Technical Information Bulletin

Use of Peltier Devices for Heating and Cooling

TEMPERATURE & PROCESS INSTRUMENTS INC

Accurate Thermal Systems Thermcal 130 dry block calibrator are heated and cooled through the use of thermoelectrics or Peltier devices. Accurate Thermal Systemse has +40 years of combined experience in the design, manufacture, service and support of a wide range of Laboratory and Industrial Temperature products.

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.

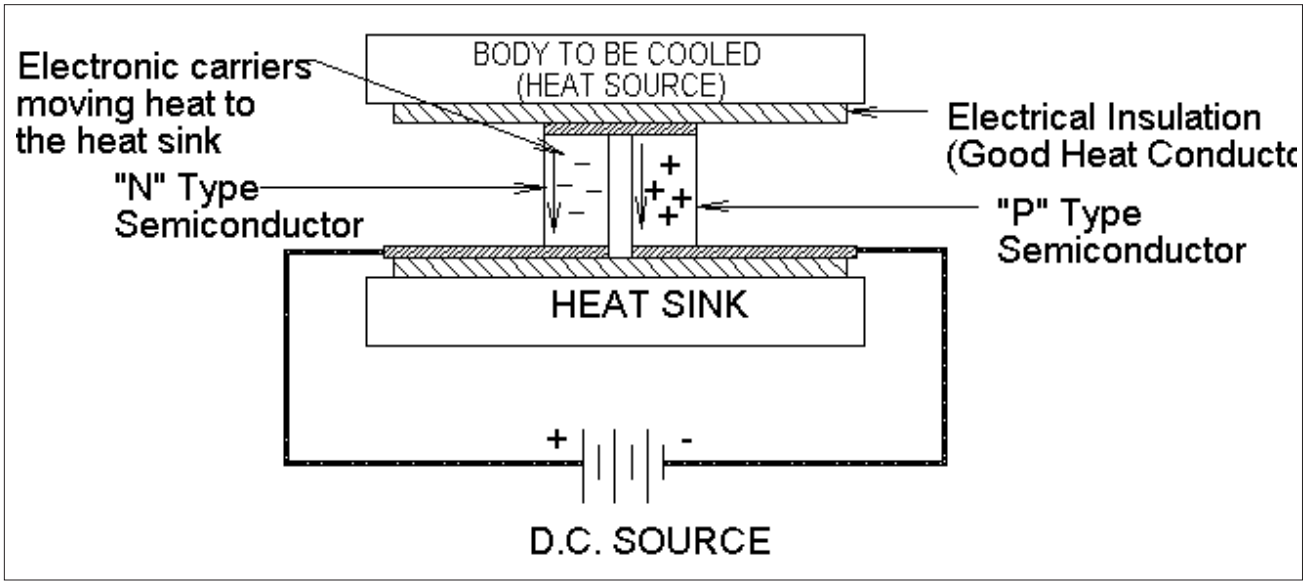

Figure 1

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.

Temperature & Process Instruments Inc. **Visit us on the web at www.tnp-instruments.com**
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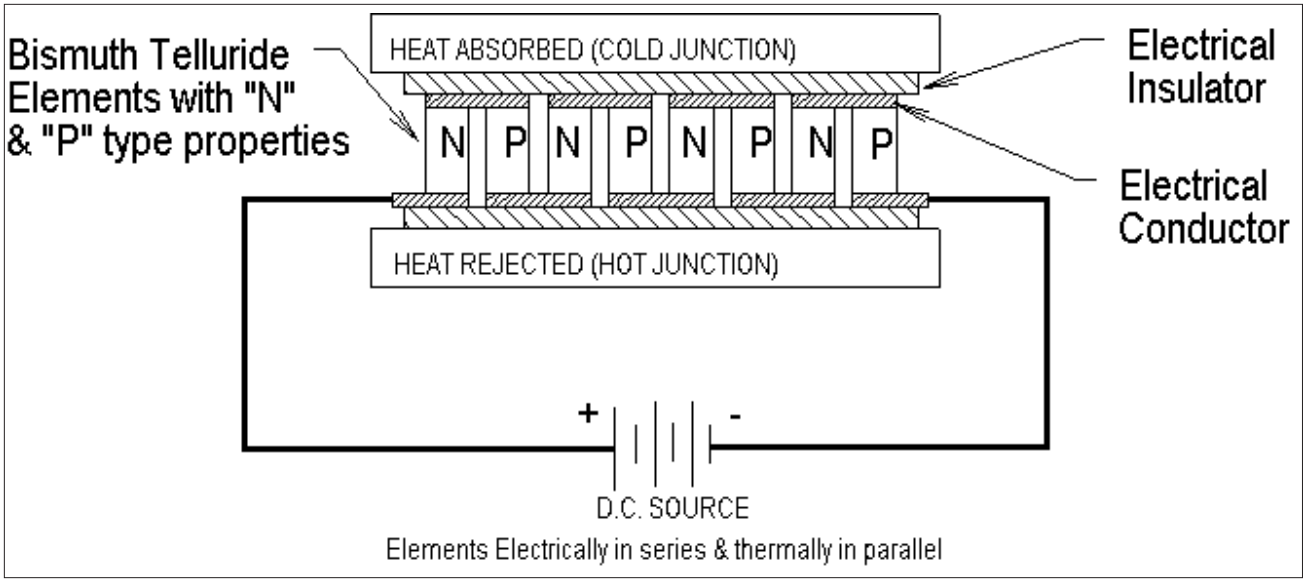

Figure 2: Typical TE Module Assembly

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 Thermcal 130 Dry Block calibrators.

ThermCal 130 Low Temperature Dry Block Temperature Calibrator for Thermocouple and RTD Sensors

The New ThermCal 130 Low Temperature Dry Block Calibrator has a small footprint, fast heat up and cool down times and is light weight for both field and laboratory use. Unlike many competing lower cost models that only offer a fixed block The ThermCal 130 accept inserts for probe size flexibility in addition to a fixed 1/4" reference hole. The Thermcal 130 may also be used as an Ice Point Reference by simply setting the calibrator to 32°F (0°C) and using your reference standard probe

Features

Fast heat up and stabilization
Operates -13°F to 266°F (-25°C to 130°C) at an ambient of 20°C/68°F
New Universal Power Supply 100 to 250VAC
Laboratory performance at an economical price
Lightweight and portable for use in the field
Removable probe inserts for flexibility & many probe sizes
Store & recall up to 8 calibration setpoints
CE marked for safety
Designed & manufactured in the USA

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