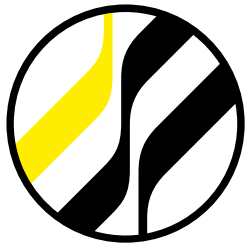


Kelvion



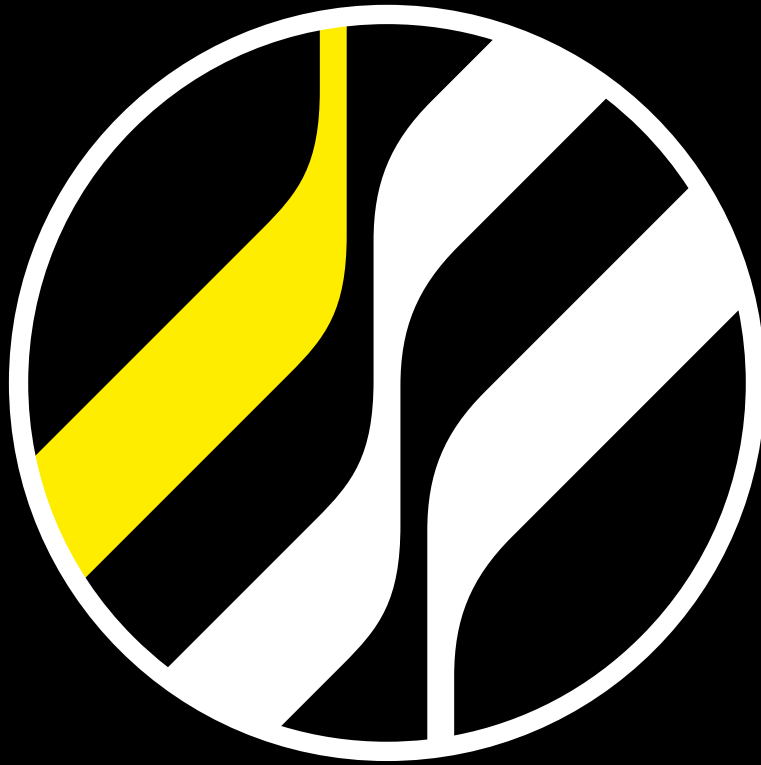
Condensers, Gas Coolers &
Dry Coolers

Kelvion Adiabatic Spray & Pad Solutions

COOLING PERFORMANCE INSPIRED BY NATURE



Kelvion



EXPERTS IN HEAT EXCHANGE – SINCE 1920

Welcome to Kelvion! Where Heat Exchange is our Business. We are one of the leading global manufacturers of heat exchangers and have been providing solutions for almost every industrial application imaginable since the 1920s, specializing in customized solutions suitable for extreme environmental conditions - as of 2015 under the name of Kelvion.

With one of the most extensive selections of heat exchangers in the world, we are a well-known partner in many industries, including transportation, energy, oil and gas, the heavy industry, chemical and marine as well as sugar, food and beverage and the HVAC and refrigeration technology sector. Our products include Compact Fin Heat Exchangers, Plate Heat Exchangers, Single Tube Heat Exchangers, Transformer Cooling Systems, Cooling Towers and Shell & Tube Heat Exchangers.

Our many years of experience and in-depth expertise have made us specialists in this field. Our heat exchangers are designed specifically to meet the needs of the respective machine or equipment system, ensuring outstanding energy efficiency and reliability in any market segment. This gives our customers a cutting-edge over their competitors while also reducing operating costs over the long term.

As your heat exchange partner, we understand that outstanding and reliable after-sales services are critical for you, our customer, and we work alongside with you in close partnership supporting you throughout the full life cycle of your plant and equipment to ensure lasting business success.

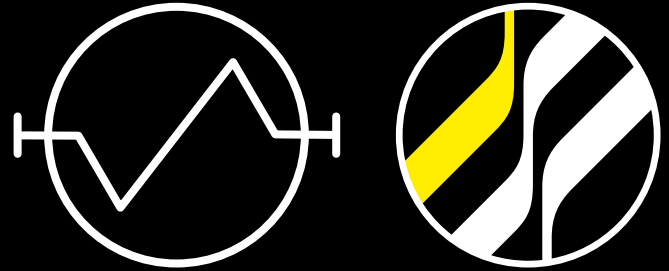
Kelvion – Experts in Heat Exchange.

KELVION – A TRIBUTE TO LORD KELVIN (1824 - 1907)

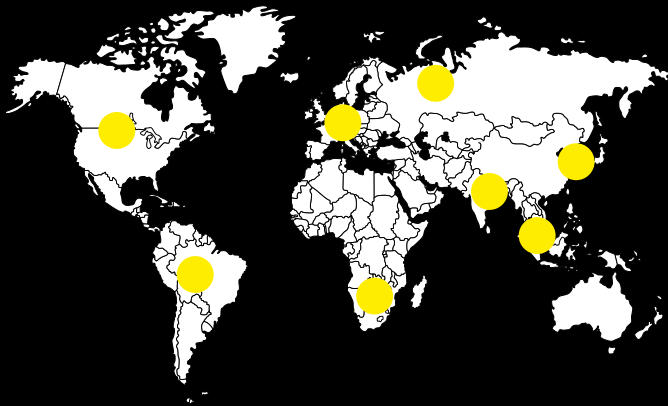


Lord Kelvin formulated the laws of thermodynamics and absolute units of temperature are stated in kelvin, in his honor.

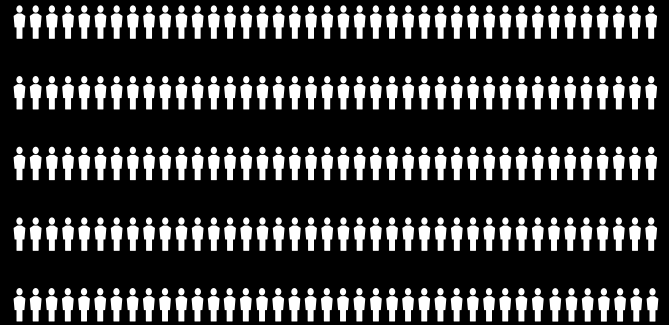
OUR LOGO – INSPIRED FROM THE SCHEMATIC FOR HEAT EXCHANGER



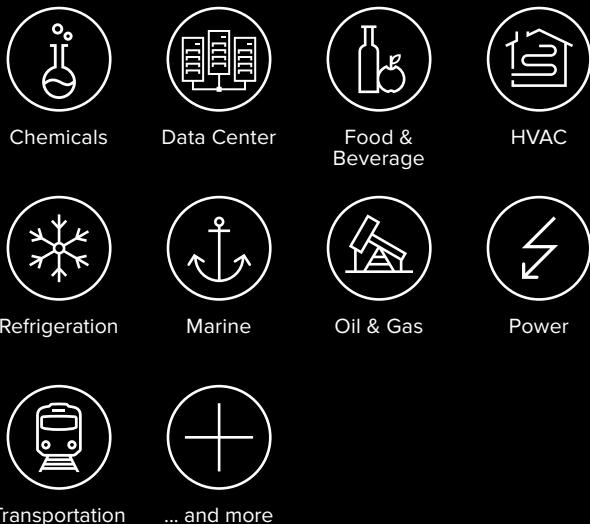
67 BRANCHES AND SALES PARTNERS WORLDWIDE



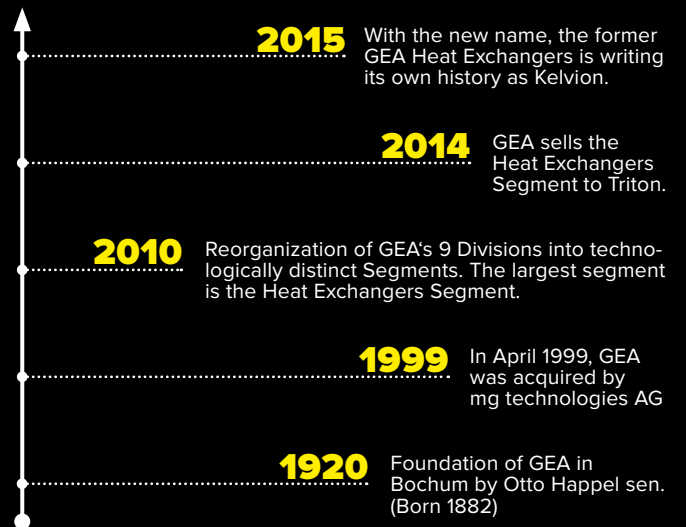
5,000 EMPLOYEES WORLDWIDE



YOUR MARKETS ARE OUR MARKETS



KELVION HAS A LONG HISTORY



Kelvion Adiabatic Solutions

PAD AND SPRAY **WET COOLING** **SOLUTIONS**

Kelvions experience of adiabatic systems can be traced back to the early 1990's. This technology can offer major benefits to your system and is perfectly adapted to our versatile V-Bank range.

During our extensive testing in our R&D facilities we verified several spray systems to get the best possible results with regard to water distribution, water mass flow and droplet formation. We also tested different pad systems from numerous suppliers in our labs to judge independently the claims made when used with our design.

The result is a tailored adiabatic pad system with a new water distribution system for outstanding performance as well as an update to our existing spray system to offer improved performance and water efficiency.

Both options will offer you a uniform, reliable cooling effect with a tested, verified air pressure drop.

YOUR BENEFITS

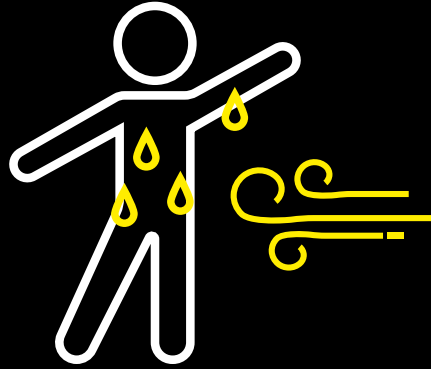
- ▶ Tested and validated in our R&D facilities
- ▶ Uniform air-cooling effect over the coil surface
- ▶ Reliable air cooling and water consumption values
- ▶ According to your preferences you could benefit from:
 - ▶ Reduced Footprint or
 - ▶ Higher Efficiency or
 - ▶ Enhanced Capacity or
 - ▶ High Peak Offset Safety or
 - ▶ Potential for prolonged free cooling

ADIABATIC PRINCIPLE



SWIM

After a nice swim on a hot sunny day



WIND

The wind evaporates the water drops



CHILL

You immediately feel the cooling of the skin through the evaporation

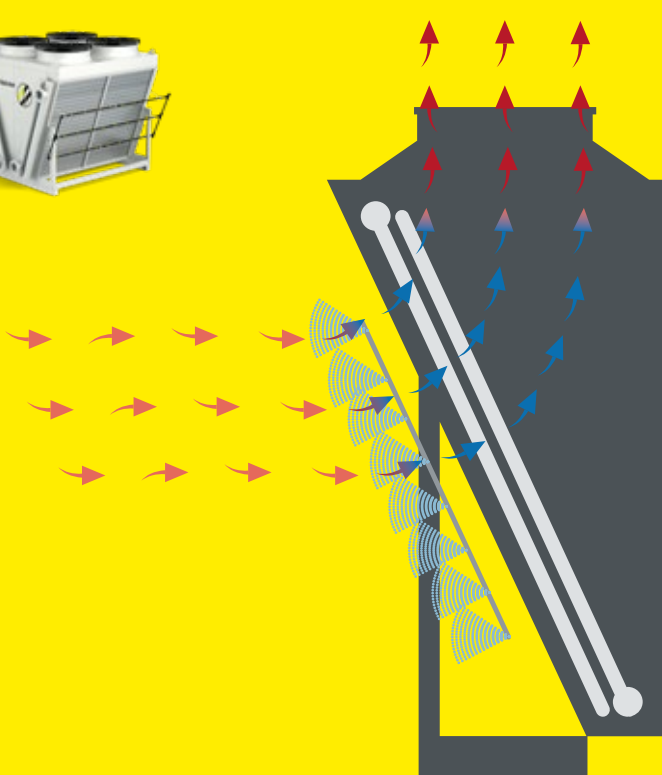
ADIABATIC FUNCTION

In an adiabatic system, the evaporation energy of the water is used to cool the air by **increasing its humidity**.

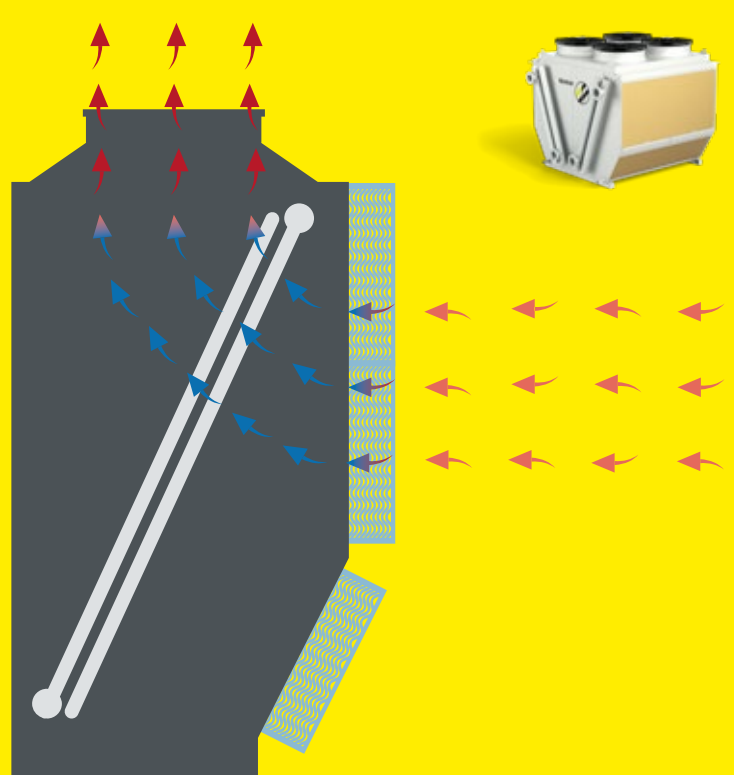
The term „adiabatic“ comes from thermodynamics and describes a system where there is no heat exchange with the environment.

An adiabatic system generates air cooling at the dry cooler.

SPRAY SYSTEM



PAD SYSTEM



THE RIGHT SOLUTION FOR EVERY CONDITION

CONDENSER

- ▶ COLD CLIMATE
- ▶ LESS MAINTENANCE
- ▶ NO WATER

ADIABATIC SPRAY SYSTEM

- ▶ HOTTEST DAYS PER YEAR
- ▶ NO LEGIONELLA
- ▶ SYSTEM PROTECTION / SUPPORT
- ▶ SMALL TEMPERATURE DROP

kW



In every cooling application you have energy to reject. Depending on the climate conditions this energy can be rejected with dry operating coolers. The fans of the dry cooler need electric energy to do the Job. On the other side we can evaporate water like the cooling tower. This method requires less power but many water. Pad and Spray systems are mixed form and can perfectly balanced in terms of water and power consumption.

ADIABATIC PAD SYSTEM

- ▶ WARM DAYS
- ▶ NO AEROSOLS
- ▶ SYSTEM EFFICIENCY INCREASE
- ▶ HIGH TEMPERATURE DROP



COOLING TOWER & GPHE



- ▶ DRY CLIMATE
- ▶ EASY MAINTENANCE
- ▶ HIGH CAPACITY AT LOW TEMPERATURE
- ▶ LARGEST TEMPERATURE DROP

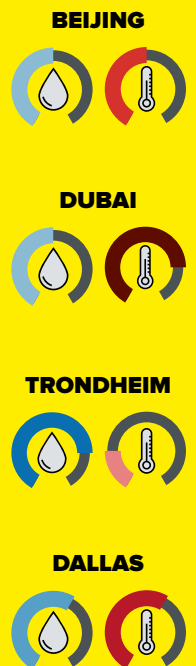


H₂O

FREE COOLING POTENTIALS FOR DIFFERENT CLIMATES

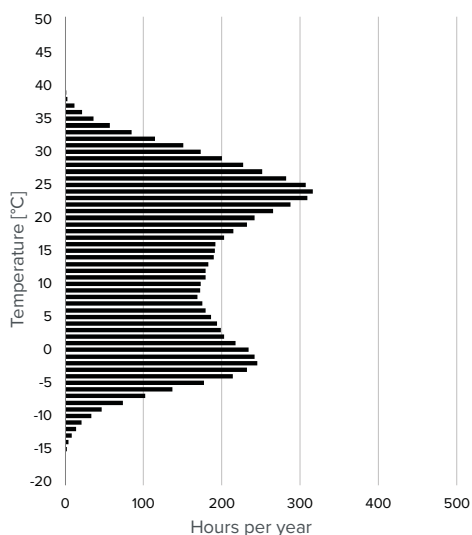
We have run sample calculations for 4 different locations to show the free cooling potential for each heat rejection method on each location. Calculations are based on 1 MW with average local temperature data over the past 40 years.

 Humidity
 Mean Temperature



BEIJING

Annual Temperature Distribution



 Power Consumption  Water Usage



Dry Cooler



73 MWh

0 m³

FREE COOLING



Adiabatic Cooler



58 MWh

3767 m³

FREE COOLING



Cooling Tower



16 MWh

18290 m³

FREE COOLING

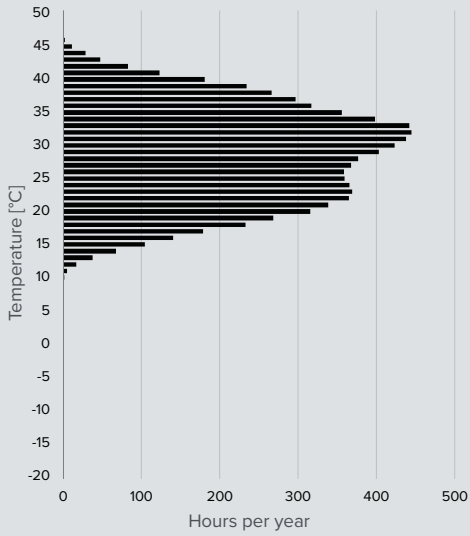


DUBAI



⚡ Power Consumption 💧 Water Usage

Annual Temperature Distribution



Dry Cooler



161 MWh

0 m³

FREE COOLING

28%



Adiabatic Cooler



136 MWh

13836 m³

FREE COOLING

54%



Cooling Tower



34 MWh

19883 m³

FREE COOLING

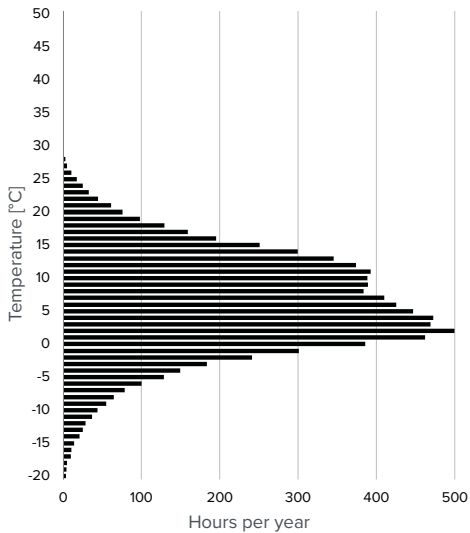
69%

TRONDHEIM



⚡ Power Consumption 💧 Water Usage

Annual Temperature Distribution



Dry Cooler



16 MWh

0 m³

FREE COOLING

99%



Adiabatic Cooler



15 MWh

44 m³

FREE COOLING

100%



Cooling Tower



7 MWh

17643 m³

FREE COOLING

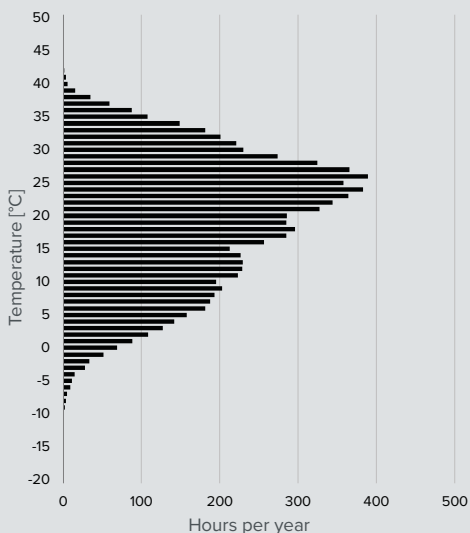
100%

DALLAS



⚡ Power Consumption 💧 Water Usage

Annual Temperature Distribution



Dry Cooler



101 MWh

0 m³

FREE COOLING

61%



Adiabatic Cooler



86 MWh

6161 m³

FREE COOLING

80%



Cooling Tower



21 MWh

18656 m³

FREE COOLING

93%

ADIABATIC SOLUTIONS



SPRAY SYSTEM

- ▶ Higher Normative Requirements in some countries
- ▶ Very good water utilization
- ▶ Less Air Cooling but improved heat transfer



Kelvion units can be fitted with an adiabatic pad or spray cooling system to reduce the air inlet temperature with evaporate water. Both pad and spray technologies help to make the units more efficient and provide a better shut off safety at high temperatures.

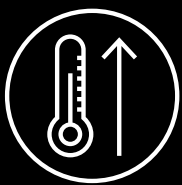


PAD SYSTEM

- ▶ Lower Normative Requirement
- ▶ Large Air Cooling Possible
- ▶ No aerosols

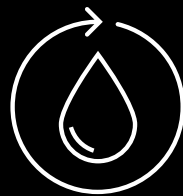


SPRAY SYSTEM



HIGH PEAK SAFETY

Air-on Temperature suppression in high ambients



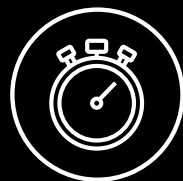
UP TO 95% WATER EFFECTIVENESS*

With modern nozzle technology



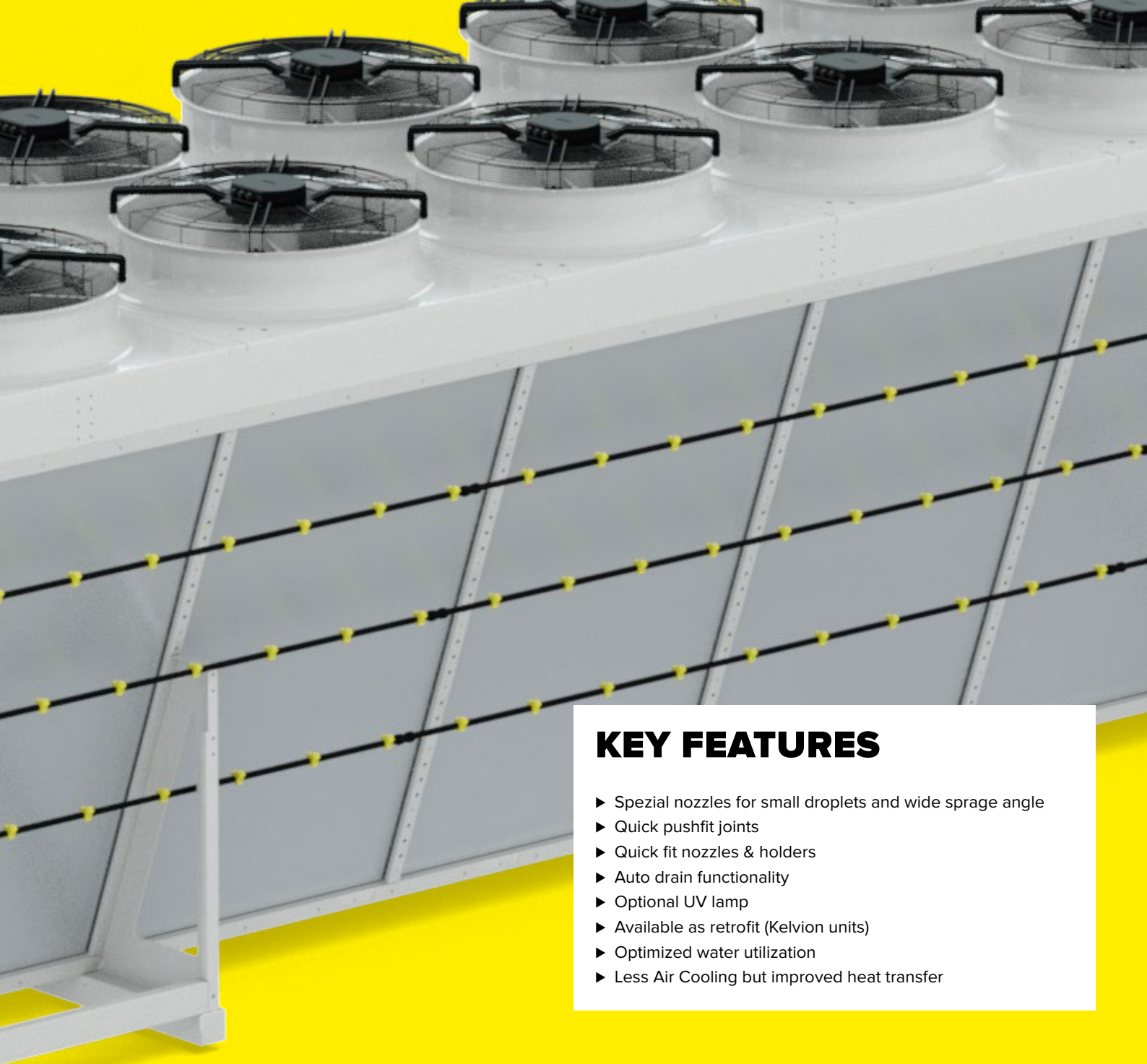
MINIMAL WATER ON COIL

Spray against the air direction. Spray pattern selected for high evaporation in air



LOW OPERATION HOURS

Typically used for low operating hours per year



KEY FEATURES

- ▶ Spezial nozzles for small droplets and wide sprage angle
- ▶ Quick pushfit joints
- ▶ Quick fit nozzles & holders
- ▶ Auto drain functionality
- ▶ Optional UV lamp
- ▶ Available as retrofit (Kelvion units)
- ▶ Optimized water utilization
- ▶ Less Air Cooling but improved heat transfer



35% IMPROVED WATER USAGE**

With greater options for control
More stages = less waste

CONTROL STAGES

- 01 Mains Pressure [2 Bar] | Half Sparges
- 02 Boost Pressure [8 Bar] | Half Sparges
- 03 Main Pressure [2 Bar] | All Sparges
- 04 Boost Pressure [8 Bar] | All Sparges

* 95% evaporation of sprayed water

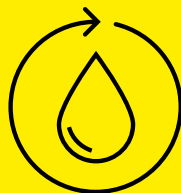
** compared with single stage control methodologies

PAD SYSTEM



PROLONGED USE

Air-on Temperature suppression in high ambients



IMPROVED WATER MANAGEMENT

With recirculation availability & stepless regulation



INCREASED ANNUAL FREECOOLING

Maximised hours of free cooling in year. Reduced hours of mechanical cooling.



GREATER AIR-ON SUPPRESSION

Longer air-water exposure leads to increased levels of evaporation



KEY FEATURES

- ▶ Thick 150mm pads standard
- ▶ Optional 200mm thick pads
- ▶ Unique water distribution
- ▶ No distribution pads
- ▶ Easy clean
- ▶ Tool-less pad removal
- ▶ Auto draining function
- ▶ Optional UV lamp
- ▶ Single drainage point
- ▶ Available as retrofit (Kelvion units)
- ▶ Less aerosols than cooling towers



EVERY WATER QUALITY SUITABLE

Basis have low water quality requirements
Recirculation need high quality soft water

CONTROL OPTIONS

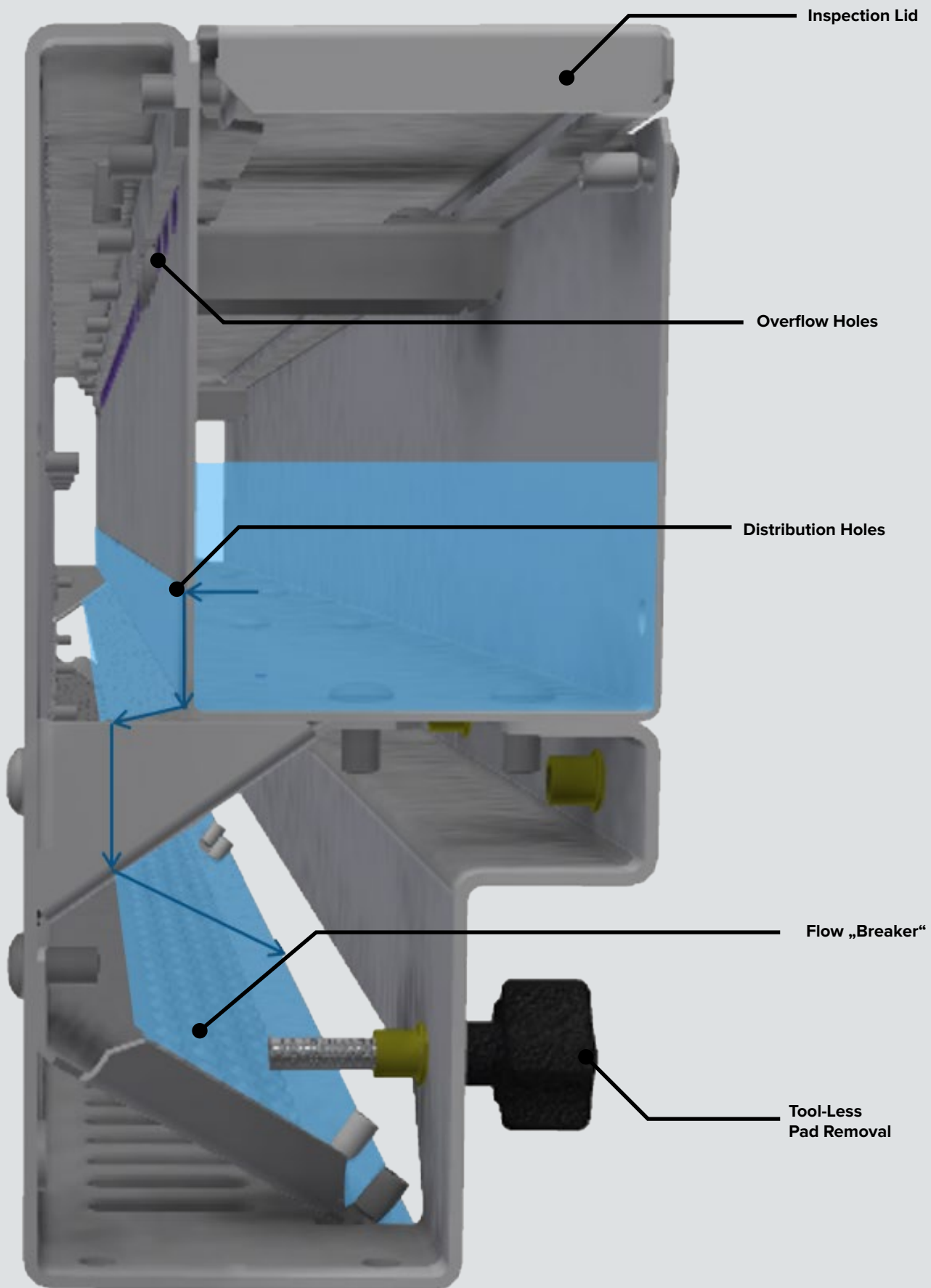
- 01 ON / OFF
- 02 Proportional Flow Control
- 03 Recirculation

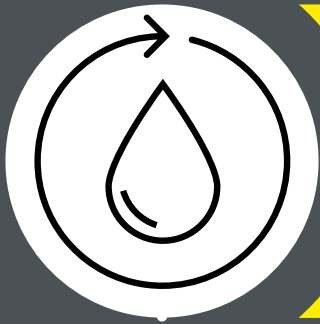
RECIRCULATION

Recirculates water a set number of times
based on site water quality

When not in use, system is totally drained

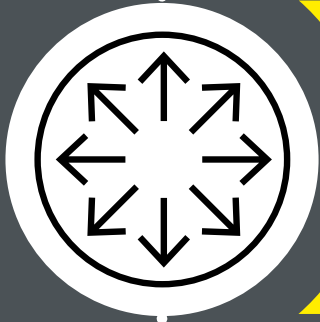
ADIABATIC PAD DISTRIBUTION





WATER LEVEL

- ▶ Harmonized distribution over the unit length
- ▶ Water flow fluctuations and control are balanced via water level



DISTRIBUTION

- ▶ Minimize distance between holes for best distribution
- ▶ Vertical hole position for safest operation



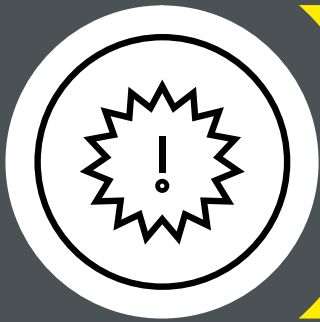
MAINTENANCE

- ▶ Hinged top plate for periodic inspection and easy clean
- ▶ All strong metal components (high pressure cleaning suitable)



GRADUAL RESPONSE TO CONTROL

- ▶ The controlled adiabatic start and stop protects the entire control concept from upswing



FLOW BREAKER

- ▶ Breaks apart water streams to create a better distribution across the pads
- ▶ Delivers water only to the front of the pad which maximises water effectiveness
- ▶ Air shears the water through the pad and is aided by capillary action

ADIABATIC CONTROLS



BASIC

- ▶ On / Off Control
- ▶ On / Off Solenoid
- ▶ Control Stages: 1
- ▶ Controller: Optional Parametric

SPRAY SYSTEM



UV

- ▶ On / Off Control with Protection*
- ▶ On / Off Solenoid
- ▶ UV Lamp*
- ▶ Control Stages: 1
- ▶ Controller: Carel



PUMP

- ▶ Boost Pressure
- ▶ On / Off Solenoid Pump
- ▶ Control Stages: 2 [4 with Shut Off]
- ▶ Controller: Carel

SHUT OFF

Option available for **PUMP** and **COMPLETE** system

- ▶ Additional Solenoid Valves
- ▶ Shut Off of half sparges
2 extra control stages
- ▶ Limit spray volume



COMPLETE

- ▶ Boost Pressure with Protection*
- ▶ On / Off Solenoid UV Lamp* Pump
- ▶ Control Stages: 2 [4 with Shut Off]
- ▶ Controller: Carel

* UV-Lamp reduces legionella risk



BASIC

- ▶ On / Off Control
- ▶ Controller: Optional Parametric

PAD SYSTEM



BASIC+

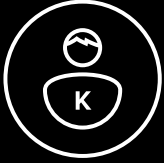
- ▶ Water Flow based on demand
- ▶ Proportional flow control
- ▶ Parametric Controller
- ▶ Regulates water flow on pad temperature



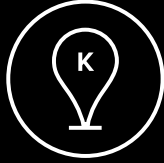
RECIRCULATION

- ▶ Minimal waste with recirculation
- ▶ Cyclic water recirculation
- ▶ Parametric Controller
- ▶ UV lamp protection

KEEPING INNOVATION AT THE FOREFRONT



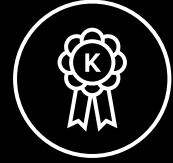
35 R&D Experts



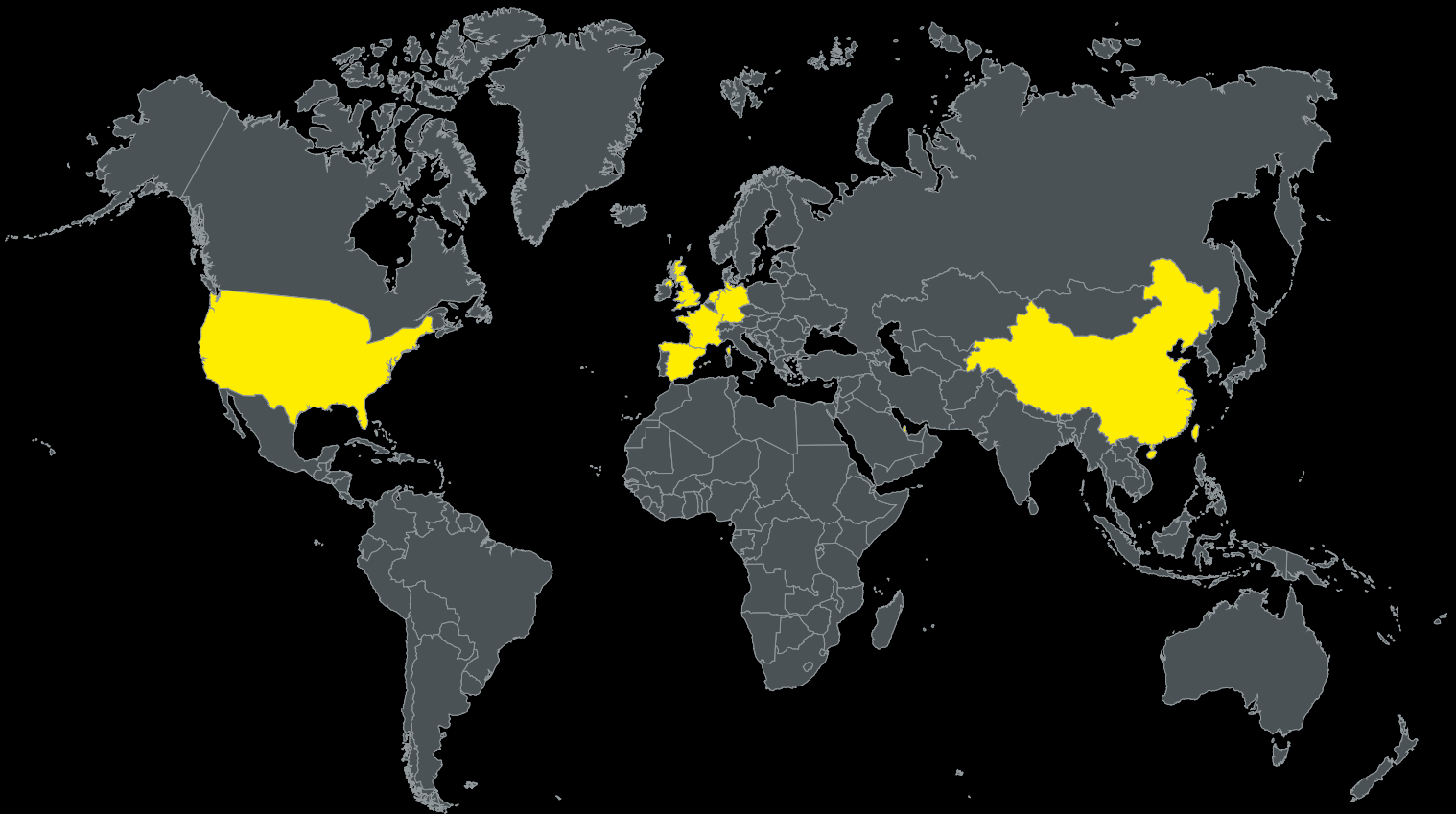
6 R&D Locations



2,000m² Lab Area



100 Years Experience



Kelvion's comprehensive research and development facilities enable us not only to validate the performance of our products, but also to optimize customized solutions directly for your application.

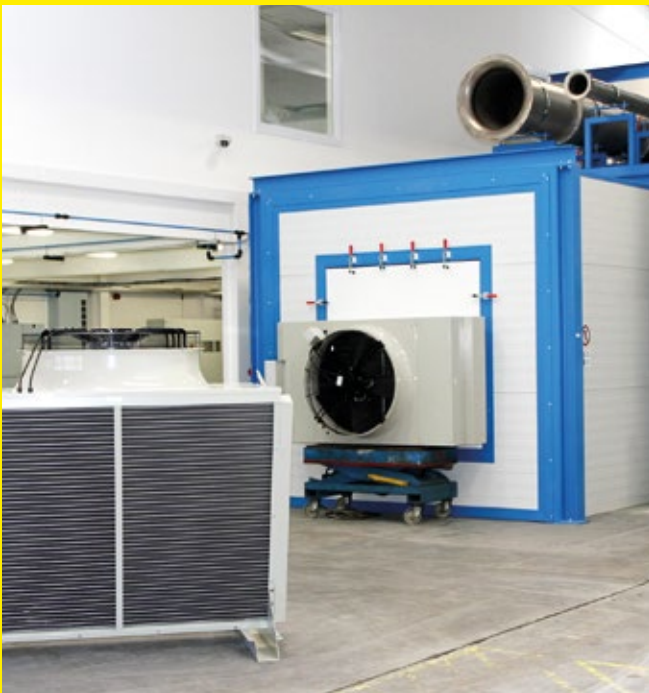
Our extensive, decades-long, experience of working as a nominated technical partner with end users, technology start-ups, universities and established engineering organizations has given us a diverse knowledge base. This enables us to find a solution to meet the most challenging cooling and heat transfer requirements. Continuously researching heat exchanger optimization is critical to achieving our innovation goals and understanding our application is pivotal to this success. Our laboratory facilities across Europe can test air coolers with a thermal balance up to a nominal maximum capacity of 600kW (from 100W), and dry air coolers/ ambient rejecters up to a 1.4MW.

A calibrated calorimeter chamber capable of holding units with dimensions of up to 12 m long, 4 m high and 3 m wide, allows for the largest of heat exchangers to be tested.

The in-house wind tunnels can test air volumes up to 50,000 m³/hour and higher air volumes can be calculated from lower fan speed testing. Synthetic refrigerants can be tested up to a nominal capacity of 600kW and CO₂ systems can be tested up to 150 kW; a range of other working fluid (synthetic and natural) can also be tested at various conditions and capacities. With a range of facilities available, we will try and find rapid testing solutions to meet requirements.



Unit under test in large calorimeter room



Wind Tunnel – Discharge Chamber 3m²



Component analysis using the x-ray micro-tomography ensures the quality of fin press and joint integrity, and is also available to validate contractor joints or other component analysis on request.

Resident CFD and FEA can be used for a range of investigations, which can also be validated against physical simulations of most scenarios in the laboratory.

We take great pride in offering a high quality, robust, efficient and reliable solution specific to application environments and the laboratory is there to help facilitate innovation and remove the risk from application critical environments.

Summary of laboratory facilities:

- ▶ Temperature controlled chamber with full control from -40°C to +60°C
- ▶ Dimension of chamber: 16 m long, 7 m wide, 8 m high
- ▶ R507A refrigeration plant with nominal cooling capacity range 0.1 kW - 600 kW
- ▶ Natural refrigerant plant (CO₂) with nominal loading of 2.5 kW - 150 kW
- ▶ Boiler system capable of 2kW - 1,400 kW
- ▶ Wind tunnel with flow range of 720 to 50,000 m³/hr and up to 1000 Pa back pressure
- ▶ Heat transfer coefficient test rig, with air flow rate from 0.5 m/s to 9 m/s
- ▶ Free field sound pressure and reverberant sound power measurements
- ▶ X-Ray micro-tomography for finite analysis of components
- ▶ Burst pressure testing up to 620 Bar
- ▶ Small environmental chamber with full humidity control, -60°C to +150°C
- ▶ Smoke generation and air distribution testing
- ▶ Prototype fabrication, motor test facilities



- ▶ Kelvion's latest user-friendly, web-based and mobile RT application
- ▶ Select the right components from our extensive product range
- ▶ Receive all information, technical specifications and calculation results
- ▶ Technical data available as pdf-file or as shared Kelvion code
- ▶ Available in several languages and suitable for all operating conditions

www.kelvion.com

SELECTION SOFTWARE

1

CHOOSE PRODUCT GROUP

- ▶ Condenser
- ▶ Dry Cooler
- ▶ Gas Cooler

2

SELECT ADIABATIC

- ▶ YES
- ▶ This will open all inputs for the Adiabatic selection
- ▶ Weather data support the specification of climate conditions

3

SELECT EITHER

- ▶ Spray System
- ▶ Pad System

4

SPRAY SELECTION

- ▶ Pressure (default 2 bar)
- ▶ Controls
- ▶ UV Lamp
- ▶ Switch Temperature (optional)

PAD SELECTION

- ▶ Recirculation Y/ N
- ▶ Controls
- ▶ Switch Temperature (optional)

5

DONE

- ▶ Optional comparisons via annual comparison can be made for your selection
- ▶ Costs and total cost of ownership can be calculated and compared
- ▶ Get your Data Sheet or request quote directly

www.kelvion.com