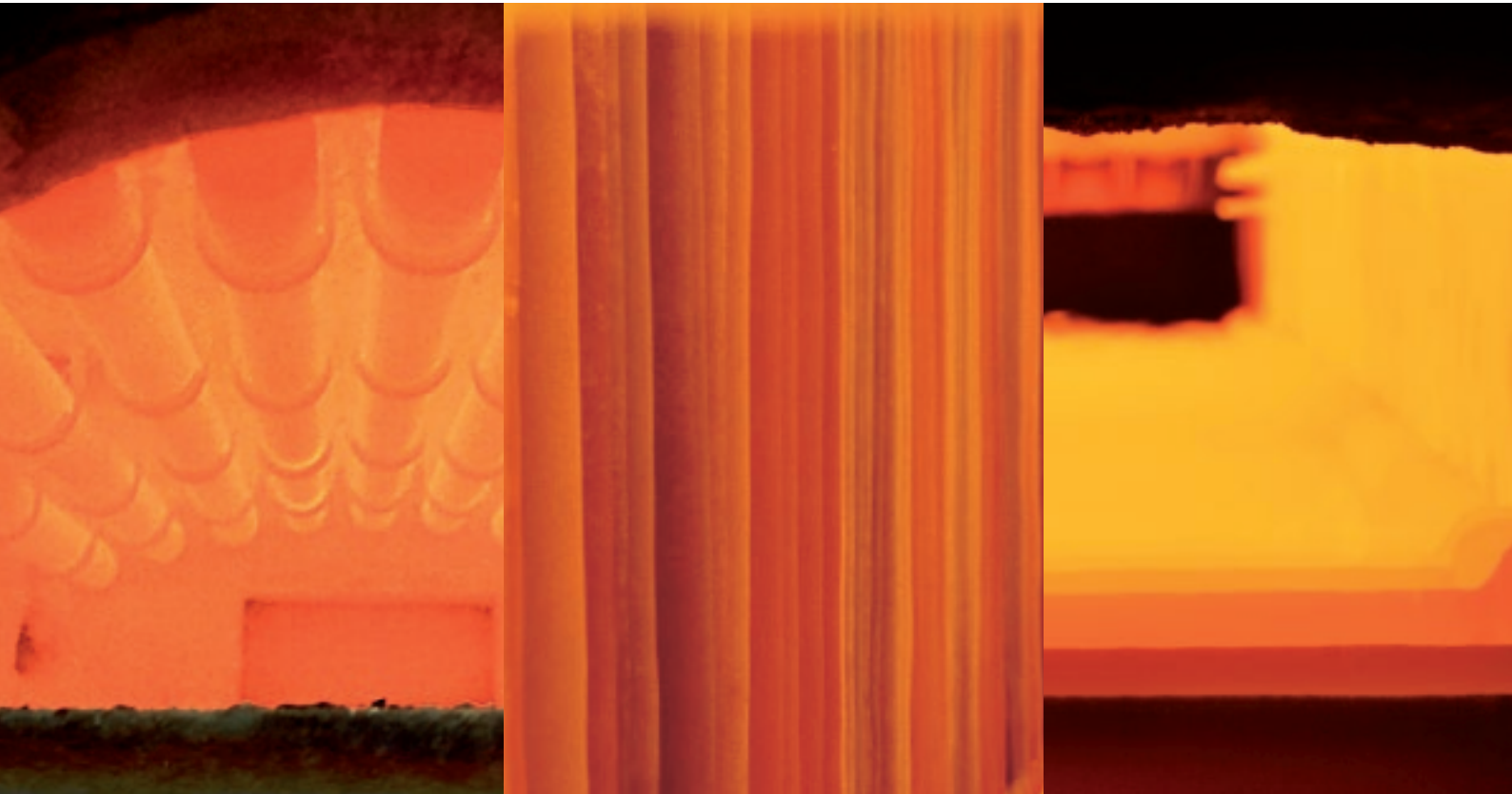


Keep in shape when the heat is on

**Kanthal APMT™ for strength and corrosion resistance
at extreme temperatures**



KANTHAL



Superior performance when the heat is on

When furnace temperatures reach as high as 1250°C (2282°F), conventional materials such as NiCrFe begin to suffer from hot corrosion and deformation. To address this problem, the engineers at Sandvik started working on a new construction material that would provide a long service life for components used in extreme temperature environments.

They came up with Kanthal APMT – an advanced powder-metallurgical, dispersion-strengthened, ferritic iron-chromium-aluminum alloy (FeCrAl alloy) with an addition of molybdenum. It offers high creep strength at temperatures of 1100–1300°C (2012–2372°F) where conventional metallic materials cannot operate.

Unique high-temperature properties

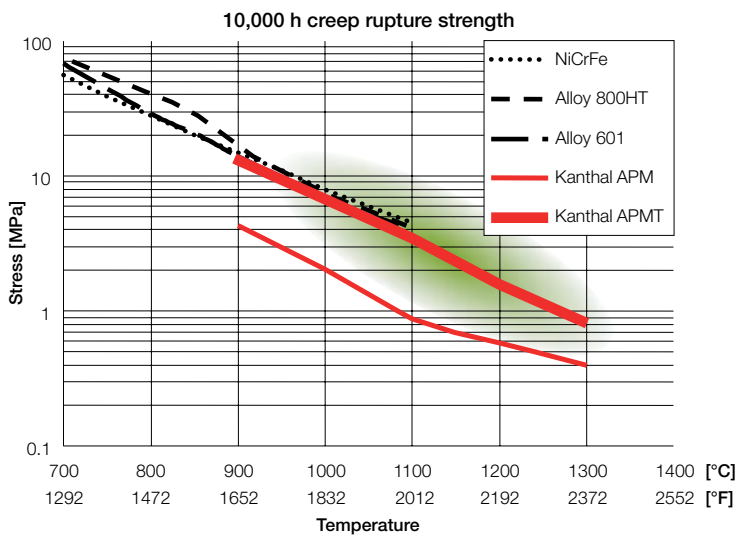
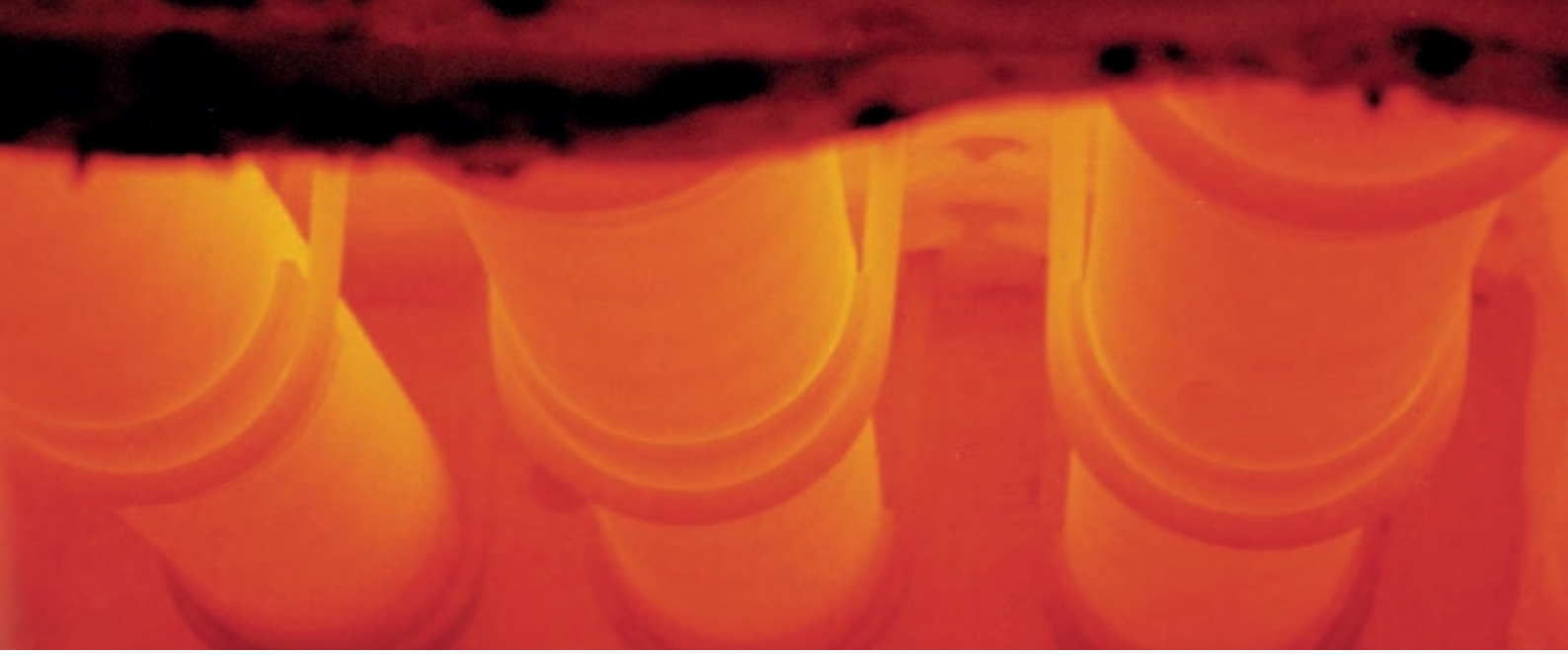
Kanthal APMT offers a unique combination of excellent oxidation properties and form stability at high temperatures. The material forms an excellent, non-scaling surface oxide Al_2O_3 , which offers good protection in most furnace environments, e.g., oxidizing, sulphidizing and carburizing gas, as well as against deposits of carbon, ash, etc.

These unique properties make Kanthal APMT uniquely suitable for a number of high-temperature applications.

The comparably higher price for advanced Kanthal APMT materials and components is offset by dramatically longer service life. Eliminating costly maintenance stops in industrial processes makes Kanthal APMT the ideal choice for increased productivity in high-temperature applications.

Key benefits of Kanthal APMT:

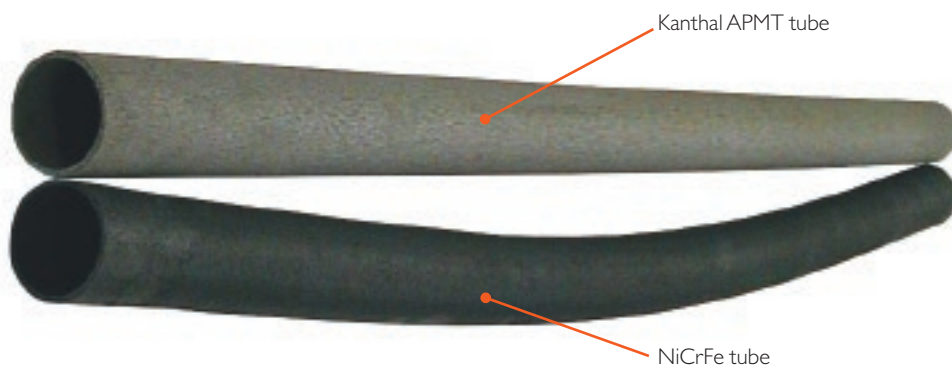
- Excellent resistance to oxidation and hot corrosion
- Can withstand most industrial atmospheres
- Better form stability than NiCrFe high-temperature alloys
- Can withstand higher temperatures than conventional materials, thus suitable for high-temperature structural parts
- More energy efficient in high-temperature processes than conventional materials
- Higher process performance and productivity than conventional materials
- Can replace ceramic materials in many applications



Excellent creep strength

Kanthal APMT and Kanthal APM offer high creep strengths at 1100–1300°C (2012–2372°F) where conventional materials cannot operate (within the green area on the graph).

Kanthal APMT therefore offers unique design opportunities for exposed components in a temperature range where Ni-base alloys degrade rapidly due to accelerated oxidation and even grain boundary softening.



Horizontal tubes after use. The deflection of the NiCrFe tube (bottom) cannot be seen in the Kanthal APMT tube (top).

Kanthal APMT products

Kanthal APMT is potentially useful wherever there is a need for metallic components that can resist corrosion and deformation when used in high-temperature applications.

The combination of oxidation resistance and mechanical strength of Kanthal APMT can give large benefits

in terms of longer life, higher productivity and higher energy efficiency – or just simply make it possible to use a metallic material instead of brittle ceramic solutions. Typical applications for Kanthal APMT are in high-temperature structural parts in furnaces, such as plates, mesh belts, loaders, mounting systems for elements or insulation and loading baskets.

Plate

Kanthal APMT plates are available in widths up to 1200 mm. Can be produced in customized dimensions for use in furnaces, as protective casing, for slag transport, etc.

Strip

Kanthal APMT strip is available in widths up to 205 mm. Can be produced in customized dimensions.

Rod

Kanthal APMT rods are available in diameters between 5.5 and 12 mm.

Wire

Kanthal APMT wire is available as custom made in dimensions between 0.20 and 9.5 mm and can be delivered on different types of spool.

Bars and square bars

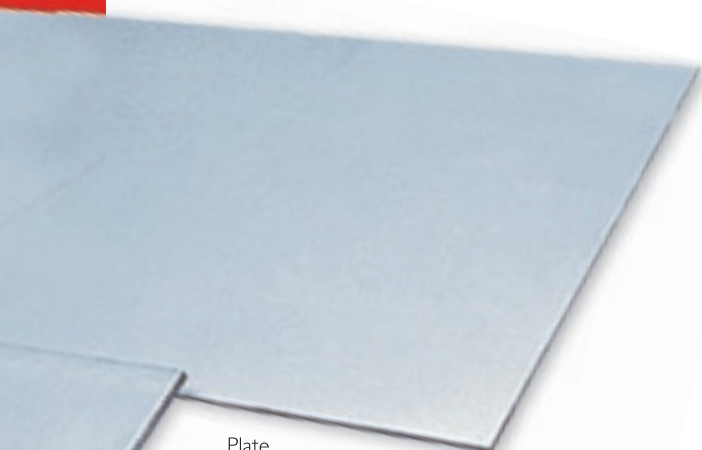
Kanthal APMT is available as square bars in dimensions up to 150 mm. Bars of Kanthal APMT can be delivered in diameters up to 100 mm.

Extruded tubes

Kanthal APMT extruded tubes are available in dimensions from 26 to 260 mm in diameter with a wall thickness of 2.87 to 11.0 mm. Dimension to wall thickness ratio depends on outer diameter.

Forging blanks

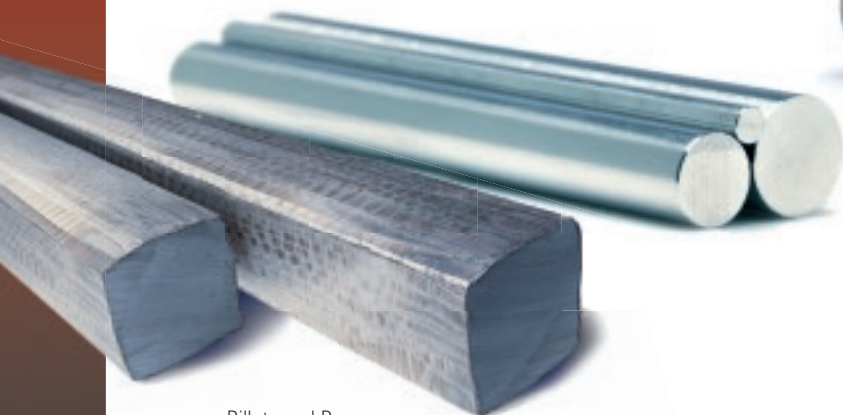
Kanthal APMT forging blanks are available in widths below 500 mm, thicknesses from 35 to 170 mm. Length will be dependent on the cross section.



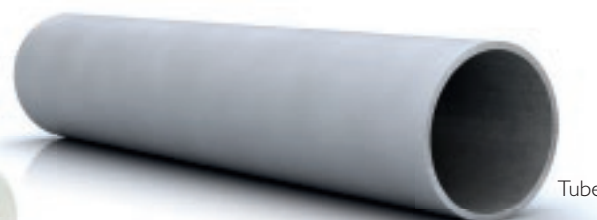
Plate



Strip, Rod, Wire



Billets and Bars



Tube

A wide range of products for your specific application

Fabricated components

The numerous delivery forms allow Kanthal APMT to be used in a wide variety of fabricated components.

A few examples:

Nozzles

Nozzles made of Kanthal APMT offer a longer service life in high temperature applications.



Nozzles

Flanges

Flanges and valves can be machined from Kanthal APMT forging blanks.



Flanges

Furnace rollers

Furnace rollers made from Kanthal APMT have dramatically increased service life as replacements in existing furnaces.



Furnace rollers

Wire mesh

Kanthal APMT's creep resistance can be used to minimize the wire dimension in mesh belts thus lowering the heating costs of the furnace.



Wire mesh

Trays and baskets

Corrosion and creep resistance in Kanthal APMT makes it a suitable material for trays and baskets in demanding atmospheres and where thermal shock resistance is needed.

Rings

Kanthal APMT rings are cut in the required dimensions from Kanthal APMT tube.

Muffles and retorts

Muffles and retorts for protecting goods from the atmosphere during thermal processing. When made of Kanthal APMT, these components offer superior resistance to heat and abrasive erosion.



Baskets and trays

Tubes

Kanthal APMT are used for, e.g., radiant tubes and muffle tubes.



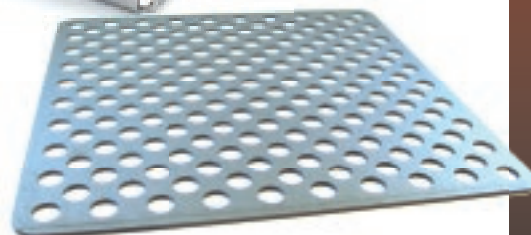
Retort



Muffles



Tubes



Technical data

Chemical composition, nominal

Cr %	Al %	Mo %	Fe %
21.0	5.0	3.0	Balance

Physical properties

Density g/cm ³	7.25
Poisson's ratio	0.30
Melting point °C (°F)	1500 (2372)
Magnetic properties	The material is magnetic up to approximately 600°C/1112°F (Curie point).

Tensile properties at room temperature 20°C (68°F)

Proof strength R _{p0.2}		Tensile strength R _m		Elongation A	Hardness (nominal)
MPa	ksi	MPa	ksi	%	HV
510–600	74–87	730–780	105–113	10–25	250

Tensile strength at elevated temperature (ε=10-l s-l)

Temperature		Tensile strength	
°C	°F	R _m MPa	R _m ksi
500	932	417–640	60–93
800	1472	320–360	46–52
1100	2012	90–105	13–15

Creep strength -1% elongation

Time hours	Temperature/Stress						
	700°C MPa	800°C MPa	900°C MPa	1000°C MPa	1100°C MPa	1200°C MPa	1300°C MPa
100	39.9	26.2	19.7	12.7	7.0	3.4	2.1
1000	36.8	23.4	16.2	9.9	5.0	2.3	1.5
10000	34.0	21.0	13.2	7.8	3.6	1.6	1.2
100000	31.4	18.8	10.8	6.1	2.6	1.1	0.9

Creep strength – rupture

Time hours	Temperature/Stress						
	700°C MPa	800°C MPa	900°C MPa	1000°C MPa	1100°C MPa	1200°C MPa	1300°C MPa
100	45.0	29.2	21.6	14.4	8.7	4.6	2.7
1000	39.7	24.8	17.0	10.8	5.5	2.5	1.5
10000	35.0	21.1	13.4	8.1	3.5	1.4	0.9
100000	30.8	18.0	10.6	6.1	2.3	0.8	0.5

Welding

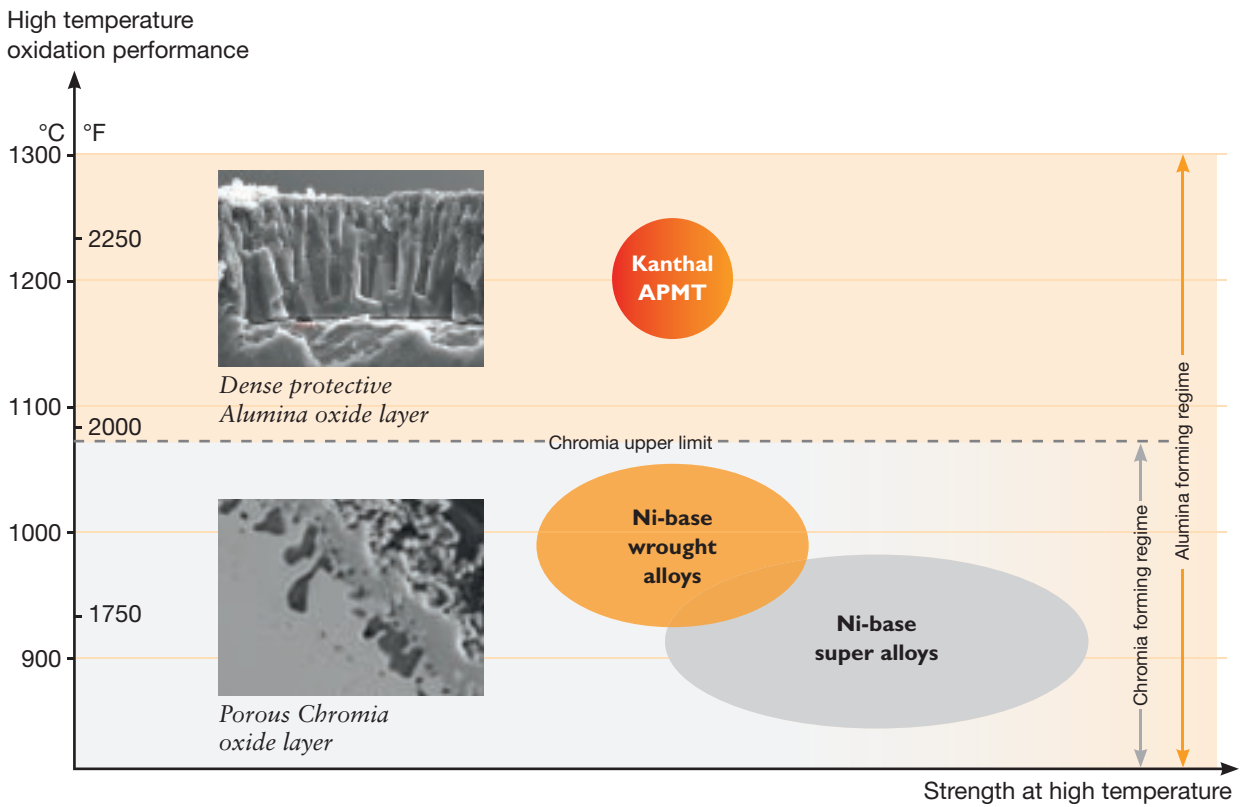
Kanthal APMT can be welded by TIG/GTAW and laser. A pre-heat treatment at 250°C (482°F) and a post weld heat treatment at 850°C (1562°F) for one hour are recommended.

Forming

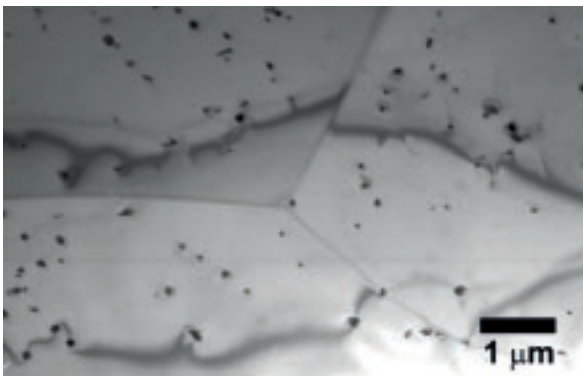
Kanthal APMT have good ductility in delivery condition and are cold formed and machined in the same way as high chrome ferritic stainless steels.

Data

Schematic relation between main groups of high temperature alloys in terms of oxidation, mechanical strength and typical maximum application temperatures

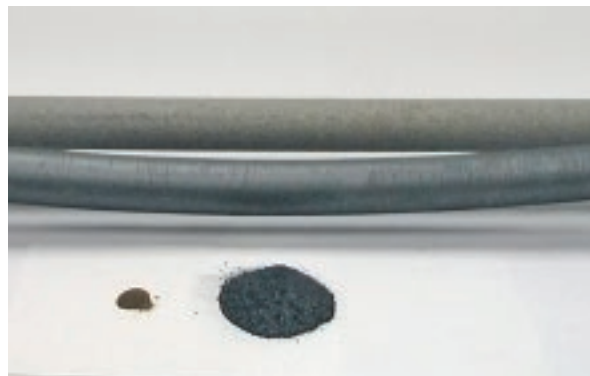


Microstructure



The unique dispersion of small refractory inclusions in Kanthal APMT improves creep properties.

Oxidation properties



Tubes after deformation test at 1200°C (2192° F) for 3000 hours. Kanthal APMT (top), and NiFeCr. Also seen is the amount of spalled oxide collected after test, Kanthal APMT (left) and NiCrFe.

Product forms		Dimensions (mm)	Dimensions (inch)
Plate	w	≤ 1200	≤ 47.24
	t	3 – 20	0.12 – 0.79
	l	≤ 3000	≤ 118.44
Extruded tubes	OD	26 – 260	1.05 – 10.24
	wt	2.87 – 11.0	0.11 – 0.43
	L**	3000 – 13000	118.11 – 511.81
Cold rolled strip*	w	≤ 205	≤ 8.07
	t	0.2 – 3	0.01 – 0.12
Wire	∅	0.2 – 9.5	0.01 – 0.37
Rod	∅	5.5 – 12	0.22 – 0.47
Round bar	∅	≤ 100	≤ 3.94
	L	≤ 4500	≤ 177.17
Forging blanks	w	≤ 500	≤ 19.69
	t	35 – 170	1.38 – 6.69
	L**	≤ 3000	≤ 118.11
Square bar	□	≤ 150	≤ 5.91
	L	≤ 4500	≤ 177.17

Other sizes and forms can be discussed.

*) Cold rolled strip can be delivered as cut to length products

**) Length depending on cross section

Sandvik Group

The Sandvik Group is a global high technology enterprise with 49,000 employees in 130 countries. Sandvik's operations are concentrated on five business areas in which the group holds leading global positions in selected niches: Sandvik Mining, Sandvik Machining Solutions, Sandvik Materials Technology, Sandvik Construction and Sandvik Venture.

Sandvik Materials Technology

Sandvik Materials Technology is a world-leading manufacturer of high value added products in advanced stainless steels, and of medical implants, steel belt based systems and industrial heating solutions.

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Quality management

Sandvik Materials Technology has quality management systems approved by internationally recognized organizations. We hold, for example, the ASME Quality System Certificates as a Material Organization, approvals to ISO 9001, ISO/TS 16949, ISO 17025, and PED 97/23/EC, as well as product approvals from TÜV, JIS, DNV and Lloyd's Register.

Environment, health and safety

Environmental awareness, health and safety are integral parts of our business and are at the forefront of all activities within our operation. We hold ISO 14001 and OHSAS 18001 approvals.

Disclaimer

Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice.

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