LIQUID COOLING — GUIDE

# ASHRAE TC 9.9 Liquid Cooling Classes (W17-W45) Explained

*Understand the ASHRAE Thermal Guidelines liquid cooling classes W17 through W45: supply temperature ranges, delta-T limits, and how to select the right class for your deployment.*

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ASHRAE Technical Committee 9.9 (Mission Critical Facilities) publishes the *Thermal Guidelines for Data Processing Environments*. The 5th Edition (2021) renamed the liquid cooling classes after their maximum facility water supply temperature: **W17, W27, W32, W40, W45 and W+** (previously W1 through W5). Each class also carries a 2°C (35.6°F) lower limit (ASHRAE TC 9.9, 2021).

## The W-class naming convention

**W** = Water (liquid) cooling class **Number** = Maximum facility water supply temperature in °C

| Class | Max supply temp | Primary facility source (ASHRAE Table 3.1) | Typical use |
|---|---|---|---|
| W17 | 17°C (62.6°F) | Water-side chiller / cooling-tower economizer | Legacy liquid-cooled HPC, tightest control |
| W27 | 27°C (80.6°F) | Water-side chiller / economizer | Modern AI/HPC, direct-to-chip, warm-water cooling |
| W32 | 32°C (89.6°F) | Chiller or cooling tower | High-density AI, reduced chiller runtime |
| W40 | 40°C (104°F) | District heating | Heat-reuse and high-temperature designs |
| W45 | 45°C (113°F) | District heating / cooling-tower system | Maximum free cooling, specialized designs |
| W+ | >45°C (>113°F) | Cooling-tower system | Custom equipment beyond standard classes |

Source: ASHRAE Thermal Guidelines for Data Processing Environments, 5th Edition (2021), Table 3.1. The 9EB 7&÷72 6öÆB Æ FW2 —2 6WB y the IT equipment spec, not the class. 10°C is a typical direct-to-chip design value.

## Key parameters per class

Each class defines:

1. **Maximum facility water supply temperature** — Coolant temperature delivered to the equipment loop
2. **A 2°C lower limit** — All classes share the same lower bound
3. **Dew-point separation** — ASHRAE TC 9.9 directs designs to stay 2°C above the dew point in the IT space to avoid condensation
4. **Water quality expectations** — Corrosion, fouling and biological growth limits for the loop

The equipment spec then sets the rest: **Example W27 deployment** (typical):

- Facility water supply: "d 27°C

- IT-loop supply: ~29-32°C (facility supply plus 2-5°C CDU approach)
- 9EB  7&÷72 6öÆB  Æ FW3  per IT equipment spec (10°C typical)
- Dew point margin: "e 2°C in the IT space

## Selecting the right class

### Factors that push toward warmer classes (W32-W45)

- **Free cooling hours**: Warmer supply = more hours of dry-cooler operation. In cool climates, W27-W32 can achieve 8,760 hours/year free cooling.
- **Chiller elimination**: W32+ often eliminates mechanical chillers entirely.
- **OEM support**: NVIDIA, AMD, Intel now publish liquid-ready reference designs that assume warm facility water (Mordor Intelligence, 2026).
- **PUE targets**: Warmer water !’ lower PUE. Allied Control achieved PUE 1.02 with two-phase immersion at warm temperatures (Wikipedia PUE, 2026).

### Factors that require cooler classes (W17-W27)

- **Legacy cold plates**: Older designs rated for "d 25°C supply.
- **High heat flux**: Some GPU cold plates need lower inlet temps to maintain junction temperature margins.
- **Condensation risk**: If rack dew point control is uncertain, cooler supply provides margin.
- **Facility loop constraints**: Existing chilled-water plants may only deliver 10-15°C.

## Facility loop implications

| Class | Typical facility approach | Chiller needed? | Dry cooler viable? |
|---|---|---|---|
| W17 | Chilled water plant | Yes | Limited hours |
| W27-W32 | Chiller + dry cooler / free cooling | Partial | Most hours (cool climates) |
| W40-W45 | Dry coolers, adiabatic | Rarely | Most/all hours |

Microsoft's Fairwater, WI facility uses closed-loop direct-to-chip cooling with >90% liquid-cooled capacity and minimal water evaporation (Mordor Intelligence, 2026).

## CDU and heat exchanger sizing

The CDU heat exchanger bridges the facility loop (W-class supply) and the IT loop. The approach temperature — the difference between the IT-loop supply and the facility supply — is typically 2-5°C. The IT loop always runs warmer than the facility supply by at least the approach.

**Example**: IT equipment needs "d30°C coolant supply and the facility delivers W27 ("d27°C) !’ approach = 3°C. A W17 facility supply ("d17°C) would give a 13°C approach, allowing a smaller heat exchanger.

## Common misconceptions

- **"Higher class is always better"** — Warmer water reduces chiller energy but increases cold-plate flow requirements (lower 9EB `or same heat load) and may stress OEM thermal limits.

- **"One class per facility"** — Different rows/pods can run different W-classes if served by separate CDUs.

## Verification checklist

- [ ] Confirm OEM server/rack liquid cooling specification (supply temp, 9E@, flow, pressure)
- [ ] Map OEM spec to nearest W-class (do not exceed class limits)
- [ ] Verify facility loop can meet the class supply temperature at design conditions
- [ ] Size CDU heat exchanger for the approach temperature
- [ ] Confirm water quality meets ASHRAE guidelines for the class
- [ ] Document class in commissioning and handover documents

## Sources


- ASHRAE TC 9.9. "Thermal Guidelines for Data Processing Environments, 5th Edition." 2021. https://www.ashrae.org/technical-resources/bookstore/thermal-guidelines-for-data-processing-environments
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## Frequently asked questions

**What does the number in W17, W27, W45 mean?**

The number indicates the maximum allowable coolant supply temperature in °C. W17 = 17°C max supply, W27 = 27°C max, W45 = 45°C max (ASHRAE Thermal Guidelines, 5th Edition, 2021).

**Which class should I choose for NVIDIA GB200 NVL72?**

NVIDIA GB200 NVL72 requires direct-to-chip liquid cooling with supply temperatures typically in the W27-W32 range. Check the specific OEM cooling specification for your server model (NVIDIA, 2026).

**Can I use a higher class (warmer water) to save chiller energy?**

Yes. Higher supply temperatures enable free cooling (dry coolers) for more hours per year. Microsoft's closed-loop liquid-cooled AI data centers use direct-to-chip cooling without evaporative losses (Mordor Intelligence, 2026).

**Does the class specify delta-T (temperature rise)?**

No. The class name only sets the facility water supply temperature envelope (2°C lower limit up to the named maximum). The allowable 9EB 7&÷72 F†R 6öÆB Æ FW2 6öÖW2 g&öÒ F†R •B W V— ÖVçB

specification, not the class name (ASHRAE TC 9.9, 2021).