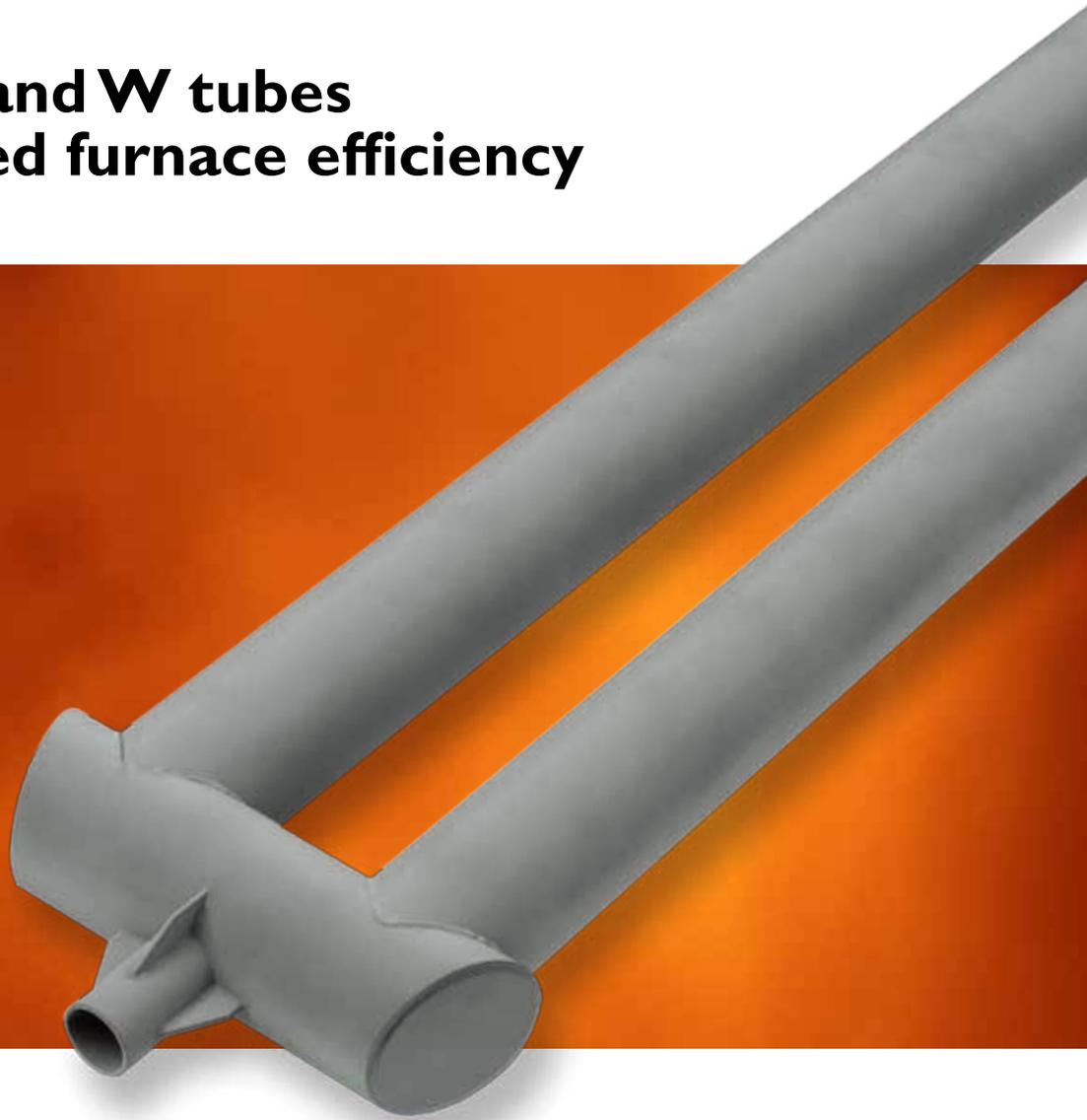


# **Radiant U and W tubes for increased furnace efficiency**



**KANTHAL**

# Tube design for efficient furnace production

*Sandvik offers a broad range of radiant tube alternatives for trouble-free and uninterrupted furnace operation in the heat treatment, steel and aluminium industries. Depending on factors such as temperature, furnace atmospheres and geometries, we can offer cost-efficient solutions for trouble-free use and maximized customer productivity.*

## **Material development for hot applications**

The right choice of radiant tubes for high temperature furnaces is a challenge, not only to production and maintenance engineers, but also to tube producers.

High temperature material is one of many Sandvik specialties. Advanced research and development has provided customers with materials that can optimize productivity for a wide range of heating applications.

Radiant tubes for high temperature furnaces are exposed to oxidation, carburization, sagging, cracking and contamination from compounds present in the furnace environment.

Sandvik's radiant tube products are developed to contribute to higher furnace productivity by

- offering longer service life
- offering less maintenance
- allowing higher power output

To satisfy various temperature and environmental demands, we offer radiant tubing ranging from high quality FeNiCr tubes with excellent oxidation behavior and carbon resistance, to extremely strong and corrosive resistant Kanthal APM™ and Kanthal APMT™ powder metallurgy products.

Our furnace experts can help you find the optimal solution for every heating requirement. Our goal is always to enhance your operation in order to produce optimum yields.

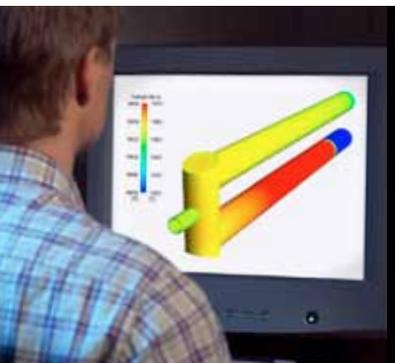
## **A cost-efficient mix of materials**

Sandvik's development of joining methods for different materials, such as Kanthal APM, Kanthal APMT and FeNiCr grades, means that radiant tube customers can choose the optimum material combination for their application.

Sandvik's material know-how and application knowledge provide furnace operators with ways to minimize cost while improving performance, safety and productivity.



To get in contact with your local representative visit [www.kanthal.com](http://www.kanthal.com) or show this QR-code to your smartphone.





## **GRADES FOR DEMANDING APPLICATIONS**

Sandvik radiant tube grades represent everything from high-quality NiCr tubing to powder metallurgical FeCrAl alloys able to withstand extreme temperatures and severe furnace environments.

### **Kanthal APM**

APM is an advanced powder metallurgical, dispersion strengthened, ferritic FeCrAl alloy, which is used at tube temperatures up to 1250°C (2280°F). Kanthal APM tubes have good form stability at high temperatures. Kanthal APM forms a non-scaling surface oxide, which gives good protection in most furnace environments, i.e. oxidizing, sulphurous and carbonaceous gases, as well as against deposits like carbon and ash. The combination of excellent oxidation properties and form stability makes the alloy unique.

### **Kanthal APMT**

Kanthal APMT is a further development of Kanthal APM, designed for especially demanding applications. The alloy has the same excellent high temperature corrosion resistance as Kanthal APM, but with even higher strength. Kanthal APMT is designed for applications where a higher mechanical strength is required.

### **Sandvik's 253MA**

253MA is an austenitic chromium-nickel steel alloyed with nitrogen and rare earth metals. The grade is characterized by high creep strength, very good resistance to isothermal and, particularly, cyclic oxidation, good structural stability at high temperatures and good weldability. The grade can be used at temperatures up to about 1075°C (1950°F).

### **Sandvik's 353MA**

353MA is an austenitic nickel-chromium steel alloyed with nitrogen and rare earth metals. It shares many of the properties of 253MA, but has a higher resistance to carburization and nitriding gases. Its high nitriding resistance is very beneficial when cracking ammonia at high temperatures. The grade can be used at temperatures up to about approximately 1100°C (2000°F).

## **U & W RADIANT TUBING FOR**

- Longer service life
- Trouble free production
- Increased productivity



*The all-Kanthal APM or all-Kanthal APMT solution.*

## Designed for the purpose

Sandvik offers three basic designs for radiant U and W shaped tubes. The range covers all-NiCr steels for high temperatures, powder metallurgy steels for extremely demanding environments, and combinations of the two. The flexible approach to material choice means that Sandvik can offer the optimal cost-efficiency depending on key factors as desired life-length, furnace atmosphere and process temperature.



*W-shaped Kanthal APM radiant tube.*

### **Radiant tubing for very high temperatures and severe conditions**

Using complete Kanthal APM™ or Kanthal APMT™ solutions opens up new possibilities to increase furnace temperatures and to cope with extremely demanding conditions.

Tubes made of Kanthal APM or Kanthal APMT are designed to support higher temperatures as well as carburizing and sulfidising atmospheres. Their life is therefore longer than conventional radiant tube alloys.



*Visual differences in oxide spallation and sagging properties between the tube Kanthal APMT (left) and a standard FeNiCr tube after 2300 h at 1100°C (2010°F).*



A mix of Kanthal APM or Kanthal APMT and NiCr tubes.

The all-NiCr solution.

**Radiant tubing for tougher conditions at the burner leg**

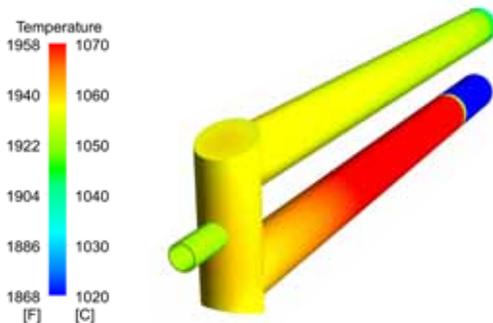
Since the temperature falls with the distance from the burner, in some cases the optimal design may be to use Kanthal APM or Kanthal APMT for the burner leg and a NiCr solution for the bend and the return tube.

Sandvik has delivered mixed material radiant tube solutions since 2008, with excellent results.

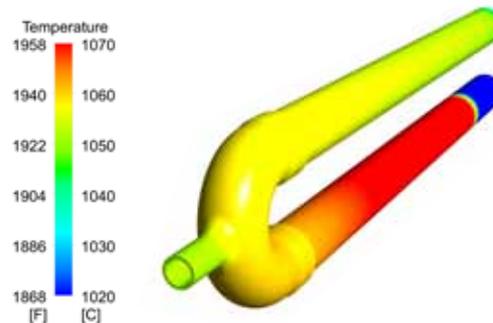
**Radiant tubing for medium high temperatures**

When furnace conditions are not too severe, a traditional NiCr solution can prove to be the most economical choice.

A solution with 253MA or 353MA in the straight tubes together with a cast FeNiCr bend is useful for many applications. Of the two, 353MA is the best choice for carburizing or nitriding atmospheres.



Temperature distribution in the all-Kanthal APM or all-Kanthal APMT design and a conventional U-tube design.



Temperature distribution in a conventional U-tube design.

# Technical information

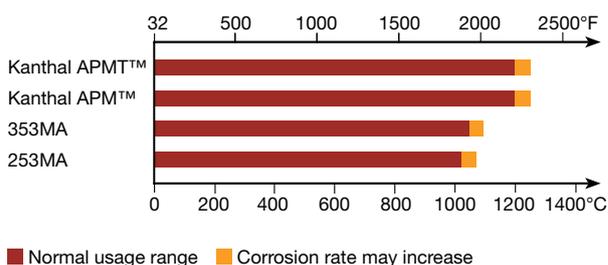
The optimal choice of radiant tube material depends on a number of factors, such as operating temperature, ambition to increase efficiency, material stability and life

length. On this page, you can find some of the answers. Your Sandvik sales representative will be happy to supply you with further detailed information.

## Standard product range

For a current list of available radiant tube products, please visit [www.kanthal.com](http://www.kanthal.com)

## Maximum tube temperature recommendations

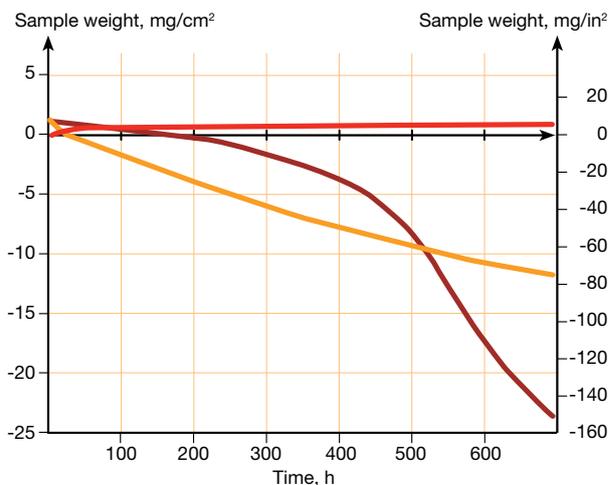


## High temp corrosion properties

Material	In air	Oxidation sulphur	Reducing sulphur	Carburizing	Nitriding
310*	0	0	0	0	0
253MA	+	+	++	+	0**
353MA	+	-	0	++	++
Kanthal APM™	++	++	++++	+++	+***
Kanthal APMT™	++	++	++++	+++	+***

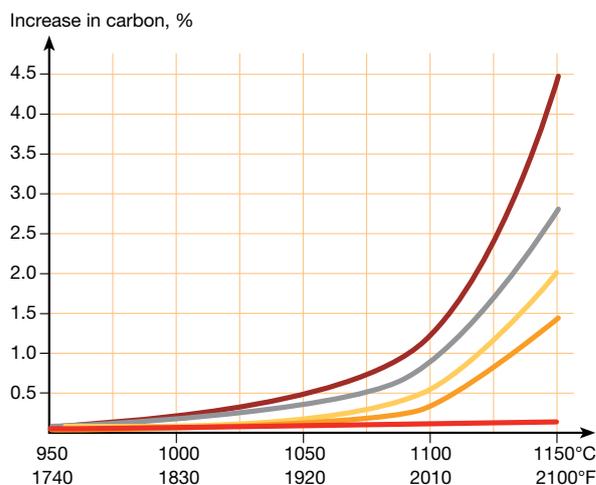
\* Sandvik stock standard  
 \*\* In low dew point (<-60°C/<-51°F) nitriding may occur  
 \*\*\* In low dew point (<-20°C/<-29°F) severe nitriding may occur  
 0 = reference value  
 + = superior to  
 - = inferior to

## Oxidation properties at 1100°C (2040°F)



■ Kanthal APM™ (Fe22CrAl5) and Kanthal APMT™ (Fe22Cr5AlMo)  
 ■ Kanthal® Super 22H (Ni28Cr20Fe3W) ■ HP (Fe35Ni25Cr)

## Carburization rate for various alloys



Carburized for 260 h in granular carbon  
 ■ Kanthal APM™ (Fe22CrAl5) and Kanthal APMT™ (Fe22Cr5AlMo)  
 ■ Kanthal® Super 22H (Ni28Cr20Fe3W) ■ (Fe35Ni25CrW)  
 ■ HP40 (Fe35Ni25CrNb) ■ HK40 (Fe25Ni20Cr)



### **Sandvik Group**

The Sandvik Group is a global high technology enterprise with 47,000 employees in 130 countries. Sandvik's operations are concentrated on three core businesses: Sandvik Tooling, Sandvik Mining and Construction and Sandvik Materials Technology – areas in which the group holds leading global positions in selected niches.

### **Sandvik Materials Technology**

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

Kanthal is a Sandvik owned brand, under which world class heating technology products and solutions are offered. Sandvik, Kanthal, Kanthal APM and Kanthal APMT are trademarks owned by Sandvik Intellectual Property AB. 253 MA and 353 MA are trademarks owned by Outokumpu Stainless.

### **Quality management**

Sandvik Materials Technology has quality management systems approved by internationally recognized organizations. We hold, for example, the ASME Quality Systems Certificate as a materials organization, approval to ISO 9001, ISO/TS 16949, ISO 17025, and PED 97/23/EC, as well as product approvals from TÜV, JIS 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.

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 printed matter is only valid for Sandvik material. Other material, covering the same international specifications, does not necessarily comply with the mechanical and corrosion properties presented in this printed matter.



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