KANTHAL

Kanthal® Super ER

Electric heating element for direct use up to 1580°C (2875°F) in oxidizing, inert and reducing atmospheres

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.

Kanthal Super ER is an 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 vacuum.

Depending on the dew point, the element can work up to 300°C (540°F) higher in reducing atmospheres, compared to standard Kanthal Super elements.

SPECIAL FEATURES
- High purity
- Very good oxide adhesion
- Corrosion resistance in reducing atmospheres
- Standard and specially designed 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.

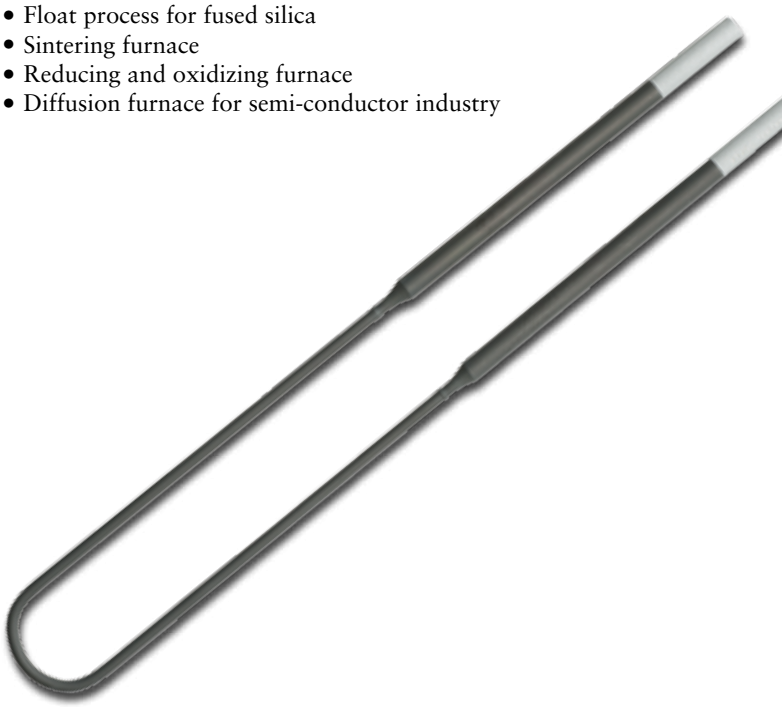
As the elements work directly in the furnace atmosphere, there is no need for a muffle to protect them from the atmosphere. Furnace design can be made simpler with a lower build cost and with much reduced maintenance costs. Kanthal Super ER is equally suitable for low temperature oxidizing processes.

The 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

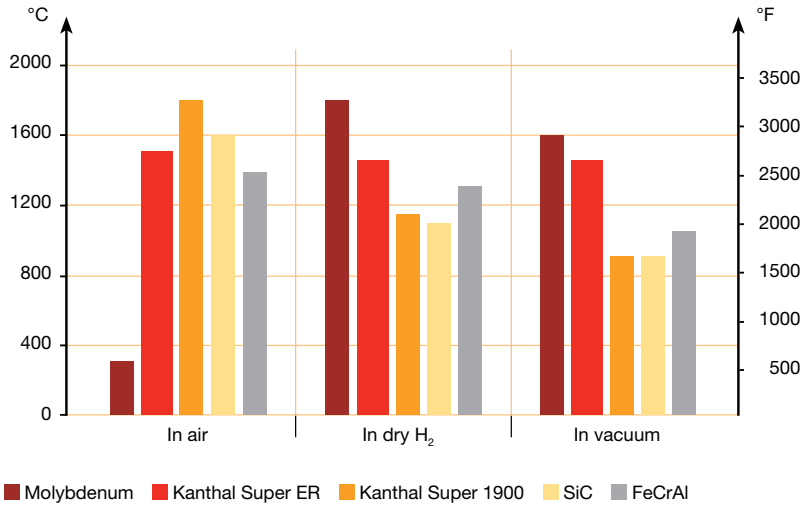
A wide range of furnace atmospheres and processes. Most types of PM (powder metallurgy) sintering in dry hydrogen and furnaces with alternating oxidizing and reducing atmospheres. Continuous furnaces with hydrogen containing atmos-pheres for ferrite sintering and MLCC processing.

Typical applications:
- Float process for fused silica
- Sintering furnace
- Reducing and oxidizing furnace
- Diffusion furnace for semi-conductor industry



Technical information

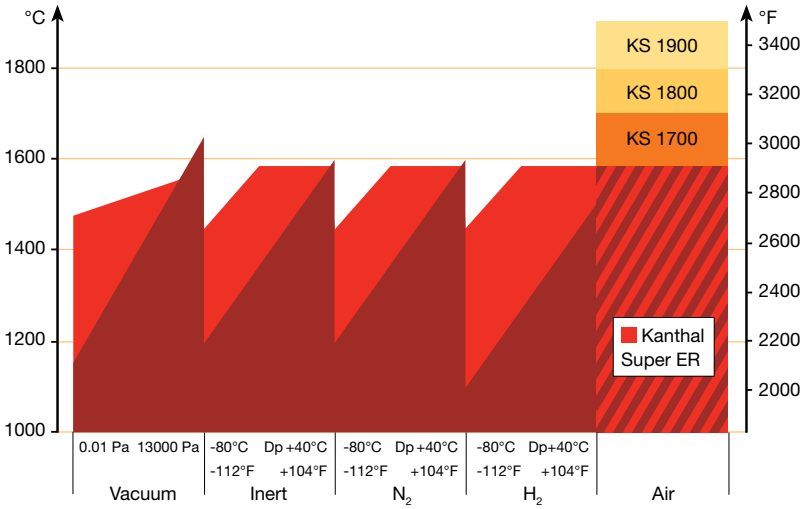
Maximum furnace temperatures for selected heating elements



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

- Kanthal Super ER is the most versatile heating element.
- Kanthal Super ER can work 300°C (540°F) higher in reducing atmosphere compared to Kanthal Super and SiC element.
- Kanthal Super ER can work 550°C (990°F) higher in vacuum compared to SiC and Kanthal Super element, and 450°C (810°F) compared to FeCrAl.
- Higher maximum temperature compared to metallic heaters.
- Resistant to further oxidation compared to molybdenum.

Maximum recommended element temperatures



The diagram is a guide to maximum temperatures in different atmospheres depending on dew point, vacuum and etc.

For details regarding specific applications, we recommend contact with Sandvik.

PROPERTIES

Maximum element temperature	1580°C (2875°F)
Composition	Mainly $Mo(Si,Al)_2$
Density	5.6 g/cm^2 (0.2 lb/in^2)
Thermal conductivity	
20–600°C (68–1110°F)	30 Wm^{-1} K^{-1}
600–1200°C (1110–2190°F)	15 Wm^{-1} K^{-1}
Coefficient of linear expansion for	
bulk	7–8 10^{-6} K^{-1}
aluminum	7–8 10^{-6} K^{-1}
Specific heat capacity at 20°C (68°F)	0.42 kJ kg^{-1} K^{-1}
Emissivity	0.75–0.85

Oxidation and corrosion properties

Corrosion properties Kanthal Super ER compared to 1800
Velocity 1.7 m/s (3.8 mph)
100% H_2 at 1550°C (2820°F), Dp -40°C (-40°F)

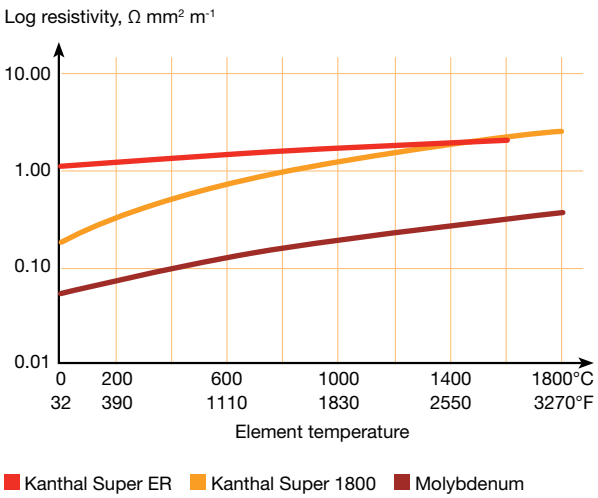
Oxidation and corrosion properties

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. As the alumina scale gets thicker, there is very low risk for any spallation during the cooling due to the same coefficient of thermal expansion between bulk and protective oxide.

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 three days due to corrosion, at a temperature of 1500°C (2730°F) and a dew point of -40°C (-40°F).

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.

Resistivity



Electrical resistivity compared to 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.

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.

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

Standard 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.

Sandvik Group
The Sandvik Group is a global high technology enterprise with 47,000 employees in 130 countries. Sandvik's operations are concentrated on three core businesses: Sandvik Tooling, Sandvik Mining and Construction and Sandvik Materials Technology – areas in which the group holds leading global positions in selected niches.

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Sandvik Materials Technology
Sandvik Heating Technology AB, Box 502, 734 27 Hallstahammar, Sweden, Phone +46 220 210 00, Fax +46 220 211 66
www.kanthal.com, www.smt.sandvik.com

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