



Brand Name	<b>ISATHERM PLUS<sup>®1)</sup></b>		
Material Code	<b>2.4870</b>		
Abbreviation	<b>KP/EP (X)</b>		
Chemical Composition (mass components) in % average values of alloy components			
Ni	Si	Fe	Cr
<b>Rest</b>	<b>0,5</b>	<b>0,4</b>	<b>10</b>

## Form of Delivery

ISATHERM PLUS<sup>®</sup>, (KP/EP and KPX/EPX) is supplied in the form of bare wire with dimensions from 0.03 to 10 mm $\varnothing$ . We supply coated wires from 0.03 to 1.5 mm $\varnothing$ . For oxidized wires the available dimensions are 1 to 4 mm $\varnothing$ . ISATHERM PLUS<sup>®</sup> can also be supplied in the form of stranded wire, ribbon, flat wire and rods. Please contact us for the range of dimensions. The dimensions 0.81 and 1.29 mm  $\varnothing$  in the KPX/EPX version are usually available ex stock.

## Features and Application Notes

ISATHERM PLUS<sup>®</sup> also known as CHROMEL<sup>®-P</sup> 2) or NiCr10, is used as positive leg of the thermocouple type K as well as the positive leg of the thermocouple type E.

In the version for extension leads ISATHERM PLUS<sup>®</sup> is used for KPX and EPX. ISATHERM PLUS<sup>®</sup> is standardized from -200 to 1260°C in thermocouple type K and from -200 to 900 °C in thermocouple type E. See also „*Special remarks on the alloy*“.

## Thermoelectrical and Electrical Values in Soft-Annealed Condition <sup>3)</sup>

EMF vers. Pt/NIST 175	EMF vers. Pt67/NIST 175	EMF vers. Pt/NIST 175	EMF vers. Pt67/NIST 175	Electrical resistivity at 20°C in	
0-200 ° F / mV	0-100 ° C / mV	0-2000 ° F / mV	0-1000 ° C / mV	$\mu\Omega \times \text{cm}$	$\Omega / \text{cir mil ft}$
<b>2.614</b>	<b>2.814</b>	<b>35.343</b>	<b>32.499</b>	<b>72</b>	<b>433</b>

## Physical Characteristics (Reference Values)

Density at 20 ° C		Melting Point	Specific heat at 20 ° C	Thermal conductivity at 20 ° C	Average linear thermal expansion coefficient between 20 ° C and 100 ° C	Magnetic at room temp.
g/cm <sup>3</sup>	lb/cub in	°C	J/g K	W/m K	10 <sup>-6</sup> /K	
<b>8.7</b>	<b>0.3143</b>	<b>1430</b>	<b>0.45</b>	<b>19</b>	<b>15.7</b>	<b>no</b>

## Mechanical Properties at 20 °C in Annealed Condition (Reference Values) <sup>4)</sup>

Annealing State	Tensile Strength		Elongation	Hardness
	MPa	lb / sq in	%	HV10
<b>hard</b>	<b>970</b>	<b>140650</b>	<b>2</b>	<b>&gt;310</b>
<b>soft</b>	<b>610</b>	<b>88450</b>	<b>30</b>	<b>130</b>

1 ISATHERM PLUS<sup>®</sup> is a registered trademark of ISABELLENHÜTTE Heusler GmbH & Co. KG.

2 CHROMEL<sup>®-P</sup> is a registered trademark of Hoskins Corp. USA..

3) The exact EMF values according to NIST 175 can be calculated with the „EMF-Software“, which can be downloaded from our homepage.

4) The mechanical values considerably depend on dimension. The indicated values refer to a dimension of 1 mm diameter.

## Notes on Treatment

ISATHERM PLUS<sup>®</sup> can be brazed without difficulty. All known welding methods are applicable. However, the alloy is difficult to soft-solder. The thermoelectric voltage of ISATHERM PLUS<sup>®</sup> may change as a result of mechanical or thermal stress; see also „*Special Remarks on the Alloy*“.

## Special Remarks on the Alloy

Due to its particular chemical composition, ISATHERM PLUS<sup>®</sup> (Chromel<sup>®</sup> or NiCr10) shows a specific thermoelectric voltage behaviour known as K condition. This means a change in the lattice structure within the alloy, which is dependent on the cooling rate in the temperature range below 450 ° C. With increasing rate of cooling the thermoelectric voltage drops. Consequently the annealing process used in production plays a decisive part in setting the thermoelectric voltage. As the only manufacturer worldwide, ISABELLENHÜTTE supplies KP/EP materials which pass the temperature range from 450 to 250 °C very slowly in a special annealing process. Thus, we achieve a state in the lattice structure that we called „stabilized condition“. If a K or E thermocouple is introduced into a stationary heat source above approx. 450 °C, the thermoelectric voltage of a non-stabilized NiCr10 leg will slowly be adjusted in the temperature range from 450°C to 250 °C. A non-homogenous thermocouple will arise. Since the thermoelectric voltage is generated over the whole length of the conductor, the thermoelectric voltage of the NiCr10 increases and thus the recorded temperature signal will also change, although the temperature of the heat source remains constant. Since the material supplied by ISABELLENHÜTTE is already stabilized, no signal shift occurs. For non-stationary application, both stabilized and non-stabilized material will show a signal shift. The difference between stabilized and non-stabilized material may amount up to 10K at a measuring temperature of 1000°C. ISATHERM PLUS<sup>®</sup> reacts corrosively at higher temperatures in the presence of varying oxidizing / reducing gases. Partial oxidation of the chromium will cause green rot. Sulphur and carbon favour the development of the green rot. As a consequence the thermoelectric voltage may change dramatically. This oxidation will also lead to brittleness of the material.