QUICK DISCONNECTS FOR LIQUID COOLING – Design, Specification & Implementation
AGENDA

- Introduction to Liquid Cooling
  - Technology scope and benefits
  - Key components
- Quick Disconnects
  - Anatomy and design
  - Performance and implementation
Liquid cooling of hot server components has a long and storied history; IBM water-cooling in 1964, Cray FC cooling in 1980’s, and even more today!
SYSTEM COMPONENT SELECTION

Every component within a liquid cooling system matters

Think holistically throughout the design process
QD POINTS OF CONNECTION

• FWS – Facilities Water System
• TCS – Technology Cooling System
  • RDHx
  • Cold Plate
  • Immersion

Ref: ASHRAE TC9.9 – Water Cooled Servers

The closer to ITE, the more critical the QDs’ performance and reliability
ANATOMY OF A QD

Materials
- Structural
- Wetted

Configurations
- Mating
- Mounting

Valves and Shutoff
- Nonspill
- Flow sizing

SMALL component with BIG influence
Chemical compatibility, corrosion, erosion

- Coolant compatibility
  - Elastomeric seals
- Galvanic corrosion
- Flow path erosion
- Environmental exposures

Consider all materials within wetted fluid loop, and interactions they may have
Configurations

- Blindmate vs. handmate
- Ball vs. latch
- Non-spill vs. wet break
- Terminations
**QD flow sizing**

- Achieve increased cooling efficiency with properly spec’d devices throughout the system.
- Sizing a QD for optimal performance – reduce pressure loss, consider physical size.
Flow coefficient – Cv
- Volumetric flow rate for 1psi loss

Balance flow and pressure for optimal performance and efficiency

\[ Q = C_v \sqrt{\frac{\Delta P}{SG}} \]

Published and catalog \( C_v \) is typically reported with water (\( SG = 1 \))
Use correction factors and correct SG when using coolants other than water
# QD Functional Requirements

<table>
<thead>
<tr>
<th>Spillage</th>
<th>Volume of fluid upon disconnect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion</td>
<td>Volume of air introduced into fluid loop on connection</td>
</tr>
<tr>
<td>Leaks</td>
<td>Unintentional fluid discharge</td>
</tr>
<tr>
<td></td>
<td>Potentially catastrophic</td>
</tr>
</tbody>
</table>

*Multi-lobed seals (vs. standard o-rings) for redundant protection against leaks*
QD FUNCTIONAL REQUIREMENTS

Temperature
- Resistance and stability

Flammability
- UL94V

Conductivity
- Metal QDs can be hot to the touch
- Consider location and operator interaction

Chemical Compatibility
- Wetted materials in fluid loop
- Long-term service and exposure

*PPSU is flame retardant – UL94 V-0 Rating*
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>L/min, gpm</td>
</tr>
<tr>
<td>Flow Coefficient</td>
<td>Kv, Cv</td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>Pa, psi</td>
</tr>
<tr>
<td>Burst Pressure</td>
<td>Pa, psi</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>Pa</td>
</tr>
<tr>
<td>Spillage (liquid expulsion)</td>
<td>mL, cc</td>
</tr>
<tr>
<td>Inclusion (air introduction)</td>
<td>mL, cc</td>
</tr>
<tr>
<td>Temperature – Operating, Storage / Shipping</td>
<td>°C, °F</td>
</tr>
<tr>
<td>Connection Force</td>
<td>N, lbf</td>
</tr>
<tr>
<td>Connection Cycles</td>
<td>Mechanical cycles / connect and disconnect</td>
</tr>
<tr>
<td>QD style and hydraulic diameter</td>
<td>Inches (eg. Blind mate, hand mate, threaded, mounting configuration)</td>
</tr>
<tr>
<td>Terminations</td>
<td>Barbed, compression style, threaded</td>
</tr>
</tbody>
</table>

Parameters of Importance – ref OCP ACS Cold Plate Liquid Cooling Requirements

- Recommendations
- System requirements locked
- Engage with experts early
FOR MORE INFORMATION

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What questions do you have?