Kawasaki

Ninja ZX-9R

Product: 1998
Full Downloa
zx-9r-motocy

Motorcycle
Service Manual

Sample of ma
https://www.a

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LIST OF ABBREVIATIONS

A	ampere(s)	lb	pounds(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)		

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Read OWNER'S MANUAL before operating.

EMISSION CONTROL INFORMATION

To protect the environment in which we all live, Kawasaki has incorporated crankcase emission (1) and exhaust emission (2) control systems in compliance with applicable regulations of the United States Environmental Protection Agency and California Air Resources Board. Additionally, Kawasaki has incorporated an evaporative emission control system (3) in compliance with applicable regulations of the California Air Resources Board on vehicles sold in California only.

1. Crankcase Emission Control System

   This system eliminates the release of crankcase vapors into the atmosphere. Instead, the vapors are routed through an oil separator to the intake side of the engine. While the engine is operating, the vapors are drawn into combustion chamber, where they are burned along with the fuel and air supplied by the carburetion system.

2. Exhaust Emission Control System

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

3. Evaporative Emission Control System

   Vapors caused by fuel evaporation in the fuel system are not vented into the atmosphere. Instead, fuel vapors are routed into the running engine to be burned, or stored in a canister when the engine is stopped. Liquid fuel is caught by a vapor separator and returned to the fuel tank.

The Clean Air Act, which is the Federal law covering motor vehicle pollution, contains what is commonly referred to as the Act's "tampering provisions."

"Sec. 203(a) The following acts and the causing thereof are prohibited...

(3)(A) for any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer knowingly to remove or render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser.

(3)(B) for any person engaged in the business of repairing, servicing, selling, leasing, or trading motor vehicles or motor vehicle engines, or who operates a fleet of motor vehicles knowingly to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title following its sale and delivery to the ultimate purchaser..."

(Continued on next page.)

Quick Reference Guide

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

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

NOTE

- *The phrase "remove or render inoperative any device or element of design" has been generally interpreted as follows:*
  1. *Tampering does not include the temporary removal or rendering inoperative of devices or elements of design in order to perform maintenance.*
  2. *Tampering could include:*
     a. *Maladjustment of vehicle components such that the emission standards are exceeded.*
     b. *Use of replacement parts or accessories which adversely affect the performance or durability of the motorcycle.*
     c. *Addition of components or accessories that result in the vehicle exceeding the standards.*
     d. *Permanently removing, disconnecting, or rendering inoperative any component or element of design of the emission control systems.*

WE RECOMMEND THAT ALL DEALERS OBSERVE THESE PROVISIONS OF FEDERAL LAW, THE VIOLATION OF WHICH IS PUNISHABLE BY CIVIL PENALTIES NOT EXCEEDING $10,000 PER VIOLATION.

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 intake system by cutting, drilling, or other means if such modifications result in increased noise levels.

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 motorcycle:

- 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 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.

General Information

Table of Contents

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 Ground

Remove the ground (−) lead from the battery before performing any disassembly operations on the motorcycle. 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 leaks.

(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.

(14) Circlip, Retaining Ring, and Cotter Pin

Replace any circlips, 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.

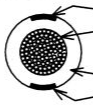
(15) Lubrication

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.

General Specifications

Items	ZX900-C1	D1
Dimensions:		
Overall length	2 050 mm, (FG)(GR)(NR)(SW) 2 115 mm	2115 mm
Overall width	720 mm	
Overall height	1 155 mm	←
Wheelbase	1 415 mm	←
Road clearance	160 mm	←
Seat height	810 mm	←
Dry mass	183 kg, (CA) 186 kg	185 kg
Curb mass: Front	107 kg (CA) 107.5 kg	107 kg
Rear	100 kg, (CA) 102.5 kg	102 kg
Fuel tank capacity	19 L	←
Performance:		
Minimum turning radius	3.2 m	
Engine:		
Type	4-stroke, DOHC, 4-cylinder	
Cooling system	Liquid-cooled	←
Bore and stroke	75.0 x 50.9 mm	←
Displacement	899 mL	←
Compression ratio	11.5	←
Maximum horsepower	105 kW (143 PS) @11 000 r/min (rpm), (KR, AS) 104 kW (142 PS) @11 000 r/min (rpm) (FG) 72 kW (98 PS) @11 000 r/min (rpm), (FR) 78.2 kW (106.3 PS) @11 000 r/min (rpm) (UTAC's norm), (SW) 55 kW (75 PS) @10 000 r/min (rpm), (US) ---	(FG) 72 kW (98 PS) @11 000 r/min (rpm) (ST) 104 kW (142 PS) @11 000 r/min (rpm)
Maximum torque	101 N-m(10.3 kg-m, 73 ft-lb) @9 000 r/min (rpm), (KR, AS) 100 N-m (10.2 kg-m, 72 ft-lb) @9 000 r/min (rpm) (FG) 83 N-m (8.5 kg-m, 61 ft-lb) @9 000 r/min (rpm), (SW) 79 N-m (8.0 kg-m, 58 ft-lb) @4 000 r/min (rpm), (FR)(UK)(US) ---	(FG) 83 N-m (8.5 kg-m, 61 ft-lb) @6 000 r/min (rpm) (ST) 100 N-m (10.2 kg-m, 72 ft-lb) @9 000 r/min (rpm)
Carburetion system	Carburetors, Keihin CVKD 40 x 4	
Starting system	Electric starter	←
Ignition system	Battery and coil (transistorized)	←
Timing advance	Electronically advanced(digital igniter)	←
Ignition timing	From 10° BTDC @1 100 r/min (rpm) to 32.5° BTDC @5 000 r/min (rpm)	←
Spark plug	NGK CR9EK or ND U27ETR	
Cylinder numbering method	Left to right, 1-2-3-4	←
Firing order	1-2-4-3	←
Valve timing:		
Inlet Open	55° BTDC	
Close	81° ABDC	←
Duration	316°	←
Exhaust Open	47° BBDC	←
Close	65° ATDC	←
Duration	292°	←

Items	ZX900-C1	D1
Lubrication system	Forced lubrication (wet sump with cooler)	←
Engine oil:		
Grade	SE, SF or SG class	←
Viscosity	SAE10W-40, 10W-50, 20W-40, or 20W-50	←
Capacity	3.8 L	←
Drive Train:		
Primary reduction system:		
Type	Gear	←
Reduction ratio	1.714 (84/49)	←
Clutch type	Wet multi disc	←
Transmission:		
Type	6-speed, constant mesh, return shift	←
Gear ratios:		
1st	2.571 (36/14)	←
2nd	1.941 (33/17)	←
3rd	1.556 (28/18)	←
4th	1.333 (28/21)	←
5th	1.200 (24/20)	←
6th	1.095 (23/21)	←
Final drive system:		
Type	Chain drive	←
Reduction ratio	2.563 (41/16)	←
Overall drive ratio	4.811 @Top gear	←
Frame:		
Type	Tubular, diamond	←
Caster (rake angle)	24°	←
Trail	93 mm	←
Front tire: Type	Tubeless	←
Size	120/70 ZR17 (58W)	←
Rear tire: Type	Tubeless	←
Size	180/55 ZR17 (73W)	←
Front suspension:		
Type	Telescopic fork	←
Wheel travel	120 mm	←
Rear suspension:		
Type	Swingarm (uni-trak)	←
Wheel travel	130 mm	←
Brake type: Front	Dual disc	←
Rear	Single disc	←
Electrical Equipment:		
Battery	12 V 8 Ah	←
Headlight: Type	Semi-sealed beam	←
Bulb	12V60/55W (quartz-halogen),	←
Tail/brake light	12 V 5/21 W × 2, (CN)(US) 12 V 8/27 W×2	12 V 5/21 W × 2
Alternator: Type	Three-phase AC	←
Rated output	27 A/ 14 V @5 000 r/min (rpm)	←

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

(AS) : Australian Model
(CA) : California Model
(FG) : German Model
(FR) : French Model
(GR) : Greek Model
(KR) : Korean Model
(ST) : Swiss Model
(SW): Swedish Model
(US): U.S.A. Model
(UK): U.K. Model
(NR): Norwegian Model

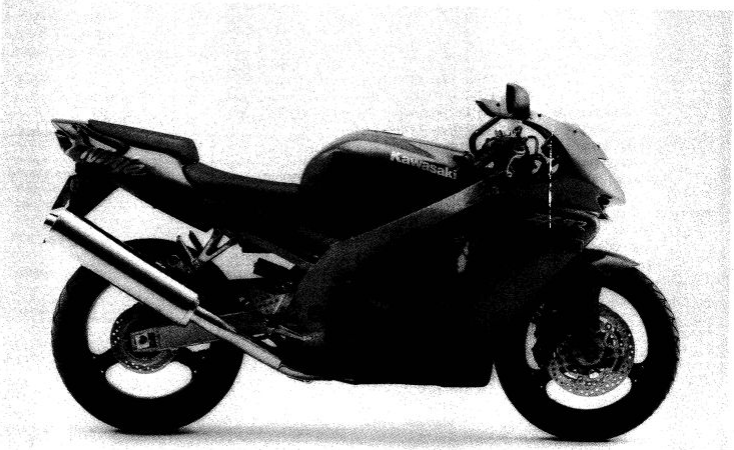
Model Identification

ZX900-C1 (US) Left Side View:

ZX900-C1 (US) Right Side View:

ZX900-D1 (Europe Model) Left Side View:

ZX900-D1 (Europe Model) Right Side View:



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 / OPERATION	Whichever comes first ➡ / Every ⬇	*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)
Spark plug – clean and gap †			●	●	●	●	●	●
Valve clearance – check †				●		●		●
Air suction valve – check †			●	●	●	●	●	●
Air cleaner element and air vent filter – clean† #				●		●		●
Throttle grip play – check †		●		●		●		●
Idle speed – check †		●		●		●		●
Carburetor synchronization – check †				●		●		●
Engine oil – change #	6 months	●	●	●	●	●	●	●
Oil filter – replace		●		●		●		●
Evaporative emission control system (CA) -check †		●	●	●	●	●	●	●
Drive chain wear – check † #			●	●	●	●	●	●
Brake pad wear – check † #			●	●	●	●	●	●
Brake light switch – check †		●	●	●	●	●	●	●
Steering – check †		●	●	●	●	●	●	●
Front fork oil – change	2 years					●		
Rear shock absorber oil leak – check †				●		●		●
Front fork oil leak – check †				●		●		●
Tire wear – check †			●	●	●	●	●	●
Swingarm pivot, Uni-trak linkage – lubricate				●		●		●
General lubrication – perform				●		●		●
Nuts, bolts, and fasteners tightness – check †		●		●		●		●
Drive chain – lubricate #	600 km		●	●	●	●	●	●
Drive chain slack – check † #	1000 km	●	●	●	●	●	●	●
Brake fluid level – check †	month	●	●	●	●	●	●	●
Clutch adjust – check †	month	●	●	●	●	●	●	●
Radiator hoses, connection – check †		●						
Brake fluid – change	2 years					●		
Brake master cylinder cup and dust seal – replace	4 years							
Coolant – change	2 years							
Caliper piston seal and dust seal – replace	4 years					●		
Steering stem bearing – lubricate	2 years							

\# : 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

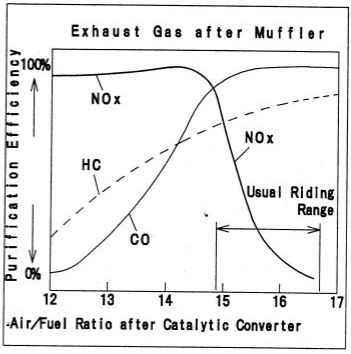
Technical Information - KLEEN (KAWASAKI LOW EXHAUST EMISSION)

The ZX900C (California), and the ZX900D (Germany and Switzerland) have catalytic converters.

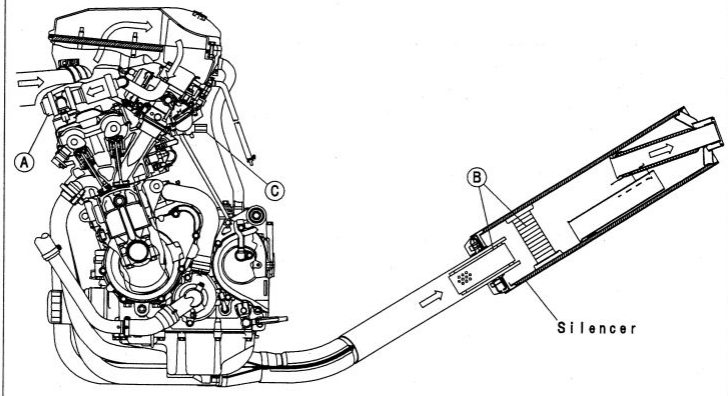
The secondary air injection system [A] helps Kawasaki keep motorcycle exhaust gases below the established emission regulation limits. This system draws air into the exhaust ports, dilutes and burns harmful ingredients in the exhaust gas in order to reduce them. This allows the carburetor to be set at a reasonable setting position without adjusting it much leaner, so engine performance and actual riding performance are not spoiled.

But, under the trend that the emission regulation becomes more severe, Kawasaki has adopted two catalytic converters [B] in addition to the secondary air injection system. Moreover, a CVKD 40-type carburetor has been adopted from the ZX1100D because of its good balance between cost and performance. As a result, we can reduce the exhaust gas emission below the current standards without hurting the output performance and the actual riding feeling at all. The harmful ingredients in the exhaust gas under LA4 or EC-mode running performance was reduced considerably. As actual examples, carbon monoxide (CO) is reduced about 70%, hydrocarbons (HC) about 60%, nitrogen oxides (NOx) about 10%.

Moreover, in order to improve the reliability of the system, we install fuel cut valves [C] as a catalyst protection system.



Kawasaki Low Exhaust Emission System

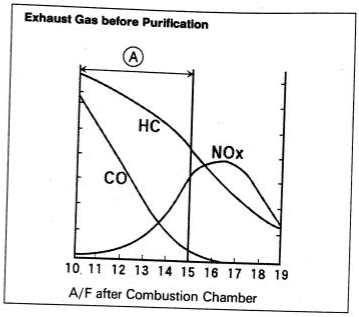


1. Exhaust Purification System

The burned gas, which goes out from the combustion chamber, is injected with secondary air (adding necessary oxygen), and is cleaned up while passing through the small precatalytic converter in the joint pipe and the main catalytic converter in the silencer, and then goes out to the atmosphere.

1) Secondary Air Injection System

In order to oxidize CO, and HC by the catalysts, the proper amount of oxygen is necessary. As original combustion gas has little remaining oxygen, air is injected in the exhaust ports by the secondary air injection system in order to supply enough oxygen to the combustion gas to purify CO, and HC to a certain extent as well as prepare for activation of the catalysts. As for NOx, as the carburetor is set at rich level [A], NOx is at lower level from the beginning as described in the figure.



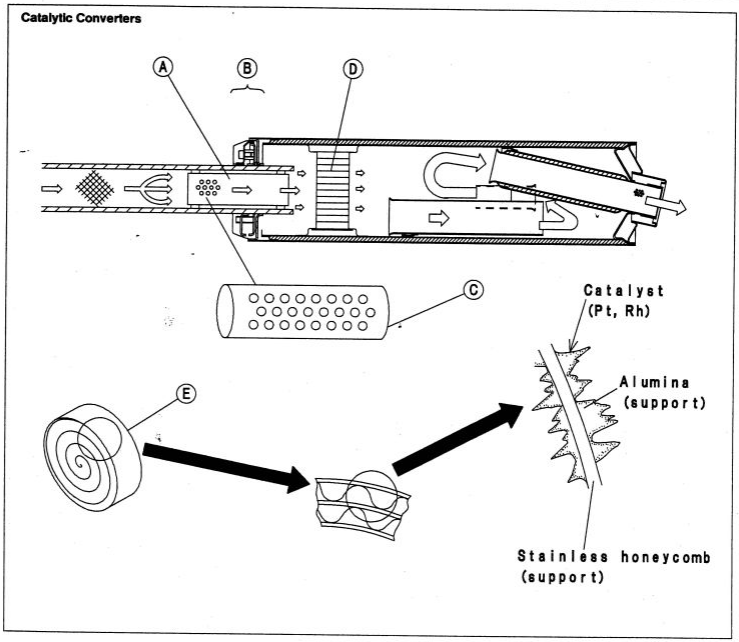
2) Precatalytic Converter [A]

A small-size three-way catalytic converter (precatalytic converter) is installed in the pipe ahead at the joint [B] of the silencer. A precatalytic converter is made from a punched metal pipe [C] of stainless steel, and its surface is covered by alumina upon which platinum and rhodium as catalysts are applied. Generally, the temperature of the exhaust gas must be higher than the activation temperature, so we set this precatalytic converter at the upper portion of the main catalytic converter where the temperature of exhaust gas is high. Accordingly, the precatalytic converter will be activated even under low load conditions. Activation of the precatalytic converter makes the passed exhaust gas heated by the heat of reaction and makes its temperature to the main catalytic converter higher, which helps the main catalytic converter operate more efficiently. The precatalytic converter purifies CO, HC, and NOx to a certain extent.

3) Main Catalytic Converter [D]

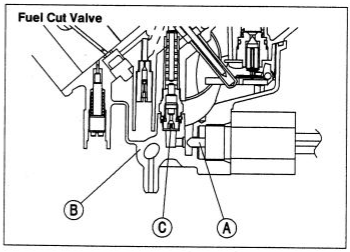
The converter is a three-way catalytic converter upon which platinum and rhodium are applied, and has a cylindrical metallic honeycomb structure [E] made by bending a corrugated sheet and a flat sheet of stainless steel into a spiral of increasing diameter. The main catalytic converter is installed in the first expansion chamber of the silencer. When the exhaust gas passes through the upper portion of the secondary air injection system, the precatalytic converter, and the inside of the honeycomb, the main catalytic converter works efficiently to reduce CO, HC, and NOx. So, we can keep it within regulation.

The honeycomb structure is convenient for the catalytic converter because it has a large surface area but small size to react effectively and low exhaust resistance. In addition, its inherent strength helps resist vibration, and has simple structure welded directly on the silencer.



2. Catalyst Protection System

When excessive unburned gasoline flows more than the allowable amount into the exhaust gas during running, the temperature of the catalysts rises abnormally because the unburned gasoline reacts with heated catalysts (at the activation temperature or higher). In an excessive case, the problem such as melting-down occurs. Moreover, there is a possibility that the purification performance becomes poorer when it is cool (below the activation temperature.) So, the fuel cut valve [A] as a catalyst protection system is installed on each carburetor float bowl [B]. It runs by the IC Igniter and opens and closes the fuel passage toward a main jet [C]. A catalyst protection system works in the following cases.



1) Prevention of unburned gasoline from flowing when overspeed limiter works.
   The limiter has fuel cut-off and ignition cut-off operations.
2) Prevention of unburned gasoline from flowing when the engine stop switch is turned off during running.
   When the engine stop switch is turned off while coasting the motorcycle, fuel is cut off. For example, fuel is cut off under the abnormal running condition that you go down the slope with the engine stop switch OFF.

3) Prevention of unburned gasoline from flowing when misfire occurs by cut-off of a primary coil in a stick coil.
Fuel is cut off when an electric current of a primary coil becomes abnormal because of cut-off the primary coil when the engine running.
4) Prevention of solenoid valve lock
If a driver always runs the engine under the red zone in the tachometer, the IC igniter doesn't operate overspeed limiter and the catalyst protection system doesn't have a chance to work. The old fuel may gum up the fuel cut valves which remain seated in the float bowls. To cope with, the IC igniter test-operates the fuel cut valves when starting the engine and prevents lock of the valves.
5) Usage of leaded gasoline is prohibited completely.
Leaded gasoline harms the purification efficiency of the catalysts. In German model, the shape of the filler cap is modified so that an oil supply nozzle for unleaded gasoline can be installed but for leaded gasoline cannot.

The performance of the catalyst protection system is summed up as follows.

[Performance of Catalyst Protection System]

No	Running condition	Ignition switch	Engine stop switch	Protection system	Fuel cut valve	Remedy (Action)
1	Normal	ON	ON	OFF	OPEN	● Not necessary (Normal condition)
2	Overspeed performance	ON	ON	ON	CLOSE	● Not necessary
3	Abnormal (misfire) ● Defects at the stick coil primary-side	ON	ON	ON	CLOSE	● Inspect the connection at the primary-side of the stick coil.
4	Abnormal (misfire) ● Defects at the stick coil secondary-side ● Battery is dead. ● Spark plug fouling ● Defects of the pickup coil ● Defects of the IC igniter ● Defects of the carburetor	ON	ON	OFF	OPEN	● Inspect the stick coil. ● Charge the battery. ● Clean the spark plug and adjust the gap. ● Inspect and replace the pickup coil. ● Inspect and replace the IC igniter. ● Inspect and adjust the carburetor.
5	Abnormal (no spark) ● Short of the engine stop switch ● While coasting the motorcycle, do not turn the engine stop switch OFF.	ON	OFF	ON	CLOSE	● Inspect and repair the engine stop switch. ● Turn the engine stop switch ON, and run.
6	Abnormal (no spark) ● Short of the ignition switch ● While coasting the motorcycle, do not turn the ignition switch OFF.	OFF	ON or OFF	OFF	OPEN	● Inspect and replace the ignition switch. ● Turn the ignition switch and the engine stop switch ON, and run.

3. Maintenance

Special maintenance is not necessary except for the inspection of the air suction valve (which has been described in manuals).

1) Replacement of Muffler Assy

It is impossible to replace only catalytic converters because they are welded in the muffler. So, in the following case, the replacement of the muffler assy is also necessary.

- In case of using not-appointed fuel (leaded gasoline, etc.):
  Purification efficiency decreases in a very short period because lead poisons the catalytic converters. Although the appearance of the converter and engine performance are not effected, the replacement of a muffler assy is necessary to secure the purification efficiency of exhaust gas.
- In case catalytic converters melt down by over-heating:
  Especially in the case that a lot of unburned gasoline flows into the catalytic converters under the extreme running condition far beyond common sense, there is a possibility that the catalysts overreact and that catalytic converters overheat severely. If they melt down, it causes poor engine performance, deterioration of emission noise level and purification efficiency. So, the muffler assy must be replaced.

2) Durability

It has the same durability as a conventional muffler.

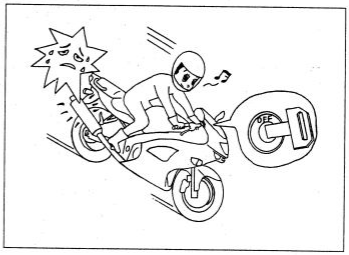
3) Disposal to Waste

As any harmful toxic substance is not used especially, it can be disposed as usual industrial wastes. The body of the muffler is made of stainless steel. The catalytic converter is also made of stainless steel which has alumina on its surface, and the main ingredients of catalysts are platinum and rhodium.

4. Handling Precautions

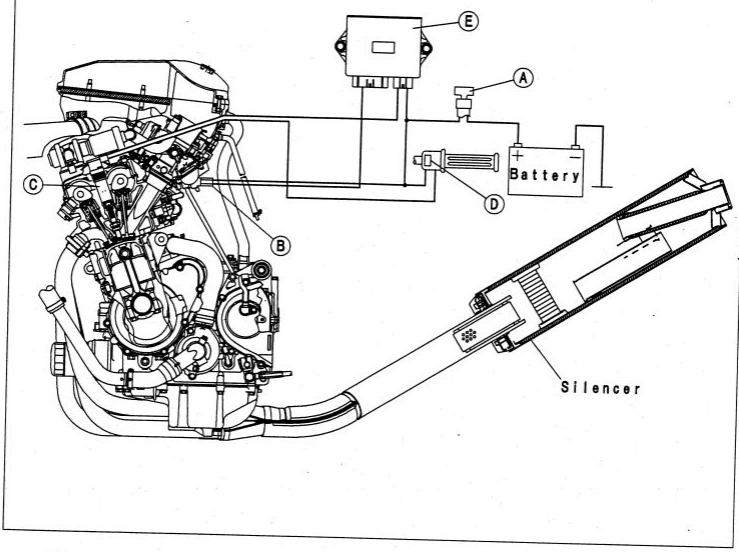
Catalyst protection system against mishandling is applied to a vehicle with catalysts. But, we prohibit depending on the system too much when running.

1) Use only unleaded gasoline:
   Usage of leaded gasoline is prohibited completely. Only fuel and additives which are specified in the Owner's manual can be used.
2) Use specified engine oil which is described in the Owner's manual:
   In case of some ingredients which give bad effects to the catalysts (such as phosphorus "P", lead "Pb", sulfur "S") are included, the purification efficiency decreases.
3) Coasting (such as cranking while going down a slope) is prohibited with the ignition system OFF:
   The engine running without igniting causes a great flow of unburned gasoline and the decreasing of purification efficiency, and melting down of catalysts at the activation temperature or higher.



- When the ignition switch [A] is turned off, the fuel cut valves [B] do not work. So, avoid coasting with the ignition switch OFF.
- Do not run the engine nor coast the motorcycle under the misfire which occurs by defects such as a bad connection with the spark plug at the secondary wiring of the stick coil [C].
- Do not coast too much with the engine stop switch [D] OFF. Under the condition that the engine stop switch is turned off during running, the IC igniter [E] closes the fuel cut valves to shut off fuel.
- Do not run the engine nor coast the motorcycle too much under the condition that the primary wiring of the stick coil does not connect completely (misfire). Incomplete connection or cut-off of the primary coil makes the fuel cut valves start to cut fuel. In this case, from the standpoint to protect the catalysts, the fuel for all cylinders is cut off even if one cylinder has been affected.

Kawasaki Low Exhaust Emission System



- Do not run overspeed limiter too much from the standpoint to protect the engine. (Overspeed limiter has a protection system that applies ignition cut method and fuel cut method together. Conventional system applies fuel-on method.)
- Do not run the engine under the condition that even if only one cylinder has a misfire or has unstable running. In this case, request the nearest service facility to correct it. If you have no choice but running by yourself, keep engine rpm as low as possible and try to finish running at the shortest period.
- When the battery is dead, do not push-start. Connect another full-charged battery with jumper cables, and start the engine.

5. Additional Information

1) Secondary Air Injection System

The mechanism is simple and power loss is minimum because the system uses the vacuum pressure created by exhaust pulses.

The secondary injection air helps the fuel/air mixture burn more completely. (The primary air means air which flows through the inlet pipe.) As the exhaust valve opens, and the burned fuel passes the exhaust valve, a stream of fresh air is introduced through the air suction valve. This fresh air burns the unburned gas and converts the carbon monoxide (CO) and hydrocarbons (HC) into harmless carbon dioxide (CO_2) and water (H_2O).

$$CO + 1/2\ O_2 \rightarrow CO_2$$
$$HC + O_2 \rightarrow CO_2 + H_2O$$

The secondary air injection system consists of a vacuum switch valve, and two air suction valves. Without using an air pump, the air suction valve can draw fresh air into the exhaust passage near the exhaust valves by vacuum that exhaust pulses generate.

Air Suction Valves

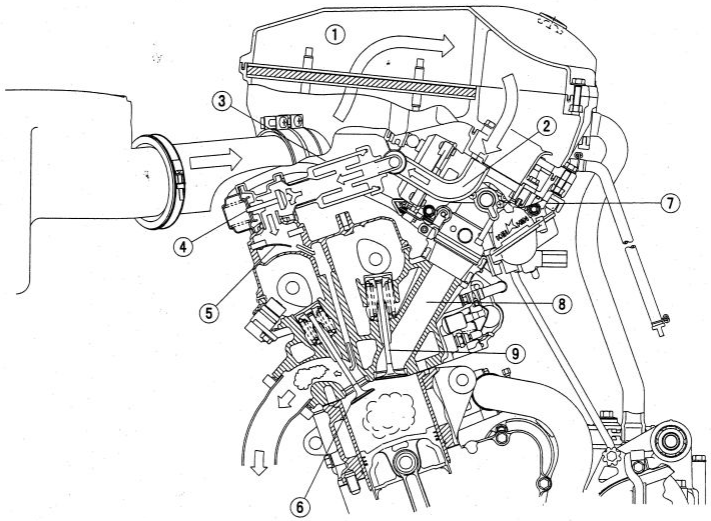
The air suction valve is a check valve which allows fresh air to flow only from the air cleaner via air hoses into the exhaust port and prevents return flow. Remove and inspect the air suction valves periodically (see Engine Top End chapter). Also, remove and inspect the air suction valves whenever the idle speed is unstable, engine power is greatly reduced, or there are abnormal engine noises.

Vacuum Switch Valve

Although the vacuum switch valve usually permits secondary air flow , it closes when a high vacuum (low pressure) is developed at the inlet pipe during engine braking. This is to shut off secondary air flow and prevent explosions in the exhaust ports which might be caused by extra unburned fuel in the exhaust during deceleration. These explosions, or backfiring in the exhaust system could damage the air suction valves.

Regular inspection of the vacuum switch valve is not needed. If backfiring occurs frequently in the exhaust system during engine braking or if there are abnormal engine noises, check the vacuum switch valve as described in the text (see Engine Top End chapter).

Secondary Air Injection System



1. Air Cleaner Housing
2. Air Hose
3. Inlet Silencer
4. Vacuum Switch Valve
5. Air Suction Valve
6. Exhaust Valve
7. Carburetors
8. Inlet Pipe
9. Inlet Valve

2) Operation of Three-way Catalytic Converter

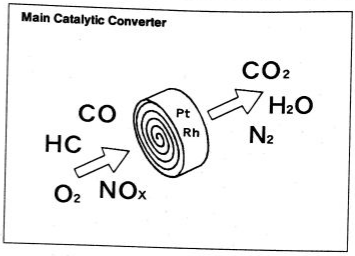
The three-way catalysts are used for the precatalytic converter and the main catalytic converter. These converters can clean up carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) at the same time.

CO and HC are oxidized (O is added) by platinum (Pt) and converted to harmless carbon dioxide gas (CO_2) and water (H_2O), and the exhaust gas is cleaned up:

$$CO + 1/2\ O_2 \rightarrow CO_2$$
$$HC + O_2 \rightarrow CO_2 + H_2O$$

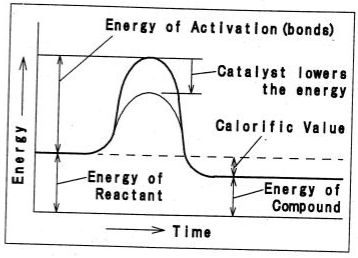
NO_x is reduced (O is removed) by rhodium (Rh) and converted to harmless nitrogen (N_2) and oxygen (O_2), and the exhaust gas is cleaned up.

$$NO_x \rightarrow N_2 + O_2$$



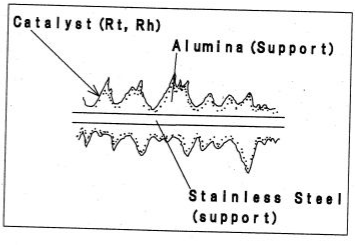
3) Property of Catalyst

Most catalysts are powders of metal or of metallic compounds, and they increase the rate of a chemical reaction. Catalysts are supposed to act in some way to loosen the bonds of the reacting substances. In other words, they lower the energy of activation, thus allowing the reaction to proceed more rapidly. To activate catalysts, the temperature of the exhaust gas must be higher than the activation temperature that is 220° ~ 230°C for new catalysts, and 270° ~ 280°C for used catalysts (after 10000 ~ 20000 km ride).



The catalyst itself undergoes no permanent chemical change, or can be recovered when the chemical reaction is completed. So, the muffler with built-in catalyst has the same durability as the conventional muffler.

The mechanism of catalytic action is supposed to be a surface phenomenon in which reactants are adsorbed onto a small portion of the surface of the catalyst. The catalytic converter is made of stainless steel and the surface is applied by alumina (aluminum oxide Al_2O_3). The alumina adheres to the stainless steel wall and the catalyst adheres to the alumina very well. The alumina surface is not uniform and there are corners, edges, dislocations, and grain boundaries. Catalyst is applied on the alumina and this makes the catalyst surface rough.



The rougher the surface is, the more actively the catalyst adsorbs the reactants. If various impurities like lead are adsorbed, they block the small portion of the catalyst surface, preventing adsorption of CO, HC, and NO_x. This is the reason why leaded fuel poisons the catalyst without any break on the surface and generation of heat.

Catalysts are generally efficient in small quantities. A catalyst can catalyze the reaction of several thousand to a million times its weight in reactants. The three-way catalyst is a blend of platinum (Pt) and rhodium (Rh) which are expensive. But a precatalytic converter uses only about 0.05 gram of Pt and 0.01 gram of Rh and a main catalytic converter uses only about 0.4 gram of Pt and 0.1 gram of Rh.

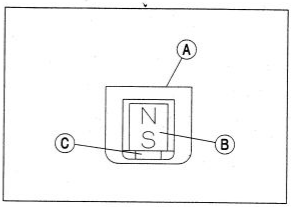
Technical Information - Non-Contact Hall IC-Type Speed Sensor

Details:

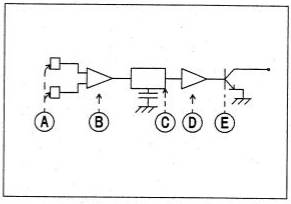
The electronic conbination meter unit, superior to the conventional type in weight and durability is installed on the ZX900-C/D. The hall IC-type speed sensor is installed on the ZX900-C/D together with it, which needs no cable and speedometer gears. Its construction and operation are described as follows;

Construction & Operation:

●The speed sensor [A] consists of a magnet [B] and the Hall IC [C].



●The Hall IC consists of Hall element [A], the differential amplifier [B], the high pass filter [C], the comparator [D] and the output transistor [E].



Hall Element;

The semi-conductors (e.g. CaAs, InAs, InSb) are colled as mentioned above. The magnetic inducation applied on the two (2) Hall elements will be converted into the voltage, and outputted.

Differential Amplifier;

This can output the difference between output powers of the two (2) Hall elements.

High Pass Filter;

Sensitivity of the two (2) Hall elements.
Surface magnetic induction of a magnet.
Relative positions of the Hall element, magnet, and detector gear.

↓ ↓

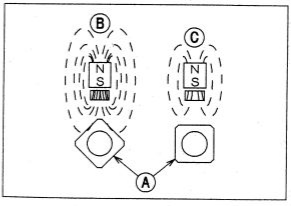
Able to cansel the DC off-set because of scattering of diffential output.

Comparator & Output Transistor;

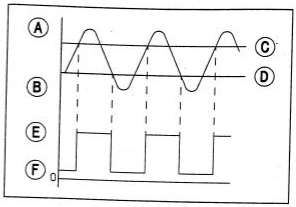
able to output the square wave in accordance with the magnetic induction alternation with the transistor turning on or off.

●The magnetic induction passing through the Hall element will be changed in accordance with the relative position of both the rotor nut [A] installed on the engine sprocket will be ratated.

amount of magnetic induction when large [B]
when small [C]



- In the internal system of the Hall IC, the switch is operated in accordance with the magnetic induction alternator. This makes the square wave equal to the pulse of the rotor nut output.
  Amount of magnetic induction when large [A]
  Amount of magentic induction when small [B]
  Operating point [C]
  Returning point [D]
  When high voltage [E]
  When low voltage [F]
- The vehicle speed is indicated in the speedometer, altering the pulse of this square wave.



Speed Sensor Inspection
- Refer to the chapter 15-55.

Technical Information – Alternator Made from Rare Magnet

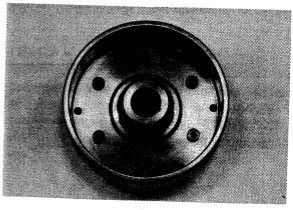
Rare Magnet Material:

Sintered matal made from mainly neodium (Nd), ferric magnet (Fe), and boron (B).

Main Characters:

Rare magnet used and assembled in the alternator for the ZX900-C and -D models has six (6) times higher performance than that of the traditional use ferrite magnet.

This allows the alternator to reduce its mass and weight to the large extent. In addition to above mentioned, there's no use to worry about the future lackage of rare magnetic resources such as samarium cobalt.



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:

L : Apply a non-permanent locking agent to the threads.
LG : Apply liquid gasket to the threads.
Lh : Left-hand threads.
M : Apply molybdenum disulfide grease.
O : Apply an oil to the threads and seating surface.
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

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 Valve Drain Screw	1.0	0.10	9 in-lb	
Cooling System:				
Coolant Hose Clamp Screws (Carburetor)	1.5	0.15	13 in-lb	
Coolant Hose Clamp Screws	2.0	0.20	17 in-lb	
Coolant By-pass Cover Bolts	11	1.1	95 in-lb	L
Coolant Fitting Nozzles	5.4	0.55	48 in-lb	
Coolant Blind Bolt (Cylinder)	5.4	0.55	48 in-lb	
Coolant Blind Bolt (Water Pump)	11	1.1	95 in-lb	
Coolant Drain Plug (Water Pump)	11	1.1	95 in-lb	
Radiator Fan Switch	18	1.8	13.0	
Water Temperature Sensor	7.8	0.80	69 in-lb	SS
Impeller Bolt	9.8	1.0	87 in-lb	
Water Pump Cover Bolts	11	1.1	95 in-lb	
Thermostat Housing Cover Bolts	11	1.1	95 in-lb	
Water Hose Banjo Bolt	11	1.1	95 in-lb	
Engine Top End:				
Spark Plugs	13	1.3	113 in-lb	
Air Suction Valve Cover Bolts	11	1.1	95 in-lb	
Vacuum Blind Bolts	5.4	0.55	48 in-lb	
Vacuum Fittings	5.4	0.55	48 in-lb	
Cylinder Head Cover Bolts	9.8	1.0	87 in-lb	
Pickup Coil Cover Bolts	11	1.1	95 in-lb	
Camshaft Chain Tensioner Mounting Bolts	11	1.1	95 in-lb	
Camshaft Cap Bolts	12	1.2	104 in-lb	
Camshaft Chain Guide Bolts (Upper)	12	1.2	104 in-lb	
Cam Sensor Rotor Bolt	12	1.2	104 in-lb	L
Cylinder Head Bolts: M10 New Bolts	54	5.5	40	S, O (Washer)
M10 Used Bolts	49	5.0	36	S, O (Washer)
M6	12	1.2	104 in-lb	S
Cylinder Head Jacket Plugs	22	2.2	16.0	L

Fastener	Torque			Remarks
	N-m	kg-m	ft-lb	
Camshaft Chain Guide Bolt (Crankcase)	25	2.5	18.0	
Carburetor Holder Bolts	12	1.2	104 in-lb	
Baffle Plate Bolts	11	1.1	95 in-lb	
Muffler and Exhaust Pipe Connection Nuts	34	3.5	25	
Clutch				
Clutch Cover Bolts	11	1.1	95 in-lb	
Clutch Cover Damper Bolts	6.9	0.7	61 in-lb	L
Clutch Spring Bolts	8.8	0.90	78 in-lb	
Clutch Hub Nut	135	14	100	R
Engine Lubrication System:				
Oil Filler Plug	1.0 or Hand-Tight	0.10 or Hand-Tight	9 in-lb or Hand-Tight	
Engine Drain Plug	20	2.0	14.5	
Oil Filter(Cartridge type)	9.8	1.0	87 in-lb	R, O
Oil Cooler Mounting Bolt	78	7.8	56	O
Oil Pan Bolts	11	1.1	95 in-lb	
Oil Pipe Holder Bolts	12	1.2	104 in-lb	L
Oil Pressure Relief Valve	15	1.5	11.0	L
Oil Pressure Switch	15	1.5	11.0	SS
Oil Pressure Switch Terminal Screw	1.5	0.15	13 in-lb	
Impeller Bolt	9.8	1.0	87 in-lb	
Engine Removal/Installation:				
Engine Mounting Bolts and Nuts	44	4.5	33	
Engine Mounting Bracket Bolts	23	2.3	16.5	
Engine Mounting Clamp Bolts	23	2.3	16.5	
Crankshaft/Transmission:				
Breather Plate Bolts	9.8	1.0	87 in-lb	L
Crankcase Damper Cover Bolts	12	1.2	104 in-lb	
Crankcase Bolts Φ 9 L81	42	4.3	30	M, S
Φ 9 L96	47	4.8	35	M, S
Φ 8	27	2.8	20	S
Φ 7	20	2.0	14.5	S
Φ 6	12	1.2	104 in-lb	S
Oil Passage Plugs	20	2.0	14.5	L
Connecting Rod Big End Nuts	in the text	←	←	←
Timing Rotor Bolt	39	4.0	29.0	
Oil Pressure Switch	15	1.5	11.0	SS
Gear Positioning Lever Bolt	12	1.2	104 in-lb	L
Shift Shaft Return Spring Pin (Bolt)	27	2.8	20	L
Neutral Switch	15	1.5	11.0	
Shift Drum Bearing Holder Bolt	12	1.2	104 in-lb	L
Shift Drum Bearing Holder Screw	5.4	0.55	48 in-lb	L
Shift Drum Cam Bolt	12	1.2	104 in-lb	L
Wheels/Tires:				
Front Axle Clamp Bolts	20	2.0	14.5	
Front Axle Nut	110	11.0	80	
Rear Axle Nut	110	11.0	80	

Fastener	Torque			Remarks
	N-m	kg-m	ft-lb	
Final Drive:				
Engine Sprocket Nut	125	13.0	94	O
Engine Sprocket Cover Bolts	11	1.1	95 in-lb	
Engine Sprocket Cover Damper Bolt	6.9	0.7	61 in-lb	L
Rear Sprocket Nuts	74	7.5	54	
Rear Sprocket Studs	–	–	–	L
Brakes:				
Bleed Valves	7.8	0.80	69 in-lb	
Front Brake Hose Joint Bracket Bolts	6.9	0.7	61	
Brake Hose Banjo Bolts	25	2.5	18.0	
Brake Lever Pivot Bolt	1.0	0.10	9 in-lb	
Brake Lever Pivot Bolt Locknut	5.9	0.60	52 in-lb	
Front Brake Reservoir Cap Stopper Screws	1.5	0.15	13 in-lb	
Front Brake Reservoir Bracket Bolt	6.9	0.7	61	
Front Brake Light Switch Screws	1.0	0.10	9 in-lb	
Front Master Cylinder Clamp Bolts	8.8	0.9	78 in-lb	S
Pad Spring Screws (Front Caliper)	2.9	0.30	26 in-lb	
Caliper Mounting Bolts (Front)	34	3.5	25	
Caliper Assembly Bolts (Front)	21	2.1	15.0	
Front Brake Disc Mounting Bolts	23	2.3	16.5	
Rear Brake Disc Mounting Bolts	23	2.3	16.5	
Caliper Mounting Bolts (Rear)	25	2.5	18.0	
Rear Master Cylinder Guard Bolts	23	2.3	16.5	
Rear Master Cylinder Push Rod Locknut	18	1.8	13.0	
Suspension:				
Front Fork Clamp Bolts (Upper)	20	2.0	14.5	
Front Fork Clamp Bolts (Lower)	20	2.0	14.5	
Front Fork Top Plugs	23	2.3	16.5	
Piston Rod Nut	27	2.8	20	
Front Fork Bottom Allen Bolts	39	4.0	29	L
Front Axle Clamp Bolts	20	2.0	14.5	
Rear Shock Absorber Nuts (Upper and Lower)	34	3.5	25	
Swingarm Pivot Shaft Nut	110	11.0	80	
Swingarm Pivot Shaft Lock Nut	98	10.0	72	
Uni-Trak				
Rocker Arm Nut	34	3.5	25	
Tie-Rod Nuts	59	6.0	43	
Steering:				
Steering Stem Head Nut	39	4.0	29	
Steering Stem Nut	4.9	0.50	43 in-lb	
Handlebar Bolts	34	3.5	25	L
Handlebar Holder Bolts	23	2.3	16.5	
Handlebar Holder Position Bolts	9.8	1.0	87 in-lb	L
Handlebar Weight Screws	–	–	–	L
Handlebar Switch Housing Screws	3.4	0.35	30 in-lb	
Frame:				
Footpeg Holder Bolts	34	3.5	25	L
Side Stand Bracket Bolts	49	5.0	36	
Electrical System:				
Spark Plugs	13	1.3	113 in-lb	
Alternator Rotor Bolt	110	11.0	80	
Stator Coil Bolts	11	1.1	95 in-lb	
Alternator Lead Holding Plate Bolts	8.3	0.85	74 in-lb	

Fastener	Torque			Remarks
	N-m	kg-m	ft-lb	
Engine Ground Lead Terminal Bolt	9.8	1.0	87 in-lb	
Alternator Cover Bolts	11	1.1	95 in-lb	
Pickup Coil Cover Bolts	11	1.1	95 in-lb	L (1)
Pickup Coil Bolts	5.9	0.60	52 in-lb	
Timing Rotor Bolt	39	4.0	29.0	
Starter Motor Mounting Bolts	11	1.1	95 in-lb	
Starter Clutch Bolts	12	1.2	104 in-lb	L
Handlebar Switch Housing Screws	3.4	0.35	30 in-lb	
Radiator Fan Switch	18	1.8	13.0	
Water Temperature Sensor	7.8	0.80	69 in-lb	SS
Oil Pressure Switch	15	1.5	11.0	SS
Oil Pressure Switch Terminal Bolt	1.5	0.15	13 in-lb	
Neutral Switch	15	1.5	11.0	
Starter Lockout Switch Screws	1.0	0.10	9 in-lb	

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