

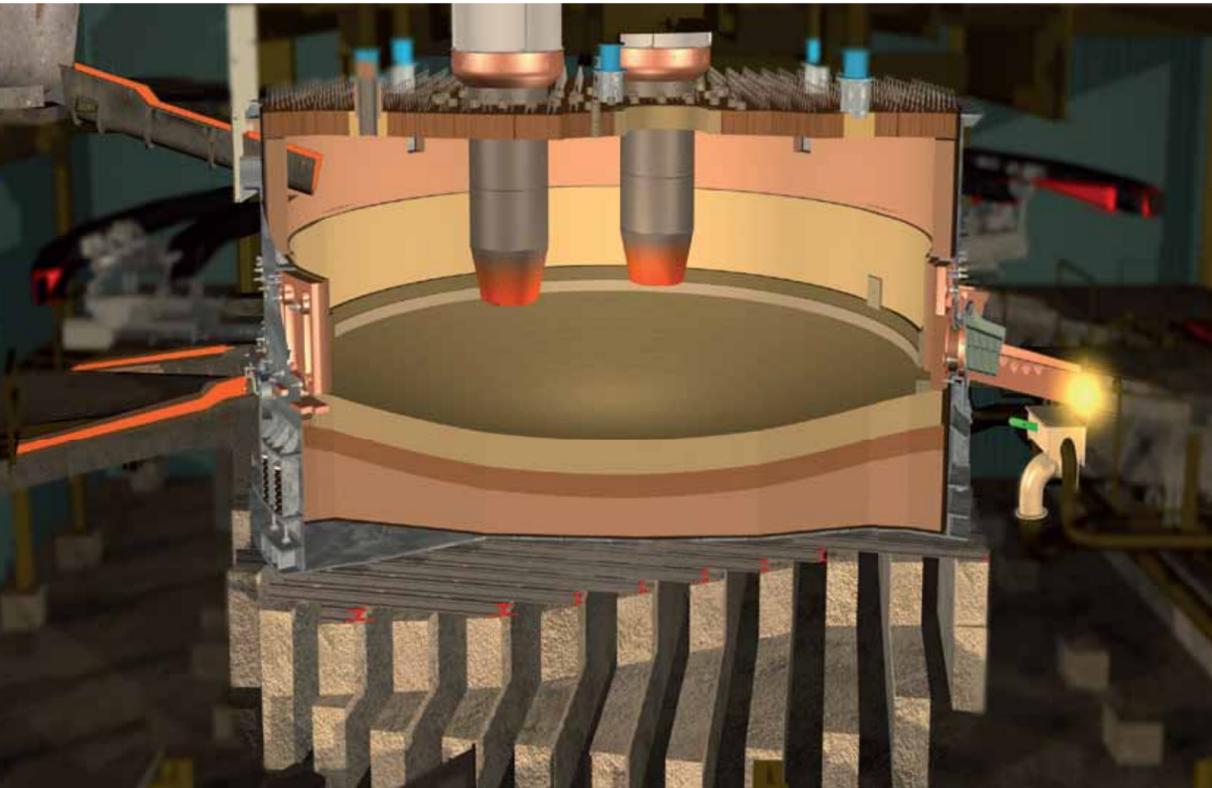
Tenova is a leading supplier of technological solutions and engineering services for the metals and mining industries, including key segments of the metallurgical process as well as in the mining value chain. Combining innovative engineering with process and automation expertise, Tenova delivers a full range of value-add solutions from greenfield projects, equipment and technology solutions to modernization upgrades and service packages. Passion for technology and a commitment to understanding needs of its global customer base are the key drivers of Tenova's business operations.

Tenova Pyromet is a leading company in the design and supply of AC and DC furnaces for the production of ferroalloys, platinum group metals, base metals, slag cleaning and alloy refining. Tenova Pyromet also designs and supplies plant equipment that is associated with furnaces such as material handling and pre-treatment, alloy conversion and refining, granulation of metal, matte and slag, furnace off-gas fume collection and treatment and treatment of hazardous dusts and waste. Tenova Pyromet provides feasibility studies, construction and commissioning supervision and training and also, provides several technologies to reduce operating costs and increase production efficiencies.

The company has been certified to ISO 9001:2008 for "The Design and Supply of Smelting Technology and Equipment".

Tenova Pyromet copper products, including copper coolers, water-cooled copper launders, water-cooled copper tapholes and other specialty products, are designed using advanced techniques such as finite element analysis (FEA) and computational fluid dynamics (CFD). Tenova Pyromet Copper Products are manufactured with high purity copper to exacting quality standards.

Each copper product solution is tailored to the specific requirements of each plant and customer.



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Copper Products

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TECHINT GROUP

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TENOVA is a worldwide supplier of advanced technologies, products, and engineering services for the metals and mining industries.

COPPER SIDEWALL COOLING

Cooling of the refractory lining is a fundamental aspect of furnace operations. Lining life is often determined by abnormal operating events and extreme operating conditions. To improve lining life and guarantee extended performance, particular care must be given to design, installation, drying and cleaning of the equipment together with a proper cooling system.

Water-cooled copper components use the freeze lining principle to reduce component wear. Lower wear means longer launder life, cutting long-term maintenance costs and downtime production losses. The design of Tenova Pyromet water-cooled copper components and copper launders eliminates inherent risk to personnel and equipment safety.

Tenova Pyromet copper tapholes are part of an integrated design solution for the entire taphole area, including the block and its surrounding refractory lining.

Using computer-aided design (CAD) and finite element analysis (FEA) techniques, Tenova Pyromet optimizes the design of copper cooling systems for:

- Heat removal capacity.
- Copper and lining maximum operating temperatures.

- Cooling-water contact area and flow characteristics.
- Temperature gradients on the lining hot face.
- Efficient use of copper.
- Use with heat transfer fluids other than water.

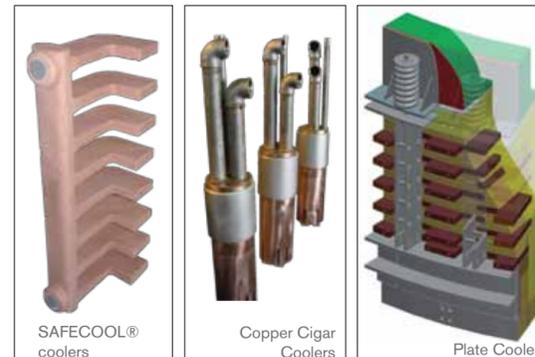
Tenova Pyromet offers a variety of cooling solutions, based on sidewall heat loads:

Applicable heat load [kW/m ²]	Cooling system type
0 – 20	Spray cooling on furnace shell
10 – 150	Tenova Pyromet's SAFECOOL systems (external cooling water circuits)
30 – 500	Tenova Pyromet's MAXICOOL system (integral monel cooling water circuits)
10 – 150	Shallow cooled plate cooling
20 – 250	Deep cooled plate cooling
Localised hotspots	Tenova Pyromet cigar coolers

All Tenova Pyromet copper cooling elements are manufactured and tested to stringent standards to ensure products of the highest quality, capable of exceeding design performance.

Main benefits include:

- Extended Lining Life: a stable freeze lining is formed and maintained on the lining hot face.
- Increased Production: higher power density levels can be maintained, for higher furnace throughput.
- Increased Recovery: the freedom to optimize process chemistry and operating temperatures without the constraint of lining life considerations.
- Lower Heat Losses: the insulating freeze lining reduces energy losses from the furnace.



SAFECOOL® coolers

Copper Cigar Coolers

Plate Cooler



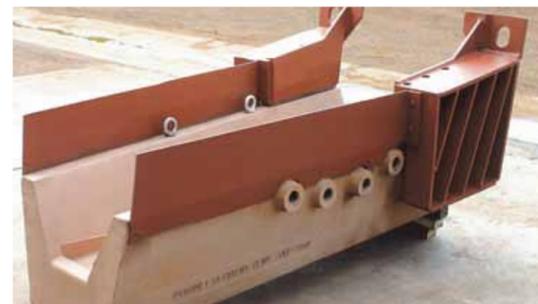
- Lower Costs: longer campaign life reduces overall capital expenditure. Decreased downtime cuts production losses.

- Safety: External water passages on SAFECOOL® cooler designs keep water outside the furnace.

- Cast-in monel tubes in MAXICOOL® coolers eliminate the risk of water leaks caused by casting defects.
- Long-term cracks in copper due to thermal fatigue cannot extend into monel passages.

COPPER LAUNDERS

Water-cooled copper launders use the freeze lining principle to reduce component wear. Lower wear means longer launder life, cutting long-term maintenance costs and downtime production losses. Many launder designs present an inherent safety risk by positioning the water cooling passages underneath the slag flow. This greatly increases the probability that a burn-through due to matte or metal entrainment will breach the channel and cause a steam explosion, putting the lives of personnel at risk and leading to downtime and repair costs.



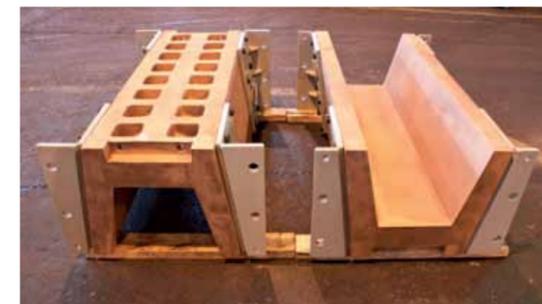
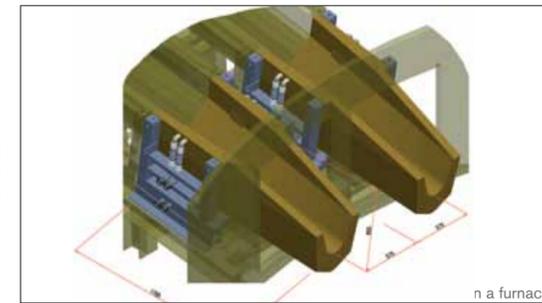
- Fusion of monel tubes with cast copper ensures excellent heat transfer.

- Easy Conversion: Same installation time for a copper-cooled lining as for a normal lining.

- Existing furnace shells can be easily modified to accommodate copper coolers.
- Part installations of 1 or 2 m² are possible for evaluation and comparison of lining performance.

Tenova Pyromet's uniquely innovative launder design eliminates the explosion hazard normally associated with water-cooled copper launders. Advanced CAD and FEA engineering tools ensure an optimum balance between maximum heat transfer efficiency and safe operation. Tenova Pyromet launders can be tailored to individual customer requirements:

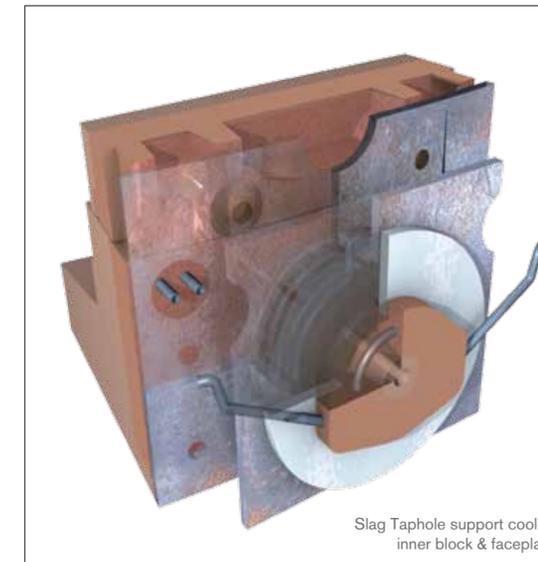
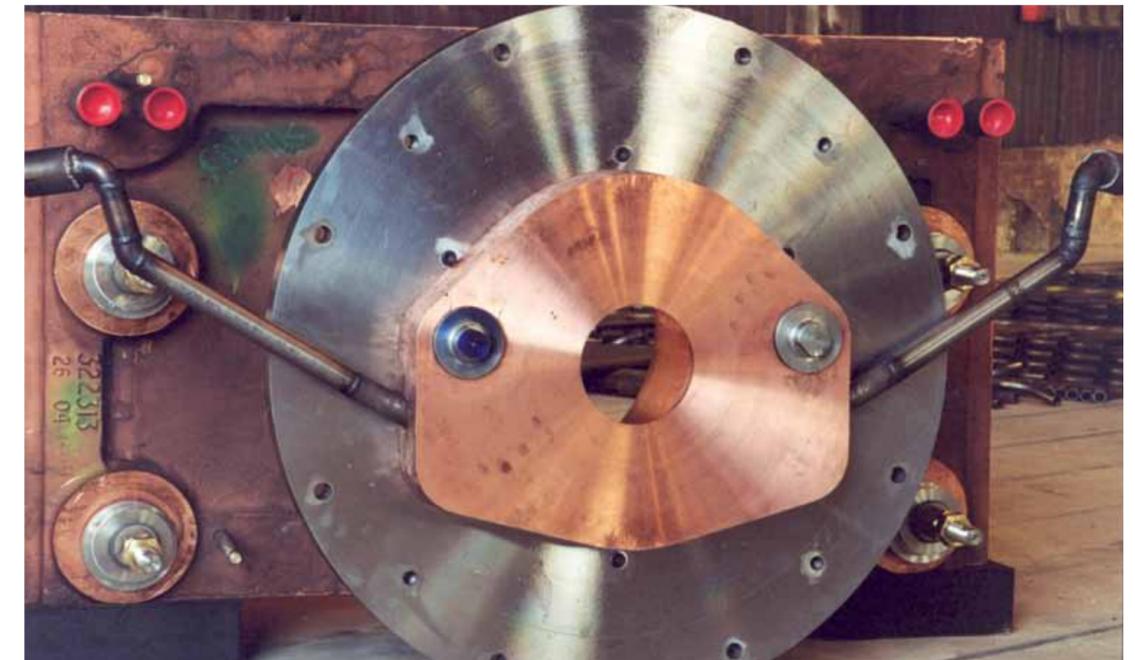
- Lengths ranging from 800 mm to multi-segment runs of over 20 m.
- Monel tubing or drilled water passages, depending on heat loads and safety requirements.



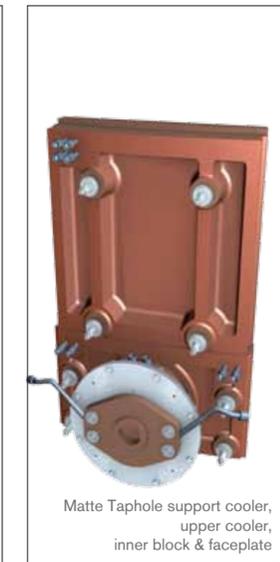
COPPER TAPHOLES

Tenova Pyromet copper tapholes are part of an integrated design solution for the entire taphole area, including the block and its surrounding refractory.

Tenova Pyromet taphole design uses FEA techniques to predict and optimize wear patterns and thermal performance.



Slag Taphole support cooler, inner block & faceplate



Matte Taphole support cooler, upper cooler, inner block & faceplate



Slag Taphole support cooler, inner block & faceplate