

MODUTHAL[®]

Electric Heating Modules



KANTHAL

Look at Kanthal as Your Partner

Welcome to the Kanthal world of heating solutions! We can solve most industrial heating problems from 0 to 2000°C (32 to 3630°F).

Kanthal has been in the market since 1931, when our first heating wire was introduced. Today, we offer many types of heating elements and systems for laboratory furnaces, industrial furnaces and processes.

Our integrated production – from melting to finished product – guarantees our product quality. We provide customized solutions as well as a broad range of standard products, including everything from basic element and furnace calculations to design, manufacture and installation.

Most of our products are developed by our own heating specialists and are at the forefront of performance and quality.

The Problem. Facts

We collect all the facts and requirements, previous experiences and limitations.



Design & Calculations

Our sales engineers analyze the facts, make the basic element and furnace calculations and prepare a preliminary recommendation.



Test

A prototype is manufactured and tested at one of our Technical Centers.

Simulation

The recommended solution is tested in special, digital simulation programs.



Providing a customized heating solution requires a questioning approach.

- Do you experience too many production stops?
- Is there a need for higher power and output in your furnace?
- Are you making plans for investment in a new heating line or furnace?

We stay in close contact to solve your problems and answer any questions you may have:

Should I choose heating elements just in the furnace roof? What about response to temperature changes in connection with e.g. shutting down for weekends?

At any given time during our project cooperation, we are ready to give you a preliminary or detailed quotation for your process.



The Solution. Delivery & Installation

We often work as project leader with the responsibility for the whole project including complementary products, like insulation and power supply, training and instruction and the actual installation.

Follow-up

Our sales engineers keep in touch to monitor and evaluate the system performance.

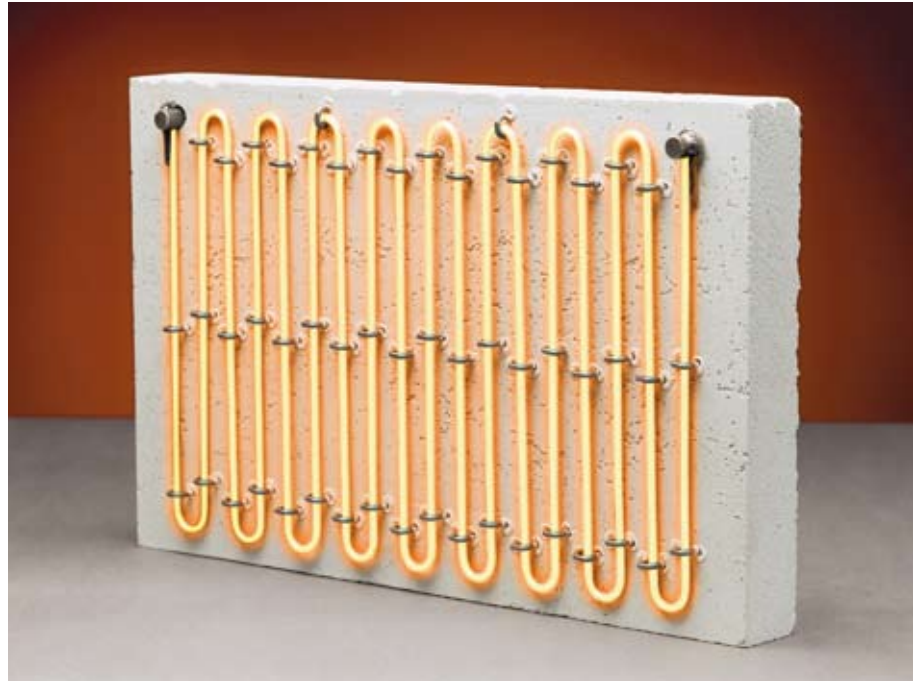
MODUTHAL Heating Element

Kanthal MODUTHAL are prefabricated radiant heating modules designed to suit a wide range of thermal processing applications at element temperatures up to 1350°C (2460°F).

To optimize performance, all resistance material is fabricated primarily from KANTHAL® A-1 and KANTHAL AF resistance alloys, given each application. The element coils are held in place in a non-electrically conductive, high quality ceramic, to form a MODUTHAL element system.

The elements may be fully embedded, semi-embedded or free radiating. The construction method ensures accurate positioning of the coils and eliminates the distortion or other problems connected to the conventional open coil elements in grooves or on tubes. A fibre free version of MODUTHAL is available up to 1250°C (2280°F).



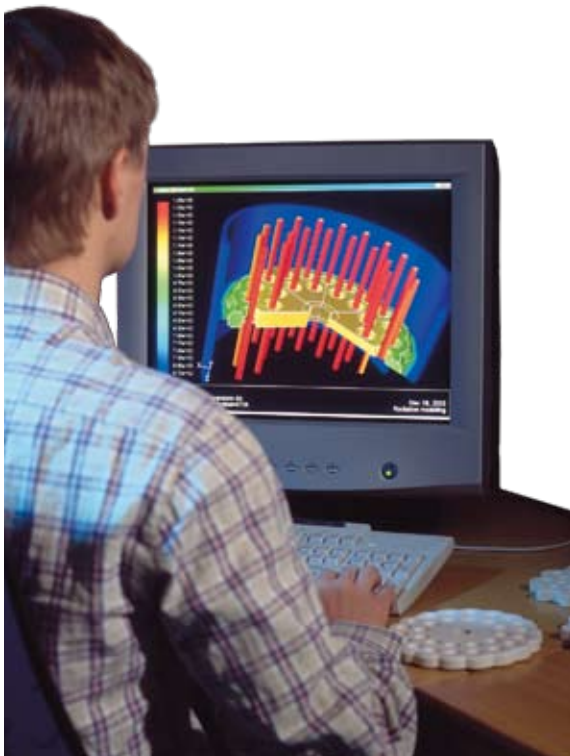


The high thermal conductivity of MODUTHAL refractory panel acts as a diffuser to distribute heat energy evenly from the elements. This provides improved heat distribution as compared with exposed element coils. To provide sophisticated temperature uniformity within a furnace, multiple zones can be used. Without altering the furnace characteristics, individual units are easily replaced, due to the modular construction.

With the introduction of MODUTHAL fully embedded, semi embedded and free radiating elements, Kanthal has taken a major step forward. The exclusive manufacturing process results in e.g. excellent temperature capability, superior element support, and a long life, these being just a few examples of Kanthal high quality reliable workmanship.

The result is an element which possesses the following features;

- Fully interchangeable modules
- High surface load
- Superior element support
- Excellent heat distribution
- Long life
- Customized design
- Easy to install



Reference Applications

MODUTHAL elements have been successfully used in these well-established applications.

Crucible Furnace

Melting or holding aluminum and copper-based alloys. With the fully embedded type of MODUTHAL some protection is given to the element against metal splashes and fluxes. MODUTHAL permits high wall loadings, gives uniform temperature around the crucible and can be easily replaced.

Billet Heating Furnace

Pre-heating of steel, copper, brass and aluminum billets prior to rolling or forging.



Glass Toughening and Bending Furnace

Toughening glass for cooker doors and similar products. Operating for an eight-hour day five days per week at 650°C (1200°F) in an air atmosphere.



Brass Melting Furnace

MODUTHAL high temperature panels in roof and walls operating at element temperatures up to 1350°C (2460°F).



Tundish Pre-Heating

For casting aluminum. MODUTHAL gives accurate and even temperature control in a compact design.



Wire Annealing Furnace

For multi-strand annealing. MODUTHAL panels are mounted in the hearth, roof and walls, operating in the range 800 – 1050°C (1470 – 1920°F) both continuously and intermittently.

Fluidized Bed Furnace

Interlinked circular muffles (embedded for protection against bed materials) operating typically at 900 – 1000°C (1650 – 1830°F).

Crystal Growing

Low-temperature crystal growing using a MODUTHAL element at 950 – 1000°C (1740 – 1830°F) in air.

Billet Holding Furnace

Arch-shaped MODUTHAL fully embedded element for billet holding at temperature after induction heating. Intermittent operation at 750 – 800°C (1380 – 1470°F).

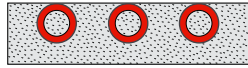


Types & Maximum Temperature

MODUTHAL cast refractory element modules can be supplied as one of the following individual types of heating module.

MODUTHAL Fully Embedded

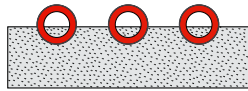
MAXIMUM ELEMENT TEMPERATURE 1100°C (2010°F)



Although being a fully embedded panel, most of the heating element is covered with a thin layer of refractory allowing the element to radiate more efficiently than a standard fully embedded panel. MODUTHAL fully embedded heating panels are also available in a fibre free version.

MODUTHAL Semi Embedded

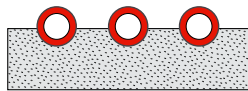
MAXIMUM ELEMENT TEMPERATURE 1150°C (2100°F)



A conventionally designed panel which offers a cost effective solution to applications that do not require the higher temperatures that can be achieved by MODUTHAL open coil elements. MODUTHAL semi embedded heating panels are also available in a fibre free version.

MODUTHAL Free Radiating

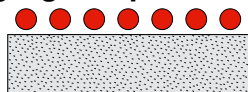
MAXIMUM ELEMENT TEMPERATURE 1200°C (2190°F)



Due to the unique Kanthal design which allows 75 % of the heating element to freely radiate this element is capable of operating up to 1200°C (2190°F). 1150°C (2100°F) when using fibre free modules.

MODUTHAL Free Radiating High Temperature

MAXIMUM ELEMENT TEMPERATURE 1350°C (2460°F)



Kanthal's unique design combines MODUTHAL ceramic casting with freely radiating APM material elements. Those elements are capable of operating up to 1350°C (2460°F). 1250°C (2280°F) when using the fibre free modules.

Design

MODUTHAL embedded elements can be designed and manufactured in a variety of shapes and sizes and can also include special features such as thermocouple holes, locating lugs and grooves. MODUTHAL elements are designed for use in either small furnaces or in multiples to suit larger industrial furnaces or kilns. Each heating panel is typically rated between 1 kW and 10 kW. The mechanical strength of MODUTHAL at different temperature is shown in Figure 1.

Process Atmospheres

MODUTHAL elements are designed to operate in clean air, but may also be used in process atmospheres within the normal limitations of the heating element alloy. The effect of furnace atmospheres is tabulated in Figure 5.

Control Equipment

MODUTHAL elements are normally operated directly from the mains electricity supply and therefore do not require any special power supply equipment. All modules are highly resistant to thermal stress and there is no need to limit the power input during start up conditions, except during the initial firing up when a slower heating rate may be required to expel any residual moisture.

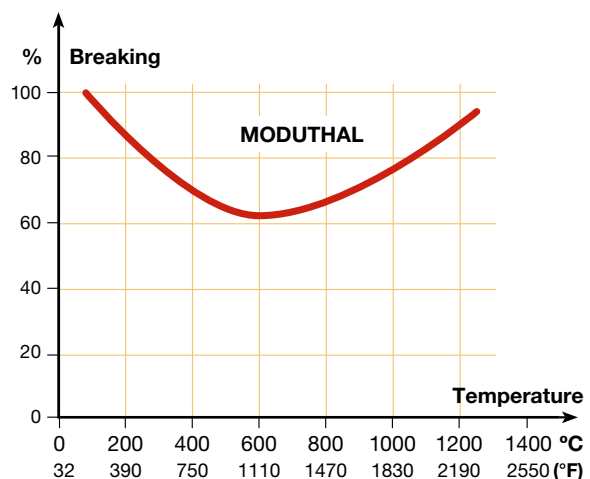


Fig 1. Results of laboratory tests showing the breaking strength of MODUTHAL

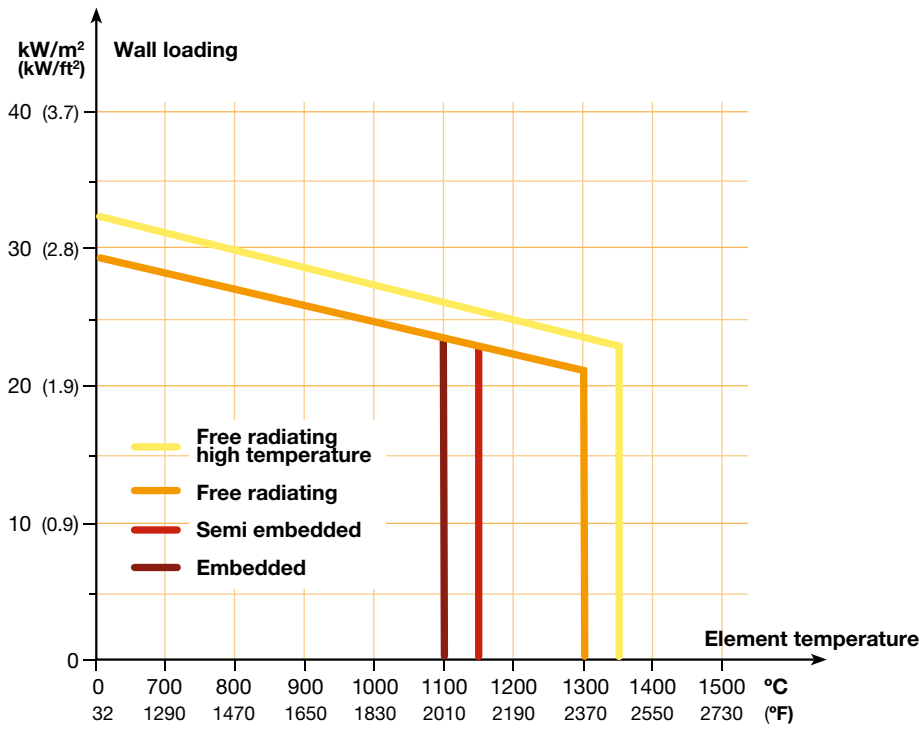


Fig 2. Maximum recommended wall loading versus furnace temperature for MODUTHAL (diagram for guidance only)

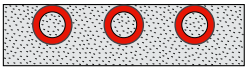
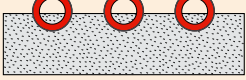

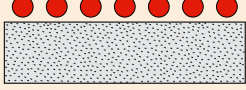
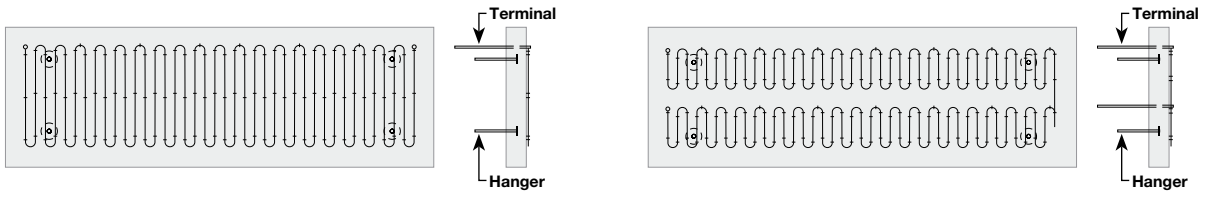
	3000 module	6000 module	(Fiber free) module
Fully embedded (coil) 	1100°C (2010°F)	1100°C (2010°F)	1100°C (2010°F)
Semi embedded (coil) 	1150°C (2100°F)	1150°C (2100°F)	1150°C (2100°F)
Free radiating (coil) 	1200°C (2190°F)	1200°C (2190°F)	1150°C (2100°F)
Free radiating high temperature 	1350°C (2460°F)	1350°C (2460°F)	1250°C (2280°F)

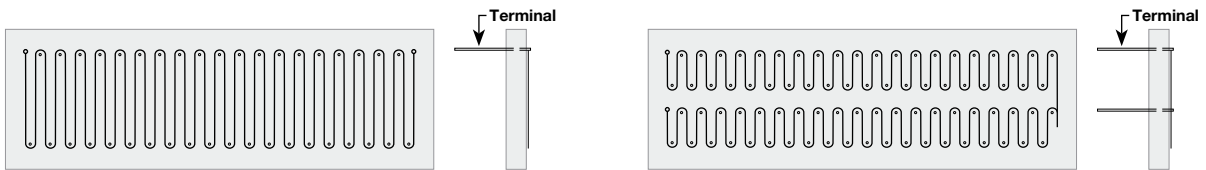
Fig 3. Maximum permissible element temperatures

Common Panel Configurations

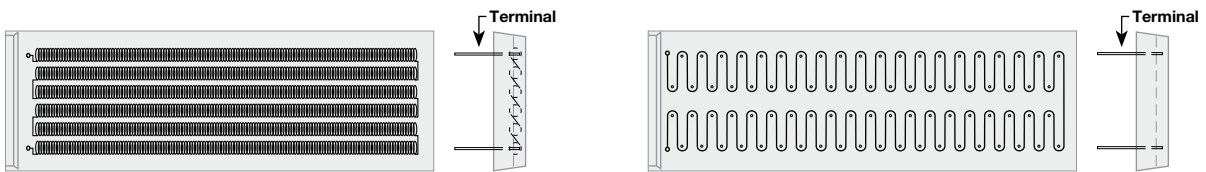
Roof & Wall Panels



Bottom Panels



Panels for Aluminum Crucible Furnaces



Power Limitation

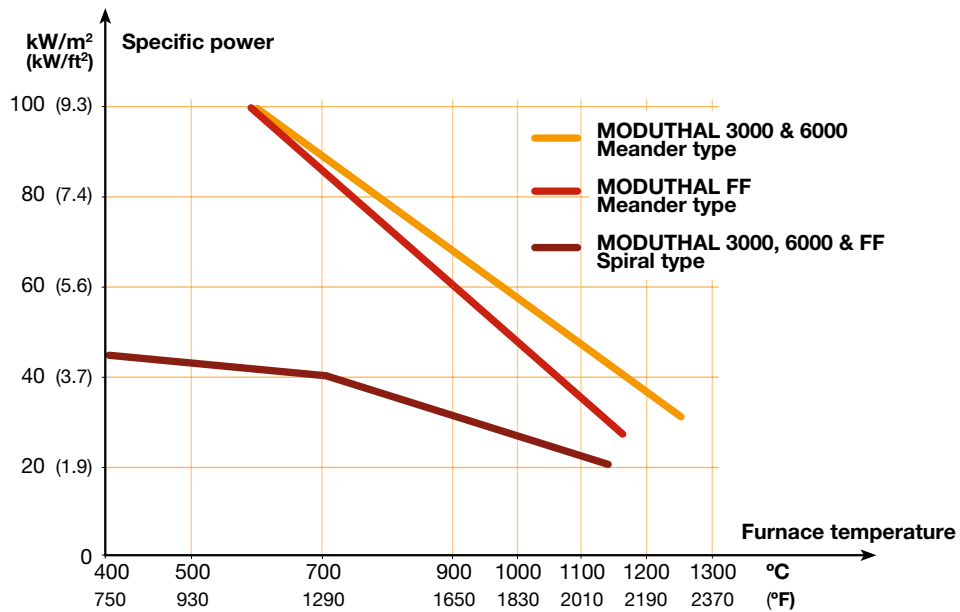


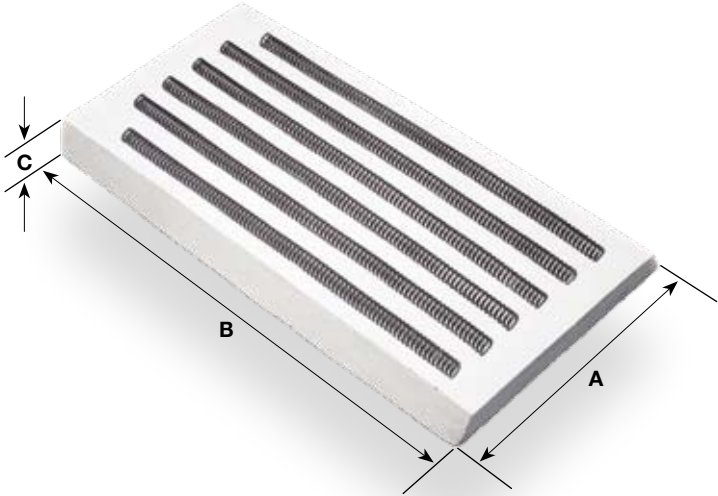
Fig 4. Power limitation

Atmospheres

Furnace atmosphere	Heating element	Max element temperature		Remarks
		MODUTHAL FF	MODUTHAL 3000 & 6000	
H ₂	1350°C (2460°F)	1250°C (2280°F)	1350°C (2460°F)	H ₂ increases heat conductivity of MODUTHAL 3–4 times
N ₂	1200°C (2190°F) preoxidized	1250°C (2280°F)	1350°C (2460°F)	
N	Don't use	–	–	
Endogas	1050°C (1920°F) preoxidized	1050°C (1920°F)	1050°C (1920°F)	Pay attention to carbon deposition! Gas tight muffle recommended
Exogas	1150°C (2100°F) preoxidized	1150°C (2100°F)	1150°C (2100°F)	Pay attention to carbon deposition! Gas tight muffle recommended
Sulphur cont. cycle	Approx. 1000°C (1830°F)	1000°C (1830°F)	1000°C (1830°F)	Gas tight muffle recommended
Sulphur interm. cycle	Approx. 1000°C (1830°F)	See remarks	See remarks	Gas tight muffle recommended
Vacuum <10 ⁻³ hPa	1150°C (2100°F) preoxidized	1150°C (2100°F)	1150°C (2100°F)	Vacuum tight muffle recommended for vacuum >10 ⁻³ bar
Chlorine, fluorine & alkali	Attacks all types of res. alloys	–	–	
Pressurized	1400°C (2550°F)	1250°C (2280°F)	1350°C (2460°F)	MODUTHAL can be used in gas or air-tight furnaces only
Scale	See remarks	See remarks	See remarks	Spray scale from heat-resistant parts is usually satisfactorily tolerated, iron oxide scale attacks KANTHAL fit cover
Vapors	See remarks	See remarks	See remarks	Vapors must not form condensates from salts or oxides, otherwise electrical bridges may be formed
Gas velocity	See remarks	See remarks	See remarks	MODUTHAL withstands high gas velocities up to 50 m/s (164 ft/s). Pay attention to butt joints with ceramic fiber blankets!

Fig 5. Maximum permissible element temperature in various furnace atmospheres

Module Dimensions



Maximum Sizes for MODUTHAL 3000 & 6000

Roof & walls	B < 1100 mm (43.3 in.)	max A 500 mm (19.7 in.)
	B 1100–1400 mm (43.3–55.1 in.)	max A 350 mm (13.8 in.)
Bottom	B < 1100 mm (43.3 in.)	max A 500 mm (19.7 in.)
	B 1100–1500 mm (43.3–59.1 in.)	max A 400 mm (15.7 in.)

Standard thickness C = 50 mm (1.97 in.)

Maximum Sizes for MODUTHAL FF

Roof & walls	B < 900 mm (35.4 in.)	max A 400 mm (15.7 in.)
	B 900–1100 mm (35.4–43.3 in.)	max A 350 mm (13.8 in.)
Bottom	B < 1100 mm (43.3 in.)	max A 500 mm (19.7 in.)
	B 1100–1400 mm (43.3–55.1 in.)	max A 400 mm (15.7 in.)

Standard thickness C = 50 mm (1.97 in.)

Dimensional Tolerances

A & B	± 5 mm (0.20 in.)
C	± 2 mm (0.08 in.)

Note: Tighter tolerances may be possible, consult Kanthal if required

Maximum Temperature

Accessories

Flexible bead-insulated and connecting leads.

The leads for electrical connections consist of NIKROTHAL® 40 and is multi-twisted. The choice of the proper cross-section depends on the power consumption of MODUTHAL panels. The diagrams below can be used to select the correct lead dimension. Remember, however, that the temperature at the terminal connection point must never exceed 200°C (390°F).

It is also necessary to note that the temperature of the lead in back insulation, in particular the welded connection to the terminal, should not exceed 800°C (1470°F). The lead temperature is due to the combination of inherent heating caused by the passing current (see the diagrams below) and the temperature of the insulation.

Number of twist, X times	3	5	6	8	10	13
Outside Ø of the twisted lead in mm (in.)	3.5 (0.14)	4.5 (0.18)	5 (0.2)	6.5 (0.26)	7 (0.28)	8.5 (0.33)
Outside Ø of the insulating beads in mm (in.)	11 (0.43)	11 (0.43)	11 (0.43)	14 (0.55)	14 (0.55)	14 (0.55)

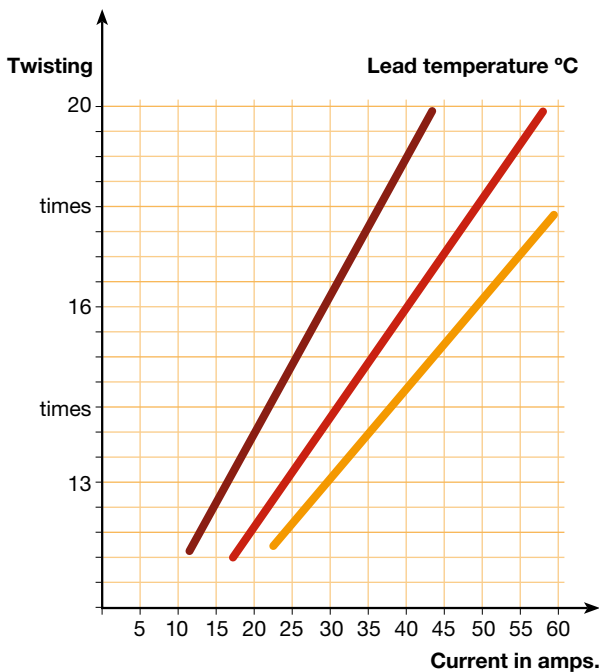


Fig 6. Leads bead-insulated in air

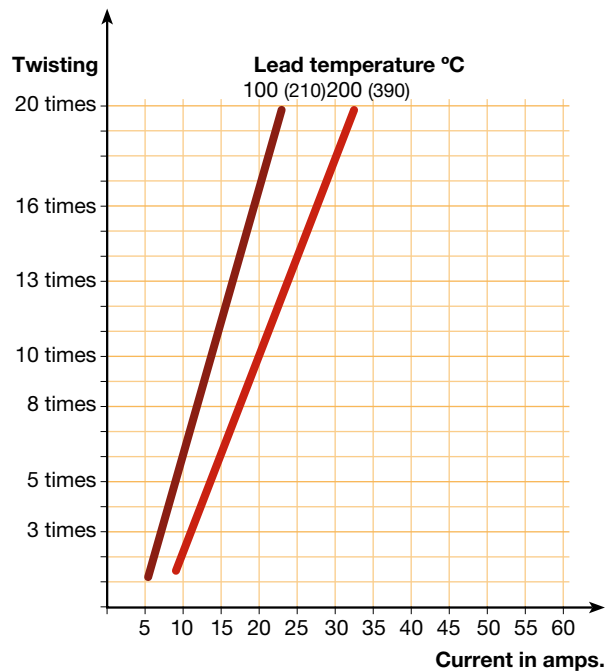
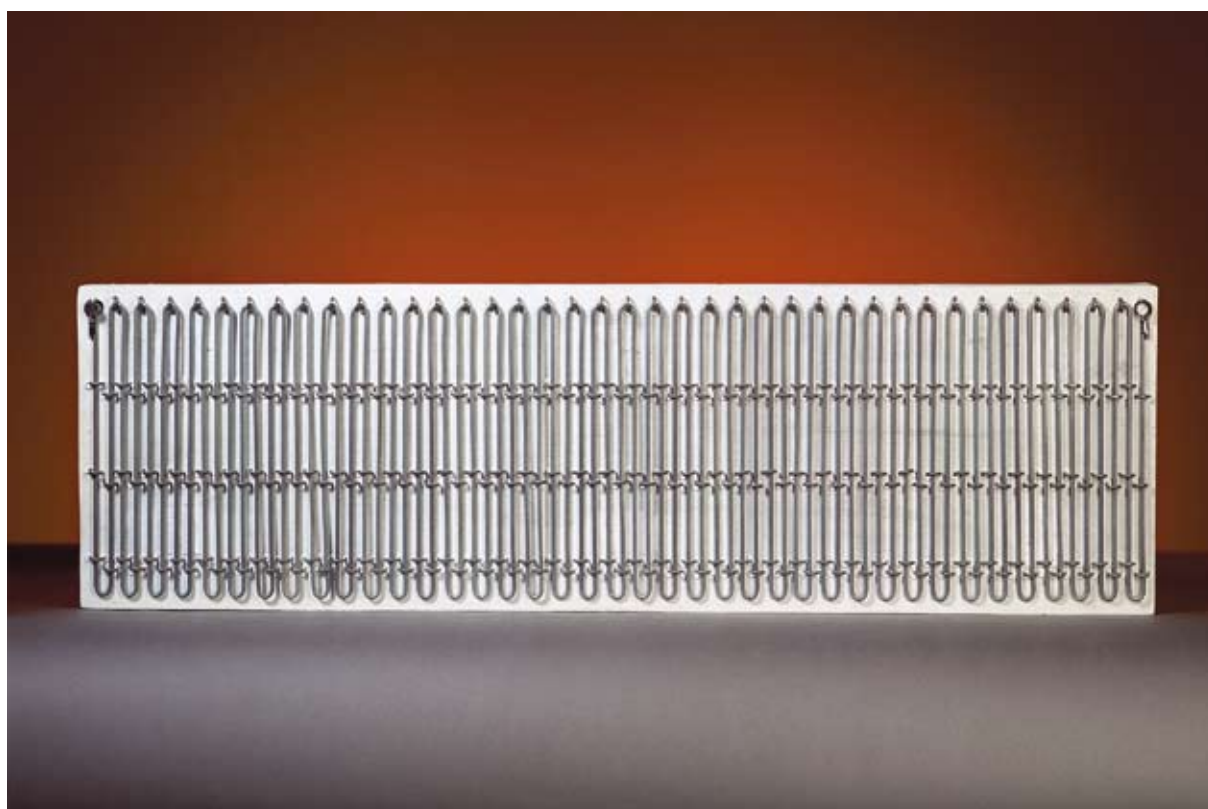


Fig 7. Leads bead-insulated in MODUTHAL

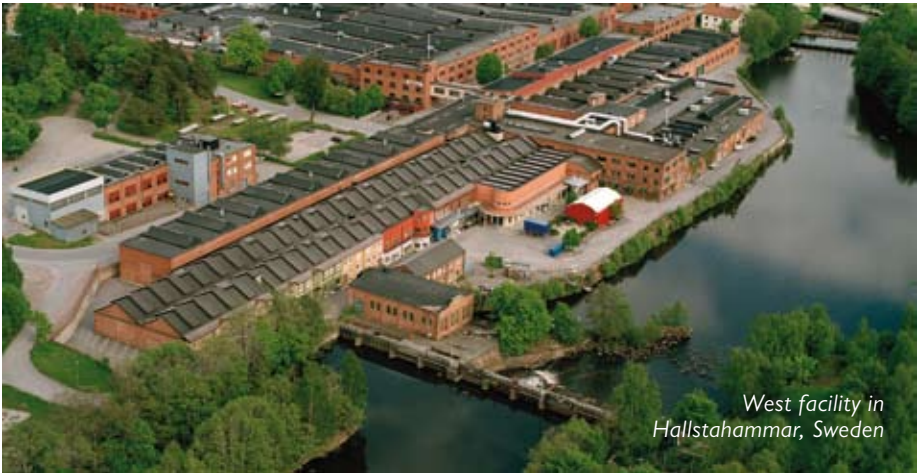
Technical Data



		MODUTHAL 3000	MODUTHAL 6000	MODUTHAL FF
Main component		Fibre	Fibre	Aluminum silicate
Classification temperature		1600°C (2910°F)	1600°C (2910°F)	1400°C (2550°F)
Maximum working temperature		1500°C (2730°F)	1500°C (2730°F)	1250°C (2280°F)
Melting point		1680°C (3060°F)	1680°C (3060°F)	1400°C (2550°F)
Chemical analysis	Al ₂ O ₃	72–73	70–71	38–40
	SiO ₂	12–13	13–15	27–29
	CaO	10–11	10–11	33–35
Density after firing at 1000°C in kg/m³ (at 1830°F in lbs/ft³)		1100–1200 (68.7–74.9)	1000 (62.4)	1200 (74.9)
Thermal conductivity W/mK (W/inF)	110°C (230°F)	–	–	167 (2.36)
	800°C (1470°F)	80 (1.13)	63 (0.89)	146 (2.06)
	1000°C (1830°F)	–	–	201 (2.84)
	1200°C (2190°F)	117 (1.65)	92 (1.30)	–
	1350°C (2460°F)	163 (2.30)	125 (1.76)	–
Thermal expansion %	1000°C (1830°F)	0.65	0.60	0.65
	1500°C (2730°F)	1.40	-1.30	–
Shrinkage %	110°C (230°F)	none	none	0.10
	1000°C (1830°F)	0.10	none	none
	1500°C (2730°F)	0.15	1.30	–
Compr. strength kg/cm² (lbs/in²)	After firing	160 (2276)	155 (2204)	140 (1991)
	700°C (1290°F)	65 (924)	60 (853)	80 (1138)
	1000°C (1830°F)	67 (953)	61 (868)	85 (1209)
	1500°C (2730°F)	86 (1223)	74 (1053)	–
Drying & firing		Firing at 50°C/h (120°F/h) one stop of 5h at 150°C (300°F)		

Fig 8. Technical data for MODUTHAL insulation

Kanthal Facilities



Kanthal is a world-renowned name within the field of electric heating. Since the early thirties, Kanthal has developed market leading, electric resistance alloy products and materials.

Our R&D efforts have always been directed at improving our materials to function fully at ever higher temperatures.

The center for production, product development and metallurgy is in Hallstahammar, Sweden, whilst sales and production finishing plants are located around the world, close to our customers and operated through our subsidiaries and local representatives.

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KANTHAL

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