19. REAR SUSPENSION

SERVICE INFORMATION

- Use only genuine Honda bolts and nuts on all suspension, swingarm, shock absorber and suspension linkage mounting locations.

⚠ WARNING

- **The shock absorber contains nitrogen under high pressure. Do not allow fire or heat near the shock absorber.**
- **Before disposal of the shock absorber, release the nitrogen (see page 19-9).**

TROUBLESHOOTING

Soft Suspension
- Weak spring(s)
- Oil leakage from damper unit
- Air or gas leakage
- Incorrect damper adjustment

Hard Suspension
- Incorrectly mounted suspension components
- Incorrect damper adjustment
- Bent swingarm pivot
- Bent damper rod
- Damaged swingarm pivot bearing(s)
- Faulty suspension linkage
- Damaged linkage pivot bearings

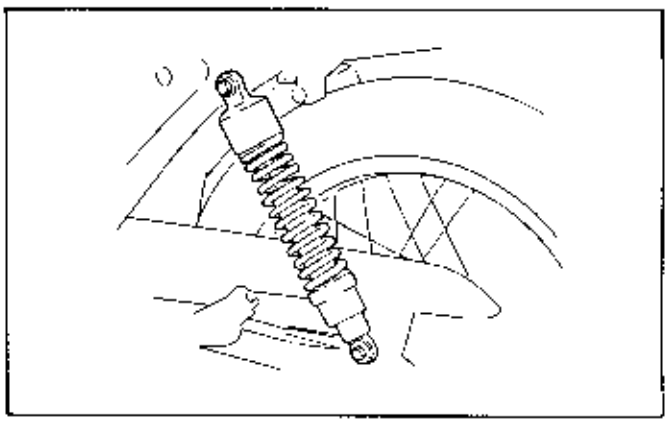
1

SYSTEM DESCRIPTIONS

Swingarm-type rear suspension systems provide a comfortable ride while offering good traction and wheel control capabilities. Using the front swingarm pivot as the fulcrum and mounting the rear axle at the trailing end of the swingarm allows the wheel to respond quickly to variations in the road or trail surface.

At present, almost all motorcycles have adopted this basic configuration for rear suspension. On some scooters, the entire engine and drive unit pivots as the "swingarm".
This basic swingarm type rear suspension design can be broken down into a few categories, depending on the number of dampers used and the design of the swingarm.

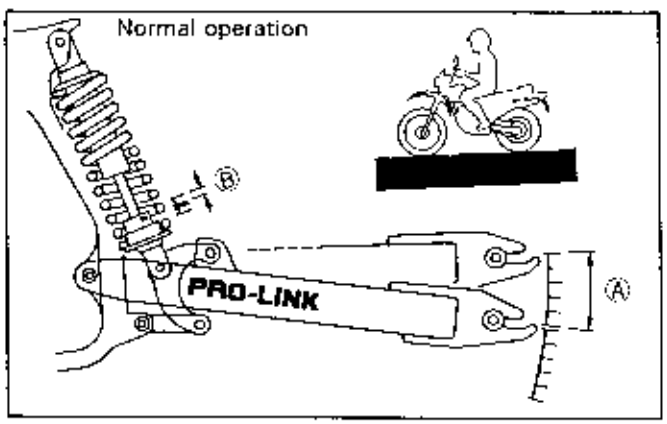
Conventional, Dual Spring/Damper Type
In the coventional type system, two spring/damper units support the rear of the frame from the rear section of the swingarm as illustrated here.



Today, this type of suspension is found primarily on small displacement motorcycles because of the simplicity of installation, the small number of components necessary and due to the systems basic economy. Up until around 1981, this dual spring/damper design was also used on most larger displacement motorcycles as well.

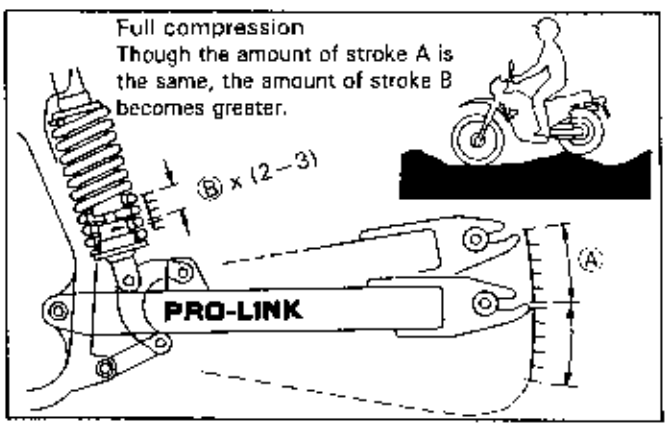
A rising rate type rear suspension is also possible on dual shock types if the shock angles are correctly positioned.

Pro-Link, Progressive Link Type
Honda's Pro-Link suspension system is designed to provide both comfort and control without compromise. Its progressive action rising rate delivers an ideal proportion of springing and damping over a wide range of riding conditions. Initial rates are soft for supple response to small bumps and ripples. Should the riding surface become rougher, increasingly stiffer rates provide the control necessary to prevent bottoming and keep the rear wheel in contact with the surface.



The swingarm and damper unit of the Pro-Link type rear suspension are connected to the swingarm by a link. The damper unit travel in relation to the rear wheel movement can be changed relatively freely during the design stage in accordance with the combination of the cushion arm and cushion connecting rod that is selected.

As the axle stroke distance increases, the piston speed of the damper and shock absorbing force increase progressively. Therefore, this type of suspension is characteristically soft on initial travel so it absorbs small riding surface inconsistencies well, and provides progressively firmer resistance to prevent bottoming at full compression when a large bump is hit.



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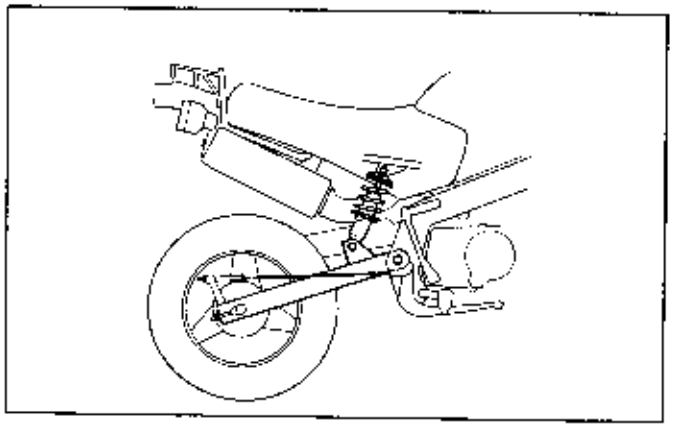
This arrangement offers a greater amount of suspension stroke compared to the amount the damper unit compresses and therefore greater control for improved suspension performance. It also enables the weight of the spring/damper unit to be centralized more compactly, nearer the center of the frame.

The Delta type Pro-Link is a further refinement which lowers the motorcycles CG by a significant amount and reduces the weight of the cushion arm.

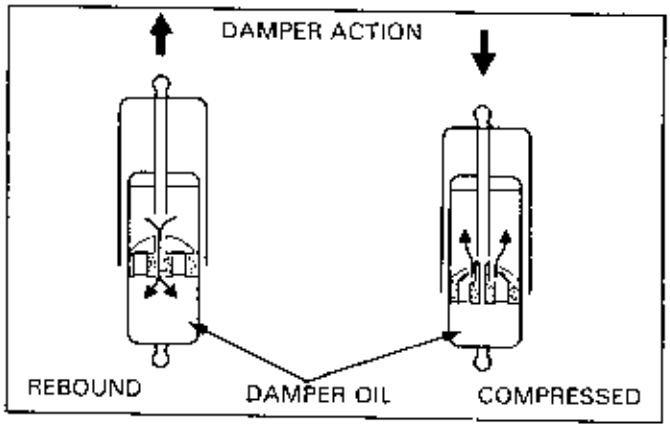
Pro-Arm Type

Honda's unique cantilever-type Pro-Arm is a stylish departure from the conventional forked-type swingarms. High rigidity and durability are achieved through the use of a massive box-section design and large diameter "axle". The "center pin" mounting allows easy wheel removal/installation and the design of the eccentric bearing carrier makes chain adjusting easy. Other benefits include minimal unsprung weight, added room for compact exhaust routing, slimmer overall machine shape, easier access for damper adjustments, and the simple design lends itself to ease of maintenance and cleaning.

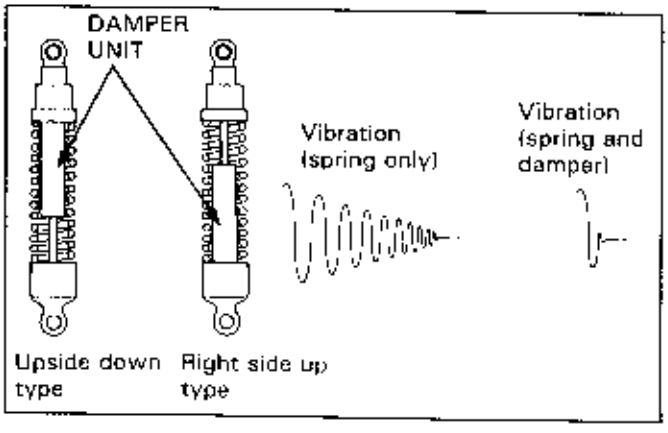


Damper Design and Operation

Riding comfort and proper rear wheel traction are provided by a combination spring/damper unit, and to some degree, by maintaining proper tire pressure. The damper absorbs some suspension compression force and controls the unwanted rebounding effects of the spring. Typically, comparatively little damping resistance is offered on the compression stroke as most of this (shock) is handled by the spring.



Oil dampers units are either the upside down type or the right side up type. Running the damper body upside down (with the shaft below and the body above) reduces unsprung weight.



In addition to the inverted and conventional damper body types, there are two basic damper designs, each named for the method used to create the damping action; the friction type and the oil damper type.

The friction type damper is comparatively simple in design and is used on only the most lightweight and economical models. This design uses only the friction of a nonmetallic piston against the greased, inside wall of the damper cylinder to counteract the natural rebounding action of the springs.

Many of the simplest and most lightweight motorcycles and scooters are equipped with single damping or single-effect type dampers. This design provides damping force only on the rebound stroke and relies on the compression resistance of the spring alone to absorb riding surface irregularities.

The most effective damper design is the double damping or double-effect type. In these, damping force is provided for both compression and rebound strokes.

Some damper designs include nitrogen gas within their bodies or within a reservoir to prevent the oil from foaming.

In emulsion type dampers the nitrogen is filled in the damper body.

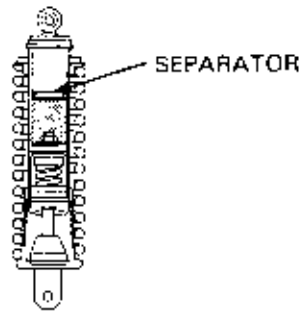
Some of this type has a separator in the gas chamber by which gas is hard to be mixed with the oil.

Decarbon design dampers keep the nitrogen gas separated from the oil by means of a free floating piston which acts as a diaphragm. This way the oil can pass through the damping orifices without interference from the gas bubbles.

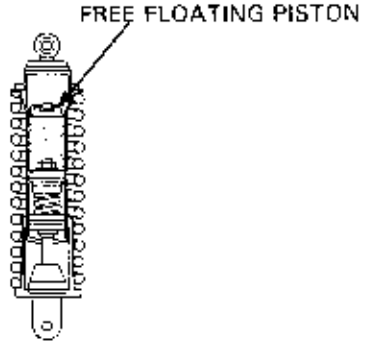
Reservoir equipped dampers are a variation of the simplest Decarbon design. A more consistent oil temperature and therefore more consistent damping is provided due to an increased oil capacity; the shock body can be entirely filled with oil since the gas chamber is elsewhere. A rubber bladder is used within the reservoir to separate the nitrogen gas from the damper oil.

DOUBLE DAMPING (DOUBLE-EFFECT) TYPE

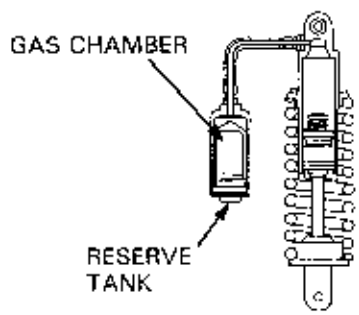
EMULSION TYPE



DECARBON TYPE



RESERVE-TANK TYPE



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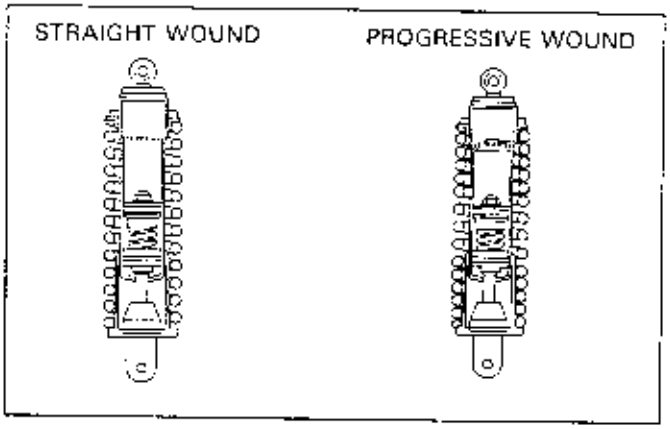
Rear Damper Springs

A variety of spring designs are used on motorcycles and scooters. Among these types are straight wound, progressive wound, wide pitch and narrow pitch, and even tapered spring wire types. Each provides different compressive force characteristics.

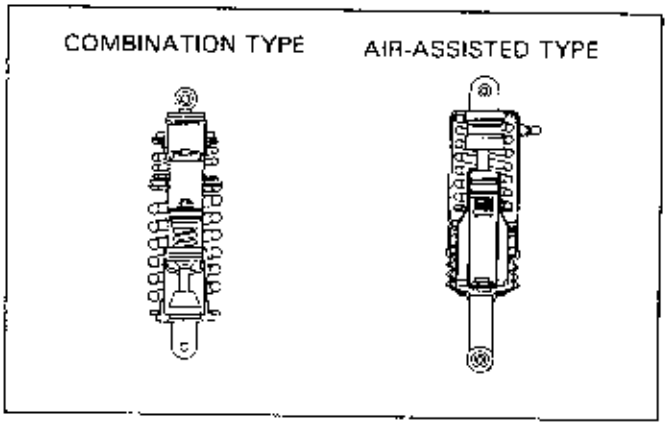
NOTE

- Unsprung weight is reduced slightly when the widely pitched (or spaced) spring coils are positioned toward the swingarm.



One means of achieving a progressive overall spring rate is to allow the spring rates of two or three different springs to "crossover" or combine their individual qualities by simply stacking the springs atop one another. This method is known as a combination type spring arrangement.

Another variation towards achieving a progressive spring action is to add an air-assist bladder to the spring/damper unit. On these types, air pressure is added up to a specified amount to compensate for increased load requirements rather than adjusting the preload on the spring.



The right "shock" on GL1500s is actually only an "air spring". It has no dampening properties aside from a very slight seal friction and is filled with only a very small amount of oil to lubricate its shaft and oil seal.

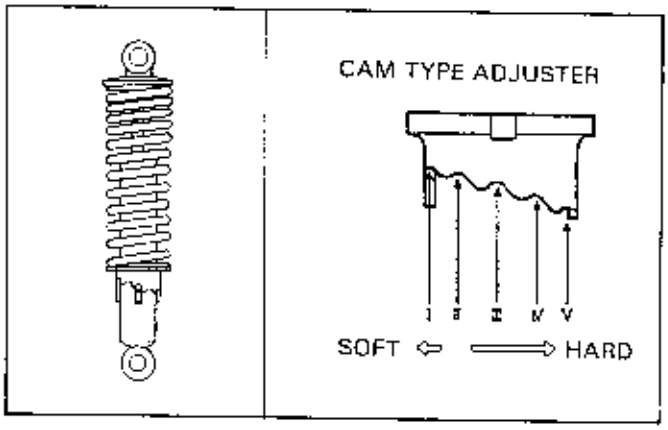
Spring Preload Adjuster Designs

The spring adjuster changes the coil spring length and the initial spring preload. There are several types of spring preload adjuster systems: pre-set type, mechanical type and both mechnical and hydraulic remote control types, all of which adjust the spring seat position.

The Pre-set category includes both the cam type preload adjuster and the near infinitely adjustable threaded, double locking nut type.

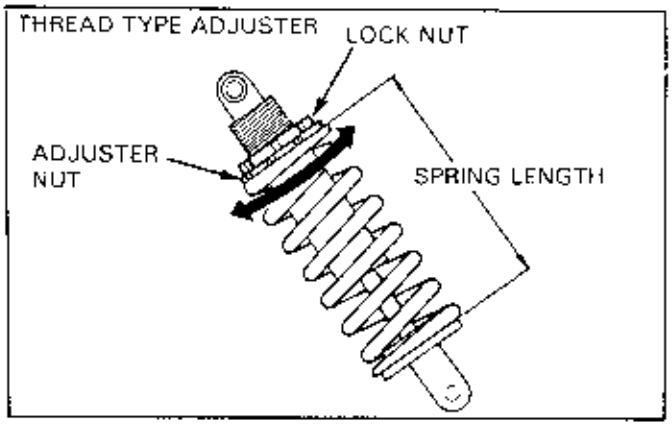
Cam Type

The cam type preload adjuster uses a collar with recessed steps that fits around the damper body. As each step is positioned against a stop or pair of stops built-in to the damper body, the spring preload can be adjusted to from three to five pre-set positions, to better suit vehicle load requirements.

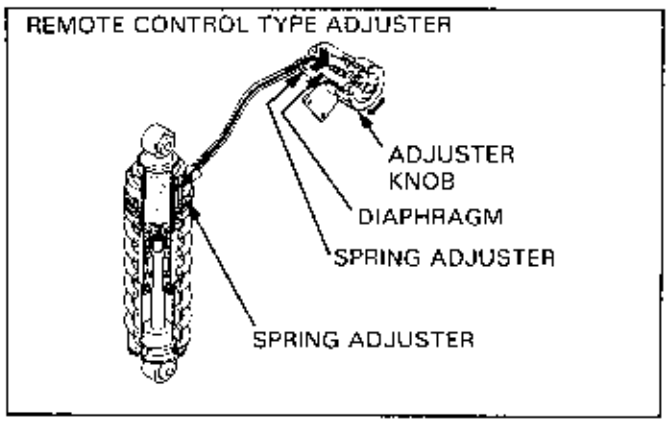


Threaded Type
Spring preload is set by moving an adjuster nut to either compress or extend the height of the spring. Once the desired preload is established, a lock nut is tightened against the adjuster nut to prevent it from changing position. A minimum and maximum spring height (spring preload) is recommended for each model. These dimensions must be complied with.

Failure to comply with the minimum and maximum spring length specifications may result in the spring coil binding near full suspension compression or the spring perch retainers coming loose near full suspension extension.

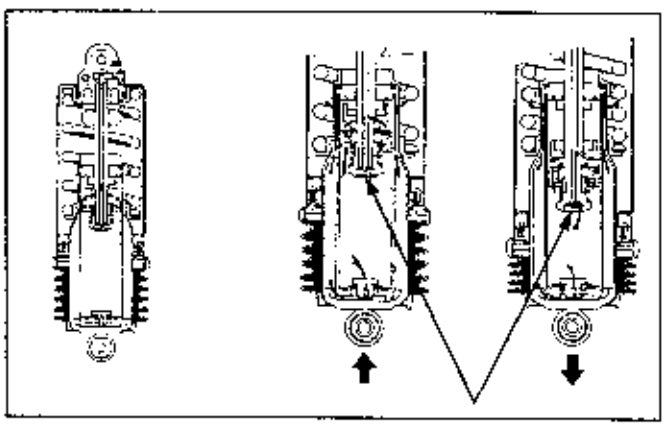


Remote Control Type
The remote type of spring preload adjuster uses hydraulic pressure to reposition the spring seat. An adjuster knob on a conveniently located control mechanism presses against a diaphragm, which in turn forces hydraulic fluid through a line to the damper unit. This hydraulic system, completely separate from the damping system, increases or decreases the height of the spring to achieve the desired preload.



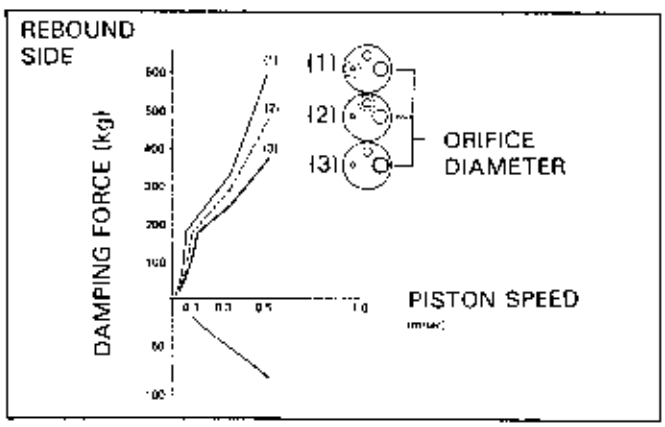
Damping adjuster
In oil damper units, a damping adjuster serves to control the oil flow by regulating the orifice diameter.

On certain types other than those shown in the drawings, the damping force is controlled by adjusting the pre-set load on the valve.



Decreasing the orifice diameter increases resistance and damper hardness.

Increasing the orifice diameter decreases resistance and damper hardness.



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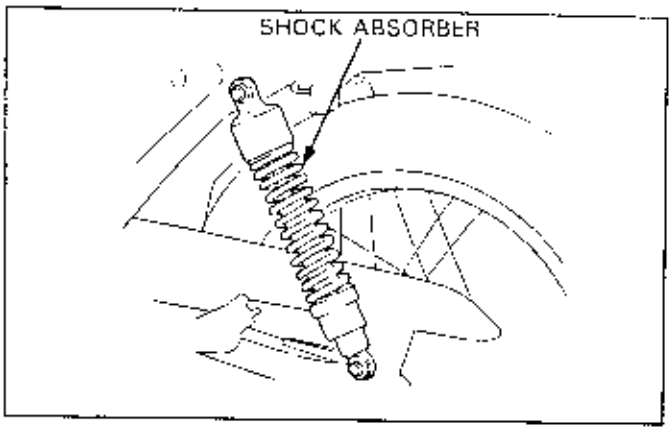
SHOCK ABSORBER



REMOVAL

Support the vehicle securely and raise the rear wheel off the ground.

Remove the mounting bolt(s) or nut(s); then remove the shock absorber.

INSTALLATION

Install the shock absorber on the upper mount noting the proper installation direction.

Raise the rear wheel enough to allow installation of the lower mounts. Slip the mounts into position.

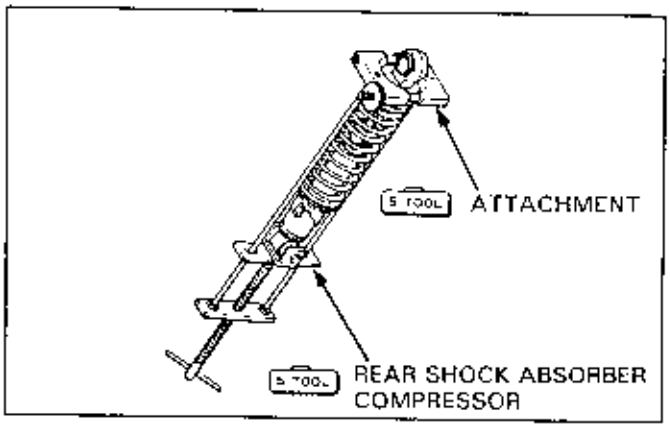
Tighten the upper and lower mounts to the specified torque.

On Pro-Link or Pro-Arm systems, refer to the Model Specific manual for shock absorber removal/installation procedures.

DISASSEMBLY

⚠ WARNING

- **Certain types of damper units are filled with high pressure nitrogen gas.**
- **Do not disassemble gas damper units.**
- **Be sure to release the gas from the damper unit before discarding it.**
- **To prevent loss of tension, do not compress the spring more than necessary to remove it.**



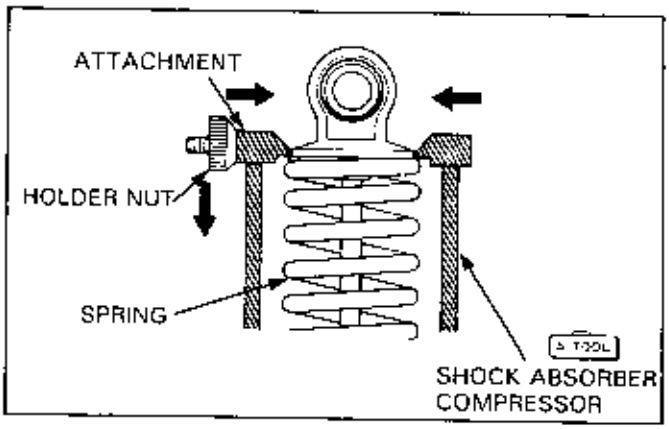
Remove the shock absorber.
Compress the spring and remove the damper unit.

Shock Absorber Compressor Use:
Install the shock absorber compressor on the rear shock absorber.

Certain types of shock absorber compressors require adapters when the attachment is installed, while others do not.

Refer to the Model Specific manual for the type of compressor.

Install the shock absorber compressor holder securely onto the coil spring end that is near the lock nut or stopper ring.
Turn the compressor handle and slowly compress the spring.

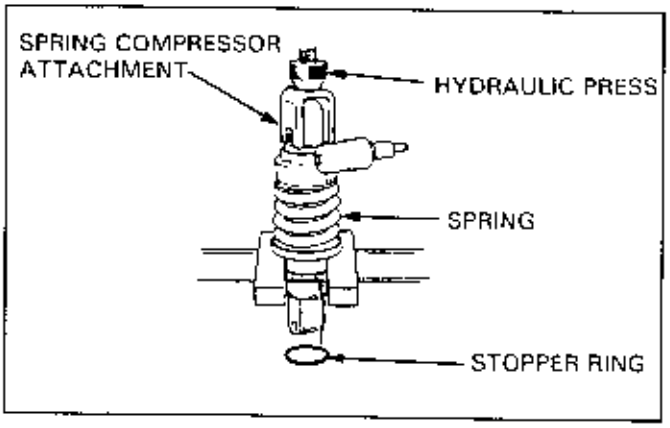


Hydraulic Press Use:
Install the spring compressor attachment and compress the spring with the hydraulic press.

Alway use a specified tool to compress the spring. Refer to Model Specific manual.

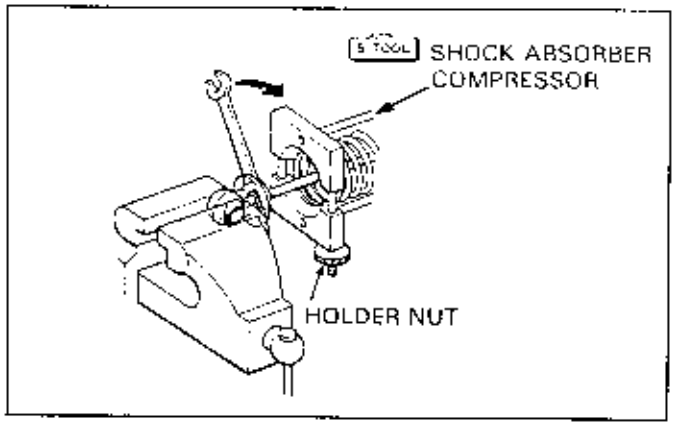
⚠ WARNING

- **Use of a hydraulic press to compress the spring can lead to the spring or shock absorber flying out of the press and causing a serious injury.**



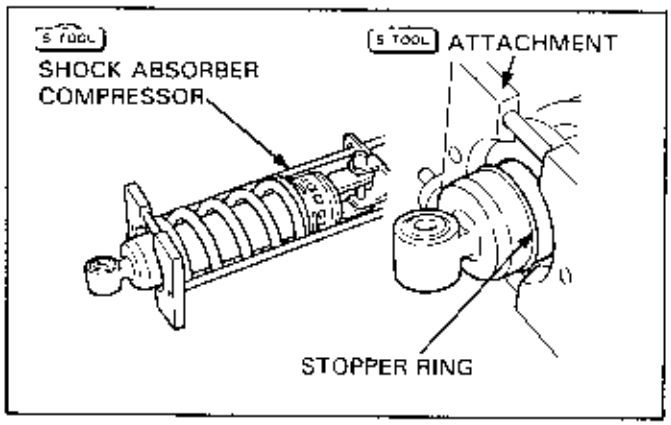
Certain types of shock absorbers are mounted with a stopper ring while other types are mounted with a lock nut.
Refer to the Model Specific manual.

Lock Nut Removal
Compress the spring and loosen the lock nut, then remove the upper or lower joint and the spring.



Stop Ring Removal
Compress the spring and remove the stopper ring.

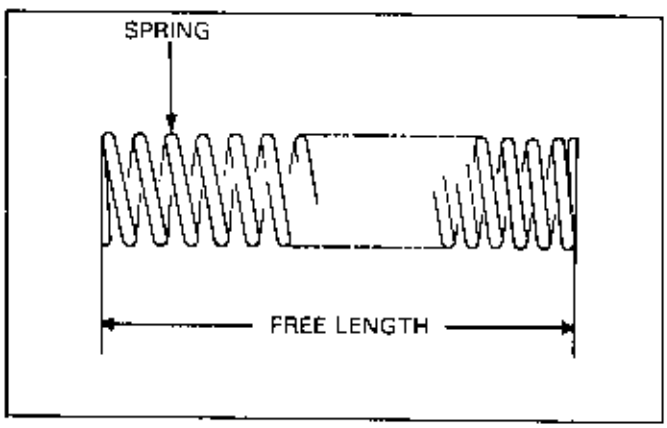
Remove the spring.



INSPECTION

Spring
Place the spring on a level surface and measure the free length.

Replace the spring if it is deformed, cracked or its free length is shorter than the service limit.



Damper Unit

Keep a gas-filled shock absorber away from fire or heat.

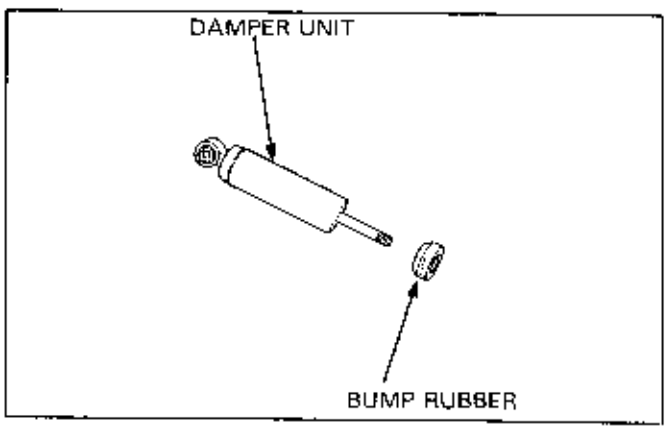
⚠WARNING

- **Heating a gas-filled damper can lead to an explosive release of pressure which can cause a serious injury.**
- **Do not try to disassemble the damper unit if the disassembly procedure is not described in the Model Specific Manual. Disassembly can lead to a release of gas under high-pressure which can cause an injury.**

Check the damper unit for deformation or oil leakage and replace if necessary.

Check the damper rod for straightness or stepped wear and replace if necessary.

Check the damper bump rubber for fatigue or damage and replace if necessary.



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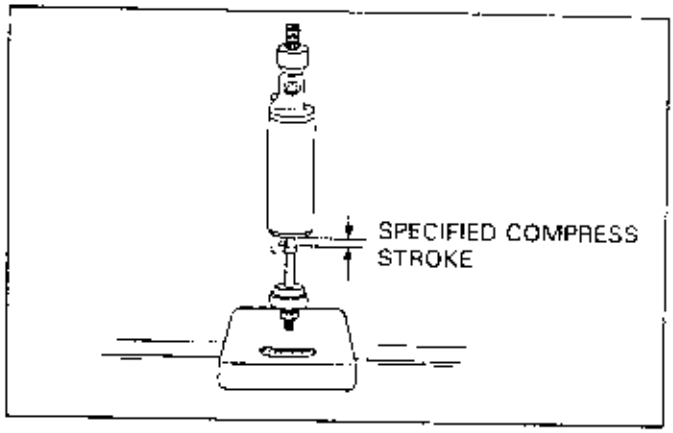
Compression Force (Gas Filled Damper Only)
Examine the damper rod and replace the damper unit if it is bent or scored.

Mark the damper rod at the ...st specified compressed stroke (i.e., 10 mm/0.4 in) exposc... from the damper body.

Place the damper rod on a scale and measure the force required to compress the damper until the mark is flush with the damper body.

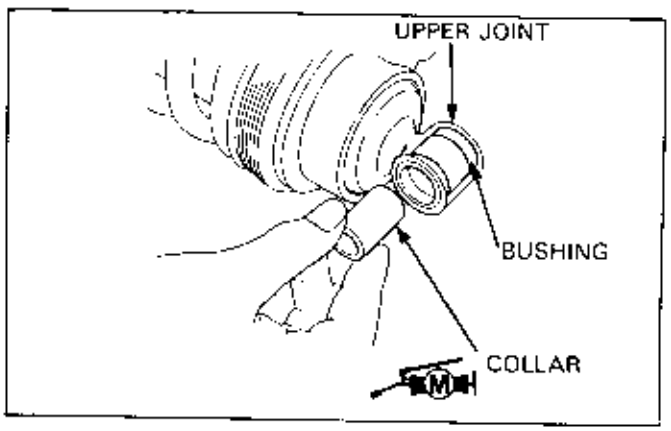
Refer to the Model Specific manual for the compression force and the specified compressed stroke.

If the force required is less than service limit, gas is leaking.



Check the upper joint and collar for wear or damage and replace if necessary.

Check the rubber bushing for wear or damage and replace if necessary.



NOTE

- Apply specified grease to the sliding surfaces of the collar and bushing, and reinstall them.
- If a needle roller and spherical bearing are installed instead of the bushing and collar, refer to the Model Specific manual for their replacement.

SHOCK ABSORBER DISPOSAL PROCEDURE

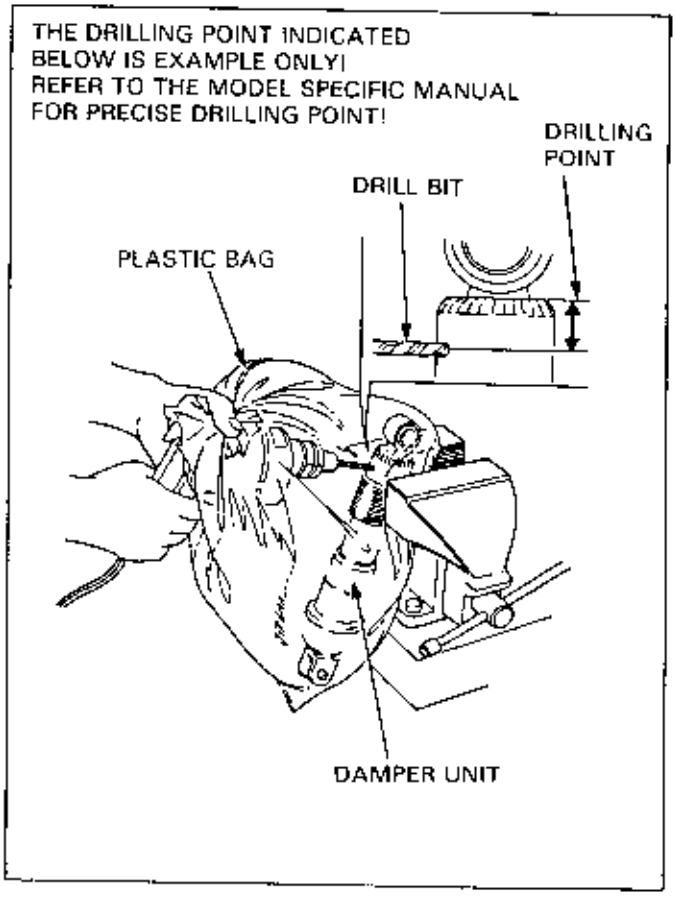
Center punch the damper case to mark the drilling point. Refer to the Model Specific manual for the precise drilling point.

Wrap the damper unit inside a plastic bag.

Support the damper unit upright in a vise.

Through the open end of the bag, insert a drill motor with a sharp 2—3 mm (5/64—1/8 in) drill bit.

Use a sharp drill bit to minimize heat buildup.



⚠WARNING

- **Using a dull drill bit allows a build-up of excessive heat and pressure inside the damper which may cause an explosion.**
- **The shock absorber contains nitrogen gas and oil under high pressure. Drilling farther into the damper case than specified can puncture the oil chamber. Oil escaping under high pressure may cause serious injury.**
- **Always wear eye protection to avoid getting metal shavings in your eyes when gas pressure is released.**

NOTE

- The plastic bag is only intended to shield you from the escaping gas.

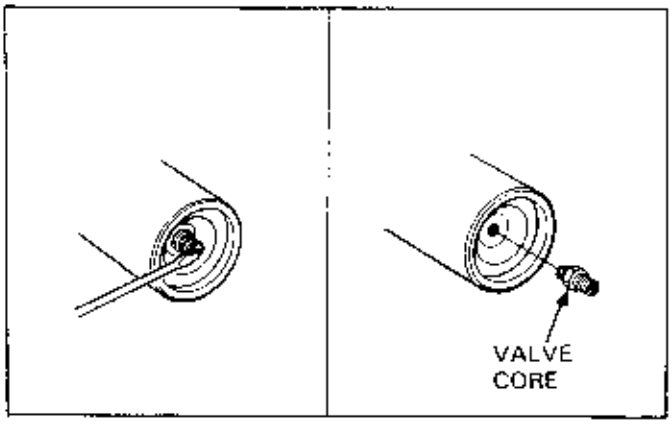
Hold the bag around the drill motor and briefly run the drill motor inside the bag; this will inflate the bag with air from the motor and help keep the bag from getting caught in the bit when you start.

On dampers with nitrogen gas filler valves, depress the valve core to release the nitrogen and then remove the valve from the shock absorber.

Point the valve away from you.

⚠WARNING

- **Always wear eye protection to avoid getting debris in your eyes.**

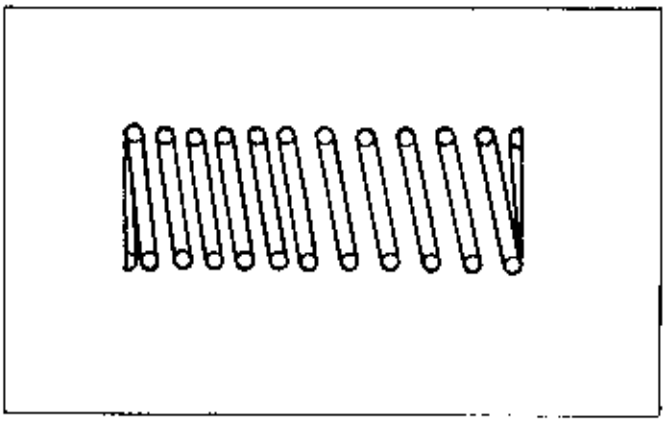


ASSEMBLY

Assemble the shock absorber in the reverse order of disassembly.

NOTE

- If the shock absorber does not have the regular pitch spring, the spring should be installed in the correct position. Refer to the Model Specific manual for spring installation direction.



Hydraulic Press Use:
Compress the spring until the stopper ring can be installed using a hydraulic press.
Refer to the Model Specific manual.

Install the stopper ring in the groove in the damper.
Be certain that the stopper ring is seated firmly in the groove.

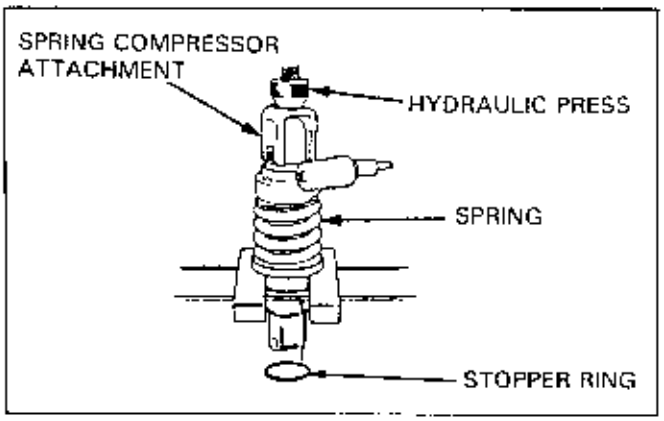
⚠WARNING

- **Failure to firmly seat the snap ring may cause the shock assembly to come apart unexpectedly and lead to a serious injury.**
- **Compressing the spring more than necessary may cause a loss of spring tension.**

Always use a Shock Absorber Spring Compressor to compress the spring on dampers with a rod screwed into the upper or lower joint.

⚠WARNING

- **Use of a hydraulic press to compress the spring can lead to the spring or shock absorber flying out of the press and causing a serious injury.**



Joint Installation:
Clean the lock nut threads before installing the lower joint.

Install the lock nut on the damper rod and tighten it by hand as full as it goes.

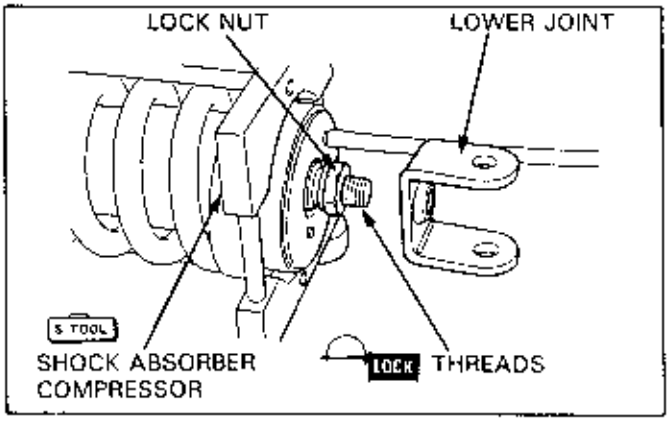
Apply a locking agent to the threads.

Install the lower joint on the damper unit.

Hold the lower joint and tighten the lock nut to the specified torque.

CAUTION

- **Loosening or removing a staked lock nut may cause the shock assembly to come apart unexpectedly and lead to a serious injury.**



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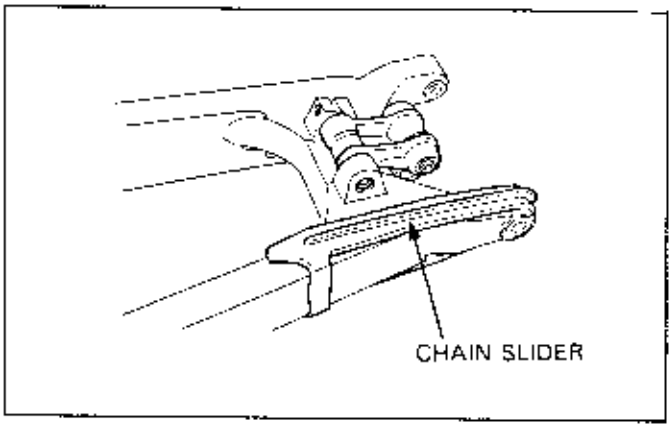
SWINGARM

Refer to the Model Specific manual for each model for swingarm removal, disassembly, reassembly and installation.



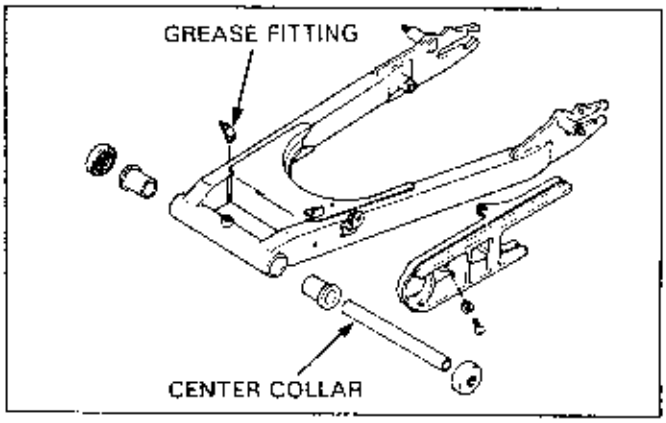
INSPECTION

Remove the chain slider, chain guide and brake torque rod (if installed).

If the motorcycle is a shaft-drive type, remove the rubber boot.

Check the removed parts for wear or damage and replace if necessary.

Check the center collar/distance collar, if installed, for wear, scoring or scratches and replace if necessary.



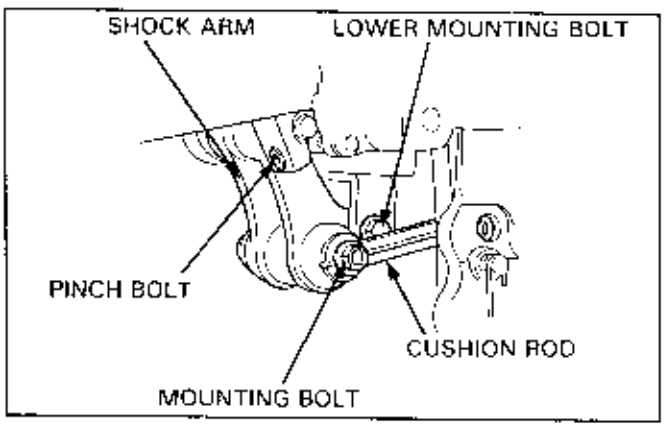
PRO-LINK SUSPENSION LINKAGE

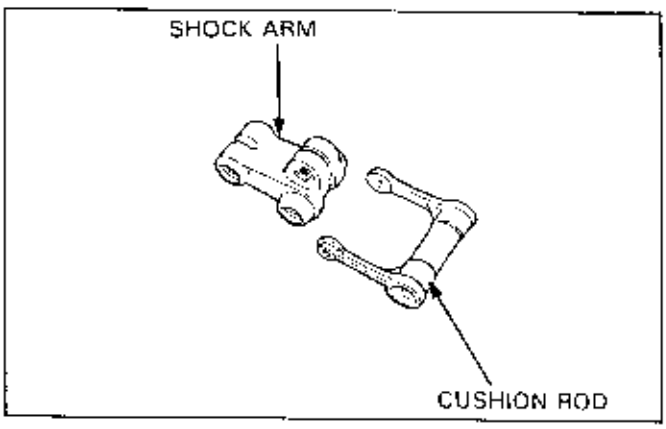
NOTE

- Mark on the suspension linkage before disassembly. The cushion arm and connecting rod often have specific installation directions and they should be installed properly. They may interfere with the frame and/or change the vehicle height unless installed properly.

REMOVAL

Remove the following:
- Rear wheel.
- Bolts from the frame side of the connecting rod.
- Rear shock absorber lower mounting bolts.
- Bolts from the swingarm side of the shock arm.



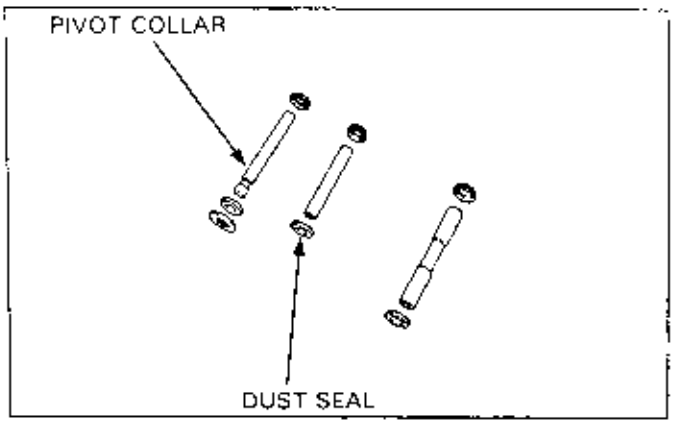


INSPECTION

Check the shock arm and connecting rod for deformation, cracks or other damage and replace as necessary.

Check the pivot collars, dust seals, bushings and/or bearings for wear or damage and replace if necessary.
Refer to the Model Specific manual for their replacement procedures.

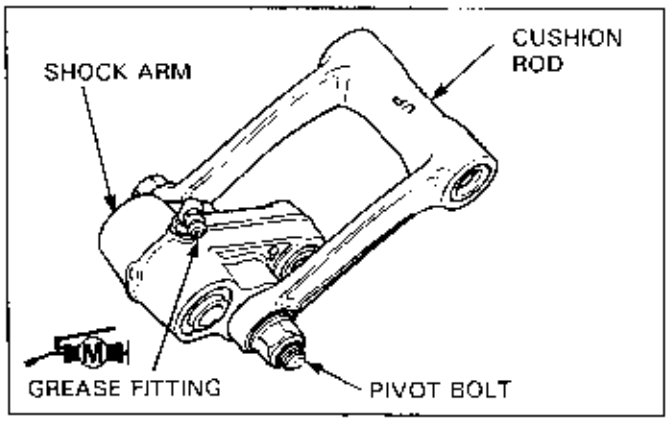
Refer to the Model Specific manual, if your motorcycle is equipped with needle roller or spherical bearings.



INSTALLATION

Apply molybdenum disulfide grease to all pivot points.
Pack the grease fittings (if installed) with grease.
Reassemble the suspension linkage with care to the proper installation directions and loosely tighten the pivot bolts.
Reinstall the suspension linkage assembly on to the frame and tighten each bolt to the specified torque.

Refer to the Model Specific manual for the proper torque specifications.



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20. FRAME/BODY PANEL

SERVICE INFORMATION

- Although it is possible to weld some cracked frames and straighten some frames that are slightly bent it is best to replace the frame with a new one when it is damaged.
- Generally speaking, plastic body panels cannot be repaired and therefore must be replaced.
- It is possible that a front end collision will bend the steering head of the frame, but not the fork, wheel or even the axle.

TROUBLESHOOTING

- Failure of the front suspension, steering or rear suspension may damage the frame enough to require replacement.
- Refer to the section 18 for front suspension and steering inspections.
- Refer to the section 19 for rear suspension inspection.

Abnormal engine vibration
- Cracked or damaged engine mounts
- Cracked, damaged or bent welded portions
- Bent or damaged frame
- Engine problems

Abnormal noise when riding (banging or cracking)
- Damaged or bent engine mounts
- Damaged welded points
- Damaged or bent frame

Steers to one side when under acceleration or deceleration
- Bent frame
- Bent fork
- Bent swingarm

DESCRIPTION

Motorcycle, scooter and ATV frames serve as a skeleton to which all other components are attached. Various forms and intensities of vibration and stress act against the frame from both the engine and suspension when the vehicle is in use. These forces are a major factor in determining the final design of each frame.

The various frame designs can be classified into one of a few general categories. Certain types are chosen for particular models according to their engine displacement, the use the vehicle is designed for, serviceability, economic reasons, and even visual appeal.

The material used for a frame is chosen by similar means. Generally, aluminum frames are reserved exclusively for sport type, on-road motorcycles, usually of middle-to-large engine displacement. Virtually all other frames are made of steel. Aluminum alloys are lighter than steel of the same strength, but are bulkier and more expensive to produce.

A wide variety of tubing and pressed steel shapes as well as castings and forgings are combined to form the optimal framework for a particular model.

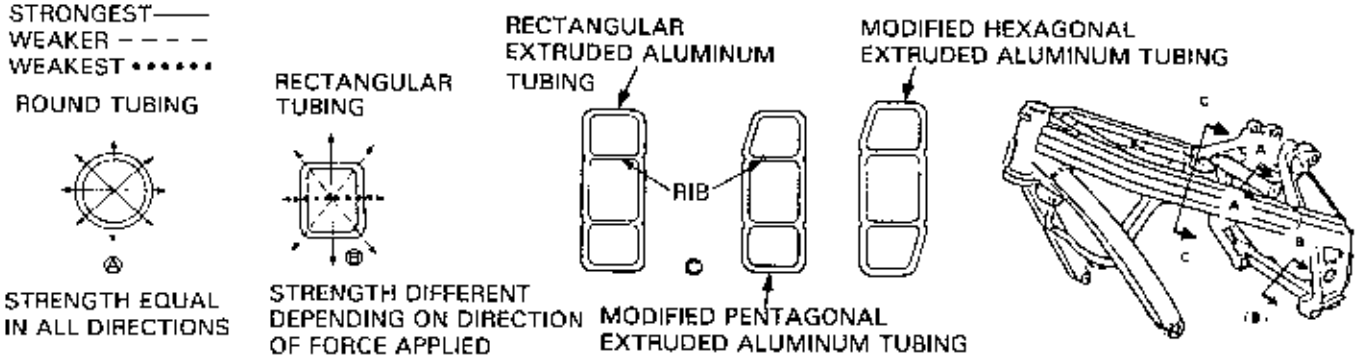
Many of the earliest Honda models used primarily a round steel tube frame.
Later models up to 305 cc used a frame made mostly or entirely of pressed steel plate.

Some of today's frames are made almost entirely of round steel tubing of various sizes and thicknesses. Others are made up mainly of square steel tubing. Most aluminum frame members are some form of rectangular tubing, though a few pieces are square. The highest stressed rectangular aluminum members are often relatively complex extrusions designed to fulfill a specific set of requirements. Most aluminum and steel frames include some castings or pressed steel sections in order to form strong and compact tube joints, and for pivot or major attachment points.

Round tubing has the same strength in all directions. Square and rectangular tubing (as well as other variants) have different strength characteristics in different directions. When the maximum strength is required in a vertical direction and the strength in a horizontal direction is not as important, rectangular tubing with greater strength in the areas needed is chosen. At times a frame is lightened by changing the combination of the types of tubing.

Thinwall rectangular aluminum tubing is given a greater strength by adding an internal stiffening ribs and producing it in the form of an extrusion. Some models use a special modified pentagonal or hexagonal extruded aluminum tubing (with internal strengthening ribs) in order to improve the frame member's strength to weight ratio, its rigidity in one or more specific directions, and in some cases, to allow a more compact and unobstructed riding position.

The various material types, forms and dimensions used in frame design are linked directly to the experience gained from Honda's ongoing racing programs around the globe. As new knowledge is gained through competition, it is combined with input from non-competition testing and utilized in the construction of each new generation of production machine.



The frame also serves to absorb vibration from the engine and, to some degree, from the road surface. The difference in basic frame structure is determined according to the engine type and the type of use the machine is designed for.
Two only slightly different frame designs may have significantly different vibration absorbing or generating characteristics which make one design correct and the other unsuitable, even with the same engine installed. Therefore, the particular frame structure a machine ends up with is chosen according to the engine type and by the specific use the machine is intended for, in order to prevent unpleasant vibration to the rider and premature fatigue to structural members.

Frames are classified as follows, according to differences in basic structure.

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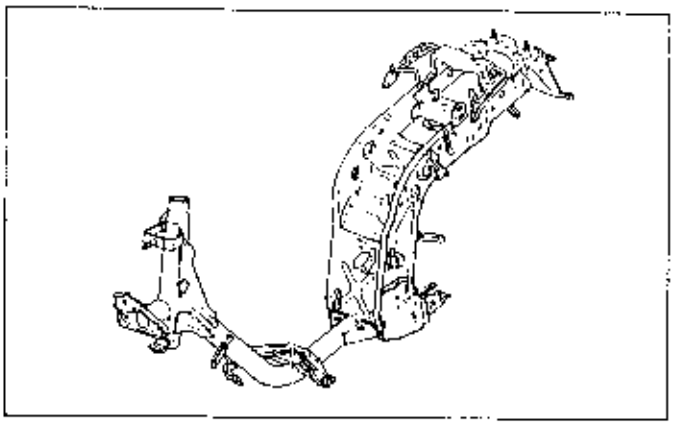
BACK-BONE TYPE

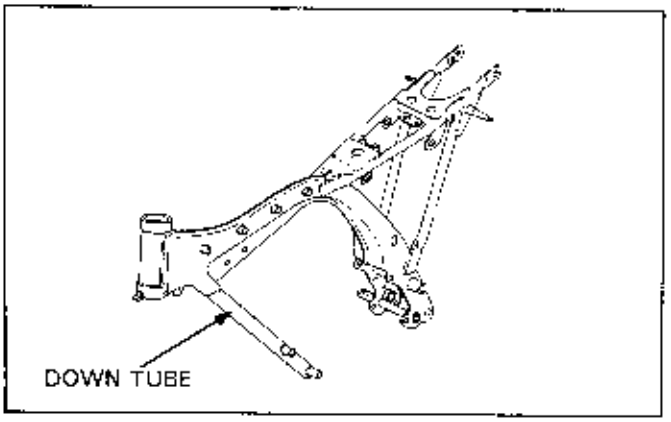
This type of frame is made up of a combination of pressed steel plate and steel tubing.

This basic frame design is used mainly on scooters and some of Honda's early motorcycle designs. This type of construction allows added freedom in the overall design of the vehicle and relatively economical production.



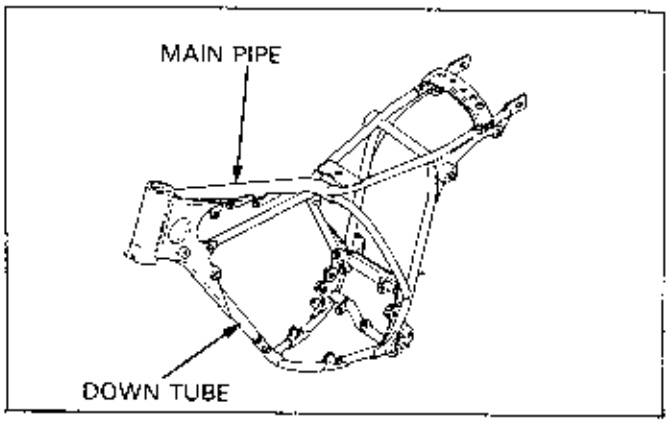
DIAMOND FRAME

The lower section of the down tube is not connected with other frame tubes. The engine forms the final portion of the frame structure.
Mounting the engine generates the frame strength.
The diamond frame is used mainly on small and middle-size vehicles due to simplicity of the structure, light weight and excellent serviceability.



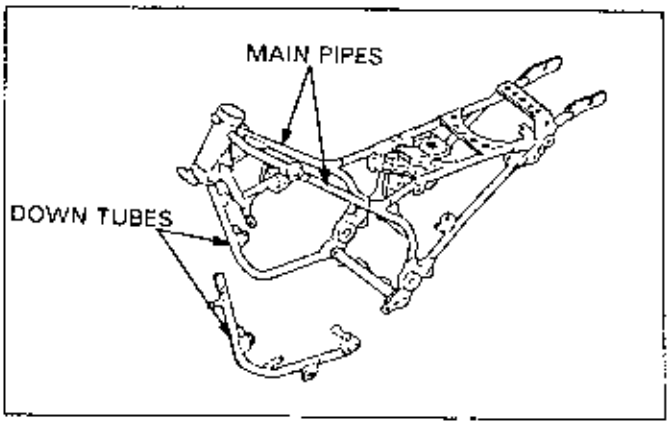
SINGLE CRADLE FRAME

The single cradle frame has one down tube and one main pipe at the front of the engine. The frame structual material surrounds the engine. This frame is mainly applied to off-road vehicles, light weight, and middle-size on-road sport type vehicles due to light weight, greater strength and ease of serviceability.



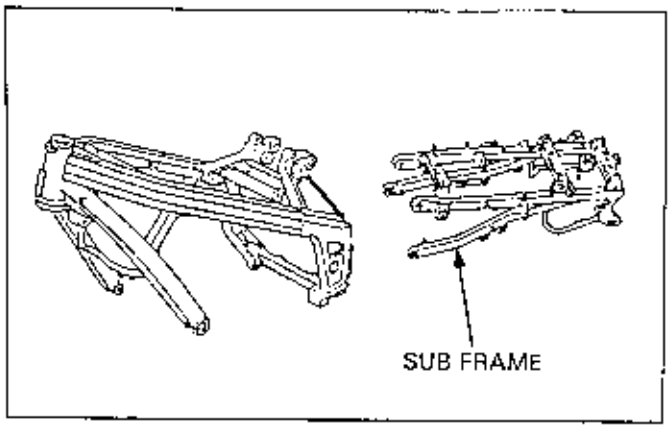
DOUBLE CRADLE FRAME

The double cradle design is similar to the above mentioned single cradle frame, but has two down tubes and main tubes, resulting in increased rigidity. A part of the down tube can be removed to facilitate engine removal on some models.
This frame is mainly used on large displacement on-road motorcycles.



ALUMINUM FRAME

The aluminum frame has a lighter weight than the steel frame. The use of rectangular and square cross-section tubing as a structural material provides a greater strength in the direction of stress. The sub frame can be removed to improve the service access on some models. This frame is mainly used on sport type on-road motorcycles.

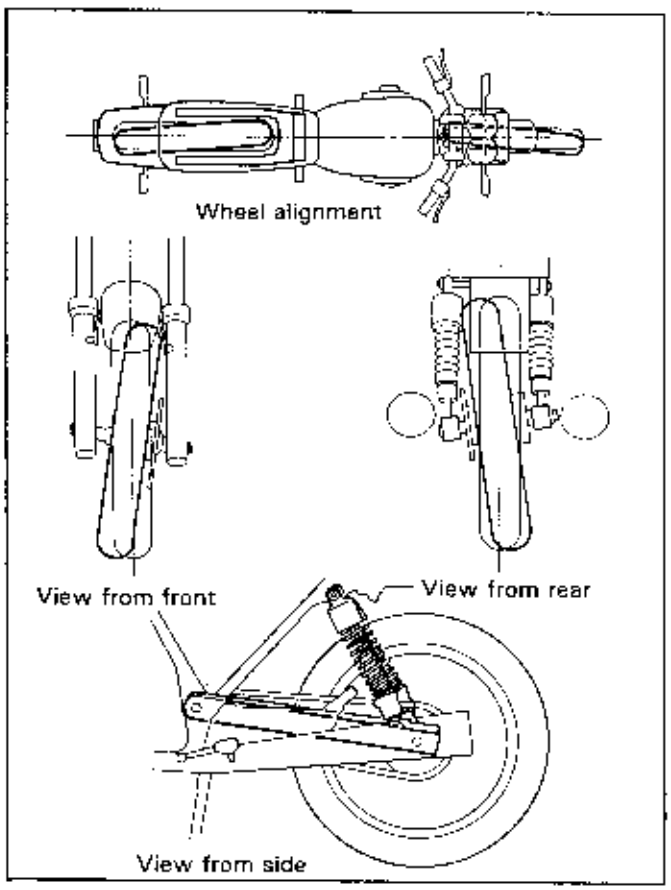


INSPECTION

Visually check the frame for damage or bent tubes and components.
Straighten the handlebar and check the alignment between the front wheel and rear wheel.

If the rear wheel does not align with the front, check that the drive chain adjusters are adjusted correctly.

If the above rear wheel leans to either side when viewed from above, check whether the right or left arm is twisted or bent from the horizontal viewpoint of the arm section of the swingarm. In the same way, check the alignment of the rear shock absorber mounts (on dual shock models).

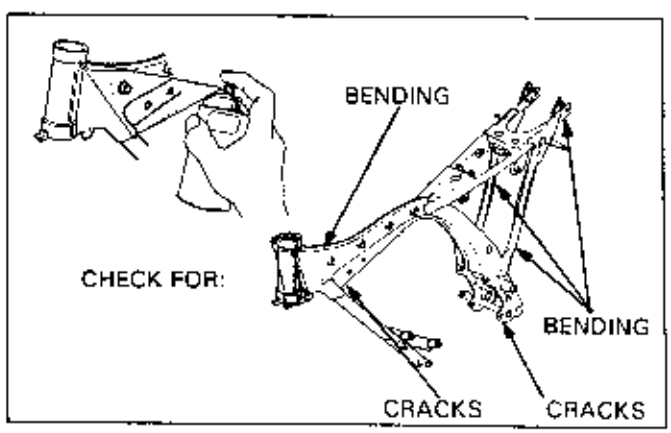


Apply penetrant to inspect the cracks.

NOTE

- Refer to the penetrant manufacturer's instruction manual for proper use and inspection procedure.

If cracks appear in the paint on the frame, inspect the area(s) more closely to find out if the frame material itself is cracked.



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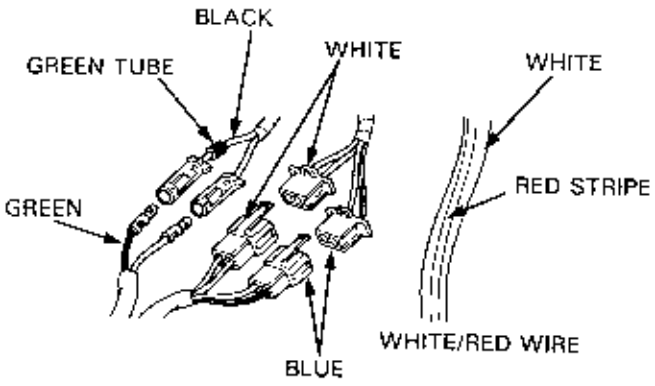
21. ELECTRICAL FUNDAMENTALS

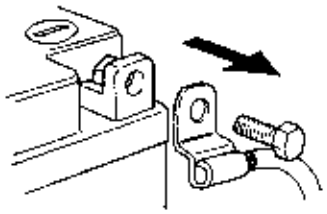
This chapter illustrates the safety precautions and the basic knowledge required for servicing electrical systems. Other chapters related to electrical systems do not contain the basic information presented in this chapter. Read this chapter thoroughly in order to understand the basic safety procedures and diagnostic methods before starting any servicing.

SERVICE INFORMATION

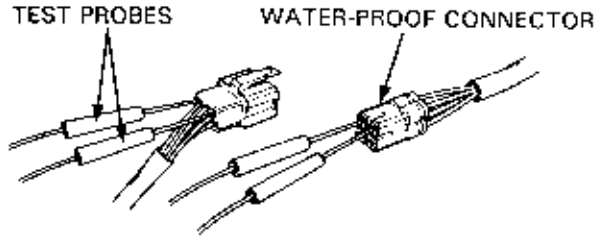
- Connect wires only with wires of the same color. However, in the few instances when wires with different colors are connected, there is always a colored band near the connector.
- Connect connectors with the same colored connectors.
- On wires with stripes, the stripe color is indicated after the color of wire.



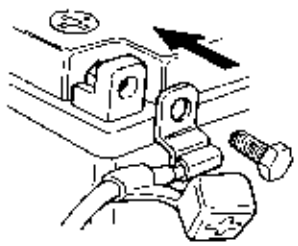
- Disconnect the negative cable of the battery before working on any electrical component.
- Do not let the tool contact the frame when disconnecting the cable.



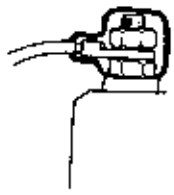
- When measuring voltage and resistance of wire terminals using testers; insert the probes from behind the connector. For water-proof connectors, insert the probes from the front to avoid opening the wire terminal.



- Connect the positive terminal first when connecting the battery.
- Coat terminals with clean grease after connection. Make sure the protective cover is secured on the terminal.

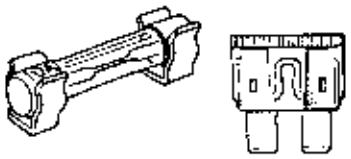


- After completing the job, check that all terminal protecters are placed correctly.

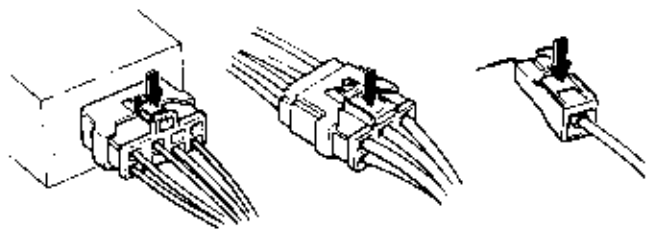


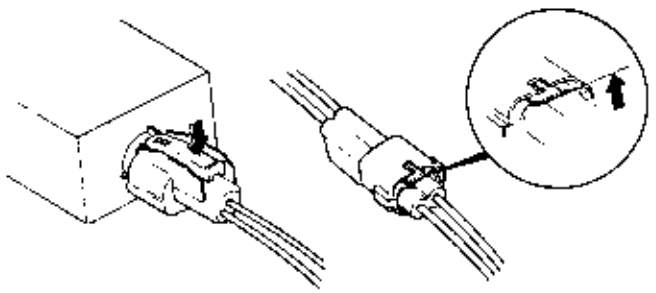
2

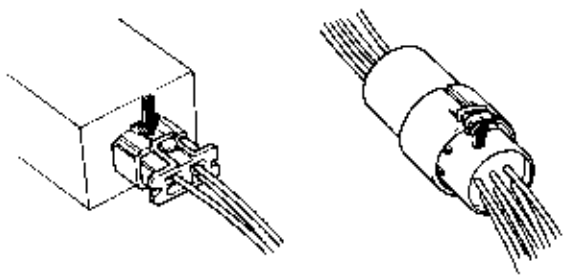
■ If a fuse blows out, diagnose the cause and repair it. Replace the fuse with one of the correct rating.



■ Always separate the connectors with the ignition switch in the OFF position.
■ Before separating the connector, check whether the connector is of the push-in type or pull-up type.
■ For connectors with locks, push the connector in lightly then unlock the lock before disconnecting.

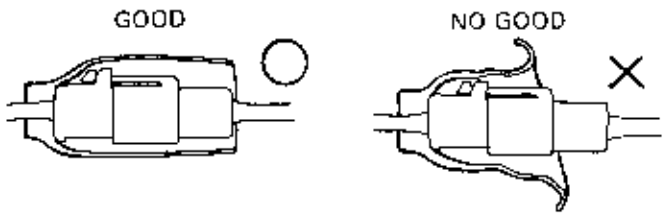






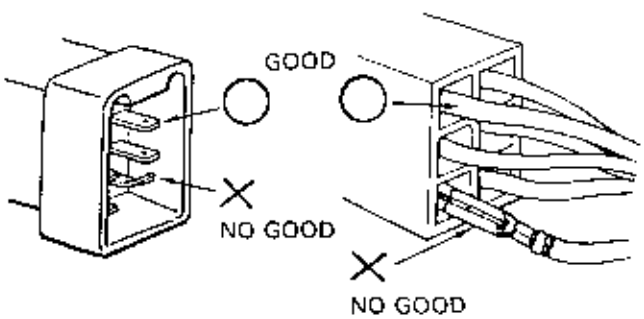
■ When separating connectors, pull only on the connector housing. Do not pull on the wires.

■ Make sure protectors completely cover the connectors.



■ Insert connectors all the way in.
■ For connectors with locks, check that the lock is securely fastened.
■ Make sure that the harnesses are secured to the motorcycle properly.

■ Before connecting connectors, check that the pins are straight and that all the wire terminals are intact and tight.
■ If a terminal is corroded, clean it thoroughly before connecting.



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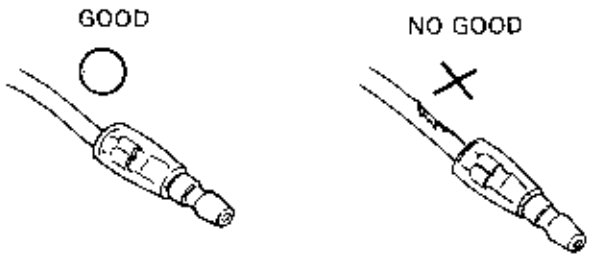
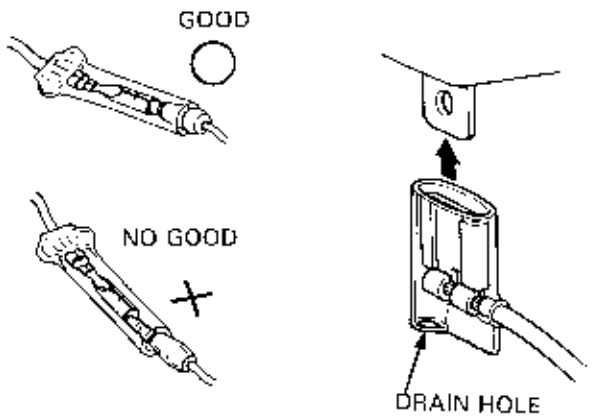
■ Check for torn protective covers and oversized, loose fitting, female terminals before installation.

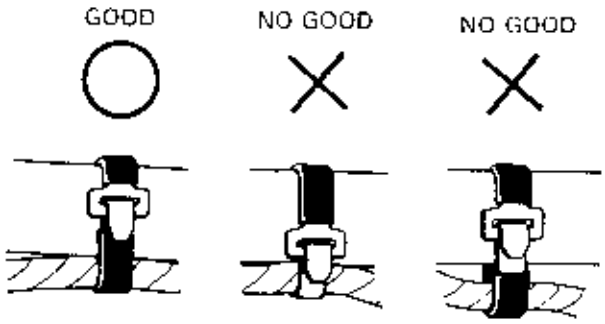
■ Replace damaged wires with new ones.



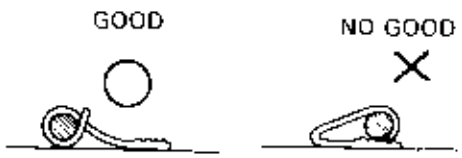
■ When installing a connector, push it until it clicks into place.
■ Check that connector protectors cover the terminals completely.
■ Connectors with protectors facing up must have a drain hole.



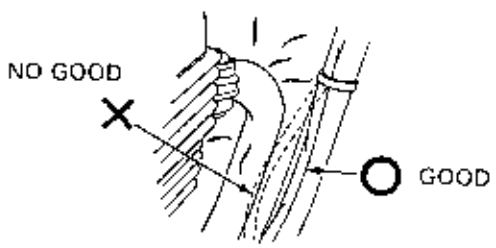
■ Secure wires and wire harnesses to the frame with wire bands at the designated locations. Install the bands so that only the insulated surfaces contact the wires or wire harnesses.



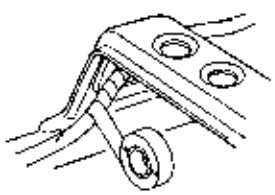
■ Do not squeeze a wire against a weld or the end of its clamps.



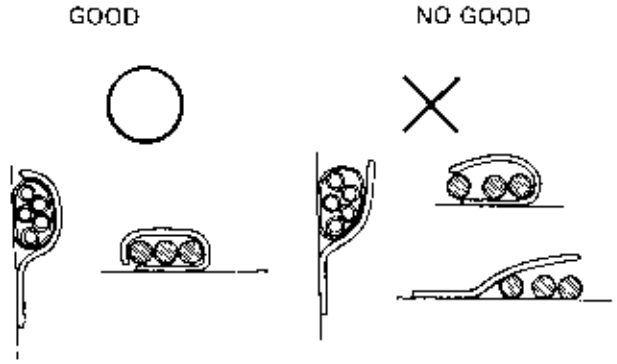
■ Check that harnesses cannot come in contact with hot parts after clamping.



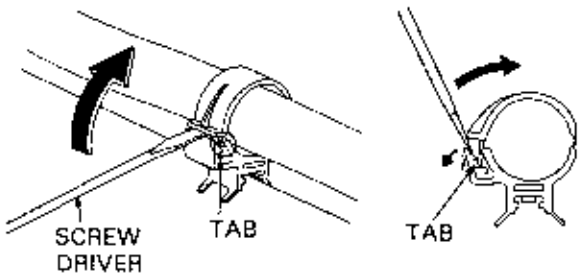
■ Protect wires and harnesses with at least two layers of electrical tape or with electrical harness tubes if they contact a sharp edge or corner.



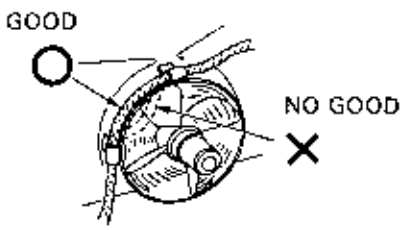
■ Check that the wire harness is securely clamped at all locations.



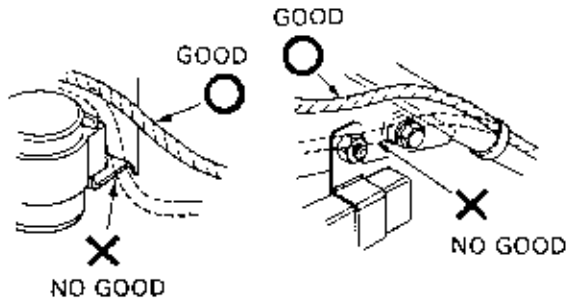
■ To unlock wire harness or hose from a clip, use a screwdriver to open up the tab. When locking the clip, press firmly until it clicks. If the clip was removed from the frame, replace it with new one.



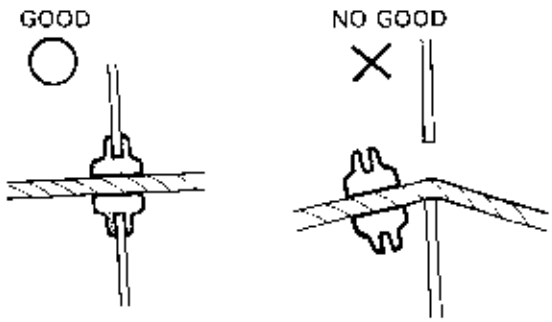
■ Check that the wire harness does not interfere with any moving or sliding parts after clamping.



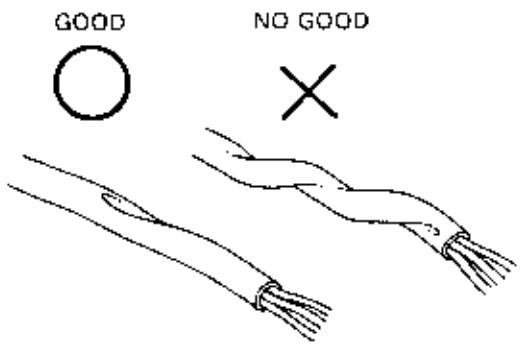
■ Route wire harnesses to avoid sharp edges, corners or the projected ends of bolts and screws.



■ Seat grommets in their holes properly.



■ Do not bend or twist wire harnesses.



■ Before using testers, read the instructions.

CAUTION

- **Do not drop parts containing semiconductors. Semiconductors are fragile and sensitive to shock. Dropping a semiconductor could damage or destroy it.**

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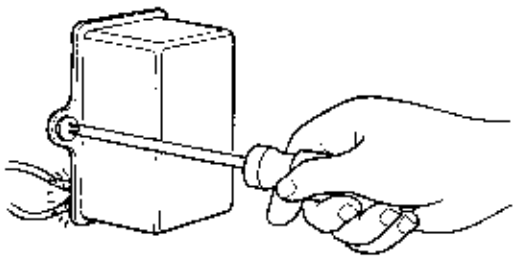
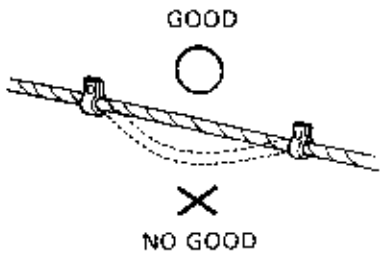
■ Be careful not to pinch or trap wires or harnesses under items during installation.

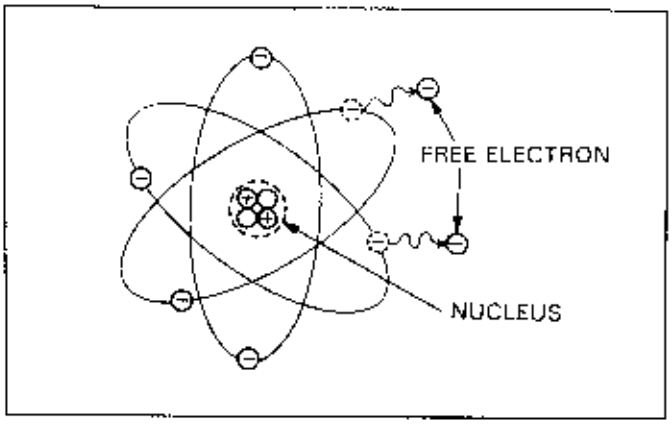


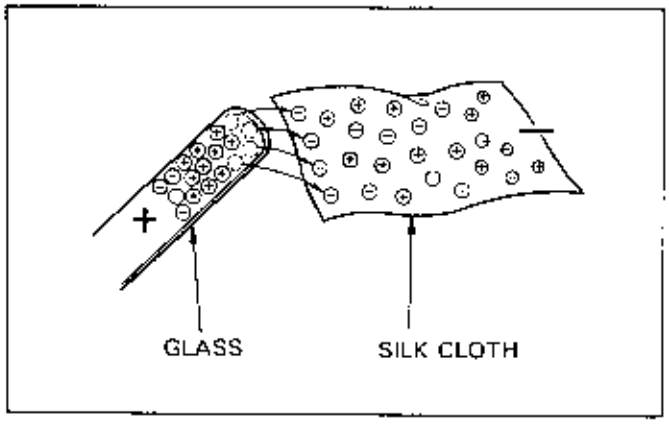
■ Route wires and wire harness so that they are not too tight or loose when the handlebar is turned all the way to the right or left.
■ Avoid routing wires and harnesses through sharp bends and arround tight corners.
■ Route harnesses so they are neither pulled taut nor have excessive slack.



BASIC ELECTRONIC KNOWLEDGE

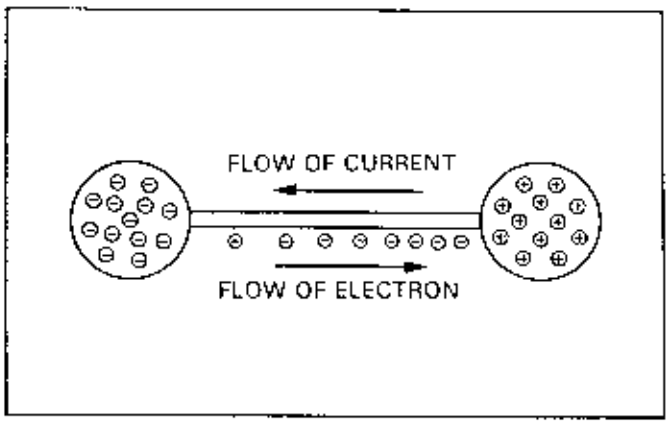
All matter, whether solid, liquid, or gas, are a collection of molecules, and each molecule is made up of atoms. Each atom consists of a nucleus, which is made up of protons and neutrons, and electrons which circle around the nucleus.
Electricity flows when these electrons freely move outward from their orbits. Some materials become conductors when there are a lot of free electrons and some become insulators when there are no free electrons. It is a well known fact that when a piece of glass is rubbed with silk cloth, it generates "Static Electricity" attracting a piece of paper towards it. This happens because the free electrons in glass move into the silk due to the heat generated by rubbing. As a result, the glass takes on a positive charge and the silk cloth takes on a negative charge.





CURRENT FLOW

When a positive charged material and a negative charged material are connected with a conductor, free electrons flow from negative charged to positive charged material. This flow of electrons is called "electricity". For a long time it was thought that electrical current flowed from the positive side of the source to the negative side. When it was discovered that electrons actually flow the other way it was too late to change existing publications on electricity. As a result, just for convenience, technical publications compromise by saying that electrical current flows from the positive to the negative side while electrons flow from the negative to the positive side.



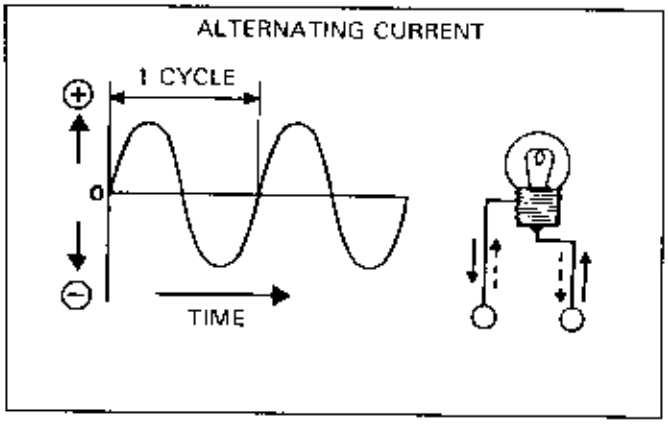
It is convenient to think of the flow of electrical current as the flow of water.
The number of electrons passing any given point in a circuit in one second determines the current flowing through the circuit. The amount of current flow is measured in "Amperes (A)".

Date of Issue: Oct., 1988

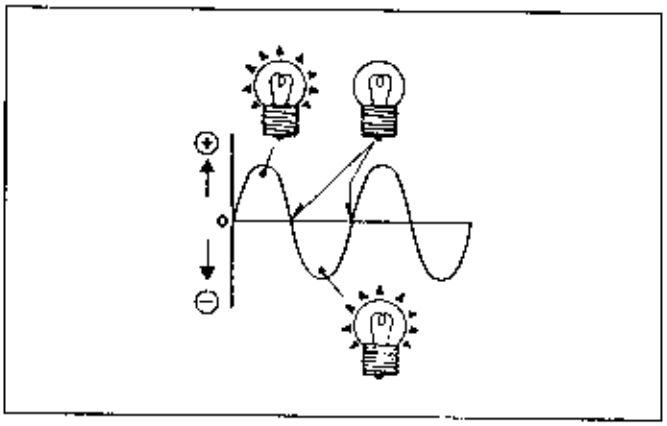
ALTERNATING CURRENT AND DIRECT CURRENT

All electrical components are supplied with either alternating current or direct current, abbreviated as AC or DC respectively.
The fundamental characteristic of the two currents differ completely, and for the purpose of servicing, you need to have a good understanding of these differences.

Alternating-current
Alternating current (AC) changes in voltage value and polarity with time. AC current flows in one direction until peak voltage is reached and then drops to zero volts. AC current then changes direction or polarity until peak voltage is achieved and again drops to zero and again changes polarity. From peak positive voltage to peak negative voltage and back again to peak positive voltage is known as a cycle.

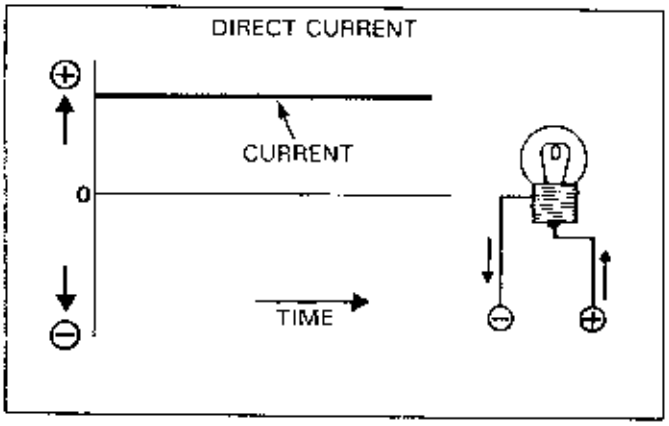


In motorcycles, all electricity generated is AC. However, AC can be converted to direct current (DC) by rectification. The DC current is then supplied to components operating on DC. For example, some models use DC for their headlights and others use AC.
For headlights operating on AC, the lights turn off when the current flow is zero, and then go back on again as the polarity becomes reversed. This ON-OFF cycle is repeated at a high frequency (number of cycles in one second) and is not noticable.



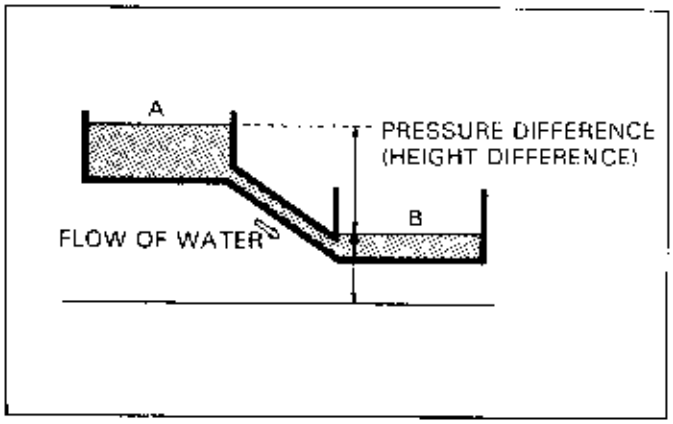
Direct current
Direct current is a current whose magnitude and direction remain constant. Its form is shown in the graph. Direct current is abbreviated as DC. Motorcycle batteries, and household batteries supply DC.

DC has the following characteristics as opposed to AC.
- DC can be stored in batteries and discharged when needed. (AC cannot be stored)
- DC is capable of a large current flow. (Good for starter motors)
- DC voltage cannot be stepped up or down. (AC can change its voltage by using a transformer)

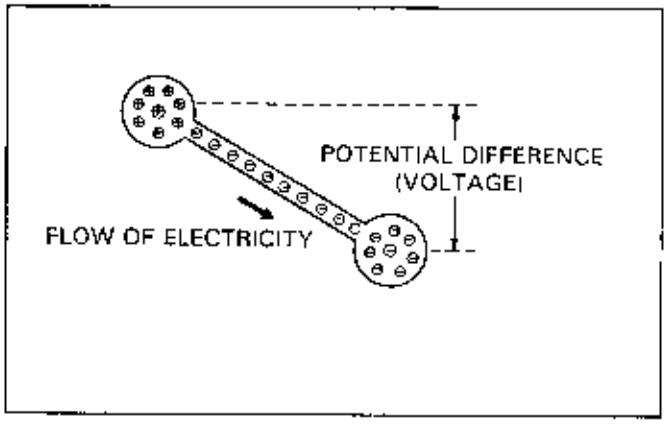


VOLTAGE

As illustrated in the figure to the right, when two water tanks, A and B, are connected, water flows from tank A to tank B. This flow is the result of a pressure difference between the two tanks.

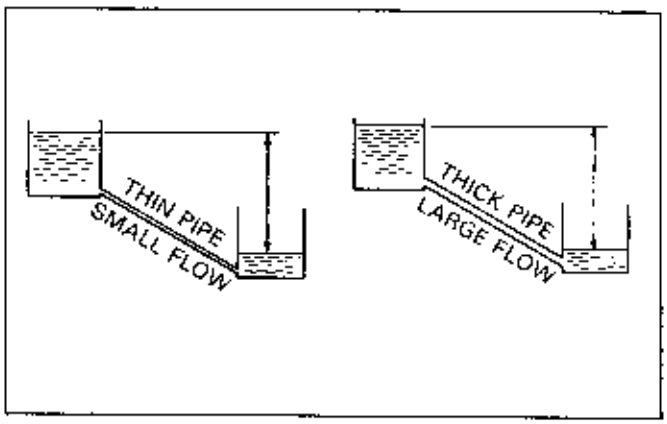


This same concept applies to electricity.
The pressure difference, called the electrical potential difference, causes current to flow through a circuit.
The pressure of the current is measured as voltage (V).

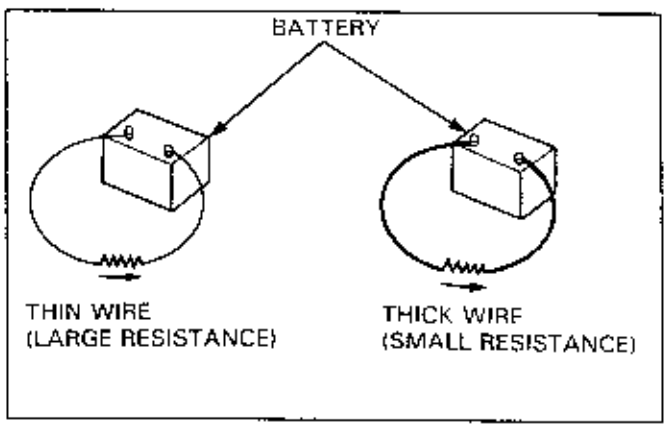


RESISTANCE

As everyone knows, water flows through a larger pipe easier than a smaller pipe. This is because the smaller pipe provides greater resistance. Similarly, electrical current flows through a thicker wire (conductor) more easily than a thinner wire. The resistance limiting the flow of electricity through a wire is measured in Ohms (Ω).



Resistance increases as the size of wire become smaller and longer.
This resistance value can be measured with an ohmmeter.



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OHM'S LAW

The amount of current flowing through a conductor in a closed circuit is proportional to the voltage applied to the conductor. The relationship between voltage and current flow and resistance is known as Ohm's law.
For example, if a 6 Ω resistor is connected to the + and − terminals of a 12 V battery, the current flowing through the resistor can be calculated by Ohm's law:

Current = Voltage ÷ Resistance = 12 ÷ 6 = 2 A

<OHM'S LAW>

$$\text{CURRENT (I)} = \frac{\text{VOLTAGE (E)}}{\text{RESISTANCE (R)}} \Rightarrow$$

⇨ VOLTAGE = CURRENT x RESISTANCE
CURRENT = VOLTAGE ÷ RESISTANCE
RESISTANCE = VOLTAGE ÷ CURRENT

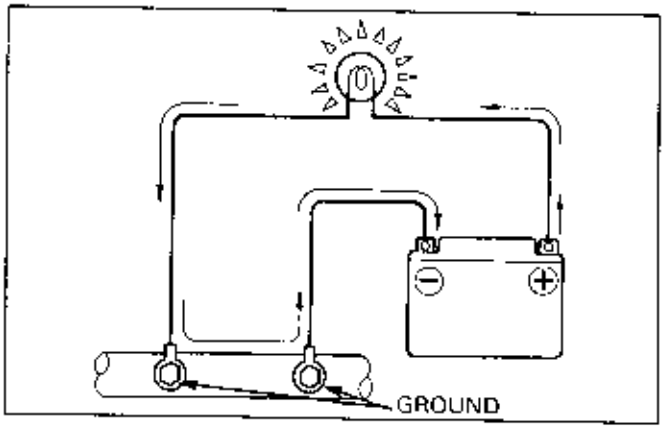
POWER

We use electricity to operate headlights or starter motors, or we convert it to heat.
The amount of work required to do these things is measured in Watts. Changing voltage (Volts) or the rate of current flow (Amperes) increases or decreases electrical power output (Watts).
The relationship is defined as:

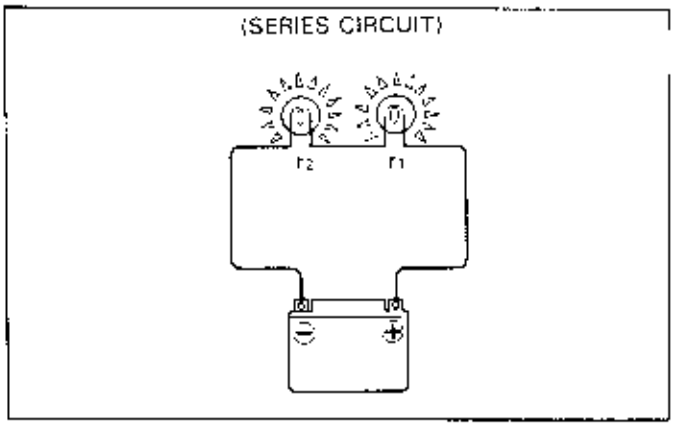
W = E.I (Power = Voltage x Current)

ELECTRICAL CIRCUIT

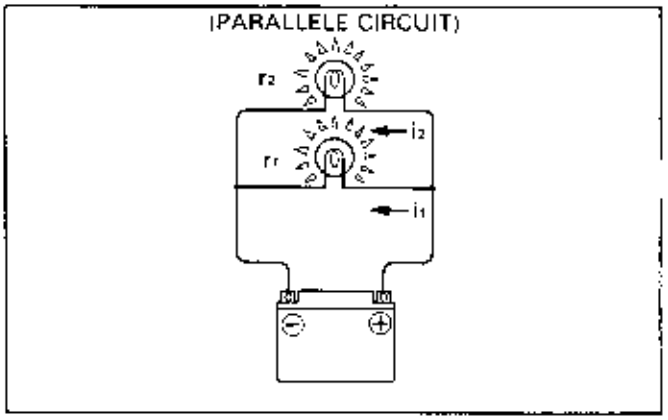
As shown in the right diagram, when a light bulb is connected to a battery, the current flows in the direction of the arrow and the light bulb turns on.
The path in which an electric current flow, is called a circuit. On Honda motorcycles, scooters and ATVs, the ground wire of an electrical circuit is connected to the engine or frame. Grounding the negative terminal is called a negative terminal ground type.
All Honda motorcycles, scooters and ATV share the negative ground circuit shown in the right diagram.



Series circuit
A series circuit is an electric circuit in which the current flows through one device into another, and then to ground. There is only one current path and the voltage is distributed by the loads. The total resistance (Ω) can be found by simply adding all the resistances. eg. R = R1 + R2

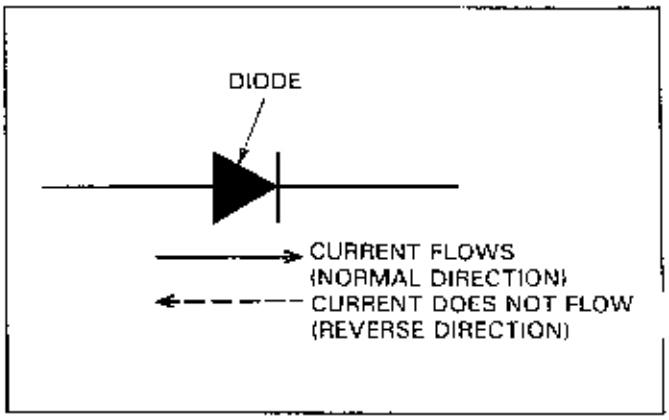


Parallel circuit
A parallel circuit is an electric circuit which has two current paths, one for the positive and one for negative. The devices are connected across the two paths. The voltage on each load is the same, but the current branches out to each load. the current flow to each load can be calculated as i1 = E ÷ r1, i2 = E ÷ r2.
The total current (I) is the sum of all current flowing to each load.



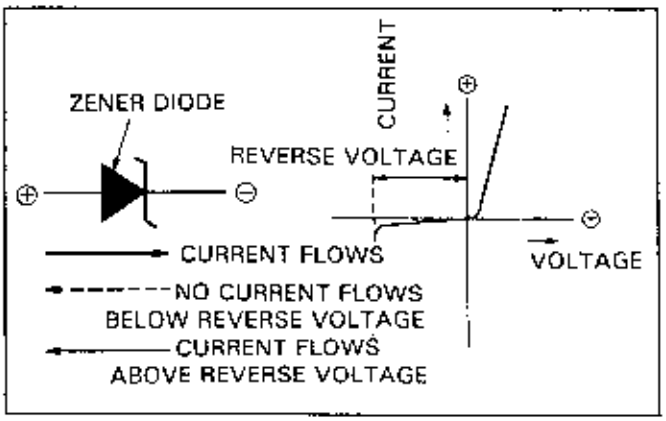
DIODE

The diode allows current to flow in only one direction. When current is flowing, there is a slight voltage drop across the diode.



ZENER DIODE

The zener diode allows current to flow in one direction similar to the diode above. When a certain reverse voltage is applied, current abruptly flows in the reverse direction. When the voltage is reduced below the reverse voltage, current flow in the reverse direction stops.



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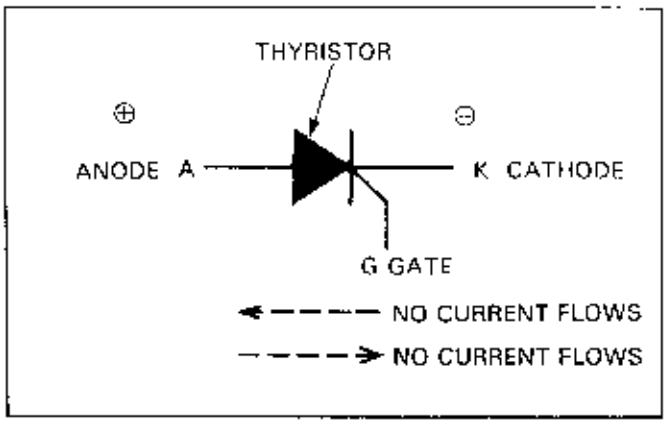
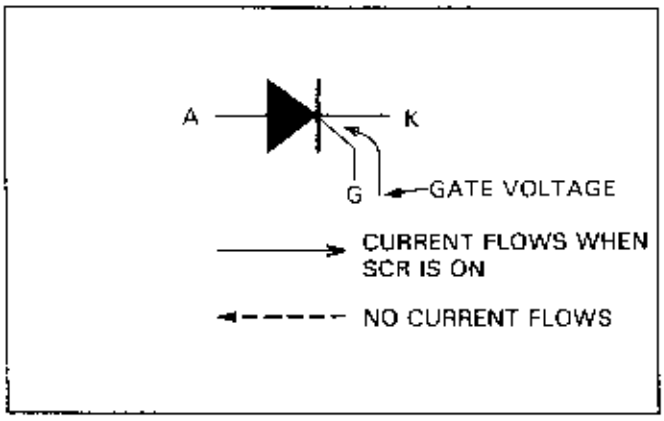
THYRISTOR (SCR)

Thyristors have three terminals: anode, cathode, and gate. The current flowing from the anode to cathode is said to be in the positive direction.
Like diodes, thyristors do not flow current in the negative direction. Thyristors allow current to flow from anode to cathode only when the thyristor is turned on.



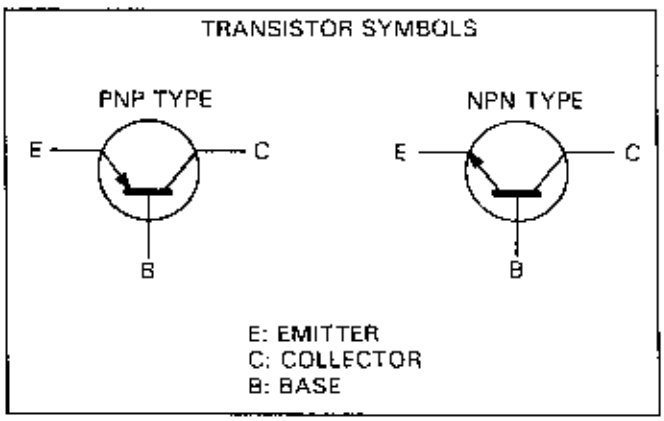
The thyristor is turned on when a certain amount of voltage is applied to the gate. This input to the gate is called gate voltage or trigger voltage.
Once the thyristor is turned on, there is no need to continuously apply voltage to the gate, and its characteristic becomes identical to a regular diode.



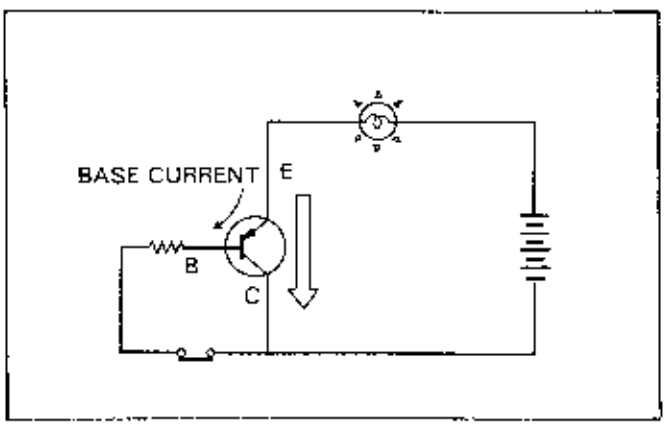
SEMICONDUCTOR

The electrical conductivity of semiconductors lies between that of conductors and insulators.
Before understanding how they work in circuits, you need to have a basic knowlege of its characteristics.

Transistor
A transistor has three terminals; emitter (E), collector (C), and base (B).
There are two types of transistors: PNP and NPN type.

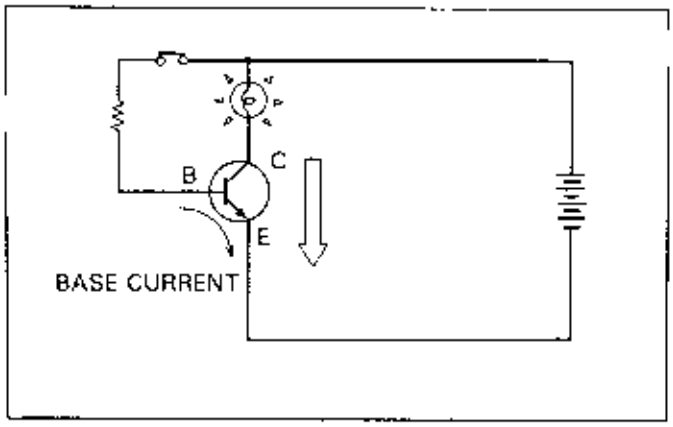


In PNP type transistors, when a positive voltage is applied to the emitter and negative voltage to the collector, almost no current flows from the collector to the emitter. If the emitter voltage is raised slightly higher than the base voltage and a small amount of current flows from the emitter to the base, a large amount of current flows from the emitter to the collector.

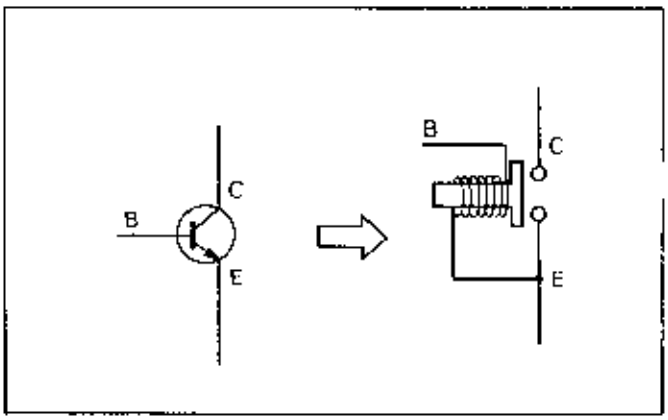


In the NPN type, almost no current flows when a positive voltage is applied to the collector and a negative voltage to the emitter. When a small current flows from the base to the emitter, a large current flows from the collector to the emitter.

In this way, the transistor resembles an amplifier in that the amount of collector to emitter current is controlled by the base current.



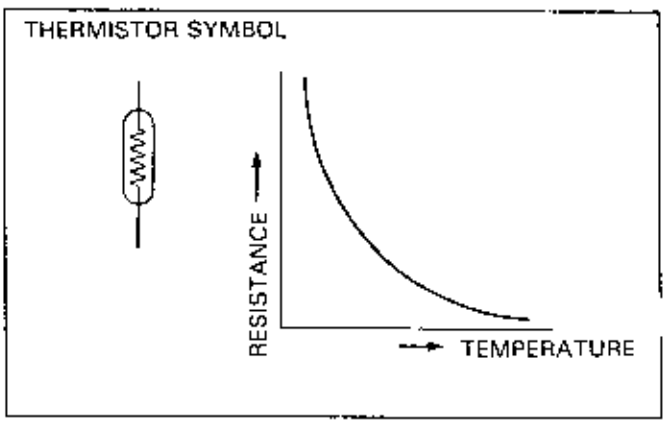
Transistors also resemble switching devices. The transistor is turned on, allowing collector to emitter current to flow when there is base current, and turn off when no base current exists.



Thermistor

In general, the resistance value of most metals, including copper, increases as the temperature rises. In contrast, the resistance of a thermistor decrases as the temperature rises. When heat is applied to a substance, the activity of its molecules increases and prohibits the flow of free electrons. This increases the resistance.

For the thermistor, the number of free electrons increases as heat is applied. In this case, the activity of the molecules no longer obstructs the flow of electrons and the resistance decreases.



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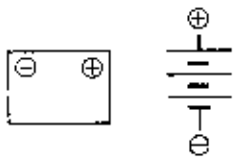
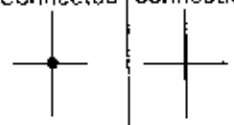
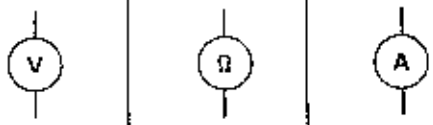
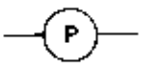
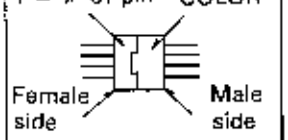
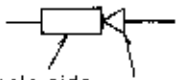
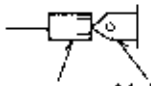
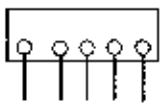
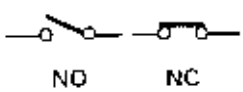
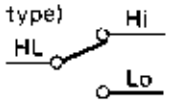
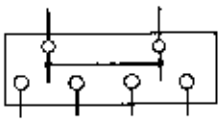
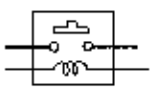
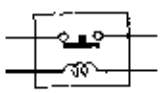
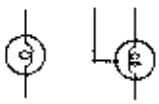
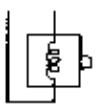
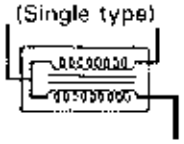
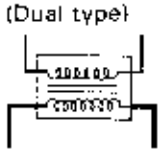
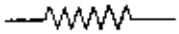
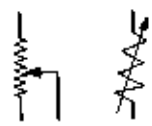
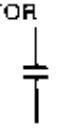
ELECTRICAL SYMBOLS

The symbols below are the most common type of symbols used in electrical circuits.

Abbreviations used in switching devices are as follows:
NO (Normally Open): Switch is open at rest
NC (Normally Closed): Switch is closed at rest.

<table>
<tr><td>BATTERY
  </td><td colspan="2">CONNECTION
Connected | No connection
  </td><td colspan="3">MULTI-TESTER
Voltmeter | Ohmmeter | Ammeter
  </td><td>MOTOR
  </td></tr>
<tr><td>PUMP
  </td><td colspan="2">CONNECTOR
P = # of pin COLOR
 
Female side | Male side</td><td colspan="2">CONNECTOR
(Round type)
 
Female side | Male side</td><td colspan="2">CONNECTOR
(Flat type)
 
Female side | Male side</td><td>EYELET TERMINAL
  </td></tr>
<tr><td>IGNITION SWITCH
(Circuit symbol)
  </td><td colspan="2">IGNITION SWITCH
(Wiring symbol)
  </td><td colspan="2">SWITCH
(Two terminal)
 
NO | NC</td><td colspan="2">SWITCH
(Three terminal type)
 
Hi | HL | Lo</td><td>SWITCH
(Combination type)
  </td></tr>
<tr><td>FUSE
  </td><td colspan="2">RELAY (NO type)
  </td><td colspan="2">RELAY (NC type)
  </td><td colspan="2">LIGHT BULB
 
DOUBLE FILAMENT</td><td>GROUND
  </td></tr>
<tr><td>THREE PHASE ALTERNATOR
  </td><td colspan="2">SINGLE PHASE ALTERNATOR
  </td><td colspan="2">PULSE GENERATOR
  </td><td colspan="2">IGNITION COIL
(Single type)
  </td><td>IGNITION COIL
(Dual type)
  </td></tr>
<tr><td>SPARK PLUG
  </td><td colspan="2">RESISTOR
  </td><td colspan="2">VARIABLE RESISTOR
  </td><td>COIL
  </td><td>SOLENOID
  </td><td>LED
  </td><td>CAPAC-ITOR
  </td></tr>
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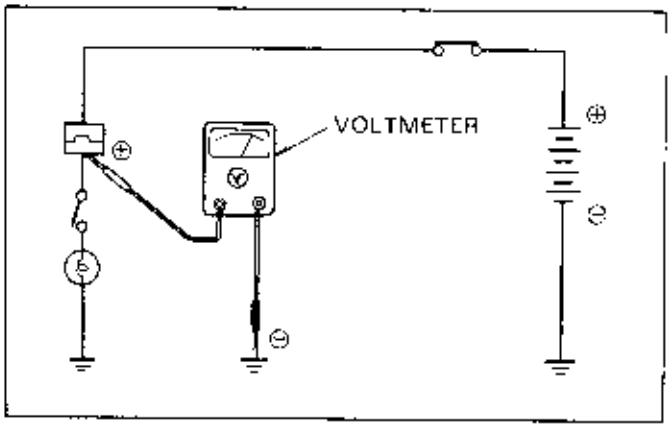
BASIC ELECTRICAL DIAGNOSTIC METHODS

VOLTAGE MEASUREMENT

Measuring voltage is a fundamental method of checking circuit components. The measurement is conducted for the following reasons.

① To check if voltage exists. A test light could be used.
② To measure the actual voltage value. A voltmeter is used to determine if electrical component is operating normally.

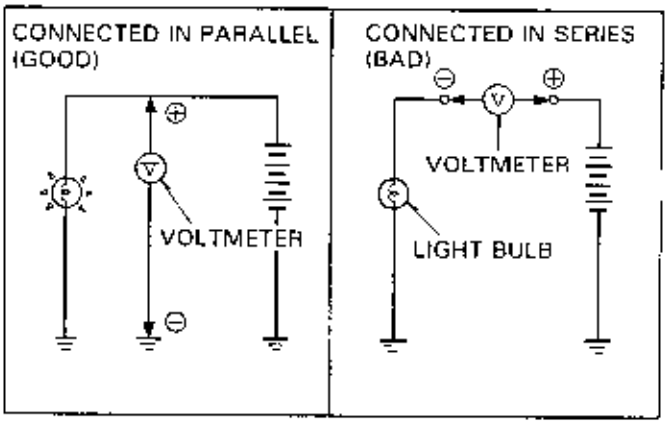


HOW TO MEASURE VOLTAGE USING VOLTMETER

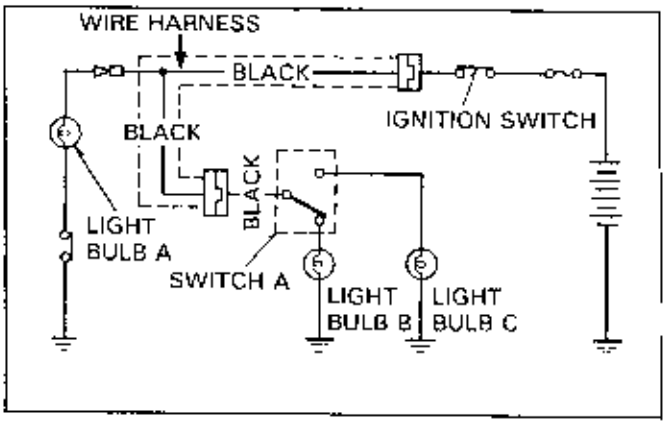
NOTE

- Make sure the ground surface is clean and free of paint. Use a bolt attached directly to the frame.

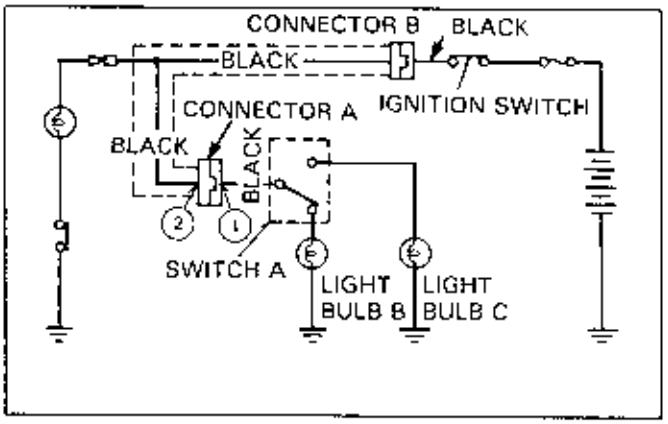
Select a range that is one scale higher than the desired voltage value. Apply the red probe to the positive end and the black probe to the negative end of circuit. The diagram on the right shows that the voltmeter registers the voltage across the light bulb. Voltmeters are always connected in parallel, not in series.



Example 1
First study the circuit diagram.
If light bulbs B and C do not work, and A is OK, the malfunction is between the grounds at B and C and switch A.
If light bulb A does not work also, the problem is between the grounds at A, B, and C and the ignition switch.



1. With the ignition switch ON and both light bulbs B and C do not work, check voltage at ①.
2. If no voltage is measured at ①, check voltage at ② in case of false connection at connector A. If voltage exists at ② and not at ①, there is problem in the connection at connector A.
   If voltage registers at both ① and ②, switch A should be checked.



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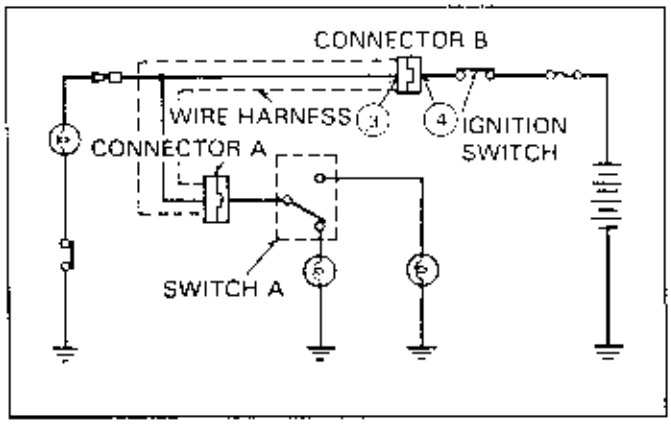
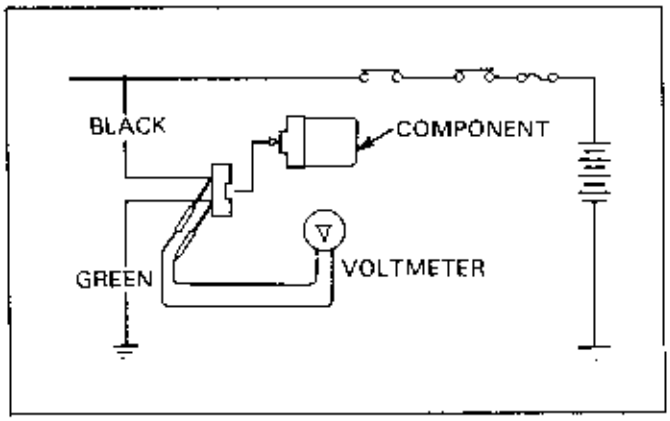
3. If voltage at ① and ② do not exist, check voltage at ③ and ④ in a similar manner.
- If there is no voltage at ③ and ④, check wiring between ignition switch and battery.
- If there is voltage at ③ and ④, check for a broken wire or a short circuit in the wire harness. Exchange the wire harness with a new one if necessary.
- If there is voltage at ④ and not at ③, then check for loose connector B.



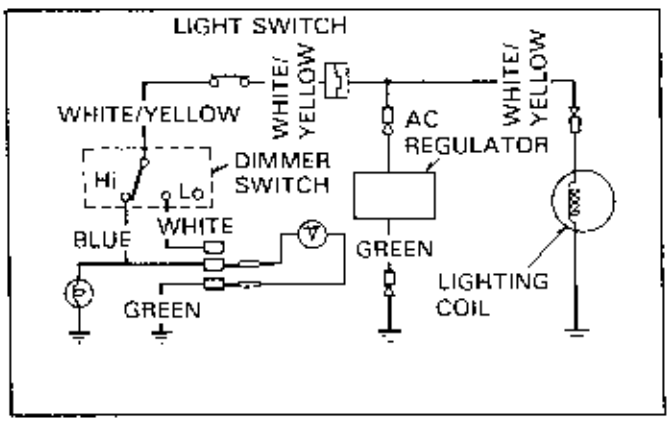
Example 2

Sometimes it is easier to diagnose a component by measuring from its input terminals directly.
Here, the (+) probe goes to the positive input terminal and (−) probe goes to the ground wire of the component.
If no voltage is measured, there are two possible causes.
① No voltage at the positive input terminal.
② A loose ground wire.
For ①, check for voltage between the input terminal leading to the battery and ground. For ②, check for continuity between the green wire terminal to ground.



Example 3

Voltage measurement is frequently used to check if a system is working correctly.
For instance, if a light bulb blows out frequently, it needs to be checked with an AC voltmeter to see if an excessive voltage is apparent.
In this case, measure the AC voltage of the light bulb terminals to see if it is within the specified voltage range.

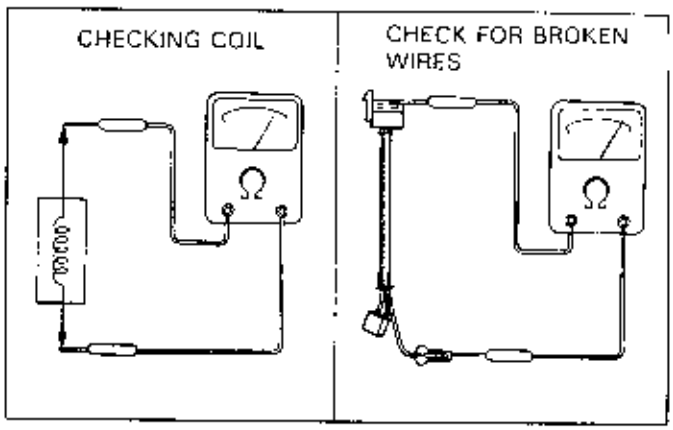


MEASURING RESISTANCE

Along with voltage, resistance is another basic parameter for diagnosing circuits and their components.
Resistance is measured for the following reasons.

① To check if components are working properly.
The resistance value of a coil (eg. ignition coil) indicates if it is normal or malfunctioning.

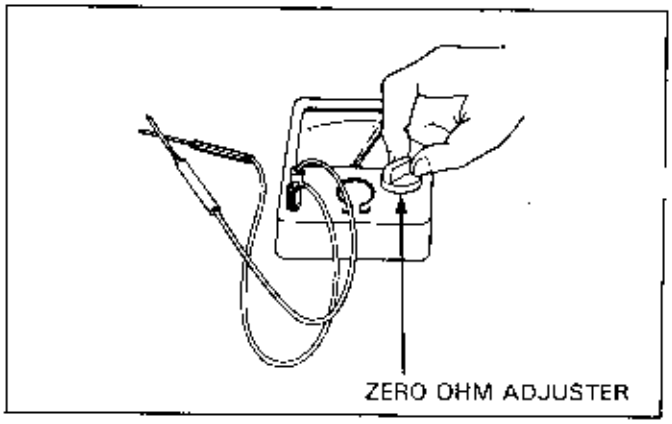
② To check for a broken wire.
A continuity check indicates if a wire is intact or broken.



How to measure resistance using an ohmmeter.

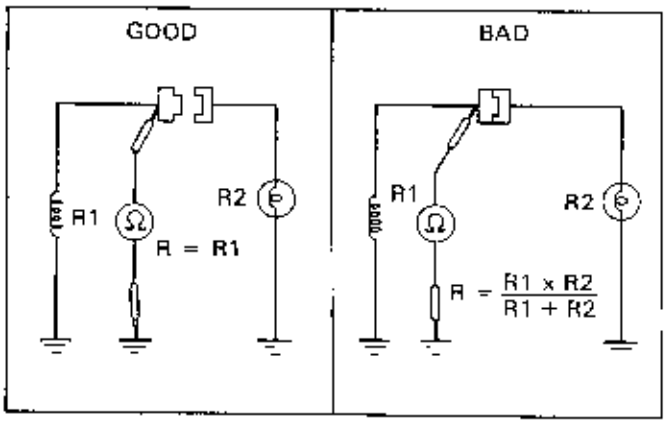
NOTE

- Proper zeroing of the ohmmeter is necessary to obtain correct measurements. Touch the two probes and adjust the ohmmeter so that it registers 0 (ohms symbol).

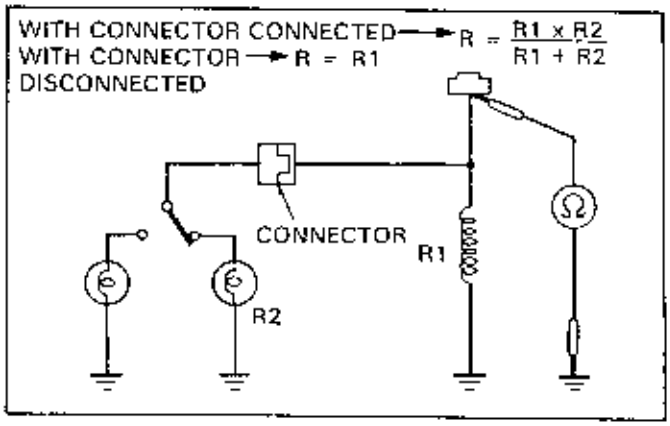


Since the polarity of terminals is not important, either probe may be applied to the terminal. However, since diodes allow current to flow in one direction only, the polarity is important.

Unlike when measuring voltage, it is necessary to disconnect the component from the circuit. If resistance is measured with the entire circuit connected, the ohmmeter will read a smaller value than the correct value.



Similarly, if a circuit has branches, the connector leading to the specific branch needs to be disconnected in order to read correctly.



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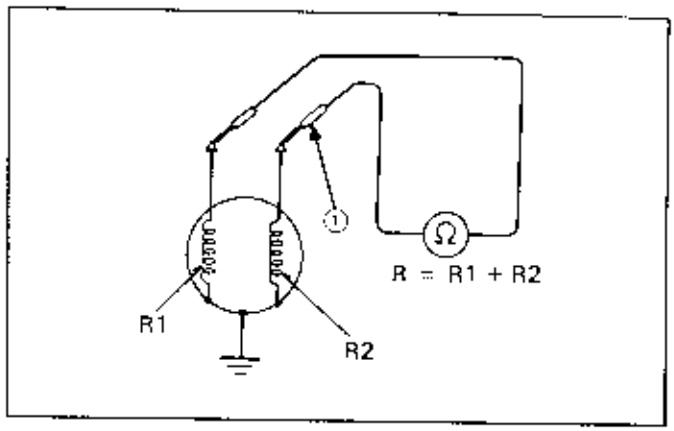
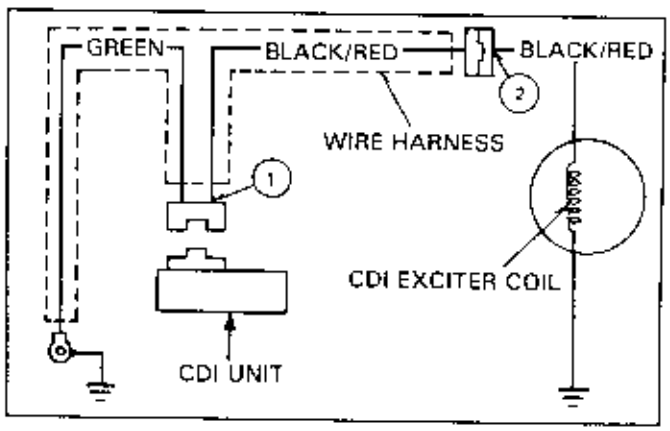
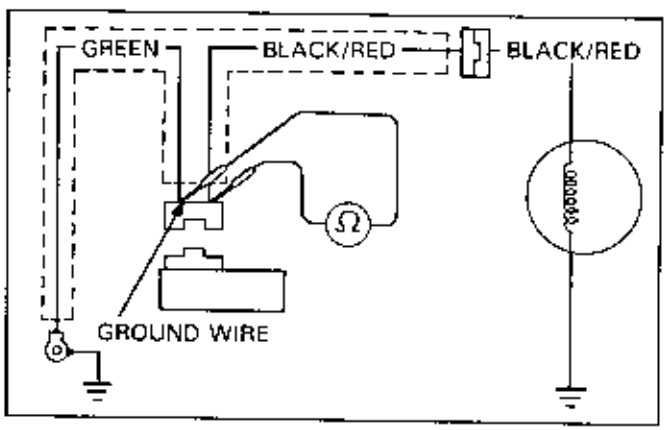
When the ohmmeter is connected in series, resistance values are large.
In the diagram, measure resistance R1 by moving the probe shown at ①, to a ground.



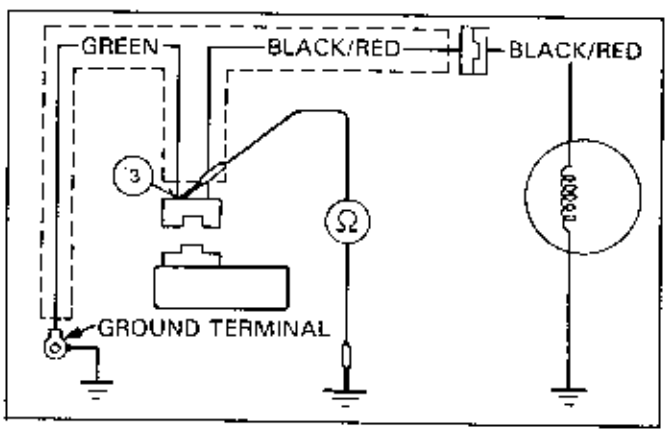
Example
To check the CDI exciter coil, resistance can be measured at ① and ②. Measuring resistance at ①, automatically checks for a broken wire (black/red) and for a bad connection at the alternator connector. If the resistance is normal at ①, ② need not be checked.
If ② was checked first and correct resistance was measured, there is still a possibility of a broken wire and loose connection. That would require more investigation to locate the fault.



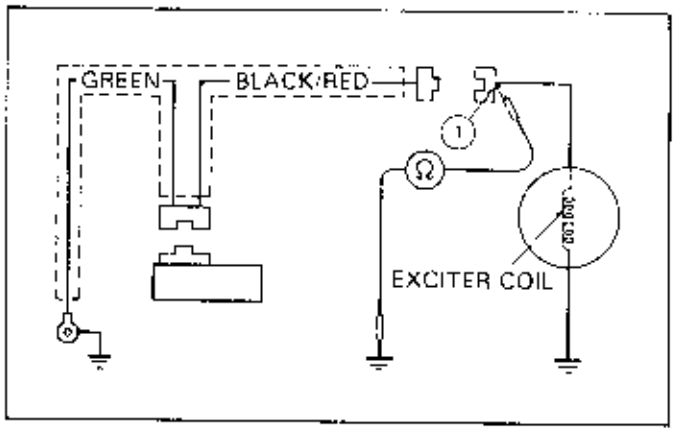
If, while measuring resistance at ①, the negative probe is placed on the ground wire (green), then the connection to ground is checked as well.
To check the operation of an exciter coil, place the probes as shown in the diagram. If the resistance is normal, then the exciter coil, the wire connected to the coil (black/red), and the ground wire (green) are all normal.



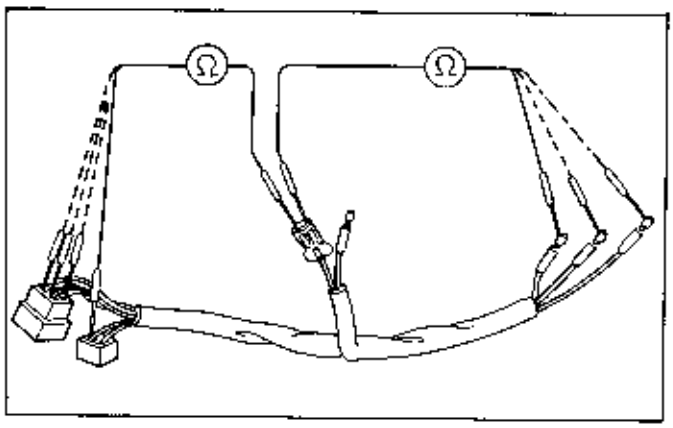
If the resistance is far off the standard value, check the following:
1. Broken ground wire (green)
   Place a probe at ③ and measure resistance.
   If 0Ω is measured, then the green wire is properly grounded.
   If ∞(infinity) is measured, then a broken wire (green) or loose connection at the ground terminal is suspect.



2. Faulty exciter coil
   Disconnect the alternator connector, compare the resistance value at ⑦ (measured on the previous page) and at ①.
- If the two values are not the same, a broken black/red wire or loose alternator connector is suspect.
- If both resistance values are the same, but not in the correct range, the exciter coil may be faulty.



3. Shorted wire or wire harness.
   To see if the green or black/red wire is shorted, check the continuity between different colored wires. If you have continuity between other wires, replace the wire harness.

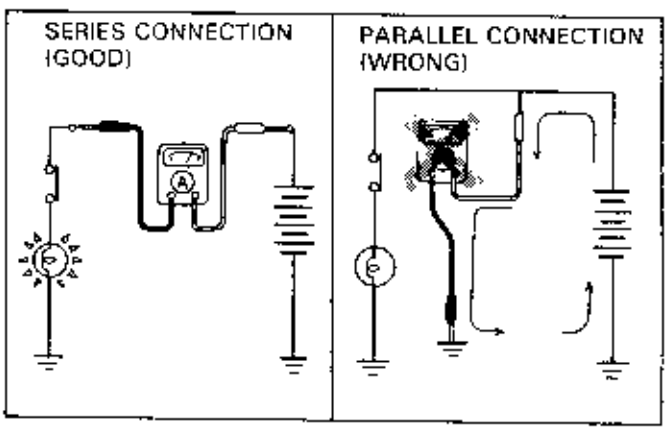


MEASURING CURRENT

Current is not normally checked during motorcycle service procedures. Though it is used for testing components, current measurements are not used for checking continuity within circuits.

How to measure current using ammeter
Ammeter is connected in series in the circuit and measures the current flowing through it.

Place the ⊕ (⊖ in circle symbol) red probe to the positive end of circuit and ⊖ (⊖ in circle symbol) black probe to the negative end.
Make sure the current flow does not exceed the maximum range selected.



CAUTION

- **Placing the ammeter in parallel, like a voltmeter, can damage the ammeter from a current overflow.**
- **Connecting the ammeter between the battery terminals will damage the ammeter.**
- **Turning on the starter motor while the ammeter is connected between the battery terminal and battery cable will damage the ammeter.**

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