2 0 7 . 1 4 7

D a t a s h e e t f o r t h e P e l t i e r e l e m e n t P K E 7 2 A 0 0 2 0

You have ordered a part that many experimenters find fascinating: this will do three different things:

1. You can use it to cool an object
2. You can use it to heat an object
3. You can use it to generate electricity.

Explanation of terms used:
We are using three different names to describe the same part. A **Peltier element** is the same as a **Thermo element** or a **Seebeck element**. The terms help to show their different uses.

Peltier element:
When electricity is passed through the element it can used as a heat exchanger to cool an object.

Seebeck element: Thermoelement:
One ceramic plate is warmed, the other is cooled. This will then work as an electricity generator.

Technical Data:

Dimension: 40x40x4,7 mm

Weight: approx 22gram

Data for use as a Peltier element (cooling or heating)

Maximum performance when used as a Peltier element:

Max. Cooling performance: 33 Watts

Max. Temperature difference: 67 degrees

Necessary voltage: 15 volts

Max. current: 3,9 Ampere

Maximum working temperature 150 degrees (constant use).

Internal resistance: 3,5 Ohm

Data for use as a Seebeck element : (Electricity generating)

Thermo power produced, 49 millivolt per degree of temperature difference between the ceramic plates.
This produces 4.9 volts (unloaded) at 100 degrees centigrade.
When connected to a motor this will sink to a maximal performance of approx 0.3 Watt.

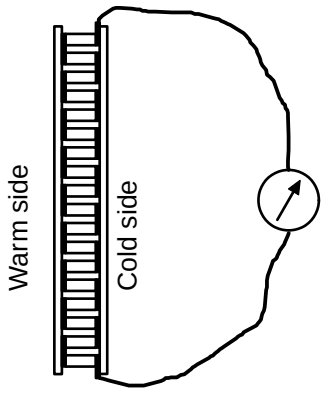
Foreword

It is fascinating to see how an electrical current can be obtained from two containers of water, each one holding water at a different temperature. The energy produced is enough to activate a small motor and a propeller.

This and other projects can be demonstrated by constructing what is called a **Seebeck device** (Thermo-element) in which one side of the element is heated and the other cooled.
Normally these are known as **Peltier elements**. They are made of small ceramic pieces with crystals blocks made from Wismut and Tellur. The Peltier element system is used for a different purpose as described in this project

Using the Peltier system direct current is sent through the connection wires (eg 8 volt 3 Ampere) and then something amazing happens.
One side is heated to 60 degrees and the other side cooled to 5 degrees. You now have the principle of a small heat exchanger like in a camping cool box or a system which can be used to cool other machines.
In our project we do not use the Peltier system in this way, we do not want to apply electricity on the contrary we want to extract it.
So we are going to do the opposite.
By warming one side of the element and cooling the other, it will deliver 1-3 volts at 10-500mA depending on the temperature difference.
To produce this electricity we do not need to turn a dynamo as on a bicycle, our system makes no noise and is a little bit like using solar cells. We are simply changing temperature differences into environmentally friendly produced electricity.

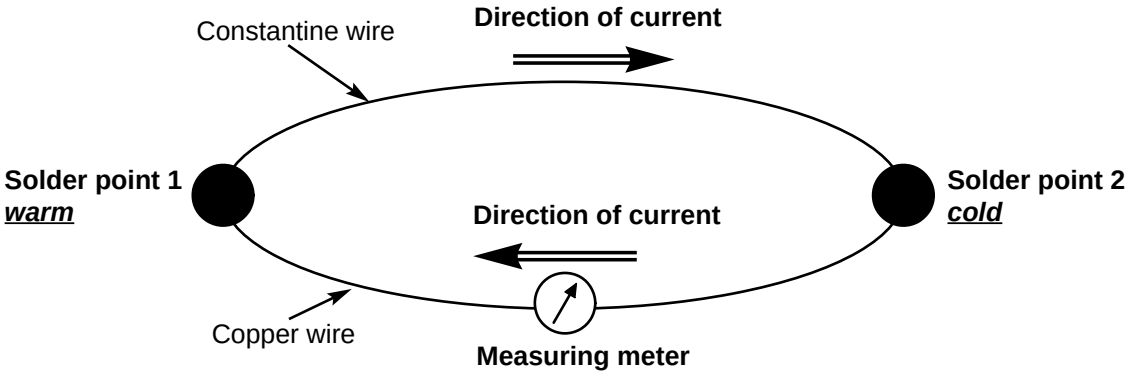
Why is this system not well known or used commercially to produce power ?
There are many technical reasons why this system is not used commercially. One is that todays Thermo-elements are only 5% efficient and are expensive to produce. To achieve a better relationship experimental work is being undertaken to produce cheaper and more efficient Thermo elements. Once this has been achieved they will have a wider application. For example the temperature difference made by burning waste and the normal outside temperature could be used as an economical system of producing power.
Our project will, we hope give you an insight into this environmental way of producing electricity.



When a temperature difference is apparent the electricity flows through the connecting wires

Thermo-element as supplied

Making the Seebeck - element system as developed by T J Seebeck (1821)



Schematic diagram layout of the Seebeck effect

Thomas Johann Seebeck experimented in 1821 with joining different types of metal wire to form a circuit. As one soldering point was heated up and the other was cooling he noted that a current flowed in the closed circuit. However if both of the solder points were heated at the time nothing happened. These were the first thermo - electrical experiments and are named after the inventor and known as the 'Seebeck –effect' All thermo-generators since have been based on developments of this idea of using different materials.

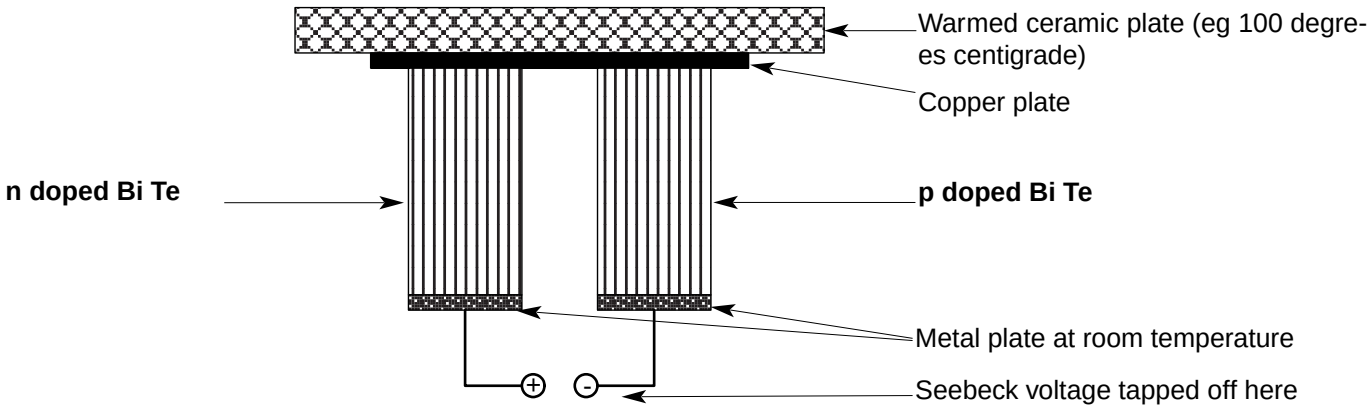
How we can use the Seebeck element in modern technology and why?

Instead of using two different metals a semi –conductor material can be used , such as so called p and n doped Wisnu Tellurit which has a higher working temperature than normal metals.
First experiments in the 1950s made use of this system and even today it is the most effective way of using materials to produce a temperature difference for generating electricity (and for cooling) a maximum of 5% temperature difference can be changed to electricity

Todays Thermo generator systems are used in special situations
The satellite Galileo is so far away from the sun that solar cells can produce little power. Here atomic energy produces the warmth which is cooled by the cold outside atmosphere. Also little known is that for many years all pipelines have used the system of thermo-generators to produce the power for their monitoring points. Here gas or oil out of the pipe is lit and the flame cooled with the air.

Since 1999 a watch has been developed which uses thin film technology to produce a thermo element to power it, whereby the temperature difference between the body heat and the surrounding air make up the small thermo element to produce the power.
Latest experiments in the development of thermo-elements will soon able to use thermo-voltaic and Photo-voltaic systems together, to produce environmentally free power

Schematic diagram of the Seebeck Thermoelement with n and p doped Bi Te crystals:

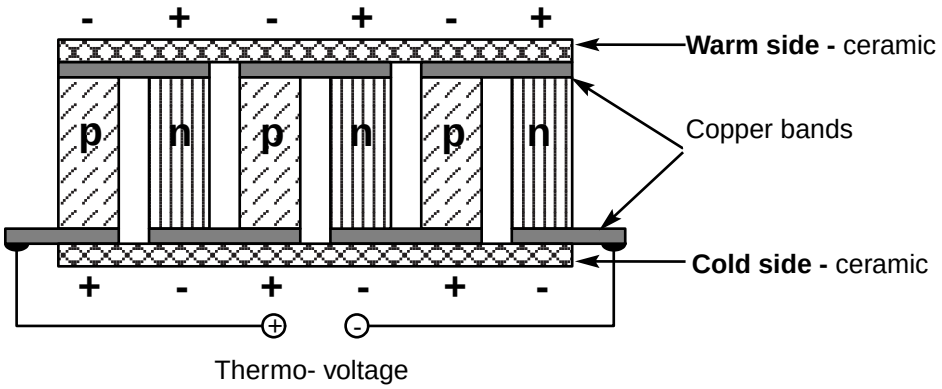


Looking at this diagram it might be confusing to see the two joining points , that were first envisaged by Seebeck

Solution: When the two metal plates are joined , at room temperature, to make up the circuit, they act in same way as the solder joints.

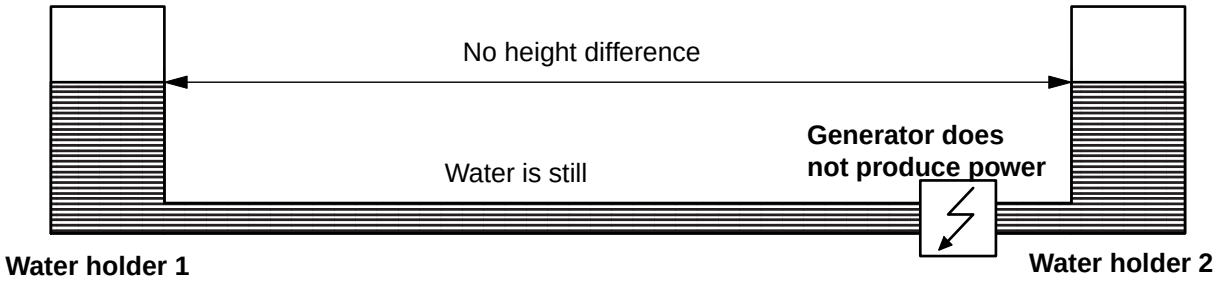
In most of the normal Seebeck elements (Peltierelements) all these basic principles are used one after the other (thermal, parallel, electrical serial)

The systematic diagram of a thermo element made up from a variety of basic building blocks; Thermal, parallel, electrical in series



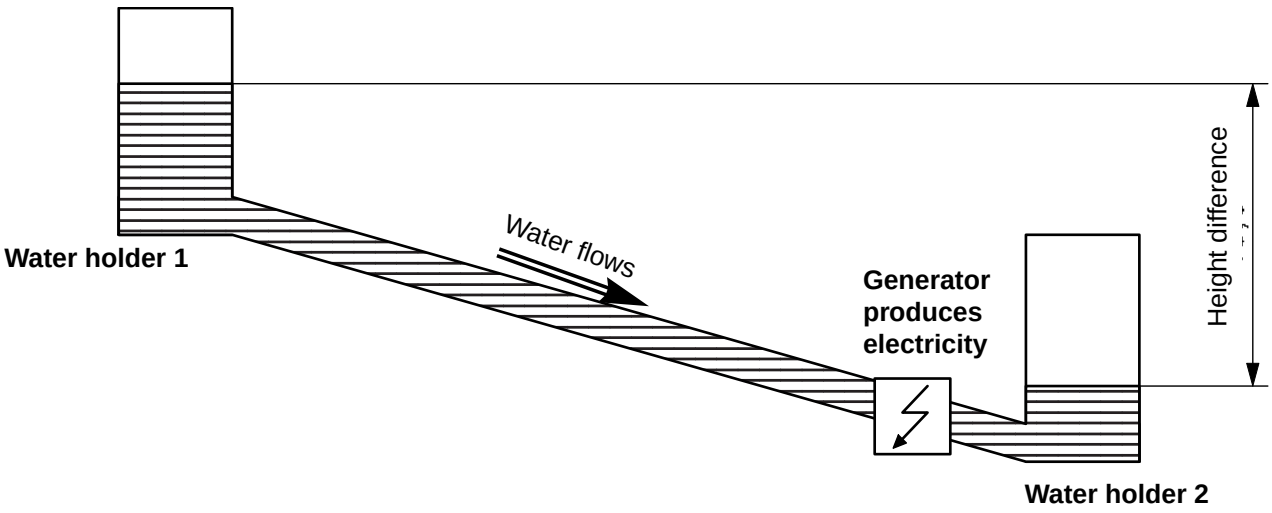
The working effect of Seebecks experiment shown as hydro power generating station

1. <u>Situation:</u> no height difference



As both the water holders have no fall between them, the water cannot flow to move the generator. The same happens with the Seebeck effect (Seebeck Generator) if there is no temperature difference.

2. <u>Situation:</u> A height difference between the water holders



Here the system is easy to see working as the water flows down through the Generator
So in short-no fall-no water flow and therefore no electricity is generated

If you use the same principle to ‘ temperature fall’ then you can see how the thermo-generator functions