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High Cooling System

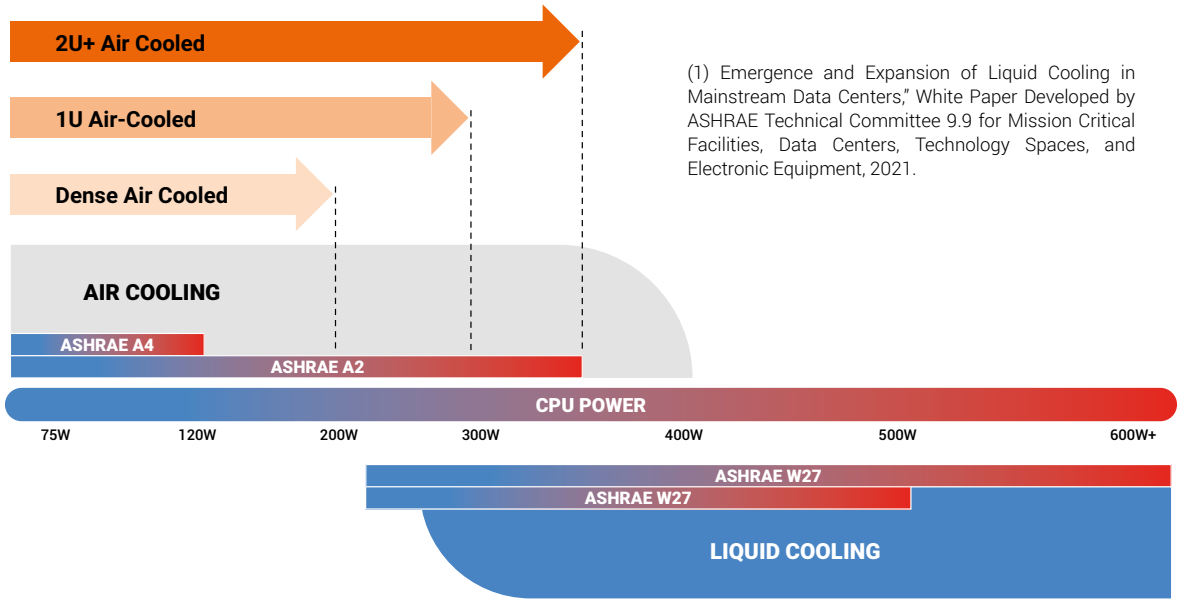
Direct To Chip Liquid Cooling

REVOLUTIONIZING DATA CENTER COOLING

The evolution of data centers, driven by High-Performance Computing (HPC), Artificial Intelligence (AI), and cloud workloads, has led to unprecedented increases in rack thermal densities, often exceeding 30-50 kW per rack.

Traditional air-cooling systems, while reliable in the past, now struggle to efficiently dissipate such immense heat loads, leading to excessive energy consumption, higher costs, and limits on data center scalability.

According to the **ASHRAE Technical Committee (1)**, liquid cooling technologies are rapidly gaining traction as an effective solution to address these challenges, offering superior thermal efficiency and enabling higher rack densities in modern data centers.



(1) Emergence and Expansion of Liquid Cooling in Mainstream Data Centers," White Paper Developed by ASHRAE Technical Committee 9.9 for Mission Critical Facilities, Data Centers, Technology Spaces, and Electronic Equipment, 2021.

Liquid cooling, particularly Direct-to-Chip Two-Phase Cooling, has emerged as the optimal solution for addressing these challenges. This cutting-edge technology targets heat removal directly at the source the CPU or GPU ensuring unmatched thermal efficiency and operational reliability.

Unlike traditional air systems that rely on fans and chillers, the HCS (High Cooling System) uses two-phase evaporative cooling to achieve superior heat management.

WHAT IS DIRECT-TO-CHIP TWO-PHASE COOLING?

Direct-to-Chip Two-Phase Cooling is an advanced thermal management technology where cooling fluid is delivered directly to processors (CPUs and GPUs) via specialized cold plates. At the processor surface, the fluid absorbs heat and undergoes evaporation, transitioning from liquid to vapor.

This phase change process efficiently removes heat at the source, significantly enhancing cooling performance while reducing energy consumption compared to traditional cooling methods. The vapor is then transported to a condenser, where it releases the absorbed heat, transitions back to liquid, and recirculates, completing the cooling cycle.

THE TWO-PHASE EVAPORATIVE PROCESS

Evaporation Phase

The cooling fluid (dielectric refrigerant) absorbs heat from the processor, transitioning from liquid to vapor. This phase change effectively removes high heat loads directly from the chip surface.

Condensation Phase

The vapor is transported to the condenser unit, where it releases the absorbed heat and transitions back to liquid form. The liquid is then recirculated to the cold plates, completing the cycle.

THIS METHOD OFFERS SEVERAL ADVANTAGES

Enhanced Heat Removal

Direct-to-chip technology efficiently handles thermal densities up to 100 W/cm² (H100 Nvidia 70W/cm²), making it ideal for advanced CPUs and GPUs.

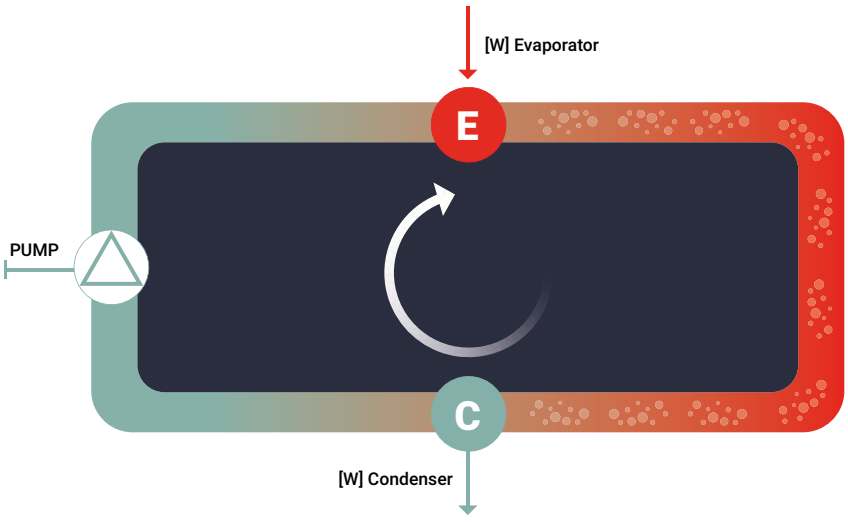
Energy Efficiency

By leveraging the refrigerant's phase change, the system achieves superior cooling performance while consuming less power.

Eco-Friendly Design

The system utilizes next-generation refrigerants with low Global Warming Potential (GWP), ensuring sustainability.

OPERATING DIAGRAM



WHY EVAPORATIVE TWO-PHASE LIQUID COOLING IS THE FUTURE?

The HCS by ITRack utilizes Direct-to-Chip **Two-Phase Liquid Cooling**, combining the **evaporation** and **condensation** phases to efficiently manage heat at the processor level. This technology not only optimizes cooling performance but also sets a new benchmark in energy savings and operational sustainability for modern data centers.

Efficiency
By removing heat at the chip level, liquid cooling minimizes thermal resistance and eliminates inefficiencies caused by air recirculation.

Scalability
Supports next-generation processors with power densities of up to **100W/cm²** and TDP (Thermal Design Power) up to **1500W**, enabling greater compute densities within existing rack footprints.

Environmental Impact
Liquid cooling enables higher data center sustainability by reducing reliance on energy-intensive air-cooling systems and supporting the use of **low-GWP refrigerants.**

Reliability
By maintaining precise thermal control, it prolongs the lifespan of IT equipment and ensures system stability under high computational load.

CURRENT LIQUID COOLING TECHNOLOGIES COMPARISON

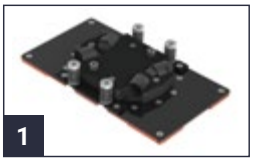
	Immersion Cooling	Direct-To-Chip Single Phase	Direct-To-Chip Two Phase (HCS)
Tank Volume 42U	1483 Liters	11 Liters	9 Liters
Fluid Weight	High	Low	Low
Large Pipe Infrastructure	Large Diameter	Small Diameter	Small Diameter
Pump Motor Sizing	Large	Small	Small
Traditional 42U-52U Cabinet	No	Yes	Yes
Raised Floor Loading	High	Low	Low
Traditional Sever Compatibility	Low	High	High
Dielectric Volume/Cost	High	Low	Low
Fluid Replenishment	Yes- Evaporation	Yes – Water Maintenance	No – Closed Loop
Risk Due To Fluid Leak	No	Yes - Conductive	No

HIGH COOLING SYSTEM

COMPONENTS

The **HCS system** is an innovative, in-rack evaporative liquid cooling solution that seamlessly integrates into ITRack's data center infrastructure.

Specifically designed to align with the dimensions and requirements of ITRacks, this system optimizes cooling performance directly at the source of heat generation, delivering unprecedented thermal management efficiency.



COLD PLATES (EVAPORATORS)

- Material: Aluminum multi-mini-channel evaporators (patented)
- Compatibility: High-performance CPUs/GPUs with TDP up to 1500W
- Flexible PTFE tubing for zero leakage

COOLING DISTRIBUTION UNIT (CDU)

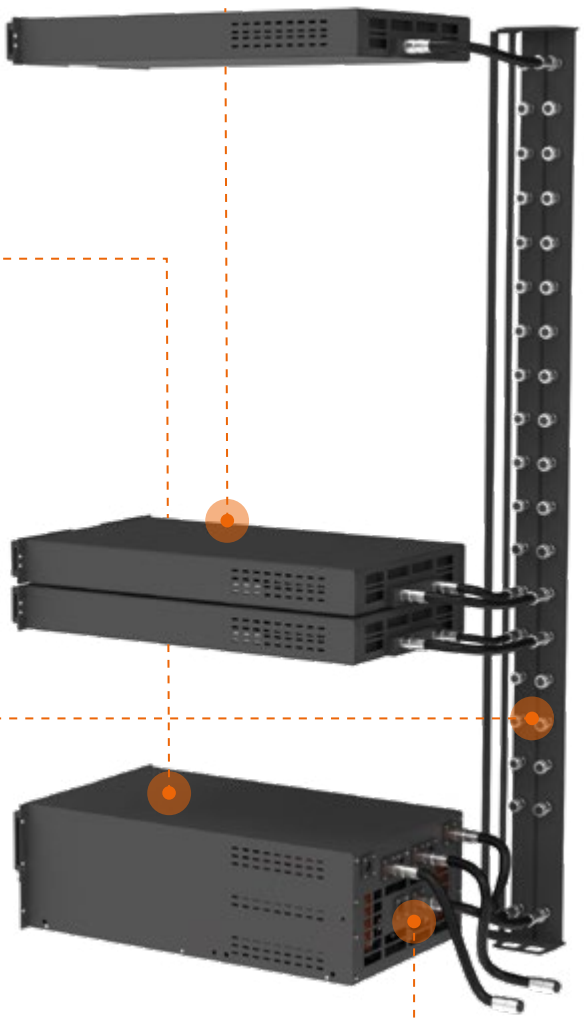
- Dimensions: 800mm x 420mm x 266.7mm (6U)
- Cooling capacity 30-100 kW
- Pumps: Redundant (N+1) centrifugal pumps for refrigerant and water lines
- Plate Brazed Heat Exchangers for efficiency

REFRIGERANT DISTRIBUTION MANIFOLDS

- Construction: Aluminum manifolds with hydraulic quick-release couplings
- Performance: Optimal fluid distribution for maximum efficiency

COOLANT

- Non-Toxic, Non-Flamable, Non-Conductive (Dielectric) refrigerant (ASHRAE A1)
- Dielectric fluid does not damage electronic components in the unlikely in the event of a leakage



ITRACK HCS

BENEFITS

PERFORMANCE

TARGETED PUE
1,035

POWER
Up to 1500W
Increased processors power

TPD
>100W/cm^2
(H100 Nvidia 70W/cm^2)

SAVINGS

DENSITY
Up to 75%
Increased Rack Density

ENERGY
Up to 50%
Energy saved compared to air cooling

PAYBACK
< 2 years

ENVIRONMENT

SAFETY
GWP 2
Proprietary dielectric coolant

ENVIRONMENT
0 issues
to dispose HCS fluid

CONSUMPTION
0 Water consumed

ITRACK HCS | Sustainable Cooling for a Greener Future

By ensuring high energy efficiency, significantly lowering power consumption, and achieving a targeted PUE of 1,035, the HCS solution is essential for more sustainable and greener data centers.

Its closed-loop system uses zero water, preserving natural resources, while the low-GWP (GWP=2) dielectric coolant guarantees minimal environmental impact and safe, sustainable operation. By eliminating the inefficiencies of air cooling, HCS enables data centers to operate more efficiently while reducing CO_2 emissions and their overall carbon footprint.

As next-generation chips become more powerful and generate higher heat loads, and the energy consumption of non-IT components becomes a critical challenge for data center deployment, HCS provides the solution. By addressing these evolving demands, HCS ensures the scalability, efficiency, and sustainability required for the data centers of the future.

TECHNICAL SPECIFICATION

6U CDU Water Specifications	
Fully contained build, including electrical components and control system. All wet materials are dielectric refrigerant compatible.	
System seal types	Compression
Cooling capacity supports	up to 100 kW (rack power ASHRAE W32 at 32°C 100kW, ASHRAE W45 at 45°C 60kW)
Reliability	Redundant pumps (N+1), power supplies, sensors, control board
Piping System	Aluminum, PTFE, or copper tubing, aluminum, hydraulic quick release couplings

Environmental	
SYSTEM	
Operating Temperature	5°C -45°C
Max Working pressure	3 bar (refrigerant), 5 bar (Cooling water)
Humidity	20% -70%
REFRIGERANT	
Type	Dielectric Fluid (proprietary)
Temperature Working Range	2°C -65°C
Buffer Tank Capacity	7L
Safety	Non-conductive, non-corrosive, non flammable, non-toxic
Environmental properties	GPW 2

Electrical Connections- Electrical and Communications	
Power Connection	N+1 phase redundancy, 120-230 VAC at 50/60 Hz
Power Consumption	< 0.7 kW

Physical Dimensions	
Height	6U
Width	19”
Length	800mm
Weight	45Kg

ITRack®

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