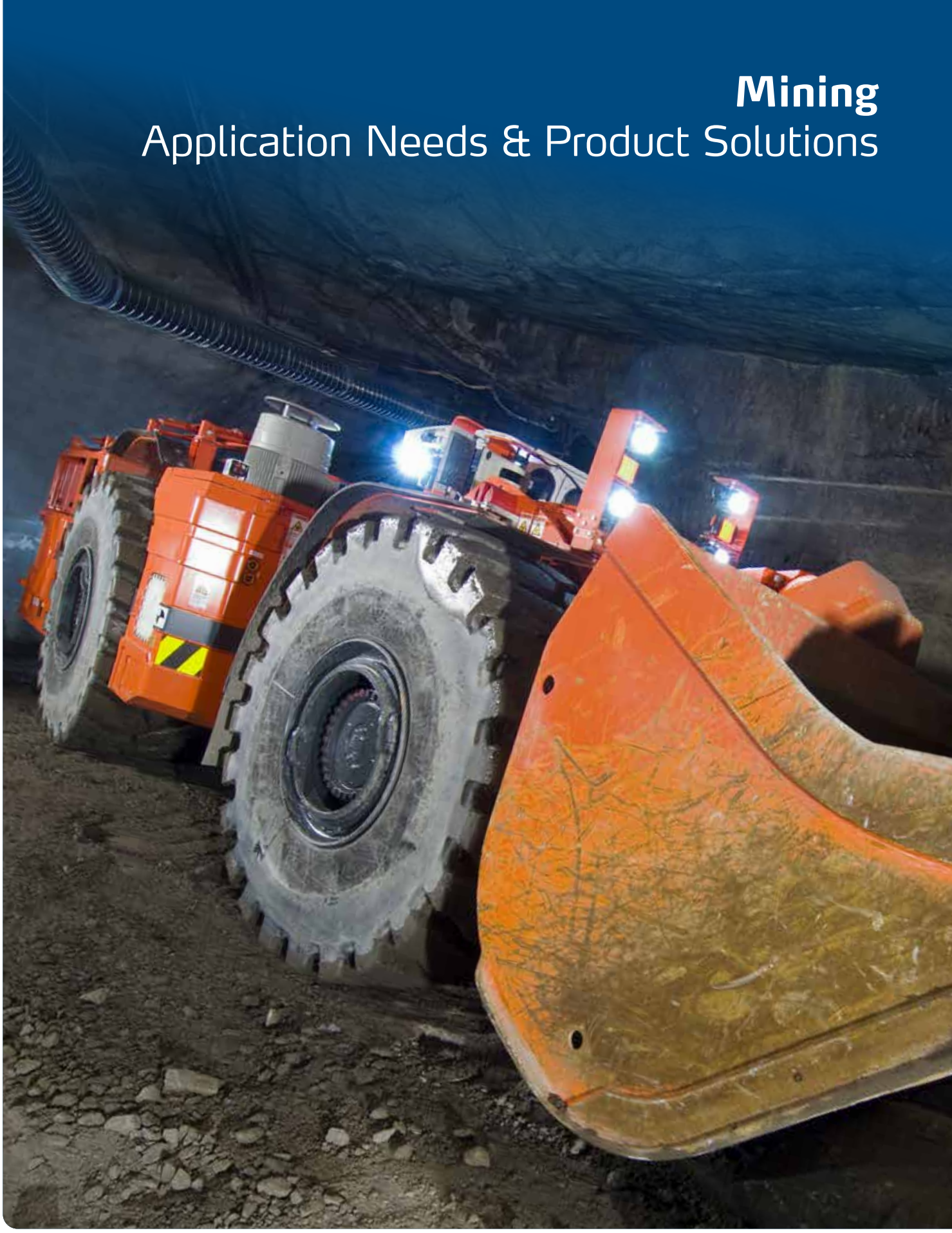
Mining
Application Needs & Product Solutions



COOLING
SOLUTIONS
MINING

Nissens®
DELIVERING **THE DIFFERENCE**

Nissens Cooling Solutions: Delivering the Difference in the Mining Industry

A DEMANDING INDUSTRY WITH TWO MAJOR CHALLENGES

With the automation and globalization of the mining industry, important requirements like growing productivity, improved safety and increased sustainability have had an immense impact on the development of the mining operations.

Today, the mining industry faces two major challenges: corrosion attacks and a dirty environment. Both challenges must be responded to in order to ensure a steady and efficient performance and operation.

PROVEN PERFORMANCE IN THE ON- & OFF-ROAD INDUSTRY AS WELL AS IN THE OFF-SHORE WIND TURBINE INDUSTRY

Both corrosion and a dirty environment may have a very detrimental effect on the mining machinery and its components. The mining machinery may wear out faster, the productivity may be affected, and the costs of repair and maintenance may be significant.

For decades, Nissens has built comprehensive knowledge in the on- & off-road industry segment as well as in the wind turbine industry segment. Having found the right solutions for the significant corrosion challenges that the off-shore wind turbine industry faces in global, off-shore wind parks, it has been a natural next step for Nissens to engage in partnerships with renowned OEMs in the mining industry in order to make customized cooling solutions for the world's leading manufacturers of mining equipment and machinery.

With our proven performance in e.g. the off-shore wind turbine industry, Nissens' customized product offer to the mining industry involves design, manufacturing, support and supply of highly advanced cooling solutions that meet the individual needs of our customers.

NISSENS FOLLOWS THE TRENDS AND MATCHES EMERGING NEEDS

In recent years, our customers in the mining segment have experienced a growing need for cost-savings, low emissions and high fuel efficiency. The aim is to ensure compliance with the Tier 4 Final emission standards and still observe the space constraints related to the mining machinery.

We add value to mining applications by supplying cooling solutions that are designed to meet the emerging needs and recent requirements of the mining industry when developing, designing, manufacturing and supplying cooling solutions for our global customers.

"Since Sandvik is a global leader and supplier of equipment and technical solutions to the mining industry, we only work with professional suppliers, who can convince us of their in-depth technical know-how and expertise within their field of performance. Zero defect is a guiding principle for us, and it must be a guiding principle for our suppliers. We thus select suppliers, who can design and manufacture customized products that offer a solution to our challenges in surface and underground mining operations. Nissens is capable of meeting our needs for high cooling performance, and we value Nissens' ability to provide high-quality, innovative and customized cooling solutions for the challenging mining environment. Proven performance is what it takes to be a preferred supplier to Sandvik."

Product Line Manager
Sandvik

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Advanced Cooling Solutions offered to challenging Mining Applications

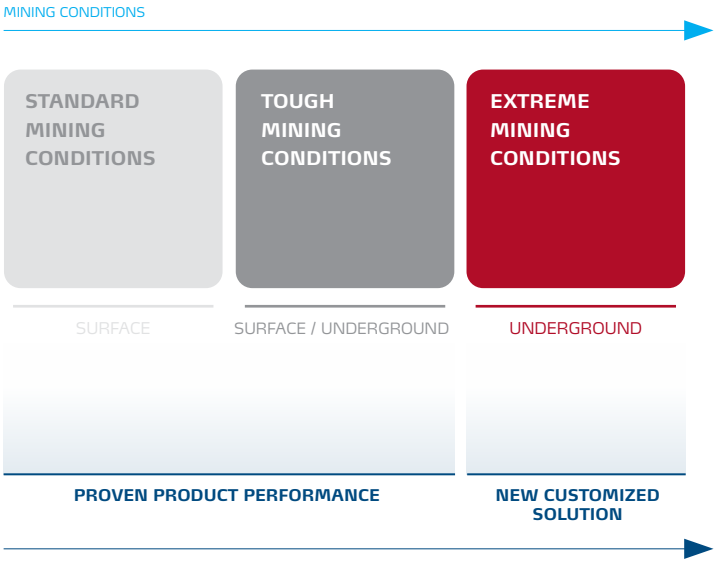
Nissens offers customized cooling solutions to a number of different surface and underground mining applications and machinery types, including among many others

- **DRILL RIGS**
- **MINING TRUCKS**
- **WHEEL LOADERS**
- **UNDERGROUND LOADERS**
- **UNDERGROUND HAUL TRUCKS**
- **MINING SHOVELS**

Supplying cooling components to machinery and equipment for the mining industry is especially challenging compared to other industry segments due to extreme circumstances that demand in-depth knowledge, comprehensive experience and innovative solutions to meet the special requirements. Consequently, Nissens takes special measures when designing cooling solutions for mining operations.

RESISTING A TOUGH ENVIRONMENT: LOAD, BUMP AND VIBRATION

The conditions in both surface and underground mining operations are tough. The load of the machinery applied is very high, and the impact from bumps and vibrations requires mining equipment and components that are very solid and stable. With a unique product design for mining equipment, Nissens customizes cooling solutions for the mining application with specially designed fins and pipes.



OFFERING CORROSION PROTECTION AT COMPETITIVE PRICING

Traditional cooling solutions for mining equipment are made in copper material, but the price of copper does not comply with the industry's requirements for cost-savings. As a result, Nissens offers a cooler in aluminum material as an attractive and high-performing alternative. In some mining applications, where the environment is very corrosive, Nissens uses special aluminum alloys for our customized mining cooling solutions, and these alloys have a remarkably improved resistance to corrosion attacks.

REDUCING MAINTENANCE NEEDS IN A DIRTY ENVIRONMENT

One of the pronounced constraints related to supplying cooling solutions for mining applications is linked to the challenges of preserving a good performance in a very dirty environment. Instead of just facilitating the maintenance of the cooling solutions by use of steam cleaning or high-pressure cleaning, Nissens has a strong focus on developing customized cooling solutions that reduce the general need for maintenance and service thanks to the cooler's ability to prevent dirt from accumulating inside the cooler.

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Our Product Offer for the most chal

Selecting the right product for a challenging application requires considerable knowledge of the application characteristics as well as of different product features. Based on proven performance, Nissens has made a specially designed aluminum plate & bar cooling solution for the most demanding mining applications that may be used for transmission and hydraulic systems as well as for cooling of both water, charge-air and oil.

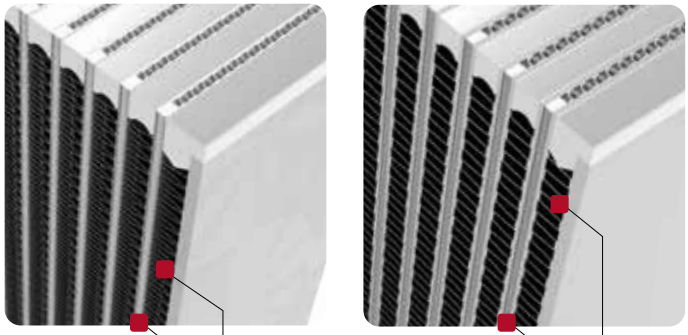
For this specially designed aluminum plate & bar cooling solution, a solid construction has been developed with special features:

SPECIAL PIPE COMPONENT

The aluminum pipes in Nissens' specially designed aluminum plate & bar cooling solution respond much better to bumps than the traditional cobber pipes applied. With a reinforced material for mining equipment, Nissens' specially designed aluminum plate & bar cooling solution is very durable, and it has been tested to have a durability that is five times higher than the conventional aluminum cooling component available in the market.

TRADITIONAL PLATE & BAR
CORE CONSTRUCTION

NISSENS' **SPECIAL PLATE & BAR**
CORE CONSTRUCTION FOR MINING



STANDARD
THICKNESS
OF CORE
CONSTRUCTION
ELEMENTS

TRADITIONAL FIN SHAPE

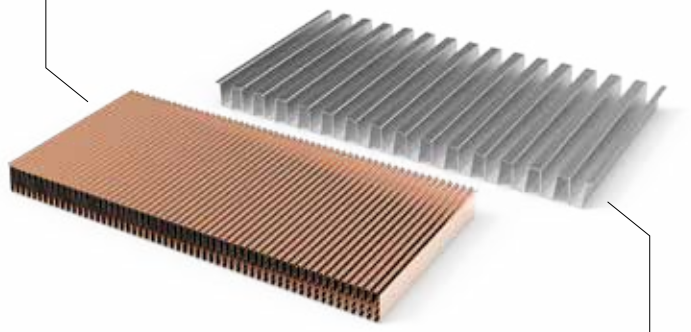
ENLARGED
THICKNESS
OF CORE
CONSTRUCTION
ELEMENTS

SPECIAL FIN DESIGN
FOR MINING CONDITIONS

SPECIAL FIN DESIGN

A unique fin construction with a more open fin design compared to the fin construction in traditional plate and bar coolers contributes to ensuring that Nissens' cooling solution may work in a dirty environment. Furthermore, Nissens' product reduces the need for cleaning and maintenance, since the accumulation of dirt is avoided thanks to the special fin design. This enables Nissens' specially designed aluminum plate & bar cooling solution to resist the challenges of a very dirty underground mining environment and to ensure a constantly high cooling performance.

TRADITIONAL FIN DESIGN APPLIED
IN OTHER MINING COOLING SOLUTIONS



NISSENS' HIGHLY EFFICIENT FIN DESIGNED
FOR DEMANDING, VERY POLLUTED
UNDERGROUND ENVIRONMENTS

INCREASED COOLING PERFORMANCE ENSURES TIER 4 FINAL COMPLIANCE

Increased cooling performance throughout the entire product life time of Nissens' specially designed aluminum plate & bar cooling solution is a noticeable product feature when comparing to other product offers in the market. This is a noticeable benefit in the pursuit of meeting the emission standards of the Tier 4 Final requirements.

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lenging Mining Applications

- SPECIAL PRODUCT SOLUTIONS ✓
- SPECIAL ALLOY MATERIALS ✓
- HIGH DURABILITY ✓
- SIMPLE AND EASY INSTALLATION ✓
- COOLING OF BOTH WATER, CHARGE-AIR AND OIL ✓
- SOLID CONSTRUCTION ✓
- SPECIAL FIN CONSTRUCTION ✓
- LIMITED NEED FOR CLEANING AND MAINTENANCE ✓

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Proven Performance – Customized Solutions

NISSENS' PLATE & BAR COOLERS

Plate & bar coolers are among the most typical constructions of aluminum coolers applied for high-performance industrial applications and designed for oil, water or air cooling.

The special construction of brazed plates and bars, available with a variety of fin performances, is mainly used for high-pressure cooling applications with a working pressure up to 522 psi (36 bar). Specially formed turbulators placed between the plates improve the cooling performance considerably, and, thanks to the Controlled Atmosphere Brazing (CAB), the cooler's aluminum elements are brazed into one solid, sturdy and extremely durable construction.

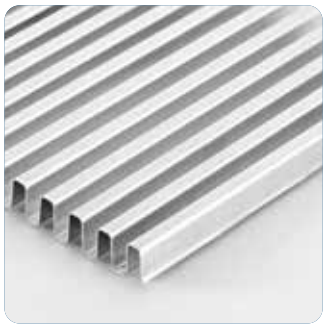
Nissens' plate & bar coolers are constructed as a modular system, allowing length and width to vary according to specified application demands and can be equipped with a deep variety of fans, shrouds, mountings, electric/hydraulic motors and connections.

ADVANTAGES OF PLATE & BAR COOLERS

- Excellent cooling performance
- Proven, extended durability and corrosion performance
- Compact and flexible design
- Deep variety of possible equipment and customizations

POSSIBLE APPLICATIONS

- Water/glycol cooling
- Charge air cooling
- Oil cooling
- Fuel cooling



ACCORDANCE WITH INTERNATIONAL STANDARDS

The plate & bar coolers are designed and manufactured according to the Pressure Equipment Directive PED 97/23/EC article 3.3

TECHNICAL INFORMATION

Temperature range	-40° C to 260° C (-40° F to 500° F)
Working pressure - dynamic	16 bar (232 psi)
Working pressure - static	25 bar (362 psi)
For special high pressure applications, a dedicated design can be developed to be applicable at working pressures up to 36 bar (522 psi)	
Corrosion	The cooler design is tested for off-shore equivalent to class C5 high
Cleanliness	The coolers can be flushed to a cleanliness of 15/13/9 or even better acc. to ISO4406

POSSIBLE SIZES

Available thicknesses	45 / 63 / 94 / 113 / 140 / 160 mm (1.77 / 2.48 / 3.70 / 4.45 / 5.51 / 6.29 in)
Max. height	3000 mm (118.0 in)
Max. width	2500 mm (98.4 in)
Tubes	3 mm (0.118 in) oil/water 4.4 mm (0.173 in) oil/water/air 6 mm (0.236 in) air
Air fins	Several customized fin types available - specially designed for the tough mining environment

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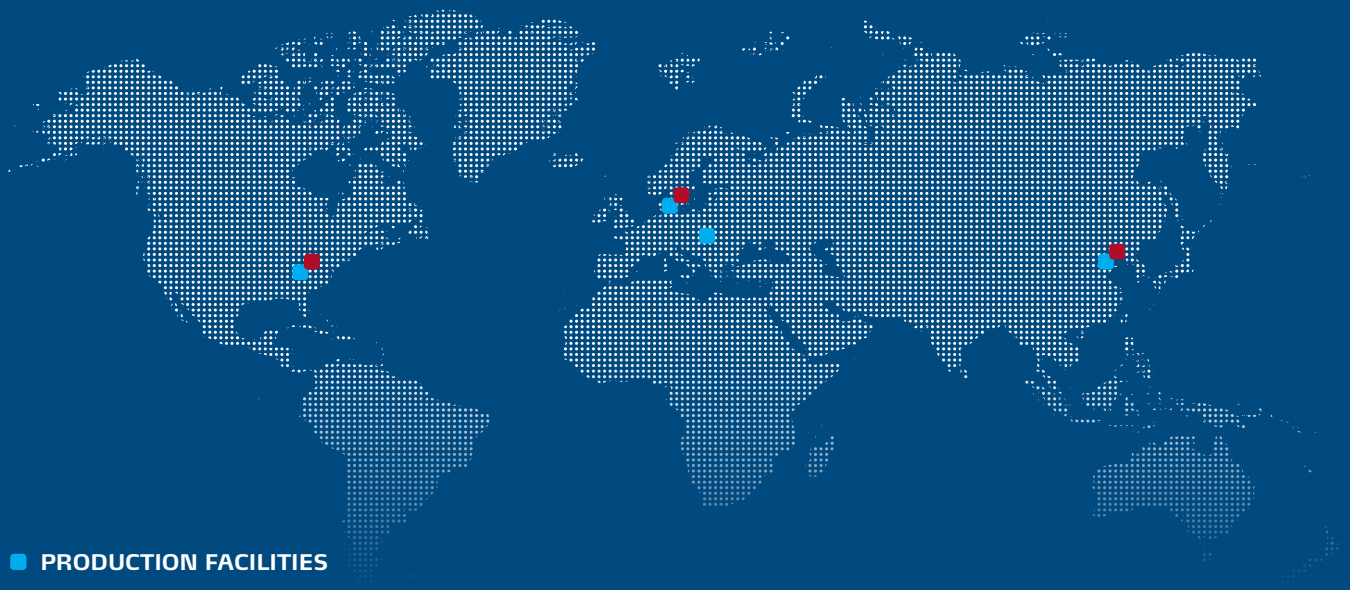
Global Support & Supply

BETTER SERVICE & FAST DELIVERY

Our focus on cooling and climate solutions has been the driving force behind our transformation from a local Danish company building upon solid craftsmanship skills to a global industrial group offering local support and global supply of technically advanced cooling solutions. Today, we have experienced employees, who serve our customers on a global scale. We have in-house production facilities in Denmark, Slovakia, China and the US to ensure high quality and short lead times. Our logistics services are second-to-none in the market.



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SLOVAKIA

USA

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