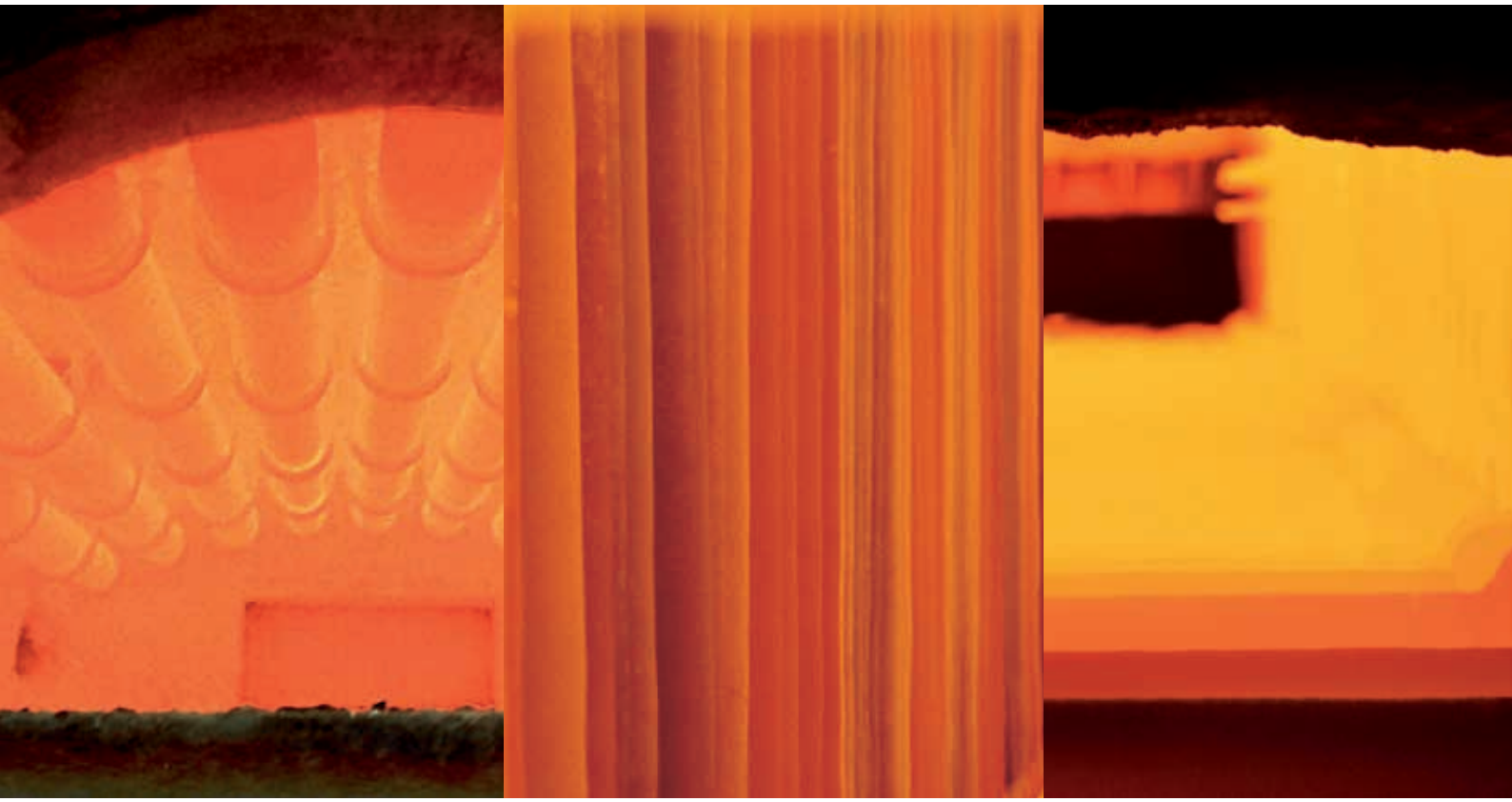
Keep in shape when the heat is on

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.

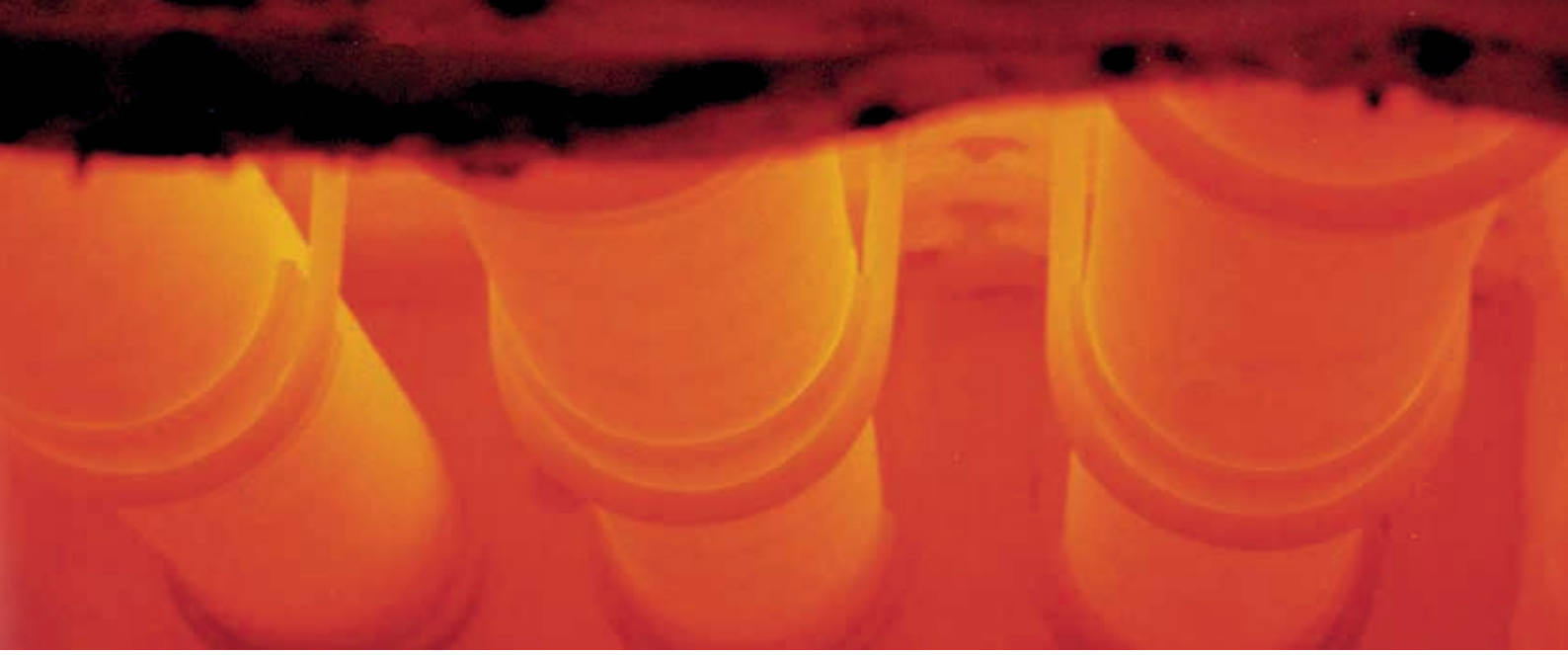
Unique high-temperature properties
Kanthal APMT offers a unique combination of excellent oxidation properties and form stability at high temperatures. The material forms an excellent, non-scaling surface oxide Al2O3, which offers good protection in most furnace environments, e.g., oxidizing, sulphidizing and carburizing gas, as well as against deposits of carbon, ash, etc.

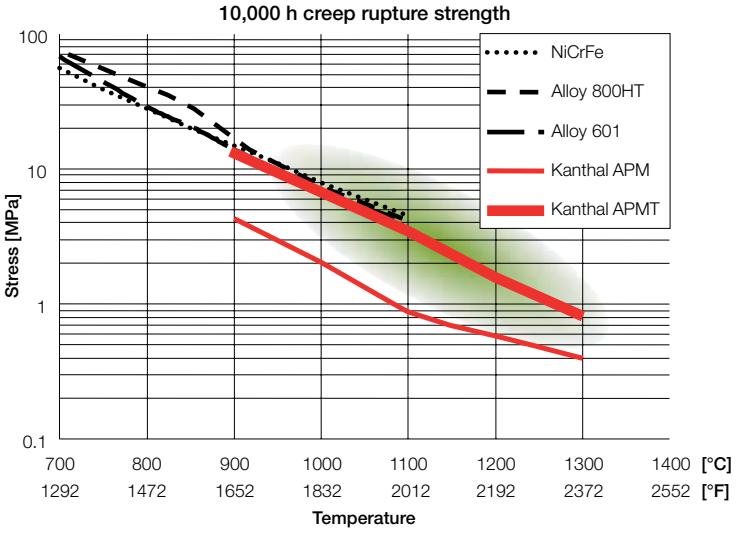
These unique properties make Kanthal APMT uniquely suitable for a number of high-temperature applications.

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:

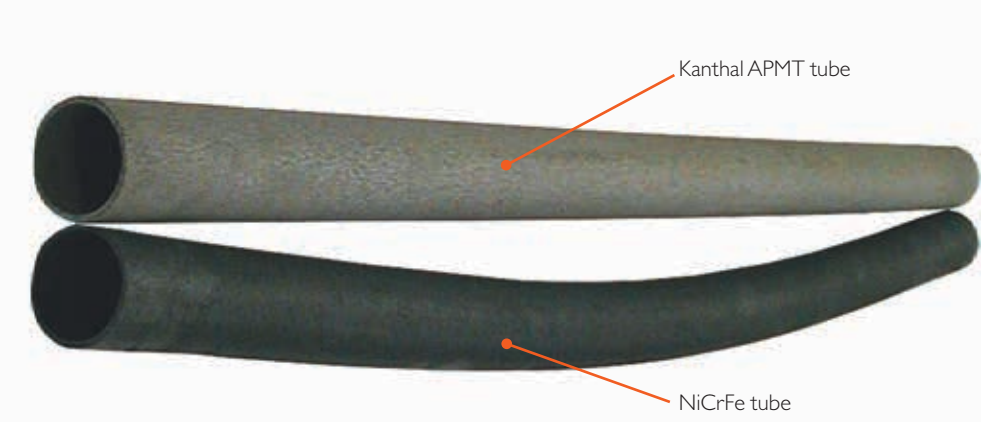
- Excellent resistance to oxidation and hot corrosion
- Can withstand most industrial atmospheres
- Better form stability than NiCrFe high-temperature alloys
- Can withstand higher temperatures than conventional materials, thus suitable for high-temperature structural parts
- More energy efficient in 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.

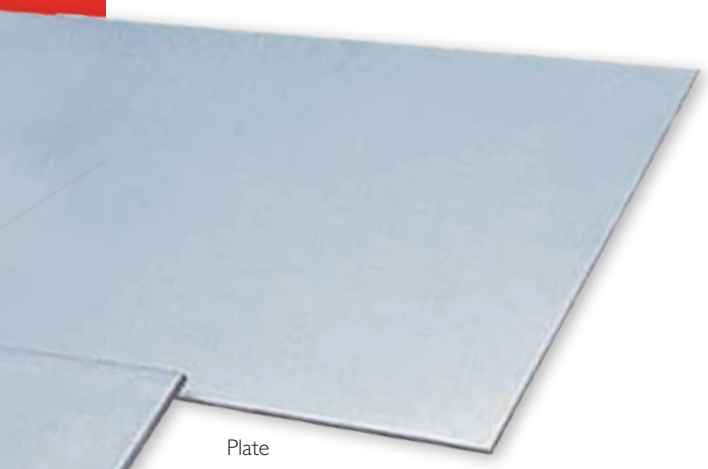


Horizontal tubes after use. The deflection of the NiCrFe tube (bottom) cannot be seen in the Kanthal APMT tube (top).

Kanthal APMT products

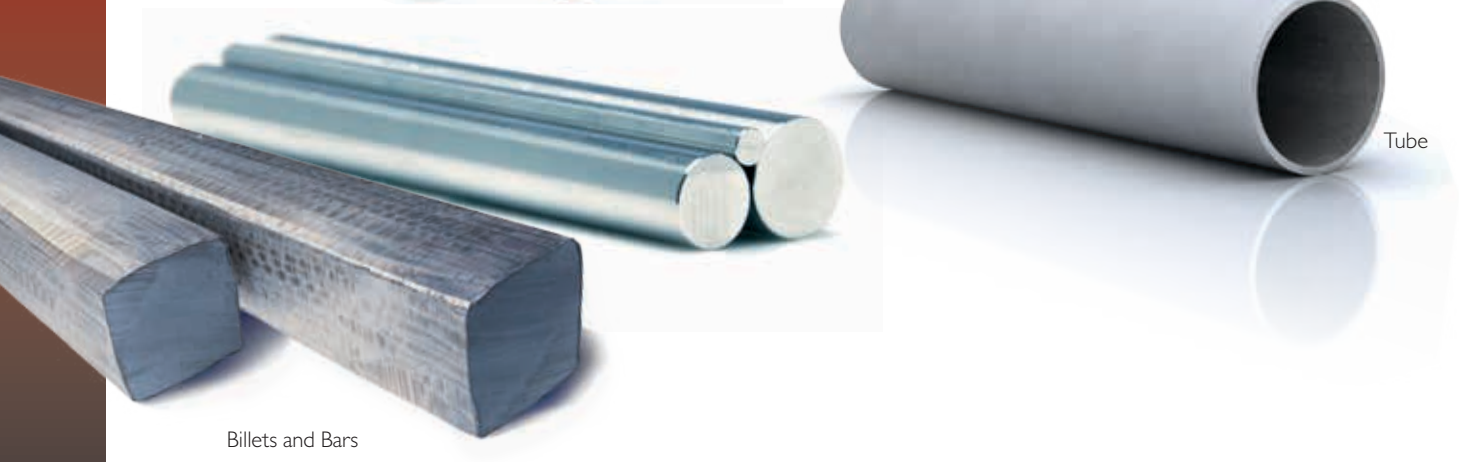
Kanthal APMT is potentially useful wherever there is a need for metallic components that can resist corrosion and deformation when used in high-temperature applications.

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

Strip, Rod, Wire



Billets and Bars

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.

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.

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

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

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.

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.

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

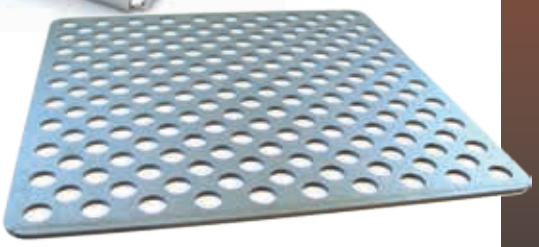
Nozzles

Flanges

Furnace rollers

Wire mesh

Baskets and trays



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=10-1 s-1)

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	Temperature/Stress						
hours	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

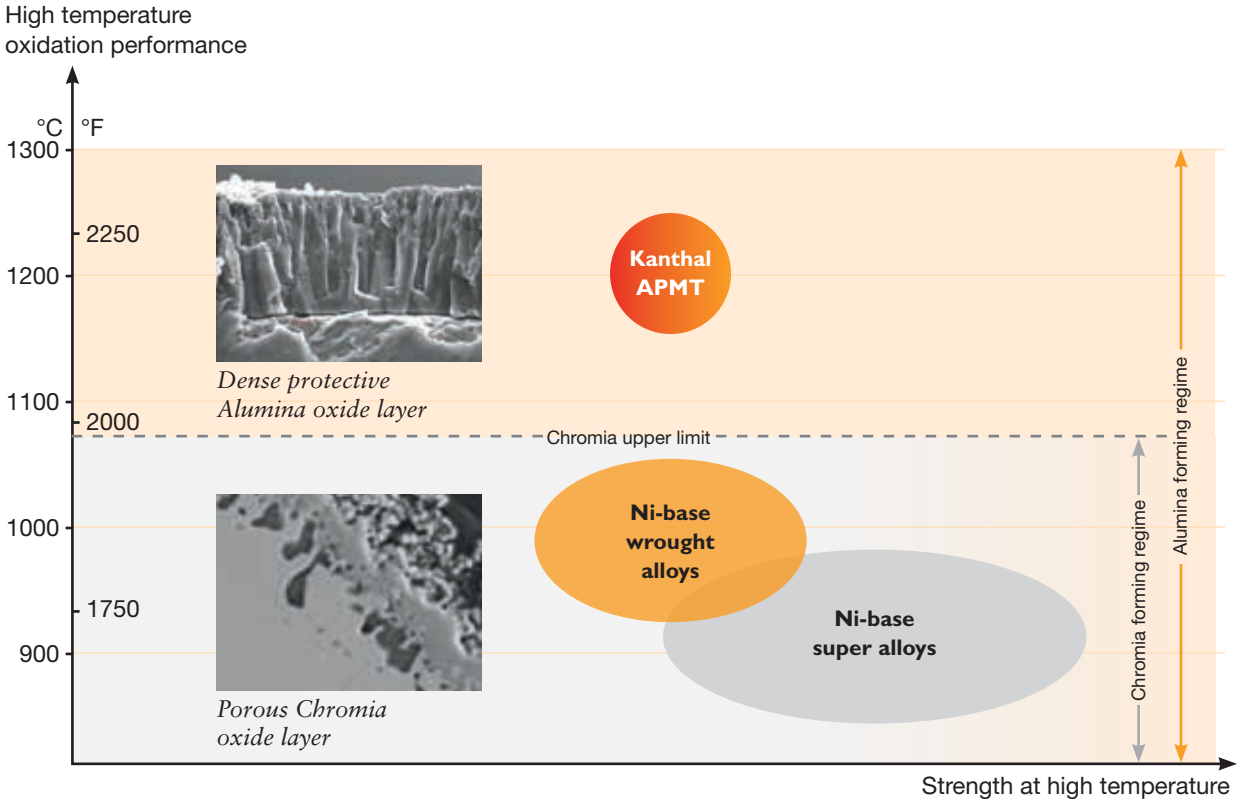
Time	Temperature/Stress						
hours	700°C MPa	800°C MPa	900°C MPa	1000°C MPa	1100°C MPa	1200°C MPa	1300°C MPa
100	45.0	29.2	21.6	14.4	8.7	4.6	2.7
1000	39.7	24.8	17.0	10.8	5.5	2.5	1.5
10000	35.0	21.1	13.4	8.1	3.5	1.4	0.9
100000	30.8	18.0	10.6	6.1	2.3	0.8	0.5

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.

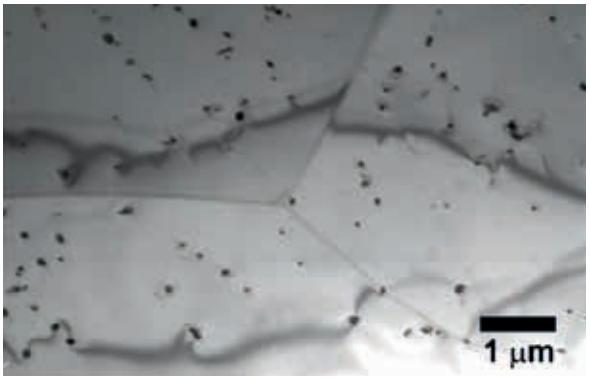
Forming
Kanthal APMT have good ductility in delivery condition and are cold formed and machined in the same way as high chrome ferritic stainless steels.

Visual data

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

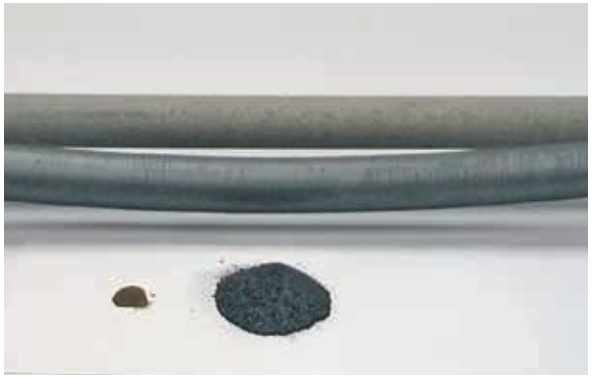


Creep properties



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

Oxidation properties



Oxide spallation. A small volume of alumina from Kanthal APMT (left) compared to the larger volume of chromia from NiCrFe (right).

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	Ø	0.2 – 9.5	0.01 – 0.37
Rod	Ø	5.5 – 12	0.22 – 0.47
Round bar	Ø	≤ 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

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