



**CONNECT AND PROTECT**

## Edge and Data Center Cooling Solutions

Precision and High Density Liquid Cooling



CADDY ERICO HOFFMAN RAYCHEM SCHROFF TRACER



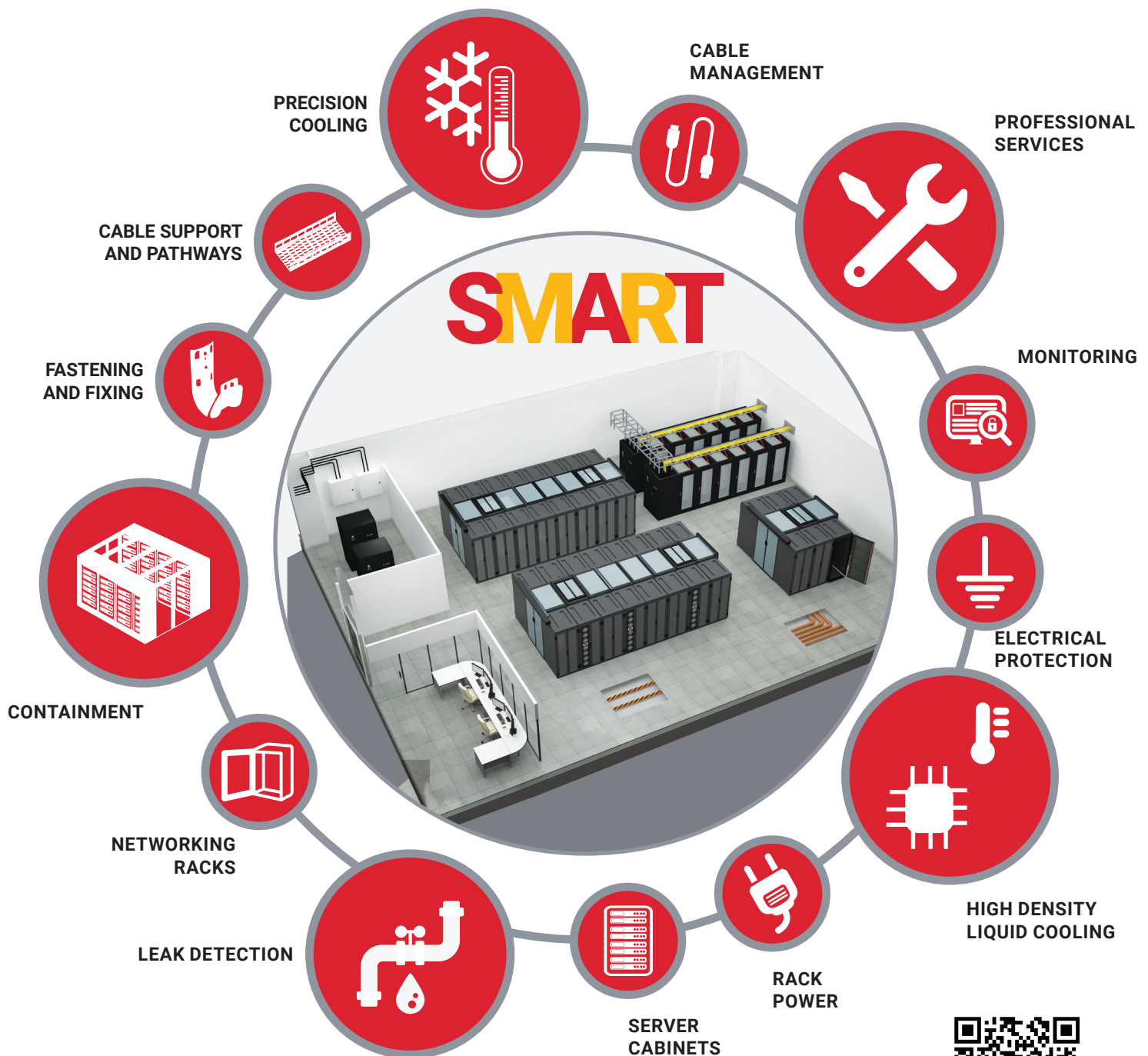


# Edge And Data Center Cooling Solutions

## Introduction

Content streaming, online banking, cloud computing, sophisticated smart phone apps, eCommerce, industrial automation. These are just a few examples of applications that are fueling data processing and traffic demand in data centers throughout the world. Emerging technologies, such as Artificial Intelligence (AI), telemedicine, machine learning, autonomous (driverless) vehicles and other real time modeling applications will accelerate demand further.

**Increasing heat densities challenge data center operators and the demand for reduced data latency requires more computing power at the edge.**



Find out more on  
**nVent Cooling Solutions**



# Precision And Liquid Cooling Overview



## Data Center Cooling Solutions

Maintaining high availability (uptime) at minimal operational costs remains a major challenge in today's data centers and networks. A significant portion of budgets includes energy consumption for IT equipment and server cooling.

nVent offers a comprehensive range of standard and customized air, indirect and direct water cooling solutions. Our product range enables you to meet these challenges and protect your IT assets, whether for smaller decentralized edge computing, harsh environments, or large data center installations.

## Edge Computing Cooling Solutions

The rapid emergence of Big Data, 5G, Industry 4.0 and IoT deployments also require protection for edge-computing applications, such as high-speed wireless, autonomous vehicles, industrial automation, transportation, security and safety systems. These complex systems are powered by smaller and faster electronics that require effective cooling protection to ensure maximum operating performance and uptime.

## Maximize Infrastructure Performance And Uptime

Legacy cooling in data centers uses technology based on traditional air conditioning systems. Entire rooms, sometimes complete buildings, are cooled with a single system. These Computer Room Air Conditioning units (CRAC) or Computer Room Air Handler (CRAH) worked well for a number of years because data rooms were smaller, IT cabinets were not densely packed, and less heat was generated in a given space. While still popular today, whole room cooling can be inefficient and expensive.

## Continuum Of Cooling



Convection



Air Conditioner



Rack w/Integrated LX Cooling (MicroEdge)

## EDGE COMPUTING

## DATA CENTER FLOOR SPACE

Direct to Chip Liquid Cooling



Rear Door Cooling (Passive/Active)



In Row Cooling - LX



Row Aisle Containment (Active w/IRC)



# Edge Compute Cooling Solutions

## Indoor/Outdoor Air Conditioners

Today's "Connected Enterprise" networks need to support expanding voice, data and video applications. Localized data processing at the edge redefines the traditional configuration of networking and wall-mount cabinets. Increased thermal loads require precision cooling solutions. Air conditioners can provide up to 8kW to address thermal loads when thermal requirements exceed convection cooling limits.

### Features

- Thermostat control and EMI/RFI noise suppressor included
- Closed-loop cooling separates clean, recirculated air from ambient airflow system
- Front cover hinges open for quick access to all components
- Filter can be inverted to double operating time between cleanings and/or filter replacement
- Filterless operation possible in many applications
- For a typical application, unique condensate management system evaporates moisture from enclosure
- High performance fans and blowers are ideal for densely packed enclosures
- All units use a universally accepted CFC-free or environmentally safe refrigerant
- Mounting hardware, gasket kit, mounting template and instruction manual furnished

## Application

These air conditioners fit in the AC cutout provided in the AC-ready voice, data and server cabinet packages. The air conditioners are shipped separately and cannot be factory installed in the cabinets.



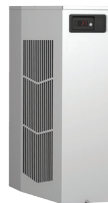
### Closed Loop Cooling

Recirculated air inside the air conditioner is kept separate from the ambient airflow system. This protects the electronic controls and prevents shutdowns caused by heat, humidity, dust and other contaminants.



**Access the Cooling Selection Tool to define the right size of your air conditioner**

## Wall-Mount Solutions

T-Series Compact Outdoor (T15)			SpectraCool Compact Indoor (N21)			SpectraCool Narrow Indoor/Outdoor (N28)		
	Outdoor Model without Heat Pkg.	T150116G100		Indoor Model	N210216G050		Indoor Model	N280416G050
	Outdoor Model/SST/Corrosion/4X	T150116G152		Indoor Model Stainless Steel Type 4X	N210216G051		Outdoor Model with Heat Pkg. Stainless Steel Type 4X	N280416G151
	Cooling Performance			Cooling Performance			Cooling Performance	
	Nominal: BTU/Hr. Watts	800/800		Nominal: BTU/Hr. Watts	1800/2000		Nominal: BTU/Hr. Watts	3800/4000
		235/235			528/586			1114/1172
	At 131 F/131 F (55 C/55 C): BTU/Hr. (50/60 Hz) W (50/60 Hz)	819		At 131 F/131 F (55 C/55 C): BTU/Hr. (50/60 Hz) W (50/60 Hz)	2000/2175		At 125 F / 125 F (50 C / 50 C): BTU/Hr. (50/60 Hz) W (50/60 Hz)	3940/4104
		240			586/637			1150/1000
	At 95 F/95 F (35 C/35 C): BTU/Hr. (50 /60 Hz) W (50/60 Hz)	948		At 95 F/95 F (35 C/35 C): BTU/Hr. (50 /60 Hz) W (50/60 Hz)	1950/2200		At 95 F/95 F (35 C/35 C): BTU/Hr. (50 /60 Hz) W (50/60 Hz)	3754/4011
		278			571/645			1100/1175

## Free standing cabinets and Outdoor Solutions

SpectraCool Indoor/Outdoor (G52)							
	Indoor Model	G520816G050	G520826G050	G520846G050	G521216G050	G521226G050	G521246G050
	Indoor Model Stainless Steel Type 4X	G520816G051	G520826G051	G520846G051	G521216G051	G521226G051	G521246G051
	Indoor Model with Remote Access Control*	G520816G060	G520826G060	G520846G060	G521216G060	G521226G060	G521246G060
	Outdoor Model without Heat Pkg.	G520816G100	G520826G100	G520846G100	G521216G100	G521226G100	G521246G100
	Outdoor Model Partial Recessed Mount**	G520816G101	G520826G101	G520846G101	G521216G101	G521226G101	G521246G101
	Outdoor Model with Heat Pkg.	G520816G150	G520826G150	G520846G150	G521216G150	G521226G150	G521246G150
	Outdoor Model with Heat Pkg. Stainless Steel Type 4X	G520816G151	G520826G151	G520846G151	G521216G151	G521226G151	G521246G151
	<b>Cooling Performance</b>						
	Nominal: BTU/Hr. Watts	8000	8000	8000	12000	12000	12000
		2300	2300	2300	3500	3500	3500
	At 131 F/131 F (55 C/55 C): BTU/Hr. Watts	7300/8200	7300/8200	8800/9800	12000/12500	12000/12500	11100/12000
		2139/2403	2139/2403	2578/2871	3516/3662	3516/3662	3252/3516
	At 95 F/95 F (35 C/35 C): BTU/Hr. Watts	6000/6800	6000/6800	7400/8200	9900/10700	9900/10700	9900/10700
		1758/1992	1758/1992	2168/2402	2900/3135	2900/3135	2900/3135

Depending on the required computing and networking performance trust in nVent to **SECURE MISSION CRITICAL DATA AVAILABILITY** combined with **OPTIMIZED EFFICIENCY** at **MINIMAL COST** of ownership.



# Ensure Maximum Performance And Uptime

## Precision Air-to-Water Heat Exchangers

The push for high bandwidth and low-latency compute resources drive decentralized high density installations outside the data center floor space.

A modular rack integrated cooling solutions with a cooling capacity of up to 25kW help you to over come this challenge.



Watch the video to learn more about edge cooling



## Micro Data Center with RackChiller In Rack

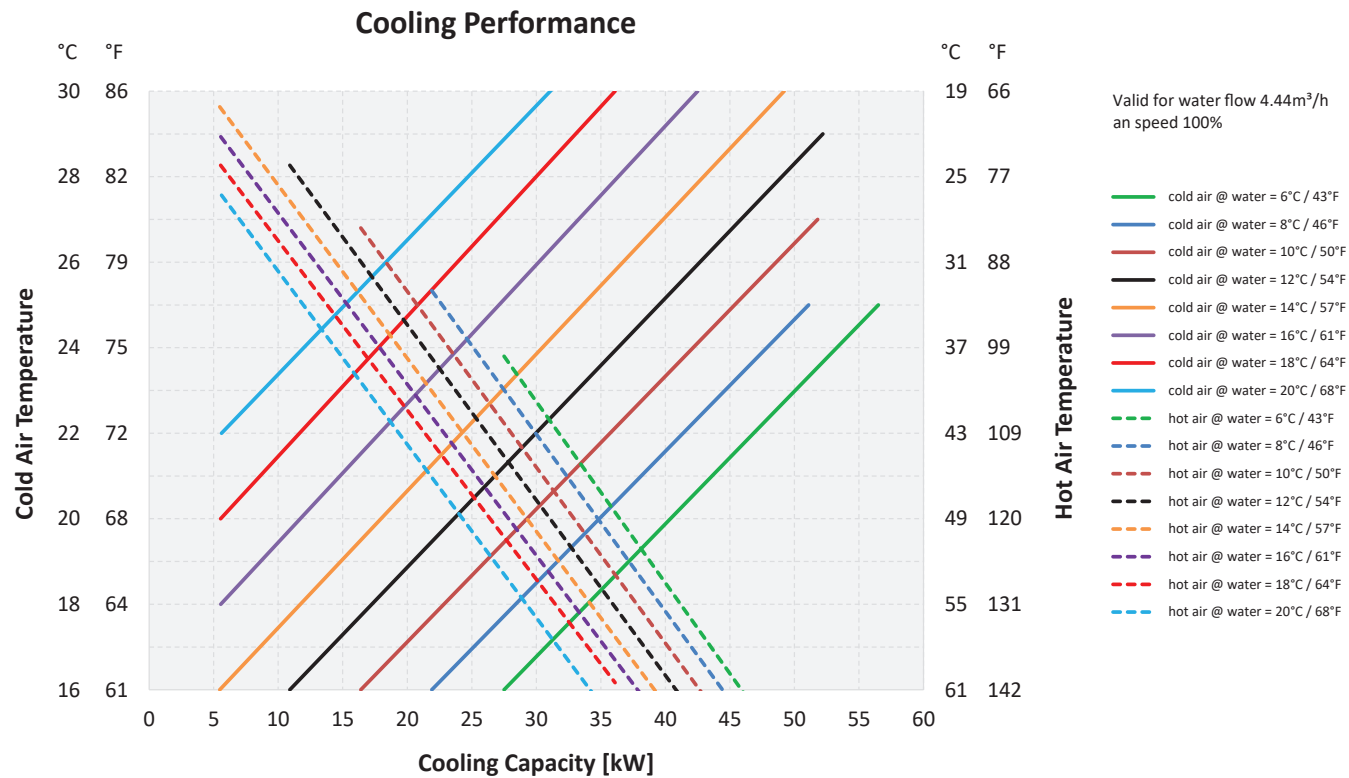
The air-to-water heat exchanger unit is integrated in a cabinet, to the left or right of the 19" plane. The cabinet offers full RU (rack unit) mounting space.

The warm exhaust air from the servers is forced past the fans of the cooler, through the air-to-water heat exchanger. The heat is transferred to the cooling medium and cooled air is provided in front of the 19" plane.

### Benefits

- The rack-based cooling solution acts room-independent and allows for set-up of various rack configurations
- EMC-shielded, harsh environment, as well as outdoor solutions available
- Reduced noise levels

CONSULT NVENT TO GET ORDERING INFORMATION



# Data Center Cooling Strategies

## Localized Row And Cabinet Level Cooling Methodologies

Room cooling can be inefficient and expensive. Four approaches for dissipating ITE heat loads include:

- Air cooled: heat is transferred directly to the room air and cooled via traditional data center cooling
- Indirect water-cooled: heat is transferred indirectly to water through an air-to-water heat exchanger located within the row or single cabinet
- Direct water-cooled: heat is transferred directly to an attached heat transfer component, such as a cold plate
- Hybrid direct and indirect water-cooled - selective cooling of highest energy-consuming components with direct contact liquid cooling and the balance of the cabinet is cooled via secondary air-to-water cooling device, such as a Rear Door Cooler (RDC).

To maintain maximum IT equipment (ITE) availability, all equipment must be kept below a specified temperature range—a requirement that has recently become more challenging to meet. As the need for information has increased, so has the processing power of the network equipment, resulting in increasingly higher processor densities and heat levels.

Elevated temperatures result in equipment failure, and ultimately, costly downtime, making the need for efficient cooling systems more important than ever. Since nearly all power consumed by the processors is converted to heat—which must be removed via air (convection)—the data center in which this equipment resides must efficiently provide cold air to network equipment intakes and recycle the hot exhaust to remove the heat and keep vital networking equipment operating.



Localized cooling improves efficiency and reliability while reducing the risk of equipment failures.

## Data Center Strategies - Cooling

Strategy	Approach	Raised floor	Capital costs/kW	Operating costs/kW	Average max kW per cabinet	Reliability (Complexity)
Random (chaos)	Room based	Yes	\$	\$ \$ \$ \$ \$	2,500 kW	☹️
Hot aisle / cold aisle		Yes	\$	\$ \$ \$ \$ \$	6 kW – 8 kW	☹️
Containment (raised floor)		Yes	\$ \$	\$ \$ \$	up to 10 kW	😐
Chimney		Yes or No	\$ \$	\$ \$ \$	10 kW – 20 kW	😐
Closed-loop, ducting, hot and cold containment		Yes or No	\$ \$ \$	\$ \$	10 kW – 20 kW	😐
In-row cooling & containment (heat exchanger)	Row based	No	\$ \$ \$ \$	\$ \$ \$	10 kW – 20 kW	😊
In-Rack & Rear Door liquid cooling (heat exchanger)	Rack based	No	\$ \$ \$	\$ \$	20 kW – 40 kW	😊
Chip-level liquid cooling	Chip based	No	\$ \$ \$ \$ \$	\$	+40 kW	😊



# Aisle Containment

## Improved Air Management Helps To Reduce Energy Costs













The use of containment systems can dramatically reduce energy costs, minimize hot spots and improve the carbon footprint of the data center. Both hot aisle containment (HAC) and cold aisle containment (CAC) systems greatly improve the data center cooling efficiency by segregating cold and hot airstreams and preventing them from intermixing. The basic design principle is to enclose the hot or cold aisle through the use of aisle-way doors, roof or baffle panels, and internal sealing within the cabinets. nVent offers tailored modular aisle containment solutions that include containment doors, aisle top covers, cladding elements and halogen-free gaskets.

### Benefits

- Consistent separation of cold and hot air
- Enables optimized aisle airflow and temperature
- Low investment with short ROI – minimal maintenance costs
- Short implementation time with minimum investment



Containment systems allow for higher cold temperatures per ASHRAE and  $\Delta T$ , optimizing cooling systems and contributing to reduced energy costs.

Cabinet With Chimney Vertical Exhaust System		Cold Aisle Containment
Heat radiation	 <b>No mixing of warm and cold air</b> Top covers and side panels are getting hot and heat up the room. CRAC has to compensate for this under certain conditions	 <b>No mixing of warm and cold air</b>
Raised floor/ false ceiling	 Sometimes requires extremely complex planning of arrangement in false ceiling and raised floor remain	 Either raised floor or false ceiling not necessarily required
Noise	 Noise level is reduced due to full metal doors at the back of the cabinet. On the other hand, noise level may increase with the high air velocity of 5m/s within the chimneys.	 The server fans are creating the noise, mostly located in the rear side of the chassis. As the rear doors are open, noise level is increased
Room layout	 Location in the room is limited as air ducts, building conditions (cross-ties), electrical cable assembly and CRAC have to be considered.	 Free location in the room within the constraints of the cold aisle are possible
Influence of external ambient	 Temperature delta between (cooled) room and external ambient temperature is smaller.	 Temperature delta between (warm) room and outside ambient temperature is higher as server exhaust air into the room
Investment	 Low initial investment, no operational costs, no points of failure	 Low initial investment, no operational costs, no points of failure

# Row Level Air-to-Liquid Cooling

## RackChiller In-Row Precision Cooler

nVent SCHROFF RackChiller In-Row chilled water heat exchanger is a modular and scalable precision cooling solution that can replace or supplement traditional data center cooling infrastructure. The RackChiller In-Row is designed to deliver localized energy efficient cooling, which includes an air-to-water heat exchanger that removes and transfers heat to a water circuit. Six integrated Electronic Commutator (EC) fans provide chilled return air to the front of the unit for localized feed to a contained row and/or adjacent IT equipment.

### Features

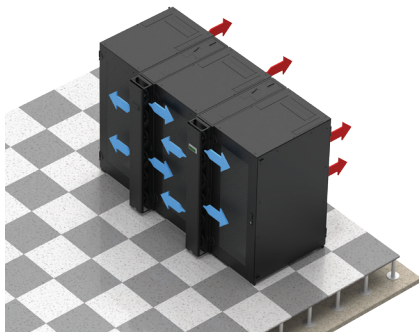
- Water connection from above or below
- Built-in redundancy through EC fan technology
- Dual A-B power feed (integrated ATS)
- Control with internal and external sensors possible
- Monitoring via SNMP or Modbus
- Compatible with nVent aisle containment system
- Available in 300 mm and 600 mm widths

### Benefits

- Up to 85% efficiency improvement vs. CRAC based systems in optimal operating conditions
- Operates with cooling water temperatures up to 84°F / 29°C while maintaining air temperatures within ASHRAE A1 allowable envelope
- Minimal planning outlay; short setup time
- Conforms to UL STD No. 61010-1 and CSA STD C22.2 No. 61010-1



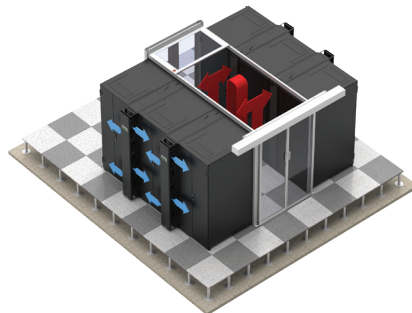
## Row Level Cooling Configurations



### Open Aisle

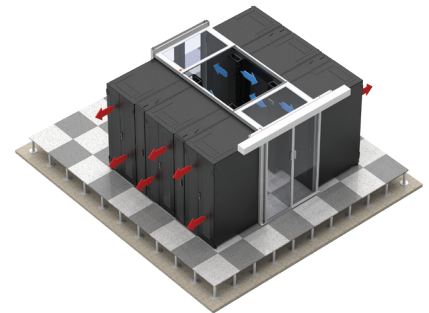
Open aisle row configuration includes a single row or dual row of cabinets that separate open cold and hot aisle, no aisle containment. The nVent SCHROFF RackChiller draws hot air from the rear of the cabinets in the hot aisle, removes the heat through an air-to-water heat exchanger and supplies cooled air to the front of IT equipment in the cold aisle.

To increase efficiency it is always better to combine in row cooling with a containment system to minimize air leakage.



### Hot Aisle Contained Row

Hot aisle contained row configuration contains the hot exhaust air generated from IT equipment to prevent mixing with cool air in the room environment. The nVent RackChiller draws the contained hot air from the hot aisle, removes the heat through an air-to-water heat exchanger, and feeds cooled air to the front of IT equipment in the uncontained cold aisle.



### Cold Aisle Contained Row

Cold aisle contained row configuration contains chilled air provided by the Schroff RackChiller in the cold aisle to prevent mixing with hot air generated by the exhaust of equipment within the hot aisle. The nVent RackChiller draws the contained hot air from the hot aisle, removes the heat through an air-to-water heat exchanger, and feeds cooled air to the front of IT equipment in the contained cold aisle.

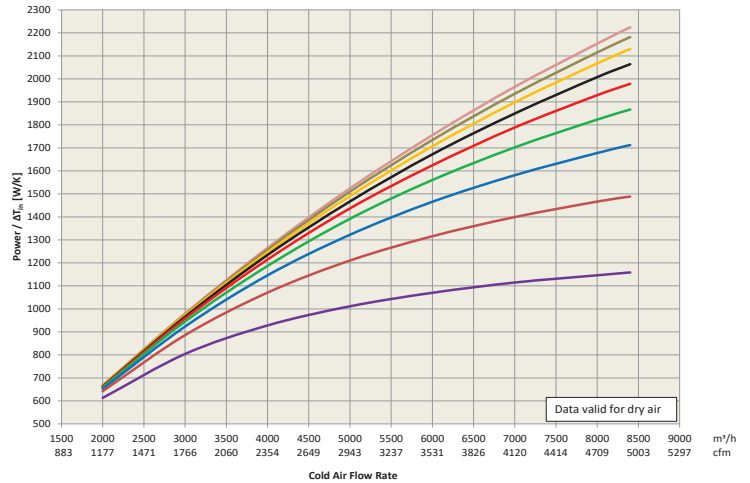


# RackChiller In-Row Technical Data



RackChiller In-Row	300 mm wide	600 mm wide
Depth	1200 mm adds 183 mm with front radial fans	1200 mm
Color	Black RAL9005; other colors on request	
Weight dry	309 lb/140 kg	441 lb/200 kg
Supply voltage [VAC]	Dual A-B power feed: 208-230 V	
Input power	Phase to phase or phase to neutral supply	
Connection	Water connection at back, top or bottom	
Pipe connection	1"/25 mm	
Coolant flow control	Included valve and actuator	
Water valve	2 way (standard), 3 way (optional)	
Volume capacity	2.9 gallons/11 liters	3.1 gallons / 11.8 liters
Fans	Backward curved centrifugal fans incorporating EC technology	
Max. airflow volume [m³/h]	4944 cfm/8400 m³/hr	
Number of fans	6	
Acoustic emission at 100% fan speed	74dB(A)	
Communication protocols	Modbus TCP/IP, SNMP	
<b>Cooling capacity</b>	<b>55kW</b>	<b>75kW</b>
Cold air temperature	72-75 °F/22-24 °C	
Water supply	57°F/14°C	
Fan air flow	4944 cfm/8400 m³/hr (100%)	
Fluid flow	20.25 gpm/4.6 m³/hr	
Pressure drop	2.17 psi/15 kPa	3.9 psi/27 kPa

## Cooling Performance 600 mm wide In-Row Cooler



Access  
RackChiller  
In-Row  
technical data

$\Delta T_{in} = T_{air,in} - T_{water,in}$	
Water flow:	
100 l/min. ~ 26.0 gpm	
90 l/min. ~ 23.4 gpm	
80 l/min. ~ 20.8 gpm	
70 l/min. ~ 18.2 gpm	
60 l/min. ~ 15.6 gpm	
50 l/min. ~ 13.0 gpm	
40 l/min. ~ 10.4 gpm	
30 l/min. ~ 7.8 gpm	
20 l/min. ~ 5.2 gpm	

## Monitoring

- Valve position (adjustable via cold air temperature)
- Fan speed (adjustable via hot air temperature)
- Return water temperature
- Fan-function display
- Local alarm display
- User-defined preventative maintenance alarms
- Alarm log
- SNMP and Modbus interface



## Standard Product

Part No.	Height x Width x Depth mm	Height x Width x Depth in.	Input Voltage
60714079	2000 x 300 x 1200	78.74 x 11.81 x 47.24	230V phase to neutral
60714080	2000 x 600 x 1200	78.74 x 23.62 x 47.24	230V phase to neutral
60714081	2000 x 300 x 1200	78.74 x 11.81 x 47.24	208V phase to phase
60714082	2000 x 600 x 1200	78.74 x 23.62 x 47.24	208V phase to phase

## RackChiller In-Row Accessories

Part No.	Description
60714083	Hose kit 3Mx25MM
60714084	Flow control valve
60714085	Controller nVent
20714007	Ganging and blanking kit - ProLine, 45U, 300mm
20714008	Ganging and blanking kit - ProLine, 45U, 600mm
20714009	Ganging and blanking kit - ProLine, 51U, 300mm
20714010	Ganging and blanking kit - ProLine, 51U, 600mm
21130594	Aisle containment adapter kit - top cover mount

# Rack Level Air-to-Liquid Cooling

## RackChiller Rear Door Precision Cooler

nVent SCHROFF RackChiller Rear Door chilled water heat exchanger is designed for managing high heat load cooling requirements within higher-density server, computing and storage racks. The entire system is integrated within an aesthetically framed perforated door with protective covers to isolate the liquid source and cooling loop from the rack-mounted equipment. The RDC installs on equipment racks as a separate complete rear door, enabling it to be retrofitted to existing racks. nVent SCHROFF Rear Door chilled water heat exchanger cools the warm exhaust air generated by the fans in the existing rack-mounted IT equipment through a large cooling coil surface before reintroducing back to the room.

### Features

- Passive solution without fans - no noise, no additional power consumption, low maintenance requirements
- Active solution with fans supporting the air flow and minimize pressure drop of the heat exchanger
- Optional water control kit allows water flow regulation according the actual heat load
- Frame solution allows separation of coil and condensate management from the rack mount equipment
- Rear space inside the cabinet is completely available for cabling and power distribution
- Available in 600 mm and 800 mm width in 2,000 mm (42RU), 2,200 mm (47RU) and 2,450 mm (52RU) height
- Easily adapts to nVent cabinets; retrofit kits available for third party cabinets



### Benefits

- Modular standard design - easy to adapt to your requirements
- Minimal planning outlay, short setup time
- Versatile infrastructure solutions and product combinations



### Passive

The passive RackChiller consists of a mounting frame and a perforated door with integrated heat exchanger. The overall depth is approx. 225mm.

### Active

The active RackChiller consists of a mounting frame and a perforated door with 4 fans and an integrated heat exchanger. The overall depth is approx. 335 mm.

**The nVent SCHROFF Rear Door Cooler (RackChiller) is an air-to-water heat exchanger that can be mounted in place of the rear door of a server cabinet.**



**Access RackChiller Rear Door user manual for detailed description**



# RackChiller Rear Door Technical Data



## Electrical rating

### RackChiller Passive

Input voltage	200 - 240 VAC, 50/60 Hz
Input current rated	180 mA
Input current max.	450 mA

### RackChiller Active

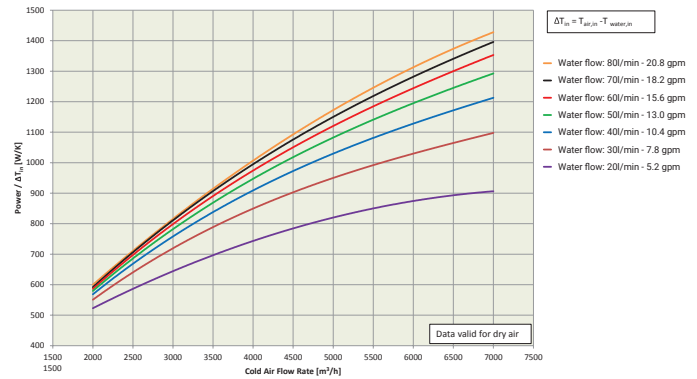
Input voltage	200 - 240 VAC, 50/60 Hz
Input current rated	2,3 A (230 V)
Input current max.	6 A (200 V)
Power consumption max.	530 W (Fan speed 100%)

## Maximum Air Flow (RackChiller Active)

6.800m³/h for 800mm wide units

5900m³/h for 600mm wide units

## Cooling Performance 2000x800mm Rear Door Cooler



Part No.	For Cabinet [mm]	Width (A) [mm]	Height (B) [mm]	Depth (C) [mm]	Weight (Dry) [kg]	Weight (W) packaging [kg]	Water capacity [l]	Cooling Capacity [kW]	Air Flow [m³/h / cfm]
<b>RackChiller Passive</b>									
21130-800	600x2000	598	2018 -2040	226	71,6	125	7	32	2850/1676
21130-801	800x2000	798	2018 -2040	226	82,8	136	9	48	4600/2706
21130-802	600x2200	598	2218 -2240	226	76,1	130	8	37	3200/1882
21130-803	800x2200	798	2218 -2240	226	88,6	142	10	54	5150/3029
21130-804	600x2450	598	2468 -2490	226	80,3	138	8	37	3200/1882
21130-805	800x2450	798	2468 -2490	226	93,3	152	10	54	5150/3029
The cooling capacity is determined under the following conditions: Δp water: <100 kPa, Δp air: 15 Pa, Water flow temperature: 12°C / 53,6 F, Outlet temperature: 24°C / 75,2 F, Water flow: 4.8 m³/h / 21,1 gal/min Airflow: Depending on cooling module dimensions, see table									

<b>RackChiller Active</b>									
21130-806	600x2000	598	2018 -2040	333	106,8	179	7	30	5900 / 3500
21130-807	800x2000	798	2018 -2040	333	123,1	195	9	45	6800 / 4000
21130-808	600x2200	598	2218 -2240	333	112,1	184	8	34	6000 / 3550
21130-809	800x2200	798	2218 -2240	333	130,3	202	10	50	7000 / 4100
21130-810	600x2450	598	2468 -2490	333	117,8	198	8	34	6000 / 3550
21130-811	800x2450	798	2468 -2490	333	136,9	217	10	50	7000 / 4100
The cooling capacity is determined under the following conditions: Δp water: <100 kPa, Water flow temperature: 12°C / 53,6 F, Outlet temperature: 24°C / 75,2 F, Water flow: 4.8 m³/h / 21,1 gal/min									

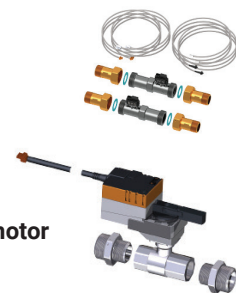
## Accessories RackChiller RearDoor

23130594 Control unit (RackChiller without fans)
23130599 Display for control unit (RackChiller without fans), PU 1 kit
23130621 Display for control unit (RackChiller without fans)
23130593 Water connection set, PU 1 kit
23130607 Control valve with servomotor, PU 1 kit
23130608 Water control package (sensor water flow, pressure and temperature)

## Display for Control Unit



## Water Control Package



## Control Valve with Servomotor



## Online RackChiller Rear Door Calculation Tool

Use our online calculator to specify your operating parameters

<http://php7.schroff.biz/rackchiller-reardoor-calculator/public/us/calculation>

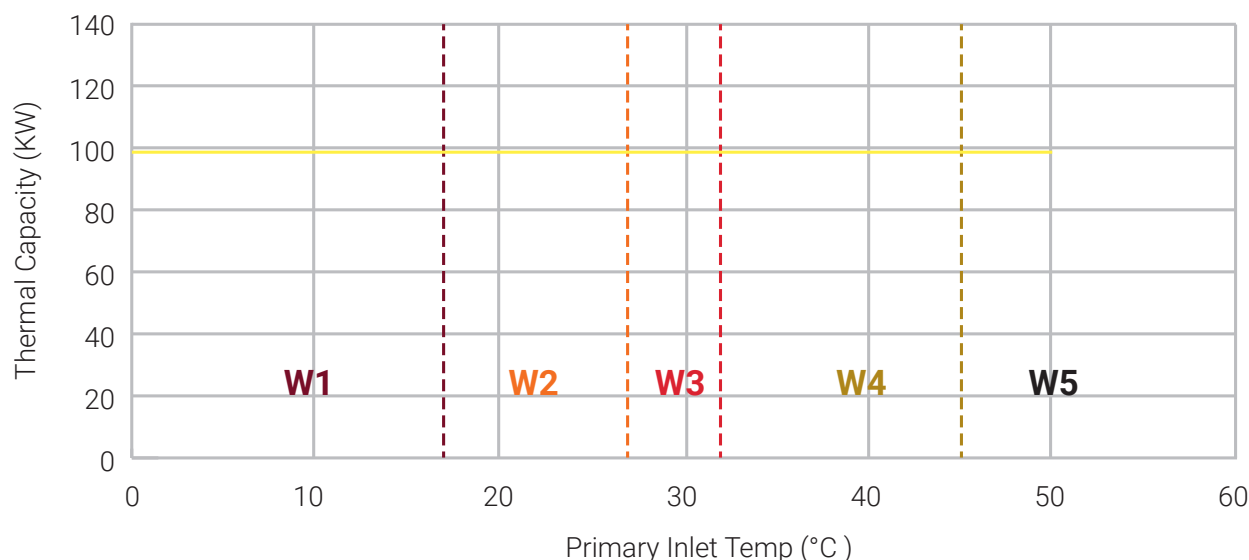
# ASHRAE TC 9.9 Overview

## Liquid Cooling Classifications For Data Centers

ASHRAE TC 9.9 defines different liquid cooling classifications for Data Centers based on facility water temperature available for cooling. The colder facility water would require higher upfront capital for the required cooling in terms of equipment and operating cost of chiller, cooling tower etc.

The warmer facility water would help alleviate the concerns of upfront capital on primary side cooling but it leads to other important factors to consider such as IT equipment max. temperature and also the approach temperature you have to live with. If approach temperature is constant, and the IT equipment can run at elevated temperatures, then CDU thermal capacity remains the same across the DC facility water temperature range.

## Thermal Capacity vs. Primary Inlet Temp



**W1**, facility water-W1 supply temperature of 2 °C to 17 °C

**W2**, facility water-supply temperature of 2 °C to 27 °C Class W1 and W2 typically apply to a data center that is traditionally cooled using chillers and a cooling tower but with an optional waterside economizer to improve energy efficiency depending on the location of the data center.

**W3**, facility water-supply temperature of 2 °C to 32 °C For most locations, these data centers may be operated without chillers in a waterside economizer mode. Some locations may still require chillers to meet facility water supply temperature guidelines during peak ambient conditions for relatively short periods of time.

**W4**, facility water-supply temperature of 2 °C to 45 °C To take advantage of energy efficiency and reduce capital expense, these data centers are operated in a waterside economizer mode without chillers. Heat rejection to the atmosphere can be accomplished by either a cooling tower or a dry (closed-loop liquid-to-air) cooler.

**W5**, facility water-supply temperature greater than 45 °C W5 facilities take advantage of energy efficiency, reducing capital and operational expense with chillerless operation, and by making use of the waste energy. The facility water temperature is high enough to make use of the water exiting the IT equipment for heating local buildings.

**Moving from a room or row based cooling to a rack or direct-to-chip based cooling solution allows to increase the water-supply temperature.**



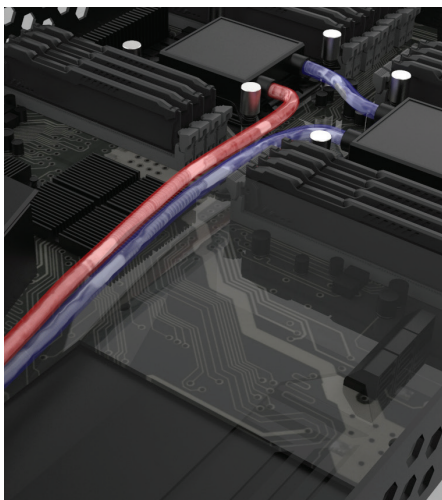
# High Density Liquid Cooling (HDLC)



**Coolant Distribution Unit (CDU)**



**Rack Manifold**



**Cold Plate (Chip Level Cooling)**

## Direct Water Cooling Solutions

- Typically reduces energy consumption and operating costs
- Superior cooling capacity
- Acoustic sound abatement
- Liquid cooling eliminates thermal stratification, which occurs as cold air settles at the bottom of the cabinet and hot air moves towards the top, allowing for increased air intake temperatures up to 80° F—further reducing energy needs
- Functions in non-raised floor environments—either by including the piping in the slab floor or installing it in a plinth base under the cabinet
- Clustering high density heat loads into liquid cooled cabinets frees up floor space within the data center.
- Higher chilled water temperatures avoid humidification issues, which decrease efficiency and increase energy costs.

## Features

- ASHRAE W4 warm direct liquid cooling
- 700kW+ cooling capacity
- Direct-to-chip & manifold connectivity
- Smart monitoring & control interface
- Integrated leak detection
- Redundant centralized pumps

## Coolant Distribution Network

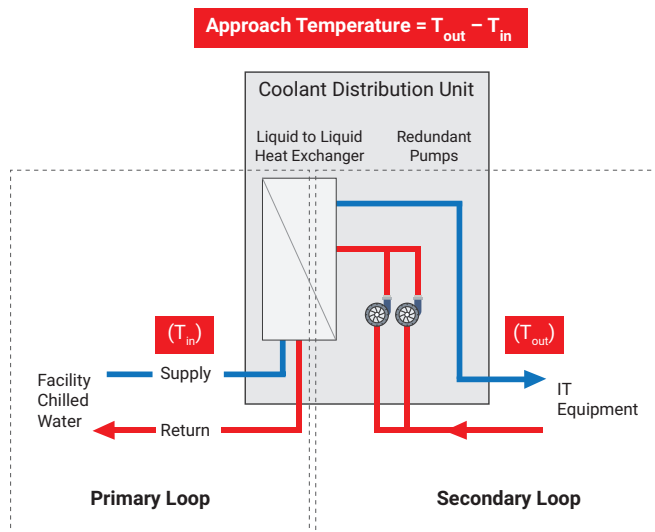
- Rack-mounted manifolds and hose kits
- Material - copper and stainless steel
- Joints - brazing, welding mechanical couples
- Dripless quick connectors

## Experience and Capabilities

- 10+ years liquid cooling experience
- Specialized in custom Coolant Distribution Unit (CDU) design
- Thermal modeling & analysis
- System design & manufacturing
- Leak testing & quality control

**With respect to its volume, water has a 3,500 times higher heat capacity versus air**

# HDLC Design Considerations

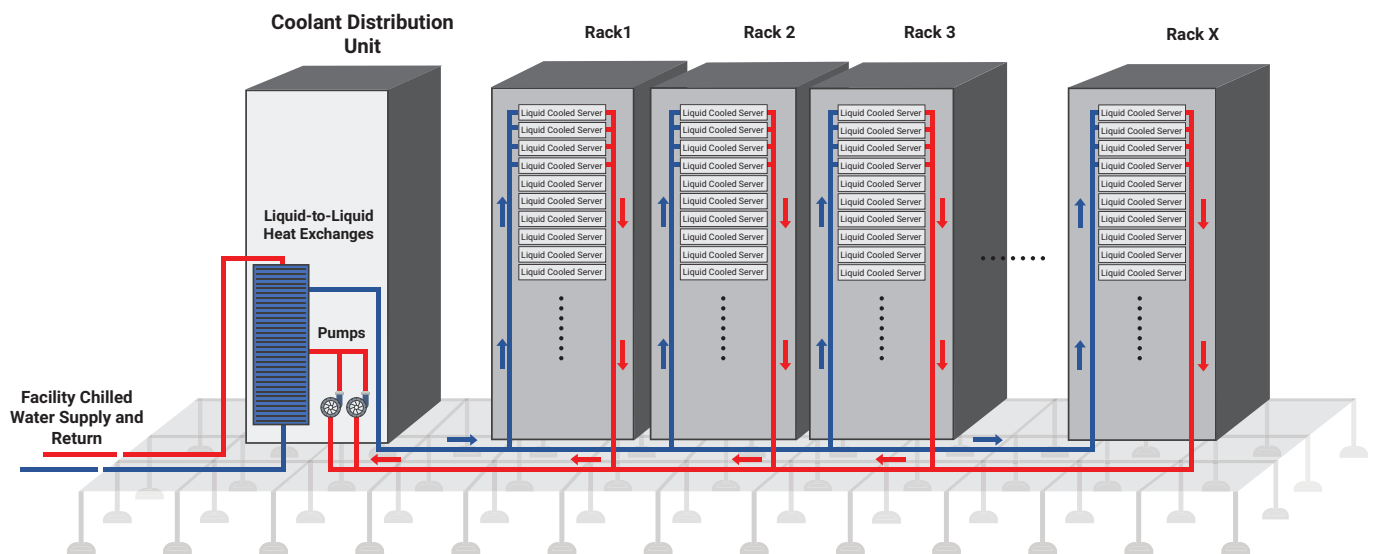


## Specifying Liquid Cooling Systems

The major sub-assemblies within a high density liquid-cooled system are typically specific to unique product designs – such as the control system, cold plates, manifolds, arrangement of piping, pumps, valves, etc. Additional common cooling system components and subsystems include quick connects, hoses and connections.

- Heat load
- Secondary return water temperature and secondary flow rate
- Primary (facility) water supply temperature and flow rate
- Secondary pressure drop
- Approach temperature
- Allowable max power consumption
- Form factor / dimensional constraints
- Voltage
- Controls/communication
- Agency approvals

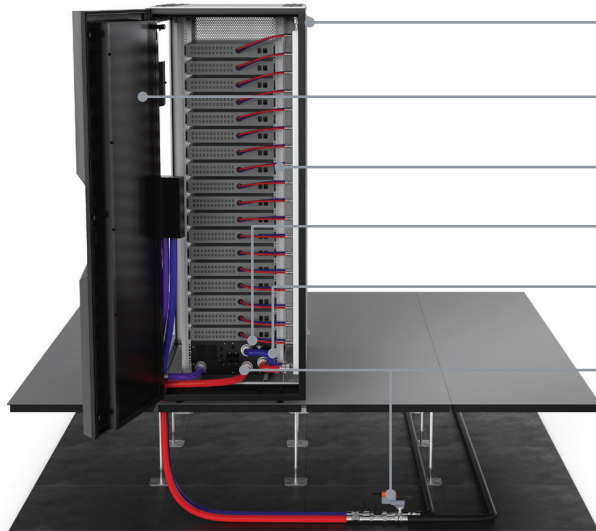
## Example High-Density Liquid Cooled (HDLC) System



In this example, the CDU separates the facility water, or primary side, from the much more tightly controlled secondary side water, which flows to the network of liquid cooled servers. Pumps within the CDU circulate the secondary water through the server cold plates and back to the CDU's heat exchanger, which transfers heat from the secondary loop into the facility water, without the two fluids ever touching.

# Exceptional Efficiency Performance

## Hybrid Liquid Cooling Combining Liquid and Air Cooling



RackChiller Rear Door Cooler is combined with a rack mounted Direct Contact Liquid Coolant Distribution Unit (rCDU) to achieve new levels of rack-level cooling efficiency.

Server cabinet

RackChiller Rear Door chilled water heat exchanger

Rack mounted Coolant Distribution Manifold (CDM)

Rack Coolant Distribution Unit (rCDU)

Integrated liquid pathway

Sophisticated, coordinated controls, integrated monitoring system (Webserver, Modbus, SNMP) and local display

### Benefits

- Reduces energy consumption
- Enables higher rack density
- Decreases total cost of ownership
- Quick and easy installation
- Modular design for easy future upgrades
- Ideal for Edge Computing applications

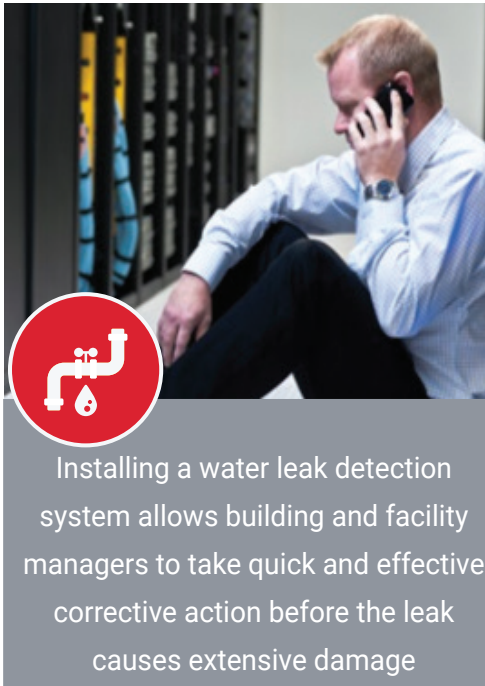
### Features

- Designed to remove 100% of the heat generated in IT racks configured with high density heat loads
- Combines the extreme heat removal of Direct Contact Liquid Cooling at the chip level with a Rear Door air-to-water heat exchanger for residual heat removal
- Uses a single facility water line
- Sophisticated, coordinated controls
- Warm water exiting the RackChiller Rear Door Cooler complements the input requirements of the Rack Coolant Distribution Unit
- High temperature return water increases efficiency and can be used for heat re-use

Parameter	Unit	Operating Point 1	Operating Point 2	Operating Point 3	Operating Point 4
Server return water temp.	[°C]	60	60	60	60
Facility supply water temp.	[°C]	15	20	30	40
Room temp.	[°C]	22,5	25	33	41.5
RackChiller Rear Door Cooler capacity	[kW]	25,5	17	11	5,7
RackChiller Rear Door return / rCDU primary supply temp.	[°C]	21	24	32	41
rCDU approach temp. diff.	[°C]	18,1	16,7	12,7	8,6
rCDU capacity	[kW]	74,8	69	52,5	35,6
<b>Combined capacity</b>	<b>[kW]</b>	<b>100.3</b>	<b>86</b>	<b>63.6</b>	<b>41.3</b>
Percentage air-cooled	[%]	25	20	17	14
Percentage liquid-cooled	[%]	75	80	83	86



# Leak Detection And Heat Tracing Solutions



## Avoid Major Problems With Water Leak Detection

Water leaks from burst pipes, indoor plumbing, faulty appliances or even the weather can damage property, data, and customer goodwill. That's why building owners invest in smart water leak detection equipment in offices, hotels, museums, computer rooms, data centers, or other industrial and commercial buildings.

nVent RAYCHEM TraceTek water leak detection systems detect, locate and communicate small leaks before major problems develop. Whether it's protecting datacenters with expensive electronics or protecting vital pipe infrastructure, our solutions are modular and tailored to your specific needs, to provide reliable and dependable protection for many years.

## Leak Detection

Product Name	Description
TTDM-128	Single channel and network master panel monitor
TT-TS12-PANEL	TT-TS12 12" touch screen monitoring panel and network master
TTSIM-1A	Modbus enabled sensor interface module with relay
TT1000	Modular water sensing cable
TT1100-OHP	Water sensing cable for use with suspended water piping
TT-FLAT-PROBE	Water and conductive liquids detector, flat probe
TT-MINI-PROBE	Water and conductive liquids sensing probe with metal connector
TT-MLC-PC	Modular leader cable with female connector on one side and pigtail lead on other side
TT-MET-PC	Modular end termination with plastic connector
TT-MBC-PC	Modular branch connector with plastic connector
TT-MJC-PC	Modular jumper cable with factory installed plastic connectors
TT5000-MC	Modular liquid fuels sensing cable with factory installed connectors
TT-FFS-WR	TT-FFS-WR series fast fuel probe. Water Resistant

## Benefits

- Long term reliable systems made with high performance polymers for maximum durability.
- Cables and probes that directly detect and accurately pinpoint the source of the leak.
- Digital communications powered independently of the sensor cable so that damage to the sensor cable does not cripple the entire system.
- A robust digital backbone that gives the ability to independently track many leaks at once, with local, networked or remote alarms and diagnostics.
- Flexible design options that permit sensor cables to be short or long and deployed on one floor or many levels of the building while being centrally monitored from the most effective locations.
- Graphic mapping that shows the location of any detected leak on a background graphic of your choosing that flashes an icon in the exact location of the detected leak.
- Optional fuel sensors to monitor the back-up emergency generators and associated diesel fuel tanks, pipes and fittings (FM7745 compliant).
- Multiple digital communications protocols and integration to building management systems, email / SMS or web page.
- Configuration options that automatically shut off pumps or valves where appropriate.
- Modular assemblies that can be configured for current needs and allow for future expansion of your leak detection system.
- Ability to monitor up to 250 cables independently of each other.

**Prevent downtime in data centers -  
find leaks before they find you**

# Configured To Your Needs

## Leak Detection Configured To Your Needs

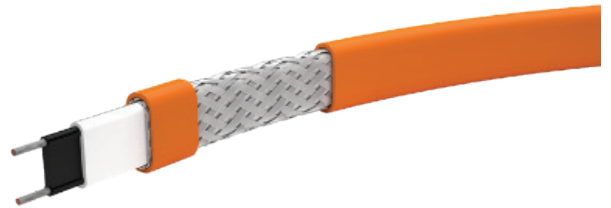
Critical infrastructure and equipment typically requires both 24/7 availability and absolutely no damage. Our water leak detection systems consist of sensor cables, probes and monitoring systems, to detect and pinpoint leaks, allowing you to take action immediately and at the right location.

TraceTek technologies include sensor cables, fast acting probes, monitoring and alarm panels. These modular units can be configured to suit simple or complex applications and allow for future expansion. The capability to integrate in building information management systems, provides central visibility over the entire system. TraceTek leak detection systems are simple to operate, rugged in design and reliable in use.



## Heating Cable Solutions

Specialized nVent RAYCHEM self-regulating heating cables, controllers, and accessories are ideal for pipe freeze protection, roof and gutter de-icing, and fuel oil temperature maintenance. These will help you protect your facility while complying with today's building regulations on energy savings. A complete nVent RAYCHEM system can result in energy savings of up to 80%! Additionally, nVent RAYCHEM connection systems are designed and configured to be fully compatible with our heating cables and decreases installation time by up to 80%.



## Heat Tracing System Design Tools

TraceCalc Pro For Buildings is an intuitive, easy-to-use, online design tool that lets you create simple or complex heat-tracing solutions. Additional BIM, MasterSpec and CAD Details tools are available at our Designer's tool box.

Protect your Data Center's pipes, roofs, and gutters from freezing water, ice and snow.



### Online Design Tool

<https://www.nventthermal.com/design-tools/online-tools/trace-calc-pro-for-buildings/index.aspx>

# Thermal Simulation

Computational Fluid Dynamics (CFD) can be used to analyze existing or future data center thermal capacity, installed IT equipment load and data center infrastructure performance. CFD analysis supports the optimization of existing or future IT equipment layouts. Virtual recording and tests maintain educated decisions on operational infrastructures to check fallout plans, redundancies, position of sensors and cooling components as well as capacity planning.

## ADVANTAGES OF CFD

- Minimize planning outlay
- Reduce operational cost
- Improve existing infrastructure
- Asset planning

## Application

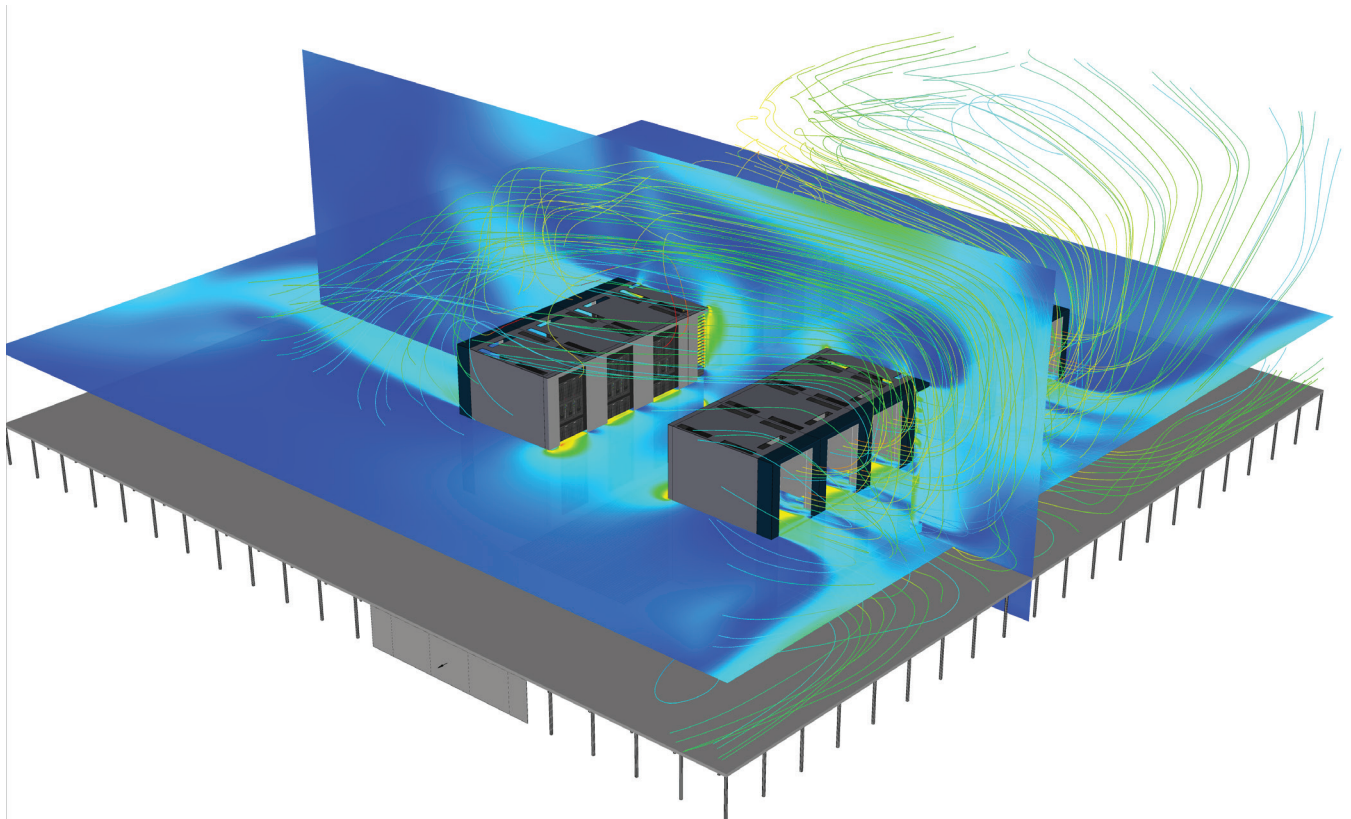
In the previous 5 years, the performance of servers, storage, and networking equipment has increased exponentially. Along with this performance growth has come a significant increase in the power dissipated by the server, storage, and networking hardware. This has caused a significant strain on the data center infrastructure that was built for hardware power levels much less than what is being delivered today. Placement of IT equipment, air handlers, close-coupled cooling, and direct liquid cooling technologies within the data center environment is critical to the efficient use of available space and data center cooling capacity. Lead time for facility upgrades and capital planning requirements mandate comprehensive planning.

## Evaluation Completed By Expert nVent Engineers

A key to the effective deployment of IT equipment is an evaluation of the current and future thermal profile of the data center. nVent thermal analysis enables customers to choose the most efficient and effective cooling technologies and layouts for their specific IT hardware by modelling the necessary infrastructure modifications or layout changes.

## Typical Project Tasks:

- Project scope/resources/schedule agreed upon
- On-site evaluation and consultation
- Analyze and optimize with CFD models
- Final meeting with evaluation report and recommendations for data center layout





# Support And Services

Whatever challenges you have to overcome, we will work together to find the perfect solution. Standard off the shelf, preconfigured products or a custom solution, our products are the result of our experts know-how in cabinets and racks integrating mechanics, electronics and thermal management. Wherever you are: trust in nVent with the widest range of application requirements. With our pre- and post-sales services we support you over the full product life cycle.

**Work with experts to specify your optimized cooling solutions.**



## PROFESSIONAL SERVICES



With a network of qualified field installation and repair technicians around the world, nVent offers unparalleled cooling support and services to quickly restore your system. Depend on us for local customer service, regional spare parts inventories and competitive standard warranties. Extended warranties and preventive maintenance are also available.