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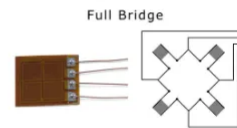
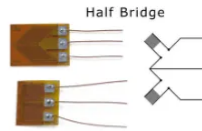
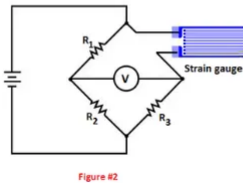
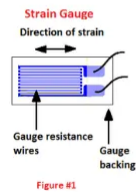


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Strain Gauge: Working Principle & Diagram

Last updated October 22, 2020 by Electrical4U

What is a Strain Gauge?



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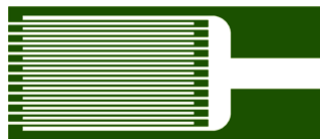
What is a Strain Gauge

A **strain gauge** is a resistor used to measure strain on an object. When an external force is applied on an object, due to which there is a deformation occurs in the shape of the object. This deformation in the shape is both compressive or tensile is called strain, and it is measured by the strain gauge. When an object deforms within the limit of elasticity, either it becomes narrower and longer or it become shorter and broadens. As a result of it, there is a change in **resistance** end-to-end.

The strain gauge is sensitive to that small changes occur in the geometry of an object. By measuring the change in resistance of an object, the amount of induced stress can be calculated.

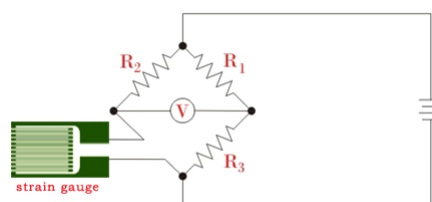
The change in resistance normally has very small value, and to sense that small change, strain gauge has a long thin metallic strip arrange in a zigzag pattern on a non-conducting material called the carrier, as shown below, so that it can enlarge the small amount of stress in the group of parallel lines and could be measured with high accuracy. The gauge is literally glued onto the device by an adhesive.

When an object shows physical deformation, its electrical resistance gets change and that change is then measured by gage.



Strain Gauge Bridge Circuit

Strain gauge bridge circuit shows the measured stress by the degree of discrepancy, and uses a **voltmeter** in the center of the bridge to provide an accurate measurement of that imbalance:



Quarter-bridge strain gauge circuit

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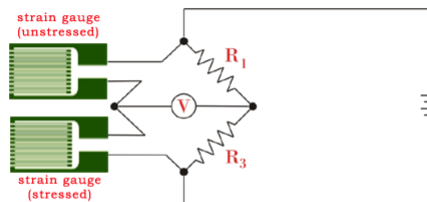
In this circuit, R_1 and R_3 are the ratio arms equal to each other, and R_2 is the rheostat arm has a value equal to the strain gauge resistance. When the gauge is unstrained, the bridge is balanced, and voltmeter shows zero value. As there is a change in resistance of strain gauge, the bridge gets unbalanced and producing an indication at the voltmeter. The output voltage from the bridge can be amplified further by a [differential amplifier](#).

Variation of Temperature of Strain Gauge

One more factor that affects the resistance of the gauge is temperature. If the temperature is more resistance will be more and if the temperature is less the resistance will be less. This is a common property of all the conductors. We can overcome this problem by using strain gauges that are self-temperature-compensated or by a dummy strain gauge technique.

Most of the strain gauges are made of constantan alloy which cancel out the effect of temperature on the resistance. But some strain gauges are not of an isoelastic alloy. In such cases, dummy gauge is used in the place of R_2 in the quarter bridge strain gauge circuit which acts as a temperature compensation device.

Whenever temperature changes, the [resistance](#) will change in the same proportion in the both arms of the rheostat, and the bridge remains in the state of balance. Effect of temperature gets nullified. It is good to keep voltage low so that the self-heating of **strain gauge** could be evaded. Self-heating of gauge depends upon its mechanical behavior.



Quarter-bridge strain gauge circuit with temperature compensation

This arrangement is considered as quarter-bridge. There are two more arrangements half-bridge and full-bridge configurations which give greater sensitivity over the quarter-bridge circuit. Still the quarter-bridge circuit is widely used in strain measurement systems.

Use of Strain Gauge

- In the field of mechanical engineering development.
- To measure the stress generated by machinery.
- In the field of component testing of aircraft like; linkages, structural damage etc.

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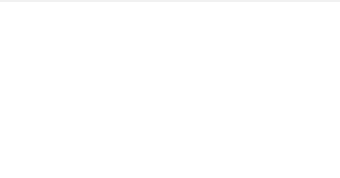
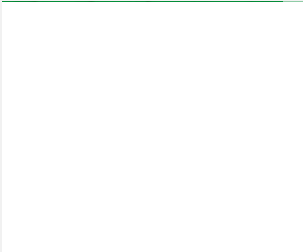
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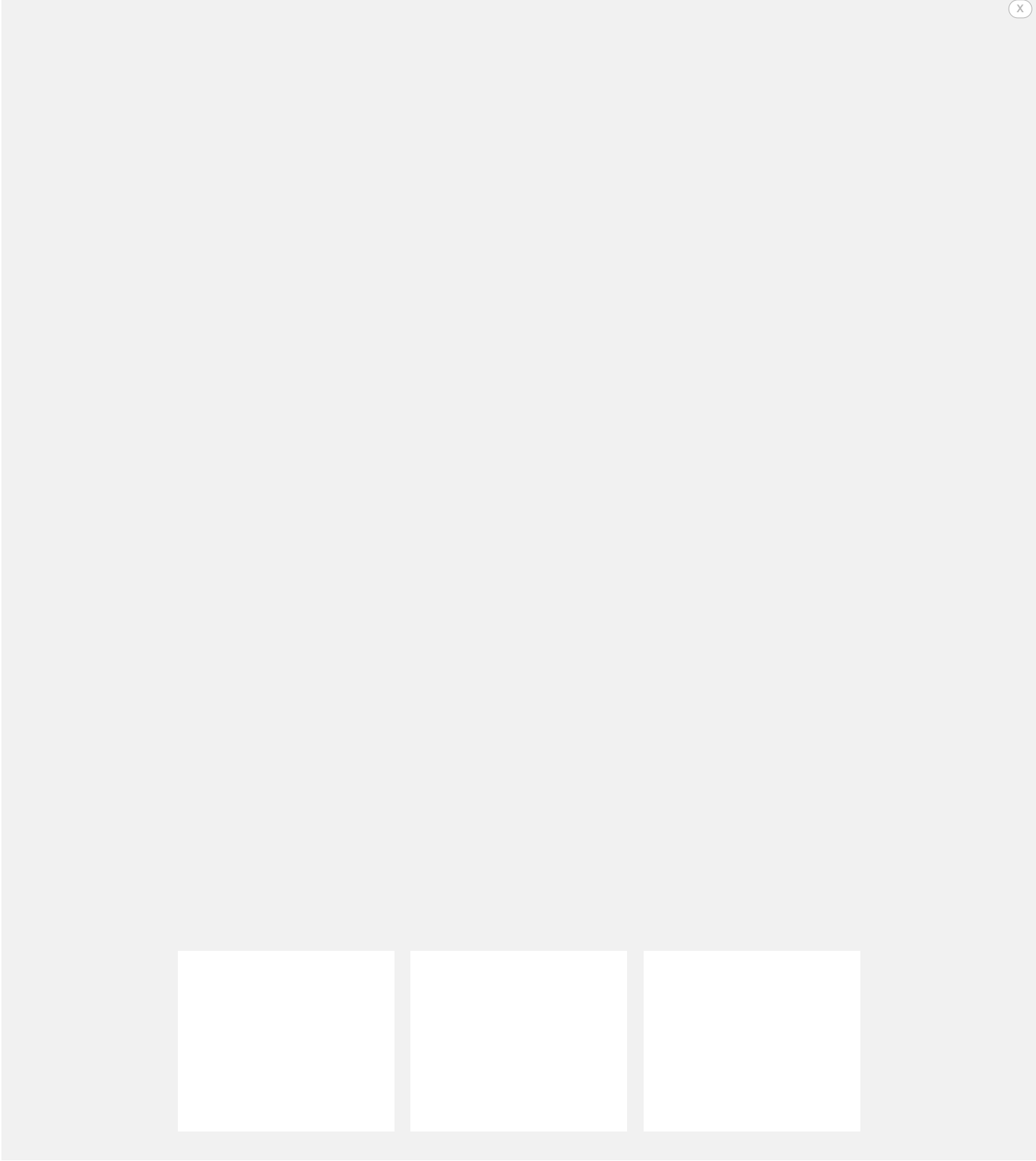


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