KANTHAL®

FIBROTHAL®
HEATING MODULES AND INSULATION SYSTEMS

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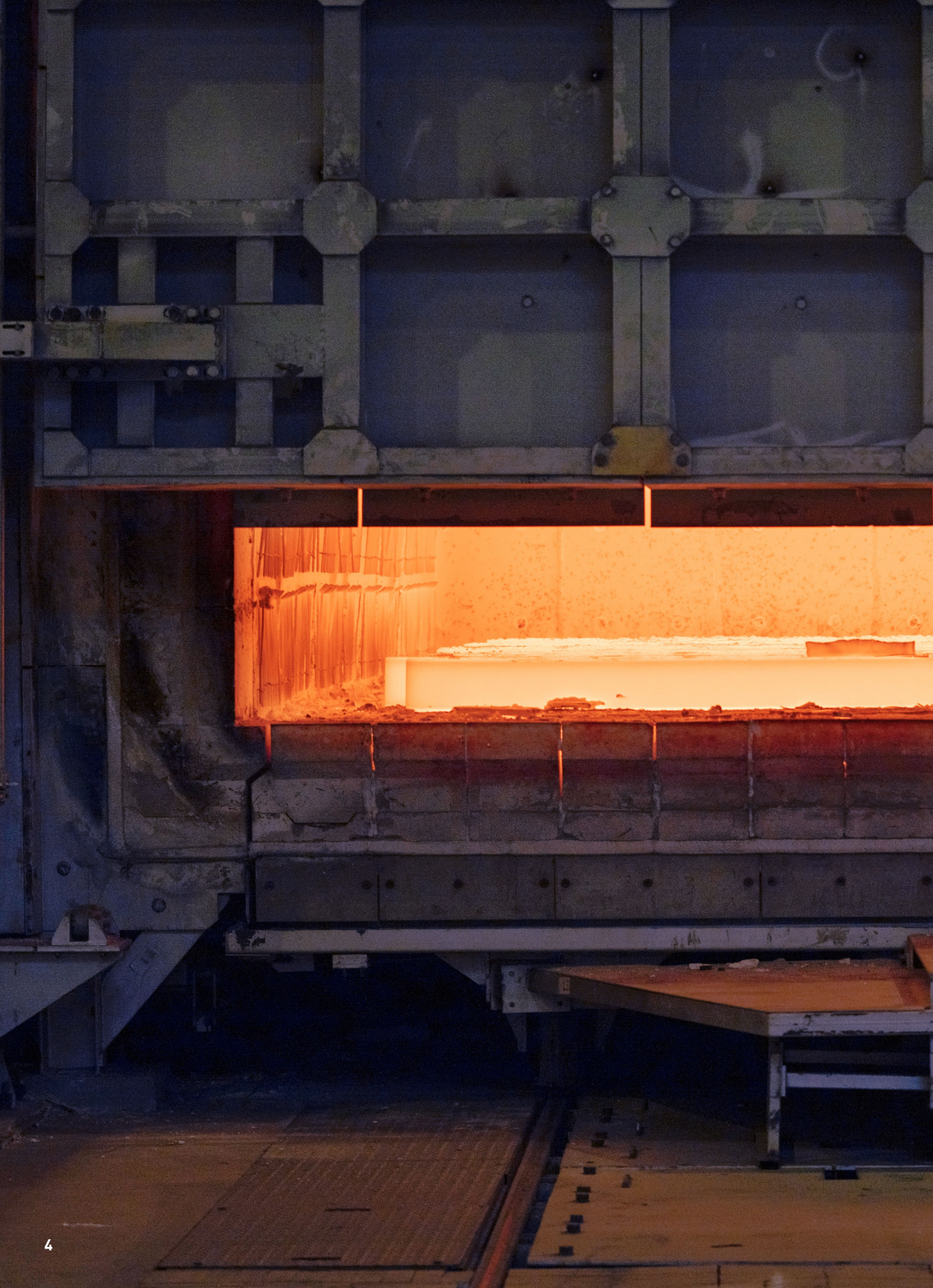
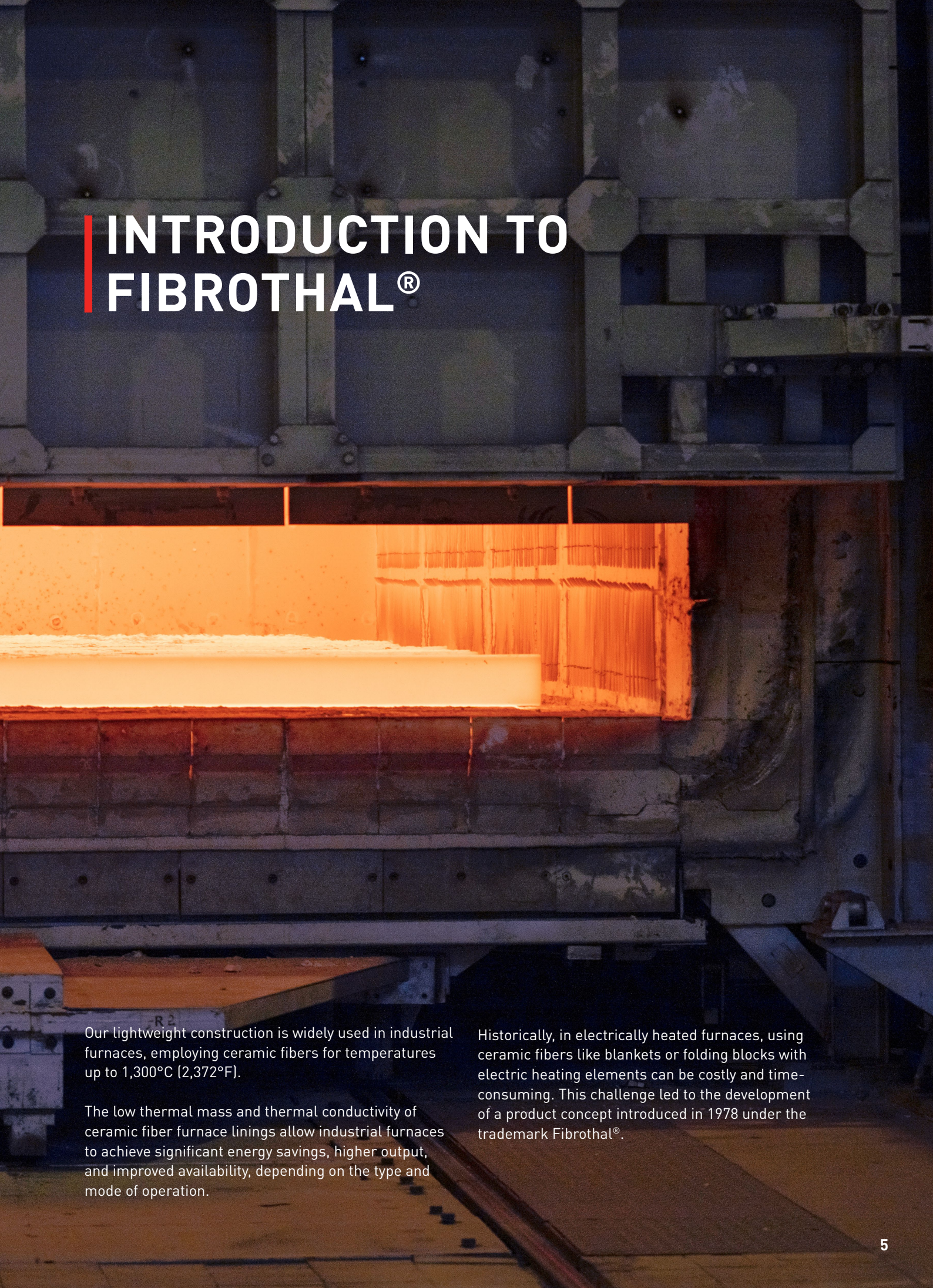


INTRODUCTION TO FIBROTHAL®



Our lightweight construction is widely used in industrial furnaces, employing ceramic fibers for temperatures up to 1,300°C (2,372°F).

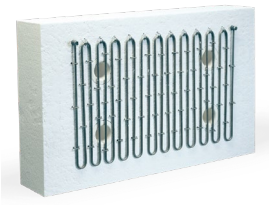
The low thermal mass and thermal conductivity of ceramic fiber furnace linings allow industrial furnaces to achieve significant energy savings, higher output, and improved availability, depending on the type and mode of operation.

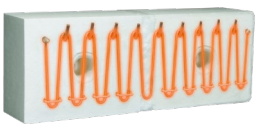
Historically, in electrically heated furnaces, using ceramic fibers like blankets or folding blocks with electric heating elements can be costly and time-consuming. This challenge led to the development of a product concept introduced in 1978 under the trademark Fibrothal®.

FIBROTHAL® HEATING MODULES AND INSULATION SYSTEMS

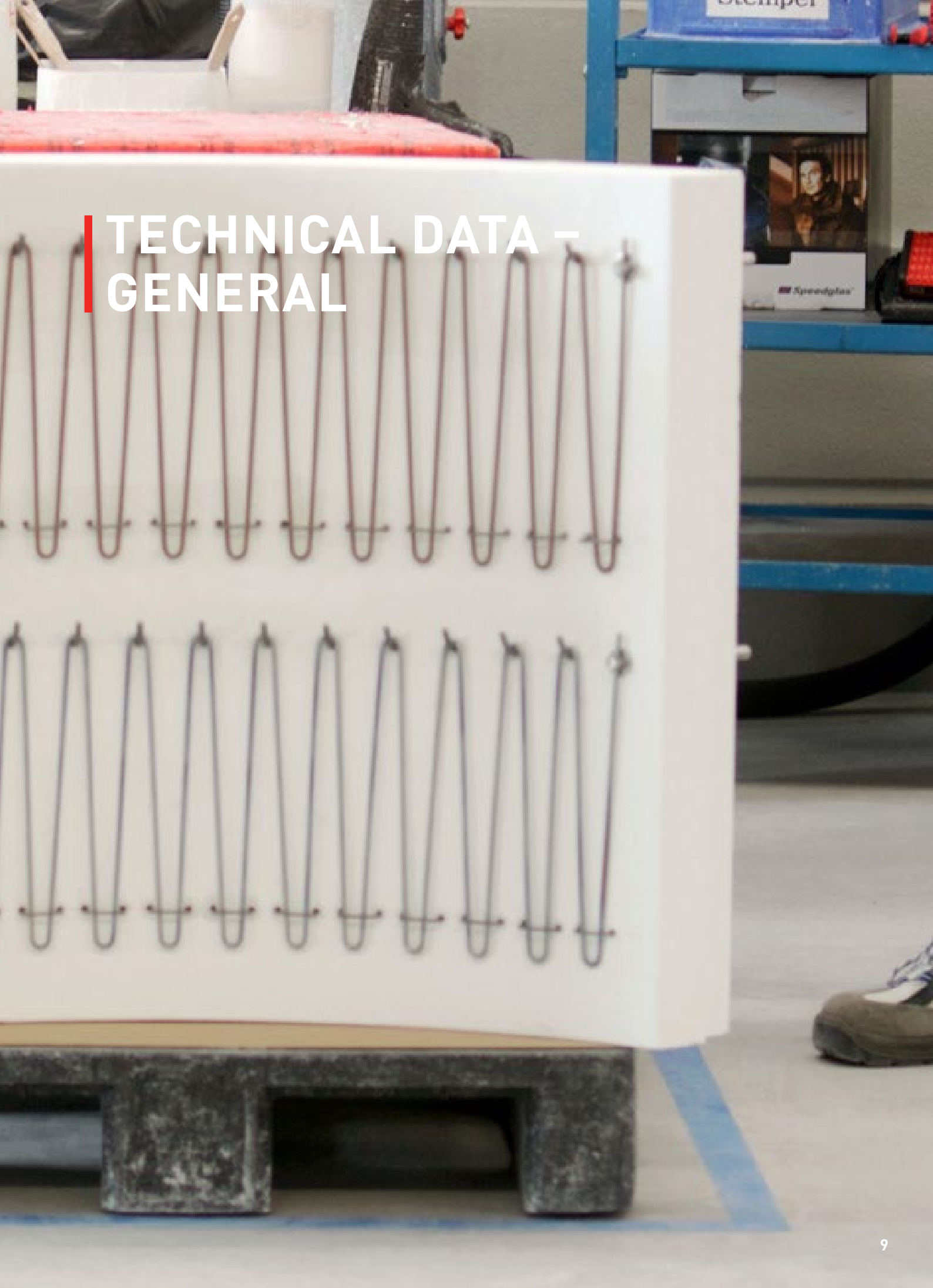
Today, the Fibrothal® range represents a family of products featuring vacuum-formed ceramic fiber components, with or without electric heating elements. It is trusted by industries worldwide for its unique combination of insulation and heating in a single, modular solution designed to reduce energy consumption, speed up installation, and provide reliable temperature control across a variety of furnace types and positions. With flexible configuration options, easy maintenance, and compatibility with numerous high-temperature applications, Fibrothal® enhances furnace uptime, optimizes process efficiency, and lowers operating costs, making it a wise investment for modern heat treatment operations.

Features:
- Lightweight insulation
- High insulation properties
- Allows for quick switching between processes
- Quick installation and replacement
- Energy savings
- Precise process control
- Customizable

Types of modules and insulation systems	Embedded heating modules	RAC tubes	Fibrothal® meander II	
				
Characteristics	Heating modules with embedded heating elements made of Kanthal® alloys for a maximum element temperature of 1,150°C (2,100°F).	RAC tubes with embedded but virtually free-radiating heating element, for a maximum element temperature of 1,250 °C (2,280°F).	Fibrothal® meander II module with free-radiating heating elements for a maximum element temperature of 1,250 °C (2,280°F), mainly for roof heating and tilting furnaces.	

	Free radiating Rod Over Bend (ROB)	Embedded muffle modules	Insulation parts	FibroSiC
				
	ROB with free-radiating heating elements for a maximum element temperature of 1,250 °C (2,280°F), mainly for wall and floor heating.	Muffles with embedded heating elements made of Kanthal® alloys for a maximum element temperature of 1,150°C (2,100°F).	Insulation parts of vacuum-formed fiber in the most varied shapes for application temperatures up to 1,400°C (2,550°F).	FibroSiC are unsupported roof insulating parts, which are strengthened by silicon carbide (SiC) tubes.

TECHNICAL DATA – GENERAL



CERAMIC FIBER MODULES

Ceramic fiber modules offer high resistance to chemicals, including most acids and strong bases. However, care is necessary when integrating heating elements due to the potential for corrosion.

TECHNICAL DATA OF CERAMIC FIBER MODULES

	F3	F-17	F-19	F-14	F-BIO
Classification temp. °C (°F)*	1,260 (2,300))	1,400 (2,550)	1,500 (2,730)	1,600 (2,910)	1,300 (2,370)
Maximum continuous duty temperature, °C (°F)	1,150 (2,100)	1,300 (2,370)	1,350 (2,460)	1,400 (2,550)	900 (1,650) (in clean air)**
Density approx. kg/m³ (lb/ft³)	200 (12.48)	200 (12.48)	200 (12.48)	200 (12.48)	180 – 200 (11.24 –12.48)
Linear shrinkage, % (24 hours at max. continuous duty temperature)	3 /<1	4.5 /<2	4.5	3.5	<2
Guide analysis, %: Al2O3 SiO2	 46 54	 50 50	 67 33	 77 23	 CaO + MgO 18 – 20 70 – 80 others <3
Thermal conductivity, W/m.K*** at 200°C (390°F) at 400°C (750°F) at 600°C (1,110°F) at 800°C (1,470°F) at 1,000°C (1,830°F) at 1,200°C (2,190°F) at 1,300°C (2,370°F) at 1,400°C (2,550°F)	 0.07 0.10 0.14 0.21 0.28 – – –	 0.07 0.10 0.14 0.21 0.29 0.41 0.49 –	 0.07 0.10 0.14 0.20 0.28 0.39 0.46 0.54	 – 0.09 0.13 0.19 0.24 0.35 0.39 0.46	 0.08 0.10 0.14 0.21 0.28 – – –

* Classification temperature of the fibers used.
** The maximum continuous duty temperature is reduced to 1,000°C (1,830°F) furnace temperature in a hydrogen atmosphere (also contents of it).
*** Measuring method: calorimeter.

Note: Values are shown as standard / Low Shrinkage grades for F3 and F-17.

Fiber free versions see Moduthal® brochure.
For F-Bio products it is absolutely necessary to know the final application.

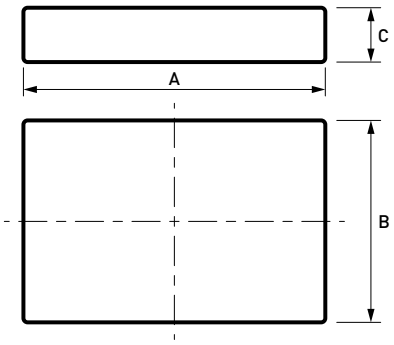
Please contact our technical sales office for advice.

TOLERANCES

MODULE DIMENSIONS

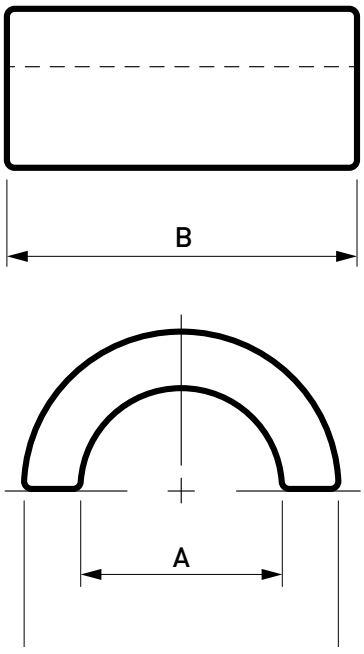
The following tolerances apply to the vacuum-formed insulation with or without heating element.

Electrical resistance: R_k ± 5%



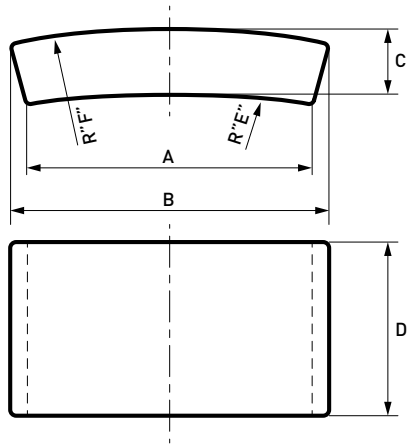
FIBROTHAL® PANELS

MODULE DIMENSION	A AND B		C, WITH MACHINING ON			
			ONE SURFACE		TWO SURFACES	
	MM	IN	MM	IN	MM	IN
≤700 mm (≤27.6 in)	± 3	± 0.12	± 5	± 0.20	± 3	± 0.12
>700 mm (>27.6 in)	± 5	± 0.20	+ 5/-10	+ 0.20/- 0.39	± 3	± 0.12



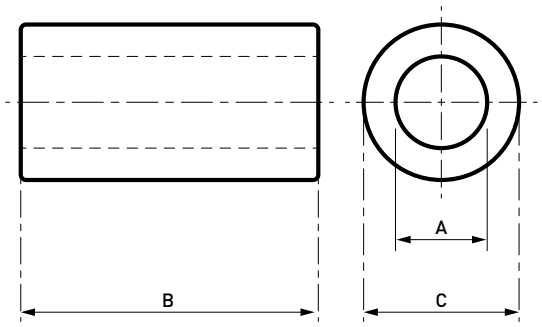
FIBROTHAL® HALF-CYLINDERS

MODULE DIMENSION	A		B		C	
	MM	IN	MM	IN	MM	IN
≤ 200 mm (≤7.9 in)	+ 4	+ 0.16	± 5	± 3	± 5	± 0.20
200 – 350 mm (7.9 – 3.8 in)	+ 6	+ 0.24	–	–	± 5	± 0.20
>350 mm (>13.8 in)	+10	+ 0.39	–	–	±10	± 0.39



FIBROTHAL® SHELLS

MODULE DIMENSION	A, B AND D		C		R "E" AND R "F"	
	MM	IN	MM	IN	MM	IN
≤700 mm (≤27.6 in)	± 3	± 0.12	± 5	± 0.20	± 5	± 0.20
>700 mm (>27.6 in)	± 5	± 0.20	–	–	± 10	± 0.39



FIBROTHAL® TUBES

A		B		C	
MM	IN	MM	IN	MM	IN
+ 4	+ 0.16	± 5	± 3	± 5	± 0.20
+ 6	+ 0.24	–	–	± 5	± 0.20
+10	+ 0.39	–	–	±10	± 0.39

ATMOSPHERES

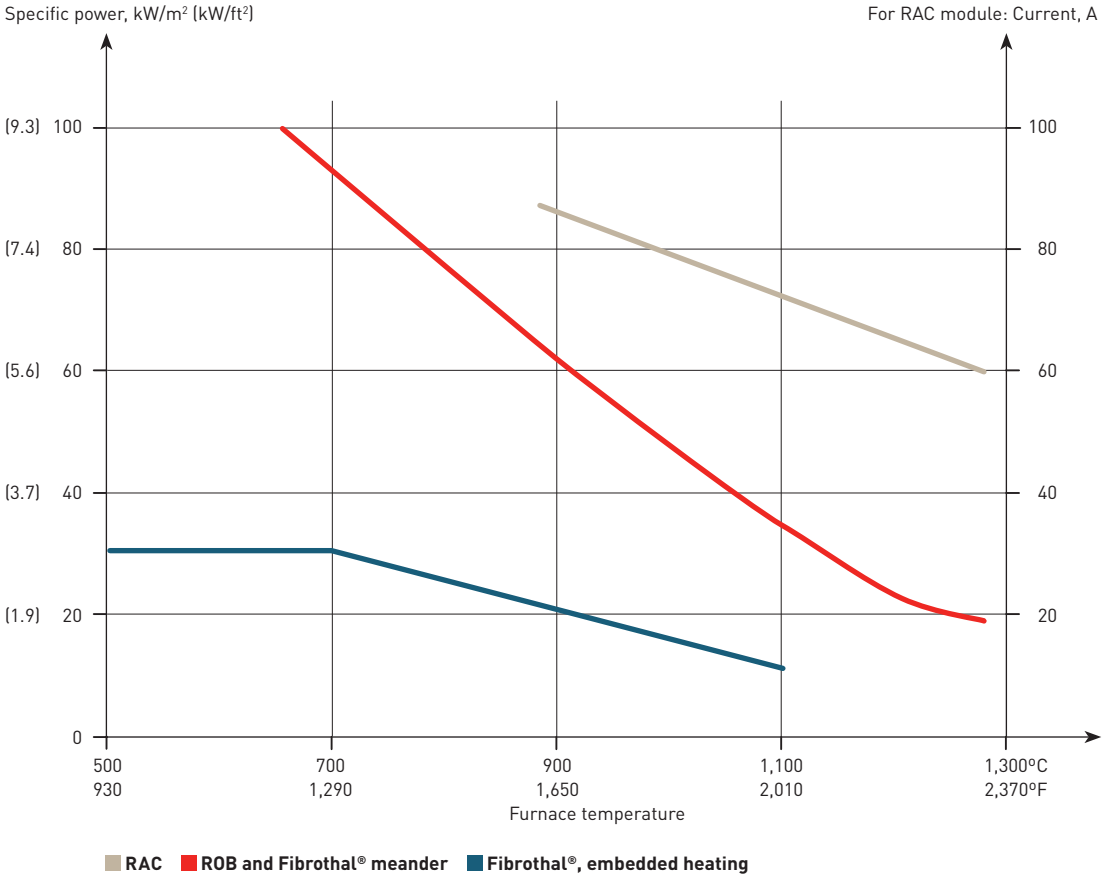
MAXIMUM PERMISSIBLE ELEMENT TEMPERATURES IN VARIOUS FURNACE ATMOSPHERES

FURNACE ATMOSPHERE	MAX. ELEMENT TEMPERATURE		REMARKS
	KANTHAL® HEATING ELEMENTS	FIBROTHAL® HEATING ELEMENTS	
H_2	1,400°C (2,550°F)	1,000°C (1,830°F)	H_2 increases heat throughput of Fibrothal® 3–4 times.
N_2	1,200°C (2,190°F) preoxidized	1,150°C (2,100°F) preoxidized	Fibrothal® heating modules without heating elements up to maximum duty temperature.
Endogas	1,050°C (1,920°F) preoxidized	1,050°C (1,920°F) preoxidized	Recommended for use with gas-tight muffle.
Exogas	1,150°C (2,100°F) preoxidized	1,050°C (1,920°F) preoxidized	Recommended for use with gas-tight muffle.
Sulphur	approx. 1,000°C (1,830°F)	—	Does not withstand sulphur pentoxide.
Chlorine, fluorine, alkali	Attacks all types of resistance alloys	Attacks all types of resistance alloys	Fibrothal® can be used without elements below 900°C (1,650°F).
Vacuum < 10^{-3} mbar	1,150°C (2,100°F) preoxidized	800 – 850°C (1,470 – 1,560°F)	Vacuum higher than 10-3 mbar will take too long to evacuate the fiber block. Better with vacuum-tight muffle.
Pressurized	1,400°C (2,550°F)	1,250°C (2,280°F)	Fibrothal® can be used in gas or air-tight furnaces only.
Scale	See remarks	See remarks	Spray scale from heat-resistant parts is usually harmless, but iron oxide scale can damage Kanthal® heating elements, use a protective cover.
Vapours	See remarks	See remarks	Vapours must not form condensates from salts or oxides, otherwise electrical bridges will be formed.
Gas velocity	See remarks	See remarks	Fibrothal® withstands high gas velocities up to 50 m/s (112 mph). Ceramic butt joints must be used with ceramic fiber blankets.

Please contact our technical sales office for the use of F-Bio.

POWER LIMITATION

MAXIMUM RECOMMENDED LOAD IN RELATION TO THE FURNACE TEMPERATURE FOR THE VARIOUS HEATING MODULE DESIGNS



RULE OF THUMB

To install a voltage of 230 V with a free radiating wire (ROB, Fibrothal® meander) an area of 1 m2 (10.8 ft2) is needed.

To install a voltage of 230 V with an embedded element (Fibrothal®) an area of 0.25 m2 (2.7 ft2) is needed.

TECHNICAL DATA – STANDARD RANGE

HEATING MODULES

Fibrothal® standard heating modules are produced with embedded heating elements, following two key principles.

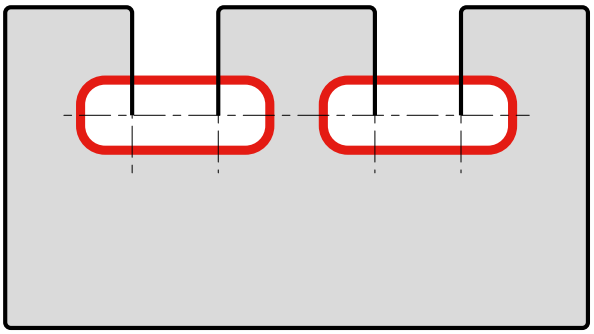
PRINCIPLE I

In this method, Kanthal® A-1 or Kanthal® APM heating wires (diameter <3.5 mm (0.14 in)) are embedded within ceramic fiber modules. The maximum element temperature achieved is 1,150°C (2,100°F).

This design is patent-protected.

For optimum heat radiation:
• A portion of the heating wire's surface remains exposed.
• The interior of the heating wires can also be produced without the ceramic fibers.

Panels, embedded cylinders, and half-cylinders are manufactured using this principle.



PRINCIPLE II

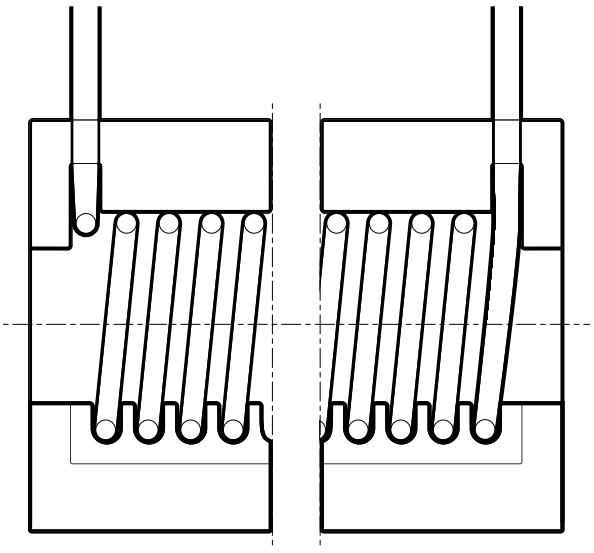
This method, exclusively used for heating tubes, involves forming a Kanthal® A-1 or Kanthal® APM heating wire (diameter 5 mm (0.20 in)) to fit a ceramic fiber module supported by ceramic spacers. In this design, the heating element rests on the surface of the insulation and functions as a virtually free-radiating element.

The maximum element temperature is 1,250°C (2,282°F).

A complete range of modules is available for manufacturing standard modules, hence no mould costs in this case.

Voltages are converted to the eurovoltage standard (400/230 V) in this brochure. However, the modules are also compatible with previously used voltages (380/220 V or 415/240 V).

If low power is required, the modules can also be operated at lower voltages. Higher power is also possible if allowance is made for the maximum wall loading (see page 14).



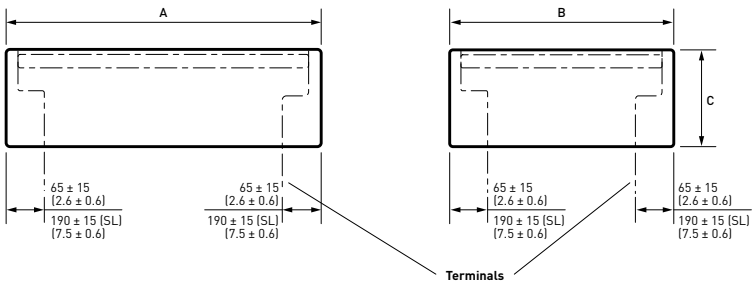
PANELS

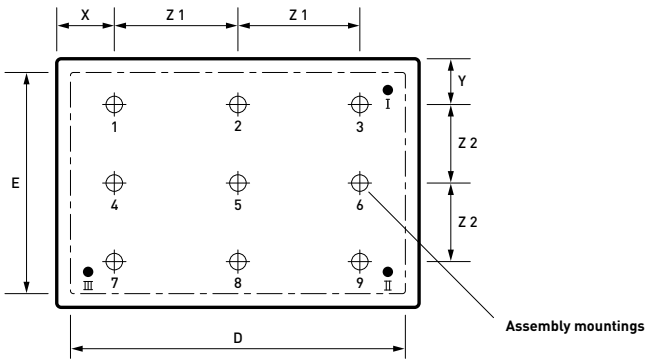
The heating surface refers to the area that accommodates the heating element. The dimensions of standard modules are based on the size of the heated surface, plus the minimum required unheated edge area.

Unheated edges can be customized, provided the total panel size does not exceed the maximum width or length. Standard modules can also include additional unheated edges of 125 mm (4.92 in) on either the width or length (type SL or SB).

Modules attached to roofs or sidewalls are secured with ceramic cups. For roof installations, we recommend using additional element anchorage with ceramic cement pins.

The standard connection design features a threaded rod, M8 × 75 mm (2.95 in), located at the back of the module. Other connection designs, such as flexible leads, are available upon request (see page 29).

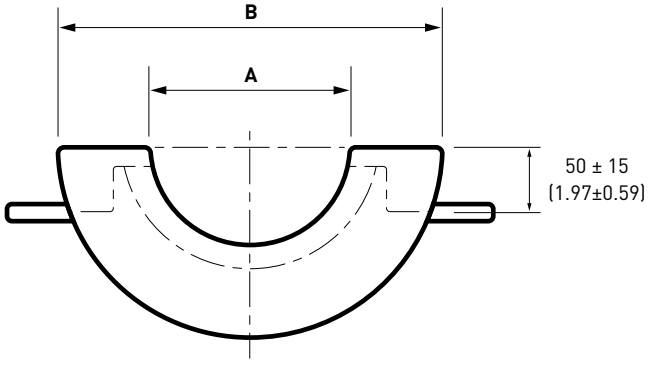


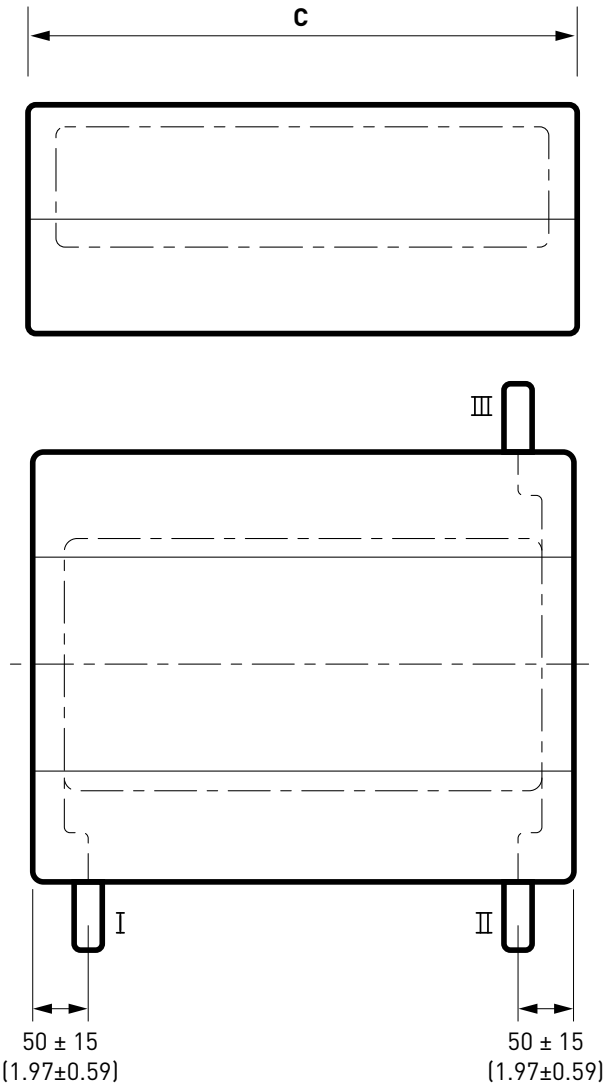


HALF-CYLINDERS

For horizontal operation, the upper half shell should incorporate the pin system (see page 17).

The standard connection design includes threaded bolts, M8 × 75 mm (2.95 in), located on the back of the module. Alternative connection designs, such as flexible leads, are available upon request (see page 29).

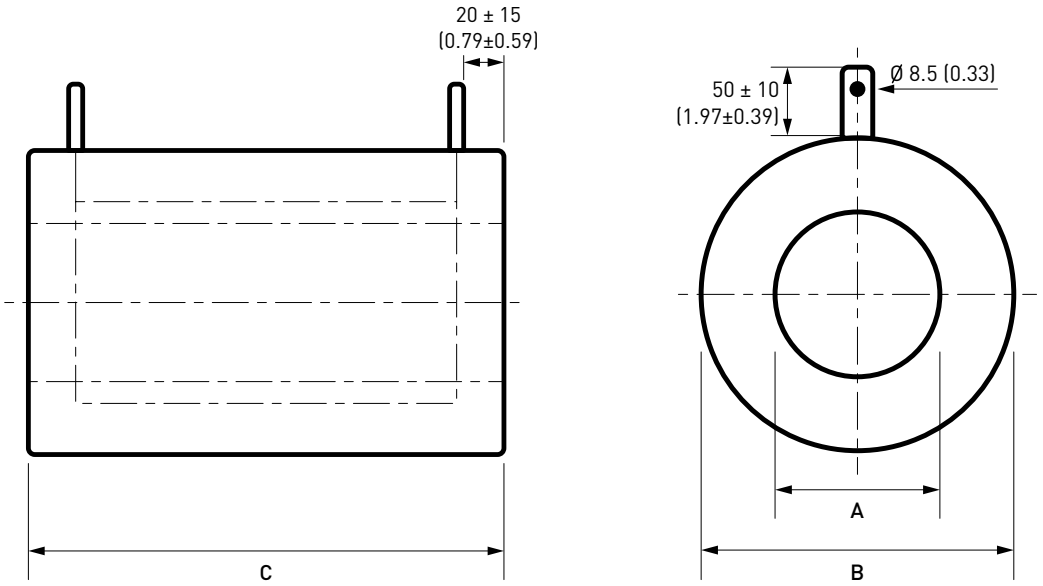




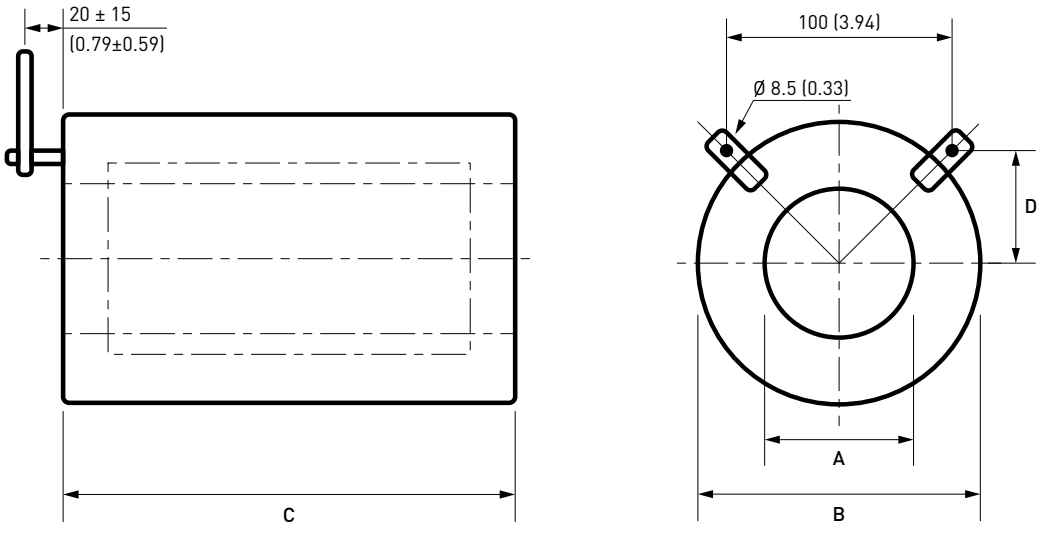
TUBES

For power connections (strip 20 × 3 mm (0.79 × 0.12 in)), you can choose either radial (type A) or face variant (type B). Due to the high current levels, flexible wire connections are not an option.

TYPE A



TYPE B



INSULATING ACCESSORIES

Fibrothal® insulating parts are offered in the same standard dimensions as the heating modules. The standard range includes insulating end pieces designed to fit the outer diameters of half-cylinders and tubes. If required, these end pieces can be supplied drilled to match the size of the work tube. The standard thicknesses are 125 mm (4.92 in) or 50 mm (1.97 in), though other dimensions are available upon request.

FIBROTHAL®, END PIECE RANGE

OUTSIDE DIAMETER		THICKNESS		WEIGHT	
MM	IN	MM	IN	KG	LB
160	6.3	125/50	4.9/2.0	0.5/0.2	1.1/0.4
220	8.7	125/50	4.9/2.0	0.9/0.3	2.0/0.7
240	9.5	125/50	4.9/2.0	1.1/0.4	2.4/0.9
300	11.8	125/50	4.9/2.0	1.2/0.7	2.6/1.5
350	13.8	125/50	4.9/2.0	2.4/1.0	5.3/2.2
450	17.7	125/50	4.9/2.0	3.9/1.6	8.6/3.5
500	19.7	125/50	4.9/2.0	4.9/2.0	10.8/4.4
600	23.6	125/50	4.9/2.0	7.0/3.0	15.4/6.6
650	25.6	125/50	4.9/2.0	8.2/3.3	18.1/7.3
700	27.6	125/50	4.9/2.0	9.6/3.8	21.2/8.4
750	29.5	125/50	4.9/2.0	11.0/4.4	24.3/9.7

MODULES TO SPECIAL DESIGN

In addition to the standard range, we provide an extensive selection of specialized heating systems, enabling the creation of custom designs. The following systems are available:
- Modules with embedded heating
- ROB in panel and shell designs
- Meander systems
- Special tube modules
- Muffles
- Insulating parts

A wide variety of forming molds are available for producing these special modules.

Please note that a portion of the mould costs may apply to custom designs.

Advantages of the system:
- The heating element is directly integrated into the module, eliminating the need for additional mountings.
- Shape, dimensions, and electrical specifications can be customized within wide limits.
- Module terminal voltages align with line voltage or its fractions.
- Modules can be easily replaced, even during operation, if the furnace is appropriately designed.
- The system allows installation in any position.

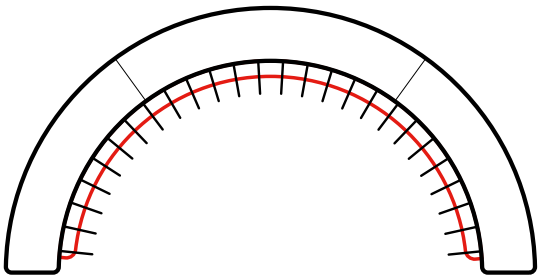
MODULES WITH EMBEDDED HEATING

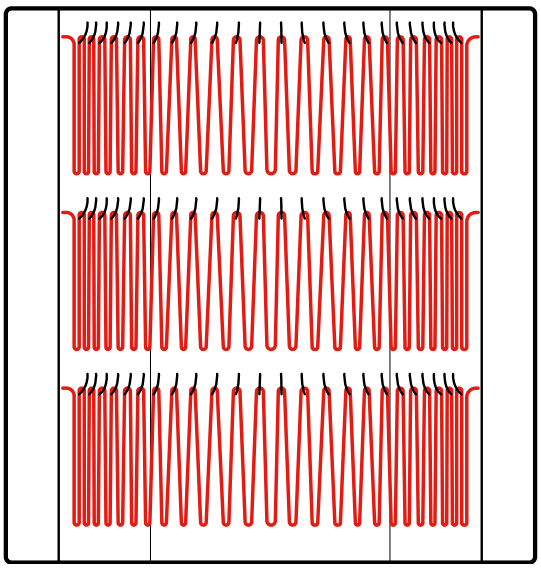
These modules are suitable for nearly all furnace layouts. In addition to panels designed for furnaces with flat walls, we produce a variety of module designs for cylindrical surfaces, including tubes with diameters up to 500 mm (19.7 in) and half-cylinders with diameters up to 650 mm (25.6 in). For larger internal diameters, shell modules (e.g., 1/3, 1/4, or 1/6 shells) are used. The designs align with those of standard panels or half-cylinders. The maximum element temperature is 1,150°C (2,100°F).

ROB IN PANEL AND SHELL DESIGN

The ROB system features Fibrothal® insulation modules with an integrated mounting system and meander-shaped heating elements made from round wire. The element legs are primarily arranged next to each other in a V-shape. Both Kanthal® and Nikrothal® alloys are compatible with this system.

General advantages:
- Free-radiating heating element reaching up to 1,250°C (2,282°F).
- Heating elements can be replaced when necessary.
- Longer heating element lengths spanning several modules reduce the number of required terminals.
- Larger heating conductor cross-sections can be installed, extending the working life of the elements.
- High power concentrations can be implemented (see figure in page 19).

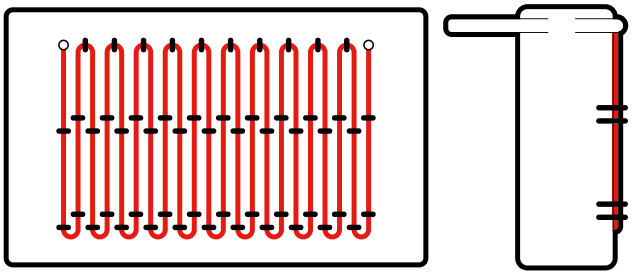


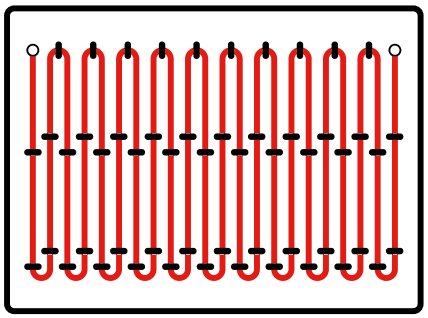


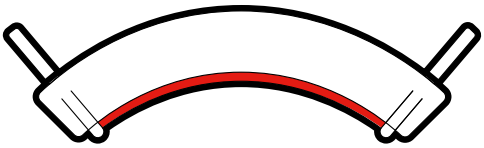
FIBROTHAL® MEANDER II

The heating element mountings are made of metallic, hairpin-shaped parts securely anchored in the ceramic fiber module.

Specific advantages:
- Can be installed in any position, including use in tilting furnaces.
- The heating element pitch can be customized.
- Suitable for round furnaces.





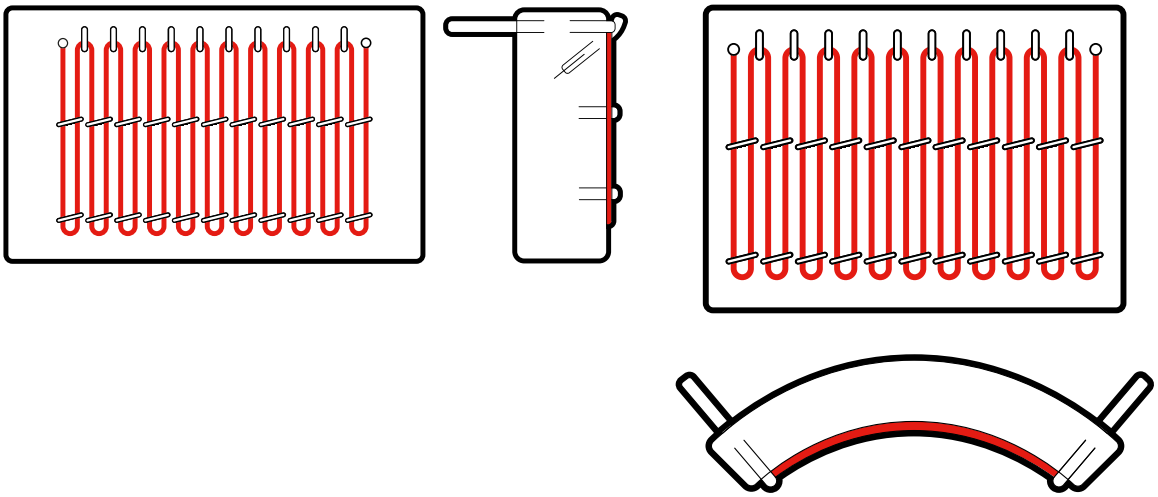


FIBROTHAL® MEANDER III

The heating element mountings consist of metallic rod supports and metallic holders, which are anchored in the ceramic fiber module. This design replaces the earlier Fibrothal® Meander I. recommended to maximize element life.

Specific advantages:

- Heating elements can be replaced when needed.
- Furnace tilting up to 90° is possible.
- Suitable for round furnaces.



SPECIAL TUBE MODULES

These modules, typically multi-zone, are designed similarly to RAC tubes (see Principle II in page 16). Additional sizes are available upon request. If needed, the heating tubes can also be supplied with a sheet metal casing. Depending on the application, Kanthal® A-1, Kanthal® AF, or Kanthal® APM alloys are used.

Advantages of the system:

- Excellent temperature uniformity
- Allows for precise temperature profiles
- Supports high power concentration
- Suitable for installation in any position

MUFFLES

Monoblock ceramic fiber modules with embedded heating elements are designed for laboratory and small chamber furnaces. These modules can be heated on up to four sides and support a maximum element temperature of 1,150°C (2,100°F). Matching door modules are available upon request.

Advantages of the system:
- Reduced assembly times
- Quick heating times
- Uniform temperature distribution within the furnace interior
- Easy and fast replacement

INSULATING PARTS

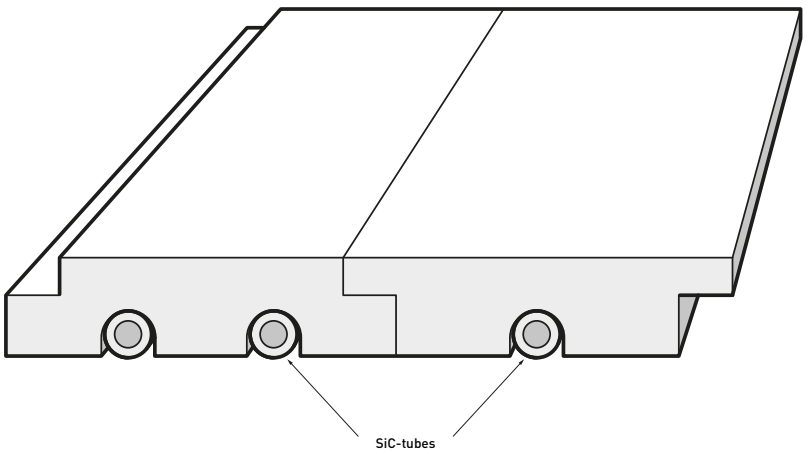
Custom-designed insulating parts can be supplied in the same dimensions as the heating modules described in the previous section.

FIBROSiC, UNSUPPORTED ROOF MODULES

The FibroSiC design represents an evolution of the Fibrothal® system, aimed at creating self-supporting, easy-to-assemble roof insulation.

This system combines ceramic fiber insulation modules with SiC tubes and is suitable for spans up to 2,200 mm (86.6 in) at a furnace temperature of 1,200°C (2,190°F).

Advantages of the system:
• Self-supporting for spans up to 2,200 mm (86.6 in) at 1,200°C (2,190°F).
• Simple and quick to assemble.
• Cost-efficient design requiring no additional roof support.



ACCESSORIES

FLEXIBLE BEAD-INSULATED CONNECTING LEADS

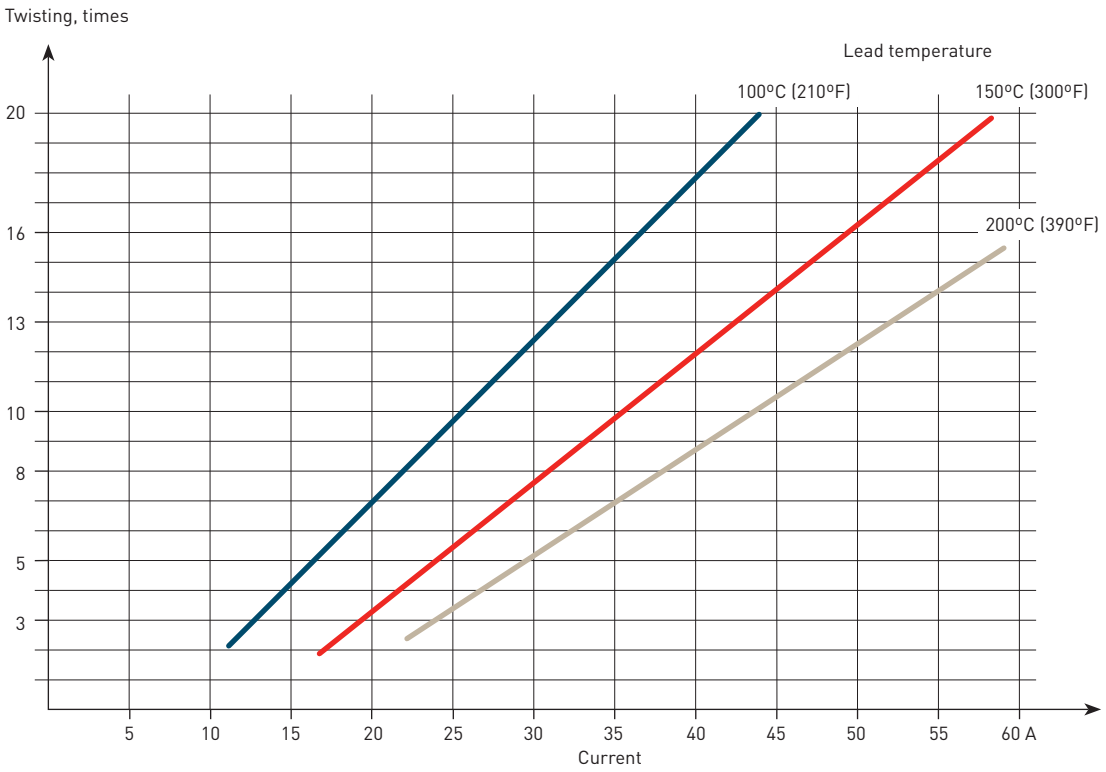
ONLY FOR MODULES WITH EMBEDDED HEATING!

The lead is made of Nikrothal®, a nickel-chromium alloy, and is multi-twisted. The required cross-section of the lead depends on the power consumption of the Fibrothal® module. The diagrams below can assist in selecting the appropriate lead dimensions.

It is crucial to ensure that terminal temperatures do not exceed 200°C (390°F).

Additionally, the temperature of the lead within the back insulation, especially at the welded connection to the terminal, must remain below 800°C (1,470°F). This temperature is influenced by a combination of inherent heating from the passing current and the temperature of the insulation.

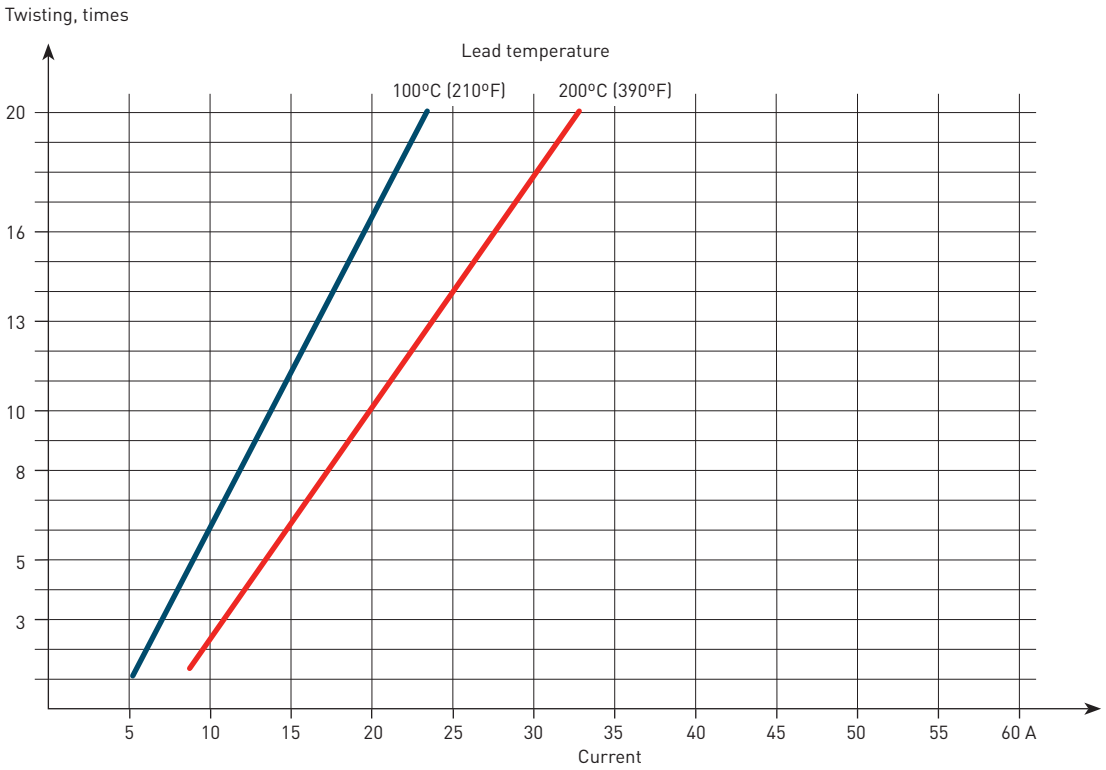
LEADS BEAD-INSULATED IN AIR



TWISTED CONNECTING LEADS

	NUMBER OF TWISTS, X TIMES							
	5.0		8.0		10.0		13.0	
OUTSIDE DIAMETER	MM	IN	MM	IN	MM	IN	MM	IN
Twisted leads	4.5	0.18	6.5	0.26	7.0	0.28	8.5	0.33
Insulating beads	11.0	0.43	14.0	0.55	14.0	0.55	14.0	0.55

LEADS BEAD-INSULATED IN FIBROTHAL® MODULES



INSULATING BLANKETS
Used to compensate for module and furnace tolerances and shrinkage. Dimensions: 6.35 × 300 mm (0.25 × 11.8 in) wide.

PROTECTION TUBES FOR THERMOCOUPLES
Available with a diameter of 7/5 mm (0.28/0.20 in) and the desired length, with both ends open.

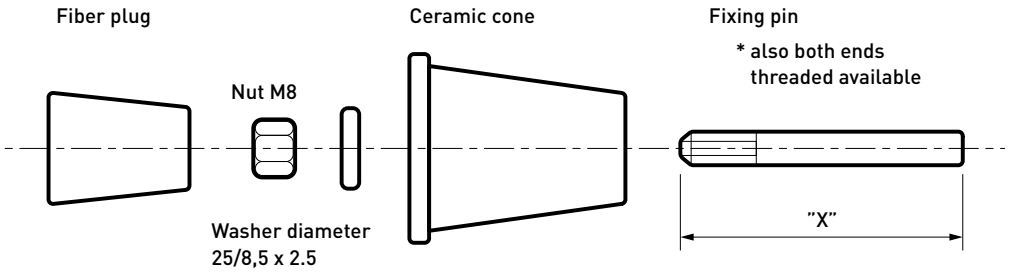
GLUE
Used for bonding Fibrothal® modules together.

HARDENER
Applied for strengthening machined surfaces.

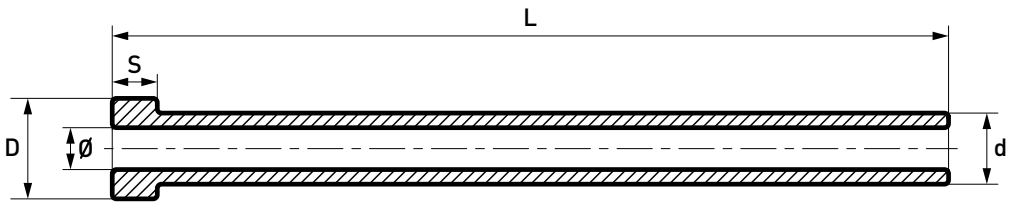
CEMENT
Used to repair damaged Fibrothal® modules.

REPAIR KIT
Includes adhesive, hardener, powder, wool, and felt.

MOUNTING OF FIBROTHAL® MODULES



CERAMIC TUBES WITH FLANGE



CERAMIC TUBES WITH FLANGE

REF.	D		D		Ø		S		L STOCK	
	MM	IN	MM	IN	MM	IN	MM	IN	MM	IN
TUT-20-10	20	0.79	10	0.39	6	0.24	6	0.24	max 300	max 11.8
TUT-25-15	25	0.98	15	0.59	9	0.35	10	0.39	100-150-200-300	3.9-5.9-7.9-11.8
TUT-30-20	30	1.18	20	0.79	12	0.47	15	0.59	100-150-200-300	3.9-5.9-7.9-11.8
TUT-35-25	35	1.38	25	0.98	15	0.59	20	0.79	150-200-300	5.9-7.9-11.8
TUT-40-30	40	1.57	30	1.18	15	0.59	20	0.79	200-250-300	7.9-9.8-11.8
TUT-45-35	45	1.77	35	1.38	20	0.79	20	0.79	150-200-300	5.9-7.9-11.8
TUT-50-40	50	1.97	40	1.57	25	0.98	30	1.18	300	11.8

Dimensional tolerances according DIN 40680 norms.
Usually manufactured in mat. A38E.
Bold stock standard.

Contact Kanthal for additional information.

CERAMIC INSULATORS AND PLUGS

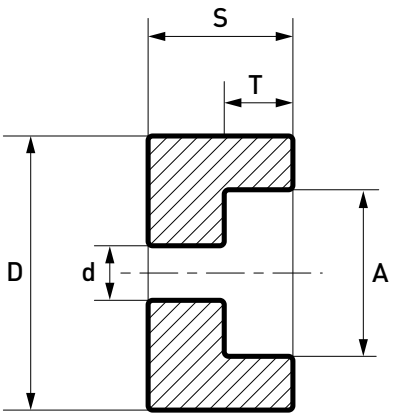


Fig. A

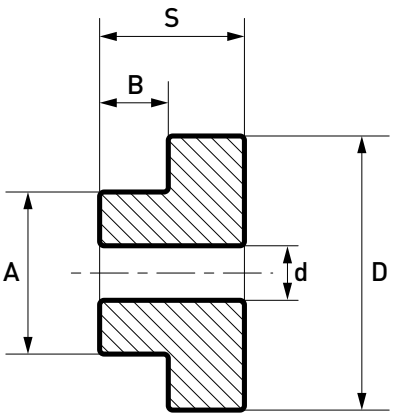


Fig. B

CERAMIC INSULATORS AND PLUGS

CODE	REF.	FIG.	D		D		A		T		B		S		MAT.
			MM	IN	MM	IN	MM	IN	MM	IN	MM	IN	MM	IN	
ISM	025-16,5-5 M	B	15.5	0.61	5	0.20	10	0.39	–	–	1.5	0.06	6	0.24	Steatite
ISF	025-16,5-5 F	A	15.5	0.61	5	0.20	11	0.43	1.8	0.07	–	–	5	0.20	Steatite
ISM	025-22-6.5 M	B	22.5	0.89	6.5	0.26	11.5	0.45	–	–	4	0.16	10.5	0.41	Steatite
ISF	025-22-6.5 F	A	22.5	0.89	6.5	0.26	12.3	0.48	4.3	0.17	–	–	8	0.31	Steatite
ISM	025-30-8 M	B	30	1.18	8.5	0.33	16	0.63	–	–	7.5	0.30	15	0.59	Steatite
ISF	025-30-8 F	A	30	1.18	8.5	0.33	18	0.71	8.5	0.3	–	–	15	0.59	Steatite
TAP	025-23-7	B	23	0.91	7	0.28	13	0.51	–	–	15	0.59	20	0.79	A38E
TAP	025-45-13	B	45	1.77	13	0.51	26	1.02	–	–	18	0.71	30	1.18	A42P
TAP	025-60-15	B	60	2.36	15	0.59	30	1.18	–	–	18	0.71	40	1.57	A42P

Dimensional tolerances according DIN 40680 norms.
Bold stock standards.

Contact Kanthal for additional information.

ASSEMBLY

For relatively small furnaces, such as tube furnaces with RAC modules, Fibrothal® half-cylinders or third cylinders, and muffle or chamber furnaces with Fibrothal® panels, no special mounting or fixing measures are typically required. These modules are self-supporting or self-stabilizing within the furnace body.

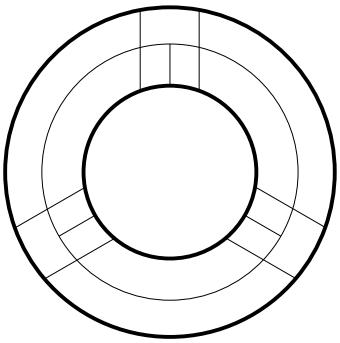
ATTACHING FIBROTHAL® MODULES

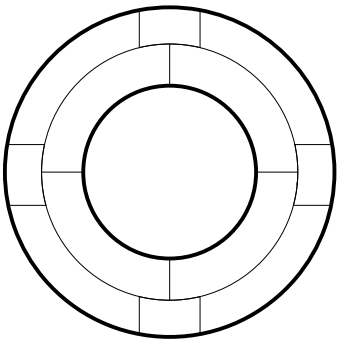
For larger furnace installations, we recommend mounting Fibrothal® modules (refer to Accessories). In some furnace designs, minimal or no mountings may be needed, as the modules can support one another like the blocks in a vault provide mutual stability.

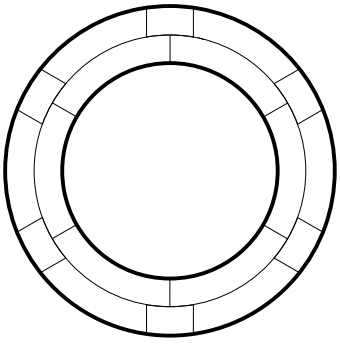
Examples of this are illustrated in below. For such assemblies, it is crucial that the modules can be installed or inserted from the outside or above. To minimize assembly time and costs, we offer completely pre-assembled module rings.

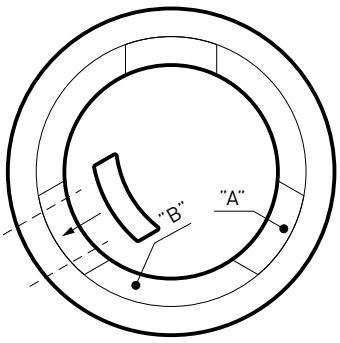
If the design requires module assembly from inside the furnace, the module combination shown in below, in figure d, is recommended.

This design uses module types A and B, where module "A" is supported by module "B." In most cases, it is sufficient to fix only the "B" modules with mountings.


a


b


c



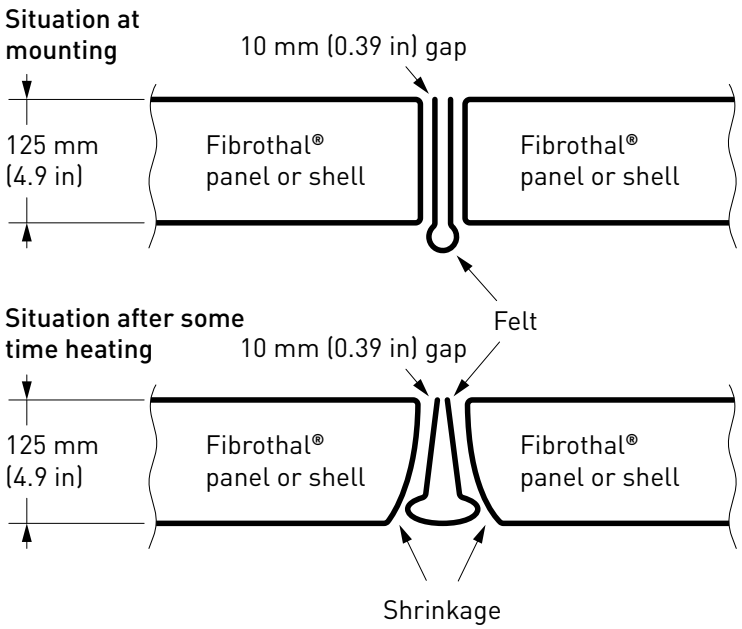
d

SEALING THE JOINTS

To account for furnace, module tolerances, and module shrinkage, and to prevent radiant losses through module gaps, we recommend placing a double-folded layer of ceramic fiber felt (see chapter about Accessories, page 29) between Fibrothal® modules. The ceramic fiber felt should extend at least 25 mm (0.98 in) beyond the front of the module, to reduce gaps between modules.

WELDING THE HEATING ELEMENT

We recommend using the TIG (Tungsten Inert Gas) welding method if welding is necessary, particularly between the terminal and the heating element. Kanthal also manufactures welding fillers. For optimal results, please follow our welding instructions carefully.



OVERVIEW OF THE HEATING SYSTEMS

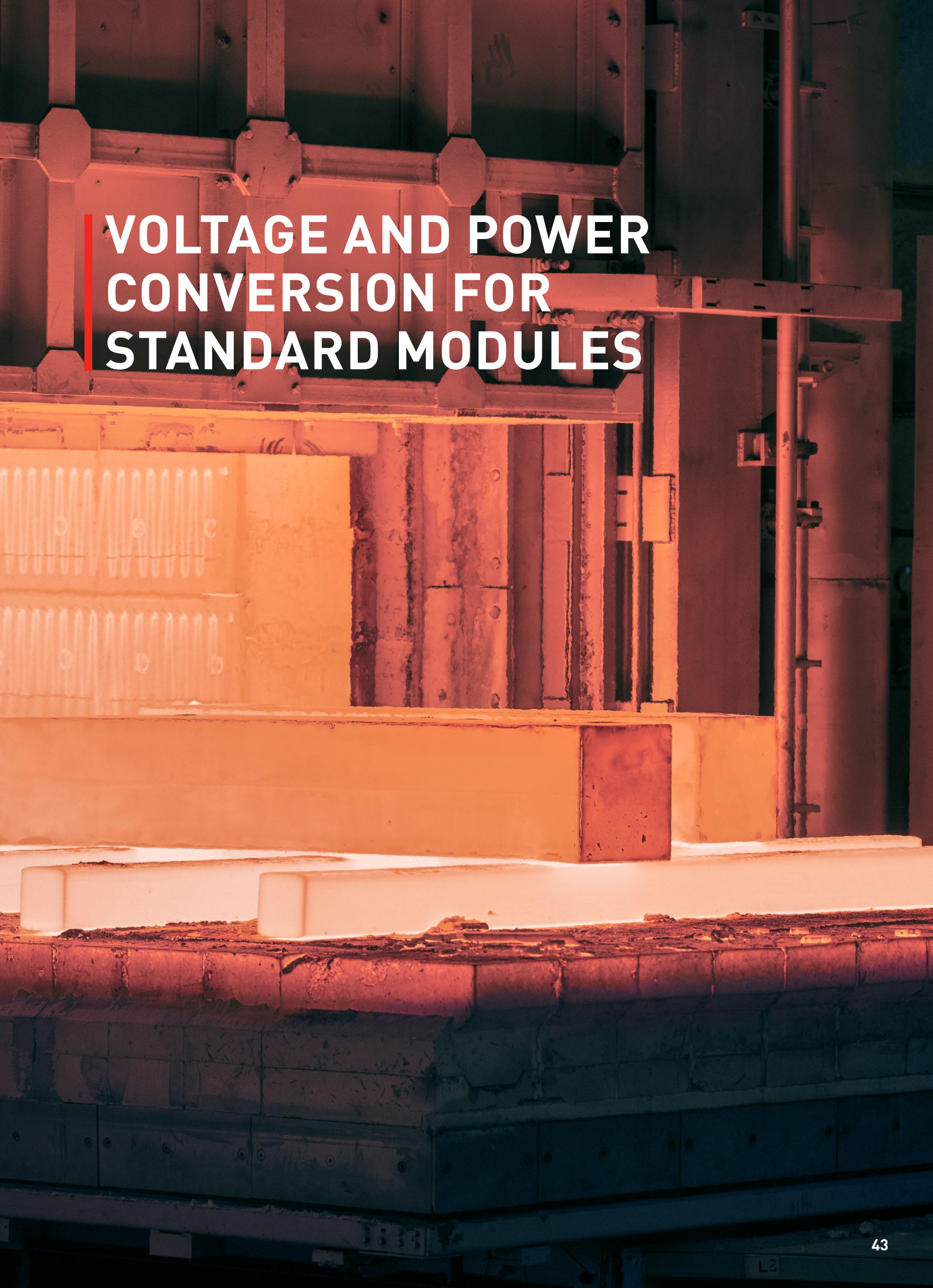
OVERVIEW OF THE HEATING SYSTEMS

The table below is intended for quick reference to the various heating systems.

SELECTION OF CRITERIA FOR HEATING SYSTEMS

	FIBROTHAL® PANELS EMBEDDED	FIBROTHAL® SHELLS EMBEDDED	FIBROTHAL® TUBES EMBEDDED	RAC	ROB	FIBROTHAL® MEANDER SYSTEM II	FIBROTHAL® MEANDER SYSTEM III
Vertical installation	X	X	X	X	X	X	X
Horizontal installation	XD	XD	X	X	–	X	O
Floor installation	X	X	n.a.	n.a.	X	X	O
Suitable for round furnaces	O	X	X	X	X	X	X
Element change possible	–	–	–	–	X	–	X
Free-radiating heating	–	–	–	X	X	X	X
Element quality Kanthal® A-1	X	X	X	X	X	X	X
Kanthal® AF	–	–	–	X	X	X	X
Kanthal® APM	–	–	–	X	X	X	X
Nikrothal® 60/ 80	–	–	–	–	X	X	X
Max. element temp. °C (°F) Kanthal® AF				1,300 (2,370)	1,300 (2,370)	1,250 (2,280)	1,250 (2,280)
Kanthal® A-1	1,150 (2,100)	1,150 (2,100)	1,150 (2,100)	1,300 (2,370)	1,300 (2,370)	1,250 (2,280)	1,250 (2,280)
Kanthal® APM				1,300 (2,370)	1,300 (2,370)	1,350 (2,460)	1,350 (2,460)
Max. element temp. °C (°F) Nikrothal® 60/ 80	–	–	–	–	1,100/1,050 (2,010/1,920)	1,100/1,050 (2,010/1,920)	1,100/1,050 (2,010/1,920)

X = possible
D = pin system recommended in certain circumstances
O = sometimes possible (customer information necessary)
– = not possible
n.a. = not applicable



VOLTAGE AND POWER CONVERSION FOR STANDARD MODULES

CALCULATION EXAMPLE

ASSUMPTION

A chamber furnace requires six Fibrothal® heating panels with dimensions of 750 × 450 × 125 mm (29.5 × 17.7 × 4.9 in). The furnace's desired power rating is approximately 25 kW.

For this requirement, the Fibrothal® heating module PAS 750/450/230 (refer to Standard Fibrothal® Heating Panel Designs) can be selected. According to the specifications, the standard module data indicate 5,400 W at 230 V supply voltage, with a cold resistance of 9.42 Ω (hot resistance is approximately 4% higher, equal to 9.8 Ω). Using six heating modules would result in a total installed furnace power of 32.4 kW (arranged in two 3-phase groups with a star connection).

CALCULATION OF THE MODIFIED POWER PER FIBROTHAL® HEATING PANEL

$$\text{Power per heating panel (P)} = \frac{\text{required furnace power (P)}}{\text{quantity of heating modules}}$$

$$\text{Power per heating panel (P)} = \frac{25\ (\text{kW})}{6} = 4{,}170\ (\text{W})$$

CALCULATION OF THE NEW SUPPLY VOLTAGE U

$$U = \sqrt{P \cdot R_w}$$

$$U = \sqrt{4{,}170\ (\text{W}) \cdot 9.8\ (\Omega)} = 202.15\ (\text{V})$$

$$U = 202.15\ \text{Volts}$$

To achieve the desired power rating, one 3-phase group in a delta connection is selected, with two heating modules connected in series. Each module operates at 200 V.

CALCULATION OF THE POWER P PER FIBROTHAL® HEATING MODULE AT 200 VOLTS SUPPLY VOLTAGE

$$P = \frac{U^2}{R_w}$$

$$\frac{200^2\ (\text{V}^2)}{9.8\ (\Omega)} = 4{,}082\ (\text{W})$$

$$P = 4{,}082\ \text{Watts}$$

The total furnace power is therefore 6 × 4,082 W = 24,489 W.

The temperature factor influencing the heating resistance is negligible in this calculation, as the heating element alloy, Kanthal® A-1, results in a maximum resistance increase of only 4%.

FOR CONTACT INFORMATION PLEASE VISIT KANTHAL.COM

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