starter Motor
27. Refer to the illustration in this page and next page.
28. Welded Clamp (Sidestand Switch Wire)
29. Strap: Clamp the wires [39], [40] through the front and rear hooks with a slack as little as possible behind the sidestand bracket.
30. Holder (Clutch hose and others)
31. White Stripe on the Clutch Hose next to the Slave Cylinder
32. Regulator/Rectifier
33. Clamps (Main Harness)
34. Starter Motor Cable
35. Tail/Brake Light and Rear Turn Signal Light Connector
36. Oil Pressure Switch
37. Strap (Regulator/Rectifier Wire)
38. Neutral Switch
39. Sidestand Switch Wire
40. Water Hose (Front Cylinder)
41. Atmospheric Pressure Sensor
42. Vacuum Sensor
43. Ignition Coil (Rear Cylinder)
44. Choke Cable
45. Ignition Switch Connector
46. Regulator/Rectifier Wire
47. Pickup Coil Connector
48. Oil Pressure/Neutral Switch Connector
49. Speed Sensor Connector
50. Starter Motor Cable
51. Speed Sensor
52. Strap (Speed Sensor Wire)
53. Alternator Connector
54. Regulator/Rectifier Connector
55. Sidestand Switch Connector
56. Insert the oil pressure/neutral switch wires, sidestand switch wire, and regulator/rectifier wires in this order between the alternator cover and the clutch slave cylinder.
57. Viewd A

1-24 GENERAL INFORMATION

Cable, Wire, and Hose Routing



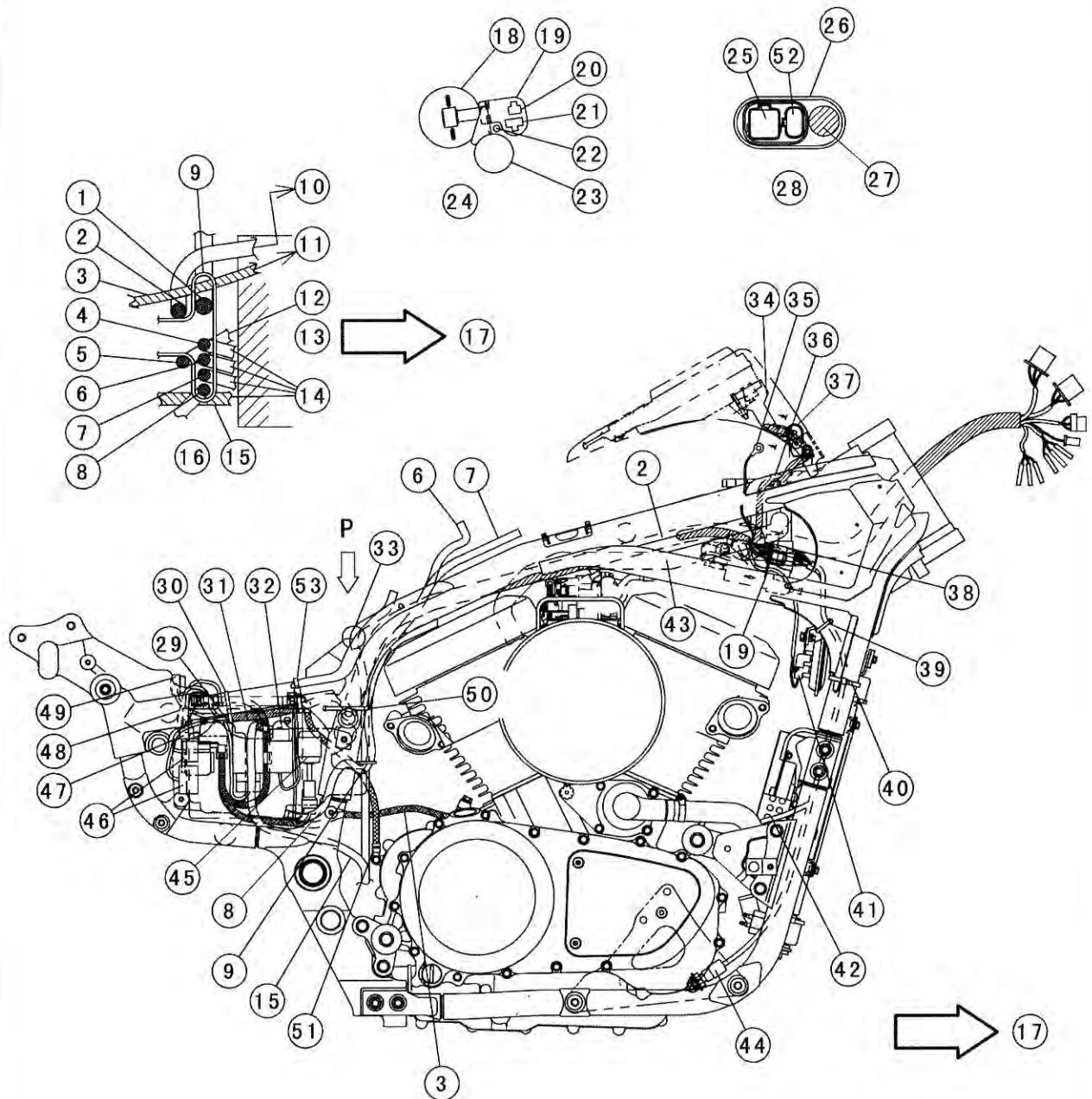
6B090451W5 C

Cable, Wire, and Hose Routing

1. Headlight Unit (Join the connectors in the headlight unit.)
2. Rubber-capped Meter Connector
3. Clamp (holds the neck of the fuel level sensor and fuel pump connector): Put the clamp facing backward on the washer and tighten the fuel tank mounting nut.
4. Clamp (Speedometer Wire)
5. Frame Ground (Place the clamp on the ground terminal and tighten them.)
6. Rear Brake Light Switch Connector 2P (Upper)
7. Radiator Fan Motor Connector 3P (Lower)
8. Right Ignition Coil Terminals (Upper: R/G Wires, Lower: BK/G Wire)
9. Rectifier
10. Grommet of Right Air Cleaner Base
11. Connector for inlet air temperature sensor and ISC valves (Fit it into the side of [12].)
12. Sensor Holder: Install the vacuum, atmospheric pressure sensors and tighten them. Run the throttle cables inside the hooks.
13. Vacuum Sensor Connector
14. Strap (Coolant Reserve Tank Hose)
15. Throttle Sensor Connector (Connect it to the throttle sensor on the throttle body.)
16. Main Harness
17. Strap (Main Harness)
18. Fit the pin of the main harness into the right hole of the frame gusset.
19. Run the fuel tank breather hose into the right hole of the frame gusset.
20. Oil Pressure Light Delay Unit
21. ECU Main Relay
22. Turn Signal Control Unit
23. Junction Box
24. Starter Relay
25. ECU Main Fuse
26. Accessory Wire Connectors (female): Face them downward.
27. Turn Signal Light Connectors (except the U.S.A., CA, CN)
28. Fuel Level Sensor Connector
29. Fuel Pump 4P Connector
30. Water Temperature Sensor Connector (Under the thermostat housing)
31. Clamp (holds the wires of [28], [29], and accessory connectors.): Face the accessory connectors downwards.
32. Ignition Switch Connector: Put the main harness side into the switch holder.
33. Left Ignition Coil Terminals (Upper: BK Wire, Lower: R/G Wire)
34. Atmospheric Pressure Sensor Connector
35. White Tape (location mark of main harness): Fit the pin of the main harness into the frame bracket.
36. Fuel Injector #2 Connector
37. Fuel Injector #1 Connector
38. Run the main harness so it does not touch the edge of the frame pipe here.
39. Strap (Holds [16], [47] and Coolant Reserve Tank Hose, CA-white vacuum hose)
40. Join the alternator, pickup coil, neutral switch, oil pressure switch and sidestand switch connectors in the alternator outer cover.
41. Vehicle-down Sensor Connector
42. Battery (-) Wire Connector
43. ECU Connectors (the top connector is the self-diagnosis connector)
44. Tail/Brake Light and Turn Signal Light Connector
45. Battery (-) Terminal (Connected to the engine ground terminal via battery (-) wire.)
46. Battery Holder
47. Rear Water Hose

1-26 GENERAL INFORMATION

Cable, Wire, and Hose Routing

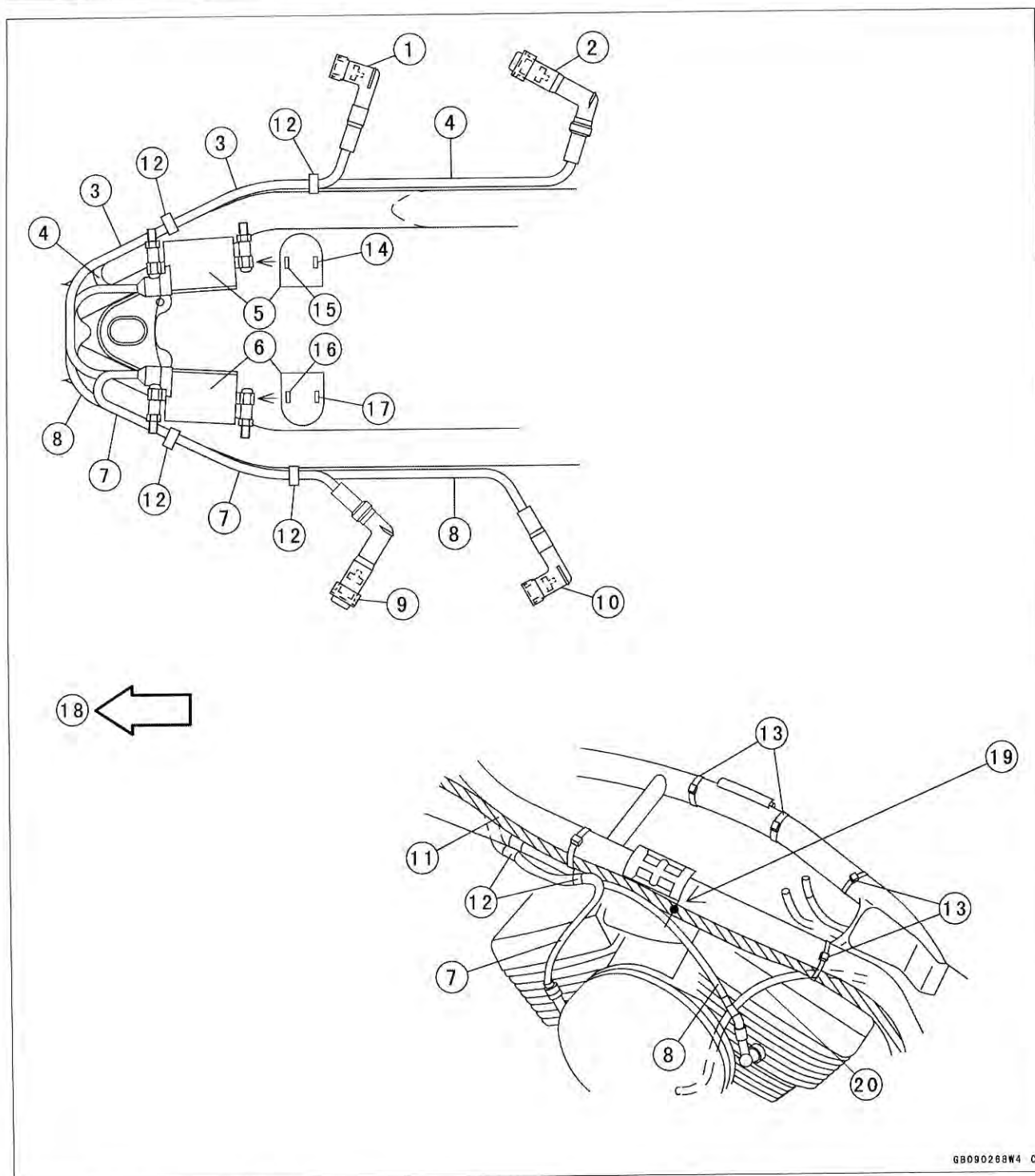


Cable, Wire, and Hose Routing

1. Clutch Hose
2. Main Harness
3. Starter Motor Cable
4. Fuel Tank Breather Hose (except CA)
5. Engine Ground Cable
6. Fuel Tank Filler Drain Hose
7. Fuel Level Sensor Drain Hose
8. Coolant Reserve Tank Hose
9. Holder
10. To Alternator Outer Cover
11. To Starter Motor
12. To Engine Ground
13. Engine
14. Put these hose into the holder on the bottom of engine.
15. Coolant Reserve Tank Overflow Hose
16. Viewd P
17. Front
18. Right Ignition Coil
19. Harness Holder
20. Rear Brake Light Switch Connector
21. Radiator Fan Connector
22. Right Horn Wire
23. Frame Pipe
24. Viewed A
25. Fuel Pump Connector
26. Band
27. Speedometer Harness
28. Section B-B
29. Branch Point
30. Strap (Hold the harness ahead of the branch to the unit [31])
31. DFI Main Relay
32. Turn Signal Control Unit
33. Run the fuel tank breather hose into the right hole of the frame gusset.
34. Rubber-capped Meter Connector
35. Frame Ground Wire (Under the right clamp [36])
36. Right Clamp (meter harness), Left Clamp (fuel level sensor, fuel pump, and accessory connector harness)
37. Clamp: Put the clamp facing backward on the washer and tighten the fuel tank mounting not. (Hold the fuel level sensor and fuel pump harness. Do not touch the meter cover.)
38. Run the harness inside the rear water hose.
39. Strap (Rear Brake Light Switch and Radiator Fan Wires)
40. Strap (Rear Brake Light Switch and Radiator Fan Wires): Pull up the rear brake light switch wire a bit tightly and clamp it. Hold the wire as shown.
41. Insert the horn terminals so both wires hang down.
42. Radiator Fan Switch Wire
43. Rear Water Hose
44. Rear Brake Light Switch
45. Oil Pressure Light Switch
46. Junction Box
47. Starter Relay
48. Accessory Connector
49. DFI Main Fuse
50. Strap (Hold the upper part of the main harness branch to ECU. Do not hold the hose [8].)
51. Engine Ground, or Battery (-) Cable (Run it downward.)
52. Fuel Level Sensor

1-28 GENERAL INFORMATION

Cable, Wire, and Hose Routing

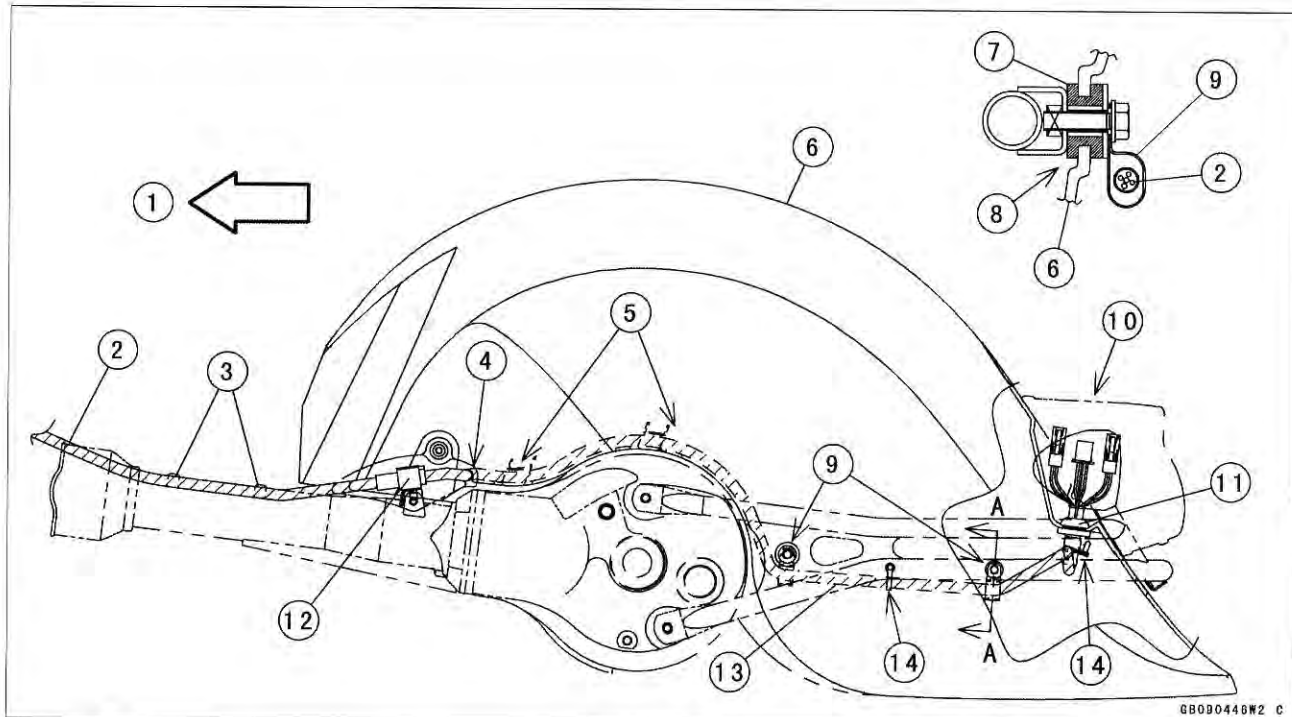


1. Front Right Spark Plug Cap
2. Rear Right Spark Plug Cap
3. High Tension Cord from the left ignition coil lower side
4. High Tension Cord from the right ignition coil lower side
5. Ignition Coil for Rear Spark Plugs
6. Ignition Coil for Front Spark Plugs
7. High Tension Cord from the left ignition coil upper side
8. High Tension Cord from the right ignition coil upper side
9. Front Left Spark Plug Cap
10. Rear Left Spark Plug Cap

11. Clutch Hose
12. Plastic Clamps
13. Straps
14. BK/G Primary Wire
15. R/G Primary Wire
16. BK Primary Wire
17. R/G Primary Wire
18. Front
19. Align the white mark with the back of the damper.
20. Canister Purge Hose (green, CA)

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Cable, Wire, and Hose Routing

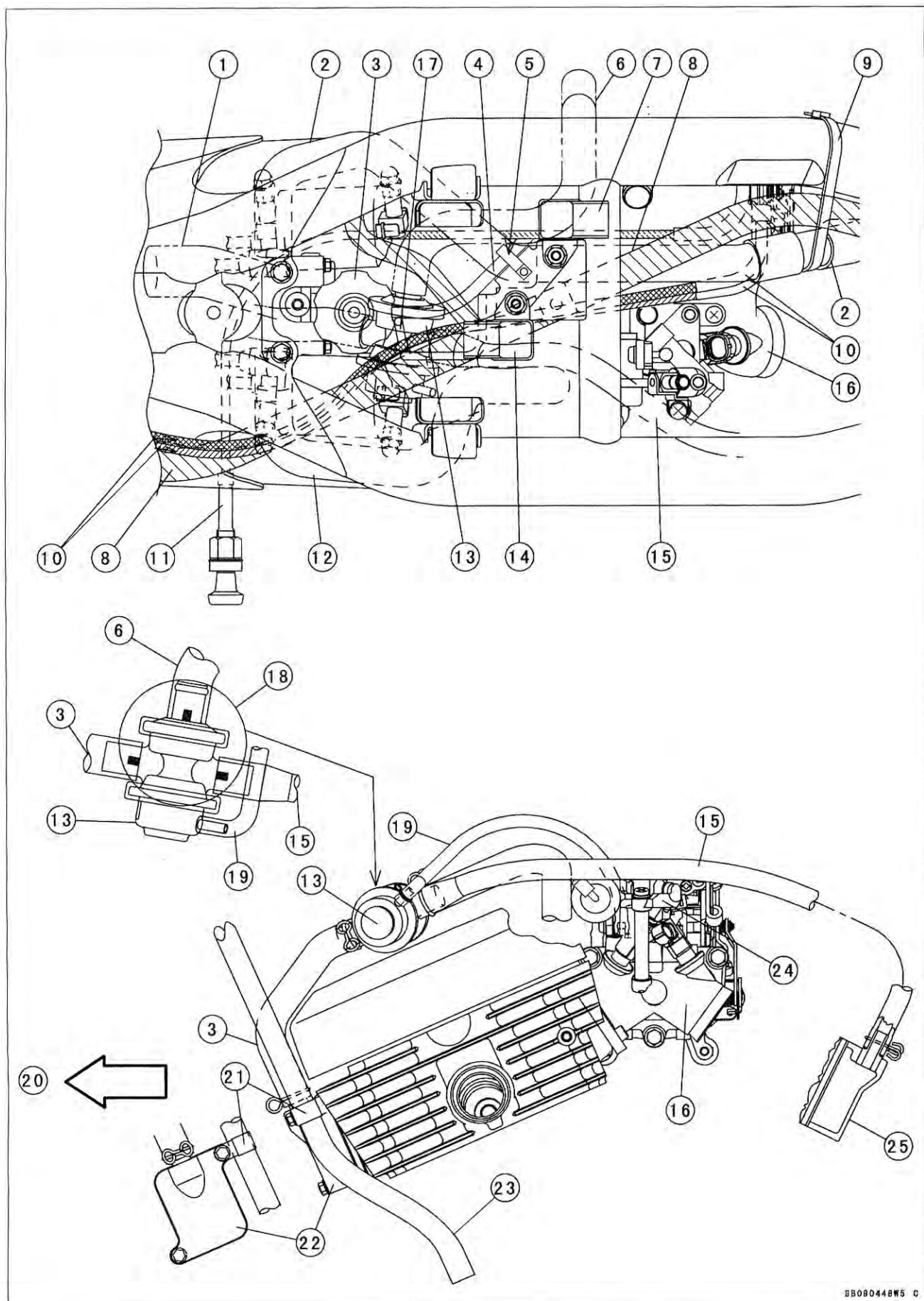


1. Front
2. Main Harness
3. Clamp(s)
4. Run the main harness into this hole.
5. Harness Guides of the Rear Fender
6. Rear Fender
7. Dampers
8. Section A-A
9. Clamps (left only)
10. Connect the tail/brake light wire connector and the turn signal light connectors. Shut the connectors between the rear fender and tail/brake light after connect the connectors.
11. Fit this grommet from the rear fender inside to the outside.
12. Put the main harness side connector into the bracket on the swingarm.
13. Tail/Brake Light and Turn Signal Light Harness
14. Fit the nylon clamps into the rear fender (left only).

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1-30 GENERAL INFORMATION

Cable, Wire, and Hose Routing



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Cable, Wire, and Hose Routing

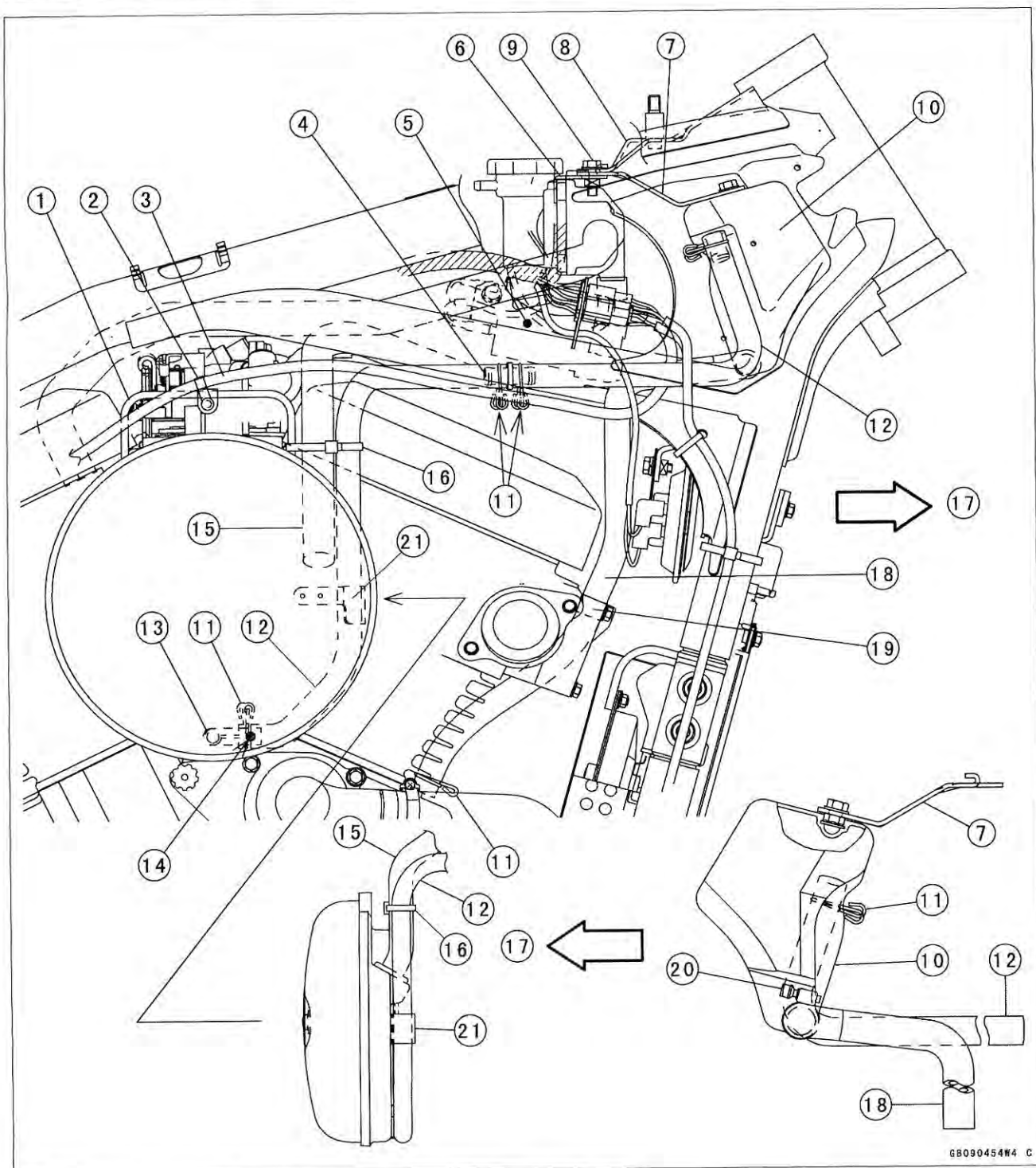
#1: Front Cylinder

#2: Rear Cylinder

1. Radiator Hose to the radiator
2. Water Hose #2
3. Vacuum Switch Valve Hose #1
4. Coolant Reservoir Tank Hose
5. Snap-on Strap
6. Vacuum Switch Valve Hose to the right air cleaner base
7. Vacuum Sensor (DFI)
8. Main Harness
9. Strap (Holds [2], [4], [8] and CA-White Vacuum Hose)
10. Throttle Cables: First, run these cables over the hose [12], inside the sensor bracket hook [17], then under the hose [2], and connect these cables to the throttle pulley.
11. Choke Cable: First, run the cable over the hose [1], then under the hose [2], over the hose [6], and then outside the hose [2], and connect the cable to the throttle pulley.
12. Water Hose #1
13. Vacuum Switch Valve
14. Atmospheric Pressure Sensor (DFI)
15. Vacuum Switch Valve Hose #2
16. Throttle Assy
17. Sensor Bracket Hook
18. Position the white marks as shown.
19. Vacuum Hose between Vacuum Switch Valve and Throttle Body
20. Front
21. Clamp
22. Air Suction Valve Cover #1
23. Crankcase Breather Hose
24. Delivery Joint
25. Air Suction Valve Cover #2

1-32 GENERAL INFORMATION

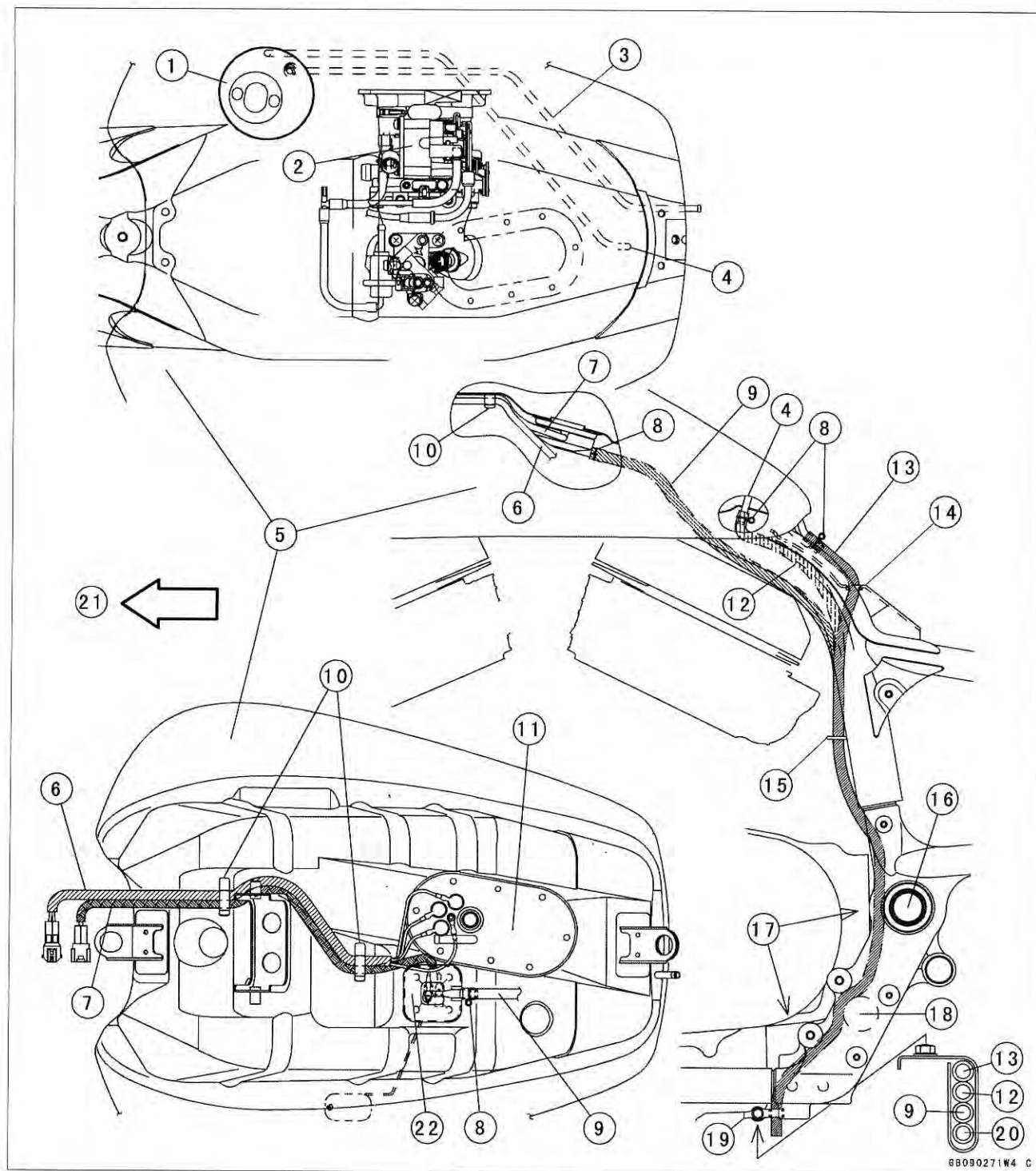
Cable, Wire, and Hose Routing



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- | | |
|---|---|
| 1. Ignition Coil High Tension Cord Holder | 13. Elbow Joint |
| 2. Snap-on Strap | 14. Face the white mark sideways and run the hose along the air cleaner base. |
| 3. Right High Tension Cord of right ignition coil | 15. Vacuum Switch Valve Hose |
| 4. Fitting | 16. Strap (holds [1], [15], [16], and harness of ISC valve & inlet air temperature sensor.) |
| 5. Right Ignition Coil | 17. Front |
| 6. Thermostat Housing Bracket | 18. Crankcase Breather Hose |
| 7. Reserve Tank Bracket | 19. Hose Clamp |
| 8. Frame Gusset | 20. Hose Clamp: place the screw along the tank [10] as shown. |
| 9. Bolt ([6], [7], [8] lower → upper) | 21. Clamp (holds the hose [12].) |
| 10. Oil Reserve Tank | |
| 11. Clips: Face the tabs as shown. | |
| 12. Oil Reserve Tank Hose | |

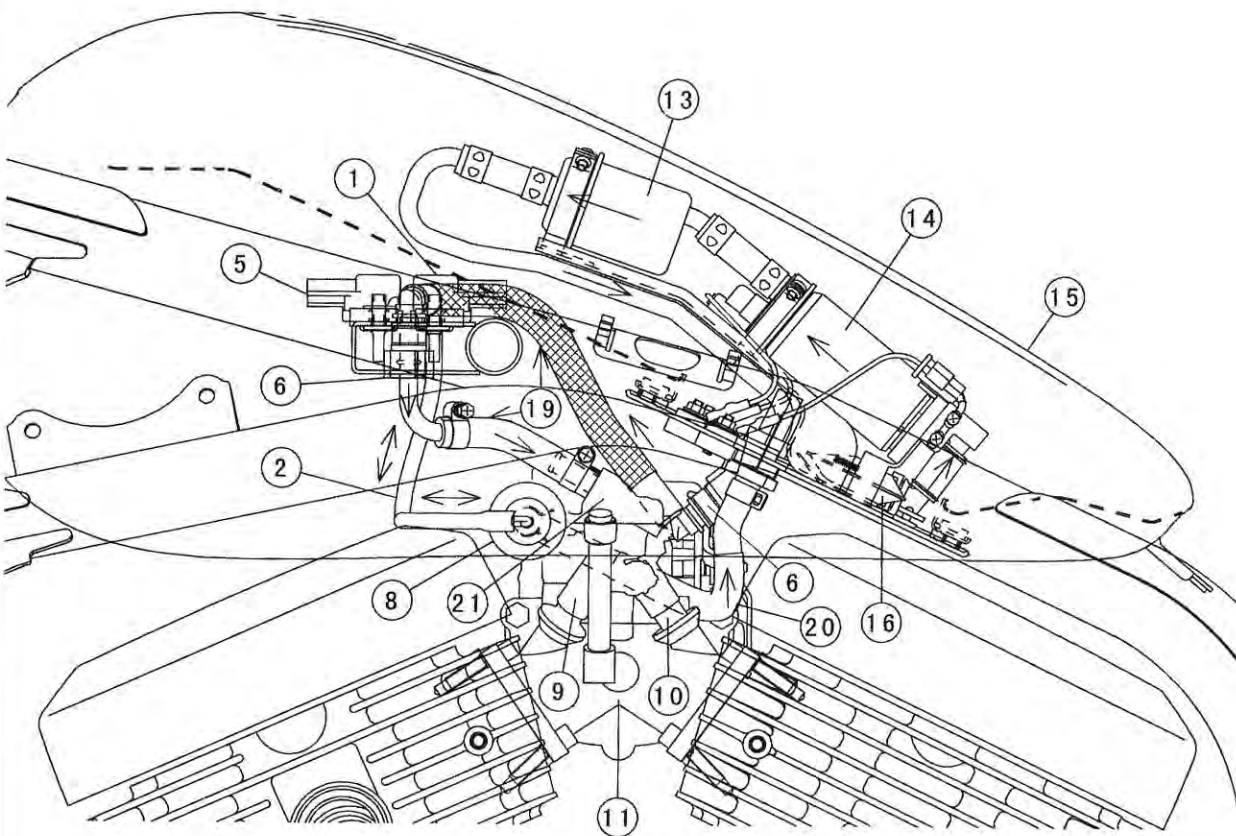
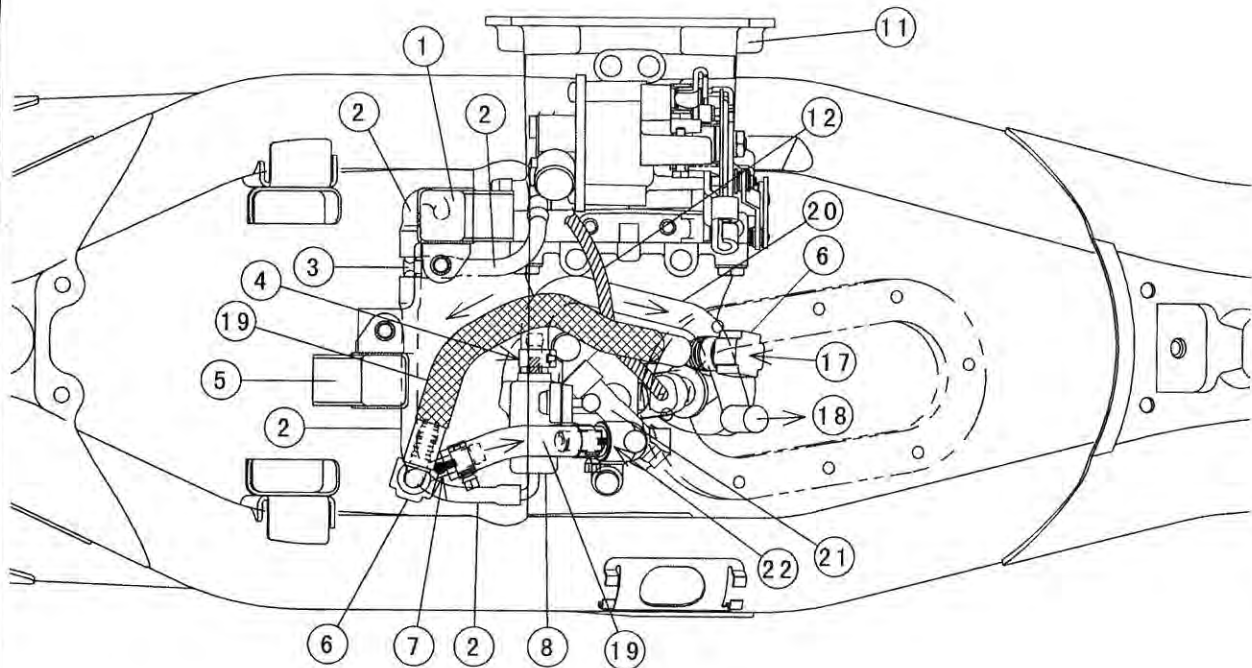
Cable, Wire, and Hose Routing



- | | |
|-----------------------------------|---|
| 1. Fuel Tank Filler | 13. Fuel Tank Breather Hose (Except for California Model) |
| 2. Throttle Assy | 14. Run the hose [13] into the right hole. |
| 3. Fuel Tank Breather Pipe | 15. Holder |
| 4. Filler Drain Pipe | 16. Swingarm Pivot |
| 5. Fuel Tank | 17. Run these hoses in front of the [16], [18]. |
| 6. Fuel Pump Wires | 18. Cross Pipe |
| 7. Fuel Level Sensor Wires | 19. Clamp |
| 8. Clips | 20. Coolant Reserve Tank Overflow Hose |
| 9. Fuel Level Sensor Drain Hose | 21. Front |
| 10. Welded Clamp (holds [6], [7]) | 22. Fuel Level Sensor: Install it with the leads inside |
| 11. Pump Base Plate | and with the fitting of the cover backward. |
| 12. Filler Drain Hose | |

1-34 GENERAL INFORMATION

Cable, Wire, and Hose Routing



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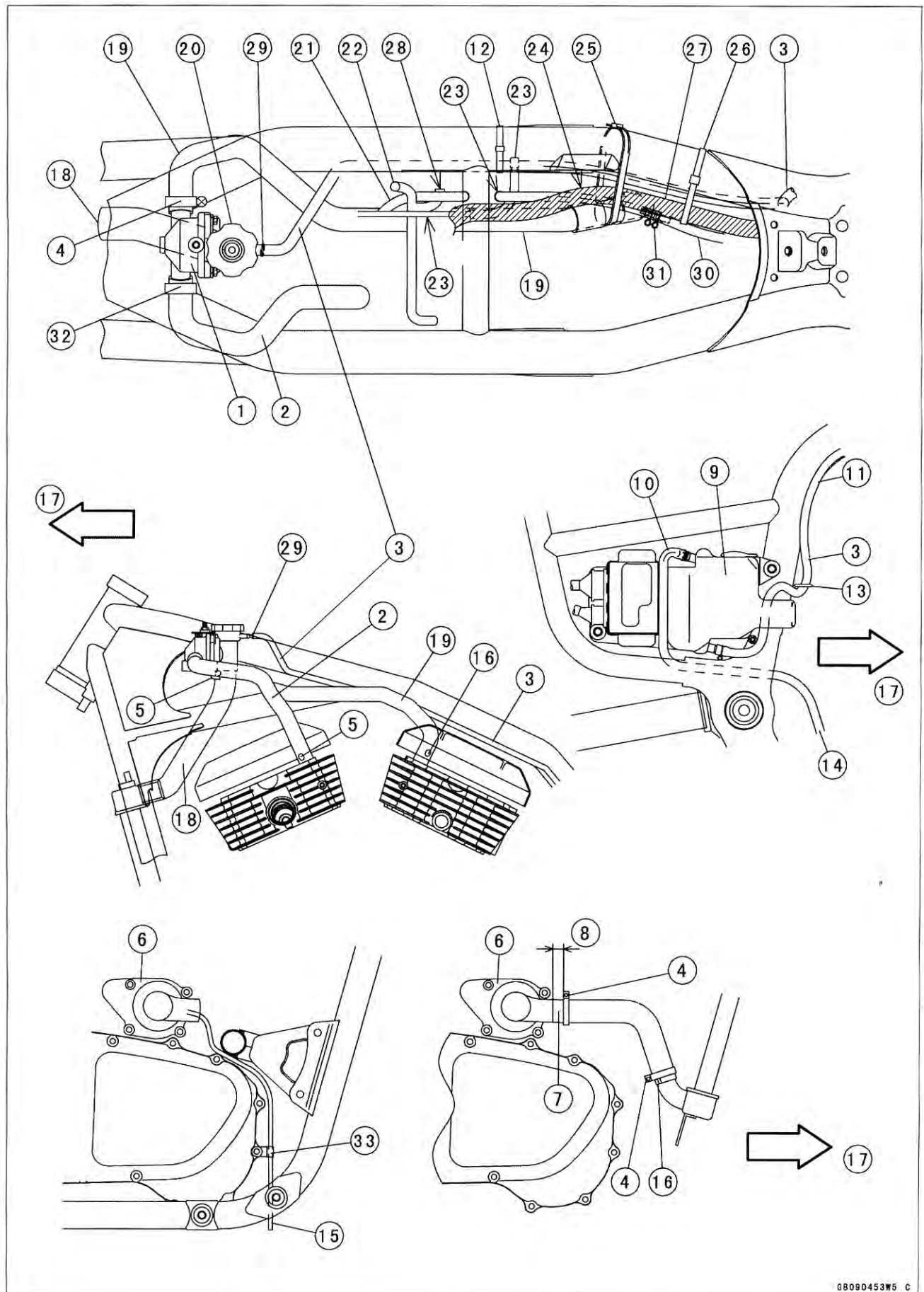
Cable, Wire, and Hose Routing

→: Fuel Flow

1. Vacuum Sensor (with the vacuum hose)
2. Vacuum Hoses for the vacuum sensor and the pressure regulator
3. T-Joint
4. Insert the hose [20] with its mark up and hold the hose with the clamp.
5. Atmospheric Pressure Sensor
6. Outlet Hose Joints
7. Insert the hose [19] with its yellow mark up.
8. Pressure Regulator
9. Fuel Injector #1 for front cylinder
10. Fuel Injector #2 for rear cylinder
11. Throttle Assy
12. Harness for fuel injector #2
13. Intank-fuel Filter
14. Intank-fuel Pump
15. Fuel Tank
16. Fuel Pump Screen
17. Outlet Fuel from fuel tank
18. Return Fuel to fuel tank
19. High Pressure Fuel Hose (fuel supply)
20. Low Pressure Fuel Hose (fuel return)
21. Delivery Joint
22. Insert the hose [19] with its white mark up.
23. Front

1-36 GENERAL INFORMATION

Cable, Wire, and Hose Routing

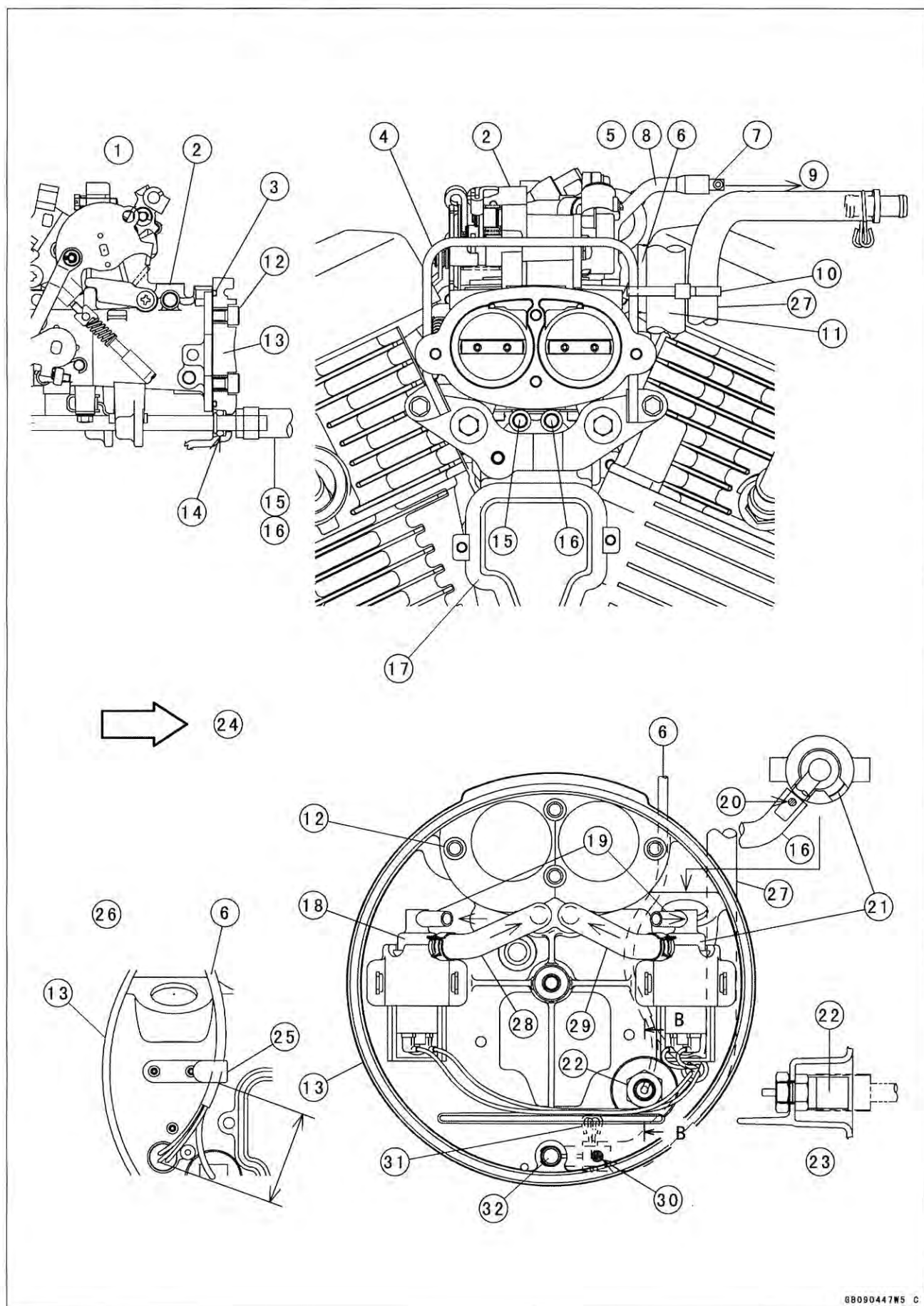


Cable, Wire, and Hose Routing

- #1: For Front Cylinder
- #2: For Rear Cylinder
- CA: California Model
- 1. Thermostat Housing
- 2. Water Hoses #1
- 3. Reserve Tank Hose
- 4. Clamps: Position the screw head as shown.
- 5. White marks on the hose [2] face forward.
- 6. Water Pump
- 7. Insert the hose until the end touches the water pump inlet step.
- 8. Gap between Pump Inlet Step and Clamp End: 13 ~ 16 mm
- 9. Coolant Reserve Tank
- 10. Overflow Hose: Run the hose outside the reserve tank and under the main harness.
- 11. Run the hose inside the frame.
- 12. Straps (coolant reserve tank hose)
- 13. Run the hose [3] through the holder.
- 14. Insert the hose [10] into the holder on the rear of the engine.
- 15. Water Pump Drainage Outlet Hose
- 16. White mark on the hose faces rear.
- 17. Front
- 18. Radiator Hose
- 19. Water Hose #2
- 20. Radiator Cap
- 21. Vacuum Switch Valve Hose
- 22. Vacuum Hose connected to Vacuum Sensor, Pressure Regulator, and Throttle Body
- 23. Choke Cable over the hose [22]
- 24. Run the main harness [27] so it does not touch the edge of the frame pipe around here.
- 25. Band which holds [3], [19], [27] and [30]: Hold the water hose [19] so the band does not pinch [19].
- 26. Band which holds [27]
- 27. Main Harness
- 28. Run the hose [21] above the vacuum hose from the throttle body around here.
- 29. Clip
- 30. Vacuum Hose (white, CA): Run over the throttle cables and the choke cable.
- 31. Fitting (CA)
- 32. Clamp: Position the screw head under the hose and it face rear.
- 33. Clamp: Position the clamp forward.

1-38 GENERAL INFORMATION

Cable, Wire, and Hose Routing

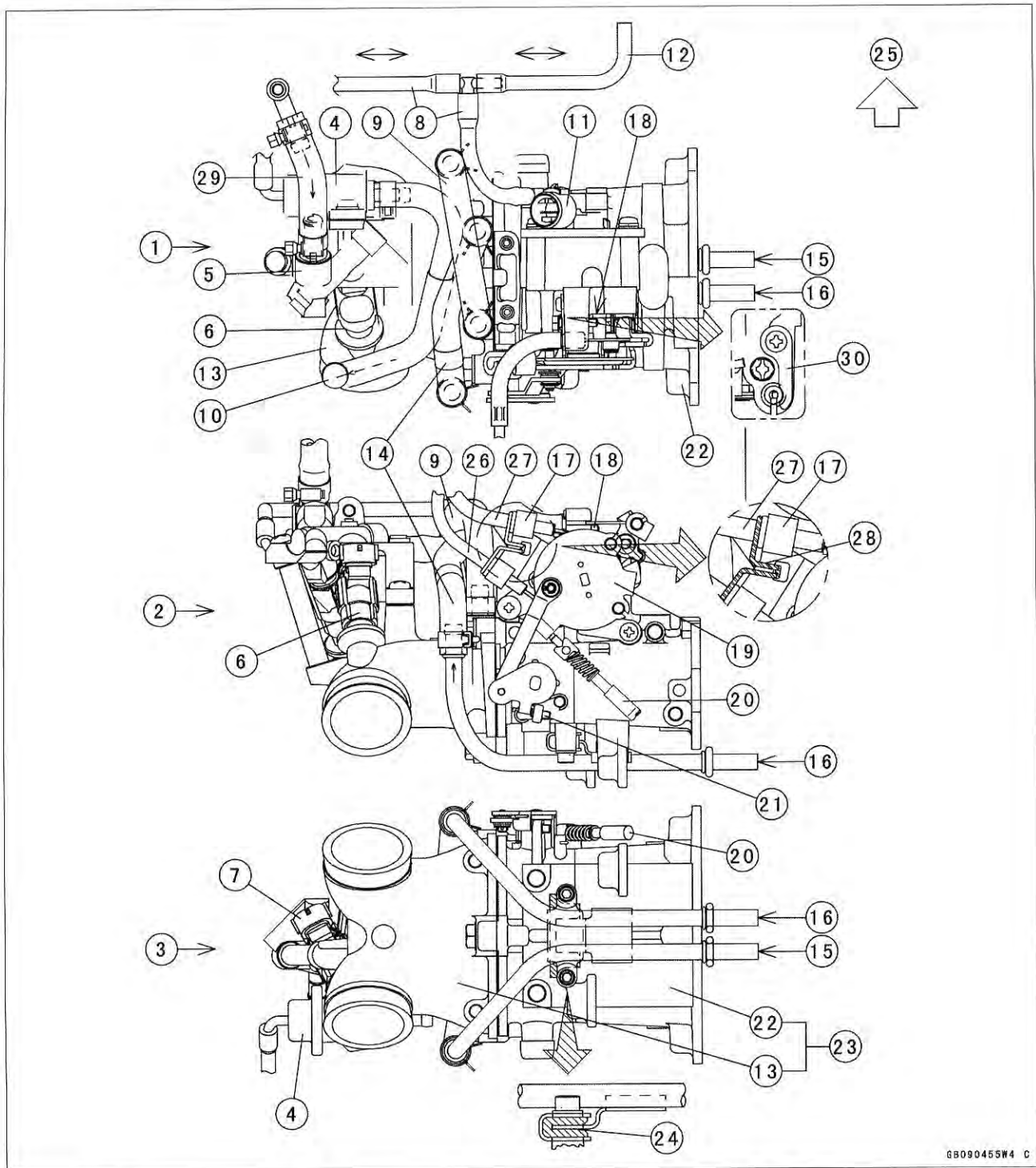


Cable, Wire, and Hose Routing

- : Bypass Air Flow
- #1: For Front Cylinder
- #2: For Rear Cylinder
 - 1. Rear View
 - 2. Throttle Assy
 - 3. Air Cleaner Base Seal
 - 4. Ignition Coil High Tension Cord Holder
 - 5. Right Side View
 - 6. Harness of Inlet Air Temperature Sensor & ISC Valves
 - 7. T-Joint
 - 8. Vacuum Hose from Throttle Body
 - 9. To Vacuum Sensor and Pressure Regulator
- 10. Strap (holds [4], [6], [27], and [11])
- 11. Vacuum Switch Valve Hose
- 12. Right Air Cleaner Base Bolts
- 13. Right Air Cleaner Base
- 14. O-rings
- 15. ISC Valve Pipe #1
- 16. ISC Valve Pipe #2
- 17. Lower Air Cleaner Duct
- 18. ISC Valve #1
- 19. ISC Valve Inlets
- 20. Blue Mark on Top
- 21. ISC Valve #2
- 22. Inlet Air Temperature Sensor (Insert the connector until a click.)
- 23. Section B-B
- 24. Front
- 25. Clamp these wires [6] with a slack as little as possible.
- 26. Back of Right Air Cleaner Base
- 27. Oil Reserve Tank Hose
- 28. ISC Valve Hose #1 (red)
- 29. ISC Valve Hose #2 (blue)
- 30. Face the white mark sideways and run the hose along the air cleaner base.
- 31. Clip: Face the tab down.
- 32. Elbow Joint

1-40 GENERAL INFORMATION

Cable, Wire, and Hose Routing



-->: Fuel Flow

←→: Vacuum Pulsation

→: Bypass Air Flow

#1: For Front Cylinder

#2: For Rear Cylinder

1. Top View

2. Rear View

3. Bottom View

4. Pressure Regulator

5. Delivery Joint

6. Fuel Injector #2

7. Fuel Injector #1

8. Vacuum Hoses from Throttle Body

9. ISC Hose #2 (blue mark)

10. Low Pressure Fuel Hose (to Fuel Tank)

11. Throttle Sensor

12. Vacuum Hose to Vacuum Sensor

13. Inlet Manifold

14. ISC Hose #1 (red mark)

15. ISC Pipe #2

16. ISC Pipe #1

17. Throttle Cable Holder

18. Choke Lever Stop Screw

19. Throttle Pulley

20. Idle Adjusting Screw

21. Throttle Stop Screw

22. Throttle Body

23. Throttle Assy

24. ISC Pipe Damper (section A-A)

25. Front

26. Accelerator Cable

27. Decelerator Cable

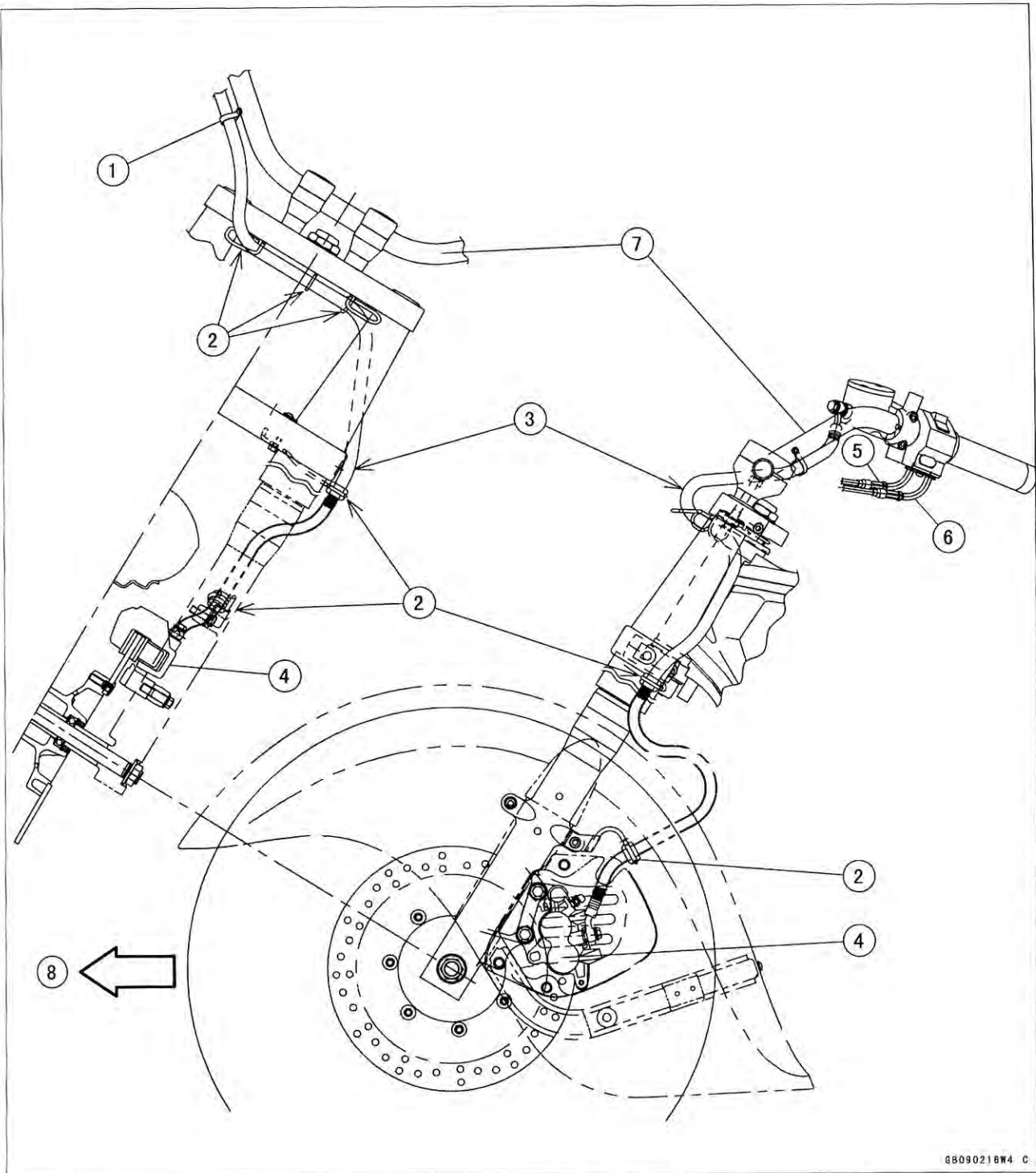
28. Cable Clip

29. High Pressure Fuel Hose

30. Choke Cable Plate

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Cable, Wire, and Hose Routing



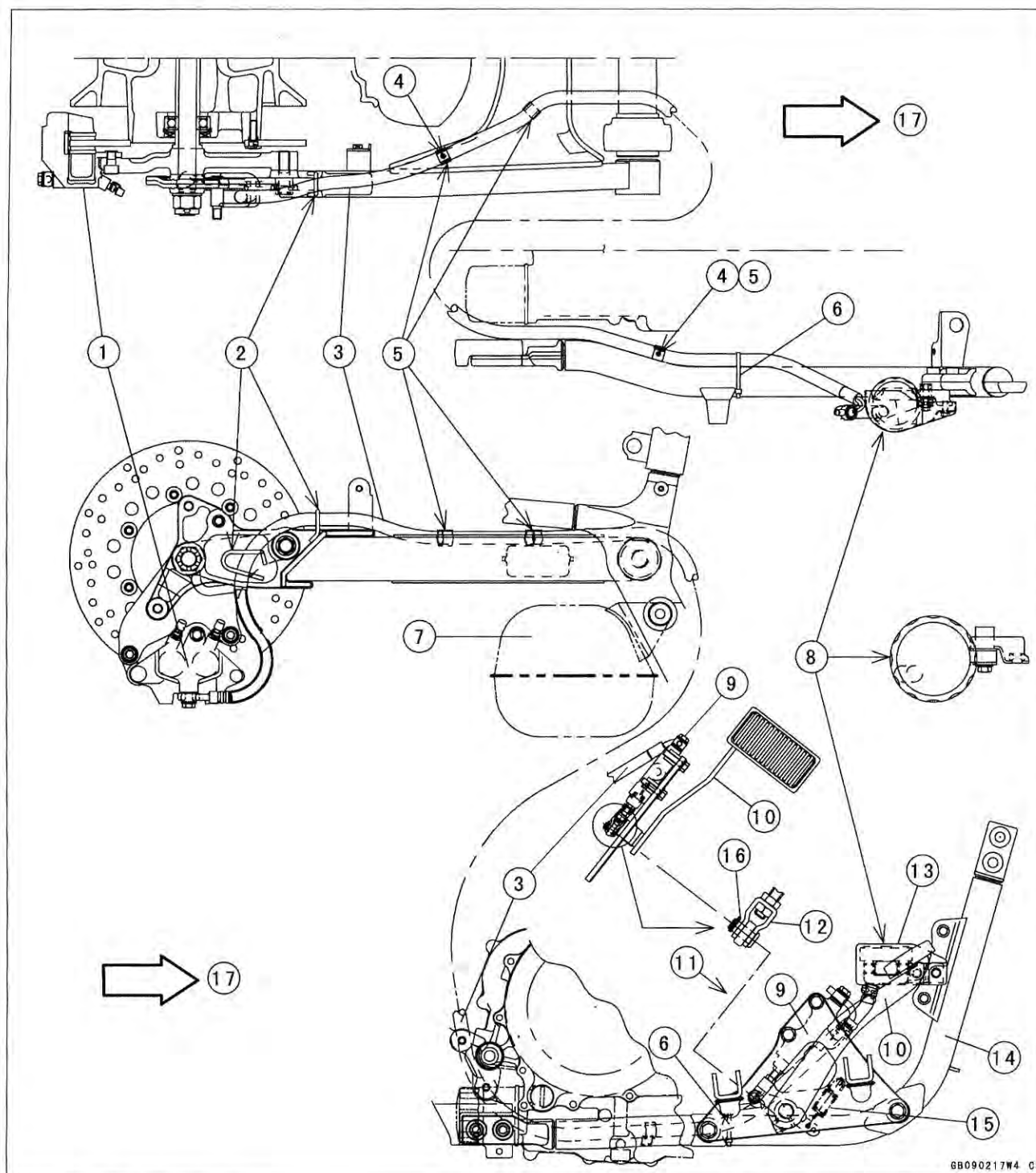
GB090216W4 C

- 1. Strap
- 2. Front Brake Hose Holders
- 3. Front Brake Hose
- 4. Front Brake Caliper

- 5. Throttle Cable (accelerator)
- 6. Throttle Cable (decelerator)
- 7. Handlebar
- 8. Front

1-42 GENERAL INFORMATION

Cable, Wire, and Hose Routing



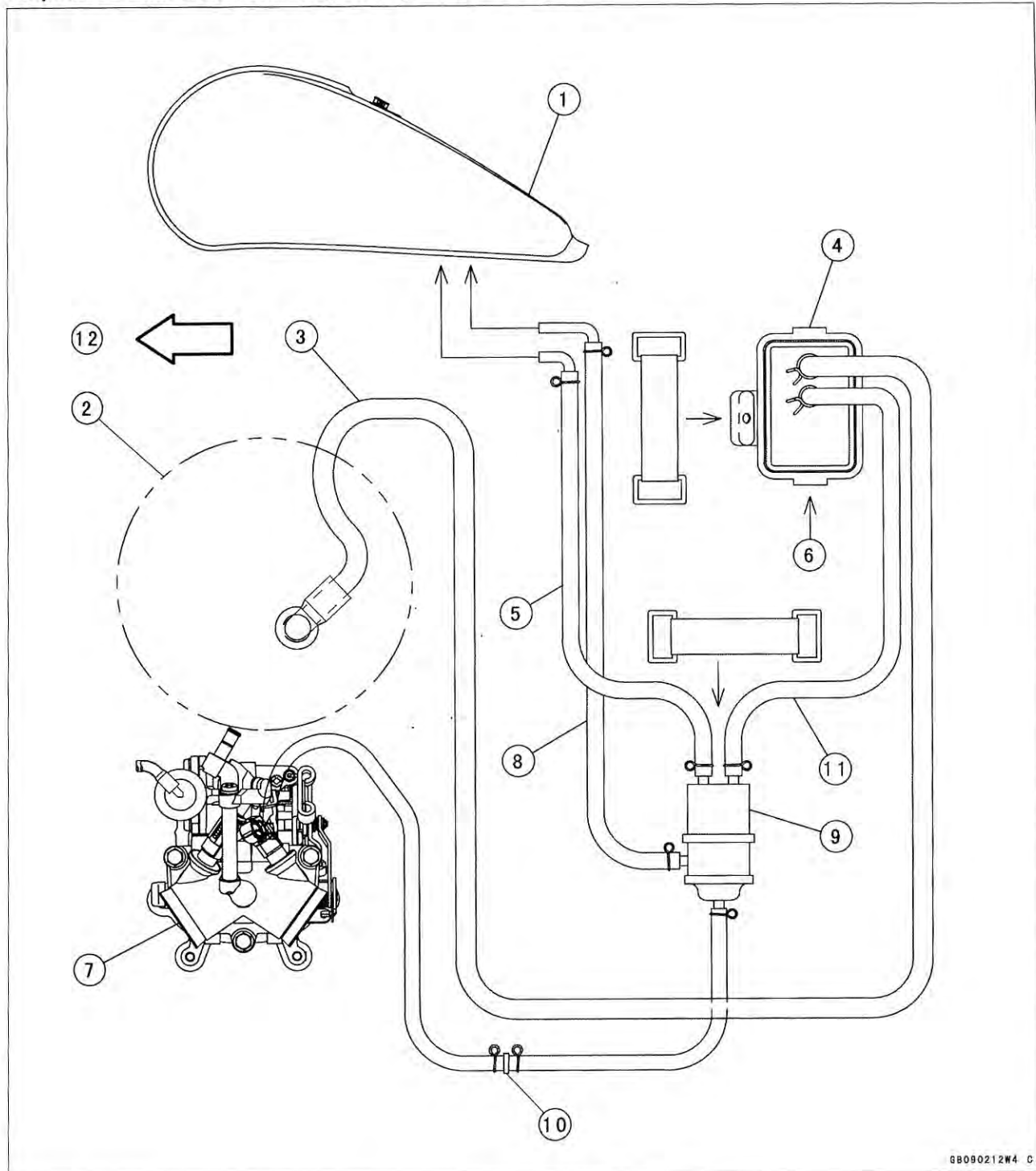
1. Rear Brake Caliper
2. Brake Hose Holders
3. Rear Brake Hose
4. Brake Hose White Marks (Position here.)
5. Clamps
6. Strap
7. Chamber
8. Rear Brake Reservoir
9. Rear Master Cylinder

10. Brake Pedal
11. View
12. Clevis
13. Rear Brake Reservoir Cover
14. Downtube
15. Brake Pedal Return Spring
16. Cotter Pin
17. Front

GB090217W4 C

Cable, Wire, and Hose Routing

Evaporative Emission Control System (California Model)

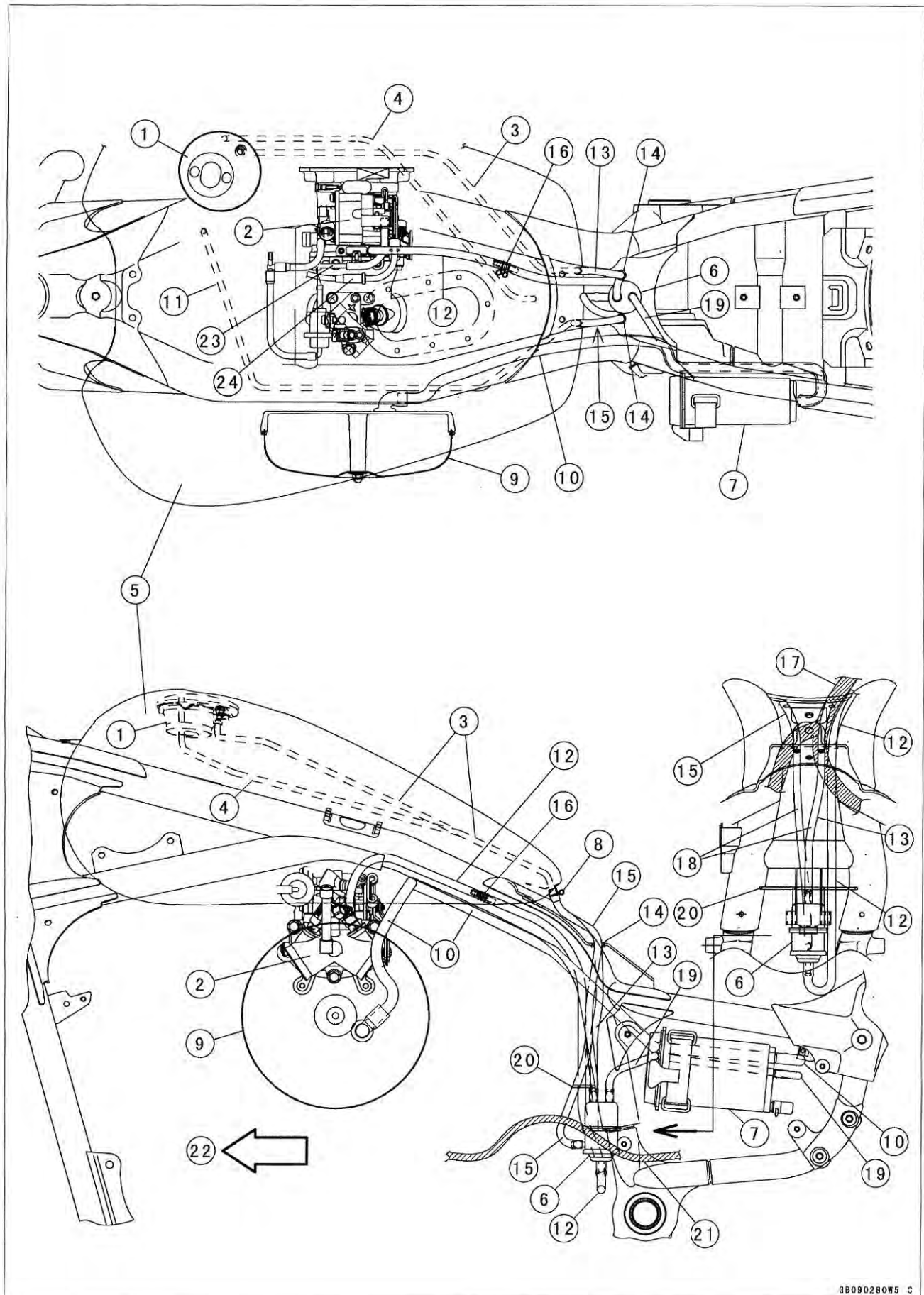


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- | | |
|------------------------------------|---------------------------------------|
| 1. Fuel Tank | 7. Throttle Assy |
| 2. Left Air Cleaner Base | 8. Fuel Tank Return Hose (red, right) |
| 3. Canister Purge Hose (green) | 9. Separator |
| 4. Canister | 10. Fitting |
| 5. Fuel Breather Hose (left, blue) | 11. Separator Breather Hose (blue) |
| 6. Rear View | 12. Front |

1-44 GENERAL INFORMATION

Cable, Wire, and Hose Routing



GB090280W5 C

Cable, Wire, and Hose Routing

Evaporative Emission Control System (California Model)

1. Fuel Tank Filler
2. Throttle Assy
3. Fuel Tank Breather Pipe
4. Filler Drain Pipe
5. Fuel Tank
6. Separator
7. Canister
8. Clips for [13] and [15]
9. Left Air Cleaner Housing
10. Canister Purge Hose (green)
11. Fuel Return Pipe
12. Vacuum Hose (white): Run the hose on the right of [6] into the holder [20].
13. Fuel Tank Breather Hose (blue, right)
14. Gusset Holes for [13] and [15]
15. Fuel Return Hose (red, left)
16. Fitting
17. Main Harness (rear view)
18. Run the hoses [13] and [15] between the branch of [17].
19. Separator Breather Hose (blue)
20. Holder
21. Electric Starter Cable: Run the cable on the left of [6].
22. Front
23. Choke Cable
24. Throttle Cables

Fuel System (DFI)

2

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2-2 FUEL SYSTEM (DFI)

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Specifications

Item	Standard
Throttle Grip Free Play:	2 ~ 3 mm
Air Cleaner Element:	Paper filter
DFI (Digital Fuel Injection) System:	
Make:	Mitsubishi Electric
Idle Speed:	950 ± 50 r/min (rpm)
Throttle Assy:	
Type × Bore	Two barrel type × $\phi 36$ mm
ECU (Electronic Control Unit):	
Type	Digital memory type, with built in IC igniter, sealed with resin
Usable engine speed	100 ~ 5950 r/min (rpm)
ISC Valves:	(Idle Speed Control Valve, or Fast Idle Solenoid Valve)
Maximum air flow rate	75 ± 7 L/min
Solenoid resistance	13.6 ~ 20.4 Ω
In-tank Fuel Filter:	
Filtration area	More than 200 cm ²
Rated flow	1.0 L/min
Fuel Pressure (high pressure line):	
Right after Ignition SW ON	310 kPa (3.2 kg/cm ² , 46 psi) with fuel pump running
3 sec or more after Ignition SW ON	280 kPa (2.9 kg/cm ² , 41 psi) with fuel pump stopped
With engine idling	260 kPa (2.7 kg/cm ² , 38 psi) with fuel pump running
With engine running at full throttle	260 ~ 280 kPa (2.7 ~ 2.9 kg/cm ² , 38 ~ 41 psi) with fuel pump running
Pressure Regulator:	
Regulated fuel pressure	294 ± 4.9 kPa (3.00 ± 0.05 kg/cm ² , 43 ± 0.73 psi)
Throttle Sensor:	Non-adjustable, and non-removable
Input voltage	4.75 ~ 5.25 V DC between BL/W and BR/BK leads
Output voltage at idle throttle opening	0.584 ~ 0.604 V DC between Y/W and BR/BK leads
Output voltage at full throttle opening	4.29 ~ 4.59 V DC between Y/W and BR/BK leads
Resistance	4 ~ 6 k Ω between BL/W and BR/BK leads
Atmospheric Pressure Sensor or Vacuum Sensor:	
Input voltage	4.75 ~ 5.25 V DC
Output voltage	3.74 ~ 4.26 V DC at standard atmospheric pressure
Inlet Air Temperature Sensor:	
Resistance	5.4 ~ 6.6 k Ω at 0° C 2.26 ~ 2.86 k Ω at 20° C 0.29 ~ 0.39 k Ω at 80° C
Water Temperature Sensor:	
Resistance	2.162 ~ 3.112 k Ω at 20° C 0.785 ~ 1.049 k Ω at 50° C 0.207 ~ 0.253 k Ω at 100° C
Vehicle-down Sensor:	
Detection method	Magnetic flux detection method
Detection angle	More than 45° ± 5° for each bank
Detection time	Within 0.5 ~ 1.0 sec.
Fuel Injectors:	
Type	INP- 786
Injection timing	60° BTDC
Static injection quantity	273.1 ~ 289.4 mL/min
Nozzle type × diameter	Two spray type with 4 holes × 0.3 mm
Resistance	14.2 ~ 14.8 Ω
Fuel Pump:	
Type	In-tank pump (friction pump) 75 mL or more for 3 seconds
Discharge	(90 L or more/h) with the filter installed at 12 V × atmospheric pressure

Special Tools - Oil Pressure Gauge: 57001-125

Hand Tester: 57001-1394

Driver-Filler Cap: 57001-1454

Needle Adapter Set - Hand Tester: 57001-1457

Fuel Pressure Gauge Adapter: 57001-1417

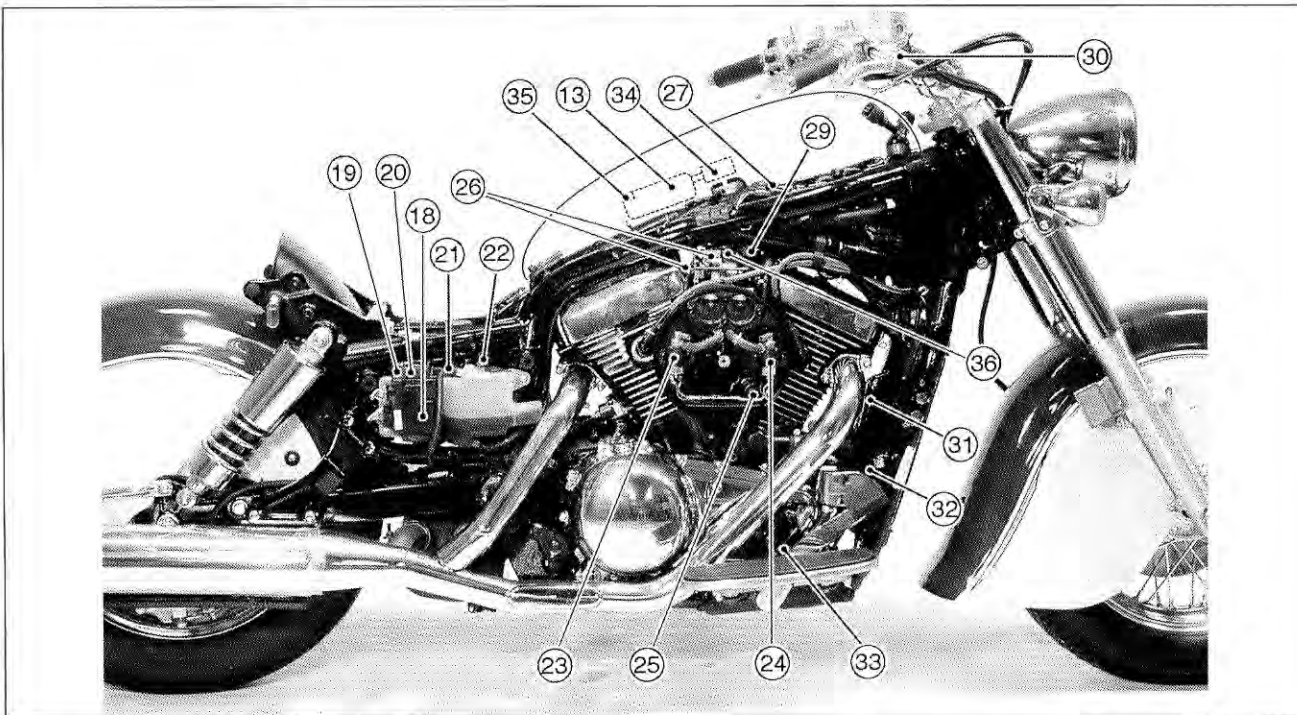
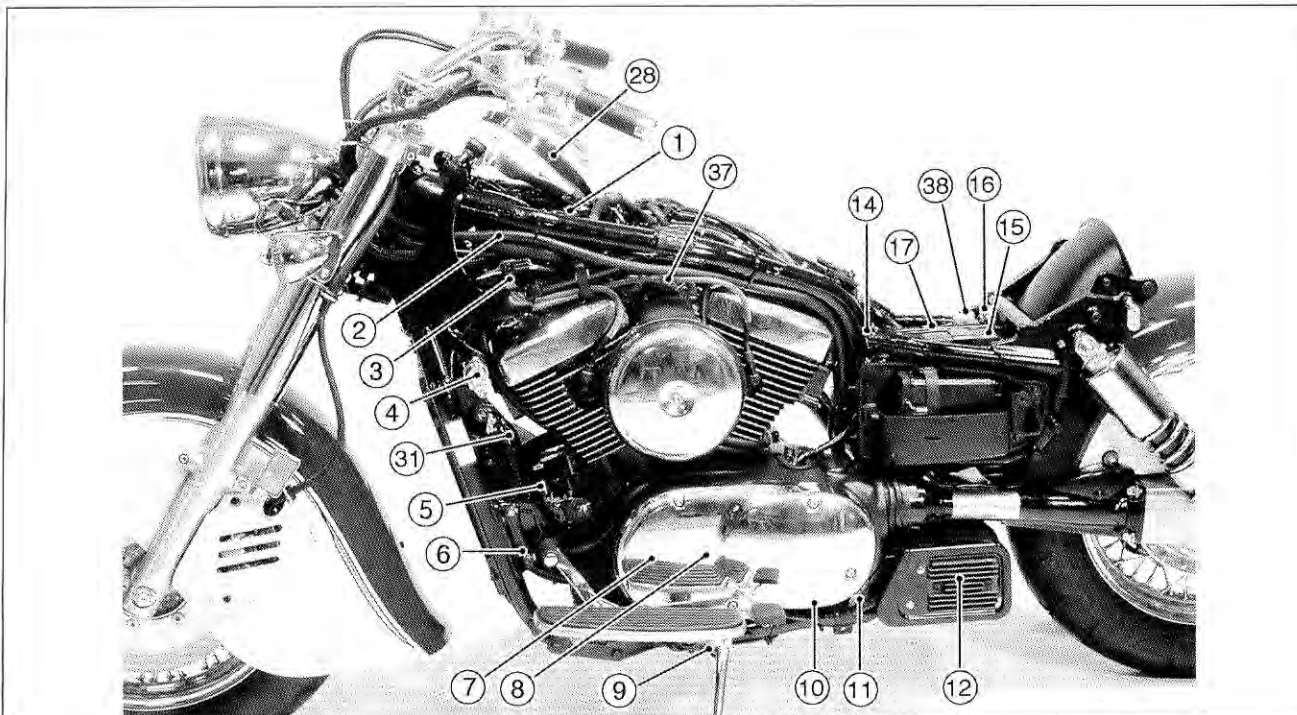
Fork Oil Level Gauge: 57001-1290

Sealant -

Kawasaki Bond (Silicone Sealant): 56019-120

2-4 FUEL SYSTEM (DFI)

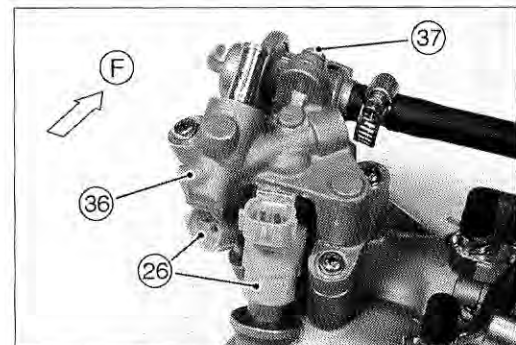
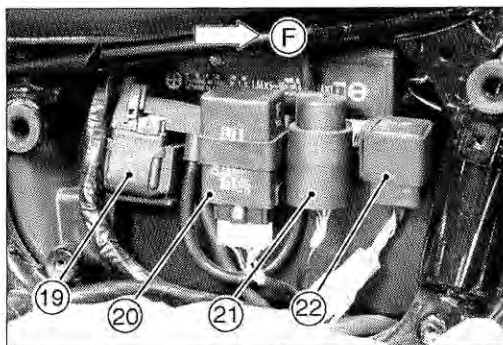
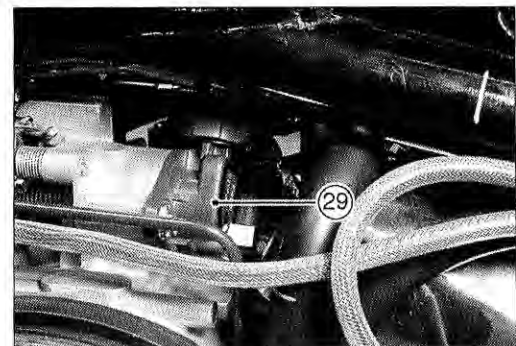
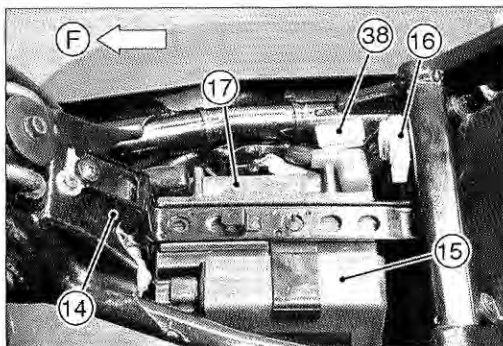
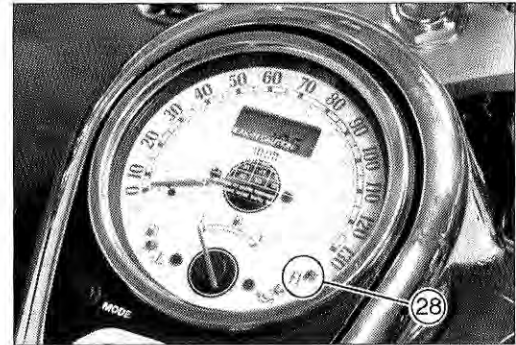
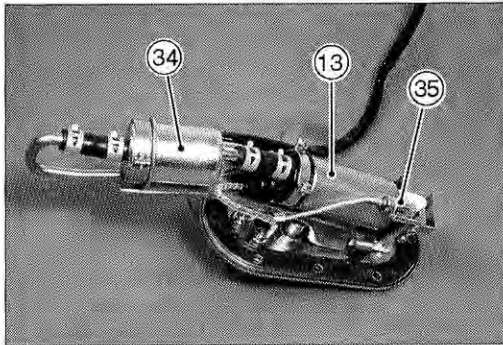
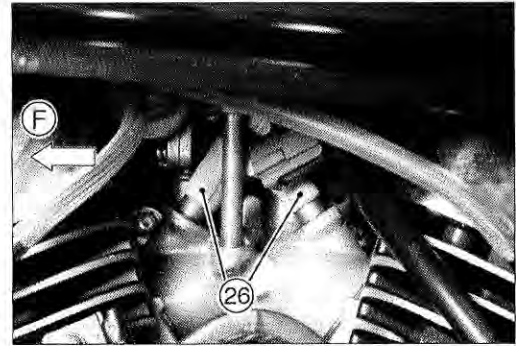
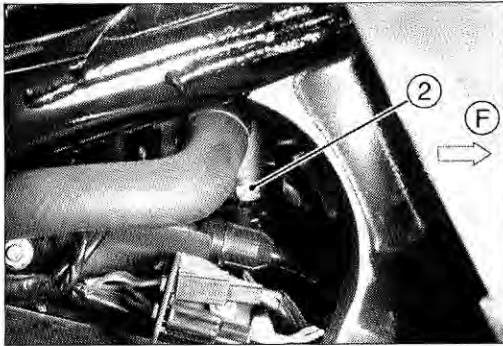
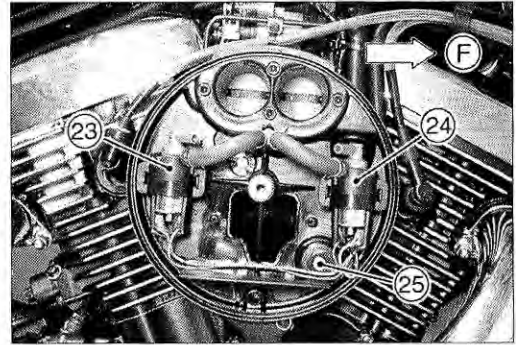
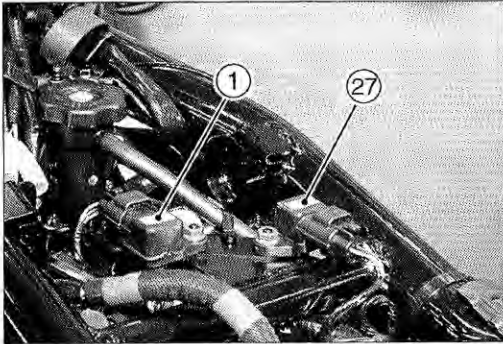
DFI Parts Location



DFI: DFI Parts (this chapter)

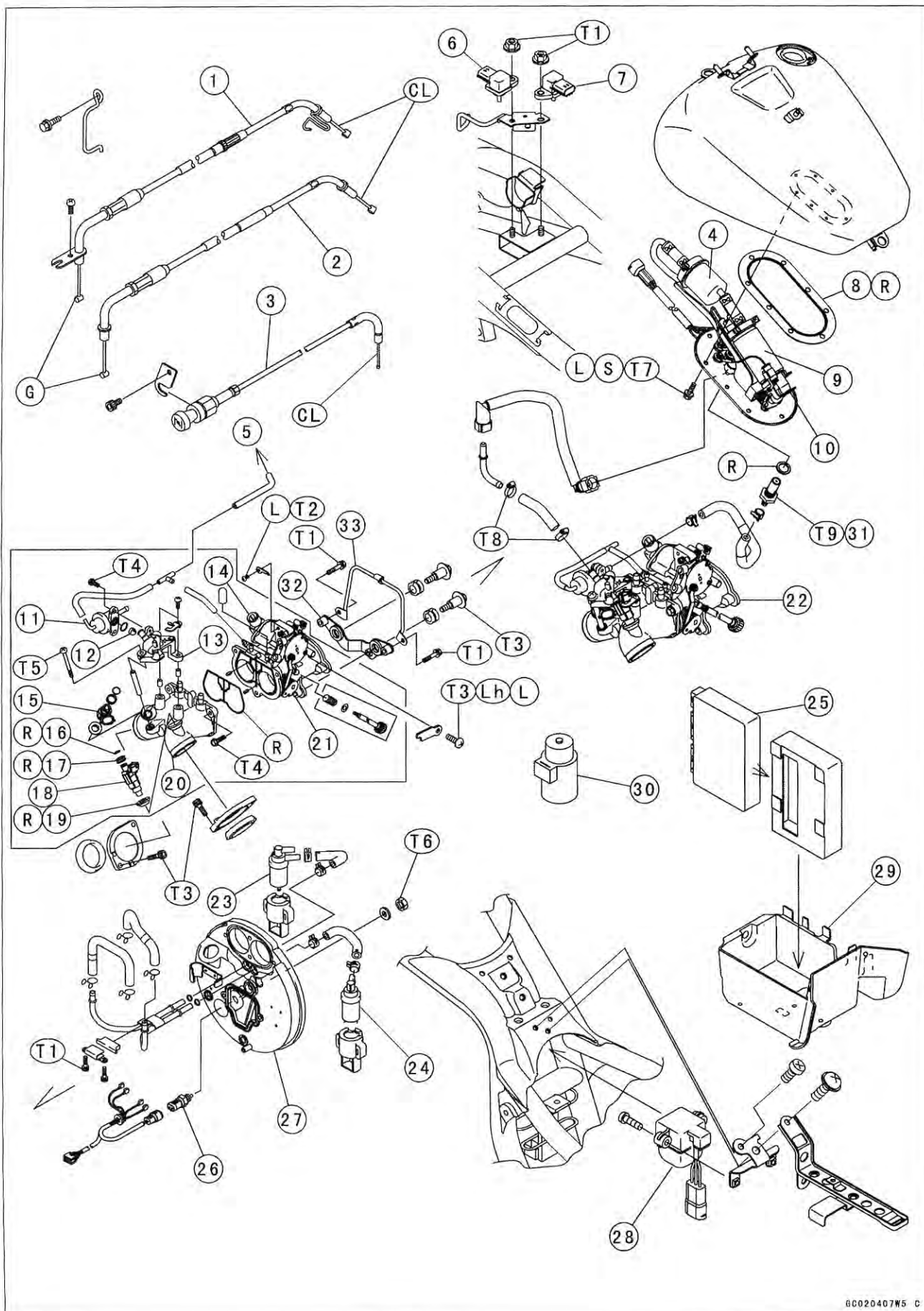
- | | | |
|--------------------------------------|--|--|
| F: Front | 11. Neutral Switch | 24. ISC Valve #2 (DFI, for Rear Cylinder) |
| 1. Atmospheric Pressure Sensor (DFI) | 12. Oil Pressure Switch | 25. Inlet Air Temperature Sensor (DFI) |
| 2. Water Temperature Sensor (DFI) | 13. In-tank Fuel Pump (DFI) | 26. Injectors (DFI) |
| 3. Ignition Coils | 14. Vehicle-down Sensor (DFI) | 27. Vacuum Sensor (DFI) |
| 4. Ignition Switch | 15. ECU (DFI) | 28. Meter Unit with FI Indicator LED Light (DFI) |
| 5. Starter Motor | 16. DFI Fuse 15 A x 32 V | 29. Throttle Sensor (DFI) |
| 6. Water Temperature Switch | 17. MF Battery | 30. Front Brake Light Switch |
| 7. Regulator/Rectifiers | 18. Junction Box | 31. Radiator Fan |
| 8. Pickup Coils | 19. Starter Relay | 32. Radiator Fan Switch |
| 9. Alternator | 20. Turn Signal Control Unit | 33. Rear Brake Light Switch |
| 10. Sidestand Switch | 21. DFI Main Relay | 34. In-tank Fuel Filter (DFI) |
| | 22. Oil Pressure Light Delay Unit | 35. Fuel Reserve Switch |
| | 23. ISC Valve #1 (DFI, for Front Cylinder) | 36. Delivery Joint (DFI) |
| | | 37. Pressure Regulator (DFI) |
| | | 38. Joint Connector |

DFI Parts Location



2-6 FUEL SYSTEM (DFI)

Exploded View

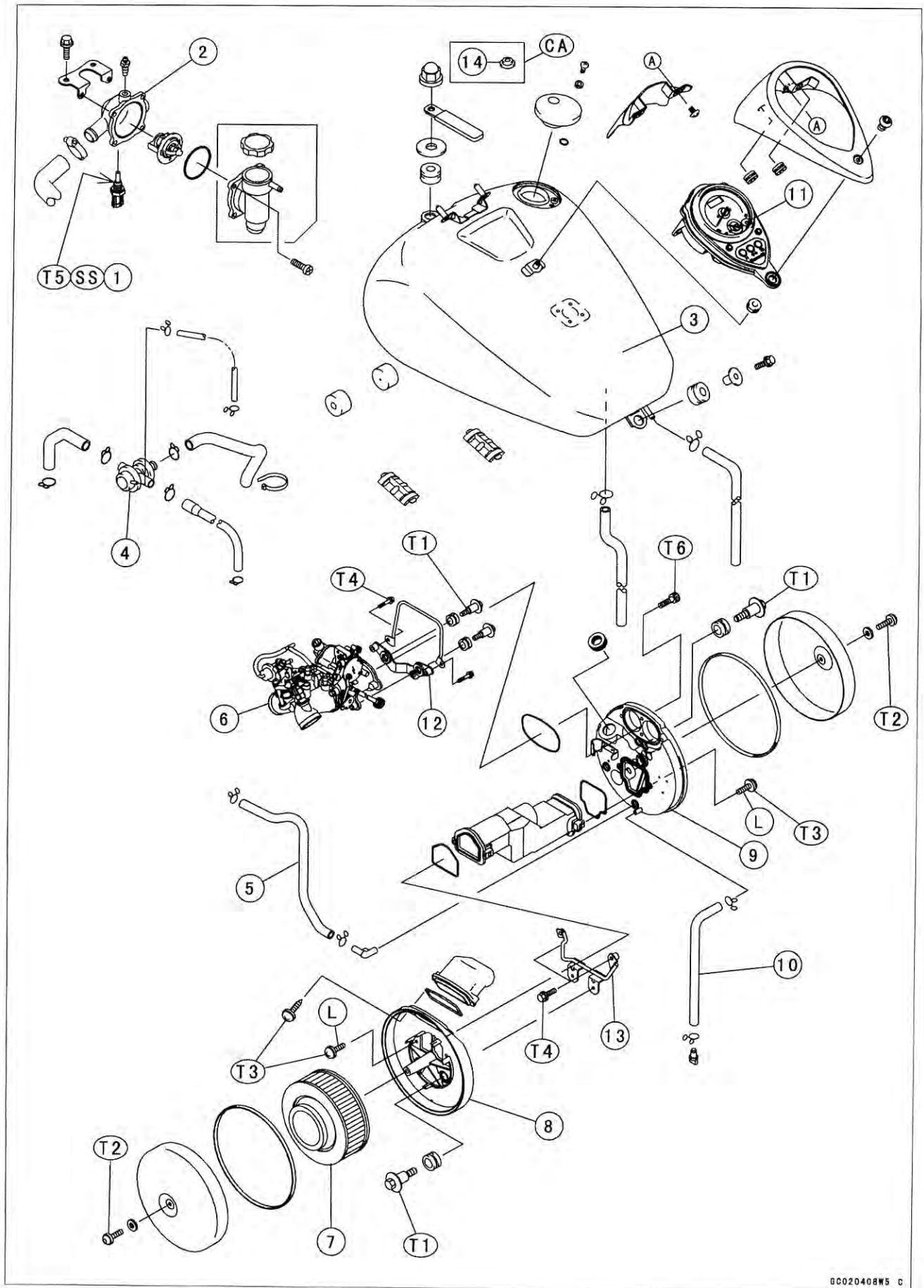


Exploded View

- CL: Apply cable lubricant.
- G: Apply grease.
- L: Apply a non-permanent locking agent.
- Lh: Left-hand Threads
- R: Replacement Parts
- S: Follow the specified tightening sequence.
- T1: 9.8 N·m (1.0 kg·m, 87 in·lb)
- T2: 2.9 N·m (0.3 kg·m, 26 in·lb)
- T3: 12 N·m (1.2 kg·m, 104 in·lb)
- T4: 4.9 N·m (0.5 kg·m, 43 in·lb)
- T5: 3.4 N·m (0.35 kg·m, 30 in·lb)
- T6: 7.8 N·m (0.8 kg·m, 69 in·lb)
- T7: 6.9 N·m (0.7 kg·m, 61 in·lb)
- T8: 1.5 N·m (0.15 kg·m, 13 in·lb)
- T9: 20 N·m (2.0 kg·m, 14 ft·lb)
- 1. Throttle Cable (accelerator)
- 2. Throttle Cable (decelerator)
- 3. Choke Cable
- 4. In-tank Fuel Filter
- 5. To vacuum sensor
- 6. Atmospheric Pressure Sensor
- 7. Vacuum Sensor
- 8. Fuel Pump Gasket
- 9. In-tank Fuel Pump (electric)
- 10. Fuel Pump Screen
- 11. Pressure Regulator
- 12. Pressure Regulator Screen
- 13. Delivery Joint
- 14. Throttle Sensor
- 15. Injector #1 for Front Cylinder
- 16. O-ring
- 17. Seal Ring
- 18. Injector #2 for Rear Cylinder
- 19. Seal
- 20. Inlet Manifold
- 21. Throttle Body
- 22. Throttle Assy
- 23. ISC Valve #2 (for Rear Cylinder)
- 24. ISC Valve #1 (for Front Cylinder)
- 25. ECU (Electronic Control Unit)
- 26. Inlet Air Temperature Sensor
- 27. Right Air Cleaner Base
- 28. Vehicle-down Sensor
- 29. Battery Case
- 30. DFI Main Relay
- 31. Return Fuel Check Valve
- 32. Throttle Assy Holder
- 33. Second Lead Holder

2-8 FUEL SYSTEM (DFI)

Exploded View



Exploded View

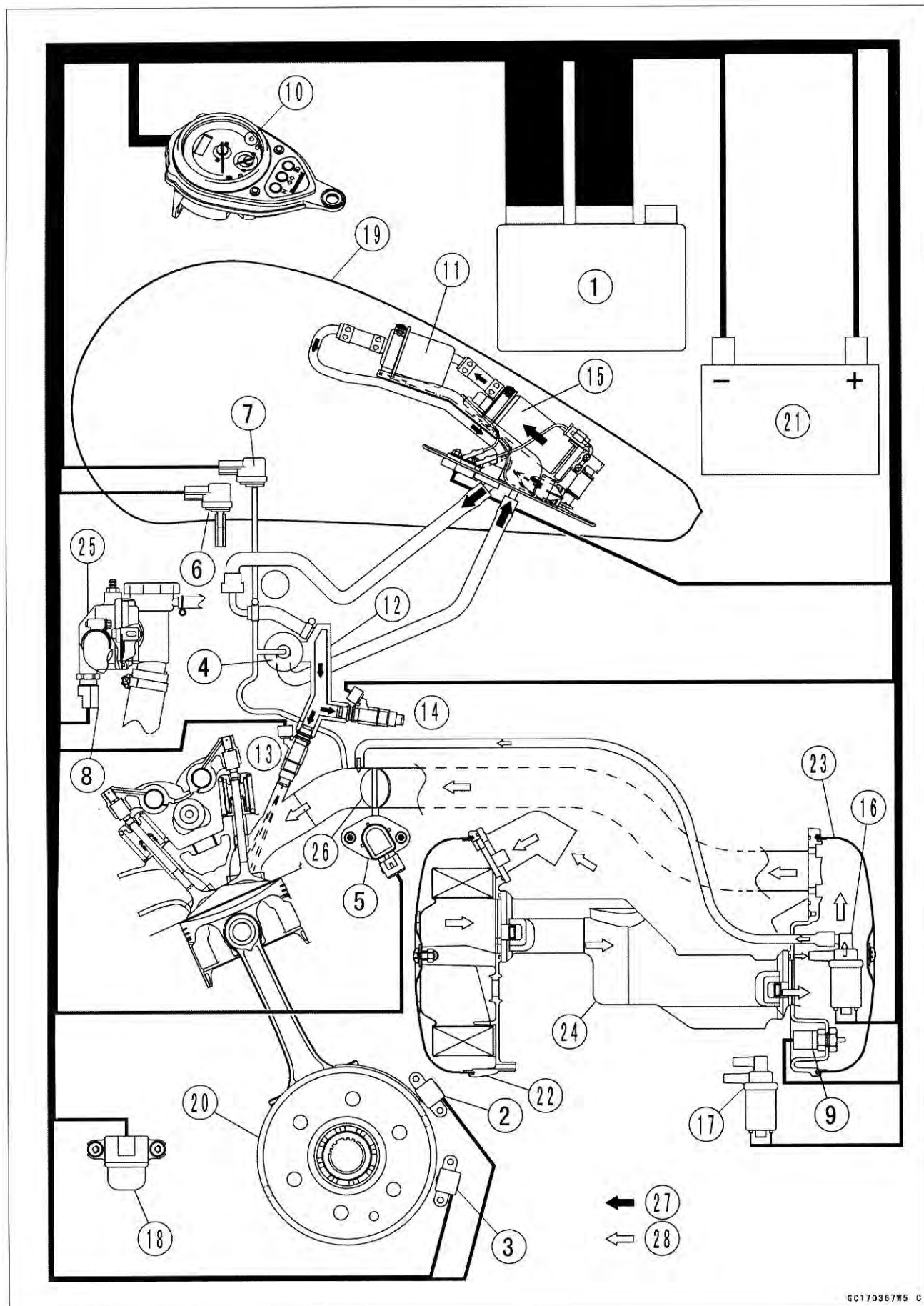
T1: 12 N·m (1.2 kg·m, 104 in·lb)
T2: 16 N·m (1.6 kg·m, 12 ft·lb)
T3: 2.2 N·m (0.22 kg·m, 19 in·lb)
T4: 9.8 N·m (1.0 kg·m, 87 in·lb)
T5: 18 N·m (1.8 kg·m, 13 ft·lb)
T6: 11 N·m (1.1 kg·m, 95 in·lb)
SS: Apply silicone sealant (Kawasaki Bond: 56019–120).

CA: California Model

1. Water Temperature Sensor (DFI)
2. Thermostat Housing
3. Fuel Tank
4. Vacuum Switch Valve
5. Oil Reserve Tank Hose
6. Throttle Assy
7. Air Cleaner Element
8. Left Air Cleaner Base
9. Right Air Cleaner Base
10. Air Cleaner Drain Hose
11. FI Indicator LED (Light Emitting Diode) Light
12. Throttle Assy Holder
13. Air Cleaner Duct Holder
14. Fuel Tank Cap Seal (CA)

2-10 FUEL SYSTEM (DFI)

DFI System

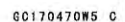


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DFI System

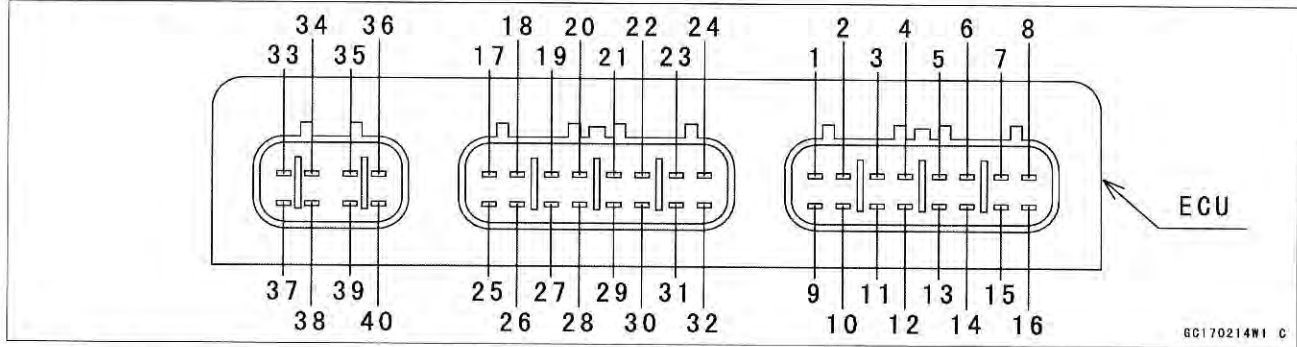
- #1: For Front Cylinder
- #2: For Rear Cylinder
 - 1. ECU (Electronic Control Unit)
 - 2. Pickup Coil #1
 - 3. Pickup Coil #2
 - 4. Pressure Regulator
 - 5. Throttle Sensor (front view)
 - 6. Atmospheric Pressure Sensor
 - 7. Vacuum Sensor
 - 8. Water Temperature Sensor
 - 9. Inlet Air Temperature Sensor
- 10. FI Indicator LED Light
- 11. In-tank Fuel Filter
- 12. Delivery Joint
- 13. Injector #1
- 14. Injector #2
- 15. In-tank Fuel Pump
- 16. ISC Valve #1 (Idle Speed Control Valve #1, rear side)
- 17. ISC Valve #2 (Idle Speed Control Valve #2, front side)
- 18. Vehicle-down Sensor (rear view)
- 19. Fuel Tank (left view)
- 20. Alternator Rotor (left view)
- 21. MF Battery (left view)
- 22. Left Air Cleaner Housing (rear view)
- 23. Right Air Cleaner Housing (rear view)
- 24. Lower Air Cleaner Duct (rear view)
- 25. Thermostat Housing (left view)
- 26. Throttle Valves
- 27. Fuel Flow
- 28. Air Flow

DFI Wiring Diagram



DFI Wiring Diagram

Terminal Numbers of ECU Connectors



Terminal Names

- #1: Front Cylinder
- #2: Rear Cylinder
- 1. Main Relay Solenoid Ground in ECU
- 2. ISC Valve #2 Output Signal
- 3. unused.
- 4. FI Indicator LED Light Output Signal
- 5. Vehicle-down Sensor Output Signal
- 6. Injector #2 Output Signal
- 7. Injector #1 Output Signal
- 8. Ignition Coil #1 Control Circuit Ground to Battery
- 9. Ignition Coil #1 Output Signal
- 10. ISC Valve #1 Output Signal
- 11. Electric Starter Button Output Signal
- 12. Interlock Circuit Output Signal
- 13. Fuel Pump Output Signal
- 14. Ignition Coil #2 Output Signal
- 15. Input Signal for Bulb Burned-out Check from ECU (for water temperature warning LED light, and fuel level indicator light)
- 16. Ignition Coil #2 Control Circuit Ground to Battery
- 17. Vacuum Sensor Output Signal
- 18. Inlet Air Temperature Sensor (+)
- 19. Water Temperature Sensor (+)
- 20. vacancy
- 21. Ground of Inlet Air Temperature, Water Temperature, Vacuum, Atmospheric Pressure, and Throttle Sensors
- 22. Pickup Coil #1 Output Signal
- 23. Pickup Coil #2 Output Signal
- 24. ECU Power Source Circuit Ground to Battery
- 25. Speed Sensor Output Signal
- 26. Throttle Sensor Output Signal
- 27. Atmospheric Pressure Sensor Output Signal
- 28. Power Supply to Sensors (vacuum, atmospheric pressure, and throttle sensors) from ECU
- 29. vacancy
- 30. vacancy
- 31. Power Supply to ECU, ISC Valves, Injectors, and Fuel Pump
- 32. ECU Power Source Circuit Ground to Battery (the same as 24)
- 33. 34. 35. 36. 38. 39. 40. unused.
- 37. Self-diagnosis Output Signal (generated by grounding this terminal and shown by FI indicator LED light)

DFI and Electrical Parts

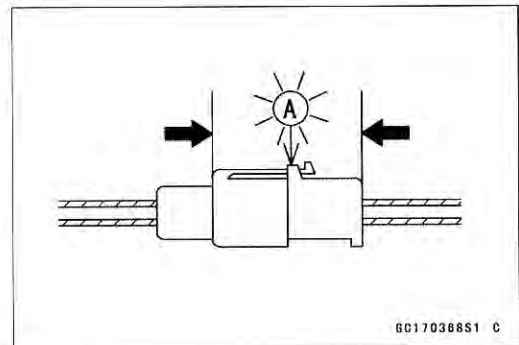
- DFI: DFI Parts
- ECU [A]: Electronic Control Unit (DFI)
- Engine Stop Switch [B]
- Starter Button [C]
- Ignition Coils [D]
- Pickup Coils [E]
- Junction Box [F]
- Starter Circuit Relay [G]
- Interlock Diodes [H]
- Diode [J] for water temperature warning LED light
- Diode [K] for fuel warning light
- FI Indicator LED Light [L]: (DFI)
- Speedometer [M]
- Ignition Switch [N]
- Starter Relay [O]
- Main Fuse 30 A × 32 V [P]
- MF Battery [Q]
- Fuel Injector #1 [R]: (DFI)
- Fuel Injector #2 [S]: (DFI)
- Fuel Reserve Switch [T]
- In-tank Fuel Pump [U]: (DFI)
- DFI Fuse 15 A × 32 V [V]: (for ECU, Injectors, In-tank Fuel Pump, DFI Main Relay, and ISC Valves)
- ISC Valve #2 [W]: (DFI)
- ISC Valve #1 [X]: (DFI)
- Inlet Air Temperature Sensor [Y]: (DFI)
- Water Temperature Sensor [Z]: (DFI)
- Vacuum Sensor [a]: (DFI)
- Atmospheric Pressure Sensor [b]: (DFI)
- Throttle Sensor [g]: (DFI)
- Vehicle-down Sensor [d]: (DFI)
- DFI Main Relay [e]: (for ECU, Injectors, In-tank Fuel Pump, and ISC Valves)
- Ignition Fuse 10 A × 32 V [f]
- Fuel Level Warning Light [h]
- Joint Connector [i]

2-14 FUEL SYSTEM (DFI)

DFI Servicing Precautions

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

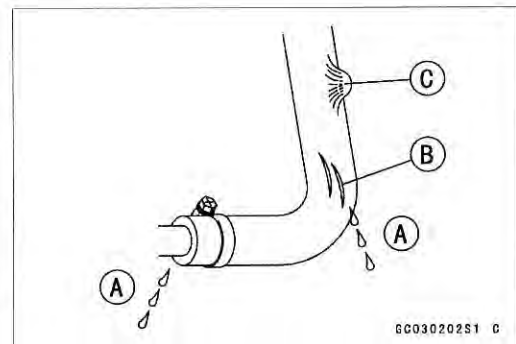
- This DFI system is designed to be used with a 12 V MF battery as its power source. Do not use any other battery except for a 12 V MF battery as a power source.
- Do not reverse the battery lead connections. This will damage the ECU.
- To prevent damage to the DFI parts, do not disconnect the battery 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 chassis ground.
- When charging, remove the battery from the motorcycle. This is to prevent ECU 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.
- Connect these connectors until they click [A].



- Do not turn the ignition SW ON while any of the DFI electrical connectors are disconnected. The ECU memorizes fault codes.
- Do not spray water on the electrical parts, DFI parts, connectors, leads, and wiring. Never water a vehicle with connectors unplugged because seals don't work and terminals could corrode.
- If a transceiver is installed on the motorcycle, make sure that the operation of the DFI system is not influenced by electric wave radiated from the antenna. Check operation of the system with the engine at idle. Locate the antenna as far as possible away from the ECU.
- To prevent corrosion and deposits in the fuel system, do not add any fuel antifreeze chemicals to fuel.
- When any fuel hose is disconnected, do not turn on the ignition SW. Otherwise, the fuel pump will operate and fuel will spout from the fuel hose.
- Do not operate the in-tank 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.

- The fuel hoses are designed to be used throughout the motorcycle's life without any maintenance, however, if the motorcycle is not properly handled, 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 fuel hose if any cracks [B] or bulges [C] are noticed.
- Route the hoses according to Cable, Wire, and Hose Routing section in the General Information chapter.
- 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.
- ★ Replace the hose if it has been sharply bent or kinked.



DFI Servicing Precautions

- 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]

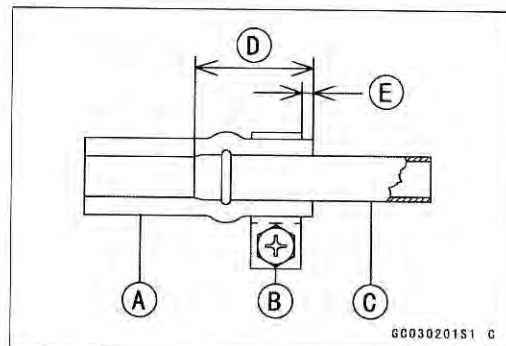
Clamp [B]

Fuel Pipe [C]

18 ~ 22 mm [D]

2 ~ 3 mm [E]

Torque - High Pressure Fuel Hose Clamp Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)



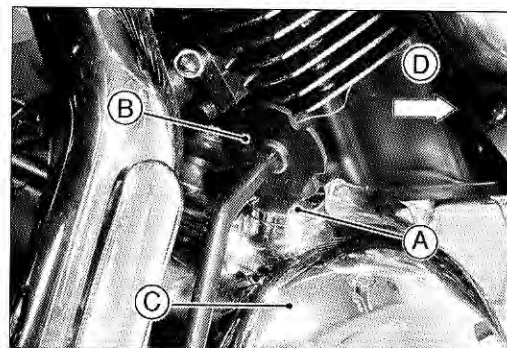
- To maintain the correct fuel/air mixture (F/A), there must be no inlet air leaks in the DFI system. Be sure to install the oil filler cap [A] after filling the engine oil, using the driver-filler cap [B].

Clutch Cover [C]

Front [D]

Special Tool - Driver-Filler Cap: 57001-1454

Torque - Oil Filler Cap: 1.5 N·m (0.15 kg·m, 13 in·lb)



2-16 FUEL SYSTEM (DFI)

Throttle Grip and Cables

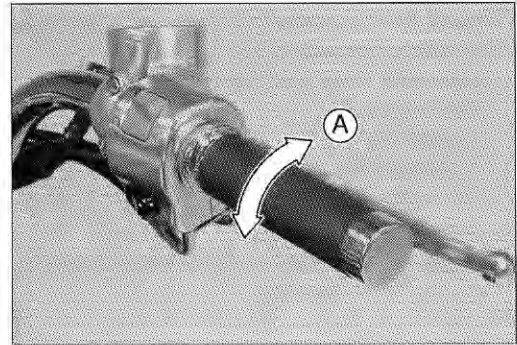
Throttle Grip Free Play Inspection

- Check the throttle grip free play [A].
- ★ If the free play is incorrect, adjust the throttle cable.

Throttle Grip Free Play

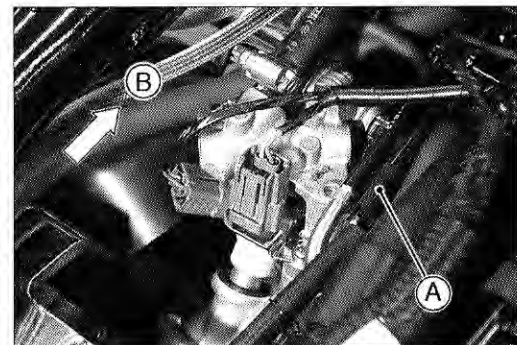
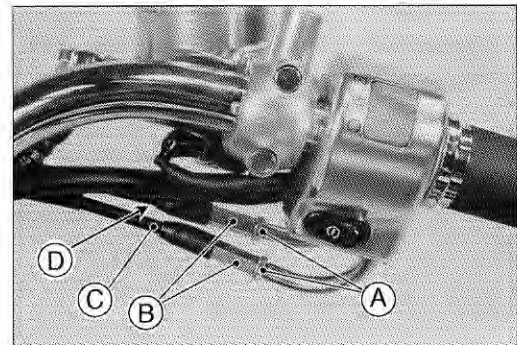
Standard: 2 ~ 3 mm

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



Throttle Grip Free Play Adjustment

- Loosen the locknuts [A] and screw the adjusters [B] all the way in so as to give the throttle grip plenty of play.
- Turn out the adjuster of the decelerator cable [C] until there is no play.
- Tighten the locknut against the adjuster.
- Turn the adjuster of the accelerator cable [D] until the proper amount of throttle grip free play is obtained and tighten the locknut against the adjuster.
- ★ If the proper amount of free play cannot be obtained by using the adjusters at the throttle grip, use the lower adjuster of the accelerator throttle cable.
- Give the throttle grip plenty of play by turning the adjusters at the grip in fully.
- Remove the fuel tank (see Fuel Tank Removal).
- Turn the lower accelerator cable adjuster [A] until the correct throttle grip free play is obtained and tighten the locknut against the adjuster.
- Front [B]
- ★ If the proper amount of free play can not be obtained with the lower adjuster, use the adjuster at the upper end of the accelerator cable again.



⚠ WARNING

Operation with incorrectly routed or improperly adjusted cables could result in an unsafe riding condition.

Throttle Cable Removal

- See Throttle Assy Removal in this chapter.

Throttle Cable Installation

- Route the throttle cables in accordance with the Cable, Wire, and Hose Routing section in the General Information chapter.
- Install the lower ends of the throttle cables in the bracket on the throttle pulley, and then install the upper ends of the throttle cables in the grip.
- Be sure to stake the cable clip against the cable holder (see Throttle Assy Installation).
- After Installation, adjust each cable properly.

⚠ WARNING

Operation with incorrectly routed or improperly adjusted cables could result in an unsafe riding condition.

Throttle Grip and Cables

Throttle Cable Lubrication and Inspection

- Whenever the cables are removed, or in accordance with the Periodic Maintenance Chart, lubricate the throttle cables (see General Lubrication in the Appendix chapter).
- Apply a thin coating of grease to the cable upper ends.
- Use a commercially available pressure cable lubricator to lubricate the cables.
- With the cable disconnected at both ends, the cable should move freely in the cable housing.

Choke Knob Operation

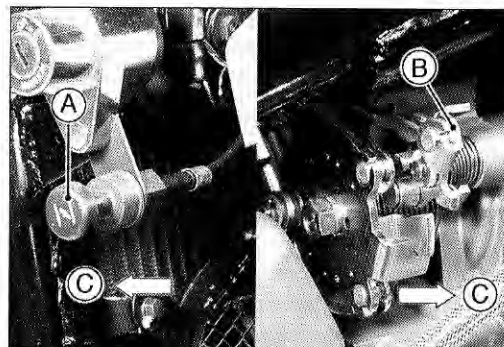
- Do not use the choke knob except when the engine has a starting difficulty, like in cold weather or at high altitude. The DFI system has an automatic choke system, using ISC valves, a water temperature sensor, and an atmospheric pressure sensor, which provide startability.

NOTE

- Pull the choke knob fully when using. The choke lever doesn't work with the choke knob halfway.
- When flooded, do not crank the engine with the throttle fully opened like a carburetor. This promotes engine flooding because more fuel is supplied automatically by the DFI system.

Choke Cable Free Play Inspection

- Choke cable free play cannot be adjusted.
 - Check that the choke inner cable slides smoothly by pulling and pushing the choke knob [A] lightly.
 - ★ If there is any irregularity, or the choke lever [B] doesn't work when the choke knob is pulled fully, replace the choke cable.
- Front [C]



Cable Removal/Installation

- See Throttle Assy section in this chapter for removal/installation of the throttle cables and choke cable.

Cable Lubrication and Inspection

- Whenever the choke cable or the throttle cables are removed or in accordance with the Periodic Maintenance Chart, lubricate these cables (see General Lubrication in the Appendix chapter).
- Use a commercially available pressure cable lubricator to lubricate these cables.
- With the cable disconnected at both ends, the cable should move freely in the cable housing.

2-18 FUEL SYSTEM (DFI)

Throttle Assy

Idle Speed Inspection

- Start the engine and warm it up thoroughly.
- At first the engine will run fast to decrease warm up time (fast idle).
- Gradually the fast idle will lower to a certain RPM automatically. This is the idle speed.
- Check the idle speed.
- ★ If the idle speed is out of the specified range, adjust it (see Idle Speed Adjustment).

Idle Speed

Standard: 950 ± 50r/min (rpm)

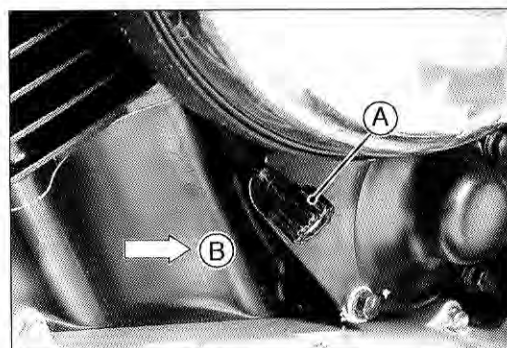
- With the engine idling, turn the handlebar to both sides.
- ★ If handlebar movement changes the idle speed, the throttle cables may be improperly adjusted or incorrectly routed, or damaged. Be sure to correct any of these conditions before riding (see Cable, Wire, and Hose Routing section in the General Information chapter).

⚠ WARNING

Operation with improperly adjusted, incorrectly routed, or damaged cables could result in an unsafe riding condition.

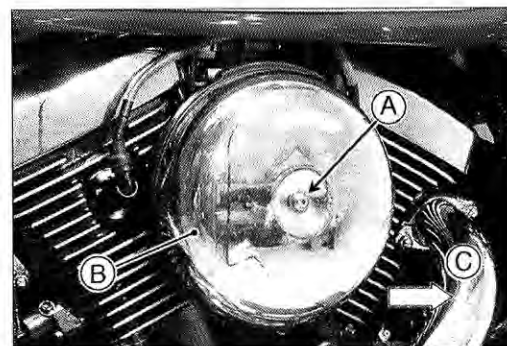
Idle Speed Adjustment

- Start the engine and warm it up thoroughly.
 - Wait until fast idle speed lowers to a certain value.
 - Turn the adjusting screw [A] until the idle speed is correct.
 - Open and close the throttle a few times to make sure that the idle speed is within the specified range. Readjust if necessary.
- Front [B]

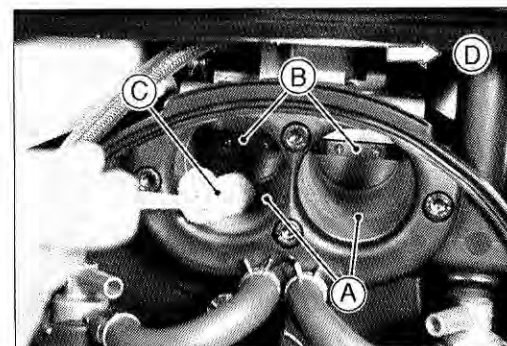


Throttle Bore Cleaning

- Remove the bolt [A] and take off the right air cleaner cover [B].
- Front [C]



- Check the throttle bores [A] at the butterfly valves [B] and around them for carbon deposits by opening the valves.
 - ★ If any carbon accumulates, wipe the carbon off the throttle bores around the butterfly valves, using a lint-free cloth [C] penetrated with a high-flash point solvent.
- Front [D]



Throttle Assy

High Altitude Performance Adjustment

- Any modification is not necessary in this model since the atmospheric pressure sensor senses atmospheric pressure change due to high altitude and the ECU compensates the change. (For reference: Mostly, Kawasaki recommends US carburetor models operated above 4000 feet, EPA - approved modification to improve the EMISSION CONTROL PERFORMANCE).

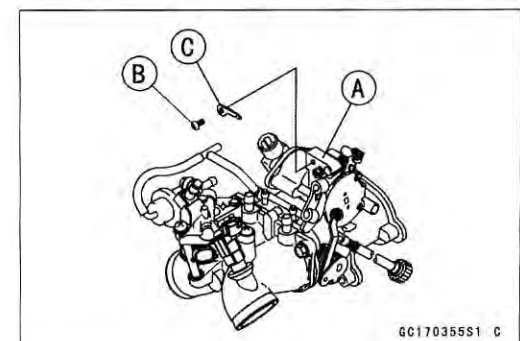
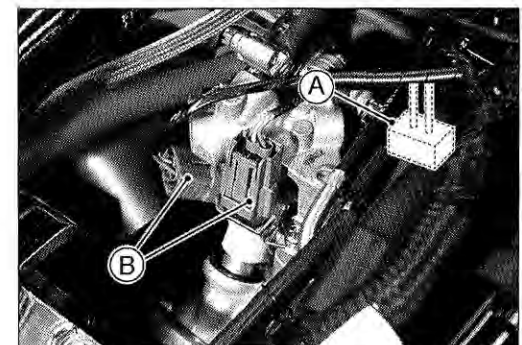
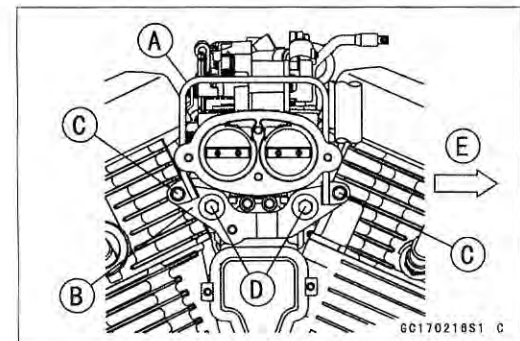
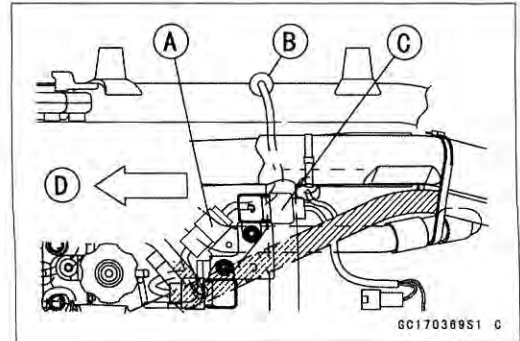
Throttle Assy Removal

- Remove the fuel tank (see this chapter).
- Remove the connector [A] of the inlet air temperature sensor [B].
Vacuum Sensor [C]
Front [D]

⚠ 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. Disconnect the battery (–) terminal. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.

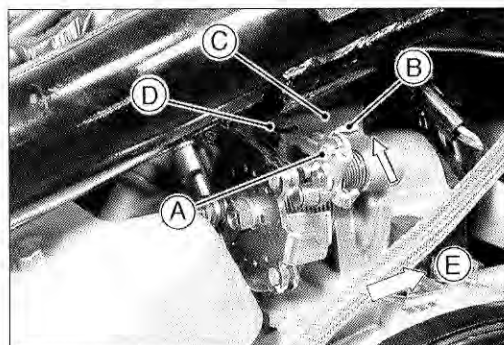
- Remove:
Right and Left Air Cleaner Base (see this chapter)
Ignition Coil Second Lead Holder Bolts [C]
Throttle Assy Holder Bolts [D]
Ignition Coil Second Lead Holder [A]
Throttle Assy Holder [B]
Front [E]
- Disconnect:
Throttle Sensor Connector [A] (from the throttle sensor)
Front and Rear Injector Connectors [B]
- Remove the following from the choke cable holder [A] (left-behind view).
Screw [B]
Choke Cable Plate [C]



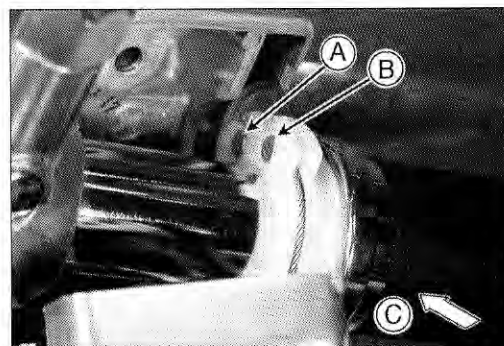
2-20 FUEL SYSTEM (DFI)

Throttle Assy

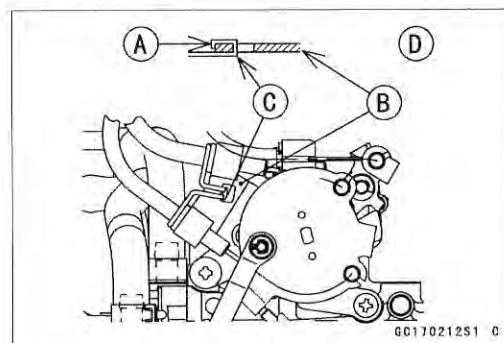
- While pushing the choke lever [B] forward, remove the cable housing from the choke cable holder [C] and the inner cable out of the holder slit [D].
- Take off the lower end [A] from the choke lever.
Front [E]



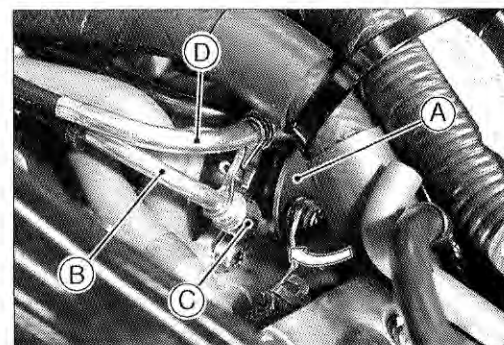
- Remove the screws and take off the right switch housing.
- Remove the accelerator cable end [A] and decelerator cable end [B] at the throttle grip.
Front [C]



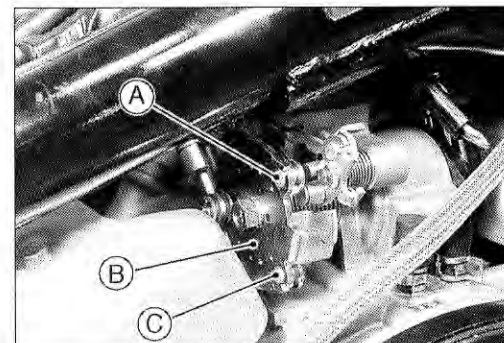
- Pry open the staking [A] on the cable holder [B], and remove the cable clip [C].
Rear View [D]



- Turn the throttle pulley [A] as shown, and pull out the accelerator cable housing [B] from the cable holder [C] (rear view).
- Return the pulley, and pull out the decelerator cable housing [D] from the cable holder.

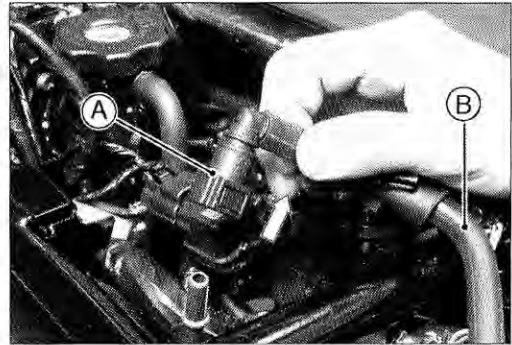


- Remove the decelerator cable end [A] from the throttle pulley [B].
- Using needle nose pliers, move the accelerator inner cable outside the engine, and remove the cable end [C] from the pulley.

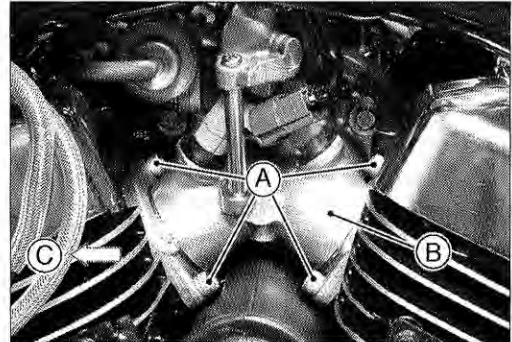


Throttle Assy

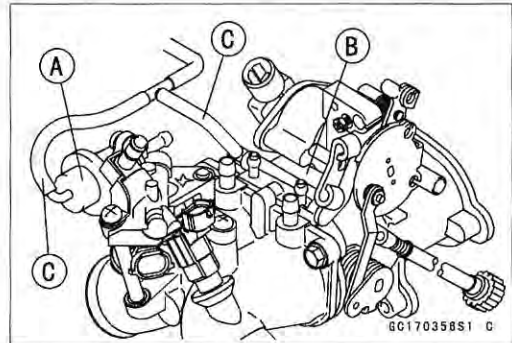
- Pinch the hose joint lock with your fingers, disconnect the joint [A] and take out the fuel hose assy [B].



- Unscrew the inlet manifold bolts [A].
Inlet Manifold [B]
Front [C]



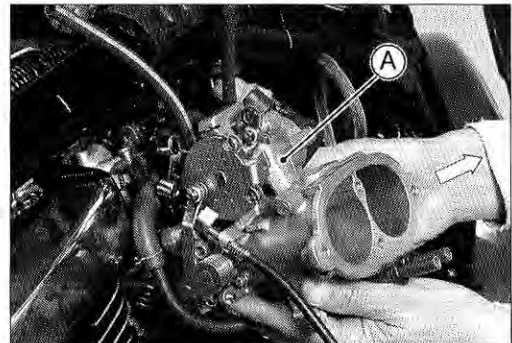
- Pull the vacuum hoses [C] off the pressure regulator [A] and the throttle body [B] (rear view).



- Take out the throttle assy [A] from the right side, while tilting it up.
- Be careful not to damage (dent, nick, flaw, and crack) the flange mating surface and the plastic parts.
- Do not drop the throttle assy, especially on a hard surface.

⚠ WARNING

The throttle assy should never be allowed to fall. Throttle may become stuck, possibly causing an accident.



- Stuff a piece of lint-free, clean cloth into the throttle assy, and the inlet ports of the cylinder heads to keep dirt out of the engine.

⚠ WARNING

If dirt or dust is allowed to pass through into the throttle bore, the throttle may become stuck, possibly causing an accident.

CAUTION

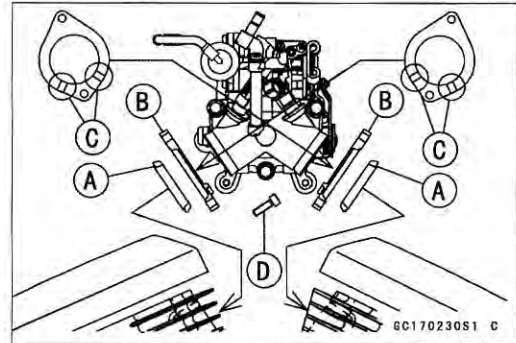
If dirt gets through into the engine, excessive engine wear and possibly engine damage will occur.

2-22 FUEL SYSTEM (DFI)

Throttle Assy

Throttle Assy Installation

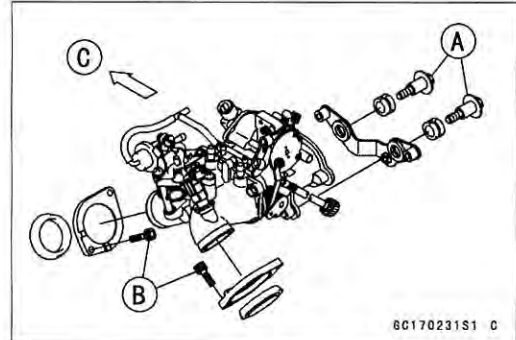
- Replace the flange seal [A] with a new one.
- With a high-flash point solvent, clean off the flange surface of the cylinder head and wipe dry.
- Install the flange [B] and the seal in the direction shown. Face the ribs [C] of the flange and the smaller diameter end upwards.
- The seal should be centered on the flange.
- Tighten the inlet manifold bolts [D] to a snug fit.



- First, tighten the throttle assy holder bolts [A], secondly the inlet manifold bolts [B] to the specified torque.

Front [C]

Torque - Throttle Assy Holder Bolts, Inlet Manifold Bolts: 12 N·m (1.2 kg·m, 104 in·lb)
Second Lead Holder Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

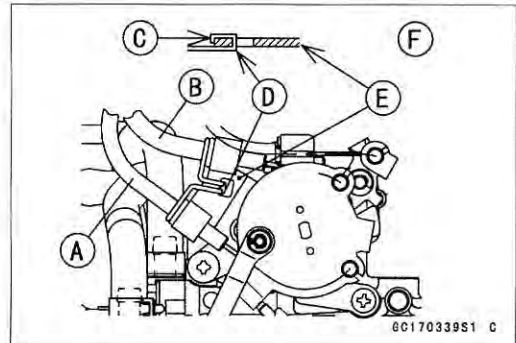


- Apply a thin coating of grease to the throttle cable upper ends.
- Install the lower ends of the throttle cables in the throttle pulley.
Accelerator Cable [A]
Decelerator Cable [B]
- Run the throttle cables correctly (see Cable, Wire, and Hose Routing section in the General Information chapter).
- Install the upper ends of the throttle cables in the grip.
- Turn the throttle grip and make sure that the throttle valves move smoothly and return by spring force.
- Check the throttle grip free play (see Throttle Grip Free Play Inspection).
- Stake [C] the cable clip [D] on the throttle cable holder [E].
Rear View [F]
- Install the lower end of the choke cable in the choke lever.

Non-permanent Locking Agent - Choke Cable Plate Screw

Torque - Choke Cable Plate Screw: 2.9 N·m (0.3 kg·m, 26 in·lb)

- Run the choke cable correctly (see Cable, Wire, and Hose Routing section in the General Information chapter).
- Check that the choke knob moves smoothly.



⚠ WARNING

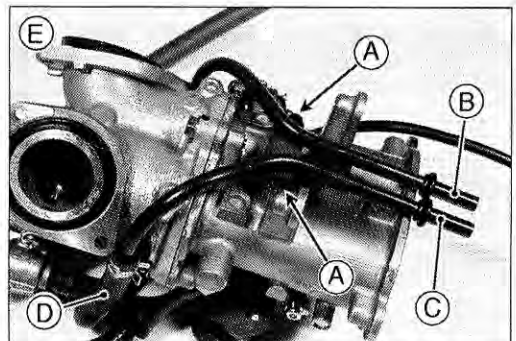
Operation with an incorrectly routed cable could result in an unsafe riding condition.

- Install the fuel tank and the air cleaner housing (see this chapter).

Throttle Assy Disassembly/Assembly

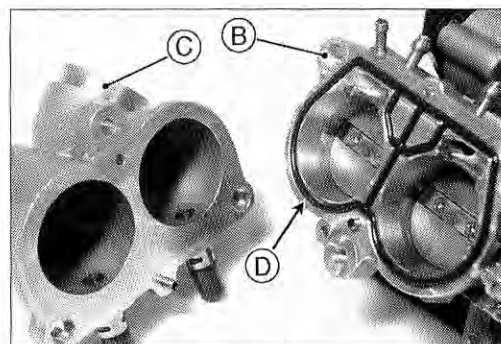
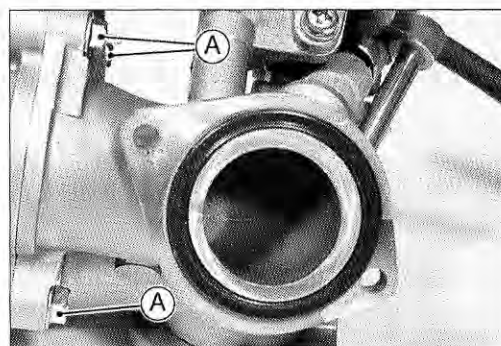
- Remove the throttle assy (see this chapter).
- Unscrew two bolts [A], and pull out the ISC pipe #1 [B], and ISC pipe #2 [C] from the hoses [D].

Bottom View [E]



Throttle Assy

- Remove the three throttle body flange bolts [A].
- Split the throttle assy into the throttle body [B] and the inlet manifold [C]. The gasket [D] comes off.
- Discard the gasket.



- Do not remove or adjust the following parts. These parts are set at the factory and cannot be readjusted.

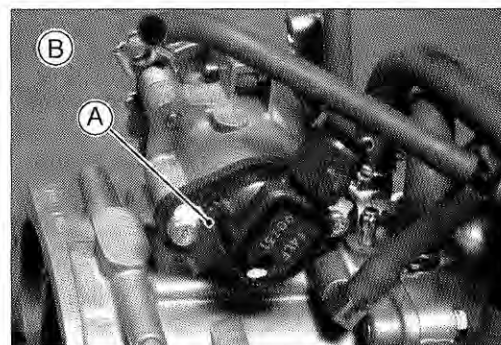
CAUTION

Adjustment of these parts could result in poor performance, requiring replacement of the throttle body.

Throttle Sensor [A]:

Turning the sensor body could spoil the ignition timing and injection quantity.

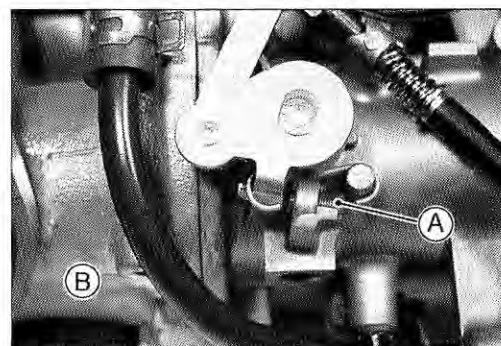
Front View [B]



Throttle Stop Screw [A]:

Tampering with this screw could spoil the idling performance since the screw sets the gap between the throttle valves and the throttle bore with throttle grip closed.

Rear View [B]



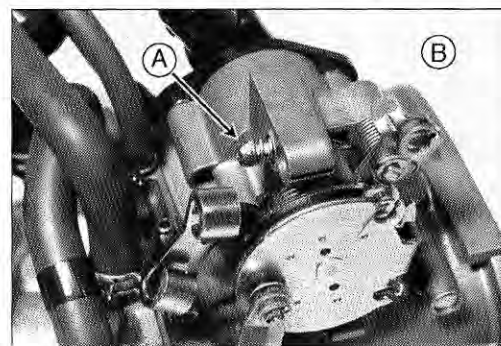
Choke Lever Stop Screw [A]:

This screw sets the throttle valve opening when the choke knob is pulled fully. Tampering with the screw could cause malfunction of the choke lever.

Rear View [B]

Throttle Valve and Throttle Shaft:

They are not allowed to remove because of difficulty of removal.



2-24 FUEL SYSTEM (DFI)

Throttle Assy

- Remove the delivery joint and injectors (see this chapter).
- Open the butterfly valves [A], and wipe any carbon off the throttle bores [B] around the valves, using a piece of lint-free cloth penetrated with a high-flash point solvent.
- Clean the bores [C] of the inlet manifold [D] as well.
- Blow away dirt or dust from the throttle body and the inlet manifold by applying compressed air.

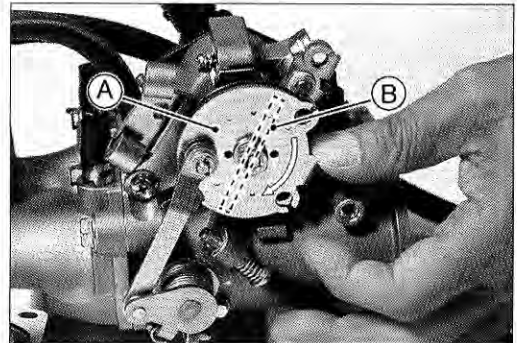
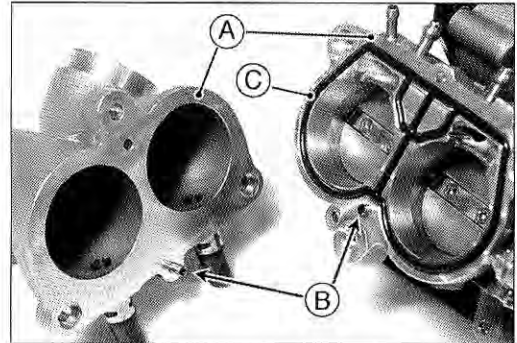
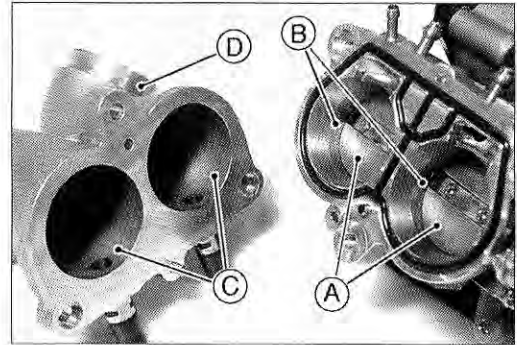
CAUTION

Do not immerse the throttle body (or throttle assy) in a high-flash point solvent for cleaning. This could damage the throttle sensor on the throttle body.

- Before assembly, visually inspect the mating surfaces [A] for any damage, like dent, nick, rust, flaw, and crack.
- Nick or rust damage can sometimes be repaired by using emery paper (first No. 200, then 400) to remove sharp edges or raised areas.
- ★ If the damage is not repairable, replace the throttle body and/or the inlet manifold to prevent leakage.
- With a high-flash point solvent, clean off the mating surfaces and wipe dry.
- Be sure to install the dowel pins [B].
- Fit the new gasket [C] into the groove. Be careful not to pinch the gasket between the mating surfaces.
- Tighten the flange bolts evenly.

Torque - Throttle Body Flange Bolts: 4.9 N·m (0.5 kg·m, 43 in·lb)

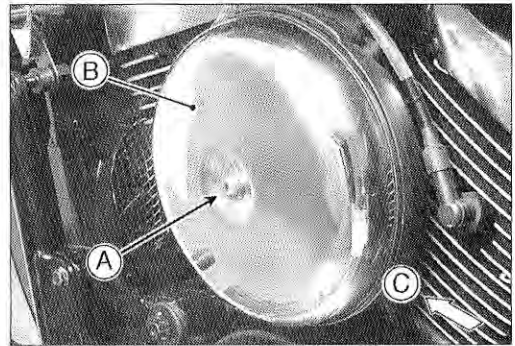
- Turn the throttle pulley [A] to check that the throttle valves [B] move smoothly and return by spring force.
- ★ If the throttle valves do not move smoothly, replace the throttle body.



Air Cleaner

Element Removal

- Remove:
 - Allen Bolt and Washer [A]
 - Left Air Cleaner Cover [B]
 - Front [C]



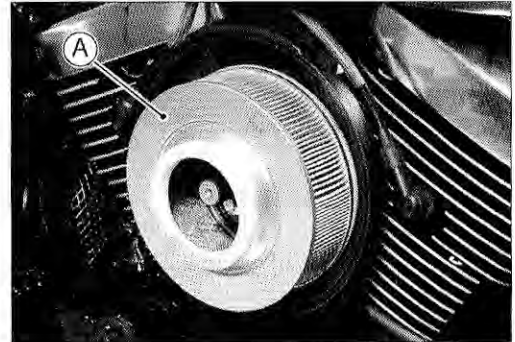
- Remove the element [A].
- Push a clean, lint-free towel into the lower air cleaner duct to keep dirt or other foreign material from entering.

WARNING

If dirt or dust is allowed to pass through into the throttle assy, the throttle may become stuck, possibly causing accident.

CAUTION

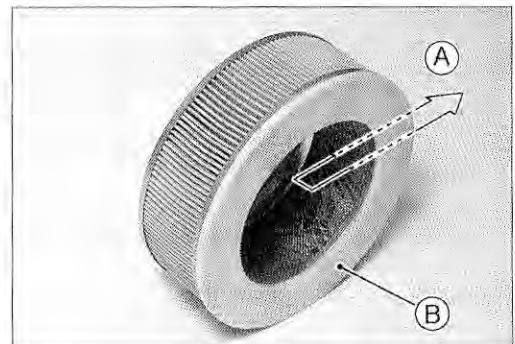
If dirt gets through into the engine, excessive engine wear and possibly engine damage will occur.



Element Cleaning and Inspection

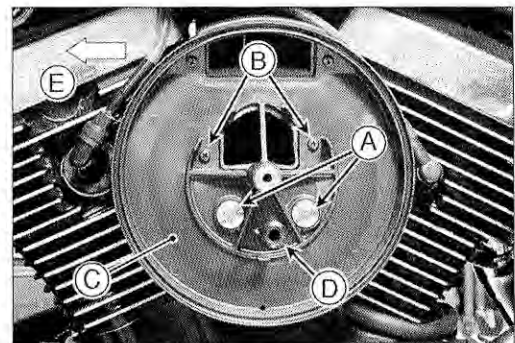
NOTE

- In dusty areas, the element should be cleaned more frequently than the recommended interval.
- After riding through rain or on muddy roads, the element should be cleaned immediately.
- Remove the air cleaner element (see Element Removal).
- Clean the element by tapping it lightly to loosen dust.
- Blow away the remaining dust by applying compressed air [A] from the inside to the outside (from the clean side to the dirty side).
- Visually check the element for no tears or no breaks and check the sponge gasket [B] also.
- ★ If the element or gasket has any tears or breaks, replace the element.



Left Air Cleaner Housing Removal/Installation

- Remove:
 - Air Cleaner Element (see Air Cleaner Element Removal)
 - Air Cleaner Base Bolts [A] and Screws [B]
- Remove the air cleaner base [C] and pull out the evaporative emission hose [D] (California Model).
- Front [E]



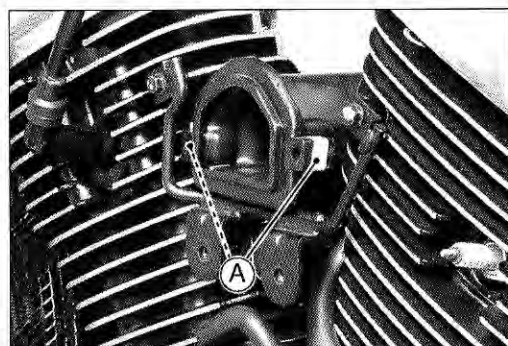
2-26 FUEL SYSTEM (DFI)

Air Cleaner

- Be careful not to lose the air cleaner base mounting nuts [A]. These nuts and lower air cleaner duct are sold as a unit.

Non-permanent Locking Agent - Air Cleaner Base Screws

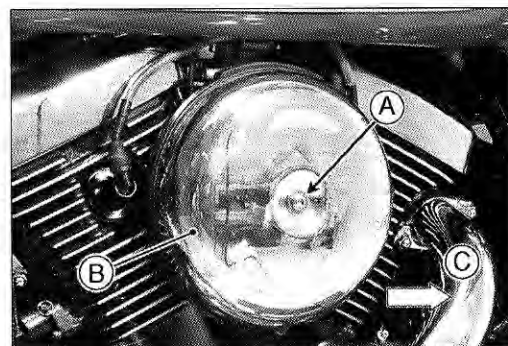
- Torque -**
- Left Air Cleaner Base Bolts:** 12 N·m (1.2 kg·m, 104 in·lb)
 - Left Air Cleaner Base Screws:** 2.2 N·m (0.22 kg·m, 19 in·lb)
 - Left Air Cleaner Cover Allen Bolt:** 16 N·m (1.6 kg·m, 12 ft·lb)



Right Air Cleaner Housing Removal

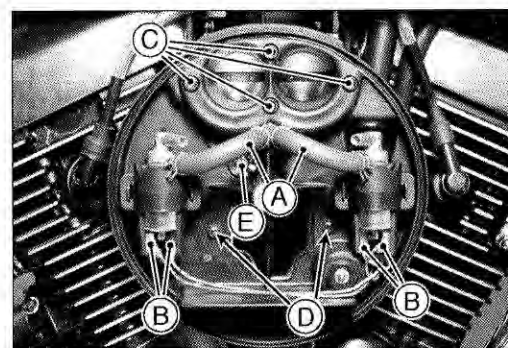
- Remove:

- Allen Bolt and Washer [A]
- Right Air Cleaner Cover [B]
- Front [C]



- Remove:

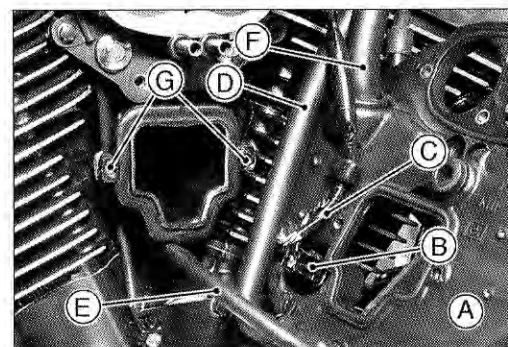
- ISC Valve Hoses [A]
- ISC Valve Connectors [B]
- Air Cleaner Allen Bolts [C] and Screws [D]
- Air Cleaner Base Bolt [E]



- Remove:

- Air Cleaner Base [A]
- Inlet Air Temperature Sensor Connector [B]
- ISC Valve Leads [C]
- Oil Reserve Tank Hose [D]
- Air Cleaner Drain Hose [E] (separate from the base [A])
- Vacuum Switch Valve Air Hose [F]

- Be careful not to lose the air cleaner base mounting nuts [G]. These nuts and lower air cleaner duct are sold as a unit.



Right Air Cleaner Housing Installation

- Check to see that the seals [A], [B] and the ISC pipe O-rings [C] are in place.

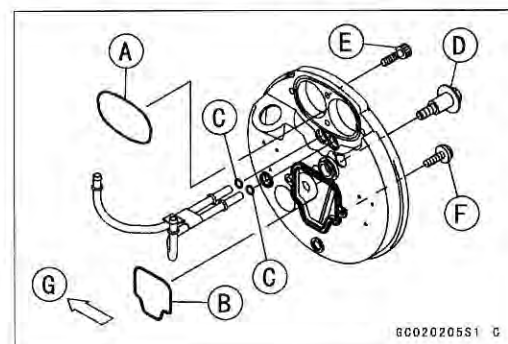
Non-permanent Locking Agent - Right Air Cleaner Base Screws

- Tighten:

Torque -

- Right Air Cleaner Base Bolt [D]:** 12 N·m (1.2 kg·m, 104 in·lb),
- Right Air Cleaner Allen Bolts [E]:** 11 N·m (1.1 kg·m, 95 in·lb),
- Right Air Cleaner Base Screws [F]:** 2.2 N·m (0.22 kg·m, 19 in·lb)

Front [G]



6C02020551 0

Air Cleaner

★ If the air cleaner drain hose [A] has been removed with it attached to the right air cleaner base, pull the drain hose off the right air cleaner base. Remove the left air cleaner base and insert the drain hose under the lower air cleaner duct.

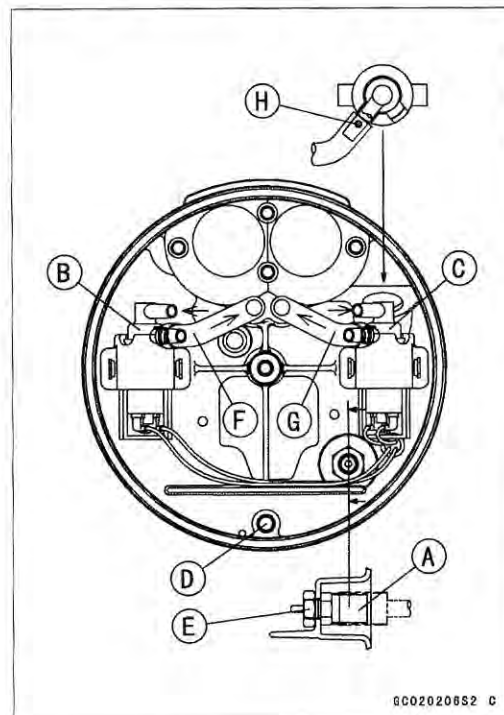


- Install the inlet air temperature sensor [A], the ISC valve #1 [B], ISC valve #2 [C], and the oil reserve tank hose [D].

Torque - Inlet Air Temperature Sensor Nut [E]: 7.8 N·m (0.80 kg·m, 69 in·lb)

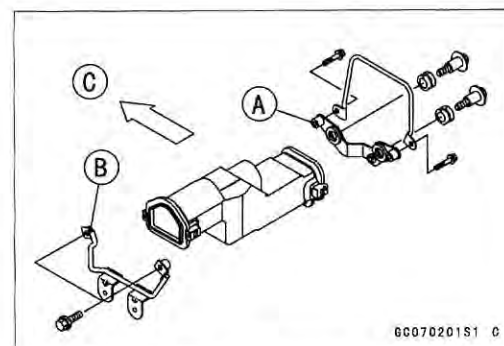
- The ISC valve #1 is connected to W/R and G/Y leads, and the hose [F] marked red.
- The ISC valve #2 is connected to W/R and G/BL leads, and the hose [G] marked blue.
- The ISC valve #1 and #2 are the same parts.
Top Marks [H]

Torque - Right Air Cleaner Cover Allen Bolt: 16 N·m (1.6 kg·m, 12 ft·lb)

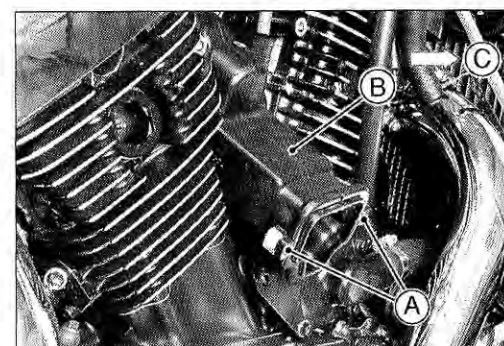


Lower Air Cleaner Duct Removal

- Remove:
 - Right and Left Air Cleaner Housing (see this chapter)
 - Throttle Assy Holder [A]
 - Air Cleaner Duct Holder [B]
 - Throttle Assy (see this chapter)
 - Inlet Manifold (see this chapter)
 - Front [C]



- Remove:
 - Right and Left Air Cleaner Base Mounting Nuts [A]
 - Lower Air Cleaner Duct [B]
 - Front [C]



2-28 FUEL SYSTEM (DFI)

Fuel Tank

Fuel Tank Removal

⚠ 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. Disconnect the battery (-) terminal.

To avoid fire, do not remove the fuel tank when the engine is still hot. Wait until it cools down.

To make fuel spillage minimum, draw the fuel out from the fuel tank with a pump as much as possible when the engine is cold. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.

- Turn both ignition switch, and engine stop switch OFF.
- Wait until the engine cools down.
- Open the fuel tank cap [A] to lower the pressure in the tank, and draw the fuel out from the fuel tank with a commercially available pump. Front [B]

⚠ WARNING

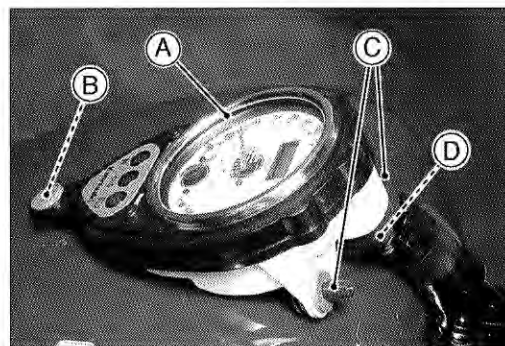
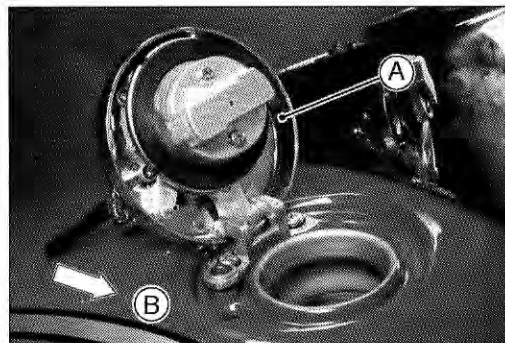
The fuel cannot be removed completely from the fuel tank. Be careful for remained fuel spillage.

- Remove the Allen bolt [A], push the cover [B] forward a little, and take it off from the meter unit.

- Raise the tail [B] of the meter unit [A], and then push the meter unit forward to take it off from the front and rear pins [C]. The meter unit comes off.
- Slide the dust cover [D] out and disconnect the meter connector.

CAUTION

Place the meter so that the face is up. If a meter is left upside down or sideways for any length of time, it will malfunction.

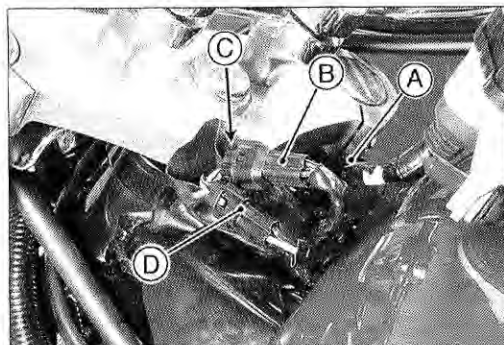


Fuel Tank

- Remove:
Band [A]

NOTE

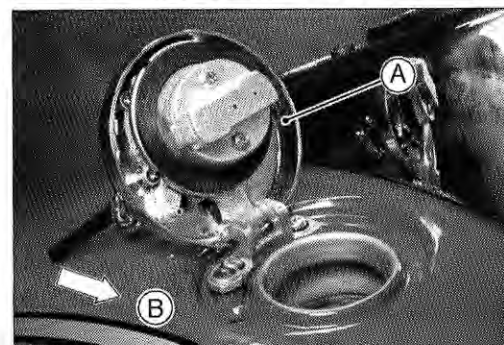
- To disconnect the fuel pump connector [B] (black, 4P), pull the outer lock [C] up.
- Fuel Level Sensor Connector [D]



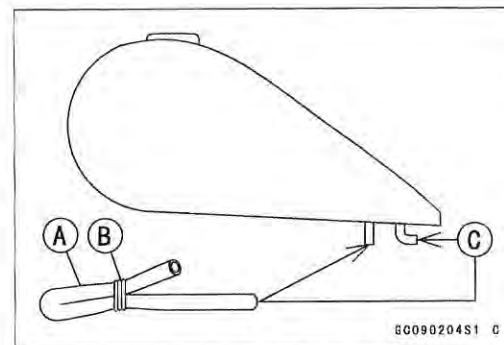
- Remove:
Seat (see Frame chapter)
Fuel Tank Bolt [A]
Fuel Tank Nut [B]
- Disconnect the battery (–) terminal.

NOTE

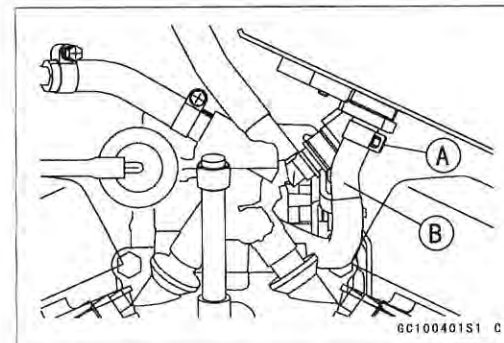
- During tank removal, keep the fuel tank cap [A] open to release pressure in the fuel tank. This makes fuel spillage less.
- Front [B]



- Prepare rubber hoses of the inside diameter 5 ~ 5.8 mm (e.g. Rubber Tube: Part No. 92191-1272) × L about 80 mm and make plug hoses [A] of the rubber hose with one end tied with a wire [B].
- Raise the rear of the tank up, and disconnect the hoses on the bottom.
- Plug these pipes [C] with plug hoses to prevent fuel spillage.



- While lifting the rear of the tank up, stuff a clean shop towel around the fuel inlet fuel hose [B] so that the fuel doesn't leak onto the engine top.
- Slide down the plate clamp [A] and pull the inlet hose off the fuel tank.



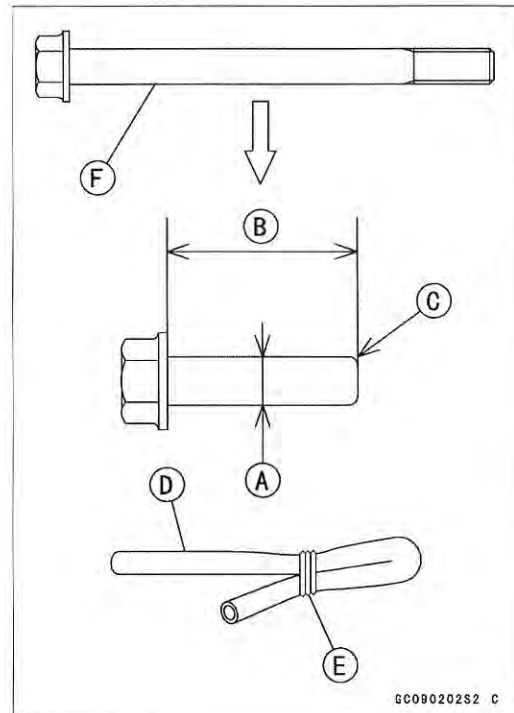
2-30 FUEL SYSTEM (DFI)

Fuel Tank

- Prepare a $\phi 8$ mm plug ($\phi 7.8 \sim 8.0$ mm [A] $\times$ L 35 mm [B] with a rounded end [C]), and a 7.3 $\sim$ 7.5 mm inside diameter fuel hose [D] (e.g. Part No. 92191-1264).
- The $\phi 8$ mm plug can be made by cutting the threaded portion off a $\phi 8$ mm bolt [F] (e.g. Part No. 92151-1444).
- Make a plug hose $\times$ L about 100 mm of the fuel hose with one end tied with a wire [E]. Do not leave the threaded portion.

WARNING

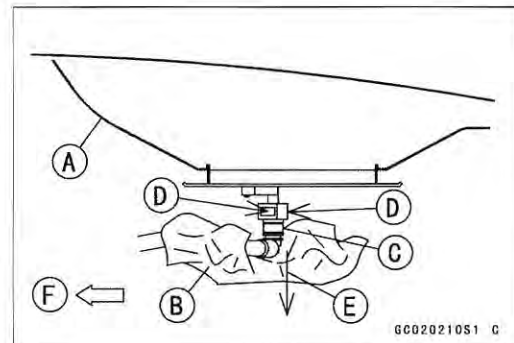
Check the outer circumference of the $\phi 8$ mm plug for no threads, no burrs, no sharp edges, and no rust. Since these defects spoil the O-rings in the fuel hose joint, causing fuel leak and leading to accident.



- Raise the fuel tank [A] up, and make sure that the shop towel [B] is around the fuel outlet hose joint [C].
- A person should pinch the hose joint locks [D] with fingers, disconnect the joint [E], and quickly plug the tank outlet pipe with the plug hose, while another person should plug the joint with the $\phi 8$ mm plug [G].
- Remove the fuel outlet hose, and quickly install the plug hose, and $\phi 8$ mm plug.

WARNING

Immediately wipe up fuel that spills.



- Close the fuel tank cap.
- Remove the fuel tank from the vehicle, and place it on a flat surface.

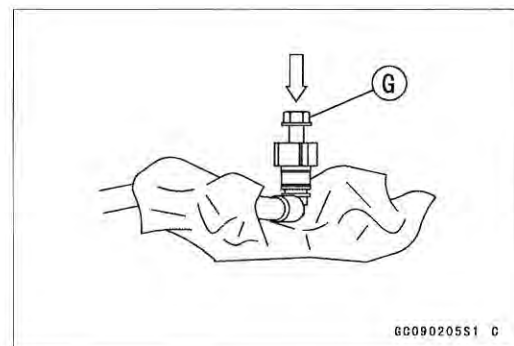
CAUTION

For California model, if gasoline, solvent, water or any other liquid enters the canister, the canister's vapor absorbing capacity is greatly reduced. If the canister does become contaminated, replace it with a new one.

- For California Model, note the following:
- To prevent the gasoline from flowing into or out of the canister, hold the separator perpendicular to the ground.
- Be sure to plug the return hose to prevent fuel spilling before fuel tank removal.

WARNING

For California model, be careful not to spill the gasoline through the return hose. Spilled fuel is hazardous.



- ★ If liquid or gasoline flows into the breather hose, remove the hose and blow it clean with compressed air (California model).

Fuel Tank

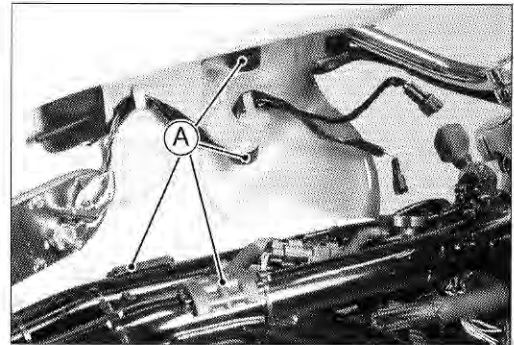
- Be careful of fuel spillage from the fuel tank since fuel still remains in the fuel tank and fuel pump.

⚠ WARNING

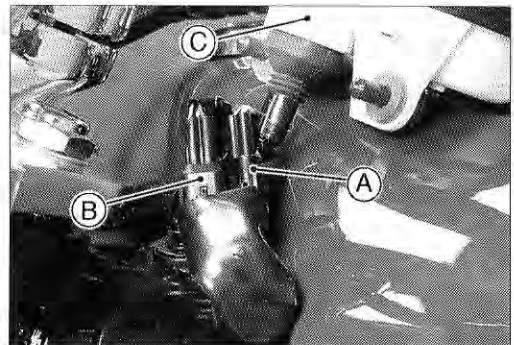
Store the fuel tank in an area which is well-ventilated and free from any source of flame or sparks. Do not smoke in this area. Place the fuel tank on a flat surface and plug the fuel pipes to prevent fuel leakage.

Fuel Tank Installation

- Read the above WARNING.
- Route the hoses correctly (see General Information chapter).
- For California Model, note the following:
 - To prevent the gasoline from flowing into or out of the canister, hold the separator perpendicular to the ground.
 - Connect the hoses according to the diagram of the system (see the last page of this chapter or Cable, Wire, and Hose Routing section in the General Information chapter). Make sure they do not get pinched or kinked.
 - Route hoses with a minimum of bending so that the air or vapor will not be obstructed.
- Check that the rubber dampers [A] are in place.
- ★ If the dampers are damaged or deteriorated, replace them.
- Remove the plug hoses, and $\phi 8$ mm plug, then quickly install the fuel hoses one by one.
- Be sure the hoses are clamped securely to prevent leakage.

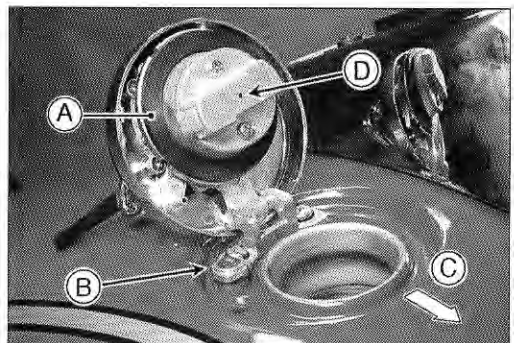


- Connect:
 - Fuel Level Sensor Connector [A]
 - Fuel Pump Connector [B]
 - Battery (-) Lead Connector
- Install the meter unit [C] (see Electrical System chapter).



Fuel Tank and Cap Inspection

- Visually inspect the gasket [A] on the tank cap for any damage.
- ★ Replace the gasket if it is damaged.
- Check to see if the breather pipe [B] in the tank is not clogged.
- ★ If the breather pipe is clogged, blow the breather free with compressed air.
- ★ If the tank cap breather is clogged, replace the tank cap.
- Front [C]



CAUTION

Do not apply compressed air to the air vent holes [D] in the tank cap. This could damage and clog the labyrinth in the cap.

2-32 FUEL SYSTEM (DFI)

Fuel Tank

Fuel Tank Cleaning

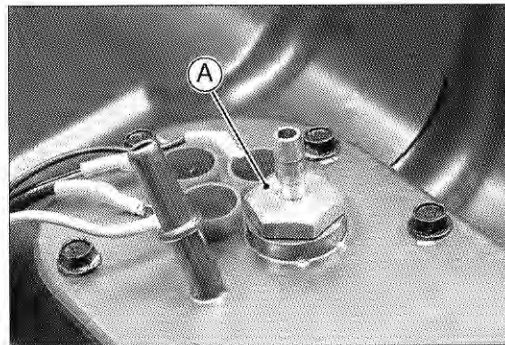
⚠ WARNING

Clean the tank in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvent to clean the tank.

- Remove the fuel tank (see this chapter).
- Remove the fuel pump and the return fuel check valve from the fuel tank (see In-tank Fuel Pump section in this chapter).
- Fill the fuel tank with some high-flash point solvent, and shake the tank to remove dirt and fuel deposits.
- Draw the solvent out of the tank.
- Dry the tank with compressed air.
- Install the return fuel check valve (see Return Fuel Check Valve Inspection) and the fuel pump on the fuel tank (see this chapter).
- Install the fuel tank (see Fuel Tank Installation).

Return Fuel Check Valve Inspection

- Remove the fuel tank (see this chapter).
- Place the fuel tank upside down.
- Unscrew the check valve [A].



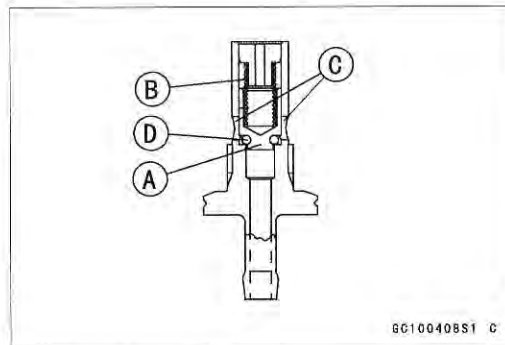
- Check to see if the valve [A] slides smoothly when pushing it in with a wooden or other soft rod, and see if it comes back to its seat by pressure of the spring [B].

NOTE

- Inspect the valve in its assembled state. Disassembly and assembly may change the valve performance.

CAUTION

Do not try to move the valve through the side hole [C]. This could damage the O-ring [D], or spoil the valve operation.



66100408S1 C

- ★ If any rough spots are found during above inspection, wash the valve clean with a high-flash point solvent and blow out any foreign particles that may be in the valve with compressed air in a well-ventilated area.
- Take care that there is no spark or flame anywhere near the working area.
- ★ If cleaning does not solve the problem, replace the check valve as an assembly along with the gasket.

Torque - Return Fuel Check Valve: 20 N·m (2.0 kg·m, 14 ft·lb)

Evaporative Emission Control System

The Evaporative Emission Control System for California Model routes fuel vapors from the fuel system into the running engine or stores the vapors in a canister when the engine is stopped. Although no adjustments are required, a thorough visual inspection must be made at the intervals specified by the Periodic Maintenance Chart.

Parts Removal/Installation

⚠ 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.

CAUTION

If gasoline, solvent, water or any other liquid enters the canister, the canister's vapor absorbing capacity is greatly reduced. If the canister does become contaminated, replace it with a new one.

- To prevent the gasoline from flowing into or out of the canister, hold the separator perpendicular to the ground.
- Be sure to plug the return hose to prevent fuel spilling before fuel tank removal.

⚠ WARNING

When removing the fuel tank, be careful not to spill the gasoline through the return hose. Spilled fuel is hazardous.

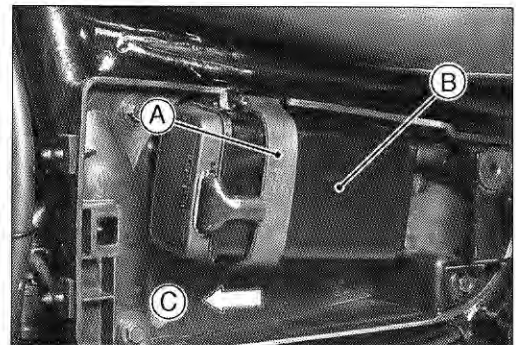
- ★ If liquid or gasoline flows into the breather hose, remove the hose and blow it clean with compressed air.
- Connect the hoses according to the diagram of the system (see the last page of this chapter or Cable, Wire, and Hose Routing section in the General Information chapter). Make sure they do not get pinched or kinked.
- Route hoses with a minimum of bending so that the air or vapor will not be obstructed.

Canister Inspection (Periodic Inspection)

- Remove the left side cover and the tool box (see Frame chapter).
- Remove the band [A] and take out the canister [B].
- Visually inspect the canister for cracks and other damage.
- ★ If the canister has any cracks or bad damage, replace it with a new one.

NOTE

- The canister is designed to work well through the motorcycle's life without any maintenance if it is used under normal conditions.
- Install the canister parallel to the ground.
Front [C]



Hose Inspection (Periodic Inspection)

- Check that the hoses are securely connected.
- Replace any kinked, deteriorated or damaged hoses.

Separator Inspection (Periodic Inspection)

- Disconnect the hoses from the liquid/vapor separator, and remove the separator from the motorcycle.
- Visually inspect the separator for cracks and other damaged.
- ★ If the separator has any cracks or damage, replace it with a new one.

2-34 FUEL SYSTEM (DFI)

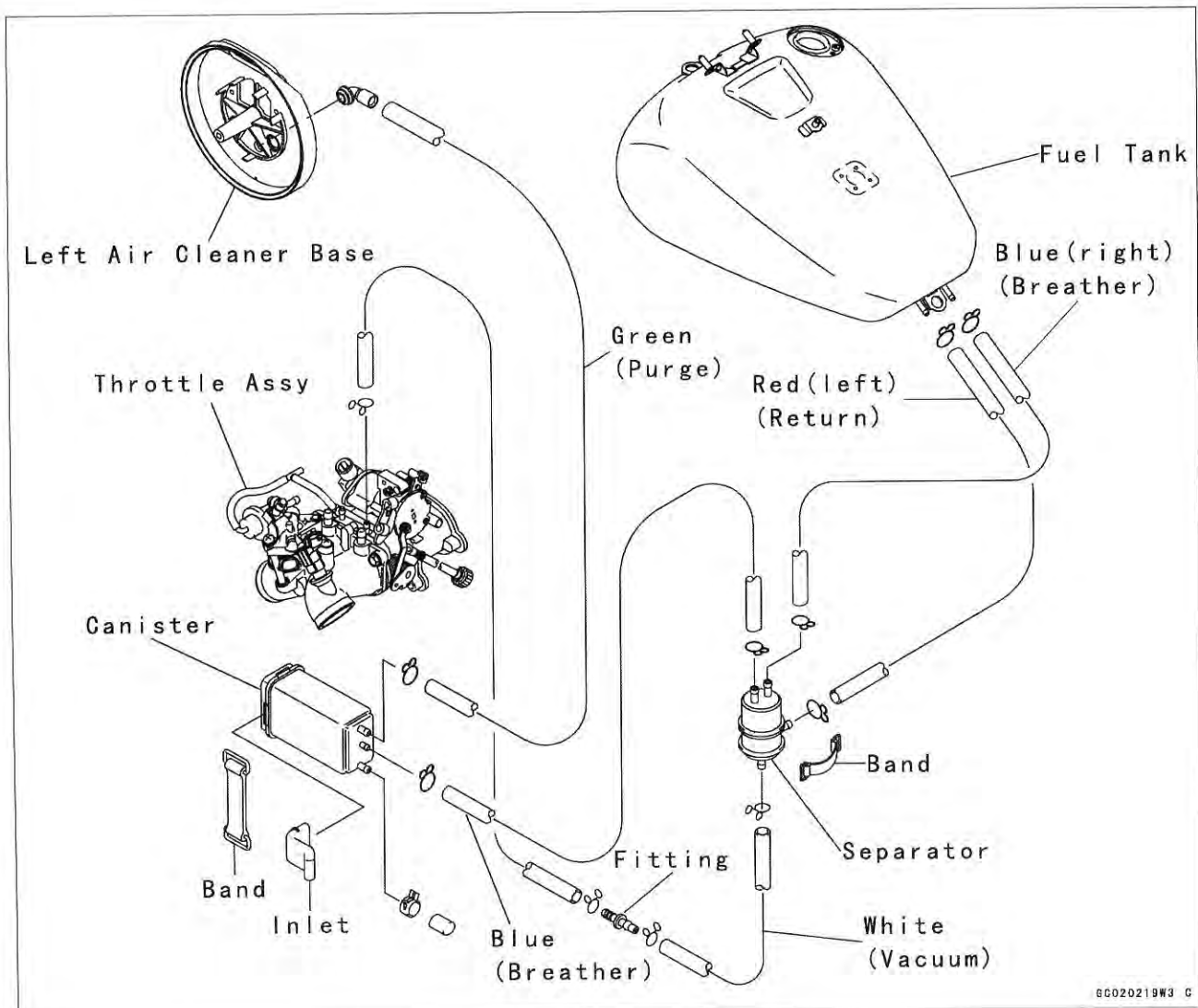
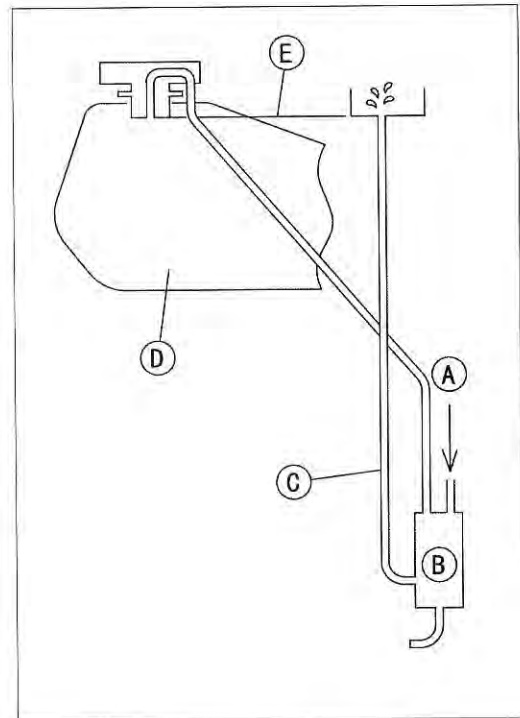
Evaporative Emission Control System

Separator Operation Test

⚠ 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.

- Remove the front seat and left side cover (see Frame chapter).
- Connect the hoses to the separator.
- Disconnect the breather hose from the separator, and inject about **20 mL** of gasoline [A] into the separator [B] through the hose fitting.
- Disconnect the fuel return hose [C] from the fuel tank [D].
- Run the open end of the return hose into the container level with the tank top [E].
- Start the engine, and let it idle.
- ★ If the gasoline in the separator comes out of the hose, the separator works well. If it does not, replace the separator with a new one.



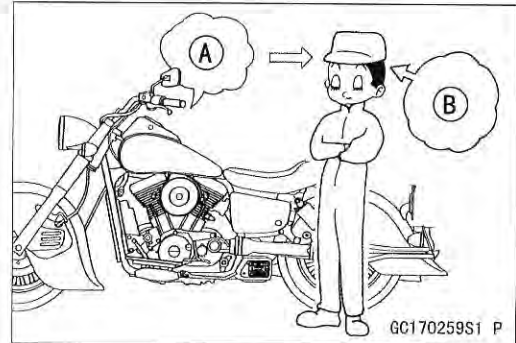
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Troubleshooting the DFI System

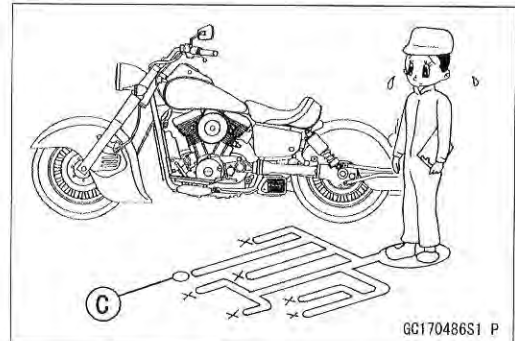
Outline

When an abnormality in the system occurs, the FI indicator LED (Light Emitting Diode) light goes on to alert the rider on the meter panel. In addition, the condition of the problem is stored in the memory of the ECU (electronic control unit). With the engine stopped and turned in the self-diagnosis mode, the fault code [A] is indicated by the number of times the FI indicator LED light blinks.

When due to a malfunction, the FI indicator LED light remains lit, ask the rider about the conditions [B] under which the problem occurred and try to determine the cause [C]. Don't rely solely on the DFI self-diagnosis function, use common sense; first conduct a pre-diagnosis inspection, check the ECU for ground and power supply, the fuel line for no fuel leaks, and for correct pressure. The pre-diagnosis items are not indicated by the FI indicator LED light.



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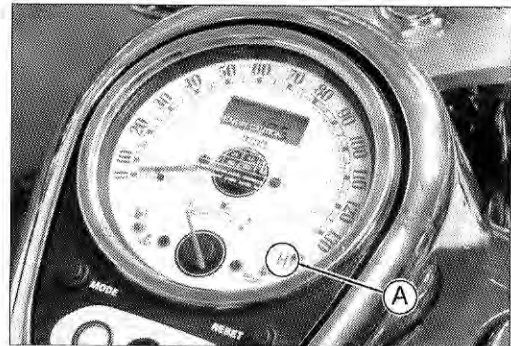
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Even when the DFI system is operating normally, the FI indicator LED light [A] may light up under strong electrical interference. No remedy needed. Turn the ignition SW (switch) OFF to stop the indicator light.

When the FI indicator LED light goes on and the motorcycle is brought in for repair, check the fault codes.

When the repair has been done, the LED light will not show the fault code any more.

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



- When checking the DFI parts, use a digital meter which can be read two decimal places voltage or resistance.
- The DFI part connectors [A] have seals [B], including the ECU (except for ISC valves). When measuring the input or output voltage with the connector joined, insert the needle adapter (special tool) [C] inside the seal from behind the connector until the adapter reaches the terminal.

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

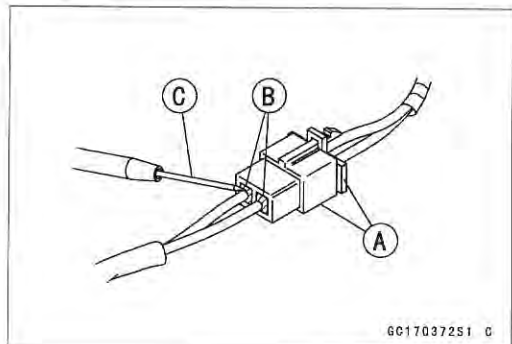
CAUTION

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

- Make sure that measuring points are correct in the connector before measurement. Do not reverse connections of the hand tester or a digital meter.
- Be careful not to short-circuit the leads of the DFI or electrical system parts by contact between adapters.

CAUTION

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



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2-36 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

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

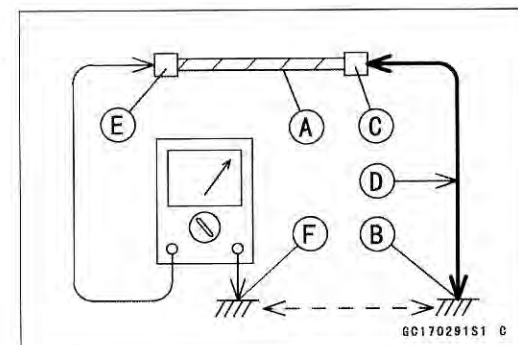
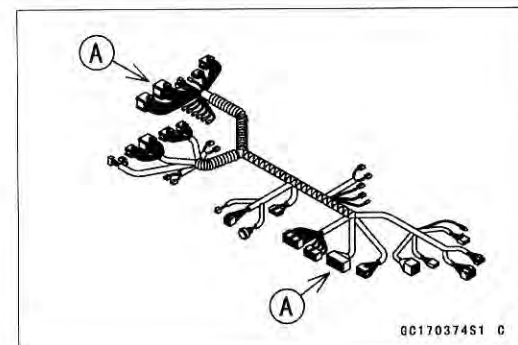
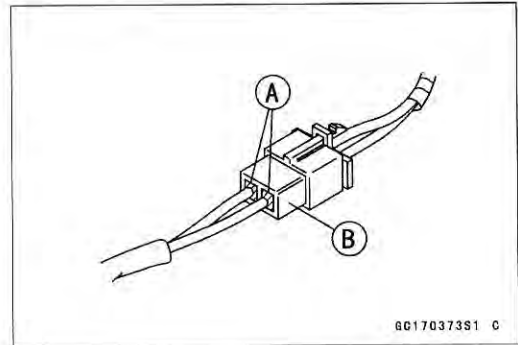
Silicone Sealant (Kawasaki Bond: 56019-120) - Seals of Connector

- Always check battery condition before replacing the DFI parts. A fully charged battery is a must for conducting accurate tests of the DFI system.
- Trouble may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the problem. If the problem was caused by some other item or items, they too must be repaired or replaced, or the new replacement part will soon fail again.
- Measure coil winding resistance when the DFI part is cold (at room temperature)
- Do not adjust or remove the throttle sensor.
- Do not directly connect a 12 V battery to a fuel injector. Insert a resistor ($5 \sim 7 \Omega$) or a bulb ($12 \text{ V} \times 3 \sim 3.4 \text{ W}$) in series between the battery and the injector.
- The DFI parts have been adjusted and set with precision. Therefore, they should be handled carefully, never strike sharply, as with a hammer, or allowed to fall. Such a shock to the parts can damage them.
- Check wiring and connections from the ECU connector to the suspected faulty DFI parts, using the hand tester (special tool, analog tester) rather than a digital tester.

Special Tool - Hand Tester: 57001-1394

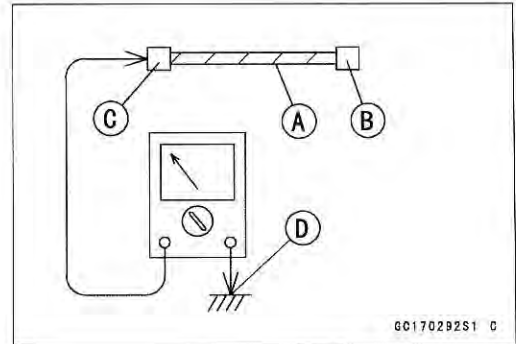
- Make sure all connectors in the circuit are clean and tight, and examine wires for signs of burning, fraying, etc. Deteriorated wires and bad connections can cause reappearance of problems and unstable operation of the DFI system.

- ★ If any wiring is deteriorated, replace the wiring.
- Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.
- ★ If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it. Connect the connectors securely.
- Check the wiring for continuity.
- Use the wiring diagram to find the ends of the lead which is suspected of being a problem.
- Connect the hand tester between the ends of the leads.
- Set the tester to the $\times 1 \Omega$ range, and read the tester.
- ★ If the tester does not read 0Ω , the lead is defective. Replace the lead.
- If both ends of a harness [A] are far apart, ground [B] the one end [C], using an auxiliary wire [D] and check the continuity between the end [E] and the ground [F]. This enables to check a long harness for continuity. If the harness is open, repair or replace the harness.



Troubleshooting the DFI System

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



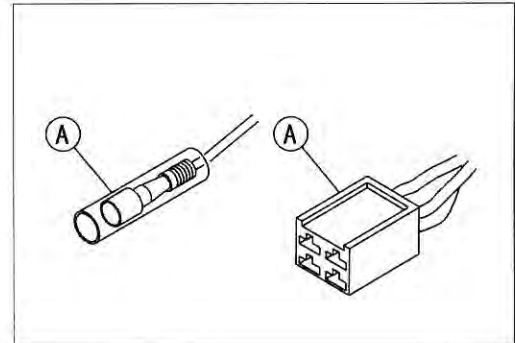
- Narrow down suspicious locations by repeating the continuity tests from the ECU connectors.
- ★ If no abnormality is found in the wiring or connectors, the DFI parts are the next likely suspects. Check the part, starting with input and output voltages. However, there is no way to check the ECU itself.
- ★ If an abnormality is found, replace the affected DFI part.
- ★ If no abnormality is found in the wiring, connectors, and DFI parts, replace the ECU.
- The following diagnosis flow chart illustrates the above procedures.
- After inspection, be sure to connect all the DFI electrical connectors. Do not turn the ignition SW ON while the DFI electrical connectors and ignition system connectors are disconnected. Otherwise, the ECU memorizes fault codes as open circuit.

○ Wire Color Codes:

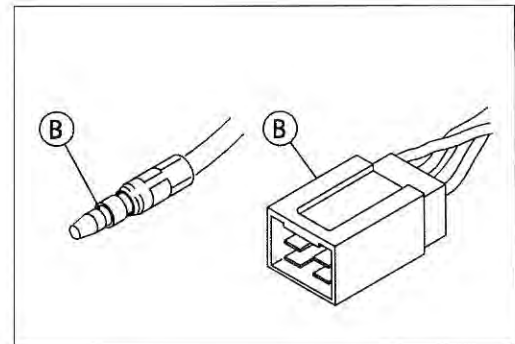
BK: Black	G: Green	P: Pink
BL: Blue	GY: Gray	PU: Purple
BR: Brown	LB: Light blue	R: Red
CH: Chocolate	LG: Light green	W: White
DG: Dark green	O: Orange	Y: Yellow

○ Electrical Connectors:

Female Connectors [A]



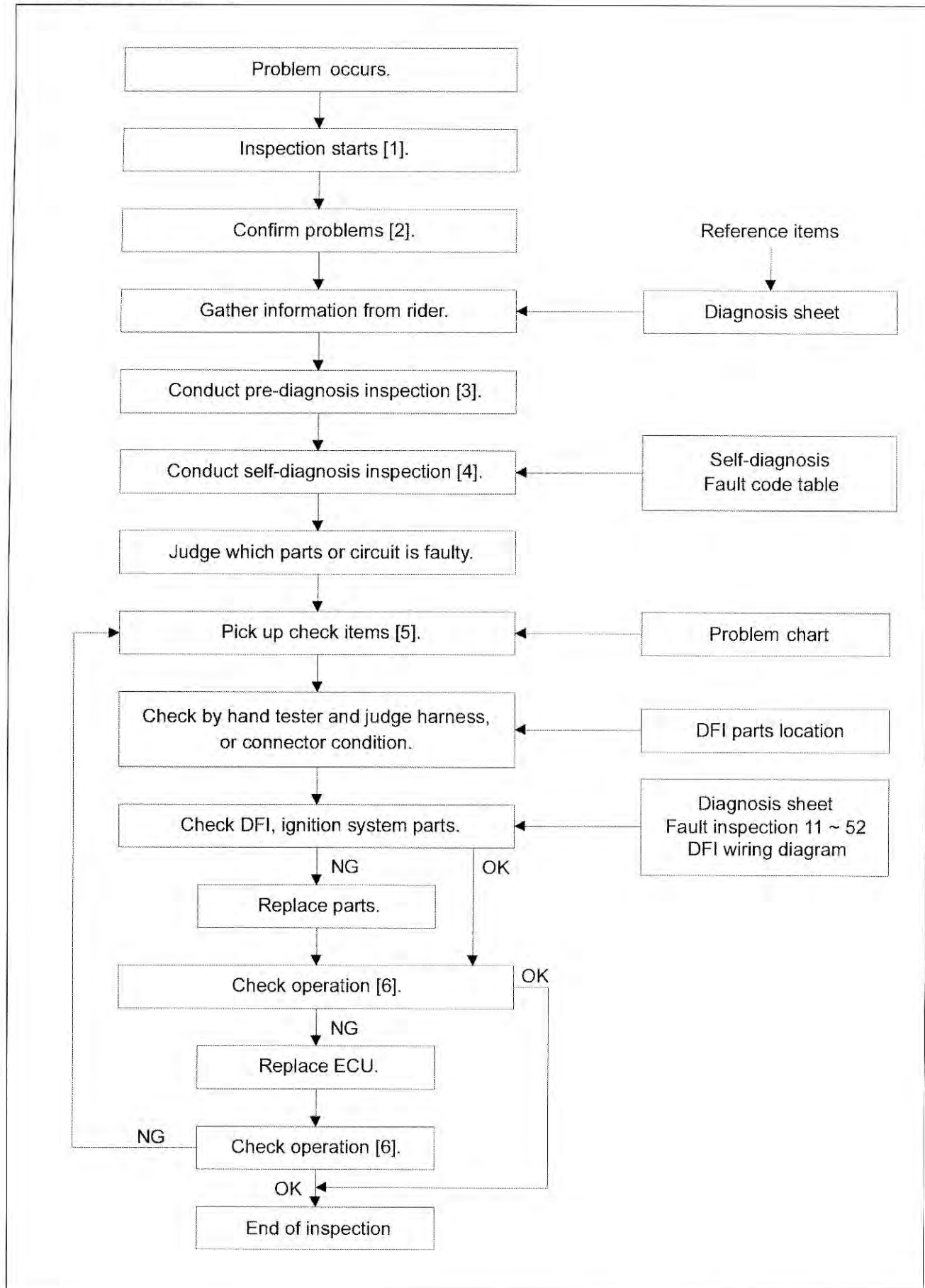
Male Connectors [B]



2-38 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

DFI Diagnosis Flow Chart

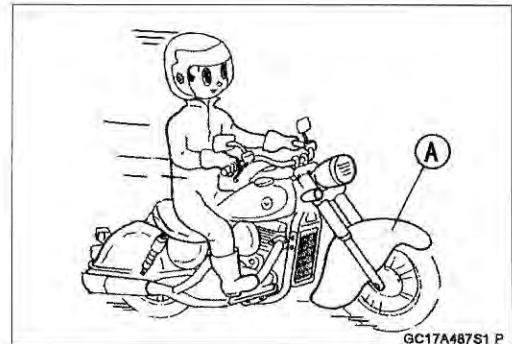


Troubleshooting the DFI System**Notes:**

OK: No problem.

NG: Problem exists.

1. Inspection starts.
 - An abnormality occurs in the DFI system, and the FI indicator LED light goes on to alert the rider.
 - Bring the motorcycle into the shop.
2. Confirm problems.
 - Reproduce the problems if possible.
3. Conduct pre-diagnosis inspection.
 - The pre-diagnosis inspection items are not handled by self-diagnosis. Check the problem before self-diagnosis, considering the symptoms of the problem.
 - Pre-diagnosis Inspection Items:
 - ECU Power Supply Inspection
 - DFI Fuse Inspection
 - DFI Main Relay Inspection
 - FI Indicator LED Light Operation Inspection
 - ISC Valve Inspection
 - Fuel Pressure Inspection
 - Fuel Flow Rate Inspection
4. Conduct self-diagnosis.
 - Enter the self-diagnosis mode and count the blinks of the FI indicator LED light to read the fault code.
 - Guess which parts or circuit is faulty, referring to the problem chart.
5. Check items.
 - Decide the check items about the faulty part, referring to the problem chart.
 - Decide the check procedure for each faulty part, referring to each section (Fault Inspection 11 ~ 52).
6. Operation check.
 - Make sure the FI indicator LED light goes off.
 - * If the problem is related to startability or idle stability, idle the engine to confirm that the DFI system and the ignition system are operating correctly.
 - * If the problem is related to driveability, ride the motorcycle [A] at 30 km/h (18 mph) or above to confirm that the DFI system and the ignition system are operating correctly.



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2-40 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

Problem Chart

Problems	Startability		Idling stability			Driveability							M	O
	A	B	C	D	E	F	G	H	I	J	K	L	N	
Inspection items	A	B	C	D	E	F	G	H	I	J	K	L	N	O
ECU ground and power supply	1 (1)													C2
Ignition SW, engine stop SW	2 (2)													C2*, C15*
Spark plug #1, #2	3 (3)	4 (5)												C15
ISC valve #1, #2		5 (6)	1 (1)	2 (2)	2 (2)									C2
In-tank fuel pump	4 (4)	1 (1)			1 (1)	1 (1)	1 (1)				1 (1)			C2
Fuel pressure		2 (2)	3 (3)		5 (5)	3 (3)	3 (3)	2 (2)	2 (2)		2 (2)			C2
Fuel injector #1, #2	8 (8)	3 (3)	2 (2)		3 (3)	2 (2)	2 (2)	1 (1)	1 (1)				1	C2
Water temperaure sensor		(4)	5 (4)	1 (1)	4 (4)	6 (6)	5 (5)	4 (4)	3 (3)		6 (6)	3 (3)		C2
Throttle sensor						5 (5)		3 (3)			4 (4)			C2
Inlet air temperature sensor			4			4 (4)	4 (4)			1 (1)	5 (5)	2 (2)		C2
Atmospheric pressure sensor			6			7 (7)	6 (6)			2 (2)	7 (7)	4 (4)		C2
Vacuum sensor						8 (8)	8 (8)	5 (5)			8 (8)	5 (5)		C2
Vehicle-down sensor	5 (5)													C2
Pickup coil #1, #2	6 (6)	6 (7)			6 (6)						3 (3)	1 (1)		C2, C15
Ignition coil #1, #2	7 (7)				7 (7)		7 (7)			3 (3)				C2, C15

Notes:

○ The ECU often participates in these problems. So if the parts, and the circuit have been checked out good, the ECU must be replaced.

1, 2, 3..... : Inspection order when engine is hot.

(1), (2), (3)..... : Inspection order when engine is cold.

C2*: DFI wiring diagram in this chapter (chapter 2)

C15*: Wiring diagram in the Electrical System chapter (chapter 15)

Startability:

(A): The starter motor rotates the engine but there is no combustion and the engine doesn't start.

(B): •There is combustion, but the engine stops immediately.

•You need to push the starter button long to start the engine.

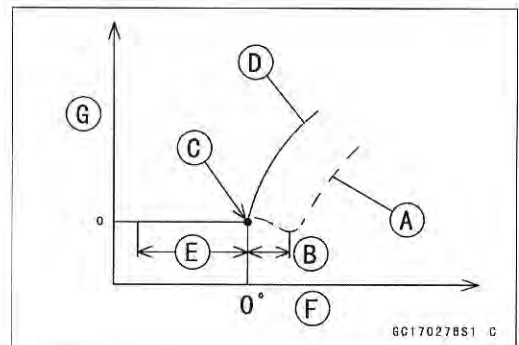
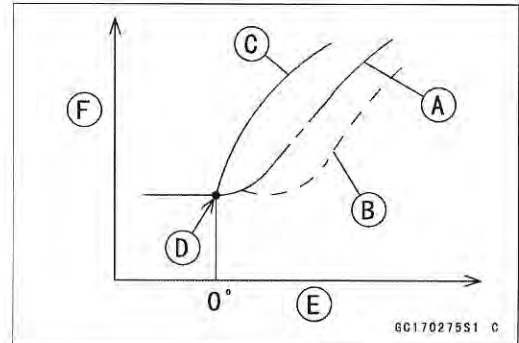
Troubleshooting the DFI System

Idling stability:

- (C): Unstable idling (rough idling)
 •The idle speed fluctuates. This can be identified by engine sound or vibration.
- (D): Incorrect idle speed
 •The idle speed cannot be adjusted within the specified range.
- (E): Lack of idling consistency
 •The engine cannot maintain idling. The following two symptoms are found.
 The engine stops when closing the throttle.
 The engine stops when opening the throttle.

Driveability:

- (F): Hesitation
 Hesitation [A]
 Severe Hesitation [B]
 Normal [C]
 Beginning [D] of Opening the Throttle
 Throttle Opening [E]
 Motorcycle Speed [F]
- (G): Poor acceleration
 The motorcycle runs smoothly, but cannot accelerate in response to throttle opening, and cannot reach maximum speed.
- (H): Stumble
 When the motorcycle is about to accelerate, the engine speed cannot increase in response to throttle opening, and increases with a lag [B] at opening [C] the throttle.
 Stumble [A]
 Normal [D]
 Idling [E]
 Opening the throttle [F]
 Motorcycle Speed [G]



- (I): Surge
 A forward and backward, periodic movement of a motorcycle at acceleration, deceleration, or at cruising.
- (J): Knock
 A periodic, rattling, thumping or pounding noise caused by spontaneous ignition of the air-fuel mixture in a cylinder, leading to engine damage. Knocking can also be caused by a connecting rod bearing, uneven combustion, or incorrect fuel.
- (K): Backfire
 An explosion of unburned or partially burned fuel in an inlet pipe caused by incomplete combustion in the cylinder head, leaner air-fuel mixture, wrong valve timing, vacuum switch broken, or air suction trouble, mainly during decelerating.
- (L): Afterfire
 An explosion of gases accumulated in a muffler caused by incomplete combustion in the cylinder head, wrong plug gap, burned electrode, or richer fuel/air mixture. Also it is caused by delayed ignition during starting or during decelerating, resulting in an explosion after the end of the combustion.

Engine doesn't stop (M):

- (N): Run-on (dieseling)
 Continuous running of an engine with the ignition SW OFF.
- (O): Reference chapters

2-42 FUEL SYSTEM (DFI)

Troubleshooting the DFI System

Inquiries to Rider

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

Diagnosis Keys

- What – Motorcycle model
- When – Date or frequency of problem
- Where – Road conditions, altitude
- How – Riding conditions
Environment

Troubleshooting the DFI System

Sample Diagnosis Sheet

Rider name:	Registration No. (license plate No.):	Year of initial registration:
Model:	Engine No.:	Frame No.:
Date problem occurred:	Mileage:	
Environment when problem occurred.		
Weather	☐ fine, ☐ cloudy, ☐ rain, ☐ snow, ☐ always, ☐ other:	
Temperature	☐ hot, ☐ warm, ☐ cold, ☐ very cold, ☐ always	
Problem frequency	☐ chronic, ☐ often, ☐ once	
Road	☐ street, ☐ highway, ☐ mountain road (☐ uphill, ☐ downhill), ☐ bumpy, ☐ pebble	
Altitude	☐ normal, ☐ high (about 1000 m or more)	
Motorcycle conditions when problem occurred.		
FI indicator LED light	☐ light up immediately after ignition SW ON, and goes off after 1 ~ 2 seconds (normal). ☐ lights up immediately after ignition SW ON, and stays on (DFI problem). ☐ lights up immediately after ignition SW ON, but goes off after about 10 seconds (DFI problem). ☐ unlights (LED light, ECU or its wiring fault). ☐ sometimes lights up (probably wiring fault).	
Starting difficulty	☐ starter motor not rotating. ☐ starter motor rotating but engine doesn't turn over. ☐ starter motor and engine don't turn over. ☐ no fuel flow (☐ no fuel in tank, ☐ no fuel pump sound). ☐ engine flooded (do not crank engine with throttle opened, which promotes engine flooding). ☐ no spark. ☐ choke knob is not pulled fully when using the knob (pull it fully when using). ☐ other:	
Engine stops	☐ right after starting. ☐ when opening throttle grip. ☐ when closing throttle grip. ☐ when moving off. ☐ when stopping the motorcycle. ☐ when cruising. ☐ other:	
Poor running at low speed	☐ choke knob left pulled out fully (push it in fully). ☐ very low fast idle speed. ☐ very low idle speed, ☐ very high idle speed, ☐ rough idle speed. ☐ battery voltage is low (charge the battery). ☐ spark plug loose (tighten it). ☐ spark plug dirty, broken, or gap maladjusted (remedy it). ☐ backfiring. ☐ afterfiring. ☐ hesitation when acceleration. ☐ engine oil viscosity too high. ☐ brake dragging. ☐ engine overheating. ☐ clutch slipping. ☐ other:	
Poor running or no power at high speed	☐ choke knob left pulled out fully (push it in fully). ☐ spark plug loose (tighten it). ☐ spark plug dirty, broken, or gap maladjusted (remedy it). ☐ spark plug incorrect (replace it). ☐ knocking (fuel poor quality or incorrect, → use high-octane gasoline). ☐ brake dragging. ☐ clutch slipping. ☐ engine overheating. ☐ engine oil level too high. ☐ engine oil viscosity too high. ☐ other:	

2-44 FUEL SYSTEM (DFI)

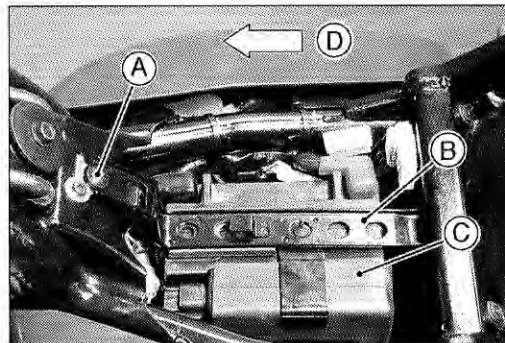
ECU

CAUTION

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

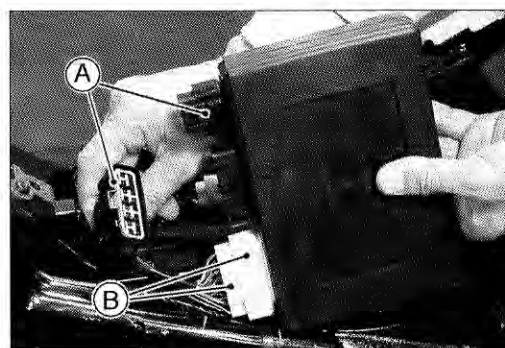
ECU Removal

- Remove:
 - Seat (see Frame chapter)
 - Screw [A] and Battery Holder [B]
- Pull the ECU [C] out.
- ★ If necessary, disconnect the ECU connectors.
 - Front [D]

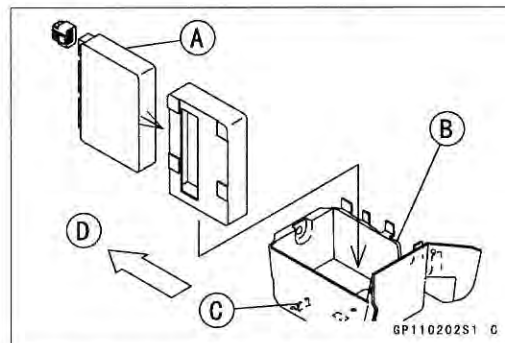


ECU Installation

- Connect the ECU connectors.
- Be sure to connect the harness connectors to the ECU connectors of the same color;
 - Black Female ↔ Black Male [A]
 - White Female ↔ White Male [B].



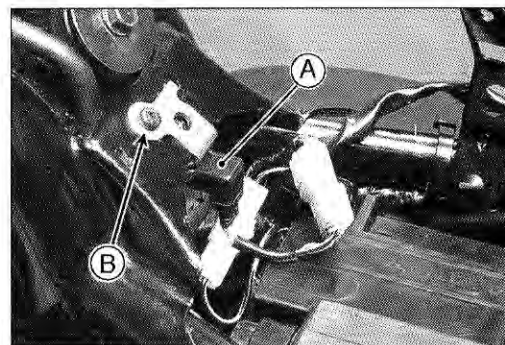
- Put the ECU [A] into the battery case [B].
- Fit the ECU in behind the left side rib [C] until the ECU bottoms.
 - Front [D]



- Check that the vehicle-down sensor assy [A] is in place as shown.
- ★ If the vehicle-down sensor assy is not correctly installed, reinstall it (see Vehicle-down Sensor section in this chapter).
- Tighten the screw [B] securely.
- Install the seat (see Frame chapter).

⚠ WARNING

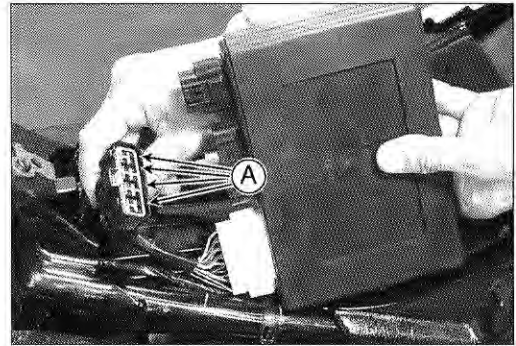
Incorrect installation of the vehicle-down sensor could cause sudden loss of engine power. The rider could lose balance during certain riding situations, like leaning over in a turn, with the potential for an accident resulting in injury or death. Ensure that the down sensor is held in place by the sensor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



ECU

ECU Power Supply Inspection

- Visually inspect the terminals [A] of the ECU 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 ECU if the terminals of the ECU connectors are cracked, bent, or otherwise damaged.



- With the ECU connectors [A] connected, check the following ground leads for continuity with the ignition SW ON or OFF, using a digital voltmeter [D].

ECU Grounding Inspection

Tester Connections:

8, 16, 24, or 32 (BK/Y) Terminal ↔ Battery (−) Terminal

21 (BR/BK) Terminal ↔ Battery (−) Terminal

Engine Ground Terminal [B] ↔ Battery (−) Terminal

Readings: 0 Ω (regardless of the ignition SW ON or OFF)

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

Battery [C] in the Frame

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

- Check the ECU power source voltage with a digital voltmeter.

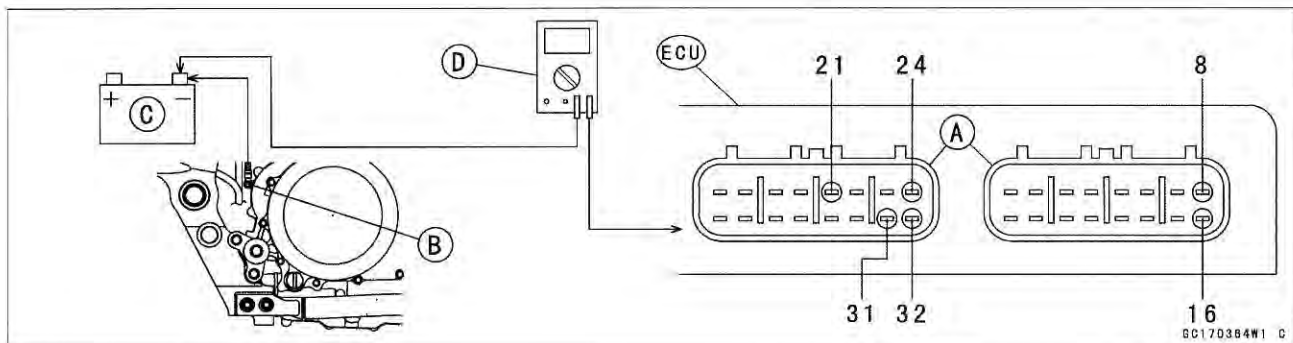
ECU Power Source Inspection

Tester Connection: between 31 (W/R) Terminal and Battery (−) Terminal

Ignition SW OFF: 0 V

Ignition SW ON: Battery Voltage (12.5 V or more)

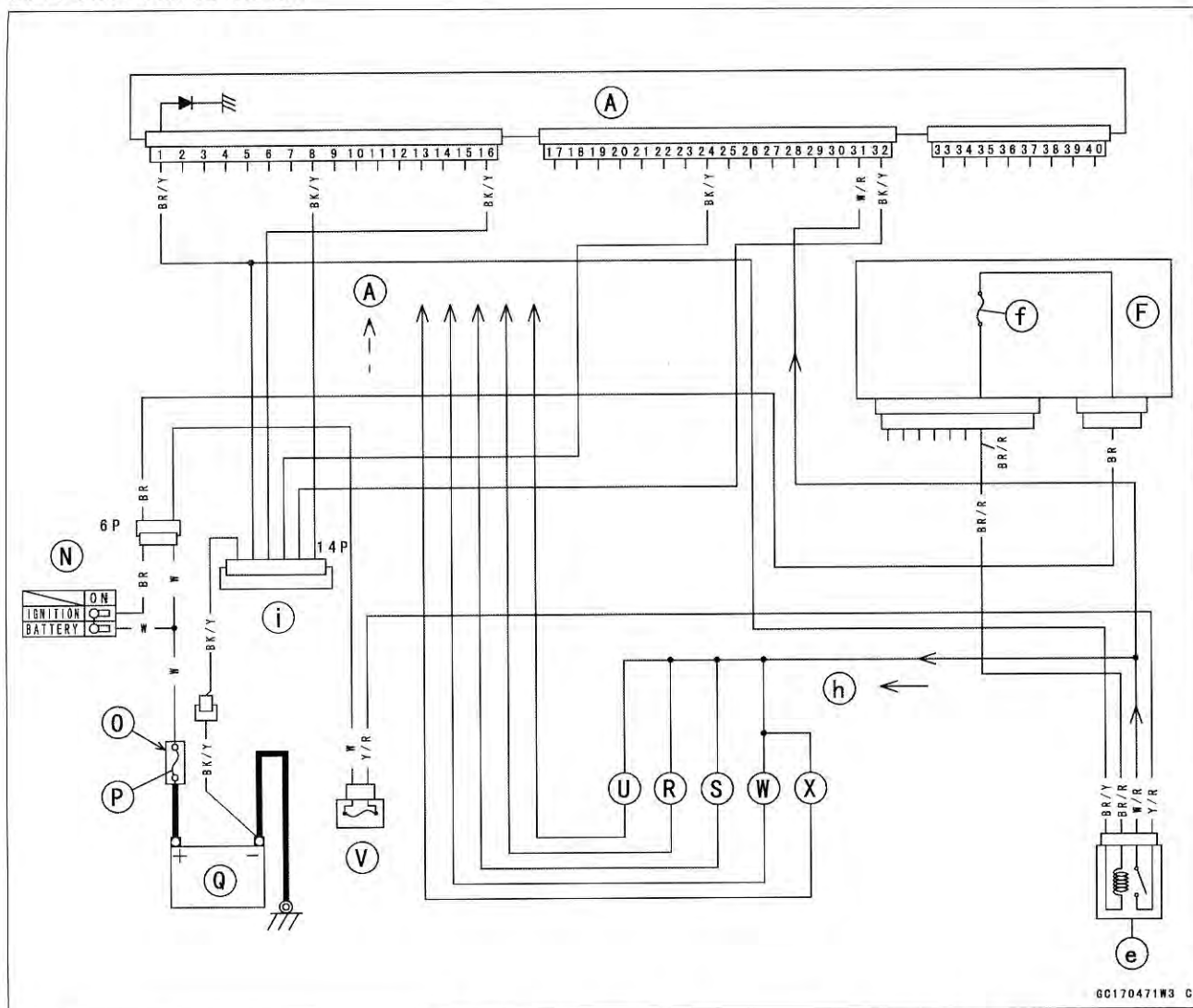
- ★ If the voltmeter does not read as specified, check the following:
 - Power Source Wiring (see wiring diagram below)
 - DFI Fuse 15 A (see DFI Power Source section)
 - DFI Main Relay (see DFI Power Source section)
 - Ignition Fuse 10 A (see Electrical System chapter)
- ★ If the inspection checks good, the ECU is damaged. Replace the ECU. The ECU itself cannot be checked or serviced.



2-46 FUEL SYSTEM (DFI)

ECU

DFI Power Source Circuit



→: Current

ECU [A]

Junction Box [F]

Ignition SW [N]

Starter Relay [O]

Main Fuse 30 A × 32 V [P]

MF Battery 12 V 18 Ah [Q]

Fuel Injector #1 [R]

Fuel Injector #2 [S]

In-tank Fuel Pump [U]

DFI Fuse 15 A × 32 V [V]

ISC Valve #2 [W]

ISC Valve #1 [X]

DFI Main Relay [e]

Ignition Fuse 10 A × 32 V [f]

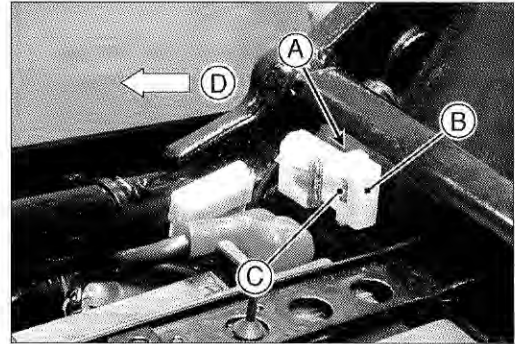
Actuators (R, S, U, W, X) [h]

Joint Connector [i]

DFI Power Source

DFI Fuse Removal

- Remove the seat (see Frame chapter).
- Pull the lock [A] and open the lid [B].
- Pull out the DFI fuse [C] from the case with needle nose pliers.
Front [D]

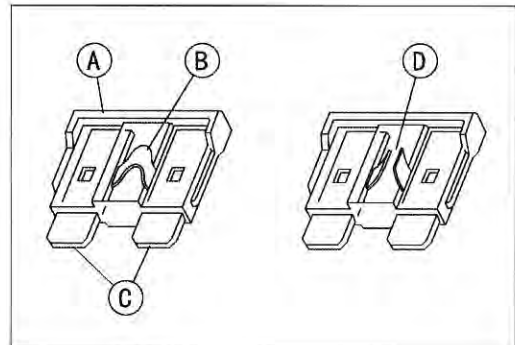


DFI Fuse Installation

- If a fuse fails during operation, inspect the DFI system to determine the cause, and then replace it with a new fuse of proper amperage.

DFI Fuse Inspection

- Remove the fuse (see DFI Fuse Removal).
 - Inspect the fuse element.
 - ★ If it is open, 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

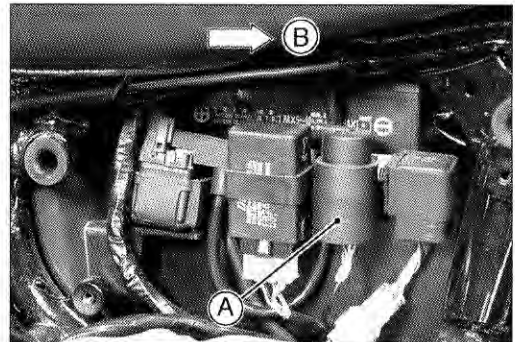
When replacing a fuse, be sure the new fuse matches the specified fuse rating for that circuit. Do not use a fuse rated for other than amperage and voltage specified in the Wiring Diagram.

DFI Main Relay Removal

CAUTION

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

- Remove:
Right Side Cover (see Frame chapter)
Coolant Reserve Tank (see Coolant Draining in the Coolant System chapter)
- Remove the DFI main relay [A] and disconnect the connector.
Front [B]



2-48 FUEL SYSTEM (DFI)

DFI Power Source

DFI Main Relay Inspection

- Remove the DFI main relay (see above).
- Connect the hand tester [A] and one 12 V battery [B] to the relay connector [C] as shown.

Special Tool - Hand Tester: 57001-1394

Relay Coil Terminals [1] and [2]

Relay Switch Terminals [3] and [4]

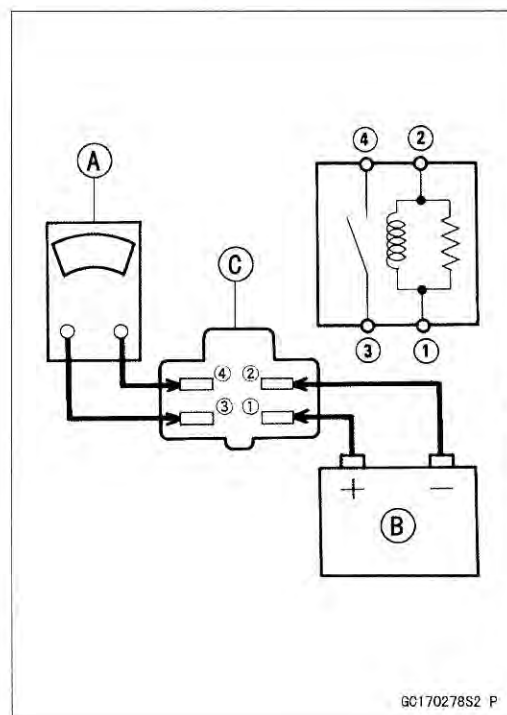
Testing Relay

Tester range: 1 Ω range

Criteria: When battery is connected $\rightarrow 0 \Omega$

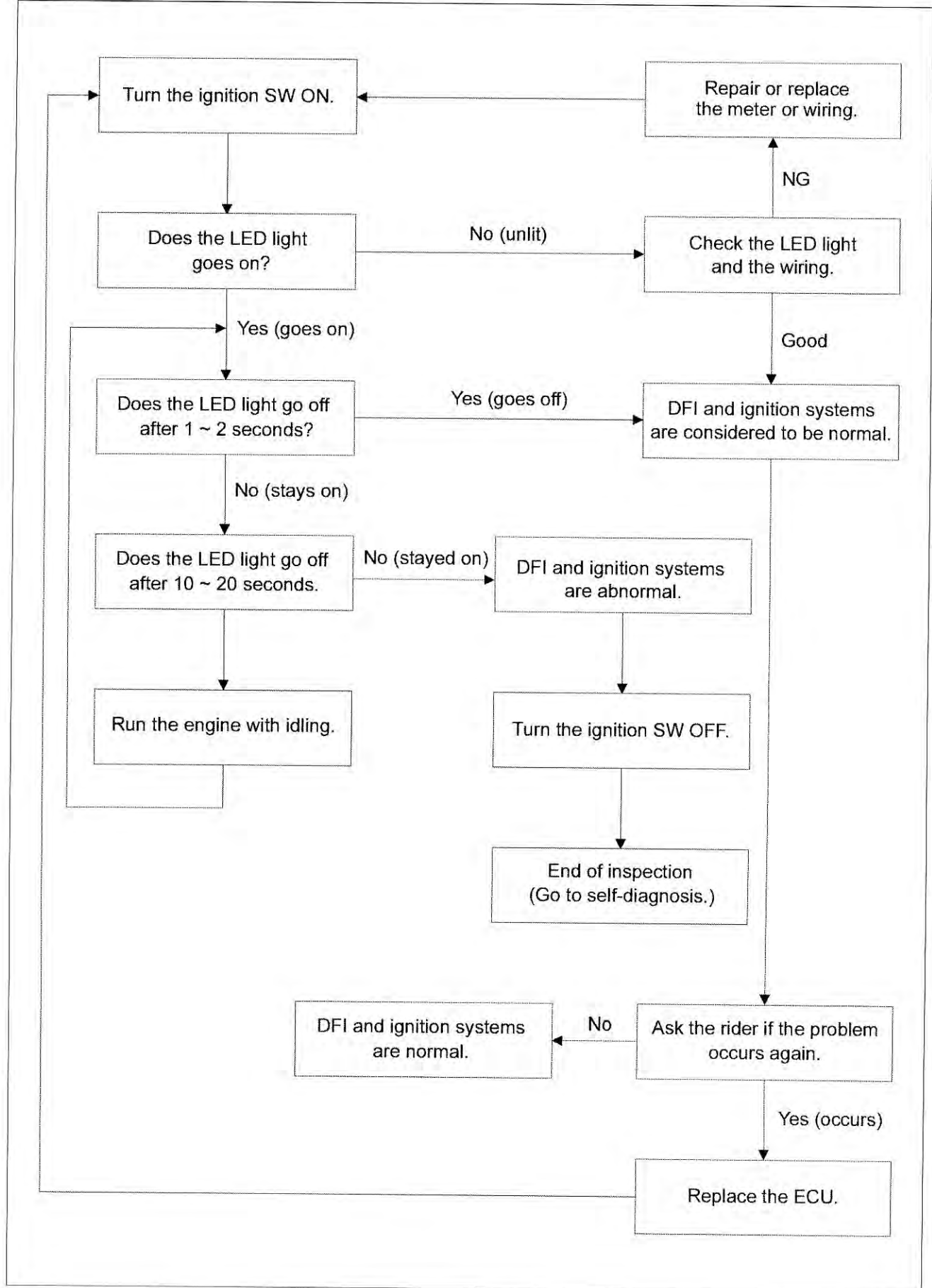
When battery is disconnected $\rightarrow \infty \Omega$

★ If the relay does not work as specified, replace the relay.



FI Indicator LED Light

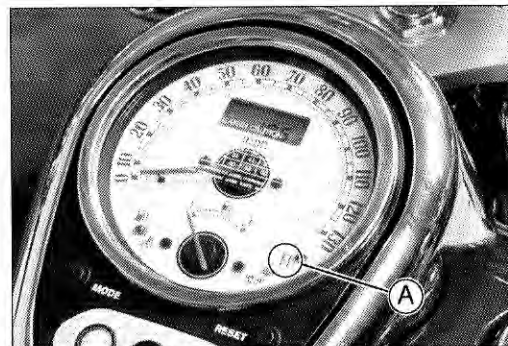
Inspection Flow Chart



2-50 FUEL SYSTEM (DFI)

FI Indicator LED Light

The FI indicator LED light [A] goes ON when the ignition SW is turned ON and the LED light goes OFF 1 ~ 2 seconds later. This is to ensure that the FI indicator LED light has not burned out and the DFI system and the ignition system function properly.



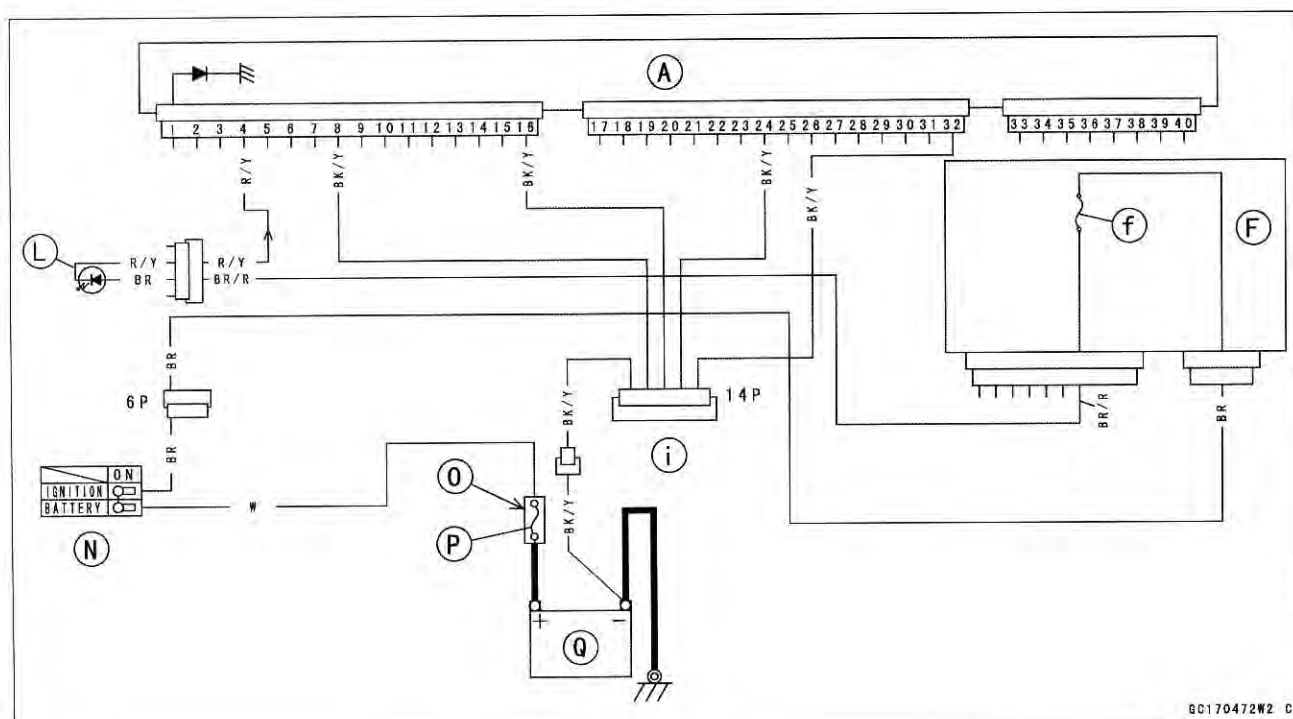
LED Light Inspection

- Refer to the Meter, Gauge section in the Electrical System chapter for LED Light Inspection.

⚠ WARNING

This inspection may produce sparks. Keep the battery and the meter unit away from the fuel tank.

- ★ If the LED light is subnormal, replace the meter unit.
- ★ If the FI indicator LED light is normal, the wiring or ECU has trouble. Check the wiring (see next diagram). If the wiring is good, replace the ECU.



QC170472W2 C

→: Signal
ECU [A]
Junction Box [F]

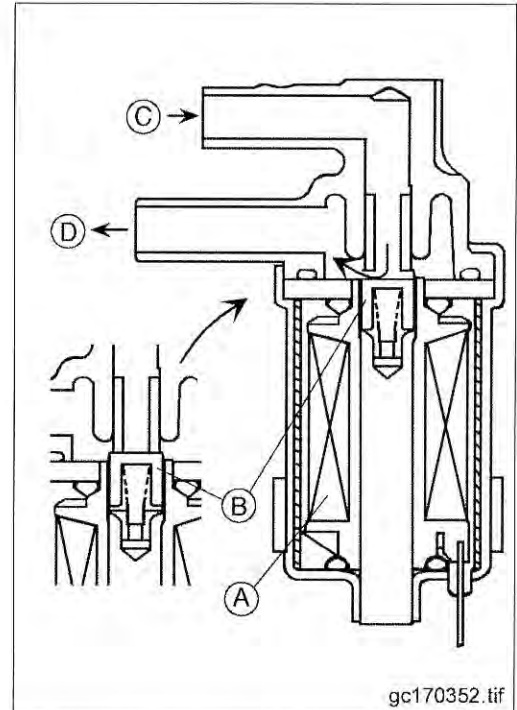
FI Indicator LED Light [L]
Ignition Switch [N]
Starter Relay [O]

Main Fuse 30 A × 32 V [P]
MF Battery [Q]
Ignition Fuse 10 A × 32 V [f]
Joint Connector [i]

ISC Valves

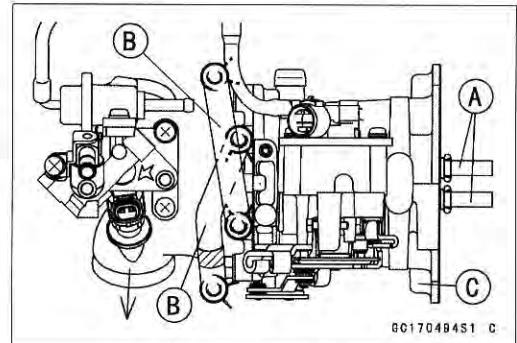
There are two ISC valves; the ISC valve #1 for the front cylinder, and the ISC valve #2 for the rear cylinder. When the engine is cold, each ISC valve is opened according to the coolant temperature by the ECU, providing good startability in cold weather and allowing the engine to run fast for quick warm up (fast idle).

Each ISC valve has a solenoid valve. When the solenoid [A] is energized by the ECU, the solenoid valve [B] opens fully and inlet air [C] flows into [D] the ISC pipe.



The air flows through the ISC pipes [A], and hoses [B] (bypass) of the throttle assy [C] into the cylinder head.

When starting the engine, the ISC valves always open fully, often causing too high fast idle. So the ECU controls ISC valves according to the coolant temperature. The ECU keeps the solenoid valves open and close repeatedly since the engine starts so that proper fast idle speed is obtained. When the engine has warmed up, the solenoid valves close and ISC valves finish operation.



When the coolant temperature is low, the ratio (duty factor) of valve opening time to total time (valve opening time and closing time) is set high, making the fast idle speed high. As the temperature goes up, the ratio is gradually decreased to lower the fast idle speed.

Coolant Temperature [A]

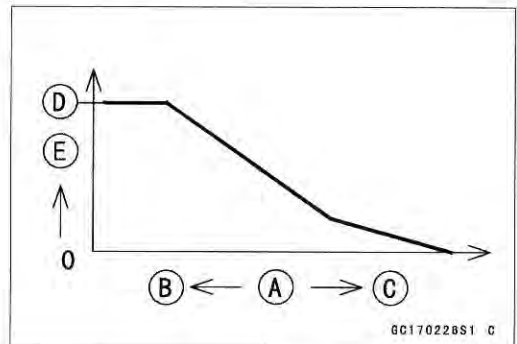
Low [B]

High [C]

Duty Factor at Full Open (100 %) [D]

Duty Factor (0 ~ 100 %) [E]

Generally, when a device is used for intermittent duty like starting, running, stopping, and idling, the device is operated under "duty control". The ratio of running, or working time to total time is called "duty factor", or "duty cycle" ("duty" means the work or operation done by a device).



2-52 FUEL SYSTEM (DFI)

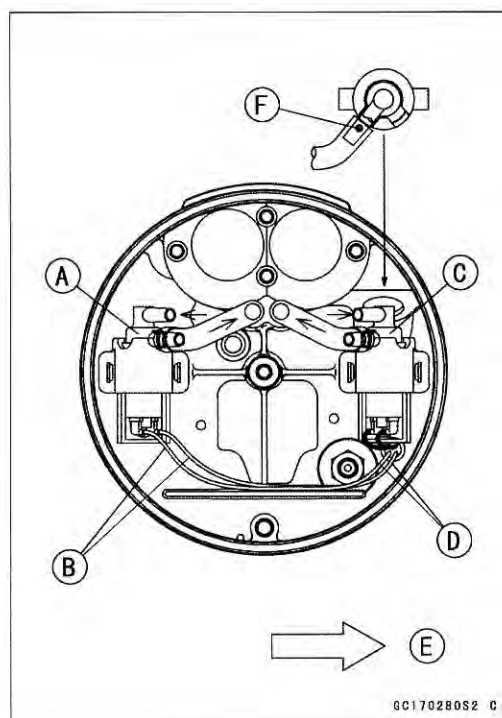
ISC Valves

Removal/Installation

CAUTION

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

- The ISC valves are removed during right air cleaner housing removal (see this chapter).
- The ISC valve itself is the same for front and rear, but wiring is different. Be careful not to reverse the leads.
 - ISC Valve #1 [A] → G/Y, W/R leads [B]
 - ISC Valve #2 [C] → G/BL, W/R leads [D]
 - Front [E]
- Install the ISC hoses as shown.
 - ISC Hose #1 with the red paint mark on the top
 - ISC Hose #2 with the blue paint mark [F] on the top



Power Source Voltage Inspection

NOTE

- Be sure the battery is fully charged.
 - The inspection is the same as "Power Source Voltage Inspection" of the fuel pump.
 - Turn the ignition SW OFF.
 - Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
 - Connect a digital voltmeter [A] to the connector [B], using the needle adapter [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Insert the needle adapter inside the seal of the ECU connector.
 - Measure the power source voltage with the engine stopped, and with the connectors joined.
 - Turn the ignition SW ON.

ISC Valve Power Source Voltage

Connections to ECU

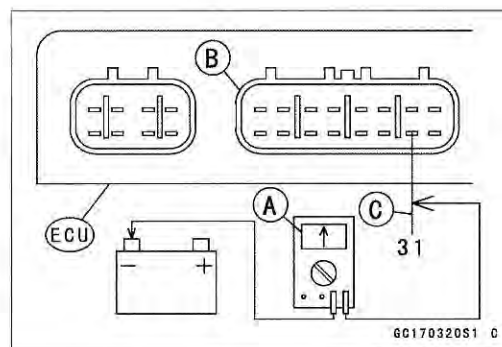
Tester (+) → W/R lead (terminal 31)

Tester (-) → Battery (-) terminal

Power Source Voltage at ECU Connector

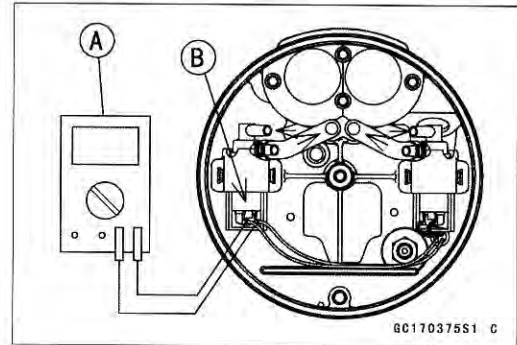
Standard: Battery Voltage (12.5 V or more)

- ★ If the reading of power source voltage is less than the standard, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the reading is normal, check the power source voltage at the connectors of the ISC valves.
- Turn the ignition SW OFF.



ISC Valves

- Remove the right air cleaner cover (see this chapter).
- Connect a digital voltmeter [A] to the connectors [B] of each ISC valve.



- Measure the power source voltage with the engine stopped, and with the connectors joined.
- Turn the ignition SW ON.

Power Source Voltage at ISC Valve Connector

Connections to ISC Valve #1, #2

Tester (+) → W/R lead

Tester (−) → Battery (−) Terminal

Power Source Voltage

Standard: Battery Voltage (12.5 V or more)

- Turn the ignition SW OFF.
- ★ If the reading is lower than the standard, check the wiring.
- ★ If the reading is normal, the power supply voltage is normal. Check the output voltage.
- After inspection, remove the needle adapters, and apply silicone sealant to the seals of the ECU connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of ECU Connectors

Output Voltage Inspection

- Measure the output voltage at the ECU connector, using the hand tester (special tool).

Special Tool - Hand Tester: 57001-1394

Needle Adapter Set — Hand Tester: 57001-1457

- Measure the output voltage with the engine stopped, and with the connectors joined.
- Turn the ignition SW ON.

Output Voltage at ECU

Connections for ISC Valve #1

Tester (+) → W/R lead (terminal 31)

Tester (−) → G/Y lead (terminal 10)

Connections for ISC Valve #2

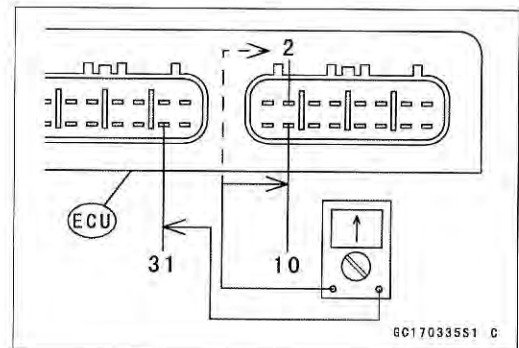
Tester (+) → W/R lead (terminal 31)

Tester (−) → G/BL lead (terminal 2)

Output Voltage at ECU

Criterion: The needle points battery voltage (12.5 V or more) and 11 seconds later 0 V.

- ★ If the output voltage is incorrect, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.



2-54 FUEL SYSTEM (DFI)

ISC Valves

- ★ If the output voltage is correct, check the output voltage at the connectors [A] of the ISC Valves.
- Remove the right air cleaner cover (see this chapter).
- Disconnect the ISC connectors.
- Connect the hand tester to the main harness connectors for each ISC valve.
- Measure the output voltage with the engine stopped, and with the connector disconnected.
- Turn the ignition SW ON.

Output Voltage for ISC Valves

Connections for ISC Valve #1

Tester (+) → W/R lead

Tester (-) → G/Y lead

Connections for ISC Valve #2

Tester (+) → W/R lead

Tester (-) → G/BL lead

Output Voltage at ISC Valve

Reading: The needle points battery voltage
 (12.5 V or more) and 11 seconds
 later 0 V.

- ★ If the reading is incorrect, check the wiring for continuity (see next diagram).
- ★ If the reading is normal, check the resistance of the ISC valve for confirmation.

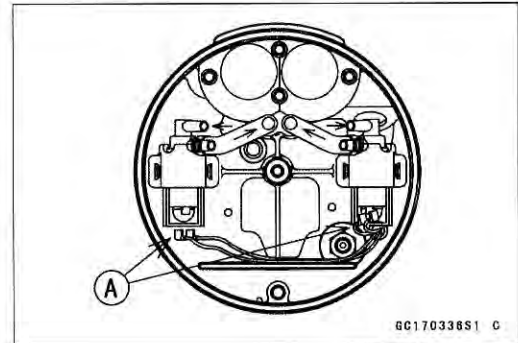
Resistance Inspection

- Disconnect the connectors from the ISC valve.
- Measure the resistance between the terminals of the ISC valve with a digital volt meter.

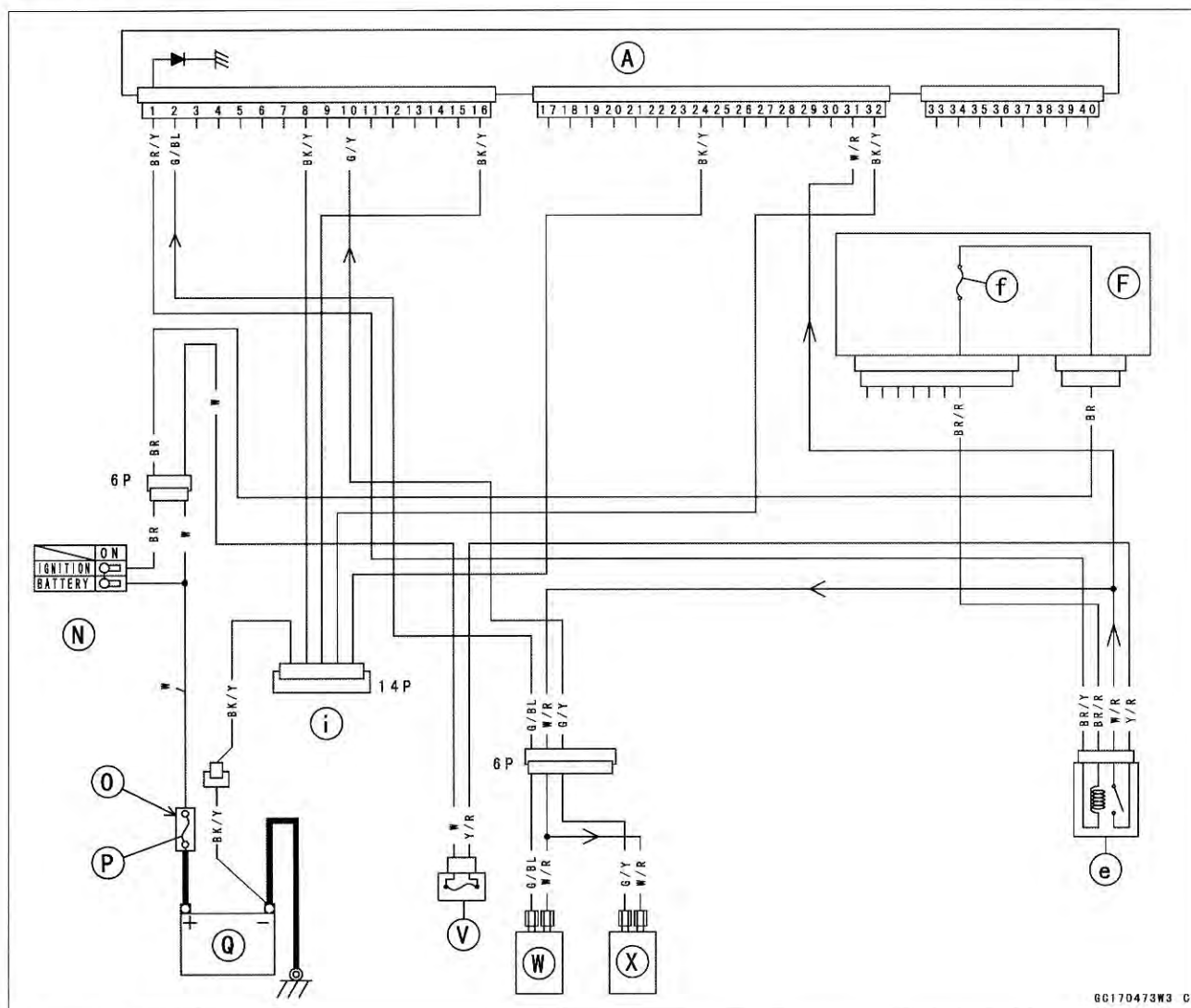
ISC Valve Solenoid Resistance (#1, #2)

Standard: 13.6 ~ 20.4 Ω

- ★ If the reading is out of the standard range, replace the ISC valve.
- ★ If the reading is good, replace the ECU.



ISC Valves



6G170473W3 C

→ : Signal

ECU [A]

Junction Box [F]

Ignition Switch [N]

Starter Relay [O]

Main Fuse 30 A × 32 V [P]

MF Battery 12 V 18 Ah [Q]

DFI Fuse 15 A × 32 V [V]

ISC Valve #2 [W]

ISC Valve #1 [X]

DFI Main Relay [e]

Ignition Fuse 10 A × 32 V [f]

Joint Connector [i]

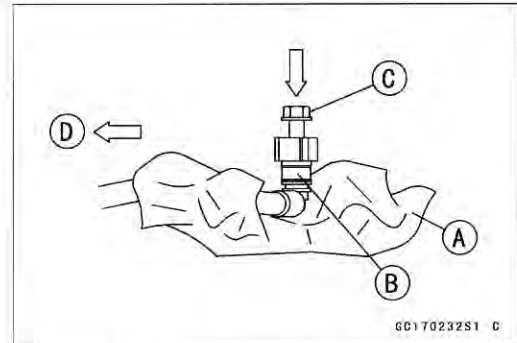
2-56 FUEL SYSTEM (DFI)

Fuel Line

Fuel Pressure Inspection

NOTE

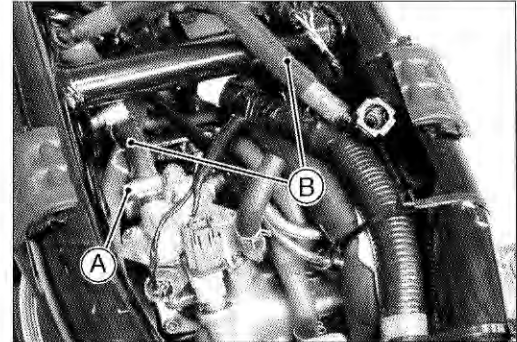
- Be sure the battery is fully charged.
- Remove the fuel tank (see this chapter).
- Be sure to stuff a clean shop towel [A] around the fuel outlet hose joint [B] of the fuel tank, and plug the joint with a plug [C] ($\phi 7.8 \sim 8.0$ mm $\times$ L 35 mm, see Fuel Tank Removal in this chapter).
Front [D]



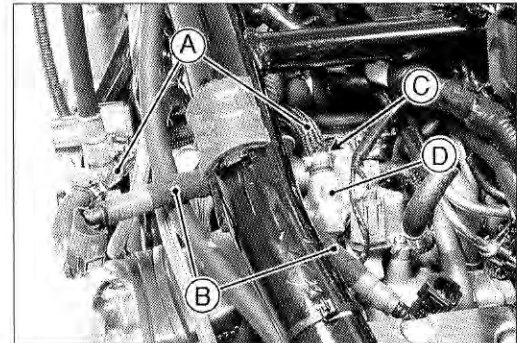
- Unscrew the clamp screw [A] and take out the high pressure fuel hose assy [B].

⚠ 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 clean shop towel to prevent fuel spillage.



- Install the fuel pressure gauge adapter [A] (special tool) between the high pressure fuel hose assy [B] and the inlet pipe [C] of the delivery joint [D].
 - Put the fuel pressure gauge adapter outside the left frame as shown.
 - Connect the pressure gauge [E] (special tool) to the fuel pressure gauge adapter.
- Fuel Tank [F]



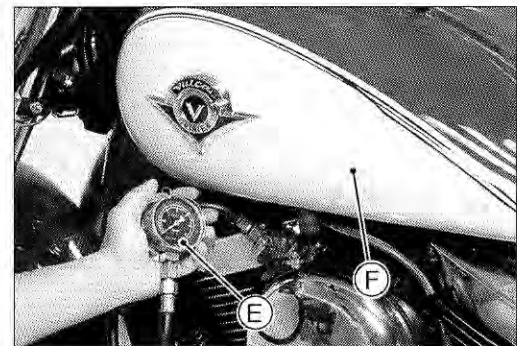
Special Tools - Fuel Pressure Gauge Adapter: 57001-1417
Oil Pressure Gauge: 57001-125

- Temporarily, install the fuel tank.
- Connect:
Fuel Pump Connector 4P (black)
Battery Lead (-) Terminal

⚠ WARNING

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

- Turn the ignition SW ON. The fuel pump will turn for 3 seconds, and then stop.



Fuel Line

- Measure the fuel pressure with the engine stopped.

Fuel Pressure

right after Ignition SW ON, with pump running:

Standard: 310 kPa (3.2 kg/cm², 46 psi)

after 3 seconds from Ignition SW ON, with pump stopped:

Standard: 280 kPa (2.9 kg/cm², 41 psi)

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

Fuel Pressure (idling)

Standard: 260 kPa (2.7 kg/cm², 38 psi)

- Measure the fuel pressure with the throttle fully opened a moment.

Fuel Pressure (with throttle fully opened)

Standard: 260 ~ 280 kPa (2.7 ~ 2.9 kg/cm², 38 ~ 41 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 Return Hose for Sharp Bend, Kinking, or Clogging

Return Fuel Check Valve (see Fuel Tank section in this chapter)

- ★ If the fuel pressure is much lower than specified, check the following:

Fuel Line Leakage

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 pressure regulator, or the fuel pump assy 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 General Information chapter.
- Install the high pressure fuel hose assy.

Torque - High Pressure Fuel Hose Clamp Screw: 1.5 N·m (0.15 kg·m, 13 in·lb)

- Install the fuel tank (see this chapter).

Pressure Regulator Removal

- The pressure regulator is removed during Injector Removal (see Injector Removal in this chapter).

Fuel Flow Rate Inspection

NOTE

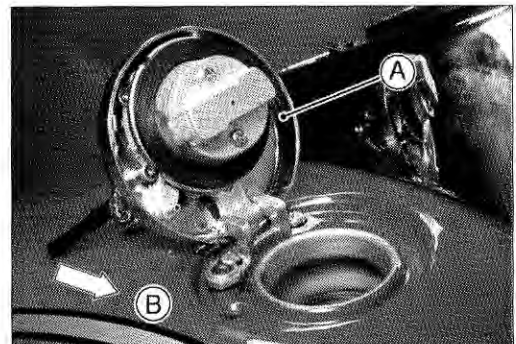
○ Be sure the battery is fully charged.

⚠ 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 both ignition SW, and engine stop SW OFF.
 - Wait until the engine cools down.
 - Open the fuel tank cap [A] to lower the pressure in the tank.
- Front [B]



2-58 FUEL SYSTEM (DFI)

Fuel Line

- Prepare a plastic hose of the inside diameter 7.5 mm × L about 400 mm and a measuring cylinder.
- Remove:
 - Front Seat (see Frame chapter)
 - Fuel Tank Bolt and Nut
- Do not remove the meter unit.
- Raise the fuel tank.
- Stuff a clean shop towel around the fuel outlet hose joint.
- A person should pinch the hose joint locks with fingers, disconnect the joint (see Fuel Tank Removal) and another person should insert the plastic hose [A] quickly onto the tank outlet pipe.
- Secure the plastic hose with a clamp [B].
- Run the other side of the plastic hose into the measuring cylinder [C].
- Temporarily install the fuel tank and close the fuel tank cap.

⚠ WARNING

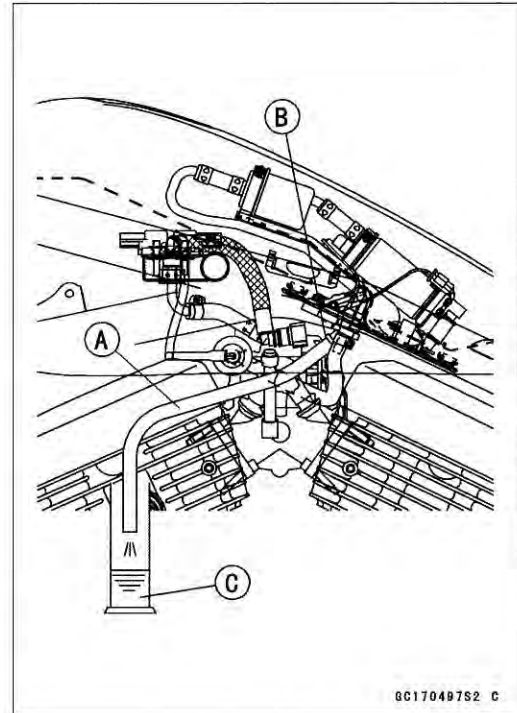
**Wipe off spilled out fuel immediately.
Be sure to hold the measuring cylinder vertical.**

- With the engine stopped, turn the ignition SW ON. The fuel pump should operate for 3 seconds, and then should stop. Repeat this several times until the plastic hose is filled with fuel.
- Measure the discharge for 3 seconds with the plastic hose filled with fuel.

Amount of Fuel Flow

Standard: 75 mL or more for 3 seconds

- ★ If the fuel flow is much less than the specified, check the following:
 - Fuel Pump Assy (see Fuel Pump Inspection in this chapter)
 - Pump Screen (see Pump Screen Cleaning in the In-tank Fuel Pump section).
- After inspection, connect the fuel hoses, and install the fuel tank (see Fuel Tank Installation).
- Start the engine and check for fuel leakage.



Self-Diagnosis

Self-diagnosis Function

The self-diagnosis indicates problems with the parts, wiring, and ECU in the DFI system and ignition system.

The ECU [C] always monitors each DFI circuit [A] for problems by measuring the voltage [B]. This circuit includes parts [D], and wiring [E].

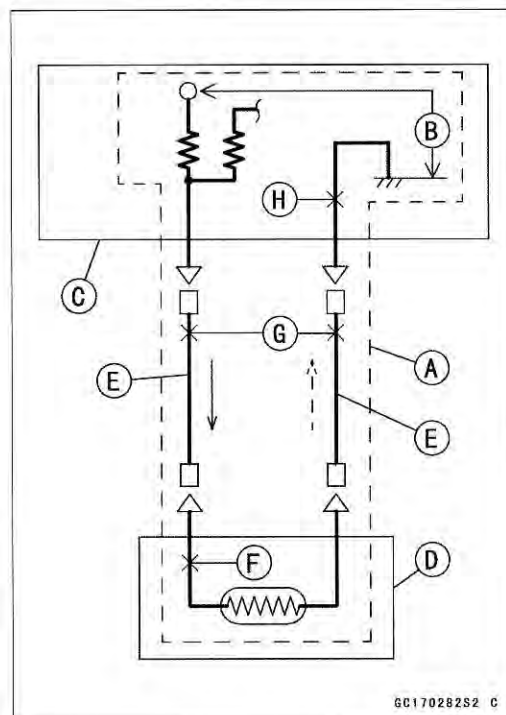
When the circuit is open (problem), the following are possible problems.

Disconnection [F] in the Parts

Disconnection [G] in the Wiring

Disconnection [H] in the ECU

When the FI indicator indicates a problem, the ECU has the possibility of the problem as well as the parts and the wiring outside the ECU.



Self-diagnosis Procedures

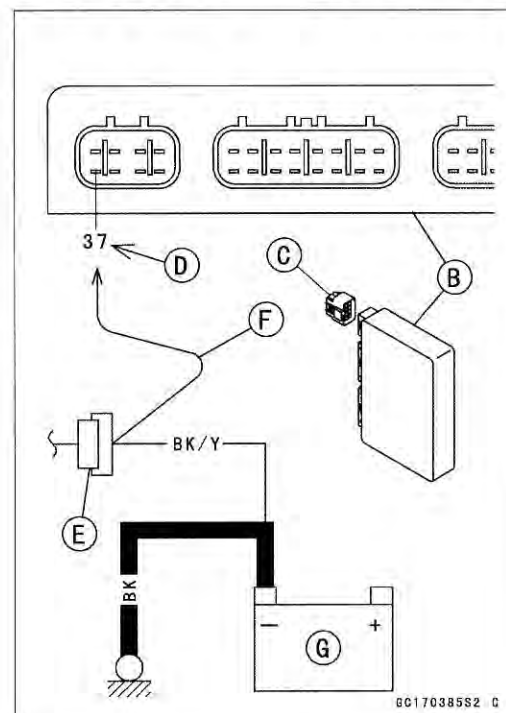
- When a problem occurs with the DFI system, the FI indicator LED light [A] goes on.



- Remove the seat (see Frame chapter) and take the ECU [B] out.
- Take off the connector cap [C].
- Enter the self-diagnosis mode by grounding the ECU's self-diagnosis check terminal 37 [D] to the battery (-) terminal [E], using a wire [F]. Battery [G]
- Count the blinks of the LED light to read the fault code.

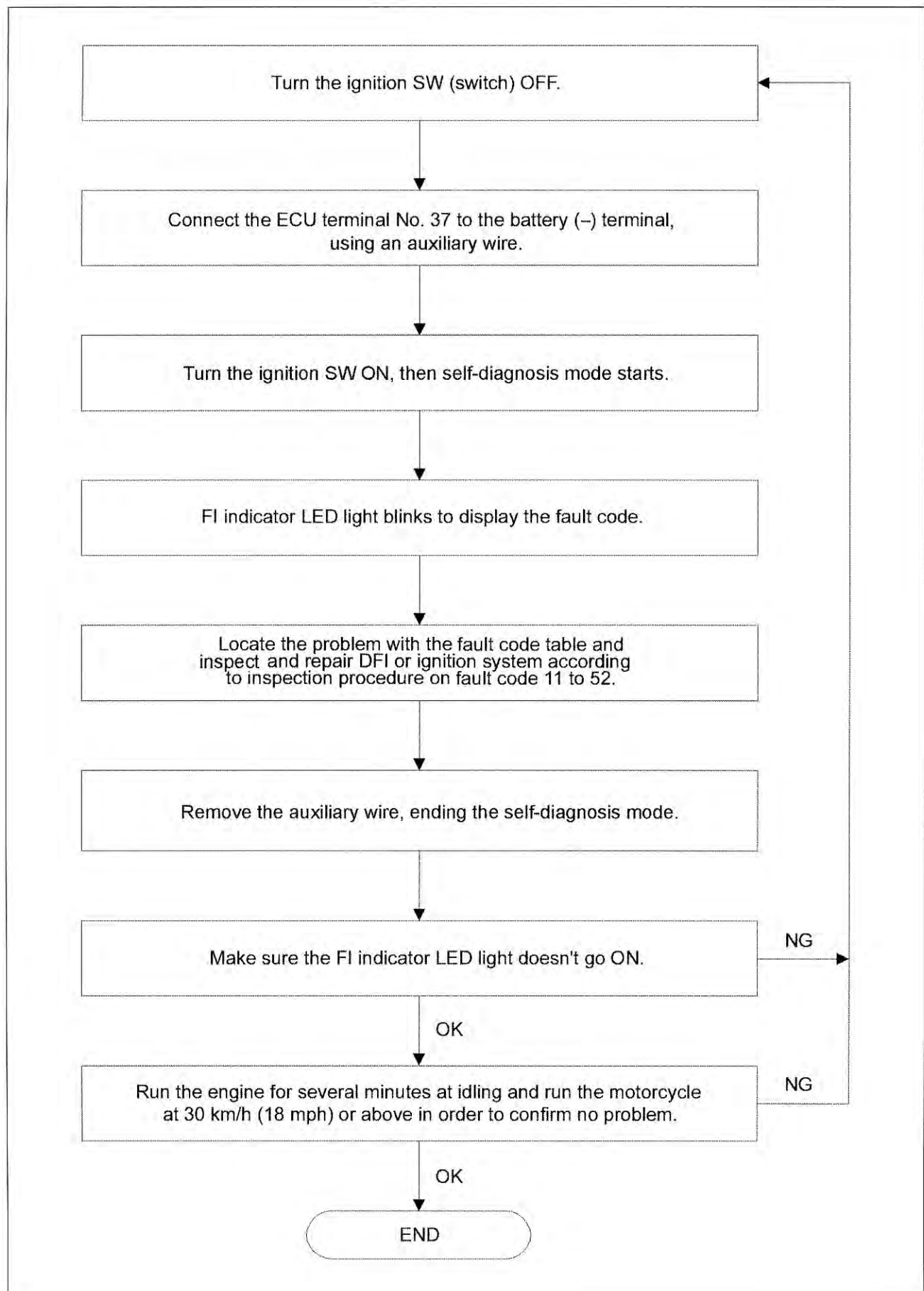
NOTE

- Use a fully charged battery when conducting self-diagnosis. Otherwise, the LED light blinks very slowly or doesn't blink.
- Keep the check terminal grounded during self-diagnosis, using a wire.



2-60 FUEL SYSTEM (DFI)

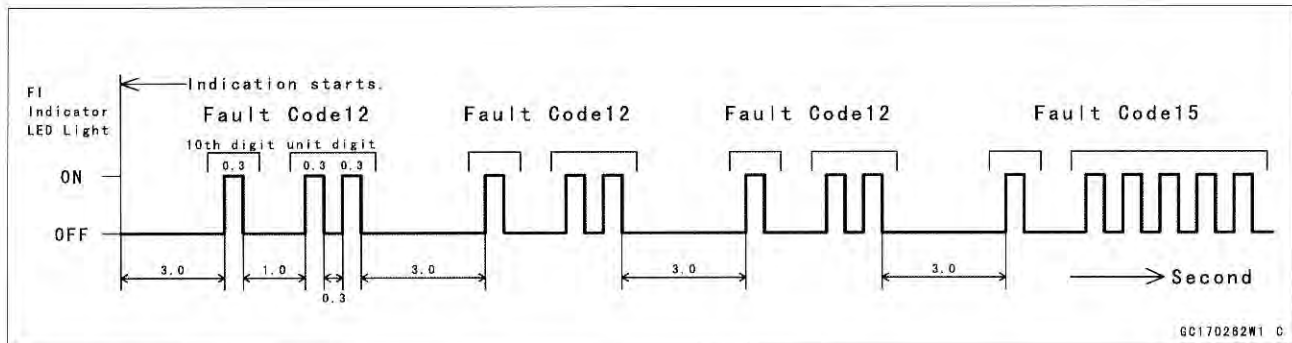
Self-Diagnosis



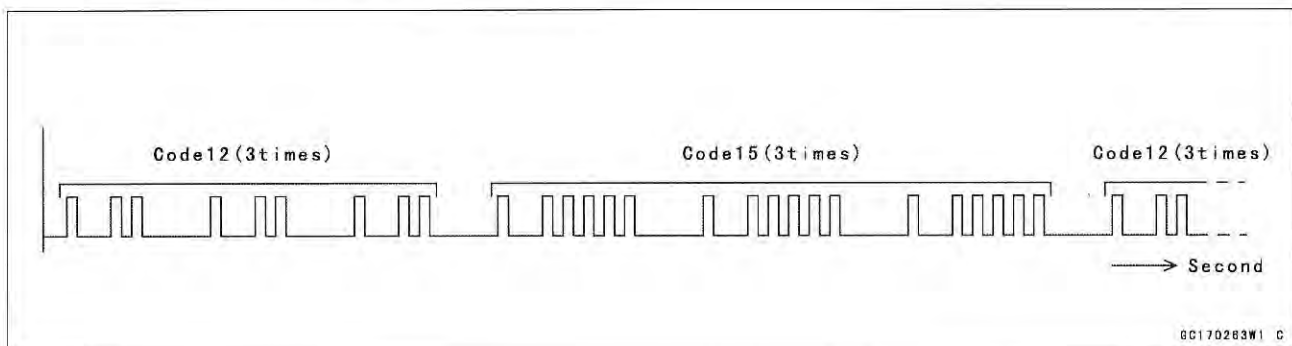
Self-Diagnosis

How to Read Fault Codes

- Fault codes are shown by a series of long and short blinks of the FI indicator LED light as shown below.
- Read 10th digit and unit digit as the FI indicator LED light blinks.
- When there are a number of problems, all the fault codes can be stored and the display will begin starting from the lowest number fault code in the numerical order. Then after completing all codes, the display is repeated until the ignition SW is turned OFF.
- For example, if four problems occurred in the order of 31, 15, 41, 12, the fault codes are displayed from the lowest number in the order listed.
(12 → 15 → 31 → 41) → (12 → 15 → 31 → 41) → ... (repeated)
- If there is no problem or when the repair has been done, no fault code is shown.
- If the problem is with the following parts, the ECU cannot memorize these problems, the FI indicator LED light doesn't go on, and no fault codes can be displayed.
 - FI Indicator LED Light
 - ISC Valves
 - Pressure Regulator (Fuel Pressure, Fuel Flow Rate)
 - DFI Main Relay
 - Ignition Coil Secondary Wiring (check the internal resistance, see Electrical System chapter)
 - ECU Power Source Wiring and Ground Wiring (see ECU Inspection in this chapter)
- For example, if two problems of 12 and 15 occur, the fault code 12 and 15 are shown as follows.



- Each fault code is continuously repeated three times.



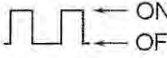
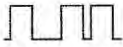
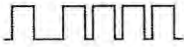
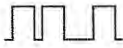
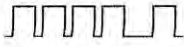
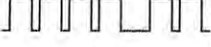
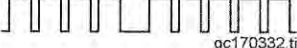
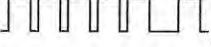
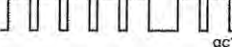
How to Erase Fault Codes

- When the repair has been done, the LED light will not show fault codes any more.
- ★ But even if the repair has been done, the ignition SW is turned OFF, or the battery is disconnected, all the fault codes remain in the ECU, which need not be absolutely erased.

2-62 FUEL SYSTEM (DFI)

Self-Diagnosis

Fault Code Table

Fault Code	FI Indicator LED Light	Problems (1)
11	 gc170322.tif	Throttle sensor malfunction, wiring open or short
12	 gc170323.tif	Vacuum sensor malfunction, wiring open or short
13	 gc170324.tif	Inlet air temperature sensor malfunction, wiring open or short
14	 gc170325.tif	Water temperature sensor malfunction, wiring open or short
15	 gc170326.tif	Atmospheric pressure sensor malfunction, wiring open or short
21	 gc170327.tif	Pickup coil #1 malfunction, wiring open or short
22	 gc170328.tif	Pickup coil #2 malfunction, wiring open or short
31	 gc170329.tif	Vehicle-down sensor, malfunction, wiring open or short
41	 gc170330.tif	Injector #1 malfunction, wiring open or short
42	 gc170331.tif	Injector #2 malfunction, wiring open or short
45	 gc170332.tif	In-tank fuel pump malfunction, wiring open or short
51	 gc170333.tif	Ignition coil primary winding #1 malfunction, wiring open or short
52	 gc170334.tif	Ignition coil primary winding #2 malfunction, wiring open or short

Footnotes:

(1) The ECU may be involved in these problems. If all the parts and circuits checked out good, be sure to check the ECU for ground and power supply. If the ground and power supply are checked good, replace the ECU.

#1: For Front Cylinder

#2: For Rear Cylinder

Self-Diagnosis

Backups

○ The ECU takes the following measures to prevent engine damage when the DFI or the ignition system parts have troubles.

Fault Codes	Parts	Output Signal Usable Range or Criteria	Backups by ECU
11	Throttle Sensor	Throttle Valve Opening Angle $\theta = -4^{\circ} \sim +85^{\circ}$	* If the throttle sensor system fails (the signal is out of the usable range, wiring short or open), the ECU locks ignition timing into the ignition timing at full throttle open position and sets the DFI in the D-J method (1).
12	Vacuum Sensor	Absolute Vacuum $P_v = 63 \text{ mmHg} \sim 860 \text{ mmHg}$	* If the vacuum sensor system fails (the signal P_v is out of the usable range, wiring short or open), the ECU sets the DFI in the α - N method (1).
13	Inlet Air Temperature Sensor	Inlet Air Temperature $T_a = -47^{\circ}\text{C} \sim +178^{\circ}\text{C}$	* If the inlet air temperature sensor fails (the signal is out of the usable range, wiring short or open), the ECU sets T_a at 45°C .
14	Water Temperature Sensor	Water Temperature $T_w = -28^{\circ}\text{C} \sim +161^{\circ}\text{C}$	* If the water temperature sensor system fails (the signal is out of the usable range, wiring short or open), the ECU sets T_w at 86°C .
15	Atmospheric Pressure Sensor	Absolute Atmospheric Pressure $P_a = 63 \text{ mmHg} \sim 860 \text{ mmHg}$	* If the atmospheric pressure sensor system fails (the signal is out of the usable range, wiring short or open), the ECU sets P_a at 760 mmHg (the standard atmospheric pressure).
21	Pickup Coil #1	Either pickup coil must send signals (output voltage) 8 or more times continuously to the ECU.	* If either pickup coil generates 8 or more signals, the ECU runs the engine by the signal of the good pickup coil, but neither pickup coils generate signals, the engine stops by itself.
22	Pickup Coil #2		
31	Vehicle-down Sensor	Vehicle-down Sensor Output Voltage (signal) $V_d = 0.2 \text{ V} \sim 4.6 \text{ V}$	* If the vehicle-down sensor system has failures (the output voltage V_d is out of the usable range, wiring short or open), the ECU shuts off the fuel pump, the fuel injectors and the ignition system.
41	Fuel Injector #1	The injector must send signals (output voltage) 16 or more times continuously to the ECU.	* If the injector #1 fails (signals less than 16 times, wiring short or open), the ECU shuts off the signal to the injector. Fuel is not supplied to the cylinder #1, though the engine keeps running.
42	Fuel Injector #2	The injector must send signals (output voltage) 16 or more times continuously to the ECU.	* If the injector #2 fails (signals less than 16 times, wiring short or open), the ECU shuts off the signal to the injector. Fuel is not supplied to the cylinder #2, though the engine keeps running.
45	In-tank Fuel Pump	The pump must send signals (output voltage) continuously to the ECU.	* If the fuel pump fails (no signals to ECU, wiring short or open), the ECU shuts off the pump, and then the engine stops because of fuel pressure drop.
51	Ignition Coil #1	The ignition coil primary winding must send signals (output voltage) continuously to the ECU.	* If the ignition primary winding #1 has failures (no signal, wiring short or open), the ECU shuts off the injector #1 to stop fuel to the cylinder #1, though the engine keeps running.
52	Ignition Coil #2	The ignition coil primary winding must send signals (output voltage) continuously to the ECU.	* If the ignition primary winding #2 has failures (no signal, wiring short or open), the ECU shuts off the injector #2 to stop fuel to the cylinder #2, though the engine keeps running.

Note:

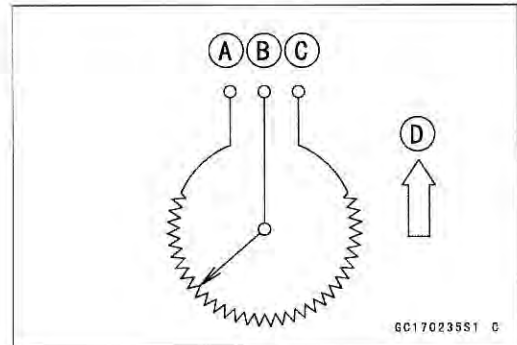
(1) α - N Method: the DFI control method from medium to heavy engine load. When the engine load is light like at idling or low speed, the ECU determines injection quantity by calculating from throttle vacuum (vacuum sensor output voltage) and engine speed (pickup coil output voltage). This method is called D-J method. As engine speed increases, and the engine load turns middle to heavy, the ECU determines injection quantity by calculating from throttle opening (throttle sensor output voltage) and engine speed. This method is called α - N method.

2-64 FUEL SYSTEM (DFI)

Throttle Sensor (Fault Code 11)

The throttle sensor is a rotating variable resistor that change output voltage according to throttle operating. The ECU senses this voltage change and determines fuel injection quantity, and ignition timing according to engine rpm, and throttle opening.

- Input Terminal [A]
- Output Terminal [B]
- Ground Terminal [C]
- Front [D]

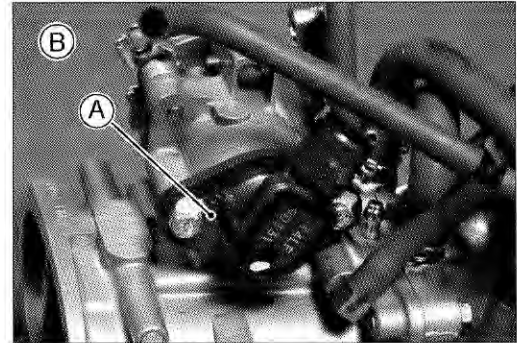


Throttle Sensor Removal/Adjustment

CAUTION

Do not remove or adjust the throttle 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.

Front View [B]



Input Voltage Inspection

NOTE

- Be sure the battery is fully charged.
 - The inspection is the same as "Input Voltage Inspection" of the vacuum sensor or the atmospheric pressure sensor.
 - Turn the ignition SW OFF.
 - Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
 - Connect a digital voltmeter [A] to the connector [B], using two needle adapters [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Measure the input voltage with the engine stopped, and with the connectors joined.
 - Turn the ignition SW ON.

Throttle Sensor Input Voltage

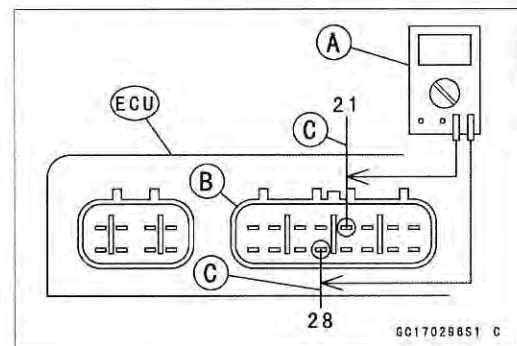
Connections to ECU Connector

- Meter (+) → BL/W lead (terminal 28)
- Meter (-) → BR/BK lead (terminal 21)

Input Voltage at ECU Connector

Standard: 4.75 ~ 5.25 V DC

- Turn the ignition SW OFF.
- ★ If the reading of input voltage is less than the standard, check the ECU for its ground, and power supply. If the ground and power supply are good, replace the ECU.
- ★ If the input voltage is within the standard range, remove the fuel tank, and check the input voltage at the throttle sensor connector.



Throttle Sensor (Fault Code 11)

- Connect a digital meter [A] to the throttle sensor connector [B], using two needle adapters [C].

Front [D]

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

CAUTION

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

- Measure the sensor input voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.

Throttle Sensor Input Voltage

Connections to Sensor

Meter (+) → BL/W lead [E]

Meter (−) → BR/BK lead [F]

Input Voltage at Sensor

Standard: 4.75 ~ 5.25 V DC

- Turn the ignition SW OFF.
- ★ If the reading is out of the range, check the wiring (see the wiring diagram in this section).
- ★ If the reading is good, check the output voltage of the sensor.

Output Voltage Inspection

- Measure the output voltage at the ECU in the same way as input voltage inspection. Note the following.
- Digital Voltmeter [A]
Connector [B]
Needle Adapters [C]
- Start the engine and warm it up thoroughly.
 - Check idle speed to make sure the throttle opening is correct.

Idle Speed

Standard: 950 ± 50 r/min (rpm)

- ★ If the idle speed is out of the specified range, adjust the idle speed (see this chapter).
- Turn off the ignition switch.
- Measure the output voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.

Throttle Sensor Output Voltage

Connections to ECU

Meter (+) → Y/W lead (terminal 26)

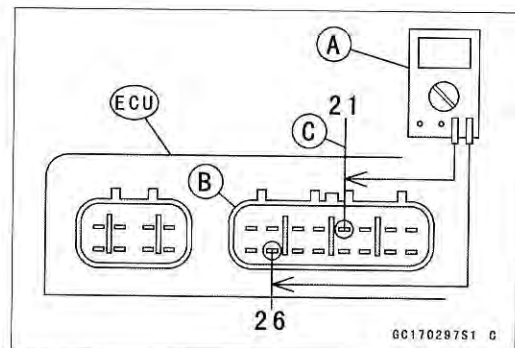
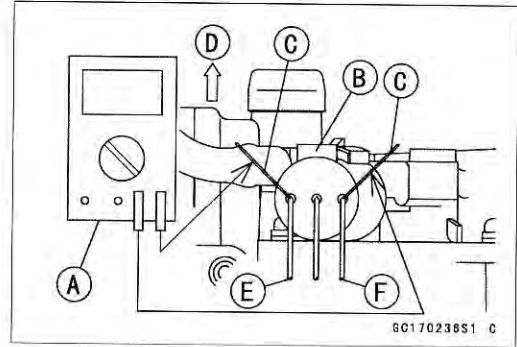
Meter (−) → BR/BK lead (terminal 21)

Output Voltage at ECU

Standard: 0.584 ~ 0.604 V DC (at idle throttle opening)

4.29 ~ 4.59 V DC (at full throttle opening)

- ★ If the output voltage is within the standard range, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the output voltage is far out of the standard range (e.g. when the wiring is open, the reading is 0 V), remove the fuel tank, and check the output voltage again at the sensor connector.



2-66 FUEL SYSTEM (DFI)

Throttle Sensor (Fault Code 11)

- Connect a digital meter [A] to the throttle sensor connector [B], using the needle adapters [C].

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

Front [D]

CAUTION

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

- Measure the sensor output voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.

Throttle Sensor Output Voltage

Connections to Sensor

Meter (+) → Y/W lead [E]

Meter (−) → BR/BK lead [F]

Output Voltage at Sensor

Standard: 0.584 ~ 0.604 V DC (at idle throttle opening)

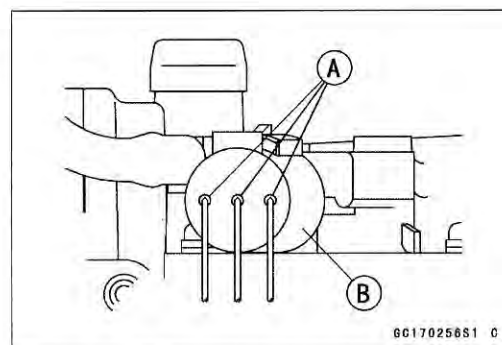
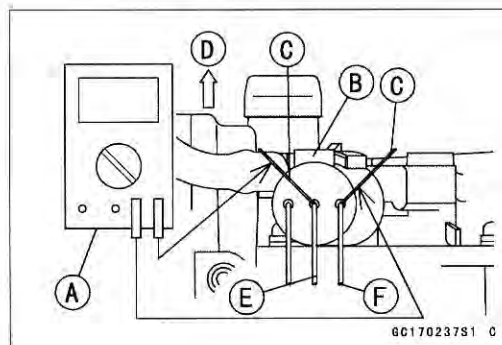
4.29 ~ 4.59 V DC (at full throttle opening)

- ★ If the output voltage is normal, check the wiring for continuity (see next diagram).
- ★ If the reading is out of the standard range, inspect the throttle sensor resistance.

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

Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of Throttle Sensor Connector



Resistance Inspection

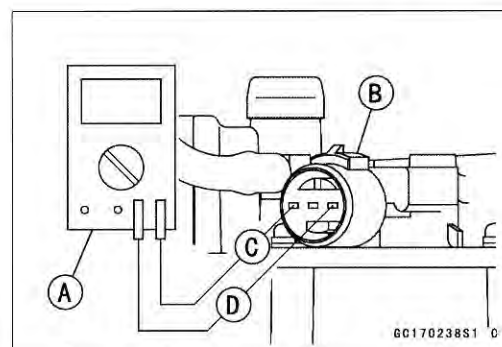
- Turn the ignition switch OFF.
- Disconnect the throttle sensor connector.
- Connect a digital meter [A] to the throttle sensor connector [B].
- Measure the throttle sensor resistance.

Throttle Sensor Resistance

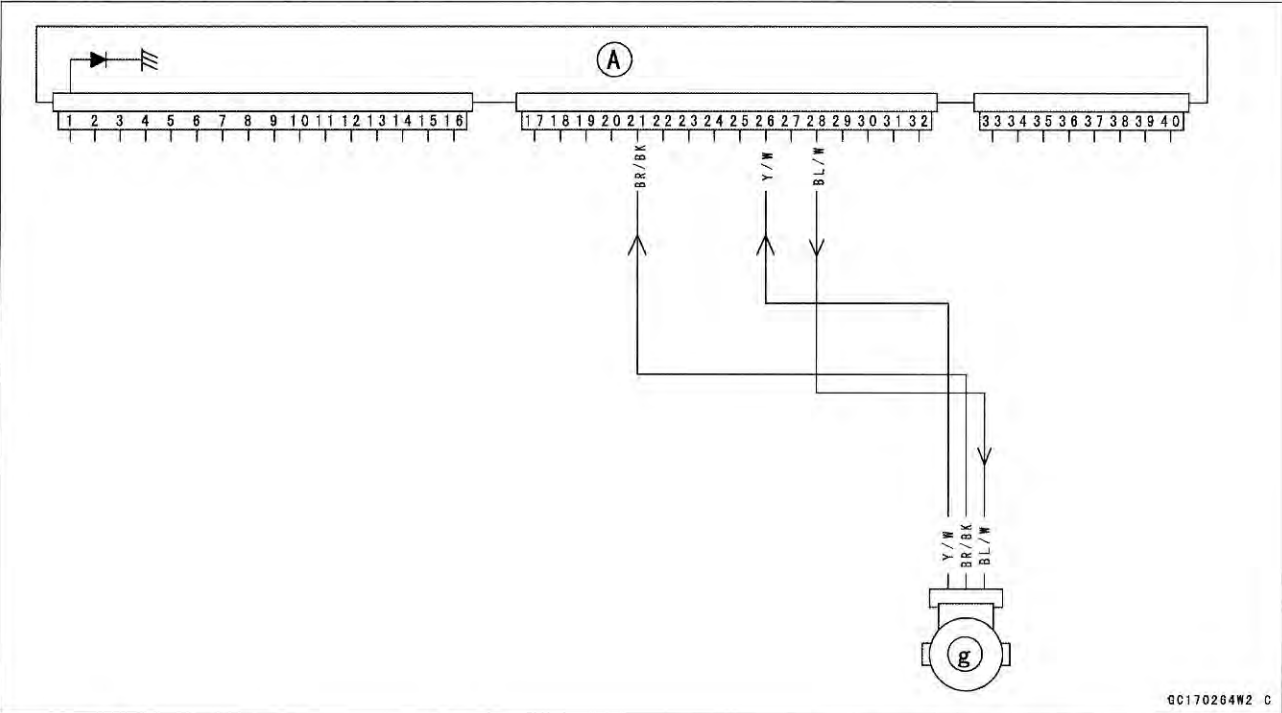
Connections: BL/W lead [C] ↔ BR/BK lead [D]

Standard: 4 ~ 6 kΩ

- ★ If the reading is out of the range, replace the throttle body.
- ★ If the reading is within the range, but the problem still exists, replace the ECU (see this chapter).



Throttle Sensor (Fault Code 11)



→: Signal

ECU [A]

Throttle Sensor [g]

2-68 FUEL SYSTEM (DFI)

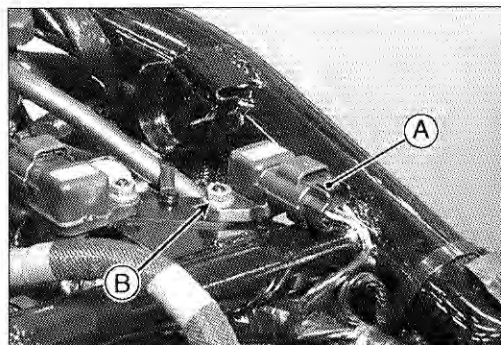
Vacuum Sensor (Fault Code 12)

Removal

CAUTION

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

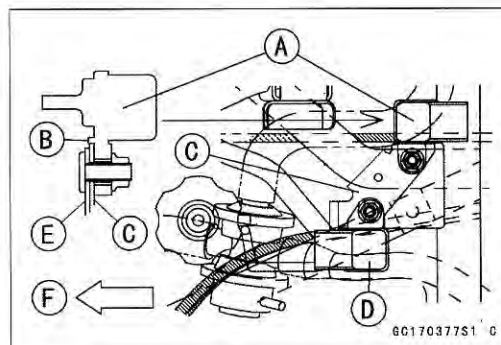
- Remove the fuel tank (see Fuel Tank section in this chapter).
- Disconnect the vacuum sensor connector [A] (left view).
- Unscrew the vacuum sensor nut [B] and remove the sensor.
- Disconnect the vacuum hose from the sensor.



Installation

NOTE

- The vacuum sensor is the same part as the atmospheric pressure sensor except that the vacuum sensor has a vacuum hose and different wiring.
- Route the vacuum hose correctly (see Cable, Wire, and Hose Routing section in the General Information chapter). Make sure it doesn't get pinched or kinked.
- Install the vacuum sensor [A].
- The stopper [B] must not be on the sensor holder [C].
Atmospheric Pressure Sensor [D] (for reference)
Frame Bracket [E]
Front [F]
- Tighten:
Torque - Vacuum Sensor Nut: 9.8 N·m (1.0 kg·m, 87 in·lb)
- Install the fuel tank (see this chapter).



Input Voltage Inspection

NOTE

- Be sure the battery is fully charged.
 - The inspection is the same as "Input Voltage Inspection" of the throttle sensor or the atmospheric pressure sensor.
 - Turn the ignition SW OFF.
 - Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
 - Connect a digital voltmeter [A] to the connector [B], using two needle adapters [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Measure the input voltage with the engine stopped, and with the connectors joined.
 - Turn the ignition SW ON.

Vacuum Sensor Input Voltage

Connections to ECU

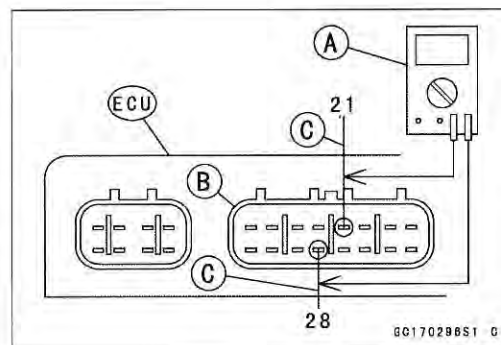
Meter (+) → BL/W lead (terminal 28)

Meter (−) → BR/BK lead (terminal 21)

Input Voltage at ECU

Standard: 4.75 ~ 5.25 V DC

- ★ If the reading is less than the standard range, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.



Vacuum Sensor (Fault Code 12)

- ★ If the reading is within the standard range, remove the fuel tank, and check the input voltage again at the sensor connector [A] (rear view). Needle Adapters [B]
- Measure the input voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.

Vacuum Sensor Input Voltage

Connections to Sensor (front view)

Meter (+) → BL/W lead [C]

Meter (−) → BR/BK lead [D]

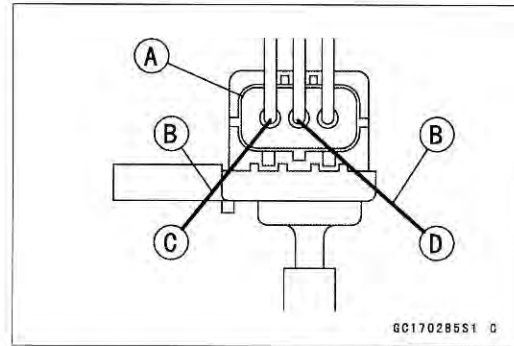
Input Voltage at Sensor Connector

Standard: 4.75 ~ 5.25 V DC

- ★ If the reading is out of the standard range, check the wiring (see wiring diagram in this section).
- ★ If the reading is good, the input voltage is normal. Check the output voltage.
- Turn the ignition SW OFF, remove the needle adapters and apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of Sensor Connector



GC170298S1 0

Output Voltage Inspection

- Measure the output voltage at the ECU in the same way as input voltage inspection. Note the following.

Vacuum Sensor Output Voltage

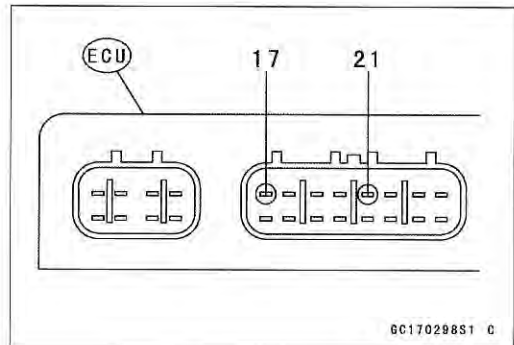
Connections to ECU

Meter (+) → W/BL lead (terminal 17)

Meter (−) → BR/BK lead (terminal 21)

Output Voltage at ECU

Usable Range: 3.74 ~ 4.26 V DC at the standard atmospheric pressure (101.32 kPa, or 76 cmHg abs.)



GC170298S1 0

NOTE

- The output voltage changes according to the local atmospheric pressure.
- The vacuum sensor output voltage is based on a nearly perfect vacuum in the small chamber of the sensor. So, the sensor indicates absolute vacuum.
- ★ If the output voltage is within the usable range, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.

2-70 FUEL SYSTEM (DFI)

Vacuum Sensor (Fault Code 12)

- ★ If the output voltage is far out of the usable range, remove the fuel tank, and check the output voltage again at the sensor connector [A] (when the wire is open, the output voltage is about 1.8 V).
Needle Adapters [B]

Vacuum Sensor Output Voltage

Connections to Sensor (front view)

Meter (+) → W/BL lead [C]

Meter (-) → BR/BK lead [D]

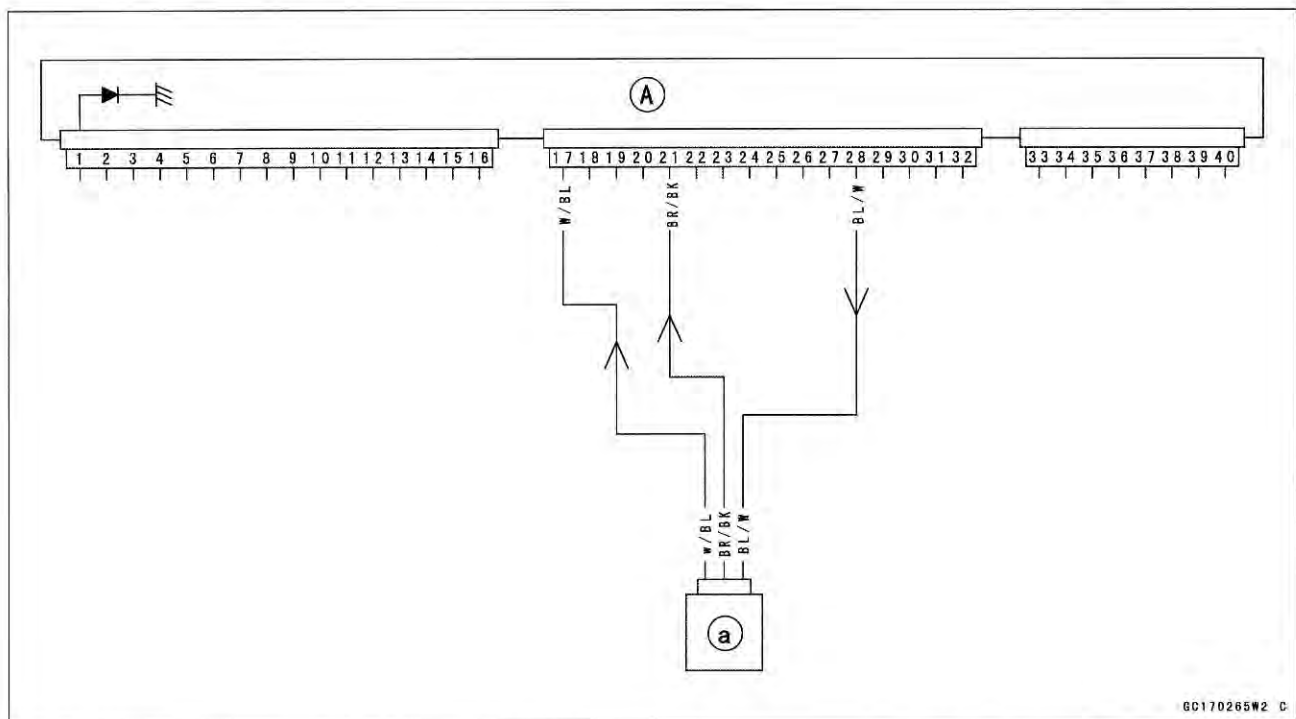
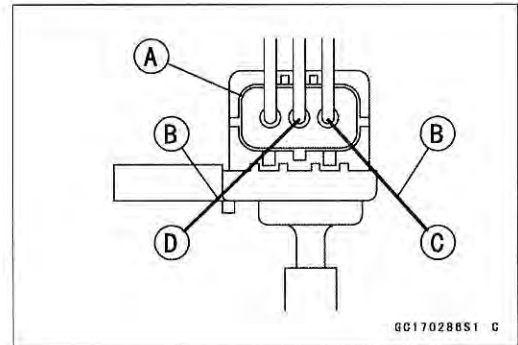
Output Voltage at Sensor Connector

Usable Range: 3.74 ~ 4.26 V DC at the standard atmospheric pressure (101.32 kPa, or 76 cmHg absolute)

- ★ If the output voltage is normal, check the wiring for continuity (see next diagram).
- ★ If the output voltage is out of the usable range, replace the sensor.
- Turn the ignition SW OFF and remove the needle adapters.
- Apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Sensor Connector Seals



→: Signal

ECU [A]

Vacuum Sensor [a]

Vacuum Sensor (Fault Code 12)

★ If you need to check the vacuum sensor for vacuum other than 76 cmHg (abs), check the output voltage as follows:

- Remove the fuel tank (see this chapter).
- Remove the vacuum sensor [D] and disconnect the vacuum hose from the sensor.
- Connect an auxiliary hose [E] to the vacuum sensor.
- Temporarily install the vacuum sensor.
- Connect a commercially available digital meter [A], the needle adapters [F], vacuum gauge [B], and the fork oil level gauge [C] to the vacuum sensor.

Special Tools - Fork Oil Level Gauge: 57001-1290

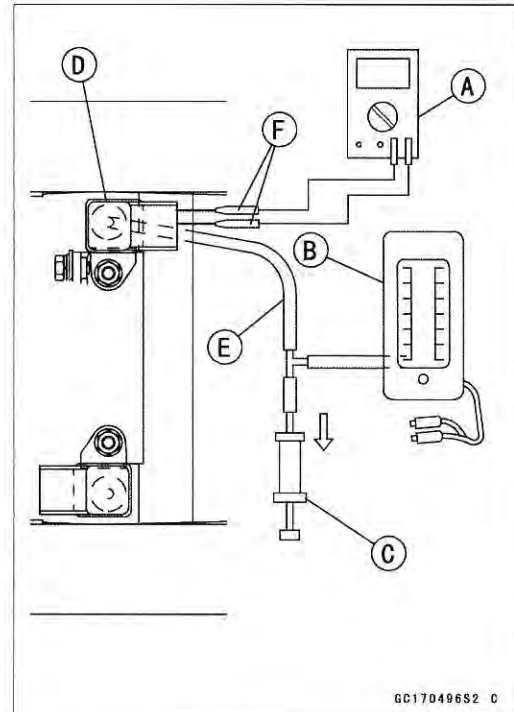
Needle Adapter Set — Hand Tester: 57001-1457

Digital Volt Meter Connections

Meter (+) → W/BL lead of Vacuum Sensor

Meter (−) → BR/BK lead of Vacuum Sensor

- Turn the ignition SW ON.
- Measure the vacuum sensor output voltage from various vacuum readings, while pulling the handle of the fork oil level gauge.
- Check the vacuum sensor output voltage, using the following formula and charts for $P_v = 24 \sim 55 \text{ cm Hg}$ and $55 \sim 86 \text{ cm Hg}$.



2-72 FUEL SYSTEM (DFI)

Vacuum Sensor (Fault Code 12)

Suppose:

Pg : Vacuum (gauge) of Throttle Assy

PI : Local Atmospheric Pressure (absolute) measured by a barometer

Pv : Vacuum (absolute) of Throttle Assy

Vv : Sensor Output Voltage (v)

then

$$P_v = P_I - P_g$$

For example, suppose the following data is obtained:

Pg = 8 cmHg (vacuum gauge reading)

PI = 70 cmHg (barometer reading)

Vv = 3.2 V (digital volt meter reading)

then

$$P_v = 70 - 8 = 62 \text{ cmHg (abs)}$$

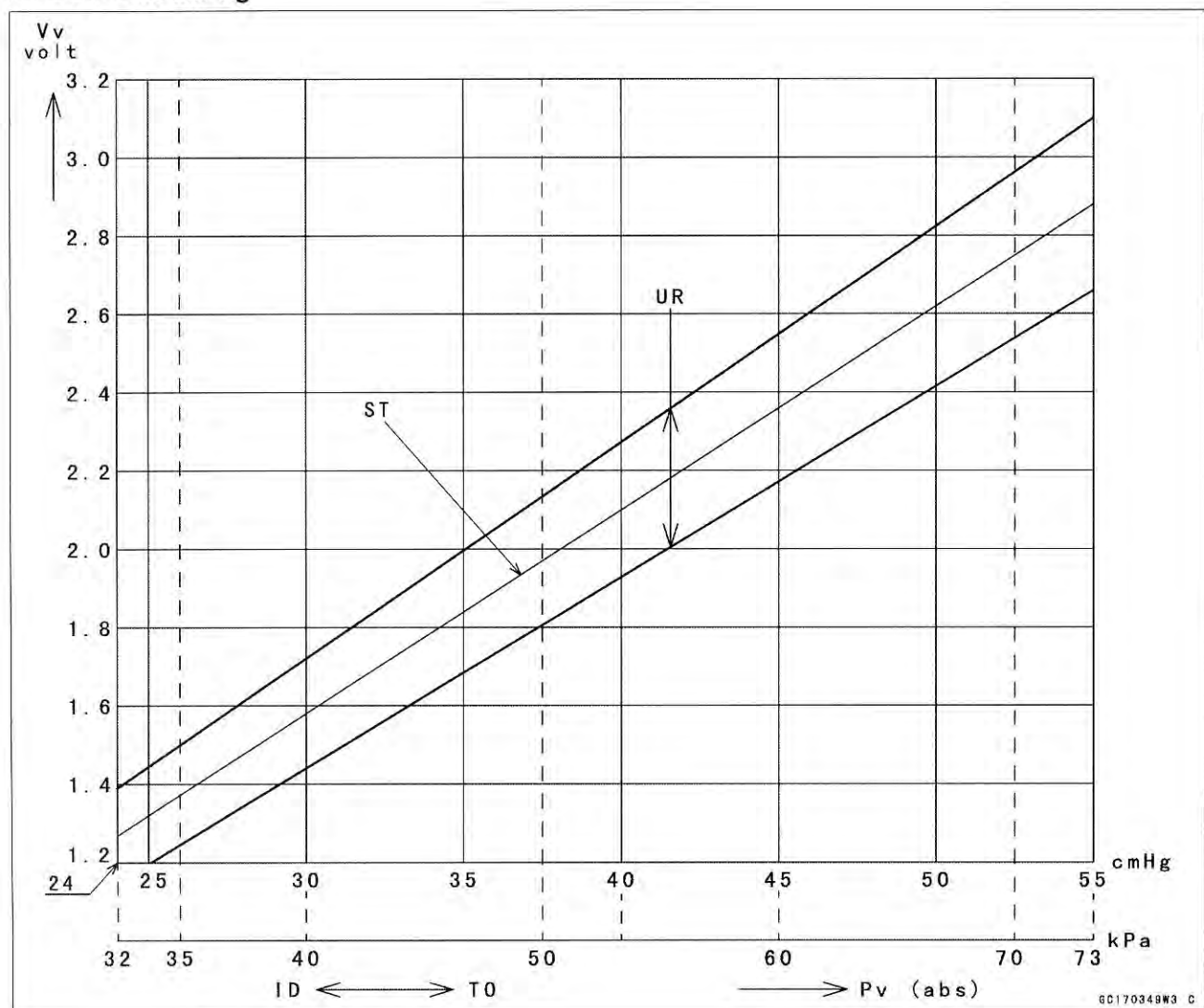
Plot this Pv (62 cmHg) at a point [1] on the chart and draw a vertical line through the point. Then, you can get the usable range [2] of the sensor output voltage.

Usable range = 3.04 ~ 3.49 V

Plot Vv (3.2 V) on the vertical line. → Point [3].

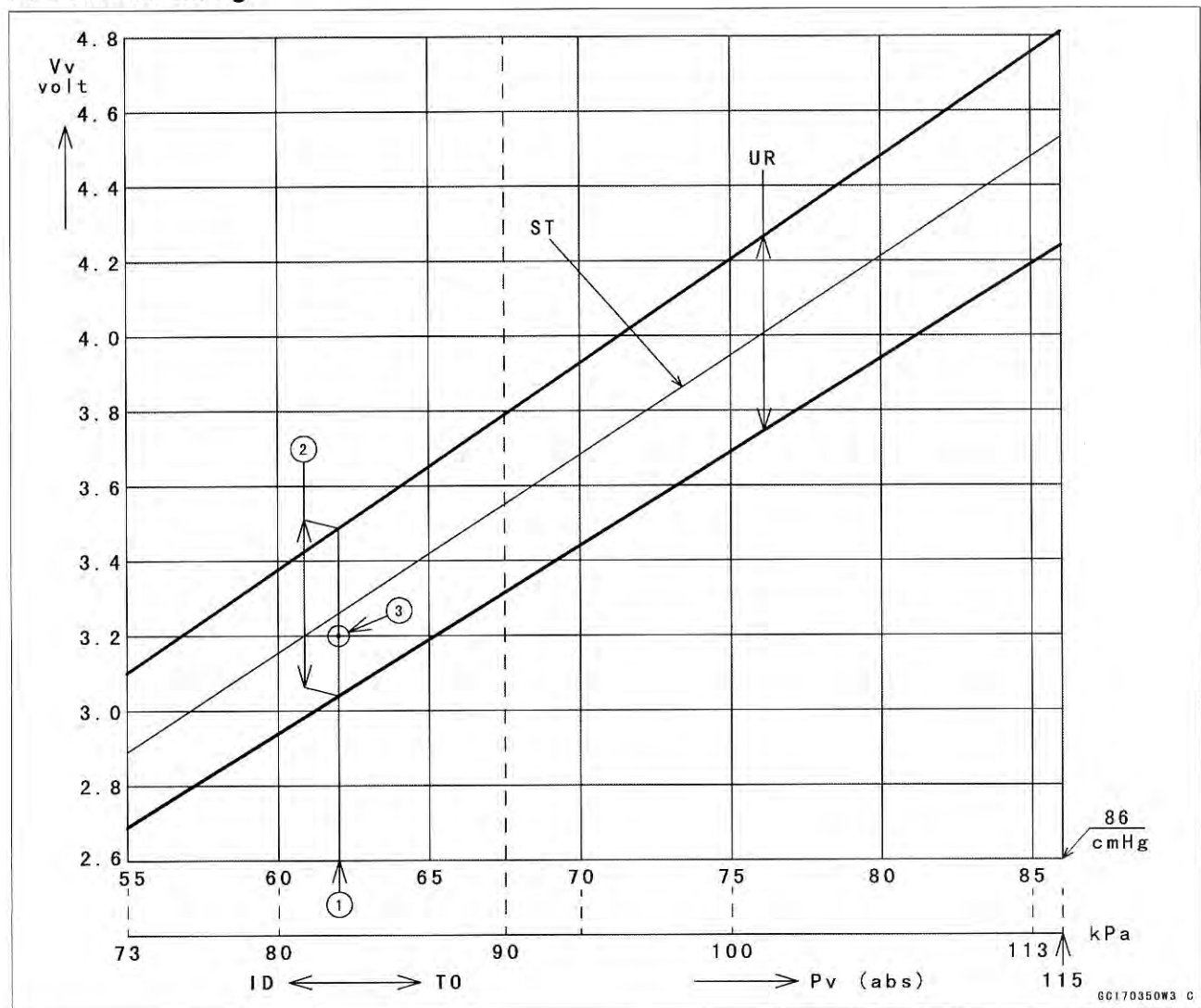
Results: In the chart, Vv is within the usable range and the sensor is normal.

Pv = 24 ~ 55 cm Hg



Vacuum Sensor (Fault Code 12)

Pv = 55 ~ 86 cm Hg



Vv: Vacuum Sensor Output Voltage (V)
(Digital Meter Reading)

Pv: Throttle Vacuum (absolute)

Ps: Standard Atmospheric Pressure (absolute)

ID: Idling

TO: Throttle Full Open

ST: Standard of Sensor Output Voltage (v)

UR: Usable Range of Sensor Output Voltage (v)

60170350W3 G

2-74 FUEL SYSTEM (DFI)

Inlet Air Temperature Sensor (Fault Code 13)

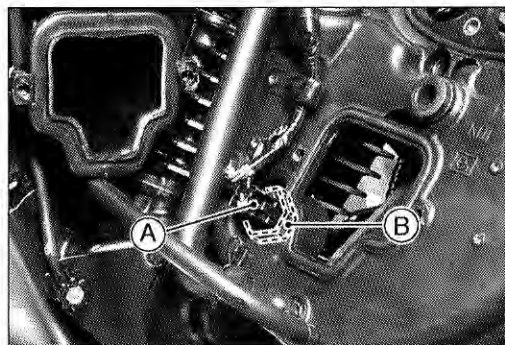
Removal/Installation

CAUTION

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

- Remove the right air cleaner base (see Right Air Cleaner Housing Removal in this chapter).
- Disconnect the connector [A] from the inlet air temperature sensor, and unscrew the nut [B].
- Remove the inlet air temperature sensor.

Torque - Inlet Air Temperature Sensor Nut: 7.8 N·m (0.8 kg·m, 69 in·lb)



Output Voltage Inspection

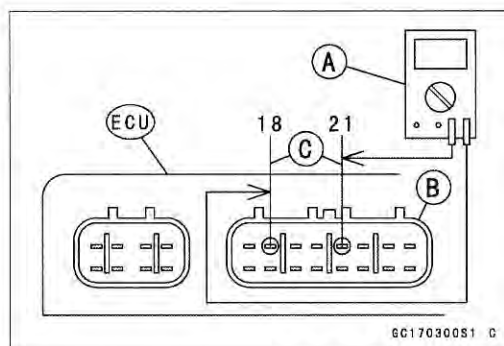
NOTE

○ Be sure the battery is fully charged.

- Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
- Connect a digital voltmeter [A] to the ECU connector [B], using two needle adapters [C].

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

- Measure the sensor output voltage with the engine stopped and the connector joined.
- Turn the ignition SW ON.



Inlet Air Temperature Sensor Output Voltage

Connections to ECU Connector

Meter (+) → P lead (terminal 18)

Meter (-) → BR/BK lead (terminal 21)

Output Voltage at ECU

Standard: 2.6 V at inlet air temperature 20°C

NOTE

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

- Turn the ignition SW OFF.
- ★ If the output voltage is out of the specified, check the ECU for its ground, and power supply (see ECU section in this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the output voltage is far out of the specified (e.g. when the wiring is open, the voltage is about 4.6 V), remove the right air cleaner base, and check the wiring (see next diagram).
- Remove the needle adapters, and apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of ECU Connectors

- ★ If the wiring is good, check the sensor resistance.

Inlet Air Temperature Sensor (Fault Code 13)

Sensor Resistance Inspection

- Remove the inlet air temperature sensor (see this section).
- 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.

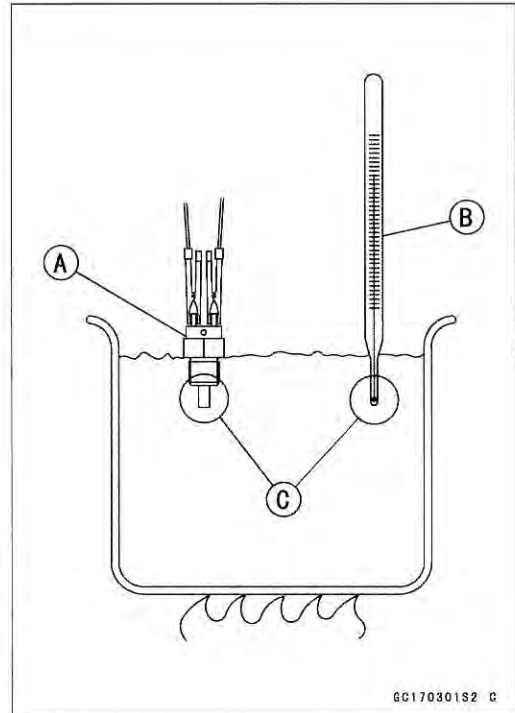
NOTE

- 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.

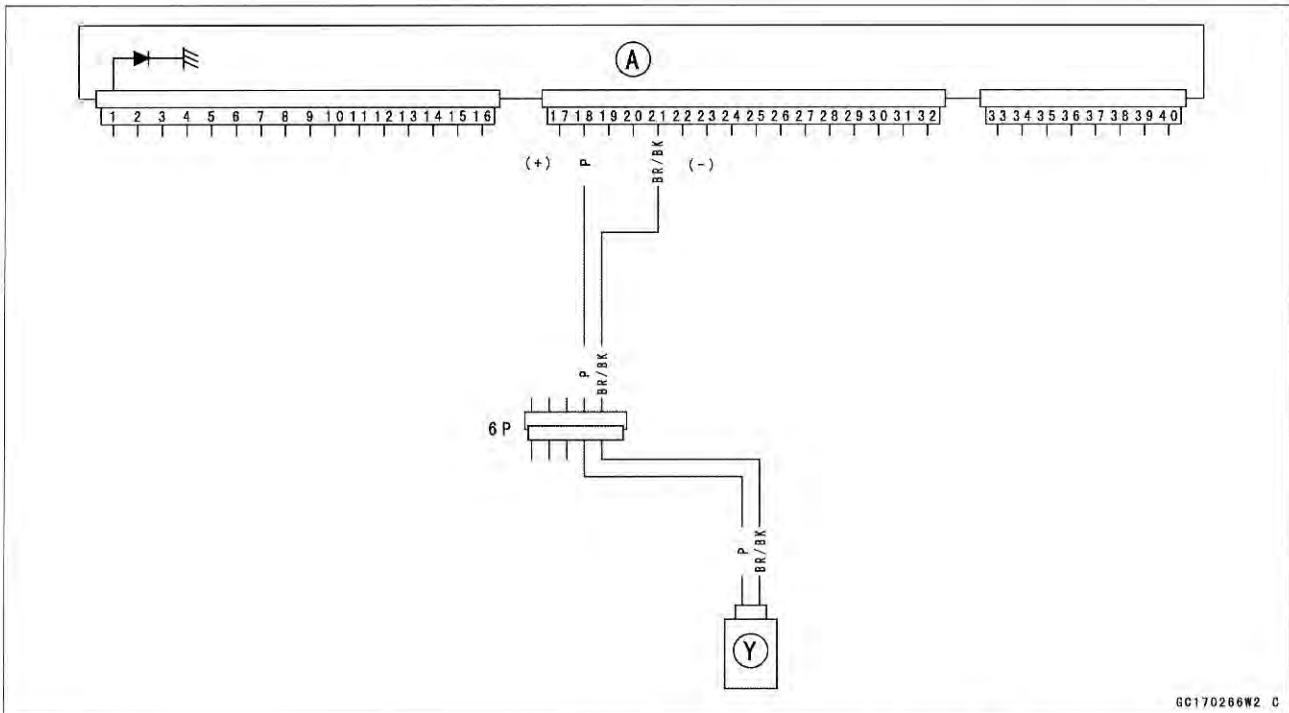
Inlet Air Temperature Sensor Resistance

Standard:	5.4 ~ 6.6 kΩ at 0°C
	2.26 ~ 2.86 kΩ at 20°C
	0.29 ~ 0.39 kΩ at 80°C

- ★ If the measurement is out of the range, replace the sensor.
- ★ If the measurement is within the specified, replace the ECU.
- Clean off machine oil that inadvertently gets on the sensor, especially on the terminals with a high-flush point solvent.



GC170301S2 C



GC170266W2 C

ECU [A]

Inlet Air Temperature Sensor [Y]

2-76 FUEL SYSTEM (DFI)

Water Temperature Sensor (Fault Code 14)

Removal/Installation

CAUTION

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

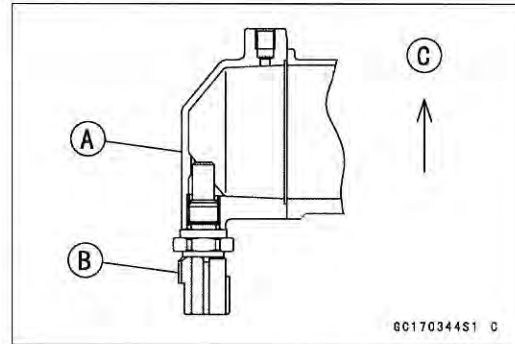
- Remove the thermostat housing [A] (see Thermostat Removal in the Cooling System chapter).
 - Disconnect the sensor connector, and unscrew the water temperature sensor [B].
- Top [C]

Silicone Sealant (Kawasaki Bond: 56019-120)

- Threads of Water Temperature Sensor

Torque - Water Temperature Sensor: 18 N·m (1.8 kg·m, 13 ft·lb)

- Fill the engine with coolant and bleed the air from the cooling system (see Coolant Filling in the Cooling System chapter).



Output Voltage Inspection

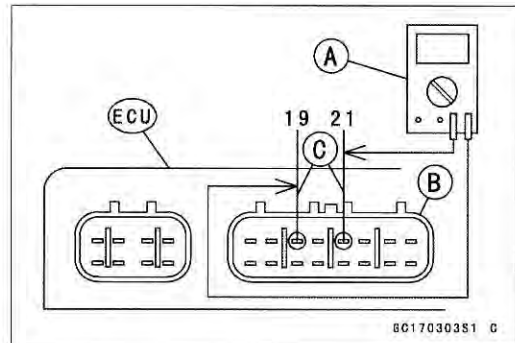
NOTE

○ Be sure the battery is fully charged.

- Remove the ECU (see this chapter). Do not disconnect the connectors.
- Connect a digital voltmeter [A] to the ECU connector [B], using two needle adapters [C].

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

- Measure the sensor output voltage with the engine stopped and the connector joined.
- Turn the ignition SW ON.



Water Temperature Sensor Output Voltage

Connections to ECU

Meter (+) → O lead (terminal 19)

Meter (-) → BR/BK lead (terminal 21)

Output Voltage at ECU

Standard: 3.5 V at coolant temperature 20°C

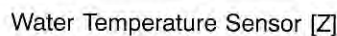
NOTE

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

- Turn the ignition SW OFF.
- ★ If the output voltage is out of the specified, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the output voltage is far out of the specified (e.g. when the wiring is open, the voltage is about 5V), check the wiring (see next diagram).
- ★ If the wiring is good, check the water temperature sensor resistance.
- Remove the needle adapters, and apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of ECU Connectors



2-78 FUEL SYSTEM (DFI)

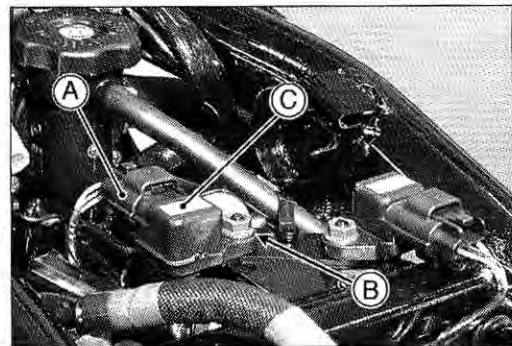
Atmospheric Pressure Sensor (Fault Code 15)

Removal

CAUTION

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

- Remove the fuel tank (see Fuel Tank section in this chapter).
- Disconnect the sensor connector [A] (rear view).
- Remove the atmospheric pressure sensor nut [B].
- Remove the atmospheric pressure sensor [C].



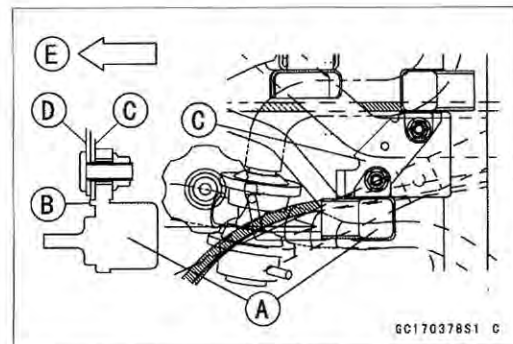
Installation

NOTE

- The atmospheric pressure sensor is the same part as the vacuum sensor except that the vacuum sensor has a vacuum hose and different wiring.
- Install the atmospheric pressure sensor [A].
- The stopper [B] must not be on the sensor holder [C].
Frame Bracket [D]
Front [E]

Torque - Atmospheric Pressure Sensor Nut: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Install the fuel tank (see this chapter).



Input Voltage Inspection

NOTE

- Be sure the battery is fully charged.
 - The inspection is the same as "Input Voltage Inspection" of the throttle sensor or the vacuum sensor.
 - Turn the ignition SW OFF.
 - Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
 - Connect a digital voltmeter [A] to the connector [B], using two needle adapters [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Measure the input voltage with the engine stopped, and with the connectors joined.
 - Turn the ignition SW ON.

Atmospheric Pressure Sensor Input Voltage

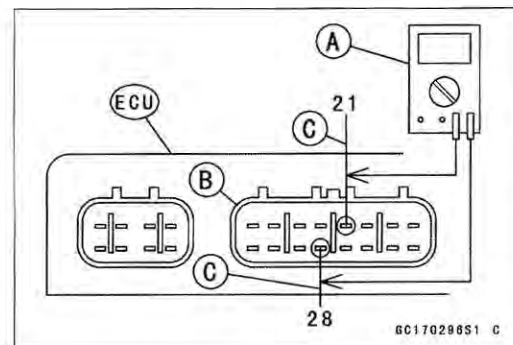
Connections to ECU

Meter (+) → BL/W lead (terminal 28)

Meter (−) → BR/BK lead (terminal 21)

Input Voltage at ECU

Standard: 4.75 ~ 5.25 V DC



- ★ If the reading of input voltage is less than the standard range, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.

Atmospheric Pressure Sensor (Fault Code 15)

- ★ If the reading is within the standard range, remove the fuel tank, and check the input voltage again at the sensor connector [A] (front view).
Needle Adapters [B]
- Measure the input voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.

Atmospheric Pressure Sensor Input Voltage

Connections to Sensor (rear view)

Meter (+) → BL/W lead [C]

Meter (-) → BR/BK lead [D]

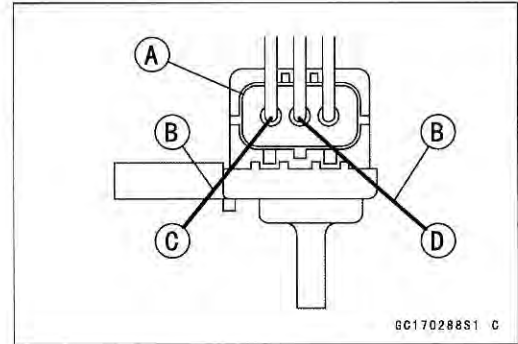
Input Voltage at Sensor Connector

Standard: 4.75 ~ 5.25 V DC

- ★ If the reading is out of the standard range, check the wiring (see wiring diagram in this section).
- ★ If the reading is good, the input voltage is normal. Check the output voltage.
- Turn the ignition SW OFF.
- Remove the needle adapters.
- Apply silicone sealant to the seals of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Sensor Connector Seals



Output Voltage Inspection

- Measure the output voltage at the ECU in the same way as input voltage inspection. Note the following.
Digital Meter [A]
ECU Connector [B]
Needle Adapters [C]

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

Atmospheric Pressure Sensor Output Voltage

Connections to ECU

Meter (+) → BL/Y lead (terminal 27)

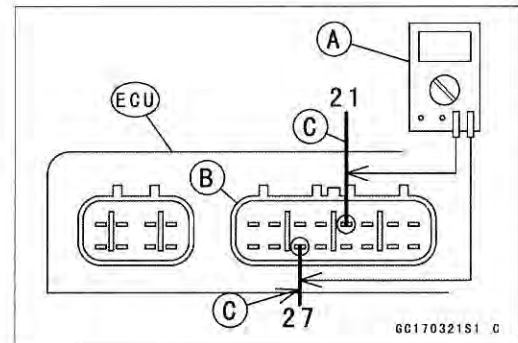
Meter (-) → BR/BK lead (terminal 21)

Output Voltage

Usable Range: 3.74 ~ 4.26 V DC at the standard atmospheric pressure (101.32 kPa, or 76 cmHg abs.)

NOTE

- The output voltage changes according to the local atmospheric pressure.
- The atmospheric sensor output voltage is based on a nearly perfect vacuum in the small chamber of the sensor. So, the sensor indicates absolute atmospheric pressure.
- ★ If the output voltage is within the usable range, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.



2-80 FUEL SYSTEM (DFI)

Atmospheric Pressure Sensor (Fault Code 15)

- ★ If the output voltage is far out of the usable range, remove the fuel tank, and check the output voltage at the sensor connector [A] (when the wiring is open, the output voltage is about 1.8 V).

Needle Adapters [B]

Atmospheric Pressure Sensor Output Voltage

Connections to Sensor (rear view)

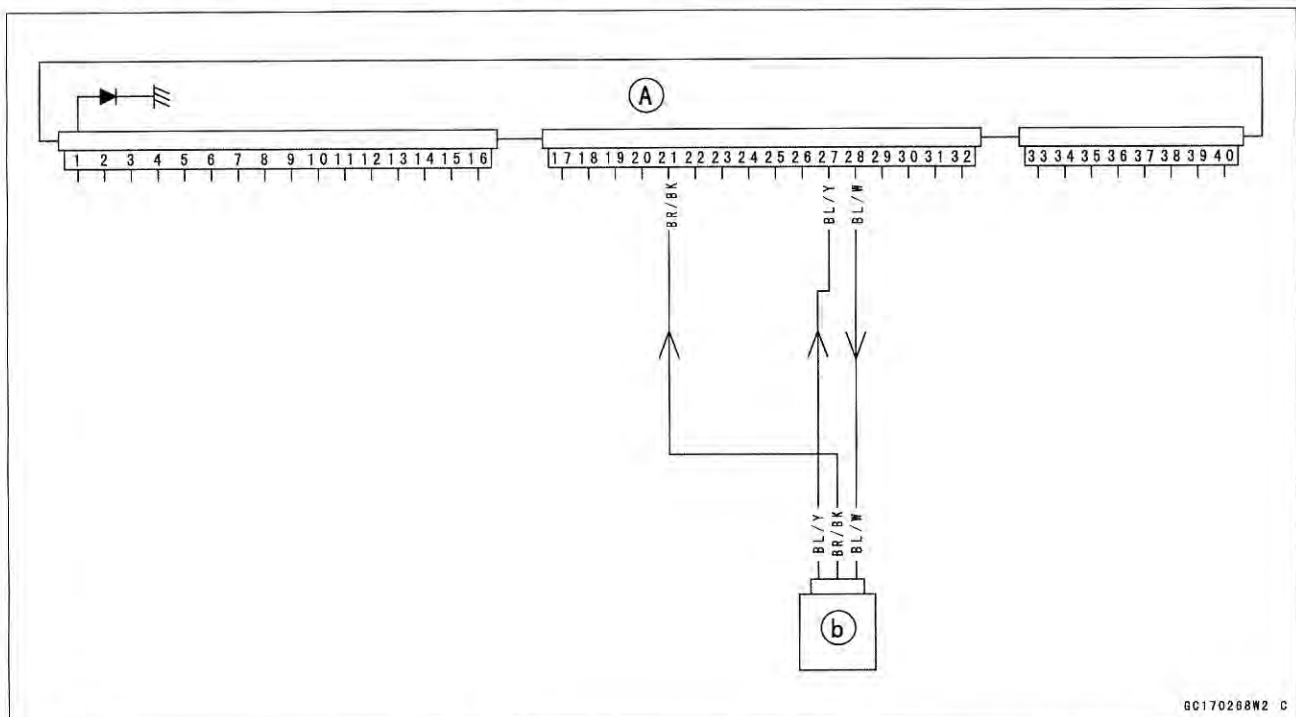
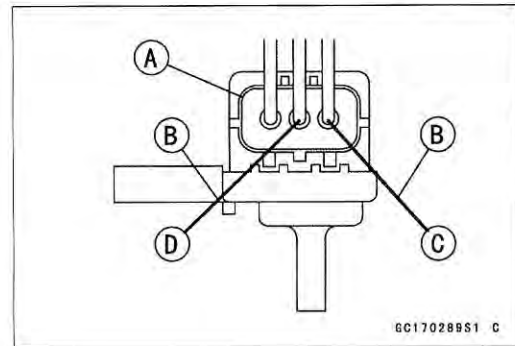
Meter (+) → BL/Y lead [C]

Meter (−) → BR/BK lead [D]

Output Voltage at Sensor

Usable Range: 3.74 ~ 4.26 V DC at the standard atmospheric pressure (101.32 kPa, or 76 cmHg abs)

- ★ If the output voltage is normal, check the wiring for continuity (see next diagram).
- ★ If the output voltage is out of the usable range, replace the sensor.



→: Signal

ECU [A]

Atmospheric Pressure Sensor [b]

Atmospheric Pressure Sensor (Fault Code 15)

- ★ If you need to check the atmospheric pressure sensor for various altitudes other than sea level, check the output voltage as follows:
 - Determine the local altitude (elevation).
- ★ If you know the local atmospheric pressure using a barometer, substitute the atmospheric pressure for Pv (Throttle Vacuum) in the vacuum sensor chart (see Vacuum Sensor section in this chapter).
- Get the usable range of the atmospheric pressure sensor output voltage in the same way as Output Voltage Inspection of the vacuum sensor and check if Va (output voltage) is within the usable range or not.
- ★ If you know the local altitude, use the following chart.

For example:

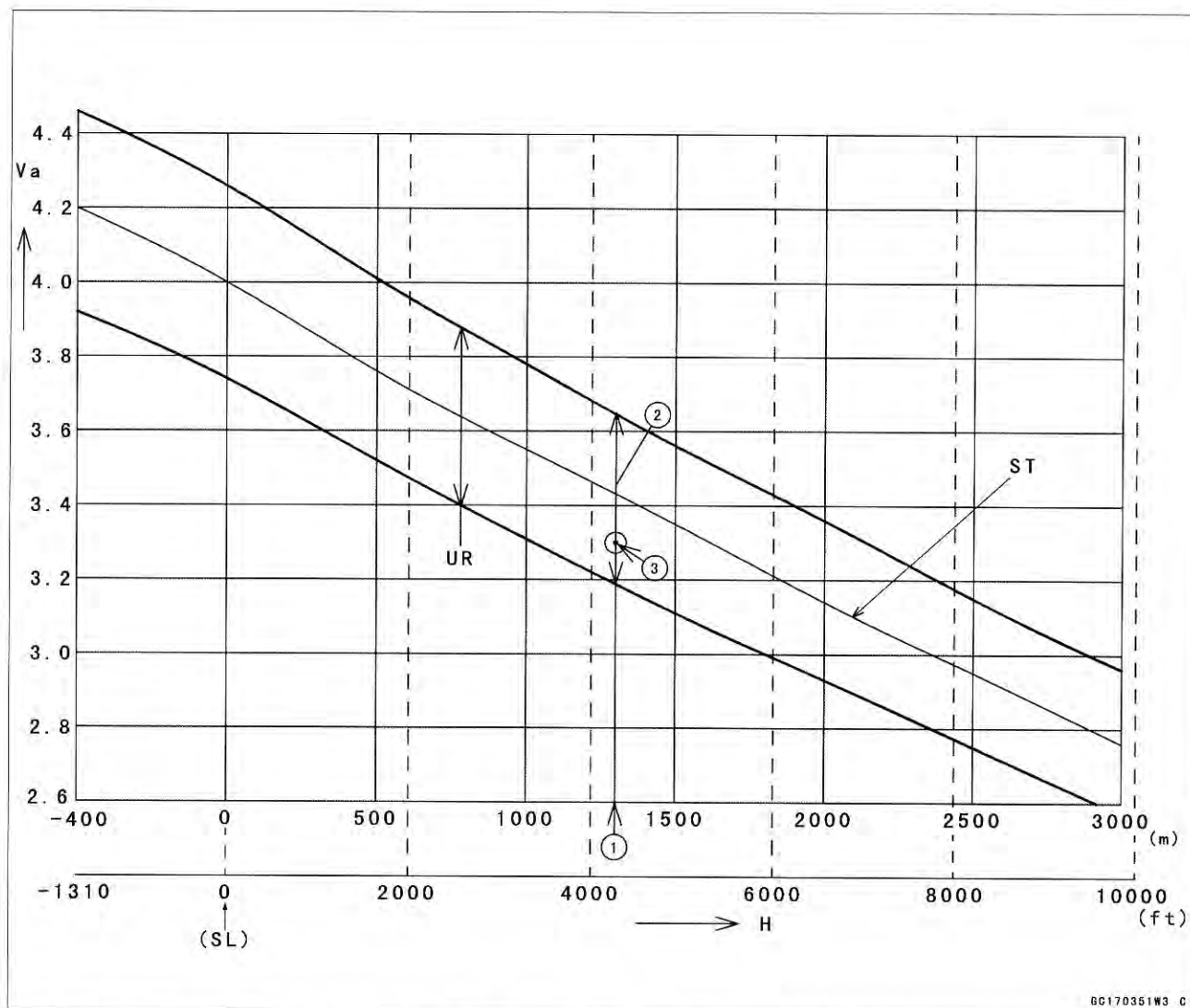
Suppose the local altitude is 1300 m (4200 ft) and the sensor output voltage Va is 3.3 V.

Plot this H (1300 m) at a point [1] on the following chart and draw a vertical line through the point. Then, you can get the usable range [2] of the sensor output voltage.

Usable Range = 3.2 ~ 3.64 V

Plot Va (3.3 V) on the vertical line → Point [3]

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



Va: Atmospheric Pressure Sensor Output Voltage (v)
 H: Altitude (m or feet)
 SL: Sea Level (0 m)

ST: Standard of Sensor Output Voltage (v)
 UR: Usable Range of Sensor Output Voltage (v)

2-82 FUEL SYSTEM (DFI)

Pickup Coils (#1, #2: Fault Code 21, 22)

Pickup Coil #1: for Front Cylinder (Fault Code 21)

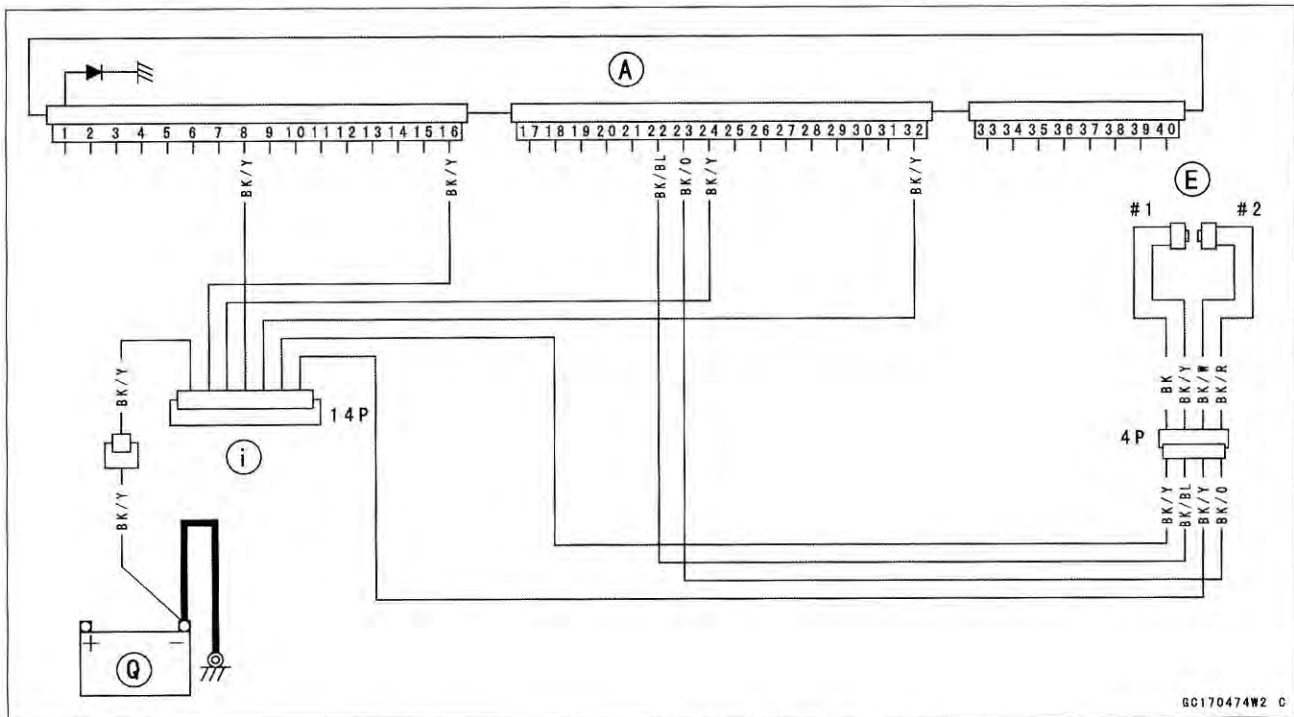
Pickup Coil #2: for Rear Cylinder (Fault Code 22)

Pickup Coil Removal/Installation

- See Ignition System section in the Electrical System chapter.

Pickup Coil Inspection

- The pickup coils have no power source, and when the engine stops, the pickup coils generates no signals.
- Crank the engine and measure the peak voltage of the pickup coils (see Electrical System chapter) in order to check the coils.
- Check the wiring for continuity, using the following diagram.



ECU [A]

MF Battery 12 V 18 Ah

Pickup Coils [E]

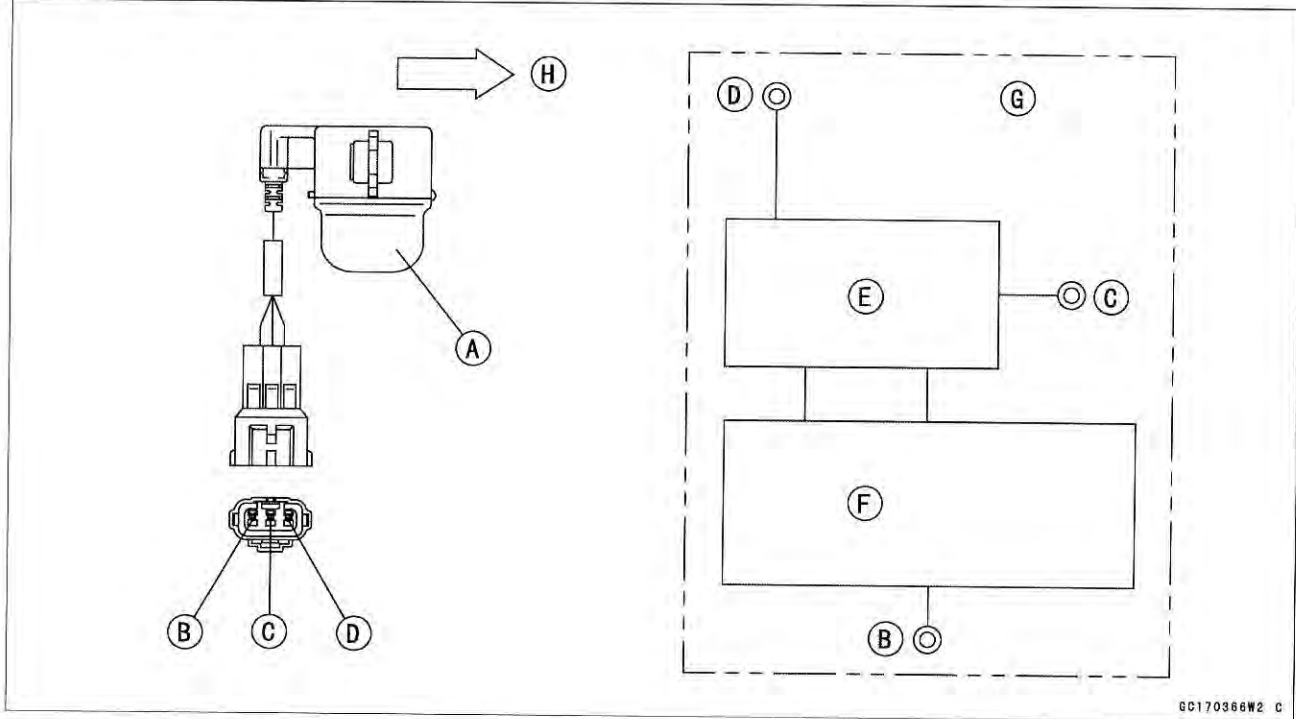
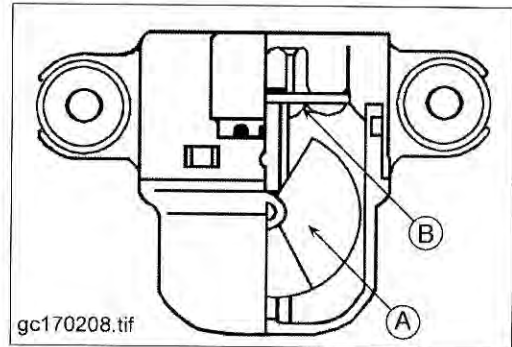
Joint Connector [i]

Vehicle-down Sensor (Fault Code 31)

This sensor has a weight [A] with two magnets inside, and sends a signal to the ECU. But when the motorcycle banks (40 ~ 50°) or more to either side (in fact falls down), the weight turns and shuts off the signal. The ECU senses this change, and stops the fuel pump, the fuel injectors, and the ignition system.

Hall IC [B]

When the motorcycle is down, the ignition SW is left ON. If the starter button is pushed, the electric starter turns but the engine doesn't start. To start the engine again, raise the motorcycle, turn the ignition SW OFF, and then ON. When the ignition SW is turned ON, current flows through the latch-up circuit and the transistor in the circuit is turned ON to unlock the latch-up circuit.



Vehicle-down Sensor [A]

Ground Terminal [B]

Output Terminal [C]

Power Source Terminal [D]

Constant Voltage Circuit [E]

Hall IC (Integrated Circuit, or Latch-up Circuit) [F]

Vehicle-down Sensor Circuit [G]

Front [H]

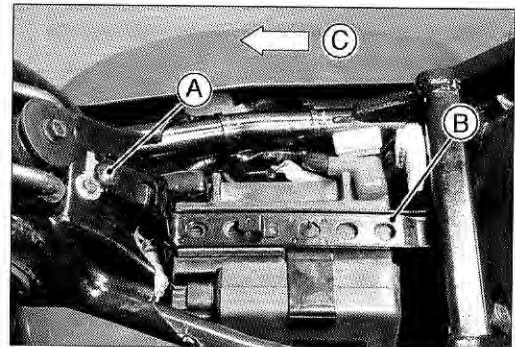
GC170366W2 C

Removal

CAUTION

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

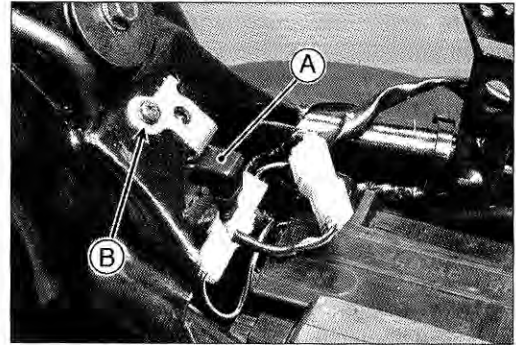
- Remove:
 - Seat (see Frame chapter)
 - Screw [A] and Battery Holder [B]
 - Front [C]



2-84 FUEL SYSTEM (DFI)

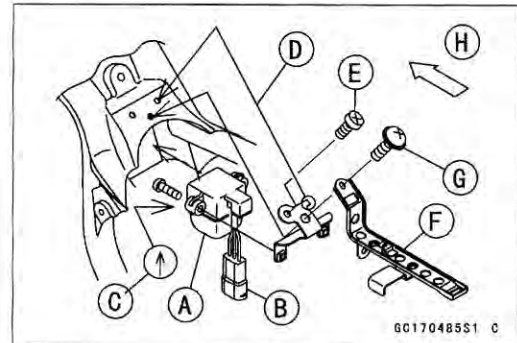
Vehicle-down Sensor (Fault Code 31)

- Remove the screw [B] and take out the vehicle-down sensor [A].
- Raise the lock, and disconnect the connector to complete sensor removal.



Installation

- Install the vehicle-down sensor assy [A] so that the sensor connector [B] faces backward. The arrow mark [C] on the sensor front must point upward.
- Insert the sensor bracket hook [D] into the hole as shown.
- Tighten the sensor bracket screw [E].
- Install the battery holder [F] and tighten the holder screw [G].
- Front [H]
- Install the seat (see Frame chapter).



⚠ WARNING

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

Inspection

NOTE

○ Be sure the battery is fully charged.

- Take out the vehicle-down sensor [A] (see this section). Do not disconnect the connector [B].
- Connect a digital volt meter [C] to the connector (natural, 3P), using two needle adapters [D].

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

- Turn the ignition SW ON, and measure the power source voltage with the connector joined.

Vehicle-down Sensor Power Source Voltage

Connections to Sensor

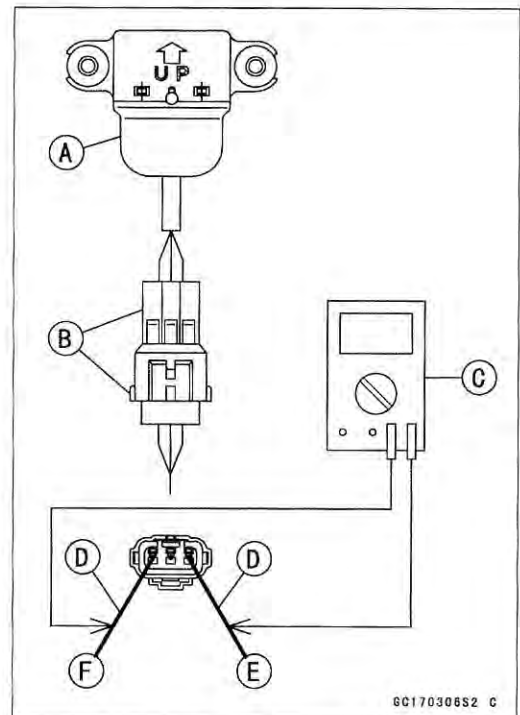
Meter (+) → BR lead [E]

Meter (-) → BK/Y lead [F]

Power Source Voltage at Sensor

Standard: Battery Voltage (12.5 V or more)

- Turn the ignition SW OFF.
- ★ If there is no battery voltage, check the following:
 - Battery (see Electrical System chapter)
 - Ignition Fuse 10 A in Junction Box
 - Wiring for Vehicle-down Sensor Power Source (see next diagram)



Vehicle-down Sensor (Fault Code 31)

- ★ If the power source is normal, check the output voltage.
- Connect a digital volt meter [A] to the connector (natural, 3P), using two needle adapters [B].
- Turn the ignition SW ON, and measure the output voltage with the connector joined.
- Tilt the sensor (40 ~ 50°) or more [C] right or left, then hold the sensor almost vertical [D] with the arrow mark pointed up, and measure the output voltage.

Vehicle-down Sensor Output Voltage

Connections to Sensor

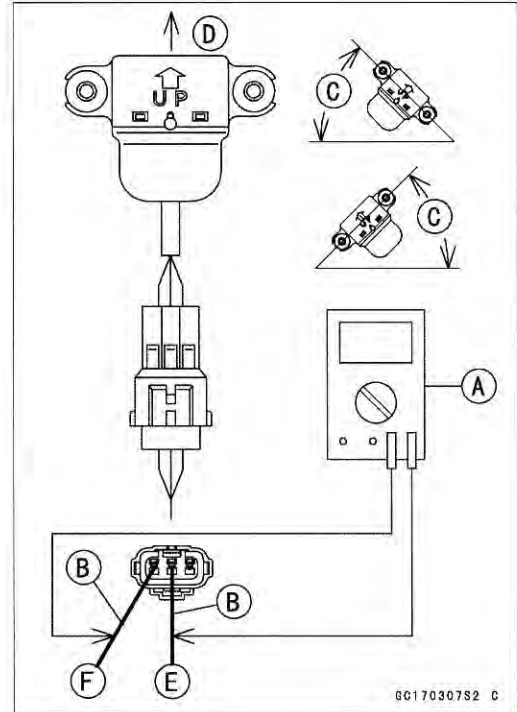
- Meter (+) → Y/G lead [E]
- Meter (-) → BK/Y lead [F]

Output Voltage at Sensor

- Standard: with sensor tilted 40 ~ 50° or more right or left:
3.7 ~ 4.4 V
- with sensor arrow mark pointed up: 0.4 ~ 1.4 V

NOTE

- If you need to test again, turn the ignition SW OFF, and then ON.



- Turn the ignition SW OFF.
- Remove the needle adapters, and apply silicone sealant to the seals of the connector for waterproofing.

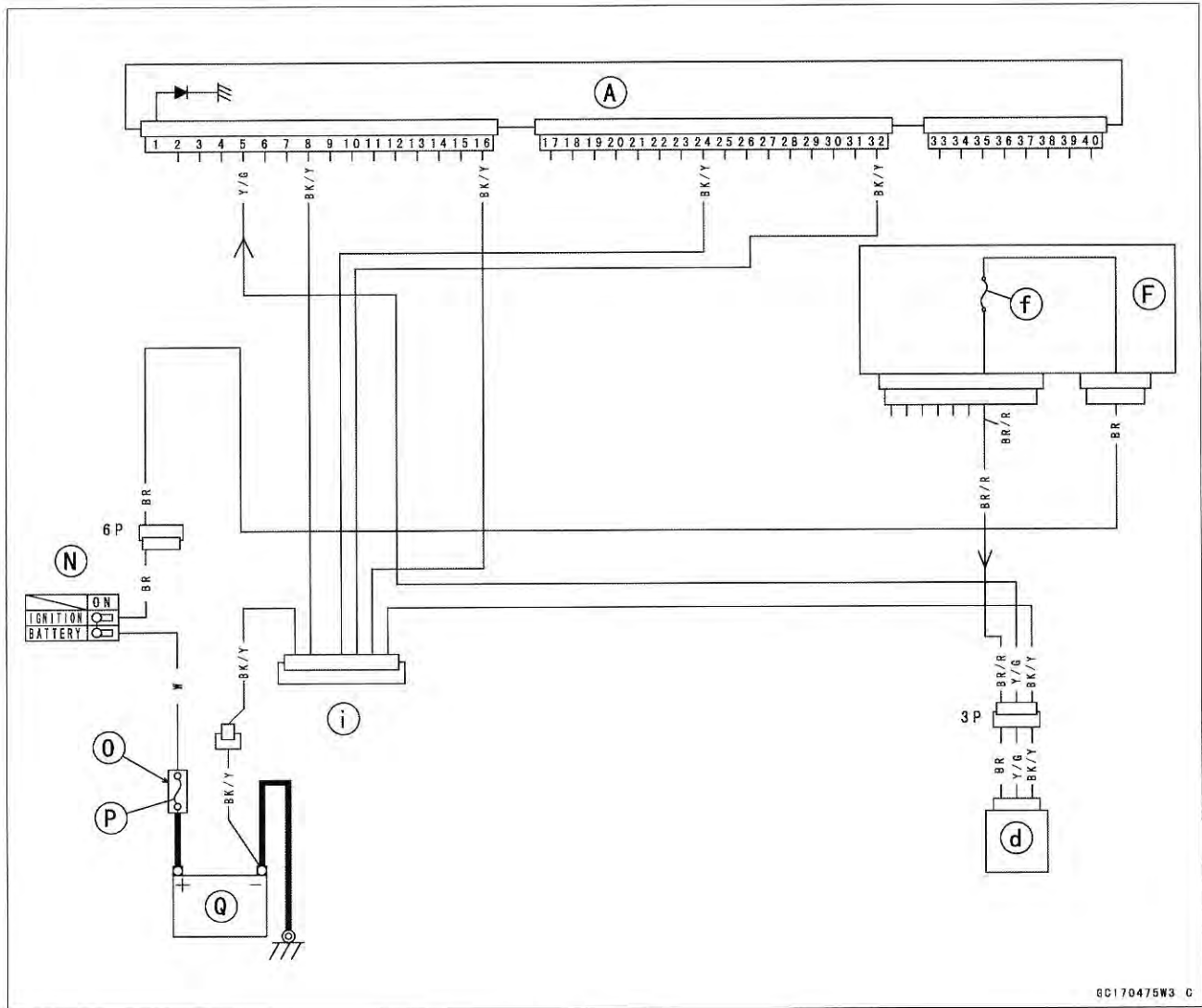
Silicone Sealant (Kawasaki Bond: 56019-120)

- Seals of Vehicle-down Sensor Connector

- ★ If the output voltage is normal, the wiring is suspect. Check the wiring.
- ★ If the wiring is good, check the ECU for its ground and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the output voltage is out of the specified, replace the vehicle-down sensor.

2-86 FUEL SYSTEM (DFI)

Vehicle-down Sensor (Fault Code 31)



→: Signal

ECU [A]

Junction Box [F]

Ignition Switch [N]

Starter Relay [O]

Main Fuse 30 A × 32 V [P]

MF Battery 12 V 18 Ah [Q]

Vehicle-down Sensor [d]

Ignition Fuse 10 A × 32 V [f]

Joint Connector [i]

Fuel Injectors (#1, #2: Fault Code 41, 42)

Fuel Injector #1: Front Fuel Injector for Front Cylinder (Fault Code 41)

Fuel Injector #2: Rear Fuel Injector for Rear Cylinder (Fault Code 42)

CAUTION

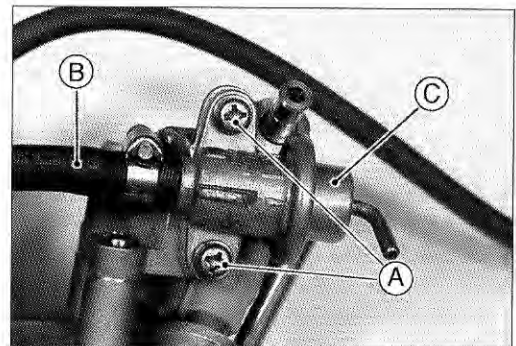
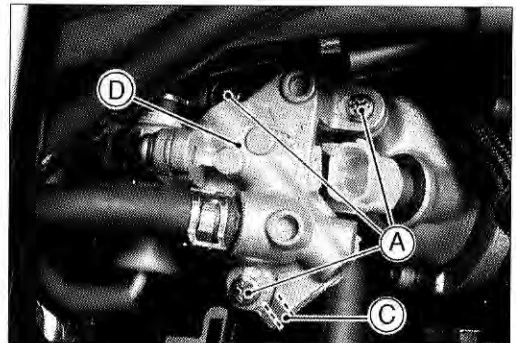
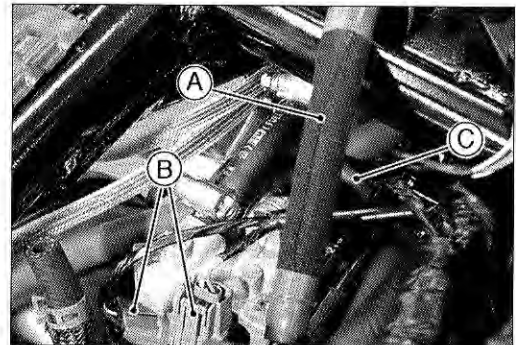
Never drop the injector, especially on a hard surface. Such a shock to the injector can damage it.

Injector Removal

⚠ WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Disconnect the battery (–) lead terminal. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.

- Check to see that the battery (–) lead terminal is disconnected.
- Remove:
 - Fuel Tank (see this chapter)
- Remove the 2nd fuel hose joint from the pipe for the delivery joint and take out the fuel hose assy (outlet hose) [A].
- Remove:
 - Front and Rear Injector Connectors [B]
 - Vacuum Hose [C] from pressure regulator
- Unscrew the three screws [A], and lift up the delivery joint [C] with the injectors [B], and the screw collar [D] left installed.
- Remove the injectors from the delivery joint.
- If necessary, remove the screws [A] and the fuel hose [B], and then take off the pressure regulator [C].



2-88 FUEL SYSTEM (DFI)

Fuel Injectors (#1, #2: Fault Code 41, 42)

- The screen [A] comes off from the pressure regulator [B].
Delivery Joint [C]
Front [D]
- Clean the screen with high-flash point solvent to remove any particles.

WARNING

Clean the screen in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvents.

- Check the screen carefully for any damage: holes and broken wires.
- ★ If the screen is damaged, replace it.
- Remove the seal [A], O-ring [B], and seal ring [C]. Discard them to prevent fuel and air leakage.
- The screen [D] cannot be removed.
- Tape the injector holes of the inlet manifold.

CAUTION

If dirt gets through the injector holes into the engine, excessive engine wear and possibly engine damage will occur.

Injector Installation

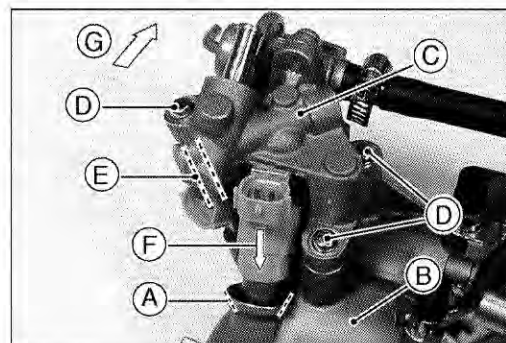
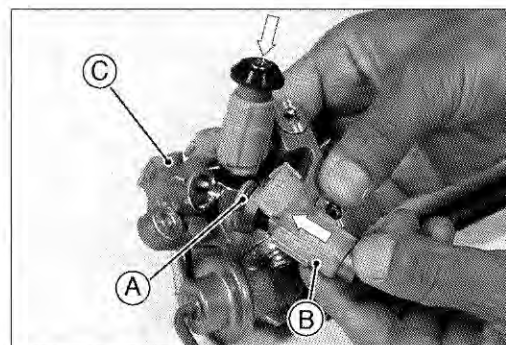
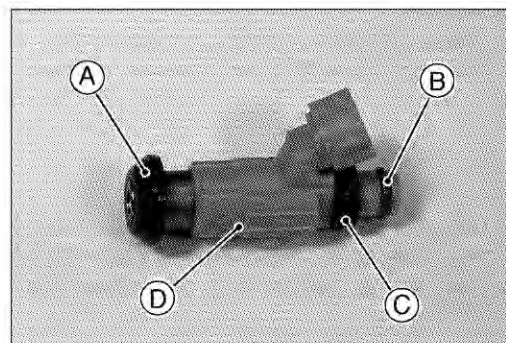
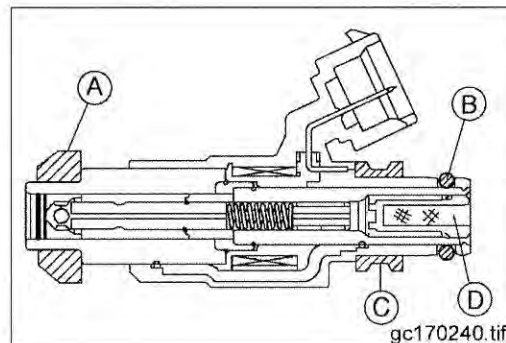
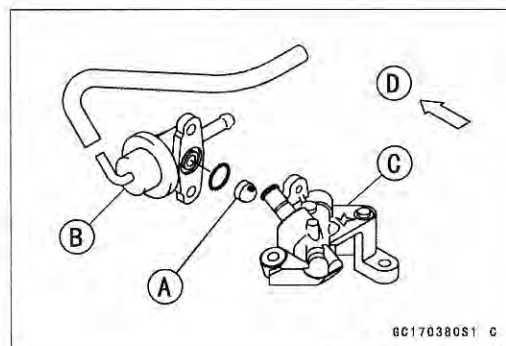
- The front and rear injectors are the same.
- Replace the seal [A], O-ring [B], and seal ring [C] with new ones, and install them onto the injector [D].
- Apply engine oil to the O-ring, and install them onto the injector.

CAUTION

To avoid air and fuel leak, be careful not to get dirt or dust on the O-ring. Be careful not to damage the O-ring.

- Apply engine oil to the O-ring [A], and install each injector [B] into the delivery joint [C].

- Check that there is no dirt or dust on the injector seating surface [A] of the inlet manifold [B].
- Check that the two dowel pins are in place in the inlet manifold.
- Fit the end of the injector into the delivery joint [C], and install them along with the joint screws [D], and the screw collar [E] onto the inlet manifold.
- Fit [F] the tip of the injector evenly into the inlet manifold.
Front [G]
- Tighten:
 - Torque - Delivery Joint Screws: 3.4 N·m (0.35 kg·m, 30 in·lb)
 - Pressure Regulator Screws: 4.9 N·m (0.5 kg·m, 43 in·lb)



Fuel Injectors (#1, #2: Fault Code 41, 42)

- Check the injector fuel line for leakage as follows:
 - Connect a commercially available vacuum/pressure pump [C] and a rubber hose [I] to the fuel hose [B] of the delivery joint [A] as shown.
 - Plug the outlet of the pressure regulator [G] with a rubber plug [J] (e.g. Plug: Part No. 92068-006).
 - Bind the plug with a wire [K].
 - Apply a soap and water solution to the areas [D] shown.
 - Watching the pressure gauge, squeeze the pump lever [E], and build up the pressure until the pressure reaches the maximum pressure.

Fuel Line Maximum Pressure

Standard: 310 kPa (3.2 kg/cm², 46 psi)

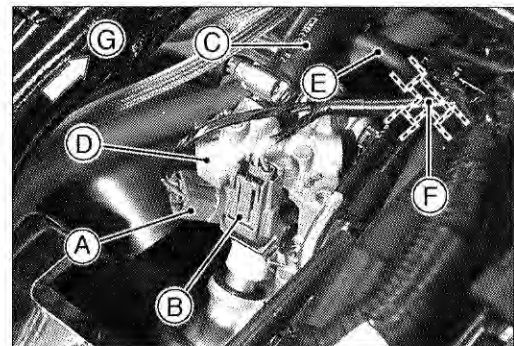
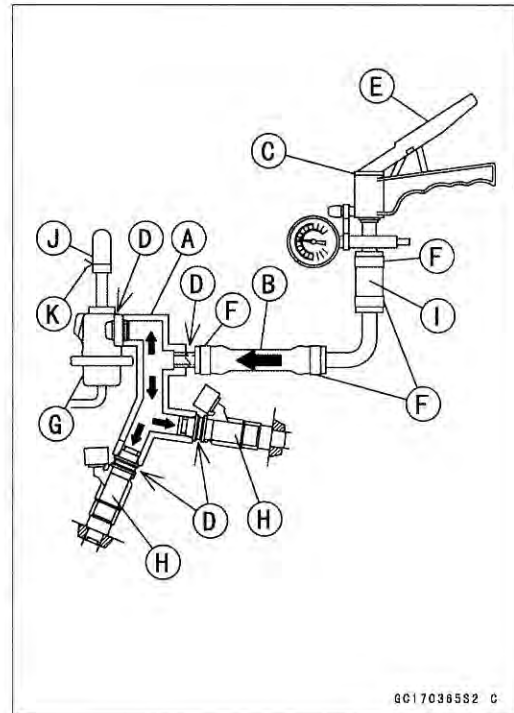
CAUTION

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

- Watch the gauge for at least 6 seconds.
- ★ If the pressure holds steady, the system is good.
- ★ If the pressure drops at once, or if bubbles are found in the area, the line is leaking. Perform the following as necessary.
- Retighten the fuel hose clamps [F].

Torque - Fuel Hose Clamp Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)

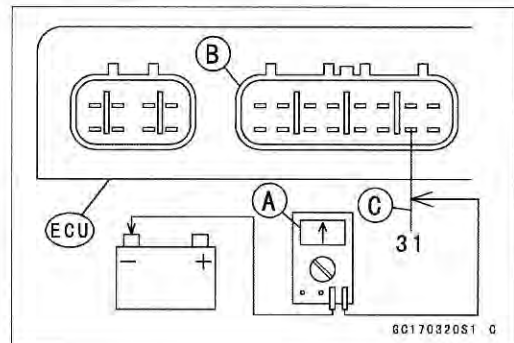
- Replace:
 - O-ring of Pressure Regulator Flange
 - O-ring, and Seal Ring of Injectors [H]
 - Pressure Regulator, Delivery Joint, and Injectors
- Repeat the leak test, and check the fuel line for no leakage.
- Connect:
 - Front Injector Connector [A] (BL/R, W/R leads)
 - Rear Injector Connector [B] (BL/G, W/R leads)
 - Fuel Hose [C] to Delivery Joint [D]
 - Vacuum Hose [E] to T-Joint [F]
 - Front [G]
- Run the hoses correctly (see Cable, Wire, and Hose Routing section in the General Information chapter).
- Torque - Fuel Hose Clamp Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)**
- Install the fuel tank (see this chapter) and connect the battery (–) terminal.



Power Source Voltage Inspection

NOTE

- Be sure the battery is fully charged.
- Turn the ignition SW OFF.
- Remove the ECU (see this chapter). Do not disconnect the ECU connectors.
- Connect a digital voltmeter [A] to the connector [B], using the needle adapter [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Measure the power source voltage with the engine stopped, and with the connectors joined.



2-90 FUEL SYSTEM (DFI)

Fuel Injectors (#1, #2: Fault Code 41, 42)

- Turn the ignition SW ON.

Injector Power Source Voltage at ECU

Connections to ECU

- Meter (+) → W/R lead (terminal 31)
- Meter (−) → Battery (−) Terminal

Power Source Voltage at ECU

Standard: Battery Voltage (12.5 V or more)

- ★ If the power source voltage is less than the standard, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the reading is normal, remove the fuel tank, and check the power source voltage at the injector connector [A], using the needle adapter [B].
- Measure the power source voltage with the engine stopped, and the connector joined, using a digital meter.
- Turn the ignition SW ON.

Injector Power Source Voltage at Injector

Connections to Injector #1, #2

- Meter (+) → W/R lead [C]
- Meter (−) → Battery (−) Terminal [D]

Power Source Voltage at Injector Connector

Standard: Battery Voltage (12.5 V or more)

- Turn the ignition SW OFF.
- ★ If the reading is out of the standard, check the wiring (see wiring diagram in this section).
- ★ If the reading is good, and the power source voltage is normal, check the output voltage.

Output Voltage Inspection

- Measure the output voltage at the ECU connector in the same way as power source voltage inspection. Note the following.

Injector Output Voltage at ECU

Connections for Injector #1

- Meter (+) → BL/R lead (terminal 7)
- Meter (−) → Battery (−) Terminal

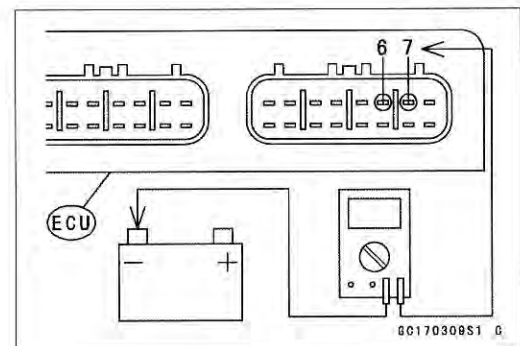
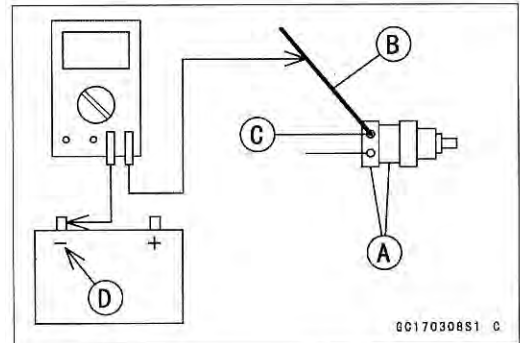
Connections for Injector #2

- Meter (+) → BL/G lead (terminal 6)
- Meter (−) → Battery (−) Terminal

Output Voltage at ECU

Standard: Battery Voltage (12.5 V or more)

- ★ If the output voltage is normal, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.



Fuel Injectors (#1, #2: Fault Code 41, 42)

- ★ If the output voltage is out of the standard, remove the fuel tank, and check the output voltage at the injector connector [A], using the needle adapter [B] (when the wiring is open, the output voltage is 0 V).

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

Injector Output Voltage at Injector

Connections to Injector #1

Meter (+) → BL/R lead [C]

Meter (-) → Battery (-) Terminal [D]

Connections to Injector #2

Meter (+) → BL/G lead [E]

Meter (-) → Battery (-) Terminal [D]

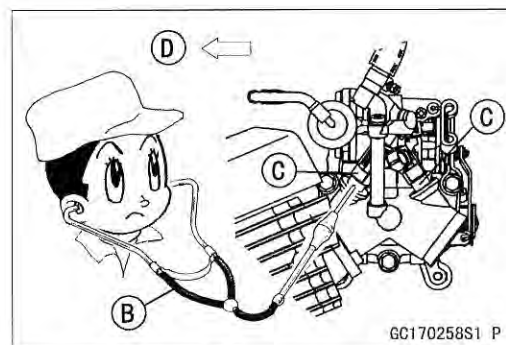
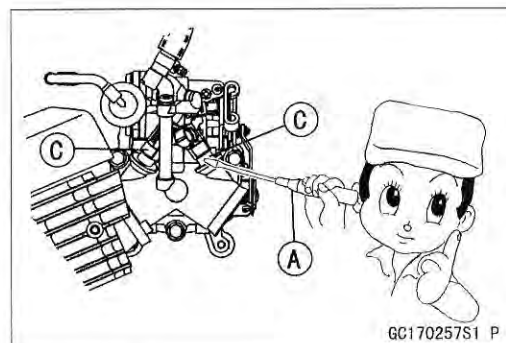
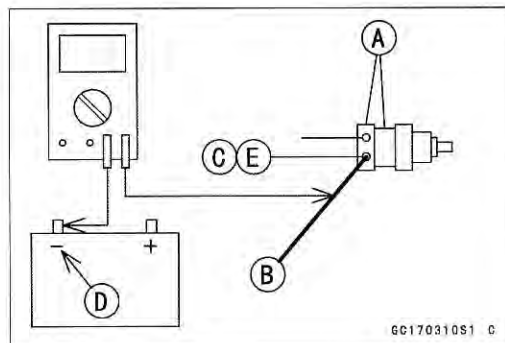
Output Voltage at Injector Connector

Standard: Battery Voltage (12.5 V or more)

- ★ If the output voltage is normal, check the wiring for continuity (see next diagram). If the wiring is good, perform “Audible Inspection” for confirmation.
- ★ If the output voltage is out of the standard, perform “Audible Inspection” for confirmation.

Audible Inspection

- Remove the left air cleaner housing (see this chapter).
 - Start the engine.
 - Apply the tip of a screwdriver [A] to the injector [C]. Put the grip end onto your ear, and listen whether the injector is clicking or not.
 - A sound scope [B] can also be used.
 - Do the same for the other injector.
- Front [D]**
- ★ If all the injectors click at a regular intervals, the injectors are good.
 - The click interval becomes shorter as the engine speed rises.
 - ★ If either injector doesn't click, perform the “Injector Signal Test” for injector operation.

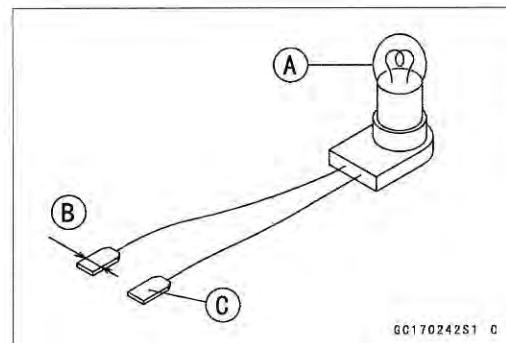


Injector Signal Test

- Prepare two test light sets with male terminals as shown.
- Rating of Bulb [A]: 12 V × 3 ~ 3.4 W
Terminal Width [B]: 1.8 mm
Terminal Thickness [C]: 0.8 mm

CAUTION

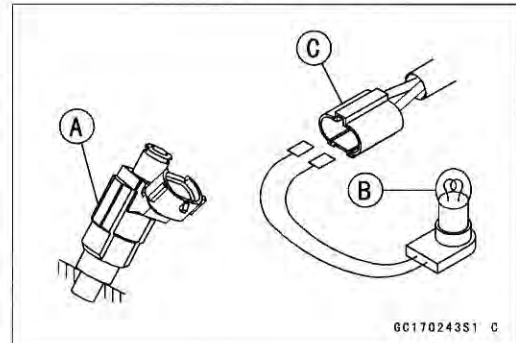
Do not use larger terminals than specified above. A larger terminal could damage the injector main harness connector (female), leading to harness repair or replacement. Be sure to connect bulbs in series. The bulb works as a current limiter to protect the solenoid in the injector from excessive current.



2-92 FUEL SYSTEM (DFI)

Fuel Injectors (#1, #2: Fault Code 41, 42)

- Remove the fuel tank (see this chapter).
- Plug the fuel hose ends.
- Remove connectors for injector [A].
- Connect each test light set [B] to the injector main harness connector [C].
- Connect the battery (–) lead terminal.
- While cranking the engine with the starter motor, watch the test lights.
- ★ If the test lights flicker at regular intervals, the injector circuit in the ECU, and the wiring are good. Perform the "Injector Resistance Inspection".



- Injector signals can be also confirmed by connecting the hand tester ($\times 10$ V AC) instead of the test light set to the injector main harness (female) connector. Crank the engine with the starter motor, and check to see if the needle oscillates at regular intervals.

Special Tool - Hand Tester: 57001-1394

- ★ If the test light doesn't flicker (or the tester needle doesn't oscillates), check the wiring and connectors again. If the wiring is good, replace the ECU.

Injector Resistance Inspection

- Remove the fuel tank (see this chapter).
 - Disconnect the connector from the injector [A] (see Injector Removal).
 - Measure the injector resistance with a digital voltmeter [B].
- Front [C]

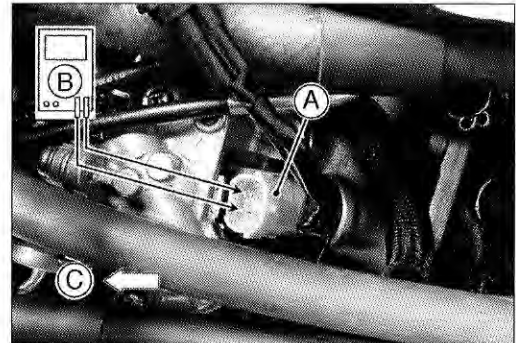
Injector Resistance

Connections to Injector

Meter (+)	Meter (–)
#1: W/R $\longleftrightarrow$	BL/R Terminal
#2: W/R $\longleftrightarrow$	BL/G Terminal

Standard: 14.2 ~ 14.8 Ω

- ★ If the reading is out of the range, perform the "Injector Unit Test".
- ★ If the reading is normal, perform the "Injector Unit Test" for confirmation.



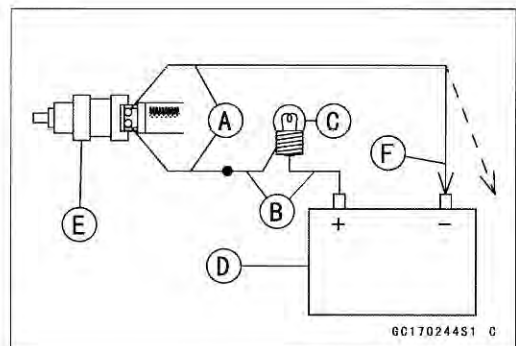
Injector Unit Test

- Use two wires [A] and the same test light set [B] as in "Injector Signal Test".
- Rating of Bulb [C]: 12 V $\times$ (3 ~ 3.4) W
12 V MF Battery [D]

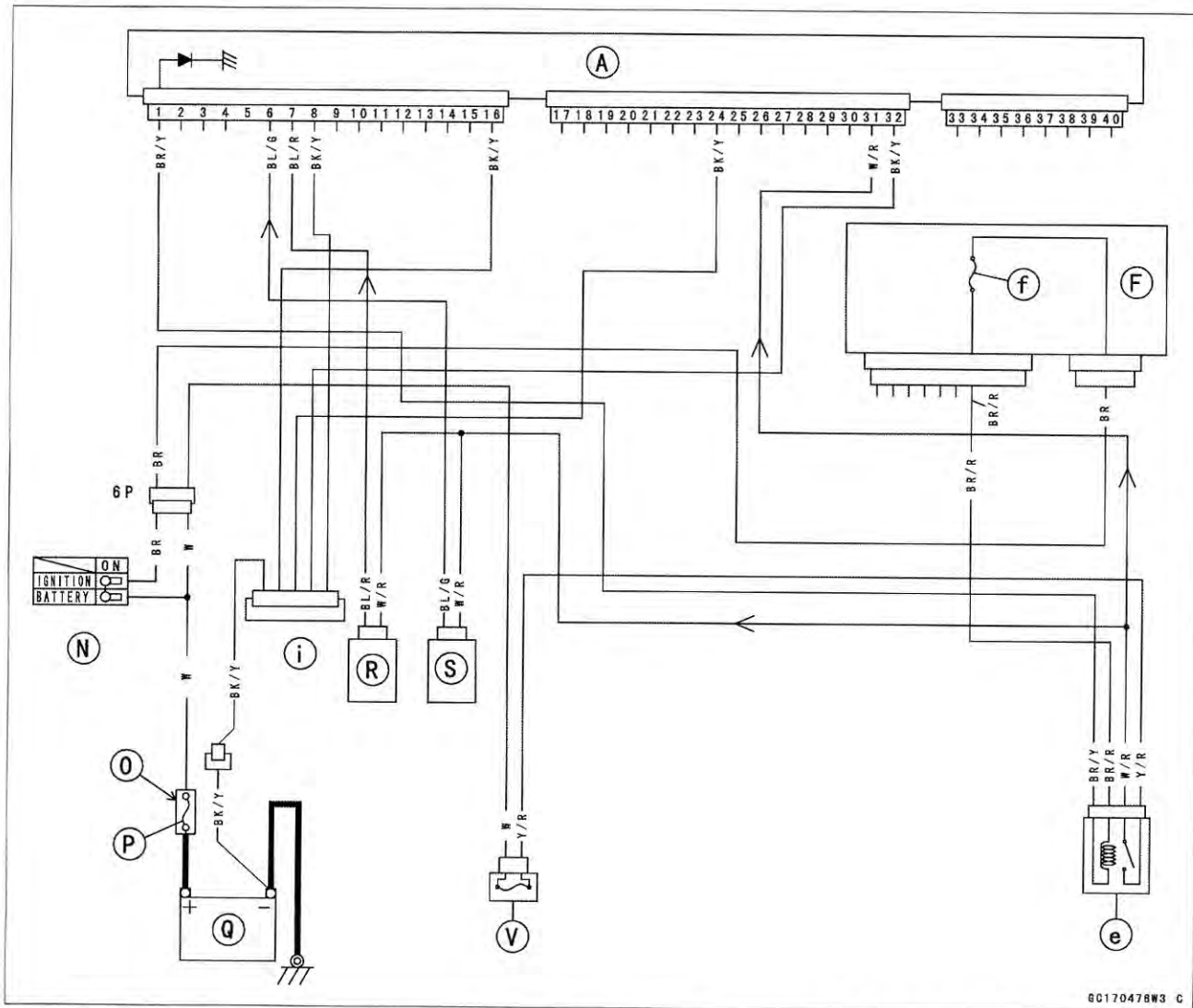
CAUTION

Be sure to connect the bulb in series. The bulb works as a current limiter to protect the solenoid in the injector from excessive current.

- Connect the test light set to the injector [E] as shown.
- Open and connect [F] the end of the wire to the battery (–) terminal repeatedly. The injector should click.
- ★ If the injector does not click, replace the injector.
- ★ If the injector clicks, check the wiring again. If the wiring is good, replace the ECU.



Fuel Injectors (#1, #2: Fault Code 41, 42)



6C170478W3 C

→: Signal

ECU [A]

Junction Box [F]

Ignition Switch [N]

Starter Relay [O]

Main Fuse 30 A × 32 V [P]

MF Battery 12 V 18 Ah [Q]

Fuel Injector #1 [R]

Fuel Injector #2 [S]

DFI Fuse 15 A × 32 V [M]

DFI Main Relay [e]

Ignition Fuse 10 A × 32 V [f]

Joint Connector [i]

2-94 FUEL SYSTEM (DFI)

In-tank Fuel Pump (Fault Code 45)

Fuel Pump Removal

CAUTION

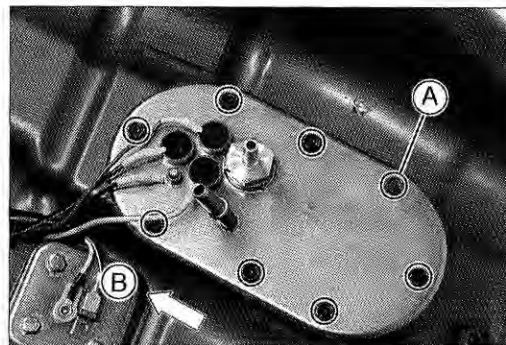
Never drop the fuel pump, especially on a hard surface. Such a shock to the pump can damage it.

WARNING

Gasoline is extremely flammable and can be explosive under certain conditions. 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. Disconnect the battery (-) terminal.

To make fuel spillage minimum, draw the fuel out from the fuel tank with a pump as much as possible when the engine is cold. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.

- The in-tank fuel pump shortens the DFI fuel lines, and suppresses vapor lock in the fuel hoses.
- Remove the fuel tank (see this chapter).
- Draw the fuel out from the fuel tank with a commercially available pump.
- Be careful of fuel spillage from the fuel tank since fuel still remains in the fuel tank and fuel pump. Plug all the fuel pipes of the fuel tank.
- Turn the fuel tank upside down.
- Unscrew the fuel pump bolts [A], and take out the fuel pump and gasket.
- Front [B]
- Discard the fuel pump gasket.

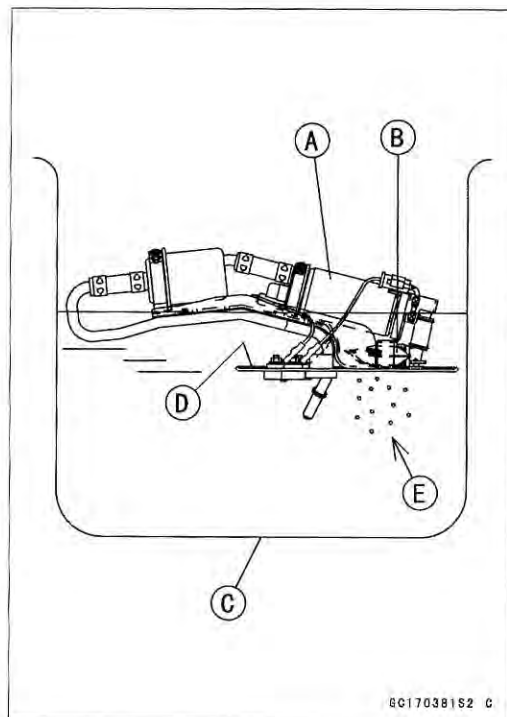


Pump Screen Cleaning

WARNING

Clean the pump screen in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvent to clean the pump screen.

- Remove the fuel pump [A] along with the pump screen [B].
- Discard the fuel pump gasket [D].
- Prepare a container [C] filled with a high-flash point solvent.
- Dip and shake the pump in the solvent to remove dirt and fuel deposits [E] from the pump screen.
- Dry the pump and screen by lightly applying compressed air.
- Replace the fuel pump gasket with a new one.
- Install the fuel pump (see this section).



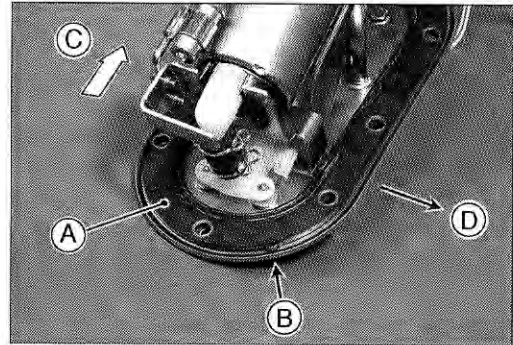
Fuel Filter Cleaning

- The fuel filter cannot be cleaned or checked.
- ★ If the fuel filter is suspected of clogging or being damaged, replace it with the fuel pump as a set.

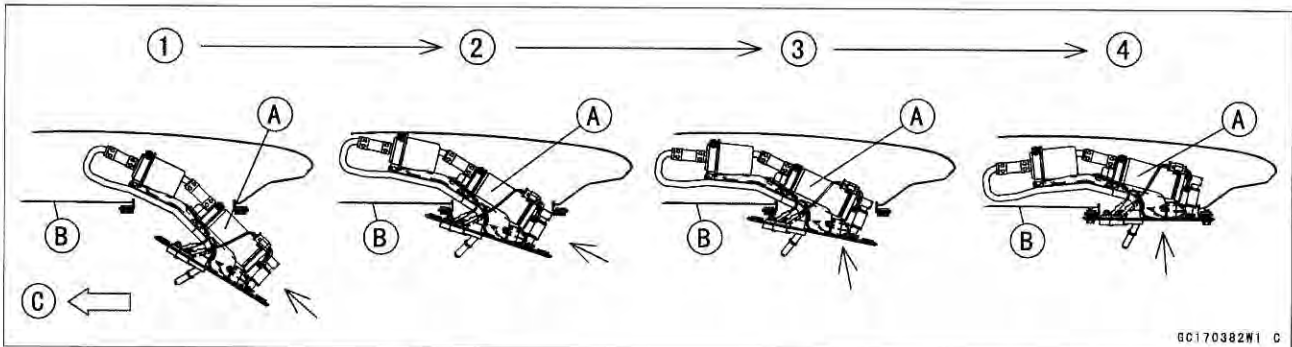
In-tank Fuel Pump (Fault Code 45)

Fuel Pump Installation

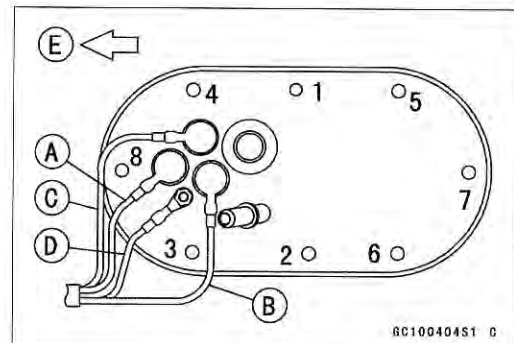
- Clean the pump screen (see Pump Filter Cleaning).
- Remove dirt or dust from the fuel pump by lightly applying compressed air.
- Replace the fuel pump gasket with a new one.
- Install a new pump gasket [A] with its tab [B] facing back and right [D] (top view).
Front [C]



- Install the fuel pump [A] into the fuel tank [B] in the order shown.
Front [C]
First [1] ~ Last [4]



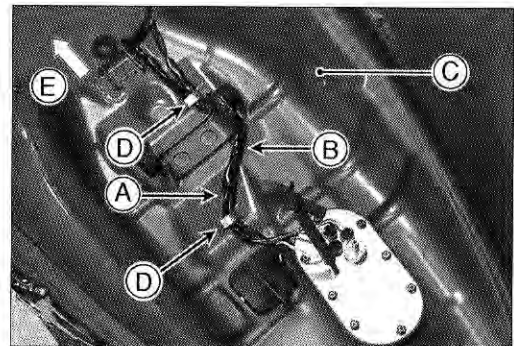
- Check that the fuel pump terminals are in place.
Pump Motor BK/W (-) Lead [A]
Pump Motor W/R (+) Lead [B]
Fuel Reserve Switch R/BK (+) Lead [C]
Fuel Reserve Switch BK/Y (-) Lead [D]
Front [E]
- Apply a non-permanent locking agent to the threads of the fuel pump bolts.
- Tighten the fuel pump bolts to a snug fit following the tightening sequence shown.
- Following the tightening sequence, tighten the pump bolts to the specified torque.



Non-permanent Locking Agent - Fuel Pump Bolts

Torque - Fuel Pump Bolts: 6.9 N·m (0.70 kg·m, 61 in·lb)

- Tighten the pump bolts again to check the tightness in the order shown.
- Secure the fuel level sensor leads [A], and fuel pump leads [B] on the fuel tank [C] with the welded clamps [D].
Front [E]
- Install the fuel tank (see this chapter).



2-96 FUEL SYSTEM (DFI)

In-tank Fuel Pump (Fault Code 45)

Operation Inspection

NOTE

- Be sure the battery is fully charged.
- Turn the ignition SW ON and make sure that the fuel pump operates (make light sounds) for 3 seconds, and then stops.
- Turn the ignition SW OFF.
- ★ If the pump does not work as described above, inspect the operating voltage.

Operating Voltage Inspection

NOTE

- Be sure the battery is fully charged.
- Turn the ignition SW OFF.
- Remove the ECU (see this chapter). Do not disconnect the ECU connectors.

- Connect the hand tester (× 25 V DC) to the connectors [A], using two needle adapters[B].

Special Tool - Hand Tester: 57001-1394

Needle Adapter Set — Hand Tester: 57001-1457

- Measure the operating voltage with the engine stopped, and with the connector joined.
- Turn the ignition SW ON.
- The tester needle should indicate battery voltage for 3 seconds, and then 0 V.

Pump Operating Voltage at ECU

Connections to ECU

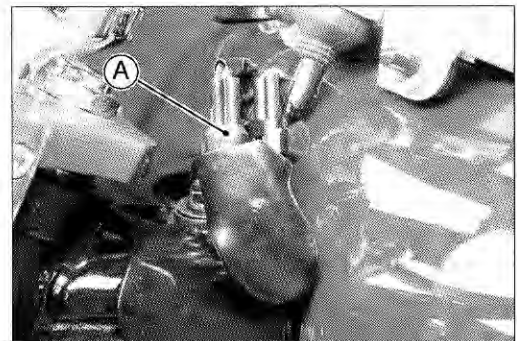
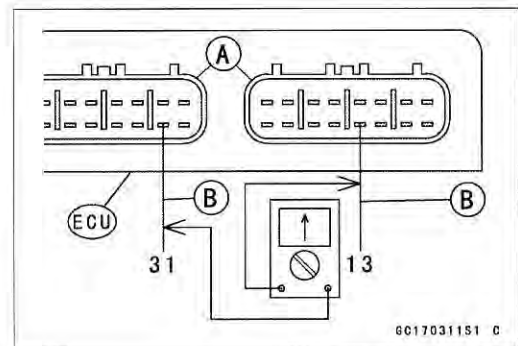
Tester (+) → W/R lead (terminal 31)

Tester (-) → BK/W lead (terminal 13)

Operating Voltage at ECU

Reading: **Battery Voltage (12.5 V or more) for 3 seconds, and then 0 V.**

- ★ If the reading stays on battery voltage, and never shows 0 V, the wiring is suspect. Check the wiring of the fuel pump.
- ★ If there is no battery voltage at all, check the pump operating voltage at the fuel pump connector as follows.
- Remove the fuel tank cover (see this chapter).
- Slide the band and take out the fuel pump connector [A].



In-tank Fuel Pump (Fault Code 45)

- Measure the pump operating voltage at the fuel pump connector with the connector joined.
Hand Tester [A]
Pump Connector [B]
Needle Adapters [C]

Pump Operating Voltage at Pump Connections to Pump Connector

Tester (+) → W/R lead [D]

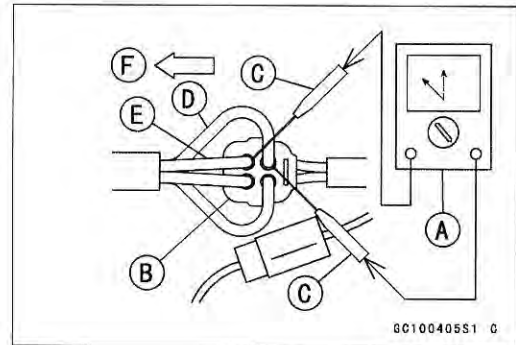
Tester (-) → BK/W lead [E]

Operating Voltage at Pump Connector

Reading: Battery Voltage (12.5 V or more) for 3 seconds,
and then 0 V

Front [F]

- ★ If the voltage is in specification, but the pump doesn't work, replace the pump.
- ★ If there is still no battery voltage, check the pump power source voltage (see next section).



Power Source Voltage Inspection

NOTE

- Be sure the battery is fully charged.
 - The inspection is the same as "Power Source Voltage Inspection" of the ISC valves.
 - Connect a digital voltmeter [A] to the connector [B], using the needle adapter [C].
- Special Tool - Needle Adapter Set — Hand Tester: 57001-1457**
- Measure the power source voltage with the engine stopped, and with the connector joined.
 - Turn the ignition SW ON.

Pump Power Source Voltage

Connections to ECU

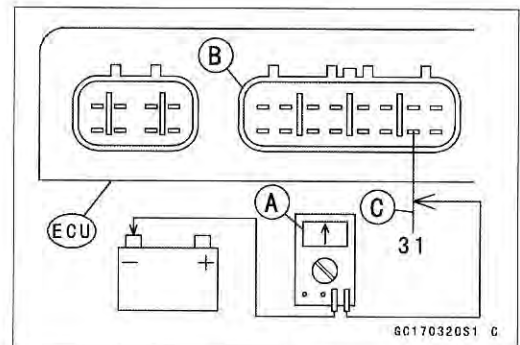
Tester (+) → W/R lead (terminal 31)

Tester (-) → Battery (-) Terminal

Power Source Voltage at ECU

Standard: Battery Voltage (12.5 V or more)

- ★ If the reading is less than the standard, check the ECU for its ground, and power supply (see this chapter). If the ground and power supply are good, replace the ECU.
- ★ If the reading is normal, measure the power source voltage at the fuel pump connector.



- Connect a digital voltmeter [A] to the fuel pump connector [B] (black, 4P), using the needle adapter [C].

Special Tool - Needle Adapter Set — Hand Tester: 57001-1457

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

Pump Power Source Voltage

Connections to Pump Connector

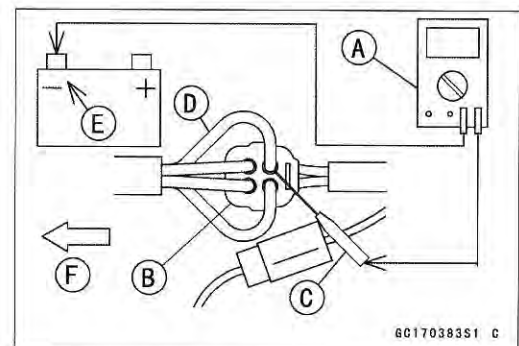
Tester (+) → W/R lead [D]

Tester (-) → Battery (-) Terminal [E]

Power Source Voltage at Pump Connector

Standard: Battery Voltage (12.5 V or more)

Front [F]



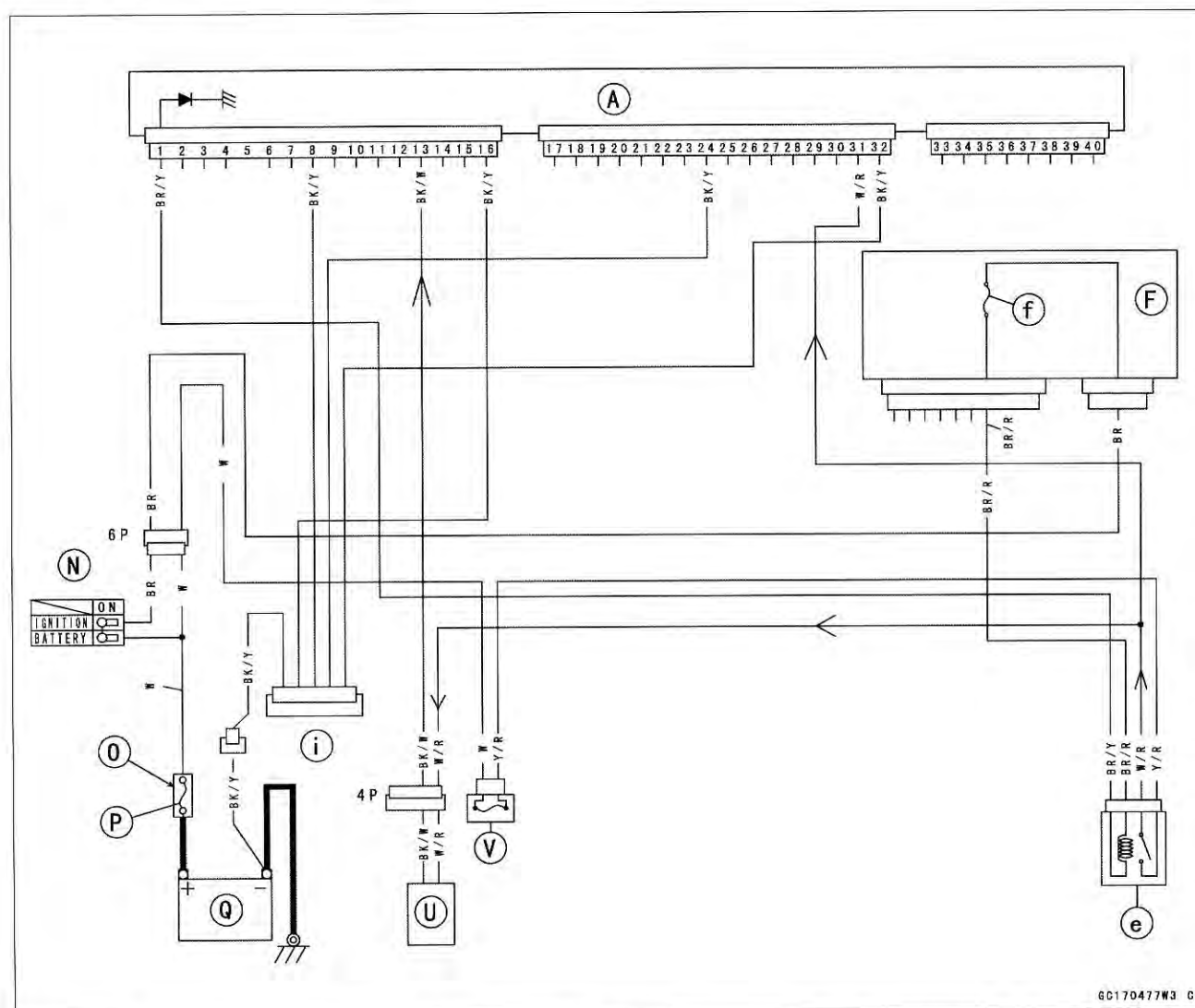
2-98 FUEL SYSTEM (DFI)

In-tank Fuel Pump (Fault Code 45)

- ★ If the reading is good, the power source voltage is normal. Replace the pump.
- ★ If the reading is below the standard, check the following:
 - Battery
 - Main Fuse 30 A in Starter Relay (see Electrical System chapter)
 - DFI Fuse 15 A (see this chapter)
 - Ignition Fuse 10 A in Junction Box (see Electrical System chapter)
 - DFI Main Relay (see this chapter)
 - Wiring for Fuel Pump Power Source (see next diagram)
 - Vehicle-down Sensor (see this chapter)
- After inspection, remove the needle adapter, and apply silicone sealant to the seal of the connector for waterproofing.

Silicone Sealant (Kawasaki Bond: 56019-120)

- Sealing of Fuel Pump Connector



→: Signal
ECU [A]
Junction Box [F]
Ignition Switch [N]

Starter Relay [O]
Main Fuse 30 A × 32 V [P]
MF Battery 12 V 18 Ah [Q]
In-tank Fuel Pump [U]

DFI Fuse 15 A × 32 V [V]
DFI Main Relay [e]
Ignition Fuse 10 A × 32 V [f]
Joint Connector [i]

GC170477W3 C

Ignition Coils (#1, #2: Fault Code 51, 52)

Ignition Coil #1: Ignition Coil for Front Cylinder (Fault Code 51)
 Ignition Coil #2: Ignition Coil for Rear Cylinder (Fault Code 52)

Removal/Installation

CAUTION

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

- See Ignition System section in the Electrical System chapter.

Input Voltage Inspection

NOTE

- Be sure the battery is fully charged.
- Turn the ignition SW OFF.
- Remove the ECU (see this chapter). Do not disconnect the ECU connector.
- Connect a digital voltmeter [A] as shown, using two needle adapters [B].
- Measure the input voltage to each primary winding of the ignition coils with the engine stopped, and with the connectors joined.
- Turn the ignition SW ON.

Ignition Coil Input Voltage at ECU

Connections for Ignition Coil #1

Meter (+) → BK lead (terminal 9)
Meter (-) → Battery (-) Terminal

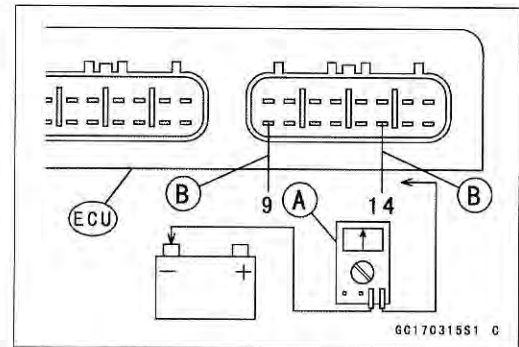
Connections for Ignition Coil #2

Meter (+) → BK/G lead (terminal 14)
Meter (-) → Battery (-) Terminal

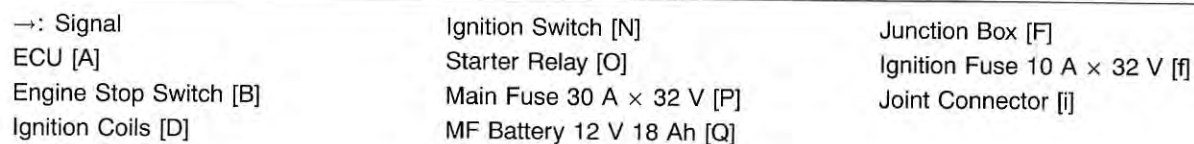
Input Voltage at ECU

Standard: Battery Voltage (12.5 V or more)

- ★ If the reading is out of the standard, check the wiring (see next wiring diagram).
- ★ If the reading is good, the input voltage is normal. Crank the engine, and check the peak voltage of the ignition coils (see Electrical System chapter) in order to check the primary coils.



Ignition Coils (#1, #2: Fault Code 51, 52)



Cooling System

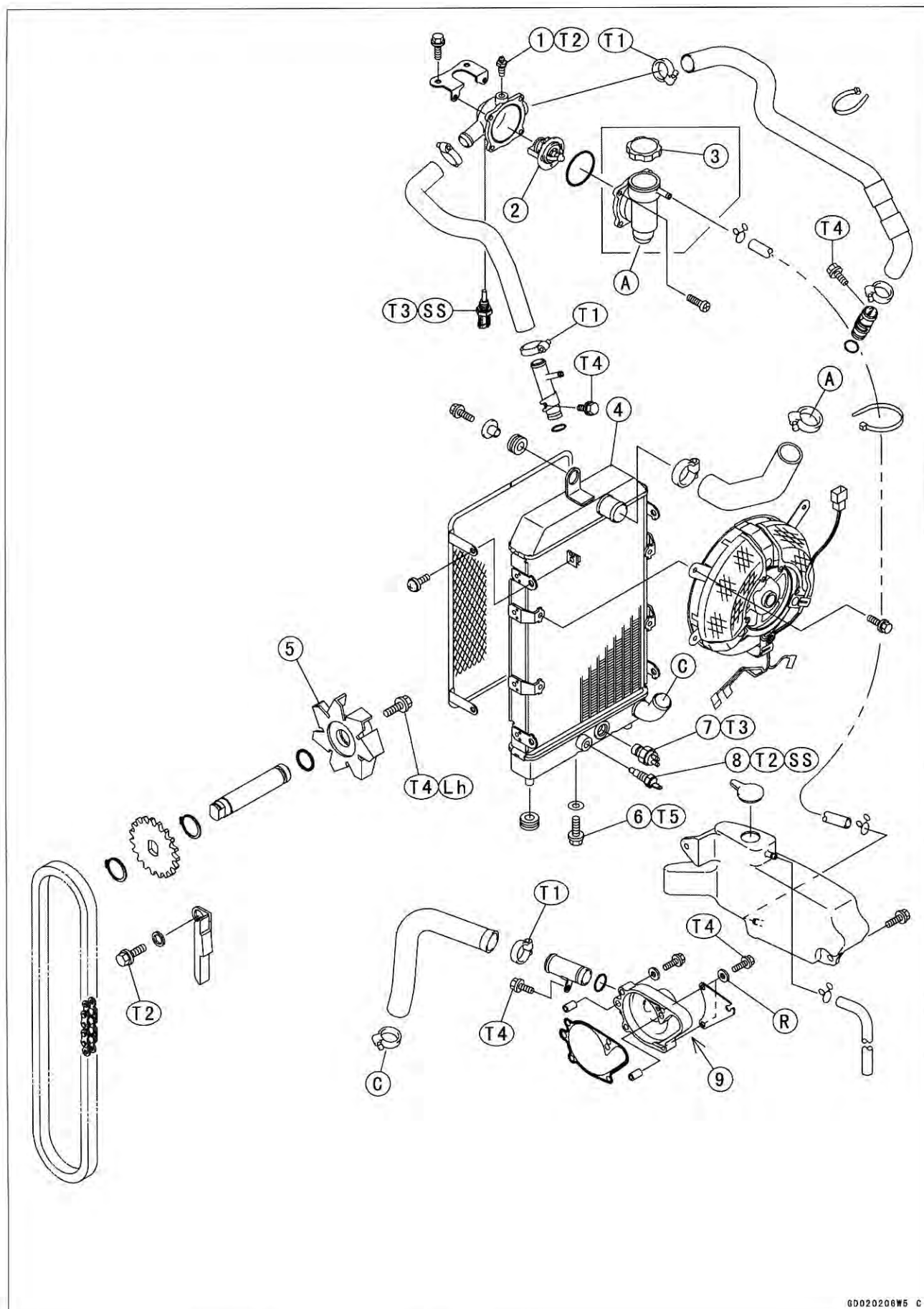
3

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3-2 COOLING SYSTEM

Exploded View



GD020206W5 C

Exploded View

- 1. Coolant Air Bleeder Bolt
- 2. Thermostat
- 3. Radiator Cap
- 4. Radiator
- 5. Water Pump Impeller
- 6. Radiator Drain Bolt
- 7. Radiator Fan Switch
- 8. Water Temperature Switch
- 9. Water Pump Drain Bolt
- 10. Water Temperature Sensor (DFI)
- Lh: Left-hand Threads
- R: Replacement Parts
- SS: Apply silicone sealant. (Kawasaki Bond: 56019-120)
- T1: 2.5 N·m (0.25 kg·m, 22 in·lb)
- T2: 7.8 N·m (0.8 kg·m, 69 in·lb)
- T3: 18 N·m (1.8 kg·m, 13 ft·lb)
- T4: 9.8 N·m (1.0 kg·m, 87 in·lb)
- T5: 7.4 N·m (0.75 kg·m, 65 in·lb)

3-4 COOLING SYSTEM

Coolant Flow Chart

Permanent type antifreeze is used as a coolant to protect the cooling system from rust and corrosion. When the engine starts, the water pump turns and the coolant circulates.

The thermostat is a wax pellet type which opens or closes with coolant temperature changes. The thermostat continuously changes its valve opening to keep the coolant temperature at the proper level. When coolant temperature is below $58 \sim 62^{\circ}\text{C}$, the thermostat closes so that the coolant flow is restricted through the air bleeder hole, causing the engine to warm up more quickly. When coolant temperature is more than $58 \sim 62^{\circ}\text{C}$, the thermostat opens and the coolant flows.

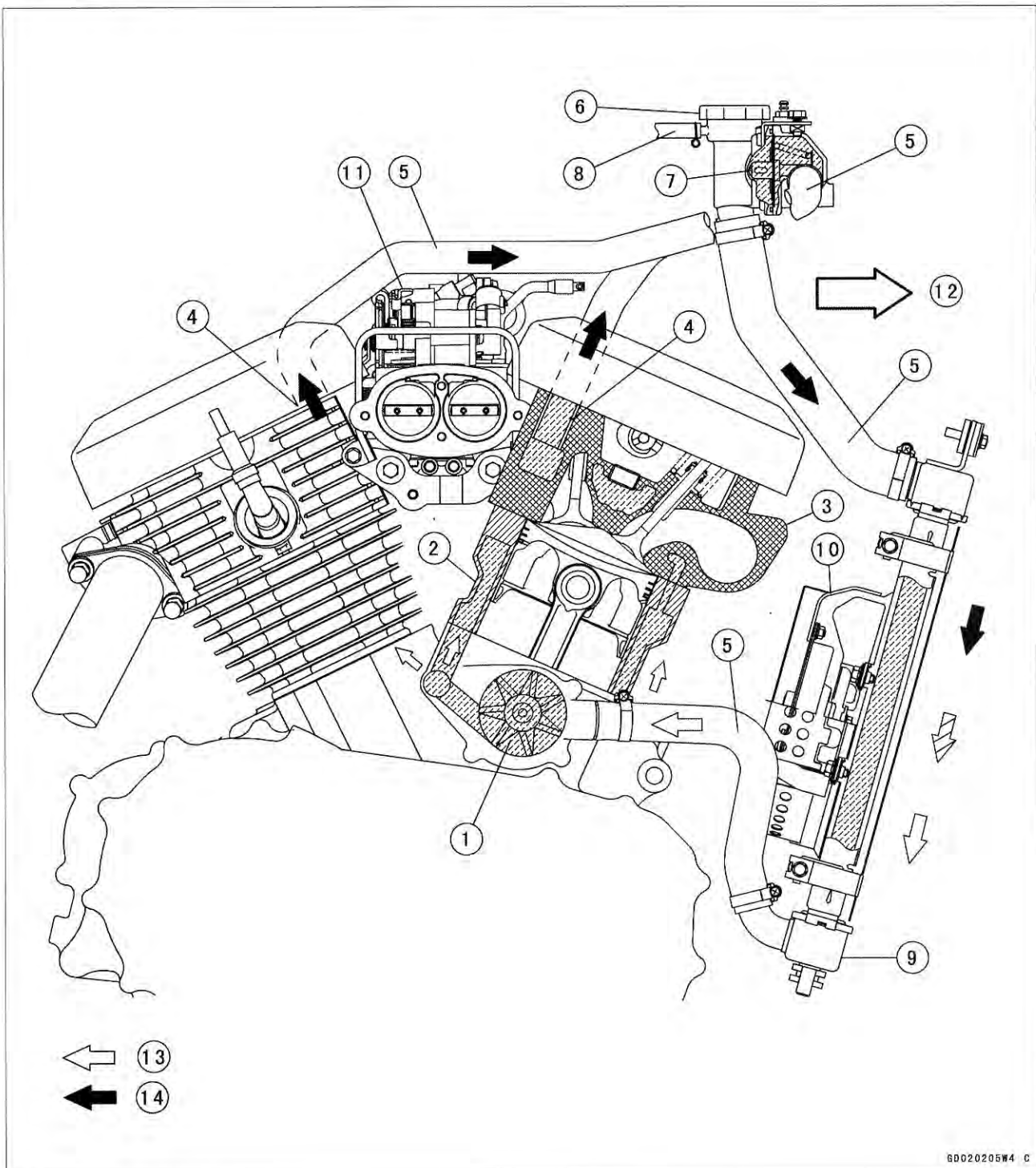
When the coolant temperature goes up beyond $100 \sim 110^{\circ}\text{C}$, the radiator fan switch conducts to operate the radiator fan. The radiator fan draws air through the radiator core when there is not sufficient air flow such as at low speeds. This increases up the cooling action of the radiator. When the temperature is below $97 \sim 103^{\circ}\text{C}$, the fan switch opens and the radiator fan stops.

In this way, this system controls the engine temperature within narrow limits where the engine operates most efficiently even if the engine load varies.

The system is pressurized by the radiator cap to suppress boiling and the resultant air bubbles which can cause engine overheating. As the engine warms up, the coolant in the radiator and the water jacket expands. The excess coolant flows through the radiator cap and hose to the reserve tank to be stored there temporarily. Conversely, as the engine cools down, the coolant in the radiator and the water jacket contracts, and the stored coolant flows back to the radiator from the reserve tank.

The radiator cap has two valves. One is a pressure valve which holds the pressure in the system when the engine is running. When the pressure exceeds $0.95 \sim 1.25 \text{ kg/m}^2$, the pressure valve opens and releases the pressure to the reserve tank. As soon as pressure escapes, the valve closes, and keeps the pressure at $0.95 \sim 1.25 \text{ kg/m}^2$. When the engine cools down, another small valve (vacuum valve) in the cap opens. As the coolant cools, the coolant contracts to from a vacuum in the system. The vacuum valve opens and allows the coolant from the reserve tank to enter the radiator.

Coolant Flow Chart



1. Water Pump
2. Water Jacket
3. Cylinder Head
4. Water Pipe
5. Water Hose
6. Radiator Cap
7. Thermostat

8. Reserve Tank Hose
9. Radiator
10. Radiator Fan
11. Throttle Assy
12. Front
13. Cold Coolant
14. Hot Coolant

60020205W4 C

3-6 COOLING SYSTEM

Specifications

Coolant provided when shipping:	
Type (recommended)	Permanent type antifreeze (soft water and ethylene glycol plus corrosion and rust inhibitor chemicals for aluminum engines and radiators)
Color	Green
Mixed ratio	Soft water 50%, coolant 50%
Freezing point	- 35°C (- 31°F)
Total amount	2.3 L (reserve tank full level including radiator and engine)
Radiator Cap:	
Relief pressure	93 ~ 123 kPa (0.95 ~ 1.25 kg/m ² , 14 ~ 17.8 psi)
Thermostat:	
Valve opening temperature	58 ~ 62°C (136 ~ 144°F)
Valve full opening lift	8 mm or more @95°C (203°F)

Special Tools - Bearing Driver Set: 57001-1129

Bearing Remover Shaft: 57001-1265

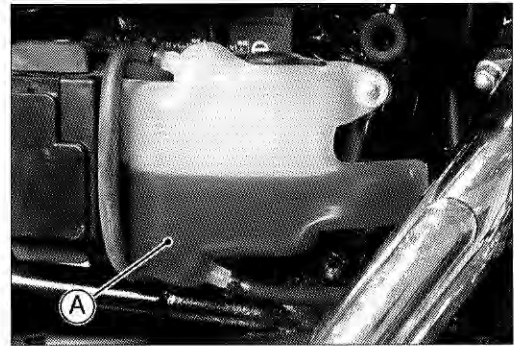
Bearing Remover Head, $\phi 10 \times \phi 12$: 57001-1266

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

Coolant

Coolant Deterioration Inspection

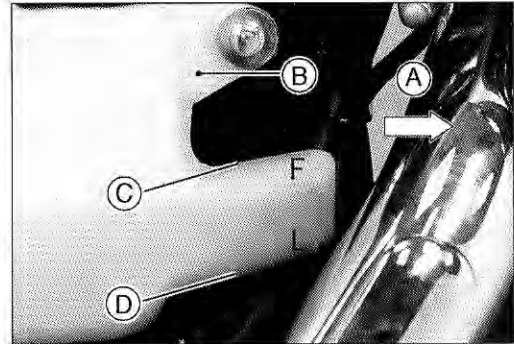
- Remove the right side cover (see Frame chapter).
- Visually inspect the coolant [A] in the reserve tank.
- ★ If whitish cotton-like wafts are observed, aluminum parts in the cooling system are corroded. If the coolant is brown, iron or steel parts are rusting. In either case, flush the cooling system.
- ★ If the coolant gives off an abnormal smell, check for a cooling system leak. It may be caused by exhaust gas leaking into the cooling system.



Coolant Level Inspection

NOTE

- Check the level when the engine is cold (room or ambient temperature).
- Check the coolant level in the reserve tank with the motorcycle held upright. The coolant level should be between the FULL level and the LOW level (In the photo, the right side cover has been removed for clarity).
 - Front [A]
 - Reserve Tank [B]
 - FULL Level [C]
 - LOW Level [D]
- ★ If the coolant level is lower than the LOW level, remove the right side cover and the reserve tank cap, then add coolant to the FULL level.



CAUTION

For refilling, add the specified mixture of coolant and soft water. Adding water alone dilutes the coolant and degrades its anticorrosion properties.

The diluted coolant can attack the aluminum engine parts. In an emergency, soft water can be added, but the diluted coolant must be returned to the correct mixture ratio within a few days. If coolant must be added often, or the reserve tank has run completely dry, there is probably leakage in the cooling system. Check the system for leaks.

Coolant ruins painted surfaces. Immediately wash away any coolant that spills on the frame, engine, wheels, or other painted parts.

Coolant Draining

⚠ WARNING

To avoid burns, do not remove the radiator cap or try to change the coolant when the engine is still hot. Wait until it cools down.

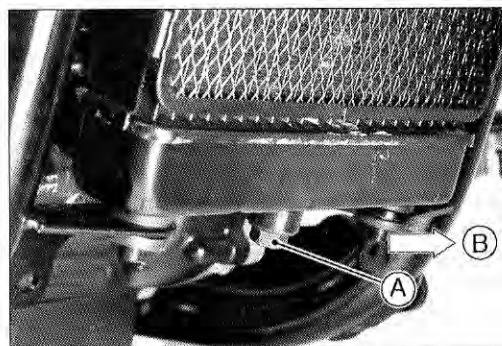
Coolant on tires will make them slippery, and can cause an accident and injury.

Since coolant is harmful to the human body, do not use for drinking.

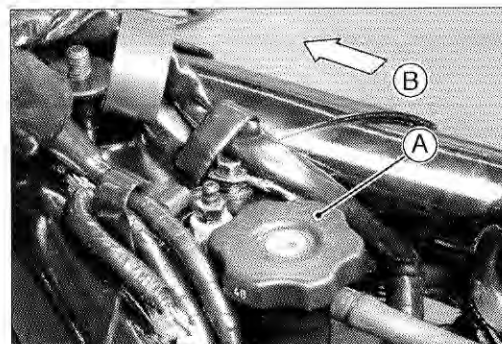
3-8 COOLING SYSTEM

Coolant

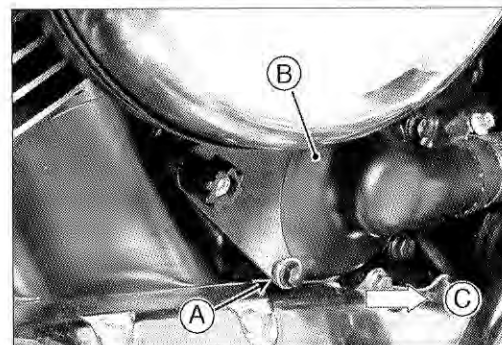
- Place a container under the radiator drain bolt [A], then remove the drain bolt.
Front [B]



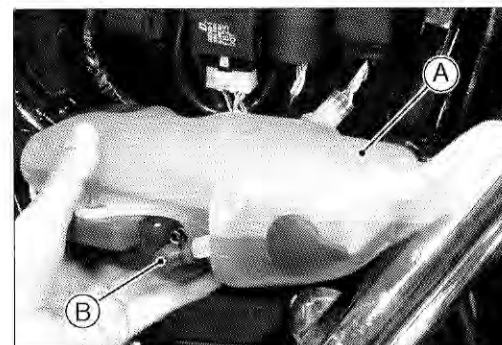
- Remove the fuel tank (see Fuel System chapter).
- Remove the radiator cap [A] in two steps. First turn the cap counterclockwise to the first stop. Then push and turn it further in the same direction and remove the cap.
- The coolant will drain from the radiator and engine.
Front [B]



- Remove the water pump drain bolt [A]. The remaining coolant will drain from the water pump [B].
- Place a conduit under the drain hole of the pump cover. The conduit leads to a container.
Front [C]



- Remove:
Right Side Cover (see Frame chapter)
Reserve Tank Bolts
- Turn over the reserve tank [A], remove the hose [B], and pour the coolant into a suitable container.
- Install the reserve tank.



Coolant Filling

CAUTION

Soft or distilled water must be used with the antifreeze (see Specifications in this chapter) in the cooling system. If hard water is used in the system, it causes scales accumulation in the water passages, and considerably reduces the efficiency of the cooling system.

Coolant

NOTE

- Choose a suitable mixture ratio by referring to the coolant manufacturer's directions.

Water and Coolant Mixture Ratio (when shipping)

Soft Water	:	50 %
Coolant	:	50 %
Freezing Point	:	-35°C (-31°F)
Total Amount	:	2.3 L

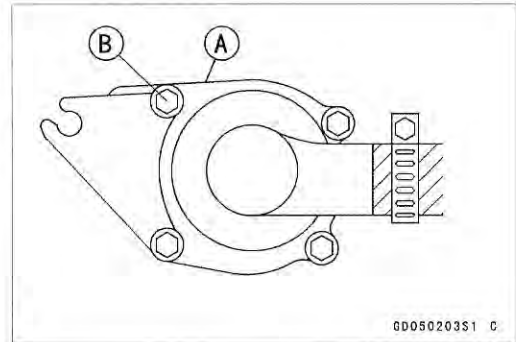
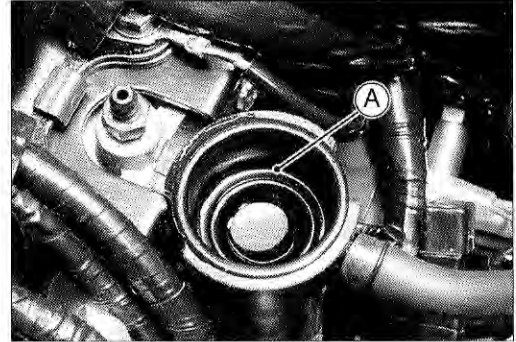
- Tighten the drain bolts.
- Torque - Radiator Drain Bolt: 7.4 N·m (0.75 kg·m, 65 in·lb)
Water Pump Drain Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)
- Fill the radiator up to the filler neck [A] with coolant.

NOTE

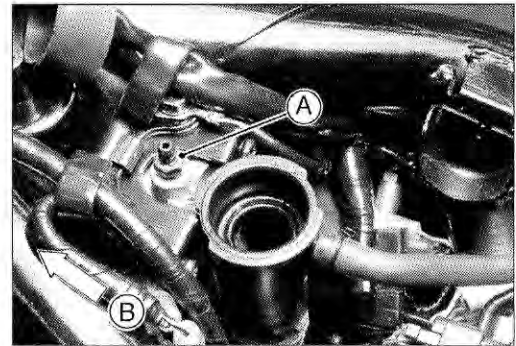
- Pour in the coolant slowly so that it can expel the air from the engine and radiator.

- Check the cooling system for leaks.
- First bleed the air from the water pump [A].
- Loosen the air bleeder bolt [B] until the coolant seeps out around the bolt, then tighten it.

Torque - Pump Air Bleeder Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)

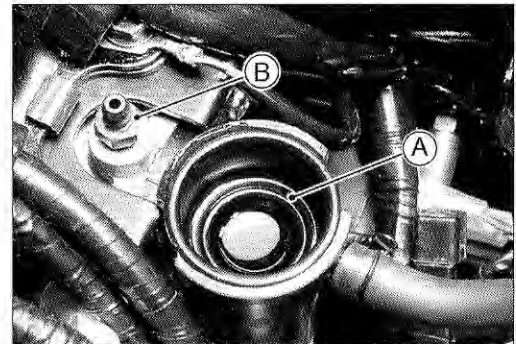


- Next, loosen the air bleeder bolt [A] on the thermostat housing. Front [B]
- Replenish the coolant into the radiator until the coolant begins to flow out the air bleeder bolt hole (that is, all the remaining air is forced out).
- Tap the radiator hoses force any air bubbles caught inside.



- Fill the radiator up to the filler neck [A] with the coolant.
- Install the radiator cap.
- Tighten the air bleeder bolt [B].

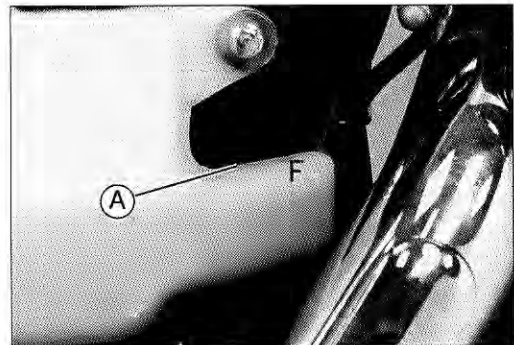
Torque - Thermostat Air Bleeder Bolt: 7.8 N·m (0.8 kg·m, 69 in·lb)



3-10 COOLING SYSTEM

Coolant

- Fill the reserve tank up to the “F” (Full) level line [A] with coolant and install the cap.
- Install the fuel tank (see Fuel System chapter).
- Start the engine and warm it up thoroughly until the radiator fan turns on and then stop the engine.
- Check the coolant level in the reserve tank several times while the engine is cooling down, and replenish as necessary.
- ★ If the coolant level is lower than the “L” (Low) level line, add coolant to the “F” (Full) level line.



CAUTION

Do not add more coolant above the FULL level.

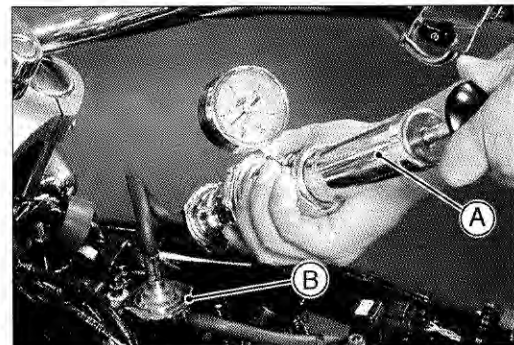
- Install the right side cover.

Pressure Testing

- Remove the fuel tank (see Fuel System chapter).
- Remove the radiator cap, and install a cooling system pressure tester [A] on the radiator filler neck [B].

NOTE

- *Wet the cap sealing surfaces with water or coolant to prevent pressure leakage.*
- Build up pressure in the system carefully until the pressure reaches 123 kPa (1.25 kg/cm², 17.8 psi).



CAUTION

During pressure testing, do not exceed the pressure for which the system is designed. The maximum pressure is 123 kPa (1.25 kg/cm², 17.8 psi).

- Watch the gauge for at least 6 seconds.
- ★ If the pressure holds steady, the system is all right.
- ★ If the pressure drops and no external source is found, check for internal leakage. Droplets in the engine oil indicate internal leakage. Check the cylinder head gasket and the water pump.
- Remove the pressure tester, replenish the coolant, and install the radiator cap.

Coolant

Cooling System Flushing

Over a period of time, the cooling system accumulates rust, scale, and lime in the water jacket and radiator. When this accumulation is suspected or observed, flush the cooling system. If this accumulation is not removed, it will clog up the water passage and considerably reduce the efficiency of the cooling system.

- Drain the cooling system (see Coolant Draining).
- Fill the cooling system with fresh water mixed with a flushing compound.

CAUTION

Do not use a flushing compound which is harmful to the aluminum engine and radiator. Carefully follow the instructions supplied by the manufacturer of the cleaning product.

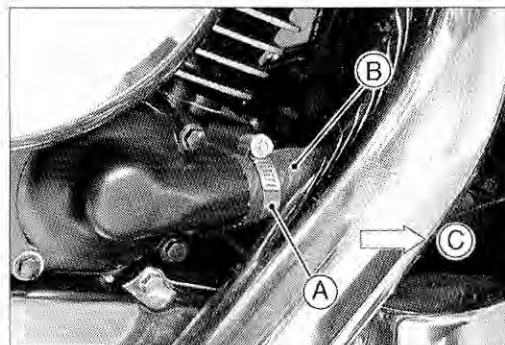
- Warm up the engine, and run it at normal operating temperature for about ten minutes.
- Stop the engine, and drain the cooling system.
- Fill the system with fresh water.
- Warm up the engine and drain the system.
- Repeat the previous two steps once more.
- Fill the system with a permanent type coolant and bleed the air from the system (see Coolant Filling).

3-12 COOLING SYSTEM

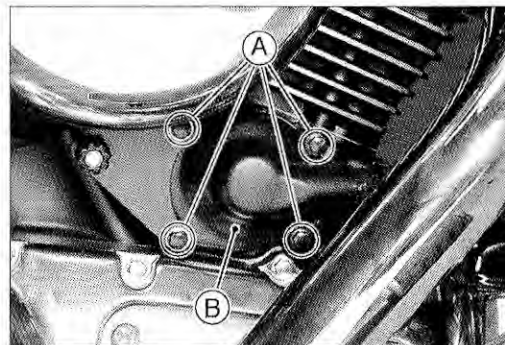
Water Pump

Water Pump Removal

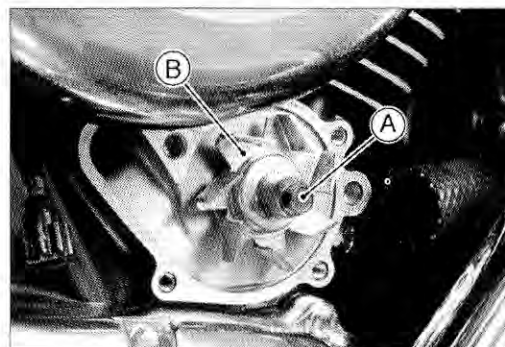
- Drain the coolant (see Coolant Draining).
- Remove:
 - Water Hose Clamp [A]
 - Water Hose [B]
 - Front [C]



- Remove:
 - Water Pump Cover Bolts [A]
 - Water Pump Cover [B]



- Remove:
 - Impeller Bolt [A]
 - Impeller [B]



NOTE

- The impeller bolt has left-hand threads. Turn the bolt clockwise and remove it.

Water Pump Installation

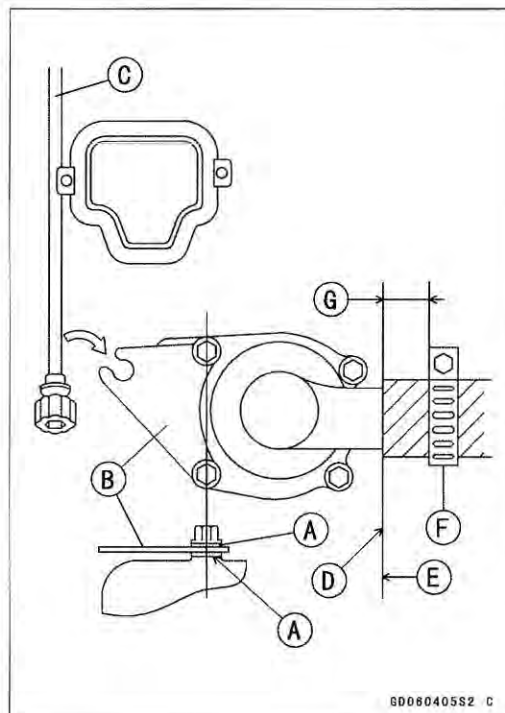
- There are aluminum washers [A] on each side of the bracket [B]. Replace them with new ones when installing.

Torque - Water Pump Cover Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Fit the idle adjusting screw [C] onto the bracket.
- Insert the pump inlet hose until the hose end [D] touches the pump inlet step [E].
- Install the clamp [F] so that the clamp end is 13 ~ 16 mm [G] apart from the pump inlet step. This prevents coolant leakage from the hose end.

- Tighten:

Torque - Hose Clamp Screws: 2.5 N·m (0.25 kg·m, 22 in·lb)

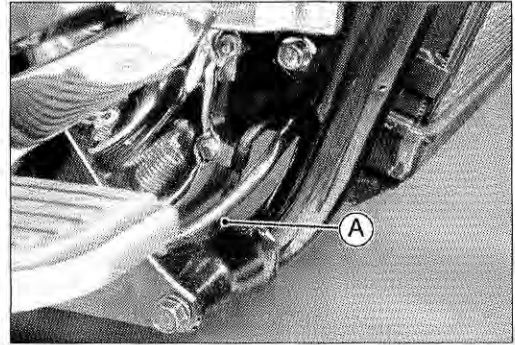


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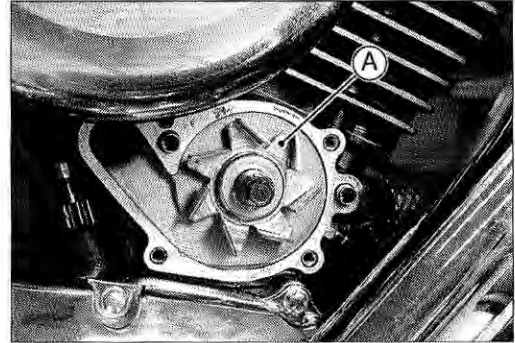
Water Pump

Water Pump Inspection

- Check the water pump drainage outlet hose [A] at the bottom of the water pump for coolant leakage.
- ★ If the mechanical seal is damaged, the coolant leaks through the seal and drain through the passage. Replace the mechanical seal.

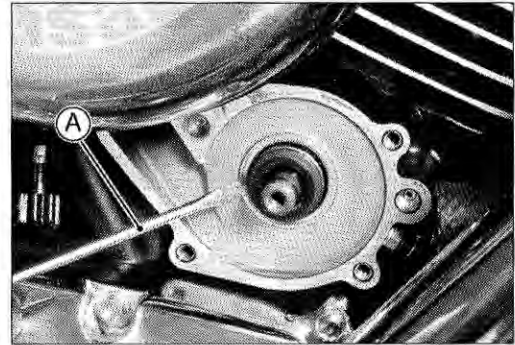


- Visually inspect the impeller [A].
- ★ If the surface is corroded, or if the blades are damaged, replace the impeller.



Mechanical Seal Replacement

- Remove the water pump impeller (see Water Pump Removal).
- Pry the mechanical seal flange off with a small chisel [A].
- Pull the mechanical seal out of the right crankcase with needle nose pliers. Discard the mechanical seal.



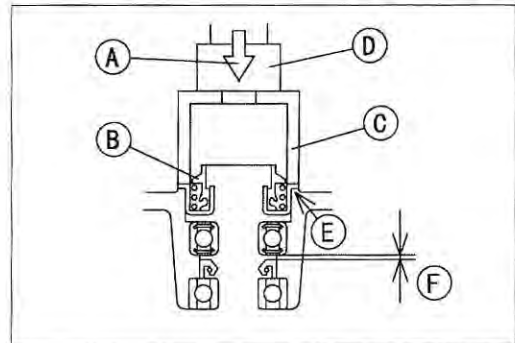
CAUTION

Be careful not to damage the water pump shaft, O-ring, and the inner sealing surface of the crankcase.

NOTE

- Since the replacement mechanical seal has an adhesive coated body, do not apply a liquid gasket to the exterior surface of the body.
- Press [A] the mechanical seal [B] by using a suitable 28 mm socket [C] and a bearing driver [D] until its flange touches the step [E].
Gap [F]

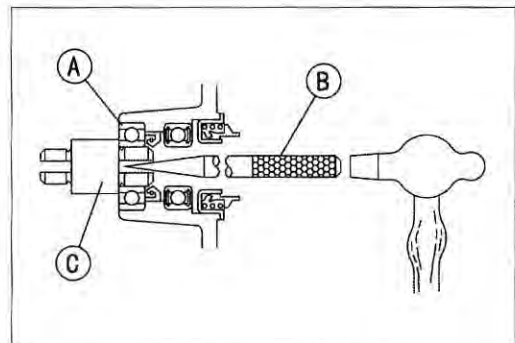
Special Tool - Bearing Driver Set: 57001-1129



- ★ If the coolant still leaks through the drainage outlet hose, the seal and ball bearings is probably damaged. Replace the mechanical seal, ball bearings, and oil seal by splitting the crankcase.
- Split the crankcase (see Crankshaft/Transmission chapter).
- Remove the water pump impeller.
- Pull out the water pump shaft from the inside of the right crankcase.
- Take the bearing [A] out of the right crankcase, using the bearing remover.

Special Tools - Bearing Remover Shaft: 57001-1265 [B]

Bearing Remover Head: $\phi 10 \times \phi 12$: 57001-1266 [C]

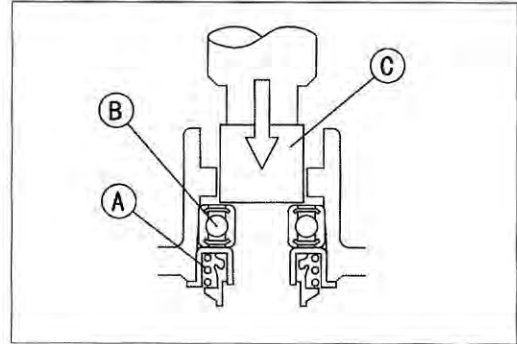


3-14 COOLING SYSTEM

Water Pump

- Using a thin-bladed screwdriver, pry out the oil seal.
- Press out the mechanical seal [A] and ball bearing [B] from the inside of the right crankcase with the bearing driver set [C].

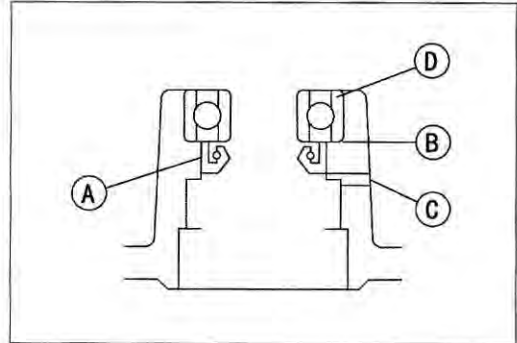
Special Tool - Bearing Driver Set: 57001-1129



- Be sure to replace the mechanical seal, oil seal, and ball bearings with new ones because these parts will be damaged by removal.
- Apply plenty of high temperature grease to the oil seal lips.
- Apply oil to the outer circumference of the oil seal.
- Press the oil seal [A] into the hole from the inside of the right crankcase with the bearing driver set so that the spring side of the seal lips is toward the inside of the crankcase.

Special Tool - Bearing Driver Set: 57001-1129

- Press the oil seal in until the seal end is even with step [B] of the hole as shown.
- Use the bearing driver which has a larger diameter than the oil seal.

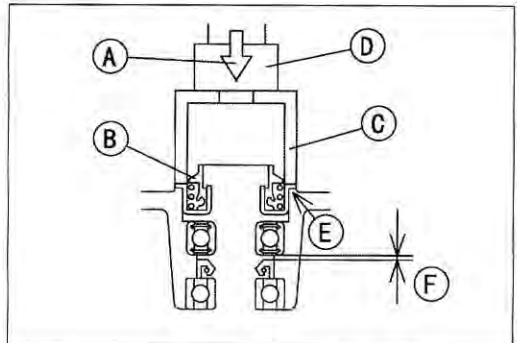


CAUTION

Do not block the coolant drainage outlet passage [C] with the oil seal by pressing it too far into the cover.

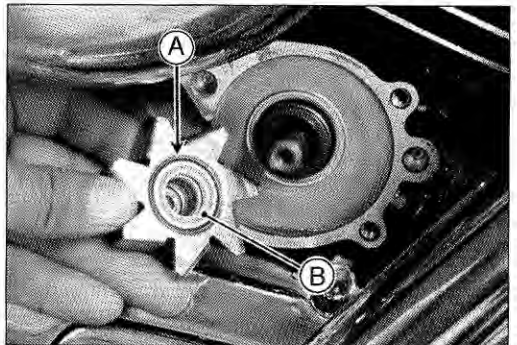
- Press in each ball bearing [D] with its manufacturer's mark facing out until it bottoms out.
- Press [A] the mechanical seal [B] by using a suitable 28 mm socket [C] and a bearing driver [D] until its flange touches the step [E].
Gap [F]
- Install the water pump shaft from the inside of the right crankcase.

Special Tool - Bearing Driver Set: 57001-1129



- Clean both sliding surfaces of a new mechanical seal with a high-flash point solvent (e.g. ethyl alcohol), and apply a little coolant to the sliding surface to give the mechanical seal initial lubrication.
- Apply coolant to the surface of the rubber seal [A] and sealing seat [B], and press the rubber seal and sealing seat into the impeller by hand until the seat bottoms out.
- Tighten the water pump impeller bolt by turning the bolt counterclockwise.

Torque - Water Pump Impeller Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)



Radiator

⚠ WARNING

The radiator fan is connected directly to the battery. The radiator fan may start even if the ignition switch is off. NEVER TOUCH THE RADIATOR FAN UNTIL THE RADIATOR FAN CONNECTOR IS DISCONNECTED. TOUCHING THE FAN BEFORE THE CONNECTOR IS DISCONNECTED COULD CAUSE INJURY FROM THE FAN BLADES.

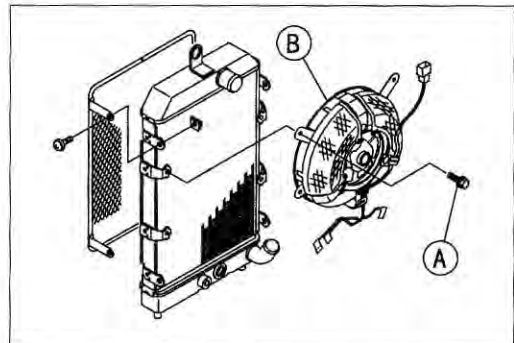
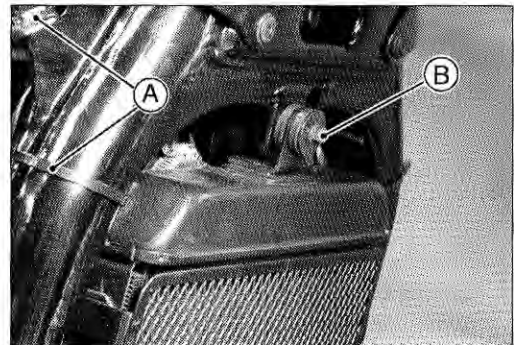
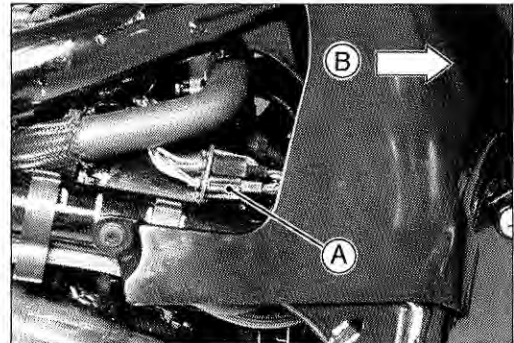
Radiator Removal

- Drain the coolant (see this chapter).
- Remove:
 - Fuel Tank (see Fuel System chapter)
 - Radiator Fan Motor Connector [A]
 - Radiator Hoses
 - Front [B]
- Cut the straps [A].
- Remove the mounting bolt [B].
- Lift up the radiator to clear the stoppers.
- Remove the radiator.

CAUTION

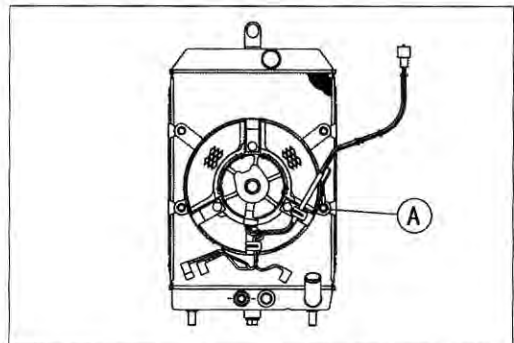
Do not touch the radiator core. This could damage the radiator fins, resulting in loss of cooling efficiency.

- Remove:
 - Radiator Fan Bolts [A]
 - Radiator Fan [B]



Radiator Installation

- Be sure to install the radiator fan ground lead terminal [A].
- Be sure to insert the pump inlet hose with the hose end 10 mm apart from the pump inlet step (see Water Pump Installation).
- Tighten:
 - Torque - Hose Clamp Screws: 2.5 N·m (0.25 kg·m, 22 in·lb)

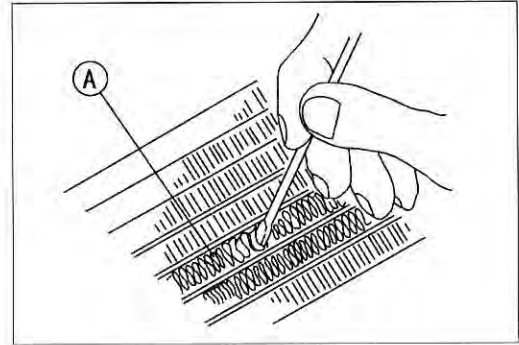


3-16 COOLING SYSTEM

Radiator

Radiator Inspection

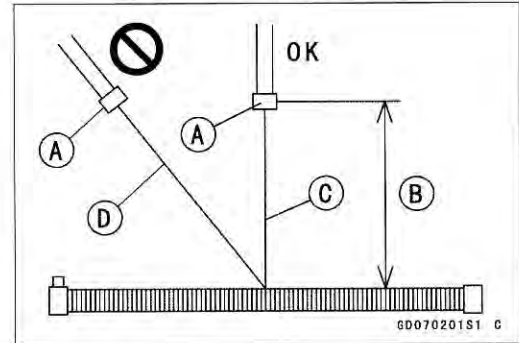
- Check the radiator core.
- ★ If there are obstructions to air flow, remove them.
- ★ If the corrugated fins [A] are deformed, carefully straighten them.
- ★ If the air passages of the radiator core are blocked more than **20%** by unremovable obstructions or irreparably deformed fins, replace the radiator with a new one.



CAUTION

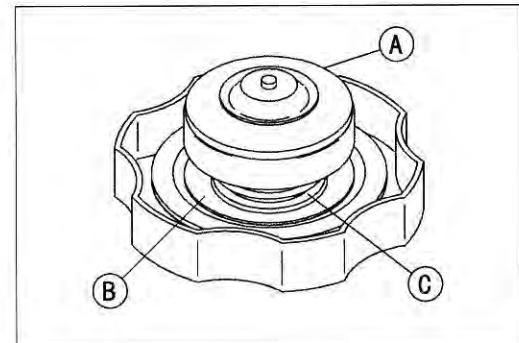
When cleaning the radiator with steam cleaner, be careful of the following to prevent radiator damage.
Keep the steam gun [A] away more than 0.5 m [B] from the radiator core.
Hold the steam gun perpendicular [C] to the core surface.
Run the steam gun following the core fin direction.

Oblique [D]



Radiator Cap Inspection

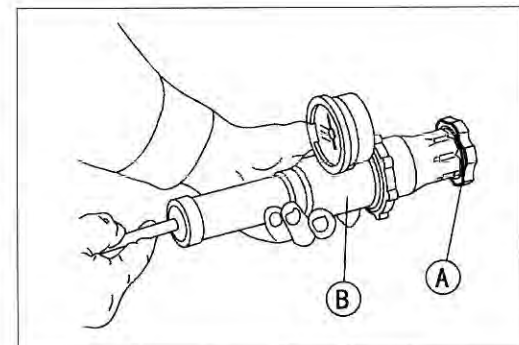
- Check the condition of the top and bottom valve seals of the radiator cap.
- ★ If any one of them shows visible damage, replace the cap.
 - Bottom Valve Seal [A]
 - Top Valve Seal [B]
 - Valve Spring [C]



- Install the cap [A] on a cooling system pressure tester [B].

NOTE

- Wet the cap sealing surfaces with water or coolant to prevent pressure leakage.
- Watching the pressure gauge, pump the pressure tester to build up the pressure until the relief valve opens: the gauge hand flicks downward. Stop pumping and measure leak time at once. The relief valve must open within the specified range in the table below and the gauge hand must remain within the same range at least 6 seconds.



Radiator Cap Relief Pressure

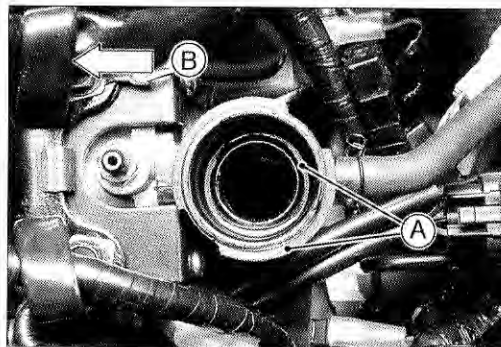
Standard: 93 ~ 123 kPa (0.95 ~ 1.25 kg/cm², 14 ~ 17.8 psi)
for 6 seconds

- ★ If the cap holds too much pressure, or if the cap cannot hold the specified pressure, replace it with a new one.

Radiator*Radiator Filler Neck Inspection*

- Remove the radiator cap.
- Check the radiator filler neck for signs of damage.
- Check the condition of the top and bottom sealing seats [A] in the filler neck. They must be smooth and clean for the radiator cap to function properly.

Front [B]

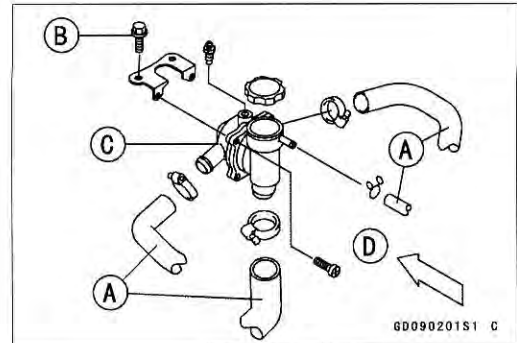


3-18 COOLING SYSTEM

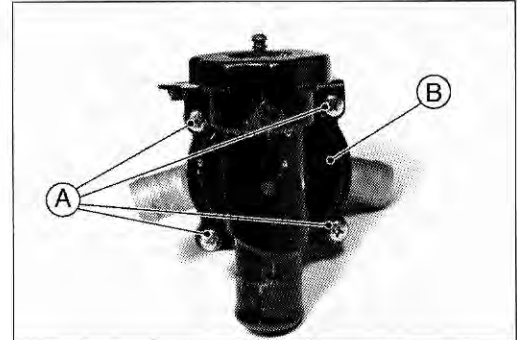
Thermostat

Thermostat Removal

- Remove:
 - Fuel Tank (see Fuel System chapter)
 - Coolant : Drain about 200 mL
 - Four Hoses [A]
 - Bracket Bolts [B]
 - Water Temperature Sensor Connector
- Remove the thermostat housing [C] along with the bracket.
Front [D]

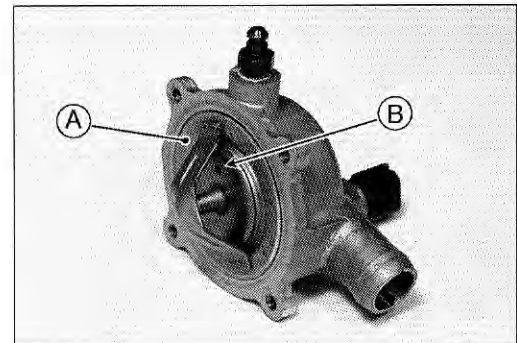


- Remove the screws [A], take off the cap [B], and take out the thermostat.



Thermostat Installation

- Install the thermostat [A] in the housing so that the air bleeder hole [B] is on top.
- Install a new O-ring into the housing.
- Fill the radiator with coolant (see Coolant Filling).



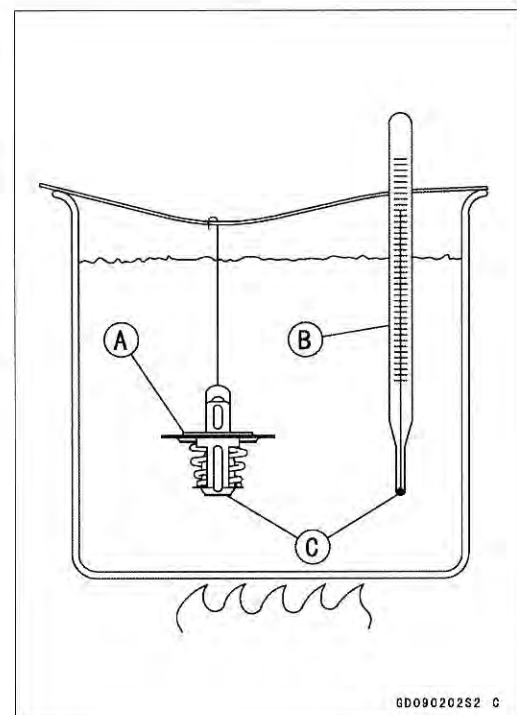
Thermostat Inspection

- Remove the thermostat, and inspect the thermostat valve at room temperature.
- ★ If the valve is open, replace the valve with a new one.
- To check valve opening temperature, suspend the thermostat [A] and an accurate thermometer [B] in a container of water with the heat-sensitive portions [C] in almost the same depth.

NOTE

- The thermostat must be completely submerged and the thermostat and thermometer must not touch the container sides or bottom.
- Gradually raise the temperature of the water while stirring the water gently for even temperature.
- ★ If the measurement is out of the range, replace the thermostat.

Thermostat Valve Opening Temperature
58 ~ 62°C (136 ~ 144°F)



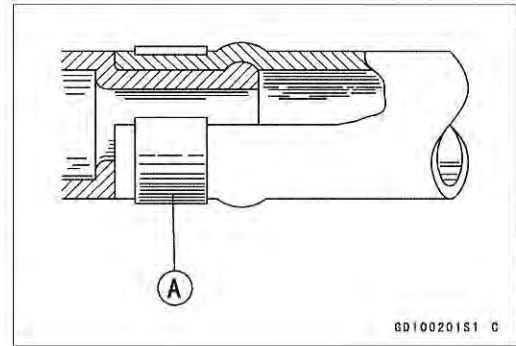
Hose

Whenever the radiator, thermostat or water hoses are removed or in accordance with the Periodic Maintenance Chart, check the radiator, thermostat or water hoses and their connections.

Hose Installation

- Install the hoses and pipes being careful to follow bending direction or diameter. Avoid sharp bending, kinking, flattening, or twisting.
- Install the clamps [A] as near as possible to the hose end to clear the raised rib or the fitting. This will prevent the hoses from working loose.
- The clamp screws should be positioned correctly to prevent the clamps from contacting anything.

Torque - Hose Clamp Screws: 2.5 N·m (0.25 kg·m, 22 in·lb)



Hose Inspection

- Visually inspect the hoses for signs of deterioration. Squeeze the hoses. A hose should not be hard and brittle, nor should it be soft or swollen.
- Replace any damaged hoses.

Engine Top End

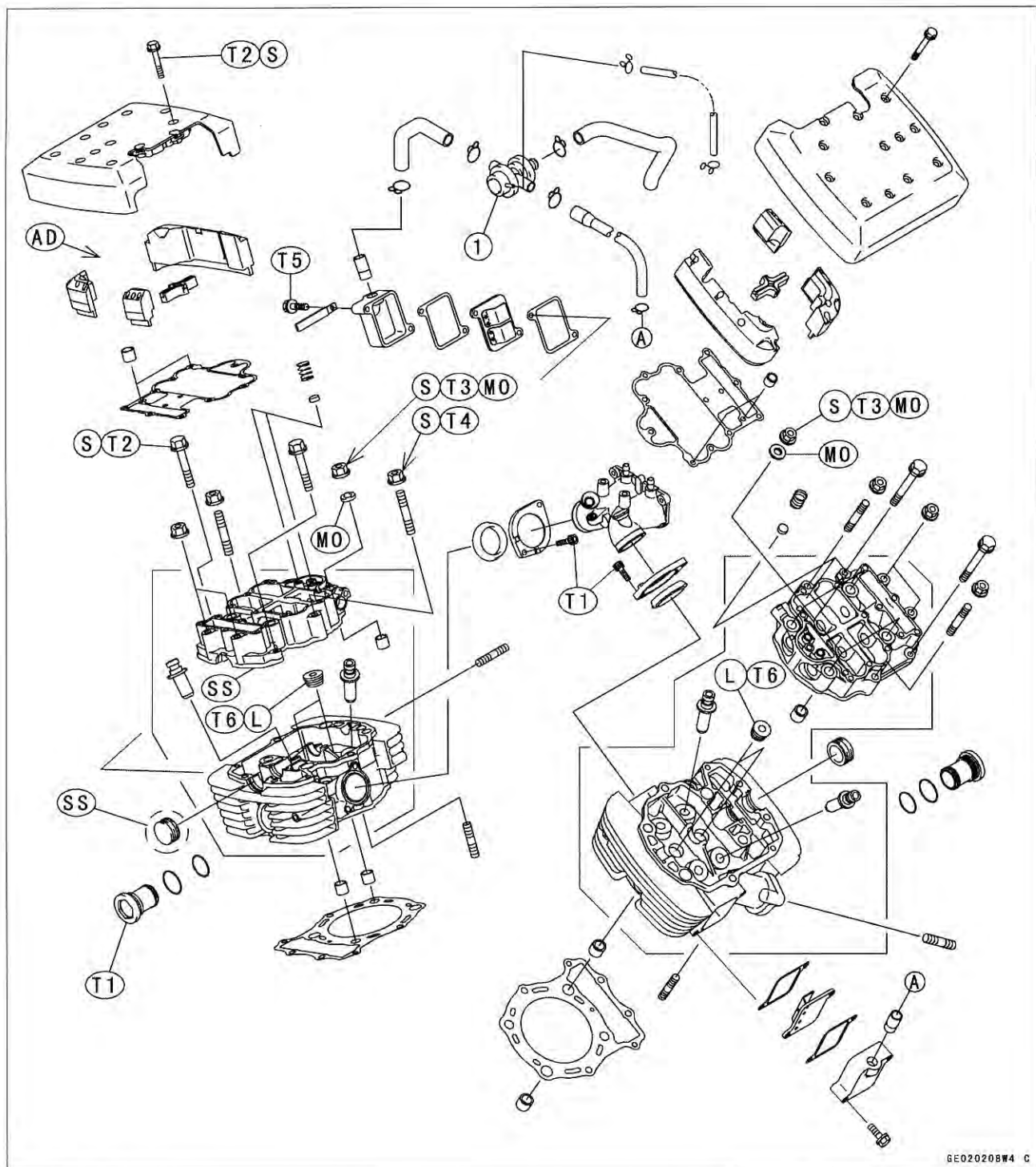
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4-2 ENGINE TOP END

Exploded View



GE020208W4 C

AD: Apply adhesive.

EO: Apply engine oil to the threads and seating surface of 12 mm nuts.

G: Apply grease.

MO: Apply molybdenum disulfide oil.

S: Follow the specific tightening sequence.

SS: Apply silicone sealant (Kawasaki Bond: 56019-120).

1. Vacuum Switch Valve

T1: 12 N·m (1.2 kg·m, 104 in·lb)

T2: 8.8 N·m (0.90 kg·m, 78 in·lb)

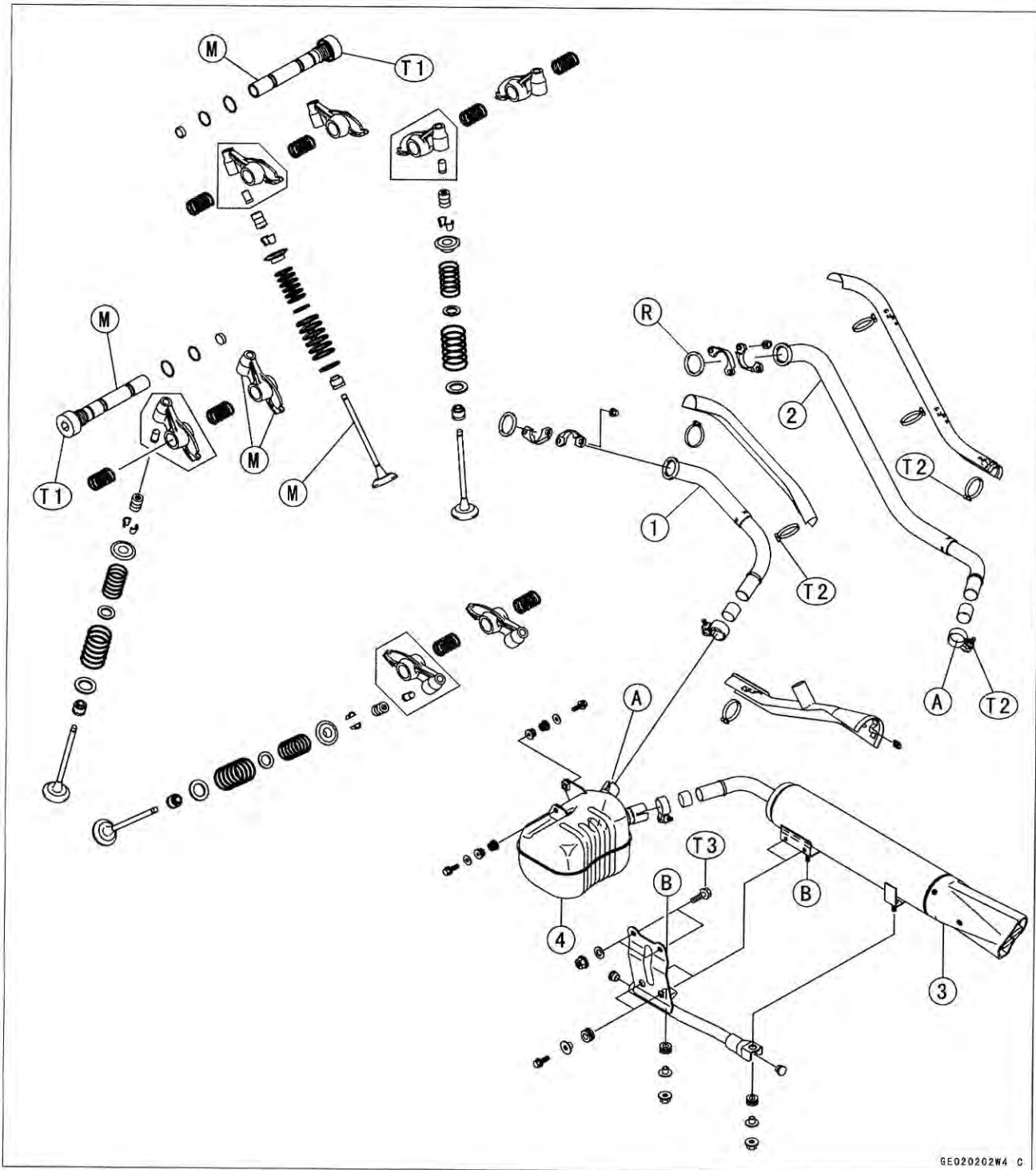
T3: $\phi 12$ mm, 78 N·m (8.0 kg·m, 58 ft·lb)

T4: $\phi 8$ mm, 25 N·m (2.5 kg·m, 18 ft·lb)

T5: 7.4 N·m (0.75 kg·m, 65 in·lb)

T6: 20 N·m (2.0 kg·m, 14 ft·lb)

Exploded View



GE020202W4 C

1. Rear Exhaust Pipe
2. Front Exhaust Pipe
3. Silencer
4. Premuffler Chamber

M: Apply molybdenum disulfide grease.

R: Replacement Parts

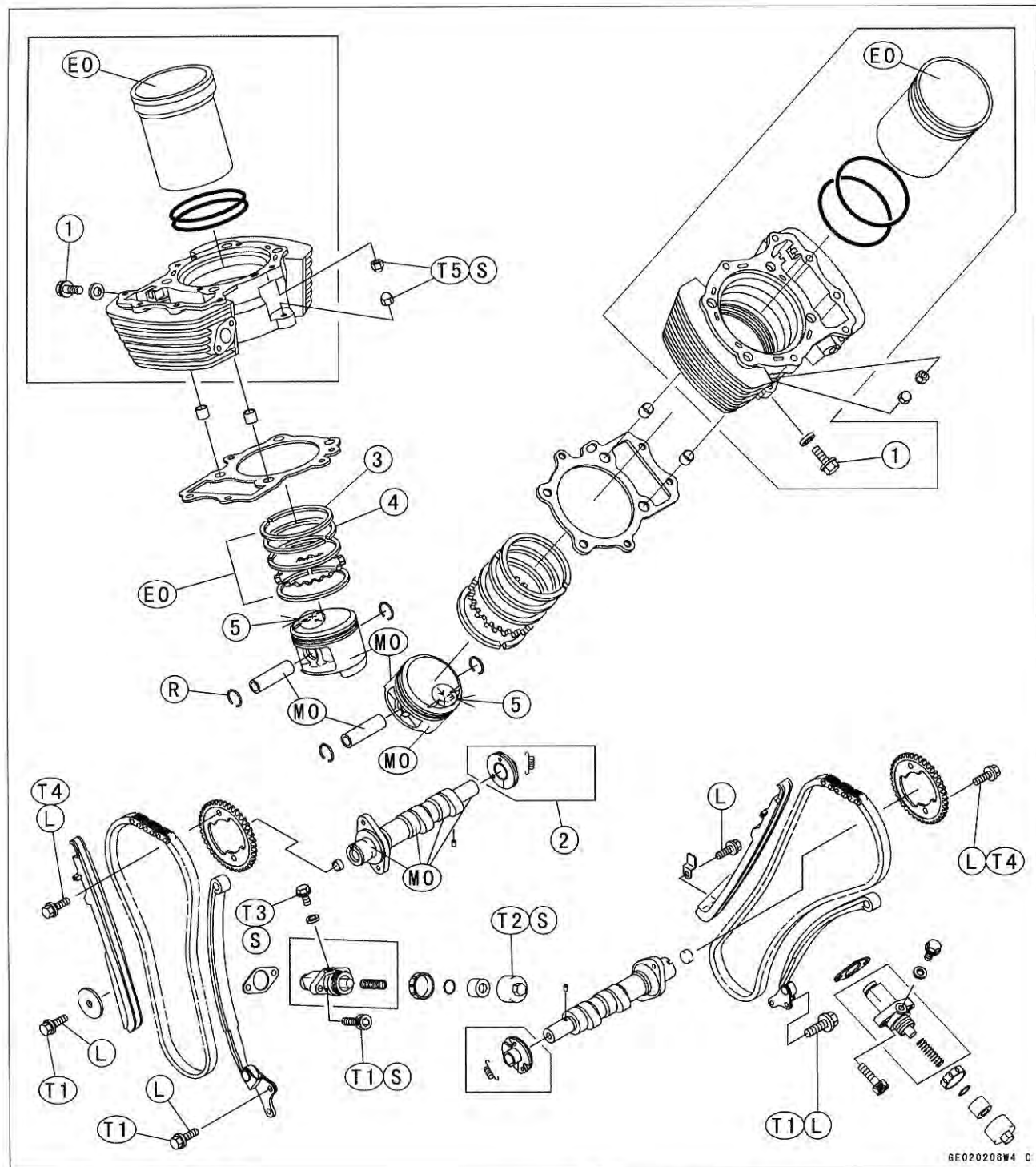
T1: 25 N·m (2.5 kg·m, 18 ft·lb)

T2: 6.9 N·m (0.7 kg·m, 61 in·lb)

T3: 34 N·m (3.5 kg·m, 25 ft·lb)

4-4 ENGINE TOP END

Exploded View



GE020208W4 C

1. Coolant Drain Bolts
 2. KACR Unit
 3. "R" marked side faces up.
 4. "RN" marked side faces up.
 5. Each "EX" mark points to the exhaust side.
- EO: Apply engine oil.
- L: Apply a non-permanent locking agent.
- MO: Apply molybdenum disulfide oil.

R: Replacement Parts

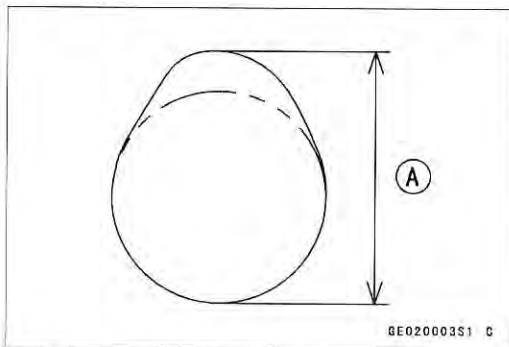
S: Follow the specific tightening sequence.

- T1: 9.8 N·m (1.0 kg·m, 87 in·lb)
- T2: 20 N·m (2.0 kg·m, 14 ft·lb)
- T3: 4.9 N·m (0.50 kg·m, 43 in·lb)
- T4: 15 N·m (1.5 kg·m, 11 ft·lb)
- T5: 25 N·m (2.5 kg·m, 18 ft·lb)

Specifications

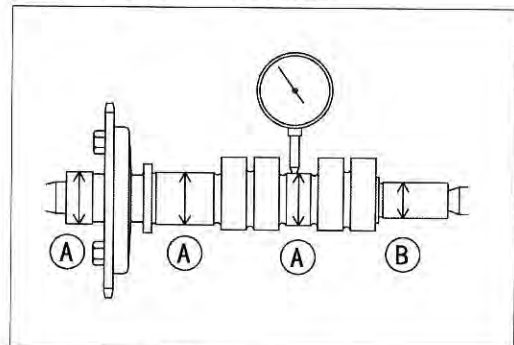
Item	Standard	Service Limit
Clean Air System: Vacuum switch valve closing pressure:	Open → Close 49.3 ~ 57.3 kPa (370 ~ 430 mm Hg)	---
Camshafts:		
Cam height:		
Exhaust	33.48 ~ 33.60 mm	33.38 mm
Inlet	33.80 ~ 33.92 mm	33.70 mm
Camshaft, camshaft cap clearance		
φ25	0.020 ~ 0.062 mm	0.15 mm
φ17	0.016 ~ 0.055 mm	0.14 mm
Camshaft journal diameter,	φ25 24.959 ~ 24.980 mm	24.93 mm
Rocker case bearing inside diameter,	φ25 25.000 ~ 25.021 mm	25.08 mm
Camshaft journal diameter,	φ17 16.966 ~ 16.984 mm	16.93 mm
Rocker case bearing inside diameter,	φ17 17.000 ~ 17.021 mm	17.08 mm
Camshaft runout	TIR 0.02 mm or less	TIR 0.1 mm
Camshaft chain 20-link length	127.0 ~ 127.36 mm	128.9 mm
Rocker arm inside diameter	16.000 ~ 16.018 mm	16.05 mm
Rocker shaft diameter	15.966 ~ 15.984 mm	15.94 mm
Cylinder Head:		
Cylinder compression usable range	340 ~ 590 kPa (3.5 ~ 6 kg/cm ² , 50 ~ 85 psi) @300 r/min (rpm) with electric starter	---
Cylinder head warp	---	0.05 mm
Valve:		
Valve clearance	Non-adjustable (Auto adjuster)	---
Valve head thickness:		
Exhaust	0.9 ~ 1.1 mm	0.7 mm
Inlet	0.9 ~ 1.1 mm	0.5 mm
Valve stem bend	TIR 0.01 mm or less	TIR 0.05 mm
Valve stem diameter:		
Exhaust	6.955 ~ 6.970 mm	6.94 mm
Inlet	6.965 ~ 6.980 mm	6.95 mm
Valve guide inside diameter:		
Exhaust	7.000 ~ 7.015 mm	7.08 mm
Inlet	7.000 ~ 7.015 mm	7.08 mm
Valve/valve guide clearance (wobble method):		
Exhaust	0.08 ~ 0.16 mm	0.30 mm
Inlet	0.05 ~ 0.13 mm	0.27 mm

Cam Height



Cam Height (maximum) [A]

Camshaft Journals and Runout



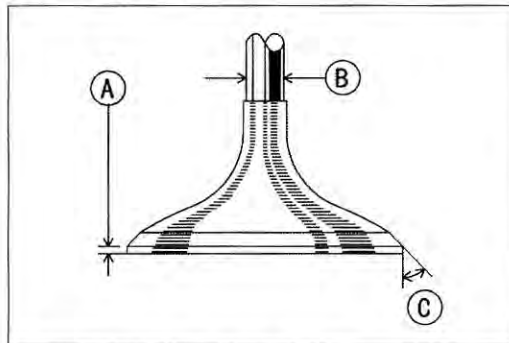
φ25 mm [A]
φ17 mm [B]

4-6 ENGINE TOP END

Specifications

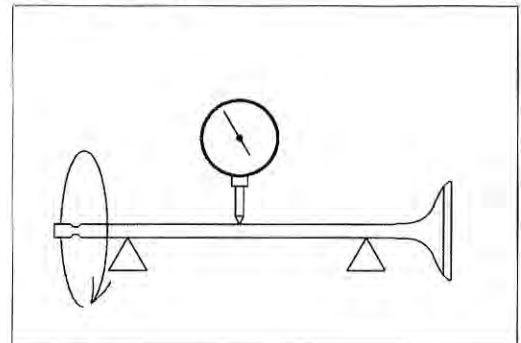
Item		Standard	Service Limit
Valve seat surface:			
Valve seat cutting angle		45°, 32°, 55°	---
Outside diameter:	Exhaust	28.9 ~ 29.1 mm	---
	Inlet	31.9 ~ 32.1 mm	---
Width:	Exhaust	0.5 ~ 1.0 mm	---
	Inlet	0.5 ~ 1.0 mm	---
Valve spring free length:	Outer (EX, IN)	44.76 mm (painted orange)	43.2 mm
	Inner (EX, IN)	39.82 mm (painted orange)	38.3 mm
Cylinder, Piston:			
Cylinder inside diameter		102.000 ~ 102.012 mm	102.10 mm
Piston diameter		101.942 ~ 101.957 mm	101.79 mm
Piston/cylinder clearance		0.043 ~ 0.070 mm	---
Oversize piston and rings		+ 0.5 mm	---
Piston ring/groove clearance:	Top	0.035 ~ 0.070 mm	0.17 mm
	Second	0.02 ~ 0.06 mm	0.16 mm
Piston ring groove width:	Top	1.025 ~ 1.040 mm	1.12 mm
	Second	1.21 mm ~ 1.23 mm	1.31 mm
Piston ring thickness:	Top	0.97 mm ~ 0.99 mm	0.9 mm
	Second	1.17 mm ~ 1.19 mm	1.10 mm
Piston ring end gap:	Top	0.30 ~ 0.40 mm	0.70 mm
	Second	0.40 ~ 0.55 mm	0.85 mm
	Oil	0.3 ~ 0.9 mm	1.2 mm

Valve Head Thickness



Valve Head Thickness [A]
Valve Stem Diameter [B]
45° [C]

Valve Stem Bend



Specifications

Special Tools - Fork Oil Level Gauge: 57001-1290
Drive-Filler Cap: 57001-1454
Spark Plug Wrench, Hex 18: 57001-1024
Compression Gauge: 57001-221
Compression Gauge Adapter, M12 × 1.25: 57001-1018
Valve Spring Compressor Assembly: 57001-241
Valve Spring Compressor Adapter, $\phi 28.2$: 57001-243
Valve Guide Arbor, $\phi 7$: 57001-163
Valve Guide Reamer, $\phi 7$: 57001-162
Valve Seat Cutter Holder, $\phi 7$: 57001-1126
Valve Seat Cutter Holder Bar: 57001-1128
Valve Seat Cutter, $45^\circ - \phi 32$: 57001-1115
Valve Seat Cutter, $45^\circ - \phi 35$: 57001-1116
Valve Seat Cutter, $32^\circ - \phi 35$: 57001-1121
Valve Seat Cutter, $32^\circ - \phi 33$: 57001-1199
Valve Seat Cutter, $55^\circ - \phi 35$: 57001-1247
Piston Ring Compressor Grip: 57001-1095
Piston Ring Compressor Belt, $\phi 95 \sim \phi 108$: 57001-1358
Piston Pin Puller Assembly: 57001-910
Piston Pin Puller Adapter: 57001-1211
Hexagon Wrench, Hex 27: 57001-1210

○ Compression Gauge Adapter: 57001-1183 can also be used.

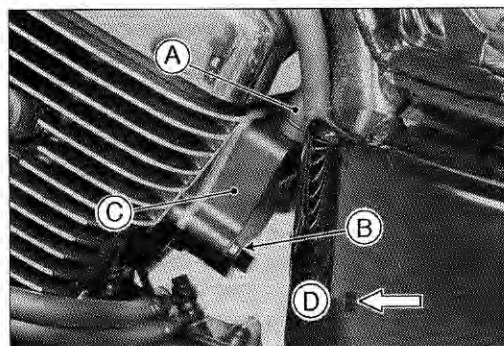
Sealant - Kawasaki Bond (Silicone Sealant): 56019-120

4-8 ENGINE TOP END

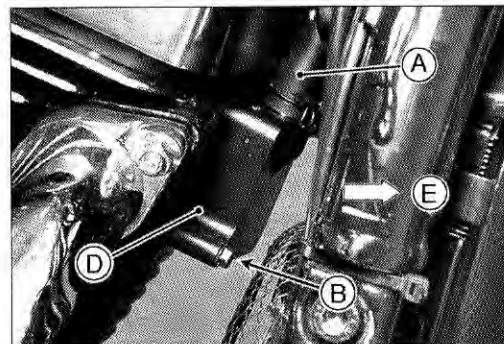
Clean Air System

Air Suction Valve Removal

- For rear air suction valve removal, remove the rear exhaust pipe (see this chapter).
- Remove the hose [A].
- Unscrew the mounting bolts [B] and remove the rear air suction valve cover [C].
- Remove the air suction valve.
Front [D]



- For front air suction valve removal, remove the radiator mounting bolt and move the radiator forward.
- Remove the hose [A].
- Unscrew the mounting bolts [B] and remove the front air suction valve cover [D].
- Remove the air suction valve.
Front [E]



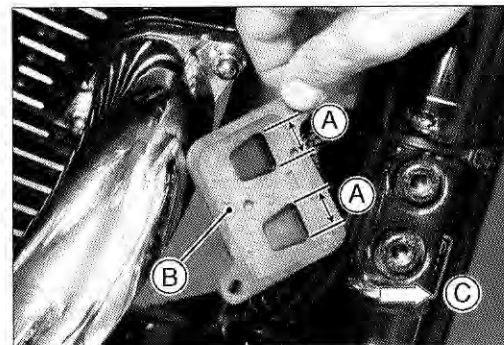
Air Suction Valve Installation

- Replace the gasket with a new one.
- Install each air suction valve so that its wider side [A] of the reed faces left.

Torque - Air Suction Valve Cover Bolts: 7.4 N·m (0.75 kg·m, 65 in·lb)

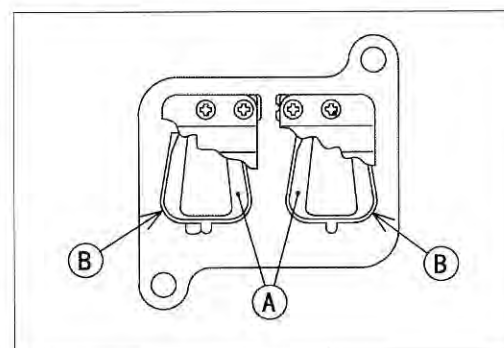
Front Air Suction Valve [B]

Front [C]



Air Suction Valve Inspection (Periodic Inspection)

- Visually inspect the reeds for cracks, folds, warps, heat damage, or other damage.
- ★ If there is any doubt as to the condition of the reeds [A], replace the air suction valve as an assembly.
- Check the reed contact areas [B] of the valve holder for grooves, scratches, any signs of separation from the holder, or heat damage.
- ★ If there is any doubt as to the condition of the reed contact areas, replace the air suction valve as an assembly.
- If any carbon or other foreign particles have accumulated between the reed and the reed contact area, wash the valve assembly clean with high-flash point solvent.



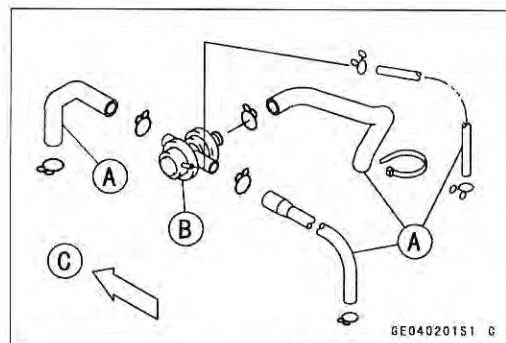
CAUTION

Do not scrape off the deposits with a scraper as this could damage the rubber, requiring replacement of the suction valve assembly.

Clean Air System

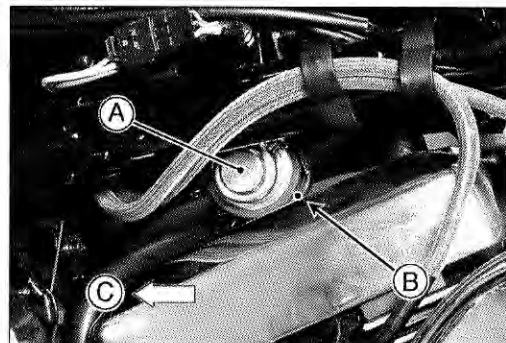
Vacuum Switch Valve Removal

- Remove:
Fuel Tank (see Fuel System chapter)
- Pull off the hoses [A] and take out the vacuum switch valve [B].
Front [C]



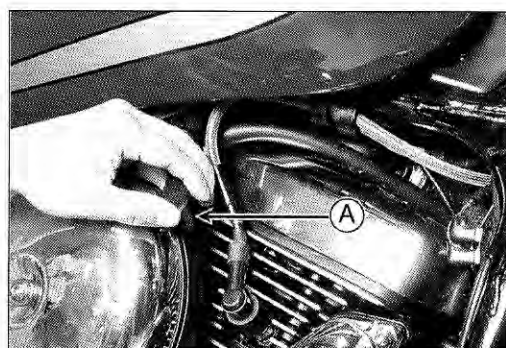
Vacuum Switch Valve Installation

- Install the vacuum switch valve [A] so that the air hole [B] faces downwards.
- Route the hoses correctly (see General Information chapter).
Front [C]

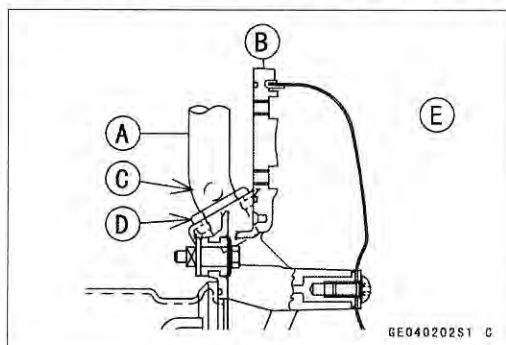


Vacuum Switch Valve Operation Test

- Pull the vacuum switch hose [A] out of the right air cleaner base.
- Start the engine and run it at idle speed.
- Plug the vacuum switch hose end with your finger and feel vacuum pulsing in the hose.
- ★ If there is no vacuum pulsation, check the hose line for leak. If there is no leak, check the vacuum switch valve (see Vacuum Switch Valve Unit Test).



- Apply a soap and water solution or rubber lubricant to the end of the vacuum switch hose [A] and put the hose into the right air cleaner base [B] with the white mark [C] faced forward until the white mark aligns with the top of the grommet [D].
Rear View [E]

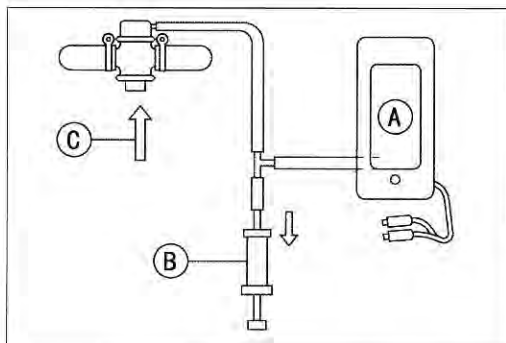


Vacuum Switch Valve Test

- Remove the vacuum switch valve (see Vacuum Switch Valve Removal).
- Connect a commercially available vacuum gauge [A] and syringe [B] (or fork oil level gauge) to the vacuum hoses as shown.

Special Tool - Fork Oil Level Gauge: 57001-1290

Air Flow [C]

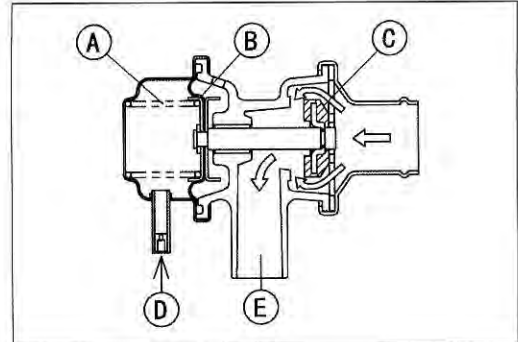


4-10 ENGINE TOP END

Clean Air System

- Gradually raise the vacuum (lower the pressure) applied to the vacuum switch valve, and check the valve operation. When the vacuum is low, the vacuum switch valve should permit air to flow. When the vacuum raises to valve closing pressure, it should stop air flow.

Spring [A]
Diaphragm [B]
Valve [C]
Low Vacuum
Secondary air flows [E].



- ★ If the vacuum switch valve does not operate as described, replace it with a new one.

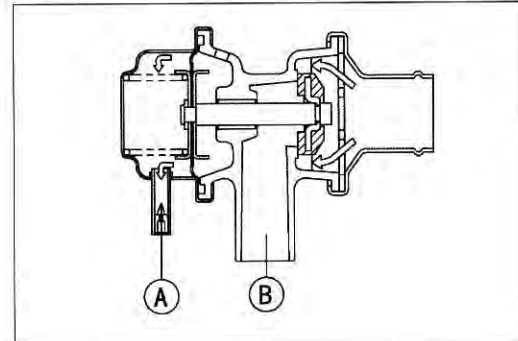
NOTE

- To check air flow through the vacuum switch valve, just blow through the air cleaner hose.

Vacuum Switch Valve Closing Pressure (Open → Close)

Standard: 49.3 ~ 57.3 kPa (370 ~ 430 mm Hg)

High Vacuum [A]
Secondary air cannot flow [B].



Clean Air System Hose Inspection

- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly to the lower air cleaner duct, vacuum switch valve, throttle body, and air suction valve covers.
- ★ If they are not, correct them. Replace them if they are damaged.

Camshaft Chain Tensioner

Removal

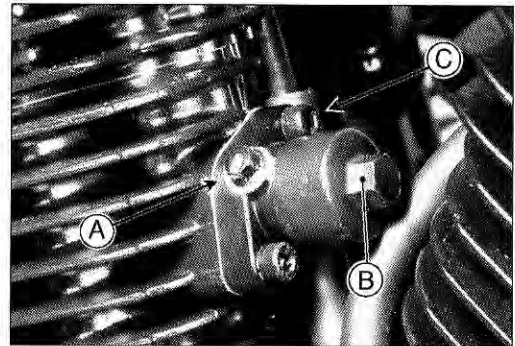
CAUTION

This is a non-return type cam chain tensioner. The push rod does not return to its original position once it moves out to take up camshaft chain slack. Observe all the rules listed below:

When removing the tensioner, do not take out the mounting bolts only halfway. Retightening the mounting bolts from this position could damage the tensioner and the camshaft chain. Once the bolts are loosened, the tensioner must be removed and reset as described in "Camshaft Chain Tensioner Installation".

Do not turn over the crankshaft while the tensioner is removed. This could upset the cam chain timing, and damage the valves.

- For the front chain tensioner, remove the lower air cleaner duct and left air cleaner base holder (see Fuel System chapter).
- For the rear chain tensioner, remove the rear exhaust pipe (see this chapter).
- The procedure to remove the front chain tensioner is as follows. The rear chain tensioner removal is same as for the front chain tensioner.
- Loosen the lockbolt [A] and remove the tensioner cap [B].
- Remove the tensioner mounting bolts [C] and take off the chain tensioner.

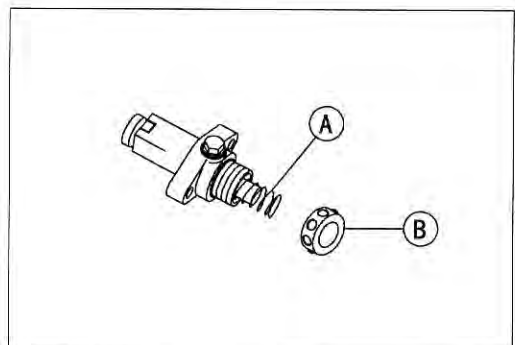
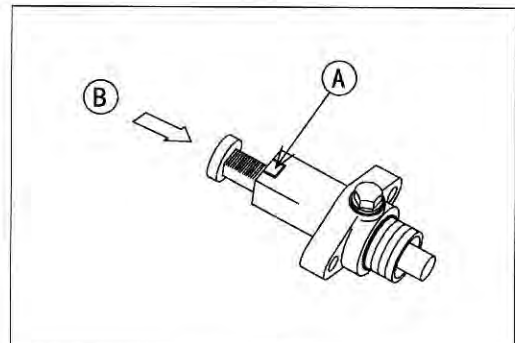


Installation

CAUTION

Be sure to install the camshaft chain tensioner after camshaft chain is timed.

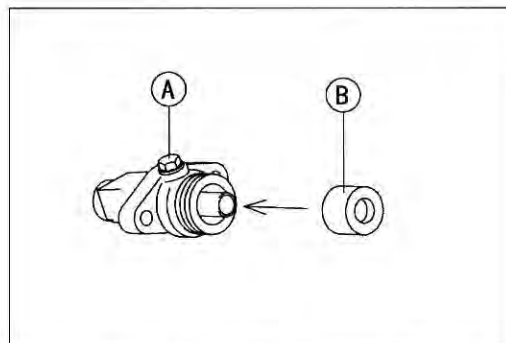
- Push the stopper [A] to release the ratchet and push the push rod [B] into the tensioner body.
- Install the larger spring [A], and then the ball bearing assy [B].
- Fit the ball bearing assy into the body until it bottoms out, using a thin-bladed screwdriver.



4-12 ENGINE TOP END

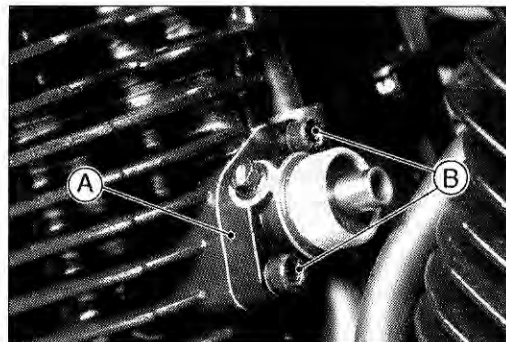
Camshaft Chain Tensioner

- Screw in the lockbolt [A] finger-tight to hold the ball bearing assy.
- Install the retainer [B].



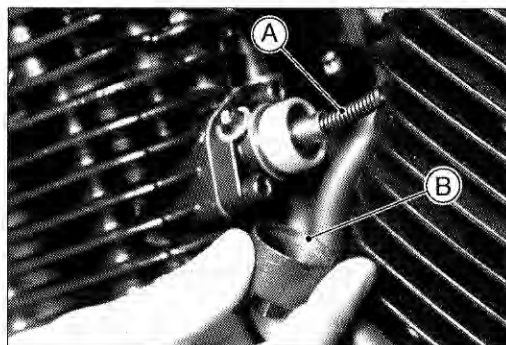
- Install the tensioner body [A] and tighten the mounting bolts [B] to the specified torque.

Torque - Chain Tensioner Mounting Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)



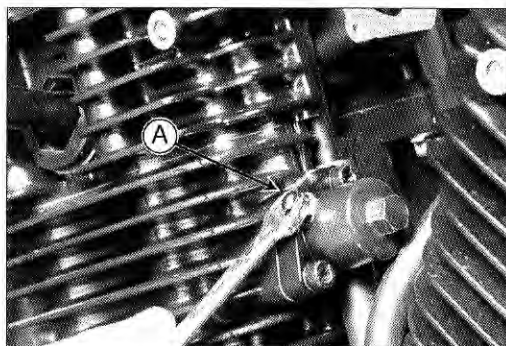
- Install the smaller spring [A] and the tensioner cap [B].
- Tighten the tensioner cap to the specified torque.

Torque - Chain Tensioner Cap: 20 N·m (2.0 kg·m, 14 ft·lb)



- Loosen the lockbolt [A] and check to be sure that the larger spring clicks, then tighten the lockbolt.

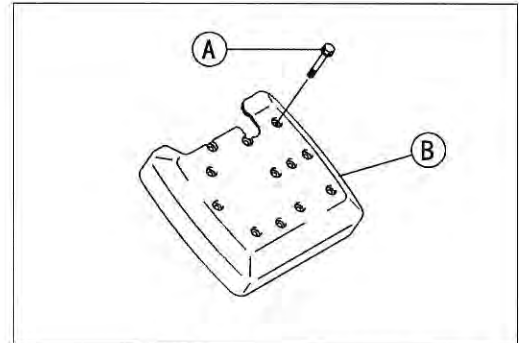
Torque - Chain Tensioner Lockbolt: 4.9 N·m (0.50 kg·m, 43 in·lb)



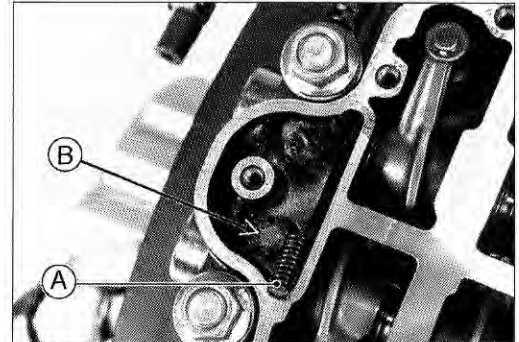
Rocker Case Cover

Removal

- Remove the engine (see Engine Removal/Installation chapter).
- Remove the bolts [A] and take off the cover [B] from the rocker case.

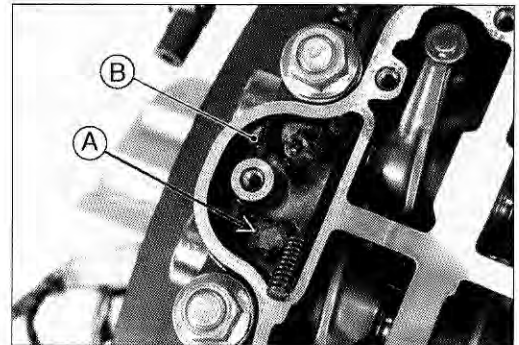


- Take out the oil filter springs [A] and HLA oil filters [B].



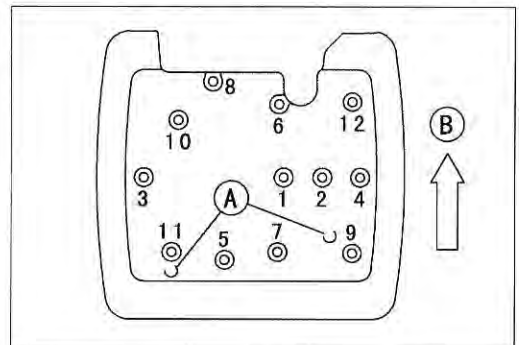
Installation

- Replace the oil filters [A] with new ones.
- After installing the rocker case, fill the oil reservoir [B] with engine oil.



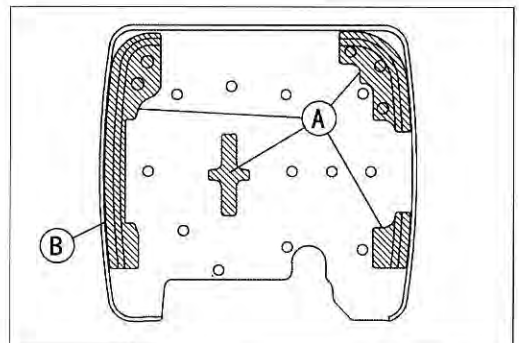
- Replace the cover gasket with a new one.
- Tighten the cover bolts to the specified torque following the tightening sequence.
Dowel Pins [A]
Front [B]

Torque - Rocker Case Cover Bolts: 8.8 N·m (0.9 kg·m, 78 in·lb)



Assembly

- Apply adhesive to the rubber dampers [A] and install them on the rocker case cover [B] as shown.

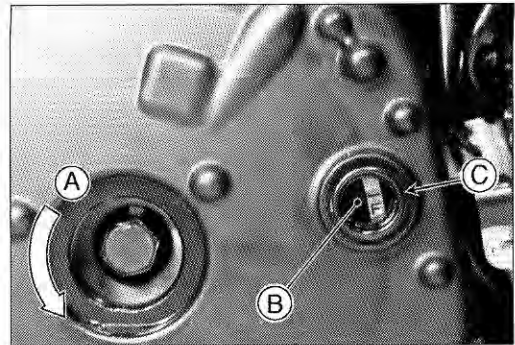


4-14 ENGINE TOP END

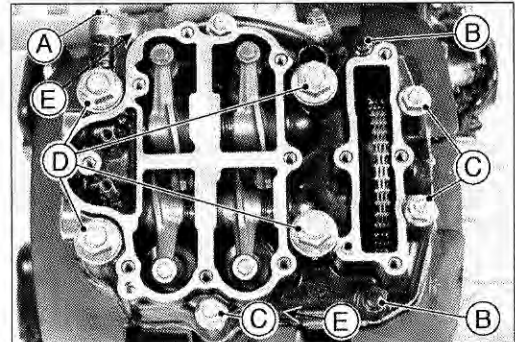
Rocker Case

Removal

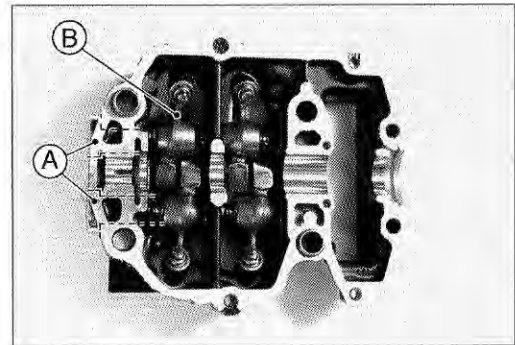
- Remove the engine (see Engine Removal/Installation chapter).
- Remove the rocker case covers (see this chapter).
- Remove the timing inspection plug and rotor bolt plug.
- Turn the crankshaft counterclockwise [A] and align the "F" mark (TDC mark for front piston) [B] with the middle of the notch [C].



- Remove the oil hose banjo bolt [A].
- Remove the camshaft chain tensioner (see Camshaft Chain Tensioner Removal).
- Remove the rocker case bolts [B], smaller nuts [C], and then larger nuts [D].
- Using the pry points [E], take the rocker case out of the cylinder head.



- Remove the rocker shafts [A], and take the rocker arms [B] out of the rocker case.
- Take out the oil filters if necessary.
- Remove the lash adjuster if necessary (see HLA Removal).

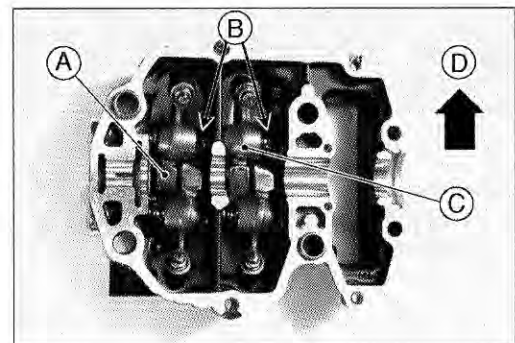


Installation

CAUTION

The cylinder head and rocker case are machined in the assembled state, so they must be used as a set. Be careful not to mix them up for front and rear cylinders.

- Install the rocker arms [A] and retaining springs [B] on each rocker shaft as shown.
- These retaining springs are the same.
- The exhaust rocker arm [C] on the chain tunnel side is different from the others.
Exhaust Side [D]
- Be careful not to tip the rocker arm and not to allow the oil to leak out of HLA.



Rocker Case

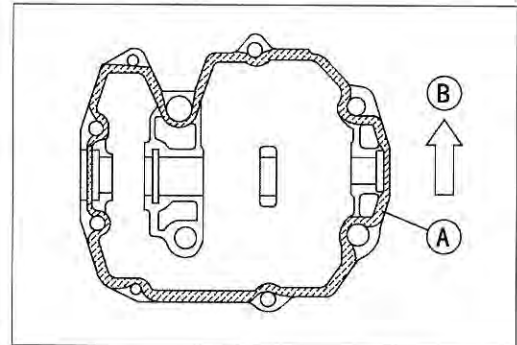
- Before installing the rocker shaft, be sure the O-rings are in place.
- Tighten the rocker shafts to the specified torque.

Torque - Rocker Shafts: 25 N·m (2.5 kg·m, 18 ft·lb)

- Apply silicone sealant [A] to the rocker case mating surface and the outer circumference of the plugs as shown.

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

- Do not apply silicone sealant around the camshaft bearing.
Inlet Side [B]



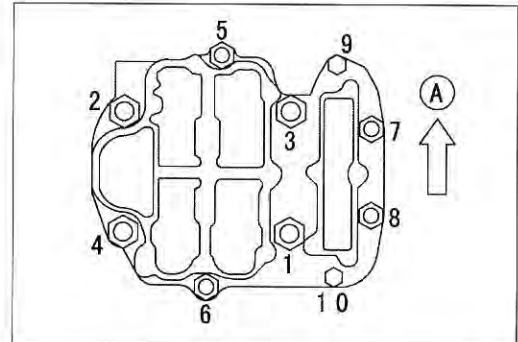
- Apply molybdenum disulfide oil to the threads and seating surface of rocker case $\phi 12$ mm nuts and both sides of washers.
- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).
- Tighten the rocker case bolts and nuts temporarily following the tightening sequence shown, and then tighten them to the specified torque.

Torque - Rocker Case Nuts $\phi 12$ mm: 78 N·m (8.0 kg·m, 58 ft·lb)

Rocker Case Nuts $\phi 8$ mm: 25 N·m (2.5 kg·m, 18 ft·lb)

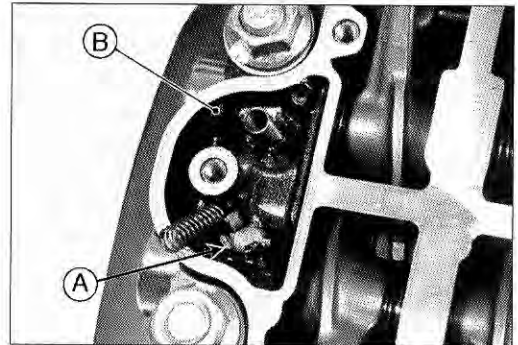
Rocker Case Bolts $\phi 6$ mm: 8.8 N·m (0.9 kg·m, 78 in·lb)

Inlet Side [A]



- Replace the oil filters [A] with new ones.
- After installing the rocker case, fill the oil reservoir [B] with engine oil.
- Tighten:

Torque - Oil Hose Flange Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)



- Tighten the cylinder head nuts [A] and cylinder nuts [B] to the specified torque.

Torque - Cylinder Head Nuts, Cylinder Nuts: 25 N·m (2.5 kg·m, 18 ft·lb)

Rocker Cases [C]

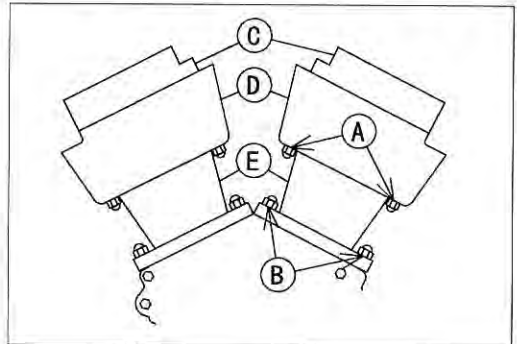
Cylinder Heads [D]

Cylinders [E]

- Tighten:

Torque - Timing Inspection Plug, Rotor Bolt Plug: 1.5 N·m (0.15 kg·m, 13 in·lb)

- Install the engine (see Engine Removal/Installation chapter).

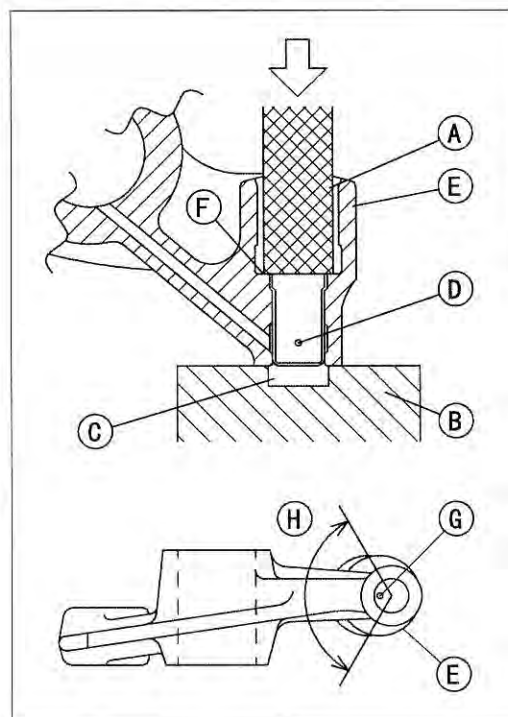


4-16 ENGINE TOP END

Rocker Case

Rocker Arm Assembly

- Prepare a flat-end bar [A] and a block [B] with a recess [C].
- Press the oil chamber [D] into the rocker arm [E] until the chamber end is even with the step [F] of the hole.
- Install the oil chamber as shown so that the air bleed hole [G] is placed within 120 degrees [H]. This makes HLA bleeding easier.



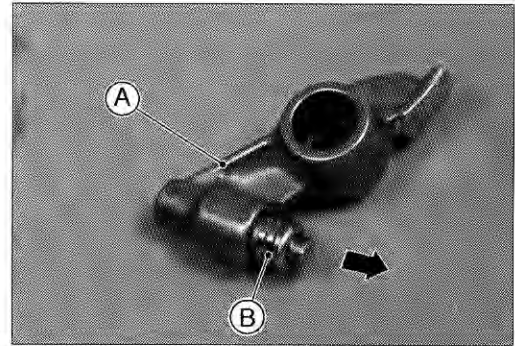
HLA (Hydraulic Lash Adjuster)

HLA Removal

- Remove the rocker case (see this chapter).
- Remove the rocker arms.
- Pull the HLA [B] out of the rocker arm [A] with your fingers.

CAUTION

Be careful not to damage or deform a lash adjuster by tapping it during removal or installation.
Do not drop the lash adjuster or hit it sharply. If it is damaged, the plunger will not operate smoothly.

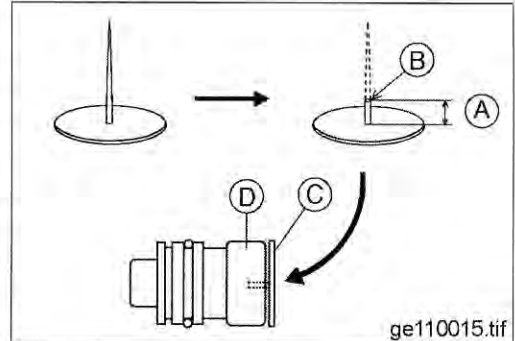


HLA Air Bleeding

- Fill a container with engine oil.
- Prepare a pin and cut its needle to 2.1 ~ 2.3 mm long [A]. Grind its cutting edge [B] smooth.
- Push in the check valve of the HLA [D] with the needle of the pin [C] and move the plunger up and down in the oil bath.

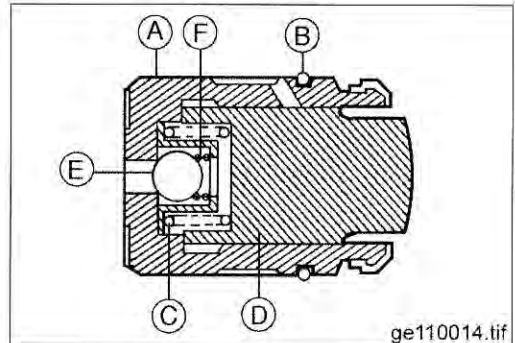
CAUTION

Do not push the check valve in more than 2.1 ~ 2.3 mm. Pushing too deep may cause the damage of the HLA.

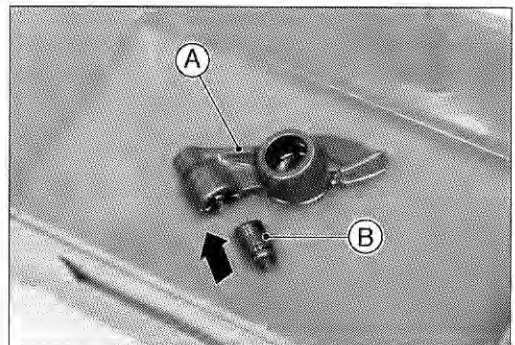


HLA Installation

- Check that the HLA plunger is not damaged.
- ★ If the plunger does damage, replace the HLA.
 - HLA Body [A]
 - O-ring [B]
 - Plunger Spring [C]
 - Pivot Plunger [D]
 - Check Valve [E]
 - Check Valve Spring [F]



- Air-bleed the HLA (see HLA Air Bleeding).
- Soak a rocker arm [A] in engine oil, and then insert the HLA [B] into the rocker arm.
- Be careful not to tip the rocker arm having the HLA, and not to allow engine oil to leak out of the HLA.



Inspection

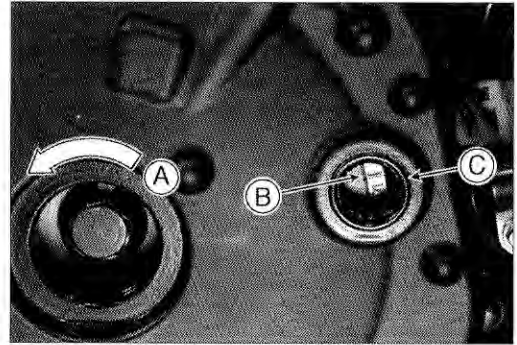
- Remove the rocker arm.
- Pull the HLA out of the rocker arm with your fingers.
- Push the plunger of the HLA with your fingers.
- ★ If the plunger sinks into the HLA body, repeat the air bleeding procedure and then push the plunger.
- ★ If the plunger sinks into the HLA body again, replace the HLA.

4-18 ENGINE TOP END

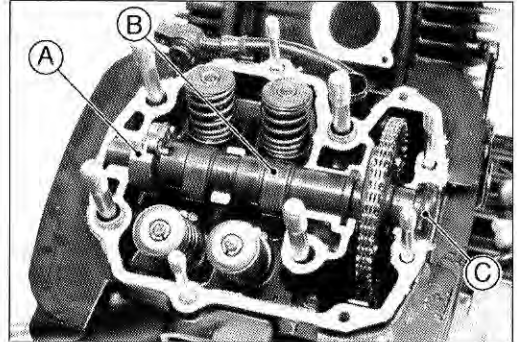
Camshafts

Removal

- Remove the timing inspection plug and rotor bolt plug.
Special Tool - Driver-Filler Cap: 57001-1454
- Turn the crankshaft counterclockwise [A] and align the "F" mark [B] (TDC mark for the front piston) with the middle of the notch [C].



- Remove the front and rear rocker case covers (see this chapter).
- Remove the front and rear rocker cases (see this chapter).
- Remove the camshaft [B] with the KACR [A] and separate them.
- Remove the camshaft plug [C].



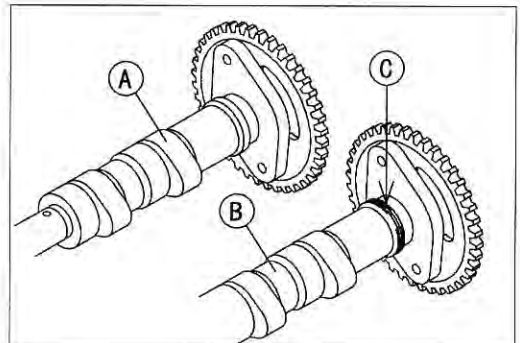
- Stuff a clean cloth into the chain tunnel to keep any parts from dropping into the crankcase.

CAUTION

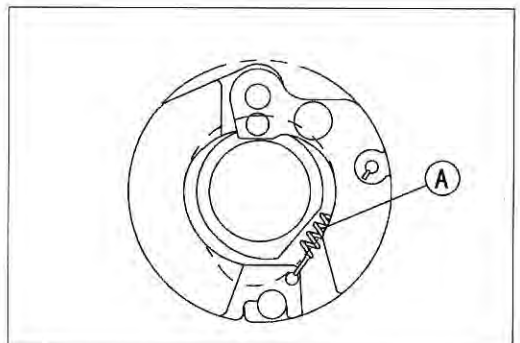
The crankshaft may be turned while the camshafts are removed. Always pull the chain taut while turning the crankshaft. This avoids kinking the chain on the lower (crankshaft) sprocket. A kinked chain could damage both the chain and the sprocket.

Installation

- The front camshaft [A] and rear camshaft [B] are different. The rear camshaft has a groove [C].
- Apply engine oil to all cam parts and journals.
- If a new camshaft is to be used, apply a thin coat of molybdenum disulfide grease to the cam surfaces.

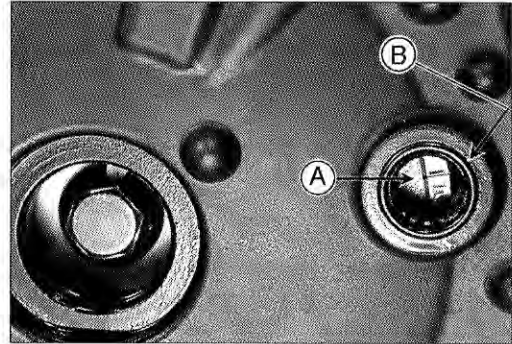


- Install the KACR on each camshaft.
- The front and rear KACR units are the same except for the spring [A]. The rear KACR unit has a yellow painting spring. Do not confuse the springs.

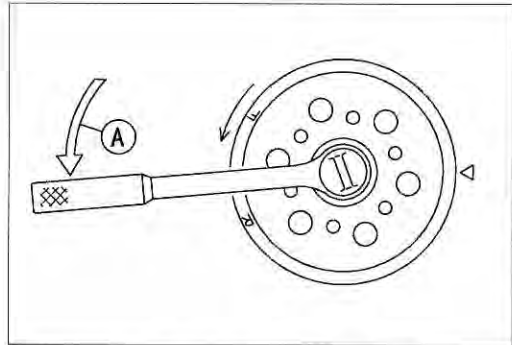
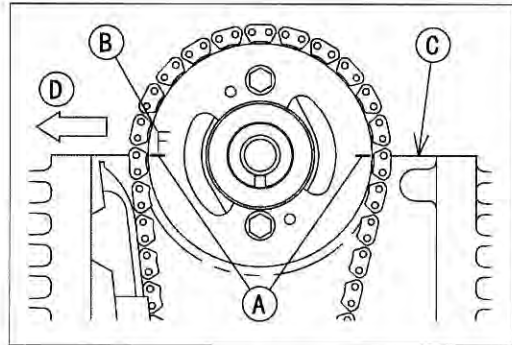


Camshafts

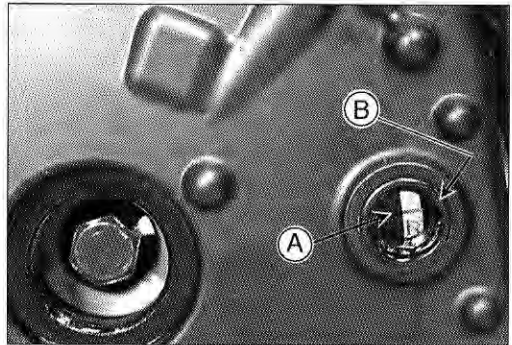
- Check that the "F" mark [A] aligns with the middle of the notch [B] (front piston TDC).
- ★ If necessary, align them.



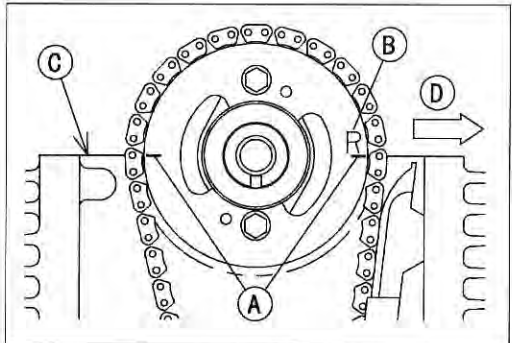
- First, install the front camshaft.
 - Engage the front camshaft sprocket with the camshaft chain as shown.
 - Timing Marks [A]
 - F mark [B]
 - Cylinder Head Upper Surface [C]
 - Front [D]
 - Pull the front side (exhaust side) of the chain taut to install the camshaft.
 - Install the front chain tensioner (see this chapter). The timing marks must be aligned with the cylinder head upper surface. The timing marks must be aligned with the cylinder head upper surface.
- Next, install the rear camshaft.
 - Check to be sure that the front camshaft chain timing is correct.
 - Turn the crankshaft counterclockwise [A].



- Align the "R" mark [A] (TDC mark for the rear piston) with the middle of the notch [B] (310° turn from the front piston TDC).



- Engage the rear camshaft sprocket with the camshaft chain as shown.
 - Timing Marks [A]
 - R Mark [B]
 - Cylinder Head Upper Surface [C]
 - Front [D]
- Pull the front side (inlet side) of the chain taut to install the camshaft.
- Install the rear chain tensioner (see this chapter).
- Check the front and rear chain timing again.
- The timing marks must be aligned with the cylinder head upper surface and positioned as shown after chain tensioner installation.



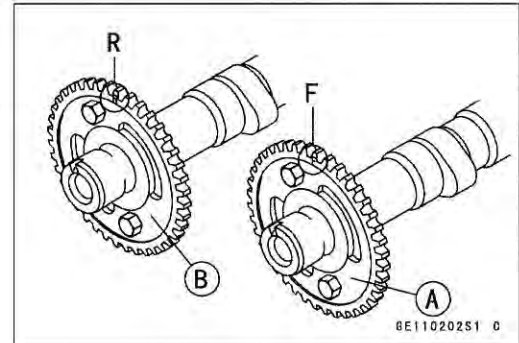
4-20 ENGINE TOP END

Camshafts

- Install:
 - Rocker Cases and Rocker Case Covers (see this chapter)
 - Timing Inspection Plug
 - Rotor Bolt Plug
- Torque - Timing Inspection Plug, Rotor Bolt Plug: 1.5 N·m (0.15 kg·m, 13 in·lb)**

Camshaft Sprocket Installation

- Use the sprocket marked **F** for the front camshaft [A] and the sprocket marked **R** for the rear camshaft [B].
 - Apply a non-permanent locking agent to the camshaft sprocket bolts and tighten them to the specified torque.
- Torque - Camshaft Sprocket Bolts: 15 N·m (1.5 kg·m, 11 ft·lb)**



Camshaft/Rocker Case Wear

- Cut strips of plastigage to journal width. Place a strip on each journal parallel to the camshaft installed in the correct position.
- Measure each clearance between the camshaft and the rocker case using plastigage.

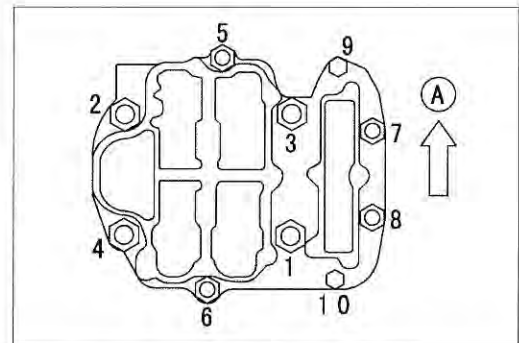
NOTE

- Do not turn the camshaft when the plastigage is between the journal and camshaft cap.
- Apply molybdenum disulfide oil to the threads and seating surface of rocker case $\phi 12$ nuts and both side of washers.
- Tighten the rocker case nuts and bolts temporarily following the tightening sequence shown, and then tighten them to the specified torque.

Torque -

- Rocker Case Nuts $\phi 12$ mm: 78 N·m (8.0 kg·m, 58 ft·lb)**
- Rocker Case Nuts $\phi 8$ mm: 25 N·m (2.5 kg·m, 18 ft·lb)**
- Rocker Case Bolts $\phi 6$ mm: 8.8 N·m (0.90 kg·m, 78 in·lb)**

Inlet Side [A]



- Remove the rocker case again, and measure the plastigage width [A] to determine the clearance between each journal and the rocker case. Measure the maximum plastigage width.

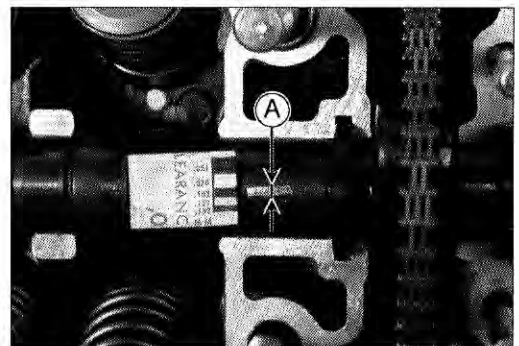
Camshaft/Rocker Case Clearance

Standard:

- ($\phi 25$) 0.020 ~ 0.062 mm
- ($\phi 17$) 0.016 ~ 0.055 mm

Service Limit:

- ($\phi 25$) 0.15 mm
- ($\phi 17$) 0.14 mm



- ★ If any clearance exceeds the service limit, measure the diameter of each camshaft journal with a micrometer.

Camshaft Journal Diameter

Standard:

- ($\phi 25$) 24.959 ~ 24.980 mm
- ($\phi 17$) 16.966 ~ 16.984 mm

Service Limit:

- ($\phi 25$) 24.93 mm
- ($\phi 17$) 16.93 mm

Camshafts

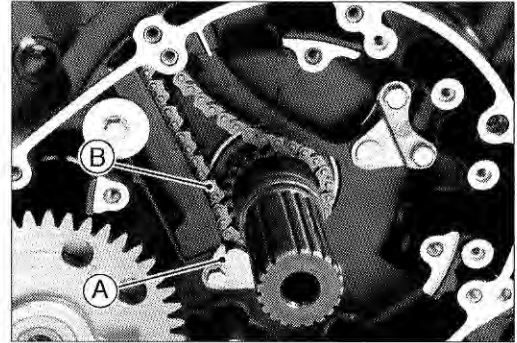
- ★ If the camshaft journal diameter is less than the service limit, replace the camshaft with a new one and measure the clearance again.
- ★ If the clearance still remains out of the limit, replace the cylinder head and rocker case.

CAUTION

The rocker case and cylinder head are machined in the assembled state, so they must be replaced as a set.

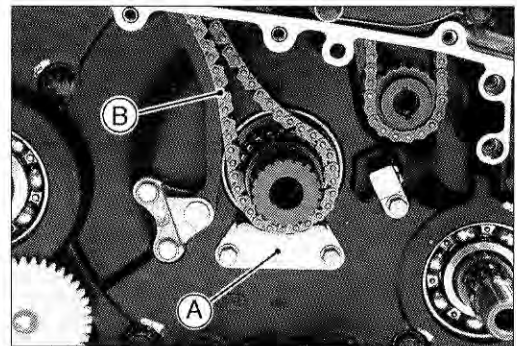
Front Camshaft Chain Removal

- Remove:
 - Front Camshaft (see this chapter)
 - Alternator Rotor (see Electrical System chapter)
 - Lower Chain Guide [A] (left view)
- Take out the front camshaft chain [B].



Rear Camshaft Chain Removal

- Remove:
 - Rear Camshaft (see this chapter)
 - Clutch (see Clutch chapter)
 - Starter Clutch Gear (see Crankshaft/Transmission chapter)
 - Starter Clutch (see Crankshaft/Transmission chapter)
 - Primary Gear Bolt (see Crankshaft/Transmission chapter)
 - Primary Gear (see Crankshaft/Transmission chapter)
 - Lower Chain Guide [A]
- Take out the rear camshaft chain [B].

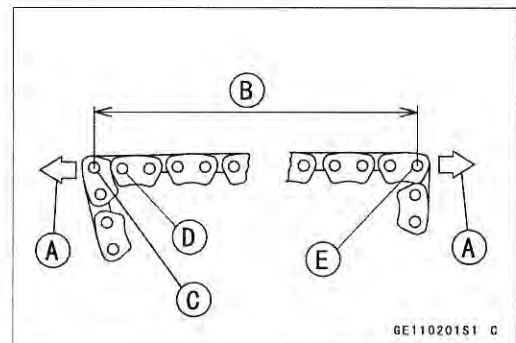


Camshaft Chain Wear

- Hold the chain taut with a force [A] of about 49 N (5 kg, 11 lb) in some manner, and measure a 20-link length. Since the chain may wear unevenly, take measurements at several places.
- ★ If any measurement exceeds the service limit, replace the chain. Also, replace the camshaft sprockets and the crankshaft when the chain is replaced.
 - 1st Pin [C]
 - 2nd Pin [D]
 - 21st Pin [E]

Camshaft Chain 20-link Length

Standard: 127.0 ~ 127.36 mm
 Service Limit: 128.9 mm

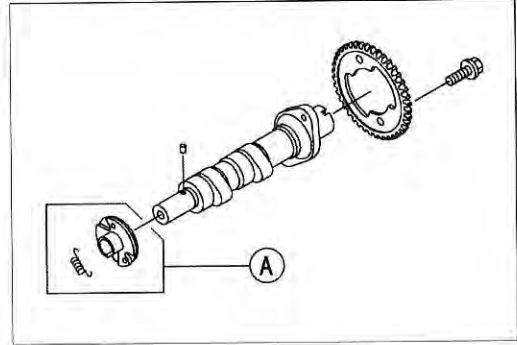


6E110201S1 C

4-22 ENGINE TOP END

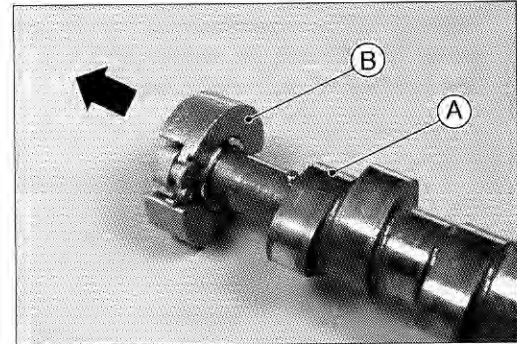
KACR (Kawasaki Automatic Compression Release)

Due to the simplicity of the mechanism, no periodic maintenance is needed. There are only two symptoms of problems with the KACR mechanism [A]; compression is not released during starting, and compression is released during running.



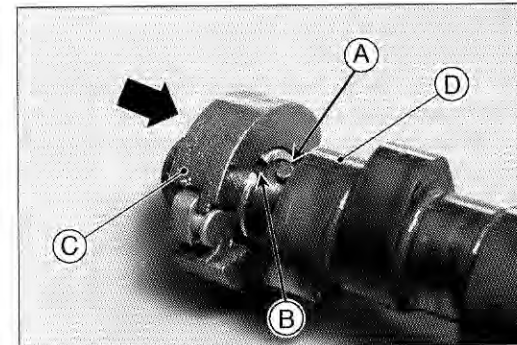
Removal

- Remove the engine (see Engine Removal/Installation chapter).
- Remove the camshaft [A] (see this chapter).
- Take the KACR unit [B] out of the camshaft.



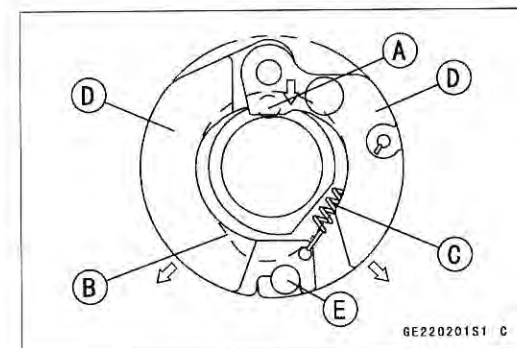
Installation

- Fit the pin [A] into the notch [B], and install the KACR [C] onto the camshaft [D].
- The front and rear KACR units are the same except for the spring. The rear KACR unit has a yellow painting spring. Do not mix up these springs.
- ★ If the new camshaft is to be used, apply a thin coat of molybdenum disulfide grease to the cam surfaces.
- Apply engine oil to all cam parts.
- Apply molybdenum disulfide oil to the camshaft journals.
- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).



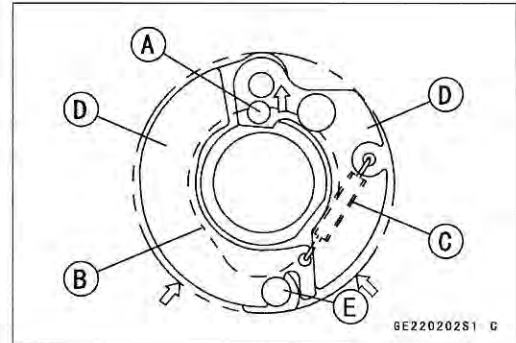
Inspection

- The cylinder compression is not released during starting (abnormal): the pin [A] stays within the cam [B] and will not push up the exhaust rocker arm.
- Remove the KACR unit and visually inspect the spring [C].
- ★ If the spring is damaged, deformed, or missing, replace the spring.
- Remove the spring and move the weights [D] back and forth.
- ★ If the weights do not move smoothly all the way, replace the KACR unit. Also inspect the exhaust rocker arm for any damage, and replace the rocker arm if necessary.
- Stopper [E]



KACR (Kawasaki Automatic Compression Release)

- The cylinder compression is released while the engine is running (abnormal): the pin [A] stays out the cam [B] and pushes up the exhaust rocker arm.
- Remove the spring [C] and move the weights [D] back and forth.
- ★ If the weights do not move easily from the retracted position, replace the KACR unit. Also inspect the exhaust rocker arm for any damage, and replace the rocker arm if necessary.
Stopper [E]



4-24 ENGINE TOP END

Cylinder Head

Cylinder Compression Measurement

NOTE

○ Be sure the battery is fully charged.

- Warm up the engine thoroughly.
- Stop the engine.
- Remove one spark plug and attach the compression gauge and adapter firmly into the spark plug hole. Do not remove the other spark plug, only the plug lead.
Front [A]
- For the other cylinder, remove both spark plugs.

Special Tools - Spark Plug Wrench, Hex 18: 57001-1024 [B]
Compression Gauge: 57001-221 [C]
Compression Gauge Adapter, M12 × 1.25: 57001-1018 [D]

- 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.

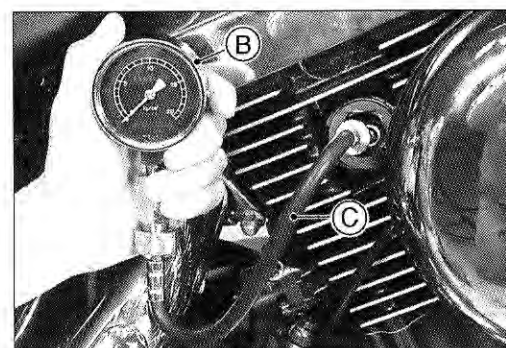
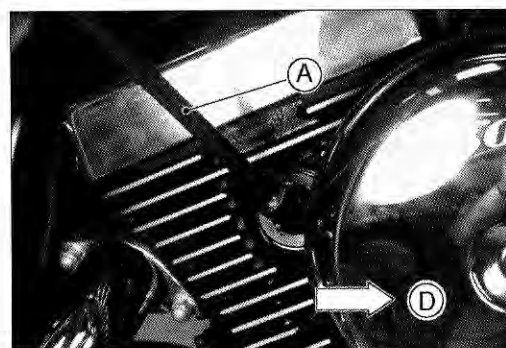
Cylinder Compression (Usable Range)

Front: 340 ~ 590 kPa (3.5 ~ 6 kg/cm², 50 ~ 85 psi)
@300 r/min (rpm)

- The compression gauge adapter: 57001-1183 can also be used.
- Repeat the measurement for the other cylinder.
- Install the spark plugs.

Torque - Spark Plugs: 18 N·m (1.8 kg·m, 13 ft·lb)

- The following table should be consulted if the obtainable compression reading is not within the usable range.



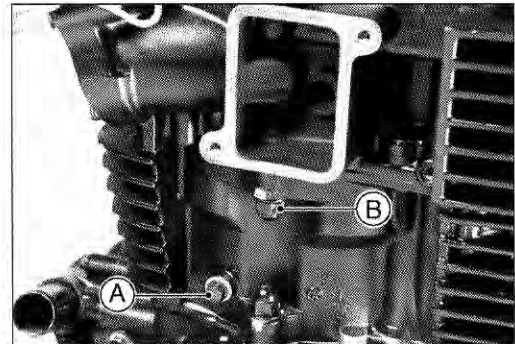
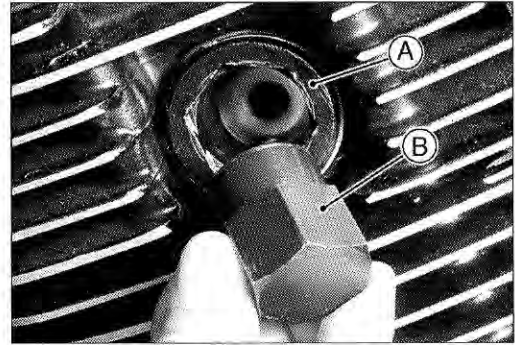
Problem	Diagnosis	Remedy (Action)
Cylinder compression is higher than usable range	Carbon accumulation on piston and cylinder head, and in combustion chamber possibly due to damaged valve stem oil seal and/or damaged piston oil rings (This may be indicated by white exhaust smoke).	Remove the carbon deposits and replace damaged parts if necessary.
	Incorrect cylinder head gasket thickness.	Replace the gasket with a standard part.
	Damaged or missing compression release cam spring	Replace the spring.
	Compression release weights do not move smoothly.	Replace the compression release unit.
Cylinder compression is lower than usable range	Gas leakage around cylinder head	Replace damaged gasket and check cylinder head warp.
	Bad condition of valve seating	Repair if necessary.
	HLA seizure.	Replace the HLA.
	Incorrect piston/cylinder clearance	Replace the piston and/or cylinder.
	Piston seizure.	Inspect the cylinder and liner and replace/repair the cylinder and/or piston as necessary.
	Bad condition of piston ring and/or piston ring grooves.	Replace the piston and/or the piston rings.
	Compression release weights do not move smoothly.	Replace the compression release unit.

Cylinder Head

Removal

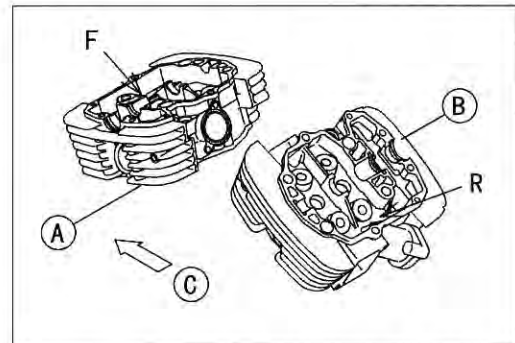
- Remove:
 - Engine (see Engine Removal/Installation chapter)
 - Front and Rear Rocker Cases (see this chapter)
 - Camshafts (see this chapter)
 - Spark Plugs
 - Spark Plug Retainer [A]
 - Throttle Assy (see Fuel System chapter)
- **Special Tool - Hexagon Wrench, Hex 27 [B]: 57001-1210**
- The camshaft chain comes off.

- Remove the coolant drain plug [A] and drain the coolant.
- Remove the cylinder head nuts [B].
- Take the cylinder head off the cylinder.



Installation

- The front cylinder head [A] has an **F** mark while the rear cylinder head [B] has an **R** mark. Be careful not to mix them up.
- Front [C]



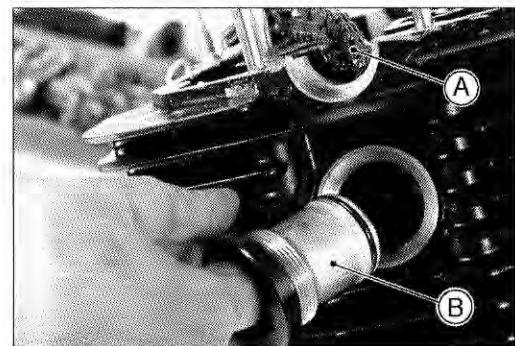
CAUTION

The cylinder head and rocker case are machined in the assembled state, so they must be used as a set.

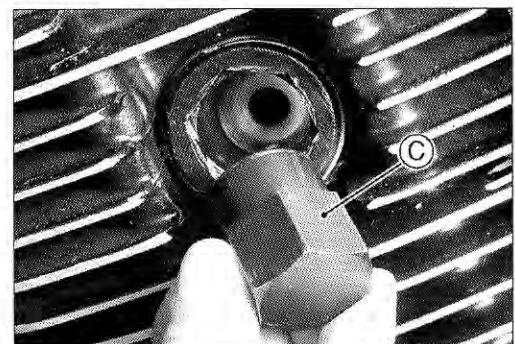
- Replace the cylinder head gasket with a new one.
- Tighten the cylinder head nuts temporarily (These nuts are tightened to the specified torque after rocker case installation).
- Pull the camshaft chain [A] up the chain tunnel, insert the spark plug retainer [B] through the chain loop, and tighten it.

Special Tool - Hexagon Wrench, Hex 27: 57001-1210 [C]

Torque - Spark Plug Retainer: 12 N·m (1.2 kg·m, 104 in·lb)
Spark Plugs: 18 N·m (1.8 kg·m, 13 ft·lb)



- Install:
 - Camshafts (see this chapter)
 - Rocker Cases (see this chapter)
- Tighten:
 - Torque - Cylinder Head Nuts and Cylinder Nuts: 25 N·m (2.5 kg·m, 18 ft·lb)**



4-26 ENGINE TOP END

Valves

Valve Clearance Adjustment

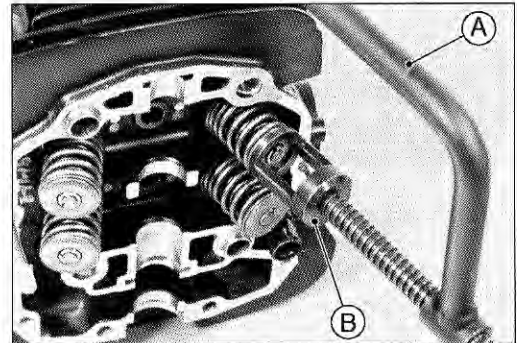
NOTE

- Since the hydraulic lash adjusters constantly maintain zero clearance, it is not necessary to inspect or adjust the valve clearance.

Valve Removal

- Remove the cylinder head (see this chapter).
- Swing open the rocker arm.
- Using the valve spring compressor assembly, remove the valve.

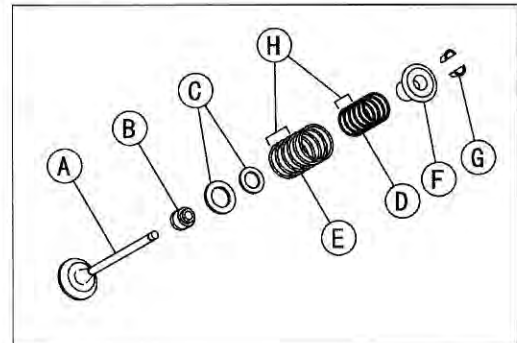
**Special Tools - Valve Spring Compressor Assembly: 57001-241 [A]
Valve Spring Compressor Adapter, $\phi 28.2$: 57001-243 [B]**



Valve Installation

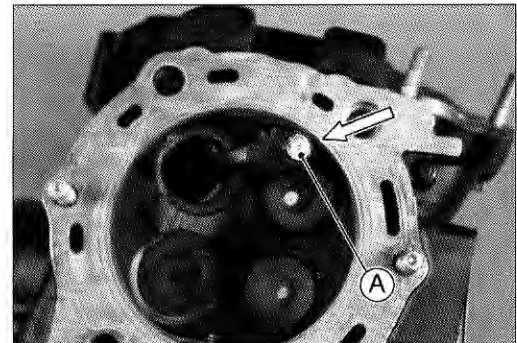
- Replace the oil seal with a new one.
- Apply a thin coat of molybdenum disulfide grease to the valve stem before valve installation.
- Install the springs so that the closed coil end faces downwards.

Valve Stem [A]
Oil Seal [B]
Spring Seats [C]
Inner Spring [D]
Outer Spring [E]
Retainer [F]
Split Keepers [G]
Closed Coil End [H]



Valve Guide Removal

- Remove:
 - Valve (see Valve Removal)
 - Oil Seal
 - Spring Seat
- Heat the area around the valve guide to 120 ~ 150°C (248 ~ 302°F), and hammer lightly on the valve guide arbor [A] to remove the guide from the top of the head.



CAUTION

Do not heat the cylinder head with a blowtorch. This will warp the head. Soak the cylinder head in oil and heat the oil.

Special Tool - Valve Guide Arbor, $\phi 7$: 57001-163

Valves

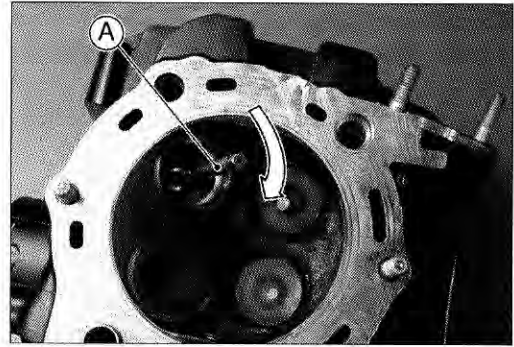
Valve Guide Installation

- Apply oil to the valve guide outer surface before installation.
- Heat the area around the valve guide hole to about 120 ~ 150°C (248 ~ 302°F) (see Valve Guide Removal).
- Drive the valve guide in from the top of the head using the valve guide arbor. The flange stops the guide from going in too far.

Special Tool - Valve Guide Arbor, $\phi 7$: 57001-163

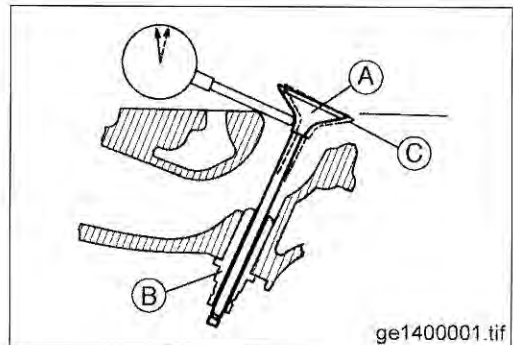
- Wait until the cylinder head cools down and then ream the valve guide with the valve guide reamer [A] even if the old guide is reused.
- Turn the reamer in a clockwise direction until the reamer turns freely in the guide. Never turn the reamer counterclockwise or it will be dulled.
- Once the guides are reamed they must be cleaned thoroughly.

Special Tool - Valve Guide Reamer, $\phi 7$: 57001-162



Valve-to-Guide Clearance Measurement

- ★ If a small bore gage is not available, inspect the valve guide wear by measuring the valve to valve guide clearance with the wobble method as indicated below.
- Insert a new valve [A] into the guide [B] and set a dial gage against the stem perpendicular to it as close as possible to the cylinder head mating surface.
- Move the stem back and forth [C] to measure valve/valve guide clearance.
- Repeat the measurement in a direction at a right angle (90°) to the first.
- ★ If the reading exceeds the service limit, replace the guide.



NOTE

- The reading is not actual valve/valve guide clearance (extended clearance) because the measuring point is above the guide.

Valve/Valve Guide Clearance (Wobble Method)

	Exhaust	Inlet
Standard:	0.08 ~ 0.16 mm	0.05 ~ 0.13 mm
Service Limit:	0.30 mm	0.27 mm

Valve Seat Inspection

- Remove the valve (see Valve Removal).
- Check the valve seating surface [A] between the valve [B] and valve seat [C].
- Measure the outside diameter [D] of the seating pattern on the valve seat.
- ★ If the outside diameter is too large or too small, repair the seat (see Seat Repair).

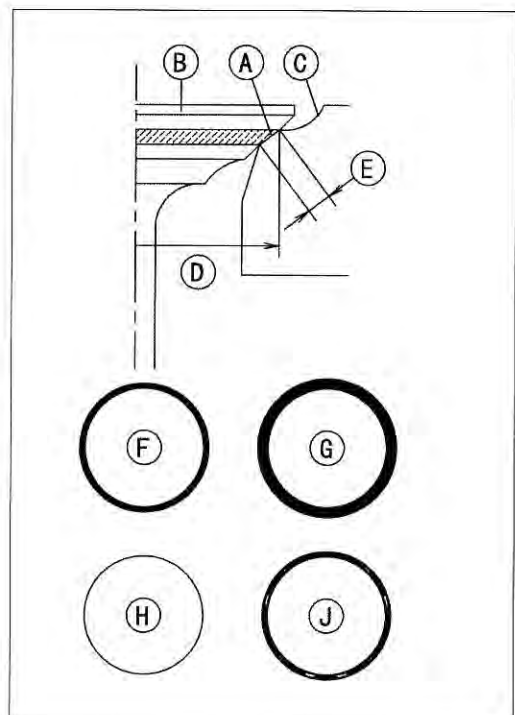
Valve Seating Surface Outside Diameter

Standard:	Exhaust	28.9 ~ 29.1 mm
	Inlet	31.9 ~ 32.1 mm

- Measure the seat width [E] of the portion where there is no build-up carbon (white portion) of the valve seat with a vernier caliper.
- Good [F]
- ★ If the width is too wide [G], too narrow [H] or uneven [J], repair the seat (see Valve Seat Repair).

Valve Seating Surface Width

Standard:	Exhaust, Inlet	0.5 ~ 1.0 mm
-----------	----------------	--------------



4-28 ENGINE TOP END

Valves

Valve Seat Repair

- Repair the valve seat with the valve seat cutters [A].

**Special Tools - Valve Seat Cutter Holder, $\phi 7$: 57001-1126 [B]
Valve Seat Cutter Holder Bar: 57001-1128 [C]**

[For Exhaust Valve Seat]

Valve Seat Cutter, 45° - $\phi 32$: 57001-1115
Valve Seat Cutter, 32° - $\phi 35$: 57001-1121 (or -1199)
Valve Seat Cutter, 55° - $\phi 35$: 57001-1247

[For Inlet Valve Seat]

Valve Seat Cutter, 45° - $\phi 35$: 57001-1116
Valve Seat Cutter, 32° - $\phi 35$: 57001-1121 (or -1199)
Valve Seat Cutter, 55° - $\phi 35$: 57001-1247

★ If the manufacturer's instructions are not available, use the following procedure.

Seat Cutter Operation Care:

1. This valve seat cutter is developed to grind the valve for repair. Therefore the cutter must not be used for other purposes than seat repair.
2. Do not drop or shock the valve seat cutter, or the diamond particles may fall off.
3. Do not fail to apply engine oil to the valve seat cutter before grinding the seat surface. Also wash off ground particles sticking to the cutter with washing oil.

CAUTION

Do not use a wire brush to remove the metal particles from the cutter. It will take off the diamond particles.

4. Setting the valve seat cutter holder in position, operate the cutter in one hand. Do not apply too much force to the diamond portion.

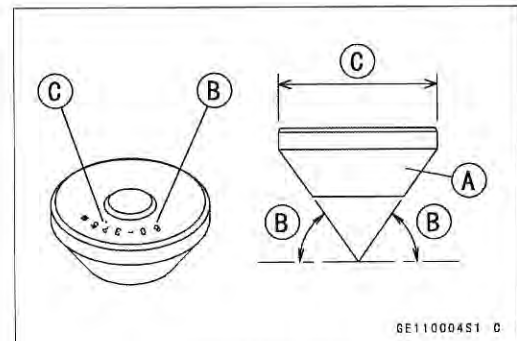
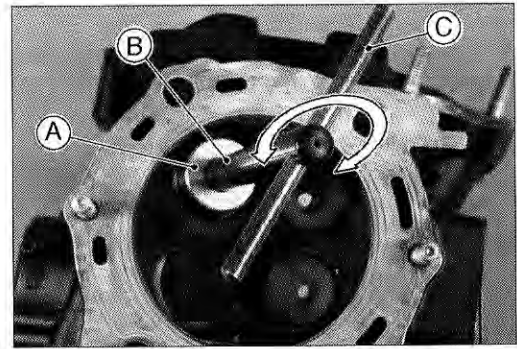
NOTE

- Prior to grinding, apply engine oil to the cutter and during the operation, wash off any ground particles sticking to the cutter with washing oil.
5. After use, wash it with washing oil and apply thin layer of engine oil before storing.

Marks Stamped on the Cutter:

The marks stamped on the back of the cutter [A] represent the following.

55° Cutter Angle [B]
 37.5ϕ Outer Diameter of Cutter [C]



Valves

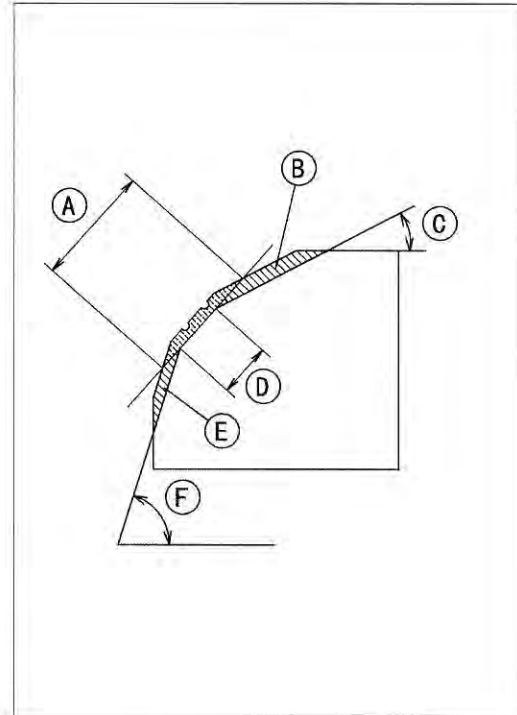
Operating Procedures:

- Clean the seat area carefully.
- Coat the seat with machinist's dye.
- Fit a 45° cutter into the holder and slide it into the valve guide.
- Press down lightly on the handle and turn it right or left. Grind the seating surface only until it is smooth.

CAUTION

Do not grind the seat too much. Overgrinding will sink the valve into the head. If the valve sinks too far into the head, it will make HLA operation useless, and the cylinder head must be replaced.

Widened Width [A] of engagement by machining with 45° cutter
Ground Volume [B] by 32° cutter
32° [C]
Correct Width [D]
Ground Volume [E] by 55° cutter
55° [F]

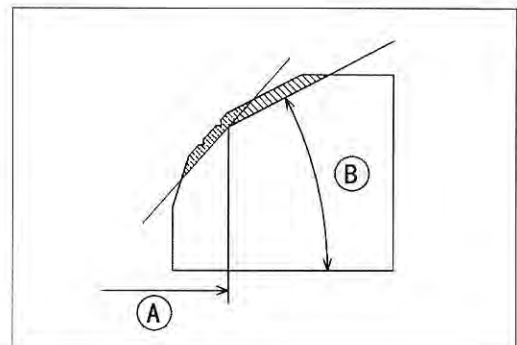
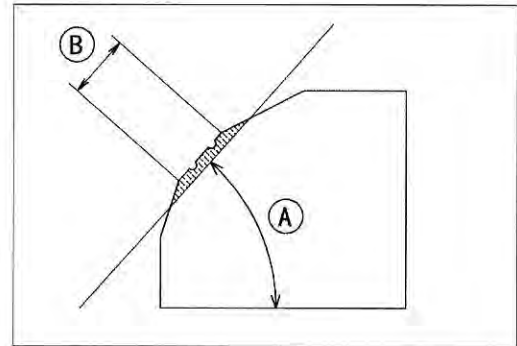


- Measure the outside diameter of the seating surface with a vernier caliper.
- ★ If the outside diameter of the seating surface is too small, repeat the 45° grind [A] until the diameter is within the specified range.
Original Seating Surface [B]

NOTE

- Remove all pittings or flaws from 45° ground surface.
- After grinding with 45° cutter, apply thin coat of machinist's dye to seating surface. This makes seating surface distinct and 32° and 55° grinding operation easier.
- When the valve guide is replaced, be sure to grind with 45° cutter for centering and good contact.

- ★ If the outside diameter of the seating surface is too large, make the 32° grind described below.
- ★ If the outside diameter [A] of the seating surface is within the specified range, measure the seat width as described below.
- Grind the seat at a 32° angle [B] until the seat O.D. is within the specified range.



4-30 ENGINE TOP END

Valves

- To make the 32° grind, fit a 32° cutter into the holder, and slide it into the valve guide.
- Turn the holder one turn at a time while pressing down very lightly. Check the seat after each turn.

CAUTION

The 32° cutter removes material very quickly. Check the seat outside diameter frequently to prevent overgrinding.

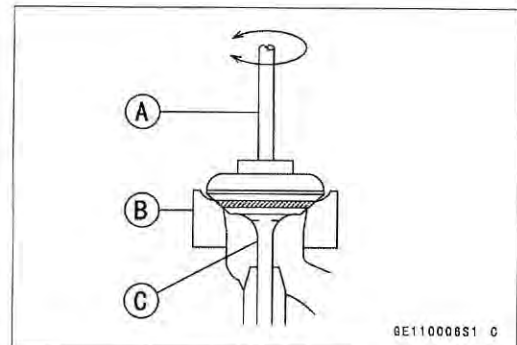
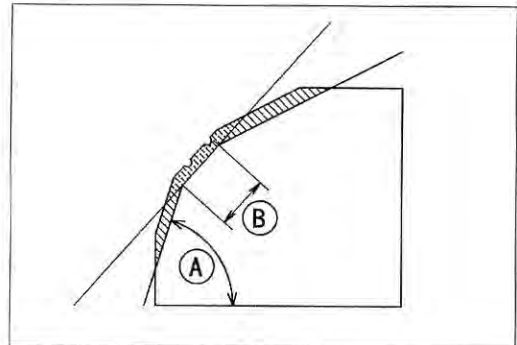
- After making the 32° grind, return to the seat O.D. measurement step above.
- To measure the seat width, use a vernier caliper to measure the width of the 45° angle portion of the seat at several places around the seat.
- ★ If the seat width is too narrow, repeat the 45° grind until the seat is slightly too wide, and then return to the seat O.D. measurement step above.
- ★ If the seat width is too wide, make the 55° grind described below.
- ★ If the seat width is within the specified range, lap the valve to the seat as described below.
- Grind the seat at a 55° angle [A] until the seat width is within the specified range.
- To make the 55° grind, fit 55° cutter into the holder, and slide it into the valve guide.
- Turn the holder, while pressing down lightly.
- After making the 55° grind, return to the seat width measurement step above.

Correct Width [B]

- Lap the valve to the seat, once the seat width and O.D. are within the ranges specified above.
- Put a little coarse grinding compound on the face of the valve in a number of places around the valve head.
- Spin the valve against the seat until the grinding compound produces a smooth, matched surface on both the seat and the valve.
- Repeat the process with a fine grinding compound.

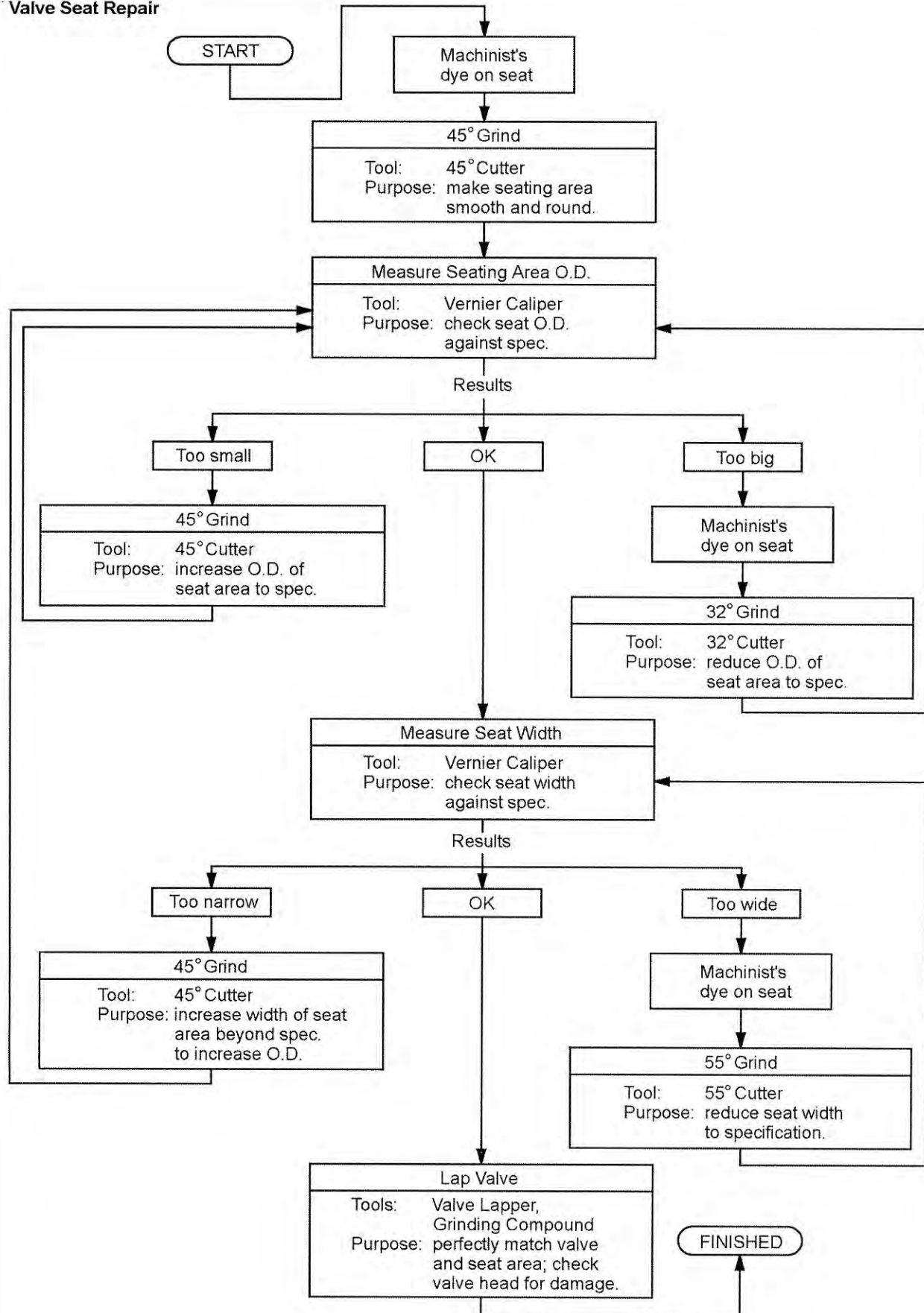
Lapper [A]
Valve Seat [B]
Valve [C]

- The seating area should be marked about in the middle of the valve face.
- ★ If the seat area is not in the right place in the valve, check to be sure the valve is the correct part. If it is, it may have been refaced too much; replace it.
- Be sure to remove all grinding compound before assembly.



Valves

Valve Seat Repair

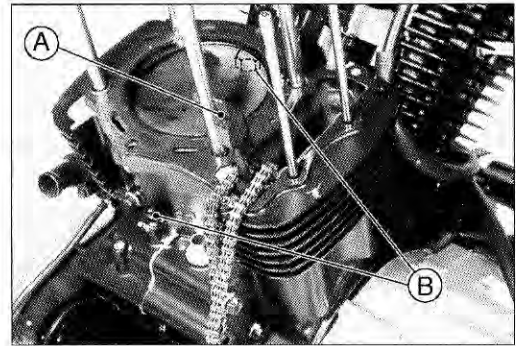


4-32 ENGINE TOP END

Cylinders, Piston

Cylinder Removal

- Remove the cylinder head (see this chapter).
- Pull out the front camshaft chain guide [A].
- Remove the cylinder nuts [B].
- Tap lightly up the cylinder with a plastic mallet to separate from the crankcase.
- Remove the cylinder base gasket.



Piston Removal

- Remove the cylinder block (see this chapter).
- Place a piece of clean cloth under the piston and remove the piston pin snap rings [A] from the outside of each piston.

CAUTION

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

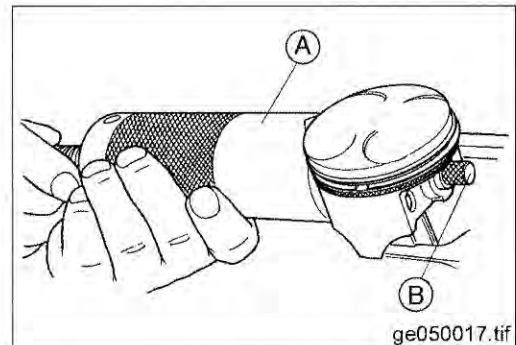


- Using the piston pin puller assembly (special tool), remove the piston pins.

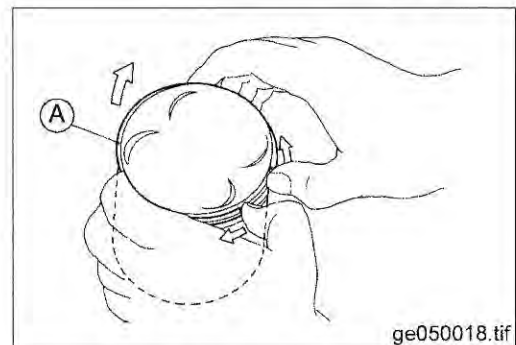
Special Tools - Piston Pin Puller Assembly [A]: 57001-910

Piston Pin Puller Adapter [B]: 57001-1211

- Remove the piston.



- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.
- Remove the 3-piece oil ring with your thumbs in the same manner.

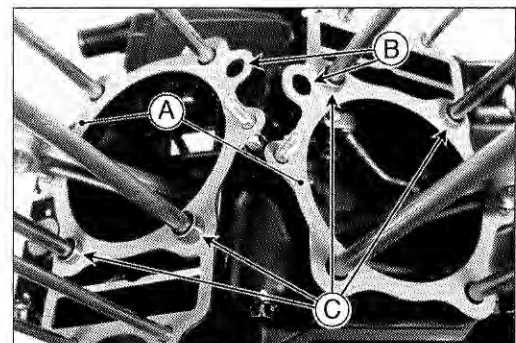


Cylinder, Piston Installation

NOTE

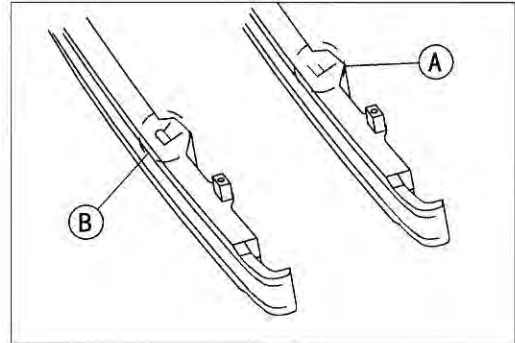
○ If a new piston or cylinder is used, check piston to cylinder clearance (see *Piston/Cylinder Clearance*), and use new piston ring.

- Replace the cylinder base gasket [A] with a new one, and install the gaskets aligning the holes with the crankcase water passages [B].
- Be sure to install the dowel pins [C].



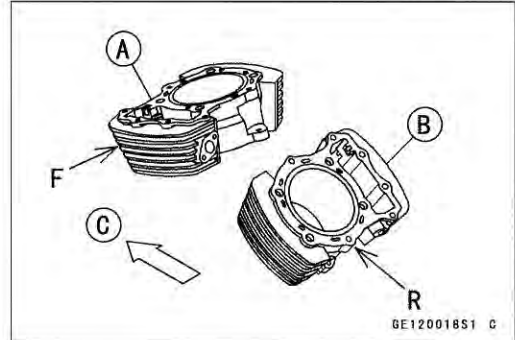
Cylinders, Piston

- The front chain guide for the front cylinder has an **F** mark [A] and the front chain guide for the rear cylinder has an **R** mark [B]. Be careful not to mix up these chain guides since the front chain guide for the rear cylinder is longer.



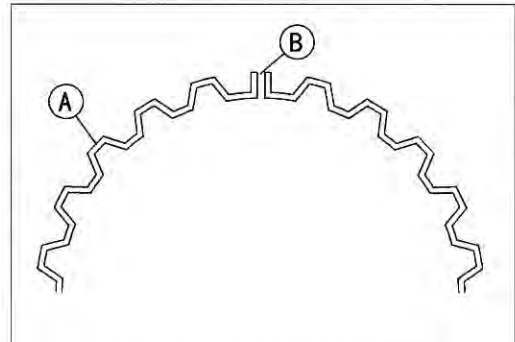
- The front cylinder [A] has an **F** mark and the rear cylinder [B] has an **R** mark. Be careful not to mix them up.

Front [C]

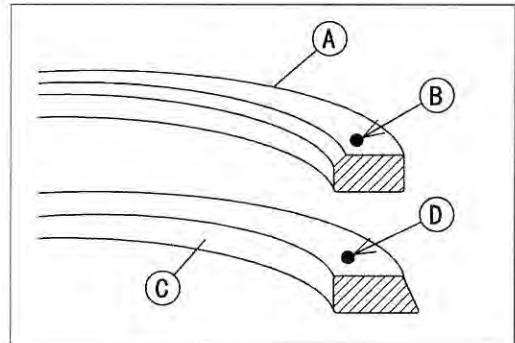


NOTE

- The oil ring rails have no "top" or "bottom".
- Install the oil ring expander [A] in the bottom piston ring groove so the ends [B] butt together.
- Install the oil ring steel rails, one above the expander and one below it.
- Spread the rail with your thumbs, but only enough to fit the rail over the piston.
- Release the rail into the bottom piston ring groove.



- Do not mix up the top ring and second ring.
- Install the top ring [A] so that the "**R**" mark [B] faces up.
- Install the second ring [C] so that the "**RN**" mark [D] faces up.



- The piston ring openings must be positioned as shown in the figure. The openings of the oil ring steel rails must be about 30 ~ 45° [F] of angle from the opening of the top ring.

Top Ring [A]

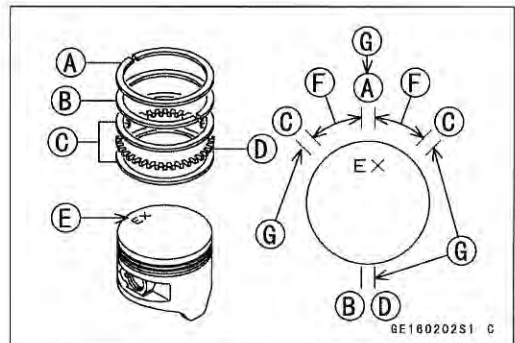
Second Ring [B]

Oil Ring Steel Rails [C]

Oil Ring Expander [D]

EX mark [E] must be faced toward Exhaust Side

Opening Positions [G]



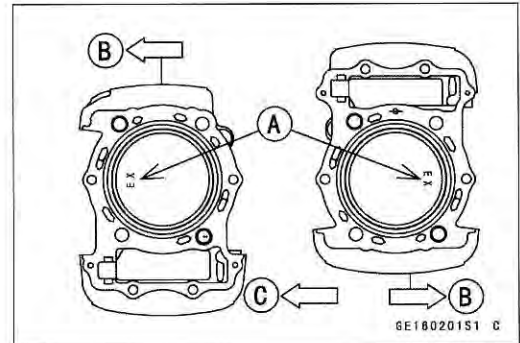
4-34 ENGINE TOP END

Cylinders, Piston

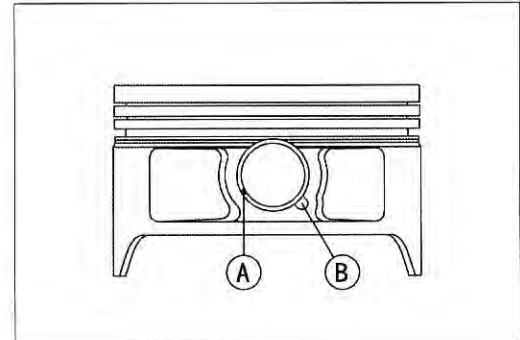
- Face the "EX" mark [A] on each piston toward the exhaust side [B].
- The front and rear pistons are identical.
Front [C]

CAUTION

Incorrect installation of the piston could cause piston seizure and result in severe engine damage.



- Fit a new piston pin snap ring into the side of the piston so that the ring opening [A] does not coincide with the slit [B] of the piston pin hole.
- Apply molybdenum disulfide oil to the outer surface of the piston pin.
- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a waight ratio (10 : 1).
- When installing the piston pin snap ring, compress it only enough to install it and no more.
- Apply engine oil to the cylinder bore and, piston ring.
- Apply molybdenum disulfide oil to the front and rear of the piston skirt.
- Install the rear cylinder, first.
- Position the rear piston at TDC.

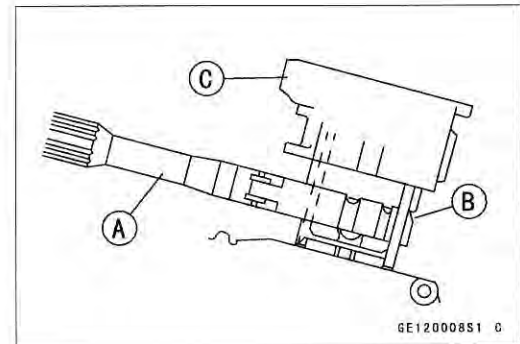


- Using the piston ring compressor assembly [A] with the chamfered side [B] upward, install the cylinder block [C].

Special Tools - Piston Ring Compressor Grip: 57001-1095

Piston Ring Compressor Belt, $\phi 95 \sim \phi 108$: 57001-1358

- Install the front cylinder in the same way.
- Position the front piston at TDC.
- Tighten the cylinder nuts temporarily (These are tightened to the specified torque after rocker case installation).



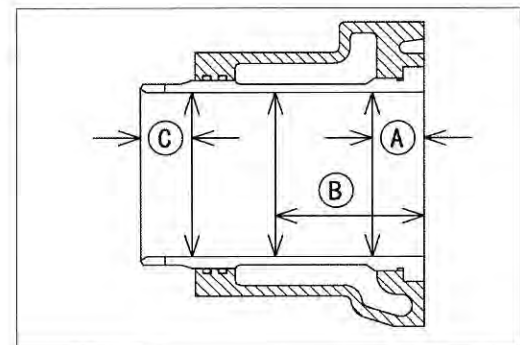
Cylinder Wear

- 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 three locations (total of six measurements) shown in the figure.
- ★ If any of the cylinder inside diameter measurements exceeds the service limit, replace the cylinder.
 - 10 mm [A]
 - 70 mm [B]
 - 20 mm [C]

Cylinder Inside Diameter

Standard: 102.000 ~ 102.012 mm, and less than 0.01mm difference between any two measurements.

Service Limit: 102.10 mm, or more than 0.05 mm difference between any two measurements.



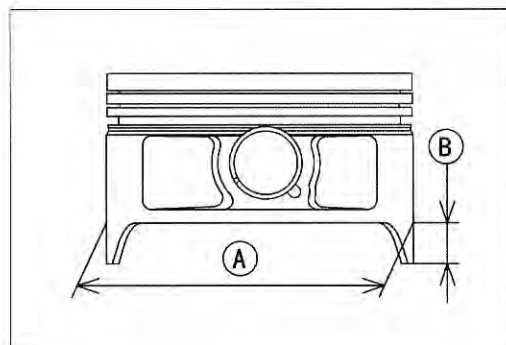
Cylinders, Piston

Piston Wear

- Measure the outside diameter [A] of each piston 5 mm [B] up from the bottom of the piston at a right angle to the direction of the piston pin.
- ★ If the measurement is under service limit, replace the piston.

Piston Diameter

Standard: 101.942 ~ 101.957 mm
Service Limit: 101.79 mm



Piston/Cylinder Clearance

- Subtract the piston diameter from the cylinder inside diameter to get the piston/cylinder clearance.

Piston/Cylinder Clearance

Standard: 0.043 ~ 0.070 mm

- ★ If the piston/cylinder clearance is less than the specified range, use a smaller piston or increase the cylinder inside diameter by honing.
- ★ If the piston/cylinder clearance is greater than specified range, use a larger piston.
- ★ If only a piston is replaced, the clearance may exceed the standard slightly. But it must not be less than the minimum in order to avoid piston seizure.

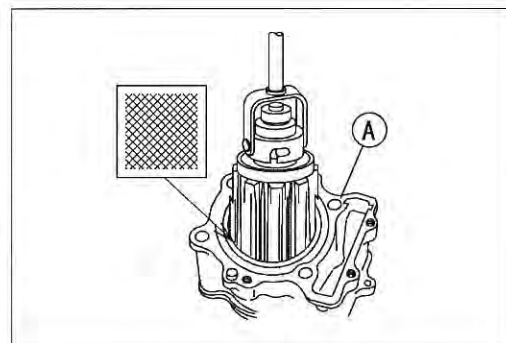
Cylinder Boring and Honing

- There is an oversize piston available. The oversize piston requires oversize rings.

Oversize Piston and Rings

0.5 mm Oversize

- Before boring a cylinder [A], first measure the exact diameter of the oversize piston, and then, according to the standard clearance in the Specifications, determine the rebore diameter. However, if the amount of boring necessary would make the inside diameter greater than **0.5 mm**, the cylinder block must be replaced.
- Cylinder inside diameter must not vary more than **0.01 mm** at any point.
- Be wary of measurements taken immediately after boring since the heat affects cylinder diameter.
- In the case of rebored cylinder and oversize piston, the service limit for the cylinder is the diameter that the cylinder was bored to plus **0.1 mm** and the service limit for the piston is the oversize piston original diameter minus **0.15 mm**. If the exact figure for the rebored diameter is unknown, it can be roughly determined by measuring the diameter at the base of the cylinder.



4-36 ENGINE TOP END

Cylinders, Piston

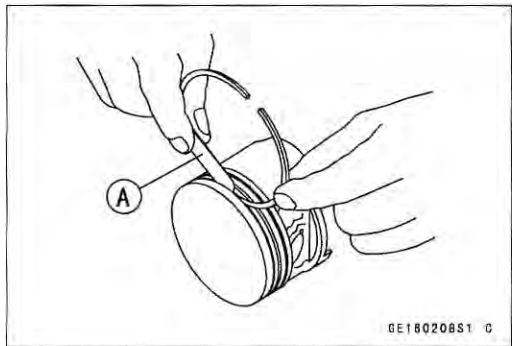
Piston Ring, Piston Ring Groove Wear

- Check for uneven groove wear by inspecting the ring seating.
- ★ The rings should fit perfectly parallel to groove surfaces. If not, replace the piston and all the piston rings.
- With the piston rings in their grooves, make several measurements with a thickness gauge [A] to determine piston ring/groove clearance.

Piston Ring/Groove Clearance

	Standard:	Service Limit:
Top	0.035 ~ 0.070 mm	0.17 mm
Second	0.02 ~ 0.06 mm	0.16 mm

- ★ If the piston ring groove clearance is greater than the service limit, measure the ring thickness and groove width as follows to decide whether to replace the rings, the piston or both.



Piston Ring Groove Width

- Measure the piston ring groove width.
- Use a vernier caliper at several points around the piston.

Piston Ring Groove Width

	Standard	Service Limit
Top	1.025 ~ 1.040 mm	1.12 mm
Second	1.21 ~ 1.23 mm	1.31 mm

- ★ If the width of any of the two grooves is wider than the service limit at any point, replace the piston.

Piston Ring Thickness

- Measure the piston ring thickness.
- Use a micrometer to measure at several points around the ring.

Piston Ring Thickness

	Standard	Service Limit
Top	0.97 ~ 0.99 mm	0.9 mm
Second	1.17 ~ 1.19 mm	1.10 mm

- ★ If any of the measurements is less than the service limit on either of the rings, replace all the rings.

NOTE

- When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.

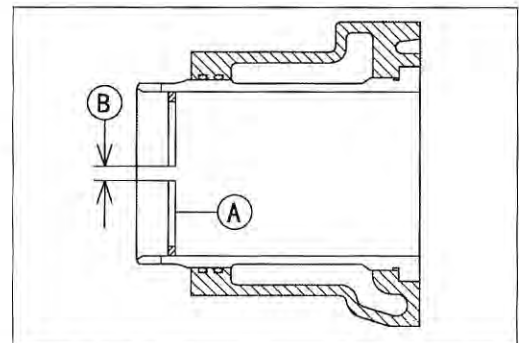
Piston Ring End Gap

- Place the piston ring [A] inside the cylinder, using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low.
- Measure the gap [B] between the ends of the ring with a thickness gauge.

Piston Ring End Gap

	Standard	Service Limit
Top	0.30 ~ 0.40 mm	0.70 mm
Second	0.40 ~ 0.55 mm	0.85 mm
Oil	0.3 ~ 0.9 mm	1.2 mm

- ★ If the end gap of either ring is greater than the service limit, replace all the rings.



Muffler

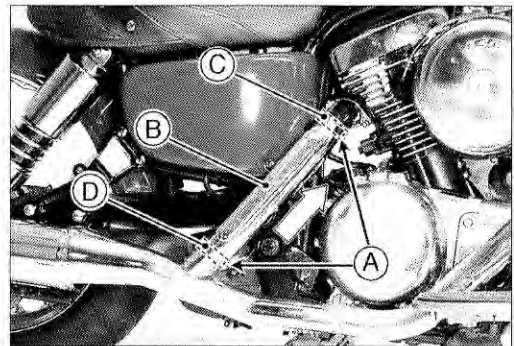
⚠ WARNING

To avoid a serious burn, do not remove the muffler when the engine is still hot. Wait until the muffler cools down.

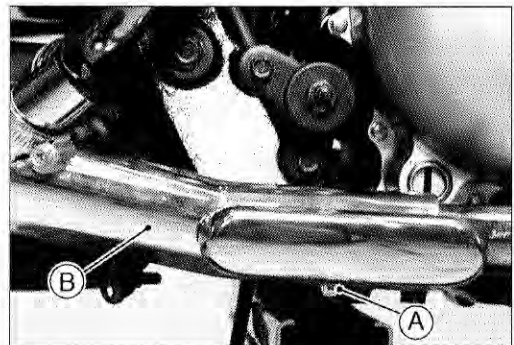
Front and Rear Exhaust Pipe Removal

- Loosen the clamp bolts [A] on the rear exhaust pipe cover [B].
- Detach the upper clamp [C] by sliding it up.
- Detach the lower clamp [D] by sliding it up.
- Remove the rear exhaust pipe cover.

Front [E]

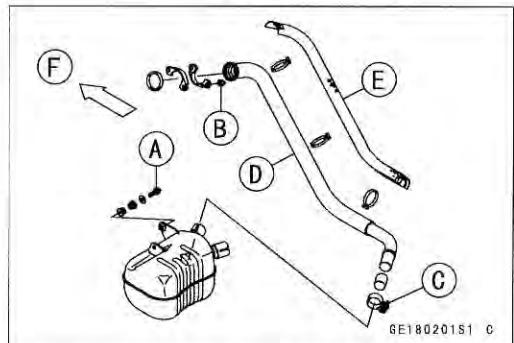


- Loosen the clamp bolt [A] and remove the lower cover [B] forward.



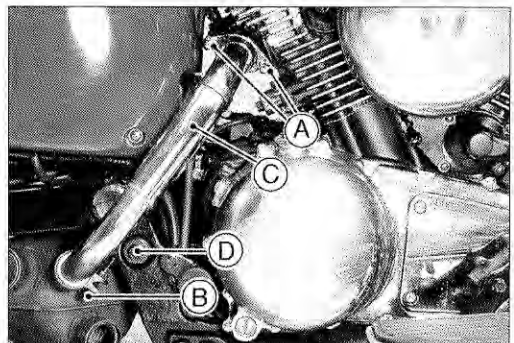
- Loosen the right chamber bolt [A].
- Remove the front exhaust pipe holder nuts [B].
- Loosen the front exhaust pipe clamp bolt [C].
- Take off the front exhaust pipe [D] with the front exhaust cover [E] installed.

Front [F]



- Remove the rear exhaust pipe holder nuts [A].
- Loosen the rear exhaust pipe clamp bolt [B].
- Pull outward and twist clockwise the upper end of the rear exhaust pipe a little, and then take off the rear exhaust pipe [C].

Right Chamber bolt [D]

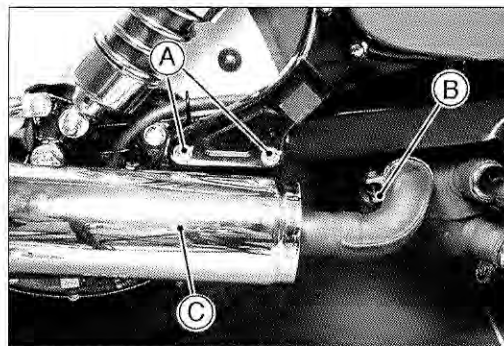


4-38 ENGINE TOP END

Muffler

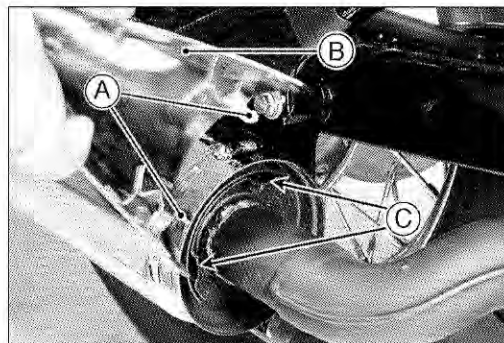
Silencer Removal

- Remove:
 - Rear Exhaust Pipe Cover (see above)
 - Silencer Stay Bolts [A]
 - Silencer Clamp Bolt [B]
- Move the silencer [C] backward and remove it.



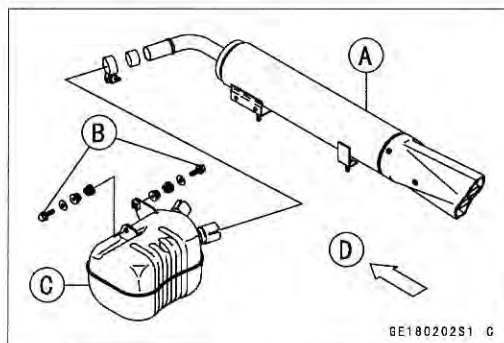
Silencer Installation

- Tighten:
 - Torque - Silencer Stay Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)**
- Fit the tangs [A] of the lower cover [B] into the grooves [C] of the silencer.



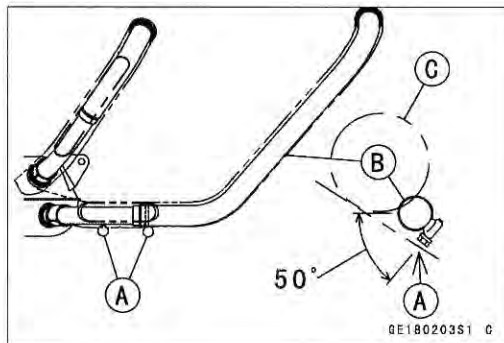
Chamber Removal

- Remove:
 - Front and rear exhaust pipes (see this chapter)
 - Silencer [A] (see this chapter)
 - Right and Left Chamber Bolts [B]
- Take out the chamber [C].
- Front [D]



Muffler Installation

- Replace the exhaust pipe holder gasket with new ones.
- Tighten the front exhaust pipe cover clamp bolts [A] with its head inclined at 50° or less to horizontal as shown. This prevents the screw from touching ground when banking.
 - Front Exhaust Pipe [B]
 - Silencer [C]
- Torque - Exhaust Pipe Cover Clamp Bolts: 6.9 N·m (0.7 kg·m, 61 in·lb)**
- First, tighten all the bolts and nuts to a snug fit.
- Secondly, tighten the exhaust pipe holder nuts evenly to avoid exhaust leakage.
- Finally, tighten the rest of the mounting bolts and clamp bolts securely.
- Thoroughly warm up the engine, wait until the engine cools down, and retighten all the clamp bolts.



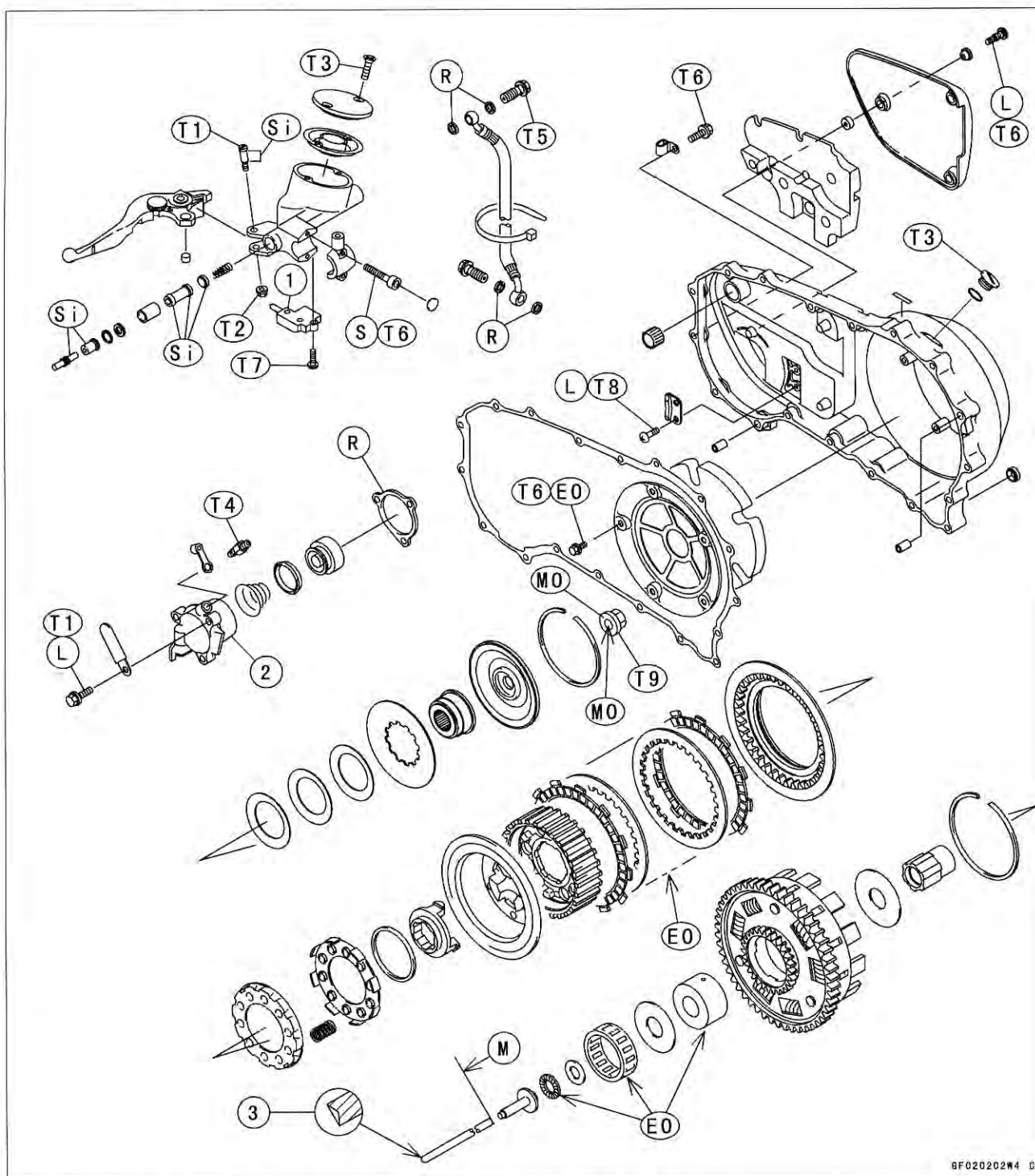
Clutch

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5-2 CLUTCH

Exploded View



BF020202M4 G

- T1: 1.0 N·m (0.10 kg·m, 8.7 in·lb)
- T2: 5.9 N·m (0.60 kg·m, 52 in·lb)
- T3: 1.5 N·m (0.15 kg·m, 13 in·lb)
- T4: 7.8 N·m (0.80 kg·m, 69 in·lb)
- T5: 25 N·m (2.5 kg·m, 18 ft·lb)
- T6: 9.8 N·m (1.0 kg·m, 87 in·lb)
- T7: 1.2 N·m (0.12 kg·m, 10 in·lb)
- T8: 4.9 N·m (0.50 kg·m, 43 in·lb)
- T9: 147 N·m (15.0 kg·m, 108 ft·lb)

E0: Apply engine oil.

L: Apply a non-permanent locking agent.

M: Apply molybdenum disulfide grease.

MO: Apply molybdenum disulfide oil.

R: Replacement Parts

S: Follow the specific tightening sequence.

Si: Apply silicone grease, or PBC grease.

1. Starter Lockout Switch

2. Clutch Slave Cylinder

3. Cup point side faces outside.

Specifications

Item	Standard	Service Limit
Clutch Fluid		
Grade	D.O.T. 4 (provided when shipping)	---
Clutch Lever Position	No. 1 (to suit rider)	5-way adjustable
Clutch Lever Free Play	Non-adjustable	---
Clutch		
Clutch spring free height	4.3 mm	4 mm
Spring plate gap	1.95 ~ 2.45 mm (usable range)	---
Friction plate thickness	3.3 ~ 3.5 mm	3.1 mm
Friction or steel plate warp	0.2 mm or less	0.3 mm

Special Tools - Inside Circlip Pliers: 57001-143

Bearing Driver Set: 57001-129

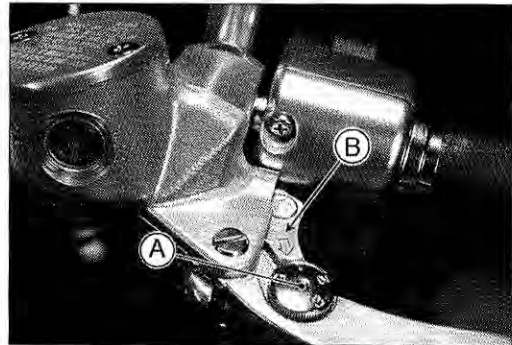
5-4 CLUTCH

Clutch Lever

The adjuster has 5 positions so that the clutch lever position can be adjusted to suit the operator's hand.

Position Adjustment

- Push the lever forward and turn the adjuster [A] to align the number with the arrow mark [B] on the lever holder (front view).
- The distance from the grip to the lever is minimum at number 5 and maximum at number 1.

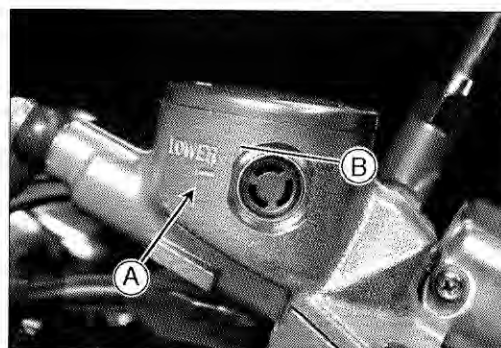


Clutch Fluid

Fluid Level Inspection

- Hold the reservoir horizontal.
- Check that the brake fluid level of the clutch reservoir is between the lower [A] and the upper [B] level lines.
- ★ If the fluid level is lower than the lower level line, fill the reservoir to the upper level line in the reservoir.
- Since the clutch fluid is the same as the brake fluid, refer to Brake Fluid Section in the Brakes chapter for further details.

Torque - Clutch Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)



⚠ WARNING

Change the fluid in the clutch line completely if the fluid must be refilled but the type and brand of the fluid that already is in the reservoir are unidentified.

After changing the fluid, use only the same type and brand of fluid thereafter. Mixing different types and brands of fluid lowers the fluid boiling point and could cause the clutch to be ineffective. It may also cause the rubber clutch parts to deteriorate.

Clutch Fluid Changing

- Level the clutch fluid reservoir and remove the reservoir cap.
- Remove the alternator outer cover and the rubber cap from the bleed valve on the clutch slave cylinder.
- Attach a clear plastic hose [A] to the bleed valve and run the other end of the hose into a container.
- Fill the reservoir with fresh fluid.
- Change the clutch fluid as follows.
 - Open [B] the bleed valve, using a wrench.
 - Pump the clutch lever and hold [C] it.
 - Close [D] the bleed valve.
 - Release [E] the clutch lever.
- Repeat this operation until fresh fluid comes out from the plastic hose or the color of the fluid changes.
- Check the fluid level in the reservoir often, replenishing it as necessary.

NOTE

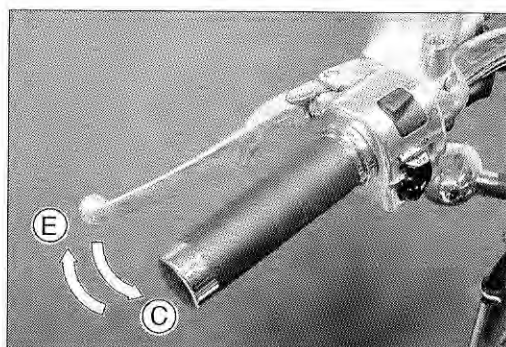
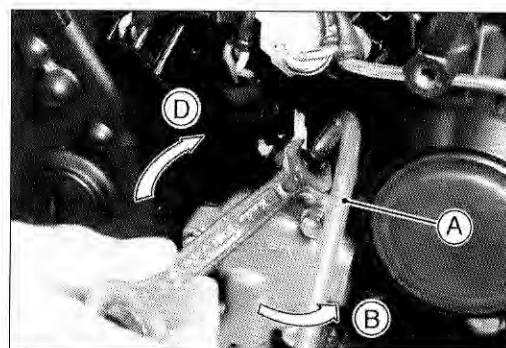
- If the fluid in the reservoir runs completely out any time during fluid changing, the bleeding operation must be done over again from the beginning since air will have entered the line.

⚠ WARNING

Do not mix two brands of fluid.

- After changing the fluid, check the clutch for good clutch power and no fluid leakage.
- ★ If necessary, bleed the air from the lines (see Clutch Line Bleeding).
- Remove the clear plastic hose.
- Install the reservoir cap.
- Tighten the bleed valve, and install the rubber cap.

Torque - Clutch Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)
Clutch Slave Cylinder Bleed Valve: 7.8 N·m (0.80 kg·m, 69 in·lb)



5-6 CLUTCH

Clutch Fluid

Clutch Line Bleeding

- With the reservoir cap off, slowly pump the clutch lever several times until no air bubbles can be seen rising up through the fluid from the holes at the bottom of the reservoir. This bleeds the air from the master cylinder end of the line.

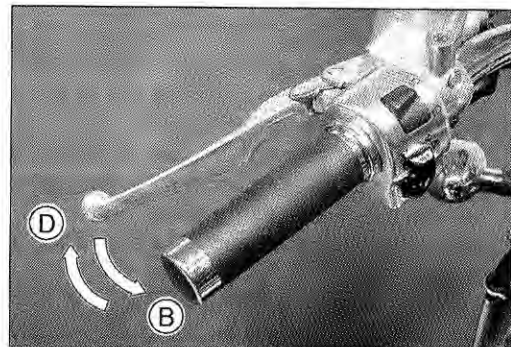
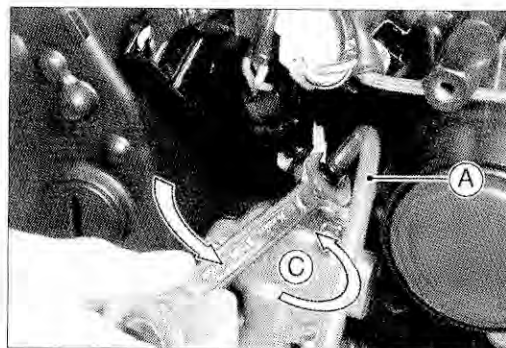
NOTE

- Tap the clutch hose lightly going from the lower end to the upper end and bleed the air off at the reservoir.
- Attach a clear plastic hose [A] to the bleed valve on the clutch slave cylinder, and run the other end of the hose into a container.

- Bleed the clutch line as follows:
 - Pump the clutch lever a few times until it becomes hard and then hold it applied [B].
 - Quickly open and close [C] the bleed valve.
 - Release [D] the clutch lever.
 - Check the fluid level in the reservoir often, replenishing it as necessary.

NOTE

- If the fluid in the reservoir runs completely out any time during bleeding, the bleeding operation must be done over again from the beginning since air will have entered the line.
- Repeat this operation until no more air can be seen coming out into the plastic hose.



⚠ WARNING

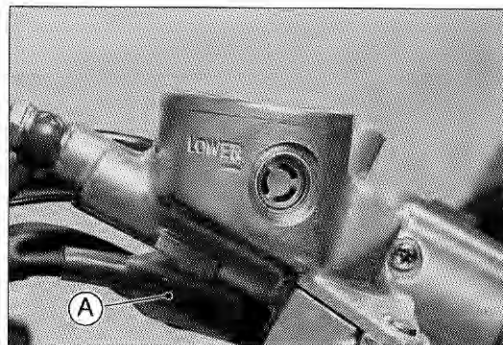
Do not mix two brands of fluid.

Torque - Clutch Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)
Clutch Slave Cylinder Bleed Valve: 7.8 N·m (0.80 kg·m, 69 in·lb)

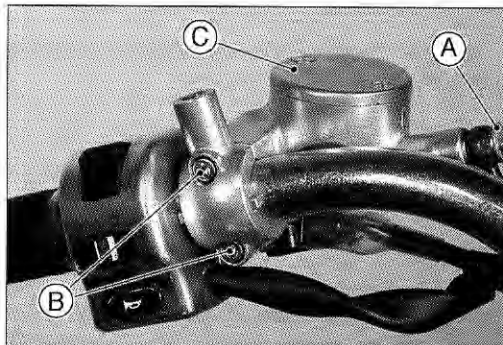
Clutch Master Cylinder

Clutch Master Cylinder Removal

- Disconnect the starter lockout switch connector [A] (front view).
- Draw out the clutch fluid from the reservoir with a means like the fork oil level gauge.



- Remove the banjo bolt [A] to disconnect the clutch hose from the master cylinder (rear view).
- Unscrew the clamp bolts [B], and take off the master cylinder [C] as an assembly with the clutch reservoir, clutch lever, and starter lockout switch installed.

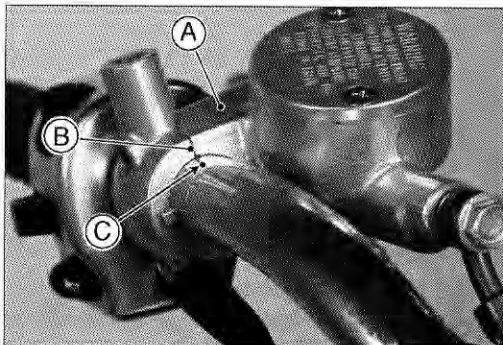


CAUTION

Clutch fluid quickly ruins painted surface; any spilled fluid should be completely washed away immediately.

Clutch Master Cylinder Installation

- Set the clutch master cylinder [A] to match its mating surface [B] to the punch mark [C] of the handlebar (rear view).



- The master cylinder clamp must be installed with the rear view mirror boss [A] upward.

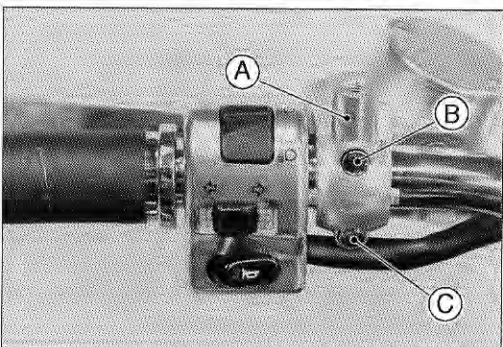
- Tighten the upper clamp bolt [B] first, and then the lower clamp bolt [C]. There will be a gap at the lower part of the clamp after tightening.

Torque - Clutch Master Cylinder Clamp Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Use a new flat washer on each side of the clutch hose fitting.
- Tighten the clutch hose banjo bolt.

Torque - Clutch Hose Banjo Bolt: 25 N·m (2.5 kg·m, 18 ft·lb)

- Replenish the clutch fluid into the reservoir and bleed the clutch line (see Clutch Line Bleeding).
- Check that the clutch line has proper fluid pressure and no fluid leakage.



5-8 CLUTCH

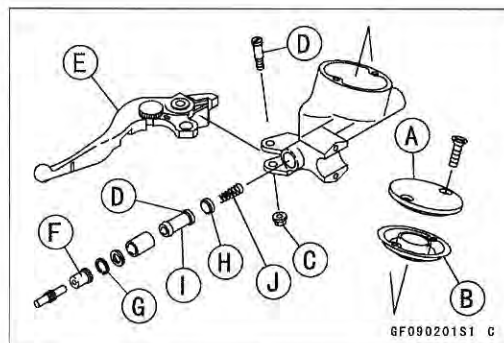
Clutch Master Cylinder

Clutch Master Cylinder Disassembly

- Remove the master cylinder.
- Remove the reservoir cap [A] and diaphragm [B], and pour the clutch fluid into a container.
- Unscrew the locknut [C] and pivot bolt [D], and remove the clutch lever [E].
- Pull the dust cover [F] out of place, and remove the circlip [G].

Special Tool - Inside Circlip Pliers: 57001-143

- Pull out the primary cup [H], piston assembly [I], and return spring [J].



CAUTION

Do not remove the secondary cup from the piston since removal will damage it.

Clutch Master Cylinder Assembly

- Before assembly, clean all parts including the master cylinder with clutch fluid or alcohol.

CAUTION

Use only disc brake fluid, isopropyl alcohol, or ethyl alcohol, for cleaning parts. Do not use any other fluid for cleaning these parts. Gasoline, motor oil, or any other petroleum distillate will cause deterioration of the rubber parts. Oil spilled on any part will be difficult to wash off completely, and will eventually deteriorate the rubber used in the cylinder.

- Apply clutch fluid to the parts removed and to the inner wall of the cylinder.
- Take care not to scratch the piston or the inner wall of the cylinder.
- Install the push rod with the dust seal fitted into the groove.
- The push rod round end must be faced inwards.

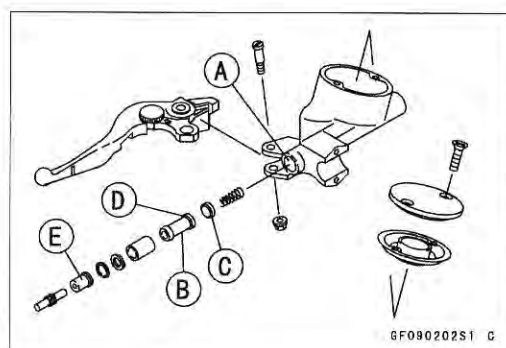
Torque - Clutch Lever Pivot Bolt: 1.0 N·m (0.10 kg·m, 8.7 in·lb)

Clutch Lever Pivot Bolt Locknut: 5.9 N·m (0.60 kg·m, 52 in·lb)

- Install the clutch master cylinder (see this chapter).

Clutch Master Cylinder Inspection

- Disassemble the clutch master cylinder.
- Check that there are no scratches, rust or pitting on the inside of the master cylinder [A] and on the outside of the piston [B].
- ★ If the master cylinder or piston shows any damage, replace them.
- Inspect the primary cup [C] and secondary cup [D].
- ★ If a cup is worn, damaged, softened (rotted), or swollen, the piston assembly should be replaced to renew the cups.
- If fluid leakage is noted at the clutch lever, the piston assembly should be replaced to renew the cups.
- Check the dust cover [E] for damage.
- If it is damaged, replace it.
- Check that the relief and supply ports are not plugged.
- ★ If the small relief port becomes plugged, the clutch will drag. Blow the ports clean with compressed air.
- Check the piston return spring for any damage.
- ★ If the spring is damaged, replace it.



Clutch Slave Cylinder

Removal

- Remove:
 - Alternator Outer Cover (see Electrical System chapter)
 - Banjo Bolt [A]
 - Clutch Slave Cylinder Bolts [B]
 - Slave Cylinder [C]

CAUTION

Immediately wash away any clutch fluid that spills. It may damage painted surfaces.

- Perform the following if the clutch slave cylinder is to be removed but not disassembled.

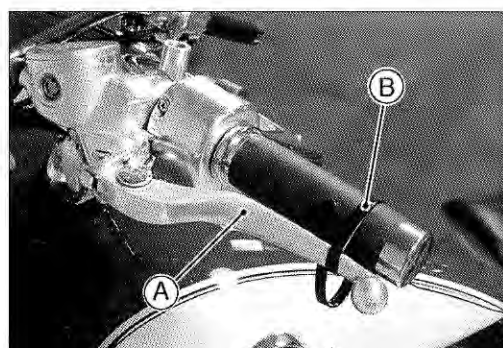
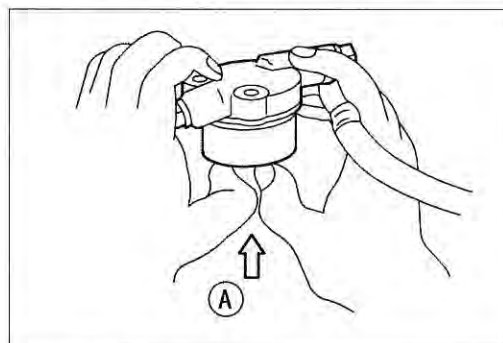
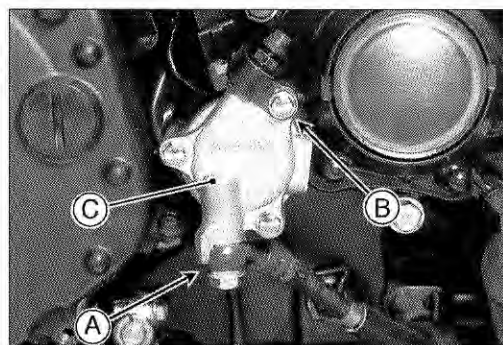
CAUTION

If the clutch slave cylinder is removed and left alone, the piston will be pushed out by spring force and the clutch fluid will drain out.

- Remove the clutch slave cylinder with the pipe installed.
- Push [A] the piston into the cylinder as far as it will go.
- Apply the clutch lever [A] slowly and hold it with a band [B].

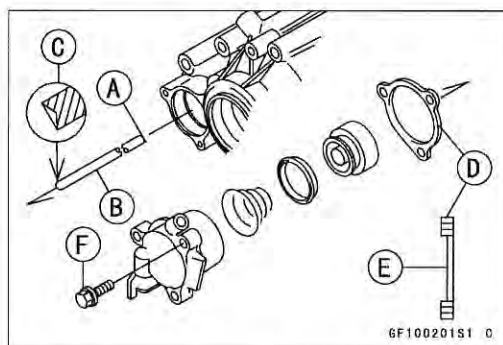
NOTE

- Holding the clutch lever keeps the piston from coming out.



Installation

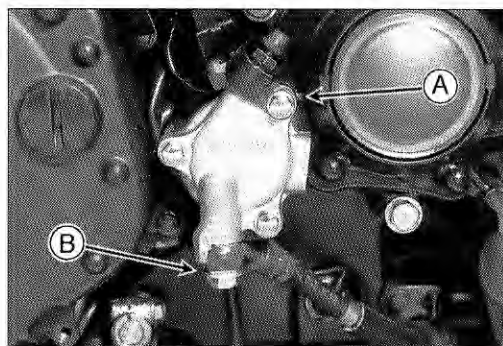
- Apply molybdenum disulfide grease to the flat end [A] of the push rod [B].
- Install the push rod so that the flat end faces in.
 - Cup Point [C]
- Replace the spacer [D] of the clutch slave cylinder with a new one.
- Install the spacer so that the stepped side [E] faces outward.
- Apply a non-permanent locking agent to the threads of the clutch slave cylinder bolts [F].
- Finger tighten the clutch slave cylinder bolts.
- Remove the band from the clutch lever and release the clutch lever.



- Tighten the slave cylinder bolts [A].
- Replace the washers on each side of the clutch hose fitting with new ones.
- Tighten the banjo bolt [B] to the specified torque.

Torque - Clutch Pipe Banjo Bolt: 25 N·m (2.5 kg·m, 18 ft·lb)

- Check the fluid level in the master cylinder reservoir, and bleed the air in the clutch line.
- Check the clutch operation.



5-10 CLUTCH

Clutch Slave Cylinder

Disassembly

- Loosen the banjo bolt [A] at the clutch pipe lower end, and tighten it loosely.
- Unscrew the slave cylinder bolts [B] and detach the slave cylinder with the pipe installed from the engine.
- Pump the clutch lever until the piston comes out of the cylinder.
- Unscrew the banjo bolt and remove the slave cylinder [C].

CAUTION

Immediately wash away any clutch fluid that spills. It may damage painted surfaces.

NOTE

○ If the clutch slave cylinder is removed and left alone, the piston will be pushed out by spring force.

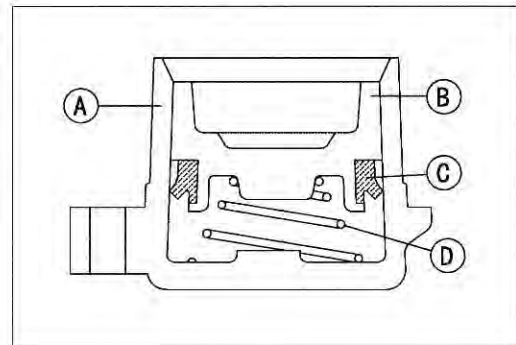
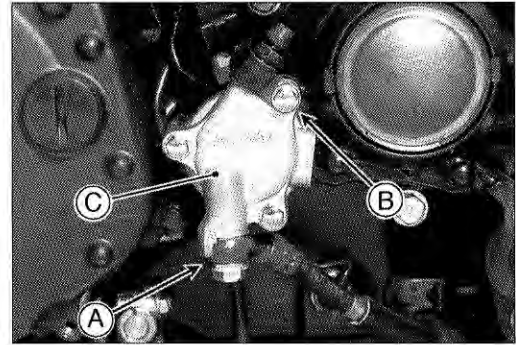
- Remove:
 - Spring
 - Fluid Seal

Assembly

CAUTION

Replace the fluid seal with a new one if it was removed from the piston.

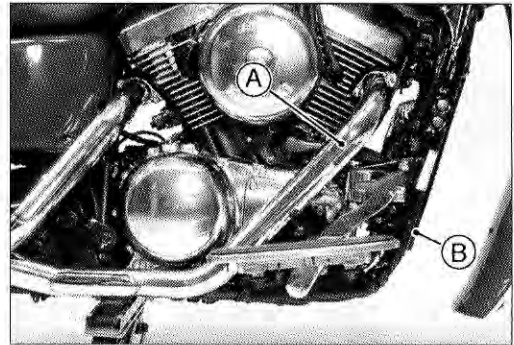
- Apply clutch fluid to the outside of the piston and the fluid seal.
- Install the fluid seal as shown.
 - Cylinder [A]
 - Piston [B]
 - Fluid Seal [C]
 - Spring [D]



Clutch

Clutch Cover Removal

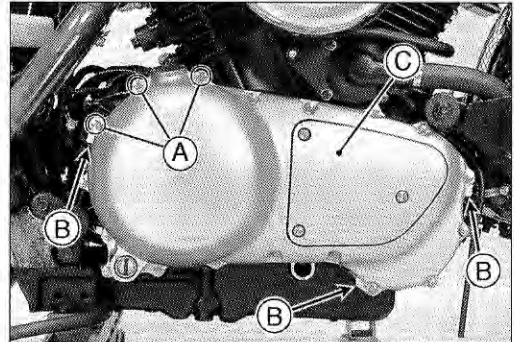
- Drain the engine oil (see Engine Lubrication System chapter).
- Remove:
 - Front Exhaust Pipe [A] (see Engine Top End chapter)
 - Downtube [B] (see Frame chapter, but remove the downtube with the right footboard and rear master cylinder left installed)



- Unscrew the eighteen cover bolts [A].
- Using the pry points [B], take the cover off the crankcase.

NOTE

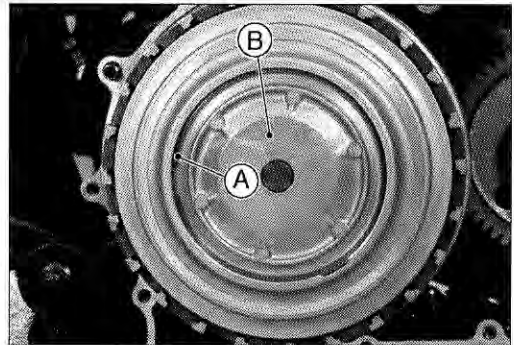
- Do not remove the damper cover [C].



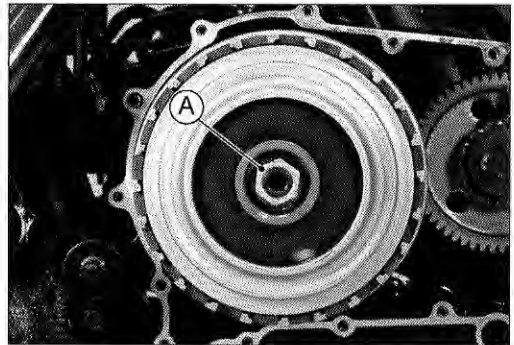
Clutch Removal

NOTE

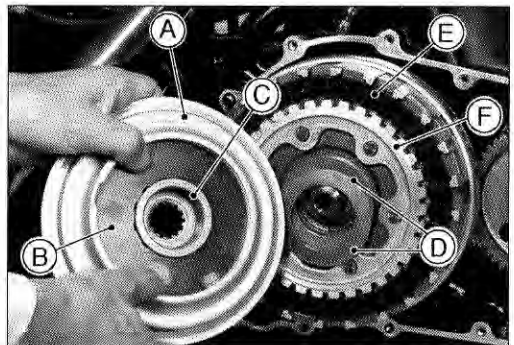
- Use an air impact wrench for removal of the clutch hub nut.
- Remove the clutch cover (see this chapter).
- Remove the retaining ring [A] and take the operating plate [B] out of the clutch assembly.



- Unscrew the clutch hub nut [A] by using an air impact wrench.



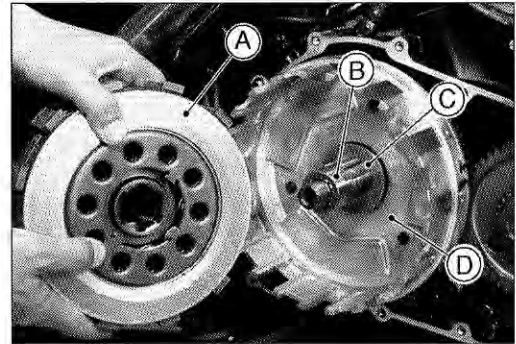
- Take the clutch spring plate [A], clutch spring [B], and the clutch spring holder [C] out of the clutch hub.
- Take the back torque limiter springs [D], friction/steel plates [E], and the outer clutch hub [F] out of the clutch housing.



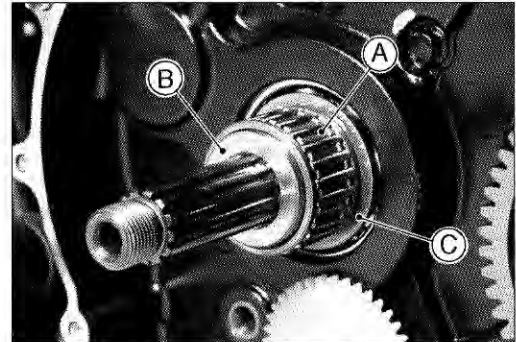
5-12 CLUTCH

Clutch

- Take the inner clutch hub [A], collar [B], washer [C] and clutch housing [D] out of the crankcase.



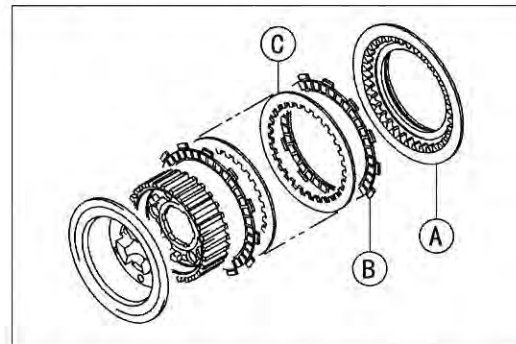
- Pull the needle bearing [A], sleeve [B], and thrust washer [C] off the drive shaft.



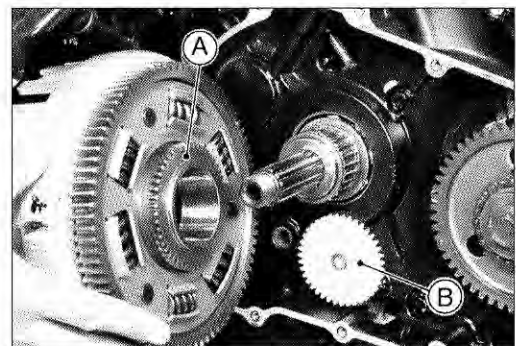
Clutch Installation

- ★ When replacing any one of the following parts, check the spring plate free play (see Spring Plate Free Play Measurement).

Spring Plate [A]
Friction Plates [B]
Steel Plates [C]



- When installing the clutch housing, mesh the oil pump drive gear [A] with the oil pump gear [B] so that the pump gear turns smoothly.

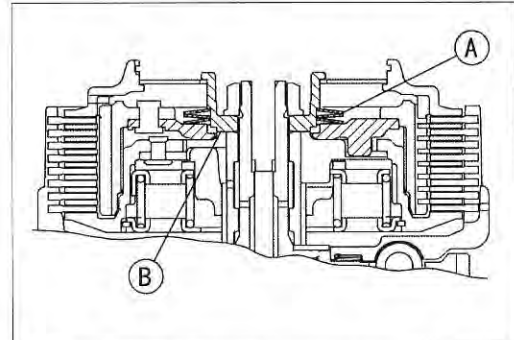
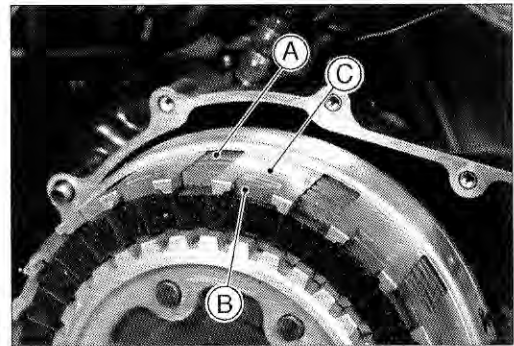


Clutch

CAUTION

If new dry steel or friction plates are installed, apply engine oil to the surfaces of each plate to avoid clutch plate seizure.

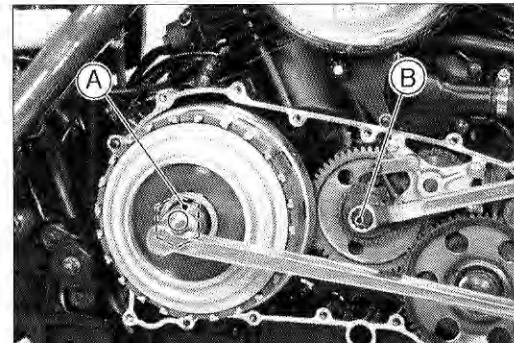
- Install the friction plates and steel plates, starting with a friction plate and alternating them.
- First, install the friction plates, fitting their tangs in the deeper grooves [A], and finally the outermost friction plate [B] in the shallower grooves [C].
- Apply grease to the back torque limiter springs [A] and install them on the spring holder [B] as shown.



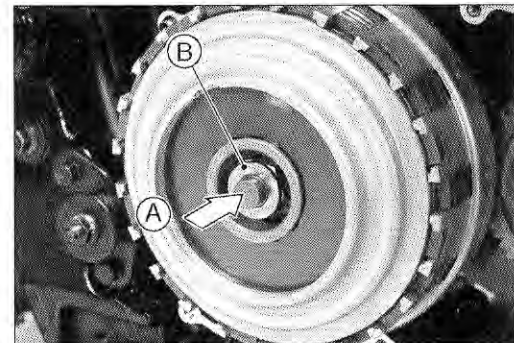
Molybdenum Disulfide Oil- Threads and Seating Surface of Clutch Hub Nut

- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).
- Tighten the clutch hub nut [A] to the specified torque while holding the primary gear bolt [B].

Torque - Clutch Hub Nut: 147 N·m (15.0 kg·m, 108 ft·lb)



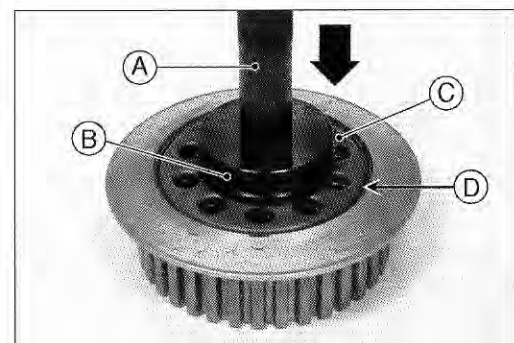
- Squeeze the clutch lever slowly and hold it with a band while pushing [A] the spring plate pusher [B] into the clutch hub.



Inner Clutch Hub Disassembly

- Using a press [A], and a suitable bearing driver [B], push the damper spring holder [C] to remove the retaining ring [D].

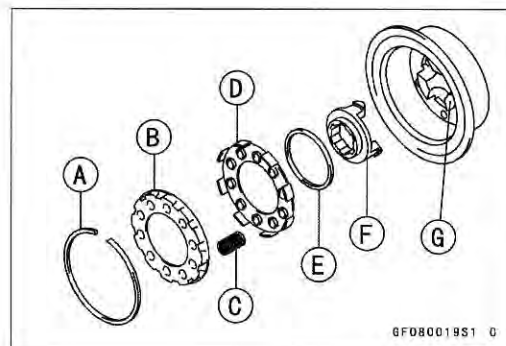
Special Tool - Bearing Driver Set: 57001-1129



5-14 CLUTCH

Clutch

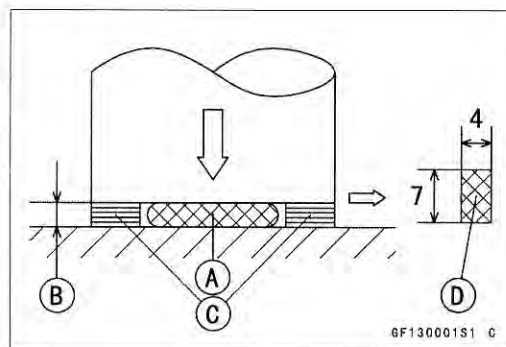
- Remove:
 - Retaining Ring [A]
 - Spring Holder [B]
 - Damper Spring [C]
 - Spring Holder [D]
 - Spacer [E]
 - Damper Cam [F]
 - Inner Clutch Hub [G]



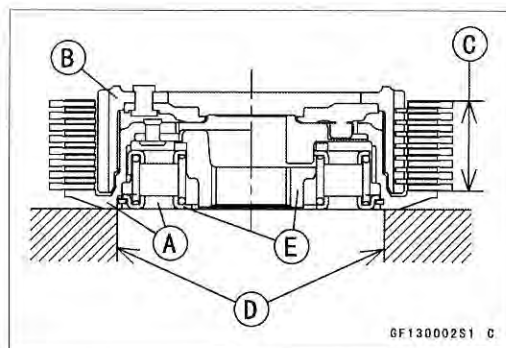
Spring Plate Gap Measurement

Insufficient spring plate gap will cause the engine braking effect to be more sudden, resulting in rear wheel hop. On the other hand, if the spring plate gap is excessive, the clutch may slip or the clutch lever may feel "spongy" or pulsate when pulled.

- Prepare sheet gum (chewing gum) or about 5 g clay [A].
- Make an about 2.5 mm thick sheet [B] of gum or clay, using a press and two thickness gauges [C] which are overlapped to about 2.5 mm.
- Cut the sheet with scissors into four strips [D] of gum or clay as shown.
unit: mm



- Remove the clutch (see this chapter).
- Place the inner clutch hub, spring holder assy [A], the outer clutch hub [B], and the clutch plates (friction and steel plates) [C] on blocks [D].
- Do not support the spring holder [E] with the blocks.

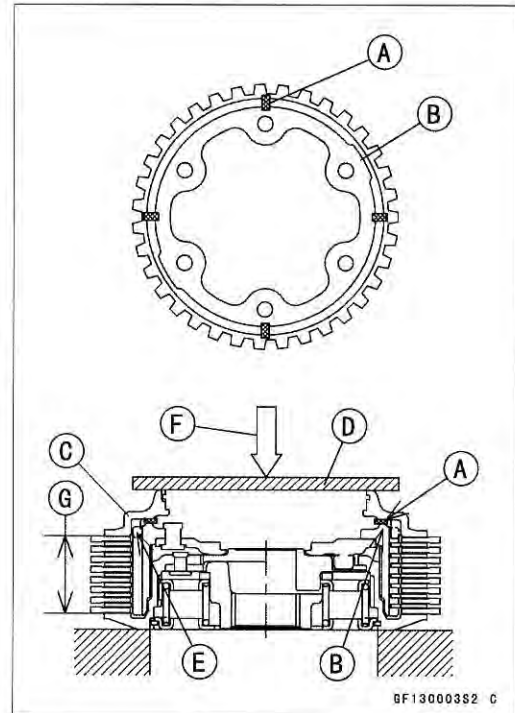


Clutch

- Apply a soap and water solution to the strips to separate the strips easily from the clutch spring plate and clutch hub after wards.
- Place these four strips [A] on the raised surface [B] of the outer clutch hub in a criss-cross pattern as shown.
- Install the clutch spring plate [C] and a block [D].
- While noting the positions of the spline teeth [E], fit the clutch spring plate into the outer clutch hub smoothly. Be careful not to move these strips.
- Press [F] the block until the clutch plates [G] seat closely.

CAUTION

Do not press the block too much. This could damage the clutch parts. The maximum press force is 100 kg.



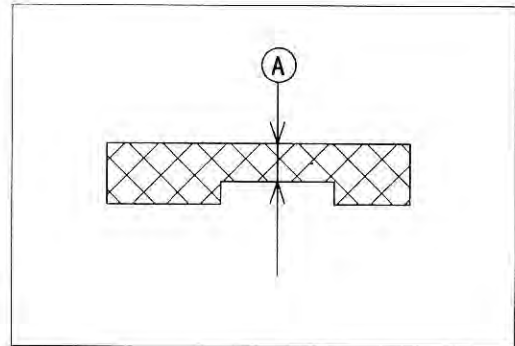
- Remove the clutch spring plate.
- Peel off these strips with a thin-bladed screwdriver.
- Measure the pressed thickness [A] of each strip with vernier calipers.
- The thickness represents the spring plate gap.

Spring Plate Gap

Usable Range: 1.95 ~ 2.45 mm

NOTE

- In case of rear wheel hop, adjust the spring plate gap a bit larger, and in case of clutch slip, or "spongy" clutch lever, adjust the gap a bit smaller within the usable range.

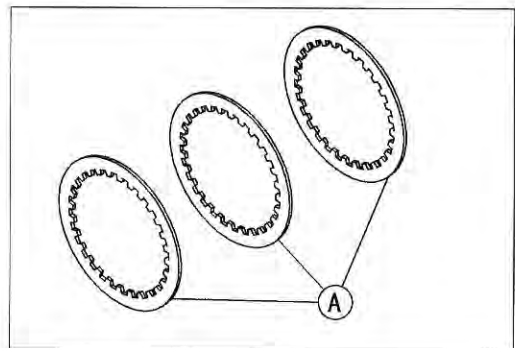


Spring Gap Adjustment

- ★ If the plate gap is out of the usable range, change one of the steel plates [A] to a thicker or thinner one to get the correct gap.
- Use the standard steel plates (2.0 mm thick) × 6 ~ 7 plates, and the adjustment steel plate (1.6 or 2.3 mm thick) × 0 ~ 1 plates: total 7 plates.

Steel Plates

Thickness (mm)	Part No.
1.6	13089-1080
2.0	13089-1075 (standard)
2.3	13089-1081



CAUTION

If new friction or steel plates are installed, apply engine oil to the surfaces of each plate to avoid clutch plate seizure.

5-16 CLUTCH

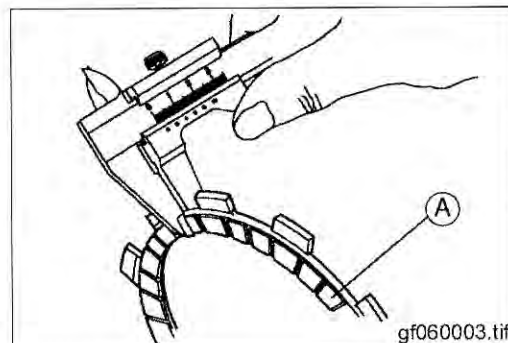
Clutch

Friction and Steel Plate Wear, and Damage Inspection

- Visually inspect the friction and steel plates for signs of seizure, overheating (discoloration), or uneven wear.
- Measure the thickness of the friction plates [A] at several points.
- ★ If any plates show signs of damage, or if they have worn past the service limit, measure the spring plate gap and adjust it if necessary.

Friction Plate Thickness

Standard:	3.3 ~ 3.5 mm
Service Limit:	3.1 mm

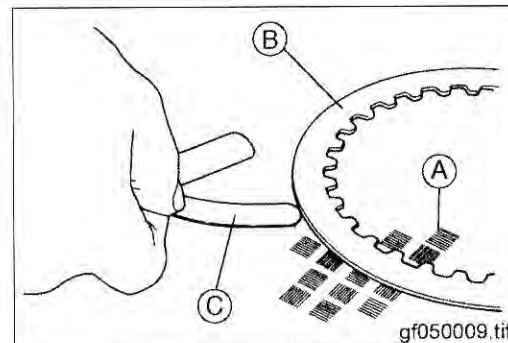


Friction or Steel Plate Warp

- Place each friction plate or steel plate on a surface plate, and measure the gap between the surface plate [A] and each friction plate or steel plate [B] with a thickness gauge [C]. The gap is the amount of friction or steel plate warp.
- ★ If any plate is warped over the service limit, replace it and measure the spring plate gap, and adjust it if necessary.

Friction or Steel Plate Warp

Standard:	0.2 mm or less
Service Limit:	0.3 mm

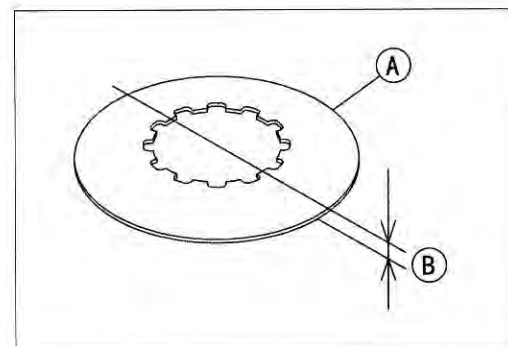


Clutch Spring Height Measurement

- Measure the height [B] of the clutch spring [A].
- ★ If the spring height is less than the service limit, it must be replaced.

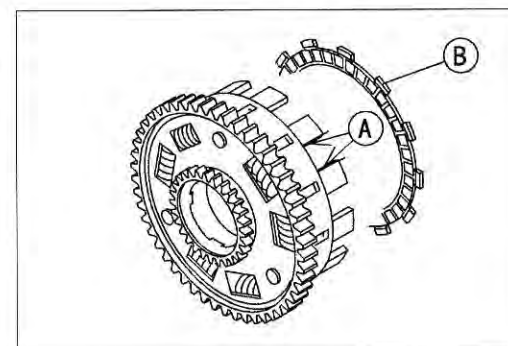
Clutch Spring Height

Standard:	4.3 mm
Service Limit:	4 mm



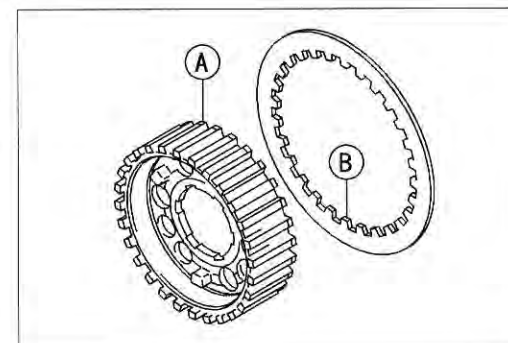
Clutch Housing Finger Inspection

- Visually inspect the fingers [A] of the clutch housing where the tangs [B] of the friction plates hit them.
- ★ If they are badly worn or if there are groove cuts where the tangs hit, replace the housing. Also, replace the friction plates if their tangs are damaged and measure the spring plate free play.



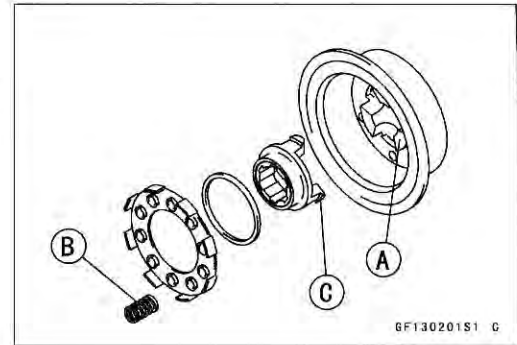
Outer Clutch Hub Spline Inspection

- Visually inspect where the teeth [B] on the steel plates wear against the splines [A] of the outer clutch hub.
- ★ If there are notches worn into the splines, replace the outer clutch hub. Also, replace the steel plate with a new one of the same thickness if their teeth are damaged.



Clutch*Cam Damper Inspection*

- Disassemble the clutch (see Clutch Inner Hub Disassembly).
- Visually inspect the damper cam [A], damper spring [B], and cam follower [C].
- ★ Replace any damaged parts.



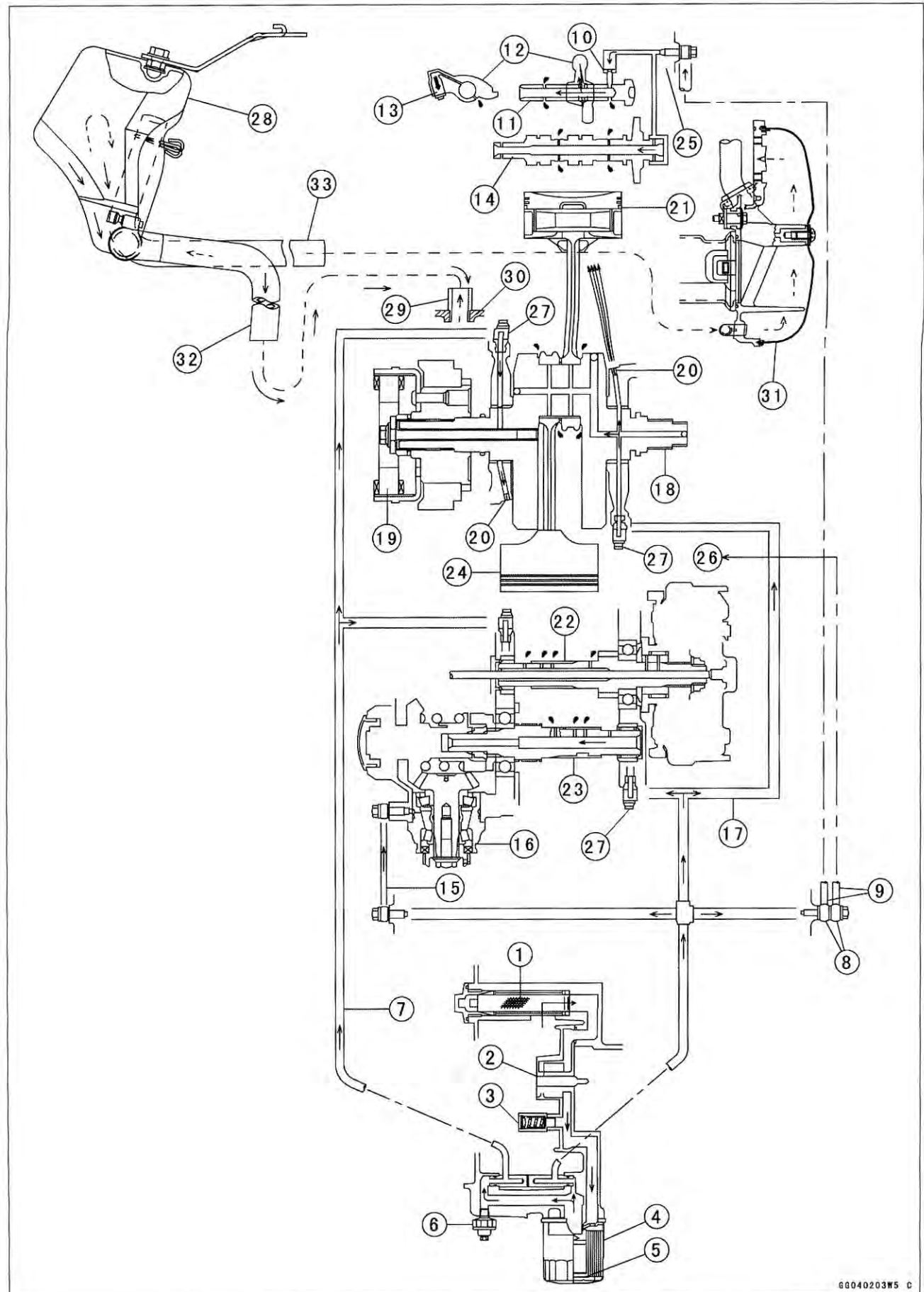
Engine Lubrication System

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6-2 ENGINE LUBRICATION SYSTEM

Engine Oil Flow Chart



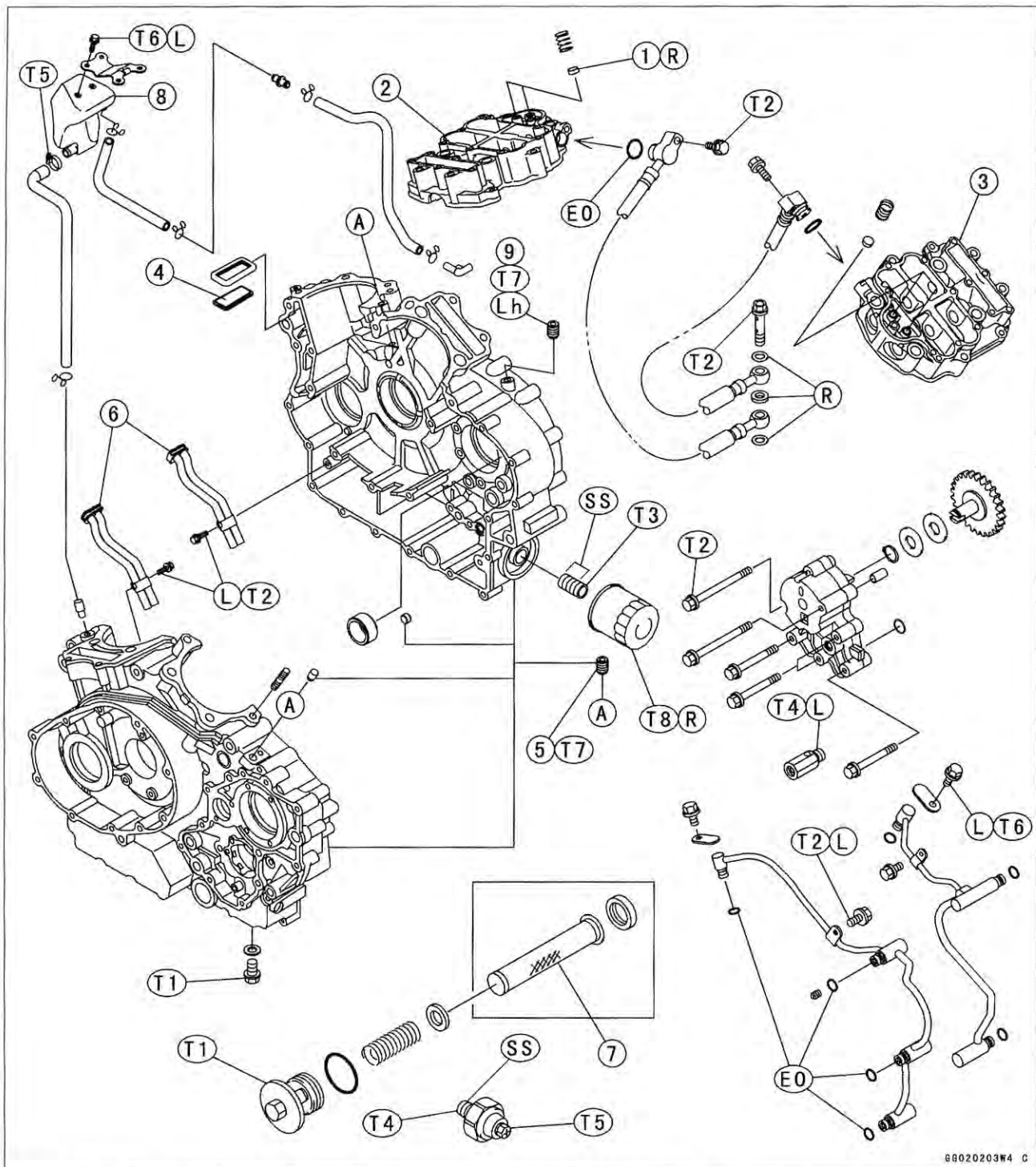
60040203W5 C

Engine Oil Flow Chart

- : Oil Flow (1 ~ 30)
- - →: Blowby Gas
- 1. Oil Screen
- 2. Oil Pump
- 3. Relief Valve
- 4. Oil Filter
- 5. Bypass Valve
- 6. Oil Pressure Switch
- 7. Inside Oil Pipe
- 8. Banjo Bolts of Right Crankcase Rear
- 9. Outside Oil Hoses
- 10. HLA Oil Filter
- 11. Rocker Shafts
- 12. Rocker Arms
- 13. HLA (Hydraulic Lash Adjuster)
- 14. Camshafts
- 15. Outside Oil Pipe
- 16. Front Gear Case
- 17. Inside Oil Pipe
- 18. Crankshaft
- 19. Alternator Rotor
- 20. Oil Nozzle
- 21. Front Piston
- 22. Drive Shaft
- 23. Output Shaft
- 24. Rear Piston
- 25. Front Rockercase
- 26. Rear Rockercase
- 27. Inside Oil Pipe Fittings
- 28. Oil Reserve Tank (left view)
- 29. Fitting
- 30. Left Crankcase
- 31. Right Air Cleaner Housing (rear view)
- 32. Crankcase Breather Hose
- 33. Oil Reserve Tank Hose

6-4 ENGINE LUBRICATION SYSTEM

Exploded View



68020203W4 C

1. HLA Oil Filter
 2. Front Rocker Case
 3. Rear Rocker Case
 4. Oil Separator
 5. Oil Nozzle (× 3), right-hand threads
 6. Oil Return Pipes
 7. Oil Screen
 8. Oil Reserve Tank
 9. Oil Nozzle (× 1), left-hand threads
- E0: Apply engine oil.
L: Apply a non-permanent locking agent.

- Lh: Left-hand Threads
R: Replacement Parts
SS: Apply silicone sealant (Kawasaki Bond: 56019-120).
- T1: 20 N·m (2.0 kg·m, 14 ft·lb)
T2: 9.8 N·m (1.0 kg·m, 87 in·lb)
T3: 25 N·m (2.5 kg·m, 18 ft·lb)
T4: 15 N·m (1.5 kg·m, 11 ft·lb)
T5: 1.5 N·m (0.15 kg·m, 13 in·lb)
T6: 8.8 N·m (0.90 kg·m, 78 in·lb)
T7: 3.4 N·m (0.35 kg·m, 30 in·lb)
T8: 18 N·m (1.8 kg·m, 13 ft·lb)

ENGINE LUBRICATION SYSTEM 6-5

Specifications

Item	Standard
Engine Oil:	
Grade	API Service Classification: SE, SF, SG or SH (JASO MA), SJ (JASO MA) class
Viscosity	SAE 10W-40, 10W-50, 20W-40, or 20W-50
Capacity	2.9 L (when filter is not removed) 3.1 L (when filter is removed) 3.5 L (when engine is completely disassembled and dry)
Level (after idling or running)	Between upper and lower level lines
Oil Pressure Measurement:	
Oil pressure @2 000 r/min (rpm), Oil temp. 100°C (212°F)	340 ~ 440 kPa (3.5 ~ 4.5 kg/cm ² , 50 ~ 64 psi)

Special Tools - Driver-Filler Cap: 57001-1454
Oil Pressure Gauge, 5 kg/cm²: 57001-125
Oil Pressure Gauge Adapter, PT 1/8: 57001-1033
Oil Filter Wrench: 57001-1249

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

6-6 ENGINE LUBRICATION SYSTEM

Engine Oil and Oil Filter

⚠ WARNING

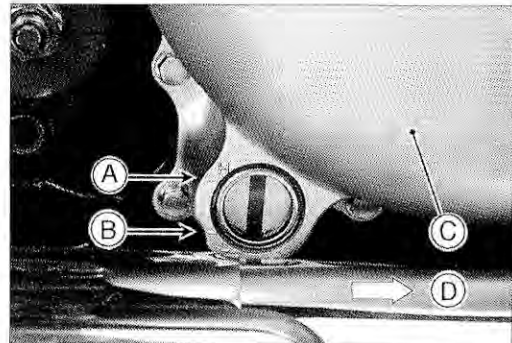
Motorcycle operation with insufficient, deteriorated, or contaminated engine oil will cause accelerated wear and may result in engine or transmission seizure, accident, and injury.

Oil Level Inspection

- Situate the motorcycle so that it is vertical.
- Check that the engine oil level is between the upper [A] and lower [B] levels in the gauge.
 - Clutch Cover [C]
 - Front [D]

NOTE

- Situate the motorcycle so that it is perpendicular to the ground.
- If the motorcycle has just been used, wait several minutes for all the oil to drain down.
- If the oil has just been changed, start the engine and run it for several minutes at idle speed. This fills the oil filter with oil. Stop the engine, then wait several minutes until the oil settles.



CAUTION

Racing the engine before the oil reaches every part can cause engine seizure.

If the engine oil gets extremely low or if the oil pump or oil passages clog up or otherwise do not function properly, the oil pressure warning light will light. If this light stays on when the engine is running above idle speed, stop the engine immediately and find the cause.

Engine Oil Change

- Situate the motorcycle so that it is vertical after warming up the engine.
- Remove the engine oil drain plug [A] and drain the oil.
 - Front [B]
- The oil in the oil screen chamber can be drained by removing the oil screen plug (see Oil Screen Cleaning).
- The oil in the filter can be drained by removing the filter (see Oil Filter Change).
- ★ Replace the drain plug gasket with a new one if it is damaged.

Torque - Engine Oil Drain Plug, Oil Screen Plug: 20 N·m (2.0 kg·m, 14 ft·lb)

Oil Filter: 18 N·m (1.8 kg·m, 13 ft·lb)

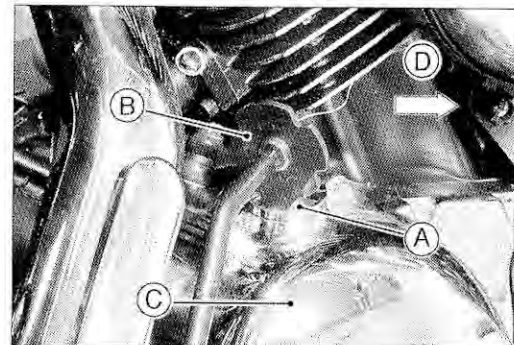
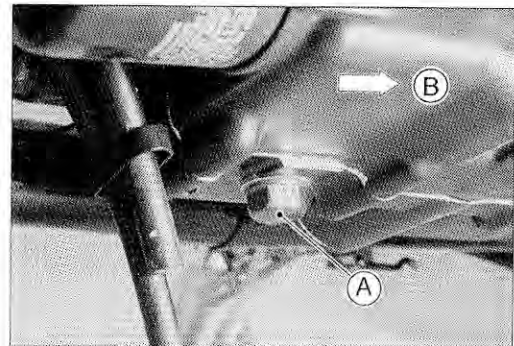
- Remove the oil filler cap [A] with the driver-filler cap [B] and pour in the specified type and amount of oil.
 - Clutch Cover [C]
 - Front [D]

Special Tool - Driver-Filler Cap: 57001-1454

Torque - Oil Filler Cap: 1.5 N·m (0.15 kg·m, 13 in·lb)

Engine Oil

- Grade:** API Service Classification: SE, SF, SG, SH (JASO MA) or (JASO MA) class
- Viscosity:** SAE 10W-40, 10W-50, 20W-40, or 20W-50
- Amount:** 2.9 L (when filter is not removed)
3.1 L (when filter is removed)
3.5 L (when engine is completely disassembled and dry)



Engine Oil and Oil Filter

Oil Filter Change

- Drain the engine oil.
- Remove the oil filter [A] with the oil filter wrench [B].
Front [C]

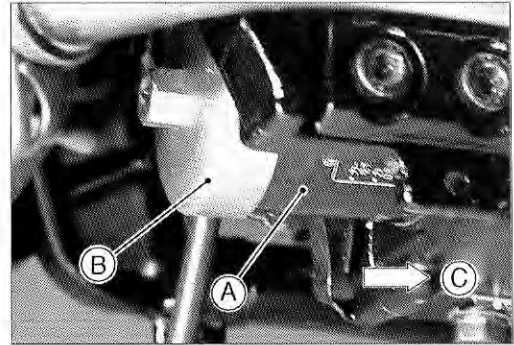
Special Tool - Oil Filter Wrench: 57001-1249

NOTE

○ The filter has an oil filter bypass valve which can not be removed.

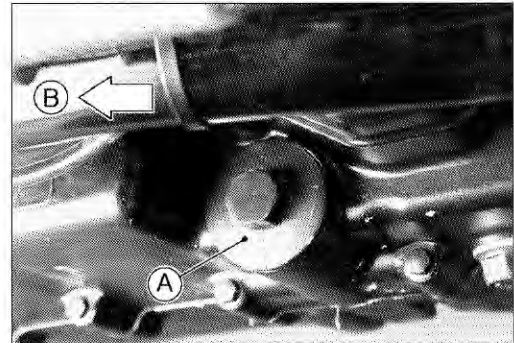
- Apply oil to the gasket before installation.
- Tighten the filter with the oil filter wrench.
- Pour in the specified type and amount of oil.

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



Oil Screen Cleaning

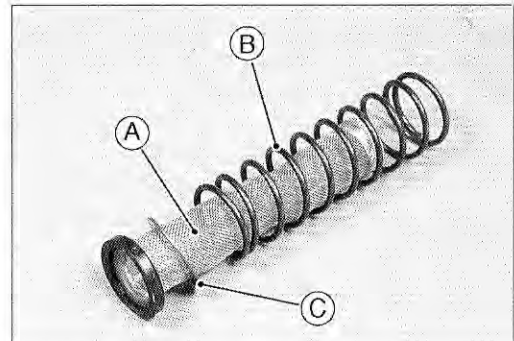
- Remove:
Engine Oil (Drain)
Oil Screen Plug [A]
Front [B]



- Remove the oil screen [A], the spring [B], and the washer [C].
- Clean the oil screen with high-flash point solvent and remove any particles stuck to it.
- Clean the screen thoroughly whenever the engine oil is changed.

⚠ WARNING

Clean the screen in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvents.



NOTE

○ While cleaning the screen, check for any metal particles that might indicate internal engine damage.

- Check the screen carefully for any damage: holes and broken wires.
- ★ If the screen is damaged, replace it.
- Be sure to put in the oil screen with the rubber gasket end [C] inside.
- ★ Replace the screen plug O-ring with new one if it is damaged.

Torque - Oil Screen Plug: 20 N·m (2.0 kg·m, 14 ft·lb)

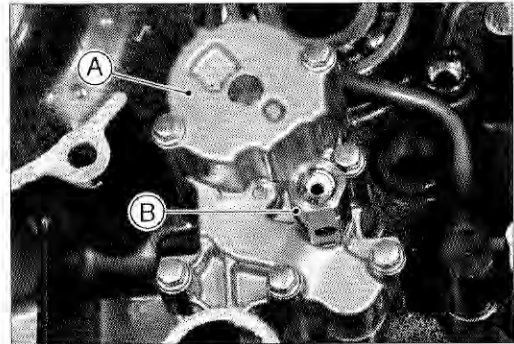
- Pour in the specified type and amount of oil.

6-8 ENGINE LUBRICATION SYSTEM

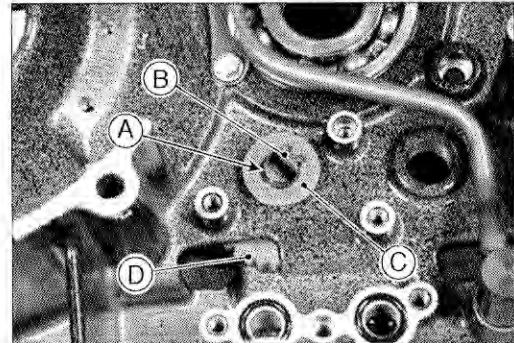
Oil Pump

Removal

- Remove the engine (see Engine Removal/Installation chapter).
- Split the crankcase (see Crankshaft/Transmission chapter).
- Remove the oil pump mounting bolts, and take off the pump [A] out of the right crankcase.
- Unscrew the relief valve [B] if necessary.



- Remove:
 - Circlip [A]
 - Pump Shaft [B]
 - Washer [C]
 - Pump Gear [D]



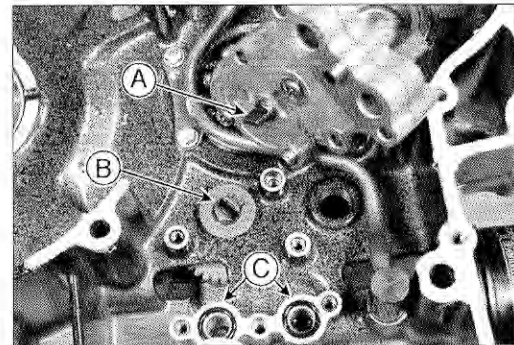
Installation

- Note the position of the oil pump shaft tang [A] and turn the pump gear shaft so that the tang fits into the slot [B] of the oil pump gear.
- Replace the O-rings [C] with new ones if they are damaged.
- Tighten:

Torque - Oil Pump Cover Screws: 9.8 N·m (1.0 kg·m, 87 in·lb)
Oil Pump Mounting Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Apply a non-permanent locking agent to the threads of the relief valve and install it.

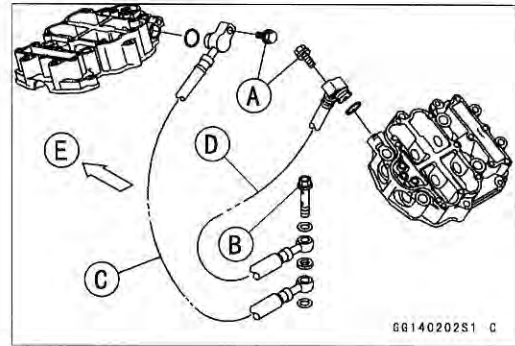
Torque - Relief Valve: 15 N·m (1.5 kg·m, 11 ft·lb)



Oil Hoses and Pipes

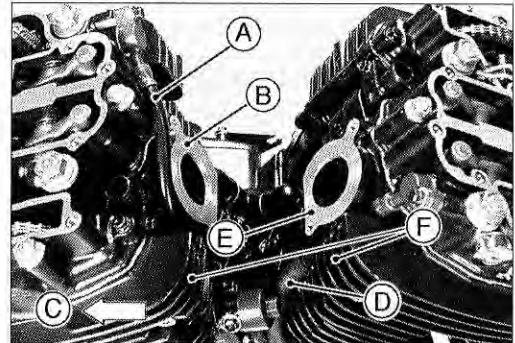
Outside Oil Hose Removal

- Remove the engine (see Engine Removal/Installation chapter).
- Remove:
 - Rocker Case Cover (see Engine Top End chapter)
 - Oil Hose Flange Bolts [A] on Front and Rear Rocker Cases
 - Oil Hose Banjo Bolt [B] on Right Crankcase behind Rear Cylinder
- Remove the front oil hose [C] and the rear oil hose [D].
- Front [E]

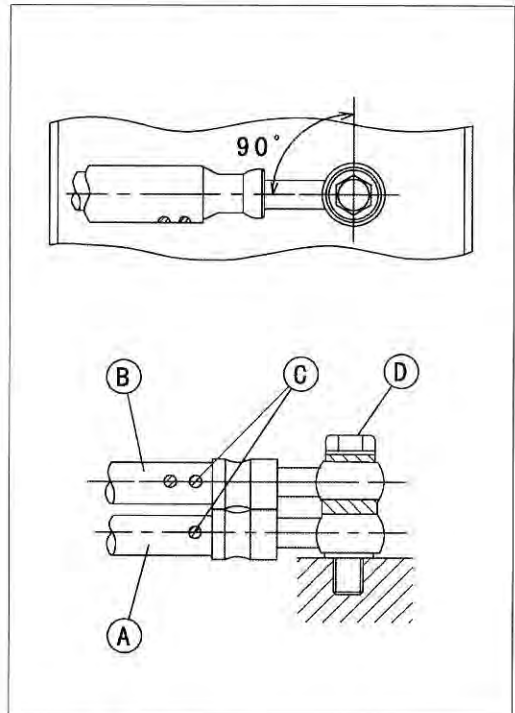


Outside Oil Hose Installation

- Run the front oil hose [A] over the inlet pipe [B] as shown.
- Front [C]
- Run the rear oil hose [D] downward.
- Run both oil hoses between the inlet pipe [E] and the cylinder fins [F].

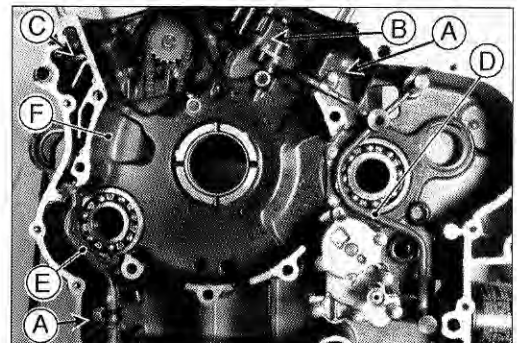


- Install each bottom end of the oil hoses on the right crankcase behind the rear cylinder as shown.
 - Front Oil Hose [A]
 - Rear Oil Hose [B]
 - Face the paint marks [C] rearward.
 - Replace the copper washers on each side of the banjo bolt with new ones.
- Torque -** Oil Hose Flange Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)
 Oil Hose Banjo Bolt [D]: 9.8 N·m (1.0 kg·m, 87 in·lb)
- Next install the rear chain tensioner (see Engine Top End chapter).



Inside Oil Pipe Removal

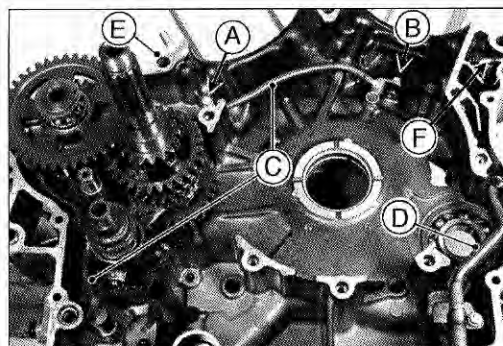
- Split the crankcase (see Crankshaft/Transmission chapter).
- Remove:
 - Oil Pipe Clamp Bolts [A]
 - Oil Pipe Holder Bolt [B]
 - Separator [C]
- Remove the inside oil pipe [D] and the oil return pipe [E] from the right crankcase [F].



6-10 ENGINE LUBRICATION SYSTEM

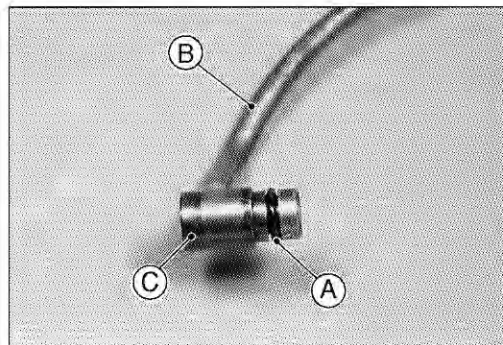
Oil Hoses and Pipes

- Remove:
 - Oil Pipe Clamp Bolt [A]
 - Oil Pipe Holder Bolt [B]
- Remove the inside oil pipe [C] and the oil return pipe [D] from the left crankcase [E].
- Remove the separator [F].

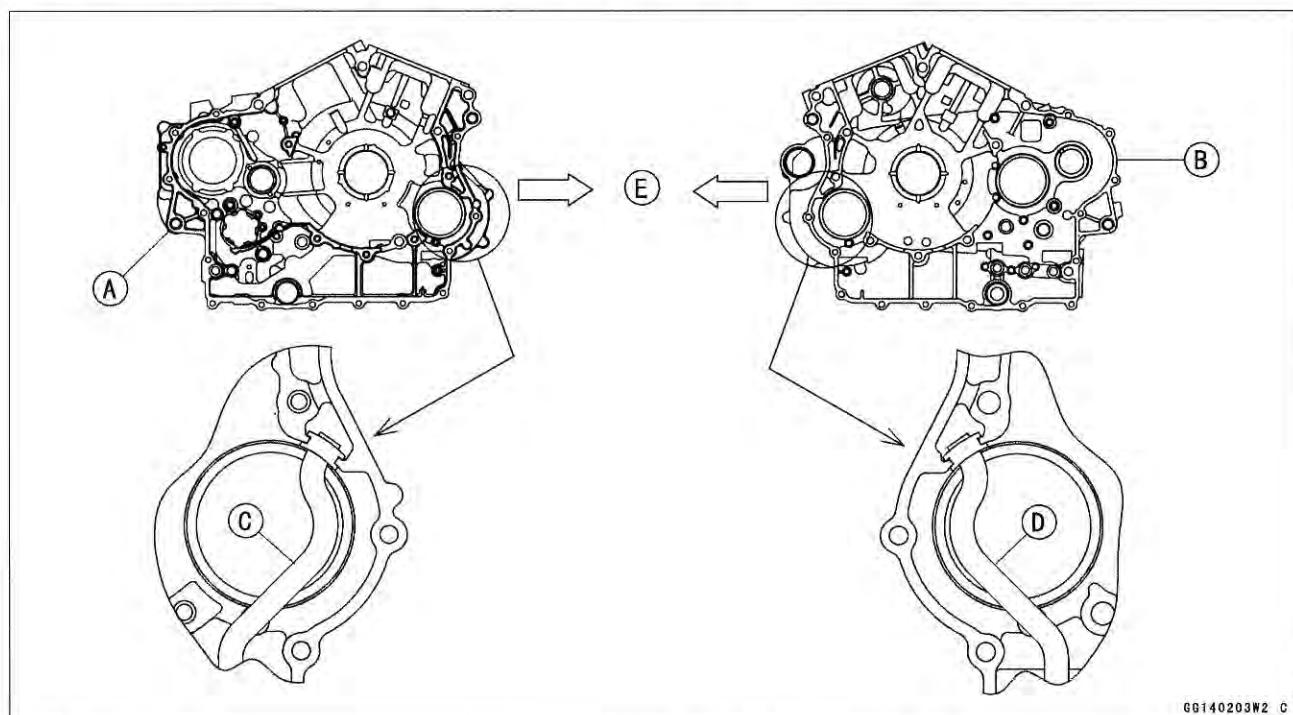


Inside Oil Pipe Installation

- Check that the oil pipe fitting O-rings [A] are in good condition.
- Apply engine oil to the O-rings before installation.
 - Oil Pipe [B]
 - Fitting [C]



- Install the oil return pipes as shown.
- Do not apply silicone sealant to the groove of the grommet and the mating surface of the grommet. This differs from the VN1500-J1.



Left Crankcase [A]
Right Crankcase [B]
Left Oil Return Pipe [C]

Right Oil Return Pipe [D]
Front [E]

GG140203W2 C

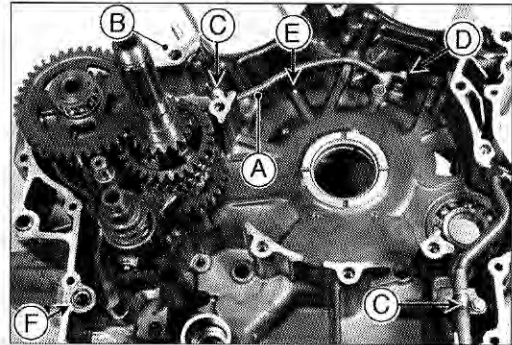
Oil Hoses and Pipes

- Install the transmission gears, and then the left inside oil pipe [A] in the left crankcase [B].
- Install:
 - Oil Pipe Clamp Bolts [C]
 - Oil Pipe Holder Bolt [D]
 - Oil Nozzle [E]
 - O-ring [F]

Non-permanent Locking Agent -

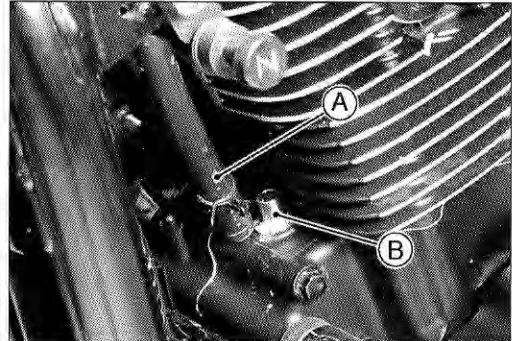
Oil Pipe Holder Bolts, Oil Pipe Clamp Bolts

- Torque -**
- Oil Pipe Holder Bolts: 8.8 N·m (0.90 kg·m, 78 in·lb)
 - Oil Pipe Clamp Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

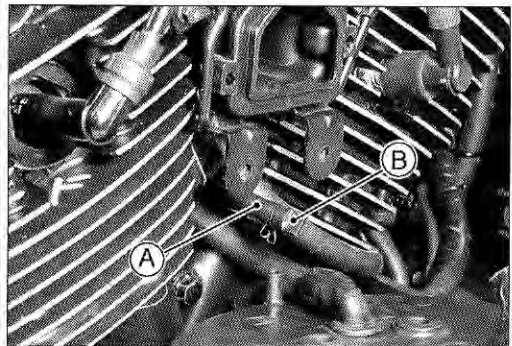


Blowby Gas System Inspection

- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly to the oil reserve tank and right air cleaner base.
- ★ If they are not, correct them.
- Inspect the breather hoses [A], breather pipe [B] (left-front view), and the air cleaner drain hose for damage or signs of deterioration. Squeeze the hoses. These hoses should not be hard and brittle, nor should be soft or swollen.
- ★ Replace any damaged hoses.
- Check that the hoses are securely connected.



- The air cleaner drain hose is provided beneath the lower air cleaner duct, and catches the water or oil from the bottom of the right air cleaner housing. Usually water or oil does not collect at the bottom of the housing. In the event that rain water is drawn in through the air cleaner, or if engine oil is blown back, drain the housing.
- Remove the left air cleaner housing (see Fuel System chapter).
- Remove the drain plug [B] from the air cleaner drain hose [A] to drain the water or breather oil when changing engine oil (see Periodic Maintenance Chart).
- Install the plug to its original position.

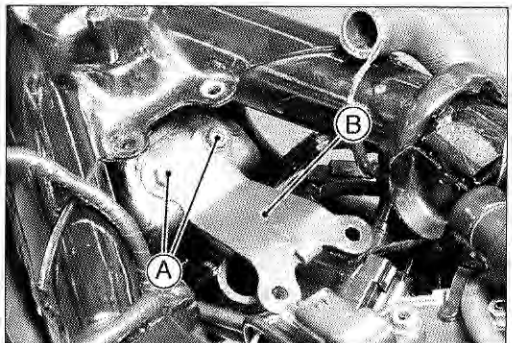


⚠ WARNING

Be sure to reinstall the plug in the drain hose after draining. Oil on tires will make them slippery and can cause an accident and injury.

Oil Reserve Tank Removal

- Remove:
 - Right and Left Ignition Coils (see Electrical System chapter)
 - Thermostat Housing and Bracket (see Cooling System chapter)
 - Bolts [A]
 - Oil Reserve Tank Bracket [B]



6-12 ENGINE LUBRICATION SYSTEM

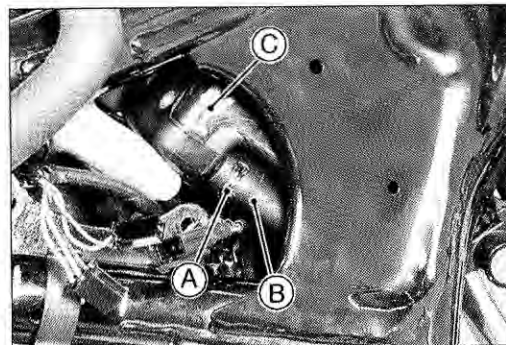
Oil Hoses and Pipes

Clamp [A]

Oil Reserve Tank Hose End [B] from Right Air Cleaner Base

Crankcase Breather Hose End from Left Crankcase

- Take out the oil reserve tank [C] with the breather hose attached.



Oil Reserve Tank Installation

- Apply non-permanent locking agent to the oil reserve tank bolts and tighten them.

Torque - Oil Reserve Tank Bolts: 8.8 N·m (0.9 kg·m, 18 in·lb)

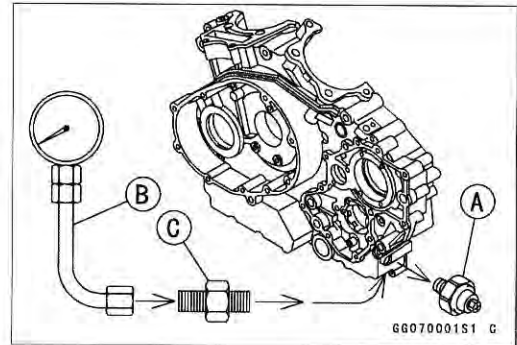
Oil Pressure

Oil Pressure Measurement

NOTE

- Measure the oil pressure after the engine is warmed up.
- Remove the oil pressure switch lead and unscrew the oil pressure switch [A].
- Attach the oil pressure gauge [B] and adapter [C] to the switch hole.

Special Tools - Oil Pressure Gauge, 5 kg/cm²: 57001-125
Oil Pressure Gauge Adapter, PT 1/8: 57001-1033



- Start the engine and warm up the engine.
- Run the engine at the specified speed, and read the oil pressure gauge.
- ★ If the oil pressure is much lower than the standard, check the oil pump, oil pump relief valve, and/or crankshaft bearing wear and con-rod big end bearing insert wear immediately.
- ★ If the reading is much higher than the standard, check the oil screen first, and the oil passages for dirt or clogging. Also, replace the oil filter.

Oil Pressure

Standard: 340 ~ 440 kPa (3.5 ~ 4.5 kg/cm², 50 ~ 64 psi)
 @2000 r/min (rpm), oil temp. 100°C (212°F)

- Stop the engine.
- Remove the oil pressure gauge and adapter.

⚠ WARNING

Take care against burns from hot engine oil that will drain through the oil passage when the plug is removed.

- When installing the oil pressure switch, apply silicone sealant to the threads of the switch, and tighten it to the specified torque.

Torque - Oil Pressure Switch: 15 N·m (1.5 kg·m, 11 ft·lb)

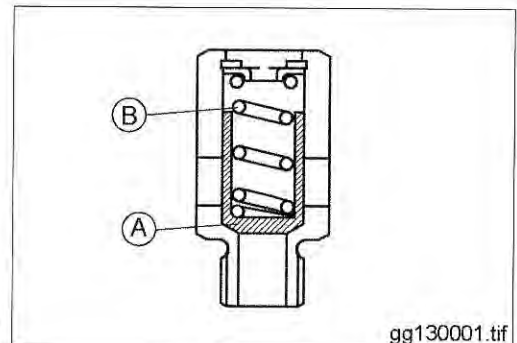
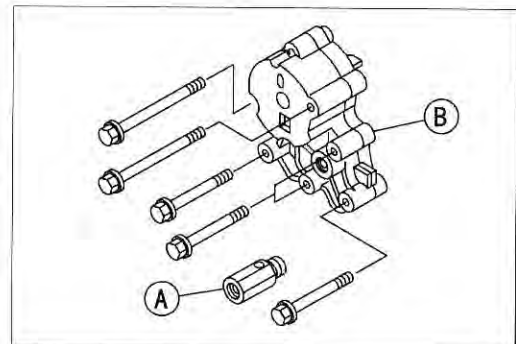
Relief Valve Inspection

- Split the crankcase (see Crankshaft/Transmission chapter).
- Remove the relief valve [A] from the oil pump [B].
- Check to see if the valve slides smoothly when pushing it in with a wooden or other soft rod, and see if it comes back to its seat by spring pressure.

NOTE

- Inspect the valve in its assembled state. Disassembly and assembly may change the valve performance.

- ★ If any rough spots are found during above inspection, wash the valve clean with a high-flash point solvent and blow out any foreign particles that may be in the valve with compressed air in a well-ventilated area.
- Take care that there is no spark or flame anywhere near the working area.
- Valve [A]
- Spring [B]
- ★ If cleaning does not solve the problem, replace the relief valve as an assembly. The relief valve is precision made with no allowance for replacement of individual parts.



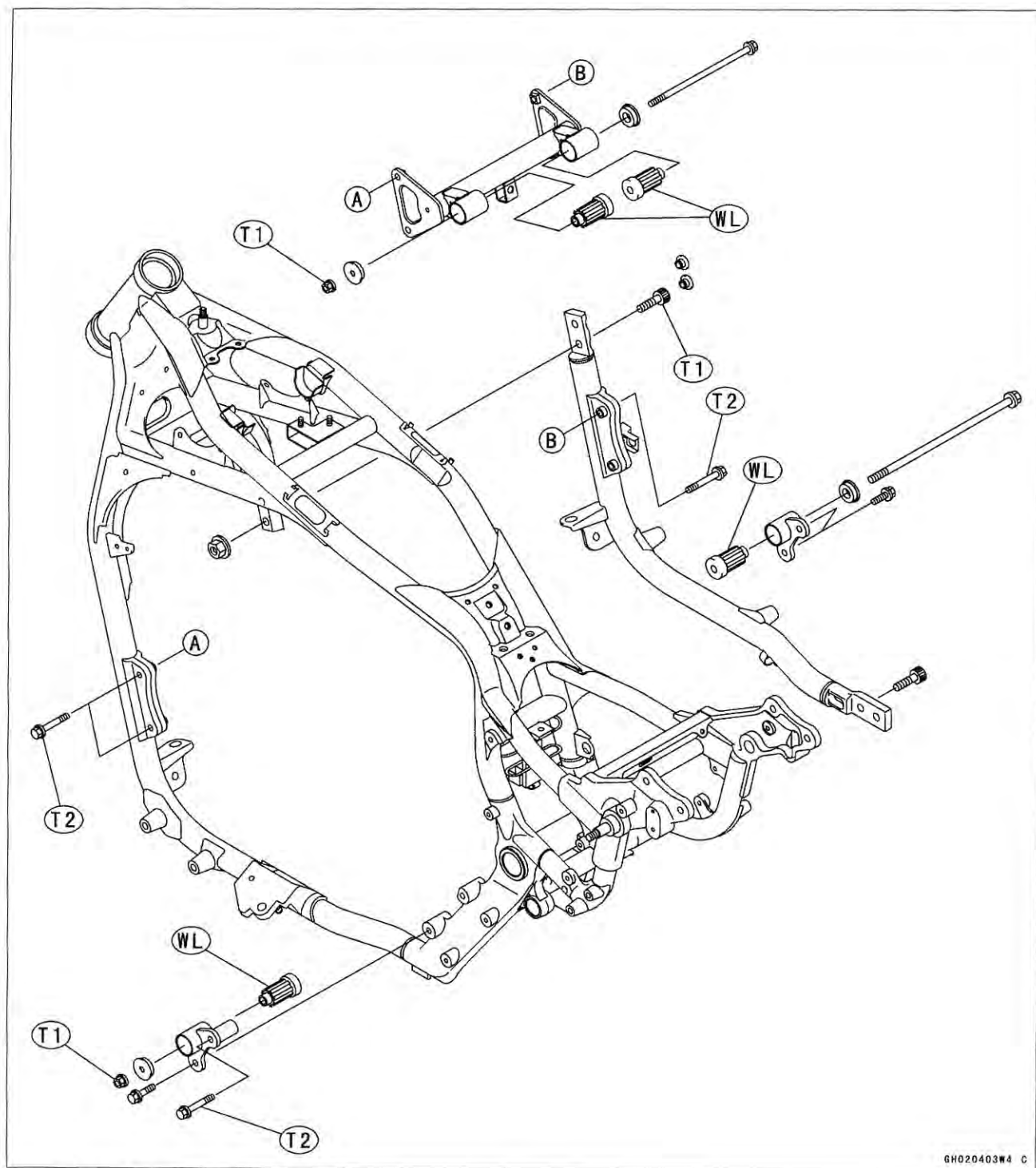
Engine Removal/Installation

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7-2 ENGINE REMOVAL/INSTALLATION

Exploded View



GH020403W4 C

WL: Apply a soap and water solution.

T1: 44 N·m (4.5 kg·m, 32 ft·lb)

T2: 25 N·m (2.5 kg·m, 18 ft·lb)

Specifications

Special Tools - Jack: 57001-1238
Attachment Jack: 57001-1398

7-4 ENGINE REMOVAL/INSTALLATION

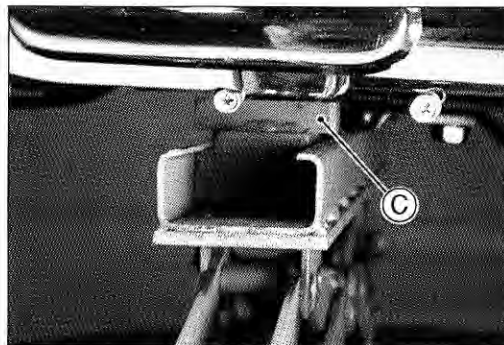
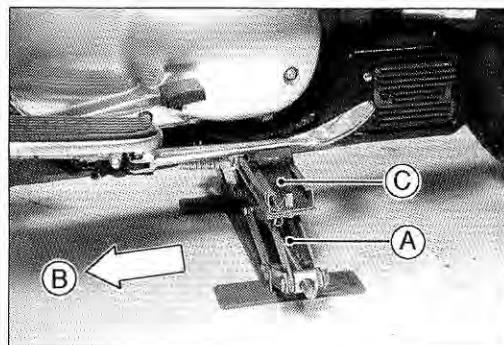
Engine Removal/Installation

Engine Removal

- Support the rear part of the frame on the jack [A], and attachment jack [C].
Front [B]

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398



- Squeeze the brake lever slowly and hold it with a band [A].

WARNING

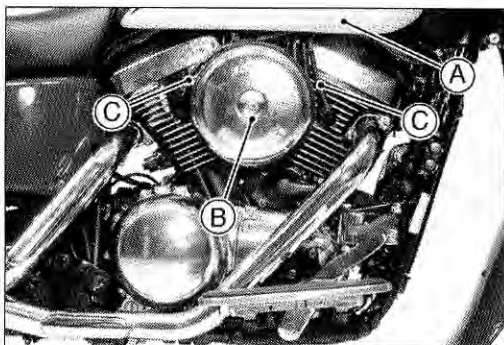
Be sure to hold the front brake when removing the engine, or the motorcycle may fall over. It could cause an accident and injury.

CAUTION

Be sure to hold the front brake when removing the engine, or the motorcycle may fall over. The engine or the motorcycle could be damaged.

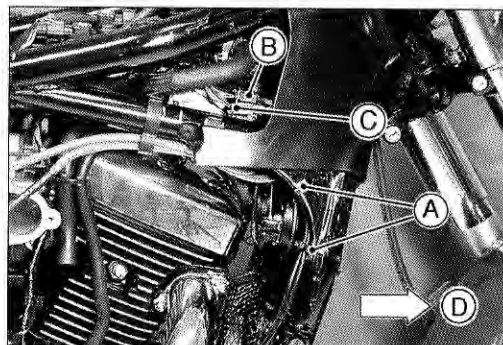


- Drain:
 - Coolant (see Cooling System chapter)
 - Engine Oil (see Engine Lubrication System chapter)
- Disconnect the battery negative (-) terminal.
- Remove:
 - Fuel Tank [A] (see Fuel System chapter)
 - Left and Right Air Cleaner Housings [B] (see Fuel System chapter)
 - Air Suction Valve and Hoses
 - Injector Connectors
 - Throttle Switch Connector
 - Fuel Hoses
 - Vacuum Hose (from T-joint)
 - Oil Reserve Tank Hose
 - Spark Plug Leads [C]

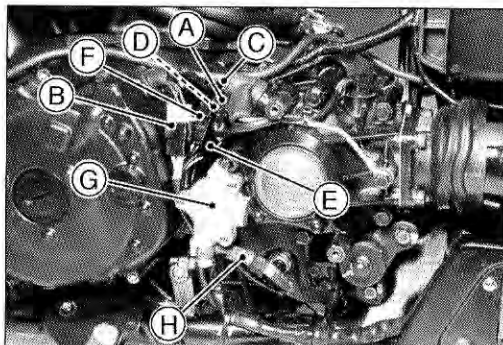


Engine Removal/Installation

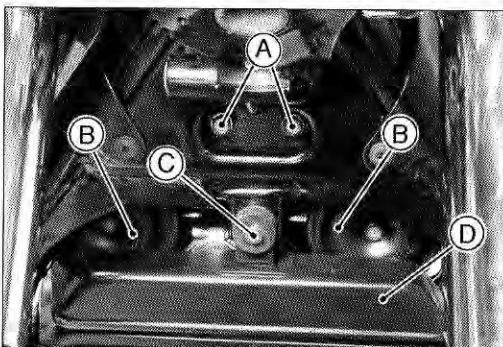
- Disconnect:
 - Bands [A]
 - Rear Brake Light Switch Connector [B]
 - Radiator Fan Motor Connector [C]
 - Front [D]
- Remove:
 - Front and Rear Shift Pedals (see Crankshaft/Transmission chapter)
 - Alternator Outer Cover (see Electrical System chapter)



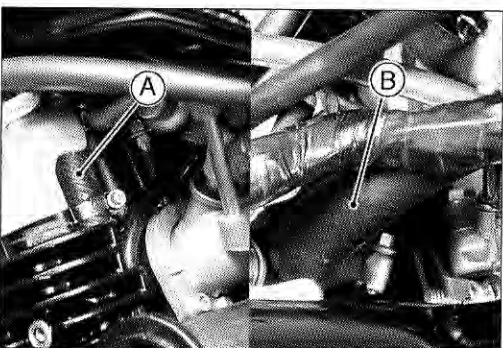
- Disconnect:
 - Starter Motor Terminal (see Electrical System chapter)
 - Speed Sensor Connector [A]
 - Alternator Connector [B]
 - Pickup Coil Lead Connector [C]
 - Oil Pressure/Neutral Switch Connector [D]
 - Regulator/Rectifier Connector [E]
 - Sidestand Switch Connector [F]
- Remove:
 - Clutch Slave Cylinder [G]
 - Clutch Hose [H] (from the holder)



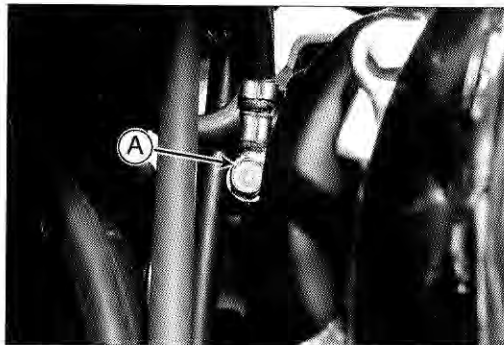
- Remove:
 - Horn Bolts [A]
 - Horns [B]
 - Radiator Mounting Bolt [C]
 - Radiator [D] (see Cooling System chapter)



- Remove:
 - Water Hose [A] on Front Cylinder Head
 - Water Hose [B] on Rear Cylinder Head



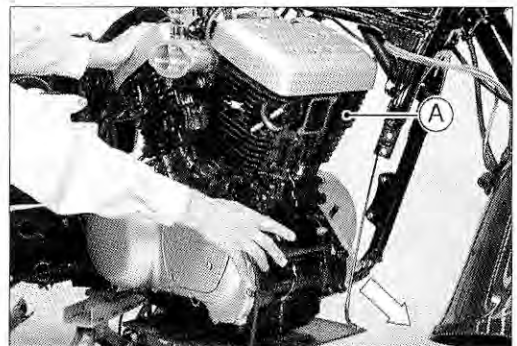
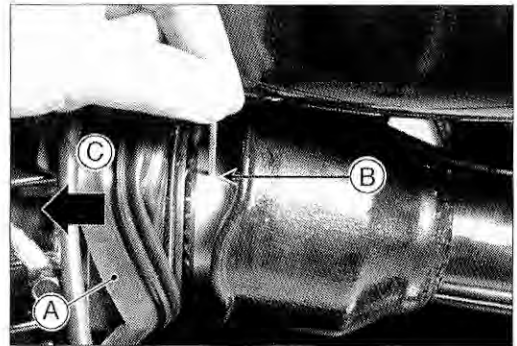
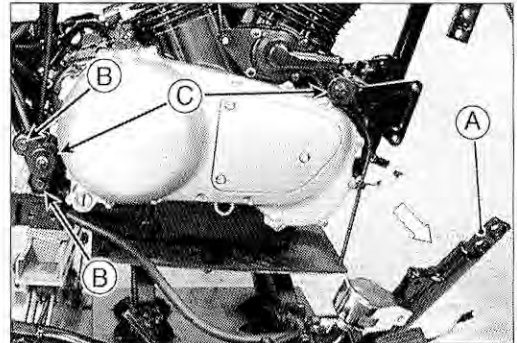
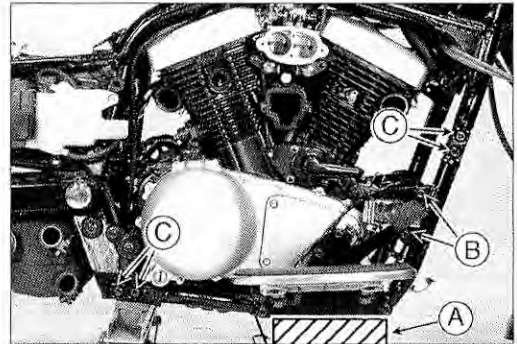
- Disconnect the engine ground terminal [A].



7-6 ENGINE REMOVAL/INSTALLATION

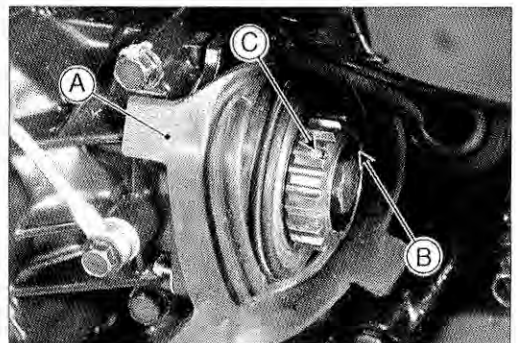
Engine Removal/Installation

- Support the engine with a commercially available stand [A].
- Remove:
 - Front and Rear Exhaust Pipes (see Engine Top End chapter)
 - Engine Mounting Bracket Bolts [B]
 - Downtube Bolts [C]
- Remove the downtube [A] with the right footboard and rear master cylinder installed.
- Remove:
 - Engine Mounting Bracket Bolts [B]
 - Engine Mounting Bolts and Nuts [C]
- Disengage the propeller shaft from the engine.
 - Pull off the rubber boot [A] and push on the lockpin [B] a little with a wire.
 - Move the engine forward [C] to free it from the rear propeller shaft.
- Remove the engine [A] from the motorcycle right side.



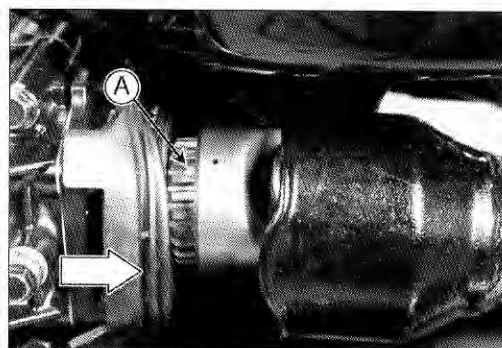
Engine Installation

- Install the rubber boot [A] on the rear end of the front bevel gear case.
- Fit the spring [B] into the front bevel gear joint.
- Put the lockpin [C] into the front bevel gear joint.

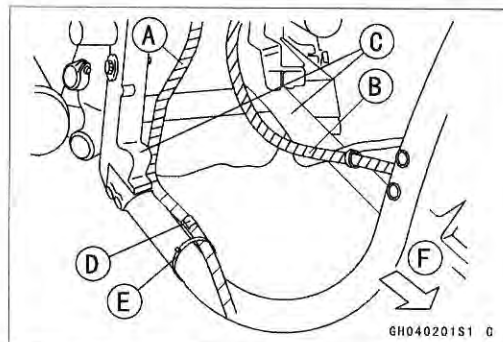


Engine Removal/Installation

- Apply a thin coat of high temperature grease to the driven gear joint and to the propeller shaft joint.
- Push on the lockpin [A] and move back the engine to engage the front bevel gear joint with the propeller shaft joint.

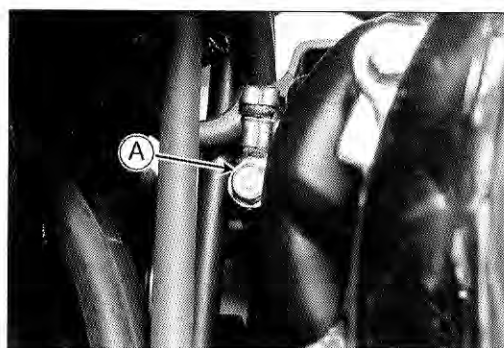


- Run the brake hose [A] and the clutch hose [B] inside the frame [C] as shown.
Clamp [D]
Strap [E]
Front [F]
- Insert the rear mounting bolt from the left side of the engine to set the engine into its original position in the frame.
- Tighten:



Torque - Downtube Bolts: 44 N·m (4.5 kg·m, 33 ft·lb)
Engine Mounting Bolts and Nuts: 44 N·m (4.5 kg·m, 33 ft·lb)
Engine Mounting Bracket Bolts: 25 N·m (2.5 kg·m, 18 ft·lb)

- Run the leads, cables and hoses correctly (see Cable, Wire and Hose Routing section in the General Information chapter).
- Connect the engine ground lead [A] down to the engine as shown.
Torque - Engine Ground Terminal Bolt: 7.8 N·m (0.8 kg·m, 69 in·lb)



- Install the removed parts (see appropriate chapters).
- Adjust the throttle cables (see Fuel System chapter).
- Fill the engine with engine oil (see Engine Lubrication System chapter).
- Fill the engine with coolant and bleed the air from the cooling system (see Cooling System chapter).
- Adjust the idling (see Fuel System chapter).
- Check the clutch operation.
- Check the brake effectiveness.

⚠ WARNING

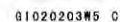
Do not attempt to ride the motorcycle until a full brake lever or pedal is obtained by pumping the brake lever or pedal until the pads are against the disc. The brake will not function on the first application of the lever or pedal if this is not done.

Crankshaft/Transmission

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Exploded View



Exploded View

1. Water Pump Drainage Outlet Hose
2. Do not apply any oil.
3. Apply a non-permanent locking agent to the tap end of this stud only.
4. Oil Nozzle (× 1): Left-hand Threads, green
5. Oil Nozzles (× 3): Right-hand Threads, green
6. Left Crankcase
7. Right Crankcase

EO: Apply engine oil.

L: Apply a non-permanent locking agent.

LG: Apply liquid gasket (Kawasaki Bond: 92104-1003).

Lh: Left-hand Threads

MO: Apply molybdenum disulfide oil to the threads and the seating surface.

S: Follow the specific tightening sequence.

SS: Apply silicone sealant (Kawasaki Bond: 56019-120).

T1: 39 N·m (4.0 kg·m, 29 ft·lb)

T2: 21 N·m (2.1 kg·m, 15 ft·lb)

T3: 9.8 N·m (1.0 kg·m, 87 in·lb)

T4: 3.4 N·m (0.35 kg·m, 30 in·lb)

T5: 59 N·m (6.0 kg·m, 43 ft·lb)

T6: 147 N·m (15.0 kg·m, 108 ft·lb)

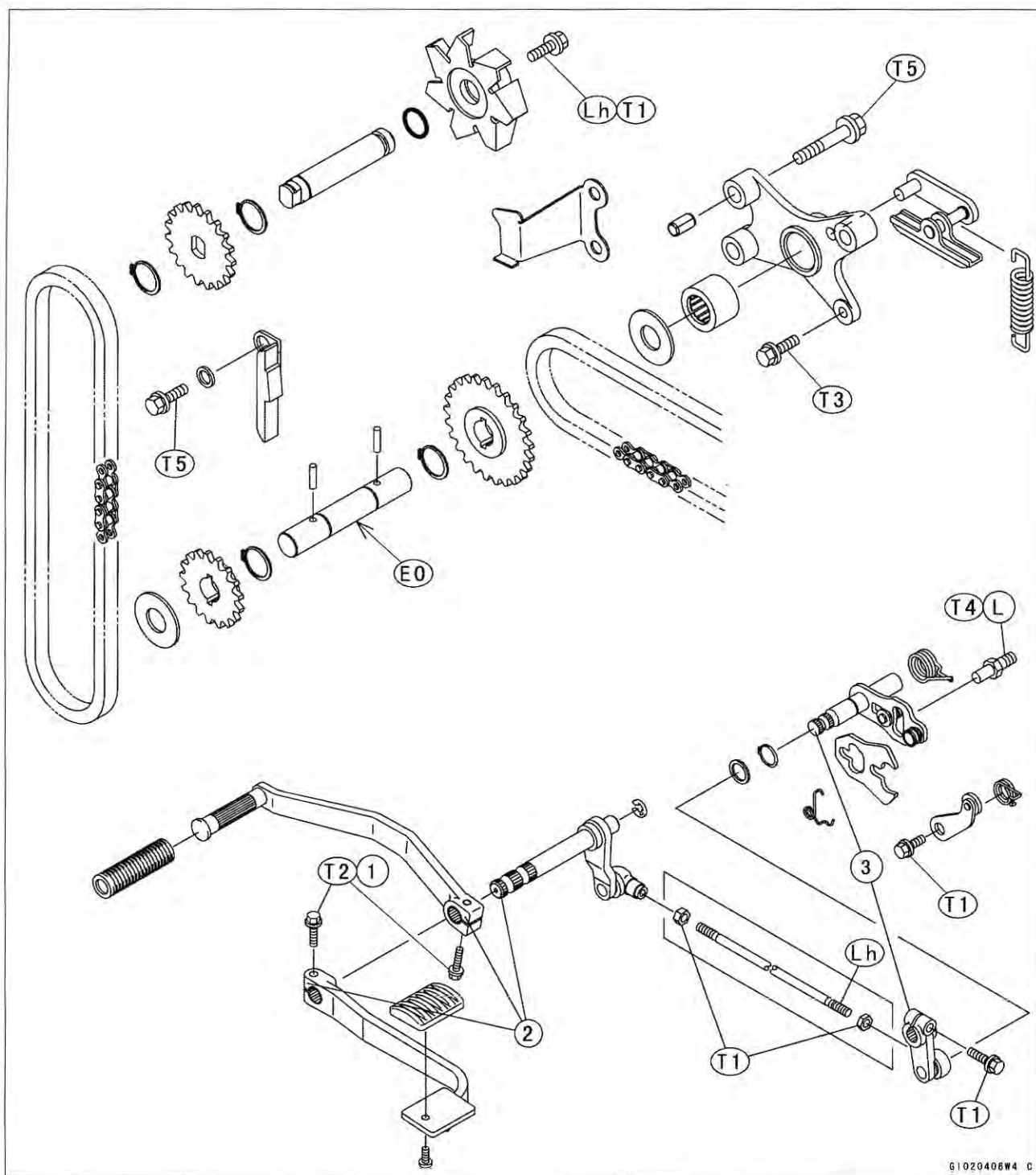
T7: 15 N·m (1.5 kg·m, 11 ft·lb)

T8: 85 N·m (8.7 kg·m, 63 ft·lb)

- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).

8-4 CRANKSHAFT/TRANSMISSION

Exploded View

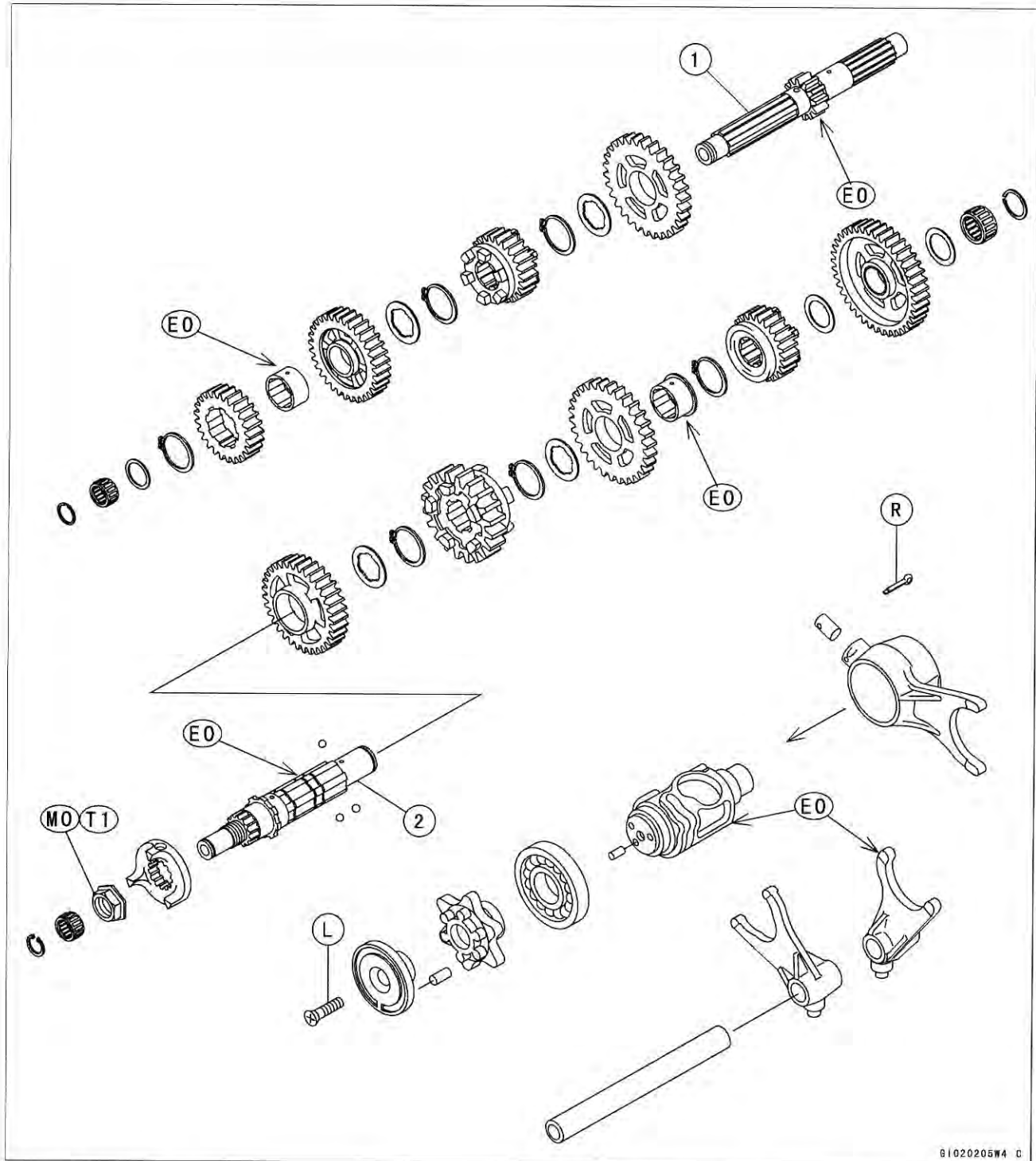


1. Each bolt head is numbered 10.
 2. Align the punch marks.
 3. Align the punch mark with the slit.
- EO: Apply engine oil.
L: Apply a non-permanent locking agent.
Lh: Left-hand Threads

- T1: 9.8 N·m (1.0 kg·m, 87 in·lb)
T2: 17 N·m (1.7 kg·m, 12 ft·lb)
T3: 2.9 N·m (0.30 kg·m, 26 in·lb)
T4: 20 N·m (2.0 kg·m, 14 ft·lb)
T5: 7.8 N·m (0.80 kg·m, 69 in·lb)

G1020406W4 C

Exploded View



81020205W4 0

- 1. Drive Shaft
- 2. Output Shaft
- EO: Apply engine oil.
- L: Apply a non-permanent locking agent.

MO: Apply molybdenum disulfide oil to the threads.
 R: Replacement Parts
 T1: 226 N·m (23 kg·m, 166 ft·lb)

8-6 CRANKSHAFT/TRANSMISSION

Specifications

Item	Standard	Service Limit																				
Crankshaft, Connecting Rods:																						
Connecting rod bend	---	TIR 0.2/100 mm																				
Connecting rod twist	---	TIR 0.2/100 mm																				
Connecting rod big end side clearance	0.16 ~ 0.46 mm	0.7 mm																				
Connecting rod big end bearing insert/crankpin clearance	0.026 ~ 0.057 mm	0.10 mm																				
Crankpin diameter:	54.981 ~ 55.000 mm	54.97 mm																				
Marking	None	---																				
	○	---																				
Connecting rod big end bore diameter:	58.000 ~ 58.020 mm	---																				
Marking	None	---																				
	○	---																				
Connecting rod big end bearing insert thickness:																						
	Brown	---																				
	Black	---																				
	Blue	---																				
Connecting rod big end bearing insert selection:																						
<table><tr><th>Con-rod Big End Bore Diameter Marking</th><th>Crankpin Diameter Marking</th></tr><tr><td>None</td><td>○</td></tr><tr><td>None</td><td>None</td></tr><tr><td>○</td><td>○</td></tr><tr><td>○</td><td>None</td></tr></table>		Con-rod Big End Bore Diameter Marking	Crankpin Diameter Marking	None	○	None	None	○	○	○	None	<table><tr><th colspan="2">Bearing Insert</th></tr><tr><th>Size Color</th><th>Parts Number</th></tr><tr><td>Brown</td><td>92028-1476</td></tr><tr><td>Black</td><td>92028-1475</td></tr><tr><td>Blue</td><td>92028-1474</td></tr></table>	Bearing Insert		Size Color	Parts Number	Brown	92028-1476	Black	92028-1475	Blue	92028-1474
Con-rod Big End Bore Diameter Marking	Crankpin Diameter Marking																					
None	○																					
None	None																					
○	○																					
○	None																					
Bearing Insert																						
Size Color	Parts Number																					
Brown	92028-1476																					
Black	92028-1475																					
Blue	92028-1474																					
Crankshaft side clearance	0.05 ~ 0.55 mm	0.75 mm																				
Crankshaft web length	96.85 ~ 96.95 mm	96.6 mm																				
Crankshaft runout	TIR 0.02 mm or less	TIR 0.05 mm																				
Crankshaft main bearing/journal clearance	0.025 ~ 0.052 mm	0.10 mm																				
Crankshaft main journal diameter	54.986 ~ 55.000 mm	54.96 mm																				
Crankcase main bearing bore diameter	55.025 ~ 55.038 mm	55.07 mm																				
Transmission																						
Shift fork ear thickness	5.9 ~ 6.0 mm	5.8 mm																				
Gear shift fork groove width	6.05 ~ 6.15 mm	6.3 mm																				
Shift fork guide pin diameter	7.9 ~ 8.0 mm	7.8 mm																				
Shift drum groove width	8.05 ~ 8.20 mm	8.3 mm																				

Special Tools - Damper Cam Holder: 57001-1025

Flywheel Holder: 57001-1410

Flywheel Holder: 57001-1313

Gear Holder: 57001-1015

Outside Circlip Pliers: 57001-144

Bearing Driver Set: 57001-1129

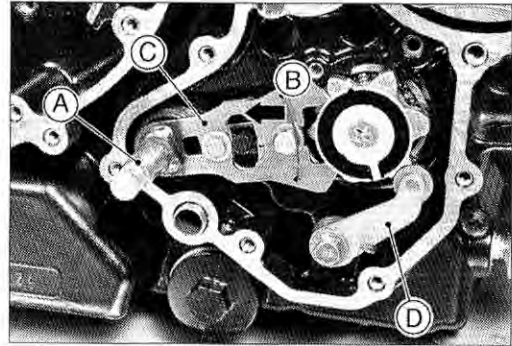
Sealant - Kawasaki Bond (Liquid Gasket-Black): 92104-1003

Kawasaki Bond (Silicone Sealant): 56019-120

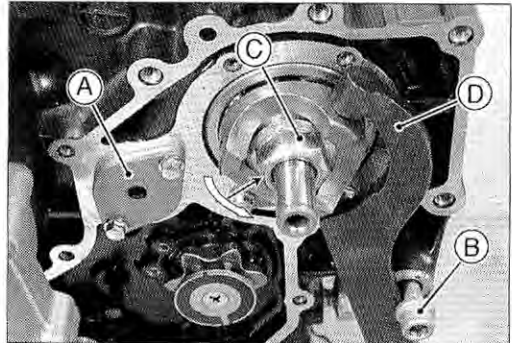
Crankcase

Disassembly

- Remove:
 - Engine (see Engine Removal/Installation chapter)
 - Cylinder Blocks (see Engine Top End chapter)
 - Pistons
 - Clutch (see Clutch chapter)
 - Front Gear Case (see Final Drive chapter)
 - Alternator Inner Cover (see Electrical System chapter)
- Remove the shift shaft [A] while pushing [B] the shift mechanism arm [C] towards the shift shaft.
- Unscrew the bolt and remove the gear set lever [D] and its spring.

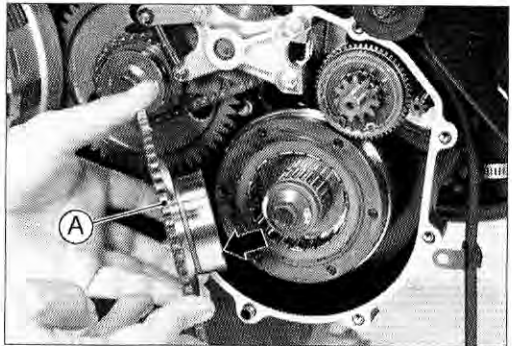


- Remove the retainer and needle bearing of the output shaft.
- Remove the clutch push rod guide [A] and bolts, and crankcase bearing upper retainer and bolts.
- Insert a bolt ($\phi 12$ mm, L 100 mm) [B] into the engine mounting bolt hole.
- Unscrew the damper cam nut [C] using the damper cam holder [D] (special tool) and deep socket wrench.

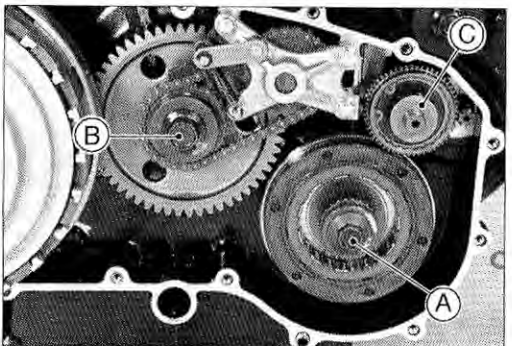


Special Tool - Damper Cam Holder: 57001-1025

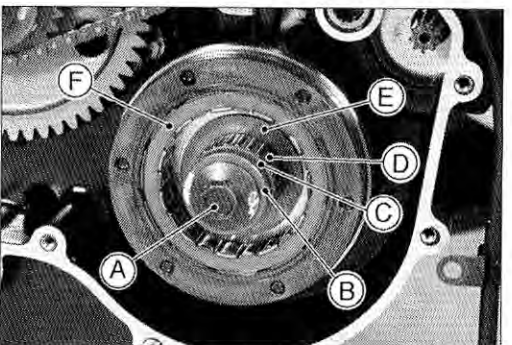
- Pull the starter clutch gear [A] out of the starter clutch (The starter clutch gear can be removed with the engine in the frame).



- Loosen the starter clutch bolt [A] while holding the primary gear bolt [B].
- Take out the torque limiter [C].



- Remove the following from the right end of the balancer shaft.
 - Starter Clutch Bolt [A]
 - Washer [B]
 - Collar [C]
 - Needle Bearing [D]
 - Copper Washer [E]
 - Starter Clutch [F]



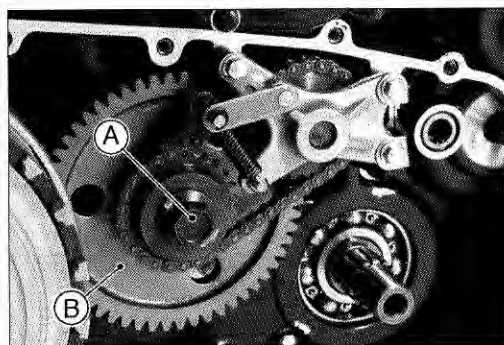
8-8 CRANKSHAFT/TRANSMISSION

Crankcase

- Loosen the primary gear bolt [A] while holding the alternator rotor steady with the flywheel holder (special tool) (The primary gear can be removed with the engine in the frame).

Primary Gear [B]

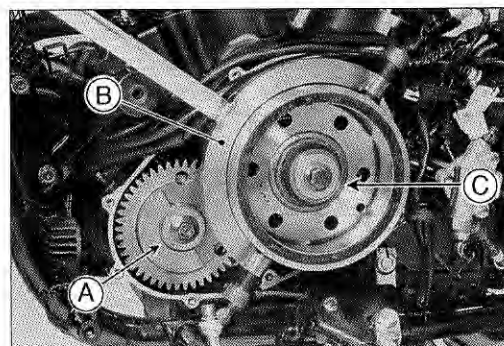
Special Tool - Flywheel Holder: 57001-1410



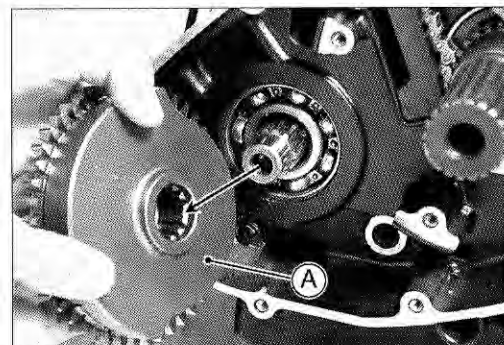
- Loosen the left balancer gear bolt [A], using the flywheel holder [B]. The left balancer gear bolt has right-hand threads.

Special Tool - Flywheel Holder: 57001-1410

- Remove the alternator rotor bolt [C].
- Take the alternator rotor with the washer and ratchet off the crankshaft.
- Remove the left balancer gear bolt.

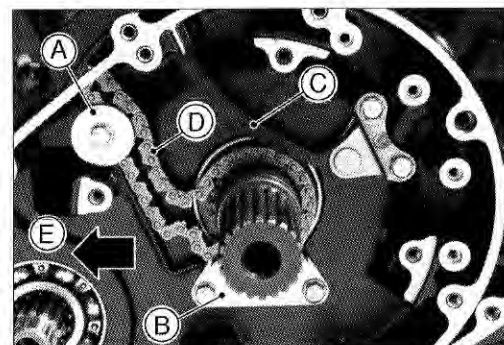


- Take the balancer gear, washer, and left balancer [A] off the balancer shaft as a set.

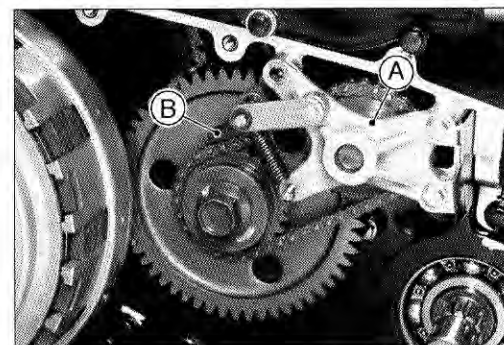


- Remove the following from the left crankcase with the cylinder head removed.

Front Chain Holder [A]
Lower Chain Guide [B]
Rear Chain Guide [C]
Front Camshaft Chain [D]
Front [E]

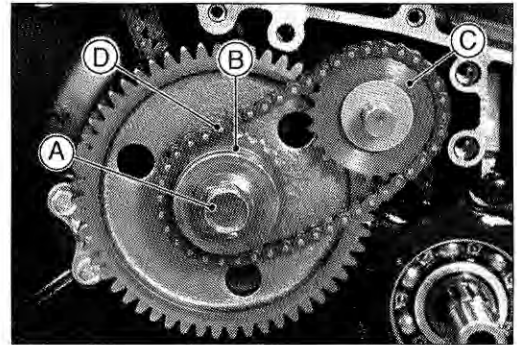


- Remove the idle shaft holder [A] and chain guide [B] from the right crankcase (The idle shaft holder can be removed with the engine in the frame).

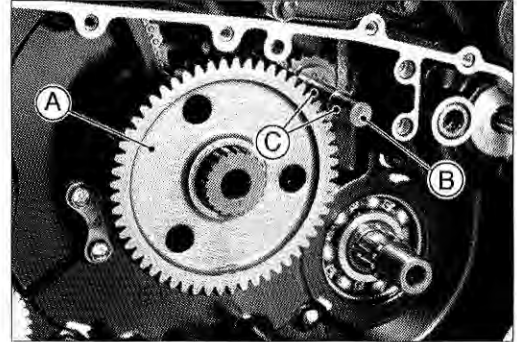


Crankcase

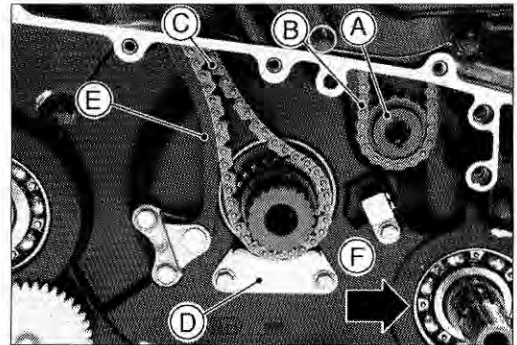
- Remove the primary gear bolt [A] and take out the water pump drive sprocket [B] and idle shaft sprocket [C] as a set.
Chain [D]



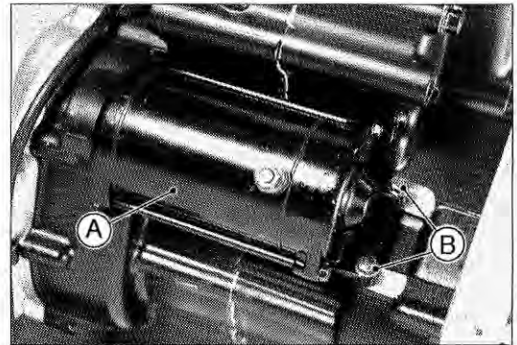
- Pull the primary gear [A] out of the crankshaft, and take the idle shaft [B] out of the crankcase. The idle shaft has two pins [C].



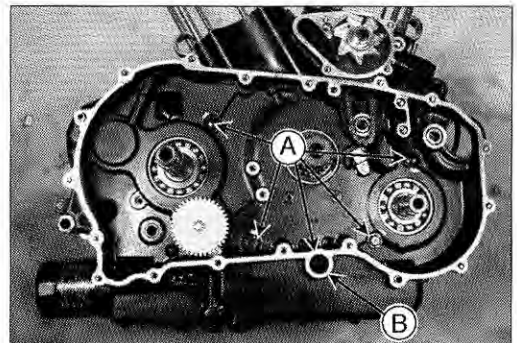
- Remove the following with the cylinder head removed.
Idle Shaft Sprocket [A] (with flat washer) from Water Pump Chain [B]
Rear Camshaft Chain [C]
Lower Chain Guide [D]
Rear Chain Guide [E]
Front [F]



- Remove the starter motor bolts [B] and the motor [A] out of the crankcase.



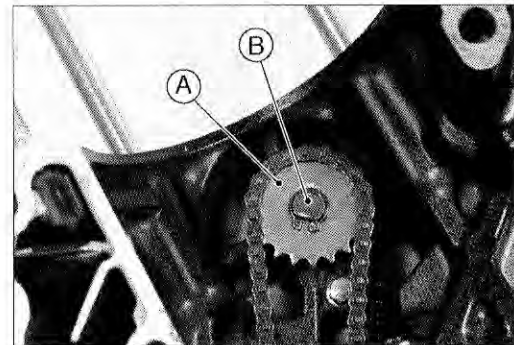
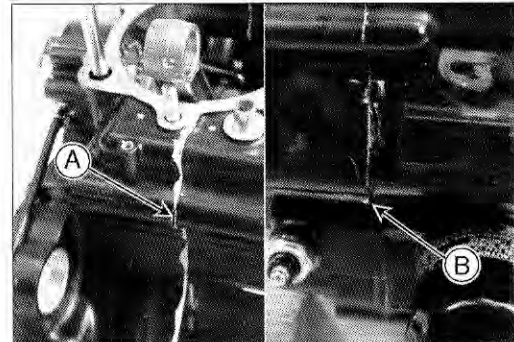
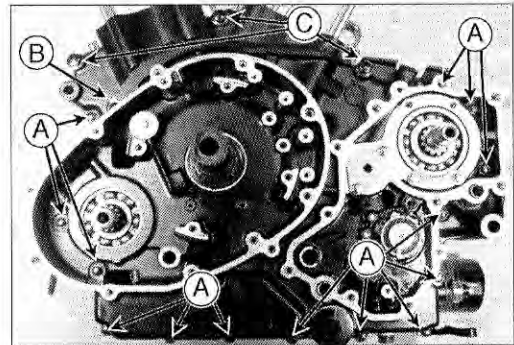
- Remove the right crankcase bolts.
φ8 mm Bolts (5) [A]
Be sure to remove this bolt [B]



8-10 CRANKSHAFT/TRANSMISSION

Crankcase

- Remove all the left crankcase bolts in the order listed.
 - φ6 mm Bolts (14) [A]
 - φ8 mm Bolt (1) [B]
 - φ10 mm Bolts (3) [C]
- Using the pry points, split the crankcase halves.
 - Pry Point (Front) [A]
 - Pry Point (Rear) [B]
- Turn the left crankcase down.
- Lift off the right crankcase.
- Remove the following from the left crankcase.
 - Crankshaft
 - Transmission Gear Assy (see Transmission Removal of the Transmission section)
 - Balancer Shaft
- Pull the water pump sprocket [A] with its chain and shaft [B] out of the inside of the right crankcase.



Assembly

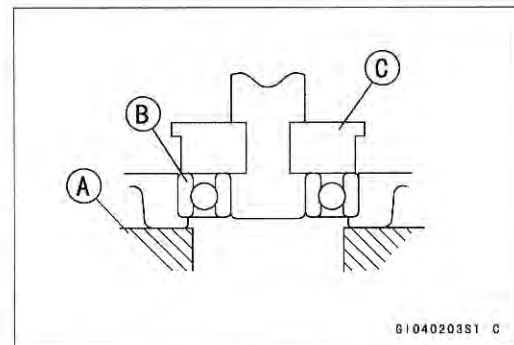
CAUTION

The right and left crankcase halves are machined at the factory in the assembled state, so the crankcase halves must be replaced as a set.

- With a high-flash point solvent, clean off the mating surfaces of the crankcase halves and wipe dry.
 - Using compressed air, blow out the oil passages in the crankcase halves.
 - Support the crankcase bearing boss with a suitable retainer [A].
 - Using a press and the bearing driver set [C], install a new bearing [B] by pushing the bearing outer race until it bottoms out.
- Special Tool - Bearing Driver Set: 57001-1129

CAUTION

Support the crankcase bearing boss when pushing the bearing, or the crankcase could be damaged.



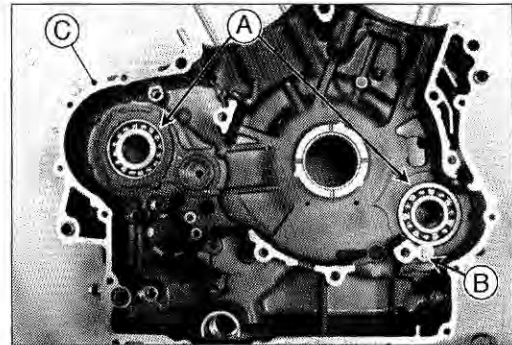
Crankcase

- Install the bearing retainers.
- Apply a non-permanent locking agent to the bearing retainer bolts and tighten them to the specified torque.

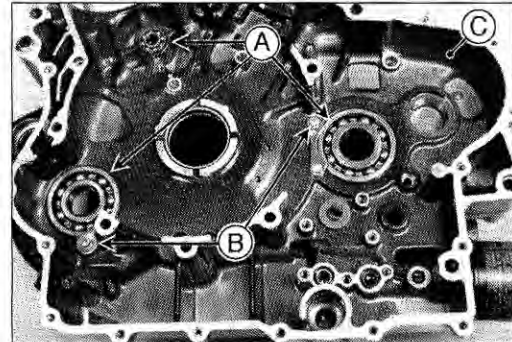
Special Tool - Bearing Driver Set: 57001-1129

Bearings [A]
Bearing Retainer [B]
Left Crankcase [C]

Torque - Bearing Retainer Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)



- Install:
Bearings [A]
Bearing Retainers [B]
Right Crankcase [C]



- Apply a non-permanent locking agent to the shift shaft return spring pin [A], and tighten it to the specified torque.

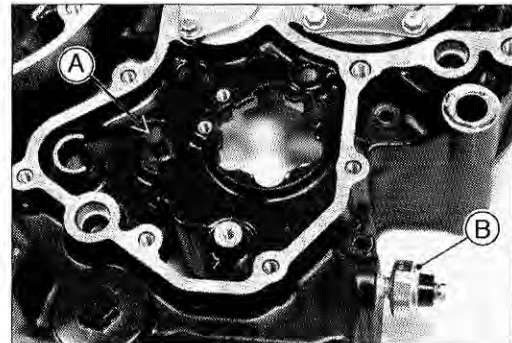
Torque - Shift Shaft Return Spring Pin: 20 N·m (2.0 kg·m, 14 ft·lb)

- Apply silicone sealant to the threads of the oil pressure switch [B], and tighten it to the specified torque.

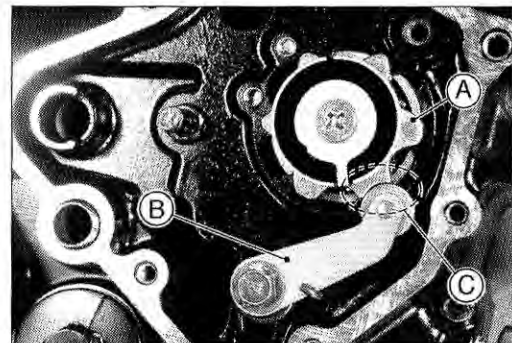
Torque - Oil Pressure Switch: 15 N·m (1.5 kg·m, 11 ft·lb)

- Install new water pump shaft bearings and oil seal (see Cooling System chapter).
- Tighten the engine oil drain plug to the specified torque.

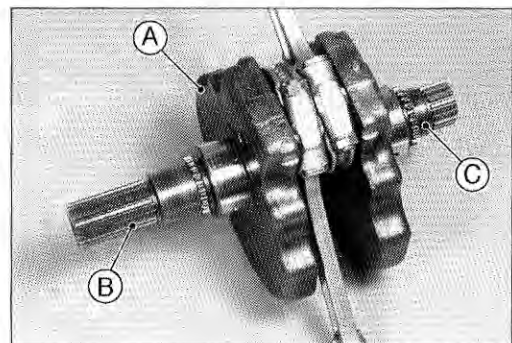
Torque - Engine Oil Drain Plug: 20 N·m (2.0 kg·m, 14 ft·lb)



- Install the transmission assy as a set (see this chapter).
- Set the gear set lever to the neutral position.
Shift Drum Cam [A]
Gear Set Lever [B]
Neutral Position [C]



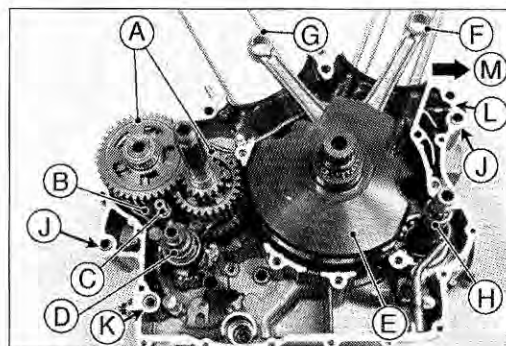
- Apply engine oil to the transmission gears, ball bearings, shift drum, and crankshaft main bearing.
- Install:
Oil Pipe and Oil Return Pipes (see Engine Lubrication System chapter)
Crankshaft [A]
- The left shaft [B] of the crankshaft is longer than the right shaft [C].



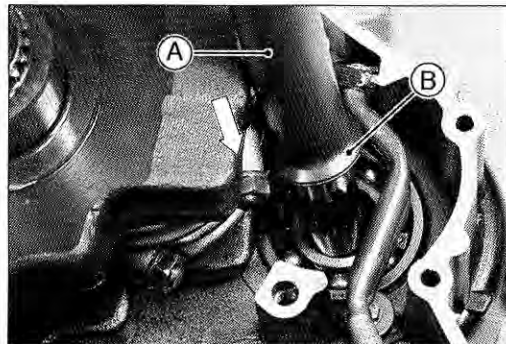
8-12 CRANKSHAFT/TRANSMISSION

Crankcase

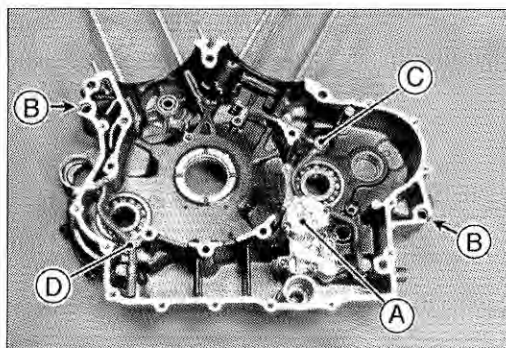
- Check to see that the following parts are in place in the left crankcase.
 - Transmission Assy [A]
 - Shift Fork [B]
 - Shift Rod [C]
 - Shift Drum [D]
 - Crankshaft [E]
 - Front Connecting Rod [F] (right)
 - Rear Connecting Rod [G] (left)
 - Balancer Shaft [H]
 - Dowel Pins [J]
 - O-ring [K]
 - Oil Separator [L]
 - Front [M]



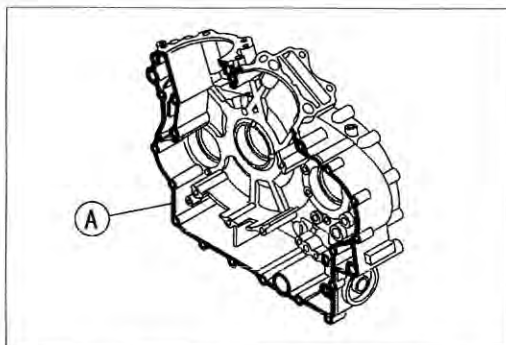
- Install the balancer shaft [A] so that the flanged side [B] faces downward (toward the left crankcase).



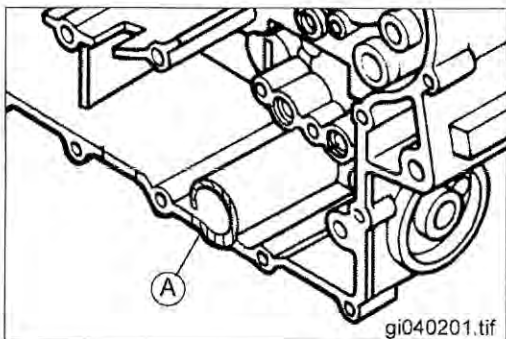
- Check to see that the following parts are in place in the right crankcase.
 - Oil Pump [A]
 - Separator [B]
 - Oil Pipe [C]
 - Oil Return Pipe [D]



- Apply liquid gasket [A] to the mating surface of the right crankcase.
Sealant - Kawasaki Bond (Liquid Gasket-Black): 92104-1003



- Also, apply liquid gasket [A] to the right crankcase mating surface around the hole of the oil screen.

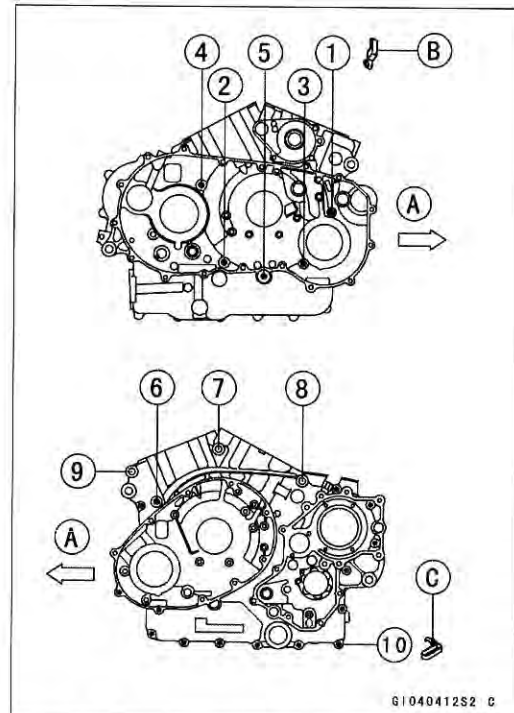


Crankcase

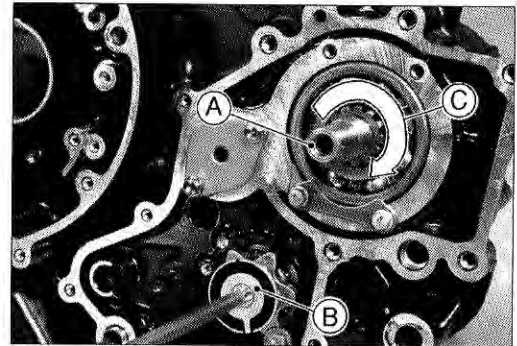
- Tighten the crankcase bolts as follows.
- Lightly tighten all the bolts to a snug fit.
 - #1: 8 mm Crankcase Bolt with Breather Plate [B]
 - #10: 6 mm Crankcase Bolt with Clamp [C]
- Tighten the **8 mm** and **10 mm** bolts in the order shown, and then tighten the **6 mm** bolts to the specified torque.

Torque - 8 mm Crankcase Bolts (1 ~ 6): 21 N·m (2.1 kg·m, 15 ft·lb)
10 mm Crankcase Bolts (7 ~ 9): 39 N·m (4.0 kg·m, 29 ft·lb)
6 mm Crankcase Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

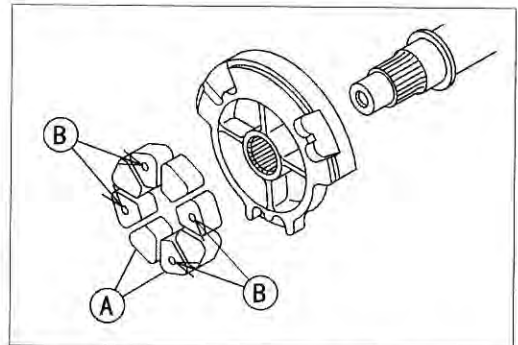
Front [A]



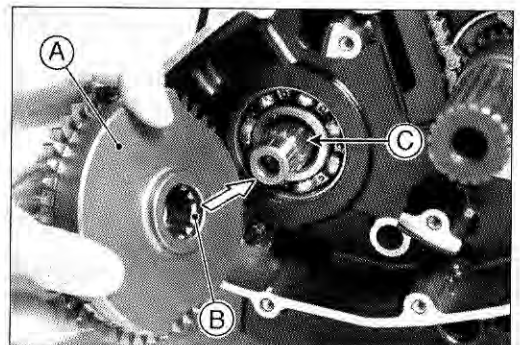
- After tightening all the crankcase bolts, check the following items.
- Turn the right crankcase down, and check that the drive shaft and output shaft turn freely.
- Check that the positive neutral finder operates properly: While spinning the output shaft using an air impact wrench, gears shift smoothly from the 1st, 2nd . . . 5th gear, and 5th, 4th . . . 1st. When the output shaft stays still, the gear can be shifted to only the 1st gear or neutral. It should not be shifted to the 2nd gear or other higher gear positions.
 - Output Shaft [A]
 - Shift Drum [B]
 - Spin the shaft fast [C].



- Install the balancer dampers [A] so that each damper hole [B] is positioned alternately.



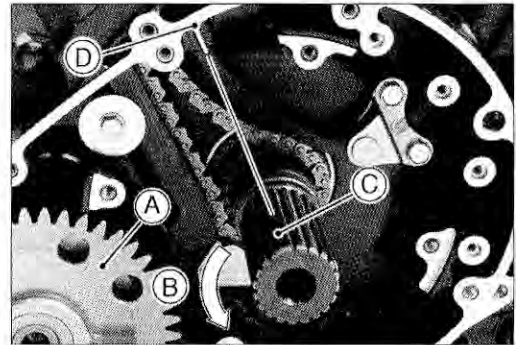
- Install the left balancer [A] on the balancer shaft in the engine left side while fitting the alignment tooth [B] onto the alignment notch [C] of the splines.



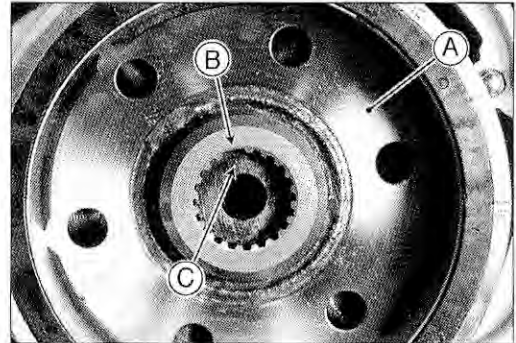
8-14 CRANKSHAFT/TRANSMISSION

Crankcase

- Install the camshaft chain and chain guide in the engine left side.
- Install the left balancer [A].
- Turn the crankshaft counterclockwise [B] and align the alignment tooth [C] with the middle of the crankcase rib [D]. This makes the front piston set to its top dead center.



- Install the alternator rotor [A] while fitting the alignment notch [B] of the splines onto the alignment tooth [C].



- Be sure to align the balancer gear mark with the alternator mark (shorter line mark) [A] while keeping the front piston on its top dead center.

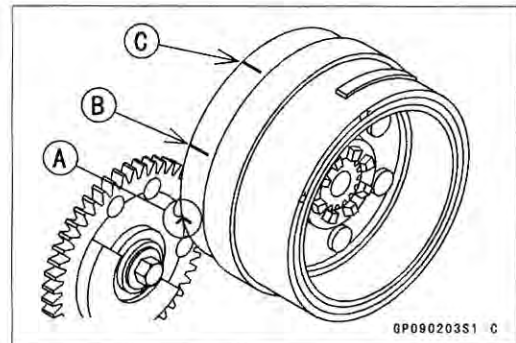
Top Mark for Rear Piston [B] (longer mark)

Top Mark for Front Piston [C] (longer mark)

- Apply molybdenum disulfide oil to the threads and the seating surface of the left balancer gear bolt, starter clutch bolt, and alternator rotor bolt.
- Tighten:

Torque - Left Balancer Gear Bolt, Starter Clutch Bolt: 85 N·m (8.7 kg·m, 63 ft·lb)

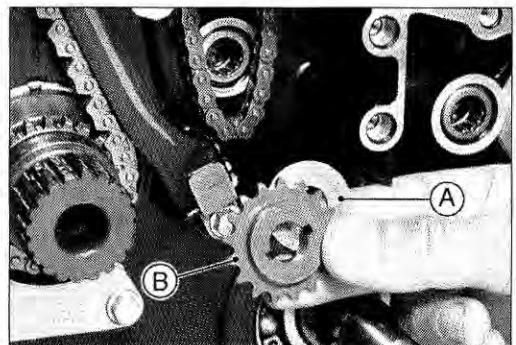
Alternator Rotor Bolt: 78 N·m (8.0 kg·m, 57 ft·lb)



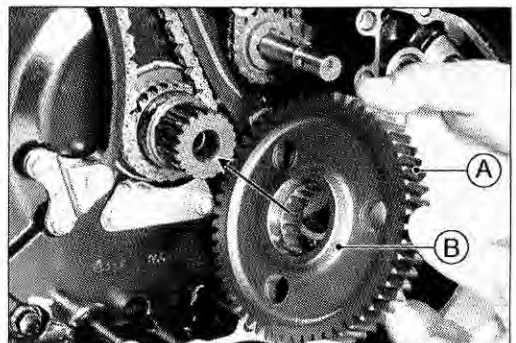
- Install the following in the engine right side.
 - Camshaft Chain and Chain Guides
 - Starter Clutch (Right Balancer)
 - Washer [A] and Idle Shaft Sprocket [B]

Non-permanent Locking Agent - Camshaft Chain Guide Bolts

Torque - Camshaft Chain Guide Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

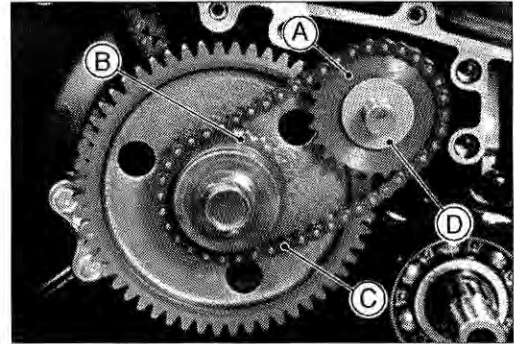


- Install the primary gear [A] with the boss [B] facing toward the engine inside.



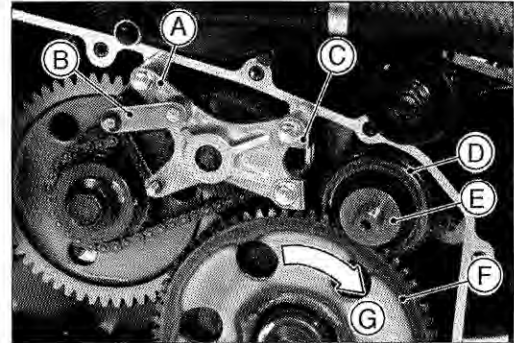
Crankcase

- Install:
 - Water Pump Idle Shaft
 - Idle Shaft Sprocket [A]
 - Water Pump Drive Sprocket [B] and Chain [C]
 - Washer [D]
- Install two pins into the water pump idle shaft.
- Fit the pins into the slots of the idle shaft drive sprocket boss.



- Install:
 - Idle Shaft Holder [A] and Water Pump Chain Guide [B]
 - Lock Washer [C]
 - Torque Limiter [D]
 - Washer [E]
 - Starter Clutch Gear [F]
 - Turn clockwise [G].

Torque - Water Pump Chain Guide Bolt, Idle Shaft Holder Bolts:
7.8 N·m (0.80 kg·m, 69 in·lb)



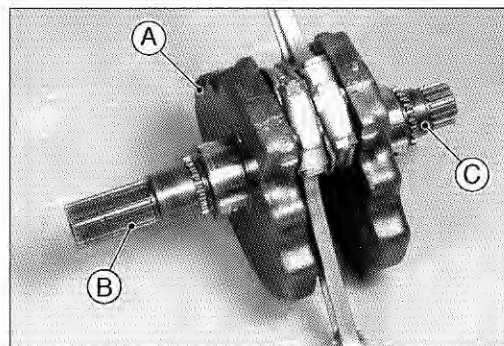
- Install:
 - Shift Mechanism (see this chapter)
 - Damper Cam and Front Gear Case (see Final Drive chapter)
 - Clutch (see Clutch chapter)
 - Water Pump (see Cooling System chapter)
 - Clutch Cover
 - Engine Top End (see Engine Top End chapter)
 - Alternator Inner Cover (see Electrical System chapter)
 - Alternator Cover (see Electrical System chapter)
 - Alternator Outer Cover (see Electrical System chapter)

8-16 CRANKSHAFT/TRANSMISSION

Crankshaft/Connecting Rods

Crankshaft Installation

- The left shaft [B] of the crankshaft [A] is longer than the right shaft [C].



Connecting Rod Removal

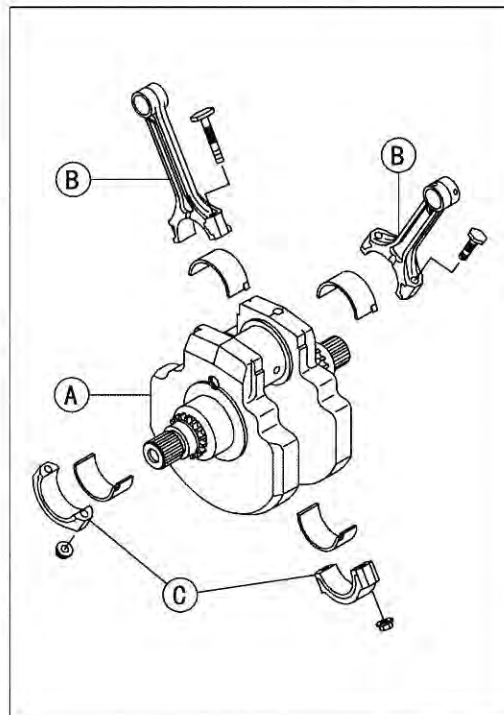
- Remove the crankshaft.
- Remove the connecting rod big end nuts, and take off the rod and cap along with the bearing inserts from the crankshaft [A].

NOTE

- Mark and record the locations of the connecting rods [B] and their big end caps [C] so that they can be installed in their original positions.

CAUTION

To prevent damage to the crankpin surfaces, do not allow the connecting rod bolts to bump against the crankpins.

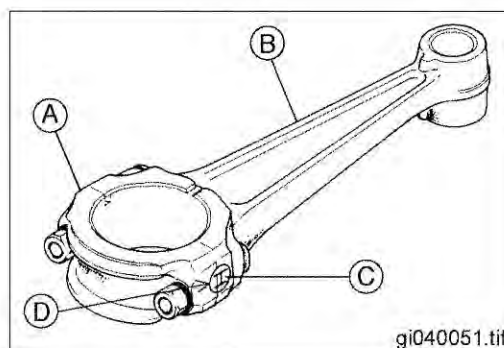


Connecting Rod Installation

CAUTION

To minimize vibration, the connecting rods should have the same weight mark.

- Big End Cap [A]
- Connecting Rod [B]
- Weight Mark, Alphabet [C]
- Diameter Mark (Around Weight Mark) [D]: "O" or no mark



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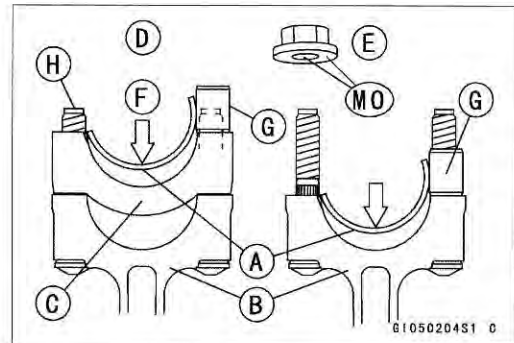
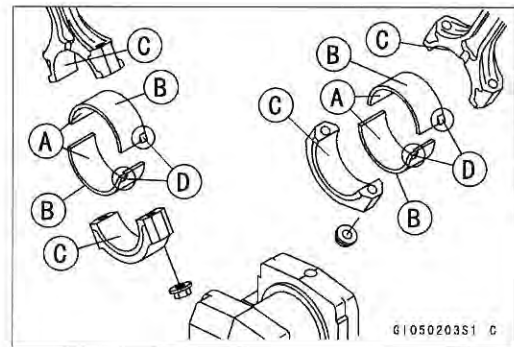
Crankshaft/Connecting Rods

CAUTION

If the connecting rods, bearing inserts, or crankshaft are replaced with new ones, select the bearing insert and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.

- Apply molybdenum disulfide oil to the inside [A] of the big end bearing inserts.
- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).
- ★ If bearing inserts are replaced, install them as follows.
- Do not apply molybdenum disulfide oil to the outside [B] of the inserts or the inside [C] of the connecting rod and cap.
- Install the inserts so that their nails [D] are on the same side and fit into the recess of the connecting rod and cap.
- When installing the inserts [A], be careful not to damage the insert surface with the edge of the connecting rod [B] or the cap [C]. One way to install inserts is as follows:
 Installation [D] to Cap
 Installation [E] to Connecting Rod
 Push [F]
 Dowel Pin [G]
 Connecting Rod Bolts [H]
- Install the cap on the connecting rod, aligning the weight and diameter marks.
- Remove debris and clean the surface of inserts.
- Apply molybdenum disulfide oil [MO] to the threads and seating surface of the big end nuts.
- Tighten the big end nuts to the specified torque.

Torque - Connecting Rod Big End Nuts: 59 N·m (6.0 kg·m, 43 ft·lb)



Crankshaft/Connecting Rod Cleaning

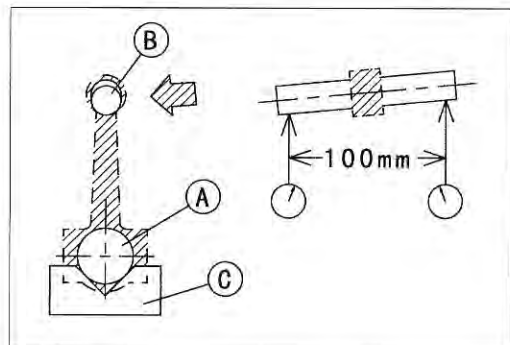
- After removing the connecting rods from the crankshaft, clean them with a high-flash point solvent.
- Blow the crankshaft oil passages with compressed air to remove any foreign particles or residue that may have accumulated in the passages.

Connecting Rod Bend

- Remove the connecting rod big end bearing inserts, and reinstall the connecting rod big end cap.
- Select an arbor [A] of the same diameter as the connecting rod big end, and insert the arbor through the connecting rod big end.
- Select an arbor of the same diameter as the piston pin and at least 100 mm long, and insert the arbor [B] through the connecting rod small end.
- On a surface plate, set the big-end arbor on a V block [C].
- With the connecting rod held vertically, use a height gage 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 connecting rod must be replaced.

Connecting Rod Bend

Service Limit: TIR 0.2/100 mm



8-18 CRANKSHAFT/TRANSMISSION

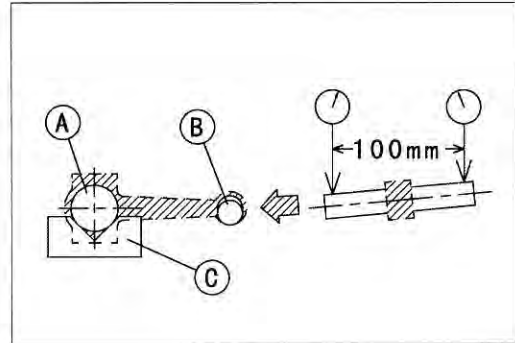
Crankshaft/Connecting Rods

Connecting Rod Twist

- With the big-end arbor [A] still on the V block [C], hold the connecting rod horizontally and measure the amount that the arbor [B] varies from being parallel with the surface plate 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 connecting rod must be replaced.

Connecting Rod Twist

Service Limit: TIR 0.2/100 mm



Connecting Rod Big End Side Clearance

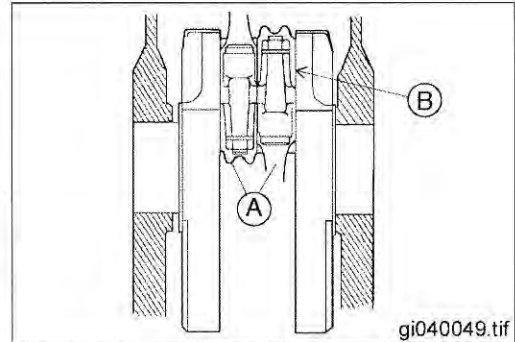
- Measure the side clearance [B] of the connecting rod big end [A].
- Insert a thickness gage between the big end and either crank web to determine clearance.

Connecting Rod Big End Side Clearance

Standard: 0.16 ~ 0.46 mm

Service Limit: 0.7 mm

- ★ If the clearance exceeds the service limit, replace the connecting rod with new one and then check clearance again. If clearance is too large after connecting rod replacement, the crankshaft also must be replaced.



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Connecting Rod Big End Bearing Wear

- Remove the big end cap and place a strip of plastigage on the crankpin [A].
- Tighten the big end nuts to the specified torque to compress the plastigage and measure the plastigage width [B] to determine the bearing insert/crankpin clearance.

Molybdenum Disulfide Oil - Threads and Seating Surface of Big End Nuts

Torque - Connecting Rod Big End Nuts: 59 N·m (6.0 kg·m, 43 ft·lb)

NOTE

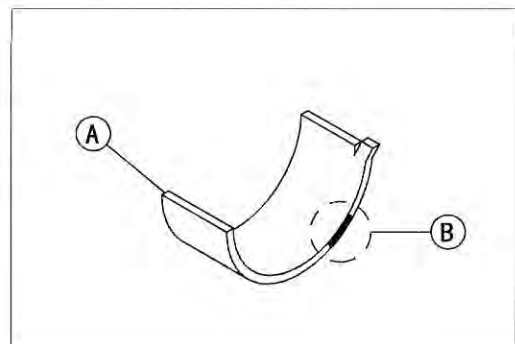
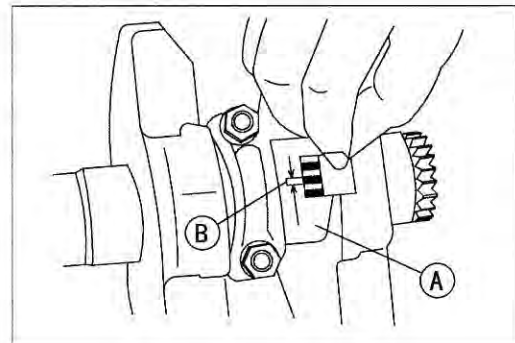
- Do not move the connecting rod and crankshaft during clearance measurement.

Connecting Rod Big End Bearing/Crankpin Clearance

Standard: 0.026 ~ 0.057 mm

Service Limit: 0.10 mm

- ★ If the clearance is within the standard, no bearing insert replacement is required.
- ★ If the clearance is between 0.057 mm and the service limit (0.10 mm), replace the bearing inserts [A] with inserts painted blue [B]. Check insert/crankpin clearance with plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.



Crankshaft/Connecting Rods

- ★ If the clearance exceeds the service limit, measure the diameter of the crankpin [A].

Crankpin Diameter

Standard: 54.981 ~ 55.000 mm

Service Limit: 54.97 mm

- ★ If the crankpin has worn past the service limit, replace the crankshaft with a new one.
- ★ If the measured crankpin diameter is not less than the service limit, but does not coincide with the original diameter marking on the crankshaft, make a new mark on it.

Crankpin Diameter Marks

None: 54.981 ~ 54.991 mm

○: 54.992 ~ 55.000 mm

Crankpin Diameter Mark: "○" mark or no mark [B]

- Tighten the big end nuts to the specified torque.

Molybdenum Disulfide Oil - Threads and Seating Surface of Big End Nuts

Torque - Connecting Rod Big End Nuts: 59 N·m (6.0 kg·m, 43 ft·lb)

- Measure the connecting rod big end inside diameter, and mark each connecting rod big end in accordance with the inside diameter.

NOTE

- The mark already on the big end should almost coincide with the measurement because of little wear.

Connecting Rod Big End Inside Diameter Marks

None: 58.000 ~ 58.010 mm

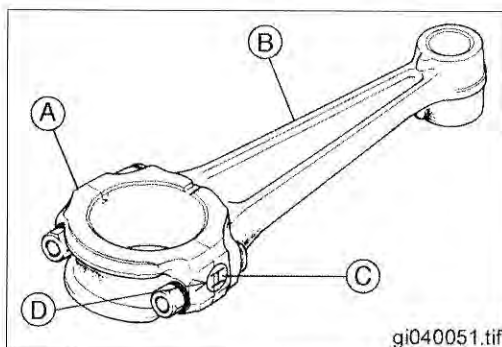
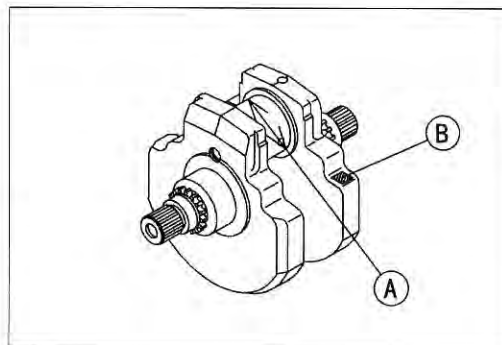
○: 58.011 ~ 58.020 mm

Big End Cap [A]

Connecting Rod [B]

Weight Mark, Alphabet [C]

Diameter Mark (Around Weight Mark) [D]: "○" or no mark

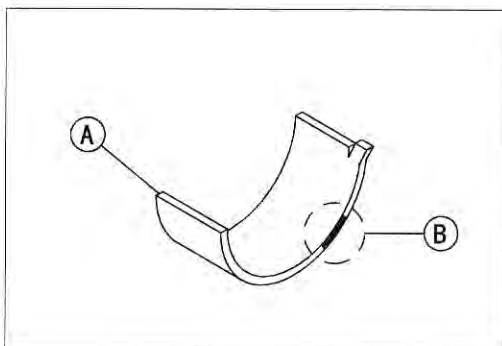


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- Select the proper bearing insert [A] in accordance with the combination of the connecting rod and crankshaft coding.
Size Color [B]

Big End Bearing Insert Selection

Con-rod Big End Bore Diameter Marking	Crankpin Diameter Mark	Bearing Insert	
		Size Color	Part Number
None	○	Brown	92028-1476
None	None	Black	92028-1475
○	○		
○	None	Blue	92028-1474



- Install the new inserts in the connecting rod and check insert/crankpin clearance with the plastigage.

8-20 CRANKSHAFT/TRANSMISSION

Crankshaft/Connecting Rods

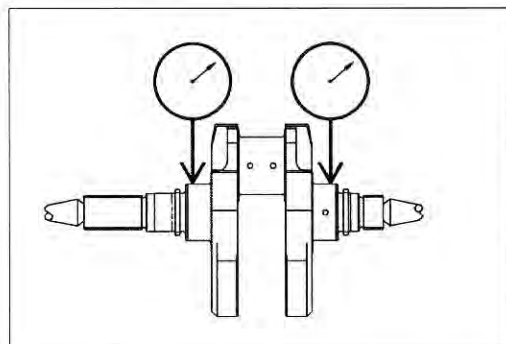
Crankshaft Runout

- Measure the crankshaft runout.
- ★ If the measurement exceeds the service limit, replace the crankshaft.

Crankshaft Runout

Standard: TIR 0.02 mm

Service Limit: TIR 0.05 mm



Crankshaft Main Bearing/Journal Wear

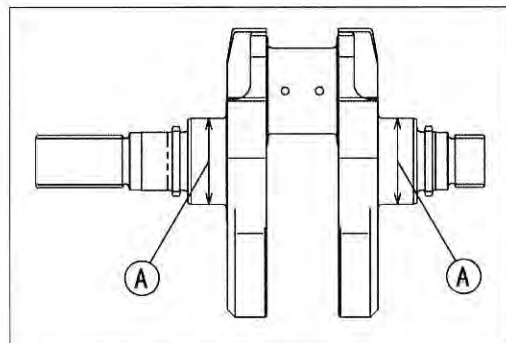
- Measure the diameter [A] of the crankshaft main journal.

Crankshaft Main Journal Diameter

Standard: 54.986 ~ 55.000 mm

Service Limit: 54.96 mm

- ★ If any journal has worn past the service limit, replace the crankshaft with a new one.



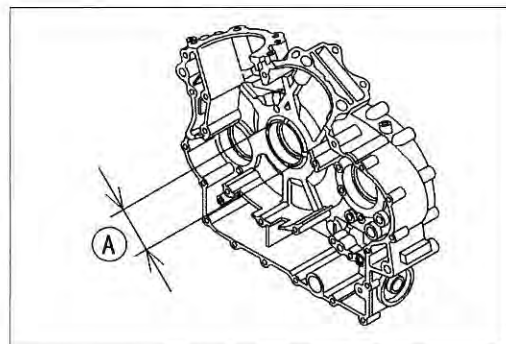
- Measure the main bearing bore diameter [A] in the crankcase halves.

Crankcase Main Bearing Bore Diameter

Standard: 55.025 ~ 55.038 mm

Service Limit: 55.07 mm

- ★ If there are any signs of seizure, damage, or excessive wear, replace the crankcase halves as a set.



Crankshaft Side Clearance

- Measure the crankshaft side clearance.

Crankshaft Side Clearance

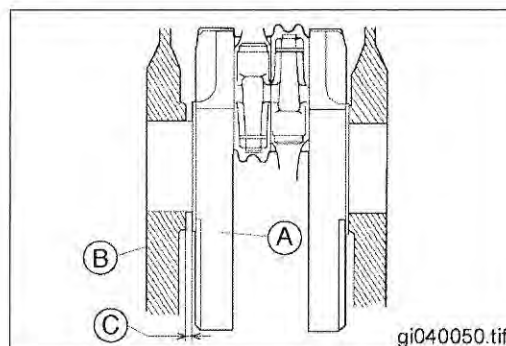
Standard: 0.05 ~ 0.55 mm

Service Limit: 0.75 mm

Crankshaft [A]

Crankcase [B]

Clearance [C]



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Crankshaft/Connecting Rods

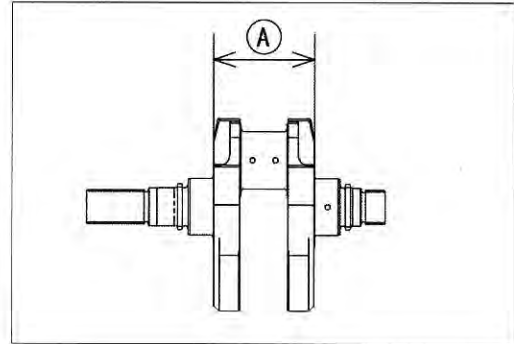
- ★ If the clearance is greater than the service limit, measure the crankshaft web length [A] to see whether the crankshaft or the crankcase is faulty.

Crankshaft Web Length

Standard: 96.85 ~ 96.95 mm

Service Limit: 96.6 mm

- ★ If the length measurement is smaller than the service limit, replace the crankshaft. Otherwise, replace the crankcase halves as a set.



CAUTION

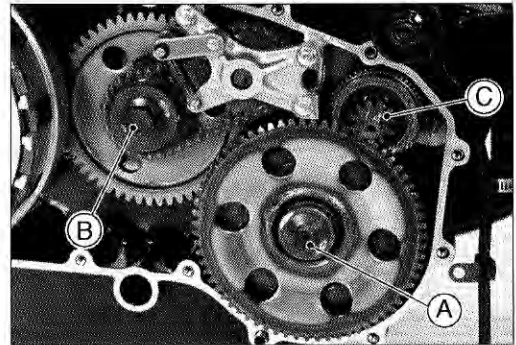
The right and left crankcase halves are machined at the factory in the assembled state, so they must be replaced as a set.

8-22 CRANKSHAFT/TRANSMISSION

Starter Clutch

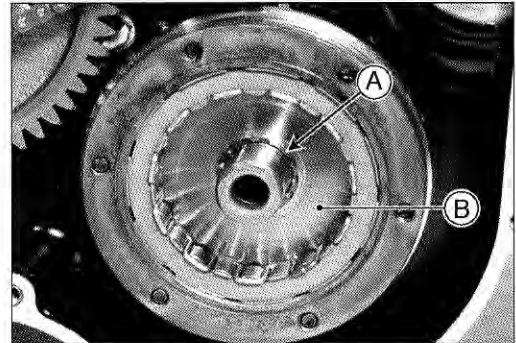
Removal

- Remove the clutch cover (see Clutch chapter).
- Unscrew the starter clutch bolt [A] while holding the primary gear bolt [B].
- Pull the starter clutch gear and starter clutch along with the right balancer as a set off the balancer shaft.
- Remove the torque limiter [C].

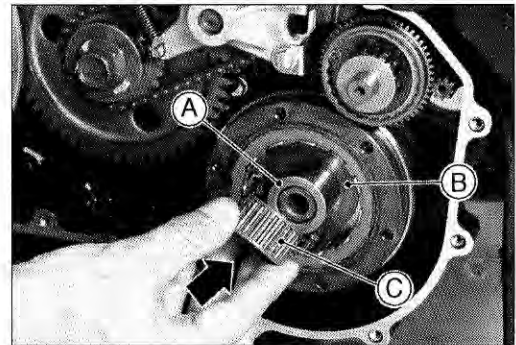


Installation

- Fit the alignment notch [A] of the splines of the right balancer [B] onto the alignment tooth of the balancer shaft.



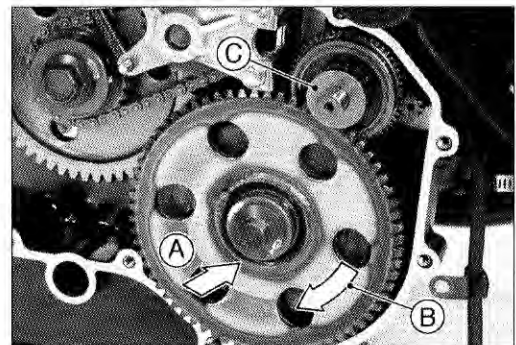
- Install the collar [A], copper washer [B], and needle bearing [C] in the order listed.
- Be sure to install the copper washer on the collar.



- Push the starter clutch gear [A] in and turn it clockwise [B] and install it.
- Apply molybdenum disulfide oil to the threads and seating surface of the starter clutch bolt and tighten it to the specified torque while holding the primary gear bolt.

Torque - Starter Clutch Bolt: 85 N·m (8.7 kg·m, 63 ft·lb)

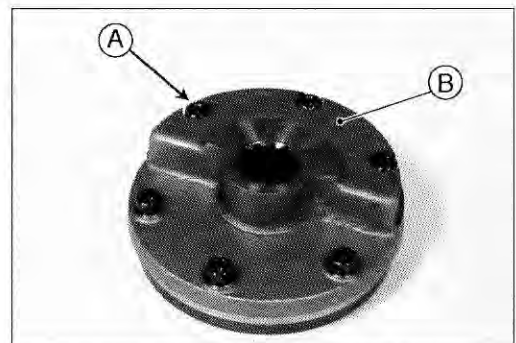
- Be sure to install the washer [C] onto the torque limiter.



Disassembly

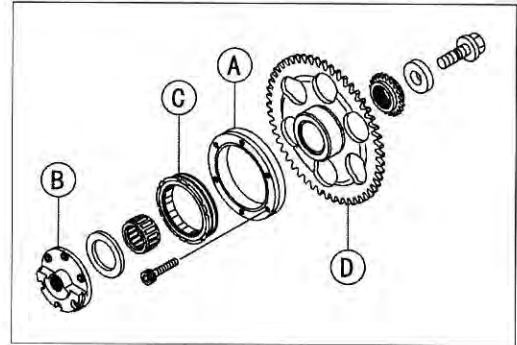
- Remove the starter clutch assy.
- Remove the Allen bolts [A] with the balancer [B] held with the flywheel holder.

Special Tool - Flywheel Holder: 57001-1313



Starter Clutch

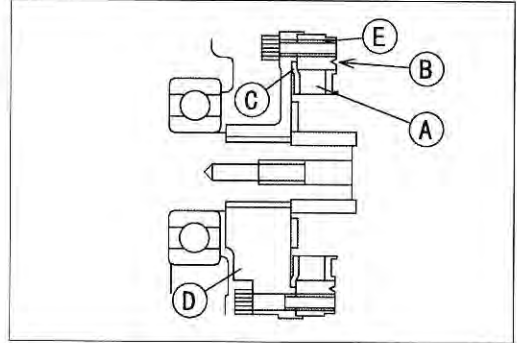
- Pull the coupling [A] out of the right balancer [B].
- Take the one-way clutch [C] out of the coupling. Starter Clutch Gear [D]



Assembly

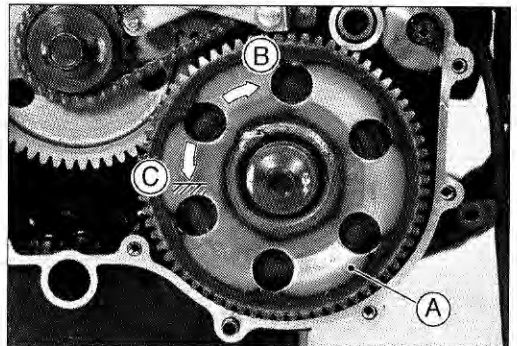
- Install the one way clutch [A] so that its groove [B] faces outward and its flange [C] fits between the right balancer [D] and the coupling [E].
- Apply a non-permanent locking agent to the threads of the coupling bolts, and tighten them to the specified torque.

Torque - Starter Clutch Coupling Bolts: 15 N·m (1.5 kg·m, 11 ft·lb)



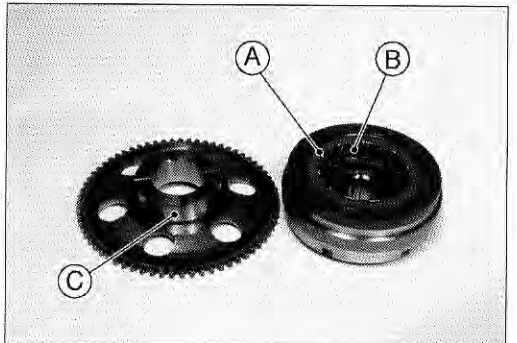
Inspection

- Remove the starter clutch gear [A] and torque limiter, then reinstall the starter clutch gear into the starter clutch.
- Turn the starter clutch to both side.
- When viewed from the right side of the engine, the clutch should turn clockwise [B] freely, but should not turn counterclockwise [C].

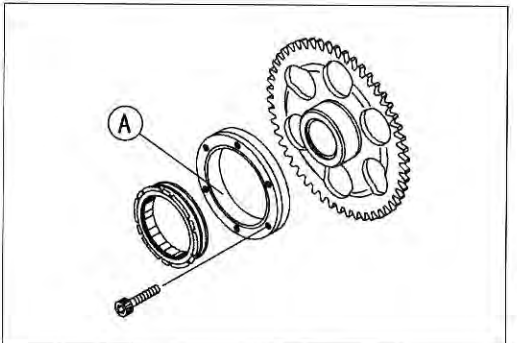


- ★ If the starter clutch does not operate as it should or if it makes noise, disassemble the starter clutch.
- ★ If one-way clutch [A] installation is wrong, reinstall it.
- ★ Visually inspect the one-way clutch, coupling and starter clutch gear for damage.
- ★ If there is any worn or damaged surface in the following parts, replace it.

Sliding Surface [B] and Cage of One-way Clutch
Sliding Surface [C] of Starter Clutch Gear



Sliding Surface [A] of Coupling



8-24 CRANKSHAFT/TRANSMISSION

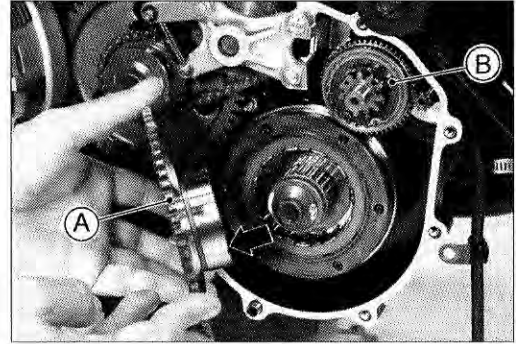
Starter Torque Limiter

Removal

- Remove the clutch cover (see Clutch chapter).
- Remove the starter clutch gear [A].
- Pull the torque limiter [B] out of the right crankcase.

CAUTION

Do not disassemble the torque limiter. The torque limiter will be damaged.



Inspection

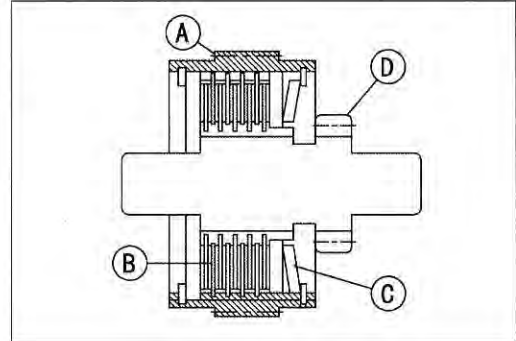
- Remove the torque limiter and visually inspect it.
- ★ If the limiter has wear, discoloration, or other damage, replace it as a set.

Gear [A]

Friction Plates [B]

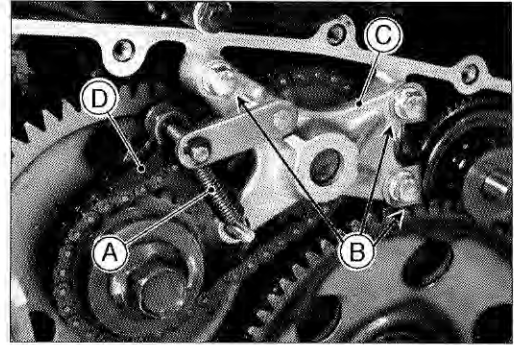
Spring [C]

Pinion [D]



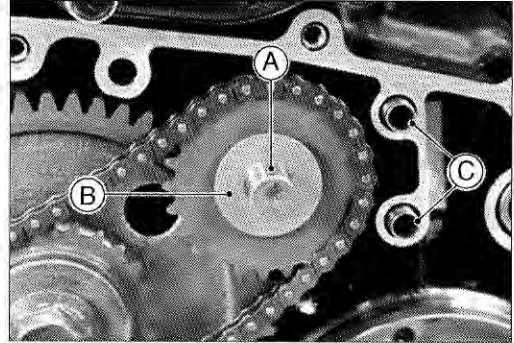
Water Pump Idle Shaft Holder*Removal*

- Remove the clutch cover (see Clutch chapter).
- Remove:
 - Starter Clutch Gear (see this chapter)
 - Starter Torque Limiter (see this chapter)
- Take the end of the spring [A] off the hook.
- Unscrew the bolts [B] with the lock washer and take the idle shaft holder [C] with the chain guide [D] out of the crankcase.
- Pull out the chain guide from the holder.

*Installation*

- Put the washer [B] onto the idle shaft [A], and fit the dowel pins [C] into the crankcase.
- Install the idle shaft holder and lock washer.

Torque - Idle Shaft Holder Bolts: 7.8 N·m (0.80 kg·m, 69 in·lb)

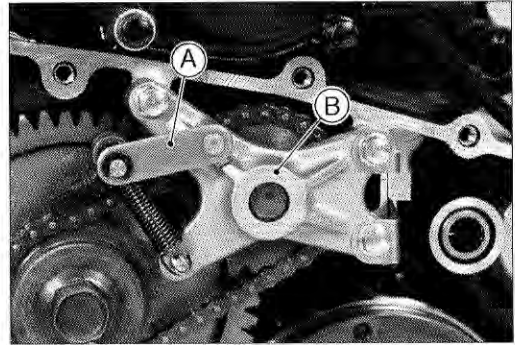


8-26 CRANKSHAFT/TRANSMISSION

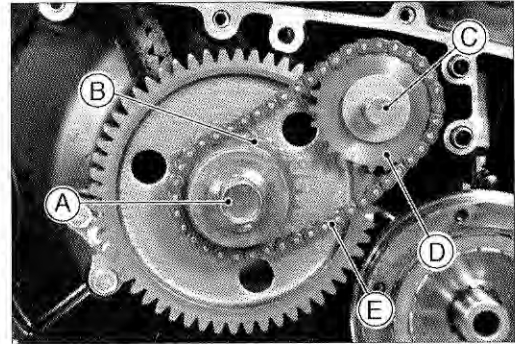
Primary Gear

Removal

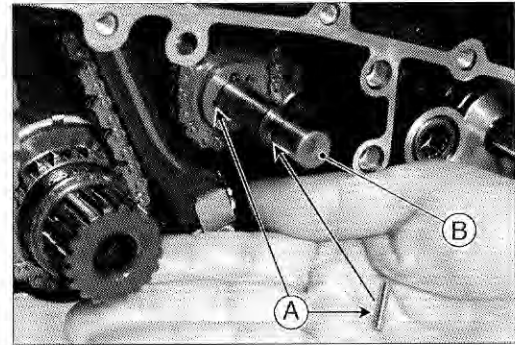
- Remove:
 - Clutch Cover (see Clutch chapter)
 - Starter Clutch Gear (see this chapter)
 - Starter Torque Limiter (see this chapter)
 - Clutch (see Clutch chapter)
- Remove the water pump chain guide [A] and water pump idle shaft holder [B] from the right crankcase.



- Using an air impact wrench, or holding the alternator rotor bolt (remove the rotor bolt plug), remove the primary gear bolt [A], water pump drive sprocket [B], idle shaft [C], and idle shaft sprocket [D].
Water Pump Chain [E]

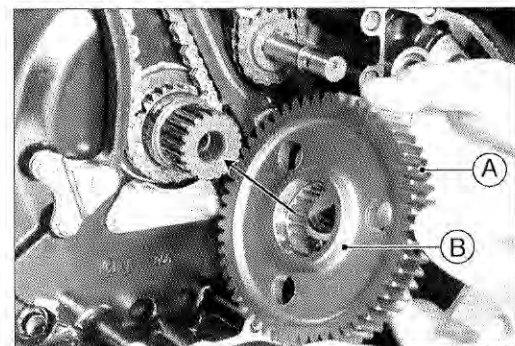


- Pull the primary gear out of the crankshaft, and take the pins [A] out of the idle shaft [B].



Installation

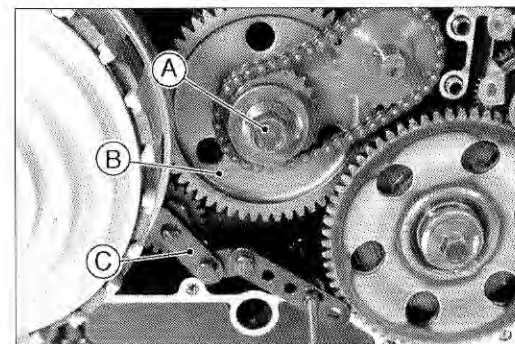
- Fit the primary gear [A] with the boss [B] facing toward the engine inside.
- Install two pins into the water pump idle shaft.
- Fit the pins into the slots of the water pump drive sprocket boss and install the sprocket.
- Install the clutch (see Clutch chapter).



- Apply molybdenum disulfide oil to the threads and seating surface, and tighten the primary gear bolt [A] to the specified torque, while holding the primary gear [B] with the gear holder [C].

Special Tool - Gear Holder: 57001-1015

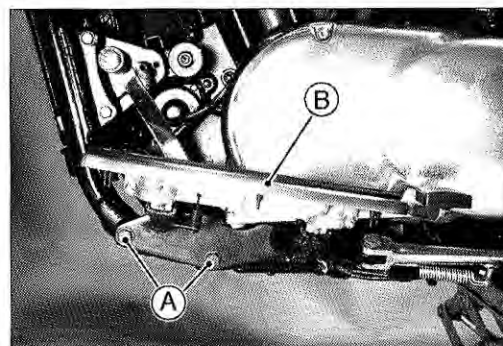
Torque - Primary Gear Bolt: 147 N·m (15.0 kg·m, 108 ft·lb)



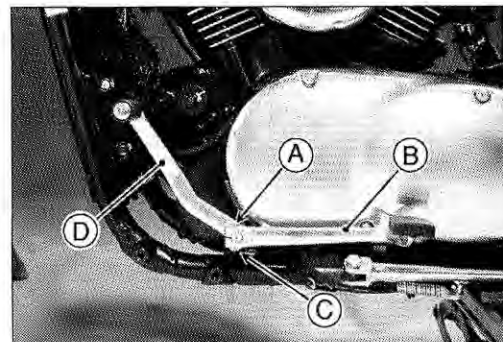
Transmission

Shift Pedal Removal

- Unscrew the bolts [A] and take off the left front footboard [B].



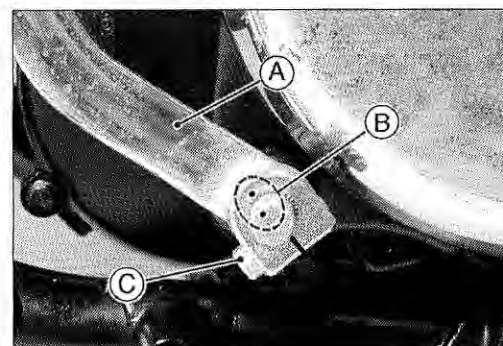
- Unscrew the clamp bolt [A] and pull out the rear shift pedal [B].
- Unscrew the clamp bolt [C] and pull out the front shift pedal [D].



Front Shift Pedal Installation

- Install the front shift pedal [A] so that the punched mark on the shaft is aligned [B] with the punched mark on the pedal.
- Tighten the clamp bolt [C].

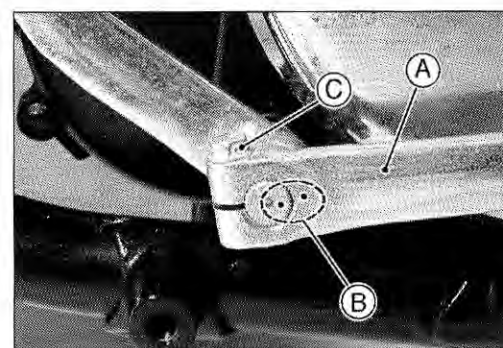
Torque - Front Shift Pedal Clamp Bolt: 17 N·m (1.7 kg·m, 12 ft·lb)



Rear Shift Pedal Installation

- Install the rear shift pedal [A] so that the punched mark on the shaft is aligned [B] with the punched mark on the pedal.
- Tighten the clamp bolt [C] of the rear shift pedal.

Torque - Rear Shift Pedal Clamp Bolt: 17 N·m (1.7 kg·m, 12 ft·lb)

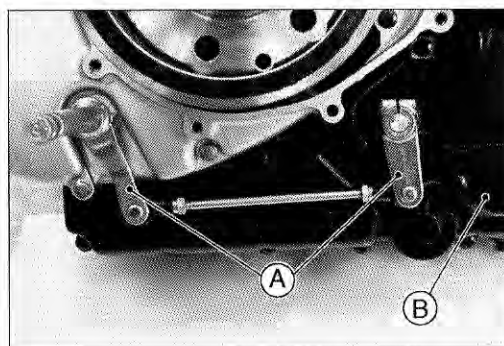


8-28 CRANKSHAFT/TRANSMISSION

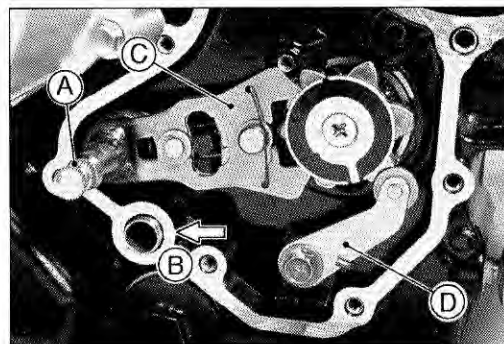
Transmission

External Shift Mechanism Removal

- Remove:
 - Front and Rear Shift Pedals (see this chapter)
 - Alternator Outer Cover (see Electrical System chapter)
 - Engine (see Engine Removal/Installation chapter)
 - Alternator Cover (see Electrical System chapter)
 - Front and Rear Shift Levers [A]
 - Front Gear Case [B] (see Final Drive chapter)

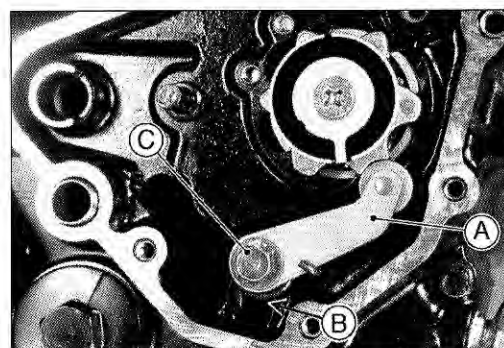


- Remove the shift shaft [A] while pushing [B] the shift mechanism arm [C] towards the shift shaft.
- Unscrew the bolt and remove the gear set lever [D] and its spring.

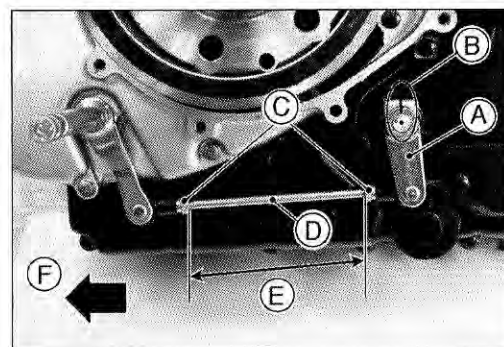


External Shift Mechanism Installation

- Install the gear set lever [A] and the spring [B] in the crankcase and tighten the bolt [C].
- Install the shift mechanism arm assy. Be sure to install the washer onto the shift shaft.
- Install the front gear case (see Final Drive chapter).



- Install the front shift lever and the rear shift lever.
- Install the rear shift lever [A] on the shift shaft so that the punched mark on the shaft is aligned [B] with the slot of the rear shift lever.
- Loosen the locknuts [C] and turn the shift rod [D] so that the outside length [E] of the locknuts is 112 ± 1 mm.
- Front [F]
- The rear locknut has left-hand threads.

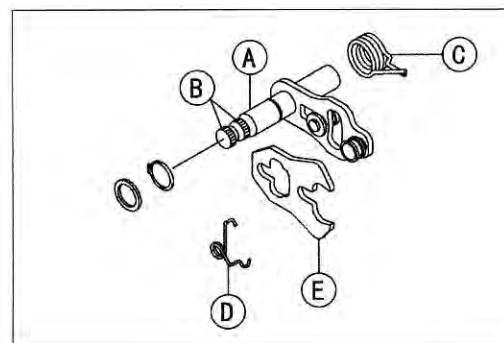


Torque - Shift Rod Locknuts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Install the clutch hose guide and grommet.
- Install the engine (see Engine Removal/Installation chapter).

External Shift Mechanism Inspection

- Examine the shift shaft [A] for any damage.
- ★ If the shaft is bent, straighten or replace it.
- ★ If the splines [B] are damaged, replace the shaft.
- ★ If the springs [C] [D] are damaged in any way, replace them.
- ★ If the shift mechanism arm [E] is damaged in any way, replace the arm.

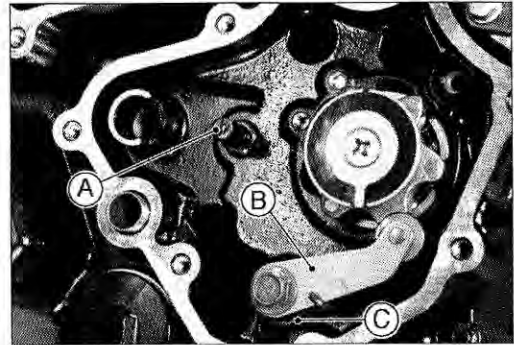


Transmission

- Check the return spring pin [A] is not loose.
- ★ If it is loose, unscrew it, apply a non-permanent locking agent to the threads, and tighten it.

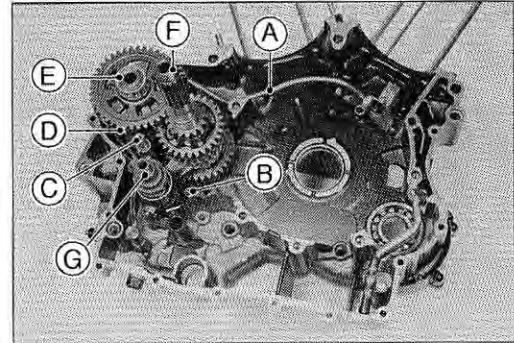
Torque - Shift Shaft Return Spring Pin: 20 N·m (2.0 kg·m, 14 ft·lb)

- Check the gear set lever [B], and its spring [C] for breaks or distortion.
- ★ If the lever or spring is damaged in any way, replace it.
- Visually inspect the shift drum pins, pin holder, and pin plate.
- ★ If they are badly worn or if they show any damage, replace them.

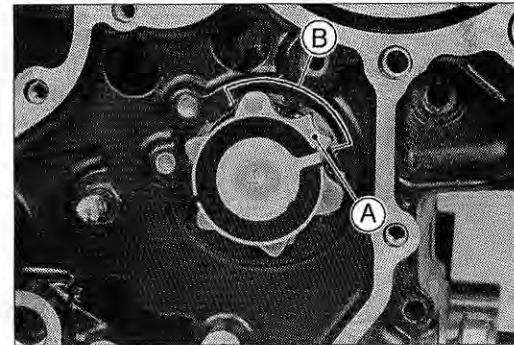


Transmission Removal

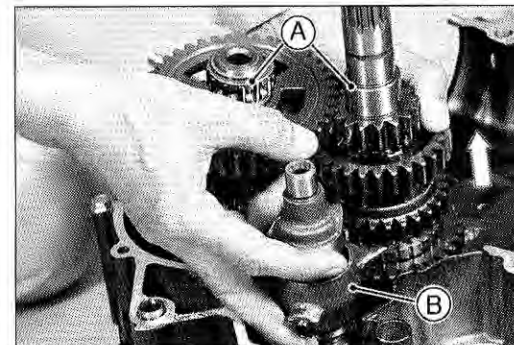
- Remove the engine (see Engine Removal/Installation chapter).
 - Split the crankcase (see this chapter).
 - Remove the crankshaft.
 - First, remove the oil pipe [A] (see Engine Lubrication System chapter), and then remove the shift drum bearing holder bolts and holder [B].
 - Pull out the shift rod [C] and take the shift fork [D] out of the output shaft 4th gear.
- Output Shaft [E]
Drive Shaft [F]
Shift Drum [G]



- Align the shift drum cam [A] with the cutoff [B] of the left crankcase by turning the shift drum.

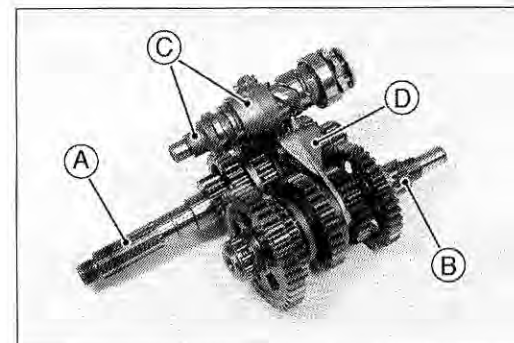


- Take out the transmission shafts [A] and shift drum [B] as a set.
- Separate the drive and output shafts, shift drum, and shift forks.



Transmission Installation

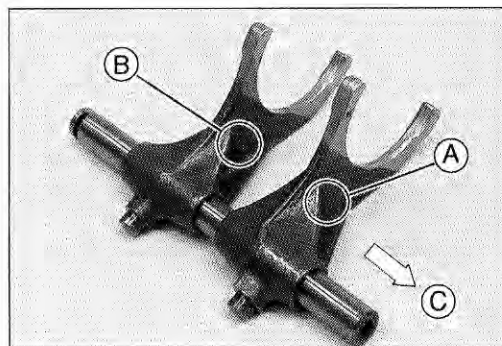
- Install the drive and output shaft assy, shift drum, and output shaft 5th gear shift fork as a set.
- Drive Shaft Assy [A]
Output Shaft Assy [B]
Shift Fork (Drive, 3rd Gear) and Shift Drum Assy [C]
Shift Fork (Output, 5th Gear) [D]



8-30 CRANKSHAFT/TRANSMISSION

Transmission

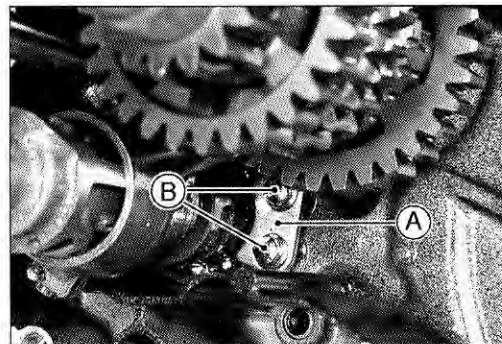
- Each output shaft shift fork has an identification number. Do not confuse them.
- Install them as shown.
 - Shift Fork (No-270), 5th Gear [A]
 - Shift Fork (No-269), 4th Gear [B]
 - Toward the left crankcase [C].



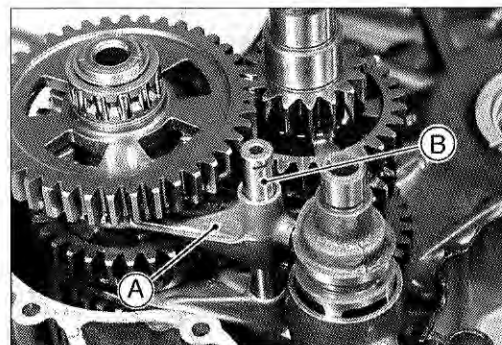
- Apply a non-permanent locking agent to the shift drum bearing holder bolts.

Torque - Shift Drum Bearing Holder Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Install:
 - Shift Drum Bearing Holder [A]
 - Bolts [B]
- Apply engine oil to the shift rod, the shift forks, and gears.

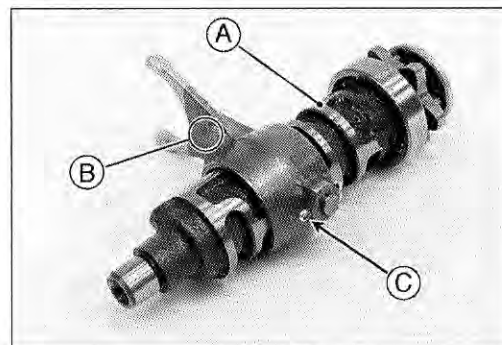


- Install:
 - Shift Fork (Output, 4th Gear) [A]
 - Shift Rod [B]

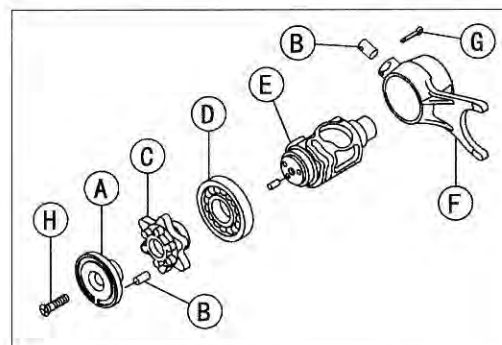


Shift Drum Disassembly/Assembly

- Remove the shift drum assy [A] (see this chapter).
- Remove:
 - Drive Shaft Shift Fork (No-268) [B]
 - Cotter Pin [C]



- Disassemble the shift drum assy as shown.
 - Pin Plate [A]
 - Pin [B]
 - Cam [C]
 - Bearing [D]
 - Shift Drum [E]
 - Drive Shaft Shift Fork (No-268) [F]
 - Cotter Pin [G]
- Apply a non-permanent locking agent to the threads of the shift drum cam screw [H].



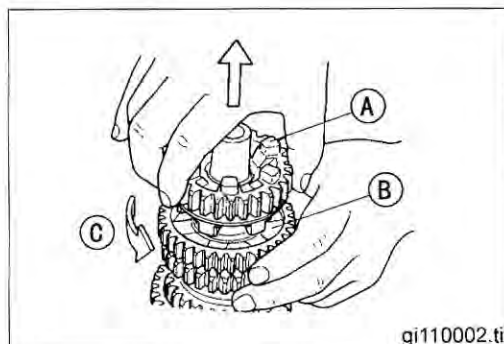
Transmission

Transmission Disassembly

- Remove the transmission shafts (see this chapter).
- Using the circlip pliers (special tool), remove the circlips, and disassemble the transmission shaft.

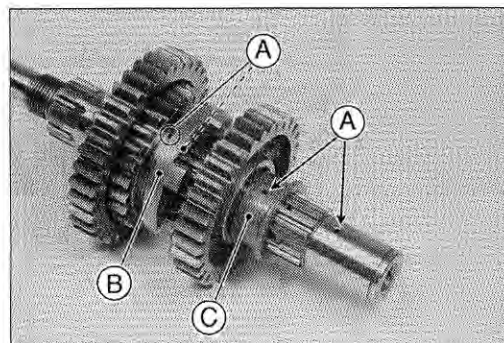
Special Tool - Outside Circlip Pliers: 57001-144

- The 4th gear [A] on the output shaft has three steel balls for the positive neutral finder mechanism.
- Remove the 4th gear as follows.
 - Set the output shaft in a vertical position holding the 3rd gear [B].
 - Spin the 4th gear quickly [C] and pull it off upward.

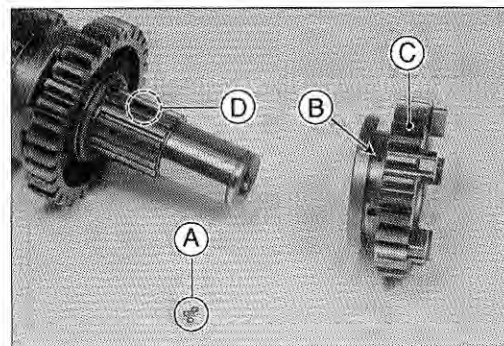


Transmission Assembly

- Align each gear oil hole with the drive shaft oil hole, when installing the 3rd gear [9] and the 5th gear [6] (see Drive Shaft Illustration).
- Align each oil hole [A] with the output shaft oil hole, when installing the 5th gear [B], 3rd gear and bushing [C], and the 4th gear.



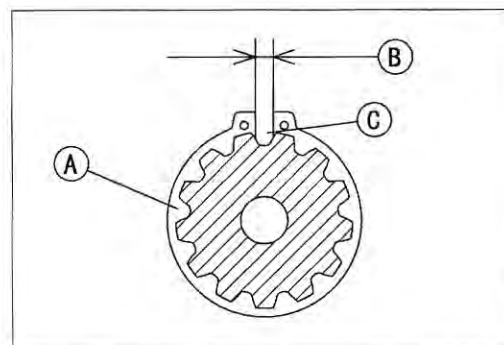
- Fit the three steel balls [A] into the holes [B] of the output 4th gear [C], and then install the gear on the output shaft so that the steel balls align with the recesses [D] in the shaft.



CAUTION

Do not apply grease to the steel balls to hold them in place. This will cause the positive neutral finder mechanism to malfunction.

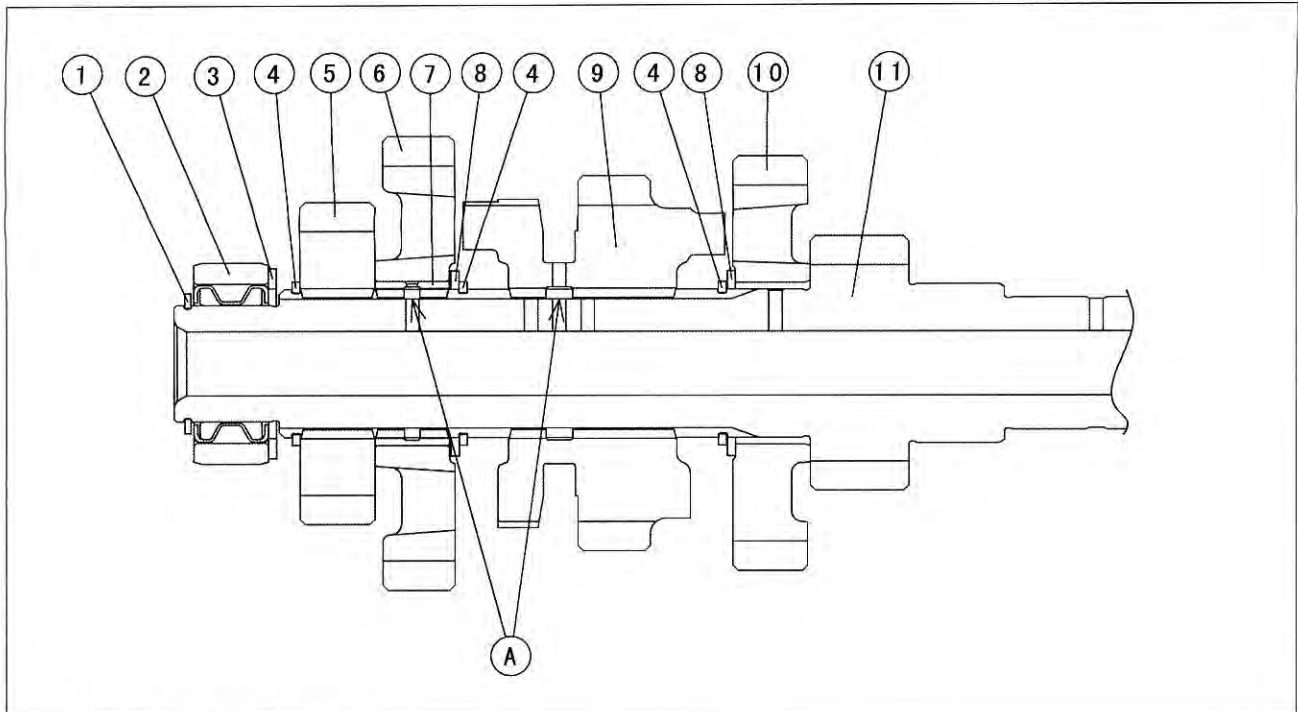
- After assembling the 4th gear with steel balls in place on the output shaft, check the ball-locking effect that the 4th gear does not come out of the output shaft when moving it up and down by hand.
- Replace any circlip [A] that were removed with new ones.
- Install the circlips so that the opening [B] is aligned with a spline groove [C].



8-32 CRANKSHAFT/TRANSMISSION

Transmission

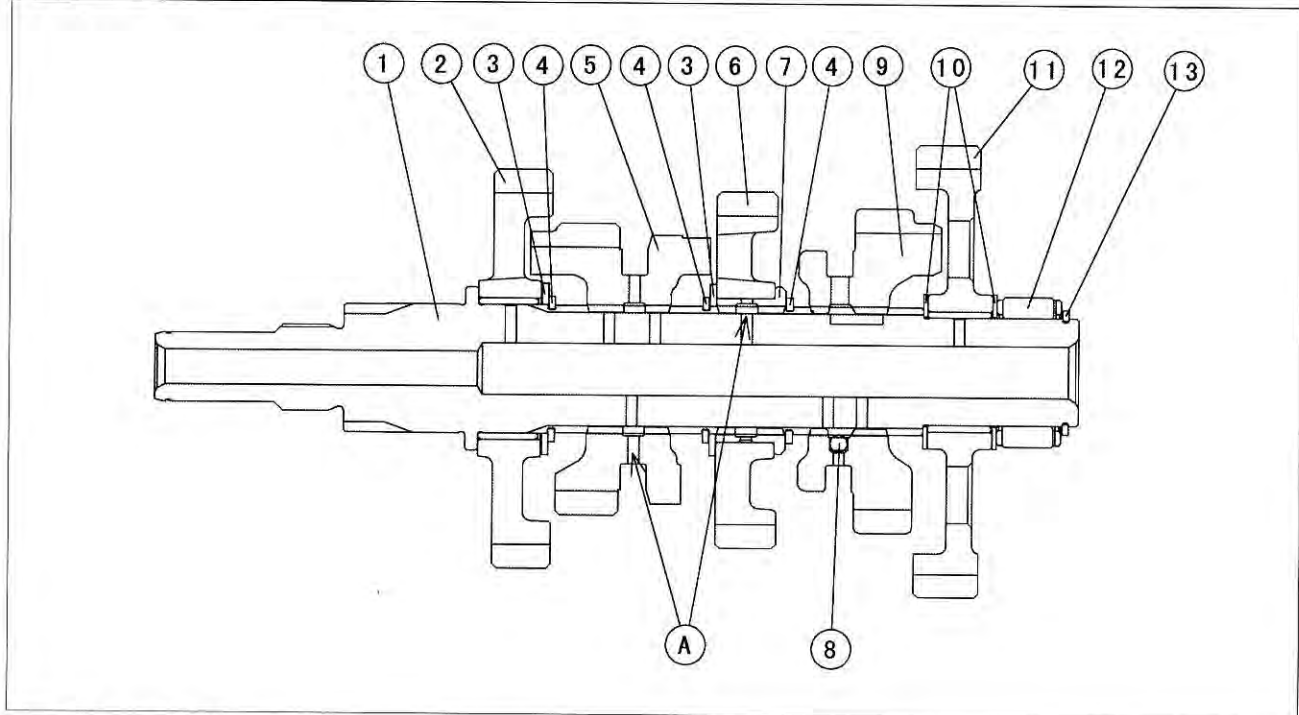
Drive Shaft:



1. Circlip (ϕ 20 $\times$ 25.5 $\times$ t 1.2)
 2. Needle Bearing
 3. Thrust Washer (ϕ 22.3 $\times$ 35 $\times$ t 1.6)
 4. Circlip (ϕ 28) (3)
 5. 2nd Gear
 6. 5th (Top) Gear
 7. Bushing (5th Gear)
 8. Washer (ϕ 28.5 $\times$ 34 $\times$ t 1.5) (2)
 9. 3rd Gear
 10. 4th Gear
 11. 1st Gear
- Align gear oil holes with the shaft holes [A].

Transmission

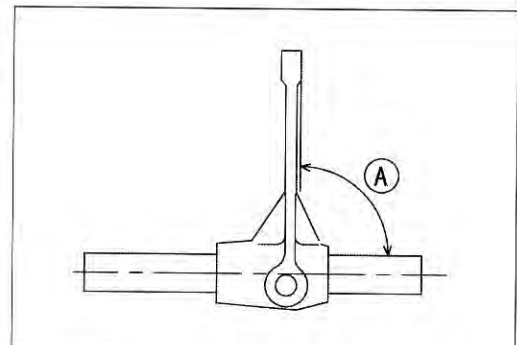
Output Shaft:



1. Output Shaft
 2. 2nd Gear
 3. Washer (ϕ 30.3 $\times$ 40 $\times$ t 1.5) (2)
 4. Circlip (ϕ 29) (3)
 5. 5th (Top) Gear
 6. 3rd Gear
 7. Bushing (3rd Gear)
 8. Steel Balls
 9. 4th Gear
 10. Washer (ϕ 25.5 $\times$ 36 $\times$ t 1.0) (2)
 11. 1st Gear
 12. Needle Bearing
 13. Circlip (ϕ 25)
- Align gear oil holes with the shaft holes [A].

Shift Fork Bending

- Visually inspect the shift forks, and replace any fork that is bent. A bent fork could cause difficulty in shifting, or allow the transmission to jump out of gear under load.
- 90° [A]



8-34 CRANKSHAFT/TRANSMISSION

Transmission

Shift Fork/Gear Groove Wear

- Measure the thickness of the shift fork ears [A], and measure the width [B] of the gear grooves.
- ★ If the thickness of a shift fork ear is less than the service limit, the shift fork must be replaced.

Shift Fork Ear Thickness

Standard: 5.9 ~ 6.0 mm

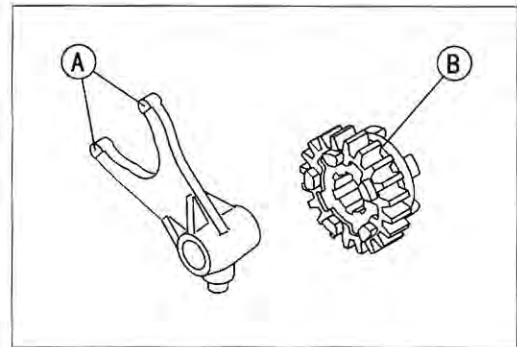
Service Limit: 5.8 mm

- ★ If the gear groove is worn over the service limit, the gear must be replaced.

Gear Groove Width

Standard: 6.05 ~ 6.15 mm

Service Limit: 6.3 mm



Shift Fork Guide Pin/Drum Groove Wear

- Measure the diameter of each shift fork guide pin [A], and measure the width [B] of each shift drum groove.
- ★ If the guide pin on any shift fork is less than the service limit, the fork must be replaced.

Shift Fork Guide Pin Diameter

Standard: 7.9 ~ 8.0 mm

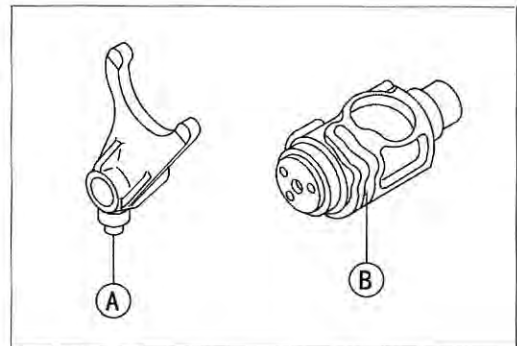
Service Limit: 7.8 mm

- ★ If any shift drum groove is worn over the service limit, the drum must be replaced.

Shift Drum Groove Width

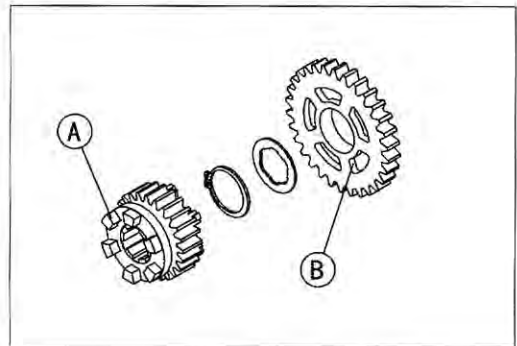
Standard: 8.05 ~ 8.20 mm

Service Limit: 8.3 mm



Gear Dog and Gear Dog Hole Damage

- Visually inspect the gear dogs [A] and gear dog holes [B].
- ★ Replace any damaged gears or gears with excessively worn dogs or dog holes.



Ball Bearing, Needle Bearing, and Oil Seal

Ball Bearing and Outer Race Replacement

CAUTION

Do not remove the ball bearing or needle bearing outer race unless it is necessary. Removal may damage them.

- Using a press or puller, remove the ball bearing and/or needle bearing outer race.

NOTE

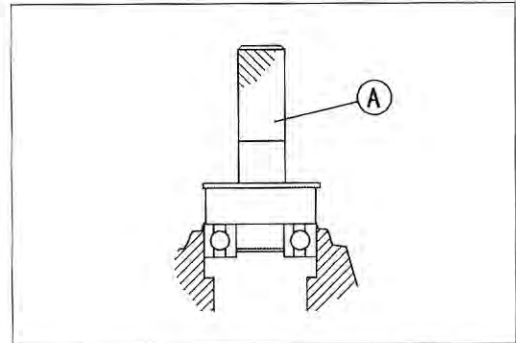
- In the absence of the above mentioned tools, satisfactory results may be obtained by heating the case to approximately 93°C (200°F) max., and tapping the bearing in or out.

CAUTION

Do not heat the case with a blowtorch. This will warp the case. Soak the case in oil and heat the oil.

- Using a press and the bearing driver set [A], install the new bearing or outer race until it stops at the bottom of its housing.

Special Tool - Bearing Driver Set: 57001-1129

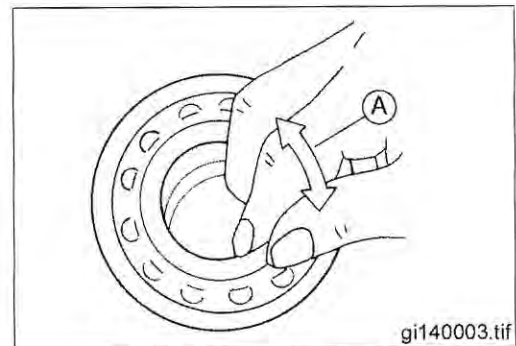


Ball and Needle Bearing Wear

CAUTION

Do not remove the ball bearings for inspection. Removal may damage them.

- Check the ball bearings.
 - Since the ball bearings are made to extremely close tolerances, the wear must be judged by feel rather than measurement. Clean each bearing in a high-flash point solvent, dry it (do not spin the bearing while it is dry), and oil it with engine oil.
 - Spin [A] the bearing by hand to check its condition.
 - ★ If the bearing is noisy, does not spin smoothly, or has any rough spots, replace it.
- Check the needle bearings.
 - The rollers in a needle bearing normally wear very little, and wear is difficult to measure. Instead of measuring, inspect the bearing for abrasion, color change, or other damage.
 - ★ If there is any doubt as to the condition of a needle bearing, replace it.



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Oil Seal Inspection

- Inspect the oil seal.
- ★ Replace it if the lips are misshapen, discolored (indicating that the rubber has deteriorated), hardened or otherwise damaged.

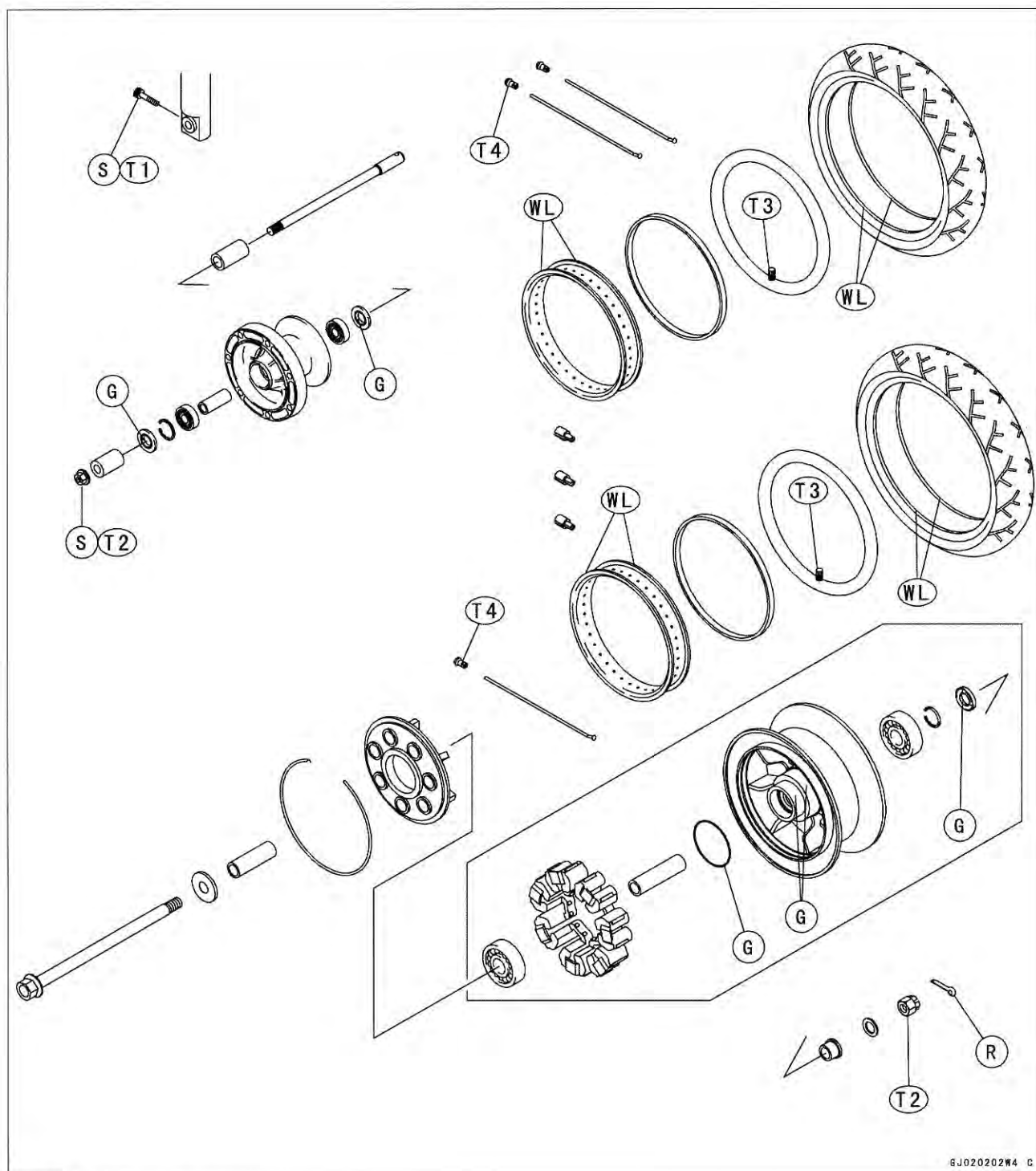
Wheels/Tires

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9-2 WHEELS/TIRES

Exploded View



GJ020202W4 C

G: Apply grease.

R: Replacement Parts

S: Follow the specific tightening sequence.

WL: Apply soap and water solution or rubber lubricant.

T1: 34 N·m (3.5 kg·m, 25 ft·lb)

T2: 110 N·m (11 kg·m, 79.6 ft·lb)

T3: 1.5 N·m (0.15 kg·m, 13 in·lb)

T4: 2.9 ~ 7.4 N·m (0.30 ~ 0.75 kg·m, 26 ~ 65 in·lb)

Specifications

Item			Standard	Service Limit
Wheels (Rims):				
Rim runout:	Front	Axial	TIR 0.8 mm or less (with tire installed)	TIR 2.0 mm
		Radial	TIR 0.8 mm or less (with tire installed)	TIR 1.5 mm
	Rear	Axial	TIR 0.8 mm or less (with tire installed)	TIR 2.0 mm
		Radial	TIR 0.8 mm or less (with tire installed)	TIR 1.5 mm
Axle runout/100 mm			TIR 0.05 mm or less	TIR 0.2 mm
Wheel balance			10 g or less	---
Balance weights			10 g, 20 g, 30 g	
Tires:				
Air pressure (when cold):				
	Front	Up to 183 kg (403 lb) load: 200 kPa (2.00 kg/cm ² , 28 psi)	---	
	Rear	Up to 97.5 kg (215 lb) load: 250 kPa (2.50 kg/cm ² , 36 psi)	---	
		97.5 ~ 183 kg (215 ~ 403 lb) load: 280 kPa (2.80 kg/cm ² , 40 psi)	---	
Tread depth:				
	Front	BRIDGESTONE: 6.2 mm (except EU) DUNLOP: 4.5 mm (EU)	1 mm	
	Rear	BRIDGESTONE: 7.2 mm (except EU) DUNLOP: 7.3 mm (EU)	Up to 130 km/h (80 mph): 2 mm Over 130 km/h (80 mph): 3 mm	
Standard tires:			Make, Type	Size
	Front	BRIDGESTONE EXEDRA G703G, Tube type DUNLOP D404FN, Tube type	130/90-16 67H	
	Rear	BRIDGESTONE EXEDRA G702G, Tube type DUNLOP D404G, Tube type	150/80B16 71H	

EU: European Models

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

Inside Circlip Pliers: 57001-143

Bearing Driver Set: 57001-1129

Bearing Remover Shaft, $\phi 13$: 57001-1377

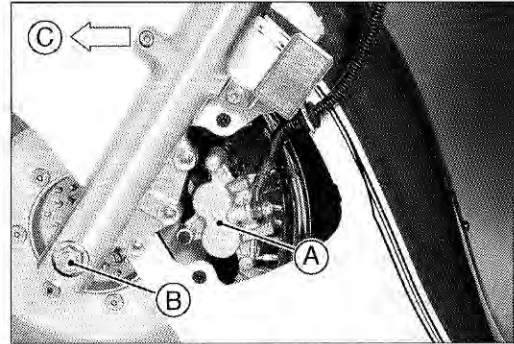
Bearing Remover Head, $\phi 20 \times \phi 22$: 57001-1293

9-4 WHEELS/TIRES

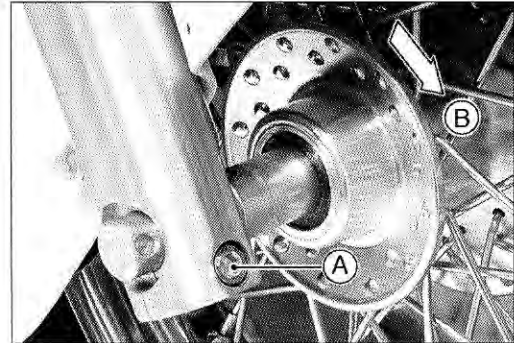
Wheels (Rims)

Front Wheel Removal

- Remove the brake caliper [A] with the hose installed (see Brakes chapter).
- Loosen the front axle nut [B].
Front [C]



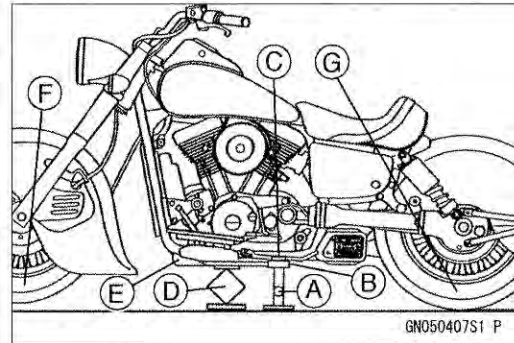
- Loosen:
Front Axle Clamp Bolt [A]
Front [B]



- Using the jack [A] and the attachment jack [B] under the frame pipe ribs [C], and a commercially available jack [D] under the engine [E], lift the front wheel OFF the ground until the rear wheel [G] touches the ground.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398



CAUTION

Be sure to put the rear wheel **ON** the ground when removing the front wheel, or the motorcycle may fall over. The motorcycle could be damaged.

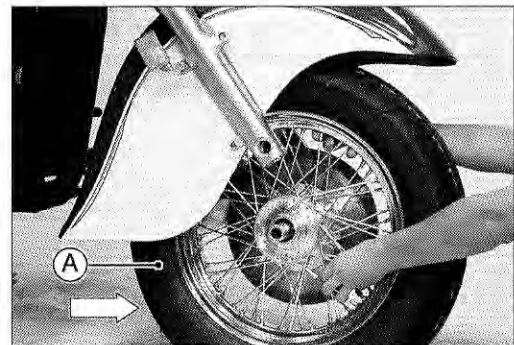
⚠ WARNING

Be sure to put the rear wheel **ON** the ground when removing the front wheel, or the motorcycle may fall over. It could cause an accident and injury.

- Remove the front axle nut.
- Pull out the axle to the right and drop the front wheel [A] out of the fork, while tilting the wheel a little.

CAUTION

Do not lay the wheel directly on the ground with the disc facing down. This can damage or warp the disc. Place blocks under the wheel so that the disc does not touch the ground.



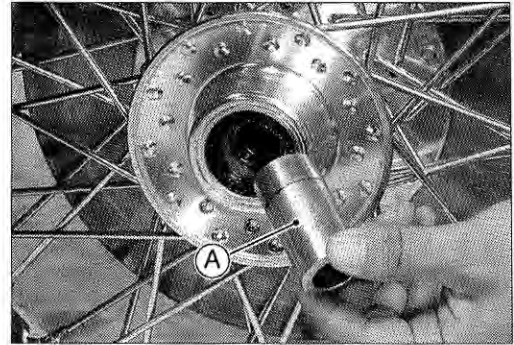
Wheels (Rims)

Front Wheel Installation

- Apply grease to the seal lips.
- Fit the shorter collar on the left side and the longer collar [A] on the right side of the hub.
- Insert the axle from the right side of the wheel.
- Tighten the axle and front axle clamp bolt.

Torque - Front Axle Nut: 110 N·m (11 kg·m, 79.6 ft·lb)
 Front Axle Clamp Bolt: 34 N·m (3.5 kg·m, 25 ft·lb)
 Front Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)

- Check the front brake effectiveness.



⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever is obtained by pumping the brake lever until the pads are against the disc. The brakes will not function on the first application of the lever if this is not done.

Rear Wheel Removal

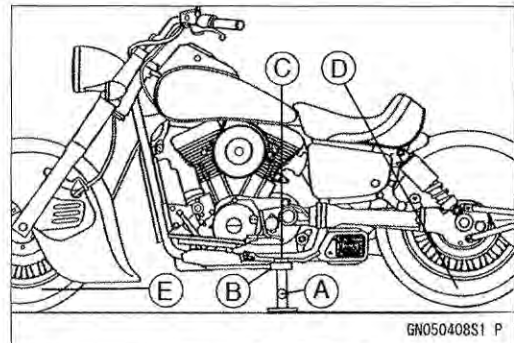
- Using the jack [A] and attachment jack [B] under the frame pipe ribs [C], lift the rear wheel [D] off the ground until the front wheel [E] touches the ground.

CAUTION

Be sure to put the front wheel ON the ground when removing the rear wheel, or the motorcycle may fall over. The motorcycle could be damaged.

⚠ WARNING

Be sure to put the front wheel ON the ground when removing the rear wheel, or the motorcycle may fall over. It could cause an accident and injury.



Special Tools - Jack: 57001-1238
 Attachment Jack: 57001-1398

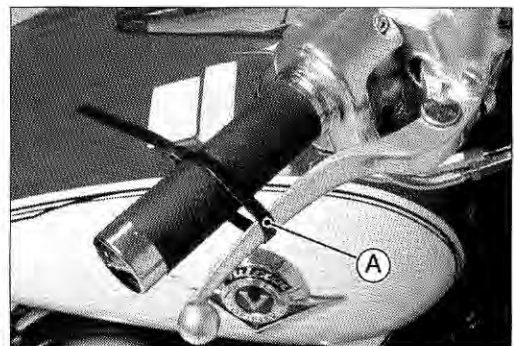
- Squeeze the brake lever slowly and hold it with a band [A]

CAUTION

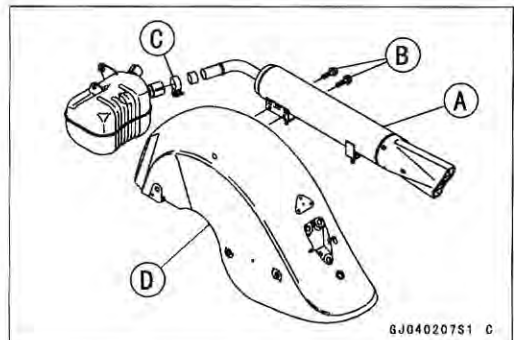
Be sure to hold the front brake when removing the rear wheel, or the motorcycle may fall over. The motorcycle could be damaged.

⚠ WARNING

Be sure to hold the front brake when removing the rear wheel, or the motorcycle may fall over. It could cause an accident and injury.



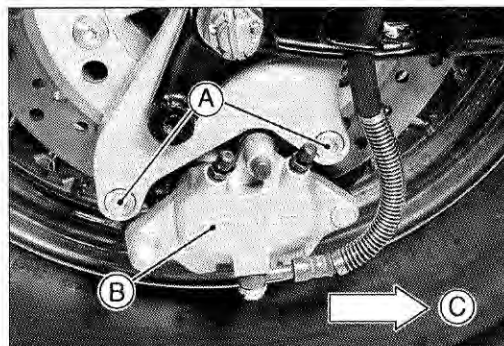
- Take off the silencer [A] by removing bolts [B] and loosening clamp [C].
- Remove the rear fender [D] (see Frame chapter).



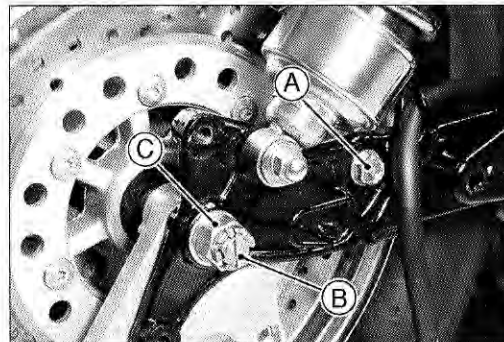
9-6 WHEELS/TIRES

Wheels (Rims)

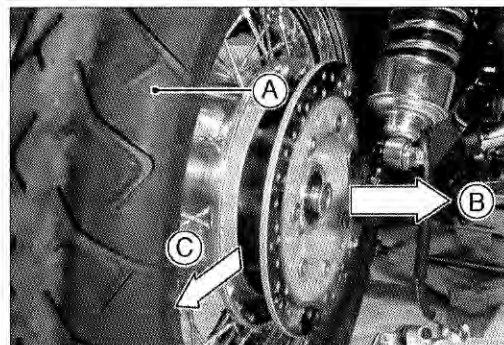
- Remove:
 - Caliper Mounting Bolts [A]
 - Caliper [B]
 - Front [C]



- Remove:
 - Caliper Holder Bolt [A]
 - Axle Nut Cotter Pin [B]
 - Axle Nut [C]



- Pull out the axle, and slide the rear wheel [A] toward the right [B] to disengage the wheel from the final gear case.
- Move the rear wheel back [C] and remove it.

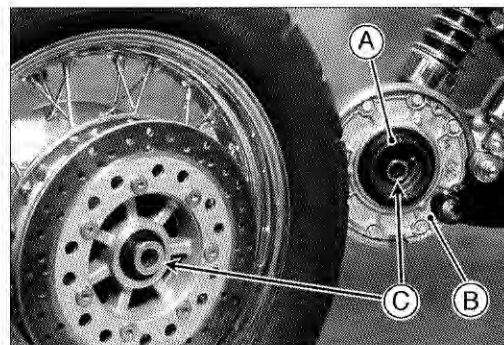


CAUTION

Do not lay the wheel directly on the ground with the disc facing down. This can damage or warp the disc. Place blocks under the wheel so that the disc does not touch the ground.

Rear Wheel Installation

- Apply grease to the grease seal of the wheel.
- Apply grease to the ring gear hub splines [A] of the final gear case [B].
- Insert the collars [C] on both sides of the hub.



- Insert the axle [A] from the left side of the rear wheel [B].
- Slide the rear wheel to the left side, and engage the ring gear hub splines with the wheel coupling hub splines.
- Pull the axle little and install the caliper holder.
- Tighten:

Torque - Rear Axle Nut: 110 N·m (11 kg·m, 79.6 ft·lb)
Rear Caliper Holder Bolt: 64 N·m (6.5 kg·m, 47 ft·lb)
Rear Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)



WARNING

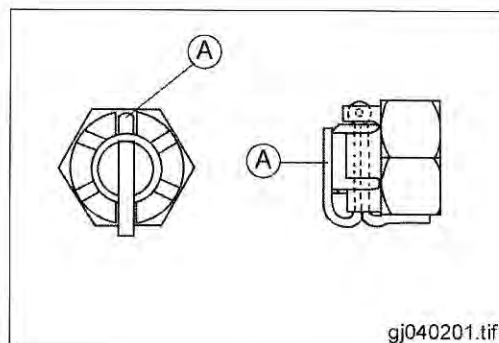
If the axle nut is not securely tightened, an unsafe riding condition may result.

Wheels (Rims)

- Insert a new cotter pin [A] and bend it over the nut as shown.
- Check the rear brake effectiveness.

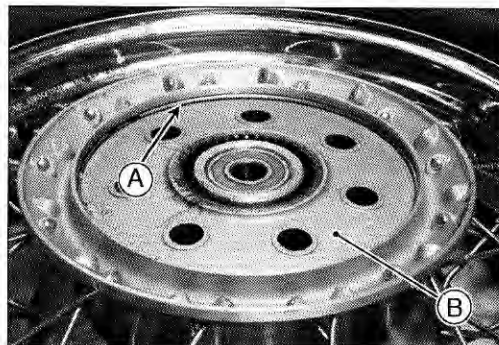
⚠ WARNING

Do not attempt to ride the motorcycle until a full brake pedal is obtained by pumping the brake pedal until the pads are against the disc. The brake will not function on the first application of the pedal if this is not done.



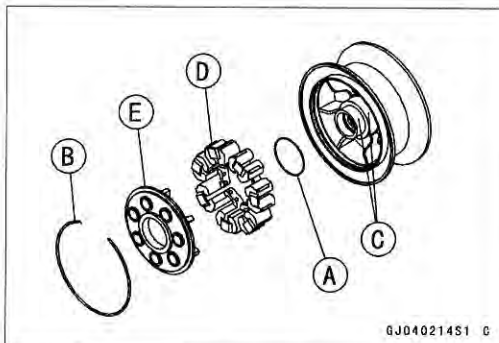
Wheel Coupling Removal

- Remove the rear wheel (see Rear Wheel Removal).
- Remove the coupling retaining ring [A].
- Remove the wheel coupling [B] with a bearing puller if necessary.



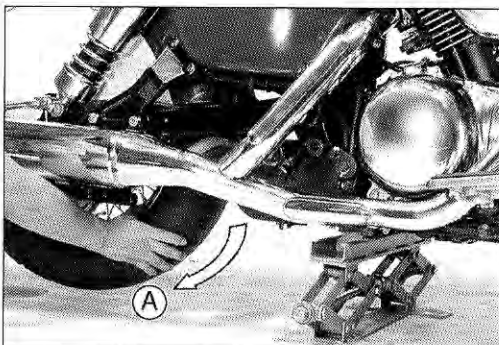
Wheel Coupling Installation

- Replace the O-ring [A] and the retaining ring [B].
- Grease the following:
 - O-ring
 - Bosses [C] of Rear Drum Hub
- Install:
 - Rubber Damper [D]
 - Coupling [E]
 - Retaining Ring



Wheel Inspection

- Raise the front or rear wheel off the ground.
 - Special Tools - Jack: 57001-1238**
 - Attachment Jack: 57001-1398**
- Spin [A] the wheel lightly, and check for roughness or binding.
 - ★ If roughness or binding is found, replace the hub bearings.
- Inspect the front and rear axles for damage (see this chapter).
 - ★ If the axle is damaged or bent, replace it.



Spoke Inspection

- Check that all the spokes are tightened evenly.
 - ★ If spoke tightness is uneven or loose, tighten the spoke nipples evenly.
- Torque - Spoke Nipples: 2.9 ~ 7.4 N·m (0.30 ~ 0.75 kg·m, 26 ~ 65 in·lb)**
- Check the rim runout.

⚠ WARNING

If any spoke breaks, it should be replaced immediately. A missing spoke places an additional load on the other spokes, which will eventually cause other spokes to break.

9-8 WHEELS/TIRES

Wheels (Rims)

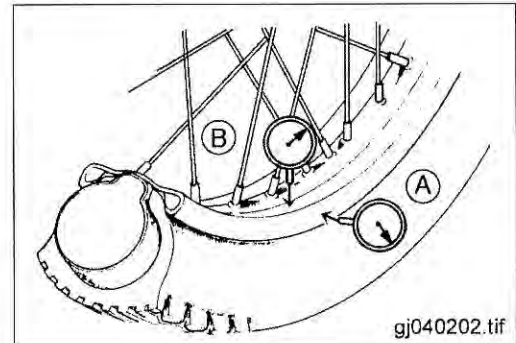
Rim Inspection

- Raise the front or rear wheel off the ground.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

- Inspect the rim for small cracks, dents, bending, or warping.
- ★ If there is any damage to the rim, it must be replaced.
- Set a dial gauge against the side of the rim, and rotate the rim to measure the axial runout [A]. The difference between the highest and lowest dial readings is the amount of runout.
- Set a dial gauge against the outer circumference of the rim, and rotate the rim to measure the radial runout [B]. The difference between the highest and lowest dial reading is the amount of runout.



NOTE

- The weld of the rim may show excessive runout. Disregard this weld when measuring runout.
- ★ If the rim runout exceeds the service limit, check the wheel bearings first. Replace them if they are damaged.
- ★ If the problem is not due to the bearings, correct the rim warp (runout).
- A certain amount of rim warp can be corrected by recentering the rim. Loosen some spokes and tighten others within the standard torque to change the position of different parts of the rim. If the rim is badly bent, however, it must be replaced.

Rim Runout (with tire installed)

Standard:

Front:	Axial: TIR 0.8 mm or less
	Radial: TIR 0.8 mm or less
Rear:	Axial: TIR 0.8 mm or less
	Radial: TIR 0.8 mm or less

Service Limit:	Axial: TIR 2.0 mm
	Radial: TIR 1.5 mm

⚠ WARNING

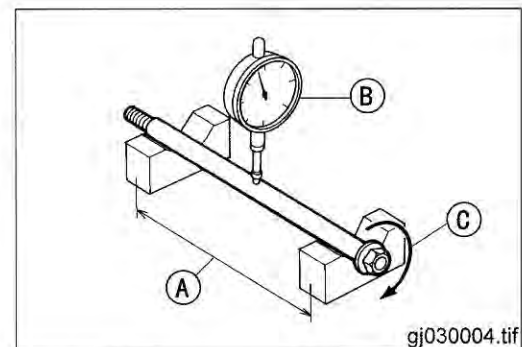
Repairing and reusing the damaged wheel parts are dangerous. If wheel parts are damaged, replace them with new ones.

Axle Inspection

- Visually inspect the front and rear axles for damage.
- ★ If the axle is damaged or bent, replace it.
- Place the axle in V blocks that are 100 mm [A] apart, and set a dial gauge [B] on the axle at a point halfway between the blocks. Turn [C] the axle to measure the runout. The difference between the highest and lowest dial readings is the amount of runout.
- ★ If axle runout exceeds the service limit, replace the axle.

Axle Runout/100 mm

Standard:	TIR 0.05 mm or less
Service Limit:	TIR 0.2 mm



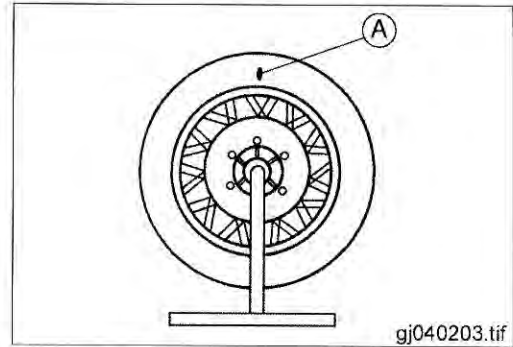
Wheel Balance

- To improve stability and decrease vibration at high speed, the front and rear wheels must be kept balanced.
- Check and balance the wheels when required, or when a tire is replaced with a new one.

Wheels (Rims)

Balance Inspection

- Remove the wheel.
- Support the wheel so that it can be spun freely.
- Spin the wheel lightly, and mark [A] the wheel at the top when the wheel stops.
- Repeat this procedure several times. If the wheel stops of its own accord in various positions, it is well balanced.
- ★ If the wheel always stops in one position, adjust the wheel balance.



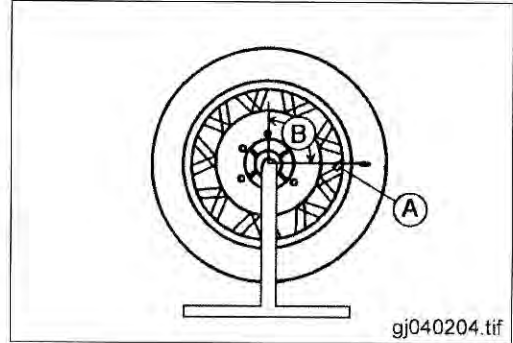
Balance Adjustment

- If the wheel always stops in one position, provisionally attach a balance weight [A] to the spoke at the marking, using adhesive tape.

WARNING

Use only the genuin balance weights.

- Rotate the wheel 1/4 turn [B], and see whether or not the wheel stops in this position. If it does, the correct balance weight is being used.
- ★ If the wheel rotates and the weight goes up, replace the weight with the next heavier size. If the wheel rotates and the weight goes down, replace the weight with the next lighter size. Repeat these steps until the wheel remains at rest after being rotated 1/4 turn.
- Rotate the wheel another 1/4 turn and then another 1/4 turn to see if the wheel is correctly balanced.
- Repeat the entire procedure as many times as necessary to achieve correct wheel balance.
- ★ If proper balance has been achieved, permanently install the balance weight.
- Clamp on the balance weight [A] firmly using pliers.

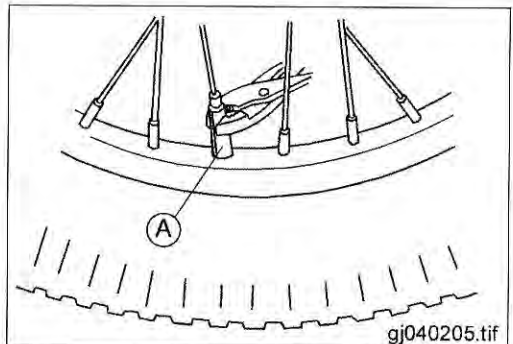


Balance Weight

Part Number	Weight (grams)
41075-1007	10
41075-1008	20
41075-1009	30

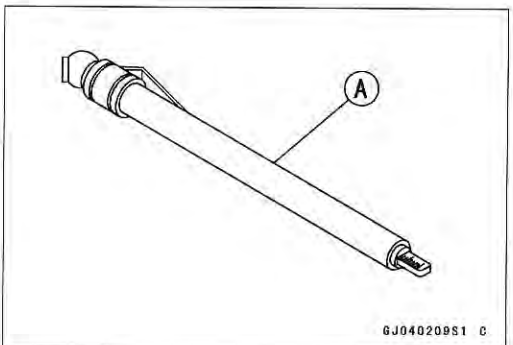
NOTE

- Balance weights are available from Kawasaki Dealers in 10, 20, and 30 gram sizes. An imbalance of less than 10 grams will not usually affect running stability.
- Do not use four or more balance weights (more than 90 gram). If the wheel requires an excess balance weight, remove and disassemble the wheel to find the cause.



Air Pressure Inspection/Adjustment

- Measure the tire air pressure with an air pressure gauge [A] (Owner's Tool: 52005-1031) when the tires are cold (that is, when the motorcycle has not been ridden more than a mile during the past 3 hours).



9-10 WHEELS/TIRES

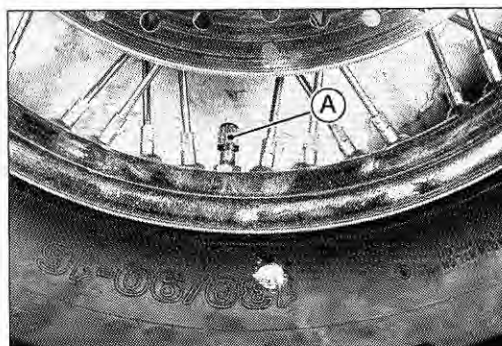
Wheels (Rims)

- ★ Adjust the tire air pressure according to the specifications if necessary.

Air Valve [A]

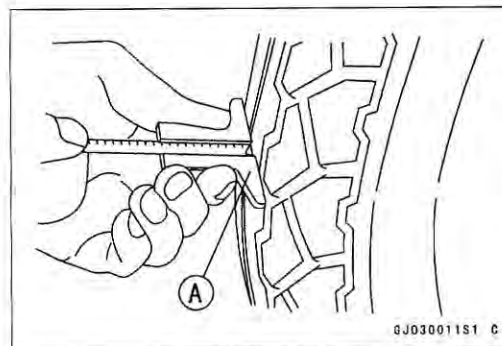
Air Pressure (when cold)

Front	Up to 183 kg (403 lb)	200 kPa (2.00 kg/cm ² , 28 psi)
Rear	Up to 97.5 kg (215 lb)	250 kPa (2.50 kg/cm ² , 36 psi)
	97.5 ~ 183 kg (215 ~ 403 lb)	280 kPa (2.80 kg/cm ² , 40 psi)



Tire Inspection

- As the tire tread wears down, the tire becomes more susceptible to puncture and failure. An accepted estimate is that 90% of all tire failures occur during the last 10% of tread life (90% worn). So it is false economy and unsafe to use the tires until they are bald.
- Check for any nails, metal pieces, stones, or other foreign particles that may be embedded or stuck in the tires.
- ★ Repair or replace the tire with a new one if necessary.
- Visually inspect the tire for cracks and cuts, replacing the tire in case of damage. Swelling or high spots indicate internal damage, requiring tire replacement.
- Measure the tread depth at the center of the tread with a depth gage [A]. Since the tire may wear unevenly, take measurement at several places.
- ★ If any measurement is less than the service limit, replace the tire.



Thread Depth

BRIDGESTONE	Standard	Service Limit
Front	6.2 mm	1 mm
Rear	7.2 mm	2 mm (Up to 130 km/h) 3 mm (Over 130 km/h)

DUNLOP	Standard	Service Limit
Front	4.5 mm	1 mm
Rear	7.3 mm	2 mm (Up to 130 km/h) 3 mm (Over 130 km/h)

⚠ WARNING

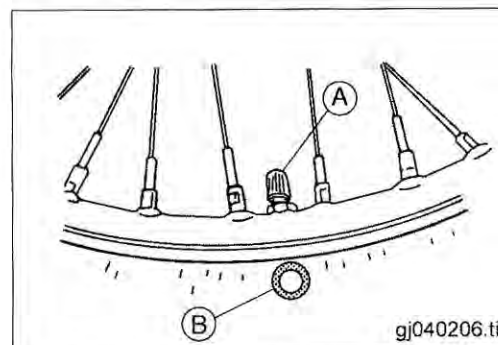
To ensure safe handling and stability, use only the standard tires for replacement, inflated to the standard pressure.
Use the same manufacturer's tires on front and rear wheels.

NOTE

- Most countries may have their own regulations requiring a minimum tire tread depth: be sure to follow them.

Tire Removal

- Remove the following.
 - Wheel (see this chapter)
 - Brake Disc
 - Valve Core (let out the air)
- To maintain wheel balance, mark the valve stem position on the tire with chalk so that the tire can be reinstalled in the same position.
 - Valve Stem [A]
 - Chalk Mark or Yellow Mark [B]



Wheels (Rims)

- Lubricate the tire beads and rim flanges on both sides with a soap and water solution or rubber lubricant. This helps the tire beads slip off the rim flanges.

CAUTION

Never lubricate with engine oil or petroleum distillates because they will deteriorate the tire.

- Remove the tire from the rim using a commercially available tire changer.

NOTE

- *The tires cannot be removed with the bead breaker because they fit the rims too tightly.*

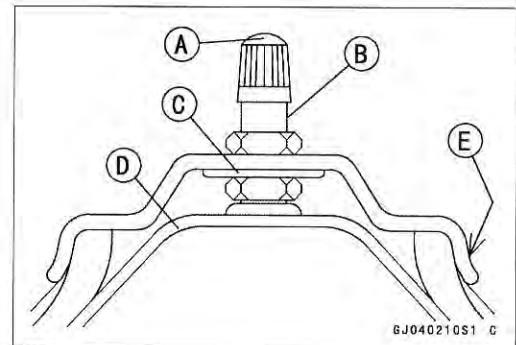
Tire Installation

WARNING

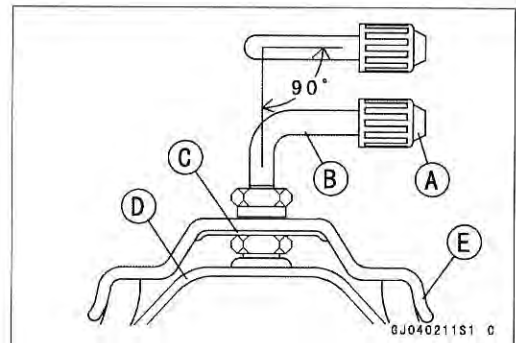
To ensure safe handling and stability, use only the standard tires for replacement, inflated to the standard pressure. Use the same manufacturer's tires on both front and rear wheels.

NOTE

- *Replace the rim band with a new one whenever the tire is replaced.*
- Inspect the rim and tire, and replace them if necessary.
- Clean the sealing surfaces of the rim and tire, and smooth the sealing surfaces of the rim with a fine emery cloth if necessary.
- Insert the valve of the front tube in the front rim.
 - Valve Cap [A]
 - Valve [B]
 - Rim Band [C]
 - Front Tube [D]
 - Front Rim [E]



- Insert the valve of the rear tube in the rear rim.
 - Torque - Tire Air Valve Nuts: 1.5 N·m (0.15 kg·m, 13 in·lb)
 - Valve Cap [A]
 - Valve [B]
 - Rim Band [C]
 - Rear Tube [D]
 - Rear Rim [E]



9-12 WHEELS/TIRES

Wheels (Rims)

- Apply a soap and water solution, or rubber lubricant to the rim flange and tire beads.

CAUTION

Never lubricate with mineral oil (engine oil) or gasoline because they will cause deterioration of the tire.

- Check the tire rotation mark on the front and rear tires and install them on the rim accordingly.
Tire Rotation Mark [A]
Rotation Direction [B]
- Install the front tire on the rim so that the larger flange of the drum hub faces left.
- Install the rear tire on the rim so that the damper faces left.
- Position the tire on the rim so that the valve [A] is at the tire balance mark [B] (the chalk mark made during removal, or the yellow paint mark on a new tire).
- Install the tire bead over the rim flange using a commercially available tire changer.
- Lubricate the tire beads and rim flanges with a soap and water solution or rubber lubricant to help seat the tire beads in the sealing surfaces of the rim while inflating the tire.
- Center the rim in the tire beads, and inflate the tire with compressed air until the tire beads seat in the sealing surfaces.

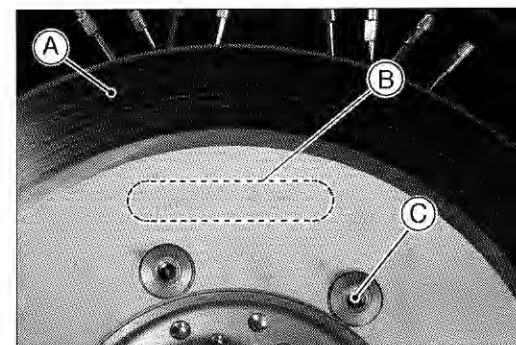
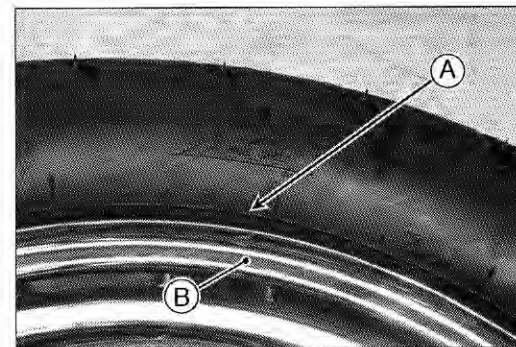
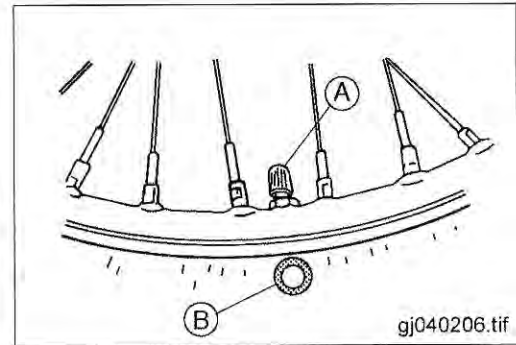
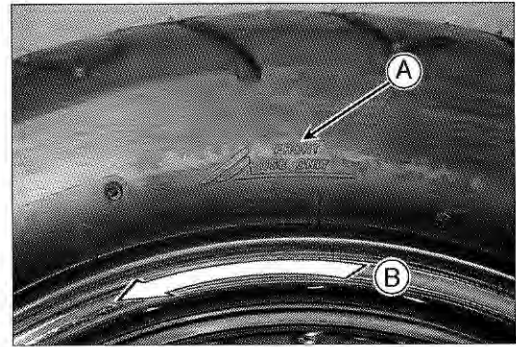
WARNING

Be sure to install the valve core whenever inflating the tire, and do not inflate the tire to more than 400 kPa (4.0 kg/cm², 57 psi). Overinflation can explode the tire with possibility of injury and loss of life.

- Check to see that the bead lines [A] on both sides of the tire sidewalls are parallel with the rim flanges.
 - ★ If the rim flanges and tire sidewall bead lines are not parallel, remove the valve core.
 - Lubricate the rim flanges and tire beads.
 - Install the valve core and inflate the tire again.
 - After the tire beads seat in the rim flanges, check for air leakage.
 - Inflate the tire slightly above standard inflation.
 - Use a soap and water solution or submerge the tire, and check for bubbles that would indicate leakage.
 - Adjust the air pressure to the specified pressure (see Tire Inspection).
 - Install the brake disc [A] so that the marked side [B] faces out.
 - Apply a non-permanent locking agent, and tighten the brake disc bolts [C].
- Torque - Brake Disc Bolts: 27 N·m (2.8 kg·m, 20 ft·lb)**
- Adjust the wheel balance.

WARNING

Check and balance the wheel when a tire is replaced with a new one.

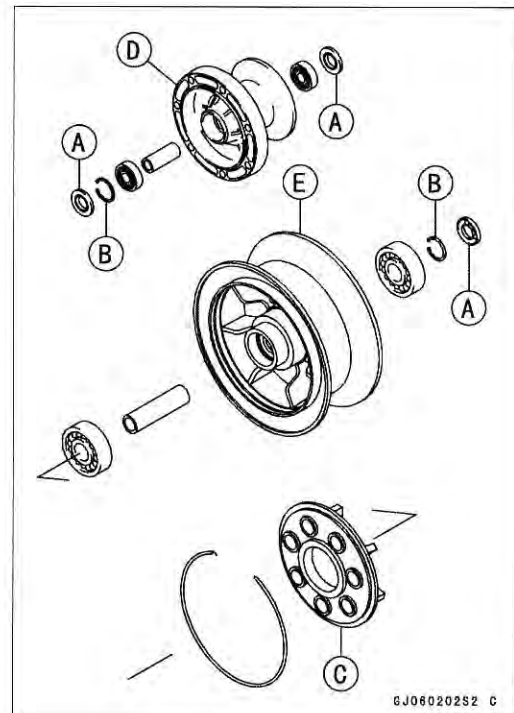


Hub Bearings (Wheel Bearings)

Removal

- Remove the wheel, and take out the following.
 - Collars
 - Grease Seals [A]
 - Circlips [B]
 - Coupling [C] (Out of Rear Hub)
 - Front Hub [D]
 - Rear Hub [E]

Special Tool - Inside Circlip Pliers: 57001-143

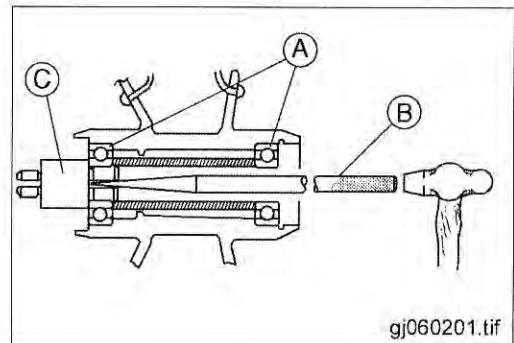


- Use the bearing remover (special tools) to remove the hub bearings [A].

CAUTION

Do not lay the wheel directly on the ground with the disc facing down. This can damage or warp the disc. Place blocks under the wheel so that the disc does not touch the ground.

**Special Tools - Bearing Remover Shaft, $\phi 13$: 57001-1377 [B]
Bearing Remover Head, $\phi 20 \times \phi 22$: 57001-1293 [C]**



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Installation

- Before installing the wheel bearings, blow any dirt or foreign particles out of the hub with compressed air to prevent contamination of the bearings.
- Replace the bearings with new ones.

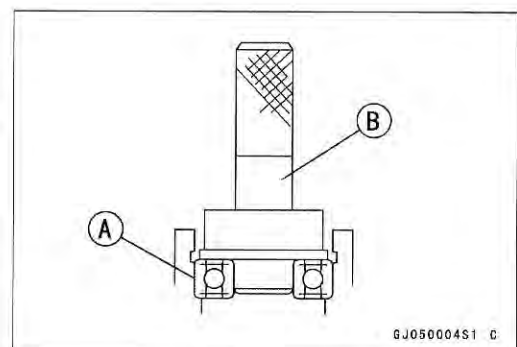
NOTE

○ Install the bearings so that the marked side faces out.

- Install the bearings by using a bearing driver which does not contact the bearing inner race.
- First, press each bearing in until it bottoms out.
 - Left Bearing (front hub) [A]
 - Right Bearing (rear hub) [A]

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

- Next, install the following:
 - New Circlip
 - Distance Collar
 - Right Bearing (front hub)
 - Left Bearing (rear hub)



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9-14 WHEELS/TIRES

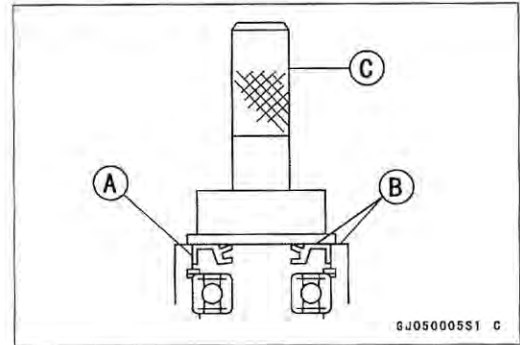
Hub Bearings (Wheel Bearings)

- Replace the circlips with new ones.

Special Tool - Inside Circlip Pliers: 57001-143

- Replace the grease seals with new ones.
- Press in the grease seals [A] so that the seal surface is flush [B] with the end of the hole.
- Apply high temperature grease to the grease seal lips.

Special Tool - Bearing Driver Set: 57001-1129 [C]

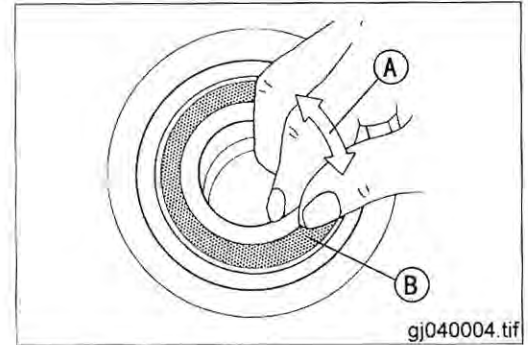


Inspection

- Since the hub bearings are made to extremely close tolerance, the clearance cannot normally be measured.

NOTE

- *Do not remove any bearings for inspection. If any bearings are removed, they will need to be replaced with new ones.*
- Turn each bearing in the hub back and forth [A] while checking for plays, roughness, or binding.
- ★ If bearing play, roughness, or binding is found, replace the bearing.
- Examine the bearing seal [B] for tears or leakage.
- ★ If the seal is torn or is leaking, replace the bearing.



Lubrication

NOTE

- *Since the hub bearings are packed with grease and sealed, lubrication is not required.*

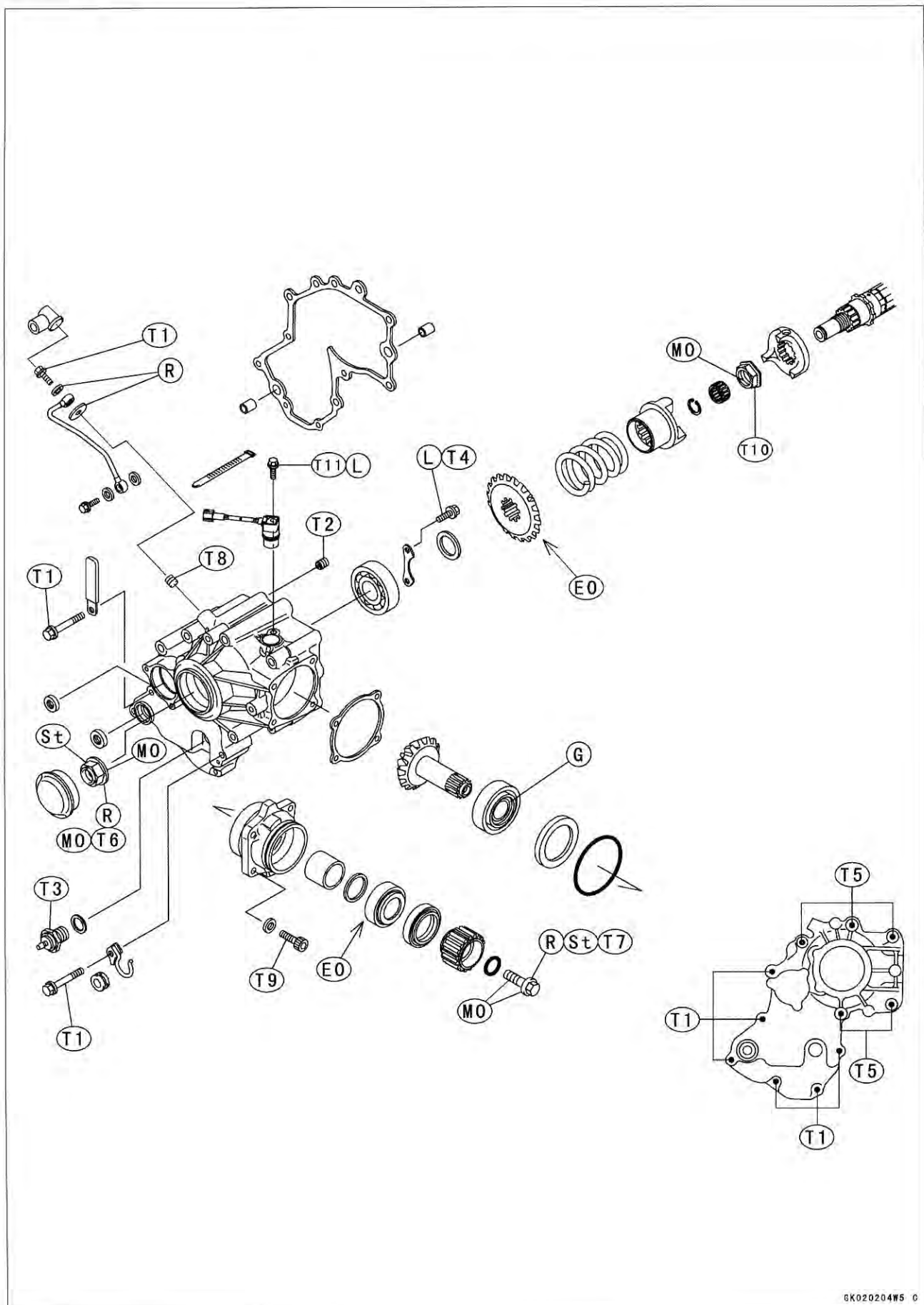
Final Drive

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10-2 FINAL DRIVE

Exploded View



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Exploded View

Front Gear Case

EO: Apply engine oil.

G: Apply grease.

L: Apply a non-permanent locking agent.

MO: Apply molybdenum disulfide oil.

R: Replacement Parts

St: Stake the fasteners.

T1: 12 N·m (1.2 kg·m, 104 in·lb)

T2: 18 N·m (1.8 kg·m, 13 ft·lb)

T3: 15 N·m (1.5 kg·m, 11 ft·lb)

T4: 8.8 N·m (0.90 kg·m, 78 in·lb)

T5: 29 N·m (3.0 kg·m, 22 ft·lb)

T6: 265 N·m (27 kg·m, 195 ft·lb)

T7: 137 N·m (14 kg·m, 101 ft·lb)

T8: 2.9 N·m (0.30 kg·m, 26 in·lb)

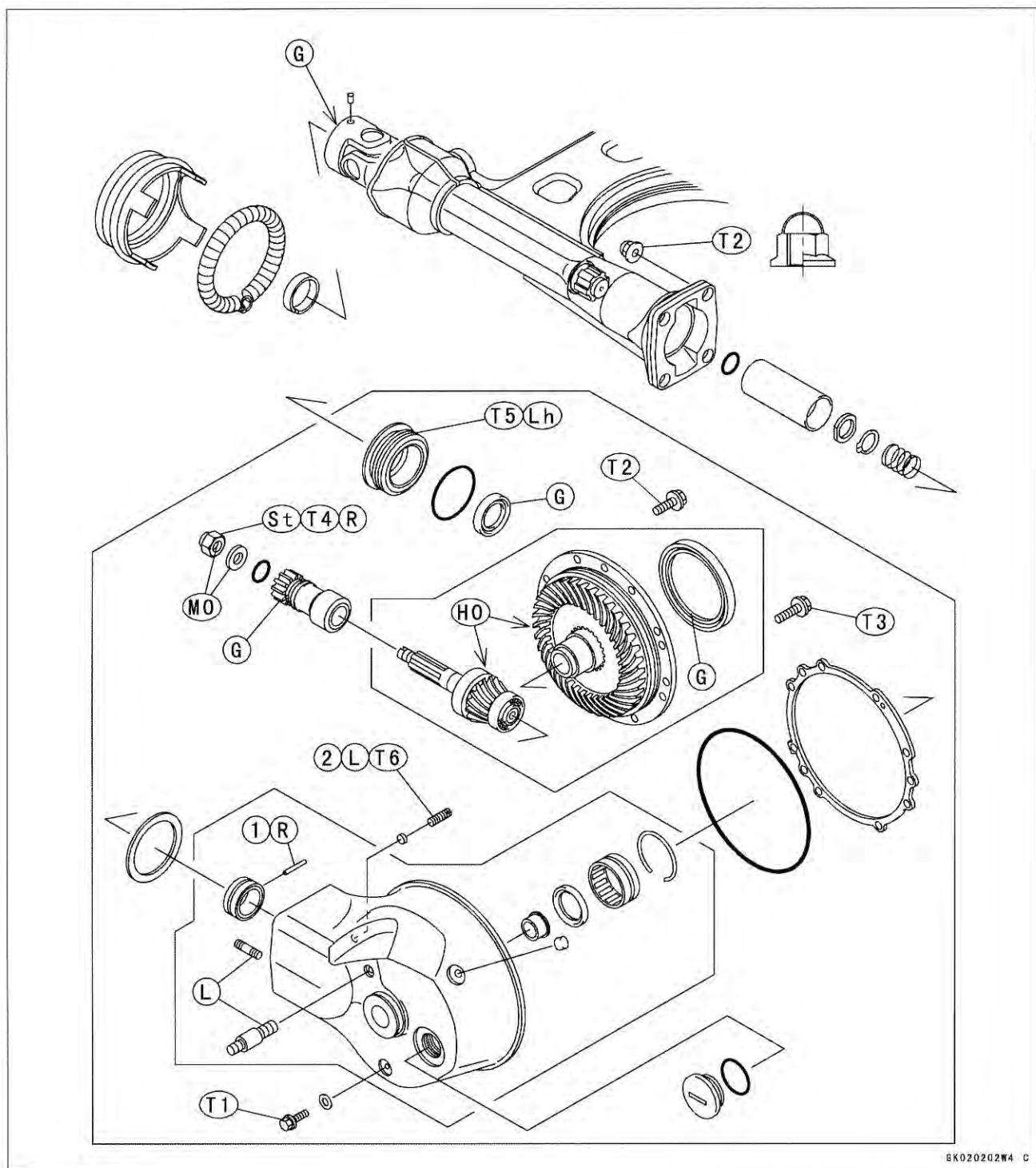
T9: 25 N·m (2.5 kg·m, 18 ft·lb)

T10: 226 N·m (23 kg·m, 166 ft·lb)

T11: 9.8 N·m (1.0 kgm, 87 in·lb)

10-4 FINAL DRIVE

Exploded View



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Final Gear Case

- G: Apply grease.
- L: Apply a non-permanent locking agent.
- MO: Apply molybdenum disulfide oil.
- Lh: Left-hand Threads
- O: Apply oil.
- HO: Apply hypoid gear oil.
- R: Replacement Parts
- St: Stake the fasteners.

- 1. Spring Pin
- 2. Retainer Stop Screw
- T1: 8.8 N·m (0.90 kg·m, 78 in·lb)
- T2: 34 N·m (3.5 kg·m, 25 ft·lb), $\phi 10$
- T3: 23 N·m (2.3 kg·m, 17 ft·lb), $\phi 8$
- T4: 128 N·m (13.1 kg·m, 94 ft·lb)
- T5: 245 N·m (25 kg·m, 181 ft·lb)
- T6: 16 N·m (1.6 kg·m, 12 ft·lb)

Specifications

Item	Standard
Final Gear Case Oil Grade Viscosity Oil level Amount	API Service Classification: GL-5 hypoid gear oil When above 5°C (41°F) SAE90 When below 5°C (41°F) SAE80 Filler opening bottom 200 mL
Final Bevel Gear Backlash	0.06 ~ 0.09 mm (at gear hub spline)
Propeller Shaft Joint Grease	20 mL, high-temperature grease
Front Bevel Gear Backlash	0.10 ~ 0.15 mm (at gear tooth)
Preload for Front Bevel Gear Bearing Torque wrench Spring scale	0.5 ~ 0.9 N·m (0.05 ~ 0.09 kg·m, 4.3 ~ 7.8 in·lb) 2.5 ~ 4.4 N (0.25 ~ 0.45 kg, 0.6 ~ 0.9 lb)

Special Tools - Oil Seal & Bearing Remover: 57001-1058
Jack: 57001-1238
Attachment Jack: 57001-1398
Pinion Gear Holder: 57001-1165
Bearing Retainer Wrench: 57001-1251
Drive Shaft Holder: 57001-1407
Bearing Driver Set: 57001-1129
Bearing Driver: 57001-382
Damper Cam Holder: 57001-1025
Driven Gear Holder: 57001-1027
Bearing Puller: 57001-158
Bearing Puller Adapter: 57001-317
Driver-Filler Cap: 57001-1454

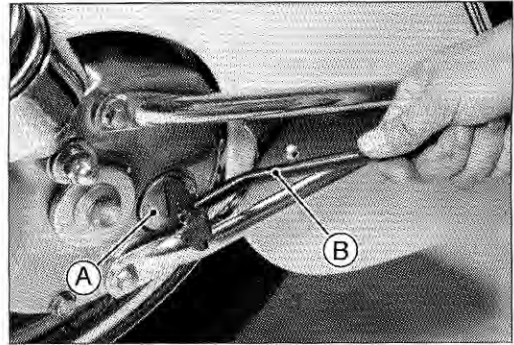
10-6 FINAL DRIVE

Final Gear Case Oil

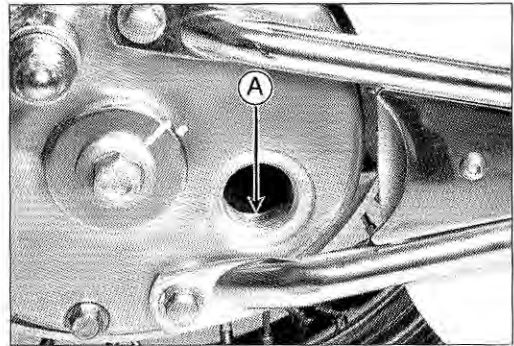
Oil Level Inspection

- Support the motorcycle perpendicular to the ground.
- Unscrew the filler plug [A], using the driver-filler cap [B] (special tool).

Special Tool - Driver-Filler Cap: 57001-1454



- The oil level [A] should come to the bottom of the filler opening.
- ★ If it is low, first check the final gear case for oil leakage, remedy it if necessary, and add oil through the filler opening. Use the same type and brand of oil that is already in the final gear case.
- Install the filler plug.



Oil Change

- Warm up the oil by running the motorcycle so that the oil will pick up any sediment and drain easily. Stop the motorcycle and turn the ignition switch OFF.
- Place an oil pan beneath the final gear case, and remove the drain plug.

⚠ WARNING

When draining or filling the final gear case, be careful that no oil gets on the tire, spoke, or rim. Clean off any oil that inadvertently gets on them with a high-flash point solvent.

- After the oil has completely drained out, install the drain plug [A] with a new gasket.

Torque - Final Gear Case Drain Plug: 8.8 N·m (0.90 kg·m, 78 in·lb)

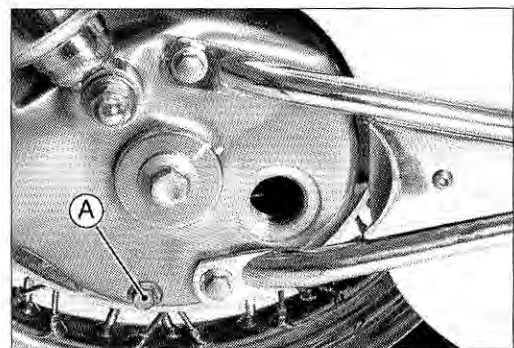
- Fill the final gear case with the specified oil and quantity.

Final Gear Case Oil:

Amount: 200 mL
Grade: API GL-5 hypoid gear oil
Viscosity: When above 5°C (41°F) SAE 90
When below 5°C (41°F) SAE 80

NOTE

- The term "GL-5" indicates a quality and additive rating. A "GL-6" rated hypoid gear oil can also be used.
- Be sure the O-ring is in place, and install the filler plug.



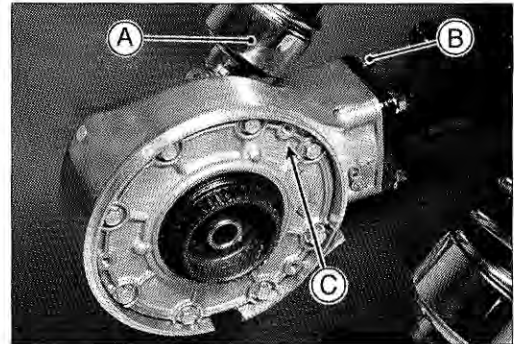
Final Gear Case

Removal

- ★ If the final gear case is to be disassembled, drain the final gear case oil.
- Remove the rear wheel (see Wheels/Tires chapter).
- Remove the left shock absorber [A] from its studs by taking off the nuts.
- Remove the final gear case by taking off the nuts [B]. The spring comes off with the case.

NOTE

- If the final gear case is full of oil, place the case so that the breather hole [C] is on top.

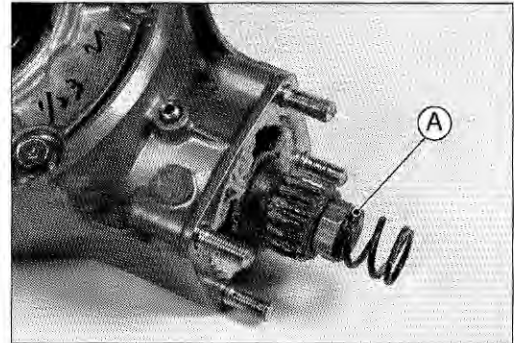


Installation

- Lubricate the propeller shaft joint (see Propeller Shaft Joint Lubrication).
- Install the spring so that the smaller diameter end [A] faces toward the final gear case.
- Fit the pinion gear splines into the propeller shaft joint while turning the ring gear hub.
- Tighten the final gear case mounting nuts to the specified torque.

Torque - Final Gear Case Mounting Nuts: 34 N·m (3.5 kg·m, 25 ft·lb)

- ★ If the final gear case oil was drained, fill the case with oil.

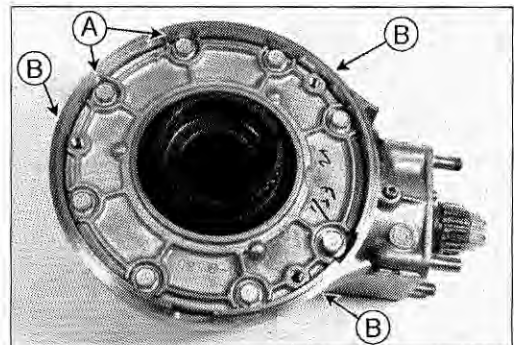


Disassembly

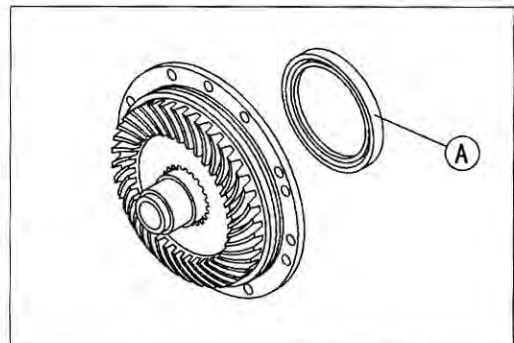
- Remove the final gear case cover bolts [A].
- Use three tapped holes [B] to lift the ring gear assy from the gear case. The shim(s) comes off with the assy.

NOTE

- Do not disassemble the ring gear assy (ring gear, ring gear hub, and final gear case cover), but the oil seal can be removed.



- To remove the ring gear oil seal [A], heat the ring gear assy in an oil bath to 120 ~ 150°C (248 ~ 302°F), then pry out the oil seal with an awl or other tool. Be careful not to scratch the sealing surface on the ring gear hub.



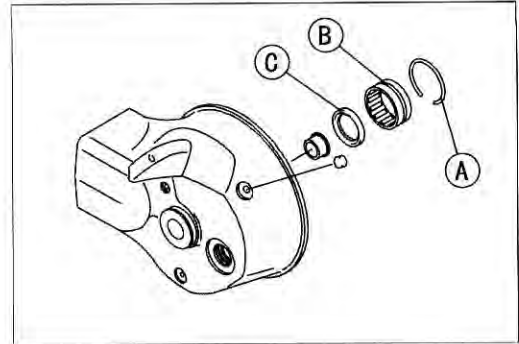
CAUTION

Do not heat the case with a blowtorch. This will warp the case.

10-8 FINAL DRIVE

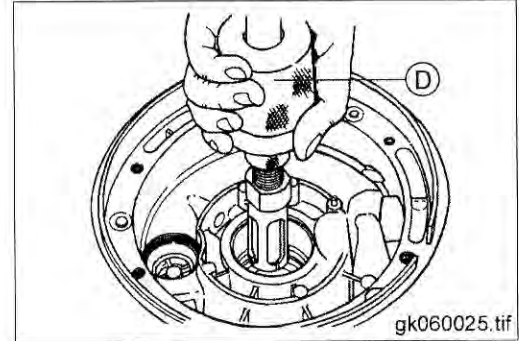
Final Gear Case

- Remove the snap ring [A] and pull out the needle bearing [B].
- ★ If the small ring gear oil seal [C] is damaged, remove it using the oil seal and bearing remover.

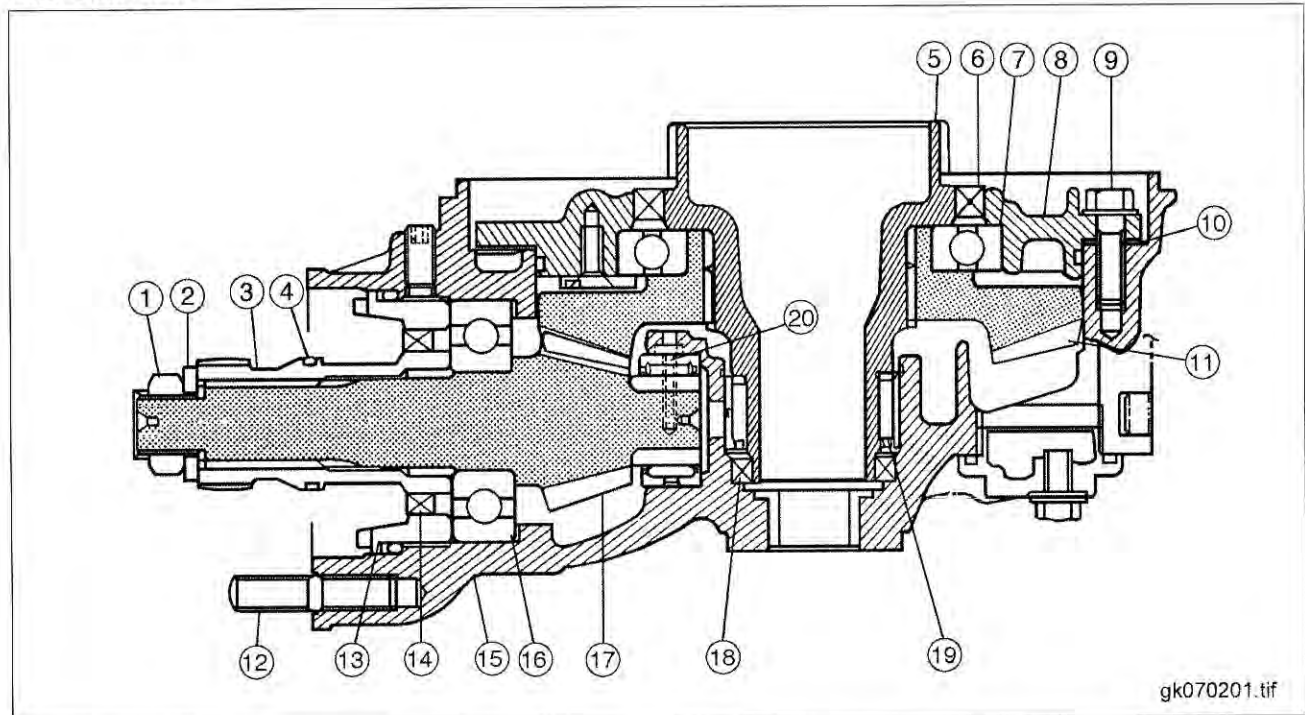


- Remove the small ring gear oil seal if damaged.

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



Final Gear Case



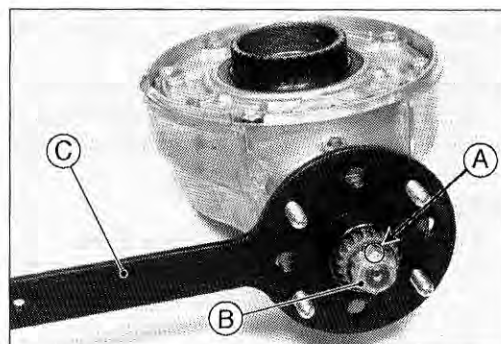
- | | |
|--------------------------|---------------------------------------|
| 1. Pinion Gear Nut | 11. Ring Gear |
| 2. Washer | 12. Studs |
| 3. Pinion Gear Joint | 13. Pinion Bearing Retainer |
| 4. O-ring | 14. Oil Seal |
| 5. Ring Gear Hub | 15. Final Gear Case |
| 6. Ring Gear Oil Seal | 16. Ball Bearing (Four-point Contact) |
| 7. Ball Bearing | 17. Pinion Gear |
| 8. Final Gear Case Cover | 18. Small Ring Gear Oil Seal |
| 9. Cover Mounting Bolts | 19. Needle Bearing |
| 10. Ring Gear Shim(s) | 20. Spring Pin |

Final Gear Case

- Pry open the staking [A] on the pinion gear nut [B], and unscrew the nut while holding the final gear case with the pinion gear holder [C].

Special Tool - Pinion Gear Holder: 57001-1165

- Remove the washer and pinion gear joint with the O-ring.
- Pull out the oil seal in the pinion bearing retainer using a puller.

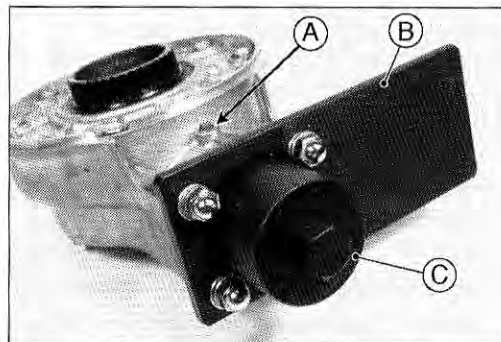


- Remove the retainer stop screw [A] and then unscrew the pinion bearing retainer with the bearing retainer wrench [B], while holding the final gear case with a holder [C].

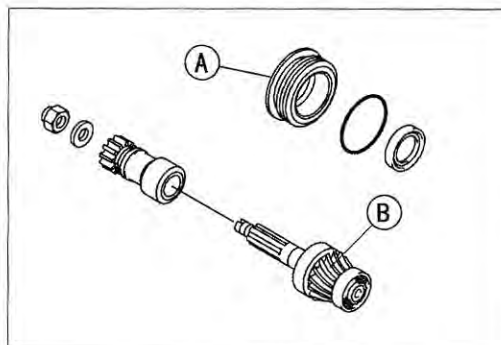
NOTE

- The bearing retainer has left-hand threads, so, turn it clockwise for removal.

Special Tool - Bearing Retainer Wrench: 57001-1251

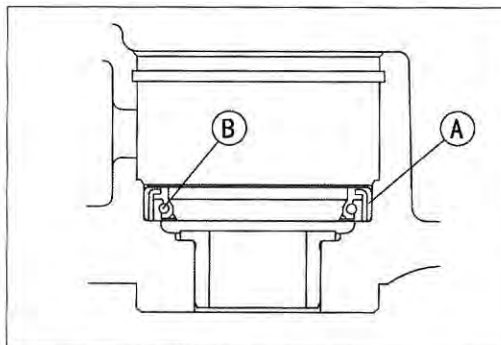


- Take the retainer [A] and pinion gear assy [B] out of the final gear case.
- Pull out the shim, stop screw and plug from the final gear case.

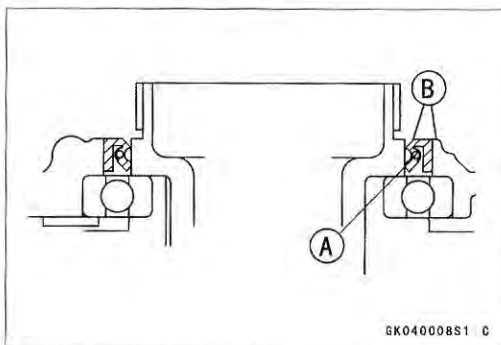


Assembly

- The ring gear and pinion gear are lapped as a set in the factory to get the best tooth contact. They must be installed as a pair, and never replace one without the other.
- Press the small ring gear oil seal [A] until it bottoms out with its spring [B] facing inward.



- Install the ring gear oil seal with its spring [A] facing inward using a suitable driver until the face of the seal is even [B] with the end of the hole.



SK040008S1 C

10-10 FINAL DRIVE

Final Gear Case

- Blow the breather hole [A] in the final gear case cover clean with compressed air.
- Apply a non-permanent locking agent to the threads of each stud and install them to the case if they were removed.
- Reinstall the original ring gear shim(s) to keep the gear backlash and the tooth contact unchanged.
- Tighten:

Torque - Final Gear Case Cover Bolts:

φ10: 34 N·m (3.5 kg·m, 25 ft·lb)

φ8: 23 N·m (2.3 kg·m, 17 ft·lb)

- Install the pinion bearing retainer.
- Reinstall the original pinion gear shim(s) to keep the gear backlash and the tooth contact unchanged.
- Using a holder [B] and bearing retainer wrench [C], tighten the pinion bearing retainer.

Special Tool - Bearing Retainer Wrench: 57001-1251

- Turn the bearing retainer counterclockwise.
- Insert the plug into the retainer stop screw [A].

Non-permanent Locking Agent - Retainer Stop Screw

Torque - Bearing Retainer: 245 N·m (25 kg·m, 181 ft·lb)

Retainer Stop Screw: 16 N·m (1.6 kg·m, 12 ft·lb)

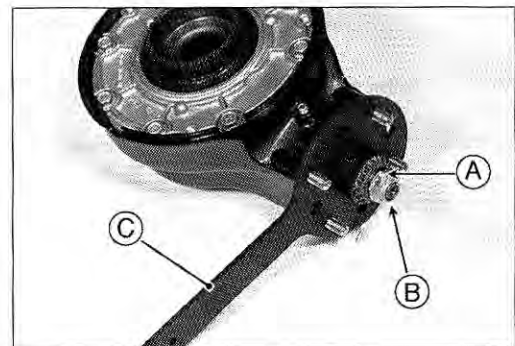
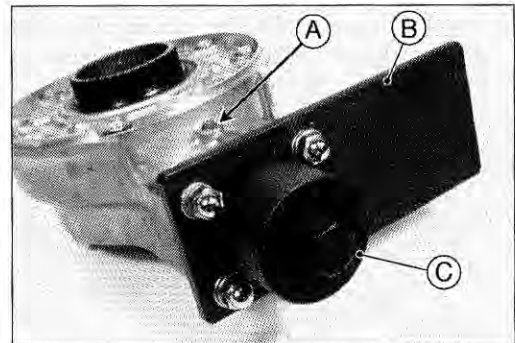
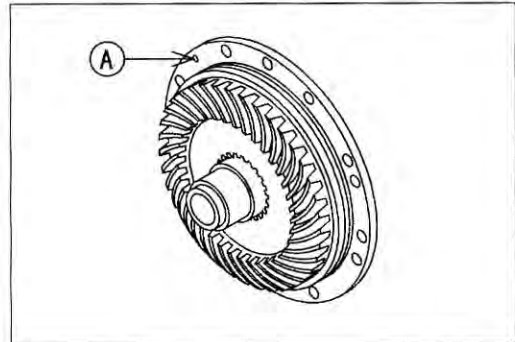
Molybdeum Disulfide Oil - Threads and Seating Surface of Pinion Gear Nut, Washer

- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).
- Using the pinion gear holder [C], tighten the pinion gear nut [B].

Special Tool - Pinion Gear Holder: 57001-1165

Torque - Pinion Gear Nut: 128 N·m (13.1 kg·m, 94 ft·lb)

- Stake [A] the pinion gear nut with a punch.



CAUTION

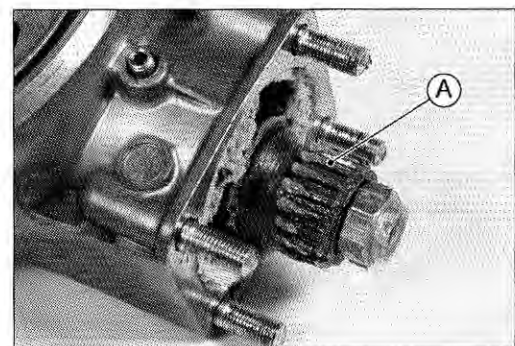
When staking the nut, be careful not to apply shock to the pinion gear and its bearing. Such a shock could damage the pinion gear and/or bearing.

Bevel Gear Inspection

- Visually check the bevel gears for scoring, chipping, or other damage.
- ★ Replace the bevel gears as a set if either gear is damaged.

Pinion Gear Joint Inspection

- Visually inspect the splines [A] of the pinion gear joint.
- ★ If they are badly worn or chipped, replace the joint with a new one. Also, inspect the propeller shaft sliding joint.

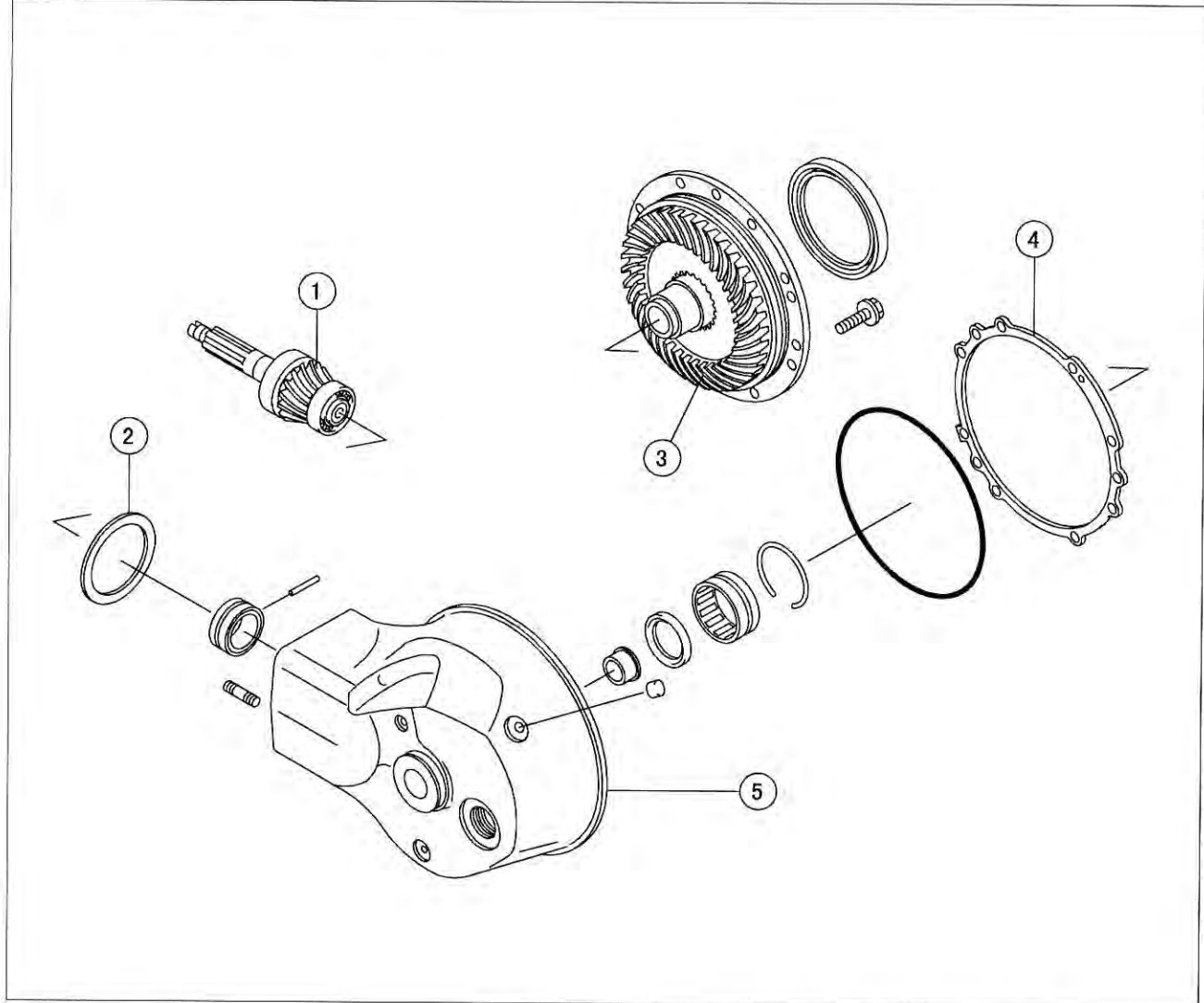


Final Gear Case

Final Bevel Gear Adjustment

- The **backlash** and **tooth contact pattern** of the bevel gears must be correct to prevent the gears from making noise and being damaged.
- After replacing any of the backlash-related parts, be sure to check and adjust the backlash and tooth contact of the bevel gears. First, adjust backlash, and then tooth contact by replacing shims.
- The amount of backlash is influenced by the ring gear position more than by the pinion gear position.
- Tooth contact locations is influenced by pinion gear position more than by ring gear position.

Backlash-Related Parts



1. Pinion Gear

2. Pinion Gear Shim(s)

3. Ring Gear Assy

4. Ring Gear Shim(s)

5. Final Gear Case

10-12 FINAL DRIVE

Final Gear Case

Ring Gear Shims for Backlash Adjustment

Thickness (mm)	Parts Number
0.15	92025-1783
0.5	92025-1784
0.6	92025-1785
0.7	92025-1786
0.8	92025-1787
0.9	92025-1788
1.0	92025-1789
1.2	92025-1790

Pinion Gear Shims for Tooth Contact Adjustment

Thickness (mm)	Parts Number
0.10	92025-1733
0.15	92025-1734
0.5	92025-1735
0.6	92025-1736
0.7	92025-1737
0.8	92025-1738
0.9	92025-1739
1.0	92025-1740
1.2	92025-1741

Backlash Adjustment

- Clean any dirt and oil off the bevel gear teeth with a high-flash point solvent.

CAUTION

Do not install the O-ring or oil seals during adjustment.

- Install the pinion gear assy with the primary shim (**1.0 mm thickness**), and tighten the pinion bearing retainer to the specified torque.

Torque - Pinion Bearing Retainer: 245 N·m (25 kg·m, 180 ft·lb)

- Install the ring gear assy with the primary shim (**1.0 mm thickness**), and tighten the cover bolts to the specified torque.

Torque - Final Gear Case Cover Bolts:

M10: 34 N·m (3.5 kg·m, 25 ft·lb)

M8: 23 N·m (2.3 kg·m, 17 ft·lb)

- Check the backlash during tightening of the cover bolts, and stop tightening them immediately if the backlash disappears. Then, change the ring gear shim to a thicker one.

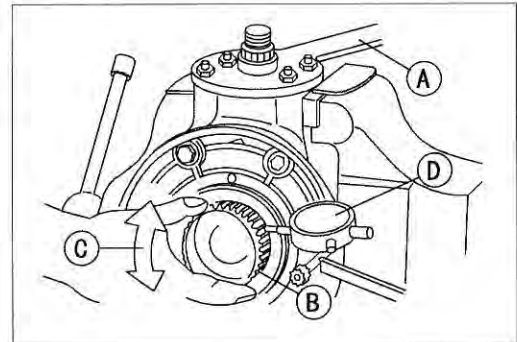
- Mount a dial gage [D] on a vise so that the tip of the gage is against the splines of the ring gear hub.
- To measure the backlash, turn the ring gear hub [B] back and forth [C] while holding the pinion gear steady with the pinion gear holder [A]. The difference between the highest and the lowest gage reading is the amount of backlash.

Special Tool - Pinion Gear Holder: 57001-1165

- Measure backlash at three locations equally spaced on the splines.

**Final Bevel Gear Backlash: 0.06 ~ 0.09 mm
(at ring gear hub splines)**

- ★ If the backlash is out of the limit, replace the ring gear shims. To increase backlash, increase the thickness of the shim(s). To decrease backlash, decrease the thickness of the shim(s).
- ★ Change the thickness a little at a time.
- Recheck the backlash, and readjust as necessary.



Final Gear Case

Tooth Contact Adjustment

- Clean any dirt and oil off the bevel gear teeth with a high-flash point solvent.
- Apply checking compound to 4 or 5 teeth of the pinion gear.

NOTE

- *Apply checking compound to the teeth in a thin, even coat with a fairly stiff paint brush. If painted too thickly, the exact tooth pattern may not appear.*
- *The checking compound must be smooth and firm, with the consistency of tooth paste.*
- *Special compounds are available at automotive supply stores for the purpose of checking differential gear tooth patterns and contact.*
- Install the shim(s) and pinion gear assy, and tighten the bearing retainer to the specified torque.

Torque - Pinion Bearing Retainer: 245 N·m (25 kg·m, 181 ft·lb)

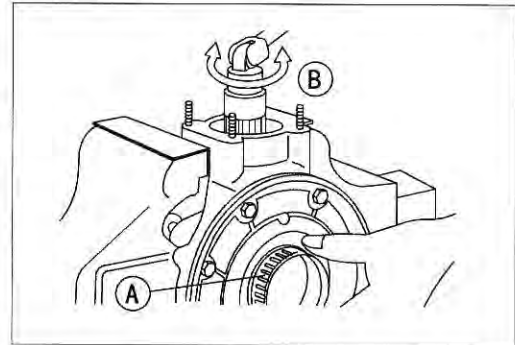
- Install the shim(s) and ring gear assy, and tighten the cover bolts to the specified torque.

Torque - Final Gear Case Cover Bolts:

M10: 34 N·m (3.5 kg·m, 25 ft·lb)

M8: 23 N·m (2.3 kg·m, 17 ft·lb)

- Turn the pinion gear for one revolution [B] back and forth, while creating a drag on the ring gear hub [A].
- Remove the ring gear assy and pinion gear assy to check the drive pattern and coast pattern of the bevel gear teeth. The tooth contact patterns of both (drive and coast) sides should be centrally located between the top and bottom of the tooth. The drive pattern can be a little closer to the toe and the coast pattern can be a somewhat longer and closer to the toe.
- ★ If the tooth contact pattern is incorrect, replace the pinion gear shim(s), following the examples shown. Then erase the tooth contact patterns, and check them again. Also check the backlash every time the shim(s) are replaced. Repeat the shim change procedure as necessary.



NOTE

- *If the backlash is out of the standard range after changing the pinion gear shim(s), replace the ring gear shim(s) to correct the backlash before checking the tooth contact pattern.*

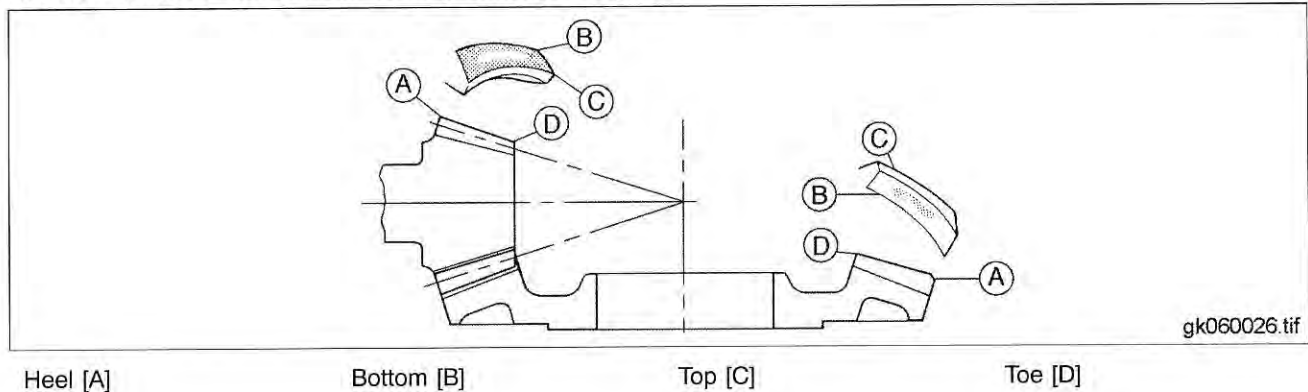
Bevel Gear Inspection

- Remove the ring gear assy and pinion gear from the final gear case (see Ring Gear Disassembly and Pinion Gear Disassembly).
- Visually check the bevel gears for scoring, chipping, or other damage.
- ★ Replace the bevel gears as a set if either gear is damaged.

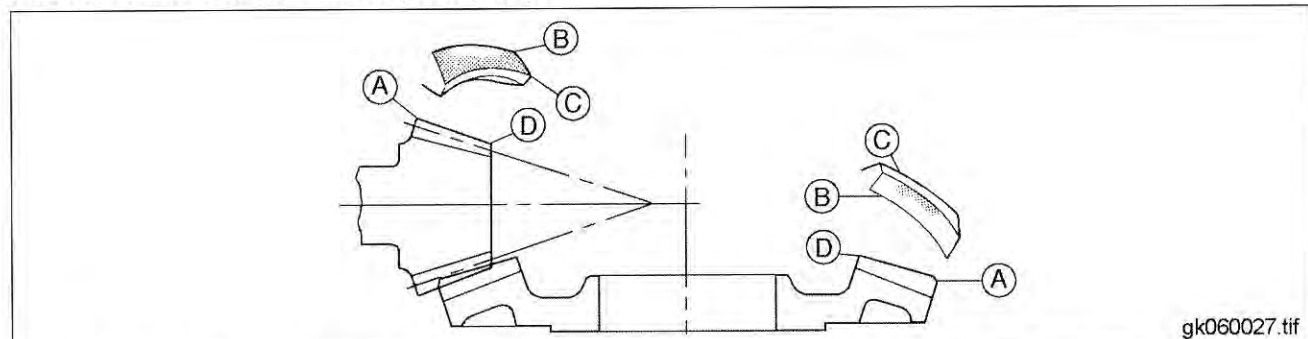
10-14 FINAL DRIVE

Final Gear Case

Correct Tooth Contact Pattern: No adjustment is required.



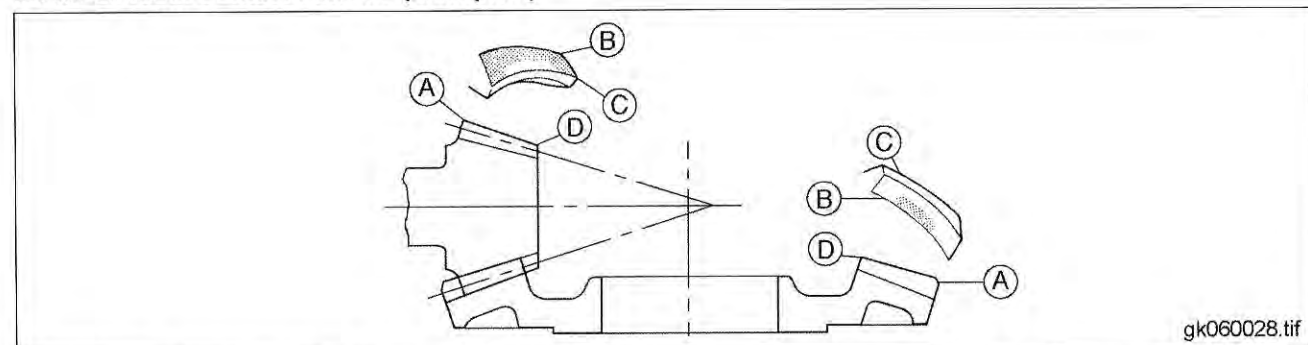
Incorrect Tooth Contact Patterns (Example 1)



○ Decrease the thickness of the pinion gear shim(s) by **0.05 mm** to correct the pattern shown above.

Heel [A] Bottom [B] Top [C] Toe [D]

Incorrect Tooth Contact Patterns (Example 2)



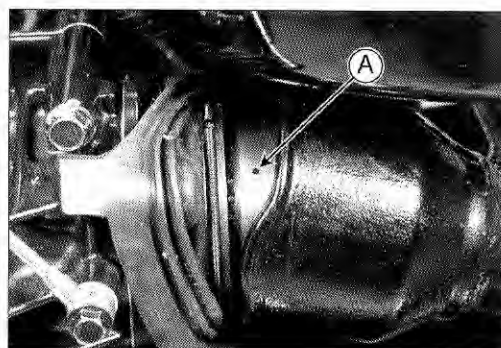
○ Increase the thickness of the pinion gear shim(s) by **0.05 mm** to correct the pattern shown above.

Heel [A] Bottom [B] Top [C] Toe [D]

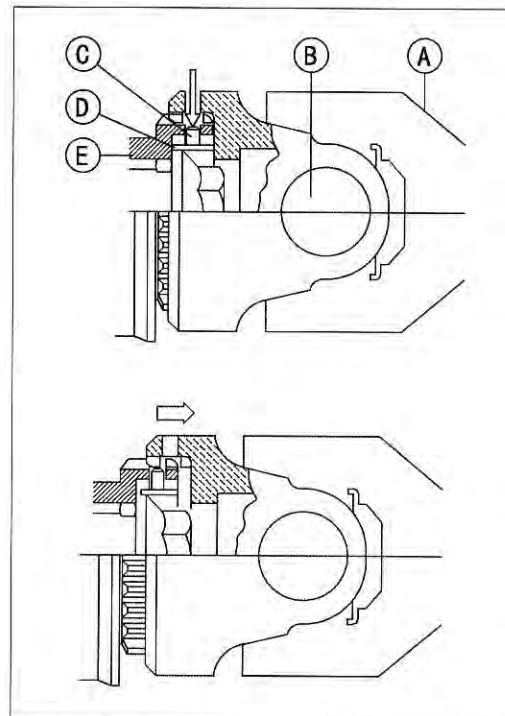
Propeller Shaft

Removal

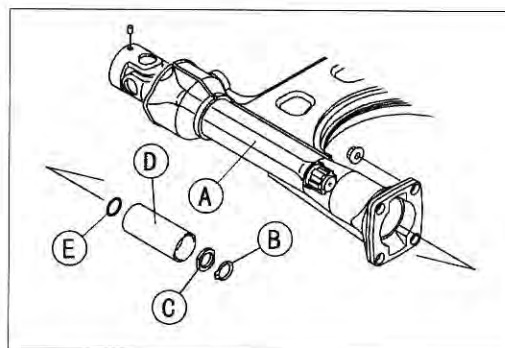
- Remove:
 - Rear Wheel (see Wheels/Tires chapter)
 - Final Gear Case (see this chapter)
- Remove the propeller shaft from the front driven gear joint.
- Turn the propeller shaft so that the lockpin access hole [A] in the propeller shaft comes outside.



- Move back the propeller shaft and slip the propeller shaft off the driven gear joint while pushing on the lockpin.
 - Propeller Shaft [A]
 - Universal Joint [B]
 - Lockpin [C]
 - Spring [D]
 - Driven Gear Joint [E]



- Remove the circlip [B] from the rear end of the propeller shaft [A] using a circlip pliers.
- Remove the washer [C] and pull out the propeller shaft sliding joint [D].



Installation

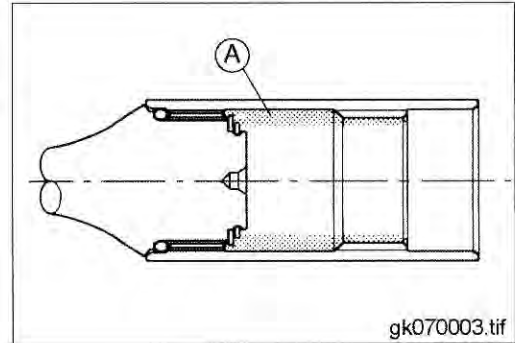
- Check the O-ring [E] on the rear end of the propeller shaft for any kind of damage, and replace it if necessary.
- Lubricate the propeller shaft joint (see Propeller Shaft Joint Lubrication).
- After connecting the propeller shaft to the driven gear joint, pull the propeller shaft rearward to check that the shaft is secured in place by the lockpin.

10-16 FINAL DRIVE

Propeller Shaft

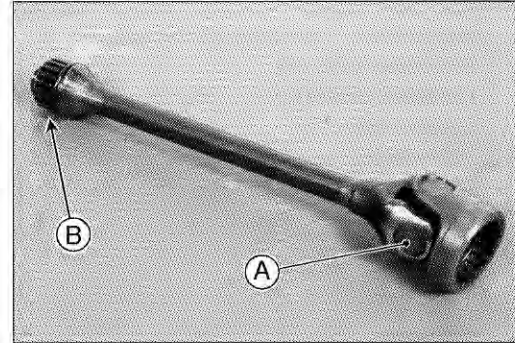
Propeller Shaft Joint Lubrication

- Wipe the old grease off the propeller shaft sliding joint and pinion joint.
- Pack the propeller shaft sliding joint with 20 mL (16 grams) of high temperature grease [A].



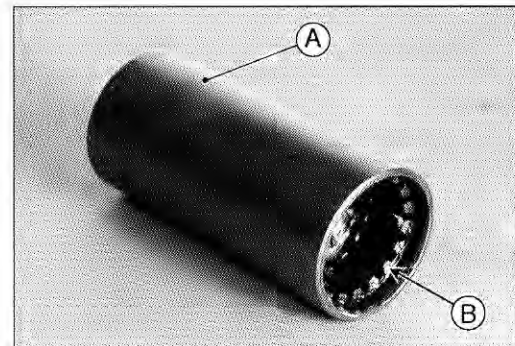
Propeller Shaft Inspection

- Check that the universal joint [A] works smoothly without rattling or sticking.
- ★ If it does not work smoothly, the needle bearings of the universal joint are damaged. Replace the propeller shaft assy with a new one.
- Visually inspect the bearing of the shaft and the wear of the splines [B] at the rear end of the shaft.
- ★ If it is bent at all, replace the propeller shaft assy. Do not attempt to straighten a bent shaft.



Sliding Joint Inspection

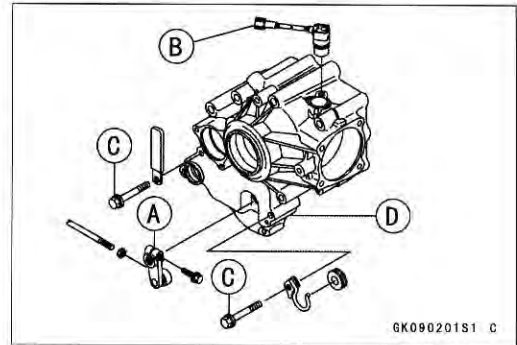
- Visually inspect the internal splines [B] of the propeller shaft sliding joint [A].
- ★ If they are badly worn or chipped, replace the joint with a new one.



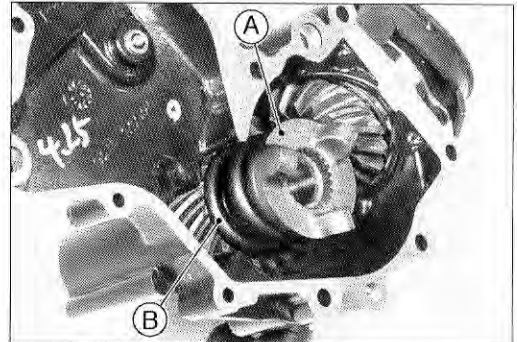
Front Bevel Gears

Front Gear Case Removal

- Remove:
 - Engine (see Engine Removal/Installation chapter)
 - Rear Shift Lever [A]
- The speed sensor connector [B] is disconnected during engine removal.
- Unscrew the front gear case bolts [C] and remove the front gear case [D].



- The cam follower [A] and the damper spring [B] come off with the gear case.
- Check that the shift shaft oil seal and replace it if damaged.



Front Gear Case Installation

- Tighten the front gear case bolts to the specified torque.

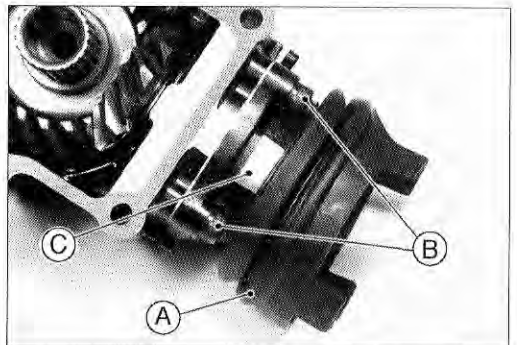
Torque - Front Gear Case Bolts:

M8: 29 N·m (3.0 kg·m, 22 ft·lb)

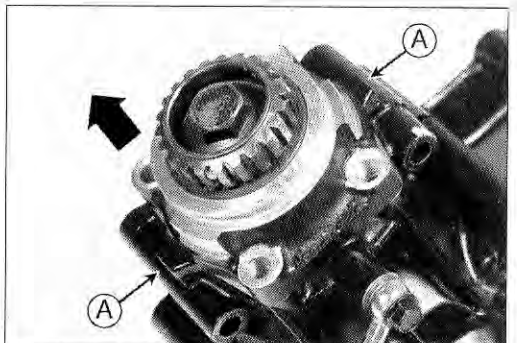
M6: 12 N·m (1.2 kg·m, 104 in·lb)

Front Gear Case Disassembly

- Remove:
 - Front Gear Case (see this chapter)
 - Cam Follower
 - Damper Spring
 - Rubber Boot [A]
- Remove the driven gear assembly mounting bolts [B] and pry the assembly [C] off the case.



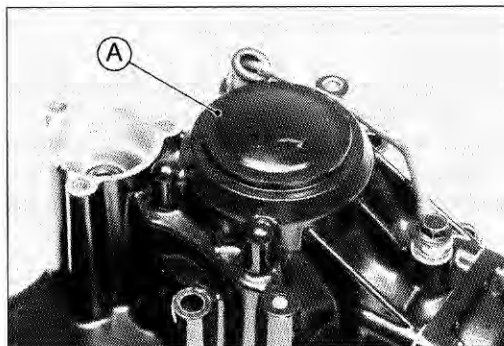
- Raise the driven gear, using the following pry points [A].



10-18 FINAL DRIVE

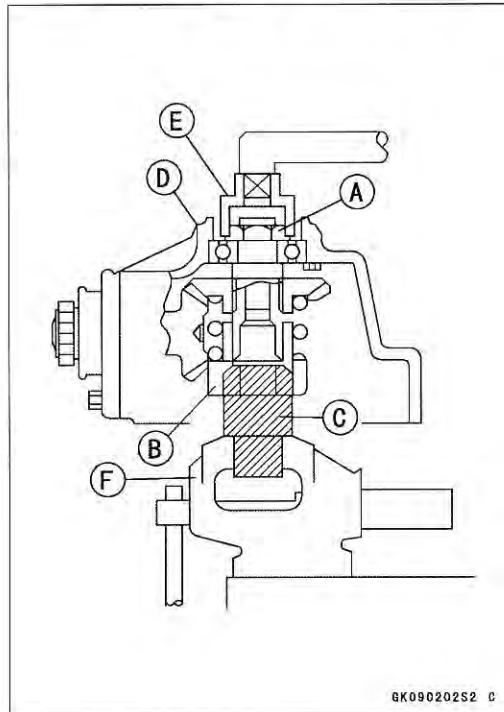
Front Bevel Gears

- Remove the drive gear assy as follows.
- Pry off the gear case cap [A] with a tool.



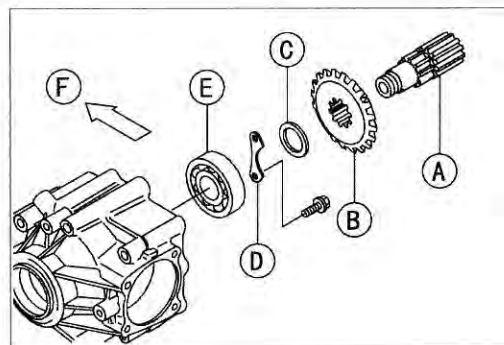
- Pry open the drive gear nut [A] with a small chisel.
- Install:
 - Damper Spring
 - Cam Follower [B]
- Unscrew the drive gear nut while holding the drive gear shaft with the drive shaft holder [C] (special tool).
 - Front Gear Case [D]
 - Socket Wrench [E]
 - Vise [F]

Special Tool - Drive Shaft Holder: 57001-1407



- Pull off the drive gear shaft [A], the drive gear [B], and shim(s) [C].
- Remove the bearing holder [D] from the gear case.
- Remove the drive gear shaft ball bearing [E] using the bearing driver set.
 - Front [F]

Special Tool - Bearing Driver Set: 57001-1129



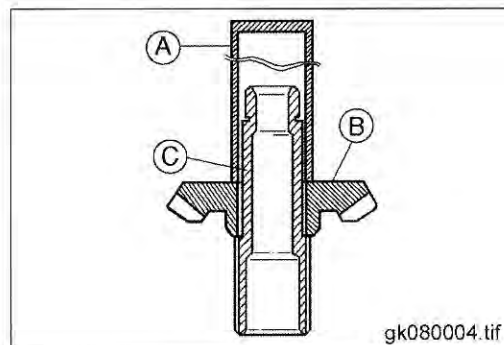
Front Gear Case Assembly

- The drive and driven gear are lapped as a set in the factory to get the best tooth contact. They must be replaced as a set.
- Press the drive gear [B] slowly with the driver [A] onto the shaft [C].

Special Tool - Bearing Driver: 57001-382

Non-permanent Locking Agent - Bearing Retainer Bolts

Torque - Bearing Retainer Bolts: 8.8 N·m (0.90 kg·m, 78 in·lb)



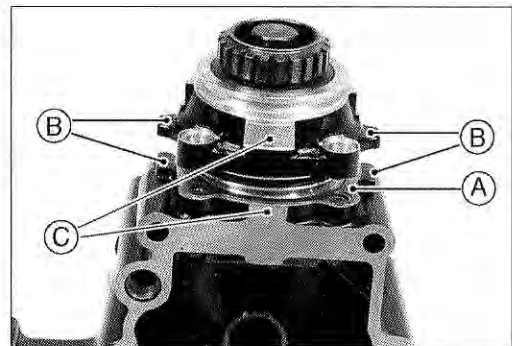
Front Bevel Gears

- Be sure to check and adjust the bearing preload, the bevel gear backlash, and tooth contact, when any of the backlash-related parts are replaced (see Front Bevel Gear Adjustment).
 - After completing all adjustment, reassemble the front gear case.
 - Replace the drive gear nut with a new one.
 - Apply molybdenum disulfide oil to the threads and seating surface of the nut, and tighten it to the specified torque to settle the bearings in place.
 - Loosen the nut completely and retighten it to the specified torque.
- Torque - Drive Gear Nut: 265 N·m (27 kg·m, 195 ft·lb)**
- Stake the nut to secure it in place.

CAUTION

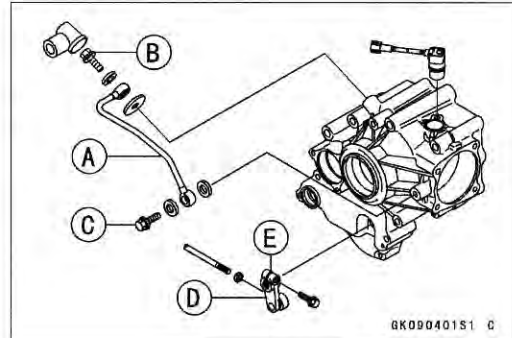
When staking the nut, be careful not to apply shock to the shaft and its bearing. Such a shock could damage the shaft and/or bearing.

- Install the shim [A].
 - Install the driven gear assy so that the pry ribs [B] and machined surfaces [C] align.
 - Tighten the driven gear assy mounting bolts to the specified torque.
- Torque - Driven Gear Assy Mounting Bolts: 25 N·m (2.5 kg·m, 18 ft·lb)**



- ★ If the oil pipe [A] was removed, use a new flat washer on each side of the fittings, and tighten the banjo bolts to the specified torque.
- Tighten the front banjo bolt [B] first, then the rear banjo bolt [C].
- Install the rear shift lever [D], aligning the lever slit [E] with the punch mark of the shaft.

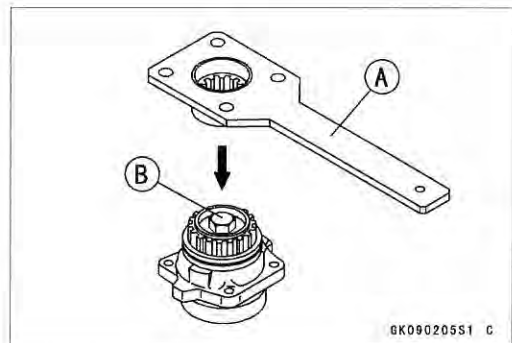
Torque - Oil Pipe Banjo Bolts: 12 N·m (1.2 kg·m, 104 in·lb)
Rear Shift Lever Clamp Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)



Driven Gear Disassembly

- Holding the driven gear joint with the driven gear holder [A] in a vise, unscrew the driven gear bolt [B].

Special Tool - Driven Gear Holder: 57001-1027



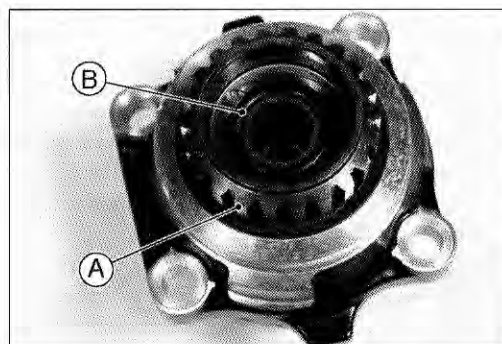
10-20 FINAL DRIVE

Front Bevel Gears

- Remove the driven gear joint [A] with the O-ring [B].
- Remove the driven gear from the bearing housing.
- Remove the oil seal from the housing with a hook, and pull the tapered roller bearing out of the housing.
- Remove the tapered roller bearing which is pressed onto the driven gear shaft with the bearing puller and adapter.

Special Tools - Bearing Puller: 57001-158

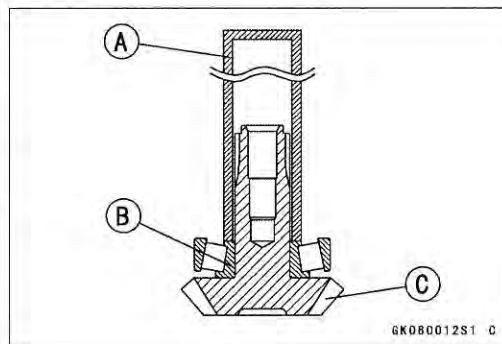
Adapter: 57001-317



Driven Gear Assembly

- Replace the driven gear bolt with a new one.
- The drive and driven gears are lapped as a set at the factory to get the best tooth contact. They must be replaced as a set.
- Be sure to check and adjust the bearing preload, the bevel gear backlash, and tooth contact (see Front Bevel Gear Adjustment).
- Drive the tapered roller bearing inner race [B] onto the driven gear shaft [C] using the bearing driver [A].

Special Tool - Bearing Driver: 57001-382



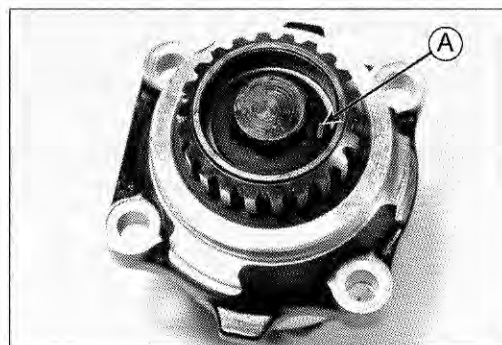
- After completing the bearing preload adjustment, reassemble the driven gear assy.
- Using the bearing driver set, press the oil seal in until the face of the seal is level with the end of the bearing housing hole.

Special Tool - Bearing Driver Set: 57001-1129

- Apply molybdenum disulfide oil to the threads and the seating surface of the driven gear bolt.
- Tighten the driven gear bolt to the specified torque.

Torque - Driven Gear Bolt: 137 N·m (14 kg·m, 101 ft·lb)

- Stake [A] the driven gear bolt to prevent it from loosening.



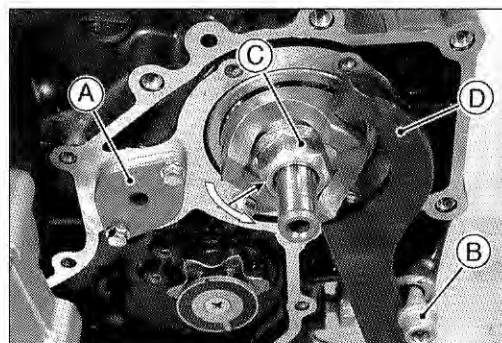
CAUTION

When staking the bolt, be careful not to apply shock to the driven gear and their bearings. Such a shock could damage the driven gear and/or bearings.

Damper Cam Removal

- Remove the front gear case (see this chapter).
- Remove the retainer and needle bearing of the output shaft.
- Remove the clutch push rod guide [A] and bolts, and crankcase bearing upper retainer and bolts.
- Insert a bolt ($\phi 12$ mm, L100 mm) [B] into the engine mounting bolt hole.
- Unscrew the damper cam nut [C] using a damper cam holder [D] (special tool) and deep socket wrench.

Special Tool - Damper Cam Holder: 57001-1025



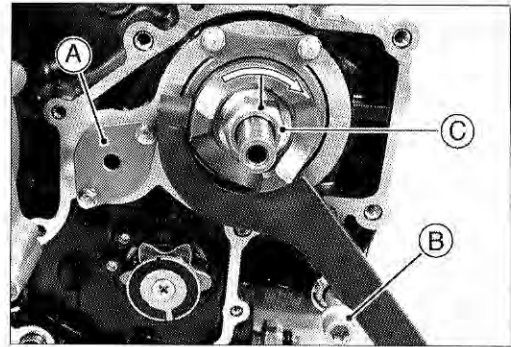
Front Bevel Gears

Damper Cam Installation

- Replace the damper cam nut with a new one.
- Remove the clutch push rod guide [A] and bolts, and crankcase bearing lower retainer and bolts.
- Insert the bolt ($\phi 12$ mm, L100 mm) [B] into the engine mounting bolt hole.
- Tighten the damper cam nut [C] to the specified torque.
- Apply oil to the threads and the seating surface of the nut.

Torque - Damper Cam Nut: 226 N·m (23 kg·m, 166 ft·lb)

Special Tool - Damper Cam Holder: 57001-1025

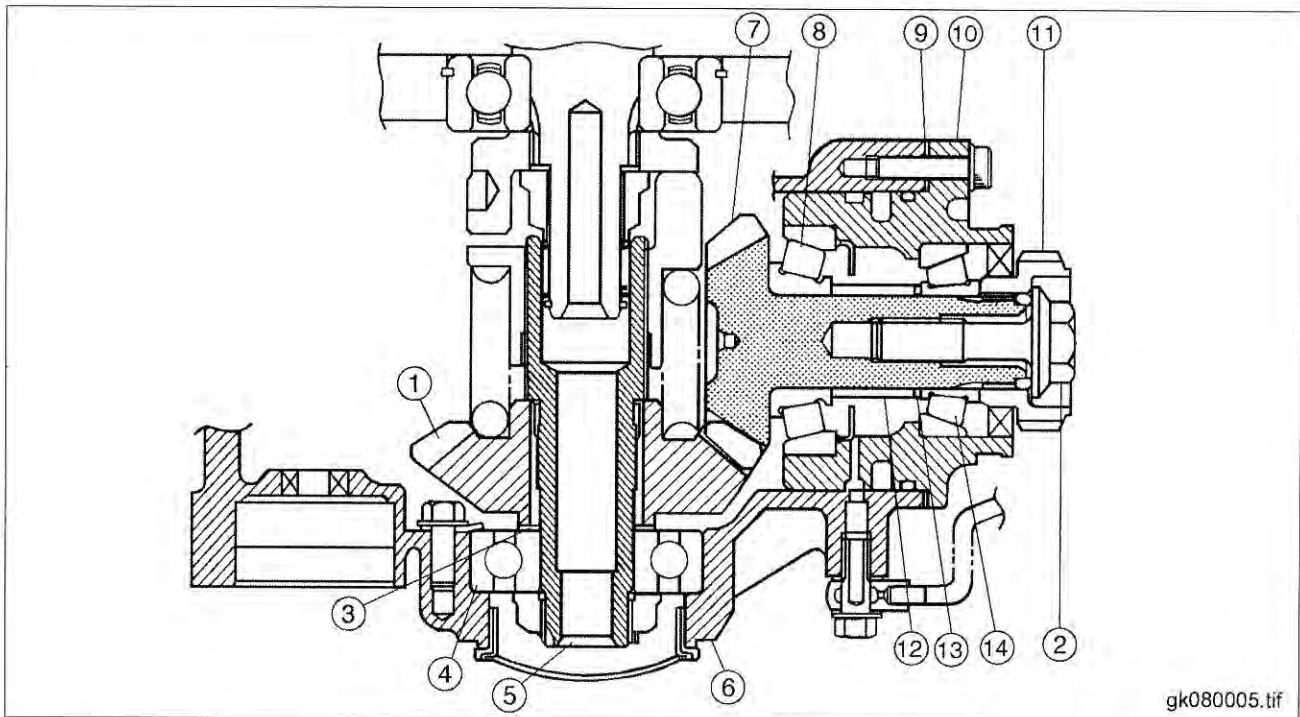


Front Bevel Gear Adjustment

In order to prevent one gear from moving away from the other gear under load, the tapered roller bearings must be properly **preloaded**. Also the **backlash** (the distance one gear will move back and forth without moving the other gear) and **tooth contact pattern** of the bevel gears must be correct to prevent the gears from making noise and being damaged.

Above three adjustments are of critical importance and must be carried out in the correct sequence and method.

- Preload adjustment is necessary whenever the driven gear bolt [2] loosened, even if the purpose is not to replace the parts.



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Backlash-related Parts

1. Drive Gear
2. Driven Gear Bolt
3. Drive Gear Shim(s)
4. Ball Bearing
5. Drive Gear Shaft
6. Front Gear Case

7. Driven Gear
8. Tapered Roller Bearing
9. Driven Gear Shim(s)
10. Driven Gear Bearing Housing
11. Driven Gear Joint

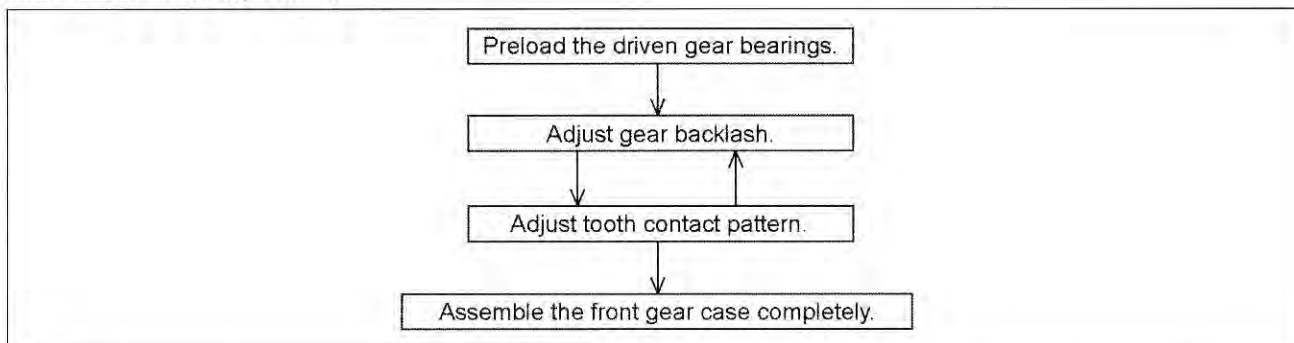
Preload-related Parts

12. Collar (Preload Adjustment)
13. Spacer (Preload Adjustment)
14. Tapered Roller Bearing

10-22 FINAL DRIVE

Front Bevel Gears

Front Bevel Gear Adjustment



- When any of the backlash-related parts are replaced, or the driven gear bolt is loosened; even if the purpose is not to replace the parts, be sure to check and adjust the bearing preload, the bevel gear backlash, and tooth contact by replacing shims.

Preload Adjustment

- Install the driven gear assy, and tighten the driven gear nut to the specified torque.

Torque - Driven Gear Bolt: 137 N·m (14 kg·m, 101 ft·lb)

- Do not install the oil seal, and O-ring, and do not stake the bolt until the correct bearing preload is obtained.

CAUTION

**To start with, choose a shim or collar so that the bearings are just SNUG with NO play and also with NO preload.
Any overpreload on the bearings could damage the bearings.**

- Apply a little engine oil to the bearings, and turn the gear shaft more than 5 turns to allow the bearings to seat.
- Measure the bearing preload. Bearing preload is defined as a force or torque which is needed to start the gear shaft turning.

Preload for Driven Gear Bearing

Using Spring Scale: 3 ~ 4 N (0.3 ~ 0.5 kg, 0.6 ~ 1.0 lb)

Using Torque Wrench: 0.5 ~ 0.9 N·m (0.05 ~ 0.09 kg·m, 4.3 ~ 7.8 in·lb)

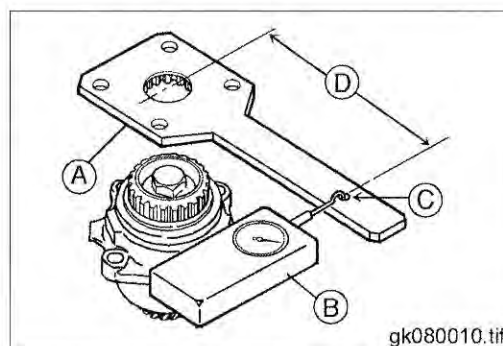
NOTE

- Preload can be measured either with a spring scale or a beam-type torque wrench. When measured with a spring scale, the preload is designated by force (N, kg, lb), and when measured with a torque wrench, it is designated by torque (N·m, kg·m, in·lb).

Preload Measurement with Spring Scale

- Hold the bearing housing in a vise so that the gear shaft axis is vertical.
- Hook [C] the spring scale [B] on the driven gear holder [A] at a point 200 mm [D] apart from the center of the gear shaft.
- Apply force to the handle horizontally and at a right angle to it.

Special Tool - Driven Gear Holder: 57001-1027



Front Bevel Gears

- ★ If the preload is out of specified range, replace the bearing collar and/or spacer. To increase preload, decrease the stack length of the collar and spacer. To decrease preload, increase the stack length of the collar and spacer.
- ★ Change the stack length a little at a time.
- Recheck the bearing preload, and readjust if necessary.

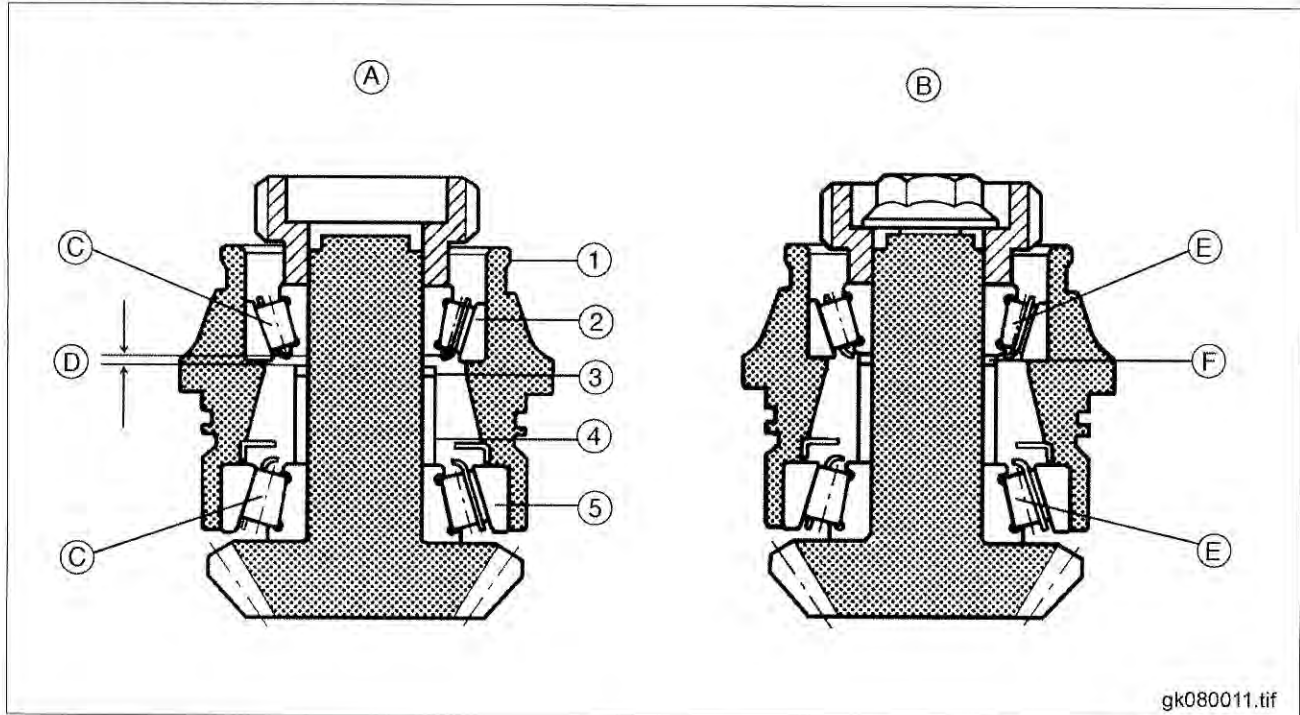
Collars for Preload Adjustment

Length (mm)	Part Number
22.8	92027-1152
22.9	92027-1153
23.0	92027-1154
23.1	92027-1155
23.2	92027-1156
23.3	92027-1157
23.4	92027-1158
23.5	92027-1159
23.6	92027-1160
23.7	92027-1161
23.8	92027-1162
23.9	92027-1163
24.0	92027-1164
24.1	92027-1165

Spacers for Preload Adjustment

Thickness (mm)	Part Number
1.70	92025-1072
1.72	92025-1073
1.74	92025-1074
1.76	92025-1075
1.78	92025-1076
1.80	92025-1077

Bearing Preloading Mechanism



1. Bearing Housing
2. Tapered Roller Bearing
Before Tightening [A]
After Tightening [B]

3. Spacer
4. Collar
Under No Preload [C]
Initial Clearance [D]

5. Tapered Roller Bearing
Under Preload [E]
No Clearance [F]

10-24 FINAL DRIVE

Front Bevel Gears

Backlash Adjustment

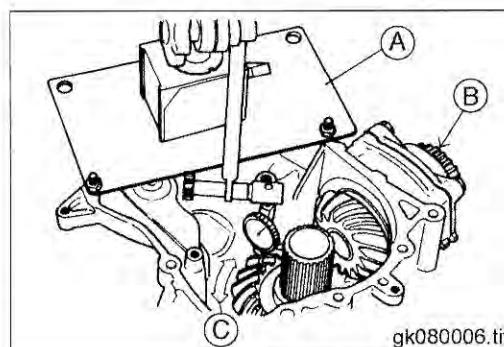
- Clean any dirt and oil off bevel gear teeth with a high-flash point solvent.
- Install the drive gear with the primary shim (1.0 mm thickness), and tighten the nut to the specified torque.

Torque - Drive Gear Nut: 265 N·m (27 kg·m, 195 ft·lb)

NOTE

- Do not stake the head of the nut until both backlash and tooth contact adjustments are finished.
 - Install the driven gear assy in the front gear case with the primary shim (1.0 mm thickness), and tighten the mounting bolts to the specified torque.
- Torque - Driven Gear Assy Mounting Bolts: 25 N·m (2.5 kg·m, 18 ft·lb)**
- Check backlash during tightening of the mounting bolts, and stop tightening them immediately if the backlash disappears. Then, change the shim to a thicker one.

- Install a holder [A] with 6 mm bolts and nuts on the front gear case to mount a dial gage.
- Set up a dial gage against a drive gear tooth to check gear backlash. The gage stem must be in line with the direction of tooth travel.
- To measure the backlash, move the drive gear back and forth [C] while holding [B] the driven gear steady with a tool. The difference between the highest and lowest gage readings is the amount of backlash.
- ★ If the backlash is not within the limit, replace the gear shim(s) at the drive and/or driven gear. To increase backlash, increase the thickness of the shim(s). To decrease backlash, decrease the thickness of the shim(s).
- ★ Change the thickness a little at a time.
- Recheck the backlash, and readjust as necessary.



NOTE

- It is OK to pack two shims. Do not pack three or more shims.

Front Bevel Gear Backlash (at the gear tooth)

0.10 ~ 0.15 mm

Shims for Drive Gear

Thickness (mm)	Parts Number
0.15	92025-1688
0.5	92025-1689
0.6	92025-1690
0.7	92025-1691
0.8	92025-1692
0.9	92025-1693
1.0	92025-1694
1.1	92025-1695
1.2	92025-1696

Shims for Driven Gear

Thickness (mm)	Parts Number
0.1	92025-1826
0.15	92025-1818
0.5	92025-1819
0.6	92025-1820
0.7	92025-1821
0.8	92025-1822
0.9	92025-1823
1.0	92025-1824
1.2	92025-1825

Front Bevel Gears

Tooth Contact Adjustment

- Clean any dirt and oil off the bevel gear teeth with a high-flash point solvent.
- Apply checking compound to 4 or 5 teeth on the driven gear.

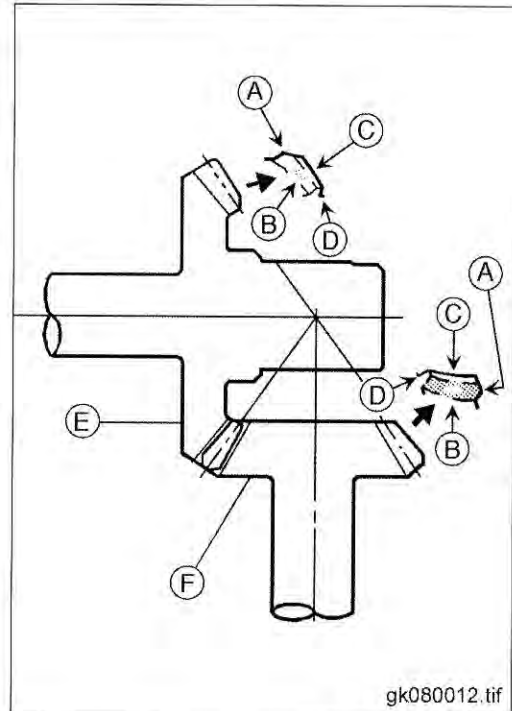
NOTE

- Apply checking compound to the teeth in a thin, even coat with a fairly stiff paint brush. If painted too thickly, the exact tooth pattern may not appear.
- The checking compound must be smooth and firm, with the consistency of tooth paste.
- Special compounds are available from automotive supply stores for the purpose of checking differential gear tooth patterns and contact. Use this for checking the bevel gears.
- Turn the driven gear for 3 or 4 revolutions in the drive and reverse (coast) directions, while creating a drag on the drive gear.
- Check the drive pattern and coast pattern of the bevel gear teeth. The tooth contact patterns of both drive and coast sides should be centrally located between the top and bottom of the tooth, and little closer to the toe of the tooth.
- ★ If the tooth contact pattern is incorrect, replace the shim(s) at the driven gear and shim(s) at the driven gear, following the examples shown. Then erase the tooth contact patterns, and check them again. Also check the backlash every time the shims are replaced. Repeat the shim change procedure as necessary.

NOTE

- If the backlash goes out of standard range after changing shims, correct the backlash before checking the tooth contact pattern.
- It is OK to pack two shims. Do not pack three or more shims.

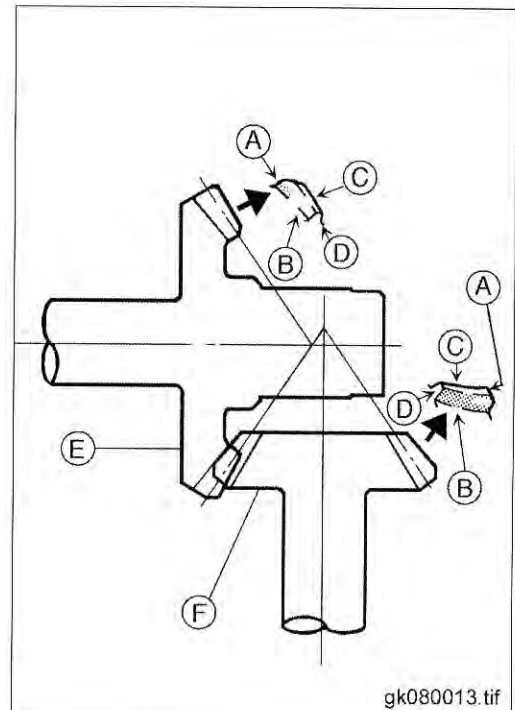
Heel [A]
 Bottom [B]
 Top [C]
 Toe [D]
 Drive Gear [E]
 Driven Gear [F]



Incorrect Tooth Contact Patterns (Example 1):

- Increase the thickness of the drive gear shim(s) by 0.05 mm, and/or increase the thickness of the driven gear shim(s) by 0.05 mm to correct the pattern shown below. Repeat in 0.05 mm steps if necessary.

Heel [A]
 Bottom [B]
 Top [C]
 Toe [D]
 Drive Gear [E]
 Driven Gear [F]



10-26 FINAL DRIVE

Front Bevel Gears

Incorrect Tooth Contact Patterns (Example 2):

- Decrease the thickness of the drive gear shim(s) by 0.05 mm, and/or decrease the thickness of the driven gear shim(s) by 0.05 mm to correct the pattern shown below. Repeat in 0.05 mm steps if necessary.

Heel [A]

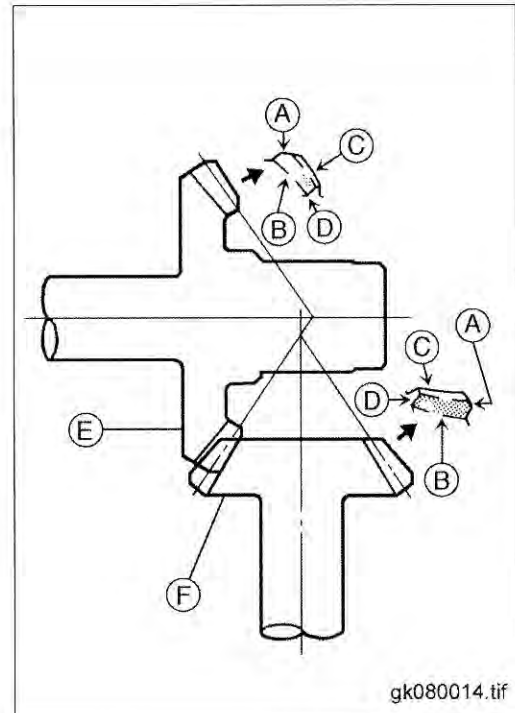
Bottom [B]

Top [C]

Toe [D]

Drive Gear [E]

Driven Gear [F]

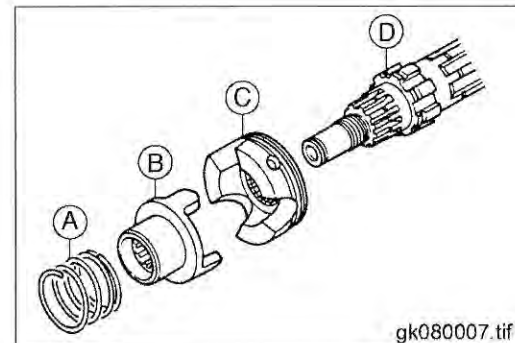


Bevel Gear Inspection

- Visually check the bevel gears for scoring, chipping, or other damage.
- ★ Replace the bevel gears as a set if either gear is damaged.

Cam Damper Inspection

- Visually inspect the spring [A], cam follower [B], damper cam [C], and output shaft [D].
- ★ Replace the damaged parts.



Bearing and Oil Seal

Ball or Needle Bearing Replacement

- Using the bearing driver set or the oil seal & bearing remover, remove the bearings.
- Remove the pinion gear needle bearing [A] in the final gear case as follows.
 - First drill the spring pin [B] using a 3.5 mm drill bit [C], second a 3.8 mm.
 - 22 mm [D]
 - Using a hook, remove the residue of the spring pin.
 - Remove the pinion gear needle bearing.

Special Tools - Oil Seal & Bearing Remover: 57001-1058
Bearing Driver Set: 57001-1129

- Install a new needle bearing [A] with the marked side facing out until it bottoms out, using the bearing driver set [B]. This prevents bearing damage.

Special Tool - Bearing Driver Set: 57001-1129

- Insert a new spring pin.

NOTE

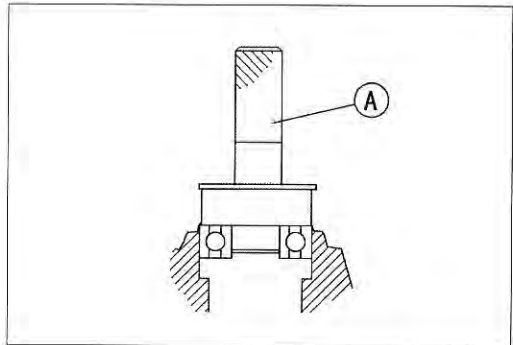
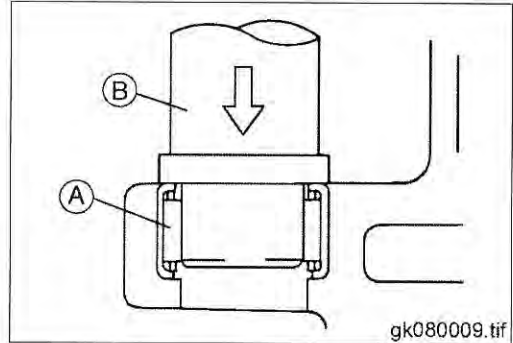
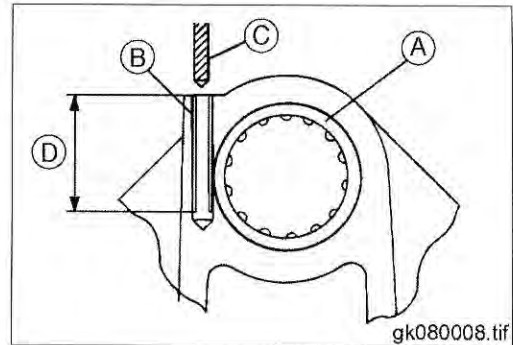
- *In the absence of the above mentioned tools, satisfactory results may be obtained by heating the case to approximately 93°C (200°F) max., and tapping the bearing in or out.*

CAUTION

Do not heat the case with a blowtorch. This will warp the case.
Soak the case in oil and heat the oil.

- Using a press and the bearing driver set [A], install a new ball bearing until it stops at the bottom of the case.

Special Tool - Bearing Driver Set: 57001-1129

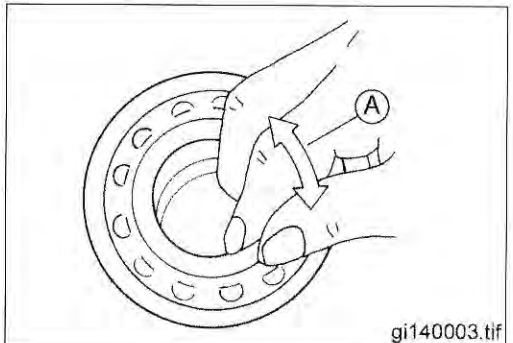


Ball Bearing Wear

CAUTION

Do not remove the bearings for inspection. Removal may damage them.

- Check the ball bearings.
- Since the ball bearings are made to extremely close tolerances, the wear must be judged by feel rather than measurement. Clean each bearing in a high-flash point solvent, dry it (do not spin the bearing while it is dry), and oil it with engine oil.
- Spin [A] the bearing by hand to check its condition.
- ★ If the bearing is noisy, does not spin smoothly, or has any rough spots, replace it.



10-28 FINAL DRIVE

Bearing and Oil Seal

Tapered Roller Bearing Inspection

CAUTION
Do not remove the tapered roller bearing for inspection. Removal may damage them.

- Visually inspect the bearing in the front gear case for abrasion, color change, or other damage.
- ★ If there is any doubt as to the condition of the bearing, replace it.

Needle Bearing Inspection

CAUTION
Do not remove the needle bearing in the final gear case for inspection. Removal may damage them.

- Check the needle bearings in the front and final gear cases.
- The rollers in the needle bearing normally wear very little, and wear is difficult to measure. Instead of measuring, inspect the bearing for abrasion, color change, or other damage.
- ★ If there is any doubt as to the condition of a needle bearing, replace it.

Oil Seal Inspection

- Inspect the oil seals.
- ★ Replace it if the lips are misshapen, discolored (indicating that the rubber has deteriorated), hardened or otherwise damaged.

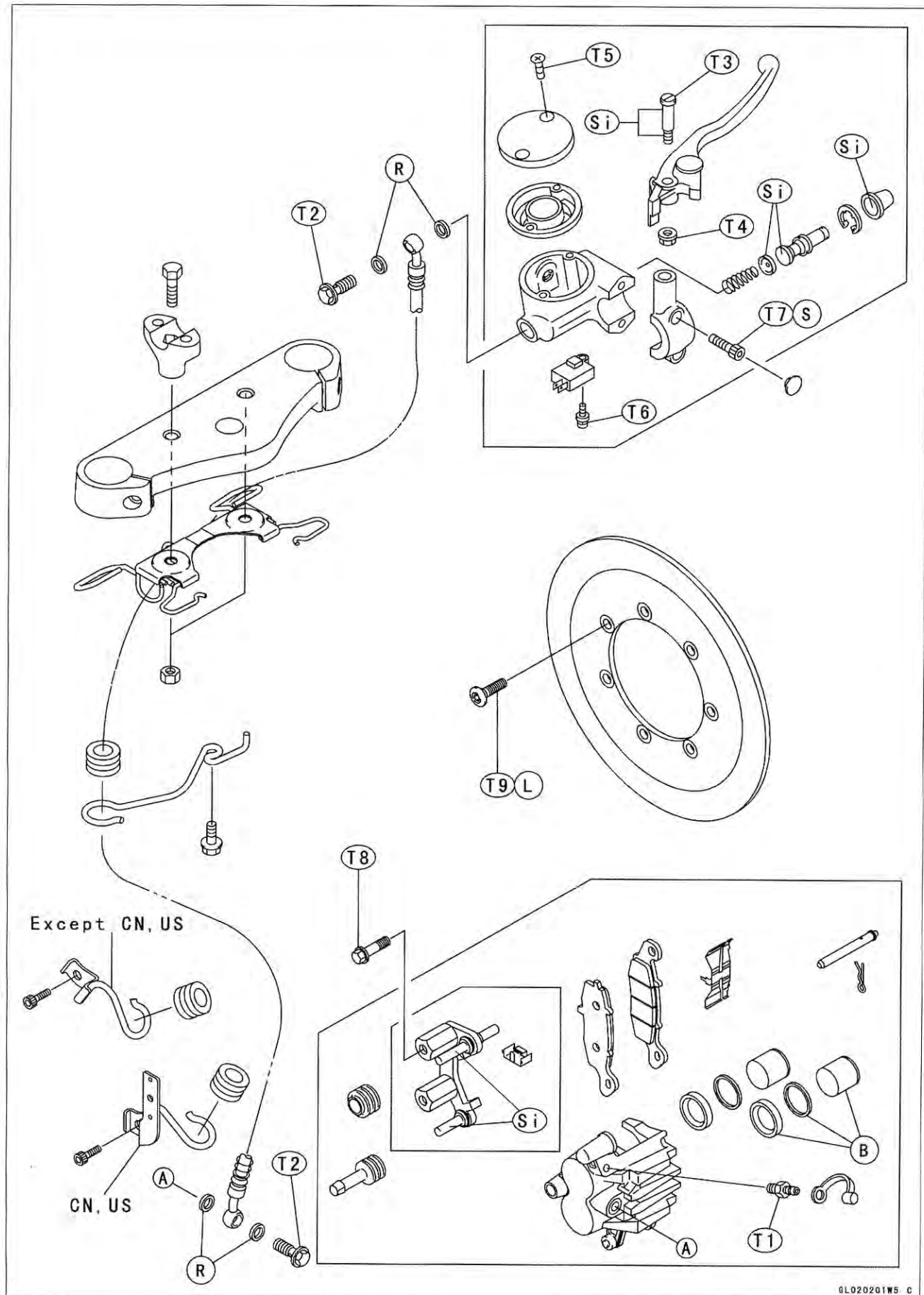
Brakes

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11-2 BRAKES

Exploded View



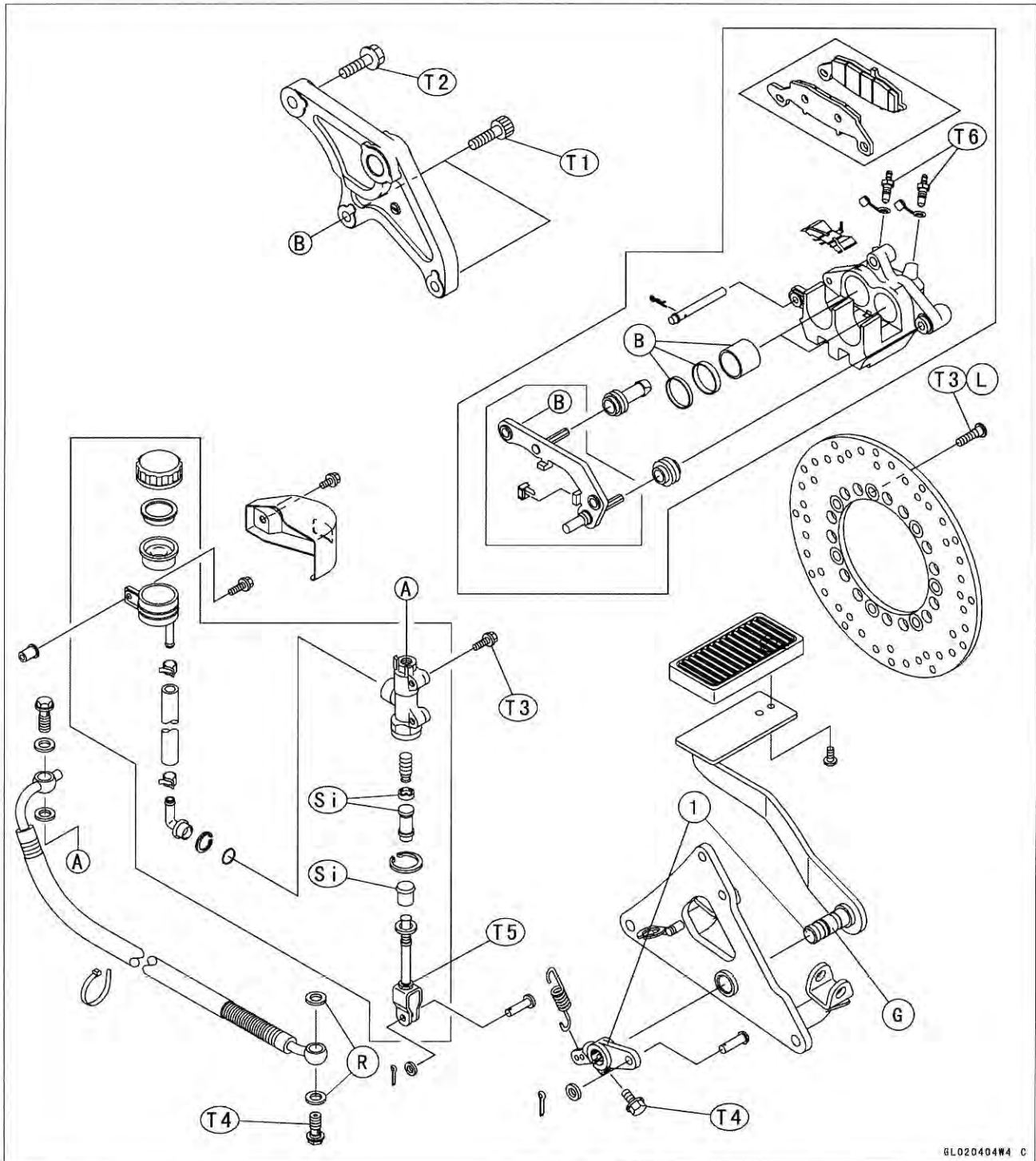
GL020201W5 C

Exploded View

- B: Apply brake fluid.
- L: Apply a non-permanent locking agent.
- R: Replacement Parts
- S: Follow the specific tightening sequence.
- Si: Apply silicone grease or PBC grease.
- T1: 7.8 N·m (0.8 kg·m, 69 in·lb)
- T2: 25 N·m (2.5 kg·m, 18 ft·lb)
- T3: 1.0 N·m (0.10 kg·m, 8.7 in·lb)
- T4: 5.9 N·m (0.60 kg·m, 52 in·lb)
- T5: 1.5 N·m (0.15 kg·m, 13 in·lb)
- T6: 1.2 N·m (0.12 kg·m, 10 in·lb)
- T7: 9.8 N·m (1.0 kg·m, 87 in·lb)
- T8: 34 N·m (3.5 kg·m, 25 ft·lb)
- T9: 27 N·m (2.8 kg·m, 20 ft·lb)

11-4 BRAKES

Exploded View



GL020404W4 C

- 1. Align the marks.
- B: Apply brake fluid.
- G: Apply grease.
- L: Apply a non-permanent locking agent.
- R: Replacement Parts
- Si: Apply silicone grease or PBC grease.

- T1: 34 N·m (3.5 kg·m, 25 ft·lb)
- T2: 64 N·m (6.5 kg·m, 47 ft·lb)
- T3: 27 N·m (2.8 kg·m, 20 ft·lb)
- T4: 25 N·m (2.5 kg·m, 18 ft·lb)
- T5: 18 N·m (1.8 kg·m, 13 ft·lb)
- T6: 7.8 N·m (0.8 kg·m, 69 in·lb)

Specifications

Item	Standard	Service Limit
Brake Lever, Brake Pedal:		
Brake lever position	No.1	5-way adjustable
Brake lever free play	Non-adjustable	---
Pedal free play	Non-adjustable	---
Pedal position	About 95 mm (height from pedal top to footboard top)	---
Brake Fluid:		
Grade	D.O.T.4	---
Brake Pads:		
Pad lining thickness: Front	4.5 mm	1 mm
Rear	4.9 mm	1 mm
Brake Discs:		
Thickness: Front	5.8 ~ 6.2 mm	5.5 mm
Rear	6.8 ~ 7.2 mm	6.0 mm
Runout	TIR 0.2 mm or less	TIR 0.3 mm

Special Tools - Inside Circlip Pliers: 57001-143

Jack: 57001-1238

Attachment Jack: 57001-1398

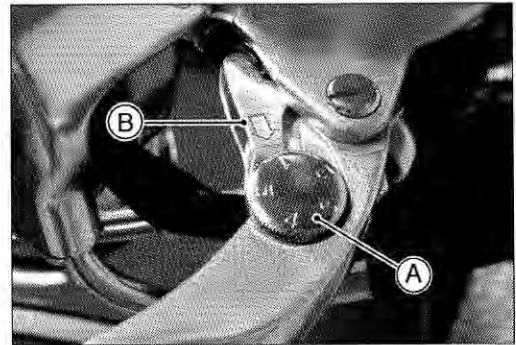
11-6 BRAKES

Brake Lever, Brake Pedal

Brake Lever Position Adjustment

The brake lever adjuster has 5 positions so that the brake lever position can be adjusted to suit the operator's hand.

- Push the lever forward and turn the adjuster [A] to align the number with the arrow mark [B] on the lever holder.
- The distance from the grip to the lever is minimum at number 5 and maximum at number 1.



Brake Pedal Position Adjustment

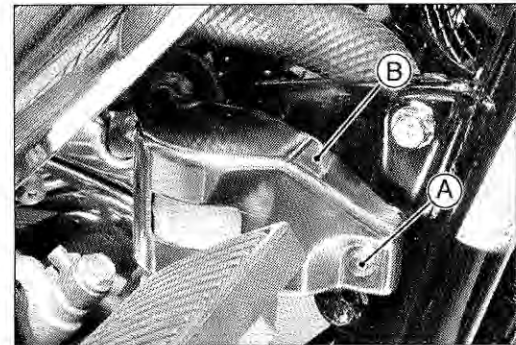
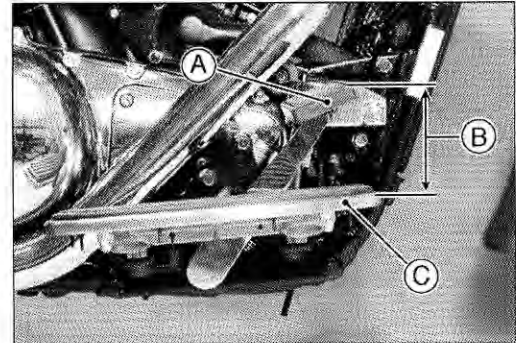
- Check that the brake pedal [A] is in the correct position.

Pedal Position

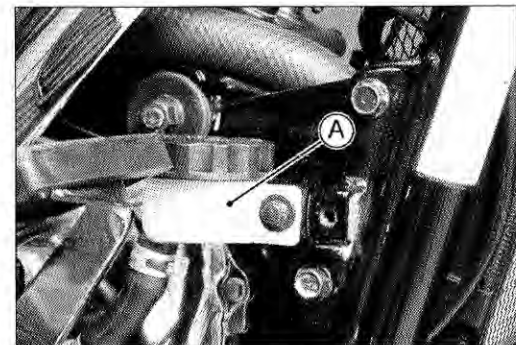
Standard: About 95 mm[B]
(height from pedal top to footboard top [C])

NOTE

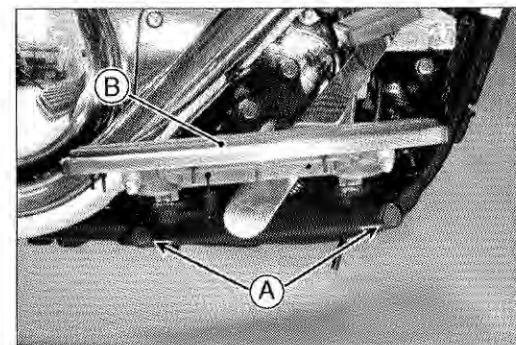
- Usually it's not necessary to adjust the pedal position, but always adjust it when push rod locknut has been loosened.
 - If the push rod length cannot be adjusted by turning the clevis, the brake pedal may be deformed or incorrectly installed.
- Unscrew the brake fluid reservoir cover bolt [A] and remove the brake fluid reservoir cover [B].



- Take off the brake fluid reservoir [A].



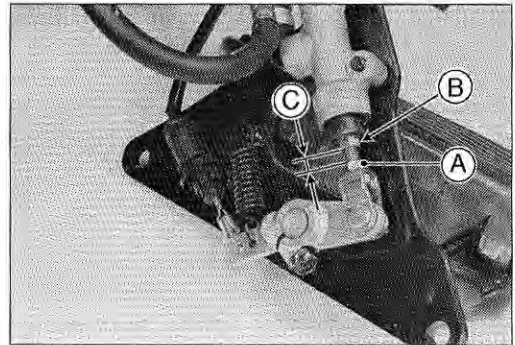
- Remove the right front footboard bolts [A] and turn over the footboard [B].



Brake Lever, Brake Pedal

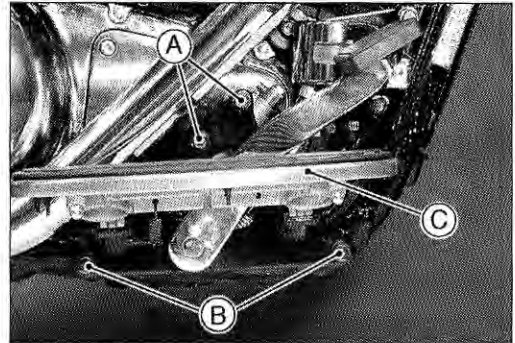
- Loosen the locknut [A] and turn the push rod with the hex head [B] to achieve the correct pedal position.
- ★ If the length [C] is 8 ± 1 mm, the pedal position will be within the standard range.
- Tighten:

Torque - Push Rod Locknut: 18 N·m (1.8 kg·m, 13 ft·lb)

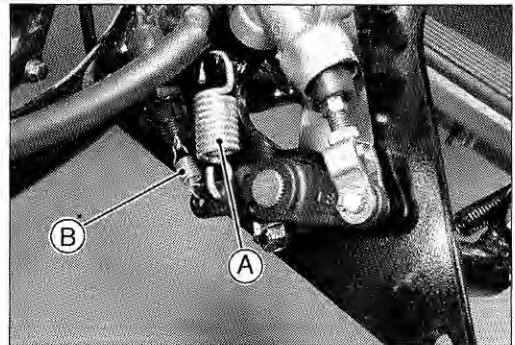


Brake Pedal Removal

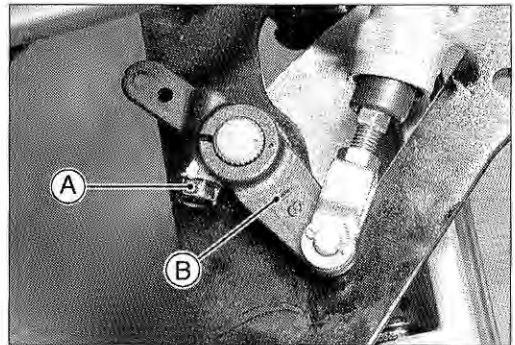
- Loosen the rear master cylinder mounting bolts [A].
- Remove the right front footboard bolts [B], and turn over the footboard [C] (see Brake Pedal Position Adjustment).



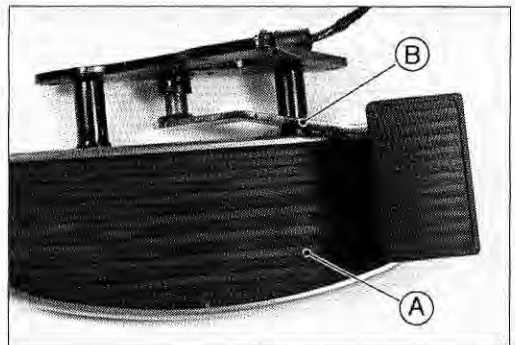
- Remove:
Rear Master Cylinder Mounting Bolts
Brake Pedal Return Spring [A]
Brake Switch Return Spring [B]



- Unscrew the brake pedal clamp bolt [A].
- Pull off the brake lever [B] with master cylinder.



- Detach the right footboard [A], and pull off the brake pedal [B].



11-8 BRAKES

Brake Lever, Brake Pedal

Brake Pedal Installation

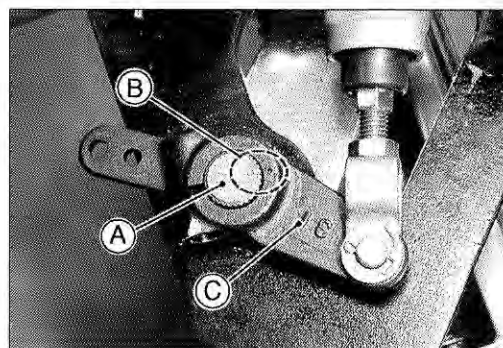
- Apply grease to the brake pedal shaft.
- Install the pedal shaft [A] so that the punched mark on the shaft is aligned [B] with the punched mark on the brake lever [C].
- Install:
 - Brake Pedal Return Spring
 - Brake Switch Return Spring
- Tighten:

Torque - Front Footboard Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)

Brake Pedal Clamp Bolt: 25 N·m (2.5 kg·m, 18 ft·lb)

Rear Master Cylinder Mounting Bolts: 25 N·m (2.5 kg·m, 18 ft·lb)

- Replenish the fluid in the reservoir, and bleed the brake line (see Bleeding the Brake Line).
- Check the brake for proper braking power, no brake drag, and no fluid leakage.



⚠ WARNING

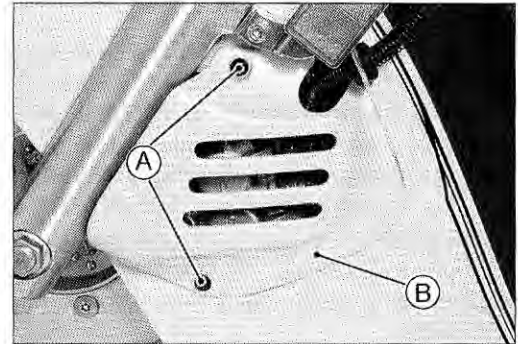
Do not attempt to ride the motorcycle until a full brake pedal is obtained by pumping the brake pedal until the pads are against the disc. The brake will not function on the first application of the pedal if this is not done.

- Check the brake pedal position and adjust it if necessary.
- Check the rear brake light switch operation and adjust the switch if necessary (see Electrical System chapter).

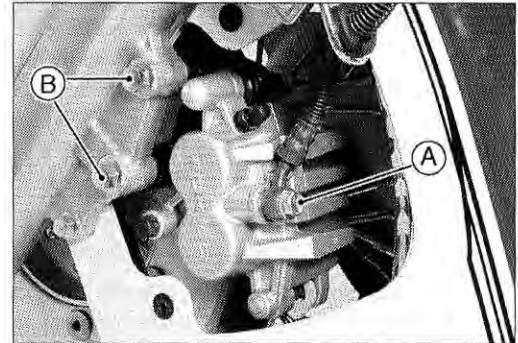
Calipers

Front Caliper Removal

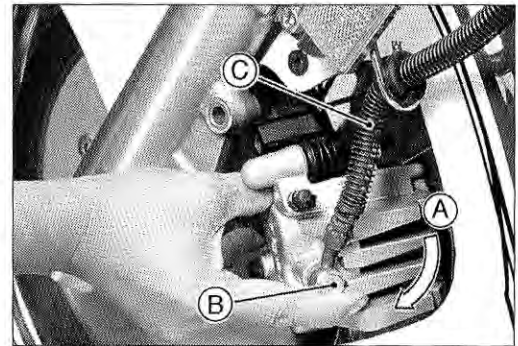
- Unscrew the screws [A] and remove the front caliper cover [B].



- Loosen the banjo bolt [A] at the brake hose lower end, and tighten it loosely.
- Unscrew the caliper mounting bolts [B].



- Twist [A] the caliper outboard to clear the disc, and then take off the caliper.
- Unscrew the banjo bolt [B] and remove the brake hose [C] from the caliper.



CAUTION

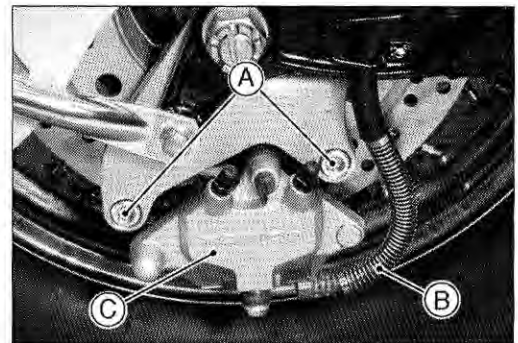
Immediately wash away any brake fluid that spills.

NOTE

- If the caliper is to be disassembled after removal and if compressed air is not available, remove the pistons before the brake hose is removed (see Caliper Disassembly).

Rear Caliper Removal

- Remove:
 - Silencer (see Engine Top End chapter)
 - Caliper Mounting Bolts [A]
 - Brake Hose [B]
 - Rear Caliper [C]



11-10 BRAKES

Calipers

Caliper Installation

- Install the caliper and brake hose lower end.
- Replace the washer on each side of hose fitting with new ones.
- Tighten the caliper mounting bolts and banjo bolt.

Torque - Front Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)

Rear Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)

Brake Hose Banjo Bolt: 25 N·m (2.5 kg·m, 18.0 ft·lb)

- Check the fluid level in the brake reservoirs.
- Bleed the brake line (see Bleeding the Brake Line).
- Check the brake for good braking power, no brake drag, and no fluid leakage.

⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever or pedal is obtained by pumping the brake lever or pedal until the pads are against the disc. The brakes will not function on the first application of the lever or pedal if this is not done.

Caliper Disassembly

NOTE

- The procedure to disassemble the front caliper is as follows. The rear caliper disassembly is the same as for the front caliper.

- Remove the caliper (see Caliper Removal) with the hose installed.
- Remove the pads and spring (see Pad Removal).
- Insert a wooden board [A] 6 mm thick inside the caliper opening.
- Pump the brake lever (or pedal) until the pistons [B] push the wooden board.
- Remove the board and pull out the pistons [A] by hand.
- These pistons can also be removed by disconnecting the hose and applying compressed air to the hose joint opening using the same wooden board. But be careful not to put your fingers or palm inside the caliper opening during work.

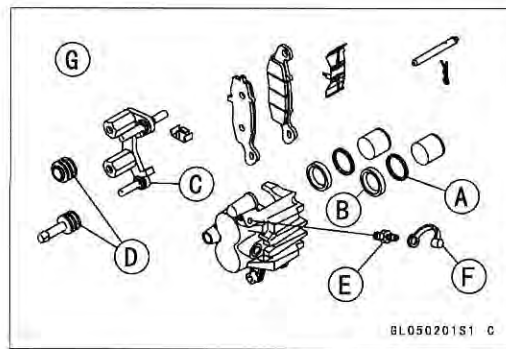
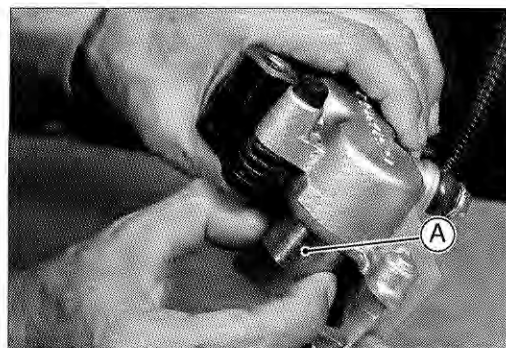
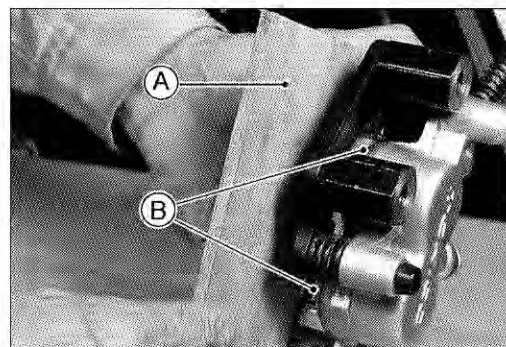
⚠ WARNING

To avoid serious injury, never place your fingers or palm inside the caliper opening. If you apply compressed air into the caliper, the pistons may crush your hand or fingers.

CAUTION

Immediately wash away any brake fluid that spills.

- Remove the dust seal(s) [A] and fluid seal(s) [B].
 - Remove the caliper holder [C], and shaft rubber friction boots [D].
 - Remove the bleed valve [E] and rubber cap [F].
- Front Caliper [G]



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Calipers

Caliper Assembly

- Tighten the bleed valve.
- Torque - Caliper Bleed Valve: 7.8 N·m (0.8 kg·m, 69 in·lb)**
- It is recommended that the fluid seal (piston seal) which is removed, be replaced with a new one.
- Replace the dust seals if they are damaged.
- Install the fluid seal. Either side of the seal may face outboard.
- Apply brake fluid to the cylinders, pistons, and fluid seals (piston seals), and push the pistons into the cylinders by hand. Take care that neither the cylinder nor the piston skirt gets scratched.

Front Caliper [L]

Caliper Body [A]

Outer Pad [B]

Inner Pad [C]

Dust Seal [D]

Fluid Seal [E]

Piston [F]

Pad Pin [G]

Caliper Holder Shafts [H]

Friction Boot [J]

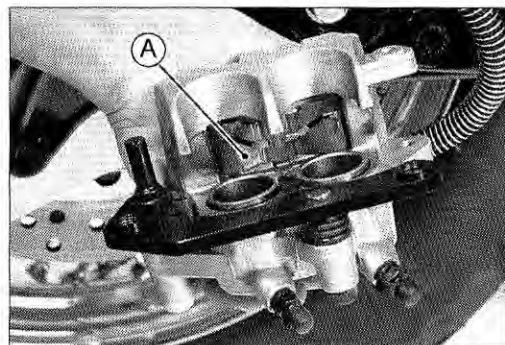
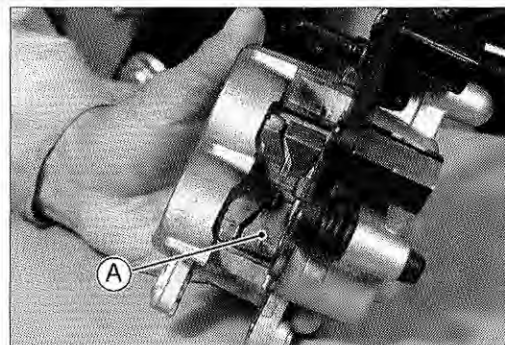
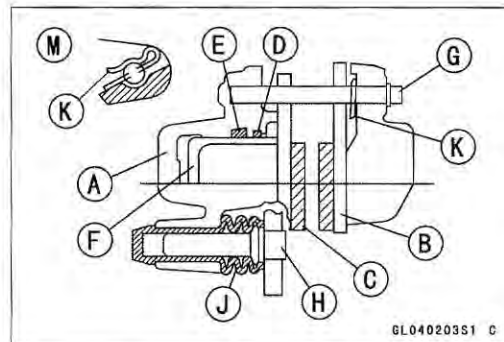
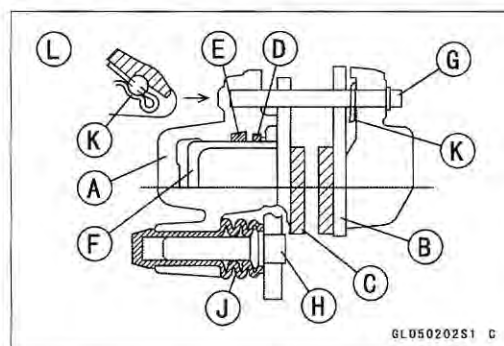
Snap Pin [K]

Rear Caliper [M]

- Replace the caliper holder shaft rubber friction boot and dust cover if they are damaged.
- Apply a thin coat of silicone or PBC grease to the caliper holder shafts and holder holes (Silicone or PBC grease is a special high temperature, water-resistance grease).
- Install the anti-rattle spring in the caliper as shown.
- Install the pads (see Brake Pad Installation).

Anti-rattle Spring for Front Caliper [A]

Anti-rattle Spring for Rear Caliper [A]



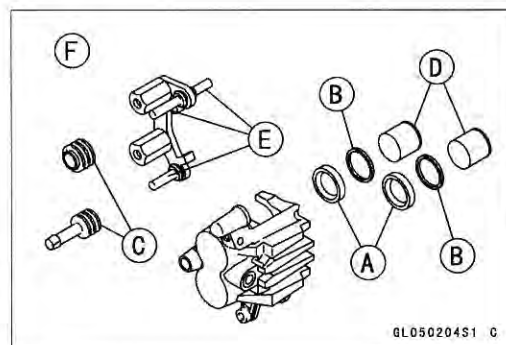
11-12 BRAKES

Calipers

Caliper Fluid Seal Damage

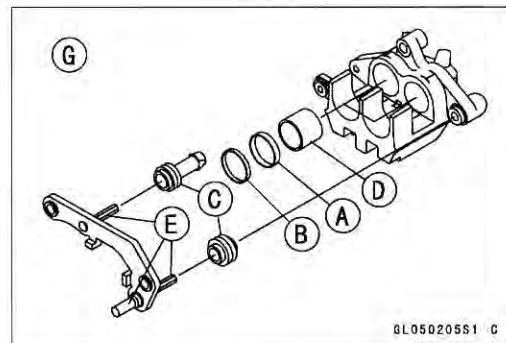
The fluid seals [A] around the piston maintain the proper pad/disc clearance. If the seals are not satisfactory, pad wear will increase, and constant pad drag on the disc will raise brake and brake fluid temperature.

- Replace the fluid seals under any of the following conditions: (a) fluid leakage around the pad; (b) brakes overheat (c) there is a large difference in inner and outer pad wear; (d) the seal is stuck to the piston.
- ★ If the fluid seal is replaced, replace the dust seal as well. Also, replace all seals every other time the pads are changed.



Caliper Dust Seal/Friction Boot Damage

- Check that the dust seals [B] and friction boots [C] are not cracked, worn, swollen, or otherwise damaged.
- If they show any damage, remove the caliper holder and replace them.
Front Caliper [F]
Rear Caliper [G]



Caliper Piston and Cylinder Damage

- Visually inspect the pistons [D] and cylinder surfaces.
- ★ Replace the caliper if the cylinder and piston are badly scored or rusty.

Caliper Holder Shaft Wear

The caliper body must slide smoothly on the caliper holder shafts [E]. If the body does not slide smoothly, one pad will wear more than the other, pad wear will increase, and constant drag on the disc will raise brake and brake fluid temperature.

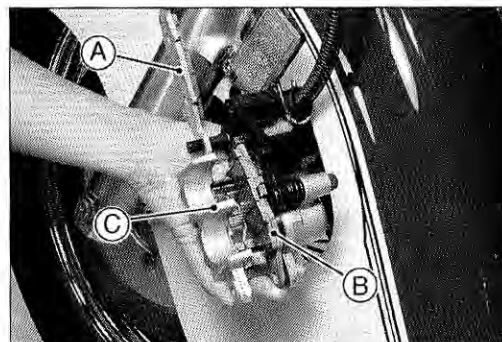
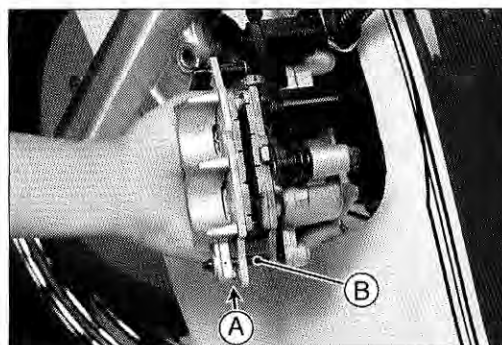
- Check to see that the caliper holder shafts are not badly worn or stepped, and that the rubber friction boots are not damaged.
- ★ If the rubber friction boot is damaged, replace the rubber friction boot.
To replace the friction boot, remove the pads and the caliper holder.
- ★ If the caliper holder shaft is damaged, replace the caliper bracket.

Brake Pads

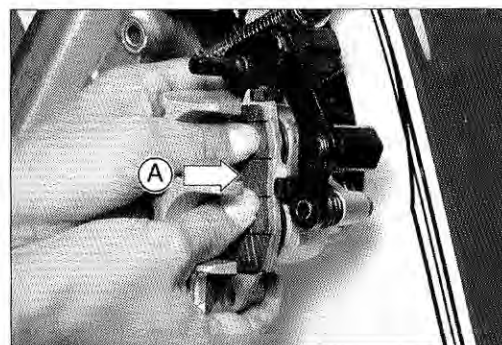
Brake Pad Removal/Installation

NOTE

- The procedure to remove the front caliper is as follows. The rear caliper pad removal is the same as for the front caliper.
- Remove the caliper with the hose installed (see Caliper Removal).
- Remove:
 - Snap Pin [A]
 - Pad Pin [B]
- Remove the jaw side pad [A], and then remove the piston side pad [B].
- Jaw [C]



- Before installation, clean the pads with a high-flash point solvent.
- Push [A] the caliper pistons in by hand as far as they will go.
- Be sure to install the snap pin for the caliper.



⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever or pedal is obtained by pumping the brake lever or pedal until the pads are against the disc. The brakes will not function on the first application of the lever or pedal if this is not done.

Brake Pad Wear Inspection

In accordance with the Periodic Maintenance Chart, inspect the brake pads for wear.

- Remove the front pad and the rear pad.
 - Front Outer Pad [A]
 - Front Piston Side Pad [B]
- Check the lining thickness [C] of the pads in each caliper.
- ★ If the lining thickness of either pad is less than the service limit [D], replace both pads in the caliper as a set.

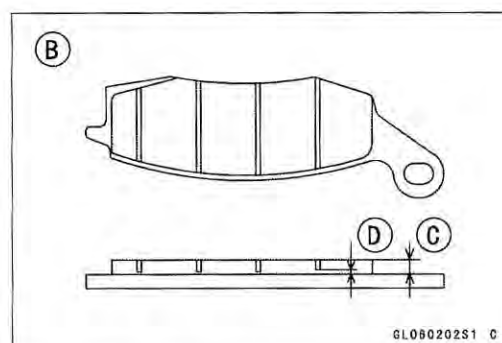
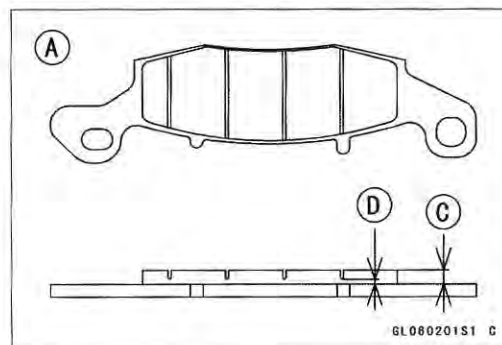
Pad Lining Thickness

Standard:

Front: 4.5 mm

Rear: 4.9 mm

Service Limit: 1 mm

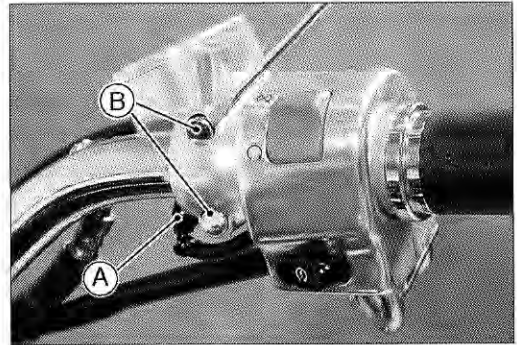


11-14 BRAKES

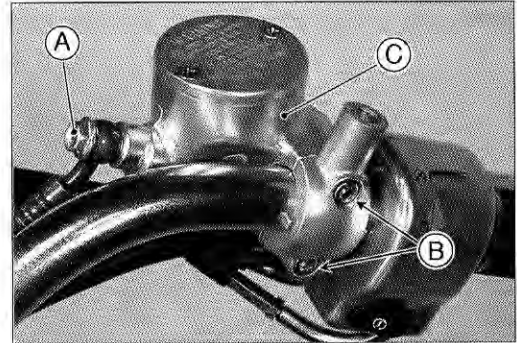
Master Cylinder

Front Master Cylinder Removal

- Disconnect the front brake light switch connectors [A].
- Draw out the brake fluid from the reservoir with a means like the fork oil level gage.
- Pull the bolt caps [B] out.



- Remove the banjo bolt [A] to disconnect the brake hose from the master cylinder (see Brake Hose Removal/Installation).
- Unscrew the clamp bolts [B], and take off the master cylinder [C] as an assembly with the reservoir, brake lever, and brake switch installed.

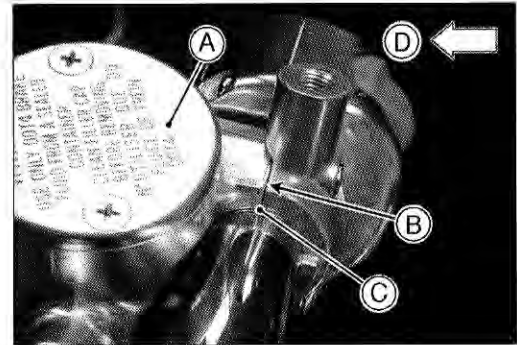


CAUTION

Immediately wash away any brake fluid that spills.

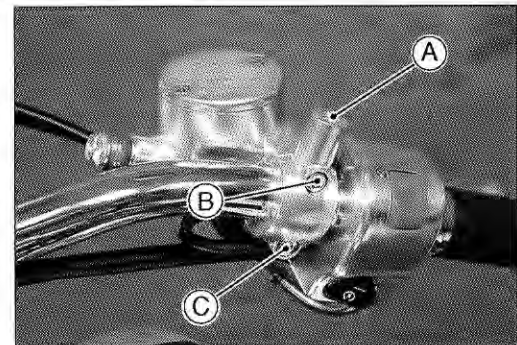
Front Master Cylinder Installation

- Set the front master cylinder [A] to match its mating surface [B] to the punched mark [C] of the handlebar.
Front [D]



- The master cylinder clamp must be installed with the rear view mirror boss [A] faced upward.
- Tighten the upper clamp bolt [B] first, and then the lower clamp bolt [C]. There will be a gap at the lower part of the clamp after tightening.

Torque - Front Master Cylinder Clamp Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)



- Install the bolt caps.
- Use a new flat washer on each side of the brake hose fitting.
- Tighten the brake hose banjo bolt.

Torque - Brake Hose Banjo Bolt: 25 N·m (2.5 kg·m, 18.0 ft·lb)

- Replenish the fluid in the reservoir, and bleed the brake line (see Bleeding the Brake Line).
- Check the brake for good braking power, no brake drag, and no fluid leakage.

Master Cylinder

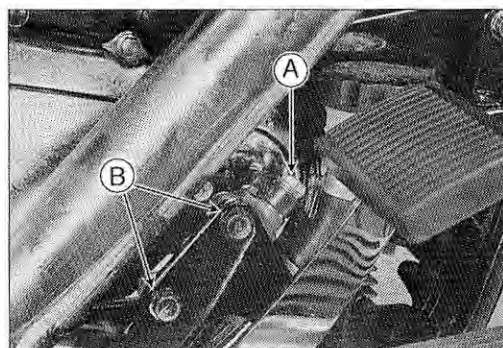
Rear Master Cylinder Removal/Installation

- The rear master cylinder is removed or installed during brake pedal removal or installation (see Brake Pedal Removal or Brake Pedal Installation).

NOTE

- Before removing the right front footboard, loosen the rear master cylinder banjo bolt [A] and mounting bolts [B].

Front [C]



⚠ WARNING

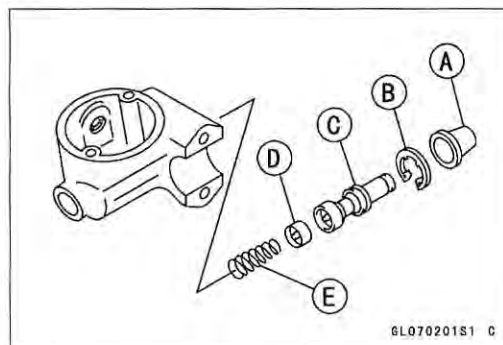
Do not attempt to ride the motorcycle until a full brake pedal is obtained by pumping the brake pedal until the pads are against the disc. The brake will not function on the first application of the pedal if this is not done.

Front Master Cylinder Disassembly

- Remove the front master cylinder.
- Remove the reservoir cap and diaphragm.
- Unscrew the locknut and pivot bolt, and remove the brake lever.
- Pull the dust cover [A] out of place, and remove the circlip [B].

Special Tool - Inside Circlip Pliers: 57001-143

- Pull out the piston assy [C], primary cup [D], and return spring [E].



CAUTION

Do not remove the secondary cup from the piston since removal will damage it.

Rear Master Cylinder Disassembly

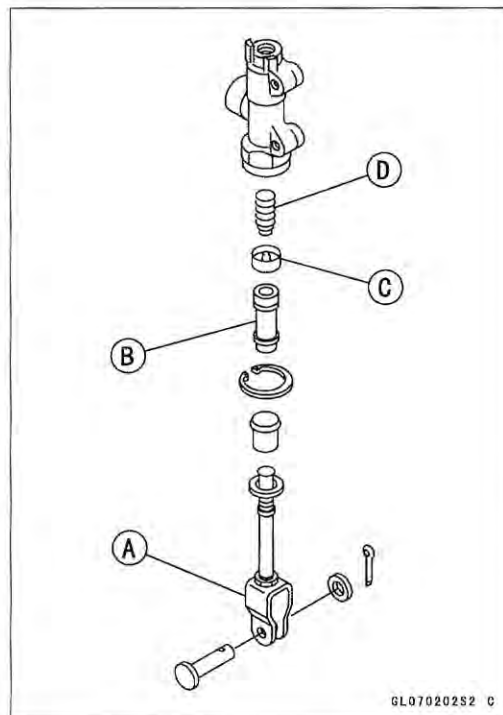
NOTE

- Do not remove the push rod clevis [A] for master cylinder disassembly since removal requires brake pedal position adjustment.

- Remove the rear master cylinder.
- Slide the dust cover on the push rod out of place, and remove the circlip.

Special Tool - Inside Circlip Pliers: 57001-143

- Pull out the push rod with the piston stop.
- Take off the piston assy [B], primary cup [C], and return spring [D].



CAUTION

Do not remove the secondary cup from the piston since removal will damage it.

11-16 BRAKES

Master Cylinder

Master Cylinder Assembly

- Before assembly, clean all parts including the master cylinder with brake fluid or alcohol.

CAUTION

Except for the disc pads and disc, use only disc brake fluid, isopropyl alcohol, or ethyl alcohol for cleaning brake parts. Do not use any other fluid for cleaning these parts. Gasoline, engine oil, or any other petroleum distillate will cause deterioration of the rubber parts. Oil spilled on any part will be difficult to wash off completely, and will eventually deteriorate the rubber used in the disc brake.

- Apply brake fluid to the removed parts and to the inner wall of the cylinder.
- Take care not to scratch the piston or the inner wall of the cylinder.
- Tighten the brake lever pivot bolt and the locknut.

Silicone Grease - Brake Lever Pivot Bolt, Brake Lever Pivot Contact, Push Rod Contact, Dust Cover

**Torque - Brake Lever Pivot Bolt: 1.0 N·m (0.10 kg·m, 8.7 in·lb)
Brake Lever Pivot Bolt Locknut: 5.9 N·m (0.60 kg·m, 52 in·lb)**

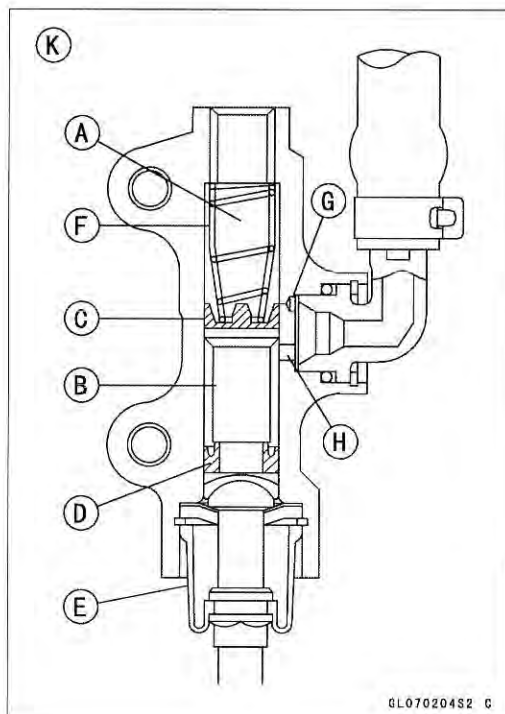
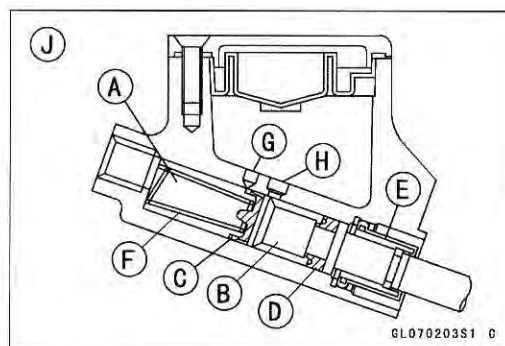
Master Cylinder Inspection

- Disassemble the front and rear master cylinders.
- Check that there are no scratches, rust or pitting on the inner wall [A] of each master cylinder and on the outside of each piston [B].
- ★ If a master cylinder or piston shows any damage, replace them.
- Inspect the primary cup [C] and secondary cup [D].
- ★ If a cup is worn, damaged softened (rotted), or swollen, the piston assy should be replaced to renew the cups.
- ★ If fluid leakage is noted at the brake lever, the piston assy should be replaced to renew the cups.

Front Master Cylinder [J]

- Check the dust covers [E] for damage.
- ★ If they are damaged, replace them.
- Check the piston return spring [F] for any damage.
- ★ If the springs are damaged, replace them.
- Check that relief port [G] and supply port [H] are not plugged.
- ★ If the relief port becomes plugged, the brake pads will drag on the disc. Blow the ports clean with compressed air.

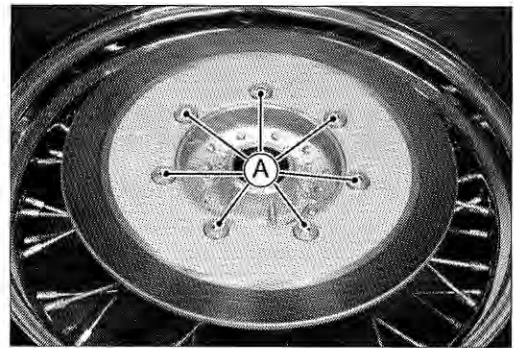
Rear Master Cylinder [K]



Brake Discs

Brake Disc Removal

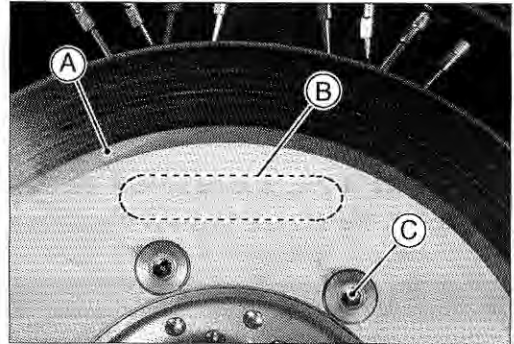
- Remove the wheel (see Wheels/Tires chapter).
- Unscrew the mounting bolts [A], and take off the disc.



Brake Disc Installation

- Install the brake disc [A] on the wheel so that the marked side [B] faces out.
- Apply a non-permanent locking agent to the threads of the brake disc bolts [C].
- Tighten:

Torque - Brake Disc Bolts: 27 N·m (2.8 kg·m, 20 ft·lb)



Brake Disc Wear

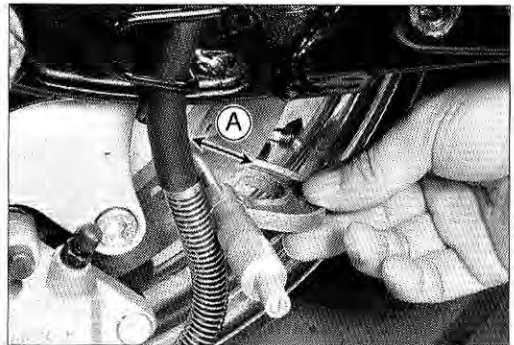
- For rear disc measurement, remove the silencer (see Engine Top End chapter).
- ★ Replace the disc if the sliding surface [A] has worn past the service limit.

Front Disc Thickness

Standard: 5.8 ~ 6.2 mm
Service Limit: 5.5 mm

Rear Disk Thickness

Standard: 6.8 ~ 7.2 mm
Service Limit: 6.0 mm

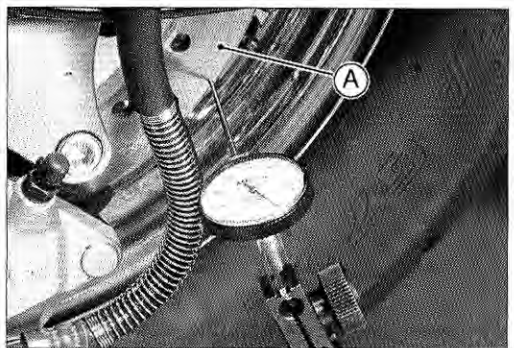


Brake Disc Warp

- Jack up the motorcycle so that the wheel is off the ground (see Wheels/Tires chapter).
- For front disc inspection, turn the handlebar fully to one side.
- For rear disc inspection, remove the silencer (see Engine Top End chapter).
- Set up a dial gage against the disc [A] as shown and measure disc runout, while turning [B] the wheel by hand.
- ★ If the runout exceeds the service limit, replace the disc.

Disc Runout

Standard: TIR 0.2 mm or less
Service Limit: TIR 0.3 mm



11-18 BRAKES

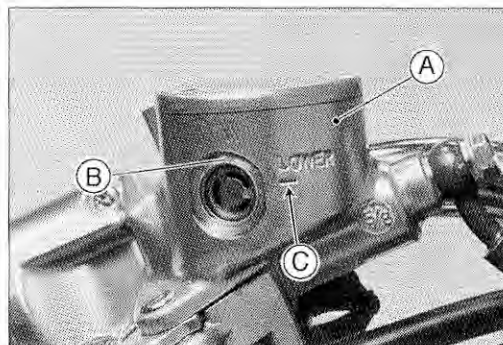
Brake Fluid

Level Inspection

- In accordance with the Periodic Maintenance Chart, inspect the brake fluid level in the front and rear brake fluid reservoirs.
- Check that the brake fluid level in the front brake reservoir [A] is between the upper [B] and the lower [C] level lines.

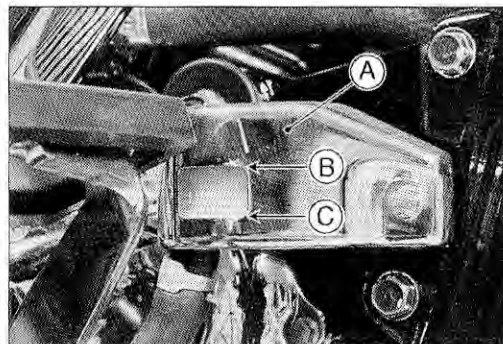
NOTE

- Hold the reservoir horizontal by turning the handlebar when checking brake fluid level.
- ★ If the fluid level is lower than the lower level line, fill the reservoir to the upper level line.



- Check that the brake fluid level in the rear brake reservoir [A] is between the upper [B] and the lower [C] level lines.
- ★ If the fluid level is lower than the lower level line, fill the reservoir to the upper level line.
- Use extra heavy-duty brake fluid only from a container marked D.O.T.4.
- Brake fluid of D.O.T.4 is installed in the brake system when shipped.

Torque - Front Brake Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)



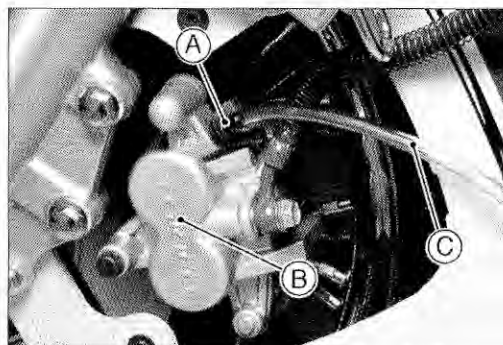
⚠ WARNING

Do not mix two brands of fluid. Change the brake fluid in the brake line completely if the brake fluid must be refilled but the type and brand of the brake fluid that is already in the reservoir are unidentified. After changing the fluid, use only the same type and brand of fluid thereafter.

Brake Fluid Change

NOTE

- The procedure to change the front brake fluid is as follows. Changing the rear brake fluid is almost the same as for the front brake.
- Level the brake fluid reservoir.
- Remove the reservoir cap.
- Remove the front caliper cover (see Front Caliper Removal).
- Remove the rubber cap from the bleed valve [A] on the front caliper [B].
- Attach a clear plastic hose [C] to the bleed valve, and run the other end of the hose into a container.
- Fill the reservoir with new brake fluid.
- Temporarily install the reservoir cap.
- Change the brake fluid as follows:

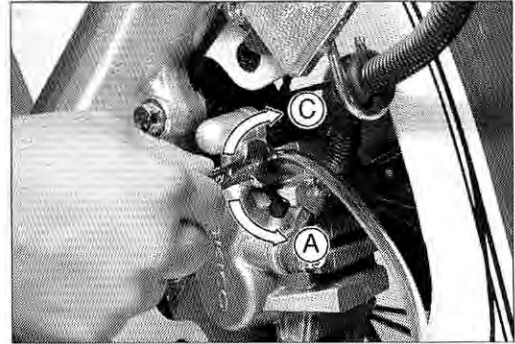


NOTE

- The fluid level must be checked often during the changing operation and replenished with fresh brake fluid. If the fluid in the reservoir runs out any time during the changing operation, the brakes will need to be bled since air will have entered the brake line.

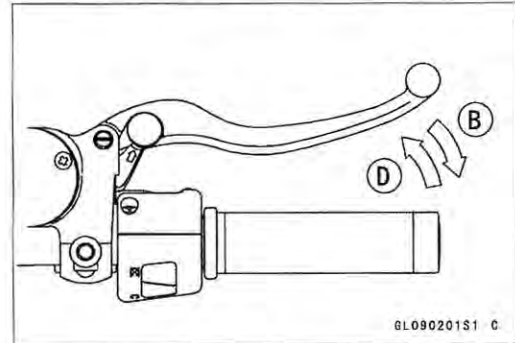
Brake Fluid

- Repeat this operation until fresh brake fluid comes out from the plastic hose or the color of the fluid changes.
 - Open the bleed valve [A].
 - Pump the brake lever and hold it [B].
 - Close the bleed valve [C].
 - Release the brake lever [D].

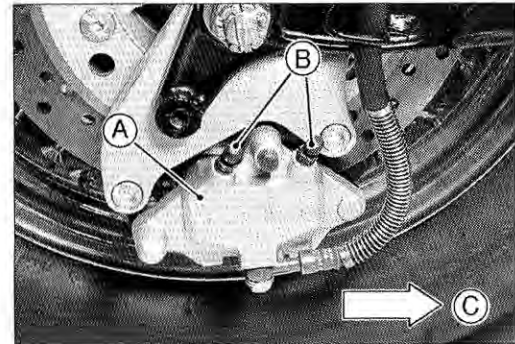


- Remove the clear plastic hose.
- Install the reservoir cap.
- Tighten the bleed valve, and install the rubber cap.

Torque - Caliper Bleed Valve: 7.8 N·m (0.8 kg·m, 69 in·lb)
Front Brake Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)



- For fluid change to the rear brake caliper, remove the silencer (see Engine Top End chapter).
- For the rear brake caliper [A], change the brake fluid for two bleed valves [B].
 - Front [C]
- After changing the fluid, check the brake for good braking power, no brake drag, and no fluid leakage.
- ★ If necessary, bleed the air from the lines.



Brake Line Bleeding

The brake fluid has a very low compression coefficient so that almost all the movement of the brake lever or pedal is transmitted directly to the caliper for braking action. Air, however, is easily compressed. When air enters the brake lines, brake lever or pedal movement will be partially used in compressing the air. This will make the lever or pedal feel spongy, and there will be a loss in braking power.

⚠ WARNING

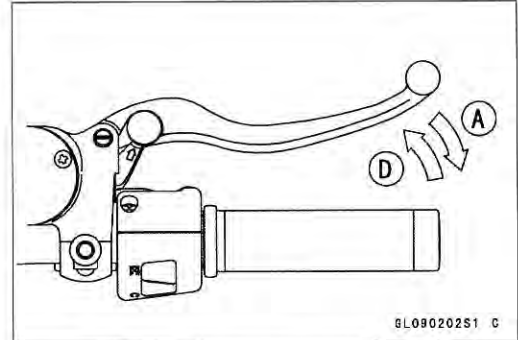
Be sure to bleed the air from the brake line whenever brake lever or pedal action feels soft or spongy after the brake fluid is changed, or whenever a brake line fitting has been loosened for any reason.

11-20 BRAKES

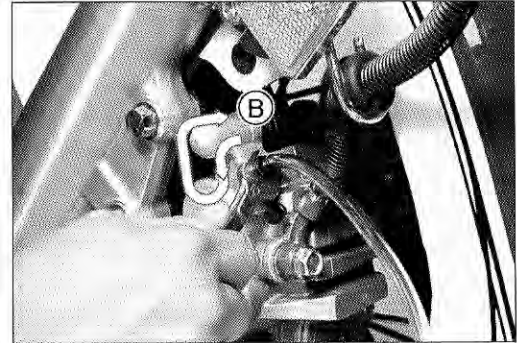
Brake Fluid

NOTE

- *The procedure to bleed the front brake line is as follows. Bleeding the rear brake line is almost the same as for the front brake.*
- Remove the reservoir cap, and fill the reservoir with fresh brake fluid to the upper level line in the reservoir.
- With the reservoir cap off, slowly pump the brake lever several times until no air bubbles can be seen rising up through the fluid from the holes at the bottom of the reservoir.
- Install the reservoir cap.

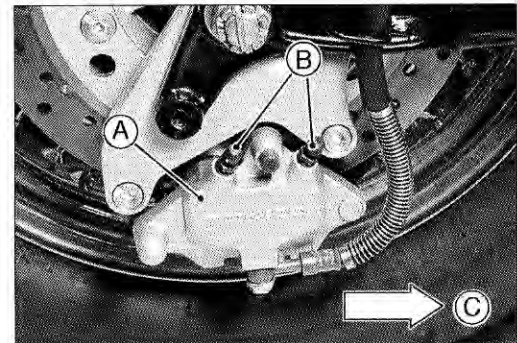


- Remove the rubber cap from the bleed valve on the caliper.
- Attach a clear plastic hose to the bleed valve, and run the other end of the hose into a container.
- Bleed the brake line and the caliper as follows:
 - Repeat this operation until no more air can be seen coming out into the plastic hose.
 - Pump the brake lever until it becomes hard, and apply the brake lever and hold it [A].
 - Quickly open and close [B] the bleed valve while holding the brake lever applied.
 - Release the brake lever [D].



NOTE

- *The fluid level must be checked often during the bleeding operation and replenished with fresh brake fluid as necessary. If the fluid in the reservoir runs completely out any time during bleeding, the bleeding operation must be done over again from the beginning since air will have entered the line.*
- *Tap the brake hose lightly from the caliper to the reservoir for more complete bleeding.*
- Remove the clear plastic hose.
- Tighten:
 - Torque - Caliper Bleed Valve: 7.8 N·m (0.8 kg·m, 69 in·lb)**
 - Front Brake Reservoir Cap Screws: 1.5 N·m (0.15 kg·m, 13 in·lb)**
- For the rear brake caliper [A], bleed the brake line for two bleed valve [B].
 - Front [C]
- Check the fluid level.
- After bleeding is done, check the brake for good braking power, no brake drag, and no fluid leakage.
- For fluid change to the rear brake caliper, remove the silencer (see Engine Top End chapter).

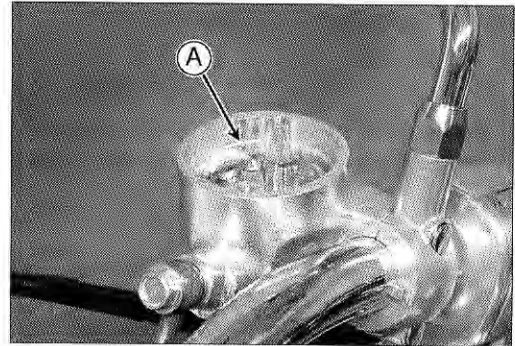


Brake Fluid

⚠ WARNING

When working with the disc brake, observe the precautions listed below.

1. Never reuse old brake fluid.
2. Do not use fluid from a container that has been left unsealed or that has been open for a long time.
3. Do not mix two types and brands of fluid for use in the brake. This lowers the brake fluid boiling point and could cause the brake to be ineffective. It may also cause the rubber brake parts to deteriorate.
4. Don't leave the reservoir cap off [A] for any length of time to avoid moisture contamination of the fluid.
5. Don't change the fluid in the rain or when a strong wind is blowing.
6. Except for the disc pads and disc, use only disc brake fluid, isopropyl alcohol, or ethyl alcohol for cleaning brake parts. Do not use any other fluid for cleaning these parts. Gasoline, engine oil, or any other petroleum distillate will cause deterioration of the rubber parts. Oil spilled on any part will be difficult to wash off completely and will eventually deteriorate the rubber used in the disc brake.
7. When handling the disc pads or disc, be careful that no disc brake fluid or any oil gets on them. Clean off any fluid or oil that inadvertently gets on the pads or disc with a high-flash point solvent. Do not use one which will leave an oily residue. Replace the pads with new ones if they cannot be cleaned satisfactorily.
8. Brake fluid quickly ruins painted surfaces; any spilled fluid should be completely washed away immediately.
9. If any of the brake line fittings or the bleed valve is opened at any time, the **AIR MUST BE BLED FROM THE BRAKE LINE.**



11-22 BRAKES

Brake Hoses

Brake Hose Removal/Installation

CAUTION

Brake fluid quickly ruins painted surfaces; any spilled fluid should be completely washed away immediately.

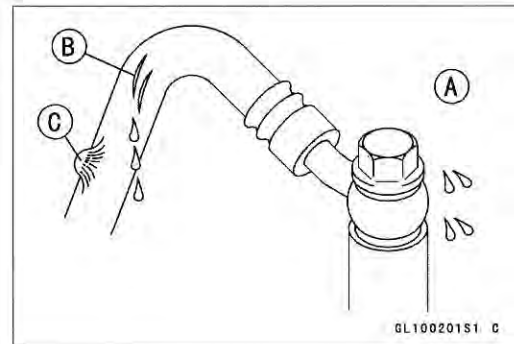
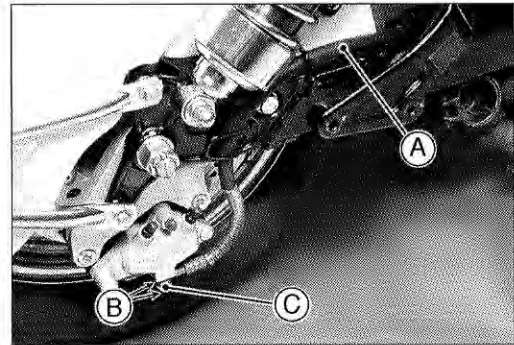
- When removing the brake hose, take care not to spill the brake fluid on the painted or plastic parts.
- When removing the brake hose [A], temporarily secure the end of the brake hose to some high place to keep fluid loss to a minimum.
- Immediately wash away any brake fluid that spills.
- There are washers [B] on each side of the brake hose fitting. Replace them with new ones when installing.
- When installing the hoses, avoid sharp bending, kinking, flattening or twisting, and route the hoses according to Cable, Wire, and Hose Routing section in the General Information chapter.
- Tighten the banjo bolts [C] on the hose fittings.

Torque - Brake Hose Banjo Bolts: 25 N·m (2.5 kg·m, 18.0 ft·lb)

- Fill the brake line after installing the brake hose (see Brake Fluid Changing).

Brake Hose Inspection

- The high pressure inside the brake line can cause fluid to leak [A] or the hose to burst if the line is not properly maintained. Bend and twist the rubber hose while examining it.
- ★ Replace the hose if any cracks [B] or bulges [C] are noticed.



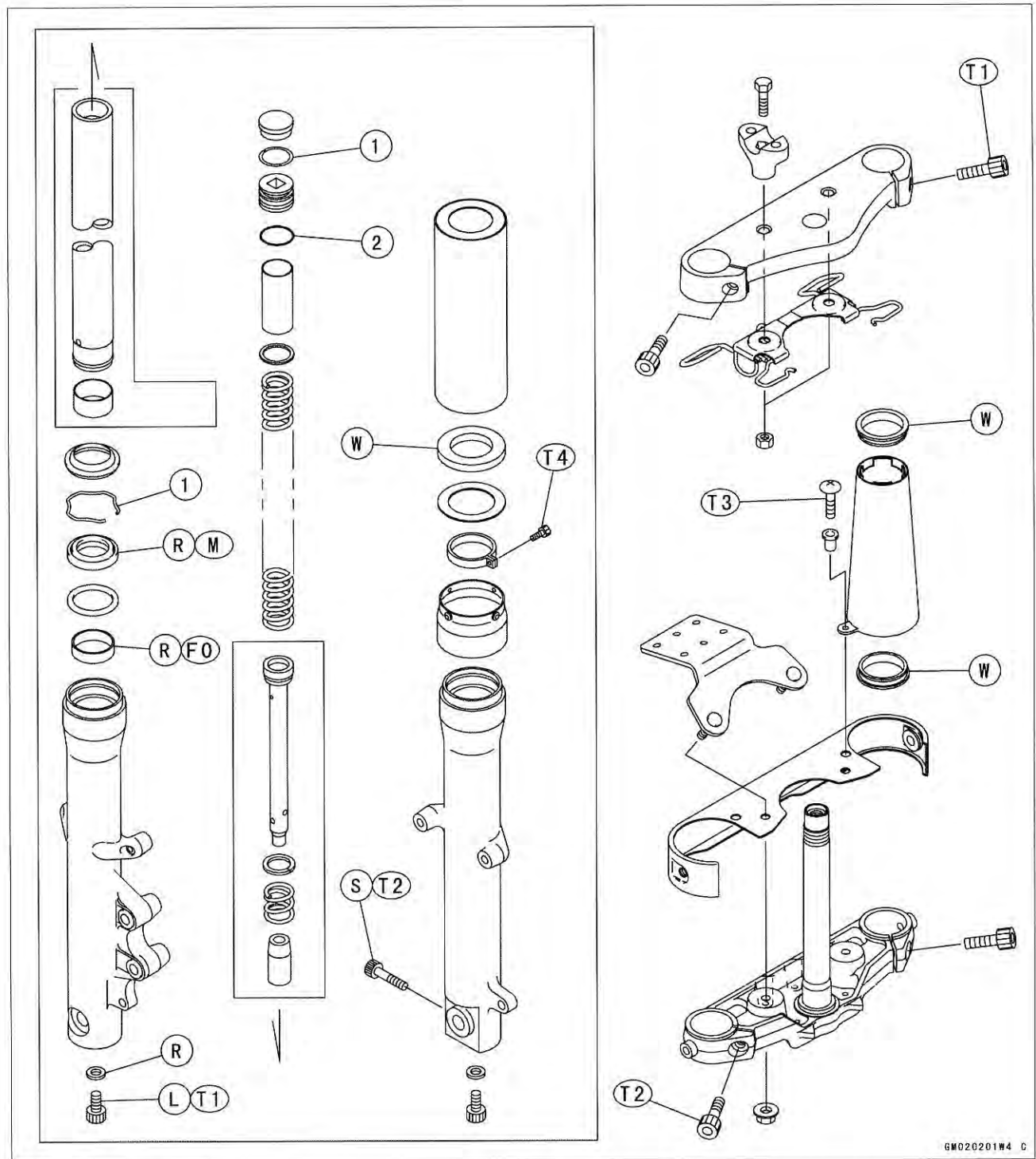
Suspension

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12-2 SUSPENSION

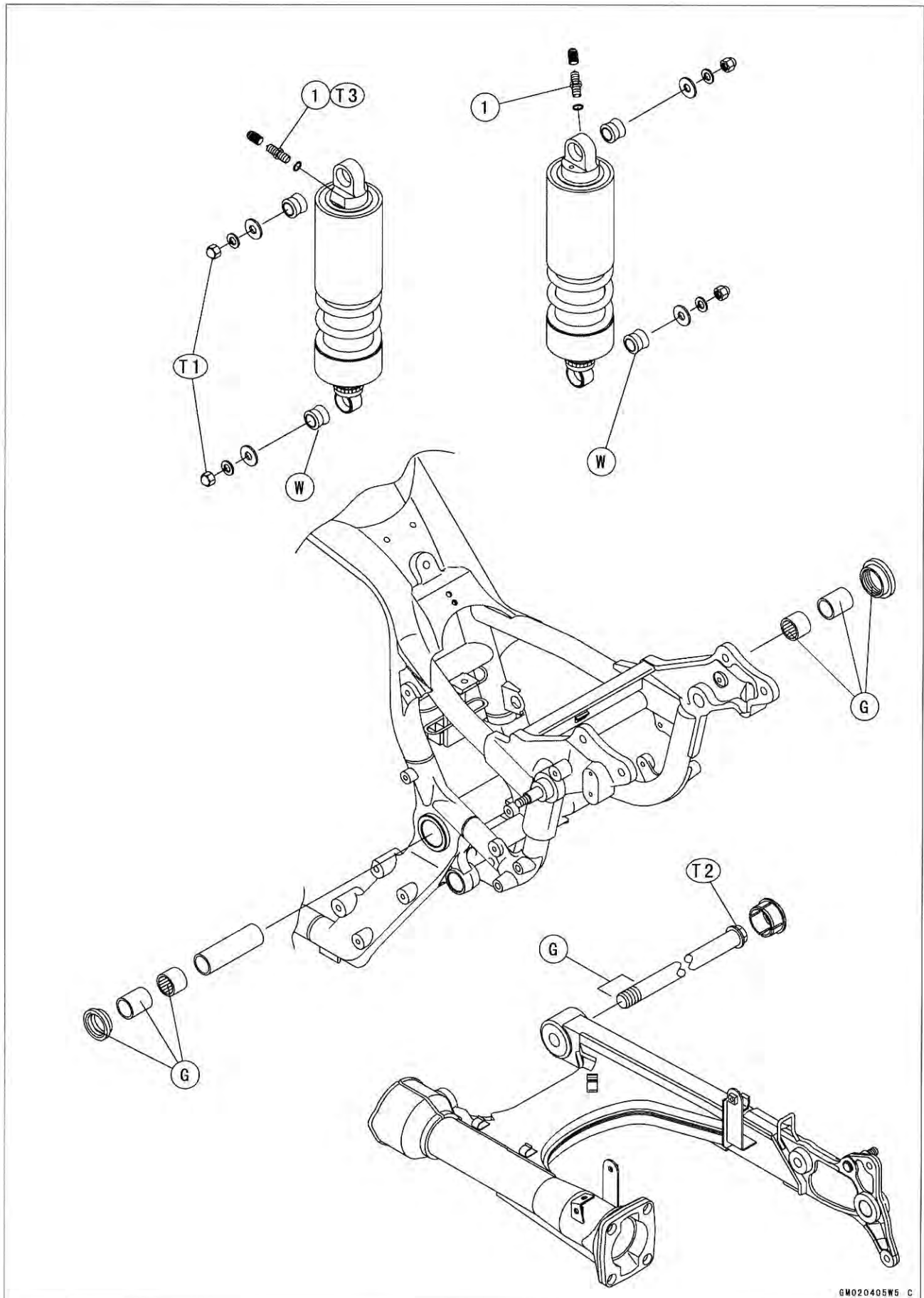
Exploded View



- 1. Retaining Ring
- 2. O-ring
- FO: Apply fork oil.
- L: Apply a non-permanent locking agent.
- M: Apply molybdenum disulfide grease.
- R: Replacement Parts

- S: Follow the specific tightening sequence.
- W: Apply a soap and water solution or rubber lubricant.
- T1: 20 N·m (2.0 kg·m, 14 ft·lb)
- T2: 34 N·m (3.5 kg·m, 25 ft·lb)
- T3: 4.4 N·m (0.45 kg·m, 39 in·lb, $\phi 5$)
- T4: 3.9 N·m (0.40 kg·m, 35 in·lb)

Exploded View



GM020405W5 C

12-4 SUSPENSION

Exploded View

1. Air Valves

G: Apply grease.

W: Apply a soap and water solution or rubber lubricant.

T1: 34 N·m (3.5 kg·m, 25 ft·lb)

T2: 110 N·m (11 kg·m, 79.6 ft·lb)

T3: 5.4 N·m (0.55 kg·m, 47 in·lb)

Specifications

Item	Standard
Front Fork (per one unit):	
Fork inner tube diameter	φ41 mm
Fork spring setting	Non-adjustable
Air pressure	Atmospheric pressure (Non-adjustable)
Rebound damper setting	Non-adjustable
Fork oil viscosity	SAE 10W-20
Fork oil capacity	419 ± 2.5 mL (completely disassembled and dry) approx. 356 mL (when changing oil)
Fork oil level	Fully compressed, without fork spring, below from inner tube top: 169 ± 2 mm
Fork spring free length	455.6 mm (Service limit: 446 mm)
Rear Shock Absorber:	
Rebound damper set	No.2 of 4 positions
Air pressure	
Standard	Atmospheric pressure
Usable range	Atmospheric pressure ~ 290 kPa (3.0 kg/cm ² , 43 psi)

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

Fork Oil Level Gauge: 57001-1290

Fork Cylinder Holder Handle: 57001-183

Fork Cylinder Holder Adapter: 57001-1057

Fork Outer Tube Weight: 57001-1218

Front Fork Oil Seal Driver: 57001-1219

Oil Seal & Bearing Remover: 57001-1058

Bearing Driver Set: 57001-1129

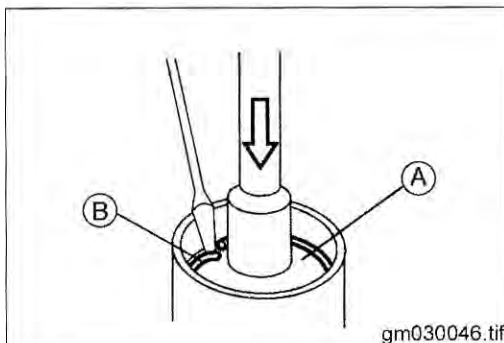
12-6 SUSPENSION

Front Fork

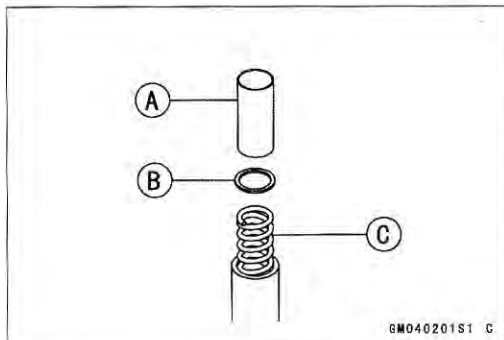
Fork Oil Change

The oil should be changed in accordance with the Periodic Maintenance Chart.

- Remove the front fork (see Front Fork Removal).
- Remove the top cap.
- Hold the outer tube vertically in a vise.
- Push the top plug [A] down to remove the plug retaining ring [B].
- Remove the plug slowly, so the plug doesn't shoot out of the fork tube.



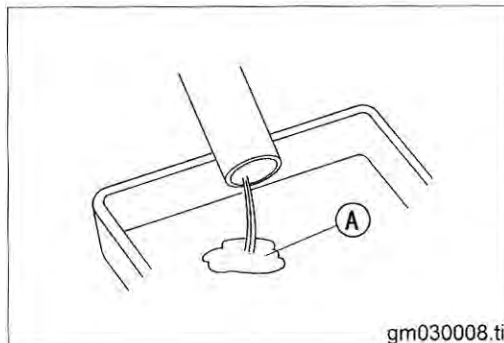
- Remove:
Spacer [A]
Washer [B]
Fork Spring [C]



- Pour out the fork oil [A] with the fork upside down.
- Hold the outer tube vertically in a vise.
- Fill the front fork with the specified oil.

Fork Oil Viscosity: SAE10W-20

Fork Oil Capacity (when changing oil): Approx. 356 mL



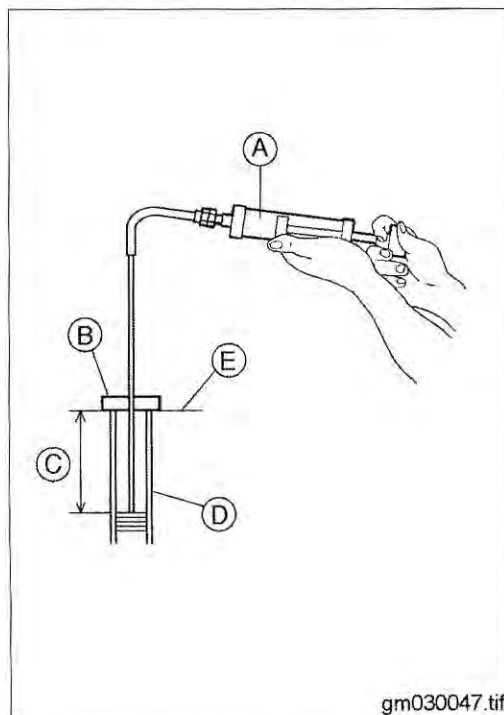
- Wait for about five minutes so that any suspended air bubbles can surface.
- Measure the oil level, using the fork oil level gauge [A].

Special Tool - Fork Oil Level Gauge: 57001-1290

- Set the gauge stopper [B] so that its lower side shows the oil level distance specified [C].
- Insert the gauge tube into the inner tube [D] and position the stopper across the top of the inner tube [E].
- Pull the handle slowly to draw out the excess oil until no more oil comes up the tube.
- ★ If no oil is drawn out from the beginning, there is not enough oil in the fork. Pour in some more oil, then draw out the excess.

Front Fork Oil Level (Fully compressed without fork spring)

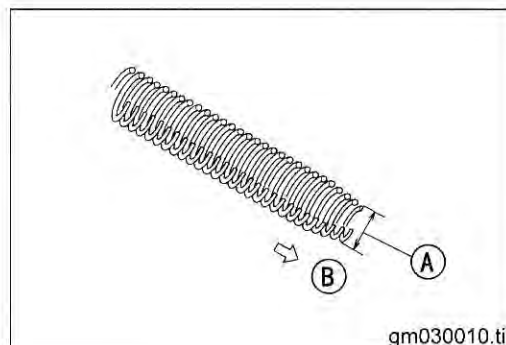
Standard: 169 ± 2 mm



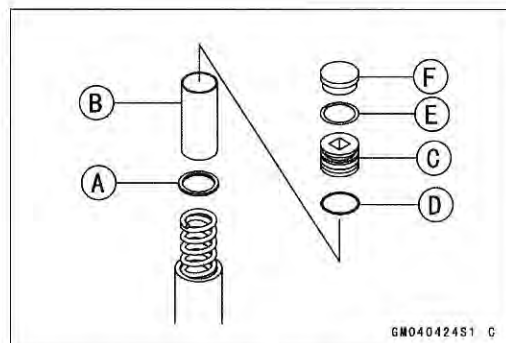
Front Fork

- Install the fork spring with the smaller diameter end [A] facing down [B].
- Tighten:

Torque - Upper Fork Clamp Bolts: 20 N·m (2.0 kg·m, 14 ft·lb)
 Lower Fork Clamp Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)
 Front Axle Clamp Bolt: 34 N·m (3.5 kg·m, 25 ft·lb)
 Front Axle Nut: 108 N·m (11 kg·m, 79.6 ft·lb)
 Front Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)



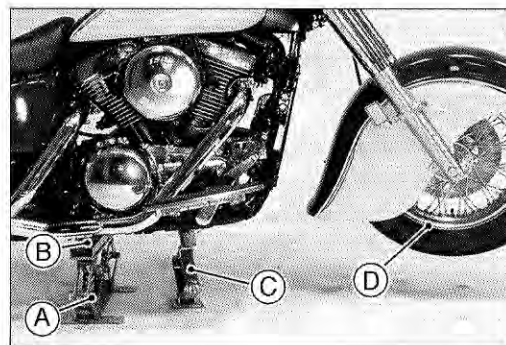
- Install:
 Washer [A]
 Spacer [B]
 Top Plug [C] and O-ring [D]
 Retaining Ring [E]
 Top Cap [F]



Removal (each fork leg)

- Loosen the front axle nut (see wheels/Tires chapter).
- Using the jack [A] and attachment jack [B] under the frame pipe ribs, and a commercially available jack [C] under the engine, lift the front wheel [D] **OFF** the ground until the rear wheel touches the ground.

Special Tools - Jack: 57001-1238
 Attachment Jack: 57001-1398



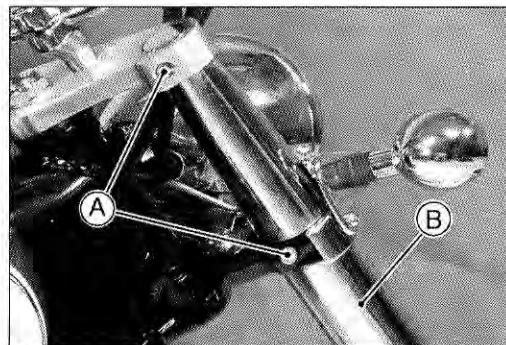
CAUTION

Be sure to put the rear wheel on the ground when removing the front fork, or the motorcycle may fall over. The motorcycle could be damaged.

⚠ WARNING

Be sure to put the rear wheel on the ground when removing the front fork, or the motorcycle may fall over. It could cause an accident and injury.

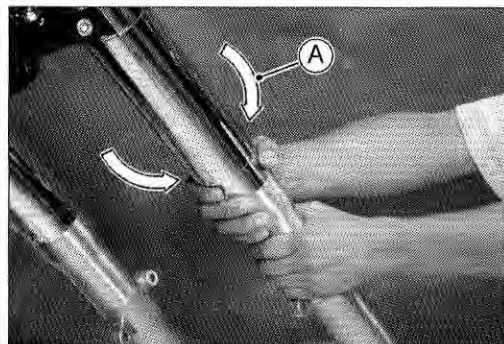
- Remove:
 Front wheels (see Wheels/Tires chapter)
 Front Fender (see Frame chapter)
- Loosen the upper and lower fork clamp bolt [A] and remove the front fork [B].



12-8 SUSPENSION

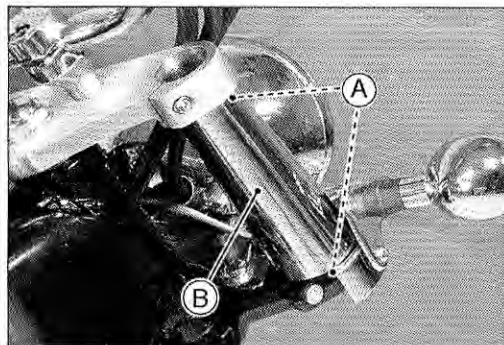
Front Fork

- With a twisting motion [A], work the fork leg down out.

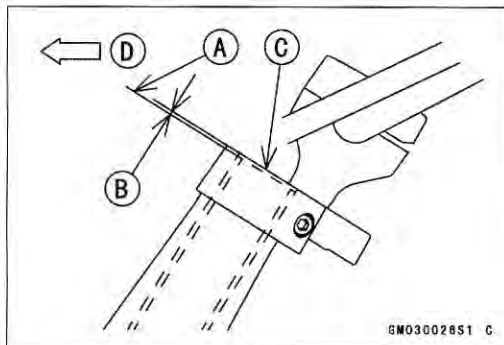


Installation

- Apply a soap and water solution to the rubber dampers [A] in the upper fork cover [B].



- Install the front fork.
- Adjust the fork position so that the inner tube top end [A] is **0 ~ 0.5 mm** [B] lower than the upper surface [C] of the steering stem head. Front [D]
- Install the removed parts and tighten:
Torque - Steering Stem Head Nut: 54 N·m (5.5 kg·m, 40 ft·lb)
Lower Fork Clamp Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)
Upper Fork Clamp Bolts: 20 N·m (2.0 kg·m, 14 ft·lb)
Handlebar Clamp Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)
- Check the front brake effectiveness after installation.

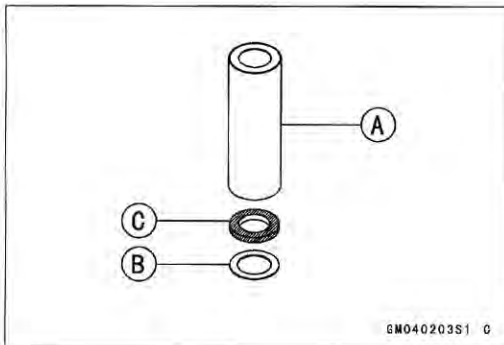


⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever is obtained by pumping the brake lever until the pads are against the disc. The brake will not function on the first application of the lever if this is not done.

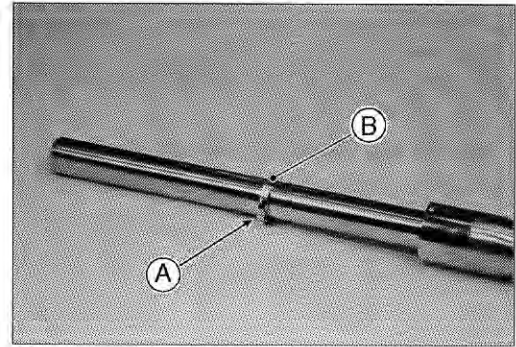
Disassembly

- Remove the front fork (see Front Fork Removal in this chapter).
- Remove the lower fork cover [A]. The washer [B], and damper [C] come off.

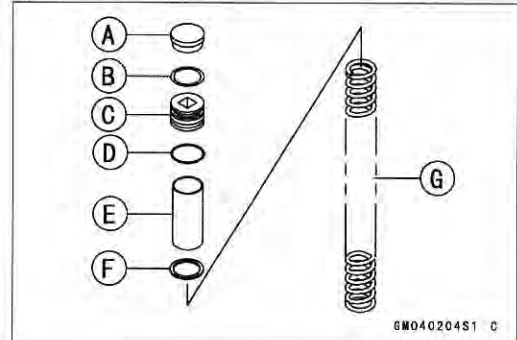


Front Fork

- Unscrew the bolt [A], and remove the spacer [B].



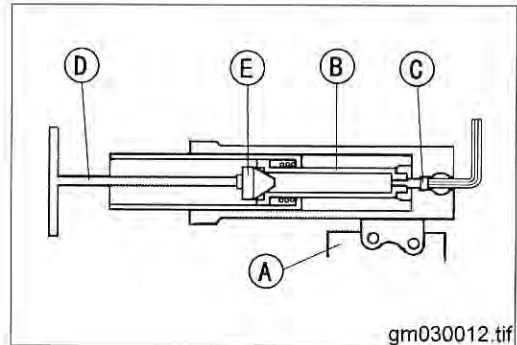
- Drain the fork oil (see Fork Oil Change in this chapter).
- The following parts are removed during draining the fork oil.
 - Top Cap [A]
 - Retaining Ring [B]
 - Top Plug [C]
 - O-ring [D]
 - Spacer [E]
 - Washer [F]
 - Fork Spring [G]



- Hold the front fork horizontally in a vise [A].
- Stop the cylinder unit [B] from turning by using the special tools.
- Unscrew the Allen bolt [C], and take the gasket out of the bottom of the outer tube.

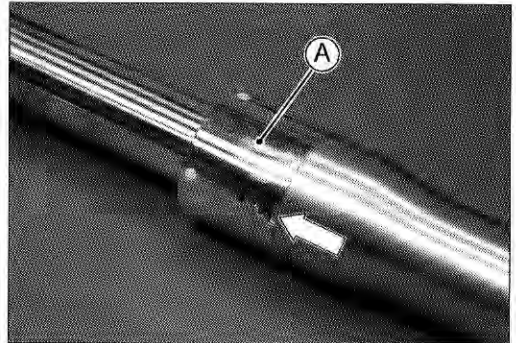
**Special Tools - Fork Cylinder Holder Handle: 57001-183 [D]
Fork Cylinder Holder Adapter: 57001-1057 [E]**

- Take the cylinder unit out of the inner tube.

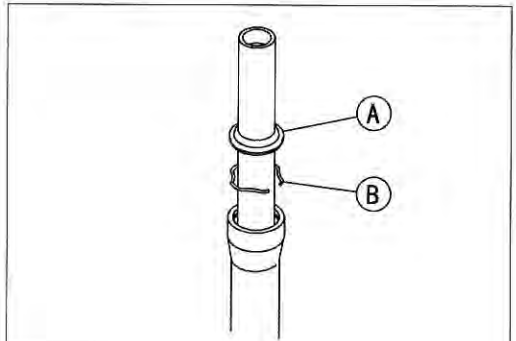


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- Tap the dust seal cover [A] out of the fork outer tube, using a thin-bladed screwdriver.



- Separate the inner tube from the outer tube as follows:
 - Remove the dust seal [A] from the outer tube.
 - Remove the retaining ring [B] from the outer tube.



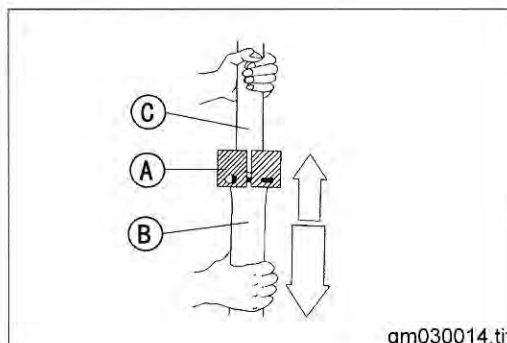
12-10 SUSPENSION

Front Fork

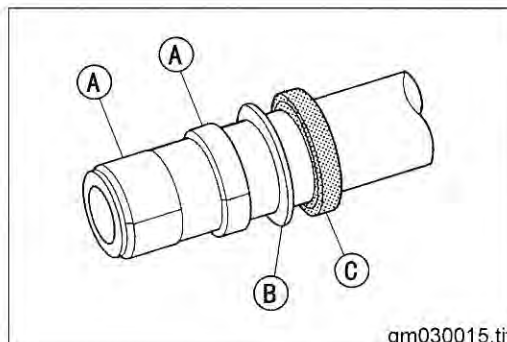
- Use the fork outer tube weight [A] to separate the outer tube [B] from the inner tube [C].
- Holding the inner tube by hand, pull the outer tube several times to pull out the inner tube.

Special Tool - Fork Outer Tube Weight: 57001-1218

- Take out the cylinder base out of the outer tube.



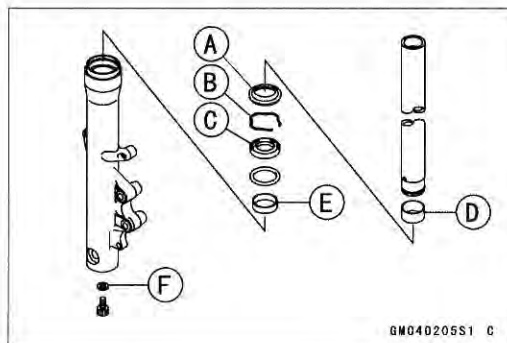
- Remove the guide bushings [A], washer [B], and oil seal [C] from the inner tube.



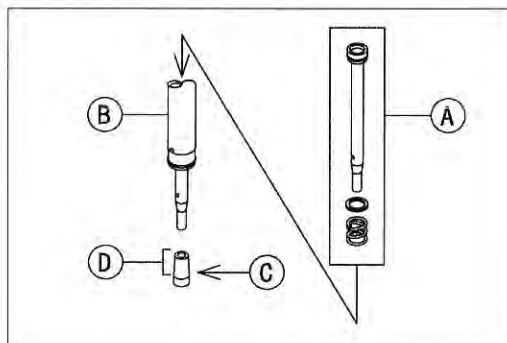
Assembly

- Replace the following parts with new ones after removal.

Dust Seal [A]
Retaining Ring [B]
Oil Seal [C]
Inner Guide Bushing [D]
Outer Guide Bushing [E]
Bottom Allen Bolt Gasket [F]

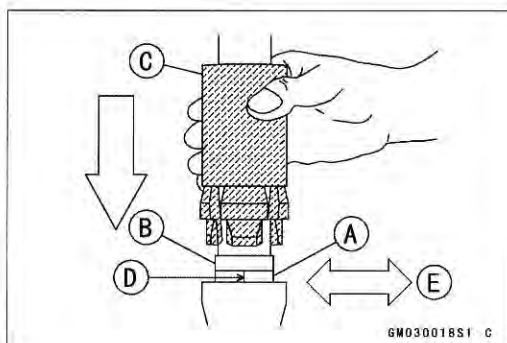


- Put the cylinder unit [A] with the spring into the inner tube [B], protruding from the inner tube, and install the cylinder base [C] onto the bottom end of the cylinder unit.
- Install the cylinder base with the tapered end [D] up.
- Install the inner tube, cylinder unit, and cylinder base as a set into the outer tube.



- Install the new guide bushing [A] with a used guide bushing [B] on it by tapping the used guide bushing with fork oil seal driver [C] until it stops.
- The split [D] of the bushing should face toward the side [E] of the vehicle.

Special Tool - Front Fork Oil Seal Driver: 57001-1219

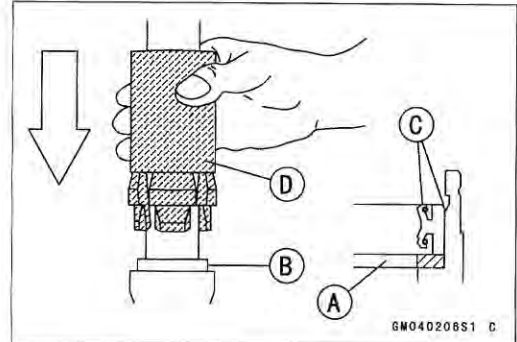


Front Fork

- Apply molybdenum disulfide grease to the oil seal lips and install the washer [A] and the oil seal [B] into the outer tube.
- Face the flat side [C] of the seal upward.

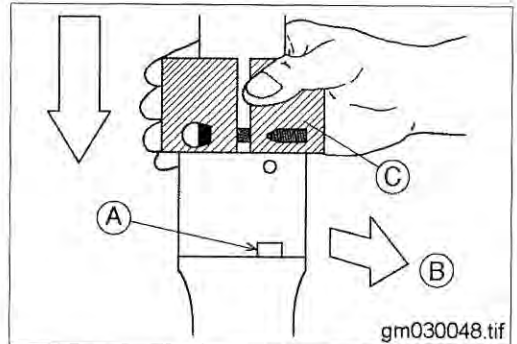
Special Tool - Front Fork Oil Seal Driver [D]: 57001-1219

- Install:
Retaining Ring
Dust Seal

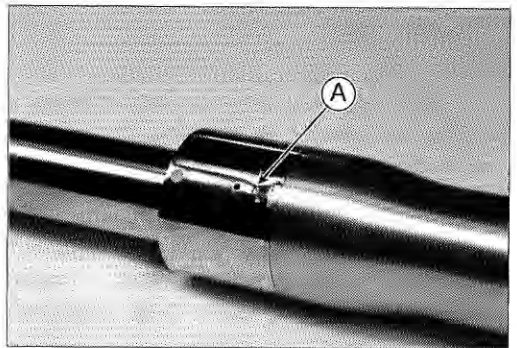


- Face the notch [A] of the dust seal cover rearward [B] and install the dust seal cover by tapping with the fork outer tube weight [C] until it stops.

Special Tool - Fork Outer Tube Weight: 57001-1218



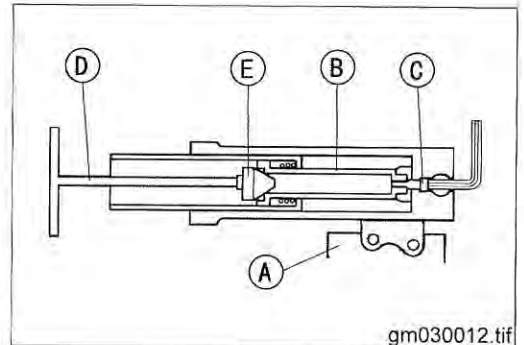
- Stake [A] the dust seal cover with a punch.



- Apply a non-permanent locking agent to the threads of the Allen bolt and screw the Allen bolt into the bottom of the outer tube.
- Hold the front fork horizontally in a vise [A].
- Hold the cylinder unit [B] with the special tools and tighten the Allen bolt [C].

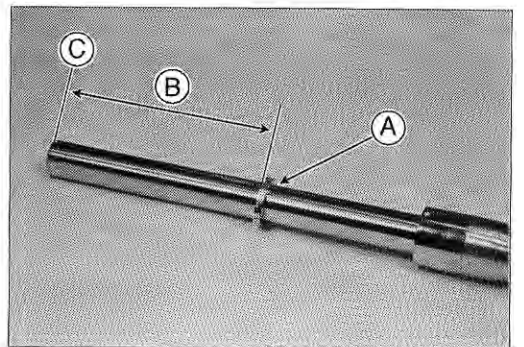
**Special Tools - Fork Cylinder Holder Handle: 57001-183 [D]
Fork Cylinder Holder Adapter: 57001-1057 [E]**

Torque - Bottom Allen Bolt: 20 N·m (2.0 kg·m, 14 ft·lb)



- Install the spacer [A] so that the distance [B] between the inner tube top [C] and the spacer top is 244.6 mm.

Torque - Spacer Bolt: 3.9 N·m (0.40 kg·m, 35 in·lb)



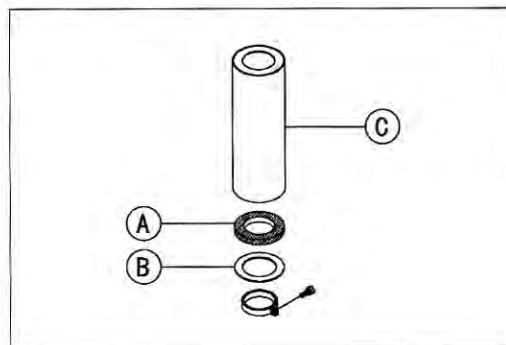
12-12 SUSPENSION

Front Fork

- Apply a soap and water solution to the damper.
- Put the damper [A] and washer [B] into the fork cover [C], and install them onto the fork.
- Pour in the specified type of oil and install the parts removed (see Fork Oil Change).

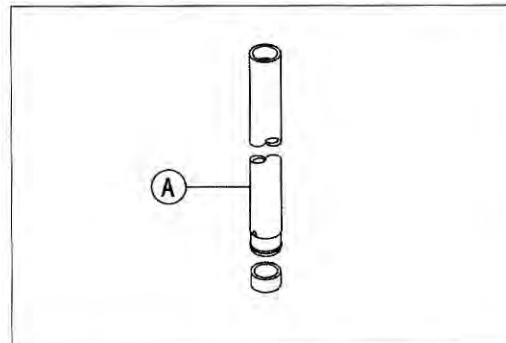
Fork Oil Viscosity: SAE10W-20

Fork Oil Capacity (completely disassembled and dry) : 419 ± 2.5 mL



Inner Tube, Outer Tube Inspection

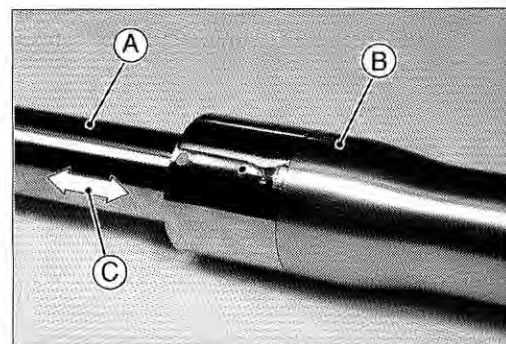
- Visually inspect the inner tube [A] and repair any damage.
- Nick or rust damage can sometimes be repaired by using a wet-stone to remove sharp edges or raised areas which cause seal damage.
- ★ If the damage is not repairable, replace the inner tube. Since damage to the inner tube damages the oil seal, replace the oil seal whenever the inner tube is repaired or replaced.



CAUTION

If the inner tube is badly bent or creased, replace it. Excessive bending, followed by subsequent straightening, can weaken the inner tube.

- Temporarily assemble the inner tube [A] and outer tube [B], and pump [C] them back and forth manually to check for smooth operation.
- ★ If you feel binding or catching, the inner and outer tubes must be replaced.



WARNING

A straightened inner or outer fork tube may fail in use, possibly, causing an accident. Replace a badly bent or damaged inner or outer tube, and inspect the other tube carefully before reusing it.

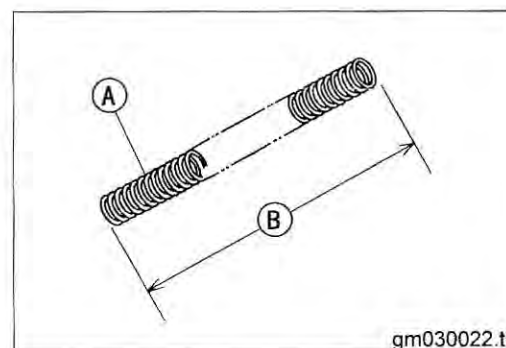
Spring Inspection

- Since the fork spring [A] becomes shorter as it weakens, check its free length [B] to determine its condition.
- ★ If the spring of either fork leg is shorter than the service limit, it must be replaced. If the length of the replacement spring and that of the remaining spring vary greatly, the remaining spring should also be replaced in order to keep the fork legs balanced for motorcycle stability.

Fork Spring Free Length

Standard: 455.6 mm

Service Limit: 446 mm



gm030022.tif

Rear Shock Absorber (Air Type)

Rebound Damping Adjustment

The rebound damping force adjuster on each rear shock absorber has 4 positions so that the rebound damping force can be adjusted for different road and loading conditions. The numbers on the adjuster show the setting position.

- Turn the adjuster [A] until the desired number [B] aligns with the triangular mark [C].

Top View [D]

- The standard adjuster setting is **No.2** for an average-build rider of 68 kg (150 lb) with no passenger and no accessories.

- ★ If the damper setting feels too soft or too stiff, adjust it in accordance with the following table.

Rebound Damping Adjustment

Adjuster Position	Damping Force	Setting	Load	Road	Speed
1	Weak	Soft	Light	Good	Low
2		↑	↑	↑	↑
3	Strong	↓	↓	↓	↓
4		Hard	Heavy	Bad	High

⚠ WARNING

If both adjusters are not adjusted equally, handling may be impaired and a hazardous condition may result.

Air Pressure Adjustment

The air pressure in the rear shock absorbers can be adjusted for different road and loading conditions.

The following table shows an example of air pressure adjustment. To obtain stable handling and a suitable ride, adjust the air pressure as indicated. The standard air pressure is **atmospheric pressure** for an average-build rider of 68 kg (150 lb) with no passenger and no accessories. Ordinarily, the heavier the total load becomes, the higher the air pressure should be set.

Air Pressure Adjustment

Air Pressure	Setting	Load	Road
Atmospheric Pressure (0 kg/cm ² , 0 psi)	Soft	Light	Good
↑	↑	↑	↑
↓	↓	↓	↓
290 kPa (3.0 kg/cm ² , 43 psi)	Hard	Heavy	Bad

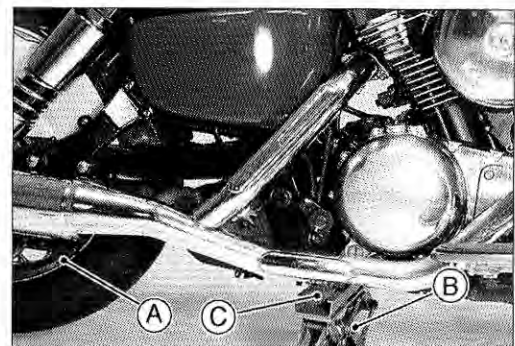
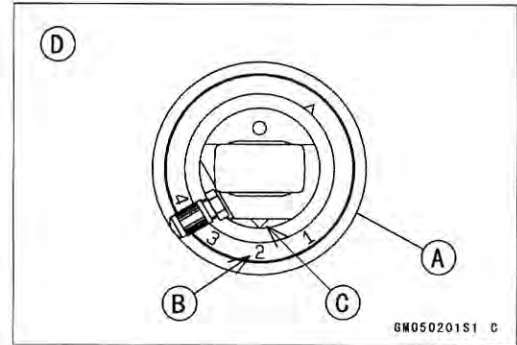
- Adjust the air pressure:

NOTE

- Check and adjust the air pressure when the rear shock absorbers are cold (room temperature).
- Raise the rear wheel [A] off the ground, using the jack [B], and the attachment jack [C].

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1290



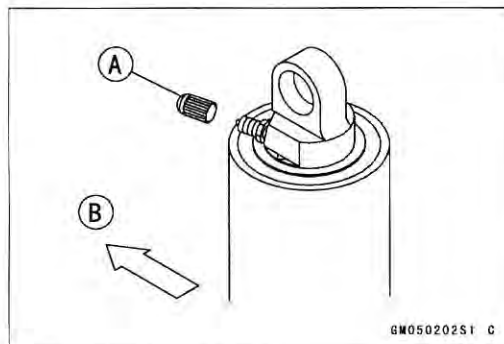
12-14 SUSPENSION

Rear Shock Absorber (Air Type)

- Take off each air valve cap [A] on the right and left shock absorbers. Front [B]
- Check the air pressure with the air pressure gauge.

NOTE

- *Do not use tire gauges for checking air pressure. They may not indicate the correct air pressure because of air leakage that occur when the gauge is applied to the valve.*



- To lower the air pressure, push the valve core in slightly. To raise the pressure, inject air through the valve with a tire pump. Change the air pressure within the range specified in the preceding table to suit various riding conditions.

CAUTION

Inject air little by little so that air pressure does not rise rapidly. Air pressure exceeding 490 kPa (5.0 kg/cm², 71 psi) may damage the oil seal. Try to set the air pressure of the right and left shock absorbers as equally as possible.

WARNING

Be sure to adjust the air pressure within the usable range. Pressure too high can produce a hazardous riding condition. Only air or nitrogen gas can be used. Never inject oxygen or any kind of explosive gas.

Removal

- Lift the rear wheel off the ground, using the jack and the attachment jack.
- Special Tools - Jack: 57001-1238
Attachment Jack: 57001-1398
- Squeeze the brake lever slowly and hold it with a band [A].

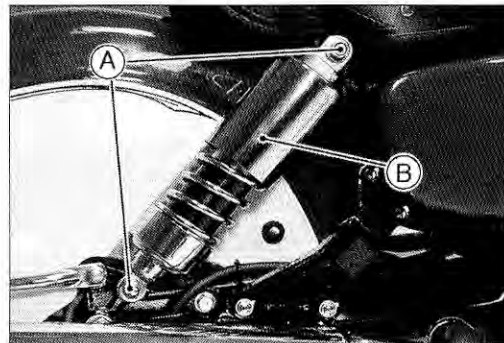
CAUTION

Be sure to hold the front brake when removing the shock absorber, or the motorcycle may fall over. The motorcycle could be damaged.

WARNING

Be sure to hold the front brake when removing the shock absorber, or the motorcycle may fall over. It could cause an accident and injury.

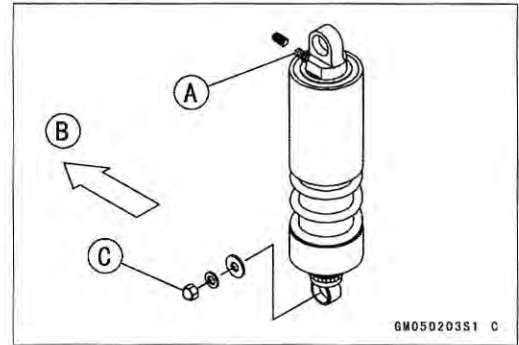
- Remove the cap nuts [A], lockwashers, and flat washers from both ends of the rear shock absorber [B].
- Pull the rear shock absorber off the frame.



Rear Shock Absorber (Air Type)*Installation*

- Install the rear shock absorber so that the air valve [A] faces forward [B].
- Tighten the rear shock absorber nuts (cap nuts) [C] to the specified torque.

Torque - Rear Shock Absorber Nuts: 34 N·m (3.5 kg·m, 25 ft·lb)

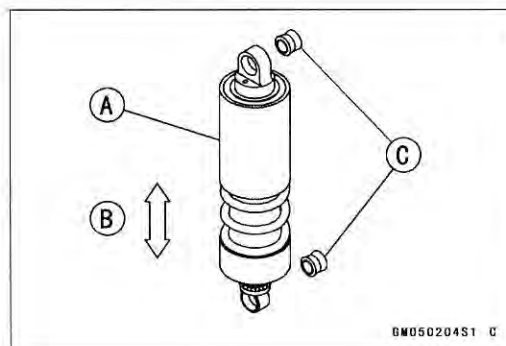


12-16 SUSPENSION

Rear Shock Absorber (Air Type)

Rear Shock Absorber Inspection

- Remove the rear shock absorbers [A].
- Visually inspect the following items.
 - Smooth Stroke [B]
 - Oil Leakage
 - Crack or Dent
- ★ If there is any damage to the rear shock absorber, one unit feels weaker than the other, replace both shock absorbers as a set.
- Visually inspect the rubber bushings [C].
- ★ If they show any signs of damage, replace them.



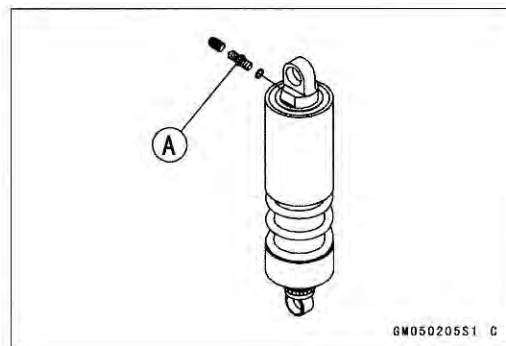
Scrapping

- Remove the rear shock absorber (see this chapter).

⚠ WARNING

Since the rear shock absorber contains air, do not incinerate the rear shock absorber without first releasing the air or it may explode.

Before a rear shock absorber is scrapped, remove the air valve [A].



Swingarm

Removal

- Remove:
 - Silencer (see Engine Top End chapter)
 - Rear Exhaust Pipe (see Engine Top End chapter)
 - Rear Fender (see Frame chapter)
- Before removing the swingarm, unscrew the banjo bolt [A] on the rear caliper [B].
- Temporarily secure the end of the brake hose to some high place to keep fluid loss to a minimum.
- Immediately wash away any brake fluid that spills.
- Detach the rear brake hose [C] from the holders [D] on the swingarm.
- Using the jack and attachment jack under the frame pipe ribs, lift the rear wheel OFF the ground until the front wheel touches the ground (see Rear Shock Absorber Removal).

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

- Squeeze the brake lever slowly and hold it with a band [A].

CAUTION

Be sure to hold the front brake when removing the swingarm, or the motorcycle may fall over. The motorcycle could be damaged.

⚠ WARNING

Be sure to hold the front brake when removing the swingarm, or the motorcycle may fall over. It could cause an accident and injury.

- Remove:
 - Rear Wheel (see Wheels/Tires chapter)
 - Final Gear Case (see Final Drive chapter)
- Remove the right rear shock absorber.
- Pull off the pivot cap.
- Unscrew the pivot shaft [A], and pull it out while turning.
- Pull the swingarm [B] rearward, and take it off.

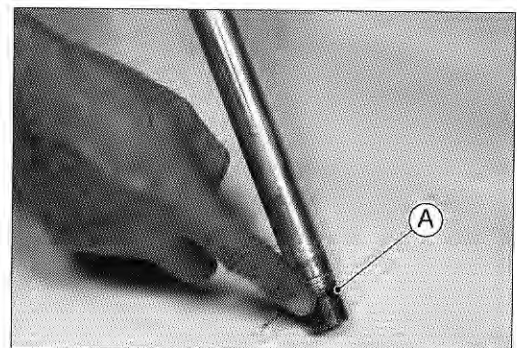
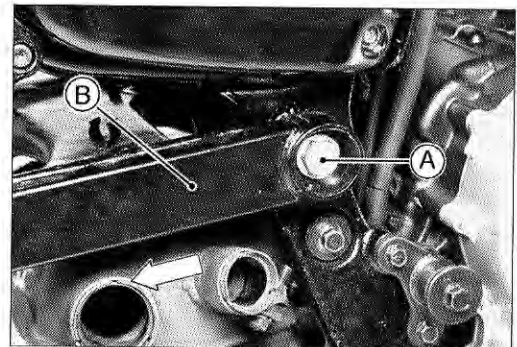
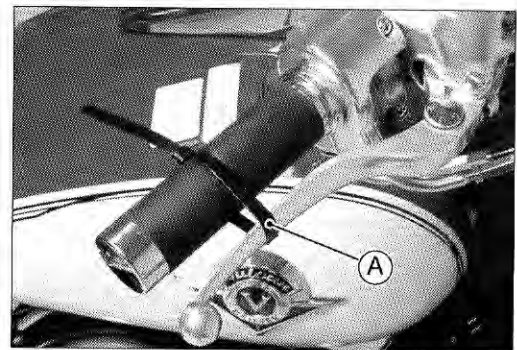
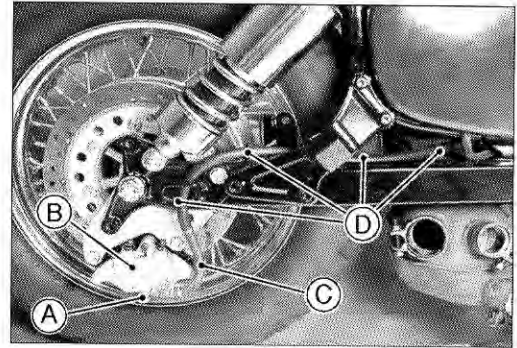
CAUTION

Do not tap the swingarm pivot shaft when removing or installing. Push or pull the pivot shaft while turning the shaft. Tapping on the shaft could damage the needle bearings in the swingarm.

Installation

- Apply grease to the needle bearings and grease seals.
- Apply grease to the threads [A] of the swingarm pivot shaft.

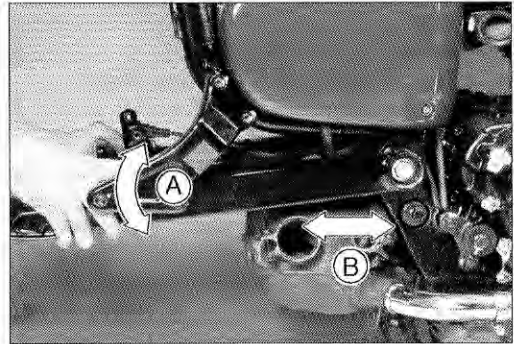
Torque - Swingarm Pivot Shaft: 110 N·m (11 kg·m, 79.6 ft·lb)



12-18 SUSPENSION

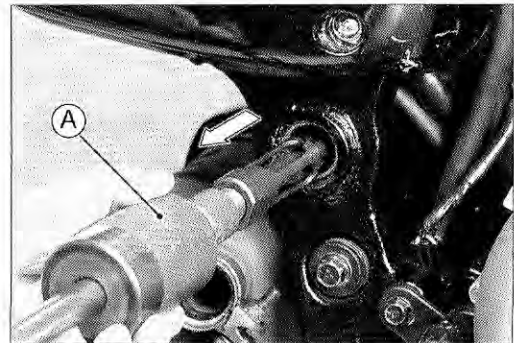
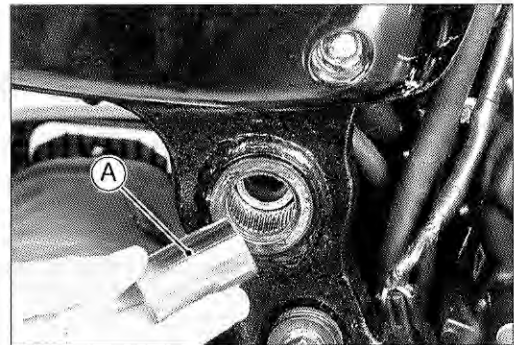
Swingarm

- Move the swingarm up and down [A] to check for abnormal friction, and push and pull [B] it to check for bearing play.
- Tighten:
 - Torque - Rear Shock Absorber Nuts: 34 N·m (3.5 kg·m, 25 ft·lb)**
 - Rear Caliper Mounting Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)**
 - Rear Caliper Holder Bolt: 64 N·m (6.5 kg·m, 47 ft·lb)**
- Install:
 - Rear Wheel (see Wheels/Tires chapter)
 - Rear Fender (see Frame chapter)
 - Rear Exhaust Pipe (see Engine Top End chapter)
 - Silencer (see Engine Top End chapter)
- After installing the swingarm, replenish the brake fluid into the reservoir and bleed the brake line (see Brake Line Bleeding in Brakes chapter).



Swingarm Bearing Removal

- Remove:
 - Swingarm (see this chapter)
 - Right and Left Grease Seals
 - Right and Left Sleeves [A]
- Remove the needle bearings, using the oil seal & bearing remover [A].
- Special Tool - Oil Seal & Bearing Remover: 57001-1058**
- Replace the bearings and sleeves with new ones.
- Remove the other side bearing in the same manner.



Swingarm

Swingarm Bearing Installation

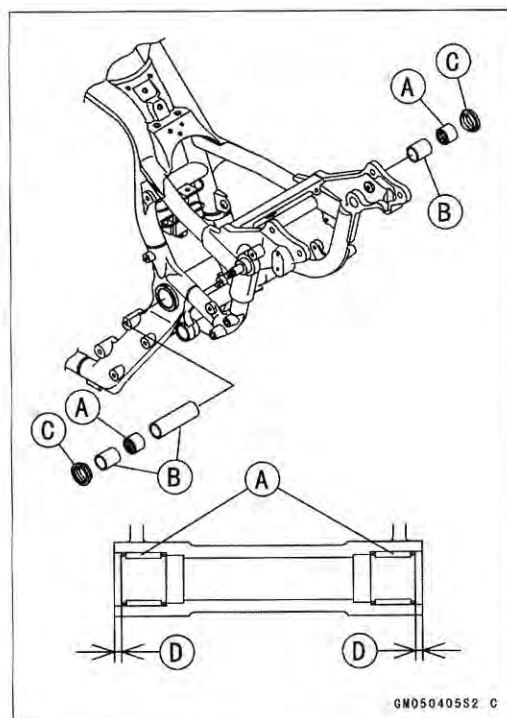
- Apply plenty of grease to the needle bearings, and sleeve.
- Be sure to install the needle bearings so that the manufacturer's marks are faced out. This prevents bearing damage.
- Position the bearings [A] as shown, using a suitable bearing driver in the bearing driver set.

Sleeves [B]

Grease Seals [C]

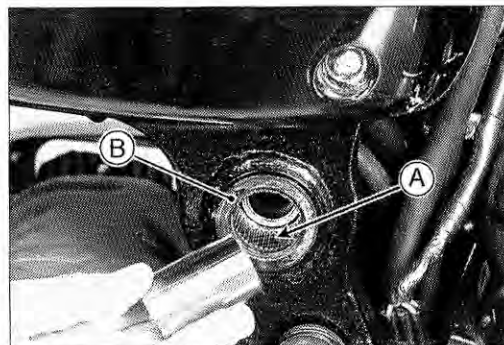
6 mm [D]

Special Tool - Bearing Driver Set: 57001-1129



Grease Seal and Needle Bearing Lubrication

- Apply grease [A] to the inner surfaces of the needle bearings in accordance with the Periodic Maintenance Chart.
- Apply a thin coat of grease to the lips of the grease seals [B].

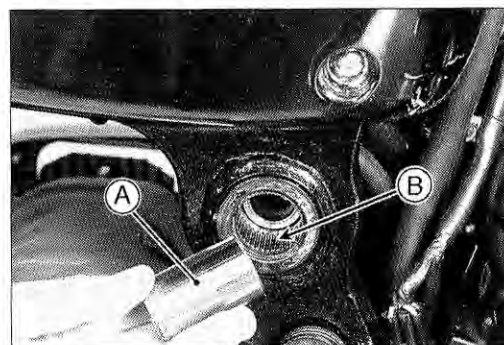


Swingarm Bearing, Sleeve Inspection

CAUTION

Do not remove the bearings for inspection. Remove may damage them.

- Visually inspect the swingarm sleeves [A] and needle bearings [B].
- The rollers in a needle bearing normally wear very little, and wear is difficult to measure. Instead of measuring, inspect the bearing in the swingarm for abrasion, color change, or other damage.
- ★ If there is any doubt as to the condition of any of the needle bearings or sleeve, replace the sleeve, and needle bearings as a set.



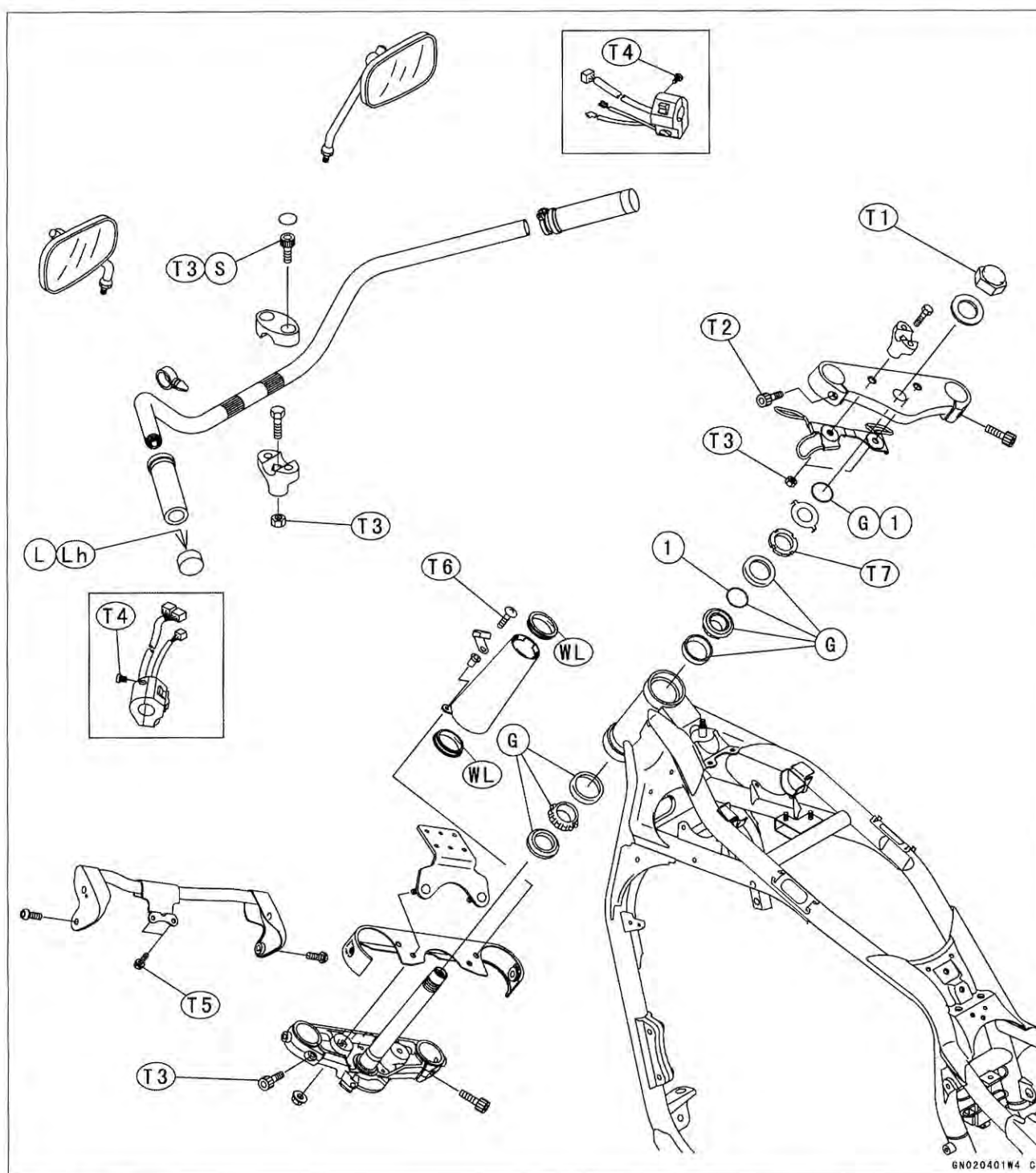
Steering

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13-2 STEERING

Exploded View



G: Apply grease.

L: Apply a non-permanent locking agent.

Lh: Left-hand Threads

S: Follow the specific tightening sequence.

WL: Apply soap and water solution.

1. O-rings

T1: 54 N·m (5.5 kg·m, 40 ft·lb)

T2: 20 N·m (2.0 kg·m, 14 ft·lb)

T3: 34 N·m (3.5 kg·m, 25 ft·lb)

T4: 3.4 N·m (0.35 kg·m, 30 in·lb)

T5: 7.4 N·m (0.75 kg·m, 65 in·lb)

T6: 4.4 N·m (0.45 kg·m, 39 in·lb)

T7: 4.9 N·m (0.5 kg·m, 43 in·lb)

Specifications

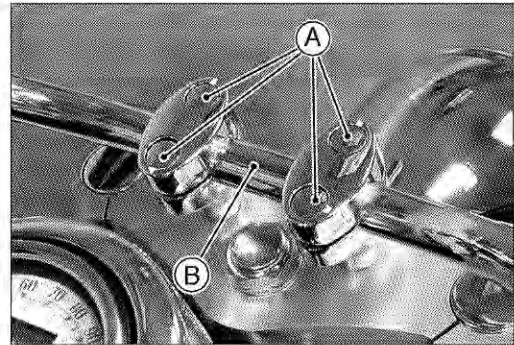
Special Tools - Jack: 57001-1238
Attachment Jack: 57001-1398
Steering Stem Nut Wrench: 57001-1100
Head Pipe Outer Race Remover: 57001-1107
Head Pipe Outer Race Press Shaft: 57001-1075
Head Pipe Outer Race Driver: 57001-1077
Steering Stem Bearing Driver: 57001-1344
Steering Stem Bearing Driver Adapter: 57001-1345

13-4 STEERING

Handlebar

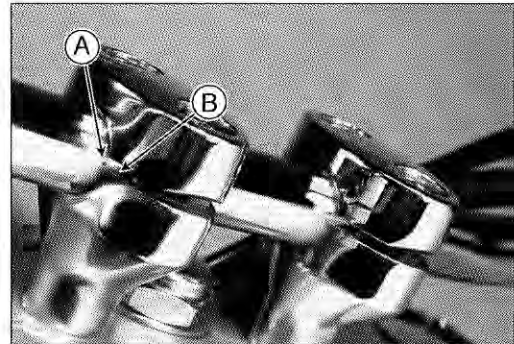
Handlebar Removal

- Remove:
 - Clutch Master Cylinder
 - Left Handlebar Switch Housing
 - Front Brake Master Cylinder
 - Right Handlebar Switch Housing
 - Throttle Grip
 - Caps [A]
 - Handlebar Holder Bolts
- Remove the handlebar [B] from the stem head.



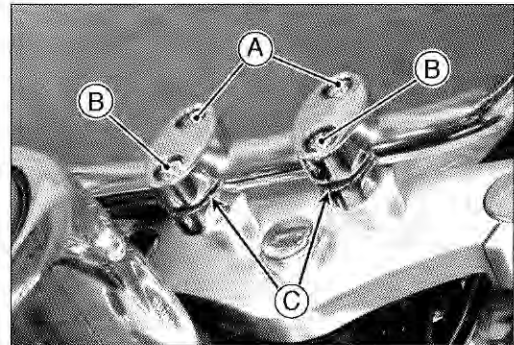
Handlebar Installation

- Set the handlebar to match its punched mark [A] to the lower mating surface [B] of the clamp rear part.

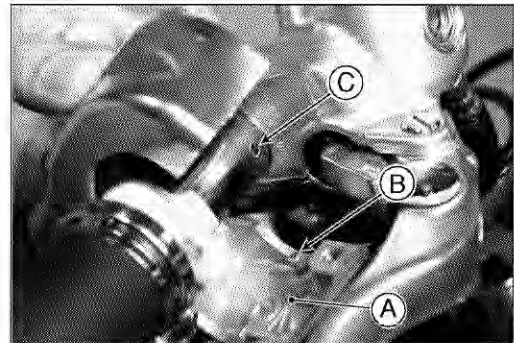


- Tighten the front clamp bolts [A] first, and then the rear clamp bolts [B]. There will be a gap [C] at the rear part of the clamp after tightening.

Torque - Handlebar Clamp Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)
Front [D]



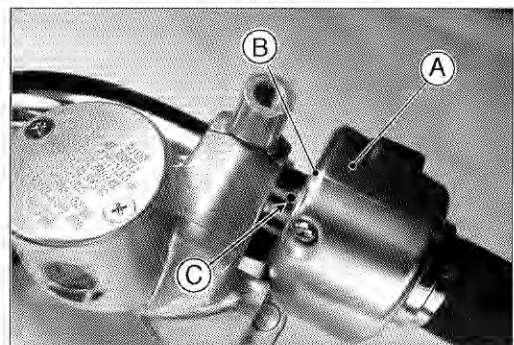
- The front half of the right switch housing [A] has a small projection [B]. Fit the projection into the small hole [C] in the handlebar.



- Set the left switch housing [A] to match its mating surface [B] to the punched mark [C] of the handlebar.
- Install the handlebar switch housings.
Front [D]

Torque - Handlebar Switch Housing Screws: 3.4 N·m (0.35 kg·m, 30 in·lb)

- Install:
 - Clutch Master Cylinder (see Clutch chapter)
 - Front Master Cylinder (see Brakes chapter)
- Check and adjust the rear view mirrors.



Steering

Check

- Check steering as follows.
- Use the jack [A], the attachment jack [B] under the frame pipe ribs [C], and a commercially available jack [D] under the engine [E] to lift the front wheel [F] off the ground.

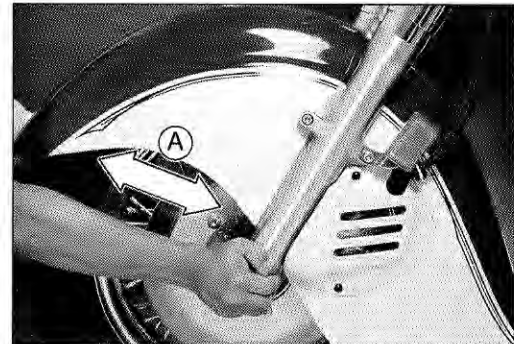
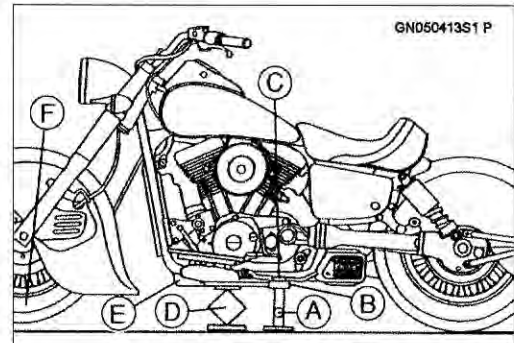
Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

- With the front wheel pointing straight ahead, alternately tap each end of the handlebar. The front wheel should swing fully right and left from the force of gravity until the fork hits the stop.
- ★ If the wheel binds or catches before the stop, the steering is too tight.
- Feel for steering looseness by pushing and pulling [A] the fork.
- ★ If you feel looseness, the steering is too loose.

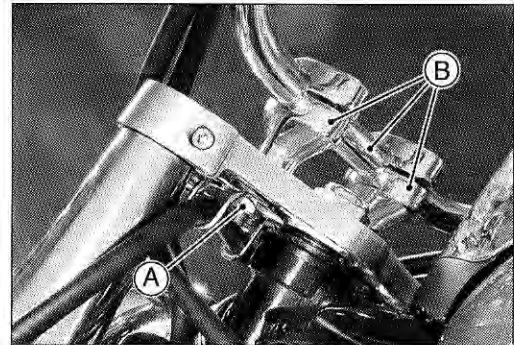
NOTE

- The cables and wiring will have some effect on the motion of the fork which must be taken into account. Be sure the wires and cables are properly routed.
- The bearings must be in good condition and properly lubricated in order for any test to be valid.

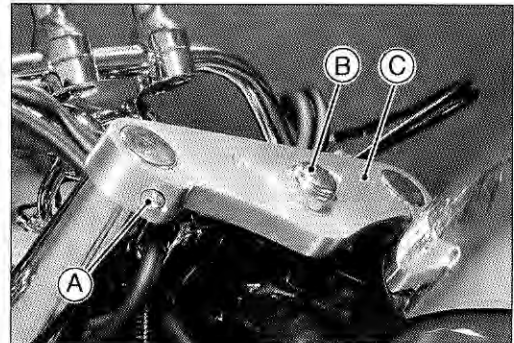


Adjustment

- ★ Adjust the steering if necessary.
- Unscrew the handlebar holder nuts [A] and take off the holder and handlebar [B] as a set.



- Loosen the upper fork clamp bolt [A] on both side and stem head nut [B].
- Remove the steering stem head [C].



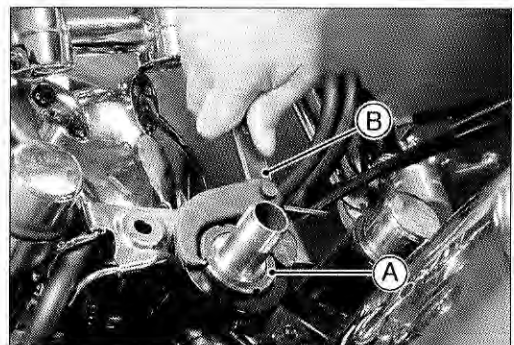
- Remove the claw washer.
- Adjust the stem nut [A] with the stem nut wrench [B] by tightening to the specified torque.

Special Tool - Steering Stem Nut Wrench: 57001-1100

Torque - Steering Stem Nut: 49 N·m (0.5 kg·m, 43 ft·lb)

- Install the stem head.
- Tighten the following in the order listed.

Torque - Upper Fork Clamp Bolts: 20 N·m (2.0 kg·m, 14 ft·lb)
Stem Head Nut: 54 N·m (5.5 kg·m, 40 ft·lb)



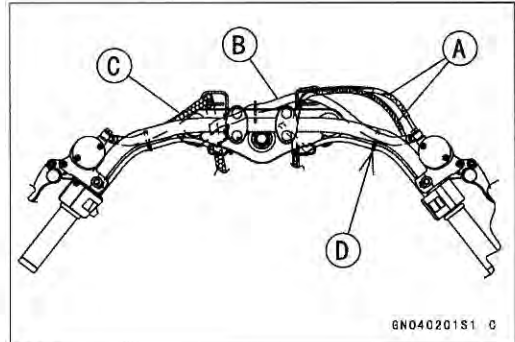
13-6 STEERING

Steering

- Install the holder with the handlebar.
Torque - Handlebar Holder Nuts: 34 N·m (3.5 kg·m, 25 ft·lb)
- Run the throttle cables [A], brake hose [B], and clutch hose [C] as shown. Do not clamp the throttle cables with the strap [D].
- Check and adjust the steering and throttle cables after installation.

⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever is obtained by pumping the brake lever until the pads are against the disc. The brakes will not function on the first application of the lever if this is not done.



Steering Stem

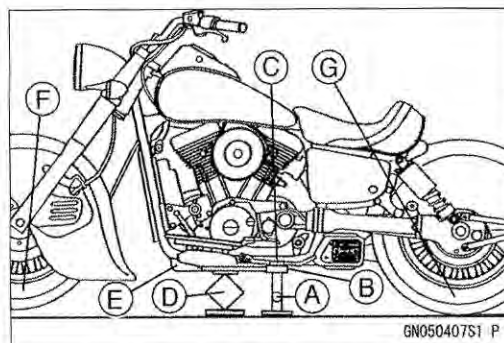
Removal

- Using the jack [A] and attachment jack [B] under the frame pipe ribs [C], and a commercially available jack [D] under the engine [E], lift the front wheel [F] **OFF** the ground until the rear wheel [G] touches the ground.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

- Remove the front wheel (see Tires/Wheels chapter).



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CAUTION

Be sure to put the rear wheel on the ground when removing the steering, or the motorcycle may fall over. The motorcycle could be damaged.

WARNING

Be sure to put the rear wheel on the ground when removing the steering, or the motorcycle may fall over. It could cause an accident and injury.

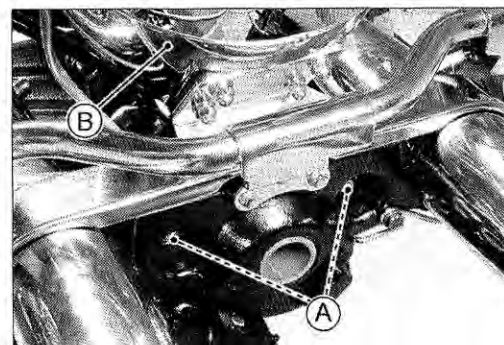
CAUTION

Cover the fuel tank with a towel to protect the painted surface.

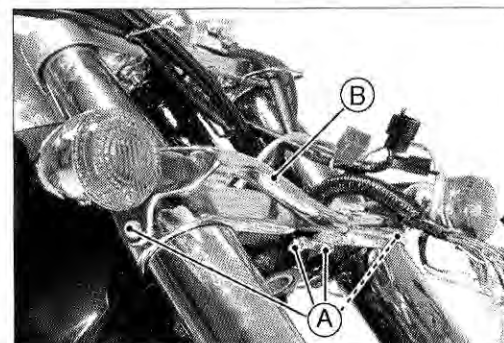
- Unscrew the headlight rim screws and open the headlight unit (see Electrical System chapter).
- Pull off the connectors [A].



- Remove the headlight body [A] by unscrewing two nuts [B].



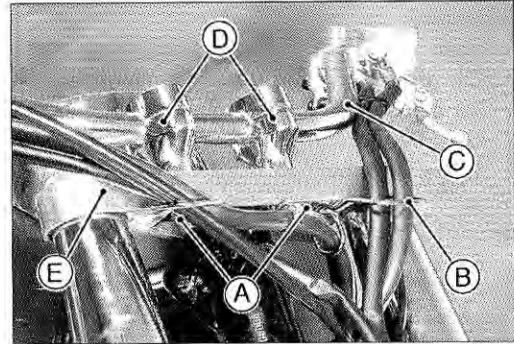
- Remove:
 - Bolts [A]
 - Turn Signal Light Holder [B] with Turn Signal Lights



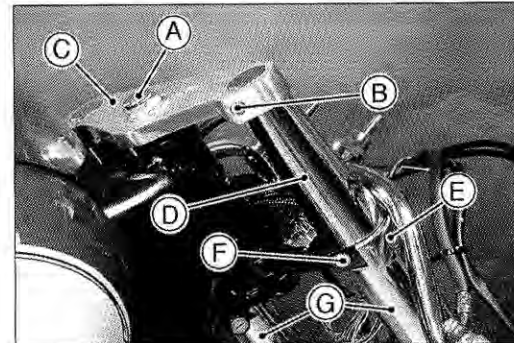
13-8 STEERING

Steering Stem

- Remove:
 - Lock Nuts [A]
 - Cable Clamp [B]
- Take off the handlebar [C] with the holder [D] from the steering stem head [E].



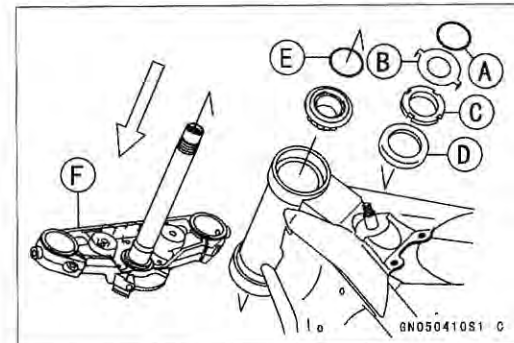
- Remove:
 - Steering Stem Head Nut [A]
 - Washer
 - Upper Fork Clamp Bolts [B] (Loosen)
 - Steering Stem Head [C]
 - Upper Fork Covers [D] with the Stem Cover [E]
 - Lower Fork Clamp Bolts [F]
 - Front Fork Legs [G] (see Suspension chapter)



- Remove:
 - O-ring [A]
 - Claw Washer [B]
 - Steering Stem Nut [C]
 - Stem Cap [D]
 - O-ring [E]

NOTE

- Be sure to remove the O-ring for removal of the steering stem.

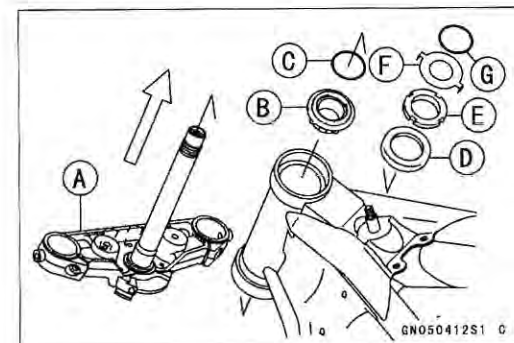


- Pull out the steering stem [F] from the bottom.

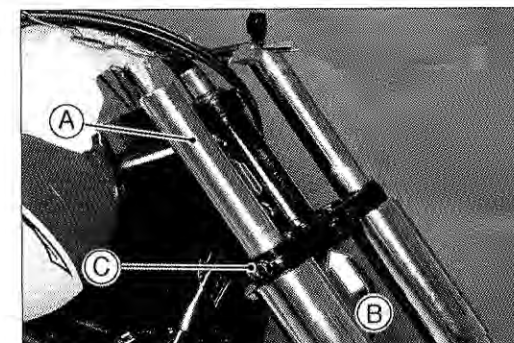
Installation

- Install:
 - Steering Stem [A]
 - Bearing [B]
 - New O-ring [C] (I.D. 34.5 × ϕ 2 mm)
 - Stem Cap [D]
 - Stem Nut [E]
 - Claw Washer [F]
 - New O-ring [G]

Torque - Steering Stem Nut: 4.9 N·m (0.5 kg·m, 43 in·lb)

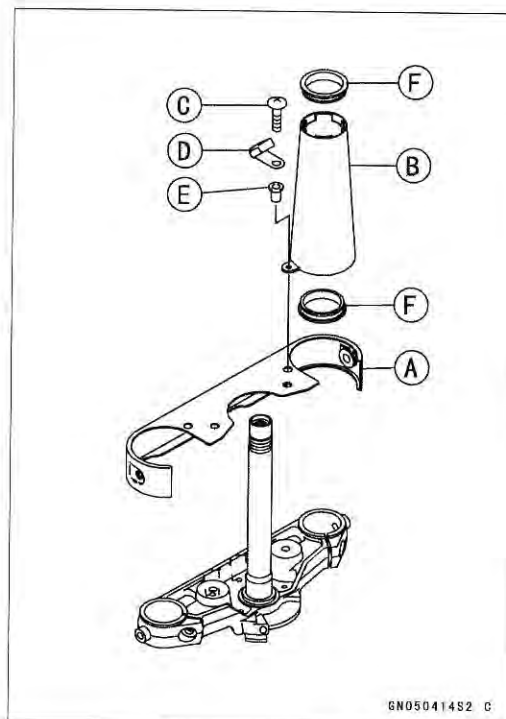


- Install the fork leg [A] and push [B] it up tightly against the stem bottom.
- Temporarily tighten the lower fork clamp bolts [C].

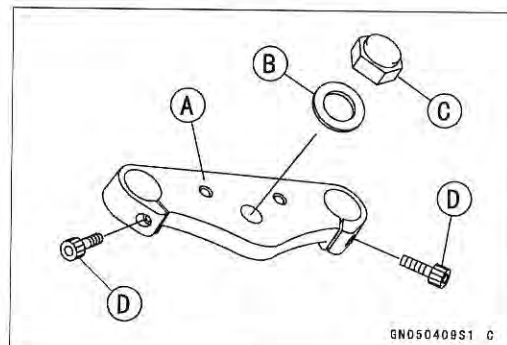


Steering Stem

- Install:
 - Stem Cover [A]
 - Upper Fork Covers [B]
 - Upper Fork Cover Screws ($\phi 5$) [C]
 - Clamp [D]
 - Well Nuts [E]
- Apply a soap and water solution or rubber lubricant to the rubber dampers [F] and install the upper fork covers.
- The right and left upper fork covers are the same parts.
- Tighten:
 - Torque - Upper Fork Cover Screws ($\phi 5$): 4.4 N·m (0.45 kg·m, 39 in·lb)**

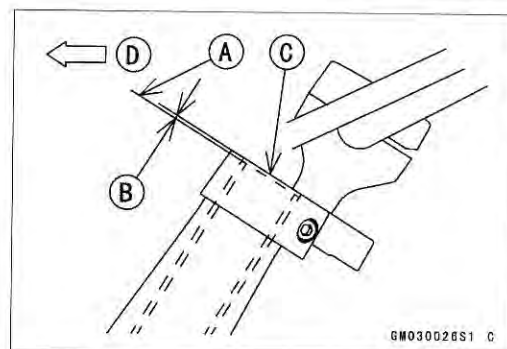


- Install:
 - Steering Stem Head [A]
 - Washer [B]
 - Stem Head Nut [C]
- Temporarily tighten the upper fork clamp bolts [D].



- Check that the top end [A] of the inner tube is **0 ~ 0.5 mm** [B] lower than the upper surface [C] of the steering stem head. Otherwise reinstall the fork leg.
- Front [D]
- Tighten the fork upper clamp bolts and then the stem head nut, and finally the fork lower clamp bolts.

Torque - Fork Upper Clamp Bolts: 20 N·m (2.0 kg·m, 14 ft·lb)
Steering Stem Head Nut: 54 N·m (5.5 kg·m, 40 ft·lb)
Fork Lower Clamp Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)



13-10 STEERING

Steering Stem

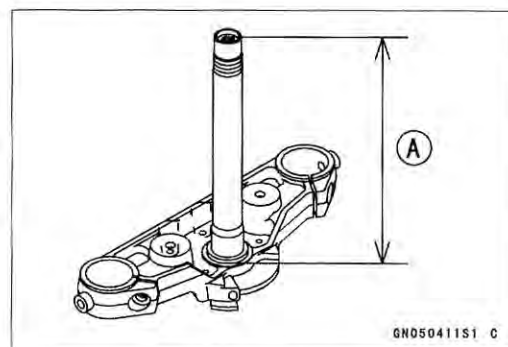
- Install the removed parts.
 - Handlebar and Handlebar Holders (see this chapter)
 - Headlight Body
 - Front Fender
 - Front Wheel (see Wheels/Tires chapter)
- Check and adjust the following items after installation.
 - Steering (see Steering Check)
 - Throttle Cables (see Fuel System chapter)
 - Headlight Aim
- Check the front brake effectiveness.

⚠ WARNING

Do not attempt to ride the motorcycle until a full brake lever is obtained by pumping the brake lever until the pads are against the disc. The brakes will not function on the first application of the lever if this is not done.

Steering Stem Warp

- Whenever the steering stem is removed, or if the steering cannot be adjusted for smooth action, check the steering stem for straightness.
- ★ If the steering stem [A] is bent, replace the steering stem.



Steering Stem Bearing

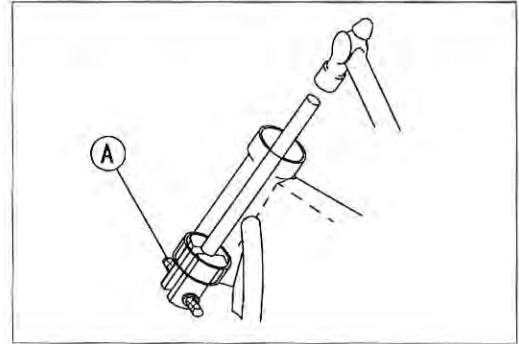
Stem Bearing Removal

- Remove the steering stem (see this chapter).
- Drive out the bearing outer races from the head pipe.

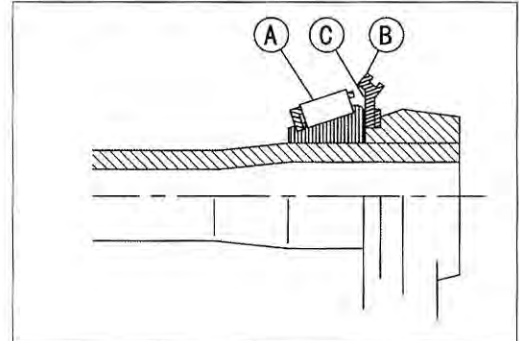
Special Tool - Head Pipe Outer Race Remover: 57001-1107 [A]

NOTE

- If either steering stem bearing is damaged, it is recommended that both the upper and lower bearings (including outer races) be replaced with new ones.



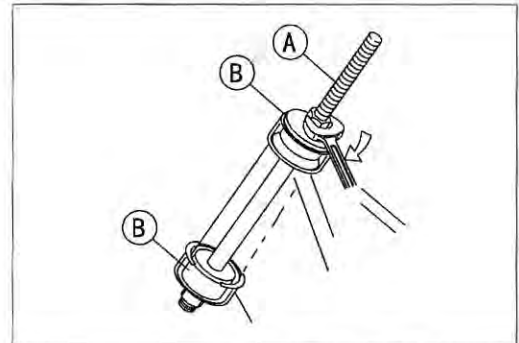
- Remove the lower inner race [A] which is pressed onto the steering stem, using a chisel.
Grease Seal [B]
Tap here [C]



Stem Bearing Installation

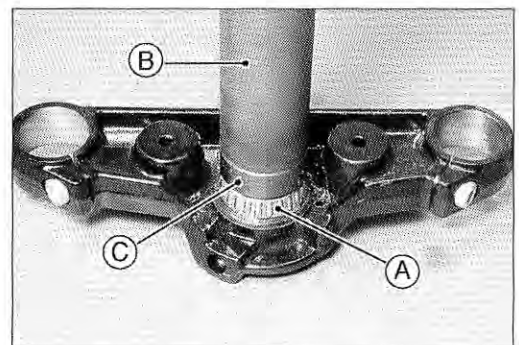
- Replace the bearing outer races with new ones.
- Apply grease to the outer races, and drive them into the head pipe at the same time.

**Special Tools - Head Pipe Outer Race Press Shaft: 57001-1075 [A]
Head Pipe Outer Race Drivers: 57001-1077 [B]**



- Replace the stem bearing inner races with new ones.
- Apply grease to the lower inner race [A], and drive it onto the stem base.

**Special Tools - Steering Stem Bearing Driver: 57001-1344 [B]
Steering Stem Bearing Driver Adapter: 57001-1345 [C]**

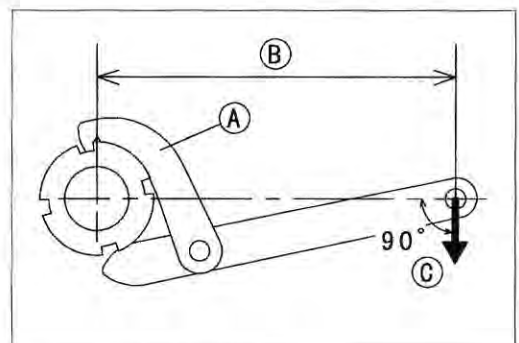


- Install the steering stem.

NOTE

- Do not install the O-rings yet.
- Settle the bearings in place as follows:
- Tighten the stem nut to **78 N·m (8.0 kg·m, 58 ft·lb)** of torque. (To tighten the steering stem nut to the specified torque, hook the wrench on the stem nut, and pull the wrench at the hole by **440 N (45 kg, 99 lb)** force in the direction shown.)

**Special Tool - Steering Stem Nut Wrench: 57001-1100 [A]
180 mm [B]
Force [C]**



13-12 STEERING

Steering Stem Bearing

- Check that there is no play and the steering stem turns smoothly without rattles. If not, the steering stem bearings may be damaged.
- Remove the stem nut.
- Install the O-rings and adjust the steering (see Steering Adjustment).

Torque - Steering Stem Nut: 49 N·m (0.5 kg·m, 43 ft·lb)

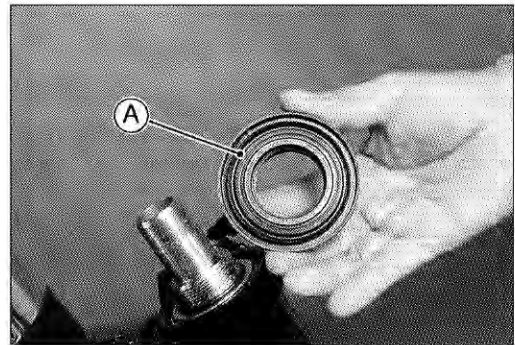
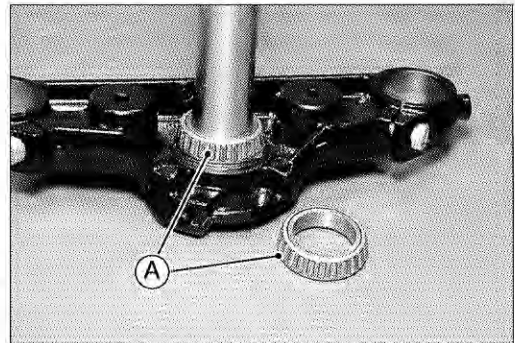
Stem Bearing Lubrication

In accordance with the Periodic Maintenance Chart, lubricate the steering stem bearings.

- Remove the steering stem.
- Using a high-flash point solvent, wash the upper and lower tapered roller bearings [A] in the cages, and wipe the upper and lower outer races, which are press-fitted into the frame head pipe, clean of grease and dirt.
- Visually check the outer races and the rollers.
- ★ If the rollers or races are worn, or if either race is dented, replace both races and all the roller bearings as a set.
- Pack the upper and lower tapered roller bearings in the cages with grease, and apply a light coat of grease to the upper and lower outer races.
- Install the steering stem, and adjust the steering.

Stem Cap Deterioration, Damage

- ★ Replace the stem cap if its grease seal [A] shows damage.



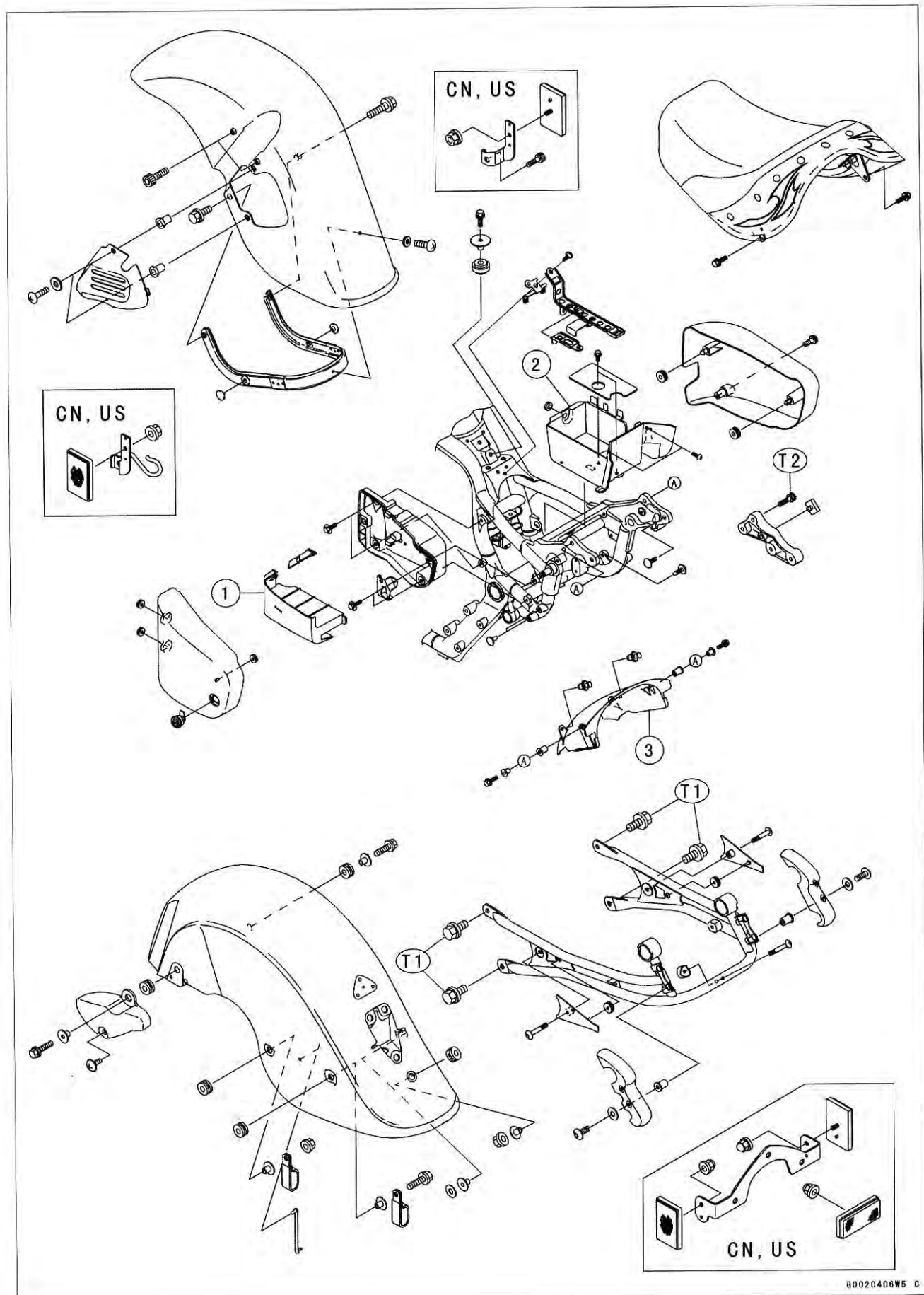
Frame

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14-2 FRAME

Exploded View

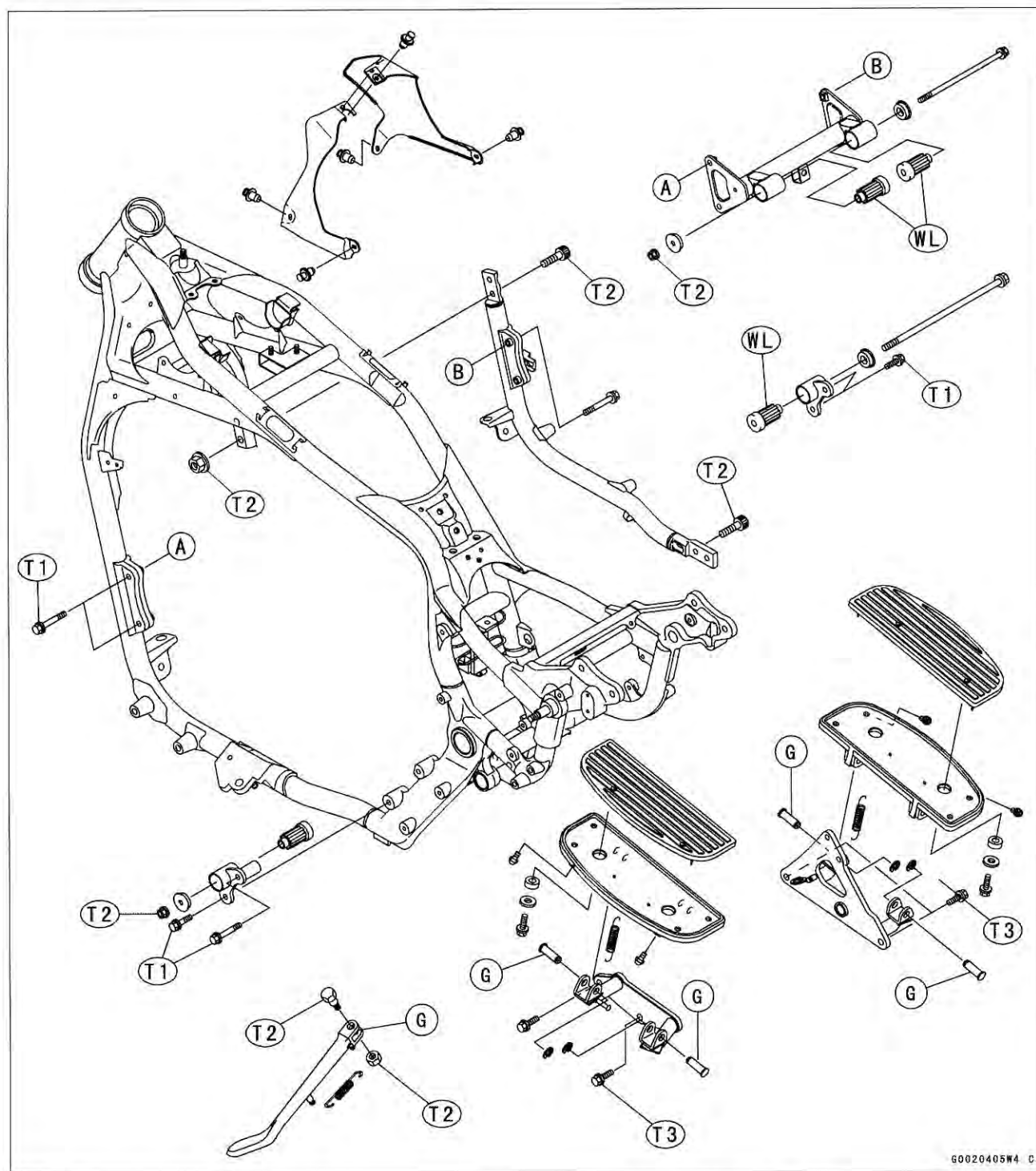


Exploded View

1. Tool Box
 2. Battery Case
 3. Seat Under Cover
- T1: 44 N·m (4.5 kg·m, 33 ft·lb)
T2: 27 N·m (2.8 kg·m, 20 ft·lb)
CN: Canadian Model
US: United States Model

14-4 FRAME

Exploded View



60020405W4 C

G: Apply grease.
 WL: Apply a soap and water solution.
 T1: 25 N·m (2.5 kg·m, 18 ft·lb)

T2: 44 N·m (4.5 kg·m, 33 ft·lb)
 T3: 34 N·m (3.5 kg·m, 25 ft·lb)

Specifications

Special Tools - Jack: 57001-1238

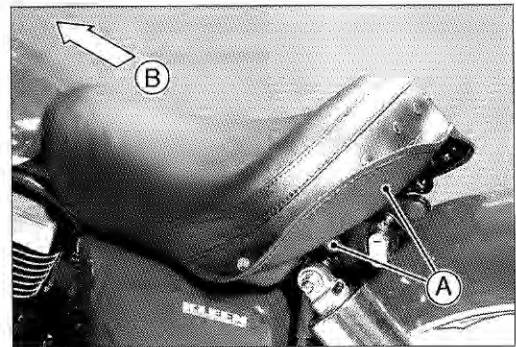
Attachment Jack: 57001-1398

14-6 FRAME

Seat

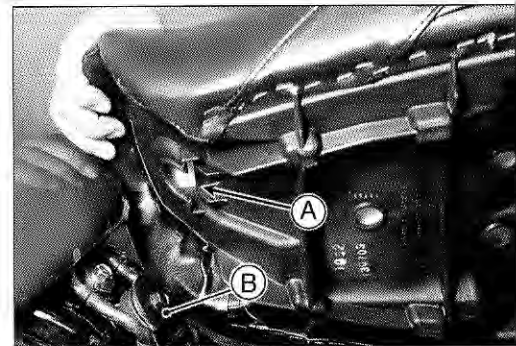
Seat Removal

- Remove the seat bolts [A] on both sides.
- Pull the seat forward [B], then remove it.



Seat Installation

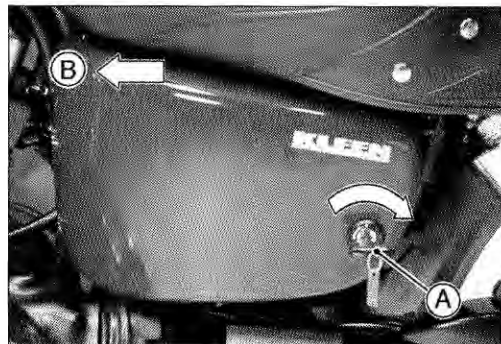
- Slip the seat hook [A] under the washer [B].
- Tighten the seat bolts.



Side Covers

Left Side Cover Removal

- Insert the ignition switch key [A] into the left side cover, and turn the key clockwise until the key slot is vertical.
Front [B]

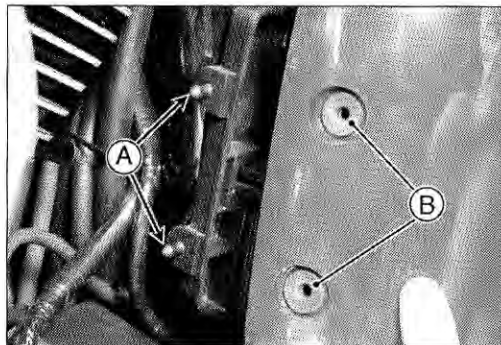


- Pull [A] the rear part of the left side cover towards you, push [B] the left side cover slightly forward, and remove it.

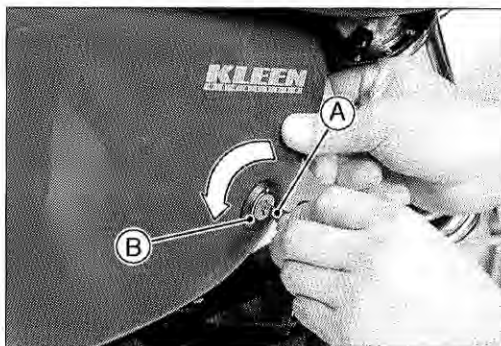


Left Side Cover Installation

- Put the front stoppers [A] into the grommets [B] first, then put the rear stopper into the grommet.



- Turn the ignition switch key [A] counterclockwise until the key slot is horizontal [B] to secure the left side cover.



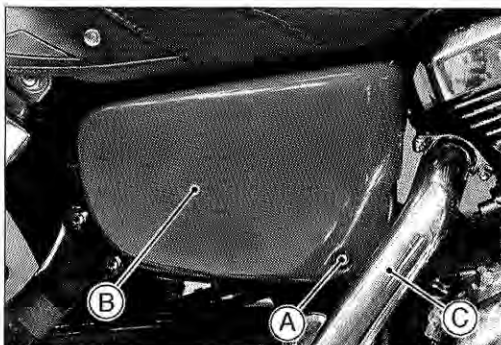
Right Side Cover Removal

- Remove the screw [A].

CAUTION

Be careful not to scratch the right side cover surface [B] with the rear exhaust pipe [C] during removal or installation.

- Cover the rear exhaust pipe with a towel and pull the right side cover evenly outward to clear the stoppers.
- Remove the right side cover.

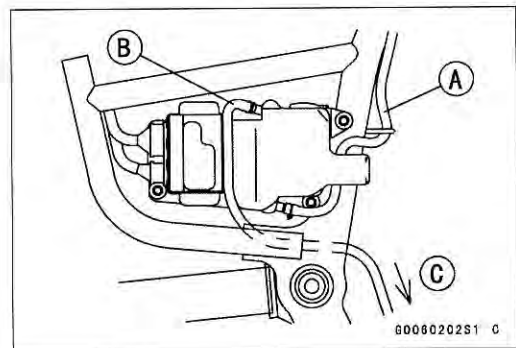


14-8 FRAME

Side Covers

Right Side Cover Installation

- Run the reserve tank hose [A] and the reserve tank overflow hose [B] as shown.
To a Clamp [C] on Engine Bottom



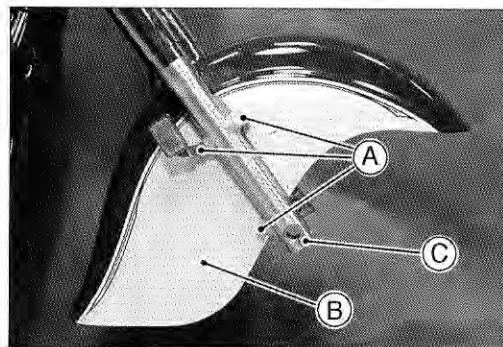
Fenders

Front Fender Removal

CAUTION

Be careful not to scratch the painted surface during removal or installation.

- Remove the front wheel (see Wheels/Tires chapter).
- Remove the mounting bolts [A] on both sides to separate the front fender [B] from the front fork [C].
- Remove the front fender.

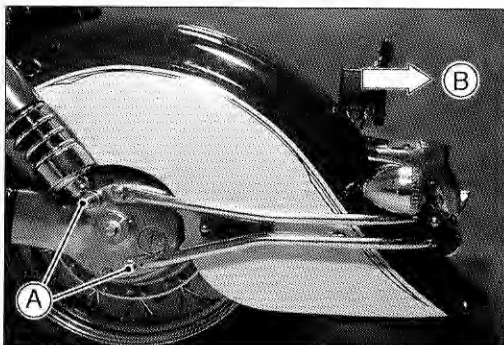
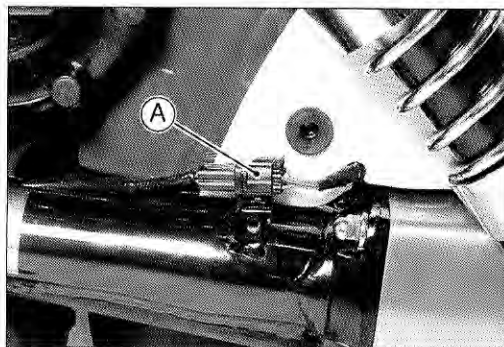
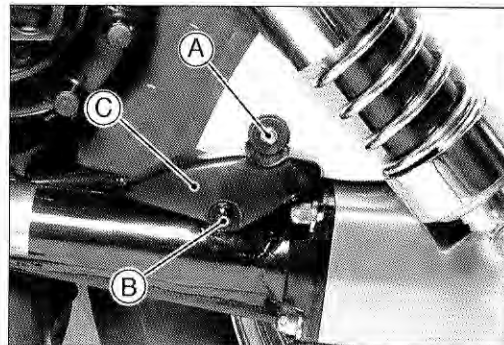


Rear Fender Removal

CAUTION

Be careful not to scratch the painted surface during removal or installation.

- Unscrew the bolts [A].
- Unscrew the screw [B] and remove the connector cover [C].
- Disconnect the rear turn signal and taillight wire connector [A].
- Remove the rear fender stay bolts [A] on both sides.
- Remove the rear fender rearward [B].



Rear Fender Installation

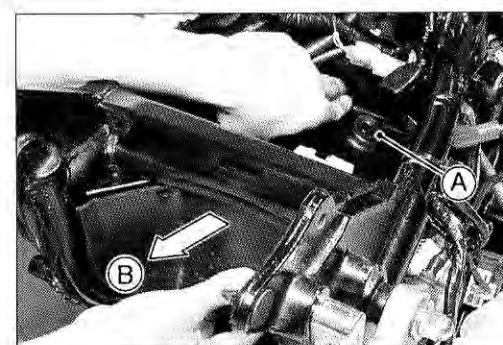
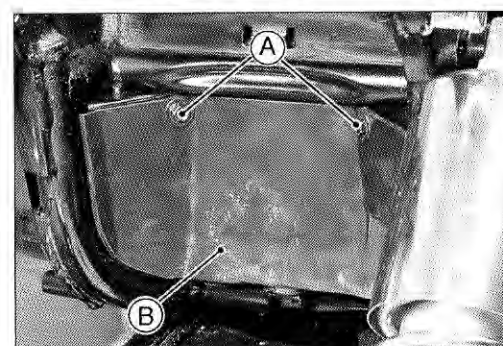
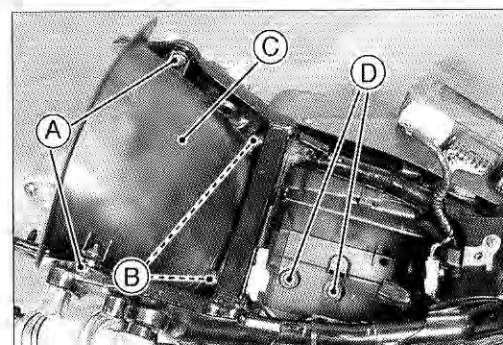
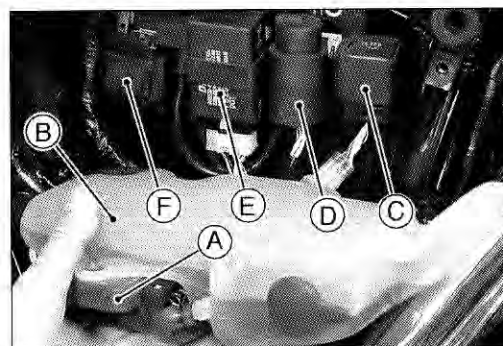
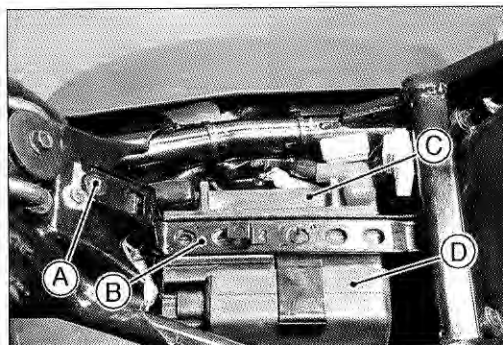
- Tighten:
Torque - Rear Fender Stay Bolts: 44 N·m (4.5 kg·m, 32 ft·lb)

14-10 FRAME

Battery Case

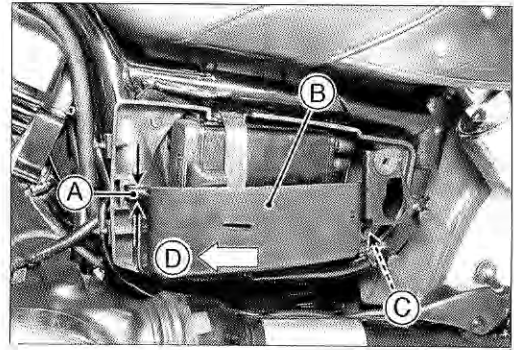
Battery Case Removal

- Remove:
 - Seat (see this chapter)
 - Screw [A] and Battery Holder [B]
 - Battery [C] (see Electrical System chapter)
 - ECU [D] (see Fuel System chapter)
 - Rear Wheel (see Wheels/Tires chapter)
- Remove:
 - Right Side Cover (see Frame chapter)
 - Junction Box [A] and Coolant Reserve Tank [B]
 - Oil Pressure Light Delay Unit [C]
 - DFI Main Relay [D]
 - Turn Signal Control Unit [E]
 - Starter Relay [F]
- Remove:
 - Bolts [A]
 - Screws [B]
 - Seat Under Cover [C]
 - Bottom Bolts [D]
- Remove two rear screws [A].
- Remove the battery case [A] from the rear [B].



Tool Box*Removal*

- Remove the left side cover (see this chapter).
- Pinch the tab [A] and move the tool box [B] forward to clear the rear stopper [C].
- Pull the tool box out.
Front [D]



14-12 FRAME

Downtube

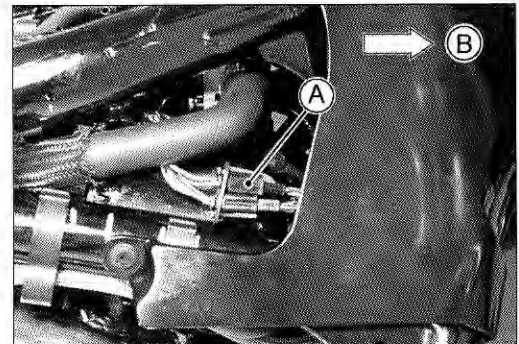
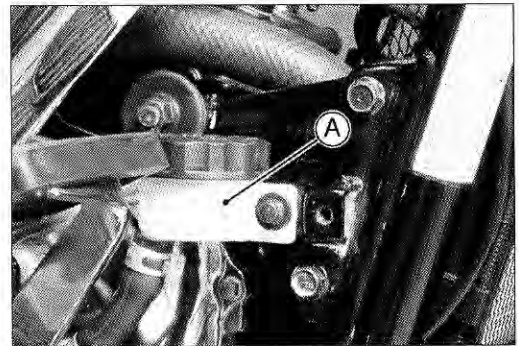
Removal

- Using the jack and the attachment jack, raise the rear wheel off the ground (see Wheels/Tires chapter).

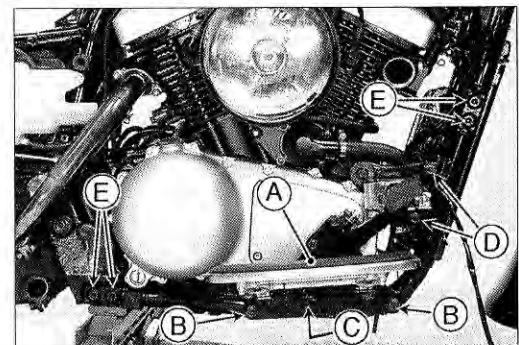
Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

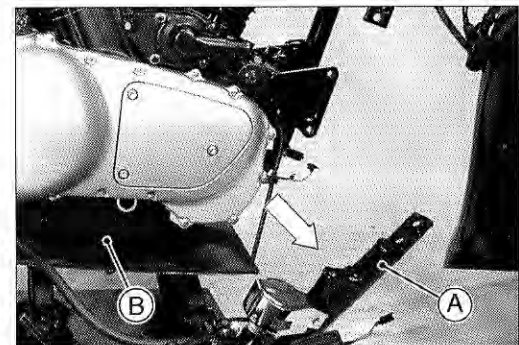
- Remove:
 - Brake Reservoir Cover
 - Brake Reservoir [A]
- Remove the fuel tank (see Fuel System chapter) and pull off the rear brake light switch connector [A].
- Remove the front exhaust pipe (see Engine Top End chapter).
 - Front [B]



- Remove the right front footboard [A] by taking off the bolts [B] with the brake pedal and rear master cylinder installed.
- Support the engine with a commercially available stand [C].
- Remove:
 - Engine Mounting Bracket Bolts [D]
 - Downtube Bolts [E]

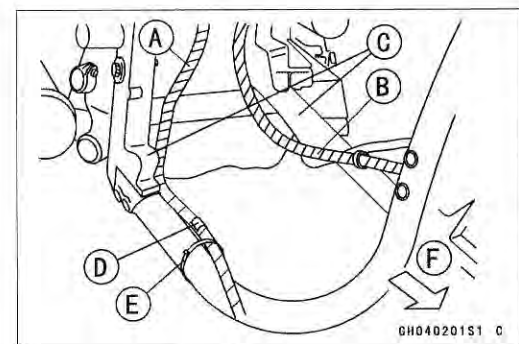


- Take off the downtube [A].
 - Commercially Available Stand [B]



Installation

- Run the brake hose [A] inside the down tube [C] and clamp it [D].
 - Clutch Hose [B]
 - Strap [E]
 - Front [F]
- Tighten:
 - Torque - Downtube Bolts: 44 N·m (4.5 kg·m, 33 ft·lb)**
 - Engine Mounting Bracket Bolts: 25 N·m (2.5 kg·m, 18 ft·lb)**
 - Front Footboard Bracket Bolts: 34 N·m (3.5 kg·m, 25 ft·lb)**



GH040201S1 C

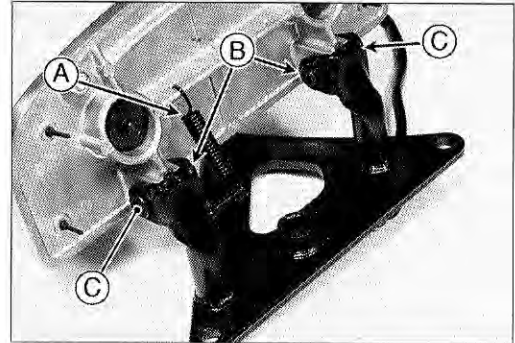
Front Footboard, Sidestand

Footboard Removal

- The left front footboard is removed during shift pedal removal (see Crankshaft/Transmission chapter).
- The right front footboard is removed during brake pedal removal (see Brakes chapter).

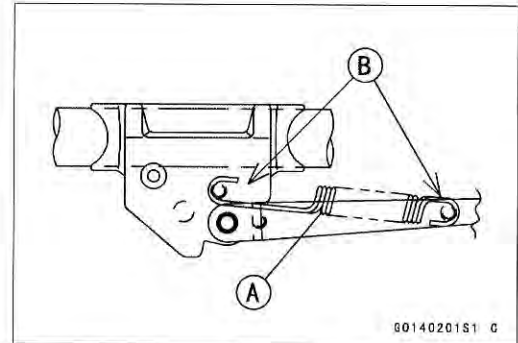
Footboard Disassembly

- Remove the front footboard.
- Remove:
 - Footboard Spring [A]
 - Circlips [B]
 - Pins [C]



Sidestand Installation

- Tighten:
 - Torque - Sidestand Bolt and Nut: 44 N·m (4.5 kg·m, 32 ft·lb)
- Install the sidestand spring [A], noting the direction of the hooks [B].



14-14 FRAME

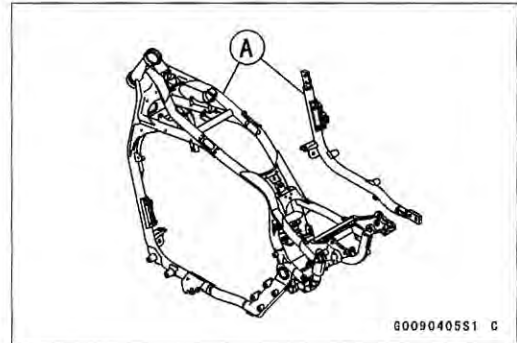
Frame

Frame Inspection

- Visually inspect the frame [A] for cracks, dents, bending, or warp.
- ★ If there is any damage to the frame, replace it.

⚠ WARNING

**A repaired frame may fail in use, possibly causing an accident.
If the frame is bent, dented, cracked, or warped, replace it.**



Electrical System

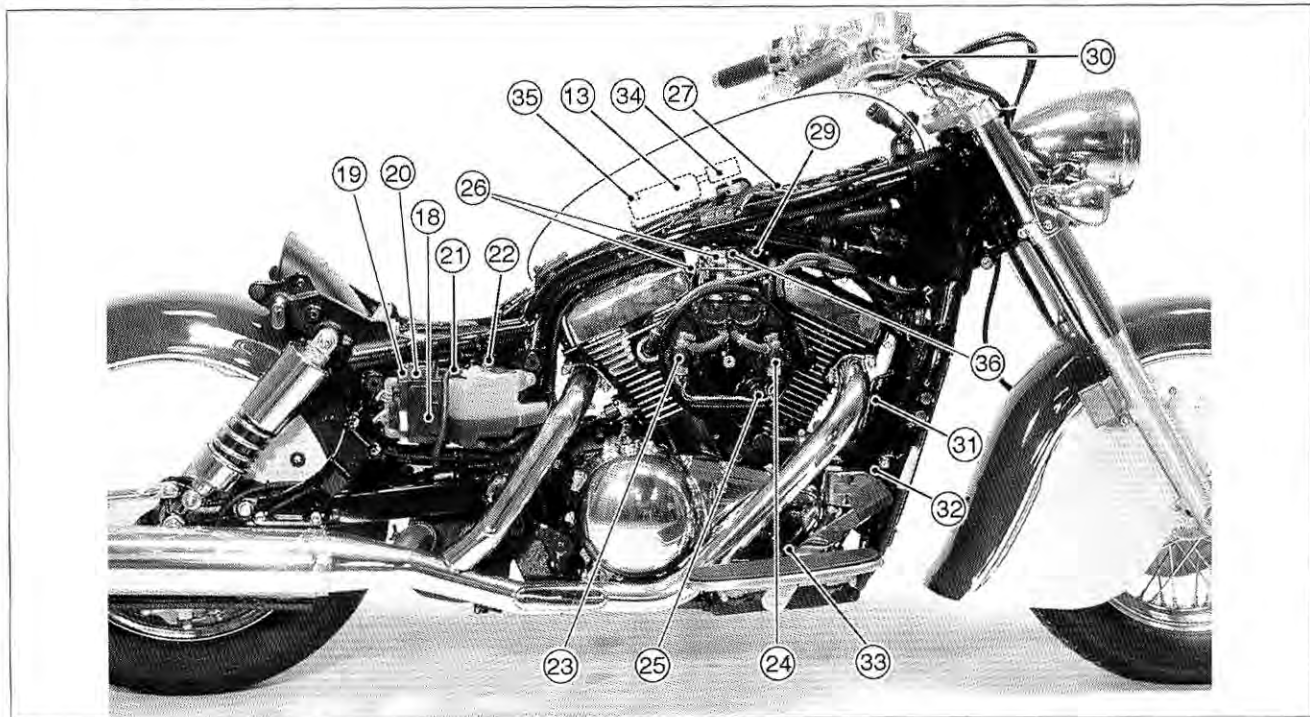
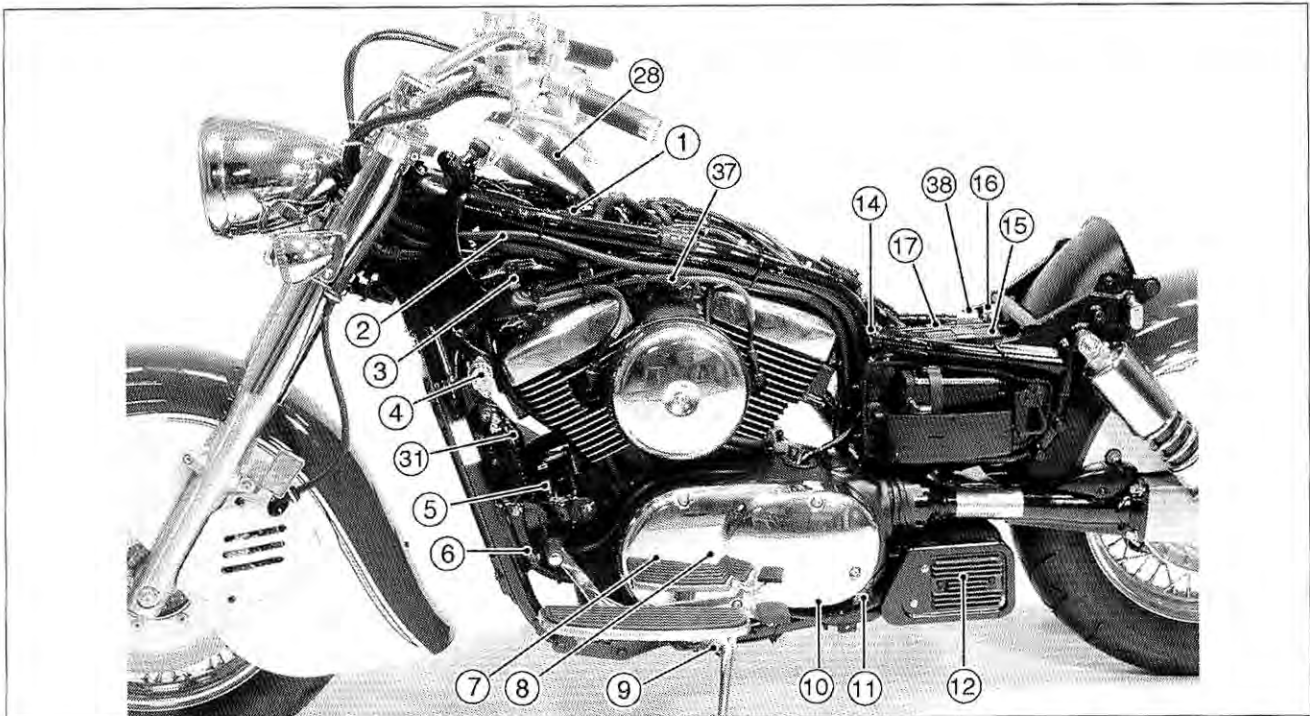
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15-2 ELECTRICAL SYSTEM

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Radiator Fan Switch Inspection.....	15-75	Starter Circuit/Headlight Relay Inspection.....	15-78
Water Temperature Switch Removal.....	15-75	Diode Circuit Inspection.....	15-79
Water Temperature Switch Installation.....	15-75	Fuse.....	15-81
Water Temperature Switch Inspection.....	15-76	Main Fuse Removal.....	15-81
Fuel Level Sensor Removal.....	15-76	Junction Box Fuse Removal.....	15-81
Fuel Level Sensor Installation.....	15-76	Fuse Installation.....	15-81
Fuel Level Sensor Inspection.....	15-77	Fuse Inspection.....	15-81
Diode (Rectifier) Inspection.....	15-77		
Junction Box.....	15-78		

Electrical Parts Location



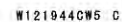
DFI: DFI Parts (see Fuel System chapter)

1. Atmospheric Pressure Sensor (DFI)
2. Water Temperature Sensor (DFI)
3. Ignition Coils
4. Ignition Switch
5. Starter Motor
6. Water Temperature Switch
7. Alternator
8. Pickup Coils
9. Sidestand Switch

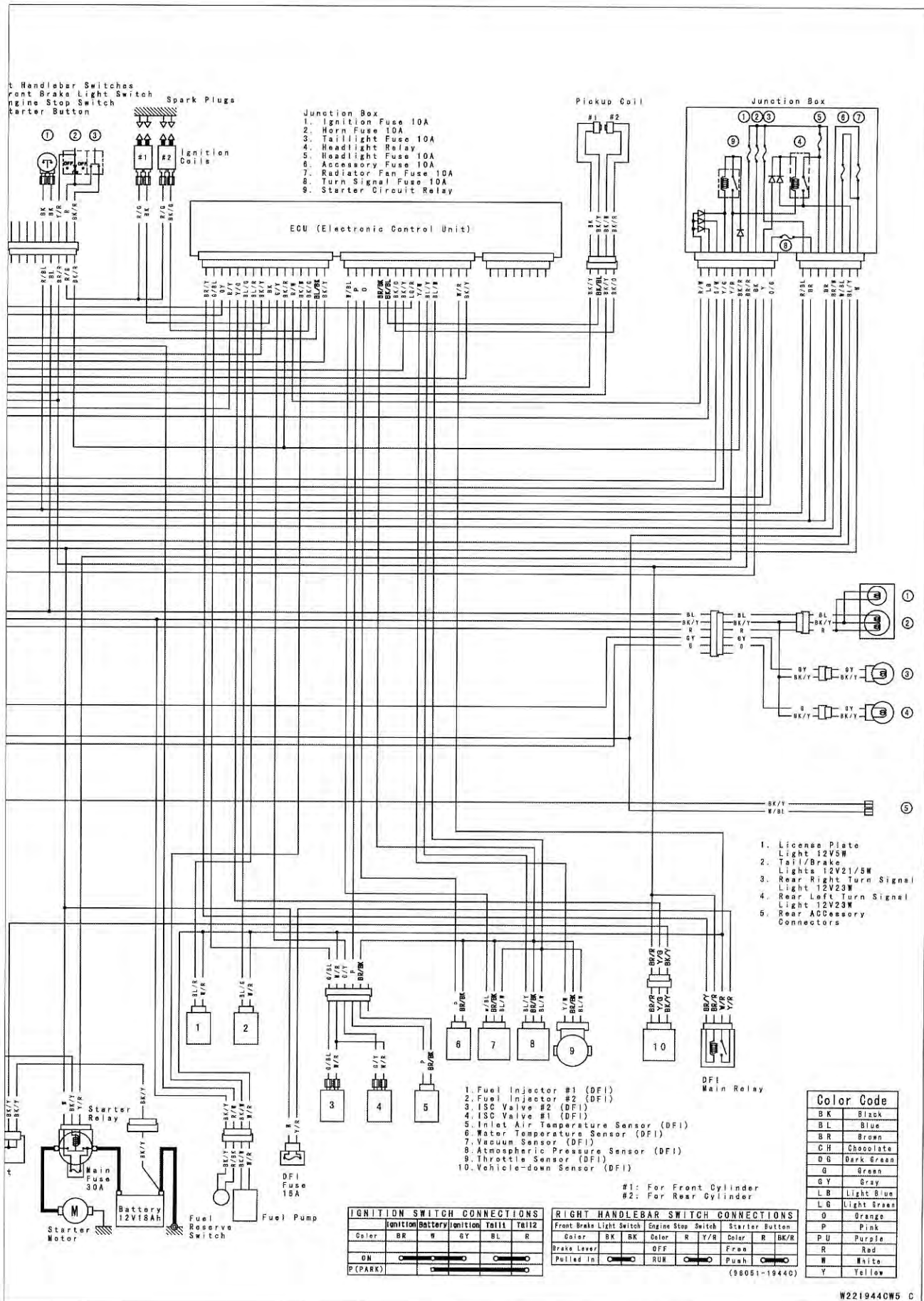
10. Neutral Switch
11. Oil Pressure Switch
12. Regulator/Rectifier
13. In-tank Fuel Pump (DFI)
14. Vehicle-down Sensor (DFI)
15. ECU (DFI, Electronic Control Unit)
16. DFI Fuse 15A
17. MF Battery
18. Junction Box
19. Starter Relay and Main Fuse 30A

20. Turn Signal Control Unit
21. DFI Main Relay
22. Oil Pressure Light Delay Unit
23. #1 ISC Valve (DFI, for Front Cylinder)
24. #2 ISC Valve (DFI, for Rear Cylinder)
25. Inlet Air Temperature Sensor (DFI)
26. Injectors (DFI)
27. Vacuum Sensor (DFI)
28. Meter Unit with FI Indicator LED Light (DFI)
29. Throttle Sensor (DFI)
30. Front Brake Light Switch
31. Radiator Fan
32. Radiator Fan Switch
33. Rear Brake Light Switch

VN1500-R1 Wiring Diagram (Canada, and U.S.)



VN1500-R1 Wiring Diagram (Canada, and U.S.)

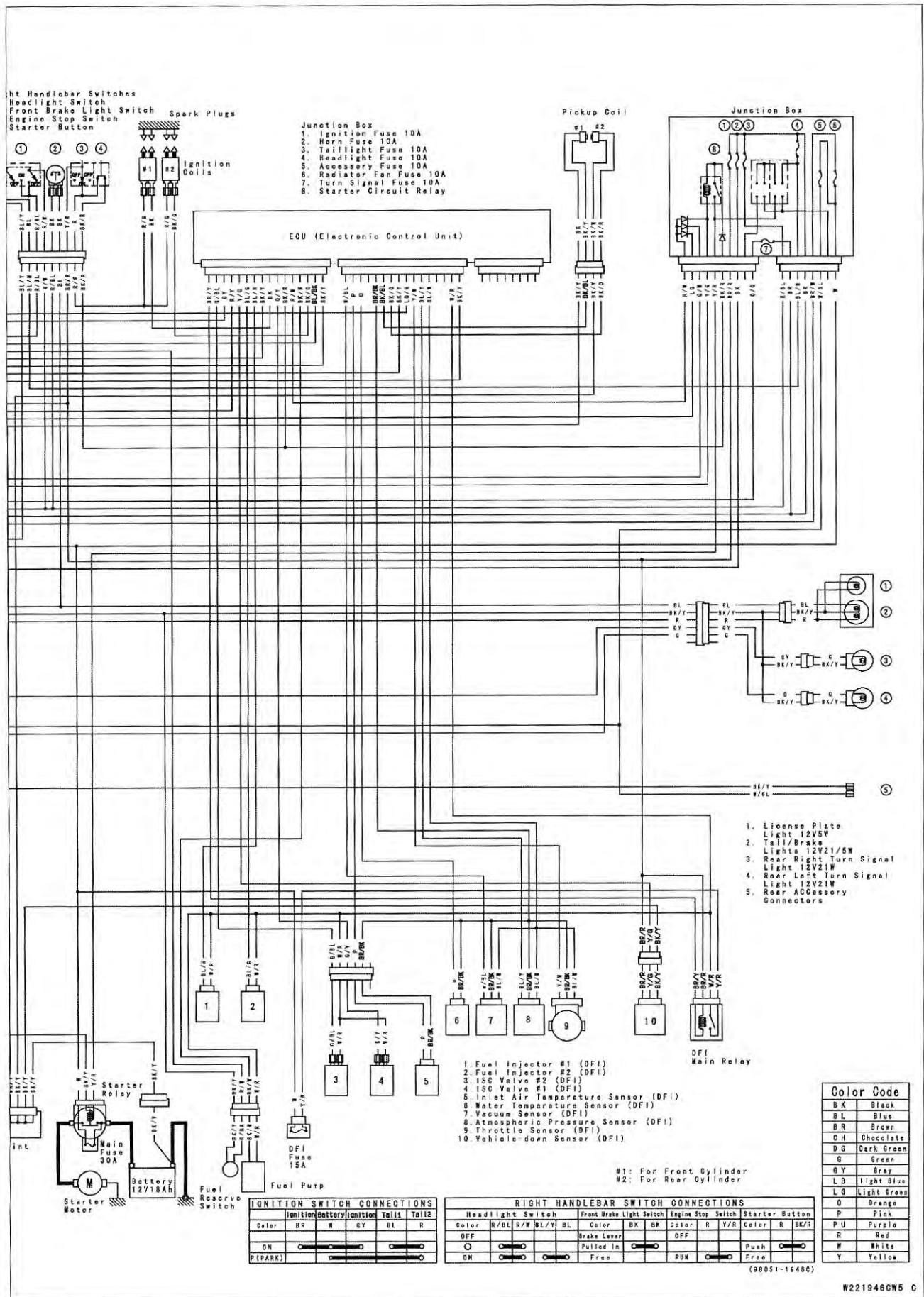


VN1500-R1 Wiring Diagram (Except for Australia, Canada, and U.S.)

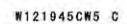


ELECTRICAL SYSTEM 15-7

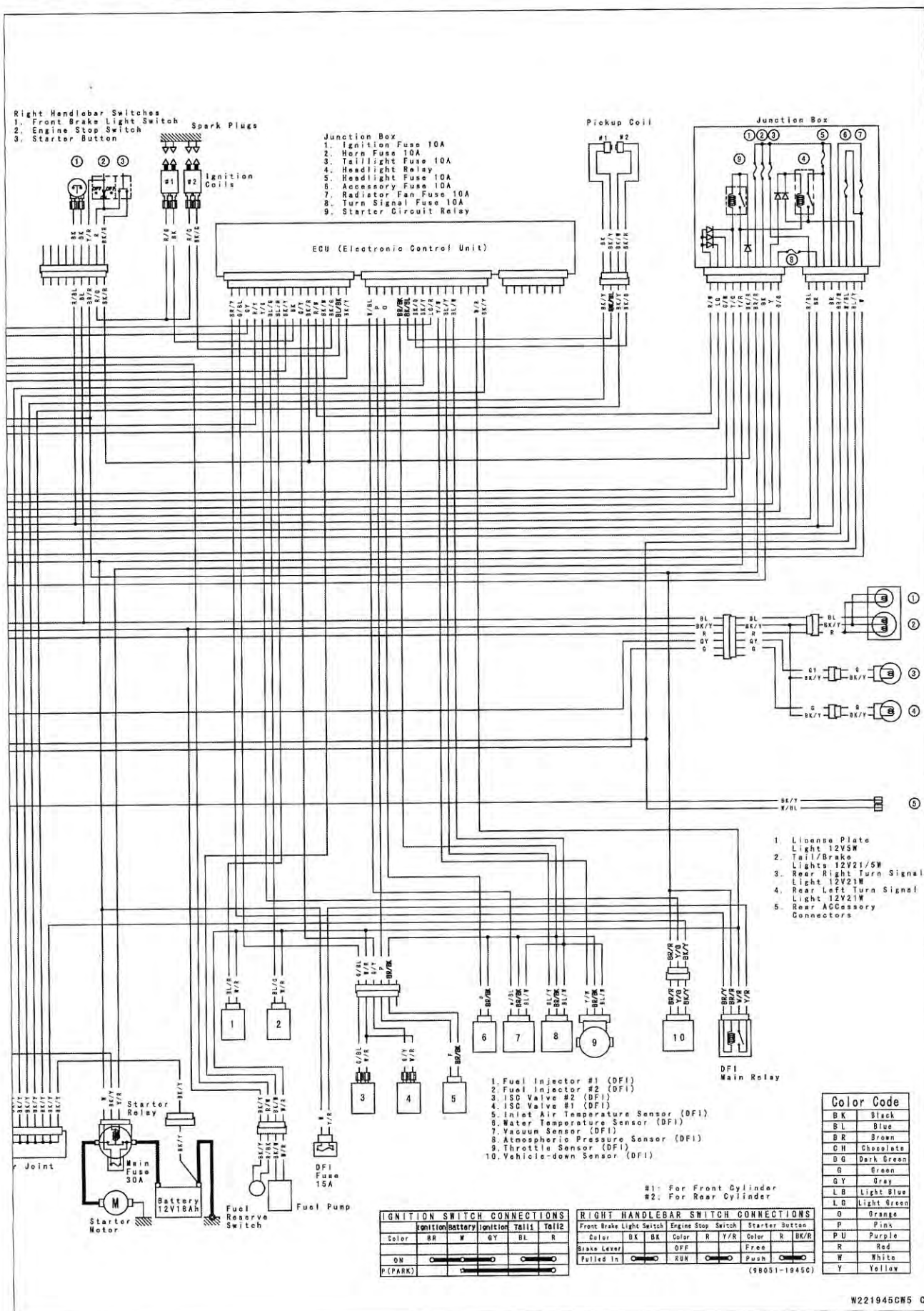
VN1500-R1 Wiring Diagram (Except for Australia, Canada, and U.S.)



VN1500-R1 Wiring Diagram (Australia)

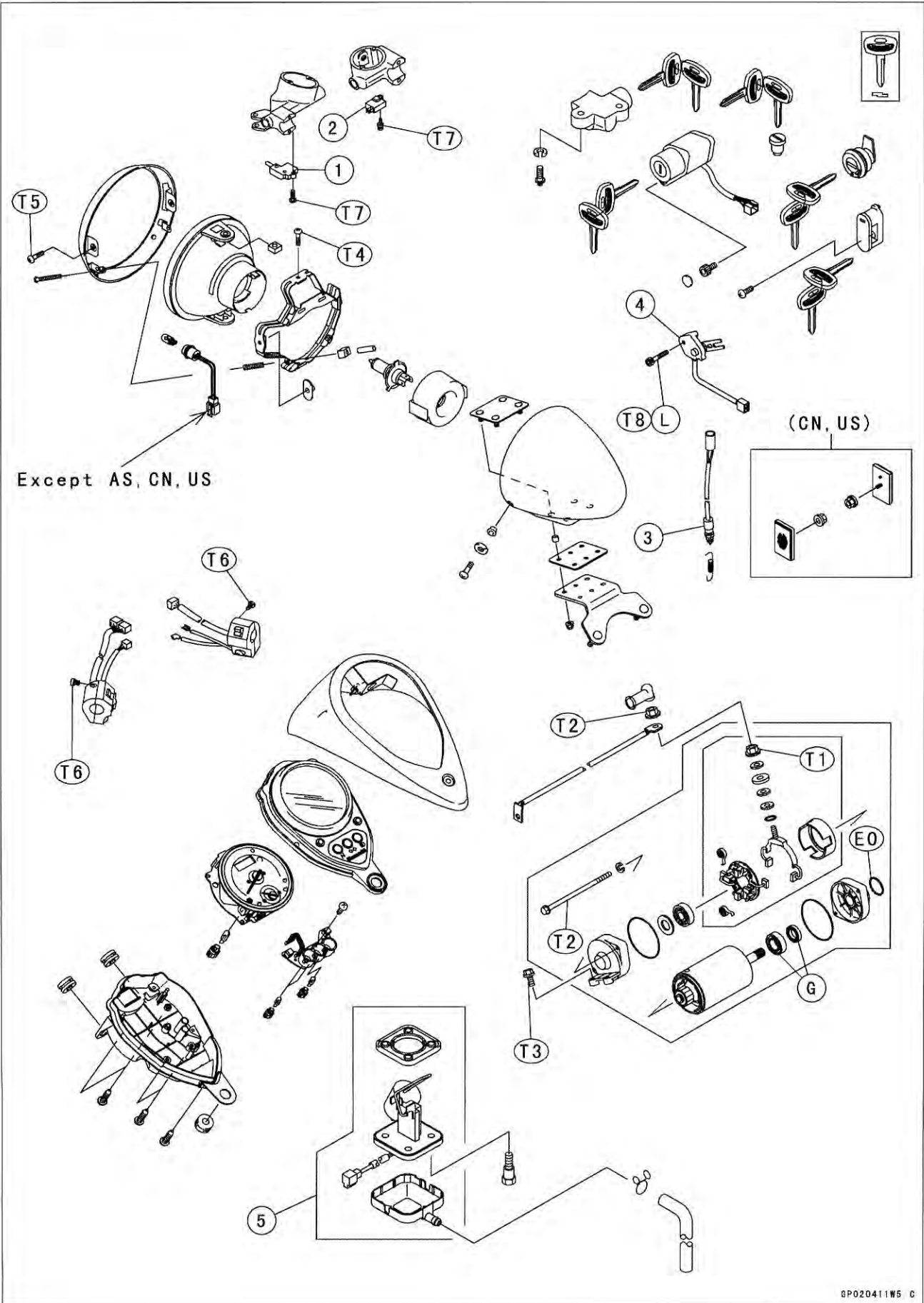


VN1500-R1 Wiring Diagram (Australia)



15-10 ELECTRICAL SYSTEM

Exploded View



Exploded View

1. Starter Lockout Switch
2. Front Brake Light Switch
3. Rear Brake Light Switch
4. Sidestand Switch
5. Fuel Level Sensor

G: Apply grease.

L: Apply a non-permanent locking agent.

CN: Canadian Model

US: United States

T1: 11 N·m (1.1 kg·m, 95 in·lb)

T2: 4.9 N·m (0.50 kg·m, 43 in·lb)

T3: 9.8 N·m (1.0 kg·m, 87 in·lb)

T4: 2.9 N·m (0.30 kg·m, 26 in·lb)

T5: 1.0 N·m (0.10 kg·m, 9 in·lb)

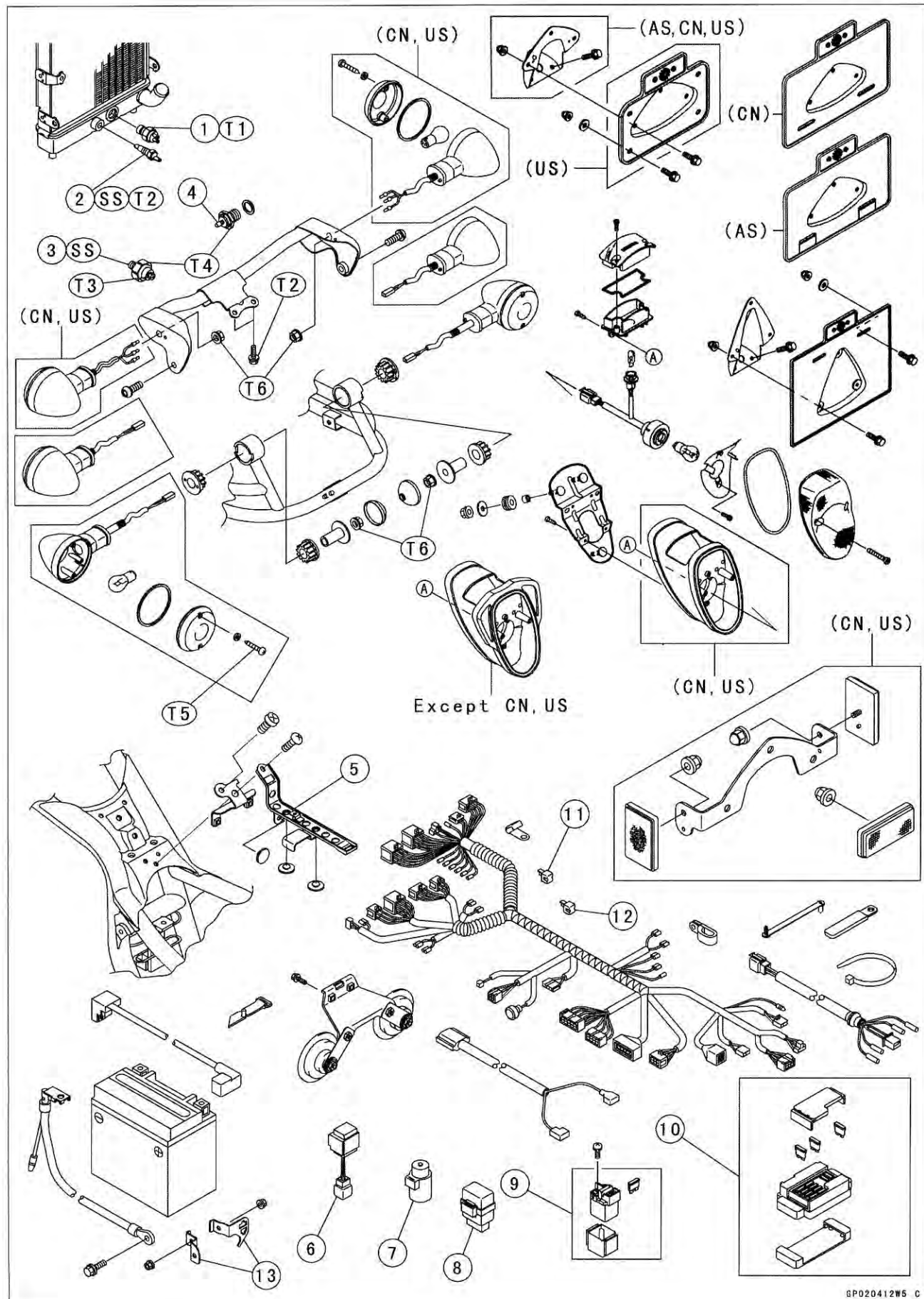
T6: 3.4 N·m (0.35 kg·m, 30 in·lb)

T7: 1.2 N·m (0.12 kg·m, 10 in·lb)

T8: 8.8 N·m (0.90 kg·m, 78 in·lb)

15-12 ELECTRICAL SYSTEM

Exploded View



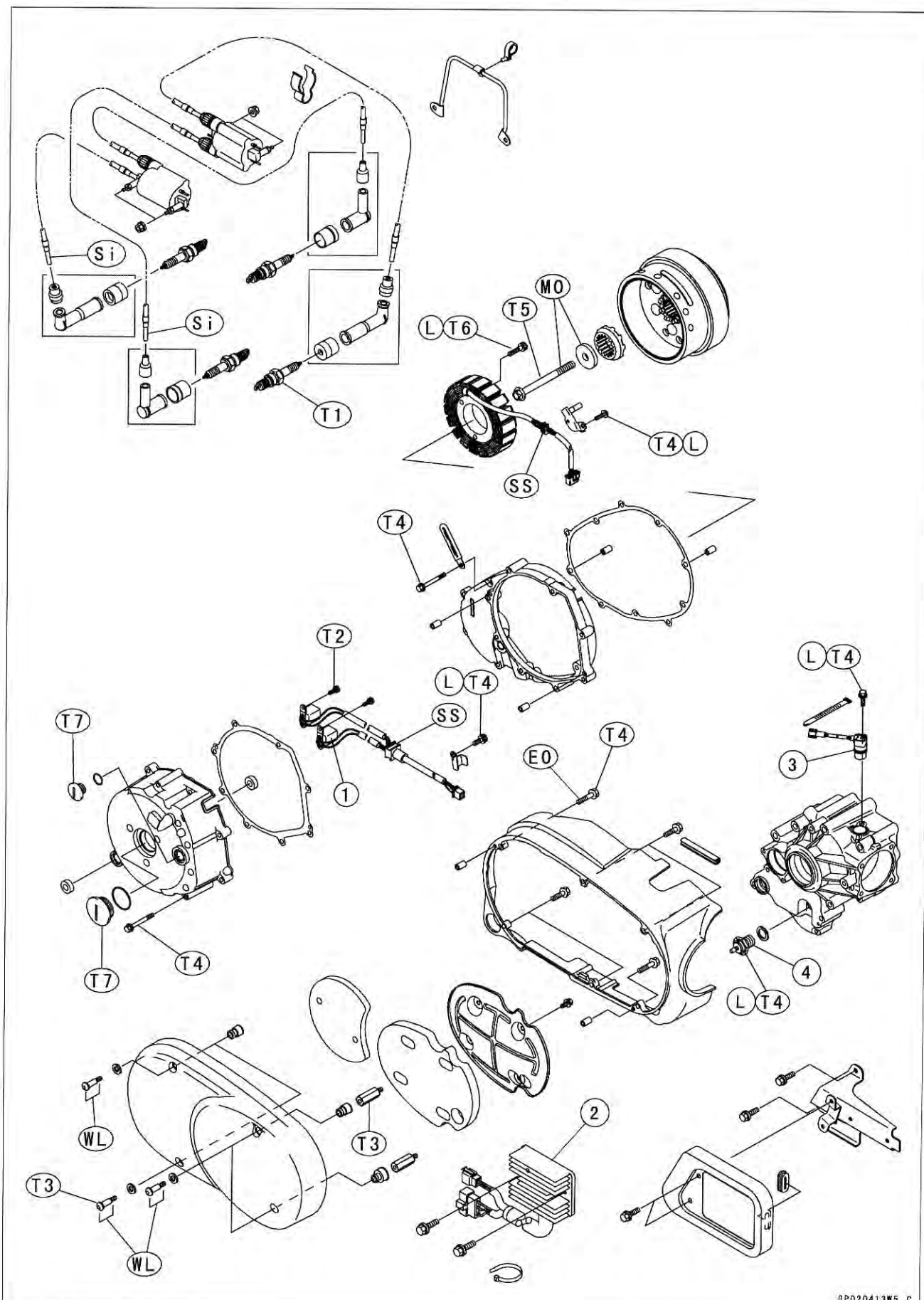
GP020412W5 C

Exploded View

1. Radiator Fan Switch
 2. Water Temperature Switch
 3. Oil Pressure Switch
 4. Neutral Switch
 5. Battery Holder
 6. Oil Pressure Light Delay Unit
 7. DFI Main Relay
 8. Turn Signal Control Unit
 9. Starter Relay
 10. Junction Box
 11. Diode (Rectifier) for Fuel Indicator LED Light
 12. Right Ignition Coil Brackets
- SS: Apply silicone sealant (Kawasaki Bond: 56019-120).
- T1: 18 N·m (1.8 kg·m, 13.0 ft·lb)
- T2: 7.4 N·m (0.75 kg·m, 65 in·lb)
- T3: 1.5 N·m (0.15 kg·m, 13 in·lb)
- T4: 15 N·m (1.5 kg·m, 11.0 ft·lb)
- T5: 1.0 N·m (0.10 kg·m, 9 in·lb)
- T6: 5.9 N·m (0.60 kg·m, 52 in·lb)
- AS: Australian Model
- CN: Canadian Model
- US: United States Model

15-14 ELECTRICAL SYSTEM

Exploded View



BP020413W5 C

Exploded View

1. Pickup Coils
2. Regulator/Rectifiers
3. Speed Sensor
4. Neutral Switch

EO: Apply engine oil.

L: Apply a non-permanent locking agent.

MO: Apply molybdenum disulfide oil to the threads and both sides of the washer.

○: The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10:1).

WL: Apply a soap and water solution or rubber lubricant.

SS: Apply silicone sealant (Kawasaki Bond: 59019-120).

Si: Apply silicone grease.

T1: 18 N·m (1.8 kg·m, 13.0 ft·lb)

T2: 2.9 N·m (0.30 kg·m, 26 in·lb)

T3: 12 N·m (1.2 kg·m, 104 in·lb)

T4: 9.8 N·m (1.0 kg·m, 87 in·lb)

T5: 78 N·m (8.0 kg·m, 57 ft·lb)

T6: 13 N·m (1.3 kg·m, 13 in·lb)

T7: 1.5 N·m (0.15 kg·m, 13 in·lb)

15-16 ELECTRICAL SYSTEM

Specifications

Item	Standard
Battery: Type Model name Capacity Voltage	MF (Maintenance Free) Battery FTZ16-BS 12 V 18 Ah 12.5 V or more
Charging System: Alternator type DC battery charging voltage Alternator output voltage (no load) Stator coil (battery charging coil) resistance Regulator/rectifier Type Resistance	Three-phase AC with delta connection, and rare-earth single magnet rotor 14 ~ 15 V @3 000 r/min (rpm) 64 ~ 96 V @3 000 r/min (rpm) 0.33 ~ 0.49 Ω ($\times$ 1 Ω) Load dumping regulator with full-wave rectifier in the text
Ignition System: Ignition coil: Primary peak voltage Front Rear 3 needle arcing distance Primary winding resistance Secondary winding resistance Spark plug: Spark plug gap Spark plug cap resistance Pickup coil: Pickup coil peak voltage Front Rear Pickup coil air gap Pickup coil resistance	129 V or more 122 V or more 6 mm or more 1.9 ~ 2.9 Ω ($\times$ 1 Ω) 18 ~ 28 k Ω ($\times$ 1 k Ω) 0.8 ~ 0.9 mm 3.75 ~ 6.25 k Ω ($\times$ 1 k Ω) 2.2 V or more 2.0 V or more 1.0 mm (Non-measurable and non-adjustable) 380 ~ 560 Ω ($\times$ 100 Ω)
Electric Starter System: Starter motor: Brush length Commutator diameter	12 mm (Service limit 8.5 mm) 28 mm (Service limit 27 mm)
Switch and Sensor: Rear brake light switch timing Engine oil pressure switch connections Radiator fan switch connections Rising temperature Falling temperature Water temperature switch resistance (Rising temperature) Fuel level sensor resistance	ON after about 15 mm pedal travel When engine is stopped: ON When engine is running: OFF From OFF to ON @100 ~ 110°C (212 ~ 230°F) From ON to OFF @97 ~ 103°C (203 ~ 217°F) ON: Less than 0.5 Ω OFF: More than 1 M Ω From OFF to ON: 110 ~ 120°C (230 ~ 248°F) From ON to OFF: 108°C (226°F) ~ temperature less than ON temperature FULL position: 4 ~ 10 Ω EMPTY position: 90 ~ 100 Ω

○ Refer to Fuel System chapter for specifications of DFI parts.

Specifications

- Special Tools -** Hand Tester: 57001-1394
Spark Plug Wrench, Hex 18: 57001-1024
Timing Light: 57001-1241
Driver-Filler Cap: 57001-1454
Flywheel Holder: 57001-1410
Jack: 57001-1238
Attachment Jack: 57001-1398
Needle Adapter Set-Hand Tester: 57001-1457
- Sealant -** Kawasaki Bond (Silicone Sealant): 56019-120

15-18 ELECTRICAL SYSTEM

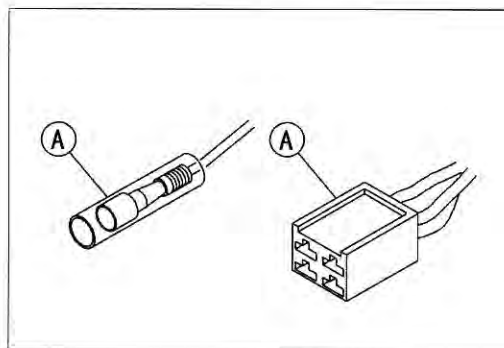
Servicing Precautions

There are a number of important precautions that should be followed servicing electrical systems.

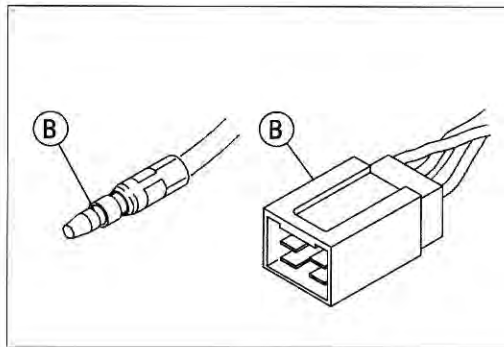
- Do not reverse the battery lead connections. This will burn out the diodes on the electrical parts.
- Always check battery condition before condemning other parts of an electrical system. A fully charged battery is a must for conducting accurate electrical system tests.
- The electrical parts should never be struck sharply, as with a hammer, or allowed to fall on a hard surface. Such a shock to the parts can damage them.
- To prevent damage to electrical parts, do not disconnect the battery wires or any other electrical connections when the ignition switch is on, or while the engine is running.
- Because of the large amount of current, never keep the starter button pushed when the starter motor will not turn over, or the current may burn out the starter motor windings.
- Do not use a meter illumination bulb rated for other than voltage or wattage specified in the wiring diagram, as the meter or gauge panel could be warped by excessive heat radiated from the bulb.
- Take care not to short the wires that are directly connected to the battery positive (+) terminal to the chassis ground.
- Troubles may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the failure. If the failure was caused by some other item or items, they too must be repaired or replaced, or the new replacement will soon fail again.
- Make sure all connectors in the circuit are clean and tight, and examine wires for signs of burning, fraying, etc. Poor wires and bad connections will affect electrical system operation.
- Measure coil and winding resistance when the part is cold (at room temperature).
- Wire Color Codes:

BK: Black	G: Green	P: Pink
BL: Blue	GY: Gray	PU: Purple
BR: Brown	LB: Light blue	R: Red
CH: Chocolate	LG: Light green	W: White
DG: Dark green	O: Orange	Y: Yellow

- Electrical Connectors
Female Connectors [A]



Male Connectors [B]



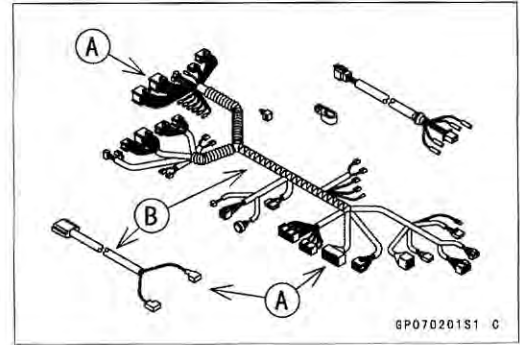
Electrical Wiring

Wiring Inspection

- Visually inspect the wiring for signs of burning, fraying, etc.
- ★ If any wiring is poor, replace the damaged wiring.
- Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.
- ★ If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it.
- Check that the connectors are not loose.
- Check the wiring for continuity.
- Use the wiring diagram to find the ends of the wire which is suspected of being a problem.
- Connect the hand tester between the ends of the wires.

Special Tool - Hand Tester: 57001-1394

- Set the tester to the $\times 1 \Omega$ range, and read the tester.
- ★ If the tester does not read 0Ω , the lead is defective. Replace the wire or the wiring harness [B] if necessary.

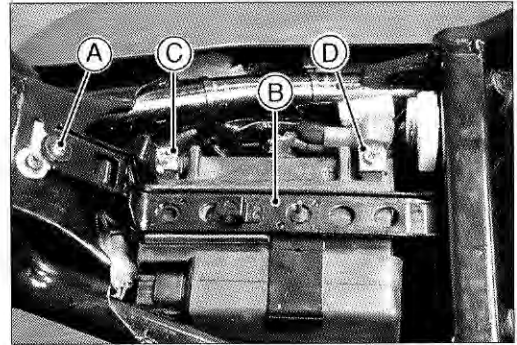


15-20 ELECTRICAL SYSTEM

Battery

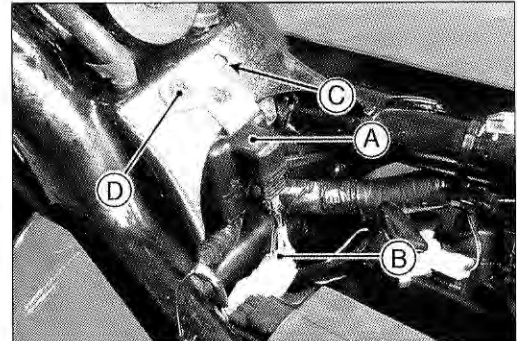
Battery Removal

- Remove:
 - Seat (see Frame chapter)
 - Screw [A] and Battery Holder [B]
- Slide the black and red caps out.
- Disconnect the negative (–) wire [C] from the battery first and then the positive (+) wire [D] from the battery.
- Pull the battery out of the case.
- Clean the battery using a solution of baking soda and water. Be sure that the wire connections are clean.



Battery Installation

- Check that the vehicle-down sensor assy [A] is installed correctly.
- The connector [B] faces back and down, the hook [C] is fitted into the hole, and the screw [D] is tightened securely. Do not install the sensor upside down.
- The arrow of the sensor should face upward.
- ★ If the vehicle-down sensor assy is not installed correctly, reinstall it (see Fuel System chapter).



⚠ WARNING

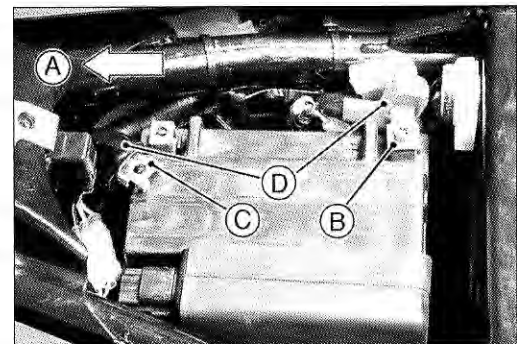
Incorrect installation of the vehicle-down sensor could cause sudden loss of engine power. The rider could lose balance during certain riding situations, like leaning over in a turn, with the potential for an accident resulting in injury or death. Ensure that the down sensor bracket is held in place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

- Face the (–) terminal forward [A] and put the battery into the battery case.

CAUTION

Do not install the battery backwards.

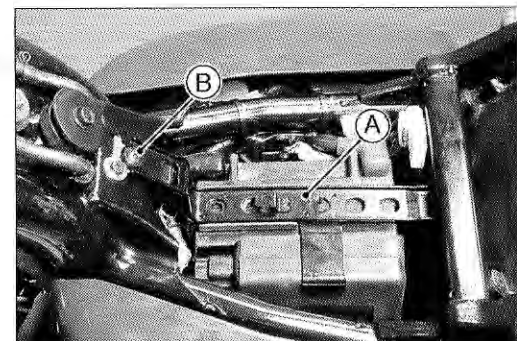
- Connect the capped wire terminal [B] to the (+) terminal first, and then the capped wire terminal [C] to the (–) terminal. Be sure to connect the (–) snap-in connector.
- Apply a light coat of grease on the terminals to prevent corrosion.
- Cover the terminals with the black and red caps [D].



CAUTION

If each battery wire is not correctly disconnected or connected, sparks can arise at electrical connections, causing damage to electrical and DFI parts.

- Put the battery holder [A] on the vehicle-down sensor bracket and insert the screw [B] through the battery holder and vehicle-down sensor bracket.
- Tighten the screw securely.
- Install the seat (see Frame chapter).



Battery

Electrolyte Filling

- Make sure that the model name [A] of the electrolyte container matches the model name [B] of the battery. These names must be the same.

Battery Model Name for VN1500-R1: FTZ16-BS

CAUTION

Be sure to use the electrolyte container with the same model name as the battery since the electrolyte volume and specific gravity vary with the battery type. This is to prevent overfilling of the electrolyte, shorting the battery life, and deterioration of the battery performance.

- Check to see that there is no peeling, tears or holes in the seal sheet on the top of the battery.
- Place the battery on a level surface.
- Remove the seal sheet [A].

CAUTION

Do not remove the seal sheet sealing the filler ports [B] until just before use.

NOTE

- A battery whose seal sheet has any peeling, tears, or holes, requires a refreshing charge (initial charge).

- Take the electrolyte container out of the plastic bag.
- Detach the seal cap [A] from the container.

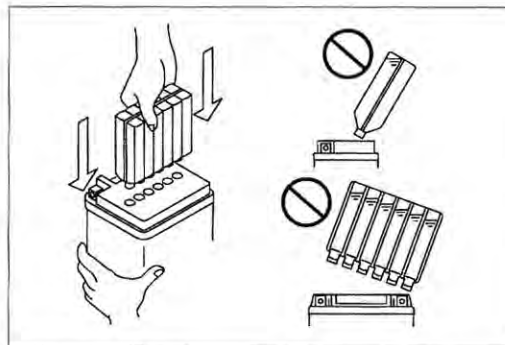
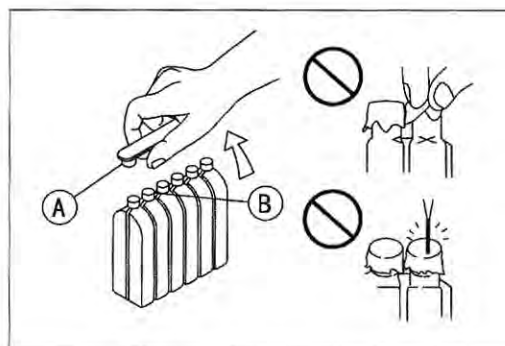
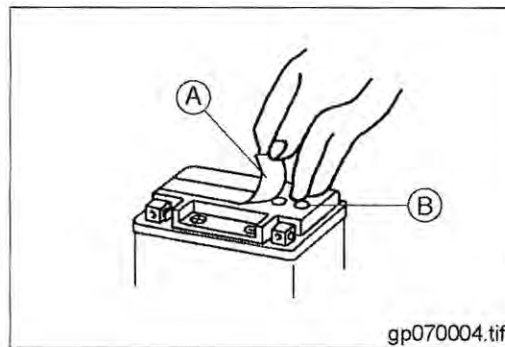
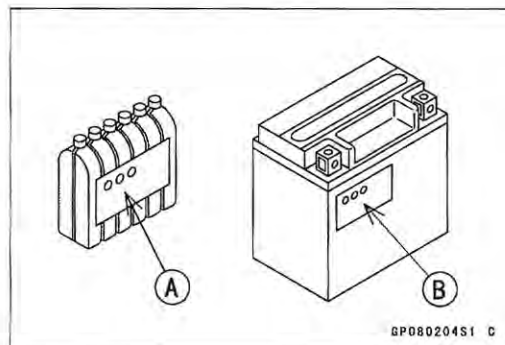
NOTE

- Do not discard the seal cap because it is used as the battery plugs later.
- Do not peel back or pierce the seals [B] on the container.

- Place the electrolyte container upside down aligning the six seals with the six battery filler ports.
- Push the container down strongly enough to break the seals. Now the electrolyte should start to flow into the battery.

NOTE

- Do not tilt the container as the electrolyte flow may be interrupted.



15-22 ELECTRICAL SYSTEM

Battery

- Make sure air bubbles [A] are coming up from all six filler ports.
- Leave the container this way for 5 minutes or longer.

NOTE

- If no air bubbles are coming up from a filler port, tap [B] the bottom of the container two or three times. Never remove the container from the battery.

CAUTION

Fill the electrolyte into the battery until the container is completely emptied.

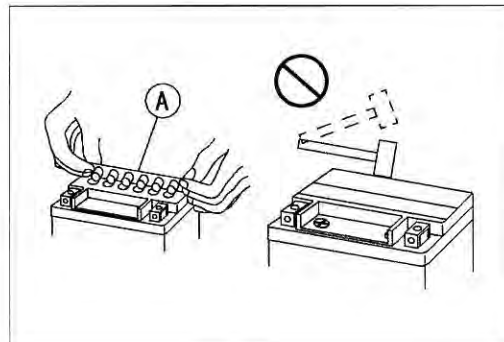
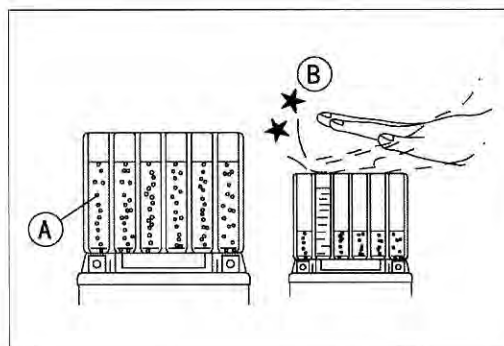
- Be certain that all the electrolyte has flowed out.
- Tap the bottom the same way as above if there is any electrolyte left in the container.
- Now pull the container gently out of the battery.
- Let the battery sit for **20** minutes. During this time, the electrolyte permeates the special separators and the gas generated by chemical reaction is released.
- Fit the seal cap [A] tightly into the filler ports until the seal cap is at the same level as the top of the battery.

NOTE

- Do not hammer. Press down evenly with both hands.

WARNING

Once you installed the seal cap after filling the battery, never remove it, nor add any water or electrolyte.



Initial Charge

While a maintenance free battery can be used after only filling with electrolyte, a battery may not be able to sufficiently move a starter motor to start an engine in the cases shown in the table below, where an initial charge is required before use. However, if a battery shows a terminal voltage of 12.5 V or more, using a digital volt meter, after 10 minutes of filling, no initial charge is necessary.

NOTE

- To measure battery terminal voltage, use a digital voltmeter which can be read one decimal place voltage.

Condition requiring initial charge	Charging method
At low temperature (lower than 0°C)	1.8 A × 2 ~ 3 hours
Battery has been stored under high temperature and humidity.	1.8 A × 15 ~ 20 hours
Seal sheet has been removed, or broken – peeling, tear or hole.	
Battery two or more years old from date of manufacture. Battery manufacturing date is printed on battery top. Example) <u>12</u> <u>10</u> <u>99</u> <u>T1</u> Day Month Year Mfg. location	

Battery

Precautions

- 1) No need of topping-up
No topping-up is necessary in this battery until it ends its life under normal use. Forcibly prying off the seal cap to add water is very dangerous. Never do that.
- 2) Refreshing charge
If an engine will not start, a horn sounds weak, or lamps are dim, it indicates the battery has been discharged. Give refresh charge for 5 to 10 hours with charge current shown in the specification (see this chapter).
When a fast charge is inevitably required, do it following precisely the maximum charge current and time conditions indicated on the battery.

CAUTION

This battery is designed to sustain no unusual deterioration if refresh-charged according to the method specified above. However, the battery's performance may be reduced noticeably if charged under conditions other than given above. Never remove the seal cap during refresh charge.
If by chance an excessive amount of gas is generated due to overcharging, the relief valve releases the gas to keep the battery normal.

- 3) When you do not use the motorcycle for months:
Give a refresh charge before you store the motorcycle and store it with the negative lead removed. Give a refresh charge **once a month** during storage.
- 4) Battery life:
If the battery will not start the engine even after several refresh charges, the battery has exceeded its useful life. Replace it (Provided, however, the vehicle's starting system has no problem).

⚠ WARNING

Keep the battery away from sparks and open flames during charging, since the battery gives off an explosive gas mixture of hydrogen and oxygen. When using a battery charger, connect the battery to the charger before turning on the charger.

This procedure prevents sparks at the battery terminals which could ignite any battery gases.

No fire should be drawn near the battery, or no terminals should have the tightening loosened.

The electrolyte contains sulfuric acid. Be careful not to have it touch your skin or eyes. If touched, wash it off with liberal amount of water. Get medical attention if severe.

Interchange

A maintenance free battery can fully display its performance only when combined with a proper vehicle electric system. Therefore, replace a maintenance free battery only on a motorcycle which was originally equipped with a maintenance free battery.

Be careful, if a maintenance free battery is installed on a motorcycle which had an ordinary battery as original equipment, the maintenance free battery's life will be shortened.

Charging Condition Inspection

- Battery charging condition can be checked by measuring battery terminal voltage with a digital voltmeter [A].
- Remove the seat (see Frame chapter).
- Disconnect the battery terminals.

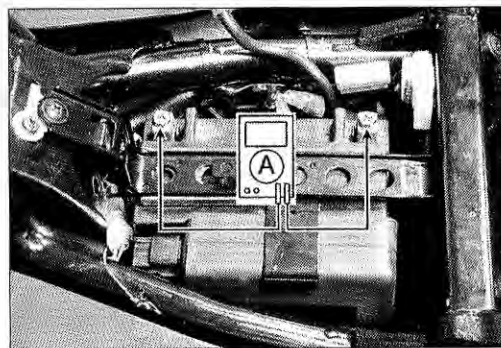
CAUTION

Be sure to disconnect the negative terminal first.

- Measure the battery terminal voltage.

NOTE

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



15-24 ELECTRICAL SYSTEM

Battery

- ★ If the reading is 12.5 V or more, no refresh charge is required, however, if the read is below the specified, refresh charge is required.

Battery Terminal Voltage

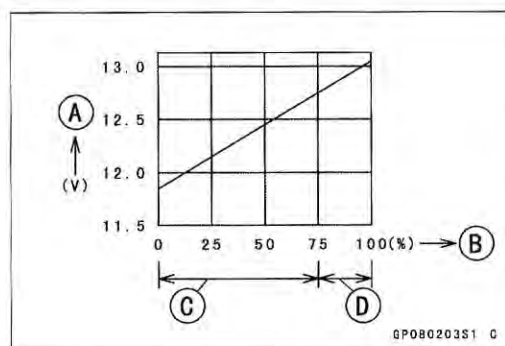
Standard: 12.5 V or more

Terminal Voltage (V) [A]

Battery Charge Rate (%) [B]

Refresh charge is required [C]

Good [D]

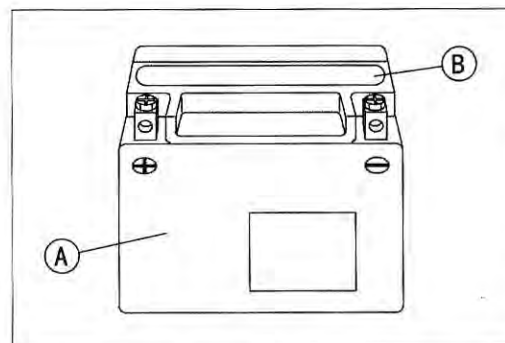


Refreshing Charge

- Remove the battery [A] (see this chapter).
- Do refresh charge by following method according to the battery terminal voltage.

WARNING

This battery is sealed type. Never remove seal cap [B] even at charging. Never add water. Charge with current and time as stated below.



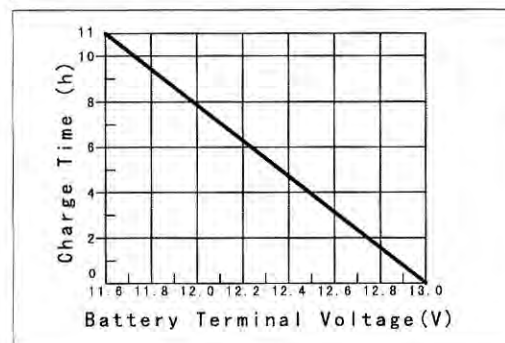
Terminal Voltage: 11.5 ~ less than 12.5 V

Standard Charge 1.8 A × 5 ~ 10 h (see following chart)

Quick Charge 9.0 A × 1.0 h

CAUTION

If possible, do not quick charge. If quick charge is done unavoidably, do standard charge later on.



Terminal Voltage: less than 11.5 V

Charging Method: 1.8 A × 20 h

NOTE

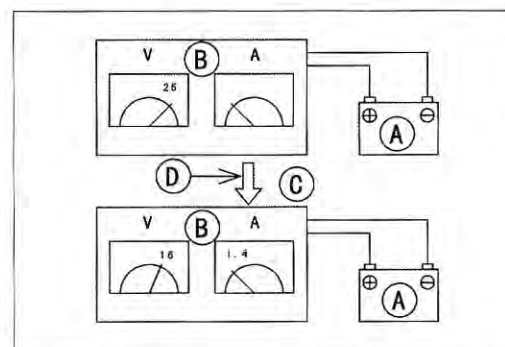
- Increase the charging voltage to a maximum voltage of 25 V if the battery will not accept current initially. Charge for no more than 5 minutes at the increased voltage then check if the battery is drawing current. If the battery will accept current decrease the voltage and charge by the standard charging method described on the battery case. If the battery will not accept current after 5 minutes, replace the battery.

Battery [A]

Battery Charger [B]

Standard Value [C]

Adjust voltage so that the current will be standard value after 5 minutes [D].



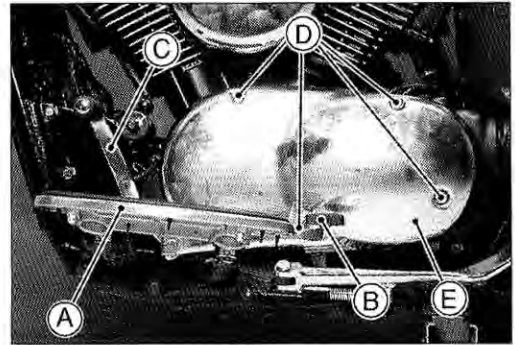
- Determine the battery condition after refresh charge.
- Determine the condition of the battery left for 30 minutes after completion of the charge by measuring the terminal voltage according to the table below.

Criteria	Judgement
12.5 V or higher	Good
12.0 ~ lower than 12.5 V	Charge insufficient → Recharge
lower than 12.0 V	Unserviceable → Replace

Charging System

Alternator Outer Cover Removal

- Remove (left side view):
 - Left Front Footboard [A] (see Crankshaft/Transmission chapter)
 - Rear Shift Pedal [B] (see Crankshaft/Transmission chapter)
 - Front Shift Pedal [C] (see Crankshaft/Transmission chapter)
- Unscrew the bolts [D] and take off the alternator outer cover [E].



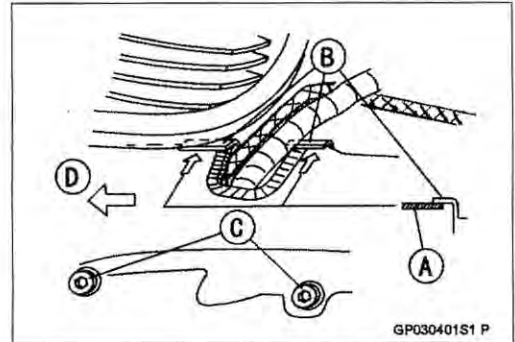
Alternator Outer Cover Installation

- First, insert the upper edge [A] of the alternator outer cover under the left crankcase ribs [B]. This prevents the rib failure.
- Apply a soap and water solution or rubber lubricant to the body of the alternator outer cover bolts [C] for easy installation and tighten them.

Torque - Alternator Outer Cover Bolts: 12 N·m (1.2 kg·m, 104 in·lb)

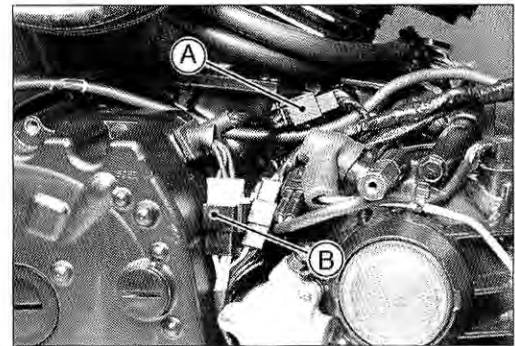
Front [D]

- Install the front and rear shift pedals (see Crankshaft/Transmission chapter).

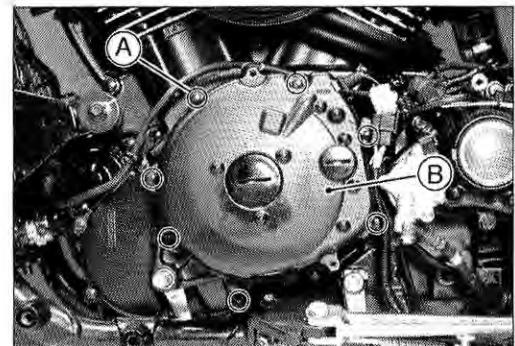


Alternator Cover Removal/Installation

- Remove:
 - Left Front Footboard (see Crankshaft/Transmission chapter)
 - Rear Shift Pedal (see Crankshaft/Transmission chapter)
 - Front Shift Pedal (see Crankshaft/Transmission chapter)
- Remove the alternator outer cover (see this chapter).
- Disconnect the pickup coil connector [A] and alternator connector [B].



- Unscrew the bolts [A] and take off the alternator cover [B].



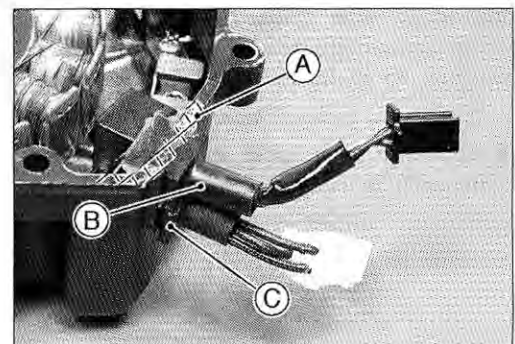
- Discard and replace the gasket with a new one.
- Apply silicone sealant to the area [A] to the pickup coil wire gromet [B].

Stator Wire Gromet [C]

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

- Tighten the cover bolts.

Torque - Alternator Cover Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

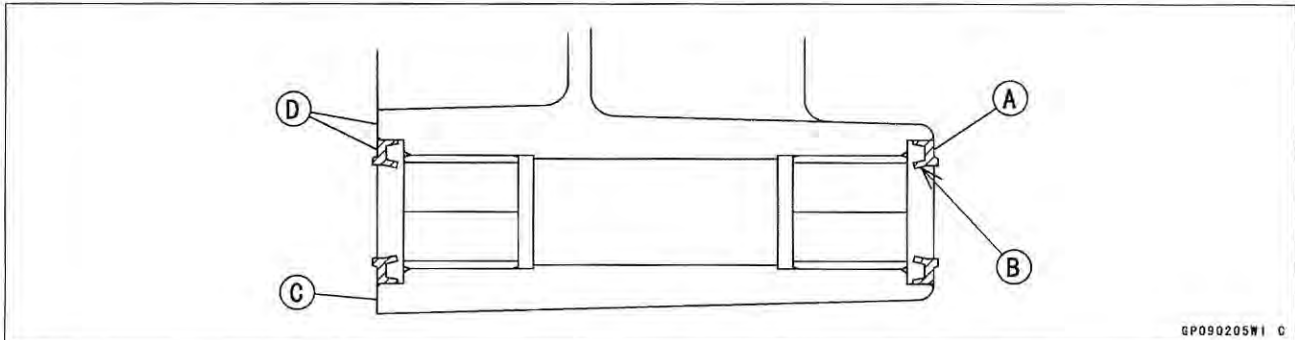


15-26 ELECTRICAL SYSTEM

Charging System

Alternator Cover Assembly

- Install each shift shaft grease seal [A] with the lip [B] facing inside the alternator cover [C] until the seal side is even [D] with the end of the hole.
- Apply a little high temperature grease on the lips.



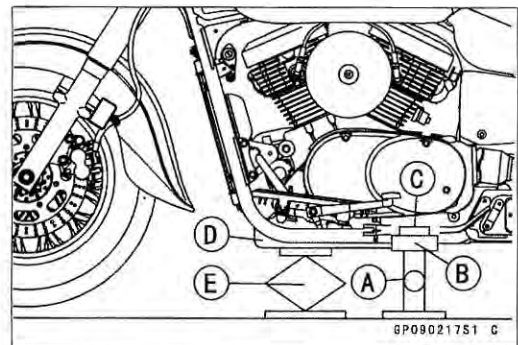
Alternator Inner Cover Removal

- Using the jack [A] and the attachment jack [B], raise the front and rear wheels just off the ground.
Frame Pipe Rib [C]

Special Tools - Jack: 57001-1238

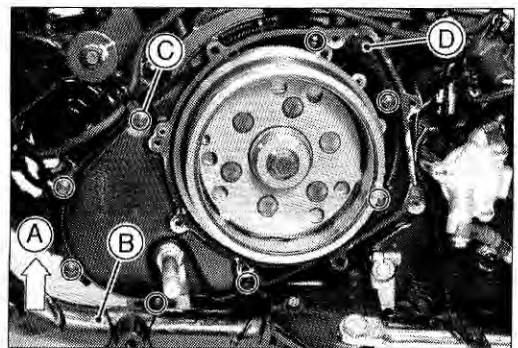
Attachment Jack: 57001-1398

- Drain the engine oil (see Engine Lubrication System chapter).
- Remove:
Fuel Tank (see Fuel System chapter)
Left Ignition Coil (see this chapter)
Alternator Outer Cover and Alternator Cover (see this chapter)
Alternator Connectors
- Loosen the front and rear exhaust pipe holder nuts, and both chamber bolts.
- Support the front part of the engine bottom [D], using a commercially available jack [E], and remove the front engine mounting bolt.
- Loosen the rear engine mounting bolt.
- Lift up [A] the front part of the engine, using the jack until the lower part of the alternator inner cover clears the lower frame [B].



NOTE

- Turn the propeller shaft so that the engine can be raised as high as possible.
- Unscrew the bolts [C] and take off the alternator inner cover [D].



Alternator Inner Cover Installation

- Replace the gasket with a new one.
- Install the alternator inner cover.
Torque - Alternator Inner Cover Bolts: 9.8 N·m (1.0 kg-m, 87 in-lb)
- Move the engine into its original position and tighten the engine mounting bolts.
Torque - Engine Mounting Bolts and Nuts: 44 N·m (4.5 kg-m, 33 ft-lb)
- Install the removed parts.

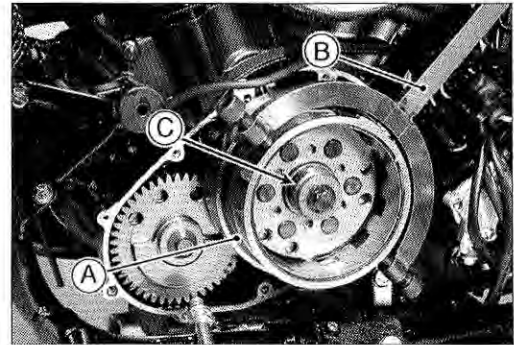
Charging System

Alternator Rotor Removal

- Remove the alternator inner cover (see this chapter).
- Hold the alternator rotor [A] steady with the flywheel holder [B], and remove the rotor bolt [C].

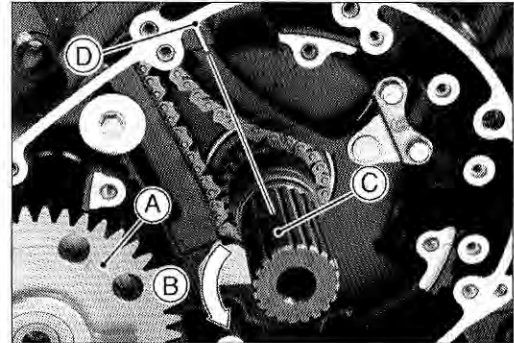
Special Tool - Flywheel Holder: 57001-1410

- Take the alternator rotor, washer, and ratchet off the crankshaft.

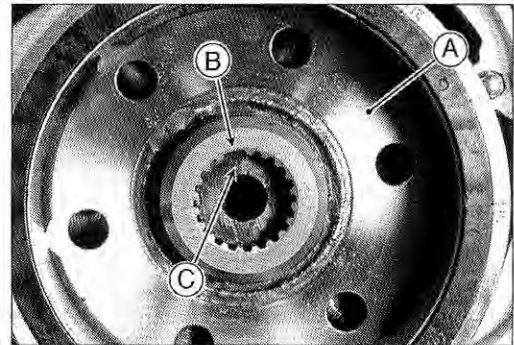


Alternator Rotor Installation

- Install the left balancer [A].
- Turn the crankshaft counterclockwise [B] and align the alignment tooth [C] with the middle of the crankcase rib [D]. This makes the front piston set to its top dead center.



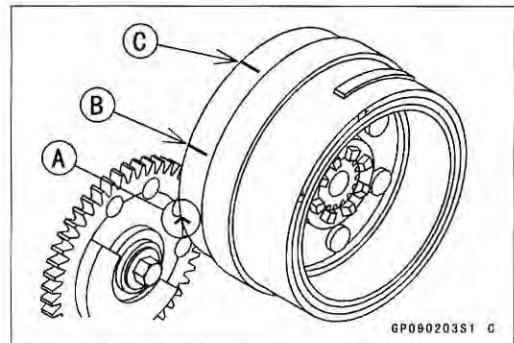
- Install the alternator rotor [A] while fitting the alignment notch [B] of the splines onto the alignment tooth [C].



- Be sure to align the balancer gear mark (shorter) with the alternator mark (line marks) [A] while keeping the front position on its top dead center.

Top Mark for Rear Piston (longer mark)

Top Mark for Front Piston (longer mark)



- Apply molybdenum disulfide oil to the threads of the alternator rotor bolt.

- The molybdenum disulfide oil is a mixture of engine oil and molybdenum disulfide grease with a weight ratio (10 : 1).

- Tighten:

Torque - Alternator Rotor Bolt: 78 N·m (8.0 kg·m, 57 ft·lb)

- Install:

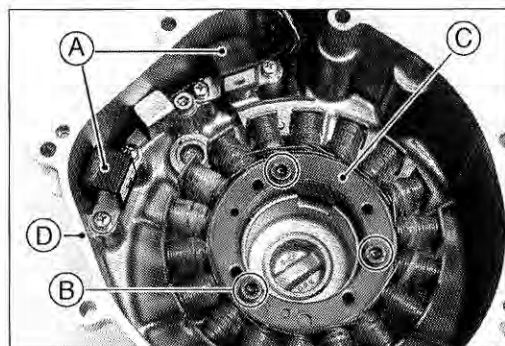
Alternator Inner Cover (see this chapter)

15-28 ELECTRICAL SYSTEM

Charging System

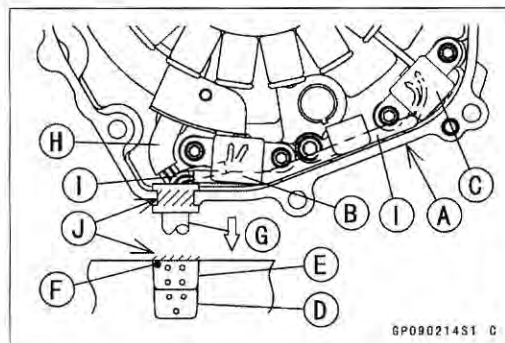
Alternator Stator Removal

- Remove the alternator cover (see this chapter).
- Remove the pickup coils [A] from the alternator cover.
- Unscrew the Allen bolts [B] and take the stator [C] off the alternator cover [D].



Alternator Stator Installation

- Install the stator with the Y wires on the alternator cover [A].
Non-permanent Locking Agent - Alternator Stator Bolts
Torque - Alternator Stator Bolts: 13 N·m (1.3 kg·m, 113 in·lb)
- Install the pickup coils as shown.
Pickup Coil [B] with shorter wires (BK and BK/Y) for #1 (front)
Pickup Coil [C] with longer wires (BK/W and BK/R) for #2 (rear)
Torque - Pickup Coil Screws: 2.9 N·m (0.30 N·m, 26 in·lb)
- Run the shorter pickup coil wires over the shorter pickup coil wires above the alternator wires.
- Non-permanent Locking Agent - Stator Lead Holder Screw**
Pickup Coil Wire Holder Bolt
Torque - Stator Wire Holder Screw: 9.8 N·m (1.0 kg·m, 87 in·lb)
Pickup Coil Wire Holder Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)
- Apply silicone sealant to the sides of the grommets as shown, and fit the grommets into the notch of the alternator cover.
- First, install the grommet [D] for the alternator wires, and then the grommet [E] for the pickup coil wires with the round mark [F] up.
- Pull [G] the alternator wires and pickup coil wires [I] outside the alternator cover, and **reduce the slack of wires inside the cover as possible** in order to prevent contact with the rotor.
- Apply silicone sealant to the mating surface [J] of the grommet.



Charging System

Charging Voltage Inspection

- Check the battery condition.
- Warm up the engine to obtain actual alternator operating conditions.
- Remove the seat (see Frame chapter).
- Check that the ignition switch is turned off, and connect the hand tester to the battery to the battery as shown in the table.

Regulator/Rectifier Output Voltage

Tester Range	Connections		Reading @3000 rpm
	Tester (+) to	Tester (-) to	
25 V DC	Battery (+)	Battery (-)	14 ~ 15 V

- Turn on the ignition switch and start the engine, and note the voltage readings at various engine speeds with the headlight turned on and then turned off (To turn off the headlight of the US model, disconnect the headlight connector in the headlight unit). The readings should show nearly battery voltage when the engine speed is low, and as the engine speed rises, the readings should also rise. But they must be kept under the specified voltage.
- Turn off the ignition switch to stop the engine, and disconnect the hand tester.
- ★ If the charging voltage is kept between the values given in the table, the charging system is considered to be working normally.
- ★ If the output voltage is much higher than the values specified in the table, the regulator/rectifier is defective or the regulator/rectifier wires are loose or open.
- ★ If the battery voltage does not rise as the engine speed increases, then the regulator/rectifier is defective or the alternator output is insufficient for the loads. Check the alternator and regulator/rectifier to determine which part is defective.

Alternator Inspection

There are three types of alternator failures: short, open (wire burned out), or loss in rotor magnetism. A short or open in one of the stator coil wires will result in either a low output, or no output at all. A loss in rotor magnetism, which may be caused by dropping or hitting the alternator, by leaving it near an electromagnetic field, or just by aging, will result in low output.

- To check the alternator output voltage, do the following procedures.
- Remove the alternator outer cover and disconnect the alternator connector [A].
- Connect the hand tester to the outer as shown.

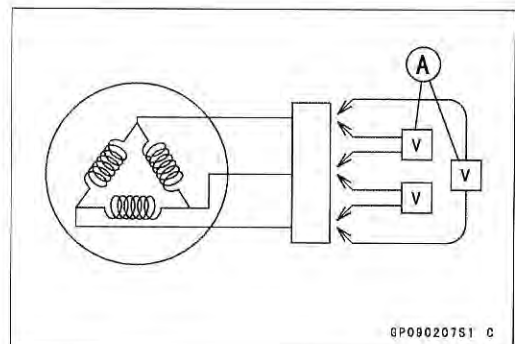
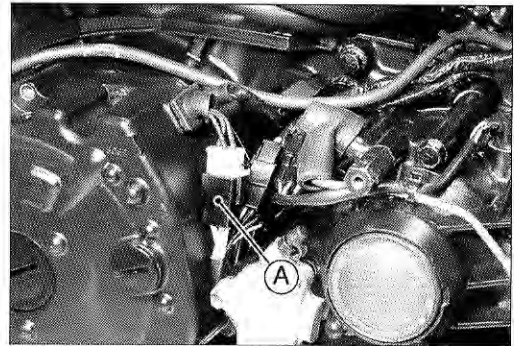
Special Tool - Hand Tester: 57001-1394

- Start the engine.
- Run it at 3000 rpm of the engine speed.
- Note the voltage readings.

Alternator Output Voltage

Tester Range	Connections		Reading @3000 rpm
	Tester (+) to	Tester (-) to	
250 V AC	One yellow wire	Another yellow wire	64 ~ 96 V

- ★ If the output voltage shows the value in the table, the alternator operates properly and the regulator/rectifier is damaged. A much lower reading than the value in the table indicates that the alternator is defective.
 - Repeat the test for the other yellow wires.
- Hand Tester [A]



15-30 ELECTRICAL SYSTEM

Charging System

- Check the stator coil resistance as follows:
 - Stop the engine.
 - Connect the hand tester [A] to the connector as shown in the table.
 - Note the resistance readings.

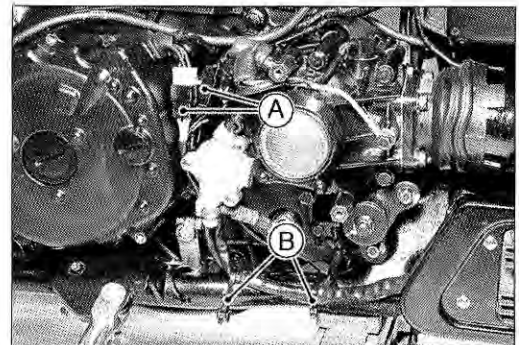
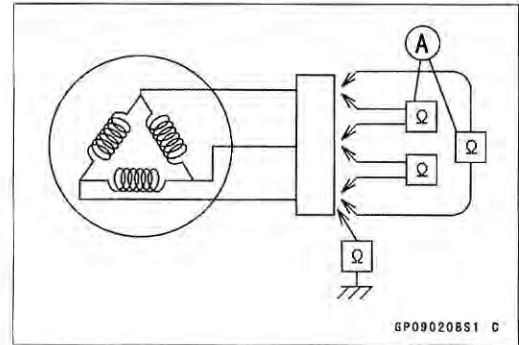
Stator Coil Resistance

Tester Range	Connections		Reading
	Tester (+) to	Tester (-) to	
$\times 1 \Omega$	One yellow wire	Another yellow wire	$0.33 \sim 0.49 \Omega$

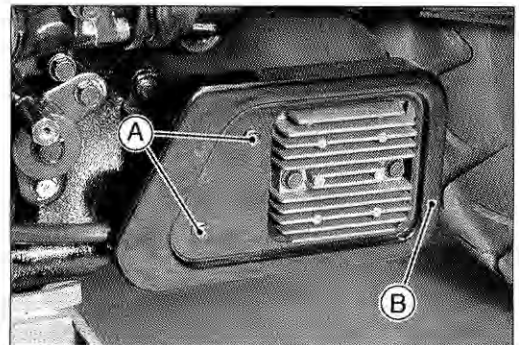
- ★ If there is more resistance than shown in the table, or no hand tester reading (infinity), the stator has an open wire and must be replaced. Much less than this resistance means the stator is shorted, and must be replaced.
- Using the highest resistance range of the hand tester, measure the resistance between each of the yellow wires and chassis ground.
- ★ Any hand tester reading less than infinity (∞) indicates a short, necessitating stator replacement.
- ★ If the stator coil has normal resistance, but the voltage check showed the alternator to be defective, then the rotor magnets have probably weakened, and the rotor must be replaced.
- Repeat the test for the other yellow wires.

Regulator/Rectifier Removal

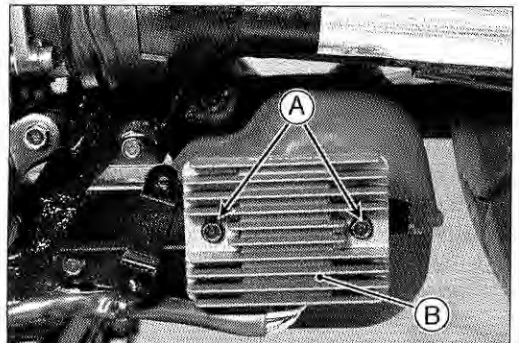
- Remove the alternator outer cover (see this chapter).
- Disconnect the regulator/rectifier connectors [A] and bands [B].



- Remove the cover bolts [A] and take off the regulator/rectifier cover [B].



- Remove the regulator/rectifier bolts [A] and take off the regulator/rectifier [B].



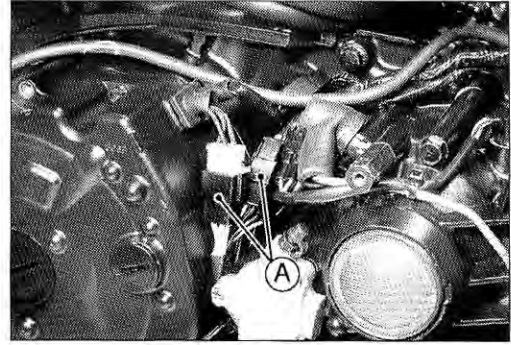
Charging System

Regulator/Rectifier Inspection

- Remove the alternator outer cover (see this chapter).
- Disconnect the regulator/rectifier connector(s) [A].
- Set the hand tester to the $\times 1 \text{ k}\Omega$ range and make the measurements shown in the table.

Special Tool - Hand Tester: 57001-1394

- Connect the hand tester to the regulator/rectifier.
- ★ If the tester readings are not as specified, replace the regulator/rectifier.



CAUTION

Use only Kawasaki Hand Tester 57001-1394 for this test. A tester other than the Kawasaki Hand Tester may show different readings.
If a megger or a meter with a large-capacity battery is used, the regulator/rectifier will be damaged.

Regulator/Rectifier Internal Resistance

Unit: $\text{k}\Omega$

		Tester (+) Lead Connection								
(-)*	Terminal	BR	W/R1	W/R2	Y1	Y2	Y3	Y4 (AS, US)	BK1	BK2
	BR	—	∞	∞	∞	∞	∞	∞	∞	∞
	W/R1	∞	—	0	∞	∞	∞	∞	∞	∞
	W/R2	∞	0	—	∞	∞	∞	∞	∞	∞
	Y1	∞	2 ~ 20	2 ~ 20	—	∞	∞	0	∞	∞
	Y2	∞	2 ~ 20	2 ~ 20	∞	—	∞	∞	∞	∞
	Y3	∞	2 ~ 20	2 ~ 20	∞	∞	—	∞	∞	∞
	Y4 (AS, US)	∞	2 ~ 20	2 ~ 20	0	∞	∞	—	∞	∞
	BK1	1 ~ 20	5 ~ 100	5 ~ 100	2 ~ 20	2 ~ 20	2 ~ 20	2 ~ 20	—	0
	BK2	1 ~ 20	5 ~ 100	5 ~ 100	2 ~ 20	2 ~ 20	2 ~ 20	2 ~ 20	0	—

(-)*: Tester (-) Lead Connection

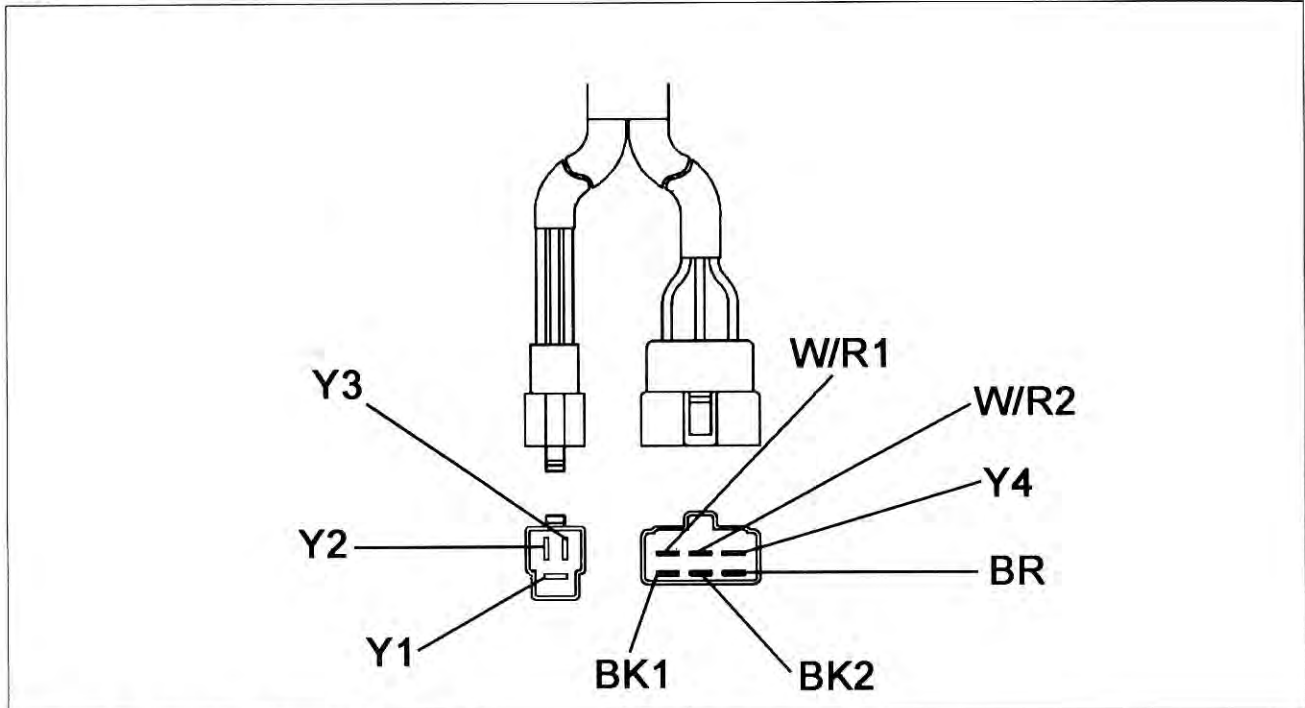
AS: Australian Model

US: United States Model

15-32 ELECTRICAL SYSTEM

Charging System

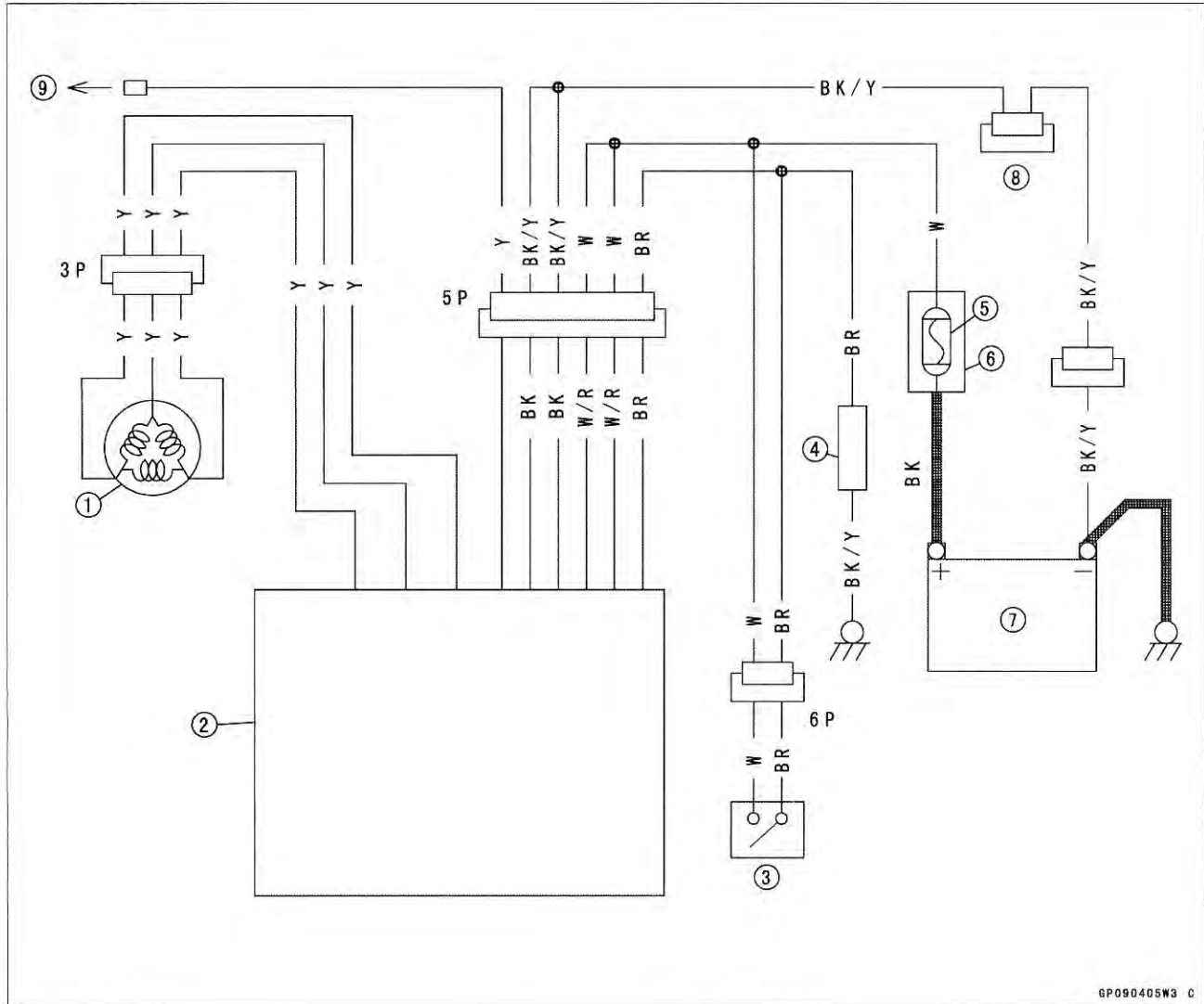
Regulator/Rectifier Connectors



Female Snap-on Terminal (AS, US) [A]

Charging System

Charging System



1. Alternator
2. Regulator/Rectifier
3. Ignition Switch
4. Load
5. Main Fuse 30 A
6. Starter Relay
7. MF Battery
8. Joint Connector
9. Headlight Relay in Junction Box (AS, US)

Ignition System

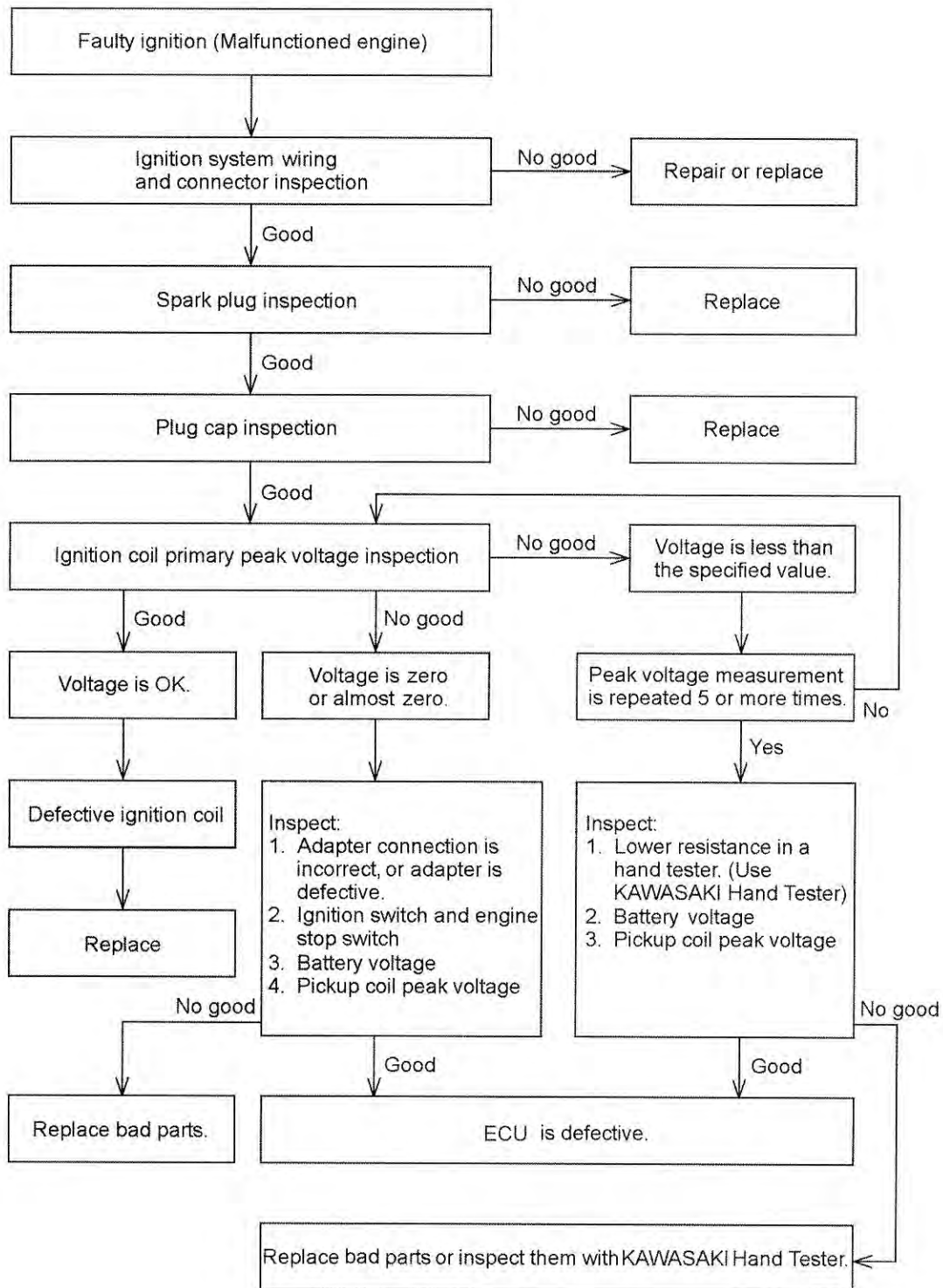
GP100404W4 C

#2: For Rear Cylinder

- | | | |
|------------------------------|---------------------------|----------------------------|
| 1. Ignition Switch | 8. Junction Box | 15. Pickup Coil #2 |
| 2. Engine Stop Switch | 9. Ignition Fuse 10 A | 16. Pickup Coil #1 |
| 3. Starter Button | 10. Throttle Sensor (DFI) | 17. Neutral Switch |
| 4. Spark Plugs | 11. Main Fuse 30 A | 18. Starter Lockout Switch |
| 5. Ignition Coil #1 | 12. MF Battery | 19. Sidestand Switch |
| 6. Ignition Coil #2 | 13. Joint Connector | 20. Interlock Diodes |
| 7. Vehicle-down Sensor (DFI) | 14. ECU (DFI) | 21. Starter Circuit Relay |

Ignition System

Ignition System Troubleshooting



15-36 ELECTRICAL SYSTEM

Ignition System

⚠ WARNING

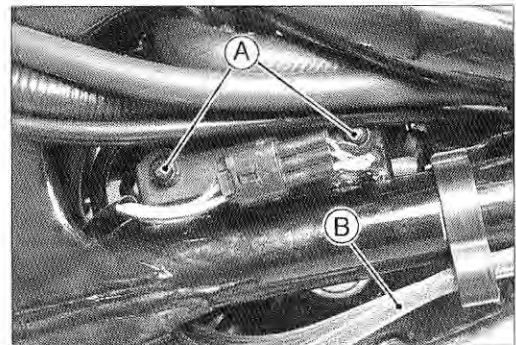
The ignition system produces extremely high voltage. Do not touch the spark plugs, ignition coils, or spark plug wires while the engine is running, or you could receive a severe electrical shock.

CAUTION

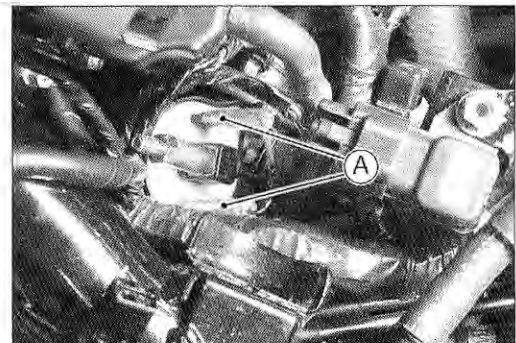
Do not disconnect the battery wires or any other electrical connections when the ignition switch is on, or while the engine is running. This is to prevent IC igniter damage in the DFI. Do not install the battery backwards. The negative side is grounded. This is to prevent damage to the IC igniter in the DFI and the diodes.

Ignition Coil Removal

- Remove the fuel tank (see Fuel System chapter).
- Remove the mounting nuts [A].
- Pull off the high-tension cables [B] from the spark plugs.



- Disconnect the primary wires [A].

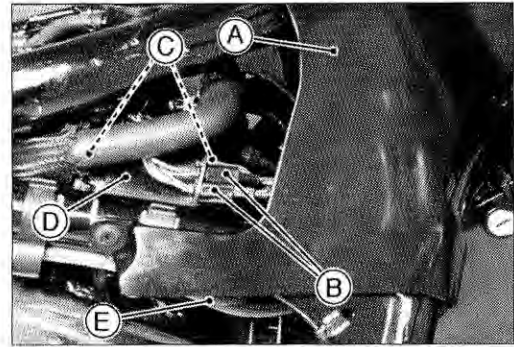


- Take out the #1 ignition coil [A] as shown.



Ignition System

- Remove the cover [A].
- Disconnect the fan motor and rear brake switch connectors [B].
- Remove the mounting nuts [C].
- Take out the #2 ignition coil [D].
- Disconnect the primary wires.
- Pull out the high-tension cables [E] from the spark plugs.



Ignition Coil Installation

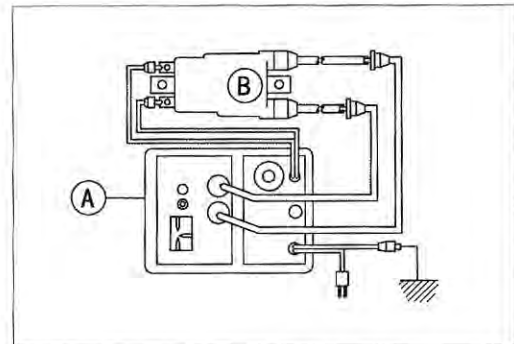
- Connect the primary wires to the ignition coil terminals and run the high-tension cables according to the Cable, Wire, and Hose Routing section in the General Information chapter.

Ignition Coil Inspection

- Remove the ignition coils (see this chapter).
- Measure the arcing distance with a commercially available coil tester [A] to check the condition of the ignition coil [B].
- Connect the ignition coil (with the spark plug cap left attached at the end of the spark plug terminal) to the tester in the manner prescribed by the manufacturer and measure the arcing distance.

Ignition Coil Arcing Distance

Standard: 6 mm or more



⚠ WARNING

To avoid extremely high voltage shocks, do not touch the coil body or wires.

- ★ If the distance reading is less than the specified value, the ignition coil or spark plug caps are defective.
- To determine which part is defective, measure the arcing distance again with the spark plug caps removed from the ignition coil. Remove the caps by turning them counterclockwise.
- ★ 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 cap.
- ★ If the coil tester is not available, the coil can be checked for a broken or badly shorted winding with the hand tester (special tool).

Special Tool - Hand Tester: 57001-1394

NOTE

- The hand tester cannot detect layer shorts and shorts resulting from insulation breakdown under high voltage.

15-38 ELECTRICAL SYSTEM

Ignition System

- Measure the primary winding resistance as follows.
 - Connect the hand tester between the coil terminals.
 - Set the tester to the $\times 1 \Omega$ range, and read the tester.
 - Measure the secondary winding resistance as follows.
 - Remove the plug caps by turning them counterclockwise.
 - Connect the tester between the spark plug wires.
 - Set the tester to the $\times 1 \text{ k}\Omega$ range and read the tester.
- Measure primary winding resistance [A].
Measure secondary winding resistance [B].
Ignition Coil [C]

Ignition Coil Winding Resistance

Primary Windings: $1.9 \sim 2.9 \Omega (\times 1 \Omega)$
Secondary Windings: $18 \sim 28 \text{ k}\Omega (\times 1 \text{ k}\Omega)$

- ★ If the tester does not read as specified, replace the coil.
- To install the plug cap, turn it clockwise.

Spark Plug Removal

- Remove the spark plug caps.
- Remove the spark plugs using the 18 mm plug wrench.

Special Tool - Spark Plug Wrench, Hex 18: 57001-1024

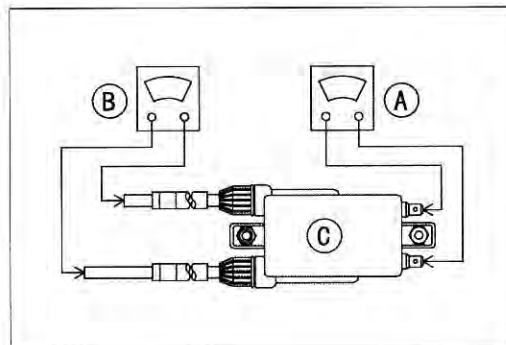
Spark Plug Installation

- Insert the spark plug vertically into the plug hole with the plug installed in the plug wrench (special tool) [A].
- Tighten the plugs.

Special Tool - Spark Plug Wrench, Hex 18: 57001-1024

Torque - Spark Plugs: 18 N·m (1.8 kg·m, 13.0 ft·lb)

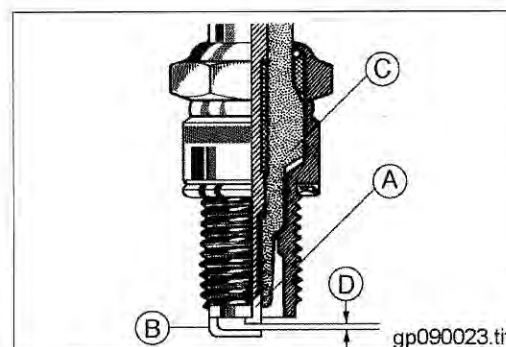
- Fit the plug caps securely.



Spark Plug Cleaning/Inspection

- Clean the spark plug, preferably in a sandblasting device, and then clean off any abrasive particles. The plug may also be cleaned using a high-flash point solvent and a wire brush or other tool.
- ★ If the spark plug center electrode [A] and/or side electrode [B] are corrected or damaged, or if the insulator [C] is cracked, replace the plug.
- Use the standard spark plug or its equivalent.
- Measure the gap [D] with a wire-type thickness gauge.
- ★ If the gap is incorrect, carefully bend the side electrode with a tool to obtain the correct gap.

Spark Plug Gap: $0.8 \sim 0.9 \text{ mm}$



Ignition Coil Primary Peak Voltage

NOTE

- Be sure the battery is fully charged.
- Remove the fuel tank (see Fuel System chapter).
- Remove all the spark plug caps but do not remove the spark plugs.
- Install new spark plugs into all the spark plug caps, and ground them onto the engine.

Ignition System

- Install a commercially available peak voltage adapter [A] into the hand tester [B].
- Connect the adapter between the ignition coil primary wire terminal and the engine ground with the primary wire left connected.

Recommended Tool: Peak Voltage Adapter

Type: KEK-54-9-B
Brand: KOWA SEIKI

- Raise the main harness and coolant hose, and insert the adapter probe into the terminal of the primary wire [C].
ECU [D]
Battery [E]
Ignition Coil [F]
New Spark Plugs [G]

Special Tool - Hand Tester: 57001-1394

Hand Tester Range: × DC 250 V

Primary Lead Connections:

	Adapter (R, +)		Adapter (BK, -)
Front Ignition Coil:	BK	↔	Ground
Rear Ignition Coil:	BK/G	↔	Ground

⚠ WARNING

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

- Turn the ignition switch and the engine stop switch ON.
- Pushing the starter button, turn the engine 4 ~ 5 seconds with the transmission in neutral to measure the primary peak voltage.
- Repeat the measurements 5 or more times for one ignition coil.

Ignition Coil Primary Peak Voltage

Standard:

Front: 129 V or more
Rear: 122 V or more

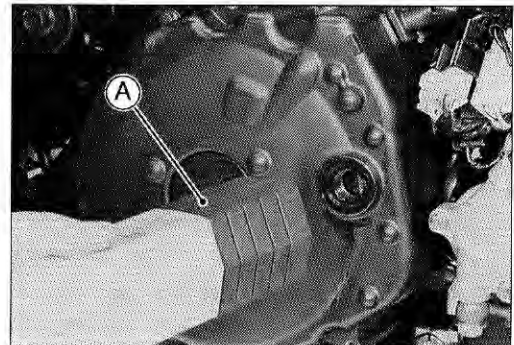
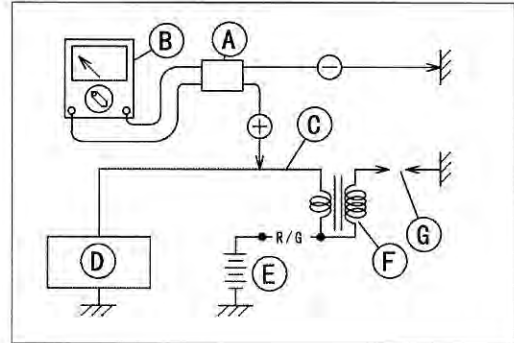
- Repeat the test for the other ignition coil.
- ★ If the reading is less than the specified value, check the following:
Ignition Coils (see Ignition Coil Inspection)
Pickup Coils (see Pickup Coil Inspection)
- ★ If the ignition coils, and pickup coils are normal, check the ECU (see Fuel System chapter).

Ignition Timing Inspection

- Remove the timing inspection plug.
- Attach the timing light [A] to the front ignition coil wire [B] in the manner prescribed by the manufacturer.

Special Tool - Timing Light: 57001-1241

- Start the engine and aim the timing light at the ignition timing mark on the alternator rotor.
- Run the engine at the speeds specified and note the alignment of the ignition timing marks.



15-40 ELECTRICAL SYSTEM

Ignition System

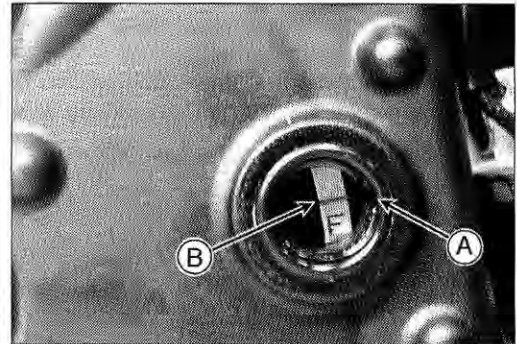
Ignition Timing

Engine speed r/min (rpm)	Hole notch [A] aligns with:
950	F or R mark [B] on alternator rotor

F Mark: For front cylinder

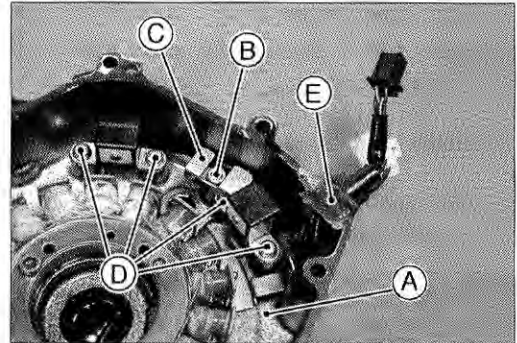
R Mark: For rear cylinder

- Repeat the test for the rear cylinder, using the rear ignition coil wire.
- ★ If the ignition timing is incorrect, check the pickup coils (see Pickup Coil Inspection).
- ★ If the pickup coils are normal, check the ECU (see Fuel System chapter).



Pickup Coil Removal

- Remove the alternator cover [A] (see this chapter).
- Unscrew the holder bolt [B] and take off the wire holder [C].
- Unscrew the screws and take off the pickup coils [D] with the grommet [E].



Pickup Coil Installation

- Refer to Alternator Stator Installation in this chapter.

Pickup Coil Inspection

- Remove the alternator outer cover (see this chapter).
- Remove all the spark plug caps but do not remove the spark plugs.
- Disconnect the pickup coil wire connector.
- Connect a commercially available peak voltage adapter [A] to the hand tester [B].

Recommended Tool: Peak Voltage Adapter

Type: KEK-54-9-B

Brand: KOWA SEIKI

- Insert the adapter probes into the connector [C] of the pickup coil [D] as shown.

Special Tool - Hand Tester: 57001-1394

Connections:

	Adapter (R, +)		Adapter (BK, -)
Front Pickup Coil:	BK/Y	↔	BK
Rear Pickup Coil:	BK/R	↔	BK/W

NOTE

- Be sure the battery is fully charged.

Hand Tester Range: × DC 10 V

- Turn the ignition switch and the engine stop switch ON.
- Pushing the starter button, turn the engine 4 ~ 5 seconds with the transmission in neutral to measure the pickup coil peak voltage.
- Repeat the measurements 5 or more times for one pickup coil.
- Repeat the test for the other pickup coil.

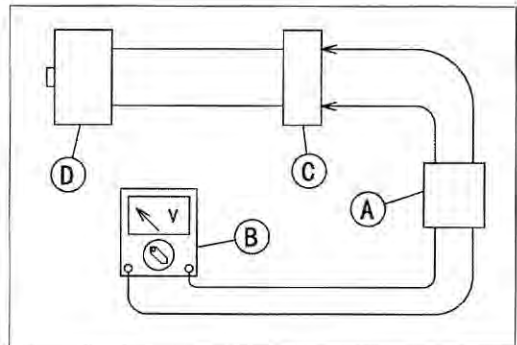
Pickup Coil Peak Voltage

Standard:

Front: 2.2 V or more

Rear: 2.0 V or more

- ★ If the reading is less than the specified value, replace the pickup coil.



Ignition System

- ★ If the reading is normal, check the ECU (see Fuel System chapter).
- ★ If the peak voltage adapter is not available, the coil can be checked for a broken or badly shorted winding with the hand tester (special tool).

NOTE

- Using the peak voltage adapter is a more reliable way to determine the condition of the pickup coil than pickup coil internal resistance measurements.
- Disconnect the pickup coil wire connector [A].

- Set the hand tester [A] to the $\times 100 \Omega$ range and wire it to the pickup coil wire connector [B].

Connections:

Tester Connections			
Front Pickup Coil:	BK/Y	↔	BK
Rear Pickup Coil:	BK/R	↔	BK/W

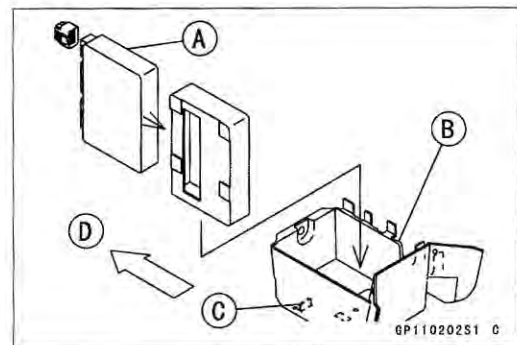
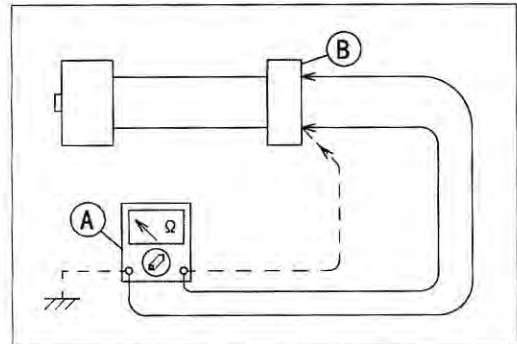
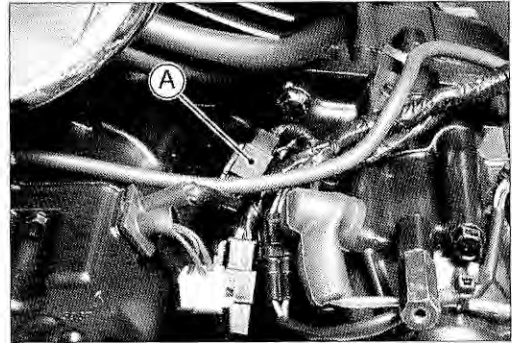
- ★ If there is more resistance than the specified value, the coil has an open wire and must be replaced. Much less than this resistance means the coil is shorted, and must be replaced.

Pickup Coil Resistance: $380 \sim 560 \Omega$

- Using the highest resistance range of the tester, measure the resistance between the pickup coil wires and chassis ground.
- ★ Any tester reading less than infinity (∞) indicates a short, necessitating replacement of the pickup coil assy.

IC Igniter Inspection

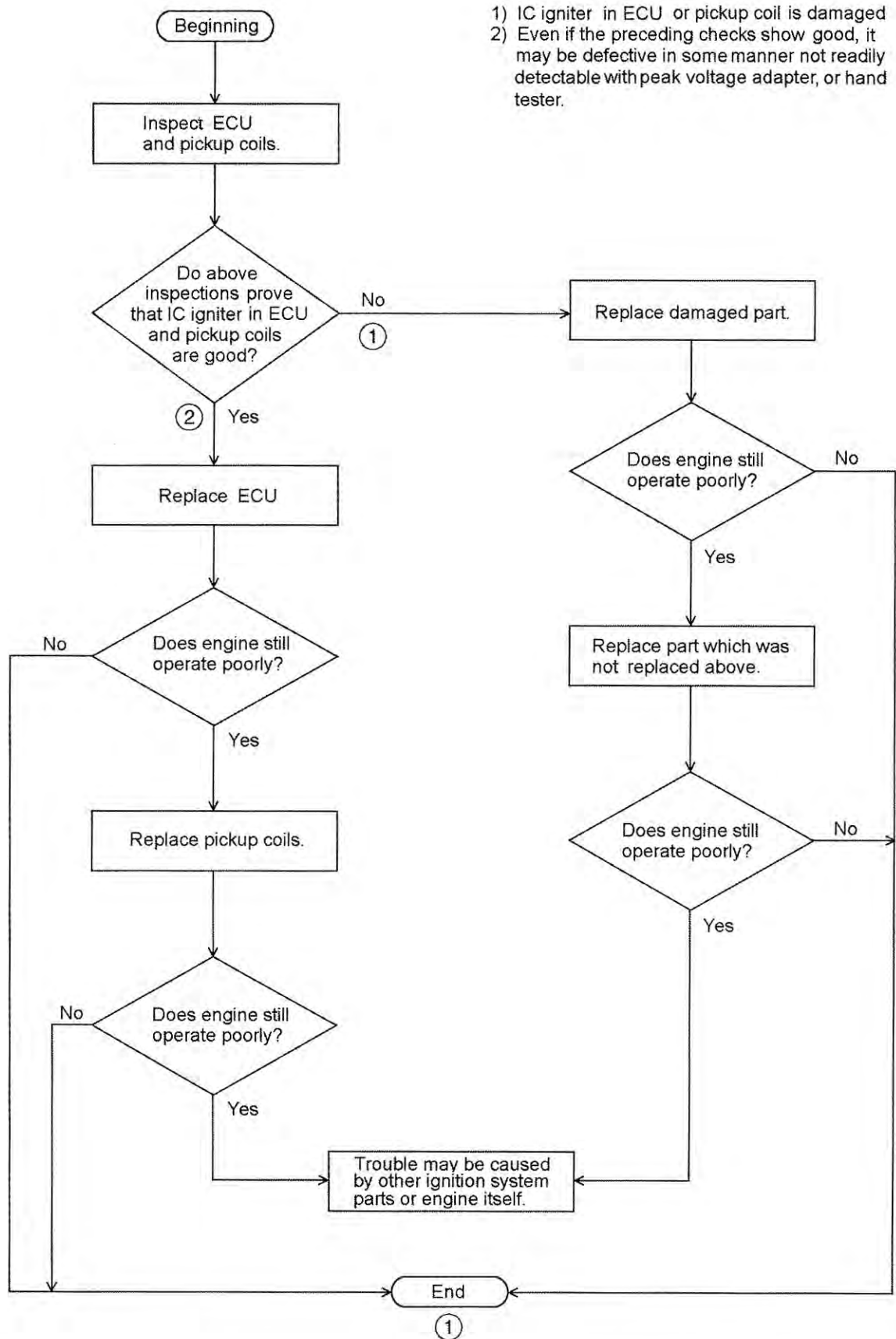
- The IC igniter is built in the ECU [A].
 - Battery Case [B]
 - Rib [C]
 - Front [D]
- Refer to Fuel System chapter for ECU Inspection.



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Ignition System

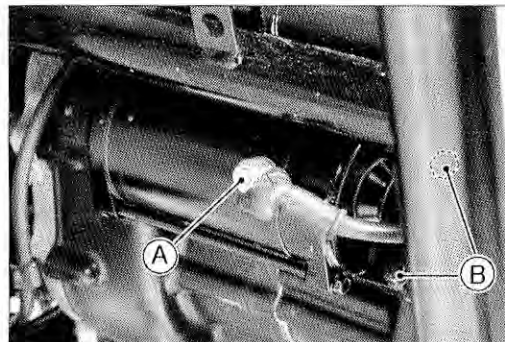
IC Igniter in ECU Troubleshooting



Starter Motor

Removal

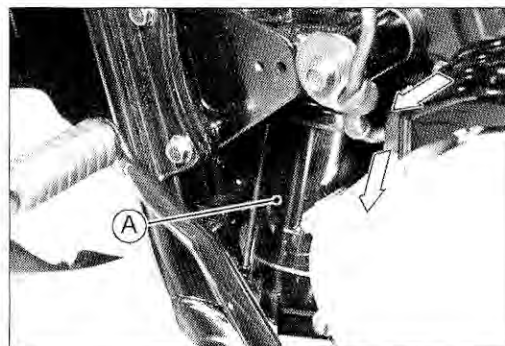
- Remove:
 - Starter Motor Terminal Nut and Wire [A]
 - Starter Motor Bolts [B]



- Pull the starter motor [A] toward the left and remove it.

CAUTION

Never drop the starter motor, especial on a hard surface. Such a shock to the motor can damage it.

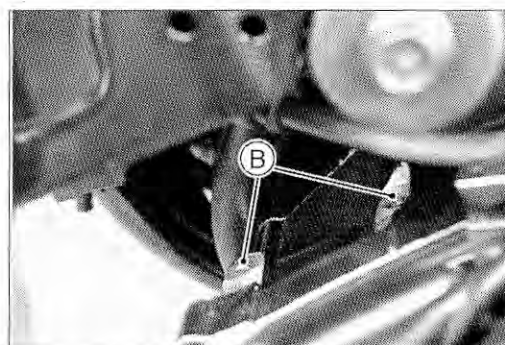
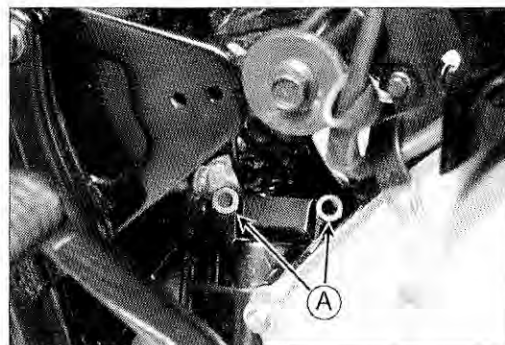


Installation

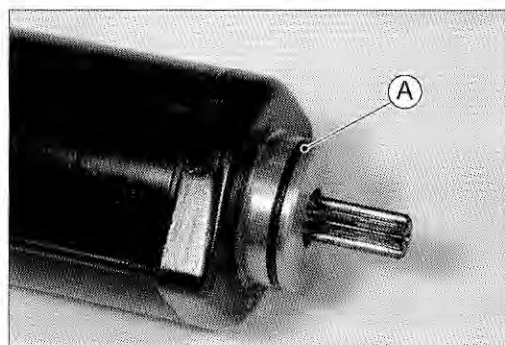
CAUTION

Do not tap the starter motor shaft or body. Tapping the shaft or body could damage the motor.

- When installing the starter motor, clean the starter motor legs [A] and crankcase [B] where the starter motor is grounded.



- Replace the O-ring [A] with a new one.
 - Apply a small amount of engine oil to the O-ring.
- Torque - Starter Motor Mounting Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)**
Starter Motor Terminal Nut: 4.9 N·m (0.50 kg·m, 43 in·lb)

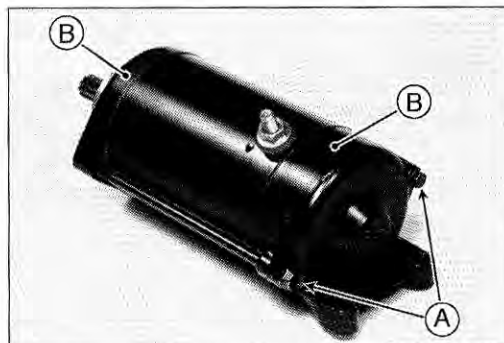


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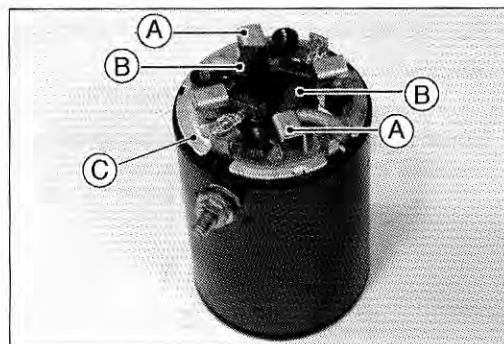
Starter Motor

Disassembly

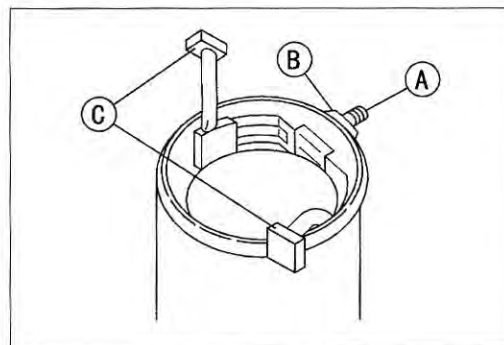
- Remove the starter motor (see this section).
- Take off the starter motor assy bolts [A] and remove both end covers [B] and pull the armature out of the yoke.



- Take the positive carbon brushes [B] out of the brush holders [A].
- Take off the brush plate [C] with brush wire from the yoke.

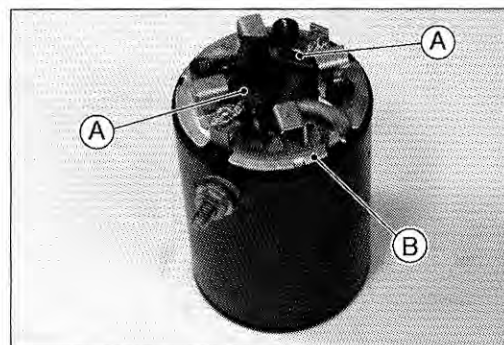


- Unscrew the terminal locknut [B] and remove the terminal bolt [A].
- Take the positive carbon brushes and wire assy [C] out of the yoke.



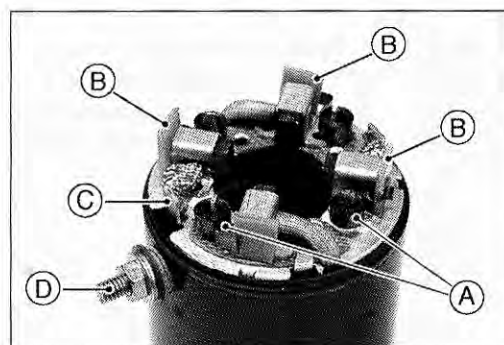
NOTE

- Do not remove the negative carbon brushes [A] from the brush plate [B].



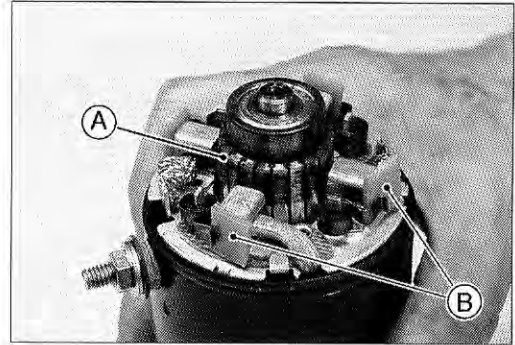
Assembly

- Holding the springs [A] with plastic washers [B], insert the brushes.
- Fit the brush wire into the holder groove.
- Align the tang [C] with the terminal bolt [D].

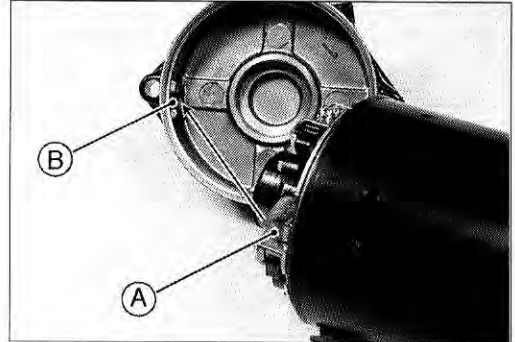


Starter Motor

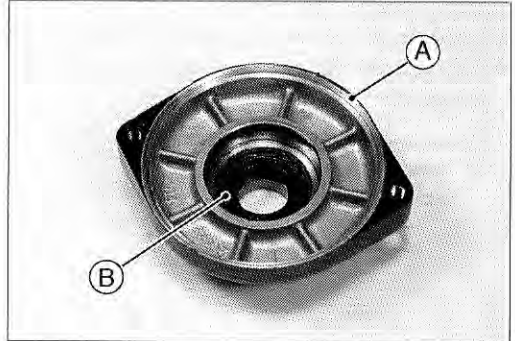
- Put the armature [A] among the brushes, and remove the plastic washers [B].



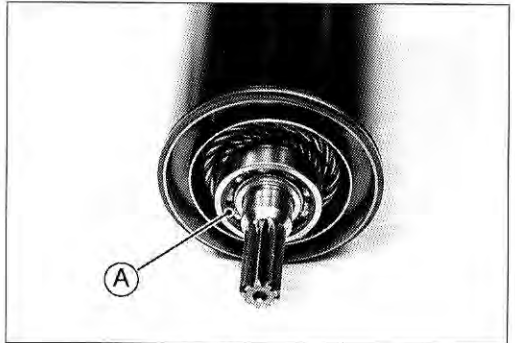
- Fit the tang [A] of the brush plate into the left end cover groove [B].



- Apply a thin coat of grease to the oil seal [B] in the right end cover [A].

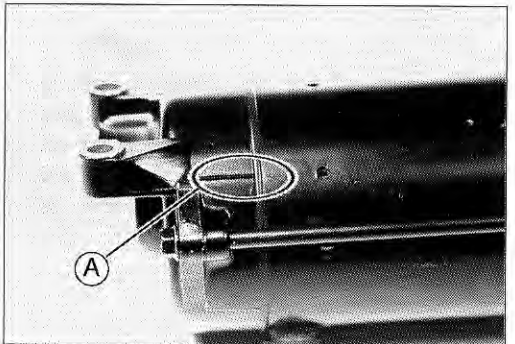


- Apply a thin coat of grease to the left bearing [A].
- Fit shims onto the right end cover.



- The line on the yoke should align [A] with the line on the left cover.

Torque - Starter Motor Assy Bolts: 4.9 N·m (0.50 kg·m, 43 in·lb)



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Starter Motor

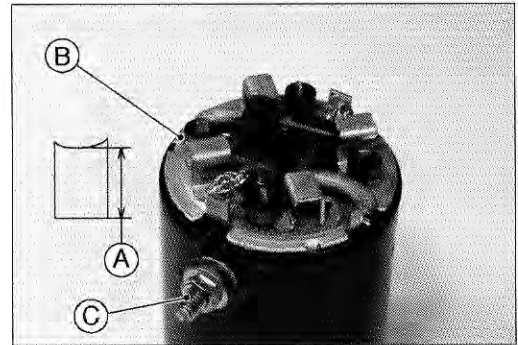
Brush Inspection

- Measure the length [A] of each brush.
- ★ If any is worn down to the service limit, replace the carbon brush holder assy [B] and the terminal bolt assy [C].

Starter Motor Brush Length

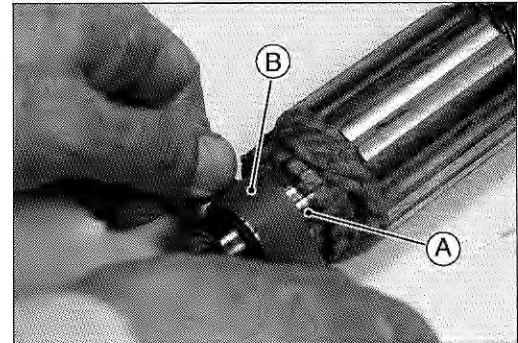
Standard: 12 mm

Service Limit: 8.5 mm



Commutator Cleaning and Inspection

- Smooth the commutator surface [A] if necessary with fine emery cloth [B], and clean out the grooves.

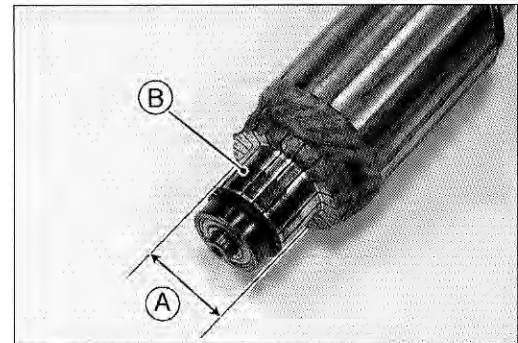


- Measure the diameter [A] of the commutator [B].
- ★ Replace the starter motor with a new one if the commutator diameter is less than the service limit.

Commutator Diameter

Standard: 28 mm

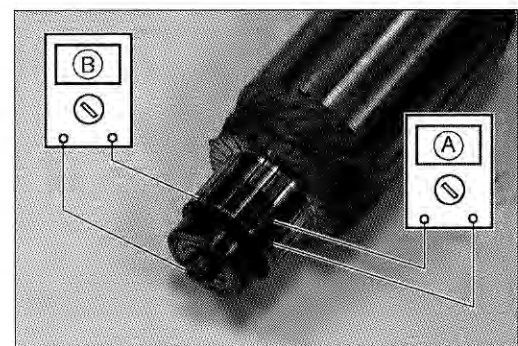
Service Limit: 27 mm



Armature Inspection

- Using the $\times 1 \Omega$ hand tester 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 hand tester range, measure the resistance between the segments and the shaft [B].
- ★ If there is any reading at all, the armature has a short and the starter motor must be replaced.

Special Tool - Hand Tester: 57001-1394



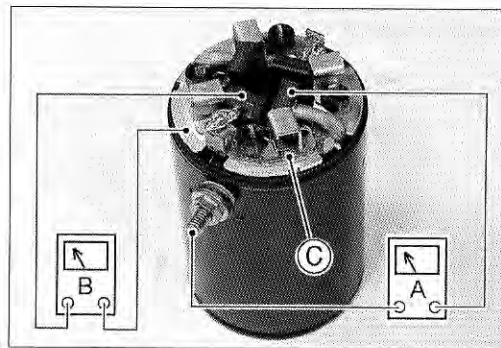
NOTE

- Even if the foregoing checks show the armature to be good, it may be defective in some manner not readily detectable with the hand tester. If all other starter motor components and starter motor circuit components check good, but the starter motor still does not turn over or only turns over weakly, replace the starter motor with a new one.

Starter Motor

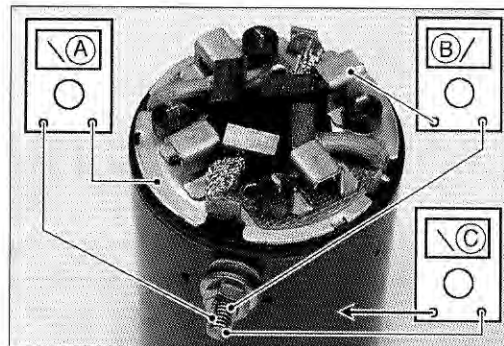
Brush Wire Inspection

- Using the $\times 1 \Omega$ hand tester range, measure the resistance as follows.
 - Terminal Bolt and Positive Brushes [A]
 - Brush Plate and Negative Brushes [B]
 - Plastic [C]
- The reading should be zero.
- ★ If there is not close to zero ohms, the brush lead has an open. Replace the terminal bolt assembly and the brush holder assembly.



Brush Plate and Terminal Bolt Inspection

- Using the highest hand tester range, measure the resistance as shown.
 - Terminal Bolt and Brush Plate [A]
 - Terminal Bolt and Negative Brush Holders [B]
 - Terminal Bolt and Yoke [C]
- The reading should be infinite ($\infty \Omega$).
- ★ If there is any reading, the brush holder assembly and/or terminal bolt assembly have a short. Replace the brush holder assembly and the terminal bolt assembly.



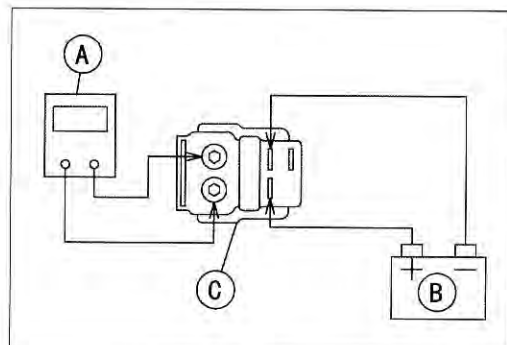
Starter Relay Inspection

- Remove the right side covers (see Frame chapter).
- Remove the coolant reserve tank, then the starter relay.
- Connect the hand tester [A] and 12 V battery [B] to the starter relay [C] as shown.
- ★ If the relay does not work as specified, the relay is defective. Replace the relay.

Testing Relay

Tester Range: $\times 1 \Omega$ range

Criteria: When battery is connected $\rightarrow 0 \Omega$
 When battery is disconnected $\rightarrow \infty \Omega$



Starter Motor

The diagram illustrates the electrical system for a vehicle, featuring the following components and connections:

- 1:** Battery (12V) with positive (+) and negative (-) terminals.
- 2:** Starter solenoid (relay) with terminals for power and ground.
- 3:** Ignition switch with positions for OFF, ON, and accessory.
- 4:** Horn relay with a coil and contacts.
- 5:** Horn (buzzer).
- 6:** Relay (likely for the wiper or another accessory).
- 7:** Relay (likely for the wiper or another accessory).
- 8:** Ground connection.
- 9:** Alternator (generator) with a field winding and output terminal.
- 10:** Starter motor.
- 11:** Relay (likely for the wiper or another accessory).
- 12:** Battery (12V) with positive (+) and negative (-) terminals.
- 13:** Relay (likely for the wiper or another accessory).

Wire color codes and labels include: BR (Brown), W (White), Y/R (Yellow/Red), BK/R (Black/Red), Y/G (Yellow/Green), Y/R (Yellow/Red), BK/Y (Black/Yellow), BK (Black), LG (Light Green), and BK/Y (Black/Yellow).

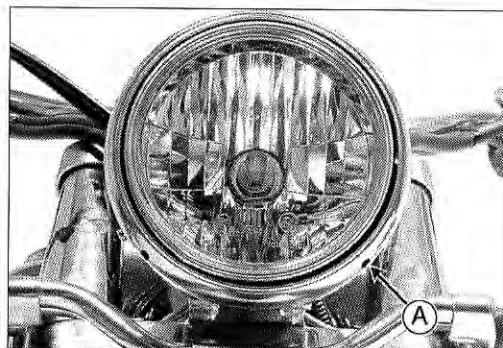
- | | | |
|-----------------------|---------------------------|---------------------|
| 1. Ignition Switch | 5. Starter Circuit Relay | 9. Starter Motor |
| 2. Engine Stop Switch | 6. Ignition Fuse 10 A | 10. Starter Relay |
| 3. Starter Button | 7. Starter Lockout Switch | 11. Main Fuse 30 A |
| 4. Junction Box | 8. Neutral Switch | 12. MF Battery |
| | | 13. Joint Connector |

Lighting System

US, Canada, and Australia models have a full-time headlight system with a headlight relay in the junction box. In these models, the headlight does not go on when the ignition switch and the engine stop switch are first turned on. The headlight comes on when the engine starts running and stays on even if the engine stalls. The headlight goes out when the ignition switch is turned off. It also goes out while the starter button is depressed.

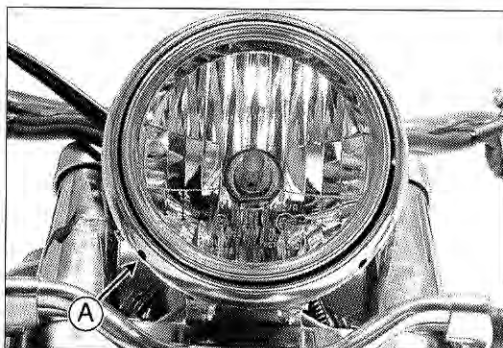
Headlight Beam Horizontal Adjustment

- Turn the horizontal adjuster [A] on the headlight with a screwdriver in or out until the beam points straight ahead.
- Turn the adjuster clockwise to face the headlight to the left.



Headlight Beam Vertical Adjustment

- Turn the vertical adjuster [A] in the headlight in or out with a screwdriver to adjust the headlight vertically.
- Turn the adjuster clockwise to face the headlight up.



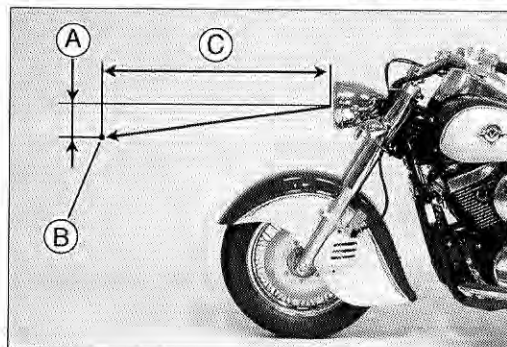
NOTE

- ON high beam, the brightest points should be slightly below horizontal with the motorcycle on its wheels and the rider seated. Adjust the headlight to the proper angle according to local regulations.
- For US model, the proper angle is 0.4 degrees below horizontal. This is 50 mm (2 in.) drop at 7.6 m (25 ft.) measured from the center of the headlight with the motorcycle on its wheels and the rider seated.

50 mm (2 in.) [A]

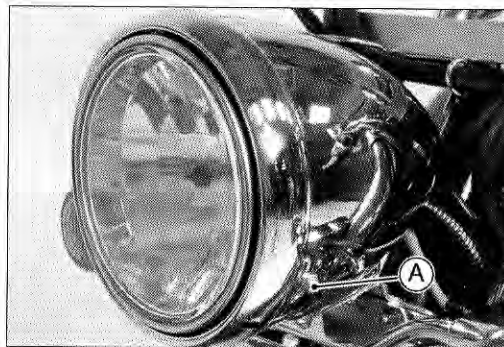
Center of Brightest Spot [B]

7.6 m (25 ft.) [C]



Headlight Bulb Replacement

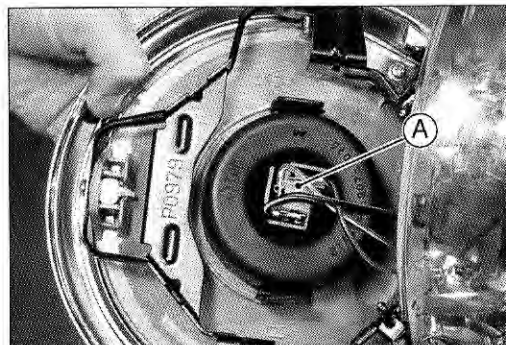
- Remove the headlight rim screws [A] on both sides.



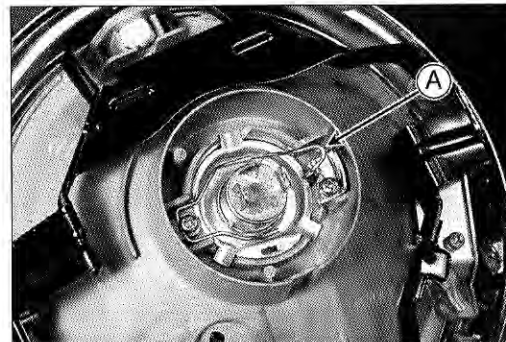
15-50 ELECTRICAL SYSTEM

Lighting System

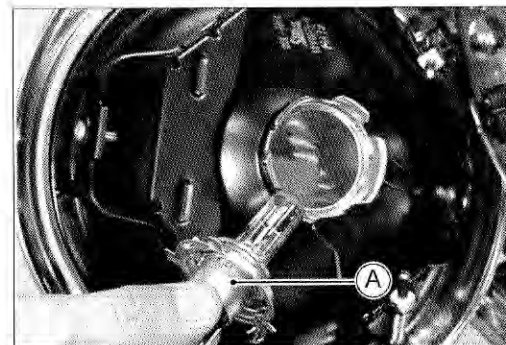
- Pull the headlight unit and drop it out.
- Pull the headlight connector [A].
- Remove the headlight dust cover [B].



- Push the hook [A] to unlock.



- Take out the bulb [A].



CAUTION

When handling the quartz-halogen bulb, never touch the glass portion with bare hands. Always use a clean cloth. Oil contamination from hands or dirty rags can reduce bulb life or cause the bulb to explode.

- Clean off any contamination that inadvertently gets on the bulb with alcohol or a soap and water solution.

- Replace the headlight bulb.
- Fit the dust cover [A] with the TOP mark [B] upward onto the bulb [C] firmly as shown.

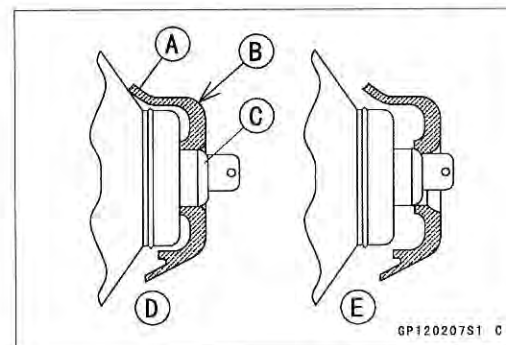
Good [D]

Bad [E]

- Tighten:

Torque - Headlight Rim Screws: 1.0 N·m (0.10 kg·m, 9 in·lb)

- After installation, adjust the headlight aim (see this chapter).



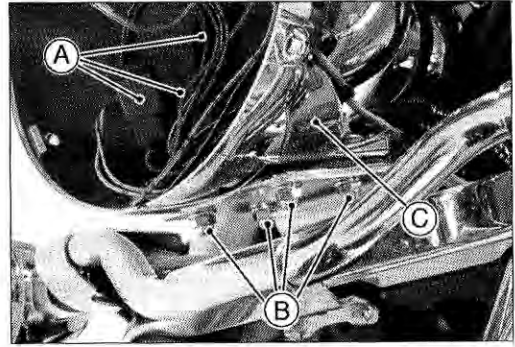
Headlight Body Removal

- Remove the headlight rim screws [A].
- Pull the headlight unit and drop it out.



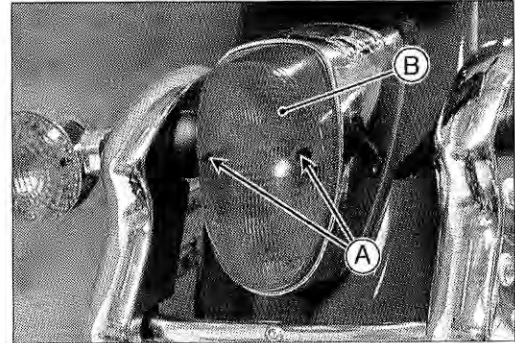
Lighting System

- Disconnect the wiring connectors [A].
- Remove the headlight body nuts [B], then take off the body [C].

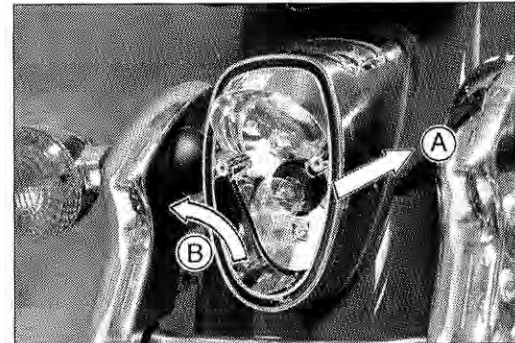


Tail/Brake Light Bulb Replacement

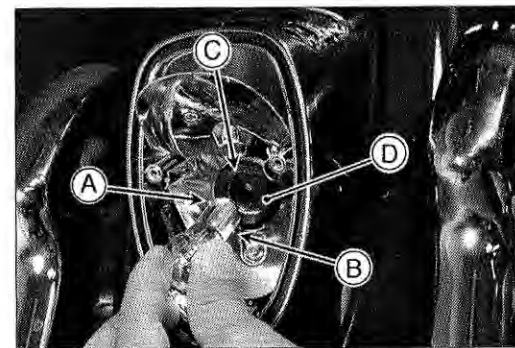
- Take out the screws [A] in the taillight lens.
- Pull the lens [B] off.



- Push the bulb in [A], turn it counterclockwise [B], and pull it out.
- Replace the bulb with a new one.



- With the front pin [A] up and the rear pin [B] down, insert the new bulb by aligning the front pin with the left groove [C] in the walls of the socket [D].
- Push the bulb in, turn it clockwise, and release it. It should lock in position.
- Tighten the lens screws. Be careful not to overtighten them.



Lighting System

[illegible][illegible]

- Downloaded from www.vulcanriders.fi

Automatic Turn Signal Canceling System

15-54 ELECTRICAL SYSTEM

Automatic Turn Signal Canceling System

Wiring Inspection

- Connect all the connectors.
- Remove the right side cover (see Frame chapter).
- Remove the turn signal control unit [A].
 - Front [B]
- Pull off the 6-pin connector of the unit, the 20-pin meter connector under the meter unit, and the 9-pin left handlebar switch connector in the head light housing.
- Make sure all connector terminals are clean and tight, and none of them have been bent.
- Clean the dirty terminals, and straighten slightly-bent terminals.
- Check conductivity or voltage of the numbered terminals with the hand tester.
- The terminal numbers are shown in the wiring diagram of Turn Signal Canceling System.

Special Tool - Hand Tester: 57001-1394

Wiring Inspection

Connectors	Tester Connection	Tester Reading
Turn Signal Control Unit ↔ Distance Sensor	1 - 8 3 - 7	0 Ω
Turn Signal Control Unit ↔ Left Handlebar Switch	2 - 11 3 - 9 4 - 10	
Turn Signal Control Unit ↔ Battery	6 - Battery (+)	
		Battery Voltage with IG. SW. ON 0 V with IG.SW. OFF

IG. SW.: Ignition Switch

- ★ If any one of the hand tester readings shows an improper values, check the wiring and connections of the turn signal switch, distance sensor, and turn signal control unit. Check the turn signal control unit (see Turn Signal Control Unit Inspection) if all of them turn out good.

Distance Sensor Inspection

- Remove the right side cover (see this chapter).
- Remove the turn signal control unit [A].
- Do not disconnect the connector [B].
- Use the jack and the attachment jack to lift the rear wheel.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

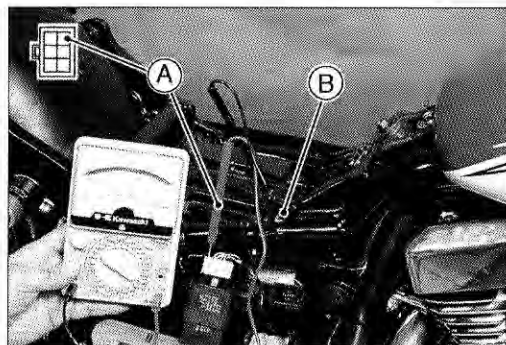
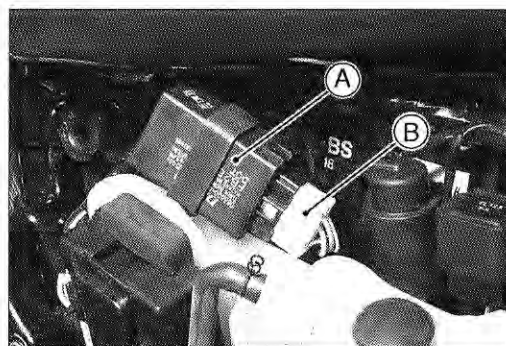
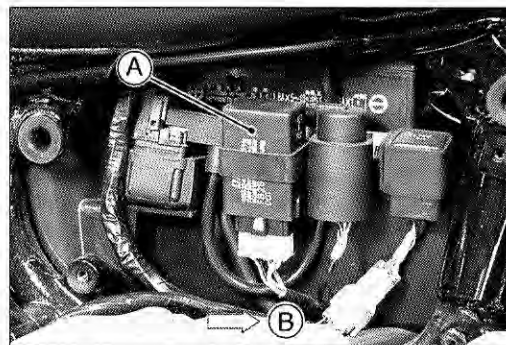
- Set the hand tester to the DC25 V range and connect it to the LB wire terminal [A] and battery (-) terminal as shown.

Connections

Hand Tester (+) → LB Wire Terminal

Hand Tester (-) → Battery (-) Terminal

- Turn the rear wheel slowly to see that the tester's pointer fluctuates repeated by reading 0.5 V and 12 V.
- ★ If the tester's pointer fluctuates, distance sensor is normal.
- ★ If the tester's pointer does not fluctuate, inspect the speed sensor and turn signal control unit. If the speed sensor and control unit are good, replace the meter unit.



Automatic Turn Signal Canceling System

Turn Signal Switch Inspection

- Open the headlight housing.
- Unplug the 9-pin connectors that leads to the left handlebar switch.
- Check the turn signal switch connections according to the table.
- ★ If the switch has an open circuit or a short, it can be disassembled for repair. The contact surfaces may be cleaned, but no internal parts are available for replacement.
- ★ If any parts are not repairable, the left handlebar switch must be replaced as a unit.

Turn Signal Switch Connections

Color	G	O	GY	BK/Y	Y/R
L (left)	●	●		●	●
OFF (push)					
R (right)		●	●	●	●

*Turn Signal Control Unit Inspection***CAUTION**

Never drop the turn signal control unit, especially on a hard surface. Such a shock to the unit can damage it.

- Remove the right side cover (see Frame chapter).
- Connect one 12 V battery and turn signal lights as indicated in the figure, and count how many times the lights flash for one minute.
Turn Signal Control Unit Connector [A]
Turn Signal Lights [B]
12 V Battery [C]
- ★ If the lights do not flash as specified, replace the turn signal control unit.

Testing Turn Signal Control Unit Inspection

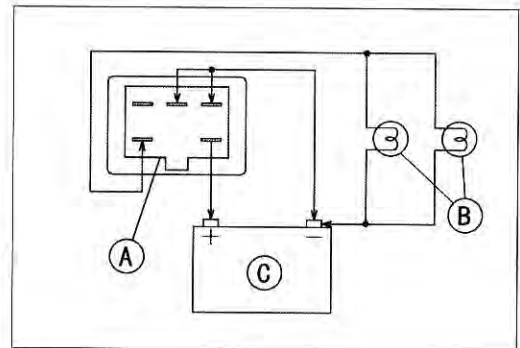
Load		Flashing Times (c/m*)
The Number of Turn Signal Lights	Wattage (W)	
1**	21 ~ 23	140 ~ 250
2	42 ~ 46	75 ~ 95

(*): Cycle(s) per minute

(**): corresponds to "one light burned out, and the other lights stay ON".

NOTE

- Even if the foregoing checks show the turn signal control unit to be good, it may be defective in some manner especially for automatic turn signal canceling operation not readily detectable with above checks. If all other checks are good, replace the turn signal control unit.

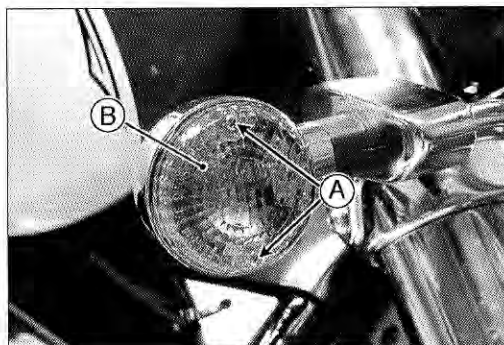


15-56 ELECTRICAL SYSTEM

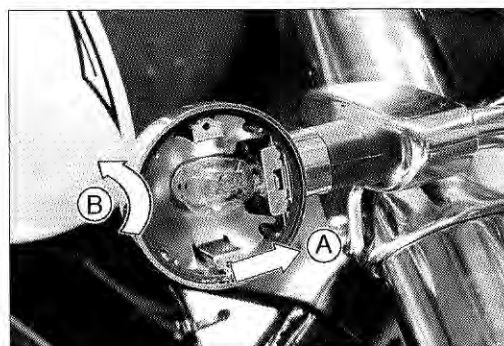
Automatic Turn Signal Canceling System

Turn Signal Light Bulb Replacement

- Remove the turn signal light lens screws [A] and take off the lens [B].

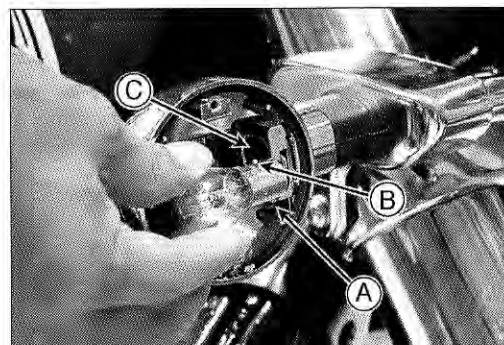


- Push the bulb [A] in the socket and turn the bulb counterclockwise [B].
- Replace the bulb.



- With the front pin [A] up and the rear pin [B] down, insert the new bulb by aligning the rear pin with the groove in the walls of the socket [C].

Torque - Turn Signal Light Lens Screws: 1.0 N·m (0.10 kg·m, 9 in·lb)



Radiator Fan System

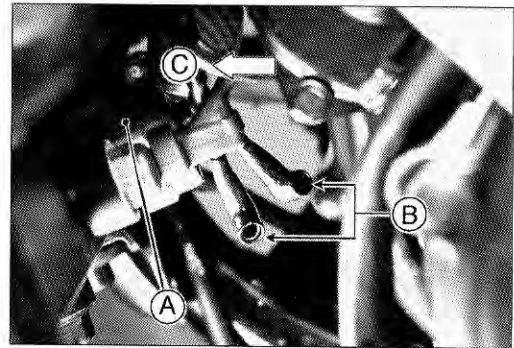
⚠ WARNING

The radiator fan is connected directly to the battery. The fan may start even if the ignition switch is off. **NEVER TOUCH THE RADIATOR FAN UNTIL THE RADIATOR FAN CONNECTOR IS DISCONNECTED.** TOUCHING THE FAN BEFORE THE CONNECTOR IS DISCONNECTED COULD CAUSE INJURY FROM THE FAN BLADES.

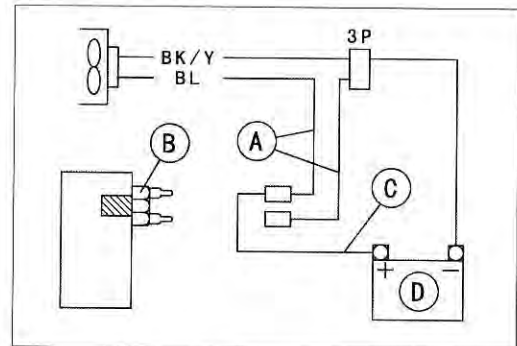
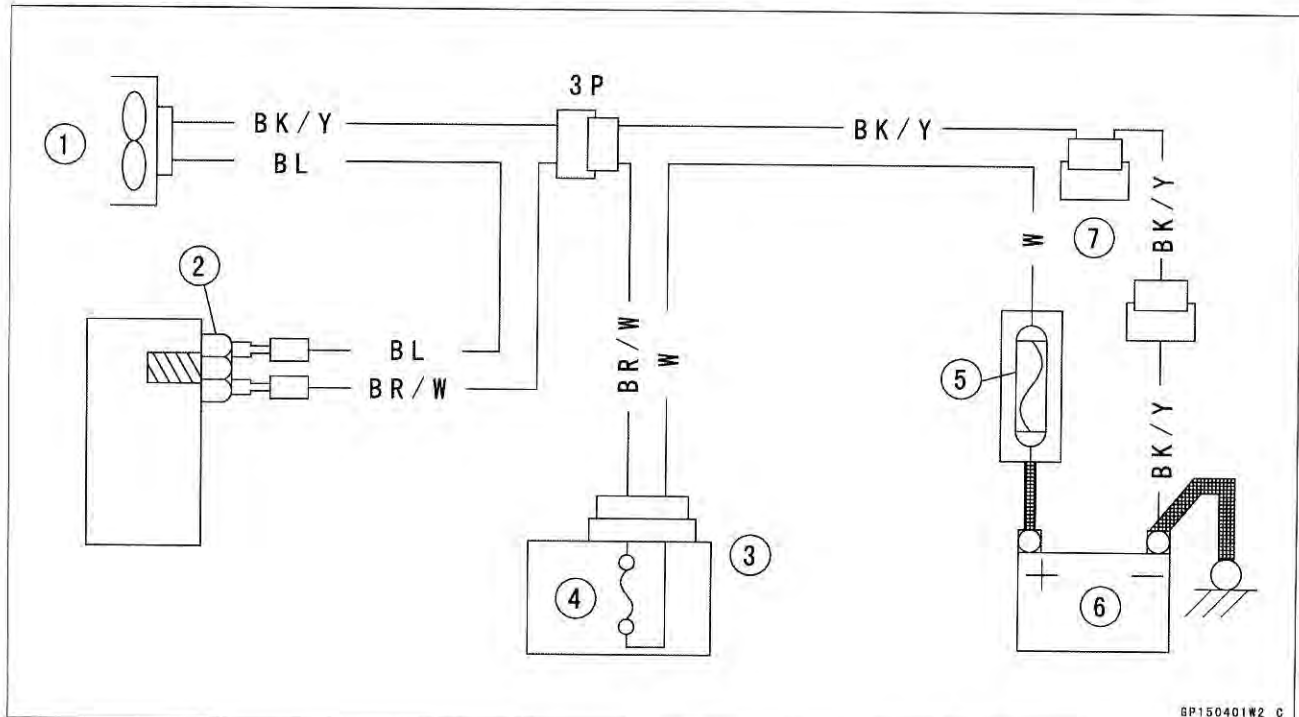
Fan System Circuit Inspection

- Disconnect the wires from the radiator fan switch [A].
- Using an auxiliary wire [B], connect the radiator fan switch wires.
- ★ If the fan rotates, inspect the fan switch.
- ★ If the fan does not rotate, inspect the following.

Wires and Connectors
Main Fuse and Fan Fuse
Fan Motor
Front View [C]

*Fan Motor Inspection*

- Remove the fuel tank (see Fuel System chapter).
 - Disconnect the wires [A] from the radiator fan switch [B].
 - Using an auxiliary wire [C], supply battery power to the fan motor.
 - ★ If the fan does not rotate, the fan motor is defective and must be replaced.
- Battery [D]

**Radiator Fan Circuit**

1. Radiator Fan
2. Radiator Fan Switch
3. Junction Box

4. Fan Fuse 10 A
5. Main Fuse 30 A

6. MF Battery 12 V 18 Ah
7. Joint Connector

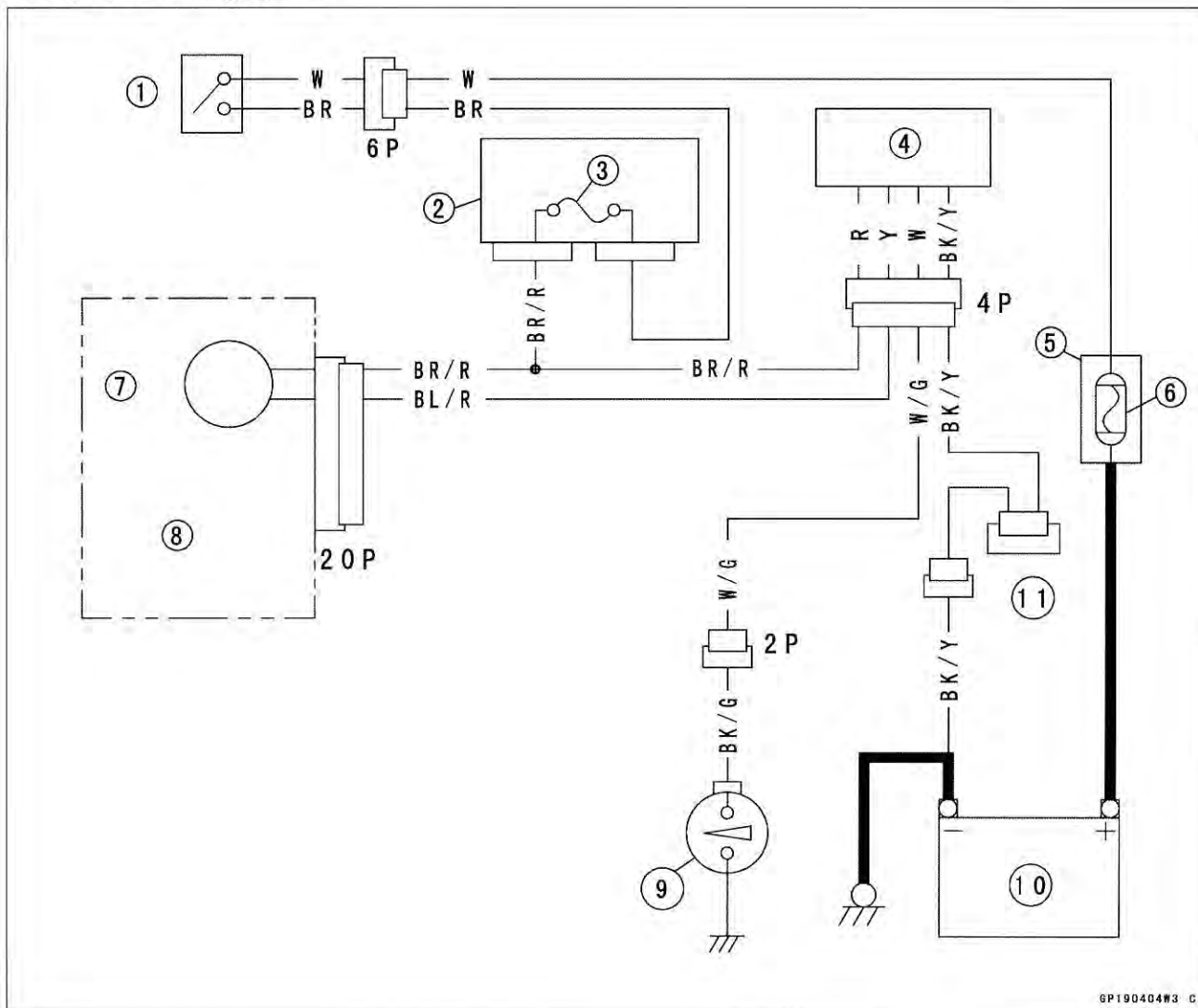
GP150401W2 C

15-58 ELECTRICAL SYSTEM

Oil Pressure Warning System

Motorcycle operation with low engine oil level, even if it is higher than the lower level line, will cause oil level change when sudden acceleration, or deceleration, and may lead flicker of the oil pressure warning light because of too rapid response of the oil pressure switch. To improve this operation, the oil pressure light delay unit is adopted, which prevents flicker of the oil pressure warning light by delaying its lighting.

Oil Pressure Warning System



1. Ignition Switch

2. Junction Box

3. Ignition Fuse 10 A

4. Oil Pressure Light Delay Unit

5. Starter Relay

6. Main Fuse 30 A

7. Oil Pressure Warning LED Light

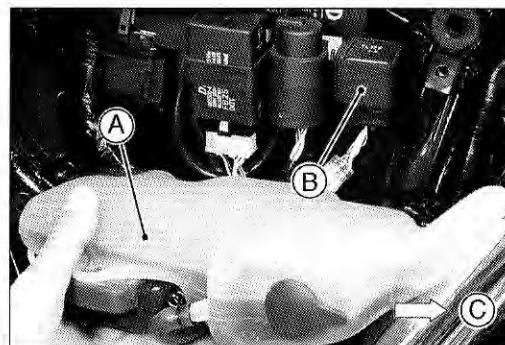
8. Speedometer Unit

9. Oil Pressure Switch

10. MF Battery 12 V 18 Ah

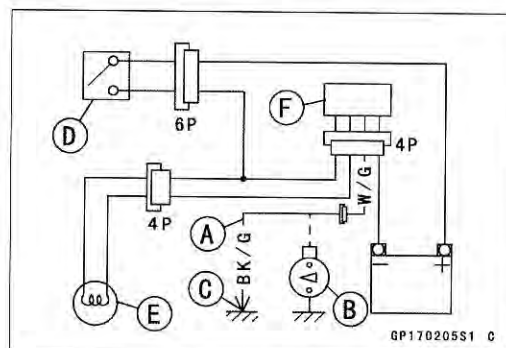
Oil Pressure Light Delay Unit Inspection

- Remove the right side cover (see Frame chapter).
- Remove the coolant reserve tank [A].
- Pull the connectors out of the oil pressure light delay unit [B].
Front [C]



Oil Pressure Warning System

- Disconnect the wire [A] of the oil pressure switch [B] and ground [C] it to the engine, using an auxiliary wire.
- Turn the ignition switch [D] ON.
- ★ If the oil pressure warning LED light [E] is lit, replace the oil pressure switch.
- ★ If the warning LED light is not lit, check the warning LED light bulb and wiring (see Fuel System chapter).
- ★ If the LED light and wiring are good, replace the oil pressure light delay unit [F].



- Turn the ignition switch ON.
- Ground the oil pressure switch wire to the engine, then the oil pressure warning LED light should be lit with a delay.
- Measure this delay time from grounding of the switch wire to lighting of the warning LED light.

Lighting Delay Time

Standard: about 3 seconds

- ★ If the lighting delay time is out of the standard too far, replace the oil pressure light delay unit.

15-60 ELECTRICAL SYSTEM

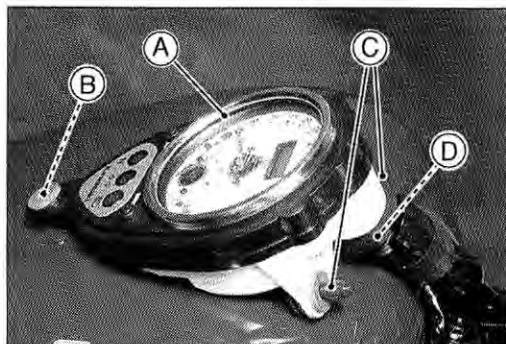
Meter, Gauge

Meter Unit Removal

- Remove the bolt [A], and lift up the tail of the meter cover [B].
- Push the cover forward a little, and remove the meter cover.



- Remove the meter unit [A].
- Pull out the meter unit end from the pin [B] on the fuel tank, and then pull out the front of the meter unit from the pins [C].
- Slide the dust cover [D] out and disconnect the connector.

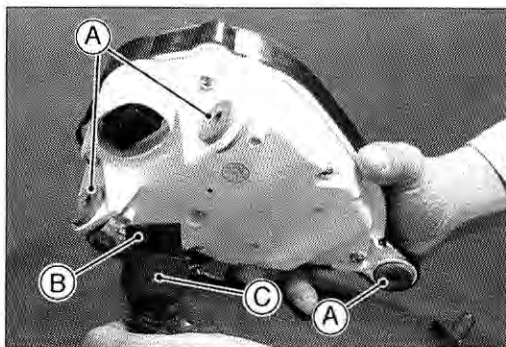


CAUTION

Never drop the meter unit, especially on a hard surface. Such a shock to the unit can damage it. Place the speedometer so that the face is up. If the meter is left upside down or sideways for any length of time, it will malfunction.

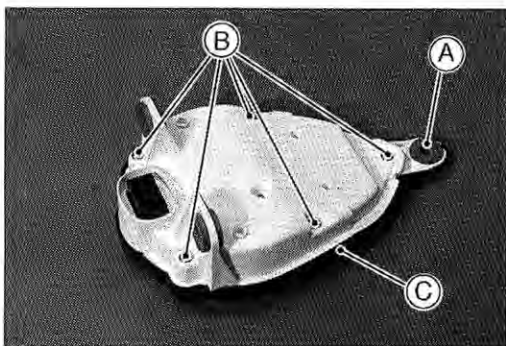
Meter Unit Installation

- Confirm the rubber dampers [A] are in the meter unit.
- Connect the connector [B] and slide the dust cover [C] in.
- Be sure to put the holes onto the pins on the fuel tank.
- Install the meter cover.

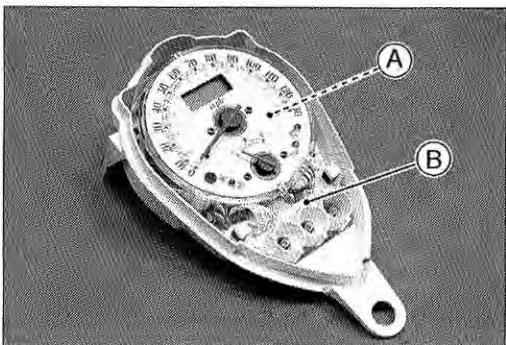


Meter Unit Disassemble

- Remove the meter unit (see this chapter).
- Remove:
 - Rubber Damper [A]
 - Screws [B]
- Remove the upper meter cover [A].



- Remove the screw [A] on the lower cover to free the speedometer.
- Remove the screw [B] on the indicator panel to remove the panel.

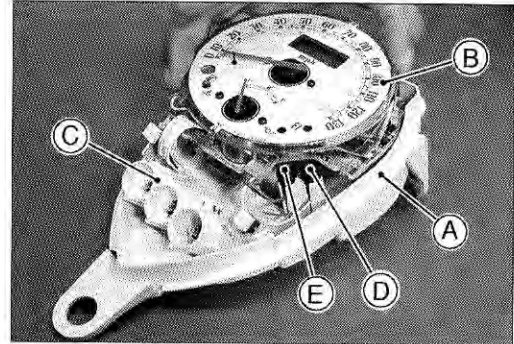


Meter, Gauge

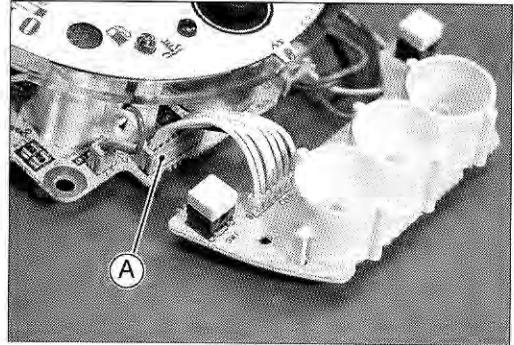
- Lifting the speedometer [B] with the indicator panel [C] pull out the FI indicator LED light [D] and oil pressure warning LED light [E] from the lower cover [A].

NOTE

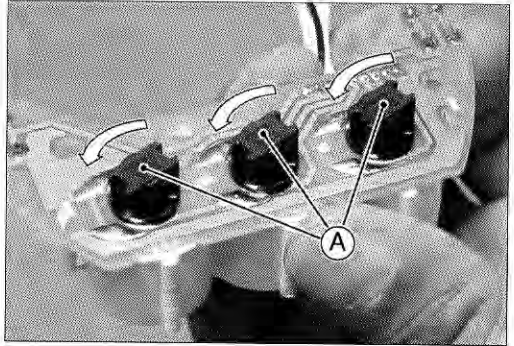
- The water temperature warning LED light, oil pressure warning LED light and FI indicator LED light can not be exchanged.



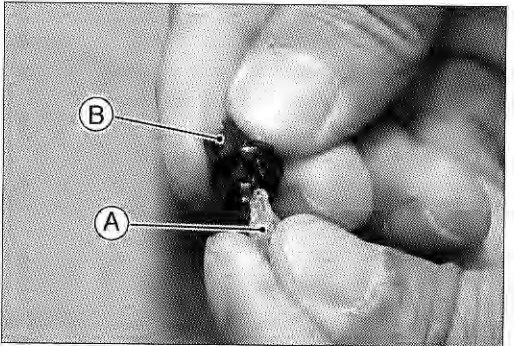
- Disconnect the connector [A].



- Turn out the socket [A] counterclockwise.
- These sockets are for the high beam indicator light, turn signal indicator light and neutral indicator light.



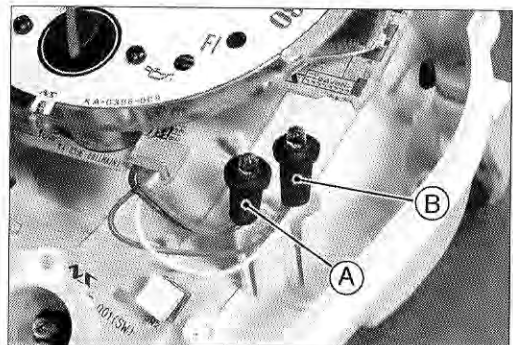
- Remove the wedge-base type bulb [A], pull the bulb straight out of the socket [B].

**CAUTION**

Do not turn the bulb. Pull the bulb out to prevent damage to the bulb. Do not use bulb rated for greater wattage than the specified value.

Meter Unit Assembly

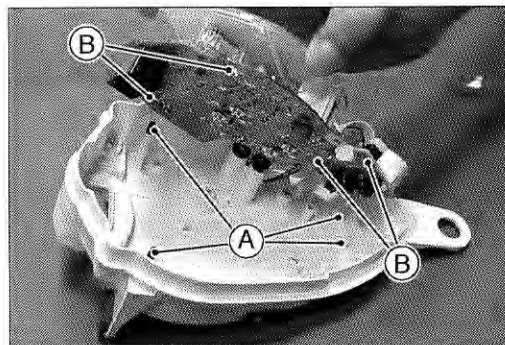
- Connect the connector of the indicator panel to the speedometer.
- Put in the oil pressure warning LED light [A] and FI indicator LED light [B] to the lower cover.
Oil Pressure Warning LED Light: Orange Wire and Green Wire
FI Indicator LED Light: Red Wire and White Wire



15-62 ELECTRICAL SYSTEM

Meter, Gauge

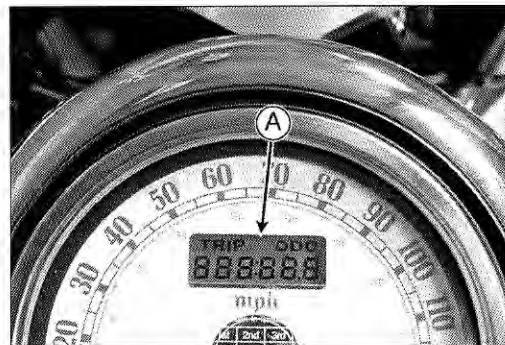
- Fit the speedometer and indicator panel to the lower cover.
- Put the holes [B] onto the projections [A] on the lower cover.
- Tighten the screw.
- Install the upper cover.



Meter Unit Inspection

Mode Selection and Reset Button Checks:

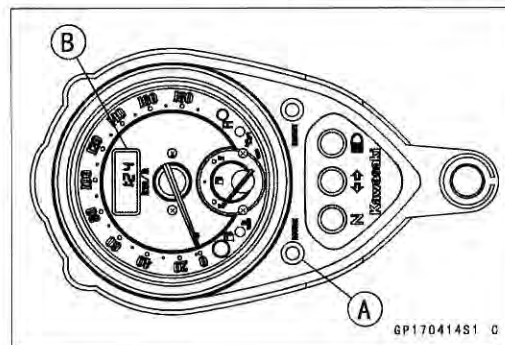
- When the ignition switch is turned ON, all the LCD segments (the letters and numbers of the liquid crystal display) [A] appear for 3 seconds on the meter.
- If they do not appear, check the LCD segments.



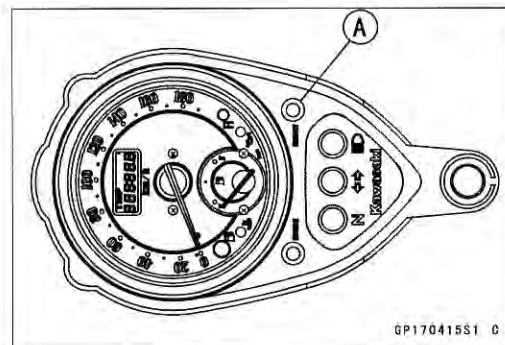
- Check that the display [B] changes to the ODO, TRIP, and CLOCK displays each time the mode selector button [A] is pushed.



- If the display doesn't change in the order specified, replace the speedometer assembly.

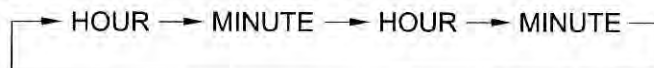


- Push the mode select button to TRIP and push the reset button [A] more than 2 seconds. The display shows "0.0".
- ★ If the display doesn't show "0.0", replace the speedometer assembly.

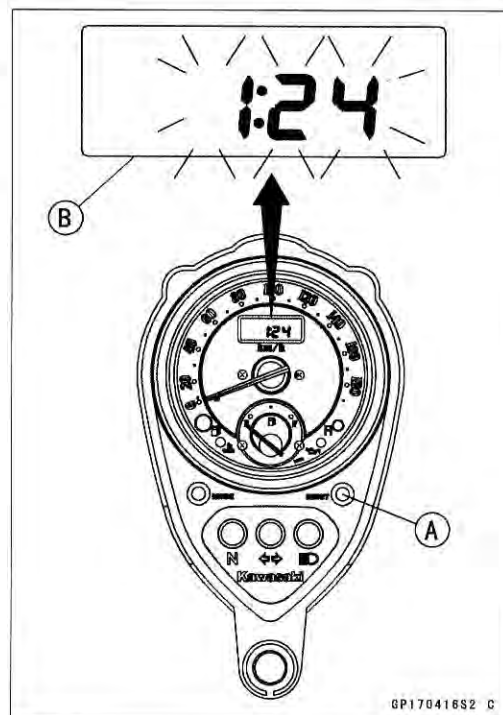


Meter, Gauge

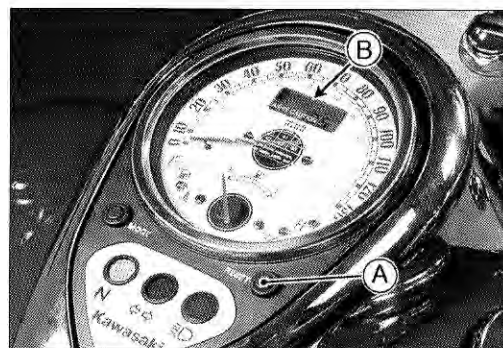
- Push the mode select button to CLOCK.
- Push the reset button [A] more than 2 seconds enables the display to assume the HOUR/MINUTE setting mode [B].
- In the HOUR/MINUTE setting mode, the numbers flashes on the display.
- Check that the flashing number changes to the HOUR and MINUTE displays each time the reset button is pushed.



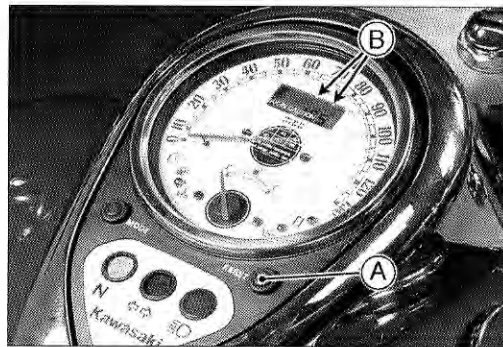
- Check that the time can be set in this mode.
- ★ If the time cannot be set, replace the speedometer assembly.

**Clock Setting:**

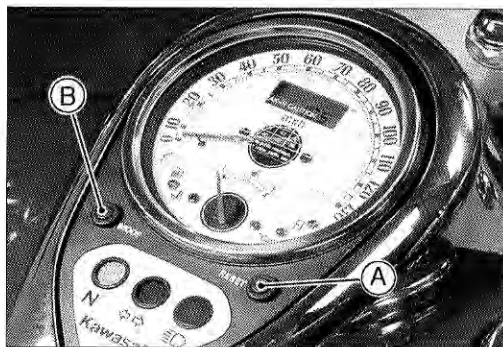
- In the HOUR/MINUTE setting mode, push the reset button [A] again to effect the HOUR setting mode.
- The hour display flashes [B] on the display.
- Push the mode selector button to set the hour.



- In the HOUR setting mode, push the reset button [A] once to effect the MINUTE setting mode.
- The minute display flashes [B] on the display.
- Push the mode selector button to set the minute.



- Set the minute, push the reset button [A] to return to the HOUR/MINUTE setting mode.
- Push the mode selector button [B] to complete the time setting process.
- The clock starts counting the seconds as soon as the mode selector button is pushed.



15-64 ELECTRICAL SYSTEM

Meter, Gauge

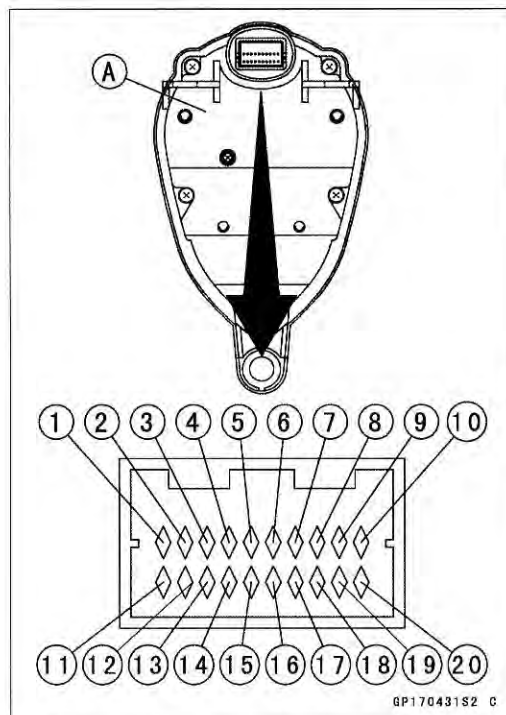
LCD Segment Inspection:

- Remove the meter unit [A] (see Meter Unit Removal).

CAUTION

Do not drop the meter unit. Such a shock to the meter unit can damage it. Place the meter facing up. If a meter is left upside down or sideways for any length of time, it will malfunction.

- [1] Neutral Indicator Light (–)
- [2] FI Indicator LED Light (–)
- [3] Oil Pressure Warning LED Light (–)
- [4] Water Temperature Warning LED Light (–)
- [5] Distance Sensor Signal
- [6] Unused
- [7] Unused
- [8] Unused
- [9] Unused
- [10] Speedometer Illumination LED Light (+)
- [11] Battery (+)
- [12] Ignition
- [13] Battery (–)
- [14] Speed Sensor Supply Voltage
- [15] Speed Sensor Signal
- [16] Fuel Gauge Signal
- [17] Right Turn Signal Indicator Light (+)
- [18] Left Turn Signal Indicator Light (+)
- [19] Fuel Level Warning Light (–)
- [20] High Beam Indicator Light (+)



CAUTION

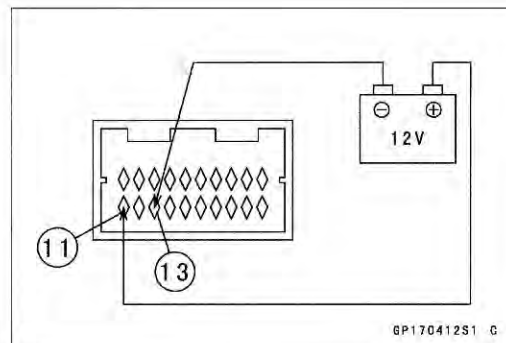
Do not short each terminals. When inspecting the meter unit be sure to connect each connections.

- Using the auxiliary wires, connect a 12 V battery to the meter unit connector terminals.

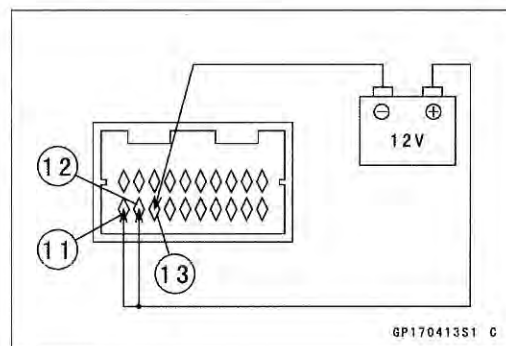
Connections

Battery Positive Terminal (+) → Terminal [11]

Battery Negative Terminal (–) → Terminal [13]



- Using the auxiliary wires, connect the battery positive wire to terminal [12].
- Verify that all the LCD segments (the letters and numbers of the liquid crystal display) to appear for 3 seconds. Then the clock or meters normally depending on the mode selected.
- Check that disconnect the terminal [12] causes all the LCD segments to become unlit.



★ If there is any problem, replace the speedometer assembly.

Meter, Gauge

Speedometer Inspection:

- If an oscillator is unavailable, check the speedometer as follows.
- Instal the meter unit.
- Use the jack and the attachment jack to lift the rear wheel.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398

- Turn the ignition switch ON.
- Turn the rear wheel by hand to see if the speedometer shows the vehicle speed [A] that corresponds to the wheel rotation.
- ★ If it does not show properly, inspect the speed sensor and power to the speed sensor.

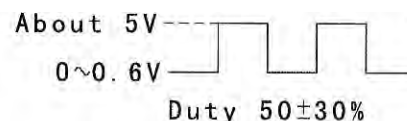
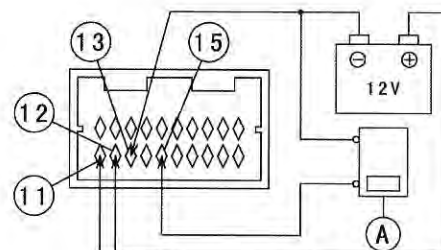
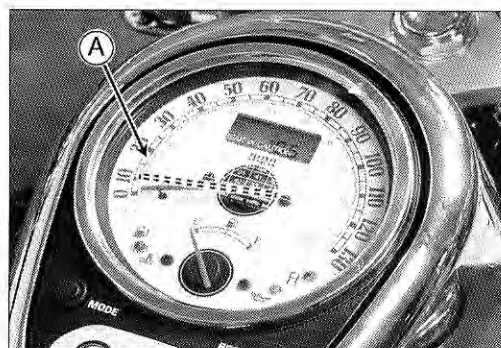
- If an oscillator is available, check the speedometer as follows.
- Connect the terminals in the same way as in the LSD segment inspection.
- Connect the oscillator [A] to the terminal [15]. The vehicle speed that corresponds to the input frequency will be displayed when a short wave form such as the one show in the diagram is input.

Example:

An input frequency of 450 Hz will display about 60 km/h.

An input frequency of 750 Hz will display about 60 mph.

- ★ If the meter does not function correctly, replace the speedometer assembly.



GP170438S2 C

Speed Sensor Power Supply Inspection:

- Connect the terminals in the same way as in the LSD segment inspection.
- Set the hand tester [A] to DC25 V, check the voltage between terminal [14] and battery negative wire.

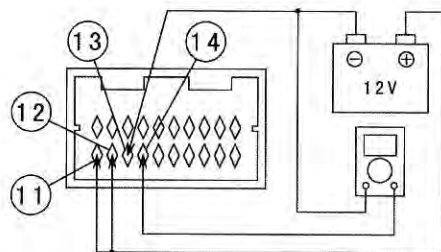
Connections

Hand Tester (+) → Terminal [14]

Hand Tester (-) → Battery Negative Wire (-)

Special Tool - Hand Tester: 57001-1394

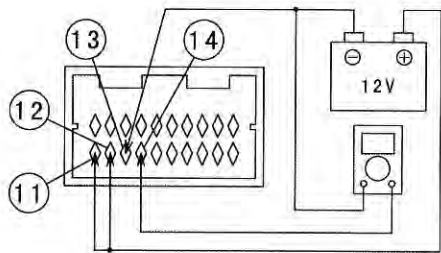
- ★ If the voltage is less than 7 V for 10 ~ 16 V battery Voltage, replace the speedometer assembly.



GP170418S1 C

ODO Meter Inspection:

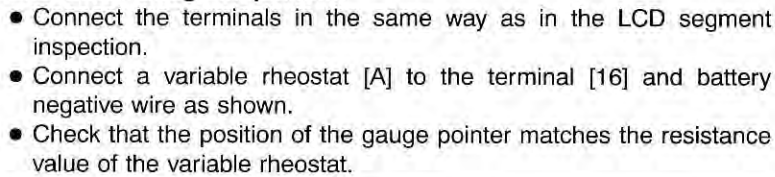
- Turn the display [A] into ODO.
- During the speedometer inspection with an oscillator, verify that the odometer reading increases.
- ★ If it does not increase, replace the speedometer assembly.



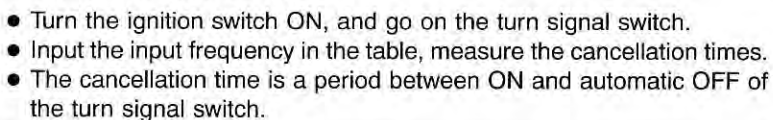
GP170418S1 C

Meter, Gauge

- Turn the display [A] into TRIP.
- During the speedometer inspection with an oscillator, verify that the trip meter reading increases.
- Stop the short wave form, press the reset button more than 2 seconds and check that the display shows "0.0".
- If they are any problem, replace the speedometer assembly.



★ If this indicator function does not work, replace the speedometer assembly.

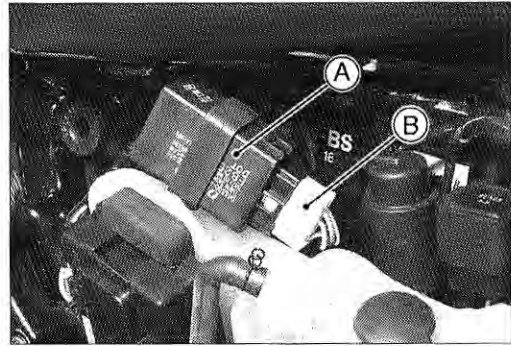


Meter, Gauge

- If an oscillation is unavailable, check that the distance sensor as follows.
 - Remove the right cover (see Frame chapter).
 - Remove the turn signal control unit [A], but do not disconnect the connectors.
 - Use the jack and the attachment jack to lift the rear wheel.

Special Tools - Jack: 57001-1238

Attachment Jack: 57001-1398



- Set the hand tester to the DC25 V range, check the voltage between the LB wire terminal [A] and the battery (-) terminal as shown.

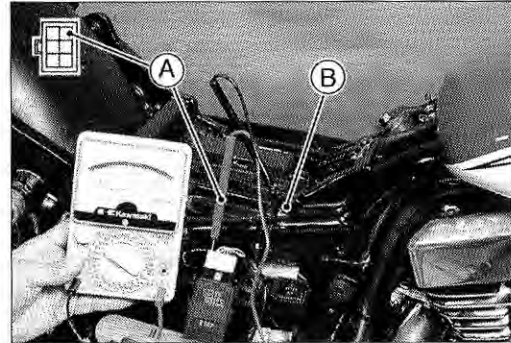
Connections

Hand Tester (+) → LB Wire Terminal

Hand Tester (-) → Battery (-) Terminal

Special Tool - Hand Tester: 57001-1394

- Turn the ignition switch ON, and slowly rotating the rear wheel.
- At this time, the tester's pointer should swing 0.5 V and 12 V.
- ★ If the tester's pointer does not swing 0.5 V and 12 V, inspect the speed sensor and the turn signal control unit. If they are normal, replace the speedometer assembly.



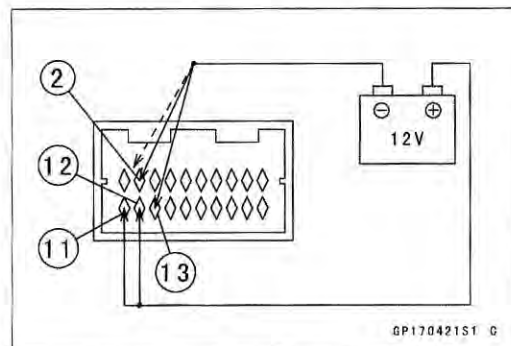
LED and Indicator Lights Inspection:

- Connect the 12 V battery to the meter terminals in the same way as in the LCD segment inspection.

FI Indicator LED Light Connections:

Battery Negative Wire (-) to Terminal [2]

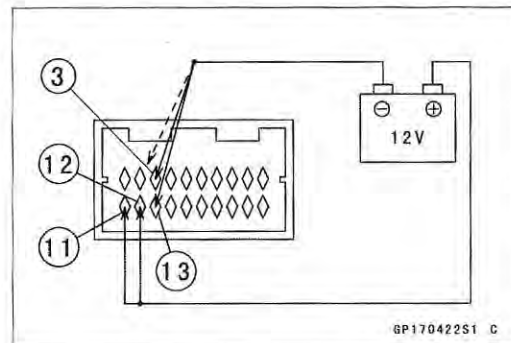
- Connect the terminal [2].
- The FI indicator LED light lights.
- Disconnect the terminal [2].
- The FI indicator LED light disappears.
- ★ If there is any problem, replace the speedometer assembly.



Oil Pressure Warning LED Light Connections:

Battery Negative Wire (-) to Terminal [3]

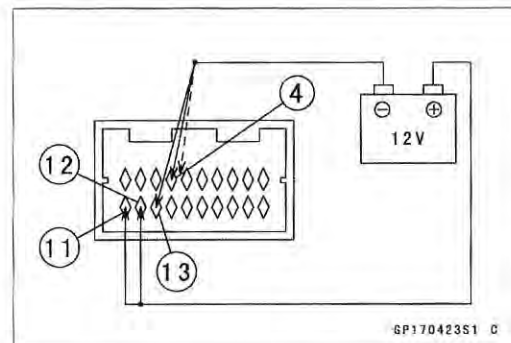
- Connect the terminal [3].
- The oil pressure warning LED light lights.
- Disconnect the terminal [3].
- The oil pressure warning LED light disappears.
- ★ If there is any problem, replace the speedometer assembly.



Water Temperature Warning LED Light Connections:

Battery Negative Wire (-) to Terminal [4]

- Connect the terminal [4].
- The water temperature warning LED light lights.
- Disconnect the terminal [4].
- The water temperature warning LED light disappears.
- ★ If there is any problem, replace the speedometer assembly.



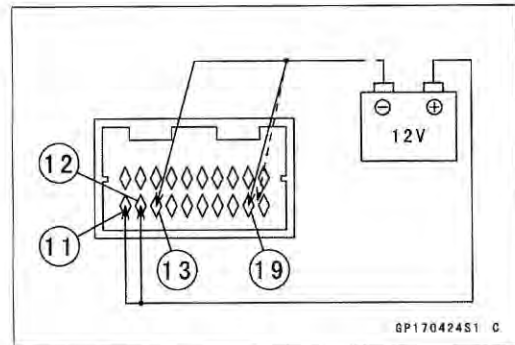
15-68 ELECTRICAL SYSTEM

Meter, Gauge

Fuel Level Indicator Light Connections:

Battery Negative Wire (-) to Terminal [19]

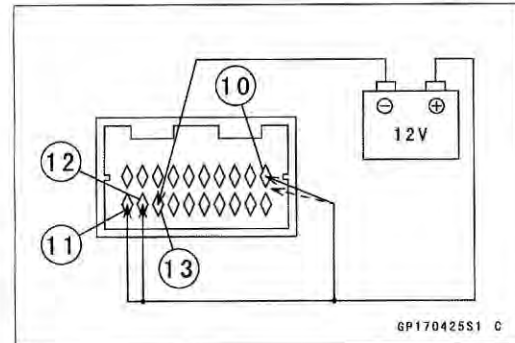
- Connect the terminal [19].
- The fuel level warning light lights.
- Disconnect the terminal [19].
- The fuel level warning light disappears.
- ★ If there is any problem, inspect the bulb and bulb socket.
- ★ If they are normal, replace the speedometer assembly.



Speedometer Illumination LED Lights Connections:

Battery Positive Wire (+) to Terminal [10]

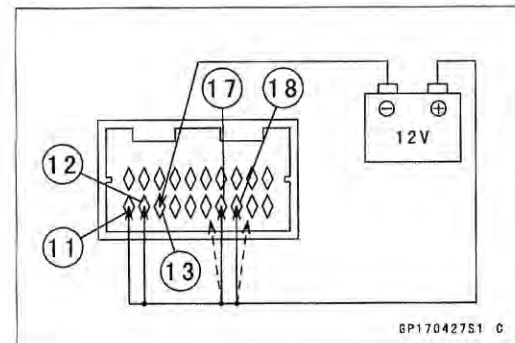
- Connect the terminal [10].
- The Illumination LED light lights.
- Disconnect the terminal [10].
- The Illumination LED light disappears.
- ★ If there is any problem, replace the speedometer assembly.
- Be dotted the illuminationLED lights in the speedometer. If the meter pointer or LCD segments are hard to reading because of the unilluminative, replace the speedometer assembly.



Turn Signal Indicator Lights Connections:

Battery Positive Wire (+) to Terminal [17] or [18]

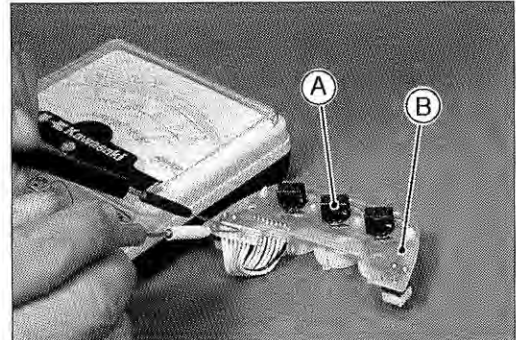
- Connect the terminal [17] or [18].
- The turn signal indicator light lights.
- Disconnect the terminal [17] or [18].
- The signal indicator light disappears.



- ★ If there is any problem, inspect the bulb, bulb socket [A] and wiring of the indicator panel [B].
- ★ If they are normal, replace the speedometer assembly.

Special Tools - Hand Tester: 57001-1394

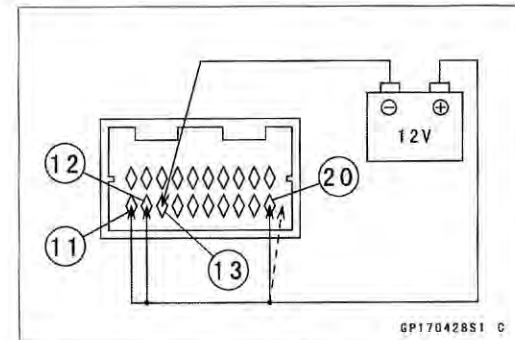
Needle Adapter Set: 57001-1457



High Beam Indicator Light Connection:

Battery Positive Wire (+) to Terminal [20]

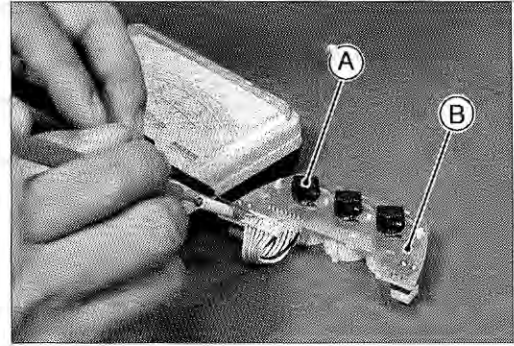
- Connect the terminal [20].
- The high beam indicator light lights.
- Disconnect the terminal [20].
- The turn signal indicator light disappears.



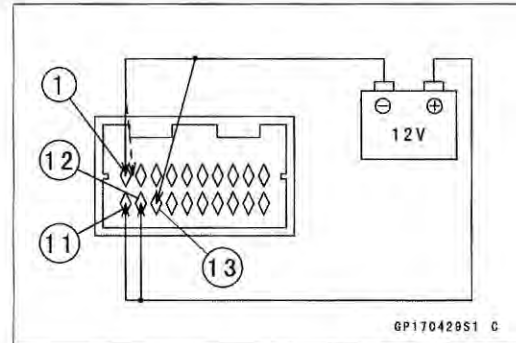
Meter, Gauge

- ★ If there is any problem, inspect the bulb, bulb socket [A] and wiring of the indicator panel [B].
- ★ If they are normal, replace the speedometer.

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

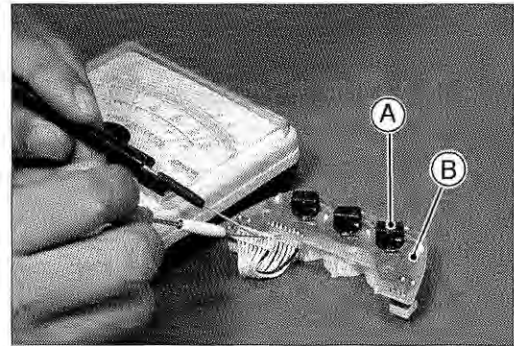
**Neutral Indicator Light Connections:****Battery Negative Wire (-) to Terminal [I]**

- Connect the terminal [1].
- The neutral indicator light lights.
- Disconnect the terminal [1].
- The neutral indicator light disappears.

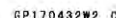


- ★ If there is any problem, inspect the bulb, bulb socket [A] and wiring of the indicator panel [B].
- ★ If they are normal, replace the speedometer assembly.

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



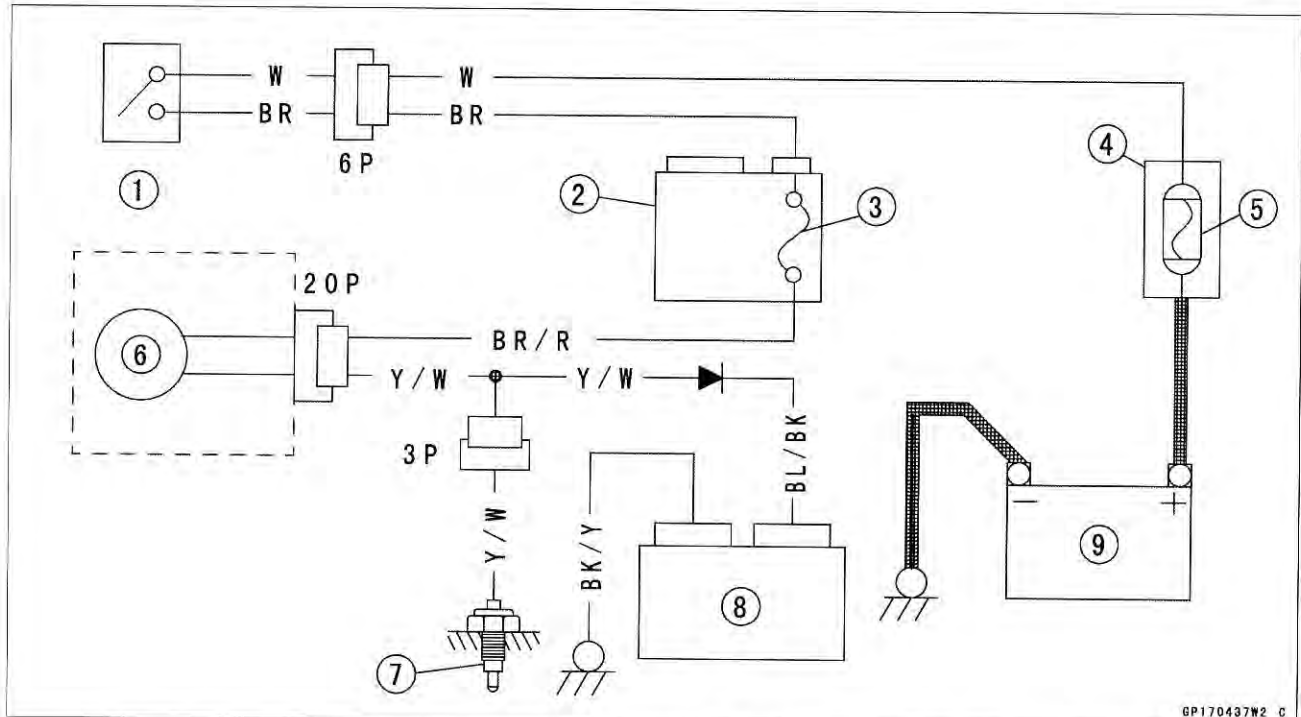
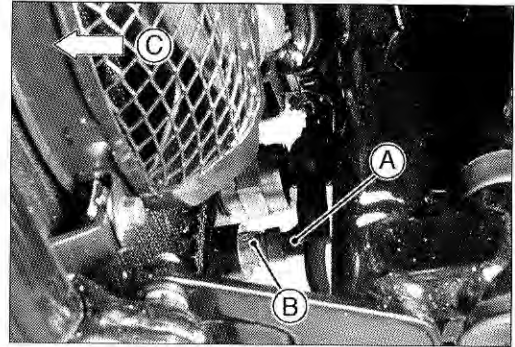
Meter, Gauge



- Downloaded from www.vulcanriders.fi

Meter, Gauge

- Inspect the water temperature warning LED light and the system wiring.
 - Turn on the ignition switch.
 - Disconnect the water temperature switch wire [A], then ground it to the frame or engine using an auxiliary wire.
 - ★ If the water temperature warning LED light is lit, inspect the water temperature switch [B] (see Switches and Sensors section). Replace the switch if damaged.
 - ★ If the warning LED light is not lit, check the warning LED light and wiring.
- Front [C]



GP170437W2 C

- | | |
|------------------------------|--|
| 1. Ignition Switch | 6. Water Temperature Warning LED Light |
| 2. Junction Box | 7. Water Temperature Switch |
| 3. Ignition Fuse 10 A × 32 V | 8. ECU |
| 4. Starter Relay | 9. MF Battery 12 V 18 Ah |
| 5. Main Fuse 30 A × 32 V | |

15-72 ELECTRICAL SYSTEM

Meter, Gauge

Fuel Gauge Operation Inspection

- Remove the speedometer cover (see this chapter).
- Prepare an auxiliary wire [A], and check the operation of the gauge.
- Open or short the fuel level sensor wires to check the fuel gauge operation.

Fuel Level Sensor Connector [B] (Fuel Tank Side)

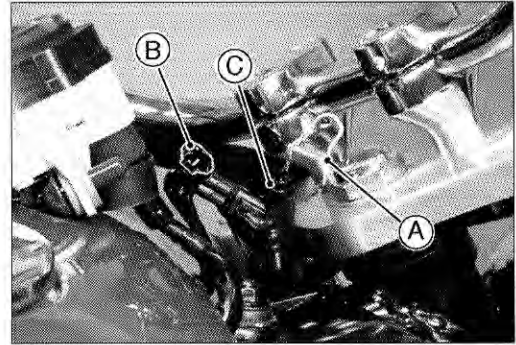
Fuel Level Sensor Connector [C] (Main Harness Side)

Fuel Gauge Operation Check

Ignition Switch Position: ON

Wire Location: Female 2-pin fuel gauge connector (disconnected)

Results: Gauge should read E when connector wires are opened.
Gauge should read F when connector wires are shorted.

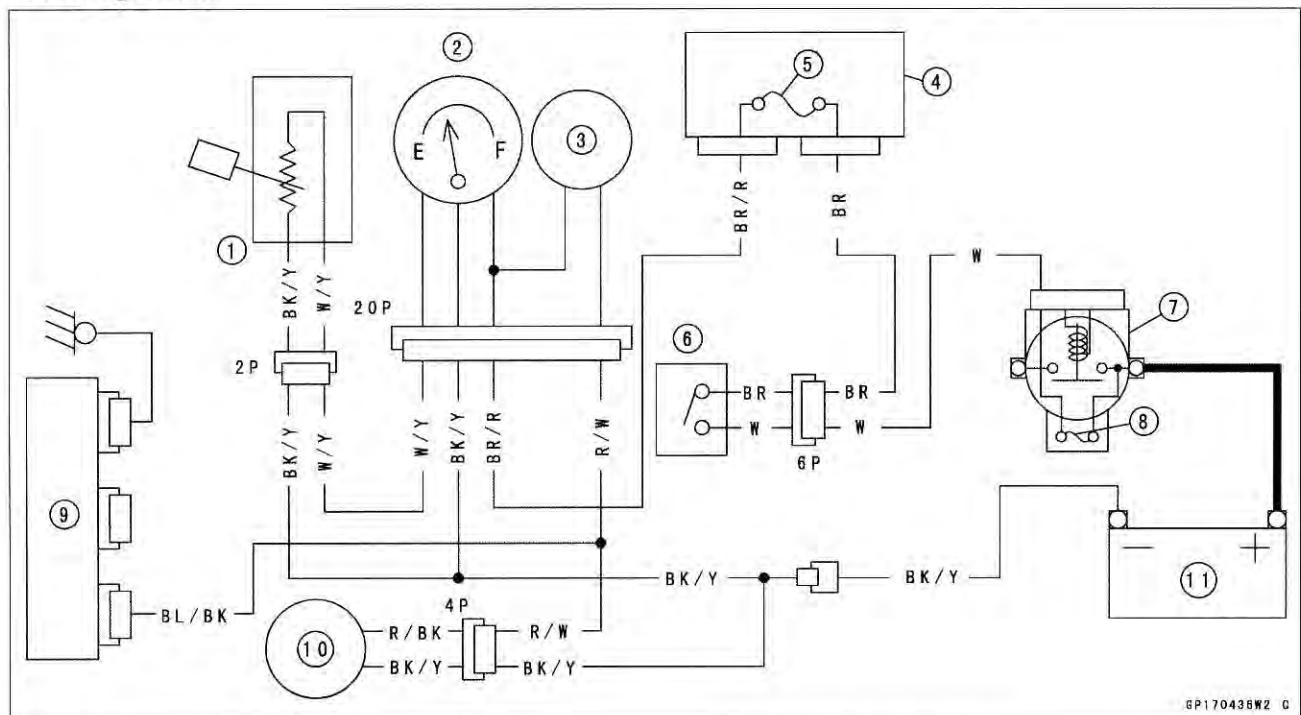


★ If the gauge readings are correct, the fuel level sensor is bad (see Fuel Level Sensor Inspection). If these readings are not obtained, the trouble is with the gauge and/or wiring.

- Check the fuel gauge circuit wiring (see Wiring Inspection).

★ If all wiring and components other than the fuel gauge check out good, the gauge is defective. Replace the speedometer assembly.

Fuel Gauge Circuit



1. Fuel Level Sensor

2. Fuel Gauge

3. Speedometer Unit

4. Junction Box

5. Ignition Fuse 10 A × 32 V

6. Ignition Switch

7. Ignition Switch Connector

8. Starter Relay

9. Main Fuse 30 A × 32 V

10. Fuel Reserve Switch

11. MF Battery 12 V 18 Ah

GP170435W2 C

Switch and Sensors

Fuel Reserve Switch Inspection

- Fill the fuel tank with fuel.
- Close the fuel tank cap surely.
- Remove:
 - Speedometer Cover (see this chapter)
 - Fuel Pump Connector (see Fuel System chapter)
- Connect the test light and 12 V battery (12 V 3.4 W bulb a socket with wires) and the 12 V battery to the fuel pump connector.

Connections:

- Battery (+) → 12 V 3.4 W Bulb (one side)
- 12 V 3.4 W Bulb (other side) → R/BK Wire Terminal
- Battery (-) → BK/Y Wire Terminal

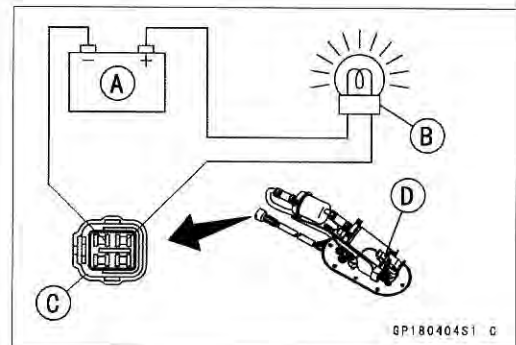
★ If the test light turn on, the reserve switch is defective. Replace it.

- Remove:
 - Fuel Pump (see Fuel System chapter)
- Connect the test light (12 V 3.4 W bulb in a socket with wires) and the 12 V battery to the fuel pump connector as shown.
 - 12 V Battery [A]
 - Test Light [B]
 - Fuel Pump Connector [C]
 - Fuel Reserve Switch [D]

★ If the test light doesn't light, replace the fuel pump.

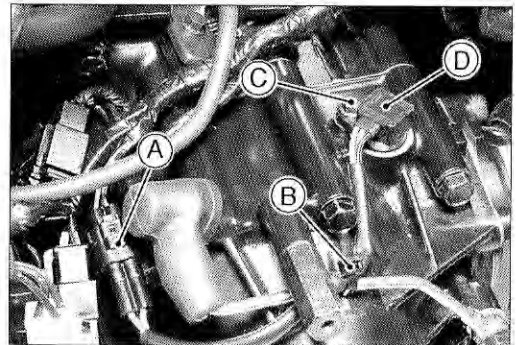
NOTE

- It may take a long time to turn on the test light in case that the fuel reserve switch is inspected just after the fuel pump is removed. Leave the fuel reserve switch with leads for inspection connected for one (1) minute.



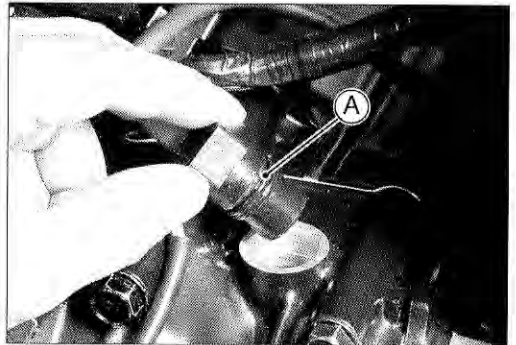
Speed Sensor Removal

- Remove:
 - Alternator Outer Cover
 - Speed Sensor Wire Connector [A]
 - Band [B]
 - Bolt [C]
 - Speed Sensor [D]



Speed Sensor Installation

- Apply grease to the O-ring [A] on the speed sensor.
- Tighten:
 - Non-permanent Locking Agent - Speed Sensor Mounting Bolt
 - Torque - Speed Sensor Mounting Bolt: 9.8 N·m (1.0 kg·m, 87 in·lb)



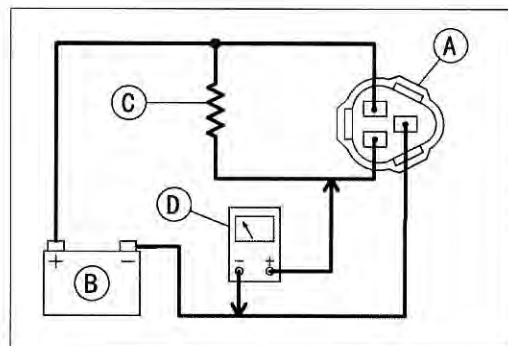
15-74 ELECTRICAL SYSTEM

Switch and Sensors

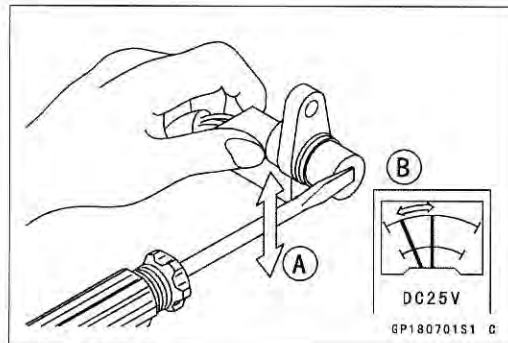
Speed Sensor Inspection

- Remove:
Speed Sensor (see Speed Sensor Removal)
- Connect the speed sensor connector [A] with a battery [B], 10 k Ω resistor [C] and hand tester [D] as shown.
- Set the tester to the DC 25 V range.

Special Tool - Hand Tester : 57001-1394



- Trace [A] the speed sensor surface with the screw driver.
- Then the tester indicator should flick [B].
- ★ If the tester indicator does not flick, replace the speed sensor.

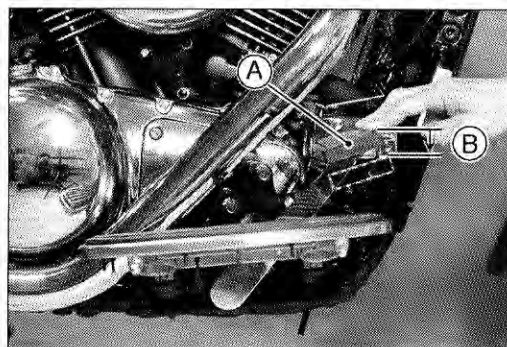


Front Brake Light Switch Inspection (Periodic)

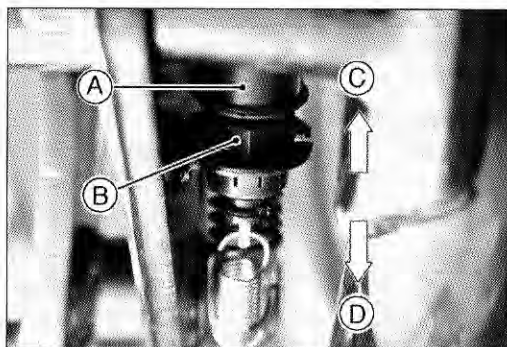
- Turn on the ignition switch.
- The brake light should go on when the front brake is applied.
- ★ If it does not, replace the switch.

Rear Brake Light Switch Check/Adjustment (Periodic)

- Check the operation of the rear brake light switch by depressing the brake pedal [A]. The brake light should go on after about 15 mm of the pedal travel [B].



- ★ If it does not, adjust the brake light switch.
- While holding the switch body, turn the adjusting nut to adjust the switch.
Switch Body [A]
Adjusting Nut [B]
Light sooner as the body rises [C]
Light later as the body lowers [D]



CAUTION

To avoid damaging the electrical connections inside the switch, be sure that the switch body does not turn during adjustment.

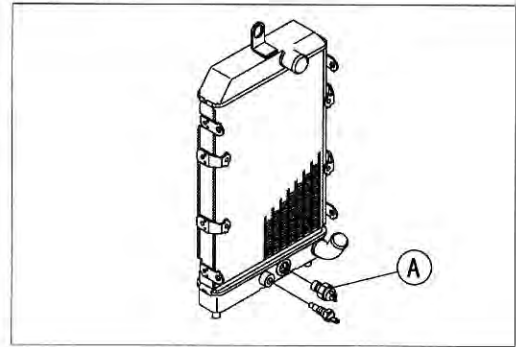
Switch and Sensors

Radiator Fan Switch Removal

CAUTION

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

- Drain the coolant (see Coolant Draining).
- Disconnect the fan switch connector.
- Unscrew the radiator fan switch [A] from the radiator.



Radiator Fan Switch Installation

Torque - Radiator Fan Switch: 18 N·m (1.8 kg·m, 13 ft·lb)

- Fill the coolant and bleed the air from the cooling system (see Coolant Filling in the Cooling System chapter).

Radiator Fan Switch Inspection

- Remove the fan switch from the radiator.
- Suspend the switch [A] in a container of machine oil so that the heat-sensitive portion and threaded portion are submerged.
- Suspend an accurate thermometer [B] with heat-sensitive portions [C] located in almost the same depth.

NOTE

- The switch and thermometer must not touch the container sides 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 the hand tester (special tool), measure the internal resistance of the switch across the terminals at the temperatures shown in the table.
- ★ If the measurement is out of the range, replace the switch.

Fan Switch Resistance

○ Rising temperature:

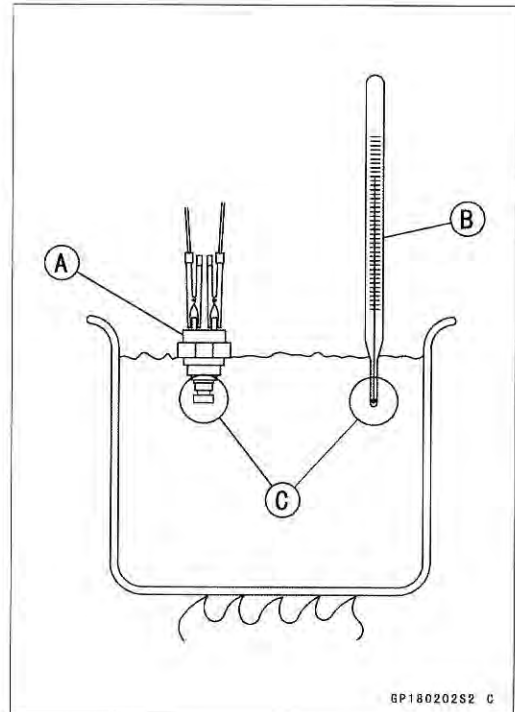
From OFF to ON at 100 ~ 110°C (212 ~ 230°F)

○ Falling temperature:

From ON to OFF at 97 ~ 103°C (203 ~ 217°F)

ON: Less than 0.5 Ω

OFF: More than 1 MΩ



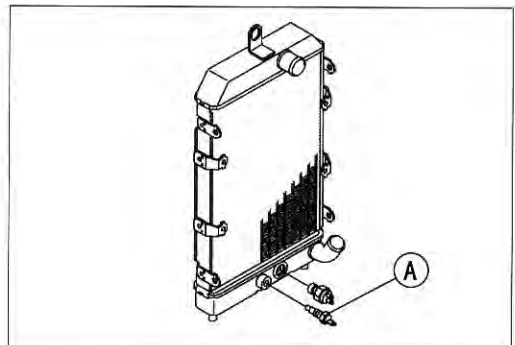
GP160202S2 C

Water Temperature Switch Removal

CAUTION

The water temperature switch should never be allowed to fall on a hard surface. Such a shock to the part can damage it.

- Drain the coolant (see Coolant Draining in the Cooling System chapter).
- Disconnect the switch connector.
- Remove the water temperature switch [A] from the radiator.



Water Temperature Switch Installation

- Apply silicone sealant to the threads of the water temperature switch.

Torque - Water Temperature Switch: 7.4 N·m (0.75 kg·m, 65 in·lb)

- Fill the engine with coolant and bleed the air from the cooling system (see Coolant Filling).

15-76 ELECTRICAL SYSTEM

Switch and Sensors

Water Temperature Switch Inspection

- Remove the water temperature switch.
- Suspend the switch [A] in a container of machine oil so that the heat-sensitive portion and threaded portion are submerged.
- Suspend an accurate thermometer [B] with heat-sensitive portions [C] located in almost the same depth.

NOTE

- The switch 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 the hand tester, measure the internal resistance of the switch across the terminal and the body at the temperatures shown in the table.
- ★ If the measurement is out of the range, replace the switch.

Water Temperature Switch Resistance

○Rising temperature:

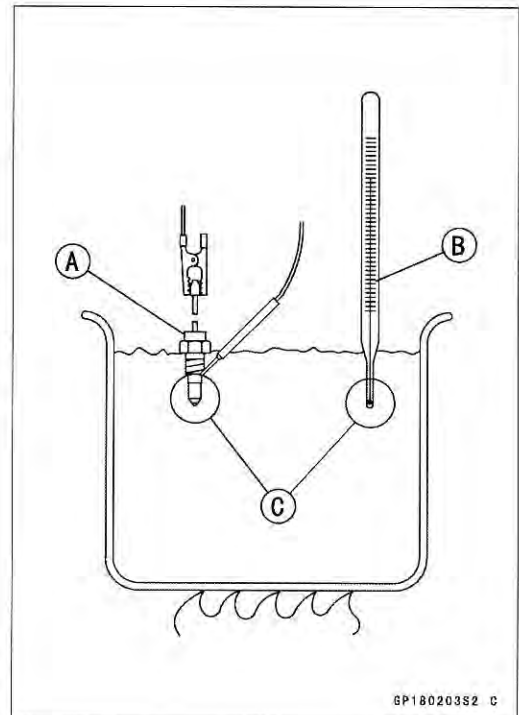
From OFF to ON at 110 ~ 120°C (230 ~ 248°F)

○Falling temperature:

From ON to OFF at 108°C (226°F) ~ temperature less than ON temperature

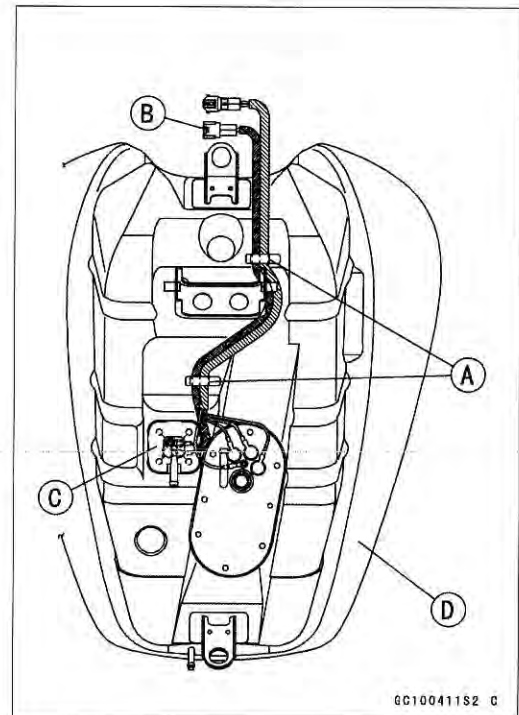
ON: Less than 0.5 Ω

OFF: More than 1 M Ω



Fuel Level Sensor Removal

- Remove the fuel tank (see Fuel System chapter).
- Turn the fuel tank upside down.
- Open the clamps [A] and take off the fuel level sensor wire [B].
- Pull out the sensor cover
- Remove the bolts and take the fuel level sensor [C] off the fuel tank [D].



Fuel Level Sensor Installation

- Replace the rubber gasket with new one.

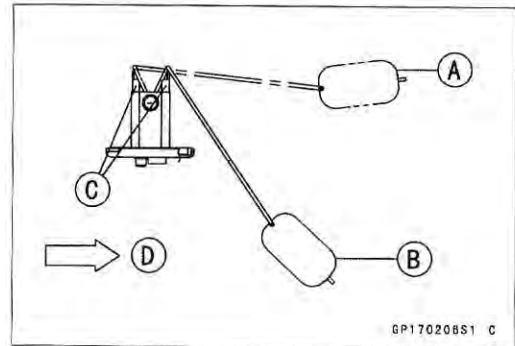
Switch and Sensors

Fuel Level Sensor Inspection

- Remove the fuel tank (see Fuel System chapter).
- Remove the fuel level sensor from the fuel tank.
- Check that the float moves up and down smoothly without binding. It should go down under its own weight.

★ If the float does not move smoothly, replace the sensor.

Float in Full Position [A]
 Float in Empty Position [B]
 Float Arm Stoppers [C]
 Front [D]



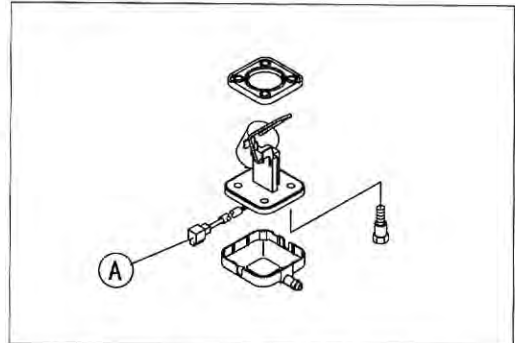
- Using the hand tester, measure the resistance across the terminals in the fuel level sensor lead connector [A].

Special Tool - Hand Tester: 57001-1394

★ If the tester readings are not as specified, or do not change smoothly according as the float moves up and down, replace the sensor.

Fuel Level Sensor Resistance

Standard: Full position: 4 ~ 10 Ω
 Empty position: 90 ~ 100 Ω

*Diode (Rectifier) Inspection*

- Remove the fuel tank (see Fuel System chapter).
- Disconnect the diode assemblies [A].



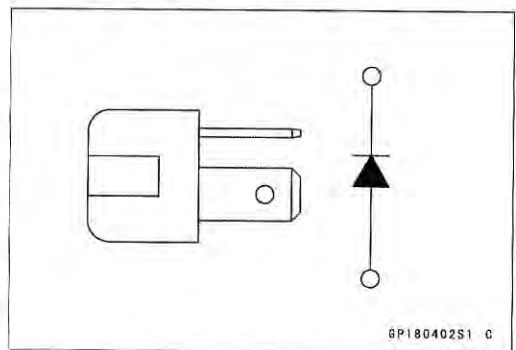
- Set the hand tester to the $\times 100 \Omega$ range.

Special Tool - Hand Tester: 57001-1394

- Check the continuity between the diode terminals in both directions.
- ★ If there is continuity in one direction (forward direction) but no continuity (infinity) in the reverse direction, the diode is normal.
- ★ The diode is defective if there is continuity after changing the direction, or if it remains with no continuity.

NOTE

- The actual resistance measurement in the forward direction varies with the tester used and the individual diodes. Generally speaking, it is acceptable if the tester's indicator swings approximately halfway.

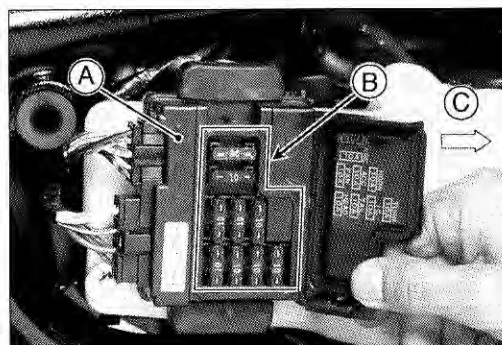


15-78 ELECTRICAL SYSTEM

Junction Box

The junction box [A] has fuses [B], relays, and diodes. The relays and diodes can not be removed.

Front [C]



Junction Box Fuse Circuit Inspection

- Remove the right side cover (see Frame chapter).
- Remove the junction box.
- Pull off the connectors from the junction box.
- Make sure all connector terminals are clean and tight, and none of them have been bent.
- ★ Clean the dirty terminals, and straighten slightly-bent terminals.
- Check conductivity of the numbered terminals with the hand tester.
- ★ If the tester does not read as specified, replace the junction box.

Fuse Circuit Inspection

Tester Connection	Tester Reading (Ω)
1 — 1A	0
1 — 2	0
3A — 4	0
6 — 5	0
6 — 10	0
6 — 7	0
6 — 17	0

Tester Connection	Tester Reading (Ω)
1A — 8	∞
2 — 8	∞
3A — 8	∞
6 — 2	∞
6 — 3A	∞
17 — 3A	∞

Starter Circuit/Headlight Relay Inspection

- Remove the junction box.
- Check conductivity of the following numbered terminals by connecting the hand tester and one 12 V battery to the junction box as shown.
- ★ If the tester does not read as specified, replace the junction box.

Relay Circuit Inspection (with the battery disconnected)

	Tester Connection	Tester Reading (Ω)
Headlight Relay	*7 — 8	∞
	*7 — 13	∞
	(+) (—)	Not ∞^{**}
	*13 — 9	

	Tester Connection	Tester Reading (Ω)
Starter Circuit Relay	9 — 11	∞
	12 — 13	∞
	(+) (—)	∞
	13 — 11	
	(+) (—)	Not ∞^{**}
	12 — 11	

(*): US, Canadian, and Australian Models only

(**): The actual reading varies with the hand tester used.

(+): Apply tester positive wire.

(—): Apply tester negative wire.

Junction Box

Relay Circuit Inspection (with the battery connected)

Reading	Battery Connection		Tester Connection	Tester Reading (Ω)
	(+)	(-)		
Headlight Relay	*9	13	*7 — 8	0
Starter Circuit Relay	11	12	(+) — (-) 13 — 11	Not ∞ **

(*): US, Canadian, and Australian Models only

(**): The actual reading varies with the hand tester used.

(+): Apply tester positive wire.

(-): Apply tester negative wire.

Diode Circuit Inspection

- Remove the junction box.
- Check conductivity of the following pairs of terminals.

Diode Circuit Inspection

Tester Connection	*13 — 8, *13 — 9, 12 — 11, 12 — 14, 15 — 14, 16 — 14
-------------------	--

(*): US, Canadian, and Australian Models only

- ★ The resistance should be low in one direction and more than ten times as much in the other direction. If any diode shows low or high in both directions, the diode is defective and the junction box must be replaced.

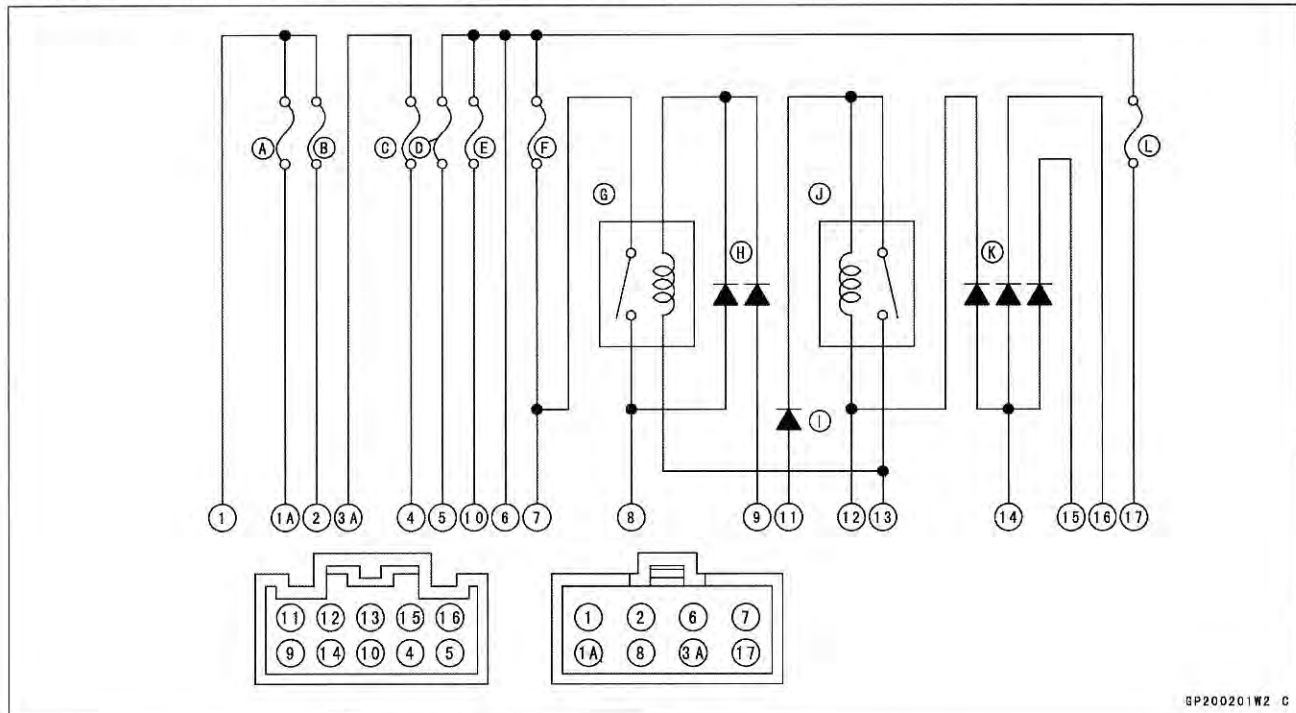
NOTE

- The actual meter reading varies with the meter or tester used and the individual diodes, but generally speaking, the lower reading should be from zero to one half the scale.

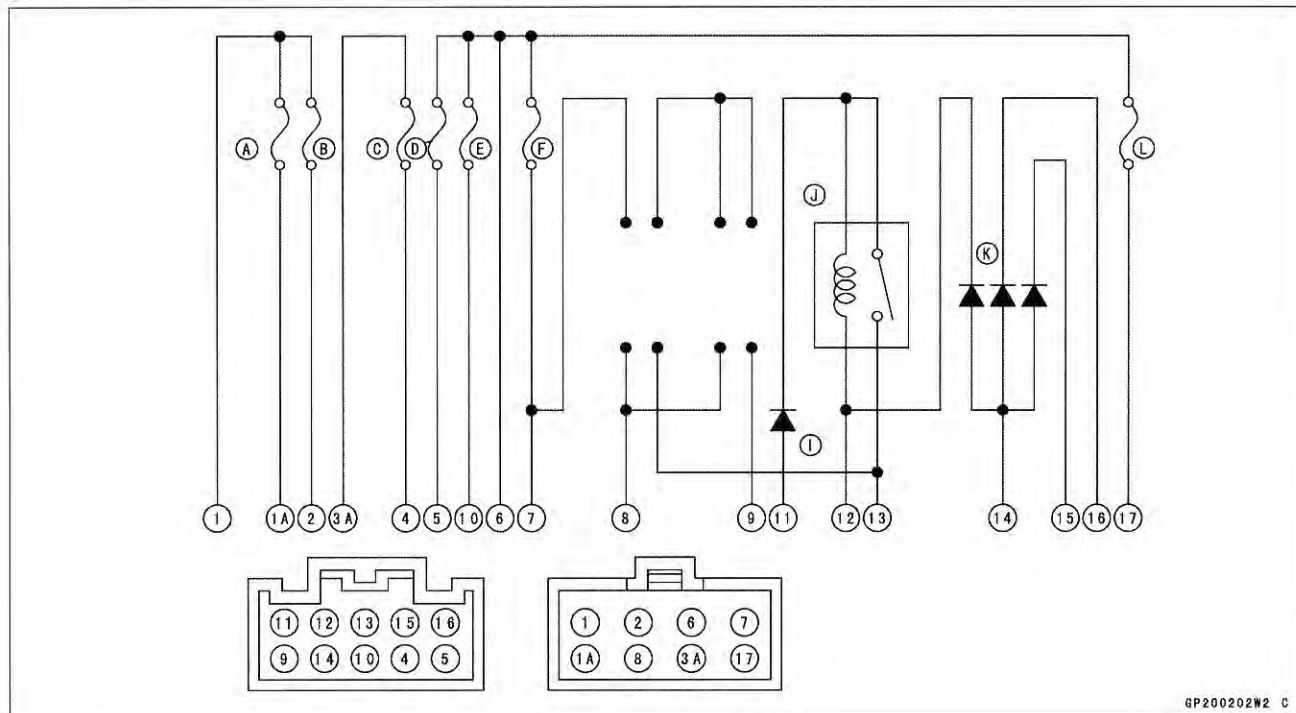
15-80 ELECTRICAL SYSTEM

Junction Box

Junction Box Internal Circuit (Australia, Canada, and U.S.)



Junction Box Internal Circuit (Except for Australia, Canada, and U.S.)



Accessory Fuse 10 A × 32 [A]

Fan Fuse 10 A × 32 [B]

Turn Signal Fuse 10 A × 32 [C]

Horn Fuse 10 A × 32 [D]

Ignition Fuse 10 A × 32 [E]

Headlight Fuse 10 A × 32 [F]

Headlight Relay [G]

Headlight Diodes [H]

Starter Diode [I]

Starter Circuit Relay [J]

Interlock Diodes [K]

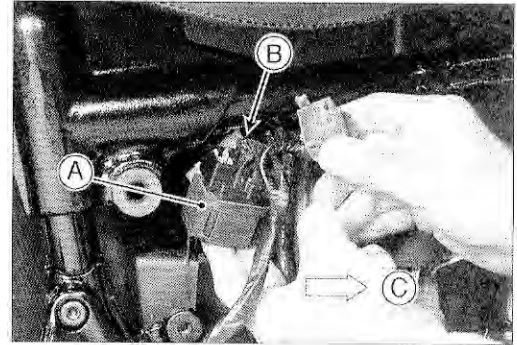
Taillight Fuse 10 A × 32 [L]

Fuse

Main Fuse Removal

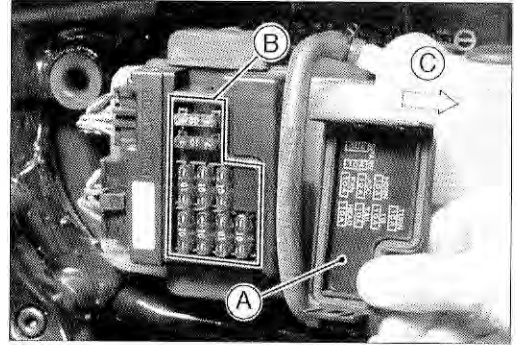
- Remove the right side cover (see Frame chapter).
- Remove the junction box and the reserve tank.
- Remove the starter relay [A].
- Pull out the main fuse [B] from the starter relay with needle nose pliers.

Front [C]



Junction Box Fuse Removal

- Remove the right side cover (see Frame chapter).
- Unlock the hook to lift up the lid [A].
- Pull the fuses [B] straight out of the junction box with needle nose pliers.



Fuse Installation

- If a fuse fails during operation, inspect the electrical system to determine the cause, and then replace it with a new fuse of proper amperage.
- Install the junction box fuses on the original position as specified on the lid.

Fuse Inspection

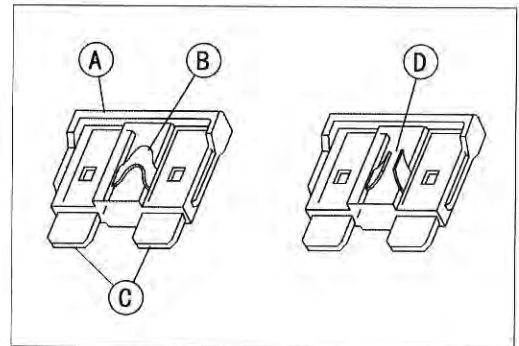
- Remove the fuse (see Fuse Removal).
- Inspect the fuse element.
- ★ If it is down out, replace the fuse. Before replacing a blown fuse, always check the amperage in the affected circuit. If the amperage is equal to or greater than the fuse rating, check the wiring and related components for a short circuit.

Housing [A]

Fuse Element [B]

Terminals [C]

Blown Element [D]



CAUTION

Do not use a fuse rated for other amperage and voltage specified in the wiring diagram. Installation of a fuse with a higher rating may cause damage to wiring and components, and a fuse of a lower rating will soon blow again.

Appendix

Table of Contents

Additional Considerations for Racing 16-2

 Spark Plug: 16-2

 Spark Plug Inspection 16-4

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General Lubrication 16-10

 Lubrication (Periodic Maintenance) 16-10

Nut, Bolt, and Fastener Tightness 16-11

 Tightness Inspection (Periodic Inspection) 16-11

Unit Conversion Table 16-12

16-2 APPENDIX

Additional Considerations for Racing

This motorcycle has been manufactured for use in a reasonable and prudent manner and as a vehicle only. However, some may wish to subject this motorcycle to abnormal operation, such as would be experienced under racing conditions. KAWASAKI STRONGLY RECOMMENDS THAT ALL RIDERS RIDE SAFELY AND OBEY ALL LAWS AND REGULATIONS CONCERNING THEIR MOTORCYCLE AND ITS OPERATION.

Racing should be done under supervised conditions, and recognized sanctioning bodies should be contacted for further details. For those who desire to participate in competitive racing or related use, the following technical information may prove useful. However, please note the following important notes.

- You are entirely responsible for the use of your motorcycle under abnormal conditions such as racing, and Kawasaki shall not be liable for any damages which might arise from such use.
- Kawasaki's Limited Motorcycle Warranty and Limited Emission Control Systems Warranty specifically exclude motorcycles which are used in competition or related uses. Please read the warranty carefully.
- Motorcycle racing is a very sophisticated sport, subject to many variables. The following information is theoretical only, and Kawasaki shall not be liable for any damages which might arise from alterations utilizing this information.
- When the motorcycle is operated on public roads, it **must** be in its original state in order to ensure safety and compliance with applicable regulations.

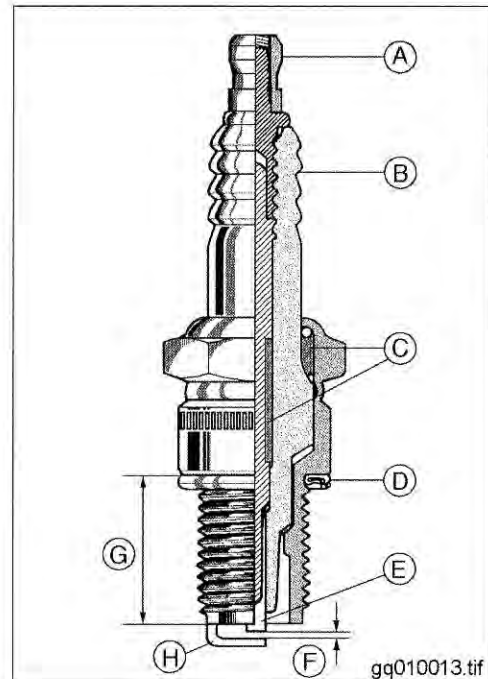
Spark Plug:

The spark plug ignites the fuel and air mixture in the combustion chamber. To do this effectively and at the proper time, the correct spark plug must be used, and the spark plug must be kept clean and the gap adjusted.

Tests have shown the plug listed in the "General Information" chapter to be the best plug for general use.

Since spark plug requirements change with the ignition and with riding conditions, whether or not a spark plug of the correct heat range is used should be determined by removing and inspecting the plug.

- Terminal [A]
- Insulator [B]
- Cement [C]
- Gasket [D]
- Center Electrode [E]
- Gap [F]
- Reach [G]
- Side Electrode [H]



Additional Considerations for Racing

When a plug of the correct heat range is being used, the electrodes will stay hot enough to keep all the carbon burned off, but cool enough to keep from damaging the engine and the plug itself. This temperature is about 400 ~ 800°C (750 ~ 1450°F) and can be judged by noting the condition and color of the ceramic insulator around the center electrode. If the ceramic is clean and of a light brown color, the plug is operating at the right temperature.

A spark plug for higher operating temperatures is used for racing. Such a plug is designed for better cooling efficiency so that it will not overheat and thus is often called a "colder" plug. If a spark plug with too high a heat range is used - that is, a "cold" plug that cools itself too well - the plug will stay too cool to burn off the carbon, and the carbon will collect on the electrodes and the ceramic insulator.

The carbon on the electrodes conducts electricity, and can short the center electrode to ground by either coating the ceramic insulator or bridging across the gap. Such a short will prevent an effective spark. Carbon build-up on the plug can also cause other troubles. It can heat up red-hot and cause preignition and knocking, which may eventually burn a hole in the top of the piston.

16-4 APPENDIX

Additional Considerations for Racing

Spark Plug Inspection

- Remove the spark plug and inspect the ceramic insulator.
- ★ Whether or not the right temperature plug is being used can be ascertained by noting the condition of the ceramic insulator around the electrode. A light brown color indicates the correct plug is being used. If the ceramic is black, it indicates that the plug is firing at too low a temperature, so the next hotter type should be used instead. If the ceramic is white, the plug is operating at too high a temperature and it should be replaced with the next colder type.

Carbon Fouling [A]

Oil Fouling [B]

Normal Operation [C]

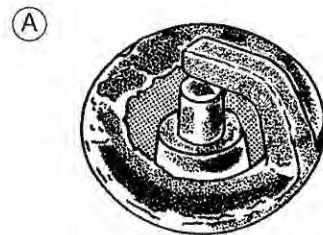
Overheating [D]

CAUTION

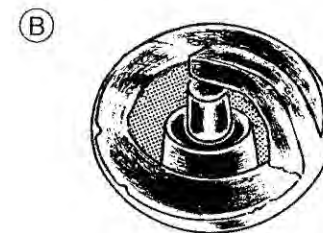
If the spark plug is replaced with a type other than the standard plug, make certain the replacement plug has the same thread pitch and reach (length of threaded portion) and the same insulator type (regular type or projected type) as the standard plug.

If the plug reach is too short, carbon will build up on the plug hole threads in the cylinder head, causing overheating and making it very difficult to insert the correct spark plug later.

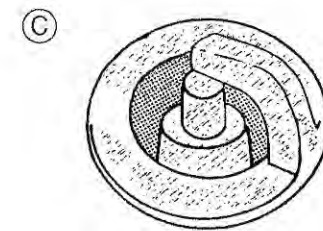
If the reach is too long, carbon will build up on the exposed spark plug threads causing overheating, preignition, and possibly burning a hole in the piston top. In addition, it may be impossible to remove the plug without damaging the cylinder head.



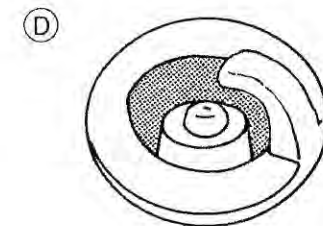
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Standard Spark Plug Threads

Diameter: 12 mm
Pitch: 1.25 mm
Reach: 19 mm

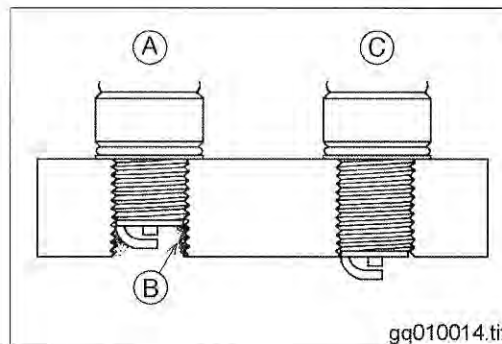
NOTE

- The heat range of the spark plug functions like a thermostat for the engine. Using the wrong type of spark plug can make the engine run too hot (resulting in engine damage) or too cold (with poor performance, misfiring, and stalling).

Too short [A]

Carbon builds up here [B]

Correct reach [C]



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Troubleshooting Guide (except DFI)

NOTE

- Refer to Fuel System chapter for most of DFI troubleshooting guide.
- This is not an exhaustive list, giving every possible cause for each problem listed. It is meant simply as a rough guide to assist the troubleshooting for some of the more common difficulties.

Engine Doesn't Start, Starting Difficulty:

Starter motor not rotating:

- Starter lockout switch or neutral switch trouble
- Starter motor trouble
- Battery voltage low
- Starter relays not contacting or operating
- Starter button not contacting
- Wiring open or shorted
- Ignition switch trouble
- Engine stop switch trouble
- Fuse blown

Starter motor rotating but engine doesn't turn over:

- Starter clutch trouble
- Vehicle-down sensor (DFI) coming off

Engine won't turn over:

- Valve seizure
- Rocker arm seizure
- Cylinder, piston seizure
- Crankshaft seizure
- Connecting rod small end seizure
- Connecting rod big end seizure
- Transmission gear or bearing seizure
- Camshaft seizure
- Balancer bearing seizure

No fuel flow:

- No fuel in tank
- Fuel pump trouble
- Fuel tank air vent obstructed
- Fuel filter clogged
- Fuel line clogged

Engine flooded:

- Clean spark plugs and adjust plug gaps
- Starting technique faulty (When flooded, do not crank the engine with the throttle fully opened. This promotes engine flood because more fuel is supplied automatically by DFI.)

No spark; spark weak:

- Vehicle-down sensor (DFI) coming off
- Ignition switch not ON
- Engine stop switch turned off
- Clutch lever not pulled in or gear not in neutral
- Battery voltage low
- Spark plug dirty, broken, or gap maladjusted
- Spark plug cap or high tension wiring trouble
- Spark plug cap shorted or not in good contact
- Spark plug incorrect
- IC igniter in ECU trouble
- Neutral, starter lockout, or sidestand switch trouble
- Pickup coil trouble
- Ignition coil trouble
- Ignition switch or engine stop switch shorted
- Wiring shorted or open
- Fuse blown

Fuel/air mixture incorrect:

- Air cleaner clogged, poorly sealed, or missing

Compression Low:

- Spark plug loose
- Cylinder head not sufficiently tightened down
- Cylinder, piston worn
- Piston ring bad (worn, weak, broken, or sticking)
- Piston ring/groove clearance excessive
- Cylinder head gasket damaged
- Cylinder head warped
- Valve spring broken or weak
- Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)
- Compression release cam (KACR) sticks open (Engine stalls when moving off)
- HLA (Hydraulic lash adjuster) damaged (worn, seizure, or spring broken)
- HLA oil passage clogged

Poor Running at Low Speed:

Spark weak:

- Battery voltage low
- Spark plug dirty, broken, or maladjusted
- Spark plug cap or high tension wiring trouble
- Spark plug cap shorted or not in good contact
- Spark plug incorrect
- IC igniter in ECU trouble
- Pickup coil trouble
- Ignition coil trouble

Fuel/air mixture incorrect:

- Air cleaner clogged, poorly sealed, or missing
- Fuel tank air vent obstructed
- Throttle assy loose
- Throttle assy O-ring damage
- Air cleaner duct loose
- Air cleaner O-ring damaged
- Fuel pump trouble

Compression low:

- Spark plug loose
- Cylinder head not sufficiently tightened down
- Cylinder, piston worn
- Piston ring bad (worn, weak, broken, or sticking)
- Piston ring/groove clearance excessive
- Cylinder head warped
- Cylinder head gasket damaged
- Valve spring broken or weak
- Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)
- KACR sticks open (Engine stalls when moving off)
- HLA seizure

Backfiring when deceleration:

- Vacuum switch valve broken
- Air suction valve trouble

Other:

- IC igniter in ECU trouble
- Engine oil viscosity too high
- Drive train trouble
- Final gear case oil viscosity too high
- Brake dragging
- Engine overheating
- Clutch slipping
- Air suction valve trouble
- Vacuum switch valve trouble

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Troubleshooting Guide (except DFI)

Poor Running or No Power at High Speed:

Firing incorrect:

- Spark plug dirty, broken, or maladjusted
- Spark plug cap or high tension wiring trouble
- Spark plug cap shorted or not in good contact
- Spark plug incorrect
- IC igniter in ECU trouble
- Pickup coil trouble
- Ignition coil trouble

Fuel/air mixture incorrect:

- Air cleaner clogged, poorly sealed, or missing
- Air cleaner duct loose
- Air cleaner O-ring damaged
- Water or foreign matter in fuel
- Throttle assy loose
- Throttle assy O-ring damage
- Fuel to injector insufficient
- Fuel tank air vent obstructed
- Fuel line clogged
- Fuel pump trouble

Compression low:

- Spark plug loose
- Cylinder head not sufficiently tightened down
- Cylinder, piston worn
- Piston ring bad (worn, weak, broken, or sticking)
- Piston ring/groove clearance excessive
- Cylinder head gasket damaged
- Cylinder head warped
- Valve spring broken or weak
- Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface.)
- KACR sticks open (Engine stalls when moving off)
- HLA seizure

Knocking:

- Carbon built up in combustion chamber
- Fuel poor quality or incorrect (Be sure to use high-octane gasoline recommended in Owner's Manual)
- Spark plug incorrect
- IC igniter in ECU trouble

Miscellaneous:

- Throttle valves won't fully open
- Brake dragging
- Clutch slipping
- Engine overheating
- Engine oil level too high
- Engine oil viscosity too high
- Drive train trouble
- Final gear case oil viscosity too high
- Air suction valve trouble
- Vacuum switch valve trouble
- Catalytic converters melt down due to muffler overheating (KLEEN)

Overheating:

Firing incorrect:

- Spark plug dirty, broken, or maladjusted
- Spark plug incorrect
- IC igniter in ECU trouble

Muffler overheating:

- For KLEEN, do not run the engine even if with only one cylinder misfiring or poor running (Request the nearest service facility to correct it)
- For KLEEN, do not push-start with a dead battery

(Connect another full-charged battery with jumper cables, and start the engine using the electric starter)

For KLEEN, do not start the engine under misfire due to spark plug fouling or poor connection of the spark plug

For KLEEN, do not coast the motorcycle with the ignition switch off (Turn the ignition switch ON and run the engine)

IC igniter in ECU trouble

Fuel/air mixture incorrect:

- Throttle assy loose
- Throttle assy O-ring damage
- Air cleaner duct loose
- Air cleaner poorly sealed, or missing
- Air cleaner O-ring damaged
- Air cleaner clogged

Compression high:

- Carbon built up in combustion chamber
- KACR sticks close

Engine load faulty:

- Clutch slipping
- Engine oil level too high
- Engine oil viscosity too high
- Drive train trouble
- Final gear case oil viscosity too high
- Brake dragging

Lubrication inadequate:

- Engine oil level too low
- Engine oil poor quality or incorrect

Water temperature warning system incorrect:

- Water temperature warning light broken
- Water temperature switch broken

Coolant incorrect:

- Coolant level too low
- Coolant deteriorated
- Wrong coolant mixed ratio

Cooling system component incorrect:

- Radiator fin damaged
- Radiator clogged
- Thermostat trouble
- Radiator cap trouble
- Radiator fan switch trouble
- Fan motor broken
- Fan blade damaged
- Water pump not turning
- Water pump impeller damaged

Over Cooling:

Cooling system component incorrect:

- Radiator fan switch trouble
- Thermostat trouble

Clutch Operation Faulty:

Clutch slipping:

- Friction plate worn or warped
- Steel plate worn or warped
- Spring plate free play maladjustment
- Clutch spring broken or weak
- Clutch slave cylinder trouble
- Clutch hub or housing unevenly worn
- Clutch master cylinder trouble

Troubleshooting Guide (except DFI)

Clutch not disengaging properly:

- Clutch plate warped or too rough
- Spring plate free play maladjustment
- Engine oil deteriorated
- Engine oil viscosity too high
- Engine oil level too high
- Clutch housing frozen on drive shaft
- Clutch slave cylinder trouble
- Clutch hub nut loose
- Clutch hub spline damaged
- Clutch friction plate installed wrong
- Clutch fluid leakage
- Clutch fluid deteriorated
- Clutch master cylinder primary or secondary cup damaged
- Clutch master cylinder scratched inside
- Air in the clutch fluid line

Gear Shifting Faulty:

Doesn't go into gear; shift pedal doesn't return:

- Clutch not disengaging
- Shift fork bent or seized
- Gear stuck on the shaft
- Gear set lever binding
- Shift return spring weak or broken
- Shift return spring pin loose
- Shift mechanism arm spring broken
- Shift mechanism arm broken

Jumps out of gear:

- Shift fork ear worn, bent
- Gear groove worn
- Gear dogs and/or dog holes worn
- Shift drum groove worn
- Gear set lever spring weak or broken
- Shift fork guide pin worn
- Drive shaft, output shaft, and/or gear splines worn

Overshifts:

- Gear set lever spring weak or broken
- Shift mechanism arm spring broken

Abnormal Engine Noise:

Knocking:

- IC igniter in ECU trouble
- Carbon built up in combustion chamber
- Fuel poor quality or incorrect (Be sure to use high-octane gasoline recommended in Owner's Manual)
- Spark plug incorrect
- Overheating

Piston slap:

- Cylinder/piston clearance excessive
- Cylinder, piston worn
- Connecting rod bent
- Piston pin, piston pin hole worn

Valve noise:

- Engine not sufficiently warmed up after HLA installation
- HLA damaged (worn, seizure, or spring broken)
- HLA aeration due to low oil level
- Air in HLA
- Metal chips or dust jammed in HLA
- Engine operated in red zone
- Valve spring broken or weak

Camshaft bearing portion worn

Other noise:

- Connecting rod small end clearance excessive
- Connecting rod big end clearance excessive
- Piston ring worn, broken, or stuck
- Piston seizure, damage
- Cylinder head gasket leaking
- Exhaust pipe leaking at cylinder head connection
- Crankshaft runout excessive
- Engine mounts loose
- Crankshaft bearing worn
- Primary gear worn or chipped
- Camshaft chain tensioner trouble
- Camshaft chain, sprocket, guide worn
- Air suction valve damaged
- Vacuum switch valve damaged
- Alternator rotor loose
- Catalytic converters melt down due to muffler overheating (KLEEN)
- Balancer gear worn or chipped
- Balancer shaft position maladjusted
- Balancer bearing worn
- Balancer shaft coupling rubber damper damaged
- Water pump chain, sprocket worn

Abnormal Drive Train Noise:

Clutch noise:

- Clutch rubber damper weak or damaged
- Clutch housing/friction plate clearance excessive
- Clutch housing gear worn
- Wrong installation of outside friction plate

Transmission noise:

- Bearings worn
- Transmission gears worn or chipped
- Metal chips jammed in gear teeth
- Engine oil insufficient

Drive line noise:

- Bevel gear bearings worn
- Bevel gears worn or chipped
- Bevel gears maladjusted
- Rear wheel coupling damaged
- Final gear case oil level too low or oil too thin
- Insufficient grease in propeller shaft joint

Abnormal Frame Noise:

Front fork noise:

- Oil insufficient or too thin
- Spring weak or broken

Rear shock absorber noise:

- Shock absorber damaged

Disc brake noise:

- Pad installed incorrectly
- Pad surface glazed
- Disc warped
- Caliper trouble
- Master cylinder damaged

Other noise:

- Bracket, nut, bolt, etc. not properly mounted or tightened

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Troubleshooting Guide (except DFI)

Oil Pressure Warning Light Goes On:

- Engine oil pump damaged
- Engine oil screen clogged
- Engine oil filter clogged
- Engine oil level too low
- Engine oil viscosity too low
- Camshaft bearing portion worn
- Crankshaft bearings worn
- Oil pressure switch damaged
- Oil pressure switch lead damaged
- Relief valve stuck open
- O-ring at the oil pipe in the crankcase damaged

Exhaust Smokes Excessively:

White smoke:

- Piston oil ring worn
- Cylinder worn
- Valve oil seal damaged
- Valve guide worn
- Engine oil level too high

Black smoke:

- Air cleaner clogged

Brown smoke:

- Air cleaner duct loose
- Air cleaner O-ring damaged
- Air cleaner poorly sealed or missing
- Choke knob left pulled out

Handling and/or Stability Unsatisfactory:

Handlebar hard to turn:

- Cable routing incorrect
- Hose routing incorrect
- Wiring routing incorrect
- Steering stem nut too tight
- Steering stem bearing damaged
- Steering stem bearing lubrication inadequate
- Steering stem bent
- Tire air pressure too low

Handlebar shakes or excessively vibrates:

- Tire worn
- Swingarm sleeve or pivot bearings worn
- Wheel rim warped, or not balanced
- Spokes loose
- Wheel bearing worn
- Handlebar clamp bolts loose
- Steering stem head nut loose
- Front, rear axle runout excessive

Handlebar pulls to one side:

- Frame bent
- Swingarm bent or twisted
- Swingarm pivot shaft runout excessive
- Steering maladjusted
- Front fork bent
- Right and left front fork oil level uneven

Shock absorption unsatisfactory:

- (Too hard)
- Front fork oil excessive
- Front fork oil viscosity too high
- Rear shock absorber adjustment too hard
- Tire air pressure too high
- Front fork bent
- (Too soft)

- Tire air pressure too low
- Front fork oil insufficient and/or leaking
- Front fork oil viscosity too low
- Rear shock adjustment too soft
- Front fork, rear shock absorber spring weak
- Rear shock absorber oil leaking

Brake Doesn't Hold:

- Air in the brake line
- Pad or disc worn
- Brake fluid leakage
- Disc warped
- Contaminated pad
- Brake fluid deteriorated
- Primary or secondary cup damaged in master cylinder
- Master cylinder scratched inside

Troubleshooting Guide (except DFI)

Battery Trouble:**Battery discharged:**

- Charge insufficient
- Battery faulty (too low terminal voltage)
- Battery leads making poor contact
- Load excessive (e.g., bulb of excessive wattage)
- Ignition switch trouble
- Alternator trouble

- Wiring faulty

- Regulator/rectifier trouble

Battery overcharged:

- Alternator trouble
- Regulator/rectifier trouble
- Battery faulty

16-10 APPENDIX

General Lubrication

Lubrication (Periodic Maintenance)

- Before lubricating each part, clean off any rusty spots with rust remover and wipe off any grease, oil, dirt, or grime.
- Lubricate the points listed below with indicated lubricant.

NOTE

- Perform the general lubrication in accordance with the Periodic Maintenance Chart or whenever the vehicle has been operated under wet or rainy conditions, or especially after using a high-pressure water spray.

Pivots: Lubricate with Motor Oil.

Rear Brake Rod Joint

Points: Lubricate with Grease.

Throttle Inner Cable Upper Ends [A]

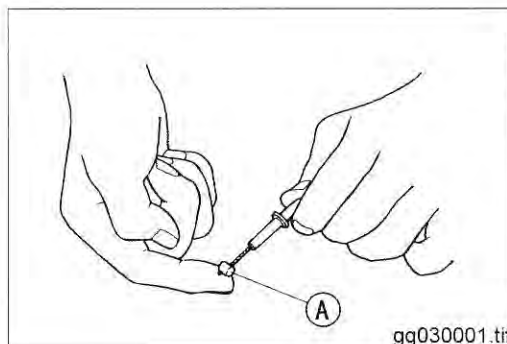
Brake Pedal

Clutch Lever (Apply silicone grease)

Brake Lever (Apply silicone grease)

Sidestand

(*): Grease the lower part of the inner cable sparingly.

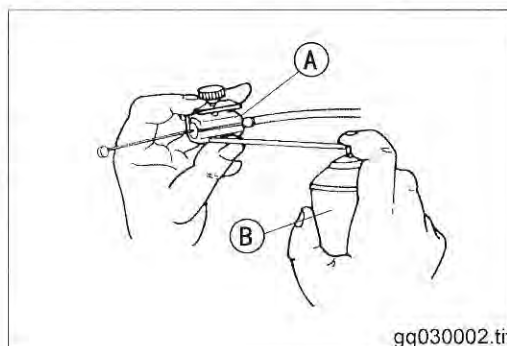


Cables: Lubricate with Cable Lubricant.

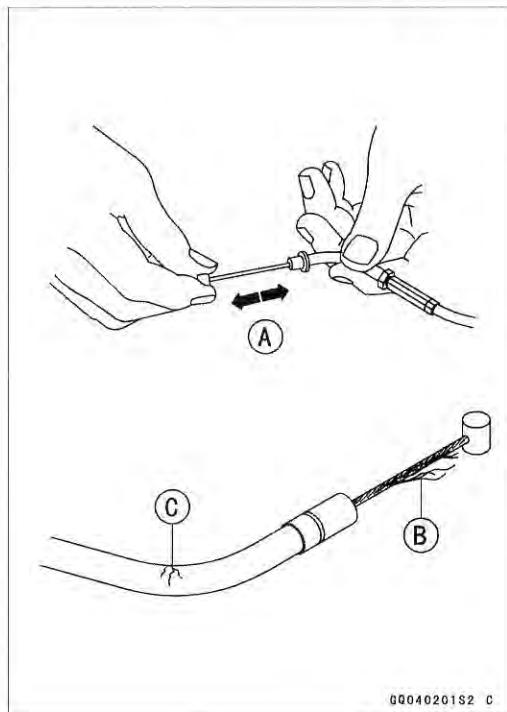
Choke Cable

Throttle Cables

- Lubricate the cables by seeping the oil between the cable and housing.
- The cable may be lubricated by using a commercially available pressure cable lubricator [A] with an aerosol cable lubricant [B].



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



Nut, Bolt, and Fastener Tightness

Tightness Inspection (Periodic Inspection)

- Check the tightness of the bolts and nuts listed here in accordance with the Periodic Maintenance Chart. 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 Torque and Locking Agent section of the General Information chapter for torque specifications. For each fastener, first loosen it by 1/2 turn, then tighten it.
- ★ If cotter pins are damaged, replace them with new ones.

Nut, Bolt and Fastener to be checked

Wheels:

Front Axle Nut
Front Axle Clamp Bolt
Front Fender Mounting Bolts
Rear Fender Bracket Bolts
Rear Axle Nut Cotter Pin
Rear Axle Nut

Final Drive:

Final Gear Case Mounting Nuts

Brakes:

Front Master Cylinder Clamp Bolts
Caliper Mounting Bolts
Rear Master Cylinder Mounting Bolts
Rear Caliper Holder Bolt
Brake Lever Pivot Nut
Brake Pedal Bolt
Brake Rod Joint Cotter Pin

Suspension:

Front Fork Clamp Bolts
Rear Shock Absorber Mounting Nuts
Swingarm Pivot Shaft

Steering:

Stem Head Nut
Handlebar Clamp Bolts

Engine:

Throttle Cable Adjuster Locknuts
Engine Mounting Bolts and Nuts
Shift Pedal Bolts
Muffler Mounting Bolts and Nuts
Muffler Connecting Clamp Bolts
Exhaust Pipe Holder Nuts
Clutch Master Cylinder Clamp Bolts
Clutch Lever Pivot Nut
Radiator Mounting Bolt
Clutch Master Cylinder Clamps

Others:

Sidestand Bolt and Nut
Footboard Bolts (front)
Footpeg Bracket Bolts (rear)
Downtube Bolts (Right)

16-12 APPENDIX

Unit Conversion Table

Prefixes for Units:

Prefix	Symbol	Power
mega	M	$\times 1\,000\,000$
kilo	k	$\times 1\,000$
centi	c	$\times 0.01$
milli	m	$\times 0.001$
micro	μ	$\times 0.000001$

Units of Mass:

kg	$\times$	2.205	=	lb
g	$\times$	0.03527	=	oz
oz: ounce				

Units of Volume:

L	$\times$	0.2642	=	gal (US)
L	$\times$	0.2200	=	gal (imp)
L	$\times$	1.057	=	qt (US)
L	$\times$	0.8799	=	qt (imp)
L	$\times$	2.113	=	pint (US)
L	$\times$	1.816	=	pint (imp)
mL	$\times$	0.03381	=	oz (US)
mL	$\times$	0.02816	=	oz (imp)
mL	$\times$	0.06102	=	cu in

imp: imperial unit

Units of Force:

N	$\times$	0.1020	=	kg
N	$\times$	0.2248	=	lb
kg	$\times$	9.80665	=	N
kg	$\times$	2.205	=	lb

Units of Length:

km	$\times$	0.6214	=	mile
m	$\times$	3.281	=	ft
mm	$\times$	0.03937	=	in

Units of Torque:

N·m	$\times$	0.101972	=	kg·m
N·m	$\times$	0.7376	=	ft·lb
N·m	$\times$	8.851	=	in·lb
kg·m	$\times$	9.80665	=	N·m
kg·m	$\times$	7.233	=	ft·lb
kg·m	$\times$	86.80	=	in·lb

Units of Pressure:

kPa	$\times$	0.01020	=	kg/cm ²
kPa	$\times$	0.1450	=	psi
kPa	$\times$	0.7501	=	cm Hg
kg/cm ²	$\times$	98.0665	=	kPa
kg/cm ²	$\times$	14.22	=	psi
cm Hg	$\times$	1.333	=	kPa

Units of Speed:

km/h	$\times$	0.6214	=	mph
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Units of Power:

kW	$\times$	1.360	=	PS
kW	$\times$	1.341	=	HP
PS	$\times$	0.7355	=	kW
PS	$\times$	0.9863	=	HP

Units of Temperature:

$$(^{\circ}\text{C}) \times \frac{9}{5} + 32 = ^{\circ}\text{F}$$

$$(^{\circ}\text{F}) \times \frac{5}{9} - \frac{160}{9} = ^{\circ}\text{C}$$

