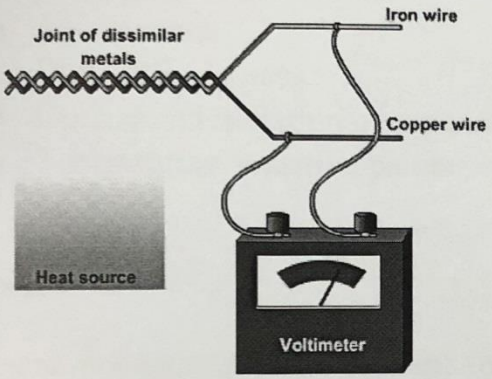
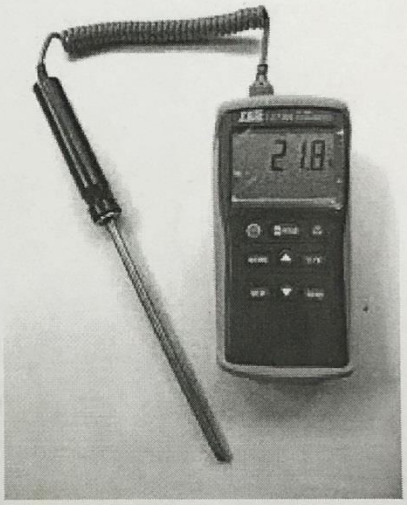
Experiment No. (1)

a. Name of Experiment:

Calibration of Thermocouples

A **Thermocouple** is a sensor used to measure temperature. **Thermocouples** consist of two wire legs made from different metals. The wires legs are welded together at one end, creating a junction. This junction is where the temperature is measured.





A **thermocouple** is a device consisting of two dissimilar conductors or semiconductors that contact each other at one or more points. A thermocouple produces a voltage when the temperature of one of the contact points differs from the temperature of another, in a process known as the thermoelectric effect. Thermocouples are a widely used type of temperature sensor for measurement and control,[1] and can also convert a temperature gradient into electricity.

Commercial thermocouples are inexpensive,[2] interchangeable, are supplied with standard connectors, and can measure a wide range of temperatures. In contrast to most other methods of temperature measurement, thermocouples are self powered and require no external form of excitation. The main limitation with thermocouples is accuracy; system errors of less than one degree Celsius (°C) can be difficult to achieve.[3]

b. Purposes of Experiment:

- Calibration of thermocouple Instrument.
- To introduce the types of temperature sensors.

Types of temperature sensors

- Filled thermal system.
- Liquid- in glass thermometers.
- Thermocouples.
- Resistance thermometers.
- Thermistors.
- Bimetallic devices.
- Optical and radiation pyrometers.
- Temperature sensitive paints.

Abstract

Instrument selection must account for overall control requirements. Low cost often justifies consideration of filled systems for measurements below 1200 F. other advantages of mechanically or pneumatically transmitted temperature measurement include low explosion hazard, simple maintenance requirements, high reliability and independence from external power. Advantages of electrical systems include higher accuracy and sensitivity, practicality of switching or scanning several measurement points, larger distances between measuring elements and controllers, replacement of components rather than complete systems in the event of failures, fast response and ability to measure higher temperatures.

Theory of Experiment:

Thermocouples are used in thousands of applications for the measurement of temperature. Thermoelectricity was discovered by Seebeck in 1821. He observed an electromotive force (emf) generated in a closed circuit of two dissimilar metals when their junctions were at different temperatures. This electricity produced by the direct action of heat is used today to measure temperatures from sub zero to high ranges.

Principles of thermocouple

A thermocouple consists basically of two dissimilar metals, such as iron and constantan wires, joined to produce a thermal electromotive force when the junction are at different temperature fig (1) the measuring or hot junction is inserted in the medium where the temperature is to be measured. The reference or cold junction is the open end that is normally connected to the measuring instrument terminals. The emf of thermocouple increases as the difference in junction temperatures increases. Therefore a sensitive instrument, capable of measuring emf, can be calibrated and used to read temperature directly.

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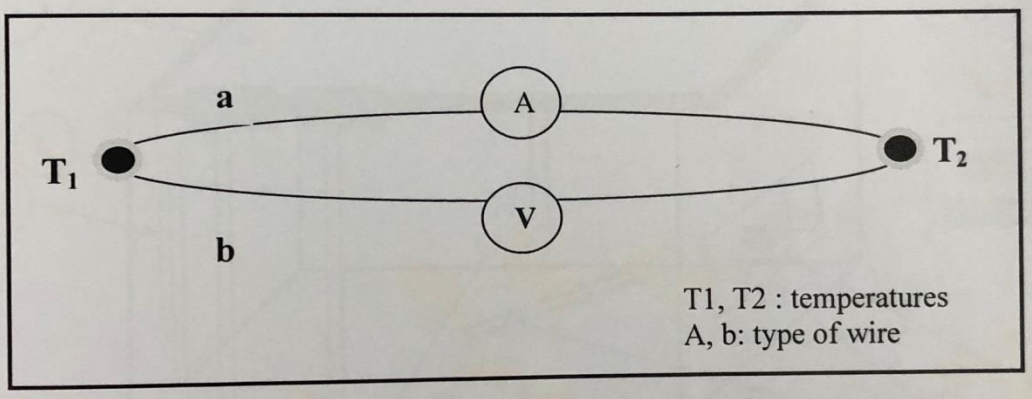
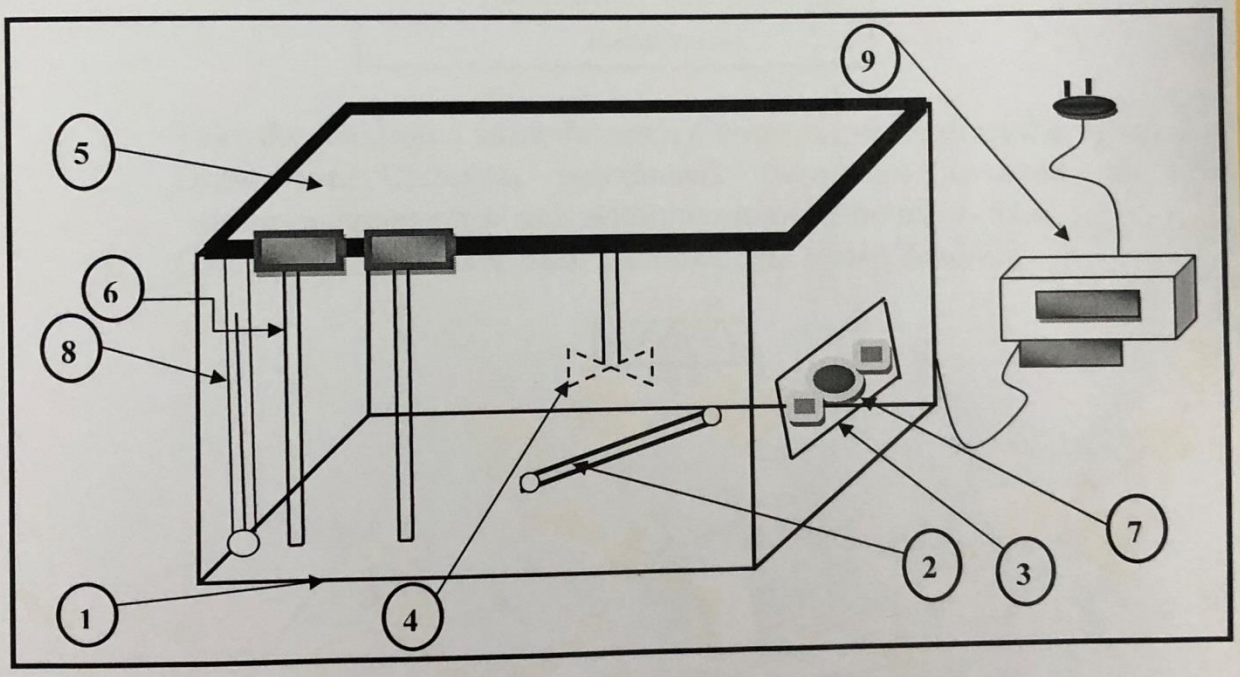


Fig (1) Thermocouple

c. Description of Instrument:

1. Transparent container.
2. Heater
3. Electric motor
4. Agitator.
5. Cover
6. Thermocouple.
7. Thermostat.
8. Thermometer.
9. Electric control system



Fig(2) Thermocouple Instrument

thermometer	Thermocouple1	Thermocouple2	Error1	Error2

d. Procedure:

1. Put the thermostat on a suitable temp to make it fused.
2. Turn on the instrument.
3. Read the first calculation for the thermometer then to the thermocouples.
4. Read the other calculation at constant periods (time).

e. Calculations:

1. Find the error for each thermocouples by the law:

$$error_n = \frac{thermometer_n - thermocouple_n}{thermometer_n}$$

2. Take the maximum value for each thermocouple (neglect the signal$_{(+,-)}$.
3. Draw the Cartesian coordinates (xy-plane) between the two thermocouples on x- axis with thermometer on the y- axis.
4. Calculate C value for each thermocouple by the function

$$y = mx + c$$

المناقشة:

١) لماذا يتم استخدام الماء المقطر؟
٢) ماذا يقصد باستخدام الجزء الزئبقي المعاير؟
٣) لماذا يتم استخدام حوض للخلط؟
٤) لماذا الهناك نسبة خطأ بين قراءة الجزء الزئبقي المعاير وبين قراءة المزدوجات؟
٥) هل من المفروض اجراء المعايرة للمزدوجات الحرارية؟
٦) ايجاد نسبة الخطأ ... اوجدها؟