KANTHAL

KANTHAL® Super ER

Electric Heating Element for Direct Use up to 1580°C in Oxidizing, Inert and Reducing Atmospheres

KANTHAL Super ER is a new electric heating element, with the unique ability to operate up to 1580°C (2875°F) directly in a wide range of furnace atmospheres – from very dry reducing to oxidizing. It is now possible, in just one furnace, to operate firing cycles where the atmosphere condition can be altered, during the cycle, between oxidizing, inert, carburizing, nitriding, reducing and rough vacuum.

Depending on the dew point, the element can work up to 300°C (570°F) higher in reducing atmospheres, compared to standard KANTHAL Super elements.

Another benefit over molybdenum or graphite elements, for example, is that the elements can be replaced whilst the furnace is still very hot, minimizing downtime.

As the elements work directly in the furnace atmosphere, there is no need for a muffle to protect them from the atmosphere. Furnace design can be made simpler with a lower build cost and with much reduced maintenance costs. KANTHAL Super ER is equally suitable for low temperature oxidizing processes.

The resistivity at room temperature is six times higher than normal KANTHAL Super elements, giving a large increase in power output at low temperatures, when working with current limitations.

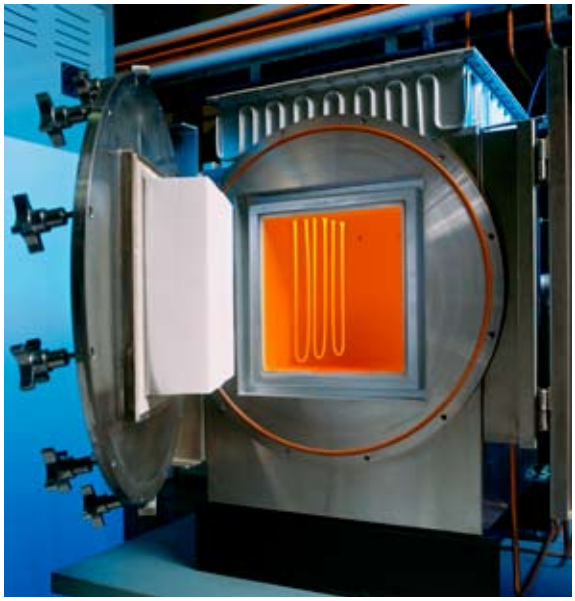
The major reason for the new and outstanding features of KANTHAL Super ER is that it has a protective surface layer of pure alumina. The alumina layer grows on the surface of the heating element at high temperatures even in dry hydrogen. The elements can work in direct contact with high alumina supports without corrosive reactions.

Applications

A wide range of furnace atmospheres and processes. Most types of PM sintering in dry hydrogen and furnaces with alternating oxidizing and reducing atmospheres. Continuous furnaces with hydrogen containing atmospheres for ferrite sintering and MLCC processing.

Combining the Best Materials

There is a wide range of heating elements available for use in heat treatment and sintering processes. Molybdenum



is often used. Operation in air or oxidizing atmospheres, however, is not possible due to the detrimental oxidation of molybdenum to MoO_3.

So called silica formers, like normal KANTHAL Super and SiC-elements, have a protective SiO_2 layer which enables extended use at high temperatures in oxidizing atmospheres. They have limited use at high temperature in reducing atmospheres, where evaporation occurs at low dew points due to the nature of the SiO_2.

KANTHAL metallic heaters (FeCrAl) are commonly used in air, oxidizing and atmosphere furnaces for heat treatment. Alumina scales, which are formed on the surface, are inherently more stable than silica formers under such conditions. The maximum temperature, however, is limited and the lifetime will be short when operating close to their melting point.

KANTHAL Super ER is a new unique concept for heating elements, combining the features of alumina formers with the higher temperature of $MoSi_2$-based heaters. The new heating element provides opportunities for designing systems that meet the demands of processes in multi-atmospheres.

Maximum Furnace Temperatures for Selected Heating Elements

Heating element	Maximum temperature in air		Maximum temperature in dry H_2		Maximum temperature in vacuum	
	°C	(°F)	°C	(°F)	°C	(°F)
Molybdenum	300	570	1800	3270	1600	2910
KANTHAL Super 1900	1800	3270	1150	2100	900	1650
SiC	1600	2910	1100	2010	900	1650
FeCrAl	1375	2510	1300	2370	1050	1920
KANTHAL Super ER	**1500**	**2730**	**1450**	**2640**	**1450**	**2640**

The data should be considered as approximate, since maximum furnace temperature depends on surface loading, gas-velocity, dew point and vacuum level.

Technical Data

Oxidation and Corrosion Properties

Due to the replacement of silicon by aluminum in the silicide phase, the oxidation mechanisms change. This also allows operation at low temperature in air. At higher temperatures a thicker alumina scale is formed.

A protective alumina layer continues to grow on the surface of a heater operating at 1575°C (2870°F) in H_2, N_2 or argon with a dew point of -50°C (-58°F). A KANTHAL Super 1800 heating element loses 20 % of its weight in 3 days due to corrosion, at a temperature of 1500°C (2730°F) and a dew point of -40°C (-40°F).

The maximum temperature allowed for a given dew point has increased by up to 300°C (570°F) compared to KANTHAL Super 1700 and 1800 elements. This is shown in the figure below.

The formation of alumina makes pure alumina ceramics or brick an excellent choice for support material. Other KANTHAL Super elements can react with Al_2O_3 materials at high temperatures.

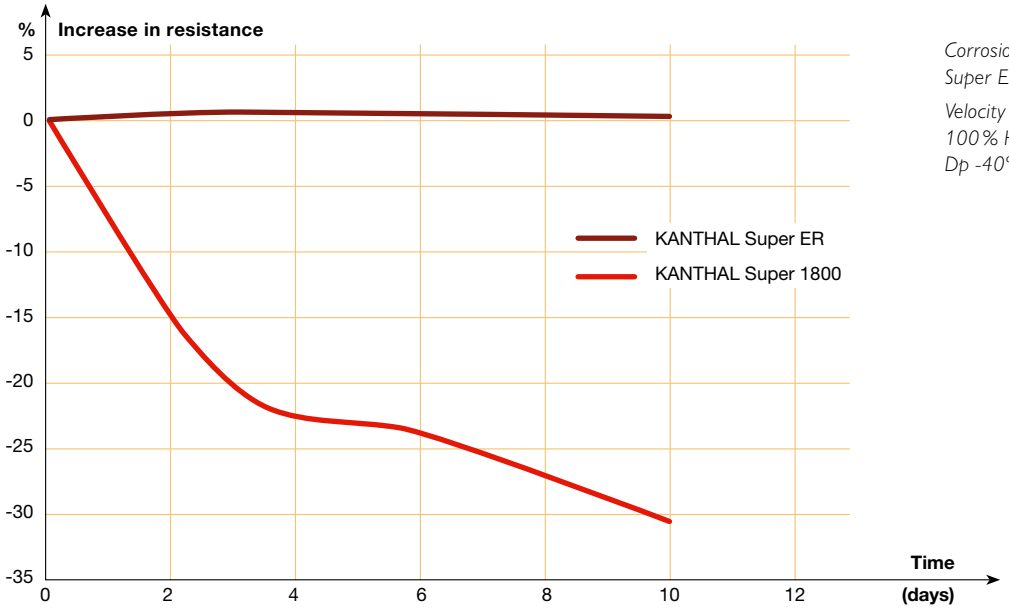
Product Range

KANTHAL Super ER is delivered as 2- and 4-shank elements with fixed terminals as an option for safe and reliable electrical connections.

Special designs are available on request.

KANTHAL Super ER	Heating zone diam. Le, mm (in.)	Terminal diam. Lu, mm (in.)
	3 (0.12)	6 (0.24)
	4 (0.16)	9 (0.35)
	6 (0.24)	12 (0.47)
	9 (0.35)	18 (0.71)

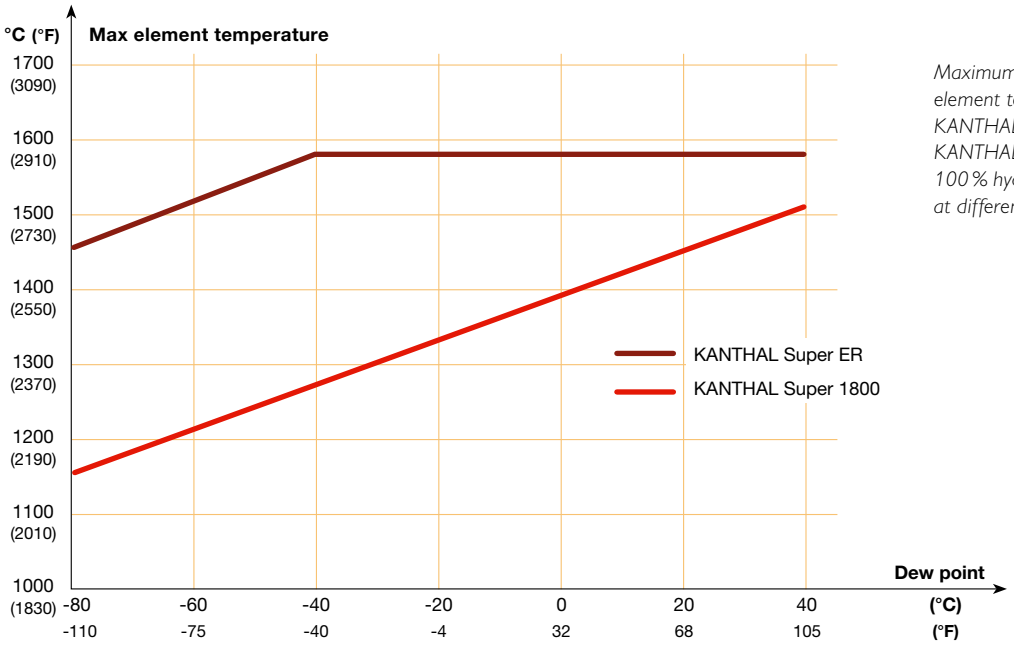
Corrosion Properties



Corrosion properties KANTHAL Super ER vs. 1800

Velocity 1.7 m/s (3.8 mph) 100 % H_2 at 1550°C (2820°F), Dp -40°C (-40°F)

Maximum Temperature in Hydrogen

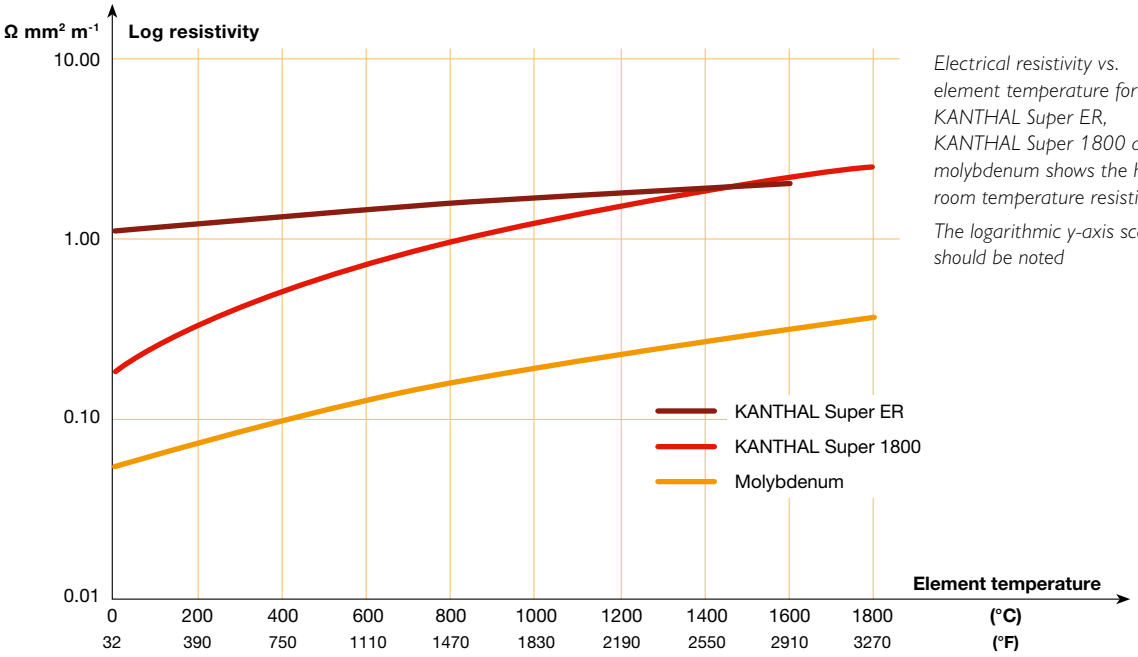


Maximum recommended element temperature for KANTHAL Super ER and KANTHAL Super 1800/1900 in 100 % hydrogen (H_2) atmosphere at different dew points

Resistivity

The alloying of $MoSi_2$ with aluminum changes the temperature dependence of the resistivity dramatically. In the figure below, the resistivity versus temperature is presented for KANTHAL Super ER, KANTHAL Super 1800 and molybdenum. Particularly notable is the resistivity at room temperature, which is six times higher than that for KANTHAL Super 1800.

One technical implication of the behavior of KANTHAL Super ER is the significantly higher power output when running at low temperature with current limitations. When this is essential for the process, it will give cost advantages in the design of the electrical control unit including thyristors compared with standard KANTHAL Super.

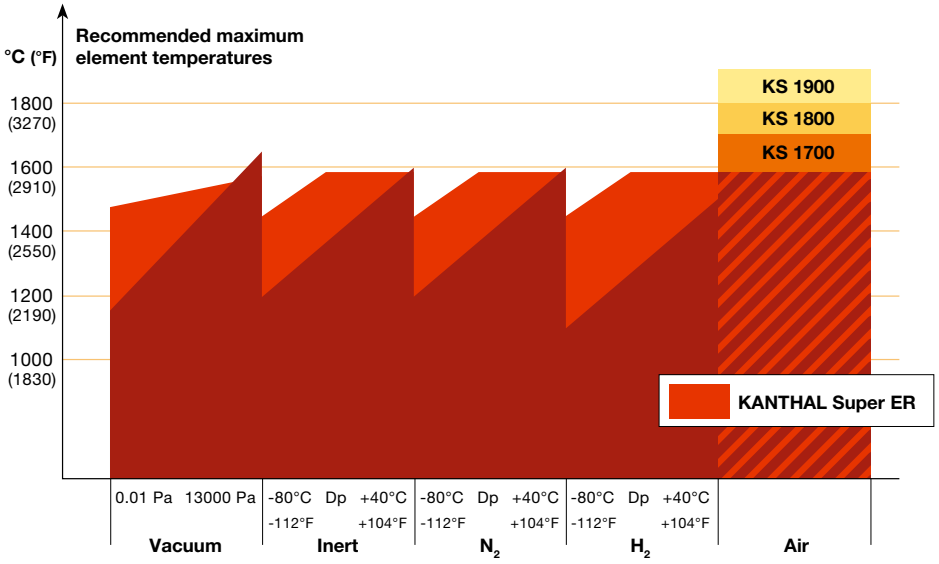


Electrical resistivity vs. element temperature for KANTHAL Super ER, KANTHAL Super 1800 and molybdenum shows the high room temperature resistivity

The logarithmic y-axis scale should be noted

Maximum Recommended Element Temperatures

The diagram below is a guide to maximum temperatures in different atmospheres depending on dew point and vacuum. For details regarding specific applications, we recommend contact with Kanthal.



Recommended maximum element temperatures in different atmospheres

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