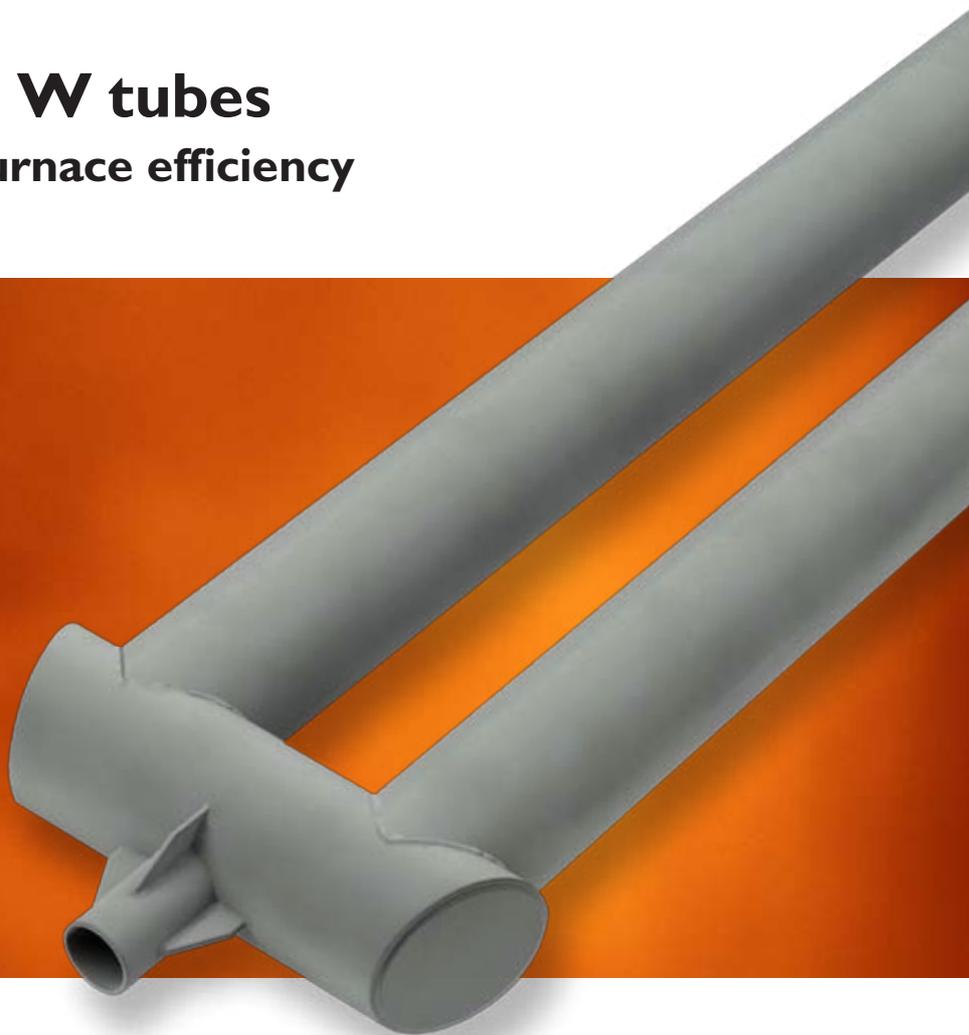


Radiant U and W tubes
for increased furnace efficiency



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 specialities. 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 Fe-Ni-Cr tubes with excellent oxidation behaviour and carbon resistance, to extremely strong

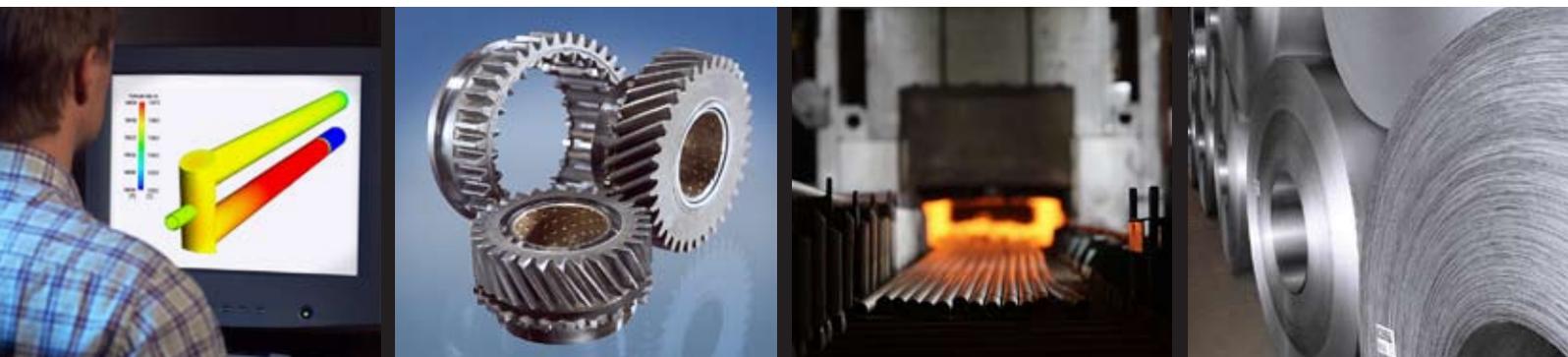
and corrosive resistant APM and Kanthal APMT powder metallurgy products.

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 APM, Kanthal APMT and Fe-Ni-Cr 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.





GRADES FOR DEMANDING APPLICATIONS

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

APM

APM is an advanced powder metallurgical, dispersion strengthened, ferritic Fe-Cr-Al alloy, which is used at tube temperatures up to 1 250°C (2 280°F). APM tubes have good form stability at high temperatures. APM forms a non-scaling surface oxide, which gives good protection in most furnace environments, i.e. oxidising, 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 APM, designed for especially demanding applications. The alloy has the same excellent high temperature corrosion resistance as APM, but with even higher strength. Kanthal APMT is designed for applications where a higher mechanical strength is required.

Sandvik 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 1 075°C (1 950°F).

Sandvik 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 1 100°C (2 000°F).

U & W RADIANT TUBING FOR

- Longer service life
- Trouble free production
- Increased productivity



The all-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.

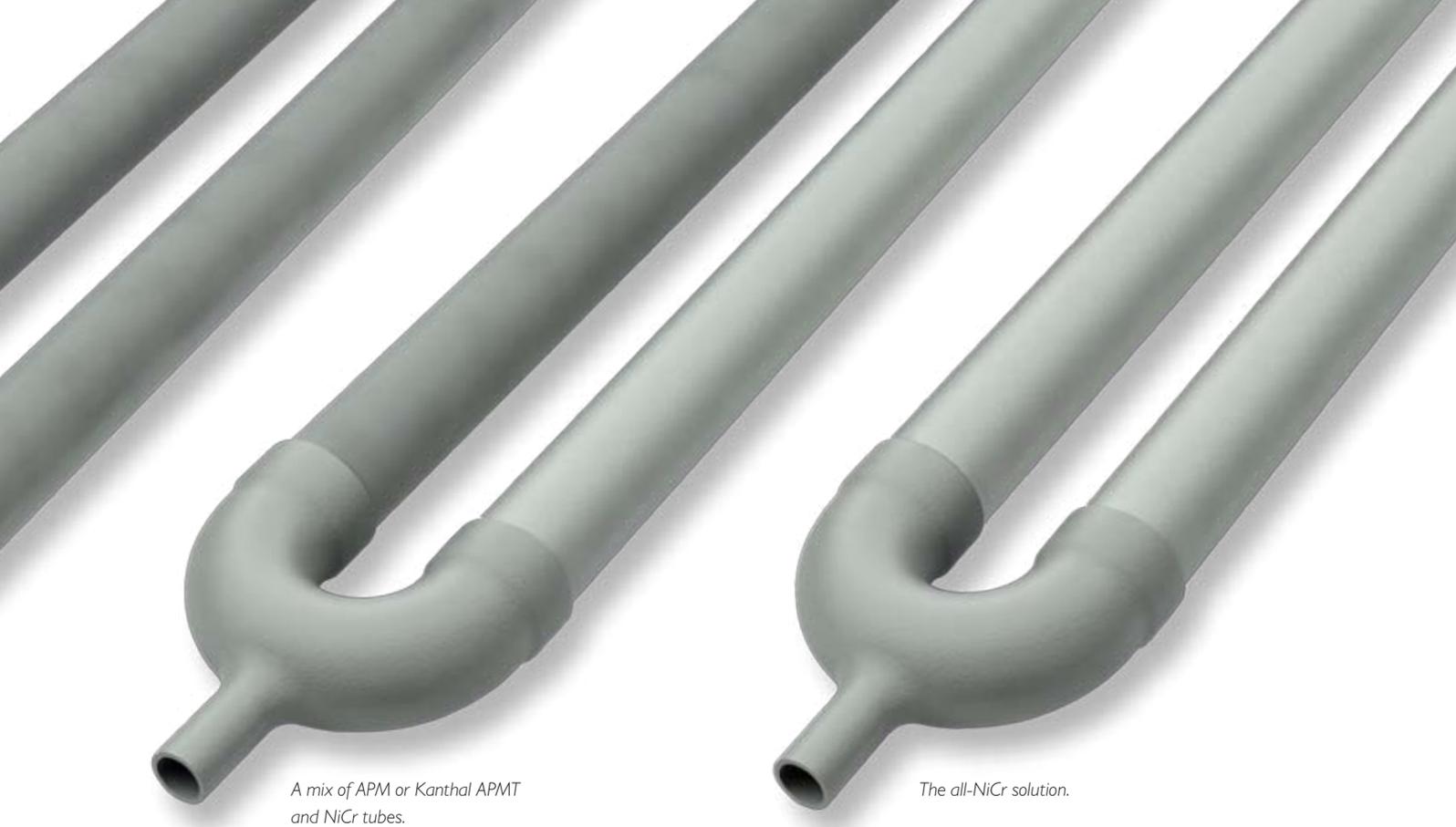
Radiant tubing for very high temperatures and severe conditions

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

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



W shaped APM radiant tube.



A mix of 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 APM or Kanthal APMT for the burner leg and a Ni-Cr solution for the bend and the return tube.

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

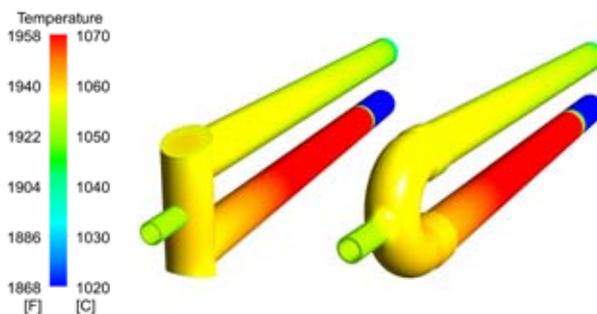
Radiant tubing for medium high temperatures

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 Fe-Ni-Cr bend is useful for many applications. Of the two, 353MA is the best choice for carburizing or nitriding atmospheres.



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



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

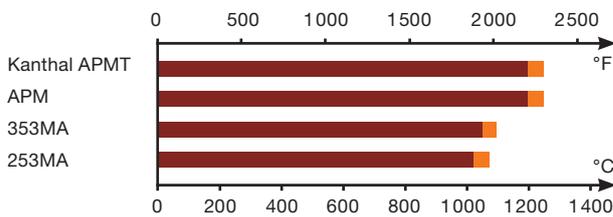
Technical data

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

Maximum tube temperature recommendations



■ Normal usage range. ■ Corrosion rate may increase.

High temp corrosion properties

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

* Sandvik Stock standard

** In low dewpoint (<-60°C/<-51°F) nitriding may occur

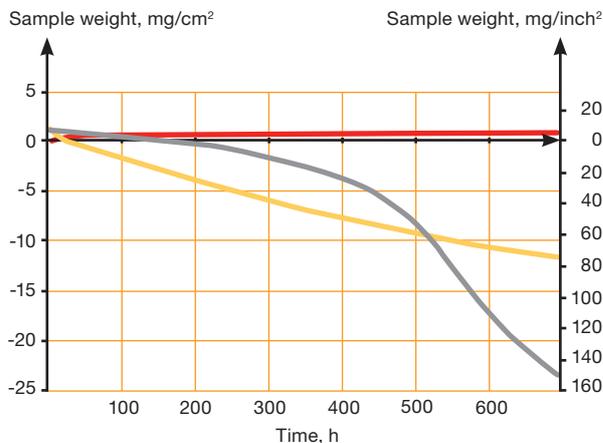
*** In low dewpoint (<-20°C/<-29°F) severe nitriding may occur

0 = reference value

+ = superior to

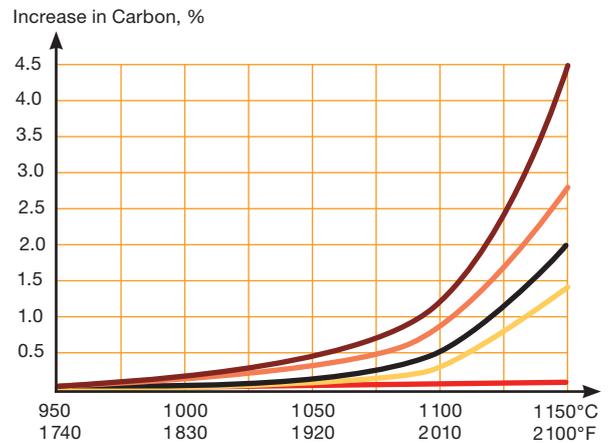
- = inferior to

Oxidation properties at 1100°C/2040°F



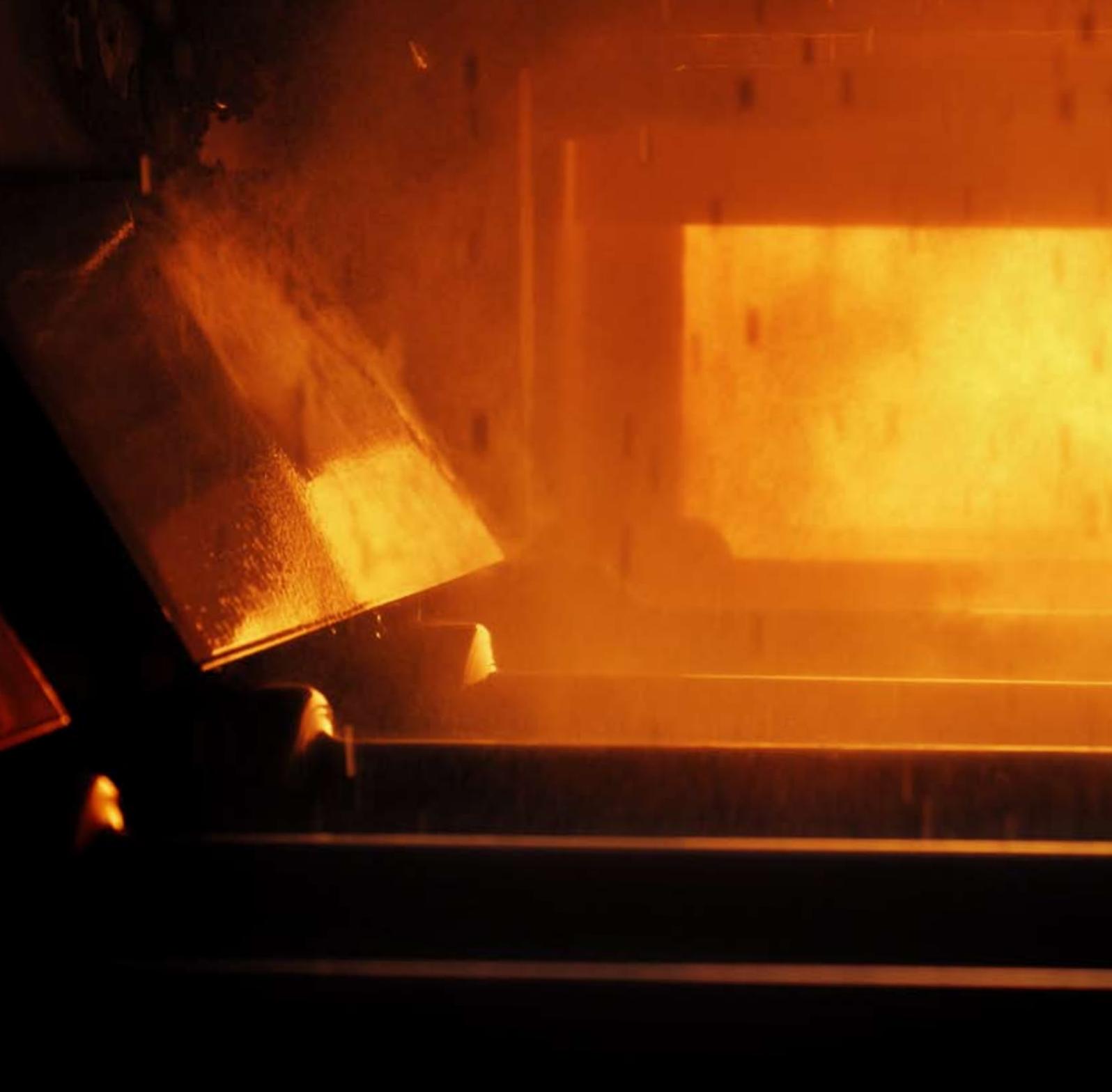
■ HP (Fe35Ni25Cr) ■ Super 22H (Ni28Cr20Fe3W)
 ■ APM (Fe22CrAl5) and Kanthal APMT (Fe22Cr5AlMo)

Carburisation rate for various alloys



Carburised for 260 h in Granular Carbon.

■ HK40 (Fe25Ni20Cr) ■ HP40 (Fe35Ni25CrNb)
 ■ (Fe35Ni25CrW) ■ Super 22H (Ni28Cr20Fe3W)
 ■ APM (Fe22CrAl5) and Kanthal APMT (Fe22Cr5AlMo)



Sandvik Group

The Sandvik Group is a global high technology enterprise with 44,000 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.

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.

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