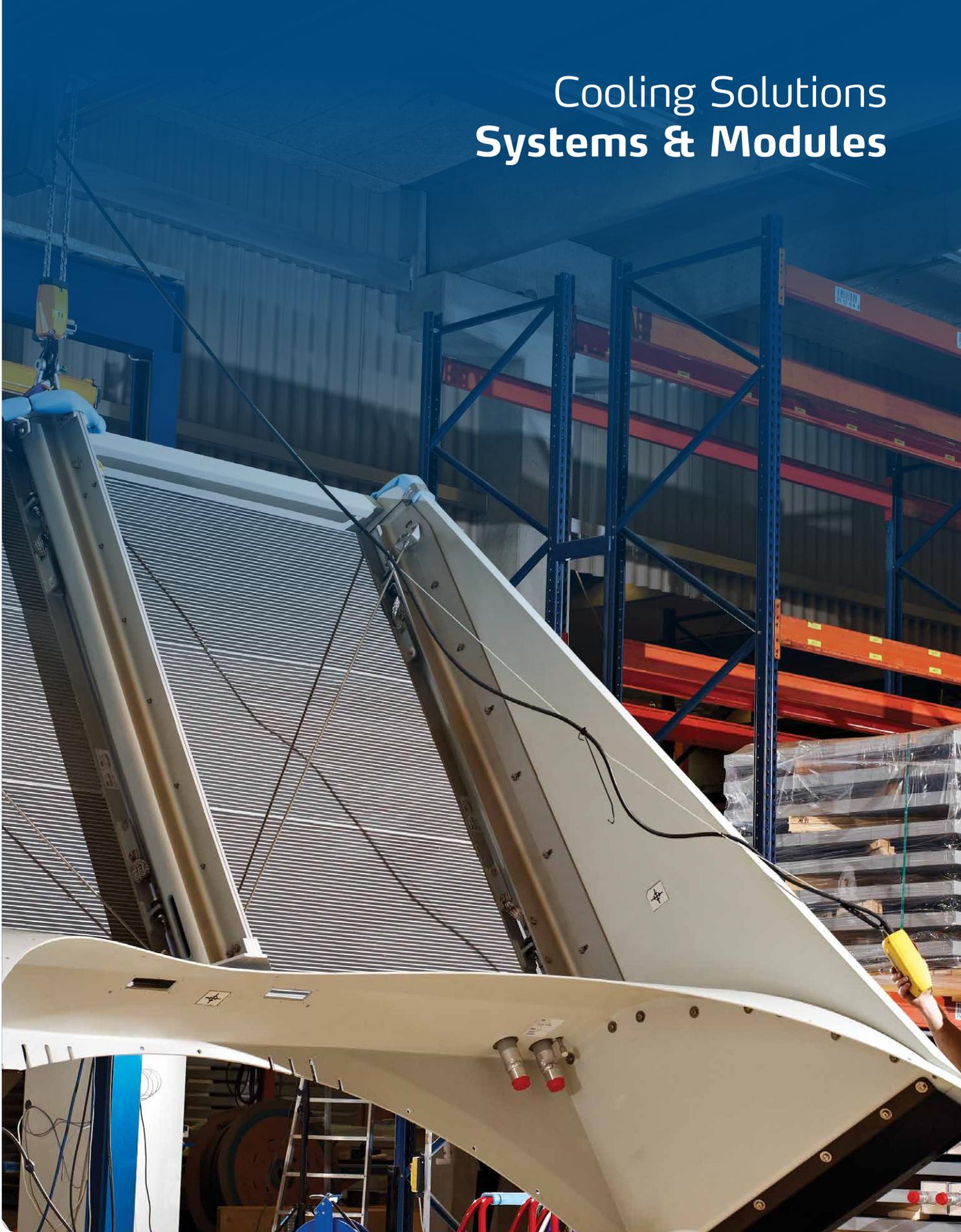


Cooling Solutions Systems & Modules



COOLING
SOLUTIONS
WIND

Nissens
COOLING SOLUTIONS

Proven performance in the wind turbine industry

Throughout the past three decades, Nissens Cooling Solutions has supplied thousands of cooling components and cooling systems to the global wind turbine industry. We have proven our performance with the market's leading wind turbine manufacturers.

Around the world, complete on- and off-shore wind parks are equipped with customized cooling solutions from Nissens Cooling Solutions. On a yearly basis, we supply cooling solutions for approx. 10 GW electricity deriving from wind energy, and the number is increasing, especially for off-shore wind parks as a natural effect of the market trend.

We have developed our business concurrently with the evolvement of the wind-turbine industry. Thanks to our presence in the wind-power segment, we are currently supplying the leading wind-turbine manufacturers around the world. We offer production facilities as well as sales and engineering support in Europe, Asia and the US.

OUR OFFERS AND STRENGTHS

Nissens Cooling Solutions offers our customers full support in the development and supply of customized cooling components and complete cooling solutions in the form of cooling systems and modules.



Keeping it simple for our customer

OFFERING CUSTOMIZATION

When designing and manufacturing our cooling systems and modules, we are working closely with our customers to understand their requirements. Every cooling solution from us is customized to meet the individual customer need. We offer customer-specified dimensioning, advanced calculations, full design and documentation as well as thorough testing and approvals.

REDUCING COMPLEXITY

We have a strong focus on reducing our customer's in-house complexity. By virtue of full project management from design to supply, Nissens Cooling Solutions assumes the responsibility from selection of suppliers, development of design and component building blocks, assembly, test and verification of prototypes, serial production start-up to delivery of the complete cooling solution.

TAKING QUALITY INTO ACCOUNT

The customer's demand for full documentation in the shape of work and test instructions, manuals, data sheets and quality approvals forms an integrated part of the solution that we offer. Seeing that Nissens Cooling Solutions is a IATF 16949-certified manufacturer, all products developed by us have passed through an APQP process, which also includes a complete PPAP documentation.

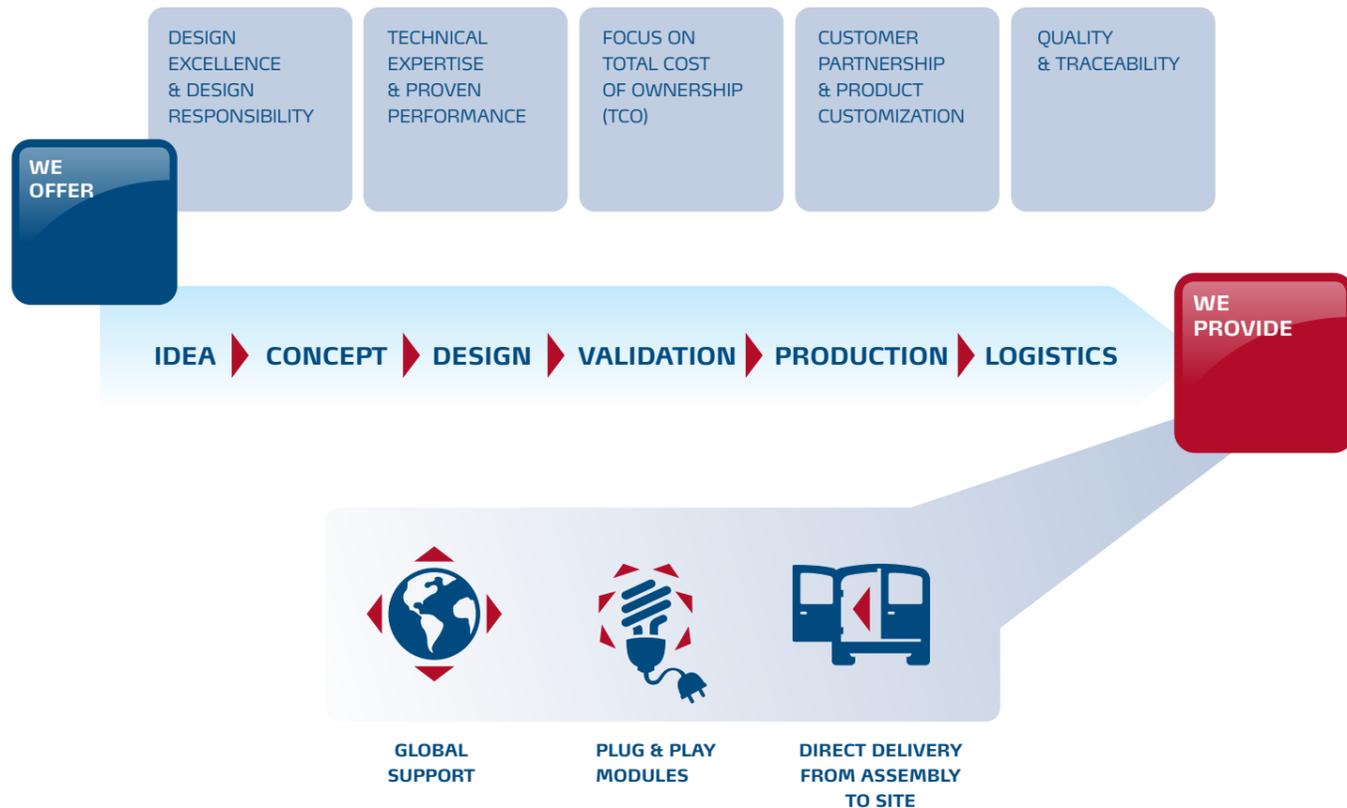
SUPPORTING THE NEED FOR TOTAL COST OF OWNERSHIP

Understanding our customer's needs and requirements obliges Nissens Cooling Solutions to take a Total Cost of Ownership perspective on the cooling solutions that we develop. Every cooling system or module is customized according to customer specification, and we consider the needs for reduced maintenance costs, low administration costs, limited costs of product development and fast time-to-market when developing and manufacturing any cooling system and module for a specific application.

"Siemens Wind Power is a global leader in the wind industry. Our guarantee of proven performance is critical for maintaining our strong market position. That obliges us to choose the best suppliers. Nissens is our preferred supplier of coolers. We greatly value their experience and know-how, especially during the development of new, innovative technical solutions. Nissens supplies high-quality products, and offers the flexibility required to meet our needs."

Siemens Wind Power

SIEMENS



PUMP STATIONS

We offer the opportunity to place the development of a complete pump station in the hands of one preferred supplier, who can provide a customized solution, where the pump unit and the rest of the cooling system form part of one integrated and optimized system.

Thanks to the compact manifold and pipe design of Nissens' pump stations, we can offer the following benefits:

- Easy installation
- High durability
- Easy maintenance

A PUMP UNIT FROM NISSENS COOLING SOLUTIONS MAY CONSIST OF THE FOLLOWING COMPONENTS:

- Pump
- Expansion tank
- Safety valve
- Heating element
- Pressure transmitter
- Temperature transmitter
- Thermo valve

The pump station design depends on the system to be cooled. The cooling of generators and gearboxes has different requirements from the cooling of converters and transformers, and Nissens Cooling Solutions takes the cooling need into consideration when designing and manufacturing the customized solution:

	Generator	Gearbox	Converter	Transformer
Pump	X	X	X	X
Expansion tank	X	X	X	X
Safety valve	X	X	X	X
Sensors/Transmitters	X	X	X	X
Heater			X	X
Thermo valve/ Mixer valve			X	X

OUR PUMP STATIONS ARE DEVELOPED FOR THE FOLLOWING APPLICATIONS:

Direct Cooling:

- Generator cooling
- Converter cooling
- Transformer cooling
- Control cabinets

Indirect Cooling:

- Pitch hydraulics
- Gearboxes
- Main bearings

EXAMPLE OF PUMP UNIT

NISSENS COOLING SOLUTIONS' PUMP UNIT: NPU-DN50/H

Pump unit for converter cooling on 3MW wind-turbine featuring:

Pump	2.2 kW, 300 l/min., 2.0 bar
Exp. tank	50 liter
Safety valve	5.0 bar opening pressure
Heater	4.5 kW
Mixer valve	30°C thermo bypass



ALUXSAFE

Nissens Cooling Solutions' AluXsafe is a safety heat exchanger. The product solution is very suitable as an integrated part of a transformer cooling system thanks to its design with two separated circuits.

With AluXsafe, Nissens Cooling Solutions has eliminated the risk of mixing water and oil, since the two media have been fully separated by an air chamber. In case of a leakage on the water/glycol side, the water will leak into the air chamber and escape from the heat exchanger without entering the transformer oil circuit. The AluXsafe thus prevents the water/glycol from causing damage to the transformer.

Thanks to a full aluminum design and the application of the turbulator technology, AluXsafe offers the following benefits compared to conventional heat exchangers in the market:

- Lower weight
- Higher heat transfer
- Improved overall efficiency and performance

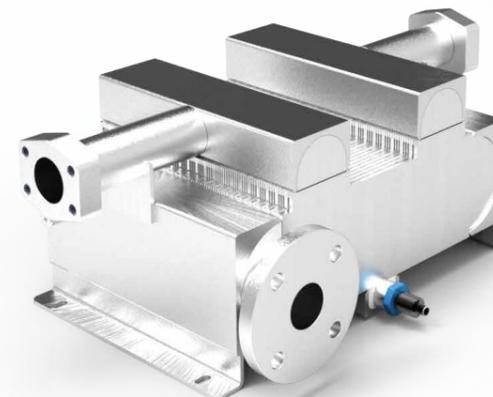
EXAMPLE OF AN ALUXSAFE SOLUTION

PRIMARY SIDE (HOT SIDE)

Medium	Oil / transformer oil
Max. operating pressure	6 bar (g)
Max. operating temperature	90°C
Min. operating temperature	- 30°C
Cleanliness	Flushed with a thin mineral oil (Shell Morlina HS2 or similar) to cleanliness class ISO 4406 -/14/11

SECONDARY SIDE (COLD SIDE)

Medium	Water / glycol (minimum 40% glycol) use approved coolant only
Max. operating pressure	6 bar (g)
Max. operating temperature	90°C
Min. operating temperature	- 30°C



ALUXCHANGER

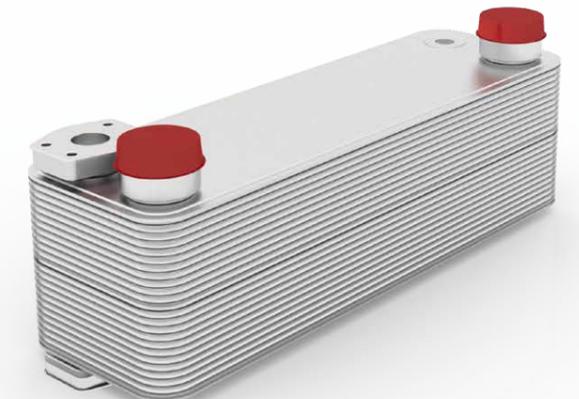
Nissens Cooling Solutions' AluXchanger is an aluminum-based plate heat exchanger for liquid-to-liquid heat exchange applications.

Heat exchangers are traditionally manufactured in stainless steel with copper-based brazing technology. With brazed aluminum as a basis for producing plate heat exchangers, the AluXchanger offers a number of crucial advantages:

- Lower weight
- Higher thermal performance
- Compact design
- Customized solutions

PRODUCT-TECHNICAL INFORMATION

Temperature range	From - 40°C to + 130°C
Working pressure - dynamic	Up to 16 bar
Working pressure - static	Up to 25 bar
Corrosion	The AluXchanger is made of long-life aluminum alloys suitable for off-shore environment.
Cleanliness	Upon request, the AluXchanger can be supplied flushed with mineral oil to cleanliness level -/13/10 according to ISO 4406.



COOLER MODULES



Nissens Cooling Solutions develops and supplies complete cooling modules to both on- and off-shore wind turbines. Depending on the application, the cooling module may be placed on top of the nacelle or on the side of the nacelle.

MAIN COMPONENTS IN NISSENS COOLING SOLUTIONS' COOLER MODULES:

- Cooler
- Mounting frame
- Steel parts
- Piping
- Valves
- Fiber-glass cover
- Other components and features are also available upon customer request.

PASSIVE COOLING

Our cooling module is based on passive cooling, which offers the opportunity to make optimal use of the wind speed and avoid the use of fans and motors. That means that the cooler works without the use of electrical power.

The benefit to our customers is that a cooling solution without the use of motors offers higher operational reliability, since the risk of motor failure as well as the need for motor maintenance are eliminated.

Nissens Cooling Solutions' investment in passive cooling is reflected in a specially developed cooler type for passive cooling as well as unique fin designs for the customized coolers used for passive cooling. These benefits increase the efficiency of the cooler and contribute to facilitating the cooler cleaning process.

FULL IN-HOUSE ASSEMBLY SET-UP

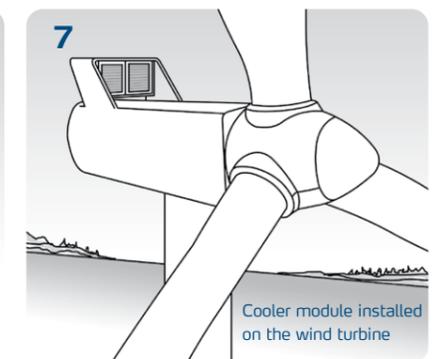
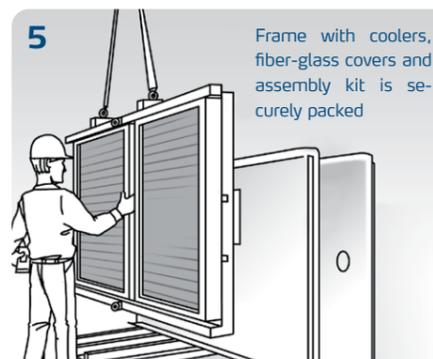
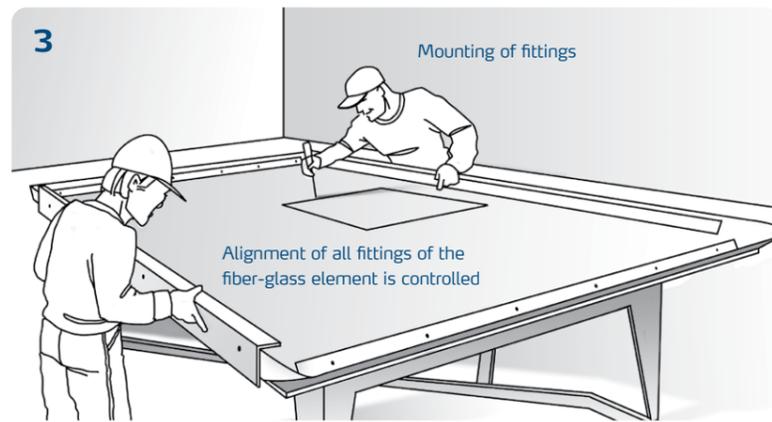
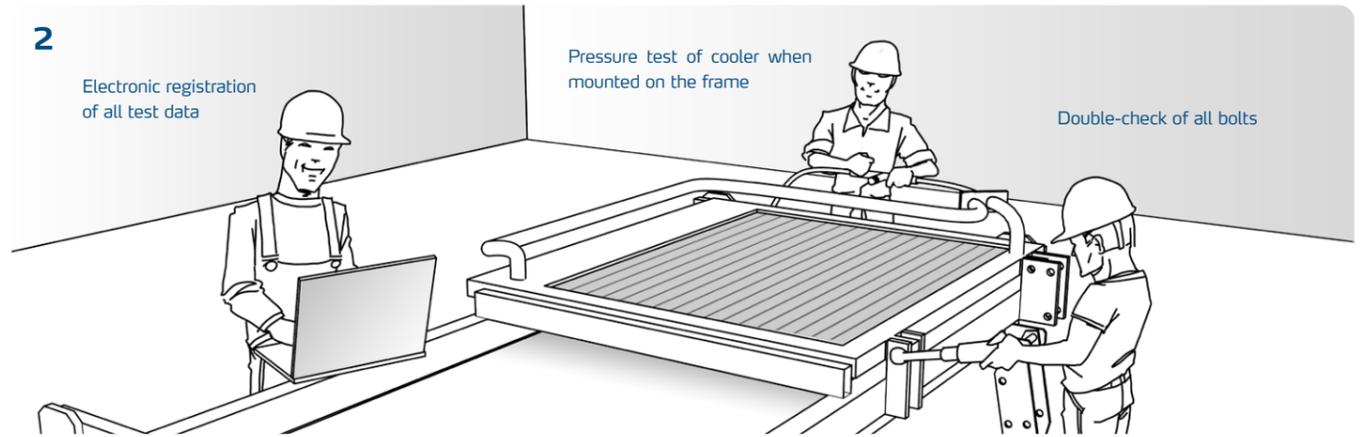
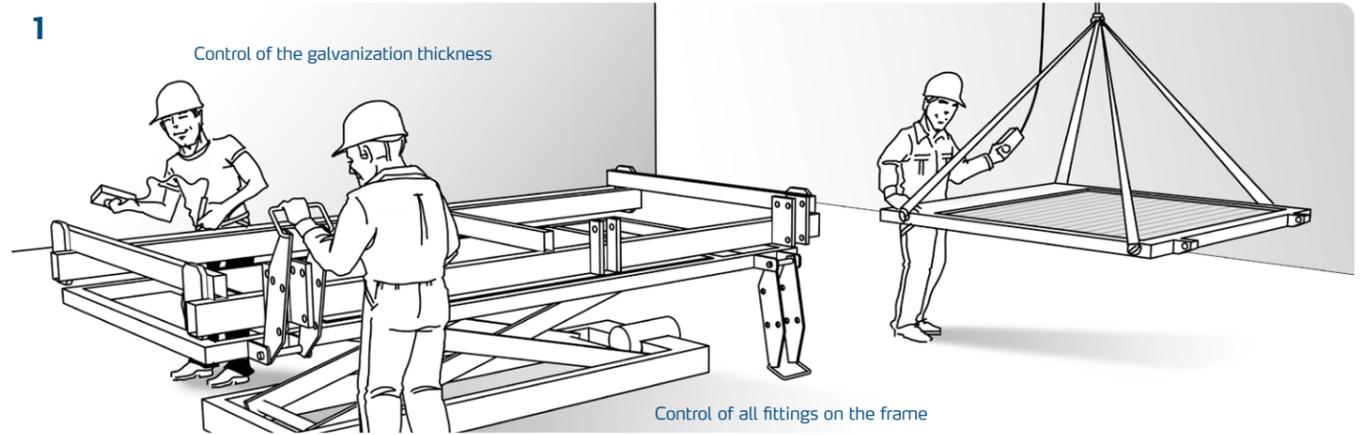
Nissens Cooling Solutions has a full cooling module assembly set-up equipped with assembly benches and fixtures ensuring that all components and parts for assembly have a perfect fit. Full alignment and control of the interfaces are thus ensured, and Nissens Cooling Solutions can supply the entire cooler module directly from the assembly hall to the site of the erected wind turbine.

TRACEABILITY

A serial logger ensures the traceability of all critical components integrated in our cooler modules. The customer's item number and Nissens Cooling Solutions' item number are matched with the serial and batch numbers of all the components that are used for the cooler module. We file the data in a secured network in order to make sure that full traceability of the product and its components is available upon request.

TEST LAB

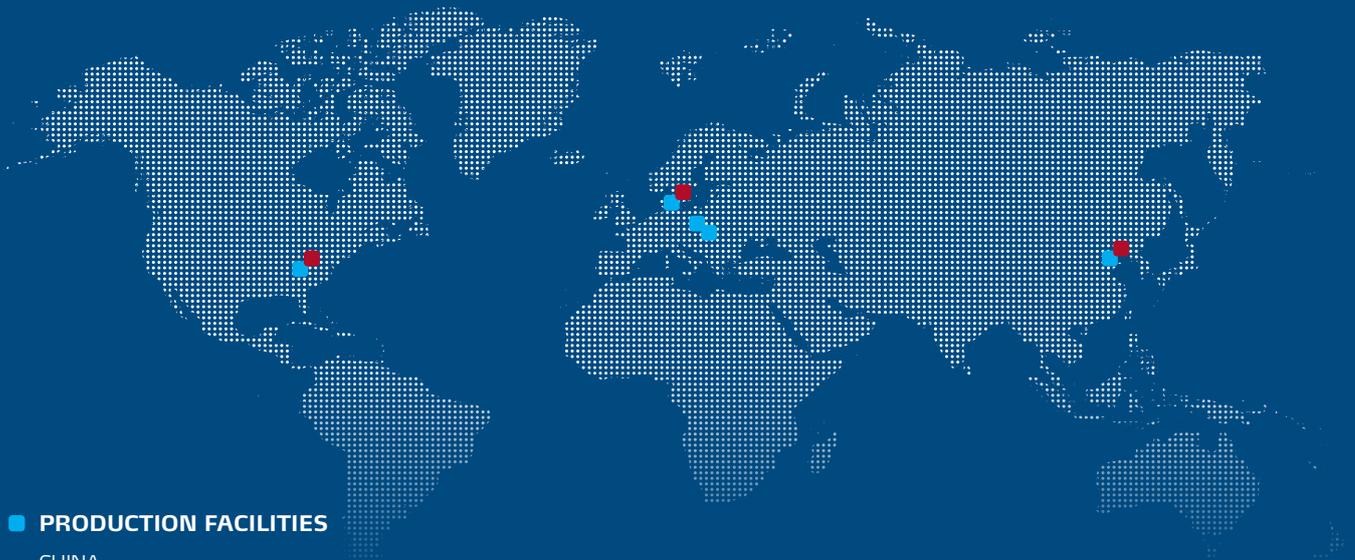
Nissens Cooling Solutions has an advanced test lab to carry out tests that offer the required data for full and sufficient product documentation. Performance curves, pressure drop tests and pressure curves, life cycle tests (vibration, pressure pulse, corrosion and thermal stress tests) are carried out by Nissens Cooling Solutions, and the test results are submitted to our customer in the form of written reports. We also perform external cooler module tests in specially designed wind tunnels on a 1:1 scale upon customer request.



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, Czech Republic, China and the US to ensure high quality and short lead times. Our logistics services are second-to-none in the market.



■ PRODUCTION FACILITIES

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DENMARK
SLOVAKIA
CZECH REPUBLIC
USA

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