

NGC

Next Generation Cooling

Beyond the Thermal Threshold

Redefining Cooling Architecture for High-Density Data Centres



Stability under dynamic load

Decarbonisation through engineering precision

Collaboration at system level



Future-Proofing Data Centres

Precise engineering. Credible sustainability.
Professional collaboration.

→ **Constructing the AI Infrastructure Bridge**

How do data centres move from low-density architectures to high-density AI demands?

The challenge is not adding capacity – it is managing the transition.

NGC operates where traditional cooling concepts stop working – where system-level understanding of thermal and hydraulic behaviour becomes critical.

Rear-door heat exchangers deliver precise rack-level temperature control in environments where response time, autonomy, and predictive control determine stability.

→ **Decarbonising the Data Centre Industry**

How can the largest climate burden in data centres – cooling energy – be reduced in practice?

Decarbonisation begins by removing inefficiency at the source.

By enabling supply temperatures of 22–30 °C and return temperatures up to 56 °C, NGC systems reduce cooling energy demand by up to 90% while improving cooling equipment efficiency.

Through retrofit-based circularity, existing data centres can be up-graded rather than rebuilt.

Excess heat can be reused as 56 °C water for district or local heating – extending sustainability beyond the data centre.

→ **Eye-to-Eye Professional Collaboration**

How are complex infrastructure challenges best resolved?

By working directly with those who understand them.

NGC works in close dialogue with engineers, operators, and service teams – engaging real constraints, not idealised scenarios.

Challenges are addressed through collaborative reasoning, pragmatic solutions, and decisions grounded in physical reality.

System Performance Characteristics



High Efficiency Across the Operating Range

Maintains efficiency and precision from low-load operation to full-load conditions.



< 0.5 s Response Time

Stabilises thermal behaviour during sudden load shifts. From idle to maximum cooling in less than one second.



Load Changer Boost™ (Patent Pending)

Predictive thermal control that anticipates change rather than reacting to it. Optimises performance continuously, multiple times per second, by learning from real-time system feedback.



Thermal Neutrality at Room Level

Removes heat at the source. Compensates autonomously for transient heat sources such as open racks or service events.



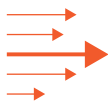
Up to 90% Cooling Energy Reduction

Enables pPUE levels below 1.1 – demonstrated as low as 1.004 under real operating conditions. 1.035 for the full cooling solution.



Zero Additional White Space

Rear-door heat exchangers mount directly onto existing racks – no additional floor footprint.



European Engineering & Supply Chain

Designed in Denmark. Manufactured in the EU using established European components (e.g. Grundfos, Alfa Laval, MODU, Stäubli).



Distributed Redundancy

N+1 or N+2 redundancy integrated at door level – resilience built into the architecture. Neighbour doors and CDUs compensate for unexpected heat loads.



Retrofit-Ready Architecture

Transition from air to liquid cooling without structural rebuild or extended downtime.

Constructing the AI Infrastructure Bridge

System Transition

1

The Thermal Threshold

Air cooling works – until compute density crosses the thermal threshold.

For years, incremental upgrades were enough. Higher airflow. Stronger fans. Better containment and more equipment. When density rises beyond a certain point, air becomes a limiting medium.

Heat accumulates faster than it can be removed.

“Beyond that point, you’re no longer removing heat – you’re chasing it.”

2

The Response Gap

AI doesn’t break cooling systems. Density does.

The challenge is not artificial intelligence.

It is the concentration of compute within the same physical footprint.

When kilowatts per rack rise sharply, response time becomes critical.

“When kilowatts per rack rise faster than response time, the system destabilises.”

3

From Product to Behaviour

We didn’t just improve a rear-door cooler. We changed how the system behaves.

Cooling can be treated as equipment – or as system behaviour. At high density, stability depends on how components interact, not how they perform in isolation. NGC’s system is designed to anticipate thermal change – not just react to it.

“At some point you stop designing components and start designing behaviour.”

4

Autonomous, Not Isolated

Each rear door is autonomous – but it never acts alone.

Every rack regulates its own flow. But stability emerges from coordination.

Units monitor conditions locally while compensating collectively. The room remains thermally neutral – even under sudden load changes.

“Neighbour help isn’t a feature. It’s a behaviour.”

5

Stability Over Peak Numbers

What matters isn’t peak performance. It’s how quickly the system stabilises.

Specifications describe capacity.

Operation reveals dynamics. Under volatile workloads, stability is measured in seconds – not kilowatts. Reaction time defines whether a system absorbs change or amplifies it.

“We don’t design for perfect conditions. We design for what actually happens.”

Managing Density Within Physical Limits

A case story

NGC understood our constraints – and engineered an energy-efficient cooling system to match.

A customer approached us when their server room began to overheat. Newly installed servers delivered higher performance – and significantly higher heat density – than the space had been designed to manage.

Ceiling height prevented additional fan coils. A downflow CRAH solution was considered, but could not be accommodated. In-row cooling was evaluated, yet available whitespace was limited.

We proposed rear-door cooling as an alternative.

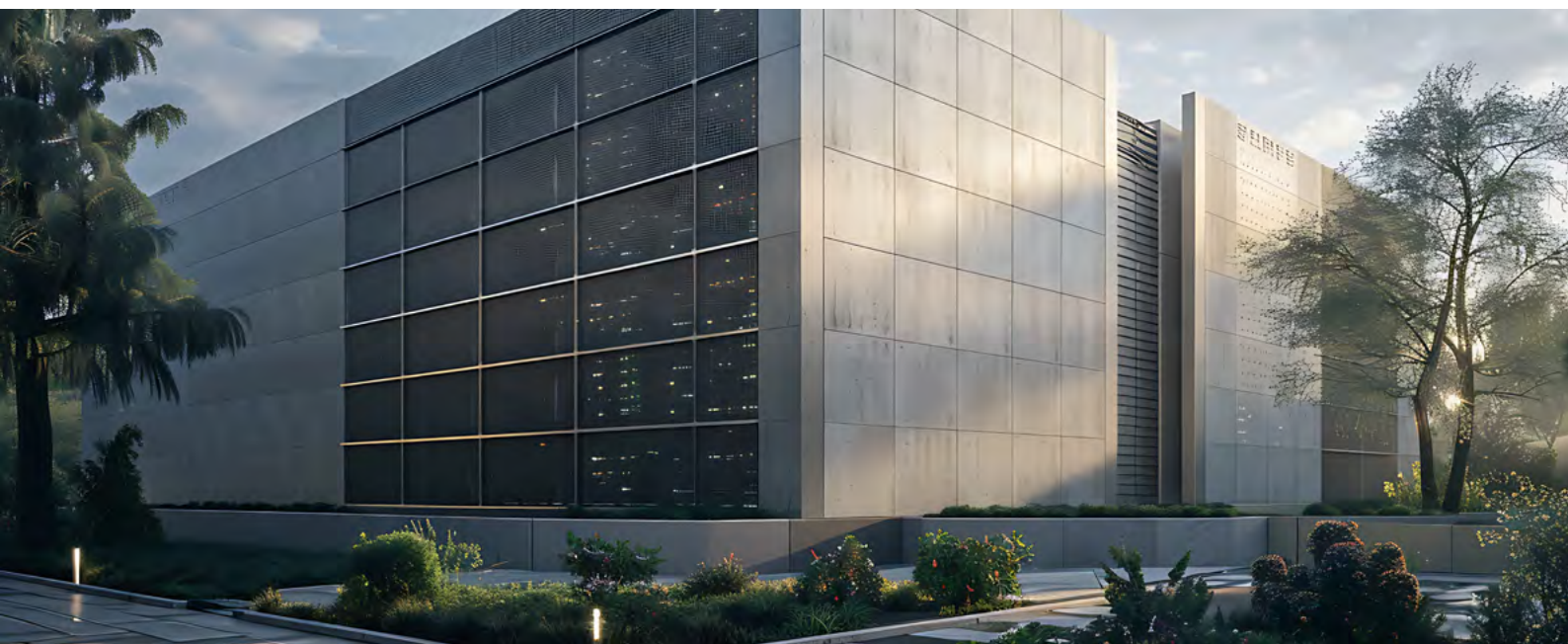
The installation centred on a 42U, 800 mm rack with a 50 kW load. Room temperature was maintained at 23 °C. Server exhaust air was estimated at 45 °C.

We implemented an RDHx with integrated circulation pump, combined with a dry cooler and chiller in a single fluid circuit. The system was engineered to balance airflow, pressure drop, and return temperature – avoiding excessive fan or pump energy while maintaining stable thermal behaviour.

At maximum load, fan power was 735 W and pump consumption 95 W. Under realistic operating conditions, indoor pPUE (partial Power Usage Effectiveness) was 1.0136.

Including dry cooler and chiller operation, total cooling sub-system pPUE reached 1.0294. The dry cooler handled 94% of annual cooling demand based on local ambient temperature data.

- The solution required no structural rebuild.
- It stabilised rack-level thermal behaviour.
- It reduced energy consumption without increasing system complexity.



Decarbonising the Data Centre Industry

Grounded in physics, not aspiration

1 Physical Inevitability

In the AI era, decarbonisation isn't a choice. It's a physical requirement.

As compute density increases, energy concentration rises. Cooling becomes the dominant operational load.

If thermal management does not change, energy demand rises proportionally.

Reducing footprint begins with changing how heat is removed.

"If you don't change the physics, you don't change the footprint."

2 Energy Burden & Precision

Cooling is the largest energy burden in a data centre – decarbonisation has to start there.

Room-level air cooling requires large volumes of conditioned air and extensive circulation.

By enabling supply temperatures of 22–30 °C and return temperatures up to 56 °C, NGC systems reduce cooling energy demand by up to 90%.

Precision at rack level replaces compensation at room level.

"At NGC, sustainability is the outcome of engineering precision."

3 Removal vs Offsetting

We don't offset energy use. We remove it.

Energy reduction is achieved by eliminating inefficiencies in flow, pressure, and control.

Distributed pumping saves energy.

Heat is captured at source rather than dispersed across the system.

Measured outcomes replace abstract commitments.

"We can substantiate our claims – because they're outcomes, not intentions."

4 Retrofit & Circularity

A sustainable data centre is also one that doesn't need to be rebuilt.

Through retrofit-based circularity, existing facilities can be upgraded without demolition.

Rear-door integration allows legacy infrastructure to transition from air to liquid without expanding footprint.

The materials and energy already invested in the building remain in use.

Operational efficiency improves without structural expansion.

"Retrofit isn't a compromise. It's the fastest path to real impact here and now."

5 Heat Reuse & System Extension

Reusing heated water at 56 °C turns waste into infrastructure.

The value of hot water increases sharply with higher return temperatures – improving cooling efficiency even without reuse, and enabling direct integration with district heating or local facilities when reuse is implemented.

Rear door, CDU, and heat rejection are engineered as one balanced system.

The temperature level is not incidental – it is designed for reuse.

"Energy leaves the data centre in two forms – cooling and reuse."

Eye-to-Eye Professional Collaboration

1

Designed for Serviceability

Serviceability isn't an add-on. It's part of the design.

At NGC, collaboration begins in the details. Systems are designed with the expectation that components will be handled, replaced, and adjusted.

All components are accessible – fans and sensors can be hot-swapped. A full refurbish can be achieved in minutes.

Service is anticipated.

"Uptime is not a promise. It's a consequence of how things are built."

2

Credibility Through Traceability

We do what we say – and we say what we do.

At NGC, credibility is practical.

Claims are made only where they can be substantiated.

Design decisions are visible.

Performance can be traced back to concrete choices in materials, control, and layout.

"Trust grows when systems behave as described."

3

Direct Engineering Dialogue

Engineering works best when people can speak eye to eye.

NGC engineers work directly with engineers, operators, and integrators.

Questions are answered by those who design the systems.

Decisions are made close to the physics – in short, agile cycles, not filtered through layers.

"Authority comes from understanding the problem – not from managing distance."

4

Agility in Practice

Agility is not speed. It's the ability to turn without breaking.

Short development cycles allow NGC to respond to real conditions.

Details are refined in use – fittings, flows, tolerances.

Systems evolve through feedback, not assumptions.

"Quality emerges from ongoing engineering dialogue where change is treated as normal."

5

Stability During Intervention

Systems should expect intervention – not fear it.

Components are designed for service.

When a rear door is opened, residual cooling remains active while neighbouring doors and distributed pumps compensate.

Cooling performance remains within defined limits.

"Dependability is proven when a system remains stable during intervention."

Precision Cooling for Quantum Infrastructure

A case story

NGC took time to understand the challenge before proposing the solution

At Data Center World, we were approached by an engineer from Aramco with a specific challenge.

A quantum computing installation required a stable 15 °C water supply. The existing infrastructure delivered 10 °C. The system had to bridge that gap without structural rebuild or interruption to ongoing operations.

The question was simple:

Can you convert 10 °C supply water into 15 °C with a flow of 3 m³/h at 1.3 bar differential pressure – reliably, and with precision?

Within weeks, we designed a modified Cooling Distribution Unit capable of delivering up to 5 bar and 5 m³/h, incorporating targeted design adjustments to improve precision and control.

We manufactured the unit and shipped it directly to Saudi Arabia. Installation was carried out by the customer's engineers, supported remotely by our team.

No local presence was required.

During commissioning, a monitoring-board issue was identified and corrected. The thermal control architecture itself performed as designed from first activation.

The CDU has now operated continuously for four months, maintaining supply temperature within ±0.1 °C.

In quantum computing environments, temperature stability is not an optimisation target – it is a prerequisite.

The project reflects a central principle of our approach:

When system architecture is understood at thermodynamic and hydraulic level, precision is achieved through control – not through excess infrastructure or unnecessary complexity.

It requires engineers who enter the customer's context, question assumptions, and allow the solution to take shape through dialogue.



Next Generation Cooling

Designing Energy Efficiency Into System Architecture

Next Generation Cooling was not founded to improve components. It was founded to rethink how cooling systems behave. From the beginning, the focus has been architectural rather than incremental. Instead of asking how to optimise individual products, we ask how the entire thermal system performs – hydraulically, thermodynamically, and operationally. *We do not begin with assumptions. We begin with physics.*

From Product to System Behaviour

In engineering, it is easy to optimise what already exists – harder to redesign the system as a whole. Many cooling solutions refine existing decisions: larger CRAH units, stronger containment, higher airflow. Each step improves performance locally. But local improvement is not the same as system optimisation.

Next Generation Cooling approaches the challenge differently. Cooling design, for us, is not abstract thinking – it is shaping thermal behaviour.

- We study how heat moves.
- How water flows.
- How pressure interacts with control.
- How response time influences stability.

From that understanding, a cooling architecture takes form.

Every installation begins with dialogue – engineer to engineer

We enter the customer's context without predefined conclusions. We question assumptions. We test alternatives. We model consequences.

Through this process, solutions are not imposed – they take shape. Quality emerges from ongoing engineering conversations where change is treated as normal, not exceptional.

Energy Efficiency by Design

Next Generation Cooling designs energy efficiency into the system architecture. High return temperatures are not marketing claims – they are thermodynamic consequences. Distributed pumping is not a feature – it is a structural decision.

Short hydraulic loops are not simplifications – they reduce risk. Rear door, CDU, and heat rejection are engineered as one balanced system. Efficiency is not added later.

It is built into the structure from the start.

Our DNA

NGC is built on a small, agile engineering core. Development runs in short cycles. Software, hydraulics, and mechanical design evolve together. Learning is continuous.

- We question norms.
- We redesign fundamentals when needed.
- We experiment – because experimentation is how knowledge grows.

Mistakes are not reputational risks. They are information.

Disciplined, Imaginative Engineering

Cooling design, for us, begins with physical reality – not abstract models alone. We work with the physical reality of each installation – shaping thermal behaviour through controlled experimentation and precise execution.

It is imaginative engineering grounded in physics:

- We prototype.
- We calculate.
- We refine.
- We adjust course as understanding deepens.
- We are not constrained by legacy decisions.

If a design assumption limits performance, it is reconsidered. This flexibility allows us to see opportunities where others see constraints.

What NGC Is

NGC is an engineering-led company. Engineers work directly with engineers. Decisions are made close to the physics – in agile cycles, not through layers.

We specialise in:

- Rear-door heat exchangers with distributed intelligence
- Coolant Distribution Units that simplify and separate hydraulic circuits
- System-wide optimisation of cooling performance and energy use
- Delivering return temperatures that improve both efficiency and reuse potential

We do not sell isolated components. We design integrated cooling architecture.

Beyond the Threshold

As compute density increases, incremental upgrades reach their limits. Cooling moves closer to the source. Control becomes predictive. Hydraulic behaviour is understood – not assumed. This is the transition beyond the thermal threshold.

Next Generation Cooling engineers that transition.



Up to 90% Cooling Energy Reduction

Enables pPUE levels below 1.1 – demonstrated as low as 1.004 under real operating conditions. 1.035 for the full cooling solution.

Designed for **Simplicity**

NGC's cooling architecture is built around a modular flow structure that simplifies integration, scaling, and operation in high-density data-centres.

- **Clear separation between rack-level cooling and facility infrastructure**
- **Modular design that adapts to deployment scale**
- **Direct integration with existing building systems**
- **Closed-loop operation for predictable thermal behaviour**

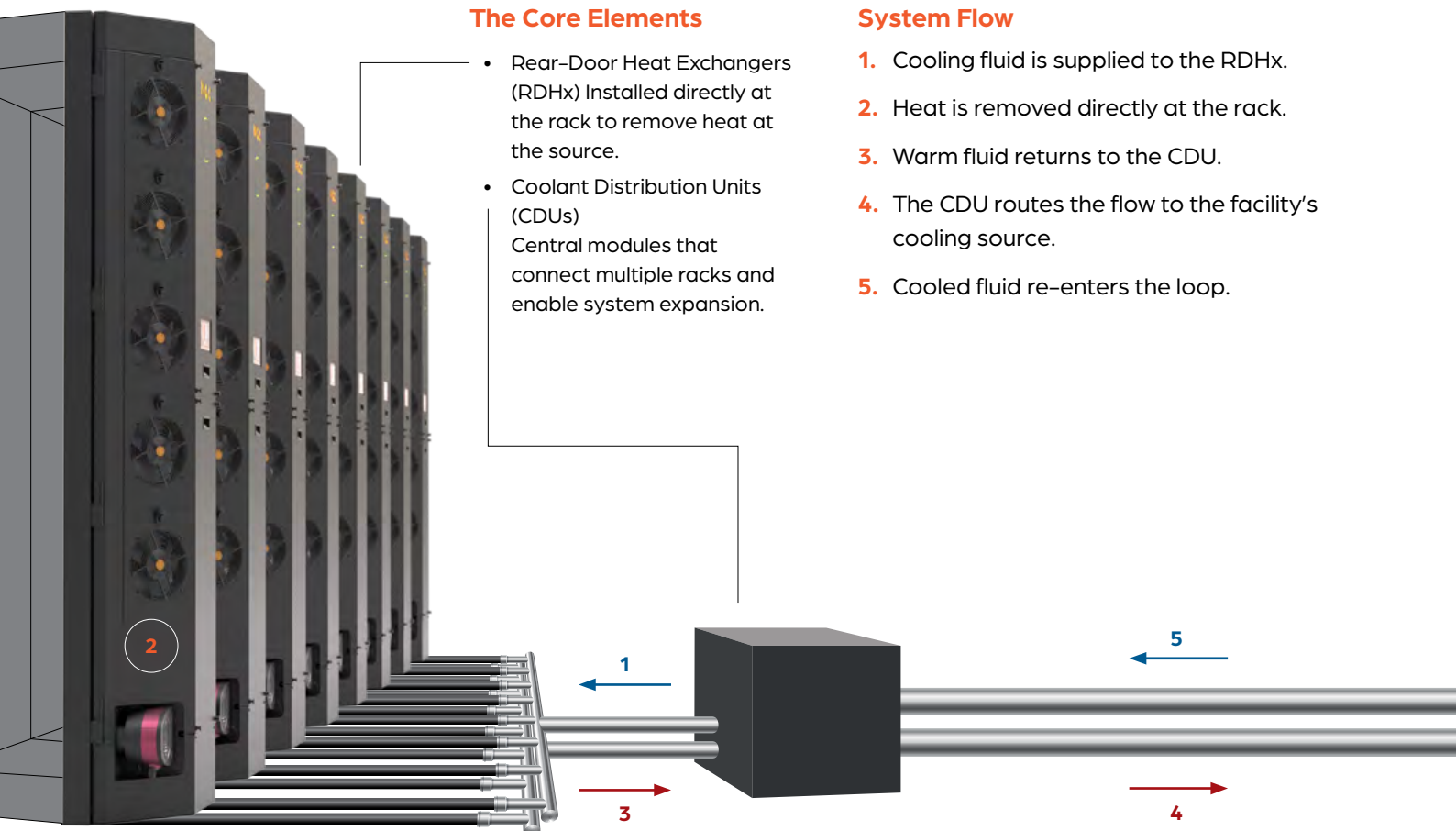
Each rear-door unit operates with its own high-efficiency Grundfos pump, ensuring that flow is regulated directly at rack level rather than through extended distribution paths.

This reduces hydraulic interaction between racks and increases system stability under dynamic load conditions.

The CDU connects rack-level cooling to the facility's cooling source and distributes fluid across multiple doors – preserving system independence.

Because each rack regulates its own flow, capacity can be added or adjusted without redesigning the overall loop – eliminating the need to rebalance the pipe network.

The result is a cooling circuit that remains short, controlled, and straightforward to operate – even as density increases.



Datasheet Overview

NGC cooling systems are engineered for reliable performance across a defined operating range.

This section presents cooling capacity, operational temperature ranges, hydraulic characteristics, and electrical requirements for RDHx and CDU units.

Rear-door heat exchangers operate with elevated supply temperatures and self-regulated flow – maintaining thermal neutrality at room level.

The datasheets specify required coolant supply conditions per rack, enabling accurate calculation of system-wide flow rates and expected return temperatures.

CDU performance profiles are presented in scalable configurations – from single-rack deployments to multi-megawatt installations.

The following technical data supports system integration, hydraulic sizing, and thermal design for both new and retrofit data-centre environments.

CDU Overview

	10–50 kW CDU	300–500 kW passive CDU
Function		
Capacity	10-50 kW	500 kW
Max	Flow: 5 m ³ /h Head: 60m	Flow: 30 m ³ /h Head: 100 m
Hydraulic Specification (at typical operation point)	Primary circuit: Fluid: Water Flow: 1,7 m ³ /h	Secondary circuit: Fluid: Purified water Flow: 3m ³ /h
Reaction time	In case of sudden changes in flow and pressure, the CDU will adjust the pump within 1-2 seconds. The patented NGC boost algorithm predicts the increased temperature of fluid from the heat load and will preemptively open the primary flow to increase the cooling and maintain the fluid supply temperature at the correct level.	In case of sudden changes to the flow, the passive CDU will predict the new operation point and require primary flow to maintain a steady fluid supply temperature to the heat load. The modulated valve is an ultra-fast version, and the reaction time is as low as 6-8 seconds going from idle to maximum load. The CDU will predict and react when the flow increases, typically 2-4 seconds before fluid with higher temperature reaches the CDU reducing the reaction time significantly.
Environment		
Dimensions	Height: 700 mm + feet (50-100 mm), Width: 602 mm, Depth: 601 mm Weight: 45kg (approximate dry weight)	Height: 800 mm + feet (50-100 mm), Width: 570 mm, Depth: 570 mm, Weight: 85kg (approximate dry weight)
Operational conditions	Room temperature: 15-40 °C Dew point: <= room temperature	Room temperature 15-40 °C Dew point: <= room temperature
Voltage and power rating	-1x200-240VAC (1 phase, 0, GND) -1x100-120VAC (1 phase, 0, GND) Power rating at operation point: 310W Maximum power rating: 520W	-1x200-240VAC (1 phase, 0, GND) Power rating at operation point: 50W Maximum power rating: 50W
Hydraulic connections	Primary: 2" (DN50) flanges, Secondary: 1" (DN25) male BSP thread, All external connections have cut-off valves	Primary: DN50(2") BSP Female, Secondary: DN50(2") BSP Female, Optionally DN50/DN75 flanges can be added, All external connections have cut-off valves
Features		
Heat exchanger	Alfa Laval CB30-24 H	Alfa Laval CB112-130 H / example
Condensation prevention	Armaflex cooling isolation for heat exchanger Primary pipes isolated	Armaflex cooling isolation for heat exchanger Primary pipes isolated
Expansion tank	8 L	16-24 L
Sensors	2 x Grundfos RPS Temperature & Pressure sensors 2 x Grundfos VFS Vortex flow sensors Dual warns leakage detector	4 x Grundfos RPS Temperature & Pressure sensors Leakage detector

RDHx Overview

	40kW	60kW	80kW	100kW	120kW
Environments supported					
Room temperature	18-34 °C	18-34 °C	18-34 °C	18-34 °C	18-34 °C
Fluid supply temperature	9-30 °C	9-22 °C	9-22 °C	9-20 °C	9-18 °C
Fluid RET temperature	30-58 °C	30-58 °C	30-52 °C	30-45 °C	26-30 °C
Fluid supply pressure	10 bar max	10 bar max	10 bar max	10 bar max	10 bar max
Fluid RET pressure	1 bar min	1 bar min	1 bar min	1 bar min	1 bar min
Fluid minimum differential pressure	0,25 bar 1 bar @ 60 kW	0,4 bar 1 bar @ 80 kW	0,6 bar 1 bar @ 100 kW	0,4 bar 0,7 bar @ 120 kW	0,4 bar 1 bar @ 160 kW
Fluid type	Purified water Up to 40% ethylene glycol	Purified water Up to 40% ethylene glycol	Purified water Up to 40% ethylene glycol	Purified water Up to 40% ethylene glycol	Purified water Up to 40% ethylene glycol
Racks supported					
Width	600, 700, 750, 800 mm	600, 700, 750, 800 mm	600, 700, 750, 800 mm	600, 700, 750, 800 mm	600, 700, 750, 800 mm
Height	42U, 45U, 48U, 50U, 52U	42U, 45U, 48U, 50U, 52U	42U, 45U, 48U, 50U, 52U	42U, 45U, 48U, 50U, 52U	42U, 45U, 48U, 50U, 52U
Depth	Any	Any	Any	Any	Any
RDHx Mechanical					
Size (WxDxH)	Same as rack	Same as rack	Same as rack	Same as rack	Same as rack
Weight	50 kg - 70 kg	50 kg - 70 kg	50 kg - 70 kg	55 kg - 75 kg	60 kg - 80 kg
Shipping weight	100 kg	100 kg	110 kg	115 kg	120 kg
Fluid volume	40 l	50 l	60 l	70 l	80 l
Fluid connector	1"-1½"	1"-1½"	1"-1½"	1"-1½"	1"-1½"
Electrical					
Voltage	230 V, 50 Hz	230 V, 50 Hz	230v,5 0Hz	230 V, 50 Hz	230 V, 50 Hz
Rated current	10A	10A	10A	10A	10A
Nominal. Power consumption (pump and fan)	300 W	500 W	850 W	950 W	1500 W
Functional specs					
Nominal cooling capacity	40 kW	60 kW	80 kW	100 kW	120 kW
Maximum cooling capacity	60 kW*	80 kW*	100 kW*	120 kW*	160 kW*
Upgrade to	80 kW	100 kW	120 kW	160 kW	160 kW
Fluid flow	1,5-5,5 m3/h	1,6-6,0 m3/h	1,9 - 9,3 m3/h	2,0 - 10,0 m3/h	3,0 - 22,5 m3/h
Fluid pressure differential	Nominal: 22 kPa Maximum: 104kPa	Nominal: 40 kPa Maximum: 104 kPa	Nominal: 56 kPa Maximum: 70 kPa	Nominal: 40 kPa Maximum: 65 kPa	Nominal: 30k Pa Maximum: 98 kPa
Air flow	Nominal: 3500 m3/h Maximum: 5700 m3/h	Nominal: 3500 m3/h Maximum: 10.000 m3/h	Nominal: 7500 m3/h Maximum: 10.000 m3/h	Nominal: 8.500 m3/h Maximum: 10.500 m3/h	Nominal: 10.500 m3/h Maximum: 12.000 m3/h
Air PD	Nominal: 16 Pa Maximum: 34 Pa	Nominal: 35 Pa Maximum: 145 Pa	Nominal: 200 Pa Maximum: 350 Pa	Nominal: 213 Pa Maximum: 330 Pa	Nominal: 320 Pa Maximum: 340 Pa
Sound level	68 dB	70 dB	72 dB(A)	74 dB(A)	78 dB
Power consumption	Nominal: 290 W (40k W) Max: 1025 W (80 kW)	Nominal: 300 W (60 kW) Max: 1125 W (100 kW)	Nominal: 608 W Max: 1200 W	Nominal: 622 W Max: 1350 W	Nominal: 1014 W Max: 1437 W
Configuration					
Type of fans	NGC-Fan1	NGC-Fan1	NGC-Fan2	NGC-Fan2	NGC-Fan2
Number of fans	6	12	10	12	12
Type of pumps / valves	Grundfos MAGNA3 25-100 N** MAGNA3 40-120 N	Grundfos MAGNA3 25-100 N** MAGNA3 40-120 N	Grundfos MAGNA3 25-100 N** MAGNA3 40-120 N	Grundfos MAGNA3 25-100 N MAGNA3 40-150 N	Grundfos MAGNA3 25-100 N MAGNA3 65-150 N
Number of pumps / valves	1	1	1	1	1

Advantages at a glance



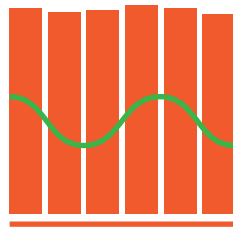
Reduction in Energy Use
Up to 90%
vs. air-cooled baseline



Lower Operational Costs
30–40% reduction



Improved PUE
1.0044 typical



Stable Operation
Rapid thermal response
and high reliability



Heat Reuse Potential
Up to 56°C outlet
temperature

European Engineering Inside