LIQUID COOLING — GUIDE

How to Size a Coolant Distribution Unit (CDU)

Step-by-step guide to sizing a CDU for direct-to-chip liquid cooling: heat load, flow rate, temperature rise, redundancy, and facility integration.

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A coolant distribution unit (CDU) is the interface between the facility cooling loop and the technology (IT) cooling loop in direct-to-chip liquid cooling. Correct sizing ensures stable temperatures, adequate flow, and operational resilience.

Sizing steps

1. Determine total heat load (Q)

Sum the thermal design power (TDP) of all liquid-cooled components in the rack or pod. Include a safety margin (typically 1.2-1.5×) for transient loads and future density increases.

Example: A rack with 8 GPUs at 1,000 W TDP each + 2 CPUs at 350 W TDP each = 8,700 W. With 1.3× margin: **Q = 11.3 kW**.

For NVIDIA GB200 NVL72, the full rack TDP approaches 140 kW (TrendForce, 2024; NVIDIA, 2026).

2. Choose target temperature rise (9EB•

9EB —2 F†R F–f`erence between coolant supply and return temperatures at the cold plates. Typical values:

- **Direct-to-chip**: 5-15°C (lower 9EB Ò †–v†W" fÆðw, smaller temperature gradient)
- **Facility loop**: 10-20°C (depends on cooling tower/dry cooler approach)

ASHRAE TC 9.9 liquid cooling classes (W17-W45) define allowable supply temperatures. Class W17 allows up to 17°C supply; W45 allows up to 45°C (ASHRAE Thermal Guidelines, 5th Edition, 2021).

3. Calculate required mass flow rate (m)

Use the energy balance equation:

Q = m × cp × 9E@

Where:

- Q = heat load (W)
- m = mass flow rate (kg/s)
- cp = specific heat capacity of coolant (J/kg·K)
- 9EB Ò FV× W ature rise (K or °C)

Coolant properties (approx.):

- Water: cp "H 4.18 kJ/kg·K, density "H 1,000 kg/m³
- 30% propylene glycol: cp "H 3.8 kJ/kg·K, density "H 1,030 kg/m³
- 30% ethylene glycol: cp "H 3.6 kJ/kg·K, density "H 1,040 kg/m³

Example: Q = 100 kW, 9EB Ò 0, 30% propylene glycol (cp = 3.8 kJ/kg·K)

- m = 100,000 / (3,800 × 10) = **2.63 kg/s**
- Volumetric flow = 2.63 / 1,030 = **0.00255 m³/s = 153 L/min**

4. Select CDU capacity

Choose a CDU rated for at least the calculated flow and heat rejection capacity. CDUs are typically rated in kW of heat rejection.

- **Rack CDU**: 50-300 kW (in-rack or rack-adjacent units)
- **Row CDU**: 300 kW - 2 MW (CoolIT CHx2000 delivers 2,000 kW per unit, April 2025)
- **Facility CDU**: 1.5 MW - 3.5+ MW (Schneider Electric WCDU up to 3.5 MW, September 2026)

Oversizing risk: Oversizing expands fault domains and complicates operations. Fit matters more than maximum output (CoolIT Systems, 2025).

5. Verify pressure requirements

Direct-to-chip cold plates impose pressure drop requirements. Typical cold-plate loops need 30-80 psi (2-5.5 bar) differential across the rack manifold. The CDU pump curve must deliver required flow at the system pressure drop.

Include losses from:

- Cold plates (varies by vendor, typically 5-20 psi per plate)
- Manifolds and quick-disconnects
- Piping runs (horizontal and vertical)
- Filtration and strainers

6. Define redundancy model

- **N+1**: One spare CDU per N active units. Common for row-based deployments.
- **2N**: Fully redundant parallel CDUs. Required for highest availability.
- **Cold standby**: Spare CDU on-site, manual switchover. Lower cost, longer recovery.

Define switchover time, failure detection, and whether the facility loop also needs redundancy.

7. Facility loop integration

The CDU heat exchanger transfers heat to the facility water loop. Verify:

- Facility supply temperature meets ASHRAE class for your IT equipment
- Facility flow rate matches CDU heat exchanger design point
- Facility pressure rating compatible with CDU heat exchanger
- Glycol concentration and corrosion inhibitors compatible with CDU materials
- Controls integration: CDU typically manages IT loop temperature; facility loop may have

separate controls

8. Controls and monitoring

Specify:

- Supply temperature control (±0.5°C typical)
- Flow monitoring and low-flow alarm
- Pressure monitoring (supply, return, differential)
- Leak detection integration
- BMS/Modbus/BACnet integration for facility monitoring
- Redundancy switchover logic

Quick reference table

| Rack density | Typical CDU type | Heat rejection | Flow (water, 9ECÓ 2’ Â
|---|---|---|---| | 30-50 kW | Rack CDU | 50-100 kW | 72-143 L/min | | 50-100 kW | Rack/Row CDU | 100-200 kW | 143-287 L/min | | 100-150 kW | Row CDU | 200-400 kW | 287-574 L/min | | 150+ kW (multi-rack) | Row/Facility CDU | 500 kW - 3.5 MW | 718-5,024 L/min |

Sources

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Frequently asked questions

What is the formula for CDU flow rate?

Q = m × cp × 9E@, where Q is heat load (W), m is mass flow rate (kg/s), cp is specific heat capacity (J/kg·K), and 9EB —2 FV× W ature rise across the cold plates (K). For 30% propylene glycol at 3.8 kJ/kg·K, a 100 kW rack with 10°C 9EB æVVG2 ã"ãc2 ¶r÷2 ‡ã S2 ÂöÖ–â’à

Do I need N+1 redundancy on the CDU?

Mission-critical deployments typically require N+1 or 2N CDU redundancy. CoolIT Systems

recommends defining the resilience model early so the system behaves predictably during component failure or maintenance (CoolIT Systems, 2025).

Can one CDU serve multiple racks?

Yes. Row-based CDUs serve multiple racks within a pod. Facility-based CDUs serve multiple zones. CoolIT Systems categorizes CDUs as rack-based, row-based, and facility-based by deployment model (CoolIT Systems, 2025).