KANTHAL HANDBOOK

Heating Alloys for Electric Household Appliances

KANTHAL®

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Kanthal is never far away!

This handbook contains basic technical and product data for our resistance and resistance heating alloys for the appliance industry.

We have also included design-, calculation- and application guidelines, in order to make it easier to select the right alloy and to design the right element.

More information is given on www.kanthal.com. There you can find product news and other Kanthal product information and handbooks ready to be downloaded as well as information on the Kanthal Group and the nearest Kanthal office.

Kanthal alloys are also produced in a range for industrial furnaces and as ready-to-install elements and systems and as precision wire in very small sizes. Ask for the special handbooks covering those areas.

We have substantial technical and commercial resources at all our offices around the world and we are glad to help you in different technical questions, or to try out completely new solutions at our R & D facilities.

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Hallstahammar, February 2003

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1. Resistance Heating Alloys

The resistance heating alloys can be divided into two main groups. The FeCrAl (KANTHAL) and the NiCr (NIKROTHAL) based alloys. For lower temperature applications CuNi and NiFe based alloys are also used. The different alloys are described below as well as a comparison of some of the properties of the KANTHAL and the NIKROTHAL alloys.

NiFe

Up to 600 °C *1110 °F*:
NIFETHAL 70 and 52
are alloys with low resistivity and high temperature coefficient of resistance. The positive temperature coefficient allows heating elements to reduce power as temperature increases. Typical applications are in low temperature tubular elements with self regulating features.

Spools and Pail Pack.

Austenitic Alloys (NiCr, NiCrFe)

Up to 1200 °C *2190 °F*: NIKROTHAL 80 is the austenitic alloy with the highest nickel content. Because of its good workability and high-temperature strength, NIKROTHAL 80 is widely used for demanding applications in the electric appliance industry.

Up to 1250 °C *2280 °F*: NIKROTHAL 70 (Normally used in furnace applications).

Up to 1150 °C *2100 °F*: NIKROTHAL 60 has good corrosion resistance, good oxidation properties and very good form stability. The corrosion stability is good except in sulphur containing atmospheres. Typical applications for NIKROTHAL 60 are in tubular heating elements and as suspended coils.

Up to 1100 °C *2010 °F*: NIKROTHAL 40 is used as electric heating element material in domestic appliances and other electric heating equipment at operating temperatures up to 1100 °C *2010 °F*.

Up to 1050 °C *1920 °F*: NIKROTHAL 20 (Produced on volume based request.)

Ferritic Alloys (FeCrAl)

Up to 1425 °C *2560 °F*: KANTHAL APM (Normally used in furnace applications).

Up to 1400 °C *2550 °F*: KANTHAL A-1 (Normally used in furnace applications).

Up to 1350 °C *2460 °F*: KANTHAL A is used for appliances, where its high resistivity and good oxidation resistance are particularly important.

Up to 1300 °C *2370 °F*: KANTHAL AF has improved hot strength and oxidation properties and is especially recommended where good form stability properties in combination with high temperature is required.

Up to 1300 °C *2370 °F*: KANTHAL AE is developed to meet the extreme demands in fast response elements in glass top hobs and quartz tube heaters. It has exceptional form stability and life in spirals with large coil to wire diameter ratio.

Up to 1300 °C *2370 °F*: KANTHAL D Employed chiefly in appliances, its high resistivity and low density, combined with better heat resistance than austenitic alloys, make it suitable for most applications.

Up to 1100 °C *2010 °F*: ALKROTHAL is typically specified for rheostats, braking resistors, etc. It is also used as a heating wire for lower temperatures, such as heating cables.

KANTHAL Advantages

Higher maximum temperature in air
KANTHAL A-1 has a maximum temperature of 1400 °C *2550 °F;*
NIKROTHAL 80 has a maximum temperature of 1200 °C *2190 °F.*

Longer life
KANTHAL elements have a life 2-4 times the life of NIKROTHAL when operated in air at the same temperature.

Higher surface load
Higher maximum temperature and longer life allow a higher surface load to be applied on KANTHAL elements.

Better oxidation properties
The aluminium oxide (Al_2O_3) formed on KANTHAL alloys adheres better and is therefore less contaminating. It is also a better diffusion barrier, better electrical insulator and more resistant to carburizing atmospheres than the chromium oxide (Cr_2O_3) formed on NIKROTHAL alloys.

Lower density
The density of the KANTHAL alloys is lower than that of the NIKROTHAL alloys. This means that a greater number of equivalent elements can be made from the same weight material.

Higher resistivity
The higher resistivity of KANTHAL alloys makes it possible to choose a material with larger cross-section, which improves the life of the element. This is particularly important for thin wire. When the same cross-section can be used, considerable weight savings are obtained. Further, the resistivity of KANTHAL alloys is less affected by cold-working and heat treatment than is the case for NIKROTHAL 80.

Higher yield strength
The higher yield strength of KANTHAL alloys means less change in cross-section when coiling wires.

NIKROTHAL Advantages

Better resistance to sulphur
In atmospheres contaminated with sulphuric compounds and in the presence of contaminations containing sulphur on the wire surface, KANTHAL alloys have better corrosion resistance in hot state. NiCr alloys are heavily attacked under such conditions.

Weight savings with KANTHAL alloys
The lower density and higher resistivity of KANTHAL alloys means that for a given power, less material is needed when using KANTHAL instead of NIKROTHAL alloys. The result is that in a great number of applications, substantial savings in weight and element costs can be achieved.

In converting from NiCr to KANTHAL alloys, either the wire diameter can be kept constant while changing the surface load, or the surface load can be held constant while changing the wire diameter. In both cases, the KANTHAL alloy will weigh less than the NiCr alloy.

Higher hot and creep strength
NIKROTHAL alloys have higher hot and creep strength than KANTHAL alloys. KANTHAL APM, AF and AE are better in this respect than the other KANTHAL grades and have a very good form stability, however, not as good as that of NIKROTHAL.

Better ductility after use
NIKROTHAL alloys remain ductile after long use.

Higher emissivity
Fully oxidized NIKROTHAL alloys have a higher emissivity than KANTHAL alloys. Thus, at the same surface load the element temperature of NIKROTHAL is somewhat lower.

Non-magnetic
In certain low-temperature applications a non-magnetic material is preferred. NIKROTHAL alloys are non-magnetic (except NIKROTHAL 60 at low temperatures). KANTHAL alloys are non-magnetic above 600 °C *1100 °F.*

Better wet corrosion resistance
NIKROTHAL alloys generally have better corrosion resistance at room temperature than nonoxidized KANTHAL alloys. (Exceptions: atmospheres containing sulphur and certain controlled atmospheres.)