



Technical Information Bulletin

Use of Peltier Devices for Heating and Cooling

TEMPERATURE & PROCESS INSTRUMENTS INC

Use of Peltier devices for heating and cooling
Techne® Tecal 140F dry block calibrator are heated and cooled through the use of thermoelectrics or Peltier devices. Techne has over 15 years design and production experience with these reliable devices

What are Peltiers and How do they work?

Since thermoelectric cooling systems are most often compared to conventional systems, perhaps the best way to show the differences in the two refrigeration methods is to describe the systems themselves. A conventional cooling system contains three fundamental parts - the evaporator, compressor and condenser. The evaporator or cold section is the part where the pressurized refrigerant is allowed to expand, boil and evaporate. During this change of state from liquid to gas, energy (heat) is absorbed. The compressor acts as the refrigerant pump and recompresses the gas to a liquid. The condenser expels the heat absorbed at the evaporator plus the heat produced during compression, into the environment or ambient.

A thermoelectric has analogous parts. At the cold junction, energy (heat) is absorbed by electrons as they pass from a low energy level in the p-type semiconductor element, to a higher energy level in the n-type semiconductor element. The power supply provides the energy to move the electrons through the system. At the hot junction, energy is expelled to a heat sink as electrons move from a high energy level element (n-type) to a lower energy level element (p-type).

Thermoelectric Coolers are heat pumps, solid state devices without moving parts, fluids or gasses. The basic laws of thermodynamics apply to these devices just as they do to conventional heat pumps, absorption refrigerators and other devices involving the transfer of heat energy.

An analogy often used to help comprehend a T.E. cooling system is that of a standard thermocouple used to measure temperature. Thermocouples of this type are made by connecting two wires of dissimilar metal, typically copper/constantan, in such a manner so that two junctions are formed. One junction is kept at some reference temperature, while the other is attached to the object being measured. The system is used when the circuit is opened at some point and the generated voltage is measured. Reversing this train of thought, imagine a pair of fixed junctions into which electrical energy is applied causing one junction to become cold while the other becomes hot.

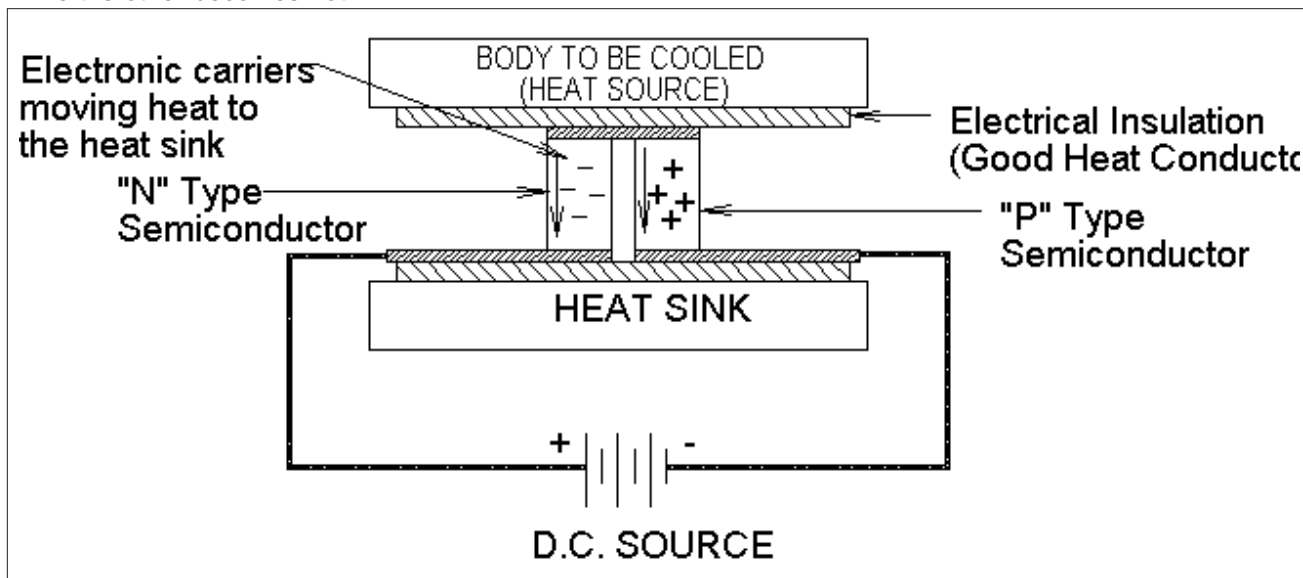


Figure 1

Thermoelectric cooling couples (Fig. 1) are made from two elements of semiconductor, primarily Bismuth Telluride, heavily doped to create either an excess (n-type) or deficiency (p-type) of electrons. Heat absorbed at the cold junction is pumped to the hot junction at a rate proportional to current passing through the circuit and the number of couples.



Application Bulletin

Calibration of Thermocouples and RTD's with Portable Dry Block Calibrators

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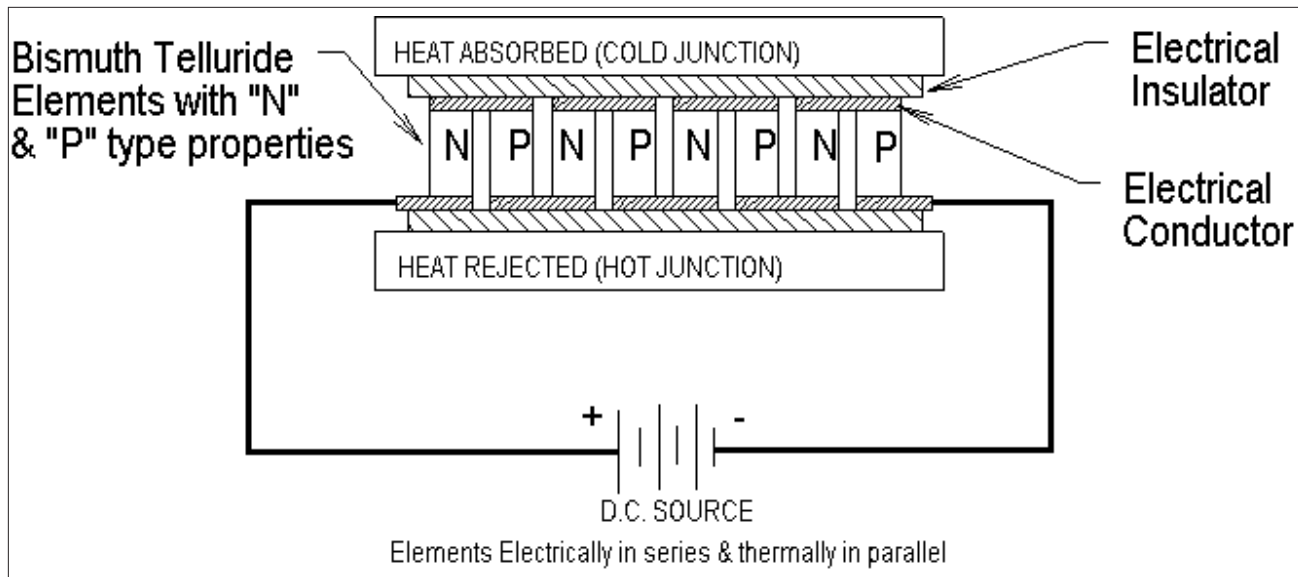


Figure 2: Typical TE Module Assembly

In practical use, couples are combined in a module (Fig. 2) where they are connected electrically in series, and thermally in parallel. Normally a module is the smallest component commercially available. Modules are available in a great variety of sizes, shapes, operating currents, operating voltages and ranges of heat pumping capacity. The present trend, however, is toward a larger number of couples operating at lower currents. The user can select the quantity, size or capacity of the module to fit the exact requirement without paying for excess power.

There is usually a "need" to use thermoelectrics instead of other forms of cooling. The "need" may be a special consideration of size, space, weight, reliability and environmental conditions such as operating in a vacuum. Some of these special considerations are just why we use thermoelectrics in our Thermal cyclers and Dry Block calibrators.



TECAL 140F Low Temperature Dry Block Calibrator

The "NEW" TECAL 140F, field low temperature range calibrator drops to -20°C and goes up to 140°C (-4°F to 284°F) in a 20°C ambient. It's stability is +/-0.05 with Accuracy of +/-0.3°C. Available in 120Vac or 230Vac.

Ideal for calibrating temperature sensors such as:
Thermocouples
RTD's
MIST Temperature Sensors
Bi-Metallic thermometers