

# Thermoelectricity



The term thermoelectricity covers the whole range of phenomena in connection with the interaction between electrical current and the flow or generation of heat in electrical conductors.

Three thermoelectric effects are defined: the Seebeck effect, the Peltier effect and the Thomson effect. In addition to the utilisation of thermoelectric effects for temperature measurement (Seebeck effect) and tempering with Peltier elements (Peltier effect), energy is also generated by means of thermo-generators, but the efficiency is very low if metal alloys are used. In explaining the action of thermocouples, the Seebeck effect takes priority.

## Thermocouple:

A thermocouple consists of two different electrical conductors which are connected in an electrical circuit. If the junctions of the two different conductors are at different temperatures, a thermoelectric voltage will result. This thermoelectric voltage is a direct measure of the temperature difference that the junctions are exposed to. A thermocouple is an instrument (converter), by means of which heat energy is converted into electrical energy. It is thus a current or voltage generator. As measuring signal, thermo voltage is used. The voltage produced is exclusively dependent on the material and the temperature gradients the thermocouple is exposed to. It is thus independent of conductor form or its dimensions. The thermoelectric power produced in a thermoelectric circuit is a product of thermoelectric current and thermoelectric voltage, i. e. if thermoelectric current flow decreases, the thermoelectric voltage will increase. If the resulting voltage is measured with a current that is as low as possible (using controllers or DVMs, which have a very high input resistance), this is a direct measure of the temperature difference the thermocouple is exposed to (due to the high input resistance of modern controllers and measuring devices, the loop resistance, important in earlier times, is nearly irrelevant today.)

## Extension lead:

Since it is difficult or impossible to directly connect the thermocouple to the transducer for reasons of cost or handling, an extension or compensating lead is frequently connected as an extension between the thermocouple and the transducer. The extension lead supplies the same thermoelectric voltage in the temperature range used and has the same nominal chemical composition as the thermocouple. However, the temperature range used is limited. The total thermoelectric voltage supplied results from the thermoelectric voltage of the thermocouple in the temperature range between the hot junction and the junction of thermocouple/extension lead and the thermoelectric voltage supplied by the extension lead or compensating lead between the junction thermocouple/extension lead and the junction extension lead/transducer.