# Modular Data Center Liquid Cooling System



## Overview

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## Key Takeaways

Modular liquid cooling is a scalable, efficient system that uses liquid coolant to remove heat directly from high-density IT equipment, improving energy efficiency and supporting higher rack power densities.

### What It Is

Modular liquid cooling is an advanced thermal management approach in data centers where liquid coolant, such as water or dielectric fluids, is used to absorb and transfer heat away from servers and components. Unlike traditional air cooling, which relies on airflow and fans, liquid cooling places the coolant closer to the heat source, enabling more efficient heat transfer and supporting higher-density racks that can exceed 30kW per rack.

### How It Works

Modular liquid cooling systems are composed of interconnected components that can be deployed incrementally or scaled as needed: Coolant Distribution Units (CDUs): Manage the flow and temperature of the liquid coolant. Cold Plates: Attached directly to CPUs, GPUs, or other heat-generating components to absorb heat. Liquid Manifolds: Distribute and collect coolant at the rack level.

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Heat Rejection Units: Transfer heat from the liquid to the external environment.

## Complementary Air-

Cooling Components: Used in hybrid systems to manage residual heat. Modular systems allow direct-to-chip cooling, where cold plates remove heat at the source, or immersion cooling, where servers are fully submerged in dielectric fluid for even higher heat densities.

## Advantages

Scalability: Modular design allows data centers to add cooling capacity as IT demands grow without major infrastructure changes. Energy Efficiency: Liquid cooling provides up to 3,500 times the heat transfer capacity of air, reducing reliance on fans and lowering overall energy consumption, improving Power Usage Effectiveness (PUE),.

## Support for High-

Density Racks: Enables racks to handle 120kW or more, which is critical for AI, HPC, and next-generation servers. Sustainability: Closed-loop designs minimize water usage and can integrate with renewable energy sources. Reduced Physical Footprint: Higher cooling efficiency allows for denser server placement, reducing the need for additional floor space.

## Applications

Modular liquid cooling is particularly valuable in high-performance computing, AI workloads, and cloud data centers, where heat generation is significant and traditional air cooling is insufficient. It also supports brownfield retrofits, allowing older facilities to upgrade cooling efficiency without complete redesigns.

## Summary

In essence, modular liquid cooling transforms data center thermal management by providing a flexible, energy-efficient, and scalable solution. It enables higher compute densities, reduces operational costs, and supports sustainable operations, making it a key technology for modern and future-ready data centers.

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