Kanthal APM (Tube)

KANTHAL

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Kanthal APM is an advanced powder metallurgical, dispersion strengthened, ferritic iron-chromium-aluminium alloy (FeCrAl alloy) for use at tube temperatures up to 1250°C (2280°F).

Kanthal APM tubes have good form stability at high temperature. Kanthal APM forms an excellent, non-scaling surface oxide, which gives good protection in most furnace environments, i.e. oxidizing, sulphurous and carburizing, as well as against deposits of carbon, ash, etc. The combination of excellent oxidation properties and formstability makes the alloy unique.

Typical applications for Kanthal APM are as radiant tubes in electrically or gas fired furnaces such as continuous galvanizing furnaces, seal quench furnaces, holding furnaces and dosing furnaces in the aluminium, zinc, lead industries, thermocouple protection tubes, furnace muffles for sintering applications.

Chemical composition

	C %	Si %	Mn %	Cr %	Al %	Fe %
Nominal composition					5.8	Bal.
Min	-	-	-	20.5	-	
Max	0.08	0.7	0.4	23.5	-	

Mechanical properties

Yield strength	Tensile strength	Elongation	Hardness
$R_{p0.2}$	R_m	A	
MPa	MPa	%	Hv
450	670	27	225

Remark: The samples are taken in the longitudinal direction.

Mechanical properties at elevated temperature

Creep data from tests on tube in delivery state with load applied in the longitudinal direction. Typical initial average grain size is 30-50µm.

Creep strength

Temperature °C	900	1000	1100	1200
MPa	5.9	2.0	0.7	0.3

1% elongation in 1000 h

Secondary creep rate at various stress levels

Creep rate	Temperature / Stress			
	900°C	1000°C	1100°C	1200°C
s-1	MPa	MPa	MPa	MPa
1.0e-10	4.0	1.5	0.9	0.7
1.0e-8	6.8	3.1	1.1	0.8
1.0e-6	11.0	6.7	3.1	1.9
1.0e-4	20.0	13.0	11.0	6.0

Creep rupture strength

Time	Temperature / Stress			
	900°C	1000°C	1100°C	1200°C
h	MPa	MPa	MPa	MPa
100	10.0	5.2	3.0	2.0
1000	7.0	3.4	1.7	1.0
10000	4.5	2.1	0.9	0.5

Maximum recommended unsupported lenght for Kanthal APM tube

	Distance between supports m					
	Tube Ø mm	Tube Ø mm	Tube Ø mm	Tube Ø mm	Tube Ø mm	Tube Ø mm
	100/90	128/117	146/134	154/142	178/162	198/182
800	2.2	2.5	2.5	2.5	2.5	2.5
900	2.2	2.3	2.5	2.5	2.5	2.5
1000	2.0	2.2	2.5	2.5	2.5	2.5
1100	1.5	1.8	2.2	2.2	2.3	2.3
1200	1.2	1.4	1.5	1.5	1.6	1.7

If the Kanthal APM is equipped with electrical resistance elements, the distance between the supports must be shortened.

Physical properties

Density g/cm^3	7.10
Electrical resistivity at 20°C Ω mm^2/m	1.45
Possion's ratio	0.30

Young's modulus

Temperature °C	**20**	**100**	**200**	**400**	**600**	**800**	**1000**
GPa	220	210	205	190	170	150	130

Temperature factor of resistivity

Temperature °C	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**
Ct	1.00	1.00	1.00	1.00	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.04	1.04	1.05

Coefficient of thermal expansion

Temperature °C	**Thermal Expansion x 10^{-6}/K**
20 - 250	11
20 - 500	12
20 - 750	14
20 - 1000	15
20 - 1200	16
20 - 1400	16

Thermal conductivity

Temperature °C	**50**	**600**	**800**	**1000**	**1200**	**1400**
W m^{-1} K^{-1}	11	20	22	26	27	35

Specific heat capacity

Temperature °C	20	200	400	600	800	1000	1200	1400
kJ kg^{-1} K^{-1}	0.46	0.56	0.63	0.75	0.71	0.72	0.74	0.80

Melting point °C	1500
Max continuous operating temperature in air °C	1250
Magnetic properties	The material is magnetic up to approximately 600°C (Curie point).
Emissivity - fully oxidized material	0.70

Welding

Welding of Kanthal APM tube to NiCr(Fe)

- Pre-heat the tube to approximately 200-300°C.
- Use TIG welding.
- Use 25Cr/20Ni low carbon, low silicon material as filler material. (As an alternative Nikrothal 40B - low silicon material can be used).
- Stress relieve the welded component at approximately 700°C for one (1) hour, followed by slow cooling in the furnace to obtain a minimum of stresses in the welded goods.

Remark: Stress relieving is not absolutely necessary to perform if the handling and installation is done with care.

Welding of Kanthal APM tube to Kanthal APM bottom

- Heat up the tube and the bottom plate to 300-500°C using a gas torch or in a furnace.
- Carry out the welding while the tube and the bottom plate are still hot. Finish off the welding before the temperature has fallen below approximately 200°C.
- Spot weld the bottom plate to the tube.
- Weld the bottom plate to the tube until the gap is completely filled up with material (3-4 passes). Use TIG welding equipment and Kanthal A-1 wire, Ø 1-3 mm, as filler material.
- Put the welded tube into a furnace for stress relieving. This must be done before the temperature of the material has fallen below approximately 150°C. Raise the temperature to 900-1000°C and maintain this temperature for two (2) hours.

Welding of Kanthal APM tube to mild steels

- Use TIG welding
- Use the same type of filler material, i.e. type of mild steel.
- Stress relieve the welded component at approximately 700°C for one (1) hour, followed by slow cooling in the furnace to obtain a minimum of stresses in the welded goods.

Remark: Stress relieving is not absolutely necessary to perform if the handling and installation is done with care.

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. This datasheet is only valid for Kanthal materials.