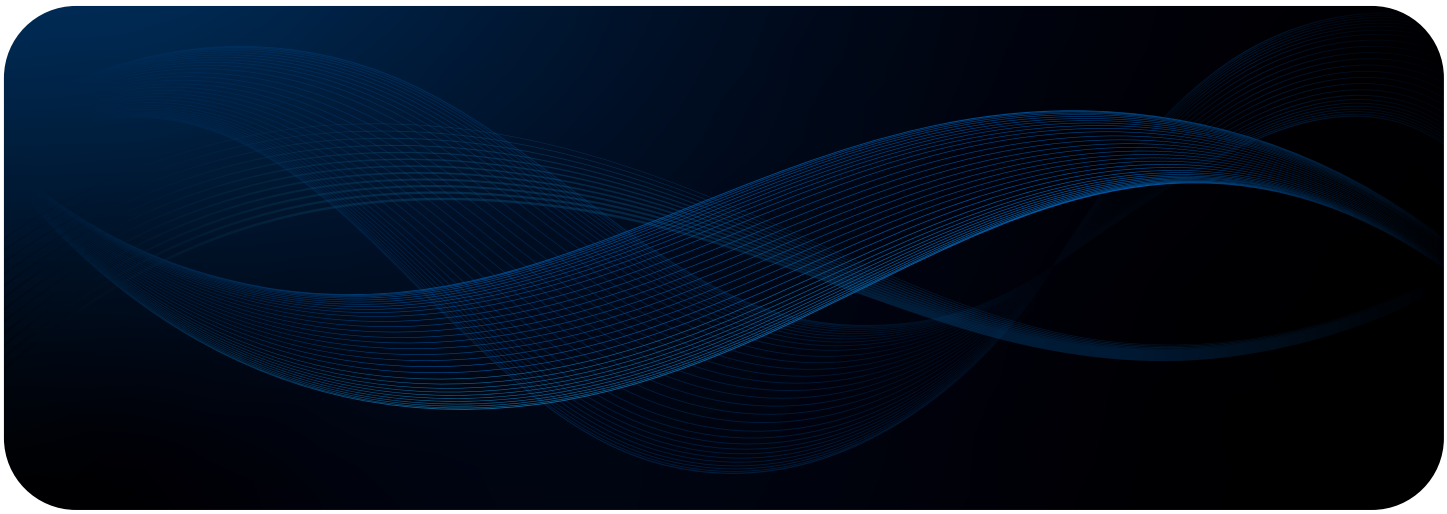
The ABC's of Quick Disconnects in Liquid Cooling Applications

Part 1: A-E, from Application to Environment



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Quick disconnects (QDs) are critical components in liquid cooling of electronics systems. Connections in liquid cooling loops must be reliable and robust to help protect sensitive equipment and support their optimal function. Understanding quick disconnects in context of the whole system and specifying QDs correctly is essential.

Part 1 of this three-part series of questions to ask when designing a liquid cooling system that utilizes QDs explores relevant considerations from A to V: defining application needs to vibration.

APPLICATION

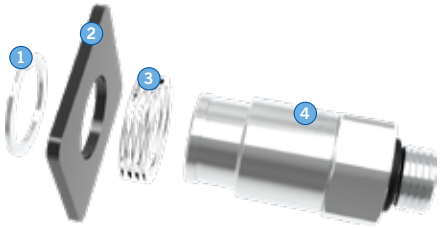
Q. Will the liquid cooling system be installed in a stationery or mobile application? How much coolant is involved and how robust is the construction? What is the anticipated maintenance schedule and how accessible will the system components be? What other application factors exist which could affect testing, repairs and upgrades and subsequently, system design?

A. How the QD will be used is key in choosing the right QD style and material composition. Application temperature and pressure, media, expected cycles, vibration profile, and spillage requirements are important factors. With integrated shut-off non spill valves, quick disconnects are designed to be easily connected and disconnected for system maaintenance. QD accessibility within the cooling loop impacts serviceability (ensuring adequate clearance for tools or technician's hands). Everis® Series QDs are designed specifically for liquid cooling, but customers may require non-standard connector configurations. CPC's Engineered Solutions team can help with non-standard QD requests.

ALIGNMENT

Q. How do users know quick disconnects are properly connected within the system? Are there ways to ensure connection, even if slightly misaligned?

A. Most standard latched versions of Everis® products are connected by hand. The operator holds at least one part in the mating process, positioning it for connection. The parts are designed to fully align at connection, which is confirmed by haptic and audible feedback. When a manual connection is impossible, or a blind mate solution is used, mounting features can be applied to either the body or insert sides of the connection. For example, using an oversized hole with a wave spring and retaining ring will secure the QD but allow for both radial and axial tolerance/movement. Everis products also have long lead-in chamfers that guide the inserts to the right position. (See specific product data sheets or Websites for radial, axial, and angular alignment tolerances by product.)



1. **Retainer Ring**
2. **Panel**
3. **Wave Spring**
4. **BLQ6 Body or Insert**

COMPLIANCE

Q. Does each component, liquid cooling system, or application need to meet a compliance standard? Will the products and/or systems need to be certified?

A. Certain industries mandate system part testing and certification prior to inclusion in a specification. By understanding compliance requirements up front, design engineers can save time by avoiding parts that are out of spec or suppliers who cannot provide certification information. When an application must meet a system-level standard, request component part test data from suppliers.

COOLANT

Q. What is your selected fluid and its thermal properties, hazard profile and viscosity? Is it corrosive?

A. The chemical and performance characteristics of liquid cooling system fluid must be considered when designing a system. Identifying the coolant type is typically the first step in determining the size and shape of the entire cooling loop. The coolant's chemical compatibility with all system and coupling subcomponent materials is particularly important. Specifiers need to understand the wetted loop properties and their interaction with fluid options. Various types of liquid cooling systems also require different fluids. Engineers typically specify water, propylene glycol, and ethylene glycol as coolants, although dielectrics and refrigerants are gaining popularity for emerging applications. After the coolant is established, best practice includes determining the fluid velocity rates and allowable pressure drop within the system, which will drive decisions in the QD selection process (size, valving, termination, etc.) Depending on the coolant, there may be special considerations when it comes to compatible materials (metal housings, plastic valving, elastomeric O-rings and seals, etc.). Everis® QDs come standard with housings of a variety of materials, high-performance plastic valves, and either EPDM or FKM elastomeric seals

Q. What fluids and other materials will be used in the system? Will fluid be in direct contact with elastomers? Various metal components? Are all components and subcomponents of the wetted loop compatible?

A. Potential corrosion can occur due to fluid and material incompatibility. Both system and component corrosion can release particles into the flow path that can affect both subcomponent reliability and system performance. Chemical compatibility between fluids and pumps, hoses, filters, and connector materials can substantially affect the performance of the whole system. After the liquid cooling fluid is chosen, select other system components' materials based upon their compatibility with the coolant. Products specifically designed for liquid cooling applications are ideal. Everis LQ products are compatible with most fluids used in the liquid cooling of electronics. Certain fluids, however, may be incompatible with standard material selections. Incompatible fluids can decrease performance characteristics or even degrade metals, polymers, and elastomers. Pitting and crevice corrosion of metal parts can occur when component and subcomponent materials are not researched and specified correctly; device or component failure may even lead to system failure. Also consider compatibility between the connector and the system itself. Combining materials with a high galvanic potential could result in galvanic corrosion of the materials. This is especially evident in systems with conductive fluid. Use of high-performance polymer materials in quick disconnects can help to avoid many of these issues

CONNECTION FORCE

Q. How easy or difficult does it need to be for assemblers or technicians to connect the coupling?

A. High connection forces can result in higher strain on operators' bodies. It is important to maintain ergonomic features when designing liquid cooling systems. Typically, the larger the connector, the greater the force to connect needed. Refer to manufacturers' product information for connection force. Also, consider fluid pressure in the system, which impacts the force needed to connect, too.

As pressure increases within the connector, the force to connect increases as well. Depending on how the connection is being made, a system that connects and disconnects at lower pressures could be beneficial. This is especially the case when it comes to manual connections. In many blind mate applications, separate latching devices secure the connectors in the correct positions. Understanding the level of connection force necessary to overcome ensures latching devices are robust enough to handle the force. This is very relevant when specifying larger products (e.g., Everis® LQ8 QD or Everis® LQ10 QD product lines.)

CYCLES

Q. How many make/break cycles will the quick disconnect need to accommodate?

A. A QD's cycle life depends on the make-and-break cycles the connector experiences. Some connections are made initially and remain untouched until the system is serviced or disposed of. Other applications subject connectors to thousands of cycles. Knowing how the QD will be used within the application is important. For example, O-rings tend to be one of the more susceptible components in the QD at high cycles. CPC incorporates O-rings and related geometry that ensure proper lubrication and have the ideal compression, stretch and gland fill that are essential to maintaining reliable cycle life. CPC incorporates O-rings and related geometry that ensure proper lubrication and have the ideal compression, stretch, and gland fill that are essential to maintaining reliable cycle life. All Everis® LQ Series products are rated to 1000 make-and-break cycles, minimum. If more cycles are required, CPC test engineers typically can test for the working conditions or application.

DIMENSION

Q. How much room is there for the QD? Are there access needs for installation or operation surrounding the QD? Based upon cooling load and space constraints, does the application require a high flow-to-size ratio for its quick disconnects?

A. Dimension comes up for many reasons when talking about quick disconnects. First are spatial constraints. Is the QD too big to fit within the allowed space? Remember that QDs also require space to disconnect. Ensuring sufficient room for QD disconnection is crucial to shutoff valves functioning properly. If the valves are not allowed to fully return to a closed state, there is risk that the system would not be shut off to flow. Another dimension to consider is overall diameter, especially in terms of flow. Many people think the larger the connector's outside diameter (OD), the better the flow. This is not always the case. Different valve shapes and designs affect the way fluid flows through the QD. Specifying engineers should refer to Cv or Kv graphs for accurate flow characteristics rather than overall size when determining which connector size to use. Orifice diameter and physical size of the QD are not necessarily good indicators of flow performance.

ENVIRONMENT

Q. Where will the application be installed? For example, is the liquid cooling infrastructure part of a high-performance computing cluster in an environmentally controlled indoor space? Or is it outdoors as part of 5G telecom equipment subject to humidity, temperature swings and dusty, salty, or other airborne particles? Will there be enclosures and if yes, how well sealed?

A. Environmental conditions around a liquid cooling system can influence its performance, regardless of system maintenance schedules. It is normal to consider the wetted loop at the interior when selecting system components but evaluating the environment's impact can be just as important because corrosion of a part's exterior is also possible. Corrosion can influence QD operability. Also, in environments with high airborne debris, the chance of particle inclusion during servicing is greater. In this case, engineers may want to consider non-spill valved QDs with low inclusion or modular systems with blind mate connectors vs. economy latched or ball-and-sleeve style connectors. Establishing service protocols with sheltered or off-site maintenance is also a possibility.

To learn more about CPC connector technologies and the Everis® line of products specifically designed for use in liquid cooling of electronics applications, visit our website or contact us at 1-800-444-2474. Also, see other technical guides and white papers on key topics in liquid cooling such as QD specification, chemical compatibility, flow and ambient conditions: https://www.cpcworldwide.com/Resources-Support/Literature/Liquid-Cooling.

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