Brand Name	ISATHERM® PLUS[1)]				
Material Code	**2.4870**				
Abbreviation	**KP (X) / EP (X)**				
Chemical Composition (mass components) in %. Average values of alloy components					
Ni	**Si**	**Fe**	**Cr**		
Balance	0.5	0.4	10		

Features and Application Notes

ISATHERM® PLUS is used as positive leg for the thermocouple type K as well as the positive leg of the thermocouple type E. In the version for extension leads ISATHERM® PLUS is used for KPX and EPX. The standardized temperature range of the different application possibilities of ISATHERM® PLUS is available in the tables of the glossary.

Form of Delivery

ISATHERM® PLUS (KP/EP and KPX/EPX) is supplied in the form of bare wire with dimensions from 0.03 to 10.00 mm Ø. We supply coated wires from 0.03 to 1.50 mm Ø. ISATHERM® PLUS 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 (AWG 20) and 1.29 mm Ø (AWG 16) in the KPX/EPX version are usually available ex stock.

Thermoelectrical[3)] and Electrical Values in Soft-Annealed Condition

EMF versus Cu/NIST 175 at +100 °C / mV[4)]	EMF versus Pt67/NIST 175 at +100 °C / mV[4)]	EMF versus Pt67/NIST 175 at +1,000 °C / mV[4)]	Electrical resistivity in μΩ x cm at +20 °C
2.040	**2.814**	**32.499**	**72**

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 temperature
g/cm³	**°C**	**J/g K**	**W/m K**	**10^{-6}/K**	
8.70	**+1,430**	**0.45**	**19.00**	**15.70**	**no**

Mechanical Properties at +20 °C in Annealed Condition[5)]

	Tensile strength MPa	Elongation %	Hardness HV10
hard	**970**	**2**	**> 310**
soft	**610**	**28**	**130**

1) ISATHERM® PLUS is a registered trademark of Isabellenhütte Heusler GmbH & Co. KG, also known as CHROMEL®-P[2)] or NiCr10.
2) CHROMEL®-P is a registered trademark Concept Alloys, L.L.C.
3) The exact EMF values can be calculated with a "EMF-Software", which can be downloaded from our homepage.
4) Reference at 0 °C.
5) The mechanical values considerably depend on dimension. The indicated values refer to a dimension of 1.0 mm diameter.

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Notes on Treatment // ISATHERM® PLUS, 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 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 shows a specific thermoelectric voltage behaviour known as K condition. This means a change in the ordered lattice structure within the alloy, which is dependent on the cooling rate in the temperature range below +600 °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 a very special annealing process. Thus, we achieve a state in the lattice structure that we call "stabilized condition". If a K or E thermocouple is introduced into a stationary heat source above approx. +600 °C, the thermoelectric voltage of a non-stabilized NiCr10 leg will slowly be adjusted in the temperature range below +250 °C. A non-homogeneous thermoelement will result. 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 10 K at a measuring temperature of +1,000 °C. ISATHERM® PLUS 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 favor the development of the green rot. As a consequence, the thermoelectric voltage may change dramatically. This oxidation might also lead to brittleness of the material.

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