# Amphenol®

## Application Note

IAN-142-1

## UQD/UQDB REV2.0 | Liquid Cooling Quick Disconnects

### BACKGROUND

The rapid growth of AI (Artificial Intelligence) is driving increased demand for high-performance data servers and advanced computing infrastructure. These systems generate significant heat, and traditional air-cooling methods are becoming increasingly insufficient to meet the thermal management requirements of high-density server environments. Liquid-cooling technology, with its high-efficiency heat dissipation capabilities, has emerged as a key industry trend for next-generation computing systems. As a result, the market urgently requires high-performance liquid-cooling connectors capable of meeting the complex performance, reliability, and integration demands of modern data server applications.

### PROBLEM

In liquid-cooling applications, accidental disconnection of a ball valve quick disconnect (QD) can result in significant coolant spillage within the thermal management system. This type of event can lead to major equipment damage, unplanned system downtime, and increased maintenance costs. In critical computing environments, coolant leakage can also negatively impact system reliability, serviceability, and operational continuity.

### AIO SOLUTION

Amphenol Industrial Operations offers connector solutions designed in accordance with the OCP UQD/UQDB Specification Rev. 2.0. This specification defines requirements for Universal Quick Disconnect (UQD) and Universal Quick Disconnect Blind-Mate (UQDB) connectors used in liquid-cooling systems for data centers and high-performance computing equipment.

The AIO solution supports hybrid configurations, including UQD plug mating with UQDB socket interfaces. These connectors feature standardized testing, defined geometry, and improved flow performance. Dimensional and performance requirements conform to the OCP UQD/UQDB Specification Rev. 2.0.

The series is available in sizes 02, 04, 06, and 08, with customized terminations available.

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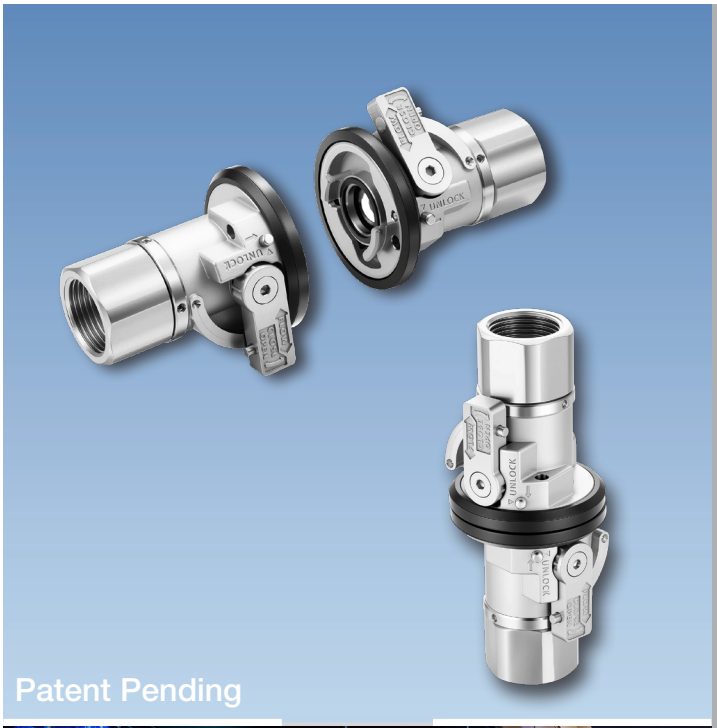

Patent Pending

## SHQD Series | Liquid Cooling Quick Disconnects

### BACKGROUND

In liquid-cooling applications, accidental disconnection of a ball valve quick disconnect (QD) can cause substantial coolant spillage within the thermal management system. This type of incident can result in severe equipment damage, unplanned system downtime, reduced operational reliability, and significant maintenance or replacement costs. In critical server environments, even a single spill event can negatively impact uptime and service continuity.

### PROBLEM

To address this challenge, we independently developed the SHQD product line, designed to deliver full flow capacity while reducing pressure drop and maximizing overall system efficiency. This design helps support reliable coolant transfer in demanding thermal management applications where both performance and safety are critical.

### AIO SOLUTION

To address this challenge, we independently developed the SHQD product line, designed to deliver full flow capacity while reducing pressure drop and maximizing overall system efficiency. This design helps support reliable coolant transfer in demanding thermal management applications where both performance and safety are critical.

In addition, the AIO SHQD series features a dual safety interlock mechanism that helps prevent coolant spillage during maintenance or servicing. It also prevents the valves from being accidentally opened when disconnected. Furthermore, disconnection cannot occur until the valves are fully closed. This functionality is achieved through an integrated locking hook design and lever handle, providing an added layer of protection for both equipment and operators.

The SHQD series is available in 1”, 1.5”, and 2” sizes, with four termination options: female thread, male thread, hose barb, and sanitary flange. Customized solutions are also available upon request to support specific application requirements.

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## Application Note

## MQD Series | Liquid Cooling Quick Disconnects

### BACKGROUND

Rapid growth in artificial intelligence (AI) is driving higher rack power density and heat flux, pushing air cooling beyond practical limits for efficiency, acoustics, and energy use. Direct liquid cooling (DLC) moves heat at the source via cold plates and manifolds, but it also raises requirements for the fluid interconnects that link servers to tray plumbing. Connectors must combine very compact packaging with high flow capacity and low pressure drop, while sustaining repeatable, verifiable seal integrity across installation and service.

### PROBLEM

AI servers allocate most internal volume to GPUs, memory, and power delivery, leaving minimal space for coolant routing. A suitable connector must meet tight z-height and pitch constraints, maintain high volumetric flow with minimal hydraulic loss, and remain leak-tight through frequent mate/de-mate operations. It should resist vibration and handling loads, tolerate side-load during service access, and use corrosion-resistant materials compatible with common data-center DLC chemistries—so cooling performance is preserved without compromising reliability.

### AIO SOLUTION

Amphenol Industrial Operations' Multi Quick Disconnect (MQD) is engineered for compact compute trays with severe space constraints. The series is offered in two geometries—02 straight and 03 right-angle (RA)—both featuring an ultra-small outside diameter to ease routing in dense layouts and to meet aggressive z-height envelopes. An optimized internal flow path supports the coolant throughput required by modern cold plates while minimizing pressure drop at the coupling. Precision sealing elements and robust mechanical retention deliver consistent, leak-free performance over repeated service cycles, and construction materials are selected for durability and corrosion resistance in typical DLC fluids. Every MQD coupling is 100% helium-leak tested to verify seal integrity prior to shipment. The result is a low-profile, high-performance liquid-cooling connector that preserves thermal headroom in space-constrained AI server trays.

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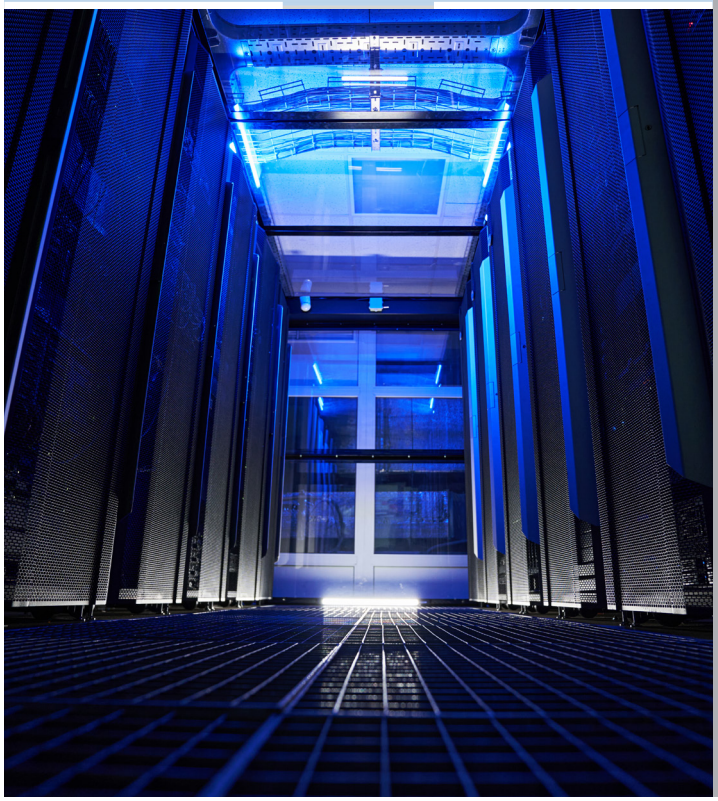

## UQD & UQDB Liquid Cooling Quick Disconnects

### BACKGROUND

The rapid advancement of Artificial Intelligence (AI) is driving the proliferation of high-performance data servers that operate at unprecedented processing speeds and densities. As these systems generate significant heat loads, traditional air-cooling methods are increasingly inadequate. Liquid-cooling has emerged as a superior thermal management solution, offering efficient and targeted heat dissipation. However, the growing complexity of server infrastructure demands compact, high-reliability connector solutions capable of supporting large-volume fluid transfer in limited space.

### PROBLEM

AI servers are deployed in increasingly compact form factors, leaving limited room for cooling infrastructure. To meet thermal demands without compromising system density, liquid-cooling connectors must deliver high-volume coolant flow within a compact footprint. In addition, they must offer exceptional reliability to prevent leakage, which could lead to critical equipment failure in high-performance computing environments.

### AIO SOLUTION

Amphenol Industrial Operations offers two advanced liquid-cooling solutions developed in accordance with Open Compute Project (OCP) standards: the UQD and UQDB series quick-disconnect connectors.

**UQD Series**
The UQD series features a precision ball-lock mechanism for secure, leak-resistant connections between server nodes and cooling manifolds. Designed for tool-less, push-to-connect operation, these couplings enable fast installation and reliable performance in high-density rack systems.

**UQDB Series**
The UQDB series incorporates blind-mate functionality and advanced sealing materials to ensure a drip-free, high-integrity connection. Ideal for modular server configurations, they simplify installation in confined spaces while enhancing overall serviceability.

Both connector series are OCP-compliant and intermateable with other vendor products, supporting flexible integration into standardized liquid-cooling architectures.

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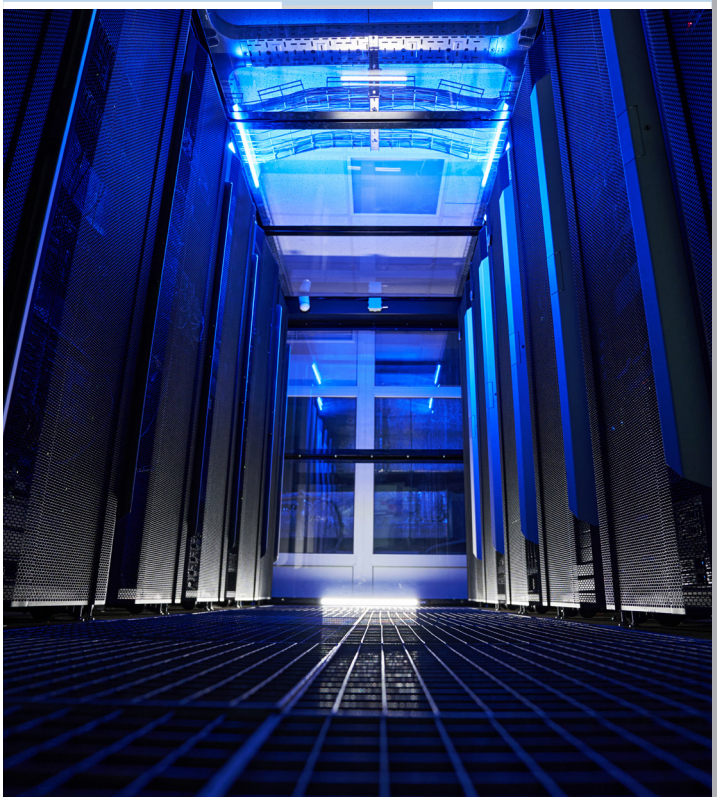

## BMQC Series | Liquid Cooling Quick Disconnects

### BACKGROUND

The rapid growth of Artificial Intelligence (AI) is pushing data center servers to new performance limits, generating heat levels that traditional air-cooling can no longer manage effectively. Liquid-cooling technology, with its superior heat-dissipation capabilities, is now the preferred solution for high-density server environments. To meet this demand, connectors must deliver high performance in a compact, reliable, and service-friendly design.

### PROBLEM

Modern AI server designs are highly compact, leaving minimal space for liquid-cooling infrastructure. Connectors in these systems must be engineered with a reduced footprint while allowing high-volume coolant flow to efficiently remove heat. They must also maintain exceptional sealing performance to prevent leakage, as even minor coolant loss can result in costly equipment damage, downtime, and safety hazards. In addition, these connectors must withstand repeated mating cycles, variable pressures, vibration, and potential exposure to corrosive fluids while ensuring consistent thermal and mechanical performance over their service life.

### AIO SOLUTION

Amphenol Industrial Operations has developed the Blind Mate Quick Connector (BMQC) series to meet these challenges. Designed in accordance with the Open Rack V3 Blind Mate Quick Connector Specification (BMQC) Revision 1.0, the BMQC is purpose-built for critical liquid cooling interfaces between data center rack servers and distribution manifolds. Its design accommodates ±5 mm radial misalignment and ±2.7° angular misalignment, enabling smooth blind-mate engagement in high-density configurations. The internal geometry is optimized to maximize coolant throughput while minimizing pressure drop, ensuring efficient heat removal without compromising system performance. Every coupling is 100% helium-leak tested to verify zero-leakage integrity, and corrosion-resistant materials and surface treatments are employed to ensure long-term durability. The quick-connect, tool-free design simplifies installation and maintenance, reducing service times and improving system uptime.

The AIO BMQC is a proven, high-performance solution for modern data center cooling systems, delivering the reliability, serviceability, and thermal efficiency required to support the next generation of AI-optimized server deployments. For additional technical information, please contact Amphenol Industrial Operations.

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## Application Note

## LQC Series | Liquid Cooling Quick Disconnects

### BACKGROUND

AI accelerators are driving rack power density and heat flux beyond what air cooling can remove without excessive airflow, noise, or energy use. Direct liquid cooling (DLC) moves heat at the source via cold plates, which demands compact, high-flow, low–pressure-drop interconnects between servers and rack manifolds. As deployments scale, connectors must deliver repeatable, verifiable seal integrity and align with open standards to streamline integration, service, and multi-vendor interoperability in modern data-center architectures.

### PROBLEM

Inside AI servers, GPUs, memory, and power delivery leave little volume for plumbing. Connectors must fit tight z-height and depth budgets, sustain high volumetric flow with minimal hydraulic loss, and lock positively to prevent accidental release under vibration or service loads. They must stay leak-tight through frequent mate/de-mate cycles, tolerate blind docking and side loads, and resist corrosion across common DLC coolants and treatments—while remaining interoperable to avoid bespoke adapters and requalification.

### AIO SOLUTION

Amphenol Industrial Operations' Liquid-Cooling Connector (LQC) is designed to the OCP Large Quick Connector Specification v1.0 for ecosystem compatibility. A 20 mm nominal flow path supports AI-class throughput with low pressure drop, while a screw-to-connect mechanism provides controlled engagement, tactile confirmation, and vibration-resistant retention—ideal for server-to-blind-mate manifold interfaces. Corrosion-resistant materials and finishes support long service life in typical DLC chemistries. Each coupling is 100% helium-leak tested to verify seal integrity. LQC delivers compact packaging, serviceability, and high hydraulic performance for reliable, standards-based DLC in next-generation racks.