



5 Questions to ask before selecting a compact liquid cooling pump

A practical selection framework for electronics cooling system designers



The changing demands of electronics cooling

As liquid cooling continues to expand across PCs, workstations, and servers, the pump plays an increasingly important role in both thermal performance and total system design. Modern cooling systems aren't just constrained by flow and pressure anymore. Designers also need to balance footprint, acoustics, efficiency, lifetime, speed control, and overall user experience. That's why it's crucial to take a system-first approach to pump selection. The right pump is the one that best aligns with the unique demands and constraints of the application.



Increasing heat loads and power densities



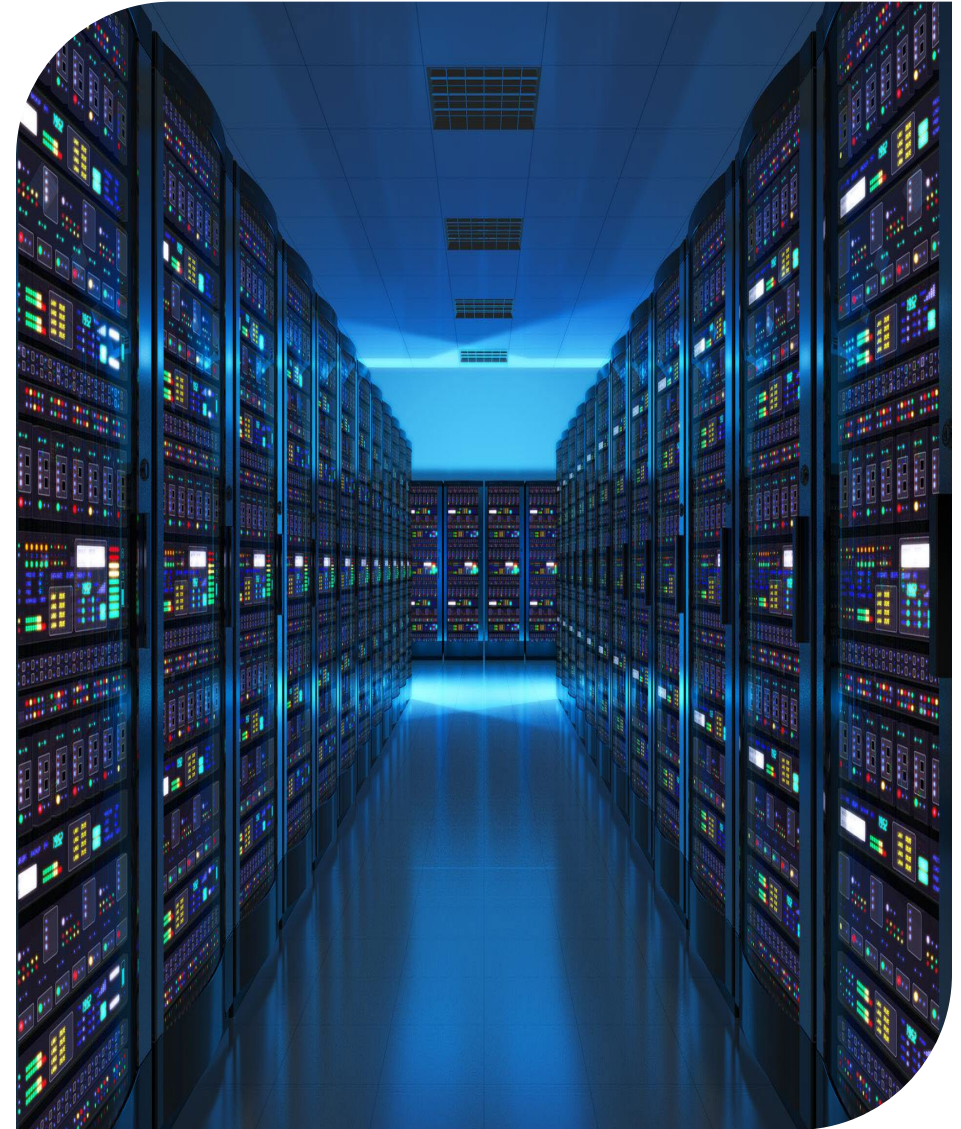
Tighter packaging constraints



Higher expectations for uptime and service life



Growing need for controllability, efficiency, and lower noise



1

What's the pump's total lifecycle cost – in hours and intervention?

In many liquid-cooling systems, the pump is one of the few moving components and often operates continuously for years. Selecting a pump designed for long service life and minimal maintenance helps maximize uptime, reduce ownership costs, and minimize service interventions.

What to look for in a pump and how that pump attribute benefits the system:

BLDC centrifugal motor design

Brushless motor design limits wear, helping lower maintenance requirements while improving efficiency.

Shaftless ceramic ball-motor architecture

Self-adjusting ceramic bearing construction minimizes wear, while the shaftless rotor reduces maintenance and potential failure points.

Electronically commutated motor (ECM) architecture

Electronic commutation reduces electrical and frictional losses, improving efficiency and converting more input power into useful hydraulic work.

Fewest number of moving components

Fewer moving components mean fewer potential wear and failure points, helping improve reliability and reduce maintenance requirements.

Continuous-duty design with long service life

Supports continuous cooling operation and long-term system reliability by matching pump duty and service life to application requirements.

➤ **Know the difference:** Continuous duty vs. service life. Continuous duty describes the pump's ability to operate continuously within specified conditions; service life describes how long the pump is expected to remain operational before failure, often measured in hours. Evaluate both when selecting a pump for continuously operating cooling systems.



Pump specifications to consider:
maintenance, life, reliability

2

Can the pump maintain adequate flow at the pressure your specific loop demands?

Effective thermal management begins with understanding the cooling performance the system must deliver. The required cooling capacity ultimately determines the flow rate, operating pressure, and duty point the pump needs to achieve.

What to look for in a pump and how that pump attribute benefits the system:

Coolant flow rate that achieves desired cooling capacity (kW)

Ensures adequate coolant flow to meet the system's heat-removal requirements.

- > **Sizing consideration:** ~1.5 L/min per kW can be used as an initial estimate when appropriate design assumptions are met.

Operating pressure to overcome system restrictions

Provides the pressure needed to overcome system resistance and maintain the required coolant flow throughout the cooling loop.

- > **Sizing consideration:** Required pump pressure is driven by losses through components and fluid paths, including cold plates, heat exchangers, manifolds, tubing, fittings, and bends, as well as factors such as tubing diameter and coolant viscosity.
- > **Know the difference:** Operating pressure relates to pump performance; system pressure relates to the pressure rating required for safe operation. Both should be evaluated against the applicable component pressure ratings and safety limits.

Power consumption at desired performance

Delivers the required flow and pressure while minimizing power consumption and heat generation, supporting overall system efficiency.

Required flow rate at system pressure

Ensures the pump delivers the required flow at actual system pressure, supporting effective cooling without unnecessary power consumption, heat, noise, or vibration.

- > **Selection consideration:** Evaluate pump performance at the required duty point on the P-Q curve rather than relying on open-flow and maximum-pressure ratings alone.



Pump specifications to consider:
hydraulic performance, power
consumption, efficiency

3

Can the pump fit where performance demands it most?

As electronics become more compact and power-dense, every cubic centimeter of available space becomes increasingly valuable. Cooling hardware should minimize packaging constraints and preserve space for processors, power electronics, heat exchangers, and other value-generating system components.

What to look for in a pump and how that pump attribute benefits the system:

Multiple installation orientations and mounting options

Provides greater design flexibility, enabling efficient use of available space without forcing the system layout around the pump.

- > **Selection consideration:** Verify that the selected mounting orientation is approved for the pump and provides adequate access for connections, installation, and service.

Compact pump footprint and connection envelope

Minimizes space required for the pump and its connections, supporting tighter system packaging and greater layout flexibility.

- > **Know the difference:** Pump footprint vs. installed envelope. Pump dimensions tell only part of the story. Evaluate the total space required for installation, connections, tubing, cabling, and service access.

High hydraulic performance density

Provides greater hydraulic output within a compact footprint, helping enable space-efficient N+1 cooling-loop designs.

- > **Know the difference:** Compactness vs. performance density. A compact pump occupies less space; high hydraulic performance density means effectively delivering the required hydraulic performance within that limited space.

Integrated motor-pump design

Reduces overall installation volume by integrating the motor and pump into a single compact assembly.



Pump specifications to consider:
footprint, integration

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Will the pump need to accommodate fluctuating cooling requirements?

Cooling demands often vary with workload, operating modes, and system conditions. Selecting the appropriate speed-control option allows pump output to be matched to the cooling demand, helping optimize performance, efficiency, and overall system operation.

What to look for in a pump and how that pump attribute benefits the system:

Control option matched to system requirements

Variable-speed control enables pump output to respond to changing thermal loads, while fixed-speed operation can simplify control for steady-state applications.

- **Selection consideration:** Consider the expected thermal load profile and determine whether the application requires variable pump output or primarily operates at a steady duty point.
- **Selection consideration:** Within variable speed control, potentiometer control provides manual speed adjustment, while PWM control enables real-time, automated speed control for maximum efficiency and responsiveness to changing system demands.

Integrated tachometer feedback

Provides real-time pump-speed feedback in revolutions per minute (rpm) to support pump monitoring and troubleshooting.

Multiple PWM control profiles

Provides flexible speed control to adjust pump output as cooling demand changes, supporting efficient partial-load operation.

- **Selection consideration:** Confirm that the pump's PWM input characteristics and control profile are compatible with the system controller and desired operating range.

Electronically commutated motor (ECM) architecture

Provides electronically controlled motor operation that enables precise adjustment of pump speed and output.



Pump specifications to consider:
speed control

5

Will noise affect the user experience?

Many liquid-cooling systems operate near end-users or sensitive equipment where acoustics matter. Minimizing the cooling system's acoustic footprint without sacrificing performance helps improve user experience and system acceptance in noise-sensitive environments.

What to look for in a pump and how that pump attribute benefits the system:

BLDC centrifugal motor design

Eliminates brush contact and associated friction, helping minimize mechanical noise during operation.

Shaftless ceramic ball-motor architecture

Minimizes mechanical contact points and potential vibration sources, helping reduce noise during operation.

Electronically commutated motor (ECM) architecture

Enables precise speed control to meet system demand without unnecessary high-speed operation and associated noise.

Low acoustic noise output

Minimizes pump-generated acoustic noise, supporting system sound-level requirements in occupied or noise-sensitive environments.

- > **Selection consideration:** Evaluate pump noise at the intended operating point and consider how installation and system integration may affect final acoustic performance.
- > **Selection consideration:** Compare acoustic ratings measured under equivalent operating and test conditions. Differences in measurement distance, operating point, and frequency weighting can affect reported sound levels.
- > **Know the difference:** Pump noise vs. system noise. Pump acoustic output is only one contributor to overall system noise. Mounting, vibration, structural resonance, coolant flow, and other components can affect the sound experienced in the final installation.



Pump specifications to consider:
vibration, acoustic profile

More efficient thermal management starts here

For over 25 years, Xylem's D5 and DDC pumps have delivered proven reliability and performance in compact, efficient designs built for demanding liquid cooling applications.



Fluctuating cooling requirements

- PQ curves provided by voltage for duty-point selection
- Efficient hydraulic performance with low power demand
- D5 up to 1900 LPH | DDC up to 800 LPH flow capacity
- Up to 1.5 bar | D5 brass up to 10 bar system pressure



Pump fit

- Integrated motor-pump design
- Horizontal or vertical with motor end down for flexible mounting
- Compact footprint supports space-constrained design
- DDC fits in 1U servers



Performance to meet the demand

- Fixed-speed and PWM options; D5 offers potentiometer control
- Multiple PWM profiles
- Tachometer feedback available



Total lifecycle cost

- Shaftless brushless DC motor design
- ECM architecture
- Self-adjusting ceramic bearing
- Rated for 50,000+ hours
- Maintenance-free design



User experience

- <40 dB
- Shaftless motor and ceramic bearing reduce friction and vibration

Find the right pump for your cooling system

Every cooling system has different requirements. Xylem can help you evaluate your application needs and identify the pump solution that delivers the right balance of performance, efficiency, size, control, and reliability.

[Explore Our Liquid Cooling Pump Solutions](#)