SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF MECHATRONICS

19MCB303 – SENSORS AND SIGNAL PROCESSING

UNIT 2 – ELECTROMECHANICAL SENSOR

RTD & THERMISTOR

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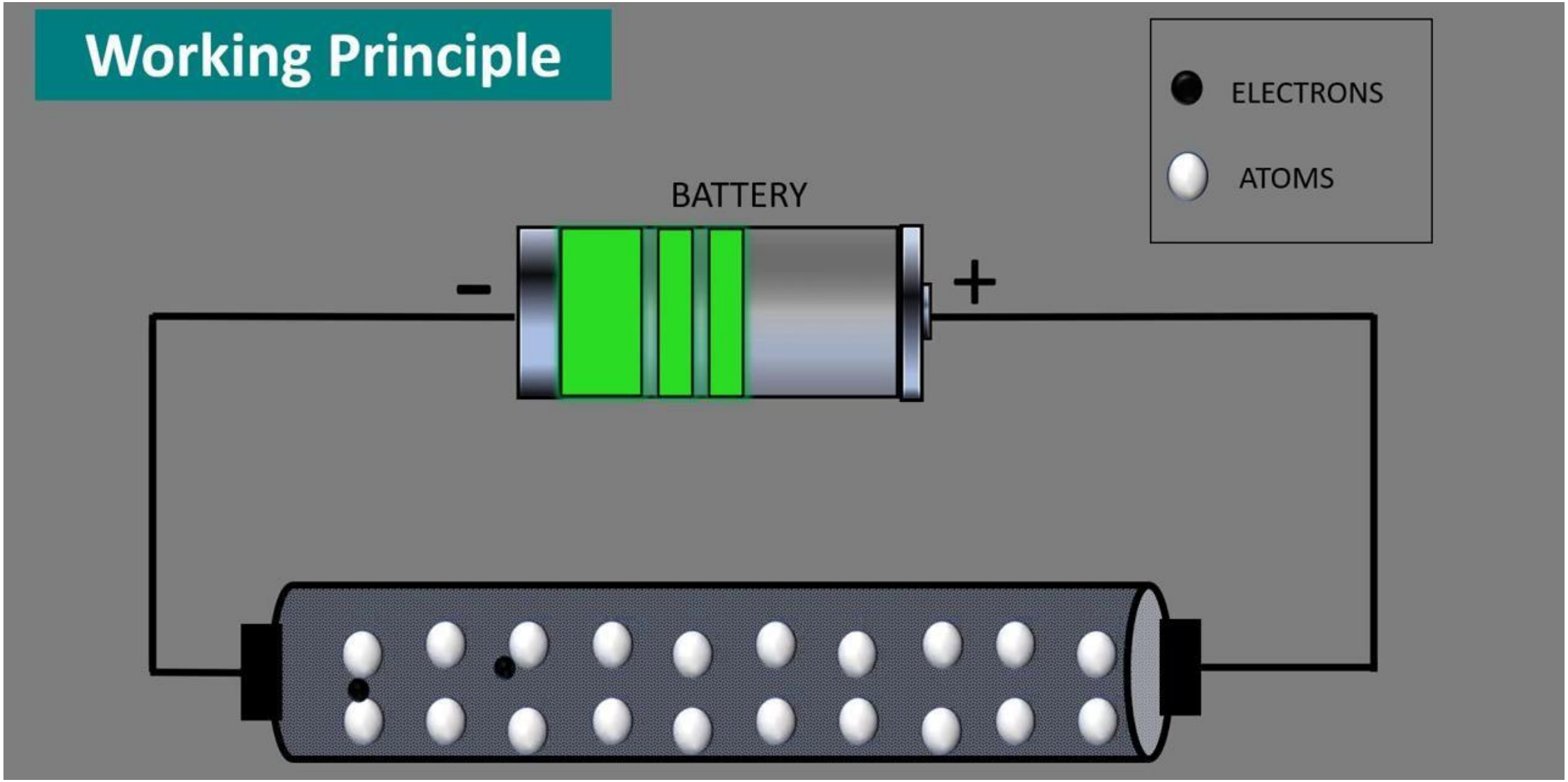
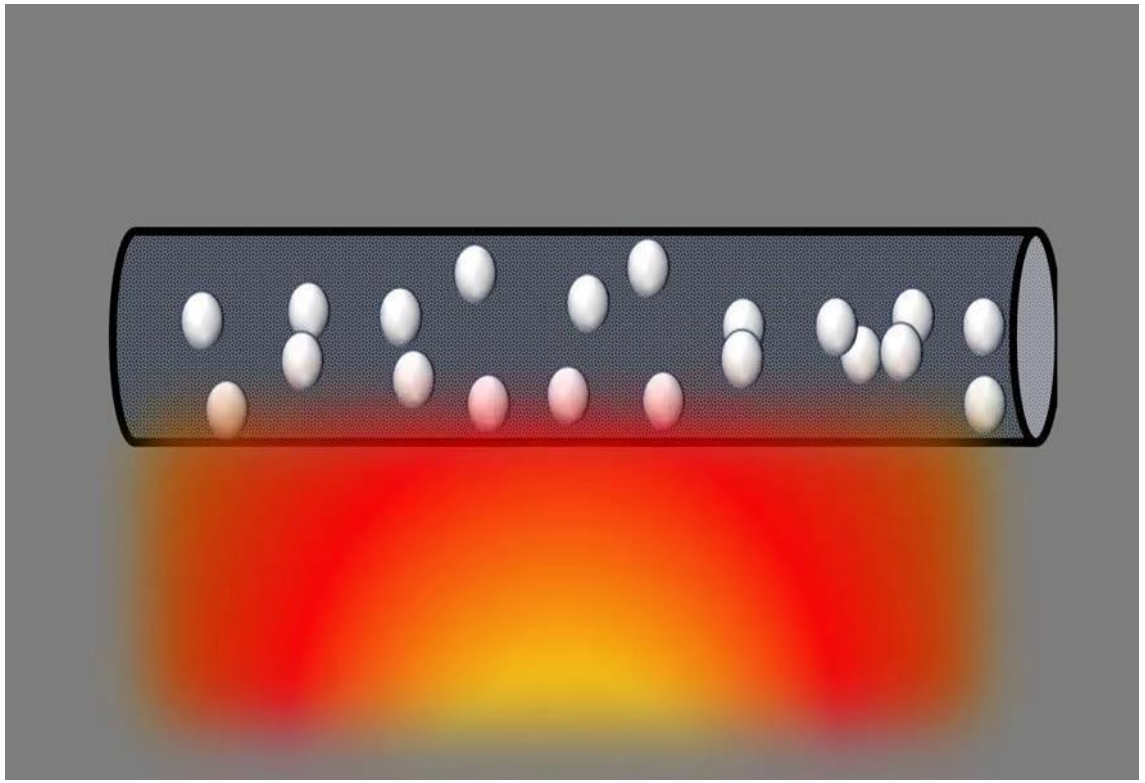
The term **RTD** stands for resistance temperature detector.

RTD is a temperature sensor that is used to measure temperature by associating the resistance of the RTD element with temperature.

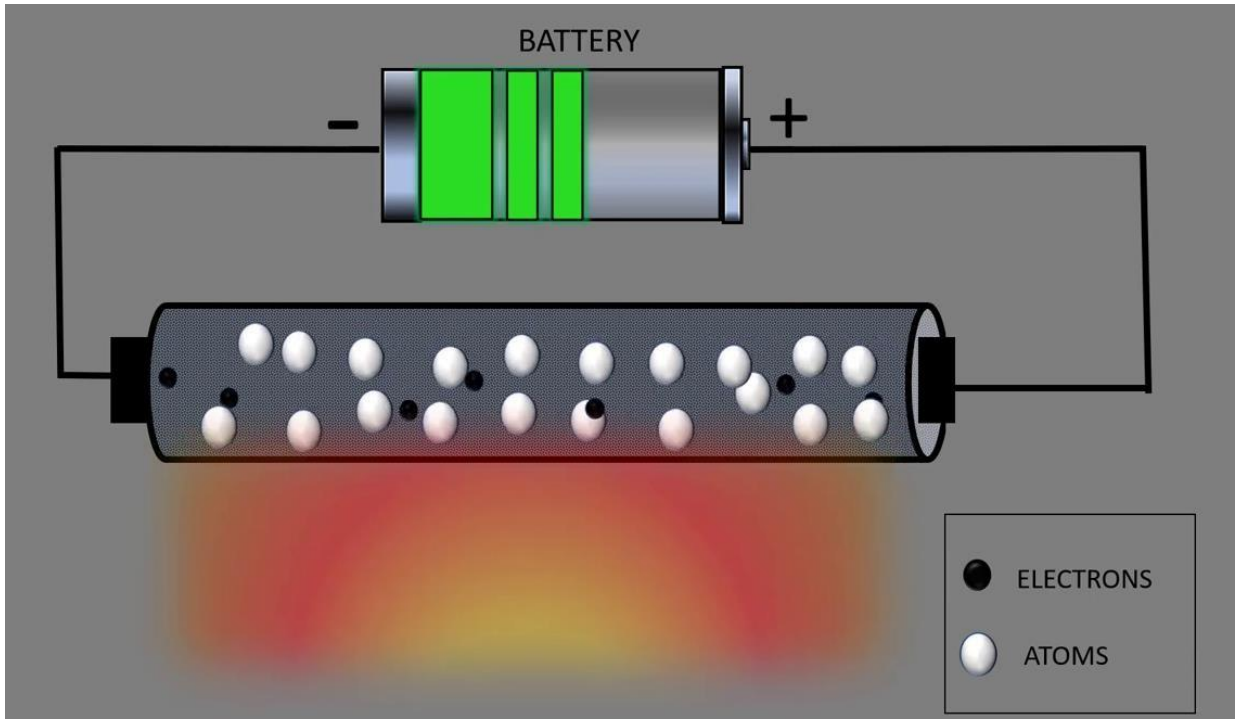
RTD is a passive device external and so electronic devices are used to measure the resistance of the sensor by passing a small electrical current through the sensor.

Working Principle

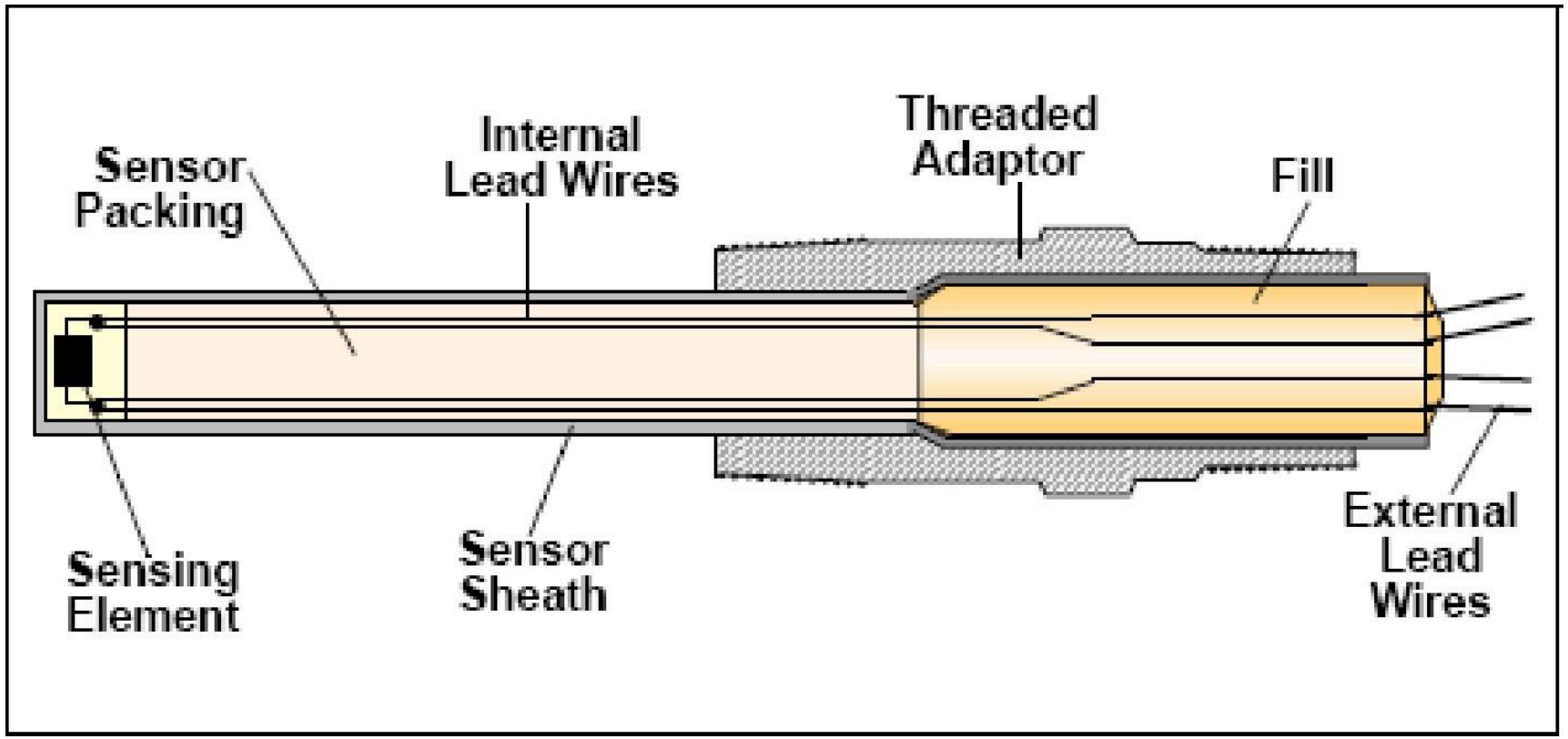




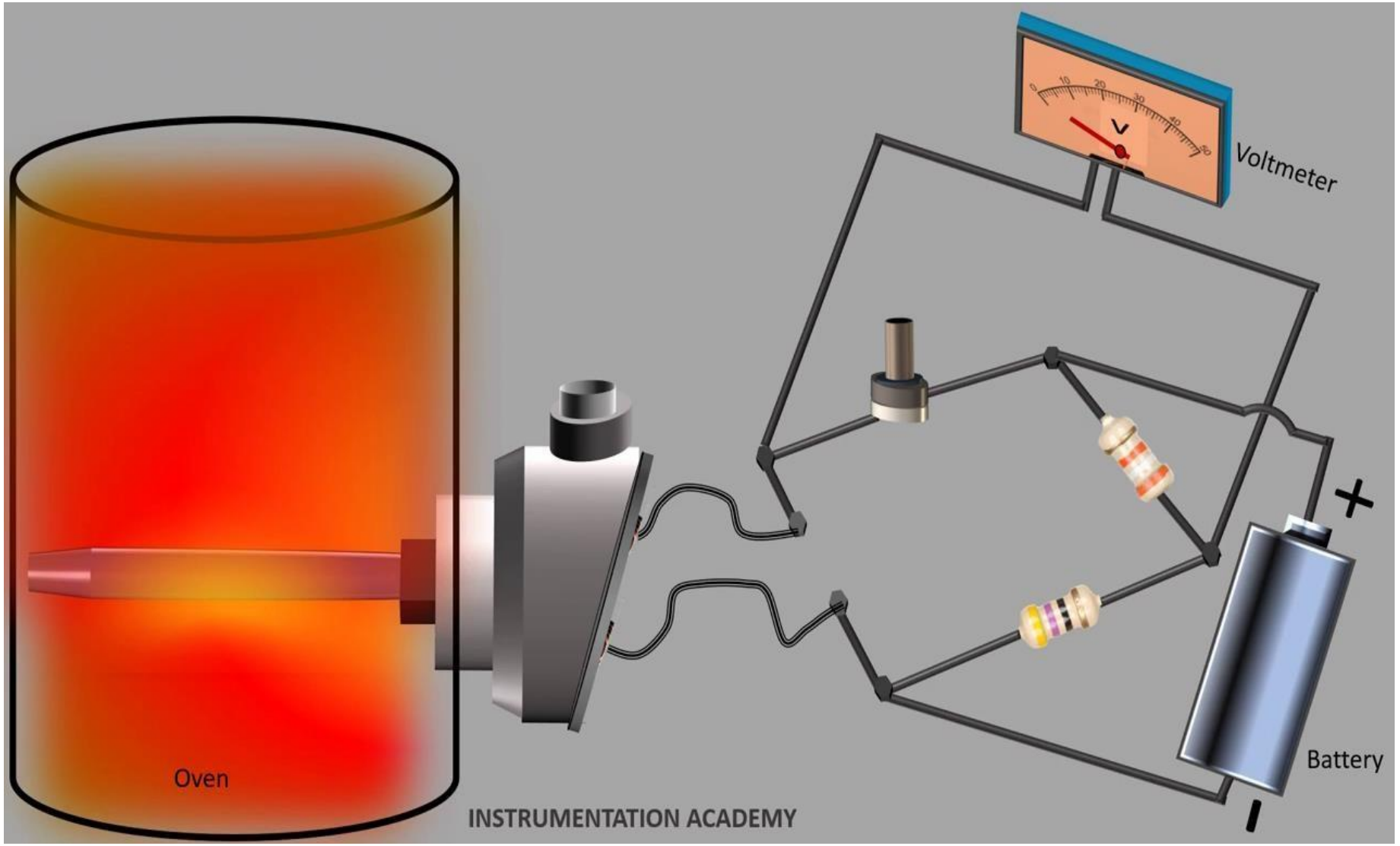
RTD works on a principle of a measurement which states that resistance of a material changes with temperature



Parts of RTD


Sensor
Packing
Internal
Lead Wires
Threaded
Adaptor
Fill
Sensing
Element
Sensor
Sheath
External
Lead
Wires

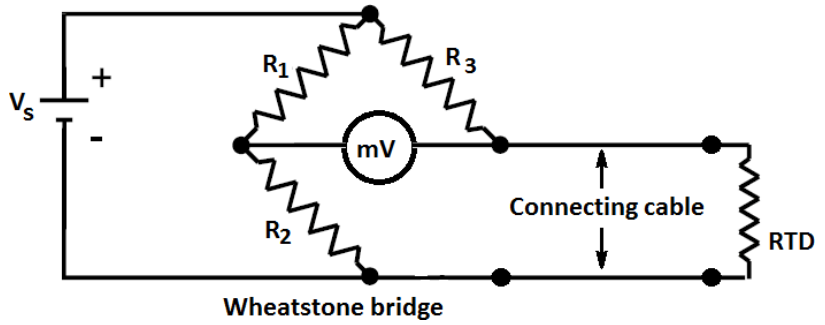
Working of RTD



1. Null Balance bridge.
2. Deflection bridge.

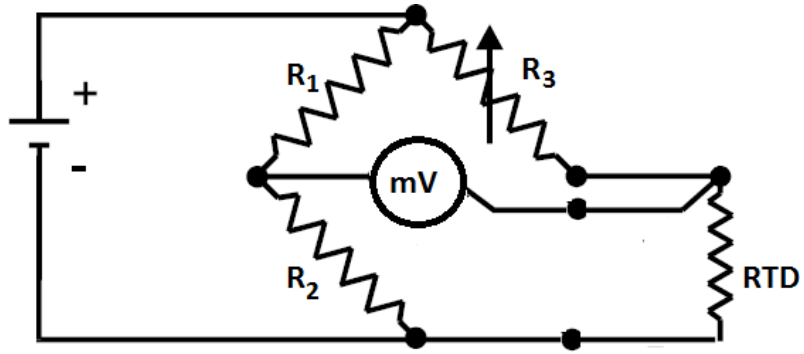
The RTD can be connected to the Wheatstone Bridge in the following three ways:

- Two-wire connection,



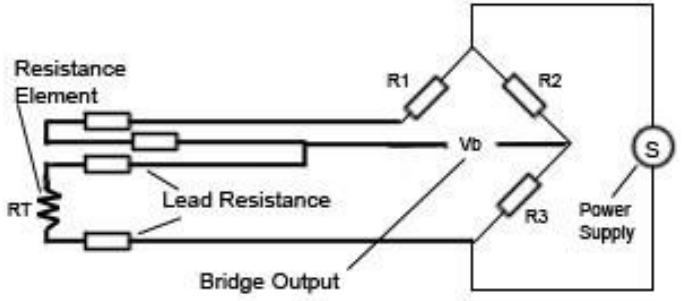
Wheatstone bridge

- three- wire connection,



Three wire RTD connection scheme

- four- wire connection.



Two-wire connection:

- This is a very cheap and simple method but used very **rarely due to its lower accuracy**.
- resistance of the connecting cable is also included.

Three wire connection:

- this method will give only accurate results if all the three connecting leads will have equal resistance. This method is **mostly used in industries**.
- the effect of the resistance of the connecting cable is eliminated.

Four wire connection:

- This is a very complex and expensive scheme. It is used for high precision measurement applications only. It is generally preferred in laboratories.

Applications of RTD

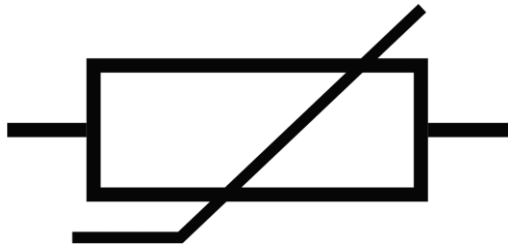
- RTD sensor is used in automotive to measure the engine temperature, an oil level sensor, intake air temperature sensors.
- In communication and instrumentation for sensing the over the temperature of amplifiers, transistor gain stabilizers, etc…
- RTD is used in power electronics, computer, consumer electronics, food handling and processing, industrial electronics, medical electronics, military, and aerospace.

Examples of RTD

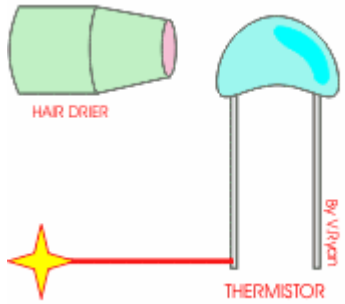
- Some of the examples of RTD sensor are coolant sensor, transmission oil temp. sensors, intake air temperature sensor, fire detectors, etc..

THERMISTOR

- A **thermistor** (or **thermal resistor**) is defined as a type of resistor whose electrical resistance varies with changes in temperature. Although all resistors' resistance will fluctuate slightly with temperature, a thermistor is particularly sensitive to temperature changes.
- A thermistor is a resistance thermometer, or a resistor whose resistance is dependent on temperature.". It is made The term is a combination of "thermal" and "resistor of metallic oxides, pressed into a bead, disk, or cylindrical shape and then encapsulated with an impermeable material such as epoxy or glass.



Symbol of thermistor



They have great resistance at low temperatures but when they warm up their resistance decreases rapidly. Current can then flow through them. This makes them ideal as one of the components for a temperature sensor.

- **HOW DOES A THERMISTOR WORK IN A CONTROLLED SYSTEM?**
- The main use of a thermistor is to measure the temperature of a device. In a temperature controlled system, the thermistor is a small but important piece of a larger system. A temperature controller monitors the temperature of the thermistor. It then tells a heater or cooler when to turn on or off to maintain the temperature of the sensor.

What are the maximum and minimum temperatures for the device?

Thermistors are ideal when measuring a single point temperature that is within 50°C of ambient. If the temperatures are excessively high or low, a thermistor will not work. While there are exceptions, most thermistors work best in the range between -55°C and +114°C.

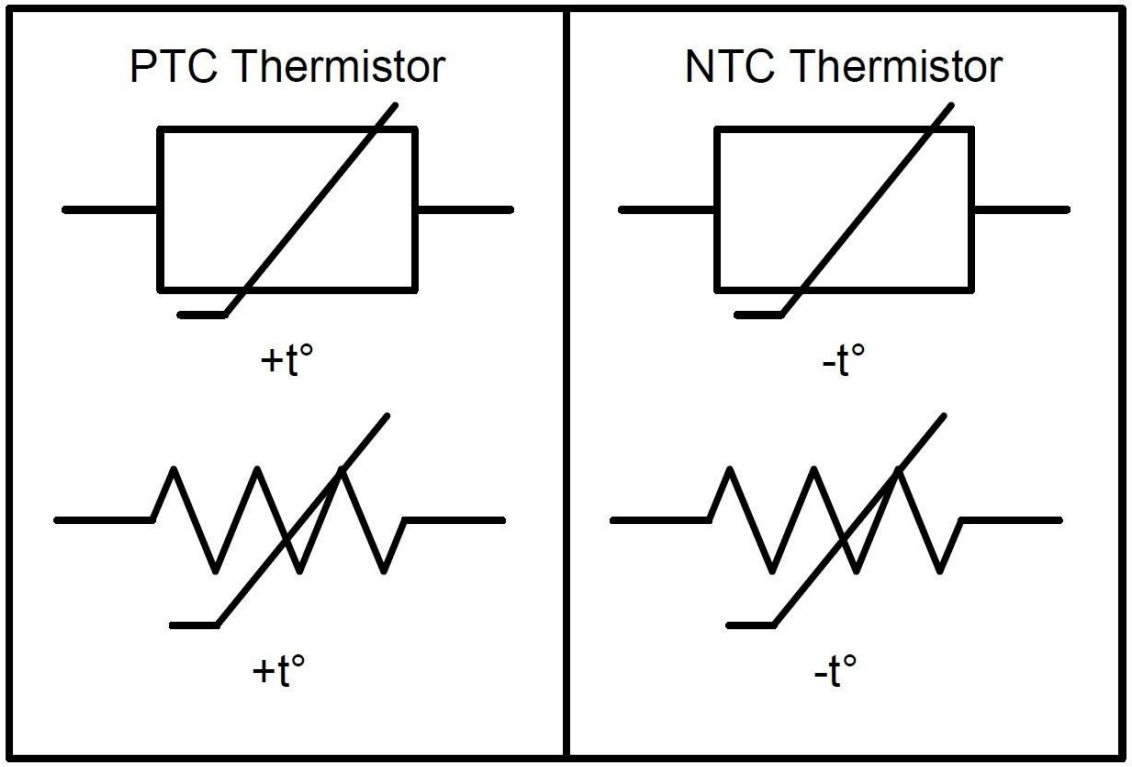
What is the optimum thermistor range?

Depending on the bias current from the controller, each thermistor has an optimum useful range, meaning the temperature range where small changes in temperature are accurately recorded.

Types of thermistor:-

1.Negative temperature coefficient (NTC) Thermistor

2.Positive temperature coefficient (PTC) Thermistor



PTC Thermistor:-

A PTC thermistor has the reverse relationship between temperature and resistance. When temperature increases, the resistance increases. And when temperature decreases, resistance decreases. Hence in a PTC thermistor temperature and resistance are inversely proportional. Although PTC thermistors are not as common as NTC thermistors, they are frequently used as a form of circuit protection.

NTC Thermistor:-

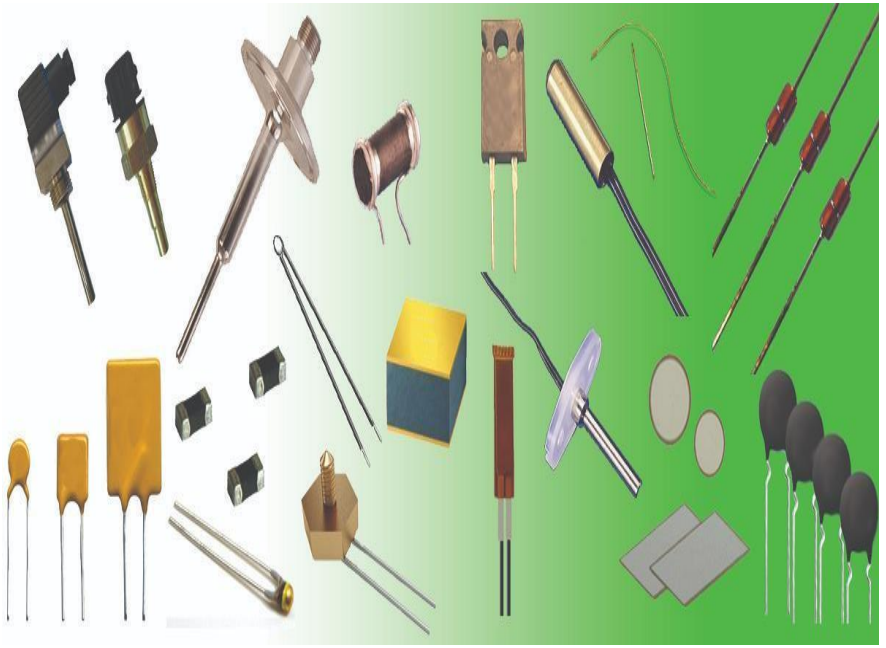
In an NTC thermistor, when the temperature increases, resistance decreases. And when temperature decreases, resistance increases. Hence in an NTC thermistor temperature and resistance are inversely proportional. These are the most common type of themistor.

Uses of Thermistors

Thermistors have a variety of applications. They are widely used as a way to measure temperature as a thermistor thermometer in many different liquid and ambient air environments. Some of the most common uses of thermistors include:

- Digital thermometers (thermostats)
- Automotive applications (to measure oil and coolant temperatures in cars & trucks)
- Household appliances (like microwaves, fridges, and ovens)
- Circuit protection (i.e. surge protection)
- Rechargeable batteries (ensure the correct battery temperature is maintained)
- To measure the thermal conductivity of electrical materials
- Useful in many basic electronic circuits (e.g. as part of a beginner Arduino starter kit)
- Temperature compensation (i.e. maintain resistance to compensate for effects caused by changes in temperature in another part of the circuit)
- Used in wheatstone bridge circuits

TYPES OF THERMISTOR:-



Choose a shape that allows maximum surface contact with the device whose temperature is being monitored. Regardless of the type of thermistor, the connection to the monitored device must be made using a highly thermally conductive paste or epoxy glue. It is usually important that this paste or glue is not electrically conductive.


Thank You