EXPERIMENT– 15

CALIBRATIONOFTHERMOCOUPLE FORTEMPERATURE MEASUREMENT

Aim: To calibrate the given thermocouple using thermometer.

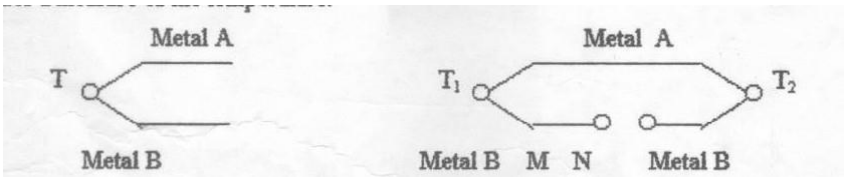
Apparatus:

Thermocouple, a heating coil to heat the water in the water bath, thermometer and a digital indicator to indicate the temperature of thermocouple.

Theory:

The common electrical method of temperature measurement uses the thermocouple, when two dissimilar metal wires are joined at both ends, an emf will exist between the two junctions, if the two junctions are at different temperatures. This phenomenon is called Seebeck effect. If the temperature of one junction is known then the temperature of the other junction may be easily calculated using the thermo electric properties of the materials. The known temperature is called reference temperature and is usually the temperature of ice. Potential(emf) is also obtained if a temperature gradient along the metal wires. This is called Thomson effect and is generally neglected in the temperature measuring process. If two materials are connected to an external circuit in such a way that current is drawn, an emf will be produced. This is called as Peltier effect. In temperature measurement, seeback emf is of prime concern since it is dependent on junction temperature.

The thermocouple material must be homogeneous. A list of common Thermocouple materials in decreasing order of emf chrome, iron and copper platinum–10%rhodium,platinum,alumelandconstantan(60%copperand 40%nickel).Each material is thermo electrically positive with respect to the below it and negatives with respect those above.



The material used in thermo couple probe is:

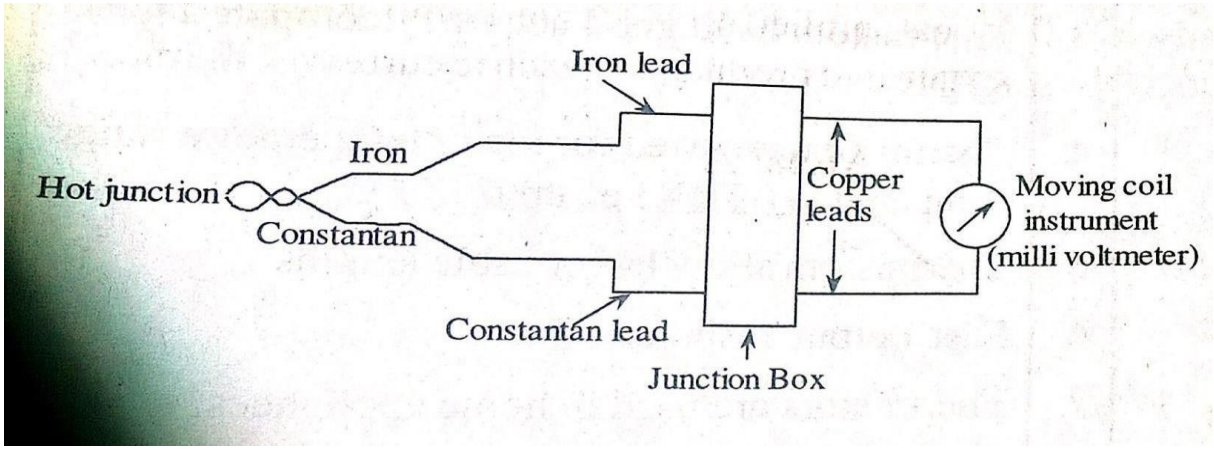
1. Iron–Constantan (TypeJ) (-300F to 1580F) 2. Copper–Constantan (TypeT) (-3000 F to 6000 F)
3. Chromyl–Alumel (TypeK).

Principle:

Thermocouple is a self-generating transducer and is basically a pair of dissimilar metallic conductors joined so as to produce an e.m.f , when junctions are at different temperatures. The magnitudes of e.m.f depends upon the magnitude of temperature difference and materials of conductors. Thermocouple is an electrical device consisting of two dissimilar electrical conductors forming electrical junctions at differing temperatures. A thermocouple produces a temperature-dependent voltage as a result of the thermoelectric effect, and this voltage is proportional to temperature of hot source.

Procedure:

1. Check connection made and Switch ON the instrument by rocker switch at the front panel. The display glows to indicate the instrument is ON.
2. Allow the instrument in 'ON' position for 10 minutes for initial warm-up.
3. Pore around 3/4th full of water to the heater kettle and place sensors and thermometer inside the kettle. Note down the Initial water temperature from the thermometer.
4. Select the sensor on which the experiment to be conducted through selection switch on the front panel. Adjust the Initial set Potentiometer in the front panel till the display reads initial water temperature.
5. Switch on the kept and wait till the water boils note down the reading inn the thermometer and set Final set potentiometer till the display reads boiling water temperature.
6. Remove the sensor from the boiling water immerse it I the cold water. Set the cold water temperature using initial set potentiometer.
7. Repeat the process till the display reads exact boiling water and cold water temperature. Change the water in the kettle with and re heat the water. Now the display starts showing exact temperature raise in the kettle.
8. Experiment can be repeated for all the three sensors. Temperature in the thermometer and the indicator readings in steps of 10^0 C can be tabulated.



Considering the first observation, the specimen calculations are as follows.

Temp. of water by Thermometer, Ta = 73 ^{o}C

Temp.of water by Thermocouple, Tm = 71 ^{o}C

Error = (Tm -Ta) = 71 – 73 = - 2

9. Correction = - error = (Ta–Tm) = 73 – 71 = + 2
10. Absolute %Error = [(Tm -Ta)/Tm]*100 = [(71 – 73)/ 71]*100 = 2.81 %