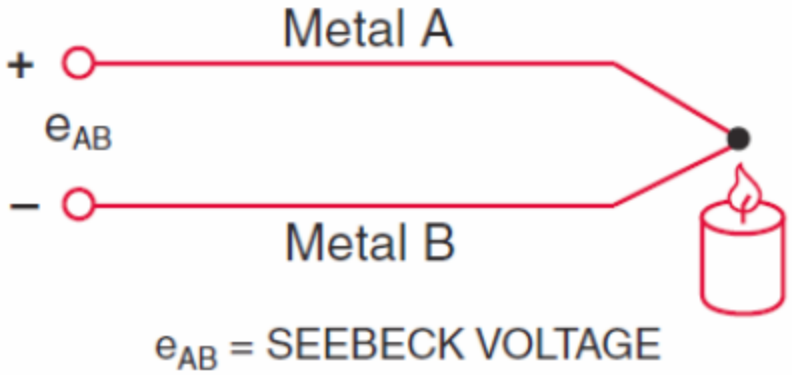
Introduction to Thermocouple and Cold Junction Compensation

Experimental Physics Laboratory

Thermocouple



e_{AB} = SEEBECK VOLTAGE

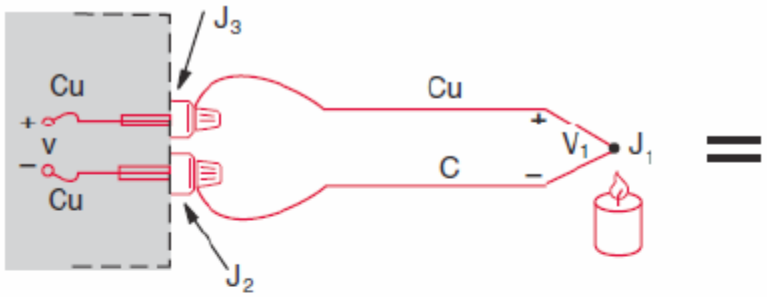
$$\Delta e_{AB} = \alpha \Delta T$$

Thermocouple Types

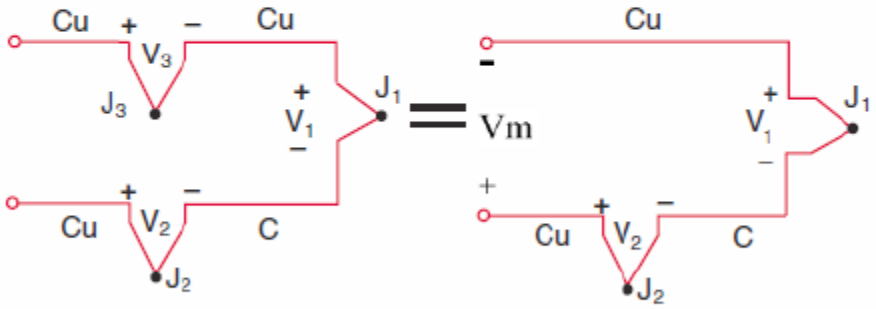
Thermocouple Type	Conductors – Positive	Conductors – Negative
B	Platinum-30% rhodium	Platinum-6% rhodium
E	Nickel-chromium alloy	Copper-nickel alloy
J	Iron	Copper-nickel alloy
K	Nickel-chromium alloy	Nickel-aluminum alloy
N	Nickel-chromium-silicon alloy	Nickel-silicon-magnesium alloy
R	Platinum-13% rhodium	Platinum
S	Platinum-10% rhodium	Platinum
T	Copper	Copper-nickel alloy

Cu-Ni (Constantan)

Temperature Measurement



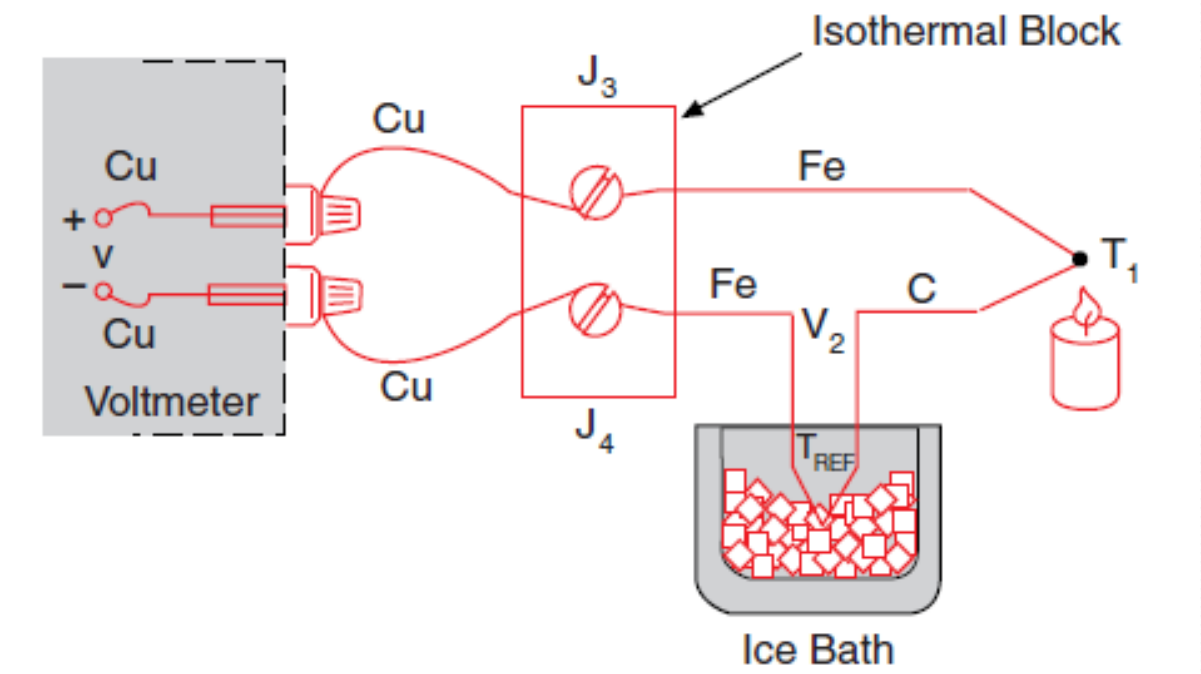
EQUIVALENT CIRCUITS



MEASURING JUNCTION VOLTAGE WITH A DVM

$$Vm = V1\text{-}V2 = \text{const.}\ (T1\text{-}T2)$$

Temperature Measurement

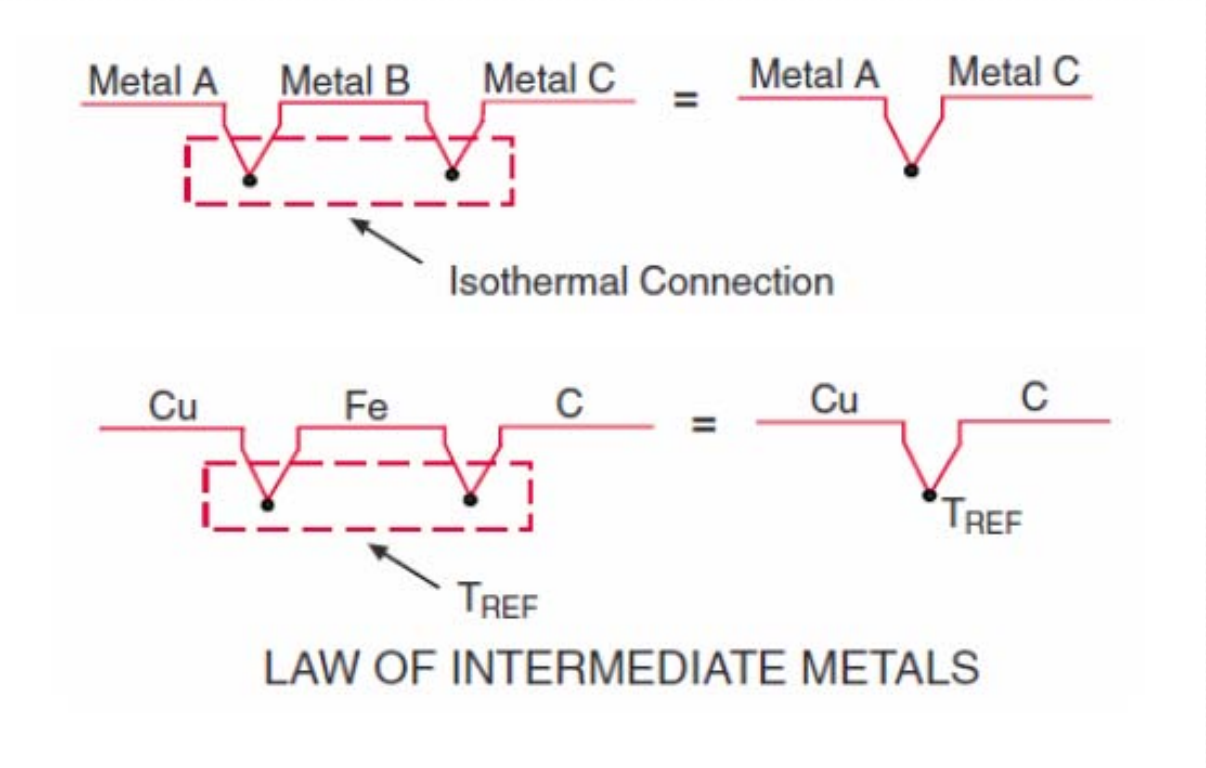


Cold junction Compensation

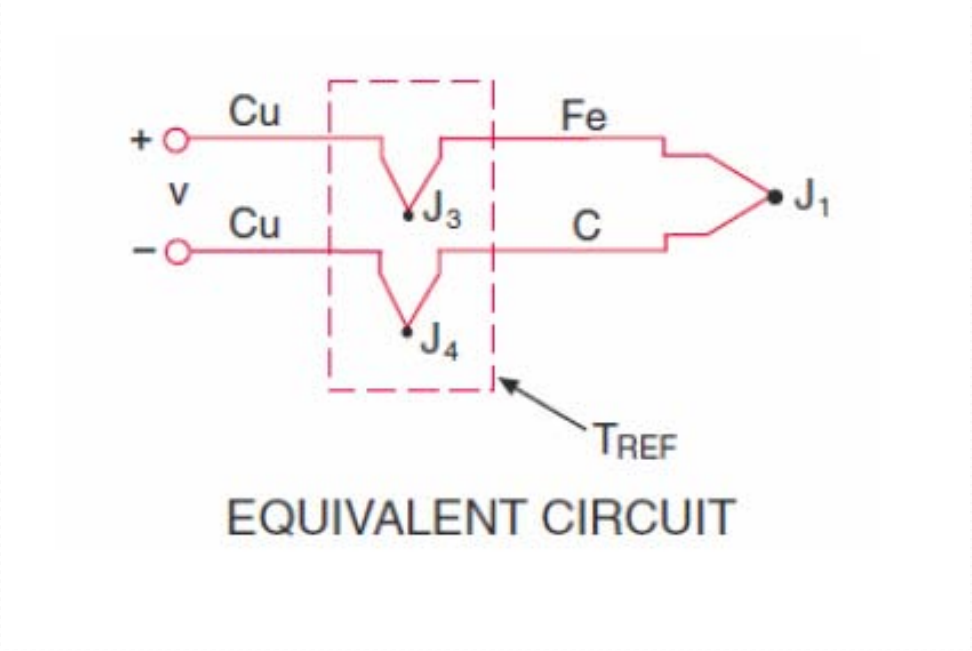
- Thermocouples require some form of temperature reference to compensate for the*cold junctions. The most common method is to measure the temperature at the*reference junction with a direct-reading temperature sensor . This process iscalled cold-junction compensation (CJC).

- Because the purpose of CJC is to compensate for the known temperature of thecold junction, another less-common method is forcing the junction from the thermocouple metal to copper metal to a known temperature, such as 0 ºC, bysubmersing the junction in an **ice-bath, and then connecting the copper wire** from each junction to a voltage measurement device.

Law of Intermediate Metals



CJC and J Type Thermocouple



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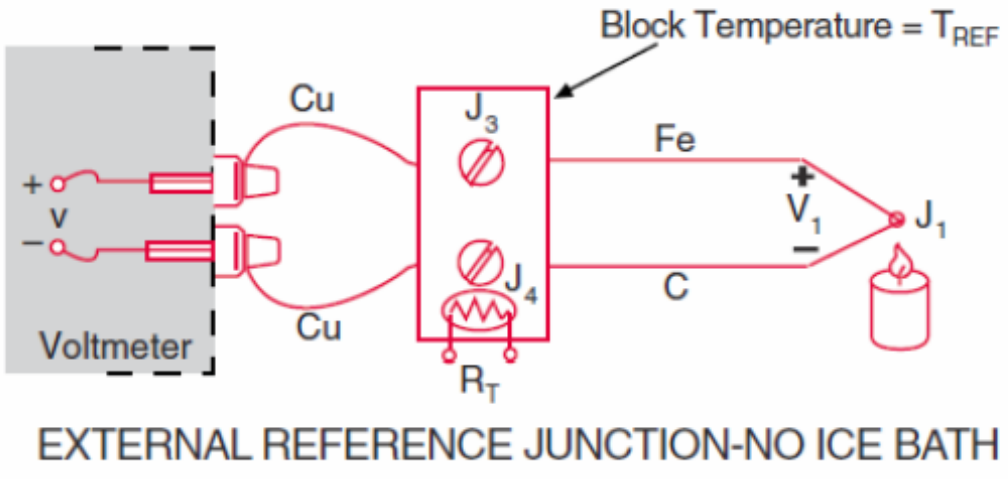

EXTERNAL REFERENCE JUNCTION-NO ICE BATH

References

- http://zone.ni.com/
- www.omega.com